U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1910, Vol. 2

Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities

Chapters 5 through 12 and Appendices A through F

Draft Report for Comment

Office of Federal and State Materials and
Environmental Management Programs

Wyoming Department of Environmental Quality
Land Quality Division

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U.S. Nuclear Regulatory Commission
Office of Federal and State Materials and Environmental Management Programs

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) has prepared a Draft Generic Environmental Impact Statement (Draft GEIS) to identify and evaluate potential environmental impacts associated with the construction, operation, aquifer restoration, and decommissioning of *in-situ* leach (ISL) uranium recovery facilities for identified regions in the western United States. Based on discussions between uranium mining companies and the NRC staff, ISL facilities could be located in portions of Wyoming, Nebraska, South Dakota, and New Mexico. NRC is the licensing authority for ISL facilities in these states.

NRC developed this Draft GEIS using (1) knowledge gained during the past 30 years licensing and regulating ISL facilities, (2) the active participation of the State of Wyoming Department of Environmental Quality as a cooperating agency, and (3) public comments received during the scoping period for the GEIS. NRC's research indicates that the technology used for ISL uranium recovery is relatively standardized throughout the industry and therefore appropriate for a programmatic evaluation in a GEIS.

As a framework for the analyses presented in this GEIS, NRC has identified four geographic regions based on

- Past and existing uranium milling sites are located within States where NRC has regulatory authority over uranium recovery;
- Potential new sites are identified based on NRC's understanding of where the uranium recovery industry has plans to develop uranium deposits using ISL technology; and
- Locations of historical uranium deposits within portions of Wyoming, Nebraska, South Dakota, and New Mexico.

The purpose behind developing the GEIS is to improve the efficiency of NRC's environmental reviews for ISL license applications required under the National Environmental Policy Act of 1969, as amended (NEPA). NRC regulations that implement NEPA and discuss environmental reviews are found in Title 10, "Energy," of the Code of Federal Regulations (10 CFR) Part 51. The NRC staff plans to use the GEIS as a starting point for its NEPA analyses for site-specific license applications for new ISL facilities. Additionally, the NRC staff plans to use the GEIS, along with applicable previous site-specific environmental review documents, in its NEPA analysis for the restart or expansions of existing facilities.

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EXECUTIVE SUMMARY

PURPOSE AND NEED

NRC prepared this Draft Generic Environmental Impact Statement (Draft GEIS) to identify and evaluate the potential environmental impacts associated with the construction, operation, aquifer restoration, and decommissioning of *in-situ* leach (ISL) uranium recovery facilities. Based on discussions between uranium mining companies and the NRC staff, these facilities potentially could be located in portions of Wyoming, Nebraska, South Dakota, and New Mexico, which are States where NRC has regulatory authority over the licensing of uranium recovery facilities. Given that the large majority of these potential license applications would involve use of the ISL process and would be submitted over a relatively short period of time, NRC decided to prepare a GEIS to support an efficient and consistent approach to reviewing site-specific license applications for ISL facilities. The NRC staff plans to use the GEIS as a starting point for its National Environmental Policy Act (NEPA) analyses for site-specific license applications for new ISL facilities. Additionally, the NRC staff plans to use the GEIS, along with applicable previous site-specific environmental review documents, in its NEPA analysis for the restart or expansions of existing facilities.

Uranium milling techniques are designed to recover the uranium from uranium-bearing ores. Various physical and chemical processes may be used, and selection of the uranium milling technique depends on the physical and chemical characteristics of the ore deposit and the attendant cost considerations. Generally, the ISL process is used to recover uranium from low-grade ores or deeper deposits that are not economically recoverable by conventional mining and milling techniques. In this process, a leaching agent, such as oxygen with sodium carbonate, is injected through wells into the subsurface ore body to dissolve the uranium. The leach solution is pumped from there to the surface processing plant and then ion exchange separates the uranium from the solution. After additional purification and drying, the uranium in the form of U_3O_8 (also known as "yellowcake") is placed in 55-gallon drums prior to shipment offsite.

THE PROPOSED FEDERAL ACTION AND ALTERNATIVES

In States where NRC is the regulatory authority over the licensing of uranium milling (including the ISL process), NRC has a statutory obligation to assess each site-specific license application to ensure it complies with NRC regulations before issuing a license. The proposed federal action is to prepare a GEIS that identifies and evaluates the potential environmental impacts associated with the construction, operation, aquifer restoration, and decommissioning of ISL milling facilities in portions of Wyoming, Nebraska, South Dakota, and New Mexico. As stated above, NRC intends to make use of the GEIS during subsequent site-specific ISL licensing actions.

A range of alternatives to the proposed action was evaluated for inclusion in the Draft GEIS. The No-Action alternative was included in the detailed impact analysis. In the No-Action Alternative, no ISL facilities would be licensed, and therefore constructed and operated, in the four uranium milling regions considered in this Draft GEIS. The environment in these regions would not be affected by uranium extraction, although other ongoing and future non-ISL activities would continue as planned.

Alternative methods for milling uranium were considered as possible alternatives to the ISL process. As stated previously, not all uranium deposits are suitable for ISL extraction. For example, if the uranium mineralization is above the saturated zone (i.e., all of the pore spaces in the ore-bearing rock are not filled with water) ISL techniques may not be appropriate. Likewise, if the ore is not located in a porous and permeable rock unit, it will not be accessible to the leach solution used in the ISL process. Because ISL techniques may not be appropriate in these circumstances, conventional mining (underground or open-pit/surface mining) and milling techniques (e.g., heap leaching) are possible viable alternative technologies.

Inasmuch as the suitability and practicality of using alternative milling methodologies depends upon site-specific conditions, a generic discussion of alternative milling methodologies is not appropriate. Accordingly, this Draft GEIS does not contain a detailed analysis of alternative milling methodologies. A detailed analysis of alternative milling methodologies that can be applied at a specific site will be addressed in NRC's site-specific environmental review for individual ISL license applications.

In addition, it should be noted that previous analyses have indicated that the potential environmental impacts associated with conventional uranium milling operations are significant, because the mill tailings, or waste, are a significant source of radon and radon progeny. For this reason, NRC has made a policy decision to prepare site-specific EISs for applications for a new, or restart of a former, conventional or heap leach facility, as required under 10 CFR 51.20(b)(8).

APPROACH

NRC developed this Draft GEIS, based on NRC's experience in licensing and regulating ISL facilities gained during the past 30 years. In the Draft GEIS, NRC does not consider specific facilities, but rather provides an assessment of potential environmental impacts associated with ISL facilities that might be located in four regions of the western United States. These regions are used as a framework for discussions in this Draft GEIS, and were identified based on several considerations, including:

- Past and existing uranium milling sites are located within States where NRC has regulatory authority over uranium recovery;
- Potential new sites are identified based on NRC's understanding of where the uranium recovery industry has plans to develop uranium deposits using ISL technology; and
- Locations of historical uranium deposits within portions of Wyoming, Nebraska, South Dakota, and New Mexico.

Using these criteria, four geographic regions were identified (Figure ES–1). For the purpose of this Draft GEIS, these regions are titled

- Wyoming West Uranium Milling Region;
- Wyoming East Uranium Milling Region;
- Nebraska-South Dakota-Wyoming Uranium Milling Region; and
- Northwestern New Mexico Uranium Milling Region.

The foundation of the environmental impact assessment in the Draft GEIS is based on (1) the historical operations of NRC-licensed ISL facilties and (2) the affected environment in each of the four regions. The structure of the GEIS is presented in Figure ES–2.

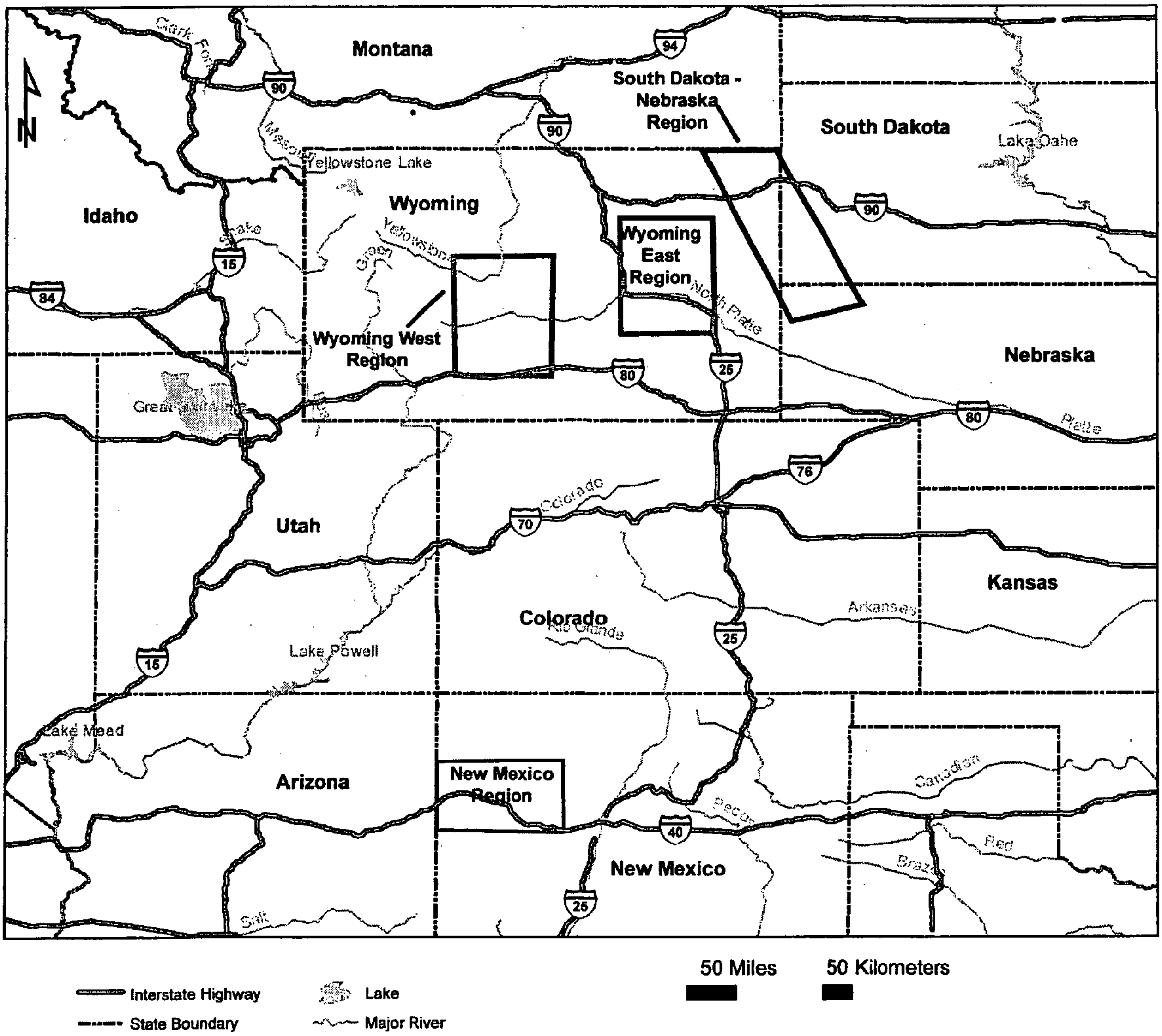

Figure ES–1. Location of Four Geographic Regions Used as a Framework for the Analyses Presented in this GEIS

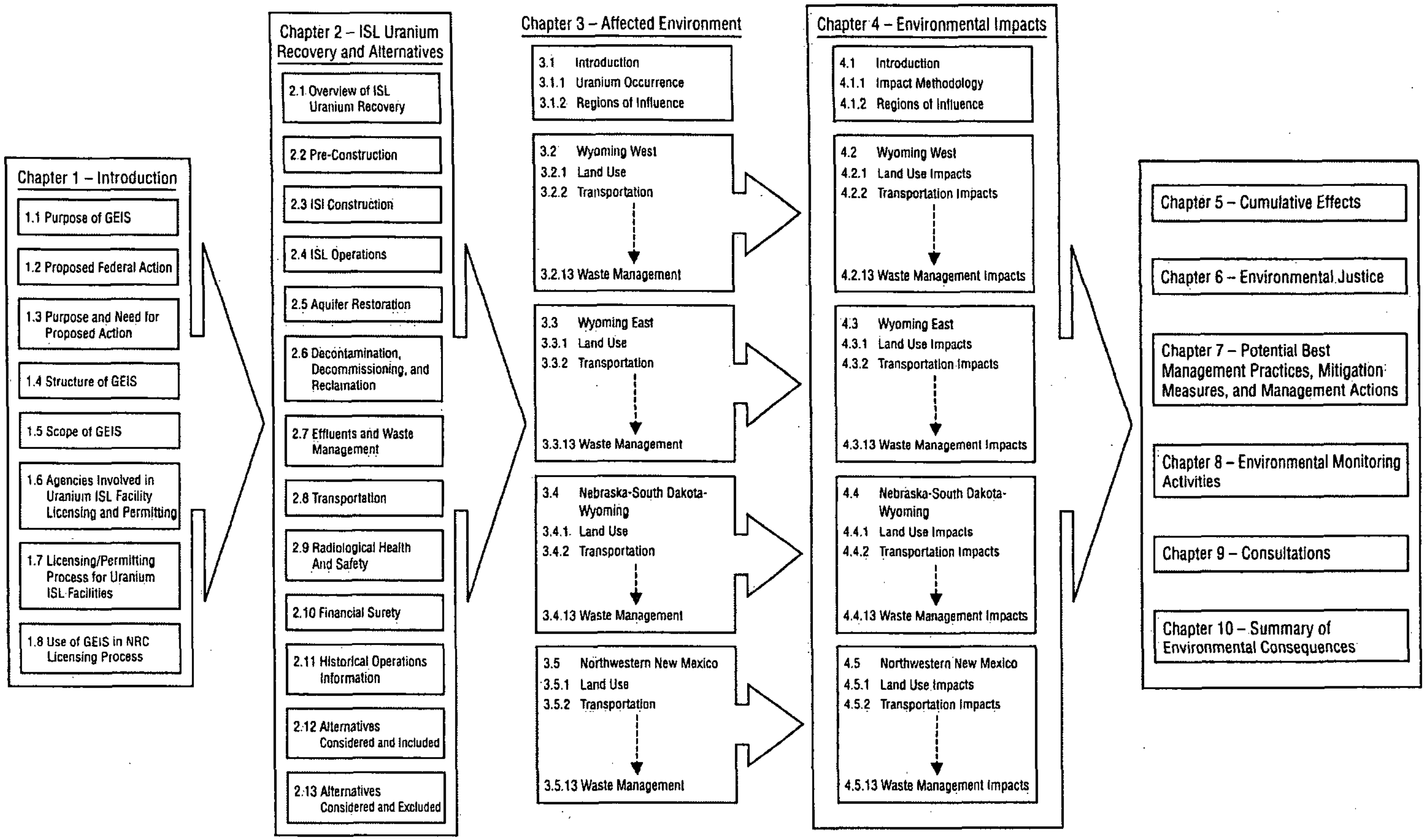

Figure ES–2. Structure of this GEIS

Chapter 2 of the Draft GEIS provides a description of the ISL process, addressing construction, operation, aquifer restoration, and decommissioning of an ISL facility. This section also discusses financial assurance, whereby the licensee or applicant establishes a bond or other financial mechanism prior to operations to ensure that sufficient funds are available to complete aquifer restoration, decommissioning, and reclamation activities.

Chapter 3 of the Draft GEIS describes the affected environment in each uranium milling region using the environmental resource areas and topics identified through public scoping comments on the GEIS and from NRC guidance to its staff found in NUREG–1748, "Environmental Review Guidance for Licensing Actions Associated With NMSS Programs," issued by NRC in 2003.

Chapter 4 of the GEIS provides an evaluation of the potential environmental impacts of constructing, operating, aquifer restoration, and decommissioning at an ISL facility in each of the four uranium milling regions. In essence, this involves placing an ISL facility with the characteristics described in Chapter 2 of the Draft GEIS within each of the four regional areas described in Chapter 3 and describing and evaluating the potential impacts in each region separately. The potential environmental impacts are evaluated for the different stages in the ISL process: construction, operation, aquifer restoration, and decommissioning. Impacts are examined for the resource areas identified in the description of the affected environment. These resource areas are:

- Land use
- Transportation
- Geology and soils
- Water resources
- Ecology
- Air Quality
- Noise
- Historical and cultural resource
- Visual and scenic resources
- Socioeconomic
- Public and occupational health

NRC identified a number of other issues that helped in the evaluation of the potential environmental impacts of an ISL facility. These issues include:

- **Applicable Statutes, Regulations and Agencies**. Various statutes, regulations, and implementing agencies at the federal, state, tribal and local levels that have a role in regulating ISL facilities are identified and discussed.

- **Waste Management**. Potential impacts from the generation, handling, treatment, and final disposal of chemical, radiological, and municipal wastes are addressed.

- **Accidents**. Potential accident conditions are assessed in the Draft GEIS. This includes consideration of a range of possible accidents and estimation of their consequences including: well field leaks and spills, excursions, processing chemical spills, and ion exchange resin and yellowcake transportation accidents.

- **Environmental Justice**. Although not required for a GEIS, to facilitate subsequent site-specific analyses, this Draft GEIS provides a first order definition of minority and low income populations. Early consultations will be initiated with some of these populations, and the potential for disproportionately high and adverse impacts from future ISL licensing in the uranium milling regions will be evaluated.

- **Cumulative Impacts**. The Draft GEIS addresses cumulative impacts from proposed ISL facility construction, operation, ground water restoration, and decommissioning on all aspects of the affected environment, considering the impacts from past, present, and reasonably foreseeable future actions in the uranium milling regions.

- **Monitoring**. The Draft GEIS discusses various monitoring methodologies and techniques used to detect and mitigate the spread of radiological and non-radiological contaminants beyond ISL facility boundaries.

SIGNIFICANCE OF LEVELS

In the Draft GEIS, NRC has categorized the potential environmental impacts using significance levels. According to the Council on Environmental Quality, the significance of impacts is determined by examining both context and intensity (40 CFR 1508.27). Context is related to the affected region, the affected interests, and the locality, while intensity refers to the severity of the impact, which is based on a number of considerations. In this Draft GEIS, the NRC used the significance levels identified in NUREG–1748:

- SMALL Impact: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource considered.

- MODERATE Impact: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.

- LARGE Impact: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

SUMMARY OF IMPACTS

As discussed previously, Chapter 4 of the Draft GEIS provides NRC's evaluation of the potential environmental impacts of the construction, operation, aquifer restoration, and decommissioning at an ISL facility in each of the four uranium milling regions. A summary of this evaluation by environmental resource area and phase of the ISL facility lifecycle is provided below.

Land Use Impacts

CONSTRUCTION—Land use impacts could occur from land disturbances (including alterations of ecological cultural or historic resources) and access restrictions (including limitations of other mineral extraction activities, grazing activities, or recreational activities). The potential for land use conflicts could increase in areas with higher percentages of private land ownership and Native American land ownership or in areas with a complex patchwork of land ownership. Land disturbances during construction would be temporary and limited to small areas within permitted areas. Well sites, staging areas, and trenches would be reseeded and restored. Unpaved access roads would remain in use until decommissioning. Competing access to mineral rights could be either delayed for the duration of the in-situ leach (ISL) project or be intermixed with ISL operations (e.g., oil and gas exploration). Changes to land use access including grazing restrictions and impacts on recreational activities would be limited due to the small size of restricted areas, temporary nature of restrictions, and availability of other land for these activities. Ecological, historical, and cultural resources could be affected, but would be protected by careful planning and surveying to help identify resources and avoid or mitigate impacts. For all land use aspects except ecological, historical and cultural resources, the potential impacts would be SMALL. Due to the potential for unidentified resources to be altered or destroyed during excavation, drilling, and grading, the potential impacts to ecological, historical or cultural resources would be SMALL to LARGE, depending on local conditions.

OPERATION—The types of land use impacts for operational activities would be similar to construction impacts regarding access restrictions because the infrastructure would be in place. Additional land disturbances would not occur from conducting operational activities. Because access restriction and land disturbance related impacts would be similar to, or less than, for construction, the overall potential impacts to land use from operational activities would be SMALL.

AQUIFER RESTORATION—Due to the use of the same infrastructure, land use impacts would be similar to operations during aquifer restoration, although some operational activities would diminish—SMALL.

DECOMMISSIONING—Land use impacts would be similar to those described for construction with a temporary increase in land-disturbing activities for dismantling, removing, and disposing of facilities, equipment, and excavated contaminated soils. Reclamation of land to preexisting conditions and uses would help mitigate potential impacts—SMALL to MODERATE during decommissioning, and SMALL once decommissioning is completed.

Transportation Impacts

CONSTRUCTION—Low magnitude traffic generated by ISL construction relative to local traffic counts would not significantly increase traffic or accidents on many of the roads in the region. Existing low traffic roads could be moderately impacted by the additional worker commuting traffic during periods of peak employment. This impact would be expected to be more pronounced in areas with relatively lower traffic counts. Moderate dust, noise, and incidental wildlife or livestock kill impacts would be possible on, or near, site access roads (dust in particular for unpaved access roads)—SMALL to MODERATE.

OPERATION— Low magnitude traffic relative to local traffic counts on most roads would not significantly increase traffic or accidents. Existing low traffic roads could be moderately impacted by commuting traffic during periods of peak employment including dust, noise, and possible incidental wildlife or livestock kill impacts on or near site access roads. High consequences would be possible for a severe accident involving transportation of hazardous chemicals in a populated area. However, the probability of such accidents occurring would be low owing to the small number of shipments, comprehensive regulatory controls, and use of best management practices. For radioactive material shipments (yellowcake product, ion exchange resins, waste materials), compliance with transportation regulations would limit radiological risk for normal operations. Low radiological risk is estimated for accident conditions. Emergency response protocols would help mitigate long-term consequences of severe accidents involving release of uranium—SMALL to MODERATE.

AQUIFER RESTORATION—The magnitude of transportation activities would be lower than for construction and operations, with the exception of workforce commuting which could have moderate impacts on, or in the vicinity of, existing low traffic roads—SMALL to MODERATE.

DECOMMISSIONING—The types of transportation activities and, therefore, the types of impacts would be similar to those discussed for construction and operations except the magnitude of transportation activities (e.g., number and types of waste and supply shipments, no yellowcake shipments) from decommissioning could be lower than for operations. Accident risks would be bounded by operations yellowcake transportation risk estimates—SMALL.

Geology and Soils Impacts

CONSTRUCTION—Disturbance to soil would occur from construction (clearing, excavation, drilling, trenching, road construction); however, such disturbances would be expected to be temporary, disturbed areas would be SMALL (approximately 10 percent of the total site area), and potential impacts would be mitigated by using best management practices. A large portion of the well fields, trenches, and access roads would be restored and reseeded after construction. Excavated soils would be stockpiled, seeded, and stored onsite until needed for reclamation fill. No impacts to subsurface geological strata would be likely—SMALL.

OPERATION—Temporary contamination or alteration of soils would be likely from operational leaks and spills and possible from transportation, use of evaporation ponds, or land application of treated waste water. However, detection and response to leaks and spills (e.g., soil cleanup), monitoring of treated waste water, and eventual survey and decommissioning of all potentially impacted soils would limit the magnitude of overall impacts to soils—SMALL.

AQUIFER RESTORATION—Impacts to geology and soils from aquifer restoration activities would be similar to impacts from operations due to use of the same infrastructure and similar activities conducted (e.g., well field operation, transfer lines, liquid effluent treatment and disposal)—SMALL.

DECOMMISSIONING—Impacts to geology and soils from decommissioning would be similar to impacts from construction. Activities to cleanup, re-contour and reclaim disturbed lands during decommissioning would mitigate long-term impacts to soils—SMALL.

Surface Water Impacts

CONSTRUCTION—Impacts to surface waters and related habitats from construction (road crossings, filling, erosion, runoff, spills or leaks of fuels and lubricants for construction equipment) would be mitigated through proper planning, design, construction methods, and best management practices. Some impacts directly related to the construction activities would be temporary and limited to the duration of the construction period. U.S. Army Corps of Engineers permits may be required when filling and crossing of wetlands. Temporary changes to spring and stream flow from grading and changes in topography and natural drainage patterns could be mitigated or restored after the construction phase. Impacts from incidental spills of drilling fluids into local streams could occur, but would be temporary, due to the use of mitigation measures. Impacts from roads, parking areas, buildings on recharge to shallow aquifers would be SMALL, owing to the limited area of impervious surfaces proposed. Impacts from infiltration of drilling fluids into the local aquifer would be localized, small, and temporary—SMALL to MODERATE depending on site-specific characteristics.

OPERATION—Through permitting processes, federal and state agencies regulate the discharge of storm water runoff and the discharge of process water. Impacts from these discharges would be mitigated as licensees would within the conditions of their permits. Expansion of facilities or pipelines during operations would generate impacts similar to construction—SMALL to MODERATE depending on site-specific characteristics.

AQUIFER RESTORATION—Impacts from aquifer restoration would be similar to impacts from operations due to use of the same (in-place) infrastructure and similar activities conducted (e.g., well field operation, transfer lines, water treatment, storm water runoff)—SMALL to MODERATE depending on site-specific characteristics.

DECOMMISSIONING—Impacts from decommissioning would be similar to impacts from construction. Activities to clean up, re-contour and reclaim disturbed lands during decommissioning would mitigate long-term impacts to surface waters—SMALL to MODERATE depending on site-specific characteristics.

Groundwater Impacts

CONSTRUCTION—Water use impacts would be limited by the small volumes of groundwater used for routine activities such as dust suppression, mixing cements, and drilling support over short and intermittent periods. Contamination of groundwater from construction activities would be mitigated by best management practices—SMALL to LARGE, depending on site-specific conditions.

OPERATION—Potential impacts to shallow aquifers can occur from leaks or spills from surface facilities and equipment. Shallow aquifers are important sources of drinking water in some areas of the four uranium milling regions. Potential impacts to the ore-bearing and surrounding aquifers include consumptive water use and degradation of water quality (from normal production activities, off-normal excursion events, and deep well injection disposal practices). Consumptive use impacts from withdrawal of groundwater would occur because approximately 1 to 3 percent of pumped groundwater is not returned to the aquifer (e.g., process bleed). That amount of water lost could be reduced substantially by available treatment methods (e.g., reverse osmosis, brine concentration). Effects of water withdrawal on surface water would be expected to be SMALL as the ore zone normally occurs in a confined aquifer. Estimated drawdown effects vary depending on site conditions and water treatment technology applied. Excursions of lixiviant and mobilized chemical constituents could occur from failure of well seals or other operational conditions that result in incomplete recovery of lixiviant. Well seal related excursions would be detected by the groundwater monitoring system and periodic well mechanical integrity testing and impacts would be expected to be mitigated during operation or aquifer restoration. Other excursions could result in plumes of mobilized uranium and heavy metals extending beyond the mineralization zone. The magnitude of potential impacts from vertical excursions would vary depending on site-specific conditions. To reduce the likelihood and consequences of potential excursions at ISL facilities, NRC requires licensees to take preventative measures prior to starting operations including well tests, monitoring, and development of procedures that include excursion response measures and reporting requirements. Alterations of ore body aquifer chemistry would be SMALL, because the aquifer would: (1) be confined, (2) not be a potential drinking water source, and (3) be expected to be restored within statistical range of preoperational baseline water quality during the restoration period. Potential environmental impacts to confined deep aquifers below the production aquifers from deep well injection of processing wastes would be addressed by the underground injection permitting process regulated by the states—SMALL to LARGE, depending on site-specific conditions.

AQUIFER RESTORATION—Potential impacts would be from consumptive use and potential deep disposal of brine slurries after reverse osmosis, if applicable. The volume of water removed from the aquifer and related impacts would be dependent on site-specific conditions and the type of water treatment technology the facility uses. In some cases, groundwater consumptive use for the aquifer restoration has been reported to be less than groundwater use during the ISL operation and drawdowns due to aquifer restorations have been smaller than drawdown caused by ISL operations. Potential environmental impacts associated with water consumption during aquifer restorations are determined by: (1) the restoration techniques chosen, (2) the volume of water to be used, (3) the severity and extent of the contamination, and (4) the current and future use of the production and surrounding aquifers near the ISL facility or at the regional scale—SMALL to LARGE, depending on site-specific conditions.

DECOMMISSIONING—Potential impacts from decommissioning would be similar to construction (water use, spills) with an additional potential to mobilize contaminants during demolition and cleanup activities. Contamination of groundwater from decommissioning activities would be mitigated by implementation of an NRC-approved decommissioning plan and use of best management practices—SMALL.

Terrestrial Ecology Impacts

CONSTRUCTION—Potential terrestrial ecology impacts would include the removal of vegetation from the well fields, the milling site, the modification of existing vegetative communities, the loss of sensitive plants and habitats from clearing and grading, and the potential spread of invasive species and noxious weed populations. These impacts would be expected to be temporary because restoration and reseeding occur rapidly after the end of construction. Introduction of invasive species and noxious weeds would be mitigated by restoration and reseeding after construction. Shrub and tree removal and loss would take longer to restore. Construction noise could affect reproductive success of sage grouse leks by interfering with mating calls. Temporary displacement of some animal species would also occur. Critical wintering and year-long ranges are important to survival of both big game and sage grouse. Raptors breeding onsite may be impacted by construction activities or milling operations, depending on the time of year construction occurs. Wildlife habitat fragmentation, temporary displacement of animal species, and direct or indirect mortalities would be possible. Implementation of wildlife surveys and mitigation measures following established guidelines would limit impacts. The magnitude of impacts depends on whether a new facility is being licensed or an existing facility is being extended—SMALL to MODERATE, depending on site-specific habitat conditions.

OPERATION—Habitats could be altered by operations (fencing, traffic, noise), and individual takes could occur due to conflicts between species habitat and operations. Access to crucial wintering habitat and water could be limited by fencing. However, the State of Wyoming Game and Fish Department specifies fencing construction techniques to minimize impediments to big game movement. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Temporary contamination or alteration of soils would be likely from operational leaks and spills and possible from transportation or land application of treated waste water. However, detection and response to leaks and spills (e.g., soil cleanup) and eventual survey and decommissioning of all potentially impacted soil limits the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts—SMALL.

AQUIFER RESTORATION—Impacts include habitat disruption, but existing (in-place) infrastructure would be used during aquifer restoration, with little additional ground disturbance. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Contamination of soils could be result from leaks and spills, and land application of treated waste water. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts—SMALL.

DECOMMISSIONING—During decommissioning and reclamation, there would be a temporary disturbance to land (e.g., excavating soils, buried piping, removal of structures). However, re-vegetation and re-contouring would restore habitat altered during construction and operations. Wildlife would be temporarily displaced, but are expected to return after decommissioning and reclamation are completed and vegetation and habitat reestablished—SMALL.

Aquatic Ecology Impacts

CONSTRUCTION—Clearing and grading activities associated with construction could result in a temporary increase in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. Clearing of riparian vegetation could affect light and temperature of water. Construction impacts to wetlands would be identified and managed through U.S. Army Corps of Engineers permits, as appropriate. Construction impacts to surface waters and aquatic species would be temporary and mitigated by best management practices—SMALL.

OPERATION—Impacts could result from spills or releases into surface water. Impacts would be minimized by spill prevention, identification and response programs, and National Pollutant Discharge Elimination System (NPDES) permit requirements—SMALL.

AQUIFER RESTORATION—Activities would use existing (in-place) infrastructure, and impacts could result from spills or releases of untreated groundwater. Impacts would be minimized by spill prevention, identification, and response programs, and NPDES permit requirements—SMALL.

DECOMMISSIONING—Decommissioning and reclamation activities could result in temporary increases in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. With completion of decommissioning, re-vegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Threatened and Endangered Species Impacts

CONSTRUCTION—Numerous threatened and endangered species and state species of concern are located in the four uranium milling regions. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impact would depend on the size of a new facility or extension to an existing facility and the amount of land disturbance. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would reduce impacts—SMALL to MODERATE to LARGE—depending on site-specific habitat and presence of threatened or endangered species.

OPERATION—Impacts could result from individual takes due to conflicts with operations. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impact would depend on the size of a new facility or extension to an existing facility and the amount of land disturbance. Impacts could potentially result from spills or permitted effluents, but would be minimized through the use of spill prevention measures, identification and response programs, and NPDES permit requirements. Inventory of threatened or endangered species developed during site-specific reviews would identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assist in reducing impacts—SMALL to MODERATE—depending on site-specific habitat and presence of threatened or endangered species.

AQUIFER RESTORATION—Impacts could result from individual takes due to conflicts with aquifer restoration activities (equipment, traffic). Existing (in-place) infrastructure would be used during aquifer restoration, so additional land-disturbing activities and habitat fragmentation would not be anticipated. Impacts may result from spills or releases of treated or untreated groundwater, but impacts would be minimized through the use of spill prevention measures, identification, and response programs, and NPDES permit requirements. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in reducing impacts—SMALL.

DECOMMISSIONING—Impacts resulting from individual takes would occur due to conflicts with decommissioning activities (equipment, traffic). Temporary land disturbance would occur as structures are demolished and removed and the ground surface is re-contoured. Inventory of threatened or endangered species developed during site-specific environmental review of the decommissioning plan would identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in reducing impacts. With completion of decommissioning, re-vegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Air Quality Impacts

CONSTRUCTION—Fugitive dust and combustion (vehicle and diesel equipment) emissions during land-disturbing activities associated with construction would be small, short-term, and reduced through best management practices (e.g., dust suppression). For example, estimated fugitive dust emissions during ISL construction is less than 2 percent of the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and less than 1 percent for PM_{10}. For NAAQS attainment areas, non-radiological air quality impacts would be SMALL. A Prevention of Significant Deterioration (PSD) Class I area exists in only one of the four regions (Wind Cave National Park in the Nebraska-South Dakota-Wyoming Region). Here, more stringent air quality standards would apply to a facility that impacts the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL.

OPERATION—Radiological impacts can result from dust releases from drying of lixiviant pipeline spills, radon releases from well system relief valves, resin transfer, or elution, and gaseous/particulate emissions from yellowcake dryers. Only small amounts of low dose materials would be expected to be released based on operational controls and rapid response to spills. Required spill prevention, control, and response procedures would be used to minimize impacts from spills. HEPA filters and vacuum dryer designs reduce particulate emissions from operations and ventilation reduces radon buildup during operations. Compliance with the NRC-required radiation monitoring program would ensure releases are within regulatory limits. Other potential non-radiological emissions during operations include fugitive dust and fuel from equipment, maintenance, transport trucks, and other vehicles. For NAAQS attainment areas, non-radiological air quality impacts would be SMALL. A PSD Class I area is located in the Nebraska-South Dakota-Wyoming Region (Wind Cave National Park). More stringent air quality standards would apply to a facility that impacts the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL.

AQUIFER RESTORATION—Because the same infrastructure is used, air quality impacts are expected to be similar to, or less than, during operations. For NAAQS attainment areas, non-radiological air quality impacts would be SMALL. Where a PSD Class I area exists, such as the

Wind Cave National Park in the Nebraska-South Dakota-Wyoming Region, more stringent air quality standards would apply to a facility that impacts the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL.

DECOMMISSIONING—Fugitive dust, vehicle, and diesel emissions during land-disturbing activities associated with decommissioning would be similar to, or less than, those associated with construction, short-term, and reduced through best management practices (e.g., dust suppression). Potential impacts would decrease as decommissioning and reclamation of disturbed areas are completed. For NAAQS attainment areas, non-radiological air quality impacts would be SMALL. However, where a PSD Class I area exists (Wind Cave National Park, in the Nebraska-South Dakota-Wyoming Region), more stringent air quality standards would apply to a facility that impacts the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL.

Noise Impacts

CONSTRUCTION—Noise generated during construction would be noticeable in proximity to operating equipment, but would be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below Occupational Health and Safety Administration (OSHA) regulatory limits and mitigated by use of personal hearing protection. Traffic noise during construction (commuting workers, truck shipments to and from the facility, and construction equipment such as trucks, bulldozers, and compressors) would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in the well fields. Relative increases in traffic levels would be SMALL for the larger roads, but may be MODERATE for lightly traveled rural roads through smaller communities. Noise may also adversely affect wildlife habitat and reproductive success in immediate vicinity of construction activities. Noise levels decrease with distance, and at distances more than about 300 m [1,000 ft], ambient noise levels would return to background. Wildlife avoid construction areas because of noise and human activity. All of the uranium districts are located more than 300 m [1,000 ft] from the closest community. As a result, noise impacts would be—SMALL to MODERATE.

OPERATION—Noise-generating activities in the central uranium processing facility would be indoors, reducing offsite sound levels. Well field equipment (e.g., pumps, compressors) would be contained within structures (e.g., header houses, satellite facilities) also reducing sound levels to offsite receptors. Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits and mitigated by use of personal hearing protection. Traffic noise from commuting workers, truck shipments to and from the facility, and facility equipment would be expected to be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for the larger roads, but may be MODERATE for lightly traveled rural roads through smaller communities. Most noise would be generated indoors and mitigated by regulatory compliance and best management practices. Noise from trucks and other vehicles are typically of short duration. Also, noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft. All the uranium districts are located more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE.

AQUIFER RESTORATION—Noise generation is expected to be less than during construction and operations. Pumps and other well field equipment contained in buildings reduce sound levels to offsite receptors. Existing operational infrastructure would be used and traffic levels would be expected to be less than during construction and operations. There are additional sensitive areas that should be considered within some of the regions, but because of decreasing noise levels with distance, construction activities would have only SMALL and temporary noise impacts for residences, communities, or sensitive areas, especially those located more than about 300 m [1,000 ft] from specific noise generating activities. Noise usually is not discernable to offsite receptors at distances more than 300 m [1,000 ft]. All the uranium districts are located more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE.

DECOMMISSIONING—Noise generated during decommissioning would be noticeable only in proximity to equipment and temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits and mitigated by use of personal hearing protection. Noise levels during decommissioning would be less than during construction and would diminish as less and less equipment is used and truck traffic is reduced. Noise usually is not discernable to offsite receptors at distances more than 300 m [1,000 ft]. All the uranium districts are located more than 300 m [1,000 ft] from the closest community—SMALL.

Historical and Cultural Resources Impacts

CONSTRUCTION—Potential impacts during ISL facility construction could include loss of, or damage and temporary restrictions on access to, historical, cultural, and archaeological resources. The eligibility evaluation of cultural resources for listing in the National Register of Historic Places (NRHP) under criteria in 36 CFR 60.4(a)–(d), and/or as Traditional Cultural Properties (TCP) would be conducted as part of the site-specific review and NRC licensing procedures undertaken during the National Environmental Policy Act (NEPA) review process. The evaluation of impacts to any historic properties designated as TCPs and tribal consultations regarding cultural resources and TCPs also occurs during the site-specific licensing application and review process. To determine whether significant cultural resources would be avoided or mitigated, consultations with State Historic Preservation Offices (SHPO), other government agencies (e.g., U.S. Fish and Wildlife Service and Sate Environmental Departments), and Native American Tribes (THPO) occur as part of the site-specific review. Additionally, as needed, the NRC license applicant would be required, under conditions in its NRC license, to adhere to procedures regarding the discovery of previously undocumented cultural resources during initial construction. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE depending on site-specific conditions.

OPERATION—Because less land disturbance occurs during the operations phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during operation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL, but depending on site-specific conditions.

AQUIFER RESTORATION—Because less land disturbance occurs during the aquifer restoration phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during aquifer restoration. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL, but depending on site-specific conditions.

DECOMMISSIONING—Because less land disturbance occurs during the decommissioning phase and because decommissioning and reclamation activities would be focused on previously disturbed areas, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during decommissioning and reclamation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL, depending on site-specific conditions.

Visual and Scenic Impacts

CONSTRUCTION—Visual impacts result from equipment (drill rig masts, cranes), dust/diesel emissions from construction equipment, and hillside and roadside cuts. Most of the four uranium milling regions are classified as Visual Resource Management (VRM) Class II through IV by the BLM. A number of VRM Class II areas surround national monuments (El Morro and El Malpais), the Chaco Culture National Historic Park, and sensitive areas managed within the Mt. Taylor district, in the Northwestern New Mexico Uranium Milling District, and would have the greatest potential for impacts to visual resources. Most of these areas, however, are located away from potential ISL facilities, at distances greater than 16 km [10 mi]. Most potential facilities are located in VRM Class III and IV areas. The general visual and scenic impacts associated with ISL facility construction would be temporary and SMALL, but from a Native American perspective, any construction activities would likely to result in adverse impacts to the landscape, particularly for facilities located in areas within view of tribal lands and areas of special significance such as Mt. Taylor. In addition, a PSD Class I area (Wind Cave National Park) is located in the Nebraska-South Dakota-Wyoming Uranium Milling Region. Nevertheless, most potential visual impacts during construction would be temporary as equipment is moved, and would be mitigated by best management practices (e.g., dust suppression). Because of the generally rolling topography of the region, most visual impacts during construction would not be visible from more than about 1 km [0.6 mi]. The visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL.

OPERATION—Visual impacts during operations would be less than those associated with construction. Most of the well field surface infrastructure has a low profile, and most piping and cables would be buried. The tallest structures include the central uranium processing facility {10 m [30 ft]} and power lines {6 m [20 ft]}. Because of the generally rolling topography of the regions, most visual impacts during operations would not be visible from more than about 1 km [0.6 mi]. Irregular layout of well field surface structures such as wellhead protection and header houses would further reduce visual contrast. Best management practices, design (e.g., painting buildings) and landscaping techniques would be used to mitigate potential visual impact. The uranium districts in the four regions are all located more than 16 km [10 mi] from the closest VRM Class II region, and the visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL.

AQUIFER RESTORATION—Aquifer restoration activities would use in-place infrastructure. As a result, potential visual impacts would be the same as, or less than, those during operations—SMALL.

DECOMMISSIONING SMALL—Because similar equipment would be used and activities conducted, potential visual impacts during decommissioning would be the same as, or less than, those during construction. Most potential visual impacts during decommissioning would be temporary as equipment is moved, and mitigated by best management practices (e.g., dust suppression). Visual impacts would be low, because these sites are in sparsely populated areas, and impacts would diminish as decommissioning activities decrease. An approved site reclamation plan is required prior to license termination, with the goal of returning the landscape to preconstruction condition (predominantly VRM Class III and IV). Some roadside cuts and hill slope modifications, however, may persist beyond decommissioning and reclamation—SMALL.

Socioeconomic Impacts

CONSTRUCTION—Potential impacts to socioeconomics would result predominantly from employment at an ISL facility and demands on the existing public and social services, tourism/recreation, housing, infrastructure (schools, utilities), and the local work force. Total peak employment would be about 200 people, including company employees and local contractors, depending on timing of construction with other stages of the ISL lifecycle. During construction of surface facilities and well fields, the general practice would be to use local contractors (drillers, construction), as available. A local multiplier of 0.7 (U.S. Bureau of the Census) is used to indicate how many ancillary jobs could be created (in this case about 140). For example, local building materials and building supplies would be used to the extent practical. Most employees would live in larger communities with access to more services. Some construction employees, however, would commute from outside the county to the ISL facility, and skilled employees (e.g., engineers, accountants, managers) would come from outside the local work force. Some of these employees would temporarily relocate to the project area and contribute to the local economy through purchasing goods and services and taxes. Because of the small relative size of the ISL workforce, net impacts would be SMALL to MODERATE.

