

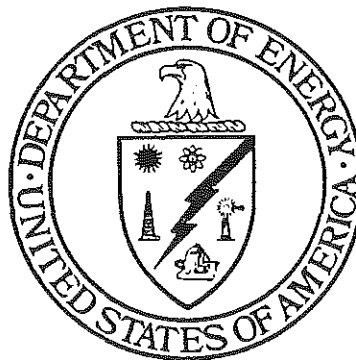
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United States Department of Energy



**Final
Environmental Impact Statement**

**REMEDIAL ACTIONS AT THE FORMER
UNION CARBIDE CORPORATION
URANIUM MILL SITES
RIFLE, GARFIELD COUNTY,
COLORADO**



VOLUME I: TEXT

MARCH 1990

U.S. DEPARTMENT OF ENERGY

Uranium Mill Tailings Remedial Action Project



Remedial Actions at the Former
Union Carbide Corporation Uranium Mill Sites
Rifle, Garfield County, Colorado

Final

March 1990

U.S. Department of Energy
UMTRA Project Office
Albuquerque Operations Office
Albuquerque, New Mexico



COVER SHEET

Final Environmental Impact Statement
Remedial Actions at the
Former Union Carbide Corporation Uranium Mill Sites
Rifle, Garfield County, Colorado

- (a) Lead agency: U.S. Department of Energy (DOE)
Cooperating Agency: Bureau of Land Management
- (b) Proposed action: Cleanup of the contaminated materials at the mill sites and associated vicinity properties at Rifle, Colorado, designated by the Uranium Mill Tailings Radiation Control Act of 1978.
- (c) For further information, contact (1) Mark Matthews, Acting Project Manager, Uranium Mill Tailings Remedial Action Project, U.S. Department of Energy, Albuquerque Operations Office, 5301 Central Avenue, N.E., Suite 1720, Albuquerque, New Mexico, 87108, phone: (505) 845-4023; (2) Carol Borgstrom, Office of NEPA Project Assistance, U.S. Department of Energy, Office of the Assistant Secretary for Environment, Safety and Health, Room 3E-080, Forrestal Building, 1000 Independence Avenue, S.W., Washington, D.C., 20585, phone: (202) 586-4600; or (3) William Dennison, Acting Assistant General Counsel for Environment, U.S. Department of Energy, Room 6D-033, Forrestal Building, 1000 Independence Avenue, S.W., Washington, D. C., 20585, phone: (202) 586-6947.
- (d) Designation: Final Environmental Impact Statement (FEIS)
- (e) Abstract: This statement evaluates and compares the environmental impacts associated with the remedial actions for the residual radioactive materials remaining at the inactive uranium processing sites at Rifle, Garfield County, Colorado. The Rifle sites consist of the separate Old and New Rifle tailings sites, which cover 164 acres of private land and contain approximately 4,135,000 cubic yards of tailings and associated contaminated soils. The tailings were produced by the Union Carbide Corporation when it processed vanadium and uranium ores from 1924 to 1932 and from 1942 to 1973. The U.S. Atomic Energy Commission purchased uranium from the sites from 1949 to 1971; additional uranium and all of the vanadium were sold to commercial buyers.

This statement evaluates interim actions at both processing sites for all four alternatives and three action alternatives for the stabilization and disposal of the tailings and other contaminated materials:

Alternative 1: No remedial action.

Alternative 2: Stabilization at the New Rifle site.

Alternative 3: Disposal at the Estes Gulch site.

Alternative 4: Disposal at the Lucas Mesa site.

Alternative 3 is the DOE's preferred alternative.

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GLOSSARY

ABBREVIATIONS AND ACRONYMS

PREPARERS OF THIS STATEMENT

AGENCIES AND PERSONS CONSULTED DURING THE PREPARATION
OF THIS STATEMENT

AGENCIES, ORGANIZATIONS, AND PERSONS RECEIVING COPIES
OF THIS STATEMENT

INDEX

Appendices C and H through K were printed in the DEIS. As no substantive changes were made to these Appendices in response to public comments or design modifications, they are incorporated by reference only in this FEIS. Section 6.14 contains an Errata Sheet that reflects modifications to these Appendices.

Appendix A, Conceptual Designs

Appendix B, Alternatives Analyses

Appendix D, Soils, Geology, and Seismicity

Appendix E, Hydrology

Appendix F, Floodplain and Wetlands Assessment

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1.0 SUMMARY

1.1 BACKGROUND

The Rifle Uranium Mill Tailings Remedial Action (UMTRA) Project sites consist of two separate tailings sites adjacent to the city of Rifle in Garfield County, Colorado (Figures 1.1 and 1.2). The eastern site is known as Old Rifle and is approximately 0.3 mile from the center of Rifle. The western site, known as New Rifle, is approximately two miles from the center of Rifle. The Colorado River is immediately south of both sites.

The uranium mill at the Old Rifle site was owned and operated by the Union Carbide Corporation (Union Carbide) from 1924 to 1932 and from 1942 to 1958. From 1932 to 1942, the mill was idle for economic reasons. The mill produced vanadium during both operating periods and uranium during the latter period. After 1958, most of the Old Rifle tailings were reprocessed at the New Rifle site.

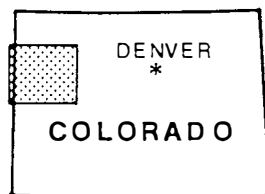
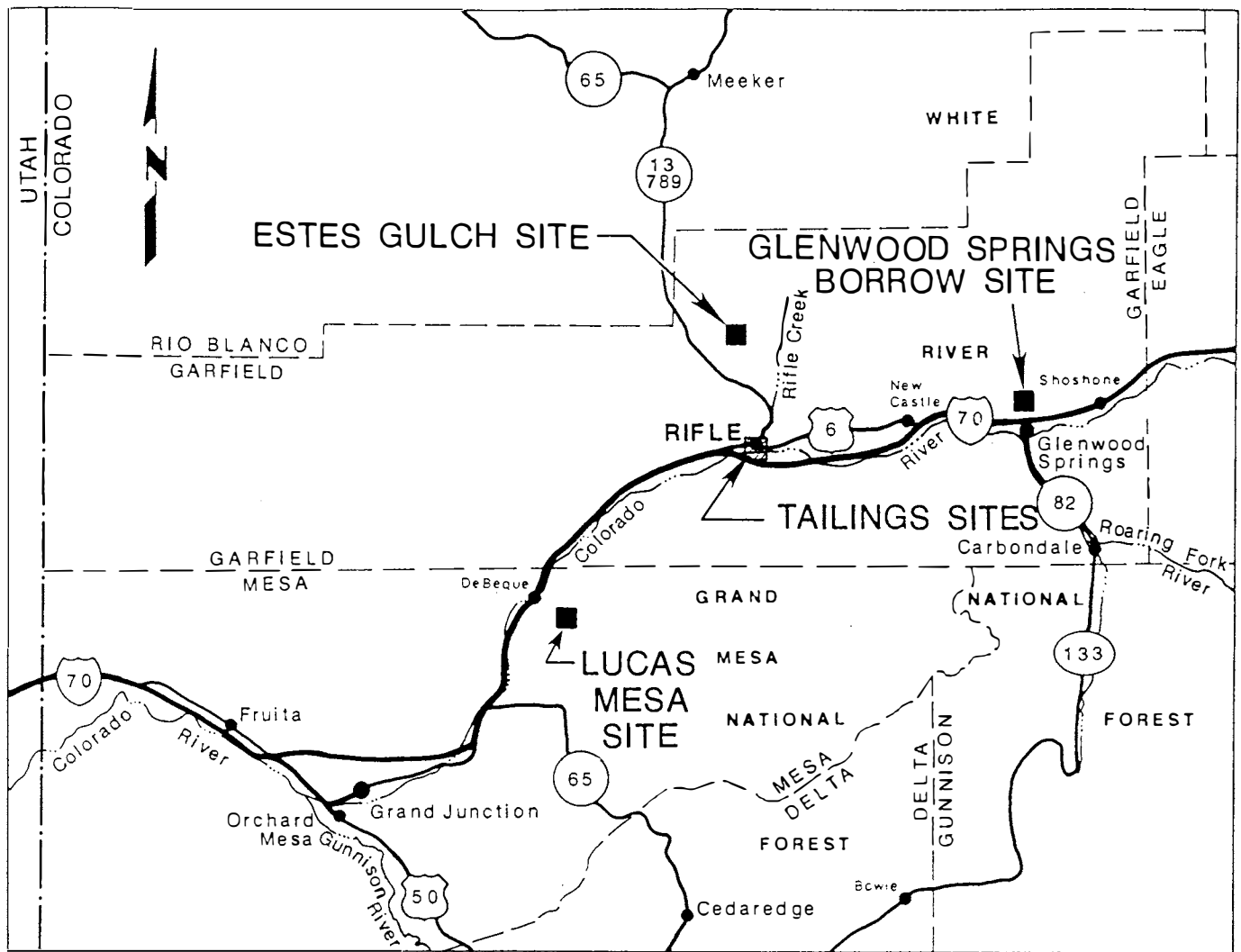
The New Rifle mill replaced the Old Rifle mill in 1958 and it was also owned and operated by Union Carbide. From 1958 to 1973, the mill produced uranium and vanadium. From 1973 to 1984, a portion of the mill was used to produce vanadium; this operation involved processing vanadium solutions and did not yield tailings.

The 22-acre Old Rifle tailings site consists of the 13-acre tailings pile and nine-acre mill area. The only structures remaining at the mill site are the assay building and the foundations of other mill facilities. Fifty-three acres adjacent to the tailings site are contaminated with windblown tailings and debris. The total amount of contaminated materials at the Old Rifle site, including contaminated soils beneath the tailings, is estimated to be approximately 661,000 cubic yards. Seepage from the tailings pile has contaminated groundwater in the alluvium and Wasatch Formation.

The New Rifle tailings site occupies 142 acres. The tailings pile covers 33 acres, and the mill area covers 59 acres. The entire New Rifle site is contaminated, and a 63-acre area adjacent to the tailings site has been contaminated with windblown tailings. The total amount of contaminated materials at the New Rifle site, including contaminated soils beneath the tailings, is estimated to be approximately 3,474,000 cubic yards. Seepage from the tailings pile has contaminated groundwater in the alluvium and Wasatch Formation.

Both the Old and New Rifle tailings piles have been partially stabilized. The Old Rifle pile was recontoured, covered with six inches of soil, and revegetated. The New Rifle pile was covered with fertilizer and mulch and revegetated.

Approximately 102 potential vicinity properties have been found in the Rifle area. These vicinity properties are residences, businesses, or open lands that may have been contaminated by the use of tailings as a sand substitute in building materials or as fill material before the hazards associated with the tailings were known.



APPROXIMATE LOCATION OF MAP

FIGURE 1.1
RIFLE SITES LOCATION

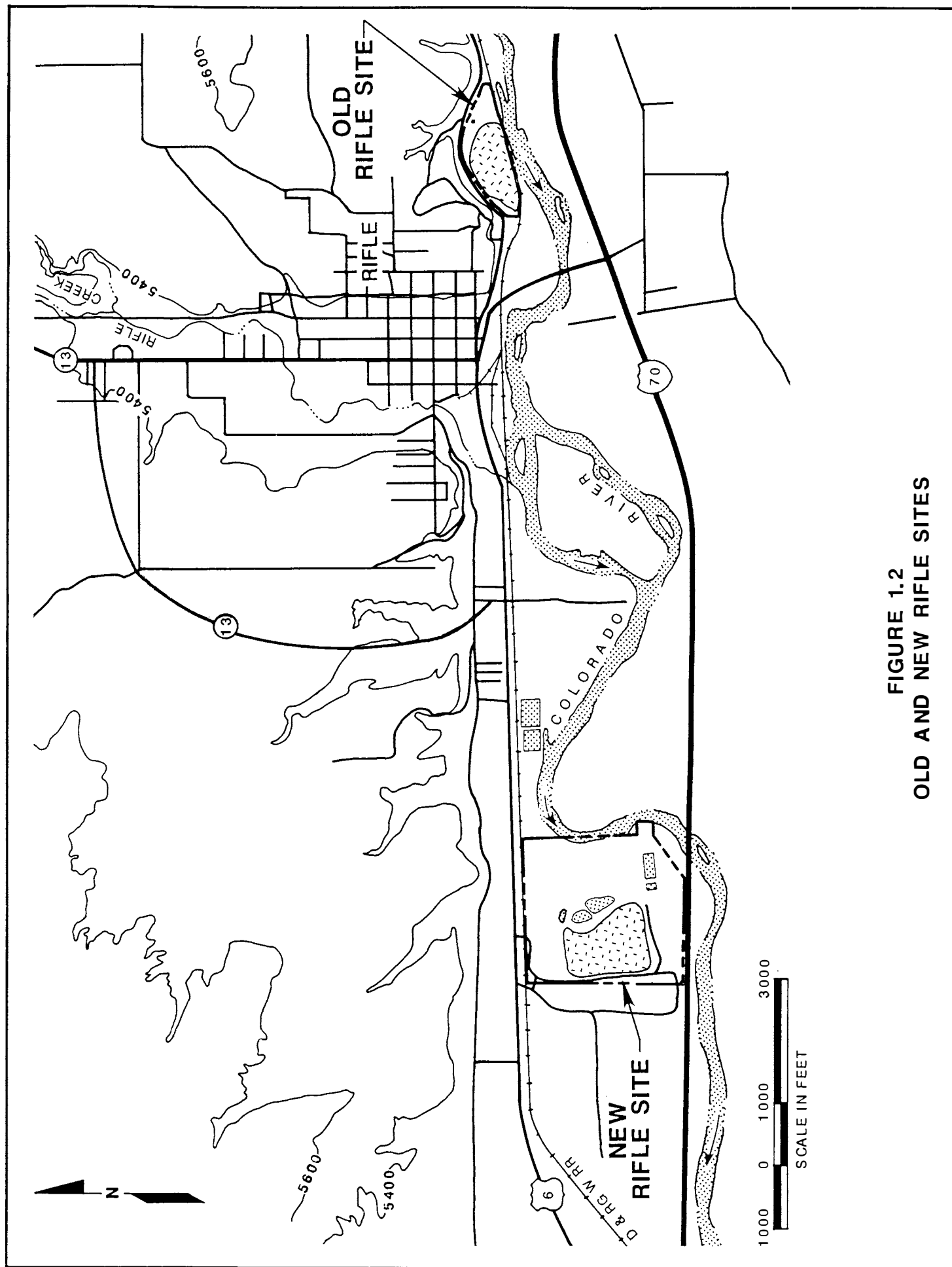


FIGURE 1.2
OLD AND NEW RIFLE SITES

The principal hazard associated with the tailings results from the production of radon, a radioactive decay product of radium contained in the tailings. Radon, a radioactive gas, can diffuse through the tailings and be released into the atmosphere where it and its radioactive decay products may be inhaled. If the concentration of radon and its decay products is high enough and the exposure time long enough, health effects (i.e., cancers) may develop in persons living and working near the tailings. If the tailings are not properly stabilized, erosion or human removal of the contaminated materials could spread the contamination over a much wider area and increase the potential public health impacts.

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), Public Law 95-604, authorizes the U.S. Department of Energy (DOE) to perform remedial action at the Rifle tailings sites (as well as at many other sites) to reduce the potential public health impacts from the residual radioactivity remaining in the tailings. The U.S. Environmental Protection Agency (EPA) promulgated standards (40 CFR 192) for this remedial action. The U.S. Nuclear Regulatory Commission (NRC) will concur in the selection of a remedial action alternative and will issue a license for the long-term surveillance and maintenance of the final disposal site.

1.2 DESCRIPTION OF ALTERNATIVES

The alternatives addressed in this environmental impact statement (EIS) include taking no action toward remedial action, stabilizing the Old and New Rifle tailings at the New Rifle site, and relocating the Old and New Rifle tailings away from Rifle to one of the two alternative disposal sites (Estes Gulch or Lucas Mesa). All of the action alternatives include remedial action at the vicinity properties.

All of the alternatives, including the no action alternative, consider the completion of interim action activities at the Old and New Rifle processing sites. After the state of Colorado acquired title to the Rifle processing sites in 1988, the DOE approved the initiation of interim actions. These interim actions, which began in August 1988 and will extend until August 1989, were initiated to remediate the existing health and safety hazards to the Rifle community that are present at the processing sites.

The interim actions include activities such as the establishment of temporary and construction facilities; the removal of asbestos, other chemicals, and materials; the demolition of unstable and unsafe mill structures; and improving site security. The costs associated with these actions are estimated to be \$5,710,000.

When the state acquired the processing sites in 1988, the mill structures were structurally unsafe and they contained asbestos; a variety of oils, gasses, solvents, chemicals and cleaners, often in unmarked containers or in unsecured areas, were present on the New Rifle site, and neither of the sites were guarded or considered physically secured. The conditions of the site presented a constant hazard to the groundskeeping crew, as well as any local residents who might easily gain unauthorized access to the sites.

In addition, both sites' proximity to the Colorado River, coupled with the chemicals and substances present on the site, could result in the potential for additional pollution of the river or local groundwater, noncompliance with applicable water pollution regulations, and a public health hazard.

Because of the unsafe conditions at both processing sites and potential liability issues, the DOE approved the initiation of the interim actions in July 1988. Performance of the interim actions was determined to be necessary for purposes of health, safety, and the removal of potential sources of ground and surface water contamination, independent of the selection of either an action alternative or the no action alternative.

While these activities may be considered part of the type of site preparation work that could proceed prior to remedial action, no uranium mill tailings piles will be disturbed as a result of this activity, no contaminated materials will leave the sites prior to the issuance of a Record of Decision, and these activities will in no way jeopardize or influence the National Environmental Policy Act (NEPA) process. Performance of the interim actions was determined to be necessary independent of the selection of any alternative.

All of the alternatives, remedial action and no action, include the performance of interim actions for the remediation of existing health and safety hazards at both processing sites. Discussions on the no action alternative have been modified to reflect incorporation of the interim actions. Discussions and analysis on the three remedial action alternatives already incorporate those activities and impacts related to the interim actions.

Therefore, the following alternatives are addressed in this EIS:

Alternative 1: No action.

Alternative 2: Stabilization at the New Rifle site.

Alternative 3: Disposal at the Estes Gulch site.

Alternative 4: Disposal at the Lucas Mesa site.

The Estes Gulch alternate disposal site is approximately six miles north of Rifle in Garfield County, and the Lucas Mesa alternate disposal site is approximately 35 miles southwest of Rifle in Mesa County. Figure 1.1 shows the locations of the tailings sites, the three potential disposal sites, and the borrow sites. A description of each alternative is provided below.

Alternative 1: No action

This alternative consists of taking no steps toward remedial action at the tailings sites. The tailings piles and vicinity properties would remain in their present locations and conditions and would be subject to dispersion by wind and water erosion and unauthorized removal by humans.

However, this alternative does consider the completion of interim action activities at the Old and New Rifle processing sites by August 1989 to remediate existing safety hazards to the Rifle community. The interim actions include such activities as removal of asbestos and other chemicals and materials; demolition of unstable and unsafe mill structures; improving site security, and the establishment of temporary and construction facilities. Vanadium-contaminated materials would be transferred to a vanadium refining facility for reprocessing; all other chemicals, acids, and materials would be transferred to a licensed disposal site. The selection of this alternative would not be consistent with the intent of Congress in the UMTRCA (PL95-604) and would not result in the site's compliance with the EPA standards (40 CFR 192).

Alternative 2: Stabilization at the New Rifle site

This alternative would involve stabilizing all of the tailings, asbestos, non-hazardous wastes, and contaminated materials at the New Rifle site. The Old Rifle tailings and contaminated materials would be excavated, trucked to the New Rifle site, and consolidated with the New Rifle tailings, contaminated materials, asbestos, and non-hazardous wastes to form one tailings pile. Vanadium-contaminated materials would be transferred to a vanadium refining facility for reprocessing; all other chemicals and hazardous materials would be packaged and transferred to a licensed disposal site. The tailings and contaminated materials would then be covered with an earthen radon barrier, a frost protection and drain layer, and a rock erosion protection barrier. A below-grade rock apron would be constructed around the base of the entire stabilized tailings pile to protect against the erosional forces of flooding in the Colorado River. Drainage diversion ditches would be constructed on the north, east, and south sides of the pile to divert surface water runoff around and away from the pile. All areas not occupied by the stabilized tailings pile and associated erosion protection features would be restored with clean fill material and graded to promote positive drainage. This acreage would also be revegetated, including the creation of wetlands to replace those cleared during remedial action.

During steady state conditions, the disposal cell at the New Rifle site would comply with Subparts A and C of 40 CFR 192, the proposed EPA groundwater protection standards, and the disposal cell would meet all concentration limits at the point of compliance (POC) in the uppermost aquifer. This steady state compliance is based on an assessment of the hydrogeologic characteristics of the site, design analysis of the disposal cell, and performance assessment of the disposal site. The cell components would function as an integrated system to limit vertical seepage through the pile, with the infiltration barrier restricting steady state vertical seepage through the tailings to 10^{-9} centimeters

per second (cm/s). However, transient drainage and the potential for periodic inundation of the disposal cell by the Colorado River could cause potential exceedance of standards. In the event that compliance with the proposed standards cannot be achieved with the proposed design, design modifications or alternate concentration limits would be considered to ensure compliance.

Alternative 3: Disposal at the Estes Gulch site--the preferred alternative

This alternative would involve relocating the Old and New Rifle tailings, contaminated materials, asbestos, and wastes to the Estes Gulch site approximately six miles north of the city of Rifle. An access road would be constructed from State Highway 13 to the Estes Gulch site, and a disposal area averaging 20 feet in depth would be excavated at the site. All of the tailings, contaminated materials, asbestos, and non-hazardous wastes would be trucked to the Estes Gulch site and placed in the disposal area. Vanadium-contaminated materials would be transferred to a vanadium refining facility for reprocessing; all other chemicals and hazardous materials would be packaged and transferred to a licensed disposal site. The tailings and contaminated materials would then be covered with an earthen radon barrier, a frost protection and drain layer, and a rock erosion protection barrier. The top surface of the pile would be nearly flush with the east and west ridges and with the existing terrain slope. The terrain adjacent to the embankment would be graded to promote sheet flow and rock-filled key trenches would be provided along the embankment and existing terrain interface. A rock-lined toe ditch would be constructed along the south end of the pile to collect surface water runoff and divert it westward toward Government Creek. The upland drainage area to the north would be graded, riprap would be added, and an interceptor ditch would be built to divert runoff away from the pile. After the removal of the tailings and contaminated materials, the Old and New Rifle sites would be restored with clean fill material to promote positive drainage. These areas, along with disturbed areas adjacent to the Estes Gulch disposal site, would be revegetated. This would also include the creation of wetlands to replace wetlands cleared at the Old and New Rifle sites.

The disposal cell at the Estes Gulch site would comply with Subparts A and C of 40 CFR 192, the proposed EPA groundwater protection standards, and would meet all concentration limits at the POC in the uppermost aquifer. This is based on an assessment of the hydrogeologic characteristics of the site, design analysis of the disposal cell, and performance assessment of the disposal site. The cell components would function as an integrated system to limit vertical seepage through the pile, with the radon barrier restricting steady state vertical seepage through the tailings to 10^{-8} cm/s. The cell would comply with the proposed EPA groundwater protection standards because the average linear groundwater velocity in the Wasatch Formation is less than 0.1 foot per year (ft/yr); therefore, contaminated groundwater would travel less than 100 feet in 1000 years, which is the distance to the POC and the design life of the disposal cell.

Alternative 4: Disposal at the Lucas Mesa site

This alternative would involve relocating the Old and New Rifle tailings, contaminated materials, asbestos, and wastes to the Lucas Mesa site approximately 35 miles southwest of Rifle. Vanadium-contaminated materials would be transferred to a vanadium refining facility for re-processing; all other chemicals and hazardous materials would be transferred to a licensed disposal site. An access road would be constructed to the Lucas Mesa site, and a disposal area averaging 15 feet in depth would be excavated at the site. All of the tailings, contaminated materials, asbestos, and non-hazardous wastes would be trucked to the Lucas Mesa site, placed in the disposal area, and covered with a radon barrier and a rock erosion protection barrier. A large, below-grade rock apron would be constructed along the northwest base of the stabilized tailings pile, and rock-lined drainage diversion ditches would be constructed on the northeast, southeast, and southwest sides of the pile to divert surface water runoff around and away from the pile. After the removal of the tailings and contaminated materials, the Old and New Rifle sites would be restored with clean fill material to promote positive drainage. These areas, along with the disturbed areas adjacent to the disposal site, would be revegetated. This would include the creation of wetlands to replace wetlands cleared at the Old and New Rifle sites.

The disposal cell at the Lucas Mesa site would comply with Subparts A and C of 40 CFR 192, the proposed EPA groundwater protection standards, and would meet all concentration limits at the POC in the uppermost aquifer. This is based on an assessment of the hydrogeologic characteristics of the site, design analysis of the disposal cell, and performance assessment of the disposal site. The cell components would function as an integrated system to limit vertical seepage through the pile, with the radon barrier restricting steady state vertical seepage through the tailings to 10^{-8} cm/s. The cell would comply with the proposed EPA groundwater protection standards because the average linear groundwater velocity in the Wasatch Formation is extremely low; therefore, contaminated groundwater should travel less than 100 feet in 1000 years, which is the distance to the POC and the design life of the disposal cell.

1.3 THE AFFECTED ENVIRONMENT

The Rifle tailings sites and the alternate disposal site are located in western Colorado (see Figure 1.1), in Garfield County. This area of Colorado is semiarid with approximately 12 inches of precipitation per year, which includes approximately 51 inches of snow. Temperatures above 100°F or below 0°F are infrequent, and sunny days usually predominate in all seasons. Winds are most frequently from the northeast and west with an average speed of approximately five miles per hour.

The region has well-developed railroad and highway systems. The Denver and Rio Grande Western Railroad and U.S. Highway 6 are immediately adjacent to the tailings sites, while Interstate 70 (I-70) passes to the south of the sites. U.S. Highway 6 and State Highway 13 provide access

to the Estes Gulch site, while U.S. Highway 6, I-70, and County Road V.5 provide access to the Lucas Mesa site.

The land around the Rifle tailings sites is used for livestock grazing and commercial and industrial purposes, but residential areas are also nearby. Both sites lie on unconsolidated alluvium of the Colorado River floodplain, which is underlain by claystones, siltstones, and sandstones of the Wasatch Formation. The alluvium contains groundwater, which can rise into the tailings piles during periods of high flow in the Colorado River.

The Estes Gulch site is approximately six miles north of Rifle on Federal land administered by the Bureau of Land Management (BLM). The terrain slopes gently upward to the north toward the Grand Hogback, and vegetation consists of a sparse cover of grasses and shrubs. The site is used primarily for low-density grazing; it is also subject to active oil and gas leases. The site is surrounded primarily by Federal land administered by the BLM, although there is some privately owned land south of the site. The nearest residences to the Estes Gulch site are 1.5 miles to the west along State Highway 13. The site lies on hard colluvium underlain by the Wasatch Formation. Major perennial surface drainages or near-surface groundwater are not present at the site.

The Lucas Mesa site is approximately 35 miles southwest of Rifle, near the town of DeBeque, on Federal land administered by the BLM. The site is on top of Lucas Mesa, which rises approximately 1000 feet above the surrounding terrain. The terrain at the site slopes gently downward to the northwest toward the Colorado River, and vegetation consists of juniper trees and sagebrush with a sparse understory of shrubs, forbs, and grasses. The site is used primarily for low-density grazing but is also subject to several active oil and gas leases. The site is surrounded by privately owned land, and the land along the Colorado River to the north is intensely farmed. The site lies on silty clay and basaltic rock that is underlain by the Wasatch Formation. Major perennial surface drainages or near-surface groundwater are not present at the site.

1.4 SUMMARY OF IMPACTS

The principal impacts of the no action alternative (which includes the interim actions at both processing sites) and each action alternative (which includes the interim actions) are summarized in Table 1.1. The impacts of remedial action at the vicinity properties were evaluated in a separate environmental report prepared by DOE (1985). The impacts of the interim action were considered with the impacts of each action alternative to arrive at the cumulative impacts considered in this EIS.

The impacts presented in this EIS are based on conservative assumptions and impact assessment procedures and thereby represent a realistic upper limit on the severity of the impacts that may occur. The actual

Table 1.1 Summary of impacts

Environmental component	Alternative 1: No remedial action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
Worker health	0.0042 fatal cancer	0.008 fatal cancer; 6.29 equipment-use injuries; 0.07 equipment-use fatality.	0.03 fatal cancer; 14.47 equipment-use injuries; 0.15 equipment-use fatality.	0.03 fatal cancer; 16.75 equipment-use injuries; 0.18 equipment-use fatality.
Public health ^a	One fatal cancer in 10 years and 100 fatal cancers in 1000 years.	0.02 fatal cancer in 10 years and two fatal cancers in 1000 years.	0.007 fatal cancer in 10 years and 0.7 fatal cancer in 1000 years.	0.005 fatal cancer in 10 years and 0.5 fatal cancer in 1000 years
Air quality ^b (non-radiological)	None.	Maximum average annual concentrations of total suspended particulates temporarily exceeding the Federal and state primary standard at the Old Rifle (76 micrograms per cubic meter) and New Rifle (364 micrograms per cubic meter) sites; no exceedences of Federal and state 24-hour standards along the transportation routes (64 micrograms per cubic meter maximum).	Maximum average annual concentrations of total suspended particulates temporarily exceeding the Federal and state primary standard at the New Rifle (88 micrograms per cubic meter) and Estes Gulch (283 micrograms per cubic meter) sites; no exceedences of Federal and state annual standards for concentrations of total suspended particulates at the Old Rifle site; maximum 24-hour concentrations of total suspended particulates temporarily exceeding the Federal and state secondary standard along the transportation routes (186 micrograms per cubic meter).	Maximum average annual concentrations of total suspended particulates temporarily exceeding the Federal and state primary standard at the Old Rifle (80 micrograms per cubic meter), New Rifle (96 micrograms per cubic meter), and Lucas Mesa (209 micrograms per cubic meter) sites; maximum 24-hour concentrations of total suspended particulates temporarily exceeding the Federal and state primary standard along the transportation routes (754 micrograms per cubic meter).
Soils ^c	Continuously increasing areas of contaminated soils due to wind and water erosion; temporary disturbance of 40 acres of soils.	Permanent loss of 330 acres (1,815,000 cy) of soils; temporary disturbance of 30 acres of soils; restoration of 142 acres of soils.	Permanent loss of 407 acres (2,131,000 cy) of soils; temporary disturbance of 40 acres of soils; restoration of 320 acres of soils.	Permanent loss of 421 acres (2,451,000 cy) of soils; temporary disturbance of 47 acres of soils; restoration of 327 acres of soils.

Table 1.1 Summary of impacts (Continued)

Environmental component	Alternative 1: No remedial action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
Mineral resources	Consumption of 50,319 cubic yards of earth and gravel.	Consumption of 1,700,500 cubic yards of earth, gravel, and rock.	Consumption of 2,130,700 cubic yards of earth, gravel, and rock.	Consumption of 2,509,400 cubic yards of earth, gravel, and rock.
Water resources	Possible contamination of surface runoff near the tailings piles; some contribution of groundwater contaminants to the Colorado River, but water quality impacts to the Colorado River would continue to be negligible. Tailings could be eroded into the river with runoff or flooding. Tailings seepage would continue to cause the proposed EPA groundwater standards to be exceeded in the alluvium and Wasatch Formation for an indefinite period of time as precipitation continues to infiltrate through the tailings.	No contamination of surface water near the tailings piles; no water quality impacts to the Colorado River. Elimination of tailings seepage to groundwater at the Old Rifle site and a reduction of seepage at the New Rifle site. Long-term reduction of contaminants in the alluvium at the Old and New Rifle sites. Conservative (geochemically nonreactive) species would flush to background concentrations or standards within ten years at the Old Rifle site and fifty years at the New Rifle site. Aquifer restoration could be required to restore groundwater quality if natural flushing (with proper institutional controls) proves to be insufficient for compliance with Subpart B of 40 CFR Part 192. The New Rifle alternative would comply with the proposed EPA groundwater protection standards. However, intermittent flooding of the Colorado River could cause groundwater to inundate the lower tailings, releasing contaminants. In the event compliance with the proposed EPA groundwater protection standards cannot be achieved with the proposed conceptual design, design modifications or alternate concentration limits (ACLs) would be considered for compliance.	No contamination of surface water near the tailings piles; no water quality impacts to the Colorado River. Elimination of tailings seepage to groundwater at both the Old and New Rifle sites. Long-term reduction of contaminants in the alluvium at the Old and New Rifle sites. Conservative (geochemically nonreactive) species would flush to background concentrations or standards within ten years at the Old Rifle site and fifty years at the New Rifle site. Aquifer restoration could be required in the alluvium beneath the processing sites to restore groundwater quality if natural flushing (with proper institutional controls) proves to be insufficient for compliance with Subpart B of 40 CFR Part 192. The Estes Gulch disposal alternative would comply with the proposed EPA groundwater protection standards, and the MCLs would be met at the POC. No long-term surface water quality impacts are predicted at Estes Gulch after remedial action.	No contamination of surface water near the tailings piles; no water quality impacts to the Colorado River. Elimination of tailings seepage to groundwater at both the Old and New Rifle sites. Long-term reduction of contaminants in the alluvium at the Old and New Rifle sites. Conservative (geochemically nonreactive) species would flush to background concentrations or standards within ten years at the Old Rifle site and fifty years at the New Rifle site. Aquifer restoration could be required in the alluvium beneath the processing sites to restore groundwater quality if natural flushing (with proper institutional controls) proves to be insufficient for compliance with Subpart B of 40 CFR Part 192. The Lucas Mesa disposal alternative would comply with the proposed EPA groundwater protection standards, and MCLs would be met at the POC. No long-term surface water quality impacts are predicted at Lucas Mesa after remedial action.

Table 1.1 Summary of impacts (Continued)

Environmental component	Alternative 1: No remedial action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
Water consumption	1,241,000 gallons	127,466,000 gallons.	284,262,000 gallons.	337,886,000 gallons.
Vegetation	Continuously increasing areas of contamination due to wind and water erosion; temporary disturbance of 1.6 acres of wetland vegetation and 38.4 acres of vegetation.	Permanent loss of 139 acres of vegetation; temporary disturbance of 21.1 acres of wetland vegetation.	Permanent loss of 145 acres of vegetation; temporary disturbance of 32 acres of vegetation including 21.1 acres of wetland vegetation.	Permanent loss of 162 acres of vegetation; temporary disturbance of 40 acres of vegetation including 21.1 acres of wetland vegetation.
Wildlife	Continuously increasing areas of contamination due to wind and water erosion; temporary disturbance of 1.6 acres of wetlands habitat and 38.4 acres of marginal wildlife habitat.	Permanent loss of 252 acres of wildlife habitat; temporary disturbance of 21.1 acres of wetlands habitat.	Permanent loss of 145 acres of wildlife habitat; temporary disturbance of 32 acres of wildlife habitat and 21.1 acres of wetlands habitat.	Permanent loss of 162 acres of wildlife habitat; temporary disturbance of 20 acres of wildlife habitat and 21.1 acres of wetlands habitat.
Threatened and endangered species	None.	None.	None.	None.
Land use	Continued restricted use of 164 acres at the Old Rifle and New Rifle sites.	Permanent restricted use of 142 acres at the New Rifle site; release of 22 acres at the Old Rifle site for other uses.	Permanent restricted use of 81 acres at the Estes Gulch site; release of 164 acres at the Old Rifle and New Rifle sites for other uses.	Permanent restricted use of 83 acres at the Lucas Mesa site; release of 164 acres at the Old Rifle and New Rifle sites for other uses.
Noise	Temporary daytime annoyance to residents in the vicinities of the Old Rifle (83 decibels maximum), New Rifle (76 decibels maximum), and borrow sites (82 decibels maximum) and along the transportation routes (80 decibels maximum).	Temporary daytime annoyance to residents in the vicinities of the Old Rifle (83 decibels maximum), New Rifle (76 decibels maximum), and borrow sites (82 decibels maximum) and along the transportation routes (80 decibels maximum).	Temporary daytime annoyance to residents in the vicinities of the Old Rifle (83 decibels maximum), New Rifle (79 decibels maximum), Estes Gulch (57 decibels maximum), and borrow sites (74 decibels maximum) and along the transportation routes (80 decibels maximum).	Temporary daytime annoyance to residents in the vicinities of the Old Rifle (83 decibels maximum), New Rifle (79 decibels maximum), Lucas Mesa (57 decibels maximum), and borrow sites (74 decibels maximum) and along the transportation routes (80 decibels maximum).

Table 1.1 Summary of impacts (Continued)

Environmental component	Alternative 1: No remedial action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
Aesthetic resources	None.	The stabilized tailings pile would average 47 feet above the surrounding terrain; visual annoyance but less than that which presently exists.	The stabilized tailings pile would be flush with the adjacent terrain and would generally conform with the surrounding terrain.	The stabilized tailings pile would average 36 feet above the surrounding terrain and would generally conform with the surrounding terrain.
Archaeological resources ^d	None.	None expected.	None expected.	None expected.
Historic resources ^d	None.	None expected.	None expected.	None expected.
Population	Increase of 39 people in Rifle and Garfield County.	Increase of approximately 39 people in Rifle and Garfield County during peak remedial action activities.	Increase of approximately 43 people in Rifle and Garfield County during peak remedial action activities.	Increase of approximately 43 people in Rifle and Garfield County during peak remedial action activities.
Employment	Average direct employment of 40 people over 12 months; peak direct employment of 69 people for one month; approximately 80 to 90 percent local labor.	Average direct employment of 95 people for 20 months; peak direct employment of 210 people for two months; approximately 80 percent local labor.	Average direct employment of 104 people for 42 months; peak direct employment of 139 people for 17 months; approximately 80 percent local labor.	Average direct employment of 120 people for 42 months; peak direct employment of 161 people for 16 months; approximately 80 percent local labor.
Community services	None.	None.	None.	None.
Transportation networks	None.	A maximum of 32 percent increase in average daily traffic on U.S. Highway 6 during peak remedial action activities; considerable congestion and maintenance for U.S. Highway 6.	Maximum increase of 68 percent traffic on State Highway 13 during peak remedial action activities; considerable congestion and maintenance for all highways used.	19 percent increase in average daily traffic on Interstate Highway 70 during peak remedial action activities.

Table 1.1 Summary of impacts (Concluded)

Environmental component	Alternative 1: No remedial action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
Energy resources	Consumption of 198,000 gallons of fuel and 145,000 kilowatt-hours of electricity.	Consumption of 1,439,000 gallons of fuel and 241,000 kilowatt-hours of electricity.	Consumption of 5,045,000 gallons of fuel and 1,041,000 kilowatt-hours of electricity.	Consumption of 6,077,000 gallons of fuel and 1,041,000 kilowatt-hours of electricity.
Traffic accidents	A total of 1.70 injuries and 0.02 fatality.	A total of 7.58 accident injuries; 0.11 accident fatality.	A total of 19.16 accident injuries; 0.35 accident fatality.	A total of 24.08 accident injuries; 0.51 traffic accident fatality.
Costs ^e (1988 dollars)	\$5,710,000	\$15,460,000.	\$28,921,000.	\$62,735,000.

^aThese estimates are based on a constant population. An increase in population would cause a greater increase in health impacts for no action or stabilization at the New Rifle site than for the other alternatives because the Estes Gulch and Lucas Mesa sites are in more remote locations. The health effects for the no action alternative were calculated assuming that the tailings would not be dispersed in the future by natural erosion or man because there is no way to accurately predict the level or rate of dispersion. Without remedial action, dispersion would occur over time, and the actual health effects for the no action alternative might be greater than those shown.

^bThe estimated maximum concentrations of total suspended particulates at the tailings, disposal, and borrow sites and along the transportation routes do not include the background concentrations of total suspended particulates at these locations. The analysis of air quality impacts was based on very conservative assumption that would tend to over-predict impacts. The DOE does not intend to knowingly violate air quality standards. Where air quality standards are projected to be exceeded, even under conservative scenarios, DOE and UMTRA Project policy and procedures dictate that air quality would be closely monitored. As an ongoing part of normal UMTRA Project construction practice, water or other chemical dust suppressants are used regularly to minimize fugitive dust emissions.

^cSoils that would be permanently lost are contaminated soils (e.g., beneath and adjacent to the tailings piles) that would be consolidated with the tailings; soils that would be used to cover the consolidated tailings and contaminated materials (i.e., radon barrier and frost protection layers); and soils that would be covered by access roads that would remain intact after remedial action.

^dThe previously disturbed, commercial borrow sites and disturbed existing ROW of State Highway 13 would not be expected to yield any cultural resources. Prior to surface disturbances, Class III cultural resource surveys of the borrow sites would be conducted to determine the existence of, and potential impacts on, cultural resources. Data collection programs would be implemented as required.

^eThese estimated costs do not include the costs of property acquisition; engineering design; overall project management including construction management and supervisory and field services; remedial action at vicinity properties; and long-term maintenance and surveillance. The remedial action costs also do not include \$5,710,000 for the interim action activities to remediate existing safety hazards at the Old and New Rifle processing sites, and the estimated costs related to access road improvements. Improvements to Highway 13 for the Estes Gulch alternative are estimated at \$466,000. Improvements to County Road V.5 for the Lucas Mesa alternative are estimated to range from an additional \$400,000 to \$500,000.

impacts that would occur would probably be less severe than those identified in this section and elsewhere. It should be noted that many of the impacts presented in this EIS (e.g., air quality and noise) are also based on continuous interim or remedial action schedules (i.e., interim or remedial action would be conducted throughout the year). In reality, inclement weather during the months of December, January, and February would probably cause construction activities to cease, and the associated impacts would likewise cease or decrease. It should also be noted that the borrow sites included in this EIS were selected as the sources of the necessary borrow materials for impacts analyses purposes. Although the Remedial Action Contractor will select the borrow sites to be used for the interim or remedial action during the final design, the impacts identified for the borrow sites included in this EIS are conservative and represent a realistic upper limit on the severity of the impacts that may occur. Section 5.0 and the appendices to this EIS contain descriptions of the impact assessment assumptions and procedures. The major impacts of each of the alternatives are described below.

The analysis of air quality impacts was based on very conservative assumptions that would tend to over-predict impacts. The DOE does not intend to violate air quality standards knowingly. Where air quality standards are projected to be exceeded, even under conservative scenarios, DOE and UMTRA Project policy and procedures dictate that air quality would be closely monitored. As an ongoing part of normal UMTRA Project construction practice, water or other chemical dust suppressants are used regularly to minimize fugitive dust emissions.

The no action alternative would leave unchanged the existing unacceptable levels of radiation exposures from the tailings piles to people in and around Rifle. These exposures are projected to result in 100 fatal cancers in 1000 years. The tailings would continue to be subject to wind and water erosion, which would result in continuously expanding areas contaminated with radioactive wastes. In addition, the 164 acres that comprise the tailings sites would be unavailable for other uses. The contamination of groundwater beneath the tailings sites would continue for an indefinite period of time. Approximately 40 acres of soils would be temporarily disturbed during interim actions, and the noise generated by interim action equipment would disturb residents living near the tailings and borrow sites. However, while there would be no impact to local transportation systems by the interim actions, there would be small increases in accidents and road maintenance requirements. This alternative would cause an increase in direct employment in Garfield County. The direct monetary cost of this alternative would be \$5.7 million. However, this alternative would not be consistent with the intent of Congress in the UMTRCA (PL95-604) and would not result in compliance with the EPA standards (40 CFR 192).

Stabilization at the New Rifle site would reduce radiation releases to comply with the EPA standards. These releases are projected to result in two fatal cancers in 1000 years. This alternative would prevent the use of 172 acres at the New Rifle site for other productive land uses such as industrial development. The 22 acres that comprise the Old Rifle site

would be decontaminated and released for other productive land uses. This alternative would cause Federal and state annual standards for the release of particulates (dust) to be temporarily exceeded during construction activities at the Old and New Rifle sites. Groundwater contamination at the Old Rifle site would eventually cease. Contaminant concentrations at the New Rifle site would eventually naturally flush to meet the proposed EPA maximum concentration limits (MCLs) at the toe of the pile. However, stabilization at New Rifle could result in periods of potential exceedance of the proposed groundwater protection standards caused by flooding of the Colorado River. If natural flushing with proper institutional controls is not sufficient to reduce all contaminant concentrations to MCLs or background levels within 100 years, or if periodic flooding causes periodic exceedance of MCLs or background levels, then design modifications, active aquifer restoration, active restoration in combination with natural flushing, or alternate concentration limits (ACLs) would be required to ensure compliance. Noise generated by construction equipment would disturb residents living near the tailings and borrow sites and along the transportation routes during the daytime. There would be a substantial increase in traffic (primarily trucks) on U.S. Highway 6 with associated increases in traffic congestion, accidents, and road maintenance. This alternative would cause an increase in direct employment in Garfield County. The direct monetary costs of this alternative would be approximately \$15.5 million.

Disposal at the Estes Gulch site would reduce the radiation releases to comply with the EPA standards (these releases are projected to result in 0.7 fatal cancer in 1000 years) and stabilize the tailings in a relatively remote area. The 164 acres that comprise the Old and New Rifle sites would be decontaminated and released for other productive land uses. Eighty-one acres at the Estes Gulch site, presently used for low-density grazing, would be used for tailings disposal. This alternative could cause Federal and state standards for the release of particulates to be temporarily exceeded during construction activities at the New Rifle and Estes Gulch sites and along the transportation routes. If Federal or state air quality standards are anticipated to be actually exceeded, appropriate mitigation measures would be implemented. Groundwater contamination at the Old Rifle site would cease. Contaminant concentrations at the New Rifle site would eventually naturally flush to meet MCLs or background levels. If natural flushing with proper institutional controls is not sufficient to reduce concentrations to MCLs or background, then active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required to ensure compliance at the New Rifle site. Proposed groundwater standards would be met at the toe of the stabilized pile at the Estes Gulch site. If the proposed concentration limits should be exceeded for any hazardous constituent at the toe of the pile during the post-disposal period, disposal cell cover modifications, supplemental standards, or ACLs would be implemented to ensure compliance. Noise generated by construction equipment would disturb residents living near the tailings, disposal, and borrow sites and along the transportation routes during the daytime. There would be substantial increases in traffic (primarily trucks) on U.S. Highway 6 and State Highway 13 between the tailings and disposal sites. Increases in traffic congestion, accidents, and road maintenance

would accompany the increases in traffic. This alternative would cause an increase in direct employment in Garfield County. The direct monetary costs of this alternative would be approximately \$28.9 million.

Disposal at the Lucas Mesa site would reduce the radiation releases to comply with the EPA standards (these releases are projected to result in 0.5 fatal cancer in 1000 years) and stabilize the tailings in a relatively remote area. The 164 acres that comprise the Old and New Rifle sites would be decontaminated and released for other productive land uses. Eighty-three acres at the Lucas Mesa site, presently used for low-density grazing, would be used for tailings disposal. This alternative could cause Federal and state standards for the release of particulates to be temporarily exceeded during construction activities at the tailings, disposal, and borrow sites and along the transportation routes. If Federal or state air quality standards are anticipated to be actually exceeded, appropriate mitigation measures would be implemented. Groundwater contamination at the Old Rifle site would cease. Groundwater contamination at the Old Rifle site would cease. Contaminant concentrations at the New Rifle site would eventually naturally flush to meet MCLs or background levels. If natural flushing with proper institutional controls is not sufficient to reduce concentrations to MCLs or background levels, then active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required to ensure compliance at the New Rifle site. Proposed groundwater standards would be met at the toe of the stabilized pile at the Lucas Mesa site. If the proposed concentration limits should be exceeded for any hazardous constituent at the toe of the pile during the post-disposal period, disposal cell cover modifications, supplemental standards, or ACLs would be implemented to ensure compliance. Noise generated by construction equipment would disturb residents living near the tailings, disposal, and borrow sites and along the transportation routes during the day. There would be substantial increases in traffic (primarily trucks) on U.S. Highway 6, I-70 and County Road V.5 between the tailings and disposal sites. Increases in traffic congestion, accidents, and road maintenance would accompany the increases in traffic. This alternative would cause an increase in direct employment in Garfield County. The direct monetary costs of this alternative would be approximately \$62.7 million.

1.5 SUMMARY OF ISSUES

Issues in this final EIS include areas of controversy raised during the public comment period and issues to be resolved. Section 6.0, Public and Agency Comments, contains summaries, analyses, and responses to all oral and written comments received by the DOE. Section 6.15 also reproduces in full the written comments received on the draft EIS. Copies of the public hearing transcripts are available for inspection at each of the public reading rooms and libraries listed in Section 6.3. These transcripts are also on file at the DOE UMTRA Project Office in Albuquerque, New Mexico.

Major areas of controversy included 13 statements of preferences or concerns about the various remedial action alternatives; 18 comments about the conceptual designs, primarily concerning radon and erosion protection barrier design and disposal site long-term stability; two

comments on the extent of contamination adjacent to the Old and New Rifle processing sites; two comments addressing the need for air pollutant emission controls to meet applicable air quality standards, and the differences in air quality impacts at the Rifle sites between alternatives; and four comments expressing concern over the impacts of remedial action on mineral, oil, and gas rights, or the use of area limestone resources for the erosion protection barrier.

The largest number of comments on one area, 45 comments, centered on concerns relating to the geological and hydrological discussions presented in the draft EIS. They all raised questions on the relationship between the geological and the hydrological conditions at the sites, and the potential impacts of remedial action on groundwater resources. Most of the comments on hydrology questioned data, assumptions, and procedures used to assess the impacts of remedial action on the local groundwater resources.

Additional areas of concern included five comments expressing concern about impacts to wildlife, wetlands, riparian habitat, and threatened and endangered species; two comments expressing opinions concerning the benefits of remedial action to future economic development in the area; one comment pointing out the presence of occupied residences close to the Estes Gulch site; three comments focusing concern on the traffic hazards created by remedial action and the steps necessary to reduce these impacts; three comments about the surveillance and maintenance requirements to assure long-term stability of the tailings; and two comments with miscellaneous and administrative concerns.

Many of the comments received were about areas or subjects of concern that the commentors felt were unresolved or inadequately treated in the draft EIS, primarily design and hydrogeologic issues. In response to these comments and concerns, the DOE has performed additional analyses and prepared additional and expanded characterizations of the existing environment and impacts related to remedial action.

The primary issue yet to be resolved is the choice between the four alternatives. Alternative 3, disposal at the Estes Gulch site, is the DOE's preferred alternative.

1.6 CHANGES TO THE EIS

The final EIS contains several changes from the draft EIS issued in May 1987. These changes include the following:

- o Increase in the amount of estimated volumes of tailings and contaminated materials from 3,510,00 cubic yards to 4,135,000 cubic yards. Increased materials requiring remedial action resulted in corresponding increases in resources consumed (water, fuel, electricity, earthen and borrow materials), increases in equipment used, projected workhours, and overall estimated project costs.

- o DOE approval and initiation of interim actions in August 1988 to remediate existing health and safety hazards to the Rifle community that are present at both processing sites. These activities have been incorporated into the analysis of all alternatives, including the no action alternative, as activities that are necessary regardless which alternative is selected. They include: establishment of temporary and construction facilities; removal of asbestos and other hazardous materials; demolition of unstable and unsafe mill structures; and improving site security.
- o Modifications to the conceptual designs to: incorporate frost protection layers; respond to erosion and long-term stability concerns; provide the appropriate radon/infiltration barrier saturated hydraulic conductivity necessary to comply with the proposed EPA groundwater protection standards; and accommodate increased tailings and contaminated materials volumes.
- o Additional geological characterization for the Estes Gulch site to incorporate additional data.
- o Substantial geohydrological re-characterization to include additional data and analysis, and a revised groundwater compliance strategy.
- o Additional information concerning the Endangered Species Act Section 7 consultation process and the impacts of remedial action on threatened and endangered species.
- o Additional characterization of the wetlands at the Old and New Rifle sites.
- o Commitment by the DOE to upgrade portions of State Highway 13 as part of the Estes Gulch alternative, and additional characterization of the associated impacts.
- o Addition of Section 6.0, which contains summaries of all public comments, the DOE's responses, and photocopies of public comments.

REFERENCE FOR SECTION 1.0

DOE (U.S. Department of Energy), 1985. Programmatic Environmental Report for Remedial Action at UMTRA Project Vicinity Properties, UMTRA DOE/AL-150327.0000, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

2.0 PURPOSE AND NEED

2.1 INTRODUCTION

In response to public concern over the potential public health effects associated with uranium mill tailings and the associated contaminated materials left abandoned or otherwise uncontrolled at inactive processing sites throughout the United States, Congress passed the UMTRCA, Public Law 95-604, which was enacted into law on November 8, 1978. In the UMTRCA, Congress acknowledged the potential health effects associated with uranium mill tailings and identified 24 sites that were in need of remedial action. The Rifle sites are two of these 24 sites.

The principal hazard associated with the tailings results from the production of radon, a radioactive decay product of the radium contained in the tailings. Radon, a radioactive gas, can diffuse through the tailings and be released into the atmosphere, where it and its radioactive decay products may be inhaled by humans. If the concentration of radon and its decay products is high enough and the exposure time long enough, cancers may develop in persons living and working near the tailings. If the tailings are not properly stabilized, erosion or human removal of the contaminated materials could spread the contamination over a much wider area and increase the potential public health effects.

Title I of UMTRCA authorizes the DOE to enter into cooperative agreements with affected states and Indian tribes to clean up those inactive sites contaminated with uranium mill tailings, requires the Secretary of the DOE to designate sites to be cleaned up, requires the EPA to promulgate standards for these sites, and defines the role of the NRC.

Effective October 19, 1981, the DOE and the state of Colorado entered into a cooperative agreement under UMTRCA. The cooperative agreement sets forth the terms and conditions for the DOE and the state's cooperative remedial action efforts, including the DOE's development of a remedial action plan (with the concurrence of the state), the preparation of an appropriate environmental document, real estate responsibilities, and other concerns.

Because of unsafe conditions at both processing sites, and potential liability issues, the DOE approved the initiation of certain interim actions in July 1988. Scheduled for completion in August 1989, these activities include establishment of temporary and construction facilities; removal of asbestos, other chemicals, and materials; demolition of unstable and unsafe mill structures; and improving site security. Performance of the interim actions was determined to be necessary to protect the health and safety of the nearby Rifle community, and to remove the potential sources of ground and surface water contamination.

Vanadium-contaminated materials will eventually be transferred to a vanadium processing facility for reprocessing; all other chemicals, acids, solvents, and materials will be transferred to a licensed disposal

facility. All contaminated demolition debris will either be transferred to a licensed disposal facility if the no action alternative is selected, or transported to the selected remedial action disposal site for burial in the tailings embankment.

While these activities may be considered part of the type of site preparation work that could proceed prior to remedial action, no uranium mill tailings piles will be disturbed as a result of these activities, and these activities will in no way jeopardize or influence the NEPA process. Performance of the interim Actions was determined to be necessary independent of the selection of any alternative.

2.2 FEDERAL HEALTH AND ENVIRONMENTAL PROTECTION STANDARDS

The EPA published an EIS (EPA 520/4-82-013-2) on the development and impacts of its standards, 40 CFR 192, and issued final standards, 48 FR 590-604, to become effective on March 7, 1983. In developing these standards, the EPA determined "that the primary objective for control of tailings should be isolation and stabilization to prevent their misuse by man and dispersal by natural forces" and that "a secondary objective should be to reduce the radon emissions from the piles." A third objective should be "the elimination of significant exposure to gamma radiation from tailings piles." The EPA standards are summarized in Table 2.1. More detailed discussions of the EPA standards are provided in the DOE's EISs for the Durango and Grand Junction, Colorado, UMTRA Project sites (DOE, 1986, 1985) and in the "Plan for Implementing EPA Standards for UMTRA Sites" (DOE, 1984).

The EPA standards (40 CFR 192) required characterization of the hydrogeologic regime at and around each UMTRA Project site. These standards state that "Judgements on the possible need for remedial or protective actions for groundwater aquifers should be guided by relevant considerations described in EPA's hazardous waste management system (47 FR 32274, July 26, 1982) and by relevant State and Federal Water Quality Criteria for anticipated or existing uses of water over the term of the stabilization."

On September 3, 1985, the U.S. Tenth Circuit Court of Appeals remanded the groundwater protection standards, 40 CFR 192.2(a)(2)-(3). The standard was remanded to the EPA for further consideration in light of the Court's opinion that the water standard was site-specific rather than of general application as required by the legislation. The EPA issued proposed standards on September 24, 1987.

Prior to the decision by the Court, the EPA reviewed available water-quality data at inactive tailings sites and determined that there was little evidence of recent movement of contaminants into groundwater. It also determined that any degradation of groundwater quality should be evaluated in the context of potential beneficial uses of the groundwater as determined by background water quality and the available quantity of groundwater. Rather than establish specific numerical limitations for contaminant discharges or groundwater quality, the EPA determined that the most appropriate course of action would be to require site-specific

PART 192 - HEALTH AND ENVIRONMENTAL PROTECTION STANDARDS FOR URANIUM MILL TAILINGS

SUBPART A - Standards for the Control of Residual Radioactive Materials from Inactive Processing Sites

192.02 Standards

Control shall be designed to:

- (a) Be effective for up to one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years, and,
- (b) Provide reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not:
 - (1) Exceed an average release rate of 20 picocuries per square meter per second, or
 - (2) Increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than one-half picocurie per liter.

SUBPART B - Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites

192.12 Standards

Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site:

- (a) The concentration of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than -
 - (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and
 - (2) 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.
- (b) In any occupied or habitable building -
 - (1) The objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL, and
 - (2) The level of gamma radiation shall not exceed the background level by more than 20 microroentgens per hour.

SUBPART C - Implementation (condensed)

192.20 Guidance for Implementation

Remedial action will be performed with the "concurrence of the Nuclear Regulatory Commission and the full participation of any state that pays part of the cost" and in consultation as appropriate with other government agencies.

192.21 Criteria for Applying Supplemental Standards

The implementing agencies may apply standards in lieu of the standards of Subparts A or B if certain circumstances exist, as defined in 192.21.

192.22 Supplemental Standards

"Federal agencies implementing Subparts A and B may in lieu thereof proceed pursuant to this section with respect to generic or individual situations meeting the eligibility requirements of 192.21."

- (a) "...the implementing agencies shall select and perform remedial actions that come as close to meeting the otherwise applicable standards as is reasonable under the circumstances."
- (b) "...remedial actions shall, in addition to satisfying the standards of Subparts A and B, reduce other residual radioactivity to levels that are as low as is reasonably achievable."
- (c) "The implementing agencies may make general determinations concerning remedial actions under this Section that will apply to all locations with specified characteristics, or they may make a determination for a specific location. When remedial actions are proposed under this Section for a specific location, the Department of Energy shall inform any private owners and occupants of the affected location and solicit their comments. The Department of Energy shall provide any such comments to the other implementing agencies [and] shall also periodically inform the Environmental Protection Agency of both general and individual determinations under the provisions of this section."

Ref: Federal Register, Volume 48, No. 3, January 5, 1983, 40 CFR Part 192.

TABLE 2.1 EPA STANDARDS

analyses of potential future contaminant discharge and a case-by-case evaluation of the significance of such a discharge. The implementation guidelines for the EPA standards called for adequate hydrological and geochemical surveys at each site as a basis for determining whether specific water-protection measures should be applied.

In response to the Court's remand, the newly proposed EPA ground-water protection standards involve:

- o Protection of human health, safety, and the environment.
- o Consideration of radiological and nonradiological hazards.
- o Consistency with the requirements of the Resource Conservation and Recovery Act (RCRA), as amended.
- o General standards applicable to all UMTRA Project Sites (i.e., not site-specific as was the case for remanded standards).

These items are discussed below.

Subpart A (40 CFR 192.01-192.02) consists of the requirements for control of potential contaminant releases to the groundwater at disposal sites. It incorporates the following:

- o RCRA list of hazardous constituents (40 CFR 264.93).
- o RCRA MCLs (40 CFR 264.94), background limits, or ACLs. The establishment of ACLs must be concurred in by the NRC, be as low as reasonably achievable, and satisfy the water quality protection considerations stipulated in 40 CFR 264.94(b).
- o RCRA point of compliance (40 CFR 264.95).
- o Four hazardous constituents (molybdenum, radium, uranium, and nitrate) and their associated MCLs are added to those taken from the drinking water standards. (Note: an MCL for an additional constituent, gross alpha activity, is included separately and without discussion in Subpart A, Table A.)
- o A liner or equivalent beneath the disposal site if tailings contain excess water (40 CFR 192.20).
- o Monitoring during a post-remedial-action period to verify design performance.
- o Corrective action to be initiated within 18 months after monitoring indicates or projects an exceedance of the applicable concentration limits.

Subpart B (40 CFR 192.11-192.12) lists the standards applicable for remediating contaminated groundwater. It incorporates:

- o Cleanup of the listed groundwater constituents to levels specified in Subpart A.
- o Extension of the remedial period to allow for natural flushing if:
 - The groundwater is not, and is not projected to be, a public drinking water source, and
 - Institutional controls will effectively protect health and satisfy other beneficial uses, and
 - Concentration limits (40 CFR 264.94) will be met in less than 100 years.

Subpart C (40 CFR 192.20-192.22) addresses supplemental standards applicable to Subparts A and B. The supplemental standards provide for alternative actions that come as close to the standards "as reasonable under the circumstances." The NRC must concur in the application of supplemental standards. The supplemental standards may be applied if protection of human health and the environment is assured (40 CFR 192.22(d)) and:

- o The proposed action would cause more environmental harm than it would prevent (40 CFR 192.21(b)), or
- o Restoration is technically impracticable from an engineering perspective (40 CFR 192.21(f)), or
- o The groundwater is Class III (40 CFR 192.21(g)).

Under the UMTRCA, the DOE must comply with the proposed standards until standards are promulgated in final form. As a result, remedial action taken with regard to the Rifle sites would not preclude subsequent design enhancements if needed to achieve compliance with the standards and would not limit the selection of reasonable groundwater restoration methods that may be necessary when the final standards are promulgated. The DOE has characterized conditions at the Rifle uranium mill tailings sites and determined that the proposed remedial action would comply with the requirements of Subpart A of the proposed EPA groundwater protection standards. When final standards are promulgated, the DOE will evaluate groundwater protection requirements and undertake such action as necessary to ensure that the final standards are met. The need for and extent of aquifer restoration will be evaluated in accordance with the NEPA.

2.3 NRC LICENSING

All remedial actions performed under the UMTRCA must be performed in accordance with the EPA standards and with the concurrence of the NRC. The NRC has not and does not intend to issue regulations applicable to the remedial actions at the inactive uranium processing sites but will issue a general license for all sites and will concur in site-specific surveillance and maintenance plans for the disposal sites. The NRC

concurrence in the site-specific surveillance and maintenance plan will render the site licensed. Section 5.21 contains additional details on the surveillance and maintenance of UMTRA Project sites.

REFERENCES FOR SECTION 2.0

- DOE (U.S. Department of Energy), 1986. Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado, DOE/EIS-0126-F, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.
- DOE (U.S. Department of Energy), 1985. Remedial Actions at the Former Vanadium Corporation of America Uranium Mill Site, Durango, La Plata County, Colorado, DOE/EIS-0111F, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.
- DOE (U.S. Department of Energy), 1984. Plan for Implementing EPA Standards for UMTRA Sites, UMTRA-DOE/AL-163, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

3.0 ALTERNATIVES FOR THE REMEDIAL ACTION

3.1 INTRODUCTION

3.1.1 The Rifle tailings

Union Carbide processed uranium and vanadium ores at the Old and New Rifle sites from 1924 to 1932 and from 1942 to 1973. The processing produced approximately 2,560,000 cubic yards of tailings. The tailings are a mixture of the processed ores (finely ground sands with a medium clay content) and the chemicals used in the milling process. A portion of the New Rifle mill was used to produce vanadium from 1973 to 1984; this process involved vanadium solutions and did not produce tailings.

The contaminated areas at the Old and New Rifle sites consist of the tailings piles, alluvium beneath the piles, the mill areas, and windblown contamination. A total of 326 acres has been contaminated and contains approximately 4,135,000 cubic yards of contaminated materials. Table 3.1 provides details on the contaminated areas at each site. Seepage from the tailings piles has contaminated groundwater in the alluvium beneath the Old Rifle site and in the alluvium and Wasatch Formation beneath the New Rifle site. The areal extent of the groundwater contamination at the New Rifle site is much larger than that at the Old Rifle site.

The Old Rifle tailings site covers approximately 22 acres between U.S. Highway 6 to the north and the Denver and Rio Grande Western (D&RGW) Railroad and the Colorado River to the south (Figure 3.1). The relatively flat tailings pile covers approximately 13 acres in the western half of the site at the base of a hill below U.S. Highway 6. The pile measures approximately 1300 feet in the east-west direction and 650 feet in the north-south direction. The nine-acre mill area where the ore storage and milling facilities were located is immediately east of the tailings pile and contains the only remaining mill structure, the concrete block assay building. The foundations of other mill structures are exposed or buried at the east end of the mill area. The entire tailings site is fenced to control access.

The Old Rifle tailings pile was partially stabilized by Union Carbide in 1967 in accordance with applicable state of Colorado regulations. The southern edge of the pile was moved north away from the railroad tracks, and the entire pile was covered with six inches of soil. The pile was then fertilized and seeded with grasses, and a sprinkler system was installed and used to promote the vegetation. Approximately 85 percent of the pile is vegetated with grasses common to the area.

The New Rifle tailings site covers approximately 142 acres between the D&RGW Railroad and U.S. Highway 6 to the north and I-70 and the Colorado River to the south (Figure 3.2). The 33-acre tailings pile is located in the west-central portion of

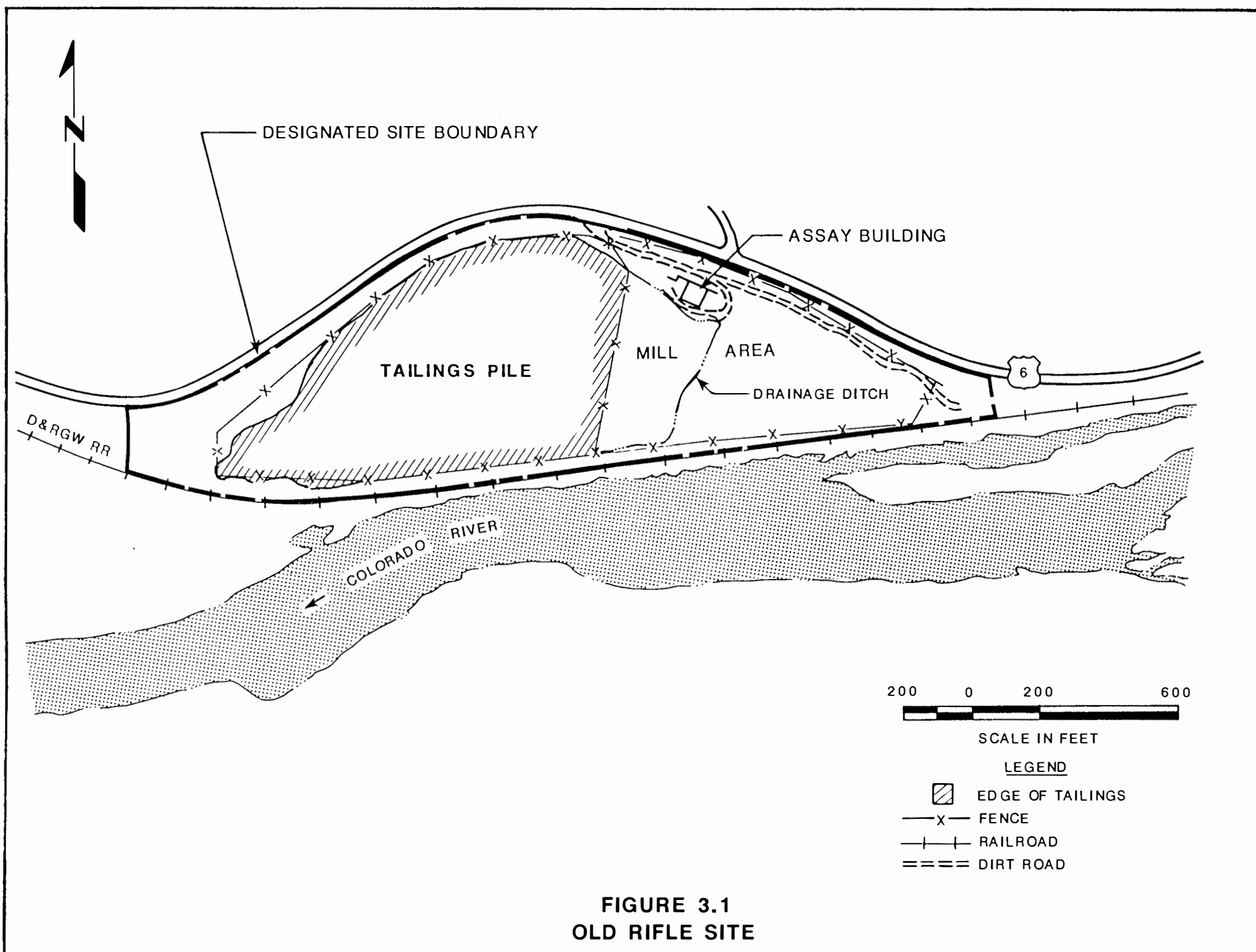


FIGURE 3.1
OLD RIFLE SITE

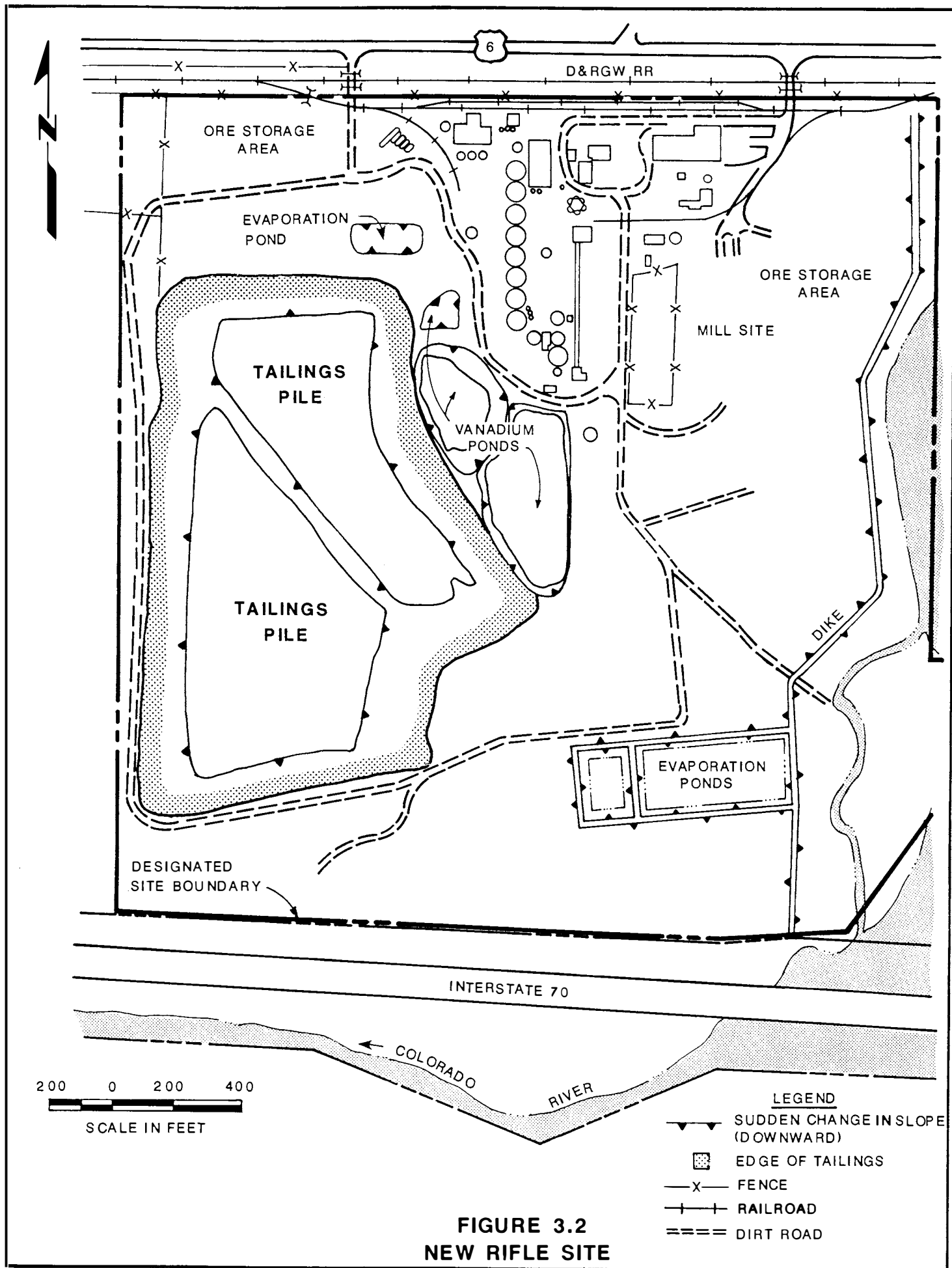


FIGURE 3.2
NEW RIFLE SITE

Table 3.1 Contaminated areas, Old and New Rifle sites

Contaminated area	Old Rifle site			New Rifle site		
	Area (acres)	Average thickness (feet)	Volume (cubic yards)	Area (acres)	Average thickness (feet)	Volume (cubic yards)
Tailings pile	13	18	333,000	33	41-55	2,415,000
Alluvium beneath tailings pile	13	5	168,000	33	4-6	375,000
Mill area and windblown tailings	62	1	160,000	172	2	684,000
Totals	88	Not applicable	661,000	238	Not applicable	3,474,000

the site and measures 1600 feet in the north-south direction and 1150 feet in the east-west direction. The pile has two distinct heights. The northeast portion of the pile averages 55 feet in height and contains older tailings; the southwest portion averages 41 feet in height and contains newer tailings. The tops of the pile are relatively flat, but the sides are steep with one-to-one (one horizontal to one vertical) slopes in many places. The mill area is located north and east of the tailings pile and contains two ore storage areas, various water retention ponds, and the mill facilities. The mill facilities are not being used, and Union Carbide has removed all useable parts and equipment from the site. The tailings site is fenced to control access except along the east and south sides next to the Colorado River.

Union Carbide has partially stabilized the New Rifle tailings pile. Approximately 1000 tons of mulch and fertilizer were applied to the pile, and native grasses were planted. An irrigation system was installed and used to promote the vegetation. The lack of soil cover, the steep slopes, and strong winds in the Colorado River valley have caused some erosion of the tailings pile. Breaks in the vegetative cover have been patched with soil, and windbreaks such as snow fences have been installed in an effort to minimize the erosion.

When the state of Colorado acquired the processing sites in 1988, the mill structures were structurally unsafe and they contained asbestos; a variety of oils, gasses, solvents, chemicals and cleaners, often in unmarked containers or in unsecured areas, were present on the New Rifle site, and neither of the sites were guarded or considered physically secured. The conditions of the

site presented a constant hazard to the groundskeeping crew, as well as any local residents who might easily gain unauthorized access to the sites.

In addition, both sites' proximity to the Colorado River, coupled with the chemicals and substances present on the site, could result in the potential for additional pollution of the river or local groundwater, noncompliance with applicable water pollution regulations, and a public health hazard.

Approximately 102 potential vicinity properties have been identified in the Rifle area. These vicinity properties are residences, businesses, or open lands that may have been contaminated by the use of tailings as a sand substitute in building materials or as fill material before the hazards associated with the tailings were known. The impacts of remedial action at the vicinity properties were evaluated in a separate environmental report prepared by the DOE (1985a) and, therefore, are not considered in this EIS.

3.1.2 Alternatives addressed

The alternatives addressed in this document include performing interim actions at the Old and New Rifle sites but performing no remedial action (Alternative 1), stabilizing the tailings at the New Rifle site (Alternative 2), and relocating the tailings to the Estes Gulch or Lucas Mesa alternate disposal sites (Alternatives 3 and 4) outside of Rifle (Figure 1.1). All of the alternatives, except no action, include remedial action at the vicinity properties. All of the alternatives, action and no action, include the performance of interim actions for the remediation of existing health and safety hazards at both processing sites. Discussions on the no action alternative have been modified to reflect incorporation of the interim actions. Discussions and analysis on the three remedial action alternatives already incorporate those activities and impacts related to the interim actions.

Therefore, the following alternatives are addressed in this EIS:

Alternative 1: No action.

Alternative 2: Stabilization at the New Rifle site.

Alternative 3: Disposal at the Estes Gulch site.

Alternative 4: Disposal at the Lucas Mesa site.

The Estes Gulch alternate disposal site is located approximately six miles north of Rifle in Garfield County. The Lucas Mesa alternate disposal site is located approximately 35 miles southwest of Rifle, near the town of DeBeque, in Mesa County. Figure 1.3 shows the locations of the three potential disposal sites.

3.2 DESCRIPTION OF ALTERNATIVES

3.2.1 Background

All of the alternatives, except no action, have been designed to comply with the EPA standards (40 CFR 192). Consistent with these standards, the following major design objectives have been established:

- o Reduce the average radon flux from the sites to levels consistent with the EPA standards.
- o Design controls to be effective for up to 1000 years to the extent reasonably achievable, and, in any case, for at least 200 years.
- o Ensure that existing or anticipated beneficial uses of surface and groundwaters are not adversely affected.
- o Reduce contaminant levels (radium-226) in areas released for unrestricted use to levels consistent with the EPA standards.
- o Reduce releases of contaminants to groundwater to meet the proposed EPA groundwater standards (40 CFR 192).
- o Reduce radiation levels in habitable buildings to levels consistent with the EPA standards.
- o Minimize the land area to be occupied by the stabilized tailings.
- o Provide flood protection, runoff and sediment control, and treatment of wastewater as required.
- o Prevent inadvertent human intrusion into the stabilized tailings.
- o Minimize animal burrowing and plant root penetration into the stabilized tailings.
- o Protect against releases of contaminants from the sites during construction.
- o Minimize areas disturbed during construction, and minimize human exposure to contaminated materials.

Sections 3.2.3 through 3.2.6 and Appendix A, Conceptual Designs, contain additional details on the conceptual remedial action designs.

Section 3.3 and Sections B.2 and B.3 of Appendix B, Alternatives Analyses, describe how the alternate sites were selected and other alternatives that were considered.

3.2.2 Alternative 1: No action (interim actions only)

The no action alternative consists of taking no steps toward remedial action at the tailings sites and vicinity properties. The tailings piles would remain in their present locations and conditions, and the contaminated materials would be subject to dispersion by wind and water erosion and unauthorized removal by man. The contamination of groundwater beneath the tailings sites would continue for an indefinite period of time. The selection of this alternative would not be consistent with the intent of Congress in the UMTRCA (PL95-604) and would not result in compliance with the EPA standards.

However, this alternative does consider the completion of interim action activities at the Old and New Rifle processing sites by August 1989 to remediate existing safety hazards to the Rifle community. Interim actions would include such activities as establishment of temporary and construction facilities, removal of asbestos and other chemicals and materials, demolition of unstable and unsafe mill structures, and improving site security. Vanadium-contaminated materials would be transferred to a vanadium refining facility for reprocessing; all other chemicals, acids, and materials would be transferred to a licensed disposal site.

Major interim action activities:

Alternative 1 would require the following interim action activities:

At the Old and New Rifle sites

- o Upgrading (as necessary) of the access road from each tailings site to U.S. Highway 6.
- o Sealing, removing, or plugging of all existing abandoned utilities and wells.
- o Installation of permanent security fences with locked gates and warning signs at each site to inhibit inadvertent human intrusion.
- o Construction of wastewater retention basin(s) at each site to protect against releases of any contaminants from the sites during interim actions.
- o Construction of drainage control measures at each site to direct all wastewater and storm-water runoff to the retention basin(s) during interim actions.
- o Installation and operation of a wastewater treatment facility (if necessary) at each site to protect against the inadvertent release of contaminants during interim actions.

- o Implementation of measures to control erosion and sedimentation from disturbed areas at each site during the interim actions.
- o Construction of temporary construction facilities, such as asbestos control areas, airtight asbestos barriers, a decontamination enclosure system at asbestos control area entrances and exits, construction worker facilities, and an equipment staging area.
- o Asbestos removal from all mill site areas and packaging for disposal. Includes post-removal cleanup of work areas, and spraying of removal surfaces with an encapsulating material to prevent fibers from becoming airborne during demolition.
- o Identification, packaging, and removal of all chemicals, oils, solvents, and the like to an appropriate licensed disposal facility.
- o Collection and transfer of all vanadium-contaminated wastes to a vanadium processing facility for reprocessing.
- o Demolition of all buildings, foundations, structures, conveyors, bins, tanks, scales, drums, existing fencing and piping; transfer of all crushed demolition debris to an approved disposal facility.
- o Removal, plugging, or sealing of abandoned or unnecessary utilities and test wells.
- o Restoration of the disturbed areas at both sites with clean fill material and grading to promote positive drainage. Includes revegetation of all disturbed wetlands.

At the Second Street and New Rifle borrow sites

- o Excavation of earthen materials for uncontaminated fill and site restoration.
- o Transportation by truck of the earthen materials to the Old and New Rifle tailings sites.

Major design considerations

The major design considerations for this alternative include providing for the remediation of existing health and safety hazards to the Rifle community that are present at the processing sites.

When the state acquired the processing sites in 1988, the mill structures were unsafe and they contained asbestos; a variety of oils, gasses, solvents, chemicals, and cleaners, often in unmarked

containers or in unsecured areas, were present on the New Rifle site, and neither of the sites were guarded or considered physically secured. The conditions of the site presented a constant hazard to the groundskeeping crew, as well as any local residents who might easily gain unauthorized access to the sites.

In addition, both sites' proximity to the Colorado River, coupled with the hazardous substances present on the site, could result in the potential for additional pollution of the river or local groundwater, noncompliance with applicable water pollution regulations, and a public health hazard.

Because of the unsafe conditions and potential liability issues, the DOE approved the initiation of the interim actions in July 1988. Performance of the interim actions was determined to be necessary for purposes of health and safety, and to remove potential sources of ground and surface water contamination, independent of the selection of either an action alternative or the no action alternative.

While these activities may be considered part of the type of the site preparation work that could proceed prior to remedial action, no uranium mill tailings piles will be disturbed as a result of this activity, and these activities will in no way jeopardize or influence the NEPA process.

Construction schedule and estimates

The interim actions at the Old and New Rifle sites will require an estimated 12 months to complete. These actions were initiated in August 1988 and are estimated to be completed by August 1989. Employment will reach an estimated maximum of approximately 69 people in the ninth month of interim action. It will average 40 people over the life of the activities.

This alternative would consume 198,000 gallons of fuel, 145,000 kilowatt-hours (kwh) of electricity, and 1,241,000 gallons of water.

This alternative was estimated to cost \$5,710,000. The costs of property acquisition, engineering design, and overall project management were not included in this cost.

Description of final conditions

All of the unstable mill structures at both sites would be demolished, crushed, and removed to an appropriate disposal facility. All asbestos, chemicals, and materials would be packaged and transferred to a licensed disposal facility. All vanadium-contaminated materials would be transferred to a vanadium processing facility for reprocessing. Both sites would be totally

restricted from use and would be enclosed by a permanent security fence with locked gates and warning signs. Those areas disturbed during the interim actions would be restored with clean fill and graded to promote positive drainage. All disturbed wetlands would be revegetated. The tailings piles would remain in their present locations and conditions, and the contaminated materials would be subject to dispersion by wind and water erosion and unauthorized removal by humans. The contamination of groundwater beneath the tailings sites would continue for an indefinite period of time.

3.2.3 Alternative 2: Stabilization at the New Rifle site

Alternative 2 would involve stabilizing all of the tailings and contaminated materials at the New Rifle site. The Old Rifle tailings and contaminated materials would be excavated, trucked to the New Rifle site on U.S. Highway 6, and consolidated with the New Rifle tailings and contaminated materials to form one tailings pile. The consolidated tailings and contaminated materials would then be covered with an earthen radon barrier, a frost protection layer, a drain layer, and a rock erosion protection barrier with an underlying filter layer. A below-grade rock apron would be constructed around the base of the entire stabilized tailings pile to protect against the erosional forces of flooding in the Colorado River. Drainage diversion ditches would be constructed on the north, east, and south sides of the pile to divert surface water runoff around and away from the pile. All areas not occupied by the stabilized tailings pile and associated erosion protection features would be restored with clean fill material to promote positive drainage.

Major construction activities

Alternative 2 would require the following major construction activities:

At the Old and New Rifle sites

- o Upgrading (as necessary) of the access road from each tailings site to U.S. Highway 6.
- o Protection (or relocation) of surface or subsurface utilities at each site during construction.
- o Construction of staging areas in the mill areas of the sites.
- o Installation of temporary security fences at each site.
- o Construction of a wastewater retention basin(s) at each site to protect against releases of contaminants from the sites during remedial action.

- o Construction of a truck washing station at each site.
- o Construction of drainage control measures at each site to direct all wastewater and storm-water runoff to the retention basin(s) during construction.
- o Installation and operation of a wastewater treatment facility (if necessary) at each site to protect against the inadvertent release of contaminants during construction.
- o Implementation of measures to control erosion and sedimentation from disturbed areas at each site during construction.
- o Removal of asbestos and demolition of the mill buildings and structures at each site.
- o Excavation and stockpiling of tailings and contaminated materials at the New Rifle site, including demolition debris from the mill buildings and structures and contaminated materials from the vicinity properties.
- o Dewatering of the tailings and alluvium beneath the tailings at the Old Rifle site.
- o Excavation and relocation (by truck) of the tailings and contaminated materials at the Old Rifle site to the New Rifle site.
- o Consolidation of all of the tailings and contaminated materials, including sediments from the wastewater retention basins and temporary drainage ditches at the sites, at the New Rifle site.
- o Placement of a compacted, earthen radon barrier over the consolidated tailings and contaminated materials to inhibit radon emanation, water infiltration, and plant root penetration, and to prevent further groundwater contamination.
- o Placement of a 2.0-foot-thick frost protection layer, consisting of loosely compacted soils excavated from the Second Street borrow site, overlain by a 0.5-foot-thick layer of drain material.
- o Placement of a rock erosion protection barrier with an underlying filter layer over the radon barrier to inhibit wind and water erosion and penetration by burrowing animals.
- o Construction of a below-grade rock apron around the base of the stabilized tailings pile to protect against the effects of a Probable Maximum Flood (PMF) in the Colorado River.

- o Construction of unlined, earthen drainage diversion ditches on the north, east, and south sides of the stabilized tailings pile to divert surface water runoff around and away from the pile.
- o Installation of a permanent security fence with locked gates and warning signs around the stabilized tailings pile to inhibit inadvertent human intrusion.
- o Restoration of the disturbed areas at each site with clean fill material and grading to promote positive drainage. Includes revegetation of all disturbed wetlands areas.

At the Second Street and New Rifle borrow sites

- o Excavation of earth and rock for the radon barrier, frost protection, erosion protection, and site restoration.
- o Transportation (by truck) of the earth and rock to the Old and New Rifle tailings sites.

At the Glenwood Springs borrow site

- o Excavation (by traditional quarrying methods) of large rock for erosion protection.
- o Transportation (by truck) of the large rock to the New Rifle tailings site.

Major design considerations

The major design considerations for this alternative include providing for the control of radon emanation, long-term stability, and groundwater protection. These considerations are discussed below, and additional details are contained in Section A.2 of Appendix A, Conceptual Designs; Section E.2 of Appendix E, Hydrology; and Sections H.3 and H.4 of Appendix H, Radiation.

Radon emanation from the stabilized tailings pile would be controlled to meet the EPA standards by the placement of a 2.0-foot-thick, compacted earthen radon barrier over the consolidated tailings and contaminated materials. The thickness of the radon barrier was determined using data on the distribution of radium in the tailings and data on the physical properties of the earthen borrow materials as inputs to the RAECOM computer model (NRC, 1984).

The radon barrier would be protected from frost heave by the installation of a 2.5-foot-thick layer of loosely compacted soil,

which includes a drain layer. Protection against slope failure would be provided by contouring the pile with relatively flat slopes as stated above, and the pile would not fail during a design earthquake.

The principal considerations for the long-term stability of the stabilized tailings pile include erosion from a major precipitation event, flooding, river meander, frost heave and slope stability. The pile would be protected against the erosive forces of a Probable Maximum Precipitation (PMP), a PMF, and river meander by contouring the pile with relatively flat slopes and placing a rock erosion protection barrier with an underlying filter layer and a below-grade rock apron. The pile would have maximum slopes of four percent on the top and 20 percent (five horizontal to one vertical) on the sides. The rock erosion protection barrier on the top of the pile would be 1.5 feet thick and would consist of rock with a mean diameter of 1.5 inches or greater and an underlying filter layer. Above the estimated maximum water level for the PMF, the rock erosion protection barrier on the sides of the pile would be two feet thick and would consist of rock with a mean diameter of seven inches or greater and an underlying filter layer. Below the PMF maximum water level, the rock erosion protection barrier on the sides would be three feet thick and would consist of larger rocks (mean diameter of 16 inches or greater) and an underlying filter layer. The rock erosion protection barrier on the sideslopes would tie into the below-grade, 10-foot-thick rock apron around the base of the pile. The mean diameter of the rock in this apron would be 40 inches or greater, and the width of the apron would vary from 50 feet on the north side of the pile to 100 feet on the south side.

The rock apron constructed around the base of the pile was designed according to standard engineering practices, taking into account the potential for any lateral movement of the stream channel that might cause undermining or erosion of the stabilized tailings pile. The calculations supporting this design are on file at the DOE Project Office in Albuquerque, New Mexico. These calculations compute water surface profiles and flood velocities with revised boundary geometries to model the sensitivity of geomorphic changes.

The consolidation of the tailings into a single embankment at the New Rifle site, the sloping of the stabilized tailings to promote drainage of precipitation off the pile, and the addition of a low-hydraulic conductivity radon barrier will reduce tailings seepage to groundwater. This will reduce the total amount of seepage from 3.8 gallons per minute (gpm), under the existing conditions, to 0.02 gpm. These design elements would reduce tailings seepage into the groundwater to a flux of 10^{-9} cm/s. This flux would ensure that the EPA's proposed groundwater protection standards would be met at the toe of the pile, once existing contamination has been flushed or removed from the underlying alluvium. However, stabilization at New Rifle would result in periods of

potential exceedance of the proposed groundwater protection standards caused by flooding of the Colorado River. If natural flushing with proper institutional controls is not sufficient to reduce all contaminant concentrations to MCLs or background levels within 100 years, or if periodic flooding causes periodic exceedance of MCLs or background levels, then design modifications, active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required to ensure compliance.

Under the UMTRCA, the DOE must comply with the proposed standards until standards are promulgated in final form. As a result, remedial actions taken with regard to the Rifle sites would not preclude subsequent design enhancements if needed to achieve compliance with the standards and would not limit the selection of reasonable groundwater restoration methods that may be necessary when the final standards are promulgated. The DOE has characterized conditions at the Rifle uranium mill tailings sites and determined that the proposed remedial action would comply with the requirements of Subpart A of the proposed EPA groundwater protection standards. When final standards are promulgated, the DOE will evaluate groundwater protection requirements and undertake such action as necessary to ensure that the final standards are met. The need for and extent of aquifer restoration will be evaluated in accordance with the NEPA.

Construction schedule and estimates

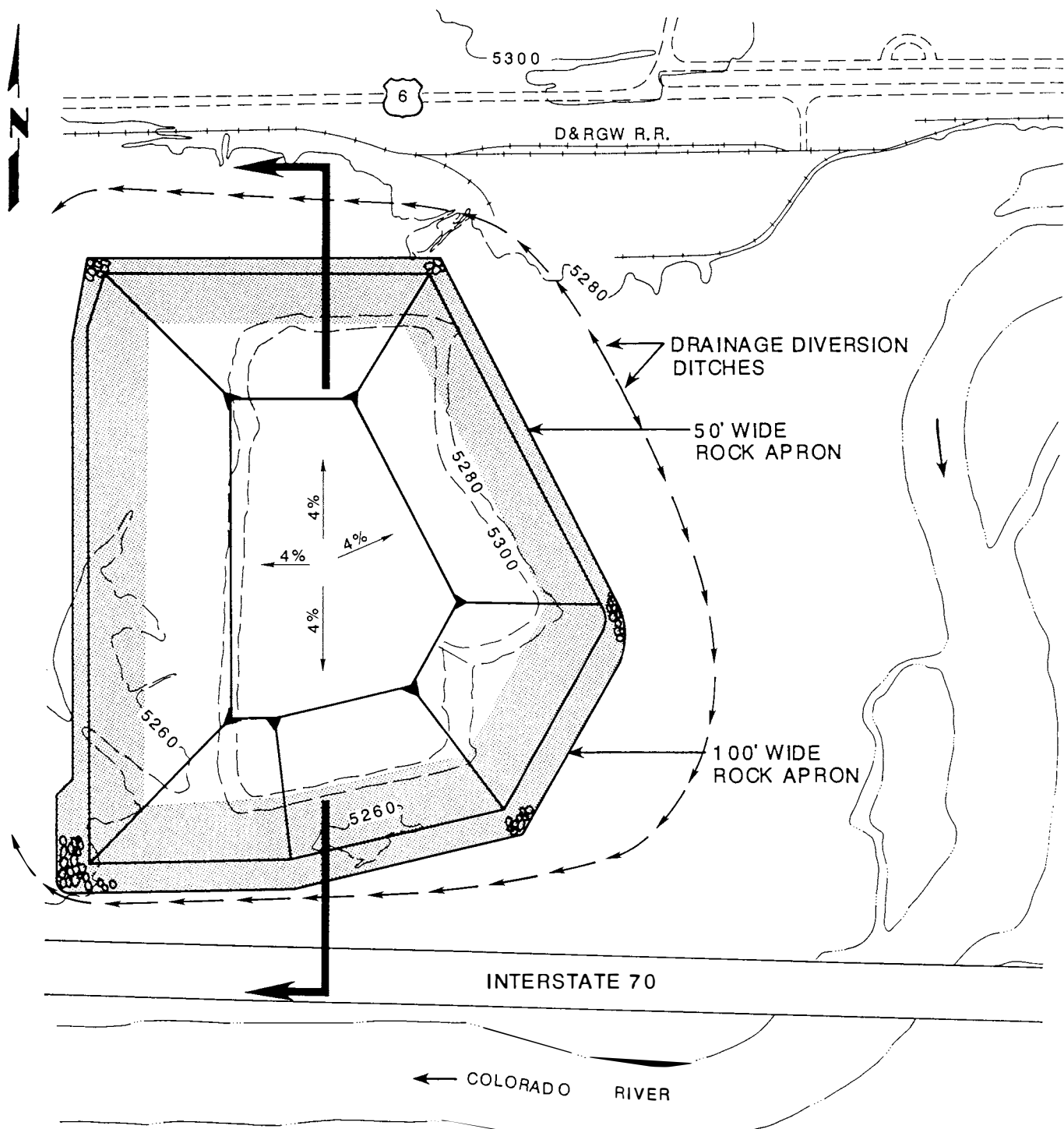
Stabilization at the New Rifle site would require an estimated 20 months to complete. Employment would reach a maximum of approximately 210 people in the fifteen months of remedial action and would average approximately 95 people over the life of the remedial action.

