

4.1.4 Biological Resources

SEIS-I (DOE 1990) describes the WIPP site area as characterized by sand dunes. Further, it describes the vegetation as dominated by shinnery oak (*Quercus havardii*), mesquite (*Prosopis grandulosa*), sand sage (*Artemisia filifolia*), dune yucca (*Yucca campestris*), smallhead snakeweed (*Gutierrezia microcephala*), three-awn (*Aristida* spp.), and numerous species of forbs and perennial grasses. The most conspicuous mammals at the site are the black-tailed jack rabbit (*Lepus californicus*) and the desert cottontail (*Sylvilagus auduboni*); other common small mammals include Ord's kangaroo rat (*Dipodomys ordii*), plains pocket mouse (*Perognathus flavescens*), and northern grasshopper mouse (*Onychomys leucogaster*). Large mammals include mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and coyote (*Canis latrans*). Loggerhead shrike (*Lanius ludovicianus*), Pyrrhuloxia (*Cardinalis sinuata*), and black-throated sparrow (*Amphispiza bilineata*) are common resident birds. The Harris hawk (*Parabuteo unicinctus*) is a resident raptor. Aquatic habitats near WIPP, which include stock watering ponds and tanks, may be frequented by yellow mud turtles (*Kinosternon flarescens*) and tiger salamanders (*Ambystoma tigrinum*) (DOE 1992, 1993b, 1994a, 1995d).

Since SEIS-I, ecological monitoring at WIPP has continued. Changes noted in vegetation distribution include an increase in shrub cover and a decrease in grasses such as black grama grass (*Bouteloua eriopoda*) near the salt tailings (due to the colonization of these habitats by salt-tolerant shrub species). No effects from salt-induced physiological stress were seen on the general vegetation of the area. Changes in cover and density during the last few years have been attributed to variations in annual rainfall (DOE 1993b, 1994a, and 1995d).

Wildlife monitoring has indicated increases in some species of birds at the site. This is primarily due to changes in surface conditions such as water availability (DOE 1992) and to increases in oilfield activities in areas surrounding the site which may have disturbed some populations and caused their relocation within the site (DOE 1994a). Surveys taken from 1984 through 1993 have documented 98 species of birds which inhabit or migrate through the area (DOE 1994a).

Mammal populations have fluctuated as a result of changes in natural conditions such as rainfall, temperature, and disease. No differences in mammal population numbers have occurred as a result of WIPP activities (DOE 1995d).

In consultation with the USFWS, the Department concluded in SEIS-I that the following threatened or endangered species occur or have the potential to occur on lands within or outlying the WIPP site: Lee's pincushion cactus (*Coryphantha sneedi* var. *leei*), American peregrine falcon, bald eagle (*Haliaeetus leucocephalus*), and Pecos gambusia (*Notropis simus pecosensis*). DOE stated that it believed the actions described in SEIS-I would have no impacts on any threatened or endangered species because those activities did

CHANGES IN RARE, THREATENED, AND ENDANGERED SPECIES

The threatened, endangered, and candidate species present in Eddy County, New Mexico, have changed since SEIS-I. In 1995, DOE consulted with the U.S. Fish and Wildlife Service (USFWS), the New Mexico Department of Game and Fish (NMDG&F), and the New Mexico Energy, Minerals and Natural Resources Department (NMEMNR) regarding the presence of federally threatened, endangered, and proposed species, state-listed rare and endangered animals, and state-listed rare and endangered plant species, respectively, in Eddy County, New Mexico. Since SEIS-I, more than 60 new state and federal species have been added to these county-wide lists, although no new species have been found at the WIPP site.

not involve any ground disturbance that was not already evaluated in the FEIS (DOE 1980). NMDG&F agreed with the Department that the anticipated WIPP activities would probably not have appreciable impacts on state-listed endangered species in the area. The Department concluded in SEIS-I that there is no critical habitat for terrestrial species identified as endangered by either the USFWS or the NMDG&F at the site (DOE 1990).

In September 1995, DOE contacted the USFWS to determine the occurrence of threatened, endangered, and proposed species at WIPP. The USFWS listed eight endangered, six threatened, and 37 proposed species for Eddy County, New Mexico (USFWS 1995) (see [Table 4-1](#)). At that time, DOE also contacted the NMDG&F and NMEMNR regarding the occurrence of state-listed rare, threatened, and endangered plant and animal species in Eddy County. The NMDG&F currently lists 22 threatened and 7 endangered animal species (NMDG&F 1995), and the NMEMNR lists 7 state-endangered and 17 state-sensitive plant species (Sivinski and Lightfoot 1995) (see [Table 4-1](#)). There is no designated critical habitat for such species at the WIPP site (NMDG&F 1995, USFWS 1995).

In 1996, DOE conducted another survey on the WIPP Land Withdrawal Area and associated lands to investigate the potential for impact to rare, threatened, endangered, or sensitive plant or animal species as a result of the potential actions presented in SEIS-II. The 1996 survey included an assessment of suitable habitats for these species. No threatened, endangered, or state-listed species were found on the WIPP Land Withdrawal Area during the survey. The data reported in the survey, which support the conclusions of other studies, suggest that dense and permanent populations of these species are not presently established on WIPP lands.

4.1.5 Cultural Resources

This section provides a brief evaluation of recent activities concerning the prehistoric and historic cultural resources at WIPP. FEIS (DOE 1980) summarized background discussions and data, followed by an update in SEIS-I (DOE 1990). More recent summaries of the WIPP cultural resources information are found in the *Waste Isolation Pilot Plant Land Management Plan* (DOE 1993a) and the *Waste Isolation Pilot Plant Site Environmental Report for Calendar Year 1994* (DOE 1995d).

Cultural resources investigations at WIPP began in 1976 and have continued to the present. A review of the bibliography of existent WIPP cultural resources reports indicates that at least 24 separate investigations have been conducted. SEIS-I summarized two archeological investigations that provide further insight into the life of the hunter-gatherers who occupied the area of the WIPP site.

CHANGES IN CULTURAL RESOURCES MANAGEMENT

Memorandum of Understanding - In 1994, a memorandum of understanding between DOE and the Department of the Interior transferred management responsibility for cultural resources in the Land Withdrawal Area to DOE.

The first investigation excavated three sites that had been identified in FEIS that were in areas which could have been disturbed during construction activities. Two of the sites were plant-collecting and processing sites, and one was a base camp used between 1,000 B.C. and 1,400 A.D. The second investigation covered Control Zones III and IV and areas identified for

Table 4-1
Species of Special Concern in Eddy and Lea Counties, New Mexico ^a

Name	FE ^b	FT ^c	FC ^d	SE ^e	ST ^f	SR ^g
Mammals						
Arizona black-tailed prairie dog (<i>Cynomys ludovicianus arizonensis</i>)			X			
Big free-tailed bat (<i>Nyctinomops macrotis</i>)			X			
Black-footed ferret (<i>Mustela nigripes</i>)	X					
Cave myotis (<i>Myotis velifer</i>)			X			
Fringed myotis (<i>Myotis thysanodes</i>)			X			
Gray-footed chipmunk (<i>Tamias canipes</i>)			X			
Guadalupe southern pocket gopher (<i>Thomomys umbrinus guadalupensis</i>)			X			
Long-legged myotis (<i>Myotis volans</i>)			X			
Occult little brown bat (<i>Myotis lucifugus occultus</i>)			X			
Pale Townsend's big-eared bat (<i>Plecotus townsendii pallescens</i>)			X			
Pecos river muskrat (<i>Ondatra zibethicus ripensis</i>)			X			
Small-footed myotis (<i>Myotis ciliolabrum</i>)			X			
Swift fox (<i>Vulpes velox</i>)			X			
Yuma myotis (<i>Myotis yumanensis</i>)			X			
Birds						
American peregrine falcon (<i>Falco peregrinus anatum</i>)	X			X		
Arctic peregrine falcon (<i>Falco peregrinus tundrius</i>)		X				
Baird's sparrow (<i>Ammodramus bairdii</i>)			X		X	
Bald eagle (<i>Haliaeetus leucocephalus</i>)		X			X	
Bell's vireo (<i>Vireo bellii arizonae</i>)					X	
Black tern (<i>Chlidonias niger</i>)			X			
Broad-billed hummingbird (<i>Cynanthus latirostris</i>)					X	
Brown pelican (<i>Pelecanus occidentalis</i>)	X			X		
Common ground-dove (<i>Columbina passerina</i>)				X		
Ferruginous hawk (<i>Buteo regalis</i>)			X			
Gray vireo (<i>Vireo vicinior</i>)					X	
Interior least tern (<i>Sterna antillarum</i>)	X			X		
Loggerhead shrike (<i>Lanius ludovicianus</i>)			X			
Mexican spotted owl (<i>Strix occidentalis lucida</i>)		X				
Neotropical cormorant (<i>Phalacrocorax brasilianus</i>)					X	
Northern aplomado falcon (<i>Falco femoralis septentrionalis</i>)	X			X		
Northern goshawk (<i>Accipiter gentilis</i>)			X			
Southwestern willow flycatcher (<i>Empidonax traillii extimus</i>)	X				X	
Varied bunting (<i>Passerina versicolor</i>)					X	
Western burrowing owl (<i>Athene cunicularia hypugea</i>)			X			
White-faced ibis (<i>Plegadis chihi</i>)			X			
Reptiles						
Arid land ribbon snake (<i>Thamnophis proximus</i>)					X	
Blotched water snake (<i>Nerodia erythrogaster</i>)					X	
Dunes sagebrush lizard (<i>Sceloporus arenicolus</i>)			X		X	
Mottled rock rattlesnake (<i>Crotalus lepidus lepidus</i>)					X	
Texas horned lizard (<i>Phrynosoma cornutum</i>)			X			
Western river cooter (<i>Pseudemys gorzugi</i>)					X	

^a Includes federal-endangered, -threatened, and -candidate species, state-endangered and -threatened species, and state-rare and -sensitive species. None of these species have been found during surveys at the WIPP sites. Due to revisions in the lists of endangered and threatened species, only two of the identified federal candidate species (the swift fox and Pecos pupfish) are still listed.

^b FE = federal-endangered species (USFWS 1995)

^c FT = federal-threatened species (USFWS 1995)

^d FC = federal-candidate species (USFWS 1995)

^e SE = state-endangered species (NMDG&F 1995, Sivinski and Lightfoot 1995)

^f ST = state-threatened species (NMDG&F 1995)

^g SR = state-rare and -sensitive species (Sivinski and Lightfoot 1995)

Table 4-1
Species of Special Concern in Eddy and Lea Counties, New Mexico — Continued ^a

Name	FE ^b	FT ^c	FC ^d	SE ^e	ST ^f	SR ^g
Fish						
Bigscale logperch (<i>Percina macrolepidia</i>)					X	
Blue sucker (<i>Cycleptus elongatus</i>)			X	X		
Gray redhorse (<i>Moxostoma congestum</i>)					X	
Greenthroat darter (<i>Etheostoma lepidum</i>)					X	
Headwater catfish (<i>Ictalurus lupus</i>)			X			
Mexican tetra (<i>Astyanax mexicanus</i>)					X	
Pecos bluntnose shiner (<i>Notropis simus pecosensis</i>)		X			X	
Pecos gambusia (<i>Gambusia nobilis</i>)	X				X	
Pecos pupfish (<i>Cyprinodon pecosensis</i>)			X		X	
Plains minnow (<i>Hybognathus placitus</i>)			X			
Rio Grande shiner (<i>Notropis jemezianus</i>)			X			
Invertebrates						
Ovate vertigo (<i>Vertigo ovata</i>)			X		X	
Pecos springsnail (<i>Fontelicella pecosensis</i>)			X		X	
Texas hornshell (<i>Popenaias popei</i>)			X	X		
Plants						
Catchfly gentian (<i>Eustoma exaltatum</i>)						X
Chapline's columbine (<i>Aquilegia chrysantha chaplinei</i>)						X
Desert parsley (<i>Pseudocymopterus longiradiatus</i>)						X
Dune unicorn plant (<i>Proboscidea sabulosa</i>)						X
Few-flowered jewelflower (<i>Streptanthus sparsifloras</i>)			X			X
Gray sibara (<i>Sibara grisea</i>)						X
Guadalupe cliff daisy (<i>Chaetopappa hersheyi</i>)			X			X
Guadalupe mescal bean (<i>Sophora gypsophila guadalupensis</i>)						X
Guadalupe milkwort (<i>Polygala rimulicola rimulicola</i>)						X
Guadalupe penstemon (<i>Penstemon cardinalis regalis</i>)						X
Guadalupe rabbitbrush (<i>Chrysothamnus nauseosus texensis</i>)			X			X
Guadalupe smooth aster (<i>Aster laevis guadalupensis</i>)			X			
Gypsum milkvetch (<i>Astragalus gypsodes</i>)						X
Gypsum wild buckwheat (<i>Erigonum gypsophilum</i>)		X		X		
Hitchcock's mockorange (<i>Philadelphus hitchcockianus</i>)						X
Kuenzler's hedgehog cactus (<i>Echinocereus fendleri kuenzleri</i>)				X		
Lee's pincushion cactus (<i>Coryphantha sneedii leei</i>)		X		X		
Lloyd's hedgehog cactus (<i>Echinocereus lloydii</i>)	X			X		
McKittrick pennyroyal (<i>Hedeoma apiculata</i>)						X
Scheer's pincushion cactus (<i>Coryphantha scheeri scheeri</i>)				X		
Shining coral root (<i>Hexalectris nitida</i>)			X	X		
Texas tobacco root (<i>Valeriana texana</i>)						X
Tharp's bluestar (<i>Amsonia tharpii</i>)			X	X		
Waterfall milkvetch (<i>Astragalus waterfallii</i>)						X
Wright's water-willow (<i>Justicia wrightii</i>)			X			X

^a Includes federal-endangered, -threatened, and -candidate species, state-endangered and -threatened species, and state-rare and -sensitive species. None of these species have been found during surveys at the WIPP sites. Due to revisions in the lists of endangered and threatened species, only two of the identified federal candidate species (the swift fox and Pecos pupfish) are still listed.

