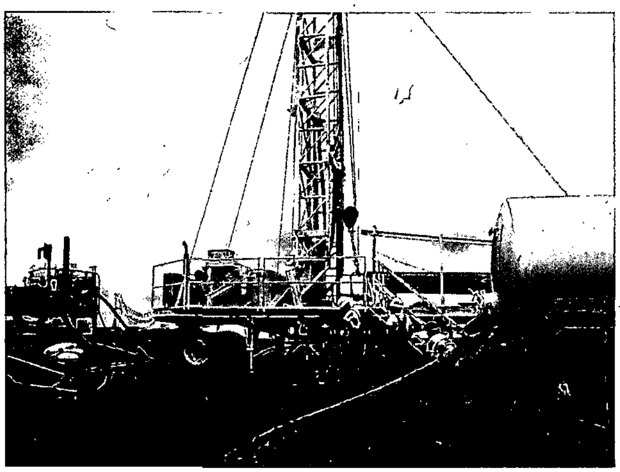
LOST CREEK ISR, LLC
Lost Creek Project
South-Central Wyoming

Environmental Report



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Application for

US NRC Source Material License

(Docket No. 40-9068)

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LIST OF ABBREVIATIONS AND ACRONYMS

$[UO_2(CO_3)^3]^{-4}$	uranyl tricarbonate ion
$[UO_2(CO_3)^2]^{-2}$	uranyl dicarbonate ion
°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
μR/hr	microRoentgens per hour
ACE	Army Corps of Engineers
ACEC	Area of Critical Environmental Concern
AD	anno domini
AM	Ante Meridiem
AUM	animal unit months
Basin	Great Divide Basin
BLM	Bureau of Land Management
BMP	Best Management Practice
BP	before present
$CaCO_3$	calcium carbonate
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
Conoco	Conoco, Inc.
Cs-137	cesium-137
CSU	Colorado State University
CV	curriculum vitaes
CWA	Clean Water Act
dBA	A-weighted decibels
DOE	Department of Energy
DOT	Department of Transportation
EIS	Environmental Impact Statement
ELI	Energy Laboratories Incorporated
EMT	emergency medical technician
EPA	Environmental Protection Agency
ER	Environmental Report
ERMA	Extensive Resource Management Area
ESD	Emergency Shut Down
Fault	Lost Creek Fault
FLPMA	Federal Land Policy and Management Act
ft^2/d	square feet per day
ft amsl	feet above mean sea level
ft bgs	feet below ground surface
ft/d	feet per day
ft/ft	feet per foot
ft/mi	feet per mile
ft/s	feet per second
FTE	full-time equivalent
FWS	Fish and Wildlife Service

g	gravity
g/L	grams per liter
g/m^2	grams per square meter
GIS	Geographic Information System
gpd/ft	gallons per day per foot
gpm	gallons per minute
GPS	Global Positioning System
GSP	Gross State Product
HDPE	high-density polyethylene
HMA	Herd Management Area
HPGe	High-Purity Germaniun
HPIC	High-Pressure Ionization Chamber
HPRCC	High Plains Regional Climate Center
IR	Isolated Resource
ISR	In Situ Recovery
JCR	Job Completion Report
km	kilometers
lb/mi^3	pounds per cubic mile
lb/VMT	pounds per vehicle miles traveled
LC	Lost Creek
LC ISR, LLC	Lost Creek ISR, LLC
LQD	Land Quality Division
LS	Lost Soldier
m^2	square meters
m/s	meters per second
man-Sv	man-Sievert
MBHFI	Migratory Birds of High Federal Interest
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MiniVol	Mini Volumetric
MIT	mechanical integrity test
mph	miles per hour
mrem	millirem
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NaI	sodium iodide
NEPA	National Environmental Protection Act
NFU	New Frontiers Uranium Wyoming, LLC
NH_3	ammonia
NIST	National Institute of Standards and Technology
NMSS	Nuclear Material Safety and Safeguards
NO_2	nitrogen dioxide
NRC	Nuclear Regulatory Commission

NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWIS	National Water Information System
NWS	National Weather Service
O_3	ozone
OHV	off-highway vehicle
Pb-210	lead-210
PC	personal computer
pCi/L	picoCuries per liter
Permit Area	Lost Creek Permit Area
PFN	Prompt Fission Neutron
PLC	Programmable Logic Controllers
PM_{10}	particulate matter less than ten micrometers in diameter
PM	Post Meridiem
PPE	personal protective equipment
ppm	parts per million
Project	Lost Creek Project
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pound-force per square inch gauge
PVC	polyvinyl chloride
PWMTF	Permanent Wyoming Mineral Trust Fund
QA	quality assurance
QC	quality control
Ra-226	radium-226
rem	röntgen (roentgen) equivalent in man
RMP	Resource Management Plan
RMPPA	Resource Management Plan Planning Area
Rn-222	radon-222
RO	reverse osmosis
ROW	right of way
RV	recreational vehicle
RWP	Radiation Work Permit
SAR	sodium adsorption ratio
SDR	standard dimension ratio
SDWS	Secondary Drinking Water Standard
SEM	scanning electron microprobe
SHPO	State Historic Preservation Office
SMRA	Special Recreation Management Area
SMU	soil mapping unit
SO_2	sulfur dioxide
SOP	standard operating procedure
SPCC	Spill Prevention, Control, and Countermeasure

SWEDA	Sweetwater Economic Development Association
T&E	threatened and endangered
TAC	Technical Assignment Control
TDS	total dissolved solids
TEDE	Total EffectiveDose Equivalent
Texasgulf	Texasgulf, Inc.
Th-230	thorium-230
U_3O_8	uranium oxide
UBC	Uniform Building Code
UIC	Underground Injection Control
U-nat	natural uranium
Ur-E	Ur-Energy USA Inc.
URPA	Ur-Energy Passive Air
US	United States
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standard
WCDA	Wyoming Community Development Authority
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WHDP	Wyoming Housing Database Partnership
WOS	Wildlife Observation System
WQD	Water Quality Division
WRDS	Water Resources Data System
WS	Wyoming Statute
WSA	Wilderness Study Area
WSEO	Wyoming State Engineer's Office
WW	World War
WYDOT	Wyoming Department of Transportation
WYPDES	Wyoming Pollution Discharge Elimination System

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4.0 ENVIRONMENTAL IMPACTS, MITIGATION, AND MONITORING

This section includes evaluations of the potential impacts of the Project on the various environmental characteristics of the Permit Area described in **Section 3**. The impacts of the Preferred Alternative described in **Section 2**, including cumulative impacts, are evaluated first. The impacts of the Other Alternatives described in **Section 2** are then evaluated. In large part, the impacts of the Other Alternatives differ little from those of the Preferred Alternative. Mitigation and monitoring associated with the Preferred Alternative are also included in this section.

The No Action Alternative is not discussed in detail in **Section 4** because without the Project, there are no changes to current conditions except those that occur naturally or due to projects unrelated to LC ISR, LLC. The Project does not intervene in any other on-going activities in the area. The No Action alternative is included in **Table 6.0-1**, Summary of Environmental Consequences.

The analyses of the cumulative impacts were based on publicly available information on existing and proposed projects, general knowledge of the conditions in Wyoming, and reasonably foreseeable changes to existing conditions. The primary concern in the evaluation of Cumulative Impacts is the resurgence in interest in mining and oil and gas development within the last few years. This resurgence has not necessarily translated into projects on the ground as of yet, making it difficult to evaluate Cumulative Impacts because of the lack of definitive information. For example, uranium exploration is ongoing in the Great Divide Basin, but uranium mines have not been established. In addition, for each discipline, a different scale is necessary for any substantive evaluation of impacts. For example, groundwater impacts can be evaluated within a few miles of the site because the complex hydrogeologic environment of the Great Divide Basin limits the number of projects that could affect groundwater. However, the socioeconomic impacts must be evaluated over a much larger area, e.g., 100 miles, because of the limited number of population centers, all of which are small, near the site.

For this report, it has been assumed that there will be no long-term changes within about five miles of the site, other than the possible installation of a limited number of dirt roads. Moving farther from the site, up to about 20 miles away, it has been assumed that there will be a few new drill pads for oil and gas development, a new pipeline, at least one other ISR operation, and that the Sweetwater Mill will be restarted. At greater distances, it has been assumed that the resurgence in extractive industries will continue and that on-going efforts by government agencies and industries to develop the infrastructure to support the industries will continue.

4.1 Land Use

4.1.1 Land Use Impacts from Preferred Alternative

The Permit Area encompasses approximately 4,220 acres. Disturbance within the six pattern areas is estimated as 254 acres; disturbance from the Plant is estimated as another ten acres; disturbance from the roads, header houses, pipelines, and mud pits is estimated as an additional 21 acres. Therefore, the Project is expected to disturb a total of about 285 acres, or less than seven percent of the total Permit Area. Of the 285 disturbed acres, only 58 acres will be stripped of vegetation and topsoil.

The Plant includes the processing circuits, office, mechanical shop, storage area, and fuel tanks. In addition, a new road from the Sooner Road to the Permit Area will be built and will be approximately 4.5 miles long and 20 feet wide, with borrow areas on the sides, and culverts and drainage as required. The road will be a gravel all-season road. Additional roads will also be used between the Plant and the mine units.

Construction and operation of the Project will have adverse impacts on the existing land uses at the Permit Area. However, most of these impacts would be temporary, because of the sequential nature of the ISR operations and because of ongoing reclamation.

4.1.1.1 Potential Interference with Existing and Future Land Uses

The predominant land use within the Permit Area is livestock grazing. A portion of the Stewart Creek, Cyclone Rim and Green Mountain grazing allotments (**Section 3.1**) will be impacted by the reduction in grazing land related to the Project. In the grazing study area, there were 3,662 AUMs associated with 31,440 acres, or 0.12 AUMs/acre. Therefore, the disturbance of 285 acres would represent the loss of about 33 AUMs, or the fodder necessary to support less than three cows for one year. This estimate is conservative because the mine units will be constructed, developed and reclaimed in succession, and the maximum area disturbed at any time should be far less than 285 acres.

Thirty-three AUMs represent a small fraction of the grazing in the area; therefore, the temporary loss of these AUMs is not expected to significantly impact the regional economy (Calton, M. Range Specialist, BLM Rawlins Field Office. Personal communication. July, 2007.). If grazing rights cannot be replaced, the temporary loss of AUMs could economically impact individual lessees. If present, these impacts will be temporary, and affect only a small number of individuals.

No other land uses will be directly impacted by the production activity. Other land uses that may be indirectly affected include hunting and other dispersed recreation, such as OHV use. However, there is an abundance of similar land surrounding the Permit Area, so the indirect impacts are not considered significant.

The planned post-operational use of these lands is grazing and wildlife habitat. Since the lands will be reclaimed after operations, the Project is compatible with the planned future use.

Land Use Plans and Regulations

The Project will 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, 2004c and 1987).

The following passages from the draft Rawlins Field Office RMP EIS 2004 demonstrate that the Project is consistent with the management goals of the BLM

- "FLPMA [Federal Land Policy and Management Act], as amended (43 USC 1701, et seq.), provides for public lands to be generally retained in federal ownership for periodic and systematic inventory of the public lands and their resources; for a review of existing withdrawals and classifications; for establishing comprehensive rules and regulations for administering public lands statutes; for multiple-use management on a sustained yield basis; for protection of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values; for receiving fair market value for the use of the public lands and their resources; for establishing uniform procedures for any disposal, acquisition, or exchange; for protecting ACEC; for recognizing the nation's need for domestic sources of mineral, food, timber, and fiber from the public lands, including implementation of the Mining and Mineral Policy Act of 1970; and for payments to compensate states and local governments for burdens created as a result of the immunity of federal lands from state and local taxation. The general land management regulations are provided in 43 CFR 2000, Sub-chapter B."
- "The General Mining Law of 1872, as amended (30 USC 22, et seq.), provides for locating and patenting mining claims where a discovery has been made for locatable minerals on public lands in specified states. Regulations for staking and maintenance of claims on BLM administered lands are listed in 43 CFR 3800" (BLM, 2004c).

Management objectives of the RMPPA are in the following language in the draft EIS:

- "With the exception of WSAs and some other Special Management Areas (SMAs), the remainder of the planning area would be open to consideration for leasing of oil shale, geothermal resources, and non-energy leasable minerals."
- "Approximately 1,582,260 acres would be closed to locatable mineral entry under existing mineral location withdrawals. The remainder of the planning area would be open to mineral location. Stipulations to protect sensitive resource values would be based on interdisciplinary review of individual proposals and environmental analysis."

The Project is not located in the area designated for land withdrawals.

Management Standards and Guidelines for the BLM Lander RMP for locatable minerals include the following language for locatable minerals.

- "All federal lands within the resource area will be open to locatable mineral exploration and development unless specifically withdrawn or segregated from appropriation under the mining laws...At the present time, approximately one percent of the federal mineral estate within the resource area is closed to locatable mineral exploration and development. The portion of the resource area that will be closed to locatable mineral exploration and development will increase by 30,000 acres to approximately two percent of the total federal mineral estate within the resource area. The additional acreage proposed for withdrawal will be withdrawn to protect crucial wildlife habitat in the East Fork Elk Winter Range and Whiskey Mountain Bighorn Sheep Winter Range, and the remaining acreage will be scattered throughout the resource area in small tracts primarily for the protection of significant cultural and historical resources."
- "In addition, in an attempt to minimize the acreage withdrawn to protect significant surface resource values, the plan will require that plans of operation be approved for all exploration and production operations (except for casual use) in certain areas designated as ACEC. Notices of intent usually allowed for operations disturbing five acres or less will not be allowed. This will provide for a higher degree of protection for significant surface values, while still providing maximum opportunity to explore and develop the locatable mineral resources within the resource area."
- "This plan incorporates the "Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for Public Lands Administered by the Bureau of Land Management in the State of Wyoming" approved August 12, 1997. Standards address the health, productivity, and sustainability of the BLM administered public rangelands and represent the minimum acceptable conditions

for the public rangelands. The standards apply to all resource uses on public lands."

The Project is not located in lands withdrawn from mineral exploration and development. Project permitting requires review by the Rawlins and Lander BLM Field and Wyoming State Lands office, which will ensure that the Project is deemed compatible with management objectives for area lands.

4.1.1.2 Short-term and Long-term Impacts

No impacts to the Permit Area can be considered permanent, since the land will ultimately be returned to its natural condition after approximately ten years, when production is complete. Surface disturbance for two weeks to six months represents a short-term impact. Mine units will be fenced prior to final construction and operation to deter access to the public and to wildlife. Each mine unit will be fenced for a period of approximately three years, which represents a medium-term impact. An estimated 28 acres will be disturbed for the duration of the Project for the Plant and access roads within the Permit Area, which represents a long-term impact.

4.1.2 Land Use Impacts from Other Alternatives

The disturbance caused by the alternative Plant location will be less than 0.5 acres greater than the disturbance caused by the preferred Plant location (Site 1). Therefore, there will be no significant land use impacts. The Site 2 location would impact a different grazing lease from the preferred Plant location (Site 1), but the potential impacts would be similar.

The scale of the monitor rings will have little or no impact on land use impacts.

4.1.3 Mitigation of Impacts for the Preferred Alternative

No mitigation of land use impacts is anticipated.

4.1.4 Monitoring for the Preferred Alternative

No monitoring of land use impacts is anticipated.

4.2 Transportation

4.2.1 Preferred Alternative

Figure 1.2-3 of this report shows the planned network of on-site roads. The eastern 4.5-mile segment of the principal east-west road will become the primary project access, extending from the Plant to Sooner Road (BLM 3215). The western 2.9 miles of this road is within the Permit Area. It will be upgraded to a 20-foot-wide, four-season gravel road with drainage. The other primary on-site road will extend 0.4 miles south from the Plant to the mine units. Additional secondary roads will be constructed from the site access road to the header houses. Two-track roads will be established within the mine units, from the network above, to individual wells. Off-site transportation routes will use established BLM, county, state, and federal roads. The railhead in Wamsutter provides the option of utilizing rail transportation.

Materials shipments are subject to both federal and state regulations. All shipments to and from the Project will be under the care of properly licensed and certified commercial drivers. Materials transportation to and from the Project is classified as either: 1) shipments of construction materials, process chemicals, office supplies, and related materials from suppliers to the Plant, 2) shipments of yellowcake slurry from the Plant to an off-site drying facility, or 3) shipments of waste material that cannot be disposed of on-site. An accident scenario for each category would have different impacts, which are discussed in the following sections. The socioeconomic effects of increased traffic due to shipments and worker transportation are discussed in **Section 4.10** of this report.

4.2.1.1 Shipments of Supplies to the Process Facilities

Local environmental impacts could occur if a truck delivering process chemicals or analytical reagents were involved in an accident. Processing chemicals required at the Permit Area are listed in Table 4.2-1. The potential for a shipping accident depends on the frequency of deliveries, the distance traveled, and the accident rates described in **Section 3.2** of this report. The environmental impacts would depend on the severity of the accident, the magnitude of the release, and the unique properties of the chemical.

4.2.1.2 Shipments of Yellowcake Slurry from On-Site Facilities to an Off-Site Dryer

The proposed action would require the truck shipment of yellowcake slurry from the Plant to an off-site facility for drying and packaging. Yellowcake slurry would be transported by truck using specially designed, DOT approved containers that contain approximately 15,000 pounds of U_3O_8. Given that the projected maximum annual production is one million pounds of uranium, about 70 shipments would be required annually when the Project is operating at full capacity. The shipment of yellowcake slurry, rather than loaded resin, would substantially reduce the number of shipments required (**Section 2.2.4**).

The specific location of the off-site dryer has not been finalized at the time of this report, so two representative facilities were analyzed to provide a realistic range of transportation risks. The Cogema Christiansen Ranch facility is the closest yellowcake dryer under consideration, and is located near Sussex, Wyoming, approximately 190 miles northeast of the Permit Area. The Mestena Alta Mesa facility near Falfurrias, Texas, located approximately 1,350 miles from the Permit Area, is the most distant yellowcake dryer under consideration. The proposed transportation routes to these facilities are shown in **Figure 4.2-1** and **Figure 4.2-2**. Other yellowcake dryers, such as the Crow Butte facility near Crawford, Nebraska, were not analyzed since the transportation accident risk would be within the range of the other two facilities.

Truck accidents occur at a rate of 6.4×10^{-7} accidents per mile on interstate highways in rural areas and 2.2×10^{-6} accidents per mile for interstate highways in urban areas and two-lane roads similar to those that may be used in this project (Harwood and Russell, 1990). These accident rates were multiplied by the distance traveled on each road type to calculate the risk of a truck accident for each one-way trip to the yellowcake dryer. Based on 2001 to 2005 WYDOT data, truck accidents occur at the rate of 7.8×10^{-7} accidents per mile on US-287 in Sweetwater County (Carpenter, T. Senior Data Analyst, WYDOT. Personal communication. March, 1997). This road is representative of the two-lane roads in both routes and the accident rate is lower than the generic accident rate used to calculate the risk per trip. The majority of both routes are two-lane roads; therefore, the risk calculation is based on conservative assumptions.

Approximately 89 percent of the route to the Christiansen Ranch facility is on two-lane roads, nine percent is on rural interstates, and three percent is on urban interstates (this does not total 100 percent due to rounding errors). The probability of a truck accident during a one-way trip to Christiansen Ranch is 0.00039. Around 70 percent of the route to the Alta Mesa facility is on two-lane roads, 26 percent is on rural interstates, and four percent is on urban interstates. Based on the roads traveled and the risk of a truck accident on each road type, the probability of a truck accident during a one-way trip to Alta Mesa is 0.0024. Assuming 70 one-way trips to the dryer annually, the probability in any given year of a transportation accident, of any severity, involving a truck loaded with yellowcake slurry is between 27 in 1,000 (Christiansen Ranch) and 170 in 1,000 (Alta Mesa). In 2002 to 2005, 0.9 percent of Wyoming traffic accidents caused a fatality and 25.4 percent of accidents caused an injury (WYDOT, 2007a). Therefore, the probability in any given year of an injury-causing or fatal accident involving a loaded or unloaded Lost Creek tanker truck is between 14 in 1,000 (Christiansen Ranch) and 89 in 1,000 (Alta Mesa).

The yellowcake slurry will be shipped in DOT approved containers designed to withstand the impact of most accidents. In a worst-case transportation accident, the loaded tank would rupture and release some or all of the slurry. Should this scenario occur, the environmental effect would be minor compared to a similar accident involving dried yellowcake. Some portion of the slurry would pour onto the ground and thicken as the liquid infiltrated, but the yellowcake would not become airborne dust until the slurry dried (NRC, 1997). The viscosity of the yellowcake slurry would reduce the chance that a spill would travel a sufficient distance to enter a waterway before being contained by emergency personnel.

For comparison, a 1977 accident resulted in a spill of 7,000 pounds of dried yellowcake. Within three hours, the spill was covered in plastic, preventing further airborne release. The estimated atmospheric release was 53 pounds of yellowcake, which resulted in an estimated dose of 0.012 man-Sv (man-Sieverts) in an area with a population density of 2.5 people per square mile. No clinical effects or chemically toxic levels of intake were observed in rescue and clean-up personnel (NRC, 1980b). If such an accident occurred as part of the Project, the drying time for slurry would provide rescue and cleanup personnel a window of time to contain the spill. For a slurry spill of comparable size to the 1977 dried yellowcake spill, the atmospheric release would be far lower.

Sufficient statistical data are not available for a quantitative analysis of an accident involving tanker trucks carrying yellowcake slurry. Previous studies have focused on transportation of dry yellowcake in 55-gallon, 18-gauge, Class A drums. A recent analysis of transportation risk for trucks carrying dried yellowcake estimated that the 50-year dose commitments to the general public would be 0.14 to 2.0 man-Sv, depending on the fraction of yellowcake that was released (NRC, 1997). Exposures would likely be much lower in the worst-case Lost Creek scenario since: 1) little or no airborne release would occur due to the slurry form of the yellowcake; 2) the analysis considered the population densities in the eastern US, which are generally much higher than in Wyoming and the western US; 3) the modeled release time was 24 hours and an actual slurry spill would be contained much more quickly; and 4) the mathematical model for the dried yellowcake scenario was conservative by nearly a factor of six (Department of Energy [DOE], 1994).

4.2.1.3 Shipments of Material for Off-site Disposal

Disposal of all 11(e)(2) byproduct waste generated by the Project will occur at an off-site, NRC-licensed disposal facility. Most shipping would occur at the end of the Project, during facility decommissioning. LC ISR, LLC is currently negotiating with existing licensees to use their disposal facilities. The estimated annual number of loads will be four to five, based on 80 to 100 cubic yards of waste per year transported by trucks with a capacity of 20 cubic yards each. This volume is exclusive of final reclamation material. The probability of an accident while transporting 11(e)(2) waste for any given trip is the same as discussed in **Section 4.2.1.2**. However, the potential risks for exposure are lower, since the waste material is generally less radioactive than the yellowcake slurry and consists partially of solid materials that would be easily contained.

4.2.1.4 Post-Reclamation Impacts

Before the on-site roads are reclaimed, BLM will be consulted and given the option to retain the Project-related roads. If BLM decides that the Project roads are beneficial to other users, such as ranchers and hunters, the roads will not be reclaimed

4.2.1.5 Cumulative Impacts from the Preferred Alternative

The Project may contribute incrementally to increased traffic loads and risk of accidents associated with continued energy resource development in the State of Wyoming. However, the volume of traffic associated with the Project is expected to be relatively small, due to the concentrated nature of the resource and the comparatively small workforce associated with ISR operations. It is believed that the tax revenue from this and other projects will help subsidize ongoing infrastructure improvements that will minimize risks and transportation impacts associated with energy resource development.

The cumulative impact of road-building will be minimized since: 1) the existing road network will be used and improved to the extent possible; 2) topsoil will be stripped where necessary for road construction and improvements; 3) all roads that are not beneficial to the approved post-operational land use will be reclaimed with topsoil and native vegetation; and 4) approval for any off-site road improvements will be sought from the BLM prior to initiating the improvements.

4.2.2 Transportation Impacts of Other Alternatives

Neither the alternate Plant locations nor the size of the monitor rings will measurably affect the transportation risk.

4.2.3 Mitigation of the Preferred Alternative

The following mitigation measures will reduce the potential impact of a traffic accident.

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

4.2.4 Monitoring of the Preferred Alternative

Records of shipping, driver training, truck safety certifications, and on-site road maintenance will be kept.

4.3 Soils

4.3.1 Soil Impacts from the Preferred Alternative

ISR operations do not disturb topsoil to the extent of conventional open-pit mining, but a portion of operations within the Permit Area will affect soils. Topsoil will be removed from approximately 58 acres within the Permit Area (4,220 acres) due to the construction and excavation of the Plant, header houses, mud pits, pipelines, primary access road, and secondary access roads. **Table 4.3-1** shows the estimated acreage for topsoil stripping. The location of the soils with respect to Project infrastructure can be seen in **Figure 4.3-1**. A portion of these effects, in addition to less significant effects, will be contained within the pattern areas of the mine units. The pattern areas encompass approximately 254 acres of the 4,220 acres.

The severity of soil impacts will depend on the number of acres disturbed, the type of disturbance and the time period of disturbance. Potential impacts include soil loss, sedimentation, compaction, salinity, loss of soil productivity, and soil contamination. Effects to soils in the Permit Area will result from the clearing of vegetation, excavating, leveling, stockpiling, compacting, and redistributing soils during construction and reclamation. While some of the disturbances related to the construction and operation of the Project are short-term in weeks or months (e.g., mud pits, pipelines, field construction laydown areas, etc.), other disturbance will be long-term, lasting for the duration of the Project (e.g., the main access roads, the Plant site).

Wind erosion is a 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. Wind erosion will be controlled by removing vegetation only where it is necessary, and by techniques that may include surfacing roads with gravel, limiting traffic speeds, watering unpaved roads, spreading soil binding agents, and timely reclamation.

Water erosion is not a large concern at the Permit Area due to very low 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. Soil loss will be reduced by timely reclamation, installing drainage controls, and reseeding and installing water bars across reclaimed areas.

Construction and operation 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 soils could decrease infiltration, promoting an increase in runoff. Reduced infiltration capacity resulting from compaction could persist for many years following operations. Soils compacted during construction and operational activities will be disced and seeded as early as possible following use.

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.

Facility development could displace topsoil, which could 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 could cause mixing of soil layers and breakdown of the soil structure. Removal and stockpiling of soils for reclamation could result in mixing of soil profiles and loss of soil structure. 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.

Increased erosion and decreased soil productivity may cause a long-term declining trend in soil resources. Long-term impacts to soil productivity and stability could occur as a result of large-scale surface grading and leveling, until successful reclamation is accomplished. Reduction in soil fertility levels and reduced productivity could affect diversity of reestablished vegetative communities. Infiltration could be reduced, creating soil drought conditions. Vegetation could undergo physiological drought reactions.

Surface spillage of process materials could occur at the Permit Area. If not remediated quickly, these materials have the potential to adversely impact soil resources.

4.3.2 Soil Impacts from Other Alternatives

4.3.2.1 Alternate Plant/Facility Locations

The disturbance caused by the alternative Plant location will be less than 0.5 acres greater than the disturbance caused by the preferred Plant location. Therefore, the additional soil disturbance caused by the alternative location would not be prohibitive.

4.3.2.2 Scale of Monitor Rings

The scale of the monitor rings will have very little impact on the amount of soil disturbance. If fewer monitor wells are installed and maintained, then there will be less surface disturbance. The differences in disturbance area, however, will not be significant (i.e., one to two acres).

4.3.3 Mitigation and Monitoring of Soil Impacts

Soil loss from erosion will be reduced by timely reclamation, the installation of drainage controls, and the reseeding and installation of water bars across reclaimed areas.

The negative effects on soil properties resulting from the high volume and degree of constant activity at the Permit Area will be minimized where possible, and soils will be loosened for reseeding during reclamation to control the effects of soil compaction. Traffic will be confined to roadways wherever possible.

The Plant site will be cleared of topsoil prior to construction. This topsoil will be stockpiled and stabilized. The stockpiled soil will be used for remediation upon site closure.

In order to minimize potential impacts from spills, a Spill Prevention, Control, and Countermeasure (SPCC) plan will be implemented. The SPCC plan will include accidental discharge reporting procedures, spill response, and cleanup measures.

Regular inspection of erosion control installments, topsoil stockpiles, and reclamation/revegetation status will be conducted to ensure that soil impact mitigation measures are working properly.

4.4 Geology

There will be no impact on geology during site preparation and construction.

The removal of uranium from the target sandstones will result in a permanent change to the composition of these rock formations. The Project will not preclude recovering other minerals that might be discovered in economic quantities within the Permit Area in the future.

No significant matrix compression or ground subsidence is expected, as the net withdrawal of fluid (bleed) will be typically one percent or less. Once groundwater restoration is complete, groundwater levels will approximate pre-operational levels.

Theoretically, changes to the aquifer pressure may impact the transmissivity (e.g., resistance to flow) of the Lost Creek Fault. The pressure of the produced aquifer will be increased during operation and restoration activities; however, this pressure will be balanced by the production and recovery wells. It is very unlikely that the planned ISR operations will 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 pounds per square inch (psi) or higher. Operations at Lost Creek are expected to induce more limited pressure changes (e.g., approximately 50 to 150 psi).

Except for the No-action Alternative, the impacts on geology from all Other Alternatives are the same as presented above for the Preferred Alternative.

No mitigation measures or monitoring programs will be required for the impacts on geology, and cumulative impacts are not anticipated.

4.5 Hydrology

4.5.1 Hydrology Impacts from the Preferred Alternative

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. In addition, shallow alluvial deposits, if present, are poorly developed. Therefore, the discussion of Hydrology Impacts is separated on the basis of Surface Water Impacts and Groundwater Impacts. The discussion is further organized on the basis of impacts to water quantity, including water uses, and water quality.