This alternative would consume an estimated 1,439,000 gallons of fuel, 241,000 kwh of electricity, and 127,466,000 gallons of water.

This alternative would cost an estimated \$15,460,000, excluding interim action costs. The costs of property acquisition, engineering design, overall project management, remedial action at vicinity properties, and long-term surveillance and maintenance are not included in this amount.

Description of final conditions

All of the tailings and contaminated materials would be consolidated and stabilized at the present location of the New Rifle tailings pile. The stabilized tailings pile would cover an area of approximately 59 acres (Figure 3.3). The top of the pile would slope down a maximum of four percent in all directions, and the



LEGEND

-  SUBMERGED SIDESLOPES DURING A PMF
-  TYPICAL CROSS-SECTION LOCATION

FIGURE 3.3
FINAL CONDITIONS, NEW RIFLE SITE

sideslopes of the pile would be a maximum of 20 percent (five horizontal to one vertical) (Figure 3.4). The tailings and contaminated materials would be covered with two feet of compacted earth (radon barrier), a 2.0-foot-thick frost protection layer, a 0.5-foot-thick drain layer, a filter layer, and 1.5 to three feet of rock (erosion protection barrier). The stabilized pile would have average and maximum heights of 47 and 80 feet above the surrounding terrain, respectively.

The rock erosion protection barrier on the toeslope of the stabilized tailings pile would tie into a below-grade rock apron around the base of the entire pile. Drainage diversion ditches outside the rock apron on the north, east, and south sides of the pile would divert surface water runoff around and away from the pile. A permanent security fence with locked gates and warning signs would enclose the stabilized pile, rock apron, and drainage diversion ditches, encompassing a total restricted area of approximately 172 acres. The mill buildings and structures at the Old and New Rifle sites would be demolished, and the demolition debris would be consolidated with the tailings and contaminated materials.

After remedial action, the Old Rifle site and adjacent disturbed areas would be restored with clean fill material, graded to promote positive drainage, revegetated, and released for any use consistent with existing land use controls. At the New Rifle site, any disturbed acreage not included in the restricted area would be restored with clean fill material, graded to promote positive drainage, revegetated, and released for any use consistent with existing land use controls. All disturbed wetlands areas at both sites will be revegetated.

3.2.4 Alternative 3: Disposal at the Estes Gulch site--the preferred alternative

Disposal at the Estes Gulch site would involve relocating the Old and New Rifle tailings and contaminated materials to the Estes Gulch site, approximately six miles north of the city of Rifle. An access road would be constructed from State Highway 13 to the Estes Gulch site, and a disposal area averaging 20 feet in depth would be excavated at the site. All of the tailings and contaminated materials would be trucked to the Estes Gulch site and placed in the disposal area. The tailings and contaminated materials would be covered with an earthen radon barrier; frost protection, drain, and filter layers; and a rock erosion protection barrier. The top surface of the embankment would be nearly flush with the east and west ridges and with the existing terrain slope of about 6.5 percent. The slope at the toe of the pile will be a maximum of 20 percent (five horizontal to one vertical). The terrain adjacent to the embankment will be graded to promote sheet flow and rock-filled key trenches will be provided along the embankment and existing terrain interface. A rock-lined toe ditch would be constructed along the south end of the pile to collect

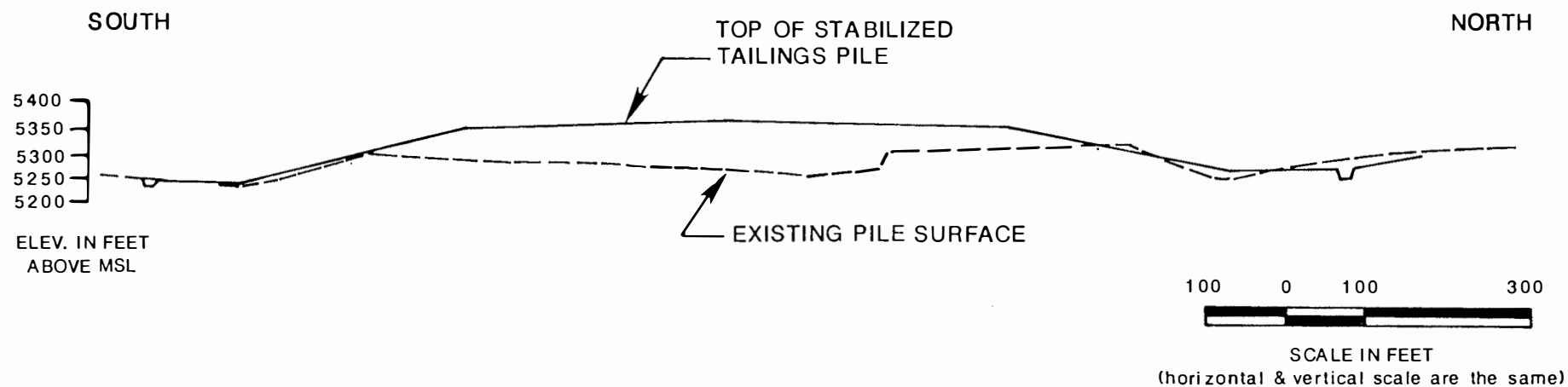
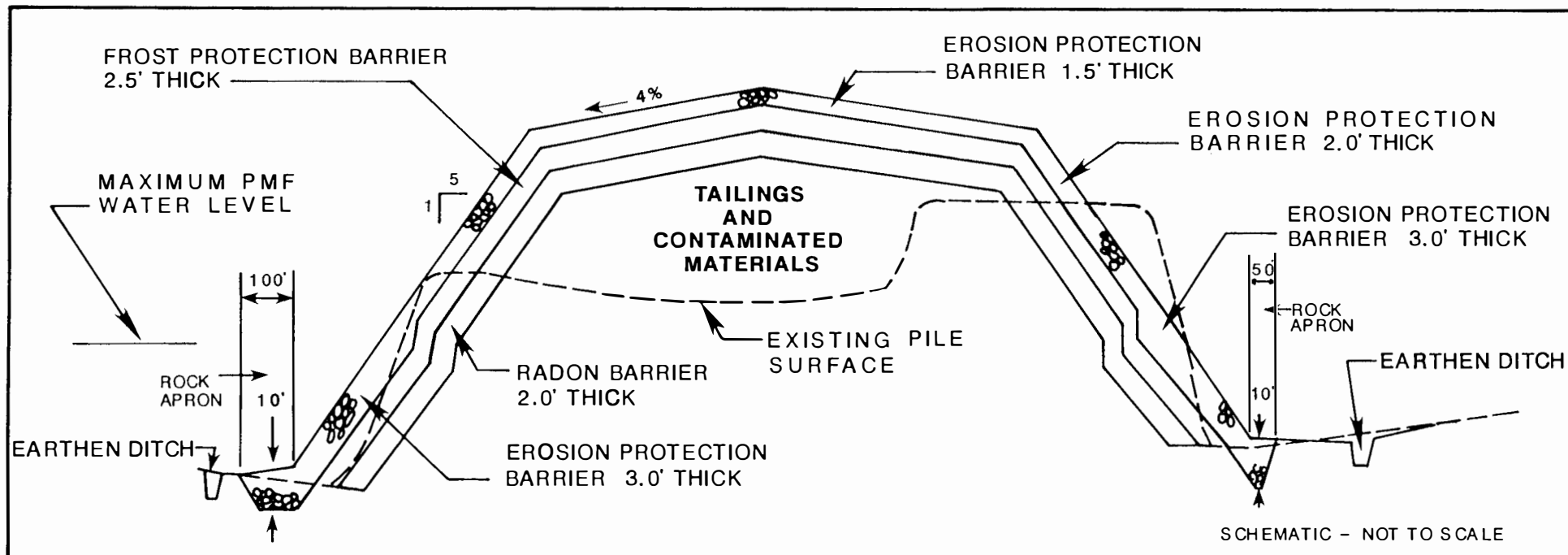


FIGURE 3.4
TYPICAL CROSS SECTION, NEW RIFLE SITE

surface water runoff and divert it westward to Government Creek. The upland drainage area to the north would be graded, riprap would be added, and an interceptor ditch would be built, which together would divert runoff away from the pile. After the removal of the tailings and contaminated materials, the Old and New Rifle sites would be restored with clean fill material and graded to promote positive drainage.

The tailings and contaminated materials would be transported to the Estes Gulch site via U.S. Highway 6 and State Highway 13. Trucks leaving the Old Rifle site would travel west on U.S. Highway 6 to the State Highway 13 bypass, north on State Highway 13 to the Estes Gulch access road (to be constructed), and then north to the Estes Gulch site. Trucks leaving the New Rifle site would travel east on U.S. Highway 6 to the State Highway 13 bypass, north on State Highway 13, turning onto the Estes Gulch access road and continuing north to the Estes Gulch site. The trucks would use the same routes to return to the Old and New Rifle sites.

To accommodate the increased tailings transport trucks and decrease impacts to local traffic and road conditions, portions of Highway 13 would be improved. These improvements include construction of a paved 12-foot-wide, 7500-foot-long climbing lane on the east side of Highway 13 between Highway 325 and the Estes Gulch site turnoff; an 800-foot-long, 12-foot-wide gravel surfaced truck turnout; and an intersection facility on Highway 13 at the Estes Gulch turnoff for trucks entering and leaving the highway. Specific construction and improvement details would be determined during the preparation of the final engineering designs.

Major construction activities

Alternative 3 would require the following major construction activities:

At the Old Rifle, New Rifle, and Estes Gulch sites

- o Installation of a temporary security fence at the sites.
- o Construction of a wastewater retention basin(s) at each site to protect against releases of contaminants from the sites during remedial action.
- o Construction of a truck washing station at each site.
- o Construction of drainage control measures at each site to direct all wastewater and storm-water runoff to the retention basin(s) during construction.
- o Implementation of measures to control erosion and sedimentation from disturbed areas at each site during construction.

At the Old Rifle and New Rifle sites

- o Upgrading (as necessary) of the access road from each site to U.S. Highway 6.
- o Protection (or relocation) of surface or subsurface utilities at each site during construction.
- o Construction of staging areas in the mill areas of the sites.
- o Installation and operation of a wastewater treatment facility (if necessary) at each site to protect against the inadvertent release of waterborne contaminants during construction.
- o Removal of asbestos and demolition of the mill buildings and structures at each site.
- o Dewatering of the tailings and alluvium beneath the tailings at the Old Rifle site.
- o Excavation and stockpiling of the tailings and contaminated materials at each site, including demolition debris from the mill buildings and structures and contaminated materials from the vicinity properties.
- o Relocation (by truck) of all of the tailings and contaminated materials, including sediments from the wastewater retention basins and temporary drainage ditches, from the sites to the Estes Gulch site.
- o Restoration of the disturbed areas at and adjacent to the sites with clean fill material and grading to promote positive drainage. Includes revegetation of all disturbed wetlands areas.

At the Estes Gulch site

- o Construction of a paved 12-foot-wide, 7500-foot-long climbing lane on the east side of Highway 13 between Highway 325 and the Estes Gulch site turnoff; an 800-foot-long, 12-foot-wide gravel surfaced truck turnout; and an intersection facility on Highway 13 at the Estes Gulch turnoff.
- o Construction of a one mile access road from State Highway 13 to the site.
- o Construction of a 10 acre staging area at the site.
- o Excavation of the partially below-grade disposal area with stockpiling of the excavated earthen materials.

- o Placement of the tailings and contaminated materials, including sediments from the wastewater retention basin(s) and temporary drainage ditches at the site, in the disposal area.
- o Placement of a compacted, earthen radon barrier over the consolidated tailings and contaminated materials to inhibit radon emanation, water infiltration, and plant root penetration.
- o Placement of a 3.0-foot-thick frost protection layer, consisting of loosely compacted soils excavated from the Estes Gulch disposal site, underlain by a 0.5-foot-thick layer of drain material.
- o Placement of a rock erosion protection barrier with an underlying filter layer over the frost protection system and the radon barrier to inhibit wind and water erosion and penetration by burrowing animals.
- o Grading the top surface of the pile nearly flush with the east and west ridges, and with the existing terrain slope of about 6.5 percent. The slope at the toe of the pile would be graded to a maximum of 20 percent.
- o Grading of the terrain adjacent to the embankment to promote sheet flow and the construction of rock-filled key trenches at the embankment and existing terrain interface.
- o Grading and riprap on the upland drainage area to the north, and the construction of an unlined interceptor ditch to divert surface runoff away from the pile.
- o Construction of a rock-armored toe ditch, founded in bedrock, along the southern base of the stabilized tailings pile to collect runoff from the embankment surface and adjacent areas and convey it westward, and to minimize or eliminate headward advancement of adjacent surface drainages.
- o Installation of concrete posts with warning signs around the stabilized tailings pile and adjacent erosion protection features to discourage inadvertent human intrusion.
- o Reclamation, including revegetation as required, of all areas disturbed at the site during remedial action.

At the Second Street and New Rifle borrow sites

- o Excavation of earth, gravel, and rock for access road construction, erosion protection, and site restoration.

- o Transportation (by truck) of the earth, gravel, and rock to the Old and New Rifle tailings sites and the Estes Gulch disposal site.

At the Glenwood Springs borrow site

- o Excavation (by traditional quarrying methods) of large rock for erosion protection.
- o Transportation (by truck) of the large rock to the Estes Gulch disposal site.

Major design considerations

The major design considerations for this alternative include providing for the control of radon emanation, long-term stability, and groundwater protection. These considerations are discussed below, and additional details are contained in Section A.3 of Appendix A, Conceptual Designs; Section E.2 of Appendix E, Hydrology; and Sections H.3 and H.4 of Appendix H, Radiation.

Radon emanation from the stabilized tailings pile would be controlled to meet the EPA standards by the placement of a 3.0-foot-thick, compacted earthen radon barrier over the consolidated tailings and contaminated materials. The earthen materials for the radon barrier would be obtained from the materials excavated from the partially below-grade disposal area. The thickness of the radon barrier was determined using data on the distribution of radium in the tailings and data on the physical properties of the earthen borrow materials as inputs to the RAECOM computer model (NRC, 1984).

The radon barrier would be protected from freezing and thawing by the placement of a four-foot-thick layer of earthen materials.

The principal considerations for the long-term stability of the stabilized tailings pile include erosion from a major precipitation event, gully erosion, frost heave, and slope stability. Flooding and river meander would not be major considerations because the tailings and contaminated materials would be located away from any major surface drainages.

The stabilized tailings pile would be protected against the erosive forces of a PMP by placing the pile partially below grade, by contouring the exposed portion of the pile with relatively flat slopes, and by placing a rock erosion protection barrier over the radon barrier. The disposal area would have an average depth of 20 feet, and the pile would have a maximum slope of 6.5 percent on the top. The rock erosion protection barrier on the top of the pile would be 1.5 feet thick and would consist of rock with a mean

diameter of 3.5 inches or greater and an underlying filter layer. The rock erosion protection barrier on the toe ditch would also be 1.5 feet thick, but would consist of rock with a mean diameter of 5.7 inches or greater and an underlying filter layer.

Although the stabilized tailings pile would not be located near any major surface drainages, there would be a potential for nearby minor drainages (gullies) to advance headward and encroach on the pile. The disposal site would be at the head of a watershed and would have very little drainage area above it. To protect the stabilized pile against surface water runoff from this small drainage area and from the disposal site itself, the pile design has been modified in order to prevent gulley encroachment and undercutting of the embankment. The drainage diversion ditches and slopes to the east and west have been eliminated by making the pile's top surface flush with the adjacent ridge lines. Rock-filled, 15-foot-wide key trenches along the pile's eastern and western boundaries, together with limited grading of the adjacent areas, would reduce erosion and promote sheet flow away from the top of the pile. An unlined interceptor ditch would be constructed on a portion of the upland drainage area to divert runoff from the uppermost portions. The remaining watershed area between the ditch and the pile would be graded and riprap would be added to effectively eliminate all existing and future gullying and to shed part of the runoff away from the top of the pile. The pile would be protected from the headward advancement of gullies to the south and west by the construction of a toe ditch that is founded in bed-rock, armored with 5.7-inch mean diameter rock, and tied into the pile's erosion protection barrier. Surface water generated on the top of the pile would be collected in this toe ditch and discharged westward into natural terrain, and eventually into Government Creek.

The susceptibility of the radon barrier to freeze/thaw effects has been studied. A freeze/thaw protection layer, consisting of 3.0 feet of loosely compacted soils excavated from the Estes Gulch disposal site and 0.5 foot of drainage material would be installed above the radon barrier to protect it against freeze/thaw effects. This frost protection layer would thereby ensure the integrity of the radon barrier.

Protection against slope failure would be provided by placing the stabilized pile partially below grade, by compacting the pile materials, and by contouring the pile with relatively flat slopes as described above. The stabilized pile would not fail during the design earthquake.

The disposal of tailings at the Estes Gulch site would remove the source of tailings seepage at the Old and New Rifle site. Seepage from the Estes Gulch disposal cell would be minimized by the addition of a sloping surface to promote drainage of precipitation off the pile, a frost protection layer, a high permeability filter layer overlying the radon barrier, and the low-hydraulic

conductivity (10^{-8} cm/s) radon barrier. Because the average groundwater flow velocity beneath the site is less than 0.1 foot per year, the proposed EPA groundwater protection standards would be met at the point of compliance (the toe of the pile), 100 feet downgradient of the tailings.

Under the UMTRCA, the DOE must comply with the proposed standards until standards are promulgated in final form. As a result, remedial action taken with regard to the Rifle sites would not preclude subsequent design enhancements if needed to achieve compliance with the standards and would not limit the selection of reasonable groundwater restoration methods that may be necessary when the final standards are promulgated. The DOE has characterized conditions at the Rifle uranium mill tailings sites and determined that the proposed remedial action would comply with the requirements of Subpart A of the proposed EPA groundwater protection standards. When final standards are promulgated, the DOE will evaluate groundwater protection requirements and undertake such action as necessary to ensure that the final standards are met. The need for and extent of aquifer restoration will be evaluated in accordance with the NEPA.

Construction schedule and estimates

Disposal at the Estes Gulch site would require an estimated 42 months to complete. Employment would reach a maximum of approximately 139 people in the sixteenth month of remedial action and would average approximately 104 people per month over the life of remedial action.

This alternative would consume an estimated 5,045,000 gallons of fuel, 1,041,000 kwh of electricity, and 284,262,000 gallons of water.

This alternative would cost an estimated \$28,921,000, excluding interim action costs. The costs of property acquisition, engineering designs, overall project management, remedial action at the vicinity properties, and long-term surveillance and maintenance are not included in this amount.

Description of final conditions

All of the tailings and contaminated materials would be relocated and stabilized partially below grade at the Estes Gulch site. The stabilized tailings pile would cover a teardrop-shaped area of approximately 71 acres (Figure 3.5). The top of the pile would slope down a maximum of 6.5 percent toward the south, and the slope at the toe of the pile would be a maximum of 20 percent (five horizontal to one vertical) (Figure 3.6). The tailings and contaminated materials would be covered with 3.0 feet of compacted earth (radon barrier), 3.0 feet of freeze/thaw protection layer

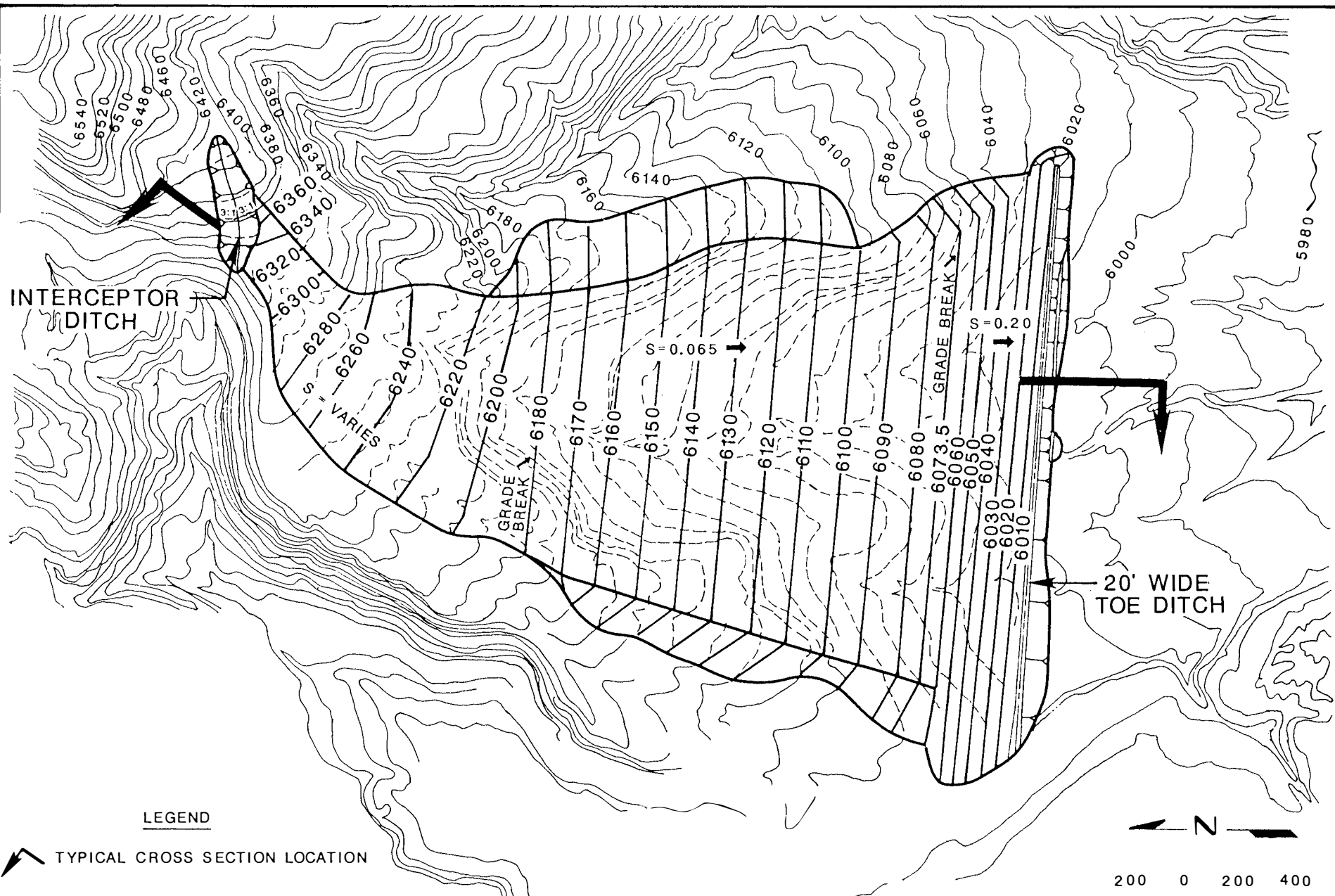
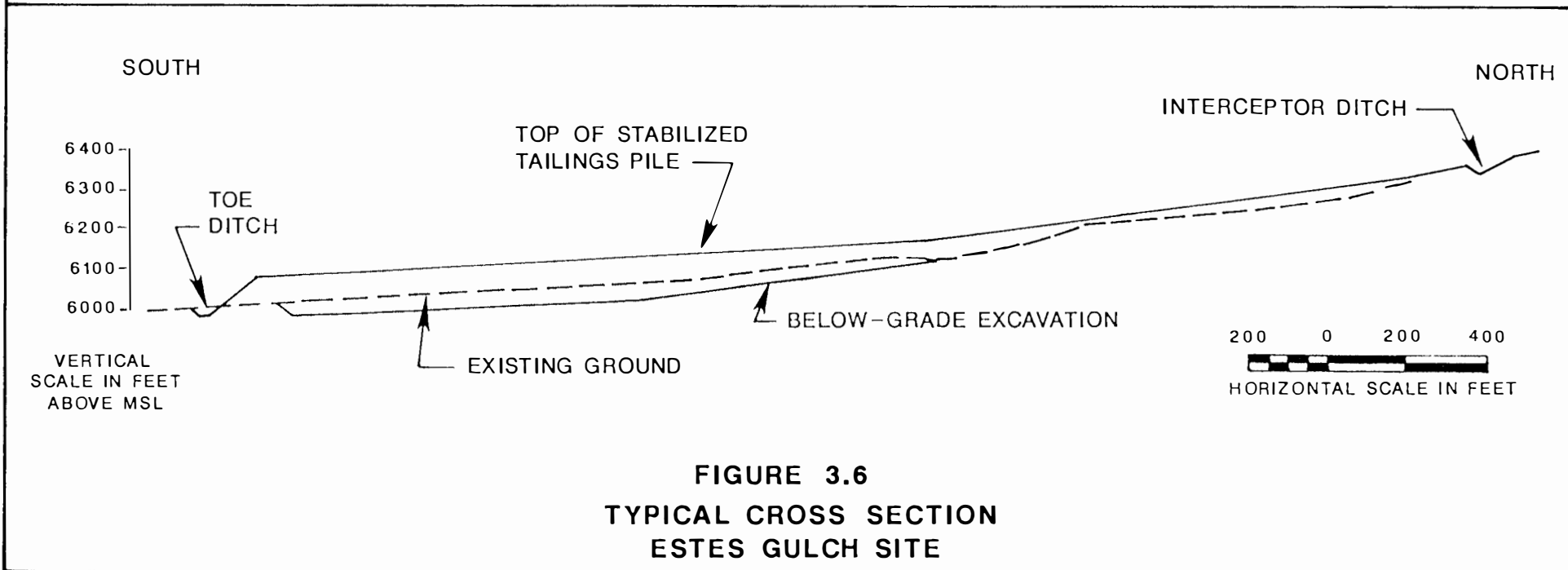
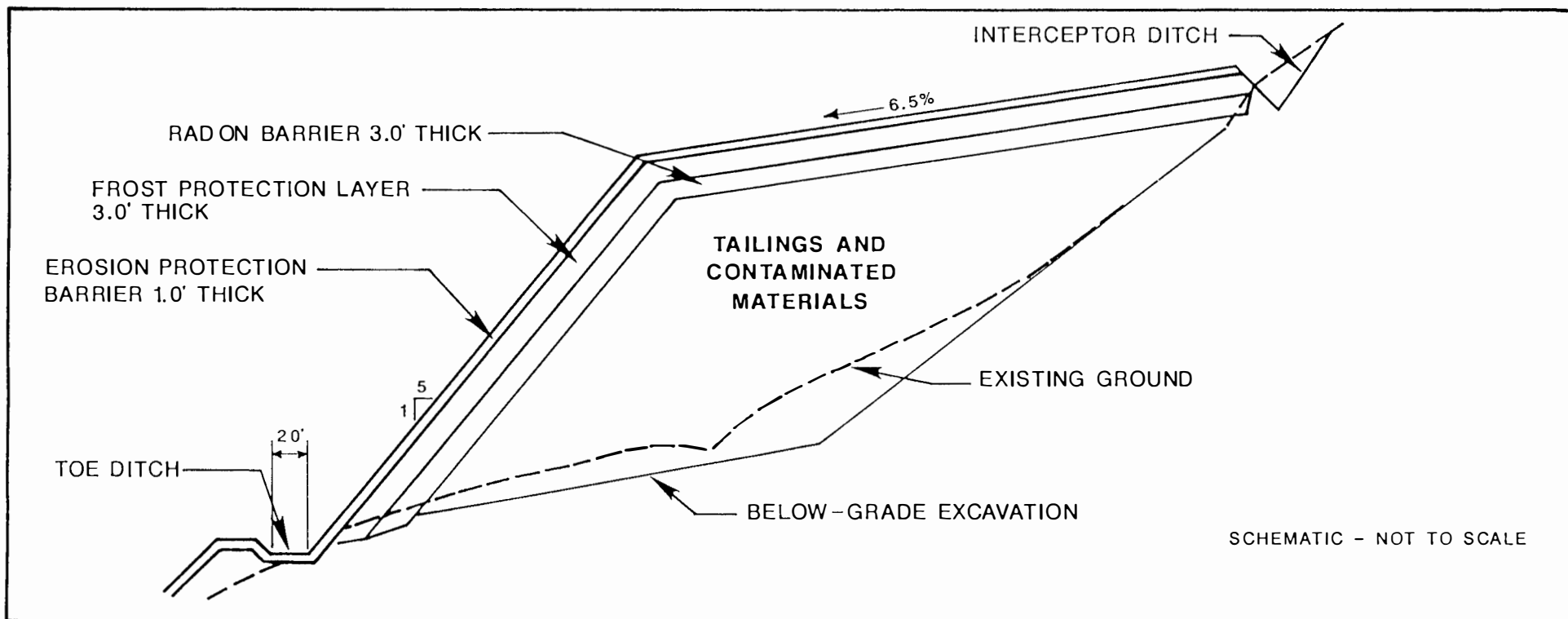


FIGURE 3.5
FINAL CONDITIONS
ESTES GULCH SITE



and 0.5 foot of drainage material, a 0.5-foot-thick filter layer, and 1.0 foot of rock (erosion protection barrier). The stabilized pile would be flush with the adjacent ridges.

The rock erosion protection barrier covering the pile would be extended to bedrock. It would also be tied into the rock-lined toe ditch to the south, the rock-filled key trenches to the east and west, and both the unlined interceptor trench and the graded, riprap-covered area of the upland drainage area to the north. These design features would divert surface water runoff away from the pile and prevent the headward advancement of drainages into the pile. Concrete posts with warning signs would enclose the stabilized pile and adjacent graded drainage areas, encompassing a total restricted area of approximately 81 acres. The access road from State Highway 13 to the site would remain intact.

After remedial action, the Old and New Rifle sites and adjacent disturbed areas would be restored with clean fill material, graded to promote positive drainage, revegetated, and released for any use consistent with existing land use controls. Disturbed wetlands areas at both sites would be revegetated.

3.2.5 Alternative 4: Disposal at the Lucas Mesa site

This alternative would involve relocating the Old and New Rifle tailings and contaminated materials to the Lucas Mesa site, approximately 35 miles southwest of Rifle. An access road would be constructed from County Road V.5 onto Lucas Mesa, and a disposal area averaging 15 feet in depth would be excavated at the site. All of the tailings and contaminated materials would be trucked to the Lucas Mesa site, placed in the disposal area, and covered with an earthen radon barrier amended with 10 percent bentonite, a four-foot-thick frost protection layer consisting of earthen material, and a rock erosion protection barrier with an underlying filter layer. A large, below-grade rock apron would be constructed along the northwest base of the stabilized tailings pile, and rock-lined drainage diversion ditches would be constructed on the northeast, southeast, and southwest sides of the pile to divert surface water runoff around and away from the pile. After the removal of the tailings and contaminated materials, the Old and New Rifle sites would be restored with clean fill material to promote positive drainage.

The disposal of tailings at the Lucas Mesa site would remove the source of tailings seepage at the Old and New Rifle sites. Seepage from the tailings at the Lucas Mesa site would be minimized by the design of the cover and the low hydraulic conductivity (10^{-8} cm/s) radon barrier. The Lucas Mesa disposal alternative would comply with the proposed EPA groundwater protection standards because the average linear groundwater velocity in the Wasatch Formation is believed to be less than 0.1 foot per year, and the proposed groundwater standards would be met at the point of compliance.

Specific details of the haul route for transportation of the tailings and contaminated materials between the Old and New Rifle tailings and the Lucas Mesa site would be determined during the preparation of the final engineering designs; however, for purposes of analysis in the EIS, the following haul routes were examined. Trucks leaving the Old Rifle site would travel west on U.S. Highway 6 to State Highway 13, south on Highway 13 to I-70, southwest on I-70 to County Road V.5 at DeBeque, and northeast on County Road V.5 to the Lucas Mesa site. Trucks leaving the New Rifle site would travel west on U.S. Highway 6 to I-70, southwest on I-70 to County Road V.5 at DeBeque, and then northeast on County Road V.5 and southeast on the one-lane Lucas Mesa access road to the Lucas Mesa site. Trucks leaving the Lucas Mesa site would either leave the site via an approximately five-mile return loop to County Road V.5, or exit alternately with arriving trucks onto the Lucas Mesa access road.

Access from County Road V.5 to the disposal site on top of Lucas Mesa is limited by steep terrain (10 percent slopes) and the relative instability of the surface material. Terrain and cut and fill requirements also limit access road construction to a one-lane gravel road that can be no more than 15 feet wide.

Major construction activities

This alternative would require the following major construction activities:

At the Old Rifle, New Rifle, and Lucas Mesa sites

- o Installation of temporary security fences at the site.
- o Construction of a wastewater retention basin(s) at each site to protect against releases of contaminants from the sites during remedial action.
- o Construction of a truck washing station at each site.
- o Construction of drainage control measures at each site to direct all wastewater and storm water runoff to the retention basin(s) during construction.
- o Implementation of measures to control erosion and sedimentation from disturbed areas at each site during construction.

At the Old Rifle and New Rifle sites

- o Upgrading (as necessary) of the access road from each site to U.S. Highway 6.

- o Protection, relocation, or removal of surface or subsurface utilities at each site during construction.
- o Construction of staging areas in the mill areas of the sites.
- o Installation and operation of a wastewater treatment facility (if necessary) at each site to protect against the inadvertent release of contaminants during construction.
- o Removal of asbestos and demolition of the mill buildings and structures at each site.
- o Dewatering of the tailings and alluvium beneath the tailings at the Old Rifle site.
- o Excavation and stockpiling of the tailings and contaminated materials at each site, including demolition debris from the mill buildings and structures and contaminated materials from the vicinity properties.
- o Relocation (by truck) of all of the tailings and contaminated materials, including sediments from the wastewater retention basins and temporary drainage ditches, from the sites to the Lucas Mesa site.
- o Restoration of the disturbed areas at and adjacent to the sites with clean fill material, grading to promote positive drainage, and revegetation. Includes revegetation of disturbed wetlands.

At the Lucas Mesa site

- o Upgrading of County Road V.5 and construction of a one lane, four-mile access road from County Road V.5 to the site; potential construction of a five-mile return loop from the site to County Road V.5.
- o Construction of a 10-acre staging area at the site.
- o Excavation of the partially below-grade disposal cell with stockpiling of the excavated earthen materials.
- o Placement of the tailings and contaminated materials, including sediments from the wastewater retention basin(s) and temporary drainage ditches at the site, in the disposal cell.
- o Placement of a four-foot-thick compacted, earthen radon barrier amended with 10 percent bentonite over the consolidated tailings and contaminated materials to inhibit radon emanation, water infiltration, and plant root penetration.

- o Placement of a four-foot-thick frost protection layer consisting of earthen material to protect the radon barrier from freezing and thawing.
- o Placement of a rock erosion protection barrier with an underlying filter layer over the radon barrier to inhibit wind and water erosion and penetration by burrowing animals.
- o Construction of a below-grade rock apron along the northeast base of the stabilized tailings pile to protect against erosion from the headward advancement of adjacent surface drainages.
- o Construction of rock-lined drainage diversion ditches on the northwest, southeast, and southwest sides of the stabilized tailings pile to divert surface water runoff around and away from the pile.
- o Installation of monuments with warning signs around the stabilized tailings pile and adjacent erosion protection features to discourage inadvertent human intrusion.
- o Reclamation, including revegetation as required, of all areas disturbed at the site during remedial action.

At the Second Street and New Rifle borrow sites

- o Excavation of earth, gravel, and rock for access road construction, erosion protection, and site restoration.
- o Transportation (by truck) of the earth, gravel, and rock to the Old and New Rifle tailings sites and the Lucas Mesa disposal site.

At the Glenwood Springs borrow site

- o Excavation (by traditional quarrying methods) of large rock for erosion protection.
- o Transportation (by truck) of the large rock to the Lucas Mesa disposal site.

Major design considerations

The major design considerations for this alternative include providing for the control of radon emanation, long-term stability, and groundwater protection. These considerations are discussed below, and additional details are contained in Section A.4 of Appendix A, Conceptual Designs; Section E.2 of Appendix E, Hydrology; and Sections H.3 and H.4 of Appendix H, Radiation.

Radon emanation from the stabilized tailings pile would be controlled to meet the EPA standards by the placement of a four-foot-thick, compacted, earthen radon barrier amended with ten percent bentonite over the consolidated tailings and contaminated materials. The earthen materials for the radon barrier would be obtained from the materials excavated from the partially below-grade disposal area; the bentonite would be obtained from a commercial source. The thickness of the radon barrier was determined using data on the distribution of radium in the tailings and data on the physical properties of the earthen borrow materials as inputs to the RAECOM computer model (NRC, 1984).

The radon barrier would be protected from freezing and thawing by the placement of a four-foot-thick layer of earthen materials.

The principal considerations for the long-term stability of the stabilized tailings pile include erosion from a major precipitation event, gully erosion, and slope stability. Flooding and river meander would not be major considerations because the tailings and contaminated material would be located away from any major surface drainages.

The stabilized tailings pile would be protected against the erosive forces of a PMP by placing the pile partially below grade, by contouring the exposed portion of the pile with relatively flat slopes, and by placing a rock erosion protection barrier over the radon barrier. The disposal cell would have an average depth of 15 feet, and the pile would have maximum slopes of four percent on the top and 20 percent (five horizontal to one vertical) on the sides. The rock erosion protection barrier on the top of the pile would be 1.5 feet thick and would consist of rock with a mean diameter of two inches or greater and an underlying filter layer. The rock erosion protection barrier on the sides of the pile would be two feet thick and would consist of rock with a mean diameter of seven inches or greater and an underlying filter layer.

Although the stabilized tailings pile would not be near any major surface drainages, there would be a potential for nearby minor drainages (gullies) to advance headward and encroach on the pile. The disposal site would be at the head of a watershed and would have very little drainage area above it. To protect the stabilized pile against surface water runoff from this small drainage area and the disposal site itself, rock-lined drainage diversion ditches would be constructed on the northeast, southeast, and southwest sides of the pile. These ditches would divert surface water runoff around and away from the pile and into existing surface drainages east and west of the pile. The pile would be protected against the headward advancement of gullies northwest of the pile by construction of a below-grade rock apron along the northwest base of the pile. This apron would be 100 feet wide, four feet thick, and would consist of rock with a mean diameter of seven inches or greater. The apron would be tied into the rock erosion protection barrier on the northwest sideslope of the pile.

Protection against slope failure would be provided by placing the stabilized pile partially below grade and by contouring the pile with relatively flat slopes as described above. The stabilized pile would not fail during a design earthquake.

Several features of the design for this alternative would serve to minimize the potential for contaminant migration from the tailings to the groundwater. These features include preparation of the base of the disposal site; placement and sloping of the tailings; placement of an earthen frost protection layer, filter layers, and the compacted, low-permeability, bentonite-amended earthen radon barrier on the pile. Compaction of the tailings to below the optimum moisture content would reduce drainage from the pile.

The disposal of tailings at the Lucas Mesa site would remove the source of tailings seepage at the Old and New Rifle sites. Seepage from the tailings at the Lucas Mesa site would be minimized by the design of the cover and the low hydraulic conductivity (10^{-8} cm/s) radon barrier. The Lucas Mesa disposal alternative would comply with the proposed EPA groundwater protection standards because the average linear groundwater velocity in the Wasatch Formation is believed to be less than 0.1 foot per year, and the proposed groundwater standards would be met at the point of compliance.

Under the UMTRCA, the DOE must comply with the proposed standards until standards are promulgated in final form. As a result, remedial actions taken with regard to the Rifle sites would not preclude subsequent design enhancements if needed to achieve compliance with the standards and would not limit the selection of reasonable groundwater restoration methods that may be necessary when the final standards are promulgated. The DOE has characterized conditions at the Rifle uranium mill tailings sites and determined that the proposed remedial action would comply with the requirements of Subpart A of the proposed EPA groundwater protection standards. When final standards are promulgated, the DOE will evaluate groundwater protection requirements and undertake such action as necessary to ensure that the final standards are met. The need for and extent of aquifer restoration will be evaluated in accordance with the NEPA.

Construction schedule and estimates

Disposal at the Lucas Mesa site would require an estimated 42 months to complete. Employment would reach a maximum of approximately 161 people in the fifteenth month of remedial action and would average approximately 120 people per month over the life of the remedial action.

This alternative would consume an estimated 6,077,000 gallons of fuel, 1,041,000 kwh of electricity, and 337,886,000 gallons of water.

This alternative would cost an estimated \$62,735,000, excluding interim action costs. The costs of property acquisition, engineering designs, overall project management, remedial action at the vicinity properties, and long-term surveillance and maintenance are not included in this amount.

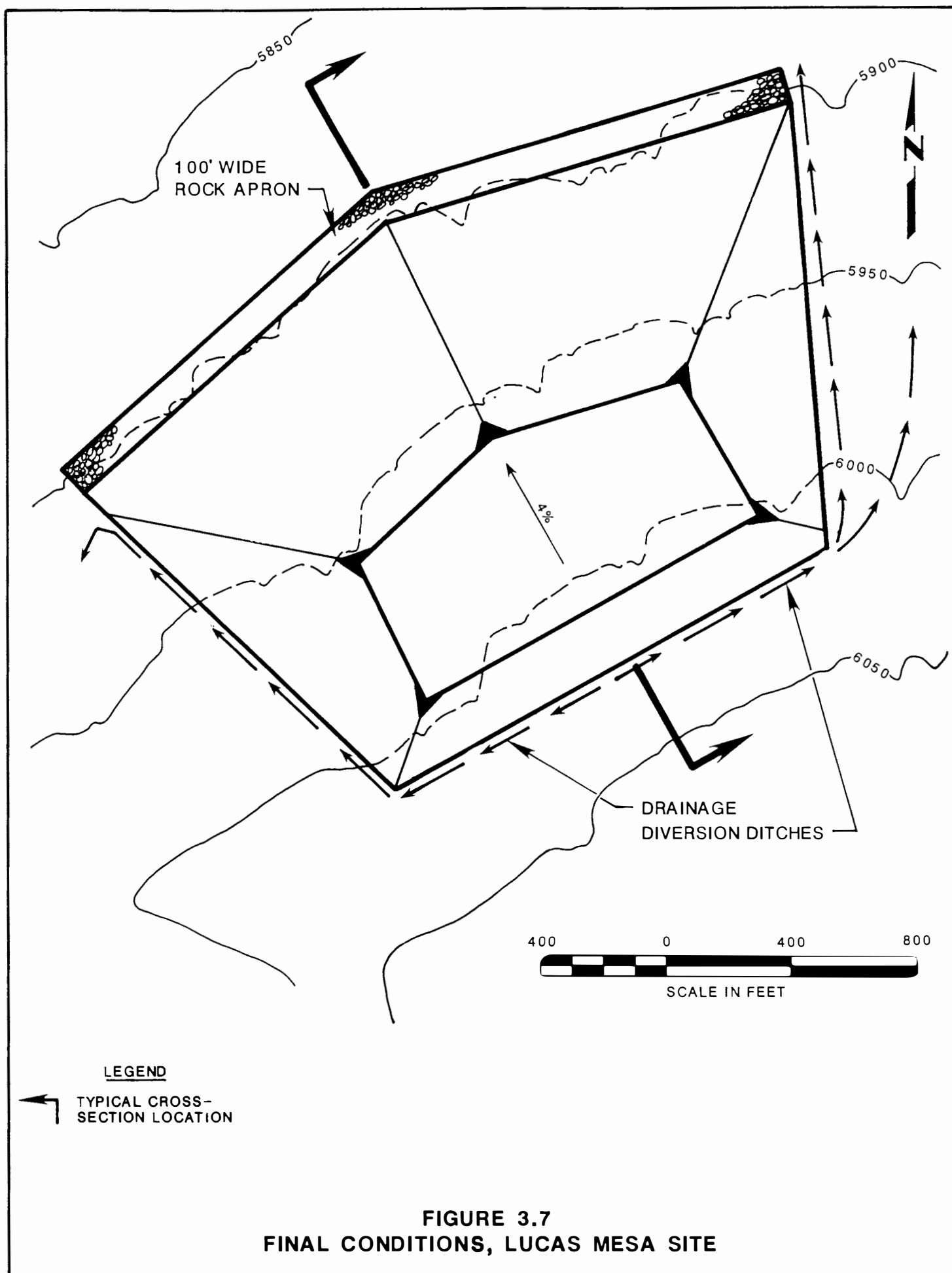
Selection of this alternative would require the construction of an improved one-lane, four-mile-long access road along the west side of Lucas Mesa. Steep terrain (10 percent slopes) and relative instability of the surface material limit access road construction to a one-lane gravel road, 15 feet wide. Returning truck traffic would either alternate with arriving truck traffic, or return via a five-mile return loop. The exact return route would be determined during the final design. Access road construction constraints could add an additional \$400,000 to the overall project costs. Selection of a one-way, alternating access road alternative could add an additional six months to the overall construction schedule; selection of a five-mile return loop could add an additional seven months to the project schedule and \$500,000 to the overall project costs.

Description of final conditions

All of the tailings and contaminated materials would be re-located and stabilized partially below grade at the Lucas Mesa site. The stabilized tailings pile would cover a roughly trapezoidal area of approximately 77 acres with a pointed northwest side (Figure 3.7). The top of the pile would slope down a maximum of four percent toward the northwest, and the sideslopes of the pile would be a maximum of 20 percent (five horizontal to one vertical) (Figure 3.8). The tailings and contaminated materials would be covered with four feet of compacted earth amended with 10 percent bentonite (radon barrier), a four-foot-thick frost protection layer consisting of earthen material, a filter layer, and 1.5 to two feet of rock (erosion protection barrier). The stabilized pile would have average and maximum heights of 36 and 160 feet above the surrounding terrain, respectively.

The rock erosion protection barrier on the northwest side-slope of the stabilized tailings pile would tie into a large, below-grade rock apron along the northwest base of the pile. Rock-lined drainage diversion ditches on the northeast, southeast, and southwest sides of the pile would divert surface water runoff around and away from the pile. Monuments with warning signs would enclose the stabilized pile, rock apron, and drainage diversion ditches, encompassing a total restricted area of approximately 83 acres. The access road from County Road V.5 to the site would remain intact.

After remedial action, the Old and New Rifle sites and adjacent disturbed areas would be recontoured, restored with clean fill material to promote positive drainage, revegetated, and



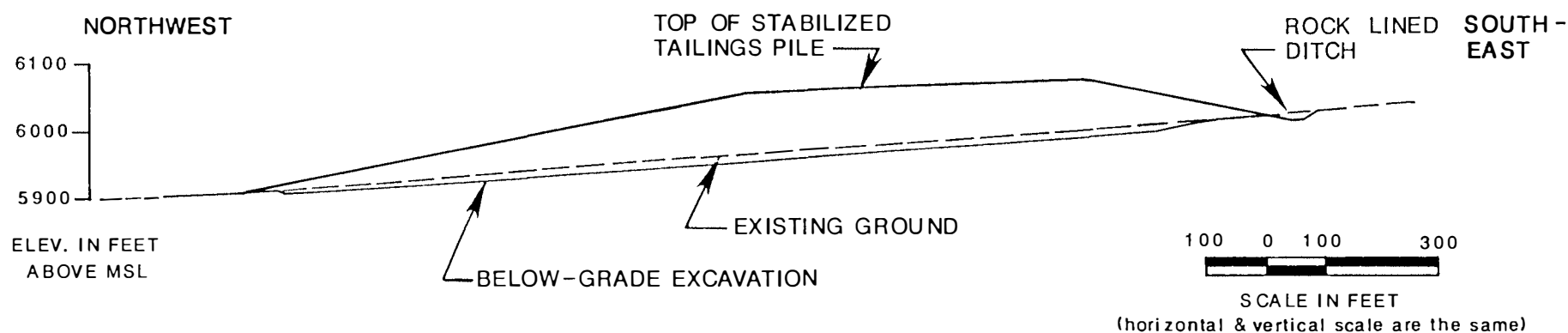
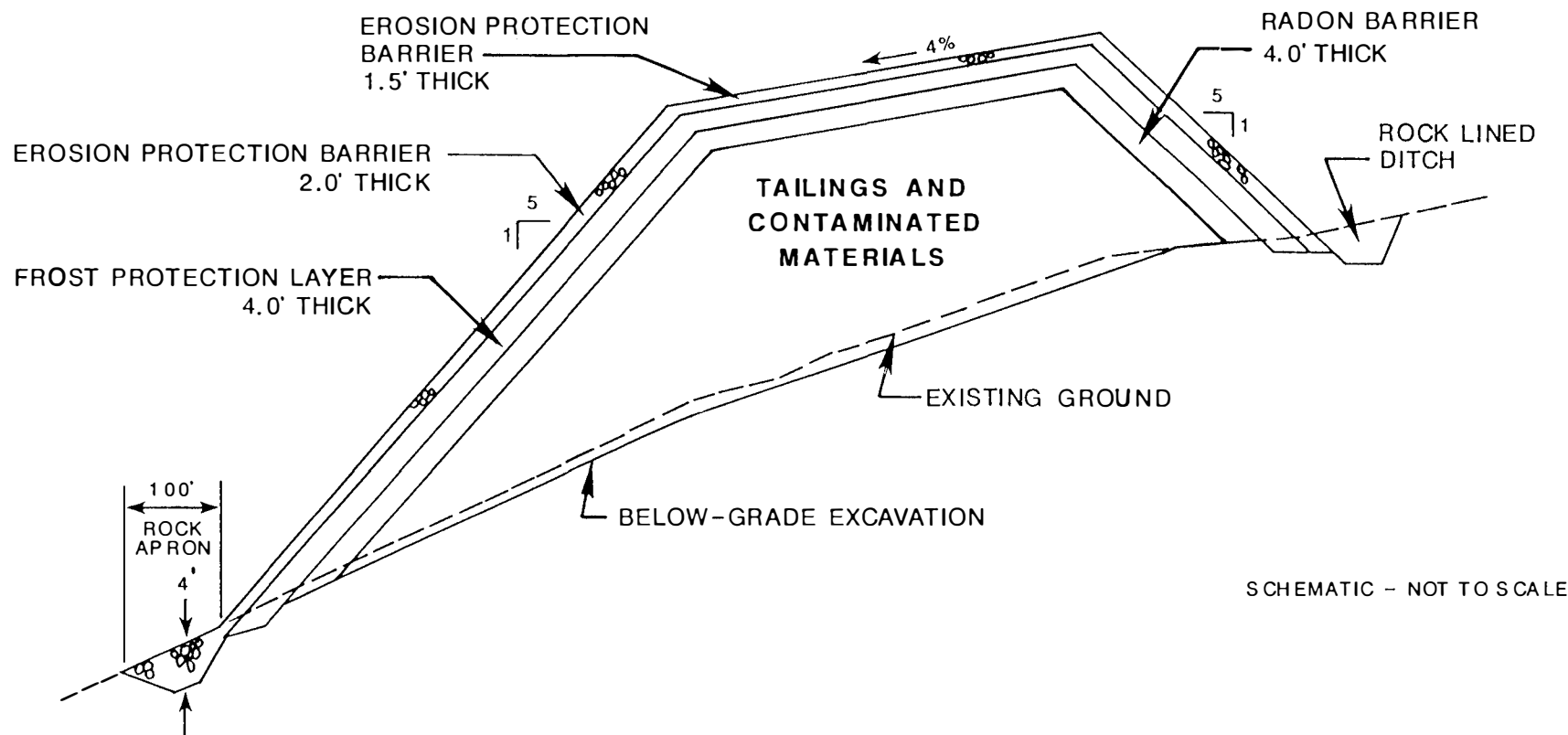


FIGURE 3.8
TYPICAL CROSS-SECTION, LUCAS MESA SITE

released for any use consistent with existing land use controls. Disturbed wetlands areas at both sites would be revegetated.

3.2.6 Borrow sites

Three borrow sites have been proposed as the sources of earthen and rock borrow materials for any of the remedial action alternatives. The borrow sites included in this EIS were selected as the sources of the necessary borrow materials for impacts analyses purposes. Although the Remedial Action Contractor (RAC) will select the borrow sites to be used for the remedial action during the final design, the impacts identified for the borrow sites included in this EIS are conservative and represent a realistic upper limit on the severity of the impacts that may occur.

The Second Street borrow site is an existing commercial borrow site immediately north of the New Rifle tailings site (Figure 3.9). The borrow operations would consist of conventional earth moving and sorting (screening) procedures. The earthen materials available at this site would be used for the radon barrier and frost protection layer for stabilization at the New Rifle site and for clean fill for site restoration for the three remedial action alternatives. The earthen materials would be purchased and trucked to the Old and New Rifle sites.

The New Rifle borrow site is an existing, commercial borrow site immediately west of the New Rifle tailings site (Figure 3.7). The borrow operations would consist of conventional earth moving and sorting (screening) procedures. The gravel and small rock available at this site would be used for access road construction and erosion protection for both of the remedial action alternatives. The gravel and rock would be purchased and trucked to the Old and New Rifle sites and the Estes Gulch site or Lucas Mesa site.

The Glenwood Springs borrow site is an existing commercial rock quarry approximately two miles northeast of the city of Glenwood Springs and approximately 30 miles east of the city of Rifle (Figure 3.10). The quarry operations consist of conventional drilling and blasting. The large rock available at this site would be used for erosion protection for all of the remedial action alternatives. The rock would be purchased and trucked to the New Rifle, Estes Gulch, or Lucas Mesa site.

For Alternatives 3 or 4, disposal at the Estes Gulch or Lucas Mesa site, the earthen materials for the radon barrier and the frost protection layer would be obtained from the excavation of the partially below-grade disposal area. For all of the action alternatives (Alternatives 2 through 4), clean fill material for restoration of the Old and New Rifle tailings sites would be obtained from the Second Street borrow site.

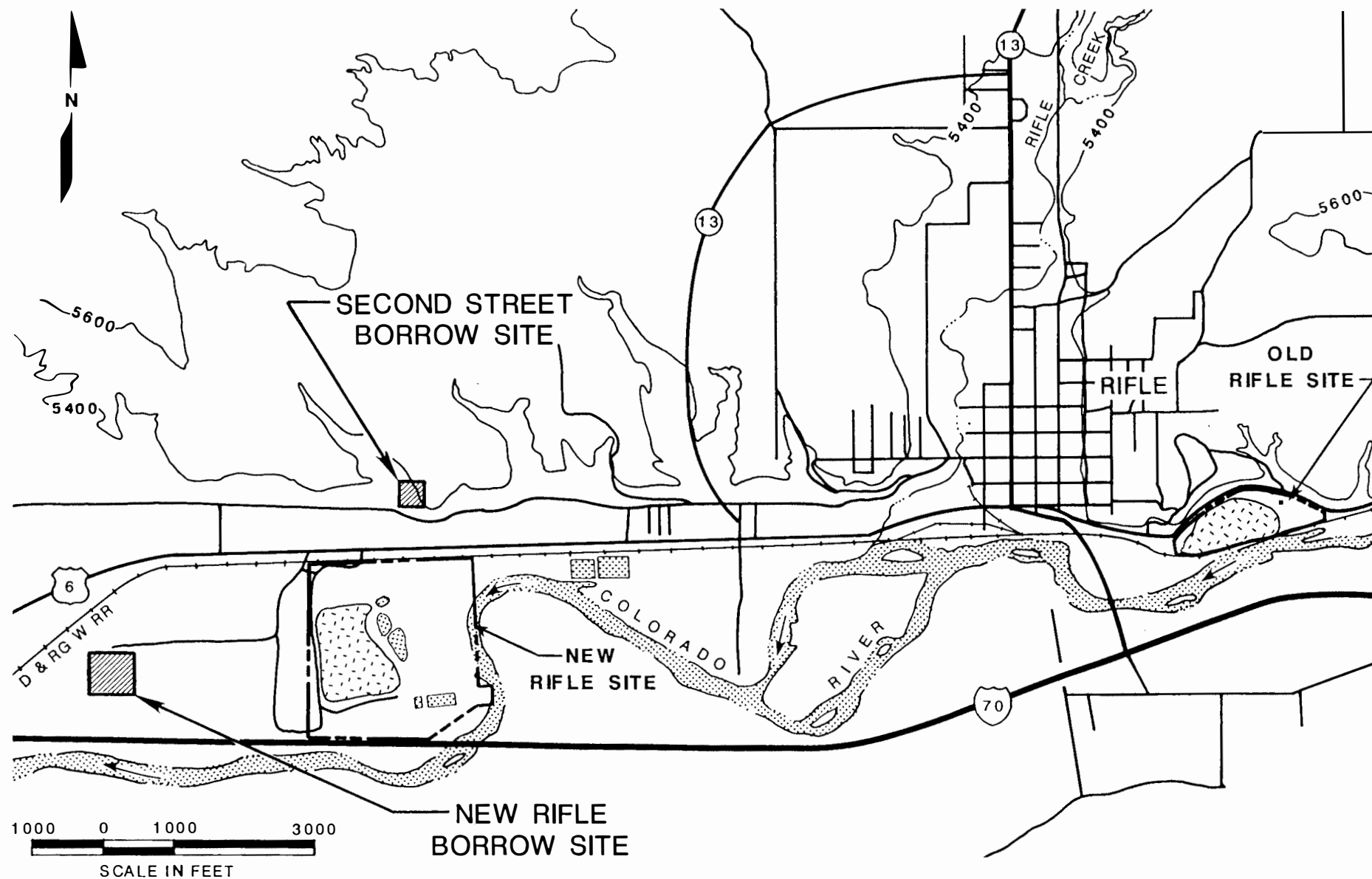
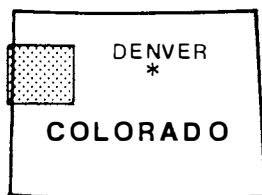
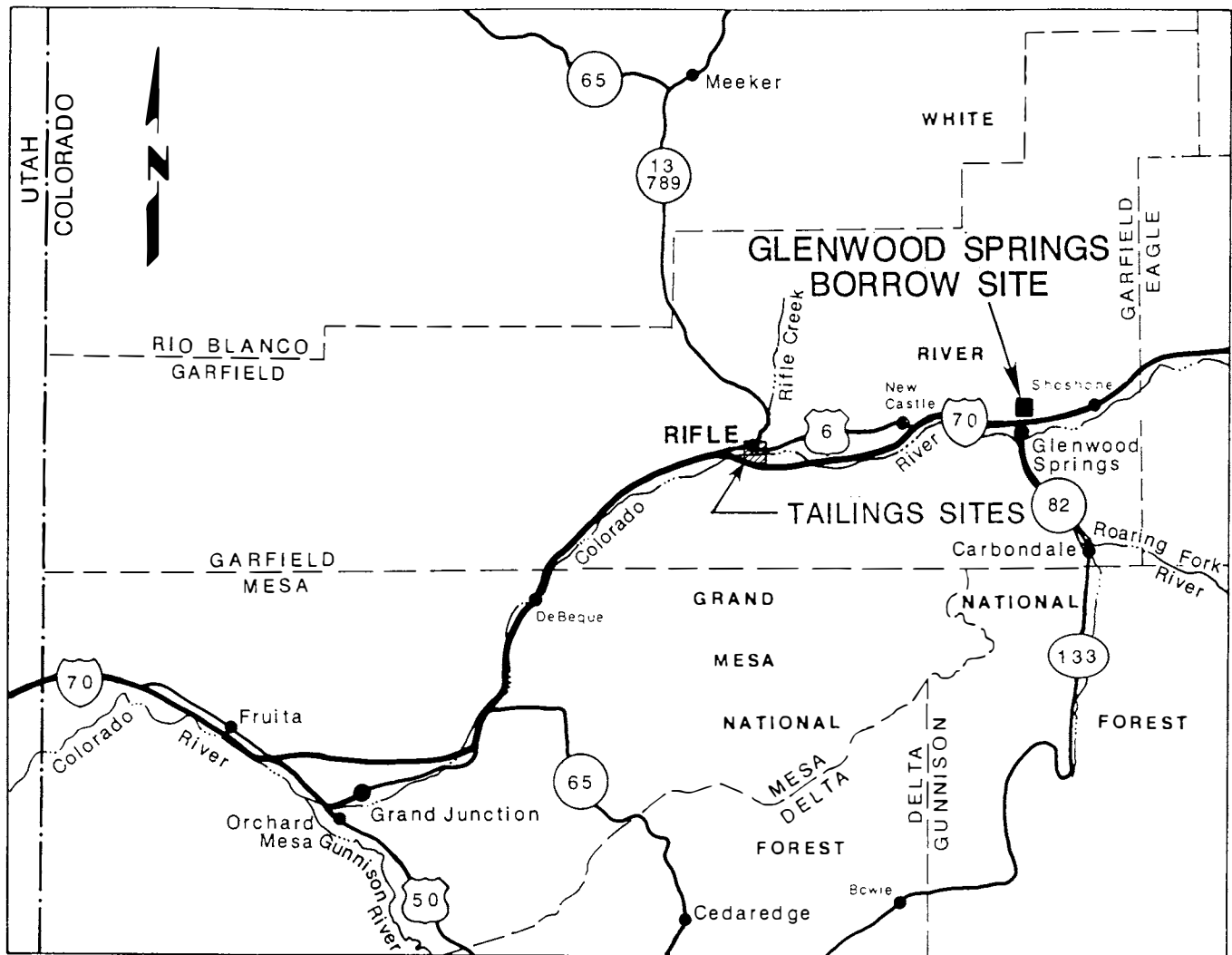


FIGURE 3.9
SECOND STREET AND NEW RIFLE BORROW SITES



APPROXIMATE LOCATION OF MAP

FIGURE 3.10
GLENWOOD SPRINGS BORROW SITE

3.3 ALTERNATIVES ELIMINATED FROM DETAILED STUDY

Alternatives eliminated from consideration in this EIS include disposal at other alternate disposal sites, using train and truck transport to relocate the tailings to the Lucas Mesa site, reprocessing the tailings prior to disposal, and returning the tailings to the mines from which the uranium ores were mined. The reasons for eliminating these alternatives are described below. Additional details are contained in Appendix B, Alternatives Analyses.

3.3.1 Other alternate disposal sites

State-nominated disposal sites

At the request of the DOE, the state of Colorado conducted a process to nominate potential disposal sites for both the Rifle and Grand Junction tailings. The process began with the Colorado Geological Survey (CGS) identifying 30 target areas on private and public lands in western Colorado. These 30 areas were evaluated by the CGS for characteristics unsuitable for tailings disposal (e.g., extensive flooding, critical groundwater resources, and unstable landforms), and this evaluation resulted in the selection of nine potential disposal sites. The CGS then ranked these nine potential sites with a geotechnical ranking matrix, and the rankings were submitted to the Candidate Site Review Committee.

The Candidate Site Review Committee consisted of city, county, and state officials who further reviewed and evaluated the nine potential disposal sites. The committee's review and evaluation considered the geotechnical ranking performed by the CGS and other important factors such as transportation systems, land use and ownership, wildlife, cultural resources, local attitudes, economics, and site location. The committee held public hearings to solicit public opinion on the potential disposal sites, and two sites, Flatiron and Lucas Mesa, were nominated for further consideration and evaluation by the DOE.

DOE alternate disposal site selection

The DOE evaluated the Flatiron Mesa and Lucas Mesa sites against technical criteria that were based on site characteristics that affect the suitability for tailings disposal. The five categories of technical criteria were environmental (including land use and wildlife), geologic, hydrologic, land ownership and land use restrictions, and engineering economics. Through this process, the DOE agreed to include the Lucas Mesa site in the draft EIS (DOE, 1987) as a potential alternate disposal site for the Rifle tailings.

In the summer of 1985, the DOE conducted another alternate disposal site selection process to identify one or more sites that would be both suitable for tailings disposal and closer to the Rifle tailings sites than the Lucas Mesa site (i.e., less costly). This process consisted of four phases: 1) designation of a search region; 2) preliminary screening of the designated search region; 3) preliminary screening and evaluation of potential areas; and 4) identification and evaluation of candidate sites. The designated search region (approximately 113 square miles) was within a six-mile radius of the Rifle tailings sites, and preliminary screening of the region eliminated approximately 100 square miles from further consideration. Evaluation of the remaining 13 square miles resulted in the selection of eight areas suitable for tailings disposal; after field inspection, five of these eight areas were eliminated from further consideration. The three remaining areas were evaluated further, resulting in the selection of three potential sites of approximately 100 acres each. Geotechnical data were collected at the two most promising sites, and the sites were ranked using geotechnical, environmental, and engineering criteria. The Estes Gulch site was determined to be the optimum alternate disposal site, and included in the draft EIS as Alternative 3 (DOE, 1987).

3.3.2 Other alternatives

Reprocessing the tailings prior to stabilization was rejected because the costs of reprocessing would greatly exceed the value of the resources produced. In addition, reprocessing the tailings would not reduce the radium content of the tailings. Since the radioactive decay of radium is the source of radon (the principal health hazard from the tailings), there would be no reduction of the hazard from radon daughters. Therefore, the reprocessed tailings would still require remedial action to meet the EPA standards. Reprocessing the tailings was therefore rejected as unreasonable.

An alternative similar to stabilization at the New Rifle site, stabilization "on" the New Rifle site, was evaluated. This alternative would involve consolidating and stabilizing the Old and New Rifle tailings and contaminated materials in the northernmost portion of the New Rifle site (the mill area). This alternative would have some advantages over the action alternatives discussed in this EIS, particularly in regards to erosion and groundwater protection and transportation impacts; locating the stabilized tailings pile in the northernmost portion of the New Rifle site would move the tailings and contaminated materials farther away from the Colorado River and rising groundwater levels while avoiding the longer haul distances to more remote disposal sites. However, groundwater protection would still be difficult to achieve, and the tailings would still be located just outside the city of Rifle. The cost of this alternative would be substantially greater than that for stabilization at the New Rifle

site but not substantially less than that for disposal at the Estes Gulch site. Therefore, this alternative was eliminated from further consideration.

The uranium ores processed at the Rifle tailings sites were mined from a large number of surface and underground mines in western Colorado and eastern Utah. These mines have been abandoned for many years, and many have collapsed. Further, Public Law 95-604 states that the governor of the receptive state must approve the transport of the tailings into his state. The possibility of returning the tailings to these mines was considered but was rejected as infeasible and unreasonable because many of the mines are inaccessible and the environmental conditions at the mines (such as the presence of groundwater) are not conducive to tailings disposal.

The Denver & Rio Grande Western (D&RGW) Railroad runs between the Rifle tailings sites and the town of DeBeque, which is approximately four miles north of the Lucas Mesa site. It was therefore determined that the combination of train and truck transport to relocate the Rifle tailings to the Lucas Mesa site would be feasible. Further evaluation of train and truck transport revealed that this alternative would involve greater environmental impacts and costs, and the alternative was therefore eliminated from further consideration.

3.4 ENVIRONMENTAL IMPACTS

This section summarizes the major environmental impacts of the remedial action alternatives. A tabular comparison of all environmental impacts is presented in Table 1.1, and Section 5.0 provides a detailed discussion of these impacts.

All of the alternatives except no action include remedial action at the vicinity properties. The impacts of remedial action at the vicinity properties were evaluated in the "Programmatic Environmental Report for Remedial Actions at UMTRA Project Vicinity Properties" (DOE, 1985a). The impacts of remedial action at the vicinity properties would be added to the impacts of each action alternative (Alternatives 2 through 4) to obtain the total impacts of remedial action.

The environmental impacts presented in this EIS are based on conservative assumptions and impact assessment procedures and thereby represent a realistic upper limit on the severity of the impacts that may occur. The actual impacts that would occur would probably be less severe than those identified in this section and elsewhere. It should be noted that many of the impacts presented in this EIS (e.g., air quality and noise) are also based on continuous interim/remedial action schedules (i.e., interim/remedial action would be conducted throughout the year). In reality, inclement weather during the months of December, January, and February would probably cause construction activities to cease, and the

associated impacts would likewise cease or decrease. Section 5.0 and the appendices to this EIS contain descriptions of the impact assessment assumptions and procedures.

3.4.1 Comparison of impacts

The primary environmental impacts of the interim/remedial action alternatives relate to radiation doses, air quality, water resources, land use, noise, population, employment, costs, and transportation.

Under the no action alternative, the radiation doses and projected health impacts from the tailings piles would continue at present unacceptable levels (100 fatal cancers in 1000 years from the radiation released from the tailings piles). Under each of the other alternatives, the radiation releases from the tailings piles would be reduced to the EPA standards and would thereby significantly reduce the potential health effects. However, there would continue to be small releases of radiation from the stabilized tailings pile, and, since stabilization at the New Rifle site would involve leaving the stabilized tailings near the city of Rifle, this alternative would result in higher projected health impacts (two cancer deaths in 1000 years) than disposal at the more remote Estes Gulch or Lucas Mesa sites (0.7 to 0.5 fatal cancers in 1000 years, respectively). These projected health impacts are based on a constant population, and an increase in the population of Garfield County would cause the health impacts for no action and stabilization at the New Rifle site to increase more than for the relocation alternatives.

Under all of the alternatives except no action, Federal and state annual air quality standards for the concentrations of particulates (dust) would be temporarily exceeded at one or more of the Rifle tailings sites and at the alternate disposal sites. Federal and state 24-hour standards would also be temporarily exceeded along the transportation routes for the Estes Gulch and Lucas Mesa relocation alternatives. The estimated maximum average annual concentrations of particulates range from 364 micrograms per cubic meter at the New Rifle site for stabilization at the New Rifle site, to 283 micrograms per cubic meter at the Estes Gulch site for the Estes Gulch alternative, to 209 micrograms per cubic meter at the Lucas Mesa site for the Lucas Mesa alternative. The Federal and state primary annual standard is 75 micrograms per cubic meter.

The no action alternative would result in continued contamination of the groundwater beneath the tailings sites for an indefinite period of time. At the Old and New Rifle sites, natural flushing would reduce concentrations of conservative contaminant species to background levels in the alluvium within 10 years after the tailings have been removed at the Old Rifle site, and within

50 years at the New Rifle site. However, natural flushing of non-conservative (geochemically reactive) species could require considerably more time and require active aquifer restoration. Natural flushing in the underlying Wasatch Formation within 100 years would be negligible because of the formation's low hydraulic conductivity.

For all of the action alternatives, natural flushing with proper institutional controls would eventually bring contaminant concentrations at the Old and New Rifle sites into compliance with MCLs. However, for stabilization at the New Rifle site, periods of flooding of the Colorado River could cause periodic exceedance of the proposed standards. If natural flushing is not sufficient to reduce all concentrations to MCLs or background levels within 100 years, or if periodic flooding causes periodic exceedance of the proposed groundwater protection standards, then design modifications, active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required to ensure compliance.

For the Estes Gulch and Lucas Mesa alternatives, the proposed groundwater standards would be met at the toe of the pile. If the proposed concentration limits are exceeded for any hazardous constituent at the toe of the pile, disposal cell cover modifications, supplemental standards, or ACLs would be implemented to ensure compliance.

According to EPA standards, the contaminants must flush naturally in at least 100 years or the DOE must actively restore groundwater at the New Rifle site. When the final EPA groundwater protection standards are promulgated, the DOE will evaluate its groundwater protection plan and undertake such action as is necessary to ensure that the revised standards are met. The need for and extent of aquifer restoration will be evaluated in accordance with the NEPA.

Under no action and stabilization at the New Rifle site, 164 and 142 acres, respectively, of land adjacent to the city of Rifle would be unavailable for productive land uses such as industrial development. However, it is unlikely that new development would be allowed on any areas within the 100-year floodplain. Under Alternatives 3 and 4, the tailings sites would be decontaminated and released for other uses while 81 (Estes Gulch) or 83 (Lucas Mesa) acres of land currently used for low-density grazing would be restricted for tailings disposal.

Under all of the alternatives, there would be daytime noise from construction equipment that would temporarily disturb residents near the tailings, disposal, and borrow sites and along the transportation routes. Estimated maximum noise levels at the residences closest to the Old and New Rifle sites are 83 and 76 decibels, respectively, for the interim actions and the stabilization at New Rifle alternative and 83 and 79 decibels, respectively,

for the relocation alternatives. Estimated maximum noise levels at the residences closest to the Estes Gulch or Lucas Mesa sites are 54 to 57 decibels. For residences closest to the borrow sites, estimated maximum noise levels range from 60 to 82 decibels for stabilization at the New Rifle site to 50 to 74 decibels for the relocation alternatives. Maximum noise levels along the transportation routes are estimated to be 80 decibels for all of the action alternatives. In addition, the Lucas Mesa alternative would cause noise that would disturb residents at and around DeBeque.

All alternatives would cause an increase in the populations of Garfield County and the city of Rifle. The increase in the populations during peak interim or remedial action activities would range from 39 people for interim actions at the Old and New Rifle sites to 43 people for disposal at the Estes Gulch or Lucas Mesa site. Community services in Garfield County and Rifle (schools, medical facilities, sewage treatment facilities, and the like) are adequate to handle these increases.

All alternatives would cause an increase in employment. The number of people directly employed during peak remedial action site activities would range from 210 people for stabilization at the New Rifle site to 69 people for interim actions at the Old and New Rifle sites. The total direct, indirect, and induced employment during peak activities would range from 357 to 118 persons. Approximately 80 to 90 percent of the jobs created would be filled by persons already living in Garfield County.

The estimated costs of the alternatives, in order of increasing costs, are as follows:

<u>Alternative</u>	<u>Cost in 1986 dollars</u>
No action (interim actions)	5,710,000
New Rifle	15,460,000
Estes Gulch	28,921,000
Lucas Mesa	62,735,000

These estimates do not include the costs of property acquisition, engineering designs, overall project management, remedial action at the vicinity properties, and long-term surveillance and maintenance. The estimates for the three action alternatives do not include the costs of interim actions. The major costs involved in the no action alternative result from the asbestos removal and demolition of the mill structures at both processing sites. The major costs involved with stabilization at the New Rifle site result from the need to place extensive rock erosion protection around the entire pile to protect it against erosion from a PMF. The major costs for the Estes Gulch and Lucas Mesa relocation alternatives result from the relatively long haul distances for both the tailings and borrow materials.

Under the no action alternative, Alternative 1, there would be minor transportation impacts. Stabilization at the New Rifle site would cause a large increase in traffic (primarily trucks) on U.S. Highway 6. This increase in traffic would cause an estimated 0.06 traffic fatality and increased congestion and highway maintenance on U.S. Highway 6. The Estes Gulch and Lucas Mesa relocation alternatives would cause greater traffic fatalities (0.24 and 0.58, respectively), traffic congestion, and highway maintenance than stabilization at the New Rifle site. Disposal at the Estes Gulch site would require upgrading and maintenance of the transportation route (U.S. Highway 6 and State Highway 13). Disposal at the Lucas Mesa site would require upgrading of U.S. Highway 6 and County Road V.5.

Alternative 3, disposal at the Estes Gulch site, is the DOE's preferred alternative. The DOE feels this alternative provides the most stable, permanent, and reliable design that balances reasonable cost and lower environmental impacts. The Estes Gulch site is not subject to the engineering design, hydrologic, land use or public concerns associated with stabilization at the New Rifle site.

This design also provides the greatest assurance of permanent compliance with the EPA's proposed groundwater protection standards. Because of the low hydraulic conductivity of the underlying Wasatch Formation, and the extremely low groundwater velocities in the formation, contaminated groundwater would travel less than 100 feet in 1000 years. This is the approximate distance to the POC and the design life of the disposal cell. The Estes Gulch alternative would comply with the proposed EPA groundwater protection standards and the MCLs would be met at the POC.

The height of the stabilized pile at Estes Gulch would be flush with the adjacent terrain, blend with the color and form of the surrounding landscape, and would not be visible from State Highway 13. Long-term impacts would be minimal due to its remote location and low public use. Disposal at the Estes Gulch site would also release the 142-acre New Rifle site for future development, which is supported by local public comments. The major costs and concerns for this alternative result from the longer hauling distances for both the tailings and the borrow materials.

Alternative 4, disposal at the Lucas Mesa site, could provide similar design stability, permanence, reliability, and compliance with the proposed groundwater protection standards. However, there are increased impacts and substantial increases in costs and materials consumption due to the much greater hauling distances for both the tailings and borrow materials.

Alternative 2, stabilization at the New Rifle site, provides the least stable, permanent, and reliable design, and may not guarantee complete and permanent compliance with the EPA's

proposed groundwater protection standards. Major concerns related to disposal at the New Rifle site include: the proximity to the Colorado River, the vulnerability to channel shifts of the river, the high groundwater table, the large quantity of contaminated materials involved, the constraints imposed by the limited areal extent of the site, a permanent loss of 142 acres at the New Rifle site from future development, and the visual impacts of the above-ground stabilized pile to the nearby Rifle community.

Because the New Rifle disposal cell would be located within the floodplain of the Colorado River, the disposal cell could be subject to erosion or undermining from a major flood event or lateral migration of the river channel. The rock apron constructed around the base of the pile was designed according to standard engineering practices and flood analyses based on computer modeling. This design should be able to withstand predictable flood events, normal erosion, and lateral channel migration. However, the potential exists for damage or destruction of the pile by unpredictable or unusual events and processes that could occur over the next 1000 years. A cataclysmic event could result in the release of contaminants directly into the Colorado River, a major western river that provides water resources to Colorado and other western states, as well as Mexico. Additional design changes or emergency pile stabilization could increase overall project costs considerably.

In addition, while the cover system has been designed to limit vertical seepage downward through the tailings, flooding of the Colorado River would result in elevated groundwater levels. This could result in encroachment on the lower portions of the tailings and contaminant releases into the groundwater. The proposed EPA groundwater protection standards could be temporarily exceeded on a periodic basis following each flooding episode. If compliance with the proposed groundwater protection standards cannot be achieved with the proposed conceptual design, then design modifications or ACLs would have to be considered. Either option could increase overall project costs considerably.

Selection of this alternative would also result in a permanent visual annoyance to the local community and travelers along I-70 and the Denver & Rio Grande Western Railroad. In addition, some local public concern has been expressed over the loss of the 142-acre New Rifle site from future development.

While the no action alternative is presented, selection of this alternative would not be consistent with the intent of Congress in the UMTRCA (PL95-604) and would not result in compliance with the EPA standards (40 CFR 192).

3.4.2 Mitigative measures

Mitigative measures have been included in all of the alternatives to reduce the impacts on the environment. The following are the primary mitigative measures that have been included in the alternatives.

Mitigative measures included in all alternatives (unless otherwise noted)

- o Performance of interim actions to remediate existing safety hazards to the Rifle community, regardless of which alternative is selected.
- o Upgrading of transportation routes (as necessary) with traffic controls such as traffic signals, flagmen, turn-outs, and passing lanes to reduce the potential for traffic accidents and congestion.
- o Construction of fences or other access barriers to inhibit unauthorized human intrusion during remedial action.
- o Construction of temporary erosion controls, wastewater retention basins, and treatment plants to protect against the release of contaminants during remedial action.
- o Treatment of any water to be discharged (as necessary) in accordance with applicable state standards.
- o Stockpiling of various soils encountered at the alternate disposal sites for future use during reclamation.
- o Application of water to disturbed areas at the Old and New Rifle sites and the alternate disposal sites to inhibit fugitive dust emissions.
- o Application of water and chemical dust suppressants to dirt and gravel access roads to inhibit dust emissions.
- o Covering of, or use of chemical dust suppressants on, haul trucks (includes tailings haul trucks for the remedial action alternatives to prevent the dispersion of tailings during relocation only).
- o Removal of all contaminated soils (consistent with the EPA standards) adjacent to and beneath the existing tailings piles (when appropriate) and consolidation of the contaminated soils with the tailings (remedial action alternatives only).
- o Selection of borrow sites that are as close to the disposal sites as possible to reduce costs and minimize the impacts of long haul distances.

- o Use of existing borrow sites for earthen and rock materials (where possible) to reduce the amount of land disturbance associated with all alternatives.
- o Use of local labor whenever possible to maximize economic benefits to the local communities.
- o Conducting construction operations only during the day to reduce noise disturbance to local residents.
- o Immediate cleanup of any off-site spills.
- o Implementation of environmental monitoring programs during interim/remedial action.
- o Design of the stabilized tailings to withstand a design earthquake (remedial action alternatives only).
- o Construction of various drainage control and diversion measures to direct surface water runoff away from the stabilized tailings and prevent long-term erosion.
- o Construction of a compacted, earthen cover on the stabilized tailings to inhibit radon emanation (consistent with the EPA standards), surface water infiltration, and plant root penetration (remedial action alternatives only).
- o Construction of an earthen frost protection layer and drain layer to protect the radon layer from freeze/thaw effects (remedial action alternatives only).
- o Construction of a rock cover on the stabilized tailings to ensure that the stabilized pile could withstand the erosive effects of the PMP and to inhibit intrusion by burrowing animals (remedial action alternatives only).
- o Construction of a complex tailings cover and access barriers for the stabilized tailings to prevent inadvertent human intrusion after remedial action (remedial action alternatives only).
- o Reclamation, including backfilling, grading, and revegetation of all areas disturbed during interim/remedial action except the stabilized tailings and access roads (remedial action alternatives only).
- o Restoration and revegetation of the disturbed wetlands (20 acres) at both Rifle sites cleared during interim/remedial action.
- o Cleanup of the equipment used in the interim/remedial action before releasing it for other projects to prevent the spread of contaminated materials.

Revegetation of disturbed upland and wetland areas would be included as part of the mitigation plan. Revegetation of these areas is important to prevent soil erosion and to preserve and enhance the natural and beneficial values of wetlands, as is mandated by law (10 CFR 1022.3(a)(6)). As is discussed in Appendix F, "Floodplains and Wetlands Assessment," the specific details of the mitigation plan will be developed in consultation with the appropriate regulatory agencies and will be incorporated into the development of the final remedial action design. General features of the mitigation plan include: starting work during an appropriate season; filling, grading and recontouring disturbed areas to encourage establishment and growth of vegetation; using appropriate materials and techniques; and using selected appropriate erosion control measures.

Mitigation measures necessary to ensure the protection of remedial action workers and the long-term stability of the tailings are described in the UMTRA Project Environmental Health and Safety Plan (DOE, 1985b), Guidance for UMTRA Project Surveillance and Maintenance (DOE, 1986), and the Rifle Remedial Action Plan (DOE, 1989).

The following mitigative measures were incorporated into the individual remedial action alternatives.

Stabilization at the New Rifle site

- o Placement of a thick rock erosion protection barrier on all sides of the stabilized tailings pile to protect it against erosion from a PMF.
- o Construction of a below-grade, rock apron around the entire stabilized tailings pile to protect it against erosion from a PMF.
- o Release of the Old Rifle site, after restoration of the site, for any use compatible with local land use plans.

Disposal at the Estes Gulch site

- o Construction of a paved 12-foot wide, 7,500-foot long climbing lane on the east side of State Highway 13 between Highway 325 and the Estes Gulch site turnoff; an 800-foot long, 12-foot wide gravel truck turnout; and an intersection facility on State Highway 13 at the Estes Gulch turnoff.
- o A cultural resources survey will be performed prior to surface disturbance related to widening and improving State Highway 13. If eligible cultural resources are identified and cannot be avoided by construction activities, a data

recovery plan would be designed and implemented with the Colorado State Historic Preservation Office and the BLM if appropriate. It is expected that due to previous surface disturbance, no cultural resources will be identified.

- o A survey for sensitive and endangered plant species (Wetherill milkvetch, Uinta Basin hookless cactus, DeBeque milkvetch, and DeBeque phacelia) will be performed prior to the initiation of surface disturbing activities related to widening and improving State Highway 13. If plant populations are identified, they will be avoided; if they cannot be avoided, site-specific mitigation measures will be developed with the appropriate state and Federal agencies.
- o Avoidance of areas containing the Wetherill milkvetch (state listed plant species of special concern) during the construction of the access road to the site.
- o Partially below-grade disposal of the tailings and contaminated materials to minimize the land area to be occupied by the stabilized pile and to ensure the long-term stability of the pile.
- o Grading of the terrain adjacent to the embankment to promote sheet flow and construction of rock-filled key trenches at the embankment and existing terrain interface.
- o Grading and adding riprap in the upland drainage area to the north, and construction of an unlined interceptor ditch, to divert surface runoff away from the pile.
- o Construction of a rock-armored toe ditch, founded in bedrock, along the southern base of the stabilized tailings pile to collect runoff from the embankment surface and adjacent areas and convey it westward, and to minimize or eliminate headward advancement of adjacent surface drainages.
- o Release of the Old and New Rifle sites, after restoration of the sites, for any use compatible with local land use plans.

Disposal at the Lucas Mesa site

- o Partially below-grade disposal of the tailings and contaminated materials to minimize the land area to be occupied by the stabilized pile and to ensure the long-term stability of the pile.
- o Amendment of the earthen radon barrier with 10 percent bentonite.

- o Construction of a large, below-grade, rock apron along the northwest base of the stabilized tailings pile to protect it against erosion from the headward advancement of adjacent surface drainages.
- o Release of the Old and New Rifle sites, after restoration of the sites, for any use compatible with local land use plans.

3.4.3 Summary of major impacts

The no action alternative, with interim actions at the Old and New Rifle processing sites, would result in:

- o Continued exposure to unacceptable levels of radiation to people in and around Rifle from the tailings piles.
- o The tailings would continue to be subject to wind and water erosion, resulting in continuously expanding areas unsafe for human use.
- o Groundwater contamination due to tailings would continue for an indefinite period of time.
- o Unacceptable levels of radiation exposures that are projected to result in 100 fatal cancers in 1,000 years.
- o Elimination of the use of the 164 acres that comprise both tailings sites for other productive uses and temporary disturbance of 40 acres of soils during interim actions.
- o This alternative would not be consistent with the intent of Congress in the UMTRCA (PL95-604) and would not result in compliance with the EPA standards (40 CFR 192).
- o Temporary annoyance to residents near both processing sites and borrow sites from noise during the day.
- o Increased traffic on U.S. Highway 6 with associated increases in traffic accidents.
- o Increased local employment for 12 months.

Stabilization at the New Rifle site would result in:

- o Temporary exceedance of Federal and state annual and 24-hour air quality standards.
- o Removal of the source of groundwater contamination at the Old and New Rifle sites.
- o Elimination of the use of 142 acres of land at the New Rifle site for other productive land uses.

- o Temporary annoyance to residents near the Old Rifle, New Rifle, and borrow sites from noise during the day.
- o Increased local employment for 20 months.
- o Increased traffic on U.S. Highway 6 with associated increases in traffic accidents and congestion and highway maintenance.

Disposal at the Estes Gulch or Lucas Mesa sites would result in:

- o Temporary exceedance of Federal and state annual and 24-hour air quality standards.
- o Removal of the sources of groundwater contamination at the Old and New Rifle sites.
- o Release of 164 acres at the Old and New Rifle sites for other productive land uses; removal of the 81 acres at Estes Gulch (or 83 at Lucas Mesa) presently used for low-density grazing and wildlife habitat, for use in tailings disposal.
- o Temporary annoyance to residents near the Old Rifle, New Rifle, Estes Gulch (or Lucas Mesa), and borrow sites and along the transportation routes from noise during the day.
- o Increased local employment for 42 months.
- o Increased traffic on U.S. Highway 6 and State Highway 13 (or U.S. Highway 6, I-70 and County Road V.5 for Lucas Mesa) with associated increases in traffic accidents and congestion and highway maintenance.

The direct monetary costs of the alternatives, in order of increasing costs, are \$5,710,000 for the no action alternative (interim actions only); \$15,460,000 for stabilization at the New Rifle site; \$28,921,000 for disposal at the Estes Gulch site; and \$62,735,000 for disposal at the Lucas Mesa site.

REFERENCES FOR SECTION 3.0

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4.0 AFFECTED ENVIRONMENT

This section describes the environmental conditions of the region (Section 4.1), the sites that may be affected by remedial action (Section 4.2), and the pertinent environmental characteristics of each site. This section emphasizes those features that may affect the region's suitability for tailings disposal and those features that would be affected by the remedial action.

4.1 REGIONAL SETTING

The Rifle tailings sites and two alternate sites are in western Colorado (see Figure 1.1) in Garfield County. The Rifle sites consist of two separate tailings sites, the eastern Old Rifle site and the western New Rifle site (see Figure 1.2). Both tailings sites are adjacent to the city of Rifle and the Colorado River.

Both of the alternate disposal sites are outside the Colorado River valley. The Estes Gulch site is approximately six miles north of Rifle, and the Lucas Mesa site is approximately 35 miles southwest of Rifle near the town of DeBeque. Both sites are on relatively remote Federal land administered by the BLM and used primarily for low-density grazing.

This area of Colorado is semiarid with approximately 12 inches of precipitation per year, which includes approximately 41 inches of snow. Temperatures above 100°F or below 0°F are infrequent, and sunny days usually predominate in all seasons. Winds are most frequently from the northeast and west with an average speed of approximately five miles per hour.

The region has well-developed railroad and highway systems. The D&RGW Railroad and U.S. Highway 6 are immediately adjacent to the Rifle tailings sites while I-70 passes to the south of the sites. U.S. Highway 6 and State Highway 13 provide access to the Estes Gulch site, while U.S. Highway 6, I-70, and County Road V.5 provide access to the Lucas Mesa site.

4.2 DESCRIPTION OF THE AFFECTED SITES

4.2.1 Rifle sites

The Old and New Rifle tailings sites are adjacent to the city of Rifle in Garfield County, Colorado (see Figure 1.2). The Old Rifle site is 0.3 mile from the center of Rifle, and the New Rifle site is two miles from the center of Rifle.

The uranium mill at the Old Rifle site was owned and operated by Union Carbide from 1924 to 1932 and from 1942 to 1958. The mill was idle from 1932 to 1942 for economic reasons. The mill produced vanadium during both operating periods and uranium during the latter period. Ore was shipped to the mill by truck and railroad

from eastern Utah and from the Uravan Mineral Belt and Meeker and Rifle Creek mines in Colorado. The mill operated under a contract to the U.S. Atomic Energy Commission (AEC) from 1947 to 1958, and AEC records show that during that period 761,000 tons of ore were processed and over 2000 tons of uranium concentrate were sold to the AEC. After 1958, most of the Old Rifle tailings were reprocessed and deposited at the New Rifle site (FBDU, 1981).

The New Rifle mill replaced the Old Rifle mill in 1958 and was also owned and operated by Union Carbide. The mill was constructed as part of a complex which included the upgraders at Slick Rock, Colorado, and Green River, Utah. Ore and the upgrader products from Slick Rock and Green River were shipped to the mill by truck and railroad. From 1958 to 1973, the mill produced uranium and vanadium, and AEC records show that 2.7 million tons of ore, upgrader products, and Old Rifle tailings were processed. Over 5000 tons of uranium concentrate were sold to the AEC, and additional uranium and vanadium products were sold commercially. From 1973 to 1984, a portion of the mill was used to produce vanadium; this operation involved processing vanadium solutions and did not produce tailings (FBDU, 1981).

Old Rifle site

The Old Rifle tailings site covers approximately 22 acres between U.S. Highway 6 to the north and the D&RGW Railroad and Colorado River to the south (see Figure 3.1). The 13-acre tailings pile is located in the western half of the site at the base of a cliff below U.S. Highway 6. The nine-acre mill area where the ore storage and milling facilities were located is immediately east of the tailings pile and contains the only remaining mill structure, the concrete block assay building. The foundations of other mill structures are exposed or buried at the east end of the mill area. The entire tailings site is fenced to control access.

The relatively flat tailings pile contains approximately 330,000 cubic yards of tailings, which are a mixture of the processed ore and the chemicals used in the milling process. The processed ore consists of finely ground sands with a medium clay content. The tailings pile has maximum dimensions of 1300 feet long (east-west) by 650 feet wide (north-south) with an average thickness of 18 feet. The pile is separated from the Colorado River by the tracks of the D&RGW Railroad, and the southern edge of the pile is 200 feet from the river's edge. The base of the pile is five feet above the normal river level, and the railroad track bed is slightly higher than the base of the pile.

The tailings pile was partially stabilized by Union Carbide in 1967 in accordance with applicable state of Colorado regulations. The southern edge of the pile was moved north away from the railroad tracks, and the entire pile was covered with six inches of soil. The pile was then fertilized and seeded with grasses. A sprinkler system was installed and used to promote the

vegetation. Approximately 85 percent of the pile is vegetated with grasses common to the area (F8DU, 1981).

The tailings site is situated on the alluvium of the Colorado River which consists of sand, gravel, and cobbles. This alluvium, both beneath the tailings pile and in the mill area, has been contaminated to varying depths as have the soils in the vegetative cover on the tailings. Also, dispersion of the tailings by wind has contaminated 53 acres of land outside the designated tailings site boundary; this acreage includes an area northeast of the site and north of U.S. Highway 6 that contains concrete, scrap metal, and other debris from the mill. The total amount of contaminated materials, including the tailings and contaminated soils, is approximately 661,000 cubic yards.