^b FE = federal-endangered species (USFWS 1995)

^c FT = federal-threatened species (USFWS 1995)

^d FC = federal-candidate species (USFWS 1995)

^e SE = state-endangered species (NMDG&F 1995, Sivinski and Lightfoot 1995)

^f ST = state-threatened species (NMDG&F 1995)

^g SR = state-rare and -sensitive species (Sivinski and Lightfoot 1995)

possible land exchange. Sites encountered in the second investigation tended to lack evident or intact features. No definitive structures were identified. Of the 40 new sites identified, 14 were considered eligible for inclusion in the National Register of Historic Places (NRHP). The sites that are eligible or potentially eligible for the NRHP were mapped, and DOE activities have avoided disturbance of these sites. As a result of this past work, about 37 percent of the WIPP withdrawal area (1,551 hectares [3,830 acres]) has been inventoried for cultural resources.

To date, 60 archeological sites have been recorded in the withdrawal area, including 91 isolated occurrences (single or few artifacts, or isolated features). Sites and isolates are almost exclusively prehistoric in origin, and only one site with both prehistoric and historic components has been recorded. Based on the inventory data, and assuming environmental homogeneity and a fairly even distribution of archeological sites, DOE estimates that the WIPP site may contain about 99 archeological sites and 153 locations where isolated artifacts may be found (1993a).

There are no known Native American sacred sites or burials in the Land Withdrawal Area. Prior to the passage of the LWA in 1992, BLM managed the cultural resources on WIPP. In 1994, a memorandum of understanding between DOE and the Department of the Interior transferred management responsibility for cultural resources to DOE. Cultural resources are currently managed according to guidelines set forth in the WIPP Land Management Plan (DOE 1993a). DOE and the State of New Mexico have signed a Joint Powers Agreement that includes provisions specifying how DOE will satisfy its obligations regarding cultural resources under Sections 106 and 110 of the National Historic Preservation Act.

4.1.6 Socioeconomic Environment

The socioeconomic ROI for WIPP, as defined in FEIS (DOE 1980) and SEIS-I (DOE 1990), is Eddy and Lea counties in southeast New Mexico.¹ Any major changes in future activities undertaken at the WIPP site would have their most immediate socioeconomic effects in the two-county ROI. Principal centers of economic activity in the ROI include Artesia, Carlsbad, Hobbs, and Lovington. The oil and gas extraction and refining industries anchor the economies in both Eddy and Lea counties. Oil and gas mining services, mineral mining, tourism, and business services are the other significant industries of the ROI. The Carlsbad area also is known as a gateway to the Carlsbad Caverns-Guadalupe Mountains National Park complex. Economic impacts associated with WIPP primarily affect the Carlsbad portion of the ROI. Very few WIPP-related expenditures occur outside of the Carlsbad area, and very few direct WIPP employees reside elsewhere within the ROI. Most of the income spent by WIPP employees for local goods and services is spent in the Carlsbad area.

CHANGES IN SOCIOECONOMICS

Since publication in 1990 of SEIS-I, the following changes have occurred:

- *Census Information* - Demographic characteristics in SEIS-II are based on 1990 U.S. Bureau of the Census information as well as more recent data.
- *Economic Characteristics* - SEIS-II uses economic characteristics involving employment and wages covered by unemployment insurance from 1980 through 1990, based on 1994 information provided by the New Mexico Department of Labor and the University of New Mexico Bureau of Business and Economic Research.

¹ Towns in this ROI include Artesia, Atoka, Black River village, Carlsbad, El Paso Gap, Hope, Lakewood, Loco Hills, Loving, Malaga, Riverside, Seven Rivers, and Whites City in Eddy County. It also includes Caprock, Crossroads, Eunice, Hillburn City, Hobbs, Humble City, Jal, Lovington, Maljamar, McDonald, Monument, Nadine, Oil Center, and Tatum in Lea County.

Previous analyses of the socioeconomic impacts of WIPP on southeastern New Mexico occurred in Fiscal Year (FY) 1982 (Adcock et al. 1983), FY 1987 (Lansford et al. 1988), and most recently FY 1988 (Adcock et al. 1989). Socioeconomic analyses were also conducted for SEIS-I (DOE 1990). Employment and wage characteristics for 1994 are based on information provided by the New Mexico Department of Labor (NMDOL 1995) and the Bureau of Business and Economic Research of the University of New Mexico (BBER 1995). Other social and demographic characteristics reported for 1990 are based on 1990 Census information and more recent data compiled by the U.S. Bureau of the Census (1994). Lansford et al. (1994, 1995, 1996) also provide summary economic data relating to WIPP.

4.1.6.1 Background Characteristics

The construction of WIPP had some notable socioeconomic impacts in the ROI from 1981 through 1986. Subsequently, WIPP has had a relatively smaller impact on the socioeconomic characteristics in the ROI relative to changes from the extraction of oil and natural gas, the major industry of Eddy and Lea counties. This industry experienced a loss of almost one-third of its 1980 work force over the decade, substantially dampening the population growth in the ROI (BBER 1995). Correspondingly, WIPP-related activities tended to have a stabilizing effect on the local economy, particularly in Eddy County.

Table 4-2 shows that in 1990, four years after the major WIPP construction effort, the total population in the ROI was 104,370. This population is comprised of approximately 81.9 percent White, 32.4 percent Hispanic (both White and non-White), and 0.5 percent Native American. The ROI has smaller portions of Hispanic and Native American populations when compared to New Mexico as a whole, where the two groups comprise 38.2 percent and 8.9 percent, respectively. About 56 percent of the total ROI population is between the ages of 18 and 65. Overall, 65.4 percent of the ROI population has completed high school, with 11.2 percent attaining a baccalaureate degree or higher.

The ROI experienced slight advances in personal income in spite of the general downturn in oil and natural gas extraction during the 1980s. The median household and per capita income levels shown in Table 4-3 for the ROI were \$23,305 and \$10,241, respectively. Table 4-3 also shows that 17.4 percent of all families in the ROI were below the national poverty threshold. Poverty thresholds vary by family size and number of related children under 18 years of age. For example, the U.S. Bureau of the Census (1994) defined the national poverty threshold for a family of five persons in 1989 to be \$14,900. New additions to the housing stock during 1990 through 1992 were relatively small across the ROI, while vacancy rates for rental units suggested ample availability of rental housing for under \$350 per month.

4.1.6.2 Role of WIPP in the Economic Base

Table 4-4 lists recent information on local employment and wage earnings for the ROI. During 1994, a total of 38,094 employees earned \$858 million in covered wages (wages covered by unemployment insurance) (NMDOL 1995). The most influential economic sectors in the ROI involved the extractive industries, the trade and service sectors, and government activities.

Given the stability of WIPP funding over the 1990s, the economic base of the ROI has been relatively less sensitive to changes in WIPP activities than to other large-scale enterprises such as the oil and gas industry. Declines in that industry in the 1980s resulted in lower employment and

Table 4-2
1990 Population and Community Characteristics by County in ROI ^a

Characteristic	Eddy	Lea	ROI Total ^b
Total population	48,605	55,765	104,370
Population by Race and Ethnicity			
White (percent)	81.5	82.2	81.9
Black (percent)	1.7	4.7	3.3
Native American (percent)	0.5	0.6	0.5
Asian (percent)	0.4	0.4	0.4
Other or Non-Reporting (percent)	15.9	12.1	13.9
Hispanic ^c (percent)	35.3	29.8	32.4
Population by Age and Education			
Percentage under 18	30.2	33.2	31.8
Percentage 65 and over	15.2	10.6	12.7
Percentage high school	67.3	63.8	65.4
Percentage bachelor degree	10.9	11.5	11.2
Total School Enrollment	13,489	16,457	29,946
College	2,010	2,765	4,775
Elementary or high schools	10,790	12,859	23,649
Community hospitals	2	2	4
Number of beds	156	278	434
Number of physicians	54	40	94

^a ROI as defined for the socioeconomic environment constitutes a two-county aggregation based on 1990 census information.

^b ROI percent totals are calculated on the total class level divided by the total ROI population.

^c Hispanic is an ethnic characterization and consequently persons of Hispanic origin can be of any race.

Source: U.S. Bureau of the Census 1994.

Table 4-3
Income, Poverty, and Housing Characteristics (1989-1992) by County in ROI

Characteristic	Eddy	Lea	ROI Total
Median household income (dollars)	23,418	23,352	23,305
Per capita income (dollars)	10,490	10,025	10,241
Families below poverty line	2,162	2,806	4,968
Percentage of families below poverty line	16.2	18.5	17.4
Persons below poverty line	9,755	12,309	22,064
Percentage of persons below poverty line	20.4	22.4	21.1
Total housing units	20,134	23,333	43,467
Median value of owner-occupied units (dollars)	44,800	39,600	42,200
Median gross rent (dollars)	304	312	308
Vacancy rate	13.2	17.3	15.41
New building permits (1990-1992) as percentage of 1990 housing stock	< 1	< 1	< 1

Source: U.S. Bureau of the Census 1994.

Table 4-4
1994 ROI County Employment and Covered Wages (in Millions of 1994 Dollars)

Sector	Eddy		Lea		ROI Total	
	Employees	Wage	Employees	Wage	Employees	Wage
Agriculture	513	6.9	232	3.0	745	9.9
Mining	2,985	103.1	4,297	132.4	7,282	235.5
Construction	1,006	19.0	1,188	24.6	2,194	43.6
Manufacturing	921	31.0	529	9.8	1,450	40.8
Transportation and Utilities	1,628	52.2	1,487	51.7	3,115	103.9
Trade	3,798	51.4	4,891	77.9	8,689	129.3
F.I.R.E. ^a	614	13.7	529	12.1	1,143	25.8
Services ^b	3,753	62.9	3,668	65.9	7,421	128.8
Government						
Federal	425	15.7	123	4.2	548	19.9
State	420	8.9	238	5.6	658	14.5
Local	2,162	49.2	2,687	56.8	4,849	106
Totals	18,225	414	19,869	444	38,094	858
Unemployed percent	6.8		5.5		6.1	

^a Finance, Insurance, and Real Estate

^b The New Mexico Department of Labor classifies WIPP employees under the service sector industry, SIC 87.

Source: NMDOL 1995 and U.S. Bureau of the Census 1994.

wage earnings, while upturns in the 1990s have resulted in higher employment and wage earnings. Future growth and diversification of the economic base in the ROI would tend to diminish the economic impact of future changes in WIPP activities. WIPP, however, continues to play a role in the economic diversification of the Carlsbad economy, and several private ventures related to WIPP science and technology have started operations in Carlsbad. Depending on the extent to which they are reliant on the WIPP budget for their revenue, such businesses will be directly affected by alternatives considered in SEIS-II. Therefore, the more independent of WIPP these businesses become, the less they will be affected by federal actions at WIPP.

The direct economic impact of the anticipated WIPP operations reflects the levels of wage and salary payments to WIPP employees and the size of business and government procurement associated with WIPP construction and operations activities. At the time of the FY 1988 study, \$24.3 million was paid in direct WIPP wages and salaries to 661 site personnel, while nonsalary expenditures were estimated to be \$95.3 million (Adcock et al. 1989). By 1994, WIPP-related employment and annual wages had risen to 1,005 jobs and \$44.56 million, respectively. This accounted for 2.6 percent of the total employment and approximately 5.2 percent of covered wage earnings in Eddy and Lea counties in 1994 (Landsford et al. 1995). In 1995, WIPP-related employment and covered wages dropped slightly to 952 jobs and annual wages of approximately \$43.48 million (Landsford et al. 1996).

Nonsalary expenditures are mainly for regional support services, materials, capital equipment, and construction. However, WIPP outlays are also used to pay for business and government expenditures, including grants, community assistance, and out of region expenditures made through or by the local WIPP project office (DOE 1990).

The indirect economic impact of the anticipated WIPP operations is reflected by the subsequent spending and creation of new jobs that follow initial WIPP outlays in any given year. To assess the economic impacts of changes in the funding at the WIPP site, Adcock et al. (1989) estimated an economic activity multiplier value of 2.19 for FY 1988. That is, for every \$1.00 spent by WIPP on materials, labor, benefits, equipment and services, another \$1.19 worth of goods and services was generated in the ROI for a total impact of \$2.19.

