- *Hydrologic resources.* Expanded flood zone, groundwater, and surface-water resources, and water demand analyses to incorporate information for variations of Nevada rail corridors and for routes for heavy-haul trucks.

- *Biological resources and soils.* Provided more details from existing information and analyses of disturbed areas, sensitive biological resources, management areas, and soil impacts.

- *Cultural resources.* Acquired and evaluated additional cultural, archeological, and Native American data and included evaluations of potential impacts of Nevada rail variations and heavy-haul truck routes.

- *Socioeconomics.* Updated socioeconomic baseline information to accommodate 2000 Census information as well as match population forecasts provided by Clark and Nye Counties and Nevada State Demographer.

- *Noise and vibration.* Added new data and developed additional analyses of impacts of ground vibration and noise on *sensitive structures,* populations, and communities along Nevada rail corridors and routes for heavy-haul trucks.

- *Aesthetics.* Incorporated field observations made after the publication of the Draft EIS for viewsheds along candidate rail corridors and routes for heavy-haul trucks and used additional detail available from existing information.

- *Environmental justice.* Added available detail, reanalyzed data on minority and low-income populations, and reevaluated impact assessments of other disciplines.

- *Utilities, energy, and materials.* Reanalyzed impacts based on new information for the repository flexible design and for variations in the candidate rail corridors.

- *Waste management.* Added new waste data, details of waste sources and shipments, and changes in waste management from changes in information regarding the repository flexible design.

Other Changes

In addition to the changes described above, DOE added Appendix M to provide general background information on transportation-related topics that are not addressed in detail in this chapter or Appendix J and are not directly related to potential impacts of the Proposed Action. This includes information on the Department's planning, under a draft Request for Proposal, to issue shipping contracts and discussion of in-transit procedures, emergency response plans, indemnification against damages from the potential release of spent nuclear fuel and high-level waste, and cask testing.

6.1 Summary of Impacts of Transportation

6.1.1 Overview of National Transportation Impacts

This section provides an overview of the potential impacts of using the Nation's highways and railroads to transport spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites to the repository at Yucca Mountain. Detailed discussions of national transportation impacts are in Section 6.2 and analytical methods are in Appendix J. All potential impacts are related to the health and safety of populations and hypothetical maximally exposed individual members of the general public and workers. This summary includes estimated impacts from loading operations, incident-free transportation, and

accidents for the mostly legal-weight truck and mostly rail national transportation scenarios. (National transportation includes transportation in Nevada to Yucca Mountain.)

Estimated national transportation impacts are based on 24 years of transportation activities during the Proposed Action and average annual shipments of about 2,200 (2,200 truck, 13 rail) for the mostly legal-weight truck scenario and about 450 (400 rail, 45 truck) for the mostly rail scenario. From all causes, about 8 fatalities could occur in the nationwide general population from transportation activities of the mostly legal-weight truck scenario and about 5 fatalities from the mostly rail scenario during the 24-year transportation period (impacts of a maximum reasonably foreseeable accident are not included).

Impact analyses for the transport of spent nuclear fuel and high-level radioactive waste in Nevada using a branch rail line are based on the assumption that the branch rail line would be dedicated to activities related to the Proposed Action. There are other possible uses for such a branch rail line in Nevada including support of ranching, industrial, and commercial endeavors; support of Federal, state, tribal and local government activities; and transport of people, materials, and products into, out of, and across the state. However, DOE has not addressed any of these possibilities because there are no concrete proposals at this time for alternative uses, and insufficient information exists to evaluate such uses. Potential uses of a branch rail line are identified in Chapter 8, but the need or level of use and growth of use has not been defined or evaluated. If the Yucca Mountain Site was designated, DOE would consider any uses that were reasonably foreseeable at that time other than transporting radioactive materials to the site in selecting an alignment within any rail corridor selected.

Impacts of Loading Operations

All spent nuclear fuel and high-level radioactive waste would be loaded onto trucks or railcars at the 77 sites for transport to the Yucca Mountain site. Some health and safety impacts would be associated with these loading operations. There would be small (0.04 latent cancer fatality) impacts to members of the public from loading operations. Over the 24 years of the Proposed Action, an estimated 6 and 2 latent cancer fatalities could occur in involved worker populations from radiation exposure for the mostly legal-weight truck and mostly rail scenarios, respectively. The probability of a latent cancer fatality to the maximally exposed involved worker would be about 0.005 for both scenarios. No worker fatalities from industrial accidents would be expected. No or very small impacts to workers or members of the public would be expected from postulated loading accidents. About 0.4 traffic fatality could occur in the worker population from commuting under the mostly legal-weight truck scenario, while about 0.2 traffic fatality could occur under the mostly rail scenario. Loading operations and potential impacts are discussed further in Section 6.2.2.

Impacts of Incident-Free Transportation

Incident-free transportation is the expected norm for transportation of spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site. Impacts of incident-free transportation would include those from external radiation emitted from transportation casks and vehicle exhaust emissions along the transportation routes.

Over the 24 years of the Proposed Action, an estimated 3 (2.5) latent cancer fatalities could occur in the general population along transportation routes from radiation exposure under the mostly legal-weight truck scenario and an estimated 1 latent cancer fatality could occur under the mostly rail scenario. Under the mostly legal-weight truck and mostly rail scenarios, the probability of a latent cancer fatality to the maximally exposed member of the public would be no more than 0.0012 and 0.0001, respectively. Under these same scenarios, about 1 (0.95 for the mostly legal-weight truck scenario and 0.77 for the mostly rail scenario) fatality from vehicle emissions could occur in the general population along transportation routes.

IMPLEMENTING ALTERNATIVES AND SCENARIOS

Implementing alternatives and scenarios are used to describe the range of reasonably foreseeable transportation actions with environmental impacts that could result from the Proposed Action.

Implementing alternatives represent feasible selections that DOE could make based in part on this EIS (for example, selecting a branch rail line corridor or an intermodal transfer station location and an associated route for heavy-haul trucks). Analytical scenarios, on the other hand, are feasible combinations of actions that DOE would have limited ability to direct (for example selecting the use of rail or truck casks for shipments from a specific nuclear powerplant). The scenarios are selected such that the analysis results bound the range of impacts that could result from the Proposed Action.

The transportation modes that make up the analytical scenarios and implementing alternatives include the following:

Legal-weight truck transportation: Legal-weight trucks have gross vehicle weights, including cargo, that do not exceed 80,000 pounds, which is the loaded weight limit for commercial vehicles operated on Interstate and U.S. highways without special state-issued permits. In addition, these vehicles have dimensions that are within the constraints of Federal and state regulation limits.

Permitted overweight, overdimension truck transportation: Semi- and tandem tractor-trailer trucks with gross vehicle weights over 80,000 pounds must obtain permits from state highway authorities to use public highways. States often permit vehicles that have gross weights above 80,000 pounds as *overweight, overdimension* vehicles with operating restrictions to protect public safety. Seven-axle tractor-trailer trucks (steering axle and three drive axles on the tractor and three axles on the trailer) with weights greater than 80,000 pounds that meet Federal bridge formulas and dimensional limits can carry payloads of 70,000 pounds.

Rail transportation: Rail transportation includes railroad transportation of spent nuclear fuel and high-level radioactive waste in large rail transportation casks (rail casks). The casks would be placed on railroad cars at commercial and DOE sites or at nearby intermodal transfer facilities for shipment on trains operated by commercial railroad companies over existing tracks. Because of the weight of the casks, only one cask would be transported on a railcar.

Heavy-haul truck transportation: Heavy-haul truck transportation includes the movement of large rail casks—both loaded and empty—on large heavy-haul trucks traveling on existing highways. For the transportation of spent fuel and high-level radioactive waste rail casks, these vehicles would weigh as much as 500,000 pounds; they would be more than 100 feet long and 10 to 12 feet wide, and would stand as high as 15 feet above the road surface. Heavy-haul trucks would require special permits issued by a state transportation agency. The permits would normally restrict the times of operation (typically daylight, non-rush-hour), operating speeds, and highways used.

Barge transportation: Barge transportation would be the transportation of loaded and empty rail casks between a commercial facility and a nearby railhead using navigable waterways. Barge terminals would have intermodal transfer capabilities sufficient to transfer casks from barges to railcars.

An estimated 12 (11.7) latent cancer fatalities could occur in the worker population from radiation exposure for the mostly legal-weight truck scenario, and an estimated 3 (3.5) latent cancer fatalities could occur for the mostly rail scenario. The probability of a latent cancer fatality to the maximally exposed involved worker would be approximately 0.02 for either the mostly legal-weight truck or mostly rail scenario. DOE expects impacts to noninvolved workers to be even lower than those to involved workers. To assess potential radiological impacts at generator facilities, the EIS analysis assumed that noninvolved

workers would have no direct involvement in handling spent nuclear fuel and high-level radioactive waste.

The differences in incident-free impacts between the mostly legal-weight truck and mostly rail scenarios are due principally to (1) the difference in the number of shipments for the two scenarios, and (2) differences in analysis assumptions about the numbers of in-transit stops, the number of potentially exposed persons, and their proximity to shipping casks that could result in external radiation exposure.

DOE identified no national environmental justice concerns or air quality impacts for incident-free transportation. Incident-free national transportation and the potential impacts to workers and the public are discussed further in Section 6.2.3.

Impacts of Transportation Accidents

The analysis evaluated impacts to human health and safety, collectively including the health and safety of the public and transportation workers, from transportation accidents. Thus, impacts to populations from transportation accidents would include impacts to affected workers. Because the population of transportation workers would be small compared to the general population, radiological accident risks and consequences for the worker population would be a small fraction of those estimated for the public (that is, the total population).

TRANSPORTATION ACCIDENT RADIOLOGICAL DOSE RISK

The risk to the general public of radiological consequences from transportation accidents is called *dose risk* in this EIS. Dose risk is the sum of the products of the probabilities (dimensionless) and the consequences (in person-rem) of all potential transportation accidents.

The probability of a single accident is usually determined by historical information on accidents of a similar type and severity. The consequences are estimated by analysis of the quantity of radionuclides likely to be released, potential exposure pathways, potentially affected population, weather conditions, and other information.

As an example, the dose risk from a single accident that had a probability of 0.001 (1 chance in 1,000), and would cause a population dose of 22,000 person-rem in a population if it did occur, would be 22 person-rem. If that population was subject to 1,000 similar accident scenarios, the total dose risk would be 22,000 person-rem. Using the conversion factor of 0.0005 latent cancer fatality per person-rem, an analysis would estimate a health and safety risk of 11 latent cancer fatalities from this population dose risk.