New Rifle site

The New Rifle tailings site covers 142 acres between the D&RGW Railroad and U.S. Highway 6 to the north and I-70 and the Colorado River to the south and east (see Figure 3.2). The 33-acre tailings pile is in the west-central portion of the site, and the mill area is north and east of the pile. The mill area contains the mill facilities, various water retention ponds, and two ore storage areas. The majority of the mill facilities have been scavenged for usable materials. The remaining buildings and facilities, some of which contain asbestos, are in various states of disrepair. The tailings site is fenced to control access except along the east and south sides next to the Colorado River.

The tailings pile contains 2,415,000 cubic yards of tailings, which are a mixture of the processed ore and the chemicals used in the milling process. The processed ore consists of finely ground sands with a medium clay content. The tailings pile is shaped like an irregular rectangle and measures 1600 feet in the north-south direction and 1150 feet in the east-west direction at its widest points. The pile has two distinct heights. The northeast portion of the pile is 55 feet high and contains older tailings; the southwest portion is 41 feet high and contains newer tailings. The tops of the two portions of the pile are relatively flat; however, the sides are steep with one-to-one (one horizontal to one vertical) slopes in many places. The pile is separated from the Colorado River by a dike on the east side of the site and by the I-70 embankment on the south side of the site. The base of the pile is 1200 feet from the river on the east and 600 feet from the river on the south. The base of the pile is 10 feet higher than the normal river level. Both the dike on the east side of the site and the I-70 embankment on the south side of the site are considerably higher than the base of the pile.

Union Carbide has partially stabilized the tailings pile. Approximately 1000 tons of mulch and fertilizer were applied to the pile, and native grasses were planted. An irrigation system was installed and was used to promote the vegetation. The lack of

soil cover, the steep slopes, and strong winds in the Colorado River valley have caused some erosion of the tailings pile. Breaks in the vegetative cover have been patched with soil, and windbreaks such as snow fences have been installed in an effort to minimize the erosion (FBDU, 1981).

The tailings site is situated on the alluvium of the Colorado River, which consists of sand, gravel, and cobbles. The alluvium beneath the entire tailings site has been contaminated as have the soils and mulch in the vegetative cover on the tailings. Dispersion of the tailings by wind has contaminated another 63 acres of land outside the designated site boundary. The total amount of contaminated materials, including the tailings and contaminated soils, is approximately 3,474,000 cubic yards.

4.2.2 Estes Gulch site

The Estes Gulch site is six miles north of Rifle, above the Colorado River valley. The site is between the Grand Hogback to the northeast and State Highway 13 to the south (Figure 4.1).

The Estes Gulch site is on Federal land administered by the BLM. The site is used primarily for low-density grazing; there are two existing oil and gas leases at the site. Most of the land around the site is also Federal land administered by the BLM; however, there is some private land south of the site along State Highway 13. The residences nearest the Estes Gulch site are 1.5 miles to the west along State Highway 13. The Rifle Gap State Recreation Area is two miles east of the site, and the Naval Oil Shale Reserve is two miles west of the site.

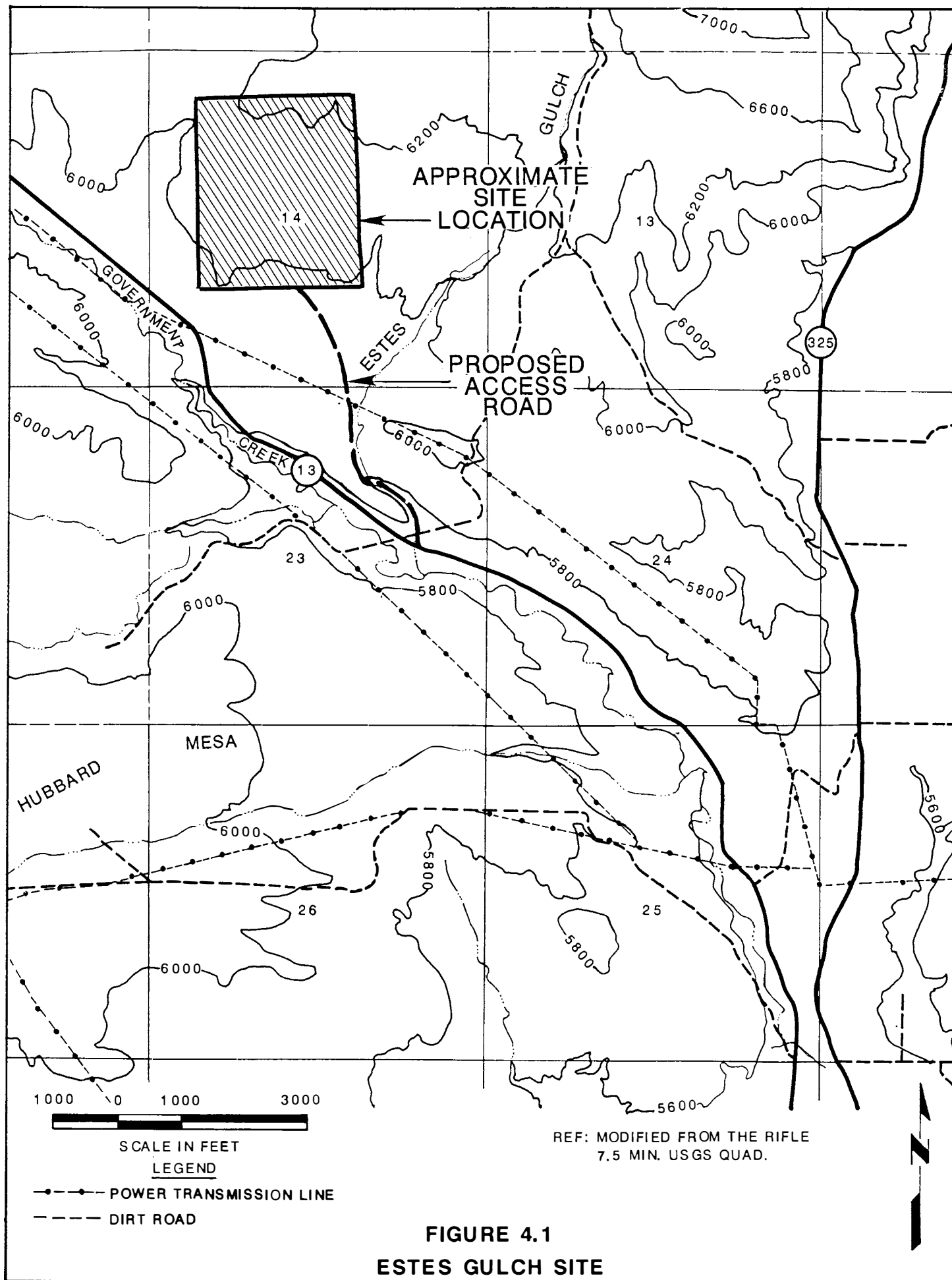
The terrain at the Estes Gulch site slopes gently upward to the north toward the Grand Hogback. Vegetation consists of a sparse cover of grasses and shrubs, and there are no major perennial surface drainages or near-surface groundwater at the site.

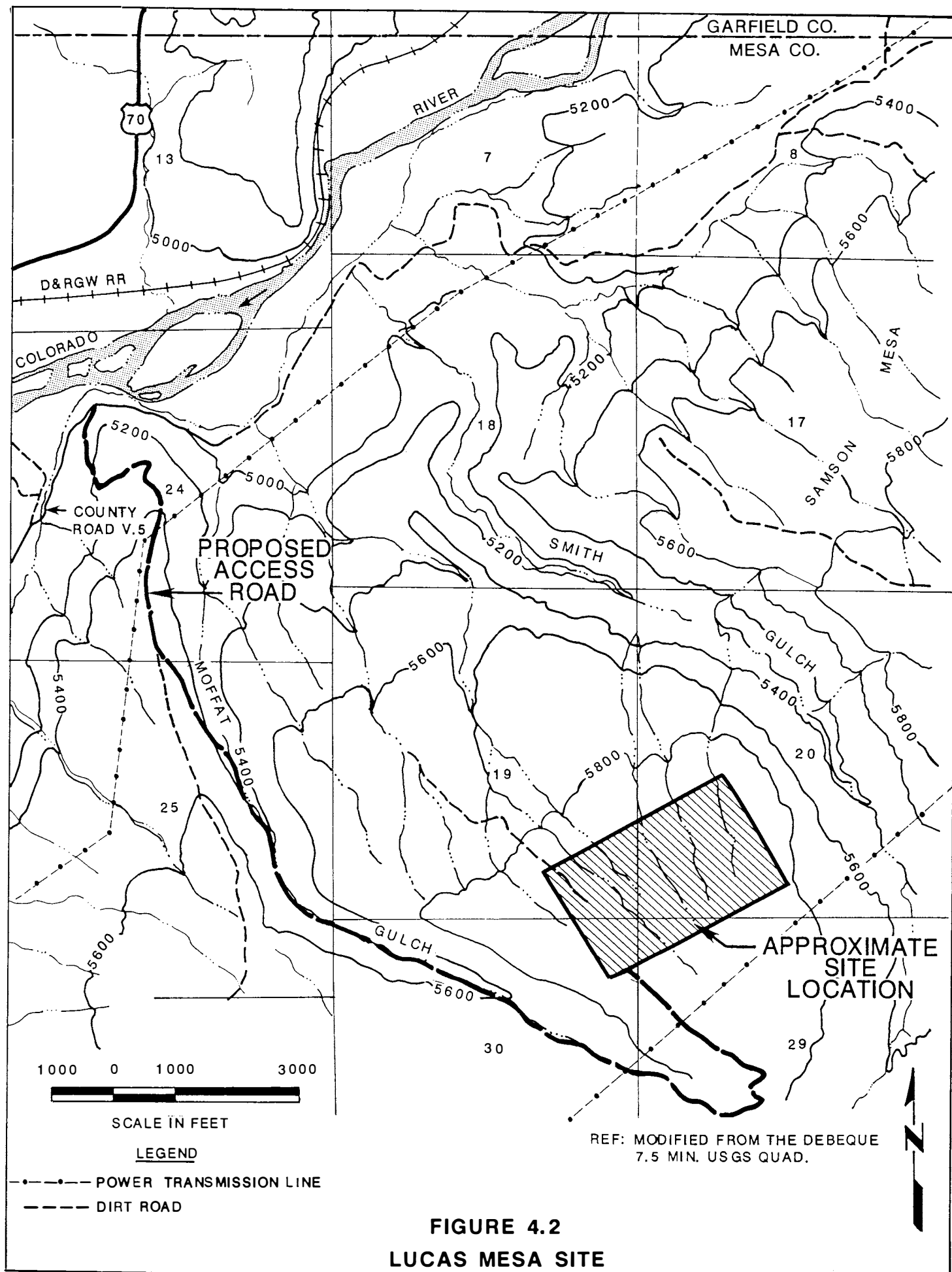
4.2.3 Lucas Mesa site

The Lucas Mesa site is 35 miles southwest of Rifle near the town of DeBeque. The site is on top of Lucas Mesa, which rises 1000 feet above the surrounding terrain (Figure 4.2).

The Lucas Mesa site is on Federal land administered by the BLM. The site is used primarily for low-density grazing, but is also subject to several existing oil and gas leases. The site is surrounded by privately owned land, and the land along the Colorado River to the north is intensely farmed.

The terrain at the Lucas Mesa site slopes gently downward to the northwest toward the Colorado River valley. Vegetation consists of juniper trees and sagebrush with a sparse understory of shrubs, forbs, and grasses. There are no major perennial surface drainages or near-surface groundwater at the site.





4.2.4 Borrow sites

Potential borrow sites have been identified for all of the alternatives. These borrow sites would be used to obtain any earthen and rock borrow materials needed to complete the interim and remedial actions that are not available at the final disposal site (see Section 3.2.6). The borrow sites included in this EIS were selected as the sources of the necessary borrow materials for impacts analyses purposes. Although the RAC will select the borrow sites to be used for the remedial action during the final design, the impacts identified for the borrow sites included in this EIS are conservative and represent a realistic upper limit on the severity of the impacts that may occur.

The Second Street borrow site is an existing, commercial borrow site immediately north of the New Rifle tailings site (see Figure 3.7). This borrow site would be the source of earthen materials for the radon barrier and the frost protection layer for stabilization at the New Rifle site, for site restoration under all remedial action alternatives, and for interim action backfill.

The New Rifle borrow site is an existing, commercial borrow site immediately west of the New Rifle tailings site (see Figure 3.7). This borrow site would be the source of gravel and small rock for access road construction and erosion protection.

The Glenwood Springs borrow site is an existing, commercial rock quarry approximately two miles northeast of the city of Glenwood Springs which is approximately 30 miles east of Rifle (see Figure 3.8). This borrow site would be the source of large rock for erosion protection.

4.3 WEATHER

The region has a semiarid, continental climate with low precipitation and humidity, large temperature variations, and high evaporation. The Rifle area is topographically and meteorologically complex, consisting of the Colorado River valley and surrounded by steep canyons and plateaus. Elevations range from over 8700 feet on the plateaus to approximately 5000 feet in the Colorado River valley. Elevation, exposure, aspect, and topographic channeling of winds affect the weather at any specific location. Changes in the weather are often caused by cold fronts moving from the Pacific Ocean or from the north. During the winter, polar cold fronts usually carry little moisture and generally produce light snow in the region (DOE, 1983).

Weather data are not available for the Estes Gulch site. Temperatures and precipitation at Estes Gulch are expected to be similar to those recorded at Rifle. However, the temperatures may be slightly cooler on the average because Estes Gulch is 600 feet higher than Rifle. Precipitation levels may be slightly higher due to orographic effects. Wind flow patterns at Estes Gulch would be different than at Rifle due to the local topographic relief.

Additional information on weather is provided in Section C.1 of Appendix C, Weather, Air Quality, and Noise.

4.3.1 Temperatures

The temperature of the region is strongly affected by elevation and the local terrain. Temperatures decrease an average of 3.5°F per 1000 feet of increased elevation. However, weather stations in sheltered locations, such as valley floors, tend to have lower minimum temperatures from cold air drainage (DOE, 1983).

Rifle and Estes Gulch sites

The temperatures recorded at Rifle have ranged from 104°F in July 1948 to -38°F in January 1949. Temperatures above 100°F are infrequent, and approximately one third of the winters have no readings below 0°F. Summer days with maximum temperatures in the middle and low 80s and minimum temperatures in the low 60s are common. In the period 1931 through 1980, the average air temperature was 47.3°F, the average maximum annual air temperature was 64.3°F, and the average minimum annual air temperature was 30.3°F. Monthly average air temperatures ranged from 22.6°F in January to 70.3°F in July (Colorado Climate Center, 1982).

Lucas Mesa site

The temperature patterns at the Lucas Mesa site should be similar to those observed at the Altenbern climatic station which is at a similar elevation 14 miles to the northwest of Lucas Mesa. Minimum temperatures at Altenbern probably average slightly less than those at Lucas Mesa because Altenbern is located in a valley whereas Lucas Mesa is an exposed mesa.

Temperatures at Altenbern for the years 1947 through 1980 have ranged from 101°F in July 1960, to -32°F in January 1963. The average annual air temperature is 46.3°F. The average maximum annual air temperature is 62.6°F, and the average minimum annual air temperature is 29.9°F. Monthly average air temperatures range from 21.6°F in January to 70.1°F in July (Colorado Climate Center, 1982b).

4.3.2 Precipitation

The interior Colorado River valley is surrounded by mountains in virtually all directions and receives little precipitation. Consequently, agriculture is dependent on irrigation, for which an adequate supply of water is usually available from mountain snows and rains. Summer rains occur mainly as scattered light showers from thunderstorms that develop over the nearby mountains. Winter

snows are fairly frequent, but they are mostly light and quickly melt off. Blizzard conditions in valley locations are extremely rare (NOAA, 1980).

Rifle and Estes Gulch sites

The average annual precipitation for Rifle was 11.02 inches for the period 1931 through 1980. The maximum monthly precipitation was 4.18 inches in August 1957 and the minimum was 0.00 inch in October 1952. Snowfall at Rifle averages 41 inches per year. The maximum monthly snowfall recorded was 38.0 inches during December 1972 (Colorado Climate Center, 1982).

4.3.3 Winds

Winds in the region are governed by large-scale weather patterns; winds near the ground can vary significantly within small distances due to the complex terrain. The winds in this region also exhibit diurnal reversals in flow. During the day, the heating of mountain slopes can generate an upslope flow of air, called a "valley breeze." On clear nights, downslope "mountain breezes" are created as the cool, dense air flows into the valleys.

Rifle sites

Wind data collected in the city of Rifle and at the New Rifle site indicate that wind speeds are light, averaging approximately 4.5 miles per hour. The prevailing wind directions at Rifle are from the northeast to east-southeast quadrant. Winds are also frequently from the west-southwest and west (DOE, 1983; DOC, 1968).

Estes Gulch

Wind flow data were not collected at Estes Gulch. The major topographic features that would affect wind speed and direction are the Grand Hogback to the north and the Government Creek valley to the southwest. Nocturnal downslope breezes from the north and north-northeast and wind channeling along the Government Creek valley causing northwest winds would be expected at the Estes Gulch site.

Lucas Mesa site

Wind data collected at the Lucas Mesa site indicate that the wind speeds are light, averaging 5.6 miles per hour. The prevailing wind directions at Lucas Mesa are from the west-southwest and southwest (DOE, 1983).

4.3.4 Storms

Because of the protective influence of the Rocky Mountains, severe weather in the area is rare, although thunderstorms are fairly frequent (about 33 per year). The thunderstorms usually occur during the summer and occasionally produce hail. No tornadoes were reported in the region during the period 1930 through 1974 (Abbey, 1976).

Gusty surface winds are rather frequent in the spring and early summer. The strongest winds are usually from the south and southwest and are associated with thunderstorms and with weather preceding cold fronts. The highest wind speeds recorded at Rifle for the period 1959 through 1963 were from 39 to 46 miles per hour (DOC, 1968).

The maximum 24-hour rainfall recorded at Rifle was 1.95 inches in October 1957. The maximum 24-hour rainfall recorded at a weather station on the Altenbern Ranch (17 miles northwest of Debeque, Colorado) was 1.66 inches during December 1966 (Colorado Climate Center, 1982).

4.4 AIR QUALITY

Rifle is in Garfield County, which is in Colorado Air Control Region 11. The air quality in Garfield County is good. Total suspended particulates (TSP) is the only "criteria" pollutant, as recognized in the National Ambient Air Quality Standards (NAAQS) of the EPA (Table 4.1), that is measured in Garfield County at state monitoring stations. Measurements taken at Rifle from 1982 through 1984 indicate that the primary annual geometric mean value for TSP has been below the standard (75 micrograms per cubic meter). Measurements taken near Glenwood Springs, 27 miles east of Rifle, indicate that this area was below the primary annual TSP standard for the period 1975 through 1984. The closest monitoring site for three of the remaining "criteria" pollutants (carbon monoxide, sulfur dioxide, and lead) is in Grand Junction, approximately 60 miles west of Rifle. Carbon monoxide and sulfur dioxide have not exceeded the standards for the period of record (1981 through 1984) while lead standards have not been exceeded since 1977. The remaining two "criteria" pollutants are ozone and nitrogen dioxide, which are measured only in the Fort Collins, Denver, and Colorado Springs area (CDH, 1984).

Background air quality measurements collected in conjunction with proposed shale oil development indicate that the 24-hour standard for TSP has been exceeded in Rifle and elsewhere in the Piceance Basin. The standards for three-hour maximum sulfur dioxide and one-hour maximum ozone have also been exceeded on occasion within the Piceance Basin. Nitrogen dioxide and carbon monoxide standards have not been exceeded in the area (BLM, 1984). Additional information on air quality is provided in Section C.2 of Appendix C, Weather, Air Quality, and Noise.

Table 4.1 National and Colorado Ambient Air Quality Standards^a

Pollutant	Averaging Time	National Standards		State of Colorado Standards		Category (incremental) ^b		
		Primary	Secondary	Primary	Secondary	I	II	III
Sulfur dioxide	Annual AM ^c	80	--	--	--	2	10	15
	24-hour ^d	365	--	--	--	5	50	100
	3-hour ^d	--	1,300	--	--	25	300	700
Total suspended particulates	Annual AM ^c	75	60	75	60 ^e			
	24-hour ^d	260	150	260	150			
Carbon monoxide	8-hour ^c	10,000	10,000	10,000	10,000			
	1-hour ^c	40,000	40,000	40,000	40,000			
Ozone	1-hour	235	235	160	--			
Nitrogen dioxide	Annual AM ^c	100	100	100	100			
Lead	Calendar quarter AM ^c	1.5	1.5	--	--			

^aAll standards are in micrograms per cubic meter.

^bState of Colorado air quality categories for sulfur dioxide (only) are analogous to EPA's Classification system for Prevention of Significant Deterioration. Category II is equivalent to the EPA's Class I, for the preservation of pristine areas with pristine air quality. Category II is approximately halfway between the state's Category I and III standards. Category III is equivalent to the EPA's Class II, which permits moderate deterioration.

^cArithmetic mean.

^dNot to be exceeded more than once per year.

^eAn annual geometric mean of 60 micrograms per cubic meter has been established by the state of Colorado as a guide to be used in assessing implementation plans to achieve compliance with the 24-hour standard. Ref. EPA, 1984a; CAQCC, 1979.

4.5 SURFACE AND SUBSURFACE FEATURES

Surface and subsurface features at the Old Rifle, New Rifle, Estes Gulch, Lucas Mesa, and borrow sites are discussed in this section. Additional details on soils, geology, seismicity, and geomorphology are contained in Appendix D, Soils, Geology, and Seismicity.

4.5.1 Soils

Old Rifle site

The Old Rifle site is on young (late Holocene), unconsolidated alluvial deposits approximately five feet above the normal level of the Colorado River. The tailings, which are finely ground sands with a medium clay content, form a deposit up to 21 feet thick and cover 13 acres. Stabilization efforts at the pile have resulted in extensive reworking and mixing of the tailings; as a result, the tailings consist predominantly of very loose to medium dense, silty sands (sand-slime mixture).

Soils beneath and adjacent to the tailings are classified according to the Soil Conservation Service (SCS) classification system as coarse-loamy, mixed, mesic Fluvaquent Haplustolls (SCS, 1985). These soils formed in relatively recent alluvium and exhibit mottling associated with periodic saturation. The soil texture is highly variable, consisting of highly variable clays, clayey sands, silts, and sandy silts. The near-surface natural soils are mapped as Wann series soils (SCS, 1985) and are underlain by dense to very dense sand, gravel, and cobble alluvium. The total thickness of the alluvial soils ranges from 16 to 21 feet beneath and in the vicinity of the tailings pile (DOE, 1983). Underlying the alluvium is bedrock of the Wasatch Formation.

New Rifle site

At the New Rifle site, the tailings were deposited on unconsolidated river alluvium approximately 10 feet above the normal level of the Colorado River. The tailings consist of varying thicknesses of very loose to medium dense sands, slimes, and sand-slime mixtures covering approximately 33 acres. Stabilization efforts at this site have not altered the original deposition stratigraphy of the pile.

Naturally occurring soils at the site range in thickness from zero to five feet and have a highly variable texture consisting of medium stiff to stiff, silty clays, clayey sands, and silty sands. These soils are mapped as Fluvaquent Haplustolls of the Wann series (SCS, 1985) and grade with depth into coarse alluvium consisting of very dense sand, gravel, and cobbles. The combined thickness of the soils and alluvium beneath and adjacent to the tailings pile ranges from 20 to 25 feet (DOE, 1983).

Estes Gulch site

The Estes Gulch site is underlain by three to 43 feet of hard, silty-clay colluvium with varying amounts of sand. Occasional calcareous cementation, silty-sand lenses, and gravel-sized rock fragments occur within this material. Soils formed in the colluvium are predominantly classified as fine-loamy, mixed, mesic Ustollic Haplargids of the Potts-Ildefonso complex (SCS, 1985). These soils have a predominantly loamy texture, a mixed mineralogy, and a seasonally fluctuating temperature regime (SCS, 1975).

Lucas Mesa site

The Lucas Mesa site is on pre-glacial pediment deposits ranging in thickness from 30 to 89 feet and with a highly variable consistency that includes very dense sands, gravels, cobbles, and boulders in a clayey-silt matrix (DOE, 1983). Near-surface soils have been mapped as the loamy Barx series, the loamy-skeletal Clapper series, and the fine-loamy Darvey series (SCS, 1985).

Borrow sites

Soils at the Second Street borrow site consist of sand and gravel and have been previously disturbed by mining operations. Soils adjacent to disturbed areas are mapped as the Arvada loam, a deep, well drained, fine textured soil of mixed mineralogical origin (SCS, 1985).

Soils at the New Rifle borrow site have been disturbed by sand and gravel mining operations. Soils formed in the alluvium adjacent to disturbed areas are mapped as nearly level Torrifluvents. These soils are stratified and vary widely in texture and depth. The surface layer is generally fine-grained in texture and grades with depth into a sand, gravel, and cobble river alluvium (SCS, 1985).

There is little soil at the Glenwood Springs borrow site due to the steep terrain and hard bedrock formations. What soils are present at the borrow site have been previously disturbed by rock quarrying operations. Soils adjacent to disturbed areas are mapped as the Dateman gravelly loam, a thin to moderately deep, well-drained soil formed from sandstone and limestone (SCS, 1985).

4.5.2 Geology

Regional geology

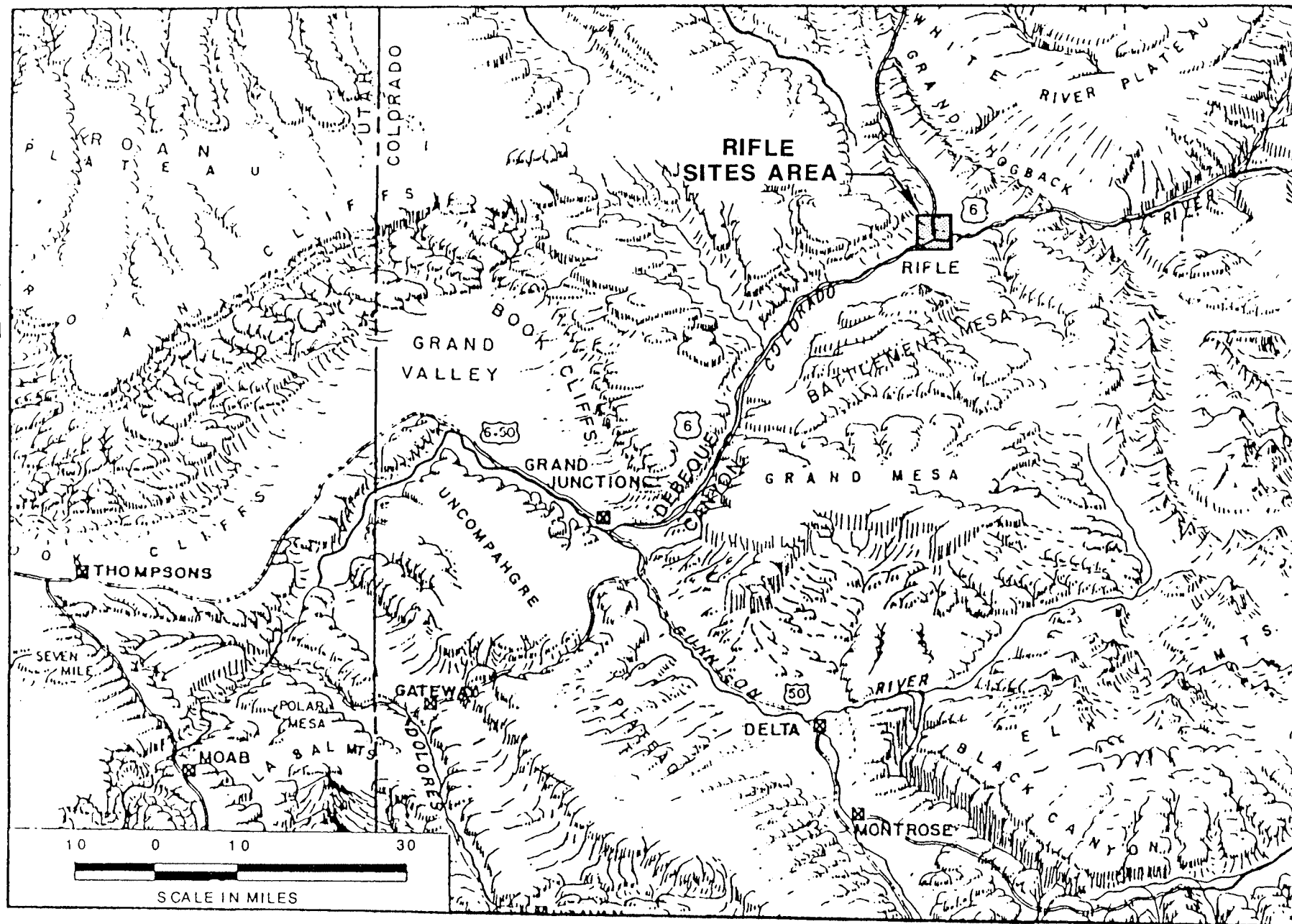
The Rifle area is near the boundary of the Canyonlands and Uinta Basin subdivisions of the Colorado Plateau physiographic province (DOE, 1983). To the south, the Canyonlands subdivision is characterized by monoclinal folds, upwarped plateaus, and

lava-capped mesas. The Uinta Basin subdivision to the north and west exhibits a mature, stream-eroded upland surface. Principal physiographic elements in the region include the Colorado River valley, Uncompahgre Plateau, Grand Mesa, Battlement Mesa, Roan Plateau, White River Plateau, and the Grand Hogback (Figure 4.3).

Underlying the Rifle area are sedimentary rocks ranging in age from Triassic to Tertiary. These sedimentary units unconformably overlie Precambrian basement rock. Figure 4.4 shows the general stratigraphy of the Rifle area. The Old Rifle, New Rifle, Estes Gulch, and Lucas Mesa sites are underlain by alluvial, colluvial, or pediment deposits mantling the Shire Member of the Wasatch Formation. The Wasatch Formation is a single stratigraphic unit divided into an upper member (the Shire), a middle member (the Molina), and a lower member (the Atwell Gulch). The Shire Member consists of variably colored claystones and siltstones with minor units of lenticular, brown sandstones. The thickness of the Shire Member near Rifle is approximately 1600 feet. The Molina Member consists mainly of sandstone and thin, interbedded claystones and siltstones approximately 500 feet thick. The Atwell Gulch Member, probably about 600 feet thick near Rifle, is a series of drab brown and gray shales and sandstones with several thin, discontinuous interbeds of lignite and carbonaceous shale.

The geologic structure in the Rifle area is dominated by the Piceance Creek Basin, which includes Rifle and the White River Uplift to the northeast. The Wasatch Formation is inclined at three degrees or less to the west and northwest at Rifle and is approximately horizontal at Lucas Mesa. The transition between the Piceance Creek Basin and the White River Uplift is marked by the Grand Hogback, which is less than 10 miles northeast of Rifle. The geologic structure of the area is shown in Figure 4.5.

The Rifle area is within the stable interior portion of the Colorado Plateau (Figure 4.6). The Colorado Plateau is a major continental block that has been uplifted since late Tertiary time at a low rate of approximately two millimeters per year. The plateau block has experienced little internal distortion in contrast with the more tectonically active regions that surround it. The largest historical earthquakes recorded within the Colorado Plateau occurred in zones near bordering seismotectonic provinces at Lockett Tanks and Fredonia, Arizona; Dulce, New Mexico; and Ridgway, Colorado. Estimated magnitudes ranged from 5.5 to 5.75 (Richter scale). The historical seismicity of the interior portion has been classified by Wong (1984) as very low level, having events of small to moderate magnitude with diffusely distributed epicenters. The largest instrumentally recorded earthquakes within the interior portion have fallen in the magnitude range of 4.5 to 5.0.



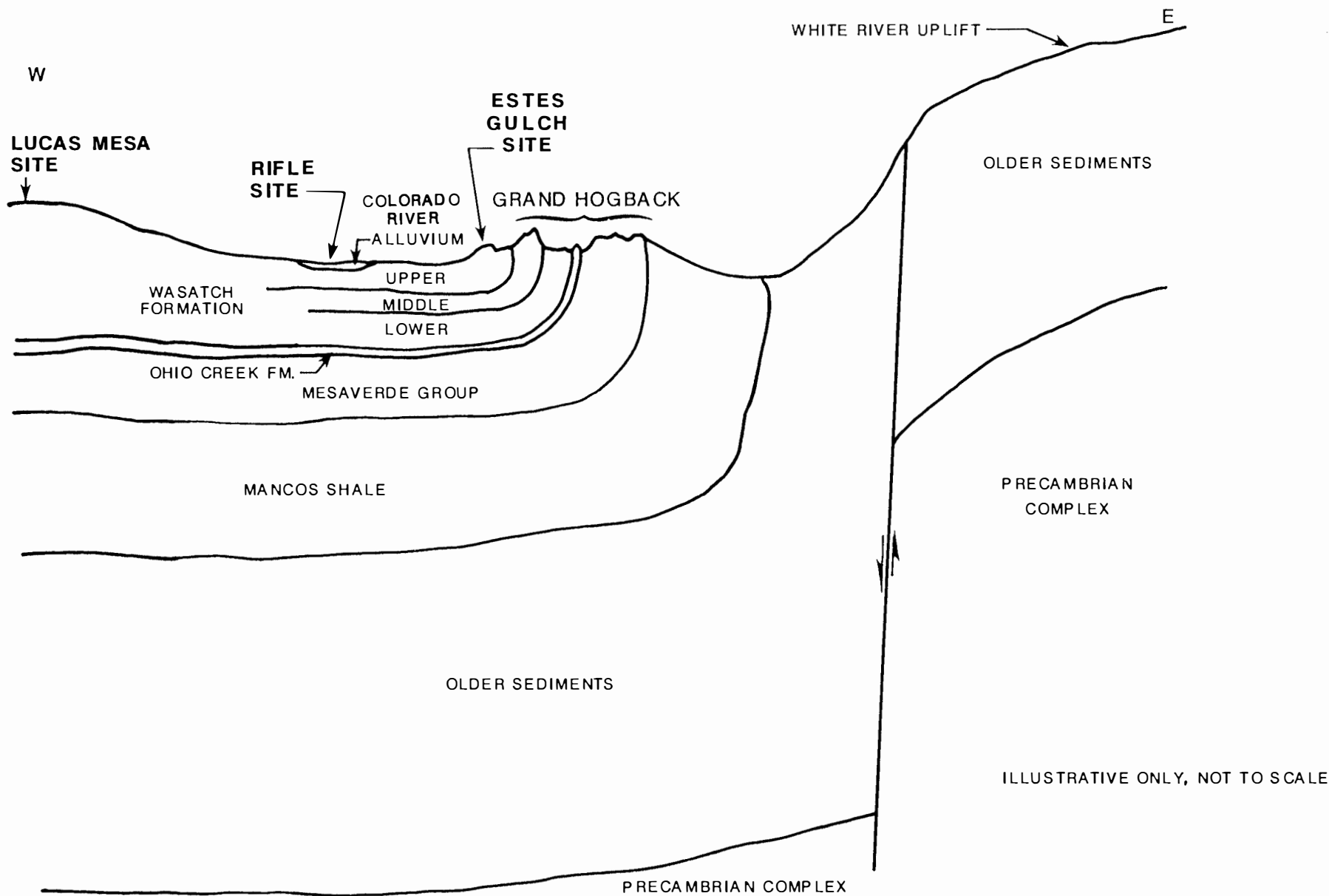
REF.: CGS, 1982

FIGURE 4.3
PHYSIOGRAPHIC FEATURES OF THE RIFLE AREA

GEOLOGIC AGE	STRATIGRAPHIC UNIT	ROCK DESCRIPTION	APPROXIMATE THICKNESS IN FEET
Early Tertiary RIFLE SITES →	Uinta Formation	Tan, gray, and buff siltstone, sandstone, and marlstone.	800-1000
	Green River Formation	Tan to gray calcareous siltstone with dark brownish gray kerogen-rich beds (oil shale); forms steep slopes and cliffs.	1000-3000
	Wasatch Formation and Ohio Creek Conglomerate	Varigated sandstone, siltstone, shale, mudstone, conglomerate; forms benches and slopes.	300-5000
Late Cretaceous	Mesa Verde Group	Unconformity Buff colored sandstones and siltstones with coal beds; forms cliffs.	1000-5000
	Mancos Shale	Gray and black shale with thin beds of sandstone and limestone; forms slopes and valley floors.	3000-6000
	Dakota Sandstone	Sandstone, coaly shale, conglomerate; forms benches and slopes.	100-225
Early Cretaceous	Burro Canyon Formation	Unconformity Green siltstone, shale, sandstone, conglomerate; forms benches and slopes.	10-225
Late Jurassic	Morrison Formation	Varicolored claystone, sandstone, siltstone with thin limestone beds; forms slopes and badlands.	300-600
Middle Jurassic	Summerville Formation	Red and green colored siltstone, mudstone and thin sandstones; forms slopes.	40-60
	Entrada Sandstone	White and salmon-red quartz sandstone; Slick Rock member forms cliffs.	75-300
Late Triassic (?)	Kayenta Formation	Unconformity Red and purple siltstone, shale, sandstone, and conglomerate; forms bench between cliffs.	0-200
Late Triassic	Wingate Sandstone	Buff and light red sandstone; cross-bedded; forms steep cliffs.	300-400
	Chinle Formation	Red siltstone, shale, limestone, and conglomerate; forms steep slopes at foot of cliffs.	80-120
Precambrian Proterozoic Y and X	Unnamed	Unconformity Gneiss, schist, granite, and pegmatite dikes; forms floors of canyons in Uncompahgre Plateau.	Unknown

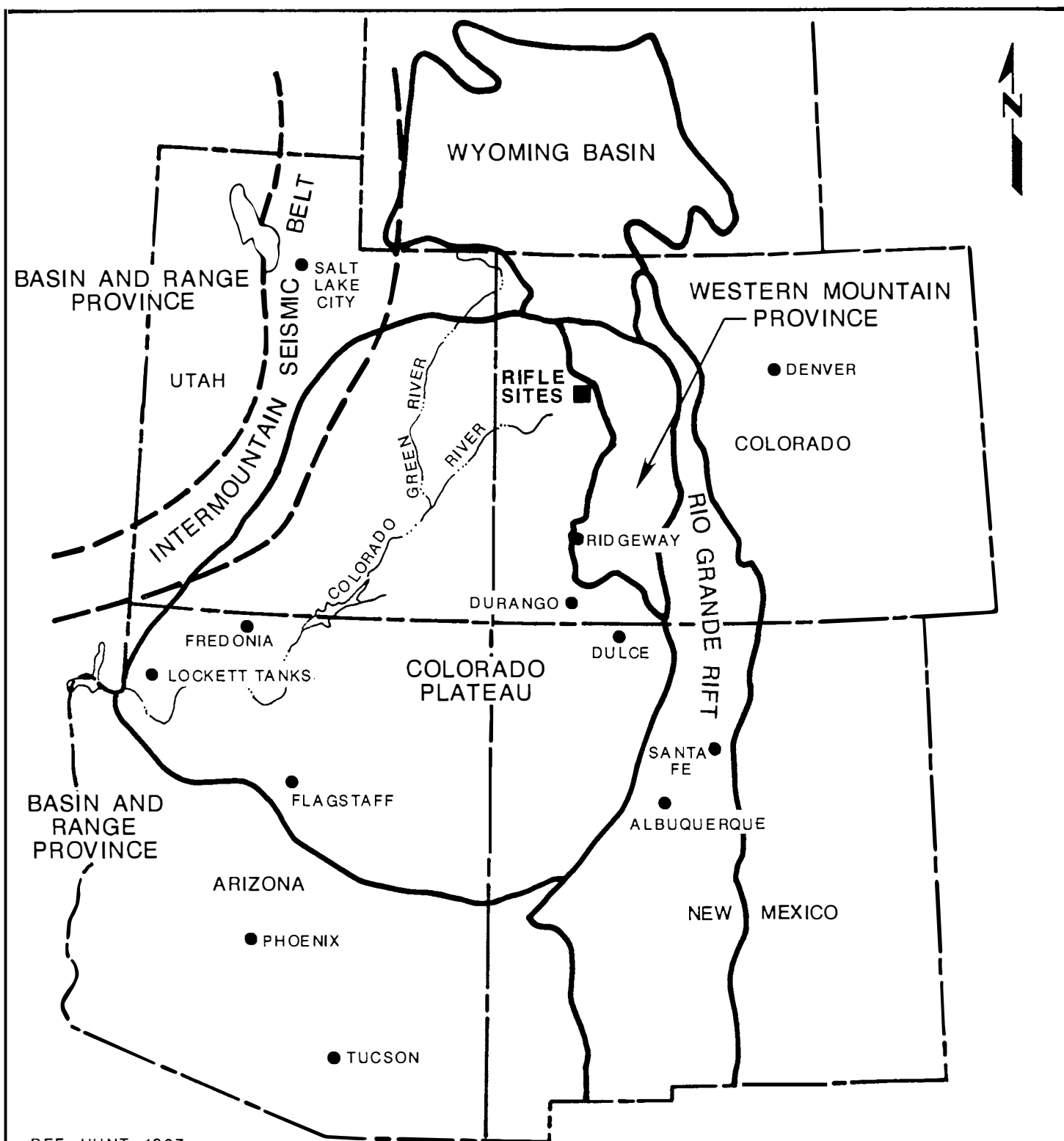
REF. FCRI, 1982.

FIGURE 4.4
GENERALIZED STRATIGRAPHIC COLUMN, RIFLE AREA



REF: DOE, 1983.

FIGURE 4.5
GENERALIZED GEOLOGIC CROSS SECTION, RIFLE AREA



REF: HUNT, 1967.
 KELLEY AND CLINTON, 1960.
 KIRKHAM AND ROGERS, 1981.
 MENGES AND PEARTHREE, 1982.
 NEW MEXICO GEOLOGICAL SOCIETY, 1982.
 PEARTHREE, et al., 1983.
 SMITH AND SBAR, 1974.

50 0 50 150
 SCALE IN MILES

FIGURE 4.6
REGIONAL SEISMOTECTONIC PROVINCES

Analysis of mapped faults and lineaments within a 70-mile radius of the Estes Gulch site, an area encompassing the Rifle sites, yielded no faults capable of magnitudes greater than 6.0 (Richter scale). A floating earthquake (an earthquake not associated with a known tectonic structure) of local magnitude 6.2 is considered to be the critical design earthquake for the Rifle sites (Section D.4 of Appendix D, Soils, Geology, and Seismicity). A floating earthquake occurring at a radial distance of 15 kilometers from the Rifle site would produce an on-site peak horizontal ground acceleration of 0.21g.

Rifle sites

The Old and New Rifle sites are underlain by alluvium deposited on the Shire Member of the Wasatch Formation. The Wasatch Formation is underlain by the Ohio Creek Formation, a single or series of massive, conglomeratic sandstones approximately 100 feet thick and containing mostly pebbles of chert and quartzite derived from older sedimentary rocks. Beneath the Ohio Creek Formation lies the Mesa Verde Group, a composite of light brown to white sandstone, gray to black shale, and coal beds. Also included are massive beds of light brown to white sandstone and interbedded shale and coal. The total thickness of the Mesa Verde Group is approximately 5000 feet. The Mancos Shale, a gray marine shale with a few thin limestone and sandstone beds, underlies the Mesa Verde Group. The Mancos Shale is approximately 6000 feet thick near Rifle. The total depth to the bottom of the Mancos Shale is approximately 14,600 feet in the Rifle area (DOE, 1983).

The Colorado River is the major geomorphic feature influencing the Old Rifle site. The site occupies an old meander scar of the river and, although the site is protected upstream and downstream by bedrock outcrops, the potential for lateral shift of the river toward the site is high. Erosion of the tailings by wind and surface water runoff also poses geomorphic hazards to the tailings pile.

The New Rifle site lies adjacent to a large meander of the Colorado River. Examination of aerial photographs and other evidence of the position of the river channel indicates that the river has occupied its entire floodplain over the past 96 years at this location (DOE, 1983). This means that the site is subject to lateral shift of the river and associated erosive forces. Other geomorphic hazards at the New Rifle site include erosion from wind and surface water runoff.

Estes Gulch site

The upper bedrock unit at the Estes Gulch site is the Shire Member of the Wasatch Formation. The near-surface bedrock is characterized by steeply dipping beds, numerous fractures, and

dip-slip secondary faulting associated with the Laramide uplift of the Grand Hogback. Local faulting separates steeply dipping beds below the site from gently dipping beds that occur south of the site. The non-capable faults and fractures have not affected the permeability of the fine-grained bedrock.

Surface drainage headcutting is the geomorphic process of greatest potential impact at the Estes Gulch site. Due to its location at the head of a small drainage basin along the south flank of the Grand Hogback, little potential exists for erosion from upland drainage. However, erosion associated with encroachment of surface drainages adjacent to the site has the potential to influence site geomorphology.

Lucas Mesa site

Pediment deposits underlying the Lucas Mesa site consist of coarse basaltic gravels, cobbles, and boulders within a clayey-silt matrix. The upper bedrock unit at the site is the Shire Member of the Wasatch Formation.

The geomorphology of the Lucas Mesa site is predominantly controlled by gully erosion. The geomorphic surface of Lucas Mesa is quite stable because of the well-graded characteristics of the pediment deposits. However, there are some landslides mapped around the flanks of the mesa and, ultimately, the mesa will erode away. It is believed that this process will take well over 10,000 years and probably at least 100,000 years (CGS, 1982).

Borrow sites

The Second Street and New Rifle borrow sites are located in Colorado River alluvial deposits. These deposits contain various sizes of materials, ranging from silts and clays up to small boulders. These borrow sites are underlain by the Shire Member of the Wasatch Formation.

The Glenwood Springs borrow site is located in dolomitic limestone of the Mississippian Leadville Limestone, which is comprised of dark-gray to black shale, carbonate rocks, and sandstone (Tweto et al., 1978).

4.5.3 Mineral resources

Rifle sites

Potential mineral resources beneath the Old and New Rifle sites include oil, natural gas, coal, and sand and gravel. Overlying the Wasatch Formation in the Rifle area is the Tertiary Green River Formation containing one of the world's richest oil

shale deposits. Oil and natural gas have also been produced from the Green River Formation. Coal resources occur in the Mancos Shale and the Mesa Verde Group at a depth of approximately 2500 feet. No active oil or gas leases exist at the Old and New Rifle sites (Abbott, 1986), and the coal deposits cannot be mined economically at present (DOE, 1983).

Sand and gravel deposits beneath the Old Rifle site are 14 to 19 feet thick. At the New Rifle site, sand and gravel deposits 18 to 28 feet thick lie directly beneath and adjacent to the site. Alluvial deposits near the New Rifle site have been mined for aggregate (DOE, 1983). Sand and gravel resources are abundant along the Colorado River floodplain and in pediment deposits along cliffs and mesas in the vicinity of the Old and New Rifle sites.

Estes Gulch site

The Estes Gulch site has the same potential for oil, gas, and coal development as the Old and New Rifle sites. However, economically important deposits of mineral resources including oil shale and natural aggregate have not been recognized beneath the Estes Gulch site. The mineral rights for the Estes Gulch site are owned by the Federal government and administered by the BLM. Two active but undeveloped oil and gas leases are on file for the Estes Gulch site and the adjacent area (Abbott, 1986).

Lucas Mesa site

The Lucas Mesa site is in a setting stratigraphically similar to the Old and New Rifle sites; therefore, the potential exists for oil, gas, and coal reserves beneath the site. Oil shale reserves are not known to exist beneath the site. Coal from the Mesaverde Group has been mined in the general vicinity; however, coal beneath Lucas Mesa is too deep to be an economical resource at present (DOE, 1983). Several active oil and gas leases exist for the Lucas Mesa site (Abbott, 1986).

The pediment deposits at the Lucas Mesa site contain a large quantity of aggregate composed of basaltic gravel, cobbles, and boulders. The economic value of this resource is limited at present because of the availability of similar resources along the Colorado River (DOE, 1983).

Borrow sites

The Second Street borrow site is an existing commercial sand and gravel operation. The site is in a stratigraphic setting similar to the Old and New Rifle sites; therefore, the potential for oil, gas, and coal exists at the site. No active oil or gas leases exist at the Second Street borrow site (Abbott, 1986).

The New Rifle borrow site is underlain by Colorado River alluvium suitable for use as an aggregate resource. The site is in a stratigraphic setting similar to the Old and New Rifle sites; therefore the potential for oil, gas, and coal exists at the site. No active oil or gas leases exist at the New Rifle borrow site (Abbott, 1986).

The Glenwood Springs borrow site is currently mined for aggregate resources. Similar aggregate resources are present in adjacent areas, and no other mineral resources are known to exist beneath the Glenwood Springs borrow site. No oil or gas leases are on file for the site (Abbott, 1986).

4.6 WATER

4.6.1 Surface water

This section describes the regional surface water features and surface water features at the Rifle tailings sites, the alternate disposal sites, and the borrow sites. A more detailed discussion of surface water features, flood analyses, and surface water quality and use for each site is contained in Section E.1 of Appendix E, Hydrology. Information on the floodplains associated with the sites is provided in Section F.2 of Appendix F, Floodplain and Wetlands Assessment.

Regional features

The Rifle tailings sites, the alternate disposal sites, and the borrow sites are all in the Colorado River basin. The headwaters of the main stem of the Colorado River originate high in the Rocky Mountains of central Colorado on the west side of the Continental Divide. The Colorado River drainage basin upstream of Rifle consists of approximately 6950 square miles of steeply sloping terrain; elevations in the basin range from more than 14,000 feet above mean sea level in the highest headwater areas to approximately 5300 feet at Rifle. The principal tributaries of the Colorado River in Colorado are the Roaring Fork, Gunnison, and Dolores Rivers. The Roaring Fork River joins the Colorado River upstream from the Rifle site. The Gunnison River, the largest of these tributaries, joins the Colorado River at Grand Junction downstream from the site, and the Dolores River joins the Colorado River in Utah farther downstream. Major tributaries to the upper Colorado River include the Roaring Fork, Eagle, and Blue Rivers.

In the Colorado River upstream from the tailings sites (below Glenwood Springs), the average minimum monthly flows from 1966 to the present were approximately 1460 cubic feet per second (cfs) and the average maximum monthly flows were approximately 9990 cfs. The seven-day, ten-year low flow (average minimum seven-day flow occurring once in ten years) was 1030 cfs. For the river

segment encompassing the sites, the flow increases only slightly with downstream distance. Downstream from the sites, at the Colorado-Utah border, the average minimum and maximum monthly flows were approximately 3140 and almost 16,700 cfs, respectively; the seven-day, 10-year low flow was 1230 cfs. The higher flows are attributable mainly to the Gunnison River (DOE, 1983).

Rifle tailings sites

The floodplain surface occupied by the Old Rifle tailings site is about five feet above the Colorado River surface during normal flow. The river now flows parallel and in contact with the elevated D&RGW railroad grade, which separates the tailings site from the river. The southern flank of the railroad grade is protected by sandstone and basalt riprap. The floodplain at the Old Rifle site has been naturally and artificially narrowed at the site from over 1200 feet to 800 feet by geologic features and construction of the railroad and the I-70 embankment south of the river. Surface water features at the site include a drainage ditch from U.S. Highway 6 that discharges just north of the tailings pile, a drainage ditch in the mill area east of the tailings pile, and small areas where there is occasional ponding of water.

At the New Rifle site, the Colorado River is within 1000 feet east and 600 feet south of the tailings pile. The mill and ore storage areas lie between the pile and the river to the east. The main channel of the Colorado River has been artificially channeled northward by blocking alternative river channels upstream of the site. This has caused the river to swing north and erode the northern portion of a dike that protects the east side of the tailings site. This dike is not considered adequate to prevent large floods from encroaching on the site nor is this dike considered to be permanent. Further downstream, the channel passes under an I-70 bridge and subsequently flows along the upland that forms the southern boundary of the valley floor. The embankment of I-70 protects the southern side of the site from the Colorado River. Due to natural topography, the floodplain narrows near the site from over 4400 feet approximately 1000 feet upstream of the tailings site to less than 2300 feet approximately three miles downstream of the site. Immediately south of the site, the construction of I-70 has narrowed the normal floodplain to virtually the river channel itself. The major surface water features at the site include the former vanadium ponds east of the tailings pile and evaporation ponds north and southeast of the pile. In addition, there are various drainage ditches and several areas throughout the site where there is occasional ponding of water.

The average monthly river flows adjacent to the tailings sites can be represented by flows measured at the U.S. Geological Survey (USGS) gauging stations on the Colorado River at Glenwood Springs, approximately 25 miles upstream of the site, and at DeBeque, approximately 30 miles downstream of the site. The

average maximum monthly flows at Glenwood Springs and DeBeque from 1966 through 1985 were 9990 and 11,210 cfs, respectively, and the average minimum monthly flows were approximately 1460 and 1580 cfs, respectively. The average flows at DeBeque are generally 100 cfs higher than those at Glenwood Springs and reflect the input of the many tributaries that enter the Colorado River between these stations (DOE, 1983).

Both the Old and New Rifle sites are in meander paths of the Colorado River and lie on 10 to 25 feet of unconsolidated alluvial material. Particle sizes of the alluvium at the sites vary from cobbly gravels to gravelly sands. The narrowing of the river floodplain at the sites tends to result in erosion of the alluvium at the sites during high floods. Therefore, shifts in the river channel can be expected during flood stages, and the river could affect the integrity of the sites if the river is not properly controlled or the sites are not adequately protected.

The Colorado River is the only potential source of floods at the sites. The main Colorado River channel has had six major redirections across its entire floodplain over the last 100 years due to major floods (Schumm and Harvey, 1983), indicating that the potential for lateral shifts of the Colorado River toward the sites is high. This documented channel instability is common for river reaches that exhibit the island-braided morphology of the Colorado River near Rifle. More details on the geomorphology of the sites are provided in Section D.3 of Appendix D, Soils, Geology, and Seismicity.

The flooding of June and July, 1884, is the most severe known on the upper Colorado River. This flooding resulted from rapid melting of the snow pack and concurrent heavy rains. In recent times, the floods of 1983 and 1984 were the most severe. The 1884 flood peak flow was estimated to be 65,000 cfs at Rifle. The 1984 flood peak flow measured below Glenwood Springs, the gauging station closest to Rifle, was 31,500 cfs. Other floods on the Colorado River were recorded in 1917, 1920, 1921, 1935, 1952, and 1957 (COE, 1976).

Flood analyses were performed to assure that the remedial action design satisfactorily addresses short-term and long-term flood protection. Short-term flood protection simply defines the extent of the 100-year and 500-year floods and the impacts, if any, on the stabilized tailings or on remedial action construction activities. To accomplish the objective of long-term flood protection, the DOE determined the magnitude and potential impacts resulting from a PMF and designed the disposal site to withstand the PMF.

A 100-year flow of 55,040 cfs and a 500-year flow of 75,200 cfs were determined for the Colorado River at the Rifle sites using methods described in Appendix E, Hydrology. The results of this analysis indicate that both the Old and New Rifle sites lie

within the boundaries of the 100- and 500-year floodplains. Flood elevations and flow velocities for the 100- and 500-year flood at the sites are presented in Table 4.2.

The estimated PMF flow at Rifle is 795,200 cfs, which is 10 times the estimated 500-year peak and 12 times the maximum recorded flow. The effect of a PMF event on the channel of the Colorado River would be catastrophic; bridges would be destroyed, and I-70 would be inundated and largely washed away, as would the railroad and many residential and industrial structures. At the Old Rifle site, the railroad grade would be overtopped by 25 feet of water during a PMF. At the New Rifle site, the tailings pile would have flowing water on all sides, and the main channel flow would likely be directed at the pile. Flood elevations, flow velocities, and scour depths for the PMF at the sites are provided in Table 4.2.

Estes Gulch site

The Estes Gulch site is at the head of a hollow and has virtually no drainage basin above it; the potential for stream flooding is therefore very low. Drainage from the site flows into an ephemeral creek in Estes Gulch 0.5 mile southeast of the site. This creek joins perennial Government Creek one mile below the site. There is a small earthen pond south of the site that is used to hold the intermittent surface runoff for livestock watering.

Gully erosion and surface drainage encroachment have the potential to affect the site. The gullies at the site are deeply incised, indicating recent downcutting. Also, numerous piping features indicate that at least some of the site soils are susceptible to erosion. While current site conditions indicate a localized base level by gully development, the potential exists for future erosion and downcutting. Development of lateral branches of adjacent surface drainages also poses a hazard to the site, requiring proper mitigative measures.

No data on historical floods exist for the Estes Gulch site. Due to the site's distance from and elevation above perennially flowing waters, river flooding would not impact the Estes Gulch site. The Colorado River, at its closest point, is six miles away and 730 feet below the site.

Lucas Mesa site

The Lucas Mesa site is at the head of a drainage divide and has virtually no drainage basin above it; the potential for stream flooding is therefore very low. Drainages on the site flow into ephemeral creeks in Smith Gulch or Moffat Gulch or into the Blue-stone Valley irrigation ditch 0.5 to two miles south of the site.

Table 4.2 Flood data, Old and New Rifle sites

Flood data	Old Rifle site ^a			New Rifle site ^b		
	100-year flood	500-year flood	PMF	100-year flood	500-year flood	PMF
Maximum water elevation (feet above mean sea level)	5,311	5,314	5,335	5,275	5,278	5,301
Maximum flow rate (cubic feet per second)	55,000	75,200	795,200	55,040	75,200	795,200
Maximum mean flow velocity (feet per second)	12	12	11	17	18	26
Maximum scour depth (feet below river channel bottom)	--	--	19	--	--	32

^aThe elevation of the base of the Old Rifle tailings pile varies from 5305 to 5330 feet above mean sea level.

^bThe elevation of the base of the New Rifle tailings pile varies from 5260 to 5270 feet above mean sea level.

The creeks in both gulches join the Colorado River one to two miles below the site. The Bluestone Valley irrigation ditch is about one mile from the site in a direct line, and the Colorado River is only two miles away. The Lucas Mesa site contains water catchment basins which, through a series of pipes, feed several stock-watering tanks in the area. More detailed descriptions of the livestock watering system are included in Section 4.9.4 and Section J.1.3 of Appendix J, Land Use and Socioeconomics.

The steeper sideslopes of Lucas Mesa are naturally armored with basalt boulders and cobbles and are resistant to erosion. Some headward migration of drainage systems into the surface of the mesa from the steeper bordering slopes is occurring; however, because of the cobbles and boulders, it is not strongly developed and does not result in significant drainage areas. Gullies which have formed drain only the mesa surface and not surrounding areas. The dominant erosion occurs by sheet wash and wind as evidenced by bare soil areas on the site. There is some minor transport by ephemeral streams and limited soil creep; however, there is no evidence of active processes degrading the mesa surface.

No data on historical floods exist for the Lucas Mesa site. Due to the site's distance from and elevation above the Colorado River (approximately 900 feet), river flooding would not impact the Lucas Mesa site.

Borrow sites

The Second Street borrow site is on the north side of the Colorado River 0.2 mile north of the New Rifle tailings site. The site is 60 to 90 feet above the river. The borrow site is drained by an ephemeral drainage channel to the west and Pioneer Ditch to the south.

The New Rifle borrow site is along the north bank of the Colorado River 0.5 mile west of the New Rifle tailings site. The site is four to six feet above the river. A pond has formed at the site due to the filling of an excavated area with groundwater from the floodplain alluvium.

The Glenwood Springs borrow site is 0.3 mile north of and 1200 feet above the Colorado River. Drainage from the borrow site flows into ephemeral Cascade Creek to the west.

Surface water quality and use

The chemical quality of surface water in the Colorado River is directly related to the source of recharge waters which, in turn, varies seasonally (DOE, 1983). During most of the year, the river is recharged by groundwater, which introduces high concentrations of dissolved metals and inorganics that have been leached from the soil. However, in the late spring and early summer,

rapidly melting snow augmented by heavy rainfalls causes stream-flow to peak. During this high flow period, the river carries a greater volume of suspended solids relative to dissolved species. Usually by late July, the streams have subsided to base flow conditions, which prevail until the cycle is repeated the following spring (Iorns et al., 1965).

Analytical results supporting the following discussion of surface water quality at the Rifle UMTRA Project sites are presented in Section E.1.3 of Appendix E, Hydrology.

Rifle tailings sites

Field investigations and sample analyses (Markos and Bush, 1983) indicate that the presence of the Old and New Rifle tailings is not causing degradation of the surface water in the Colorado River. No health-threatening chemical constituents were found to be in excess of the state of Colorado water quality standards (CWQCC, 1983), and none of the constituents indicative of uranium tailings contamination (NRC, 1980) were found to be elevated in surface waters in the vicinity of the tailings.

There are no domestic users of Colorado River water for 20 miles downstream of the city of Rifle. Water for the city of Rifle is pumped directly from the Colorado River 0.5 mile upstream of the Old Rifle site and treated at the city water plant. At the present time, there are no other alternative sources for municipal water.

Water from Rifle Creek and the Colorado River is diverted into the Pioneer and Last Chance Ditches, respectively, at points upgradient from both the Old and New Rifle sites. This water is used for gravity-fed irrigation at the farms that are within the Colorado River valley. The Last Chance Ditch is on the opposite side of the Colorado River from both the sites, 0.5 mile south of the Old Rifle site, and one mile southeast of the New Rifle site. The Pioneer Ditch is on the same side of the Colorado River as the Old and New Rifle sites. It is 3500 feet west of the Old Rifle site and 1000 feet north of the New Rifle site.

Estes Gulch site

Analysis of a water sample from Thirty-two Mile Gulch, a tributary of Government Creek, revealed low concentrations for all dissolved constituents. An analysis of Government Creek water downgradient of the site revealed that only the concentration of sulfate exceeded state of Colorado standards (Markos and Bush, 1983). There are no known uses of the water in Government Creek in the vicinity of the Estes Gulch site.

Lucas Mesa site

Analyses of water from the USGS sampling station on the Colorado River at DeBeque indicate that average concentrations are within state of Colorado standards (DOE, 1983). The ephemeral surface water flows at Lucas Mesa are collected at certain locations and used to provide water for livestock (see Section 4.9.4 and Section J.1.3 of Appendix J, Land Use and Socioeconomics).

Borrow sites

The Second Street, New Rifle, and Glenwood Springs borrow sites are existing, commercial borrow operations. Activities related to supplying borrow materials for the remedial action would be similar to those currently performed at the sites. Thus, the present surface water quality in the vicinity of the sites would not be affected by the proposed borrow activities. The New Rifle borrow site has an existing pond created by the current operations, which has intercepted the water table. Analyses indicate that the pond is recharged by alluvial groundwater that has been contaminated by the New Rifle tailings.

4.6.2 Groundwater

Groundwater conditions and groundwater quality impacts resulting from the processing and disposal of uranium at the Old and New Rifle sites are summarized in this section. Hydrogeologic conditions at the Estes Gulch and Lucas Mesa disposal sites are also summarized. A detailed discussion is provided in Appendix E, Hydrology.

The affected groundwater environment at the alternative disposal sites has been studied further since publication of the Draft EIS in May 1987. The following discussion reflects new information gained through the DOE's investigations.

Hydrogeology

Tailings piles at the Old and New Rifle sites rest on the alluvium along the Colorado River. The alluvium occurs in a 40-foot-deep, one-mile-wide channel incised into the underlying Wasatch Formation. Groundwater in the alluvium is recharged by precipitation, return irrigation flow, and the Colorado River. Beneath the alluvium, groundwater occurs in the interlayered sandstone, siltstone, and claystone beds of the Wasatch Formation. The Wasatch Formation is semi-confined with lower hydraulic conductivities than the alluvium.

In general, groundwater flow at the Rifle sites in the alluvium and the Wasatch Formation is toward the west, roughly paralleling the Colorado River. Seasonal water level fluctuations in the Colorado River control flow in the alluvium. During the summer, when the Colorado River is high, the river recharges the alluvium. During the fall and winter, when the river is low, groundwater in the alluvium discharges to the Colorado River. Similarly, the alluvium also discharges to the Wasatch Formation during periods of high river flow, and the Wasatch Formation discharges to the alluvium during periods of low river flow. Water quality in the alluvial groundwater also varies seasonally, with concentrations of total dissolved solids (TDS) increasing during periods of low flow in the Colorado River. Seepage of tailings fluids has affected groundwater quality in the alluvium and the Wasatch Formation at the Old and New Rifle sites. Concentrations of hazardous constituents in the alluvium and the Wasatch exceed background concentration levels and the proposed EPA groundwater protection standards (Table 4.3).

The Estes Gulch disposal site is underlain by the Wasatch Formation. Groundwater beneath the site flows to the southeast, along the strike of the steeply dipping beds beneath the disposal site.

The Lucas Mesa disposal site is located on a pediment surface and unconsolidated pediment materials underlain at depth by the Shire Member of the Wasatch Formation. No groundwater was encountered in the unconsolidated materials of the pediment, although localized perched zones may occur in these materials, or at the pediment-bedrock interface.

Old Rifle site

The alluvium at the Old River Site is approximately 20 feet thick, with depths to groundwater ranging from two to 12 feet below land surface. Groundwater may enter the tailings during periods of high flow in the Colorado River. Sources of recharge to the alluvium include bank-infiltration from the Colorado River, precipitation, surface and subsurface irrigation return flow, and discharge from the Wasatch Formation in areas with upward vertical potentiometric gradients. A groundwater mound occurs northeast of the tailings, where a submerged culvert discharges. Groundwater flows to the west within the Colorado River alluvium under a gradient of 0.003. Groundwater at the tailings site probably does not flow across the Colorado River in the alluvium, because the river is a groundwater flowline.

Pumping tests conducted on five monitor wells in the alluvium at the Old Rifle site yielded an average hydraulic conductivity of 200 feet per day (ft/day). The average linear groundwater velocity in the alluvium at the Old Rifle site was calculated to be 840 ft/day using Darcy's Law, a hydraulic conductivity of 200 ft/day, an effective porosity of 0.27, and a hydraulic gradient of 0.003.

Table 4.3 Proposed EPA Groundwater Protection Standards applicable to the Rifle UMTRA Project sites

Constituent	Maximum Concentration Limit (MCL)
<u>Inorganic Chemical^a</u>	<u>mg/l</u>
Arsenic	0.05
Barium	1.00
Cadmium	0.01
Chromium	0.05
Lead	0.05
Mercury	0.002
Molybdenum	0.1
Nitrate (as NO ₃) ^b	44
Selenium	0.01
Silver	0.05
<u>Inorganic Chemical^a</u>	<u>pCi/l</u>
Ra-226 & Ra-228	5
U-234 & U-238	30 (0.044/mg/l)
Gross Alpha (excluding uranium and radon)	15
<u>Organic Chemical^c</u>	<u>mg/l</u>
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.10
Toxaphene	0.005
2, 4-D	0.10
2, 4, 5-TP (Silvex)	0.01

^aProposed EPA Groundwater Protection Standards - UMTRA, 52 FR 36,000.

^bNitrate (as N) 10 mg/l.

^cSee Appendix VIII, 40 CFR Part 261 for complete list of hazardous organic constituents.

The Wasatch Formation consists of interbedded layers of sandy siltstones and shales at the Old Rifle site. Although these layers are regionally discontinuous, the Wasatch Formation is semi-confined. The potentiometric surface within the Wasatch Formation ranges from two to eight feet below ground surface, with the groundwater flow toward the west. Within the site vicinity, vertical potentiometric gradients are generally upward, with the Wasatch Formation discharging into the alluvium. However, groundwater mounding in the alluvium northeast of the tailings, where a culvert discharges, has caused a downward potentiometric gradient. Because groundwater in the alluvium is recharging the Wasatch Formation in this area, contaminants within the alluvium have affected water quality in the Wasatch Formation.

Slug injection tests performed in monitor wells in the Wasatch Formation yielded an average hydraulic conductivity of 0.027 ft/day. The average horizontal linear groundwater velocity was calculated to be 0.3 ft/year using Darcy's Law, an average westward hydraulic gradient of 0.003, an effective porosity of 0.10, and a hydraulic conductivity of 0.027 ft/day.

New Rifle site

The alluvium at the New Rifle site is 25 to 30 feet thick, and depths to water range from five to 10 feet. The potentiometric surface does not extend into the tailings during high flow periods, as it does at the Old Rifle site, but remains two to three feet below the pile.

Flow in the alluvium is toward the west and southwest under a hydraulic gradient ranging from 0.002 to 0.006. The alluvium is recharged by the Colorado River east of the New Rifle site, and groundwater flow approximately parallels the river channel, eventually discharging into the Colorado River downgradient of the site. Seasonal flow in Pioneer Ditch, north of the site, may also recharge the alluvium, adding a slight southwestward component to the flow. Downward potentiometric gradients between the alluvium and the Wasatch Formation occur, and groundwater in the alluvium discharges to the Wasatch Formation.

Pumping tests performed on monitor wells in the alluvium at the New Rifle site indicate the hydraulic conductivity averages 70 ft/day. The average linear groundwater velocity in the alluvium at the New Rifle site was calculated to be 280 ft/year, using Darcy's Law, an average hydraulic conductivity of 70 ft/day, an effective porosity of 0.27, and an average hydraulic gradient of 0.003 toward the west.

The Wasatch Formation at the New Rifle site contains more sandstone interbeds than at the Old Rifle site, and is more transmissive to flow. Groundwater flow in the Wasatch Formation is to the southwest, paralleling groundwater flow in the alluvium. The

potentiometric surface in the Wasatch Formation is lower than in the alluvium, and consequently, downward flow of groundwater from the alluvium has transported contaminants into the Wasatch Formation.

Slug injection tests in the Wasatch Formation at the New Rifle site yielded an average hydraulic conductivity of 0.46 ft/day. This is an order of magnitude greater than the mean hydraulic conductivity measured at the Old Rifle site, reflecting the greater transmissivity of the underlying sandstone beds in the Wasatch Formation at the New Rifle site.

The average linear groundwater velocity was calculated for the Wasatch Formation at the New Rifle site, using Darcy's Law. Based on a westward hydraulic gradient of 0.003, a mean hydraulic conductivity of 0.46 ft/day, and an effective porosity of 0.15, the average linear velocity is 3.0 ft/year.

Estes Gulch site

The Estes Gulch disposal site is six miles north of Rifle on the southwestern flank of the Grand Hogback monocline. The Wasatch Formation underlies the site and consists of several thousand feet of variegated claystones, siltstones, and fine-grained sandstones. Bedding planes in the Wasatch Formation dip 65 to 75 degrees to the southwest beneath the disposal site. Approximately 500 to 800 feet south of the disposal site, a fault trends to the southeast, roughly parallel to the Grand Hogback. South of the fault, bedding dips at a 10 to 20 degree angle to the southeast.

Groundwater beneath the disposal site occurs at approximately 170 feet below ground surface and flows in a southeast direction along the strike of the steeply dipping beds of the Wasatch Formation. The upper twenty feet of the bedrock is weathered and fractured, with a hydraulic conductivity of 0.03 to 0.3 ft/day (10^{-4} to 10^{-5} cm/s), based on packer tests. The fractures close with depth, and the underlying, non-weathered bedrock of the Wasatch Formation has a saturated hydraulic conductivity of 6×10^{-5} ft/day (2×10^{-8} cm/s), measured by constant head permeability tests on four monitor wells. The average linear groundwater velocity beneath the site is less than 0.1 ft/year.

Lucas Mesa site

The Lucas Mesa alternate disposal site is located on a pediment surface underlain by the Shire Member of the Wasatch Formation (Tweto et al., 1978). The pediment consists of approximately 30 to 90 feet (and perhaps as much as 203 feet by one log) of sands, gravels, cobbles, and boulders in a clay/silt matrix.

The Shire Member of the Wasatch Formation underlies the unconsolidated pediment materials of the mesa, and consists of approximately 200 to 400 feet of predominantly shale and claystone (CGS, 1982) with some sandstone interlayers. Bedding planes in the Wasatch Formation dip gently to the northeast at two to three degrees (CGS, 1982).

Groundwater was not encountered in any of the five monitor wells completed at the Lucas Mesa site, and no springs, seeps, or moist areas have been noted around the flanks of the mesa (CGS, 1982). However, localized perched groundwater zones may exist within the pediment materials or at the bedrock interface.

Limited quantities of groundwater may occur in the Wasatch Formation beneath the pediment. Infiltration through the unconsolidated materials may recharge the Wasatch Formation. Saturated groundwater flow in the Wasatch Formation is probably structurally controlled, flowing downdip along the bedrock towards the northeast.

Packer tests conducted on the unconsolidated pediment materials of Lucas Mesa indicate that the hydraulic conductivity of the pediment materials ranges from 0.6 ft/day to 0.003 ft/day, with a geometric mean of 0.02 ft/day. The hydraulic conductivity of the Wasatch Formation beneath the site is unknown but is probably similar to that of the Wasatch Formation at Estes Gulch (approximately 10-5 ft/day). Because of the low hydraulic conductivity of the Wasatch Formation, groundwater velocities beneath the site are believed to be extremely low.

Borrow sites

The Second Street borrow site is a terrace gravel deposit north of the New Rifle tailings site. In a well immediately west of the site, groundwater is pumped from a depth of approximately 20 feet below the elevation of the borrow site. The New Rifle borrow site is west of the New Rifle processing site. This borrow site is an active gravel operation in the alluvial aquifer; the geohydrology of this borrow site is the same as that described for the New Rifle tailings site. The Glenwood Springs borrow site is an active limestone and dolomite quarry 30 miles east of the city of Rifle. Groundwater occurs approximately 50 feet below the land surface at this site.

Background water quality, tailings source characterization, and extent of contamination

Background groundwater quality at the Old and New Rifle sites was characterized and compared with the proposed EPA groundwater protection standards. These standards are shown in Table 4.3. The ensuing discussion will refer to these proposed EPA standards

and will refer only to water quality constituents with concentrations that exceed background concentrations or these standards.

For the purposes of this report, background water quality is defined as the quality of water that would be present had processing activities not occurred. This is determined by the maximum average concentration of chemical constituents in water samples from each background well. Because the natural variation in background water quality is large, and because other non-related activities may have affected groundwater quality between the Old and New Rifle sites, background water quality was defined separately for the two sites.

Old Rifle site

Background water quality was determined for the alluvium at the Old Rifle site from chemical analyses of samples from two upgradient and two off-gradient monitor wells across the Colorado River from the site. Background water quality in the alluvium at the Old Rifle site exceeds the proposed EPA groundwater protection standards for molybdenum, selenium, uranium, and gross alpha activity. Groundwater from background monitor wells in the alluvium is a calcium sulfate type water.

Background water quality of the Wasatch Formation at the Old Rifle site was defined by samples from upgradient and off-gradient monitor wells. Background water quality in the Wasatch Formation exceeds proposed EPA groundwater protection standards for molybdenum, selenium, and gross alpha activity. Samples from background monitor wells in the Wasatch Formation are a sodium sulfate type water.

The Old Rifle tailings are approximately 13 acres in area, and are finely ground sands with a medium clay content. The tailings are up to 20 feet thick, and are above the water table. However, during periods of high flow in the Colorado River, the tailings are saturated with up to 5.5 feet of groundwater. Saturated hydraulic conductivities for tailings sands and slimes at the Old Rifle site, measured using triaxial falling head tests, ranged from 0.02 cm/s to 1.7×10^{-6} cm/s. Total seepage from the Old Rifle tailings is estimated to be 1.5 gpm.

Seepage of tailings has affected groundwater quality through the 20 foot thickness of alluvium beneath the Old Rifle site. Most of the contaminated groundwater occurs directly beneath and immediately downgradient (west) of the tailings (Figure 4.7). The contamination extends westward to a distance of approximately 200 feet, where it pinches out much of the alluvium. At this point, the contaminated groundwater is diverted into the Colorado River, considerably reducing the contamination downgradient from that point. The lateral extent of the contamination in the alluvium is limited by the Wasatch Formation claystone north of the site and the Colorado River south of the site. Uranium concentrations

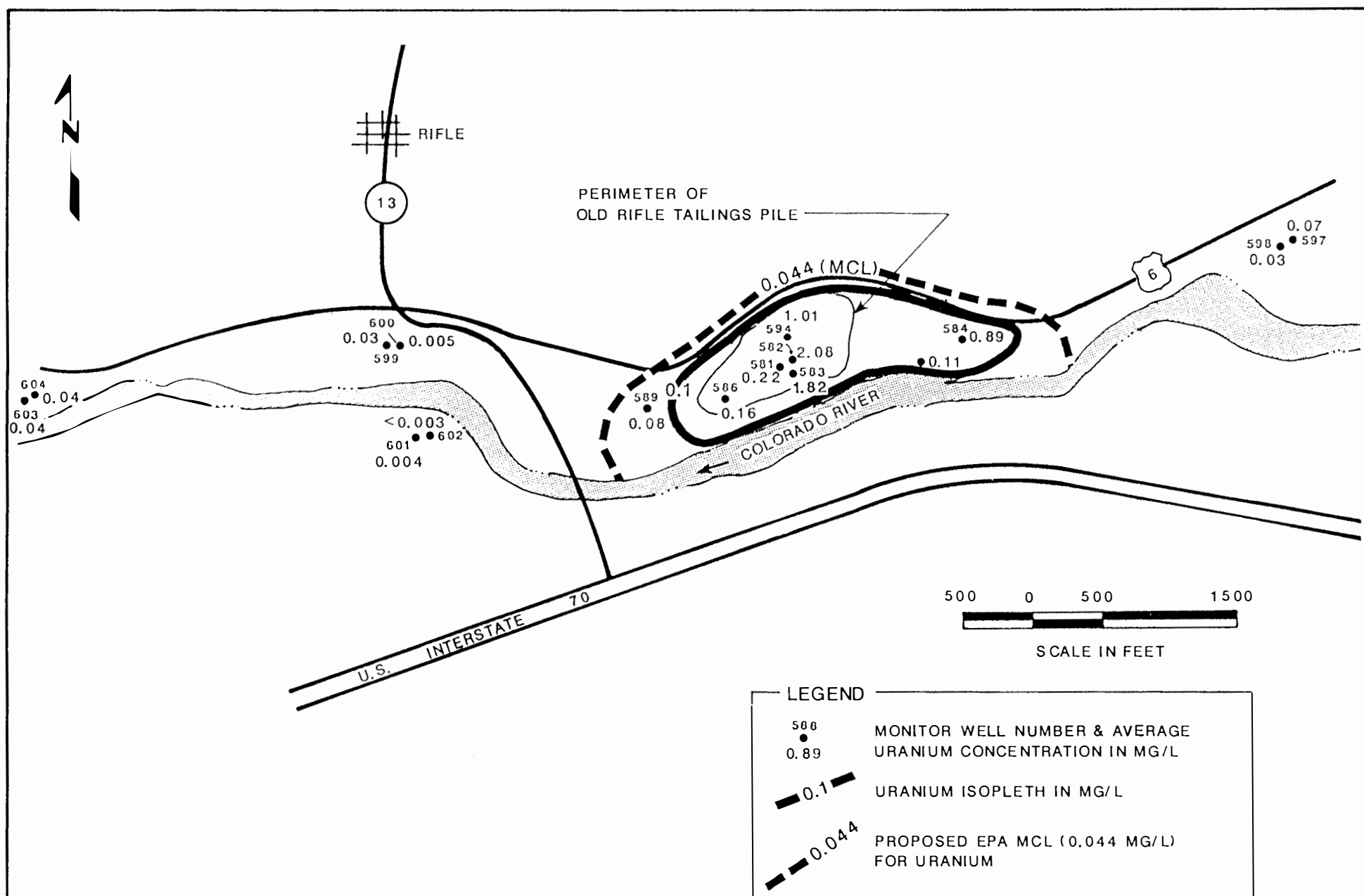


FIGURE 4.7
URANIUM CONCENTRATIONS IN ALLUVIAL GROUNDWATER, OLD RIFLE SITE

provide a good indication of the extent and magnitude of the contamination in the alluvium at the Old Rifle site (Figure 4.7).

The contaminant source at the Old Rifle site was characterized using analysis of tailings pore fluid samples from lysimeters completed in the tailings. Samples of tailings pore fluids contained concentrations of arsenic, calcium, chromium, molybdenum, selenium, uranium, and activities of gross alpha and radium-226 and -228 combined which exceed the proposed EPA groundwater protection standards.

Groundwater quality in the Wasatch Formation at the Old Rifle site has also been affected by uranium milling activities, with contaminants occurring to a depth of at least 100 feet. The lateral extent of contamination is believed to be significantly less than in the alluvium due to the lower hydraulic conductivity of the formation and the upward potentiometric gradients which occur in the vicinity of the site. However, seasonal drainage from a culvert north of the tailings pile has created a localized groundwater mound, forcing contaminants from the alluvium into the Wasatch Formation. This contamination is believed to be localized, and is limited to areas where the overlying alluvium is contaminated and downward potentiometric gradients occur.

Contaminated groundwater in the Wasatch Formation contains concentrations of selenium that exceed the proposed EPA groundwater protection standards. In addition, tailings seepage has resulted in elevated concentrations of the Appendix VIII constituents vanadium and zinc.

Limited sampling for organic constituents in alluvial groundwater at the Old rifle site revealed low concentrations of the solvents acetone and toluene, and the herbicide alpha-BHC. Although these chemicals were not used directly in the milling process, they may have been used on the site during the milling operation.

New Rifle site

Background water quality in the alluvium at the New Rifle site was defined using samples from upgradient monitor wells. Concentrations of molybdenum and uranium and activities of gross alpha radiation exceed the proposed EPA groundwater protection standards. Background alluvial groundwater samples are a calcium sulfate type water.

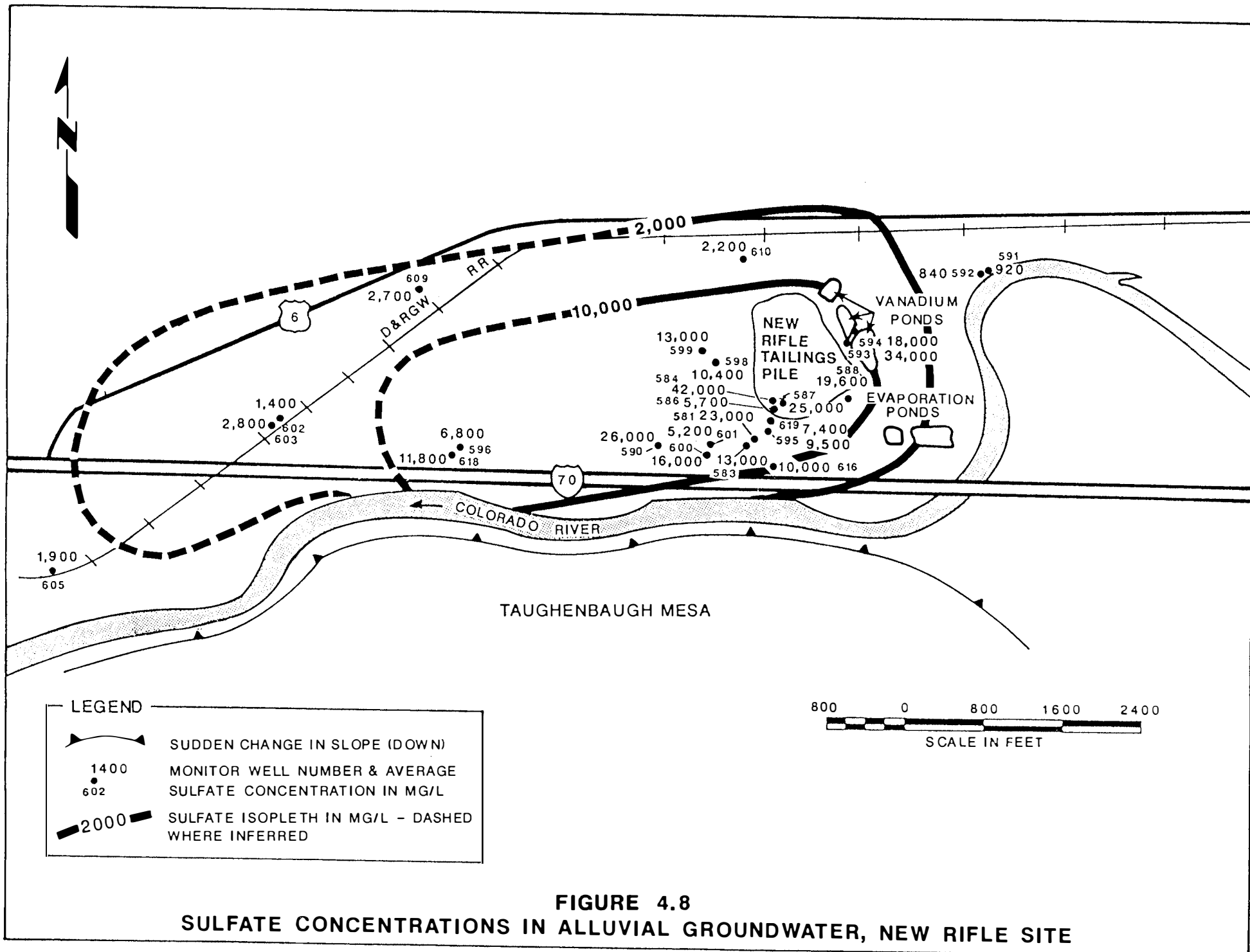
Major sources of contamination at the New Rifle processing site include seepage from two vanadium ponds and from the tailings pile. The vanadium ponds are 50 feet east of the tailings pile and are presently dry, although surface runoff may accumulate in them during spring. The total area of the ponds is about six acres. The tailings pile at the New Rifle site covers 33 acres and contains 2,415,000 cubic yards of tailings. The tailings are

a sandy mixture of the processed ore material and tailings raffinate from the solvent-extraction milling process. A saturated hydraulic conductivity of 7.2×10^{-7} cm/s was measured in the tailings slimes. Total seepage from the 33 acres of tailings is approximately 200,000 gallons per day, or 140 gallons per minute (gpm).

Analytical results of samples from monitor wells adjacent to the vanadium ponds, or screened beneath the tailings pile, represent a mixture of the contaminant fluids with groundwater and are the best available indicators of the contaminant source chemistry at the New Rifle site. Chemical analyses of groundwater samples from these wells contain high concentrations of uranium, TDS, sulfate, and chloride. Maximum concentrations or activities from these samples exceed proposed EPA groundwater protection standards for arsenic, cadmium, chromium, molybdenum, nitrate, selenium, gross alpha activity, and uranium.

Seepage of tailings and vanadium pond fluids has significantly affected groundwater quality in the alluvium at the New Rifle site. The areal extent of contamination is much greater than at the Old Rifle site (Figures 4.8 and 4.9), and the concentrations of contaminants exceed the EPA standards by a greater magnitude. The distribution of sulfate and uranium was used to indicate the approximate areal extent and magnitude of contamination, as both are relatively mobile in groundwater and both are found in the groundwater at high concentrations below the site. Sulfate is a more conservative parameter than uranium, and provides a better indication of the actual extent of contamination. More than 400 acres of alluvium at the New Rifle site have been contaminated by activities at the processing facility, with contamination extending the entire thickness of the alluvium. Highest contaminant concentrations in groundwater occur beneath and immediately west of the tailings pile and vanadium ponds. Contaminated groundwater in the alluvium discharges to the Colorado River southwest of the pile, but does not affect river water quality. Most of the contamination occurs within 4,000 feet of the downgradient (west) edge of the New Rifle tailings pile (Figures 4.8 and 4.9), although concentrations of chloride, sulfate, and TDS exceed background concentrations out to at least 8,000 feet downgradient of the tailings. Maximum concentrations of arsenic, chromium, molybdenum, nitrate, selenium, and uranium and activities of gross alpha in the alluvial groundwater exceed the proposed EPA groundwater protection standards. Concentrations of Appendix VIII constituents antimony, cobalt, copper, nickel, thallium, tin, vanadium, and zinc are elevated above background concentrations. Contaminated groundwater from the alluvium at the New Rifle site is a sodium sulfate type water.

Downward movement of contamination from the alluvium has affected groundwater quality in the Wasatch Formation at the New Rifle site, although the areal extent of contamination is less



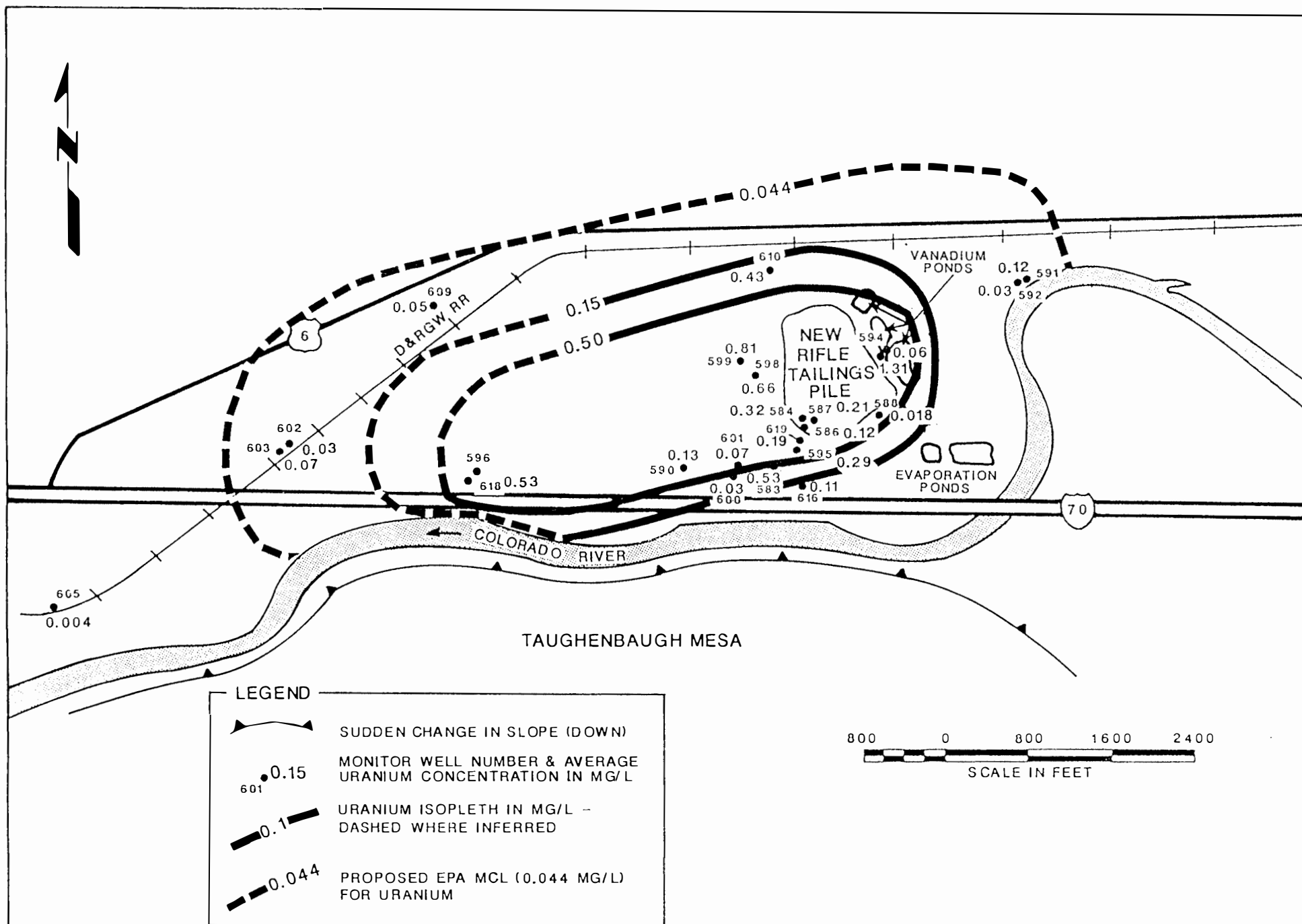


FIGURE 4.9
URANIUM CONCENTRATIONS IN ALLUVIAL GROUNDWATER, NEW RIFLE SITE

than in the alluvium (Figures 4.10 and 4.11) due to the lower hydraulic conductivity of the Wasatch Formation. Groundwater in the Wasatch Formation is contaminated 3500 feet downgradient of the tailings pile to a depth of 90 feet. No contamination has been observed in monitor wells completed in the Wasatch Formation across (south of) the Colorado River. Furthermore, no contamination is expected to occur in the Wasatch Formation across the Colorado River, as the formation dips between four and ten degrees to the northwest, and the groundwater flows to the west.

Maximum concentrations of some contaminants in samples from monitor wells completed in the Wasatch Formation exceed EPA standards. Barium, molybdenum, selenium, and uranium concentrations, and gross alpha and radium-226 (Ra-226) and radium-228 (Ra-228) activities exceed the proposed EPA groundwater protection standards. The tailings seepage has also resulted in elevated concentrations of the Appendix VIII constituents cobalt, nickel, sulfides, tin, vanadium, and zinc in the Wasatch Formation. Background and contaminated samples of groundwater from the Wasatch Formation at the New Rifle site are a sodium sulfate type water.

Limited sampling for organic contaminants in monitor wells completed in the alluvium at the New Rifle site revealed low concentrations of the solvents acetone and toluene and the herbicide 2,4,5-T. Low concentrations of the solvents acetone and toluene were also detected in one monitor well completed in the Wasatch Formation at the New Rifle site. These chemicals were believed to have been used on the site during the milling operation.

Estes Gulch

Groundwater in the Wasatch Formation beneath Estes Gulch is Class III, based on the high concentrations of naturally occurring contaminants and the low yield of the aquifer (see Section E.2.3.6). Beneath the site, groundwater contains TDS contents ranging from 8,620 to 24,300 mg/l and concentrations of selenium, molybdenum, barium, cadmium, and lead that exceed the proposed EPA MCLs.

Groundwater in the Wasatch Formation is a sodium chloride type. The predominance of sodium and chloride in the groundwater and the hydrodynamic properties of the Wasatch Formation indicate that groundwater has a long residence time in the bedrock (Freeze and Cherry, 1979). The high concentrations of constituents in groundwater in the formation reflect low flow velocities in the bedrock and minimal recharge from precipitation.