Relative to the \$24.3 million of direct salaries and wages paid in FY 1988, an estimated additional \$26.2 million of indirect wages and salaries were paid in the ROI in FY 1988 in support of 1,153 indirect jobs (Lansford et al. 1988). Meanwhile, the direct nonsalary expenditures of \$95.3 million were estimated to generate an additional \$113.6 million of indirect nonsalary expenditures in the local economy.

4.1.6.3 Environmental Justice

Environmental justice in the context of this document refers specifically to the potential for minority and low-income populations to bear a disproportionate share of high and adverse environmental impacts from activities at WIPP under the various SEIS-II alternatives. The environmental justice ROI covers all populations within an 80-kilometer (50-mile) radius of the reservation boundary of WIPP.¹ This region includes parts of three counties in New Mexico (Chaves, Eddy, and Lea) and parts of seven counties in Texas (Andrews, Culberson, Gaines, Loving, Reeves, Ward, and Winkler). Seventy-five percent of the ROI lies within New Mexico, and the remaining 25 percent lies within Texas.

The following population data are derived from the 1990 Census of Population and Housing (U.S. Bureau of the Census 1994). Within the Environmental Justice ROI, the total population of 101,129 persons includes 4.1 percent non-White, 32.6 percent Hispanic, and 36.8 percent minority (all except White non-Hispanic persons). In addition, 21.5 percent of the total population had 1989 incomes below the poverty level, as defined by the U.S. Bureau of the Census. There are no Native American reservations in the ROI. Figures 4-11 and 4-12 display maps of the distribution of minority and low-income populations according to the percentage of the block group population in the environmental justice ROI. Block grouping is a division of territory, the size of which varies according to population density, that has approximately 400 households.

The proportion of Hispanic, minority, and low-income persons in the ROI are all greater than in the United States as a whole. Also, the proportion of low-income persons in the ROI is greater than in both New Mexico and Texas. Finally, the proportion of Hispanic persons in the ROI is smaller than in New Mexico but greater than in Texas.

¹ Towns in this ROI include Artesia, Atoka, Black River village, Carlsbad, El Paso Gap, Hope, Lakewood, Loco Hills, Loving, Malaga, Riverside, Seven Rivers, and Whites City in Eddy County, New Mexico and Eunice, Hobbs, Humble City, Jal, Lovington, Maljamar, Monument, Nadine, and Oil Center in Lea County, New Mexico. This ROI also includes Mentone in Loving County, Texas, and both Armo and Orla in Reeves County, Texas. The other counties in New Mexico and Texas that are part of this ROI have no communities within the 80-kilometer radius.

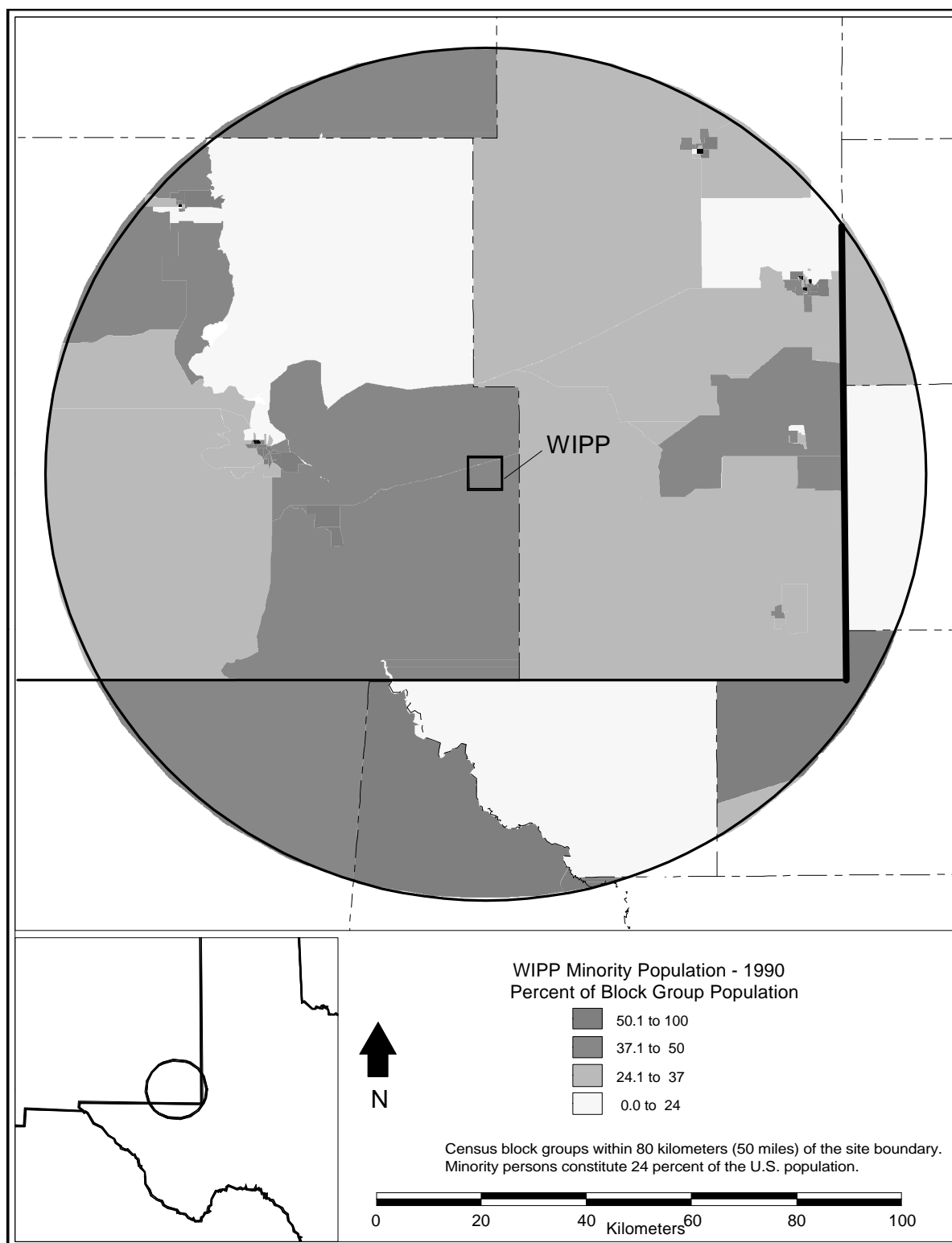


Figure 4-11
Minority Population

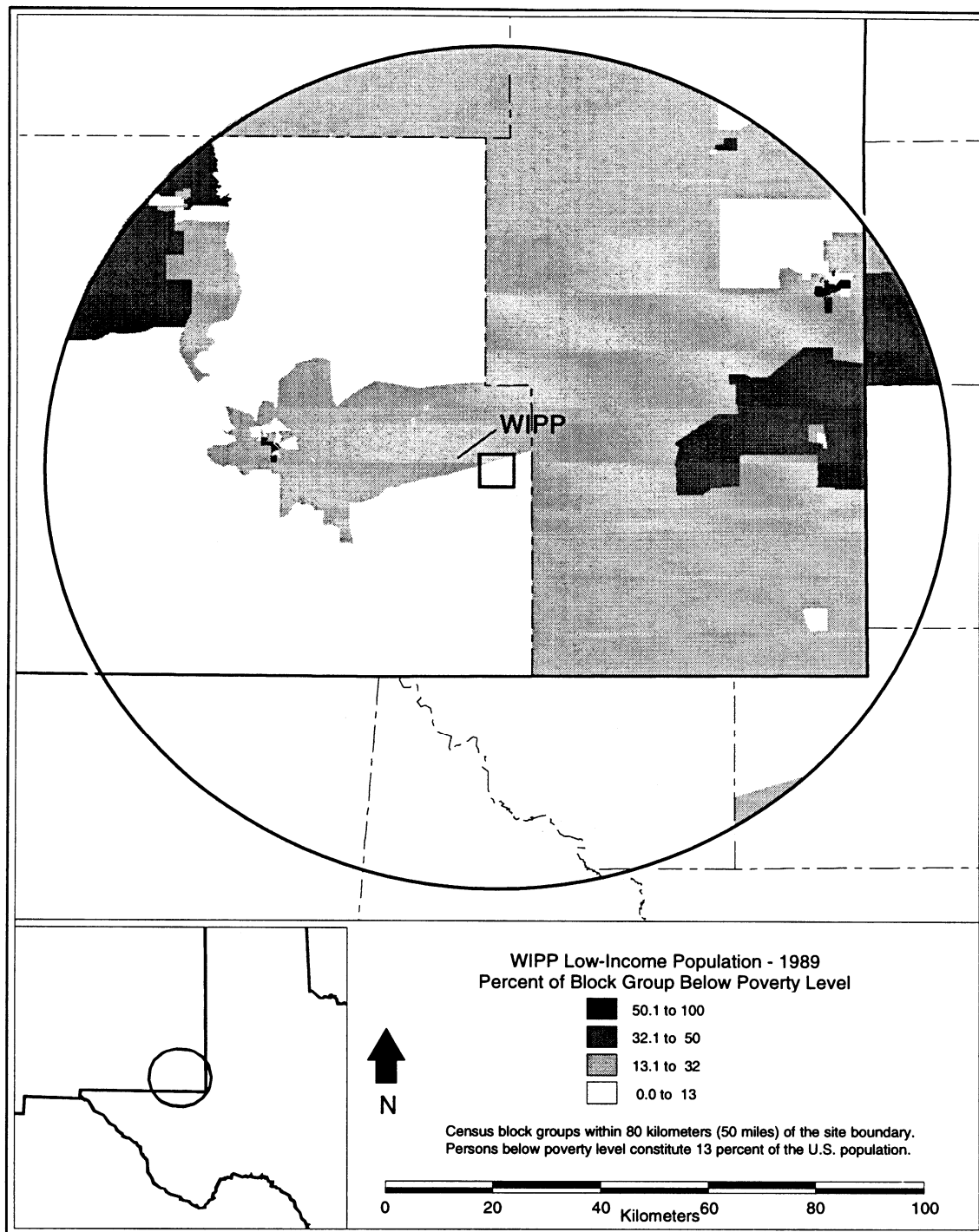


Figure 4-12
Low-Income Population

4.1.7 Transportation

SEIS-I briefly describes the transportation routes leading to WIPP. The site can be reached by rail or highway. DOE has constructed a rail spur to the site from the Burlington Northern and Santa Fe Railroad 10 kilometers (6 miles) west of the site. The site can also be reached from the north and south access roads constructed for the WIPP project. The north access road intersects U.S. Highway 62/180 (U.S. 62/180) 21 kilometers (13 miles) north of WIPP. The south access road intersects New Mexico Highway 128 6.5 kilometers (4 miles) to the southwest of WIPP.

Transportation routes from principal DOE sites and facilities are shown in Appendix E, which also presents additional information on transportation methods and routes.

4.1.8 Background Radiation

The background radiation conditions in the vicinity of WIPP are influenced by natural sources of radiation, fallout from nuclear tests, and Project Gnome, a local research project (DOE 1990).

DOE established long-term radiological monitoring programs in southeastern New Mexico prior to the WIPP project, to determine the widespread impacts of nuclear tests at the Nevada Test Site (NTS) and to evaluate the effects of Project Gnome. The background radiation levels measured at WIPP from 1976 to 1979 are discussed in FEIS (DOE 1980).

The WIPP Radiological Baseline Program (RBP) was initiated in 1985 to describe background levels of radiation and radionuclides in the WIPP environment prior to the underground emplacement of radioactive waste (DOE 1990). The RBP consists of five subprograms: (1) atmospheric baseline, (2) ambient radiation (gamma radiation), (3) terrestrial baseline (soils), (4) hydrologic baseline (surface water, bottom sediments, and groundwater), and (5) biotic baseline (radiological parameters in key organisms along potential radionuclide-migration pathways). Mean gross alpha activity in airborne particulates has shown little variation and is within the range of 1 to 3×10^{-15} microcuries per milliliter. Mean gross beta activity in airborne particulates fluctuates but is typically within the range of 1 to 4×10^{-15} and 1 to 4×10^{-14} microcuries per milliliter. The average level of gamma radiation in the environment is approximately 66 millirem per year. On average, a person in the United States receives an effective dose equivalent of about 350-360 millirem per year from all sources of radiation (DOE 1997b, 1995g). Radionuclide concentrations in soil, surface water, sediment samples, and key organisms fall within expected ranges and do not indicate any unexpected environmental concentrations (DOE 1990).

In 1994, atmospheric particulates, ambient radiation, soil, surface water and sediment, groundwater, and biota (vegetation, fish, rabbit, and deer) samples were collected throughout the year from a number of locations and analyzed radiologically. Table 4-5 highlights the radionuclides sampled in the WIPP vicinity. An estimated annual dose of approximately 65 millirem was determined, indicating that no unusual levels of environmental radioactivity exist at WIPP (DOE 1995d).

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Background Radiation - Since publication of SEIS-I, the WIPP Radiological Baseline Program (RBP) has shown that there has been little variation in mean gross alpha, beta, and gamma levels in airborne particulates. Radionuclide concentrations in soil, surface water, sediment samples, and key organisms have fallen within the expected ranges and have not indicated any excessively high environmental concentrations.