Accident impacts include the consequences where shipping casks could be breached with subsequent release of radioactive material to nearby individuals and populations. In addition, there could be impacts to individuals from “normal” traffic accidents, in which there would be no release of radioactive material from shipping casks and only those directly involved in the accident would be affected. The analysis examined radiological consequences under the maximum reasonably foreseeable accident scenario, and also estimated overall accident risk. The maximum reasonably foreseeable accident scenario is the one with the greatest potential consequences that are reasonably foreseeable. The scenario must also have an occurrence likelihood of 1 in 10 million per year or greater to be considered “reasonably foreseeable.” Accident risk considers the potential consequences of all foreseeable accident scenarios and their occurrence likelihood, ranging from accident scenarios that are likely to occur but would have no release of radioactive material to those accident scenarios that are extremely unlikely to occur but could have large consequences (for example, the maximum reasonably foreseeable accident scenario).

The overall radiological accident risk, as described in Appendix J, Section J.1.4.2.1, from all accident scenarios over the 24 years of transportation activities during the Proposed Action would be about 0.0002 latent cancer fatality for the mostly legal-weight truck scenario and about 0.0005 latent cancer fatality for the mostly rail scenario. These estimated latent cancer fatalities would occur in the hypothetically exposed population residing within 80 kilometers (50 miles) of the accident site.

The maximum reasonably foreseeable accident scenario for the mostly legal-weight truck scenario would result in about 1 latent cancer fatality in the exposed population. It is postulated to involve a release of radioactive material from a truck cask in an urbanized area under stable weather conditions. The probability of this accident scenario would be about 0.00000023 per year (a rate of about 2.3 in 10 million years). The maximum reasonably foreseeable accident scenario for the mostly rail scenario would result in about 5 latent cancer fatalities in the exposed population. It is postulated to involve a release of radioactive material from a rail cask in an urbanized area under stable weather conditions. The probability of this accident scenario would be about 0.00000028 per year (a rate of about 2.8 in 10 million years). The probability of a latent cancer fatality occurring in the hypothetical maximally exposed individual would be about 0.0015 for the mostly legal-weight truck scenario and about 0.015 for the mostly rail scenario.

DOE evaluated accidents involving the crash of a jet airliner into a legal-weight truck cask or rail cask (DIRS 157210-BSC 2001, all). Such an accident could result in up to 0.65 latent cancer fatality.

Nationwide, during the 24 years of the Proposed Action transportation activities, about 5 nonradiological fatalities could result from traffic accidents under the mostly legal-weight truck scenario. For the same time period, about 3 nonradiological fatalities could also result from traffic accidents under the mostly rail scenario. These fatalities would all be related to physical injuries associated with traffic accidents, not radiological impacts.

No environmental justice concerns were identified for transportation accident scenarios. Transportation accident scenarios and potential impacts are discussed further in Section 6.2.4.

Table 6-1 summarizes the national impacts of transporting spent nuclear fuel and high-level radioactive waste from 77 generator sites to the proposed Yucca Mountain Repository. The table lists impacts for the two transportation scenarios—mostly legal-weight truck and mostly rail. It includes impacts that would occur in Nevada among the national impacts. For the mostly rail scenario, Table 6-1 lists a range of impacts. Ten unique national impacts comprise the range—one for each of the five rail and five heavy-haul truck implementing alternatives in Nevada.

As listed in Table 6-1, impacts to the general population would be small for both scenarios. For example, impacts to individuals in a population of between 10 million and 17 million who lived within 800 meters (0.5 mile) of routes and to individuals who used the routes could range from about 0.12 millirem to as much as 0.5 millirem over the 24-year shipping campaign. These small doses would increase the risk of cancer for an average individual who lived along a route by 0.5 to 2.5 in 10 million over the individual's lifetime. This level of health and safety risk would not be discernible. A hypothetical maximally exposed individual who would live or work along transportation routes for 24 years would receive a dose of 2.4 rem (a truck stop worker for the mostly legal-weight truck scenario) or 0.29 rem (a person who lived near a rail stop for the mostly rail scenario). The estimated dose to the hypothetical truck stop worker would increase the risk of a latent cancer fatality by about 1 in 1,000 over the person's lifetime. For the maximally exposed individual who lived near a rail stop, the risk of a latent cancer fatality would increase by about 1 in 10,000 over the person's lifetime. The health and safety risks for these hypothetical individuals would not be discernible. For perspective, in the United States, about one in four deaths is caused by cancer from all causes.

Table 6-1. National transportation impacts for the transportation of spent nuclear fuel and high-level radioactive waste for the mostly rail and mostly legal-weight truck scenarios.[a,b]

Group	Impact	Mostly legal-weight truck scenario	Mostly rail scenario
Worker	*Incident-free health impacts, radiological*		
	Maximally exposed individual (rem)	48[c]	48[c]
	Individual latent cancer fatality probability	0.02	0.02
	Collective dose (person-rem)	29,000	7,900 - 8,800
	Latent cancer fatality incidence	11.7	3.2 - 3.5[d]
	Industrial safety (fatalities)	0.9	0.29
Public	*Incident-free health impacts, radiological*		
	Average exposed individual (rem)	0.0005	0.0001
	Maximally exposed individual (rem)	2.4[e]	0.29
	Individual latent cancer fatality probability	0.0012	0.00014
	Collective dose (person-rem)	5,000	1,200 - 1,600
	Latent cancer fatality incidence	2.5	0.61 - 0.81
	Incident-free vehicle emissions impacts (fatalities)	0.95	0.55 - 0.77
	Radiological impacts from maximum reasonably foreseeable accident scenario		
	Frequency (per year)	2.3 in 10,000,000	2.8 in 10,000,000
	Maximally exposed individual (rem)	3	29
	Individual latent cancer fatality probability	0.0015	0.015
	Collective dose (person-rem)	1,100	9,900
	Latent cancer fatality incidence	0.55	5
	Accident dose risk (person-rem)	0.46	0.89
	Accident risk (latent cancer fatalities)	0.00023	0.00045
Public and transportation workers	*Fatalities from vehicular accidents*	4.9	2.3 - 3.1

a. The assumed external dose rate is 10 millirem per hour at 2 meters (6.6 feet) from the vehicle for all shipments.
b. Totals for 24 years of operation, including impacts of loading.
c. Based on 2-rem-per-year dose limit.
d. Range for the 10 rail and heavy-haul truck implementing alternatives in Nevada.
e. Based on 100-millirem-per-year dose limit.

Radiological impacts of transportation accidents, which DOE estimated by summing the products of the probability of releases of radioactive materials from casks and the consequences of the releases if they occurred, would be very small. They would be small because accidents that could cause a release from a cask would be very unlikely and consequences from the small releases that could occur would generally be small. For example, Table 6-1 lists the consequences of maximum reasonably foreseeable accidents for the mostly rail and mostly legal-weight truck scenarios. In these accidents, which would have an annual likelihood of 2.3 in 10 million for the legal-weight truck scenario and 2.8 in 10 million for the mostly rail scenario, the estimated consequences would be 1,100 person-rem for a truck accident and 9,900 person-rem for a rail accident. The health and safety consequences of these doses would be about 0.55 latent cancer fatality for the truck accident and 5 latent cancer fatalities for the rail accident. The risk impacts of these accidents would be 2.3 in 10 million multiplied by 1,100 person-rem for the truck accident—about 0.00025 person-rem—and about 2.8 in 10 million multiplied by 9,900 person-rem for the rail accident—about 0.0028 person-rem. A *dose risk* of 0.0028 person-rem to a population is equivalent to a risk of 1 in 1 million of a single latent cancer fatality in the population. Thus, the radiological risks to health and safety from transportation accidents would be exceedingly small for both scenarios.

The radiological risks of accidents for the general public are not comparable with the risks of fatalities associated with immediate nonradiological consequences of transportation accidents. For the mostly legal-weight truck scenario, the analysis estimated there could be as many as 5 (4.9) fatalities over 24 years from vehicle collisions and other traffic accidents during the 53,000 legal-weight truck and 300 rail shipments. For the mostly rail scenario, which would involve as many as 9,600 rail and 1,100 legal-weight truck shipments, the analysis estimated there could be about 3 (2.5 to 3.3) fatalities over 24 years

attributable to train operations; these could include fatalities from grade-crossing accidents and trespassers struck and killed by trains.

The analysis estimated long-term health effects fatalities that could be caused by the exhaust and fugitive dust emissions of the vehicles that would transport spent nuclear fuel and high-level radioactive waste. There would be 1 (0.95) fatality under the mostly legal-weight truck scenario and less than 1 (between 0.55 and 0.77) fatality under the mostly rail scenario as a consequence of 24 years of transportation. These fatalities would be latent, or would occur well after exposure to the vehicle exhaust and dust emissions.

Radiological doses to the workers who would load casks, drive trucks, operate trains, and inspect vehicles in transit would be higher than doses to the general public. Radiological protection programs would manage and limit doses to workers whose jobs would cause them to receive the greatest exposures. Even so, the analysis assumed a maximally exposed individual worker could receive a dose as high as 2 rem per year for each of the 24 years of the Proposed Action, for a total of 48 rem over 24 years. The analysis assumed that this dose, which is the maximum currently allowed under DOE administrative controls, would occur for both the mostly legal-weight truck and mostly rail scenarios. A dose of 48 rem would increase the worker's lifetime risk of a latent fatal cancer from an average of 23 percent from all causes to 25 percent.

The radiological impacts to all workers involved in shipping spent nuclear fuel and high-level radioactive waste to a Yucca Mountain Repository would be greatest for the mostly legal-weight truck scenario. For this scenario, the analysis estimated the workers would receive a total dose of 29,000 person-rem. Thus, the estimated lifetime impact to the worker population for the mostly legal-weight truck scenario would be 11.7 latent cancer fatalities from shipments over the 24 years of the Proposed Action. For the mostly rail scenario, the estimated lifetime impacts would be between 7,900 and 8,800 person-rem, or about one-third of the impacts for the mostly legal-weight truck scenario.

6.1.2 OVERVIEW OF NEVADA TRANSPORTATION IMPACTS

This section provides an overview of the environmental impacts associated with transportation of spent nuclear fuel and high-level radioactive waste in the State of Nevada. Although this section provides a more detailed, regional subset of some of the information gathered and analyses conducted for national transportation (see Section 6.1.1), it also includes information analyzed specifically for Nevada. This includes impacts from construction and operation of branch rail lines, routes for heavy-haul trucks and intermodal transfer stations, commuter transportation for construction and operations activities, and transportation of other materials in support of Yucca Mountain operations. Detailed discussions of potential impacts in Nevada are in Section 6.3 and Appendix J. The following areas were evaluated for potential impacts in Nevada from Yucca Mountain transportation activities:

- Transporting spent nuclear fuel and high-level radioactive waste by legal-weight truck in Nevada
- Constructing a branch rail line in Nevada and using it to transport spent nuclear fuel and high-level radioactive waste by rail to the repository
- Upgrading highways in Nevada for use by heavy-haul trucks to transport spent nuclear fuel and high-level radioactive waste to the repository
- Constructing and operating an intermodal transfer station in Nevada
- Transporting materials, consumables, supplies, equipment, waste, and people to support construction, operation and monitoring, and closure of the repository

Overviews are presented for the 12 environmental resource areas analyzed in this chapter and for the transportation of other materials and supplies, which is presented in further detail in Appendix J. Section 6.3 contains summaries that provide information for assessing the relative impacts in these resource areas from the mostly legal-weight truck transportation scenario, the five implementing alternatives for rail transportation, and the five implementing alternatives for heavy-haul truck transportation.

