3.5.6 BIOLOGICAL RESOURCES

Terrestrial Resources. Pantex is located within a treeless portion of the High Plains that is classified as mixed prairie. The High Plains vegetational area is a southern extension of the short- and mid-grass prairies of the Western Great Plains. The primary vegetation of the High Plains includes short-grasses (that is, buffalo-grass and blue grama) and mid-grasses (that is, little bluestem, sideoats grama, and western wheatgrass) (PX DOE 1991a:2). Approximately 25 percent of the site, including land leased from Texas Tech University, has been developed (PX 1992a:5). Much of the remainder of the site is currently being managed as native and improved pasture or cultivated by the University or its tenant farmers (PX DOE 1983a:3-20,3-23). Small areas of relatively undisturbed vegetation exist around playas. Some protection for native habitat is also provided where plant operations preclude agricultural activities. Vegetation within these areas is primarily grasses and herbs, although barrel cactus is also present (PX DOE 1995d:5-3,5-4). A site vegetation map is not available (PX 1992a:6). While the area proposed for storage facilities has been largely disturbed by past activities, the assumed analysis site for the evolutionary LWR is in agricultural use. A total of 229 plant species have been identified on the Pantex Site (PX DOE 1993c:2).

Terrestrial wildlife species occurring on Pantex include 7 amphibian, 8 reptile, 43 bird, and 19 mammal species (PX DOE 1994c:4,5; PX DOE 1994d:7-11). Common bird species known to occur in the vicinity of Pantex include the western meadowlark, mourning dove, horned lark, and several species of sparrows. Common species of mammals found in the vicinity of Pantex include the black-tailed jackrabbit, black-tailed prairie dog, and hispid cotton rat (PX 1994a:1; PX DOE 1991a:2). Among the game animals occurring onsite are the desert cottontail, northern bobwhite, scaled quail, mourning dove, and numerous waterfowl species (PX 1994a:1). Hunting is not permitted at Pantex (PX 1992a:5). Common raptors on Pantex include the Swainson hawk, American kestrel, and burrowing owl (PX DOE 1994b:3,5). Carnivores present include the badger and coyote. A variety of migratory birds has been found at Pantex. Migratory birds, as well as their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Wetlands. Wetlands at Pantex are associated with the five playa basins occurring on the site, and Pantex Lake (also a playa), located approximately 5 km (3 mi) northeast of the site. The NWI map identifies Playas 1 through 5 and part of Pantex Lake as wetlands. Playas 1, 2, and 3 are classified by the USFWS as palustrine systems. The larger Playas, 4 and 5, and most of Pantex Lake are classified as lacustrine systems. Playas 1, 2, and 4 currently receive stormwater discharge. There are numerous smaller wetlands (approximately 4 ha [10 acres] or less) located on western and southwestern parts of Pantex in areas that are largely grazed or farmed (PX 1992a:4). While these wetlands have not been delineated using COE criteria (USCOE 1987a:13-14), they are classified on NWI maps as palustrine systems. Situated along the central flyway migratory route, the Pantex playas are important to migratory birds and also provide valuable habitat for nesting and wintering species. While the consolidated Pu storage facility site does not contain any of the smaller wetlands noted above, the assumed analysis site for the evolutionary LWR could contain one such wetland.

Aquatic Resources. Aquatic habitat at Pantex is limited to five ephemeral playas (including Pantex Lake), one permanent playa, and several ponds and ditches. Although the playas and ditches may provide habitat for amphibians and macroinvertebrates, they do not support any fish populations (PX 1992a:5), except for a small pond at the southeast corner of Pantex Lake, which supports a population of minnows (PX DOE 1996b:4-139). Aquatic resources do not occur on the consolidated Pu storage facility site or the assumed analysis site for the evolutionary LWR.

Threatened and Endangered Species. Ten federally or State-listed threatened, endangered, and other special status species may be found on or in the vicinity of Pantex; eight of these are federally or State-listed as threatened or endangered (Table 3.5.6–1). Five species listed in Table 3.5.6–1 have been observed on Pantex, including four of the federally or State-listed threatened or endangered species. Once specific project locations have been determined, site surveys will verify the presence of special status species. The discussion presented

Table 3.5.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Pantex Plant

Common Name	Scientific Name	Status[a] Federal	State
Mammals			
[Text deleted.]			
Swift fox[b]	*Vulpes velox*	C	NL
[Text deleted.]			
Birds			
American peregrine falcon[c]	*Falco peregrinus anatum*	E	E
Arctic peregrine falcon	*Falco peregrinus tundrius*	E (S/A)	T
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	E
[Text deleted.]			
Interior least tern[c]	*Sterna antillarum athalassos*	E	E
[Text deleted.]			
Mountain plover	*Charadrius montanus*	C	NL
[Text deleted.]			
White-faced ibis[b]	*Plegadis chihi*	NL	T
Whooping crane[b,c]	*Grus americana*	E	E
Reptiles			
Smooth green snake	*Opheodrys vernalis*	NL	E
[Text deleted.]			
Texas horned lizard[b]	*Phrynosoma cornutum*	NL	T

[a] Status codes: C=Federal candidate; E=endangered; NL=not listed; S/A=protected under the similarity of appearance provision of the ESA; T=threatened.
[b] Species observed on the Pantex Plant site.
[c] USFWS Recovery Plan exists for this species.
Source: 50 CFR 17.11; 50 CFR 17.12; 61 FR 7596; PX DOE 1996b; PX MH 1994c; TX PWD 1993a; TX PWD 1995a; TX PWD 1995b.

in this section is generally applicable to Pantex as a whole. No critical habitat for threatened and endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on Pantex.

The bald eagle is a winter resident that has been observed foraging at playas on the site each year. Prairie dog towns provide feeding habitat for bald eagles and other raptors. The whooping crane, an infrequent migrant in the Texas Panhandle, was observed foraging onsite and in the surrounding area in the fall of 1990 (PX 1992a:3). Migratory peregrine falcons (undetermined subspecies) have been observed hunting shorebirds and waterfowl near area playas (PX WTS 1992a:1). [Text deleted.] Possible swift fox dens have been found on Pantex. The Texas horned lizard is known to reside on the site. [Text deleted.] White-faced ibis forage at the playas.

There is little undisturbed habitat at Pantex that would accommodate any of the threatened, endangered, and other special status species, other than the Texas horned lizard, listed in Table 3.5.6–1. Most of these species are attracted to the playas, which provide water and foraging habitat. No federally or State-listed plant species are known to occur on Pantex. However, there are three cactus species at Pantex that may be proposed for a watchlist of potentially threatened plant species (PX DOE 1993c:15-16).

3.5.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric site types identified at Pantex include small temporary campsites and limited activity locations characterized by surface scatters of artifacts. Archaeological surveys at Pantex have systematically covered approximately one-half of the facility. Approximately 60 prehistoric sites have been recorded to date on DOE and Texas Tech University property. Some of the sites contain heat-altered rock and artifact types that suggests food processing. These prehistoric campsites tend to be clustered near the Pantex playa drainages. Of 23 archaeological sites tested, only one has been determined potentially eligible for listing on the NRHP. It is a late prehistoric bison kill or butchering site north of Pantex Lake. Some areas where the facilities would be located have not been systematically surveyed for prehistoric resources. However, a site location model has been developed and tested at Pantex, and indicates it is highly unlikely that such sites are present. In this model, prehistoric sites would be located only within 0.4 km (0.25 mi) of playas or their obvious drainages. A Programmatic Agreement to ensure regulatory compliance at Pantex will be in place by fiscal year 1997, and a cultural resource management plan is being developed. Implementation of this plan, which will supersede the Programmatic Agreement, is scheduled for 1998. An interim programmatic agreement is in place to ensure regulatory compliance, and potential impacts are evaluated on a case-by-case basis.

Historic Resources. The Pantex facility was originally constructed in 1942 as a World War II bomb-loading plant on land claimed from local farmers. To date, 12 historic archaeological sites associated with these original farmsteads have been located and recorded. These sites have minimal integrity and are highly unlikely to be eligible for the NRHP. All of Pantex has been surveyed for World War II-era structures and foundations, and all such properties have been systematically recorded. Based on information gathered during surveys, Zone 4, originally constructed as a High Explosive Storage Area for ammonium nitrate, does not appear to possess the architectural integrity necessary to be eligible for the NRHP. The Texas SHPO prepared a list of 45 buildings in Zones 11 and 12 that may be eligible for NRHP listing. The Cold War historic context has not yet been fully defined for Pantex. When completed, it is probable that a number of plant structures will be determined NRHP eligible.