OPERATION—Employment levels for ISL facility operations would be less than for construction, with total peak employment depending on timing and overlap with other stages of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction would diminish. Revenues would be generated from federal, state, and local taxes on the facility and the uranium produced. Employment types would be similar to construction, but the socioeconomic impacts would be less due to fewer employees—SMALL to MODERATE.

AQUIFER RESTORATION—In-place infrastructure would be used for aquifer restoration, and employment levels would be similar to those for operations—SMALL to MODERATE.
DECOMMISSIONING—A skill set similar to the construction workforce would be involved in dismantling surface structures, removing pumps, plugging and abandoning wells, and reclaiming/re-contouring the ground surface. Employment levels and use of local contractor support during decommissioning would be similar to that required for construction. Employment would be temporary, however, as decommissioning activities are in duration. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE.

Public and Occupational Health and Safety Impacts

CONSTRUCTION—Worker safety would be addressed by standard construction safety practices. Fugitive dust would result from construction activities and vehicle traffic, but would likely be of short duration and would not result in a radiological dose. Diesel emissions would also be of short duration and readily dispersed into the atmosphere—SMALL to MODERATE.

OPERATION—Potential occupational radiological impacts from normal operations would result from: (1) exposure to radon gas from well field, (2) ion-exchange resin transfer operations, and (3) venting during processing activities. Workers would also be exposed to airborne uranium particulates from dryer operations and maintenance activities. Potential public exposures to radiation could occur from the same radon releases and uranium particulate releases (i.e., from facilities without vacuum dryer technology). Both worker and public radiological exposures are addressed in NRC regulations at 10 CFR Part 20, which require licensees to implement an NRC-approved radiation protection program. (Measured and calculated doses for workers and the public are commonly only a fraction of regulated limits.) Non-radiological worker safety matters are addressed through commonly-applied occupational health and safety regulations and practices. Radiological accident risks could involve processing equipment failures leading to yellowcake slurry spills, or radon gas or uranium particulate releases. Consequences of accidents to workers and the public are generally low, with the exception of a dryer explosion which could result in worker dose above NRC limits. The likelihood of such an accident would be low, and therefore the risk would also be low. Potential non-radiological accidents impacts include high consequence chemical release events (e.g., ammonia) for both workers and nearby populations. The likelihood, however, of such release events would be low based on historical operating experience at NRC-licensed facilities, primarily due to operators following commonly-applied chemical safety and handling protocols—SMALL to MODERATE.

AQUIFER RESTORATION—Activities involving aquifer restoration overlap with similar operational activities (e.g., operation of well fields, waste water treatment and disposal). The resultant types of impacts on public and occupational health and safety are similar to operational impacts. The absence of some operational activities (e.g., yellowcake production and drying, remote ion exchange) further limits the relative magnitude of potential worker and public health and safety hazards—SMALL.

DECOMMISSIONING—Worker and public health and safety would be addressed in a NRC-required decommissioning plan. This plan details how a 10 CFR Part 20 compliant radiation safety program would be implemented during decommissioning, ensuring the safety of workers and the public would be maintained and applicable safety regulations complied with—SMALL.

Waste Management Impacts

CONSTRUCTION—Relatively small scale construction activities (Section 2.3) and incremental well field development at ISL facilities would generate low volumes of construction waste—SMALL.

OPERATION—Operational wastes primarily result from liquid waste streams including process bleed, flushing of depleted eluant to limit impurities, resin transfer wash, filter washing, uranium precipitation process wastes (brine), and plant wash down water. State permit actions, NRC license conditions, and NRC inspections ensure the proper practices would be used to comply with safety requirements to protect workers and the public. Waste treatments such as reverse osmosis and radon settling would be used to segregate wastes and minimize disposal volumes. Potential impacts from surface discharge and deep well injection would be limited by the conditions specified in the applicable state permit. NRC regulations address constructing, operating, and monitoring for leakage of evaporation ponds used to store and reduce volumes of liquid wastes. Potential impacts from land application of treated wastewater would be addressed by NRC review of site-specific conditions prior to approval and routine monitoring in decommissioning surveys. Offsite waste disposal impacts would be SMALL for radioactive wastes as a result of required preoperational disposal agreements. Impacts for hazardous and municipal waste would also be SMALL due to the volume of wastes generated. For remote areas with limited available disposal capacity, such wastes may need to be shipped greater distances to facilities that have capacity; however, the volume of wastes generated and magnitude of such shipments are estimated to be low—SMALL.

AQUIFER RESTORATION—Waste management activities during aquifer restoration would use the same treatment and disposal options implemented for operations. Therefore, impacts associated with aquifer restoration would be similar to operational impacts. While the amount of wastewater generated during aquifer restoration would be dependent on site-specific conditions, the potential exists for additional wastewater volume and associated treatment wastes during the restoration period. However, this would be offset to some degree by the reduction in production capacity from the removal of a well field. NRC review of future ISL facility applications would verify that sufficient water treatment and disposal capacity (and the associated agreement for disposal of byproduct material) are addressed. As a result, waste management impacts from aquifer restoration would be—SMALL.

DECOMMISSIONING—Radioactive wastes from decommissioning ISL facilities (including contaminated excavated soil, evaporation pond bottoms, process equipment) would be disposed of as byproduct material at an NRC-licensed facility. A preoperational agreement with a licensed disposal facility to accept radioactive wastes ensures sufficient disposal capacity would be available for byproduct wastes generated by decommissioning activities. Safe handling, storage, and disposal of decommissioning wastes would be addressed in a required decommissioning plan for NRC review prior to starting decommissioning activities. Such a plan would detail how a 10 CFR Part 20 compliant radiation safety program would be implemented during decommissioning to ensure how the safety of workers and the public would be maintained and applicable safety regulations complied with. Overall, volumes of decommissioning radioactive, chemical, and solid wastes would be—SMALL.

ABBREVIATIONS/ACRONYMS

BLM	U.S. Bureau of Land Management
CBSA	Core-Based Statistical Area
CEA	Cumulative Effects Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CEQ	Council on Environmental Quality
Dod	Department of Defense
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FONSI	Finding of No Significant Impact
GEIS	Generic Environmental Impact Statement
ISL	*In-situ* Leaching
MIT	Mechanical Integrity Testing
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NDEQ	Nebraska Department of Environmental Quality
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PVC	Polyvinyl Chloride
RFFA	Reasonably Foreseeable Future Action
SHPO	State Historic Preservation Officer
TDS	Total Dissolved Solids
THPO	Tribal Historic Preservation Officer
UCL	Upper Control Limit
UIC	Underground Injection Control
UMTRCA	Uranium Mill Tailings Radiation Control Act
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
VRM	Visual Resource Management
WDEQ	Wyoming Department of Environmental Quality

SI* (MODERN METRIC) CONVERSION FACTORS

Approximate Conversions From SI Units				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
Length				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
Area				
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
Volume				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
m^3	cubic meters	0.0008107	acre-feet	acre-feet
Mass				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
Temperature (Exact Degrees)				
°C	Celsius	1.8C + 32	Fahrenheit	°F

*SI is the symbol for the International System of Units. Appropriate rounding should be performed to comply with Section 4 of ASTM E380 (ASTM International. "Standard for Metric Practice Guide." West Conshohocken, Pennsylvania: ASTM International. Revised 2003.).

5 CUMULATIVE EFFECTS

5.1 Introduction

The Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations, as amended (40 CFR Parts 1500–1508) define cumulative effects as "... the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

A National Research Council study on hardrock mining on federal lands recognized the cumulative effects could become a concern due to past, current, and future activities in the vicinity of the mine under consideration. Specifically, cumulative impacts were defined as the collective impacts of several operations involving human activities, including mining, grazing, farming, timbering, water diversion or discharge, and industrial processing; they also include future impacts not immediately observable (Committee on Hardrock Mining on Federal Lands, 1999, p. 242). While this definition does not precisely match the definition in the CEQ's NEPA regulations, it does include the concept that a variety of other past, present, and future actions in the vicinity of the proposed project could cumulatively contribute to the effects on specific resources resulting from the proposed project subjected to NEPA analyses.

The study also noted that there were many uncertainties related to the cumulative effects of mineral production, including technologies such as the *in-situ* leaching (ISL) process for uranium recovery. As a result, several research needs were articulated. Examples include the need for methodologies (or models) for predicting cumulative effects from mineral recovery activities under different environmental circumstances, the need for collaborative approaches for resolving multiple and conflicting demands on common resources, and the need for the design of a long-term monitoring program and strategies which can be used to identify impact contributions from various actions, as well as the occurrence resource sustainability (Committee on Hardrock Mining on Federal Lands).

When the many activities potentially associated with an ISL project (e.g., several satellite well fields, solution-water injection wells, and associated extraction wells are drilled; extracted fluids are processed at remote locations; pipelines are built to transport liquid from these locations to a central processing plant; selected wastewaters are disposed of using deep wells; and yellowcake is shipped by truck) are considered, they could cause impacts to specific local and regional resources. In addition, ISL projects could involve relicensing or expanding existing facilities and operations, possibly with the use of new designs for new well fields or modifications in existing designs. These new or relicensed projects could be located within or near geographical areas that have been subject to uranium recovery via conventional mining and milling, oil and gas exploration and production, and other energy developments such as coal-bed methane projects. For all of these reasons, cumulative effects assessment is an important part of the licensing process for ISL projects.

Establishing the appropriate "scope" of the cumulative effects portion of an impact study is a fundamental feature of planning and conducting such a study for an ISL project. The CEQ NEPA regulations in 40 CFR Parts 1500–1508 indicate that "scope consists of the range of actions ..." to be considered in a NEPA compliance document. CEQ regulations in

40 CFR 1508.25 of the regulations identifies the following three types of actions for consideration, which all pertain to ISL projects:

- Connected actions are closely related and should be discussed in the same environmental impact statement (EIS) (or environmental assessment). The multiple activities of an ISL project illustrate connected actions. Such actions are interdependent parts of a larger action (the overall ISL project) and depend on the larger action for their justification.

- Cumulative actions, when viewed with other proposed actions, have cumulatively significant impacts and should therefore be discussed in the same NEPA compliance document. Cumulative actions could include future planned expansion of the proposed ISL facility, proposals for other new ISL projects in the same geographic areas, and relicensing of nearby existing ISL projects.

- Similar actions, when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a way to evaluate their environmental consequences together, such as common timing, or geography or impacts on common resources. Similar actions could include other local or regional energy or industrial development projects, or land usage activities, which could impact the same resources the proposed ISL project hopes to change.

In 1997, the CEQ published guidance on an approach to consider cumulative effects within the NEPA compliance process (CEQ, 1997) as described in Appendix F. This guidance contains an 11-step process, integrated within the traditional NEPA (or environmental impact assessment) process. Steps 1–4 relate to scoping (including the establishment of the scope), Steps 5–7 to describing the affected environment, and Steps 8–11 to determining the environmental consequences. These 11 steps can be applied at a general study planning level and at a detailed level for specific resources, ecosystems, and human communities, which are impacted by the original proposed action. For uranium recovery, the original action could be associated with a license application for a new ISL facility or with a relicensing action for an existing facility.

The resource areas addressed in this generic EIS (GEIS) include land use, transportation, geology and soils, surface water, groundwater, wetlands, terrestrial ecology, aquatic ecology, threatened or endangered species, air quality, noise, historical and cultural resources, visual and scenic resources, socioeconomic conditions, public health and safety, occupational health and safety, waste management, and environmental justice.

Cumulative impacts (effects) was one of the topical areas addressed in three public scoping meetings related to this GEIS (see Appendix A). In addition, impacts from ISL facilities on groundwater and surface water, ecology, historic and cultural resources, and environmental justice were also noted. Such impacts could occur from direct and indirect effects from ISL facilities, as well as cumulative effects from these facilities and other past, present, and reasonably foreseeable future actions (RFFAs) within the four defined geographic uranium milling regions.

5.2 Other Past, Present, and Reasonably Foreseeable Future Actions in the Four Regions

This section includes summary information on historical, current, and anticipated uranium recovery sites. In addition, other current and potential projects in the regions are illustrated by current draft and final EISs within the regions. Information sources for the regions are then included. Finally, "actions matrices" for each of the regions are included.

5.2.1 Uranium Recovery Sites

Table 5.2-1 includes tabulations of the cumulative history and short-term future of uranium recovery sites in the states of Wyoming, South Dakota, Nebraska, and New Mexico based on indications from industry to NRC (NRC, 2008). A total of 40 sites is included, with the sites subdivided into three types (research and development, conventional uranium milling, and ISL facilities). A total of eight research and development sites is listed, with the majority associated with activities from the late 1970s to the early 1980s. Several of these research and development sites were associated with basic information gathering on the ISL process and later converted to a license for commercial production.

Seven of the sites involve conventional mining and milling. Two of the conventional sites were initiated in the late 1970s, while one site was decommissioned in August 2006. The remaining five listed sites are associated with license applications dated from 2007 (one application) to 2009 (four applications). It should be noted that the license application for the Sweetwater site lists both a conventional mine and an ISL facility.

A total of 22 sites past and potential future sites are in Wyoming and associated with the ISL process (including the Sweetwater site which lists both the ISL process and a conventional mine). The Homestake site is decommissioned and the type of facility which was there is unknown. Out of the 22 ISL sites, nine are in the counties comprising the Wyoming West Uranium Milling Region, and 11 are in the counties that compromise the Wyoming East Uranium Milling Region. In addition, two other Wyoming sites (Aladdin and Dewey Terrace) are in the Nebraska-South Dakota-Wyoming Uranium Milling Region (which also includes the Dewey Burdock site in South Dakota and the Crow Butte, Crow Butte North Trend, and Three Crow sites in Nebraska). Six sites are listed for the Northwestern New Mexico Uranium Milling Region, with four being conventional mining and milling operations, one being an ISL site, and the other one being decommissioned or idle.

To reflect present actions and RFFAs related to uranium recovery in the four uranium milling regions analyzed in the GEIS, the following ISL sites, unless otherwise noted, are associated with 2006 or 2007 license applications, or with 2007 letters of intent to submit license applications in 2007, 2008, 2009, or 2010 (NRC, 2008).

5.2.2 EISs as Indicators of Present and RFFAs

One indicator of present and RFFAs in the four uranium milling regions is the number of draft and final EISs prepared by federal agencies within a recent time period. The informational database which was queried is the EPA EIS Database at <http://yosemite.epa.gov/oeca/webeis.nsf/viEIS01?OpenView>. The time period selected for the review was the 38-month period from January 7, 2005, through February 22, 2008. A total of 10 draft and 22 final EISs

Table 5.2-1. Past, Existing, and Potential Uranium Recovery Sites in Wyoming, South Dakota, Nebraska, and New Mexico

Site Name	County	State	Type	Company/Owner	Date	Docket No.
Moore Ranch	Campbell	WY	ISL	Energy Metals Corp.	Oct-07	40-9073
			ISL	Conoco	Mar-82	40-8473
Nichols Ranch	Campbell & Johnson	WY	ISL	Uranerz Energy Corp.	Dec-07	-
			ISL		Jun-07	40-9067
North Butte & Ruth	Campbell	WY	ISL	Power Resources Inc.	Aug-03	40-8964
					Dec-90	40-8958
Reno Creek 1	Campbell	WY	R&D	Rocky Mountain Energy Co.	Sep-78	40-8697
Reno Creek 2	Campbell	WY	ISL	International Uranium Corp.	Jul-99	40-9048
Ruby Ranch	Campbell	WY	R&D	Cameco	Jul-82	40-8793
Highland 1	Converse	WY	Conv.	Exxon Minerals	Nov-78	40-8102
					May-78	
Highland 2	Converse	WY	ISL	Power Resources Inc.	Aug-03	40-8857
					Aug-95	
					Jul-87	
Leuenberger	Converse	WY	R&D	Teton Exploration Drilling	Aug-83	40-8781
					Jan-80	40-8728
Peterson Ranch	Converse	WY	R&D	Energy Metals Corp.		40-8502
Reynolds Ranch	Converse	WY	ISL	Power Resources Inc.	Nov-06	40-8964
Smith Ranch - Highland	Converse	WY	ISL	Power Resources Inc.	Dec-07	40-8964
					Jan-92	
South Powder River Basin	Converse	WY	R&D	Powertech Uranium Corp.	Dec-87	40-8768
					Jun-81	
Aladdin	Crook	WY	ISL	Powertech Uranium Corp	2010*	
Bison Basin	Fremont	WY	ISL	Wildhorse Energy Inc	Jun-88	
					Apr-81	40-8745
JAB & Antelope	Fremont	WY	ISL	Energy Metals Corp.	May-07	40-4492
Sky	Fremont	WY	ISL	Strathmore Minerals Corp.	May-07	40-9072
Splitrock	Fremont	WY	Conv.		Aug-06	40-1152

Table 5.2-1. Past, Existing, and Potential Uranium Recovery Sites in Wyoming, South Dakota, Nebraska, and New Mexico (continued)

Site Name	County	State	Type	Company/Owner	Date	Docket No.
Allemand-Ross	Johnson	WY	ISL	Energy Metals Corp.	2009*	N/A†
Irigaray/ Christensen Ranch	Johnson	WY	ISL	COGEMA	Apr-07	40-8502
					May-88	
				Malapai Resources	Apr/Sep -78	
Nine Mile Lake	Natrona	WY	R&D	Energy Metals Corp.	May-81	40-8721
					Feb-75	40-8380
Gas Hills	Natrona & Fremont	WY	ISL	Power Resources Inc.	Jan-04	40-8857
						40-8964
Shirley Basin - Fab	Natrona	WY	ISL	Pathfinder	2009*	N/A†
Dewey Terrace	Niobrara	WY	ISL	Powertech Uranium Corp	2010*	N/A†
North Platte	Platte	WY	R&D	Uranium Resources	Oct-81	40-8786
Lost Creek	Sweetwater	WY	ISL	UR-Energy Corp.	Dec-07	40-9068
Lost Soldier	Sweetwater	WY	ISL	UR-Energy Corp.	2009*	N/A†
West Alkali Creek	Sweetwater	WY	ISL	Wildhorse Energy	2009*	N/A†
Sweetwater	Sweetwater	WY	ISL & Conv.	Wildhorse Energy	2009*	N/A†
Willow Creek	Sweetwater	WY	R&D	J&P Corp / Western Nuclear	Feb-85	40-8684
Dewey Burdock	Fall River	SD	ISL	Powertech Uranium Corp.	Aug-07	40-9075
Crow Butte	Dawes	NE	ISL	Crow Butte Resources	Nov-07	40-8943
					Dec-89	40-8943
					Oct-84	40-8829
Crow Butte North Trend	Dawes	NE	ISL	Crow Butte Resources	May-07	40-8943
Three Crow	Dawes	NE	ISL	Crow Butte Resources	2009*	N/A†
Homestake	Cibola	NM	Conv.	Homestoke Mining Co.	May-93	40-8903
Ambrosia Lake	McKinley	NM	Conv.	Rio Algom	2009*	N/A†
Church Rock	McKinley	NM	Conv.	Strathmore Minerals Corp.	Apr-07	40-8907

Table 5.2-1. Past, Existing, and Potential Uranium Recovery Sites in Wyoming, South Dakota, Nebraska, and New Mexico (continued)

Site Name	County	State	Type	Company/Owner	Date	Docket No.
Crownpoint	McKinley	NM	ISL	Hydro Resources	Feb-97	40-8968
Mt Taylor	McKinley	NM	Conv.	Rio Grande Resources	2009*	N/A†
Roca Honda	McKinley	NM	Conv.	Strathmore Minerals Corp.	2009*	N/A†

*Information on potential future uranium recovery applications is based on indications from industry summarized in: NRC. "Expected New Uranium Recovery Facility Applications/Restarts/Expansions: Updated 1/24/2008." 2008. <http://www.nrc.gov/info-finder/materials/uranium/2008-ur-projects-list-public-012408.pdf> (08 February 2008).
†N/A—not assigned, no license application as of this writing.

were identified for specific projects and counties within the four regional areas. In addition, three draft programmatic and seven final programmatic EISs were identified for large-scale actions primarily related to several states, including Wyoming, Nebraska, and South Dakota. Tables 5.2-2 through 5.2-6 include lists of the specific project-related EISs for the four regional areas. The EISs can be obtained via Internet searching and utilized in site-specific cumulative effects assessments for proposed ISL facilities.

For the Wyoming West Uranium Milling Region, Table 5.2-2 includes three draft EISs and seven final EISs. Four projects are related to gas developments, two are associated with natural gas pipelines, and one involves coal mining. These seven projects could contribute to both local and regional cumulative impacts on air quality, land usage, terrestrial plants and animals, and groundwater and surface water resources. The extent of such contributions depends on the locations of these projects in relation to other past actions and reasonably foreseeable future actions, including ISL facilities for uranium recovery. The remaining three projects listed in Table 5.5-2 involve resource management actions which are focused on reducing historical impacts from grazing practices, improving resource conditions by planning and management, and/or minimizing continuing practices with adverse impacts.

For the Wyoming East Uranium Milling Region, Table 5.2-3 includes three draft EISs and four final EISs. Three of the projects are related to leases for coal extractions (mining), and one to the development of a power plant and transmission line. However, the draft EIS on the power plant and transmission line was withdrawn. Nonetheless, it was included in Table 5.2-3 because it could be reactivated at a future date. Coal extraction projects can contribute to local and regional cumulative impacts on air quality, land usage, terrestrial plants and animals, and surface and groundwater hydrology and quality. Further, impacts on wetlands, threatened and endangered species, and cultural resources could also occur as a result of specific project locations. As noted for the Wyoming West Uranium Milling Region, the extent of contributions of these projects to cumulative effects depends on their locations in relation to other past and present actions and RFFAs, including future ISL facilities. Two of the three remaining projects involve better management of grazing practices, while the final one is focused on the management of black-tailed prairie dogs. These latter three projects should result in environmental improvements. Table 5.2-4 includes five listed "programmatic" EISs (two draft EISs and three final EISs) and five regional EISs (one draft EIS and four final EISs). These

Table 5.2-2. Draft and Final Environmental Impact Statements (EISs) Related to the Wyoming West Uranium Milling Region (in Chronological Order From January 2005 to February 2008)

Date	Statement
February 4, 2005	U.S. Forest Service, Final EIS, Upper Green River Area Rangeland Project, Proposed Site-Specific Grazing Management Practices, Bridger-Teton Forest, Sublette, Teton and Fremont Counties, WY (resource management)
July 8, 2005	Federal Energy Regulatory Commission, Final EIS, Entrega Pipeline Project, Construction and Operation New Interstate Natural Gas Pipeline System, Right-of-Way Grant Issue by BLM, Meeker Hub and Cheyenne Hub, Rio Blanco and Weld Counties, CO, and Sweetwater County, WY (gas pipeline)
August 19, 2005	Federal Energy Regulatory Commission, Final EIS, Piceance Basin Expansion Project, Construction and Operation of a New Interstate Natural Gas Pipeline System, Wamsutter Compressor Station to Interconnections and Greasewood Compressor Station, Rio Blanco County, CO, and Sweetwater County, WY (gas pipeline)
December 2, 2005	Seminoe Road Natural Gas Development Project, Proposed Coal Bed Natural Gas Development and Operation, Carbon County, WY (gas development)
November 17, 2006	U.S. Bureau of Land Management (BLM), Final EIS, Pit 14 Coal Lease-by-Application Project, Black Butte Coal Mine, Surface Mining Operations, Federal Coal Lease Application WYW160394, Sweetwater County, WY (coal mining)
December 1, 2006	BLM, Final EIS, Atlantic Rim Natural Gas Field Development Project, Proposed Natural Gas Development to 2000 Wells, 1800 to Coal Beds and 200 to Other Formations, Carbon County, WY (gas development)
June 8, 2007	BLM, Final EIS, Casper Field Office Planning Area Resource Management Plan, Implementation, Natrona, Converse, Goshen, and Platte Counties, WY (resource management)
October 12, 2007	BLM, Draft EIS, Moxa Arch Area Infill Gas Development Project, Drill, Extract, Remove, and Market Natural Gas Under Valid Existing Oil and Gas Leases, Approval, Right-of-Way Grants and U.S. Army COE Section 404 Permit(s), Lincoln, Uinta, and Sweetwater Counties, WY (gas development)
November 1, 2007	Bureau of Indian Affairs, Draft EIS, Riverton Dome Coal Bed Natural Gas and Conventional Gas Development Project, Construction of Well Pads, Roads, Pipelines, and Production Facilities, Wind River Indian Reservation, Fremont County, WY (gas development)
January 14, 2008	BLM, Final EIS, Rawlins Field Office Planning Area Resource Management Plan, Addresses the Comprehensive Analysis of Alternatives for the Planning and Management of Public Land and Resources Administered by BLM, Albany, Carbon, Laramie, and Sweetwater Counties, WY (resource management)

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Table 5.2-3 Draft and Final Environmental Impact Statements (EISs) Related to the Wyoming East Uranium Milling Region (in Chronological Order From January 2005 to February 2008)	
Date	**Statement**
February 4, 2005	U.S. Forest Service (USFS), Final EIS, Tongue Allotment Management Plan, Proposal To Continue Livestock Grazing on All or Portions of the 22 Allotments, Bighorn National Forest, Tongue and Medicine Wheel/Paintrock Ranger Districts, Johnson, Sheridan, and Bighorn Counties, WY (resource management-grazing)
April 13, 2007	U.S. Bureau of Land Management (BLM), Final EIS, Maysdorf Coal Lease by Application (LBA) Tract, Federal Coal Application WYW154432, Implementation, Campbell County, WY (coal mining)
August 17, 2007	USFS, Final EIS, Thunder Basin Analysis Area Vegetation Management, To Implement Best Management Grazing Practices and Activities, Douglas Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, Campbell, Converse, and Weston Counties, WY (resource management-grazing)
August 31, 2007	BLM, Final EIS, Eagle Butte West Coal Lease Application, Issuance of Lease for a Tract of Federal Coal, Wyoming Powder River Basin, Campbell County, WY (coal mining)
August 31, 2007	Rural Utilities Service, Draft EIS, Dry Fork Station and Hughes Transmission Line, Construct Electric Generating Facilities, Campbell and Sheridan Counties, WY; withdrawn (power plant and transmission line)
December 21, 2007	USFS, Draft EIS, Thunder Basin National Grassland Prairie Dog Management Strategy, Land and Resource Management Plan Amendment #3, Proposes To Implement a Site-Specific Strategy To Manage Black-Tailed Prairie Dog, Douglas Ranger District, Medicine Bow-Routt National Forest and Thunder Basin National Grassland, Campbell, Converse, Niobrara, and Weston Counties, WY (species management)
February 2, 2008	BLM, Draft EIS, West Antelope Coal Lease Application Federal Coal Lease Application WYW163340, Implementation, Converse and Campbell Counties, WY (coal mining)

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Table 5.2-4. Draft and Final Programmatic or Large-Scale Environmental Impact Statements (EISs) Related to One or Both of the Wyoming Regional Study Areas (in Chronological Order From January 2005 to February 2007)	
Date	**Statement**
March 30, 2006	U.S. Bureau of Land Management (BLM), Revised Final EIS, Programmatic—Proposed Revision to Grazing Regulations for the Public Lands, 42 CFR Part 4100, in the Western Portion of the United States (resource management-grazing)
May 26, 2006	Bureau of Reclamation, Final EIS, Programmatic—Platte River Recovery Implementation Program, Assessing Alternatives for the Implementation of a Basinwide, Cooperative, Endangered Species Recovery Program, Four Target Species: Whooping Crane, Interior Least Tern, Piping Plover, and Pallid Sturgeon, NE, WY, and CO (resource management-endangered species recovery)

Table 5.2-4. Draft and Final Programmatic or Large-Scale Environmental Impact Statements (EISs) Related to One or Both of the Wyoming Regional Study Areas (in Chronological Order From January 2005 to February 2007) (continued)

Date	Statement
August 17, 2006	Federal Railroad Administration, Final EIS, Powder River Basin Expansion Project, Construction of New Rail Facilities, Finance Docket No. 33407 Dakota, Minnesota and Eastern Railroad, SD, WY, and MN (railroad)
March 22, 2007	Federal Energy Regulatory Commission, Final EIS, Rockies Express Western Phase Project, Construction and Operation for the Natural Gas Pipeline Facilities: Rockies Express (CP06–354–000), TransColorado (CP06–401–000), and Overthrust (CP06–423–000), CO, WY, NE, KS, MO, and NM (gas pipeline)
June 15, 2007	U.S. Forest Service, Final EIS, Northern Rockies Lynx Management Direction, Selected Alternative F, Conservation and Promote Recovery of the Canada Lynx, NFS and BLM to Amend Land Resource Management Plans for 18 National Forests (NF), MT, WY, UT, and ID (resource management-Canada lynx)
June 29, 2007	BLM, Final EIS, Programmatic—Vegetation Treatments Using Herbicides on BLM Public Lands in 17 Western States, including Alaska (resource management-herbicides)
August 24, 2007	BLM, Final EIS, Overland Pass Natural Gas Liquids Pipeline Project (OPP), Construction and Operation of 760-mile Natural Gas Liquids Pipeline, Right-of-Way Grant, KS, WY, and CO (gas pipeline)
November 16, 2007	U.S. Department of Energy, Draft EIS, PROGRAMMATIC—Designation of Energy Corridors in 11 Western States, Preferred Location of Future Oil, Gas, and Hydrogen Pipelines and Electricity Transmission and Distribution Facilities on Federal Land, AZ, CA, CO, ID, MT, NV, NM, UT, WA, and WY (energy corridors)
November 30, 2007	Federal Energy Regulatory Commission, Draft EIS, Rockies Express Pipeline Project, (REX-East) Construction and Operation of Natural Gas Pipeline Facilities, WY, NE, MO, IL, IN, and OH (gas pipeline)
December 21, 2007	BLM, Draft EIS, Programmatic EIS—Oil Shale and Tar Sands Resource Management Plan (RMP) Amendments To Address Land Use Allocations in Colorado, Utah, and Wyoming (oil shale and tar sands)

Table 5.2-5. Draft and Final Environmental Impact Statements (EISs) Related to the Nebraska-South Dakota-Wyoming Uranium Milling Region (in Chronological Order From January 2005 to February 2007)

Date	Statement
June 3, 2005	U.S. Forest Service (USFS), Final EIS, Dean Project Area, Proposes To Implement Multiple Resource Management Actions, Black Hills National Forest, Bearlodge Ranger District, Sundance, Crook County, WY (resource management)
August 12, 2005	USFS, Final EIS, Black-Tailed Prairie Dog Conservation and Management on the Nebraska National Forest and Associated Units, Implementation, Dawes, Sioux, Blaine, Cherry, Thomas Counties, NE, and Custer, Fall River, Jackson, Pennington, Jones, Lyman, Stanley Counties, SD (resource management-prairie dog)

Table 5.2-5. Draft and Final Environmental Impact Statements (EISs) Related to the Nebraska-South Dakota-Wyoming Uranium Milling Region (in Chronological Order From January 2005 to February 2007) (continued)	
Date	**Statement**
October 28, 2005	National Park Service, Draft EIS, Badlands National Park/North Unit General Management Plan, Implementation, Jackson, Pennington, and Shananon Counties, SD (resource management)
November 20, 2005	USFS, Final EIS, Deerfield Project Area, Proposes To Implement Multiple Resource Management Actions, Mystic Ranger District, Black Hills National Forest, Pennington County, SD (resource management)
November 25, 2005	USFS, Final EIS, Bugtown Gulch Mountain Pine Beetle and Fuels Projects, To Implement Multiple Resource Management Actions, Black Hills National Forest, Hell Canyon Ranger District, Custer County, SD (resource management)
January 13, 2006	USFS, Final EIS, Black Hills, National Forest Land and Resource Management Plan Phase II Amendment, Proposal To Amend the 1997 Land and Resource Management Plan, Custer, Fall River, Lawrence, Meade, and Pennington Counties, SD, and Crook and Weston Counties, WY (resource management)
February 3, 2006	USFS, Final EIS, Black-Tailed Prairie Dog Conservation and Management on the Nebraska National Forest and Associated Units, Implementation, Dawes, Sioux, Blaine, Cherry, Thomas Counties, NE, and Custer, Fall River, Jackson, Pennington, Jones, Lyman, Stanley Counties, SD (resource management-prairie dog)
May 12, 2006	USFS, Final Supplemental EIS, Dean Project Area, Proposes To Implement Multiple Resource Management Actions, New Information to Disclose Direct, Indirect, and Cumulative Environmental Impacts, Black Hills National Forest, Bearlodge Ranger District, Sundance, Crook County, WY (resource management)
June 1, 2007	USFS, Final EIS, Norwood Project, Proposes To Implement Multiple Resources Management Actions, Black Hills National Forest, Hell Canyon Ranger District, Pennington County, SD, and Weston and Crook Counties, WY (resource management)
June 8, 2007	USFS, Draft EIS, Nebraska and South Dakota Black-Tailed Prairie Dog Management, To Manage Prairie Dog Colonies in an Adaptive Fashion, Nebraska National Forest and Associated Units, Including Land and Resource Management Plan Amendment 3, Dawes, Sioux, Blaine Counties, NE, and Custer, Fall River, Jackson, Pennington, Jones, Lyman, Stanley Counties, SD (resource management-prairie dog)
June 29, 2007	USFS, Final EIS, Mitchell Project Area, To Implement Multiple Resource Management Actions, Mystic Ranger District, Black Hills National Forest, Pennington County, SD (resource management)
September 14, 2007	USFS, Final EIS, Citadel Project Area, Proposes To Implement Multiple Resource Management Actions, Northern Hills Ranger District, Black Hills National Forest, Lawrence County, SD (resource management)
February 22, 2008	USFS, Draft EIS, Upper Spring Creek Project, Proposes To Implement Multiple Resource Management Actions, Mystic Ranger District, Black Hills National Forest, Pennington County, SD (resource management)

Table 5.2-6. Draft and Final Environmental Impact Statements (EISs) Related to the Northwestern New Mexico Uranium Milling Region (in Chronological Order From January 2005 to February 2007)	
Date	**Statement**
February 2, 2005	Bureau of Indian Affairs, Final Supplemental EIS, Programmatic—Navajo Nation 10-Year Forest Management Plan, Selected Preferred Alternative Four, Chuska Mountain and Defiance Plateau Area, AZ and NM (forest management)
April 20, 2007	U.S. BLM, Draft EIS, Socorro Resource Management Plan Revision, Implementation, Socorro and Catron Counties, NM (resource management)

10 EISs are characterized by either management actions encompassing large geographical areas or proposed projects extending over large areas. For purposes of this GEIS, all 10 EISs will be considered as programmatic documents, whether or not they are labeled as such. Six of the EISs are related, either directly or indirectly, to energy development projects. Three of the six involve natural gas pipelines encompassing several states (two related to the Rockies Express and one to the Overland Pass project). Of interest herein are segments of the projects related to Wyoming (the Wyoming West and Wyoming East Uranium Milling Regions) and Nebraska (the Nebraska-South Dakota-Wyoming Uranium Milling Region). The U.S. Department of Energy draft EIS addresses energy corridors involving future oil, gas, and hydrogen pipelines and electricity transmission lines on federal lands in 11 western states, including Wyoming. In general, pipeline projects can have impacts on terrestrial resources within their specified corridors, and on aquatic resources near pipeline crossings of surface streams and rivers. The fifth energy-related project in Table 5.2-4 involves rail facilities associated with the Powder River Basin in Wyoming and South Dakota; regional coal transport could be enhanced by this project. The final energy-related project is associated with land use allocations for oil shale and tar sands development activities. Each of these six programmatic projects should be considered for inclusion, as appropriate, within any cumulative effects analyses of proposed ISL facilities in the Wyoming West and Wyoming East, Uranium Milling Regions. Further, the four resource management actions listed in Table 5.2-4 (grazing regulations, endangered species recovery programs for four listed species, lynx management, and herbicide usage) should also be considered within any cumulative effects studies of proposed ISL facilities in the three regions.

For the Nebraska-South Dakota-Wyoming Uranium Milling Region, a total of three draft EISs and 10 final EISs are identified in Table 5.2-5. All 13 EISs are related to resource management actions in the Black Hills National Forest or associated management units. Multiple actions related general resources management are addressed in 10 of the EISs. The remaining three actions are specifically associated with black-tailed prairie dog conservation and management. The actions in all 13 EISs are focused on improving natural resources conditions and reducing adverse impacts from various man-related activities.

For the Northwestern New Mexico Uranium Milling Region, Table 5.2-6 includes only one draft EIS and one final EIS issued over the study period. Both EISs are related to resource management; hence they are focused on improving natural resources conditions and reducing adverse impacts from various man-related activities.

5.3 Concurrent Actions

5.3.1 Wyoming West Uranium Milling Region

Table 5.3-1 contains a listing of six categories of actions in the State of Wyoming that could impact the resources and topics addressed in Chapters 3 and 4 (see Sections 3.2 and 4.2). The six categories (traditional land uses; wildlife/fisheries/forest management; recreation; government lands and land management; mineral extraction/energy development; and cultural resources preservation) include specific actions which illustrate the respective categories. Step 4 of the CEQ's 11-step cumulative effect process (see Appendix F) indicates that other past, present, and RFFAs that could contribute to cumulative effects on specific resources and topics should be identified. The listed actions in Table 5.3-1 are reflective of both past and continuing actions; further, the majority of the actions are expected to continue into the future. Locational information (by county) is included for several of the listed actions. Where county information is not available, it is assumed that the actions are statewide and applicable in both the Wyoming West and Wyoming East Uranium Milling Regions.

Table 5.3-1 also includes a series of codes to reflect that each listed action can impact certain resources and topics that are known to be impacted the ISL process for uranium recovery. The 12 resources and topics, and their designator codes are defined in the footnotes to the table. Further, these resources and topics provide the basic structure used in this GEIS for describing the affected environment (Chapter 3) and addressing the impacts of the four phases of an ISL project (Chapters 4 and 10). When a designator code (e.g., LU for land use) is listed for a specific action within a category, this denotes that the action would be anticipated to cause an impact on the resource or topic.

Table 5.3-2 contains a list of 21 coal mines in Wyoming. This listing and status information was procured from the following Wyoming website—<http://www.wma-minelife.com/coal/coalfrm/coaldat.htm>. A total of four surface mines and one underground mine are located in the Wyoming West Uranium Milling Region, with three in Carbon County and two in Sweetwater County. The 2006 production from these mines in the Hanna Coal Field and the Green River Coal Region ranged from about 25,580 to 4,912,960 metric tons [28,200 to 5,414,423 short tons]. Surface mining of coal can cause adverse impacts on land use, geology and soils, water resources, ecology, air quality, noise, historical and cultural resources, visual and scenic resources, socioeconomics, and waste management. The impacts of additional coal-related actions are included in Table 5.3-3.

5.3.2 Wyoming East Uranium Milling Region

Table 5.3-3 contains a listing of six categories of actions in the State of Wyoming that could impact the 12 resources and topics addressed in Chapters 3 and 4 for the Wyoming East Uranium Milling Region (see Section 3.3 and 4.3). The structure of Table 5.3-3 is the same as that for the Wyoming West Uranium Milling Region (Table 5.3-1). Where county information is not available, it is assumed that the actions are statewide and applicable in both the Wyoming West and Wyoming East Uranium Milling Regions. The listed actions in Table 5.3-3 are reflective of both past and continuing actions; further, the majority of the actions are expected to continue into the future.