4.5.1.1 Surface Water Impacts from the Preferred Alternative

Because of the limited quantity of surface water within the Permit Area and the operational measures that will be taken to avoid impacts to the surface water, no impacts are anticipated. However, the potential impacts are outlined below to better illustrate the need for the mitigation measures described in **Section 4.5.2.1**.

Surface Water Quantity and Use

As previously noted, perennial or intermittent streams do not exist within the Permit Area or on adjacent lands. Surface-water-use permits with legal descriptions inside and within two miles of the Permit Area were queried using the WSEO Water Rights Database (WSEO, 2006). According to the query, no use permits exist inside or within two miles of the Permit Area. Since ISR operations do not involve the use of or discharge to surface water, the proposed operation has no foreseeable impact to surface water quantity or uses..

Surface Water Quality

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 very short-term impacts. The larger areas of surface disturbance, such as the Plant and the main road, may require the diversion of stormwater runoff. Without appropriate mitigation measures, the disturbances and diversions could result in adverse impacts, especially at places where relief is higher, 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 and to areas where sheet flow evaporates or infiltrates. There are no 'live' streams that would be impacted.

Activities associated with drilling, pipeline installations, and road and mine construction can lead to reduced 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 localized 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 will be stripped from specific areas, such as mud pits and the Plant, and stockpiled for replacement during reclamation, improperly protected stockpiles can also erode, potentially 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.

In very rare instances, it may be necessary to locate a production or injection well in an ephemeral drainage. The potential impacts of concern in such instances are impacts to groundwater if the wellhead is not designed to withstand the occasional surface water flow. However, surface water runoff could also be impacted due to a leak from the well piping.

4.5.1.2 Groundwater Impacts from the Preferred Alternative

Potential impacts to groundwater resources from the ISR operations and restoration activities include groundwater consumption, which will necessitate operational decisions to reduce interference between mine units on-site and monitoring to evaluate impacts to existing wells off-site. The ISR process depends on changes to groundwater quality, but those changes are anticipated and mitigated, as outlined below.

Groundwater Quantity and Use

As discussed in Section 3.5, groundwater underneath the Permit Area occurs in a series of relatively flat-lying sandstones, confined by shales. In general, the extents, transmissivities, and saturation of these sandstones are sufficient such that wells can produce on the order of a few tens of gpm of water. One series of uranium-bearing sandstones, grouped geologically and hydrologically as the HJ Horizon, is of interest for this application.

Within the Permit Area

Currently, exploration activities consume a negligible amount of groundwater for monitoring, testing, and miscellaneous purposes. A key component of ISR production and restoration is groundwater extraction. During production, most of the extracted groundwater is re-injected into the mine unit. The mine unit is operated with a 0.5 to 1.5 percent bleed that creates an inward hydraulic gradient to the mine unit. This bleed rate accounts for the consumptive use of groundwater during production. During restoration, groundwater is initially extracted without re-injection to hydraulically capture groundwater impacted by production and to draw ambient, baseline-quality water into the mine unit from the surrounding aquifer. This groundwater sweep accounts for the largest consumptive use of groundwater during the ISR project. Following sweep, groundwater is extracted and treated using reverse osmosis. The bulk of the treated water is re-injected into the affected aquifer to improve water quality, but a bleed rate is maintained, which will result in continued groundwater consumption, although at a much reduced rate compared to sweep.

As discussed in **Section 3.5**, pump tests have been conducted to assess the hydraulic characteristics of the HJ Horizon which contains the uranium-bearing sands of interest for this application, overlying and underlying aquifers (FG and KM Horizons), and confining units. Pump tests will also be performed before production in each mine unit to: demonstrate hydraulic containment above and below the pattern area; reduce the possibility of vertical excursions; demonstrate communication between the pattern area and monitor well ring; help ensure any horizontal excursion could be detected; and further evaluate the hydrologic properties of the HJ Horizon aquifer for efficient ore recovery and monitoring.

Results of the hydrologic investigations to date indicate that the HJ aquifer is laterally extensive and hydraulically connected, except where separated by the Lost Creek Fault (**Section 3.5**). Furthermore, the HJ aquifer is hydraulically separated from the overlying and underlying aquifers by laterally continuous confining units. Groundwater consumption during production and restoration will generally be limited to the HJ aquifer.

The 2007 long-term pump test demonstrated the hydraulic barrier effects of the Fault on the HJ Horizon in the immediate area of the pumping well. The aquifer properties calculated from the pump test are strongly impacted by the effects of the Fault, which effectively reduces the aquifer volume supplying the pumping well, thus increasing the observed drawdown at the pumping well and surrounding observation wells. The effects of this Fault on the hydrologic characteristics of each mine unit will be determined as part of the Hydrologic Testing Proposal and subsequent Test Report that will be submitted to WDEQ-LQD for review and approval. A variety of options are available to manage the

the effects of the Fault during production and restoration, such as progression of activities on alternating sides of the Fault.

To generally quantify the potential impact of drawdown due to production and restoration operations, the following assumptions were used:

- production/restoration life: eight years;
- average net consumptive use: 174 gpm;
  (60 gpm bleed from ISR; 160 gpm from groundwater sweep; 100 gpm from RO);
- location of pumping centroid: center of Section 18;
- observation radius: two and three miles radially from centroid of pumping;
- formation transmissivity: 65 ft^2/d (preliminary pump test results);
- formation thickness: 120 feet;
- formation hydraulic conductivity: 0.54 ft/d; and
- formation storativity: 1.1×10^{-4} (preliminary pump test results).

The data were used to predict the drawdown over time with a Theis semi-steady state analytical solution, which includes the following assumptions.

- The aquifer is confined and has apparent infinite extent.
- The aquifer is homogeneous and isotropic, and of uniform effective thickness over the area influenced by pumping.
- The piezometric surface is horizontal prior to pumping.
- The well is pumped at a constant rate.
- No recharge to the aquifer occurs.
- The pumping well is fully penetrating.
- The well diameter is small, so the well storage is negligible.

Based on these assumptions and results from the Lost Creek Pump Test, drawdown, after eight years of operation at two-mile and three-mile radial distances from the centroid of pumping, was estimated to be 146 and 114 feet, respectively. This amount of drawdown is approximately 50 percent of the available drawdown in the HJ Sand. While this amounts to a significant portion of the available drawdown, there is little, if any, use of shallow groundwater in the immediate vicinity of Lost Creek. In addition, the calculated drawdown is very conservative because one of the assumptions is that there is no recharge to the aquifer.

These calculations also neglect the impact of the Lost Creek Fault, which as noted above, limits groundwater flow to a significant degree. The calculated drawdowns from ISR and restoration are based on the assumption of an infinite radial system, which would result in less drawdown as compared to a system bisected by the Fault. However, it is anticipated that ISR and restoration activities will progress on alternating sides of the Fault to manage the impact, so the duration of ISR and restoration on each side of the Fault would be less than the eight-year period used in these calculations. In addition, it is anticipated that LC ISR, LLC will apply for a license amendment to conduct ISR in the overlying FG and underlying KM Sands, increasing the options for management of the effects of the Fault. The drilling to refine the delineation of each mine unit and the testing performed as part of the Hydrologic Testing Proposal and Report for each mine unit will provide information on the extent of the Fault and its impact on the hydrologic characteristics of each mine unit and will allow for refinement of the drawdown calculations.

Based on a bleed of 0.5 percent to 1.5 percent, which has been historically applied at numerous ISR facilities, the potential impact from the consumptive use of groundwater is expected to be manageable. In this regard, the vast majority (e.g., on the order of 99 percent) of groundwater used during production and restoration will be treated and re-injected. Potential impacts on groundwater quality due to consumptive use outside the Permit Area are expected to be small.

Outside the Permit Area

Groundwater-use permits with legal descriptions inside and within two miles of the Permit Area were queried using the WSEO Water Rights Database (WSEO, 2006). Currently, groundwater is not used for domestic or irrigation purposes inside the Permit Area or within two miles of the Permit boundary. In this vicinity, water is used for livestock and wildlife watering as well as for purposes related to mining. The majority of the groundwater-use permits are for monitoring or miscellaneous purposes related to mining and do not represent consumptive use of groundwater.

BLM has four active wells (and four associated stock ponds), located outside of the Permit Area for livestock and wildlife use (**Figure 3.5-18**). These stock wells are approximately 1,500- to 4,000-feet from the Permit boundary, and approximately 6,000 to 8,000 feet from the centroid of pumping, in the center of Section 18, Township 25 North, Range 92 West. As such, potential drawdown at these locations, due to production and restoration operations, could be on the order of 100 feet. As noted above, the calculated drawdown at this distance is based on continuous operations at one location, rather than on alternating sides of the Fault, and on the conservative assumption that no recharge will occur. However, water level monitoring of the wells adjacent to the Permit Area and, potentially, mitigation of water resource impacts is warranted, as discussed in **Sections 4.5.4.2 and 4.5.5.2**.

Groundwater Quality

ISR from a mineral deposit is accomplished by reversing the natural processes that deposited the uranium. The native formation waters in the ore zones in the HJ and UKM aquifers are not suitable for human consumption because of naturally high levels of dissolved radioactive materials (uranium and Ra-226) (**Section 3.5**). In addition to uranium, other metals may be mobilized by the ISR process. This process affects the ore zone, which must be exempted per the water use classifications of the WDEQ and the aquifer exemption provisions of the EPA UIC regulations.

Excursions represent a potential impact on the adjacent groundwater outside of the mine unit as a result of operations. During production, injection of the lixiviant into the mine unit results in a temporary degradation of water quality in the exempted aquifer compared to pre-production conditions. However, proper balancing of production and injection rates and pressures restricts these water quality changes to that portion of the aquifer within the mine unit. Inadvertent movement of the affected water out of the mine unit is termed an excursion. Excursions of contaminated groundwater in a mine unit can result from an improper balance between injection and recovery rates, undetected high permeability strata or geologic faults, improperly abandoned exploration drill holes, discontinuity and unsuitability of the confining units that could allow movement of the lixiviant out of the ore zone, poor well integrity, and hydrofracturing of the ore zone or surrounding units (if the injection wells were operated above fracture pressure).

Groundwater quality could potentially be impacted during operations due to an accident such as Storage Pond leakage or failure or an uncontrolled release of process liquids due to a mine unit accident. If there should be an uncontrolled pond leak or mine unit accident, potential contamination of the shallow aquifer as well as the surrounding soil could occur. This could occur as a result of a slow leak or a catastrophic failure, a shallow excursion, an overflow due to excess production or restoration flow, or due to the addition of excessive rainwater or runoff. Another potential cause of groundwater impacts from accidents could be the release of injection or production solutions from a mine unit building or associated piping as a result of a spill.

The geologic and hydrologic data presented in **Sections 3.4** and **3.5**, respectively, demonstrate that the occurrence of uranium mineralization is primarily within the HJ Horizon and UKM Sand and that th eHJ and UKM aquifers are isolated from underlying and overlying sands. This permit application is only for ISR in the HJ Horizon. Hence, the ISR operations are expected to impact water quality only in the HJ Horizon, and restoration operations will be conducted in this horizon following completion of production.

4.5.1.3 *Cumulative Hydrologic Impacts*

Cumulative Surface Water Impacts

Adverse impacts to surface water are not anticipated due to the absence of nearby surface water bodies and due to the operational practices to prevent erosion and the control measures that will be implemented according to WYPDES permits that will be obtained from WDEQ.

Within the Permit Area, cumulative impacts to surface water resources from historic and proposed activities are not reasonably foreseeable. Historic and present land uses include, but are not limited to, livestock grazing, exploratory drilling, and federal management of land, water, and wildlife. The proposed activities involve the construction and operation of an uranium facility.

ISR operations minimize disturbance by recovering uranium in solution and leaving the surrounding resources in tact. Proposed disturbed areas (mine units, Plant, and access roads) will be reseeded as soon as conditions allow. Ultimately, the disturbed areas will be reclaimed to their pre-operation contours and revegetated to support post-operation land uses. Due to the absence of surface water in the Permit Area, the limited disturbance from ISR operations, and surface reclamation requirments, no cumulative impacts to surface-water resources are anticipated.

Cumulative Groundwater Impacts

Cumulative impacts to groundwater are expected to be minimal due to the distance between the Lost Creek Project and other potential operations, and the time lag between this project and other potential ISR projects in the Great Divide Basin. Should another ISR project be developed, the primary concern would be the cumulative drawdown, which is additive from more than one operation and can be readily estimated. In addition, each operation would be required to conduct water level measurements, so the impacts of the individual operations could be differentiated.

Systematic monitoring and mitigation measures will be performed at the Project. Potential impacts to groundwater from the Project include changes to water levels on- and off-site and to groundwater quality on-site. However, the water levels are projected to recharge within ten to 15 years once groundwater extraction ceases. In addition, groundwater restoration will allow for the same water uses after ISR as before, with some potential improvement due to removal of uranium and radium.

4.5.2 Hydrologic Impacts from Other Alternatives

4.5.2.1 Surface Water Impacts from Other Alternatives

No significant differences are expected between the potential impacts from the Preferred Alternative and the potential impacts from the alternate site for the Plant or from the alternate scales for the monitor rings.

4.5.2.2 Groundwater Impacts from Other Alternatives

No significant differences are expected between the potential impacts from the Preferred Alternative and the potential impacts from the alternate site for the Plant. With respect to alternate scales for the monitor rings, the overall impacts of the Project on groundwater quantity and quality do not differ significantly. However, from an operational standpoint, the alternate scales could increase the interference between mine units, make balancing the injection and production more difficult, and/or make monitoring for excursions more difficult. Therefore, the alternate scales for the monitor rings could decrease the efficiency of the Project and extend the time for production and restoration.

4.5.3 Mitigation Measures

4.5.3.1 Mitigation Measures for Surface Water Impacts

The primary mitigation activities for surface-water impacts will be: limiting soil compaction; conducting operations in accordance with standard operating procedures (SOPs) and SPCC plans; ensuring that runoff from disturbed areas meet WYPDES permit guidelines for stormwater management and sediment reduction; and completing appropriate reclamation practices in a timely manner.

Soil compaction during drilling and pipeline installation can be limited by using existing roads to the extent possible. Roads will cross drainages at right angles to prevent surface runoff flowing along the road from eroding the drainage. Other measures to minimize erosion may include: contouring and re-vegetation to stabilize soils; placement of hay bales, engineered sedimentation breaks and traps, and water contour bars; and the use of diversion ditches, engineered culverts, and energy dissipaters to prevent excessive erosion and to control runoff.

Once a drill site, pipeline route, or facility location has been selected, the appropriate topsoil protection methodology will be employed to prevent excess erosion and movement of sediment into drainages (See **Section 4.3** of this Environmental Report for mitigation of soil impacts.). In addition, BMPs will be followed to divert the flow of runoff water away from exposed soils, store flows and sediment, or otherwise limit runoff and the discharge of pollutants from exposed areas to the degree attainable. There are several design features that would mitigate impacts to surface water and ephemeral drainages. Such practices might include, but not necessarily be limited to, 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.

When designing and constructing new roads, weather, elevation contours, land rights, and drainages will be considered. New roads will cross ephemeral drainages or channels at right angles to enhance erosion protection measures. However, as it may not always be feasible or warranted to construct roads or crossings at right angles or along elevation contours, implementation of erosion measures appropriate for the situation will be implemented.

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 will be used to prevent erosion and to control runoff. 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. A sediment control plan will be developed for disturbed areas exceeding five acres (two hectares).

Culverts will be installed as appropriate during the development of site access roads to maintain existing site surface drainage conditions. Culvert design includes providing adequate capacity (ten-year to 25-year event) for both water and sediment yield. Culvert construction will meet all State of Wyoming standards, including inlet and outlet control, head room, and bedding, where appropriate. On a local scale, surface drainage will be directed away from facilities, roads and topsoil stockpiles using shallow ditches and/or berms.

No paved areas are currently planned for the Permit Area. However, if any areas are paved, storm water runoff from those areas will be collected by a storm water system.

The storm water will 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 will be designed to control the release of storm-water runoff at a rate equal to or slightly less than that of the pre-exploration stage.

During leaching, restoration, and after reclamation, re-vegetation work will be initiated as soon as possible. The spring/summer is generally the best time for re-vegetation work for optimum growth. Either temporary cover crops or the permanent seed mix, described in **Section 6** of the Technical Report for the Project, will be used to stabilize the soil and minimize erosion due to runoff.

If appropriate erosion prevention methods are employed, impacts to surface water runoff from exploration and development activities are expected to be insignificant. Similarly, impacts from accidental releases of contaminants such as gasoline, oil, or diesel fuel are expected to produce small impacts on surface-water runoff because cleanup activities will be prompt and thorough, as required in the facility's SPCC plan.

Wells that are constructed in drainages where runoff has a likely potential to impact the wellhead will need added wellhead protection. This protection will vary depending on the drainage and its potential for runoff. 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.

4.5.3.2 Mitigation Measures for Groundwater Impacts

The discussion of mitigation 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 production and restoration as efficiently as possible, and emphasizing water quality monitoring. Off-site, the concern is related to the extent to which on-site groundwater extraction, particularly during the first phase of restoration, will draw down water levels in four off-site BLM wells, which are within one mile of the Permit boundary.

On-Site Mitigation Measures

Excursions of lixiviant at ISR facilities have the potential to impact adjacent aquifers with radioactive and trace elements that have been mobilized by the ISR process. These excursions are typically classified as horizontal or vertical. A horizontal excursion is a lateral movement of production fluids outside the mine unit monitor well ring. A vertical excursion is a movement of ISR fluids into overlying or underlying aquifers.

While rare, horizontal excursions can occur during ISR operations. However, excursions are typically detected rapidly because of appropriately spaced monitor well networks which are regularly sampled. Once detected, excursions are typically recovered through overproduction in the immediate vicinity of the excursion. The excursions rarely threaten the water quality of an underground source of drinking water because the monitor wells are suitably located within the aquifer exemption area approved by the EPA and WDEQ. LC ISR, LLC anticipates that excursion control will be maintained by detailed investigations and engineering design, SOPs, and employee training.

LC ISR, LLC will control lateral movement of lixiviant by maintaining mine unit production flow at a rate slightly greater than the injection flow. This difference between production and injection flow is referred to as process bleed. The bleed solution is either recycled in the Plant or is sent to the liquid waste disposal system. When process bleed is properly distributed among the many production/injection patterns within a mine unit, the mine unit is considered balanced.

To mitigate the likelihood of pond failure, the two Storage Ponds which are part of the waste water disposal system at the Project will be designed and built to NRC standards using impermeable synthetic liners. A leak detection system will also be installed, and all ponds will 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 4.13.**

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. Shallow groundwater should not be affected, since the outer pond liner is designed to prevent a release of the pond contents. All pond leaks, causes, and corrective actions are reported to NRC and WDEQ.

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

Groundwater impacts from a spill of injection or production solutions from a mine unit building or associated piping are unlikely due to the depth to groundwater. In addition, any impacts can be prevented by proper design, construction, and testing. In general, piping from the plant to and within the mine unit will be constructed of HDPE with butt-welded joints or the equivalent. All pipelines will be pressure tested before they are placed into operation. It is unlikely that a break would occur in a buried section of line because no additional stress is placed on the pipes. In addition, underground pipelines will be protected from a major cause of potential failure which is vehicles driving over the lines causing breaks. Typically, the only exposed pipes will be at the Plant, at the wellheads, and in the header houses in the mine unit. Trunkline flows and manifold pressures will be monitored for spill detection and process control.

Off-Site Mitigation Measures

As noted in Section **4.5.1.2**, the water levels in four BLM stock wells within one mile of the Permit boundary potentially could be impacted due to the drawdowns associated with groundwater withdrawal for ISR operations and restoration 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 mitigation measures will be considered:

- lowering the pump level in the wells, if possible;
- deepening the wells, if possible; and
- replacing the wells with new wells completed in deeper sands that are not impacted by ISR operations.

4.5.4 Hydrologic Monitoring

4.5.4.1 Surface-Water Monitoring

The drainages throughout the Permit Area are ephemeral and flow only in response to spring runoff or occasional strong thunderstorms. The surface water monitoring sites from which baseline samples were collected are described in **Table 3.5-4** and shown on **Figure 3.5-5**. 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.

4.5.4.2 Groundwater Monitoring

Similar to the discussion of mitigation measures in **Section 4.5.3.2**, 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 helping ensure production and restoration are conducted as efficiently as possible, and emphasize monitoring of water quality (although water level data will also be collected). 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 ring. Off-site, the concern is related to the extent to which on-site groundwater extraction, particularly during the first phase of restoration, will draw down water levels in off-site wells. There, the emphasis is on water level data.

On-Site Groundwater Monitoring

Mine Units

In addition to the baseline monitoring already conducted, extensive groundwater monitoring will be conducted on a mine unit basis prior to, during and following ISR operations at the Permit Area to identify any potential impacts to water resources of the area. This monitoring is summarized below and described in more detail in **Sections 5.7.8.2** and **6.2** of the Technical Report.

During ISR operations, water levels will 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.

LC ISR, LLC will 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. It is anticipated that monitor wells will be installed about 500 feet from the mine unit boundary and appropriately spaced to detect an excursion in a timely manner based on the hydrologic characteristics of each mine unit. Monitor wells will be sampled semi-monthly for approved excursion indicators.

LC ISR, LLC will 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 will be located within the mine unit boundary at a density of about one well per three acres, depending on the hydrologic characteristics of each mine unit. Shallow and deep monitor wells will be sampled semi-monthly for approved excursion indicators.

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 ponds will be designed, inspected and monitored in accordance with NRC Regulatory Guide 3.11. The Storage Ponds, associated inspection schedule and monitoring system, and corrective actions that will be taken in case a leak is detected, are briefly described in **Section 4.13** of this report and in more detail in **Sections 3** and **5** of the Technical Report for the Project.

Class I UIC Wells

These wells are part of the waste treatment and handling system and will be much deeper than any of the mine units. Testing of the mechanical integrity of these wells is required prior to their use, and periodically thereafter, and regulation of injection rates and pressures is also required. These wells are briefly described in **Section 4.13** of this report and in more detail in **Sections 3** and **5.7** of the Technical Report for the Project.

Off-site Groundwater Monitoring

To help ensure water level drawdowns resulting from the ISR groundwater withdrawals are not interfering with the four BLM wells in the vicinity of the Permit Area (**Figure 3.5-18**). LC ISR, LLC will monitor the water levels in those wells prior to production and quarterly during ISR operations. In addition, per NRC requirements, these wells will be sampled quarterly for uranium and radium (**Section 5.7.8.2** of the Technical Report).

4.6 Ecology

Construction and operation of the Project have the potential to adversely affect flora and fauna in limited areas. Most of the impacts would occur during the initial construction phase, particularly at the mine units, roads, and the Plant site. The Project is not likely to adversely affect sensitive plant or animal species, because federal- and state-listed or proposed endangered or threatened species or proposed or designated critical habitats do not occur within the Permit Area. Similarly, the absence of permanent surface water within the Permit Area excludes impacts to aquatic resources, which do not exist.

Ecological resources could be affected from the land disturbance of mine unit construction. Construction would involve vegetation removal during clearing for facilities (e.g., individual well sites, header houses, the Plant, roads, parking, field laydown areas, and Storage ponds). Facility construction will be completed in phases, with restoration following each stage to minimize impacts to vegetation and wildlife. Approximate land areas of various habitat types that will be disturbed are presented in (**Table 4.6-1**).

The off-site impacts of construction will be minimal. Construction activities will produce a minor increase in vehicle traffic and, hence, could increase the number of animals killed on the roadways. Construction will also produce a temporary increase in dust, some of which will be deposited on vegetation both on- and off-site. However, vegetation in this naturally dusty, arid region is expected to be adapted to moderate, temporary increases.

4.6.1 Ecological Impacts from Preferred Alternative

During the Project, less than seven percent of the total Permit Area will be temporarily disturbed. However, ISR operations will be conducted in a series of mine units that are installed, produced, and reclaimed sequentially; therefore, only small portions of the Permit Area will be disturbed at a given time (**Figure 4.6-1**). Unless otherwise arranged and approved by the relevant agencies, all disturbed areas will be reclaimed to support the pre-operational land uses, livestock grazing and wildlife habitat.

The construction of the Plant, main access roads and mine units will involve vegetation removal. The Plant will have long-term disturbance (the life of the Project), while the mine unit areas will have a shorter period of disturbance (approximately two years). Impacts from mud pit and pipeline constructions will be short-term, which will be reclaimed within weeks. **Figure 4.6-1** displays the projected disturbed areas of the Plant and mine units.

LC ISR, LLC consulted state and federal agencies to discuss minimization of impacts to ecological resources. Appropriate state and federal agencies, including WDEQ, WGFD, BLM, and FWS, were consulted in 2006 and 2007.

4.6.1.1 Vegetation Impacts

During the life of the Project, the land area that will be disturbed will be about 285 acres (seven percent) of the approximate total Permit Area of 4,220 acres. Approximate land areas of the disturbed vegetation types are listed in (**Table 4.6-1**). After operations are completed, buildings will be removed and disturbed areas will be re-vegetated with native plants. As required, LC ISR, LLC will submit an updated reclamation plan for approval, following review and approval by the appropriate state and federal agencies.

Vegetation will be temporarily impacted during the construction, operation, and reclamation of the Permit Area. During construction activities, vegetation will be removed at some areas of the mine units, supporting facilities, and roads. To stabilize soils and support the ecosystem, vegetation will be established at disturbed areas as soon as conditions allow. During operation activities, mine units and supporting facilities will be accessed frequently using the defined road network. Reclamation will involve abandonment of the mine units, decommissioning and removal of the supporting facilities and roads, and the establishment of vegetation that supports the approved land uses.

Surface disturbance increases the susceptibility of the Permit Area to invasive and noxious weeds. As such, surface disturbance will be minimized and vehicular access will be restricted to specific roads. Disturbed areas will be reseeded with WDEQ and BLM approved seed mixture, as soon as conditions allow, preventing the establishment of competitive weeds. The approved seed mixture is listed in (**Table 4.6-2**). The seed mixture was selected to successfully establish vegetation supportive of the approved land uses. Invasive and noxious weeds will be monitored and if they become an issue, other alternatives, such as herbicide application, will be considered.

The Project is not likely to adversely affect sensitive plant species because federal- and state-listed or proposed endangered or threatened species or proposed or designated critical habitats do not occur within the Permit Area. Similarly, the absence of perennial surface water within the Permit Area prevents development of any aquatic resources.

4.6.1.2 Aquatic Life and Wetlands Impacts

Baseline surveys indicate that aquatic life and wetlands do not exist within the boundaries of the Permit Area. Surface water may be present for a short period of time mainly during snow melting season, but does not sustain aquatic wildlife or wetland species. Therefore, no impacts to aquatic wildlife or wetlands are anticipated.

4.6.1.3 Wildlife Impacts

Wildlife impacts that are likely to occur from construction and operation of the Preferred Alternative include: 1) direct and indirect loss of habitat; 2) increased mortality from collision with vehicles; 3) possible exposure to toxic compounds or chemicals; 4) wildlife displacement due to increased human activity; and 5) increased disruption/stress to wildlife using the sagebrush habitats in the area.

Direct impacts to wildlife habitat would occur in areas that are physically altered by the construction of roads, pipelines, mud pits/wells, field laydown areas, header houses, transmission lines, and the Plant. In addition, direct impacts could occur from increased vehicle mortality. Indirect impacts would occur from Project disturbance associated with Project construction and operation, resulting from increased human presence, dust, and noise. Indirect impacts may displace wildlife or preclude the use of areas near human use/disturbance.

Displacement of wildlife is an unavoidable impact under all alternatives except the no-action alternative. Displacement impacts have the potential to be the most significant to wildlife resources. Wildlife avoidance of disturbed areas and human associated activities could extend beyond the areas of disturbance. The magnitude of wildlife displacement would depend on the species and on many other factors, including noise level, type of human activity, duration of activity, and visual prominence of activity. Wildlife sensitivity to this type of impact varies by wildlife species. For example, ferruginous hawks are very sensitive to human presence/disturbance, while small mammals have a higher tolerance. It is not possible to quantify the magnitude of wildlife displacement. Reactions of wildlife to human disturbance vary greatly by species and even individuals within a species. It is possible that displacement impacts could result in the local reduction of a wildlife population if adjacent habitats are already at carrying capacity. Impacted wildlife populations could have lower reproduction and survival rates, resulting in reduced populations (WGFD, 2004b).

Wildlife use of habitats near human activity (construction, drilling, noise, and buildings) would be expected to decline for species that are sensitive to human presence. Development impacts to wildlife can extend well beyond the actual areas of vegetation or habitat loss. For example, to protect nesting ferruginous hawks the BLM recommends a one-mile buffer around nest sites from human activities (BLM, 2004b). More widespread development in an area can cause habitat fragmentation. Wildlife species can be expected to exhibit some habituation to the human activity associated with Project operation. Use of habitat adjacent to the ISR operations will probably increase as animals become habituated to the activity. After initial drilling, construction, and startup, human activity (noise, traffic, human presence) would be expected to decline, and impacts to wildlife would probably concurrently decrease. However, the combined habitat loss and increased human presence in a previously undisturbed area could be detrimental to big game species, raptors, sage grouse, and other species that have shown sensitivity to human presence. Following reclamation, other ISR locations have proven to be attractive to wildlife especially deer and antelope.

Primary wildlife resources of concern that are known to occur in the Permit Area include: big game year-long range; sage grouse leks, nesting habitat, and winter habitat; raptor nesting habitat; and sagebrush endemic species. In addition, the area supports a variety of small mammals, birds, reptiles, and amphibians.

The vegetation map (**Figure 4.6-1**) of the Permit Area shows important vegetation communities and wildlife habitats.

