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ENVIRONMENTAL ASSESSMENT OF GROUND WATER COMPLIANCE ACTIVITIES AT THE URANIUM MILL TAILINGS SITE, SPOOK, WYOMING

March 1996

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**ENVIRONMENTAL ASSESSMENT OF
GROUND WATER COMPLIANCE ACTIVITIES
AT THE URANIUM MILL TAILINGS SITE
SPOOK, WYOMING**

March 1996

Work performed under DOE Contract No. DE-AC04-91AL62350.

**Prepared for
U.S. Department of Energy
Grand Junction Projects Office**

**Prepared by
Jacobs Engineering Group Inc.
Albuquerque, New Mexico**

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LIST OF ACRONYMS

<u>Acronym</u>	<u>Definition</u>
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
NRC	U.S. Nuclear Regulatory Commission
PEIS	programmatic environmental impact statement
UMTRA	Uranium Mill Tailings Remedial Action
USGS	U.S. Geological Survey

1.0 DOCUMENT SUMMARY

This document is an environmental assessment of the Spook, Wyoming, Uranium Mill Tailings Remedial Action (UMTRA) Project site. It analyzes the impacts of the U.S. Department of Energy (DOE) proposed action for ground water compliance.

The proposed action is to comply with the U.S. Environmental Protection Agency (EPA) standards for the UMTRA Project sites (40 CFR Part 192) by meeting supplemental standards based on the limited use ground water at the Spook site. This proposed action would not require site activities, including ground water monitoring, characterization, or institutional controls.

Ground water in the uppermost aquifer was contaminated by uranium processing activities at the Spook site, which is in Converse County, approximately 48 miles (mi) (77 kilometers [km]) northeast of Casper, Wyoming. Constituents from the site infiltrated and migrated into the uppermost aquifer, forming a plume that extends approximately 2500 feet (ft) (800 meters [m]) downgradient from the site. The principal site-related hazardous constituents in this plume are uranium, selenium, and nitrate.

Background ground water in the uppermost aquifer at the site is considered limited use. It is neither a current nor a potential source of drinking water because of widespread, ambient contamination that cannot be cleaned up using treatment methods reasonably employed in public water supply systems (40 CFR §192.11(e)). Background ground water quality also is poor due to first, naturally occurring conditions (natural uranium mineralization associated with an alteration front), and second, the effects of widespread human activity not related to uranium milling operations (uranium exploration and mining activities). There are no known exposure pathways to humans, animals, or plants from the contaminated ground water in the uppermost aquifer because it does not discharge to lower aquifers, to the surface, or to surface water.

Site-related sources of ground water contamination in the uppermost aquifer are no longer exposed to the environment because surface remedial action stabilized the uranium mill tailings and other residual radioactive materials in a disposal cell at the bottom of the Spook open pit mine. The cell was covered with overburden material. Surface remediation was completed in November 1989 (DOE, 1989; 1990).

This document compares the potential impacts from the proposed action to potential impacts from the no action alternative. DOE requires consideration of the no action alternative as a baseline for comparison with impacts from the proposed action. The no action alternative is to take no further action at the site, and to not document compliance with EPA standards.

This environmental assessment shows how, with no adverse impacts, the proposed action would result in compliance with the EPA standards and protection of human health and the environment because there are no current or reasonably projected uses of the background or affected ground water.

2.0 PURPOSE AND NEED FOR ACTION

The DOE must comply with congressional and EPA requirements at the Spook site so as to protect human health and the environment. Congress mandated that DOE protect human health and the environment from the potentially harmful effects of uranium mill tailings and directed the EPA to establish regulatory standards for site activities (42 USC §7901 et seq.). Uranium mill tailings at abandoned processing sites are being stabilized and licensed under the UMTRA Surface Project. During the UMTRA Ground Water Project, the DOE must document protection of human health and the environment from processing site-related ground water contamination.