Table 5.3-1. Other Actions Concurrent With Uranium Recovery in the Wyoming West Uranium Milling Region*

Categories of Actions	Impacts on Resource and Topics†
Traditional Land Uses	
Livestock grazing	LU, WR, E, HC, S
Agricultural activities	LU, WR, E, HC, S
Protection of significant alluvial farmland	LU, WR, S
Irrigation	GS, WR, S
Development of new or expanded communities	LU, T, GS, WR, E, HC, S, WM
Roads and highways	LU, T, WR, E, HC, S
Indian Reservations Wind River [Northern Arapaho and Eastern Shoshone (Fremont)]	LU, WR, E, HC, VS
Wildlife/Fisheries/Forest Management	
Timber harvests (see National Forests)	LU, T, GS, WR, E, N, S
Wild horse management (Carbon, Sweetwater, Fremont)	LU, E
Protection of T/E species – critical habitat identification	LU, E
Riparian habitat preservation/enhancement	LU, WR, E
Recreation (See Information on National Forests and State Parks for Specific Location of Activities)	
Hunting, fishing, hiking	E
Camping	LU, E
Overland vehicle use (OHVs)	LU, GS, WR, E
Trail riding	LU, GS
Recreation management plans (Natrona, Converse)	LU, WR, E, HC, VS
Government Lands and Land Management	
State Parks	
• Sinks Canyon and Boysen State Park and Reservoir (Fremont)	LU, WR, E
• Endess K. Wilkins State Park and Independence Rock State Historical Site (Natrona)	LU, E, HC
• Seminoe SP & Reservoir (Carbon)	LU, WR, E
National Forest/Grasslands	
• Shoshone National Forest (Fremont)	LU, WR, E, HC, VS
National Wildlife Areas	
• Pathfinder National Wildlife Refuge (Natrona/Carbon)	LU, E, HC, VS
• Seedskadee National Wildlife Refuge (Sweetwater)	LU, E, HC, VS

Table 5.3-1. Other Actions Concurrent With Uranium Recovery in the Wyoming West Uranium Milling Region* (continued)

Categories of Actions	Impacts on Resource and Topics†
Mineral Extraction/Energy Development	
Transmission lines/substations (Fremont)	LU, E
Coal related actions (Weston, Campbell, Converse, Carbon, Sweetwater)	
• Power plants	WR, E, AQ, N, HC, VS, S, WM
• Railroad development for hauling coal; past and present action, throughout coal regions	LU, T, WR, E, N, S
• Coal mines	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• Mine reclamation (Carbon, Converse, probably Campbell)	GS, WR, E, AQ
• Coal Bed natural gas/methane development (Carbon, Fremont, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S
Natural gas and oil	
• Conventional oil development (Natrona, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• Natural gas field development (Carbon, Sweetwater)	LU, GS, WR, E, AQ, HC, S
• Overland natural gas pipelines and compressor stations (Carbon, Sweetwater, Natrona, Fremont)	LU, T, WR, E, N, HC, S
• Oil shale and tar sands energy development (Fremont, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• CO_2-enhanced oil recovery (Natrona, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S, WM
Uranium activities	
• Permitting of new or inactive ISL facilities (Johnson, Campbell, Fremont, Sweetwater)	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Conventional mining and milling	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Reclaimed open pit mines (Converse, Carbon, Fremont)	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
Mining of other minerals	
• Trona (Sweetwater)	LU, T, GS, WR, E, AQ, N, HC, VS, S, WM

Table 5.3-1. Other Actions Concurrent With Uranium Recovery in the Wyoming West Uranium Milling Region* (continued)	
Categories of Actions	**Impacts on Resource and Topics†**
Cultural Resources Preservation	
Historic trails—crisscrossing state of Wyoming	LU, HC
Ghost towns (Fremont)	LU, HC

* The Wyoming West Uranium Milling Region includes the western parts of Natrona and Carbon Counties, the northeastern portion of Sweetwater County, and the eastern portion of Fremont County.
†The resources and topics codes include
- LU = land use
- T = transportation
- GS = geology and soils
- WR = water resources (wetlands, surface water, and groundwater)
- E = ecology (terrestrial, aquatic, and threatened/endangered species)
- AQ = air quality (non-radiological)
- N = noise
- HC = historical and cultural resources
- VS = visual and scenic resources
- S = socioeconomics
- PO = public and occupational health and safety
- WM = waste management

Table 5.3-2. Coal Mining Projects as Identified by the Wyoming Mining Association (Data Through 2006)*

Mine Name	Owner/Operator (If Different)	Location	Mine Type	Production in 2006 (Tons)
Powder River Basin Coal				
Buckskin	Buckskin Mining Co.	Campbell Co.	Surface	22,768,303
Rawhide	Powder River Coal	Campbell Co.	Surface	17,092,993
Dry Fork	Western Fuels of WY	Campbell Co.	Surface	5,860,998
Eagle Butte	Foundation Coal West	Campbell Co.	Surface	25,355,158
KFx	KFx Fuel Partners	Campbell Co.	Surface	87,863 (just recently back in production)
Wyodak	Wyodak Resources Development	Campbell Co.	Surface	4,698,473
Caballo	Powder River	Campbell Co.	Surface	32,700,000
Belle Ayr	Foundation Coal West	Campbell Co.	Surface	24,593,035
Cordero/Rojo	Rio Tinto Energy America	Campbell Co.	Surface	39,747,620
Coal Creek		Campbell Co.		3,097,584 (No production 2000-2005)
Jacobs Run	Rio Tinto Energy America	Campbell Co.	Surface	40,000,376
Black Thunder	Thunder Basin Coal	Campbell Co.	Surface	92,517,728
North Rochelle	Triton Coal	Campbell Co.	Surface	No data since 2004
North Antelope/ Rochelle	Powder River Coal	Campbell Co.	Surface	88,527,969
Antelope	Rio Tinto Energy America	Converse Co.	Surface	33,984,178

Table 5.3-2. Coal Mining Projects as Identified by the Wyoming Mining Association (Data Through 2006)* (continued)

Mine Name	Owner/Operator (If Different)	Location	Mine Type	Production in 2006 (Tons)
Dave Johnston	Glenrock Coal	Converse Co.	Surface	Reclaimed—no production since 2000
Seminoe #2	Arch Coal, Inc.	Carbon Co.	Surface	Final reclamation in 2006
Medicine Bow	Arch Coal, Inc.	Carbon Co.	Surface	28,212, but 0 in 2005; relatively small operation
Green River Coal Region				
Jim Bridger	Bridger Coal	Sweetwater Co.	Surface	5,414,423
Black Butte	Black Butte Coal	Sweetwater Co.	Surface	3,410,309
*SOURCE: http://www.wma-minelife.com/coal/coalfrm/coaldat.htm				

Table 5.3-3. Other Actions Related to or Conflicting With Uranium Recovery in the Wyoming East Uranium Milling Region*

Categories of Actions	Impacts on Resource and Topics†
Traditional Land Uses	
Livestock grazing	LU, WR, E, HC, S
Agricultural activities	LU, WR, E, HC, S
Protection of significant alluvial farmland	LU, WR, S
Irrigation	GS, WR, S
Development of new or expanded communities	LU, T, GS, WR, E, HC, S, WM
Roads and highways	LU, T, WR, E, HC, S
Wildlife/Fisheries/Forest Management	
Timber harvests (see National Forests)	LU, T, GS, WR, E, N, S
Wild horse management (Carbon, Sweetwater, Fremont)	LU, E
Protection of T/E species – critical habitat identification	LU, E
Riparian habitat preservation/enhancement	LU, WR, E
Prairie dog management (Campbell, Converse, Weston)	LU, E
Recreation (see Information on National Forests and State Parks for Specific Location of Activities)	
Hunting, fishing, hiking	E
Camping	LU, E
Overland vehicle use (OHVs)	LU, GS, WR, E
Trail riding	LU, GS
Recreation management plans (Natrona, Converse)	LU, WR, E, HC, VS
Government Lands and Land Management	
State Parks	
• Endess K. Wilkins State Park and Independence Rock State Historical Site (Natrona)	LU, E, HC
• Seminoe SP & Reservoir (Carbon)	LU, WR, E

Table 5.3-3. Other Actions Related to or Conflicting With Uranium Recovery in the Wyoming East Uranium Milling Region* (continued)	
Categories of Actions	**Impacts on Resource and Topics†**
National Forest/Grasslands	
• Thunder Basin National Grasslands (Weston, Campbell, Converse)	LU, WR, E, HC, VS
• Medicine Bow National Forest (Converse, Natrona, Carbon)	LU, WR, E, HC, VS
• Bighorn National Forest (Johnson)	LU, WR, E, HC, VS
National Wildlife Areas	
• Pathfinder NWA (Natrona/Carbon)	LU, E, HC, VS
Mineral Extraction/Energy Development	
Transmission lines/substations (Fremont)	LU, E
Coal-related actions (Weston, Campbell, Converse, Carbon, Sweetwater)	
• Power plants	WR, E, AQ, N, HC, VS, S, WM
• Railroad development for hauling coal; past and present action, throughout coal regions	LU, T, WR, E, N, S
• Coal mines	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• Mine reclamation (Carbon, Converse, probably Campbell)	GS, WR, E, AQ
• Coal leasing (Campbell, Converse)	LU, S
• Coal Bed natural gas/methane development (Carbon, Fremont, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S
Natural gas and oil	
• Conventional oil development (Natrona, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• Natural gas field development (Carbon, Sweetwater)	LU, GS, WR, E, AQ, HC, S
• Overland natural gas pipelines and compressor stations (Carbon, Sweetwater, Natrona, Fremont)	LU, T, WR, E, N, HC, S
• Oil shale and tar sands energy development (Fremont, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• CO_2-enhanced oil recovery (Natrona, Sweetwater)	LU, GS, WR, E, AQ, N, HC, VS, S, WM
Uranium activities	
• Permitting of new or inactive ISL facilities (Johnson, Campbell, Fremont, Sweetwater)	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Continued operation of ISL facilities (Converse)	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Conventional mining and milling	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Reclaimed open pit mines (Converse, Carbon, Fremont)	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
Mining of other minerals	
• Bentonite (Weston, Johnson, Natrona)	LU, T, GS, WR, E, AQ, N, HC, VS, S, WM

Table 5.3-3. Other Actions Related to or Conflicting With Uranium Recovery in the Wyoming East Uranium Milling Region* (continued)	
Categories of Actions	**Impacts on Resource and Topics†**
Cultural Resources Preservation	
Historic trails – crisscrossing state of Wyoming	LU, HC
Historic mines and other pioneer sites (Converse, Johnson)	LU, HC

* The Wyoming East Uranium Milling Region is composed of Converse County, the southern portion of Campbell County, the southeastern portion of Johnson County, and the eastern boundary of Natrona County. Further, the Nebraska-South Dakota-Wyoming Milling Region includes all or portions of three Wyoming counties; specifically, this region includes Crook County, the eastern half of Weston County, and the northeastern portion of Niobrara County.

†The resources and topics codes include
- LU = land use
- T = transportation
- GS = geology and soils
- WR = water resources (wetlands, surface water, and groundwater)
- E = ecology (terrestrial, aquatic, and threatened/endangered species)
- AQ = air quality (non-radiological)
- N = noise
- HC = historical and cultural resources
- VS = visual and scenic resources
- S = socioeconomics
- PO = public and occupational health and safety
- WM = waste management

As noted previously, Table 5.3-2 contains a list of coal mines in Wyoming. This listing and status information was procured from the following Wyoming website—<http://www.wma-minelife.com/coal/coalfrm/coaldat.htm>. The Wyoming East Uranium Milling Region includes 15 surface mines in the Powder River Basin, with 13 in Campbell County and two in Converse County. The 2006 coal production levels indicated that 14 mines were in operation in the Wyoming East Uranium Milling Region, with annual production levels ranging from 79,700 to about 83,916,000 metric tons [87,900 to 92,500,000 short tons]. Surface mining of coal can cause adverse impacts on land use, geology and soils, water resources, ecology, air quality, noise, historical and cultural resources, visual and scenic resources, socioeconomics, and waste management. The impacts of additional coal-related actions are included in Table 5.3-3.

5.3.3 Nebraska-South Dakota-Wyoming Uranium Milling Region

Table 5.3-4 is structured similarly to Table 5.3-1, with a listing of six categories of actions in the states of Nebraska and South Dakota that could impact the resources and topics addressed in Chapters 3 and 4 (see Sections 3.4 and 4.4). Concurrent actions in Wyoming are described in Tables 5.3-1 and 5.3-3. When the county is not identified for the action, it is assumed that the actions are statewide and applicable in the South Dakota and Nebraska portions of the Nebraska-South Dakota-Wyoming Uranium Milling Region. There are no coal mines identified in the affected counties in this uranium milling region. The listed actions in Table 5.3-4 are reflective of both past and continuing actions; further, the majority of the actions are expected to continue into the future.

Table 5.3-4. Other Actions Concurrent With Uranium Recovery in the Nebraska-South Dakota-Wyoming Uranium Milling Region*

Categories of Actions	Impacts on Resource and Topics†
Traditional Land Uses	
Livestock grazing	LU, WR, E, HC, S
Agricultural activities	LU, WR, E, HC, S
Protection of significant alluvial farmland	LU, WR, S
Irrigation	GS, WR, S
Development of new or expanded communities	LU, T, GS, WR, E, HC, S, WM
Roads and highways	LU, T, WR, E, HC, S
Indian Reservations • Pine Ridge (Oglala Sioux)	 LU, WR, E, HC, VS
Wildlife/Fisheries/Forest Management	
Timber harvests (see National Forests)	LU, T, GS, WR, E, N, S
Wild horse management	LU, E
Protection of T/E species; critical habitat identification	LU, E
Riparian habitat preservation/enhancement	LU, WR, E
Prairie dog management (Weston, Sioux, Dawes)	LU, E
Wildland fires (Black Hills National Forest; all four counties)	LU, T, WR, E, AQ, HC, VS, S
Recreation (See Information on National Forests and State Parks for Specific Location of Activities)	
Hunting, fishing, hiking	E
Camping	LU, E
Overland vehicle use (OHVs)	LU, GS, WR, E
Trail riding	LU, GS
Recreation management plans	LU, WR, E, HC, VS
Scenic byways (Custer, Lawrence, and Pennington)	LU, T, WR, E, HC, VS, S
Black Hills major tourist center (all four counties in South Dakota)	LU, T, WR, E, HC, VS, S
Government Lands and Land Management	
National Forest/Grasslands (Wyoming) • Thunder Basin National Grasslands (Weston, Campbell, Converse)	 LU, WR, E, HC, VS
National Parks/Monuments (Wyoming) • Devils Tower, New Mexico (Weston)	 LU, WR, E, HC, VS
State Parks (South Dakota) • Custer State Park (Custer) • Angostura State Recreation Area (Fall River)	 LU, WR, E LU, WR, E

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Table 5.3-4. Other Actions Concurrent With Uranium Recovery in the Nebraska-South Dakota-Wyoming Uranium Milling Region* (continued)	
Categories of Actions	**Impacts on Resource and Topics†**
National Forest/Grasslands (South Dakota)	
• Black Hills National Forest (Fall River, Custer, Pennington, Lawrence)	LU, WR, E, HC, VS
• Buffalo Gap National Grassland (Fall River, Custer, Pennington)	LU, WR, E, HC, VS
National Parks/Monuments (South Dakota)	
• Mt. Rushmore National Memorial (western Pennington)	LU, WR, E, HC, VS
• Jewel Cave National Monument (Custer)	LU, WR, E, HC, VS
• Wind Cave National Park (Custer)	LU, WR, E, HC, VS
State Parks/Recreation Areas (Nebraska)	
• Chadron SP (Dawes); within the Nebraska National Forest	LU, WR, E, HC, VS
• Ft. Robinson SP (Sioux, Dawes)	LU, WR, E, HC, VS
• Box Butte Reservoir State Recreation Area (Dawes)	LU, WR, E, HC, VS
National Forests/Grasslands	
• Oglala National Grasslands (Sioux, Dawes)	LU, WR, E, HC, VS
o Toadstool Geologic Park (Sioux); operated by US Forest Service	LU, WR, E, HC, VS
• Nebraska National Forest (Sioux, Dawes)	LU, WR, E, HC, VS
o Within the Forest is Soldier Creek Wilderness (Sioux)	LU, WR, E, HC, VS
o Within the Forest is Pine Ridge National Recreation Area (Dawes)	LU, WR, E, HC, VS
National Parks/Monuments	
• Agate Fossil Beds National Monument (Sioux)	LU, WR, E, HC, VS
Mineral Extraction/Energy Development	
Transmission lines/substations	LU, E
Coal-related actions	
• Power plants	WR, E, AQ, N, HC, VS, S, WM
• Railroad development for hauling coal; past and present action, throughout coal regions	LU, T, WR, E, N, S
• Coal mines	GS, WR, E, AQ
• Mine reclamation	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• Coal leasing	LU, GS, WR, E, AQ, N, HC, VS, S

Table 5.3-4. Other Actions Concurrent With Uranium Recovery in the Nebraska-South Dakota-Wyoming Uranium Milling Region* (continued)

Categories of Actions	Impacts on Resource and Topics†
Natural gas and oil	
• Oil and gas leasing (Custer National Forest)	LU, GS
• Conventional oil development (Fall River)	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• Natural gas field development	LU, GS, WR, E, AQ, N, HC, S
• Overland natural gas pipelines and compressor stations	LU, T, WR, E, N, HC, S
Uranium activities	
• Permitting of new or inactive ISL facilities (Fall River, Custer, Dawes)	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Continued operation of ISL facilities	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Conventional mining and milling	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
Other	
• Energy corridors‡	LU, T, WR, E, N, HC, S
• Limestone conveyor system (Custer)§	LU, T, E, AQ, N, HC, VS, S
Cultural Resources Preservation	
Big Thunder historic gold mine (Pennington)	LU, HC
Several pioneer homesteads in Black Hills	LU, HC
Museum of the Fur Trade (Dawes)	LU, HC

*The Nebraska-South Dakota-Wyoming Uranium Milling Region includes all or portions of three Wyoming counties; specifically, this region includes Crook County, the eastern half of Weston County, and the northeastern portion of Niobrara County. In addition, the South Dakota portion of the region includes Fall River, Custer, and Lawrence Counties and the western half of Pennington County. The Nebraska portion of the region includes Sioux, Box Butte, and Dawes Counties in the far northwestern portion of the state.

†The resources and topics codes include
- LU = land use
- T = transportation
- GS = geology and soils
- WR = water resources (wetlands, surface water, and groundwater)
- E = ecology (terrestrial, aquatic, and threatened/endangered species)
- AQ = air quality (non-radiological)
- N = noise
- HC = historical and cultural resources
- VS = visual and scenic resources
- S = socioeconomics
- PO = public and occupational health and safety
- WM = waste management

‡Federal Departments of Agriculture, Commerce, Defense, Energy, and the Interior are proposing to designate corridors on Federal land for locating future oil, natural gas, and hydrogen pipelines and electricity transmission and distribution infrastructure in the West. These corridors would be the agency-preferred locations where pipelines and transmission lines may be sited and built in the future. Such corridors could be proposed for South Dakota.

§This is a proposed 11-km [7-mi] enclosed, aboveground conveyor belt to transfer limestone in Custer County, South Dakota. The project will cross national forest lands, BLM lands, and private lands. The BLM is preparing an EIS on this project.

5.3.4 Northwestern New Mexico Uranium Milling Region

Table 5.3-5 is structured similarly to Table 5.3-1, with a listing of six categories of actions in the State of New Mexico that could impact the resources and topics addressed in Chapters 3 and 4 (see Sections 3.5 and 4.5). The six categories (traditional land uses; wildlife/fisheries/forest management; recreation; government lands and land management; mineral extraction/energy development; and cultural resources preservation) include specific actions which illustrate the respective categories. The listed actions in Table 5.3-5 are reflective of both past and continuing actions; further, the majority of the actions are expected to continue into the future.

5.4 Approaches to Conducting a Site-Specific Cumulative Effects Analysis

Each of the four uranium milling regions analyzed in this GEIS includes existing and previous uranium recovery facilities (Table 5.2-1), as well as anticipated new, modified, or planned restarts of uranium ISL facilities (NRC, 2008). In addition, each region includes a number of individual and programmatic present and RFFAs as reflected by recent EISs (Tables 5.2-2 through 5.2-6).

Table 5.3-5. Other Actions Concurrent With Uranium Recovery in the Northwestern New Mexico Uranium Milling Region*

Categories of Actions	Impacts on Resource and Topics†
Traditional Land Uses	
Livestock grazing	LU, WR, E, HC, S
Agricultural activities	LU, WR, E, HC, S
Protection of significant alluvial farmland	LU, WR, S
Irrigation	GS, WR, S
Development of new or expanded communities	LU, T, GS, WR, E, HC, S, WM
Roads and highways	LU, T, WR, E, HC, S
Indian reservations	
• Navajo (McKinley)	LU, WR, E, HC, VS
• Zuni (McKinley, Cibola)	LU, WR, E, HC, VS
• Ramah Navajo (Cibola)	LU, WR, E, HC, VS
• Acoma (Cibola)	LU, WR, E, HC, VS
• Lacuna (Cibola)	LU, WR, E, HC, VS
• Canonito (Cibola)	LU, WR, E, HC, VS
• Alamo Bend Navajo (Socorro)	LU, WR, E, HC, VS
Wildlife/Fisheries/Forest Management	
Timber harvests (see National Forests)	LU, T, GS, WR, E, N, S
Wild horse management	LU, E
Protection of T/E species; critical habitat identification	LU, E
Riparian habitat preservation/enhancement	LU, WR, E
Endangered species reintroduction (Aplomado falcon) (Socorro)	LU, E

Table 5.3-5. Other Actions Concurrent With Uranium Recovery in the Northwestern New Mexico Uranium Milling Region* (continued)	
Categories of Actions	**Impacts on Resource and Topics†**
Recreation (See Information on National Forests and State Parks for Specific Location of Activities)	
Hunting, fishing, hiking	E
Camping	LU, E
Overland vehicle use (OHVs) (Catron, Socorro)	LU, GS, WR, E
Trail riding	LU, GS
Recreation management plans	LU, WR, E, HC, VS
Government Lands and Land Management	
State Parks	
• Bluewater SP (Cibola)	LU, WR, E
• Red Rock SP (McKinley)	LU, WR, E
National Forest/Grasslands	
• Cibola National Forest (all four counties)	LU, WR, E, HC, VS
• Apache-Sitgreaves National Forest (Catron)	LU, WR, E, HC, VS
• Gila National Forest (Catron)	LU, WR, E, HC, VS
National Monuments/Recreation areas/Wildlife refuges/Conservation areas	
• Gila Cliff Dwelling National Monument (Catron)	LU, E, HC, VS
• El Morro National Monument (Cibola)	LU, E, HC, VS
• Chain of Craters Wilderness Study Area (Cibola)	LU, E, HC, VS
• El Malpais National Conservation Area (surrounds El Malpais National Monument, but does not include it; Cibola)	LU, E, HC, VS
• El Malpais National Monument; lava beds (Cibola)	LU, E, HC, VS
• Salinas Pueblo Mission National Monument (Socorro)	LU, E, HC, VS
• Datil Well NRA (Catron; within the Cibola National Forest)	LU, E, HC, VS
• Bosque del Apache NWR (Socorro)	LU, E, HC, VS
Ft. Wingate Military Reservation (McKinley)	LU, E, HC
Mineral Extraction/Energy Development	
Transmission lines/substations	LU, E
Coal-related actions	
• Power plants (McKinley)	WR, E, AQ, N, HC, VS, S, WM
• Coal mines (McKinley, Cibola)	GS, WR, E, AQ
• Coal leasing	LU, GS, WR, E, AQ, N, HC, VS, S

Table 5.3-5. Other Actions Concurrent With Uranium Recovery in the Northwestern New Mexico Uranium Milling Region* (continued)	
Categories of Actions	**Impacts on Resource and Topics†**
Natural gas and oil	
• Conventional oil development	LU, GS, WR, E, AQ, N, HC, VS, S, WM
• Natural gas field development (McKinley)	LU, GS, WR, E, AQ, HC, S
• Overland natural gas pipelines and compressor stations	LU, T, WR, E, N, HC, S
Uranium activities	
• Permitting of new or inactive ISL facilities	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Continued operation of ISL facilities	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Conventional mining and milling	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
• Reclaimed open pit mines	LU, T, GS, WR, E, AQ, N, HC, VS, S, PO, WM
Mining of other minerals	
• Perlite (Socorro)	LU, T, GS, WR, E, AQ, N, HC, VS, S, WM
• Humate (McKinley)	LU, T, GS, WR, E, AQ, N, HC, VS, S, WM
• Travertine (Cibola)	LU, T, GS, WR, E, AQ, N, HC, VS, S, WM
Cultural Resources Preservation	
Numerous Native American sacred sites	LU, HC

*The Northwestern New Mexico Uranium Milling Region includes McKinley County and the northern portions of Cibola, Catron, and Socorro Counties.
†The resources and topics codes include
LU = land use
T = transportation
GS = geology and soils
WR = water resources (wetlands, surface water, and groundwater)
E = ecology (terrestrial, aquatic, and threatened/endangered species)
AQ = air quality (non-radiological)
N = noise
HC = historical and cultural resources
VS = visual and scenic resources
S = socioeconomics
PO = public and occupational health and safety
WM = waste management

As described in Chapter 4, construction, operations, aquifer restoration, and decommissioning/reclamation activities associated with uranium ISL facilities can affect different resource areas within each of the uranium milling regions. In conducting a site-specific cumulative effects analysis, an approach such as the CEQ (1997) 11-step process described in Appendix D can be tailored, depending on the current conditions of the affected environment and the level of impacts (SMALL, MODERATE, or LARGE) to a specific resource area.

If a proposed ISL facility (or an expansion/restart) is in compliance with applicable federal and state laws and policies (e.g., the Endangered Species Act) and if the expected impacts to a specific resource area are small, then a Level 1 site-specific cumulative effects analysis would be appropriate. Based on the CEQ (1997) 11-step process described in Appendix D, a Level 1 analysis is based on consideration of the four scoping steps (Steps 1 through 4) along with two of the three environmental description steps (Steps 6 and 7). Further, brief consideration should be given to the types, sizes, and locations of other present and RFFAs in the uranium milling region (including other uranium ISL facilities) and their contribution to effects on each resource area.

If concerns are identified during the site-specific analysis with respect to the sustainability or quality of a given resource area in the uranium milling region, then a Level 2 cumulative effects analysis would be appropriate. Based on the CEQ (1997) 11-step process (see Appendix D), a Level 2 analysis is based on the same considerations as a Level 1 analysis, with a more detailed evaluation of the types, sizes, and locations of present and RFFAs and their relative contributions to effects on each resource area (Step 8). The effects of each of the other actions (for example, activities included in the EISs identified in Tables 5.2-3 through 5.2-6) would be tabulated and discussed with respect to the timing of different stages (construction, operation, aquifer restoration, and decommissioning/reclamation) of the ISL facility life cycle.

If the site-specific analysis identifies that a specific resource area reflects stresses that exceed regulatory or policy limits, has diminished usage due to quality degradation, or there are concerns regarding noncompliance with respect to statutory or policy requirements as reflected by moderate or large impacts, then a Level 3 cumulative effects analysis would be appropriate. In undertaking a site-specific Level 3 analysis, each of the CEQ (1997) 11 steps would be applied, including scoping (Steps 1 through 4), environmental description (Steps 5-7) and environmental consequences (Steps 8 through 11). Detailed descriptions and analysis would be used to fully characterize the cumulative effects of the ISL facility and other past, present, and RFFAs on the status of a resource area, such as land use or groundwater, within the affected environment.

A systematic resource-by-resource review of the conditions of the affected environment within each geographic region, the levels of impacts of ISL facilities for all four stages of the ISL lifecycle (construction, operations, aquifer restoration, and decommissioning) and the identification of other past, present, and RFFAs in each designated region, was used to determine the potential level of cumulative effects analysis. The results of this analysis revealed that a Level 1 or Level 2 site-specific cumulative effects analysis would be expected to be sufficient for nine resources in each of the four regions. The nine resources included land use, transportation, geology and soils, air quality, noise, visual and scenic resources, socioeconomics, public and occupational health and safety, and waste management. Another result of this review was that for the four other resources, a Level 1, 2, or 3 analysis might be required. The Level 3 analysis would be highly dependent on local site-specific conditions. The four resources that could potentially be analyzed at this level included surface water resources (primarily wetlands), groundwater resources, terrestrial and aquatic ecology (primarily threatened or endangered species), and historical and cultural resources.

5.5 References

CEQ. "Considering Cumulative Effects Under the National Environmental Policy Act." Washington, DC: Executive Office of the President. 1997.

Committee on Hard Rock Mining on Federal Lands. "Hardrock Mining on Federal Lands." Washington, DC: National Research Council, National Academics Press. 1999.

NRC. "Expected New Uranium Recovery Facility Applications/Restarts/Expansions: Updated 1/24/2008." 2008. <http://www.nrc.gov/info-finder/materials/uranium/2008-ur-projects-list-public-012408.pdf> (08 February 2008).

6 ENVIRONMENTAL JUSTICE

Environmental justice means that people of all races, cultures, and incomes are treated fairly with regard to the development and implementation (or lack thereof) of environmental laws, regulations, and policies (Executive Order 12898). On February 11, 1994, The President signed Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," which directs each federal agency to "... make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations" (Office of the President, 1994). Executive Order 12898 makes it clear that environmental justice matters also apply to programs involving Native Americans (CEQ, 1997).

On December 10, 1997, the Council on Environmental Quality (CEQ) issued, "Environmental Justice Guidance Under the National Environmental Policy Act." The Council developed this guidance to "... further assist Federal agencies with their National Environmental Policy Act (NEPA) procedures." As an independent agency, the Council's guidance is not binding on the U.S. Nuclear Regulatory Commission (NRC). However, the NRC considered the Council's guidance on environmental justice in developing its own environmental justice analysis procedures.

In August 2004, NRC published a final policy statement in the Federal Register to provide a "... comprehensive statement of the Commission's policy on the treatment of environmental justice matters in NRC regulatory and licensing actions" (NRC, 2004). The NRC Environmental Justice Policy is to use its normal and traditional NEPA review process to meet the goals articulated in Executive Order 12898. "NRC believes that an analysis of disproportionately high and adverse impacts needs to be done as part of the agency's NEPA obligations to accurately identify and disclose all significant environmental impacts associated with a proposed action."

NRC received comments on its draft Environmental Justice Policy on whether environmental justice should be considered in a programmatic or generic environmental impact statement (GEIS). In clarifying its position, NRC noted that for a non-site-specific assessment of potential environmental impacts such as that presented in a GEIS, it is "... difficult to foresee or predict many circumstances, if any, in which a meaningful environmental justice analysis could be completed." However, the final policy statement does not preclude the possibility of an environmental justice analysis in a GEIS if "... a meaningful review can be completed."

NRC has concluded that it can use the GEIS to help conduct a meaningful environmental justice analysis by using population information available through the U.S. Census Bureau, the regional and sub-regional information discussed in Chapter 3, and the potential environmental impacts evaluated in Chapters 4 and 5. The GEIS lists regional resource areas where there is no information indicating that the impacts described in Chapters 4 and 5 would be any different for the identified minority or low-income population than the general population. The GEIS also lists regional resource areas where further site-specific information should be gathered to evaluate whether there is a disproportionately high and adverse environmental or health impact on the minority or low-income populations in the area.

It should be noted, under NEPA, the identification of a disproportionately high and adverse human health or environmental effect on a minority or low-income population does not preclude a proposed agency action from going forward, nor does it necessarily result in a conclusion that a proposed action is environmentally unsatisfactory. Rather, the identification of such an effect should heighten agency attention to alternatives (including alternative sites), mitigation strategies, monitoring needs, and preferences expressed by the affected community or population (CEQ 1997).

The following sections in this chapter discuss NRC's procedure to conduct an environmental justice analysis and then apply the procedure to the regional areas under consideration in this GEIS.

6.1 Environmental Justice Analysis

6.1.1 Background and Guidance

NRC environmental justice guidance (NRC, 2004) discusses the procedure to evaluate potential disproportionately high and adverse impacts associated with physical, socioeconomic, health, and cultural resources to low-income and minority populations. The environmental justice process is shown in Figure 6.1-1.

NRC guidance (NRC, 2004; 2003, Appendix C) states that NRC's policy is to address environmental justice in every environmental impact statement (EIS) and, as appropriate, supplements to an EIS, which are issued by the Office of Nuclear Materials Safety and Safeguards. Under most circumstances, no environmental justice review should be conducted where an environmental assessment is prepared because if a particular action would have *no significant environmental impact*, then there is no need to consider whether the action would have disproportionately high and adverse impacts on certain populations. However, on a case-by-case basis where there is an obvious potential that consideration of site-specific demographic information may identify significant impacts that would not otherwise be considered, a manager can determine that an environmental justice review should be conducted for an environmental assessment.

Components of an Environmental Justice Analysis (CEQ, 1997; NRC, 2004)

Minority population is identified as consisting of individual(s) who are American Indian or Alaskan Native, Asian or Pacific Islander, Black (not of Hispanic origin), or Hispanic.

Low-income population is identified in comparison to statistical poverty thresholds identified in U.S. Census Bureau information.

Disproportionately high and adverse effects include both potential effects on human health and the environment. Disproportionately high and adverse effects are evaluated by determining whether there are one or more attributes that could lead to impacts that would be expected to significantly and adversely affect a minority or low-income population more than the general population as a whole.

The first step in the process is to gather demographic and socioeconomic data for the immediate site and surrounding communities to identify minority or low-income populations. The guidance document describes the radius of influence it considers when it evaluates potential environmental justice concerns for licensing a uranium recovery facility, as an ISL mill. That radius is normally 1 km [0.6 mi] from the center of the proposed site in urban areas and 6.4 km [4 mi] if the facility is located in a rural area.

Most potential ISL facilities are expected to be located in rural areas, indicating that the 6.4-km [4-mi] radius would generally be appropriate. The NRC final policy statement (NRC, 2004) notes, however, that the distances are intended as guidelines, not requirements. The geographic scale considered in a site-specific environmental justice analysis should be

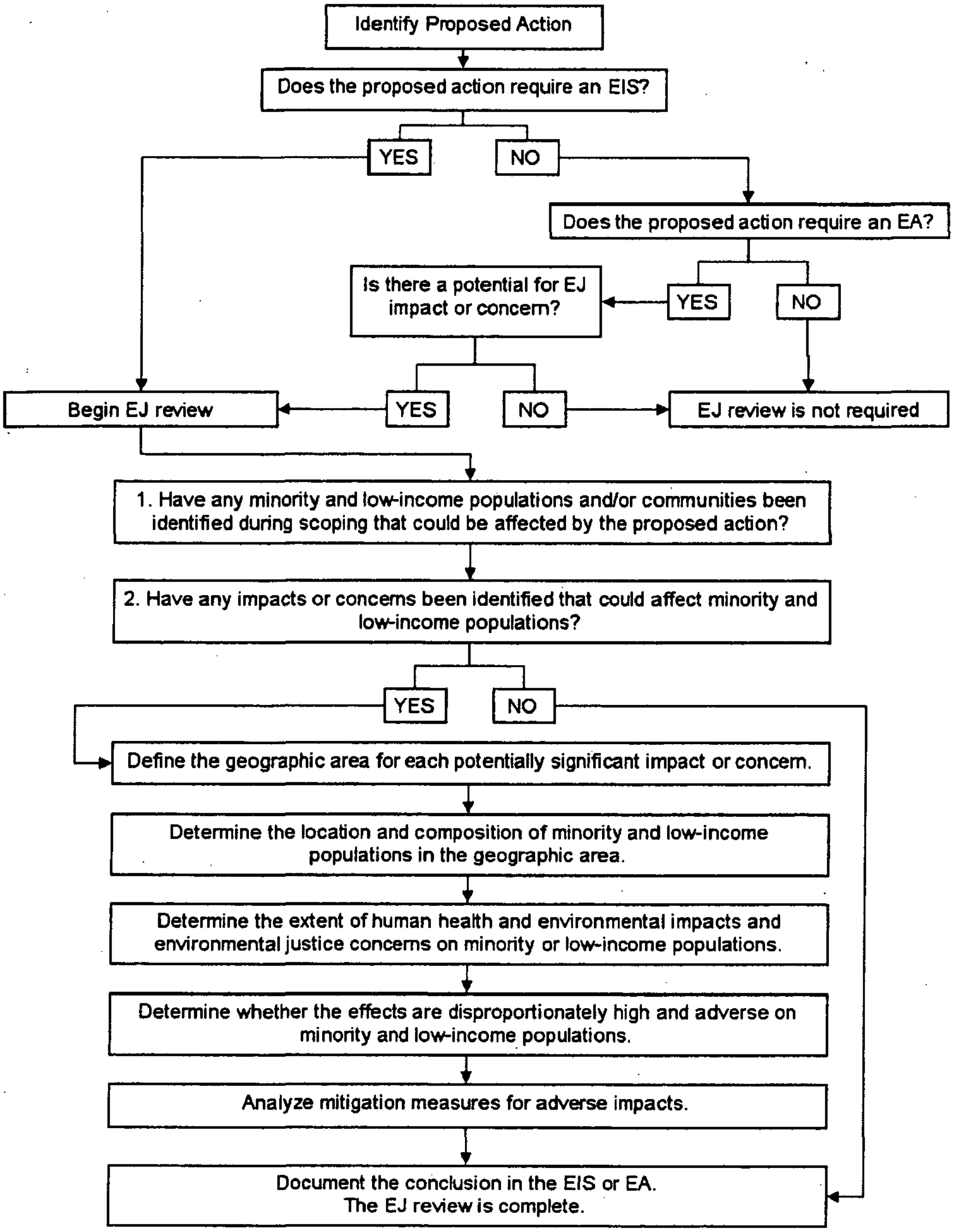

Figure 6.1-1. Environmental Justice Process Flow Chart

appropriate for the potential impact area. Because ISL well fields can cover large geographic areas, NRC has decided to evaluate demographic and socioeconomic data within at least an 80-km [50-mi] radius of the existing or potential facilities. This analysis includes a sample of the surrounding population, because the goal of environmental justice analysis is to evaluate the "communities," neighborhoods, or areas that may be disproportionately impacted (NRC, 2003, Appendix C).

NRC guidance recommends using the U.S. Census Bureau "census block group" as the geographic area for evaluating demographic and income data. NRC used this data source and examined delineations of tribal lands and resources for this GEIS. NRC can also use other site-specific information to identify minority or low-income populations not identified through this demographic data to determine whether further environmental justice analysis is needed in an environmental review for an individual license application.

The next step is to compare the percentage of minority populations in the area for assessment to the state and county percentages of minority populations and compare the area's percentage of economically stressed households to the state and county percentages of economically stressed households. As general guidance, NRC (2003, Appendix C) notes that differences greater than 20 percentage points may be considered significant, and if either the minority or low-income population percentage in the radius of influence exceeds 50 percent, environmental justice should be considered in greater detail. Depending on a specific facility's location, it is possible that the radius of influence could cross county and state lines—a fact that should be considered when making comparisons. If no minorities or low-income populations are identified in the potentially affected area or environmental impact area, then the conclusion should be documented and the environmental justice review is complete.

After minority or low-income populations are identified, the next step is to determine whether there is a "disproportionately high and adverse" impact (human health or environmental effect) to these populations.

NRC guidance recommends determining the impacts of the proposed action in the usual manner, including cumulative and multiple impacts, where appropriate. Environmental impacts and cumulative impacts for facilities using ISL technology are discussed in Chapters 4 and 5 of the GEIS. These impacts have been evaluated to determine whether they would disproportionately affect minority or low-income populations by considering whether there are unique pathways of exposure to these populations compared to the general population. Where a proposed action would not cause adverse environmental impacts, and therefore not cause any high and adverse health or environmental impacts, specific demographic analysis may not be warranted (CEQ, 1997).

The next step is to determine whether the impacts disproportionately impact the minority or low-income populations. In general, populations located next to a site would likely have a disproportionate impact compared to other populations located farther from the site. For example, potential exposure to effluents may be greater to those living closest to the facility, noise and traffic may disrupt nearby residents to a greater extent than those living far from the site, and the potential risk due to accidents may be greater for nearby residents. Additionally, cultural differential patterns of consumption of natural resources may change the impact to the identified population (NRC, 2003, Appendix C). In this example, a subsistence consumption analysis can be used to evaluate whether there are cultural factors that change the estimated "dose" for the sections discussing impacts on public and occupational health and safety. If there are no disproportionate impacts, no further analysis would be needed and the reviewer would document this finding in the environmental justice section (NRC, 2003, Appendix C).

If there are disproportionate impacts to minority or low-income populations, the next step in the analysis would be to evaluate the significance of the impacts to determine whether they are "high and adverse." Impacts that are significant, unacceptable, or above generally accepted levels (such as regulatory limits or state and local statutes and ordinances) may be considered high and adverse. Each impact, and where appropriate, the cumulative and multiple effect of the impacts, should be reviewed for significance. If it can be stated that no combination of the impacts is significant, then there are not disproportionately adverse or high on the minority or low-income populations, and this finding should be documented in the environmental justice section of the environmental review (NRC, 2003, Appendix C).

If there are significant impacts to minority or low-income populations, it is then necessary to look at mitigative measures and benefits. Any mitigation measures that could be taken to reduce the impact should be considered. To the extent practicable, mitigation measures should also reflect the needs and preferences of the affected minority or low-income populations. The environmental review should also discuss benefits of the project to the surrounding communities, including economic benefits (NRC, 2003, Appendix C).

The resulting environmental justice review should indicate whether there is a disproportionately high and adverse human health or environmental impact that is likely to result from the proposed action and if there are any alternatives. It should also indicate any mitigation measures that could be used to reduce this impact and any benefits of the project to the surrounding community. In this way, the final decision makers can weigh all aspects when making the agency decision (NRC, 2003, Appendix C).

6.1.2 Identifying Minority and Low-Income Populations in the Four Geographic Uranium Milling Regions Considered in This GEIS

Demographic and socioeconomic information from the 2000 Census is presented in detail in Sections 3.2.10 (Wyoming West), 3.3.10 (Wyoming East), 3.4.10 (Nebraska-South Dakota-Wyoming), and 3.5.10 (Northwestern New Mexico) for the four geographic regions considered in this GEIS. Minority and low-income populations within the regions were identified using the criteria in NRC guidance (NRC, 2004, 2003) by comparing community demographics to the state level (Table 6.1-1). The distances provided in Table 6.1-1 are given from the border of an identified population (e.g., a reservation boundary) to the nearest existing or potential ISL facility as well as to the farthest ISL facility, based on current information (NRC, 2008).

In the Wyoming West Uranium Milling Region, the only sensitive population identified using the criterion from NRC (2004, 2003) is the Wind River Indian Reservation (Figure 6.1-2). The boundary of the Wind River Indian Reservation is 16 km [10 mi] from the closest potential ISL facility and about 107 km [65 mi] from the farthest potential facility. The reservation has a Native American population of about 35 percent (Eastern Shoshone and Northern Arapaho). This compares to the Wyoming state level of 2.3 percent. The towns of Arapahoe, Ethete, and Fort Washakie are located within the reservation and have both minority (80 percent or more Native American) and low-income populations. The closest potential ISL facility would be about 24 km [15 mi] to the southeast of Araphaoe at Sand Draw.

Table 6.1-1. Minority and Low-Income Populations* in the Four Geographic Uranium Milling Regions Considered in This Generic Environmental Impact Statement

Uranium Milling Region	Affected Area Within Region of Influence	Distance (Range) of Project Locations to Affected Area	Minority Population	Low-Income Population?
West Wyoming	Wind River Indian Reservation (Towns of Arapahoe, Ethete, and Fort Washakie)	16-105 km (10–65 mi)	Native American (Eastern Shoshone and Northern Arapaho Tribes)	Yes
East Wyoming	Albany County	8-161 km (5–100 mi)	None	Yes
Nebraska-South Dakota-Wyoming	Pine Ridge Indian Reservation (Towns of Oglala and Pine Ridge)	32-161 km (20–100 mi)	Native American (Oglala Sioux Tribe)	Yes
Northwestern New Mexico	Cibola County	0-43 km (0–27 mi)	Native American and Hispanic Origin	Yes
	McKinley County	0-5 km (0–3 mi)	Native American	Yes
	City of Gallup	29-101 km (18–63 mi)	Native American and Hispanic Origin	Yes
	Town of Grants	16-85 km (10–53 mi)	Some Other Race and Hispanic Origin	Yes
	Acoma Pueblo (Cibola County)	21-92 km (13–57 mi)	Native American (Acoma)	Yes
	Laguna Pueblo (Bernanillo, Cibola, Sandoval, Valencia Counties)	27-97 km (17–60 mi)	Native American (Laguna)	Yes
	Navajo Nation (Cibola and McKinley Counties)	2-74 km (1–46 mi)	Native American (Navajo)	Yes
	Ramah Navajo Indian Reservation (Cibola and McKinley Counties)	37-64 km (23–40 mi)	Native American (Ramah Navajo)	Yes
	Tohajiilee Indian Reservation (Cibola and Sandoval Counties)	45-129 km (28–80 mi)	Native American (Tohajiilee)	Yes
	Zuni Indian Reservation (Cibola and McKinley Counties)	37-80 km (23–50 mi)	Native American (Zuni)	Yes

*Based on U.S. Census Bureau. "American FactFinder." 2000. <http://factfinder.census.gov/home/saff/main.html?_lang=en> (18 October 2007 and 25 February 2008).

