10

Unavoidable Adverse Impacts; Short-Term Uses and Long-Term Productivity; and Irreversible or Irretrievable Commitment of Resources

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10. UNAVOIDABLE ADVERSE IMPACTS; SHORT-TERM USES AND LONG-TERM PRODUCTIVITY; AND IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

This chapter discusses adverse impacts that would remain after the application of mitigation measures (see Chapter 9). It analyzes the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and it identifies irreversible or irretrievable commitments of resources. The chapter presents information drawn from the analysis of the Proposed Action. It summarizes and consolidates information from the impact and mitigation analyses in Chapters 4, 5, 6, and 9, and provides references to earlier chapters for readers who require more detailed information.

The chapter discusses only resource areas for which preceding analyses have identified some potential for unavoidable adverse impacts. Nevertheless, the discussions in Sections 10.1, 10.2, and 10.3 reflect an examination of all of the resource areas analyzed in this EIS.

The construction, operation and monitoring, and eventual closure of the proposed Yucca Mountain Repository and the associated transportation of spent nuclear fuel and high-level radioactive waste would have the potential to produce some environmental impacts that the U.S. Department of Energy (DOE) could not mitigate. Similarly, some aspects of the Proposed Action could affect the long-term productivity of the environment or would require the permanent use of some resources.

10.1 Unavoidable Adverse Impacts

This section summarizes potential impacts associated with the proposed repository and transportation actions that would be unavoidable and adverse and that would remain after DOE implemented mitigation measures, which are discussed in Chapter 9. Some aspects and activities discussed in Section 10.1 are analyzed from different perspectives in Sections 10.2 and 10.3.

10.1.1 YUCCA MOUNTAIN REPOSITORY

This section summarizes unavoidable adverse impacts associated with the construction, operation and monitoring, closure, and long-term performance of the proposed repository.

10.1.1.1 Land Use

To develop the proposed Yucca Mountain Repository, DOE would need to obtain permanent control of land surrounding the Yucca Mountain site. DOE could obtain permanent control over the land only if Congress completed a land withdrawal action. A Congressional withdrawal would include lands already withdrawn for the Nevada Test Site and Nellis Air Force Range as well as lands under the control of the Bureau of Land Management and not currently withdrawn.

In general, the permanent withdrawal of land for the repository would prevent human use of the withdrawn lands for other purposes. Nevada Test Site activities would continue on a noninterference basis unless the Congressional land withdrawal specifically precluded them. DOE would remove mining and mineral claims from public use as they expired. Because the Yucca Mountain site has a low present resource value, is remote, and is partly withdrawn, the resultant impact would be small.

The disposal of spent nuclear fuel and high-level radioactive waste would permanently affect the availability of the subsurface area of the Yucca Mountain site and surface portions posted as off limits.

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The Chapter 4 land-use discussion includes the availability of the land and the consequences of withdrawal.

10.1.1.2 Air Quality

Construction, operation and monitoring, and closure of a repository at Yucca Mountain would produce small impacts to regional air quality. Radiological impacts could occur from the release of radionuclides. The principal radionuclides released from the subsurface would be naturally occurring radon-222 and its decay products in ventilation exhaust air. There are no applicable regulatory limits for radon releases from Yucca Mountain facilities. Other impacts would come from criteria pollutants and materials such as cristobalite and erionite. Exposures of maximally exposed individuals to radionuclides and criteria pollutants would be a small fraction of applicable regulatory limits. If offsite manufacturing occurred in nonattainment areas, the manufacturing processes could detract from the ability of local governments to meet air quality goals.

10.1.1.3 Hydrology

Construction activities would temporarily restrict and minimally alter natural surface-water drainage channels. Facilities and roadways would be designed to withstand at least a 100-year flood. Therefore, after construction was complete, only flow from infrequent more-intense floods would affect those facilities and roadways. Ground-disturbing activities and the surface facilities that DOE would build would alter surface-water infiltration and runoff rates in localized areas. Given the relatively small size of the affected land in comparison to the total drainage area, drainage channels and washes would experience little difference in impacts as a result of the disturbances. DOE estimates that overall consequences from the construction of roadways and facilities would be minimal.

The proposed repository construction and operation would unavoidably involve crossing washes designated as floodplains in the vicinity of Yucca Mountain, but effects on these washes would be small.

There would be withdrawals of groundwater during construction, operations and monitoring, and closure, but they would not exceed estimates of perennial yield. Chapter 4, Section 4.1.3, provides details on the effects of repository construction, operation and monitoring, and closure on hydrology.

Analysts estimate that the placement of drip shields would prevent dripping water from reaching the waste packages for more than 10,000 years (DIRS 154659-BSC 2001, Figure 4.2.5.1, p. 4F-39. Therefore, with the potential exception of a very small number of waste packages (0 to 3) that could fail due to manufacturing defects, there would be no breaches of waste packages before 10,000 years.