Table 4-5
Radionuclides Sampled in the Vicinity of WIPP

Name	Symbol	Particulate	Soil	Surface-water/ Sediment	Groundwater	Biota
Actinium-228	²²⁸ Ac			X		X
Beryllium-7	⁷ Be	X				
Potassium-40	⁴⁰ K	X	X	X	X	X
Cobalt-60	⁶⁰ Co	X	X	X	X	X
Strontium-90	⁹⁰ Sr	X	X	X	X	X
Cesium-137	¹³⁷ Cs	X	X	X	X	X
Radium-226/228	^{226/228} Ra	X	X	X	X	X
Thorium-228/230/232	^{228/230/232} Th	X	X	X	X	X
Uranium-233/234/235/238	^{233/234/235/238} U	X	X	X	X	X
Plutonium-238/239/240/241	^{238/239/240/241} Pu	X	X	X	X	X
Americium-241	²⁴¹ Am	X	X	X	X	X
Lead-210	²¹⁰ Pb	X	X	X	X	X
Polonium-210	²¹⁰ Po	X	X	X	X	X

As discussed in FEIS (DOE 1980) and SEIS-I (DOE 1990), Project Gnome resulted in a nuclear device being detonated underground approximately 14 kilometers (9 miles) south-southwest of the WIPP site in 1961 as part of the Plowshare Program sponsored by the Atomic Energy Commission. In 1972, the EPA established a program to monitor radionuclide levels in surface water and groundwater in areas potentially affected by Project Gnome. EPA (1989) published the results in its "Off-Site Environmental Monitoring Report: Radiation Monitoring Around United States Test Areas, Calendar Year 1988." In June 1995, the Environmental Evaluation Group (EEG) conducted a limited radiological survey of the Project Gnome area (EEG 1995) as well as a radiochemical analyses with a commercial laboratory. The results indicated that there were elevated levels of plutonium-238 (Pu-238), plutonium-239 (Pu-239), plutonium-240 (Pu-240), and americium-241 (Am-241) in localized surface soils at the Gnome site. Although the results indicated measurable transuranic (TRU) contamination at the Gnome site, EEG reported that the levels did not appear to present any immediate health and safety concern.

4.2 EXISTING ENVIRONMENT AT THE TEN MAJOR GENERATOR-STORAGE SITES

The following sections briefly summarize the existing environments at the 10 major generator-storage sites listed in Chapter 1. Maps showing the locations of the sites can be found in Chapter 3.

4.2.1 Argonne National Laboratory-East (ANL-E)

ANL-E occupies 690 hectares (1,700 acres) in northeast Illinois, in DuPage County, approximately 35 kilometers (22 miles) southwest of downtown Chicago, Illinois. The site is north of the Des Plaines River valley, south of Interstate-55, and west of Illinois Highway 83. Comprised of several buildings, ANL-E is a multi-program laboratory that conducts basic and applied research in the areas of reactor development, physical sciences, and life and environmental sciences.

Technology commercialization and science education are also ANL-E missions (META/Berger 1995).

Regional land use surrounding ANL-E is characterized by high concentrations of urban development, including commercial, industrial, public, and residential usage. Several large forest preserves are east and southeast of the site. The site itself is in a suburban area. ANL-E uses only 80 hectares (200 acres) of the site for DOE activities, devoting the rest to forest and landscape areas (META/Berger 1995).

Four on-site wells provide the water supply for ANL-E. An average of 3,000 to 3,400 cubic meters (800,000 to 900,000 gallons) of water is pumped from the wells each day. ANL-E is now in the process of converting from local groundwater supplies to a municipal supply obtained from Lake Michigan (Holdren et al. 1995). The current site load for electricity is 23 megawatts (META/Berger 1995).

The ANL-E is located in a Class II designated PSD air quality area. The nearest Class I designated PSD area is the Seney National Wildlife Refuge located approximately 525 kilometers (325 miles) north of the site in Seney, Michigan. The EPA classifies the site and the surrounding counties as severe nonattainment areas for the criteria pollutant ozone. All other surrounding counties and areas are in attainment of the remaining NAAQS criteria pollutants except for Lyons Township in southeast Chicago, which is listed as a moderate nonattainment area for PM₁₀ (META/Berger 1995).

There are no known active tectonic features within 100 kilometers (62 miles) of the site. Several areas of considerable seismic activity are present at moderate distances from ANL-E, including the New Madrid fault zone in southeastern Missouri (a fault zone along the southern Illinois-Indiana border) and one in western Ohio. Horizontal accelerations greater than 0.1 gravity are estimated to occur on the site approximately once in 600 years (META/Berger 1995).

ANL-E is on the northern margin of the Des Plaines River valley. The largest on-site stream is Sawmill Creek, which originates north of the site and enters the Des Plaines River about 2 kilometers (1.25 miles) southeast from the center of the site. ANL-E is located approximately 46 meters (150 feet) above the Des Plaines River and thus is not subject to major flooding (META/Berger 1995). Sawmill Creek is currently the receiving body for effluent from ANL-E treatment facilities. The quality of waters in both Sawmill Creek and the Des Plaines River is poor. The Des Plaines River is used for neither agricultural nor domestic supplies for more than 100 kilometers (62 miles) downstream of ANL-E (Holdren et al. 1995).

ANL-E uses two principal aquifers for its water supply. The upper aquifer is about 60 meters (200 feet) thick and supplies potable water. The other aquifer is below the first, lying between 150 and 460 meters (500 and 1,500 feet) beneath the surface. The two aquifers are not directly connected and pumpage from the upper aquifer does not appear to affect the lower aquifer. No aquifers in the ROI are considered sole source aquifers under Safe Drinking Water Act regulations (META/Berger 1995).

Federal-listed threatened or endangered species are not known to reside on the ANL-E site. The site is known to contain one state-listed endangered bird. Six federally- or state-threatened or endangered species reside in the area and may possibly reside on the site (META/Berger 1995).

As of 1994, a complete survey of ANL-E revealed 43 prehistoric and 6 historic archeological properties, but no sites listed with the NRHP or designated as National Historic Landmarks. Three sites are potentially eligible for the NRHP, 20 sites are not considered eligible, and 26 sites have

not been evaluated. The potential of ANL-E to contain traditional cultural resources of interest to Native American groups has also not been evaluated (META/Berger 1995).

The counties of DuPage, Cook, Kane, and Will, in Illinois comprise the economic ROI in which 95.4 percent of all ANL-E's employees reside. About 4,500 persons were employed at ANL-E. The ROI total population in 1992 was 6,568,800, of which approximately 98 percent was urban. Within the ROI, Whites comprise approximately 68.5 percent of the population, Blacks comprise 21.2 percent, and Hispanics comprise 12.1 percent. In 1989, about 9 percent of all families were below the poverty level. The dominant industries in the ROI include manufacturing, finance, insurance, real estate, and government (META/Berger 1995).

The ANL-E ROI is served by Interstate Highways 55, 80, 294, and 355. In addition, U.S. Routes 34 and 45/20 and Illinois Route 83 provide local access. The Chicago metropolitan area has a number of rail lines which can be accessed by truck from ANL-E. The nearest major airport is Chicago's O'Hare International Airport (META/Berger 1995).

Radionuclide sampling at ANL-E is carried out for soil, water, and air. The 1990 data indicated no substantial difference between on-site and off-site radionuclide concentrations in soil samples. In 1993, measurable levels of several radionuclides were detected in Sawmill Creek downstream from the wastewater treatment plant outfall. The concentrations of all these radionuclides were only a small fraction of the DOE-derived concentration guides for water. In 1993, elevated levels of Am-241, cesium-137 (Cs-137), cobalt-60 (Co-60), and Pu-239 were found in sediments below the outfall and are attributed to past releases. Radionuclides found in groundwater include Cs-137, strontium-90 (Sr-90), and tritium (H-3). In 1993, all radionuclide monitoring results were less than the limits established by the Safe Drinking Water Act. Airborne particulates and other airborne sources added to the background radiation in the ANL-E area.

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 3×10^{-3} latent cancer fatalities (LCFs). The population within this area was 7,900,000. The annual dose from airborne radionuclides to the maximally exposed individual (MEI) during 1994 would result in a 8×10^{-9} probability of an LCF. The corresponding dose is below the National Emission Standard for Hazardous Air Pollutants (NESHAP) limit.

4.2.2 Hanford Site (Hanford)

Hanford covers about 1,450 square kilometers (560 square miles) of the southeastern part of the state of Washington in parts of Benton, Grant, and Franklin Counties. The nearest city, Richland, Washington, borders the site on its southeast corner. The site is bounded on the east by the Columbia River, on the west by the Rattlesnake Hills, and on the north by Saddle Mountain. The site has a number of facilities including retired plutonium production reactors, operating reactors, waste management and spent nuclear fuel processing facilities, and nuclear research and development laboratories (DOE 1995a).

Land on the Hanford site is used primarily by DOE. However, there are also areas used as a wildlife refuge and for game management. The land adjacent to the site is either urban, commercial, or agricultural. Agricultural areas include irrigated and dry-land farming and grazing. The Columbia River adjacent to the site is heavily used for recreation (DOE 1995a).

The Columbia River is the principal source of water for Hanford. In 1992, the site consumed approximately 15 million cubic meters (4 billion gallons) of water. The Bonneville Power Administration provides electricity. In 1992, electricity consumption at the site was approximately 340,000 megawatt-hours, with a power demand of 57 megawatts (DOE 1995a).

Air quality in the Hanford region is well within the State of Washington and EPA standards for criteria pollutants, except that short-term particulate concentrations occasionally exceed the PM₁₀ standard (DOE 1995a). Hanford is in a Class II air quality area (META/Berger 1995). The Class I areas nearest to the site are Goat Rocks Wilderness Area and Mount Rainier National Park, both about 145 kilometers (90 miles) away. Two other Class I areas are within 175 kilometers (110 miles) of the site (DOE 1995a).

The climate of the area is semiarid, with hot, dry summers and cool winters. Temperatures range from an average high of 2 degrees Celsius (36 degrees Fahrenheit) in January to an average high of 35 degrees Celsius (95 degrees Fahrenheit) in July (DOE 1995a). On average, thunderstorms occur 11 days per year, mostly in summer. The annual average precipitation is 16 centimeters (6.3 inches). The prevailing wind is from the west and the monthly average wind speeds range from 3 meters per second (7 miles per hour) in the winter to 4 meters per second (9 miles per hour) in the summer (META/Berger 1995). Tornadoes are extremely rare, occurring within 160 kilometers (100 miles) of the site about once every three years. The estimated probability of a tornado striking a point on the site is 9.6×10^{-6} per year.

Hanford is on a low-lying, modified plain of the Columbia River. Recent alluvial or windblown sands comprise the surface of the plain, with basaltic lava flows and various layers of gravel, silts, and clays underneath (DOE 1995a).

Earthquake activity in the area of Hanford has historically been low-to-moderate. The site is in a Uniform Building Code Seismic Risk Zone 2B. The largest shock recorded near the site was approximately 4.5 to 5.0 on the Richter scale (Modified Mercalli Intensity of V) in Corfu, 35 kilometers (22 miles) north of the site, in 1918. Another Modified Mercalli Intensity V quake occurred in the area in 1973. The site often experiences low intensity earthquakes occurring in clusters over a short period of time. Volcanic hazards are low as the site is located approximately 160 kilometers (100 miles) east of the Cascade Range, which includes several volcanic vents. Foreseeable volcanic effects at the site are limited to windborne volcanic ash (DOE 1995a).

The Columbia River passes through the northern part of Hanford and forms part of the eastern boundary. The Yakima River is located near the southern portion of the site. There are also two intermittent creeks. Upstream dams control potential flooding from the Columbia River. Minor flooding away from on-site facilities occurs from the other watercourses. The water quality of the Columbia River is high, and the river contributes to the water supply for the site and for nearby cities. Radiological monitoring shows low levels of radionuclides in the river, considerably below concentration guidelines established by EPA drinking water standards. Wastewaters are discharged to several ponds on the site and the Columbia River. Nonradiological contaminant concentrations are within Washington State Water Quality Standards (DOE 1995a).

There are unconfined aquifers located beneath Hanford (DOE 1995a). No aquifers are considered sole-source aquifers (META/Berger 1995). In 1993, several radionuclides and nonradioactive chemicals were detected at levels exceeding EPA drinking water standards and/or DOE derived

concentration guides (DOE 1995a). Preliminary investigations have identified four major groundwater contaminant plumes that have been found to enter the Columbia River in at least three locations (META/Berger 1995). Groundwater beneath the site is not used for human consumption or food production, except for one well used for drinking at one of the facilities.

Above-background levels of radionuclides have been detected in this well; however, the levels are considerably below EPA drinking water standards (DOE 1995a).

Hanford, a shrub-steppe environment dominated by cheatgrass and sagebrush, includes 10 different types of plant communities. Deer and elk are the major large animals, and coyotes are the main large predators (DOE 1995a). Wetlands existing along the Columbia River and other streams and seeps support extensive stands of various types of vegetation as well as the waterfowl that use them for nesting. The river supports 44 species of fish, including salmon and trout, which use it as a spawning area (META/Berger 1995). A 310-square-kilometer (120-square-mile) area of the site set aside for ecological studies, a wildlife refuge, and a game management area comprises the Arid Land Ecology Reserve.