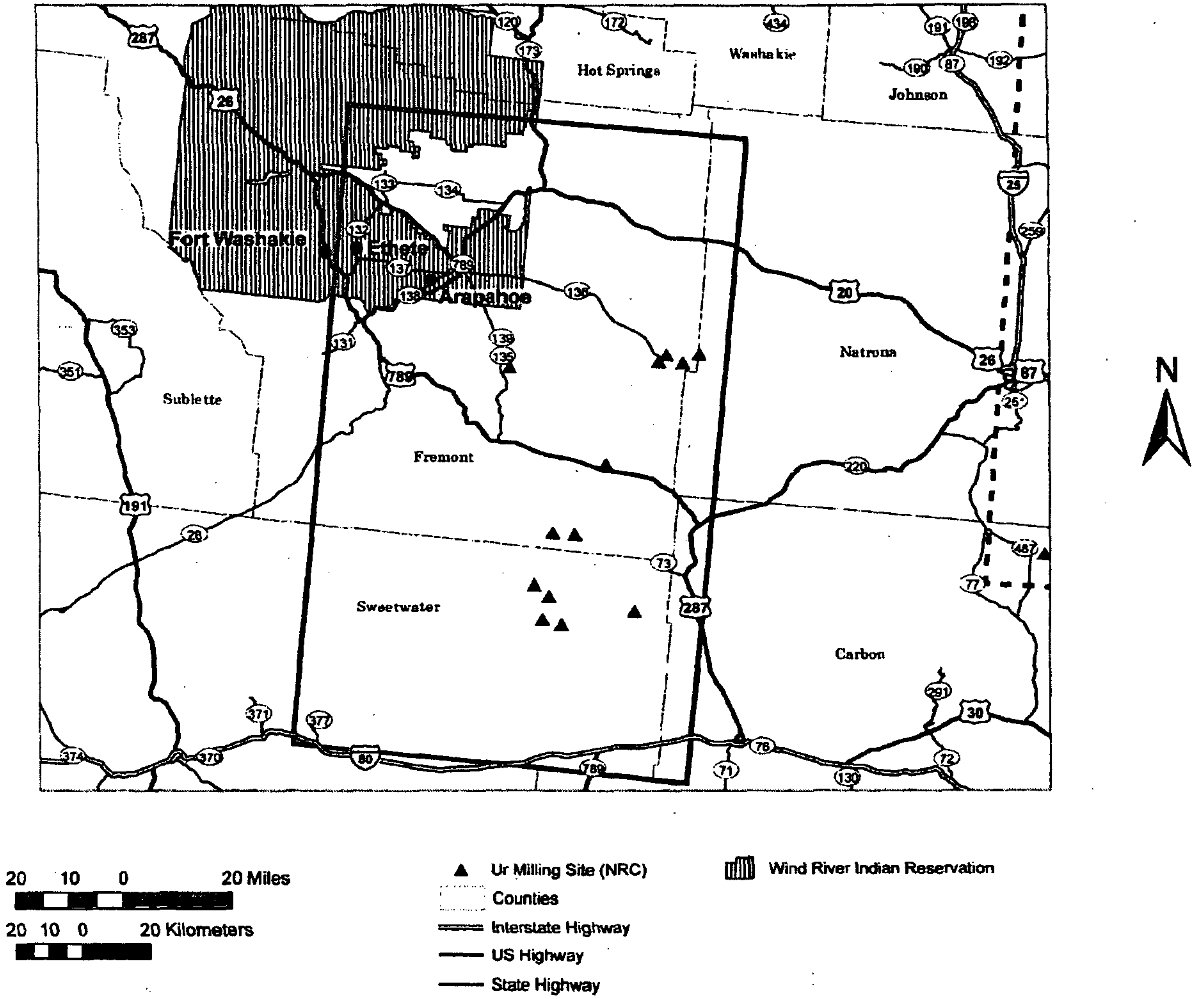

Figure 6.1-2. Affected Minority and Low-Income Population for the Wyoming West Uranium Milling Region

In the Wyoming East Uranium Milling Region, no minority populations were identified using 2000 Census data and the criteria from NRC (2004, 2003), but Albany County was identified as a low-income population (Figure 6.1-3). Albany County is about 8 km [5 mi] from the closest Wyoming East Uranium Milling Region. Northern Albany County is predominantly rural (see Section 3.3.1), with no population centers or towns identified by the U.S. Census Bureau within the portion of the county that lies within the Wyoming East Uranium Milling Region.

In the Nebraska-South Dakota-Wyoming Uranium Milling Region, the closest sensitive population identified using criteria from NRC (2004, 2003) is the Pine Ridge Indian Reservation, adjacent to the southeastern boundary of the region (Figure 6.1-4). The Pine Ridge Indian Reservation is 48 km [30 mi] from the closest existing and potential ISL facilities at Crow Butte in Dawes County, Nebraska, and about 160 km [100 mi] from the farthest potential facility in Crook County, Wyoming. Communities within the Pine Ridge Indian Reservation include the towns of Oglala and Pine Ridge. Based on U.S. Census Bureau information, these towns have both minority (greater than 90 percent Native American) and low-income populations. They are a little over 75 km [47 mi] from the nearest existing ISL facility at Crow Butte.

In the Northwestern New Mexico Uranium Milling Region (Figure 6.1-5), the potential sensitive minority and low-income populations include the following:

Acoma Indian Reservation

The Acoma Indian Reservation is 21 km [13 mi] from the nearest potential ISL facility and approximately 92 km [57 mi] from the farthest potential known facility. A portion of the Acoma Indian Reservation lies within eastern Cibola County.

Tohajiilee Indian Reservation

The Tohajiilee Indian Reservation is about 45 km [28 mi] from the closest potential ISL facility and approximately 129 km [80 mi] from the farthest potential ISL facility.

Laguna Indian Reservation

The Laguna Indian Reservation is 27 km [17 mi] from the closet potential ISL facility and 97 km [60 mi] from the farthest ISL facility. The majority of the Tohajiilee and Laguna Indian Reservations lie within eastern Cibola County with small portions within Sandoval, Bernalillo, and Valencia Counties.

Navajo Nation

The Navajo Nation represents the largest tribal area and is located approximately 1.6 km [1 mi] from the closest potential ISL facility and 74 km [46 mi] from the farthest known potential ISL facility. A portion of the Navajo Nation lies within McKinley County in the northwestern portion of the Northwestern New Mexico Uranium Milling Region.

Ramah Navajo Nation

The Ramah Navajo Nation is 37 km [23 mi] from the nearest potential ISL facility and 64 km [40 mi] from the farthest potential ISL facility. The majority of the Ramah Navajo Nation lies within western Cibola County.

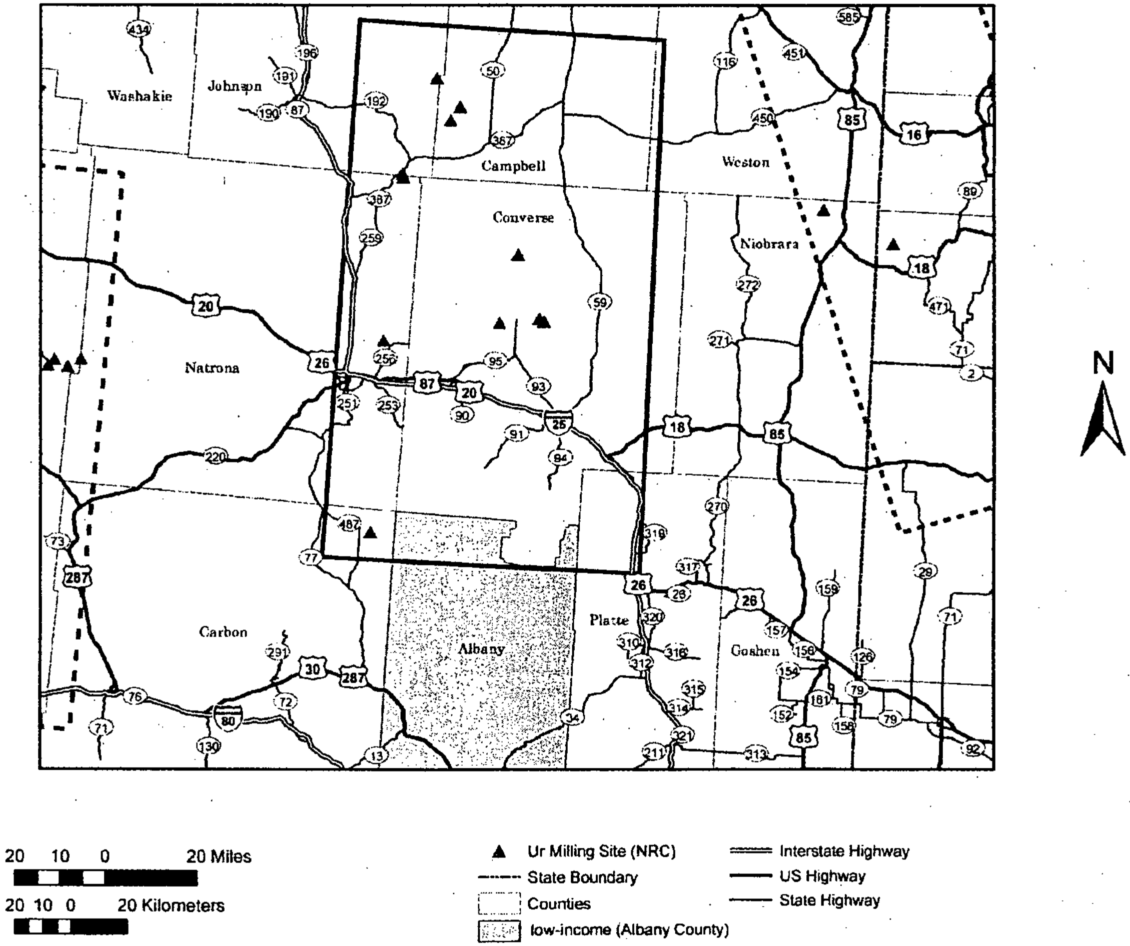

Figure 6.1-3. Affected Minority and Low-Income Population for the Wyoming East Uranium Milling Region (No Minority Populations Were Identified)

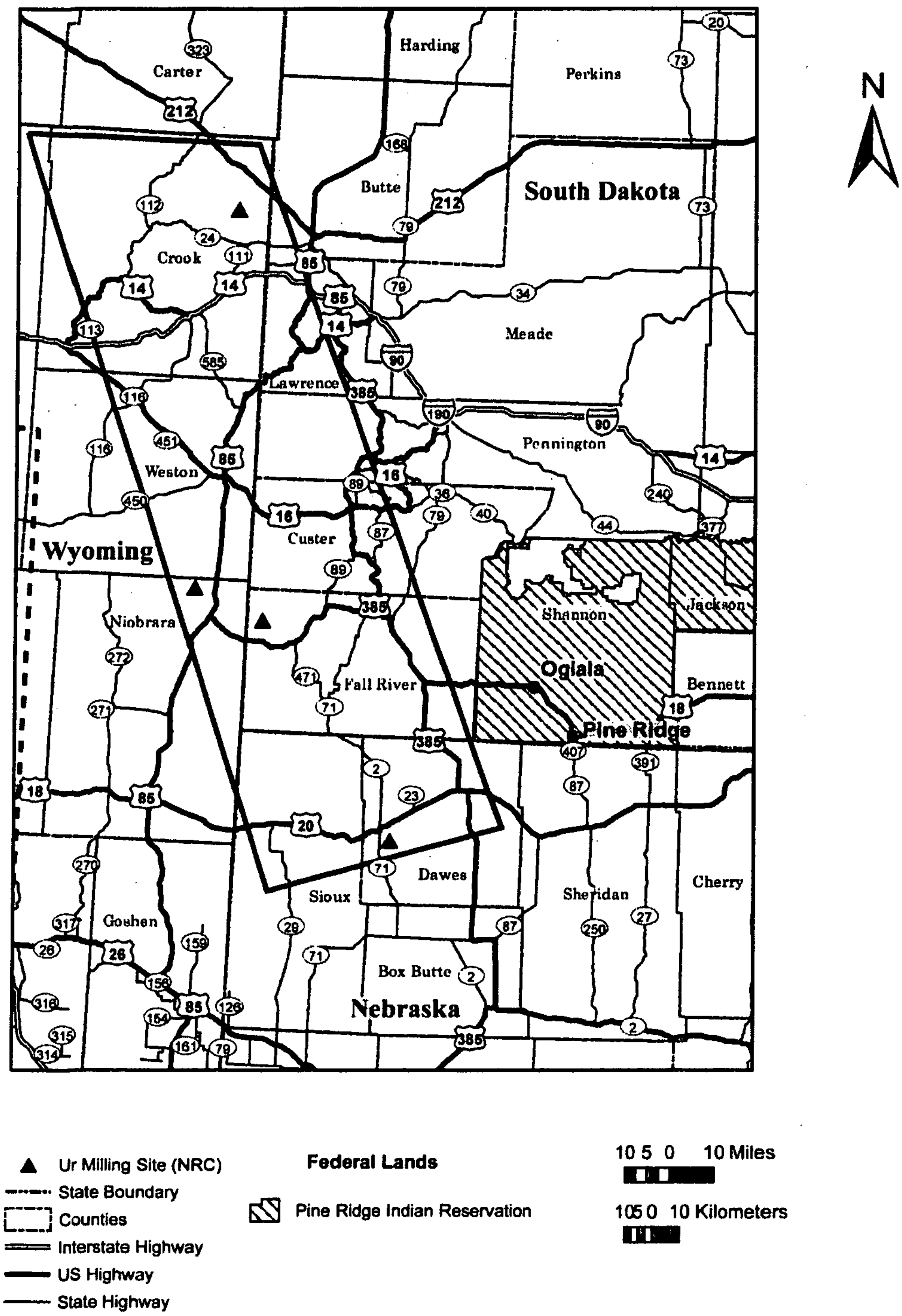

Figure 6.1-4. Affected Minority and Low-Income Population for the Nebraska-South Dakota-Wyoming Uranium Milling Region

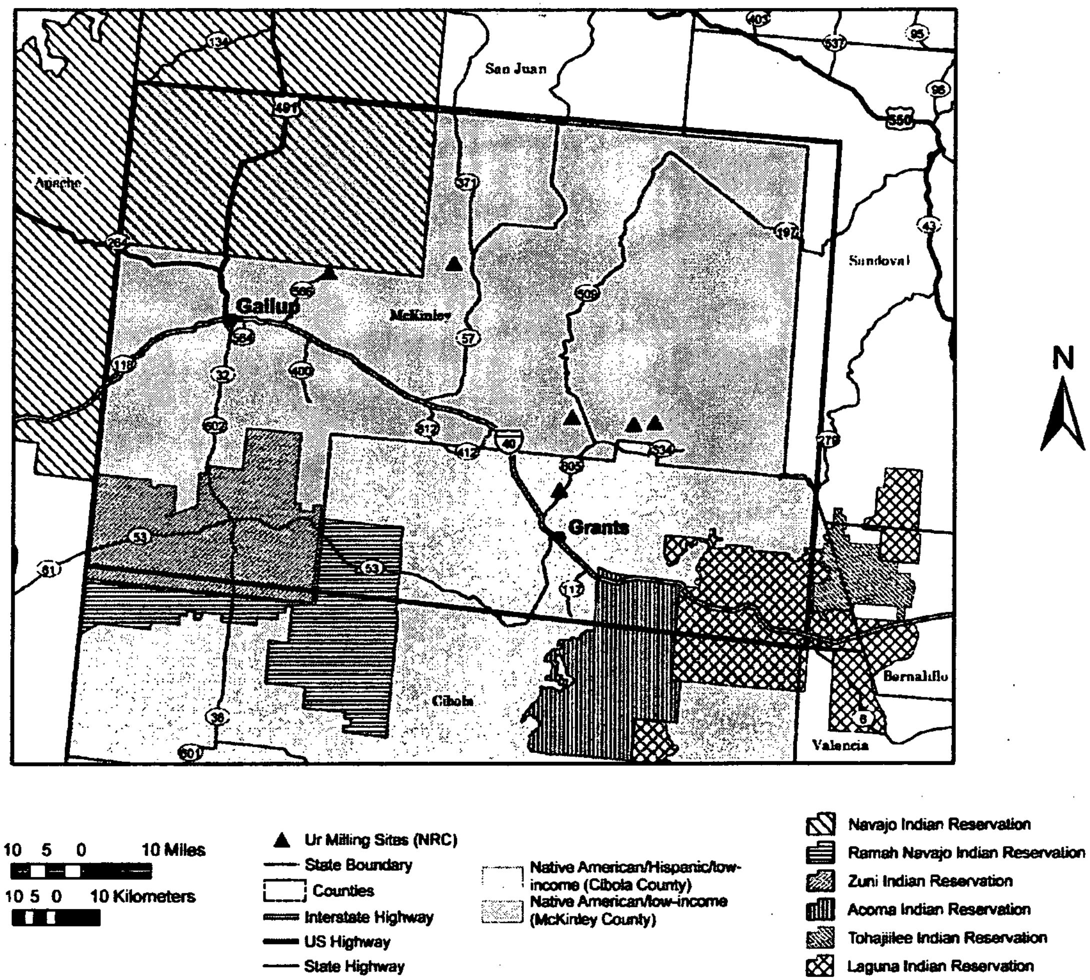

Figure 6.1-5. Affected Minority and Low-Income Populations for the Northwestern New Mexico Uranium Milling Region

Zuni Indian Reservation

The Zuni Indian Reservation is 37 km [23 mi] from the nearest potential ISL facility and 80 km [50 mi] from the farthest potential ISL facility. The majority of the Zuni Indian Reservation lies within southwest McKinley County.

Each of these six tribal areas has a Native American population of greater than 95 percent (compared to the state level of 9.5 percent) and is classified as a low-income population based on 2000 Census information. Where reported, unemployment levels on the reservations are greater than 60 percent (Laguna, Navajo, and Zuni).

Town of Grants

The Town of Grants, located in Cibola County, is about 16 km [10 mi] from the closest potential ISL facility and 85 km [53 mi] from the farthest potential ISL facility. Grants has Hispanic population of greater than 50 percent.

Sandoval County

A small portion of Sandoval County is included within the eastern border of the Northwestern New Mexico Uranium Milling Region. The southwestern border of Sandoval County is about 37 km [23 mi] from the closest potential ISL facility and 108 km [67 mi] from the furthest ISL facility. The total population of the county is 29.4 percent Hispanic and 16.3 percent Native American. However, the southwestern portion of the county that is nearest to the Grant's Uranium Milling District is expected to have a lower percentage of Native American population than the county as a whole.

McKinley County

McKinley County includes most of the potential ISL facilities identified to date (NRC, 2008) and has a Native American population of almost 75 percent, as compared to the state level of 9.5 percent. McKinley County contains portions of three of the reservations identified in Table 6.1-1. These comprise approximately 35 percent of the area in the county. The percentage of individuals below poverty level in McKinley County (36 percent) and Gallup (21 percent) also identify low-income populations. The Core-Based Statistical Area of Gallup is located 29 km [18 mi] from the nearest potential ISL facility and 101 km [63 mi] from the farthest potential ISL facility. It is located in McKinley County, but outside of the tribal lands.

Cibola County

With the exception of the Navajo Nation, Cibola County contains portions of all of the tribal reservations identified in Table 6.1-1, and they comprise almost 50 percent of the county by area. Cibola County has a Native American population of greater than 40 percent, and the percentage of individuals living below the poverty level in Cibola County (25 percent) and Grants (21.9 percent) indicates low-income populations.

The socioeconomic information from the 2000 Census indicates that all of the existing or potential ISL facilities are located in areas of low income. The census data for the Wyoming East Uranium Milling Region did not identify a minority population. The other milling regions used for this analysis identified Native American or Hispanic populations may be impacted if an individual ISL facility is located in their proximate area.

6.2 Wyoming West Uranium Milling Region

The affected minority and low-income populations for the Wyoming West Uranium Milling Region are in the Wind River Indian Reservation and the towns of Ethete, Arapahoe, and Fort Washakie (see Figure 6.1-2). The closest potential ISL facility to the Wind River Indian Reservation is at least 16 km [10 mi] away. Based on current information, the tribal populations on the Wind River Indian Reservation could be located within a 80 km [50 mi] radius of potential ISL facilities and could raise specific environmental justice concerns. The low-income population in the area also triggers an environmental justice analysis for existing and potential facilities located in this area.

General cultural information indicates tribal populations in the Great Plains still use hunting and wild plant gathering, to a limited extent, to supplement family food resources that today are derived primarily from tribal and federal assistance programs or wage labor on and off the reservation. In addition, herbs gathered for subsistence, medicinal, and ritual/ ceremonial uses remain important to maintaining traditional cultural practices. Traditional use areas claimed by the tribes are places in which traditional subsistence practices and the procurement of animals and plants for ritual, ceremonial, medicinal, and other traditional needs should be accessed on a site-specific basis. Disruption in the availability of or access to areas in which traditional subsistence and ritual/ceremonial practices can be performed should be considered as having the potential to differentially affect the ability of the tribes in this region to practice their traditional lifeways. No culturally significant places listed in the National Register of Historic Places or the state register are located in the Wyoming West Uranium Milling Region (see Section 4.2.8).

NRC concludes that environmental reviews for ISL facilities located in the Wyoming West Uranium Milling Region would need an environmental justice analysis based on this demographic data. Using current available information, NRC has concluded there are no known cultural factors that would change the Chapters 4 and 5 analyses and conclusions of the potential environmental or health impacts from ISL facility activities for tribal or low-income populations compared to the general population for the following resource areas: land use, transportation, geology and soils, meteorology/climate/air quality, noise, visual/scenic resources, and socioeconomic in the Wyoming West Uranium Milling Region.

NRC also concludes that site-specific information is needed to complete the environmental justice analysis in the following resource areas: water resources, historic and cultural resources, ecological resources, and public and occupational health. Site-specific cultural information should be used to evaluate whether the analyses and conclusions in Chapters 4 and 5 should be supplemented before determining whether the minority or low-income populations in the area would receive a disproportionately high and adverse environmental or health impact from the ISL facility activities.

For further site-specific analyses, staff will consider, among other things:

- Subsistence—In areas where there is a significant consumption of native plants and animals, a subsistence consumption analysis of fish, wildlife, and other natural resources should be done to evaluate the estimated "dose" discussed in the occupational and public health sections.

- Cultural—site-specific historic and cultural information should be gathered because of the proximity of tribal populations.

NRC will continue to examine potential environmental justice considerations that may be identified as part of the public comment period on this GEIS or during consultations with Native American and other affected communities within the Wyoming West Uranium Milling Region. The NRC staff would conduct an environmental justice analysis based on the methodologies in the appropriate NRC guidance for site-specific environmental reviews.

6.3 Wyoming East Uranium Milling Region

No minority populations were identified in the Wyoming East Uranium Milling Region using 2000 Census data and the criteria from NRC (2004, 2003). Albany County was identified as a low-income population (Figure 6.1-3). At its closest point, Albany County would be about 8 km [5 mi] from the closest potential ISL facility at Shirley Basin. However, northern Albany County is predominantly rural (see Section 3.3.1) with no population centers or towns identified by the U.S. Census Bureau within the portion of the county that lies within the Wyoming East Uranium Milling Region. For this reason, no environmental justice considerations would be expected for the portion of Albany County that is located within the Wyoming East Uranium Milling Region.

NRC concludes that for ISL facilities located in the Wyoming East Uranium Milling Region, no minority and low-income population will experience a disproportionately high and adverse impact. However, NRC would review environmental justice on a site-specific basis to confirm the GEIS conclusion remains valid. Based on NRC's information, the area in northern Albany County that is nearest potential ISL facilities is sparsely populated. There are no known cultural factors that would change the Chapters 4 and 5 analyses and conclusions of the potential environmental or health impacts from ISL facility activities on this low-income population compared to the general population in this region.

6.4 Nebraska-South Dakota-Wyoming Uranium Milling Region

As identified in Table 6.1-1, the closest affected minority and low-income population for the Nebraska-South Dakota-Wyoming Uranium Milling Region is the Pine Ridge Indian Reservation and the towns of Oglala and Pine Ridge in South Dakota (Figure 6.1-4). The Pine Ridge Indian Reservation is 48 km [30 mi] from the closest existing, and potential, ISL facilities at Crow Butte in Dawes County, Nebraska. Based on current information, the tribal populations on the Pine Ridge Indian Reservation could be located within a 80 km [50 mi] radius of potential ISL facilities and could raise specific environmental justice concerns. The low-income population in the area also triggers an environmental justice analysis for existing and potential facilities located in this area.

General cultural information indicates tribal populations in the Great Plains still use hunting and wild plant gathering, to a limited extent, to supplement family food resources that today are derived primarily from tribal and federal assistance programs or wage labor on and off the reservation. In addition, herbs gathered for subsistence, medicinal, and ritual/ ceremonial uses remain important to maintaining traditional cultural practices. Traditional use areas claimed by the tribes are places in which traditional subsistence practices and the procurement of animals and plants for ritual, ceremonial, medicinal, and other traditional needs should be assessed on a site-specific basis. Disruption in the availability of, or access to, areas in which traditional subsistence and ritual/ceremonial practices can be performed should be considered as having the potential to differentially affect the ability of the tribes in this region to practice their traditional lifeways.

Historically, the land of Black Hills is seen by tribes in Montana, Wyoming, and South Dakota to have provided both sustenance (for fishing, hunting, and plant food gathering) and spiritual value (i.e., as a place in which important personal and tribal rituals and ceremonies were customarily performed and are still performed today). Devils Tower, or Bear Lodge as it is known to many of the tribes in the region, is located in northeastern Wyoming at the western fringe of the Black Hills in the Nebraska-South Dakota-Wyoming Uranium Milling Region. It is the site of annual ritual and ceremonial events by tribal members in the month of June. Native American tribes in the region believe that preserving and maintaining access to sacred lands is essential to both cultural and spiritual aspects of traditional Native American societies of the northern plains (Iverson, 1985). The cultural significance of these areas should also be considered during the environmental justice analysis for licensing applications in this region.

In addition, availability of affordable housing with water, electricity, plumbing, and sewer service is a concern at the Pine Ridge Indian Reservation in Shannon County, South Dakota (Housing Assistance Council, 2002; Steele, 2007). Inadequate availability of housing may be a concern with regard to overcrowding and should be evaluated in the environmental justice analysis for the socioeconomic resource area.

NRC concludes that environmental reviews for ISL facilities located in the Nebraska-South Dakota-Wyoming Uranium Milling Region would need an environmental justice analysis based on this demographic data. Using current available information, NRC has concluded there are no known cultural factors that would change the Chapters 4 and 5 analyses or conclusions of the potential environmental or health impacts from ISL facility activities for tribal or low-income populations compared to the general population for the following resource areas in the Nebraska-South Dakota-Wyoming Uranium Milling Region: land use, transportation, geology and soils, meteorology/climate/air quality, noise, and visual/scenic resources.

NRC also concludes that site-specific information is needed to complete the environmental justice analysis in the following resource areas: water resources, historic and cultural resources, ecological resources, public and occupational health, socioeconomics, and visual/scenic resources. Site-specific cultural information should be used to evaluate whether the analysis and conclusions in Chapters 4 and 5 should be supplemented before determining whether the minority or low-income populations in the area would receive a disproportionately high and adverse environmental or health impact from the ISL facility activities.

For further site-specific analyses, staff would consider, among other things:

- Subsistence—In areas where there is a significant consumption of native plants and animals, a subsistence consumption analysis of fish, wildlife, and other natural resources should be conducted to evaluate the estimated "dose" discussed in the occupational and public health sections.

- Cultural—site-specific historic and cultural information should be gathered because of the proximity of tribal populations.

NRC would continue to examine potential environmental justice considerations that may be identified as part of the public comment period on this GEIS or during consultations with Native American and other affected communities within the Nebraska-South Dakota-Wyoming Uranium Milling Region. The NRC staff would conduct an environmental justice analysis based on the methodologies in the appropriate NRC guidance for site-specific environmental reviews.

6.5 Northwestern New Mexico Uranium Milling Region

Based on 2000 Census information and the NRC environmental justice criteria (NRC, 2004, 2003), affected minority and/or low-income populations for the Northwestern New Mexico Uranium Milling Region include Acoma Pueblo, Laguna Pueblo, the Navajo Nation, the Ramah Navajo Indian Reservation, the Tohajiilee Indian Reservation, and the Zuni Indian Reservation (Figure 6.1-4). In addition, minority and low-income populations are identified for Cibola County, McKinley County, the Gallup Core-Based Statistical Area, and the town of Grants. The affected communities are located throughout the region and are close to potential ISL facilities, based on current information. For example, at least one potential facility would be located within about 1.6 km [1 mi] of the border of the Navajo Nation (Figure 6.1-4) and another would be located near the community of Crownpoint. The location of minority and low-income populations triggers an environmental justice analysis for existing and potential facilities located in this area.

In particular, sensitive communities in proximity to a potential ISL facility would also receive potentially disproportionately high and adverse impacts with regard to water resources in the Northwestern New Mexico Uranium Milling Region. As described in Section 3.5.4, these impacts could include: (1) sedimentation in surface waters, (2) degradation of water quality in the ore-bearing aquifer, (3) degradation of groundwater quality near well fields if lixiviant unexpectedly travels from the production zone and beyond the boundaries of the well field, and (4) vertical excursions where barren or pregnant lixiviant migrates into other aquifers above or below the production zone. As described in Section 4.5.4 and Chapters 7 and 8, licensees are required to obtain underground injection control permits and implement monitoring programs and remediation actions to mitigate these potential impacts. In addition, aquifer restoration upon completion of uranium recovery is designed to reduce potential impacts to groundwater quality and use. Site-specific analysis of environmental justice concerns with respect to sensitive communities would be necessary for individual license applications. These site-specific environmental reviews would include consultations with local communities or jurisdictions to evaluate key concerns with respect to water resources.

Land use impacts could result in environmental justice considerations if a potential ISL facility is located near tribal lands or abuts private lands, allottees, or residences, particularly in the checkerboard region where land ownership is complicated. As described in Section 4.5.1, impacts from all phases could: (1) change and disturb land uses, (2) restrict access and/or establish right-of-way for access, (3) affect mineral rights and land use by allottees and others, (4) restrict livestock grazing areas and revoke grazing permits, (5) restrict recreational activities, and (6) alter ecological, cultural, and historical resources. Site-specific analysis of environmental justice concerns for sensitive communities would be necessary for individual license applications. These site-specific environmental reviews would include consultations with local communities or jurisdictions to evaluate key land ownership and jurisdictional issues.

Because of the large area covered by tribal lands in the Northwestern New Mexico Uranium Milling Region, there may be disproportionately high and adverse affects related to historical, cultural, and visual resources. As described in Section 3.5.8, there are a large number of cultural and historical sites in the Northwestern New Mexico Uranium Milling Region that could be affected by land-disturbing activities, such as grading roads, installing wells, and constructing surface facilities and well field infrastructure. Impacts to a community's historical and cultural resources may also occur if activities at an ISL facility prevent or limit access to a culturally significant site or affect the visual landscape. The Mt. Taylor Traditional Cultural Property listing in February 2008 is one example of a culturally significant area that would need to be evaluated for disproportionate potential impacts. As described in Section 4.5.8, site-specific analysis of environmental justice concerns with respect to cultural resources and sensitive communities would be necessary for individual license applications. These site-specific environmental reviews would include consultations with local communities or jurisdictions to evaluate key concerns with respect to water resources.

Western Puebloan Tribes (Acoma and Zuni)

The Acoma and Zuni foster and encourage the continuance of traditional subsistence practices including agriculture and, to a limited extent, herding (Garcia-Mason, 1979; Ladd, 1979). The Acoma and Zuni traditionally reside in clustered settlements or villages. Both tribes view game hunting and the gathering of wild plant foods and herbs for subsistence, medicinal, and ritual/ceremonial uses as central to their traditional cultural practices (Dozier, 1970; Dutton, 1976; Green, 1979; Ladd, 1979).

Traditional agricultural practices in the arid Southwest rely on the availability of arable land with access to reliable sources of water from rainfall and runoff at Zuni and from irrigation at Acoma (Dozier, 1970; Garcia-Mason, 1979). Summer precipitation in the arid upland Southwest is characterized by high spatial and temporal variability. As a result, successful traditional agricultural practice distributes fields in a variety of areas where rainfall, runoff, and other techniques help to maximize the potential for sufficient rainfall to occur at least one of the fields. Traditional hunting and gathering of wild plant food resources also contribute to annual subsistence to a limited extent. Farming, hunting, and gathering are used to supplement store-bought food items purchased with funds obtained through tribal and federal assistance programs, by working for federal and tribal governments on the reservation, or from wage labor away from the reservation.

Because of Acoma and Zuni reliance on traditional forms of agriculture and hunting and gathering of wild foods to supplement their food resources, disruption in the availability and access to areas in which these traditional subsistence practices can be performed, or disruptions in the ability to gather animal and plant foods, should be considered as having the potential to differentially affect the ability of the Acoma and Zuni tribal members to practice traditional lifeways. In addition, specific types of plants and animals are obtained for use in ritual and ceremonial and, in the case of plants, medicinal contexts. Restriction of access to the places in which these resources might be obtained or in which they have traditionally been obtained should also be considered as a differentially adverse effect to the practice of traditional Acoma and Zuni lifeways.

Navajo Tribe

Traditional Navajo subsistence relies on a mix of small agricultural fields and herding of sheep and goats (Kluckhohn and Leighton, 1974; Bailey and Bailey,1986). The traditional Navajo settlement pattern is characterized by extended family household clusters, traditionally termed and outfitted (Kluckhohn and Leighton, 1974), that reside in proximity to one another. Several such related households are often spatially dispersed across the landscape. In traditional

Navajo practice, agricultural fields are tended by individual households, whereas sheep and goats from related households are combined into larger flocks that graze over wide areas of open range belonging to the combined related households (Downs, 1964; Witherspoon, 1983; Bailey and Bailey, 1986). Goats and sheep, in addition to supplying meat and milk for consumption, also provide wool and mohair for sale and for use in making traditional textiles that are then sold to supplement family income (Adams, 1971; Aberle, 1983). Traditional households often maintain one or more horses and occasionally cattle as well. The horses and cattle are often grazed on the open range wherever sufficient forage is available. Subsistence farming, sheep and goat grazing, and to a far more limited extent, hunting and wild plant gathering, are used to supplement family food resources obtained through tribal and federal assistance programs or wage labor on and off the reservation (Aberle, 1983; Bailey and Bailey, 1986).

Like the Zuni and Acoma tribes, disruption in the availability of or access to areas in which traditional subsistence practices can be performed should be considered as having the potential to differentially affect the ability of the Navajo to practice traditional lifeways. Animals are hunted and plants are gathered for non-subsistence use as well. Both animals and plants are used for traditional ritual, ceremonial, medicinal, and other needs. Restriction of access to the places in which these resources might be obtained or in which they have traditionally been obtained should also be considered as a differentially adverse effect to the practice of traditional Navajo lifeways.

NRC concludes that environmental reviews for ISL facilities located in the Northwestern New Mexico Uranium Milling Region would need an environmental justice analysis based on this demographic data. Using current available information, NRC has concluded there are no known cultural factors that would change the Chapters 4 and 5 analyses or conclusions of the potential environmental or health impacts from ISL facility activities for tribal or low-income populations compared to the general population for the following resource areas in the Northwestern New Mexico Uranium Milling Region: transportation, meteorology/climate/air quality, noise, or socioeconomic.

NRC also concludes that site-specific information is needed to complete the environmental justice analysis in the following resource areas: water resources, historic and cultural resources, ecological resources, public and occupational health, visual/scenic resources, and land use. Site-specific cultural information should be used to evaluate whether the analyses and conclusions in Chapters 4 and 5 should be revised before determining whether the minority or low-income populations in the area would receive a disproportionately high and adverse environmental or health impact from the ISL facility activities.

For further site-specific analyses, staff woul consider, among other things:

- Subsistence—In areas where there is a significant consumption of native plants and animals, a subsistence consumption analysis of fish, wildlife, and other natural resources should be done to evaluate the estimated "dose" discussed in the occupational and public health sections.

- Cultural—site-specific historic and cultural information should be gathered because of the proximity of tribal populations.

6.6 Summary

Based on 2000 Census information and criteria from NRC guidance (NRC, 2004, 2003), a number of sensitive populations were identified (Table 6.1-1). NRC concludes potential environmental justice concerns were raised in three of the identified uranium milling regions. All of the identified milling regions are located in low-income areas. Environmental reviews for ISL facilities located in the Wyoming East Uranium Milling Region do not need an environmental justice analysis, because demographic data failed to identify a minority or low-income population that has the potential to receive disproportionately high and adverse environmental or health impacts compared to the general population in the area. Minority populations and tribal lands were identified in: (1) the Wyoming West, (2) the Northwestern New Mexico, and (3) the Nebraska-South Dakota-Wyoming Uranium Milling Regions. This situation triggers NRC's obligation to conduct an environmental justice analysis in these three regions.

While the GEIS does not identify impacts that are disproportionately high and adverse for a minority or low-income area, it does identify resource areas that could raise environmental justice concerns and note where site-specific information is needed to complete the environmental justice analysis. For example, resource areas are identified where there are no known cultural factors that would change the Chapters 4 and 5 analyses or conclusions of the potential environmental or health impacts from ISL facility activities for tribal or low-income populations compared to the general population for specific resource areas in each region.

Other regional resource areas were identified that need site-specific information to evaluate whether the analyses and conclusions in Chapters 4 and 5 should be revised when determining whether the minority or low-income populations in the area would receive a disproportionately high and adverse environmental or health impact from the ISL facility activities. In those cases, the revised impact analysis would be used in the environmental justice analysis to determine whether there is a disproportionately high and adverse environmental or health impact on these minority or low-income populations.

NRC continues to examine potential environmental justice issues that may arise during the public comment period on this draft GEIS or during consultations with Native American and other affected communities within all four regions.

6.7 References

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7 POTENTIAL BEST MANAGEMENT PRACTICES, MITIGATION MEASURES, AND MANAGEMENT ACTIONS TO MITIGATE ADVERSE ENVIRONMENTAL IMPACTS

7.1 Introduction

This chapter describes potential best management practices, mitigation measures, and management actions that a licensee or facility operator might use to reduce potential adverse impacts associated with construction, operation, aquifer restoration, and decommissioning of an *in-situ* leach (ISL) milling facility. The Council on Environmental Quality (CEQ) defines mitigation as (40 CFR 1508.20):

- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensating for the impact by replacing or providing substitute resources or environments.

Potential mitigation measures can include general best management practices and more site-specific management actions.

How Are Adverse Impacts Mitigated?

Best Management Practices are techniques, methods, processes, activities, or incentives that are more effective at delivering a particular outcome. Best management practices can also be defined as efficient and effective ways of meeting a given objective based on repeatable procedures that have proven themselves over time. Well-designed best management practices combine existing managerial and scientific knowledge with knowledge about the resource being protected. The Wyoming Department of Environmental Quality (WDEQ) defines best practicable technology as "A technology based process determined by WDEQ as justifiable in terms of existing performance and achievability (in relation to health and safety) which minimizes, to the extent safe and practicable, disturbances and adverse impacts of the operation on human or animal life, fish, wildlife, plant life and related environmental values." (WDEQ, 2007).

Management Actions are active measures a licensee or facility operator implements to reduce potential adverse impacts to a specific resource area. These site-specific actions are sometimes related to environmental (or adaptive) management systems (CEQ, 2007).

7.2 Best Management Practices

Best management practices are processes, techniques, procedures, or considerations that can be used to cost-effectively avoid or reduce the potential environmental impacts. While best management practices are not regulatory requirements, they can overlap and support such requirements. Best management practices would not replace any U.S. Nuclear Regulatory Commission (NRC) requirements or other local, state, or federal regulations.

7.3 Management Actions

Management actions are those that the licensee specifically implements to reduce potential adverse impacts. These actions include compliance with applicable government agency stipulations or specific guidance, coordination with government agencies or interested parties, and monitoring of relevant ongoing and future activities. If appropriate, corrective actions could be implemented to limit the degree or magnitude of a specific action leading to an adverse impact (reducing or eliminating the impact over time by preservation and maintenance operations) and repairing, rehabilitating, or restoring the affected environment.

Licensees may also minimize potential adverse impacts through specific management actions. These may be part of a broad, more formalized environmental (or adaptive) management system similar to those described in CEQ (2007), or they may be more focused on a particular impact. In establishing management actions, the licensee should create measurable environmental objectives with measurable goals and targets (for example, pollution prevention goals for reducing waste). The licensee then would implement these programs, procedures, and controls for monitoring and measuring progress; document progress; and, if appropriate, institute corrective actions. These management actions may be established through standard operating procedures that are reviewed and approved by the appropriate local, state, or federal agency (including NRC). NRC may also establish requirements for management actions by identifying license conditions. These conditions are written specifically into the NRC source and byproduct material license and then become commitments that are enforced through periodic NRC inspections.

The management actions should specifically describe how mitigation commitments would be implemented and reflect available information about these actions. In an environmental management system approach, planned mitigation actions can be revised as more specific and detailed information becomes available. Typically, monitoring activities could be conducted during all phases of the project to ensure the mitigation of potential adverse impacts.

7.4 Potential Best Management Practices, Management Actions, and Mitigation Measures

Potential best management practices and mitigation measures that are commonly used to minimize potential adverse impacts are listed in Table 7.4-1. The list is based on historical best management practices and mitigation measures used for existing and planned ISL uranium recovery facilities (NRC, 1997, 1998, 2006a,b; Energy Metals Corporation, U.S., 2007). The list in Table 7.4-1 is not comprehensive and does not imply that NRC endorses these measures. Because the practices, actions, and measures identified in Table 7.4-1 have been developed for a broad geographic area, each practice or mitigation measure described in the table may not apply to a specific project. The list provides a foundation for developing customized management and mitigation plans for a proposed facility or project.

Table 7.4-1. Summary of Potential Best Management Practices and Management Actions

Environmental Resource	Potential Best Management Practices and Management Actions
Land use	• Limit land disturbance to only what is necessary for operation. • Conduct historic and cultural resource surveys prior to land disturbance. • Conduct ecological resource surveys prior to land disturbance. • Reclaim lands disturbed during the construction process. • Decontaminate and decommission facilities. • Reclaim lands disturbed by surface facilities no longer needed. • Plug and abandon wells.
Transportation	• Use dedicated tanker trucks for transporting uranium-loaded and barren resins from satellite facilities. • Use of accepted industry codes and standards for handling and transporting hazardous chemicals. • Maintain shipping records (bill of lading) to identify nature and quantity of shipped materials. • Conduct surveys of truck exterior and cab prior to each shipment of yellowcake or resin. • Establish an emergency response plan for yellowcake spill and other potential transportation accidents. • Implement safe driving and emergency response training for personnel and truck drivers. • Use check-in/check-out or global positioning satellite technology to track shipments. • Install communication systems to connect trucks to shipper/receiver/emergency responders.
Geology and soils	• Use structures to temporarily divert and/or dissipate surface runoff from undisturbed areas around the disturbed areas. • Retain sediment within the disturbed areas by using silt fencing, retention ponds, and hay bales. • Salvage and stockpile topsoil from the central plant facility area and from well field access roads so that wind and/or water erosion can be avoided (e.g., graded stockpiles, temporary vegetative cover, fencing and signs, sedimentation catchments). • Fill pipeline and cable trenches with excavated rock and soil soon after completion and regrade to surrounding topography. • Reestablish temporary or permanent native vegetation as soon as possible after disturbance. • Construct roads to minimize erosion (e.g., surfacing with a gravel road base, construct stream crossings at right angles with adequate embankment protection and culvert installation, and provide adequate road drainage with runoff control structures and revegetation). • Implement a spill prevention and cleanup plan to minimize soil contamination. • Collect and monitor soils and sediments for potential contamination including areas used for land application of treated waste water, transport routes for yellowcake and ion exchange resins, and well field areas where spills or leaks are possible.