Direct habitat loss from construction will equal approximately seven percent of the Permit Area (**Table 4.6-1**). The two major vegetation/habitat types disturbed by Project construction include Lowland and Upland Big Sagebrush Shrubland. Project construction will result in the long-term loss of about four acres of Lowland Big Sagebrush Shrubland and 24 acres of Upland Big Sagebrush Shrubland (**Table 4.6-1**). In addition, approximately 35 acres of Lowland Big Sagebrush Shrubland and 222 acres of Upland Big Sagebrush Shrubland will be temporarily disturbed, e.g., without total removal of vegetation (**Table 4.6-1**). **Figure 4.6-1** shows the Permit Area in relation to key wildlife habitats and features, and vegetation types.

General Wildlife

Project construction could potentially impact 246 acres of Upland Big Sagebrush Shrubland and 39 acres of Lowland Big Sagebrush Shrubland habitat (**Table 4.6-1**). Once disturbed, it will take five to ten years for sagebrush habitats to re-establish.

Several species of sagebrush obligate birds (passerine birds, including BLM sensitive species) have been found nesting in the sagebrush habitats of the Permit Area. Common species include the Brewer's sparrow, sage sparrow, sage thrasher, loggerhead shrike, vesper sparrow, and lark sparrow.

Of special importance is the Lowland Big Sagebrush Shrubland habitat (an area of high sagebrush in swales or draws). The Lowland Big Sagebrush Shrubland habitat had the highest diversity and density of nesting birds at the Permit Area (LWR Consultants Inc., 2007). Long-term loss of four acres of Lowland Big Sagebrush Shrubland habitat would occur with Project construction. Depending on the timing of construction, direct mortality or loss of nests could occur.

Impacts to small mammals, reptiles, and amphibians will include direct mortality during the construction and clearing phase of the Project. There is no way to quantify the extent of direct mortality; however, local populations should recover rapidly

Other direct impacts to passerine birds, small mammals, reptiles, and amphibians could include mortality from motor vehicle collisions or from exposure to toxic chemicals. The waste stream in the Storage Ponds will be evaluated to see if it is potentially harmful to passerine birds and small mammals.

Indirect impacts to passerine birds will include the displacement of shrub-dependent species away from human activities. Birds are mobile and will disperse into adjacent habitat areas. However, adjacent areas may already be at carrying capacity and may not be able to support additional individuals.

Big Game and Wild Horses

The Permit Area provides winter/yearlong range to pronghorn, is not considered mule deer range and is considered transitional range for elk. The site provides range to the Stewart Creek and Lost Creek wild horse herds (BLM, 2006).

Because the site provides marginal habitat to mule deer and elk, minimal impacts are anticipated to these species. There would be no impacts to big-game critical or key winter or summer ranges or migration corridors.

Impacts to big game (especially pronghorn) and wild horses may include direct loss and modification of habitat, displacement from increased human activity, increased mortality from increased traffic on local and regional roads, and increased poaching and/or harvest from improved access, and increased human presence.

About 285 acres of pronghorn and wild horse habitat (Lowland and Upland Big Sagebrush Shrubland) would be disturbed by Project construction (**Table 4.6-1**).

In addition to direct impacts, increased human presence due to construction and operation would affect pronghorn and wild horse use of areas adjacent to the Project. 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). However, initial well drilling activities and unpredictable traffic flows may cause pronghorn to flee. Pronghorn displacement of up to 0.6 miles has been observed from construction activities (Easterly et al., 1991).

General observations in the region indicated that pronghorn densities are higher in undisturbed areas away from human disturbance (BLM, 2004b). Some long-term disturbance of pronghorn habitat would occur with Project construction. The proposed staged reclamation of disturbed areas would provide grass and forb forage within a few years of habitat disturbance. This would reduce habitat loss and would provide quality forage.

Sage grouse

Greater sage grouse are common in the Permit Area. The entire Permit Area provides quality sage grouse habitat. The site provides high quality sage grouse habitat due to lack of habitat fragmentation, interspersion of Upland and Lowland Big Sagebrush Shrubland habitats, and proximity to higher elevation habitat areas to the north. There are five active leks within two miles of the Permit Area and another lek that is two miles from the boundary (**Figure 4.6-2**). There are four active leks within two miles of the proposed production facilities, including upgraded roads. The Sooner lek is greater than two miles from the Permit Area, but is within 100 yards of Sooner Road, which could be subject to increased traffic volume as a result of Project construction and operations. No surveys have been completed for wintering sage grouse at the Permit Area. Wintering sage grouse prefer dense sagebrush stands that extend above snow cover and provide escape and thermal cover to the birds. Based on habitat conditions, the Lowland Big Sagebrush Shrubland habitat areas likely provide important sage grouse winter habitat (Naugle et al., 2006; WGFD, 2003).

Potential impacts to sage grouse include loss of nesting/brood-rearing habitat, loss of wintering habitat, decreased population productivity due to loss of nesting/brood-rearing habitat, increased predation due to increased roosting sites for raptors on power poles and other structures, mortality due to exposure from toxic chemicals, loss of nests due to construction activities, and displacement of birds into adjacent areas.

Project construction would result in the short and long-term loss of 285 acres potential habitat for sage grouse within the Permit Area. However, vast areas of similar vegetation and habitat are available within and beyond the Permit Area in the region.

Construction of Project facilities, pipeline, transmission line and roads creates a long-term loss of sage grouse habitat and increases fragmentation of existing habitat. Transmission line poles, power lines and other facilities provide roosting sites to raptors and corvids, and can result in increased predation. Other sources of direct impacts may occur from disruptive human activities near leks or other key habitat areas. Human activities can also disrupt normal sage grouse behavior related to breeding, brood-rearing, or foraging. Increased human-caused noise may reduce lek attendance and reduce wintering habitat suitability. Increased dust from Project roads may reduce the palatability of sagebrush plants (WGFD, 2004b). The increased traffic adjacent to the Sooner Lek (located approximately 100 yards from Sooner Road) could result in lower lek attendance.

Raptors

Several species of raptors have been observed within the Permit Area. The only raptor species that has been confirmed nesting at the Permit Area is the ferruginous hawk. Based on 2007 nesting raptor surveys, there is one active ferruginous hawk nest within one mile of the Permit Area and two active ferruginous hawk nests within one mile of the main access road, Sooner Road (**Figure 4.6-2**). Two additional active ferruginous hawk nests are located between the Permit Area and Sooner Road; although they are not within one mile of either. All active ferruginous hawk nests are located on artificial nest platforms.

Potential impacts to raptors include loss of nesting and foraging habitat and collisions with other structures and vehicles, nest abandonment and reproductive failure due to increased human activities, reduction in prey populations, and displacement of birds into adjacent areas.

Ferruginous hawks have 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. Mortality from power lines will be minimized by the use of raptor deterrent products and the burial of transmission lines from the transformer to the header houses, and the header houses to the wells.

Special Status Wildlife Species

The bald eagle (formerly listed as threatened) and black-footed ferret (endangered) are the only federally listed, previously listed, or candidate species that may occur in the area (FWS, 2006). The bald eagle may occur as a sporadic migrant, and may forage on the site occasionally. The nearest known bald eagle nest to the site is greater than five miles away. The black-footed ferret is found in active prairie dog colonies. There are no active black or white-tailed colonies on the Permit Area and the nearest active prairie dog colonies are one to two miles south and southwest of the Permit Area. No impacts are anticipated from Project construction and operation to the bald eagle or black-footed ferret.

The Permit Area was evaluated for potential habitat for the long-billed curlew and mountain plover. There is no potential nesting habitat for these species. The Permit Area is dominated by sagebrush vegetation with little open grassland or other open shrubland suitable for nesting mountain plover. No mountain plover were observed on-site while completing other spring and summertime field surveys.

Lowland Big Sagebrush Shrubland habitat provided the highest densities of breeding birds; however, birds were also located in the Upland Big Sagebrush Shrubland Habitat. Project construction and operation may result in the loss of 285 acres of nesting habitat for these species within the Permit Area. Construction and operation activities may displace birds to lower quality habitat areas and could result in localized lower reproduction and increased predation. Other potential direct impacts to sagebrush obligate birds could include mortality from motor vehicles collisions or from exposure to toxic chemicals.

Surveys were conducted for pygmy rabbits at the Permit Area during the summer of 2007. Based on these surveys, pygmy rabbits were found sporadically in the Lowland Big Sagebrush Shrubland habitat. Scat, burrows, and individual Pygmy rabbits were observed along all transects completed within the Lowland Big Sagebrush Shrubland communities at the Permit Area. (**Figure 4.6-1**) shows pygmy rabbit habitat at the Permit Area in relation to construction and production facilities. Project construction and operation will result in the short-term and long-term loss of 39 acres of pygmy rabbit habitat (Lowland Big Sagebrush Shrubland) within the Permit Area. Mortality of individual pygmy rabbits may occur as a result of construction activities in Lowland Big Sagebrush Shrubland habitat. Pygmy rabbits stay within limited habitat areas. Project facilities, mine units, mud pits, Storage Ponds, and access roads may result in exposure to pygmy rabbits of harmful substances or materials.

The state-listed olive-backed pocket mouse and prairie vole were not observed at the Permit Area; however, suitable habitat exists and these species are known to be in the region (WGFD, 2004a). Loss of potential habitat would occur with Project construction and operation.

4.6.1.4 Cumulative Impacts

Within the Permit Area, cumulative impacts to ecology from historic and proposed activities are not reasonably foreseeable due to anticipated reclamation. Historic and present land uses include, but are not limited to, livestock grazing, wildlife habitat, recreation and exploratory drilling. The proposed activities involve the construction and operation of an ISR uranium facility.

Historic and present land uses affect much of the Permit Area. To support present land uses, much of the Permit Area will not be disturbed during the life of the Project. Areas of disturbance will be temporarily stabilized until reclamation activities commence.

ISR operations will minimize disturbance by chemically removing the uranium and leaving the matrix surrounding the ore in tact. Proposed disturbed areas (mine units, the Plant, pipelines, and access roads) will be reseeded as soon as conditions allow. Ultimately, the disturbed areas will be reclaimed to their pre-operational contours and revegetated to support the approved land uses. Due to this reclamation, cumulative impacts to ecological resources are not anticipated.

Future activities could affect the cumulative impacts to wildlife and vegetation at the Permit Area. At this time, there are no known projects that would affect the general area.

4.6.2 Ecological Impacts from Other Alternatives

Ecological impacts from the Other Alternatives will be comparable to those of the Preferred Alternative. The alternate Plant location will have the same impacts, since the same amount of area will be disturbed. Changing the scale of the monitor ring(s) will have negligible differences. The amount of area disturbed, and perhaps fenced, for the mine units will be approximately the same, regardless of the size of the monitor rings.

4.6.3 Mitigation of Ecological Impacts

Off-site impacts of the Project would be minor. Flora and fauna in the areas surrounding the Permit Area are similar to those on-site and are common in the region. Mitigation measures for erosion and sedimentation are discussed in **Sections 4.3 and 4.5**.

Under normal operations, the only routine release would be low concentrations of radon released to the airshed. Provided the concentration is protective of human health, it would not be expected to adversely affect native plants and animals (Barnthouse, 1995).

In the event of a spill, areas of contamination would be cleaned or removed and properly disposed of in accordance with SOPs. As such, spills are unlikely to extend off-site. The materials most likely to be spilled, such as retained process water, would not contain hazardous constituents in concentrations that would be harmful to wildlife.

The goal of the Project is to be proactive to minimize and mitigate ecologyl impacts. This will be done by following agency-recommended mitigation, minimization measures and BMPs, regarding restoration, habitat protection and enhancement, and wildlife protection.

4.6.3.1 Vegetation Mitigation

Successful revegetation cover counts (mostly grasses and forbs) are anticipated to occur within two to five years of seeding. In order to reestablish vegetation in this time frame, noxious weeds will be reduced or eliminated. Disturbed areas will be reseeded with the approved seed mixture as soon as conditions allow. This would prevent the establishment of competitive weeds. Should invasive and noxious weeds become an issue, other alternatives will be considered, such as herbicide application.

Due to the remoteness and the limited historical disturbance to the Permit Area, very few weeds are present. Tansy mustard (*Descurainia pinnata*) was the only listed noxious weed species observed during the vegetation surveys. The tansy mustard was observed as scattered individuals in the Lowland Big Sagebrush Shrubland. Areas dominated by weedy species were not observed. Selenium indicator species were not observed.

Temporary fencing may be installed to restrict access to reseeded areas until vegetation is successfully reestablished. The fences will be constructed according to BLM specifications. Upon demonstration of successful revegetation, the fencing will be removed.

Because many of the reclaimed areas are relatively small in comparison with the total Permit Area, and the vegetation communities within the Permit Area are similar, LC ISR, LLC will be able to use the undisturbed portions of the site for collection of vegetation data that can be compared to the reclaimed areas. In addition, LC ISR, LLC will 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 general locations of native comparison areas, will be submitted to WDEQ for review and approval at least six months prior to the fifth full growing season.

The total vegetation cover, species diversity and composition in revegetated areas will be quantitatively assessed in accordance with WDEQ-approved procedures after the fifth growing season after seeding. Revegetation shall 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) in the undisturbed portions of the Permit Area; and
- species diversity and composition are suitable for the post-operational land use.

4.6.3.2 Wildlife Mitigation

All wildlife management practices are established in conjunction with the BLM, WGFD and FWS guidelines. The following measures and BMPs are proposed in order to minimize and mitigate impacts to wildlife. These measures are designed to be consistent with regional recommendation by land and wildlife management agencies (BLM, 2004c; WGFD, 2003 and 2004b). These measures will also help minimize impacts to plant communities. Standard construction, erosion control, and other BMPs described in other sections will also help to minimize ecological impacts.

Road and Right of Way (ROW) Measures

- Access roads of the Project will use existing two-track roads to the extent possible to help minimize new disturbance of sagebrush habitat. The roads will be constructed following BLM and WGFD recommendations to minimize the road width, revegetate road shoulders, and limit vehicular speeds.
- All utilities will be located in the same ROW. The proposed pipeline and transmission line will be placed in or adjacent to the access road ROW to help minimize habitat impacts where possible.
- All Project access by employees and visitors will be restricted to the main access road.
- Existing two-track roads that are adjacent to the main access road and Project facilities will be gated and or signed to help prevent additional traffic disturbances in the area. This measure will help prevent disturbance of nesting raptors and sage grouse leks.

Fencing and Screening Measures

- Mine units will be fenced to keep out cattle and wild horses and will be designed to minimize mortality rates. Fences will be temporary and will be removed after ISR operations at the mine unit are complete. Fences will be constructed to BLM specifications.
- All mud pits outside of fenced areas will be fenced during the drilling phase, while the pits are open and contain drilling liquid.
- If the fluid in the storage ponds is determined to be harmful to birds, netting or other appropriate deterrents will be placed to eliminate any hazard to migratory

birds, sage grouse or other wildlife. The deterrent will be consistent with agency recommendations.

- Vent pipes will be covered by netting or other methods to prevent bats, birds, or small mammals from being trapped.

Transmission Line

- To prevent the electrocution of raptors, the primary transmission line and power poles will be built to the latest approved methods (Olendorf et al., 1996). This would include cross-arm design, transformer design, and perch guards.
- To help minimize raptor roosting on power poles and to minimize predation on sage grouse, appropriate roost guards will be attached to power poles and cross-arms. The design will follow BLM guidelines (Oles, 2007) or other appropriate guidelines.
- Secondary and tertiary transmission lines will be buried in order to minimize risks to raptors and large birds.

Restoration/Reclamation

- Reclamation will be staged during all phases of the construction and operation of the operations plan. Areas that are temporarily disturbed will be restored and reseeded after disturbance at the next available seeding opportunity. Temporary access roads will be restored and reseeded when no longer needed. Non-maintained road shoulders will be seeded and left undisturbed.
- All seed mixes used for restoration will be approved by BLM. Only native species will be used in seed mixes. All seed mixes designed for permanent restoration will include sagebrush.
- Weed control is an important issue for restoration and protection of existing habitats for sage grouse and other species, and plant communities. Weed prevention measures following BLM guidelines and recommendations will be implemented (BLM, 1996 and 2004c).

Reduce Human Disturbance and Incidental Loss of Wildlife

- Inform all employees of applicable wildlife laws and penalties associated with unlawful take and harassment of wildlife.
- Require that employees undergo training describing the types of wildlife in the area susceptible to collisions with motor vehicles, the circumstances when collisions are most likely to occur, and measures that should be taken to avoid wildlife/vehicle collisions.
- All new and improved roads related to the Project will be signed and or gated to minimize public traffic.

- All two-track roads that connect to Project access road(s) will be signed or gated as needed to minimize disturbance of nesting ferruginous hawks or sage grouse leks. This will be coordinated with appropriate staff from the BLM and/or WGFD.
- Prior to any ground disturbance activities in potential sage grouse nesting habitat, a survey will be completed for sage grouse and sage grouse nests following BLM guidelines.

Wildlife Closures and Timing Windows

Standard BLM exclusion periods, as presented in **Table 4.6-3**, will be followed to protect key wildlife resources during construction and operation.

Wildlife Enhancements

- LC ISR, LLC will work with BLM and WGFD to complete wildlife enhancements in the Permit Area or nearby areas that are not proposed for operations 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 sage grouse or other high interest species.
- All seeding will be completed with native species; sagebrush will be included in all seed mixes.

4.6.4 Monitoring of Ecology

Site-specific monitoring programs need to be implemented per WDEQ, FWS, WGFD, BLM, and Army Corps of Engineers (ACE) guidelines. Regular inspections on the status of mitigation installments also need to be incorporated into the ecological monitoring plan.

4.6.4.1 Vegetation Monitoring

Vegetation monitoring of the Permit Area will consist of evaluating disturbed areas for the presence of undesirable weedy species. If noxious weed species are noted, they will be controlled either by manual removal, mowing, herbicide applications, or other appropriate control measures.

Once disturbed areas have been reclaimed and vegetation is developing, the reclaimed areas will be monitored in accordance with WDEQ and WDEQ requirements. Evaluation of these areas will continue until the vegetation cover values (exclusive of noxious weeds) become comparable to the native shrubland areas.

4.6.4.2 Wildlife Monitoring

Monitoring of key wildlife resources in and near the Permit Area will be completed on an annual basis through the life of the Project. The purpose of the annual monitoring will be to document key wildlife resources, population trends, and key habitats to help minimize adverse impacts to wildlife.

Annual Report and Meetings

- Annual wildlife monitoring will be coordinated with the Rawlins BLM, and WGFD. Consultation with BLM and WGFD will be conducted prior to completing any annual survey work. A work plan will be approved by BLM and WGFD prior to completing annual monitoring.
- An annual monitoring report will be prepared and submitted to the BLM, WGFD, and other interested parties by November 15 of each year. The report will 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). All data and mapping will be formatted to meet BLM requirements. GIS data and maps will be provided to meet BLM specifications.

Annual Inventory and Monitoring

Wildlife inventory and monitoring will be completed by BLM or WGFD biologists, or a third-party contractor paid for by LC ISR, LLC. Any third-party contractor will be approved by BLM prior to completing any work. Only qualified wildlife biologists or ecologists will be approved to complete wildlife monitoring.

Raptors

- Annual monitoring of known raptor nests will be completed each spring between April and July to determine nest status. Nest surveys can be completed by helicopter or from the ground. Nest monitoring will be conducted using protocol to minimize adverse effects to nesting raptors. Monitoring visits will be scheduled for as late in the nesting season as possible to avoid disturbance during the incubation and early brood rearing periods.

- In addition to annual monitoring of known nests, surveys for new nests will be completed within the Permit Area and a one-mile radius at least every five years. For any area of new disturbance, a survey for new nests will be completed prior to any disturbance.

Sage grouse

- A survey for new leks will be completed within the Permit Area and surrounding two-mile radius every five years or as deemed appropriate by BLM. Surveys may be complete aerially or by ground, following standard survey protocol.
- All known leks will be monitored on an annual basis to determine lek attendance and trends in lek activity. Monitoring will be completed three times during the appropriate season (late March to early May), following standard protocol.

Big Game

No annual monitoring of big game is proposed. To determine the extent of big game road kill all wildlife/vehicle collisions on Project access roads will be recorded and reported in the annual monitoring report. Any other big game mortality due to project features will be recorded and reported.

General Wildlife

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

Sensitive Species

- Known mortality of sensitive wildlife species due to Project activities will be recorded and reported. Any significant die-offs or other evidence of possible wildlife exposure to toxic chemicals will be reported immediately to BLM, WGFD, and FWS.
- Specific monitoring of sensitive species (except as noted above for raptors and sage grouse) is not proposed.

4.7 Air Quality and Noise

Unlike conventional open-pit mine sites, fugitive dust emissions and noise level increases are minimal at ISR project sites, as operations of major dirt-moving equipment and haul trucks are much less common, and large-scale excavations are not conducted.

4.7.1 Air Quality and Noise Impacts from the Preferred Alternative

4.7.1.1 Air Quality Impacts from the Preferred Alternative

During construction, gaseous and particulate releases from drilling equipment will have a localized impact on air quality. Air-quality impacts during construction will come from dirt-moving activities during drilling and ground-clearing activities, as well as emissions from the use of heavy equipment. Atmospheric stability in the area is low due to the winds and any releases will be quickly dispersed. The closest off-site receptor, Bairoil is located 14.7 miles from the Permit Area and not downwind of the prevailing wind direction.

Temporary roads will be used to access well sites. These will be two-track roads, with each track being approximately 1.5 feet wide, and a total width of eight feet. Installation of two-track roads will be minimized where possible. Other potential impacts during this period will come from dust from vehicular traffic on these unpaved roads and gaseous emissions (vehicular and heavy equipment). On-road cars and trucks will have the required emission control equipment.

Estimated vehicle requirements for construction, operations and maintenance may include the motor grader, trackhoe, scraper, compactor, drill rig, water truck, pipe truck, rig pick-up, backhoe, pick-up, generator, welding machine, air compressor, tractor/trailer, and fusion cart. **Table 4.7-1** shows the estimated amount of emission from these vehicles.

Non-stationary sources of air pollutants will be the diesel engines on the drill rigs and other construction equipment. Drilling will be conducted as the mine units are developed. By far, this equipment has the greatest use throughout the year; other equipment is used sporadically and will have negligible impacts.

Dust generation from surface disturbance during construction also has the potential to impact air quality. However this impact is temporary, and revegetation of the disturbed areas not used for project facilities will reduce the amount of surface disturbance.

Another source of dust will come from vehicular traffic, especially on unpaved roads. To estimate the amount of dust generated from project traffic, calculations using EPA Emission Factors for unpaved and paved roads were made.

Compilation of Air Pollutant Emission Factors, Volume I (EPA, 2006) contains the following equation for light-duty vehicles traveling on publicly accessible unpaved roads (equation 1b in the document):

$$E = \frac{k\ (s/12)^{a}(S/30)^{d}}{(M/0.5)^{c}} - C$$

where k, a, b, c and d are empirical constants provided in the document and:

- E = size-specific emission factor in pounds per vehicle miles traveled (lb/VMT),
- s = surface material silt content (percent),
- M = surface material moisture content (percent),
- S = mean vehicle speed (mph), and
- C = emission factor for 1980s vehicle fleet exhaust, brake wear, and tire wear.

To account for rainfall, which naturally mitigates dust generation, the following equation was used:

$$E_{ext} = E\ [(365\text{-}P)/365]$$

where:

- E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT;
- E = emission factor from Equation 1a or 1b; and
- P = number of days in a year with at least 0.01 inch (0.254 millimeter) of precipitation (see below).

For paved roads, the following formula was used:

$$E_{ext} = \left[k\left(\frac{sL}{2}\right)^{0.65}\left(\frac{W}{3}\right)^{1.5} - C\right]\left(1 - \frac{P}{4N}\right)$$

where:

- E = particulate emission factor (having units matching the units of k);
- k = particle size multiplier for particle size range and units of interest (see below);
- sL = road surface silt loading (grams per square meter [g/m^2]);
- W = average weight (tons) of the vehicles traveling the road;
- C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear;
- E_{ext} = annual or other long-term average emission factor in the same units as k;
- P = number of "wet" days with at least 0.01 inch (0.254 millimeter) of precipitation during the averaging period; and
- N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

For purposes of this calculation, the following estimates and assumptions were made:

- Weight for passenger vehicles used by employees was two tons, average weight (full versus empty) for supply/delivery truck was ten tons, and average weight of resin truck (full versus empty) was 20 tons.
- Distance of unpaved roads is equal to 19 miles. Speed limit of passenger vehicles was 35 mph, delivery and resin trucks were 15 mph.
- Resin trucks made 70 trips a year, delivery trucks made weekly trips (52 a year).
- For employees, it was assumed that 70 percent would be commuting from Casper, and 30 percent from Rawlins. Eighty-seven employees carpool in 33 vehicles, driving 240 days each year (the number of work days take holidays and vacations into account).
- Emissions were calculated for the operation stage only.

The amount of emissions and dusts generated during the operation phase of the project will be less than those generated during the construction phase. Impacts on air quality will be limited to emissions and dusts from service vehicles from the Plant to the mine units, as well as the transportation of supplies, yellowcake slurry and workers in and out of the Plant. Most of the dust, generated from all vehicles, originates from the unpaved road. The greatest amount of dust will be generated from employee vehicles, with 169.9 tons per year for PM_{10}. The resin truck is modeled to generate 4.3 tons of dust/year, and delivery trucks are modeled to generate 2.7 tons per year from vehicular traffic. Radon may be vented from the Plant as part of normal operations (see detail in **Section 4.13**). Mine unit construction (mainly drilling) will continue throughout operations and emissions and dusts will be generated.

The closest receptors near the project area are approximately 15 miles away. The emissions and dusts generated by the Project during operations will be dispersed rapidly and are expected not to cause any exceedance of applicable air quality standards in the Permit Area.

4.7.1.2 Noise Impacts from the Preferred Alternative

Noise impacts were assessed by measuring noise levels associated with exploration and pre-operational activities on-site, which are as loud as the projected noise levels during construction and operations. The potential impact to off-site receptors was evaluated using a widely accepted noise attenuation model (Golden et al., 1979). The closest residence, church, or school is about 15 miles from the Permit Area (e.g., Bairoil) and more than 16 miles from the nearest mine unit.

During construction, ISR projects create noise due to heavy equipment use and mine unit drilling. Drill rigs, heavy trucks, and equipment will generate noise that will be audible on-site above the 30 to 35 A-weighted decibels (dBA) of the background noise levels. The maximum noise measured during exploration activities was from a cement mixer and a generator running concurrently, which was 102 dBA, four feet from the source. During construction, occasional instantaneous levels could be somewhat higher.

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). Due to natural attenuation, the highest sustained noise at the closest off-site receptor in Bairoil would be 39 dBA, which would not be audible above background noise levels in this community. This calculation used the conservative assumption that no noise attenuation occurred between four and 50 feet. Field observations indicate that drilling activities are inaudible at distances greater than one mile, due to topographic interference and other factors.

Outdoor noise levels at the nearest off-site receptors are well within the 55-dBA guideline, to protect against activity interference and annoyance (EPA, 1978). Noise levels during mine unit construction should cause no off-site impacts, since the Permit Area is not in close proximity to off-site receptors. Mine unit construction will occur only during daylight hours, and the 70 dBA 24-hour average sound-energy guideline to protect hearing (EPA, 1978) will not be exceeded on-site.

During construction, truck transport of materials will be the only noise source that will affect off-site receptors, and this impact will be very minor. Less than ten deliveries per day will be required, and trucks will only pass occupied residences once they reached US-287. This is a well-traveled road, and the increase in truck traffic caused by the Project will be approximately two percent. This incremental increase is not expected to be noticeable.

Due to the continuous nature of mine unit construction and remediation, there will be only short intervals in which only production activities occur. During production, the only anticipated on-site noise sources are pumps and periodic truck traffic for maintenance visits and inspections. As such, no on-site sources will result in a significant noise increase to off-site receptors during production. During operations, truck transportation of production-related materials and yellowcake slurry will be the only noise source that will affect off-site receptors, and this impact will be very minor. Less than one delivery per day will be required, and the associated increase in truck traffic on US-287 will be less than 0.1 percent, which would not be noticeable.

During restoration and reclamation, impacts are anticipated to be similar to construction, although there would be no active drilling. Truck traffic will be similar to the construction phase due to transportation of waste material to disposal sites, but should not exceed ten truck loads per day.

4.7.1.3 Cumulative Air Quality and Noise Impacts

Air Quality

Most of the dust and emissions generated will peak during construction. Long-term operations will generate insignificant amounts of gaseous emissions, and the impact will be negligible. Wind conditions at the Permit Area will quickly disperse any emissions, and no residential receptors are nearby.

Noise

Since on-site noise sources will not be audible by off-site receptors, all cumulative noise impacts will relate to off-site transport of materials and yellowcake slurry. Noise impacts related to the Project are so minor that even when combined with other energy-related projects, the impact will be negligible.

4.7.2 Air Quality and Noise Impacts from Other Alternatives

4.7.2.1 Air Quality Impacts from Other Alternatives

Neither the Plant location nor the size of the monitor rings would substantially change the air-quality impacts described in **Section 4.7.1.1**

4.7.2.2 Noise Impacts from Other Alternatives

Neither the Plant location nor the size of the monitor rings would appreciably affect the noise impacts described in **Section 4.7.1.2**.

4.7.3 Mitigation of Air Quality and Noise Impacts

4.7.3.1 Mitigation of Air Quality Impacts

No mitigation is required; however, best management practices (BMPs) to minimize dust and emission generation will be employed. Since the use of temporary, non-compacted roads have the potential to generate dust, an on-site speed limit will be set to reduce dust generation. Regular maintenance on engines and pollution-prevention equipment should be conducted and maintained to ensure that emissions are minimized. Bussing and/or car pooling of employees should be encouraged, and consideration should be given for the establishment of a man camp for temporary workers. Disturbed areas within each mine unit will be revegetated during the first available seeding window, after construction is complete, to minimize soil loss and fugitive dust emissions to the atmosphere. Dust control measures for unpaved roads will be conducted and may include water spraying, application of gravel, or application of organic/chemical dust suppressants.