6.1.2.1 Land Use

Land-use impacts (land areas that would be disturbed or whose ownership or use would change) would be greatest for the mostly rail scenario. Land-use and ownership impacts based on a 60-meter- (200-foot)-wide rail right-of-way (land withdrawn) would affect from approximately 9.4 square kilometers (2,323 acres) for the Valley Modified route to 33.2 square kilometers (8,204 acres) for the Caliente route. Actual land disturbance in each 400-meter- (0.25-mile)-wide corridor for individual rail routes would range from approximately 5.1 square kilometers (1,260 acres) for the Valley Modified route to approximately 19.2 square kilometers (4,744 acres) for the Carlin route (see Figure 6-3). DOE based these estimated disturbances on anticipated construction activities (borrow areas, construction camps, soil areas) in the 400-meter corridor associated with the construction of a railroad and the projected width of the average construction disturbance for each rail bed. The average disturbance widths, for example, range from approximately 28 meters (91 feet) for the Caliente-Chalk Mountain Corridor to approximately 37 meters (120 feet) for the Jean Corridor. Land disturbance calculations do not include access roads. Existing roads would be used where possible. Due to possible variations along the rail corridors, land-use, ownership, and disturbances could vary from those discussed above (see Appendix J, Section J.3.1.2). Section 6.3.2.2 reports ranges due to these variations, as well as information on the representative corridor routes. No prime farmland would be affected by any of the transportation routes. The Carlin Corridor would affect the most private land [14 square kilometers (3,459 acres)]. Table 6-2 summarizes the land-use conflicts along the corridors. Selecting variations of a corridor, as described in Appendix J, Section J.3.1.2, could reduce some conflicts and increase or change conflicts in others. Overall impacts are generally proportional to the length of the corridor.

Disturbed land area for all of the heavy-haul truck implementing alternatives would range from 0.83 to 3.6 square kilometers (205 to 890 acres). No more than 0.2 square kilometer (50 acres) of private land would be affected for any route. There would be no land-use impacts from legal-weight trucks using existing highways. Land-use impacts are discussed for Nevada transportation rail implementing alternatives and for Nevada transportation heavy-haul truck implementing alternatives in Sections 6.3.2 and 6.3.3, respectively. None of the transportation implementing alternatives currently being considered would be affected by the flexible design evaluated for the proposed repository. Chapter 2, Table 2-7, summarizes the impacts to the various resource areas as the result of the repository operating modes. Section 6.3 contains summary information about the impacts in Nevada from the mostly legal-weight truck scenario and the rail and heavy-haul alternatives of the mostly rail scenario.

There are potential land-use conflicts for the Nevada implementing alternatives. The Carlin, Caliente, and Valley Modified Corridors encroach on the western and southern boundaries of the Nellis Air Force Range (also known as the Nevada Test and Training Range), and the Caliente-Chalk Mountain rail corridor and Caliente/Chalk Mountain heavy-haul truck route travel through the Range from north to south, essentially bisecting it. The U.S. Air Force has stated to DOE that the construction and use of routes through the Nellis Air Force Range would seriously affect sensitive and classified programs, would severely reduce Air Force training capabilities, and would impair the ability to comply with international testing and training obligations on the Range. In response to these concerns, DOE has identified the Caliente-Chalk Mountain Corridor and Caliente/Chalk Mountain heavy-haul route as nonpreferred alternatives. In addition, the Air Force noted the potential for safety risks of using other routes that could cross lands that are hazard areas and encompass weapons safety footprints for live weapons deployment. Although DOE is unaware of specific safety risks, the Caliente, Carlin, and Valley Modified rail corridors

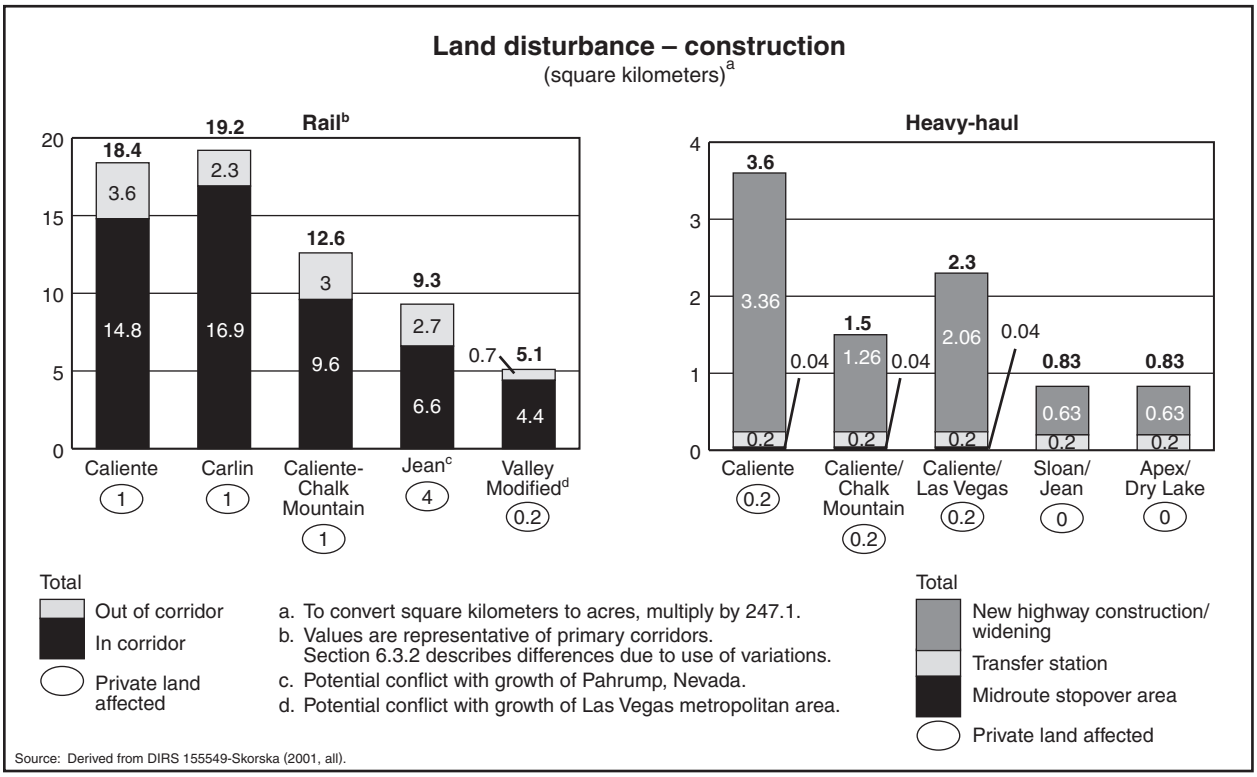

Figure 6-3. Land disturbed for construction of branch rail lines and upgrades to Nevada highways for heavy-haul use.

include sections that would encroach on the Range for short distances. For the Caliente Corridor, Carlin Corridor, and one section of the Valley Modified Corridor, DOE has identified variations that would avoid entering the Range. A short segment of the Valley Modified Corridor for which there is no currently identified variation would cross the southern Range boundary. If DOE selected this corridor, it would consult with the Air Force to determine avoidance or mitigation measures.

The Steiner Creek Alternate of the Carlin Corridor passes just west of the Simpson Park Wilderness Study Area and might encroach slightly into the Wilderness Study Area. The Caliente Corridor passes close to the Weepah Springs and Kawich Wilderness Study Areas, and passes inside and along the western boundary of the South Reveille Wilderness Study Area. The Wilson Pass Option of the Jean Corridor passes through Bureau of Land Management Visual Resource Management Class II lands in the vicinity of Wilson Pass in the Spring Mountains. The Jean and Valley Modified Corridors could have conflicts with the future community growth of Pahrump and Las Vegas, respectively. The Valley Modified Corridor passes near the Las Vegas Paiute Indian Reservation. The Valley Modified Corridor and its Sheep Mountain Alternate cross Nellis Wilderness Study Areas A, B, and C; the Quail Mountain Wilderness Study Area; and penetrates the Desert National Wildlife Refuge. The routes for heavy-haul trucks pass through the Las Vegas Paiute Indian Reservation along U.S. Highway 95 northwest of Las Vegas and approximately 4.8 kilometers (3 miles) west of the Moapa Indian Reservation. The rail origination location for the Stateline Pass Option is on lands to be used for the construction of the Ivanpah Valley Airport (Ivanpah Valley Airport Public Lands Transfer Act, Public Law 106-362, 114 Stat. 1404). The Bonnie Claire Alternate of the Carlin and Caliente Corridors passes through the newly established Timbisha Shoshone trust lands near Beatty.

Table 6-2. Land-use conflicts of rail corridor variations.[a,b]

Corridor[c]	Forest Service land	Fish and Wildlife Service land/ range	Desert Land Entry Program/ withdrawal area	Right-of-way/ road	Wilderness Study Area	Private land	Grazing allotments	Nellis Air Force Range	BLM[d]/ Nevada Test Site land	Native American Reservation
Caliente										
Caliente Corridor with Eccles Option	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Eccles Option	No	No	No	No	No	Yes	Yes	No	Yes	No
Caliente Option	No	No	No	Yes	No	Yes	No	No	Yes	No
Crestline Option	No	No	No	Yes	No	Yes	No	No	Yes	No
White River Alternate	No	No	No	No	No	Yes	No	No	Yes	No
Garden Valley Alternate	No	No	No	Yes	No	Yes	No	No	Yes	No
Mud Lake Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Goldfield Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Bonnie Claire Alternate	No	No	No	Yes	No	Yes	Yes	No	Yes	Yes
Oasis Valley Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Beatty Wash Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Carlin										
Carlin Corridor with Big Smoky Valley Option	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Big Smoky Valley Option	No	No	Yes	Yes	No	No	Yes	No	Yes	No
Crescent Valley Alternate	No	No	No	Yes	No	Yes	Yes	No	Yes	No
Wood Spring Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Rye Patch Alternate	No	No	No	Yes	No	No	Yes	No	Yes	No
Steiner Creek Alternate	No	No	No	No	Yes	No	Yes	No	Yes	No
Monitor Valley Option	No	No	Yes	Yes	No	No	Yes	No	Yes	No
Mud Lake Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Gold Field Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Bonnie Claire Alternate	No	No	No	Yes	No	Yes	Yes	No	Yes	Yes
Oasis Valley Alternate	No	No	No	No	No	Yes	Yes	No	Yes	No
Beatty Wash Alternate	No	No	No	No	No	No	Yes	No	Yes	No
Caliente-Chalk Mountain										
Caliente-Chalk Mountain Corridor with Eccles Option	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Eccles Option	No	No	No	No	No	Yes	Yes	No	Yes	No
Caliente Option	No	No	No	Yes	No	Yes	No	No	Yes	No
Crestline Option	No	No	No	Yes	No	Yes	No	No	Yes	No
White River Alternate	No	No	No	No	No	Yes	No	No	Yes	No
Garden Valley Alternate	No	No	No	Yes	No	Yes	No	No	Yes	No
Orange Blossom Road Option	No	No	No	Yes	No	No	No	No	Yes	No
Mercury Highway Option	No	No	No	No	No	No	No	No	Yes	No
Topopah Option	No	No	No	No	No	No	No	No	Yes	No
Mine Mountain Alternate	No	No	No	No	No	No	No	No	Yes	No
Area 4 Alternate	No	No	No	Yes	No	No	No	No	Yes	No
Jean										
Jean Corridor with Wilson Pass Option	No	No	No	Yes	No	Yes	Yes	No	Yes	No
Wilson Pass Option	No	No	No	Yes	No	Yes	Yes	No	Yes	No
North Pahrump Alternate	No[e]	No	No	Yes	No	Yes	No	No	Yes	No
Stateline Pass Option	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No
Valley Modified										
Valley Modified Corridor	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Indian Hills Alternate	No	Yes	Yes	Yes	No	No	No	No	Yes	No
Sheep Mountain Alternate	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No
Valley Connection	No	No	No	No	No	Yes	No	No	Yes	No

a. Sources: Derived from DIRS 101504-BLM (1979, all), DIRS 103077-BLM (1983, all), DIRS 101523-BLM (1994, all), DIRS 103079-BLM (1998, all), DIRS 104993-CRWMS M&O (1999, all), DIRS 155549-Skorska (2001, all).