Table 7.4-1. Summary of Potential Best Management Practices and Management Actions (continued)	
Environmental Resource	**Potential Best Management Practices and Management Actions**
Surface water	• Follow construction practices to reduce potential impacts as defined by the U.S. Army Corps of Engineers permitting process. • Minimize disturbance of surface areas and vegetation, which would minimize changes in surface-water flow and soil porosity that would change infiltration and runoff rates. • Minimize physical changes to drainage channels by building bridges or culverts where roadways would intersect areas of intermittent water flow. • Use erosion and runoff control features such as proper placement of pipe, grading to direct runoff away from water bodies, and use of riprap at these intersections to make bridges or culverts more effective. • Use sediment-trapping devices such as hay or straw bales, fabric fences, and devices to control water flow and discharge to trap sediments moved by runoff. • Maintain natural contours as much as possible, stabilize slopes, and avoid unnecessary off-road vehicle travel to minimize erosion. • Follow reclamation guidelines in and near floodplains. • Train employees in the handling, storage, distribution, and use of hazardous materials. • Conduct fueling operations and store hazardous materials and other chemicals in bermed areas with proper set back distances from water bodies. • Provide rapid response cleanup and remediation capability, techniques, procedures, and training for potential spills. • Prepare and implement a Storm Water Pollution Prevention Plan consistent with state and federal standards for construction activities. • Implement a spill prevention and cleanup plan to minimize soil contamination. • Conduct land application of treated waste water activities in a manner consistent with local climate, soil, and vegetation conditions to ensure excess irrigation does not run off into surface water.
Groundwater	• Recycle water collected in subsurface areas for use in dust suppression and other activities. • Implement measures to minimize water use during operations. • Minimize surface disturbance, which will minimize changes in surface-water flow and subsequent infiltration. • Implement a spill prevention and cleanup plan to minimize soil contamination. • Provide rapid response cleanup and remediation capability, techniques, procedures, and training for potential spills. • Monitor to detect and define unanticipated surface spills, releases, or similar events that may infiltrate into the groundwater system. • Manage water balance to ensure hydraulic flow into production zone. • Monitor well pressures to detect leaks. • Install monitoring wells in well field and near surface impoundments to monitor for potential lixiviant that travels beyond the production zone or for process solution leaks from impoundments. • Manage pumping and injection to control and recover excursions. • Monitor closest private domestic, livestock, and agricultural wells as appropriate during operations.

Table 7.4-1. Summary of Potential Best Management Practices and Management Actions (continued)

Environmental Resource	Potential Best Management Practices and Management Actions
Ecology	• Use measures to control erosion, dust, and particulates that may affect ecological resources from construction, operation, aquifer restoration, and decommissioning. • Use dust suppression measures to minimize wind and other erosion and aid recovery on disturbed areas. • Conduct pre-construction surveys to evaluate important ecological resources and habitats and to determine the reclamation potential of sites. • Implement measures to relocate or avoid sensitive species. • Minimize groundbreaking or land-clearing activities during the critical nesting period for migratory birds. • Before ground-disturbing activities, collect data to plan to restore disturbed areas and minimize impacts to sensitive habitats. • Phase construction to the extent practicable. • Limit grading activities to the phase immediately under construction, and limit ground disturbance to areas necessary for project-related construction activities. • Revegetate with appropriate native species to minimize potential for invasive species. • Use weed control as necessary.
Air quality	• Reduce fugitive dust emissions using standard dust control measures (e.g., water application, speed limits). • Reduce maximum fugitive dust by coordinating dust-producing activities. • Use fossil-fuel vehicles that meet applicable emission standards.
Noise	• Avoid construction activities during night. • Use sound controls on operating equipment and facilities. • Use personal hearing protection for workers in high noise areas.
Historic and cultural resources	• Consult with appropriate state and tribal historic preservation officers. • Ensure that onsite employees complete cultural resource sensitivity and protection training to reduce the potential for intentional or accidental harm to sites or artifacts. • Conduct pre-construction surveys to ensure that work would not affect important archaeological resources. • Develop additional mitigation measures such as documenting and collecting resources according to a cultural resource management plan if construction threatens important archaeological resources and modification or relocation of facilities and roads is not feasible.
Visual and Scenic	• Use exterior lighting only where needed to accomplish facility tasks. • Limit the height of exterior lighting units. • Use shielded or directional lighting to limit lighting only to areas where it is needed.
Socioeconomics	• Purchase materials from local vendors as appropriate. • Hire local employees and contractors.
Occupational and public health and safety	• Use ventilation to keep radon levels as low as is reasonably achievable. • Use vacuum dryers, bag filters, and vapor filtration to reduce particulate emissions during yellowcake drying. • Use high-efficiency particulate air filters or similar controls for particulates. • Use personal monitoring devices and respirators as appropriate. • Design task procedures to reduce potential accidents.

Table 7.4-1. Summary of Potential Best Management Practices and Management Actions (continued)	
Environmental Resource	**Potential Best Management Practices and Management Actions**
	• Implement health and safety procedures and administrative controls to minimize worker risks during construction and operations.
Waste and hazardous materials	• Recycle wastewater to reduce the amount of water needed for facilities and the amount of wastewater that could require disposal. • Use decontamination techniques that would reduce waste generation. • Institute preventive maintenance and inventory management programs to minimize waste from breakdowns and overstocking. • Recycle nonradioactive materials where appropriate. • Encourage the reuse of materials and use of recycled materials. • Avoid using hazardous materials when possible. • Develop a spill prevention plan for petroleum products and other hazardous materials. • Ensure that equipment is available to respond to spills, and identify the location of such equipment. • Inspect and replace worn or damaged components. • Salvage extra materials and use them for other construction activities or for regrading activities.
Utilities, energy, and materials	• Implement procedures and equipment that would minimize the use of utility services, energy, and materials. • Incorporate high-performance and sustainable building criteria into the design and construction of nonnuclear facilities.

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8 ENVIRONMENTAL MONITORING ACTIVITIES

8.1 Introduction

Monitoring programs, in general, are developed for *in-situ* leach (ISL) facilities to verify compliance with standards for the protection of worker health and safety in operational areas and for protection of the public and environment beyond the facility boundary. Worker safety monitoring programs are developed as part of a radiological protection program summarized in Section 2.7. This chapter discusses environmental monitoring programs that address the environment beyond the operational areas.

Monitoring programs provide data on operational and environmental conditions so that prompt corrective actions can be implemented when adverse conditions are detected. In this regard, monitoring helps to limit potential environmental impacts at ISL facilities. Required monitoring programs can be modified to address unique site-specific characteristics by the addition of license conditions resulting from the conclusions of the U.S. Nuclear Regulatory Commission's (NRC) safety and environmental reviews.

The discussion of monitoring programs in this section is organized by the following general categories:

- Radiological monitoring (Section 8.2)
- Physiochemical monitoring (Section 8.3)
- Ecological monitoring (Section 8.4)

Descriptions of typical monitoring programs are provided in this chapter. Other NRC guidance documents (NRC, 2007a, 2003, 1980) provide more detailed descriptions.

8.2 Radiological Monitoring

NRC regulations at 10 CFR Parts 20 and 40 address radiological effluents and exposures to the public. NRC requires that operators have an effluent and environmental monitoring program that complies with these rules. An effluent and environmental monitoring program includes a number of monitoring sites where surface waters, groundwater, sediments, soils, and the air are sampled for radionuclides. Operators must document the sampling and monitoring results and maintain records for a specified period of time. In addition, under 10 CFR 40.65, operators must submit the results of the effluent and environmental monitoring program to NRC twice a year.

General radiological monitoring practice is described in NRC (1980). Although this regulatory guidance was developed for conventional uranium mills, both NRC and the Wyoming Department of Environmental Quality (WDEQ) (NRC, 2003, WDEQ, 2007) have recommended it for ISL facilities. Other acceptable approaches to radiological monitoring are described in a series of NRC guidance documents listed in NRC (2003, Section 5.7).

8.2.1 Airborne Radiation Monitoring Program

For offsite air monitoring, operators must establish monitoring stations and environmental sampling areas. Sampling locations are selected based on the proposed facility, nearest residences, and population centers. As described in NRC (1980), offsite air quality is typically monitored for particulates and radon at a variety of locations near the facility, including the following:

- At least three locations at or near the site boundary;
- At the nearest residence or "occupiable" structure within 10 km [6 mi] of the site with the highest predicted airborne radionuclide concentrations;
- At least one residence or occupiable structure where predicted doses exceed 5 percent of the standards in 40 CFR Part 190;
- A remote location representing background conditions.

The guidance recommends sampling locations be the same as those used to establish pre-operational baseline conditions; filters be changed at least weekly, depending on dust conditions; and radon-222 be monitored continuously for at least 1 week per month (NRC, 1980, Section 2.1).

8.2.2 Soils and Sediments Monitoring

Soils and sediments are typically monitored annually, both onsite and offsite (NRC, 1980). For consistency, soil sampling locations are generally the same as those for the airborne radiation monitoring program (see Section 8.2.1) and sediment samples should be collected from surface water locations (see Section 8.3.3). Sampling is conducted both at the surface and across a soil-depth profile to a depth of about 1 m [3 ft] or until rock is encountered. These sampling programs may include surveys for gamma radiation, as well as sampling for natural uranium, thorium-230, and lead-210.

As an example of soil and sediment monitoring, the operator of the Crow Butte ISL uranium facility in Dawes County, Nebraska, implemented a soil monitoring program that involves sampling surface soil at the plant site before and after topsoil removal, at evaporation pond sites before excavation, and at air sampling stations (NRC, 1998).

8.2.3 Vegetation, Food, and Fish Monitoring

If a potentially significant exposure pathway is identified, vegetation (forage), food, and fish samples may be collected and analyzed for radionuclides in accordance with NRC sampling location and sampling frequency guidance (NRC, 1980, Section 2). Vegetation should be sampled three times during the growing season, and livestock grazing within 3 km [5 mi] of the site are sampled at the time of slaughter.

8.2.4 Surface Water Monitoring

Water and bed-sediment samples from perennial streams, standing water bodies (ponds, lakes, etc.) and water samples from springs within and near the ISL facility are tested periodically to determine whether contaminants are leaving the facility through surface runoff. The chemical analyses are established on a site- and process-specific basis, and include, but are not limited to, the measurements of sulfate or bicarbonate (or total alkalinity), pH, uranium, iron, aluminum, and heavy metals.

Sampling frequency and distribution are site specific and established by license condition. For example, at the Crow Butte ISL uranium facility in Dawes County, Nebraska, the effluent monitoring program requires one upstream and one downstream sample for each stream passing through the well field area, as well as quarterly sampling from each water impoundment area in the well field area (NRC, 1998).

8.2.5 Groundwater Monitoring

Environmental monitoring of groundwater for radiological constituents at an ISL facility is similar to chemical constituent groundwater monitoring discussed in Section 8.3.1.

8.3 Physiochemical Monitoring

Environmental monitoring for chemical constituents at ISL facilities, as needed to comply with environmental requirements or license conditions, is expected to overlap with radiological monitoring activities already discussed in Section 8.2 (e.g., sampling of surface water, sediments, soils). Unique and important aspects of physiochemical monitoring at ISL facilities primarily include the groundwater and well field monitoring activities discussed in this section.

8.3.1 Groundwater Monitoring

The ISL production process directly affects groundwater near the operating well field. For this reason, groundwater conditions are extensively monitored both before and during operations.

8.3.1.1 Pre-Operational Groundwater Sampling

Typically, a licensee must establish baseline groundwater quality before beginning uranium production in a well field. This is done to characterize water quality in monitoring wells that are used to detect lixiviant excursions from the production zone, to recover excursions, and to establish standards for aquifer restoration after uranium recovery ends. General criteria for establishing baseline water quality are described in NRC (2003, Section 2.7)

Baseline water quality can be established through examining records and reports for existing local water wells and by sampling wells developed for the ISL program before production begins. Although it will vary with deposit and aquifer geometry, a typical sampling to establish baseline conditions is about one production or injection well for every 1.6 ha [4 acres], all wells in the monitoring ring, and wells in aquifers above and below the confining layers for the production zone. Wells are sampled periodically for 25 or more major, minor, and trace elements and other parameters such as pH, specific conductivity, and total dissolved solids (see Table 8.2-1). Sampling should ensure that a stable baseline water quality is established. To determine baseline water quality conditions, at least four sets of samples, spaced sufficiently to indicate seasonal

Table 8.2-1. Typical Baseline Water Quality Parameters and Indicators for Groundwater*

Physical Indicators		
Specific Conductivity	Total Dissolved Solids†	pH‡
Major Elements and Ions		
Alkalinity	Chloride	Sodium
Bicarbonate	Magnesium	Sulfate
Calcium	Nitrate	
Carbonate	Potassium	
Trace and Minor Elements		
Arsenic	Iron	Selenium
Barium	Lead	Silver
Boron	Manganese	Uranium
Cadmium	Mercury	Vanadium
Chromium	Molybdenum	Zinc
Copper	Nickel	
Fluoride	Radium-226§	
Radiological Parameters		
Gross Alpha‖	Gross Beta	

*Based on U.S. Nuclear Regulatory Commission (NRC). NUREG–1569, "Standard Review Plan for *In-Situ* Leach Uranium Extraction License Applications—Final Report." Table 2.7.3-1. Washington, DC: NRC. June 2003.
†Laboratory only.
‡Field and laboratory determination.
§If site initial sampling indicates the presence of thorium-232, then radium-228 should be considered in the baseline sampling, or an alternative may be proposed.
‖Excluding radon, radium, and uranium.

variability, should be collected and analyzed for each listed constituent (NRC, 1997, 1998, 2003).

8.3.1.2 Groundwater Quality Monitoring

For early detection of potential horizontal and vertical excursions of lixiviants from the production zone, monitoring wells are situated around the well fields, in the aquifers overlying and underlying the ore-bearing production aquifers within the well field. Monitoring well placement is based on what is known about the nature and extent of the confining layer and presence of drill holes, hydraulic gradient, and aquifer transmissivity and well abandonment procedures used in the region. For example, monitoring wells should be placed downgradient from the production zone to detect excursion plumes. Monitoring wells completed in the uranium bearing horizon must be in hydraulic communication with the production zone to be effective (i.e., groundwater can easily flow between the production zone and the monitoring wells). Additional, more closely spaced wells may be necessary if there are preferred flow paths in the aquifer (preferred flow paths are identified in the subsurface drilling program discussed in Section 2.11.4). If an excursion is detected, additional monitoring wells may also be installed to delineate the extent of the excursion (NRC, 1998).

The ability of a monitoring well to detect groundwater excursions is influenced by several factors, such as the thickness of the aquifer monitored, the distance between the monitoring wells and the well field, the distance between adjacent monitoring wells, the frequency of groundwater sampling, and the magnitude of changes in chemical indicator parameters (see bulleted list below) that are monitored to determine whether an excursion has occurred.

The spacing, distribution, and the number of monitoring wells at a given ISL facility are site specific and established by license condition. For example, at the Smith Ranch ISL uranium facility, Wyoming, the monitoring wells for detecting horizontal excursions are located approximately 150 m [500 ft] beyond the well field perimeter, with a maximum spacing of 150 m [500 ft] between wells (NRC, 2006). At the proposed ISL facility at Crownpoint, New Mexico, the applicant proposed that wells completed in the production zone (Westwater Canyon formation) encircle each well field 140 m [460 ft] from the outermost production or injection wells with 140 m [460 ft] between each monitoring well (NRC, 1997).

Spacing for monitoring wells to detect vertical excursions in overlying and underlying aquifers at uranium ISL facilities is variable and ranges from 1 well per 1.2 ha [3 acres] to 1 well per 2 ha [5 acres] (NRC, 2006; 1998; 1997; Mackin et al., 2001). In some cases, hydrologic conditions are such that underlying aquifers may not need to be monitored. For example, at the Crow Butte ISL facility in Dawes County, Nebraska, the underlying confining layer is very thick (more than 300 m [1,000 ft]), and the underlying aquifer is not used as source of water (NRC, 1998).

Generally, a small group of parameters provides early warning of an excursion. These indicators are based on lixiviant chemistry and groundwater geochemistry (NRC, 2003, Section 5.7.8). The best excursion indicators are measurable and more highly concentrated in the lixiviant during ISL operations than in the natural groundwater. Typical excursion indicators include the following:

- *Chloride (Cl).* Chloride does not interact strongly with the minerals in the aquifer (a conservative tracer), is easily measured, and Cl concentration significantly increases during the ISL process because of ion exchange reactions in the milling circuit.

- *Specific conductivity.* Lixiviants have higher total dissolved solids than the local groundwater and therefore, have a higher specific conductivity. Elevated specific conductivity measurements, therefore, may indicate an excursion has taken place. If conductivity is used to estimate total dissolved solids, measurements will be normalized to a reference temperature (usually 25 °C [77 °F]) because of the temperature dependence of conductivity (Staub, et al., 1986; Deutsch, et al., 1985).

- *Total alkalinity* (carbonate plus bicarbonate plus hydroxide). This is appropriate for ISL operations where sodium bicarbonate or carbon dioxide is used in the lixiviant.

Cations such as calcium and sodium are usually found at significantly higher levels in lixiviants, but these elements tend to interact more strongly with the minerals in the aquifer. This interaction tends to delay the arrival of calcium and sodium at a monitoring well. For this reason, calcium and sodium should generally not be used as excursion indicators. Similarly, some major ions such as sulfate are present in significantly higher concentrations in the lixiviants, but complex reduction-oxidation chemistry may complicate the interpretation of the results (NRC, 2003, Section 5.7.8).

An excursion is detected when the concentrations of one or more of the excursion indicators exceed the upper control limit (UCL) concentrations. These UCLs are typically developed for the chosen excursion indicators by analyzing the baseline groundwater quality for a given well field. The UCLs should be set high enough that false positives (false alarms from natural fluctuations in water quality) are not a frequent problem, but not so high that groundwater quality significantly degrades by the time an excursion is identified. Each UCL also must be greater than the baseline concentration for its respective excursion indicator. ASTM D6312 (ASTM International, 1998) and NRC (2003, Section 5.7.8) discuss appropriate statistical methods that can be used to establish UCLs.

The monitoring wells are sampled periodically to verify that ISL solutions are contained within the operating well field; monitoring frequency depends on hydraulic conductivity. NRC (2003, Section 5.7.8) provides basic guidelines for monitoring frequency and response to an excursion detection. As an example, at the Crow Butte ISL uranium recovery facility in Dawes County, Nebraska, baseline water quality was established within the ore zone and in the first aquifer overlying the ore zone prior to uranium recovery. These water quality data are used to determine groundwater monitoring UCLs for five excursion parameters (chloride, sulfate, sodium, conductivity, and alkalinity) (NRC, 1998). The UCLs were calculated as 20 percent above the maximum baseline standards from three samples taken from a well. During well field production, samples are taken every two weeks from monitoring wells. A lixiviant excursion is assumed only when two UCLs in any monitoring well are exceeded or if a single UCL at a monitoring well is exceeded by 20 percent. If there is a lixiviant excursion, the operator must notify NRC within 24 hours to institute corrective actions, increase the sampling frequency to weekly, and prepare an excursion report for NRC. If the actions taken in response to the excursion are not effective by the time the 60-day excursion report is submitted, the licensee must stop injecting lixiviant until aquifer cleanup is complete (NRC, 1998, 2003). The surety may also be revised to cover the anticipated increase in aquifer restoration costs (NRC, 2003).

8.3.2 Well Field and Pipeline Flow and Pressure Monitoring

The operator typically will monitor injection and production well flow rates to manage the water balance for the entire well field (NRC, 2006). For example, at the proposed Reynolds Ranch expansion for the Smith Ranch/Highlands Uranium Project in Converse County, Wyoming, the operator proposed to monitor the flow rate of each production and injection well by monitoring individual flow meters in each well field header house (NRC, 2006, Section 6). Production well flow rates would be monitored daily and injection well flow rates at least every 3 days.

Additionally, the pressure of each production well and the production trunk line in each well field header house is monitored daily and compared to a maximum surface pressure that is calculated to maintain well integrity. Unexpected losses of pressure may indicate equipment failure, a leak, or a problem with well integrity.

8.4 Ecological Monitoring

Depending on the ecological resources in the area of a facility, the operator may be required to monitor other environmental resources such as plant or animal species.

Ecological monitoring may include surveys of habitat, species counts, or other measures of the health of endangered, threatened, and sensitive species. In addition, surveys may be used to determine whether planned activities are resulting in establishing invasive species populations. Specific survey requirements typically are established through consultations with Federal agencies such as the U.S. Fish and Wildlife Service or State agencies such as the Wyoming Department of Environmental Quality or the New Mexico Environmental Department. Surveys typically cover all phases and areas of planned activity for the life of the project (Energy Metals Corporation, U.S., 2007, Section 6.3). To understand potential impacts on seasonal breeding, timing may be important for some species. For example, in accordance with Wyoming Department of Environmental Quality requirements, Power Resources Inc. conducts a raptor survey in late April or early May of each year to identify any new nests and to address whether known nests are being used (NRC, 2007b). These surveys are conducted to protect against unforeseen conditions where raptors would be nesting in close proximity to operations.

8.5 References

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9 CONSULTATIONS

This Generic Environmental Impact Statement (GEIS) takes a programmatic look at the environmental impacts of *in-situ* leach (ISL) uranium mining on the four regions previously described in Section 1.4. For the purpose of the GEIS, the programmatic aspects of the consultation process are described in this chapter. Each site-specific review would include its own consultation process with the relevant agencies including, but not limited to, state and tribal historic preservation offices [National Historic Preservation Act, Section 106 (NHPA)], U.S. Fish and Wildlife Service (USFWS) (Endangered Species Act, Section 7), and tribal consultations with appropriate Native American communities. The U.S. Nuclear Regulatory Commission (NRC) Consultation process involves early interaction in an effort to gather information to prepare an environmental review. In particular, 10 CFR 51.28(a)(3–5) specifically requires NRC to extend invitations to affected (state, local, tribal and federal government) agencies to meet as part of the scoping process for an environmental impact statement.

National Historic Preservation Act

NRC uses its National Environmental Policy Act (NEPA) process to coordinate Section 106 of the NHPA, which requires that Federal agencies "take into account the effects of their undertakings on historic properties and afford the Council (Advisory Council on Historic Preservation) a reasonable opportunity to comment on such undertakings." Typically, NRC licensing actions can be defined as undertakings based on 36 CFR 800.16(y) because the proposed actions consider applications and licensing amendments that require a "Federal permit, license or approval." NRC performs an evaluation of the proposed action to determine whether the activity has a potential to cause effects on historic properties. NRC initiates consultation with relevant agencies including the State Historic Preservation Office and/or the Tribal Historic Preservation Office, reports the conclusions of its evaluation, and seeks concurrence with its findings.

For the purpose of the GEIS, the proposed action considers the impact of construction, operation, aquifer restoration, and decommissioning of ISL facilities in four geographical regions in the western United States. Because the actual undertaking would occur when site-specific applications are submitted, the GEIS would not include Section 106 consultations. The site specific environmental reviews would identify the area of potential effect and lists any historic properties. Each site-specific environmental review would address the potential impact of the proposed action on the appropriate historic properties.

Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973 was enacted to protect critically imperiled species from extinction as a "consequence of economic growth and development untendered by adequate concern and conservation." Section 7 of the ESA directs all Federal agencies to use their existing authorities to conserve threatened and endangered species and, in consultation with the USFWS, to ensure that their actions do not jeopardize listed species or destroy or adversely modify critical habitat. Section 7 applies to management of federal lands as well as other federal actions that may affect listed species, such as federal approval of private activities through the issuance of federal permits, licenses, or other actions.

NRC uses its NEPA process to coordinate Section 7 consultations under the ESA. The staff perform an evaluation to identify the action area, determine whether listed species or critical habitat exist in the action area, and evaluates the potential impact on any listed species or critical habitat. For the purpose of this GEIS, the NRC staff identified endangered species in the four regions previously identified. Consultation would be initiated with the USFWS to determine whether critical habitats exist for species of concern on a site-specific basis. At the end of the consultation process, NRC would notify the USFWS of its conclusions and document them in the site-specific environmental analysis.

State Consultation

As a part of the environmental review process, NRC consults with the affected states and solicits comments on the environmental impact of the proposed action. This consultation is designed to address issues raised by state and local agencies and to reduce any duplication of effort in complying with federal, state, and local environmental requirements. During the scoping and information gathering process for a site-specific environmental review, NRC staff typically contact appropriate state and local agencies for initial, informal discussion about the proposed action and potential impacts. Because the GEIS contains a regional, programmatic evaluation, state consultations are not reported as these would be would be conducted during the site-specific review. Should the site-specific review result in the preparation of an environmental assessment (EA), NRC would submit a copy of the draft EA to the State for review and comment.

Tribal Consultation

NRC consults with the affected tribes as part of carrying out the intent behind Executive Order 13175 "Consultation and Coordination With Indian Tribal Governments" and requirements under 10 CFR 51.28(a)(5). Formal and informal consultations through the environmental review process can fulfill these responsibilities. Because the GEIS contains a regional, programmatic evaluation, tribal consultations are not reported as these would be conducted during the site-specific review. Should the site-specific review result in the preparation of an EA, NRC would submit a copy of the draft EA to affected tribes for review and comment.

For applications for new ISL facilities that have potential cultural and resource impacts on the Navajo Nation, NRC has committed to consultations with the Navajo Nation, through the Navajo Nation Department of Justice (U.S. DOI, 2008). These consultations for site-specific environmental reviews would take into account topics identified by NRC and the tribal agencies (e.g., Navajo Nation EPA).

Reference

U.S. Department of the Interior (Bureau of Indian Affairs), et al., 2008. "Health and Environmental Impacts of Uranium Contamination in the Navajo Nation: Five-Year Plan." June 9, 2008.

10 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

The environmental resources in the four geographic regions where current *in-situ* leach (ISL) facilities are located and where future ISL facilities may be located are discussed in Chapter 3. Based on the description of the ISL process and the historical information on ISL facilities in Chapter 2, the potential environmental impacts are described and analyzed in Chapter 4. In this chapter, for each of the four uranium milling regions considered within this Draft GEIS, the potential environmental impacts are summarized for construction, operation, aquifer restoration, and decommissioning at an ISL facility for each environmental resource.

In the Impact Findings column of the table that follows, the impacts are categorized by the significance levels described in Chapter 1:

- **SMALL**—The environmental effects would not be detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource considered.

- **MODERATE**—The environmental effects would be sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.

- **LARGE**—The environmental effects would be clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

As described in Section 1.8, for each new ISL license application, NRC will conduct an independent site-specific environmental review to meet its responsibilities under the National Environmental Policy Act, drawing on the information and conclusions in the GEIS as appropriate.

Topic/ Resource	GEIS Section	Impact Findings
Land Use	4.2.1	CONSTRUCTION—Land use impacts could occur from land disturbances (including alterations of ecological cultural or historic resources) and access restrictions (including limitations of other mineral extraction activities, grazing activities, or recreational activities). Land disturbances during construction would be temporary and limited to small areas within permitted areas. Well sites, staging areas, and trenches would be reseeded and restored. Unpaved access roads would remain in use until decommissioning. Competing access to mineral rights could be either delayed for the duration of the *in-situ* leaching (ISL) project or be intermixed with ISL operations (e.g., oil and gas exploration). Changes to land use access including grazing restrictions and impacts on recreational activities would be limited due to the small size of restricted areas, temporary nature of restrictions, and availability of other land for these activities. Ecological, historical, and cultural resources could be affected, but would be protected by careful planning and surveying to help identify resources and avoid or mitigate impacts. For all land use aspects except ecological, historical and cultural resources, the potential impacts would be SMALL. Due to the potential for unidentified resources to be altered or destroyed during excavation, drilling, and grading, the potential impacts to ecological, historical or cultural resources would be SMALL to LARGE, depending on local conditions. OPERATION—The types of land use impacts for operational activities would be expected to be similar to construction impacts regarding access restrictions because the infrastructure would be in place. Additional land disturbances would not occur from conducting operational activities. Because access restriction and land disturbance related impacts would be similar to, or less than, expected for construction, the overall potential impacts to land use from operational activities would be expected to be SMALL. AQUIFER RESTORATION—Due to the use of the same infrastructure, land use impacts would be similar to operations during aquifer restoration, although some operational activities would diminish—SMALL. DECOMMISSIONING—Land use impacts would be similar to those described for construction with a temporary increase in land-disturbing activities for dismantling, removing, and disposing of facilities, equipment, and excavated contaminated soils. Reclamation of land to preexisting conditions and uses would help mitigate potential impacts—SMALL to MODERATE during decommissioning and SMALL once decommissioning is completed.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Transportation	4.2.2	CONSTRUCTION—Low magnitude traffic generated by ISL construction relative to local traffic counts would not significantly increase traffic or accidents on many of the roads in the region. Existing low traffic roads could be MODERATEly impacted by the additional worker commuting traffic during periods of peak employment. The potential impact would be more pronounced in areas with lower traffic counts. MODERATE dust, noise, and incidental wildlife or livestock kill impacts would be possible on, or near, site access roads (dust in particular for unpaved access roads)—SMALL to MODERATE. OPERATION—Low magnitude traffic relative to local traffic counts on most roads would not significantly increase traffic, or accidents. Existing low traffic roads could be moderately impacted by commuting traffic during periods of peak employment including dust, noise, and possible incidental wildlife or livestock kill impacts on, or near site access roads. High consequences would be possible for a severe accident involving transportation of hazardous chemicals in a populated area. However, the probability of such accidents occurring would be low, owing to the limited number of shipments, comprehensive regulatory controls, and use of best management practices. For radioactive material shipments (yellowcake product, ion exchange resins, waste materials), compliance with transportation regulations would limit radiological risk for normal operations. Consequently, there is low radiological risk associated with accident conditions. Emergency response protocols would help mitigate long-term consequences of severe accidents involving release of uranium—SMALL to MODERATE. AQUIFER RESTORATION—The magnitude of transportation activities would be lower than for construction and operations, with the exception of workforce commuting which could have moderate impacts on, or in the vicinity of, existing low traffic roads—SMALL to MODERATE. DECOMMISSIONING—The types of transportation activities and therefore types of impacts would be similar to those discussed for construction and operations except the magnitude of transportation activities (e.g., number and types of waste and supply shipments, no yellowcake shipments) from decommissioning could be lower than for operations. Accident risks would be bounded by operations yellowcake transportation risk estimates—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Geology and Soils	4.2.3	CONSTRUCTION—Disturbance to soil would occur from construction (clearing, excavation, drilling, trenching, road construction). However, such disturbances would be temporary and SMALL (approx. 10 percent of the total site area), and potential impacts would be mitigated by using best management practices. The well fields, trenches, and access roads would be restored and reseeded after construction. Excavated soils would be stockpiled, seeded, and stored onsite until needed for reclamation fill. No impacts to subsurface geological strata are likely—SMALL. OPERATION—Temporary contamination or alteration of soils would be likely from operational leaks and spills and possible from transportation, use of evaporation ponds, or land application of treated waste water. However, detection and response techniques, monitoring of treated waste water, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to soils—SMALL. AQUIFER RESTORATION—Impacts to geology and soils from aquifer restoration activities would be similar to impacts from operations due to use of the same infrastructure and similar activities conducted (e.g., well field operation, transfer lines, waste water treatment and disposal)—SMALL. DECOMMISSIONING—Impacts to geology and soils from decommissioning would be similar to impacts from construction. Activities to cleanup, recontour and reclaim disturbed lands during decommissioning would mitigate long-term impacts to soils—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Surface Waters	4.2.4.1	CONSTRUCTION—Impacts to surface waters and related habitats from construction (road crossings, filling, erosion, runoff, spills or leaks of fuels and lubricants for construction equipment) would be mitigated through proper planning, design, construction methods, and best management practices. Some impacts directly related to the construction activities would be temporary and limited to the duration of the construction period. U.S. Army Corps of Engineers permits may be required when filling and crossing of wetlands. Temporary changes to spring and stream flow from grading and changes in topography and natural drainage patterns could be mitigated or restored after the construction phase. Incidental spills of drilling fluids into local streams would be SMALL and temporary, due to the implementation of mitigation measures. Impacts from construction of roads, parking areas, and buildings on recharge to shallow aquifers would be SMALL, owing to the limited area of impervious surfaces proposed. Infiltration of drilling fluids into the local aquifer would be SMALL, temporary, and localized to a few feet around boreholes—SMALL to MODERATE depending on site-specific characteristics. OPERATION—Impacts from storm water runoff or direct discharge of process waters (brine reject from reverse osmosis, or spent eluants from an ion exchange system) to surface waters would be regulated by the Wyoming Department of Environmental Quality through the Wyoming Pollutant Discharge Elimination System permit. Expansion of facilities or pipelines during operations would generate impacts similar to construction—SMALL to MODERATE, depending on site-specific characteristics. AQUIFER RESTORATION—Impacts from aquifer restoration would be similar to impacts from operations due to use of in-place infrastructure and similar activities conducted (e.g., well field operation, transfer lines, water treatment, storm water runoff)—SMALL to MODERATE, depending on site-specific characteristics. DECOMMISSIONING—Impacts from decommissioning would be similar to impacts from construction. Activities to clean up, re-contour and reclaim disturbed lands during decommissioning would mitigate long-term impacts to surface waters—SMALL to MODERATE, depending on site-specific characteristics.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Water—Groundwater	4.2.4.2	CONSTRUCTION—Water use impacts would be limited by the small volumes of groundwater used for routine activities such as dust suppression, mixing cements, and drilling support over short and intermittent periods. Contamination of groundwater from construction activities would be mitigated by use of best management practices—SMALL to LARGE, depending on site-specific conditions. OPERATION—Potential impacts to shallow aquifers can occur from leaks or spills from surface facilities and equipment. Shallow aquifers are important sources of drinking water in some areas of the Wyoming West Uranium Milling Region. Potential impacts to the ore-bearing and surrounding aquifers include consumptive water use and degradation of water quality (from normal production activities, off-normal excursion events, and deep well injection disposal practices). Consumptive use impacts from withdrawal of groundwater would occur because only 1 to 3 percent of pumped groundwater is not returned to the aquifer (e.g., process bleed). The amount of water lost could be reduced substantially by available treatment methods (e.g., reverse osmosis, brine concentration). Effects of water withdrawal on surface water would be SMALL as the ore zone normally occurs in a confined aquifer. Estimated drawdown effects vary depending on site conditions and water treatment technology applied. Excursions of lixiviant and mobilized chemical constituents could occur from failure of well seals or other operational conditions that result in incomplete recovery of lixiviant. Well seal related excursions would be detected by the groundwater monitoring system and periodic well mechanical integrity testing and impacts would be mitigated during operation or aquifer restoration. Other excursions could result in plumes of mobilized uranium and heavy metals extending beyond the mineralization zone. The magnitude of potential impacts from vertical excursions would vary depending on site-specific conditions. To reduce the likelihood and consequences of potential excursions at ISL facilities, NRC requires licensees to take preventative measures prior to starting operations including well tests, monitoring, and development of procedures that include excursion response measures and reporting requirements. Alterations of ore body aquifer chemistry would be SMALL because the aquifer would: (1) be confined, (2) not be a potential drinking water source, and (3) be expected to be restored within statistical range of preoperational baseline water quality during the restoration period. Potential environmental impacts to confined deep aquifers below the production aquifers from deep well injection of processing wastes would be addressed by the underground injection permitting process regulated by the state of Wyoming—SMALL to LARGE, depending on site-specific conditions. AQUIFER RESTORATION—Potential impacts concern consumptive use and potential deep disposal of brine slurries after reverse osmosis, if applicable. The volume of water removed from the aquifer and related impacts would be dependent on site-specific conditions and the type of water treatment technology the facility uses. In some cases, groundwater consumptive use for the aquifer restoration has been reported to be less than groundwater use during the ISL operation and drawdowns due to aquifer restorations have been less than drawdown caused by ISL operations. Potential environmental impacts associated with water consumption during aquifer restorations are determined by: (1) the restoration techniques chosen, (2) the volume of water to be used, (3) the severity and extent of the contamination, and (4) the current and future use of the production and surrounding aquifers near the ISL facility or at the regional scale—SMALL to LARGE, depending on site-specific conditions. DECOMMISSIONING—Potential impacts from decommissioning would be similar to construction (water use, spills) with an additional potential to mobilize contaminants during demolition and cleanup activities. Contamination of groundwater from decommissioning activities would be mitigated by implementation of an NRC-approved decommissioning plan and use of best management practices—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Terrestrial	4.2.5.1	CONSTRUCTION—Potential terrestrial ecology impacts would include the removal of vegetation from well fields, the milling site, the modification of existing vegetative communities, the loss of sensitive plants and habitats from clearing and grading, and the potential spread of invasive species and noxious weed populations. These impacts would be temporary because restoration and reseeding occur rapidly after the end of construction. Introduction of invasive species and noxious weeds would be possible but could be mitigated by restoration and reseeding after construction. Shrub and tree removal would have a longer restoration period. Wildlife habitat fragmentation, temporary displacement of animal species, and direct or indirect mortalities is possible. Implementation of wildlife surveys and mitigation measures following established guidelines would limit these impacts. The magnitude of impacts depends on whether a new facility is being licensed or an existing facility is being extended—SMALL to MODERATE, depending on site-specific conditions. OPERATION—Habitat could be altered by operations (fencing, traffic, noise), and individual takes could occur due to conflicts between species habitat and operations. Access to crucial wintering habitat and water could be limited by fencing. The Wyoming Game and Fish Department specifies fencing construction techniques to minimize impediments to big game movement. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Temporary contamination or alteration of soils would be from operational leaks and spills and possible from transportation or land application of treated waste water. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures, such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys, would reduce overall impacts—SMALL. AQUIFER RESTORATION—Impacts include habitat disruption, but existing (in-place) infrastructure would be used during aquifer restoration, with little additional ground disturbance. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Contamination of soils could result from leaks and spills, or land application of treated waste water. However, detection and response techniques and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites and periodic wildlife surveys would reduce overall impacts—SMALL. DECOMMISSIONING—During decommissioning and reclamation, there would be a temporary disturbance to land (e.g., excavating soils, buried piping, removal of structures). However, revegetation and re-contouring would restore habitat altered during construction and operations. Wildlife would be temporarily displaced, but are expected to return after decommissioning and reclamation are completed and vegetation and habitat is reestablished—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Aquatic	4.2.5.2	CONSTRUCTION—Clearing and grading activities associated with construction could result in a temporary increase in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. Clearing of riparian vegetation could affect light and temperature of water. Construction impacts to wetlands would be identified and managed through U.S. Army Corps of Engineers permits, as appropriate. Construction impacts to surface waters and aquatic species would be temporary and mitigated by best management practices—SMALL. OPERATION—Impacts could result from spills or releases into surface water. Impacts would be minimized by spill prevention, identification and response programs, and National Pollutant Discharge Elimination System (NPDES) permit requirements—SMALL. AQUIFER RESTORATION—Activities would use existing (in-place) infrastructure, and impacts could result from spills or releases of untreated groundwater. Impacts would be minimized by spill prevention, identification, and response programs, and NPDES permit requirements—SMALL. DECOMMISSIONING—Decommissioning and reclamation activities could result in temporary increases in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Threatened or Endangered Species	4.2.5.3	CONSTRUCTION—Numerous threatened and endangered species and State Species of Concern are located in the region. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts depends on the size of a new facility or extension to an existing facility and the amount of land disturbance. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assiste in identifying potential impacts—SMALL to MODERATE to LARGE—depending on site-specific habitat and presence of threatened or endangered species. OPERATION—Impacts could result from individual takes due to conflicts with operations. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts would depend on the size of a new facility or extension to an existing facility and the amount of land disturbance. Impacts could potentially result from spills or permitted effluents, but would be minimized by spill prevention measures, identification and response programs, and NPDES permit requirements. Inventory of threatened or endangered species developed during site-specific reviews would identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL to MODERATE—depending on site-specific habitat and presence of threatened or endangered species. AQUIFER RESTORATION—Impacts could result from individual takes due to conflicts with aquifer restoration activities (equipment, traffic). Existing (in-place) infrastructure would be used during aquifer restoration, so additional land-disturbing activities and habitat fragmentation would not be anticipated. Impacts may result from spills or releases of treated or untreated groundwater, but impacts would be minimized by spill prevention measures, identification, and response programs, and NPDES permit requirements. Inventory of threatened or endangered species would be expected to be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL. DECOMMISSIONING—Impacts resulting from individual takes would occur due to conflicts with decommissioning activities (equipment, traffic). Temporary land disturbance would occur as structures are demolished and removed and the ground surface is re-contoured. Inventory of threatened or endangered species developed during site-specific environmental review of the decommissioning plan would identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in identifying potential impacts. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Air Quality	4.2.6	CONSTRUCTION—Fugitive dust and combustion (vehicle and diesel) emissions during land disturbing activities associated with construction would be SMALL, short-term, and reduced through best management practices (e.g., dust suppression). For example, estimated fugitive dust emissions during ISL construction is less than 2 percent of the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and less than 1 percent for PM_{10}. For NAAQS attainment areas such as the Wyoming West Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no Prevention of Significant Deterioration (PSD) Class I areas in the Wyoming West Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. OPERATION—Radiological impacts can result from dust releases from drying of lixiviant pipeline spills, radon releases from well system relief valves, resin transfer, or elution, and gaseous/particulate emissions from yellowcake dryers. Only small amounts of low dose materials would be released based on operational controls and rapid response to spills. Required spill prevention, control, and response procedures would be used to minimize impacts from spills. High Efficiency Particulate Air (HEPA) filters and vacuum dryer designs would reduce particulate emissions from operations, and ventilation would reduce radon buildup during operations. Compliance with the NRC-required radiation monitoring program would ensure releases are within regulatory limits. Other potential nonradiological emissions during operations include fugitive dust and fuel from equipment, maintenance, transport trucks, and other vehicles. For NAAQS attainment areas such as the Wyoming West Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no PSD Class I areas in the Wyoming West Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions, or mitigation measures to reduce impacts—SMALL. AQUIFER RESTORATION—Because the same infrastructure would be used, air quality impacts are expected to be similar to, or less than, operations. For NAAQS attainment areas such as the Wyoming West Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no PSD Class I areas in the Wyoming West Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions, or mitigation measures to reduce impacts—SMALL. DECOMMISSIONING—Fugitive dust and combustion (vehicle and diesel) emissions during land-disturbing activities associated with decommissioning would be similar to, or less than, associated with construction, short-term, and reduced through best management practices (e.g., dust suppression). These potential impacts would decrease as decommissioning and reclamation of disturbed areas are completed. For NAAQS attainment areas such as the Wyoming West Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no PSD Class I areas in the Wyoming West Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions, or mitigation measures to reduce impacts—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Noise	4.2.7	CONSTRUCTION—Noise generated during construction would be noticeable in proximity to operating equipment, but would be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below Occupational Health and Safety Administration (OSHA) regulatory limits and mitigated by use of personal hearing protection. Traffic noise during construction (commuting workers, truck shipments to and from the facility, and construction equipment such as trucks, bulldozers, compressors) would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Noise may also have an adverse effect on wildlife habitat and their reproductive success in the immediate vicinity of construction activities. Noise levels, however, decrease geometrically with distance, and at distances more than 300 m [1,000 ft], ambient noise levels return to background. Wildlife generally avoid construction noise areas. The two uranium districts within the Wyoming West Uranium Milling Region are more than 16 km [10 mi] from the closest community—SMALL to MODERATE. OPERATION—Noise-generating activities in the central uranium processing facility would be indoors, minimizing offsite sound levels. Well field equipment (e.g., pumps, compressors) would also be contained within structuress (e.g., header houses, satellite facilities), minimizing sound levels to offsite receptors. Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits, and mitigated by use of personal hearing protection. Traffic noise from commuting workers, truck shipments to and from the facility, and facility equipment would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Most noise would be generated indoors and mitigated by regulatory compliance and use of best management practices. Noise from trucks and other vehicles is typically of short duration. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The two uranium districts within the Wyoming West Uranium Milling Region are more than 16 km [10 mi] from the closest community—SMALL to MODERATE. AQUIFER RESTORATION—Noise generation is expected to be less than during construction and operations. Pumps and other well field equipment contained in buildings minimize sound levels to offsite receptors. Existing operational infrastructure used and traffic levels would be less than during construction and operations. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The two uranium districts within the Wyoming West Uranium Milling Region are more than 16 km [10 mi] from the closest community—SMALL to MODERATE. DECOMMISSIONING—Noise generated during decommissioning would be noticeable only in proximity to operating equipment and be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits and mitigated by use of personal hearing protection. Noise levels during decommissioning would be expected to be less than during construction and would diminish as less and less equipment is used and truck traffic is reduced. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]} The two uranium districts within the Wyoming West Uranium Milling Region are more than 16 km [10 mi] from the closest community—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Historical and Cultural	4.2.8	CONSTRUCTION—Potential impacts during ISL facility construction could include loss of, or damage and temporary restrictions on access to, historical, cultural, and archaeological resources. The eligibility evaluation of cultural resources for listing in the National Register of Historic Places (NRHP) under criteria in 36 CFR 60.4(a)–(d) and/or as Traditional Cultural Properties (TCPs) would be conducted as part of the site-specific review and NRC licensing procedures undertaken during the National Environmental Policy Act (NEPA) review process. The evaluation of impacts to any historic properties designated as TCPs and tribal consultations regarding cultural resources and TCPs also occur during the site-specific licensing application and review process. Consultation to determine whether significant cultural resources would be avoided or mitigated occurs during consultations with State Historic Preservation Offices (SHPOs), other governmental agencies, and Native American tribes, including Tribal Historic Preservation Offices (THPOs), as part of the site-specific review. Additionally, as needed, the NRC license applicant would be expected to be required, under conditions in its NRC license, to adhere to procedures regarding the discovery of previously undocumented cultural resources during initial construction. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. OPERATION—Because less land disturbance occurs during the operations phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during operation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. AQUIFER RESTORATION—Because less land disturbance occurs during the aquifer restoration phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during aquifer restoration. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE depending on site-specific conditions. DECOMMISSIONING—Because less land disturbance occurs during the decommissioning phase, and because decommissioning and reclamation activities would be focused on previously disturbed areas, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during decommissioning and reclamation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE depending on site-specific conditions.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Visual and Scenic	4.2.9	CONSTRUCTION—Visual impacts result from equipment (drill rig masts, cranes), dust/diesel emissions from construction equipment, and hillside and roadside cuts. Most of the Wyoming West Uranium Milling Region is classified as Visual Resource Management (VRM) Class II through IV, and no VRM Class I or Prevention of Significant Deterioration (PSD) Class I areas are located in the region. Most potential visual impacts during construction would be temporary as equipment is moved, and would be mitigated by implementing best management practices (e.g., dust suppression). Because of the generally rolling topography of the region, most visual impacts during construction would not be expected to be visible from more than about 1 km [0.6 mi]. The two uranium districts in the region are located more than 24 km [15 mi] from the closest VRM Class II region, and the visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL. OPERATION—Visual impacts during operations would be expected to be less than those associated with construction. Most of the well field surface infrastructure has a low profile, and most piping and cables would be buried. The tallest structures would include the central uranium processing facility {10 m [30 ft]} and power lines {6 m [20 ft]}. Because of the generally rolling topography of the region, most visual impacts during operations would not be visible from more than about 1 km [0.6 mi]. Irregular layout of well field surface structures such as wellhead protection and header houses would reduce visual contrast. Best management practices, design (e.g., painting buildings), and landscaping techniques would be used to mitigate potential visual impact. The two uranium districts in the region are located more than 24 km [15 mi] from the closest VRM Class II region, and the visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL. AQUIFER RESTORATION—Because aquifer restoration activities use the same infrastructure, potential visual impacts would be the same as, or less than, during operations—SMALL. DECOMMISSIONING SMALL—Because similar equipment would be used and activities conducted, potential visual impacts during decommissioning would be the same as or less than those during construction. Most potential visual impacts during decommissioning would be temporary as equipment is moved and would be mitigated by use of best management practices (e.g., dust suppression). Visual impacts would be low because sites would be in sparsely populated areas, and impacts would diminish as decommissioning activities decrease. An approved site reclamation plan would be required prior to license termination, with the goal of returning the landscape to preconstruction condition (predominantly VRM Class III and IV). Some roadside cuts and hill slope modifications may, however, persist beyond decommissioning and reclamation—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Socioeconomics	4.2.10	CONSTRUCTION—Potential impacts to socioeconomics would result predominantly from employment at an ISL facility and demands on the existing public and social services, tourism/recreation, housing, infrastructure (schools, utilities), and the local work force. Total peak employment would be about 200 people including company employees and local contractors, depending on timing of construction with other stages of the ISL lifecycle. During construction of surface facilities and well fields, the general practice has been to use local contractors (drillers, construction) if available. A local multiplier of 0.7 would indicate a maximum of about 140 ancillary jobs could be created. For example, local building materials and building supplies would be used to the extent practical. Most employees would live in larger communities with access to more services. Some construction employees, however, would commute from outside the county to the ISL facility, and skilled employees (e.g., engineers, accountants, managers) would come from outside the local work force. Some of these employees would temporarily relocate to the project area and contribute to the local economy through purchasing goods and services and taxes. Because of the small relative size and temporary nature of the ISL construction workforce, net impacts would be SMALL to MODERATE, depending on proximity to less populated communities such as Jeffrey City and Bairoil. OPERATION—Employment levels for ISL facility operations would be similar to, or less than, for construction, with total peak employment depending on timing and overlap with other stages of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Additional revenues would be generated by federal, state, and local taxes on the facility and the uranium produced. Because of similar employment levels, other socioeconomic impacts would be similar to construction SMALL to MODERATE, depending on proximity to sless populated communities such as Jeffrey City and Bairoil. AQUIFER RESTORATION—Because much of the same (in-place) infrastructure would be used, employment levels would be similar to, or less than, for operations, with total peak employment depending on timing and overlap with other activities during the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated communities such as Jeffrey City and Bairoil. DECOMMISSIONING—A skill set similar to the construction workforce would be involved in dismantling surface structures, removing pumps, plugging and abandoning wells, and reclaiming/recontouring the ground surface. Employment levels and use of local contractor support during decommissioning would be similar to, or less than, would be required for construction. Employment would be temporary, as decommissioning activities would be limited in duration. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated communities such as Jeffrey City and Bairoil.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Public and Occupational Health and Safety	4.2.11	CONSTRUCTION—Worker safety would be addressed by standard construction safety practices. Fugitive dust would result from construction activities and vehicle traffic, but would likely be of short duration, and not result in a radiological dose. Diesel emissions would not be expected to be a concern for worker or public health, because the releases are usually of short duration and are readily dispersed into the atmosphere—SMALL. OPERATION—Potential occupational radiological impacts from normal operations would be caused primarily by exposure to radon gas from the well field, ion-exchange resin transfer operations, and venting during processing activities. Workers would also be exposed to airborne uranium particulates from dryer operations and maintenance activities. Potential public exposures to radiation would occur from the same radon releases and uranium particulate releases (i.e., from facilities without vacuum dryer technology). Both worker and public radiological exposures would be limited by NRC regulations at 10 CFR Part 20 that require licensees to implement an NRC-approved radiation monitoring and protection program. (Measured and calculated doses for workers and the public are commonly a fraction of regulated limits.) Non-radiological worker safety matters would be addressed through commonly applied occupational health and safety regulations and practices. Radiological accident risks could involve processing equipment failures leading to yellowcake slurry spills, or radon gas or uranium particulate releases. Consequences of accidents to workers and the public are generally low, with the exception of a dryer explosion, which could result in worker dose above NRC limits. The likelihood of such an accident would be low, and therefore, the risk would also be low. Potential non-radiological accidents impacts include high-consequence for chemical release events (e.g., ammonia) for both workers and nearby populations. The likelihood of such release events would be low, based on historical operating experience at NRC-licensed facilities, which is partly the result of operators following commonly applied chemical safety and handling protocols—SMALL to MODERATE. AQUIFER RESTORATION—Because the activities during aquifer restoration overlap with similar operational activities (e.g., operation of well fields, waste water treatment and disposal) the types of impacts on public and occupational health and safety would be similar to operational impacts. The absence of some operational activities (e.g., yellowcake production and drying, remote ion exchange) further limits the relative magnitude of potential worker and public health and safety hazards—SMALL. DECOMMISSIONING—Worker and public health and safety would be addressed in a required Decommissioning Plan. This plan details how a 10 CFR Part 20-compliant radiation safety program would be implemented during decommissioning, and ensure the safety of workers and the public, as well as comply with applicable safety regulations—SMALL.