If water entered a waste package, it would have to penetrate the metal cladding of the spent nuclear fuel to reach the waste. For approximately 99 percent of the commercial spent nuclear fuel, the cladding is highly corrosion-resistant metal designed to withstand the extreme temperature and radiation environment in the core of an operating nuclear reactor. Current models indicate that it would take thousands of years to corrode cladding sufficiently to allow water to reach the waste and begin to dissolve the radionuclides.

During the thousands of years required for water to reach the waste, the radioactivity of most radionuclides would decay to virtually zero. Remaining radionuclides would have to dissolve in the water to pass from a waste package. Few of the remaining radionuclides could dissolve at a meaningful rate. Thus, only long-lived water-soluble radionuclides could get out of a waste package. Long-lived water-soluble radionuclides that migrated from the waste packages would then have to move down through about 300 meters (about 1,000 feet) of rock to the groundwater and then travel about 18 kilometers (11 miles) to reach a point where they could be taken up in a well and consumed or used to irrigate crops (see Chapter 5, Sections 5.3 and 5.4).

As the long-lived water-soluble radionuclides began to move down through the rock, some would stick (or adsorb) to the minerals in the rock and be delayed in reaching the water table. After reaching the water table, radionuclides would disperse to some extent in the larger volume of groundwater beneath Yucca Mountain, and the concentrations would be diluted. Eventually, groundwater with varying concentrations of different radionuclides could reach locations in the hydrologic (groundwater) region of influence where the water could be consumed.

Of the approximately 200 different radioactive isotopes present in spent nuclear fuel and high-level radioactive waste, 26 are present in sufficient quantities and are sufficiently long-lived, soluble, mobile, and hazardous to contribute meaningfully to calculated radiation exposures.

10.1.1.4 Biological Resources and Soils

Unavoidable adverse impacts to biological resources would include the loss of small pieces of habitat totaling less than 6 square kilometers (2.5 square miles or 1,500 acres). The pieces that would be disturbed are habitat for terrestrial plant and animal species that are widespread throughout the region and typical of the Mojave and Great Basin Deserts. The death or displacement of individuals of some animal species as a result of site clearing and vehicle traffic would be unavoidable; however, changes in the regional population of any species would be undetectable.

No Federally endangered species are found on the site. The only Federally threatened species on the site is the desert tortoise (see Chapter 4, Section 4.1.4). Approximately 6 square kilometers (2.5 square miles or 1,500 acres) of desert tortoise habitat would be lost. This habitat is at the northern end of the range of the desert tortoise and is not designated critical habitat for the tortoise. The quantity of habitat that could be lost would be minimal in comparison to the range of the desert tortoise.

The U.S. Fish and Wildlife Service has issued a Biological Opinion (see Appendix O) stating reasonable and prudent measures and conditions that DOE would have to observe to protect the desert tortoise if the Proposed Action was implemented. DOE would adhere to all terms stated in the Biological Opinion, but, as the opinion acknowledges, individual tortoises could be killed inadvertently during site clearing, by vehicle traffic, or by predation from ravens. Preconstruction surveys, relocation of affected individuals, and adherence to conditions stated in the Biological Opinion would minimize, but not prevent, such deaths. Chapter 4, Section 4.1.4, discusses in detail the potential for loss of habitat or the deaths of individual members of this species. Chapter 9 (Sections 9.2.4.1 and 9.3.4.1) discusses mitigation measures to reduce potential impacts to the desert tortoise, including measures to locate facilities and roadways to avoid sensitive areas and measures to protect tortoises from construction impacts.

10.1.1.5 Cultural Resources

In the view of Native Americans, the implementation of the Proposed Action would further degrade the environmental setting. Even after closure and reclamation, the presence of the repository would, from the perspective of Native Americans, represent an irreversible impact to traditional lands.

NATIVE AMERICAN VIEW

A Native American view of facility and transportation route development, especially in remote areas such as Yucca Mountain and its surroundings, as expressed in the *American Indian Perspectives on the Yucca Mountain Site Characterization Project and the Repository Environmental Impact Statement* (DIRS 102043-AIWS 1998, pages 2-20 and 3-1), is that development of such facilities and routes inherently degrades the entire environment. This view is based on the concept that the earth, its waters, the air, and the sky are a whole and have a sacred integrity in their natural form. Chapter 4, Section 4.1.13, of this EIS presents an environmental justice discussion of this Native American perspective.

Some unavoidable adverse impacts could occur to archaeological sites and other cultural resources, although no such sites or culturally important artifacts have been found at the site of the proposed repository. There could be a loss of archaeological information due to illicit artifact collection. In addition, excavation activities could cause a loss of archaeological information. Similarly, the location of a solar power generating facility on the repository site, could affect archaeological sites. Chapter 3, Section 3.1.6, discusses the program DOE has in place to address and mitigate cultural resource impacts and issues during site characterization. DOE anticipates this program would continue through repository closure.