b. For definition and illustration of Corridor, Option, Variation, and Alternative terms, see Chapter 3, Section 3.2.2. For additional explanation, see Appendix J, Section J.3.1.2.

c. The first line under each corridor indicates land-use conflicts for the entire corridor with the use of that particular variation. Further listings indicate conflicts only along the length of the particular variation.

d. BLM = Bureau of Land Management.

e. Route abuts Toiyabe National Forest.

6.1.2.2 Air Quality

The main air pollutants would be fugitive dust (PM_{10}) and equipment emissions (carbon monoxide, nitrogen dioxide, and sulfur dioxide) from construction or upgrade activities associated with the rail and heavy-haul truck implementing alternatives, and vehicle emissions associated with legal-weight truck, heavy-haul truck, and rail transportation.

Because the Las Vegas air basin is in nonattainment of air quality regulations for PM_{10} and carbon monoxide, more restrictive regulations are applied to these criteria pollutants within the Las Vegas air basin. Construction activities are a major source of PM_{10} emissions (DIRS 155557-Clark County 2001, all). Vehicle emissions are the major source of carbon monoxide emissions (DIRS 156706-Clark County 2000, all). The transportation air quality analyses focused on these pollutants and sources within the Las Vegas air basin. Annual emissions were estimated and compared to the General Conformity threshold levels established in EPA regulations implementing the Clean Air Act.

The PM_{10} emissions during construction activities would result primarily from earthmoving operations, but also from construction vehicle fuel combustion. Dust control measures are required for activities in the Las Vegas air basin (DIRS 155557-Clark County 2001, all). These measures include water application and limiting activity on windy days. Construction activities would occur under the rail and heavy-haul transportation implementing alternatives in Nevada. The General Conformity threshold level for PM_{10} (63,500 kilograms per year) would be exceeded under the mostly rail scenario for total estimated emissions of the Valley Modified Corridor (190 percent of threshold). Construction activities in other corridors would not exceed the PM_{10} threshold. The General Conformity threshold level for PM_{10} would be exceeded under the heavy-haul scenario for the Caliente-Las Vegas route (100 percent of threshold). Construction activities of other heavy-haul routes would not exceed the PM_{10} threshold.

Carbon monoxide emissions would largely be a result of vehicle emissions. The greatest vehicle emissions under all three transportation scenarios would result not from radioactive material transport to Yucca Mountain, but from commuter and materials transportation to the site. Transport of personnel and materials results indicate maximum emissions during the operations and monitoring phase (67 percent of the carbon monoxide threshold). Vehicle emissions from transportation of radioactive materials would be, at most, 14 percent of the threshold level for the Valley Modified Corridor. During the construction phase, current estimates of fuel use for construction vehicles would result in exceedances of the General Conformity threshold levels for construction of the Valley Modified Corridor (110 percent of threshold).

Section 6.1.3 discusses air quality impacts from the transportation of personnel and materials. Section 6.3.1 discusses air quality impacts for Nevada legal-weight truck transportation. Sections 6.3.2 and 6.3.3 discuss rail and heavy-haul truck implementing alternatives, respectively.

DOE has conducted a separate conformity review for the Nevada transportation implementing alternatives that could result in the release of pollutants to the Las Vegas air basin, which is in nonattainment for carbon monoxide and PM_{10} (DIRS 101826-FHWA 1996, pp. 3-53 and 3-54). Sections 6.3.1.1, 6.3.2.1, and 6.3.3.1 summarize the results of conformity reviews for legal-weight truck, rail, and heavy-haul truck transportation, respectively, in Nevada.

6.1.2.3 Hydrology

Surface-water resources are most prevalent among the Caliente and Carlin Corridors and could be affected by construction activities. The potential Caliente intermodal transfer station is about 0.19 kilometer (0.12 mile) from a perennial stream, and the Caliente, Caliente/Chalk Mountain, and Caliente/Las Vegas routes for heavy-haul trucks would pass within 1 kilometer (0.6 mile) of water resources. Surface-water impacts during construction would be avoided by implementing good management

practices to prevent and mitigate spills of pollutants and would avoid, minimize, or otherwise mitigate possible changes to stream flows. Therefore, DOE does not anticipate impacts to surface waters from the construction of a rail or heavy-haul truck implementing alternative. In addition, surface-water impacts would be unlikely from legal-weight truck, rail, or heavy-haul truck operations or the operation of an intermodal transfer station.

Potential for groundwater impacts would be limited. There would be the potential for temporary withdrawals of water from groundwater sources during the construction of a branch rail line or upgrades to highways and construction of an intermodal transfer station. Estimated water use would be greater for construction of branch rail lines than for upgrades for routes for heavy-haul trucks (see Figure 6-4). Such withdrawals would require temporary permits from the State of Nevada or possibly leases of temporary water rights from individuals along the route. If groundwater could not be withdrawn for construction, water would be transported from permitted sources to the construction sites by truck.

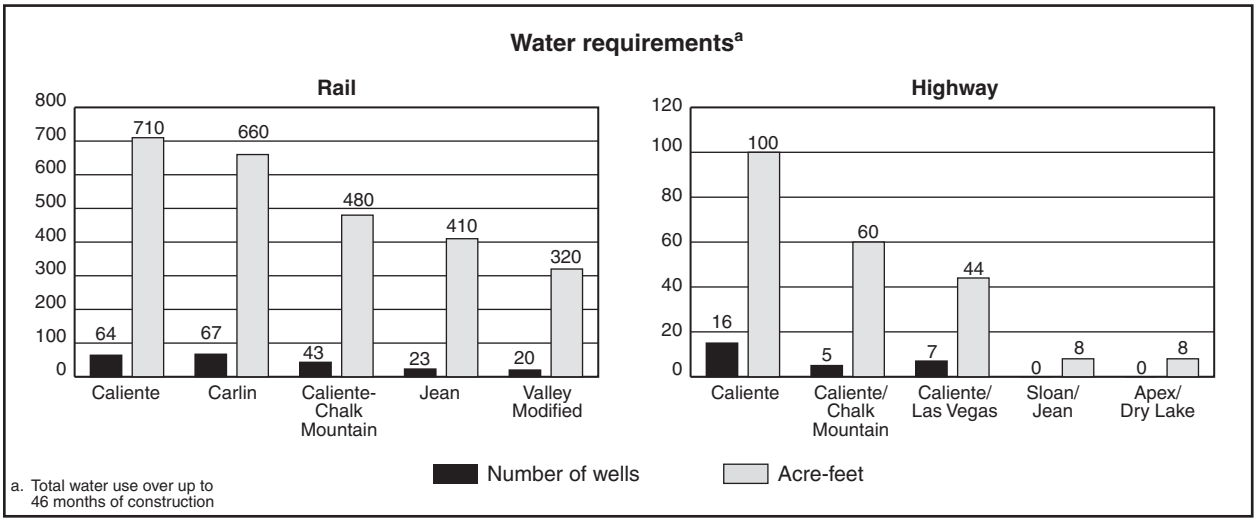

Figure 6-4. Water and number of wells required for construction of branch rail lines and upgrades to Nevada highways for heavy-haul use.

Legal-weight truck shipments, operations of a branch rail line, or operations of heavy-haul trucks, including the operation of an intermodal transfer station, would not affect groundwater resources. Water needs for these operations would be minor, and there would be little potential for contaminant releases to occur, particularly releases of a magnitude that could affect groundwater. Hydrology impacts are discussed for Nevada transportation rail implementing alternatives and for Nevada transportation heavy-haul truck implementing alternatives in Sections 6.3.2 and 6.3.3, respectively.

6.1.2.4 Biological Resources and Soils

Loss of habitat from construction of a branch rail line would be the greatest potential impact to biological resources (vegetation, habitat, threatened and endangered species, small animals, birds, game animals, wild horse and wild burro herds, and soils), potentially affecting the desert tortoise, a threatened species. Loss of desert tortoise habitat would be approximately 2.4 square kilometers (590 acres) for the Caliente/Chalk Mountain route, 3 square kilometers (740 acres) for the Caliente and Carlin routes, 5 square kilometers (1,200 acres) for the Valley Modified route (which is within the range of the desert tortoise along its entire length), and more than 11 square kilometers (2,700 acres) for the Jean route. All of these potential routes have low abundance of desert tortoises with the exception of some limited areas of the Jean route where abundance is higher.

In general, the number of herd management areas crossed by each route is related to the length of the route (as described in Section 3.2.2.1.4). Therefore, the potential for impacts to game animals or horses and burros through disruption of movement patterns or from loss of individual animals would be greater for the longer routes. The Valley Modified route does not cross any herd management areas, but passes through the Desert National Wildlife Range. The Carlin route passes through or near the greatest number of herd management areas or other areas that provide habitat for important biological resources (such as sage grouse strutting grounds). The adverse impact that loss of an individual animal could have on a particular herd would depend on the particular individual that was lost and the size of the herd. Small herds could be affected to a greater degree than large herds. Noise from passing trains could disturb game animals, horses, or burros until those animals became acclimated to the presence of the trains. DOE anticipates that two trains could pass by each day, so this disruption should be minimal.

Other features of the particular routes could affect the potential for impacts to biological resources along each route. Fencing along portions of a route could affect the number of individual animals lost because animals could be blocked from escape routes in fenced areas. Tunnels along the Jean route could be used by wildlife for shelter. Animals seeking shelter in a tunnel might not be able to escape if a train passed through while they were in the tunnel.