Native American Resources. Native Americans known to have potential interests in Pantex include the Comanche Tribe of Oklahoma; the Kiowa Tribe of Oklahoma; the Apache Tribe of Oklahoma; the Cheyenne-Arapaho Tribe of Oklahoma; the Wichita and Affiliated Tribes; the Caddo Tribe of Oklahoma; the Delaware Tribe of Western Oklahoma; and the Fort Sill Apache Tribe. Four of these tribes, the Fort Sill Apache Tribe, the Apache Tribe of Oklahoma, the Kiowa Tribe of Oklahoma, and the Comanche Tribe of Oklahoma, have recognized traditional interests in Pantex. DOE is performing a historic treaties search and a public outreach program to involve Native American stakeholders in decisionmaking related to the use of Pantex land and the protection of cultural resources. Traditional cultural properties have not been identified at Pantex, but the remains of temporary historic campsites and hunting locations are possible.

Paleontological Resources. The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation contains Late Pleistocene vertebrate remains, including bison, camel, horse, mammoth, and mastodon, with occasional evidence of their use by humans. [Text deleted.]

3.5.8 SOCIOECONOMICS

Socioeconomic characteristics described for Pantex include employment, regional economy, population, housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA, which encompasses 32 counties surrounding Pantex in Texas and New Mexico (Table L.1–1). Statistics for population, housing, community services, and local transportation are presented for the ROI, a four-county area in which 95.8 percent of all Pantex employees reside: Armstrong County (1.4 percent), Carson County (5.4 percent), Potter County (34.4 percent), and Randall County (54.6 percent) (Table L.1–5). In 1994, Pantex employed 3,559 persons (1.8 percent of the total REA employment).

Regional Economy Characteristics. Selected employment and regional economy statistics for the Pantex REA are summarized in Figure 3.5.8–1. Between 1980 and 1990, the civilian labor force increased 9.3 percent to 209,786. In 1994, the unemployment rate in the REA was 4.8 percent, lower than 6.4 percent unemployment in Texas and 6.3 percent unemployment in New Mexico. The 1993 per capita income in the REA was $19,312, higher than the per capita income in both Texas ($19,145) and New Mexico ($16,346).

Employment patterns in the REA closely parallel those in Texas and New Mexico, with manufacturing, retail trade, and service providing the majority jobs. The service sector accounts for the largest percentage of employment in both Texas and New Mexico, 27.7 percent and 28.3 percent, respectively, as well as in the region, 22.1 percent.

Population and Housing. Population and housing trends in the Pantex ROI are summarized in Figure 3.5.8–2. The ROI population, which totaled 205,684 in 1994, grew 12.8 percent between 1980 and 1994, less than half the growth rate of Texas (29.2 percent) during the same period. Within the ROI, the population of Carson County fell by 1.5 percent, while Randall County's grew 25.4 percent.

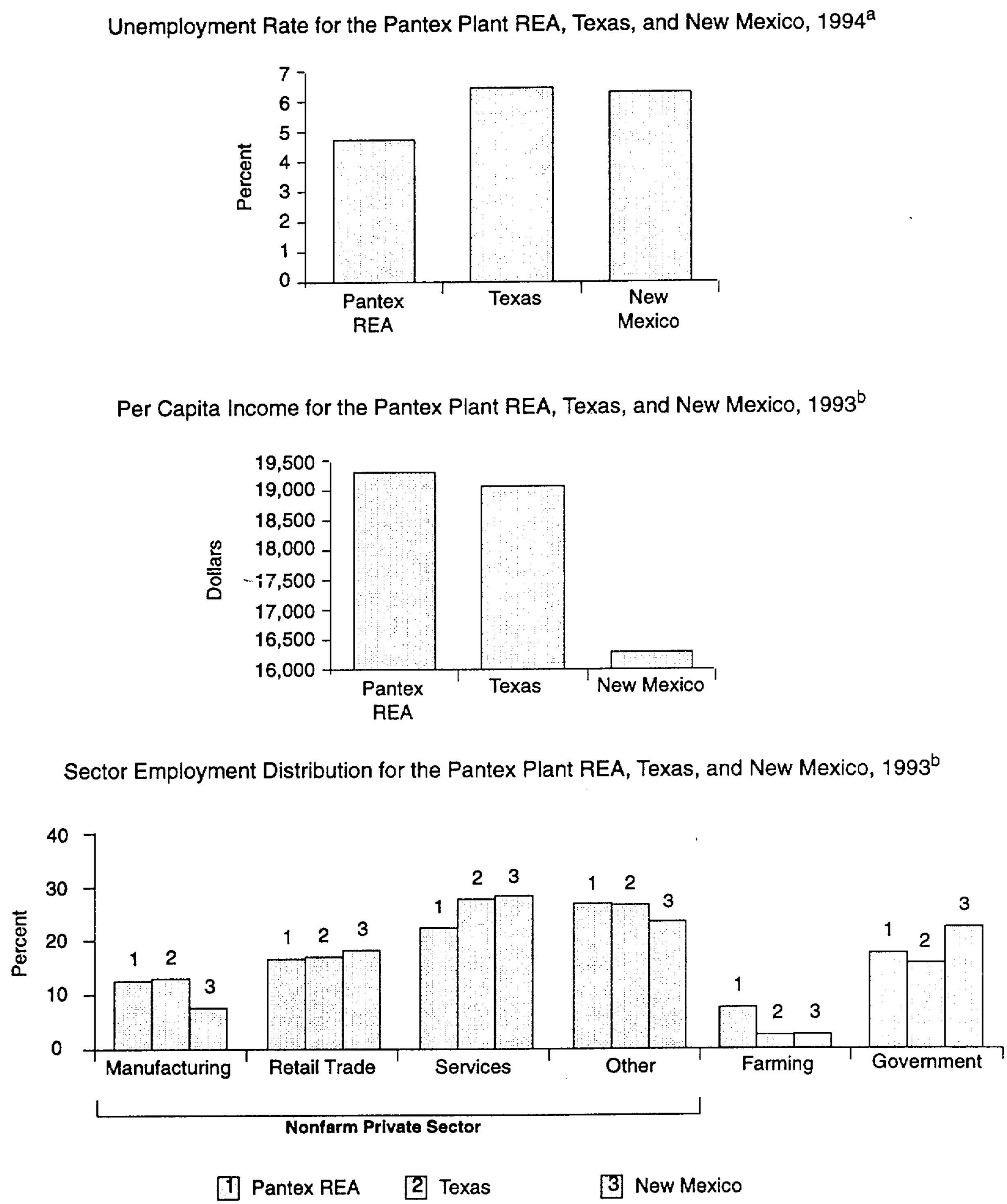
The increase in the total number of housing units in the ROI between 1980 and 1990 was approximately 11 percent, less than half the 26.3-percent increase in Texas. In Randall County, however, the number of housing units increased 28.3 percent during the same period. In 1990, homeowner and rental vacancy rates in the Pantex ROI were similar to those in Texas, approximately 3 percent and 14 percent, respectively.

Community Services. Community services described for the Pantex ROI are education, public safety, and health care. Figure 3.5.8–3 presents school district characteristics for the Pantex ROI, and Figure 3.5.8–4 presents public safety and health care characteristics.

Education. In 1994, the nine school districts that provided public education services and facilities in the Pantex ROI ranged in enrollment size from 229 students in the Groom School District to 28,925 students in the Amarillo School District. As shown in Figure 3.5.8–3, school districts were operating between 63.5 and 99.7 percent of capacity. The average student-to-teacher ratio for the ROI was 16.3:1.

Public Safety. Six city and county law enforcement agencies provide police protection in the ROI. In 1994, the city of Amarillo maintained the largest police force in the ROI, with 253 officers. The average ROI officer-to-population ratio was 2.3 officers per 1,000 persons. Figure 3.5.8–4 displays the sworn police officer-to-population ratios for the ROI counties and cities.

Ten fire departments consisting of a total of 491 regular and volunteer firefighters provided fire protection services in 1995. The city of Amarillo had the largest department in the ROI, with 213 paid firefighters. The highest firefighter-to-population ratio was 19.0 firefighters per 1,000 persons in Armstrong County. The average ROI firefighter-to-population ratio was 2.3 firefighter per 1,000 persons.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.5.8–1. Employment and Local Economy for the Pantex Plant Regional Economic Area and the States of Texas and New Mexico.