4.7.3.2 Mitigation of Noise Impacts

Since the Project will have negligible off-site noise impacts, no mitigation measures are called for, other than regular equipment maintenance.

4.7.4 Air Quality and Noise Monitoring

4.7.4.1 Air Quality Monitoring

Air quality monitoring will be conducted by measuring PM_{10} dust particles around the Permit Area, in locations upwind and downwind of activities. Visual inspection of ground conditions for dust will be conducted at disturbed and unprotected soil locations.

4.7.4.2 Noise Monitoring

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

4.8 Historic and Cultural Resources

Requesting NRC confidentiality. Section submitted separately.

4.9 Impacts on Visual and Scenic Resources

4.9.1 Impacts from the Preferred Alternative

The Project will result in temporary, minor impacts to the visual and scenic resources of the area. The nature of the impacts would be in keeping with the visual resource classification of the area by BLM. The management objective for Visual Resource 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).

During construction and operations, visual resources will be impacted to some degree by vegetative disturbance, road building, drilling, piping, and facility construction. A maximum of approximately 165 acres of vegetation will be disturbed at any one time. This estimate includes the Plant, all on-site roads, operating mine units, mud pits for resource and delineation and monitor wells, and pipelines. The total footprint of the Plant will be ten acres, and the maximum height of any building will be 45 feet. Mine unit development will occur sequentially, with reclamation in the first mine unit concurrent with construction and operations in later mine units. No more than four percent of the Permit Area should be disturbed at any time.

Most of these modifications will not be visible from the public road network, which is lightly traveled (**Section 3.2**). The Plant will be located 4.5 miles from the nearest county road, and the rolling topography will hide the facilities from travelers, except from a limited number of vantage points. There are no locally important or high-quality views that will be affected by the proposed action. Project facilities will be discernable, but will not be a dominant landscape feature to observers outside the Permit Area.

Impacts will also be temporary, since buildings and roads will be decommissioned and removed at the Project's end, probably within ten to 12 years of permit approval, and vegetation will be restored to its previous condition. ISR operations cause no modifications to scenery or topography that will persist after restoration and reclamation.

4.9.1.1 Cumulative Impacts from the Preferred Alternative

Visual impacts are only temporary. Since the Plant will be removed and the site reclaimed, there will be no cumulative impacts with other existing or foreseeable future projects.

4.9.2 Impacts from Other Alternatives

Neither the Plant location nor the size of the monitor rings would substantially change the impacts of the Project on visual and scenic resources.

4.9.3 Mitigation of Impacts from the Preferred Alternative

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

- Building materials and paint will 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 will be visible.
- The site will remain clean and well-maintained according to operations protocols.

4.9.4 Monitoring Impacts from the Preferred Alternative

Since impacts to visual and scenic resources will be negligible, no monitoring is currently planned. The annual environmental report will include any changes to the status of the visual and scenic resources on-site.

4.10 Socioeconomics

4.10.1 Socioeconomic Impacts from the Preferred Alternative

The major socioeconomic issues relevant to all alternatives are the following.

- The majority of the workforce associated with the Project is likely to come from outside the study area (70 percent). Transfer of workforce from other job sites to the Project will be minimal.
- The Project will provide permanent year-round employment, which is generally preferable to seasonal jobs such as tourism and highway construction or temporary jobs such as interstate gas pipeline construction or oil exploration.
- Temporary rental and permanent housing availability is limited for all surrounding communities. Existing motel units and RV/mobile home spaces have few vacancies. All housing in the area is generally considered to be tight (Allen, D. Business Development Specialist, City of Rawlins. Personal communication. March, 2006).
- School capacity in the region is sufficient to meet current needs. Increases in population of school-age children will not impact the local schools.
- Although water and sewer capacity is adequate in Rawlins, the systems are old and need improvements and repair. Infrastructure condition is poor for water and sewer and streets in Rawlins. The infrastructure costs may further increase the price of housing.
- All public services have an adequate capacity for additional population in the Rawlins and Bairoil areas. Public safety personnel have not experienced dramatic increases in crime in the area in the past 18 months of increased growth in the area.
- Increased employment during the eight- to ten-year drilling and operations period would occur. Direct employment during construction is anticipated to peak at 70 to 80 employees in 2009. During the operations phase, direct employment is expected to average 87 employees for the remaining nine years. Indirect employment has not been estimated, but would likely be a multiplier of at least one.
- The additional expenditures by LC ISR, LLC will result in collection of additional sales and use tax for the state, counties, and communities. Estimated severance taxes, ad valorem production and property taxes.

4.10.1.1 Labor Force and Income

The estimated direct-hire labor force is presented in **Table 4.10-1** for all alternatives. **Table 4.10-1** depicts the types of jobs that would be ongoing during development and production. All of the wells drilled during a given year will be completed by contract drillers, employing many of the same people during drilling and construction activities. The type of wells drilled requires water-well-style drill rigs. The peak period of employment during the construction phase is anticipated from April 2009 to October 2009. During this period, approximately 50 independent drilling and plant construction contractors will be on-site, and an additional 20 to 30 LC ISR, LLC employees, as well as other intermittent contract employees at the site. During normal operations (after October 2009), approximately 30 independent drilling contractors will be on-site from 2008 through 2014 to complete production goals. LC ISR, LLC plans to employ 57 full-time salaried and hourly employees for the life of the Project.

Construction

The peak construction phase of the Project is anticipated to begin in April 2009 and end in October 2009. At this time, there should be ten drill rigs (30 independent contractors), ten LC ISR, LLC construction employees, ten to 20 samplers, geologists, supervisors, and drilling support personnel, and 20 independent Plant construction contractors. The total number of construction workers on-site will be between 70 and 90. Due to the limited number of unemployed construction labor force in the area, it is anticipated that a large percentage (70 percent) is anticipated to be non-local, from the outside the Rawlins/Bairoil area. Many of the workers are anticipated to come from Casper. Some workers may commute from Casper on a daily basis, others coming from Casper will stay in temporary accommodations during the week and commute back to Casper on the weekend. Construction workers, coming from outside the region, will likely stay in RV campers or short-term rental units. If local, some workers will commute to and from their permanent residence on a daily basis if within one hour of the Permit Area.

The average weekly wage rate for skilled and unskilled construction workers was $870 for the fourth quarter of 2006. This was up 16 percent from the fourth quarter in 2005 (Wyoming Department of Employment, Research and Planning, 2007a). A portion of this income will be spent for goods and services in the local area of the Project. This will have a positive impact on local businesses such as restaurants, service stations, and miscellaneous retail stores. In addition to local expenditures near the Project, workers will also be contributing to their local economy in the form of local expenditures for goods, services, housing, insurance, entertainment, and food.

Operations

The operations phase of the Project will require approximately 87 workers, including project and operations managers, project engineer, chief site geologist, drill foreman, casing crew, restoration engineer and crew, construction foreman and crew, geologists, secretary, personnel responsible for environmental, health, and safety related tasks, plant manager, plant operators, equipment operators, electrician, chemist, lab technicians, and drill contractors. Operations and restoration will continue for approximately nine years from 2008 through 2017 (**Figure 1.2-8**). Employment in the natural resources, mining, and construction sectors has increased considerably from 2006. In the Casper area, annual natural resources and mining monthly employment changes have ranged from 2.4 percent to 7.7 percent increases in employment. In construction, the annual monthly changes have ranged from 3.7 percent to 4.3 percent (US Bureau of Labor Statistics, 2007).

The workforce is comprised of both skilled and non-skilled workers with 75 percent of the LC ISR, LLC employees having some experience in their jobs. Therefore, salaries for permanent employees of LC ISR, LLC are anticipated to average approximately $50,000 per year. The total annual payroll for operations is estimated at $2.9 million. Wage rates are relatively competitive due to the high demand for labor within the region and state. Labor rates have increased substantially in the past three to four years, partially because of competition among natural resource development companies, but also because the cost of living, particularly housing, has increased dramatically.

4.10.1.2 Economic Effects

The economic impact of the Project would include the effects of the Project on employment, income and earnings, and direct and indirect economic activity in the local, regional, and national economies. LC ISR, LLC will have a positive effect on most economic indicators. But the Project may have some short-term, indirect negative effects on local government infrastructure and area housing due to increases in population and demand for local government services. Population is not anticipated to increase dramatically for the first several years of the Project operations since housing availability is limited and the trend has been for workers to commute to and from their permanent places of residence rather than move families to locations where housing is expensive or uncertain.

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

Tax Revenues

The Project would contribute substantially to the local and state economies in the form of tax revenues generated, as shown in **Table 4.10-2**. Future tax revenues are dependent on uranium prices, which cannot be forecast with any accuracy. To the extent that uranium prices remain at current levels, the uranium production will contribute significantly to local tax revenues. Tax revenues generated include ad valorem (gross products) taxes in Sweetwater County, severance taxes for the State of Wyoming, and federal income taxes. Property taxes will also be generated for Sweetwater County.

Increases in tax revenues will provide counties and communities with more discretionary dollars to develop infrastructure and support the population. However, short-term budgetary impacts to local governments will occur due to population growth and its effects on housing and local infrastructure, services, and facilities. Receipt of taxes generally lags one year behind production; therefore, affected counties and communities will not receive any funds until two years after drilling activities begin (**Table 4.10-2**).

Over the life of the Project, all counties and communities in the study area will benefit from increased revenues from ad valorem taxes, as shown in **Table 4.10-2**. Some state mineral royalties and severance taxes would also be distributed to the counties and communities, based on a state distribution formula. Other tax revenues generated, but not included in the table, would include sales, use, and lodging taxes. These amounts have not been estimated, even though they will represent a significant increase in local revenues throughout the region.

4.10.1.3 Housing and Public Facilities and Services

The population of the study area is anticipated to increase as a result of increased employment opportunities generated both directly and indirectly by the Project. Both Sweetwater and Carbon Counties are facing a housing shortage, and any additional pressure will exacerbate an already-tight housing market (Allen, D. Business Development Specialist, City of Rawlins. Personal communication. March, 2006). Moreover, the increased demand for housing will likely cause housing prices (rental costs and home sales prices) to rise. Housing rental costs and sales prices have both increased in Rawlins (Allen, D. Business Development Specialist, City of Rawlins. Personal communication. March, 2006). Additionally, affluence in the study area is likely to cause an increase in the demand for higher-quality housing, which also will drive the cost of housing upwards. Single-family housing continues to be relatively expensive for most of the population in the Rawlins area. Casper also has a relatively tight housing market at less than two percent vacancy for rental property (Wyoming Community Development Authority [WCDA], 2007). Rents for apartments and single-family homes have increased by 3.4 percent and four percent, respectively, in Casper.

Construction

The 20 short-term employees anticipated during construction will probably be accommodated in motels in the Rawlins area. Tourist housing will likely be impacted by the construction phase of the Project, considering construction activities will occur during the peak tourist period. Some workers will prefer to commute from Casper, which is about 90 miles from the Permit Area. Others may opt to stay in RVs. Permanent employees will likely prefer to stay in the local area of Rawlins or Bairoil for the life of the Project.

Emergency services including fire, police, ambulance, and hospital services will not be impacted by increases in population or employment during the construction phase of the Project. The only impacts that will affect the provision of emergency services within the Permit Area would be a construction accident or possibly traffic impedance for short periods of time. Basic medical and emergency services, which may be required in the event of an accident, are available throughout the Permit Area, as described in **Section 3.11.3.2** of this report.

Operations

The total operations workforce is estimated at 87 salaried and hourly employees; 57 of these employees will work for the company on a permanent basis through the life of the Project. If labor is available from the Casper labor market for the Project, many of the workers coming from the Casper area may opt to commute 1.5 hours rather than relocate to the Rawlins/Bairoil area, due to housing availability and cost. However, workers who move to the study area from outside the state or region will prefer to minimize commuting time when possible and will prefer to locate in the local area and bring their families. These additional workers and their families will most likely locate in the Rawlins/Bairoil area. Housing is minimally available in both locations, and Rawlins will be the preferred location, due to public facilities, services, and other community amenities, including shopping. This will be an additional demand for housing in the Rawlins area, adding to the already-tight housing market.

Public facilities and services have excess capacity throughout the study area. However, the Rawlins utility infrastructure is in need of repair. With the additional influx in population, improvements to these public systems may be required sooner than anticipated and will have budgetary effects on local governments for capital improvement funding, since ad valorem revenues accrue to Sweetwater County and not Carbon County. Severance taxes will likely accrue to Carbon County, but would lag behind impacts. Public facilities and services that may be impacted by increased population from the Project include the Rawlins water and sewer distribution system and streets, and the Carbon and Sweetwater County road maintenance divisions.

Transportation systems will be impacted by both construction- and operations-related commuter traffic and truck traffic transporting materials to and from the Permit Area. Construction and operations workers will commute to and from the site on a daily basis. A typical shift for construction workers (the majority of the staff) would be from 7:00 Ante Meridian (AM) to 3:30 Post Meridian (PM). Approximately 80 to 87 workers will be commuting to the Permit Area. Some may carpool, however, no transportation will be provided by LC ISR, LLC. In addition, shipments of processing chemicals and yellowcake slurry will also occur throughout the year as described in **Section 4.2.** Approximately 25 new trips per day will be generated on these roads due to employee, contractor and delivery traffic.

The increased commuter and truck traffic will have an impact on county, state, and national roadways, particularly Mineral Exploration, Sooner Road, and County Road 22. Maintenance costs will accrue to both Carbon and Sweetwater Counties, while most Project revenues will be generated in Sweetwater County. Increased traffic on major highways will be less of an impact than those on the county roads. Major public highways have adequate capacity to handle the increase in commuter and truck traffic, but local county and BLM roads may require improvements or more regular maintenance schedules. A transportation risk analysis is presented in **Section 4.2.**

4.10.1.4 Quality of Life

Quality of life could be impacted by the uranium development and production in the area. Potential beneficial effects include: increased local economic activity and reduced poverty, and the potential for improved public facilities and services once taxes and other revenues become available to the local counties and communities. The short-term (one to two years) and potential long-term impacts to the local communities of Rawlins and Bairoil will be negative, since increased population from the increased workforce will exacerbate impacts on the already-tight housing market. Increased economic activity could enhance the availability of goods and services, as well as cultural, educational, and recreational opportunities.

Increases in taxes and revenues will provide counties and communities with more discretionary dollars to develop infrastructure and support the population. However, short-term budgetary impacts to local governments will occur, due to population growth and its effects on housing and local infrastructure, services, and facilities. In the case of Rawlins, since the Permit Area is located in Sweetwater County, all ad valorem taxes will accrue in Sweetwater County, not in Carbon County.

The socioeconomic impacts from the Project are more likely to occur in Carbon County, which will not reap as many tax benefits as Sweetwater County. Receipt of taxes generally lags one year behind production; therefore, affected counties and communities will not receive any funds until two years after drilling activities begin in any case. Over the life of the Project, all counties and communities in the study area will benefit from increased revenues from ad valorem taxes. Some state severance taxes will also be distributed to the counties and communities, based on a state distribution formula. Other tax revenues include property taxes as well as sales, use, and lodging taxes. These amounts have not been estimated, even though they will represent a significant increase in local revenues throughout the region.

In addition, real property values are likely to change as population fluctuates within the study area. Housing costs have escalated during the past several years and with increased demand for housing in the region, these housing cost increases are likely to continue. Population growth will also stimulate additional commercial and residential activity, but indirect property taxes generated by this activity are beyond the scope of this analysis and are not addressed further.

4.10.1.5 Cumulative Impacts

As long as the Project remains the sole change to natural resource development in the area, the impacts would not differ from those described above. However, as noted at the beginning of **Section 4**, other changes are reasonably foreseeable. Similar to the Project, these changes would be primarily related to uranium development, with similar additions to the work force and demands and benefits to the communities. As with the Project, the lag in housing availability and infrastructure improvements until after new projects are brought on line will strain the communities in the short term, but the increased revenues will benefit the communities.

4.10.2 Socioeconomic Impacts from Other Alternatives

Socioeconomic impacts from the alternate Plant location do not differ from those of the Preferred Alternative. The scale of the monitor rings, as discussed in **Section 2.4.2**, may slightly affect the timing of production, but the overall change to the socioeconomic impacts, such as the period over which tax revenues would accrue, would not be substantial as compared to the Preferred Alternative.

4.10.3 Mitigation of Socioeconomic Impacts

Mitigation of socioeconomic impacts is not anticipated.

4.10.4 Monitoring on Socioeconomic Impacts

No monitoring of socioeconomic impacts is anticipated.

4.11 Environmental Justice

Under Executive Order 12898 (published in the Federal Register February 11, 1994), federal agencies are required to identify and address disproportionately high or adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. A specific consideration of equity and fairness in resource decision-making is encompassed in the issue of environmental justice. As required by law and Title VI, all federal actions will consider potentially disproportionate negative impacts on minority or low-income communities. Within the area potentially affected by the Project, minimal minority populations are affected.

Income levels throughout the study area are diverse. The most recent estimate of per capita personal income was $28,438 for Carbon County and $34,656 in Sweetwater County in 2004. The median income in 2004 was $40,750 in Carbon County and $54,700 in Sweetwater County. These numbers are fairly consistent with the economic base of the area, which is mineral resource and agriculturally driven. The most recent poverty status statistics are from 2003 census data. These data showed a poverty status of 11.8 percent in Carbon County and 8.6 percent in Sweetwater County (US Census Bureau, 2003). These rates are similar to the state-wide average of 10.3 percent, which is lower than the national average of 12.5 percent (US Census Bureau, 2003). Since the economic base of the study area is largely ranching and resource extraction, low-income areas are dispersed within the study area. People with incomes below the poverty status may reside within the study area, but not disproportionately.

Table 4.11-1 highlights demographic statistics for identifying potential areas of concern. Various years of census data were used for the analysis of race and income. Since greater than 95 percent of the population is identified as white in Sweetwater and Carbon County, there will be no disproportionately high impacts on any minority race.

4.12 Public and Occupational Health

Potential public and occupational health impacts from the Project are summarized in this section.

4.12.1 Public and Occupational Health Impacts from the Preferred Alternative

The Project will use ISR technology to extract uranium from permeable, uranium-bearing sandstones. Once extracted, the uranium will be recovered by means of ion exchange, elution, and precipitation/filtration to ultimately produce yellowcake slurry. The detailed operation plan is located in **Section 1** of this report and **Section 3** of the Technical Report.

The Permit Area is located on federal land, managed by the BLM, and on land owned by the State of Wyoming. There are no permanent residents within 15 miles of the Permit Area, significantly reducing the possibility of public impacts. In addition, the workforce for the ISR operation will 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.

4.12.1.1 Nonradiological Impacts

Effluents from the Project containing non-radiological contaminants will not be released into pathways that could impact public and occupational health. In addition, no other aspects of the preferred alternative will impact public and occupational health beyond that reasonably foreseeable from any mining project (e.g., mechanical risks due to operation of machinery).

Gaseous emissions and airborne particulates from the Project are summarized in **Section 4.13.1.1**. The primary concern is radiological, specifically radon release. Results of the MILDOS modeling to evaluate radon impacts are presented in **Attachment 4.12-1**.

There will be no impacts to public water supplies or to water sources that may be tapped for public use in the foreseeable future. Impacts to water resources are described in more detail in **Section 4.5**. The impacts to groundwater quantity are mitigated by the recharge, and the impacts to groundwater quality are mitigated due to the requirements for groundwater restoration. Impacts to water resources are not expected to be significant.

Net consumptive use of groundwater is anticipated to be no more than 175 gpm for the operational life of the Lost Creek Project.

Liquid effluents and the measures used to handle those effluents are summarized in **Section 4.13.1.2.** The largest quantity of liquid effluent is from the production bleed, and this effluent, along with others, will be managed in the Storage Ponds and the UIC Class I wells. The Storage Ponds discharge to the Class I wells. Based on the operation of other ISR facilities in Wyoming, no non-radiological impact on public or occupation health is expected due to the liquid effluent from the Project.

Solid wastes and the measures used to handle those wastes are summarized in **Section 4.13.1.3.** As with liquid effluents, use of up-to-date techniques for waste storage, handling, and disposal are being used to preclude impacts to public or occupational health.

4.12.1.2 Radiological Impacts

Efficient ISR operation, including mine unit balancing and monitoring (as described in **Section 1** of this report and in more detail in **Sections 3** and **5.7** of the Technical Report), and up-to-date techniques for waste storage, handling, and disposal, are being used to keep contaminants of concern out of any pathways that could result in impacts to public or occupational health. Therefore, the radiological impacts of concern for public and occupational health all relate to radon.

No radiological particulates will be generated at the Permit Area, and radon is the only gaseous radiological emission. The MILDOS-AREA code (ANL, 1998) was used to calculate radon doses at 17 locations around the perimeter of the Permit Area, as shown in **Figure 4.12-1**. The map shows modeled receptor locations, as well as centroids of each mine unit, and the two locations considered for the Plant (Plant 1 and Plant 2 on the figure). MILDOS calculations and output use metric units (**Attachment 4.12-1**); this discussion refers to English and metric units for the sake of consistency.

MILDOS modeling indicates that releases from the Plant 1 location lead to a calculated total effective dose equivalent (TEDE) to a resident at the northern boundary of the Permit Area of about 140 millirem (mrem), which exceeds the 100-mrem-per-year limit of Title 10 CFR Part 20. This maximum dose would occur in 2014. Doses in 2012 to 2015 would also exceed 100 mrem per year at the northern boundary. This result is not surprising, given that the northern boundary is only about 1,000 feet (305 meters) from the Plant 1 location. This "resident" dose is also extremely conservative, given that the land north of the Permit Area is federal land, not available for residential use. In addition, the dose decreases to below 100 mrem per year within 1,000 feet (305 meters) of the Permit Area boundary.

Population doses to residents within 50 miles (80 km) of the Permit Area were calculated using MILDOS. Bairoil, Jeffrey City, Wamsutter, and Rawlins were included. Results of the population modeling indicate that the TEDE population dose would peak during 2014 at 0.133 person-rem. Bronchial epithelial doses to the population within 80 km would also peak in 2014 at 4.56 person-rem. While there are no standards for population dose, it is interesting to compare these calculated doses to the natural background for the same region. The average US resident receives 360 mrem per year (National Council on Radiation Protection and Measurements, 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 approximately 24,000 times higher than that of the calculated maximum 0.133-person-rem-per-year population dose of the Project.

MILDOS is not commonly used to calculate occupational doses, because such doses are calculated using results of personal monitoring during facility operation. However, a hypothetical worker location was used in MILDOS to calculate doses through the operation of the Plant. The worker was placed 460 feet (140 meters) from the Plant 1 location as follows: Northeast (460 feet East and 460 feet North), Southeast (460 feet East and 460 feet South), Southwest (460 feet West and 460 feet South), and Northwest (460 feet West and 460 North). For each worker receptor location, a dose was calculated, multiplied by 0.22 to represent an occupational year (2,000 work hours in a 8,760-hour year), and averaged. The maximum worker dose would be 94.9 mrem in 2014, which is well below the occupational standard of five rem. 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.

4.12.1.3 Cumulative Impacts

Releases of nonradiological contaminants from the Project are not anticipated, and the radiological release of concern, radon gas, is not anticipated to exceed any limit for public or occupational health. Given the lack of other activities near the Permit Area, the Project is essentially the only source of a potential impact at present. Even if other activities are assumed to occur near the Permit Area, as described in **Section 4**, the Project contribution to the cumulative impacts is negligible.

4.12.2 Public and Occupational Health Impacts from Other Alternatives

There are two alternatives described in **Section 2.4**. One of these is an alternative Plant location (**Figure 2.4-1**). The public health impact of moving the Plant to the alternative location would be a reduction in the maximum MILDOS-calculated residential dose (TEDE) at the northern permit boundary from 140 mrem per year to below 40 mrem per year. However, as noted in the previous section, a residential dose at the northern boundary location is not representative because there are no residents within miles of the Permit Area. There is no difference between these two options with regard to occupational health because the same worker population will be involved with either option.

The Other Alternative (**Section 2.4.2**) would affect the scale of the monitor rings, and would have no impact on either public or occupational health.

4.12.3 Mitigation of Impacts from the Preferred Alternative

As mentioned above, there are essentially no impacts to either public or occupational health. Therefore, under SOPs, no mitigation is required.

4.12.4 Monitoring of Impacts from the Preferred Alternative

Annual reports of effluent release and consequent estimates of public dose will be used to monitor potential public health impacts once the Plant becomes operational. Further, a series of environmental air samplers, as described in **Section 5.7** of the Technical Report, will assure that unpredicted releases of radon are monitored.

A radiation safety program will be implemented to assure that occupational dose limits are not exceeded. Reports of worker dose will be published and given to each worker annually.

4.13 Waste Management

With respect to waste management, there are no differences in the anticipated impacts, or in the monitoring and mitigation, between the Preferred Alternatives and the Other Alternatives described in **Section 2**.

During the Project, gaseous/airborne, liquid, and solid effluents will be produced 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. Additional details about the types of effluents, their potential impacts, and the monitoring and mitigation measures are provided below.

4.13.1 Waste Management Impacts

4.13.1.1 Gaseous Emissions and Airborne Particulates

Non-radioactive and radioactive airborne effluents are anticipated during the Project. Non-radioactive airborne effluents will be limited to gaseous emissions and fugitive dust. The radioactive airborne effluent will be radon gas. The types of effluents and the control systems that will be in place for them are summarized below.

Non-Radioactive Emissions and Particulates

Gaseous emissions will result from the operation of internal-combustion engines. Exhaust from diesel drilling rigs and other diesel or gasoline-fueled vehicles will produce small amounts of CO, SO_2 and other internal-combustion engine emissions. Most of the airborne particulates will be dust from traffic on unpaved roads and wind erosion of disturbed areas, such as during installation of wells at a mine unit.

Detailed discussions of non-radioactive emissions and particulates generated during the Project as well as their potential impacts are presented in **Section 4.7** of this report.

Radioactive Emissions

Radioactive airborne effluents will be less than other ISR operations in Wyoming because yellowcake drying and packaging will not occur within the Permit Area and because the Storage Ponds will be kept wet.

Radon will be the radioactive gaseous emission from ISR production and processing, as it is present in the orebody and concentrated in the lixiviant solution. Radon will be released occasionally from the mine unit wells as gas is vented from the injection wells. Production wells will be continually vented to the surface; however, water levels will typically be low and radon venting will be minimal. All of the well releases will be outside of buildings and are directly vented to the atmosphere. Radon will also be released during ion exchange resin transfers and subsequent processing steps, as described in more detail below. The radon will be discharged into the atmosphere, where it will disperse rapidly.

The work areas of concern for radon exposure are at the vents from: the bleed storage tanks, the resin transfer points, the fluid collection sump, and the yellowcake slurry loading area, as well as low-lying areas and confined spaces. The bleed storage tanks will be used for temporary storage of the production bleed fluid. Because these tanks will be at atmospheric pressure (unlike other tanks in the ore processing circuits) and not always full, radon (as well as oxygen and CO_2) present in the bleed fluid may be liberated into the headspaces of the tanks. Therefore, these tanks will be vented. Resin transfer will occur when an ion exchange vessel is fully loaded and is transferred from the ion exchange circuit to the elution circuit. Because radon may be liberated during the transfer, ventilation will be provided at the resin transfer points and operated during the transfers. A sump will be used to collect any fluids released from the ion exchange vessels during resin processing, from tanks during maintenance procedures and from routine washdown of the area. To prevent radon accumulation, the sump will be covered and vented. The yellowcake slurry will be transferred from storage tanks into trucks for transport to a drying and packaging facility. During this transfer, radon gas will potentially escape, so ventilation will be provided in the transfer area. The UIC Class I well pumphouses will also be vented.

The primary impact of concern is to those workers closest to the radon sources. Potential radon exposure will be reduced or eliminated with ventilation to the outside of the buildings. The secondary impact of concern is to the environment because of the venting of the radon. Occupational and public exposures to radon emitted from the mine units and from the ore processing were analyzed using the MILDOS computer model to ensure the exposures will be within regulatory dose limits (**Section 4.12**, Public and Occupational Health). Based on those analyses, the radon impacts due to occupational exposures can be addressed by the ventilation to the outside of the buildings using high-volume exhaust fans, personal protective equipment (PPE), and limited exposure durations, in accordance with SOPs, or in the case of an unanticipated release, a Radiation Work Permit (RWP). The radon impacts due to public exposures will be minimal, especially in comparison with natural radon exposures.

4.13.1.2 Liquid Wastes

The Project will generate several different types of liquid wastes, including three classified as 11(e)(2) byproduct material by NRC (NRC, 2000). The 11(e)(2) byproduct material is defined in Chapter 2, Section 11 of the Atomic Energy Act of 1954 (42 US Code 2014(e)(2)), as amended, as "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." In 2000, this definition was interpreted to include more of the fluids associated with ISR than had been previously included in the definition (NRC, 2000).

The different types of liquid wastes the Project will generate are:

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

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

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

Groundwater is recovered during well installation, sample collection, and pump testing conducted prior to production 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 will be discharged to the surface under the provisions of a general WYPDES permit, in a manner that mitigates erosion, or reused in the drilling process. Because of the relatively small quantities of water discharged at any given time, no impacts are anticipated.

Storm Water Runoff

Per the requirements of the WYPDES, the applicable permits for runoff control during construction and operation of the Plant will be obtained from the Water Quality Division (WQD) of WDEQ. Because of the dry conditions in the area and the runoff controls, no impacts are anticipated.

Waste Petroleum Products and Chemicals

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

Waste petroleum products will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of the Mine Safety and Health Administration (MSHA) and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes.

Waste chemicals not closely associated with the processing of 11(e)(2) byproduct materials will be clearly labeled and stored, in sealed containers, above ground in accordance with the requirements of MSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or disposal at a licensed disposal facility.