The potential for impacts from upgrading Nevada highways for heavy-haul truck use would be small because modifications to roads would occur in previously disturbed rights-of-way. An intermodal transfer station constructed in association with a heavy-haul truck implementing alternative would potentially disturb only about 0.2 square kilometer (50 acres) of potential desert tortoise habitat. The activities associated with constructing a branch rail line, building an intermodal transfer station, or upgrading and maintaining a heavy-haul truck route to Yucca Mountain would be likely to adversely affect a few individual desert tortoises. However, based on review of past experience and available information, DOE believes it could mitigate the impacts of these activities such that they would not negatively affect regional populations of desert tortoises, jeopardize the continued existence of the species, or result in adverse modification of designated critical habitat. Individuals of other special status species could be affected based on the route chosen. Impacts from operations, with the exception of infrequent wildlife kills by vehicles, would be unlikely. Although the proposed routes for heavy-haul trucks pass near or through herd management areas and other areas containing sensitive biological resources, adverse impacts to those resources would be small because the heavy-haul trucks would use existing roads and would represent a very small percentage of the traffic along those roads. [See DIRS 156930-NDOT (2001, all) for traffic counts along Nevada highways.] As with heavy-haul trucks, legal-weight truck shipments that used existing highways would cause only very small impacts to biological resources.

For highway upgrades, DOE or the State of Nevada would reduce concerns about soil contamination or erosion by incorporating appropriate mitigation measures during construction. These measures would include the proper control of hazardous materials and use of dust suppression and other control techniques to reduce erosion. As a result, the implementing alternatives for transportation in Nevada would be unlikely to have impacts on soil. Impacts to biological resources and soils are discussed for Nevada transportation rail implementing alternatives and for Nevada transportation heavy-haul truck implementing alternatives in Sections 6.3.2 and 6.3.3, respectively.

6.1.2.5 Cultural Resources

A comprehensive review of existing literature and many discussions with responsible Federal and State of Nevada agencies and Native American groups has identified many archaeological and cultural sites and features. Pertinent information is presented in Chapter 3, Sections 3.1.6, 3.2.2.1.5, and 3.2.2.2.5. Much of the information has been confirmed and additional information acquired during field observations.

Based on this extensive review of available information and recent field observations, the construction and operation of a branch rail line in any of the candidate corridors could present the potential for direct or indirect impacts (such as crushing or disturbing of sites; soil erosion exposing or covering sites) to archaeological and historic resources, including those related to Native American culture. None of the five rail corridors passes through presently established reservation lands, but the Bonnie Claire Alternate (for either the Carlin or Caliente Corridor) passes directly through the recently established Timbisha Shoshone Trust Lands at Scottys Junction. In some cases, proposed corridors cross historic linear sites (such as the Pony Express Trail) (see Chapter 3, Section 3.2.2.1.5). In these cases potential impacts could be identified during field studies that would evaluate the current condition of the resources at particular locales, the overall character of the impacts, and the effort required to mitigate the impacts. If a rail corridor was selected, DOE would conduct additional archaeological surveys and ethnographic studies as part of additional National Environmental Policy Act reviews to determine potential impacts of alternative alignments within a corridor.

The determination of the potential for impacts to archaeological resources and Native American cultural values from the upgrading and use of existing Nevada highways for heavy-haul truck shipments could require study. Although the widening of roadways and development of turnouts would occur within existing rights-of-way, disturbance of cultural resources near the roadway and, in some cases, within existing rights-of-way could occur. The American Indian Writers Subgroup has commented that ethnographic field studies will be needed to determine specific potential impacts to Native American cultural properties and values for candidate rail corridors (DIRS 102043-AIWS 1998, p. 4-6).

6.1.2.6 Occupational and Public Health and Safety

Impacts to occupational and public health and safety include industrial safety impacts to workers from construction and operations, radiological impacts to workers and the general public from external radiation exposure and exposure to vehicle emissions during normal operations and incident-free transportation, radiological impacts from transportation accident scenarios, radiological impacts from hypothetical severe accident scenarios that would breach shipping casks, and impacts from traffic accidents.

Potential industrial safety impacts to workers from construction and operations are listed in Table 6-3. Estimated impacts from industrial accidents would be higher for rail than for heavy-haul trucks, but in all cases there would be less than 1 industrial safety-related fatality during construction for any of the five branch rail line or five heavy-haul truck implementing alternatives. No industrial safety-related fatalities would be expected to occur during operations.

Table 6-3. Industrial safety impacts to workers from construction and operation of Nevada transportation implementing alternatives.[a]

	Branch rail line				
Impact	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified
Total recordable cases	220	210	180	150	110
Lost workday cases	110	110	95	76	58
Fatalities (industrial accidents)	0.4	0.4	0.4	0.3	0.2
	Heavy-haul truck[b]				
	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake
Total recordable cases	370	320	330	210	210
Lost workday cases	190	170	180	110	110
Fatalities (industrial accidents)	0.9	0.8	0.8	0.5	0.5

a. Impacts are totals for 24 years of operations. There are no impacts for the legal-weight truck scenario.
b. Includes impacts to workers at an intermodal transfer station.

Potential radiological impacts and vehicle emissions-related impacts from normal operations and incident-free transportation in Nevada for each of the rail and heavy-haul truck implementing alternatives and for the mostly legal-weight truck scenario are presented in Table 6-4. Radiological impacts to members of the public from external radiation exposure and risks from exposure to vehicle emissions during incident-free transportation would be lowest for rail, intermediate for heavy-haul trucks, and highest for legal-weight truck transportation, where an estimated 0.3 latent cancer fatalities could occur over 24 years. Impacts from vehicle emissions would be low in all cases (0.001 or fewer fatalities).

Table 6-4. Worker and public health and safety impacts from Nevada transportation implementing alternatives.[a]

Impact	Legal-weight truck[b]	Branch rail line: Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified
Workers						
Maximally exposed individual probability of LCF[c]	0.02	0.02	0.02	0.02	0.02	0.02
Worker population LCFs	0.75	0.34	0.39	0.3	0.3	0.28
Public						
Maximally exposed individual probability of LCF	0.0016	0.00015	0.00015	0.00015	0.00015	0.00015
General population LCFs	0.17	0.009	0.019	0.009	0.08	0.013
Vehicle emissions-related health effects (fatalities)	0.09	0.25	0.25	0.2	0.23	0.13
Accident risk[d]						
Population LCFs	0.000026	0.000001	0.000001	0.000001	0.000004	0.000001
Maximum reasonably foreseeable accident scenario						
Population LCFs	0.5	5	5	5	5	5
Maximally exposed individual probability of LCF	0.0015	0.02	0.02	0.02	0.02	0.02
Traffic accident fatalities	0.49	1.93	1.85	1.57	1.27	0.94

Impact	Heavy-haul truck[b]: Caliente	Caliente-Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake
Workers					
Maximally exposed individual probability of LCF[c]	0.02	0.02	0.02	0.02	0.02
Worker population LCFs	0.76	0.61	0.66	0.59	0.57
Public					
Maximally exposed individual probability of LCF	0.00016	0.00016	0.00016	0.00016	0.00016
General population LCFs	0.04	0.03	0.11	0.17	0.08
Vehicle emissions-related health effects (fatalities)	0.47	0.32	0.46	0.42	0.29
Accident risk[d]					
Population LCFs	0.000005	0.000001	0.000028	0.00006	0.000028
Maximum reasonably foreseeable accident scenario					
Population LCFs	5	5	5	5	5
Maximally exposed individual probability of LCF	0.02	0.02	0.02	0.02	0.02
Traffic accident fatalities	4.1	2.76	3.47	1.98	1.93

a. Impacts are totals for 24 years of operations.
b. Includes impacts to workers at an intermodal transfer station.
c. LCF = latent cancer fatality.
d. In this table, radiological accident dose risk is the sum of the products of the probabilities (dimensionless) and consequences (in person-rem) of all potential transportation accidents. This sum is converted to latent cancer fatalities using the conversion factor of 0.0005 latent cancer fatality per person-rem.

The overall radiological accident risk from all accidents over the 24 years of transportation activities in Nevada would be no higher than about 0.003 latent cancer fatality in the potentially exposed population within 80 kilometers (50 miles). Accident risk would be highest for the heavy-haul implementing alternatives and lower for the mostly legal-weight truck scenario and rail implementing alternatives. The Jean rail and Sloan/Jean heavy-haul truck implementing alternatives would have higher accident risks than other implementing alternatives. The estimated accident risks are presented in Table 6-4.

The Nuclear Regulatory Commission published a draft Addendum 1 (DIRS 148185-NRC 1999, all) to NUREG-1437, Volume 1, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (DIRS 101899-NRC 1996, all) to provide a technical basis to amend Commission regulations with the objective of improving the efficiency of renewing nuclear plant operating licenses well-understood

environmental impacts to avoid repetitive reviews. The addendum addresses two aspects of spent nuclear fuel transportation that the original Commission analysis did not address—the cumulative impacts of transportation of commercial spent nuclear fuel in the vicinity of the proposed repository at Yucca Mountain, and the impacts of transporting higher-burnup fuel. The results of this DOE EIS analysis appear to be consistent with the Nuclear Regulatory Commission conclusion in the addendum, which is that "radiological and accident risks of SNF [spent nuclear fuel] transport in the vicinity of Las Vegas are within regulatory limits and small."

6.1.2.7 Socioeconomics

Socioeconomic impacts of transportation (changes in the level of employment, population, real disposable income, Gross Regional Product, and State of Nevada and local government expenditures) would occur from the construction and operation of a branch rail line, from upgrading a heavy-haul truck route, from transporting large shipping casks using heavy-haul trucks, and from constructing and operating an intermodal transfer station. Figures 6-5 through 6-8 show total regional employment changes in the peak year of construction, and average total employment in the region of influence from operations activities. Because of the large population and employment in the socioeconomic region of influence (principally in Clark County), impacts from construction activities would generally be less than 3 percent of the baseline for each socioeconomic measure in all three counties in the region of influence, for the rail or heavy-haul truck implementing alternatives. Changes in Lincoln County (the two rail corridors and three routes for heavy-haul trucks originating in Caliente) would be more visible, but still generally less than 3 percent of the applicable baseline and would not be greater than historic short-term socioeconomic changes in the county over the past two decades. The operational period for either a branch rail line or a heavy-haul truck route probably would generate relatively constant employment levels. Changes to the baseline regional populations and employment from construction or operation of a rail or heavy-haul truck implementing alternative would be unlikely to have consequences greater than 3 percent of the population baseline. DOE anticipates that the changes in the economic measures of Gross Regional Product, real disposable income, and State of Nevada and local government expenditures would be less than 3 percent of the baselines in each county. Changes in employment and subsequent changes in population would be the principal cause of the changes in these measures. Figures 6-5 through 6-8 show the changes in employment and population expected during construction and operations if DOE implemented one of the five rail or five heavy-haul truck implementing alternatives.