3.0 PROPOSED ACTION AND ALTERNATIVES

3.1 PROPOSED ACTION

The proposed action at the Spook site is to comply with EPA standards by meeting supplemental standards based on the limited use ground water at the Spook site. No site activities would be required, including ground water monitoring, characterization, and institutional controls.

Activities that are associated with the proposed action include modification of Section E.4 of the Surface Project remedial action plan (DOE, 1990) so that it includes pertinent information from the site observational work plan (DOE, 1995) and the surface environmental assessment (DOE, 1989), and a discussion of the steps taken to select the proposed action. The modified remedial action plan would be submitted to the U.S. Nuclear Regulatory Commission (NRC) for concurrence, as required by UMTRCA.

Two documents were used to select the proposed action: the programmatic environmental impact statement (PEIS) for the UMTRA Ground Water Project and the Spook site observational work plan. The PEIS established a framework for protecting human health and the environment while complying with EPA standards at each of the UMTRA Project sites. The PEIS also analyzed the potential impacts of the UMTRA Ground Water Project, and provided a framework for determining a ground water compliance strategy that is specific to each site. This compliance strategy becomes the proposed action in the site-specific environmental assessment.

The site observational work plan for the Spook site used the PEIS framework to determine the most appropriate ground water compliance strategy (hereafter called the proposed action) for the site. The site observational work plan assessed existing site characterization data, analyzed risk, and documented that the site was adequately characterized during the UMTRA Surface Project and that no additional data collection was necessary. Using the PEIS framework, it was determined that even though there is site-related ground water contamination at the Spook site, the proposed action would be the application of supplemental standards based on limited use ground water. This proposed

action is appropriate for three reasons: 1) The naturally occurring ground water has widespread, ambient contamination not due to activities involving residual radioactive materials from a processing site (the ambient contamination cannot be cleaned up using treatment methods reasonably employed in a public water system) (40 CFR §192(e)); 2) the proposed action would be protective of human health and the environment; and 3) there are no current or reasonably projected uses of contaminated background ground water in the uppermost aquifer.

3.2 NO ACTION ALTERNATIVE

DOE requires that an environmental assessment evaluate the no action alternative to provide an environmental baseline for comparing the impacts of the proposed action (10 CFR §1021.321(c)).

Under the no action alternative no site activities would be performed. In this respect, the no action alternative is the same as the proposed action. However, unlike the proposed action, the no action alternative does not document compliance with EPA standards nor does it allow the public, state, and NRC to participate in DOE's decision-making for the Spook site.

3.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM ANALYSIS

This assessment does not evaluate the impacts of complying with the EPA standards using the other compliance strategies evaluated in the PEIS: natural flushing or active remediation. Conditions at the Spook site do not require the use of these compliance strategies. The PEIS provides the logic for the selection of alternatives evaluated below in this environmental assessment.

4.0 AFFECTED ENVIRONMENT

Resources evaluated

This environmental assessment evaluates potential impacts to the following resources: ground water, surface water, biological systems, and land use. The contaminated ground water in the uppermost aquifer potentially could affect these resources, directly or indirectly.

Resources not evaluated

Because the proposed action requires no ground-disturbing activities, resources that do not require analysis in this environmental assessment are worker health and safety, air quality, ecological habitat, background noise, transportation, utilities, energy resources, and social, economic, and environmental justice issues. Visual and cultural resources were not considered in this environmental assessment because remediation activities would not take place at the site. In addition, the potential visual impact of monitor wells is low because these wells are small and intrusive, have been in place for a number of years, and are remote from human activity. Furthermore, these wells will be removed eventually. This

environmental assessment does not address the potential economic benefits of this proposed action because no activities associated with the UMTRA Ground Water Project would take place at the Spook site.