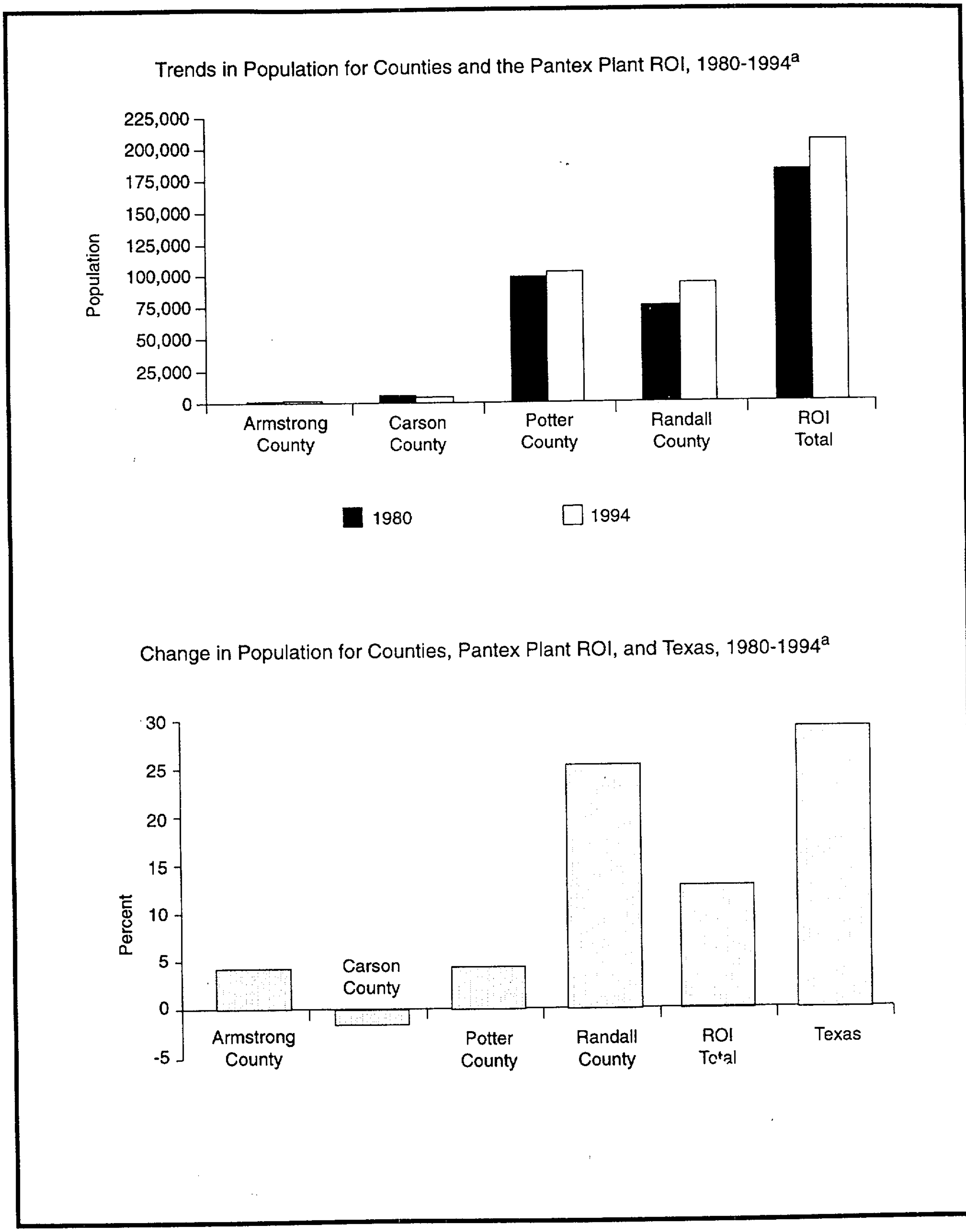
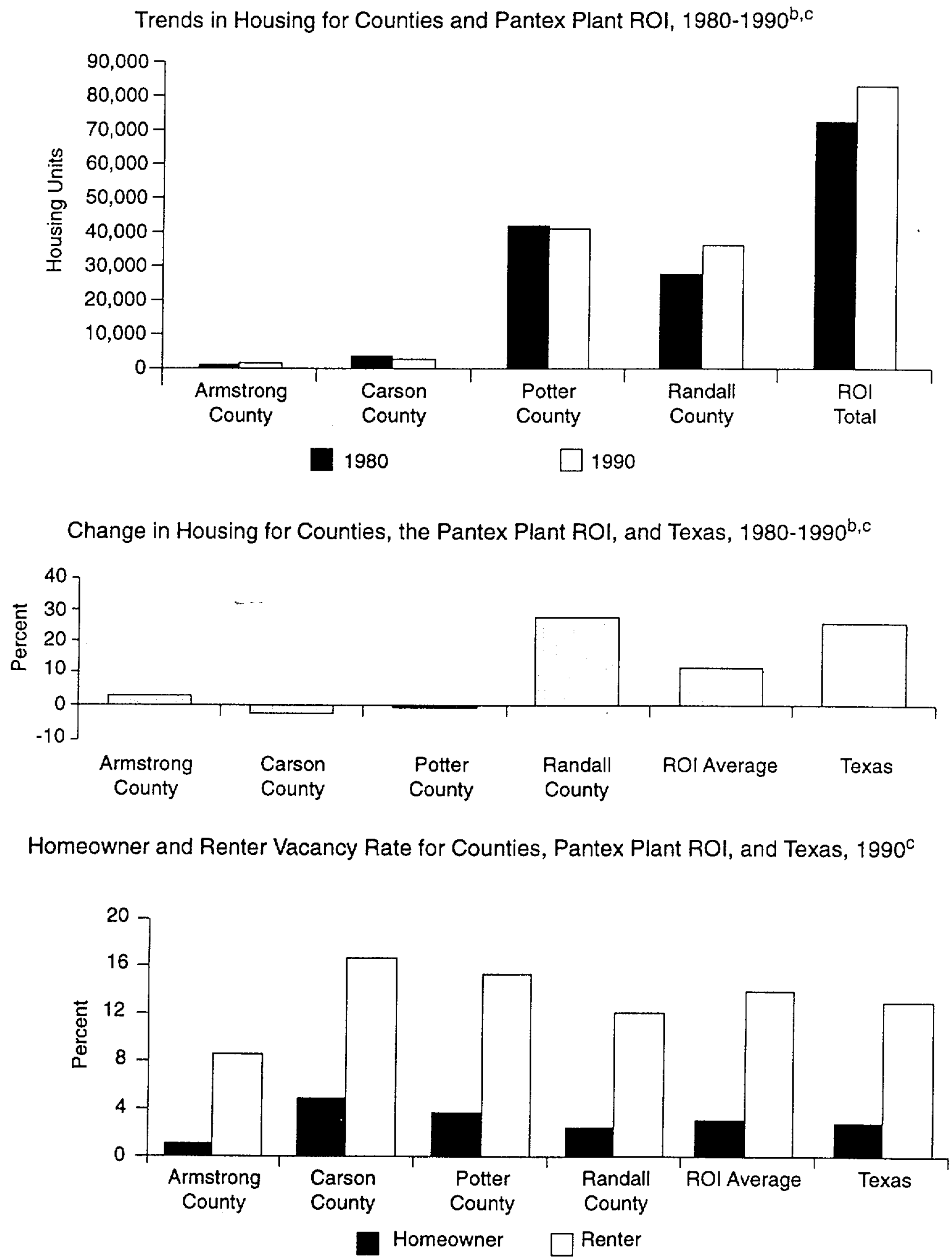
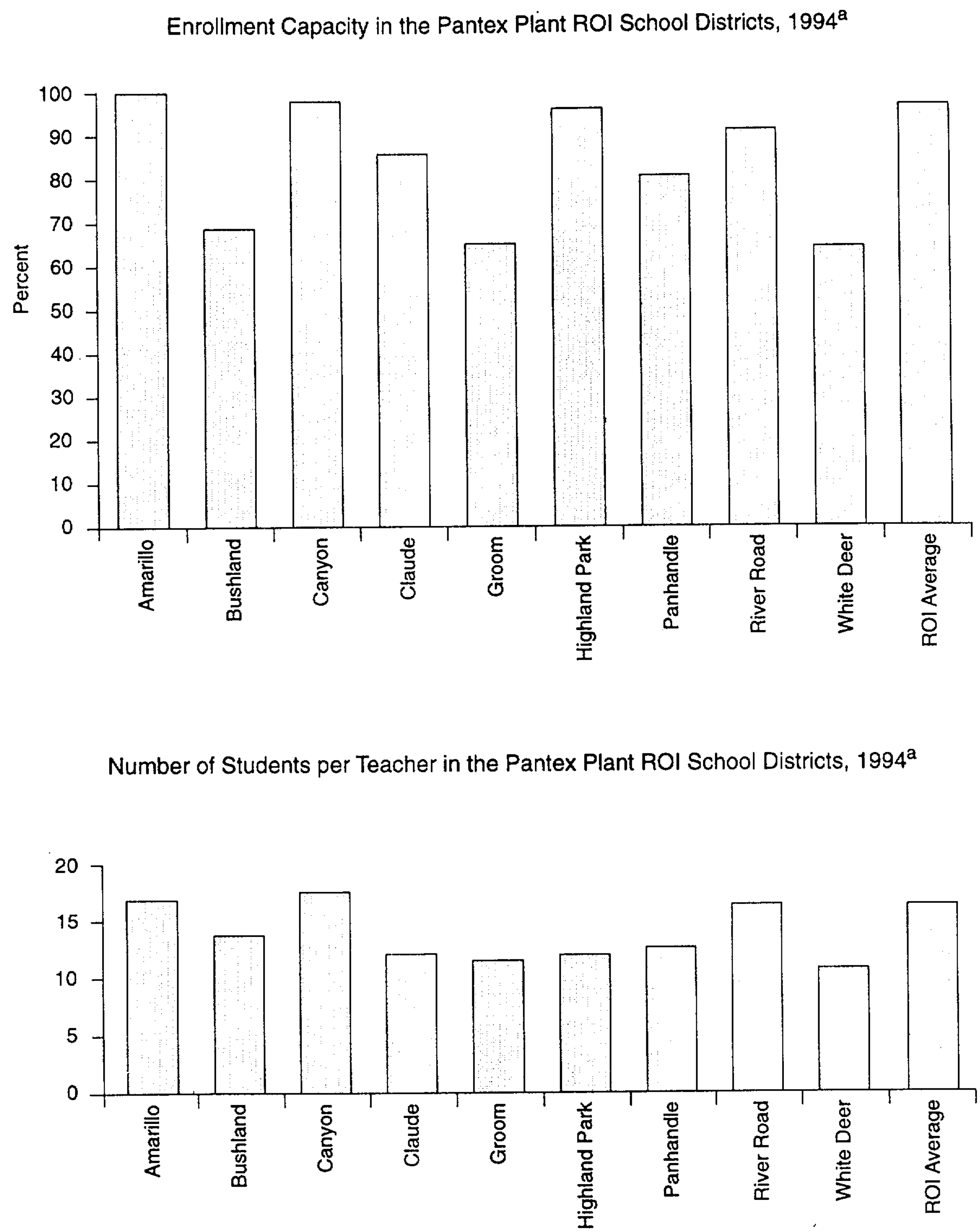