DOE performed detailed analyses for the corridors of the five branch rail line implementing alternatives and the five heavy-haul truck implementing alternatives. The results of these analyses, which are driven by the length of the rail corridors or the cost of construction and upgrades for the proposed routes for heavy-haul trucks, are representative of the variations (options and alternates) of each corridor listed in Appendix J, Section J.3.1.2. The lengths of the variations for each corridor are similar, as listed in Section 6.3.2.2.

In light of public comments received on the Draft EIS concerning perception-based and stigma-related impacts, DOE examined relevant studies and literature on perceived risk and stigmatization of communities to determine whether the state of the science in predicting future behavior based on perceptions had advanced sufficiently since scoping to allow DOE to quantify the impact of public risk perception on economic development or property values in potentially affected communities. Of particular interest were those scientific and social studies carried out in the past few years that directly relate to either Yucca Mountain or to DOE actions such as the transportation of foreign research reactor spent nuclear fuel. DOE also reevaluated the conclusions of previous literature reviews such as those

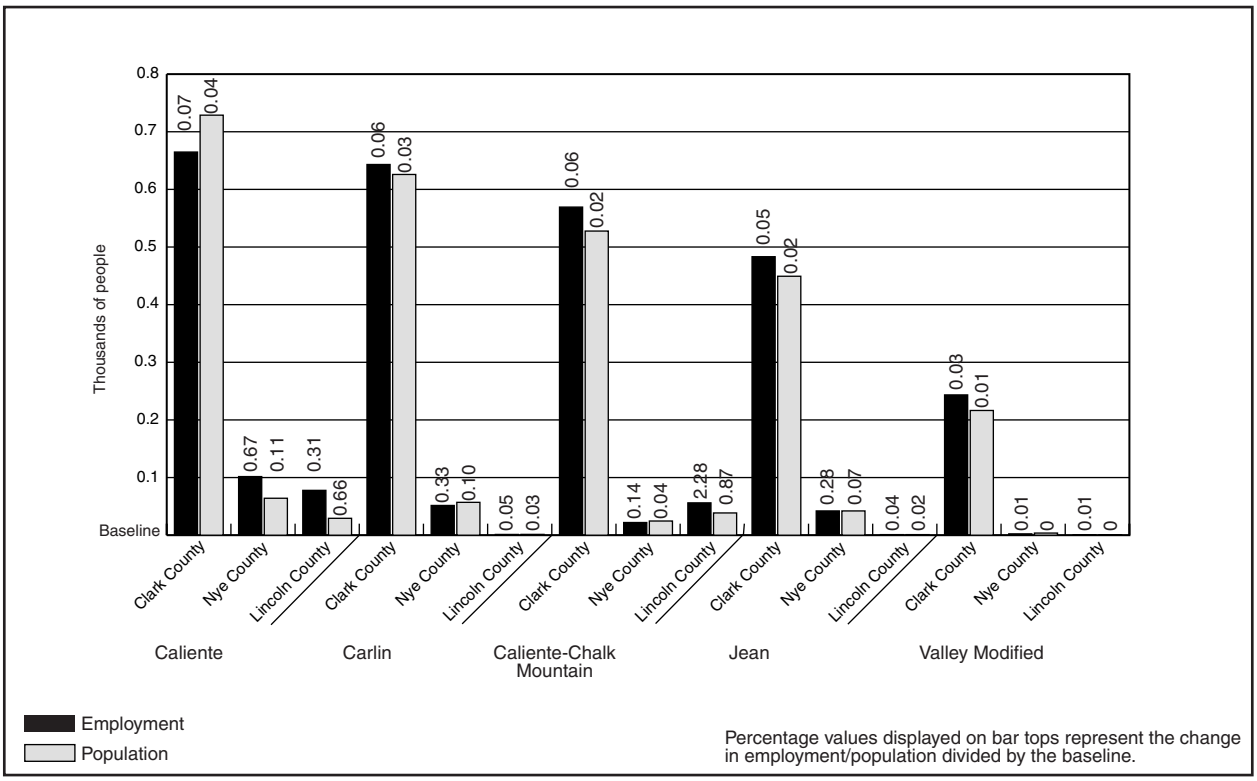

Figure 6-5. Population and employment for branch rail line implementing alternatives, construction (peak years).

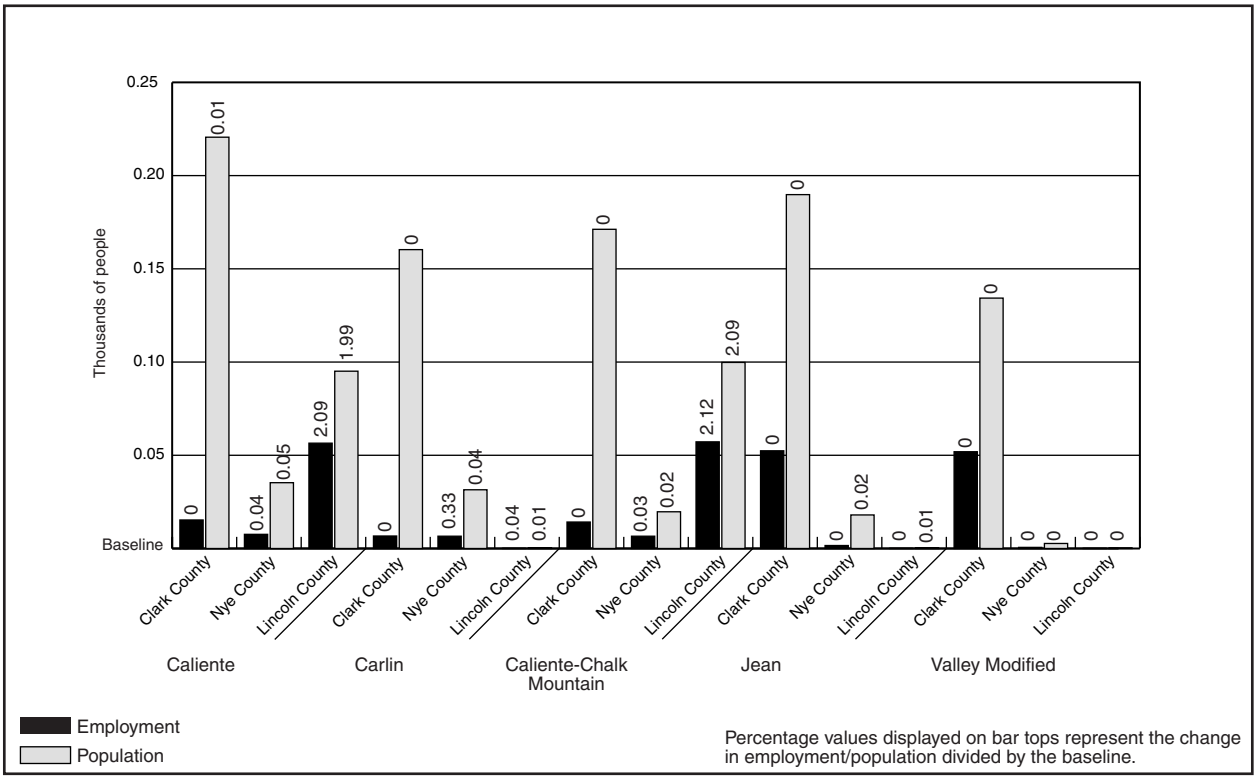

Figure 6-6. Population and employment for branch rail line implementing alternatives, operations (average years).

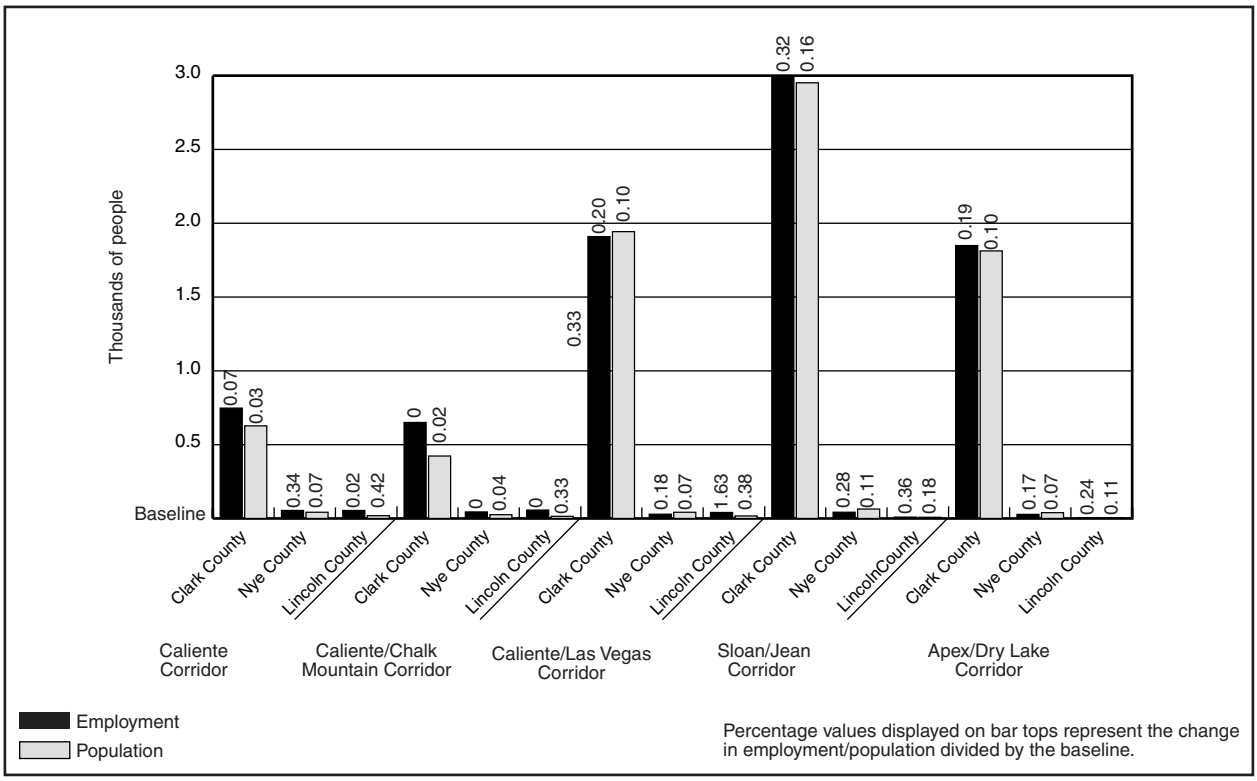

Figure 6-7. Population and employment for heavy-haul implementing alternatives, construction (peak years).