The entire Hanford site has been designated a National Environmental Research Park (NERP) (DOE 1995a). There are six federal- or state-threatened or endangered species of birds on the Hanford site. One state-endangered mammal and four state-threatened or endangered plant species are also found. In addition, there are 12 other species of animals which are federal- or state-classified as species of concern (META/Berger 1995).

As of 1992, 248 prehistoric archeological sites were recorded, 48 of which are on the NRHP (DOE 1995a). In addition, 11 historic archeological sites and 11 other properties are also listed on the NRHP (META/Berger 1995). Archeological sites include the remains of villages, campsites, cemeteries, monuments, hunting sites, and quarries. Several Native American groups retain traditional secular and religious ties to the region. Some native plant and animal foods used in religious ceremonies can be found on the Hanford site (DOE 1995a).

The primary socioeconomic impact area includes the tri-cities (Richland, Kennewick, and Pasco) and the counties of Franklin and Benton in Washington state. The estimated population for this area in 1992 was about 160,000. The larger economic ROI includes eight other counties in both Washington and Oregon. The estimated population for this ROI in 1992 was about 550,000. The primary economies of the economic ROI, each employing about 40,000 to 50,000 people, include agriculture/fishing/lumbering, manufacturing, trade, services, and government (DOE 1995a). The environmental justice ROI, which is the area within an 80-kilometer (50-mile) radius from the site, contains about 380,000 people. This ROI population includes 20 percent minority, 18 percent low-income (DOE 1995a), and 19 percent Hispanic (META/Berger 1995). The site employs about 14,200 people, accounting for almost 25 percent of the nonagricultural employment in Benton and Franklin Counties. These two counties also account for approximately 93 percent of site employees (META/Berger 1995).

DOE has entered into agreements with the tribal governments representing the Yakama Indian Nation, Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation. These agreements pertain to the core environmental programs and the emergency preparedness and response program.

U.S. Highways 12 and 395, Interstate-82, and State Route 240 run through the Hanford site. Two railroads also connect the area with much of the rest of the nation.

High-level radioactive waste has been accumulating at Hanford since 1944. Before 1970, TRU waste was disposed of on-site in unlined trenches; since 1970, however, Hanford has stored TRU waste in aboveground storage facilities. Besides high-level radioactive waste, the site also has low-level waste, mixed waste, and hazardous waste stored in large amounts. Hanford is included on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List.

In 1993, radiation workers at the site were monitored and found to have average annual doses resulting in an 8×10^{-6} probability of an LCF per individual (DOE 1995a). The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 2×10^{-4} LCFs. The population within this area was 380,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 3×10^{-9} probability of an LCF. The corresponding dose is below the NESHAP limit. About 50 cancer deaths could be projected by the total public radiation dose from Hanford activities since 1944. Essentially all of these would have been the result of radiation exposures received during 1945 (DOE 1995a).

4.2.3 Idaho National Engineering and Environmental Laboratory (INEEL)

INEEL encompasses 230,000 hectares (568,000 acres) within five counties in southeastern Idaho. The site is located 44 kilometers (27 miles) west of Idaho Falls, Idaho, on the Eastern Snake River Plain in the Basin and Range Province of North America. The site is bordered by mountain ranges and volcanic buttes (DOE 1995a).

Land at INEEL is used for DOE operations, recreation, grazing, and environmental research. About 2 percent of the total INEEL site area (4,600 hectares [11,400 acres]) is used for facilities and operations. Recreational uses include public tours of general facility areas and controlled hunting. Between 121,000 and 142,000 hectares (300,000 and 350,000 acres) are used for cattle and sheep grazing. BLM does not allow grazing within 3 kilometers (2 miles) of any nuclear facility, and, to avoid the possibility of milk contamination by long-lived radionuclides, does not permit dairy cattle anywhere on the site. BLM also manages some of the undeveloped areas for wildlife habitat. No mineral exploration or development is allowed on INEEL land (DOE 1995a).

Site activities at INEEL withdraw an average of 7.4 million cubic meters (1.9 billion gallons) of groundwater per year. The peak demand on the INEEL electric system from 1990 to 1993 was about 40 megawatts, and the average usage was approximately 200,000 megawatt-hours per year (DOE 1995a).

The Craters of the Moon National Monument is 25 kilometers (15 miles) southwest of INEEL's western boundary and is in a designated Wilderness Area for which Class I air quality standards must be maintained. Concentrations of criteria pollutants at the site are below the NAAQS, state, and PSD standards and limits. The estimated on-site concentrations of most toxic air pollutants are well below levels established for protection of workers. The maximum short-term benzene concentration slightly exceeds the standard at the highest predicted location. For off-site conditions, all toxic air pollutant levels are below reference levels (DOE 1995a).

INEEL has an arid climate, with low relative humidity, wide daily temperature fluctuations, and large variations in annual precipitation. Thunderstorms occur 2-3 days per month during the

summer; otherwise, severe weather is uncommon. No tornadoes were reported on-site from 1950 to 1988. The mean annual temperature is 5.6 degrees Celsius (42 degrees Fahrenheit) and the mean annual precipitation is 22 centimeters (8.7 inches) (DOE 1995a). Notable variations in wind direction and speed are characteristic of the INEEL site. The prevailing wind direction ranges from west-southwest to north, and the average wind speed is about 3.2 meters per second (7.2 miles per hour) (Holdren et al. 1995).

The surface at the INEEL site is comprised primarily of basaltic lava flows ranging in age from about 2,000 years to over 1 million years. The site also contains wind-blown loess and sand and floodplain sediments. Volcanic hazards at INEEL can come from sources inside or outside the boundary of the site. Regional major volcanic activity has occurred at Craters of the Moon National Monument as recently as 2,100 years ago and at Yellowstone National Park (160 kilometers [100 miles] away) three times within the past 2 million years. The probability that volcanism would affect an INEEL site facility is less than 2.5×10^{-5} per year (DOE 1995a).

There are volcanic rift zones lying across INEEL, and the surrounding basin and range landscape also has frequent earthquakes (DOE 1995a). Two major earthquakes, of magnitude 7.3 and 7.5, have occurred within 100 miles of the site during the last 35 years (DOE 1996b). However, based on the seismic history and geologic conditions, earthquakes greater than magnitude 5.5 are unlikely within the site, though moderate to strong ground shaking from earthquakes within the nearby basin and range areas can affect the site (DOE 1995a).

The INEEL site is covered with wind-blown sediments generally less than 2.1 meters (7 feet) deep (DOE 1995a). These soils have a low-to-moderate water erosion hazard and a moderate-to-high wind erodibility (DOE 1995g).

INEEL is located in the Mud Lake-Lost River Basin, a closed drainage basin that includes three main tributaries (the Big and Little Lost Rivers and Birch Creek) which together drain approximately 753,000 hectares (1,860,000 acres). The Big Lost River crosses the site to an area of playas, or sinks, where water is discharged during an unusually wet year. However, surface water from this river, as well as the Little Lost River, does not usually reach the site. Water from Birch Creek flows into the site during the winter and infiltrates into channel gravels, where it recharges a local aquifer (DOE 1995a). During most years, all surface waters in the Little Lost River and Birch Creek are diverted to irrigation before entering the site (Holdren et al. 1995). Local flooding can occur at the site when the ground is frozen and runoff from melting snow is combined with heavy spring rains (DOE 1995a).

Chemical and radioactive parameters measured in the three rivers have not exceeded applicable drinking water quality standards. INEEL site activities do not directly affect the quality of surface water outside the site because surface water does not flow directly off-site. Discharges from facilities are made to manmade seepages and evaporation basins, rather than natural surface water bodies (DOE 1995a).

INEEL overlies the Snake River Plain Aquifer, the largest in Idaho, designated as a sole-source aquifer. This aquifer is also the source of all water used at INEEL. The depth to groundwater from the surface ranges from approximately 60 meters (200 feet) to over 270 meters (900 feet). Groundwater quality is affected by natural water chemistry and contaminants originating at INEEL facilities. Concentrations of radionuclides in the aquifer have decreased over time, primarily due to reduced discharges, adsorption, radioactive decay, and improved waste management practices.

Inside the site boundary, several radionuclide concentrations have exceeded the EPA maximum contaminant levels for drinking water. Outside the site boundary, all contaminant levels measured have been below the EPA levels (DOE 1995a). INEEL is included on the CERCLA National Priorities List.

INEEL site vegetation includes saltbrush deserts, juniper woodlands, native grasslands, big and low sagebrush, and riparian communities. Big sagebrush is dominant, covering approximately 80 percent of INEEL (DOE 1996b). The USFWS National Wetlands Inventory maps show over 130 potential wetlands, most found near the rivers and associated playas. As of December 1994, at least one area at the Big Lost River sinks was found to meet the criteria for jurisdictional wetland delineation by the United States Army Corps of Engineers (DOE 1995a). In 1975, DOE designated most of INEEL as a NERP (DOE 1995g).

Several migratory species use the INEEL site for part of the year. Two federal-endangered and nine federal species of concern were identified as potentially occurring on the site. Two state-protected and ten state species of special concern also potentially occur on the site. No federal- or state-listed plant species were identified as potentially occurring. Eight plant species considered sensitive, rare, or unique are known to occur (DOE 1995a).

INEEL contains paleontological fossil sites and numerous prehistoric archeological sites. As of June 1994, more than 100 cultural resource surveys have been conducted, and over 1,500 archeological resources have been identified. Over 700 of these resources are considered to be potentially eligible for NRHP. The Experimental Breeder Reactor-I is a national historic landmark. INEEL contains many resources culturally important to the Shoshone-Bannock Tribes. These include not only cultural sites but also features of the natural landscape. In accordance with federal laws and in consideration of DOE's Native American policy, DOE has committed to additional interaction and exchange of information with the Shoshone-Bannock Tribes of the nearby Fort Hall Indian Reservation and is developing procedures for consultation and coordination at INEEL (DOE 1995a).

The socioeconomic ROI is a 7-county area where over 95 percent of INEEL's approximate 6,400 employees reside (DOE 1996b). The ROI labor force was 104,654 in 1991, and the 1990 population was 219,713 (DOE 1995a). About 2.5 percent of this population was Native American, and 5.5 percent was Hispanic (META/Berger 1995). The population within an 80-kilometer (50-mile) circle centered at Argonne National Laboratory-West (on the INEEL site) contains 7 percent minority and 14 percent low-income. Retail trade and educational services are the two largest employment sectors in the ROI, accounting for 17.6 percent and 11.4 percent of employment, respectively (DOE 1995a). In 1990, the per capita income for the ROI was \$14,622 (META/Berger 1995).

DOE has entered into an agreement with the tribal governments representing the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation. This agreement is designed to enhance Tribal technical and scientific capability in the areas of environmental restoration, emergency preparedness and response, and management of cultural resources.

About 144 kilometers (90 miles) of paved public highway run through the INEEL site. Railroads also serve the area, and a rail line into INEEL connects the towns of Arco and Blackfoot.

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 2×10^{-4} LCFs. The population within this area was 120,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 2×10^{-9} probability of an LCF. The corresponding dose is below the NESHAP limit. In addition, DOE estimates no adverse health effects from any noncarcinogenic chemical contaminants (DOE 1995a).

4.2.4 Lawrence Livermore National Laboratory (LLNL)

LLNL includes the Livermore site, the adjoining Sandia National Laboratories, California site (SNL-CA), and the LLNL experimental test site (Site 300). The Livermore site is approximately 64 kilometers (40 miles) east of San Francisco, California, and about 5 kilometers (3 miles) east of Livermore, California. The SNL-CA site is located next to and south of the Livermore site. Site 300 is about 24 kilometers (15 miles) southeast of Livermore in the sparsely populated hills of the Diablo Range. Today, the major programs at LLNL include defense and related programs, laser fusion, laser isotope separation, biomedical and environmental research, and environmental restoration and waste management (META/Berger 1995).

The Livermore and SNL-CA sites are at the southeast end of Livermore Valley in southern Alameda County. Site 300 is in a mostly rural area of San Joaquin County. Land adjacent to LLNL is predominantly private and consists of agricultural, residential, and light/industrial lands, with a smaller portion of public lands (META/Berger 1995).

The water supply for LLNL is provided by San Francisco's Hetch Hetchy water system. The current site load for water is 2,714,000 liters (717,000 gallons) per day and the maximum capacity is 9.54 million liters (2.52 million gallons) per day. The Pacific Gas and Electric Company and the Western Area Power Administration supply power to LLNL. The current site load is 61 megawatts. The maximum capacity is 100 megawatts (META/Berger 1995).

The Livermore site is in the San Francisco Bay Area Interstate Air Quality Control Region. This region has been classified as a nonattainment area for two criteria pollutants: CO and O₃. The Livermore site is in a Class II area, and any new sources of emissions must adhere to the increment standards for a Class II area (META/Berger 1995). Site 300 is located within the San Joaquin Valley Unified Air Pollution Control District. This area is classified as a nonattainment area for O₃ and PM₁₀. Several PSD Class I areas have been designated in the vicinity of LLNL, including Point Reyes National Wilderness Area, approximately 89 kilometers (55 miles) northwest of the Livermore site; Desolation National Wilderness Area; Mokelumne National Wilderness Area; Emigrant National Wilderness Area; Hoover National Wilderness Area; and Yosemite National Park. Since the promulgation of the PSD regulations in 1977, no PSD permits have been required for any emission source at the Livermore site (DOE 1996b).