10.1.1.6 Socioeconomics

The construction, operation and monitoring, and closure of a repository at Yucca Mountain would result in increased employment and population, which would place increased demands on housing and public services, including schools. Nonetheless, these demands would be small in comparison to total employment, population, real disposable income, gross regional product, and public expenditures in the region of influence.

10.1.1.7 Occupational and Public Health and Safety

There would be a potential for injuries to or fatalities of workers from facility construction, including accidents and inhalation of cristobalite and erionite. Cristobalite and erionite are naturally occurring hazardous materials in the rock of Yucca Mountain. Engineering controls and training and safety programs would reduce but not eliminate the potential for injuries or fatalities to workers.

Short-term impacts during the operation and monitoring phase would present a potential for injuries or fatalities to workers from industrial accidents and exposure to radioactive materials. Engineering controls and training and safety programs would reduce but not eliminate the potential. There would also be a potential for injuries and fatalities during closure. The occupational and public health and safety discussion in Chapter 4 (Sections 4.1.7 and 4.1.8) provides details on the potential for worker injuries and fatalities. The potential for injury or death to members of the public from exposure to radioactive materials or industrial activity would be extremely small.

While there would be a potential for radioactive contamination of groundwater during the 10,000-year analysis period from materials stored at the proposed repository, there would be only a small potential for such contamination to produce long-term adverse health impacts in the surrounding region during this period, even when the potential for changing climate and seismic events is considered. Potential long-term impacts to human health from the repository in the far future would be dominated by impacts from radioactive materials dissolved or suspended in water pathways. The dose to the reasonably maximally exposed individual would depend on the distance from the repository and the uses made of the land and waters.

At the compliance point defined in Chapter 5 [36 degrees, 40 minutes, 13.6661 seconds North latitude in the predominant direction of groundwater flow (40 CFR Part 197)], the highest 95th percentile annual dose to the reasonably maximally exposed individual for the 10,000-year analysis period would be 0.0001 millirem. The highest chance of a latent cancer fatality to this hypothetical individual would be 4 in 1 billion (see Chapter 5, Section 5.4.2.1). A latent cancer fatality is a cancer fatality that could occur after and as a result of exposure to radionuclides from the repository and that would be in addition to cancer fatalities occurring from all other causes.

Expected doses and consequences to the population from exposure to radionuclides transported by groundwater from the repository were forecast for the 10,000-year analysis period. The 95th-percentile population dose over the 10,000-year period could be 0.04 person-rem over an assumed 70-year lifetime.

The estimated 95th-percentile number of latent cancer fatalities in the population during any 70-year lifetime would be 0.00002. Over the 10,000-year analysis period, the estimated number of latent cancer fatalities would be 0.0003 (see Chapter 5, Section 5.4.2.1). These consequences would be small.

DOE estimates that most waste packages would remain intact longer than 10,000 years. Current model simulations forecast that some packages would last more than 1 million years. The highest 95th-percentile peak annual dose to a hypothetical reasonably maximally exposed individual could be 620 millirem approximately 410,000 years in the future. The highest mean peak annual dose rate to a reasonably maximally exposed individual at 18 kilometers (11 miles) could be 150 millirem per year approximately 480,000 years in the future (see Chapter 5, Section 5.4.2.1). In the unlikely event of an igneous disruption of the repository, the probability-weighted peak mean annual dose resulting to an individual would be approximately 0.1 millirem.

As determined by a bounding analysis (see Appendix I, Section I.6), there would also be a potential that chromium releases could produce estimated peak concentrations during the first 10,000 years of 0.01 milligram per liter at 18 kilometers (11 miles). This value is approximately one-tenth of the Maximum Contaminant Level Goal in drinking water.

10.1.1.8 Utilities, Energy, and Materials

The construction, operation and monitoring, and closure of a repository at Yucca Mountain would result in irreversible commitments of energy (mostly electricity and petroleum products) and materials (mostly cement, steel, and copper). These commitments would not be large enough to affect national or regional supplies.

10.1.2 NATIONAL TRANSPORTATION ACTIONS

10.1.2.1 Air Quality

To determine if pollutants of concern from national transportation by truck and rail would degrade air quality in nonattainment areas outside Nevada, DOE reviewed traffic volumes in nonattainment areas (see Chapter 6, Section 6.2). From this review DOE determined that the number of shipments to Yucca Mountain would be very small in relation to normal traffic volumes in the nonattainment areas studied, and that, therefore, impacts to air quality in these areas from repository-related shipments would be very small.

