Groundwater Impacts

Potential environmental impacts to groundwater at the Moore Ranch site may occur during all phases of the ISR facility's lifecycle, but primarily during operations and aquifer restoration.

Detailed discussion of the potential environmental impacts to groundwater from construction, operation, aquifer restoration, and decommissioning are provided in the following sections.

Construction Phase

The GEIS (Section 4.3.4.2.1) indicates that potential impacts to groundwater during construction would be primarily from the consumptive use of groundwater, injection of drilling fluids and muds during well drilling, and spills of fuels and lubricants from construction equipment. As further stated in the GEIS, groundwater use during the construction phase is limited and is expected to have a SMALL and temporary impact. Groundwater quality of near surface aquifers is expected to be protected by best management practices such as spill prevention and cleanup. The amount of drilling fluids and muds introduced into aquifers would be limited. Thus, the construction impacts to groundwater resources would be SMALL based on the limited nature of construction activities and implementation of management practices to protect shallow groundwater.

Operations Phase

As indicated in Section 4.3.4.2.2 of the GEIS, during ISR operations, potential environmental impacts to shallow (near-surface) aquifers are related to leaks of lixiviant from pipelines, wells, or header houses and to waste management practices such as the use of evaporation ponds and disposal of treated wastewater by land application. Potential environmental impacts to groundwater resources in the production and surrounding aquifers also include consumptive water use and changes to water quality. Water quality changes would result from normal operations in the production aquifer and from possible horizontal and vertical lixiviant excursions beyond the production zone. Disposal of processing wastes by deep well injection during ISR operations also can potentially impact groundwater resources (NRC, 2008).

Impacts to Shallow (Near-Surface) Aquifers

The GEIS (Section 4.3.4.2.2.1) discusses the potential impacts to shallow aquifers during ISR operations. A network of buried pipelines is used during ISR operations for transporting lixiviant between the pump house and the satellite or main processing facility and also to connect injection and extraction wells to manifolds inside the pumping header houses. The failure of pipeline fittings or valves, or failures of well mechanical integrity in shallow aquifers could result in leaks and spills of pregnant and barren lixiviant which could impact water quality in shallow aquifers. The potential environmental impact of such pipeline, valve, or well integrity failure depends on a number of factors, including the depth to shallow groundwater, the use of shallow groundwater, and the degree of hydraulic connection of shallow aquifers to regionally important aquifers.

As indicated in the GEIS, the use of evaporation ponds or land application to manage process water generated during operations also could impact shallow aquifer. However, neither evaporation ponds nor land application to manage process water generated during operations are planned at Moore Ranch. Consequently, there is no potential impact to shallow groundwater from these aspects of ISR operations.

As indicated by the GEIS, the potential impact of releases at or near the ground surface on shallow groundwater can be greatly reduced by leak detection programs required by the NRC.

[begin site-specific analysis]

Impacts to Production and Surrounding Aquifers

The potential environmental impacts to groundwater supplies in the production and other surrounding aquifers are related to consumptive use and groundwater quality.

Water Consumptive Use: As discussed in the GEIS (Section 4.3.4.2.2.2), groundwater is withdrawn and reinjected into the production zone during ISR operations. Most of the water withdrawn from the aquifer is returned to the aquifer. The portion that is not returned to the aquifer is referred to as consumptive use. The consumptive use is due primarily to production bleed and also includes other smaller losses. The production bleed is the net withdrawal maintained to ensure groundwater gradients toward the production network. This net withdrawal ensures there is an inflow of groundwater into the wellfield to minimize the potential movement of lixiviant and its associated contaminants out of the wellfield.

Consumptive water use during ISR operations could impact local water user who use water from the production aquifer outside the exempted zone. This potential impact would result from lowering the water levels in nearby wells and reducing the yield of these wells. In addition, if the production zone is hydraulically connected to other aquifers above and/or below the water zone, consumptive use may impact the water levels in these overlying and underlying aquifers and reduce the yield in any nearby wells withdrawing water from these aquifers.

[begin site-specific analysis]

Excursions and Groundwater Quality: As discussed in the GEIS, groundwater quality in the production zone is degraded as part of ISR operations. After production is completed, the licensee is required to conduct aquifer restoration activities Licensee are required to restore groundwater parameters to the standards in 10 CFR Part 40, Appendix A, Criterion 5 or to an alternate NRC-approved standard. For these reasons, potential impacts to the water quality of the uranium-bearing production zone aquifer as a result of ISR operations would be expected to be SMALL.