The climate at LLNL and the surrounding region is classic Mediterranean with hot dry summers and cold wet winters. The average annual temperature is 12.5 degrees Celsius (54.5 degrees Fahrenheit). The temperature range at Site 300 is more extreme than at the Livermore site because of the higher elevation and pronounced relief (DOE 1996b). Annual precipitation at the SNL-CA ranges from 30 to 38 centimeters (12 to 15 inches) (META/Berger 1995).

All three sites lie within Seismic Zone 4 (DOE 1996b). The San Andreas fault system, the Sur-Nacimiento fault system, and the Coast Range thrust fault system are the major fault systems in the area. Along with local faults, these major regional faults are potential sources of ground motion at LLNL. In January 1980, an earthquake sequence on a local fault produced two earthquakes of magnitudes 5.5 and 5.6. These earthquakes caused structural damage at the Livermore and SNL-CA sites. Larger earthquakes on more distant faults, such as the San Andreas, do not substantially affect the hazard estimation for LLNL. The potential for surface faulting within the Livermore site is very low. Surface faulting at Site 300 in areas adjacent to the active Carnegie fault is possible (META/Berger 1995).

The main surface water features at the Livermore site are the Arroyo Las Positas and Arroyo Seco. Both stream channels are dry for most of the year. Two areas on the Livermore site are within the 100-year floodplains of these two streams; however, no existing on-site structures are within the 100-year floodplain. There are no perennial streams at or near Site 300. The canyons that dissect the hills and ridges at Site 300 drain into intermittent streams. The majority of these on-site streams drain to the south into Corral Hollow Creek, also intermittent, which flows east along the southern boundary of Site 300 in San Joaquin Valley. In addition to these streams, 24 springs and 2 vernal pools exist on-site. Some surface water discharge occurs from cooling towers and other process runoff areas (DOE 1996b).

Groundwater in the vicinity of the Livermore site is generally suitable as a domestic, municipal, agricultural, and industrial supply, with the exception of groundwater less than 90 meters (300 feet) deep. This groundwater is routinely monitored for radioactive and nonradioactive parameters. In 1993, the maximum concentrations of gross alpha, nitrate/nitrite, trichloroethylene, and tritium were above their water quality criteria or standard. The maximum concentrations found for tritium are in one local on-site well and pose no threat to water supplies. VOCs have also been detected in the on-site groundwater and in the area around the Livermore site. All site practices known to contribute VOCs to groundwater have been discontinued. LLNL is working with EPA and the State of California to identify appropriate remedial measures (DOE 1996b).

Two regional aquifers have been identified at Site 300. These are an upper water table aquifer of the Neroly Formation and a deeper confined aquifer also in the Neroly Formation (META/Berger 1995). At Site 300, groundwater is sampled quarterly from inactive and active water supply wells and monitoring wells, and analyzed for radioactive and nonradioactive parameters. Maximum concentrations of arsenic, gross alpha, nitrate/nitrite, trichloroethylene, tritium, and uranium were above their water quality criteria or standard at least once in 1993. LLNL is included on the CERCLA National Priorities List. LLNL is investigating and identifying characteristics of groundwater contamination at Site 300. Several plumes of VOCs and tritium have been identified in shallow and deeper bedrock aquifers in this area and several adjacent off-site areas. LLNL is working with the EPA and the State of California to remediate these plumes (DOE 1996b).

Fifty-nine federal- and state-listed threatened, endangered, and other special status species may be found on and in the vicinity of the Livermore site. Ten of these species have been observed on the site, including the federal-listed bald eagle (*Haliaeetus leucocephalus*). Thirty federal- and state-listed threatened, endangered, and other special status species have been observed on Site 300, and an additional 32 may be found on and in the vicinity of the site. These species include the federal-listed San Joaquin kit fox (*Vulpes macrotis mutica*), American peregrine falcon (*Falco peregrinus anatum*), large-flowered fiddleneck (*Amsinckia grandiflora*) and bald eagle; and the

federal-proposed Alameda whipsnake (*Masticophis lateralis euryxanthus*) and California red-legged frog (*Rana aurora draytoni*). Although suitable habitats for several of the other listed species exist on-site at LLNL, potential occurrence of most of the other species is minimal due to the lack of suitable habitat (DOE 1996b). No critical habitat for threatened or endangered species exists at LLNL (META/Berger 1995).

Since 1974, several archeological investigations have taken place at the Livermore site and Site 300. No prehistoric sites have ever been located at the Livermore site. A preliminary investigation at the Livermore site in 1992 explored the historic significance of World War II-era buildings and developed a potential context for initial consideration of the distinguished technical and scientific resources of LLNL. Cultural resource investigations at Site 300 have resulted in the discovery of 7 prehistoric sites, 21 historic sites, and 1 with elements of each. Of these, 24 are officially recorded, but no evaluations to determine site significance have been performed. Sacred and important Native American resources that might be found in the vicinity of LLNL include burials, cremations, vision quest sites, and traditional-use areas. Initial consultation with Native American groups to determine important resources has begun (DOE 1996b).

Four counties comprise the ROI in which 97.2 percent of the approximately 7,850 Livermore site and Site 300 employees reside. In 1990, the population in the ROI was 2,952,000. The population in the ROI is predominantly White (69 percent), and approximately 8.4 percent of the families were living below the poverty level in 1989. In 1991, the unemployment rate for the ROI was 9.3 percent. The 1990 per capita income in the ROI was \$21,099. The dominant industries in the ROI include services, government, manufacturing, and retail, which account for 68.8 percent of total earnings (META/Berger 1995).

LLNL is serviced by Interstate-580, Interstate-5, and Interstate-680. South Vasco Road and Greenville Road, both of which are accessed from Interstate-580, service the Livermore site from the north. Patterson Avenue and East Avenue provide access to the Livermore site from the east and west. The Southern Pacific Railroad and the Western Pacific Railroad are the primary providers of rail service to the LLNL region (META/Berger 1995).

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 4×10^{-4} LCFs. The population within this area was 6,300,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 3×10^{-8} probability of an LCF. The corresponding dose is below the NESHAP limit. The impact to the LLNL worker population from operations in 1994 was estimated to be 7.3×10^{-3} LCF (DOE 1996b).

4.2.5 Los Alamos National Laboratory (LANL)

LANL is located in north-central New Mexico, 97 kilometers (60 miles) north-northeast of Albuquerque, New Mexico, and 40 kilometers (25 miles) northwest of Santa Fe, New Mexico. The 11,300-hectare (28,000-acre) LANL site and adjacent communities are situated on the Pajarito Plateau (DOE 1995e). Since its inception in 1943, LANL's primary mission has been nuclear weapons research and development and related projects (META/Berger 1995). The land surrounding LANL is largely undeveloped, and large tracts of federal land surrounding the site are managed by the United States Forest Service, BLM, National Park Service, and Los Alamos County.

Three DOE-operated well fields provide an average of 15.5 million liters (4.1 million gallons) per day for LANL. Electricity usage in 1993 was 68 megawatts (META/Berger 1995).

LANL and its surrounding counties are considered attainment areas with respect to applicable NAAQS. The criteria pollutants make up approximately 79 percent of the stationary source emissions at LANL. Toxic and other hazardous pollutants represent the remaining 21 percent of the stationary source emissions. One PSD Class I area, Bandelier National Monument's Wilderness Study Area, borders LANL to the south. Since promulgation of regulations, no PSD permits have been required for any emissions source at LANL (DOE 1996b).

Los Alamos has a semiarid, temperate mountain climate. The annual average temperature at LANL is 8.9 degrees Celsius (48.1 degrees Fahrenheit) (META/Berger 1995). The average annual precipitation is 48 centimeters (18.7 inches) but is quite variable from year to year. Approximately 36 percent of the annual precipitation normally occurs from thunderstorms during July and August (DOE 1995e).

LANL is located on the Pajarito Plateau, which lies between the Jemez Mountains on the west and the Rio Grande on the east. Deep southeast-trending canyons, separated by long, narrow mesas, dissect the surface of the plateau (DOE 1995e). Studies have determined that the area has three active faults. The strongest earthquake in the past 100 years within a 80-kilometer (50-mile) radius had an estimated magnitude of 5.5 to 6 measured on the Richter scale and a Modified Mercalli Intensity of VII (META/Berger 1995). The site lies within Seismic Zone 2 (DOE 1996b), as established by the Uniform Building Codes.

All groundwater and surface water drainages from the Pajarito Plateau flow toward the Rio Grande. On-site tributaries to the Rio Grande include 14 drainage areas that pass through or start at LANL. Three of the canyons receive treated industrial or sanitary effluent. Surface water in these canyons is principally ephemeral and is not a source of municipal, industrial, or agricultural water supply. Regional, perimeter, and on-site surface waters are monitored to provide routine surveillance on the effect of LANL operations on water quality (META/Berger 1995). Surface water in the Los Alamos area principally occurs as short-lived or intermittent reaches of streams. The overall flood risk to LANL is low because nearly all the structures are located on the mesa tops, from which runoff drains rapidly into the deep canyons (DOE 1996b).

Groundwater in the LANL area occurs in four modes: shallow alluvium in canyons, perched water, the unsaturated zone between the surface and the main aquifer, and the main aquifer (DOE 1995e). Nearly all groundwater used at LANL originates from deep wells that produce water from the main aquifer. Under LANL are Class II aquifers, which provide current sources of drinking water and have other beneficial uses. Most of the wells in the Pajarito Plateau yield fresh water (total dissolved solids less than 500 milligrams per liter), although some wells east of the site have a higher total dissolved solids content (1,000 milligrams per liter or more). The primary, secondary, and radiochemical groundwater quality, as measured from wells and springs in the main aquifer, are below the DOE derived concentration guides or the New Mexico standards applicable to a DOE drinking water system. LANL and the nearby communities are entirely dependent on groundwater for their water supply (DOE 1996b).

The predominant vegetative communities at LANL are ponderosa pine, piñon-juniper, and juniper-grassland. LANL was designated a NERP in 1976 (META/Berger 1995). Most LANL wetlands occur in canyons. Wetlands have developed in the vicinity of some outfalls serving

LANL facilities. Thirty-four federal- or state-listed threatened, endangered, and other special status species may be found in the vicinity of LANL. Five of these species have been observed at LANL, but only one has been found to nest there and occupy the site year-round. Critical habitat for the Mexican spotted owl (*Strix occidentalis lucida*), a federally threatened species, exists at LANL and in areas bordering the northern and western boundaries of LANL (DOE 1996b).

Approximately 75 percent of LANL has been inventoried for cultural resources. More than 1,000 prehistoric sites have been recorded, and approximately 95 percent of these sites are considered eligible or potentially eligible for inclusion in the NRHP. Two areas in the vicinity of LANL have been established as NRHP sites or districts: Bandelier National Monument and Puye Cliffs Historical Ruins. Many of these cultural resources are of special importance to Native Americans in the area. Consultations with local Native Americans to identify any such cultural resources have been conducted in the past and are ongoing. More than 40 historic resources have been recorded at LANL, and about 90 percent of the resources are considered eligible or potentially eligible for the NRHP, based on their association with the broad historic theme of the Manhattan Project and initial nuclear production (DOE 1996b).

Three counties comprise the economic ROI in which 94.7 percent of LANL's 9,700 employees reside. In 1990, the population in the ROI was 152,300. The population in the ROI is predominantly White (79.8 percent) and 12.1 percent of the families are below the poverty level (META/Berger 1995). The 1994 unemployment rate in the ROI was 6.2 percent, and the per capita income in 1993 was \$17,689. The service sector accounts for 31 percent of the nonfarm private sector employment in the ROI (DOE 1996b).

DOE has entered into an agreement with Tribal governments representing the Pueblos of Santa Clara, Cochiti, Jemez, and San Ildefonso. The purpose of this agreement is to build Tribal technical and scientific capability in environmental restoration and waste management and to assist the Tribes in participating in DOE decision making.

LANL is served by U.S. 84 and U.S. 285, which link Los Alamos to Santa Fe, New Mexico. U.S. 502, which can be accessed by U.S. 285 from Santa Fe, also services LANL. The nearest railway access is south of Santa Fe in Lamy, New Mexico (META/Berger 1995).

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 2×10^{-3} LCFs. The population within this area was 220,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 4×10^{-6} probability of an LCF. The corresponding dose is below the NESHAP limit. Two epidemiological studies have recently been conducted in the LANL area. The most recent study presented an increased incidence of thyroid cancer in residents of Los Alamos county compared to the rest of New Mexico (DOE 1996b).

4.2.6 Mound Plant (Mound)

Mound is located in west-central Ohio, in Montgomery County, within the city limits of Miamisburg, Ohio, about 16 kilometers (10 miles) south-southwest of Dayton, Ohio (Holdren et al. 1995). Mound occupies about 124 hectares (306 acres) (DOE 1979) and is situated on the highlands overlooking the Great Miami River. Until December 1991, Mound manufactured nonnuclear components and tritium-containing components for nuclear weapons. Mound's current mission is environmental restoration and economic development (DOE 1994b). Land use and

cover within the vicinity of the Mound site is primarily residential and woodland, and on the site itself there are heavily wooded areas (Holdren et al. 1995).