10.1.2.2 Occupational and Public Health and Safety

Certain adverse impacts to workers and the public from the transportation of spent nuclear fuel and high-level radioactive waste would be unavoidable. The loading and transportation of these materials would have the potential to affect workers and the public through industrial accidents, exposure to radiation and vehicle emissions, and through traffic accidents. This EIS evaluates two transportation scenarios—one in which DOE would transport the materials mostly by legal-weight truck and the other in which it would transport the materials mostly by rail. DOE estimates that the transportation of spent nuclear fuel and high-level radioactive waste nationally, including in Nevada, in the mostly legal-weight truck scenario could cause as many as 21 fatalities among workers and the public over the 24 years of the Proposed Action. These fatalities would include fatalities in industrial accidents, traffic fatalities, latent cancer fatalities caused by exposure to radiation, and health effect fatalities caused by exposure to vehicle emissions. DOE estimates that transportation mostly by rail could cause between 8 and 14 fatalities among workers and the public, including fatalities from upgrading and maintaining highways and constructing an intermodal transfer facility or constructing a branch rail line in Nevada as well as fatalities from operations over 24 years. These fatalities would also result from industrial accidents, vehicle crashes, radiation exposure, and exposure to vehicle emissions.

10.1.3 NEVADA TRANSPORTATION ACTIONS

This section summarizes unavoidable adverse impacts associated with the transportation of spent nuclear fuel and high-level radioactive waste and with the construction and operation of transportation facilities and routes in Nevada. Chapter 6 (Sections 6.1.2 and 6.3) provides more detailed discussions.

10.1.3.1 Land Use

Constructing and operating a new branch rail line would result in unavoidable changes to present land uses and control of the lands affected directly. The range of potentially affected uses includes grazing, wildlife habitat and management areas, mining, wilderness, Native American tribal uses, recreation, utility corridors, lands leased for oil and gas development, and military lands. Present uses of adjoining lands could also be affected to some extent. Each of the five corridors for a branch rail line encompasses a range of different land uses and surface features. If the choice was to construct a new branch rail line, the selection of a specific corridor would determine the land actually taken and the extent of impacts to land uses along that corridor. Land disturbed for a specific corridor implementing alternative could vary from 5.1 to 19.2 square kilometers (1,300 to 4,700 acres). Most land along the corridors under consideration is government administered or controlled. The Valley Modified Corridor crosses two Wilderness Study Areas. The Steiner Creek Alternate for the Carlin Corridor passes close to or encroaches on the Simpson Park Wilderness Study Area, depending on alignment. The Bonnie Claire Alternate for the Carlin and Caliente Corridors crosses lands of the Timbisha Shoshone Tribe near Scottys Junction, Nevada. The Caliente Corridor crosses a portion of the South Reveille Wilderness Study Area. The Caliente Corridor and the Caliente-Chalk Mountain Corridor pass through or encroach on the Weepa Springs Wilderness Study Area, depending on alignment.

Routes for heavy-haul or legal-weight trucks would follow existing highways and could require establishing and using access roads to obtain construction materials and additional land disturbance for road widening. Building and operating an intermodal transfer station would result in unavoidable changes of land use and ownership. The land for an intermodal transfer station could be public or private. Actual land uses lost would depend on the site and route selected. DOE expects that the total land disturbance for any implementing alternative for the construction of an intermodal transfer station and upgrades to existing highways could be as much as 3.5 square kilometers (about 860 acres). For heavy-haul truck routes originating at Caliente, an additional 0.04 square kilometer (10 acres) could be required for a midroute stop. A further 0.04 square kilometer could be required for the construction of a highway segment near Beatty, Nevada.

In some instances transportation facilities could remain in place to serve other purposes after DOE had ended use. Similarly, affected land could revert to other uses after the end of transportation activities and the removal of facilities.

10.1.3.2 Air Quality

The potential construction of the Valley Modified Alternate branch rail line or upgrades to roads to accommodate heavy-haul trucks in the Las Vegas Valley air basin, which is in nonattainment with Environmental Protection Agency standards for emissions of PM_{10} and carbon monoxide, could affect the ability of local governments to meet air quality goals.

The operation of a branch rail line or an intermodal transfer station and associated heavy-haul truck routes would lead to releases of pollutants, but these would be below thresholds of concern.

Legal-weight truck shipments through the Las Vegas Valley air basin would also emit pollutants. However, the number of legal-weight truck shipments would be less than 1 percent of all truck traffic in the area and would not contribute discernibly to sources of air pollution.