Figure 3.5.8–2. ***Population and Housing for the Pantex Plant Region of Influence and the State of Texas.***



[a] Census 1994o; Census 1995a
[b] Census 1982a.
[c] Census 1991m.

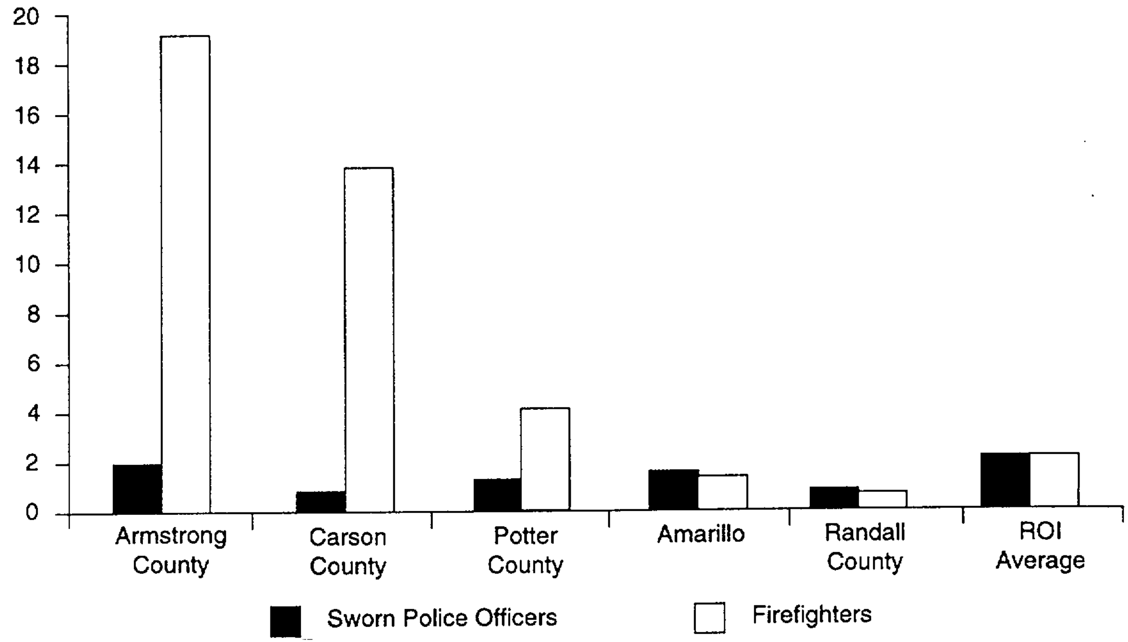
Figure 3.5.8–2. Population and Housing for the Pantex Plant Region of Influence and the State of Texas—Continued.



[a]Socio 1996a.

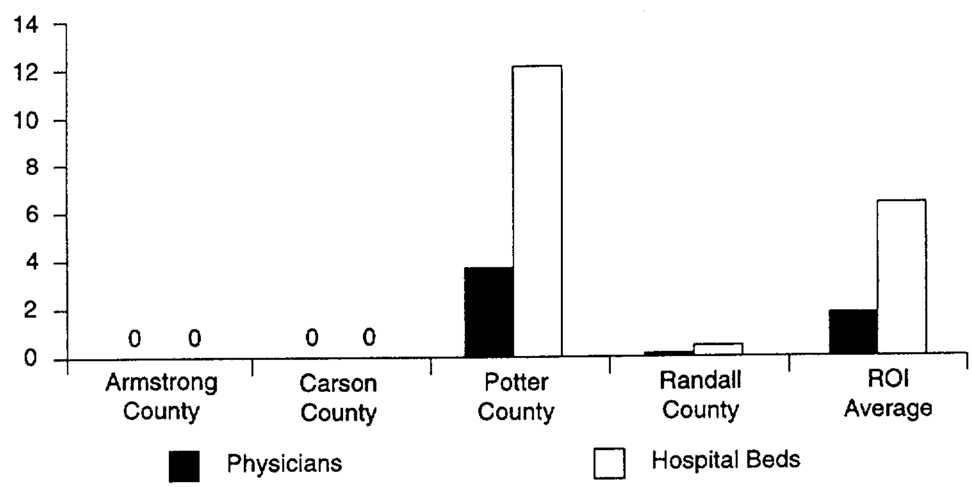
Figure 3.5.8–3. School District Characteristics for the Pantex Plant Region of Influence.

Number of Sworn Police Officers (1994) and Firefighters (1995) per 1,000 Persons in the Pantex Plant ROI[a]



Note: Non-ROI city values are included in county totals. Amarillo police and firefighters serve both Potter and Randall Counties.

Number of Physicians and Hospital Beds per 1,000 Persons in the Pantex Plant ROI, 1994[b]



[a] Census 1995a; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.5.8–4. Public Safety and Health Care Characteristics for the Pantex Plant Region of Influence.

Health Care. Six hospitals serve the four-county ROI, all operating well below capacity. The highest hospital bed-to-population ratio was 12.3 beds per 1,000 persons in Potter County. There are no hospitals in Armstrong or Carson Counties; medical emergencies in these counties are customarily transported to the cities of Amarillo or Pampa via ambulance service. In 1994, a total of 407 physicians served the ROI. Figure 3.5.8–4 shows that the highest physician-to-population ratio was 3.8 physicians per 1,000 persons in Potter County while there were no physicians in Carson and Armstrong Counties. The average physician-to-population ratio in the ROI was 2.0 physicians per 1,000 persons.