Because of the controlled off-site and on-site disposal procedures, no impacts from the waste petroleum products and laboratory chemicals are anticipated, other than those associated with the UIC Class I wells.

Domestic Sewage

Domestic sewage will be disposed of in an approved septic system that meets the requirements of WDEQ WQD. A Class V UIC permit will be obtained for the septic system prior to construction of the system. The septic system will receive waste from restrooms, shower facilities, and miscellaneous sinks located within the office. The septic system will 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 will be limited.

In addition, chemical toilets may be temporarily placed at mine units and other drilling areas. The chemical toilets will 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 will be treated and disposed of on-site through a system of Storage Ponds and UIC Class I wells, as described below.

Liquid Process Wastes

The ore processing produces three wastes, a production bleed, an eluant bleed, and yellowcake wash water. In addition, the laboratory analyses for evaluating uranium content of the production fluid and similar operational parameters will generate waste. These wastes will be collected, treated, and the waste discharged to 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 well, are anticipated in the Permit Area.

"Affected" Groundwater Generated during Well Development

It may be necessary to develop (or redevelop) wells that have been affected by the ISR operations to the extent that surface discharge of the water is not appropriate. During well development, this water will be collected and treated, and the waste will be discharged to the Storage Ponds and UIC Class I wells. Because of the controlled on-site disposal procedures, no impacts from the "affected" groundwater, other than those associated with the UIC Class I wells, are anticipated in the Permit Area.

Groundwater Generated during Aquifer Restoration

During the various steps of aquifer restoration (**Section 6** of the Technical Report), groundwater will be generated, and disposal of some or all of the water will be required. During sweep, groundwater will be pumped from the production zone, creating an area of drawdown. This will create an influx of water from outside the production zone that will "sweep" the affected zone. In most cases, the water produced during sweep will be processed for residual uranium content through the ion exchange facility and then disposed directly to the UIC Class I wells. In some cases, the groundwater pumped from the production zone may be treated by RO to reduce the waste volume, and the treated water (permeate) may be used in Plant processes or for makeup water in other restoration activities. To maintain the area of drawdown, the permeate will not be reinjected into the production zone, but will be transferred to other mine units for use as makeup water or injected into the UIC Class I wells. The concentrated byproduct material (brine) will be injected into the UIC Class I wells.

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

4.13.1.3 *Solid Wastes*

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

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

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

The non-hazardous materials, with the exception of sewage sludge, will be recycled when possible or temporarily stored in commercial bins prior to disposal by a contracted waste disposal operator at an approved off-site solid waste disposal facility, such as the Carbon County Landfill. Hazardous wastes will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of MSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes. Because of the controlled off-site disposal procedures, no impacts from the non-hazardous solid waste disposal are anticipated in the Permit Area.

Solid 11(e)(2) Byproduct Materials

The solid 11(e)(2) byproduct materials will include process wastes, such as spent ion exchange resin, filter media, and tank sludge, generated during ISR and ore processing, and will include equipment that becomes contaminated during ISR and ore processing. These items include tanks, vessels, PPE, and process pipe and equipment. Such wastes could also include soils contaminated from spills. Where possible, equipment will be decontaminated for disposal as non-11(e)(2) material or for re-use. Equipment that cannot be decontaminated and process wastes will be placed in clearly labeled, covered containers and temporarily stored in restricted areas with clearly visible radioactive warning signs. The solid 11(e)(2) byproduct materials will then be disposed of at an NRC-licensed facility, typically a uranium mill tailings impoundment, by personnel qualified to dispose of radioactive wastes. Because of the controlled off-site disposal procedures, no impacts from the non-hazardous solid waste disposal are anticipated in the Permit Area.

4.13.1.4 Cumulative Impacts

As noted at the beginning of **Section 4** of this report, the evaluation of cumulative impacts is difficult because, even though LC ISR, LLC is an isolated operation at present, it is reasonably foreseeable that other resource extraction operations will be developed in the area in the next few years. Even so, because of the isolation of the Project and the relatively minimal waste management impacts, the impact analysis does not change appreciably whether LC ISR, LLC is the only operation considered or if other operations are considered.

4.13.2 Mitigation of Waste Management Impacts

Effluents will be reduced by minimizing disturbance and reusing/recycling materials whenever possible. On-site waste handling facilities will have proper storage to segregate the materials and signage to indicate the types of materials present. These areas will be routinely checked to ensure proper waste segregation and storage. All materials delivered to or transported from the Permit Area, including wastes, will be packaged in accordance with US DOT and WYDOT requirements.

Employees will receive training, guidance, and PPE to safely handle, store, decontaminate, and dispose of waste materials. Employees will also be trained to recognize potential hazards and to perform assigned duties in a safe and healthy manner to help reduce the possibility of accidental release.

SOPs will be accessible for guidance on routine activities; for unusual circumstances, an approved work plan and approved RWP will provide guidance for non-routine work or maintenance activities. Spill Prevention and Response Plans will also be in place to help reduce the possibility of accidental release, and to provide for appropriate action in the event of a release.

4.13.2.1 Gaseous Emissions and Airborne Particulates

Regular maintenance of vehicles, SOPs, and PPE will be used to reduce non-radioactive gaseous emissions. Alternatives will be considered to help reduce fuel consumption and emissions.

Restricted vehicular access and speed limits will be used to minimize dust from roads; additional dust control measures may include water spraying, application of gravel, or application of organic/chemical dust suppressants. Disturbance will be minimized to the extent possible, and disturbed areas will be revegetated during the first available seeding window. Standardized delivery procedures that minimize material loss (and address health and safety concerns) and efficient construction practices will be used to minimize generation of such particulates.

Fumes from the limited use of liquid chemicals, such as hydrochloric or sulfuric acid, will be controlled (e.g., laboratory hoods). Pressure venting at the mine units and supporting facilities will produce some non-radioactive gaseous emissions, such as CO_2, oxygen, and water vapor, but the primary effluent of concern from pressure venting is radon gas, as discussed in more detail below. Because of the limited quantities of non-radioactive gaseous emissions, no discernable impacts are expected.

Potential radon exposure will be reduced or eliminated with ventilation to the outside of the buildings using high-volume exhaust fans, PPE, and limited exposure durations, in accordance with SOPs, or in the case of an unanticipated release, an RWP. Occupational and public exposures to radon, emitted from the mine units and from the ore processing, were analyzed using the MILDOS computer model to ensure the discharged amount will be within regulatory dose limits (**Section 4.12,** Public and Occupational Health).

4.13.2.2 Liquid Wastes

A variety of mitigation measures will be employed to reduce or eliminate impacts from liquid wastes, as outlined below.

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

During well development, sample collection, and pump testing, groundwater will be discharged to the surface under the provisions of a general WYPDES permit, in a manner that mitigates erosion, or reused in the drilling process.

Storm Water Runoff

Procedural and engineering controls will be implemented such that storm water runoff from the area of the Plant will not pose a potential source of pollution, in accordance with the applicable requirements of the WYPDES storm water permit.

Waste Petroleum Products and Chemicals

The primary mitigation measures that will be employed to minimize or eliminate waste management impacts will be reduction of wastes and proper storage, handling, and disposal. In addition, by disposing of the waste petroleum products at a licensed facility off-site, this type of waste will not be present in the Permit Area after the Project is completed.

Domestic Sewage

Proper construction and maintenance will reduce potentially adverse impacts from the septic system.

Liquid 11(e)(2) Byproduct Materials

The three 11(e)(2) byproduct materials will be treated and disposed of on-site through a system of Storage Ponds to UIC Class I wells. Prevention measures will be in place to help reduce potential impacts from unanticipated releases of these materials. Pipeline flows and manifold pressures will be monitored for spill detection, and process control will be such that any release of liquid waste will be contained within the structure. A concrete curb will be built around the entire Plant building. This pad will be designed to contain the contents of the largest tank within the building in the event of a rupture. In the event of a piping failure, the pump system will shut down, limiting any release. Liquid inside the building, both from a spill or from washdown water, will be drained through a sump and treated as 11(e)(2) byproduct material.

To reduce the possibility of a pond failure, the Storage Ponds will be designed and built to NRC standards using impermeable synthetic liners. A leak detection system will also be installed, and all Storage Ponds will be inspected on a regular basis. Any sludge that accumulates in the Storage Ponds and the pond liners will be removed during decommissioning and disposed off-site at a licensed 11(e)(2) disposal facility.

UIC Class I wells will be constructed following all applicable regulations and guidelines. Routine inspection and testing will be conducted to minimize any impacts that may occur from the malfunction of these wells. The UIC Class I wells in the Permit Area will be plugged and abandoned as part of decommissioning of the Project.

4.13.2.3 Solid Wastes

As noted at the beginning of this section, the primary mitigation measures that will be employed to mitigate waste management impacts will be reduction of wastes and proper storage, handling, and disposal of wastes. In addition, by disposing of the waste petroleum products at a licensed facility off-site, this type of waste will not be present in the Permit Area after the Project is completed.

4.13.3 Monitoring of Waste Management Impacts

4.13.3.1 Gaseous Emissions and Airborne Particulates

The monitoring programs for non-radioactive emissions and particulates and for radon are described briefly in **Sections 4.7.4** and **4.12.4**, respectively, and in more detail in **Section 5.7** of the Technical Report.

4.13.3.2 Liquid Wastes

Storage Ponds and UIC Class I wells will be routinely inspected, maintained and tested to ensure that any impact-generating potential be kept to minimum. The monitoring programs for the Storage Ponds and the UIC Class I wells are described in more detail in **Section 5.7** of the Technical Report.

4.13.3.3 Solid Wastes

Monitoring of solid wastes, other than for proper storage, is not necessary because all of these materials will be disposed off-site by licensed contractors.

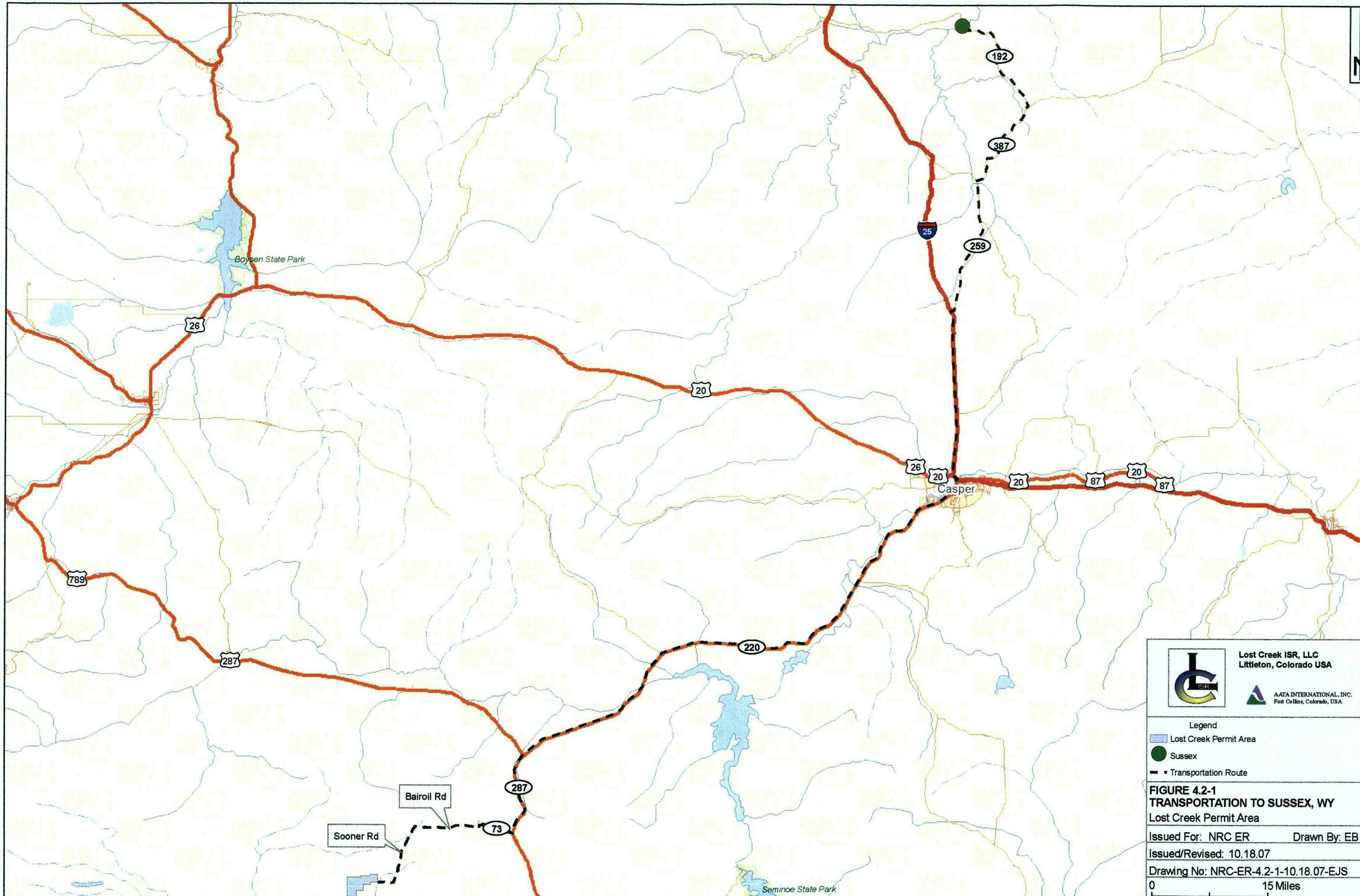


FIGURE 4.2-1
TRANSPORTATION TO SUSSEX, WY
Lost Creek Permit Area
Issued For: NRC ER Drawn By: EB
Issued/Revised: 10.18.07
Drawing No: NRC-ER-4.2-1-10.18.07-EJS

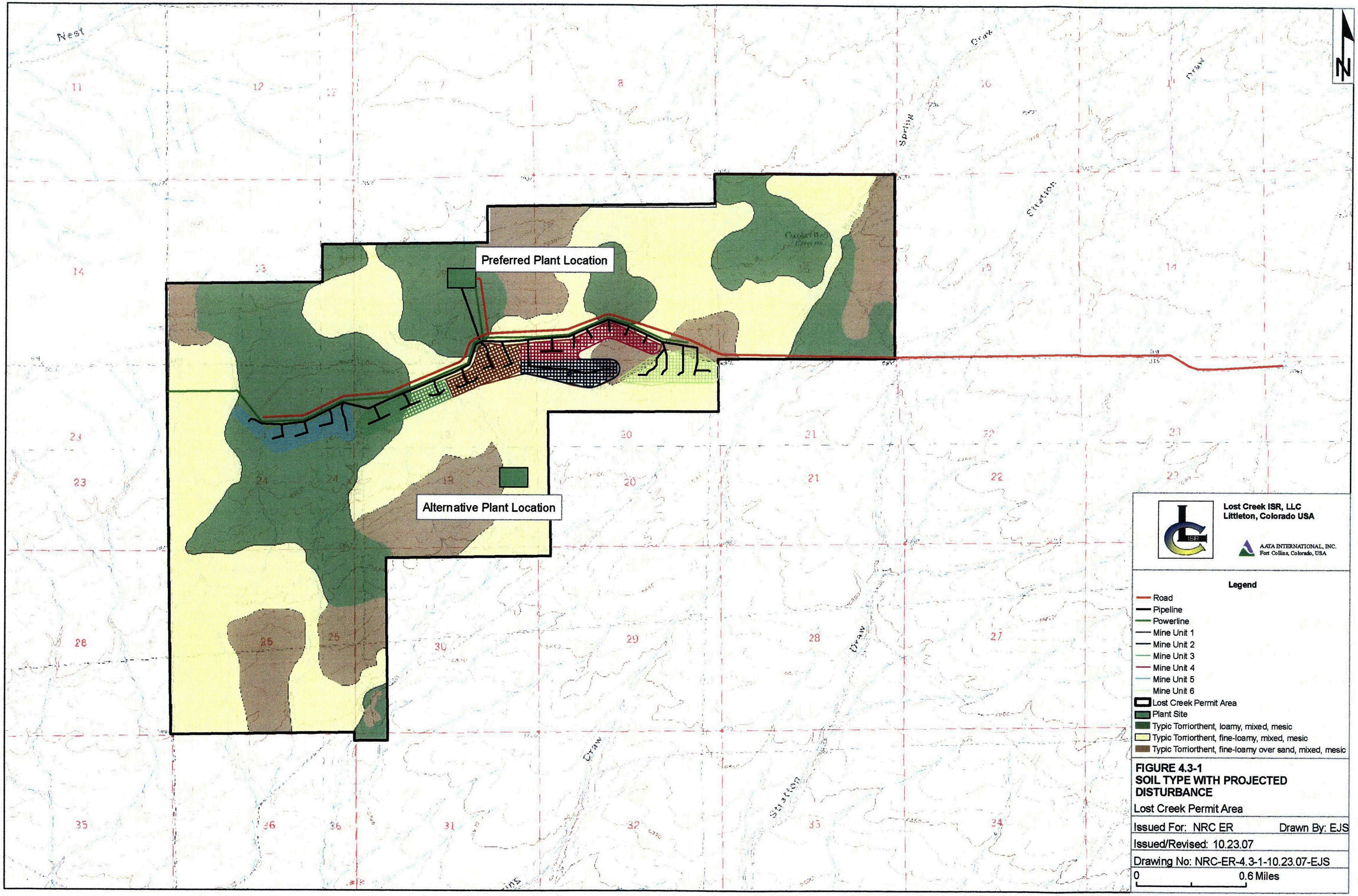
Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

Legend
- Lost Creek Permit Area
- Falfurrias
- Transportation Route

FIGURE 4.2-2
TRANSPORTATION TO FALFURRIAS, TX
Lost Creek Permit Area

Issued For: NRC ER Drawn By: EB
Issued/Revised: 10.18.07
Drawing No: NRC-ER-4.2-2-10.18.07-EJS
0 200 Miles


Preferred Plant Location
Alternative Plant Location
Lost Creek ISR, LLC
Littleton, Colorado USA
AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA
Legend
Road
Pipeline
Powerline
Mine Unit 1
Mine Unit 2
Mine Unit 3
Mine Unit 4
Mine Unit 5
Mine Unit 6
Lost Creek Permit Area
Plant Site
Typic Torriorthent, loamy, mixed, mesic
Typic Torriorthent, fine-loamy, mixed, mesic
Typic Torriorthent, fine-loamy over sand, mixed, mesic
FIGURE 4.3-1
SOIL TYPE WITH PROJECTED DISTURBANCE
Lost Creek Permit Area
Issued For: NRC ER
Drawn By: EJS
Issued/Revised: 10.23.07
Drawing No: NRC-ER-4.3-1-10.23.07-EJS
0
0.6 Miles
N

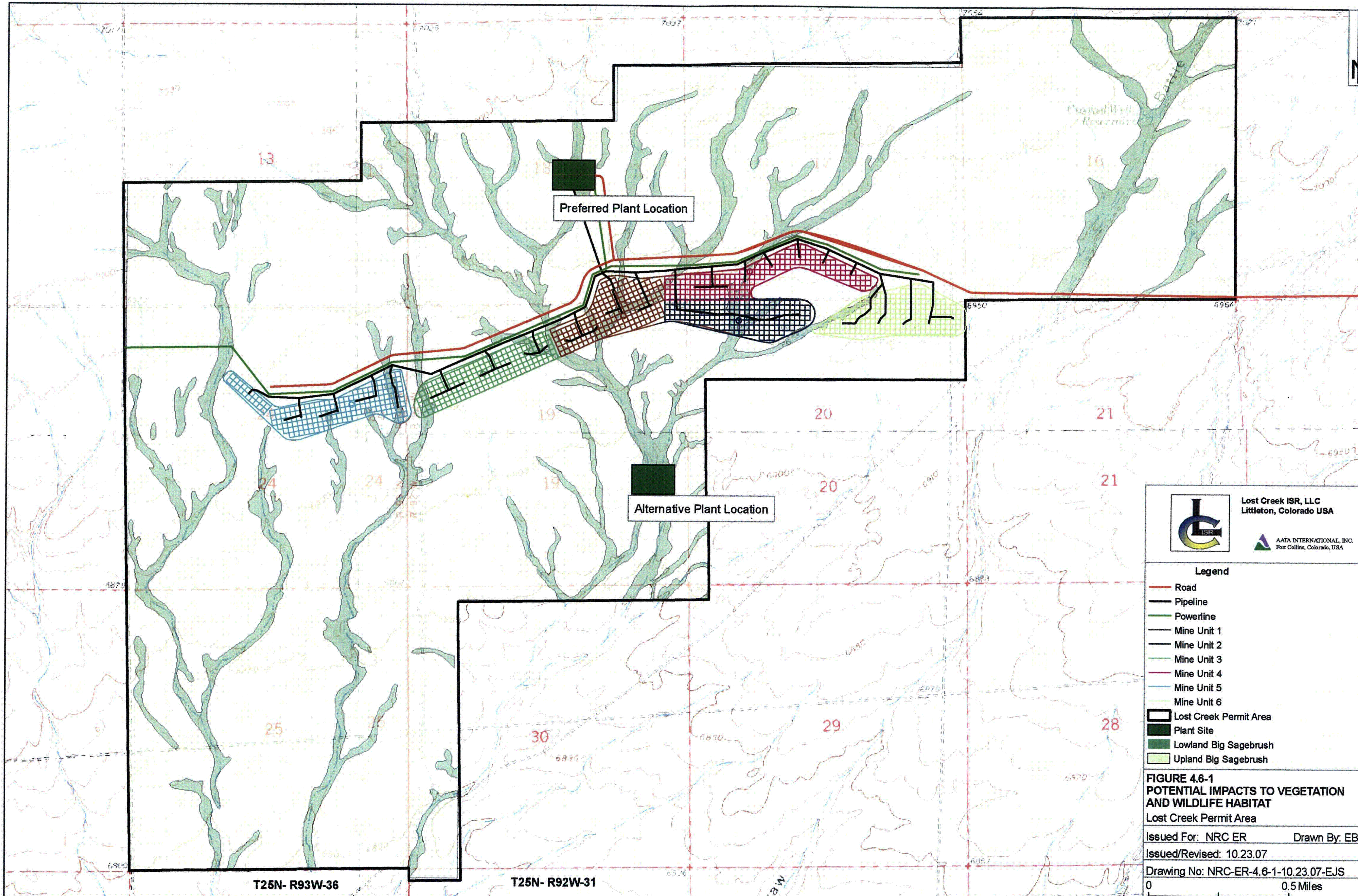
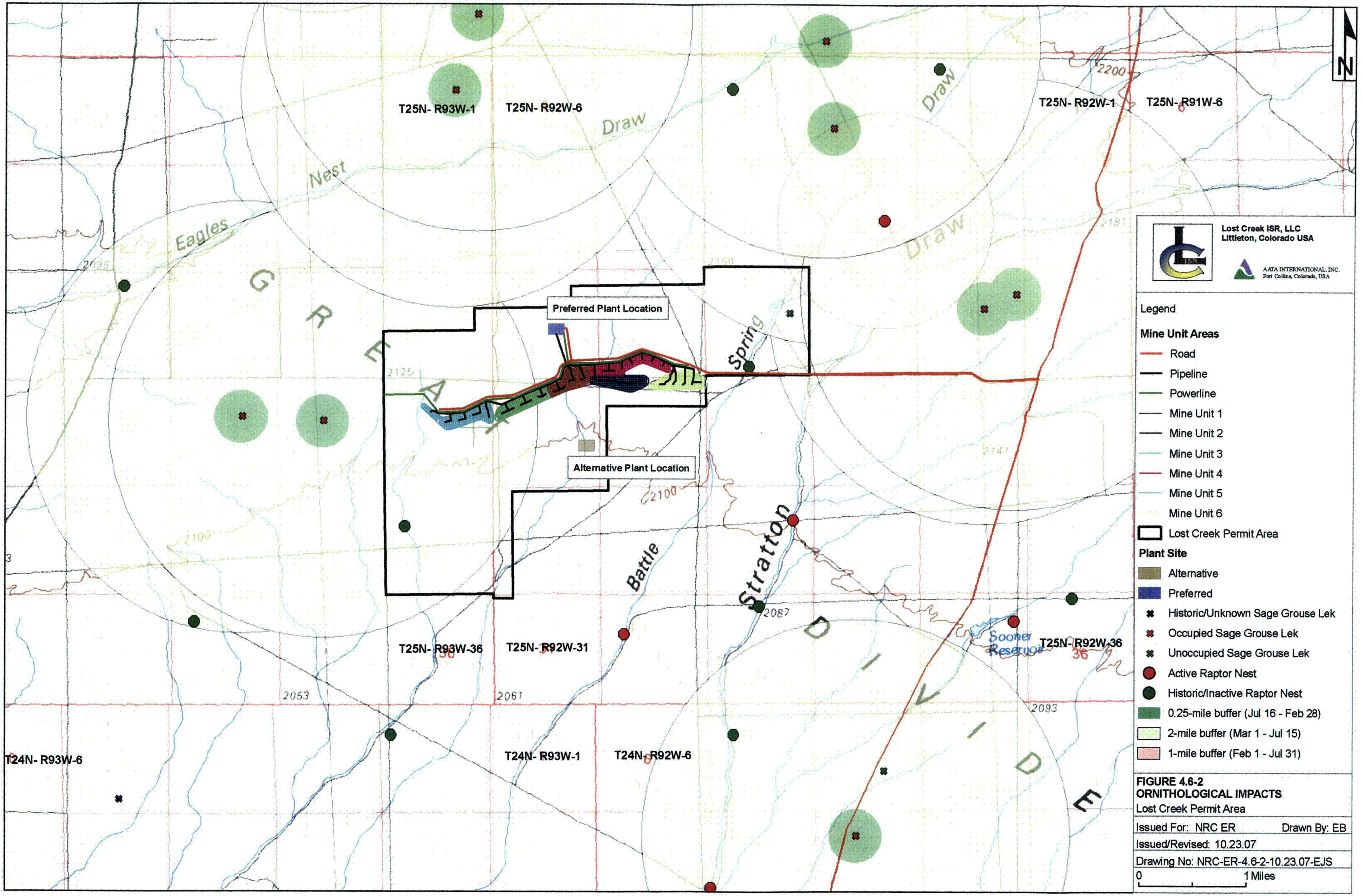


FIGURE 4.6-1
POTENTIAL IMPACTS TO VEGETATION AND WILDLIFE HABITAT
Lost Creek Permit Area



T25N- R93W-1
T25N- R92W-6
T25N- R92W-1
T25N- R91W-6
Eagles
Nest
Draw
Draw
Draw
Spring
Battle
Stratton
G R E A T
D I V I D E
Preferred Plant Location
Alternative Plant Location
Sooner Reservoir
T25N- R93W-36
T25N- R92W-31
T25N- R92W-36
T24N- R93W-6
T24N- R93W-1
T24N- R92W-6
2200
2181
2150
2125
2095
2100
2100
2141
2087
2053
2061
2093
Lost Creek ISR, LLC
Littleton, Colorado USA
AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA
Legend
Mine Unit Areas
Road
Pipeline
Powerline
Mine Unit 1
Mine Unit 2
Mine Unit 3
Mine Unit 4
Mine Unit 5
Mine Unit 6
Lost Creek Permit Area
Plant Site
Alternative
Preferred
Historic/Unknown Sage Grouse Lek
Occupied Sage Grouse Lek
Unoccupied Sage Grouse Lek
Active Raptor Nest
Historic/Inactive Raptor Nest
0.25-mile buffer (Jul 16 - Feb 28)
2-mile buffer (Mar 1 - Jul 15)
1-mile buffer (Feb 1 - Jul 31)
FIGURE 4.6-2
ORNITHOLOGICAL IMPACTS
Lost Creek Permit Area
Issued For: NRC ER
Drawn By: EB
Issued/Revised: 10.23.07
Drawing No: NRC-ER-4.6-2-10.23.07-EJS
0
1 Miles
N