10.1.3.3 Hydrology

The construction of a branch rail line or the upgrading of roads to accommodate heavy-haul transportation in Nevada would involve the unavoidable adverse impact of altering natural surface-water drainage patterns. Any of the Nevada transportation corridors would cross a number of natural drainage channels. Upgrade activities for a route to be used by heavy-haul trucks would involve the extension of existing drainage control structures as necessary to support the road upgrades. In this case, there would be minor changes to drainage channels already altered to some extent by the original road construction. The construction of a branch rail line would require alterations to many natural drainage areas along the line. Bridges and culverts would be used as necessary to cross streams, creeks, or, most predominantly, washes of any size. These structures would be built to accommodate a 100-year flow in the channels; the resulting drainage alteration would be confined to relatively small areas. Construction could alter small drainage channels or washes more because the railway design could call for the collection of some channels to a single culvert. At the end of the period during which DOE would transport spent nuclear fuel and high-level radioactive waste to the repository, the Department could remove facilities built for transportation and land recovery could begin, or it could use the facilities for other purposes. Appendix L contains a floodplain/wetlands assessment that presents a comparison of what is known about the floodplains, springs, and riparian areas along the five alternative rail routes and at the three alternative intermodal transfer station sites with their five associated heavy-haul truck routes.

In addition, the construction of a branch rail line or upgrades to a route for heavy-haul trucks would involve the withdrawal and use of water from groundwater resources. In many areas that a branch rail line would cross, other uses or commitments of groundwater resources approach or exceed the perennial yield of the underlying groundwater basins. The Nevada State Engineer has identified these areas as Designated Groundwater Basins, which the State watches for potential groundwater depletion. DOE would apply for State water appropriations for withdrawal of groundwater from any wells it developed to construct a branch rail line or would acquire water from appropriated sources and ship the water to its construction sites.

10.1.3.4 Biological Resources and Soils

Unavoidable adverse impacts to biological resources from transportation in Nevada could occur as a result of habitat loss and the deaths of small numbers of individuals of species along transportation routes. Habitat loss would be associated with the construction of either a new rail line or an intermodal transfer station and upgrades to existing highways. This loss would occur in widely distributed land cover types, and would include the loss of a small amount of desert tortoise habitat and the deaths of a small number of tortoises. The deaths of individual members of a species as a result of construction activities or from vehicle traffic would be unlikely to produce detectable changes in the regional population of a species.

Transportation route construction or upgrades would subject disturbed soils to increased erosion for at least some of the construction phase. The recovery of these disturbed areas to predisturbance conditions would occur with the passage of time. Transportation facilities such as a branch rail line could be used for nonrepository-related purposes, potentially extending their useful life beyond the period needed for the Proposed Action. The removal of transportation facilities after the end of their useful life would assist habitat recovery.

Disturbance of habitat could lend to intrusion of invasive species. These species would compete with native species and could become dominant in areas adjacent to the routes. In addition, they could increase the risk of fire in areas adjacent to the routes.

10.1.3.5 Cultural Resources

Some unavoidable impacts could occur to archaeological sites and other resources as a result of the construction of a rail line or the upgrade of a highway to heavy-haul capability. The potential for impacts to specific resources cannot be identified before final surveys and actual construction. An agreement now in effect between DOE and the Advisory Council on Historic Preservation for repository site characterization could serve as a model for an agreement to protect archaeological sites and other resources along transportation corridors. In addition, a number of statutes provide protective frameworks (see Chapter 11). Nevertheless, there would be a potential for grading and other construction activities to degrade, cause the removal of, or alter the setting of archaeological sites or other cultural resources. Although mitigated to some extent by worker education programs, there could be some loss of archaeological information due to the illicit collection of artifacts. In addition, excavation activities could cause loss of archaeological information.

10.1.3.6 Socioeconomics

The construction of a branch rail line in Nevada or of an intermodal transfer station and upgrades to associated highways for heavy-haul trucks would result in the irreversible use of economic resources. In addition, economic activity spawned by construction and subsequent operations would affect the availability and cost of resources used for other purposes in Nevada. Increased employment and population would place increased demands on housing and public services, including schools. Nonetheless, overall socioeconomic impacts in the region of influence would be small in comparison to total employment, population, real disposable income, Gross Regional Product, and public expenditures.

10.1.3.7 Occupational and Public Health and Safety

Certain adverse impacts to workers and the public from the construction and operation of the rail and heavy-haul implementing alternatives would be unavoidable. Table 10-1 presents potential health and safety impacts to workers and the public (fatalities) during construction and operations for each implementing alternative.

Table 10-1. Unavoidable adverse impacts from rail and heavy-haul truck implementing alternatives.[a]

	Construction (worker and public fatalities)	Operations (worker and public fatalities)
Rail		
Caliente	1.6	1.5
Carlin	1.4	1.6
Caliente-Chalk Mountain	1.0	1.4
Jean	0.89	1.3
Valley Modified	0.5	1.1
Heavy-haul truck[b]		
Caliente	1.8	4.5
Caliente/Chalk Mountain	0.74	3.8
Caliente/Las Vegas	1.3	4.3
Apex/Dry Lake	0.6	3.0
Sloan/Jean	0.6	3.1

a. Source: Chapter 6, Sections 6.3.2.2 and 6.3.3.2.
b. Includes intermodal transfer station impacts.