Local Transportation. Vehicular access to Pantex is provided by Farm-to-Market Roads 683 to the west and 2373 to the east. Both roads connect with Farm-to-Market Road 293 to the north and U.S. Highway 60 to the south. No major improvements are scheduled or currently ongoing for roads providing immediate access to Pantex (see Figure 2.2.4-1 and Figure 2.2.4-2).

Four road segments in the ROI could be affected by the storage and disposition alternatives. The first is I-27 from Local Route 335 at Amarillo to I-40 at Amarillo. This segment operated at level of service A in 1995. The second is Farm-to-Market Route 683 from U.S. 60 to Farm-to-Market Route 293. This segment operated at level of service A in 1995. The third is Farm-to-Market Route 2373 from I-40 to U.S. 60. This segment operated at level of service A in 1995. The fourth is Farm-to-Market Route 2373 from U.S. 60 to Farm-to-Market Route U.S. 60. The segment operated at level of service A in 1995.

Amarillo City Transit provides public transport service to Amarillo, but the service does not extend to Pantex. The major railroad in the Pantex ROI is the Burlington Northern and Santa Fe Railroad, a mainline which forms the southern boundary of Pantex and provides direct access to the site. There are no navigable waterways within the ROI capable of accommodating material transports to the plant.

Amarillo International Airport provides jet air passenger and cargo service from national and local carriers. Several smaller private airports are located throughout the ROI.

3.5.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of Pantex are shown in Table 3.5.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to Pantex operations.

Table 3.5.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Pantex Plant Operation

Sources	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic and external terrestrial radiation[a]	95
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	399

[a] PX DOE 1995d.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from Pantex operations provide another source of radiation exposure to people in the vicinity of Pantex. Types and quantities of radionuclides released from Pantex operations in 1994 are listed in the *1994 Environmental Report for Pantex Plant* (DOE/AL/65030-9506). The doses to the public resulting from these releases are given in Table 3.5.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1994 report were used in the development of the reference environment (No Action) radiological releases and resulting impacts at Pantex in the year 2005 (Section 4.2.4.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Pantex operations in 1994 is estimated to be 2.9×10^{-11}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Pantex operations is less than 3 chances in 100 billion. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 7×10^{-8} excess fatal cancers are projected in the population living within 80 km (50 mi) of Pantex from normal operations in 1994. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this mortality rate, the number of fatal cancers expected to occur during 1994 from all causes in the population living within 80 km (50 mi) of Pantex was 550. This number of expected fatal cancers is much higher than the estimated 5×10^{-8} fatal cancers that could result from Pantex operations in 1994.

Table 3.5.9–2. Radiation Doses to the Public From Normal Pantex Plant Operation in 1994 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	5.8×10^{-5}	4	0	100	5.8×10^{-5}
Population within 80 km[b] (person-rem)	None	1.4×10^{-4}	None	0	100	1.4×10^{-4}
Average individual within 80 km[c] (mrem)	None	5.0×10^{-7}	None	0	None	5.0×10^{-7}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (see 58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] In 1994, this population was approximately 275,000.

[c] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: PX DOE 1995d.

Pantex workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.5.9–3 presents the average worker, maximally exposed worker, and total cumulative worker dose to Pantex workers from operations in 1994. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to Pantex workers from normal operations in 1994 is estimated to be 0.012.

Table 3.5.9–3. Radiation Doses to Workers From Normal Pantex Plant Operation in 1994 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	10
Maximally exposed worker (mrem)	5,000	660
Total workers[b] (person-rem)	ALARA	30

[a] DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1994 was approximately 2,980.

Source: 10 CFR 835; PX DOE 1995d.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *1994 Environmental Report for Pantex Plant* (DOE/AL/65030-9506). In addition, the concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are presented in the same reference. Past discharges to Playa 1 were substantial, but as in 1994, they were mainly nonradiological. However, this playa is located onsite and is not used as a drinking water source. Appropriate monitoring is conducted to ensure that contamination of any kind from this playa will not reach drinking water supplies.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface water during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.5.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at Pantex via inhalation of air containing hazardous chemicals released to the atmosphere by Pantex operations. Risks to public health from other possible pathways such as ingestion of contaminated drinking water or by direct exposure are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.5.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. All annual concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to Pantex workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with particular work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Pantex workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemical utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at Pantex are expected to be substantially better than required by the standards.

Health Effects Studies. Only one cancer incidence and mortality study was conducted on the general population in communities surrounding the Pantex facility (with data collected between 1980 and 1990), and only one study of workers (employed between 1951 and 1978) has been done. No significant excess cancer mortality was found, and the analysis on excess cancer incidence had too few cases to be considered reliable. Workers were reported to show a non-statistically significant excess of brain cancer and leukemia in the study conducted, but the small number of cases could be attributed to chance alone. For a more detailed description of the studies reviewed and the findings, refer to Section M.4.5.

Accident History. There have been no Pu-dispersing detonation accidents during nuclear weapons operations at Pantex. In 1989, during a weapon disassembly and retirement operation, a release of tritium in the assembly cell occurred. As a result, four workers received negligible doses and a fifth worker received a dose of 1.4 mrem. [Text deleted.]

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with planning, preparedness, and response.

Pantex has an Emergency Management Plan, with guidance on implementation provided by a series of Emergency Preparedness Procedures manuals, to protect life and property within the facility, the health and welfare of surrounding areas, and the defense interests of the Nation during any credible emergency situation. Formal mutual assistance agreements have been made with the Amarillo Fire Department, the National Guard, and St. Anthony's Hospital. Under accident conditions, an emergency coordinating team of DOE and Pantex contractor management personnel would initiate the Pantex Emergency Plan and coordinate all onsite actions.

If offsite areas could be affected, the Texas Department of Public Safety would be notified immediately and would make emergency announcements to the public and local governmental agencies in accordance with Annex R of the *State of Texas Emergency Management Plan.* Pantex has Radiological Assistance Teams with a total of 46 personnel who are equipped and trained to respond to an accident involving radioactive contamination either onsite or offsite. In addition, the Joint Nuclear Accident Coordination Center in Albuquerque, New Mexico, can be called upon should the need arise. This would mobilize radiation emergency response teams from DOE, DoD, and other participating Federal agencies.

3.5.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for Pantex. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.4. Table 3.5.10–1 presents a summary of waste management activities at Pantex for 1994.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at Pantex. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements.

On July 29, 1991, EPA Region 6 proposed Pantex for listing on the NPL of Superfund cleanup sites. EPA placed Pantex on the NPL on May 31, 1994. The DOE Amarillo Area Office is currently negotiating a tri-party Federal Facility Agreement with the EPA and the State of Texas. Currently, all environmental restoration activities are conducted in compliance with an RCRA permit issued in April 1991, as modified in February 1996. Environmental restoration activities are expected to be completed in 2000.

Pantex's waste management goals are to avoid waste generation or minimize the volumes of wastes generated to the extent that is technologically and economically practicable; reduce the hazard of waste through substitution or process modification; minimize contamination of existing or proposed real property and facilities; minimize exposure and associated risk to human health and the environment; and ensure safe, efficient and compliant long-term management of all wastes. Pantex manages the following waste categories: TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. Pantex does not generate or manage spent nuclear fuel.

High-Level Waste. Pantex does not generate or manage HLW.

Transuranic Waste. Pantex does not generate or manage TRU waste as a result of normal operations. In the unlikely event that any TRU waste is generated, there are established procedures to manage this waste.

Low-Level Waste. Low-level waste generated at Pantex consists of contaminated parts from weapons assembly and disassembly functions and radioactive waste materials associated with these functions, such as protective clothing, cleaning materials, filters, and other similar materials. As shown in Table 3.5.10–1, Pantex generates a small quantity of liquid LLW. Liquid LLW is being stored onsite awaiting a treatment process. Compactible wastes are processed at Pantex's Solid Waste Compaction Facility and stored along with the noncompactible materials for shipment to a DOE-approved disposal site or a commercial vendor. Pantex's LLW is currently shipped to NTS for disposal.

Mixed Low-Level Waste. Mixed LLW is generated during various production, maintenance, modifications, and dismantlement functions. These wastes consist primarily of small quantities of materials such as radioactively- contaminated solvents and wipes contaminated by organic solvents and radioactive scrap metals. Mixed LLW is currently stored onsite in RCRA-permitted facilities. Pantex has received exemptions to DOE Order 5820.2A for mixed waste shipments to two RCRA-permitted commercial facilities. One shipment had been made as of June 1994. Pantex developed the *Pantex Plant Federal Facility Compliance Act Compliance Plan* to provide mixed waste treatment capability for all mixed waste streams in accordance with the *Federal Facility Compliance Act* of 1992. This plan was approved by the TNRCC and adapted through an Agreed Order on September 27, 1995. The Agreed Order, signed by the State of Texas on October 2, 1995, requires implementation of this plan.