4.1 SURFACE WATER

The Spook site is located between two unnamed east and southeast trending ephemeral drainages that are tributaries of the Dry Fork of the Cheyenne River. Dry Fork is approximately one mi (1.6 km) south of the Spook site. The elevation in the area of the site is approximately 4990 ft (1520 m) above mean sea level. The Dry Fork drainage area is approximately 140 square miles (360 square kilometers); it empties into the Cheyenne River approximately 40 mi (64 km) from the Spook site. Information from a U.S. Geological Survey (USGS) gauging station that was in Dry Fork from 1976 to 1980 showed that flow ranged from 0 to 3.45 cubic feet per second (0.1 cubic meter per second). Dry Fork has extended periods of no-flow, particularly in winter and late summer. Water in the shallow alluvium of Dry Fork is relatively close to the surface even during no-flow periods, as evidenced by the dense growth of riparian vegetation and scattered wetlands in the streambed.

4.2 GROUND WATER

The site observational work plan describes the most probable ground water conditions at the Spook site. The assessment of the interaction of site-related constituents with the environmental setting, constituent release mechanisms, contaminant fate and transport, and potential risks to human health and the environment was based on this description. The proposed action was based on this assessment.

Detailed information on ground water at the Spook site also is available in the UMTRA Surface Project remedial action plan. Site characterization is based on data collected through 1988. These data fulfilled the requirements to adequately characterize the site in the surface remedial action plan. The NRC concurred with the surface remedial action compliance decision to apply supplemental standards for ground water protection based on the limited use of ground water (DOE, 1990). The NRC, DOE, and the state also agreed that no further ground water monitoring would be conducted.

4.2.1 Hydrogeologic setting

Ground water beneath the Spook site occurs in the upper and lower sandstone units of the Tertiary Wasatch Formation under unconfined and confined conditions, respectively (Figure 4.1). Depths to the water table in the upper sandstone unit (uppermost aquifer) range from 40 to 120 ft (12 to 37 m) below ground surface, with a saturated thickness of approximately 20 ft (6 m). The upper and lower sandstone units are separated by an aquitard consisting of a thick, laterally extensive silty-shale unit (middle shale unit). There is no apparent

Map Location

Uranium Mineralization Trend

Potentiometric Surface

hydraulic interconnection between the two sandstone units. Ground water in the upper sandstone unit near the site is recharged by infiltration of precipitation and seepage from intermittent streams. During uranium milling operations in the 1960s, ground water also was recharged by the release of processing solutions. Field observations and interviews with local ranchers indicate no evidence of ground water discharge from the upper sandstone unit to the surface or to surface water near the site (DOE, 1990). Ground water in the upper sandstone unit flows predominantly northeast, under an average horizontal hydraulic gradient of 0.005. The average transmissivity of the upper sandstone unit is 225 square feet per day (2.42 square centimeters [cm] per second) and the average hydraulic conductivity is 15 ft per day (5.3×10^{-3} cm per second). The average linear ground water velocity in the upper sandstone unit is 0.4 ft per day (1.3×10^{-4} cm per second), based on the above hydraulic conductivity, an average hydraulic gradient of 0.005, and an estimated effective porosity of 0.2 (DOE, 1995).

4.2.2 Ground water quality

Background ground water quality in the site vicinity is affected by the uranium mineralization trend associated with an alteration front in the upper sandstone unit (Figure 4.1). Widespread, ambient concentrations of uranium and selenium in ground water in the altered sandstone beneath and downgradient from the site exceed the EPA maximum concentration limits of 0.044 and 0.01 milligrams per liter (mg/L) (Table 4.1) (DOE, 1995). The ground water in the upper sandstone unit (uppermost aquifer) is limited use (as drinking water) due to widespread, ambient contamination that cannot be cleaned up using treatment methods reasonably employed in public water systems (40 CFR §192.11(e); DOE, 1990; 1995). This contamination is not due to activities involving residual radioactive materials from a designated processing site. Background ground water quality was determined by assessing regional ground water conditions within the altered upper sandstone unit and conditions in downgradient monitor wells that are not impacted by uranium processing activities (Table 4.1) (DOE, 1995).