The Air Quality Control Region comprising the facility has been classified as attainment of the NAAQS for NO₂, SO₂, and lead. However, EPA lists Montgomery County as nonattainment for O₃ and TSP (DOE 1995c). Operations at Mound emitted a wide variety of nonradioactive contaminants, such as organic solvents, acids, and metals (DOE 1989). Various radioactive contaminants such as Pu-238 and tritium were also released. The site is also a source of radionuclides due to resuspension of contaminated soils related to past practices. Recorded levels of these contaminants are well below DOE guidelines (DOE 1995c).

Tornadoes may touch down along short and narrow paths, but are infrequent in the region. Tornado wind speeds of 146 kilometers (90 miles) per hour or greater have an annual probability of occurrence of one in one thousand. Tornadoes with wind speeds exceeding 368 kilometers (227 miles) per hour have an annual probability of one in one million (DOE 1995c).

The major surface water feature in the area is the Great Miami River, located approximately 450 to 600 meters (1,500 to 2,000 feet) west of the site. The tributary valley between the two main hills contains a drainage ditch, the only perennial stream within Mound boundaries (Holdren et al. 1995). Surface water quality in the vicinity of Mound is satisfactory, with radioactivity levels far below established limits (DOE 1995b).

The major aquifer in the area, the Buried Valley Aquifer (also called the Great Miami Aquifer), is the major source of the area's potable water. Typically, groundwater occurs 6 to 8 meters (20 to 26 feet) below ground surface in the valley. The bedrock also contains groundwater but cannot provide a reliable source. The glacial tills overlying the bedrock may also contain perched water zones but are generally too thin to act as a water supply (Holdren et al. 1995). There has been minor contamination of the groundwater by Mound activities. Tritium and plutonium have been detected in the Miamisburg water supply at levels far below regulatory limits. Some on-site groundwater VOCs exceed EPA levels; however, off-site concentrations are far lower, with none exceeding EPA levels (DOE 1995b).

The site lies within the range of the Indiana bat (*Myotis sodalis*), a federally-listed endangered species. However, the bat has not been seen on-site, and habitats hosting the bat are not present at the site. A single specimen of the Inland rush (*Juncas interior weig*), a state-endangered plant species, was found but it is not considered a viable breeding population. No other rare or endangered species have been found on the site (DOE 1995b).

The only historic landmark in the vicinity of the site is the Miamisburg Mound, an ancient mound located 120 meters (390 feet) east-southeast of the site. It is believed to be a burial place of a member of the Adena culture of Mound Builders which inhabited the Ohio region in prehistoric times (DOE 1979). The site itself does not contain any properties listed or eligible for the NRHP (DOE 1995b).

The city of Miamisburg is largely residential, with limited commercial and industrial development. The 1990 population of the city was 17,770. Within an 8-kilometer (5-mile) radius of the site, the population is estimated to be 76,061, based on 1988 figures (DOE 1995b). The population rises to several hundred thousand within a 16-kilometer (10-mile) radius and to over one million within a

32-kilometer (20-mile) radius. The facility employs about 1,200 people, the majority of whom live either in Miamisburg or in immediately adjacent areas (DOE 1979).

Area routes include the Dayton-Cincinnati Pike, 0.6 kilometers (0.4 miles) west of Mound; State Route 725, 1.4 kilometers (0.9 miles) to the north; and Interstate-75, 5 kilometers (3 miles) to the east. The tracks of the Penn Central Railroad roughly parallel the western boundary of the site at distances ranging from approximately 15 to 60 meters (50 to 200 feet) (DOE 1979).

Mound is included on the CERCLA National Priorities List. There are 22 known radioactively contaminated soil areas on-site and one area off-site. Sediments in the Great Miami River also contain levels of radioactive material that are higher than background levels for the surrounding area. There are also approximately 100 areas on-site that are either known or suspected to be contaminated with nonradioactive hazardous substances (DOE 1989).

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 1×10^{-3} LCFs. The population within this area was 3,000,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 2×10^{-8} probability of an LCF. The corresponding dose is below the NESHAP limit.

4.2.7 Nevada Test Site (NTS)

NTS occupies 3,500 square kilometers (1,350 square miles) of desert valley and Great Basin mountain terrain in southern Nevada, 105 kilometers (65 miles) northwest of Las Vegas, Nevada. Limited access areas, including the Nellis Air Force Base Bombing and Gunnery Range and the Tonopah Test Range, surround the site. The NTS has been the primary location for testing the nation's nuclear explosive devices since 1951 (META/Berger 1995).

Fourteen on-site wells supply an average of 5.15 million liters (1.36 million gallons) of water per day. The Nevada Power Company supplies electricity to NTS. The current site load is 30 megawatts (META/Berger 1995).

NTS is designated as an attainment or unclassified area with respect to all applicable NAAQS. Two PSD Class I areas in the vicinity of NTS are Grand Canyon National Park, Arizona, approximately 193 kilometers (120 miles) to the southeast and Sequoia National Park, California, located approximately 169 kilometers (105 miles) to the west-southwest of the site. Since promulgation of regulations, no PSD permits have been required for any emissions source at NTS (DOE 1996b).

NTS is in an area of moderate historic seismicity on the southern margin of the Southern Nevada East-West Seismic Belt in Seismic Zones 2 and 3. Since about 1848, more than 4,000 earthquakes have been recorded within a 242-kilometer (150-mile) radius of NTS. Most of these were minor events with Richter magnitudes of less than 5.5 (DOE 1995g). The Yucca fault is the only active fault on NTS within the underground nuclear testing area. The Rock Valley fault near the southern boundary of NTS has been the most active fault since 1990. (META/Berger 1995).

There are no continuously flowing streams at NTS, but there are permanent on-site water bodies, including natural springs and water-well overflow ponds, that are not associated with wastewater disposal. Sanitary wastewater influents to ponds and lagoons are regulated under a series of state

permits. Surface water bodies at NTS are routinely monitored for radioactive and nonradioactive parameters, and off-site surface water bodies and springs are also monitored for radionuclides (META/Berger 1995).

NTS has three general water-bearing units, and all are classified as Class IIA or Class IIB aquifers. Groundwater is the only source of drinking water in the NTS area. On-site wells are routinely monitored for radioactive and nonradioactive parameters, as required by the Safe Drinking Water Act, State of Nevada regulations, and DOE orders. Off-site groundwater is routinely monitored at 22 locations for radionuclides. Only three locations have evidenced detectable tritium levels on a consistent basis. In all three cases, the tritium activity has been less than 2 percent of the primary maximum contaminant level for tritium (20,000 picocuries per liter) (META/Berger 1995).

Thirteen federal- and state-listed threatened, endangered, and other special status species are present in the vicinity of NTS. The peregrine falcon is the only known species at NTS that is on the federal endangered species list. No critical habitat for threatened or endangered species exists on NTS (DOE 1996b).

Approximately 6 percent of NTS has been inventoried for cultural resources, and over 1,200 prehistoric sites have been recorded (DOE 1996b). Many of these sites may be eligible for listing on the NRHP. The only historic site that is currently listed is the Sedan Crater, which was created as part of the Plowshare Program to identify peaceful uses for nuclear explosions. Native American resources include ceremonial sites, petroglyphs, and traditional-use areas. Native Americans view many natural resources at NTS as cultural resources (DOE 1995g).

Two counties comprise the economic ROI in which 97 percent of the 1,600 NTS employees live. The ROI population totaled 865,144 in 1992 (DOE 1996b). The population in the ROI is predominantly White (81.5 percent), and in 1989, 7.5 percent of the population was below the poverty level (META/Berger 1995). During 1994, unemployment in the ROI was 6.1 percent. The 1993 per capita income in the ROI was \$20,561. The service sector is the major economic sector in the ROI, with over half of the region's nonagricultural activity (DOE 1996b).

DOE has entered into two separate agreements with Consolidated Group of Tribes and Organizations to foster a government-to-government relationship and to encourage involvement in programs associated with NTS operations. This group is composed of 17 Tribes representing three ethnic groups (Western Shoshone, Owens Valley Paiute, and Southern Paiute) from Arizona, California, Nevada, and Utah, with cultural or historic ties to NTS.

Vehicular access to NTS is provided by U.S. Route 95 from the south and off-road access via State Route 375 from the northeast (DOE 1995a). Interstate-15 is the major transportation route in the region (META/Berger 1995). The major railroad in the area is the Union Pacific, which runs through Las Vegas and is located approximately 80 kilometers (50 miles) east of the NTS.

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 2×10^{-4} LCFs. The population within this area was 33,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 8×10^{-8} probability of an LCF. The corresponding dose is below the NESHAP limit. Epidemiologic studies on groups surrounding NTS have concentrated on health effects in

soldiers and children associated with aboveground nuclear testing rather than operational emissions. Results are contradictory regarding the observed leukemia incidence and deaths in exposed children (DOE 1996b).

4.2.8 Oak Ridge National Laboratory (ORNL)

ORNL is part of the 13,980-hectare (34,545-acre) Oak Ridge Reservation (ORR) located 32 kilometers (20 miles) west of Knoxville, Tennessee, in the rolling terrain between the Cumberland Mountains and Great Smoky Mountains. The primary mission of ORNL is basic and applied research, technology development, and special DOE research. ORR also contains the Y-12 plant whose missions include dismantling nuclear weapons components, maintaining nuclear production capability and stockpile support, and providing storage for nuclear materials; and the K-25 site, which presently serves as an operations center for environmental restoration and waste management programs. The K-25 site formerly provided enriched uranium for United States nuclear weapons (DOE 1995g). The land surrounding ORR is primarily rural, dominated by agricultural and residential land (Holdren et al. 1995).

The Clinch River provides an average of 69.3 million liters (18.3 million gallons) of water per day to ORNL and ORR. The Tennessee Valley Authority provides electric power. The current site load is 116 megawatts (META/Berger 1995).

As of 1991, the area within the Air Quality Control Region was designated as attainment with respect to all NAAQS for criteria pollutants. The Great Smoky Mountains National Park is the only PSD Class I area in the vicinity of ORNL. Since the promulgation of regulations, no PSD permits have been required for any emissions source at ORNL (DOE 1995g).

Winters are generally mild and summers are warm, with few extremes in precipitation, temperature, or winds (DOE 1995g). Summer thunderstorms are frequent. Tornado occurrence in the general region averages about 0.5 per year (DOE 1995f). The annual average temperature is 14.2 degrees Celsius (57.5 degrees Fahrenheit). The annual average precipitation is 139 centimeters (55 inches) (DOE 1995g).

The topography, primarily ridge-and-valley, is part of the Tennessee Valley and Ridge Province of the Southern Appalachian fold and thrust belt (Holdren et al. 1995). There is no evidence of active faulting in the immediate area, although many inactive faults are present at ORNL (DOE 1995g). Regionally, earthquake frequency averages 1-2 per year (META/Berger 1995). Since 1812, at least 26 earthquakes with a Modified Mercalli Intensity of II to VI have been recorded in the area (DOE 1995f). ORNL lies within Seismic Zone 2, indicating that the probability of future seismic damage is low to moderate (META/Berger 1995). The site lies on moderately-well to well-drained soils. Soil erosion has ranged from light to severe, and the present erosion potential is high in some areas (DOE 1995g). The typical soil in the area is a reddish-brown clay (DOE 1997b).

The Clinch River and its tributaries are the major surface water features of the area (Holdren et al. 1995). ORR streams receive effluents from treated sanitary wastewater, industrial discharges, cooling water blowdown, stormwater, surface water runoff, and groundwater. Substantial cleanup activities are required both on-site and off-site (DOE 1995g).

Although groundwater occurs in all formations that outcrop at ORNL and ORR, three major hydrologic units are present. Mechanisms and rates of flow appear to be controlled by topography,

structure, and lithology (Holdren et al. 1995). There are no Class I sole-source aquifers beneath the site. Very little groundwater is used; only one supply well exists on ORR. Background groundwater quality is generally good in surface and bedrock aquifer zones and poor at depths greater than 305 meters (1,000 feet) due to high total dissolved solids. Hazardous chemicals and radionuclides from weapons production process activities have contaminated groundwater in some areas. The contaminated sites include past waste disposal sites, waste storage tanks, spill sites, and contaminated inactive facilities (DOE 1995g). ORR is included on the CERCLA National Priorities List.

ORR is heavily forested, with pine and pine-hardwood forest being the most extensive plant community, followed by oak-hickory forest (DOE 1995g). Approximately 20 percent of the site consists of wetlands; half of this is bottomland forest and half is pothole wetlands (META/Berger 1995). Approximately 5,500 hectares (13,590 acres) has been designated as a NERP (DOE 1995f). There are 88 federal- and state-listed threatened, endangered, and other special status species that have been identified on or in the vicinity of ORR. However, no critical habitat for threatened or endangered species exists on ORR (DOE 1995g).

More than 20 cultural resource surveys have been conducted on ORR. Over 45 prehistoric sites have been recorded, one site has been included in the NRHP, and several more are considered eligible. More than 240 historic resources have been recorded, and 50 of those sites may be eligible for the NRHP. The Graphite Reactor is a National Historic Landmark. There are also some resources that may be sensitive to Native American groups, including historic burial mounds, camps, quarries, chipping stations, limited activity locations, and shell scatters (DOE 1995g).