Lucas Mesa site

Groundwater quality in the Wasatch Formation beneath the Lucas Mesa disposal site would probably be very similar to that of the Wasatch Formation at Estes Gulch, because both sites overlie

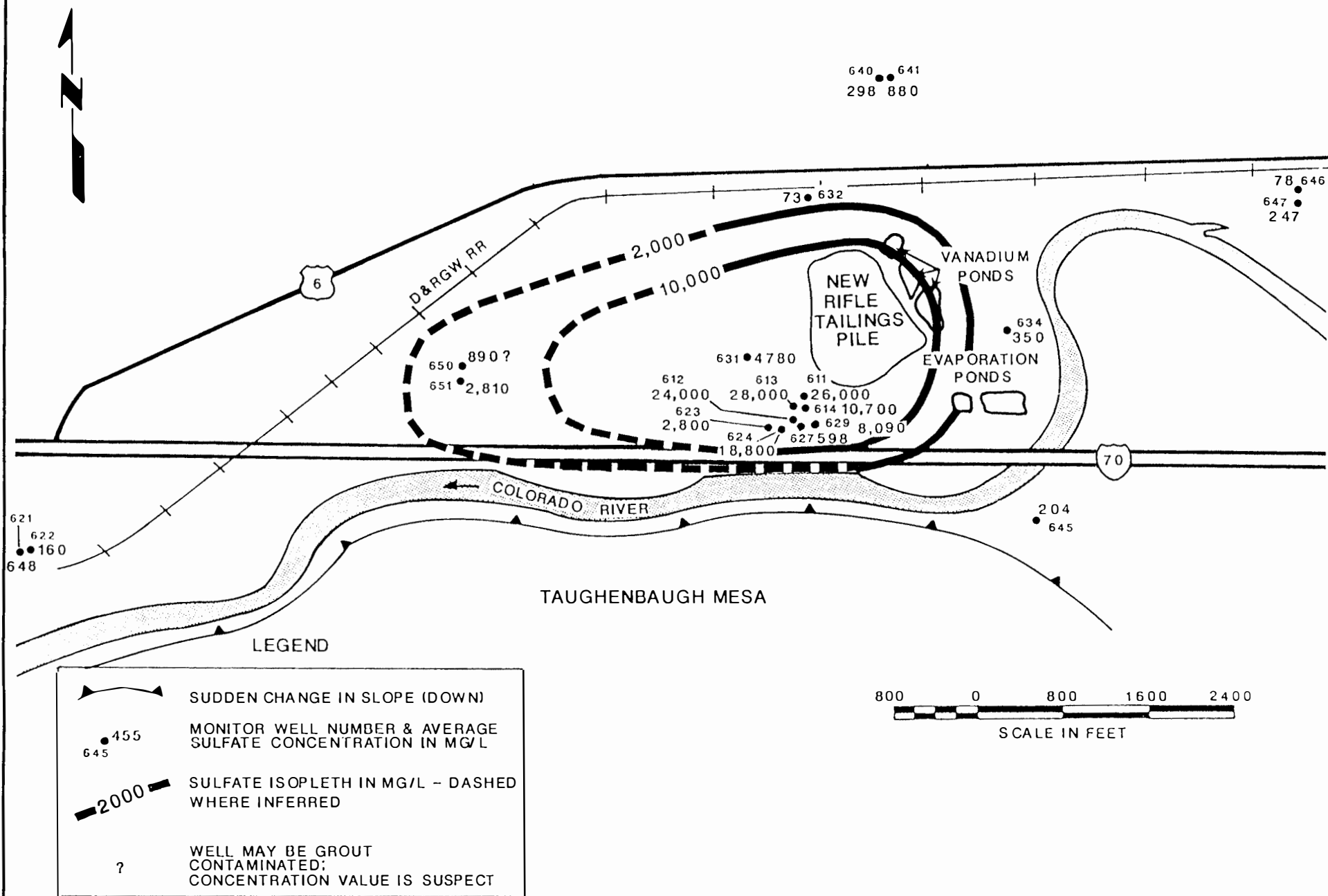


FIGURE 4.10
SULFATE CONCENTRATIONS IN THE WASATCH FORMATION, NEW RIFLE SITE

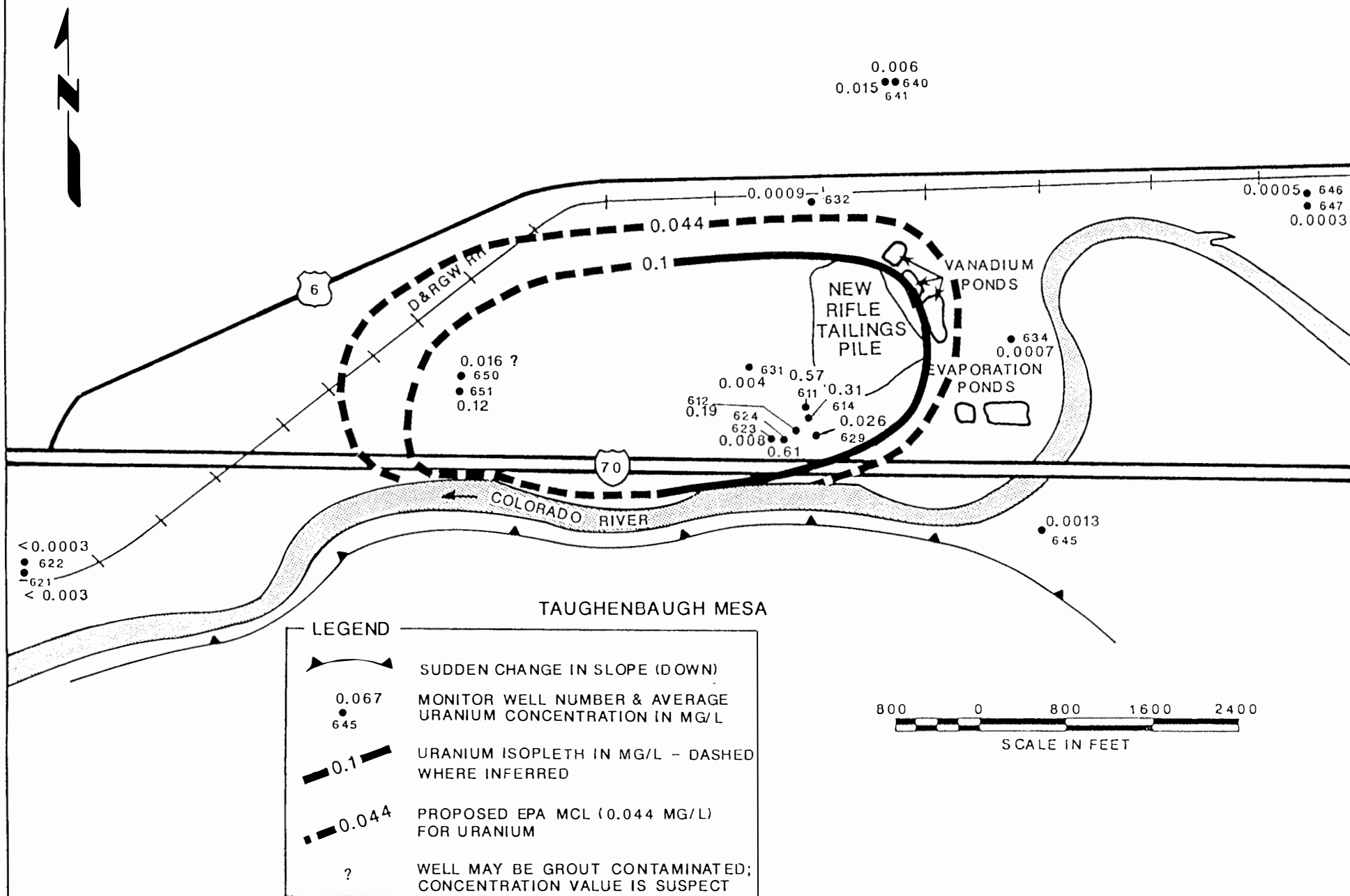


FIGURE 4.11
URANIUM CONCENTRATIONS IN THE WASATCH FORMATION, NEW RIFLE SITE

the Shire Member of the formation. Consequently, groundwater quality would probably be very poor due to the limited recharge and the low hydraulic conductivity of the Wasatch Formation. Total dissolved solids concentrations would be predicted to be high, and high concentrations of other constituents could occur. Groundwater could probably be classified as Class III due to the known high concentrations of naturally occurring contaminants and low yield of the formation.

Borrow sites

The Second Street borrow site is upgradient of the New Rifle tailings site and has not been affected by contamination from the tailings pile. Thus, the quality of the groundwater in the alluvium and the Wasatch Formation is presumably representative of background water quality at the New Rifle Site. The New Rifle borrow site is located within the contaminated zone identified on Figure 4.7. The quality of the groundwater in the alluvium and Wasatch Formation is similar to that described for the New Rifle tailings site. The Glenwood Springs borrow site is located far from the Rifle tailings sites and has not been affected by contamination from the tailings piles. The existing groundwater quality at this site is unknown.

Water use

The Colorado River is the primary source of domestic water in the Rifle area. The city of Rifle obtains all of its water for municipal use from the Colorado River approximately 0.5 mile upgradient of the Old Rifle tailings site, and all water users within the city are connected to the municipal water system. The city also supplies water to users outside the city limits (Minturn, 1986).

Fifty wells have been identified in the vicinity of the Rifle processing sites and the Estes Gulch disposal site. Thirty-nine wells are within two miles of the Old Rifle site, twenty-six wells are within two miles of the New Rifle site, and eight wells are within two miles of the Estes Gulch site. Three of the wells near the Estes Gulch site are screened in the Wasatch Formation approximately 0.75 mile west of the site, and two of these wells are used for domestic purposes. Although situated at a lower elevation than the Estes Gulch site, these wells are crossgradient to groundwater flow beneath the site. The other wells in the Rifle area are used primarily for irrigation and livestock watering. The only wells within a two-mile radius of the Lucas Mesa site are completed in the alluvium adjacent to the Colorado River. There is presently no usage of groundwater at or in the immediate vicinity of the Lucas Mesa site.

4.7 ECOSYSTEMS

This section provides an overview of the vegetation, fish, and wildlife existing at the Old and New Rifle tailings sites, alternate disposal sites, and borrow sites. The information presented is based on published and unpublished reports on terrestrial and aquatic resources, and personal communications with the Colorado Division of Wildlife (CDOW) and the BLM. Additional information is provided in Appendix G, Biology.

4.7.1 Vegetation

Rifle sites

The Old Rifle site consists of 22 acres of disturbed land. Most of the site has been modified for the storage of uranium mill tailings. The vegetative cover consists primarily of grasses, forbs, and Russian olive; greasewood and cottonwood are found near the abandoned mill area (DOE, 1983). Other species near the site include salt cedar, alder, rabbitbrush, sagebrush, and New Mexican locust (TAC, 1986).

A small wetland area (0.7 acre) is present along a drainage ditch that crosses the site. The wetland area is dominated by cattail and willow. (See Figure F.3.1 in Appendix F, Floodplains and Wetlands Assessment.)

The New Rifle site, covering approximately 142 acres, has been extensively disturbed and little native vegetation is present. The tailings pile has been reseeded with wheat grass. A total of 20.4 acres of wetland habitat occurs in the southeast portion of the site and in the windblown contamination area west of the site. (See Figures F.3.2 and F.3.3 in Appendix F, Floodplains and Wetlands Assessment.) Three wetland plant community types were identified: 1) 9.3 acres of shrub wetlands that are dominated by willow and salt cedar; 2) 5.8 acres of emergent wetlands that are dominated by cattail and other emergent plant species such as Phragmites and Carex; and 3) 5.5 acres of wet meadow, which is dominated by saltgrass. These wetlands were confirmed as being subject to U.S. Army Corps of Engineers (COE) regulations (Davis, 1988). As such, the disturbance of these wetlands would require a COE 404 permit.

Estes Gulch site

The Estes Gulch site consists primarily of big sagebrush with an understory of grasses and forbs (EES, 1986; Burt, 1985a,b). A study conducted in the sagebrush vegetation type in the area has indicated a total vegetative cover and a total mean shrub density of 32 percent and 6000 plants per hectare, respectively, with big sagebrush contributing a large percentage to total cover and density (Mobil, 1982). The surrounding area consists of pinyon pine

and juniper, a sparse cover of native grasses and forbs, greasewood, and slopes that are almost devoid of vegetation. Plant species observed at the site are listed in Table G.2.1 of Appendix G, Biology. Greasewood, cottonwood saplings, and salt cedar saplings occur near a small pond located adjacent to the southern portion of the site. This pond is approximately 0.5 acre in area (EES, 1986; Burt, 1985a,b).

Lucas Mesa site

Most of the Lucas Mesa site is occupied by a dense stand of big sagebrush with a sparse understory of forbs and grasses. The eastern and southern portions of the site are occupied by juniper trees with a sparse understory of shrubs, forbs, and grasses dominated by low rabbitbrush, scarlet globemallow, and Indian ricegrass (DOE, 1983). Table G.2.2 in Section G.2 of Appendix G, Biology, presents a list of plant species that are likely to occur at the site. Shrub and tree density measurements taken at the site indicate a relatively high density of sagebrush and juniper when compared to other studies in the area (CDM, 1983; DOE, 1983; Mobil, 1982). However, measurements taken by the BLM indicate a decrease in vegetative cover since 1980 (Jenkins, 1986a).

Borrow sites

The Second Street and New Rifle borrow sites are existing borrow operations north and west of the New Rifle mill site, respectively. Before disturbance, the Second Street borrow site occurred on the salt-flat range site, and the New Rifle borrow site occurred on the salt-meadow range site and the floodplain along the Colorado River (SCS, 1985).

The Glenwood Springs borrow site is also an existing borrow operation. It occurs on what was a shallow, subalpine range site (SCS, 1985). The area around the site is characterized by pinyon-juniper and oak brush vegetation communities.

4.7.2 Fish and wildlife

Rifle sites

Wildlife diversity at the Old and New Rifle sites is low due to the disturbed nature of the sites and the close proximity of the city of Rifle. However, the wetland and aquatic habitats near the sites, although not unique, serve as important wildlife habitats. Wildlife species found in the riparian zone are indicated in Tables G.3.1 through G.3.3 in Section G.3 of Appendix G, Biology, and the fish species that occur in the Colorado River near the sites are listed in Table G.3.4 in Section G.3 of Appendix G, Biology. In addition to the species listed, waterfowl and shorebirds also use the habitats. Areas north and east of the Old

Rifle site are considered a resident population area for mule deer. Areas north of the New Rifle site are considered critical winter range habitat for mule deer (Schnuur, 1985). Mule deer activity areas are shown on Figure G.3.1 in Section G.3 of Appendix G, Biology.

Estes Gulch site

The pinyon-juniper and sagebrush habitat types at the Estes Gulch site provide for a diversity of wildlife; the area is also important for big game species. Tables G.3.1 through G.3.3 in Section G.3 of Appendix G, Biology, provide a list of wildlife species that occur in these habitats.

The site is within an area that is considered a critical winter range for mule deer with a density estimated at 25 deer per square mile (Coleman, 1985; Schnuur, 1985; CDOW and BLM, 1984). Figure G.3.2 in Section G.3 of Appendix G, Biology, shows the mule deer activity areas. Although few elk have been observed on the site during the winter, the higher elevations nearby are known elk activity areas (Schnuur, 1985). Other game species which may occur within the site are cottontail rabbits, mourning doves, coyotes, bobcats, and chukar (Gray, 1986).

The Grand Hogback, north of the site, was proposed for the reintroduction of bighorn sheep (CDOW and BLM, 1984). The CDOW transplanted 21 bighorn sheep in January of 1987 and at least eight sheep plus lambs are still in the area. Additional transplants to supplement this herd are being considered. These transplants may take place within the next couple of years (Coleman, 1988). The release site is on BLM land in Section 5, Township 5 South, Range 93 West, approximately three miles northwest of the proposed disposal site. The bighorn sheep habitat as outlined by CDOW and BLM (1984) extends across the Grand Hogback for approximately nine miles. The Estes Gulch site is less than 0.5 mile south of (and approximately 200 feet lower in elevation than) the bighorn sheep habitat along the west side of the Grand Hogback.

No aquatic habitat is present at the Estes Gulch site. A small pond and Government Creek are west and southwest of the site, respectively, but do not provide significant aquatic habitat.

Lucas Mesa site

The pinyon-juniper and sagebrush habitat types at the Lucas Mesa site support a diversity of wildlife. The site area is within a winter concentration area and critical winter range for mule deer (Lambeth, 1986; Schnuur, 1986). Mule deer activity areas are shown in Figure G.3.3 in Section G.3 of Appendix G, Biology. Other important game species occurring within the site include cottontail rabbits and mourning doves and possibly black bear, turkey, and

sage grouse (Tables G.3.1 through G.3.3 in Section G.3 of Appendix G, Biology) (Gray, 1986; Lambeth, 1986; DOE, 1983).

No aquatic habitat is present at the Lucas Mesa site.

Borrow sites

The Second Street and New Rifle borrow sites are existing borrow operations, and, thus, wildlife diversity is low. These sites are not considered important wildlife habitat; however, the sites are near the Colorado River. The river and adjacent riparian zone provide habitat for a number of fish and wildlife species as described for the Old and New Rifle sites. Areas north of the sites are considered critical winter range for mule deer.

The Glenwood Springs borrow site is located northeast of Glenwood Springs. Because of its disturbed nature, the site does not constitute significant wildlife habitat; however, it is within a critical winter range for mule deer and elk. Mule deer winter in the pinyon-juniper woodland while elk winter in the pinyon-juniper woodland and the oak brush zone. The BLM, which regulates borrow site activities, prohibits blasting and quarrying during the period from December 15 to April 15 to mitigate adverse impacts on wintering deer and elk populations. Truck haul is conducted year-round (Coleman, 1986).

4.7.3 Threatened, endangered, and sensitive species

The Fish and Wildlife Service (USFWS) indicated that two endangered (bald eagle and black-footed ferret), one threatened (Uinta Basin hookless cactus), and nine candidate species may be present at the Old and New Rifle sites and the Estes Gulch alternate disposal site. At the Lucas Mesa site, the bald eagle and Uinta Basin hookless cactus were listed as species potentially present by the USFWS (see Attachment G1 of Appendix G, Biology). The candidate species are the ferruginous hawk, Swainson's hawk, western yellow-billed cuckoo, long-billed curlew, white-faced ibis, western snowy plover, razorback sucker, DeBeque milkvetch, and DeBeque phacelia. In addition, the state of Colorado indicated that the Wetherill milkvetch, a plant species of special concern, may be present at the Estes Gulch site. The occurrence or potential occurrence of these species at the Old and New Rifle sites, Estes Gulch site, and the Lucas Mesa site are shown in Table 4.4.

Recently, the DOE agreed to widen and improve portions of State Highway 13 to accommodate increased truck traffic resulting from transport of tailings from the Rifle processing sites to the proposed Estes Gulch disposal site. Widening and improving State Highway 13 is a mitigation measure designed to offset the impacts of tailings transportation. If the Estes Gulch alternative is selected, an endangered species survey will be performed prior to the initiation of road improvement activities.

Table 4.4 Threatened, endangered, and sensitive species
at the Rifle UMTRA Project sites

Species	Federal and/or state listings ^a	Type of habitat that the species are observed or expected to occur in ^b		
		Old and New Rifle sites	Estes Gulch site	Lucas Mesa site
<u>MAMMAL</u>				
Black-footed ferret	E	NH	NH	
<u>BIRDS</u>				
Bald eagle	E	R	NH	NH
Ferruginous hawk	C	NH	PJ/S?	
Swainson's hawk	C	NH	PJ/S?	
Western yellow- billed cuckoo	C	R?	NH	
Long-billed curlew	C	R?	NH	
White-faced ibis	C	R?	NH	
Western snowy plover	C	R?	NH	
<u>FISH</u>				
Razorback sucker	C	A?		
<u>PLANTS</u>				
Uinta Basin hookless cactus	T	NH	NH	NH
DeBeque phacelia	C	NH	NH	
DeBeque milkvetch	C	NH	NH	
Wetherill milkvetch	SC		PJ/S	

^aE indicates endangered; T indicates threatened; C indicates candidate for Federal listing; SC indicates species of special concern.

^bR indicates riparian; PJ indicates pinyon-juniper; S indicates sagebrush; A indicates aquatic; NH indicates appropriate habitat not available at site; ? indicates that the species has not been observed but could potentially occur.

Borrow sites

The Second Street, New Rifle, and Glenwood Springs borrow sites are existing borrow operations. Appropriate habitats for the listed endangered, threatened, or candidate species are not present at the disturbed sites. However, the bald eagle occurs along the Colorado River near the New Rifle borrow site, and the white-faced ibis, western snowy plover, western yellow-billed cuckoo, long-billed curlew, and razorback sucker may occur in or along the Colorado River near the New Rifle borrow site.

4.8 RADIATION

The radiological environments at the Old and New Rifle tailings sites and the Estes Gulch and Lucas Mesa alternate disposal sites are summarized in this section. The radiological units of measurement commonly used are picocuries per gram (pCi/g) for soil samples, picocuries per liter (pCi/l) for water samples and radon air concentrations, and picocuries per cubic meter (pCi/m³) for radionuclide air particulate samples. There are 10^{12} picocuries in a curie (Ci), where one curie is 3.7×10^{10} nuclear disintegrations per second. Radiological gamma exposure rates are presented in microroentgens per hour (microR/hr) and millirem per year (mrem/yr). For purposes of this document, the roentgen and rem may be considered equivalent; therefore, 1000 microroentgens would equal one millirem.

The radiological environments at the two Rifle tailings sites and the Lucas Mesa alternate disposal site were determined by a review of literature and field monitoring programs. Only background radon data for the Estes Gulch site are currently available. A more extensive discussion of radiological matters in general is provided in Section H.1 of Appendix H, Radiation.

The elevated levels of radiation reported in the following sections and in Section H.3 of Appendix H, Radiation, should be compared to the levels of natural background radiation and other anthropogenic radiation levels for perspective. Natural materials in the earth's crust (primarily uranium, thorium, radium, and potassium) and cosmic rays from outer space continually expose people to radiation. Additionally, people are routinely exposed to sources of radiation as a result of human activity such as medical exposures, fallout from weapons testing, and consumer products. On the average, a person in the United States receives a gamma dose equivalent of 200 mrem/yr. Approximately 45 percent of this dose equivalent comes from medical exposures such as X-rays, 51 percent comes from natural radiation sources, and four percent results from other exposure categories (Shleien and Terpilak, 1984). A person living at a high altitude such as Albuquerque, New Mexico (5000 feet above mean sea level), receives nearly twice as much cosmic radiation as a person living at sea level. Some activities, occupations, and areas of the country expose a person to a greater radiation dose equivalent than the average. A person employed in a nuclear power plant receives approximately 400 mrem/yr, or approximately two times the average radiation dose to a person in the United States (EPA, 1984b).

4.8.1 Rifle sites

Background radioactivity levels typical of the Rifle area and not influenced by the Rifle tailings piles have been established (ORNL, 1980). Average background concentrations in soil were 1.4 pCi/g for Ra-226, 0.5 pCi/g for U-238, and 1.2 pCi/g for Th-232.

The EPA maintained a surface water quality monitoring system in the Colorado River basin from 1962 to 1972 (EPA, 1973). Six of the monitoring stations were considered by the EPA to be representative of background conditions. The mean dissolved Ra-226 concentration for these six stations was 0.08 pCi/l, with a range of 0.02 to 0.19 pCi/l. Additional information on surface and groundwater quality is provided in Section 4.6 and Appendix E, Hydrology.

The outdoor background radon concentration for Rifle was determined to be 0.4 pCi/l. This is the annual average radon concentration for the time period of one year prior to the start of remedial action (JEG, 1988).

The average background gamma radiation exposure rate in the Rifle area from both terrestrial and cosmic sources, measured by Bendix Field Engineering Corporation (BFEC) at three feet above the ground, was 15 microR/hr (BFEC, 1985a). An aerial radiological survey of the area was conducted in 1979. The average gamma exposure rate was calculated to be 13 microR/hr within Rifle and 13 to 14 microR/hr in the areas east and west of the city. These results are similar to the BFEC results mentioned previously. Cosmic rays (radiation from the sun and other sources external to the earth) contribute approximately 5.6 microR/hr (43 percent) to the 13 microR/hr total exposure rate (EG&G, 1983).

Old Rifle site

As part of a study by Mountain States Research and Development (MSRD) to investigate the economic feasibility of reprocessing the Old Rifle tailings for uranium, vanadium and molybdenum, 67 boreholes were drilled into the tailings pile. Tailings and sub-pile samples were analyzed for radium (BFEC 1984). This data was supplemented with additional field investigation data collected by Morrison Knudson-Fergusson (MK-F) (MK-E, 1988). This data set was used to determine the average radium concentration of the tailings and sub-pile materials. The average Ra-226 concentration of the tailings material was 722 pCi/g as determined from 111 samples. The estimated volume of tailings material was 333,000 cubic yards. The average radium concentration of the sub-pile was 503 pCi/g as determined from 102 samples. The estimated volume of sub-pile material was 168,000 cubic yards. The average radium concentration for the tailings pile was 674 pCi/g. The 674 pCi/g average includes the tailings, the existing 0.5-foot-thick cover, and the sub-pile contamination. The sub-pile material exceeds the EPA standard of 15 pCi/g of Ra-226 to an average depth of 4.8 feet. The total volume of tailings, cover, and sub-pile was approximately

501,000 cubic yards. The MSRD tailings sampling program (MSRD, 1982a) estimated the tailings uranium content to be 0.0379 percent, which is equivalent to 110 pCi/g of U-238. The Th-230 concentration in the tailings is assumed to be in equilibrium with Ra-226; therefore, the tailings pile contains an average of 674 pCi/g of Th-230.

Stream sediment samples were collected at 16 locations on or surrounding the Old Rifle site to determine whether contamination has been transported off the site by surface drainage (BFEC, 1985a). Radium-226 concentrations ranged from 3.0 pCi/g in the dry stream channel near the hospital (located approximately 1.25 miles north of the site) to 247 pCi/g in the small drainage ditch running across the site at a point five feet above its junction with the Colorado River. The Old Rifle site is 100 feet north of the Colorado River, so sediment-transported contamination would have been diluted upon reaching the Colorado River. Additional information on surface water quality for the Colorado River at the Old Rifle site is provided in Section 4.6.1 and Section E.1.3.1 of Appendix E, Hydrology. Groundwater quality at the Old Rifle site is discussed in Section 4.6.2 and Section E.2.3 of Appendix E, Hydrology.

The radon flux source term from the tailings pile was calculated for existing conditions using the MSRD data (BFEC, 1984) and the RAECOM model (NRC, 1984) and resulted in an annual average radon flux of 410 picocuries per square meter per second ($\text{pCi}/\text{m}^2\text{s}$). This calculation is considered to be more representative of the average tailings pile radon flux than short-term, isolated field measurements. Dispersion modeling described in Section H.3, of Appendix H, Radiation, estimated the radon air concentration at the center of the pile to be 6.5 pCi/l above background for existing conditions. This calculation was based on an average wind speed of two meters per second (see Section 4.3.3).

Using Schiager's (1974) estimate of 2.5 microR/hr per pCi/g, the bare tailings gamma exposure rate would be 1688 microR/hr, based on the average tailings pile Ra-226 concentration of 674 pCi/g. The 1688-microR/hr gamma exposure rate is considered to be conservatively high as the existing cover on the tailings pile reduces the pile surface gamma exposure rate to an average of less than 250 microR/hr (EG&G, 1983). Gamma traverse measurements across the pile indicated an average gamma exposure rate of 160 microR/hr on the pile with a maximum of 292 microR/hr (ORNL, 1980).

Field data (BFEC, 1985a) (MK-E, 1988) indicate that an additional 160,000 cubic yards of contaminated materials exist in areas adjacent to the tailings pile. These contaminated areas include the mill area east of the tailings pile, the previous ore storage area on the bluff north of the tailings site, and wind-blown tailings on the bluffs northeast of the tailings site. Figure 4.12 illustrates the off-pile areas of contamination in the vicinity of the Old Rifle tailings pile. Based on field data

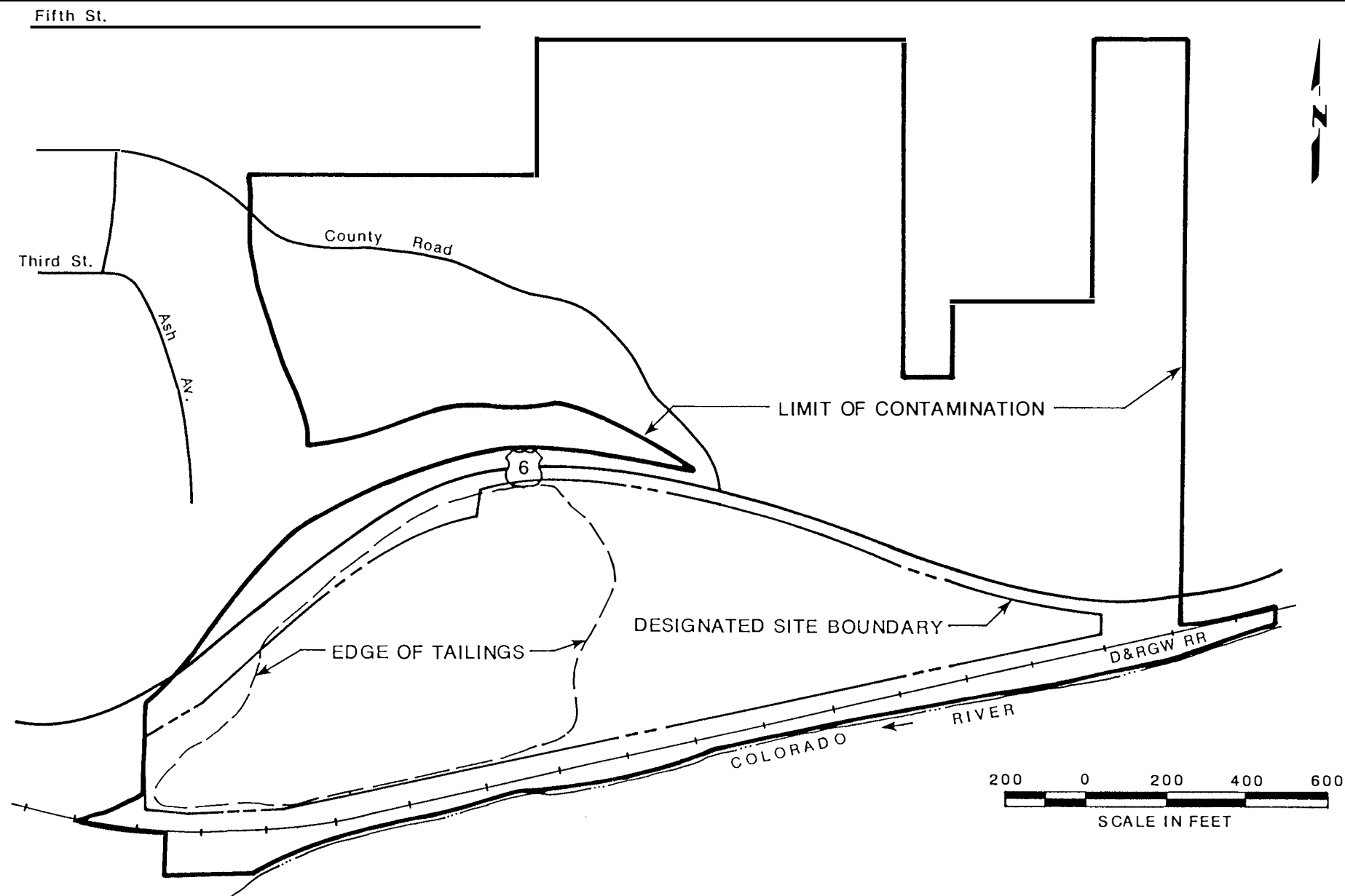


FIGURE 4.12
OFF-PILE CONTAMINATION, OLD RIFLE SITE

(BFEC, 1985a) (MK-E, 1988), the average Ra-226 concentration of the off-pile contaminated materials was estimated to be 275 pCi/g.

Gamma exposure rates in the windblown tailings area to the northeast decrease below 20 microR/hr at distances beyond 2000 feet from the edge of the tailings pile. In all other directions, gamma exposure rates decrease below 20 microR/hr at distances of 500 feet from the edge of the tailings pile (BFEC, 1985a).

New Rifle site

As part of the MSRD study (1982b) to investigate the economic feasibility of reprocessing the New Rifle tailings for uranium, vanadium, and molybdenum, 95 boreholes were drilled into the New Rifle tailings pile. Tailings and sub-pile samples were analyzed for radium (BFEC, 1984). This data was supplemented with additional field investigation data collected by MK-F (MK-F, 1987). This data set was used to determine the average radium concentration of the tailings and sub-pile materials. The average radium-226 concentration of the tailings material was 638 pCi/g as determined from 238 samples. The estimated volume of tailings material was 2,415,000 cubic yards. The estimated volume of sub-pile material was 375,000 cubic yards. The average radium concentration for the sub-pile was 236 pCi/g as determined from 102 samples. The average radium concentration for the tailings pile was 610 pCi/g. The 610 pCi/g average includes the tailings and sub-pile contamination. The sub-pile exceeds the EPA standards of 15 pCi/g to an average depth of 4.3 feet. The total volume of tailings and sub-pile material is approximately 2,790,000 cubic yards. The MSRD tailings sampling program (MSRD, 1982b) estimated the tailings uranium content to be 0.0176 percent, which is equivalent to 50 pCi/g of U-238. The Th-230 concentration in the tailings is assumed to be in equilibrium with Ra-226; therefore, the tailings pile contains an average of 610 pCi/g of Th-230.

Stream sediment samples were collected at 17 locations on the New Rifle site to determine whether contamination was transported by surface drainage (BFEC, 1985a). Radium-226 concentrations ranged from 1.0 to 149 pCi/g. Elevated Ra-226 concentrations were found in the swampy area west of the tailings pile, suggesting that contamination is moving off the site through water erosion. Thorium-230 was generally found at higher concentrations than Ra-226, again suggesting surface drainage transport of contamination. In general, off-pile sediment and soil samples indicated Th-230 concentrations exceed Ra-226 concentrations by a factor of approximately three. Additional information on surface water quality for the Colorado River at the New Rifle site is provided in Section 4.6.1 and Section E.1.3.1 of Appendix E, Hydrology. Groundwater quality at the New Rifle site is discussed in Section 4.6.2 and Section E.2.3 of Appendix E, Hydrology.

The radon flux source term from the tailings pile was calculated for existing conditions using the MSRD data (BFEC, 1984) and RAECOM model (NRC, 1984) and resulted in an annual average radon flux of 350 pCi/m²s. Dispersion modeling described in Section H.3 of Appendix H, Radiation, estimated the radon air concentration at the center of the pile to be 7.2 pCi/l above background for existing conditions. This calculation was based on an average wind speed of two meters per second (see Section 4.3.3).

Using Schiager's (1974) estimate of 2.5 microR/hr per pCi/g, the bare tailings gamma exposure rate would be 1900 microR/hr based on the average tailings pile Ra-226 concentration of 610 pCi/g. The 1525 microR/hr gamma exposure rate is considered to be conservatively high as the average pile surface gamma exposure rate under existing conditions is less than 500 microR/hr (EG&G, 1983). Gamma traverse measurements indicated an average gamma exposure rate of 430 microR/hr with a maximum of 888 microR/hr (ORNL, 1980).

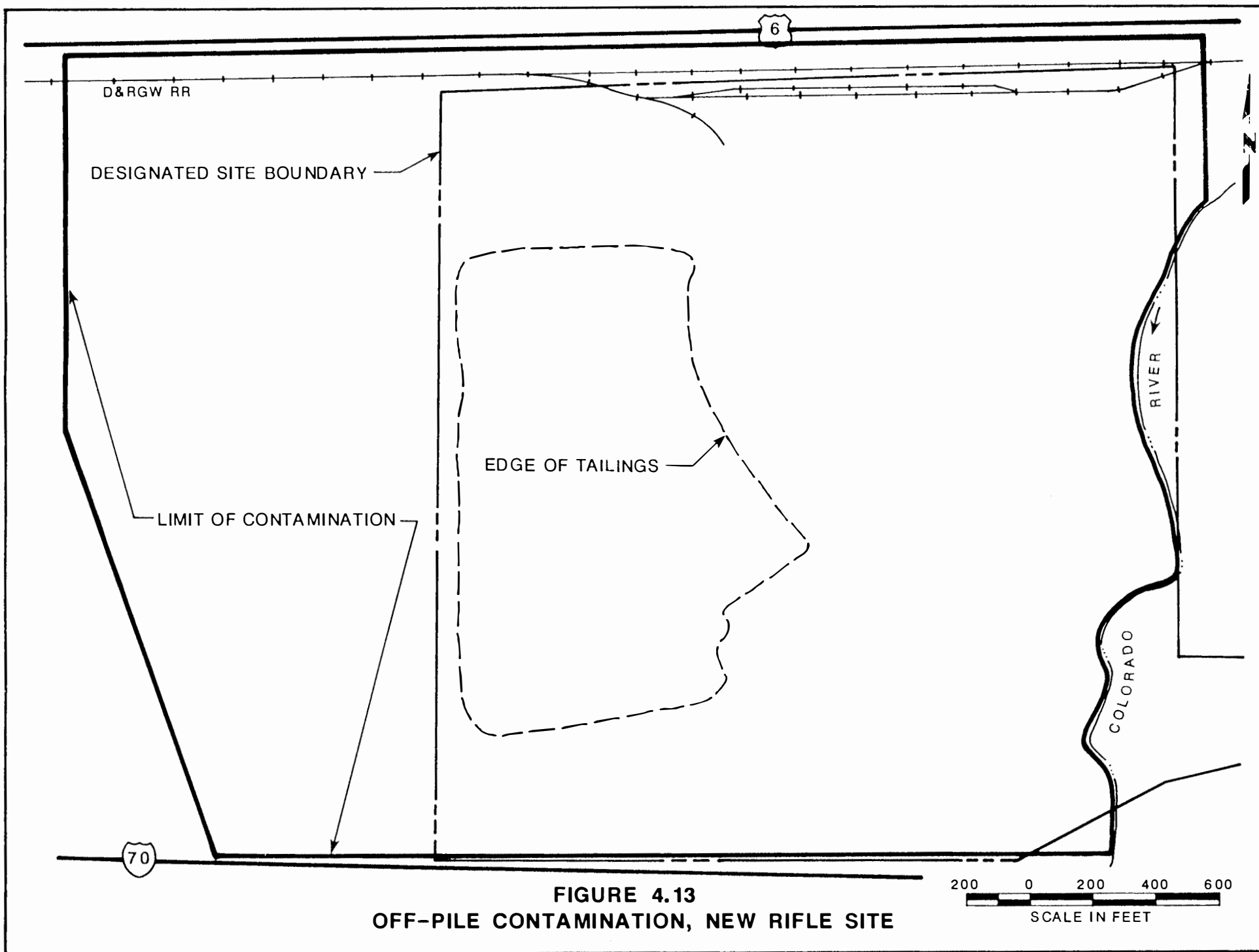
Field data (MK-F, 1987; BFEC, 1985a) indicate that an additional 684,000 cy of contaminated materials exist in areas adjacent to the tailings pile. These contaminated areas include the mill and previous ore storage areas north and east of the tailings pile. Some windblown and waterborne tailings are present west of the tailings pile. The majority of the off-pile windblown tailings is within the designated tailings site. Figure 4.13 illustrates the off-pile areas of contamination in the vicinity of the New Rifle tailings pile. The average Ra-226 concentration of the off-pile contaminated materials was estimated to be 86 pCi/g.

Gamma radiation levels have been found to decrease rapidly with distance from the New Rifle tailings pile. Gamma exposure rates decrease to below 20 microR/hr at distances of 1500 feet in all directions from the edge of the tailings pile (BFEC, 1985a).

Small, isolated pockets of contamination were located by a gamma scan along U.S. Highway 6 between the Old and New Rifle sites (BFEC, 1985a). The maximum Ra-226 concentration in a soil sample collected along the highway was 60 pCi/g.

4.8.2 Estes Gulch and Lucas Mesa sites

The background radiation levels at the Estes Gulch disposal site are expected to be very similar to the Rifle area's natural background radiation levels. Background values were provided in Section 4.8.1. Using the Track-Etch R method, annual average radon concentration (as determined from the one-year pre-remedial action monitoring program) around the Estes Gulch site was 0.5 pCi/l (TAC, 1988). The annual average background radon concentration for the Rifle area was 0.4 pCi/l as provided in Section 4.8.1.



Radiation levels at the Lucas Mesa site have been determined from a field study conducted by the DOE in the spring of 1985. Surface soil samples were collected at four measurement locations and analyzed for Ra-226 concentrations. The average Ra-226 concentration was 1.6 pCi/g with a standard deviation of 0.3 pCi/g.

Using the Track-Etch method, radon air concentrations were measured using three detectors at one location on the Lucas Mesa site for a three-month period from April 16 to July 15, 1985. The measurements resulted in an average radon concentration of 0.53 pCi/l (Oswald, 1985).

A general survey of terrestrial and cosmic radiation levels was also conducted by the DOE in the area of the Lucas Mesa site. Pressurized ionization chamber (PIC) measurements were made at four locations, and the average gamma exposure rate was 15.3 microR/hr with a standard deviation of 1.0 microR/hr. A sodium iodide scintillometer was calibrated against the PIC at each location. Subsequent traverse measurements across the site indicated readings similar to the PIC measurements with no anomalies.

4.8.3 Borrow sites

The radiological environments at the proposed borrow sites have not been characterized. The background radiation levels at these sites are expected to be similar to the area's natural background radiation levels and the background radiation measurements provided in Section 4.8.1.

4.9 LAND USE

4.9.1 Regional setting

The Rifle tailings sites are located in northwestern Colorado in Garfield County. Mountains and the Colorado River have largely guided the settlement and development of the county. Several peaks over 10,000 feet are evidence of the rugged and inaccessible terrain. See Section J.1 of DEIS Appendix J, Land Use and Socio-economics, for a more detailed description of settlement patterns and existing land use.

Garfield County is sparsely settled. The 1980 population density was 7.63 people per square mile; however, this low population density is typical of the rural, western Colorado counties. Garfield County had a 1984 estimated area of 1.9 million acres (Garfield County Planning Department, 1985). Although the city of Rifle (1985 population of 4524) has existed since 1882, it has always been second in size to Glenwood Springs (1985 population of 5325), the county seat (Kennedy, 1986; Peterson, 1986).

Historically, Rifle and Glenwood Springs have been the major cities within the county. Other towns include New Castle, Silt, Parachute, and Battlement Mesa. The growth of Glenwood Springs paralleled the rise in mining and the popularity of mineral baths at the turn of the century. It quickly became a resort spa frequented by the residents of the nearby mining communities. Rifle, at the terminus of the D&RGW Railroad, originated as a supply point for homesteaders. Its history is tied to an agricultural and ranching economy, mining cycles, and retail sales.

Non-Federal lands used for agriculture comprise approximately 702,752 acres in Garfield County (Stindt, 1986). Overall, Garfield County does not make a significant contribution to Colorado's farm economy. Between 1979 and 1984, Garfield County's contribution averaged 0.5 percent of the total Colorado annual income from farm products (CDA, 1985). The major crops grown in Garfield County, by order of economic importance, are hay, corn, and grains (Cogburn, 1986).

In addition to agriculture, mineral extraction occurs throughout Garfield County. Levels of mining activity, however, are currently much reduced as compared to the previous mining cycles. In 1985, the primary mineral activities included sand and gravel extraction, coal mining, and oil and gas development. Natural gas production is currently providing the majority of revenue from mineral-related activities (Belcher, 1986). Oil shale development is inactive.

Approximately 64 percent of Garfield County is administered by either the BLM or the U.S. Forest Service (USFS). The USFS administers the three national forests (White, Routt, and Grand Mesa) found within the county. However, the BLM administers the majority of the Federal land. Much of the land surface is used for cattle and sheep grazing. The remainder of the county (36 percent) is divided between state, county, and private ownership. Approximately 75 percent of all private land is zoned agricultural-residential. Private lands also include large acreages owned primarily by five major oil companies for potential oil shale development.

4.9.2 Rifle sites

Both the Old and New Rifle sites are located on the Colorado River floodplain and are bounded by U.S. Highway 6 to the north and the Colorado River to the south. Figure 4.14 shows land uses in the area of the sites.

The sites are outside of the Rifle city limits and are under Garfield County jurisdiction. Garfield County zoning regulations identify allowable uses on the sites, and both sites are zoned agricultural-industrial. Under this zoning classification, residential development on a two-acre minimum lot size is allowed; industrial uses such as a mill site are also allowed (Bean, 1986).

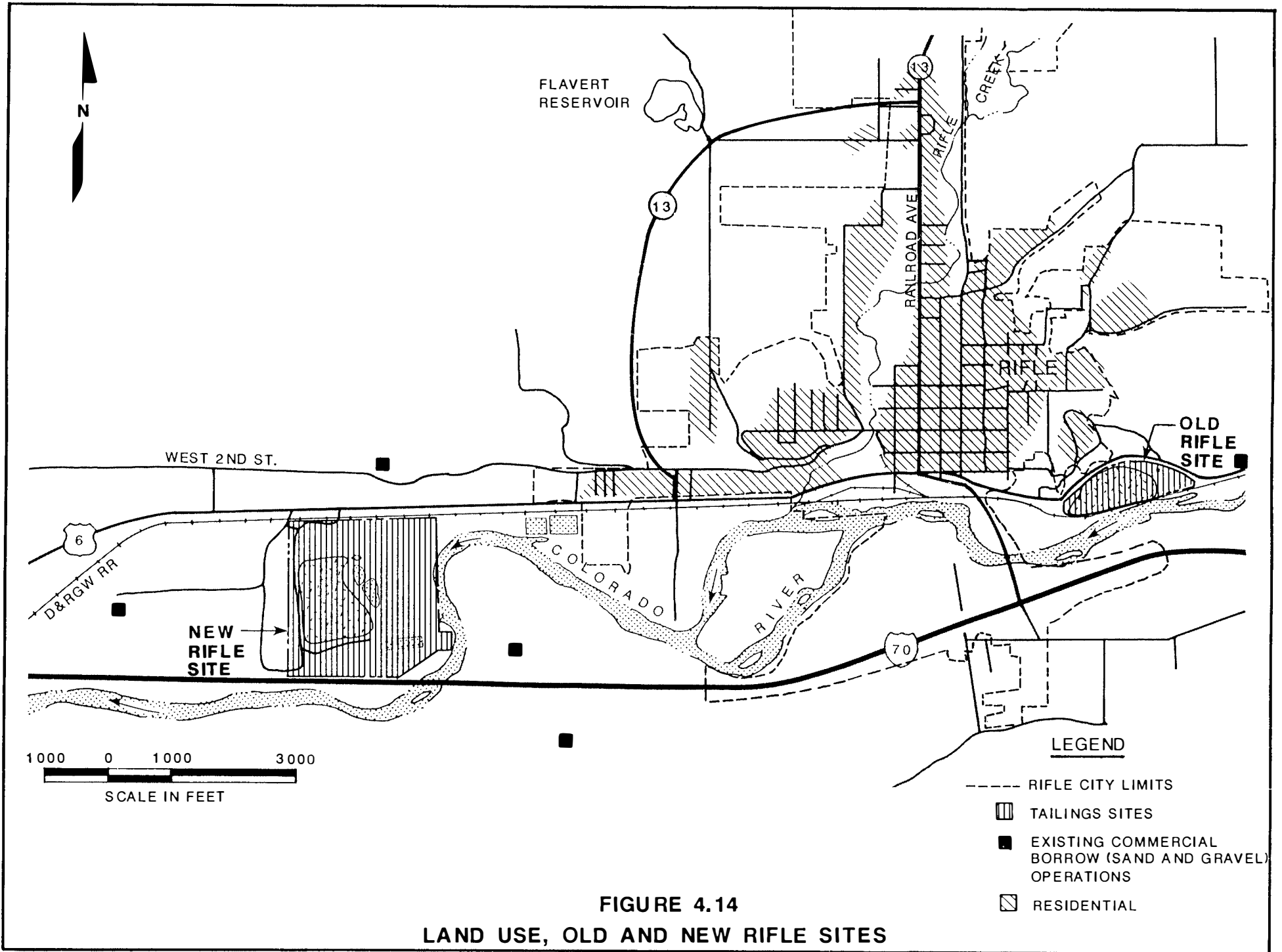


FIGURE 4.14
LAND USE, OLD AND NEW RIFLE SITES

There are no adjacent residences or commercial buildings at either site.

Areas contaminated with windblown tailings occur adjacent to both the Old and New Rifle sites and on the bluff above the Old Rifle site. There are no residences in these contaminated areas although there are residences adjacent to the contaminated area above the Old Rifle site.

There is currently no demand for residential or industrial building site locations within Garfield County. It is unlikely that building permits for residences on the 100-year floodplain at both Rifle sites would be approved by the Garfield County Planning Commission (Bean, 1986).

4.9.3 Estes Gulch site

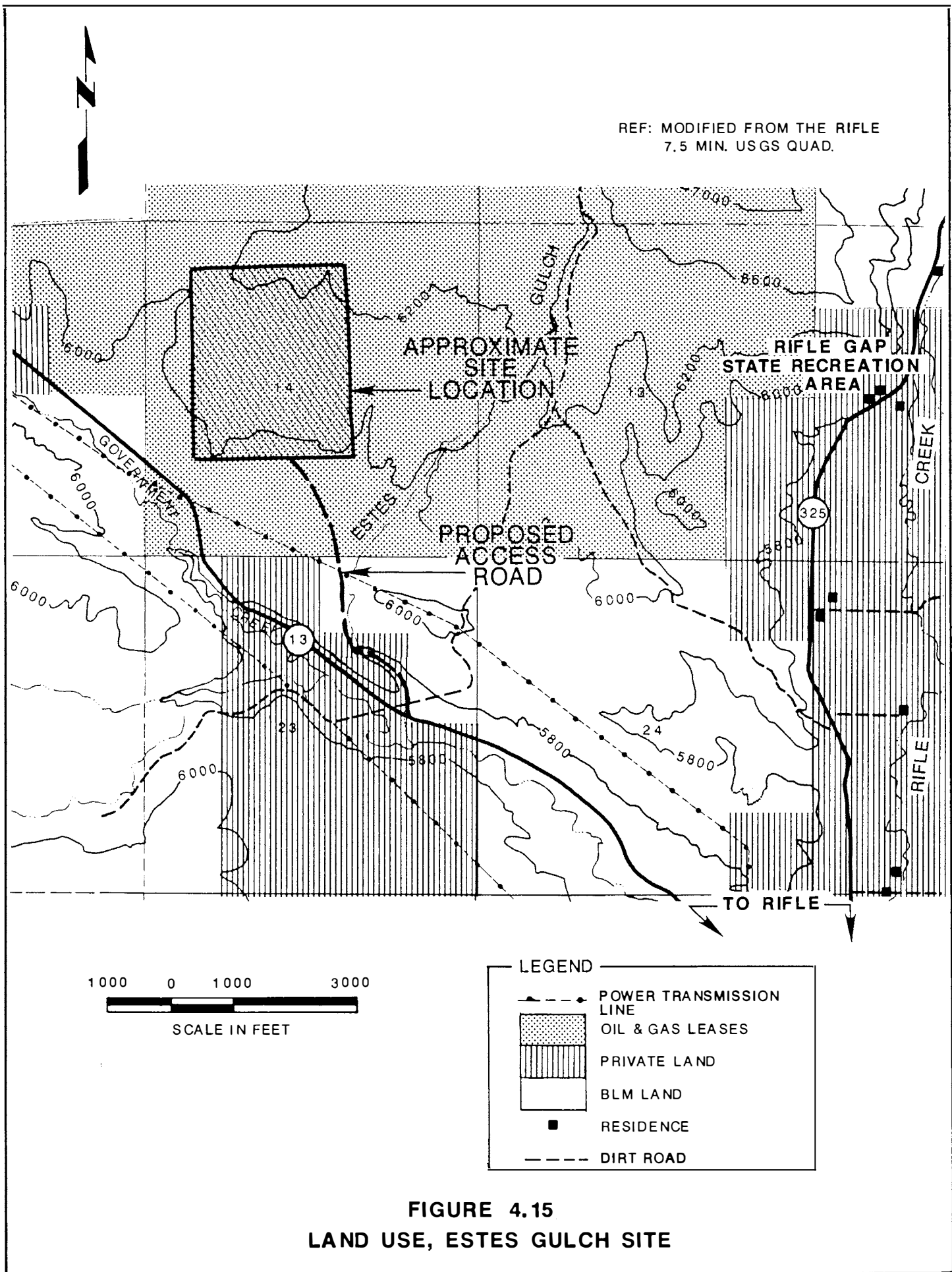
Estes Gulch is located approximately six miles north of Rifle; the nearest residences occur along State Highway 13, 0.75 mile to the west. Figure 4.15 shows land use in the area of the site.

The Estes Gulch site is within a large block of land administered by the BLM and within the Government Creek grazing allotment. The current land use consists of grazing cattle during a one-month period between mid-May and mid-June and grazing sheep during a two-month period from January through February. The entire grazing allotment consists of approximately 7580 acres and is assigned to two permittees. The disposal site is located within the most productive portion of the allotment. Several livestock watering facilities are found within the site area (Atkins, 1986; Ligon, 1986). Estes Gulch is within the lease boundaries of two undeveloped oil and gas leases. Current demand for development of the leases is low (Atkins, 1986). Present and future management of the Estes Gulch area is designated by the BLM as grazing and wildlife habitat.

4.9.4 Lucas Mesa site

The Lucas Mesa site is 35 miles southwest of Rifle near the town of DeBeque. The nearest residences are two miles northwest of the site along County Road V.5 (Figure 4.16).

The site is located on land administered by the BLM and within one of three pastures which comprise the Sunnyside grazing allotment. Use levels on the Lucas Mesa pasture are 248 animal unit-months (AUMs) between April 16 and May 31 for two of every three years. The adjacent pasture to the south, Horsethief pasture, is larger (523 AUMs) and is used in the spring and fall. It is also part of the Sunnyside grazing allotment (Stevens, 1986). The level of use of the Sunnyside grazing allotment by the designated five to six permittees is based on balanced use of all three pastures.



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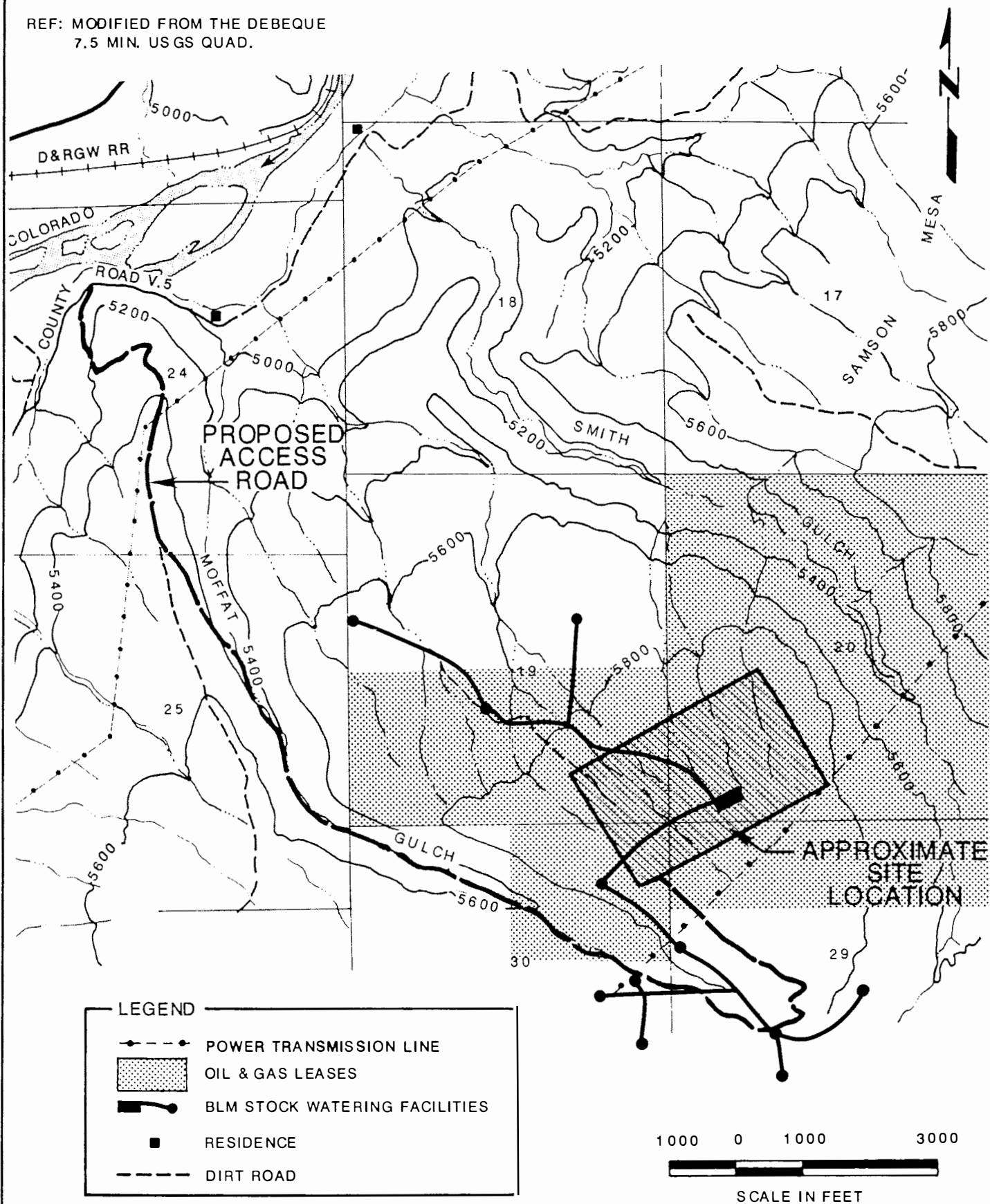


FIGURE 4.16
LAND USE, LUCAS MESA SITE

Each pasture is rested one out of every three years. The Lucas Mesa site contains a 200,000-gallon water catchment basin (Figure 4.16). Several pipelines radiate to downslope watering facilities which are necessary to use of the entire Lucas Mesa pasture and the northern portion of the Horsethief pasture (Jenkins, 1986b; Stevens, 1986).

Other uses of the area include wildlife habitat and potential oil and gas development. The Rifle-San Juan 345-kilovolt power transmission line traverses the area; one of the transmission towers is several hundred feet from the site. The Lucas Mesa site is within three undeveloped oil and gas leases. Due to the low market demand, these leases have not been developed (Ginouves, 1986).

4.9.5 Borrow sites

The Second Street borrow site is immediately north of the New Rifle tailings site. It is a privately owned, commercial sand and gravel operation. Garfield County has zoned the area north of U.S. Highway 6 and west of State Highway 13 as resource lands. This classification allows a variety of uses, including mineral extraction and residential use. A county land use permit is required for all mineral extraction activities (Bean, 1986). The existing operation covers 10 acres of the 40-acre property. Current operating levels are low due to market demand. The nearest residence is the owner's residence-office on the property. There is a residence across the road on West 2nd Street and a trailer park 0.5 mile east of the site (Runyon, 1986).

The New Rifle borrow site is 0.5 mile west of the New Rifle tailings site. This operation is currently leased by a construction company from Union Carbide, and operating levels vary with market demand. The operation is under Garfield County jurisdiction and is zoned agricultural-industrial. The nearest residence is 0.5 mile north of the site along West 2nd Street.

The Glenwood Springs borrow site is 30 miles east of Rifle and two miles north of Glenwood Springs. It is a privately owned, commercial rock quarry consisting of three pits, each approximately 260 acres in area. One pit is inactive but could be re-opened if demand existed, one pit is currently active, and one is being developed. Two of the pits are patented mining claims on private land under Garfield County jurisdiction; use of these pits is grandfathered under a county special use permit. The third pit is an unpatented mining claim on land administered by the BLM. Although the BLM does not have special use restrictions, Garfield County has use stipulations in the county permit. This pit can process rock only between 7:00 am and 5:00 pm and between April 15 and December 15 (Harris, 1986). The nearest residences are in a small subdivision 1.5 miles from the site.

4.10 AMBIENT SOUND LEVELS

Humans can hear sound over a wide range of pressures. The decibel (dB) is the unit used to express the relative intensity of sound levels over a wide physical range. The human ear does not perceive sound at low frequencies in the same manner that it does at higher frequencies. Sounds at low frequencies do not seem as loud as those of equal intensity at higher frequencies. The A-weighting network is provided in sound analysis systems to simulate the sensitivity of the human ear to different frequencies. A-weighted sound levels are expressed in units of decibels (dBA) and are used throughout this section. Typical values of day-night sound levels are shown in Table 4.5.

Allowable noise levels for construction projects are stated in the Garfield County Plan and regulated by the Garfield County Planning Commission. The plan regulates noise levels based on Colorado Revised Statute 25-12-101-108 (Bean, 1986), which sets noise limits at the boundaries of properties on which noise-producing activities occur. Under this statute, the production of noise levels would be restricted to the limits shown in Table 4.6. Section C.3.1 of Appendix C, Weather, Air Quality, and Noise, of the draft EIS provides additional details on noise regulation for Garfield County.

4.10.1 Rifle sites

A survey of background sound levels was conducted in the vicinities of the Old and New Rifle sites in 1982 (DOE, 1983). Measurements were made at three stations around each of the two sites. The results of the survey are described in Section C.3.2 of Appendix C, Weather, Air Quality, and Noise, of the DEIS.

Noise levels at the Old Rifle site originate primarily from traffic on U.S. Highway 6 and to a lesser degree from the D&RGW Railroad. Two sound level measurement stations were monitored over a four-day period at and near the site, and a third station was located south of the site and I-70. The measurements indicate that sound levels around the site are characteristic of a rural town setting. The residual background sound levels (levels exceeded 90 percent of the time) are greater than 30 dBA at night and generally greater than 40 dBA during the day. Both values are below the applicable Colorado noise limits (Table 4.6).

The primary sources of noise at the New Rifle site are traffic on U.S. Highway 6 and the D&RGW Railroad. However, sound level measurement stations monitored in the 1982 study also included noise from the Union Carbide mill, which is no longer in operation. The current noise levels are assumed to be equivalent to those recorded at the Old Rifle site or possibly higher due to truck traffic on I-70 and exiting I-70 east of the New Rifle site.

Table 4.5 Typical day-night sound levels

Land use	Population density (people per square mile)	L _{dn} ^a (dBA)
Rural, undeveloped	20	35
Rural, partially developed	60	40
Quiet suburban	200	45
Normal suburban	600	50
Urban	2,000	55
Noisy urban	6,000	60
Very noisy urban	20,000	65

^aDay-night sound level (L_{dn}) is an EPA description of environmental sound. It is the average of daytime and nighttime A-weighted sound levels with nighttime sound given a penalty of 10 dBA.

Ref. NAS, 1977.

Table 4.6 Colorado noise limits

Zone	7:00 a.m. to next 7:00 p.m. (dBA)	7:00 p.m. to next 7:00 a.m. (dBA)
Residential	55	50
Commercial	60	55
Light industrial	70	65
Industrial	80 ^a	75

^aBecause of noise production, activities during remedial action are scheduled for daytime hours only; it is the 80-dBA standard at the property line that would be applicable.

4.10.2 Alternate disposal sites

No measurements of ambient sound levels have been made at the alternate disposal sites. However, ambient sound levels at the sites can be estimated by considering the rural, undeveloped nature of the sites. Sound levels in rural locations removed from human activity are primarily a function of the wind speed, which varies seasonally and daily. Wind speeds above 12 miles per hour normally produce enough local turbulence in trees and bushes to dominate other natural sounds. In periods of calm, the noises made by birds and insects predominate. Distant traffic may also be heard at the Estes Gulch and Lucas Mesa sites. The perceptibility of noise from traffic is governed by the distance from the road, road conditions, vehicle speed, and weather conditions. Day-night sound levels at both alternate disposal sites are expected to be approximately equivalent to the level listed for "rural, undeveloped" in Table 4.5.

4.10.3 Borrow sites

No sound measurements have been taken at the proposed borrow sites. The Second Street borrow site is currently inactive; therefore, the primary source of noise would be traffic on adjacent U.S. Highway 6. Noise levels would be similar to those recorded for the Old Rifle tailings site. The New Rifle and Glenwood Springs borrow sites are currently in operation and noise levels at these sites would be typical of construction equipment. Noise levels for construction equipment, measured at 50 feet, vary between 80 and 90 dBA (Kessler et al., 1978).

4.11 SCENIC AND CULTURAL RESOURCES

Detailed information on the regional cultural resources (i.e., archaeological and historical) is provided in Appendix I, Cultural Resources, of the DEIS.

4.11.1 Scenic resources

The region is dominated by the narrow Colorado River valley. The terrain, which is moderate to rugged, consists of terraces, rolling hills, and abrupt mesas. Elevations in the region vary from approximately 5000 feet to over 10,000 feet above mean sea level.

Rifle sites

The scenic resources in the immediate vicinity of the sites are dominated by the Colorado River valley, which is bounded on either side by prominent mesas such as Graham, Grass, and

Taughenbaum Mesas. The Old and New Rifle sites are located in the Colorado River valley south of the city of Rifle, on the north bank of the Colorado River near I-70.

At the Old Rifle site, the only remaining building is the two-story, concrete block assay building with loading dock. The Old Rifle pile, which averages 18 feet in thickness, is located at the base of a hill below U.S. Highway 6. The New Rifle site consists of the tailings pile and the mill facilities (buildings, tanks, ponds, and the like). The maximum heights of the existing upper and lower portions of the piles averages between 55 and 41 feet, respectively. Both the New and Old Rifle tailings piles have partial vegetative covers.

The Old Rifle tailings pile is not particularly visible from either the highways or the railroad. The New Rifle tailings piles can be seen from both I-70 and U.S. Highway 6 and from the D&RGW Railroad, adversely affecting the overall visual character of the river valley and the community of Rifle. Both sites can be seen from the mesas south of the river valley; however at these distances, the sites blend into the overall urban character of Rifle.

Estes Gulch site

The majority of the Estes Gulch site is a wide expanse of relatively level, sagebrush-covered terrain that gradually rises to the northeast into the Grand Hogback, a major topographic feature in the area. Steep, forested, narrow ridges begin at the extreme northern edge of the site. Grand Mesa, to the southwest, can be seen from the site. The site is not visible from nearby U.S. Highway 13 or the Colorado River valley.

Lucas Mesa site

The Lucas Mesa site, which is within two miles of the Colorado River, consists of both open and sparsely wooded rangeland. Visual diversity is enhanced by variations in the tree cover. The site is reasonably flat with steep downward slopes on the north, west, and south sides. The Lucas Mesa site cannot be seen from most of the river valley. The site is also less than two miles from the White River National Forest; however, the site cannot be seen from within the forest boundaries.

Borrow sites

The Second Street and New Rifle borrow sites are in the Colorado River valley in the immediate vicinity of the New Rifle tailings site. The scenic resources of these two borrow sites are the same as those described for the Old and New Rifle sites.

The Glenwood Springs borrow site is located on a relatively steep slope at an elevation of approximately 7000 feet above mean sea level. Vegetation at and around the site is primarily scrub oak. The surrounding hills restrict the view from the site in all directions. The Colorado River is visible to the south, but the city of Glenwood Springs is not visible.

4.11.2 Archaeological resources

In the region, evidence of human habitation goes back to the Paleo-Indian Period (10,000 to 5500 B.C.). Archaeological remains of this period consist mainly of fragmentary or isolated finds of the characteristic spear tips. More extensive remains of this period have been found elsewhere in North America. Evidence dating to the Archaic Period (5500 B.C. to 500 A.D.) is quite plentiful. Large and small sites consisting of chipped-stone debris, tools, and open hearths are known. The next historical period, the Formative (500 to 1200 A.D.), is recorded by remains of pottery, masonry structures, and drawings on rock faces. The sites of this period that yield masonry structures, ceramics, or cultigens are rare (Reed, 1984). It should be noted that recent archaeological investigations have indicated that the transition between the Archaic and Formative Periods was not as definitive as for other periods. Recent evidence indicates that the nomadic groups never really disappeared and continued into the next period (Gooding and Shields, 1985).

During the latter part of the next period, the Proto-historic (1200 to 1820 A.D.), Spanish explorers from Santa Fe, New Mexico, entered the Rifle area; however, they left little evidence of their visits. Aboriginal remains from the Proto-historic Period are, on the other hand, common in the region. They include campsites and scatters of artifacts (Reed, 1984).

European incursions became more frequent and organized at the beginning of the Historic Period (1820 to 1932 A.D.). For nearly two decades beginning in 1863, the region was a reservation for the Ute Indians. After the Utes were expelled in 1880, full-scale settlement by Euroamericans ensued. Communities like Grand Junction and Rifle were established during the latter part of the nineteenth century. Railroads and roads were built along the Colorado River in the early years of the twentieth century (Reed, 1984).

The region is known for cycles of mining activity. The mining of coal goes back to the 1880s. The mining and milling of uranium and vanadium began in the 1920s and 1930s (Viola and Firebaugh, 1983).

Rifle sites

Both the Old and New Rifle sites were surveyed for archaeological resources, and none were identified (GRI, 1985).

Estes Gulch site

No significant archaeological resources were identified in the Class III survey of the Estes Gulch site. One lithic scatter site and four isolated finds were recorded (CASA, 1986).

Recently, the DOE agreed to widen and improve portions of State Highway 13 to accommodate increased truck traffic resulting from transport of tailings from the Rifle processing sites to the proposed Estes Gulch disposal site. Widening and improving State Highway 13 is a mitigation measure designed to offset the impacts of tailings transportation. Preliminary results of the cultural resources survey performed during Spring 1989 indicate no cultural resources are present within the proposed upgrade area (Hammack, 1989).

Lucas Mesa site

A Class III survey of the Lucas Mesa site identified four lithic scatter sites and 23 isolated finds (GRI, 1985). These archaeological resources are not considered eligible for the National Register of Historic Places (NRHP) (Wildesen, 1985).

Borrow sites

The Second Street, New Rifle, and Glenwood Springs borrow sites are existing commercial borrow sites. The sites have been disturbed and are not expected to contain archaeological resources.

4.11.3 Historic resources

Old Rifle site

At the Old Rifle site, the assay building (5GF417) from the vanadium mill built in 1924 still stands. The State Historic Preservation Officer (SHPO) has determined that it is not eligible for the NRHP.

New Rifle site

The New Rifle mill began operations in 1958. As a result, none of the mill buildings are old enough to be considered for eligibility to the NRHP.

Estes Gulch site

There are no historic resources at the Estes Gulch disposal site (CASA, 1986).

Lucas Mesa site

No historic resources have been identified at the Lucas Mesa site (GRI, 1985).

Borrow sites

The Second Street, New Rifle, and Glenwood Springs borrow sites are existing commercial borrow sites. The sites have been disturbed and are not expected to contain historic resources.

4.12 SOCIOECONOMIC CHARACTERISTICS

The following sections provide a brief summary of the socioeconomic conditions in the Rifle area. More detailed information is presented in Section J.2 of Appendix J, Land Use and Socioeconomics, of the draft EIS.

4.12.1 Population

The 1980 populations of Garfield County and Rifle, as tabulated by the U.S. Census, were 22,514 and 3215, respectively. The 1985 county population was estimated at 25,153 by the state of Colorado Demographer's Office, and the 1985 city of Rifle population was estimated at 4352. The oil shale boom between 1978 and 1982 had a significant effect on the population level and distribution in Garfield County. Between 1980 and 1982, the Garfield County population increased from 22,514 to 28,752 (Lin, 1986).

From 1970 to 1977 (prior to oil shale related population increases), the county population increased 26.85 percent. However, the population increased 52.9 percent between 1978 and 1982, clearly reflecting oil shale employment opportunities. The collapse of the oil shale based economy in 1982 affected a three-county area; in Garfield County, the Parachute area was the most severely affected, followed by Rifle. The Garfield County population showed an approximate 12.5 percent decline between 1982 and 1985 from 28,752 to 25,153 (Lin, 1986). By the end of 1985, the county population appeared to have stabilized.

Table 4.7 presents population projections for Garfield County; the Garfield County estimate is based on an adaptation of the state of Colorado's Cumulative Impacts Task Force-Planning and Assessment System (CITF-PAS) model (Bean, 1986). Both Garfield County's and the state of Colorado's CITF-PAS model values are provided for comparison.

In 1980, the median age in Garfield County was 28.6 years. Approximately 72 percent of the Garfield County population was over the age of 18 in 1980 (DOC, 1982). The average family size

Table 4.7 Population projections for Garfield County

Year	Garfield County estimate (people)	State of Colorado estimate (people)
1985	25,200	24,432
1986	26,579	23,979
1990	27,443	24,250
1995	28,254	25,881

Ref. Bean, 1986.

in Garfield County was 3.17 in 1985 (Picaso, 1986). The county population was approximately 95 percent white, four percent Hispanic, and one percent black. The 1980 average household size was 2.71 for Garfield County and 2.70 for Rifle. In comparison, the average household size was 2.67 for adjacent Mesa County and 2.65 for the state of Colorado (DOC, 1981). Estimates for 1985 indicate that the average household size has decreased.

The nearest residences to the Old Rifle tailings site are to the northwest on the bluff above the site. The residences are effectively separated from the site by U.S. Highway 6 and the 150-foot bluff. Areas immediately east, west, and south of the site are uninhabited. There are no residences located adjacent to the New Rifle tailings site. The closest residence is approximately 0.5 mile northeast of the site along U.S. Highway 6. Scattered residences occur along the highway corridor east to Rifle.

The Estes Gulch site has two residences within a one-half mile radius. Residences in the vicinity are located along State Highways 13 and 325 to the west and east, respectively. The Rifle city limits are within five miles of the Estes Gulch site. The Lucas Mesa site is virtually isolated from any population centers. The nearest residences are approximately two miles northwest of the site where there are four to six residences between County Road V.5 and the Colorado River.

4.12.2 Social and economic structures

Earnings by industry for the state of Colorado indicate continuous growth in all industry categories since 1978. The most important industry sectors in 1983 were services, government, and manufacturing, in order of importance. The least important, representing less than two percent of the total earnings by industry, was the farming industry. In 1983, farm income represented only 1.4 percent of total personal income in the state of Colorado. The 1983 average per capita personal income for the state was \$12,771 (DOC, 1985).

Garfield County earnings by industry indicate changes in most sectors in response to the oil shale boom between 1978 and 1982. In 1983, the top sector was construction (31 percent of total industry earnings) followed by the services and government sectors, still indicating the influence of the oil shale industry. By the first quarter of 1985, the construction sector represented only eight percent of total industry earnings; this clearly reflected declines in all areas of construction due to oil shale closures and the resulting population migration relieving the need for additional housing. In comparison, the construction industry throughout the state of Colorado has represented eight percent of all earnings by industry since 1978. The least important industry by earnings in Garfield County has been the farm industry. In 1983, farm industry earnings were approximately one percent of all earnings by industry in Garfield County. In 1983, farm income was 0.89 percent of total personal income. The 1983 average per capita income in Garfield County was \$12,456, approximately two percent lower than the average for the state of Colorado (DOC, 1985).

A comparison of employment and earnings by industry in Garfield County for the first quarter of 1985 is presented in Table 4.8. In most cases, employment sectors parallel earnings by industry with the exception of the mining and retail trade sectors. It should be noted that the government sector includes all school district personnel.

Table 4.8 Employment and revenue for non-farm industries in Garfield County, 1985^a

Industry	Employment (people)	Percent of total non-farm employment	Revenue (dollars)	Percent of total non-farm revenues
Agriculture, forestry, fisheries	51	1	138,988	0
Mining	753	8	6,681,978	17
Construction	639	7	3,031,034	8
Manufacturing	311	3	1,510,207	4
Transportation, public utilities	546	6	3,471,762	9
Wholesale trade	232	3	1,005,805	3
Retail trade	2246	25	5,793,070	15
Finance, insurance, real estate	412	5	2,061,983	5
Services	1995	22	6,998,172	18
Government	1905	21	8,299,074	21
Totals for non-farm industries	9090		38,992,073	

^aData are for the first quarter of 1985 only. Employment data do not include self-employment. Percentages may not total 100 percent due to rounding.

Ref. Larson, 1986.

4.12.3 Work force

Employment in Garfield County has undergone significant changes over the past 10 years. Between 1975 and 1978, unemployment levels averaged 6.8 percent per year in Garfield County and 6.3 percent for the state of Colorado (Larson, 1986). By the late 1970s, five major oil shale projects were in the planning or construction phases in Garfield, Rio Blanco, and Mesa Counties; in addition, I-70 highway construction was underway. Boom conditions followed with large numbers of oil shale and construction workers moving into the area for employment.

By 1980, there were approximately 1100 oil shale jobs in Garfield, Rio Blanco, and Mesa Counties; by 1981, this had more than doubled to 2700 oil shale jobs. By early 1982, 2347 oil shale workers had moved into Garfield County, and the forecasts were for continued high growth levels. In addition, construction work on I-70, which had begun in 1972, had escalated to its present levels of employment, further attracting construction trades to the area. By the end of 1982, however, virtually all oil shale related employment had ceased due to the closure of many oil shale projects (Mountain West Research-North, Inc., 1982).

Because of the effect of the oil shale industry in Garfield County between 1978 and 1982, it is difficult to establish an employment trend based on previous employment data. By the end of 1985, unemployment levels appeared to be stabilizing although they were still higher than the state averages. The 1985 unemployment rate for Garfield County was eight percent, compared to 5.9 percent for the state of Colorado. The majority of the unemployment is thought to be occurring in the Rifle area although there are no figures available by location within the county (McGill, 1986).

Employment categories with an oversupply of job applicants include those related to the construction industry (truck drivers, heavy equipment operators, welders, miners, and the like). Construction-related categories accounted for about four percent of the 1985 county unemployment rate of eight percent. As an example, an estimate of immediately available truck drivers (licensed and experienced) based on the fourth quarter job orders for 1985 would be 100 to 150 (McGill, 1986).

The major sources of employment in Garfield County are mining, construction, transportation and public utilities, retail trade, services, and government. The majority of employment (75 percent) is occurring in the private sector (DOC, 1982). Table 4.9 presents 1980 and 1984 annual average non-farm employment by job category. In 1980, there were 214 farm employees (Bean, 1986); no farm employment data are available for 1984. The total available labor force for Garfield County in 1984 was 16,146 (Larson, 1986).

Table 4.9 Non-farm employment by job category, Garfield County

Job category	1980 non-farm employment ^a	Percent of total 1980 non-farm employment ^b	1984 non-farm employment ^c	Percent of total 1984 non-farm employment ^b
Private				
Agricultural services	63	1	74	1
Mining	93	1	800	8
Construction	905	11	996	10
Manufacturing	209	2	294	3
Transportation, public utilities	809	9	568	6
Wholesale trade	234	3	245	2
Retail trade	2051	24	2294	22
Finance, insurance, real estate	400	5	474	5
Services	1727	20	1948	19
SUBTOTAL, private employment	6491	76	7693	75
plus, Government employment	2069	24	2509	25
TOTAL, non-farm employment	8560		10,202	

^aRef. Bean, 1986.^bPercentages may not total 100 percent due to rounding.^cRef. DOC, 1982.

4.12.4 Housing

In 1980, there were a total of 9345 housing units in Garfield County, and 11.7 percent of these were vacant. Between 1980 and 1982, approximately 2410 additional residences were constructed for a total of 11,755 units. Rental units accounted for about 34 percent of the 1980 total (Garfield County Planning Department, 1985). A current vacancy rate for Garfield County is unavailable; however, a comparison of total housing units available through 1982, household size, and county population indicates that vacancy rates are still high. In Rifle, a 1986 housing survey indicated that there are presently a total of 2045 units with a vacancy rate of approximately 14 percent (Kennedy, 1986).

The 1985 estimated average household size in Garfield County was 2.63 (Lin, 1986), and the 1986 average household size in Rifle, based on the housing survey, is 2.55 (Kennedy, 1986).

4.12.5 Government

Government structure

Garfield County has three county commissioners, a clerk, a treasurer, and an assessor; each elected official serves a four-year term of office. An appointed administrative assistant oversees finances and the provision of county services. Services provided by Garfield County include law enforcement, road construction and maintenance, planning and zoning, building permits and inspections, sanitary inspections, and social services (Garfield County Planning Department, 1985).

Fiscal characteristics

In 1984, general revenues in Garfield County totalled \$12,293,600. The majority of the revenues (77 percent) were derived from taxes and inter-governmental transfer of funds. County operational expenditures were \$9,547,500 in 1984. The Garfield County per capita expenditure was approximately \$379 in 1984.

In comparison, the average county expenditure per capita for all of Colorado, excluding Denver County, was \$234, indicating that Garfield County is relatively prosperous compared to other Colorado counties (McGrane, 1986).

The city of Rifle had 1984 general fund revenues of \$1,419,306 and expenditures of \$1,330,167. The majority of the city revenues (53 percent) were derived from sales tax, use fees, and property tax (real and personal). Inter-governmental revenue contributed 17 percent. The majority of expenditures (32 percent) were for the police department (Bestor, 1986).

The total sales tax in Rifle is 5.025 percent and consists of city sales tax (two percent), county sales tax (0.025 percent), and state sales tax (three percent) (Bestor, 1986). State income tax receipts are used primarily to fund state government. Individual counties receive a negligible portion of state income tax receipts but benefit indirectly through county programs which receive funding based on income tax receipts (McGrane, 1986).

4.12.6 Community services

Education

The three school districts in Garfield County are RE-1, RE-2, and District 16. Rifle is within the RE-2 district, which also includes Silt and New Castle. Each district has its own elementary, middle, and high schools. The RE-1 district, which includes Carbondale, Glenwood Springs, and Basalt, is the largest school district in Garfield County; it had a 1985 enrollment of 3009 students. District 16, which includes the Parachute area, had the lowest 1985 enrollment (490 students) while the RE-2 district had 2177 students. Enrollment figures are based on enrollment during October of the school year and do not reflect year-end enrollment figures which, through natural attrition, would be slightly smaller (Keith, 1986). All school districts had excess capacities in 1985.

Student-to-teacher ratios in 1985 varied from 14.0 in District 16 to 20.5 in the RE-2 district. In comparison, the state of Colorado student-to-teacher ratio was 18.4. Student-to-teacher ratios, in this case, are based on the ratio of October enrollments to full-time equivalent teachers (Keith, 1986).

The majority of operational revenues for all school districts are obtained from the general fund property tax, which is derived from the county mill levy. In the RE-2 school district, 86 percent of the total property tax allocated for school district use was available for the school district operating expenditures in 1985 (Saul, 1986).

Hospitals and health services

Garfield County has two hospitals, Clagett Memorial Hospital in Rifle and Valley View Hospital in Glenwood Springs. Together, the hospitals have 112 licensed hospital beds. Occupancy rates in 1985 varied between 32 percent at Clagett Memorial to 45 percent at Valley View. In addition, Clagett Memorial Hospital had 57 licensed nursing beds (Hansen, 1986; Hays, 1986).

Other health facilities and programs that are available through Garfield County or the city of Rifle include community and mental health programs, alcohol and drug abuse counseling, care and training of the disabled, and care and assistance to the aged.

Water supplies and wastewater treatment

Some Garfield County residents are supplied with water from wells, springs, and creeks; however the city of Rifle's water source is the Colorado River. In 1986, approximately 5000 Rifle and area residents used Colorado River water. The Rifle water treatment plant is currently used at less than full capacity. Sewage is treated by an aerated lagoon that discharges into the Colorado River. The sewage treatment system is operating at 50 percent capacity (Moore, 1986).

Police and fire protection

The Garfield County Sheriff's office is in Glenwood Springs. There are 10 deputies and six patrol vehicles, which provide law enforcement services throughout the unincorporated areas of the county (Lillie, 1986). The city of Rifle maintains a police force of 10 officers and six police vehicles (Garfield County Planning Department, 1985).

There are five fire districts in Garfield County. Rifle has a 28-person volunteer fire department and six fire trucks. The Rifle Police Department coordinates calls for fire protection in Rifle and the vicinity. Ambulance service is also coordinated through the Rifle Police Department (Savage, 1986).

4.12.7 Transportation networks

Mountainous terrain limits access throughout Garfield County. The primary east-west route is I-70, which connects Rifle with Glenwood Springs and Denver to the east and Grand Junction to the west. State Highways 13 and 82 provide access to towns north (Meeker and Craig) and south (Basalt and Aspen), respectively. State Highway 13 west of Rifle, known as the Rifle Bypass, was completed in 1984 to route commercial and passenger traffic heading for oil shale projects in Rio Blanco County around Rifle (Tenney, 1986). It joins U.S. Highway 6 between the Old and New Rifle sites (Figure 1.2). U.S. Highway 6 extends from New Castle west to its interchange with I-70 approximately one mile west of the New Rifle tailings site. U.S. Highway 6 parallels I-70 and is now considered a frontage road in the Rifle area. Figure 1.1 shows the locations of major highways in the Rifle area, and Table 4.10 presents traffic data for the highways.

Table 4.10 Highway traffic data for the Rifle area

Highway location	1984 average daily traffic (vehicles per day)	Truck traffic as a percentage of average daily traffic ^a	1984 estimated peak hourly traffic ^b (vehicles per hour)
I-70 west of the western Rifle interchange (at U.S. Highway 6)	6300	Not available	732 ^d
I-70 at the middle Rifle interchange (at State Highway 13)	4250	20	544 ^d
I-70 at the western Glenwood Springs interchange	8850	13	1062
U.S. Highway 6 between the western Rifle interchange (at I-70) and Rifle	2350	Not available	282
Rifle Bypass (State Highway 13)- U.S. Highway 6 junction ^c	1350	19	162
North end of the Rifle Bypass (State Highway 13) ^c	1550	18	186
State Highway 13-State Highway 325 junction	2700	Not available	324
U.S. Highway 6-Railroad Avenue intersection	4300	Not available	516

^aTruck traffic includes tractor-trailer combinations and single unit trucks that are larger than a pick-up truck on a single chassis (e.g., motor home and cement truck).

^bPeak hourly traffic estimates are based on the hourly design capacity or 12 percent of the average daily traffic.

^cData for these highway locations are for 1985.

^dData are actual traffic counts.

Ref. Tenney, 1986; CDOH, 1984.

The Old and New Rifle tailings sites are accessed via U.S. Highway 6 (Figure 1.2). The majority of use on U.S. Highway 6 in the Rifle vicinity would be considered local; however, from the Rifle Bypass (State Highway 13) to the western I-70 interchange, commercial truck traffic would account for a higher percentage (Tenney, 1986). The 1984 average daily traffic (ADT) on U.S. Highway 6 in the vicinity of the New Rifle tailings site was 2350 vehicles per day; the amount of commercial truck traffic is unknown. The 1984 ADT at the intersection of U.S. Highway 6 and Railroad Avenue (formerly State Highway 13) was 4300 vehicles.

The Estes Gulch site would be accessed via State Highway 13 (Figures 1.3 and 4.1). The 1984 ADT at the State Highway 13-State Highway 325 junction was 2700 vehicles. The Lucas Mesa site would be accessed via I-70 and a short segment of County Road V.5 (Figures 1.3 and 4.2). The 1984 ADT on I-70 was 8850 vehicles at the western Glenwood Springs interchange, 6300 vehicles at the western Rifle interchange (at U.S. Highway 6), and 5550 vehicles at the DeBeque interchange. Traffic on County Road V.5 in the vicinity of the Lucas Mesa site is estimated at 150 vehicles per day by the Mesa County Road Department (Hinnant, 1986).

The conditions of the highways in the Rifle area vary. The construction of I-70 (two lanes in each direction) began in 1972 and continues today. The Rifle Bypass (State Highway 13) was constructed in 1984, and the portion of State Highway 13 between the Rifle Bypass and the State Highway 325 junction has been upgraded to four lanes (two lanes in each direction). U.S. Highway 6 in the vicinity of Rifle was constructed in the 1950s and 1960s, and the condition of the highway is variable (Spanicek, 1986; Tenney, 1986).

In addition to highway transportation, Rifle is connected by railroad to points east and west. The D&RGW Railroad primarily carries freight. Approximately 20 freight trains, pulling 30 to 75 cars each, pass through Rifle on a daily basis. In addition, passenger service in each direction is provided once daily by Amtrak (Cox and Garrison, 1986).

Accident rates.

Table 4.11 presents accident rates for I-70, U.S. Highway 6, and State Highway 13 in the Rifle area. These rates are 1984 calendar-year averages for all similar highway segments in the state that are considered rural. For example, the accident rates for I-70 in the Rifle area were determined by averaging 1984 accident data for all segments of Federally aided interstate routes that are considered rural in Colorado. Actual accident rates for the highways in the Rifle area are much lower than the state averages due to the lower population (e.g., there were no fatal accidents on highways in the Rifle area, and,

Table 4.11 Traffic accident rates for the Rifle area

Highway	Fatal accident rate (fatalities per 100 million vehicle-miles)	Injury accident rate (injury per million vehicle-miles)
Interstate Highway 70	1.83	0.37
U.S. Highway 6	3.83	0.78
State Highway 13	3.47	0.59

Ref. CDOH, 1984.

therefore, 1984 fatal accident rates are zero). For comparison, the national average accident rates for all truck travel (both urban and rural) are 4.80 fatalities per 100 million vehicle-miles (one fatality per 20,833,000 vehicle-miles) and 0.79 injury per million vehicle-miles (one injury per 1,270,000 vehicle-miles) (Rao et al., 1982).

There were no railroad accidents in the past two years in the Rifle area (Cox and Garrison, 1986).

4.12.8 Public attitudes

Public awareness of the potential hazards associated with the unstabilized tailings has been increased by a series of events in the Rifle area. Health studies of the residents of Mesa County, the Grand Junction Remedial Action Program conducted by the Colorado Department of Health, public meetings and hearings on the alternate disposal site selection process, the EIS scoping process, press releases to the Rifle and other local newspapers, and discussions with the DOE have all contributed to the public's understanding and awareness of the UMTRA Project.

Public scoping meetings were held in Rifle on February 7th and 8th, 1983, on the scope of this EIS. The public voiced its concern about the health hazards associated with the existing tailings piles. Subsequent public meetings and discussions with the local task force revealed that the public favors moving the tailings to an isolated area. Several citizens, including those representing organizations, were in favor of remedial action that would provide local jobs and boost the economy of the Rifle area. Citizens were generally in favor of remedial action at the vicinity properties and expressed the desire for open communication on the project.

Public meetings were also held in October 1985 and May 1986 to solicit additional public input into the selection of the alternatives to be addressed in this EIS. Comments at these meetings amplified the comments received during the scoping meetings in February 1983. Some people were concerned that the site selected for the disposal of the tailings may also be used for disposal of other low-level radioactive waste. Most people were opposed to using the site for this purpose.

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5.0 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of the remedial action alternatives are described in this section. The environmental consequences presented in this section are based on conservative assumptions and impact assessment procedures and thereby represent a realistic upper limit on the severity of the impacts that may occur. The actual impacts that would occur would probably be less severe than those identified in this section. It should be noted that many of the impacts presented in this EIS (e.g., air quality and noise) are also based on continuous remedial action schedules (i.e., remedial action would be conducted throughout the year). In reality, inclement weather during the months of December, January, and February would probably force remedial action activity to cease, and the associated impacts would likewise cease or decrease. It should also be noted that the borrow sites included in this EIS were selected as the sources of the necessary borrow materials for impacts analyses purposes. Although the RAC will select the borrow sites to be used for the remedial action during the final design, the impacts identified for the borrow sites included in this EIS are conservative and represent a realistic upper limit on the severity of the impacts that may occur. This section and the appendices to this EIS contain descriptions of the impact assessment assumptions and procedures.

All of the alternatives, action and no action, include the performance of interim actions for the remediation of existing health and safety hazards at both processing sites. Discussions on the no action alternative have been modified to reflect incorporation of the interim actions. Discussions and analyses of the three remedial action alternatives already incorporate these activities and impacts related to the interim action.

All of the remedial action alternatives except no action include remedial action at the vicinity properties. The impacts of remedial action at the vicinity properties were evaluated in a separate environmental report (DOE, 1985). The impacts of remedial action at the vicinity properties would be added to the impacts of each action alternative (Alternatives 2 through 4) to obtain the total impacts of remedial action.

5.1 RADIOLOGICAL IMPACTS

5.1.1 Introduction

This section assesses the incremental radiological impacts resulting from the alternatives and indicates the methods used to perform these impact assessments. The data and information used to perform these impact assessments are described in greater detail in Appendix H, Radiation. Radiation doses and excess health effects for the general population within 80 kilometers (km) of the New Rifle tailings site and for interim or remedial action workers are addressed.

5.1.2 Exposure pathways

There are five principal pathways by which individuals could be exposed to radioactivity during remedial action (Figure 5.1). These are (1) inhalation of radon and radon daughters; (2) exposure to direct gamma radiation from the tailings piles; (3) inhalation or ingestion of airborne radioactive particulates; (4) ingestion of contaminated foods produced in areas contaminated by tailings; and (5) ingestion of surface or groundwater contaminated by radioactive materials.

For the calculation of health effects, the first four pathways mentioned above are considered. Exposures via the surface water or groundwater pathway are not considered because the water sources used for human consumption do not show evidence of radioactive contamination or the potential for contamination (Sections 4.6 and 5.5 and Sections E.2.7 and E.2.8 of Appendix E, Hydrology). Additional information about the water ingestion pathway is provided in Section H.2 of Appendix H, Radiation, of the draft EIS.

The health effects from radon releases result from inhalation of radon daughter radionuclides. Radon is an inert gas produced from the radioactive decay of Ra-226. As a gas, radon can diffuse through the tailings and into the atmosphere where it is transported by wind over large areas. In the atmosphere, radon decays into its solid daughter radionuclides, which attach to airborne dust particles and may be inhaled. These dust particles with the attached radon daughters may adhere to the lining of the respiratory tract (bronchia and the lungs). The decay of the radon daughters releases radiation to the bronchia and lung tissue.