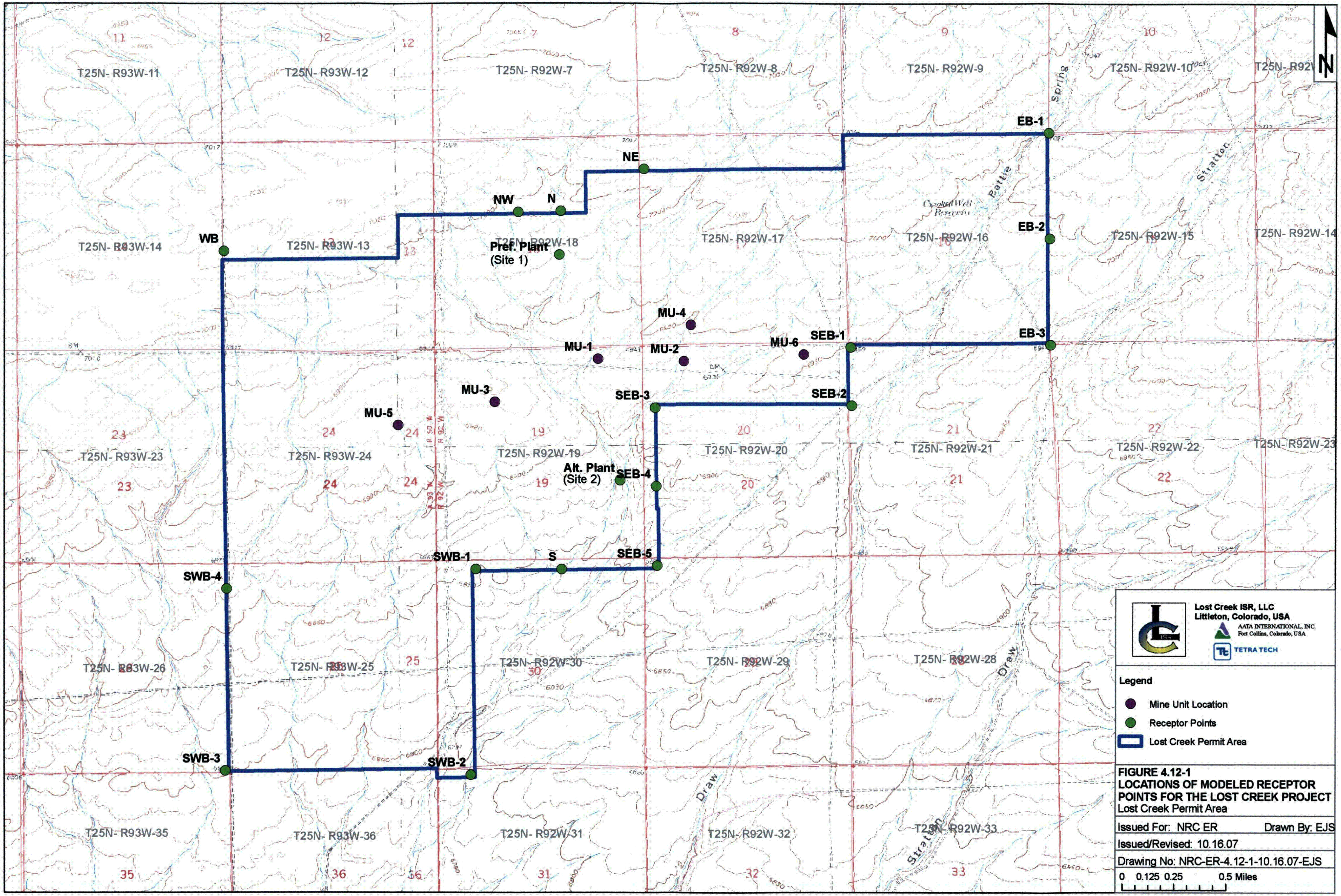


FIGURE 4.12-1
LOCATIONS OF MODELED RECEPTOR POINTS FOR THE LOST CREEK PROJECT
Lost Creek Permit Area

Table 4.2-1 Bulk Chemicals Required at the Permit Area

Shipped as Dry Bulk Solids	Shipped as Liquids and Gases
Sodium carbonate	Gasoline
Salt	Diesel fuel
Soda ash	Propane
Drilling mud	Oxygen
	Carbon dioxide
	Sulfuric acid
	Hydrogen peroxide
	Drilling mud

Table 4.3-1 Disturbance Type and Associated Stripped Acreage

Disturbance Type	Term of Disturbance	Acres
Roads		
Permanent main access road from the Sooner Road to the plant	Long term (≥ project life)	11.4
Permanent main roads - from plant into and through the mine unit	Long term (≥ project life)	3.4
Secondary roads- from main road to header houses	Long term (≥ project life)	4.5
Pipelines and Header Houses		
Header Houses	Long term (≥ project life)	0.4
Main Pipeline Ditch	Short term (2 weeks to 6 months)	1.0
Secondary lines (from main line to header house)	Short term (2 weeks to 6 months)	1.5
Tertiary lines (from HH to wellheads)	Short term (2 weeks to 6 months)	5.4
Mud Pits		
Mud Pits (I/P wells)	Short term (2 weeks to 6 months)	10.4
Mud Pits (Monitoring wells)	Short term (2 weeks to 6 months)	1.2
Mud Pits (Delineation Holes)	Short term (2 weeks to 6 months)	7.4
Field construction laydown areas	Short term (6 to 20 months)	1.4
Lost Creek plant compound	Long term (≥ project life)	10.0
	Total	58.0

Table 4.6-1 Stripped and Disturbed Acreage by Vegetation Type

Disturbance Location	Term of Disturbance[1]	Disturbed Vegetation (acres)				Total Stripped Area (acres)	Total Disturbed Area (acres)
		Upland Big Sagebrush Shrubland		Lowland Big Sagebrush Shrubland			
		Stripped	Disturbed	Stripped	Disturbed		
ROADS							
Permanent main access road	LT	9.8	9.8	1.6	1.6	11.4	11.4
Permanent main roads	LT	2.9	2.9	0.5	0.5	3.4	3.4
Secondary roads	LT	3.9	IPA[3]	0.6	IPA	4.5	IPA
Two-track roads (OPA)[2]	LT	0	2.5	0	0.4	0	2.9
PIPELINES AND HEADER HOUSES							
Header Houses	LT	0.3	IPA	0.1	IPA	0.4	IPA
Main Pipeline Ditch	ST	0.9	0.9	0.1	0.1	1.0	1.0
Secondary lines (OPA)	ST	1.3	1.3	0.2	0.2	1.5	1.5
Tertiary lines	ST	4.6	IPA	0.8	IPA	5.4	IPA
MUD PITS							
Mud Pits (I/P wells)	ST	9.0	IPA	1.4	IPA	10.4	IPA
Mud Pits (Monitoring wells)	ST	1.1	1.1	0.1	0.1	1.2	1.2
Mud Pits (Delineation Holes)	ST	6.4	IPA	1.0	IPA	7.4	IPA
FIELD CONSTRUCTION LAYDOWN AREAS	ST	1.2	IPA	0.2	IPA	1.4	IPA
PATTERN AREAS	MT	--	219	--	35	--	254
PLANT COMPOUND	LT	5.1	8.6	4.9	1.4	10.00	10.00
Totals		46.5	246.1	11.5	39.3	58.0	285.4

[1] LT = long term (greater than or equal to the Project life)
MT= mid-term (mine unit life- 3 years)
ST = short term (two weeks to six months)
[2] OPA=the portion that is Outside Pattern Areas
[3] IPA = Inside Pattern Areas (production field + monitoring ring =mine unit)

Table 4.6-2 Permanent Seed Mixture

Common Name	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
Prairie sandreed	*Calamovilfa longifolia*	2.0
Great Basin wildrye	*Leymus cinereus*	2.0
Winterfat	*Ceratoides lanata*	1.5
Sandberg bluegrass	*Poa secunda*	1.5
Big Sagebrush	*Artemesia tridentata*	1.0
Rubber Rabbitbrush	*Ericameria nauseosa*	1.0
TOTAL		19.5

Table 4.6-3 Exclusion Periods for Migration of Activity from Rawlins

Species	Exclusion Period	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Sage Grouse	Avoid disturbance within 1 ¾ miles from the ¼ mile lek protection zone from March 1st to July 15th. (no human activity between 6:00pm and 9:00am within ¼ mile of the sage grouse lek and no surface disturbance activity within the 2 mile buffer)												
Raptors	Avoid disturbance within ¾ buffer from February 1st to July 31st except: • 1 mile buffer for Ferruginous Hawks • 2 ½ mile buffer for Bald Eagle, Golden Eagle												
Big Game	No surface disturbance on winter game ranges.												

Table 4.7-1 Estimated Emission (pounds/year) from Vehicles

NOx	53,777
CO	11,585
SOx	3,536
PM_{10}	3,780
CO_2	1,999,815
TOC	4,390

Table 4.10-1 Estimated Work Force Requirements for All Alternatives

Project Phase	Employment Category	Total workers
Construction and Development	Drill Rig Contractors (10 rigs)	30
	LC ISR, LLC Construction employees	10
	LC ISR, LLC Other Employees (samplers, geologists, supervision, drilling support)	10 to 20
	Plant Construction Contractors	20
	Total Peak Employment	**70 to 80**
Operations	Operation Staff - Plant and Well fields	57
	Drilling Contractors (10 rigs)	30
	Average Employment	**87**

Table 4.10-2 Estimated Tax Revenues Based on Lost Creek Annual Production (Page 1 of 2)

Estimated Tax Revenues at $60 per pound U_3O_8 [1]

Year	Production U_3O_8	Estimated Federal Income Taxes	Wyoming Severence Taxes	County Ad valorem Taxes	County Property Taxes
2008					
2009	45,000				
2010	1,000,000		900,000	1,600,000	300,000
2011	1,000,000	9,000,000	1,000,000	1,900,000	300,000
2012	1,000,000	10,000,000	1,000,000	2,000,000	300,000
2013	1,000,000	10,000,000	1,000,000	2,000,000	250,000
2014	1,000,000	10,000,000	1,000,000	2,000,000	250,000
2015	1,000,000	10,000,000	1,000,000	2,000,000	100,000
2016	400,000	3,000,000	700,000	900,000	50,000
2017					50,000
TOTALS:	**6,445,000**	**$52,000,000**	**$6,600,000**	**$12,400,000**	**$1,600,000**

Table 4.10-2 Estimated Tax Revenues Based on Lost Creek Annual Production (Page 2 of 2)

Estimated Tax Revenues at $80 per pound U_3O_8 [1]

Year	Production U_3O_8	Estimated Federal Income Taxes	Wyoming Severence Taxes	County Ad valorem Taxes	County Property Taxes
2008					
2009	45,000				
2010	1,000,000	5,600,000	1,200,000	2,000,000	300,000
2011	1,000,000	16,000,000	1,400,000	2,500,000	300,000
2012	1,000,000	17,000,000	1,400,000	2,700,000	300,000
2013	1,000,000	17,000,000	1,400,000	2,700,000	250,000
2014	1,000,000	17,000,000	1,400,000	2,700,000	250,000
2015	1,000,000	17,000,000	1,400,000	2,700,000	100,000
2016	400,000	4,000,000	600,000	1,200,000	50,000
2017					50,000
TOTALS:	**6,445,000**	**$93,600,000**	**$8,800,000**	**$16,500,000**	**$1,600,000**

[1] ± 30 percent

Table 4.11-1 U.S. Census Bureau Community Statistics for Environmental-Justice Analysis *

Percent of Population	Carbon County	Sweetwater County
Persons Below Poverty Level (2005)	1,808	3,266
Percent Below Poverty (2003)	11.8 percent	8.6 percent
White (2004)	96.3 percent	95.7 percent
Black (2004)	1.0 percent	1.0 percent
American Indian (2004)	1.2 percent	1.1 percent
Asian (2004)	0.9 percent	0.9 percent
Native Hawaiian or Pacific Islander (2004)	0.0 percent	0.1 percent
Other Race (2004)	0.5 percent	1.3 percent
Hispanic Origin (of any race) (2004)	13.0 percent	10.2 percent

* (Census Bureau (U.S.) 2000a)

Attachment 4.12-1

MILDOS-AREA Modeling Results

September 2007

INTRODUCTION

Lost Creek ISR, LLC (LC ISR, LLC) is planning to construct and operate an in situ facility for recovery of uranium at a location in central Wyoming in the vicinity of Lost Creek (Lost Creek Project). The permit area is approximately 50 miles northwest of Rawlins, WY in the Great Divide Basin. In order to estimate the potential impact to members of the public residing near the facility, radiation doses were modeled using the MILDOS-AREA code. MILDOS-AREA has been approved for this use by the United States (US) Nuclear Regulatory Commission (NRC).

PROJECT DESCRIPTION

The Lost Creek Project (Project) will consist of six mine units that will be developed for injection and recovery of uranium leaching solutions over an eight year period. The leaching solution or lixiviant, which consists of groundwater augmented with oxygen and carbon dioxide, is pumped into the underground orebody to mobilize the uranium. Extraction wells remove the lixiviant containing uranium (pregnant solution) from the orebody. The uranium is then extracted from the pregnant solution by passing through ion exchange columns.

Mine units and processes are staged as shown in Figure 1. The plan calls for installation of new wells in Mine Unit 1 to begin in 2009 and be completed in 2010. The underground ore will be lixiviated (termed "Production" on the figure) beginning approximately eight months following the initiation of new well installation. Production in Mine Unit 1 will continue into the second quarter (Q2) of 2011. Restoration of MU-1 will begin in the third quarter (Q3) of 2011 and continue for approximately the first half of 2012 (Q1-2). Mine Units 2-6 will follow the same pattern with initiation of each subsequent unit in the year following the previous mine unit installation.

The Ion Exchange facility, located at the main plant, will be operational beginning in the fourth quarter (Q4) of 2009 and will continue more or less constantly through the first half of 2016. Lixiviant will be pumped from each active mine unit to the Ion Exchange facility for elution.

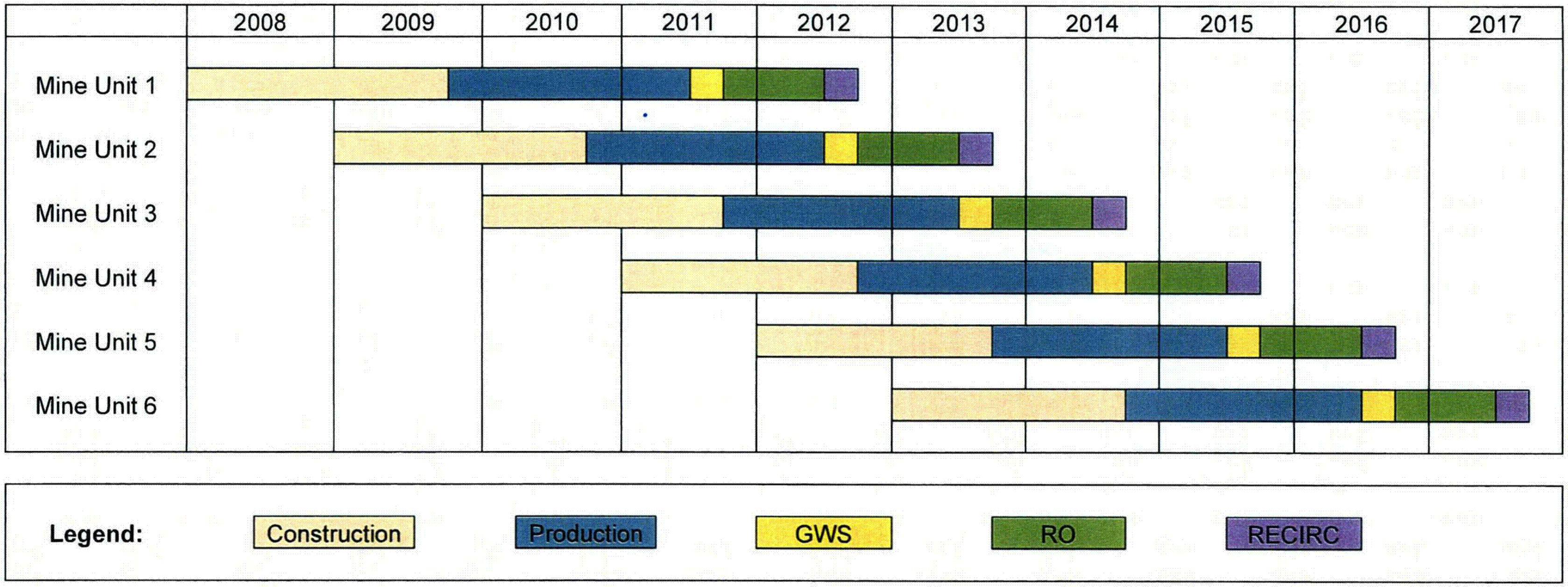


Figure 1 **Staging of various processes at the Lost Creek ISR facility.**

POTENTIAL RADIOACTIVE EFFLUENTS

Uranium-238 (U-238) in the orebody ultimately decays to Ra-226 and then Rn-222. Uranium (including U-238, U-234, and U-235) and radon are soluble in the leach solution and may be released during operations. Because the facility will not have a dryer, there is no potential for release of radionuclides in airborne particulates. Thus, radon gas is the only potential radioactive effluent. The MILDOS code was used to estimate potential doses to members of the public and workers from radon released during the following operations.

- New wells: When drilling new wells into the orebody, drill cuttings, including ore, are transported to the surface in drilling mud. Cuttings are temporarily storing in mud pits where Rn-222 may be released to the atmosphere.
- Producing mine units: Radon this is dissolved in the lixiviant may be released in two ways, either from purge water or from gas venting at the wellhead.
- Ion Exchange columns: Radon gas may be released from the columns as a function of the volume of the columns, the porosity of the resin and the unloading rate of the column.
- Restoration activities: During the restoration of the mine units, water is circulated within and discharged from the wells in release rates similar to those from producing mine units.

MILDOS MODELING

The computer code MILDOS-AREA was used to estimate potential radiation doses from planned Lost Creek ISR operations. MILDOS (ANL, 1989) was originally developed to estimate doses from conventional uranium milling operations, including large area releases such as ore storage pads and tailings beaches. Inputs to the dose are limited to uranium decay chain radionuclides. MILDOS was subsequently updated in 1998 to address potential impacts of uranium in situ leaching operations. ISR-specific types of source terms, such as production wells and restoration wells are included in the updated version. Modeling assumptions and parameters are addressed below.

METEOROLOGY

Meteorological conditions greatly influence dispersion of radionuclides from estimated releases during the year. LC ISR, LLC has a meteorological station about 9.5 miles northeast of the Lost Creek Permit Area (Premit Area) that records wind speed, wind direction, and stability class simultaneously. Data for the period April 2006 through April 2007 were converted to the site-specific joint frequency distribution (STAR file) required as input by MILDOS. These calculations were performed using the STARMD program which is based on the Sigma-Theta method in the Environmental Protection Agency (EPA) 454/R-99-005 (EPA, 1987). STAR data represent percentages of time for each wind direction (16 compass points) in particular wind speed and stability classes.

INPUT PARAMETERS

Important parameters for various source types are shown in **Table 2**. Size and mine unit-dependent parameters are given in **Table 3**. The specific mine unit parameters include location relative to the Central Plant or Ion Exchange Facility.

Table 2 Important input parameters.

All sources	Thickness of orebody	3.7 m
	Density of orebody	1.94 g/L
New Well sources	Number of mud pits/yr	935
	Ore material added to mudpits	2.3E5 kg per year
	Duration of storage in mudpit	4 days
	percent U_3O_8	0.055percent
Production Mine Unit sources	Emanation fraction	0.25
	Fraction of radon in solution	0.80
	Rate of radon venting	0.01 per day
	Treated water purge rate	3.3E5 liters per day
	Percent U_3O_8	0.055percent
	Volume in circulation	Varies with size of unit
Ion Exchange columns	Column volume	1.41E5 liters
	Column unloading rate	0.68 per day
	Porosity of resin	0.4
	percent U_3O_8	0.055percent
Restoration mine unit sources	Emanation fraction	0.25
	Volume in circulation	Varies with size of unit
	Operating days	365 per year
	Treated water purge rate	7.63E5 liters

Table 3 **Mine unit-specific parameters.**

Mine Unit	MU-1	MU-2	MU-3	MU-4	MU-5	MU-6
X (km)*	0.29	0.96	-0.51	1.02	-1.27	1.90
Y (km)*	-0,80	-0.83	-1.14	-0.55	-1.32	-0.77
Z (m)*	-13.4	-11.3	-10.7	-5.8	-14.9	-4.6
Area of active drilling (m^2)	1.66E5	1.62E5	1.55E5	1.69E5	1.88E5	1.88E5
Volume in circulation (L)	6.53E5	7.57E5	9.52E5	1.16E6	1.40E6	1.47E6
* Relative to IX plant (0,0,0)						

RECEPTOR LOCATIONS

There are no nearby permanent residents near the facility, so receptors were placed at the property boundary as listed in **Table 4**.

Table 4 **Receptor locations.**

Receptor	X (km)	Y (km)	Z (m)
NB	0.00	0.33	0.61
NEB	0.66	0.66	9.14
EB1	3.80	0.92	-3.96
EB2	3.81	0.11	3.66
EB3	3.81	-0.69	-8.53
SEB1	2.26	-0.71	-11.6
SEB2	2.26	-1.16	-17.7
SEB3	0.73	-1.18	-15.2
SB	0	-2.41	-45.1
ALT 1	0.74	-1.77	-36.0
ALT 2	0.75	-2.40	-39.0
SWB1	-0.66	-2.42	-39.0
SWB2	-0.64	-4.06	-60.4
SWB3	-2.57	-4.07	-57.3
SWB4	-2.58	-2.58	-33.2
WB	-2.61	0	9,75
NWB	-0.33	0.33	3.66
IX plant	0	0	0

Locations of proposed Plants and centroids of the various mine units, as well as specific receptor locations are also shown **Figure 2**.

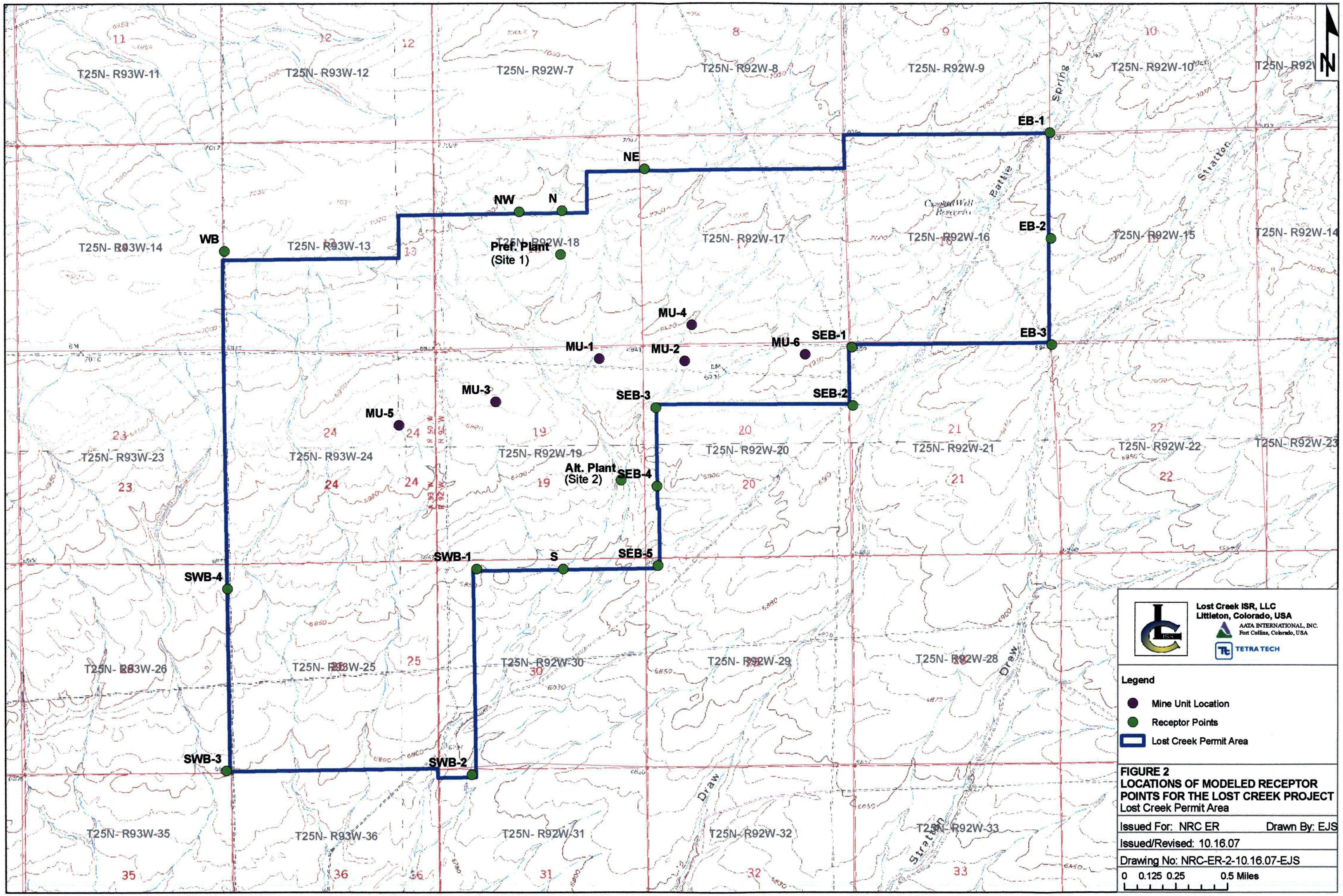


FIGURE 2
LOCATIONS OF MODELED RECEPTOR POINTS FOR THE LOST CREEK PROJECT
Lost Creek Permit Area

Issued For: NRC ER | Drawn By: EJS
Issued/Revised: 10.16.07
Drawing No: NRC-ER-2-10.16.07-EJS

POPULATION DISTRIBUTION

There are no towns of any size within 30 km from the proposed site. However, towns within 80 km from the Permit Area include Rawlins, Jeffrey City, Wamsutter, and Bairoil. Directions, distances and census data are listed in Table 5.

Table 5 **Population distribution surrounding the Lost Creek site.**

Town	Direction	Distance (km)	Population
Rawlins	SE	75	8500
Jeffrey City	NNE	40	110
Wamsutter	S	50	275
Bairoil	ENE	35	100

SOURCE STRENGTH

The QADJUST factor in MILDOS was used to adjust the timing and fraction of a year that various sources operated in keeping with the pattern shown in **Figure 1**. The annual rate of release from a specific mine unit was varied depending timing of the release. For example, if a source operated for only 0.75 year, QADJUST was set at 0.75 to account for that diminished output on a yearly basis. By varying QADJUST in this way, it was possible to plot the variation in dose as the project progresses.

MODELING ASSUMPTIONS

Sources were modeled according to the staging shown in **Figure 1**. New wells, producing mine units, and restoration were modeled using the MILDOS-prescribed format and inputs for that type of source. Releases from the Ion Exchange columns were modeled as a point source with an average Rn-222 release rate as calculated by the MILDOS production well model. Venting from producing mine units and restoration wells were calculated assuming that the venting occurred at the centroid of the mine unit under consideration. Because no water is released at the location of the mine unit, purge water for the producing mine unit and restoration wells was assumed to occur at the location of the Ion Exchange columns.

Two sites were modeled for the location of the Ion Exchange columns and the purge water releases. Site 1 is situated in the Northwest Quarter of the Southweast Quarter of Section 18, Township 25 north, Range 92 west and is the 0,0 point for the MILDOS modeling. Site 2 is situated in the Southeast Quarter of the Northeast Quarter of Section 18, Township 25 north, Range 92 west. Hence, Site 2 is located -1.736 km (to the south), 0.478 km (to the east) from the Site 1 location. Results are summarized below for both sites.

MODEL RUNS

Dose modeling was conducted in several MILDOS Code runs as follows.

- New Wells were modeled for each of the six proposed mine units over a total period of seven annual time steps beginning in 2009.
- Production Wells were modeled for each mine unit over a total period of eight annual time steps from 2009 through 2016. Venting and water purging were modeled separately because of the different release locations for those activities.
- Ion Exchange Facility operation was modeled over a series of eight annual time steps from 2009 to 2016.
- Restoration was modeled for each mine unit over a total period of seven annual time steps from 2011 to 2017.
-

As described above, the period of each year in which dose was calculated was varied using the QADJUST factor. So, for some time steps, certain mine units would be turned on or off depending on the staging shown in **Figure 1** above.

MODELING RESULTS

INDIVIDUAL RECEPTOR LOCATIONS

Site 1 Plant Location

Estimated annual doses at individual receptor locations from the Site 1 location for the Ion Exchange columns are shown below in **Table 6** and **Figure 3**. The total effective dose equivalent (TEDE) for the north boundary (NB) location exceeds the 10 CFR 20 allowable level of 100 mrem/yr for year 2012 to 2015, with 2014 being the maximum year. This dose results exclusively from exposure to radon decay products, since there are no particulate releases from the facility. For this reason, the 40 CFR 190 annual dose commitments are zero in all cases. The TEDE result is understandable because the potential plant site is located only 300 m south of the NB receptor location. For this plant location, no other property boundary receptor exceeds 100 mrem/yr. As mentioned above there are no nearby residences.

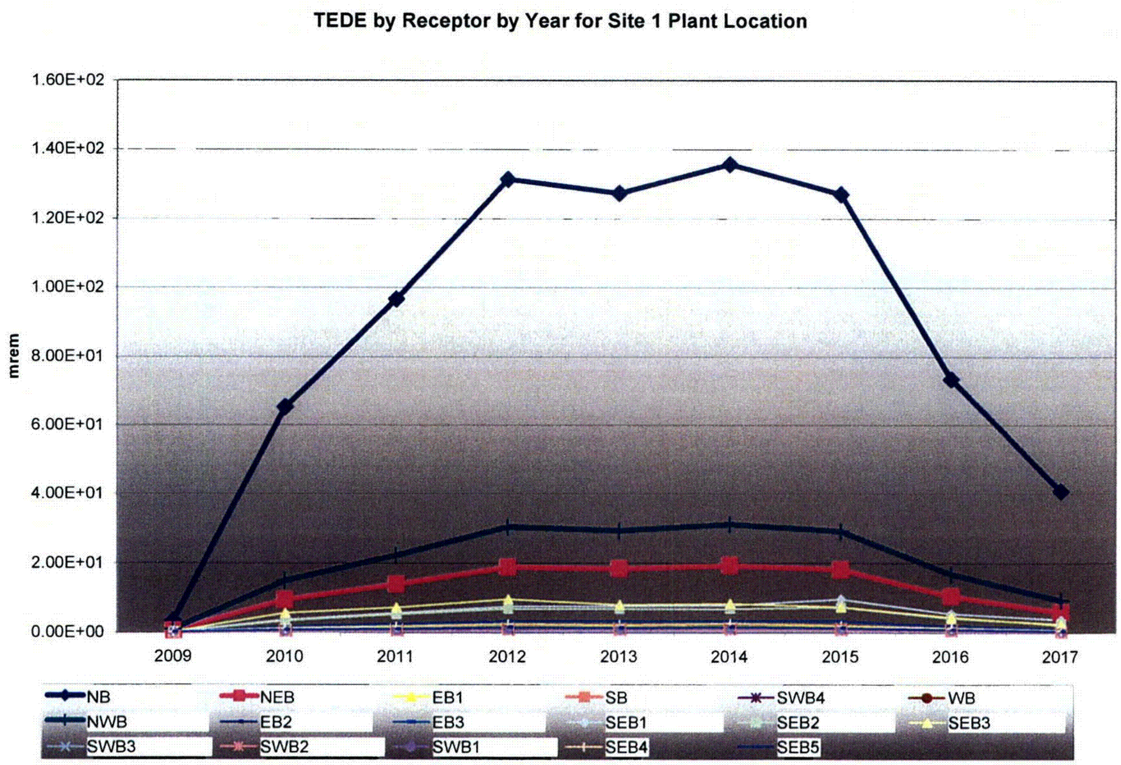


Figure 3. Estimated Dose by Year for the Site 1 Plant Location.