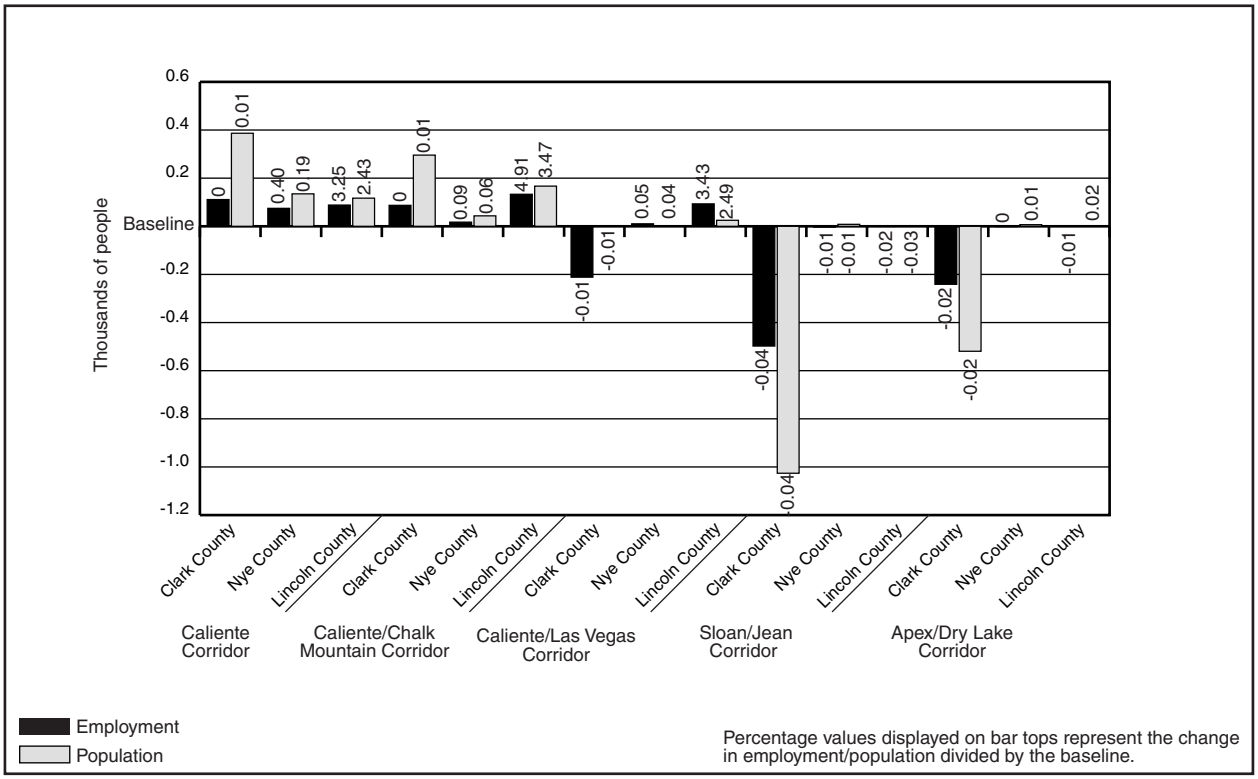

Figure 6-8. Population and employment for heavy-haul implementing alternatives, operations (average years).

conducted by the Nuclear Waste Technical Review Board and the State of Nevada, among others. DOE has concluded that:

- While in some instances risk perceptions could result in adverse impacts on portions of a local economy, there are no reliable methods whereby such impacts could be predicted with any degree of certainty
- Much of the uncertainty is irreducible, and
- Based on a qualitative analysis, adverse impacts from perceptions of risk would be unlikely or relatively small.

While stigmatization of southern Nevada can be envisioned under some scenarios, it is not inevitable or numerically predictable. Any such stigmatization would likely be an aftereffect of unpredictable future events, such as serious accidents, which may not occur. As a consequence, DOE did not attempt to quantify any potential for impacts from risk perceptions or stigma in this Final EIS. Chapter 2, Section 2.5.4 contains further detail.

6.1.2.8 Noise and Vibration

Noise from the construction of a branch rail line or upgrades to highways for heavy-haul trucks would be transient and not excessive. In addition, noise from trains, which would occur during as many as five weekly round trips, would not be excessively disruptive. Heavy-haul truck operations would use existing highways that already have traffic, including semi-trailer trucks. The American Indian Writers Subgroup identified noise from transportation as a concern because of its effects on ceremonies and the solitude necessary for healing and praying (DIRS 102043-AIWS 1998, all).

Construction upgrades of heavy-haul truck routes and construction of branch rail lines would be unlikely to cause vibration damage to historic buildings because of the distance of potentially sensitive buildings from construction sites. Upgrading of roads where they pass through or near communities would have the most potential for noise or vibration to affect buildings or be a nuisance to residents.

Train Operations. Ground vibration from trains using a branch rail line in Nevada to transport spent nuclear fuel and high-level radioactive waste to Yucca Mountain would be well below levels that would contribute to damage to historic buildings or structures.

Because DOE would place the candidate branch rail lines in areas away from communities, and because development and construction and most operations would occur during daylight hours, the potential for noise or vibration impacts from rail line construction and operation is low.

Heavy-Haul Truck Operation. Because they would use air-filled rubber tires with loads distributed to over 100 wheels and would operate on improved roadways having compacted foundation soils, ground vibration from heavy-haul trucks would be much less than that from trains. In addition, DOE assumes that speeds near communities with sensitive historic structures and buildings would be limited for safety, further ensuring that vibration criteria were not exceeded.

6.1.2.9 Aesthetics

Four of the five candidate rail corridors would not have large or lasting aesthetic impacts. The upgrades of existing highways would present short-term aesthetic impacts during construction but these would be temporary and transient, resulting largely from widening the highways. Routes originating in Caliente could cause impacts on the Class II lands of Kershaw Ryan State Park, the entrance of which is on the

east side of the Meadow Valley Wash across from a potential location for an intermodal transfer station. However, the character of this area of the Meadow Valley Wash has been modified by the Union Pacific rail line, the City of Caliente water treatment facility, and agricultural uses of lands in the vicinity. Studies have identified a potential visual resource impact for the northeastern portion of the Jean Corridor that passes through the Spring Mountains. The character of Class II lands (defined in Chapter 3, Section 3.1.10) in that part of the corridor would change, possibly in conflict with visual resource management goals. All routes for heavy-haul trucks and all branch rail lines except Carlin would pass through Class III lands. Aesthetic conditions would not be affected by legal-weight trucks on existing, well-traveled highways.

6.1.2.10 Utilities, Energy, and Materials

Impacts to utility, energy, and material resources from the construction and operation of any of the rail or heavy-haul truck implementing alternatives would be small compared to usage in Nevada. For example, Nevada fossil-fuel consumption during 1996 was about 3.8 billion liters (1 billion gallons) (DIRS 148081-BTS 1999, Table MF-21). By comparison, the largest fossil-fuel use for any of the implementing alternatives would be less than 50 million liters (13 million gallons) over the construction period, or less than 0.5 percent of the Nevada annual use. Similarly, concrete use for the largest implementing alternative would be about 460,000 metric tons (200,000 cubic meters), also less than 2 percent of the Nevada annual use of 7.4 million metric tons (3.2 million cubic meters) (DIRS 104926-Bauhaus 1998, all). Figures 6-9 and 6-10 compare the use of resources for construction of the rail and heavy-haul truck implementing alternatives, respectively.

6.1.2.11 Wastes

Construction and operation of a branch rail line or use of heavy-haul trucks would produce small amounts of construction debris, sanitary solid waste, and sanitary wastewater and possibly a small amount of hazardous waste. Under the heavy-haul truck alternative, a small amount of low-level radioactive waste could be generated at an intermodal transfer station. Nonradioactive wastes would be recovered for recycling, placed in permitted landfills, reused, or in the case of sanitary sewage, treated and disposed of on the site. All waste would be managed in accordance with applicable environmental, occupational safety, and public health and safety requirements to minimize the possibility of adverse impacts to animals, vegetation, air quality, soil, and water resources.

There would be minimal impacts on the capacity of facilities to treat or dispose of wastes from Nevada transportation. For example, branch rail line construction camps with running water would generate about 37 million liters (10 million gallons) of sanitary sewage that could be treated and disposed of in permitted septic systems and about 940 metric tons (1,000 tons) of sanitary solid waste during the peak year of employment. For comparison, the waste volume from Nevada transportation would be small in relation to the volumes disposed of in the State in 2000 [3.5 million metric tons (3.9 million tons) of sanitary solid waste] (DIRS 155565-NDEP 2001, Section 2.1), so the rail construction camps would add about 0.027 percent. The estimated construction debris from an intermodal transfer station would be 23 metric tons (26 tons). Approximately 750,000 metric tons (820,000 tons) of construction debris was disposed of in Nevada in 2000 (DIRS 155565-NDEP 2001, Section 2.1), so the construction of an intermodal transfer station would add less than approximately 0.01 percent to the total. About 1,400 kilograms (3,000 pounds) of tires and drained oil filters (industrial and special wastes) would be generated during truck maintenance activities at an intermodal transfer station. About 83,000 metric tons (91,000 tons) of this type of waste was disposed of in Nevada in 2000 (DIRS 155565-NDEP 2001, Section 2.1), so the truck maintenance waste would add less than about 0.01 percent. Hazardous and low-level radioactive waste would have a small impact on the ability of facilities to treat and dispose of the waste. According to the Environmental Protection Agency, treatment and disposal capacity in the western states for hazardous waste would be above the expected demand (by 7 times for incineration and

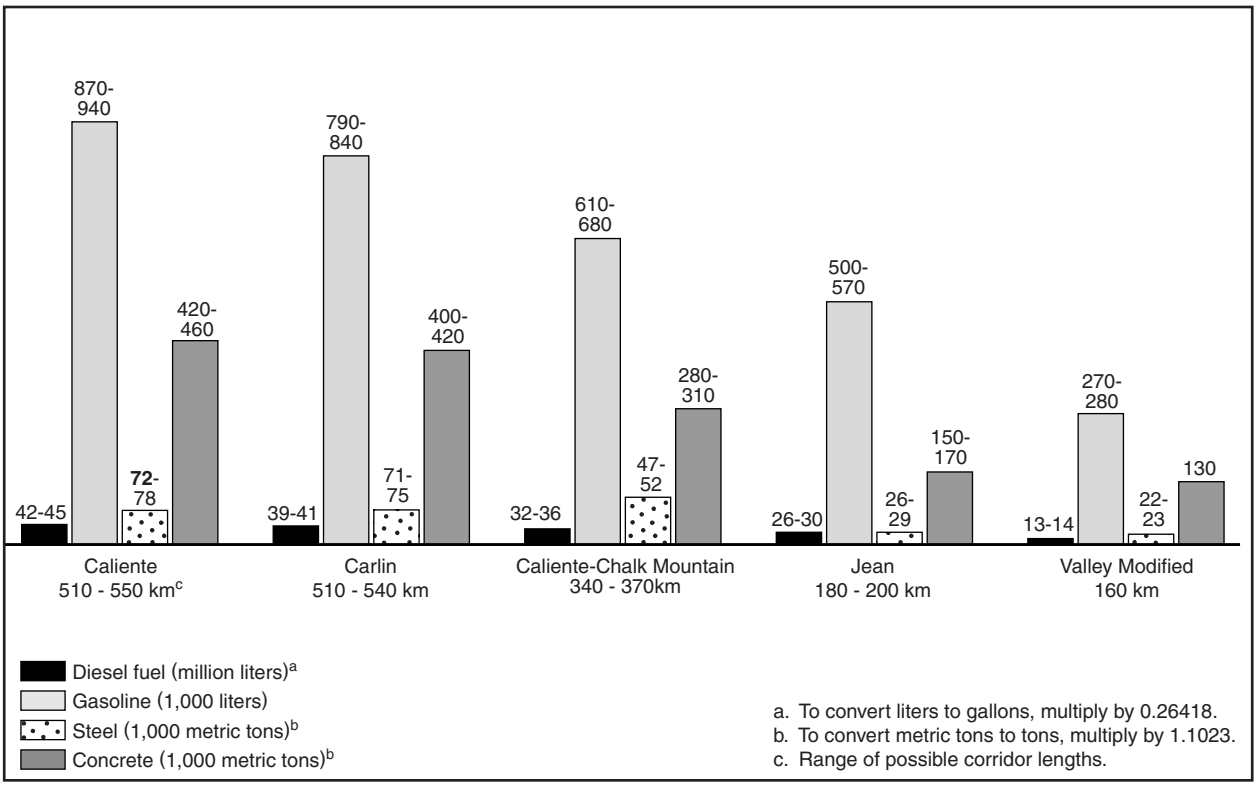

Figure 6-9. Utility, energy, and material use for construction of a branch rail line in Nevada.