Table 3.5.10–1. Waste Management Activities at Pantex Plant

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Low-Level							
Liquid	33	Solidification onsite pending	12	Staged for processing	Varies[a]	None	NA
Solid	122	Compaction	168	Staged for shipment	Included in liquid low-level	Shipped offsite to NTS	NA
Mixed Low-Level							
Liquid	1	None onsite encapsulation pending	Planned	Staged for future treatment	1,470[b]	NA	NA
Solid	15	Compaction and open burning (HE only)	Planned	Staged for future treatment	Included in liquid mixed LLW	In accordance with Pantex Site Treatment Plan	NA
Hazardous							
Liquid[c]	16	Offsite	Variable	Staged for shipment	Included in liquid mixed LLW	Shipped offsite	NA
Solid	185[d]	Open burning[e]	Variable	Staged for shipment	Included in liquid mixed LLW	Shipped offsite	NA
Nonhazardous (Sanitary)							
Liquid	476,000[f]	Evaporation and filtration	898,000[g]	None	NA	Playa 1	898,000 m^3/yr[g]
Solid	1,150[h]	Compaction	1,020	None	NA	Landfill (offsite)	NA

Table 3.5.10–1. Waste Management Activities at Pantex Plant—Continued

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Other)							
Liquid	4,190[i]	Carbon absorption/ filtration	Included in liquid sanitary	None	NA	Playa 1 and 2	Included in liquid sanitary
Solid	47,400[j]	Compaction	Included in solid sanitary	None	NA	Landfill (onsite)–construction debris only	Expandable

[a] Total amount of storage capacity available for LLW is a function of the percentage of total capacity currently occupied by hazardous wastes and mixed LLW.
[b] Operating capacity. Permitted storage can accommodate both LLW and mixed LLW.
[c] Includes solvent-contaminated wastewater and spent organic solvents contaminated with explosives.
[d] Includes 177 m^3 of RCRA-regulated and 8 m^3 of TSCA-regulated (PCB and asbestos-contaminated) wastes.
[e] High explosives-contaminated wastes only. Open burning is done in thermal treatment units (trays, pans, and flashing pads) on a per burn basis.
[f] Sewage wastewater.
[g] Permit limit.
[h] Data reported as 824,407 kg. For analysis 720 kg/m^3 density assumed (PX 1995a:2). Includes 820 m^3 of waste disposed at Amarillo landfill and 327 m^3 disposed at other offsite treatment/disposal facilities.
[i] Includes 3,790 m^3 of wastewater discharged to Playa 1. Treatment is filtration only and is not included in treatment capacity.
[j] Construction debris.
Note: NA=not applicable.
Source: PX 1995a:2; PX DOE 1995d; PX DOE 1995i; PX DOE 1996b.

Hazardous Waste. Pantex received a RCRA Part B hazardous waste permit from EPA and TNRCC on April 25, 1991. This permit authorizes Pantex to manage hazardous and industrial solid wastes listed in the permit. The permit also requires Pantex to notify TNRCC of the discovery of any release of hazardous waste or hazardous constituents that may have occurred from any solid waste management unit. This permit specifically excluded the RCRA units at the Burning Ground. These units operated under interim status with a written grant of authority from TNRCC for air emissions. A Class 3 permit modification was submitted to add the RCRA units at the Burning Ground to the permit; however, it was contested by members of the public. After the settlement of the contested case hearing, Pantex received the Class 3 modification effective February 16, 1996. In this modification the RCRA units at the Burning Ground were added to the permit with the exception of the cages and flashing pits which were specifically excluded. The cages have been dismantled and removed and are currently undergoing closure. Under the modification the flashing pits will continue to be permitted under interim status for one year after which they must undergo closure. The written grant of authority is no longer in place as the modification contains air emissions provisions for all RCRA units, with additional provisions for the Burning Ground units.

Much of the hazardous waste generated at Pantex comes from high explosive operations, electroplating, photographic, and various other operations also generate hazardous waste streams. High explosives, high-explosive support material, high-explosive-contaminated materials, and high-explosive-contaminated solid wastes are burned under controlled conditions at the Burning Ground. Ash, debris, and residue resulting from this burning are transported offsite for approved disposal at a commercial RCRA-permitted facility. All other hazardous wastes generated at Pantex, including various chemicals, solvents, heavy metals, and other hazardous constituents, are manifested and shipped offsite by DOT-certified transporters for recycle or disposal at a commercial RCRA-permitted facility.

Nonhazardous Waste. Nonhazardous liquid and solid sanitary wastes are generated at Pantex. Sewage and some pretreated industrial wastewater are treated by a sanitary sewage treatment system. The liquid effluent from the system is discharged into a playa, which then either evaporates or infiltrates into the ground. Stormwater discharges are regulated by a NPDES permit. A proposed upgrade to the sanitary wastewater treatment system would permit all industrial wastewater and sewage to be treated at one location.

Nonhazardous solid waste generated onsite consists primarily of paper, cardboard, construction wastes, and cafeteria waste. Only construction wastes are disposed of onsite. Until late 1989, sanitary waste was disposed of at the onsite sanitary landfill. Since then, sanitary waste has been transported to the city of Amarillo landfill for disposal. Waste asbestos is sent to an offsite permitted landfill.

3.6 OAK RIDGE RESERVATION

The ORR is located in Oak Ridge, Tennessee (Figure 2.2.5–1), and contains ORNL, Y–12, and the K–25 Site. The primary focus of ORNL is conducting basic and applied scientific research and technology development. Y–12 engages in national security activities and manufacturing outreach to U.S. industries. K–25 serves as an operations center for ORR's environmental restoration and waste management programs. The locations of facilities within ORR are illustrated in Figure 2.2.5–2.

Department of Energy Activities. These activities can be categorized as defense programs, environmental management, and other DOE missions. The current missions and functions at ORR are described in Table 3.6–1.

The ORR DP assignments are performed at Y–12 and include storing uranium and lithium materials and weapons parts, maintaining the capability to fabricate components for nuclear weapons, dismantling nuclear weapon components returned from the national stockpile, processing special nuclear materials, and providing special production support to the DOE design agencies and other DOE programs.

Table 3.6–1. Current Missions at Oak Ridge Reservation

Mission	Description	Sponsor
Uranium and lithium storage	Store enriched uranium, depleted uranium, and lithium materials and parts	Assistant Secretary for Defense Programs
Weapons components	Maintain capability to fabricate uranium and lithium components and parts for nuclear weapons	Assistant Secretary for Defense Programs
Dismantlement activities	Dismantle nuclear weapon components returned from the stockpile	Assistant Secretary for Defense Programs
Special nuclear material	Process uranium	Assistant Secretary for Defense Programs
Support services	Provide support to design agencies	Assistant Secretary for Defense Programs
Environmental restoration and waste management	Waste management and D&D activities at ORNL, Y–12, and K–25	Assistant Secretary for Environmental Management
Research and development	ORNL basic research and development in energy, health, and environment	Office of Energy Research; Assistant Secretary for Environment, Safety and Health; Office of Nuclear Energy
Isotope production	ORNL produces radioactive and stable isotopes not available elsewhere	Office of Nuclear Energy
Educational and research programs	Oak Ridge Institute for Science and Education programs in the areas of health, environment, and energy	Office of Energy Research; Assistant Secretary for Environment, Safety and Health; Office of Nuclear Energy
Work for other Federal agencies	Meteorological, reactor safety, environmental research	NOAA, NRC, EPA
Technology transfer	Programs to transfer unique technologies developed at ORR to private industry	Department of Energy

Source: OR LMES 1995e; OR DOE 1994c.

The Y–12 Plant was constructed as part of the World War II Manhattan Project. The site's first mission was the separation of U-235 from natural uranium by electromagnetic separation. The magnetic separators were taken out of commission at the end of 1946, when gaseous diffusion became the accepted process for enriching uranium. Missions have evolved and changed with the end of the Cold War resulting in a reduction of Y–12's weapon component production mission. Due to the reduced workloads, the operational space at Y–12 is being significantly downsized. However, since Y–12 is designated as the interim DOE repository for unirradiated enriched uranium, the present interim storage space is being expanded in existing facilities to accommodate additional enriched uranium returned from stockpiled weapons and other DOE sites. The majority of this HEU would be housed in facilities currently utilized for HEU storage. The remaining HEU would be stored in facilities currently being converted into storage areas. This expansion of the plant's storage capacity is an ongoing DOE-approved effort to prepare Y–12 for the large quantity of HEU arriving over the next few years.