Table 6. Summary of TEDE to Maximum Individual by Location and Year (mrem/yr).

Receptor	2009	2010	2011	2012	2013	2014	2015	2016	2017
NB	3.24E+00	6.53E+01	9.67E+01	1.31E+02	1.27E+02	1.36E+02	1.27E+02	7.34E+01	4.07E+01
NEB	4.69E-01	9.39E+00	1.39E+01	1.88E+01	1.84E+01	1.93E+01	1.81E+01	1.04E+01	5.77E+00
EB1	4.10E-02	8.14E-01	1.23E+00	1.64E+00	1.62E+00	1.69E+00	1.67E+00	9.52E-01	5.58E-01
SB	2.18E-02	4.77E-01	6.97E-01	9.76E-01	8.92E-01	1.18E+00	9.30E-01	6.22E-01	2.45E-01
SWB4	1.13E-02	2.32E-01	3.39E-01	4.66E-01	4.33E-01	4.99E-01	4.29E-01	2.63E-01	1.27E-01
WB	3.04E-02	5.97E-01	8.79E-01	1.22E+00	1.17E+00	1.29E+00	1.17E+00	6.92E-01	3.63E-01
NWB	7.47E-01	1.50E+01	2.21E+01	3.03E+01	2.92E+01	3.11E+01	2.91E+01	1.68E+01	9.28E+00
EB2	2.07E-02	1.31E-01	1.32E-01	1.32E-01	1.32E-01	1.33E-01	1.32E-01	6.65E-02	1.16E-03
EB3	7.64E-02	1.52E+00	2.28E+00	3.06E+00	3.02E+00	3.14E+00	3.13E+00	1.77E+00	1.04E+00
SEB1	1.82E-01	3.65E+00	5.57E+00	7.40E+00	7.49E+00	7.75E+00	9.55E+00	5.35E+00	3.73E+00
SEB2	1.66E-01	3.33E+00	5.17E+00	6.75E+00	6.74E+00	6.83E+00	7.27E+00	4.09E+00	2.55E+00
SEB3	3.10E-01	5.55E+00	7.19E+00	9.58E+00	7.98E+00	8.32E+00	7.32E+00	4.30E+00	2.24E+00
SWB3	6.58E-03	1.46E-01	2.17E-01	2.98E-01	2.79E-01	3.13E-01	2.75E-01	1.66E-01	8.44E-02
SWB2	9.17E-03	2.08E-01	3.09E-01	4.26E-01	3.96E-01	4.57E-01	3.95E-01	2.43E-01	1.19E-01
SWB1	1.78E-02	3.81E-01	5.56E-01	7.67E-01	7.04E-01	9.23E-01	7.41E-01	4.93E-01	1.96E-01
SEB4	5.87E-02	1.20E+00	1.70E+00	2.44E+00	2.15E+00	2.59E+00	2.02E+00	1.28E+00	5.68E-01
SEB5	3.43E-02	7.13E-01	1.03E+00	1.45E+00	1.31E+00	1.61E+00	1.29E+00	8.27E-01	3.58E-01
Maximum	3.24E+00	6.53E+01	9.67E+01	1.31E+02	1.27E+02	1.36E+02	1.27E+02	7.34E+01	4.07E+01

As shown in **Figure 4**, the vast majority of the dose to the NB receptor location results from releases of purge water at the ion exchange plant during production and restoration phases. Again, this is consistent with the relatively close proximity of the proposed plant location to the north boundary of the facility.

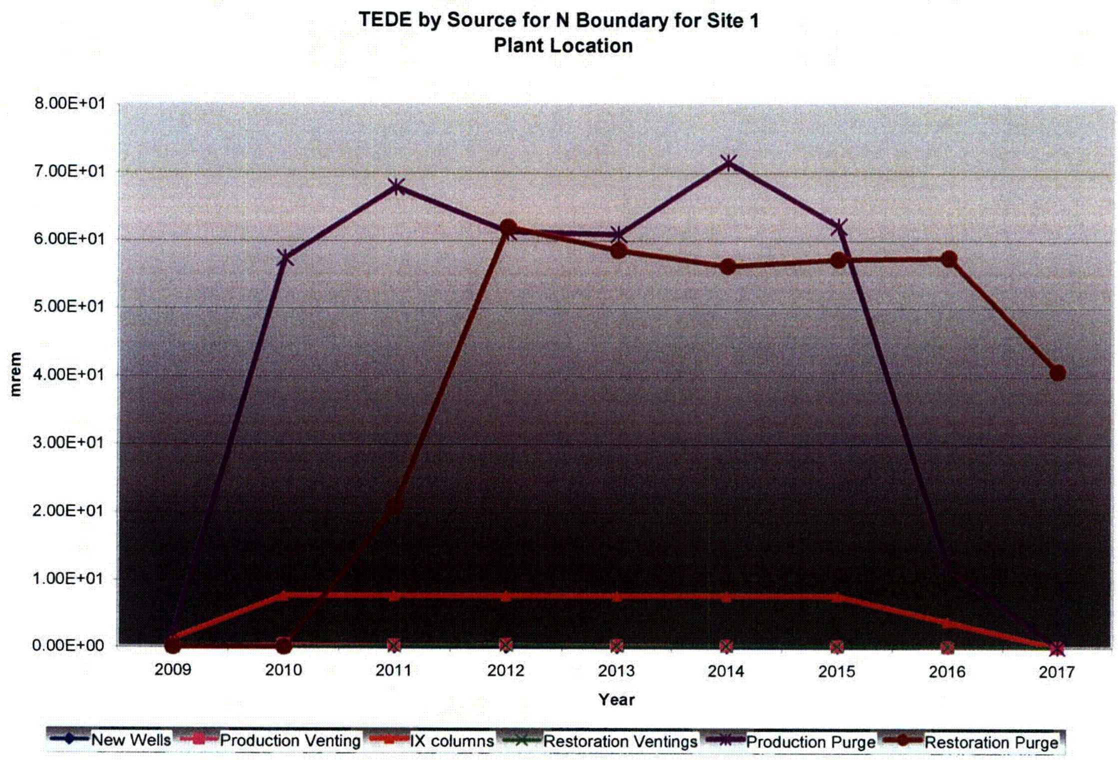


Figure 4 **Estimated Dose for North Boundary for Site 1 Plant Location**

Because of the proximity of the Site 1 Plant Location to the north boundary, the decrease in dose with distance from the north boundary was also evaluated. As shown in **Figure 5**, the estimated dose decreases rapidly, and is below 40 mrem/yr within about 1,000 feet of the boundary.

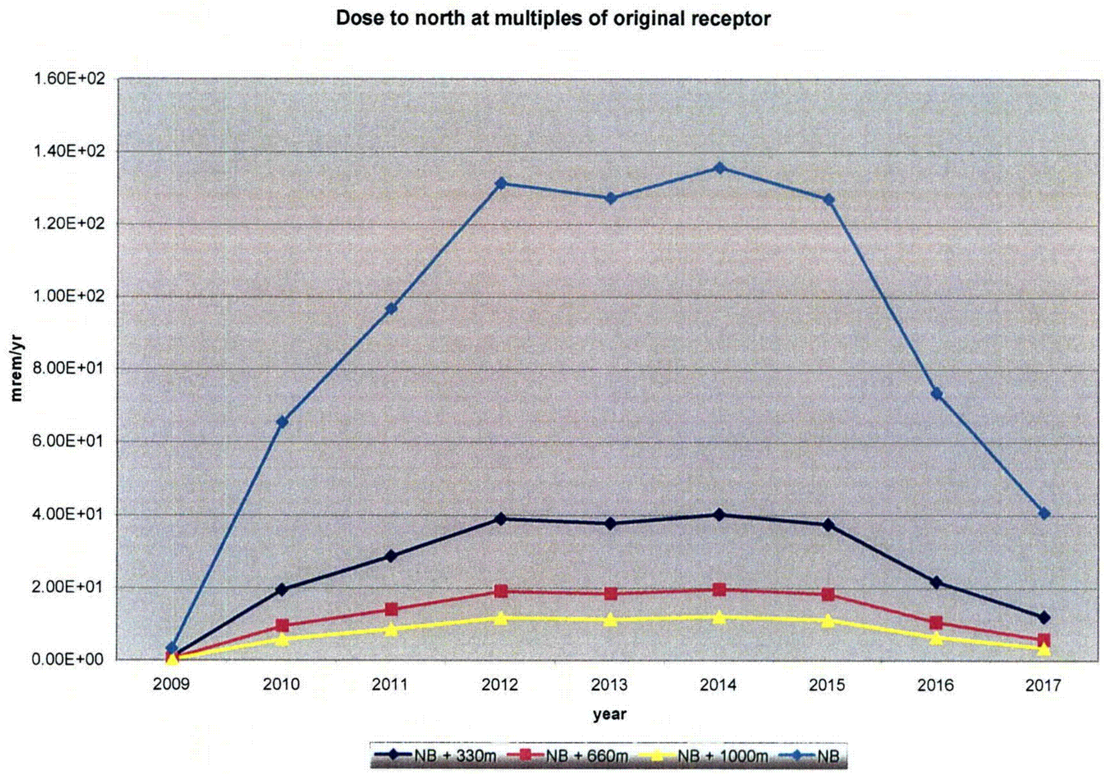


Figure 5 **Estimated Dose for North Boundary for Site 1 Plant Location**

Site 2 Plant Location

Estimated annual doses at individual receptor locations assuming the Ion Exchange columns are located at Site 2 are shown below in **Table 7** and **Figure 6**. The maximum TEDE for any receptor assuming the Site 2 Ion Exchange Facility location is at SEB3 with an annual estimated dose less than 40 mrem in 2012. SEB3 is approximately due east of the Mine Unit 3 centroid and to the northeast of the Site 2 Plant location. This dose results exclusively from exposure to radon decay products, since there are no particulate releases from the facility. For this plant location, no other property boundary receptor exceeds 25 mrem/yr. As mentioned above there are no nearby residences.

Table 7. Summary - TEDE to Maximum Individual by Location & Year (mrem/yr)

Receptor	2009	2010	2011	2012	2013	2014	2015	2016	2017
NB	1.40E-01	2.65E+00	3.75E+00	5.21E+00	4.85E+00	5.13E+00	4.70E+00	2.71E+00	1.48E+00
NEB	1.28E-01	2.46E+00	3.62E+00	4.84E+00	4.77E+00	4.86E+00	4.57E+00	2.56E+00	1.42E+00
EB1	3.86E-02	7.68E-01	1.16E+00	1.55E+00	1.52E+00	1.59E+00	1.58E+00	8.99E-01	5.28E-01
SB	5.31E-02	1.25E+00	1.79E+00	2.44E+00	2.11E+00	2.71E+00	2.11E+00	1.41E+00	5.50E-01
SWB4	1.53E-02	3.15E-01	4.63E-01	6.32E-01	5.94E-01	6.70E-01	5.91E-01	3.56E-01	1.78E-01
WB	2.77E-02	5.42E-01	7.99E-01	1.11E+00	1.06E+00	1.18E+00	1.07E+00	6.31E-01	3.29E-01
NWB	1.03E-01	1.96E+00	2.81E+00	4.06E+00	3.73E+00	4.00E+00	3.59E+00	2.09E+00	1.12E+00
EB2	1.28E-02	8.09E-02	8.18E-02	8.28E-02	8.27E-02	8.29E-02	8.27E-02	4.17E-02	1.15E-03
EB3	4.40E-02	8.61E-01	1.30E+00	1.73E+00	1.74E+00	1.78E+00	1.84E+00	1.03E+00	6.27E-01
SEB1	9.90E-02	1.97E+00	3.06E+00	4.00E+00	4.19E+00	4.24E+00	6.26E+00	3.45E+00	2.67E+00
SEB2	1.10E-01	2.21E+00	3.50E+00	4.48E+00	4.53E+00	4.48E+00	5.06E+00	2.81E+00	1.84E+00
SEB3	8.94E-01	1.96E+01	2.81E+01	3.80E+01	3.26E+01	3.63E+01	2.95E+01	1.85E+01	8.43E+00
SWB3	9.02E-03	2.01E-01	3.00E-01	4.10E-01	3.83E-01	4.27E-01	3.77E-01	2.27E-01	1.17E-01
SWB2	1.28E-02	3.05E-01	4.51E-01	6.18E-01	5.64E-01	6.53E-01	5.56E-01	3.45E-01	1.66E-01
SWB1	4.22E-02	9.28E-01	1.35E+00	1.84E+00	1.67E+00	2.03E+00	1.69E+00	1.08E+00	4.74E-01
SEB4	4.68E-01	1.26E+01	1.62E+01	2.15E+01	1.43E+01	2.36E+01	1.43E+01	1.22E+01	2.05E+00
SEB5	1.19E-01	2.78E+00	3.95E+00	5.34E+00	4.54E+00	5.67E+00	4.39E+00	2.91E+00	1.16E+00
Maximum	8.94E-01	1.96E+01	2.81E+01	3.80E+01	3.26E+01	3.63E+01	2.95E+01	1.85E+01	8.43E+00

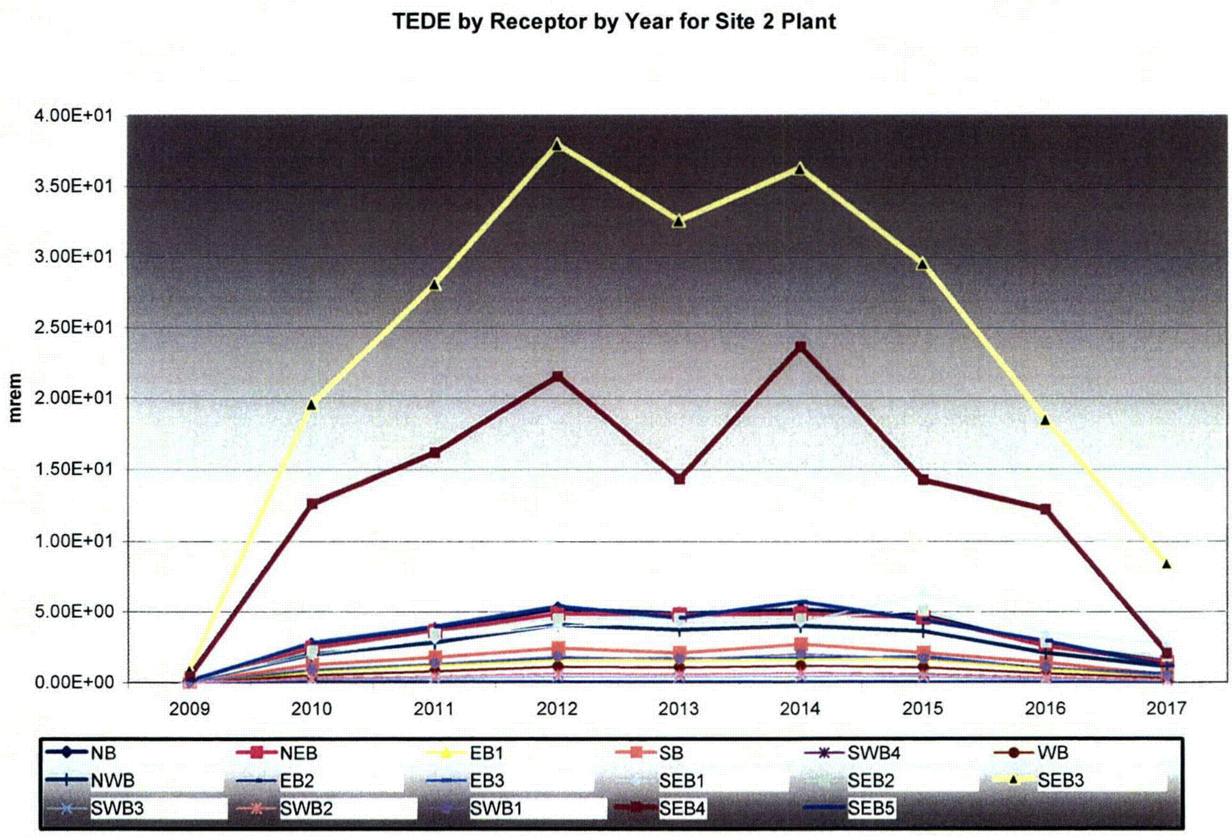


Figure 6 Estimated Dose by Year for the Site 2 Plant Location.

The vast majority of the dose to the SEB3 receptor location results from releases of purge water at the ion exchange plant during production and restoration phases, as shown in **Figure 7**. Doses from other sources are a few mrem/yr.

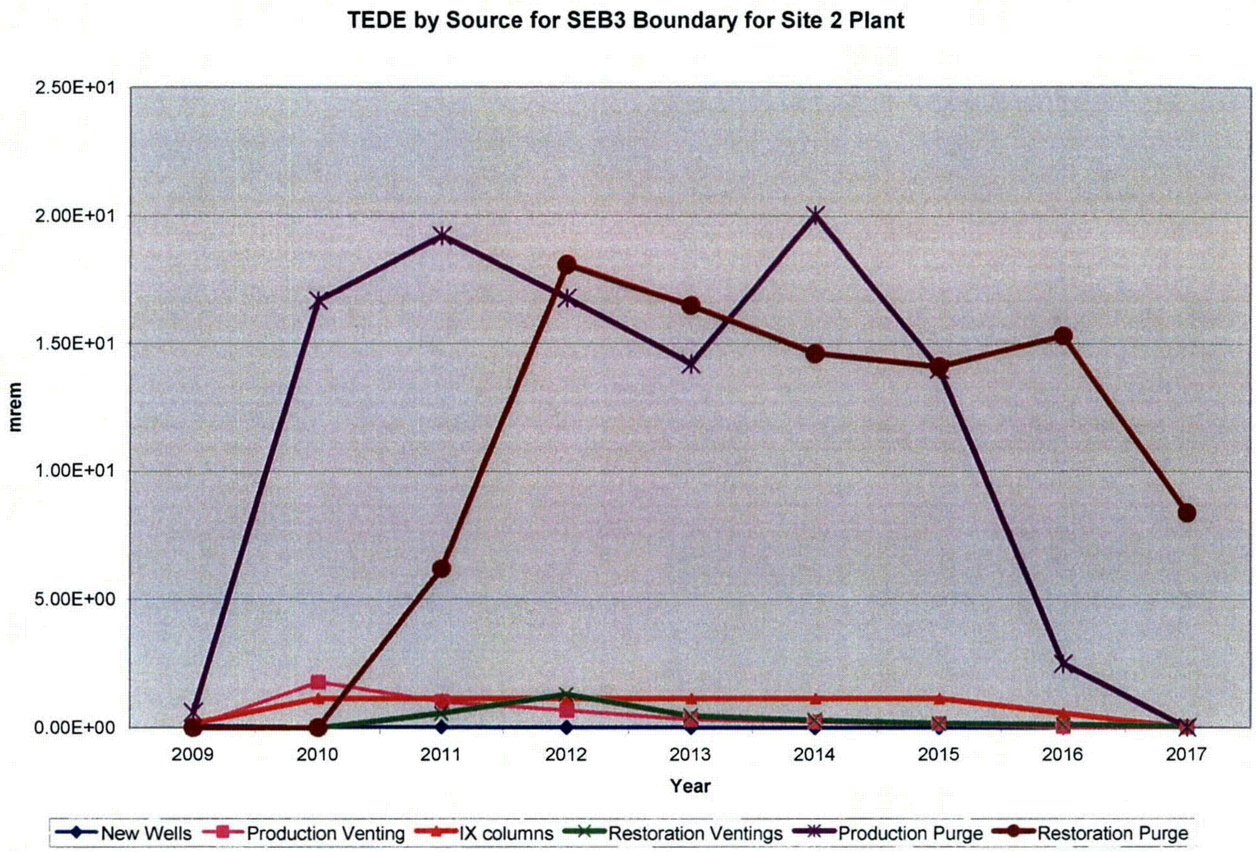


Figure 7 Estimated Dose for SEB3 Receptor Location from Site 2 Plant Location

Potential Radon Releases from Storage Ponds

Two Storage Ponds are proposed for the site. In total, they encompass approximately 1.85 acres (7.5E3 m^2). The ponds will continuously contain water a minimum of one foot deep with a maximum depth of 4 feet. Water contained in the ponds will have a concentration of approximately 950 pCi/L of Ra-226. Potential releases from the ponds were calculated using the web-based Uranium Mill Tailings Radon Flux Calculator (http://www.wise-uranium.org/ctb.html?unit=c) and making conservative assumptions for every parameter.

The calculator is designed to estimate radon flux from either bare or water-covered uranium mill tailings, but input parameters were varied to simulate a pond. It uses the calculations described in Nielson (1986), although this was not verified with the original reference. Key parameters are as follows:

- tailings concentrations: 500 pCi per gram;
- fraction of pond area less than one meter deep: 1.0;
- Average depth of ponds: 0.6 meters;
- Ra-226 concentration in pond water: 951 pCi/L based on analytical data from the site;
- Effective stagnant water transport coefficient: 3E-7 m^2 per second (m^2/s). The web site cites Nielson (1986);
- Pond surface area: 7.5E-3 m^2; and
- Rn-222 effective diffusion coefficient: 1e-10 m^2/s. This is the coefficient for fully saturated soil material, so it is likely adequate to estimate diffusion in water.

Based on the above parameters, the equation estimates a Rn-222 release from the ponds of 1.2 Curies per year (Ci/y). This represents roughly 0.5percent of the annual total that results from the ion exchange columns (224 Ci/y). In terms of dose, this means that doses from the evaporation ponds would represent 0.18 mrem/yr to the maximum receptor if released at the Plant 1 location and 0.06 mrem/yr to the maximum receptor if released at the Plant 2 location. These releases and doses are negligible and were not modeled using MILDOS.

POPULATION DOSES

Using populations as shown in **Table 5** above, population doses (person-rem/yr) from Site 1 releases were calculated for both total effective dose equivalent (TEDE) and the dose to the bronchial epithelium of receptors. Population dose results are summarized in **Table 8**. The maximum estimated annual population dose, 0.13 person-rem within 80 km and 45.6 person-rem to all populations, occurs in 2014 as expected, based on results for individual receptors. While there is no regulatory limit for population dose, it is interesting to compare results in **Table 6** to exposures from natural background. Again using the population data in **Table 5**, and assuming 350 mrem/yr from natural background, the natural background population dose would be approximately 3.1E3 person-rem/yr, or approximately 24,000 times higher than the maximum year of the Project. Population doses from releases from the Site 2 placement of the plant are effectively the same, which is understandable given the minimal change in distance relative to the population distribution.

Table 8 **Dose to populations surrounding the proposed site.**

	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Total Effective Dose Equivalent (person-rem)								
Population within 80 km	3.25E-03	6.40E-02	9.48E-02	1.28E-01	1.25E-01	1.33E-01	1.26E-01	7.29E-02	4.01E-02
Population outside 80 km	1.11E+00	2.18E+01	3.24E+01	4.39E+01	4.27E+01	4.54E+01	4.29E+01	2.47E+01	1.37E+01
All populations	1.11E+00	2.19E+01	3.25E+01	4.40E+01	4.29E+01	4.56E+01	4.30E+01	2.48E+01	1.37E+01
	Bronchial Dose (person-rem)								
Population within 80 km	1.12E-01	2.20E+00	3.26E+00	4.41E+00	4.30E+00	4.56E+00	4.31E+00	2.47E+00	1.37E+00
Population outside 80 km	4.62E+00	9.10E+01	1.35E+02	1.83E+02	1.79E+02	1.90E+02	1.79E+02	1.03E+02	5.73E+01
All populations	4.73E+00	9.32E+01	1.39E+02	1.88E+02	1.83E+02	1.94E+02	1.83E+02	1.06E+02	5.86E+01

OCCUPATIONAL DOSES

Potential annual doses to a worker at the facility were modeled using MILDOS by creating a hypothetical receptor nearby the Site 1 plant. Four locations of the worker were defined by varying the (x,y) coordinates in km as (0.1, 0.1), (0.1, -0.1), (-0.1, -0.1) and (-0.1, 0.1). The hypothetical worker is therefore located 141 meters NE, SE, SW, and NW from the plant. Annual doses were calculated to each worker location, multiplied by 0.22 (2000/8760) and averaged (**Table 9, Figure 8**). Calculated doses peak in 2014 and are well below occupational limits. For the specific locations modeled, these doses likely overestimate worker doses, because MILDOS includes food intake pathways that would not be applicable to the milling facility.

Table 9 Dose to "Worker" Locations Calculated by MILDOS.

	TEDE (mrem/yr)								
Location	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NE (0.1, 0.1, 1)	2.93E+00	5.91E+01	8.77E+01	1.19E+02	1.15E+02	1.23E+02	1.15E+02	6.68E+01	3.70E+01
SE (0.1, -0.1, 1)	3.80E+00	7.65E+01	1.14E+02	1.54E+02	1.49E+02	1.59E+02	1.49E+02	8.63E+01	4.80E+01
SW (-0.1, -0.1, 1)	1.47E+00	2.96E+01	4.39E+01	5.98E+01	5.79E+01	6.18E+01	5.79E+01	3.33E+01	1.85E+01
NW (-0.1, -.1, 1)	8.40E-01	1.70E+01	2.51E+01	3.41E+01	3.30E+01	3.52E+01	3.29E+01	1.90E+01	1.06E+01
Average	2.26E+00	4.55E+01	6.76E+01	9.18E+01	8.90E+01	9.49E+01	8.89E+01	5.14E+01	2.85E+01

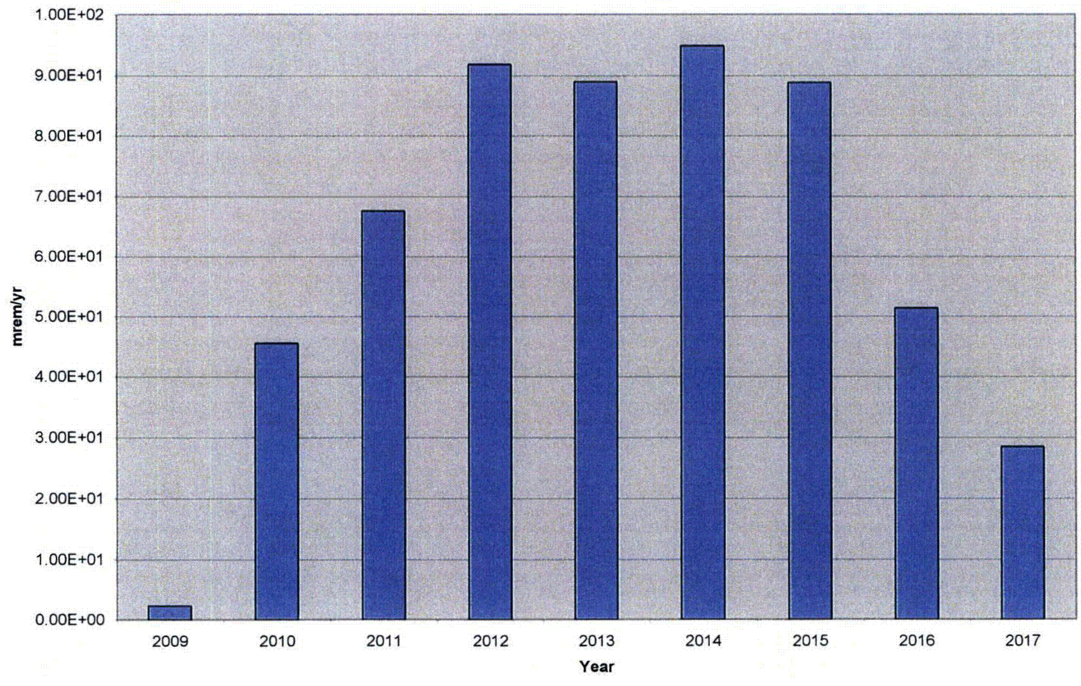


Figure 8 MILDOS-calculated doses to hypothetical worker 140 m from Site 1 Plant Location.

SUMMARY

Results of MILDOS modeling show that north boundary receptors exceed the 10 CFR 20 limit of 100 mrem per year total effective dose equivalent (TEDE) when the plant is placed at the Site 1 location. The Site 2 location results in no boundary point exceeding 40 mrem. In both cases, the majority of the dose comes from releases of purge water at the Ion Exchange plant location during production and restoration.

Because the region is sparsely populated, very little population dose (person-rem/yr) occurs from the plant regardless where it is placed. Background exposures to surrounding populations far exceed contributions from the proposed facility.

Doses to workers from releases at the facility are expected to be far below occupational dose limits and will be monitored during operations as required to provide actual exposure documentation.

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5.0 COST-BENEFIT ANALYSIS

LC ISR, LLC has evaluated the costs and the benefits associated with uranium production in order to formulate the Project. Historically, several companies considered mining uranium within the Permit Area, but the costs outweighed the benefits at that time. However, due to the increased demand for uranium, associated price increase, and improved technologies, LC ISR, LLC believes the benefits now outweigh the costs.

Although the specific amount of yellowcake produced will depend on the market price and the cost of production, LC ISR, LLC anticipates producing about one million pounds of uranium per year. Based on current information and projections, the anticipated life of the Project is eight years. Current demand/supply projections indicate that the price should remain sufficiently high to support the Project over that time frame. With appropriate regulatory approval, the Plant could take loaded resins from other ISR sites in the region, even after the ISR operation at the Permit Area is complete.