Gamma radiation is emitted by many radionuclides of the U-238 decay series. Gamma radiation is independent of atmospheric conditions and travels in a straight line until it interacts with matter, just as X-rays do. Gamma radiation emitted from the tailings delivers an exposure to the whole body. Gamma radiation becomes negligible beyond one km from the perimeter of the tailings piles due to interactions with matter, which attenuates the gamma radiation field.

The general population is currently exposed to radon daughters and gamma radiation from the unstabilized tailings at the Old and New Rifle tailings sites. As remedial action is implemented, the exposures are anticipated to increase slightly as the tailings are disturbed and transported. However, as remedial action progresses and after its completion, the exposures would be greatly reduced due to the isolation of the radioactive materials from the environment. All action alternatives include the construction of a thick, earthen cover that cannot be penetrated by gamma radiation from the tailings. The thick, earthen cover would also serve as a barrier to the diffusion of radon from the tailings into the atmosphere. Some radon would escape and produce small exposures to the surrounding population. The radon release rate through the cover would be no greater than the allowable rate of 20 pCi/m²s set by the EPA standards.

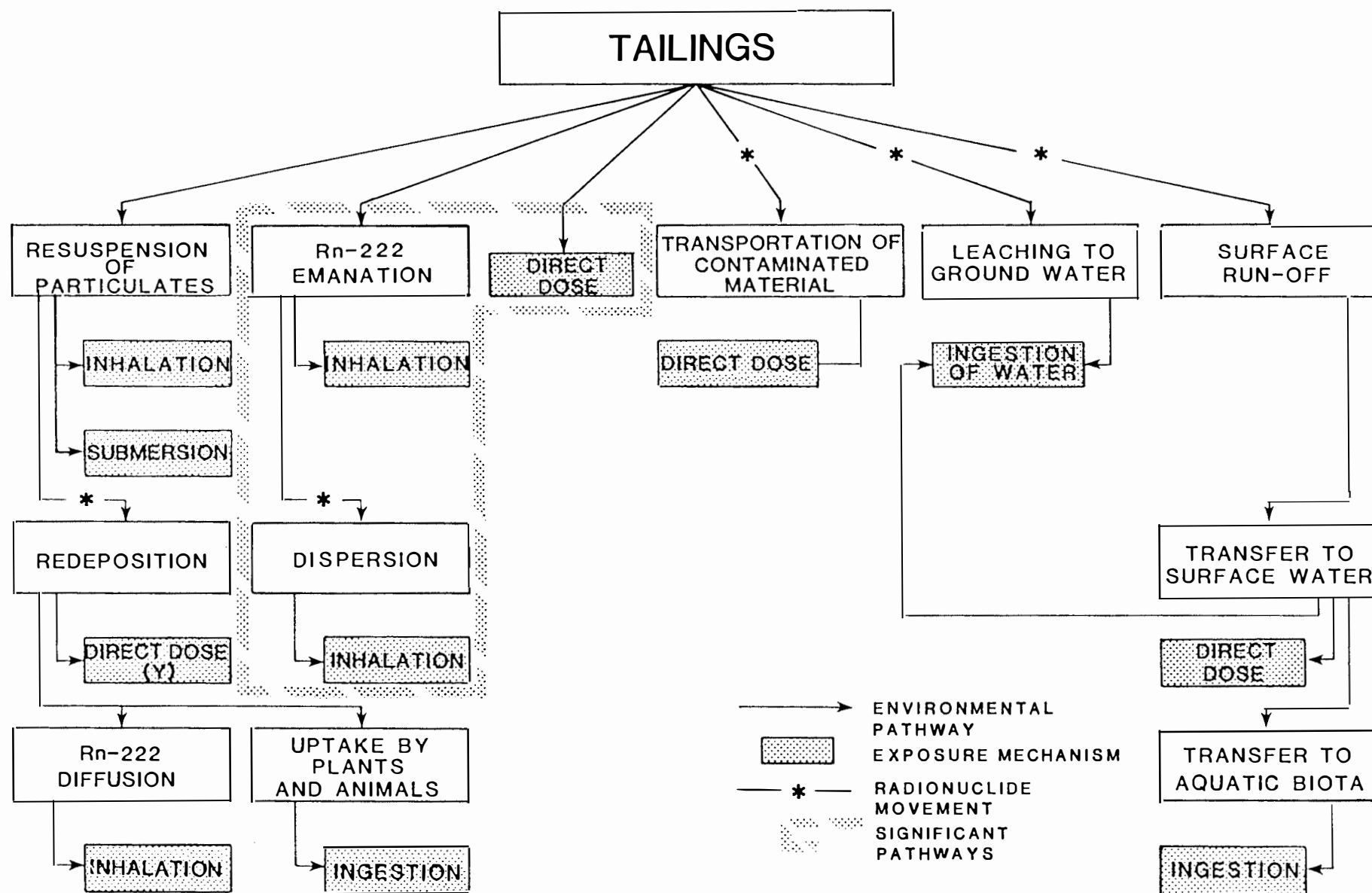


FIGURE 5.1
POTENTIAL RADIATION EXPOSURE PATHWAYS
TO THE GENERAL PUBLIC AND REMEDIAL ACTION WORKERS

ADAPTED FROM
NRC 1981a,b ; 1980

5.1.3 Methods of impact assessment

Radiation doses to the general population from one to 80 km from the New Rifle site were evaluated using the computer code MILDOS (NRC, 1981a). The MILDOS code provides estimates of the potential radiation doses to individuals in the vicinity of a typical uranium mill tailings disposal site. The input required by the MILDOS code includes (1) population distribution data; (2) meteorological data; and (3) radionuclide release data. The data used are presented and discussed in Section H.3 of Appendix H, Radiation of the draft EIS.

The required radionuclide release data from each source area (tailings piles, mill areas, and the like) include the (1) the radon emission rates from the surfaces; (2) the radionuclide release rates for airborne particulates emissions; and (3) the time periods over which the releases occur. Since the minimum time step in the MILDOS code is two years, some averaging of releases on shorter time scales is required. The MILDOS code does not calculate radiation exposures within one km of a site. The radon concentrations in air at 0.5 km from each tailings site were determined by modeling the on-pile radon concentration, plotting this on-pile radon concentration and MILDOS concentrations beyond one km on a log-log plot, and interpolating to find the radon concentration at 0.5 km.

The surface radon releases and subsequent radiation doses to people dominate the doses due to airborne radioactive particulates releases (wind erosion and the mechanical suspension of dust by earthmoving equipment). The general population and worker radiation exposures, therefore, result primarily from radon releases (Section H.4, Appendix H, Radiation).

For tailings relocation, people near the transportation routes may be exposed to gamma radiation from passing trucks carrying radioactive materials from the Old and New Rifle sites to the selected disposal site. The time of exposure to these people is small, and the radiation exposure from a truck is low. Calculations of the exposure due to tailings transportation were based on the average tailings radionuclide content, the average population density, vehicle speed, the average transportation distance, and the number of loaded truck trips.

Estimates of health effects (i.e., cancer deaths) in excess of those occurring normally in a population, as caused by radiation exposures from the tailings, were made using the following risk factors:

- o 300×10^{-6} (0.000300) excess health effect per person-working level-month (person-WLM) from radon daughters inhalation (ICRP, 1977).

- o 120 excess health effects in an exposed population for each 1,000,000 person-rem of dose equivalent commitment from exposure to gamma radiation (NAS, 1980; Cohen, 1981).

A wide range of risk factors are accepted by experts who attempt to relate health effects to radiation exposure. The DOE has selected these risk factors as realistic values for the comparison of the remedial action alternatives after reviewing figures in the literature.

5.1.4 Radiological impacts

Estimates of the radiation dose equivalent commitments to the general population during the remedial action alternatives are presented in Table 5.1. The potential excess health effects are given in Table 5.1 as well. Table 5.2 shows the potential excess health effects in the general population for 10, 100, and 1000 years following remedial action. These estimates were made using the methods outlined in Section 5.1.3 and detailed in Sections H.2, H.3, and H.4 of Appendix H, Radiation, of the draft EIS. The estimated excess health effects were obtained by multiplying the dose equivalent commitments by the risk factors identified in Section 5.1.3. The doses and excess health effects to the general population were calculated for an 80-km radius around the New Rifle site. The estimated excess health effects are lowest for disposal at the Lucas Mesa site due to the site's distance from the population of and around the city of Rifle. The estimated excess health effects are based on a constant population; an increase in population would cause a greater increase in health impacts for no action or stabilization at the New Rifle site than for the other alternatives because Estes Gulch and Lucas Mesa site are in more remote locations.

Health impacts for the no action alternative were calculated assuming that the tailings would not be dispersed in the future by natural erosion or man because there is no way to accurately predict the level or rate of dispersion. Without remedial action, dispersion would occur over time, and the actual health impacts for the no action alternative to the general population might be greater than those shown. Estimates for impacts to interim action workers were made by multiplying the dose equivalent commitments by the risk factors identified in Section 5.1.3.

The single most important pathway to the general population is the inhalation of radon daughters and the subsequent irradiation of the tracheobronchial system (bronchial epithelium and lungs). In order to put the estimated dose equivalent commitments in perspective, the estimated background radiation doses are presented in Table 5.3.

In the population of the United States, about one person in six dies of cancer. This means that approximately 12,940 of the 77,650 persons who live within 80 km of the New Rifle site may be

Table 5.1 Estimates of general population dose equivalent commitments during interim/remedial action and excess health effects caused by interim/remedial action^a

Organ	Alternative 1: No action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
<u>General population dose equivalent commitment (person-rem)</u>				
Whole body (external gamma radiation)	280	55	54	54
Bronchial epithelium	24,000	7,700	12,000	9600
Lung	110	240	330	330
Bone	260	480	760	800
<u>Excess health effects</u>				
Cancer from whole-body external gamma radiation exposure	0.030	0.0070	0.0070	0.0070
Lung cancer from doses to the bronchial epithelium and lung	0.47	0.15	0.25	0.20
Total	0.5	0.2	0.3	0.2

^aEstimates are based on a four-year period.

Table 5.2 Estimates of excess health effects to the general population after interim/remedial action

Time period (years)	Alternative 1: No action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
<u>Estimated excess health effects</u>				
10	1	0.02	0.007	0.005
100	10	0.2	0.07	0.05
1000	100	2	0.7	0.5

Table 5.3 Background radiation doses

Parameter	Individual dose (mrem/year)	Population dose equivalent commitment ^a (person-rem per year)
Background external whole-body dose ^b	110	8540
Background bronchial dose ^c	1550	120,300

^aValues are based on 77,650 persons living within 80 km of the New Rifle site.

^bValues are based on a background gamma radiation exposure rate of 13 microR/hr.

^cValues are based on a background radon concentration of 0.8 pCi/l.

expected to die of cancer, regardless of the presence of the unstabilized tailings piles. With the no action alternative, an additional 10 people would contract cancer in a 100 year period. That number would be reduced to less than 0.2 excess cancer following any of the action alternatives.

The excess health effect for the general population along the transportation route was estimated to be 3×10^{-6} (0.000003) for the Estes Gulch relocation alternative. In comparison to the excess health effects shown in Table 5.1, excess health effects for the transportation route are negligible and were therefore not estimated for the other action alternatives.

The maximally exposed individual during any remedial action alternative would be one who resides approximately 0.5 km from the New Rifle site. That person could receive dose equivalent commitments as much as 35 mrem/year to the whole body from external gamma radiation exposure, 7620 mrem/year to the bronchial epithelium, 150 mrem/year to the lungs, and 320 mrem/year to the bone. These elevated dose equivalent commitments would only be for the two- or four-year remedial action depending on the alternative and exposures would be reduced to near-background levels following remedial action.

Estimates of the radiation dose equivalent commitments to the workers for each alternative are presented in Table 5.4 along with the potential resulting excess health effects. The inhalation of radon daughters and external gamma radiation are the primary radiation exposure pathways of concern for the workers.

5.1.5 Radiological impacts of transportation accidents

All of the alternatives, except no action, would involve the transportation of tailings and contaminated materials from the existing tailings sites to the selected disposal site. Truck transportation could result in the accidental spillage of tailings and contaminated materials as a result of a transportation accident. The probability of an accident leading to the spillage of tailings and contaminated materials would be somewhat greater for the 3.5 years of remedial action for the relocation alternatives than for the 20 months of stabilization at the New Rifle site. Approximately three spills could reasonably occur during transportation to the Estes Gulch site, and five spills could reasonably occur during transportation to the Lucas Mesa site during the 3.5 years of remedial action. However, the radiological consequences would be minimal considering the limited quantity of tailings and contaminated materials involved and the short period of time that would be required for cleanup of a spill (one day or less). Again, the exposures would be small compared to those of the workers at the Old and New Rifle tailings sites and alternate disposal site (see Sections H.3.5 and H.4 of Appendix H, Radiation of the draft EIS).

Table 5.4 Estimates of collective dose equivalent commitments to workers and excess health effects

Organ	Alternative 1: No action (interim actions only)	Alternative 2: Stabilization at the New Rifle site	Alternative 3: Disposal at the Estes Gulch site	Alternative 4: Disposal at the Lucas Mesa site
	<u>worker dose equivalent commitment (person-rem)</u>			
Whole body (external gamma radiation)	136	30	114	133
Bronchial epithelium	12	210	930	875
	<u>Excess health effects</u>			
Cancer from whole-body external gamma radiation exposure	0.0027	0.0040	0.014	0.016
Lung cancer from doses to the bronchial epithelium and lung	0.0015	0.0040	0.019	0.018
Total	0.0042	0.008	0.03	0.03

5.2 IMPACTS ON AIR QUALITY

5.2.1 Sources of air pollutants

The major sources of air pollution would be on-site construction activities, the transportation of contaminated and borrow materials, and wind erosion of the land exposed during remedial action. Total air pollutant emissions were calculated for each alternative. Details regarding these calculations are provided in Section C.2. of Appendix C, Weather, Air Quality, and Noise, of the DEIS.

The dominant pollutant generated by the remedial action alternatives would be fugitive dust (TSP), which would range from over 39,500 tons for the Lucas Mesa relocation alternative to 2103 tons for stabilization at the New Rifle site (Table 5.5). Fugitive dust produced by haul trucks along the transportation routes would be the largest source, accounting for 98 percent of the TSP emissions for the Lucas Mesa alternative, 92 percent for the Estes Gulch alternative, and 84 percent for stabilization at the New Rifle site. Exhaust particulates would account for a very small portion (less than 3.5 percent) of the TSP released into the environment during remedial action. The TSP emissions associated with the no action alternative were assumed to be close to zero since the Old and New Rifle tailings piles are mostly covered with vegetation.

Nitrogen oxides (NO_x) would be the most abundant gaseous pollutants released during remedial action (Table 5.5). As with TSP, emissions by haul trucks along the transportation routes would contribute the most NO_x , with 1098 tons (86 percent of the total NO_x emissions) for the Lucas Mesa alternative, 876 tons (83 percent of the total NO_x emissions) for the Estes Gulch alternative, and 194 tons (75 percent) for stabilization at New Rifle.

Emissions of the remaining exhaust pollutants would be relatively slight; as with TSP and NO_x , the majority of the emissions would be generated along the transportation routes (Table 5.5). In addition, the Lucas Mesa alternative would generate the largest quantities of emissions, while stabilization at New Rifle would generate the least.

The level of construction activity during the interim actions would be much lower than during remedial action. For example, the estimated numbers of tons of uncontrolled fugitive dust emissions at both sites during the 12 months of interim actions would be 26 tons, as compared to 227 tons at the two sites under the siposal at Estes Gulch alternative. Therefore, air quality standards for fugitive dust would not be exceeded at the Old and New Rifle sites during interim action activities due to the relatively light levels of construction activity. Correspondingly, levels of NO_x and other exhaust pollutants would be significantly less during the interim actions than for stabilization at New Rifle.

Table 5.5 Estimated tons of uncontrolled airborne pollutants emitted

Pollutant/ site	Alternative		
	Stabilization at New Rifle	Disposal at Estes Gulch	Disposal at Lucas Mesa
Fugitive dust (TSP)			
Old Rifle	50	48	44
New Rifle	277	179	164
Disposal site	----	550	563
Transportation routes	<u>1776</u>	<u>9089</u>	<u>38,742</u>
Total	2103	9866	39,513
Exhaust particulates (TSP)			
Old Rifle	2	1	1
New Rifle	5	6	5
Disposal site	--	11	11
Transportation routes	<u>66</u>	<u>296</u>	<u>371</u>
Total	73	314	388
Nitrogen oxides (NO _x)			
Old Rifle	14	14	13
New Rifle	50	61	57
Disposal site	---	108	111
Transportation routes	<u>194</u>	<u>876</u>	1098
Total	258	1059	1279
Sulfur dioxide (SO ₂)			
Old Rifle	2	1	1
New Rifle	8	7	8
Disposal site	--	15	11
Transportation routes	<u>19</u>	<u>52</u>	<u>65</u>
Total	29	75	85
Carbon monoxide (CO)			
Old Rifle	3	3	3
New Rifle	9	13	13
Disposal site	---	19	20
Transportation routes	<u>66</u>	<u>154</u>	<u>193</u>
Total	78	189	229
Hydrocarbons (HC)			
Old Rifle	1	1	2
New Rifle	3	4	4
Disposal site	--	5	6
Transportation routes	<u>11</u>	<u>50</u>	<u>63</u>
Total	15	60	75

5.2.2 Air quality impacts

The impacts of TSP emissions were assessed by using the Industrial Source Complex Long Term (ISCLT) and Short Term (ISCST) dispersion models (EPA, 1979). These models allow for the consideration of multiple sources, multiple meteorological conditions, gravitational settling, and dry deposition. Input data regarding emission rates, source locations, and meteorology are required. Section C.2.2 of Appendix C, Weather, Air Quality, and Noise, contains additional information on these models.

The ISCLT model was used to estimate the average annual TSP concentrations for the New Rifle, Estes Gulch, and Lucas Mesa alternatives. For each of the alternatives, the concentrations at the Old Rifle, New Rifle, and disposal site (where appropriate) were calculated. The ISCST model was used to estimate the maximum 24-hour TSP concentrations along the unpaved portions of the transportation routes. The control of TSP emissions by the use of water sprays was assumed to be 50 percent effective (CDH, 1981). Emission rates for both models were derived from the total emissions for the duration of remedial action, and the background TSP concentrations at the sites and along the transportation routes were not considered in the models. A circular receptor grid was placed around source areas, except for the transportation routes, where a grid was placed downwind of the roads.

Site-specific, hourly meteorological data collected for one year were available for the Lucas Mesa and New Rifle sites. These data were used in the ISCLT model for the site; the New Rifle data were used for the Old Rifle and Estes Gulch site. Site-specific meteorological data were not available for most of the transportation routes so simplified, conservative data were used for the ISCST model. Winds were assumed to be light (2.5 meters per second) and blow persistently from the same direction for six hours under stable conditions (Pasquill-Gifford Category F). It was assumed that there would be no TSP emissions for the remaining 18 hours. This approach is assumed to be conservative (i.e., overestimates air pollution impacts) in that stable meteorological conditions and persistent winds from the same direction are rare under normal conditions. Unpaved access road emissions were calculated for a 900 meter length of road.

The estimated maximum average annual TSP concentrations at the Old Rifle and New Rifle processing sites exceed the Federal and state primary standard of 75 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) for all alternatives except at the Old Rifle site for disposal at the Estes Gulch site alternative (Table 5.6). These concentrations fall below the standard anywhere from 250 meters from the Old Rifle site for the disposal at Estes Gulch alternative to over 1300 meters from the New Rifle site for the stabilization at New Rifle alternative.

Table 5.6 Estimated maximum average annual TSP concentrations

Site	Remedial action alternative ^a		
	Stabilization at New Rifle	Disposal at Estes Gulch	Disposal at Lucas Mesa
Old Rifle	76	49	80
New Rifle	364	88	96
Estes Gulch	---	283	---
Lucas Mesa	---	---	209

^aAll concentrations, in micrograms per cubic meter, were reduced by 50 percent to reflect dust control measures (CDH, 1981). Concentrations do not include background (existing) TSP concentrations at the respective sites.

The Federal and state 24-hour secondary standard of 150 microg/m³ was exceeded for the Estes Gulch alternative (186 microg/m³) while neither standard was exceeded for stabilization at New Rifle (64 microg/m³). Fugitive dust emissions along unpaved access roads would be minimized because only 2.5 miles of roads are unpaved for the stabilization at New Rifle alternative and 3.5 miles for the Estes Gulch alternative, and 6.5 miles for the Lucas Mesa alternative.

The analysis of air quality impacts was based on very conservative assumptions that would tend to over-predict impacts. The DOE does not intend to violate air quality standards knowingly. Where air quality standards are projected to be exceeded, even under conservative scenarios, DOE and UMTRA Project policy and procedures dictate that air quality would be closely monitored. As an ongoing part of normal UMTRA Project construction practice, water or other chemical dust suppressants are used regularly to minimize fugitive dust emissions.

Air quality impacts for the interim actions and at the borrow sites were not modeled. The impacts associated with emissions from these sources would be expected to be relatively small in comparison to the impacts at the tailings and disposal sites.

5.3 IMPACTS ON SOILS

5.3.1 No action

Under the no action alternative, the Old and New Rifle tailings piles and contaminated materials would remain as they currently exist. Continued contamination of soils adjacent to the piles would occur due to dispersion of the tailings by wind and water.

Interim actions at the Old and New Rifle sites would result in the disturbance of 62 acres of soil at the Old Rifle site and 172 acres of soil at the New Rifle site. These soils would not be removed from either site upon completion of the interim actions, however. Both sites would be restored with clean fill, as necessary, graded to promote positive drainage, and revegetated.

Some earthen and borrow materials would be obtained from the Second Street and New Rifle borrow sites for site preparation and any restoration as needed.

5.3.2 Stabilization at the New Rifle site

Stabilization at the New Rifle site would result in the loss of 88 acres of soils at and adjacent to the Old Rifle site and 238 acres of soils at and adjacent to the New Rifle site. These soils would be consolidated with the tailings (Table 5.7). Soils present at the Old Rifle site and adjacent disturbed area would be restored following removal of the tailings and contaminated materials. Thirty-three acres of soils adjacent to the New Rifle site would be restored following remedial action.

Earthen and rock borrow materials would be obtained from the Second Street, New Rifle, and Glenwood Springs borrow sites. Fifty acres of soils would be lost at the Second Street borrow site to obtain earthen materials for construction of the radon barrier and site restoration at the Old and New Rifle sites. Ten acres of soils at the New Rifle borrow site would be disturbed during the excavation of rock erosion protection materials. Large rock borrow materials for erosion protection would be obtained at the Glenwood Springs borrow site, resulting in the disturbance of 20 acres of soils.

5.3.3 Disposal at the Estes Gulch site

Construction activities at the Estes Gulch (Table 5.7) disposal site would require the disturbance of 103 acres of soils for the Highway 13 improvements (six acres), access road (six acres), staging area (10 acres), and disposal site (81 acres). In addition, 280 acres at and adjacent to the Old and New Rifle tailings sites would be lost under this alternative. Soils in the 10-acre staging area, two acres of the access road, and in the 10 acres around the final stabilized tailings pile would be stockpiled and restored as required by the BLM after completion of the remedial action. All of the 280 acres of soils at the Old and New Rifle sites would be restored following removal of the tailings and contaminated materials.

Borrow materials for construction of the stabilized tailings pile and restoration of the tailings sites would be obtained during excavation of the partially below-grade disposal area and from the borrow sites. Earthen materials for the radon barrier would be obtained from the disposal area. Fifty acres of soils

Table 5.7 Estimated soil disturbance

Site	Area (acres)	Volume (cubic yards)
<u>Old Rifle</u>		
Tailings pile	13	333,000
Alluvium beneath tailings pile	13	168,000
Mill area and adjacent contaminated areas	<u>62</u>	<u>160,000</u>
TOTALS	88	661,000
<u>New Rifle</u>		
Tailings pile	33	2,415,000
Alluvium beneath tailings pile	33	375,000
Mill area and adjacent contaminated areas	<u>172</u>	<u>684,000</u>
TOTALS	238	3,474,000
<u>Estes Gulch</u>		
Disposal site	81	820,000
Access road	12	600
Staging area	<u>10</u>	<u>32,000</u>
TOTALS	103	853,600
<u>Lucas Mesa</u>		
Disposal site	83	497,000
Access road	24	12,000
Staging area	<u>10</u>	<u>32,000</u>
TOTALS	117	541,000

would be lost at the Second Street borrow site to obtain clean fill material for restoration of the Old and New Rifle sites. Fifteen acres of soils at the New Rifle borrow site would be disturbed during excavation of rock materials for access road construction and erosion protection. Three acres of soils would be disturbed at the Glenwood Springs borrow site during the excavation of large rock for erosion protection.

5.3.4 Disposal at the Lucas Mesa site

Construction activities at the Lucas Mesa site would disturb 117 acres of soils for the access road (24 acres), staging area (10 acres), and disposal site (83 acres). At the Old and New Rifle tailings sites, 280 acres of soils would be lost during removal of the tailings and contaminated materials. Soils at the 10-acre staging area, 10 acres of the access road, six acres around the final stabilized tailings pile, and the 280 acres at the Old and New Rifle sites would be restored following completion of the remedial action.

Earthen materials for the radon barrier would be obtained from the disposal area. Earthen and rock materials for access road construction, erosion protection, and site restoration would be obtained from the borrow sites. Fifty acres of soils at the Second Street borrow site would be lost during excavation of clean fill material for restoration of the Old and New Rifle sites. At the New Rifle and Glenwood Springs borrow sites, the excavation of rock materials for access road construction and erosion protection would result in the disturbance of 18 and three acres of soils respectively.

5.4 IMPACTS ON MINERAL RESOURCES

5.4.1 No action

The no action alternative (interim actions only) would require 34,270 cubic yards of earth and 16,049 cubic yards of gravel from the Second Street and New Rifle borrow sites. Since there are abundant supplies of these borrow materials throughout the Colorado River valley, the consumption of these resources for the interim actions would have a very small impact on the region's reserves.

5.4.2 Stabilization at the New Rifle site

Stabilization at the New Rifle site would require 1,484,500 cubic yards of earth and small rock from the Second Street and New Rifle borrow sites and 216,000 cubic yards of large rock from the Glenwood Springs borrow site. Since there are abundant supplies of these borrow materials throughout the Colorado River valley, the

consumption of earth and rock for the remedial action would have a very small impact on the region's reserves of these resources.

Stabilization at the New Rifle site would not necessarily preclude future development of any oil, gas, coal reserves beneath or adjacent to the site. Public Law 95-604 requires that surface and subsurface rights at the disposal site be transferred to the Federal government. Public Law 95-604 also authorizes the Secretary of the Interior, with the concurrence of the Secretary of Energy and the NRC, to dispose "of any subsurface mineral rights by sale or lease . . . if the Secretary of the Interior takes such action as the Commission deems necessary pursuant to a license issued by the Commission to assure that the residual radioactive materials will not be disturbed by reason of any activity carried on following such disposition." However, it is unlikely that these resources would ever have a value sufficient to warrant development under the conditions that the NRC may place on development of these resources in order to ensure that the stabilized tailings are not disturbed by resource recovery operations.

5.4.3 Disposal at the Estes Gulch site

The consumption of 2,130,700 cubic yards of earth, gravel, and rock would result from disposal at the Estes Gulch site. Of this total, 720,000 cubic yards of earthen materials would be excavated from the partially below-grade disposal area for construction of the radon barrier and frost protection layer, and 1,393,700 cubic yards of earth, gravel, and small and large rock would be excavated from the borrow sites for access road construction, erosion protection, and site restoration. As with stabilization at the New Rifle site, the consumption of borrow materials for disposal at the Estes Gulch site would have a very small impact on the region's reserves of these resources.

As stated above, the DOE would acquire all subsurface mineral rights beneath the restricted area. Disposal of the tailings at the Estes Gulch site would not necessarily preclude development of the two oil and gas leases present since the lease areas are large (over 2000 acres). This would allow for many development alternatives; if necessary, they could be developed using directional drilling techniques.

5.4.4 Disposal at the Lucas Mesa site

Disposal at the Lucas Mesa site would consume 2,554,000 cubic yards of borrow materials. A total of 881,000 cubic yards of earthen materials would be excavated from the partially below-grade disposal area for the radon barrier and frost protection barrier, and 1,673,000 cubic yards would be excavated from the borrow sites for access road construction, erosion protection, and site restoration. As with the other action alternatives, the consumption of these borrow materials would have a very small impact on the availability of these resources in the region.

As discussed above for the New Rifle site, disposal at the Lucas Mesa site would not necessarily preclude the development of any oil, gas, or coal reserves beneath or adjacent to the site.

5.5 IMPACTS ON WATER

5.5.1 Impacts on surface water

This section describes the potential surface water impacts from each remedial action alternative and summarizes water use during each remedial action alternative. Additional details are provided in Section A.5 of Appendix A, Conceptual Designs, and Section E.1 of Appendix E, Hydrology.

No action

Performance of the interim actions would include the removal of the chemicals, solvents, oils and other materials that are found at the New Rifle processing site. Removal of these materials would remove potential sources of surface waste contamination.

However, the selection of the no action alternative would result in the continued exposure of the Old and New Rifle tailings piles to erosion from surface runoff. The present covers on the piles were not designed to provide protection against sheet and gully erosion created by severe rainfall events. Eventual erosion of the present covers would result in the transport of contaminants from the tailings piles into local surface waters.

Both the Old and New Rifle tailings piles were partially stabilized with vegetation, but complete vegetative covers have not been achieved. The Old Rifle pile was recontoured prior to vegetation; however, some erosion has occurred as a result of minor channelization occurring across the top of the pile. Some erosion is also visible on the steep banks of the New Rifle pile.

The Old Rifle site is presently protected by the riprap placed to protect the D&RGW railroad grade from the potential of lateral shift of the Colorado River. At the New Rifle tailings site, the main channel of the Colorado River has been artificially channeled northward by blocking alternative river channels upstream of the site. This has caused the river to swing north and erode the northern portion of a dike that presently protects the eastern side of the New Rifle site from normal annual floods. This dike is not considered adequate to prevent large floods from encroaching on the site. The embankment of I-70 also provides some protection for the southern boundary of the New Rifle site from the Colorado River.

Both the Old and New Rifle sites are in meander paths of the Colorado River. The history of the river indicates that the river

has meandered back and forth across its floodplain; therefore, the potential for lateral shifts of the river toward the sites is high. Section D.3 of Appendix D, Soils, Geology, and Seismicity, provides further details on the geomorphology of the sites.

It is apparent that under the no action alternative the potential for erosion of the tailings is high. The effect of the release of contaminants into local surface waters would be offset by dilution associated with large flows in the Colorado River.

Stabilization at the New Rifle site

During remedial action, the cleanup and consolidation of the tailings and contaminated materials would result in surface disturbance, and runoff from these disturbed areas could likewise be contaminated. Also, contaminated wastewater would be generated by activities such as the washing of equipment. The remedial action design includes the construction of drainage controls, wastewater retention basins, and wastewater treatment facilities (if necessary) during site preparation to prevent the discharge of contaminated water from the sites. The contaminated water would be directed to the retention basins and treated prior to discharge or used as dust suppression or compaction water.

Several control features were incorporated into the remedial action design to prevent erosion of the stabilized pile and subsequent contamination of adjacent surface waters. The toeslope of the pile would be limited to five horizontal to one vertical (20 percent), and the top of the pile would be gently sloped (maximum of four percent). These shallow slopes would promote drainage from the pile with non-erosive flow velocities. Drainage ditches around the pile would direct surface runoff around and away from the pile. The rock erosion protection barrier and underlying filter layer on the top and toeslope of the pile are designed to withstand the erosive forces of severe rainfall events such as a PMP. In order to protect the stabilized tailings pile from a major flood of the Colorado River, the rock erosion protection barrier on the sideslopes of the pile would be designed to withstand PMF flows. Below the maximum PMF water level, the erosion protection barrier would be three feet thick and would consist of larger rock. The rock erosion protection barrier would tie into a massive, below-grade rock apron around the base of the entire pile. This rock apron would be designed to withstand PMF flows and protect the pile against scour caused by PMF flows; the apron would also protect the pile against direct flows impinging on the pile caused by channel shifts of the Colorado River.

The rock apron around the base of the pile was designed according to standard engineering practices, taking into account the potential for any lateral movement of the stream channel that might cause undermining or erosion of the stabilized tailings pile. The calculations supporting this design are on file at the DOE

UMTRA Project Office in Albuquerque, New Mexico. These calculations compute water surface profiles and flood velocities with revised boundary geometry to model the sensitivity of geomorphic changes.

The remedial action design includes features to prevent the discharge of contaminated water from the tailings sites during remedial action and to prevent erosion of the stabilized tailings pile and subsequent contamination of adjacent surface waters after remedial action. Considering these features, this alternative would have no impacts on surface water.

Disposal at the Estes Gulch site

As with stabilization at the New Rifle site, appropriate measures would be taken during site preparation to prevent the discharge of contaminated water during remedial action from any of the sites.

Likewise, the stabilized tailings pile would be constructed with a 20 percent toeslope (five horizontal to one vertical) and a 7.1 percent topslope that is flush with the adjacent terrain. The rock erosion protection (1.5 feet thick) and an underlying filter layer (0.5 feet thick), designed to withstand the erosive forces of severe rainfall events such as a PMP, would be placed over the entire tailings pile. A permanent grading scheme, consisting of grading, riprap, and an interceptor ditch, on the upland drainage area to the north will intercept and direct surface runoff away from the pile. Limited grading of the adjacent areas will also promote sheet flow away from the pile. A rock-lined ditch would be placed at the southern toe of the pile and a portion of the western toe of the pile. This ditch would be designed to prevent headcutting into the stabilized tailings pile and would divert runoff from the pile's top surface to the west, and eventually into Government Creek.

After remedial action, the areas of excavation at and around the Old and New Rifle sites would be restored with clean fill material, graded to promote positive drainage, and revegetated. There would be no impacts to surface water under this alternative.

Disposal at the Lucas Mesa site

As in the other relocation alternative, appropriate measures would be taken during site preparation to prevent the discharge of contaminated water from any of the sites during remedial action.

Likewise, the stabilized tailings pile would be constructed with 20 percent sideslopes (five horizontal to one vertical) and a four percent (maximum) topslope. Rock erosion protection and an underlying filter layer for the topslope (1.5 feet thick) and the sideslopes (two feet thick) designed to withstand the erosive

forces of severe rainfall events such as a PMP would be placed over the entire tailings pile. Drainage ditches adjacent to the pile would direct on-site flows around and away from the pile. The west ditch adjacent to the pile would also intercept a portion of the drainage area above the site. The flow from the remaining drainage area would be intercepted by the far east ditch and would be directed into the natural drainage pattern east of the site. A large, below-grade rock apron would be placed at the northern toe of the pile. This apron would be designed to prevent headcutting into the stabilized tailings pile.

After remedial action, the areas of excavation at and around the Old and New Rifle sites would be restored with clean fill material, graded to promote positive drainage, and revegetated. There would be no impacts to surface water under this alternative.

Borrow sites

During remedial action, appropriate drainage controls would be used at all borrow sites in order to minimize or prevent erosion and any corresponding surface water impacts. None of the borrow sites would be reclaimed since they are existing commercial borrow sites.

Water use

Table 5.8 lists the estimated water consumption for the no action alternative (interim actions only) and for each remedial action alternative. Water would be used by remedial action workers for personal consumption and cleanup, dust control on disturbed areas and access roads, the compaction of the tailings and radon barrier, and for washing equipment. Possible sources of construction water for each alternative are discussed in Sections A.2.3.4 and A.3.4.4 of Appendix A, Conceptual Designs. The RAC will select the sources of the water to be used, but it is anticipated that the majority of the construction water for any alternative would be obtained from the Colorado River and Rifle Gap Reservoir. The consumption of water for any alternative would not be expected to adversely affect any existing water supplies due to the availability of water in the Rifle area.

Table 5.8 Estimated water consumption

Alternatives	Gallons consumed
No action (interim actions only)	1,241,000
Stabilization at New Rifle	119,968,000
Disposal at Estes Gulch	284,262,000
Disposal at Lucas Mesa	337,886,000

5.5.2 Impacts on groundwater

In this section, the impacts on groundwater are discussed for all alternatives. The data and analyses supporting these discussions are provided in Section E.2.4 of Appendix E, Hydrology. Aquifer restoration, ACLs, and supplemental standards are discussed in Sections E.2.4 and E.2.6.

Presently, there is no human exposure to contaminated groundwater in the Rifle area, and the risk for future exposure is low. The City of Rifle withdrawn all of its water from the Colorado River approximately 0.5 mile upgradient of the Old Rifle tailings site. The current water supply is not affected by the uranium tailings contamination and will not be affected by future contaminant migration. Although the City of Rifle is steadily growing, the current water supply is more than adequate for future development and there are no plans for additional development of groundwater for municipal needs (Anderson, 1988).

During remedial action, no groundwater impacts will occur at any of the borrow sites, as all borrow sites are existing commercial operations. Hence, there will be no impacts different from those associated with the current operations.

Under UMTRCA, the DOE must comply with the proposed groundwater standards until standards are promulgated in final form. As a result, remedial action taken with regard to the Rifle sites would not preclude subsequent design enhancements if needed to achieve compliance with the standards, and would not limit the selection of reasonable groundwater restoration methods that may be necessary when the final standards are promulgated. The DOE has characterized conditions at the Rifle uranium mill tailings sites and determined that the proposed remedial action would comply with the requirements of Subpart A of the proposed EPA groundwater protection standards. When final standards are promulgated, the DOE will evaluate groundwater protection requirements and undertake such action as necessary to ensure that the final standards are met. The need for and extent of aquifer restoration will be evaluated in accordance with the National Environmental Policy Act.

No action

Under this alternative, no action would be taken to minimize the infiltration of precipitation through the old and New Rifle tailings piles, or to prevent the rise of groundwater into the tailings. Seepage from the tailings piles would continue to contaminate groundwater until all contaminants have been leached from the tailings. Groundwater contamination would persist for an indefinite period of time and then decrease as the concentrations in the tailings seepage decreased.

Performance of the interim actions would include removal of the chemicals, solvents, oils, and other materials that are found at the New Rifle site. Removal of these materials would remove potential sources of additional groundwater contamination.

Stabilization at the New Rifle site

Under this alternative action, the tailings and contaminated materials from both the Old and New Rifle sites would be consolidated and stabilized in an above-grade disposal cell at the present location of the New Rifle tailings pile.

During steady state conditions, the disposal cell at the New Rifle site would comply with Subparts A and C of 40 CFR 192, the proposed EPA groundwater protection standards for inactive uranium mill sites. The disposal cell would meet all concentration limits at the POC in the uppermost aquifer. The DOE defines POCs for all UMTRA disposal sites as the downgradient edge of the engineered facility. The concentration limits are defined as either MCLs or background water quality, whichever is higher. At the New Rifle site, the alluvium is the uppermost aquifer. The steady state compliance is based on an assessment of the hydrogeologic characteristics of the site, design analysis of the disposal cell, and performance assessment of the disposal site.

A cover system would be constructed over the tailings and contaminated materials. The disposal cell cover at the New Rifle site would consist of the following (in ascending order): 1) a compacted clay radon barrier; 2) an infiltration barrier with a saturated hydraulic conductivity of 10^{-9} cm/s (using CLAYMAX, a thin layer of bentonite sandwiched between geotextile layers, or its equivalent); 3) a lower filter layer of sand; 4) a frost protection layer; 5) an upper filter (bedding) layer of sand; and 6) a layer of erosion protection riprap.

The cell components would function as an integrated system to limit vertical seepage through the tailings. The infiltration barrier overlying the radon barrier would restrict steady state vertical seepage through tailings to 10^{-9} cm/s. The lower filter layer would eliminate the potential for standing water to remain in the radon barrier. The frost protection layer and the erosion protection layer would prevent degradation of the radon barrier by frost heave or erosion. Groundwater mounding (as a result of tailings seepage) would not be a problem in the alluvium because of the high hydraulic conductivity of the alluvium.

The hazardous constituents (from 40 CFR 192 and Appendix IX of 40 CFR 264) identified in the tailings at the Rifle processing sites include arsenic, chromium, molybdenum, selenium, uranium, radium-226 and -228 combined, beryllium, vanadium, benzene, diethyl phthalate, benzo [a] anthracene, benzo [a] pyrene, chrysene, fluoranthene, ideno (1,2,3-ed) pyrene, pyrene, acrylonitrile, 2,4-D and

Silvex (2,4,5-TP). The concentration limits for these constituents are the MCLs or background concentrations, whichever are higher.

Metals such as molybdenum and uranium are typically geochemically nonconservative constituents, which are reactive. Their concentrations will be affected by geochemical processes such as sorption, oxidation/reduction, precipitation, etc. Anions such as chloride, nitrate and sulfate are typically geochemically conservative constituents, which are relatively nonreactive. These constituents will not be affected by the geochemical processes described above. Therefore, changes in concentrations will directly reflect groundwater flow.

However, natural flushing of nonconservative (geochemically reactive) species could require considerably more time, and active aquifer restoration to ensure compliance with the proposed groundwater protection standards may be necessary. Natural flushing in the underlying Wasatch Formation within 100 years would be negligible due to the formation's low hydraulic conductivity.

The need for and extent of aquifer restoration will be evaluated when the final groundwater protection standards are promulgated. If it can be demonstrated that natural flushing will reduce concentrations of hazardous constituents in groundwater to background or MCLs within 100 years (as required by Subpart B of 40 CFR 192), then natural flushing with institutional controls will be used to comply with the groundwater standards. However, if natural flushing is not sufficient to reduce concentrations to MCLs or background, then active aquifer restoration, active restoration in combination with natural flushing, or ACLs, would be required.

Following remedial action, there would be a transient drainage period during which contaminant concentrations in groundwater within the alluvium would gradually decrease to background concentrations. The MCLs for the hazardous constituents could initially be exceeded while the tailings are draining and while existing contamination in the alluvium is being flushed from the aquifer. Transient drainage from the tailings in the disposal cell would affect natural flushing of contaminants from the alluvium and could interfere with aquifer restoration if it is determined to be necessary.

Because the New Rifle disposal cell would be located within the floodplain of the Colorado River, the proposed EPA groundwater protection standards could temporarily be exceeded following periods of flooding of the Colorado River. Flooding could result in elevated groundwater levels, which may encroach upon the lower portions of the tailings and release contaminants into the groundwater.

As described above, transient tailings drainage and the potential for periodic releases of groundwater contaminants related to

flooding of the Colorado River could cause potential exceedance of the proposed EPA groundwater protection standards. In the event that compliance with the proposed EPA groundwater standards cannot be achieved with the proposed conceptual design for the New Rifle alternative, design modifications or ACLs would be considered. The ACLs would be established only if it could be demonstrated that a given constituent would not pose a substantial threat or potential hazard to human health or the environment as long as the ACL is not exceeded (40 CFR 264.94(b)). An ACL could be applied provided that, after considered corrective actions, a determination can be made that the lower of the values given by the standard for setting ACLs in 40 CFR 264.94(b) is satisfied, and the concentrations established as a result of the corrective action are as low as reasonably achievable (ALARA).

Should contaminated groundwater migrate beyond the POC during the 1000-year design life of the disposal cell, it would not significantly affect human health or the environment. There are no users of contaminated groundwater from the alluvium downgradient of the New Rifle site, nor any known sensitive population. Furthermore, future development of the groundwater in the alluvium immediately downgradient of the site is unlikely due to the poor quality of the water and readily available uncontaminated water upgradient (see Section E.2.5, Groundwater Use, Value and Alternate Supplies).

Because the period of construction would be relatively short at Rifle, and because there are no users of groundwater contaminated by tailings seepage at the Rifle sites, there would be little or no risk to human health or the environment by leaving groundwater contamination in place during the interim period between remedial action and evaluation of groundwater cleanup.

Tailings disposal at the Estes Gulch site

Under the preferred alternative, the tailings and contaminated materials from the Old and New Rifle sites would be placed in a partially below-grade disposal cell at the Estes Gulch disposal site. The disposal cell at Estes Gulch would comply with 40 CFR 192, Subparts A and C of the EPA groundwater protection standards for inactive uranium mill sites. This is based on an assessment of the hydrogeologic characteristics of the site, design analysis of the disposal cell, and performance assessment of the disposal site. The disposal cell would meet all concentration limits at the POC in the uppermost water-bearing unit. The concentration limits are defined as either the MCLs or background water quality, whichever is higher. At the Estes Gulch site, the Wasatch Formation is the uppermost water-bearing unit.

A cover system would be constructed over the tailings and contaminated materials. The disposal cell cover at Estes Gulch would consist of the following (in ascending order): 1) a clay

radon/infiltration barrier with a hydraulic conductivity of 10^{-8} cm/s; 2) a lower filter layer of sand; 3) a frost protection layer; 4) an upper filter (bedding) layer of sand; and 5) a layer of erosion protection riprap.

The cell components would function as an integrated system to limit vertical seepage through the tailings. The radon barrier would restrict steady state vertical seepage through the tailings to 10^{-8} cm/s. The lower filter layer would eliminate the potential for standing water to remain in the radon barrier. The frost protection layer and the erosion protection layer would prevent future degradation of the radon barrier by frost heave or erosion.

The steady state seepage flux of 10^{-8} cm/s is within the drainage capacity of the underlying Wasatch Formation bedrock, preventing tailings seepage from perching along low hydraulic conductivity strata beneath the disposal cell. No groundwater mounding in the underlying Wasatch Formation would occur into the disposal cell because the depth to groundwater is 163 feet.

The hazardous constituents (from 40 CFR 192 and Appendix IX of 40 CFR 264) identified in the tailings at the Rifle processing sites include arsenic, chromium, molybdenum, selenium, uranium, radium-226 and -228 combined, beryllium, vanadium, benzene, diethyl phthalate, benzo [a] anthracene, benzo [a] pyrene, chrysene, fluoranthene, ideno (1,2,3-ed) pyrene, pyrene, acrylonitrile, 2,4-D and Silvex (2,4,5-TP). The concentration limits for these constituents are the MCLs or background concentrations, whichever are higher. The seepage from the disposal cell would not cause concentration limits of these constituents to be exceeded at the POC. The cell would comply with the proposed EPA groundwater protection standards because the average linear groundwater velocity in the Wasatch Formation is less than 0.1 ft/year. Consequently, contaminated groundwater would travel less than 100 feet in 1000 years, which is the design-life of the disposal cell. This is approximately the distance from the perimeter of the tailings to the downgradient edge of the riprap (the POC).

In the unlikely event that contaminated groundwater migrates beyond the POC within 1000 years, it would not significantly affect human health or the environment. Groundwater in the Wasatch Formation beneath the Estes Gulch disposal cell could be classified as Class III, based on the high concentrations of naturally occurring contaminants and on the low yield of the Wasatch Formation. Because of the poor quality of groundwater, the low yield of the Wasatch Formation, and the relatively remote location and Federal ownership of the site, Wasatch Formation groundwater resources in the immediate vicinity of the disposal cell at Estes Gulch would probably remain undeveloped.

Should the proposed concentration limits be exceeded for any hazardous constituent at the POC, the DOE would investigate methods of corrective action to bring the disposal cell into compliance,

including disposal cell cover modifications, the application of supplemental standards based on Class III groundwater, or ACLs.

At the Old and New Rifle processing sites, natural flushing would reduce concentrations of conservative contaminant species to background concentrations in the alluvium within 10 years after the tailings have been removed at the Old Rifle site, and within 50 years at the New Rifle site. However, natural flushing of nonconservative (geochemically reactive) species could require considerably more time, and aquifer restoration could be necessary. Natural flushing in the underlying Wasatch Formation within 100 years would be negligible because of the formation's low hydraulic conductivity.

The need for and extent of aquifer restoration will be evaluated when the final groundwater protection standards are promulgated. If it can be demonstrated that natural flushing will reduce concentrations of hazardous constituents in groundwater to background or MCLs within 100 years (as required by Subpart B of 40 CFR 192), then natural flushing with institutional controls will be used to comply with the groundwater standards. However, if natural flushing is not sufficient to reduce concentrations to MCLs or background, then active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required.

Tailings disposal at the Lucas Mesa site

Under the Lucas Mesa disposal alternative, the tailings and contaminated materials from the Old and New Rifle sites would be placed in a partially below-grade disposal cell at the Lucas Mesa site. The disposal cell at Lucas Mesa would comply with 40 CFR 192, Subparts A and C of the EPA groundwater protection standards for inactive uranium mill sites. This is based on an assessment of the disposal cell, and performance assessment of the disposal site. The disposal cell would meet all concentration limits at the POC in the uppermost water-bearing unit. The concentration limits are defined as either the MCLs or background water quality, whichever is higher. The Wasatch Formation is the uppermost water-bearing unit at the Lucas Mesa site.

A cover system would be constructed over the tailings and contaminated materials. The disposal cell cover at Lucas Mesa would consist of the following (in ascending order): 1) a clay radon/infiltration barrier with a hydraulic conductivity of 10^{-8} cm/s; 2) a lower filter layer of sand; 3) a frost protection layer; 4) an upper filter (bedding) layer of sand; and 5) a layer of erosion protection riprap.

The cell components would function as an integrated system to limit vertical seepage through the tailings. The radon barrier would restrict steady state vertical seepage through the tailings

to 10^{-8} cm/s. The lower filter layer would eliminate the potential for standing water to remain in the radon barrier. The frost protection layer and the erosion protection layer would prevent future degradation of the radon barrier by frost heave or erosion.

The steady state seepage flux of 10^{-8} cm/s is probably within the drainage capacity of the underlying Wasatch Formation bedrock, preventing tailings seepage from perching along the low hydraulic conductivity strata of the bedrock beneath the disposal cell. No groundwater mounding in the underlying Wasatch Formation would occur into the disposal cell, because the depth to groundwater is greater than 200 feet.

The hazardous constituents (from 40 CFR 192 and Appendix IX of 40 CFR 264) identified in the tailings at the Rifle processing sites include arsenic, chromium, molybdenum, selenium, uranium, radium-226 and -228 combined, beryllium, vanadium, benzene, diethyl phthalate, benzo [a] anthracene, benzo [a] pyrene, chrysene, fluoranthene, ideno (1,2,3-ed) pyrene, pyrene, acrylo- nitrile, 2,4-D and Silvex (2,4,5-TP). The concentration limits for these constituents are the MCLs or background concentrations, whichever are higher. The seepage from the disposal cell would not cause concentration limits of these constituents to be exceeded at the POC. The cell would comply with the proposed EPA groundwater protection standards because the average linear groundwater velocity in the Wasatch Formation is extremely low. Contaminated groundwater should travel less than 100 feet in 1000 years, which is the design-life of the disposal cell. This is approximately the distance from the perimeter of the tailings to the downgradient edge of the riprap (the POC).

In the unlikely event that contaminated groundwater migrates beyond the POC within 1000 years, it would not significantly affect human health or the environment. Groundwater in the Wasatch Formation beneath the Lucas Mesa disposal cell probably could be classified as Class III due to the high concentrations of naturally occurring contaminants and the low yield of the Wasatch Formation. Furthermore, there are no downgradient users of groundwater in the immediate vicinity of the disposal site. Because of the probable poor quality of groundwater, the low yield of the Wasatch Formation, and the site's relatively remote location and Federal ownership, Wasatch Formation groundwater resources in the immediate vicinity of the disposal cell at Lucas Mesa would probably remain undeveloped.

Should the proposed concentration limits be exceeded for any hazardous constituent at the POC, the DOE would investigate methods of corrective action to bring the disposal cell into compliance, including modifications to the disposal cell cover, the application of supplemental standards based on Class III groundwater, or ACLs.

At the Old and New Rifle processing sites, natural flushing would reduce concentrations of conservative contaminant species to background concentrations in the alluvium within 10 years after the tailings have been removed at the Old Rifle site, and within 50 years at the New Rifle site. However, natural flushing of nonconservative (geochemically-reactive) species could require considerably more time, and aquifer restoration could be necessary. Natural flushing in the underlying Wasatch Formation within 100 years would be negligible because of the formation's low hydraulic conductivity.

The need for and extent of aquifer restoration will be evaluated when the final groundwater protection standards are promulgated. If it can be demonstrated that natural flushing will reduce concentrations of hazardous constituents in groundwater to background or MCLs within 100 years (as required by Subpart B of 40 CFR 192), then natural flushing with institutional controls will be used to comply with the groundwater standards. However, if natural flushing is not sufficient to reduce concentrations to MCLs or background, then active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required.

5.6 IMPACTS ON ECOSYSTEMS

Ecosystems would be impacted directly and indirectly by interim actions or remedial action at the Old and New Rifle tailings sites, the alternate disposal site, and borrow sites. Direct impacts such as loss of habitat and wildlife mortality would result from the construction and upgrading of access roads, excavation of contaminated soils, disposal of the tailings, borrow activities, and from truck traffic. Indirect impacts include elevated noise levels, increased fugitive dust emissions, and human activities at and adjacent to the direct impact areas. The effects of these indirect impacts would minimize use of the areas immediately surrounding the remedial action sites by wildlife. Direct impacts can either be long term or short term (i.e., for the duration of remedial action--20 or 42 months), while most indirect impacts are short term. This section addresses the impacts for each remedial action alternative on terrestrial, riparian, and aquatic ecosystems and threatened, endangered, and candidate species.

5.6.1 Impacts on terrestrial ecosystems

No action

The no action alternative would result in additional, although unestimated, impacts at the Old and New Rifle sites in that wind and water erosion would continue to contaminate adjacent areas. In addition, surface water would continue to accumulate in low lying areas at these sites and potentially contaminated water would be accessible to wildlife. The no action alternative would not impact

the terrestrial ecosystems at the Estes Gulch or Lucas Mesa alternate disposal sites.

Interim action activities would impact plant communities and wildlife within the designated site boundaries at the Old and New Rifle sites. Approximately 35 acres of land would be cleared during the interim action activities at the New Rifle site (Table 5.9). Most of this land is highly disturbed and represents marginal wildlife habitat. One acre of valuable wildlife habitat (saltgrass wetland) would be cleared during the interim action activities. Approximately five acres of land would be cleared at the Old Rifle site, including 0.7 acre of cattail and shrub wetland. The remaining land that would be disturbed represents habitat dominated by introduced species of grass; therefore, this area is marginal wildlife habitat.

Stabilization at the New Rifle site

Stabilization at the New Rifle site would directly impact 360 acres (Table 5.9), of which 75, 205, and 80 acres would be at the Old Rifle site, New Rifle site, and the borrow sites, respectively. The New Rifle site is highly disturbed with little vegetation present, and the Old Rifle site consists mainly of introduced grasses; these sites do not provide significant habitat for wildlife.

At the New Rifle site, a total of 172 acres of the 205 acres disturbed would be used for the final disposal site and would represent a permanent loss, as the site would be restricted from any use, with an additional 33 acres of disturbance of subsurface materials beneath the pile (Table 5.7) for the removal of additional contaminated materials from the underlying alluvium. The remaining 33 of the 205 surface acres disturbed by the cleanup of windblown tailings at the New Rifle site would be restored with clean fill material, graded to promote positive drainage, and revegetated following remedial action. The 75 acres disturbed at the Old Rifle site, and an additional 13 acres of subsurface contaminated material beneath the pile, would also be restored with clean fill material, graded to promote positive drainage, and revegetated. Following remedial action, the Old Rifle site would be released for any use consistent with existing land use controls. Disturbed wetlands areas at both sites would be revegetated.

A total of 50 acres of sagebrush, 10 acres of greasewood-saltgrass, and 20 acres of sparse pinyon-juniper vegetation would be affected at the Second Street, New Rifle, and Glenwood Springs borrow sites, respectively (Table 5.9). These are new areas to be disturbed at existing borrow operations and would result in a long-term loss of habitat.

Truck traffic between the Old and New Rifle sites and borrow sites would result in increased wildlife mortality on the roads

Table 5.9 Estimated acres of land affected

Disturbed area/site	Acres of land ^a			
	No action (interim actions)	Stabilization at New Rifle	Disposal at Estes Gulch	Disposal at Lucas Mesa
<u>Old Rifle</u>				
Tailings pile	0	13	13	13
Mill and on- site windblown	5	9	9	9
Off-site wind- blown tailings	<u>0</u>	<u>53</u>	<u>53</u>	<u>53</u>
Subtotal	5	75	75	75
<u>New Rifle</u>				
Tailings pile	0	33	33	33
Mill area and on- site windblown	35	109	109	109
Off-site wind- blown tailings	<u>0</u>	<u>63</u>	<u>63</u>	<u>63</u>
Subtotal	35	205	205	205
<u>Disposal site</u>				
Disposal pile area	0	0	81	83
Access roads	0	0	12	24
Staging areas	<u>0</u>	<u>0</u>	<u>10</u>	<u>10</u>
Subtotal	0	0	103	117
<u>Borrow sites</u>				
Section Street	0	50	50	50
New Rifle	0	10	15	18
Glenwood Springs	<u>0</u>	<u>20</u>	<u>3</u>	<u>3</u>
Subtotal	0	80	68	71
TOTALS	<u>40</u>	<u>360</u>	<u>447</u>	<u>468</u>

^aAcres disturbed during the interim actions are also included in the action alternatives.

used. However, this direct impact would be minimal on roads leading to the Old Rifle Site and Second Street and New Rifle borrow sites because of their close proximity to the New Rifle site and the lack of significant wildlife habitat along established roads. Truck traffic between the Glenwood Springs borrow site and the New Rifle site would be short-term, lasting for only five months of the remedial action.

Stabilization at the New Rifle site would directly and indirectly affect mule deer populations adjacent to the Old Rifle site and Second Street and Glenwood Springs borrow sites due to changes in or loss of habitat and disturbances or harassment that often result from increased human use of an area. The deer and elk populations adjacent to the Glenwood Springs borrow site would be directly affected.

Adjacent to the Old Rifle site, short-term indirect impacts would occur to the resident deer population. Deer on critical winter range north of the Second Street borrow site would be affected indirectly by increased human activities; this might result in avoidance of the borrow site and would be short-term, lasting for only nine months of the remedial action. The permanent loss of deer and elk winter range habitat would occur at the Glenwood Springs borrow site. Since the area to be disturbed is sparsely vegetated, the impacts (which might include the displacement of deer and elk onto undisturbed areas) would be minimal. The indirect impacts on wintering deer referred to above would be minimized since many of the remedial action activities may not take place from December through February.

Disposal at the Estes Gulch site

Disposal at the Estes Gulch site would impact a total of 447 acres (Table 5.9), 280 acres (combined) of which are at the Old and New Rifle tailings sites. The impacts at the Old and New Rifle sites would be short-term in that the disturbed areas would be restored with clean fill material, graded to promote positive drainage, and revegetated. Afterward, both of the sites would be released for any use consistent with existing land use controls. Wetlands areas cleared during interim and remedial actions would be revegetated.

At the Estes Gulch site, 103 acres of habitat would be impacted. The habitat lost would be primarily of the sagebrush type. The area of the final disposal site would be 81 acres and would represent a permanent loss of habitat. The twelve acres disturbed to construct access would remain intact and represents a permanent loss of habitat. Six acres of haul road construction would occur between State Highway 13 and the disposal site, while the remaining six acres represent land disturbed to widen and improve State Highway 13. The six acres of haul road leading to the disposal site consist of improvements to an existing dirt

road, while the six acres of disturbance along State Highway 13 would occur in the highly disturbed areas within the existing highway right-of-way. The ten acre staging area would be recontoured, graded to promote positive drainage, and revegetated, and represents a long-term loss of habitat.

A total of 50 acres of sagebrush, 15 acres of greasewood-saltgrass, and three acres of sparse pinyon-juniper vegetation would be lost at the Second Street, New Rifle, and Glenwood Springs borrow sites, respectively. These are new areas to be disturbed at existing borrow operations and would result in a long-term loss of habitat.

Truck traffic between the Estes Gulch site, Old and New Rifle sites, and borrow sites would result in increased wildlife mortality along the roads used. This increased, yet unknown quantity, of wildlife mortality would be a short-term impact lasting for the 42 months of remedial action.

Disposal at the Estes Gulch site would have direct and indirect impacts on mule deer populations at and adjacent to the Estes Gulch site, Old Rifle site, and Second Street and Glenwood Springs borrow sites similar to those described for stabilization at the New Rifle site. Although signs of elk have been observed at the Estes Gulch site, the elk winter range is north of the site; thus, impacts on the elk population would be indirect and minimal, lasting only for the duration of the remedial action. The impacts on deer adjacent to the Old Rifle site and Second Street borrow site would be the same as for stabilization at the New Rifle site; however, the impacts on deer and elk at the Glenwood Springs borrow site would be less due to the smaller acreage to be disturbed.

The Estes Gulch site is situated within a critical winter habitat for mule deer. It has long been accepted that the availability and condition of winter range limits big game numbers in the Rocky Mountains (Robinette et al., 1952). Impacts related to remedial action on the mule deer population would include direct and indirect disturbances or harassment that often result from increased human use of an area. The direct loss of habitat and other disturbances would result in the displacement of deer onto the surrounding habitat, which might increase the population densities in these areas unless the carrying capacity of these areas limits increased use. Similarly, avoidance of the remedial action and other human activities by deer could increase densities in undisturbed areas. Dorrance et al. (1975) hypothesized that even small-scale displacement is detrimental in severe winters on poor range. The direct or indirect loss of habitat may decrease the quality of the remaining range and result in poor survival and reproduction of the deer population, particularly at south slope wintering areas that are essential to fawning (Verme, 1969; Ritchens, 1967; Loveless, 1964). The Estes Gulch site is on a south-facing slope.

Direct losses of deer from injury or death may be caused by vehicular traffic. Vehicles would pass through approximately three miles of deer highway crossing area along State Highway 13. The winter concentration period for deer is from December through April (five months), and an increase in deer mortality due to vehicular traffic would be expected during two out of the five months since remedial action activities are not scheduled during the winter months of December, January, and February. During the remainder of the year, wintering deer move into higher elevations (except for the resident population), and highway mortality would be reduced. This direct impact would be short-term, lasting for only the duration of remedial action. Vehicular traffic may also increase stress, which would disrupt normal movements. In some cases, the speed, intensity, and frequency of vehicular traffic may have greater impacts on game populations than death caused by collisions due to disruption of the game's normal movements (USFWS, 1977).

The disposal of the tailings at the Estes Gulch site would not be expected to directly impact the bighorn sheep that were reintroduced onto the Grand Hogback north of the site (Coleman, 1988; 1985). However, the bighorn sheep may be impacted indirectly from noise generated by the remedial action activities; such noise may cause the bighorn sheep to avoid potential wintering areas (Gray, 1986). Bighorn sheep are not well adapted to deep snow and are usually forced to winter on the confines of southern exposures or windswept slopes next to rocky terrain (Gray, 1986; Schmidt and Gilbert, 1978). However, the indirect impact would be minimal, since remedial action activities are not scheduled during the winter, and would be short-term, lasting only for the duration of the remedial action. In addition, the riparian (wetlands) habitat at the New Rifle site would not be disturbed, although it would continue to be susceptible to contamination from the New Rifle site.

Disposal at the Lucas Mesa site

Disposal at the Lucas Mesa site would impact a total of 468 acres (Table 5.9), 280 acres of which are located at the Old and New Rifle tailings sites. The impacts at the tailings piles would be short term in that the areas would be restored with clean fill, recontoured to promote positive drainage, revegetated, and released for any use consistent with existing land use controls following removal of the tailings and contaminated materials.

At the Lucas Mesa site, 117 acres of habitat would be impacted. The habitat lost would be primarily of the sagebrush type. The area of the final disposal site would be 83 acres and would represent a long-term loss of habitat. The remaining 34 acres would be covered by the access road to the site and the staging area, of which 10 acres would be backfilled with clean fill material, graded to promote positive drainage, and revegetated; 24 acres of access road would be permanently lost.

A total of 50 acres of sagebrush, 18 acres of greasewood-saltgrass, and three acres of sparse pinyon-juniper vegetation would be lost at the Second Street, New Rifle, and Glenwood Springs borrow sites, respectively. These are new areas to be disturbed at existing borrow operations and would result in a long-term loss of habitat.

Truck traffic between the Lucas Mesa site, the Old and New Rifle sites, and borrow sites would result in increased, although unknown, wildlife mortality along the roads used. The direct impact would be short-term, lasting for 33 months of remedial action.

Disposal at the Lucas Mesa site would have direct and indirect impacts on mule deer populations at and adjacent to the Lucas Mesa site, Old Rifle site, Second Street borrow site, and Glenwood Springs borrow site similar to those described for disposal at the Estes Gulch site. The Lucas Mesa site is also situated within a winter concentration area and critical winter range for mule deer. Remedial action related impacts on the mule deer population would be the same as those described for the Estes Gulch site.

5.6.2 Impacts on aquatic and wetlands ecosystems

No action

The no action alternative would result in additional, unestimated impacts at the Old and New Rifle sites; wind and water erosion would continue to contaminate adjacent areas.

Interim actions would impact one acre of saltgrass wetlands at the New Rifle site and 0.6 acre of cattail and shrubs wetlands at the Old Rifle site. Those disturbed wetlands areas requiring restoration would be revegetated with plant species identical or similar to those that present exist.

Stabilization at the New Rifle site

Wetlands ecosystems would be directly impacted by the excavation of 20 acres of contaminated materials. The affected wetlands areas are typical of the wetlands areas along the Colorado River. The impact would be short-term in that the area would be restored with clean fill material, graded to promote positive drainage, and revegetated with wetland plant species identical or similar to existing species. The specific details of this revegetation (e.g., revegetation methods and plant species) would be developed during the final engineering design in consultation with the appropriate regulatory agencies. The nearby undisturbed aquatic and wetland ecosystems would not be directly impacted; however, they might be impacted indirectly by increased human

activities, elevated noise levels, and increased fugitive dust emissions. The indirect impacts would be short-term, lasting for the duration of the remedial action.

Disposal at the Estes Gulch site

The impacts of this alternative on the aquatic and wetlands ecosystems would be the same as for stabilization at the New Rifle site.

Disposal at the Lucas Mesa site

The impacts of this alternative on the aquatic and wetlands ecosystems would be the same as for stabilization at the New Rifle site.

5.6.3 Impacts on threatened, endangered, and sensitive species

No action

The no action alternative would cause no impacts to threatened, endangered, or sensitive species.

Stabilization at the New Rifle site

As noted in Section 4.7.3 and Section G.4 of Appendix G, Biology, the USFWS identified several endangered, threatened, or candidate species that potentially occur at or near the Old and New Rifle sites. The USFWS has issued determinations of "no effect" for the bald eagle, razorback sucker, Uinta Basin hookless cactus, and the black-footed ferret at the Old and New Rifle sites based on biological assessments prepared by the DOE (see Attachment G1 of Appendix G, Biology).

The white-faced ibis, western snowy plover, western yellow-billed cuckoo, and long-billed curlew would not be directly impacted due to the limited amount of wetlands habitat that would be disturbed. This wetlands habitat is fairly typical along the Colorado River; therefore, these species would move to adjacent areas. Indirect impacts on these species from the remedial action activities would be minimal and of short duration.

Disposal at the Estes Gulch site

The USFWS has issued a determination of "no effect" for the bald eagle, Uinta Basin hookless cactus, and black-footed ferret at the Estes Gulch site (see Attachment G1 of Appendix G, Biology).

The potential impacts of remedial action on bird species listed for the Old and New Rifle sites are the same as those described for stabilization at the New Rifle site.

To mitigate adverse impacts on the Wetherill milkvetch (state listed species) found near the proposed access road, populated areas would be avoided.

The DOE has determined that the Estes Gulch alternative will utilize a total of 280,036,000 gallons (860 acre-feet) of Colorado River and Rifle Gap Reservoir water (excluding potable water supplied through the City of Rifle's water treatment and supply system) over the project's nearly four-year lifespan. This water use could result in a net depletion of water from the upper Colorado River basin and may affect the Colorado squawfish, the bonytail chub, and the humpback chub, as well as potentially impacting the razorback sucker. The DOE has requested USFWS concurrence in a "may affect" determination for the listed species and has requested a formal consultation under the Endangered Species Act (See Attachment G1 of Appendix G, Biology). The DOE will comply with all conditions and mitigation measures specified in the USFWS Biological Opinion. However, the Record of Decision cannot be issued until the question of effects on the endangered species have been resolved.

Recently, the DOE agreed to widen and improve portions of State Highway 13 to accommodate increased truck traffic resulting from transport of tailings from the Rifle processing sites to the proposed Estes Gulch disposal site. Widening and improving State Highway 13 is a mitigation measure designed to offset the impacts of tailings transportation. If the Estes Gulch alternative is selected, surveys for sensitive plant species (Uinta Basin hookless cactus, DeBeque milkvetch, and DeBeque phacelia) will be performed prior to the initiation of road improvement activities. Site specific mitigation measures will be developed with the appropriate Federal agency should any endangered species be encountered.

Disposal at the Lucas Mesa site

The potential impacts of remedial action on bird species listed for the Old and New Rifle sites are the same as those described for stabilization at the New Rifle site.

The USFWS issued a determination of "no effect" for the bald eagle and Uinta Basin hookless cactus at the Lucas Mesa site based on a biological assessment prepared by the DOE (see Attachment G1 of Appendix G, Biology).

5.7 IMPACTS ON LAND USE

5.7.1 No action

The no action alternative would have little impact on the desirability of the Old and New Rifle tailings sites for potential adjacent land uses. At present, there is not a demand for residential or industrial property in these areas and should the demand change, there are many such properties already developed and available. Additionally, because both sites are located within the 100-year floodplain of the Colorado, it is unlikely that residential building permits would be approved by Garfield County.

However, without any kind of remedial action, additional areas would become contaminated by windblown tailings materials. Since the prevailing wind direction is to the west, contaminated soils on the bluff above the Old Rifle site may encroach upon residential areas to the west.

5.7.2 Stabilization at the New Rifle site

Stabilization of the tailings and contaminated materials at the New Rifle site would preclude any alternative land use of 172 acres. The final disposal site would consist of the original 142-acre designated tailings site and 30 acres of the 63 acre area contaminated with windblown tailings adjacent to the designated site. The remainder (33 acres) of the off-site contaminated area would be released for any use consistent with existing land use controls. The entire Old Rifle site (22 acres) would be released for any use consistent with existing land use controls along with the 53 acres contaminated by windblown tailings.

The 172 acres of the final disposal site currently have little marketable value. The location of the land parcel within the 100-year floodplain of the Colorado River would most likely preclude approval from Garfield County for most uses. In addition, it is unlikely that future demand for developable sites would exhaust the existing availability of suitable sites.

Property values for the 33 contaminated acres off the site could likely increase but would not exceed adjacent land values. A 1985 market value of between \$800 to \$4000 per acre for adjacent lands would be possible. The land closest to U.S. Highway 6 would have the highest value (Whaley, 1986).

The 22 acre Old Rifle tailings site would be available for other uses. However, the lower portion of the site, which is within the 100-year floodplain, would not likely be approved for development by Garfield County. Property values would increase but would not exceed adjacent property values of \$2000 per acre (Whaley, 1986).

Since the borrow operation at each borrow site is an existing approved land use, there would be no land use impacts associated with the removal of borrow materials.

5.7.3 Disposal at the Estes Gulch site

Disposal of the tailings at the Estes Gulch site would preclude 85 acres from any alternative land use. This would directly affect use of the Government Creek grazing allotment by two permittees. Although this acreage is a small portion of the allotment (approximately one percent), it is the most productive portion and the best suited for range improvements that would further enhance productivity. The loss of 85 acres would translate to a loss of a minimum of nine AUMs per year; potential losses may be higher since this is the most productive portion of the allotment and the noise and activity in the area would impact surrounding as well as on-site uses. The existing oil and gas leases would not be affected by the remedial action since development of the leases could still occur as discussed in Section 5.4.3.

Disposal of the tailings at the Estes Gulch site would allow other land use opportunities at the Old and New Rifle sites. However, currently there is no demand for such sites. The characteristics of most of both sites would appear to preclude developmental interest in either site. In addition, it is unlikely that approval to build within the 100-year floodplain of the Colorado River would be granted by Garfield County.

The use of existing borrow sites would be in accordance with the approved land use plans for these areas.

5.7.4 Disposal at the Lucas Mesa site

Disposal of the tailings at the Lucas Mesa site would preclude any alternative land uses on 97 acres. The site is within the Sunnyside grazing allotment, and withdrawal of 97 acres would affect the five or six permittees who use the allotment. This allotment consists of three pastures which are used on a rotational basis.

The loss of the 200,000 gallon water catchment and downslope watering facilities as well as the construction and use of the access road to the site would preclude use of the entire Lucas Mesa pasture and northern portion of the Horsethief pasture during the term of construction (42 months). Although the period of grazing use for both pastures is brief in duration, the availability of use is essential to use of the entire allotment. A loss of 510 AUMs represents a 50 percent operating loss to the five to six permittees and a projected long-term loss of approximately 17 AUMs. The watering facilities would have to be reconstructed to enable future use of the Lucas Mesa and northern portion of

Horsethief pasture. Development of the three oil and gas leases would still be possible if market demand changed as discussed in Section 5.4.4.

Disposal of the tailings at Lucas Mesa site would result in the same land use impacts at the Old and New Rifle tailings sites and the existing borrow sites as disposal at the Estes Gulch site.

5.8 IMPACTS ON NOISE LEVELS

All of the alternatives would involve the operation of heavy construction and transportation equipment. This section describes the impacts from the operation of this equipment on noise levels in adjacent areas and along the transportation routes to be used for remedial action.

The distribution and impacts of the noise created by interim and remedial action would be different for each alternative depending on the relative locations of noise sources and receptors, the types and numbers of equipment used, wind speed and direction, topography, vegetative cover, deflective surfaces, and air flows. Typical sound levels generated by the types of equipment that would be used are presented in Table 5.10. A noise prediction model (Kessler et al., 1978) was used to estimate the maximum A-weighted equivalent sound level (L_{ea}) emitted by the construction activities at the tailings, alternate disposal, and borrow sites. The noise prediction model is conservative (i.e., the noise levels predicted are probably higher than would be realized) because it assumes a clustering of equipment when, in reality, the equipment would be located over a number of acres. The model does not discretely portray the impacts of loud, single-event sounds nor does it consider the spatial pattern of equipment activities through time at the sites. A detailed discussion of the analysis of the impacts on noise levels is provided in Section C.3.3 of Appendix C, Weather, Air Quality, and Noise, of the draft EIS.

5.8.1 Stabilization at the New Rifle site/interim actions

All of the alternatives would involve construction activities at the Old and New Rifle sites. The maximum potential equivalent sound levels at the Old and New Rifle sites for stabilization at the New Rifle site would be approximately 99 dBA at a location 100 feet from the center of activity. This would result in maximum outdoor noise levels of approximately 83 and 82 dBA at the closest residential areas northeast and northwest of the Old Rifle site, respectively. The maximum outdoor noise level at the closest residential area northeast of the New Rifle site would be approximately 76 dBA. These potential noise levels would occur only during daytime hours for the duration of the remedial action and would represent a conservative situation for maximum equipment utilization; average daytime noise levels through the duration of the remedial action would be up to three dBA less.

Table 5.10 Sound levels for equipment used

Type of equipment	Maximum sound level at 50 feet (dBA)
D-8 bulldozer	88
Front-end loader	85
Scraper	87
Water truck	89
Haul truck	86
Compactor	87
Grader	83

Ref. Kessler et al., 1978.

Tailings disposal at either the Estes Gulch or Lucas Mesa site would result in noise levels approximately two to three dBA higher at the New Rifle site, while noise levels at the Old Rifle site would be the same as for stabilization at the New Rifle site. The higher noise levels at the New Rifle site would be due to the greater amount of construction equipment being used at the site. For any of the alternatives, daytime noise levels for residents near the Old and New Rifle sites would be elevated over 20 dBA above existing noise levels.

The DOE would abide by all applicable noise abatement permits. Mufflers would function and be maintained, and tailgates on haul trucks would be secured. Access roads constructed by the DOE would be maintained.

5.8.2 Alternate disposal sites

For the relocation alternatives, the noise levels at the Estes Gulch or Lucas Mesa site would not be as great as those at the New Rifle site. Noise levels, at 100 feet from the centers of activity, were calculated to be 102 dBA for the New Rifle site and 97 dBA for the Estes Gulch and Lucas Mesa sites. This would result from the greater amount of construction equipment being used at the New Rifle site than at the alternate disposal sites. Noise levels from the alternate disposal sites would probably be in the 54- to 57-dBA range at the nearest residences even under the most unfavorable conditions. As for stabilization at the New Rifle site, the noise impacts would occur only during daytime hours for the duration of the remedial action. Daytime noise levels for the residences closest to the alternate disposal sites would be elevated approximately 20 dBA above existing noise levels for the relocation alternatives.

5.8.3 Borrow sites

For all of the alternatives, the maximum equivalent noise levels associated with equipment activities at the Second Street, New Rifle, and Glenwood Springs borrow sites would range from approximately 82 to 92 dBA 100 feet from the centers of activity. The resulting estimated daytime noise levels at the nearest residences are presented in Table 5.11. Daytime noise levels at the residences near the Second Street, New Rifle, and Glenwood Springs borrow sites would be elevated approximately 30, 10, and 20 dBA above existing noise levels, respectively, due to the increased equipment activities at the sites.

5.8.4 Transportation routes

All of the alternatives would involve moderate to substantial truck traffic on public highways and roads. A haul truck can be expected to produce noise levels of approximately 79 dBA at a distance of 100 feet from the source and up to 73 dBA at 200 feet from the source (Kessler et al., 1978). Maximum noise levels 100 feet from the transportation route segments receiving peak remedial action traffic were calculated to be 80 dBA for all of the action alternatives. Daytime noise levels along the transportation routes would therefore be elevated approximately 10 to 30 dBA above existing noise levels; the duration of these elevated noise levels would range from two months for stabilization at the New Rifle site to 17 months for the relocation alternatives. For stabilization at the New Rifle site, high levels of truck traffic on U.S. Highway 6 may cause annoyance to some residential areas. For the Estes Gulch alternative, State Highway 13 north and west of Rifle would experience substantial traffic. The Lucas Mesa alternative would involve high levels of truck traffic along U.S. Highway 6 west of Rifle.

5.9 IMPACTS ON SCENIC AND CULTURAL RESOURCES

Impacts to scenic and cultural (i.e., archaeological and historical) resources are discussed below.

5.9.1 Scenic resources

No action

Performance of the interim actions at the Old and New Rifle sites would cause short-term impacts at both sites while the mill structures are demolished and other construction activities take place. These activities would generate traffic and dust. With the removal of the mill structures and grading of the sites, both sites would blend more readily with the surrounding terrain.

Table 5.11 Estimated noise levels from equipment activities at borrow sites

Alternative	Second Street borrow site (dBA)	New Rifle borrow site (dBA)	Glenwood Springs borrow site (dBA)
Interim action/ Stabilization at the New Rifle site	82	60	60
Disposal at the Estes Gulch site	74	52	50
Disposal at the Lucas Mesa site	74	52	53

Stabilization at the New Rifle site

Stabilization of the tailings and contaminated materials at the New Rifle site would cause short-term visual impacts at the Old Rifle site while the tailings are being relocated because the construction activities would generate traffic and dust. After remedial action, the Old Rifle site would be restored with clean fill material and would blend in well with the color and form of the surrounding terrain.

At the New Rifle site, both short- and long-term visual impacts would occur. The increased traffic and dust associated with the remedial action activities would be an annoyance to nearby residents. The stabilized tailings pile would have an average height of 47 feet, which is lower than the existing pile; however, the stabilized pile could still be a visual annoyance to the community and travelers along I-70 and the D&RGW Railroad. Viewed from the surrounding mesas, the stabilized tailings pile would blend in with the surrounding terrain.

Disposal at the Estes Gulch site

At the Old and New Rifle sites, traffic and dust generated by the remedial action activities associated with the relocation of the tailings would cause short-term visual impacts. Upon completion of the remedial action, the Old and New Rifle sites would be restored with clean fill material and would blend in with the surrounding terrain.

Disposal of the tailings at the Estes Gulch site would result in both short- and long-term visual impacts. Short-term impacts would be associated with the traffic and dust generated by the construction activities. Long-term impacts, due to the presence of the stabilized tailings pile, would be minimal due to the remote location of the site. The height of the stabilized pile would be flush with the adjacent land surface and it would blend in well with the color and form of the surrounding terrain. The stabilized pile would not be visible from State Highway 13.

Disposal at the Lucas Mesa site

Disposal of the tailings at the Lucas Mesa site would cause short-term impacts at both the Old and New Rifle sites. These impacts would be caused by traffic and dust from the remedial action activities. Once remedial action was complete, both Rifle sites would be restored with clean fill material, blending in well with the surrounding terrain.

Disposal of the tailings at the Lucas Mesa site would result in both short- and long-term visual impacts. Short-term impacts would be associated with the traffic and dust generated by the construction activities. Long-term impacts, due to the presence of the stabilized tailings pile, would be minimal due to the remote location of the site. Although the height of the stabilized pile would average 36 feet above the land surface, the pile would blend in well with the color and form of the surrounding terrain. The stabilized pile would not be visible from any of the highways in the area.

Borrow sites

All of the borrow sites are existing, commercial borrow sites. Therefore, borrow site operations would not be expected to cause any additional visual impacts.

5.9.2 Archaeological resources

No action

No archaeological resources would be impacted at the Old and New Rifle sites by the interim actions and remedial action as there have been no archaeological resources identified at either site.

Stabilization at the New Rifle site

No archaeological resources would be impacted by stabilization of the tailings at the New Rifle site as there have been no

archaeological resources identified at either the Old or New Rifle site (GRI, 1985).

Disposal at the Estes Gulch site

No eligible (NRHP) archaeological resources would be impacted by disposal of the tailings at the Estes Gulch site (CASA, 1986).

Recently, the DOE agreed to widen and improve portions of State Highway 13 to accommodate increased truck traffic resulting from transport of tailings from the Rifle processing sites to the Estes Gulch disposal site. Widening and improving State Highway 13 is a mitigation measure designed to offset the impacts of tailings transportation. Preliminary results of a cultural resources survey performed during the Spring 1989 indicated that no eligible cultural resources are present (Hammack, 1989). If subsurface cultural resources are discovered during construction, a data recovery plan would be designed and implemented with the Colorado SHPO and the BLM as appropriate. It is expected that due to previous surface disturbance, no cultural resources will be discovered.

Disposal at the Lucas Mesa site

Disposal of the tailings at the Lucas Mesa site would not impact any eligible (NRHP) archaeological sites (GRI, 1985; Wildesen, 1985).

Borrow sites

All of the borrow sites have been previously disturbed and are not expected to yield archaeological resources. Prior to any surface disturbances, Class III surveys of the sites would be conducted and data collection programs implemented, as required.

5.9.3 Historic resources

No known historic resources exist at the Old and New Rifle, Estes Gulch, Lucas Mesa, or borrow sites (CASA, 1986; GRI, 1985).

5.10 IMPACTS ON POPULATION AND WORK FORCE

The impacts of remedial action on population and employment in the Rifle area were analyzed by estimating the population and employment increases that would be created by the alternatives. For estimating the population and employment increases, it was assumed that 17 to 19 personnel for field services and general supervision (e.g., health physics

personnel) would relocate to Rifle due to the specialized skill requirements for each action alternative. The remainder of the remedial action work force should be available in the Rifle area due to the present high unemployment in the construction trades. For the estimated population increases, it was also assumed that 60 percent of the in-migrant remedial action personnel would relocate with families (Mountain West Research, Inc., 1979) and that the size of the average in-migrant family would be the same as that of the average Colorado family, or 3.19 persons (Picasso, 1986). Local non-labor remedial action expenditures (e.g., purchases of borrow materials, fencing, and fuel) would generate local indirect employment as the monies are respent and circulated throughout the economy; additional local employment would be "induced" as remedial action wages and salaries circulated throughout the local economy. For the estimated employment increases, indirect and induced employment multipliers of 0.17 and 0.53 were used, respectively (Westcock, 1986). In this analysis, the indirect and induced employment related to the interim actions or remedial action may be over-estimated because existing employment may not be fully utilized due to depressed conditions in the Rifle area.

It should be noted that remedial action at the Grand Junction uranium mill tailings site would probably be performed concurrently with the interim actions or remedial action at the Rifle sites. Due to the widespread unemployment throughout western Colorado, the remedial action employment needs at Grand Junction would probably not affect the availability of construction personnel in the Rifle area. It is likely that some additional workers may move into the area once information about the activities at Grand Junction and Rifle becomes known among unemployed construction workers in adjacent counties. These workers would not likely remain in the area once employment needs were met, due to the lack of other local employment.

There is the possibility of renewed oil shale activity in the Rifle area, and such a renewal could increase employment in the construction trades (Treese, 1986). If the oil shale activity were to occur concurrently with remedial action at the Grand Junction and Rifle sites, the availability of construction personnel in the Rifle area could be affected. However, due to the unlikely occurrence of any renewed oil shale activity during the period of Interim or remedial action, an analysis of the impacts of concurrent employment requirements was not made.

Table 5.12 presents the estimated increases in population and employment resulting from interim or remedial action. It should be noted that these estimates are based on continuous interim or remedial action schedules of 12 months for interim actions at the Old and New Rifle sites, 20 months for stabilization at the New Rifle site, 42 months for the Estes Gulch and Lucas Mesa relocation alternatives, and 12 months for the no action alternatives. In actuality, remedial action would probably cease during the three winter months of December, January, and February due to inclement weather.

Table 5.12 Estimated population and employment increases

Alternative	Direct employment (number of workers)		In-migrant workers	In-migrant worker families ^a		Total in-migrants	Indirect employment ^b (number of jobs)		Induced employment ^b (number of jobs)		Total employment (number of jobs)	
	Average	Peak		Spouses	Children		Average	Peak	Average	Peak	Average	Peak
No action (interim actions at the Old and New Rifle sites)	40	69	17	10	12	39	7	12	21	37	86	118
Stabilization at the New Rifle site	95	210	17	10	12	39	16	36	50	111	161	357
Disposal at the Estes Gulch site	104	139	19	11	13	43	18	24	55	74	177	237
Disposal at the Lucas Mesa site	120	161	19	11	13	43	20	27	64	85	204	273

^aEstimates are based on 60 percent of in-migrant workers bringing families (Mountain West Research, Inc., 1979) and an average family size of 3.19 persons (Picaso, 1986).

^bEstimates are based on indirect and induced employment multipliers of 0.17 and 0.53, respectively (Westcock, 1986).

5.10.1 No action

The 12 months of interim actions would require an average of 40 interim action workers and would peak at 69 interim action workers during one month. There would be an estimated population increase of 39 workers, spouses, and children related to the interim action. This increase would be less than one percent of the Rifle city population. As shown on Table 5.13, an average of 68 new jobs are estimated to be attributed to the interim action activities and associated indirect and induced employment. Based on a 1985 Garfield County available work force of 14,782 and an eight percent unemployment level (1985), interim action related employment would decrease countywide unemployment by 0.4 percent (Larsan, 1986).

5.10.2 Stabilization at the New Rifle site

Stabilization at the New Rifle site would require an average work force of 95 remedial action workers for a 20-month period and a peak work force of 210 remedial action workers for two months. The total population increase due to remedial action would be 39 people. Based on 1985 population estimates (Section 4.12.1), this would represent less than a one percent increase in the population of Garfield County and approximately a one percent increase in the population of Rifle. Total employment related to remedial action, including indirect and induced employment, is estimated to be an average of 161 jobs and a peak of 357 jobs. This would result in a decrease of one percent in the Garfield County unemployment rate, based on 1985 employment data (Larsan, 1986).

5.10.3 Disposal at the Estes Gulch site

Disposal at the Estes Gulch site would require an average work force of 104 remedial action workers for a 42-month period and a peak work force of 139 remedial action workers for 17 months. The total population increase due to remedial action would be 43 people. Based on 1985 population estimates, this would represent less than a one percent increase in the population of Garfield County and approximately a one percent increase in the population of Rifle. Total employment related to remedial action, including indirect and induced employment, is estimated to be an average of 177 jobs and a peak of 237 jobs. This would result in a decrease in the Garfield County unemployment rate of one percent, based on 1985 Garfield County employment data.

5.10.4 Disposal at the Lucas Mesa site

Disposal at the Lucas Mesa site would require an average work force of 120 remedial action workers over a 42-month period and a peak work force of 161 remedial action workers for 16 months. The total population increase of 43 would be the same as for the Estes Gulch relocation alternative. Total employment related to remedial action, including indirect and induced employment, is estimated to be an average of 204 jobs and a peak of 273 jobs. This would result in an average decrease of one percent in the Garfield County unemployment rate, based on 1985 Garfield County data.

5.11 IMPACTS ON HOUSING, SOCIAL STRUCTURE, AND COMMUNITY SERVICES

This section describes the impacts of each alternative on housing, the social structure, and community services in the Rifle area. The impacts presented here are based on the population increases estimated for each alternative in Section 5.10 and the existing availabilities of housing and community services described in Sections 4.12.4 and 4.12.6.

5.11.1 Housing

Each alternative would create an estimated population increase of 39 to 43 people. The 1986 housing survey for the city of Rifle indicated that 286 residential units were available for occupancy at that time. It is unlikely that the projected natural population increase in combination with in-migrants related to each of the alternatives would exhaust available housing. Based on a two percent per year natural population increase, approximately 71 residential housing units would no longer be available in 1988, leaving a supply of 215 housing units for workers.

5.11.2 Social structure

No studies have been done on the characteristics of the social structures in Rifle and Garfield County. However, it is unlikely that the small, estimated increases in population due to interim or remedial action would have any impacts on existing social structures.

5.11.3 Community services

Education

The estimated increases of between 12 to 13 school-age children (Table 5.12) would have negligible effects on any of the three school districts in the area even if all of the

children were of primary or secondary school age. Existing school enrollments, student-to-teacher ratios, and projected school capacities indicate the abilities of all school districts in the area to absorb the estimated increases in school-age children. The school district revenues would be little affected by increased revenues related to interim or remedial action since the most significant school revenue source is the property tax. After interim or remedial action, the Rifle sites would have higher assessed values but this could have an insignificant effect on mill levy revenues that are allocated to school districts.

Hospitals and health services

Medical and social services in the area would be adequate to meet the needs of the estimated population increases or emergency needs arising related to interim or remedial action. Both area hospitals, Valley View and Clagett Memorial Hospitals, were operating below 50 percent of their capacities in 1985.

Water supplies and wastewater treatment

The water and sewage treatment plants in Rifle are not currently used at full capacities and could easily accommodate daily needs for the estimated interim or remedial action population increases. Rifle's 1986 water usage was approximately 67 percent of the treatment plant's capacity during peak use periods; average daily usage was 50 percent of the treatment plant capacity. Water could be provided to an additional 1650 residents before the plant would need modification. The sewage treatment plant operated at 50 percent capacity in 1986; an additional 500,000 gallons of sewage could be treated on a daily basis.

Daily interim or remedial action needs for potable water would be primarily for shower and laundry facilities. For example, a peak work force of 210 remedial action workers (for the New Rifle disposal alternative), in combination with in-migrant daily personal needs and natural population growth, would not exceed either the water or sewage treatment plants' capacities.

Police and fire protection

An increase of between 39 to 43 people for between 12 to 42 months in the Rifle area would not impact the ability of the Rifle Police Department, the Garfield County Sheriff's Department, or the Rifle Fire Protection District to continue to provide adequate protection for area residents. For incidents occurring at the Lucas Mesa site, the Mesa County Sheriff's

Department would be available to answer calls of an emergency nature (DOE, 1986).

5.12 IMPACTS ON ECONOMIC STRUCTURES

Salaries and wages, supplies, materials, and other miscellaneous costs would be associated with each alternative. The following estimated earnings are based on earnings multipliers believed to be representative of Garfield County. An indirect earnings multiplier of 0.12 and an induced earnings multiplier of 0.51 were used in the following estimations (Westcock, 1986).

State and local sales taxes would not be affected by purchases of supplies and materials associated with the interim or remedial action since Federal projects are exempt from such taxes. Salaries and wages would be subject to state and Federal income taxes; the impact of these taxes is described for each alternative. The reader should note that all calculations in this section are based on estimated costs. It is believed that projecting annual changes to the Garfield County economy would not be realistic because the interim or remedial action schedule is not final and weather conditions each year could require variable down times (an average of three months per year) at the sites. The majority of the direct interim or remedial action wages would positively impact the mining and construction industry sectors because the primary interim or remedial action activities are the excavation and transportation of tailings and borrow materials.

5.12.1 No action

Interim action activities would cost an estimated \$5.7 million. An estimated \$1.9 million would be spent locally on salaries and wages, which would further generate indirect and induced monies of \$1.2 million for a total personal income of \$3.1 million. In addition to salaries and wages, it is estimated that \$3.3 million would be spent within Colorado, but probably outside of Garfield County, for supplies, materials, and miscellaneous costs such as bond monies.

State income tax receipts would increase over the 12-month interim activity period as a result of salary and wage payments to interim action workers and indirect and induced increases in labor income. The average annual state income tax rate for incomes between \$25,000 and \$35,000 was estimated at 2.96 percent in 1985 (Dunn, 1986). Applying this rate to the estimated \$3.1 million increase in labor income resulting from interim action activities, an increase of approximately \$91,800 in state income tax receipts would be expected over the 12-month period of activities. However, counties only benefit indirectly from state income tax monies because the majority of state income tax revenues are used for state operational expenditures. Federal income tax receipts would be similarly affected. However, the

benefits to county or state revenues from Federal income tax receipts is so indirect that the monies were not calculated. Smaller, additional increases in state and Federal income tax receipts would be expected as a result of income generated from non-labor purchases outside of Garfield County.

After interim action activities are completed, there would be a continued annual loss of \$2,500 in projected property tax revenues for both the Old and New Rifle tailings sites.