Table 10-1. Summary of Impacts for the Wyoming West Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Waste Management	4.2.12	CONSTRUCTION—The relatively small scale of construction activities (Section 2.3) and incremental development of well fields at ISL facilities would generate low volumes of construction waste—SMALL. OPERATION—Operational wastes primarily result from liquid waste streams including process bleed, flushing of depleted eluant to limit impurities, resin transfer wash, filter washing, uranium precipitation process wastes (brine), and plant washdown water. State permitting actions, NRC license conditions, and NRC inspections ensure the proper practices would be used to comply with safety requirements to protect workers and the public. Waste treatment such as reverse osmosis and radon settling would help in segregating wastes and minimizing disposal volumes. Potential impacts from surface discharge and deep well injection would be limited by the applicable permitting processes. NRC regulations address constructing, operating, and monitoring for leakage from evaporation ponds used to store and reduce volumes of liquid wastes. Potential impacts from land application of treated wastewater would be addressed by NRC review of site-specific conditions prior to approval, routine monitoring, and inclusion of irrigated land areas in decommissioning surveys. Offsite waste disposal impacts would be SMALL for radioactive wastes as a result of required preoperational disposal agreements. Impacts for hazardous and municipal waste would be SMALL due to the volume of wastes generated. For remote areas with limited available disposal capacity, such wastes may need to be shipped greater distances to facilities that have capacity. However, the volume of wastes generated, and magnitude of the shipments, are estimated to be—SMALL. AQUIFER RESTORATION—Waste management activities during aquifer restoration would utilize the same treatment and disposal options implemented for operations. Therefore, impacts associated with aquifer restoration would be similar to operational impacts. While the amount of wastewater generated during aquifer restoration is dependent on site-specific conditions, the potential exists for additional generated wastewater volume and associated treatment wastes during the restoration period. However, this would be offset to some degree by the reduction in production capacity from the removal of a well field. NRC review of future ISL facility applications would verify that sufficient water treatment and disposal capacity (and the associated agreement for disposal of byproduct material) are addressed. As a result, waste management impacts from aquifer restoration would be—SMALL. DECOMMISSIONING—Radioactive wastes from decommissioning ISL facilities (including contaminated excavated soil, evaporation pond bottoms, process equipment) would be disposed of as byproduct material at an NRC-licensed facility. A pre-operational agreement with a licensed disposal facility to accept radioactive wastes ensures sufficient disposal capacity would be available for byproduct wastes generated by decommissioning activities. Safe handling, storage, and disposal of decommissioning wastes would be addressed in a required Decommissioning Plan , subject toNRC review . This plan would detail how a 10 CFR Part 20-compliant radiation safety program would be implemented during decommissioning, and to ensure safety of workers and the public, as well as to identify measures to comply with applicable safety regulations. Overall, volumes of decommissioning radioactive, chemical, and solid wastes would be—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region

Topic/ Resource	GEIS Section	Impact Findings
Land Use	4.3.1	CONSTRUCTION—Land use impacts could occur from land disturbances (including alterations of ecological cultural or historic resources) and access restrictions (including limitations of other mineral extraction activities, grazing activities, or recreational activities). A higher percentage of private land ownership occurs in this region than in the Wyoming West Uranium Milling Region, and could increase the potential for land use conflicts with private land owners. Land disturbances during construction would be temporary and limited to SMALL areas within permitted site. Well sites, staging areas, and trenches would be reseeded and restored, but unpaved access roads would remain in use until decommissioning is complete. Competing access to mineral rights could be either delayed for the duration of the ISL project or be intermixed with ISL operations (e.g., oil and gas exploration). Changes to land use access including grazing restrictions and impacts on recreational activities would be limited due to the SMALL size of restricted areas, temporary nature of restrictions, and availability of other land for these activities. Ecological, historical, and cultural resources could be affected but would be protected by careful planning and surveying to help identify resources and avoid or mitigate impacts. For all land use aspects except ecological, historical and cultural resources, the potential impacts would be SMALL. Due to the potential for unidentified resources to be altered or destroyed during excavation, drilling, and grading, the potential impacts to ecological, historical or cultural resources would be SMALL to LARGE, depending on local conditions. OPERATION—The types of land use impacts for operational activities would be similar to construction impacts regarding access restrictions because the infrastructure would be in place. Additional land disturbances would not occur from conducting operational activities. Because access restriction and land disturbance related impacts would be similar to, or less than, expected for construction, the overall potential impacts to land use from operational activities would be SMALL. AQUIFER RESTORATION—Due to the use of the same infrastructure, land use impacts would be similar to operations during aquifer restoration, although some operational activities would diminish—SMALL. DECOMMISSIONING—Land use impacts would be similar to those described for construction with a temporary increase in land-disturbing activities for dismantling, removing, and disposing of facilities, equipment, and excavated contaminated soils. Reclamation of land to preexisting conditions and uses would help mitigate potential impacts—SMALL to MODERATE during decommissioning, and SMALL once decommissioning is completed.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Transportation	4.3.2	CONSTRUCTION—Low magnitude traffic generated by ISL construction relative to local traffic counts would not significantly increase traffic or accidents on many of the roads in the region. Existing low traffic roads could be moderately impacted by the additional worker commuting traffic during periods of peak employment. The impact would be more pronounced in areas with lower traffic counts. MODERATE dust, noise, and incidental wildlife or livestock kill impacts would be possible on, or near, site access roads (dust in particular for unpaved access roads)—SMALL to MODERATE. OPERATION—Low magnitude traffic relative to local traffic counts on most roads would not significantly increase traffic or accidents. Existing low traffic roads could be moderately impacted by commuting traffic during periods of peak employment including dust, noise, and possible incidental wildlife or livestock kill impacts on, or near, site access roads. High consequences are possible for a severe accident involving transportation of hazardous chemicals in a populated area. However, the probability of such accidents occurring would be low, owing to the limited number of shipments, comprehensive regulatory controls, and use of best management practices. For radioactive material shipments (yellowcake product, ion exchange resins, waste materials) compliance with transportation regulations would limit radiological risk for normal operations. Low radiological risk is estimated for accident conditions. Emergency response protocols would help mitigate long-term consequences of severe accidents involving release of uranium—SMALL to MODERATE. AQUIFER RESTORATION—The magnitude of transportation activities would be lower than for construction and operations, with the exception of workforce commuting which could have moderate impacts on, or near, existing low traffic roads—SMALL to MODERATE. DECOMMISSIONING—The types of transportation activities, and therefore, types of impacts would be similar to those discussed for construction and operations except the magnitude of transportation activities (e.g., number and types of waste and supply shipments, no yellowcake shipments) from decommissioning could be lower than for operations. Accident risks would be bounded by operations of yellowcake transportation risk estimates—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Geology and Soils	4.3.3	CONSTRUCTION—Disturbance to soil would occur from construction (clearing, excavation, drilling, trenching, road construction). However, such disturbances would be temporary and SMALL (approx. 10 percent of the total site area), and potential impacts would be mitigated by using best management practices. A large portion of the well fields, trenches, and access roads would be expected to be restored and reseeded after construction. Excavated soils would be stockpiled, seeded, and stored onsite until needed for reclamation fill. No impacts to subsurface geological strata are likely—SMALL. OPERATION—Temporary contamination or alteration of soils would be likely from operational leaks and spills and possible from transportation, use of evaporation ponds, or land application of treated waste water. However, detection and response techniques, monitoring of treated waste water, and eventual survey and decommissioning of all potentially impacted soils would limit the magnitude of overall impacts to soils—SMALL. AQUIFER RESTORATION—Impacts to geology and soils from aquifer restoration activities would be similar to impacts from operations due to use of the same infrastructure and similar activities conducted (e.g., well field operation, transfer lines, waste water treatment and disposal)—SMALL. DECOMMISSIONING—Impacts to geology and soils from decommissioning would be similar to impacts from construction. Activities to clean up, re-contour, and reclaim disturbed lands during decommissioning would mitigate long-term impacts to soils—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Surface Waters	4.3.4.1	CONSTRUCTION—Impacts to surface waters and related habitats from construction (road crossings, filling, erosion, runoff, spills or leaks of fuels and lubricants for construction equipment) would be expected to be mitigated through proper planning, design, construction methods, and best management practices. There is more surface runoff per given area in this region than in the Wyoming West Uranium Milling Region. As a result, there may be a slight increase in runoff-related impacts. Some impacts directly related to the construction activities would be expected to be temporary and limited to the duration of the construction period. U.S. Army Corps of Engineers permits may be required when filling and crossing of wetlands. Temporary changes to surface flows from grading, changes in topography, and natural drainage patterns would be mitigated through best management practices, and restored once the construction phase is complete. Incidental spills of drilling fluids into local streams would be SMALL and temporary due to implementation of mitigation measures. Impacts from construction of roads, parking areas, and buildings on recharge to shallow aquifers would be SMALL, owing to the limited area of impervious surfaces proposed. Infiltration of drilling fluids into the local aquifer would be SMALL, temporary, and localized to a few feet around boreholes—SMALL to MODERATE, depending on site-specific characteristics OPERATION—Impacts from storm water runoff or direct discharge of process waters (brine reject from reverse osmosis, or spent eluants from an ion exchange system) to surface waters would be regulated by the Wyoming Department of Environmental Quality through the Wyoming Pollutant Discharge Elimination System permit..The increased areal runoff projections for this region would result in a potential increase of runoff-related impacts Expansion of facilities or pipelines during operations would generate impacts similar to construction—SMALL to MODERATE depending on site-specific characteristics. AQUIFER RESTORATION—Impacts from aquifer restoration would be similar to impacts from operations due to use of in-place infrastructure and similar activities conducted (e.g., well field operation, transfer lines, water treatment, stormwater runoff)—SMALL to MODERATE depending on site-specific characteristics. DECOMMISSIONING—Impacts from decommissioning would be similar to impacts from construction. Activities to clean up, re-contour, and reclaim disturbed lands during decommissioning would mitigate long-term impacts to surface waters—SMALL to MODERATE depending on site-specific characteristics.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Water—Groundwater	4.3.4.2	CONSTRUCTION—Water use impacts would be limited by the small volumes of groundwater used for routine activities such as dust suppression, mixing cements, and drilling support over short and intermittent periods. Contamination of groundwater from construction activities would be mitigated by best management practices—SMALL to LARGE, depending on site-specific conditions. OPERATION—Potential impacts to shallow aquifers can occur from leaks or spills from surface facilities and equipment. Shallow aquifers are important sources of drinking water in some areas of the Wyoming East Uranium Milling Region. Potential impacts to the ore-bearing and surrounding aquifers include consumptive water use and degradation of water quality (from normal production activities, off-normal excursion events, and deep well injection disposal practices). Consumptive use impacts from withdrawal of groundwater would be SMALL because only 1 to 3 percent of pumped groundwater would be returned to the aquifer (e.g., process bleed). However, this amount of water lost could be reduced substantially by currently available treatment methods (e.g., reverse osmosis, brine concentration). Effects of water withdrawal on surface water would be SMALL, as the ore zone normally occurs in a confined aquifer. Estimated drawdown effects vary depending on site conditions and water treatment technology applied. Excursions of lixiviant and mobilized chemical constituents could occur from a failure of well seals or other operational conditions that result in incomplete recovery of lixiviant. Well-seal-related excursions could be detected by the groundwater monitoring system, and periodic well integrity testing and impacts would be expected to be mitigated during operation or aquifer restoration. Other excursions could result in plumes of mobilized uranium and heavy metals extending beyond the mineralization zone. The magnitude of potential impacts from vertical excursions would vary depending on site-specific conditions. To reduce the likelihood and consequences of potential excursions at ISL facilities, NRC requires licensees to take preventative measures prior to starting operations including well tests, monitoring, and development of procedures that include excursion response measures and reporting requirements. Alterations of ore body aquifer chemistry would be SMALL because the aquifer would: (1) be confined, (2) not be a potential drinking water source, and (3) be restored within statistical range of preoperational baseline water quality during the restoration period. Potential environmental impacts to confined deep aquifers below the production aquifers from deep well injection of processing wastes would be addressed by the underground injection permitting process regulated by the State of Wyoming—SMALL to LARGE, depending on site-specific conditions. AQUIFER RESTORATION—Potential impacts would result in consumptive use and potential deep disposal of brine slurries after reverse osmosis, if applicable. The volume of water removed from the aquifer and related impacts would be dependent on site-specific conditions and the type of water treatment technology the facility used. In some cases, groundwater consumptive use for the aquifer restoration has been reported to be less than groundwater use during the ISL operation and drawdowns due to aquifer restorations have been reported as smaller than drawdown caused by ISL operations. Potential environmental impacts associated with water consumption during aquifer restorations are determined by: (1) the restoration techniques chosen, (2) the volume of water to be used, (3) the severity and extent of the contamination, and (4) the current and future use of the production and surrounding aquifers in the vicinity of the ISL facility or at the regional scale—SMALL to LARGE, depending on site-specific conditions. DECOMMISSIONING—Potential impacts from decommissioning would be similar to construction (water use, spills) with an additional potential to mobilize contaminants during demolition and cleanup activities. Contamination of groundwater from decommissioning activities would be mitigated by implementation of an NRC-approved decommissioning plan and use of best management practices—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Ecology—Terrestrial	4.3.5.1	CONSTRUCTION—Potential terrestrial ecology impacts would include the removal of vegetation from well fields, the milling site, the modification of existing vegetative communities, the loss of sensitive plants and habitats from clearing and grading, and the potential spread of invasive species and noxious weed populations. These impacts would be temporary because restoration and reseeding occur rapidly after the end of construction. Introduction of invasive species and noxious weeds would be expected to be possible but could be mitigated by restoration and reseeding after construction. Shrub and tree removal would have a longer restoration period. Construction noise could affect reproductive success of sage grouse leks by interfering with mating calls. Temporary displacement of animal species would also be possible. Crucial wintering and year-long ranges are important to survival of big game and sage grouse. Wildlife habitat fragmentation, temporary displacement of animal species, and direct or indirect mortalities is also possible. Implementation of wildlife surveys and mitigation measures following established guidelines would limit these impacts. The magnitude of impacts depends on whether a new facility is being licensed or an existing facility is being extended—SMALL to MODERATE, depending on site-specific habitat. OPERATION—Habitat could be altered by operations (fencing, traffic, noise), and individual takes could occur due to conflicts between species habitat and operations. Access to crucial wintering habitat and water could be limited by fencing. However, the Wyoming Game and Fish Department specifies fencing construction techniques to minimize impediments to big game movement. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Temporary contamination or alteration of soils would be from operational leaks and spills and possible from transportation or land application of treated waste water. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soil, limits the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts—SMALL. AQUIFER RESTORATION—Impacts include habitat disruption, but existing (in-place) infrastructure would be used duringaquifer restoration, with little additional ground disturbance. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Contamination of soils could result from from leaks and spills, or land application of treated waste water. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts—SMALL. DECOMMISSIONING—During decommissioning and reclamation, there would be a temporary disturbance to land (e.g., excavating soils, buried piping, removal of structures). However, revegetation and re-contouring would restore habitat altered during construction and operations. Wildlife would be temporarily displaced, but are expected to return after decommissioning and reclamation were completed and vegetation and habitat reestablished—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Aquatic	4.3.5.2	CONSTRUCTION—Clearing and grading activities associated with construction could result in a temporary increase in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. Clearing of riparian vegetation could affect light and temperature of water. Construction impacts to wetlands would be identified and managed through U.S. Army Corps of Engineers permits, as appropriate. Construction impacts to surface waters and aquatic species would be temporary and mitigated by best management practices—SMALL. OPERATION—Impacts could result from spills or releases into surface water. Impacts would be minimized by spill prevention, identification and response programs, and National Pollutant Discharge Elimination System (NPDES) permit requirements—SMALL. AQUIFER RESTORATION—Activities would use existing (in-place) infrastructure, and impacts could result from spills or releases of untreated groundwater. Impacts would be minimized by spill prevention, identification, and response programs, and NPDES permit requirements—SMALL. DECOMMISSIONING—Decommissioning and reclamation activities could result in temporary increases in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Threatened or Endangered Species	4.3.5.3	CONSTRUCTION—Numerous threatened and endangered species and State Species of Concern are located in the region. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts depends on the size of a new facility or extension to an existing facility and the amount of land disturbance. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would reduce impacts—SMALL to MODERATE to LARGE—depending on site-specific habitat and presence of threatened or endangered species. OPERATION—Impacts could result from individual takes due to conflicts with operations. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts would depend on the size of a new facility or extension to an existing facility and the amount of land disturbance. Impacts could potentially result from spills or permitted effluents, but would be minimized by spill prevention measures, identification and response programs, and NPDES permit requirements. Inventory of threatened or endangered species developed during site-specific reviews would identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL to MODERATE—depending on site-specific habitat and presence of threatened or endangered species. AQUIFER RESTORATION—Impacts could result from individual takes due to conflicts with aquifer restoration activities (equipment, traffic). Existing (in-place) infrastructure would be used during aquifer restoration, so additional land-disturbing activities and habitat fragmentation would not be anticipated. Impacts may result from spills or releases of treated or untreated groundwater, but impacts would be minimized by spill prevention measures, identification, and response programs, and NPDES permit requirements. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL. DECOMMISSIONING—Impacts resulting from individual takes would occur due to conflicts with decommissioning activities (equipment, traffic). Temporary land disturbance would occur as structures are demolished and removed and the ground surface is re-contoured. Inventory of threatened or endangered species developed during site-specific environmental review of the decommissioning plan would identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assit in identifying potential impacts. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Air Quality	4.3.6	CONSTRUCTION—Fugitive dust and combustion (vehicle and diesel) emissions during land-disturbing activities associated with construction would be small, short-term, and reduced through best management practices (e.g., dust suppression). For example, estimated fugitive dust emissions during ISL construction is less than 2 percent of the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and less than 1 percent for PM_{10}. For NAAQS attainment areas such as the Wyoming East Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no Prevention of Significant Deterioration (PSD) Class I areas in the Wyoming East Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation to reduce impacts—SMALL. OPERATION—Radiological impacts can result from dust releases from drying of lixiviant pipeline spills, radon releases from well system relief valves, resin transfer, or elution, and gaseous/particulate emissions from yellowcake dryers. Only small amounts of low dose materials would be expected to be released based on operational controls and rapid response to spills. Required spill prevention, control, and response procedures would be used to minimize impacts from spills. High Efficiency Particulate Air (HEPA) filters and vacuum dryer designs reduce particulate emissions from operations and ventilation reduces radon buildup during operations. Compliance with the NRC-required radiation monitoring program ensures releases would be within regulatory limits. Other potential nonradiological emissions during operations include fugitive dust and fuel from equipment, maintenance, transport trucks, and other vehicles. For NAAQS attainment areas such as the Wyoming East Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no PSD Class I areas in the Wyoming East Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions, or mitigation measures to reduce impacts—SMALL. AQUIFER RESTORATION—Because the same infrastructure would be used, air quality impacts are expected to be similar to, or less than, operations. For NAAQS attainment areas such as the Wyoming East Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no PSD Class I areas in the Wyoming East Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. DECOMMISSIONING—Fugitive dust, vehicle, and diesel emissions during land-disturbing activities associated with decommissioning would be similar to, or less than that associated with construction, short-term, and reduced through best management practices (e.g., dust suppression). These impacts would decrease as decommissioning and reclamation of disturbed areas are completed. For NAAQS attainment areas such as the Wyoming East Uranium Milling Region, nonradiological air quality impacts would be SMALL, and there are no PSD Class I areas in the Wyoming East Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Noise	4.3.7	CONSTRUCTION—Noise generated during construction would be noticeable in proximity to operating equipment, but would be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below Occupational Health and Safety Administration (OSHA) regulatory limits and mitigated by use of personal hearing protection. Traffic noise during construction (commuting workers, truck shipments to and from the facility, and construction equipment such as trucks, bulldozers, compressors) would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Noise may also adversely affect wildlife habitat and their reproductive success in immediate vicinity of construction activities. Noise levels decrease geometrically with distance, and at distances more than 300 m [1,000 ft], ambient noise levels would return to background levels. Wildlife generally avoid construction noise areas. The three uranium districts in the Wyoming East Uranium Milling Region are located in undeveloped rural areas, more than 300 m [1,000 ft] from the closest communities—SMALL to MODERATE. OPERATION—Noise-generating activities in the central uranium processing facility would be indoors, minimizing offsite sound levels. Well field equipment (e.g., pumps, compressors) would also be expected to be contained within structuress (e.g., header houses, satellite facilities) minimizing sound levels to offsite receptors. Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits and mitigated by use of personal hearing protection. Traffic noise from commuting workers, truck shipments to and from the facility, and facility equipment would be expected to be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Most noise would be generated indoors and mitigated by regulatory compliance and best management practices. Noise from trucks and other vehicles is typically of short duration. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The three uranium districts in the Wyoming East Uranium Milling Region are located in undeveloped rural areas, at least 16 km [10 mi] from the closest communities—SMALL to MODERATE. AQUIFER RESTORATION—Noise generation is expected to be less than during construction and operations. Pumps and other well field equipment contained in buildings, minimizing sound levels to offsite receptors. Existing operational infrastructure would be used and traffic levels would be less than during construction and operations; however, relative increases to existing traffic levels from commuting may be more significant for lightly traveled rural roads through smaller communities. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The three uranium districts in the Wyoming East Uranium Milling Region are located in undeveloped rural areas, at least 16 km [10 mi] from the closest communities—SMALL to MODERATE. DECOMMISSIONING—Noise generated during decommissioning would be noticeable only in proximity to equipment and be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits and mitigated by use of personal hearing protection. Noise levels during decommissioning would be expected to be less than during construction and would diminish as less and less equipment is used and truck traffic is reduced. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The three uranium districts in the Wyoming East Uranium Milling Region are located in undeveloped rural areas, at least 16 km [10 mi] from the closest communities—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Historical and Cultural	4.3.8	CONSTRUCTION—Potential impacts during ISL facility construction could include loss of, or damage and temporary restrictions on access to, historical, cultural, and archaeological resources. The eligibility evaluation of cultural resources for listing in the National Register of Historic Places (NRHP) under criteria in 36 CFR 60.4(a)–(d) and/or as Traditional Cultural Properties (TCPs) is conducted as part of the site-specific review and NRC licensing procedures undertaken during the National Environmental Policy Act (NEPA) review process. The evaluation of impacts to any historic properties designated as TCPs and tribal consultations regarding cultural resources and TCPs also occurs during the site-specific licensing application and review process. Consultation to determine whether significant cultural resources would be avoided or mitigated occurs during consultations with State Historic Preservation Offices (SHPOs), other governmental agencies (federal, state, and local), and Native American Tribes, including Tribal Historic Preservation Offices (THPOs) as part of the site-specific review. Additionally, as needed, the NRC license applicant would be required, under conditions in its NRC license, to adhere to procedures regarding the discovery of previously undocumented cultural resources during initial construction. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. OPERATION—Because less land disturbance occurs during the operations phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during operation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. AQUIFER RESTORATION—Because less land disturbance occurs during the aquifer restoration phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during aquifer restoration. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. DECOMMISSIONING—Because less land disturbance occurs during the decommissioning phase and because decommissioning and reclamation activities would focus on previously disturbed areas, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during decommissioning and reclamation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Visual and Scenic	4.3.9	CONSTRUCTION—Visual impacts result from equipment (drill rig masts, cranes), dust/diesel emissions from construction equipment, and hillside and roadside cuts. Most of the Wyoming East Uranium Milling Region is classified as Visual Resource Management (VRM) Class II through IV, and no VRM Class I or Prevention of Significant Deterioration (PSD) Class I areas are located in the region. Most potential visual impacts during construction would be expected to be temporary as equipment is moved, and would be mitigated by implementing best management practices (e.g., dust suppression). Because of the generally rolling topography of the region, most visual impacts during construction would not be visible from more than about 1 km [0.6 mi]. The uranium districts in the region are located more than 32 km [20 mi] from the closest VRM Class II region, and the visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL. OPERATION—Visual impacts during operations would be expected to be less than those associated with construction. Most of the well field surface infrastructure has a low profile, and most piping and cables would be buried. The tallest structures would include the central uranium processing facility {10 m [30 ft]} and power lines {6 m [20 ft]}. Because of the generally rolling topography of the region, most visual impacts during operations would not be expected to be visible from more than about 1 km [0.6 mi]. Irregular layout of well field surface structures such as wellhead protection and header houses would reduce visual contrast. Best management practices, design (e.g., painting buildings), and landscaping techniques would be used to mitigate potential visual impact. The two uranium districts in the region are located more than 32 km [20 mi] from the closest VRM Class II region, and the visual impacts associated with ISL construction would be expected to be consistent with the predominant VRM Class III and IV—SMALL. AQUIFER RESTORATION—Because aquifer restoration activities use the same infrastructure, potential visual impacts would be the same as or less than those during operations—SMALL. DECOMMISSIONING—Because similar equipment would be used and activities conducted, potential visual impacts during decommissioning would be the same as or less than those during construction. Most potential visual impacts during decommissioning would be expected to be temporary as equipment is moved, and mitigated by best management practices (e.g., dust suppression). Visual impacts would be low because these sites would be in sparsely populated areas and impacts would be expected to diminish as decommissioning activities decrease. An approved site reclamation plan is required prior to license termination, with the goal of returning the landscape to preconstruction condition (predominantly VRM Class III and IV). Some roadside cuts and hill slope modifications may, however, persist beyond decommissioning and reclamation—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Socioeconomics	4.3.10	CONSTRUCTION—Potential impacts to socioeconomics would result predominantly from employment at an ISL facility and demands on the existing public and social services, tourism/recreation, housing, infrastructure (schools, utilities), and the local work force. Total peak employment would be about 200 people, including company employees and local contractors, depending on timing of construction with other stages of the ISL lifecycle. During construction of surface facilities and well fields, the general practice has been to use local contractors (drillers, construction) if available. A local multiplier of 0.7 would indicate a maximum of about 140 ancillary jobs could be created. For example, local building materials and building supplies would be used to the extent practical. Most employees would live in larger communities with access to more services. Some construction employees, however, would commute from outside the county to the ISL facility, and skilled employees (e.g., engineers, accountants, managers) would come from outside the local work force. Some of these employees would temporarily relocate to the project area and contribute to the local economy through purchasing goods and services and taxes. Because of the small relative size and temporary nature of the ISL construction workforce, net impacts would be SMALL to MODERATE, depending on proximity to less populated areas such as those in Niobrara or Albany Counties. OPERATION—Employment levels for ISL facility operations would be similar to, or less than for construction, with total peak employment depending on timing and overlap with other stages of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Additional revenues would be generated by federal, state, and local taxes on the facility and the uranium produced. Because of similar employment levels, other socioeconomic impacts would be expected to be similar to construction—SMALL to MODERATE, depending on proximity to less populated areas such as those in Niobrara or Albany Counties. AQUIFER RESTORATION—Because much of the same (in-place) infrastructure would be used, employment levels would be similar to, or less than, for operations, with total peak employment depending on timing and overlap with other activities during of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated areas such as those in Niobrara or Albany Counties. DECOMMISSIONING—A skill set similar to the construction workforce would be involved in dismantling surface structures, removing pumps, plugging and abandoning wells, and reclaiming/re-contouring the ground surface. Employment levels and use of local contractor support during decommissioning would be similar to or less than what would be required for construction. Employment would be expected to be temporary as decommissioning activities are limited in duration. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated areas such as those in Niobrara or Albany Counties.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Public and Occupational Health and Safety	4.3.11	CONSTRUCTION—Worker safety would be addressed by standard construction safety practices. Fugitive dust would result from construction activities and vehicle traffic but would likely be of short duration, and would not result in a radiological dose. Diesel emissions would not be a concern for worker or public health, because the releases would be of short duration and readily dispersed into the atmosphere—SMALL. OPERATION—Potential occupational radiological impacts from normal operations would be caused primarily by exposure to radon gas from the well field, ion exchange resin transfer operations, and venting during processing activities. Workers would also be exposed to airborne uranium particulates from dryer operations and maintenance activities. Potential public exposures to radiation would occur from the same radon releases and uranium particulate releases (i.e., from facilities without vacuum dryer technology). Both worker and public radiological exposures would be limited by NRC regulations at 10 CFR Part 20 that require licensees to implement an NRC-approved monitoring and radiation protection program. (Measured and calculated doses for workers and the public are commonly a fraction of regulated limits.) Non-radiological worker safety matters would be addressed through commonly applied occupational health and safety regulations and practices. Radiological accident risks could involve processing equipment failures leading to yellowcake slurry spills, or radon gas or uranium particulate releases. Consequences of accidents to workers and the public are generally low, with the exception of a dryer explosion, which could result in worker dose above NRC limits. The likelihood of such an accident would be low, and therefore, the risk would also be low. Potential non-radiological accidents impacts include high-consequence chemical release events (e.g., ammonia) for both workers and nearby populations. The likelihood of such release events would be low, based on historical operating experience at NRC-licensed facilities, which is partly the result of operators following commonly applied chemical safety and handling protocols—SMALL to MODERATE. AQUIFER RESTORATION—Because the activities during aquifer restoration overlap with similar operational activities (e.g., operation of well fields, waste water treatment and disposal) the types of impacts on public and occupational health and safety would be similar to operational impacts. The absence of some operational activities (e.g., yellowcake production and drying, remote ion exchange) further limits the relative magnitude of potential worker and public health and safety hazards—SMALL. DECOMMISSIONING—Worker and public health and safety would be addressed in a required Decommissioning Plan. This plan details how a 10 CFR Part 20-compliant radiation safety program would be implemented during decommissioning, to ensure safety of workers and the public, and to identify measures to comply with applicable safety regulations—SMALL.