The Y–12 Plant continues to maintain the capability to fabricate nuclear weapon components as a major mission. Maintaining production capability involves the ability to fabricate materials into components, inspect and certify the components, and produce weapons subassemblies from the components.

As nuclear weapons are removed from the stockpile, they must be dismantled, and materials and parts appropriately dispositioned. These returned materials and components, as well as those currently located at Y–12, are safely and securely placed in interim storage.

The Y–12 Plant also provides fabrication support to DOE's weapon design laboratories at LANL, LLNL, and Sandia National Laboratories (SNL), and produces components design evaluations for these customers. In addition, Y–12 performs some stockpile surveillance activities to ensure reliability of the nuclear stockpile.

Environmental management activities are in progress at each of the major facilities within ORR. These activities consist of environmental remediation and restoration, D&D of surplus facilities, and waste management. DOE's Center for Environmental Technology and Center for Waste Management are located at K–25. Environmental restoration and waste management activities at ORR are discussed in detail in Section 3.6.10 and Appendix E.

Oak Ridge Reservation, in conjunction with the Oak Ridge Institute for Science and Education, supports other offices and missions within DOE (Energy Research, ES&H, Nuclear Energy).

Non-Department of Energy Activities. Non-DOE activities pursued at ORR include missions and programs of the NOAA, which conducts meteorological and atmospheric diffusion research that is supported by itself and DOE. This work is done at the Atmospheric Turbulence and Diffusion Laboratory and field sites on ORR. This laboratory also provides services to DOE contractors and operates the Weather Instrument Telemetering Monitoring System for DOE. In addition, ORR provides support to other Federal agencies (NRC, EPA, and others), and private industry in conducting basic scientific research; engineering technology development and transfer; and educational research in the areas of health, environment, and energy.

3.6.1 LAND RESOURCES

Land Use. The ORR consists of approximately 13,980 ha (34,500 acres) located mostly within the corporate limits of the city of Oak Ridge, approximately 19 km (12 mi) west of Knoxville, Tennessee. All the land within ORR is owned by the Federal Government and is administered, managed, and controlled by DOE. One alternative proposes to site a new facility on a section of land located on undeveloped land south of Bear Creek Road along the Clinch River. The potential site is not within the ORR boundary, but it is owned by the TVA.

Existing Land Use. Generalized land uses at ORR and in the vicinity are shown in Figure 3.6.1–1. Land uses within ORR can be grouped into four classifications: industrial, forest/undeveloped, public/quasi-public, and water. The industrial areas account for approximately 4,700 ha (11,600 acres) of the total site acreage. About 500 ha (1,240 acres) are used for a security buffer zone around various facilities. About 300 ha (741 acres) of ORR's land is classified as public land and consists mainly of the 36-ha (89-acre) Clark Center Recreational Park, numerous small public cemeteries, and an onsite public road (OR DOE 1989a:5-10). The remaining area, about 8,500 ha (21,000 acres), consists of forest/undeveloped land, some of which is managed as pine plantations for production of pulpwood and saw timber. The DOE water treatment facility, which provides water to many ORR facilities and the city of Oak Ridge, is located just north of Y–12. There are no prime farmlands on ORR.

In 1980, DOE designated a portion of ORR's undeveloped land as a NERP. As of July 1994, the NERP consisted of segments totalling 5,008 ha (12,375 acres) spread over ORR. The NERP is used by the national scientific community as an outdoor laboratory for environmental science research on the impact of human activities on the eastern deciduous forest ecosystem (DOE 1994u:37,51).

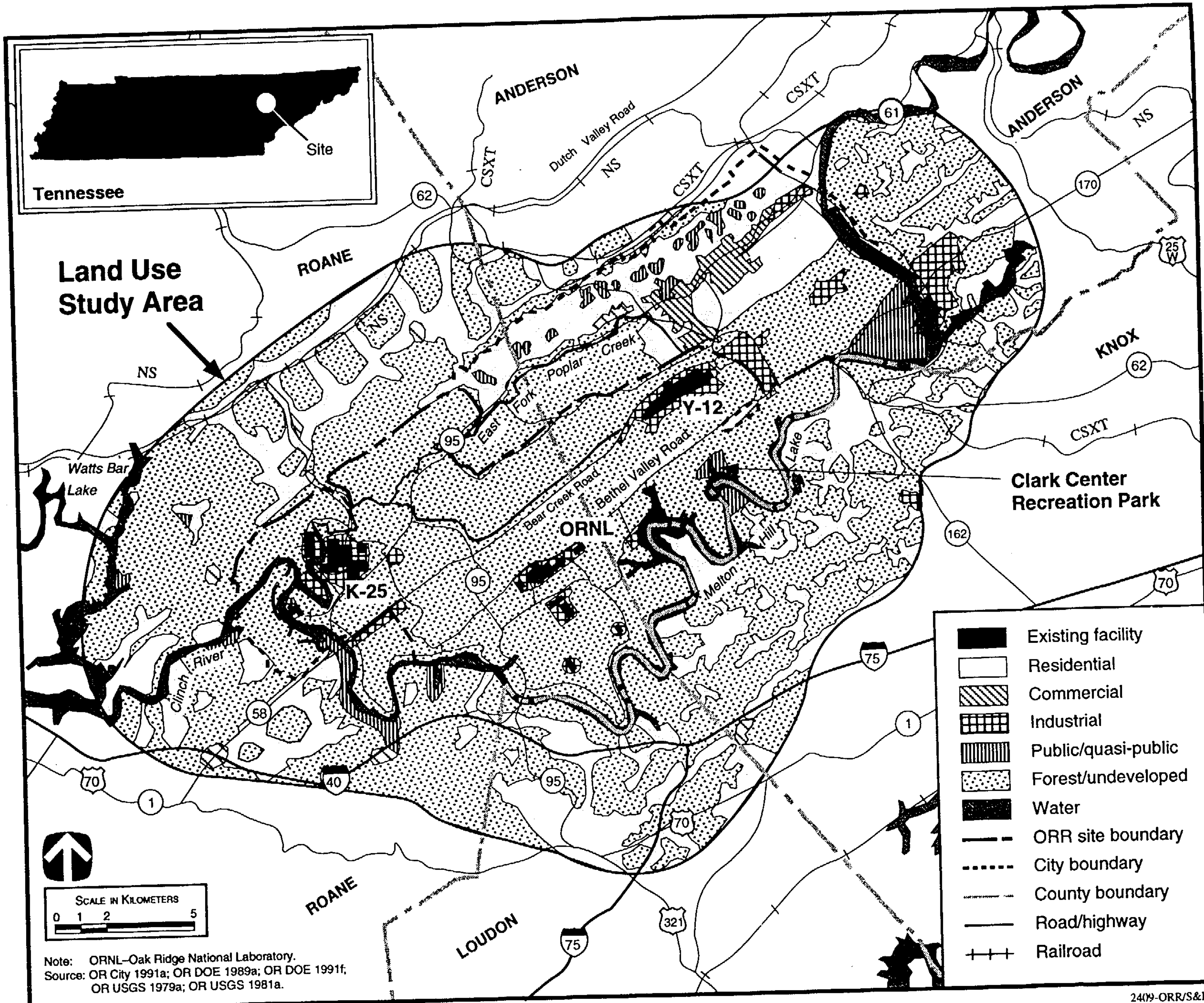
Land bordering ORR is predominantly rural and used largely for residences, small farms, forest land, and pasture land. The city of Oak Ridge, adjacent to the northeast portion of ORR, has a typical urban mix of residential, public, commercial, and industrial land uses. There are four residential areas along the northern boundary of ORR; each has several houses within 30 m (98 ft) of the site boundary.

Land-Use Planning. The ORR has other facilities planned. Proposed short-range projects (1995 through 1999) include the Composite Materials Laboratory, Center for Biological Sciences, Mixed Waste Treatment Facility, Recycle and Materials Processing Facility, Process Waste Treatment Facility, Industrial Landfill Expansion and Upgrades, and Steam Plant Waste Water Treatment Facility. Figure 3.6.1–2 shows potential facility areas in relation to existing ORR facilities.