5.12.2 Stabilization at the New Rifle site

This alternative would cost an estimated \$15.5 million. An estimated \$5.2 million would be paid in direct remedial action salaries and wages; indirect and induced earnings would total approximately \$3.3 million. The total personal income attributed to this alternative would be approximately \$8.5 million over the 20 months of remedial action.

In addition to salaries and wages, and indirect and induced monies, \$8.7 million would be spent for supplies, materials and miscellaneous costs within Colorado, but outside of Garfield County. Total expenditures within Colorado are estimated at \$17.2 million.

Based on the 1977 tax year, the Old Rifle site had an assessed value of \$13,690 and approximately \$1000 were paid in 1985 property taxes. After remedial action, the value of the Old Rifle site would almost approach the value of adjacent lands, and property taxes would be assessed at approximately \$2000 if the property is sold by the state of Colorado. If the state retains ownership, no taxes would be assessed.

The New Rifle site had an assessed valuation of approximately \$20,600 in 1977, and an estimated \$1500 were paid in 1985 property taxes. After remedial action, the county would no longer receive property tax monies for the designated site area because it would remain the property of the DOE and would not be subject to tax collection. The remaining portion of the site would be owned by the state of Colorado and also would not be subject to tax assessment.

Total state income tax receipts would increase as a result of the salaries and wages earned by remedial action workers and indirect and induced increases in local labor income. The average annual state income tax rate for incomes between \$25,000 and \$35,000 was approximately 2.96 percent in 1985 (Dunn, 1986). Applying this rate to the estimated \$8.5 million increase in labor income due to remedial action, an increase of approximately \$251,600 in state income tax receipts would be expected over the 20 months of remedial action. The majority of state income tax revenues are used for state operational expenditures

and only return to counties indirectly to benefit county programs. Federal income tax receipts would be similarly affected. However, the benefits to county or state revenues from Federal income tax receipts is so indirect that these monies were not calculated. Smaller, additional increases in state and Federal income tax receipts would be expected as a result of income generated from non-labor purchases outside of Garfield County for remedial action.

5.12.3 Disposal at the Estes Gulch Site

This alternative would cost an estimated \$28.9 million. An estimated \$8.5 million would be paid in direct remedial action salaries and wages; indirect and induced earnings would total approximately \$5.4 million. The total personal income attributed to this alternative would be approximately \$13.9 million over the 42 months of remedial action.

In addition to salaries and wages, and indirect and induced monies, \$17.5 million would be spent for supplies, materials and miscellaneous costs within Colorado, but outside of Garfield County. Total expenditures in Colorado are estimated at \$31.4 million.

State income tax receipts would increase by approximately \$411,400 as a result of state income tax rates applied to salaries and wages earned by remedial action workers and indirect and induced increases in local labor income. Federal income tax receipts would also increase but would have little effect on local revenues. Smaller additional increases in state and Federal income tax receipts would be expected as a result of income generated from non-labor purchases outside of Garfield County for remedial action.

The release of the Old and New Rifle sites could increase annual property tax revenues paid to Garfield County by approximately \$2515 based on the 1977 valuations. Property values would likely approach adjacent land market values of \$2000 to \$4000 per acre (Whaley, 1986). These revenues would occur only if the sites are sold by the state of Colorado after completion of the remedial action.

Since the Estes Gulch site is on land administered by the BLM and would be withdrawn from all future uses, the BLM would be impacted through losses in revenues associated with the current grazing use.

5.12.4 Disposal at the Lucas Mesa site

Remedial action activities at the Lucas Mesa site are estimated to cost \$62.7 million. An estimated \$20.9 million would be paid in direct remedial action salaries and wages;

indirect and induced earnings would result in approximately \$13.2 million. The total personal income attributed to this alternative is estimated at \$34 million over the 42 months of remedial action.

In addition to salaries and wages, and induced and indirect monies, \$35.5 million would be spent for supplies, materials and miscellaneous costs within Colorado, but outside of Garfield County. For this alternative, it is likely that some of this money would be spent within Mesa County. Total expenditures in Colorado are estimated at \$69.6 million.

State income tax receipts would increase by approximately \$1 million as a result of state income taxes on salaries and wages earned by remedial action workers and indirect and induced increases in local labor income. Federal income tax receipts would also increase but would have little impact on local revenues. Smaller additional increases in state and Federal income tax receipts would be expected as a result of income generated from non-labor purchases for remedial action outside of Garfield County.

The release of the Old and New Rifle sites would increase annual property tax revenues paid to Garfield County by approximately \$2515 based on the 1977 valuations. Property values would likely approach adjacent land market values of \$2000 to \$4000 per acre (Whaley, 1986).

Since the Lucas Mesa site is on land administered by the BLM and would be withdrawn from all future uses, the BLM would be impacted by the loss in revenues associated with the current use of the Sunnyside grazing allotment.

5.13 IMPACTS ON TRANSPORTATION NETWORKS

The impacts on local highways from the interim and remedial action-related activities would include large increases in truck and automobile traffic, and the resulting degradation of pavement surfaces. To identify these impacts, the traffic volumes associated with each alternative were estimated and then combined when activities overlapped to determine a maximum, average, and minimum increase in traffic on area highways. The following assumptions were used in the analysis of each alternative:

- o Use of 18-cy capacity trucks (10-cy capacity truck with an eight-cy capacity pup.)
- o There would be a variable number of daily miscellaneous trips between the borrow sites and the Old and New Rifle sites.
- o There would be daily commute trips by all workers to the various work locations.

- o The tailings and other contaminated materials at the Old Rifle site would be transported west on U.S. Highway 6 to the New Rifle site.
- o Restoration materials for the New Rifle site would be trucked west on Second Street for approximately 0.5 mile, then south on an unnamed access road, across U.S. Highway 6, to the vicinity of the New Rifle site. These trucks would not use U.S. Highway 6.
- o Restoration materials for the Old Rifle site would be transported on Second Street to Railroad Avenue in Rifle, then south to the junction with U.S. Highway 6 and east on U.S. Highway 6 to the Old Rifle site.
- o All radon barrier and frost protection materials used for the stabilization at the New Rifle site alternative would be trucked to the site on an existing, private road and would not impact public highways.

The increases in local highway use are summarized in Table 5.13. It should be noted that these are estimates and would change with contractor schedule equipment modifications. For example, the use of larger or smaller capacity trucks, or change in schedule would significantly change these estimates.

State highway maintenance is funded through the state, and individual projects are not directly responsible for highway maintenance. Indirectly, projects contribute to state road maintenance funding through payment of fuel taxes and user fees such as driver license fees or vehicle registrations. Interstate road maintenance is based on Federal funding; again, individual projects are not assessed special fees for road maintenance even though their use may contribute to early maintenance and repair needs.

5.13.1 No action

Interim action activities would occur on the Old and New Rifle sites and would not impact the public use of area roads. Daily worker commute trips and miscellaneous off-site contractor trips would have a negligible effect on existing highway use and capacity, and therefore are not considered further.

5.13.2 Stabilization at the New Rifle site

The first four months of the 20-month remedial action would consist of mobilization work at the tailings sites and would not require extensive highway travel. Since averages would be unfairly weighted by this period of light highway use, remedial action trips during the first four months were dropped from further consideration.

Table 5.13 Estimated increases in average daily traffic

Alternative	Highway location	1984 average daily traffic ^a (vehicles per day)	Remedial action daily traffic ^b (vehicles per day)		
			Minimum	Average	Maximum
Stabilization at the New Rifle site	U.S. Highway 6 between the western Rifle interchange (at I-70) and Rifle	2350 ^c	468	528	758
	U.S. Highway 6-Railroad Avenue intersection	4300	248	572	1088
	I-70 at the western Glenwood Springs interchange	8850	320	320	320
Disposal at the Estes Gulch site	North end of the Rifle Bypass (State Highway 13)	1550 ^d	67	801	1051
	State Highway 13-State Highway 325 junction	2700	67	801	1051
	I-70 at the western Glenwood Springs interchange	8850	9	9	9
Disposal at the Lucas Mesa site	I-70 at the DeBeque interchange	5550	992	1066	1076

^aRef. Tenney, 1986.

^bRemedial action traffic includes truck transportation of tailings and borrow materials, miscellaneous trips between the sites, and, where applicable, remedial action worker commutes.

^cThese values were assumed to be representative of the traffic on U.S. Highway 6 at the New Rifle site.

^dThese values are for 1985.

As shown in Table 5.13, there would be significant increases in traffic on U.S. Highway 6 between the New Rifle site and the junction with Railroad Avenue due to remedial action activities. The two critical road segments include: 1) the junction of U.S. Highway 6 and Railroad Avenue through which the tailings materials from the Old Rifle site, and the erosion protection and restoration materials destined for the Old Rifle site would pass; and 2) the segment of U.S. Highway 6 between the New Rifle site and the Railroad Avenue intersection. There would be maximum increases of between 25 and 32 percent, respectively, over a two-month period. Average increases would be between 13 percent at the Railroad Avenue and U.S. Highway 6 junction, and 22 percent on U.S. Highway 6 between the New Rifle site and the junction with Railroad Avenue.

There would be an estimated daily 1088 remedial action-related vehicles passing through the Railroad Avenue - U.S. Highway 6 junction over the two month worst case situation. Approximately 30 percent of these (320 trucks) would be carrying rock from the Glenwood Springs borrow site; 38 percent (408 trucks) would be coming to or from the Old Rifle site for tailings materials; and 17 percent (180 trucks) would be bringing restoration materials to the Old Rifle site or returning to the Second Street borrow site. Because this is the main intersection in Rifle, and has a traffic regulator light, it is likely that traffic would back up on the I-70 bridge as well as on U.S. Highway 6 and Railroad Avenue. Daily train traffic (as stated in Section 4.12.6) of 22 freight and passenger trains would additionally disrupt traffic flow.

The public use of U.S. Highway 6 at the turnoff to the New Rifle site would also be severely disrupted by remedial action traffic. During the same worst case period of time addressed above, 758 trucks or other vehicles would daily be turning onto the New Rifle site. There would be additional disruptions caused by the 22 daily freight and passenger trains using the Denver and Rio Grande Railroad tracks, as discussed in Section 4.12.7.

The increased truck traffic on U.S. Highway 6 would be expected to degrade the quality of the roadbed. According to the Colorado Department of Highways, it is likely that U.S. Highway 6 in the vicinity of the New Rifle tailings site would need improvement before it could sustain the projected remedial action traffic (Spanicek, 1986).

5.13.3 Disposal at the Estes Gulch site

It was assumed that the New Rifle tailings, other contaminated materials, and the erosion protection materials would be transported to the Estes Gulch site on the Rifle bypass and State Highway 13, and that the radon barrier and frost protection

materials would be obtained from on-site excavation. Maximum impacts on area highways were determined to occur on State Highway 13, north of the junction with Rifle Bypass. Remedial action activities would result in a maximum daily increase in traffic of 68 percent (see Table 5.13). This increase would occur over a 17-month period of time when all tailings, other contaminated materials, and all erosion protection materials would be transported to the Estes Gulch site.

However, to mitigate transportation impacts to State Highway 13, improvements have been proposed. These improvements include construction of a paved 12-foot-wide, 7500-foot-long climbing lane on the east side of State Highway 13 between Highway 325 and the Estes Gulch site turnoff; an 800-foot-long, 12-foot-wide gravel surfaced truck turnout, and an intersection facility on State Highway 13 at the Estes Gulch turnoff.

To determine an average increase in traffic due to the remedial action, only those phases that would affect use of State Highway 13 were considered. It was determined that daily use would increase 52 percent over 37 months when tailings and other contaminated materials would be transported to Estes Gulch. This average includes a nine-month period when only 67 additional remedial action vehicles per day would travel to Estes Gulch, transporting rock borrow materials from the Glenwood Springs borrow site.

5.13.4 Disposal at the Lucas Mesa site

It is anticipated that the major impact of remedial action traffic would be on Interstate 70 between Rifle and the Lucas Mesa disposal site. A maximum of 1076 daily remedial action-related vehicles would use the interstate, resulting in a 19 percent increase in traffic (see Table 5.13). Other highways would not be significantly affected since activities would be dispersed over several roadways. For example, it is anticipated that restoration material truck traffic would use Second Street to access the New Rifle site and return on U.S. Highway 6 or Second Street to the borrow site. It is also likely that tailings trucks from the Old Rifle site would egress I-70 just before the Railroad Avenue - U.S. Highway 6 junction on Whiteriver Avenue.

5.14 USE OF ENERGY AND OTHER RESOURCES

All of the alternatives would require the use of fuel, electricity, water, construction materials, manpower, and financial resources. Fuel would be used to operate construction equipment and haul trucks. Electricity would be used for lighting and the operation of small construction equipment. Water would be used for compaction, dust suppression, washing equipment, and personal hygiene. The no action alternative would require the continued irrigation of the vegetation on the New

Rifle tailings pile as stipulated by the CDH permit. Construction materials would primarily be various types of earthen and rock borrow materials for the construction of access roads and radon, frost protection, and erosion protection barriers. Work force and financial resources would be required for all aspects of the remedial action. Table 5.14 lists the estimated resource requirements for each alternative.

5.15 IMPACTS FROM ACCIDENTS NOT INVOLVING RADIATION

The alternatives would involve varying numbers of haul truck trips as tailings and borrow materials were transported to and from the tailings, final disposal, and borrow sites. Additional traffic would result from remedial action workers commuting to the sites and from daily miscellaneous trips related to interim or remedial action needs. The traffic associated with the interim or remedial action would pose the risk of accidents and resulting injuries and fatalities.

For the purpose of this analysis, it was assumed that all workers would live in Rifle and commute to the Old or New Rifle tailings site, or disposal site, for each action alternative. It was estimated that the average, one-way commuting distances to the Old and New Rifle sites would be one and 2.5 miles, respectively, 7.8 miles to the Estes Gulch site, and 34 mile to the Lucas Mesa site. It was also assumed that all construction equipment would remain at the sites and that the haul trucks would return to either the Old or New Rifle site at the end of each work day. The total off-site haul truck mileage for each action alternative was estimated conservatively.

In addition to injury and fatal accidents related to interim or remedial action traffic, accidents associated with the operation of construction equipment and materials handling activities could occur with the action alternatives. These hazards would be similar to those encountered in any large earthmoving project such as surface mining or heavy construction. Based on 1981 accident data for the mining and construction industries, approximately 0.0422 injury accident and 0.00045 fatal accident would occur per person-year of labor (DOC, 1983).

Any alternative would involve crossings of the D&RGW railroad tracks at the New Rifle site by haul trucks and other miscellaneous vehicles. Given the frequency of train traffic at this crossing (Section 4.12.7), there would be the possibility of accidents (i.e., collisions) involving trains and vehicular traffic. However, no assessment of such accidents can be made because no accident rates are available.

Table 5.15 presents the estimated injury and fatal accidents for each alternative. The estimated traffic accidents are based on the total off-site vehicle-miles associated with the alternatives and the local and national accident rates presented in Section 4.12.7. The estimated equipment-use accidents are based on the total person-years of labor associated with the alternatives and the accident rates associated with the mining and construction industries as presented above.

Table 5.14 Estimated resource requirements

Interim/remedial action alternative	Resource					
	Fuel (gallons)	Electricity (kilowatt-hours)	Water (gallons)	Construction materials (cubic yards)	Manpower (man-months)	Financial resources ^a (1986 dollars)
No action (interim actions only)	198,000	145,000	1,241,000	50,319	480	5,710,000
Stabilization at the New Rifle site	1,439,000	241,000	127,466,000	1,700,500	1788	15,460,000
Disposal at the Estes Gulch site	5,045,000	1,041,000	284,262,000	2,130,700	4114	28,921,000
Disposal at the Lucas Mesa site	6,077,000	1,041,000	337,886,000	2,509,400	4762	62,735,000

^aEstimates are based on a four-year period. The remedial action costs do not include the interim action costs.

Table 5.15 Estimated nonradiological accident impacts

Alternative	Total off-site vehicle miles traveled	Total person-years of labor	Traffic accidents		Equipment-use accidents		Total injuries	Total fatalities
			Injuries	Fatalities	Injuries	Fatalities		
No action	27,360	40	0.02	NA	1.68	0.02	1.70	0.02
Stabilization at the New Rifle site ^a	1,120,590	159	0.87	0.04	6.71	0.07	7.58	0.11
Disposal at the Estes Gulch site ^a	4,924,602	363	3.84	0.19	15.32	0.16	19.16	0.35
Disposal at the Lucas Mesa site ^b	17,290,575	419	6.40	0.32	17.68	0.19	24.08	0.51

NA too low to provide

^aInjury and accident rates are based on rates calculated for US Highway 6.

^bInjury and accident rates are based on rates for Interstate 70.

No action

The no action alternative would involve interim action activities on the site. However, a total of 27,360 miles were calculated for worker commutes and miscellaneous contractor trips. An estimated 1.70 injuries and 0.02 fatality may occur during the interim action phase.

Stabilization at the New Rifle site

Stabilization at the New Rifle site would involve approximately 1,120,590 off-site vehicle-miles and 159 person-years of labor. The total accidents for this alternative are estimated to be 7.58 injuries accidents and 0.11 fatality.

Disposal at the Estes Gulch site

Disposal at the Estes Gulch site would involve approximately 4,924,602 off-site vehicle-miles and 363 person-years of labor. The total accidents for this alternative are estimated to be 19.16 injuries and 0.35 fatality.

Disposal at the Lucas Mesa site

Disposal at the Lucas Mesa site would involve approximately 17,290,575 off-site vehicle-miles and 397 person-years of labor. It is estimated that this alternative would result in 24.08 injuries and 0.51 fatality.

5.16 RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

5.16.1 No action

The no action alternative would result in the permanent exclusion of approximately 164 acres from any alternative land use. The Old and New Rifle sites are outside the Rifle city limits, and, therefore, are subject to Garfield County's land-use plans, policies, and controls. The areas containing the sites are zoned agricultural-industrial (Bean, 1986), and the no action alternative would preclude the acreage covered by the sites from being developed according to Garfield County land-use policies. If no action were taken, the areas contaminated by windblown and waterborne tailings would continue to increase in size, and any restrictions on future development would depend on actions taken by Federal, state, and local governing bodies and agencies. Any such restrictions would prevent existing land use plans, policies, and controls from being fully implemented.

5.16.2 Stabilization at the New Rifle site

Stabilization of the tailings and contaminated materials at the New Rifle site would preclude approximately 172 acres at the New Rifle site from being developed for any alternative land use. This acreage would include the 142-acre New Rifle site plus 30 acres west of the site that are contaminated with windblown tailings. However, relocation of the Old Rifle tailings and contaminated materials to the New Rifle site would make the 22 acres at the Old Rifle site available for any alternative land use. Therefore, the 22 acres could be developed for agricultural or industrial purposes according to the land use policies of Garfield County. Agricultural use could include rural residences on two-acre (minimum) lots. Any development would require the approval of the Garfield County Board of Commissioners because the Old Rifle site is within the 100-year floodplain of the Colorado River (Bean, 1986).

5.16.3 Disposal at the Estes Gulch site

Relocation of the tailings and contaminated materials to the Estes Gulch site would make the 164 acres at the Old and New Rifle sites available for any alternative land use. Therefore, the 164 acres could be developed for agricultural or industrial purposes according to the land use policies of Garfield County. Agricultural use could include rural residences on two-acre (minimum) lots, but any development would require the approval of the Garfield County Board of Commissioners because both the Old and New Rifle sites are within the 100-year floodplain of the Colorado River (Bean, 1986).

The final tailings disposal site (81 acres) and access road (six acres) at the Estes Gulch site would preclude 87 acres from any alternative land use. The Estes Gulch site, owned by the Federal government, is currently designated for livestock grazing and critical deer winter range, and there are existing, undeveloped oil and gas leases at the site (Atkins, 1986). Relocation of the tailings to the Estes Gulch site would require BLM approval of a land withdrawal application.

5.16.4 Disposal at the Lucas Mesa site

Relocation of the tailings and contaminated materials to the Lucas Mesa site would make the 164 acres at the Old and New Rifle sites available for any alternative land use. Therefore, the 164 acres could be developed for agricultural or industrial purposes according to the land use policies of Garfield County. Agricultural use could include rural residences on two-acre (minimum) lots, but any development would require the approval of the Garfield County Board of Commissioners because both the Old and New Rifle sites are within the 100-year floodplain of the Colorado River (Bean, 1986).

The final tailings disposal site (83 acres) and access road (24 acres) at the Lucas Mesa site would preclude 107 acres from any alternative land use. The Lucas Mesa site, owned by the Federal government, is currently designated for oil and gas development and deer and elk winter range, and there are existing, undeveloped oil and gas leases at the site. The site is currently used primarily for livestock grazing, and contains a livestock watering system (Graham, 1986). Relocation of the tailings to the Estes Gulch site would require BLM approval of a land withdrawal application.

5.17 UNAVOIDABLE ADVERSE IMPACTS

Conservative but realistic assumptions and impact assessment procedures have been used to estimate the impacts identified in this EIS. Therefore, these impacts represent a realistic upper limit on the severity of the impacts, and the actual impacts caused may be less than those identified in this document.

All of the alternatives include interim actions at the Old and New Rifle sites. All of the alternatives except no action include remedial action at the vicinity properties. The impacts of remedial action at the vicinity properties were evaluated in a separate environmental report (DOE, 1985). The impacts of remedial action at the vicinity properties would be added to the impacts of both action alternatives (Alternatives 2 through 4) to obtain the total impacts of remedial action.

No action

The primary adverse impact of the no action alternative would be the continued health hazard to the general public from exposure to radon and its daughter products. The tailings piles would continue to cause exposures that exceed the EPA standards. An estimated 100 fatal cancers would occur over the next 1000 years from the tailings piles if the no action alternative were taken. The tailings would continue to be subject to wind and water erosion, which would result in a continuously expanding area unsafe for human use. Groundwater contamination at the tailings site would continue for an indefinite period of time. In addition, the 164 acres that comprise the tailings sites would be unavailable for productive land uses such as industrial development.

There would be a temporary increase in traffic on U.S. Highway 6, and the interim actions would also cause temporary increases in noise and fugitive dust in the vicinities of the Rifle sites for approximately one year. Interim action workers would be exposed to above-background levels of radiation and the possibility of construction-related accidents.

Stabilization at the New Rifle site

The primary adverse impacts of the stabilization at the New Rifle site would be the permanent restriction of 172 acres of land adjacent to the city of Rifle from productive land uses such as industrial development and the temporary increase in traffic on U.S. Highway 6. This alternative would also cause temporary increases in noise and fugitive dust in the vicinities of the Rifle tailings sites for approximately two years; the releases of dust would exceed Federal and state standards. The tailings pile would extend 47 feet above the surrounding land surface and could be a visual annoyance to some persons. Remedial action workers could be exposed to above-background levels of radiation and construction-related accidents.

Disposal at the Estes Gulch site

The primary adverse impact of disposal at the Estes Gulch site would be increases in traffic on U.S. Highway 6 and State Highway 13. An increase in traffic accident injuries and fatalities as well as possible traffic congestion would result. This alternative would also cause temporary increases in noise and fugitive dust in the vicinities of the Rifle tailings sites and the Estes Gulch site for approximately 3.5 years. The releases of dust would exceed Federal and state standards. Approximately 81 acres of the Estes Gulch site would be withdrawn from the existing use as low-density grazing land. Remedial action workers would be exposed to above-background levels of radiation and the possibility of construction-related accidents.

Disposal at the Lucas Mesa site

The primary adverse impact of this alternative would be increases in traffic on U.S. Highway 6 and I-70. An increase in traffic accidents and fatalities as well as possible traffic congestion would result. This alternative would also cause temporary increases in noise and fugitive dust in the vicinities of the Rifle sites and the Lucas Mesa site for approximately 3.5 years. Approximately 83 acres of the Lucas Mesa site would be withdrawn from the existing use as low-density grazing land. Remedial action workers would be exposed to above-background levels of radiation and the possibility of construction-related accidents.

5.18 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

All of the alternatives would require the same types of resource commitments. These include fuel, electricity, water, borrow materials, manpower, financial resources, and land. The only resources which would be irretrievably lost are engine fuel, electricity, and manpower. The amounts of the resources lost are identified in Section 5.14.

The use of water would not be a permanent commitment of the resource since it would be released into the environment following treatment. Even the use of borrow materials, and the land in general, would not necessarily be permanently committed. The uranium and vanadium resources within the tailings would not be lost since the tailings could be excavated and the uranium and vanadium recovered, if permitted by law.

The commitment of land for long-term stabilization of the tailings and the potential groundwater impacts discussed in Section 5.5.2 would represent irreversible and irretrievable commitments of resources.

5.19 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Under Alternative 1, no action, there would be no short-term use of the environment. The long-term productivity of the Rifle sites would continue to be restricted because the unstabilized tailings would remain on the sites. A continuously enlarging area would be contaminated by wind and water erosion of the tailings, and associated restrictions on the use of the newly contaminated areas may be imposed. Groundwater contamination would continue at the Rifle site for an indefinite period of time. In addition, the interim action activities at the Rifle sites and borrow sites would cause temporary inconveniences such as noise, increased traffic, and dust during daytime hours.

Under Alternative 2, stabilization at the New Rifle site, there would continue to be restricted use of the Rifle sites for a period of approximately two years. In addition, the construction activities at the tailings sites, transportation routes, and borrow sites would cause temporary inconveniences such as noise, increased traffic, and dust during daytime hours. Following remedial action, the area of restricted use would be increased from the 164 acres that presently exist to 172 acres. Groundwater contamination at both sites would cease and the proposed EPA groundwater protection standards would be met at the toe of the pile.

Under Alternatives 3 and 4, the relocation alternatives, there would continue to be restricted use of the Rifle sites for a period of approximately 3.5 years. In addition, the construction activities at the tailings sites, transportation routes, borrow sites, and disposal site would cause temporary inconveniences such as noise, increased traffic, and dust during normal work hours. Groundwater contamination at the Rifle tailings sites would cease, and the proposed EPA groundwater protection standards at the Estes Gulch site would be met at the toe of the pile. Following remedial action, the Rifle sites would be released for any use consistent with local land use plans; however, 81 acres (Estes Gulch site) to 83 acres (Lucas Mesa site) would be permanently restricted from any other uses. Since the potential productivity of the Rifle sites for industrial development is far greater than the potential productivity of the alternate disposal sites (low-density grazing only), the net long-term productivity of lands would be enhanced.

5.20 MITIGATIVE MEASURES

5.20.1 Mitigative measures

Mitigative measures have been included in all of the interim or remedial action alternatives to reduce the impacts on the environment. The following are the primary mitigative measures that have been included in the Interim or remedial action alternatives.

Mitigative measures included in all alternatives (unless otherwise noted)

- o Demolition of unsafe mill structures; removal of all asbestos, chemicals, oils, solvents, and other materials to a licensed disposal facility; and securing of both Rifle sites to remediate unsafe conditions present at both sites (interim actions).
- o Upgrading of transportation routes (as necessary) with traffic controls such as traffic signals, flagmen, turn-outs, and passing lanes to reduce the potential for traffic accidents and congestion.
- o Construction of fences or other access barriers to inhibit unauthorized human intrusion during remedial action.
- o Construction of temporary erosion controls, wastewater retention basins, and treatment plants (if required) to protect against the release of contaminants during remedial action.
- o Treatment of any water to be discharged (as necessary) in accordance with applicable state standards.
- o Stockpiling of various soils encountered at the alternate disposal sites for future use during reclamation.
- o Application of water to disturbed areas at the Old and New Rifle sites and the Estes Gulch disposal site to inhibit fugitive dust emissions.
- o Application of water and chemical dust suppressants to dirt and gravel access roads to inhibit dust emissions.
- o Covering of haul trucks to prevent the dispersion of tailings during relocation.
- o Removal of all contaminated soils (consistent with the EPA standards) adjacent to and beneath the existing tailings piles (when appropriate) and consolidation of the contaminated soils with the tailings.

- o Selection of borrow sites that are as close to the disposal sites as possible to reduce costs and minimize the impacts of increased tailings transportation distances.
- o Use of existing borrow sites for earthen and rock materials (where possible) to reduce the amount of land disturbance associated with the remedial action.
- o Use of local labor whenever possible to maximize economic benefits to the local communities.
- o Conducting construction operations only during the day to reduce noise disturbance to local residents.
- o Immediate cleanup of any offsite spills.
- o Implementation of an environmental monitoring program during remedial action.
- o Design of the stabilized tailings to withstand a design earthquake.
- o Construction of various drainage control and diversion measures to direct surface water runoff away from the stabilized tailings and prevent long-term erosion.
- o Construction of a compacted, earthen cover on the stabilized tailings to inhibit radon emanation (consistent with the EPA standards), surface water infiltration, and plant root penetration.
- o Construction of a loosely compacted earthen frost protection layer over the radon barrier to protect it from freeze-thaw action and solifluction effects.
- o Construction of a rock cover on the stabilized tailings to ensure that the stabilized pile could withstand the erosive effects of a PMP, and to inhibit intrusion by burrowing animals.
- o Construction of a complex tailings cover and access barriers for the stabilized tailings to inhibit inadvertent human intrusion after remedial action.
- o Reclamation, including backfilling, grading, and revegetation of all areas disturbed during remedial action except the stabilized tailings and access roads.
- o Restoration and revegetation of wetlands (20 acres) disturbed at both Rifle sites during interim and remedial actions.

- o Cleanup of the equipment used in the remedial action before releasing it for use on other projects to prevent the spread of contaminated materials.
- o Maintaining close communications with the local population through an established public information task force.

Revegetation of disturbed upland and wetland areas would be included as part of the mitigation plan. Revegetation of these areas is important to prevent soil erosion and to preserve and enhance the natural and beneficial values of wetlands, as is mandated by law (10 CFR 1022.3(a)(6)). As is discussed in Appendix F, "Floodplains and Wetlands Assessment," the specific details of the mitigation plan will be developed in consultation with the appropriate regulatory agencies and will be incorporated into the development of the final remedial action design. General features of the mitigation plan include starting during an appropriate season; filling, grading and recontouring disturbed areas to encourage establishment and growth of vegetation; use of appropriate materials and techniques; and use of appropriate erosion control measures.

Mitigation measures necessary to ensure the protection of remedial action workers and the long-term stability of the tailings are described in the UMTRA Project Environmental Health and Safety Plan (DOE, 1985), Guidance for UMTRA Project Surveillance and Maintenance (DOE, 1986), and the Rifle Remedial Action Plan (DOE, 1989).

The following mitigative measures were incorporated into the individual remedial action alternatives.

Stabilization at the New Rifle site

- o Placement of a thick rock erosion protection barrier on all sides of the stabilized tailings pile to protect it against erosion from a PMF.
- o Construction of a below-grade rock apron around the entire stabilized tailings pile to protect it against erosion from a PMF.
- o Release of the Old Rifle site, after restoration of the site, for any use compatible with local land use plans.

Disposal at the Estes Gulch site

- o Construction of a paved 12-foot-wide, 7500-foot-long climbing lane on the east side of State Highway 13 between Highway 325 and the Estes Gulch site turnoff; an

800-foot-long, 12-foot-wide gravel truck turnout; and an intersection facility on State Highway 13 at the Estes Gulch turnoff.

- o A cultural resources survey will be performed prior to surface disturbance related to widening and improving State Highway 13. If eligible cultural resources are identified and cannot be avoided by construction activities, a data recovery plan would be designed and implemented with the Colorado SHPO and the BLM if appropriate. It is expected that due to previous surface disturbance, no cultural resources will be identified.
- o A survey for sensitive and endangered plant species (Wetherill milkvetch, Uinta Basin hookless cactus, DeBeque milkvetch, and DeBeque phacelia) will be performed prior to the initiation of surface disturbing activities related to widening and improving State Highway 13. If plant populations are identified, they will be avoided; if they cannot be avoided, site-specific mitigation measures will be developed with the appropriate state and federal agencies.
- o Avoidance of areas containing the Wetherill milkvetch (state listed plant species of special concern) during the construction of the access road to the site.
- o Partially below-grade disposal of the tailings and contaminated materials to minimize the land area to be occupied by the stabilized pile and to ensure the long-term stability of the pile.
- o Grading of the terrain adjacent to the embankment to promote sheet flow and construction of rock-filled key trenches at the embankment and existing terrain interface.
- o Grading and addition of riprap in the upland drainage area to the north, and construction of an unlined interceptor ditch to divert surface runoff away from the pile.
- o Construction of a rock-armored toe ditch, founded in bed-rock, along the southern base of the stabilized tailings pile to collect runoff from the embankment surface and adjacent areas and convey it westward, and to minimize or eliminate headward advancement of adjacent surface drainages.
- o Release of the Old and New Rifle sites, after restoration of the sites, for any use compatible with local land use plans.

Disposal at the Lucas Mesa site

- o Partially below-grade disposal of the tailings and contaminated materials to minimize the land area to be occupied by the stabilized pile and to ensure the long-term stability of the pile.
- o Amendment of the earthen radon barrier with 10 percent bentonite.
- o Construction of a large, below-grade rock apron along the northwest base of the stabilized tailings pile to protect it against erosion from the headward advancement of adjacent surface drainages.
- o Release of the Old and New Rifle sites, after restoration of the sites, for any use compatible with local land use plans.

5.20.2 Worker protection during interim or remedial action

Training sessions applicable to the degree of asbestos, chemical and radiation hazards present at the sites would be conducted for all employees prior to the start of work. These sessions would include a discussion of the industrial and radiological safety procedures, emergency procedures, and the effects of prenatal radiation exposure. Records would be maintained to document successful completion of training by employees.

During the asbestos removal and demolition process, temporary safety facilities will be constructed. These facilities include temporary asbestos control areas; airtight barriers to separate work areas where higher amounts of asbestos exist, and a decontamination enclosure system at entrances and exits to the asbestos control area. To ensure that no asbestos fibers remain to become airborne during demolition, work areas would be cleaned and surfaces where asbestos has been removed would be sprayed with an encapsulating material.

Controlled areas would be designated and conspicuously marked. Access to these areas would be restricted, and all personnel and equipment would be monitored for contamination. Access control records would be maintained. Those records would include a log of personnel and equipment entering and leaving the restricted area and a log of dosimeters issued.

Protective clothing would be distributed to employees at the access control point when conditions warrant. Change and cleanup facilities would be provided.

Thermoluminescent dosimeters (TLDs) or film badges would be supplied to permanent employees working in controlled areas. Dosimeters would be changed quarterly or more frequently if

necessary. Urinalysis would be used to monitor employees' internal exposures where potential ingestion of radioactive material is indicated by air sampling data. Additional dosimetry might be required if positive results were noted. A system of employee health records would be maintained and would document individual radiation exposures and the results of personnel dosimetry and bioassays.

Air particulate samples would be collected in work areas and at site boundaries. Samples would be analyzed for asbestos and gross alpha levels and would be stored for later isotopic analyses, if necessary. In work areas where ventilation is limited, additional samples would be collected and analyzed for radon daughter concentrations.

A respiratory protection program would be developed by the RAC, with procedures developed for training employees and checking for the adequate fit of respirators. Respirators would be used in work areas where air particulate concentrations exceeded a projected monthly concentration of 25 percent of the regulatory limit for a given radionuclide. Industrial hazards would be controlled in accordance with Occupational Safety and Health Administration (OSHA) regulations.

Additional details of the health and safety plan will be available in the remedial action plan, which will be prepared following the selection of a preferred alternative.

5.21 SURVEILLANCE AND MAINTENANCE

Title I of the UMTRCA defines the authority and roles of the DOE, the NRC ("Commission"), and the intent of licensing regarding inactive tailings sites in the various states. In part, Section 104(f)(2) of the UMTRCA reads:

"upon completion of the remedial action program...(the site) shall be maintained pursuant to a license issued by the Commission in such manner as will protect the public health, safety, and the environment. The Commission may, pursuant to such license or rule or order, require...monitoring, maintenance, and emergency measures necessary to protect public health and safety and other actions as the Commission deems necessary to comply with the standards (EPA) of Section 275...."

Accordingly, the remedial action must demonstrate compliance with the EPA standards (40 CFR 192), and, thus, the prime objective of licensing is to assure continued compliance with the EPA standards via a post-remedial-action surveillance and maintenance program.

The DOE would conduct the surveillance and maintenance pursuant to the requirements of the NRC's license until termination of the UMTRA Project (i.e., March 7, 1994). At that time, the DOE or another agency to be designated by the President would maintain the site as required by the NRC.

A detailed custodial surveillance and maintenance program would be defined jointly by the DOE and the NRC during the NRC license application and approval process. This program may include any or all of the following activities.

Site inspections

Site inspections would constitute a visual and definitive verification that the disposal site continues to function as designed and would assure continued compliance with the design standards. Inspections would consist of two phases: Phase I, a systematic walk-over, is designed to qualitatively evaluate the condition of the disposal site; Phase II would constitute investigations to quantitatively assess changes in the disposal site that could lead to failure of the functional design in the absence of custodial maintenance. The Phase I inspections would be conducted on a specific schedule, such as annually, by a team of qualified professionals. The inspection team would review as-built drawings, engineering details, aerial photographs, and supporting documentation. A site walk-over would then be performed to evaluate any changes at the site with regard to factors such as erosion, flood effects, slope/cover stability, settlement, displacement, plant or animal intrusion, and access control.

Based upon the evaluation and recommendations of the inspection team, Phase II studies might be conducted to quantitatively determine the magnitude and rate of effect of change in the above factors. From these studies, the need for corrective action (i.e., custodial maintenance) would be ascertained.

Aerial photographs

Aerial photographs might be used to supplement site inspections. The objectives would be to identify changes in site conditions (e.g., patterns of developing erosion that could affect the functional design), provide visual documentation of year-to-year variations in site conditions, and identify activities (e.g., road conditions, storm drainage construction) adjacent to the site that might affect its function.

Aerial photographs could be taken on the same schedule as the site inspections. Photographs could be taken at both low (i.e., high resolution) and higher (i.e., for adjacent activities) altitudes, and at oblique and vertical angles. The types of film, ground control, camera specifications, amount of aerial overlap, interpretative keys, and other requirements would be established prior to completion of remedial action.

Groundwater monitoring

Certain existing wells will be preserved during construction for use as monitoring wells after completion of the remedial action. In addition to these wells, a series of both shallow and deep wells will be

installed for the purpose of monitoring groundwater quality. The locations for these wells would be selected in order to monitor the performance of the disposal site. Details of the groundwater monitoring would be developed during the NRC licensing process.

Reporting

Summary surveillance and monitoring reports that evaluate the results of these activities and recommend custodial maintenance (i.e., corrective actions) and future surveillance and monitoring would be prepared. Reports and supporting documentation would be placed on file with the DOE, NRC, state of Colorado, and Garfield County.

Custodial maintenance

The need for custodial maintenance (i.e., corrective action) could only be determined by the site inspections and monitoring and by NRC and DOE evaluation of the reports of these activities. However, it is anticipated that custodial maintenance would consist primarily of the following:

- o Limited earth/rock replacement because of unanticipated erosion, human or animal intrusion, or cover disturbance. These activities are expected to be required infrequently.
- o Control of deep-rooted plants by infrequent application of herbicides or physical removal as required.
- o Mechanical repairs to the access barrier and warning signs, when necessary.

Contingency plans

In case of severe natural events (e.g., extreme rainfall or seismic events) or unusual human intrusion, procedures would be developed to initiate inspection and to institute custodial maintenance of the disposal site.

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6.0 PUBLIC AND AGENCY COMMENTS

6.1 INTRODUCTION

This section discusses the comments made by private citizens, public organizations, and government agencies (Federal, state, and local) on the draft EIS (DEIS) for remedial actions at the former Union Carbide Corporation uranium mill tailings sites at Rifle, Colorado.

Comments on the DEIS were received from private citizens, public organizations, and government agencies during two public hearings and a 45 day written comment period. Two public hearings were held in Rifle, Colorado, on July 9, 1987. A total of six people presented oral statements on the DEIS. The EPA's Notice of Availability was published in the Federal Register on May 29, 1987 (52FR20142). The DEIS was distributed on May 13, 1987. Although the formal comment period lasted 45 days (May 29 through July 13, 1987), the DOE received and considered comments until August 11, 1987. Written comments were received from nine individuals or organizations during the written comment period. Table 6.1 lists the people, organizations, and agencies that presented oral statements at the public hearings or submitted written comments.

To put all the comments in an easily accessible form, each oral statement (recorded by a certified stenographer) and written comment was analyzed in detail to identify specific topics. A preliminary outline of this section was then prepared based on these topics, and all comments were grouped by topic. This system allowed the preparers of the final EIS (FEIS) to consider all comments received on a topic while revising the sections of the FEIS dealing with that topic.

As a result, comments have been grouped into 12 major topics that cover all of the substantive comments received. Where the responses to the comments required revisions in the text (Volume I) of the DEIS, those revisions appear in the text of this FEIS. For example, the U.S. Department of the Interior expressed concern about the reclamation of the wetlands-riparian habitat disturbed during remedial action. In responding to this comment, the main text of the EIS was revised to be consistent with Appendix F, Floodplain and Wetlands Assessment, which contains provisions for the reclamation, including revegetation, of the wetlands-riparian habit disturbed during remedial action. Where the responses to the comments required appreciable revision of an appendix (e.g., revision of Section E.2 of Appendix E, Hydrology), the appendix was revised and reprinted with this FEIS. If the responses to the comments required only slight revision of an appendix (e.g., revision of Table C.2.9 in Section C.2.2 of Appendix C, Weather, Air Quality, and Noise), the individual revisions are included as errata in Section 6.14 of the text of this FEIS.

Sections 6.2 and 6.3 contain comments and responses on the remedial action alternatives and conceptual designs. Sections 6.4 through 6.11 contain comments and responses on various environmental components (e.g., air quality and transportation); Sections 6.12 and 6.13 contain comments

Table 6.1 Index of people, organizations, and agencies providing oral statements at the public hearings or submitting written comments

Index number	Name	Affiliation	Oral statement (O) or written comment (W)
1	Howard W. Earnest	Resident of Rifle, Colorado; Rifle Creek Estates Homeowners Association	O, W
2	Howard Roitman	Colorado Department of Health	W
3	Bruce Blanchard	U.S. Department of the Interior	W
4	Paul H. Lohaus	U.S. Nuclear Regulatory Commission	W
5	Milton W. Lammering	U.S. Environmental Protection Agency	W
6	Susan Livingstone	Veterans Administration	W
7	Wayne L. Gustin	Garfield County Economic Development Incorporated	O
8	Edwin Gast	Rifle Area Industrial Development Organization	O
9	Jack A. Marshall	Resident of Rifle, Colorado	O
10	Richard N. Babcock	Resident of Rifle, Colorado	O
11	Will Laintz, Gary Ward, Dave Ling	Rifle Area Chamber of Commerce	O, W
12	Grady L. McNure	U.S. Army Corps of Engineers	W
13	Leroy W. Carlson	U.S. Fish and Wildlife Service	W

and responses on surveillance and maintenance and miscellaneous subjects, respectively. Finally, Section 6.14 contains the errata for the appendices that were not reprinted with this FEIS.

Section 6.15 of this FEIS reproduces in full the written comments received on the DEIS. The numbers in the margins of the written comments indicate the location in Section 6.0 where the comment is responded to and the specific comment number (e.g., 6.8.1 indicates Comment 1 in Section 6.8, Ecosystems). Copies of the public hearing transcripts are available for inspection at each of the public reading rooms and libraries listed in Table 6.3 of Section 6.15.

6.2 REMEDIAL ACTION ALTERNATIVES

Several commentors expressed preferences for, or concerns about, the various remedial action alternatives. Table 6.2 summarizes the commentors' preferences for alternatives.

Table 6.2 Preferences for remedial action alternatives expressed by commentors

Alternatives	Commentors in favor ^a	Total by alternative	Commentors opposed ^a	Total by alternative
<u>Alternative 1</u>				
No action	None	0	None	0
<u>Alternative 2</u>				
Stabilization at the New Rifle site	None	0	2	1
<u>Alternative 3</u>				
Disposal at the Estes Gulch site	2, 5, 6, 8, 11	5	1	1
<u>Alternative 4</u>				
Disposal at the Lucas Mesa site	1, 6, 8	3	None	0

^aThe numbers in these columns correspond to the index numbers in Table 6.1.

6.2.1 Comment

The EIS does not adequately address several of the issues that are relevant to the selection of the Estes Gulch site as the preferred alternative. In fact, it appears that the selection was based primarily on the identification of the closest and least costly site outside the city of Rifle (1).

Response

Section B.3 of Appendix B, Alternatives Analyses, describes the process used by the DOE to select the Estes Gulch disposal site as the preferred alternative. While this process did consider the locations, and hence costs, for potential disposal sites, numerous other factors such as geotechnical (e.g., erosional stability) and hydrological criteria (e.g., depth to groundwater) were also considered in the process.

6.2.2 Comment

Section B.2 of Appendix B, Alternatives Analyses, discusses the criteria used by the state of Colorado to select potential sites for disposal of the Rifle uranium mill tailings. Apparently, the state used several more restrictive criteria than the DOE chose to use in its site selection process. Three of the more obvious differences are:

- o The tailings and contaminated materials should be placed below grade, not in a 150-foot-high pile.
- o The tailings and contaminated materials should be covered with a minimum of three meters (9.8 feet) of radon barrier, not 3.5 feet.
- o The radon barrier should reduce the radon flux from the tailings and contaminated materials to less than two pico-curies per square meter per second ($\text{pCi}/\text{m}^2\text{s}$), not 20 $\text{pCi}/\text{m}^2\text{s}$.

Why were not the state's more stringent criteria used (1)?

Response

Using input from the DOE, the State of Colorado developed its own criteria for the site selection process. These criteria were based on the state's interpretation of the UMTRCA and Colorado's own regulatory and land use constraints and issues. The state's criteria were not limited by or subject to the Federal standards, criteria, laws, and budgetary constraints with which the DOE and the UMTRA Project must comply. The state conducted a separate and independent site selection process, and nominated the Lucas Mesa

site to be evaluated under the EIS process. The DOE, operating under slightly different constraints, developed a separate site selection process under which the Lucas Mesa site was also selected to be evaluated. Thus, by state and DOE agreement, the Lucas Mesa site was carried forward into the EIS process.

In 1985, in an effort to identify an additional site in the Rifle area that was technically suitable and less expensive to relocate the contaminated materials to than the Lucas Mesa site, the DOE conducted another site selection process. The state of Colorado participated in and concurred with this process and the criteria developed. From this process the Estes Gulch site was identified and was evaluated during the EIS process with state concurrence. Therefore, while the state may have used some site selection criteria that were different and based on different constraints, no sites were evaluated, and no remedial action will take place, without the input and concurrence of the state of Colorado.

6.2.3 Comment

We are in favor of relocating the uranium mill tailings away from Rifle, but we feel that moving them into the proximity of our subdivision (Rifle Creek Estates) and other homes in the Estes Gulch area is uncalled for. I think it is safe to say that there is not a person here who would really feel comfortable if the tailings were to be put two miles from their home, whether it be in Albuquerque or Denver or wherever. We believe that the impacts of remedial action would be more economic than health related. There are many public perceptions regarding radioactive substances, and these perceptions possibly far exceed the true hazards. However, these perceptions find their way into our everyday lives and economic situations (1).

Response

The DOE acknowledges the expressed concerns and agrees that the economic impacts of the remedial actions would be greater than the health impacts. The nearby populations were considered in the processes used to select the disposal site alternatives (Sections B.2 and B.3 of Appendix B, Alternatives Analyses). The Lucas Mesa site was farther away from the nearest residence, but its more remote location added to its greater remedial action cost and impacts (Table 1.1). The Estes Gulch disposal site has been designed to meet the EPA standards, and these standards were promulgated to reduce the potential public health effects associated with uranium mill tailings.

6.2.4 Comment

We are perhaps more concerned about the precedent that the location of the tailings this close to our homes and Rifle would present because the state of Colorado is currently trying to locate a site for the disposal of low-level radioactive wastes. This site would receive radioactive wastes not only from Colorado but possibly also from New Mexico, Wyoming, Nevada, Utah, and Arizona. This potential site has no defined limits while the uranium mill tailings are a finite amount that we can cope with. If the tailings are stabilized at the Estes Gulch site, we cannot be assured that the state would not deem the Estes Gulch site also suitable for the disposal of other radioactive wastes, and we strongly believe that these wastes would pose a far greater hazard to us than the tailings (1).

Response

Task Force and public meetings held as recently as May 21, 1987, in Rifle have presented the DOE's position on this matter. To reiterate this position, the DOE has stated that it may allow an UMTRA Project disposal site to be used for other purposes. The conditions for such multiple use, however, are very restrictive. Any co-disposal concept proposed by the State of Colorado would have to prove to DOE that such actions would not affect the cost, longevity or schedule for completion of the UMTRA Project cleanup. Further, other project wastes would not be mixed with UMTRA Project tailings; however, they could possibly be allowed nearby. Any such disposal site sponsored by the state would be subject to the same NEPA regulations and requirements, and require similar environmental documentation. Further, any such proposal by the state would also require the same type of land acquisition from the BLM through the BLM's land withdrawal process. This process requires a minimum of two years to complete. Since the State of Colorado has already licensed the Uravan site for receipt of the Denver radium waste, the selection of a site in Garfield County is highly unlikely.

6.2.5 Comment

I think that the withdrawal of Federal lands for tailings disposal is appropriate, but the Estes Gulch site is not the appropriate location. I will make this comment to the Bureau of Land Management within the proper deadline (1).

Response

The Estes Gulch site was selected as a suitable tailings disposal site using a site selection process that considered numerous environmental, geologic, and hydrologic criteria as well as criteria related to land ownership, land use restrictions, and

engineering economics (Section B.3 of Appendix B, Alternatives Analyses). The Bureau of Land Management will determine whether or not the Federal land at the Estes Gulch site should be withdrawn for this purpose as requested by the DOE. The DOE will forward this comment to the BLM.

6.2.6 Comment

There are several problems associated with stabilization at the New Rifle site as presented in the DEIS. Some of these problems are the location within the floodplain of a major river; the potential for changes in channel geometry (river meander) with consequent disruption of the reclaimed tailings pile; inadequate foundation materials beneath the reclaimed pile to separate contaminated materials from expected high groundwater levels; and inadequate protection of groundwater quality. We feel this alternative is technically unfavorable from the standpoint of meeting the EPA standards.

From the discussions presented in the DEIS, it seems that the Estes Gulch site has acceptable disposal site characteristics and the shortest haul distance of the two alternatives to relocate the uranium mill tailings. We believe that both the Old and New Rifle tailings piles should be moved away from the Colorado River floodplain. Therefore, we support disposal at the Estes Gulch site as the preferred alternative (2).

Response

The DOE believes that the conceptual design for stabilization at the New Rifle site would meet MCLs by limiting the steady state flux of tailings seepage to groundwater. However, because the proposed disposal cell would be located within the floodplain of the Colorado River, the stabilized tailings pile could be periodically inundated during floods. If natural flushing with proper institutional controls is not sufficient to reduce all contaminant concentrations to MCLs or background within 100 years, or if periodic flooding causes periodic exceedance of MCLs or background levels, then design modifications, active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required to ensure compliance.

6.2.7 Comment

It would be helpful to the reader if the DOE would specify the criteria that were used to select a disposal site and eliminate alternate disposal sites in Section 3.3.1, Other alternate disposal sites, of the DEIS (3).

Response

Section 3.3.1 of the DEIS is a summary of the site selection processes that are discussed in Sections B.2 and B.3 of Appendix B, Alternatives Analyses. Section B.3 describes the DOE's site selection criteria in detail.

6.2.8 Comment

Appendix B, Alternatives Analyses, provides the factors used to rank each potential disposal site and should provide a table showing the score for each site so that the reader can make a fully informed judgement. The specific location of the Anvil Point site should be shown on Figure B.3.2, Locations of field-evaluated areas, and the criteria for rejecting a site on DOE land should be explicitly stated. The Hubbard Mesa and Estes Gulch sites scored almost the same in the ranking process, and it would be helpful to include the reason for choosing the Estes Gulch site over the Hubbard Mesa site (3).

Response

Table B.3.12 in Section B.3.4 of Appendix B, Alternatives Analyses, has been revised to include the Hubbard Mesa and Estes Gulch sites' scores for the 30 individual factors in the site selection criteria (Table B.3.11) and to correct erroneous scores. Also, Figure B.3.2 has been revised to specify the field-evaluated areas that are shown. The reasons for rejecting the Anvil Point site (the site of the former DOE oil shale project) are provided in the paragraph of page B-29 in the DEIS (Section B.3.4 of Appendix B, Alternatives Analyses). Page B-36 of the DEIS (Section B.3.4 of Appendix B, Alternatives Analyses) provided a discussion of the scoring differences between the Hubbard Mesa and Estes Gulch sites, and this page has been revised to include a discussion of the sites' scoring differences for the hydrological ranking factors. Obviously, the Estes Gulch site was selected due to its higher scores for the environmental and engineering factors.

6.2.9 Comment

Based on the review of the DEIS, I agree with the basic approach for ultimate disposal of the tailings and contaminated materials at an offsite location (as opposed to consolidation at the New Rifle site). The physical, hydrological, and geological characteristics and engineering designs for both the Estes Gulch and Lucas Mesa disposal sites should be adequate for compliance with the EPA standards for radon emissions control and longevity against erosive forces. The obvious cost advantage of disposal at the Estes Gulch site is apparent. However, I assume your staff will continue to work with state and local officials to gain their concurrence in the preferred alternative (5).

Response

See Response 6.2.2 above.

6.2.10 Comment

It is stated that the Candidate Site Review Committee nominated two disposal sites for further consideration and evaluation by the DOE. These sites are identified as Flatiron Mesa and Lucas Mesa. There is no discussion concerning the apparent rejection of the Flatiron Mesa site from the evaluation process for potential alternate disposal sites. This information should be presented with a general description of the Flatiron Mesa site including its location relative to the Old and New Rifle sites (5).

Response

As stated in Section B.2.2 of Appendix B, Alternatives Analyses, the Candidate Site Review Committee evaluated the Flatiron Mesa and Lucas Mesa sites and nominated only the Lucas Mesa site for further consideration and evaluation by the DOE. Section 3.3.1 of the text has been revised to be consistent with the appendix. Rejection of the Flatiron Mesa site was based on numerous factors, but the site's proximity to a public water supply and the need to acquire access across private lands adjacent to the site were primary factors. Details for the Flatiron Mesa site are not within the scope of the DEIS, but are provided in Potential Sites Suitable for Reclamation and/or Reprocessing of the Grand Junction and Rifle Uranium Mill Tailings Pile, Open-File Report 82-2, Colorado Geological Survey, Denver, Colorado, 1982.

6.2.11 Comment

The U.S. Veterans Administration has provided grant assistance to the state of Colorado for the construction of a State Veterans Nursing Home Care Facility in Rifle, Colorado. The nursing home property is approximately 1,000 feet north of the Old Rifle site. As partners with the state in the funding of the project and patient care, we are interested in the resolution of the long-term hazards in the area. Therefore, the Veterans Administration supports both Alternatives 3 and 4 as solutions which remove the source of the hazards from the community area (6).

Response

No response is required.

6.2.12 Comment

We believe that it is very important to move the tailings and contaminated materials away from Rifle. However, we do not support the state of Colorado's potential use of the tailings disposal site for the disposal of other low-level radioactive wastes, and we feel that this use would negate most of the benefits of relocating the tailings and contaminated materials. We would hope that those who are responsible for the removal of the tailings and contaminated materials would do everything in their power to distance themselves from the disposal of other low-level radioactive wastes at the tailings disposal site (8,9).

Response

See Response 6.2.4 above.

6.2.13 Comment

I am representing the Rifle Area Chamber of Commerce (Chamber). The Board of Directors, members, and staff of the Chamber wish to convey their support of the Rifle UMTRA Project as proposed by the DOE. For the following reasons, the Chamber favors adoption of the DOE's Alternative No. 3, disposal at the Estes Gulch site, which is the preferred alternative:

- o The economic status of the area would genuinely benefit from the construction phase of the project, both in the creation of new jobs and in the local procurement of goods and services. The financial magnitude and proposed time span of the project are viewed by the Chamber as being positive factors in the continued stabilization and necessary growth of the area's private sector.
- o Decontamination of the Rifle tailings sites heightens the possibility for an increase in the valued commercial, industrial, and/or recreational land inventory in the area. The location of the New Rifle site and its proximity to major highway and railroad networks make it one of Garfield County's and western Colorado's more suitable pieces of real estate for revitalization by either public or private entities.
- o Health risks to the population of Rifle and surrounding areas would be mitigated by the decontamination of the Rifle tailings sites and by remedial action at the Rifle contaminated vicinity properties.

It is, therefore, the Chamber's desire to see the adoption and implementation of the DOE's preferred alternative. The Chamber would also like to take this opportunity to commend the DOE and Jacobs Engineering Group Inc. for their thorough and efficient efforts during the preliminary phases of the project (11).

Response

No response is required.

6.3 CONCEPTUAL DESIGN

Numerous comments about the conceptual design for the proposed action were received. Most of these comments concerned the design of the radon and erosion protection barriers and the long-term stability of the final tailings disposal site.

6.3.1 Comment

For disposal at the Estes Gulch site, no mention is made of slope stabilization during the extended construction phase prior to placing the erosion protection barrier on the final top and toeslope of the tailings pile. The placement of slime tailings in the lower part of the pile and the inclusion of wood and other construction materials in the pile are not adequately discussed from the standpoints of tailings pile stability and permeability. It is alluded that the tailings would be compacted during placement. What density and permeability values were used in the pile design (1)?

Response

Specific details concerning slope stabilization during tailings pile construction are not within the scope of the DEIS, but would be included in the development of the final engineering design. The placement of slime tailings, demolition debris, and organic materials and the compaction of the tailings during construction are discussed in Section A.3.3 (pages A-39 and A-40) of Appendix A, Conceptual Designs, of the DEIS. As stated there, appreciable differential and total settlement of the tailings would not occur, and normal consolidation and settlement of the tailings would not adversely affect the long-term stability of the final disposal site. Materials in the tailings pile would be compacted to increase strength and reduce compressibility. They would be placed and compacted in lifts, and mixing of the tailings during excavation, unloading, spreading, and compaction would be expected to preclude the occurrence of extensive lenses of slime tailings in the final disposal site. Organic materials would be evenly distributed throughout the final disposal site so that there would be no more than five percent of organics by volume in any area of the disposal cell; this requirement would be specified in the remedial action plan (RAP) and final engineering design. Demolition debris that is relatively more contaminated would be placed in the lower portions of the final disposal site and surrounded by compacted tailings; the procedures for this placement would be specified in the RAP to avoid a concentration of demolition debris in any area

and to assure adequate compaction of the tailings around the debris. Test data (Table D.1.1 in Appendix D, Soils, Geology, and Seismicity) indicate that the compacted tailings would have a saturated hydraulic conductivity of 10^{-3} to 10^{-5} centimeters per second (cm/s) and a dry density of 82 to 99 pounds per cubic foot.

6.3.2 Comment

The final tailings pile design for the Estes Gulch site is basically adequate. The construction of a filter layer and coarse rock cover over the stabilized tailings pile would result in maximum infiltration of precipitation into the pile while reducing any possible evapotranspiration from the pile. The coarse rock cover would be an excellent moisture retainer and would probably also have an adverse effect on the freeze/thaw cycles, thereby limiting or shortening the effective life of the compacted radon barrier (1).

Response

The susceptibility of the radon barrier to freeze/thaw effects has been studied. The DOE agrees that the rock erosion protection barrier and underlying filter layer would increase infiltration of precipitation into the stabilized tailings pile and reduce evapotranspiration from the pile. However, the slopes of the stabilized pile and hydraulic conductivities of the filter layer and compacted radon barrier would promote the drainage of precipitation from the pile to minimize infiltration. In addition, a freeze/thaw protection layer, consisting of 3.0 feet of loosely compacted soils excavated from the Estes Gulch disposal site, and 0.5 foot of drainage material, would be installed above the radon barrier to protect it against freeze/thaw effects. For frost action (and possibly frost heave) to occur, three conditions must be simultaneously present in a soil: susceptibility to frost, freezing temperatures, and a source of free water (Mitchell, 1976). The DOE believes that the design of the erosion protection barrier, filter layer, frost protection layer, and radon barrier would prevent frost action by preventing these three conditions from being simultaneously present (see Frost Heave/Solifluction in Sections A.2.6, A.3.7, and A.4.7 of Appendix A, Conceptual Designs). The RAP contains additional details on infiltration and frost action for the stabilized tailings pile.

6.3.3 Comment

Is the Glenwood Springs borrow site the only source of coarse aggregate to be used for the proposed project? It is rumored that the DOE has decided to use limestone from upper Rifle Creek instead; if this is so, then the DEIS is in error (1).

Response

The DOE presently considers the limestone rock from the Glenwood Springs borrow site to be suitable for erosion protection materials for the action alternatives. Upper Rifle Creek was considered to be a potential source of durable rock for the remedial actions, but use of this source is not planned at the present time. As stated in Sections 1.4, 3.2.6, and 5.0 of the DEIS, the borrow sites included in the DEIS were selected as the sources of the necessary borrow materials for impacts analyses purposes only. Other sources of borrow materials may be considered during the final engineering design, and the Remedial Action Contractor (RAC) will select the borrow sites to be used for the remedial actions. The DOE believes that the inclusion of the Glenwood Springs borrow site in the DEIS resulted in a conservative estimate (i.e., realistic upper limit) of the environmental impacts associated with obtaining rock borrow material for the remedial actions.

6.3.4 Comment

It is stated that the alluvial groundwater table at the New Rifle site lies within five to 10 feet of the ground surface and that groundwater levels fluctuate almost five feet during the year. It is also stated that the depths to groundwater at the Old Rifle site range from two to 12 feet below the ground surface and that these groundwater levels fluctuate more than seven feet during the year. It is quite possible that excavations of contaminated sub-pile soils at the New Rifle site would intercept the groundwater table, and it is clear that similar excavations at the Old Rifle site would definitely encounter significant amounts of water. Pumping of these contaminated groundwaters to allow excavations "in the dry" would necessitate special control and containment measures to prevent further degradation of water quality. If any discharges are anticipated, a Colorado Pollutant Discharge System Permit would be required (2).

Response

The DOE agrees with the comment. As indicated in Section 3.2 and Appendix A, Conceptual Designs, of the DEIS, dewatering of the tailings and underlying soils would be necessary at the Old and New Rifle sites and would require special control, containment, and treatment procedures to prevent water quality degradation. Appendix K, Permits, Licenses, and Approvals, of the DEIS indicates that a Colorado Pollutant Discharge System Permit may be required (page K-3).

6.3.5 Comment

Additional data is needed to verify that future erosion, downcutting, and encroachment of nearby gullies would not compromise tailings pile integrity through undercutting and piping at depths greater than those in the existing gullies at the Estes Gulch site. Figure 3.27 indicates that the depth to bedrock in the area of the proposed pile exceeds 15 feet. Given the relatively high surface soil erosion rates (up to 8.3 feet or more per 1,000 years on page D-38) and soil piping effects, it would be essential that the rock apron be sufficiently deep and adequately anchored to withstand further headcutting processes over the design life. Headward erosion in the existing large gullies may require direct erosion control in addition to rock apron protection at the south edge of the proposed pile. The Colorado Geological Survey has expressed concern that the design thickness of the rock apron for the southern edge of the pile would allow rocks to fall into the gullies and would, over time, cause the rocks to become resituated enough to defeat the design purpose. It would be prudent to place the toe of the proposed apron at bedrock especially where the potential for gully development is judged to be the greatest. Final design measures to protect against gully intrusion should be based on future, more detailed site observations (1,2).

Response

The DOE agrees with the comment. In response to public concerns, additional design changes have been implemented to specifically control potential erosion problems at the Estes Gulch disposal site. These design modifications are detailed in Section 3.2.4, Disposal at the Estes Gulch site--the preferred alternative, and in A.3, Disposal at the Estes Gulch site. The DOE believes that the modified conceptual design for the rock aprons in the FEIS is adequate for impacts analyses purposes.

6.3.6 Comment

The stratigraphy of the disposal site foundation includes sands, silts, and silty sands with areas of blocky, fractured soil units and an extensive weathered and fractured zone of the Wasatch Formation. Excavation of the clayey, infiltration-inhibiting soils at the Estes Gulch site could effectively open these potential avenues for enhanced migration of tailings pile leachate beneath the tailings pile. It would be prudent to consider excavation of sandy lenses, cobbles, etc. as necessary prior to the preparation of a compacted low-permeability layer. This would serve to minimize the effects of preferential or fractured flow conditions which may be encountered beneath the site during its development (2).

Response

As indicated in Section A.3.3 of Appendix A, Conceptual Designs, the base of the below-grade excavation for the final disposal cell would be scarified, moisture conditioned, and recompactd to minimize the potential for contaminant migration from the tailings. Contaminated seepage from the tailings will also be reduced by minimizing the addition of construction water to the tailings. This would mitigate the transient drainage from the tailings following completion of the disposal cell. Finally, the steady-state seepage flux through the tailings will be minimized by the low hydraulic conductivity (10^{-8} cm/s) radon barrier overlying the cell.

Hydrologic field testing of the Estes Gulch disposal site indicates that the underlying stratigraphy of the disposal site primarily consists of variegated claystones, siltstones, shales and fine-grained sandstones. The weathered zone of the Wasatch Formation is not extensive, but rather, it occurs in a layer approximately 20 feet thick immediately beneath the surficial colluvium. Furthermore, the Wasatch Formation is not extensively fractured, except in the weathered bedrock. Packer tests in the fracture zones below the weathered bedrock indicate that the fractures do not serve as potential avenues for contaminant migration as they are relatively impermeable and close with depth.

Thus, the excavation of sandy lenses, cobbles, etc., will not be necessary to minimize the potential for preferential or fractured flow conditions in the Wasatch Formation. This potential will be minimized by the low permeability cover, the placement of relatively dry tailings, and the ideal stratigraphy below the proposed disposal site.

6.3.7 Comment

The source and quality of the water to be used at the Estes Gulch site should be given, and the effects of this water use should be evaluated (3).

Response

The potential sources of water to be used at the Estes Gulch site are identified in Section A.3.4.4 (page A-43) of Appendix A, Conceptual Designs, of the DEIS. The estimated quantity of water to be used at all sites during the Estes Gulch alternative is provided in Table A.5.11 of Appendix A, Conceptual Designs, and in Tables 5.8 and 5.15 in Sections 5.5.1 and 5.14 of the EIS, respectively. Section 5.5.1 has been revised to adequately describe the impacts of this water consumption.

6.3.8 Comment

The FEIS should specify the design life intended for the stabilized tailings. This is especially necessary given the 200- to 1,000-year range of design lives (page 26) that could be designated (3).

Response

As stated in the DEIS, the design life of the stabilized tailings pile would be at least 200 years and, to the extent reasonably achievable, 1,000 years due to the following design features:

- o Erosion protection for the PMP and PMF.
- o Durable, natural materials for erosion protection.
- o Slope stability for both static and dynamic (seismic) conditions.

In reality, the pile would be stable for a period considerably exceeding 1,000 years due to the use of durable, natural materials and the design features for severe natural events such as the PMP and PMF.

6.3.9 Comment

We suggest that the DOE evaluate the effects of continual use of contaminated water for dust suppression over time because such a practice would tend to concentrate the contaminants on the surface. The DOE should specify what precautions would be taken to prevent this from becoming a health hazard and to prevent contamination of riparian areas through overland flow (3).

Response

Contaminated water would be used for dust control only on areas already contaminated by the tailings or uranium milling (e.g., windblown tailings); contaminated materials from these areas would be consolidated with the tailings at the final disposal site. As stated in the DEIS, the design for each action alternative includes drainage control measures (e.g., berms, drainage ditches, wastewater treatment plants and retention basins) to control surface water runoff at each UMTRA Project site. These drainage control measures would protect against the release of contaminants during interim or remedial action.

6.3.10 Comment

The FEIS should state that the degree of differential settling would also depend largely on the compaction achieved (3).

Response

Sections A.2.2, A.2.6, A.3.3, and A.4.3 of Appendix A, Conceptual Designs, have been appropriately revised to reflect that the total long-term settlement of the materials in the disposal pile will be very small due to compaction of the pile materials, as well as the granular, non-plastic nature of the tailings.

6.3.11 Comment

We would like to point out a factor that could be overlooked when evaluating the groundwater protection function of the radon barrier. The radon barrier's holding of moisture would be enhanced by the rock cover as stated in the DEIS. However, the effect of the freeze-thaw cycles that would operate at depth in the barrier would, in our opinion, increase the permeability of the barrier. This would lessen the groundwater protection function of the barrier. We believe that the effects of freezing and thawing should be carefully evaluated and included in the FEIS (2,3).

Response

See Response 6.3.2 above.

6.3.12 Comment

The DEIS states that 10 percent of the radon barrier at the Lucas Mesa site would be bentonite to assure a minimum of 500 years for water to percolate 200 feet (pages 46 and 47). However, no mention of using bentonite in the radon barrier at the Estes Gulch site is made (page 38). Also, the radon barrier at the Lucas Mesa site would be slightly thicker than that at the Estes Gulch site (four feet versus 3.5 feet). These differences should be clearly explained (3,5).

Response

The specific physical properties of the Lucas Mesa earthen borrow materials required amendment with bentonite to prevent piping and erosion of the finer-grained radon barrier and for groundwater protection. The Estes Gulch earthen borrow materials did not require this addition. As stated in the DEIS (Sections 3.2.3, 3.2.4, and 3.2.5 and Sections A.2.4, A.3.5, and A.3.6 of Appendix A, Conceptual Designs), the reasons for the different radon barrier thicknesses for the action alternatives are the results of the RAECOM computer model; this model considers data on the distribution of radium in the tailings and the physical properties of the earthen borrow materials to be used for the radon barrier.

6.3.13 Comment

The DEIS discusses the occurrence of piping at the Estes Gulch site (e.g., pages 89 and D-43). If piping occurs, this could create severe headcutting into the stabilized tailings pile, and parts of the pile could collapse. This collapse could, in turn, cause pollution of the alluvial aquifer at Government Creek and consequent deterioration of the quality of water taken from the domestic wells that tap it. Remedial action measures to prevent piping should be specified in the FEIS, and a contingency plan should be formulated for monitoring the pile for piping and long-term erosion and for mitigation should piping or erosion occur (3).

Response

The piping that has occurred at the Estes Gulch site is contained within soils overlying the bedrock; the bedrock is not susceptible to piping or gully development. Piping and development of gullies in adjacent drainages would not affect the disposal site because the site is protected by bedrock at or very near the ground surface immediately adjacent to the proposed location of the stabilized tailings pile. As described in Section 3.2.4 and Sections A.2.6, A.3.7, and A.4.7 of Appendix A, Conceptual Designs, the rock erosion protection barrier would have an underlying filter layer to prevent piping and the erosion of the finer-grained radon barrier. This filter layer would extend between any layers, including drainage ditches, where grain size compatibility is required. The composition of the filter layer would be determined during the final engineering design when the grain size distributions of the radon and erosion protection barriers are finalized.

6.3.14 Comment

The measures for mitigating the development of lateral branches of adjacent surface drainages should be specified (page 89) (3).

Response

In response to concerns raised by the public, design modifications have been implemented to protect the stabilized tailings pile at the Estes Gulch site against the headward advancement of nearby surface drainages (Section 3.2.4 and Section A.3.7 of Appendix A). The rock erosion protection barrier covering the pile would be extended to bedrock and tied into the rock-lined toe ditch to the south, the rock-lined key trenches to the east and west, the unlined interceptor ditch to the north, and the graded, riprap-enhanced area of the upland

drainage region to the north. These design features all serve to divert surface water runoff away from the pile and prevent the headward advancement of drainages into the pile.

6.3.15 Comment

We found significant inconsistencies and voids in the technical data supporting the remedial action, but, more importantly, we have serious reservations about the ability of the proposed design to meet the long-term stability requirements of the EPA standards. We are concerned about both the characteristics of the proposed Estes Gulch disposal site and the resultant, extensive and elaborate design measures necessary to provide stability for the tailings. Erosion protection for the stabilized tailings may be difficult because of the steep slopes adjacent to and upgradient of the disposal site and the need to divert upstream surface water flows around the site. The design also incorporates steep, heavily armored diversion ditches whose satisfactory performance may not be demonstrated without relying on periodic maintenance. We also note that the design for the disposal site does not seem to be consistent with the site's geologic setting. Based on the items mentioned above and the more detailed comments enclosed, we conclude that the proposed remedial action for the Rifle sites has not been shown to provide control of the stabilized tailings for the specified period (200 to 1,000 years). Although you may choose to modify the design for the Estes Gulch site in accordance with our comments to provide reasonable assurance of long-term stability, it may be more prudent to re-examine the site selection process to determine if less costly and more viable disposal alternatives exist. Our review of the DEIS suggests that better sites than Estes Gulch may indeed be reasonably available near Rifle (4).

Response

In response to public concerns, additional design changes have been implemented to specifically control potential erosion problems at the Estes Gulch disposal site. These design modifications are detailed in Section 3.2.4, Disposal at the Estes Gulch site (the preferred alternative) and in A.3, Disposal at the Estes Gulch site. The DOE believes that the conceptual design for the Estes Gulch site complies with the EPA standards (40 CFR 192), and feels the final engineering design assures that the design life specified in the EPA standards would be met. The alternate site selection process used to select the Estes Gulch site is described in detail in Appendix B, Alternatives Analyses. Numerous factors such as geotechnical (e.g., erosional stability) and hydrological (e.g., depth to groundwater) criteria were considered in this process, and the Estes Gulch site had the highest score of the two sites selected for field evaluation. The DOE therefore believes that the Estes Gulch site will provide a tailings disposal site that will meet the requirements of PL 95-604 and the proposed EPA groundwater protection standards.

6.3.16 Comment

We are concerned that the shear strength data presented in Table D.1.1 of the DEIS were not determined using standard engineering practice (4).

Response

The shear strength data in Table D.1.1 in Section D.1.3 of Appendix D, Soils, Geology, and Seismicity, are a summary of more detailed data on file at the DOE's UMTRA Project Office in Albuquerque, New Mexico. As stated in Section D.1.1 of Appendix D, Soils, Geology, Seismicity, "laboratory tests were performed in accordance with the standard methods and specification of the American Society for Testing and Materials (ASTM) or accepted practice." Additional details of the field and laboratory testing programs in the DOE's files also indicate that the shear strength values generally exceed those of typical tailings materials that are similar to uranium tailings. While none of the laboratory tests performed exactly duplicates expected field conditions, the following statements are applicable:

- The tailings exhibit high drained strengths.
- Partially saturated direct shear samples usually show high strength values due to capillary effects that arise during shearing of the test sample.
- Density should have an effect on shear strength.
- Triaxial and direct shear tests were performed according to Army Corps of Engineers Testing Manual EM 1110-2-1906 with the exception that multi-phased triaxial tests were performed.

6.3.17 Comment

Strength test values for the relocated tailings and the assumption that no extensive lenses of slimes would exist in the compacted tailings are both based on the expected uniform mixing of sands and slimes of the two existing Rifle tailings piles. Because of this uniform mixing assumption, it is stated that no appreciable differential and total settlement would occur. The procedures that would be required to give the expected uniform mixing should be described (4).

Response

Disposal at the Estes Gulch site would require excavation, loading and unloading, spreading, and compaction of the tailings, and all of these activities would result in mixing of the

tailings. Further, mixing of slimes with drier materials will be required in order to meet long-term moisture requirements for the tailings pile. Mixing of the tailings would be accomplished at the direction of the appropriate construction personnel. Successful mixing of sand and slime tailings has been accomplished at other UMTRA Project tailings sites such as Salt Lake City, Utah, and Shiprock, New Mexico, without specific mixing requirements being included in the final engineering design. The Rifle tailings are uranium tailings subjected to similar milling procedures and techniques as tailings at other UMTRA Project tailings sites. This similarity in milling procedures creates tailings with similar physical properties. Therefore, the DOE believes that the Rifle tailings will mix and behave successfully as tailings have behaved at Salt Lake City, Utah and Shiprock, New Mexico.

6.3.18 Comment

Preparation of the base of the Estes Gulch disposal site is listed as one of the design features to minimize the potential for contaminant migration from the tailings to the groundwater. A detailed description of what would be included in the preparation (clay barrier, simple compaction, etc.) should be presented in the FEIS (5).

Response

Preparation of the base of the below-grade disposal area at the Estes Gulch site is described in section A.3.3 of Appendix A, Conceptual Designs, under Tailings pile construction. The base would be scarified, moisture conditioned, and recompacted.

6.4 RADIATION

The comments on radiation concerned the extent of contamination adjacent to the Old and New Rifle tailings sites.

6.4.1 Comment

Elevated levels of radioactivity and heavy metals exist in the soils and in some waters in the large area to the west of the New Rifle tailings pile. How would this contamination, which is not included in the designated site area, be cleaned up (2)?

Response

Both the DEIS (Section 4.8.1 and Section A.2.2 of Appendix A, Conceptual Designs) and the RAP call for the removal of off-pile contamination (e.g., windblown tailings) at the Old and New Rifle sites to meet the EPA standards (40 CFR 192).

6.4.2 Comment

Section 4.2.1, Old Rifle site (page 67), indicates that the tailings have been dispersed by wind into the area of the State Nursing Home. The area is shown on Figure 4.9, Off-pile contamination, Old Rifle site (page 111). We believe that the State Nursing Home property is partially within the contaminated area, although the lack of landmarks on Figure 4.9 makes it difficult to assure an accurate location. Additionally, the scale on Figure 4.9 is incorrect.

Prior to construction, contaminated soil was removed from the nursing home site and immediately adjacent ground. Following the cleanup, a gamma scan survey of the property was conducted. Based on this survey, the Colorado Department of Health stated that the property receives gamma radiation shine from the contaminated adjacent hillsides and area directly south across the paved county road. They also stated that the slightly elevated gamma readings should diminish when the UMTRA Project decontaminates the area. Please clarify Figure 4.9 with the additions of Fifth Street and any other helpful landmarks so that we may be assured that the UMTRA Project would remove the source of the radiation shine. Maps showing the location of the State Nursing Home are enclosed for your use (6).

Response

The scale on Figure 4.9 has been corrected, and additional landmarks north of the Old Rifle tailings site have been added to the figure. In addition, the RAP and final engineering design contain more detailed maps and drawings of the areas to be decontaminated during the remedial actions. Please see the response to 6.4.1 above, regarding the removal of off-pile contamination during the remedial actions.

6.5 AIR QUALITY

One commentor addressed the need for air pollutant emissions controls to meet applicable air quality standards. Another commentor questioned the difference in the air quality impacts at the Old and New Rifle tailings sites between the remedial action alternatives.

6.5.1 Comment

Estimates of maximum average annual concentrations of total suspended particulates (TSP) during remedial action (Table 5.6) suggest that the Federal and state primary TSP standards would be exceeded except at the Old Rifle site during the Estes Gulch alternative. Appropriate emissions controls would need to be implemented to minimize fugitive dust emissions and to meet

acceptable ambient air quality standards. Specific final control measures would need to be established during the emissions permit review process (2).

Response

The DEIS has been revised to show that the Federal and state primary TSP standard of 75 $\mu\text{g}/\text{m}^3$ would not be exceeded at the Old Rifle site during the Estes Gulch disposal alternative (see Tables 1.1 and 5.6 in Sections 1.4 and 5.2 of the DEIS, respectively). The analysis of air quality impacts was based on very conservative assumption that would tend to over-predict impacts. The DOE does not intend to violate air quality standards knowingly. Where air quality standards are projected to be exceeded, even under conservative scenarios, DOE and UMTRA Project policy and procedures dictate that air quality would be closely monitored. As an ongoing part of normal UMTRA Project construction practice, water or other chemical dust suppressants are used regularly to minimize fugitive dust emissions.

6.5.2 Comment

Alternative 3 is slightly preferable in that the maximum average annual concentrations of TSP would not be exceeded at the Old Rifle site. The same criteria is listed as temporarily exceeded under Alternative 4 (Table 1.1, Summary of impacts, page 9) although it is not clear why this characteristic differs between Alternatives 3 and 4 (6).

Response

See Response 6.5.1 above.

6.6 MINERAL RESOURCES

Most of the comments about mineral resources concerned the impacts of the remedial actions on mineral and oil and gas resources or the use of limestone for the erosion protection barrier.

6.6.1 Comment

Remedial action impacts on future mineral production in the area are not clearly described. Although known mineral deposits in the area are not currently economic, the FEIS should state whether possible future mineral development would be precluded or adversely impacted by the remedial actions. Also, there is the possibility that economically recoverable minerals such as uranium or vanadium could be present in the tailings. This possibility should also be addressed in the FEIS (3).

Response

As stated in Section 5.4 of the DEIS, stabilization of the tailings and contaminated materials at a final disposal site would not necessarily preclude future development of any oil, gas, and mineral reserves beneath or adjacent to the disposal site. Public Law 95-604 requires that surface and subsurface rights at the disposal site be transferred to the Federal government. Public Law 95-604 also authorizes the Secretary of the Interior, with the concurrence of the Secretary of Energy and the NRC, to dispose "of any subsurface mineral rights by sale or lease. . . . if the Secretary of the Interior takes such action as the Commission deems necessary pursuant to a license issued by the Commission to assure that the residual radioactive materials will not be disturbed by reason of any activity carried on following such disposition." However, it is unlikely that these resources would ever have a value sufficient to warrant development under the conditions that the NRC may place on development of these resources in order to ensure that the stabilized tailings are not disturbed by resource recovery operations. The possibility of recovering economic minerals such as uranium and vanadium from the Rifle tailings is discussed in Section 3.3.2 and Section B.4.1 of Appendix B, Alternatives Analyses.

6.6.2 Comment

If limestone is to be used to armor the radon barrier, it should be considered that the only limestone available is on unpatented mining claims. Also, the Glenwood Springs borrow site is a limestone quarry on a locatable mining claim. Under the existing laws, limestone can be used from a locatable mining claim only for certain purposes, and the proposed use does not appear to qualify as one of them. The DOE should consider finding an alternate source of limestone (3).

Response

As stated in the DEIS, the borrow sites included in the DEIS were selected as the sources of the necessary borrow materials for impacts analyses purposes only. The RAC will select the borrow sites to be used for the remedial actions during the final engineering design, and this selection will necessarily comply with applicable laws and regulations. Limestone on lands administered by the BLM is considered a locatable mineral, and, as such, its use is governed by the General Mining Law of 1872. This law requires that end use of such limestone must utilize the high purity and total carbonate content of the limestone. The rock used for erosion protection of the final tailings disposal site must meet certain durability requirements in order for the disposal site to meet the long-term stability criteria of the EPA standards (40 CFR 192). High-purity limestone can meet these durability requirements, and the DOE therefore believes that the

use of limestone for erosion protection of the final disposal site would be consistent with the end use requirements of the General Mining Law of 1872.

6.6.3 Comment

The ownership of mineral rights under the Estes Gulch site should be identified (3).

Response

Section 4.5.3 of the DEIS has been revised to identify the ownership of the mineral rights at the Estes Gulch site.

6.6.4 Comment

The Estes Gulch site is subject to active oil and gas leases (page 6), but disposal would preclude oil and gas drilling. The FEIS should address this issue (3).

Response

See Response 6.6.1 above.

6.7 GEOLOGY AND WATER

There were numerous comments about the geological and hydrological discussions presented in the DEIS. All of the comments about geology concerned the relationships between geological and hydrological conditions and the impacts of remedial actions on groundwater resources. Most of the comments about hydrology concerned the data, assumptions, and procedures used to assess the impacts of remedial actions on groundwater resources.

6.7.1 Comment

Section E.2.2.2, Geohydrology, provides details about the groundwater parameters at the two Rifle tailings sites, but the discussion of the Estes Gulch site is limited to the range of soil depths, number of test holes drilled, and depth to groundwater. There is no definitive discussion of the pertinent geohydrologic parameters for the soils and underlying rock strata, which could affect the rate at which leachates could migrate from the stabilized tailings pile. Permeability of the soils is listed in Table D.1.1, and minimum attainable permeability for the radon barrier is given in Section A.3.8; however, the permeabilities of the tailings and the underlying rock are not discussed. Based on the statement that it would take 800 years for leachate to reach the

groundwater level (270 feet), it seems that the radon barrier permeability was assumed for all underlying materials. This ignores the fractured nature of the underlying Wasatch Formation (Section D.1.2, page D-8; Figure D.1.8, page D-10; and Section D.2.4, page D-28), which could have much higher permeability and could influence the velocity and direction of leachate migration. The Estes Gulch site is on the flank of the Grand Hogback, where the dip of the sedimentary beds is increasing from about 10 to 60 degrees from the horizontal. These steeply dipping beds, coupled with the fracturing mentioned above and the faulting in less competent shale beds in the North Canyon Coal Mine at the head of Estes Gulch about one mile northeast of the proposed disposal site (Horn, G. H. & W. C. Gere, Geology of the Rifle Gap Coal District, Garfield County, Colorado, U.S. Geological Survey Open File Report 59-0063, 1959), suggest that geohydrologic conditions are more complex and not necessarily as ideal as concluded in the DEIS. Reference was made to drill holes, logs, etc. being available in the UMTRA Project Office in Albuquerque, New Mexico; however, discussions or tables such as those used to describe the two Rifle sites were not included in the DEIS to support the author's position or to enhance the reader's understanding of the conclusions for the Estes Gulch site (1).

Response

In response to the issuance of the proposed EPA groundwater protection standards (40 CFR 192) and to public comments, additional subsurface investigations were recently conducted to address more fully the characterization of groundwater and the potential for the migration of unsaturated flow from the Estes Gulch disposal site. Specifically, vertical and slant hole core drilling and packer tests were performed to characterize fracturing. Additional monitoring wells were installed to establish conductivity, flow gradient, and the relationship to the regional aquifers. These findings are detailed in Sections 4.5.1 and 4.5.2 of the text, and D.1.2, D.1.3, and D.3.2 of Appendix D (Soils, Geology, and Seismicity). The test results indicate that the average hydraulic conductivity of the upper 20 feet of the Wasatch Formation is approximately 10^{-4} to 10^{-5} cm/s, but the conductivity decreases to 2×10^{-8} cm/s in the nonweathered bedrock. Furthermore, the underlying fractures close with depth and do not contribute significantly to the permeability of the bedrock at depths greater than 20 feet. In addition, there is little or no increased permeability in the fault zone located several hundred feet south of the disposal area. The DOE believes these field investigations adequately demonstrate that the extremely low conductivity, coupled with the nature of the strata beneath the site, will not provide a pathway for the infiltration of leachate from the pile over the long term, and the pile will comply with the EPA's proposed groundwater protection standards.

6.7.2 Comment

The conclusion that the minimum amount of time required to flush all contaminants from the alluvial aquifer would be approximately two years is lacking in substantive documentation. Geochemical processes such as absorption, precipitation, etc. do not appear to have been considered in this estimate. Based on similar situations at other UMTRA Project sites, there is evidence that the minimum amount of time for natural flushing at this site would be in the range of many decades and perhaps several centuries. It is misleading for the DEIS to represent a two-year natural cleanup scenario as indicative of what may optimistically occur in the future at the Old Rifle site. This section should be amended to reflect an estimate based on the best available data for this situation (2).

Response

Additional analysis has determined that the flushing times for groundwater contaminants included in the DEIS were preliminary, and they have since been removed from presentation by the DOE. Additional modeling indicates that, at the Old and New Rifle sites, natural flushing would reduce concentrations of conservative contaminant species to background levels in the alluvium within 10 years after the tailings have been removed at the Old Rifle site, and within 50 years at the New Rifle site. However, natural flushing of non-conservative (geochemically reactive) species could require considerably more time and require active aquifer restoration. Natural flushing in the underlying Wasatch Formation within 100 years would be negligible because of the formation's low hydraulic conductivity.

For all of the action alternatives, natural flushing with proper institutional controls would eventually bring contaminant concentrations at the Old and New Rifle sites into compliance with MCLs. However, for stabilization at the New Rifle site, periods of flooding of the Colorado River could cause periodic exceedance of the proposed standards. If natural flushing is not sufficient to reduce all concentrations to MCLs or background within 100 years, or if period flooding causes periodic exceedance of the proposed groundwater protection standards, then design modifications, active aquifer restoration, active restoration in combination with natural flushing, or ACLs would be required to ensure compliance. The need for and extent of aquifer restoration will be evaluated under a separate NEPA decision-making process when the final groundwater protection standards are promulgated. Sections 5.5.2 and E.2.4 have been revised to reflect this new information.

6.7.3 Comment

There is no existing law in Colorado that gives the state authority to regulate or prevent access to a private well in an

area of known or suspected groundwater contamination. The State Engineer's Office cannot take quality-based considerations into account when authorizing permits to construct private groundwater wells. Therefore, there is currently no mechanism available to the state to enforce institutional controls should they be advocated by the DOE as a means of providing groundwater protection to meet the EPA standards (2).

Response

Institutional controls can be used for passive aquifer restoration if natural flushing can be accomplished in less than 100 years. A variety of stipulations apply to this issue, including precluding the use of the contaminated water during the institutional control period. Currently, the state of Colorado does not have a mechanism for prevention of use of contaminated groundwater. The institutional control special study conducted for the UMTRA Project concluded that the best form of institutional control is outright ownership of the land by the Federal government.

6.7.4 Comment

The statements that "At the Old Rifle site, the hydraulic heads...and contaminants are therefore confined to the alluvium" and "Contamination in the alluvium cannot enter the underlying Wasatch Formation due to its greater hydraulic head" do not seem to completely reflect the data presented in the DEIS. Head measurements shown in Tables E.2.1 and E.2.31 indicate that a higher head exists in the Wasatch Formation at a point some distance east of the tailings pile, but heads are nearly the same or lower west of the pile. This type of situation appears to be only a local phenomenon, i.e., higher heads in the Wasatch Formation reflecting either relatively impermeable zones within this unit or similar, non-laterally continuous, clay layers in the alluvial system. Because of the inconsistencies in the head data, the conservative conclusion is the one made on page E-59 of the DEIS in the first paragraph, i.e., that the data may not be representative and contamination of the Wasatch Formation may have occurred. The DEIS should be changed to consistently reflect this equally plausible but more conservative conclusion for the Old Rifle site (2).

Response

The DOE agrees with your comment. Downward potentiometric gradients occur at the Old Rifle site, and the Wasatch Formation is contaminated. The revised FEIS contains additional information on this subject in Section E.2.3.4 of Appendix E, Hydrology.

6.7.5 Comment

The hydraulic gradient of 0.005 estimated for the New Rifle site seems too large. The gradient, as measured from data in the DEIS, seems to be closer to 0.003 (2).

Response

The DOE agrees. Additional field data indicate a revised estimate of 0.003 for the hydraulic gradient at the New Rifle site (Section E.2.3.5).

6.7.6 Comment

Unfortunately, wells chosen to represent the background water quality of the New Rifle alluvial aquifer were located within areas of known contamination (eg., radium and thorium). These are wells 591 and 592 at the New Rifle site. The April, 1985, radiological characterization of the New Rifle site by Bendix Field Engineering Corporation shows that the area of contamination extends eastward from the tailings pile beyond the locations of these two wells. If contamination has entered these wells, water quality within the wells will have been impacted and true background water quality at the New Rifle site will have not been determined. Thus, all conclusions in the DEIS that are based on background water quality, such as some from well 591, which appears to exhibit elevated gross alpha activity and uranium concentrations, and those presented in the aquifer restoration section of Appendix E, Hydrology, are suspect. Additional data are needed to confirm whether background alluvial water quality has been properly defined at the New Rifle site before the FEIS is completed (2).

Response

Monitor wells RFN 591 and 592 are located off the site and upgradient of the New Rifle pile, but are in areas of windblown contamination. However, groundwater quality in these wells has not been affected by the windblown contamination, and samples from the wells are representative of background water quality. A trilinear diagram (Figure E.2.22) and bivariate plot of alkalinity and sulfate in alluvial groundwater at the New Rifle site (Figure E.2.2.6) indicate that these monitor wells are uncontaminated and may be used to indicate background water quality.

6.7.7 Comment

The DEIS reports that the Wasatch Formation background water quality exceeds EPA primary drinking water standards for barium in two samples (New Rifle well 625 and Old Rifle well 630) and radium

in one sample (Old Rifle well 645). However, well 625 at the New Rifle site is located in a contaminated area near the tailings pile and vanadium ponds. Also, well 645 at the Old Rifle site appears to be contaminated with radium-226 (Ra-226) and radium-228 (Ra-228) combined, possibly from the Old Rifle tailings pile (see Comment 6). Furthermore, the alluvial aquifer system is hydraulically connected to the Wasatch Formation aquifer at the New Rifle site and apparently, to some extent, at the Old Rifle site. These wells will not produce the data necessary to distinguish between Wasatch Formation water influenced by the tailings and water that is truly "background" (2).

Response

None of these wells were used to define background water quality in the revised FEIS (Sections E.2.3.4 and E.2.3.5 of Appendix E, Hydrology).

6.7.8 Comment

The source of elevated radium concentrations (an Ra-226 and Ra-228 combined value of 9.3 pCi/l + 2.1) in well 645 (screened in the Wasatch Formation and located downgradient of the Old Rifle pile; Figure E.2.11) is not defined. Comparison with chemical analyses of alluvial groundwater samples at the Old Rifle site (Table E.2.22) indicates anomalously high concentrations of radium in alluvial wells 582 and 586. Several onsite or downgradient alluvial wells at the Old Rifle site were not sampled for radium. Additional documentation is needed for radium concentrations in well 645, perhaps also in adjacent well 644, and in other downgradient wells in the Wasatch Formation as necessary to verify possible radium or other contaminants in groundwater in the Wasatch Formation caused by seepage from the Old Rifle tailings pile (2).

Response

Radium concentrations in monitor well RFO 645 are somewhat elevated, but do not appear to be caused by tailings seepage from the Old Rifle site. In fact, groundwater from well 645 and the adjacent well 644 contains low levels of sulfate, uranium, and molybdenum--constituents which probably would be present if the well was contaminated. Furthermore, samples from these wells plot within the background concentration range on a trilinear diagram and on bivariate plots (Figure E.2.12 and E.2.15).