Table 10-2. Summary of Impacts for the Wyoming East Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Waste Management	4.3.12	CONSTRUCTION—The relatively small scale of construction activities (Section 2.3) and incremental development of well fields at ISL facilities would generate low volumes of construction waste—SMALL. OPERATION—Operational wastes primarily result from liquid waste streams including process bleed, flushing of depleted eluant to limit impurities, resin transfer wash, filter washing, uranium precipitation process wastes (brine), and plant washdown water. State permitting actions, NRC license conditions, and NRC inspections ensure the proper practices would be used to comply with safety requirements to protect workers and the public. Waste treatment such as reverse osmosis and radon settling would help in segregating wastes and minimizing disposal volumes. Potential impacts from surface discharge and deep well injection would be limited by the applicable permitting processes. NRC regulations address constructing, operating, and monitoring for leakage evaporation ponds used to store and reduce volumes of liquid wastes. Potential impacts from land application of treated wastewater would be addressed by NRC review of site-specific conditions prior to approval, routine monitoring, and inclusion of irrigated land areas in decommissioning surveys. Offsite waste disposal impacts would be SMALL for radioactive wastes as a result of required preoperational disposal agreements. Impacts for hazardous and municipal waste would be SMALL due to the volume of wastes generated. For remote areas with limited available disposal capacity, such wastes may need to be shipped greater distances to facilities that have capacity. However, the volume of wastes generated, and magnitude of such shipments, are estimated to be low—SMALL. AQUIFER RESTORATION—Waste management activities during aquifer restoration would utilize the same treatment and disposal options implemented for operations. Therefore, impacts associated with aquifer restoration would be similar to operational impacts. While the amount of waste water generated during aquifer restoration is dependent on site-specific conditions, the potential exists for additional generation of wastewater volume and associated treatment wastes during the restoration period. However, this would be offset to some degree by the reduction in production capacity from the removal of a well field. NRC review of future ISL facility applications would verify that sufficient water treatment and disposal capacity (and the associated agreement for disposal of byproduct material) are addressed. As a result, waste management impacts from aquifer restoration would be—SMALL. DECOMMISSIONING—Radioactive wastes from decommissioning ISL facilities (including contaminated excavated soil, evaporation pond bottoms, process equipment) would be disposed of as byproduct material at an NRC-licensed facility. A preoperational agreement with a licensed disposal facility to accept radioactive wastes ensures sufficient disposal capacity would be available for byproduct wastes generated by decommissioning activities. Safe handling, storage, and disposal of decommissioning wastes would be addressed in a required Decommissioning Plan, subject to NRC review . This plan details how a 10 CFR Part 20-compliant radiation safety program would be implemented during decommissioning, and how the safety of workers and the public would be maintained, as well as how applicable safety regulations would be complied with. Overall, volumes of decommissioning radioactive, chemical, and solid wastes would be small—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Land Use	4.4.1	CONSTRUCTION—Land use impacts could occur from land disturbances (including alterations of ecological cultural or historic resources) and access restrictions (including limitations of other mineral extraction activities, grazing activities, or recreational activities). A higher percentage of private land ownership occurs in this region than in the Wyoming West Uranium Milling Region, and could increase the potential for land use conflicts with private land owners. Land disturbances during construction would be temporary and limited to specific areas within permitted area. Well sites, staging areas, and trenches would be reseeded and restored. Unpaved access roads would remain in use until decommissioning. Competing access to mineral rights could be either delayed for the duration of the ISL project or be intermixed with ISL operations (e.g., oil and gas exploration). Changes to land use access including grazing restrictions and impacts on recreational activities would be limited due to the SMALL size of restricted areas, temporary nature of restrictions, and availability of other land for these activities. Ecological, historical, and cultural resources could be affected, but would be protected by careful planning and surveying to help identify resources and avoid or mitigate impacts. For all land use aspects except ecological, historical and cultural resources, the potential impacts would be SMALL. Due to the potential for unidentified resources to be altered or destroyed during excavation, drilling, and grading, the potential impacts to ecological, historical or cultural resources would be SMALL to LARGE, depending on local conditions. OPERATION—The types of land use impacts for operational activities would be similar to construction impacts regarding access restrictions because the infrastructure would be in place. Additional land disturbances would not occur from conducting operational activities. Because access restriction and land disturbance related impacts would be be similar to, or less than, expected for construction, the overall potential impacts to land use from operational activities would be SMALL. AQUIFER RESTORATION—Due to the use of the same infrastructure, land use impacts would be similar to operations during aquifer restoration, although some operational activities would diminish—SMALL. DECOMMISSIONING—Land use impacts would be similar to those described for construction with a temporary increase in land-disturbing activities for dismantling, removing, and disposing of facilities, equipment, and excavated contaminated soils. Reclamation of land to preexisting conditions and uses would help mitigate potential impacts—SMALL to MODERATE during decommissioning and SMALL, once decommissioning is completed.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Transportation	4.4.2	CONSTRUCTION—Low magnitude traffic generated by ISL construction relative to local traffic counts would not significantly increase traffic or accidents on many of the roads in the region. Existing low traffic roads could be moderately impacted by the additional worker commuting traffic during periods of peak employment. This impact would be more pronounced in the Nebraska-South Dakota-Wyoming Uranium Milling Region owing to the relatively lower traffic counts in this region, in comparison to the other milling regions. Moderate dust, noise, and incidental wildlife or livestock kill impacts would be possible on, or near, site access roads (dust in particular for unpaved access roads)—SMALL to MODERATE. OPERATION—Low magnitude traffic relative to local traffic counts on most roads would not significantly increase traffic or accidents. Existing low traffic roads could be moderately impacted by commuting traffic during periods of peak employment including dust, noise, and possible incidental wildlife or livestock kill impacts on, or near, site access roads. High consequences would be possible for a severe accident involving transportation of hazardous chemicals in a populated area. However, the probability of such accidents occurring would be low owing to the limited number of shipments, comprehensive regulatory controls, and use of best management practices. For radioactive material shipments (yellowcake product, ion exchange resins, waste materials), compliance with transportation regulations would limit radiological risk for normal operations. Low radiological risk is estimated for accident conditions. Emergency response protocols would help mitigate long-term consequences of severe accidents involving release of uranium—SMALL to MODERATE. AQUIFER RESTORATION—The magnitude of transportation activities would be lower than for construction and operations, with the exception of workforce commuting, which could have moderate impacts on, or near, existing low traffic roads—SMALL to MODERATE. DECOMMISSIONING—The types of transportation activities and, therefore, types of impacts would be similar to those discussed for construction and operations except the magnitude of transportation activities (e.g., number and types of waste and supply shipments, no yellowcake shipments) from decommissioning could be lower than for operations. Accident risks would be bounded by operations yellowcake transportation risk estimates—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Geology and Soils	4.4.3	CONSTRUCTION—Disturbance to soil would occur from construction (clearing, excavation, drilling, trenching, road construction). However, such disturbances would be temporary and SMALL (approx. 10 percent of the total site area), and potential impacts would be mitigated by using best management practices. A large portion of the well fields, trenches, and access roads would be restored and reseeded after construction. Excavated soils would be stockpiled, seeded, and stored onsite until needed for reclamation fill. No impacts are expected to subsurface geological strata—SMALL. OPERATION—Temporary contamination or alteration of soils would be likely from operational leaks and spills and possible from transportation, use of evaporation ponds, or land application of treated wastewater. However, detection and response techniques, monitoring of treated waste water, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to soils—SMALL. AQUIFER RESTORATION—Impacts to geology and soils from aquifer restoration activities would be similar to impacts from operations due to use of the same infrastructure and similar activities conducted (e.g., well field operation, transfer lines, waste water treatment and disposal)—SMALL. DECOMMISSIONING—Impacts to geology and soils from decommissioning would be similar to impacts from construction. Activities to clean up, recontour, and reclaim disturbed lands during decommissioning would mitigate long-term impacts to soils—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Surface Waters	4.4.4.1	CONSTRUCTION—Impacts to surface waters and related habitats from construction (road crossings, filling, erosion, runoff, spills or leaks of fuels and lubricants for construction equipment) would be mitigated through proper planning, design, construction methods, and best management practices. This region has a higher surface runoff (areal flow) than the Wyoming West Uranium Milling Region, and for that reason, could contribute to a slight increase in runoff-related impacts. Some impacts directly related to the construction activities would be temporary and limited to the duration of the construction period. U.S. Army Corps of Engineers permits may be required when filling and crossing of wetlands. Temporary changes to spring and stream flow from grading and changes in topography and natural drainage patterns could be mitigated or restored after the construction phase. Incidental spills of drilling fluids into local streams would be SMALL and temporary, due to the implementation of mitigation measures. Impacts from construction of roads, parking areas, and buildings on recharge to shallow aquifers would be SMALL, owing to the limited area of impervious surfaces relatiproposed. Infiltration of drilling fluids into the local aquifer would be SMALL, temporary, and localized to a few feet around boreholes—SMALL to MODERATE depending on site-specific characteristics. OPERATION—Impacts from storm water runoff or direct discharge of produced waters (brine reject from reverse osmosis, or spent eluants from an ion exchange system) to surface waters would be regulatedby individual states through the National Pollutant Discharge Elimination System permits. Increased runoff compared to the Wyoming West Uranium Milling Region could potentially contribute to a slight increase in runoff-related impacts. Expansion of facilities or pipelines during operations would generate impacts similar to construction—SMALL to MODERATE depending on site-specific characteristics. AQUIFER RESTORATION—Impacts from aquifer restoration would be similar to impacts from operations due to use of in-place infrastructure and similar activities conducted (e.g., well field operation, transfer lines, water treatment, stormwater runoff)—SMALL to MODERATE depending on site-specific characteristics. DECOMMISSIONING—Impacts from decommissioning would be similar to impacts from construction. Activities to clean up, re-contour, and reclaim disturbed lands during decommissioning would mitigate long-term impacts to surface waters—SMALL to MODERATE depending on site-specific characteristics.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Water—Groundwater	4.4.4.2	CONSTRUCTION—Water use impacts would be limited by the small volumes of groundwater used for routine activities such as dust suppression, mixing cements, and drilling support over short and intermittent periods. Contamination of groundwater from construction activities would be expected to be mitigated by use of best management practices—SMALL to LARGE, depending on site-specific conditions. OPERATION—Potential impacts to shallow aquifers can occur from leaks or spills from surface facilities and equipment. Shallow aquifers are important sources of drinking water in some areas of the Nebraska-South Dakota-Wyoming Uranium Milling Region. Potential impacts to the ore-bearing and surrounding aquifers include consumptive water use and degradation of water quality (from normal production activities, off-normal excursion events, and deep well injection disposal practices). Consumptive use impacts from withdrawal of groundwater would be SMALL because only 1 to 3 percent of pumped groundwater is not returned to the aquifer (e.g., process bleed). However, this amount of lost water can be reduced substantially by currrently available treatment methods (e.g., reverse osmosis, brine concentration). Effects of water withdrawal on surface water would be SMALL, as the ore zone normally occurs in a confined aquifer. Estimated drawdown effects vary depending on site conditions and water treatment technology applied. Excursions of lixiviant and mobilized chemical constituents could occur from a failure of well seals or other operational conditions that cause incomplete recovery of lixiviant. Well-seal-related excursions would be detected by the groundwater monitoring system, and periodic well integrity testing and impacts would be mitigated during operation or aquifer restoration. Other excursions could result in plumes of mobilized uranium and heavy metals extending beyond the mineralization zone. The magnitude of potential impacts from vertical excursions would vary depending on site-specific conditions. To reduce the likelihood and consequences of potential excursions at ISL facilities, NRC requires licensees to take preventative measures prior to starting operations including well tests, monitoring, and development of procedures that include excursion response measures and reporting requirements. Alterations of ore body aquifer chemistry would be SMALLbecause the aquifer would: (1) be confined, (2) not be a potential drinking water source, and (3) be expected to be restored within statistical range of preoperational baseline water quality during the restoration period. Potential environmental impacts to confined deep aquifers below the production aquifers from deep well injection of processing wastes would be addressed by the underground injection permitting process regulated by the state—SMALL to LARGE, depending on site-specific conditions. AQUIFER RESTORATION—Potential impacts would occur concerning consumptive use and potential deep disposal of brine slurries after reverse osmosis, if applicable. The volume of water removed from the aquifer and related impacts would be dependent on site-specific conditions and the type of water treatment technology the facility used. In some cases, groundwater consumptive use for the aquifer restoration has been reported to be less than groundwater use consumption during the ISL operation and drawdowns due to aquifer restorations have been smaller than drawdown caused by ISL operations. Potential environmental impacts associated with water consumption during aquifer restorations would be determined by: (1) the restoration techniques chosen, (2) the volume of water to be used, (3) the severity and extent of the contamination, and (4) the current and future use of the production and surrounding aquifers in the vicinity of the ISL facility or at the regional scale—SMALL to LARGE depending on site-specific conditions. DECOMMISSIONING—Potential impacts from decommissioning would be similar to construction (water use, spills) with an additional potential to mobilize contaminants during demolition and cleanup activities. Contamination of groundwater from decommissioning activities would be mitigated by implementation of an NRC-approved decommissioning plan and use of best management practices—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Ecology—Terrestrial	4.4.5.1	CONSTRUCTION—Potential terrestrial ecology impacts would include the removal of vegetation from well fields, the milling site, the modification of existing vegetative communities, the loss of sensitive plants and habitats from clearing and grading; and the potential spread of invasive species and noxious weed populations. These impacts would be temporary because restoration and reseeding occur rapidly after the end of construction. Introduction of invasive species and noxious weeds would be possible but could be mitigated by restoration and reseeding after construction Shrub and tree removal would have a longer restoration period. Construction noise could affect reproductive success of sage grouse leks (in the Wyoming part of the region) by interfering with mating calls. Temporary displacement of animal species would be possible. Crucial wintering and year-long ranges are important to survival of big game and sage grouse. . Wildlife habitat fragmentation, temporary displacement of animal species, and direct or indirect mortalities would be possible. Implementation of wildlife surveys and mitigation measures following established guidelines would limit impacts. The magnitude of impacts depends on whether a new facility is being licensed or an existing facility is being extended—SMALL to MODERATE, depending on site-specific habitat. OPERATION—Habitat could be altered by operations (fencing, traffic, noise), and individual takes could occur due to conflicts between species habitat and operations. Access to crucial wintering habitat and water could be limited by fencing. However, the Wyoming Game and Fish Department specifies fencing construction techniques to minimize impediments to big game movement. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Temporary contamination or alteration of soils would be likely from operational leaks and spills or from land application of treated wastewater. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduces overall impacts—SMALL. AQUIFER RESTORATION—Impacts include habitat disruption, but existing (in-place) infrastructure would be used during aquifer restoration, with little additional ground disturbance. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Contamination of soils could result from leaks and spills or land application of treated wastewater. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys, would reduce overall impacts—SMALL. DECOMMISSIONING—During decommissioning and reclamation, there would be a temporary disturbance to land (e.g., excavating soils, buried piping, removal of structures). However, revegetation and re-contouring would restore habitat altered during construction and operations. Wildlife would be temporarily displaced, but are expected to return after decommissioning and reclamation were completed and vegetation and habitat reestablished—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Aquatic	4.4.5.2	CONSTRUCTION—Clearing and grading activities associated with construction could result in a temporary increase in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. Clearing of riparian vegetation could affect light and temperature of water. Construction impacts to wetlands would be identified and managed through U.S. Army Corps of Engineers permits, as appropriate. Construction impacts to surface waters and aquatic species would be temporary and mitigated by best management practices—SMALL. OPERATION—Impacts could result from spills or releases into surface water. Impacts would be minimized by spill prevention, identification and response programs, and National Pollutant Discharge Elimination System (NPDES) permit requirements—SMALL. AQUIFER RESTORATION—Activities would use existing (in-place) infrastructure, and impacts could result from spills or releases of untreated groundwater. Impacts would be minimized by spill prevention, identification, and response programs, and NPDES permit requirements—SMALL. DECOMMISSIONING—Decommissioning and reclamation activities could result in temporary increases in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Ecology—Threatened or Endangered Species	4.4.5.3	CONSTRUCTION—Numerous threatened and endangered species and State Species of Concern are located in the region. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts depends on the size of a new facility or extension to an existing facility and the amount of land disturbance. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would reduce impacts—SMALL to MODERATE to LARGE—depending on site-specific habitat and presence of threatened or endangered species. OPERATION—Impacts could result from individual takes due to conflicts with operations. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts would depend on the size of a new facility or extension to an existing facility and the amount of land disturbance. Impacts could potentially result from spills or permitted effluents, but would be minimized by implementing spill prevention measures, identification and response programs, and NPDES permit requirements. Inventory of threatened or endangered species developed during site-specific reviews would identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL to MODERATE—depending on site-specific habitat and presence of threatened or endangered species. AQUIFER RESTORATION—Impacts could result from individual takes due to conflicts with aquifer restoration activities (equipment, traffic). Existing (in-place) infrastructure would be used during aquifer restoration, so additional land-disturbing activities and habitat fragmentation would not be anticipated. Impacts may result from spills or releases of treated or untreated groundwater, but impacts would be minimized by implementing spill prevention measures, identification, and response programs, and NPDES permit requirements. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL. DECOMMISSIONING—Impacts resulting from individual takes would occur due to conflicts with decommissioning activities (equipment, traffic). Temporary land disturbance would occur as structures are demolished and removed and the ground surface is re-contoured. Inventory of threatened or endangered species developed during site-specific environmental review of decommissioning plan would identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in identifying potential impacts. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Air Quality	4.4.6	CONSTRUCTION—Fugitive dust combustion (vehicle and diesel) emissions during land-disturbing activities associated with construction would be SMALL, short-term, and reduced through best management practices (e.g., dust suppression). For example, estimated fugitive dust emissions during ISL construction is less than 2 percent of the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and less than 1 percent for PM_{10}. For NAAQS attainment areas such as the Nebraska-South Dakota-Wyoming Uranium Milling Region, nonradiological air quality impacts would be SMALL. A Prevention of Significant Deterioration (PSD) Class I area exists (Wind Cave National Park, Black Hills, South Dakota)). More stringent air quality standards would apply to any facility that could potentially impact the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. OPERATION—Radiological impacts can result from dust releases from drying of lixiviant pipeline spills, radon releases from well system relief valves, resin transfer, or elution, and gaseous/particulate emissions from yellowcake dryers. Only small amounts of low dose materials would be released based on operational controls and rapid response to spills. Required spill prevention, control, and response procedures would be used to minimize impacts from spills. HEPA filters and vacuum dryer designs reduce particulate emissions from operations and ventilation reduces radon buildup during operations. Compliance with the NRC-required radiation monitoring program would ensure releases are within regulatory limits. Other potential nonradiological emissions during operations include fugitive dust and fuel from equipment, maintenance, transport trucks, and other vehicles. For NAAQS attainment areas such as the Nebraska-South Dakota-Wyoming Uranium Milling Region, nonradiological air quality impacts would be expected to be small. A PSDClass I area exists at Wind Cave National Park, South Dakota. More stringent air quality standards would apply to any facility that could potentially impact the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. AQUIFER RESTORATION—Because the same infrastructure would be used, air quality impacts are expected to be similar to, or less than, operations. For NAAQS attainment areas such as the Nebraska-South Dakota-Wyoming Uranium Milling Region, nonradiological air quality impacts would be SMALL. A PSD Class I area exists at Wind Cave National Park, South Dakota. More stringent air quality standards would apply to any facility that could potentially impact the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. DECOMMISSIONING—Fugitive dust, vehicle, and diesel emissions during land-disturbing activities associated with decommissioning would be similar to, or less than, construction, short-term, and reduced through use of best management practices (e.g., dust suppression). These impacts would decrease as decommissioning and reclamation of disturbed areas are completed. For NAAQS attainment areas such as the Nebraska-South Dakota-Wyoming Uranium Milling Region, nonradiological air quality impacts would be SMALL. A PSD Class I area exists at Wind Cave National Park, South Dakota. More stringent air quality standards would apply to any facility that could potentially impact the air quality of that area. If impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Noise	4.4.7	CONSTRUCTION—Noise generated during construction would be noticeable in proximity to operating equipment, but would temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below Occupational Health and Safety Administration (OSHA) regulatory limits and mitigated by use of personal hearing protection. Traffic noise during construction (commuting workers, truck shipments to and from the facility, and construction equipment such as trucks, bulldozers, compressors) would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads inwell fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Noise may also adversely affect wildlife habitat and their reproductive success in immediate vicinity of construction activities. Noise levels decrease geometrically with distance, and at distances more than 300 m [1,000 ft], noise levels return to background. Wildlife would be anticipated to avoid construction areas. The three uranium districts within the Nebraska-South Dakota-Wyoming Uranium Milling Region are more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE. OPERATION—Noise-generating activities in the central uranium processing facility would be indoors, minimizing offsite sound levels. Well field equipment (e.g., pumps, compressors) would also be contained within structures (e.g., header houses, satellite facilities) minimizing sound levels to offsite receptors. Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits and mitigated by use of personal hearing protection. Traffic noise from commuting workers, truck shipments to and from the facility, and facility equipment would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Most noise would be generated indoors and mitigated by regulatory compliance and use of best management practices. Noise from trucks and other vehicles is typically of short duration. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The three uranium districts within the Nebraska-South Dakota-Wyoming Uranium Milling Region are more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE. AQUIFER RESTORATION—Noise generation is expected to be less than during construction and operations. Pumps and other well field equipment contained in buildings and minimize sound levels to offsite receptors. Existing operational infrastructure would be used and traffic levels would be less than during construction and operations. There are additional sensitive areas that should be considered within this region, but because of decreasing noise levels with distance, construction activities would have only SMALL and temporary noise impacts for residences, communities, or sensitive areas located more than 300 m [1,000 ft] from specific noise generating activities. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The three uranium districts within the Nebraska-South Dakota-Wyoming Uranium Milling Region are more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE. DECOMMISSIONING—Noise generated during decommissioning would be noticeable only in proximity to operating equipment and be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits, and mitigated by use of personal hearing protection. Noise levels during decommissioning would be expected to be less than during construction and would diminish as less and less equipment is used and truck traffic is reduced. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The three uranium districts within the Nebraska-South Dakota-Wyoming Uranium Milling Region are generally more than 300 m [1,000 ft] from the closest community—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Historical and Cultural	4.4.8	CONSTRUCTION—Potential impacts during ISL facility construction could include loss of, or damage and temporary restrictions on access to, historical, cultural, and archaeological resources. The eligibility evaluation of cultural resources for listing in the National Register of Historic Places (NRHP) under criteria in 36 CFR 60.4(a)–(d) and/or as Traditional Cultural Properties TCPs) is conducted as part of the site-specific review and NRC licensing procedures undertaken during the National Environmental Policy Act (NEPA) review process. The evaluation of impacts to any historic properties designated as TCPs and tribal consultations regarding cultural resources and TCPs also occurs during the site-specific licensing application and review process. Consultation to determine whether significant cultural resources would be avoided or mitigated occurs during consultations with State Historic Preservation Offices (SHPOs), other governmental agencies (federal, state, and local), and Native American Tribes, including Tribal Historic Preservation Offices (THPOs) as part of the site-specific review. Additionally, as needed, the NRC license applicant would be required, under conditions in its NRC license, to adhere to procedures regarding the discovery of previously undocumented cultural resources during initial construction. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. OPERATION—Because less land disturbance occurs during the operations phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during operation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE depending on site-specific conditions. AQUIFER RESTORATION—Because less land disturbance occursduring the aquifer restoration phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during aquifer restoration. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. DECOMMISSIONING—Because less land disturbance would be anticipated during the decommissioning phase and because decommissioning and reclamation activities would be focused on previously disturbed areas, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during decommissioning and reclamation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Visual and Scenic	4.4.9	CONSTRUCTION—Visual impacts can result from equipment (drill rig masts, cranes), dust/diesel emissions from construction equipment, and hillside and roadside cuts. Most of the Nebraska-South Dakota-Wyoming Uranium Milling Region is classified as Visual Resource Management (VRM) Class II through IV. Most potential visual impacts during construction would be expected to be temporary as equipment is moved, and would be mitigated by use of best management practices (e.g., dust suppression). Because of the generally rolling topography of the region, most visual impacts during construction would not be visible from more than 1 km [0.6 mi]. The three uranium districts in the region are located more than 16 km [10 mi] from the closest VRM Class II region and 40 km [25 mi] from the Prevention of Significant Deterioration PSD Class I area at Wind Cave National Park in South Dakota. The visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL. OPERATION—Visual impacts during operations would be expected to be less than those associated with construction. Most of the well field surface infrastructure has a low profile, and most piping and cables would be buried. The tallest structures would include the central uranium processing facility {10 m [30 ft]} and power lines {6 m [20 ft]}. Because of the generally rolling topography of the region, most visual impacts during operations would not be visible from more than about 1 km [0.6 mi]. Irregular layout of well field surface structures such as wellhead protection and header houses would reduce visual contrast. Best management practices, design (e.g., painting buildings), and landscaping techniques would be used to mitigate potential visual impact. The three uranium districts in the region are located more than 16 km [10 mi] from the closest VRM Class II region and 40 km [25 mi] from the PSD Class I area at Wind Cave National Park in South Dakota. The visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL. AQUIFER RESTORATION—Because aquifer restoration activities use the same infrastructure, potential visual impacts would be the same as, or less than, during operations—SMALL. DECOMMISSIONING SMALL—Because similar equipment would be used and activities conducted, potential visual impacts during decommissioning would be the same as or less than those during construction. Most potential visual impacts during decommissioning would be temporary as equipment is moved and mitigated by use of best management practices (e.g., dust suppression). Visual impacts would be low because these sites would be in sparsely populated areas, and impacts would diminish as decommissioning activities decrease. An approved site reclamation plan is required prior to license termination, with the goal of returning the landscape to preconstruction condition (predominantly VRM Class III and IV). Some roadside cuts and hill slope modifications may, however, persist beyond decommissioning and reclamation—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Socioeconomics	4.4.10	CONSTRUCTION—Potential impacts to socioeconomics would result predominantly from employment at an ISL facility and demands on the existing public and social services, tourism/recreation, housing, infrastructure (schools, utilities), and the local work force. Total peak employment would be about 200, people including company employees and local contractors, depending on timing of construction with other stages of the ISL lifecycle. During construction of surface facilities and well fields, the general practice has been to use local contractors (drillers, construction) if available. A local multiplier of 0.7 would indicate a maximum of about 140 ancillary jobs could be created. For example, local building materials and building supplies would be used to the extent practical. Most employees would live in larger communities with access to more services. Some construction employees, however, would commute from outside the county to the ISL facility, and skilled employees (e.g., engineers, accountants, managers) would come from outside the local work force. Some of these employees would temporarily relocate to the project area and contribute to the local economy through purchasing goods and services and taxes. Because of the relative limited size of the ISL workforce, net impacts would be SMALL to MODERATE, depending on proximity to less populated communities such as Oglala, Pine Ridge, and Sioux City. OPERATION—Employment levels for ISL facility operations would be similar to, or less than, for construction, with total peak employment depending on timing and overlap with other stages of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Additional revenues would be expected to be generated by federal, state, and local taxes on the facility and the uranium produced. Because of similar employment levels, other socioeconomic impacts would be expected to be similar to construction—SMALL to MODERATE, depending on proximity to smaller communities such as Oglala, Pine Ridge, and Sioux City. AQUIFER RESTORATION—Because much of in-place infrastructure would be used, employment levels would be similar to, or less than, for operations, with total peak employment depending on timing and overlap with other stages of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated communities such as Oglala, Pine Ridge, and Sioux City. DECOMMISSIONING—A skill set similar to the construction workforce would be involved in dismantling surface structures, removing pumps, plugging and abandoning wells, and reclaiming/recontouring the ground surface. Employment levels and use of local contractor support during decommissioning would be similar to or less than what would be required for construction. Employment would be temporary as decommissioning activities are limited in duration. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated communities such as Oglala, Pine Ridge, and Sioux City.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Public and Occupational Health and Safety	4.4.11	CONSTRUCTION—Worker safety would be addressed by standard construction safety practices. Fugitive dust would result from construction activities and vehicle traffic, but would likely be of short duration, and not result in a radiological dose. Diesel emissions would not be a concern for worker or public health, because the releases would be of short duration and readily dispersed into the atmosphere—SMALL. OPERATION—Potential occupational radiological impacts from normal operations would be caused primarily by exposure to radon gas from well field, ion-exchange resin transfer operations, and venting during processing activities. Workers would also be exposed to airborne uranium particulates from dryer operations and maintenance activities. Potential public exposures to radiation would occur from the same radon releases and uranium particulate releases (i.e., from facilities without vacuum dryer technology). Both worker and public radiological exposures would be addressed by NRC regulations at 10 CFR Part 20 which require licensees to implement an NRC-approved radiation protection program. (Measured and calculated doses for workers and the public are commonly a fraction of regulated limits.) Non-radiological worker safety matters would be addressed through commonly applied occupational health and safety regulations and practices. Radiological accident risks could involve processing equipment failures leading to yellowcake slurry spills, or radon gas or uranium particulate releases. Consequences of accidents to workers and the public are generally low, with the exception of a dryer explosion, which could result in worker dose above NRC limits. The likelihood of such an accident would be low, and therefore the risk would also be low. Potential non-radiological accidents impacts include, high-consequence chemical release events (e.g., ammonia) for both workers and nearby populations. The likelihood of such release events would be low, based on historical operating experience at NRC-licensed facilities, which is partly the result of operators following commonly applied chemical safety and handling protocols—SMALL to MODERATE. AQUIFER RESTORATION—Because the activities during aquifer restoration overlap with similar operational activities (e.g., operation of well fields, waste water treatment and disposal) the types of impacts on public and occupational health and safety would be similar to operational impacts. The absence of some operational activities (e.g., yellowcake production and drying, remote ion exchange) further limits the relative magnitude of potential worker and public health and safety hazards—SMALL. DECOMMISSIONING—Worker and public health and safety would be addressed in a required Decommissioning Plan. This plan details how a 10 CFR Part 20 compliant radiation safety program would be implemented during decommissioning, and how to ensure the safety of workers and the public be maintained, as well as how applicable safety regulations would be complied with—SMALL.

Table 10-3. Summary of Impacts for the Nebraska-South Dakota-Wyoming Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Waste Management	4.4.12	CONSTRUCTION—The relatively small scale of construction activities (Section 2.3) and incremental development of well fields at ISL facilities would generate low volumes of construction waste—SMALL. OPERATION—Operational wastes primarily result from liquid waste streams including process bleed, flushing of depleted eluant to limit impurities, resin transfer wash, filter washing, uranium precipitation process wastes (brine), and plant washdown water. State permitting actions, NRC license conditions, and NRC inspections ensure the proper practices would be used to comply with safety requirements to protect workers and the public. Waste treatment such as reverse osmosis and radon settling would help in segregating wastes and minimizing disposal volumes. Potential impacts from surface discharge and deep well injection would be limited by the applicable permitting processes. NRC regulations address constructing, operating, and monitoring for leakage evaporation ponds used to store and reduce volumes of liquid wastes. Potential impacts from land application of treated wastewater would be addressed by NRC review of site-specific conditions prior to approval, routine monitoring, and inclusion of irrigated land areas in decommissioning surveys. Offsite waste disposal impacts would be SMALL for radioactive wastes as a result of required preoperational disposal agreements. Impacts for hazardous and municipal waste would be SMALL due to the volume of wastes generated. For remote areas with limited available disposal capacity, such wastes may need to be shipped greater distances to facilities that have capacity. However, the volume of wastes generated, and magnitude of the shipments, are estimated to be—SMALL. AQUIFER RESTORATION—Waste management activities during aquifer restoration would utilize the same treatment and disposal options implemented for operations. Therefore, impacts associated with aquifer restoration would be similar to operational impacts. While the amount of wastewater generated during aquifer restoration is dependent on site-specific conditions, the potential exists for additional generation of wastewater volume and associated treatment wastes during the restoration period. However, this would be offset to some degree by the reduction in production capacity from the removal of a well field. NRC review of future ISL facility applications would verify that sufficient water treatment and disposal capacity (and the associated agreement for disposal of byproduct material) are addressed. As a result, waste management impacts from aquifer restoration would be—SMALL. DECOMMISSIONING—Radioactive wastes from decommissioning ISL facilities (including contaminated excavated soil, evaporation pond bottoms, process equipment) would be disposed of as byproduct material at an NRC-licensed facility. A preoperational agreement with a licensed disposal facility to accept radioactive wastes ensures sufficient disposal capacity would be available for byproduct wastes generated by decommissioning activities. Safe handling, storage, and disposal of decommissioning wastes would be addressed in a required Decommissioning Plan, subject to NRC review. This plan would detail how a 10 CFR Part 20 compliant radiation safety program would be implemented during decommissioning, how to ensure safety of workers and the public would be maintained, and how applicable safety regulations would be complied with. Overall, volumes of decommissioning radioactive, chemical, and solid wastes would be—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Land Use	4.5.1	CONSTRUCTION—Land use impacts could occur from land disturbances (including alterations of ecological cultural or historic resources) and access restrictions (including limitations of other mineral extraction activities, grazing activities, or recreational activities). A higher percentage of private land and Native American land ownership occurs in this region than in the Wyoming West Uranium Milling Region, and a more complex patchwork of land ownership could increase the potential for land use conflicts with private and other land owners. Land disturbances during construction would be temporary, but limited to specific locations within permitted site. Well sites, staging areas, and trenches would be reseeded and restored after construction. Unpaved access roads would remain in use until decommissioning is completed. Competing access to mineral rights could be either delayed for the duration of the ISL project or be intermixed with ISL operations (e.g., oil and gas exploration). Changes to land use access including grazing restrictions and impacts on recreational activities would be limited due to the SMALL size of restricted areas, temporary nature of restrictions, and availability of other land for these activities. Ecological, historical, and cultural resources could be affected but would be minimized due to careful planning and surveying to help identify resources and avoid or mitigate impacts. For all land use aspects except ecological, historical and cultural resources, the potential impacts would be SMALL. Due to the potential for unidentified resources to be altered or destroyed during excavation, drilling, and grading, the potential impacts to ecological, historical or cultural resources would be SMALL to LARGE, depending on local conditions. OPERATION—The types of land use impacts for operational activities would be similar to construction impacts regarding access restrictions because the infrastructure would be in place. Additional land disturbances would not occur from conducting operational activities. Because access restriction and land disturbance related impacts would be expected to be similar to, or less than, expected for construction, the overall potential impacts to land use from operational activities would be SMALL. AQUIFER RESTORATION—Due to the use of the same infrastructure, land use impacts would be similar to operations during aquifer restoration, although some operational activities would diminish—SMALL. DECOMMISSIONING—Land use impacts would be similar to those described for construction with a temporary increase in land-disturbing activities for dismantling, removing, and disposing of facilities, equipment, and excavated contaminated soils. Reclamation of land to preexisting conditions and uses would help mitigate potential impacts—SMALL to MODERATE during decommissioning and SMALL, once decommissioning is completed.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Transportation	4.5.2	CONSTRUCTION—Low magnitude traffic generated by ISL construction relative to local traffic counts would not significantly increase traffic or accidents on many of the roads in the region. Existing low traffic roads could be MODERATEly impacted by the additional worker commuting traffic during periods of peak employment. The impact would be more pronounced in areas of low traffic counts. MODERATE dust, noise, and incidental wildlife or livestock kill impacts would be possible on, or near, site access roads (dust in particular for unpaved access roads)—SMALL to MODERATE. OPERATION—Low magnitude traffic relative to local traffic counts on most roads would not significantly increase traffic or accidents. Existing low traffic roads could be moderately impacted by commuting traffic during periods of peak employment including dust, noise, and possible incidental wildlife or livestock kill impacts on, or near, site access roads. High consequences would be possible for a severe accident involving transportation of hazardous chemicals in a populated area. However, the probability of such accidents occurring would be low, owing to the limited number of shipments, comprehensive regulatory controls, and use of best management practices. For radioactive material shipments (yellowcake product, ion exchange resins, waste materials), compliance with transportation regulations would limit radiological risk for normal operations. Consequently, there is low radiological risk associated with accident conditions. Emergency response protocols would help mitigate long-term consequences of severe accidents involving release of uranium—SMALL to MODERATE. AQUIFER RESTORATION—The magnitude of transportation activities would be lower than for construction and operations, with the exception of workforce commuting, which could have moderate impacts on, or near, existing low traffic roads—SMALL to MODERATE. DECOMMISSIONING—The types of transportation activities and, therefore, types of impacts would be similar to those discussed for construction and operations except the magnitude of transportation activities (e.g., number and types of waste and supply shipments, no yellowcake shipments) from decommissioning could be lower than for operations. Accident risks would be bounded by operations yellowcake transportation risk estimates—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Geology and Soils	4.5.3	CONSTRUCTION—Disturbance to soil would occur from construction (clearing, excavation, drilling, trenching, road construction). However, such disturbances would be temporary and SMALL (approx. 10 percent of the total site area), and potential impacts would be mitigated by using best management practices. The well fields, trenches, and access roads would be restored and reseeded after construction has been completed. Excavated soils would be stockpiled, seeded, and stored on site until needed for reclamation fill. No impacts are expected to subsurface geological strata—SMALL. OPERATION—Temporary contamination or alteration of soils would be likely from operational leaks and spills and possible from transportation, use of evaporation ponds, or land application of treated wastewater. However, detection and response techniques, monitoring of treated wastewater, and eventual survey and decommissioning of all potentially impacted soils would limit the magnitude of overall impacts to soils—SMALL. AQUIFER RESTORATION—Impacts to geology and soils from aquifer restoration activities would be similar to impacts from operations due to use of the same infrastructure and similar activities conducted (e.g., well field operation, transfer lines, waste water treatment and disposal)—SMALL. DECOMMISSIONING—Impacts to geology and soils from decommissioning would be expected to be similar to impacts from construction. Activities to clean up, re-contour, and reclaim disturbed lands during decommissioning would mitigate long-term impacts to soils—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Surface Waters	4.5.4.1	CONSTRUCTION—Impacts to surface waters and related habitats from construction (road crossings, filling, erosion, runoff, spills or leaks of fuels and lubricants for construction equipment) would be mitigated through proper planning, design, construction methods, and best management practices. This region experiences less runoff per given area (areal flow per square mile) than the Wyoming West Uranium Milling Region. As a result, the potential for runoff-related impacts would be less. Some impacts directly related to the construction activities would be temporary and limited to the duration of the construction period. U.S. Army Corps of Engineers permits may be required when filling and crossing of wetlands. Temporary changes to spring and stream flow from grading and changes in topography and natural drainage patterns could be mitigated or restored after the construction phase. Incidental spills of drilling fluids into local streams would be SMALL and temporary, due to implementation of mitigation measures. Impacts from construction of roads, parking areas, and buildings on recharge to shallow aquifers would be SMALL, owing to the limited area of impervious surfaces proposed. Infiltration of drilling fluids into the local aquifer would also be SMALL, temporary, and localized to a few feet around boreholes—SMALL to MODERATE depending on site-specific characteristics. OPERATION—Impacts from storm water runoff or direct discharge of produced waters (brine reject from reverse osmosis, or spent eluants from an ion exchange system) to surface waters would be regulated by a state or EPA-issued National Pollutant Discharge Elimination System (NPDES) permit. . Expansion of facilities or pipelines during operations would generate impacts similar to construction—SMALL to MODERATE depending on site-specific characteristics. AQUIFER RESTORATION—Impacts from aquifer restoration would be similar to impacts from operations due to use of in-place infrastructure and similar activities conducted (e.g., well field operation, transfer lines, water treatment, storm water runoff)—SMALL to MODERATE depending on site-specific characteristics. DECOMMISSIONING—Impacts from decommissioning would be similar to impacts from construction. Activities to cleanup, re-contour, and reclaim disturbed lands during decommissioning would mitigate long-term impacts to surface waters—SMALL to MODERATE depending on site-specific characteristics.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Water—Groundwater	4.5.4.2	CONSTRUCTION—Water use impacts would be limited by the small volumes of groundwater used for routine activities such as dust suppression, mixing cements, and drilling support over short and intermittent periods. Contamination of groundwater from construction activities would be mitigated by use of best management practices—SMALL to LARGE, depending on site-specific conditions. OPERATION—Potential impacts to shallow aquifers can occur from leaks or spills from surface facilities and equipment. Shallow aquifers are important sources of drinking water in some areas of the Northwestern New Mexico Uranium Milling Region. Potential impacts to the ore-bearing and surrounding aquifers include consumptive water use and degradation of water quality (from normal production activities, off-normal excursion events, and deep well injection disposal practices). Consumptive use impacts from withdrawal of groundwater would occur because approximately 1 to 3 percent of pumped groundwater would not be returned to the aquifer, due mostly to process bleed. However, this amount of lost water could be reduced substantially by currently available treatment methods (e.g., reverse osmosis, brine concentration). Effects of water withdrawal on surface water would be SMALL, as the ore zone normally occurs in a confined aquifer. Estimated drawdown effects vary depending on site conditions and water treatment technology applied. Excursions of lixiviant and mobilized chemical constituents could occur from failure of well seals or other operational conditions that result in incomplete recovery of lixiviant. Well-seal-related excursions would be detected by the groundwater monitoring system, and periodic well integrity testing and impacts would be mitigated during operation or aquifer restoration. Other excursions could result in plumes of mobilized uranium and heavy metals extending beyond the mineralization zone. The magnitude of potential impacts from vertical excursions would vary depending on site-specific conditions. To reduce the likelihood and consequences of potential excursions at ISL facilities, NRC requires licensees to take preventative measures prior to starting operations including well tests, monitoring, and development of procedures that include excursion response measures and reporting requirements. Alterations of ore body aquifer chemistry would be SMALL because the aquifer would: (1) be confined, (2) not be a potential drinking water source, and (3) be restored within statistical range of preoperational baseline water quality during the restoration period. Potential environmental impacts to confined deep aquifers below the production aquifers from deep well injection of processing wastes would be addressed by the underground injection permitting process regulated by the state of New Mexico—SMALL to LARGE, depending on site-specific conditions. AQUIFER RESTORATION—There would be potential groundwater impacts resulting from consumptive use and potential deep disposal of brine slurries after reverse osmosis, if applicable. The volume of water removed from the aquifer and related impacts would be dependent on site-specific conditions and the type of water treatment technology the facility used. In some cases, groundwater consumptive use for the aquifer restoration has been reported to be less than groundwater use consumption during the ISL operation and drawdowns due to aquifer restorations have been less than drawdown caused by ISL operations. Potential environmental impacts associated with water consumption during aquifer restorations would be determined by: (1) the restoration techniques chosen, (2) the volume of water to be used, (3) the severity and extent of the contamination, and (4) the current and future use of the production and surrounding aquifers in the vicinity of the ISL facility or at the regional scale—SMALL to LARGE, depending on site-specific conditions. DECOMMISSIONING—Potential impacts from decommissioning would be similar to construction (water use, spills) with an additional potential to mobilize contaminants during demolition and cleanup activities. Contamination of groundwater from decommissioning activities would be mitigated by implementation of an NRC-approved decommissioning plan and use of best management practices—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Terrestrial	4.5.5.1	CONSTRUCTION—Potential terrestrial ecology impacts would include the removal of vegetation from well fields, the milling site, the modification of existing vegetative communities, the loss of sensitive plants and habitats from clearing and grading, and the potential spread of invasive species and noxious weed populations. These impacts would be temporary because restoration and reseeding occur rapidly at the completion of construction. Introduction of invasive species or noxious weeds would be possible but could be mitigated by restoration and reseeding after construction. Shrub and tree removal would require a longer restoration period. Construction noise could affect reproductive success of sage grouse leks by interfering with mating calls. In addition ttemporary displacement of animal species is also possible. Critical wintering habitats vital for survival of local elk populations are located within the region. Raptors breeding onsite may be impacted by construction activities or mining operations and may be temporarily impacted depending on the time of year construction activities occur. Wildlife habitat fragmentation, temporary displacement of animal species, and direct or indirect mortalities are also possible. Implementation of wildlife surveys and mitigation measures following established guidelines would limit impacts. The magnitude of impacts depends on whether a new facility is being licensed or an existing facility is being extended—SMALL to MODERATE, depending on site-specific habitat affected. OPERATION—Habitat could be altered by operations (fencing, traffic, noise), and individual takes could occur due to conflicts between species habitat and operations. Access to crucial wintering habitat and water could be limited by fencing. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) could limit impacts. Temporary contamination or alteration of soils would be likely from operational leaks and spills and possible from transportation or land application of treated wastewater. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts—SMALL. AQUIFER RESTORATION—Impacts include habitat disruption, but existing (in-place) infrastructure would be used during aquifer restoration, with little additional ground disturbance. Migratory birds could be affected by exposure to constituents in evaporation ponds, but perimeter fencing, netting, and periodic wildlife surveys (e.g., raptor surveys) would limit impacts. Contamination of soils result from leaks and spills, or land application of treated waste water. However, detection and response techniques, and eventual survey and decommissioning of all potentially impacted soils, would limit the magnitude of overall impacts to terrestrial ecology. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts—SMALL. DECOMMISSIONING—During decommissioning and reclamation, there would be a temporary disturbance to land (e.g., excavating soils, buried piping, removal of structures). However, revegetation and re-contouring would restore habitat altered during construction and operations. Wildlife would be temporarily displaced, but are anticipated to return after decommissioning and reclamation were complete and vegetation and habitat is reestablished—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Aquatic	4.5.5.2	CONSTRUCTION—Clearing and grading activities associated with construction could result in a temporary increase in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. Clearing of riparian vegetation could affect light and temperature of water. Construction impacts to wetlands would be identified and managed through U.S. Army Corps of Engineers permits, as appropriate. Construction impacts to surface waters and aquatic species would be temporary and mitigated by use of best management practices—SMALL. OPERATION—Impacts could result from spills or releases into surface water. Impacts would be minimized by spill prevention, identification and response programs, and National Pollutant Discharge Elimination System (NPDES) permit requirements—SMALL. AQUIFER RESTORATION—Activities would use existing (in-place) infrastructure, and impacts could result from spills or releases of untreated groundwater. Impacts would be minimized by spill prevention, identification, and response programs, and NPDES permit requirements—SMALL. DECOMMISSIONING—Decommissioning and reclamation activities could result in temporary increases in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Ecology—Threatened or Endangered Species	4.5.5.3	CONSTRUCTION—Numerous threatened and endangered species and State Species of Concern are located in the region. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts depends on the size of a new facility or extension to an existing facility and the amount of land disturbance. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations conducted with U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL to MODERATE to LARGE—depending on site-specific habitat and presence of threatened or endangered species. OPERATION—Impacts could result from individual takes due to conflicts with operations. Small fragmentation of habitats would occur, but most species readapt quickly. The magnitude of impacts would depend on the size of a new facility or extension to an existing facility and the amount of land disturbance. Impacts could potentially result from spills or permitted effluents, but would be limited by spill prevention measures, identification and response programs, and NPDES permit requirements. Inventory of threatened or endangered species developed during site-specific reviews would identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL to MODERATE—depending on site-specific habitat and presence of threatened or endangered species. AQUIFER RESTORATION—Impacts could result from individual takes due to conflicts with aquifer restoration activities (equipment, traffic). Existing (in-place) infrastructure would be used during aquifer restoration, so additional land-disturbing activities and habitat fragmentation would not occur. Impacts may result from spills or releases of treated or untreated groundwater, but would be limited by spill prevention measures, identification, and response programs, and NPDES permit requirements. Inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in identifying potential impacts—SMALL. DECOMMISSIONING—Impacts resulting from individual takes would occur due to conflicts with decommissioning activities (equipment, traffic). Temporary land disturbance would occur as structures were demolished and removed and the ground surface re-contoured. Inventory of threatened or endangered species developed during site-specific environmental review of Decommissioning Plan would identify unique or special habitats, and Endangered Species Act consultations with the U.S. Fish and Wildlife Service would assist in identifying potential impacts. With completion of decommissioning, revegetation, and re-contouring, habitat would be reestablished and impacts would, therefore, be limited—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Air Quality	4.5.6	CONSTRUCTION—Fugitive dust and combustion (vehicle and diesel) emissions during land-disturbing activities associated with construction would be SMALL, short-term, and reduced through use of best management practices (e.g., dust suppression). For example, estimated fugitive dust emissions during ISL construction is less than 2 percent of the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and less than 1 percent for PM_{10}. For NAAQS attainment areas such as the Northwestern New Mexico Uranium Milling Region, nonradiological air quality impacts would be SMALL. There are no Prevention of Significant Deterioration (PSD) Class I areas in the Northwestern New Mexico Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. OPERATION—Radiological impacts can result from dust releases from drying of lixiviant pipeline spills, radon releases from well system relief valves, resin transfer, or elution, and gaseous/particulate emissions from yellowcake dryers. Only small amounts of low dose materials would be released based on operational controls and rapid response to spills. Required spill prevention, control, and response procedures would be used to minimize impacts from spills. HEPA filters and vacuum dryer designs reduce particulate emissions from operations and ventilation reduces radon buildup during operations. Compliance with the NRC-required radiation monitoring program would ensure releases are within regulatory limits. Other potential nonradiological emissions during operations include fugitive dust and fuel from equipment, maintenance, transport trucks, and other vehicles. For NAAQS attainment areas such as the Northwestern New Mexico Uranium Milling Region, nonradiological air quality impacts would be SMALL. There are no PSD Class I areas in the Northwestern New Mexico Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. AQUIFER RESTORATION—Because the same (in-place) infrastructure would be used, air quality impacts would be similar to, or less than, operations. For NAAQS attainment areas such as the Northwestern New Mexico Uranium Milling Region, nonradiological air quality impacts would be SMALL. There are no PSD Class I areas in the Northwestern New Mexico Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL. DECOMMISSIONING—Fugitive dust and combustion (vehicle and diesel) emissions during land disturbing activities associated with decommissioning would be similar to, or less than, associated with construction, be short-term, and reduced through use of best management practices (e.g., dust suppression). These impacts would decrease as decommissioning and reclamation of disturbed areas are completed. For NAAQS attainment areas such as the Northwestern New Mexico Uranium Milling Region, nonradiological air quality impacts would be SMALL. There are no PSD Class I areas in the Northwestern New Mexico Uranium Milling Region. Furthermore, if impacts were initially assessed at a higher significance level, permit requirements would impose conditions or mitigation measures to reduce impacts—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Noise	4.5.7	CONSTRUCTION—Noise generated during construction would be noticeable in proximity to operating equipment, but would be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below Occupational Health and Safety Administration (OSHA) regulatory limits and mitigated by use of personal hearing protection. Traffic noise during construction (commuting workers, truck shipments to and from the facility, and construction equipment such as trucks, bulldozers, compressors) would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Noise may adversely affect wildlife habitat and their reproductive success in immediate vicinity of construction activities. Noise levels decrease geometrically with distance, and at distances more than 300 m [1,000 ft], ambient noise levels return to background. Wildlife generally avoid construction noise areas. The uranium districts within the Northwestern New Mexico Uranium Milling Region are more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE. OPERATION—Noise-generating activities in the central uranium processing facility would be indoors, minimizing offsite sound levels. Well field equipment (e.g., pumps, compressors) would also be contained within structures (e.g., header houses, satellite facilities) minimizing sound levels to offsite receptors. Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits and mitigated by use of personal hearing protection. Traffic noise from commuting workers, truck shipments to and from the facility, and facility equipment would be localized, limited to highways in the vicinity of the site, access roads within the site, and roads in well fields. Relative increases in traffic levels would be SMALL for larger roads, but may be MODERATE for lightly traveled rural roads through less populated communities. Most noise would be generated indoors, and mitigated by regulatory compliance and use of best management practices. Noise from trucks and other vehicles is typically of short duration. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The uranium districts within the Northwestern New Mexico Uranium Milling Region are more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE. AQUIFER RESTORATION—Noise generation is expected to be less than during construction and operations. Pumps and other well field equipment contained in buildings, minimize sound levels to offsite receptors. Existing operational infrastructure would be used and traffic levels would be less than during construction and operations. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The uranium districts within the Northwestern New Mexico Uranium Milling Region are more than 300 m [1,000 ft] from the closest community—SMALL to MODERATE. DECOMMISSIONING—Noise generated during decommissioning would be noticeable in proximity to operating equipment, but would be temporary (typically daytime only). Administrative and engineering controls would be used to maintain noise levels in work areas below OSHA regulatory limits, and mitigated by use of personal hearing protection. Noise levels during decommissioning would be expected to be less than during construction and would diminish as less and less equipment is used and truck traffic is reduced. Noise usually is not discernable to offsite receptors at distances of more than 300 m [1,000 ft]. The uranium districts within the Northwestern New Mexico Uranium Milling Region are more than 300 m [1,000 ft] from the closest community—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Historical and Cultural	4.5.8	CONSTRUCTION—Potential impacts during ISL facility construction could include loss of, or damage and temporary restrictions on access to, historical, cultural, and archaeological resources. Prominent cultural resources in the Northwestern New Mexico Uranium Milling Region include culturally significant landscapes such as Mt. Taylor. The eligibility evaluation of cultural resources for listing in the National Register of Historic Places (NRHP) under criteria in 36 CFR 60.4(a)–(d) and/or as Traditional Cultural Properties (TSPs) is conducted as part of the site-specific review and NRC licensing procedures undertaken during the National Environmental Policy Act (NEPA) review process. The evaluation of impacts to any historic properties designated as TSPs and tribal consultations regarding cultural resources and TSPs also occurs during the site-specific licensing application and review process. To determine whether significant cultural resources would be avoided or mitigated, consultations occur with the State Historic Preservation Office, other governmental agencies (federal, state, and local), and Native American Tribes, including Tribal Historic Preservation Offices (THPOs) during the site-specific review process. Additionally, as needed, the NRC license applicant is required, under conditions in its NRC license, to adhere to procedures regarding the discovery of previously undocumented cultural resources during initial construction. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to appropriate mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. OPERATION—Because less land disturbance occurs during the operations phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during operation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. AQUIFER RESTORATION—Because less land disturbance would occur during the aquifer restoration phase, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during aquifer restoration. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions. DECOMMISSIONING—Because less land disturbance would occurs during the decommissioning phase and because decommissioning and reclamation activities would focus on previously disturbed areas, potential impacts to historical, cultural, and archaeological resources would be less than during construction. Conditions in the NRC license requiring adherence to procedures regarding the discovery of previously undocumented cultural resources would apply during decommissioning and reclamation. These procedures typically require the licensee to stop work and to notify the appropriate federal, tribal, and state agencies with regard to mitigation measures—SMALL or MODERATE to LARGE, depending on site-specific conditions.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	GEIS Section	Impact Findings
Visual and Scenic	4.5.9	CONSTRUCTION—Visual impacts result from equipment (drill rig masts, cranes), dust/diesel emissions from construction equipment, and hillside and roadside cuts. Most of the Northwestern New Mexico Uranium Milling Region is classified as Visual Resource Management (VRM) Class II through IV. A number of VRM Class II areas surrounding the national monuments (El Morro and El Malpais), the Chaco Culture National Historic Park, and the sensitive areas managed within the Mt. Taylor district of the Cibola National Forest would have the greatest potential for impacts to visual resources. Most of these areas, however, are located to the north, south, and east of the potential ISL facilities, at distances of 16 km [10 mi] or more. The facilities would be located in VRM Class III and IV areas. Current understanding indicates that several potential ISL facilities may be located near the Navajo Nation or near Mt Taylor in the San Mateo Mountains. The general visual and scenic impacts associated with ISL facility construction would be temporary and SMALL, but from a Native American perspective, any construction activities would likely to result in adverse impacts to the landscape, particularly for facilities located in areas within view of tribal lands and areas of special significance such as Mt. Taylor. Most potential visual impacts during construction would be temporary as equipment is moved and would be mitigated by use of best management practices (e.g., dust suppression). Because of the generally rolling topography of the region, most visual impacts during construction would not be visible from more than 1 km [0.6 mi]. The visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL. OPERATION—Visual impacts during operations would be less than those associated with construction. Most of the well field surface infrastructure has a low profile, and most piping and cables would be buried. The tallest structures would include the central uranium processing facility {10 m [30 ft]} and power lines {6 m [20 ft]}. Because of the generally rolling topography of the region, most visual impacts during operations would not be visible from more than about 1 km [0.6 mi]. Irregular layout of well field surface structures such as wellhead protection and header houses would reduce visual contrast. Best management practices, design (e.g., painting buildings) and landscaping techniques would be used to mitigate potential visual impact. The uranium districts in the region are located more than 16 km [10 mi] from the closest VRM Class II region, and the visual impacts associated with ISL construction would be consistent with the predominant VRM Class III and IV—SMALL. AQUIFER RESTORATION—Because aquifer restoration activities use the same infrastructure, potential visual impacts would be the same as, or less than, during operations—SMALL. DECOMMISSIONING SMALL—Because similar equipment would be used and activities conducted, potential visual impacts during decommissioning would be the same as or less than those during construction. Most potential visual impacts during decommissioning would be temporary as equipment is moved, and mitigated by use of best management practices (e.g., dust suppression). Visual impacts would be low because these sites are in sparsely populated areas and impacts would diminish as decommissioning activities decrease. An approved site reclamation plan would be required prior to license termination, with the goal of returning the landscape to preconstruction condition (predominantly VRM Class III and IV). Some roadside cuts and hill slope modifications, hoever, may persist beyond decommissioning and reclamation—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)		
Topic/ Resource	**GEIS Section**	**Impact Findings**
Socioeconomics	4.5.10	CONSTRUCTION—Potential impacts to socioeconomics would result predominantly from employment at an ISL facility and demands on the existing public and social services, tourism/recreation, housing, infrastructure (schools, utilities), and the local work force. Total peak employment would be about 200 people, including company employees and local contractors, depending on timing of construction with other stages of the ISL lifecycle. During construction of surface facilities and well fields, the general practice has been to use local contractors (drillers, construction) if available. A local multiplier of 0.7 would indicate a maximum of about 140 ancillary jobs could be created. For example, local building materials and building supplies would be used to the extent practical. Most employees would live in larger communities with access to more services. Some construction employees, however, would commute from outside the county to the ISL facility, and skilled employees (e.g., engineers, accountants, managers) would come from outside the local work force. Some of these employees would temporarily relocate to the project site and contribute to the local economy through purchasing goods and services and taxes. Because of the small relative size of the ISL workforce, net impacts would be SMALL to MODERATE, depending on proximity to less populated communities such as those in Cibola County and the Town of Grants. OPERATION—Employment levels for ISL facility operations would be similar to, or less than, for construction, with total peak employment depending on timing and overlap with other stages of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Additional revenues would be generated by federal, state, and local taxes on the facility and the uranium produced. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated communities such as those in Cibola County and the Town of Grants. AQUIFER RESTORATION—Because much of the same (in-place) infrastructure would be used, employment levels would be similar to, or less than, for operations, with total peak employment depending on timing and overlap with other stages of the ISL lifecycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction is associated with the construction stage. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated communities such as those in Cibola County and the Town of Grants. DECOMMISSIONING—A skill set similar to the construction workforce would be involved in dismantling surface structures, removing pumps, plugging and abandoning wells, and reclaiming/re-contouring the ground surface. Employment levels and use of local contractor support during decommissioning would be similar to or less than what would be required for construction. Employment would be temporary, as decommissioning activities would be limited in duration. Because of similar employment levels, other socioeconomic impacts would be similar to construction—SMALL to MODERATE, depending on proximity to less populated communities such as those in Cibola County and the Town of Grants.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Public and Occupational Health and Safety	4.5.11	CONSTRUCTION—Worker safety would be addressed by standard construction safety practices. Fugitive dust would result from construction activities and vehicle traffic but would likely be of short duration, and not result in a radiological dose. Diesel emissions would not be expected to be a concern for worker or public health, because the releases would be of short duration readily dispersed into the atmosphere—SMALL. OPERATION—Potential occupational radiological impacts from normal operations would be caused primarily by exposure to radon gas from well field, ion-exchange resin transfer operations, and venting during processing activities. Workers would also be exposed to airborne uranium particulates from dryer operations and maintenance activities. Potential public exposures to radiation would occur from the same radon releases and uranium particulate releases (i.e., from facilities without vacuum dryer technology). Both worker and public radiological exposures would be addressed by NRC regulations at 10 CFR Part 20, which require licensees to implement an NRC-approved radiation protection program. (Measured and calculated doses for workers and the public are commonly a fraction of regulated limits.) Non-radiological worker safety matters would be addressed through commonly applied occupational health and safety regulations and practices. Radiological accident risks could involve processing equipment failures leading to yellowcake slurry spills, or radon gas or uranium particulate releases. Consequences of accidents to workers and the public are generally low, with the exception of a dryer explosion which could result in worker dose above NRC limits. The likelihood of such an accident would be low, and therefore the risk would also be low. Potential non-radiological accidents impacts include high-consequence chemical release events (e.g., ammonia) for both workers and nearby populations. The likelihood of such release events would be low, based on historical operating experience at NRC-licensed facilities which is partly the result of operators following commonly applied chemical safety and handling protocols—SMALL to MODERATE. AQUIFER RESTORATION—Because the activities during aquifer restoration overlap with similar operational activities (e.g., operation of well fields, waste water treatment and disposal) the types of impacts on public and occupational health and safety would be similar to operational impacts. The absence of some operational activities (e.g., yellowcake production and drying, remote ion exchange) further limits the relative magnitude of potential worker and public health and safety hazards—SMALL. DECOMMISSIONING—Worker and public health and safety would be addressed in a required Decommissioning Plan. This plan details how a 10 CFR Part 20 compliant radiation safety program would be implemented during decommissioning to ensure safety of workers and the public would be maintained and how applicable safety regulations would be complied with—SMALL.