As discussed in the GEIS, inward hydraulic gradients are expected to be maintained by the licensee in the production aquifer during ISR operations. These inward hydraulic gradients are created by the net groundwater withdrawals (production bleeds) maintained through continued pumping during ISR operations. Groundwater flows in response to these inward hydraulic gradients, thus ensuring that groundwater flow is toward the production zone. This inward groundwater flow toward the extraction wells prevents horizontal excursions of leaching solutions away from the production zone.

As discussed in the GEIS, NRC requires the licensee to take preventive measures to reduce the likelihood and consequences of potential excursions. A ring of monitoring wells within and encircling the production zone is required for early detection of horizontal excursions. If excursions are detected, corrective actions are required outside of the exempted portion of the production aquifer.

Vertical excursions may also potentially occur into aquifers overlying or underlying the production zone aquifer. As analysis presented in the GEIS indicates, the potential for migration of leaching solution into an overlying or underlying aquifer is SMALL if the thickness of the aquitard separating the production zone from the overlying and underlying is sufficient and the permeability of the aquitard is low. Hydraulic gradient between the production zone and overlying or underlying aquifers also help to determine the potential for vertical excursions. The NRC also requires monitoring in the overlying and underlying aquifers. Corrective action is also required if any vertical excursions are detected.

[begin site-specific analysis]

Impacts to Deep Aquifers Below the Production Aquifers

Potential environmental impacts to confined deep aquifers below the production aquifers could be due to deep well injection of processing wastes into deep aquifers. Under different environmental laws such as the Clean Water Act, the SDWA, and the Clean Air Act, the EPA has statutory authority to regulate activities that may affect the environment. Underground injection of fluid requires a permit from the WDEQ or from an authorized state UIC program. The WDEQ has been authorized to administer the UIC program in Wyoming and is responsible for issuing any permits for deep well disposal at the Moore Ranch site.

The GEIS indicates that the potential environmental impact of injection of leaching solution into deep aquifers below ore-bearing aquifers would be expected to be SMALL, if water production from deep aquifers is not economically feasible or the groundwater quality from these aquifers is not suitable for domestic or agricultural uses (e.g., high salinity), and they are confined above by sufficiently thick and continuous low permeability layers.

The WDEQ would evaluate the suitability of the proposed deep injection wells. The WDEQ would only grant such a permit if the waste fluids can be suitably isolated in a deep aquifer. Additionally, NRC review and approval of deep well injection is required to ensure disposal of wastes complies with the dose limits in 10 CFR Pat 20. Consequently, it is assumed that the potential environmental impact to deep aquifers below the production aquifers of deep well disposal of waste would be SMALL.

[begin site-specific analysis]

Aquifer Restoration Phase

The potential environmental impacts to groundwater resources during aquifer restoration are related to groundwater consumptive use and waste management practices, including deep well injection of wastes. In addition, aquifer restoration directly affects groundwater quality in the vicinity of the wellfield being restored.

As discussed in the GEIS, the impacts of consumptive use during aquifer restoration are generally greater than during ISR operations. A greater amount of groundwater is generally withdrawn when groundwater sweeps are employed during the aquifer restoration phase. These larger withdrawals can result in larger drawdowns in the production aquifer which can result in greater impacts on the yields of nearby wells.

[begin site-specific analysis]

Decommissioning Phase

As indicated in the GEIS (Section 4.3.4.2.4), potential impacts to groundwater during construction are primarily from consumptive use of groundwater, potential spills of fuels and lubricants, and well abandonment. The consumptive use during decommissioning would be much less than during ISR production or aquifer restoration. Spills of fuels and lubricants during decommissioning activities could impact shallow groundwater. Implementation of best management practices during decommissioning would reduce the likelihood of such spills and the impact to groundwater resources in shallow aquifers from decommissioning would be SMALL.

As part of the restoration and reclamation activities, all monitor, injection, and recovery wells would be plugged and abandoned in accordance with the Wyoming UIC program requirements. If this process is properly implemented and the abandoned wells are properly isolated from the flow domain, the potential environmental impacts would be SMALL.

[begin site-specific analysis]

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L