The transportation of spent nuclear fuel and high-level radioactive waste would have the potential to affect workers and the public in Nevada through exposure to radiation and vehicle emissions and through traffic accidents. This EIS evaluates two transportation scenarios—one in which DOE would transport the materials mostly by legal-weight truck and the other in which it would transport the materials mostly by rail to Nevada and then to the repository by either heavy-haul truck or a branch rail line. DOE estimates that the transportation of spent nuclear fuel and high-level radioactive waste in the mostly legal-weight truck scenario could cause approximately 1.4 fatalities among workers and the public in Nevada as a result of exposure to radiation, vehicle emissions, and accidents over the course of 24 years. Over the same period, DOE estimates that transportation using a branch rail line in Nevada could cause up to 3.1 fatalities among workers and the public, while use of heavy-haul trucks in Nevada could result in up to 6.3 worker and public fatalities.

10.1.3.8 Aesthetics

The construction of a branch rail line in the Jean Corridor (Wilson Pass Option) would lead to a change to the aesthetic resource value of lands along the western slopes of the Spring Mountains, which the Bureau of Land Management classifies as a Class II visual resource. The construction of an intermodal transfer station near Caliente, Nevada, could affect the aesthetic value of lands in the entrance portion of the Kershaw-Ryan State Park until the station was removed.

10.1.3.9 Noise and Vibration

The long-term use of a branch rail line in any of the five rail corridors in Nevada would lead to an increase in ambient noise from periodically passing trains in areas of the State that are currently mostly uninhabited. This could affect solitude which the American Indian Writers Subgroup identified as essential for meditation and prayer. In addition, it could degrade the recreation values of the areas for individuals who seek primitive outdoor experiences. Noise from trains could be noticeable as new noise in residential areas near a potential branch rail line.

For Nevada transportation implementing alternatives that would use heavy-haul trucks, the noise from the trucks and the operation of an intermodal transfer station would be only slightly discernable above the noise of normal traffic and nearby industrial or railroad noise.

10.1.3.10 Utilities, Energy, and Materials

The construction of a branch rail line or upgrades to highways for use by heavy-haul trucks and construction of an intermodal transfer station would result in irreversible commitments of energy (mostly petroleum products) and materials (steel, concrete, and rock). These commitments would not be large enough to affect national or regional supplies.

10.1.3.11 Waste Management

The construction and operation of any of the 10 Nevada heavy-haul truck or rail implementing alternatives would generate small amounts of construction debris, sanitary solid waste, sanitary sewage, and hazardous waste. This waste would be managed by recycling, placement in permitted landfills, reuse or, in the case of sanitary sewage, onsite treatment and disposal. Waste would be managed in accordance with applicable requirements to minimize the possibility of adverse impacts to the environment. A small amount of low-level radioactive waste could be generated at an intermodal transfer station under the heavy-haul truck implementing alternative and would be disposed of in accordance with applicable regulations. The quantities of waste to be disposed of would not affect the availability of waste disposal resources for other users.

DOE would use excavated soil and rock from the construction of a branch rail line and the State of Nevada would use material from existing borrow areas and roadway excavations (highway upgrades) for fill to the extent feasible. However, some previously undisturbed areas could be covered with excavated soil and rock. To place and stabilize these materials, DOE would use approved practices that would minimize affected land areas and reduce potential impacts to biological resources and surface-water resources.

10.2 Relationship Between Short-Term Uses and Long-Term Productivity

The Proposed Action could require short-term uses of the environment that would affect long-term environmental productivity. This section describes possible consequences to long-term productivity from those short-term environmental uses.

The EIS analysis identified two distinct periods for the evaluation of the use of the environment by the Proposed Action:

- A period of 115 to 341 years for surface activities consisting of construction, operation and monitoring, and closure of the proposed repository. DOE activities during this period would include construction of facilities, receipt and emplacement of spent nuclear fuel and high-level radioactive waste, recovery of recyclable materials, ventilation of subsurface emplacement areas, decontamination, closure of surface and subsurface facilities, reclamation of land, and long-term monitoring. Sections 10.1.1.1 through 10.1.1.6 describe the unavoidable impacts that could occur during this period. This period would be the only time during which DOE would actively use the affected lands and the only time during which activities would involve the surface of the land used for the repository.

- The balance of a 10,000-year period would be for the evaluation of consequences from the disposal of spent nuclear fuel and high-level radioactive waste.