The complete water quality analyses for all the Old Rifle monitor wells are included in Table E.2.9. Radium was not always analyzed as a cost saving measure. However, other chemical parameters such as sulfate, nitrate, and chloride are more conservative,

and are better indicators of contamination. In addition, the trilinear diagrams and bivariate plots in the revised EIS Hydrology Appendix are excellent indicators of which wells are contaminated.

6.7.9 Comment

Except for local variations, it does not seem reasonable to conclude that higher heads exist in the Wasatch Formation at the Old Rifle site to the degree necessary to prevent tailings contamination in this formation. This is especially true considering the small total number of wells and the lack of any wells on the tailings pile or near its periphery. Relative hydraulic relationships between the Wasatch Formation and the alluvium, and the degree to which any contaminants exist in the Wasatch Formation beneath and downgradient of the Old Rifle site, appear to be uncertain and poorly defined (see Comment #8) (2).

Response

The DOE agrees with this comment. These issues have been addressed in Section E.2.3.4 of Appendix E, Hydrology, of the FEIS.

6.7.10 Comment

The DEIS states that uranium and molybdenum are "relatively immobile" with respect to travel time in groundwater. This is not true, and the DEIS should be changed to reflect this (2).

Response

The DOE notes your suggested correction and it has been incorporated into the revised Appendix E, Hydrology.

6.7.11 Comment

Colorado's "Basic Standards for Groundwater" were promulgated on March 3, 1987. Section E.2.3.2 of the DEIS should be revised to reflect this fact and include appropriate information (2).

Response

Subsequent to promulgation of Colorado's "Basic Standards for Groundwater," the DOE and the Colorado Department of Health agreed that the UMTRA project design standard would be the EPA's proposed groundwater standards issued in September 1987. Therefore, the EPA's proposed groundwater protection standards are the only standards addressed in this FEIS. However, for the purposes

of characterizing groundwater conditions, the DOE has found it useful to discuss other chemical constituents not listed under the proposed EPA groundwater protection standards. The UMTRA Project will comply with all applicable standards.

6.7.12 Comment

There seems to be potential problems with some of the wells used to define the background water quality in the alluvial aquifer at the Old Rifle site. It is conceivable that wells 597 and 598 may have been affected by windblown contamination. Wells 599, 600, 603, and 604 are downgradient, making their use as "background" wells possibly suspect. As stated in the Technical Approach Document, sample locations should be free of windblown radioactive contamination...and should not lie along the flow path hydraulically downgradient from any suspect contaminant source. Wells 601 and 602 across the river are probably adequate. Evidence to support this conclusion is that concentrations of total dissolved solids (TDS), sulfate, and uranium are consistently lower in wells 601 and 602 than all other wells used for determining background in the vicinity of the Old Rifle site (2).

Response

Monitor wells RFO 597, 598, 601 and 602 were used to define background water quality in the alluvium at the Old Rifle site in the EIS. Because monitor wells 599, 600, 603 and 604 are downgradient, they were not used to define background water quality in the EIS.

It is unlikely that windblown contamination has affected groundwater quality from monitor wells 597 and 598. The monitor wells are located outside of the zone of off-pile contamination at the Old Rifle site (Figure 4.11), measured by radiological surveys. Furthermore, groundwater underflow in the alluvium is so great that windblown contamination would probably not affect groundwater quality. Although some constituents in these two monitor wells exceed the EPA groundwater MCLs for molybdenum, selenium, and uranium, the somewhat high concentrations in these wells may be due to the gravel pits located upgradient of these wells. However, these two wells are more indicative of background water quality (and the quality of groundwater underflow in the alluvium beneath the Old Rifle processing site) than monitor wells 601 and 602. These wells are located in an area of alluvium which is recharged by the Colorado River. Use of groundwater quality data from only monitor wells 601 and 602 would be overly conservative, as water quality from these wells is exceptionally good, and would not facilitate differentiation between contaminated and uncontaminated monitor wells. Thus, background water quality was defined from both sets of monitor wells (597 and 598 as well as 601 and 602) to reflect the natural range of variability in groundwater quality within the alluvium.

6.7.13 Comment

For all of the chemical analyses presented in the DEIS, the analytical balance has not been reported with the individual analysis. This information is critical to an assessment of the reliability of the analytical results and should be provided in the FEIS (2).

Response

Analytical balances for all chemical analyses are reviewed as part of UMTRA Quality Assurance/Quality Control (QA/QC) procedures. No data from analyses were included if analytical balances did not conform to the standards set by the program. All information concerning QA/QC data acceptance are maintained in the DOE's files in Albuquerque, New Mexico, and may be reviewed there. The amount of the data supporting the data reported in the EIS is too voluminous to include in the EIS.

6.7.14 Comment

Wells 621, 624, and 640 (and possibly wells 622 and 626) at the Old Rifle site and wells 625, 628, 633, 643, 644, 650, and 651 (and perhaps well 631) at the New Rifle site suffer from cement contamination as a result of improper completion techniques. Analytical results from these wells may therefore be of little or no value for interpretation purposes. This fact should be made clear in the FEIS (2).

Response

All analytical results on samples from grout-contaminated wells were disregarded and were not used for interpretive purposes in the FEIS. Wells were considered to be grout contaminated if the pH values of the samples from wells were consistently higher than 9.0.

6.7.15 Comment

Strictly speaking, the modified Millington-Quirk method of estimating unsaturated hydraulic conductivity is not valid for very fine-grained soils, and great caution must be used in its application. The value of saturated hydraulic conductivity assumed for the radon barrier, 1.6×10^{-4} foot per day or 5.6×10^{-8} centimeter per second, seems to be too small to be reasonably representative of actual values of hydraulic conductivity for the compacted barrier after placement. Additionally, under unsaturated conditions, it is probable that vertical hydraulic gradients in the proposed cover (i.e., compacted, silty clay

overlain by a layer of gravel and rock) would greatly exceed unity due to the existence of strong negative capillary suctions in the radon barrier. The travel time calculations presented seem to be in error. These calculations have assumed that the hydraulic conductivity of the in situ materials beneath the stabilized tailings pile would be equivalent to the hydraulic conductivity of the compacted radon barrier. The radon barrier is estimated to be only 3.5 feet thick; at this thickness and using the values stated, the travel time of precipitation infiltration would be about 10 years. Subsequent to percolation passing through the barrier, the average linear velocity of the seepage would change. Using a K value of 1.0×10^{-6} centimeter per second, seepage would require on the order of 45 years to reach a depth of 75 feet and 175 years to reach a depth of 270 feet. Actual travel times may be less due to the fractured and weathered nature of the near-surface zone(s) of the Wasatch Formation (2).

Response

Travel time estimations for contaminants to reach groundwater in the DEIS have been determined by the DOE to be preliminary and have been removed from presentation in the FEIS. They would require detailed unsaturated flow modeling and additional information on the in situ moisture content of the various sandstones, siltstones, and shales of the Wasatch Formation, which is beyond the scope of this EIS. In addition, the proposed EPA groundwater protection standards address Maximum Concentration Levels (MCLs) in groundwater, not the travel time for the contamination to reach groundwater.

The saturated hydraulic conductivity of the radon barrier will be 10^{-8} cm/s in order to prevent ponding of tailings seepage on the low hydraulic conductivity (2×10^{-8} cm/s) bedrock of the Wasatch Formation. Because no significant quantities of perched water currently exist in the Wasatch Formation, natural infiltration is believed to be less than 2×10^{-8} cm/s.

Seepage through the tailings pile must be restricted to naturally occurring levels, and for this reason the hydraulic conductivity of the radon barrier will be 10^{-8} cm/s.

6.7.16 Comment

The assumptions used in the calculations of minimum times required to flush all contaminants from the alluvial and Wasatch Formation aquifers at the Old and New Rifle sites for the relocation alternatives are overly simplistic. Such assumptions should not be considered as realistic approximations of actual conditions at the Rifle tailings sites. Additional documentation is needed

to confirm projected clean-up rates, including adequate consideration of geochemical mechanisms operating at the sites and clarification of hydraulic head relationships and the degree of present and potential groundwater contamination at the Old Rifle site (2).

Response

Flushing time calculations in the DEIS were preliminary, and are not included in the revised EIS. Projected clean-up rates will be addressed in a separate NEPA decision-making process. Hydraulic head relationships and extent of contamination at the Old Rifle site have been re-evaluated and are described in Section E.2.3.4, Appendix E, Hydrology.

6.7.17 Comment

The state does not agree with the reported value of the contaminated groundwater in the Rifle area. Because contaminants would remain in the sediments of the aquifers for a very long time after removal of the tailings, the present water in the aquifers, along with the water that would move through the area in the future, would be indefinitely removed from Colorado's inventory of groundwater resources. Our order-of-magnitude calculations indicate that the total number of pore volumes flowing through the area over the life of the remedial actions would result in a loss of over 25,000 acre-feet of water. This number is based on the probable extent of contamination at the tailings sites and was reduced by a 30 percent recovery rate for any future pumping scheme. The value of this water would be difficult to quantify, but we do not feel that a subsidized price of \$109 per acre-foot, as computed for the municipal supply at the Village of South Rifle, represents a conservative or fair market estimate of the value of the lost resource. Accordingly, the Glenwood Springs Office of the Colorado River Water Conservation District was contacted for an estimate of the value of water in this area. A representative of this office informed the Colorado Department of Health that the cost of new reservoir water, under the favorable arrangement of a long-term lease, is on the order of \$400 per acre-foot. At this price, the value of the lost water would be slightly more than 10 million dollars over a 200-year term of tailings stabilization. This value is almost 42 times greater than the DOE's estimated value for the existing contaminated groundwater (page E-121) (2).

Response

The value of groundwater potentially used, rather than the total actual value of all contaminated groundwater, is estimated and addressed on a conceptual or general level of detail in the FEIS. Currently, the value of contaminated groundwater beneath the Rifle processing sites cannot be accurately determined. The

estimated value of contaminated groundwater presented is based on the current known extent of contamination and the volume of groundwater likely to become contaminated during the period when contaminants are being flushed from the aquifer. The DOE has estimated that conservative (geochemically nonreactive) species will be flushed to background concentrations within fifty years in the alluvium beneath the New Rifle site and within ten years in the alluvium beneath the Old Rifle site. However, the total number of pore volumes required to flush the geochemically reactive species from the alluvium is presently unknown, and hence the value of contaminated groundwater cannot be accurately assessed. The value of groundwater will be addressed with considerably more detail during the aquifer restoration phase.

6.7.18 Comment

The cost estimates for aquifer restoration exclude a plume management scenario, which could be the most cost-effective approach of cleaning up the tailings sites. Plume management and capture options should be further addressed in the FEIS. It is not necessarily true that plume management or capture is complicated and made more costly by the presence of the Colorado River adjacent to the contaminant plumes (2).

Response

Cost estimates for aquifer restoration are not addressed in detail in the final EIS. A detailed review of the various possibilities for aquifer restoration at the Old and New Rifle sites will be evaluated in a separate NEPA decision-making process.

6.7.19 Comment

No data are given on the soluble chemical content of the tailings. Heavy metals are stated to be present, but no data on concentrations are given. A thorough chemical analysis to determine soluble and insoluble constituents is necessary before developing a disposal plan. Both concentrations and ranges are necessary (3).

Response

The only existing data on soluble chemical content of the tailings was unacceptable according to UMTRA quality assurance/quality control (QA/QC) standards. The contaminant source was characterized using analytical results from monitor wells screened beneath the tailings piles at both sites (Sections E.2.3.4 and E.2.3.5). This provides a good indication of the geochemical mobility of heavy metals and other chemical constituents within the contaminant source.

6.7.20 Comment

The construction and completion details for monitor wells should be provided. This is especially necessary when multiple water-bearing zones are present. Also, no information is given about the fate of the monitor wells. Some wells must be kept active to monitor the success of remedial action or the movement of groundwater at the disposal site. The standards for sealing and plugging abandoned wells should also be given (3).

Response

A diagram of typical monitor well construction details is included as Figure E.2.1. Completion intervals of all monitor wells are presented in Tables E.2.2, E.2.4, E.2.10, E.2.12, and E.2.17 in Appendix E, Hydrology. Following remedial action at the site, some monitor wells will be kept active to monitor the results of the clean-up activities. All other monitor wells will be properly abandoned in accordance with the state of Colorado well abandonment requirements. Additional information on post-remedial-action monitoring of the sites will be included in the Rifle Surveillance and Maintenance Plan.

6.7.21 Comment

Although much is known about the Rifle tailings sites, we believe that additional geologic and hydrological studies are needed at the Estes Gulch site. For example, more definition of the fracture system at the Estes Gulch site is needed. This will permit a better calculation of the time for water to travel from the surface to the water table. Field measurements are also necessary for parameters used to estimate the travel time of subsurface water or the dispersion of any contaminant plume that could develop in the groundwater. We discourage the use of estimates taken from text or reference books for use in such calculations. We emphasize this point because such estimates are generally not site-specific and seldom take groundwater fracture flow into account. The influence of fractures on travel time has become increasingly recognized as a factor that cannot be ignored (3).

Response

Additional site characterization at Estes Gulch has been conducted and is summarized in Response 6.7.1.

6.7.22 Comment

If the contaminated groundwater in the Wasatch Formation under the New Rifle site would require 3,840 years to be flushed

and if a relatively undisturbed deep aquifer at the New Rifle site is contaminated within less than 50 years, it is unclear how it can be expected that a minimum of 800 years would elapse before the contamination of an aquifer in a highly fractured area (page 38). Water has moved downward 300 feet in a few hours along fractures in a prototype oil shale tract elsewhere in the Piceance Creek Basin (3).

Response

Additional analysis has determined that the flushing times for groundwater contaminants at the processing sites and the travel time estimates to contaminate groundwater in the Wasatch Formation beneath the proposed disposal sites included in the DEIS were preliminary, and they have since been removed from presentation by the DOE. See Response 6.7.2 and Sections 5.5.2 and E.2.4 of the FEIS for a revised discussion of flushing times for groundwater contaminants at the Old and New Rifle sites. Additional characterization of the fracture system at Estes Gulch has indicated that the fractures are relatively impermeable and close with depth. See Response 6.7.1 for additional information on the fractures at the Estes Gulch site.

More accurate estimations to quantify the travel time for contaminants to reach groundwater at both Lucas Mesa and Estes Gulch would require additional field characterization and detailed unsaturated flow modeling. However, since the compliance strategy for both sites is not based on travel time, the DOE determined that this level of additional characterization was not necessary.

6.7.23 Comment

We suggest that the calculations supporting the statement that it would take 500 years for surface water to reach 200 feet be revised. For a representative value, it is necessary to take into account the fractures at the site (3).

Response

See Response 6.7.22.

6.7.24 Comment

The comparison of times to contaminate groundwater at the Estes Gulch and Lucas Mesa sites should be recalculated when further geologic studies have provided information on fractures (3).

Response

See Response 6.7.22.

6.7.25 Comment

For the Estes Gulch Site, the origin of the estimated percolation rate through the radon barrier and the use of that figure to calculate the 800-year (minimum) travel time to reach the groundwater 270 feet below the site should be explained. We believe that the percolation rate and other properties of the materials below the radon barrier should also be given because of their possible influence on the estimated travel time. Of equal importance is the fact that fractures occur at the site (page D-28), and a downward travel time of less than an hour in 300 feet was measured in other fractured areas. The necessity for thorough fracture studies is indicated, and we recommend that these be done. We further suggest that any travel time estimates include the effect of fractures on downward water movement. This information is needed for the reader to evaluate the usefulness of the 800-year time or any adjusted time based on the suggested additional information. If the 800-year time is not changed, it should be designated as an estimate because the percolation rate on which it is based is estimated (3).

Response

See Response 6.7.22.

6.7.26 Comment

The basis for the use of 200 feet for the percolation depth at the Lucas Mesa Site should be made explicit. Likewise, the values used to calculate a minimum of 500 years for infiltration and percolation should be given and designated as estimates or measurements made in the field or laboratory. If the 500-year time is not supportable by measured data, it should be designated as an estimate (3).

Response

A percolation depth of 200 feet was originally used, as that was the minimum depth to groundwater. However, additional analysis has determined that the travel time estimates to contaminate groundwater beneath the proposed disposal sites included in the DEIS were preliminary, and they have since been removed from presentation by the DOE. See Responses 6.7.1, 6.7.2, and 6.7.22, and Sections 4.6.2, 5.5.2, E.2.3, and E.2.4 for additional information on the radon barrier, percolation, travel times, and fractures.

6.7.27 Comment

We suggest that the belief that only alluvial water is economically recoverable in the Estes Gulch area be re-examined. At least one domestic well is known to be producing abundantly from a depth of 350 to 400 feet approximately eight miles east of Estes Gulch (3).

Response

Although isolated domestic residences obtain water from the Wasatch Formation, production is limited and water quality is poor (Section E.2.3.6, Estes Gulch site characterization). The Wasatch Formation beneath the disposal site at Estes Gulch cannot be considered an aquifer because of its low hydraulic conductivity (2×10^{-8} cm/s) and low yields.

6.7.28 Comment

In the discussion of aquifer restoration on page 171, it would be helpful in evaluating the \$240,000 value for water if the premises used and calculations made were provided or if a reference were made to where these are stated in the FEIS (3).

Response

Aquifer restoration is not discussed in the FEIS. See Response 6.7.18.

6.7.29 Comment

The origin and supplier of the existing water supplies referred to on page 171 should be identified. In our experience, isolated residences are not easily serviced by the Rifle municipal water supply (3).

Response

The water supply for the city of Rifle is the Colorado River, and the city of Rifle supplies water to all residents living within the municipal boundaries. Most residents living outside the municipal boundaries obtain their water from private wells (Figure E.2.30 and Section E.2.5).

6.7.30 Comment

Given the proximity of human habitation to the Estes Gulch site, we believe some additional investigations are essential

before the final selection of any disposal site. These investigations should include an intensive study of the fracture system present at the Estes Gulch site; a better determination of the location of the groundwater; an evaluation of the springs, which are common along the Grand Hogback and which are used for domestic water; a determination of groundwater volume, depth, quality, and direction of flow; and a determination of the permeability of the Wasatch Formation. Measures to mitigate contamination of the springs along the Grand Hogback should also be formulated (3).

Response

These issues are discussed in detail in response 6.7.1 and in Section E.2.3.6 (Estes Gulch site characterization) in the FEIS. No springs have been observed in the vicinity of the Estes Gulch disposal site.

6.7.31 Comment

Given the importance of the sites being considered for tailings relocation, we suggest more thorough geologic studies for each. The fracture studies suggested previously are very important, as is additional water table definition. We also suggest that illustrations for all disposal sites be as fully informative as those for the Rifle tailings sites. For example, Figure D.2.6 is a cross section following standard professional practice, but we would suggest indicating vertical exaggeration for completeness. The cross sections for the Estes Gulch site (Figures D.1.8 and D.1.9), on the other hand, show only the total depths and lithologies as logged in the borings; no interpretation between the control borings are shown. The groundwater level of 270 feet (reported on pages A-59 and E-69) can also be shown in the appropriate borings (3).

Response

The cross sections in Figures D.1.8, D.1.9, and D.2.6 have been revised to incorporate these suggestions, and to reflect the new data gathered during the recent geologic and hydrologic field investigations.

6.7.32 Comment

A potentiometric map for the aquifer(s) at each site would be helpful supplements in Appendix E, Hydrology. Depth-to-water maps are especially valuable when evaluating sites for the purposes intended, and we urge that these be added so as to conveniently and fully inform the reader of these essential considerations (3).

Response

Potentiometric maps have been included and depths to water are presented in tabular form in Sections E.2.3.4 and E.2.3.5, Old Rifle and New Rifle site characterizations, of Appendix E.

6.7.33 Comment

The word "height" on page D-19 (third paragraph) should probably be "elevation" (3).

Response

This change has been made, as suggested.

6.7.34 Comment

The calculation of percolation through the compacted radon barrier on page E-113 assumes that the barrier would maintain its initial compaction. As pointed out in our comments for pages A-40 and A-41, we believe the normal freeze-thaw cycles and frost heaving would increase the permeability of the radon barrier to percolation, thus invalidating the percolation rates given for all or most of the sites (3).

Response

The susceptibility of the radon barrier to freeze-thaw effects has been studied. A freeze-thaw protection layer, consisting of 3.5 feet of loosely compacted soils excavated from the Estes Gulch disposal site, or 2.0 feet of loosely compacted soils for stabilization at the New Rifle site, plus 0.5 feet of drainage material would be installed above the radon barrier to protect it against freeze-thaw effects. This frost protection layer would thereby ensure the integrity of the radon barrier.

6.7.35 Comment

Table E.2.27 (Page E-114) is correct but could be misunderstood. The data suggest that groundwater contamination would occur 300 years sooner at the Lucas Mesa site. A footnote should explain that the DOE drilled only to a depth of 200 feet at the Lucas Mesa site and that the depth to groundwater is unknown.

Response

Additional analysis has determined that the travel time estimates to contaminate groundwater beneath the proposed disposal sites included in the DEIS were preliminary, and they have since been removed from presentation by the DOE. Section 4.6.2 and E.2.3.7 of the FEIS have been revised as suggested. See Responses 6.7.2 and 6.7.22 for additional information on travel times.

6.7.36 Comment

Several methods in reports on water rights appraisal and valuation show the value of water to be substantially greater than the \$109 per acre foot used in Sections E.2.6 and E.2.8. We suggest that alternate methods for the valuation of the water be presented in the DEIS and that these water valuation methods be examined before aquifer restoration is ruled out as not being cost-effective. Furthermore, institutional controls on water extraction should be considered as a means to prevent inadvertent use of contaminated water for human consumption (3).

Response

See Responses 6.7.3 and 6.7.17.

6.7.37 Comment

The DEIS contains inconsistencies and discrepancies that complicate independent verification of the DOE's conclusions about groundwater protection. The examples below illustrate the inconsistencies and deficiencies:

- o Page E-104 of the DEIS states that New Rifle alluvial well 581 has the highest concentration of uranium, but uranium concentrations are not contained in the table of water quality data for this well (Table E.2.24).
- o Page E-115 of the DEIS states that alluvial groundwater contamination at the Old Rifle site extends 800 feet downgradient, but page E-127 states that contaminated groundwater extends only 300 feet downgradient from the tailings pile in the alluvial aquifer.

The DEIS should be revised to resolve these and other discrepancies (4).

Response

The inconsistencies and deficiencies in the DEIS have been corrected in the FEIS. Analysis of new and existing data has indicated that the highest average uranium concentration occurs in New Rifle monitor well 593, as shown in Table E.2.15 of the FEIS. The discrepancy concerning the extent of contamination at the Old Rifle site has been corrected, as shown in Section E.2.3.4 under Extent of Contamination.

6.7.38 Comment

The DOE determined that contaminated groundwater at the Old Rifle site would be restored naturally in 1.9 years. Based on our review of the DEIS, this restoration period is highly non-conservative. Specifically, we question the assumption that additional contaminants would not be released to the groundwater by dissolution and desorption of contaminants. If dissolution and desorption occur, the amount of water flux required to restore the contaminated aquifer would be expected to exceed the one pore volume assumed in the DEIS. Numerous research programs have shown that several pore volumes of groundwater are needed to clean up contaminated aquifers because of dissolution and mobilization of constituents sorbed onto the porous media. In addition, we question the assumption that contaminants would migrate at one-half the groundwater flow rate. Some of the contaminants would be expected to be mobile and thus would migrate at the same velocity as groundwater. Migration of other contaminants, however, may be considerably retarded as a result of sorption and precipitation-dissolution reactions which would result in a wide variability of contaminant migration rates relative to groundwater flow rates. The DEIS should be revised to assess natural restoration using conservative assumptions and calculations to present a reasonable range of restoration rates (4).

Response

See Response 6.7.2.

6.7.39 Comment

The DOE used the concentrations of constituents in neutralized groundwater in subsoils beneath the tailings as the source term for contamination. This method underestimates the potential source term because contaminant concentrations in neutralized solutions are generally much lower than in solutions that are in contact with the tailings. In addition, the source term at the Rifle sites may be considerably higher than at other UMTRA Project sites because of the recent operation of raffinate ponds and other onsite activities creating a range of potential

contaminants. The DOE should collect representative samples of tailings material and/or tailings pore water. The DEIS should be revised to characterize the contaminant source term (4).

Response

Samples of groundwater commingled with tailings fluids collected from wells screened below the tailings piles were used to characterize the source, as they are the best available indicators of the chemistry of the source. As part of the geochemical characterization of the Rifle sites, lysimeter samples of tailings fluids will be collected and analyzed to better evaluate the source.

6.7.40 Comment

The DOE claims that irrigation water is no longer percolating through the tailings, thereby inferring that irrigation of the tailings piles has ceased. However, during a site visit on June 11, 1987, we observed the New Rifle tailings pile being irrigated at a rate of 700 gallons per minute for about 8 hours per day. Therefore, additional leachate may be percolating downward into the alluvial groundwater system at the New Rifle site. The DEIS should be revised to indicate that irrigation is ongoing and that additional leachate is being produced (4).

Response

The DOE concurs with this comment. The tailings pile at the New Rifle site is currently being irrigated as a dust control measure, as stated in Section 4.2.1. The additional leachate produced is contributing to the groundwater contamination problem at the New Rifle site.

6.7.41 Comment

The DOE claims that sufficient data are not available for calculating natural restoration rates for the aquifers at the New Rifle site. Natural restoration represents, in part, the no action alternative for assessing environmental impacts associated with remedial actions at Rifle. If impacts associated with natural restoration cannot be assessed, then the DOE cannot compare these impacts to water quality impacts for tailings stabilization at the New Rifle site. The DEIS should be revised to sufficiently characterize the groundwater systems at the New Rifle site to assess natural restoration and to evaluate the environmental impacts (4).

Response

See Response 6.7.18.

6.7.42 Comment

Accepting the estimated flushing time of 45 years to lower pollutant concentrations in the alluvial aquifer at the Old and New Rifle sites to background levels, the proposed program of long-term institutional controls to prohibit the use of groundwater from the affected zones does seem to be a reasonable and acceptable approach. However, for the contaminated zone in the Wasatch Formation at the New Rifle site, this approach does not seem to be a viable control mechanism in view of the projected flushing time of 3,840 years. It may well be that future utilization of this aquifer at this location is not a critical concern; however, an approach other than institutional controls would be needed if there is a definite need to protect public health in the event of use (5).

Response

See Responses 6.7.2 and 6.7.4.

6.7.43 Comment

The statement "Groundwater was not encountered in the three monitor wells drilled (maximum depth of 203 feet) at the Lucas Mesa site; . . ." is made in the DEIS. This finding raises doubt about the need for the inclusion of the bentonite in the radon barrier at the Lucas Mesa site and the prediction that the migration of pollutants could reach groundwater in approximately 500 years (as opposed to 800 years at the Estes Gulch site). Moreover, it undermines the credibility of the conclusion presented on the second page of the cover sheet (i.e., "Also, groundwater contamination could occur at the Lucas Mesa site in a short period of time"). There is no justification for the implication of a greater groundwater pollution potential at the Lucas Mesa site in comparison to the Estes Gulch site (5).

Response

In response to public concern, the Lucas Mesa groundwater characterization (Sections 4.6.2 and E.2.3.7) has been revised in the FEIS. However, additional analysis has determined that the travel time estimates to contaminate groundwater beneath the proposed disposal sites included in the DEIS were preliminary, and they have since been removed from presentation by the DOE. See Responses 6.7.2 and 6.7.22 for additional information on

travel times. Bentonite would still be required in the radon barrier to ensure an estimated hydraulic conductivity of 10^{-8} cm/s. This low hydraulic conductivity would limit the steady state seepage of tailings fluids to 10^{-8} cm/s and would minimize the potential for perching of contaminated seepage on the Wasatch Formation/pediment contact.

6.7.44 Comment

I am concerned that the hydrologic conditions at the Estes Gulch site were not sufficiently characterized. I don't think enough monitor wells were installed at the site (9).

Response

Three additional monitor wells were recently installed at the Estes Gulch site to provide information on conductivity, permeability, transmission, and/or gradient from the disposal site to the nearest known aquifer. The results are discussed in Response 6.7.1.

6.7.45 Comment

I am concerned that the DEIS does not adequately address the mobility of radioactive contaminants in the groundwater at the Old and New Rifle tailings sites and the Estes Gulch disposal site. Would the DOE have to excavate to bedrock at the tailings sites to remove all of the tailings contamination (10)?

Response

The extent of contamination in the alluvium and the Wasatch Formation at the processing sites has been thoroughly evaluated using water quality analyses data from the 94 monitor wells installed by the DOE. A complete radiological survey has been conducted, and all contaminated soils will be excavated. Excavation to bedrock will not be necessary, however.

Additional hydrogeological characterization was conducted at Estes Gulch, and the potential for contaminant transport in groundwater at Estes Gulch is addressed in Section E.2.4.1, Impacts of the preferred alternative.

6.8 ECOSYSTEMS

Five comments about the impacts to wildlife, wetlands and riparian habitat, and threatened and endangered species were received.

6.8.1 Comment

The U.S. Department of the Interior has specific concerns regarding impacts to wetlands and riparian habitat resulting from the uranium tailings removal. Interim actions or remedial action at the New Rifle site would require the excavation of approximately four acres of wetlands-riparian habitat. The restoration of all excavated or otherwise disturbed wetlands-riparian areas is crucial. Based on the U.S. Fish and Wildlife Service's (USFWS) mitigation policy, it has been determined that the riparian habitat within the impact area meets the criteria for resource category 2. The mitigation goal for habitat in this category is no net loss of in-kind habitat value. On page F-9 of Appendix F, Floodplain and Wetlands Assessment, the DEIS commits to a general mitigation plan for wetlands and riparian re-establishment. However, page 177 of the DEIS indicates that restored wetlands-riparian areas could be "released for any use consistent with existing land use controls." Depending on the use, these lands may not be available for mitigating fish and wildlife losses. Consequently, these two sections of the DEIS appear to conflict with each other. We recommend that a detailed mitigation plan be included in the FEIS. The mitigation plan should provide for the restoration of wetlands-riparian areas impacted by the remedial actions. The plan should also include provisions to protect the restored areas from noncompatible use (3).

Response

Sections 3.4.2, 5.6.2, and 5.20.1 of the DEIS have been revised to be consistent with the commitment to revegetate wetlands in Appendix F, Floodplain and Wetlands Assessment. A detailed mitigation plan for the restoration of wetlands-riparian habitat affected by the remedial actions is not within the scope of the DEIS. As stated in Section 5.6.2 and Section F.3.3 of Appendix F, Floodplain and Wetlands Assessment, the specific details of such a plan would be developed during the final engineering design with input from the appropriate regulatory agencies. In addition, the number of acres of wetland habitat has been revised as of the recent consultation with the U.S. Army Corps of Engineers (COE). The revised estimates appear in Sections 4.7.1 and 5.6.2, as well as Appendices F and G.

6.8.2 Comment

On July 1, 1983, the USFWS received a biological assessment from the DOE regarding potential impacts to threatened and endangered species as a result of remedial actions for uranium mill tailings at Grand Junction and Rifle, Colorado. The USFWS concurred with the "no effect" finding of that biological assessment in a letter of August 8, 1983. The Estes Gulch disposal site, however, was not included in the DOE's 1983 assessment. A

species list for the Estes Gulch, Webster Hill, and Hubbard Mesa disposal sites was provided by the USFWS on November 15, 1985. The species listed were the bald eagle (endangered), black-footed ferret (endangered), and Uinta Basin hookless cactus (threatened). The DOE has now identified Estes Gulch as the preferred disposal site. To satisfy its obligation under Section 7 of the Endangered Species Act, the DOE must prepare a new biological assessment for the preferred alternative. The 1983 assessment could be revised for the project description, potential impacts, and conclusion of "may affect" or "no effect" to satisfy this obligation. Following preparation of the biological assessment, the DOE should submit it to the USFWS with a request for formal consultation if a "may affect" finding is concluded or for USFWS review and concurrence of a "no effect" finding (3).

Response

The DOE agrees with the comment. The DOE has requested that the USFWS re-initiate formal Section 7 consultation. The USFWS was requested to consider Sections 4.7 and 5.6 and Appendix G, Biology, of the DEIS as a biological assessment for the preferred alternative and to concur in the DOE's determination of "no effect." To date, the USFWS has concurred with the DOE's "no effect" determination for the bald eagle, the black-footed ferret, and the Uinta Basin hookless cactus, as presented in the DEIS and biological assessment. However, because the DEIS disclosed the need for the use of Colorado River water for the Estes Gulch alternative, the USFWS requested additional information on the potential use and net depletion of upper Colorado River basin water resources. The USFWS believes that any depletion of water from the upper Colorado River basin has a negative impact on the federally listed Colorado squawfish, humpback chub, and bonytail chub. Upon further analysis, the DOE has determined that the project will cause a net depletion of Colorado River water of 280,036,000 gallons (excluding potable water), or 860 acre-feet, over the approximately four year project life. The DOE, therefore, has requested that the USFWS concur in a "may affect" determination and has requested a formal consultation under the Endangered Species Act. The DOE is awaiting the USFWS' final Biological Opinion and will comply with conditions stated therein. However, the Record of Decision (ROD) cannot be issued until the question of effects on the endangered species has been resolved.

6.8.3 Comment

No mitigative measures have been proposed for the impacts to wildlife. Some potential mitigative measures might include improving offsite areas to compensate for loss of crucial winter range; rehabilitation of disturbed areas, including reseeding with forage that would improve wildlife habitat; and, closing the access road to the disposal site from December 1 to April 15 to reduce the effects of human disturbance on wildlife (3).

Response

The DOE acknowledges that no specific mitigative measures for impacts to wildlife were included in the DEIS. Reclamation measures, including revegetation (as required), are included in the DEIS for all areas disturbed during the remedial actions except the stabilized tailings and access roads. Also, reclamation measures for wetlands-riparian habitat are included in the DEIS as noted in Response 1 above. These measures would re-establish wildlife habitat disturbed during the remedial actions. As noted in the DEIS (Sections 1.4, 3.4, and 5.0), the remedial actions would probably cease during the months of December, January, and February due to inclement weather; this would mitigate impacts to wildlife such as mule deer at the Estes Gulch site and bald eagles along the Colorado River during these crucial winter months.

6.8.4 Comment

The U.S. Army Corps of Engineers (COE) has concerns regarding wetlands impacts at the Old and New Rifle sites along the Colorado River. Vegetative types present at both sites are wetland indicator species. Reclamation of the Old Rifle site may require fill activities in wetlands and if the New Rifle alternative is selected, wetland fill activities would conceivably occur. In either event, if discharge of fill material in the Colorado River or wetlands is required to perform the project, then a permit will be required under Section 404 of the Clean Water Act. COE intends to perform an on-site inspection of the sites to determine extent of wetlands in the project area (12.)

Response

The DOE agrees with the comment and will comply with all applicable regulations and permit requirements. In Sections 3.4.2, 5.6.2, and 5.20.1 of the FEIS, and Appendix F of the DEIS, the DOE commits to a general mitigation plan for wetlands and riparian re-establishment. The on-site inspection by the COE resulted in a revision in the number of acres of wetland habitat. These revised estimates appear in Sections 4.7.1 and 5.6.2, as well as Appendices F and G.

6.8.5 Comment

The USFWS concurs with the DOE's "no effect" determination for the bald eagle, black-footed ferret, and Uinta Basin hookless cactus. However, because the DEIS discloses the need for approximately 175 acre-feet of water for the Estes Gulch alternative, additional information is needed to determine whether UMTRA Project water use will result in a net depletion of upper Colorado River basin water resources. The USFWS believes that any depletion of these waters will have a negative impact to the federally listed

Colorado squawfish, the humpback chub, and the bonetail chub. If a net depletion is determined, a "may affect" determination is expected and a formal consultation under the Endangered Species Act should be initiated (13).

Response

See Response 6.8.2 above.

6.9 LAND USE AND SOCIOECONOMICS

Two comments concerned the benefits of remedial actions to future economic development in Rifle, Colorado.

6.9.1 Comment

I would like to comment on the actions of the people that have been charged with responsibility for remedial actions at the Rifle tailings sites. In my opinion, they have done a very professional job in covering all of the issues associated with the remedial actions.

I would also like to comment on the field of economic development. This field is very competitive at this particular time, and there are some 15,000 different economic development agencies or organizations in the United States trying to increase business for their communities and counties to get a good diversified economic base in place.

We in Garfield County have seen the ups and downs of the various businesses that have come and gone. We see the terrific assets that we have in this community with a wonderful quality of life, and we have always looked with a very positive attitude at any change that does take place. We look at the removal of the mill tailings as a good opportunity for us because we have two sites that would be cleaned up to improve the appearance of the area. It certainly would afford us an opportunity to interest more people into bringing business and its associated employment into our area. It would also eliminate the potential health effects associated with the tailings piles. Both of the Rifle tailings sites are ideally suited for a business park or for light industrial development. Both sites have highway access, and natural gas and city utilities are readily available at the sites. After reading Public Law 95-604, it is my understanding that the sites would belong to the state after completion of the remedial actions and that the state could donate or transfer ownership of the sites. I am advocating that the sites be transferred to the city of Rifle. If these sites were available to the city, we could offer long-term leases on the sites as incentives for business or industrial development. Therefore, I recommend that we begin the remedial action process as soon as possible so that the sites can be cleaned up and used for economic development by the city of Rifle (7,8).

Response

Public Law 95-604 requires that the State acquire the designated processing sites. When the removal of residual radioactive materials from a processing site is determined to be appropriate, as is the case in the DOE's preferred Estes Gulch disposal alternative, the State, with the concurrence of the Secretary of Energy and the NRC, may eventually sell the lands, permanently retain or donate the lands, or transfer the lands to the United States. Public Law 95-604 further states that processing site lands retained by the State, or donated to another State entity, are to be permanently used solely for park, recreational, or other public purposes. The DOE will pass this statement of interest on to the State of Colorado.

6.10 POPULATION

One comment pointed out that there are four occupied residences within 1.5 miles of the Estes Gulch disposal site.

6.10.1 Comment

The following statements from the DEIS are typical of those that ignore the fact that there are four occupied residences along State Highway 13 within 1.5 miles of the proposed Estes Gulch site (1):

- o "Forty-seven wells have been identified within a two-mile radius of the Rifle tailings sites and the Estes Gulch disposal site (Figure E.2.21). Only one of these, a well operated by the village of South Rifle, is known to be used for domestic purposes." (Sec. E.2.6).
- o "The nearest residences are two miles to the east along State Highway 325."

Response

Sections 1.3, 4.2, 4.9, and 4.12 of the DEIS text and Section J.1.3 of Appendix J, Land Use and Socioeconomics, have been revised to indicate the locations of the nearest residences to the Estes Gulch site. The DEIS has also been revised to reflect the most current data from the state of Colorado on the locations and uses of registered wells in the vicinity of the Rifle tailings sites and Estes Gulch disposal site. It should be noted that additional wells not registered with the site may exist in the vicinity and the locations and uses of these unregistered wells could not be identified for the DEIS. It should also be noted that residents near the tailings and disposal sites were not overlooked in the impacts analyses of the DEIS. Impacts on people, such as the radiological impacts, were

analyzed using conservative assumptions (e.g., overestimating the population to be affected) and impact assessment procedures; these conservative assumptions and procedures would more than account for any nearby residents that were not specifically identified in the DEIS.

6.11 TRANSPORTATION

Three comments focused on the traffic hazards created by remedial actions and on the highway improvements necessary to reduce the traffic hazards.

6.11.1 Comment

Trucks would be used to haul tailings and other materials during the remedial actions, and this truck traffic would create potential hazards from traffic accidents. This traffic would need to be strictly controlled to avoid unnecessary traffic hazards. In particular, heavy truck traffic should be eliminated during those times of the day when school buses are transporting children to and from school. Also, the DEIS states that the source of large rock for the remedial actions would be a quarry in the Glenwood Springs area. However, I have heard that a source in the Rifle Creek area may be used, and this would create traffic and other problems for the residents of the Rifle Creek area because State Highway 325 is narrow and winding. These problems should be addressed in the DEIS (1).

Response

The DOE acknowledges the expressed concerns and recognizes the potential traffic hazards resulting from the transportation of tailings and borrow materials during remedial actions (Sections 5.13 and 5.15 of the DEIS). The DOE agrees that remedial action traffic would need to be controlled as much as is reasonably possible to prevent or minimize traffic hazards. The RAC will cooperate with the Colorado Department of Highways (see Response 2 below) and the local task force to mitigate traffic hazards, and the remedial actions would be conducted in compliance with applicable traffic laws, regulations, and permits. As stated in Sections 1.4, 3.2.6, and 5.0 of the DEIS, the borrow sites included in the DEIS were selected as the sources of the necessary borrow materials for impacts analyses purposes. Other sources of borrow materials may be considered during the final engineering design, and the RAC will select the borrow sites to be used for the remedial actions. Upper Rifle Creek was considered to be a potential source of durable rock for the remedial actions, but use of this source is not planned at the present time (see Response 3 in Section 6.3).

6.11.2 Comment

Disposal at the Estes Gulch site would require loaded trucks to travel north on State Highway 13 which would involve climbing a continuous grade once turning north on State Highway 13. The loaded trucks would pose a safety problem as slow moving vehicles. We recommend that a continuous climbing lane be constructed on State Highway 13 from just north of Rifle (at the intersection with State Highway 325) to the point where the Estes Gulch access road intersects with State Highway 13. At this intersection, we would require pavement widening of State Highway 13 that would accommodate channelization (acceleration and deceleration) at that intersection. Prior to construction of this channelization, an access permit must be submitted to Mr. Chuck Dunn, District 3 Right-of-Way Manager, P. O. Box 2107, Grand Junction, Colorado 81502.

In addition, we note that a portion of the existing U.S. Highway 6 roadbed in the vicinity of the Old Rifle site is contaminated and would be removed. Prior to construction, we would need to approve a set of construction plans that detail the removal (excavation) and stable replacement of the contaminated roadbed. Replacement of the excavated roadbed should be conducted so as to provide a standard highway shoulder width and channelization at the intersection of U.S. Highway 6 and the Old Rifle site access road. An acceleration lane and left turn lane (to present design standards) would be needed at this intersection. An access permit would also be needed for this intersection prior to beginning construction.

With these highway improvements incorporated into the remedial actions, the tailings relocation and associated haul can be carried out as safely as possible (2).

Response

The DOE acknowledges your recommendations and requirements. To accommodate the increased tailings transport trucks and decrease impacts to local traffic and road conditions, the DOE has agreed to widen and improve portions of State Highway 13. These improvements include construction of a paved 12-foot-wide, 7500-foot-long climbing lane on the east side of Highway 13 between Highway 325 and the Estes Gulch site turnoff; an 800-foot-long, 12-foot-wide gravel surfaced truck turnout; and an intersection facility on Highway 13 at the Estes Gulch turnoff for trucks entering and leaving the highway. These improvements are discussed in Sections 3.2.4, 5.20.1, and A.3.2 of the FEIS. Specific construction and improvement details, however, would be determined during the preparation of the final engineering designs.

The RAC will cooperate with the Colorado Department of Highways to mitigate remedial action traffic hazards and to

comply with the applicable permit requirements. Your recommendations and requirements will be reviewed by the DOE and transmitted to the RAC which will be responsible for obtaining the applicable permits and including the appropriate provisions in the final engineering design.

6.11.3 Comment

For disposal at the Estes Gulch site, the DEIS should specify the number of trucks, time interval between trucks, hours of truck operation, and the proposed routes from the tailings sites through or around Rifle (3).

Response

The estimated number of haul trucks (18 cubic yard) required for the remedial action alternatives are presented in Tables A.5.1, A.5.3, and A.5.5 in Section A.5 of Appendix A, Conceptual Designs. Possible transportation routes for the tailings relocation alternatives are described in Sections 3.2.4 and 3.2.5 and Sections A.3.4.5 and A.4.4.5 of Appendix A, Conceptual Designs; the exact transportation route would be determined during the final engineering design. The exact hours of haul truck operation and time intervals between haul trucks are not within the scope of the DEIS although the average numbers of haul trucks per hour were estimated for certain portions of the transportation routes to assess impacts on transportation networks (Section 5.13 of the DEIS). The actual hours of truck operation and time intervals between trucks would depend on numerous factors such as the final engineering design (e.g., actual volumes of materials moved), actual remedial action schedule, and specific transportation route involved (e.g., uphill or downhill).

6.12 SURVEILLANCE AND MAINTENANCE

Three comments focused on surveillance and maintenance requirements to assure long-term stability of the tailings.

6.12.1 Comment

The DEIS should describe what monitoring would be conducted after remedial actions to assure that the design is functioning as planned (1).

Response

Section 5.21 of the DEIS provides a general description of the surveillance and maintenance activities that would be conducted to assure continued compliance with the EPA standards. As noted in that section, "A detailed custodial surveillance and maintenance program would be defined jointly by the DOE and the NRC during the NRC license application and approval process." The specific features of this program would be described in the surveillance and maintenance plan for the final tailings disposal site and would depend on the final engineering design for the site.

6.12.2 Comment

Due to the presence of large amounts of big sagebrush at the Estes Gulch site, the state is concerned that long-term plant root intrusion of the stabilized tailings pile by this deep-rooted species could disrupt the radon barrier leading to increased infiltration and percolation into the pile and/or premature release of radon from the pile. Eolian processes could result in fine-grained materials filling in the voids of the rock erosion protection barrier, thereby providing natural micro-environments conducive to the capture and germination of windblown seeds and consequent plant growth. Surveillance and maintenance requirements to control these invading plants could be substantial over the long term (2).

Response

Section 5.21 of the DEIS provides a general description of the surveillance and maintenance activities that would be conducted to assure continued compliance with the EPA standards. As noted in that section, the DOE anticipates that one of the primary features of custodial maintenance (i.e., corrective action) would be the control of deep-rooted plants by the infrequent application of herbicides or physical removal as required; the extent to which such control would be required could only be determined by the site inspections and monitoring and by evaluation of the reports of these activities. The DOE agrees that filling of the voids in the rock erosion protection barrier with windblown soils could be conducive to the germination of windblown seeds and consequent plant growth. However, the thicknesses of the erosion protection (1.5 to 2.0 feet thick) and radon (3.5 feet thick) barriers at the Estes Gulch site would minimize the potential for deep-rooted plants such as big sagebrush to affect the long-term stability of the final tailings disposal site.

6.12.3 Comment

Besides the need for more definitive site characterization, a plan for mitigation is also necessary should piping threaten the integrity of the tailings pile as a result of headward erosion, or similar processes, along tributary valleys near the proposed tailings pile. Furthermore, we suggest that monitoring systems be specified which would alert the responsible authorities of contaminants reaching the groundwater, erosion threatening the tailings, and similar adverse effects. It would be helpful to define the word "limited" on page 212 (fourth paragraph) because complete restoration or mitigation, should a major headcut or other erosion occur, could require considerable quantities of earth and/or rock (3).

Response

See the response to Comment 6.12.1 above in regards to the specifics of the custodial surveillance and maintenance program for the final tailings disposal site. As noted in Section 3.2 and Appendix A, Conceptual Designs, of the DEIS, all of the remedial action alternatives except no action have been designed to comply with the EPA standards for long-term stability of the final tailings disposal site. The word limited is used to describe the required replacement of earth and rock due to unanticipated erosion, human or animal intrusion, or cover disturbance because the DOE believes that the amounts of materials required would be very small in relation to the amounts of materials used for initial construction of the final disposal site. However, the need for earth/rock replacement and the amounts of materials required could only be determined by the site inspections and monitoring described in Section 5.21 and by evaluation of the reports of these activities.

6.13 MISCELLANEOUS

6.13.1 Comment

The FEIS should indicate the content of the environmental monitoring plan cited on page 60 of the DEIS and what outside input will be solicited for that plan. The Bureau of Land Management will be pleased to provide information as requested (3).

Response

The specific features of the environmental monitoring plan cited in Sections 3.4.2 and 5.20.1 of the DEIS cannot be described at this time. While some of the features of this plan are generally applicable to all UMTRA Project sites, others

would be determined by details of the final engineering design and any permits, licenses, and approvals required for the remedial actions. The RAC is responsible for formulating the environmental monitoring plan and will request input from the appropriate parties as necessary.

6.13.2 Comment

Section A.3.8, Groundwater protection, is missing in our copy of the DEIS (3).

Response

The omission of Section A.3.8 of Appendix A, Conceptual Designs, in your copy of the DEIS was evidently a printing error. The DOE apologizes for the omission and will send another copy of the DEIS to you. Due to the similarities in the remedial action designs for the Estes Gulch and Lucas Mesa sites (e.g., sloping of the tailings and the compacted, low-permeability radon barriers) and the status of the EPA water protection standards, the discussions of groundwater protection for the Estes Gulch and Lucas Mesa sites (Section A.3.8 and A.4.8, respectively) were very similar. The major differences between the discussions were due to the specific groundwater conditions at the sites.

6.14 ERRATA FOR APPENDICES

This section contains the errata for the DEIS appendices that were not reprinted with this FEIS.

List of Appendices

Change "Appendix B, Alternatives Analysis" to "Appendix B, Alternatives Analyses."

Appendix C, Weather, Air Quality, and Noise

Page C-16, Table C.2.9, replace with new Table C.2.9 (see attached).

Appendix H, Radiation

Page H-5, second paragraph, last sentence, change "dose to individuals" to "doses to individuals."

Appendix I, Cultural and Historic Resources

Page I-3, paragraph three, delete the last two sentences and after the second sentence add: "The State Historic Preservation Officer (SHPO) has stated that the assay building is not eligible for inclusion in the National Register of Historic Places, and that there will be little potential for historical archaeological properties to be discovered. In the event that subsurface archaeological remains are uncovered during ground-disturbing activities, a data recovery plan would be designed and implemented, in consultation with the SHPO, to mitigate any impacts if the site were eligible."

Include letter from SHPO to W. John Arthur, III (attached) as Attachment I-1.

Table B.3.12 Ranking of Rifle alternatives

Ranking criteria ^a	<u>Potential disposal site score</u>	
	Hubbard Mesa	Estes Gulch
<u>Geotechnical factors</u>		
1. Land slope	3	1
2. Surficial materials lithology	5	4
3. Surficial materials thickness	3	3
4. Bedrock lithology	2	6
5. Permeability of soils	12	8
6. Distance to nearest active fault	16	16
7. Susceptibility to slope failure	8	4
8. Erosional/depositional settling	12	4
9. Geomorphic stability	16	12
10. Conflict with mineral resources	<u>4</u>	<u>4</u>
Subtotal	81	62
<u>Hydrological factors</u>		
11. Aquifer characteristics -- surficial materials	16	16
12. Aquifer characteristics -- bedrock	16	16
13. Recharge area	16	12
14. Depth to water table	12	16
15. Distance to nearest major spring	4	4
16. Size of drainage basin	8	8
17. Evaporation to precipitation ratio	<u>4</u>	<u>4</u>
Subtotal	76	76

Table 8.3.12 Ranking of Rifle alternatives (Continued)

Ranking criteria ^a	<u>Potential disposal site score</u>	
	Hubbard Mesa	Estes Gulch
<u>Environmental factors</u>		
18. Population density	16	16
19. Farmland potential	8	12
20. Irrigated lands	12	12
21. Transportation use	6	12
22. Antiquities and historical sites	4	4
23. Threatened and endangered species	16	16
24. Scenic and recreational values	<u>3</u>	<u>6</u>
Subtotal	65	78
<u>Engineering factors</u>		
25. Land use	16	16
26. Distance from existing site	7	7
27. Distance to borrow site -- fine/coarse materials	10/2.5	10/2.5
28. Land ownership	12	24
29. Existing road network	3	3
30. Road grade	<u>6</u>	<u>6</u>
Subtotal	<u>56.5</u>	<u>68.5</u>
Total	278.5	284.5

^aFactor numbers correspond to factor numbers in Table 8.3.11

Table C.2.9 Maximum average annual TSP concentrations during remedial action^a

Remedial action alternative/site	Distance from source (meters)									
	250	400	550	700	850	1000	1150	1300	1450	1600
Stabilization at New Rifle										
Old Rifle	65	76	57	44	36	30	25	22	19	17
New Rifle	364	241	173	163	131	109	92	79	69	60
Disposal at Estes Gulch										
Old Rifle	25	49	38	30	24	21	18	15	13	12
New Rifle	88	58	42	64	53	45	39	34	30	27
Estes Gulch	283	221	162	124	99	81	68	58	50	44
Disposal at Lucas Mesa										
Old Rifle	16	34	26	20	16	14	12	10	8	8
New Rifle	61	39	27	43	36	30	26	23	20	18
Lucas Mesa	209	158	112	84	66	54	45	38	33	29

^aConcentrations, in micrograms per cubic meter, are reduced by 50 percent to reflect dust control measures. Concentrations do not include background TSP concentrations at the respective sites.



COLORADO
HISTORICAL
SOCIETY

The Colorado History Museum 1300 Broadway Denver, Colorado 80203-2137

August 5, 1988

W. John Arthur, III
Project Manager
Uranium Mill Tailings Project Office
Department of Energy
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, NM 87115

RE: Old Rifle Uranium Mill Tailings Remedial Action Site

Dear Mr. Arthur:

Thank you for your correspondence dated July 21, 1988, concerning the above proposed undertaking.

Since the assay lab does not meet the fifty year age criterion, we concur with your determination that this property is not eligible for inclusion in the National Register of Historic Places. It is also our opinion that the condition of the site is such that there will be little potential for historical archaeological properties to be discovered. However, in the event that subsurface archaeological remains are uncovered during ground-disturbing activities, it will be necessary to halt the work until such resources have been evaluated in consultation with our office.

We find that the proposed undertaking will have no effect on historic properties. However, we do request copies of the three figures referenced in your supporting documentation, since they were not included with your correspondence.

If we may be of further assistance, please contact Kaaren Patterson, our Technical Services Director, at (303) 866-3398.

Sincerely,

Kaaren A. Patterson

la Barbara Sudler
State Historic Preservation Officer

MS 2 2 30 67 85

BS/KKP:jc

Appendix J, Land Use and Socioeconomics

Page J-5, Estes Gulch Site, first paragraph, last sentence, change to "The nearest residences are 1.5 miles to the west along State Highway 13."

6.15 COPIES OF WRITTEN COMMENTS

This section contains copies of the written comments submitted on the DEIS for remedial actions at the inactive uranium mill sites at Rifle, Colorado. Each written comment has a number in the upper right corner to identify the author; this number corresponds to the index number in the first column of Table 6.1 (Section 6.1). Each substantive comment in the written comments has been bracketed and numbered to indicate the subsection of Section 6.0 in which the comment and corresponding response are contained. For example, 6.8.1 indicates Comment 1 in Section 6.8, Ecosystems. It should be noted that some written comments (e.g., the U.S. Department of the Interior's letter dated June 19, 1987) contain comments on the RAP for remedial actions at the Rifle tailings sites; these comments are not bracketed and numbered and were not included in this FEIS.

Oral statements on the DEIS were recorded by a certified stenographer in the public hearing transcripts. Copies of these transcripts are available at the public reading rooms and libraries listed in Table 6.3.

0458 MESA DRIVE
RIFLE, CO 81650
JULY 9, 1987

MR. James R. Anderson, Project Manager
Uranium Mill Tailings Project Office
U.S. Department of Energy
5301 Central Avenue N.E.
Suite 1720
Albuquerque, NM 87108

Subject: Draft Environmental Impact Statement - Remedial Actions
at the Former Union Carbide Corporation Uranium Mill Sites
Rifle, Garfield County Colorado.

Dear Mr. Anderson:

The above mentioned DEIS does not adequately address several of the issues which are relevant to the selection of the Estes Gulch site as the preferred alternative. In fact, it appears that the selection was based primarily on the identification of the nearest and cheapest site outside the city of Rifle. The following areas of the DEIS are of special concern to me. All sectional figures referenced one in Volume II, Appendices to DEIS, Geology/Hydrology.

The geohydrology section (E.2.2.2) went into great detail concerning the groundwater parameters at the two Rifle tailings sites, but the discussion on the Estes Gulch site was limited to three sentences which listed the range of soil depths, number of test holes drilled and the depth to groundwater. No definitive discussion of the pertinent geohydrologic parameters for the soils and underlying rock strata which could affect the rate at which leachates could migrate from the pile. Permeability of the soils is listed in Table D.1.1 and minimum attainable permeability for the radon containment layer is given in section A.3.8, but the permeabilities of the tailings and the underlying rock are not discussed. Based on the statement that it would take 800 years for leachate to reach the groundwater level (270 feet), it appears that the radon cover layer permeability was assumed for all underlying materials. This conveniently ignores the fractured nature of the underlying Wasatch formation (Sec D.1.2 page D-8, Figure D.1.8 and Sec. D.2.4 page D-28) which could have much higher permeability and could influence the velocity and direction of leachate migration. The Estes Gulch site is on the flank of the Grand Hogback where the dip of the sedimentary beds is increasing from about 10 to 60 degrees from the horizontal. The steeply dipping beds coupled with the fracturing mentioned above and the existence of faulting in the less competent shale beds encountered in the North Canyon Coal Mine that is located at head of Estes Gulch and is about one mile northeast of the proposed site (Horn, G.H. & W.C. Gere, "Geology of the Rifle Gap Coal District, Garfield County, Colorado", U.S.G.S. Open File Report 59-0063, 1959) suggest that geohydrologic conditions are more complex and not necessarily as ideal

as the DEIS has concluded. Reference was made to drill holes logs, etc. being available in D.O.E.'s offices in Albuquerque, NM, but discussion or tables, such as those used to describe the two Rifle sites, were not included in the DEIS to support the author's position or to enhance the reader's understanding of the conclusions presented relative to Estes Gulch.

The proposed pile construction using a filter cover and coarse riprap cover will result in maximum infiltration of precipitation into the pile while reducing any possible evapotranspiration from the pile.

There is no mention of post deposition monitoring to assure that the plan is really working.

PILE STABILITY

No mention is made of slope stabilization during the extended construction phase prior to riprapping the final top and slopes. Mention is made to tailings slimes being placed in the lower part of the pile, but no mention is made of how they will be stabilized. The inclusion of wood and other construction materials is mentioned, but not adequately discussed from the standpoint of pile stability and permeability effects. It is alluded to that the tailings will be compacted during emplacement. What density and permeability were used in the pile design calculations?

Even though the pile, as planned, has a limited drainage area above it, the area is susceptible to very localized and severe storms (Summer -1982) that could jeopardize the pile stability. The discussion on sheet flow in section A.3.7 is impressive, but channeling will occur along with more destructive forces than anticipated in the sheet flow scenario. The upslope migration of the arroyos immediately below the proposed pile (Fig A.3.2) will endanger the pile. The geomorphology discussions in Section A.3.7 and D.3.2 address this potential for erosion, but there is serious doubt that rock apron planned will adequately mitigate the problem.

GENERAL CONCERNS

Section B-2 discusses criteria used by the State of Colorado in their report entitled "Potential Sites Suitable for Reclamation and/or Reprocessing of the Grand Junction and Rifle Uranium Mill Tailings Piles", Colorado Geological Survey 1982. Apparently the state used several more restrictive criteria than the D.O.E. chose to use in the DEIS. Three of the more obvious differences are:

- 1) Tailings and waste should be placed below grade - not a 150 foot high pile.
- 2) Tailings and waste should be covered with a minimum of 3 meters (9.8 feet) - not 3.5 feet.
- 3) Reduce surface exhalation of radon from the tailings or waste

to less than 2pCi/m2s - not 20pCi/m2s.

I am curious as to why the the state's more stringant criteria was ignored.

Nearby residents have been overlooked or ignored in water and SOCIO economic sections of the DEIS. The following are typical statements which ignore the fact that there are four residences along Colorado State Highway #13 which are within 1.5 miles of the proposed Estes Gulch site.

- 1) Fortyseven wells have been identified within a ten-mile radius of the Rifle tailings sites and the Estes Gulch disposal site (Figure E.2.21) Only one of these, a well operated by the village of South Rifle, is known to be used for domestic purposes. (Sec E.2.6)
- 2) The nearest residences are two miles to the east along State Highway #325 (Sec J.1.3)

SOURCE OF RIPRAP

Is the Glenwood Springs quarry the only source of riprap and coarse aggregate material to used on the proposed project? It is rumored that D.O.E. has determined to use limestone from upper Rifle Creek instead. If this is so, then the entire EIS procedure is a sham.

TRAFFIC

Heavy truck traffic must be eliminated during those times of the day when school buses will be conveying children to and from school.

Sincerely,

Howard W. Earnest
Howard W. Earnest

STATE OF COLORADO

COLORADO DEPARTMENT OF HEALTH

4210 East 11th Avenue
Denver, Colorado 80220
Phone (303) 320-8333

July 16, 1987



Roy Romer
Governor

Thomas M. Vernon, M.D.
Executive Director

Mr. James R. Anderson
UMTRA Project Manager
5301 Central Avenue, N.E., Suite 1720
Albuquerque, New Mexico 87108

Re: Rifle Draft Environmental Impact Statement

Dear Mr. Anderson:

We have reviewed the Draft Environmental Impact Statement (DEIS) for Remedial Actions at the former Union Carbide Corporation Uranium Mill sites, Rifle, Garfield County, Colorado, dated May, 1987. Specific comments are attached on UMTRA document review forms for your convenience. Also enclosed is a copy of a letter submitted by the Colorado Department of Highways. Our general comments are summarized below.

Based on our review of the DEIS, and upon input provided by the Water Quality Control, Air Quality Control and Radiation Control Divisions of the Colorado Department of Health, the Colorado Geological Survey and the Department of Highways, a number of general concerns exist with regard to the proposed remedial action project. These concerns will need to be adequately addressed during final design and construction activities at the Rifle sites. Included among areas requiring further investigation and discussion are:

1) Transportation Concerns

The Colorado Department of Highways has expressed concern that loaded trucks travelling north on Colorado SH 13 will pose a safety problem as slow moving vehicles. They have recommended that a continuous climbing lane be constructed on SH 13 north from the intersection of SH 325/SH 13 to the disposal site turn off. The need for channelization features and widening of SH 13 at the intersection is also indicated. In addition, an approved set of plans will be needed for excavation of existing contaminated fill materials along U.S. Highway 6 in the vicinity of the "old" Rifle tailings site access road, in conjunction with intersection widening, acceleration and left turn lanes in this area.

2) Air Quality Concerns

Estimates of maximum average annual TSP concentrations during remedial action provided in Table 5.6 suggest that total suspended particulate levels will exceed the federal and state primary standard except for the old Rifle site for the Estes Gulch alternative. Appropriate emission controls will need to

Page Two

6.5.9 be applied to minimize fugitive dust emissions and to meet acceptable ambient air quality standards. As at other sites, specific final control measures will need to be established and agreed upon during the emission permit review process.

3) Water Quality Protection

6.3.4 Substantial dewatering of the old and new Rifle sites may be necessary to allow complete excavation of contaminated subpile soils. Contaminated ground water, if pumped to on-site retention ponds, will require special handling and/or treatment. A water treatment facility may be needed during removal of the tailings. Contaminated ground waters must be contained and controlled so as to prevent further degradation of water quality in the vicinity of the piles.

6.7.2 Assumptions used to estimate natural clean-up rates for
6.7.6 contaminants in the alluvial and wasatch formation aquifers at
6.7.7 the old and new Rifle sites appear to be overly simplistic.
6.7.12 Hydraulic relationships and geochemical characteristics of the
6.7.16 two aquifer systems have not been adequately defined to permit accurate, realistic projections of clean-up rates and scenarios to be made. Specific concerns also exist with respect to the determination of background water quality (please see detailed comments) in the vicinity of the Rifle tailings sites.

4) Stabilization at the New Rifle Site Alternative

6.2.9 There are several problems associated with the Stabilization-at-the-New Rifle site alternative presented in the DEIS. Included among these are: a) location within the floodplain of a major river; b) potential for changes in channel geometry (river meander) with consequent disruption of the reclaimed tailings pile; c) inadequate foundation materials beneath the reclaimed pile to separate contaminated materials from expected high ground water levels; d) inadequate protection of ground water quality. We feel this alternative is technically unfavorable from the standpoint of meeting the EPA requirements.

5) Estes Gulch Site Disposal Site Design

5.6.9 Some concerns exist with regard to potential surface erosion problems at the Estes Gulch site. Direct erosion control measures may be needed in existing gullies to protect against headward erosion of the gullies into the repository. Future gullying and soil piping may defeat rock apron protection alone. Rock aprons should be sufficiently well anchored to withstand such future erosional (esp, undercutting) processes. The apron at the southern edge of the proposed tailings cell, for example, should probably be solidly anchored to bedrock.

Page Three

6.3.5 Additionally, some soils in the area may erode quickly and could become restructured/retextured through climate and weathering action. This should be further evaluated in determining final uses for excavated soils and in providing control/reclamation of any nearby soil areas disturbed during remedial action.

6.3.6 Foundation stratigraphy includes sands, silts, and silty sands and zones of fracturing and weathered bedrock. It would be prudent to consider excavation of sandy lenses and the installation of a suitable layer of compacted low permeability material over the clay rich foundation material. This would serve to minimize the effects of fractured/secondary porosity conditions which may be encountered as the disposal site is developed.

6.3.11 The cap and cover design described in the DEIS does not appear
6.7.15 to provide effective protection against potential deep rooted
6.7.21 plant intrusion (e.g., big sage brush) or freeze-thaw.
6.7.22 Additionally, estimates of infiltration rates as presented in the
6.7.23 DEIS appear to be non-conservative (please see detailed
6.7.24 comments). Absence of perched water tables beneath the site
6.7.25 argues for free water movement in the soils and bedrock. The location or locations of discharge zones for any infiltrating ground water in the vicinity of the site is(are) unknown. It is, therefore, recommended that additional verification of expected long-term infiltration rates be performed and documented, and more detail be provided of anticipated impacts on recharge/discharge regimes in the vicinity of the Estes Gulch site due to disposal of the tailings at this location.

We appreciate the opportunity to review and provide comments on the Rifle Draft Environmental Impact Statement. If you have any questions regarding these comments, please contact me at (303) 331-4517.

Sincerely,



Howard Roitman
Program Manager, UMTRAP

Enclosures

cc: w/enclosures
Tom Looby, OHEP
John Leifer, WQCD
Richard Fox, APCD
Al Hazle, RCD
Pat Rogers, CGS
Barbara Choccol, Dept. of Highways
Ted Anderson, Rifle Task Force
Bill Taber, JEG/Albq.

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
Document: Draft EIS
Commentor: CDH

Comment: Page 21; 112 Comment No. 1

6.4.9 Elevated levels of radioactivity and heavy metals exist in the soils and in some waters in the large area to the west of the New Rifle tailings pile. How will this contamination, which is not included in the designated site area, be addressed?

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
Document: Draft EIS
Commentor: CDH

Comment: Page 35; E-54; E-59 Comment No. 2

4.6.9 It is stated that the alluvial ground water table at the New Rifle site lies within 5 to 10 feet of the ground surface, and that ground-water levels fluctuate almost five feet during this year. It is also stated that the depths to ground water at the at the Old Rifle site range from two to twelve feet below the surface, and that these ground water levels fluctuate more than 7 feet during this year.

It is quite possible that excavations of contaminated subpile soils at New Rifle will intercept the ground water table, and it is clear that similar excavations at the Old rifle will definitely encounter significant amounts of water. Pumping of these contaminated ground waters to allow excavations "in the dry", if performed, will necessitate that special control and containment measures be implemented to prevent further degradation of water quality. If any discharges are/anticipated, a Colorado Pollutant Discharge System Permit will be required.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH

Comment: Page 37/A-53, Comment No. 3

6.12.2 The State has concerns that, due to the presence of large amounts of big sagebrush at the Estes Gulch site, (appendix G, P. G-4), long-term plant/root intrusion of the reclaimed pile by this potential deep-rooted climax species could disrupt the proposed thin radon barrier leading to increased infiltration/percolation rates into the pile, and/or premature release of radon from the repository. Eolian processes could result in fine-grained materials filling in the voids of the pile cap, thereby providing natural micro-environments conducive to the capture and germination of wind blown seeds, and consequent plant growth. Surveillance and maintenance requirements to control these invading plants could be substantial over the long term.

SECTION 2

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SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS
 Commentor: CDH

Comment: Page 38/84; 89; D-43 Comment No. 4

6.3.5 Additional data is needed to verify that future erosion, downcutting and encroachment of near pile gullies will not compromise pile integrity through undercutting and piping at depths greater than those in the existing gullies at the site Estes Gulch. Observation of Figure 3.27 indicates that depth to bedrock in several areas of the proposed pile location exceeds 15 feet. Given the relatively high surface soil erosion rates (up to 8.3 feet or more per 1000 years) [p. D-38] and soil piping effects it will be essential that the rock apron be sufficiently deep and adequately anchored to withstand further headcutting processes over the design life. Gully headward erosion in the existing large gullies may at the south edge of the proposed pile area require direct erosion control in addition to pile apron protection.

The Colorado Geological Survey has expressed concern that the design thickness of the apron for the southern edge of the pile will allow rocks to fall into the gullies and will, over time, cause the rocks to become resituated enough to defeat the design purpose. It would be prudent to found the toe of the proposed apron at bedrock especially where the potential for gully development is judged to be the greatest. Final design considerations regarding measures to protect against gully intrusion should be based on future, more detailed site observations.

UMTRA DOCUMENT REVIEW FORM

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS _____
 Commentor: CDH _____

Comment: Page 38 _____ Comment No. 5

Disposal site foundation stratigraphy includes sands, silts and silty sands with areas of blocky, fractured soil units, and an extensive weathered and fractured zone in the Wasatch Formation. Excavation of the current infiltration - inhibiting clayey soils at the Estes Gulch site could effectively open these potential avenues for enhanced migration of tailings pile leachate beneath the tailings cell. It would be prudent to consider excavation of sandy lenses, cobbles, etc. as necessary, prior to the preparation of a compacted low permeability layer. This would serve to minimize the effects of preferential/or fractured flow conditions which may be encountered beneath the site during its development.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

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Approved by: _____, Date: _____

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987 _____
 Commentor: CDM _____

Comment: Page 38; 169 _____ Comment No. 6

The conclusion that the minimum amount of time required to flush all contaminants from the alluvial aquifer is approximately two years is lacking in substantive documentation. Geochemical processes such as adsorption, precipitation, etc...do not appear to have been considered when this estimate was formulated. Based on similar situations at other UMTRA sites, there is evidence that the minimum amount of time for natural flushing at this site will be in the range of many decades, and perhaps several centuries. It is misleading for the DEIS to represent a two year natural clean-up scenario as indicative of what may optimistically occur in the future at the Rifle site. This section should be amended to reflect an estimate based on the best available data for the situation.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH

Comment: Page _____ Deis: 38-39,30 Comment No. 7

There is no existing law in Colorado which gives the State authority to regulate (or prevent) access to a private well in an area of known or suspected ground water contamination. The State Engineer's Office cannot take quality-based considerations into account when authority permits to construct private ground water wells. Therefore there is currently no mechanism available to the State to enforce institutional controls should they be advocated by the DOE as a means of providing ground water protection to meet the EPA standards.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH

Comment: Page 94; E-54 Comment No. 8

The statements that "At the Old Rifle site, the hydraulic heads... and contaminants are therefore confined to the alluvium," and "contamination in the alluvium cannot enter the underlying Wasatch Formation due to its greater hydraulic head," do not appear to completely reflect the data presented in the DEIS. Head measurements shown in Table E.2.1 and E.2.31 indicate that a higher head exist in the Wasatch at a point some distance east of the pile, but heads are nearly the same or lower west of the pile. This type of situation appears to be only a local phenomenon, i.e. higher heads in the Wasatch, reflecting either relatively impermeable zones within this unit, or similar non-laterally-continuous clay layers in the alluvial system. Because of the inconsistencies in the head data, the conservative conclusion is the one made on page E-59 of the DEIS in the first paragraph, i.e. that the data may not be representative and contamination of the Wasatch may have occurred. The documents should be changed to consistently reflect this equally plausible but more conservative conclusion for the Old Rifle site.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH
 Comment: Page 94; E-59, E-65 Comment No. 9

6.7.5 The hydraulic gradient of 0.005 estimated for the New Rifle Site appears over-stated. The gradient as measured from data in the DEIS, appears to be closer to 0.003.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:
 Checked by: _____, Date: _____
 Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH
 Comment: Page 95 Comment No. 10

6.7.6 Unfortunately, wells chosen to represent background water quality of the New Rifle alluvial aquifer were located within areas of known contamination (eg. radium, thorium). These wells are wells 591 and 592 at the New Rifle site. The Radiologic Characterization of the Rifle Site, April, 1985, by Bendix Field Engineering, shows that the area of contamination extends eastward from the pile beyond the locations of these two wells. If contamination has entered these wells, water quality within the wells will have been impacted and true background water quality at the New Rifle Site will have not been determined. Thus, all conclusions in the DEIS that are based on background water quality, such as some from well 591, which appears to exhibit elevated gross alpha and uranium levels, and those presented in the aquifer restoration section of Appendix E, are suspect. Additional data are needed to confirm whether background alluvial water quality has been properly defined at the New Rifle site before the EIS is completed.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:
 Checked by: _____, Date: _____
 Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH

Comment: Page 97 _____ Comment No. 11

6.7.7 The DEIS reports that the Wasatch Formation background water quality exceeds EPA primary drinking water standards for barium in two samples (wells 625, New Rifle, and 630, Old Rifle) and radium in one sample (well 645, Old Rifle). However, well 625 at the New Rifle site is located in a contaminated area near the tailings pile and vanadium ponds. Also, well 645 at Old Rifle appears to be contaminated with Radium 226 and Radium 228, possibly from the Old Rifle tailings pile (see previous comment). Further, the alluvial aquifer system is hydraulically connected to the Wasatch formation aquifer at the New Rifle site and apparently, to some extent at the Old Rifle site. These wells will not produce the data necessary to distinguish between Wasatch water influenced by the tailings, and water that is truly "background."

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH

Comment: Page 97 _____ Comment No. 12

6.7.8 The source of elevated radium levels (Ra-226 and Ra-228 combined value of 9.3 pCi/l + 2.1) in well 645 (screened in the Wasatch Formation and located downgradient of the Old Rifle pile) (figure E.2.11) is not defined. Comparison with chemical analyses of alluvial ground water samples at the Old Rifle Site (table E.2.22, Appendix E) indicates anomalously high concentrations of radium in alluvial wells 582 and 586. Several on-site or downgradient alluvial wells at Old Rifle were not sampled for radium. Additional documentation is needed of radium levels in well 645 (Old Rifle), and perhaps also in adjacent well 644, and other downgradient wells as necessary in the Wasatch formation to verify possible radium or other contaminants in ground water in the Wasatch caused by seepage from the Old Rifle tailings pile.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH _____
 Comment: Page 98 _____ Comment No. 13

Except for local variations, it does not appear reasonable to conclude that higher heads exist in the Wasatch Formation at the Old Rifle site, to the degree necessary to prevent tailings contamination to this formation. This is especially true considering the small total number of wells, and the lack of any wells on the pile or near its periphery. Relative hydraulic relationships between the Wasatch and the alluvium, and the degree to which any contaminants exist in the Wasatch Formation beneath and downgradient of the Old Rifle site, appear to be uncertain and poorly defined. (see also Comment # 12).

6.7.9

SECTION 2

Response: Page _____ By: _____ Date: _____

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SECTION 3

Confirmation of Implementation:

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH _____
 Comment: Page 169 _____ Comment No. 14

The DEIS states that uranium and molybdenum are "relatively immobile" with respect to travel times in groundwater. This is not true, and the document should be changed to reflect this.

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SECTION 3

Confirmation of Implementation:

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May, 1987
 Commentor: CDH

Comment: Page E - 71 Comment No. 15

6.7.11 Colorado's 'Basic Standards for Ground Water' were promulgated on March 3, 1987. Section of E.2.3.2 of the DEIS should be revised to reflect this fact and include information as appropriate. (A copy of the standards was provided to DOE on January 15, 1987.)

SECTION 2

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July, 1987
 Document: Draft EIS, May, 1987
 Commentor: CDH

Comment: Page E-74 Comment No. 16

6.7.12 There appears to be potential problems with some of the wells used to define the background water quality in the alluvial aquifer at the Old Rifle site. It is conceivable that wells 598 and 597 may have been affected by windblown contaminants. Wells 599, 600, 603, and 604 are downgradient, making their use as "background" wells possibly suspect. As stated in the Technical Approach Document (p.130), sample locations should be free of windblown radioactive contamination...and - should not lie along the flow path hydraulically downgradient from any suspected contaminant source. Wells 601 and 602 across the river are probably adequate. Evidence to support this conclusion is that concentrations of TDS, sulfate, and uranium are consistently lower in wells 601 and 602 than all other wells used for determining background in the vicinity of "Old Rifle".

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH
 Comment: Page E-75 Comment No. 17

6.7.13 The analytical balance for all of the chemical analyses presented in the DEIS has not been reported with the individual analysis. This information is critical to an assessment of the reliability of the analytical results and should be provided in the FEIS.

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SECTION 3

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH
 Comment: Pages see below Comment No. 18
 E-82 through E-85
 E-95; E-106 through E-108

6.7.14 Wells 621, 640 and 624 at the Old Rifle Site (and possibly also wells 622 and 626), and wells 625, 633, 644, 628, 643, 650, 651, and perhaps well 631 at the New Rifle Site suffer from cement contamination, as a result of improper completion techniques. Analytical results from these wells may therefore be of little or no value for interpretation purposes. This fact should be made clear in the FEIS.

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH
 Comment: Page E-112/113 Comment No. 19

The modified Millington-Quirk method of estimating unsaturated hydraulic conductivity, strictly speaking, is not valid for very fine grained soils and great caution must be used in its application. The value of saturated hydraulic conductivity assumed for the radon barrier materials, 1.6×10^{-4} ft/day (5.6×10^{-8} cm/sec), appears to be too small a value to be reasonably representative of actual values of hydraulic conductivity of the compacted clay barrier after emplacement. Additionally, under unsaturated conditions, it is probable that vertical hydraulic gradients in the proposed cover (i.e. compacted silty clay barrier overlain by a layer of gravel and rock) will greatly exceed unity due to the existence of strong negative capillary suctions in the radon barrier.

The travel time calculation presented appear to be in error. These calculations have assumed that the hydraulic conductivity of the in-situ materials beneath the completed impoundment will be equivalent to the hydraulic conductivity of the compacted radon barrier. The radon barrier is estimated to be only 3.5 feet thick; at this thickness, the travel time of infiltrating precipitation, using the values stated, is about 10 years. Subsequent to percolation passing through the barrier, the average linear velocity of the seepage will change. Using a K value of 1.0×10^{-6} cm/sec, seepage would require on the order of 45 years to reach a depth of 75 feet and 175 years to reach a depth of 270 feet. Actual travel times may be less due to the fractured, weathered nature of the near-surface zone(s) of the Wasatch Formation site.

UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH
 Comment: Page E-115-117 Comment No. 20

The assumptions listed in the calculations of minimum times required to flush all contaminants from the alluvial and Wasatch Formation aquifers at the New and Old Rifle sites for the relocation alternative are overly simplistic. Such assumptions should not be considered as realistic approximations of actual conditions at the Rifle tailings sites. Additional documentation is needed to confirm projected clean-up rates, including adequate consideration of geochemical mechanisms operating at the sites, and clarification of hydraulic head relationships and the degree of present and potential ground water contamination at the Old Rifle site.

SECTION 2

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH

Comment: Page E-117; E-121, Comment No. 21

The State does not agree with the reported value of the contaminated ground water in the Rifle area. Because contaminants will remain in the sediments of the aquifers for a very long time period after removal of the tailings, the present water in the aquifer, along with the water that will move through the area in the future, will be indefinitely removed from Colorado's inventory of ground water resources. Our Order-of-Magnitude calculations indicate that the total number of pore volumes flowing through the area over the life of the project will result in a loss of over 25,000 acre-feet of water. This number is based on the probable extent of contamination at the site, and was reduced by a 30% recovery rate for any future pumping scheme. The value of this water will be difficult to quantify, but we do not feel that a subsidized price of \$109 per acre-foot, as computed for the municipal supply at South Rifle, represents a conservative or fair market estimate of the value of the lost resource. Accordingly, the Glenwood Springs office of the Colorado River Water Conservation District was contacted for an estimate of the value of water in this area. A representative of this office informed the Department that the cost of new reservoir water, under the favorable arrangement of a long-term lease, is on the order of \$400 per acre-foot. At this price, the value of the lost water would be slightly more than 10 million dollars over a 200 year term of stabilization. This value represents a 42 fold difference from the DOE valuation [p. E-121] of the existing contaminated ground water.

SECTION 2

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UMTRA DOCUMENT REVIEW FORM

Section 1

Site: Rifle _____, Date: July 1987
 Document: Draft EIS, May 1987
 Commentor: CDH

Comment: Page E-122 thru 124 Comment No. 22

The cost estimates for aquifer restoration exclude a plume management scenario, which could be the most cost-effective approach for cleaning up the site. Plume management/capture options should be further addressed in the Final EIS. It is not necessarily true that plume capture or management is complicated and made more costly by the presence of the Colorado River adjacent to the contaminant plumes (see, eg., NRC comments on the Grand Junction Draft RAP, dated October 29, 1986).

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

STATE OF COLORADO

DEPARTMENT OF HIGHWAYS

4201 East Arkansas Ave.
Denver, Colorado 80222
(303) 757-8011



July 10, 1987

Mr. Howard Roitman
Program Manager, UMTRAP
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Attention: Jon Luellen

Dear Mr. Roitman:

The Colorado Department of Highways has completed its review of the Draft Environmental Impact Statement for the Remedial Actions at the Former Union Carbide Uranium Mill Sites in Rifle. We have several comments about the site itself and use of State Highways as haul routes for disposal of the uranium mill tailings.

First, from the material presented in the DEIS, it appears that the Estes Gulch site has acceptable disposal site characteristics and the shortest haul of the alternatives that relocate the tailings pile. We feel the uranium tailing piles (old and new) should be moved away from the Colorado River floodplain. Therefore, we support the recommendation of this alternative as the preferred alternative.

However, as the disposal site is located approximately six miles north of Rifle, it will require loaded trucks to travel north on SH 13, which involves climbing a continuous grade once turning north onto SH 13. The loaded trucks will pose a safety problem as slow moving vehicles. Therefore, as noted in Mr. Robert Moston's letter of April 10, 1987 to Morrison-Knudson Engineers, we recommend that a continuous climbing lane be constructed on SH 13 from just north of Rifle (intersection of SH 325) to the point where the Estes Access Road intersects with SH 13. At the intersection we will require pavement widening of SH 13 which will accommodate channelization (acceleration and deceleration) of that intersection. Prior to construction of this channelization, an access permit must be submitted to Mr. Chuck Dunn, District 3 Right of Way Manager, P.O. Box 2107, Grand Junction 81502.

In addition, we note that a portion of the existing US 6 fill in the vicinity of the "old" Union Carbide mill is contaminated and scheduled for removal. Prior to construction, we will need to approve a set of construction plans which will detail the removal (excavation) process and replacement of the contaminated fill in a way that is stable. Replacement of excavated

Mr. Howard Roitman
July 10, 1987
Page Two

roadway embankment should be conducted so as to provide a standard highway shoulder width and channelization of the US 6 intersection with the uranium mill access road. An acceleration lane and left turn lane (to present design standards) will be needed at this intersection. An access permit will also be needed for this intersection location prior to beginning construction to remove contaminated soil.

With these highway improvements incorporated into the uranium mill tailings removal plan, the removal process and associated haul can be carried out as safely as possible for the time it will take to decontaminate the Rifle sites (old and new).

If you have any questions concerning these comments, please contact Mr. Larry Abbott, District 3 Environmental Manager, at 248-7223 in Grand Junction. Thank you for the opportunity to provide comments on this document.

Very truly yours,

Barbara L. S. Choccol
Manager
Project Development Branch



United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
WASHINGTON, D.C. 20240



ER 87/561

JUN 15 1987

Mr. John R. D'Antonio
Operations Group Leader
Uranium Mill Tailings Project Office
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. D'Antonio:

We have reviewed the draft Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings Sites at Rifle, Colorado. Inasmuch as the draft EIS was not widely available during this review we must provide conditional comments which may be modified in light of future information. Our conditional comments follow.

Project impacts on future mineral production in the area are not clearly described. Although known mineral deposits in the area are currently subeconomic, the final version of the plan should state whether possible future mineral development would be precluded or adversely impacted by the project. Also, there is the possibility that economically recoverable minerals such as uranium or vanadium could be present in the tailings. This possibility should also be addressed in future versions of the plan.

If limestone is used to armor the radon suppression cover, it should be taken into account that the only limestone available is located on unpatented mining claims.

The design of the radon barrier cover at the Estes Gulch site should be discussed more adequately. The proposed average hydraulic conductivity of the cover materials (1.6×10^{-4} cm/sec) appears to be about the same as the average hydraulic conductivity for the tailings (p. 75, D-146, D-211, D-224, D-225). Only the slime tailings appear to be consistently lower in hydraulic conductivity than the proposed radon cover materials. Cross sections of the Rifle tailings suggest a large proportion of sand. If slimes or appropriate sand-slime mixtures are to be selectively used in the uppermost layers of the tailings at Estes Gulch to ensure lower permeability, this should be indicated in the plan.

The source and quantity of water needed for use at the Estes Gulch site should be given, and the effects of the water use evaluated.

No data is given on the soluble chemical content of the tailings. Heavy metals are stated to be present but no data on concentrations is given. A thorough chemical analysis to determine soluble and insoluble constituents is necessary before developing a disposal plan. Both concentrations and ranges are necessary.

The construction and completion details of monitor wells should be provided. This is especially necessary where multiple water-bearing zones are present. Also, no information is given on the fate of the monitor wells. Some wells must be kept active to monitor success of cleanup or movement of ground water at the disposal sites. The standards for sealing and plugging abandoned wells should be given also.

The ownership of mineral rights under the Estes Gulch site should be identified.

In moving the tailings to Estes Gulch the number of trucks, time interval between trucks, hours of truck operation, or proposed routes from the tailings piles through or around Rifle should be specified.

Specific comments are attached.

Contact Dr. F. L. Doyle of my staff (FTS 343-8661 or 202-343-8661) for any further information.

Sincerely,

Bruce Blanchard
Bruce Blanchard, Director
Environmental Project Review

Enclosure

-334-

Specific Comments

P. 17 and 93 - The borrow site identified as the Rifle Gap Borrow Site cannot provide the amount of materials needed. The site is a mining claim by Colorado Lien for metallurgical grade limestone. Only waste limestone and in quantities less than the amount of produced metallurgical grade may be sold to DOE. Also, at this time no production or market is established, therefore, Colorado Lien cannot sell any material to DOE.

P. 61, Section 3.5.2, 1st paragraph - This paragraph should be clarified with additional information. An existing well 8 to 9 miles east of Estes Gulch penetrated 50' of water bearing rock beginning at 350'. The well is being used for domestic water. The water quality in this well changes very noticeably within a week after snow melting starts. It is located at the base of the Hogback just as Estes Gulch is. Figure 3.22 supports this by showing highly fractured rock below the disposal site. This would allow rapid deep percolation.

P. 66, 3rd paragraph - The ditches will have roughly a 10% grade (200' fall in 2250'). In a heavy runoff event these ditches will flow swiftly as is common in this area. In addition, the area is subject to extensive piping (p. 29, 3rd par.). The central flat is an old alluvial fan with intermixed sand and gravel deposits (p. 29, 2nd par.) which provide a drainage conduit into existing drainage. Consequently, it is likely that the drainage ditches will start active headcutting or will side cut into the existing drainages. The pile will then start to erode. There should be a contingency plan to handle this.

P. 70 Alternative Considered - The text states "the rationale behind the choice of this site is detailed in Appendix C of the DEIS, Rejected Alternatives." In the DEIS, Appendix C concerns only weather, air quality, and noise. There is no Rejected Alternatives section nor a detail analysis of why they were rejected. Neither the DRAP or the DEIS presents any documentation of the good and bad points of each alternate site, how they are ranked, and why each site was rejected from further consideration. NEPA requires this process to be documented. These deficiencies should be corrected in the final draft.

P. 75, Section 4.3.7, 1st paragraph - All calculations are based on the permeability immediately following construction. Because of freeze/thaw cycles and vegetation growth the permeability will increase allowing infiltration and leachate formation. DOE should plan remedial action to stop both deep percolation and/or piping which would permit leachate flow into existing drainages.

P. 76, Section 4.3.8 - The use of the term "Head of Hollow" site is misleading. Any sloughing or piping of the sides will immediately expose the tailings to active headcutting and possible contamination of Government Creek. DOE should take precautions to ensure that piping and sloughing will not expose the tailings.

P. 80 Design Rationale 1st paragraph, last sentence - Evidence is necessary to support the statement "By placing...a rock apron...the potential for gully erosion into the pile will be eliminated."

P. 82 1st paragraph - A secondary settlement of 1.8 feet for a 100 foot fill is a reasonable amount. It is possible that the moisture barrier will remain intact if the settling is uniform. However, uniform settling is unlikely and plans for mitigation, should cracks occur, should be prepared in advance.

P. 91, last paragraph - If waste water reservoirs are designed to only hold a one year flow and safely discharge a 25-year storm into existing streams, it is unlikely that Federal and State water quality standards can be met prior to discharge.

P. D-65, 3rd paragraph, first sentence - The legal description should read R93W, not R93N.

P. D-233 - The text states that the hydraulic conductivity integrity of the random cover is "extremely important in the disposal pile...." However, in the text of the plan (p. 75) there is no discussion of the effects of the freeze/thaw cycles and of vegetation on the cover's integrity. Note that the potential frost depth is well past 2-1/2 feet and this will tend to increase permeability. As the permeability increases so does the formation of leachates and deep percolation. Also the DOE plan to maintain the desired compaction of the cover for the design life of 1,000 years should be specified.

P. D-327, line 3 - Allowing the construction contractor to choose the rock type after the review period denies the reviewers the opportunity to comment on the adequacy of the materials chosen to implement the chosen design. Both mineral composition and texture are factors in rock durability. DOE should explicitly state these in the text. For this and other UMTRA projects, these deficiencies in information should be corrected.

P. D-335, third paragraph - The names and quantities of heavy metal contaminants should be specified.

P. D-336, first paragraph - The text states "It is possible there is undetected contamination in the Wasatch directly under the pile. It is doubtful, however, that contamination is widespread...." The documentation to support this claim, such as water quality analysis from specific zones, is not in the text. On page D-334 background water quality is referenced in a document not available for review. Table D.7.9 gives some concentrations without specifying individual wells, nor is the range or mean given. These should be provided.

P. D-339 - The text mentions "No known users of contaminated ground water." It should be definitely stated if any nearby wells are or are not used for human consumption. In addition, the consequences of contaminant discharge into the river, given that the river water is used by people, should be evaluated.

P. D-341, Section D.7 2.5 - This section states that the estimated saturated, in-place permeability is calculated to be 0.00016 ft/day ($1.6 \times 10^{-4} \text{ ft/day}$). The method used to calculate this figure and the data used should be explicitly given here for public evaluation. Citing references is not sufficient in this instance. Also, during snow

melting saturation of the radon barrier is likely. This should be taken into account in establishing percent of saturation.

P. D-348-352 (Fig. D 7.15 to 19) - Further definition of the extent of the contamination plume is necessary. Accordingly, more borings may be required. Also, the ranges in concentration of the dissolved solids, and the depths at which the samples were taken, should be shown both in tables and graphically (average concentrations are insufficient and can be misleading).

P. D-387 - Reconstruction of the Estes Gulch Road will require a right-of-way reservation. If a powerline is needed this will also require a right-of-way. Both actions will also require an environmental analysis.

P. D-387 - Legal access from the highway across patented lands in SW1/4, NW1/4, Section 23, T.5S., R.93W. must be obtained, and should be designated for public access in the process.



ER 87/678

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
WASHINGTON, D.C. 20240



AUG 6 1987

Mr. James R. Anderson
Project Manager
Uranium Mill Tailings Project Office
Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Anderson:

We have reviewed the draft environmental impact statement (DEIS) for Remedial Actions at the Former Union Carbide Corporation Uranium Mill Sites, Rifle, Garfield County, Colorado. The following comments should be used in conjunction with our enclosed comments of June 19, 1987, on the draft Remedial Action Plan and Site Conceptual Design for Stabilization at Rifle, Colorado.

Although much is known about the Rifle sites, we believe that additional geological and hydrological studies are needed at the Estes Gulch site to which the tailings would be transported under the preferred alternative. For example, more definition is needed of the fracture system at Estes Gulch. This will permit a better-founded calculation of the time for water to travel from the surface to the water table. Field measurements are also necessary for parameters used to estimate travel time of subsurface water, or the dispersion of any contaminant plume that could develop in the ground water. We would discourage the use of estimates taken from ranges given in text or reference books for use in calculations. We emphasize this point because such figures are generally not site specific, and seldom take ground-water fracture flow into account. The influence of fractures on travel time has increasingly become recognized as a factor that cannot be ignored. Besides the need for more definitive site characterization, a plan for mitigation is also necessary should piping threaten the integrity of the pile as a result of headward erosion, or similar processes, along tributary valleys near the proposed tailings pile. Furthermore, we suggest that monitoring systems be specified which would alert the cognizant authorities of contaminants reaching the ground water, erosion threatening the tailings, and similar adverse effects. Our specific comments give particulars on these and other considerations.

The Department of the Interior also has specific concerns regarding impacts to wetland and riparian habitat resulting from the uranium tailings removal. Remedial actions at the new Rifle site will require the excavation of approximately 4 acres of wetland/riparian habitat. The restoration of all excavated or otherwise disturbed wetland/riparian areas is crucial. Based on the Fish and Wildlife Service's (FWS) mitigation policy, it has been determined that the riparian habitat within the project impact area meets the criteria for resource category 2. The mitigation goal for habitat in this category is no net loss of in-kind habitat value. On page F-9 of Appendix F, the DEIS commits to a general mitigation plan for wetland and riparian reestablishment.