The extent of site-related ground water contamination was determined by evaluating nitrate concentrations (a component of nitric acid used in uranium processing). Nitrate concentrations in ground water in excess of 13 mg/L delineate the contaminated area that consists of a plume extending approximately 2500 ft (800 m) downgradient from the site (Figure 4.1). Comparisons of background and plume ground water quality data in the upper sandstone unit indicate that concentrations of several constituents in the plume (chromium, nitrate, selenium, uranium, and radium-226 and -228) exceed background and are above maximum concentration limits (Table 4.1). The depth of contamination is restricted to the upper sandstone unit, which is underlain by a continuous shale aquitard (the middle shale unit). Ground water in the lower sandstone unit is not contaminated as a result of uranium processing operations at this site is due to the demonstrated lack of hydraulic interconnection with the upper sandstone unit.

Table 4.1 Ground water quality in the upper sandstone unit near the Spook, Wyoming, site

Constituent	Ground water contaminated ^a (median)	Background ^b (median)	MCL	Aquatic life criteria ^c		Terrestrial plant benchmarks ^d	Terrestrial wildlife benchmarks ^e	Irrigation water guideline ^f	Livestock water guideline ^f
				Acute	Chronic				
Ammonium	98	<0.1	—	—	—	—	—	—	—
Antimony	0.02	<0.003	—	—	—	—	0.462	—	—
Arsenic	0.012	<0.01	0.05	0.36	0.19	0.001	0.465	0.1	0.2
Barium	<0.06	<0.10	1.0	—	—	—	45.2	—	—
Chromium	0.15	0.06	0.05	0.016	0.011	0.05	27.3	0.1	0.05
Manganese	15	0.02	—	—	1.0	4	731	0.2	—
Molybdenum	0.07	0.01	0.10	—	—	0.5	—	—	—
Nitrate (as NO ₃)	350	4.0	44	—	—	—	5665	—	—
Radon-226, -228 (pCi/L)	44	2.2	5.0	—	—	—	—	5	5
Selenium	0.96	0.39	0.01	—	—	0.7	0.28	0.02	0.05
Silver	0.03	0.01	0.05	—	—	0.1	—	—	—
Sulfate	2940	159	—	—	—	—	—	200	3000
Total dissolved solids	4970	500	—	—	—	—	—	2000	5000
Uranium	0.80	2.0	0.044	—	—	40	11.08	5.0	5.0

^aBased on data from DOE monitor wells SPK-01-0920, -0930, -0935, and -0940 (see Figure 4.1 for well locations).

^bBased on data from DOE monitor wells SPK-01-0918, -0925, -0931, -0943, and -0944 (see Figure 4.1 for well locations).

^cFrom WDEQ, 1990.

^dFrom Opresko et al., 1994; benchmarks for white-footed mouse.

^eFrom Will and Suter, 1994.

^fFrom WDEQ, 1993.

Notes: 1. All data in milligrams per liter except as noted.

2. Median represents 50th percentile of the pooled data from the wells in each category.

Dash indicates value is not available.

4.3 BIOLOGICAL COMMUNITIES

The climate in the area of the Spook site is semiarid and cool with moderate humidity, abundant sunshine, and large daily and seasonal temperature ranges. The maximum summer air temperature is generally 70 to 80 degrees Fahrenheit (°F) (21 to 27 degrees Celsius [°C]) while the winter minimum is typically 7 to 11 °F (-14 to -12 °C). The average annual precipitation (measured in Casper, Wyoming) is about 11 inches (28 cm). The Spook site is an area of flat to rolling topography, between 5030 and 5160 ft (1530 and 1570 m) above mean sea level. Predominant vegetation in the area is sagebrush with grass ground cover. Stands of large cottonwoods occur in the nearby Dry Fork of the Cheyenne River, which is the water body nearest the site. Typically, Dry Fork has extended periods with no flowing surface water. During field observations in August 1986, most of the riverbed was dry. Grass, the dominant ground cover, was being mowed for hay. Occasional pools and wet depressions were noted and cattails, soft stemmed bulrush, wild mint, and sedges were common in these areas (TAC, 1986). This vegetation indicates that even during dry periods, water in the shallow alluvium of the Dry Fork is relatively close to the surface, if not expressing onto the surface (DOE, 1995).