In general, transportation and disposal activities associated with the proposed repository would benefit long-term productivity by removing spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites around the country. In addition, removing these materials from existing sites would also free people and resources committed—now and in the future—to monitoring and safeguarding these materials for other potentially more productive activities. Removal could create conditions that would enable the initiation of other productive uses at the commercial and DOE sites. Finally, disposing of spent nuclear fuel and high-level radioactive waste in the proposed repository would provide a long-term global benefit by isolating the materials from concentrations of human population and human activity, thereby reducing the potential for sabotage.

10.2.1 YUCCA MOUNTAIN REPOSITORY

This section summarizes the relationship between short-term uses of land and resources and long-term land and resource productivity for the construction, operation and monitoring, closure, and long-term performance of the proposed repository. The terms "short-term" and "long-term" commonly used in National Environmental Policy Act analyses do not have a consistent duration in this section. For the analysis of impacts associated with repository activities, *short-term* refers to the time from the start of construction to the end of relevant surface and subsurface human activity, which DOE anticipates to range from 115 to 341 years. *Long-term* refers to the time between the end of relevant surface and subsurface human activity and the time when environmental resources have recovered from the potential for impacts and are again productive, or a maximum of 10,000 years. For transportation, *short-term* refers to the time of construction or actual transportation, as appropriate. *Long-term* refers to the time from the end of the short-term period to the time of environmental recovery. *Productivity* refers to the ability of an element of the environment to generate crops, provide habitat, or otherwise serve as a medium for the creation of value.

10.2.1.1 Land Use

From the start of construction through the 10,000-year period, the construction, operation and monitoring, and closure of the proposed repository would deny other users the use of the Yucca Mountain vicinity for other purposes. Chapter 4, Section 4.1.1, discusses the long-term uses of land. Conversely, a repository at Yucca Mountain would enable consideration of other uses for the sites where spent nuclear fuel and high-level radioactive waste are being stored and the land buffering those sites. Many present storage sites are in locations that would permit a wider range of alternative uses than does Yucca Mountain.

10.2.1.2 Hydrology

The proposed repository would be in a terminal basin that is hydrologically isolated and separated from other bodies of surface and subsurface water; that is, once water enters the basin it can leave only by evapotranspiration. As explained in Section 10.1.1.3, there would be a potential for materials disposed of at the proposed Yucca Mountain Repository to reach groundwater at some time between several thousand years and several hundred thousand years. If such contamination reached groundwater in the accessible environment, and if the groundwater contamination exceeded applicable regulatory requirements, there could be an attendant loss of productivity for the affected groundwater and for surface waters in the basin that the groundwater supplied. Conversely, the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain would free a wide range of major and minor water bodies throughout the United States from the potential threat of radioactive contamination from the materials at the present storage sites.

10.2.1.3 Biological Resources and Soils

Short-term uses that could cause impacts to biological resources and soils would be associated with the construction, operation and monitoring, and closure of the repository; those activities could lead to long-term productivity loss in disturbed areas. This loss would be limited to less than 6.0 square kilometers (1,500 acres) of widely distributed habitats adjacent to existing disturbed areas. Biological resources would be affected directly by land disturbances. The overall impact to populations of species would be limited because the area disturbed and the number of individual animals lost would be small in relation to the regional availability.

Long-term productivity loss for soils would be limited to areas affected by land disturbances. These areas would be revegetated after the completion of closure activities. Revegetation would be accomplished through the reclamation of disturbed sites using surface soils stockpiled during construction, reseeding, and similar activities that would enhance recovery. Chapter 4, Section 4.1.4, contains more detail on productivity losses and reclamation. The disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain would remove these materials from proximity to biota near the present storage sites across the United States.

10.2.1.4 Occupational and Public Health and Safety

A repository at Yucca Mountain would be likely to have a positive effect on the nationwide general occupational and public health because of the cessation of doses to workers at the present storage sites and because the spent nuclear fuel and high-level radioactive waste would be substantially more isolated from concentrations of people and from pathways to concentrations of people.

10.2.2 TRANSPORTATION ACTIONS

The construction of a rail line or an intermodal transfer station and improvements to existing highways, all short-term uses, could lead to a long-term loss of productivity in disturbed areas along the routes. In the context of transportation, *long-term* refers to the period of environmental recovery after the end of the construction period or the active use of a transportation route for repository purposes. A route could be used for repository purposes from 10 to approximately 30 years.

The land cover types along any route are widely distributed in the region. A loss of vegetation from a disturbed area along a route would have little effect on the regional productivity of plants and animals.

Productivity loss for soils would be limited to areas affected by land clearing and construction. These areas would not be available for revegetation and habitat for some time. Disturbed areas would recover, however, and eventually would return to predisturbance conditions, although the process of recovery would be slow in the arid environment. Chapter 6 contains more data on transportation.

The construction of a rail line, if the line were also used for nonrepository uses, could result in productivity benefits for Nevada by increasing transportation opportunities, lowering transportation costs, reducing accidents, and lowering nitrogen oxides, carbon monoxide, and other gaseous criteria pollutant emissions by diverting transportation from highway to rail.