Specific Comments
Volume I

6.8.1 However, page 177 of the DEIS indicates that restored wetland/riparian areas could be "released for any use consistent with existing land use controls." Depending on the use, these lands may not be available for mitigating fish and wildlife losses. Consequently, these two sections of the DEIS appear to conflict with each other. We recommend that a detailed mitigation plan be included in the Final Environmental Impact Statement (FEIS). The mitigation plan should provide for the restoration of wetland/riparian areas impacted by the project. The plan should also include provisions to protect the restored areas from noncompatible use.

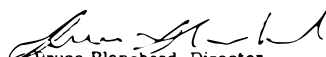
6.8.2 We also have comments involving threatened and endangered species. On July 1, 1983, the FWS received a biological assessment from the Department of Energy (DOE) regarding potential impacts to threatened and endangered species as a result of remedial actions for uranium mill tailings at Grand Junction and Rifle, Colorado. The FWS concurred with the "no affect" finding of that biological assessment in a letter of August 8, 1983. The Estes Gulch disposal site, however, was not included in DOE's 1983 assessment. A species list for the Estes Gulch, Webster Hill, and Hubbard Mesa disposal sites was provided by the FWS on November 15, 1985. The species listed were the bald eagle (endangered), black-footed ferret (endangered), and Uinta Basin hookless cactus (threatened). The DOE has now identified Estes Gulch as the preferred disposal site. To satisfy their obligation under section 7 of the Endangered Species Act, the DOE must prepare a new biological assessment for the preferred alternative. The 1983 assessment could be revised regarding project description, potential impacts, and conclusion of "may affect" or "no affect" to satisfy this obligation.

Following preparation of the biological assessment, the DOE should submit it to the FWS with a request for formal consultation if a "may affect" is concluded, or for FWS review and concurrence of a "no affect" finding.

For technical assistance on fish and wildlife matters, please contact the Field Supervisor, Fish and Wildlife Service, 529-25 1/2 Road, Suite B-113, Grand Junction, Colorado, at (FTS) 322-0348.

Our specific comments are enclosed.

Sincerely,


Bruce Blanchard, Director
Environmental Project Review

Enclosures

6.6.4 Page 6, Paragraph 5, Sentence 3. The Estes Gulch site is subject to active oil and gas leases, yet disposal would preclude oil and gas drilling. The FEIS should address how this issue will be handled.

6.7.25 Page 10, Table 1.1, Summary of Impacts, Water Resources. See comments provided for
6.7.26 pages 169 and 170.

6.3.8 Page 26, 3.2.1 - second bullet. The FEIS should specify the design control life intended. This is especially necessary given the 200 to 1,000 year range of design times which could be designated.

6.6.2 Pages 29, 37, and 45; Page 50, 6th Paragraph; Page 70, 5th Paragraph. The Glenwood Springs borrow site is a limestone quarry on a locatable mining claim. Under the existing laws, limestone can be used from a locatable mining claim only for certain purposes. The proposed use does not appear to qualify as one of them. DOE should consider finding an alternate source of limestone.

6.7.22 Page 38, 3rd Paragraph. If the contaminated ground water in the Wasatch Formation under the New Rifle site will require 3,840 years to be flushed, and if a relatively undisturbed deep aquifer at the New Rifle site is contaminated within less than 50 years, it is unclear how it can be expected that a minimum of 800 years will elapse before contamination of an aquifer in a highly-fractured area. Water has moved downward 300 feet in a few hours along fractures in the prototype oil shale Tract C-a elsewhere in the Piceance Creek Basin.

6.3.12 Page 46, 3rd Paragraph, 4th Sentence; Page 47, 5th Paragraph. The statement is made that 10 percent bentonite would have to be added to the radon cover to assure a minimum of 500 years for water to percolate 200 feet. However, no mention of using bentonite on the radon cover for the Estes Gulch site is made (page 38). The reason for not taking the same precautions at both sites should be made clear.

6.7.23 We suggest that the calculations supporting the statement that it would take 500 years for surface water to reach 200 feet be redone. For a representative value it is necessary to take into account the fractures at the site.

6.2.7 Page 54, 2nd Paragraph. It would be helpful to the reader if DOE would specify the criteria that were used to select a site and eliminate alternative sites.

6.7.24 Page 57, 1st Paragraph, 5th Sentence; Page 63, 3rd Paragraph. The comparison of times to contaminate ground water at Lucas Mesa and Estes Gulch should be recalculated when further geologic studies have provided information on fractures.

6.13.1 Page 60, 6th Bullet. The FEIS should indicate the content of the environmental monitoring plan, and what outside input will be solicited. The BLM will be pleased to provide information as requested.

6.8.3

Page 61. No mitigation appears to have been proposed for the impacts to wildlife. Some potential mitigation measures might include: improving off-site areas to compensate for loss of crucial winter range; rehabilitation of disturbed areas, including reseeding with forage that would improve wildlife habitat; and, closing the road from December 1 to April 15 to reduce the effects of human disturbance on wildlife.

6.3.4

Page 89, 4th Paragraph, 3rd Sentence. The statement is made that Estes Gulch is subject to numerous piping fractures. We believe that construction standards to manage piping should be specified in the FEIS. If piping occurs and breaches the drainage ditch, this could quickly start an active headcut into the pile. Furthermore, a contingency plan should be formulated and stated for monitoring the pile for piping and erosion on a long-term basis, and for remedial action to be initiated if piping or erosion occurs.

6.3.5

Page 89, 4th Paragraph, Last Sentence. The mitigative measures for development of lateral branches of adjacent surface drainages should be specified.

6.7.25

Page 169, 4th Paragraph, Impacts on Ground Water, Disposal at the Estes Gulch Site. The origin of the estimated percolation rate through the radon barrier should be explained, along with the use of that figure to calculate the 800 year (minimum) travel time to reach the ground water 270 feet below the site. We believe that the percolation rate and other properties of the materials below the radon barrier should be given also, because of their possible influence on the estimated travel time. Of equal importance is the fact that fractures occur at the site (page D-28, 6th paragraph, last sentence) and downward travel time of 300 feet in less than an hour was measured in other fractured areas. The necessity for thorough fracture studies is, therefore, indicated, and we recommend that these be done. We further suggest that any travel time estimates factor-in the effect of fractures on downward water movement. This information is needed for the reader to evaluate the usefulness of the 800 year figure, or any adjusted figure based on the suggested additional information.

6.7.26

The 800 year figure also appears on page 10 in Table 1.1. Summary of Impacts, Water Resources, last line, and on page 14, fourth paragraph, fifth line and should be adjusted in these and all other places it appears if the suggested new data cannot support that estimate. If the 800 year figure is not changed it should be designated as an estimate, given the fact that the percolation rate on which it is based is estimated.

6.7.27

Page 170, 4th paragraph, Disposal at the Lucas Mesa Site. The basis for the use of 200 feet for percolation depth should be made explicit. Likewise, the figures used to calculate a minimum of 500 years for infiltration and percolation should be given and indicated as to whether they are estimates or measurements made in the field or laboratory. If the 500 year figure is not supportable by measured data, it should be identified as an estimate on page 10 in Table 1.1 Summary of Impacts, and anywhere else it appears.

Page 171, 2nd Paragraph, 1st Sentence. We suggest that the belief that only alluvial water is economically recoverable be reexamined. At least one domestic well is known to be producing abundantly from a depth of 350 to 400 feet approximately 8 miles east of Estes Gulch.

6.7.28

Page 171, 2nd Paragraph, 2nd and 3rd Sentences. It would be helpful in evaluating the \$240,000 value for water if the premises used and calculations made are given here, or a reference made to where these are stated in the FEIS.

6.7.29

Page 171, 2nd Paragraph, 5th Sentence. The origin and supplier of the existing water supplies referred to should be identified. In our experience isolated residences are not easily serviced by Rifle Municipal.

6.12.3

Page 212, 1st Bullet. It would be helpful to define the word limited. Complete restoration or mitigation, should a major headcut or other erosion occur, could require considerable quantities of earth and/or rock.

Specific Comments
Volume II

6.13.2 Page A-i, A.3.8. This section is missing in our copy.

6.3.9 Page A-19, 4th Paragraph, 3rd Sentence. We suggest DOE evaluate the effects of continual use of contaminated water for dust suppression over time, because such a practice will tend to concentrate the contaminants on the surface. DOE should specify what precautions will be taken to prevent this becoming a health hazard, and to prevent contamination of riparian areas through overland flow.

6.3.10 Page A-40, 1st paragraph. The FEIS should also point out that the degree of differential settling will also depend in large measure on the compaction achieved.

6.3.11 Page A-40, 4th paragraph, Cover Construction, and Page A-41, 2nd paragraph, Ground-Water Protection. We would like to point out a factor which could be overlooked when evaluating the ground-water protection function of the radon barrier. The radon barrier's holding of moisture will be enhanced by the rock cover, as DOE points out. However, the effect of the freeze-thaw cycles which will operate at the depth of the barrier will, in our opinion, increase the permeability of the barrier. This will lessen the ground-water protection function of the barrier. We believe the effect of freezing and thawing should be carefully evaluated and included in the FEIS.

Section B.

This section gives the factors used in ranking each site and should provide a table showing the score on each site. We believe that this information should be provided so that the reader can make a fully informed judgment.

6.2.8 Page B-29, 4th Paragraph. A specific site for Anvil Points should be shown. The criteria for rejecting a site on DOE land should be explicitly stated.

Page B-36, 1st Paragraph. Given that Hubbard Mesa and Estes Gulch scored so nearly the same in the ranking process, and both are acceptable sites, it would be helpful to include the reason for choosing Estes Gulch over Hubbard Mesa.

6.7.30 Given the proximity of human habitation to the Estes Gulch site, we believe some additional investigations are essential before final selection of any site. Those investigations should include: an intensive study of the fracture system present at the Estes Gulch site; a better determination of the location of the ground water; an evaluation of the springs which are common along the Hogback and which are used for domestic water; and, a determination of ground-water volume, depth, quality, and direction of flow, and of the permeability of the formation. Mitigation measures, should springs along on Hogback be contaminated, should also be formulated.

Sections D and E, General

6.7.31 Given the importance of the sites being considered for tailings relocation, we suggest more thorough geologic studies for each. The fracture studies suggested above are very important, as is additional water table definition. We also suggest that illustrations for

6.7.30 all sites be as fully informative as those of the Rifle site. Figure D.2.6 (page D-31), for example, is a cross-section following standard professional practice, although we would suggest indicating vertical exaggeration for completeness. The cross-sections for Estes Gulch (Figures D.1.8 and D.1.9), on the other hand, show only the total depths and lithologies as logged in the borings. No interpretation between the control borings are shown. The ground water level of 270 feet (reported on page A-59 and E-69) can also be shown in the appropriate borings.

6.7.31 A potentiometric map for the aquifer(s) at each site would be helpful supplements in Section E. Depth to water maps are especially valuable when evaluating sites for the purposes intended, and we urge that these be added so as to conveniently and fully inform the reader of these essential considerations.

Section D.

6.7.33 Page D-19, D. 2.1, 3rd Paragraph. "Height" should probably read "elevation."

Section E.

6.3.13 Page E-7, E.1.1.2, 1st Sentence. The Estes Gulch Site is said to have almost no upland drainage above the site due to "...deeply cut drainages to the east and west." We would like to point out, however, that these drainages, make the pile very susceptible to piping into the drainages. The presence of piping at Estes Gulch site is noted on page D-43, 3rd paragraph. This piping would create severe head-cutting into the pile and cause the collapse of parts of the pile. Measures to insure that this does not happen should be stated, because of the potential for pollution of the alluvial aquifer on Government Creek, and the consequent deterioration of quality of water taken from the domestic wells tapping it.

6.7.34 Page E-113, Last Paragraph. The calculation of percolation through the compacted radon barrier assumes it will maintain its initial compaction. As pointed out in our comments for pages A-40 and A-41, we believe the normal freeze-thaw cycles and frost heaving will increase the permeability of the radon barrier to percolation, thus invalidating the percolation rates given for all or most sites.

6.7.35 Page E-114, Table E.2.27. This table is correct but could be misunderstood. The data suggest that ground water contamination would occur 300 years sooner at the Lucas Mesa site. A footnote should explain that DOE only drilled to 200 feet on Lucas Mesa and that the depth to ground water is unknown.

6.7.36 Page E-117, E.2.6, Last paragraph, and Page E-121, 3rd Paragraph. Several methods in reports on how water rights are appraised and valued show the value of water to be substantially greater than the \$109/acre feet used. We suggest that alternate methods of valuing water be presented. These methods are available in "Water Rights of Ryan Acquisition near Ashcroft, Colorado" (May 1984), available from Enartech, 818 Colorado Ave., P.O. Box 160, Glenwood Springs, Colorado 81602, and in U.S. Forest Service, "Water Rights from Hunter Creek, Pitkin County, Colorado, USFS Region II Whiteriver National Forest" by R. Scott Fifer and Duane D. Helton (February 1980).

Page F-120, 2nd paragraph and Page E-121, 2nd and 3rd paragraphs. We suggest that the water valuation methods above be examined before aquifer restoration is ruled out as not being cost effective. Furthermore, institutional controls on water extraction should be considered as a means to prevent inadvertent use of contaminated water for human consumption.



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUL 9 1987

Mr. James R. Anderson, Project Manager
Uranium Mill Tailings Project Office
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87115

Dear Mr. Anderson:

The Nuclear Regulatory Commission has completed its review of the draft Remedial Action Plan (DRAP) and the draft Environmental Impact Statement (DEIS) for the former Union Carbide Corporation Uranium Mill Sites at Rifle, Colorado. Enclosed are our comments on those documents in the areas of surface water hydrology, groundwater hydrology, geology, geomorphology and seismology. Our comments on geotechnical stability will follow under separate cover.

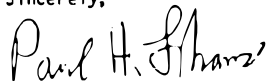
As you will note, the comments are quite lengthy. This attribute reflects not only the fact that the staff found significant inconsistencies and voids in the technical data supporting the remedial action, but more importantly, that the staff has serious reservations about the ability of the proposed design to meet the long-term stability requirements of 40 CFR 192. As noted in a telephone conversation between members of our staffs and the Technical Assistance Contractor on June 30, NRC's concerns focus on both the characteristics of the proposed Estes Gulch disposal site and the resultant extensive and elaborate design measures necessary to provide stability to the reclaimed tailings. Erosion protection of the reclaimed tailings may be difficult because of steep slopes adjacent to and upgradient from the disposal site and the need to divert upstream surface water flows around the site. The design also incorporates steep, heavily-armored diversion ditches whose satisfactory performance may not be able to be demonstrated without relying on periodic maintenance. Our comments also note that the design basis for the disposal site does not appear to be consistent with the site geologic setting.

Based on the items mentioned above and the more detailed comments enclosed, we conclude that the proposed remedial action for the Rifle sites has not been shown to provide control of the reclaimed tailings for the period specified in 40 CFR 192 (200-1000 years). Although you may choose to modify the RAP and design of the Estes Gulch site in accordance with our comments to provide reasonable assurance of long-term stability, it may be more prudent to reexamine the site selection process to determine if less costly and more viable disposal alternatives exist. Our review of the DEIS suggests that better sites than Estes Gulch may indeed be reasonably available near Rifle.

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If you have questions regarding these comments, feel free to contact me at FTS 427-4799 or George Pangburn of my staff at FTS 427-4160.

Sincerely,



Paul H. Lohaus, Acting Chief
Operations Branch
Division of Low-Level Waste Management
and Decommissioning

Enclosures:
As stated

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SWB. DEIS; Page 29.

One of the major design considerations affecting siting of alternatives included long-term stability and the ability to withstand flooding and erosion. NRC staff review indicates that long-term stability may be a significant problem at the Estes Gulch site. The long-term maintenance problem, in conjunction with the need to provide extensive and elaborate hydraulic design features, have resulted in a design that may not satisfy the EPA long-term stability standards given 40 CFR 192. The use of such elaborate and expensive hydraulic design measures may not be feasible or cost-effective and may not provide the required confidence in predicting long-term performance. Based on these deficiencies, the EIS should be revised to assess the other disposal alternatives at more favorable sites.

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GW8. dRAP/dEIS, General, Discrepancies

The dRAP and dEIS contain so many inconsistencies and discrepancies between text and tables, text and figures, and between text sections that NRC's documentation of each one is inappropriate. These inconsistencies complicate independent verification of DOE's conclusions with regard to ground-water protection. It also may indicate quality control problems with failure to ensure that information is accurately documented. The examples below illustrate the deficiencies:

A. Page E-104 of the dEIS claims that New Rifle alluvium well 581 has the highest level of uranium, but uranium concentrations are not contained in the water quality table for this unit (Table E.2.24).

B. Page E-115 of the dEIS claims that alluvial ground-water contamination at Old Rifle extends 800 feet downgradient, yet page E-127 claims that contaminated ground water extends only 300 feet downgradient from the pile in the alluvial aquifer.

C. Page D-332 of the dRAP claims that the hydraulic gradient in the Old Rifle alluvium is 0.005. Table D.7.5 (Page D-369) indicates that the gradient is 0.003, and from Figure D.7.8 (Page D-351), NRC staff calculated a range of gradients from 0.0033 - 0.0064.

D. Page D-386 of the dRAP provides water levels measurements of monitor wells completed in the Wasatch Formation at New Rifle. Page E-50 of the dEIS contains the same table, but water level measurements taken on May 13, 1986, for several wells differ greatly from those presented in the dRAP.

The dRAP and dEIS should be revised to resolve these and other discrepancies through internal review of the documents prior to their release.

GW9. dRAP, Page D-339, Restoration

DOE justified the decision not to implement ground water restoration actions at the Rifle sites based on the following points: 1) restoration costs (\$18 million) exceed the value of the resource, 2) no known users of potentially contaminated ground water, 3) measures other than restoration will ensure that no health effects occur from ingestion, 4) the State of Colorado would institute controls, and 5) citizens wishing to use ground water should be required to treat it. Based on NRC staff review, however, the staff concludes that DOE has not adequately supported these assertions. The following points support this conclusion:

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A. DOE did not provide a technical basis or methodology from which the \$18 million restoration cost was derived. DOE cannot accurately calculate restoration cost because (1) the extent of contamination is not known and (2) EPA has not yet promulgated ground-water protection standards. Without a cost estimation methodology, NRC staff cannot independently verify DOE's cost estimate. Therefore, the restoration cost estimates have not been adequately supported in the dEIS/dRAP.

B. Although at least 47 wells exist within a two-mile radius of the Rifle sites, DOE asserts that none of the wells are expected to be affected by contaminated ground water. Figure D.7.20 identifies several wells located just north of the tailings piles. DOE's assertion with respect to potential impacts cannot presently be supported because the extent of ground-water contamination is not known, the possible seasonal changes in flow direction have not been established, and DOE has not estimated the rate and direction of contaminated ground-water migration.

C. According to Colorado Department of Health staff, the State of Colorado currently does not have statutory authority to control ground-water use. Therefore, DOE cannot rely upon state imposed institutional controls to preclude ground-water use or to require testing of ground water by residents prior to use.

D. The dRAP does not demonstrate how measures other than aquifer restoration will ensure protection of health for residents who ingest contaminated ground water. It would appear likely that ingestion of contaminated water may cause health impacts to the population, regardless of the institutional measures designed to minimize or preclude consumption. DOE should revise this statement appropriately.

The dRAP should be revised to reassess the need for ground-water restoration or to substantiate assertions about ground-water restoration based on assessments that can be independently verified.

GW10. dRAP, Pages D-369 - D-372, Hydraulic Conductivity

The dRAP presents a summary of hydraulic conductivity (K) values determined during site characterization. All K values were included in the dEIS (Tables E.2.7, E.2.9, E.2.11, E.2.13). The dRAP summary, however, omits hydraulic conductivity values recorded in well 641 (Wasatch, Old Rifle). The dRAP does not explain why this K value was omitted in the summary. Although this value of 99 ft/day is higher than other values for the Wasatch Formation at Old Rifle, the higher K value may indicate the existence of preferential pathways for contaminant migration beneath the site. Because lithologic logs in the dRAP are either absent or ambiguous, NRC staff cannot assess unique characteristics of each well that could result in the higher K value. The dRAP should be revised to include the K value from well 641 in the summary or to justify why it should not be included.

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GW11. dRAP, Page D-334, Suitability of Ground Water

DOE indicates that natural ground water derived from the alluvial aquifer at Old Rifle is unsuitable for domestic consumption. Water quality data from wells 601 and 602 in the alluvial aquifer, however, indicate that ground water is suitable for domestic use because TDS levels and other contaminant concentrations are below drinking water standards. Although the dRAP states that ground water is used primarily for livestock and irrigation, the possibility exists that domestic consumption will occur. The dRAP should be revised to state that alluvial ground water of background quality at Old Rifle is suitable for domestic consumption or to demonstrate why it is unsuitable.

GW12. dRAP, Page D-382, Precipitation Rate

DOE stated that an annual average of 11.02 inches of rainfall and 41.1 inches of snowfall are recorded at Rifle, CO. These averages may not be representative of precipitation at the Estes Gulch disposal area because the elevation is 600 feet higher than the town of Rifle. Orographic influences could create a microclimate in which substantially higher rainfall and snowfall could occur. This difference in precipitation could result in larger infiltration rates than expected, thus enhancing leachate generation and migration. The dRAP should be revised to characterize precipitation at the Estes Gulch site based on site-specific information or to demonstrate its comparability to precipitation rates at Rifle.

GW13. dRAP, Page D-341, Estes Gulch Water Quality

DOE conducted a field characterization program at Estes Gulch, which included the construction of 10 ground-water monitoring wells. Despite this program, DOE has not been able to characterize background ground-water quality or hydrogeologic conditions at the Estes Gulch site. Only one well was drilled deep enough to intercept the saturated zone and allow collection of water samples. The other nine wells were completed at shallower depths above the water table. DOE sampled ground water once in well 963 and found the pH level to be 11.6, which is elevated due to grout contamination in the borehole. Thus, DOE has not characterized baseline or background ground-water quality at the Estes Gulch site. The dRAP should be revised to characterize ground-water quality and the hydrogeologic system at Estes Gulch or to justify why additional characterization is not necessary.

GW14. dEIS, Page E-115, Ground-Water Restoration

DOE determined that contaminated ground water at the Old Rifle site would be restored naturally in 1.9 years. Based on NRC staff review, this restoration period is highly non-conservative. Specifically, NRC staff questions the assumption that additional contaminants will not be released to the ground water via dissolution and desorption of contaminants. If dissolution and

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desorption occur, the amount of water flux required to restore the contaminated aquifer would be expected to exceed the one pore volume assessed in the dEIS. Numerous research programs have shown that several pore volumes of ground water are needed to clean-up contaminated aquifers because of dissolution and mobilization of constituents sorbed onto the porous media (e.g. NRC, 1985). In addition, NRC staff questions the assumption that contaminants migrate at one-half the ground-water flow rate. Some of the contaminants would be expected to be mobile and thus migrate at the same velocity as ground water. Migration of other contaminants, however, may be considerably retarded as a result of sorption and precipitation/dissolution reactions which result in a wide variability of contaminant migration rates relative to ground-water flow rates. The dEIS should be revised to assess natural restoration using conservative assumptions and calculations to present a reasonable range of restoration rates.

Reference: U.S. NRC, 1985, Methods of Minimizing Ground-Water Contamination From In-Situ Leach Uranium Mining, NUREG/CR-3709, prepared by Battelle Pacific Northwest Laboratory.

GW15. dEIS, Page E-87, Source Term

DOE used concentration levels of constituents in neutralized ground water in subsoils beneath the tailings as the source term for contamination. This method underestimates the potential source term because contaminant concentrations in neutralized solutions are generally much lower than in solutions that are in contact with the tailings. In addition, the source term at the Rifle sites may be considerably higher than at other UMTRAP sites because of the recent operation of raffinate pits and other on-site activities creating a range of potential contaminants. DOE should collect representative samples of tailings material and/or tailings pore water. The dEIS should be revised to characterize the contaminant source term.

GW16. dEIS, Page E-111, Irrigation

DOE claims that irrigation water is no longer percolating through the tailings, thereby inferring that irrigation of the pile has ceased. However, during a site visit on 11 June 1987, NRC staff observed the New Rifle pile being irrigated at a rate of 700 gallons per minute. The staff were also told that irrigation occurred for about 8 hours a day. Therefore, additional leachate may be percolating downward into the alluvial ground-water system at New Rifle. The dEIS should be revised to indicate that irrigation is ongoing and that additional leachate is being produced.

GW17. dEIS, Page E-115, Impact Assessment

DOE claims that sufficient data are not available for calculating natural restoration rates for aquifers at New Rifle. Natural restoration represents, in part, the no action case for assessing environmental impacts associated with tailings stabilization at Rifle. If impacts associated with natural

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6.7.41 restoration cannot be assessed, then DOE cannot compare impacts to water quality for tailings stabilization. The dEIS should be revised to characterize the ground-water systems at the New Rifle site sufficient to assess natural restoration and to evaluate environmental impacts.

GCh1. dRAP, General, Geochemical Characterization

Review of the dRAP and dEIS indicates that DOE has not adequately considered geochemistry in evaluating environmental transport of contaminants for the remedial action proposed at the Rifle sites. The subject documents do not characterize the geochemistry of the site soil and hydrochemistry, which includes a description of the baseline conditions, contaminant source term, and the supporting quantitative and representative site-specific geochemical data (e.g. dispersion coefficients, attenuating capacities) as required for site characterization by the DOE's Technical Approach Document (TAD). Such characterization is necessary to assess transport of contaminants in ground water to ensure protection of ground water resources from significant degradation of quality. This deficiency should be corrected in the final dRAP and/or dEIS.

GCh2. dRAP, General, Salt Disequilibrium

Similar to comments on the Green River, UT UMTRA Project site, DOE has not adequately considered potential dissolution of salts within the tailings pile and resulting contaminant transport and physical instability of the pile during the design life of 200-1000 years. Following the review of DOE's response to NRC comments on the Grand Junction dRAP, NRC staff agreed in principle with DOE that salt dissolution and transport due to geochemical disequilibrium leading to failure of the disposal cell and radon barrier could be moderated under certain site conditions. These conditions include, but are not limited to: a water table sufficiently below the bottom of the pile to preclude upward movement of water into the tailings, salt concentrations in the tailings low enough so that dissolution will not promote settlement of the pile, and a sufficiently moist cover system which will preclude the development of strong upward hydraulic gradients.

The dRAP should be revised to assess the effects of salt dissolution and related processes on contaminant transport and tailings stability during the design life of 200-1000 years. Specifically, DOE should determine representative salt concentrations in the tailings and evaluate the potential for shallow ground water accumulating beneath the pile. Further, DOE should demonstrate that hydraulic gradients in the tailings will be downward.

Mr. James R. Anderson, Project Manager
Uranium Mill Tailings Project Office
U.S. Department of Energy
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Anderson:

Enclosed are our comments in the area of geotechnical engineering for the draft Remedial Action Plan and the draft Environmental Impact Statement for the UMTRA sites at Rifle, Colorado. With the receipt of the enclosed, our comments on the dRAP and dEIS are complete.

If you have questions regarding these comments, feel free to contact me at FTS 427-4799 or George Pangburn of my staff at FTS 427-4160.

Sincerely,

Paul H. Lohaus, Acting Chief
Operations Branch
Division of Low-Level Waste Management
and Decommissioning

Enclosures: As stated

GT1 - dRAP - Figure 3.3, Page B-7 - Characterization of Vanadium Ponds

Figure 3.3 on page 14 shows three areas labeled as Vanadium Ponds on the New Rifle processing site. Page B-7 of Appendix B discusses the estimation of the depth of contamination beneath these ponds of 5 feet. It is stated that no boreholes were drilled during site characterization because the ponds were filled with process liquor at the time the site characterization was done. It is explained that the ponds have been dredged since the time of site characterization, and the depth of contamination has been re-estimated as 3.5 feet. This new estimated depth of contamination should be supported by field data. Additionally, the disposition of the dredged material should be described. If the dredged material is to be moved with the tailings and other contaminated materials, it may be necessary to characterize it since it may exhibit properties different than the tailings and the other contaminated materials.

GT2 - dRAP - Pages 56, Pages D-144 and D-145; Figures D.4.51 thru D.4.61;
Figures D.5.40a thru D.5.40d; Figures D.5.57a thru D.5.61c
dEIS - Page D-1 - Shear Strength Tests and Values

(a) Figures D.5.40a to D.5.40d and Figures D.5.57a to D.5.61c report results of "staged" triaxial shear strength tests performed on in-situ and remolded radon cover soil at three different densities and three different moisture contents. These results are questionable because the laboratory samples were tested at densities and moisture contents which are different from the planned design values. It is standard engineering practice to perform triaxial compression tests on several samples of the same material at the same density and moisture content. The staff recommends that the stability analysis use shear strength values determined by this standard engineering practice, or that clear justifications be given as to why these staged triaxial tests give results that are as representative as the test results are when employing the standard engineering practice.

(b) Figures D.40a to D.40d report the results of 1 laboratory test for shear strength conducted on the in-situ soils at the Estes Gulch site. The staff recommends that additional tests be conducted or that a justification be given that substantiates the use of only 1 test for shear strength on the in-situ soils.

(c) Figures D.4.51 through D.4.61 report results of triaxial shear strength tests performed on tailings at three different densities and moisture contents. Therefore, the staff has the same comments and recommendations that are discussed in GT2 (a) directly above.

(d) Page D-145 reports the results of one unconsolidated-undrained triaxial test for the sand-slime tailings. As discussed in (b) above, the staff recommends more testing, or a discussion that justifies the use of one test result for determining this property of the tailings. Also, the results from

this test should be displayed graphically like the other test results in Appendix D.

(e) The text on page D-144 admits that none of the tests for strength reported in Figures D.4.51 through D.4.61 were conducted with moisture contents and dry densities that replicate field conditions. Additionally, although some of the tests were conducted on sand-slime mixtures, there were no strength tests performed on a sample with the expected typical field mixture of 55% sand -- 45% slime. The staff is concerned that the strength parameters resulting from these tests are not representative compared to strength parameters resulting from tests that could be conducted on samples with field condition sand-slime mixtures, densities, and moisture contents.

GT3 - dRAP - Figure 4.3, Pages 48 and 72 - Disposal Site Characterization

Figure 4.3 shows an area of small debris flow partially within the approximate site location. On page 72 of the text, the discussion on this debris flow says that this area will be completely covered by the pile and thus is eliminated as a problem. The site plan on page 48 that displays the locations of borings and test pits shows that this area was not characterized. The staff feels that this area should be characterized because it may exhibit properties significantly different from soils tested at the Estes Gulch site. Such differences may be significant when considering the long-term stability of the site.

GT4 - dRAP - Page B-15 and Table B.1.5 - Radon Cover Long-Term Moisture Content

The long-term moisture content of the radon barrier has been identified as 17.4% in Table B.1.5. The staff is concerned that this value may not be representative of the actual long-term moisture content. The staff's concerns are based on two reasons. First, the average of the in-situ moisture content values for soils from the Estes Gulch site is only 8.2%. Second, the semi-arid climate of the site vicinity (average annual precipitation is 11.02 inches and there is "high evaporation" (dEIS, page 71)) would indicate that the maximum placement moisture content of 17.9% (Table D.5.2) would be reduced to a lower value than 17.4%. The staff recommends that values that have been measured for the near surface material existing at the borrow site should be correlated to the conditions at the actual disposal site to aid in the selection of a conservative long-term moisture value for the cover.

GT5 - dRAP - Page D-67 and Figure D.3.9 - Geomorphic Characteristic

Figure D.3.9 shows two areas of landslide or slump deposits within 1000 feet of the proposed Estes Gulch site. These areas are briefly discussed on page D-67 and the conclusion reached is that the deposits do not affect the proposed tailings disposal area. While this may be true, there should be additional information that describes why other nearby areas are not susceptible to similar processes and why a continuing minor slumping of the northeast deposit

will not become larger and affect the stability of the pile. Characterization of these movements may be required, or a justification of why some characterization is not needed.

GT6 - dRAP - Table D.4.1 and Page D-145 - Parameter Value Discrepancies

(a) The parameters reported in Table D.4.1 for maximum dry density and optimum moisture content for the placed tailings are reversed. Therefore, the values for density and moisture content currently listed under "Old Rifle" are supposed to be under "New Rifle," and vice-versa.

(b) The parameter for phi reported in Table D.4.1 for the short-term strength of the placed tailings does not agree with the text on page D-145. This discrepancy should be corrected.

(c) The assumed parameters for phi reported in Table D.4.1 for the other "contaminated materials" are not justified with any discussion in the text. The references that were used to obtain these assumed values and a discussion about why these assumed values are representative should be included, at a minimum, to substantiate the choices of parameter values.

GT7 - dRAP - Page D-155

dEIS - Page A-40 - Tailings Pile Construction

Strength test values for the relocated tailings and the assumptions that no extensive lenses of slimes would exist in the compacted tailings are both based on the expected uniform mixing of sands and slimes of the two existing Rifle tailings piles. Because of this uniform mixing assumption, it is stated that no appreciable differential and total settlement will occur. Procedures and operations that will be specified to give the expected uniform mixing should be described.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII

999 18th STREET—SUITE 500
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JUL 15 1987

Ref: 8HWM-RP

James R. Anderson, Manager
Uranium Mill Tailings Project Office
Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Anderson:

The Radiation Programs Branch, EPA Region VIII, has reviewed the draft Environmental Impact Statement for the proposed remedial actions at the former Union Carbide Corporation uranium mill sites, Rifle, Colorado.

Based on the review of the draft EIS, I agree with the basic approach providing for ultimate disposal of tailings and other contaminated materials at an off-site location (as opposed to consolidation in-place or on-site at the New Rifle site). The physical, hydrological, and geological characteristics and engineering designs for both of the proposed off-site disposal sites - Estes Gulch and Lucas Mesa - should be adequate for compliance with the EPA standards for radon emissions control and longevity against erosive forces. The obvious cost advantage of disposal at the Estes Gulch site is apparent. However, I assume your staff will continue to work with State and local officials to gain their concurrence of this D.O.E. - preferred remedial action.

Specific review comments are presented on the attached UMTRA Document Review Forms. Although these comments will not impact the technical evaluation, I think the consideration of the same will improve the completeness of the final EIS.

Sincerely yours,

Milton W. Lammering
Milton W. Lammering, Chief
Radiation Programs Branch

Attachments

UMTRA DOCUMENT REVIEW FORM

SECTION 1

Site: Rifle - Colorado, Date: July 10, 1987
 Document: Draft EIS
 Commentor: Milton W. Lammering, EPA
 Comment: Page 38 (3rd Paragraph)

6.3.18 Preparation of the base of the disposal site is listed as one of the design features to minimize the potential for contaminant migration from the tailings to the ground water. A detailed description of what is to be included in the preparation (clay barrier, simple compaction, etc.) should be presented in the final EIS.

SECTION 2

Response: Page _____ Ey: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

SECTION 1

Site: Rifle - Colorado, Date: July 10, 1987
 Document: Draft EIS
 Commentor: Milton W. Lammering, EPA

Comment: Page 38 (3rd Paragraph)

6.7.42 Accepting the estimated flush time of 45 years to lower pollutant levels in the alluvial aquifer at the Old and New Rifle sites to background levels, the proposed program of long-term institutional controls to prohibit the use of ground water from the affected zones does seem to be a reasonable and acceptable approach. However, for the contaminated zone in the Wasatch Formation at the New Rifle site, this approach does not seem to be a viable control mechanism in view of the projected flush time of 3840 years. It may well be that future utilization of this aquifer at this location is not a critical concern. However, an approach other than institutional controls will be needed if there is a definite need to protect public health in the event of use.

SECTION 2

Response: Page _____ Ey: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

SECTION 1

Site: Rifle Colorado Date: July 10, 1987
 Document: Draft EIS
 Commentor: Milton Lammering, EPA

Comment: Page 47 (Description of final conditions)

6.3.12 Since the physical, geological and hydrological conditions as well as the final disposal pile designs for Estes Gulch and Lucas Mesa Sites are very similar, an explanation should be provided for the need of the slightly thicker radon barrier at the Lucas Mesa site (4 feet versus 3.5 feet). More importantly, the need for the 10% bentonite amendment in the barrier at the Lucas Mesa site and not a similar need at the Estes Gulch site should be explained.

SECTION 2

Response: Page _____ Ey: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UMTRA DOCUMENT REVIEW FORM

SECTION 1

Site: Rifle - Colorado, Date: July 10, 1987
 Document: Draft EIS
 Commentor: Milton W. Lammering, EPA

Comment: Page 53 (State-nominated disposal sites)

6.3.10 It is stated the Candidate Site Review Committee nominated two sites for further consideration and evaluation as disposal sites; consideration and evaluation by DOE. These sites are identified as Flatiron Mesa and Lucas Mesa. There is no discussion concerning the apparent rejection of the Flatiron Mesa site from the EIS evaluation process of potential alternate disposal sites. This information should be presented as well as a general description of the Flatiron Mesa site (including location relative to the Old and New Rifle sites).

SECTION 2

Response: Page _____ Ey: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

UNTER DOCUMENT REVIEW FORM

SECTION 1

Site: Rifle - Colorado, Date: July 10, 1987
 Document: Draft EIS
 Commentor: Milton W. Lammering, EPA

Comment: Page 100 (Alternate disposal sites)

The statement is made: "Ground water was not encountered in the three monitor wells drilled (maximum depth of 203 feet) at the Lucas Mesa site; . . ." This finding raises doubt on the need for the inclusion of the bentonite in the radon barrier at the Lucas Mesa site and the prediction at several places in the EIS that the migration of pollutants could reach groundwater in approximately 500 years (as opposed to 800 years at the Estes Gulch site). Moreover, it undermines the credibility of the conclusion presented in the second page of the cover sheet. "Also, groundwater contamination could occur at the Lucas Mesa site in a short period of time." There is no justification for the implication of a greater ground water pollution potential at the Lucas Mesa site in comparison to the Estes Gulch site.

SECTION 2

Response: Page _____ By: _____ Date: _____

Plans for Implementation:

SECTION 3

Confirmation of Implementation:

Checked by: _____, Date: _____

Approved by: _____, Date: _____

Office of the
 Administrator
 of Veterans Affairs

Washington DC 20420



Veterans
 Administration

JUL 10 1987

Mr. James R. Anderson
 Project Manager
 Uranium Mill Tailings Remedial
 Action Project
 U. S. Department of Energy
 Albuquerque Operations Office
 Suite 1720
 5301 Central Avenue, N.E.
 Albuquerque, NM 87108

Dear Mr. Anderson:

We have reviewed the Draft EIS for Remedial Actions at the Former Union Carbide Corporation Uranium Mill Sites, Rifle, Garfield County, Colorado (DOE/EIS-01320), and have the following comments.

The U. S. Veterans Administration has provided grant assistance to the State of Colorado for the construction of a State Veterans Nursing Home Care Facility in Rifle, Colorado. The nursing home property is approximately 1,000 feet north of the Old Rifle Site. As partners with the State in the funding of the project and patient care, we are interested in the resolution of the long-term hazards of the area. Therefore, the Veterans Administration supports both Alternatives 3 and 4 as solutions which remove the source of the hazard from the community area.

Alternative 3 is slightly preferable in that the maximum average annual concentrations of total suspended particulates will not be exceeded at the Old Rifle Site. The same criteria is listed as temporarily exceeded under Alternative 4 (Table 1.1, Summary of Impacts, page 9), although it is not clear why this characteristic differs between alternatives 3 and 4.

Section 4.2.1, Old Rifle Site (page 67), indicates that the tailings have been dispersed by wind into the area of the State Nursing Home. The area is shown on Figure 4.9, Off Site Contamination, Old Rifle Site (page 111). We believe that the State Nursing Home property is partially within the contaminated area, although the lack of landmarks on Figure 4.9 makes it difficult to assure an accurate location. Additionally, the scale on Figure 4.9 is incorrect.

Prior to construction, contaminated soil was removed from the nursing home site and immediate adjacent ground. Following the cleanup, a gamma scan survey of the property was conducted. Based on this survey, the Colorado Department of Health stated that the property receives

6.2.11

6.5.2

6.4.2

Page 2

Mr. James R. Anderson
Albuquerque, NM 87108

6.4.2 gamma radiation shine from the contaminated adjacent hillsides and area directly south across the paved county road. They also stated that the slightly elevated gamma readings should diminish when the Uranium Mill Tailings Remedial Action (UMTRA) Program decontaminates the area. Please clarify Figure 4.9 with the additions of Fifth Street and any other helpful landmarks so that we may be assured that the UMTRA Program will remove the source of the radiation shine. Maps showing the location of the State Nursing Home are enclosed for your use.

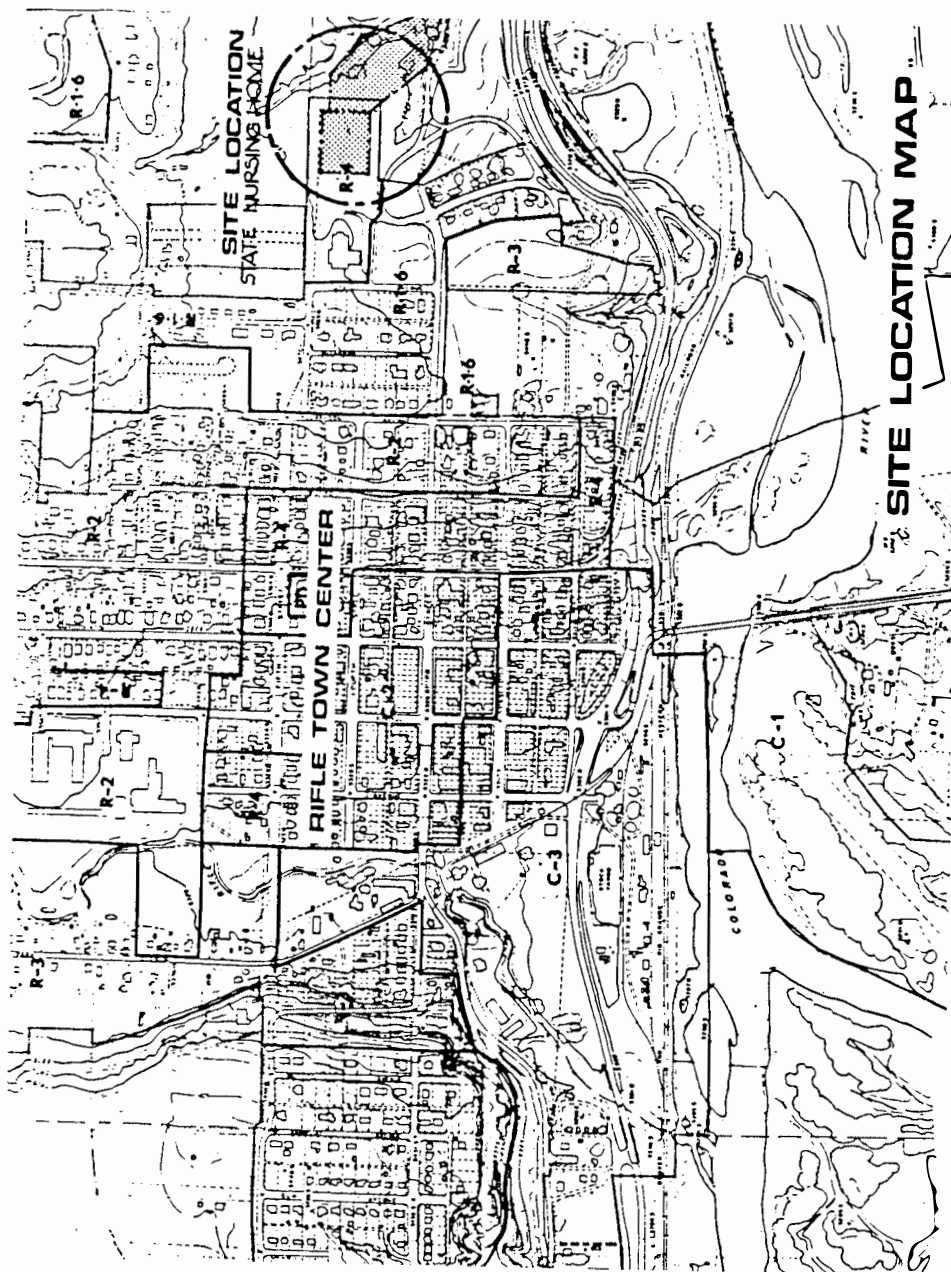
Thank you for the opportunity to comment on this document.

Sincerely,

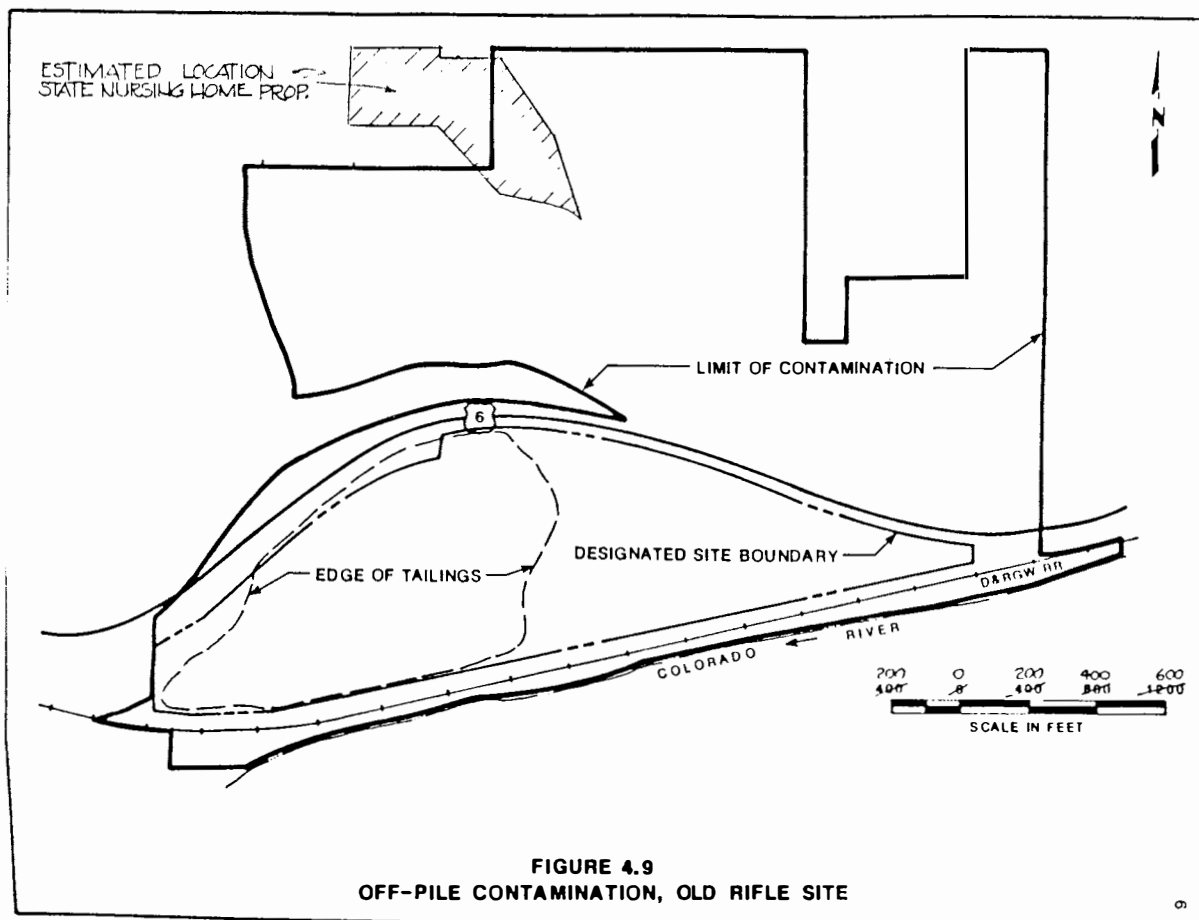
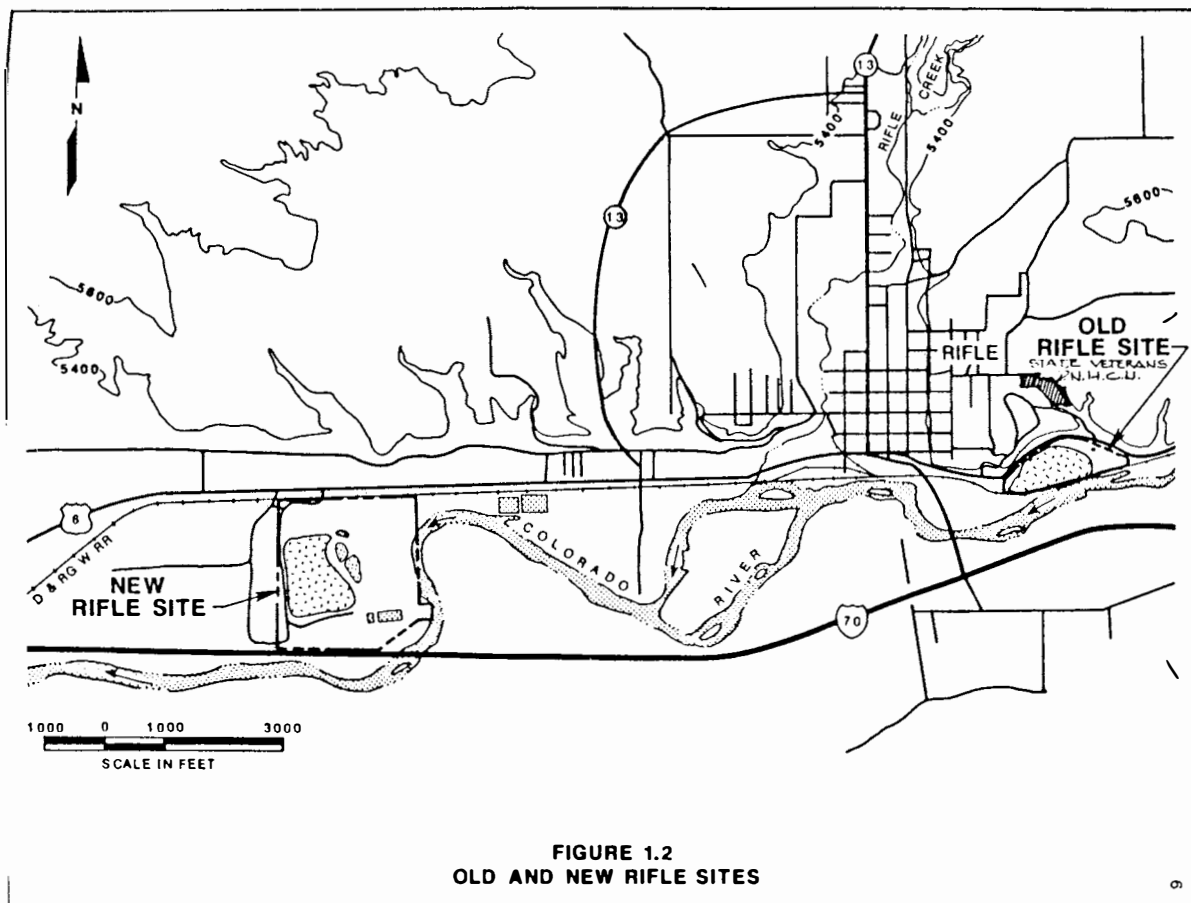
Susan L. Ingstone
SUSAN L. INGSTONE
Director of Environmental Affairs

Enclosures

6



6



Rifle Area Chamber of Commerce¹¹
 P.O. Box 809 / 101 S. Railroad Avenue / Rifle, Colorado 81650
 303-625-2085 From Willbur Lantz

July 9, 1987

U.S. Department of Energy
 Albuquerque Operations Office
 P.O. 5400
 Albuquerque, N.M. 87115

Sirs,

The Board of Directors, members, and staff of the Rifle Area Chamber of Commerce wish to convey their support of the Rifle Uranium Mill Tailings Remedial Action (UMTRA) Project as proposed by the U.S. Dept. of Energy. For the following reasons, the Chamber favors adoption of DOE alternative #3: Disposal at the Estes Gulch Site, which is the preferred alternative:

- 1) The economic status of the area would genuinely benefit from the construction phase of the project, both in the creation of new jobs and in the local procurement of goods and services. The financial magnitude of the project and the proposed time span of the project are viewed by the Chamber as being positive factors in the continued stabilization and necessary growth of the area's private sector.
- 2) Decontamination of the Rifle sites heightens the possibility for an increase in valuable commercial, industrial, and/or recreational land inventory in the area. The location of the new Rifle site, and its proximity to major highway and rail networks, make it one of Garfield County's and western Colorado's more suitable pieces of real estate for revitalization by either public or private entities.
- 3) Health risks to the populus of the city of Rifle and surrounding areas would be mitigated by the decontamination of the old and new Rifle mill tailings sites and by remedial action to Rifle's contaminated vicinity properties.

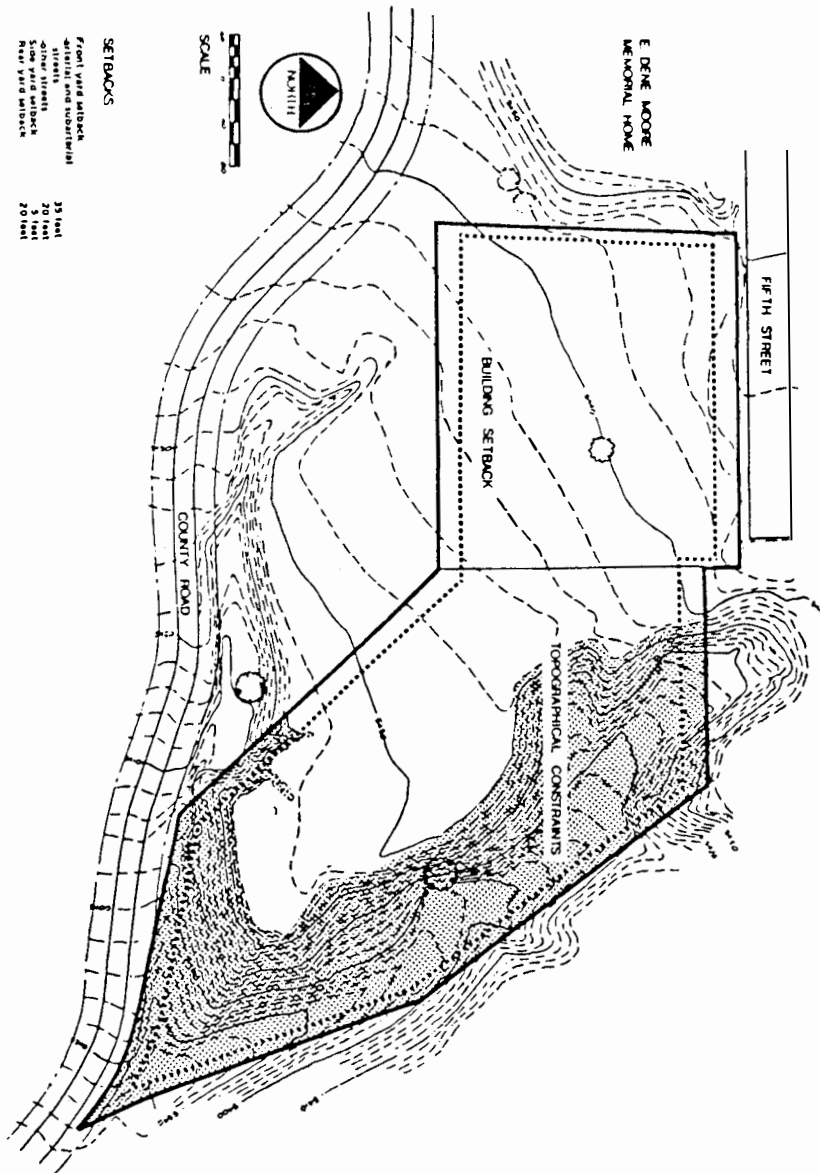
It is, therefore, the Chamber's desire to see the adoption and implementation of the Department of Energy's preferred alternative. The Chamber would also like to take this opportunity to commend the Department of Energy and Jacobs Engineering for their thorough and efficient efforts during the preliminary phases of the project.

Yours for a better Rifle,

Gary Ward
 President - Rifle Chamber of Commerce

Dave Ling
 Chamber Liason to UMTRA Task Force

Rifle — Colorado's Best Shot!



6.2.13

SITE CONSTRAINTS



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814 4794

12

12

June 11, 1987

Regulatory Section

Mr. James R. Anderson, Manager
Uranium Mill Tailings Project Office
Department of Energy
Albuquerque, New Mexico 87115

Dear Mr. Anderson:

We have completed our review of the Draft Environmental Impact Statement for remedial actions at the former Union Carbide Corporation Uranium Mill Sites Rifle, Garfield County, Colorado (DEIS).

Our major concern centers around wetlands adjacent to the Old and New Rifle sites along the Colorado River. According to the DEIS, the riparian zone along this portion of the Colorado River consists primarily of palustrine scrub-shrub wetlands dominated by willow and cottonwood. There are also small areas of willows and cattails and extensive areas of dense saltgrass bordering the river near the New Rifle site. All of the aforementioned vegetative types are wetland indicator species.

It appears that the potential for wetland impacts is present at either site. Reclamation of the Old Rifle site may require fill activities in wetlands and if the New Rifle Site is selected as the alternative disposal site, wetland fill activities will conceivably occur. In either event if the discharge of fill material in the Colorado River or wetlands is required to perform the project then a permit will be required under Section 404 of the Clean Water Act.

We intend to perform an onsite inspection of the sites to determine the extent of wetlands in the project area. It would be helpful if someone familiar with the project could be available for an inspection to determine the limit of project fill activities.

If you feel there is merit in having Department of Energy personnel or other knowledgeable individuals available for the onsite inspection, please contact Ken Jacobson at telephone (303) 243-1199 to establish a date and time of attendance.

Thank you for the opportunity to comment on the DEIS.

Sincerely,

Grady L. McNure
Chief, Regulatory Unit 4
764 Horizon Drive, Room 211
Grand Junction, Colorado 81506-8719



United States Department of the Interior

FISH AND WILDLIFE SERVICE
COLORADO FIELD OFFICE
730 SIMMS STREET
ROOM 202
GOLDEN, COLORADO 80401

IN REPLY REFER TO:

(FWE)

October 4, 1988

CC: FWS/FWE, Salt Lake City
FWS/FWE, Grand Junction
Reading File
Official File

W. John Arthur, III
Project Manager
Uranium Mill Tailings Project Office
Department of Energy
Albuquerque, New Mexico 87115

Dear Mr. Arthur:

This responds to your September 12, 1988, letter requesting our review and comment on the Draft Environmental Impact Statement for the Uranium Mill Sites at Rifle, Colorado. Specifically, we were requested to review sections regarding potential impacts to federally listed species and concur with the Department of Energy's (Department) "no affect" determination.

We concur with your "no affect" determination for bald eagle, black-footed ferret and Uinta Basin hookless cactus. However, the draft environmental statement discloses the need for approximately 175 acre-feet of water for the Estes Gulch Alternative (Table 5.7, page 167). The Service believes that any depletion of water from the upper Colorado River basin has a negative impact to federally listed fish species. Therefore, if completion of the project, as proposed, will result in a net water depletion from the upper Colorado River basin, we would expect a may affect determination for the Colorado squawfish, humpback chub, and bonytail chub. Consequently, we are requesting the Department to evaluate the total water requirements of the Rifle uranium tailings remedial action project, and determine whether the water use will result in a net depletion of water from the upper Colorado River basin. The depletion should be quantified as an average annual depletion expressed in acre-feet for the life of the project. If a net depletion is documented, formal consultation under the Endangered Species Act should be initiated by the Department with this office.

If we may be of any assistance, please contact me or Bob Leachman in our Grand Junction office at (303) 243-2778 or FTS 322-0351.

Sincerely,

LeRoy W. Carlson
for

LeRoy W. Carlson
Acting State Supervisor

Table 6.3 Public reading rooms and libraries having copies of public hearing transcripts

Energy/Environment Center, Denver Public Library,
1357 Broadway, Denver, Colorado 80210

Environmental Center, University of Colorado,
Boulder, Colorado 80309

Freedom of Information Reading Room, U.S. Department of Energy,
Room 1E-190, Forrestal Building, 1000 Independence Avenue, S.W.,
Washington, D.C. 20585

Learning Resource Center, Mesa College, P.O. Box 2647,
Grand Junction, Colorado 81502

Library, Albuquerque Operations Office, U.S. Department of Energy,
National Atomic Museum, Kirtland Air Force Base East,
Albuquerque, New Mexico 87115

Library, Chicago Operations Office, U.S. Department of Energy,
9800 South Cass Avenue, Argonne, Illinois 60639

Library, Idaho Operations Office, U.S. Department of Energy,
550 Second Street, Idaho Falls, Idaho 83401

Library, Nevada Operations Office, U.S. Department of Energy,
2753 South Highland Drive, Las Vegas, Nevada 89114

Library, Oak Ridge Operations Office, U.S. Department of Energy,
Federal Building, Oak Ridge, Tennessee 37830

Library, Richland Operations Office, U.S. Department of Energy,
Federal Building, Richland, Washington 99352

Library, Savannah River Operations Office, U.S. Department of Energy,
Aiken, South Carolina 29801

Mesa County Library, 5301 Grand Avenue,
Grand Junction, Colorado 81502

National Wildlife Federation Library, Fleming Law Building,
Boulder, Colorado 80309

Rifle Branch Library, 357 East Avenue,
Rifle, Colorado 81650

The Libraries, Documents Department, Colorado State University,
Fort Collins, Colorado 80523

UNC Technical Services, Inc., 2597 B 3/4 Road,
Grand Junction, Colorado 81503

REFERENCE FOR SECTION 6.0

Mitchell, J. K., 1976. Fundamentals of Soil Behavior, John Wiley and Sons, New York, New York.

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for ensuring the integrity of the financial system and for providing a clear audit trail. The document also highlights the need for transparency and accountability in all financial dealings.

In the second part, the focus shifts to the role of the auditor in verifying the accuracy of the financial statements. The auditor is responsible for conducting a thorough examination of the records and providing an independent opinion on the fairness and reliability of the information presented. This process is crucial for building trust and confidence among stakeholders.

The third part of the document addresses the challenges faced by organizations in implementing effective internal controls. It identifies common weaknesses and provides practical advice on how to strengthen these controls to prevent fraud and errors. The document stresses that a robust internal control system is a key component of any organization's risk management strategy.

Finally, the document concludes by reiterating the importance of ongoing monitoring and improvement. Financial systems are dynamic, and organizations must regularly review and update their processes to adapt to changing circumstances and regulatory requirements. Continuous improvement is essential for maintaining the highest standards of financial performance and compliance.

GLOSSARY

aboriginal	Being the first of its kind in a region.
absorbed dose, radiological	Radiation energy absorbed per unit mass, usually given in units of rads.
aggradation	The building up of the earth's surface by deposition; specifically, the upbuilding performed by a stream in order to establish or maintain uniformity of grade or slope.
aggregate	Mineral materials, such as sand or stone.
alluvium	Sediment deposited by a flowing river.
alpha particle	A positively charged particle emitted from certain radionuclides; it is composed of two protons and two neutrons and is identical to the helium nucleus.
ambient	Surrounding on all sides; encompassing.
animal unit-month (AUM)	The amount of feed or forage required by one mature cow and calf for one month.
anisotropy	A variation in the general water flow direction within an aquifer; water in an anisotropic aquifer may not flow parallel to the hydraulic gradient.
anthropogenic	Relating to or involving the impact of man on nature.
aquifer	A subsurface formation containing sufficiently saturated permeable material to yield usable quantities of water.
aquitard	A water-bearing zone that allows transmission of water at a very slow rate but cannot yield significant quantities of water to production wells.
artesian	Artesian is synonymous with confined; see "groundwater, confined."
atom	A unit of matter; the smallest unit of an element consisting of a dense, central, positively charged nucleus surrounded by a system of electrons, equal in number to the number of nuclear protons and characteristically remaining undivided in chemical reactions except for a limited removal, transfer, or exchange of certain electrons.
attenuate	To reduce in strength, force, value, or amount.

GLOSSARY (Continued)

A-weighted scale	Sound pressure level scale which most closely matches the response of the human ear; this scale is most commonly used to measure environmental noise and is often supplemented by the time and duration of the noise to determine the total quantity of sound affecting people.
background groundwater quality	The quality of groundwater that would be present beneath the site had processing activities not occurred.
background radiation	Radiation arising from radioactive material other than that under consideration; background radiation due to cosmic rays and natural radioactivity is always present, and there is always background radiation due to the presence of radioactive substances in building materials and the like.
beta particle	Charged particle emitted from the nucleus of an atom during radioactive decay, with mass and charge equal to that of an electron.
bioassay	A method for quantitatively determining the concentration of radionuclides in a body by measuring the quantities of those radionuclides that are eliminated from the body, usually in the urine or the feces.
calcareous	Composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.
Class I to III archaeological surveys	Relates to an archaeological investigation of probable occurrence of cultural resources within a given locale. A Class I survey is a literature search for predetermined archaeological features of historic significance; a Class II survey is a combination of a literature review and a partial but cursory excavation of an area to determine the presence of cultural resources; a Class III survey is an in-depth inspection of an area to determine the presence of archaeological materials where the likelihood of their occurrence is high, based on the history of the area.
cobble (cobbly)	A rock fragment larger than a pebble and smaller than a boulder, having a diameter in the range of 2.5 to 10.1 inches, and somewhat rounded or otherwise modified by abrasion in the course of transport.
colluvium	Weathered geologic material transported by gravity.

GLOSSARY (Continued)

concentration, maximum permissible	The maximum concentration of a radionuclide that a remedial action worker may be exposed to during a set time interval and accumulate a total exposure that is within Federal safety standards.
confined aquifer	An aquifer bounded above and below by relatively impermeable rock layers.
confining bed	Confining bed is defined as a body of "impermeable" material stratigraphically adjacent to one or more aquifers; in nature, however, its hydraulic conductivity may range from nearly zero to some value distinctly lower than that of the aquifer.
conglomerate	Rounded waterworn fragments of rock or pebbles cemented together by another mineral substance.
conifer	An evergreen needle-leaved tree.
contamination	In this report, the presence of radioactive material in concentrations above natural levels.
controls, passive institutional	Those controls which preclude human contact with the waste or require a continuing social order. Examples include Federal ownership of a disposal site, monuments on the site, records with agencies, and physical barriers (e.g., riprap covers, vegetation, waste burial).
cultigen	A cultivated crop (such as Indian corn) for which a wild ancestor is unknown.
curie (Ci)	The unit of radioactivity of any nuclide, defined as precisely equal to 3.7×10^{10} disintegrations per second.
daughter product(s)	A nuclide resulting from radioactive disintegration of a radionuclide, formed either directly or as a result of successive transformations in a radioactive series; it may be either radioactive or stable.
decay, radioactive	Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles, photons, or both.
decay chain, radioactive	A succession of nuclides, each of which transforms by radioactive disintegration into the next until a stable nuclide results.
decibel (dBA)	A unit used to express power or intensity ratios in electrical or acoustical technology.

GLOSSARY (Continued)

decontamination	The reduction of radioactive contamination from an area to a predetermined level set by a standards-setting body, such as the EPA, by removing the contaminated material.
differential settlement	The relative movement of two parts of a structure.
dip	The angle at which a stratum or any planar feature is inclined from the horizontal.
disintegrations per minute or second	The number of radioactive decay events occurring per minute or second.
disposal	The planned, safe, permanent placement of radioactive waste.
dose	A general term denoting the quantity of radiation or energy absorbed, usually by a person; for special purposes, it must be qualified; if unqualified, it refers to absorbed dose.
dose, absorbed	The amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material at the point of interest; given in units of rads.
dose commitment	The cumulative dose equivalent that results and will result from exposure to radioactive materials over a discrete time period; given in units of rems.
dose equivalent	The quantity that expresses all kinds of radiation on a common scale for calculating the effective absorbed dose; defined as the product of the absorbed dose in rads and modifying factors, especially the qualifying factor; given in terms of rems; often abbreviated "dose."
dosimetry	The measurement of radiation doses.
earthquake, design	The earthquake which produces the largest on-site peak horizontal acceleration; this earthquake could be the floating earthquake or an earthquake whose magnitude is derived from a relationship between fault rupture or fault length and maximum magnitude.
earthquake, floating	An earthquake within a specific seismotectonic province which is not associated with a known tectonic structure; also defined as an earthquake which is moved over an inclusive area because it cannot be pinned down for lack of precise information on where the earthquake may occur.

GLOSSARY (Continued)

endemic	Belonging to or native to a locality or region.
ephemeral	Lasting for a brief time; an ephemeral stream carries water only during and immediately after periods of rainfall or snowmelt.
epicenter	The part of the earth's surface directly above the origin of an earthquake.
erg	A unit of work or energy.
escarpment	A steep face terminating high lands abruptly; a cliff.
exposure	The presence of gamma radiation that may deposit energy in an individual; given in units of roentgens.
external dose	The absorbed dose that is due to a radioactive source external to the individual as opposed to radiation emitted by inhaled or ingested sources.
fault	A surface or zone of rock fracture along which there has been movement.
fault, capable	As defined by the Atomic Energy Commission (AEC) and adopted by the Nuclear Regulatory Commission (NRC) for the siting of nuclear power plants (10 CFR 100), a capable fault is a fault which has exhibited one or more of the following characteristics: movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years; macroseismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; structural relationship to a capable fault such that movement on one fault could be reasonably expected to cause movement on the other.
fauna	The animals of a specified region or time.
floodplain	Lowland or relatively flat areas that are subject to flooding; a 100-year floodplain has a one percent or greater probability of flooding in any given year.
flora	The plants of a specified region or time.
flux, radon	The emission of radon gas from the earth or other material; usually measured in units of picocuries per square meter per second.
frost heave	The lifting of a surface by the internal action of frost within the soil structure.

GLOSSARY (Continued)

fugitive dust	Dust particles which are dispersed from a construction site or from trucks during hauling.
gamma	A high energy and deep penetrating form of radiation.
gamma dose	Radiation dose caused by gamma radiation.
gamma logging (or logs)	A technique for determining gamma radiation levels at various depths in a borehole.
gamma ray	High energy electromagnetic radiation emitted from some radiation radionuclides; the energy levels are specified for different radionuclides.
gamma spectral analysis (gamma spectroscopy)	An analytical technique for identifying radionuclides based on their different gamma energy levels.
geomorphic	Of or pertaining to the figure of the earth or the form of its surface.
geomorphology	The study of the origin of secondary topographic features which are carved by erosion in the primary elements and made up of the erosional debris.
grazing allotment	An entitlement given by a government agency or Indian tribe to a person or persons to use a specified parcel of land for the grazing of livestock.
grazing capacity	The maximum number of livestock which can graze each year on a given area of range for a specific number of days without inducing a downward trend in forage production, forage quality, or soil.
groundwater	Water below the land surface, generally in a zone of saturation.
groundwater, confined	Confined groundwater is under pressure significantly greater than atmospheric, and its upper limit is the bottom of the bed of distinctly lower hydraulic conductivity than that of the material in which the confined water occurs.
groundwater, unconfined	Unconfined groundwater is water in an aquifer that has a water table.
half-life	The time required for 50 percent of the quantity of a radionuclide to decay into its daughters.
head	When used alone, it is understood to mean static head; the static head is the height above a standard datum of

GLOSSARY (Continued)

	the surface of a column of water (or other liquid) that can be supported by the static pressure at a given point.
head, total	The total head of a liquid at a given point is the sum of three components: (1) elevation head, h_e , (2) pressure head, h_p , and (3) velocity head, h_v ; under conditions to which Darcy's Law may be applied, the velocity of groundwater is so small that the velocity head, $h_v = v^2/2g$, is negligible.
headwaters	The source and upstream waters of a stream or river.
health effect	Adverse physiological response to radiation exposure; in this report, one excess health effect is defined as one cancer death from exposure to radioactivity.
hogback	A ridge produced by highly tilted strata.
hydraulic conductivity	The volume of groundwater that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.
hydraulic gradient	The change in static head per unit of distance in a given direction.
hydrostratigraphic unit	A body of rock with considerable lateral extent that composes a geologic framework for a reasonably distinct hydrologic system.
inert gas	One of the chemically unreactive gases: helium, neon, argon, krypton, xenon, and radon.
in-migrant	A person that moves into an area from outside the local area.
inorganic	Pertaining to or composed of chemical compounds that do not contain carbon as the principal element (excepting carbonates, cyanides and cyanates); i.e., matter other than plant or animal.
in situ	In the natural or original position.
interbedded	Occurring between beds, or lying in a bed parallel to other beds of a different material.
internal dose	The absorbed dose or dose commitment resulting from inhaled or ingested radioactivity.
island-braided	The formation of islands, e.g., in a river, in a braided fashion.

GLOSSARY (Continued)

isotopes	Nuclides having the same number of protons in their nuclei but differing in the number of neutrons; the chemical properties of isotopes of a particular element are almost identical.
isotropy	That condition in which all significant properties are independent of direction.
jacal	A hut with a thatched roof and walls made of upright poles covered and chinked with mud or clay.
lanceolate	Shaped like a lance head; specifically, tapering to a point at the apex and sometimes the base.
leachate	The solution generated by the percolation of water through a body of soil, waste rock, or solid waste.
licensing	In this report, the process by which the NRC will, after the remedial actions are completed, approve the final disposition and controls over a disposal site; it will include a finding that the site does not and will not constitute a danger to the public health and safety.
lignite	A low-grade, brownish-black coal.
liquefaction	A condition where a soil undergoes continued deformation at a constant low residual stress or with low residual resistance, due to the buildup and maintenance of high pore water pressures in excess of the effective confining pressure.
lithic	Pertaining to, or indicating the use of, stone.
lithologic unit	Unit of rock type based on the physical character of a rock, generally as determined megascopically or with the aid of a low power magnifier.
loam	Soil material that contains seven to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.
maintenance, custodial (passive)	The repair of fencing, the repair or replacement of monitoring equipment, revegetation, minor additions to soil cover, and general disposal site upkeep such as mowing grass.
man-rem	Unit of population exposure obtained by summing individual dose-equivalent values for all people in the population; thus, the number of man-rem attributed to one person exposed to 100 rem is equal to that attributed to 100 people each exposed to one rem.

GLOSSARY (Continued)

mass wasting	The slow downslope movement of rock debris (due to gravity).
meander	A sharp, sinuous loop or curve in a stream or river (usually part of a series); a deviation of the flow pattern of a current.
micro	A prefix meaning one millionth ($1/1,000,000$ or 10^{-6}).
microseismic	Referring to the occurrence of small magnitude earthquakes which cannot be felt by humans; microseismicity can be generated by tectonic forces or by nontectonic forces including gravity slumping, thermal forces, cavity collapse, mining, detonation of explosives, and surface loading.
milli	A prefix meaning one thousandth ($1/1000$ or 10^{-3}).
Modified Mercalli (scale)	A standard scale for the evaluation of the local intensity of earthquakes based on observed phenomena such as the resulting level of damage; not to be confused with magnitude, such as measured by the Richter scale, which is a measure of the comparative strength of earthquakes at their sources.
monitor	To observe and make measurements to provide data for evaluating the performance and characteristics of the disposal site.
morphology	A branch of biology that deals with the structure and form of an organism at any stage of its life history; sometimes applied to geomorphic processes.
National Register of Historic Places	Established by the Historic Preservation Act of 1966; the Register is a listing of archaeological, historical, and architectural sites nominated for their local, state, or national significance by state and Federal agencies and approved by the Register staff.
neotectonic	Referring to post-Miocene (within the last five million years) structures and structural history of the earth.
nuclide	A general term applicable to all atomic forms of the elements; nuclides comprise all the isotopic forms of all the elements; nuclides are distinguished by their atomic number, atomic mass, and energy state.
organics	Referring to or derived from living organisms; in chemistry, any compound containing carbon.

GLOSSARY (Continued)

orographic	Pertaining to mountains, especially in regard to their location and distribution.
outcrop	The exposure of bedrock or strata projecting through the overlying cover of detritus and soil.
passive institutional controls	Those controls which preclude human contact with the waste or require a continuing social order; examples include Federal ownership of a disposal site, monuments on the site, records with agencies, and physical barriers (e.g., riprap covers, vegetation, and waste burial).
pediment	Gently inclined erosion surfaces carved in bedrock.
perched groundwater	Groundwater separated from an underlying body of groundwater by unsaturated rock.
percolate	To pass (a liquid) through a porous substance.
permeability	The ease with which liquids or gases penetrate or pass through a layer of soil; technically, it is the volume of fluid that will flow through a unit area under a unit hydraulic gradient; measured in centimeters per second or equivalent units.
permissible dose	That dose of ionizing radiation that is considered acceptable by standards-setting bodies such as the EPA.
person-rem	Same as man-rem.
pico	A prefix meaning one trillionth ($1/1,000,000,000,000$ or 10^{-12}).
picocurie	A unit of radioactivity defined as 0.037 disintegrations per second.
piezometric surface	The potentiometric surface of an aquifer; this represents the pressure exerted on a confined aquifer or the water table in an unconfined aquifer.
pipng	The erosive action of water passing through or under an embankment which may result in failure of the embankment.
pit-run rock	Rock materials (sometimes with a rock diameter specification) that are not screened for size segregation prior to use in the construction industry.
porosity	The porosity of a rock or soil is its property of containing interstices or voids and may be expressed quantitatively as the ratio of the volume of its

GLOSSARY (Continued)

	interstices to its total volume; also called total porosity.
porosity, effective	Effective porosity refers to the amount of interconnected pore space available for fluid transmission.
potentiometric surface	The potentiometric surface is a surface which represents the static head.
primary succession type	A plant that colonizes an area not previously covered by vegetation.
Probable Maximum Flood (PMF)	The hypothetical flood (peak discharge, volume, and hydrograph shape) that is considered to be the most severe reasonably possible, based on comprehensive hydrometeorological application of Probable Maximum Precipitation (PMP) and other hydrologic factors favorable for maximum flood runoff such as sequential storms and snowmelt.
Probable Maximum Precipitation (PMP)	The estimated depth for a given duration, drainage area, and time of year for which there is virtually no risk of exceedence.
proton	An electrically positive elementary particle found in the nucleus of an atom; also, the nucleus of a hydrogen atom.
province, physiographic	A region with similar climate and geologic structure that has a unified geomorphic history.
quality factor (QF)	The principal modifying factor by which absorbed doses are multiplied to obtain dose equivalents for radiation-protection purposes and thus express the effectiveness of absorbed doses on a common scale for all kinds of ionizing radiation; the quality factor depends on the type and the energy of the radiation being considered.
rad	A unit of measure for the absorbed dose of radiation; it is equivalent to 100 ergs per gram of material.
radioactive decay chain	A succession of nuclides, each of which transforms by radioactive disintegration into the next until a stable nuclide results.

GLOSSARY (Continued)

radioactivity (radioactive decay)	The property of some nuclides of spontaneously emitting particles or gamma radiation or of spontaneous fission.
radioisotope	A radioactive isotope of an element with which it shares almost identical chemical properties.
radionuclide	A radioactive nuclide.
radium-226 (Ra-226)	A radioactive daughter product of uranium-238; radium is present in all uranium-bearing ores; it has a half-life of 1620 years.
radon-222 (Rn-222)	The gaseous radioactive daughter product of radium-226; it has a half-life of 3.8 days.
radon daughter product	One of several short-lived radioactive daughter products of radon-222; all are solids.
range type	A distinctive kind of rangeland that has a certain potential for producing rangeland plants; each type has its own combination of environmental conditions and characteristic plant communities.
recharge	Resupply or replenish.
rem	A unit of dose equivalent equal to the absorbed dose in rads times quality factor times any other necessary modifying factor; it represents the quantity of radiation that is equivalent in biological damage to one rad of X-rays.
Richter scale	A logarithmic scale ranging from one to 10 used to express the magnitude or total energy of an earthquake.
riparian	Of, on, or pertaining to the bank of a natural course of water.
riprap	Rock used for the protection of bluffs or structures exposed to erosional forces from direct surface runoff or adjacent flooding.
roentgen	A unit of measure of ionizing radiation in air; one roentgen in air is approximately equal to one rad and one rem in tissue.
scintillometer	An instrument used in the field which measures gamma exposure rate levels.
scour	The process of cutting and filling channels in sediments.

GLOSSARY (Continued)

secular equilibrium	The condition of a radionuclide decay chain in which the rate of decay of any radioactive product is just equal to its production from the previous member of the chain.
sedimentary	A descriptive term for rock formed of sediment, especially: (1) clastic rocks (such as conglomerate, sandstone, and shales) formed of fragments of other rock transported from their sources and deposited by water, and (2) rocks formed by precipitation from solution (such as rock salt and gypsum) or from secretions of organisms such as most limestone.
seismic	Pertaining to an earthquake or earth vibration.
seismotectonic	Referring to regions of the earth characterized by consistency of geologic and tectonic features, geologic history, inferred crustal structures, geophysical data, and historical seismicity; within the seismotectonic regions, earthquakes are assumed to result from similar tectonic processes and are assumed to follow similar statistical laws.
sheet piling	Closely spaced piles (or posts) of wood, steel, or concrete driven vertically into the ground to obstruct lateral movement of earth or water and often to form an integral part of the permanent structure.
slickenside	Polished and scratched surface that results from friction along a fault plane.
slimes	In this report, fine-grained waste materials from uranium-ore processing that are mixed with small amounts of water.
slope, dip	A slope of the land surface which conforms approximately to the dip of the underlyings rocks.
soil infiltration rate	The rate at which water enters the soil surface and moves vertically.
soil percolation rate	The rate at which water moves through soil in all directions.
soldier piling	H-shaped piles driven with the flanges parallel to the sides of the excavation; used when portions of the vertical face of the excavation can be exposed without danger of collapse; horizontal logging may be used to connect adjacent piles to ensure stable excavation faces.

GLOSSARY (Continued)

solifluction	The slow viscous downslope flow of waterlogged soil and other unsorted and saturated surficial material; especially the flow occurring at high elevations in regions underlain by frozen ground that acts as a downward barrier to water percolation.
somatic	Radiation health effects to the body of an individual, as opposed to genetic health effects to future generations.
stabilization	The reduction of radioactive contamination in an area to a predetermined level by a standards-setting board, such as the EPA, by encapsulating or covering the contaminated material.
standard deviation	The square root of the arithmetic mean of the squares of the deviation from the arithmetic mean of a frequency distribution.
storage coefficient	The storage coefficient is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.
stratigraphy	That branch of geology which treats the formation, composition, sequence, and correlation of the stratified rocks as part of the earth's crust.
surveillance	The observation of the disposal site for purposes of visual detection of need for custodial care, evidence of intrusion, and compliance with other license and regulatory requirements.
synergistic	Of or pertaining to the action of two or more substances, organs, or organisms to achieve an effect of which each is individually incapable.
tailings, uranium mill	The wastes remaining after most of the uranium has been extracted from uranium ore.
tectonic	Of, pertaining to, or designating the rock structure and external forms resulting from the deformation of the earth's crust.
thorium-230 (Th-230)	A radioactive daughter product of uranium-238; it has a half-life of 80,000 years and is the parent of radium-226.
transmissivity, hydraulic	Transmissivity is the rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient.

GLOSSARY (Concluded)

trapezoid	A quadrilateral (i.e., four-sided polygon) having two parallel sides.
tributary	A stream or river flowing into a larger stream or river.
UMTRA Project	Uranium Mill Tailings Remedial Action Project of the U.S. Department of Energy.
unconfined aquifer	An aquifer without an upper confining layer; also known as phreatic or water-table aquifers.
unconformably	Not succeeding the underlying strata in immediate order of age and in parallel position.
uranium-238 (U-238)	A naturally-occurring radioisotope with a half-life of 4.5 billion years; it is the parent of uranium-234, thorium-230, radium-226, radon-222, and others.
vicinity property	A property in the vicinity of the Rifle site that is determined by the DOE, in consultation with the NRC, to be contaminated with residual radioactive material derived from the Rifle site and which is determined by the DOE to require remedial action.
water table	The surface of a body of unconfined water at which pressure is equal to that of the atmosphere.
working level (WL)	A measure of radon-daughter product concentrations; technically, it is any combination of short-lived radon decay products in one liter of air that will result in the ultimate emission of alpha particles with a total energy of 130,000 MeV.
working level- month (WLM)	The exposure resulting from inhalation of air with a concentration of one WL for 170 working hours; continuous exposure of a member of the general public to one WL for one year results in approximately 53 WLM.
zone, unsaturated	The unsaturated zone is the zone between the land surface and the deepest water table.

ABBREVIATIONS AND ACRONYMS

ac	Acre; a unit of area = 43,560 square feet
ADT	Average daily traffic
AEC	U.S. Atomic Energy Commission
AIRREL	A computer code used to calculate the theoretical radiological impacts to an individual or the general population resulting from an accidental release of uranium mill tailings to the atmosphere
ANL	Argonne National Laboratory, Argonne, Illinois
ANSI	American National Standards Institute, New York, New York
AQCR	Air Quality Control Region
ASTM	American Society for Testing and Materials, Philadelphia, Pennsylvania
atm	Atmosphere; a unit of pressure = 30 inches of mercury
AUM	Animal unit-month
BEIR	Advisory Committee on the Biological Effects of Ionizing Radiation of the National Academy of Sciences (also their report)
BFEC	Bendix Field Engineering Corporation, Grand Junction, Colorado
BLM	Bureau of Land Management, U.S. Department of the Interior
°C	Degrees Centigrade or Celsius
CAQCC	Colorado Air Quality Control Commission, Colorado Department of Health, Denver, Colorado
CASA	Complete Archaeological Service Associates, Cortez, Colorado
CDH	Colorado Department of Health, Denver, Colorado
CDM	Camp Dresser & McKee Inc., Wheat Ridge, Colorado
CDOH	Colorado Department of Highways, Denver, Colorado
CDOW	Colorado Division of Wildlife, Glenwood Springs, Colorado
CEQ	Council on Environmental Quality

ABBREVIATIONS AND ACRONYMS (Continued)

CFR	Code of Federal Regulations
cfs	Cubic feet per second
cfs/ft	Cubic feet per second per foot
CGS	Colorado Geological Survey, Denver, Colorado
CHS	Colorado Historical Society, Denver, Colorado
CITF-PAS	Cumulative Impacts Task Force-Planning and Assessment System; a computer model used by the State of Colorado to predict the socioeconomic impacts of energy development projects
Ci	Curie; a unit of radioactivity = 3.7×10^{10} radioactive disintegrations per second
cm	Centimeter; a unit of length = 0.394 inch
cm/sec	Centimeters per second
CNHI	Colorado Natural Heritage Inventory
CO	Carbon monoxide; a gas
COE	Corps of Engineers, U.S. Department of the Army
CSU	Colorado State University, Fort Collins, Colorado
CWQCC	Colorado Water Quality Control Commission, Colorado Department of Health, Denver, Colorado
cy	Cubic yard; a unit of volume = 27 cubic feet
dBA	Decibels on the A scale; a logarithmically based unit of sound intensity weighted to account for human auditory responses
DEIS	Draft Environmental Impact Statement
DOA	U.S. Department of the Army
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation

ABBREVIATIONS AND ACRONYMS (Continued)

EDC	Environmental dose commitment
EES	Ecosphere Environmental Services, Farmington, New Mexico
e.g.	For example
EG&G	EG&G, Las Vegas, Nevada
EGR	External gamma radiation
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
et al.	And others
°F	Degrees Fahrenheit
FBDU	Ford, Bacon & Davis Utah Inc., Salt Lake City, Utah
FCRI	Four Corners Research Institute, Durango, Colorado
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency, Federal Insurance Administration
fps	Feet per second
FR	Federal Register
ft	Foot; a unit of length = 12 inches
ft ²	Square foot; a unit of area = 144 square inches
ft/day	Feet per day
g	Gram; a unit of weight = 0.035 ounce
g	Gravity; a force expressed as acceleration equal to 32 feet per second per second
GECR	Geochemistry and Environmental Chemistry Research, Inc., Rapid City, South Dakota
g/m ² s	Grams per square meter per second
gpd	Gallons per day
gpm	Gallons per minute
GRI	Grand River Institute, Grand Junction, Colorado

ABBREVIATIONS AND ACRONYMS (Continued)

HC	Hydrocarbon
hr	Hour; a unit of time = 60 minutes
ICRP	International Commission on Radiological Protection
ISCLT	Industrial Source Complex Long-Term dispersion model; an air quality computer code
ISCST	Industrial Source Complex Short-Term dispersion model; an air quality computer code
JEG	Jacobs Engineering Group Inc.
kg	Kilogram; one thousand grams
kg/yr	Kilograms per year
km	Kilometer; one thousand meters
km ²	Square kilometer; a unit of area = 1,000,000 square meters
kw	Kilowatt; one thousand watts
kwh	Kilowatt-hours
l	Liter; a unit of volume = 1.057 quarts
lb	Pound; a unit of weight = 16 ounces
lb/cy	Pounds per cubic yard
lb/hr	Pounds per hour
lb/mi	Pounds per mile
L _{dn}	Day-night sound level, measured in decibels
L _{eq}	Equivalent sound level, measured in decibels
LLD	Lower limit of detection
m	Meter; a unit of length = 3.28 feet; also milli, a prefix meaning one-thousandth (10^{-3})
m ²	Square meter; a unit of area = 10.76 square feet
m ³	Cubic meter; a unit of volume = 35.31 cubic feet

ABBREVIATIONS AND ACRONYMS (Continued)

MCE	Maximum Credible Earthquake
MeV	Million electron volts
mg	Milligram; a thousandth of a gram
mgd	Million gallons per day
mg/l	Milligrams per liter
mg/m ³	Milligrams per cubic meter
mi	Mile; a unit of length = 5280 feet
micro	Micro, a prefix meaning one-millionth (10 ⁻⁶)
microg	Microgram; a millionth of a gram
microg/m ³	Micrograms per cubic meter
microR	Microroentgen; a millionth of a roentgen
microR/hr	Microroentgens per hour
MILDOS	A computer code used to calculate both the spread of radon and particulates in the atmosphere and the consequent radiation doses
MMI	Modified Mercalli Intensity; a measure of earthquake intensity
MPC	Maximum Permissible Concentration
mph	Miles per hour
mrem	Millirem; a thousandth of a rem
mrem-m ³ /pCi	Millirems per cubic meter per picoCurie
mrem/yr	Millirem's per year
mR/hr	Milliroentgens per hour
msl	Mean sea level
MSRD	Mountain States Research and Development, Tucson, Arizona
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences, Washington, D.C.
NEPA	National Environmental Policy Act of 1969 (PL91-190)

ABBREVIATIONS AND ACRONYMS (Continued)

NOAA	National Oceanic and Atmospheric Administration, U.S. Department of Commerce
NO ₂	Nitrogen dioxide; a gas
NO _x	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NUS	NUS Corporation, Aurora, Colorado
O ₃	Ozone; a gas
ORNL	Oak Ridge National Laboratory, Oak Ridge, Tennessee
OSHA	Occupational Safety and Health Administration, U.S. Department of Labor
p	Pico, a prefix meaning one trillionth (10 ⁻¹²)
Pb	Lead
Pb-210	Lead-210
pCi	Picocurie; a trillionth of a Curie
pCi/g	Picocuries per gram
pCi/l	Picocuries per liter
pCi/m ³	Picocuries per cubic meter
pCi/m ² s	Picocuries per square meter per second
person-rem/yr	Person-rems per year
pH	A logarithmic scale of hydrogen-ion concentration, and hence, an indication of acidity or alkalinity; pH = 7 is neutral; pH less than 7 is acidic; pH greater than 7 is alkaline
PIC	Pressurized ionization chamber
PL91-190	Public Law 91-190, National Environmental Policy Act of 1969

ABBREVIATIONS AND ACRONYMS (Continued)

PL95-604	Public Law 95-604, Uranium Mill Tailings Radiation Control Act of 1978
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
Po-210	Polonium-210
ppm	Parts per million
PSCR	Processing Site Characterization Report
R	Roentgen; a unit of gamma radiation = one rem
RAC	Remedial Action Contractor
RAECOM	Radon Attenuation Effectiveness and Cover Optimization with Moisture Effects; a radon attenuation computer code
Ra-226	Radium-226
RDC	Radon daughter concentration
RMP	Resource Management Plan
Rn-222	Radon-222
s	Second; a unit of time
SCS	Soil Conservation Service, U.S. Department of Agriculture
SHB	Sergent, Hauskins & Beckwith, Geotechnical Engineers, Inc., Phoenix, Arizona
SHPO	State Historic Preservation Officer
SMSA	Standard Metropolitan Statistical Area
SO ₂	Sulfur dioxide; a gas
SO _x	Sulfur oxides
t	Ton (short); a unit of weight = 2000 pounds
TAC	Technical Assistance Contractor
TDS	Total dissolved solids
Th-230	Thorium-230

ABBREVIATIONS AND ACRONYMS (Concluded)

Th-232	Thorium-232
t/km ² yr	Ton per square kilometer per year
TLD	Thermoluminescent dosimeter; a device for measuring radiation
TOC	Total organic carbon
TSP	Total suspended particulates
TSS	Total suspended solids
U-234	Uranium-234
U-235	Uranium-235
U-238	Uranium-238
U ₃ O ₈	Uranium oxide, also called yellowcake
UMTRA Project	Uranium Mill Tailings Remedial Action Project
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (PL95-604)
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USDA	U.S. Department of Agriculture
USDC	U.S. Department of Commerce
USFWS	Fish and Wildlife Service, U.S. Department of the Interior
USGS	U.S. Geological Survey, U.S. Department of the Interior
WD	Wind direction
WL	Working level (a measure of radon-daughter product concentration)
WLM	Working level-month (exposure to one WL for 170 hours)
$\bar{X}$	Mean (average value of the variable)
yr	Year; a unit of time = 365 days

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Rocky Mountain News
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Sentinel Newspapers
Editor, Denver, Colorado

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