Before surface remedial action, standing water occurred temporarily in the bottom of the Spook pit and in ponds west and south of the pit. A few cottonwoods in the bottom of the pit and near the temporary ponds used these water sources. After surface remediation was completed, the Spook pit was filled and the temporary ponds were excavated, filled, and recontoured. The cottonwoods that were near the former acid pond were still alive in 1994 and they may be accessing water from the drainage that leads into the pond.

4.4 LAND USE

The Spook site is in a remote area, far from any large population centers. The nearest residence is 1.4 mi (2.3 km) southwest of the Spook site. Approximately 10 residents live within a 3-mi (5-km)-radius of the site. The Converse County Planning Commissioner and local ranchers have indicated the large ranches near the site have been owned and operated by successive generations of the families currently in residence; this pattern is expected to continue. Thus, the current population density is very low and likely will remain very low in the future (DOE, 1990).

As agent for the United States of America, the state of Wyoming acquired title to a 13.5-acre (5.5-hectare)-area containing the disposal cell. DOE controls the subsurface mineral rights below the site. The land near the site, including the land overlying the ground water plume, is privately owned by two individuals who raise sheep and cattle. Consistent with ranching, this area contains numerous stock watering ponds. The water source for all ponds investigated was determined to be surface runoff or aquifers below the upper sandstone unit (DOE, 1989). Some hay production takes place along Dry Fork. Uranium mining

occurred extensively in this area, which also experienced some oil and gas development.

5.0 ENVIRONMENTAL IMPACTS

EPA regulations require that supplemental standards protect human health and the environment and that if the ground water is limited use, current and reasonably projected uses of the affected ground water must be preserved (40 CFR §192.22(d)). This section focuses on determining if the proposed action would be protective of human health and environment, and whether there are current and reasonably projected uses of the affected ground water.

5.1 IMPACTS FROM THE PROPOSED ACTION

5.1.1 Human health

A screening level human risk analysis was performed using background ground water quality data from the altered upper sandstone unit (DOE, 1995). This analysis determined there are no known current exposure pathways for ground water from the upper sandstone unit near the Spook site because the ground water is not used as a drinking water source or for any other beneficial purposes. Local ranchers do not use ground water from the upper sandstone unit for drinking water because of its poor quality; they use good quality ground water that is readily available from deeper confined aquifers in the area. Historical and projected land uses for this area indicate population and ranching activities will not increase to the extent that additional ground water resources would be required.

Livestock watering and irrigation could produce a secondary exposure pathway to humans. As the Spook ground water plume disperses areally, it will contaminate previously uncontaminated (though naturally poor-quality) ground water. To determine if the contaminated ground water plume would affect potential future uses of uncontaminated portions of the upper sandstone unit, such as using the water for human use or livestock watering or irrigation, the ground water quality was compared to state of Wyoming guidelines (Table 4.1). Using either the contaminated or uncontaminated but naturally poor quality ground water could be detrimental to livestock; both types would not be suitable for irrigation. The contaminated ground water exceeds the livestock watering guidelines for chromium, selenium, and radium-226 and -228. The background ground water in the altered sandstone, though less contaminated, exceeds the livestock watering guideline for selenium by 8 times.

Because there are no current or foreseeable future exposure pathways to ground water in the uppermost aquifer near the Spook site, this ground water does not threaten human health. Therefore, no impacts to human health are expected from the contaminated ground water in the uppermost aquifer, if the proposed action is implemented.

5.1.2 Surface water

Field observations in the area of the Spook site indicate that ground water from the upper sandstone unit has not discharged to the surface (DOE, 1995). Ground water in the upper sandstone unit is more than 100 ft (30 m) deep in the site area, which prevents the ground water from surfacing (DOE, 1995). Some of the contaminated ground water flows toward the Dry Fork of the Cheyenne River. The depth of ground water in the upper sandstone unit beneath the Dry Fork has not been determined, but the Spook site observational work plan indicates that depth to water in this unit could be as little as 25 ft (7.6 m) below the river alluvium (DOE, 1995). Given that ground water in the upper sandstone unit is unconfined and there is no upward hydraulic gradient, water in the shallow alluvium of the Dry Fork likely recharges the upper sandstone unit. At present, there is no evidence that ground water from the upper sandstone unit is discharging into Dry Fork.