5.1 Costs

Since exploratory studies of the Permit Area were commenced in the late 1960's, production methods have been improved to minimize costs. The primary method of producing uranium from deposits such as those in the Permit Area has shifted from conventional open-pit or underground mining to ISR. Open-pit and underground mining require the ores be physically removed from the ground, which would be associated with not only high operating costs (especially with low-grade ores), but also with increased exposure of radioactive materials to the atmosphere and with significant surface disturbance. In contrast, ISR operations lower the operating cost and minimize disturbance by chemically removing the mineral and leaving the matrix surrounding the ore intact. While some alternatives to various steps in ISR operations have been considered for the Project, such as facility locations, the overall costs do not differ substantially with the choice of alternative.

5.1.1 Health and Environmental Costs

LC ISR, LLC proposes the Project for the societal benefit of a uranium supply, knowing that health and environmental costs will be minimized by ISR operations. The health and environmental costs that were evaluated include:

- disturbance of soil and vegetation,
- disturbance to wildlife and wildlife habitat,

- disturbance of hydrogeology,
- use of groundwater,
- depletion of uranium minerals,
- production of waste,
- potential exposure to radioactive material, and
- impact on aesthetics.

The soil, vegetation, hydrology, wildlife, and wildlife habitat will be temporarily disturbed during the Project. These natural resources were characterized during studies of the baseline conditions at the Permit Area, which are summarized in **Section 3** of this report. The resources will be reclaimed to support the approved post-project land use of livestock and wildlife grazing, which is similar to the pre-project land use, in accordance with applicable standards and regulations. Reclamation activities are described in more detail in **Section 1** of this report and **Section 6** of the Technical Report. Because ISR operations are conducted in a series of mine units, which are installed, produced, and reclaimed sequentially, only portions of the Permit Area will be disturbed at a given time.

Inherent to the proposed action, the uranium mineral will be depleted. However, this mineral will provide a source of fuel for producing nuclear energy. Currently, the nation and the public are strongly supporting alternative sources of energy, including nuclear energy, to reduce dependence on foreign petroleum supplies and to reduce carbon emissions. The proposed action will remove uranium, in a safe and controlled manner, from the geological formation in which it naturally occurs. By doing so, the radioactivity of the material associated with uranium will be reduced. This will improve the health of humans and the environment that may otherwise be exposed to the ores.

Groundwater will serve as a tool to recover uranium. Groundwater will be: pumped from the production wells in the ore zone; oxidized by the addition of lixiviant (a bicarbonate-based solution); re-introduced to the ore zone through the injection wells; recovered from the production wells; treated at the Plant for removal of uranium; and circulated through this system again and again. Ultimately, the majority of the water will be restored and returned to the aquifer containing the ore zone. A fraction of the groundwater will be consumed as waste. This fraction of consumed groundwater will be minimized by concentrating the waste through multiple wastewater treatments where feasible.

Various types of wastes will be produced from the Project. These wastes may be categorized as domestic sewage, non-radiological wastes, and radiological wastes. Materials will be decontaminated or treated to reduce the volume of waste. Radiological waste will be removed from the Permit Area and disposed at an NRC-licensed facility or will be disposed of in a UIC Class I well, depending on the type of waste, in accordance with current NRC regulations. All other wastes will also be disposed of according to the applicable local, state, and federal regulations.

Exposures to radioactive materials were estimated using results from the radiation survey and the MILDOS model. Estimated public exposure to radioactive materials is negligible due to the remote location of the Permit Area, the nature of ISR operations, and the ore processing technologies. Occupational exposure will be reduced or eliminated by providing the proper training, guidance, and PPE to safely handle, store, decontaminate, and/or dispose waste materials.

Interference with other uses of the Permit Area will be limited due to the lack of development in the area and the reclamation requirements. For example, due to limited development of groundwater in the area to date, minimal impact to other water users outside the Permit Area is anticipated. As another example, hunting will be restricted at the Permit Area during production and reclamation to reduce safety concerns; but in the long term, hunting access will be improved due to road construction and maintenance. To ensure that future users of the Permit Area are aware of the presence of abandoned wells, a deed notice of the mine unit locations will be required. Any decreases in aesthetics at the Permit Area, such as increased noise, will be minimal due to the remoteness of the Permit Area, the nature of ISR operations, improved technologies, and required reclamation. In addition, the activities at the Permit Area, such as well installation, are similar to the activities associated with other extractive industries in the region (e.g., oil and gas drilling).

There is no difference in health and environmental costs between the Preferred Alternative and the Other Alternatives considered for the Project.

5.1.2 Internal Costs

In order to quantitatively compare the costs to the benefits of the Project, internal and external costs were estimated. Internal costs impact LC ISR, LLC and cover the construction, operation, and reclamation phases of the Project.

The primary internal costs will 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 5.1-1**. Because of the sequential development of mine units during ISR operations, some of the facility construction costs are distributed throughout the life-of-Project rather than concentrated during the initial Project development.

There is no significant difference (if any) in total internal project costs between the Preferred Alternative and the Other Alternatives considered for the Project.

5.1.3 External costs

External costs impact the local economy and include the services and resources of the neighboring communities. The primary external costs will affect:

- housing;
- public facilities and services;
- historic, scenic, and recreational resources; and
- natural and material resources.

As with the internal costs, some of the external costs are distributed throughout the life of the Project due to the nature of ISR operations, rather than concentrated during the initial Project development.

Impacts to housing availability are expected to be dispersed because of the remoteness of the Permit Area, the relatively small number of the workforce (both on payroll and on contract), and the progressive nature of construction and reclamation in the Permit Area. In addition, short-term, overnight housing may also be provided in the remote Permit Area. (Some drillers prefer long workdays to take advantage of daylight and good weather. During production, personnel will be on-site 24 hours per day.) Because of energy-related projects throughout Wyoming, workforce and housing availability has become a critical factor in some locations. However, in response, state and local agencies have been assisting industries and communities to address these issues.

The costs associated with increased demand of public facilities and services are expected to be minimal. Water supply and some waste disposal facilities will need to be developed by the operator of the Project, because of the lack of such facilities in the vicinity of the Permit Area. (The nearest population center, Bairoil, is about 15 miles to the northeast.) The relatively small increase in the workforce will not overtax education and health resources. 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. Representatives from LC ISR, LLC met with the Sweetwater County commissioners on October 16, 2007. LC ISR, LLC described the operations and schedule of the Project to the commissioners and answered related questions. Additional public consultation is planned.

Historic, scenic, and recreational resources within the Permit Area were identified during studies of the baseline conditions, as summarized in **Sections 3.9** and **3.10** of this report. Of the historical sites identified in the Permit Area, only one has the potential for being disturbed by future mine unit development activities. Mitigation plans for sites of historical significance are described in **Section 4.8** of this report. The limited presence of local residents and/or regular visitors, lack of roads, and austere topography reduces the number of people who might be impacted by noise or facility visibility. The construction equipment and facilities in the landscape (e.g., drilling rigs, header houses and the Plant) are of limited height and will not be visible to bypassing travelers on any major roads. In addition, reclamation is required once the facilities are decommissioned. As noted earlier, hunting, which is the primary recreational activity, will be restricted for safety reasons during operations, but will not be permanently affected, and may be improved due to wildlife habitat reclamation and improved transportation routes.

During the implementation of the Project, natural and material resources will be used. The natural resources include uranium and groundwater. The goal of the Project is to maximize uranium recovery; thus, uranium will be depleted. Groundwater will be used as a medium to extract the uranium; the Project is designed to re-use the groundwater as much as possible and limit losses to waste. Material resources needed for the Project include a variety of industrial products such as automotive fluids, building materials, well casing, piping, and cement, as well as energy. Processing chemicals will also be needed, although most of these are relatively benign.

There is no difference in external costs between the Preferred Alternative and the Other Alternatives considered for the Project.

5.2 Benefits

Outside of the economic benefits to the operator, the estimated community benefits resulting from the Project are shown in **Table 5.2-1**. The local communities within Sweetwater County will benefit economically from the Project development, construction, and operation because of employment opportunities, including skilled jobs on the Project and an improved tax base for other local jobs. The economic benefit of expenditures related to the Project will magnify as funds are dispersed throughout the communities. Approximately 70 to 90 individuals (including both full-time employees and subcontractors) will be employed during the Project. Local businesses will also be subcontracted for many services, such as drilling, and will employ additional individuals. Domestic supplies and equipment will be purchased from local vendors.

The local, state, and federal governments will receive various revenues from employee income taxes, severance taxes, ad valorem taxes, and sales taxes. The estimated benefit from taxes is shown in **Table 5.2-1**.

In addition to the specific, tangible Project benefits, the Project also provides more diverse benefits. For example, regional recreation may be enhanced following the reclamation of the disturbed area, because of improved access and the reclamation of the Permit Area to wildlife and livestock grazing. As another example, due to the remoteness and low population of the Great Divide Basin in which the Project is located, the baseline studies and monitoring associated with the Project have greatly increased the information available on natural resources. Required monitoring during the Project will continue to provide scientific data about this basin.

The Project will support energy-independent and environment-friendly policies. The uranium production will assist to supply a reliable, economical, domestic source of uranium while applying new technologies to minimize disturbance. The Project will also help offset the deficit in annual domestic uranium production and help meet increasing energy demands. Between 1989 and 2003, annual domestic uranium production decreased by 75 percent. The US produces about two percent of the world uranium, while it consumes over 25 percent of the total production. As of 2006, the world produced just over 50 percent of the annual consumption of U_3O_8. The gap between demand and supply has been filled by stockpiles and uranium from non-traditional sources (e.g., dilution of weapon-grade uranium). There are concerns about the long-term availability of uranium from non-traditional sources. The Project, once in full-scale production, will add 1,000,000 pounds of U_3O_8 per year to the market. With appropriate regulatory approval, the processing facilities could also take loaded resins from other ISR sites in the region, even after the ISR operation is complete in the Permit Area.

There is no difference in the benefits between the Preferred Alternative and the Other Alternatives considered for the Project.

Table 5.1-1 Estimated Project Costs

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

Table 5.2-1 Estimated Project Benefits

Item	Present Worth [1] (US dollars x 1,000)
Taxes	73,000
Employment	32,505
Supplies and equipment	56,306
Services	36,493
Improved recreation	43
Improved roads	57
Environmental studies and monitoring	2,000

[1] Assumptions: 58 employees, ten contract drill rigs (3 contractors for each rig) per construction year, and a realized sales price of 60.00 US dollars per pound U_3O_8

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6.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Table 6.0-1 presents the Summary of Environmental Consequences by topic (e.g., Land Use), in the same order as topics are presented in **Sections 3** and **4** of this report.

For each topic, the anticipated impacts during construction and operation of the Project are summarized, based on the Project operation plans outlined in **Section 1** of this report, and described in more detail in **Section 3** of the Technical Report for this project. Monitoring programs are also summarized, based on the programs described in **Section 4** of this report, and described in more detail in **Sections 3 and 5** of the Technical Report. Mitigation plans are summarized from the groundwater restoration and surface reclamation requirements outlined in **Section 1** of this Environmental Report and described in more detail in **Section 6** of the Technical Report.

In general, there are few unavoidable long-term environmental consequences; primarily because of existing federal and state requirements on groundwater restoration and surface reclamation, which have been in place for a number of years. The primary consequences are the changes in the groundwater conditions of the ore zones that are produced, including the oxidation/reduction conditions and the water levels. However, because adequate characterization of the ore zones is essential for efficient operations and best ore recovery and because of requirements for groundwater restoration, the changes in water quality are mitigated to a considerable extent. Assessment of existing and reasonably foreseeable water uses, evaluation of drawdown and recharge rates, and efficient production and restoration provide opportunities to mitigate any adverse impacts from water level changes. In addition, ISR operations continue to improve the understanding of the processes and impacts of ISR. In many instances, such as the Project, the groundwater monitoring data collected during the operation, provides the only information on the depth(s) and extent of uranium ore zones, their natural impact on water quality, and the water resources of the area.

Table 6.0-1 addresses all of the alternatives described in **Section 2** of this report. Because the consequences from the Preferred Alternative and the Other Alternatives are essentially the same, the table is divided into only two columns. The first column includes information related to all of the alternatives other than the No-Action Alternative; and the second column includes information related to the No-Action Alternative.

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Land Uses	
<u>Construction Impacts</u> *Some reduction in grazing capacity due to installation of roads and facilities.*	*Current land uses, including stock and wildlife grazing, seasonal hunting, and increased drilling activities for oil/gas/other mineral resources are not expected to change.*
<u>Operational Impacts</u> *Some reduction in grazing capacity due to use of roads and facilities. Limitations on seasonal hunting to protect workers, prevent damage to facilities, and provide security. Any drilling for oil/gas/other mineral resources will need to be carefully coordinated to prevent damage to facilities, including wells and pipelines and prevent interference with uranium production.*	
<u>Monitoring and Mitigation</u> *No specific monitoring of land uses is required, but periodic inspections, annual reports, and 5-year permit review required by WDEQ-LQD will allow for evaluation of significant changes in land use in the general area.* *Impacts, which are expected to be minimal, will be mitigated by reclamation/ restoration of the Permit Area. These activities will include tasks such as well plugging and vegetation re-establishment in accordance with criteria for the approved post-production land uses.*	
<u>Unavoidable Environmental Consequences</u> *Limited due to requirements for reclamation/restoration to established criteria for the post-project land uses specified in the approved reclamation plan. Future drilling for water, oil, or gas or site excavation will need to take into account presence of abandoned wells at the site, but the presence of the wells will be recorded through a deed notice per WDEQ-LQD requirements.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Transportation	
Construction Impacts *Impacts will not be significantly greater during construction than during operation, since mine units (with associated increased rig and truck supply traffic) are generally installed sequentially. Primary on-site impacts will be construction of a variety of access roads. Off-site impacts will include slightly increased traffic, although anticipated vehicle size and weight (e.g. drilling rigs and haul trucks) should not differ significantly from current use.*	*Current transportation options, primarily paved and dirt roads, are not expected to change other than upgrades and regular maintenance to existing traffic routes.*
Operational Impacts *Primary on-site impacts will be road use, which will require maintenance of the roads, culverts, and related items. Primary off-site impacts will be slightly increased traffic. Containers used for transport of yellowcake slurry will be designed to prevent spills during reasonably foreseeable accidents, but the weight and length of the transport trucks will not differ from typical trucks. Transportation of hazardous materials will be limited.*	
Monitoring and Mitigation *No specific transportation monitoring will be required, but periodic inspections required by NRC and WDEQ-LQD will allow for evaluation of transportation impacts.* *Mitigation efforts will include: optimizing on-site road networks; constructing roads to weather varying conditions (e.g., snowmelt); avoiding 'driving around' trouble spots such as muddy spots, potholes; and providing program on work procedures and safety for employees and contractors. Reasonable steps will also be taken to ensure transporters are properly licensed, equipped, and staffed.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Transportation (cont'd)	
Unavoidable Environmental Consequences *Limited due to requirements for identification of those roads that will be removed/reclaimed to established criteria after production is complete and identification of those roads that will remain to support the approved post-project land use.*	
Soils	
Construction Impacts *Soil compaction due to construction trafficking, erosion due to disturbance, or loss due to building placement.*	*No assessment of the soils in this portion of the Great Basin was available prior to initiation of baseline data collection for this project.*
Operational Impacts *Potential contamination from spills, soil compaction from operational trafficking.*	
Monitoring and Mitigation *Baseline assessment of soil resources throughout the Permit Area and in more detail in each mine unit will result in site-specific protection measures, including: stripping where necessary (e.g., plant site, roads, and mud pits for wells); marking short-term topsoil stockpiles; and constructing long-term stockpiles with adequate erosion protection. Reclamation will be staged during all phases of the construction and operation. Areas that are temporarily disturbed will be restored and reseeded immediately after disturbance.* *Operational monitoring will include periodic checks of topsoil stockpiles for undue erosion. Procedures will also be in place for spill response. Requirements for reclamation/restoration to established criteria for the post-project land uses specified in the approved reclamation plan will result in replacement of any stripped topsoil.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Soils (cont'd)	
Unavoidable Environmental Consequences *Limited due to requirements for topsoil protection during construction & operation, and for topsoil replacement & vegetation re-establishment in accordance with approved reclamation plan.*	
Geology	
Construction and Operational Impacts *None foreseeable.*	*Subsurface information for the Great Basin in Wyoming is generally somewhat limited and data collection efforts are generally limited except for exploration work associated with projects such as this.*
Monitoring and Mitigation *Not required.*	
Unavoidable Environmental Consequences *None foreseeable.*	
Hydrology – Surface Water	
Construction Impacts *The lack of surface water in the Permit Area significantly reduces the potential for impacts. Facility and road construction and well installation could result in disturbance to existing drainage patterns and an increased sediment load in runoff if appropriate procedures are not followed for installation of culverts and protection of areas which have been stripped of topsoil or in which vegetation has been disturbed.*	*Information on surface water quantity and quality in the Great Divide Basin is generally limited, particularly due to the limited number of major drainages, and data collection efforts are generally limited.*

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Hydrology – Surface Water (cont'd)	
Operational Impacts *Impacts will not be significantly greater during construction than during operation, since mine units (with associated increased rig and truck supply traffic) are generally installed sequentially. In addition to the limited occurrence of surface water, there are no surface water rights in and around the Permit Area that could be impacted.*	
Monitoring and Mitigation *Baseline assessment of surface water quantity and quality throughout the Permit Area and in more detail in each mine unit allows for development of site-specific surface water protection measures, including: installation of culverts; sediment ponds; and other facilities that may be necessary to minimize erosion.* *Operational monitoring will include continuation of surface water quantity and quality monitoring as necessary. However, the only surface water at the site is ephemeral flow in response to stormwater runoff and snowmelt. Procedures will also be in place for spill response.*	
Unavoidable Environmental Consequences *Limited due to lack of surface water and low topographic relief in Permit Area. In addition, requirements for surface water monitoring as necessary, proper construction, maintenance, and reclamation of roads and facilities in accordance with approved operation and reclamation plans will minimize any potential consequences.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Hydrology – Ground Water	
<u>Construction Impacts</u> *Exploration drilling and well installation will impact ground water quantity slightly due to use of ground water. Ground water quality could be impacted due to introduction of drilling mud and potential for connection of aquifers.* <u>Operational Impacts</u> *In situ recovery, by definition, changes the water quality in the ore zone, in particular the oxidation/reduction conditions, and mobilizes uranium by introducing lixiviant (bicarbonate solution) and circulating it through the aquifer. Impacts to ground water quantity are limited due to re-use of the water, and <1.5% of the water in the ore zone is generally removed to help ensure the production fluids do not migrate from the ore zone. Ground water restoration after production is designed to re-establish the pre-production ground water class of use, as defined by WDEQ/WQD. The 1st restoration phase, ground water sweep, may require removal of an equivalent quantity of water to that in the ore zone. The later phases of restoration have less impact on ground water quantity and are designed to re-establish oxidation/reduction conditions and precipitate metals that may have been mobilized during production.* <u>Monitoring and Mitigation</u> *Baseline assessment of water quantity and quality has been essential for design of efficient production, including choosing appropriate lixiviants, design of production/ injection well patterns and monitoring programs, and selecting optimal pumping rates. Review of existing water rights has also provided information for determining if mitigation measures are necessary.*	*Information on ground water quantity and quality in the Great Divide Basin is generally limited, despite the presence of significant quantities of ground water in the Basin, and data collection efforts are generally limited.* *At present, there are no federal or state restrictions on water quality for private wells in Wyoming, although some guidelines exist. Also, there are no regulatory requirements for sampling private wells prior to use. There are guidelines provided, but these generally do not cover radionuclides, except in areas where near-surface natural radon emissions may impact building use. Occasionally, a lending institution may require sampling, but again, radionuclides are often not covered.*

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Hydrology – Ground Water (cont'd)	
Monitoring and Mitigation (cont'd) *During operation and restoration, regular monitoring of wells within and around each mine unit, and in overlying and underlying aquifers, will be conducted to ensure there has not been any movement of lixiviant outside the ore zone and to determine production or restoration progress. In addition, production and injection rates and volumes will be balanced to help ensure the lixiviant circulation is within the ore zone. Well integrity testing will also be conducted, and all drill hole and well plugging will be done in accordance with applicable requirements. In addition, water levels will be monitored in wells outside the Permit Area that could be impacted by operations, based on projected drawdowns. If necessary, alternate water sources will be obtained for those well users should water levels decline sufficiently to interfere with adequate supply.*	
Unavoidable Environmental Consequences *Economic incentives for efficient production and regulatory requirements for ground water restoration help reduce impacts. In Wyoming, the restoration requirements are to return ground water quality to that commensurate with the uses for which the water could have been used before production. Removal of the uranium may even result in improved post-production water quality, due to the reduction in radionuclides, if production and restoration are conducted efficiently. Based on restoration progress at other ISR operations in Wyoming, long-term changes in ground water quality are generally limited to elevated concentrations of one or two parameters compared to pre-production concentrations. A deed notice of the mine unit boundaries also is required to help ensure future subsurface activities, such as drilling of oil and gas wells, can avoid interference with the abandoned drill holes and wells.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Ecological Resources – Vegetation	
<u>Construction Impacts</u> *Facility and road construction and well installation will result in removal of vegetation in specific, limited portions of the Permit Area.*	*Current vegetation communities are not expected to change except in response to change in other site characteristics, such as land use or transportation routes.*
<u>Operational Impacts</u> *Minimal, especially if monitoring and maintenance traffic stays on designated routes.*	
<u>Monitoring and Mitigation</u> *Baseline assessment of vegetation communities throughout the Permit Area and in more detail in each mine unit allows for identification of areas where disturbance should be prevented or minimized, but no such areas have been found to date. In addition, the disturbance will not impact either of the vegetation communities present on-site disproportionately. The baseline assessment also allowed for design of a reclamation seed mix suited for site conditions and usage.* *During operations, weed control and erosion protection will reduce the potential for adverse impacts to existing vegetation.* *During reclamation, proper seed bed preparation and seeding practices, weed control, grazing control on newly reseeded areas, and monitoring of the seed expression and plant growth will allow for vegetation re-establishment to complement existing conditions.*	
<u>Unavoidable Environmental Consequences</u> *Limited due to requirements for minimizing disturbance during mine unit installation, for establishing traffic patterns during operations, for weed control, and for topsoil replacement and vegetation re-establishment in accordance with approved reclamation plan.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Ecological Resources – Aquatic Life and Wetlands	
The baseline field investigations indicate aquatic life and wetlands do not exist within the Permit Area; therefore, there will be no impacts to aquatic wildlife and wetlands.	
Ecological Resources - Wildlife	
<u>Construction Impacts</u> *Facility and road construction and well installation will disturb wildlife in specific, limited portions of the Permit Area, such as the facilities area.*	*Current wildlife communities are not expected to change except in response to change in other site characteristics, such as land use or transportation routes.*
<u>Operational Impacts</u> *Outside of the facility area, the structures and equipment at ISR facilities do not generally interfere with wildlife and often provide additional cover. Monitoring and maintenance traffic may impact wildlife.*	
<u>Monitoring and Mitigation</u> *Baseline assessment of the species and their use of the Permit Area (e.g., feeding, nesting, cover, and/or migration route) allows for development of site-specific protection measures, and regulatory requirements in place at the time of construction and operations, such as timing restrictions on drilling and related activities will be implemented. For reclamation, use of a seed mix reflective of pre-project conditions will help develop post-project habitat.* *Monitoring will include periodic assessment of wildlife for comparison with baseline conditions.*	
<u>Unavoidable Environmental Consequences</u> *Limited due to requirements for reclamation to established criteria for the post-project land uses specified in the approved reclamation plan.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Air Quality	
Construction Impacts *Facility and road construction and well installation will generate dust and engine emissions from equipment.*	*Current dust contributions from travel on dirt roads, and emissions from heavy equipment and drilling operations (e.g. uranium exploration by other operators) will continue.*
Operational Impacts *Similar to impacts during construction, plus the emission of radon during processing. Radon emissions are discussed in more detail under Public and Occupational Health. Radionuclide particulates are not anticipated because no yellowcake dryer will be used on-site and because the Storage Ponds will be kept wet.*	
Monitoring and Mitigation *Baseline assessment of meteorological conditions allows for development of site-specific air quality protection measures. The primary protection measure for dust will be wetting of roads with water or chemical dust suppressants (such as magnesium chloride which is commonly used at mines in Wyoming) as necessary. The primary protection measure for engine emissions will be proper engine maintenance. Limitations for road use on an as-needed basis, speed limits, and similar measures will also help reduce dust and engine emissions. Radon emissions are discussed in more detail under Public and Occupational Health.*	
Unavoidable Environmental Consequences *Limited due to mitigation requirements.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Noise	
Construction and Operational Impacts *Temporary increase due to construction activities, but noise will be similar to that present during on-going exploration activities.* Monitoring and Mitigation *None considered necessary.* Unavoidable Environmental Consequences *None anticipated.*	*Current noise contributions from truck traffic, heavy equipment, and drilling operations (e.g., uranium exploration by other operators) will continue.*
Historic and Cultural Resources	
Construction and Operational Impacts *None anticipated due to requirements for baseline delineation of historic and cultural resources, including determination of specific resource sites for which mitigation will be necessary prior to any disturbance. Baseline studies indicate only a limited number of sites within the Permit Area, and of those sites, prevalence of relatively modern, industrial artifacts (e.g., old mineral exploration artifacts) rather than older archeological and paleontological artifacts. In addition, the operator will request that all resource information will be held confidential by reviewing regulatory agencies to avoid providing information to the public that could lead to unauthorized disturbance of the resource sites.*	*Possible inadvertent or intentional disturbance or destruction of sites because sites are not fenced or otherwise protected.*

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Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Historic and Cultural Resources (cont'd)	
Monitoring and Mitigation *Mitigation plans for resource sites specified by the State Historic Preservation Office (SHPO), after their review of the baseline resource survey, will be developed by the operator and approved by SHPO as part of the permit application process. After mitigation, the operator must submit a report to SHPO identifying the steps taken in accordance with the approved plan. Based on current plans, only a limited number of sites are present within the Permit Area and of those, only two or three may require mitigation.*	
Unavoidable Environmental Consequences *Limited due to requirement for baseline assessments and mitigation plans for any sites determined to be of particular significance by SHPO.*	
Visual/Scenic Resources	
Construction and Operational Impacts *Minimal due to: 'wide-open' spaces; limited presence of local residents and/or regular visitors to the area who might be affected; similarity of existing 'intrusions' on the landscape (e.g., drilling rigs and compressors) to those in the Permit Area; and limited height of Process Plant.*	*None.*
Monitoring and Mitigation *None considered necessary.*	
Unavoidable Environmental Consequences *None anticipated.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Socioeconomic Impacts	
Construction and Operational Impacts *Increased employment opportunities and corresponding increase to tax base, but limited work force and infrastructure such as housing may strain existing resources. Compared to other development projects in the region, the Lost Creek Project will employ relatively few workers, and the majority of those will need to be skilled.*	*Continued strain on existing infrastructure due primarily to increased oil and gas development, but also due to increased tourism and public land use for a variety of activities (e.g., hunting and off-road recreational vehicles).*
Monitoring and Mitigation *Communication with state and local agencies evaluating socioeconomic conditions.*	
Unavoidable Consequences *No disproportionate consequences are anticipated.*	
Public and Occupational Health	
Construction Impacts *Typical of those for any construction site and primarily related to mechanical health and safety issues, such as working on drilling rigs and driving heavy equipment.* Operational Impacts *Primarily related to mechanical health and safety issues. Radon emissions associated with the uranium processing will be vented from any enclosed spaces, such as Header Houses and the Process Plant.*	*Current public and occupational health concerns are primarily mechanical health and safety issues typical of the extractive industries, including oil and gas drilling and coal mining, in Wyoming.*

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Public and Occupational Health (cont'd)	
<u>Monitoring and Mitigation</u> *Worker education and training for all workers, designation of areas in which only those workers with additional education and training on radionuclides may enter, and health and air monitoring targeted to the work areas. Preparation for reasonably foreseeable accidents, including mechanical accidents and those accidents with potential chemical releases to the environment. Calculation of radon emissions from uranium processing and designation of restricted areas based on calculations and other factors which require restricted access. Analysis of dose consequences from reasonably foreseeable accidents.*	*Exposure rates to naturally occurring radioactivity are relatively high in the region due to the geologic conditions.*
<u>Unavoidable Consequences</u> *None anticipated, especially as exposure rates to naturally occurring radioactivity far exceed projected radon emissions from the project.*	
Waste Management	
<u>Construction Impacts</u> *Other than removal of trash typically associated with construction and drilling projects, no additional waste management impacts are anticipated.*	*None.*
<u>Operational Impacts</u> *Trash typically associated with mine operations, e.g., office waste, will be collected for disposal at a landfill. Sewage will be disposed of in septic system. Storage Ponds, will provide for storage of waste water from uranium processing prior to disposal in UIC Class I wells and will be constructed with leak detection system to reduce possibility of impacts. Use of UIC Class I wells will change quality and pressure in the injection formation.*	

Table 6.0-1 Summary of Environmental Consequences – Lost Creek In Situ Recovery Project	
Preferred Alternative and Other Alternatives (Section 2.0)	**No Action Alternative**
Waste Management (cont'd)	
Monitoring and Mitigation *Regular inspection of waste storage areas and review of waste disposal practices to ensure proper containers, labels, storage, and segregation. Reasonable efforts to ensure any contracted waste haulers are properly licensed, equipped, and staffed. Regular inspection of piping systems used to route waste water. For Storage Ponds, regular inspection of liner and leak detection system. Installation of system to discourage birds from pond area if necessary. During reclamation, disposal of any pond sludge, liner, impacted material under the ponds, and associated equipment as 11(e)(2) byproduct material, and revegetation of the pond site in accordance with approved reclamation plan. For the UIC Class I wells, baseline assessment of water quantity and quality to determining operating pressures and waste compatibility and to ensure selected injection formation provides for appropriate waste isolation. During operation, monitoring of injection rates and pressures, and periodic well integrity testing. Well plugging after wells no longer needed.*	
Unavoidable Environmental Consequences *None anticipated except for changes to the quality and pressure in the injection formation.*	

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