The major long-term consequence of transporting spent nuclear fuel and high-level radioactive waste to the repository would be the permanent consolidation of these materials in an isolated location away from concentrations of people and without exposure pathways to concentrations of people.

10.3 Irreversible or Irretrievable Commitment of Resources

The Proposed Action would involve the irreversible or irretrievable commitment of land, energy, and materials. The commitment of a resource is irreversible if its primary or secondary impacts limit future options for the resource. An irretrievable commitment refers to the use or consumption of resources that are neither renewable nor recoverable for later use by future generations. Construction, operation and monitoring, and eventual closure of a repository at Yucca Mountain would result in a permanent commitment of land, groundwater, surface, subsurface, mineral, biological, soil, and air resources; materials such as steel and concrete; and consume energy in forms such as gasoline, diesel fuel, and electricity. Water use would support construction, operation and monitoring, and closure actions, and options for using groundwater could become limited if there was contamination from radionuclides. There would be an irreversible and irretrievable commitment of associated natural resource services such as uses of land and habitat productivity.

10.3.1 YUCCA MOUNTAIN REPOSITORY

The construction, operation and monitoring, closure, and long-term performance of the Yucca Mountain Repository would result in the permanent commitment of the surface and subsurface of Yucca Mountain and the permanent withdrawal of lands from public use. Because of the remote location of Yucca Mountain, the lack of present uses of the land, the terminal and isolated nature of the water basin, and the limited amounts of materials and energy required for the repository in comparison to the supply capability of the regional and national economies, the irreversible and irretrievable commitments of resources for repository-related activities would be small.

Mitigation approaches that would involve the excavation of archaeological sites to prevent degradation by construction activities would destroy the contexts of those sites and reduce the finite number of such resources in the region. DOE expects that its activities at the proposed repository would affect no more than a minimal number of such sites. The Department would use state-of-the-art mitigation techniques on the Yucca Mountain Project.

Electric power, fossil fuels, and construction materials would be irreversibly committed to the project. Most of the steel used for the surface facilities would be recyclable and, therefore, not an irreversible or irretrievable commitment. Some copper and steel in the ramps and access mains to subsurface facilities would be recyclable, while some in the emplacement drifts would be irreversibly and irretrievably lost. Some steel, such as rebar, would be difficult to recycle. The quantity of resources consumed would be small in comparison to their national consumption or their availability to consumers in southern Nevada. These quantities are described in Chapter 4. To the extent that there is value in spent nuclear fuel or high-level radioactive waste, that value would be committed to the repository.

Aggregate would be crushed as required and mixed in concrete for the cast-in-place and precast concrete structures and liners that would be used in the repository. The amount of sand and aggregate could range from 1.2 million to 2.54 million metric tons (1.3 to 2.8 million tons). If Yucca Mountain tuff was used as the aggregate component of the subsurface concrete, the amount crushed and used as aggregate would be less than 15 percent of the total excavated from the drifts (see Chapter 4, Section 4.1.11).

Repository closure would make the energy content of uranium and plutonium in spent nuclear fuel unavailable for use by future generations.

10.3.2 TRANSPORTATION ACTIONS

The construction of a rail line or an intermodal transfer station would result in an irretrievable but not irreversible commitment of resources. Many resources could be retrieved at a later date through such actions as removing roadbeds, revegetating land, and recycling materials. Land uses would change along the selected transportation corridor during repository construction, operation and monitoring, and closure, thereby limiting or eliminating other land uses for that period. At the end of that period, however, land along the corridor could revert to public or private ownership.

Mitigation approaches involving the recovery of archaeological resources before construction activities degraded the sites would reduce the finite number of such resources in the Yucca Mountain region and destroy the context of sites. DOE would use state-of-the-art mitigation techniques during the construction of a rail corridor or an intermodal transfer station or the modification of roadways to accommodate heavy-haul trucks. Heavy-haul construction would be likely to generate only minimal impacts to cultural resources because construction would largely involve modifications to existing roads.

DOE would use about 500 to 700 million liters (132 to 185 million gallons) of fossil fuel from the nationwide supply system to transport spent nuclear fuel and high-level radioactive waste to the repository. The analysis in Chapter 6 (Sections 6.1.2.10, 6.3, 6.3.2.1, 6.3.2.2, 6.3.3.1, and 6.3.3.2), evaluates fuel use for the different transportation scenarios. The amount used would be a very small fraction of a percent of the Nation's supply over the period of fuel use.

The manufacture of casks and containers would require commitment of aluminum, chromium, copper, depleted uranium, lead, molybdenum, nickel, and steel. The required amounts of these materials, expressed as percentages of U.S. production, would be low with the exception of nickel, which would require approximately 8.2 percent of annual U.S. production.

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