One surface water sample was collected from the Dry Fork near the ranch more than 1 mi (1.6 km) southwest of the site. No constituents in this water exceeded the EPA maximum concentration limits. However, this sample is of limited value because it was taken outside the alteration zone. Surface water samples were not collected from Dry Fork inside the alteration zone. As indicated above, ground water from the upper sandstone unit does not discharge into the Dry Fork.

5.1.3 Ground water

The impact of the proposed action to ground water in the upper aquifer would be to further degrade the naturally occurring poor ground water quality as the plume moves from the site. Ground water in other deeper aquifers would not be affected.

5.1.4 Biological communities

If contaminated ground water were to affect the biological communities at or near the Spook site, it would be through surface expression or through plant root uptake. There is no evidence that contaminated ground water in the upper sandstone unit is discharging into the environment in the area of the Spook site. Ground water from the upper sandstone unit is not discharging into the Dry Fork of the Cheyenne River, because the projected depth to ground water is below the base of the shallow alluvium in Dry Fork.

Because ground water is about 100 ft (30 m) below land surface in the site area, plants growing around the site have not sent roots into the ground water. A small group of cottonwoods grows in the area of the former acid pond. This pond and the associated contaminated soil were cleaned up during surface remediation in 1989, but these trees were still alive in 1994. The cottonwoods are obtaining underground water because they cannot survive on the annual precipitation alone. The depth to ground water in the upper sandstone unit in

this area is much deeper than the rooting depth of this species. These trees likely rooted in an area of localized alluvial ground water that may be associated with the ephemeral drainage area (Dry Fork). There is no evidence that this water is contaminated from processing site activities.

Because there is no known surface expression of ground water and no plant uptake of contaminated ground water, there are no impacts to threatened and endangered species, sensitive habitats, or any other ecological resource. However, using ground water from the plume or from the altered background water to create a wildlife habitat such as ponds or wetlands would not be advisable because ground water concentrations of both selenium and silver exceed the aquatic life criteria (Table 4.1). Concentrations in the contaminated and in the altered background ground water exceed the acute criteria for selenium by 48 and 20 times, respectively, and the acute silver criteria by 7 and 2 times, respectively. In addition, these concentrations would be highly toxic to wildlife. For example, a study at a national wildlife refuge in California showed that selenium entering this refuge at much lower concentrations (0.122 mg/L) than occur in the upper sandstone unit at the Spook site resulted in almost complete reproductive failure and mortality in marsh birds (Ohlendorf, 1989).

5.1.5 Land use

The proposed action would not result in adverse impacts to land use in the area of the Spook site because ground water monitoring would not be conducted, institutional controls would not be used, and no known uses of water from the upper sandstone unit need modification.

5.2 IMPACTS OF NO ACTION

The DOE previously characterized the Spook site and monitoring data were collected during the surface remediation. No additional ground water data would be collected for the Spook site. Under both the proposed action and the no action alternatives, remediation activities would not take place at or near the site. Therefore, the impacts to human health, surface water, ground water, biological communities, and land use would be the same under the no action alternative as under the proposed action.

Under the no action alternative, however, certain legal requirements would not be met. These requirements include NRC concurrence on the adequacy and protectiveness of DOE actions, and public, state and NRC review of/participation in DOE's decision. If DOE would not be in compliance with these requirements, DOE may face legal challenges that could divert DOE from other activities.

6.0 LIST OF PREPARES AND AGENCIES CONSULTED

The following individuals contributed to the preparation of this report.

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- 40 CFR Part 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings*, U.S. Environmental Protection Agency.

UNITED STATES CODE

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