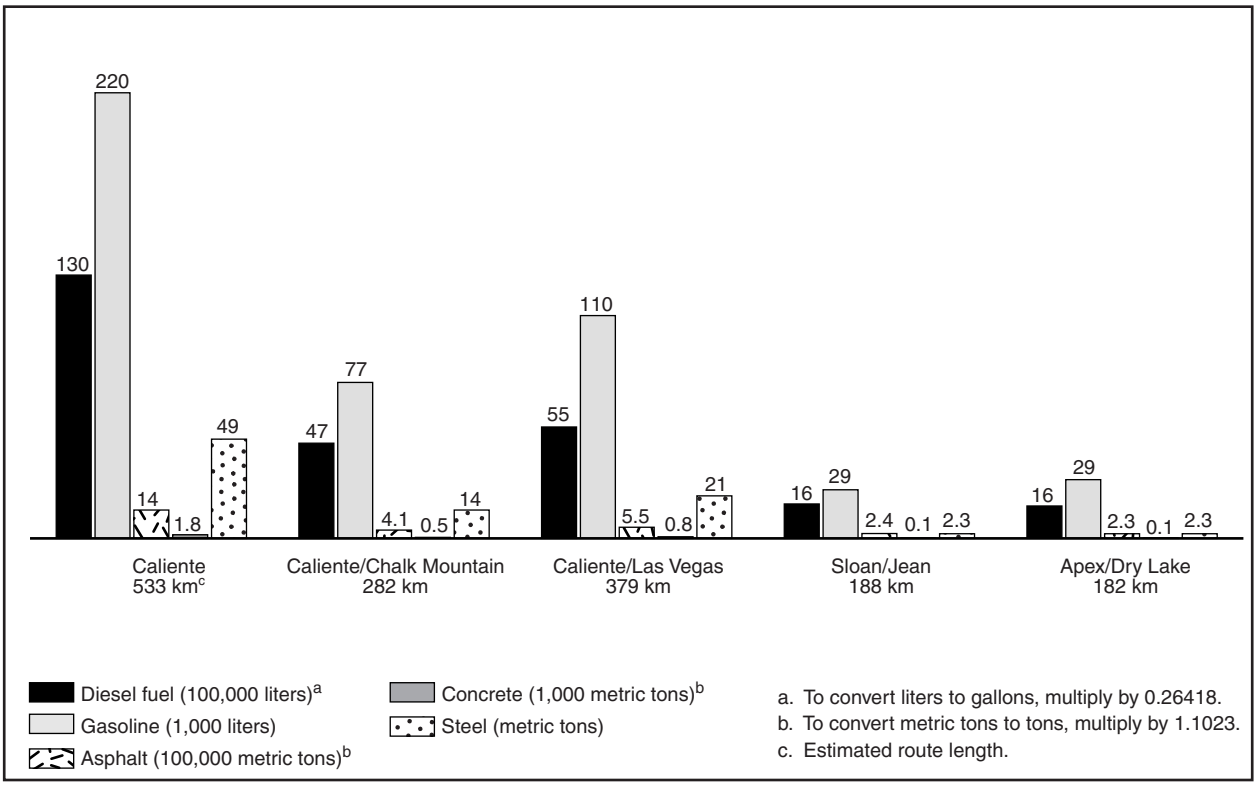

Figure 6-10. Utility, energy, and material use for upgrading of Nevada highways for heavy-haul truck use.

50 times for landfill) until 2013 (DIRS 103245-EPA 1996, pp. 32, 33, 36, 46, 47, and 50). Disposal capacity for a broad range of low-level radioactive wastes would be available at two currently licensed facilities (DIRS 152583-NRC 2000, section on U.S. Low-level Radioactive Waste Disposal).

6.1.2.12 Environmental Justice

Section 6.3 discusses the methods used in the analysis of potential environmental justice concerns. No potentially disproportionately high and adverse impacts to minority or low-income populations were identified in areas of land use; air quality; hydrology; biological resources and soils; socioeconomics; aesthetics; and occupational and public health and safety for construction or operations under the mostly legal-weight truck scenario in Nevada or any of the 10 rail and heavy-haul truck transportation implementing alternatives. Potential visual resource (aesthetic) impacts were identified for the Jean Corridor but these were not determined to be disproportionate. However, no potentially disproportionately high and adverse impacts would occur in these areas for legal-weight truck transportation that would use existing highways. If DOE identified potentially high and adverse impacts for a corridor or route, it would mitigate them (as discussed in Chapter 9).

Because impacts to humans and other impacts that could affect minority or low-income populations or populations of American Indians would not be disproportionately high and adverse, including mitigation as needed, an additional environmental justice analysis is not required. Chapter 4, Section 4.1.13.4, contains an environmental justice discussion of a Native American perspective on the Proposed Action.

6.1.3 TRANSPORTATION OF OTHER MATERIALS AND PERSONNEL

Other types of transportation activities associated with the Proposed Action would involve the transportation of personnel and of materials other than the spent nuclear fuel and high-level radioactive waste discussed above. These other materials include construction materials and consumables for repository construction and operation, including repository components (for example, disposal containers, drip shields, etc.); waste including low-level waste, construction and demolition debris, sanitary and industrial solid waste, and hazardous waste; and office and laboratory supplies, mail, and laboratory samples.

The quantities of construction materials, consumables, site-generated waste, laboratory samples, and supplies, would differ for the range of repository operating modes. The number of commuting employees would also differ. Therefore, the transportation impacts listed in Table 6-5 are ranges, from the least to the greatest impact. Appendix J, Section J.3.6, provides additional detail.

Table 6-5. Impacts related to repository transportation activities.

Factor	Impact
Total kilometers traveled (millions)	610 - 1,100
Total nonradiological latent fatalities[a]	0.9 - 1.6
Total nonradiological traffic fatalities[b]	6.3 - 11.4
Total nonradiological commuting worker traffic fatalities	2.4 - 4.2

a. From commuter and materials transportation.
b. From materials transportation and public fatalities from commuter transportation.

Additional traffic in the Las Vegas air basin would result in emissions of carbon monoxide, most significantly during the repository phases of construction and operation and monitoring. The Las Vegas air basin is in nonattainment status for carbon monoxide, which is largely a result of vehicle emissions (DIRS 156706-Clark County 2000, Appendix A, Table 1-3). As part of the conformity review DOE conducted using the guidance in DIRS 155566-DOE (2000, all), it was determined that the transportation of personnel, materials, and supplies through the Las Vegas air basin would not exceed the carbon monoxide General Conformity threshold level [91 metric tons (100 tons) per year; 40 CFR 93.153] for serious nonattainment status. The highest total emissions for personnel, materials, and

supplies would be 50 tons per year during the construction phase and 67 tons per year during the operations and monitoring phase; emissions would contribute a maximum of an additional 0.07 percent to the estimated 2000 daily carbon-monoxide levels in the nonattainment area (DIRS 156706-Clark County 2000, Appendix A, Table 1-3).

Impacts in other environmental resource areas would be unlikely to occur.

6.2 National Transportation

This section describes the estimated national transportation impacts from shipping spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites throughout the United States to the proposed Yucca Mountain Repository. This section includes the following:

- Definition and an overview of the analysis scenarios (Section 6.2.1)
- Impacts to workers and the public from spent nuclear fuel and high-level radioactive waste loading operations at commercial and DOE sites (Section 6.2.2)
- Potential incident-free (routine) radiological impacts and vehicle emission impacts (Section 6.2.3)
- Potential accident scenario impacts (Section 6.2.4).

National transportation of spent nuclear fuel and high-level radioactive waste, which would use existing highways and railroads, would average 7.8 million truck kilometers (4.9 million miles) per year for the mostly truck case and 1.6 million railcar kilometers (1 million miles) per year for the mostly rail case. Barges used to ship rail casks to nearby railheads from commercial sites not served by a railroad could average as much as 6,500 kilometers (4,000 miles) per year. The national yearly average for total highway and railroad traffic is 186 billion truck kilometers (116 billion miles) and 49 billion railcar kilometers (30 billion miles) (DIRS 150989-BTS 1998, pp. 5 and 6)]. Spent nuclear fuel and high-level radioactive waste transportation would represent a very small fraction of the total national highway and railroad traffic (0.004 percent of truck kilometers and 0.003 percent of railcar kilometers). Domestic waterborne trade in 1995 accounted for about 1 billion metric tons (910 million tons) (DIRS 148158-MARAD 1998, all). This represents about 1 million barge shipments per year. Thus, shipments of spent nuclear fuel by barge would only be a very small fraction of the total annual domestic waterborne commerce.

With the exception of occupational and public health and safety impacts, which are evaluated in this section, the environmental impacts of this small fraction of all national transportation would be very small in comparison to the impacts of other nationwide transportation activities. Thus, the national transportation of spent nuclear fuel and high-level radioactive waste would have very small impacts on land use and ownership; hydrology; biological resources and soils; cultural resources; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; or waste management.

To determine if pollutants of concern from national transportation vehicles (truck and rail) would degrade air quality in nonattainment areas, DOE reviewed traffic volumes in these areas. This review determined that the numbers of shipments of Yucca Mountain-destined vehicles through these areas would be very small in relation to normal traffic volumes. Therefore, the impact to air quality in these areas, except Nevada (see Section 6.1.3), would be very small.

Radiological impacts of accidents on biological resources would be extremely unlikely. The analysis focused the impacts from accidents on human health and safety. A severe accident scenario, such as the