Four counties comprise the economic ROI in which about 92 percent of ORR employees live. The 1990 population of this ROI was about 489,000 (DOE 1995a). Minorities comprised 8.4 percent of this population, while 10.6 percent was below the poverty level (META/Berger 1995). The unemployment rate was 5.9 percent in 1991, and the per capita income was almost \$17,000 (DOE 1997b). Major economic sectors include services, with over 26 percent of the region's total private sector nonagricultural activity; manufacturing (19 percent); and retail trade (17 percent) (DOE 1996b).

Interstate-40, located 2.4 kilometers (1.5 miles) south of the ORR boundary, provides the main access to the cities of Nashville and Knoxville, Tennessee. Interstate-75, located 24 kilometers (15 miles) south of the site serves as a major route to the north and south. Several state routes provide local access and form interchanges with Interstate-40. Railroad service is also available in the area (DOE 1995a).

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 2×10^{-2} LCFs. The population within this area was 940,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 9×10^{-7} probability of an LCF. The corresponding dose is below the NESHAP limit.

4.2.9 Rocky Flats Environmental Technology Site (RFETS)

RFETS covers almost 17 square kilometers (7 square miles) in northern Jefferson County, Colorado. The site is located east of the foothills of the Rocky Mountains, approximately 25 kilometers (16 miles) northwest of Denver, Colorado. RFETS is situated in a generally rural

area with some ranches and industrial facilities nearby. Before January 1992, RFETS's primary mission was to produce nuclear weapon components from plutonium and other metals. The mission has now changed to decontamination and decommissioning, and the primary focus of the activities at RFETS is currently on environmental remediation and waste and materials management (META/Berger 1995).

The Denver Water Board from the Ralston and Gross Reservoirs provides the water supply for RFETS. Water is treated on-site at a plant with a maximum capacity of 3.8 million liters (1 million gallons) per day. The current site load for the treatment plant is 1.03 million liters (272,000 gallons) per day. The Public Service Company of Colorado supplies power to RFETS. The current site load for electricity is 18.3 megawatts (META/Berger 1995).

RFETS is located in an Air Quality Control Region that is a nonattainment area for the NAAQS criteria pollutants CO, O₃, and PM₁₀ and an attainment area for the remaining criteria pollutants, SO₂, NO₂, and lead. Because the site is in a Class II PSD area, any new emission sources would have to adhere to the increment standards for a Class II area. The nearest Class I PSD area is Rocky Mountain National Park, approximately 50 kilometers (30 miles) northwest of RFETS (META/Berger 1995).

The climate in the area is semiarid. July is the warmest month, with daily maximum and minimum temperatures averaging 31 degrees Celsius (88 degrees Fahrenheit) and 15 degrees Celsius (59 degrees Fahrenheit), respectively. January is the coolest month, with daily maximum and minimum temperatures averaging 6 degrees Celsius (43 degrees Fahrenheit) and -9 degrees Celsius (16 degrees Fahrenheit), respectively. Annual precipitation is approximately 39 centimeters (15 inches), with about 80 percent falling from April through September (Holdren et al. 1995).

The topography at RFETS is generally flat except for areas along three creeks. Seismic activity in the area is low. An earthquake with a maximum horizontal acceleration of 0.21 gravity has an annual probability of occurrence of 1 in 5,000. The surface soils at the site are moderately deep, well-drained clay, cobbly clay, and sandy loams, with moderate-to-low permeability. Twenty-nine on-site locations monitor soil for plutonium contamination (META/Berger 1995).

There are five ephemeral streams at RFETS that form a west-to-east surface drainage pattern. The primary source of flood potential is from flash flooding in these streams; however, most facilities are located outside the 500-year floodplain. The site has seven National Pollutant Discharge Elimination System (NPDES) permitted outfalls, three of which discharge to surface waters that flow off-site. In 1992, only one case was reported in which the NPDES permit limits were exceeded, and this was for low pH at the wastewater treatment plant. Surface water is also monitored for radioactive and nonradioactive parameters in 3 on-site detention ponds. Monitoring of local drinking water supplies was discontinued in October 1992 (META/Berger 1995).

Groundwater systems at RFETS consist of a shallow, unconfined system in the Rocky Flats Alluvium and valley fill, and a confined system in the deeper sandstone units within the underlying bedrock. Recharge is from rainfall, snowmelt, leakage from other aquifers, and percolation from streams, ditches, and reservoirs. Discharge is by seeps, springs, base flow to streams, and evapotranspiration. Groundwater also leaves the area as subsurface flow. No aquifers in the area are sole source aquifers under the Safe Drinking Water Act regulations. The results of 1992

groundwater quality monitoring indicate that the groundwater in the area contains elevated levels of several VOCs, several radionuclides, and other contaminants (META/Berger 1995).

The major terrestrial communities at RFETS are mesic-mixed and xeric-mixed grassland (mixed tall- and short-grass communities), reclaimed grassland, riparian woodland, complex deciduous woodland and bottomland shrubland, tall upland shrubland, tall marsh, short marsh, and wet meadow. Wetlands represent 3.9 percent of the plant communities at RFETS and comprise a total of 100 hectares (250 acres). There are 40 federal- and state-listed threatened, endangered, proposed, candidate, and other special status species that are known to occur or may occur at RFETS (META/Berger 1995); in addition, the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) was recently proposed for federal listing.

RFETS has no properties designated as National Historic Landmarks or listed in the NRHP. According to the Colorado Historic Society, portions of the site have been the subject of at least three cultural resource investigations. The historic cultural resources in the area are archeological sites or standing structures associated with homesteads and ranching. Many Native American groups historically occupied or traversed the foothills area around RFETS. Important sites, such as burials or vision quest locations, and several unidentified rock features and alignments that have been recorded on RFETS may be of concern to Native American groups (META/Berger 1995).

Five counties comprise the economic ROI in which 92.5 percent of the site's 3,500 employees reside. In 1990, the ROI population was 1,790,600. The population was predominantly White (86.2 percent) with 7.2 percent of the total population living below the poverty level. In 1991, the unemployment rate for the ROI was 4.5 percent, and the per capita income in 1990 was \$20,961. The dominant industries in the ROI include services, manufacturing, government, transportation and public utilities. These account for 68.1 percent of total earnings (META/Berger 1995).

The site is well served by both road and rail. Interstate-70, Interstate-25, and State Highways 72 and 93 serve the area. The city of Denver is a major railway hub in the Rocky Mountain region. A Southern Pacific line, approximately 1.6 kilometers (1 mile) south of the site, is the rail line nearest the plant and provides access to Denver. The nearest major airport is in Denver (META/Berger 1995).

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 1×10^{-4} LCFs. The population within this area was 2,100,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 1×10^{-9} probability of an LCF. The corresponding dose is below the NESHAP limit. Radiological monitoring of animals shows no notable uptake of radionuclides in deer and no ecologically appreciable quantities of plutonium or americium in small animals (META/Berger 1995).

4.2.10 Savannah River Site (SRS)

SRS is located approximately 20 kilometers (12 miles) south of Aiken, South Carolina, bordering the State of Georgia at the Savannah River. DOE activities conducted at SRS involve tritium recycling, support for the nation's space program missions, storage of plutonium on an interim basis, processing of backlog targets and spent nuclear fuel, waste management, and research and development (DOE 1995g).

Land use at SRS, which comprises 80,200 hectares (198,200 acres), is generally categorized as forest, water, or developed facility locations. A total of 77,400 hectares (191,300 acres) of SRS are undeveloped, of which 72 percent are forested. A majority of the woodlands, comprising 53 percent of the total site, are in revenue producing, managed timber production. DOE designated the entire SRS as a NERP, which allows the scientific study of the cypress swamp, southeastern pine, and hardwood forest ecosystems (DOE 1995g).

On-site wells provide an average of 6.1 million liters (1.6 million gallons) of water per day. The capacity of the system is 19 million liters (5 million gallons) per day. Both on-site and public supply sources provide electrical power. The existing site load is 130 megawatts (META/Berger 1995).

SRS is located near the center of the Augusta-Aiken Interstate Air Quality Control Region. The EPA classifies the areas within SRS and its surrounding counties as attainment areas with respect to the NAAQS for criteria pollutants. There are no known PSD Class I areas in the vicinity of SRS (DOE 1995g).

The SRS region is in a temperate climate with short, mild winters and long, humid summers. The average annual temperature is 19 degrees Celsius (66 degrees Fahrenheit); average daily temperatures vary from 3 degrees Celsius (38 degrees Fahrenheit) in January to 33 degrees Celsius (91 degrees Fahrenheit) in July. The average annual precipitation is 126 centimeters (50 inches) (DOE 1995g). Prevailing winds at SRS are from the southwest through west-northwest and from the northwest and east-northeast. The average annual wind speed is 5.7 meters per second (12.8 miles per hour) (DOE 1995g).

SRS is located in the Aiken Plateau portion of the Upper Atlantic Coastal Plain east of the Fall Line, a major physiographic and structural feature that separates the Piedmont from the Coastal Plain, in southeastern South Carolina. The soils at the site are mainly sandy and sandy loams. The site lies within a Seismic Zone 2 and is in an area where earthquakes capable of producing structural damage are not likely to occur. Probabilistic seismic hazard curves were developed for all DOE sites in the 1980s, and the results for SRS indicated that a peak acceleration of 0.19 gravity was associated with a probability of 2×10^{-4} per year (5,000-year return period). Since 1985, only three earthquakes, all of Richter magnitude 3.0 or less, have occurred in the immediate area of SRS (DOE 1995g).

The primary surface water feature is the Savannah River, which borders the site for approximately 32 kilometers (20 miles) to the southwest. There are six major streams that flow through SRS into the Savannah River, and approximately 190 Carolina bays scattered throughout the site. Carolina bays are naturally occurring land depressions that can hold water. The Savannah River and on-site streams are classified as fresh water suitable for primary and secondary contact recreation, as a source for drinking water supply following conventional treatment, fishing, and industrial and agricultural uses (DOE 1995g).

The most shallow aquifer at SRS is commonly referred to as the water table. Below the water table is the Congaree aquifer, and below it is the Cretaceous aquifer. Although there are variations, groundwater in the Cretaceous aquifer discharges predominantly along the Savannah River. The Cretaceous aquifer is an abundant and important water resource for the SRS region. Some of the local cities, such as Aiken, also obtain groundwater from the Cretaceous, but most of the rural population in the SRS region gets its water from the Congaree or water table. Groundwater quality

ranges from excellent (soft and slightly acidic) to poor (exceeding EPA drinking water standards for several constituents) in the vicinity of some waste sites. The Cretaceous aquifer is generally unaffected except for a relatively small portion of the site near existing waste treatment, storage, and disposal facilities that is contaminated with trichloroethylene. The Congaree aquifer is contaminated with trichloroethylene over a relatively small portion of the site in the northeast part of SRS and low levels of tritium in the General Separation areas. The water table is contaminated with solvents, metals, or low levels of radionuclides at several waste sites and facilities (DOE 1995g). SRS is included on the CERCLA National Priorities List.

There have been five major plant communities identified at SRS. The loblolly-longleaf-slash pine community is the dominant community covering approximately 65 percent of the site. Swamp forests and bottomland hardwood forests are found along the Savannah River. SRS supports a diverse and abundant wildlife community, including 43 amphibian, 58 reptile, 213 bird, and 54 mammal species. SRS contains approximately 19,850 hectares (49,030 acres) of wetlands, most of which are associated with floodplains, streams, and impoundments. Sixty-one federal- and state-listed threatened, endangered, and other special status species have been identified at SRS. There is potential habitat in some areas for the Red Cockaded Woodpecker (*Dendrocopos borealis*).

More than 60 percent of SRS has received some level of cultural resources evaluation. More than 800 prehistoric sites have been identified, although fewer than 8 percent have been evaluated for eligibility to the NRHP. Approximately 400 historic sites have been identified within SRS, ten of which are eligible for the NRHP. Literature reviews and consultations with Native American representatives reveal that there are some concerns related to the American Indian Religious Freedom Act within the central Savannah River valley.

Four counties in which 87 percent of all SRS employees reside compose the economic ROI. SRS currently employs approximately 16,300 persons (4.6 percent of the total regional economic area employment) (DOE 1995g). The total population in the ROI in 1990 was 460,028 with approximately 37 percent minority and 14 percent below poverty level. The ROI unemployment rate was 8.4 percent in 1991 (META/Berger 1995).

Interstate-20 is located approximately 29 kilometers (18 miles) northeast of SRS, providing the nearest interstate access to the site. State Routes 19, 64, and 125 are used by 40, 10, and 50 percent of the SRS commuters, respectively. SRS is served by more than 200 miles of primary roads on-site. Railroad service is also available through SRS (DOE 1995g).

The annual radiation dose to the population residing within 80 kilometers (50 miles) of the site from normal accident-free operations during 1994 would result in 8×10^{-3} LCFs. The population within this area was 620,000. The annual dose from airborne radionuclides to the MEI during 1994 would result in a 8×10^{-8} probability of an LCF. The corresponding dose is below the NESHAP limit.

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