Table 10-4. Summary of Impacts for the Northwestern New Mexico Uranium Milling Region (continued)

Topic/ Resource	GEIS Section	Impact Findings
Waste Management	4.5.12	CONSTRUCTION—The relatively small scale of construction activities (Section 2.3) and incremental development of well fields at ISL facilities would generate low volumes of construction waste—SMALL. OPERATION—Operational wastes primarily result from liquid waste streams including process bleed, flushing of depleted eluant to limit impurities, resin transfer wash, filter washing, uranium precipitation process wastes (brine), and plant wash down water. State permitting actions, NRC license conditions, and NRC inspections ensure the proper practices would be used to comply with safety requirements to protect workers and the public. Waste treatment such as reverse osmosis and radon settling would help in segregating wastes and minimizing disposal volumes. Potential impacts from surface discharge and deep well injection would be limited by the applicable permitting processes. NRC regulations address constructing, operating, and monitoring for leakage evaporation ponds used to store and reduce volumes of liquid wastes. Potential impacts from land application of treated wastewater would be addressed by NRC review of site-specific conditions prior to approval, routine monitoring, and inclusion of irrigated land areas in decommissioning surveys. Offsite waste disposal impacts would be SMALL for radioactive wastes as a result of required preoperational disposal agreements. Impacts for hazardous and municipal waste would be SMALL due to the volume of wastes generated. For remote areas with limited available disposal capacity, such wastes may need to be shipped greater distances to facilities that have capacity. However, the volume of wastes generated and magnitude of the shipments would be limited—SMALL. AQUIFER RESTORATION—Waste management activities during aquifer restoration would utilize the same treatment and disposal options implemented for operations. Therefore, impacts associated with aquifer restoration would be similar to operational impacts. While the amount of wastewater generated during aquifer restoration would be dependent on site-specific conditions, the potential exists for additional generation of wastewater volume and associated treatment wastes during the restoration period. However, this would be offset to some degree by the reduction in production capacity from the removal of a well field. NRC review of future ISL facility applications would verify that sufficient water treatment and disposal capacity (and the associated agreement for disposal of byproduct material) are addressed. As a result, waste management impacts from aquifer restoration would be—SMALL. DECOMMISSIONING—Radioactive wastes from decommissioning ISL facilities (including contaminated excavated soil, evaporation pond bottoms, process equipment) would be disposed of as byproduct material at an NRC licensed facility. A preoperational agreement with a licensed disposal facility to accept radioactive wastes ensures sufficient disposal capacity would be available for byproduct wastes generated by decommissioning activities. Safe handling, storage, and disposal of decommissioning wastes would be addressed in a required Decommissioning Plan, subject to NRC review. This plan details how a 10 CFR Part 20 compliant radiation safety program would be implemented during decommissioning to ensure safety of workers and the public and how applicable safety regulations would be complied with. Overall, volumes of decommissioning radioactive, chemical, and solid wastes would be limited—SMALL.

11 LIST OF PREPARERS

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12 GLOSSARY

Agreement State: A state that signed an agreement with the U.S. Nuclear Regulatory Commission (NRC) under Section 274 of the Atomic Energy Act (42 U.S.C. 2021). The state subsequently issues licenses and establishes remedial action requirements under its state laws and according to an alternative to Sections 62 or 81 of the Atomic Energy Act.

Alluvial—Pertaining to or composed of alluvium, or deposited by a stream or running water.

Alluvial fan—An outspread, gently sloping mass of alluvium deposited by a stream.

Alluvium—A general term for detrital deposits made by streams on river beds, floodplains, and alluvial fans.

Anticlinal—Of or pertaining to a generally convex upward fold, whose core contains the stratigraphically older rocks.

Aquifer—Porous water-bearing formation (bed or stratum) of permeable rock, sand, or gravel capable of producing significant quantities of water.

Aquifer Exemption—The process by which an aquifer, or a portion of an aquifer, that meets the criteria for an underground source of drinking water, for which protection under the Safe Drinking Water Act has been waived by the applicable underground injection control. Art 146.4, an aquifer may be exempted if it is:

- Not currently being used — and will not be used in the future — as a drinking water source, or
- It is not reasonably expected to supply a public water system due to a high total dissolved solids content (40 CFR 146.4).

Without an aquifer exemption, certain types of energy production, mining, or waste disposal into underground sources of drinking water would be prohibited.

Aquiclude or Aquitard—Geologic units that are impermeable (aquiclude) or of low permeability (aquitard) adjacent to an aquifer. These units serve to confine groundwater (or uranium recovery solutions) within the aquifer.

Arkosic—Sediments with a considerable amount of the mineral feldspar.

Artesian—Pertaining to groundwater under sufficient hydrostatic pressure to rise above the aquifer containing it.

Ash fall—A rain of airborne volcanic ash falling from an eruption cloud.

Ball mill—A rotating, horizontal cylinder with a diameter almost equal to its length supported by a frame or shaft in which ores are ground using various grinders (such as steel balls, quartz pebbles, or porcelain balls).

Bar—An elongate offshore ridge, bank, or mound of sand or gravel, built by waves and currents, especially at the mouth of a river or at a slight distance from the beach.

Barren solution—A solution in hydrometallurgical treatment that has had valuable constituents removed.

Basin—A low area in the earth's crust, of tectonic origin, in which sediments have accumulated.

Bentonite—A soft plastic light-colored clay formed by chemical alteration of volcanic ash.

Bleed solution—A solution drawn to adjust production or to restore groundwater by pumping more fluids from the production zone than are injected, causing fresh groundwater to flow into the production area.

Braided stream—A stream that divides into an interlacing network of branching and reuniting shallow channels separated from each other by islands or channel bars.

Brine solution—A concentrated solution containing dissolved minerals (usually greater than 100,000 mg/liter), especially chloride salts.

Byproduct material—The tailings or wastes produced by extracting or concentrating uranium or thorium from any ore processed primarily for its source material content. See also Source Material.

Calcareous—containing calcium carbonate ($CaCO_3$).

Carbonaceous—A rock or sediment containing organic matter.

Cenozoic—the latest of the four eras into which geologic time is divided; it extends from the close of the Mesozoic era, about 65 million years ago, to the present. The Cenozoic era is subdivided into Tertiary and Quaternary periods.

Channel—The deepest part of a stream.

Channel-fill deposit—Sediments deposited in a stream channel, where the transporting capacity of the stream is insufficient to remove the material supplied to it.

Clastic—Pertaining to a rock or sediment composed principally of fragments derived from pre-existing rocks or minerals, and transported some distance from their places of origin.

Clay—An earthy, extremely fine-grained sediment or soft rock composed primarily of clay-size particles (e.g., particles with diameters less than 1/256 mm).

Claystone—A cemented clay.

Coastal plain—A low, broad plain that has its margin on the oceanic shore and its strata either horizontal or very gently sloping toward the water.

Colluvium—A general term applied to loose or incoherent deposits, usually at the foot of a slope or cliff and brought three chiefly by gravity.

Confining units—A general term applied to low permeability geologic units above and below an aquifer that confine groundwater to flow within the aquifer.

Conformable—Geologic layers or strata characterized by an unbroken sequence in which the layers are formed one above the other in parallel order by uninterrupted deposition.

Conglomerate—A coarse-grained clastic sedimentary rock composed of fragments larger than 2 mm in diameter.

Continental—A sedimentary deposit laid down on land or in bodies of water not directly connected with the ocean.

Conventional Uranium Milling—A chemical process used to extract uranium from mined uranium ore. At conventional uranium mills, the ore arrives via truck and is crushed and chemically leached with sulfuric acid or alkaline solutions to remove about 90 to 95 percent of the uranium. NRC regulates the milling process (after ore enters the mill), but other agencies regulate the mining processes used to extract the ore.

Cretaceous—The first period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 144 and 65 million years ago; also, the corresponding system or rocks.

Crystalline—A general term for igneous and metamorphic rocks as opposed to sedimentary.

Cuesta—An asymmetrical ridge, with a long gentle slope on one side conforming with the dip of the underlying strata, and a steep or cliff like face on the other side formed by the outcrop of the resistant beds.

Decantation—The process of separating sediments from liquid by settling solids below and pouring off liquids above.

Decommissioning—The process of closing down a facility followed by reducing residual radioactivity.

Detrital—Minerals occurring in sedimentary rocks, which were derived from pre-existing rocks.

Disseminated—A scattered distribution of generally fine-grained minerals throughout a rock body, in sufficient quantity to make the deposit an ore.

Dome—An uplift or anticlinal structure, circular or elliptical in outline, in which the rocks dip gently away in all directions.

Eocene—An epoch of the Tertiary period (after the Paleocene and before the Oligocene), thought to have covered the span of time between 54.8 and 33.7 million years ago; also, the corresponding worldwide series of rocks.

Effluent—A waste liquid, solid, or gas, in its natural state or partially or completely treated, that discharges into the environment.

Elution—The process of extracting (or eluting) one material from another by washing with a solvent (eluant) to remove adsorbed material (such as uranium) from an adsorbent such as an ion exchange resin.

Ephemeral—A stream which flows briefly in direct response to precipitation in the immediate vicinity.

Erosion—The wearing-away or soil and rock by weathering, mass wasting, and the action of streams, glaciers, waves, wind, and underground water.

Escarpment—A long, more or less continuous cliff or relatively steep slope, separating two level or gently sloping surfaces, and produced by erosion or faulting.

Excursion—The unintended spread, either horizontally or vertically, of recovery solutions beyond the production zone. Monitoring wells are installed to analyze for appropriate water quality parameters and detect excursions.

Evaporation pond—A containment pond, typically lined, to hold liquid wastes and to concentrate wastewater through evaporation.

Feldspar—A group of abundant rock-forming minerals of the general formula, $MAl(Al, Si)_3O_8$, where M can be K, Na, Ca, Ba, Rb, Sr, or Fe. Feldspars are the most widespread of any mineral group and constitute 60% of the earth's crust.

Flare—The undetected spread of recovery solutions between the well field and monitor wells of the production zone. Flare is also a factor that estimates the amount of aquifer water outside of the pore volume that has been affected by lixiviant flow during the recovery phase. The flare is usually expressed as a horizontal and vertical component to account for differences between the horizontal and vertical hydraulic conductivity of an aquifer material.

Floodplain—That portion of a river valley, adjacent to the channel, which is built of sediments deposited during the present regimen of the stream and is covered with water when the river overflows its banks at flood stages.

Fluvial—Produced by the action of a stream or river.

Formation—A body of rock or strata that consists dominantly of a certain lithologic type or combination of types.

Gangue—The valueless rock or mineral aggregates in an ore; that part of the ore that is not economically desirable but cannot be avoided in mining.

Granite—An igneous rock formed below the earth's surface in which quartz makes up 10 to 50 percent of the rock components.

Granitic—Pertaining to or composed of granite.

Groundwater—Water beneath the surface in the saturated zone that is under atmospheric or artesian pressure.

Heap Leach—A method of extracting uranium from ore using a leaching solution. Small ore pieces are placed in a heap on an impervious material (plastic, clay, asphalt) with perforated pipes under the heap. Acidic solution is then sprayed over the ore, dissolving the uranium. The solution in the pipes is collected and transferred to an ion-exchange system for concentration of the uranium.

Heavy metals—Metallic elements, including those required for plant and animal nutrition, in trace concentration, that become toxic at higher concentrations. Examples are mercury, chromium, cadmium, and lead.

Hogback ridge—A sharp-crested ridge formed by the outcropping edges of steeply inclined resistant rocks, and produced by differential erosion.

Holocene—An epoch of the Quaternary period, from the end of the Pleistocene, approximately 8 thousand years ago, to the present time; also, the corresponding series of rocks and deposits.

Horizon—An interface that indicates a particular position in a stratigraphic sequence. Technically it is a surface with no thickness, but in practice it is commonly a distinctive very thin bed.

Humic—Pertaining to or derived from the dark, more or less stable part of the organic matter in soil.

Hydrothermal—Pertaining to a mineral deposit precipitated from a hot solutions.

Igneous—A rock or mineral that solidified from a magma.

Impermeable—A rock, sediment, or soil that is incapable of transmitting fluids under pressure.

Injection—The subsurface discharge of fluids through a well.

Injection zone—A geological formation, group of formations, or part of a formation that receives fluids through a well.

***In-situ* leaching (ISL)**—The in-place recovery of a mineral resource without removing overburden or ore. This is typically accomplished by installing a well and recovering the resource directly from the natural deposit by exposing it to the injection and recovery of a fluid that causes the leaching, dissolution, or recovery of the mineral.

Injection well—A well or a drill hole in an *in-situ* leach operation through which barren solutions enter an underground stratum or ore body by gravity or under pressure.

Interbedded—Rock material or sediments lying between or alternating with others of different character.

Interfinger—To grade or pass from one material into another through a series of interpenetrating wedge-shaped layers.

Interstitial—A mineral deposit in which the minerals fill the pores of the host rock.

Interstratified—*See* **Interbedded**.

Intertonguing—The disappearance of sedimentary bodies in laterally adjacent masses owing to splitting into may thin tongues, each of which reaches an independent pinch-out termination.

Ion exchange— A chemical process used to recover uranium from solution by the exchange dissolved uranium ions between a lixiviant (leach solution) and a solid, either a mineral surface or, more commonly, a synthetic polymer resin.

Isotope—Any two or more forms of an element having identical or very closely related chemical properties and the same atomic number but different atomic weights or mass numbers.

Jurassic—The second period of the Mesozoic era (after the Triassic and before the Cretaceous), thought to have covered the span of time between 206 and 144 million years ago; also, the corresponding system or rocks.

Lacustrine—Pertaining to or produced by a lake or lakes.

Lagoonal—Pertaining to a channel or bay partly or completely separated from the sea by a reef or barrier island, especially the water between an offshore coral reef and the mainland.

Leach—Dissolving of soluble constituents (e.g., uranium) from a rock or ore body by the natural action of percolating water or a lixiviant (leaching solution).

Leachate—The liquid that has percolated through the soil or other medium.

Lenticular—Pertaining to a stratigraphic lens; resembling in shape the cross section of a lens.

Lithologic—The physical character of a rock, such as color, mineralogical composition, and grain size.

Lixiviant—Leachate solution pumped underground to a uranium ore body; it may be alkaline or acidic.

Loam—A rich, permeable soil composed of a mixture of clay, silt, sand, and organic matter.

Marine—A sedimentary deposit laid down or caused by the sea.

Mechanical integrity—The absence of significant leakage within the injection tubing, casing, or packer (known as internal mechanical integrity), or outside of the casing (known as external mechanical integrity). Mechanical integrity tests (MITs) are performed to determine the adequacy of the construction of an injection well. Periodic mechanical integrity tests (MITs) are performed to confirm that a well maintains internal and external mechanical integrity.

Mesa—A flat-topped mountain bounded on a least one side by a steep cliff.

Mesozoic—An era of geologic time, from the end to the Paleozoic to the beginning of the Cenozoic, or from about 248 to about 65 million years ago; also, the rocks formed during that era. It includes the Triassic, Jurassic, and Cretaceous periods.

Metamorphic—A rock derived from pre-existing rocks by mineralogical, chemical, and/or structural changes in response to marked changes in temperature, pressure, shearing stress, and chemical environment.

Meteoric—Pertaining to or derived from the earth's atmosphere, e.g. meteoric water.

Micaceous—Consisting of, containing, or pertaining to mica – a group of minerals of the general formula $(K, Na, Ca)(Mg, Fe, Li, Al)_{2-3}(Al, Si)_4O_{10}(OH, F)_2$. Micas are prominent rock-forming constituents of igneous and metamorphic rocks.

Mill feed—Uranium ore supplied to a crusher or grinding mill in an ore-dressing process.

Mill tailings—*See* **Tailings**.

Miocene—An epoch of the Tertiary period (after the Oligocene and before the Pliocene), thought to have covered the span of time between 23.8 and 5.3 million years ago; also, the corresponding worldwide series of rocks.

Mudstone—A fine-grained sedimentary rock in which the proportion of clay and silt are approximately equal.

Natural levee—A ridge or embankment of sand and silt, built up by a stream on its flood plain along both banks of its channel.

Oligocene—An epoch of the Tertiary period (after the Eocene and before the Miocene), thought to have covered the span of time between 33.7 and 23.8 million years ago; also, the corresponding worldwide series of rocks.

Ore—A naturally occurring mineral that contains an economically valuable constituent, such as uranium, in sufficient concentration and quantity to allow economic production.

Outcrop—That part of a geologic formation or structure that appears at the surface of the earth.

Overbank deposit—Silt and clay deposited from suspension on a flood plain by floodwaters that cannot be contained within the stream channel.

Oxidation—An oxidizing environment is characterized by an excess of free oxygen (either dissolved or as a gas). During oxidation, the atoms in an element lose electrons and the valence state of the element increases. Chemically, oxidation is the opposite process from reduction (*see* **Reduction**). Oxidized uranium with a 6+ valence state (U^{6+} with fewer electrons) is more readily dissolved than reduced uranium (U^{4+} with more electrons).

Packer—A mechanical device set immediately above the injection zone that seals the outside of the tubing to the inside of the long string casing. A packer may be a simple mechanically set rubber device or a complex concentric seal assembly.

Paleocene—An epoch of the Tertiary period (after the Cretaceous period and before the Eocene), thought to have covered the span of time between 65 and 54.8 million years ago; also, the corresponding worldwide series of rocks.

Paleosol—A buried soil; a soil of the past.

Paleozoic—An era of geologic time, from the end of the Precambrian to the beginning of the Mesozoic, or from about 543 to about 248 million years ago. Also, the rocks formed during that era.

Paludal—Pertaining to a marsh.

Pennsylvanian—A period of the Paleozoic era (before the Permian), thought to have covered the span of time between 323 and 290 million years ago; also, the corresponding system or rocks.

Permeability—The ease with which fluid flows through a porous rock or sediment. Rock or sediment that allows water to move through at an appreciable rate are called "permeable."

Permian—The last period of the Paleozoic era, thought to have covered the span of time between 290 and 248 million years ago; also, the corresponding system of rocks.

Physiographic province—A region of which all parts are similar in geologic structure and climate and which has had a unified geologic history.

Plateau—A relatively elevated area of comparatively flat land which is commonly limited on a least one side by an abrupt descent to lower ground.

Pleistocene—An epoch of the Quaternary period, after the Pliocene of the Tertiary and before the Holocene; also, the corresponding worldwide series of rocks. It began about 1.8 million years ago and lasted until the start of the Holocene some 8,000 years ago.

Pliocene—An epoch of the Tertiary period (after the Miocene and before the Pleistocene), thought of have covered the span of time between 5.3 and 1.8 million years ago; also, the corresponding worldwide series of rocks.

Pore space or porosity—The collective open spaces of a rock. It is a measure of the amount of liquid or gas that may be absorbed or produced by a particular formation.

Pore volume—A volume equal to the open space in rock or soil. The ISL industry uses this term to define an indirect measurement of a unit volume of aquifer water affected by ISL recovery. It represents the volume of water that fills the void space inside a certain volume of rock or sediment. Pore volume provides a unit reference that an operator can use to describe (1) the amount of lixiviant circulation needed to leach an ore body or (2) the unit number of treated water circulations needed to flow through a depleted ore body to achieve restoration. A pore volume allows an operator to use relatively small-scale studies and scale the results to field-level pilot tests or to commercial well field scales. Typically, a pore volume is calculated by multiplying the surficial area of a well field (the area covered by injection and recovery wells) by the thickness of the production zone being exploited and the estimated or measured porosity of the aquifer material.

Potentiometric surface—An imaginary surface representing the total head of groundwater and defined by the level to which water will rise in a well.

Precambrian—All geologic time, and its corresponding rocks, before the beginning of the Paleozoic.

Pregnant solution—A solution containing a dissolved, extractable mineral that was leached from the ore; uranium leach solution pumped up from the underground ore zone through a production hole. Also called "pregnant lixiviant."

Primacy or primary enforcement authority—The authority delegated by EPA to implement the UIC Program. To receive primacy, a state, territory, or tribe must demonstrate to EPA that its UIC program is at least as stringent as the federal standards; the state, territory, or tribal UIC requirements may be more stringent than the federal requirements. (For Class II, states must demonstrate that their programs are effective in preventing pollution of USDWs.) EPA may grant primacy for all or part of the UIC program, e.g., for certain classes of injection wells.

Production zone—The uranium-bearing portion of a geological formation or part of a formation that is the target of ISL uranium recovery by underground injection and production of lixiviant.

Pyrite—The most widespread and abundant of the sulfide minerals, H_2S.

Quaternary—The second period of the Cenozoic era, following the Tertiary; also, the corresponding system or rocks. It began about 1.8 million years ago and extends to the present. It consists of two epochs: the Pleistocene and the Holocene.

Quartz—Crystalline silica, an important rock-forming mineral, SiO_2.

Quartzose—Containing quartz as a principal constituent.

Production bleed—*See* **Bleed Solution**.

Production (or recovery) well—A well or a drill hole in an *in-situ* leach operation through which pregnant (uranium-bearing) solutions are extracted from an underground stratum or uranium deposit.

Radioisotope—An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. Approximately 5,000 natural and artificial radioisotopes have been identified.

Radon—A chemically inert radioactive gaseous element formed when radium decays. Exposure to radon may pose a potential health hazard.

Reclamation—The process of restoring the surface environment to acceptable pre-existing conditions. Reclamation includes activities such as surface contouring, equipment removal, well plugging, and revegetation.

Reduction—A reducing environment is characterized by little or no free oxygen (dissolved or as a gas). During reduction, the atoms in an element gain electrons and the valence state of the element decreases. Chemically, reduction is the opposite process from oxidation (*see* **Oxidation**). Reduced uranium (U^{4+} with more electrons) is less dissolvable than oxidized uranium (U^{6+} with fewer electrons).

Remote Ion Exchange (RIX)—A type of ISL uranium recovery operation where pregnant lixiviant from production wells is collected at a small satellite (RIX) facility. The uranium is stripped from the lixiviant by loading onto ion exchange resins. The loaded resins are then transported by tanker truck to a larger central facility for additional processing and uranium recovery. RIX operations are used to produce uranium from smaller, more disperse uranium deposits.

Restoration—Returning affected groundwater to its pre-recovery quality or class of use by employing the best practical technology.

Reverse osmosis—The act of reversing a diffusion through a semipermeable membrane, typically separating a solvent and a solution, that tends to equalize their concentrations. In ISL facilities, this process is used to treat wastewater to remove dissolved constituents and reduce total dissolved solids.

Rip rap—Cobblestone or coarsely broken rock used for protection against erosion of embankments or gullies.

Roll front—A localized uranium deposit in the form of a roll or interface that separates an oxidized interior from a reduced exterior. The reduced side of this interface is significantly enriched in uranium.

Runoff—The portion of rainfall that is not absorbed by soil, evaporated, or transpired by plants, but finds its way directly into streams or as overland surface flows.

Sand—A loose aggregate of particles having a diameter in the range of 1/16 to 2 mm.

Sandstone—A clastic sedimentary rock composed of grains of sand size set in a matrix of silt or clay and more or less firmly united by a cementing material.

Satellite facility—A remotely located facility for initial processing of uranium bearing solutions [see **Remote Ion Exchange (RIX)**].

Scour protection—Using flushing water to protect the trench surface from erosion.

Sediment—Solid fragmental material transported and deposited by wind or water, or chemically precipitated from solution, that forms in layers in loose unconsolidated form.

Sedimentary—Pertaining to or containing sediment, or formed by its deposition.

Shale—A fine-grained detrital sedimentary rock, formed by the compaction of clay, silt, and mud.

Silicified—A rock in which silica, in the form of quartz, chalcedony, or opal, has replaced existing minerals.

Silt—A loose aggregate of rock or mineral particles commonly in the range of 1/16 to 1/256 mm.

Siltstone—A massive mudstone in which silt predominates over clay.

Source material—Uranium or thorium ores containing 0.05 percent uranium or thorium regulated under the Atomic Energy Act. In general, this includes all materials containing radioactive isotopes in concentrations greater than natural and the byproduct (tailings) from the formation of these concentrated materials.

Spit—A small point of sand or gravel projecting from the shore into a body of water; a fingerlike extension of the beach.

Stratabound—A type of mineral deposit contained within a single layer of sedimentary rock. Usually refers to a deposit in a permeable rock such as a sandstone bounded by impermeable confining layers such as shelves.

Stratigraphic unit—A body of strata recognized as a unit for description, mapping, and correlation.

Stratigraphic section or sequence—A chronologic succession of sedimentary rocks from older below to younger above, essentially without interruption.

Subsidence—Sinking or downward settling of the earth's surface.

Surety—A type of bond to ensure that funds are available for a specific activity (in this case, dismantling, reclamation, restoration, and remediation of uranium production sites). If the company goes bankrupt, the bonding company pays NRC or the appropriate state the amount of the bond. NRC or the appropriate state must ensure that the amount is adequate for the remediation activities.

Synclinal—Pertaining to a fold of which the core contains the stratigraphically younger rocks; it is generally concave upward.

Tailings—The remaining portion of a metal-bearing ore consisting of finely ground rock and process liquid after some or all of the metal, such as uranium, has been extracted.

Terrace—A relatively level bench or steplike surface breaking the continuity of a slope.

Tertiary—The first period of the Cenozoic era (after the Cretaceous of the Mesozoic era and before the Quaternary), thought to have covered the span of time between 65 million and 1.8 million years ago; also, the corresponding system of rocks. It is divided into five epochs: the Paleocene, Eocene, Oligocene, Miocene, and Pliocene.

Texture—The physical nature of a soil, according to the relative proportions of sand, silt, and clay.

Tiering—For the purposes of the National Environmental Policy Act, tiering is defined by the Council on Environmental Quality in 40 CFR 1508.28. It refers to "the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basinwide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared."

Topography—The general configuration of a land surface including elevations.

Tongue—A minor stratigraphic unit of limited extent, especially a member that extends outward beyond the main body of a formation and disappears laterally.

Transgression—The spread of the sea over land areas.

Triassic—The first period of the Mesozoic era (after the Permian of the Paleozoic era, and before the Jurassic), thought to have covered the span of time between 248 and 206 million years ago; also, the corresponding system of rocks.

Trunkline—Main pipeline that brings together flow from individual wells.

Tuff—A general term for consolidated rocks formed by volcanic explosion or aerial expulsion from a volcanic vent.

Tuffaceous—Rocks or sediments containing particles derived from pre-existing tuff rocks.

Underground Injection Control (UIC)—The UIC Program is administered by the EPA or by tribal or state agencies that have been granted primacy by EPA. The UIC program is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal. Based on EPA regulations, UIC programs identify five different classes of injection wells.

Class I wells—Technologically sophisticated wells that inject wastes into deep, isolated rock formations below the lowermost USDW. Class I wells may inject hazardous waste, non-hazardous industrial waste, or municipal wastewater.

Class II wells—Wells that inject brines and other fluids associated with oil and gas production, or storage of hydrocarbons. Class II well types include salt water disposal wells, enhanced recovery wells, and hydrocarbon storage wells.

Class III wells—Wells that inject fluids associated with solution mining of minerals. Mining practices that use Class III wells include salt solution mining, in-situ leaching of uranium, and sulfur mining using the Frasch process.

Class IV wells—Wells that inject hazardous or radioactive wastes into or above a USDW. These wells are banned unless authorized under a federal or state groundwater remediation project.

Class V wells—Wells not included in Classes I to IV. Class V wells inject non-hazardous fluids into or above a USDW and are typically shallow, on-site disposal systems; however, this class also includes some deeper injection operations. There are approximately 20 subtypes of Class V wells.

Underground Source of Drinking Water (USDW)—An aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/l total dissolved solids and is not an exempted aquifer.

Uplift—A structurally high area in the crust, produced by movements that raise the rocks, as in a broad dome or arch.

Uraniferous—A rock or sediment that contains uranium.

Viewshed—The Bureau of Land Management uses this term in the Visual Resource Management process to describe landscape that can be seen under favorable atmospheric conditions from a viewpoint (key observation point) or along a transportation corridor.

Visual resources—The visible physical features of a landscape (topography, water, vegetation, animals, structures, and other features) that constitute the scenery of an area.

Visual resource management (VRM) classes—

Class I—The objective of this class is to maintain a landscape setting that appears unaltered by humans. It is applied to wilderness areas, some natural areas, wild portions of wild and scenic rivers, and other similar situations in which management activities are to be restricted.

Class II—The objective of this class is to design proposed alterations so as to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

Class III—The objective of this class is to design proposed alterations so as to partially retain the existing character of the landscape. Contrasts to the basic elements (form, line, color, and texture) caused by a management activity may be evident and begin to attract attention in the characteristic landscape; however, the changes should remain subordinate to the existing characteristic landscape.

Class IV—The objective of this class is to provide for management activities that require major modification of the existing character of the landscape. Contrasts may attract attention and be a dominant feature of the landscape in terms of scale; however, changes should repeat the basic elements (form, line, color, and texture) inherent in the characteristic landscape.

Class V or Rehabilitation Area—Change is needed or change may add acceptable visual variety to an area. This class applies to areas where the naturalistic character has been disturbed to a point at which rehabilitation is needed to make it conform to the surrounding landscape. This class would apply to areas where the quality class has been reduced because of unacceptable cultural modification as identified in the scenic evaluation. The contrast is inharmonious with the characteristic landscape. It may also be applied to areas that have the potential for enhancement, where it would add acceptable visual variety to an area or site. It should be considered an interim or short-term classification until one of the other VRM class objectives can be reached through rehabilitation or enhancement. The desired VRM class should be identified.

Volcanic—Pertaining to the activities, structures, or rock types of a volcano.

Volcanic ash—Fine (under 2 mm in diameter) clastic rock material formed by volcanic explosion or aerial expulsion from a volcanic vent.

Volcaniclastic—Pertaining to a clastic rock containing volcanic material.

Well field—The area of an ISL operation that encompasses the array of injection, recovery (or production), and monitoring wells and interconnected piping employed in the leaching process.

Yellowcake—Sludge of uranium oxide (nominally U_3O_8) concentrate formed during the final step of the milling process.