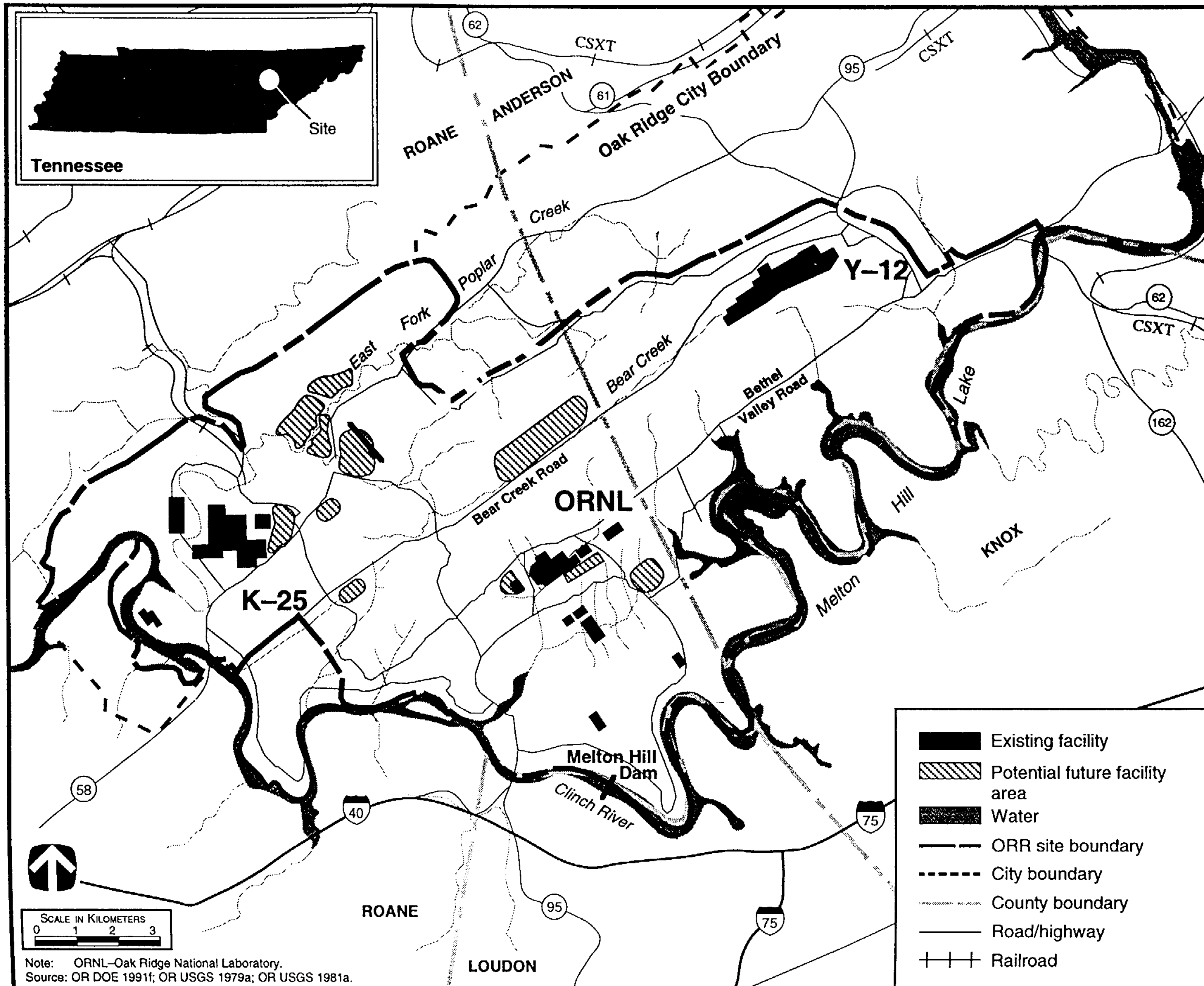
The majority of ORR lies within the city of Oak Ridge. A small portion of the northwest corner of ORR lies outside the city, in Roane County. The Oak Ridge Area Land Use Plan (city of Oak Ridge) designates ORR with the following land uses: residential, office/institutional, industrial, public, and undesignated (OR City 1995a:1). The city of Oak Ridge zoning ordinance classifies the entire ORR as Forest, Agriculture, Industry, and Research District (OR City 1995a:2). The Roane County zoning ordinance does not classify ORR lands, rather, it identifies ORR as a DOE Reservation (OR City 1995a:3).

Visual Resources. The ORR landscape is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. Much of ORR's open field area (about 2,000 ha [4,940 acres]) has been planted in shortleaf and loblolly pine; smaller areas have been planted in a variety of deciduous and coniferous trees (OR DOE 1989a:3-14). The DOE facilities are brightly lit at night, making them especially visible. The developed areas of ORR are consistent with BLM's VRM Class 5 designation. The remainder of ORR ranges from a VRM Class 3 to Class 4 designation.

The viewshed consists mainly of rural land. The city of Oak Ridge is the only adjoining urban area. Sensitive viewpoints affected by DOE facilities are primarily associated with Interstate 40, State Highway 62, 95, and 58;


Tennessee
Site
Land Use
Study Area
ANDERSON
ROANE
KNOX
LOUDON
ROANE
Dutch Valley Road
CSXT
NS
East Fork Poplar Creek
Y-12
ORNL
K-25
Bear Creek Road
Bethel Valley Road
Watts Bar Lake
Clinch River
Melton Hill Lake
Clark Center
Recreation Park
Existing facility
Residential
Commercial
Industrial
Public/quasi-public
Forest/undeveloped
Water
ORR site boundary
City boundary
County boundary
Road/highway
Railroad
Scale in Kilometers
0 1 2 5
Note: ORNL–Oak Ridge National Laboratory.
Source: OR City 1991a; OR DOE 1989a; OR DOE 1991f; OR USGS 1979a; OR USGS 1981a.

2409-ORR/S&D


Tennessee
Site
ROANE
ANDERSON
Oak Ridge City Boundary
CSXT
62
61
95
Poplar Creek
East Fork
Bear Creek
Bear Creek Road
Bethel Valley Road
Y–12
ORNL
K–25
Melton Hill Lake
Melton Hill Dam
Clinch River
KNOX
162
58
40
75
ROANE
LOUDON
Scale in Kilometers
0 1 2 3
Note: ORNL–Oak Ridge National Laboratory.
Source: OR DOE 1991f; OR USGS 1979a; OR USGS 1981a.
Existing facility
Potential future facility area
Water
ORR site boundary
City boundary
County boundary
Road/highway
Railroad

2410-ORR/S&D

and Bethel Valley and Bear Creek Roads. The Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River also have views of ORR, but views of most of the existing DOE facilities are blocked by terrain and/or vegetation. Although only a small portion of State Highways 62 crosses ORR, it is a major route for traffic to and from Knoxville and other communities (OR DOE 1989a:3-29). Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric conditions. Partial views of the DOE water treatment plant facilities can be seen from the urban areas of the city of Oak Ridge.

3.6.2 SITE INFRASTRUCTURE

Baseline Characteristics. To support ORR missions, an extensive infrastructure exists, as shown in Table 3.6.2–1.

Table 3.6.2–1. Oak Ridge Reservation Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	71	71
Railroads (km)	27	27
Electrical		
Energy consumption (MWh/yr)	726,000	13,880,000
Peak load (MWe)	110	2,100
Fuel		
Natural gas (m^3/yr)	95,000,000	250,760,000
Oil (l/yr)	416,000	416,000[a]
Coal (t/yr)	16,300	16,300[a]
Steam (kg/hr)	150,000	150,000

[a] Oil and coal availability is unlimited, figures are for current use.
Source: OR LMES 1996i; OR DOE 1994c.

Oak Ridge Reservation is served by three major highways, the mainline of two railroads, a regional airport, and a barge facility on the Inland Waterway system. A well-maintained system of interstate, regional, and local highways supports the onsite road network of approximately 71 km (44 mi) of roadway. Rail spurs connect onsite facilities to national lines of the Norfolk Southern and CSX Transport systems. There are 27 km (17 mi) of onsite rail to service operations at ORNL, Y–12, and K–25. Existing barge facilities on the Clinch River, adjacent to State Route 58, provide access to the Inland (Tennessee-Tombigbee) Waterway system via the Tennessee River to ports ranging from the Great Lakes to the Gulf of Mexico.

Numerous high-voltage transmission lines from the TVA power systems supply electric power to major plants on ORR. Transmission lines serving other areas also cross the site. Current energy consumption is 726 gigawatt-hours/yr, with a peak load of 110 MWe. The current load capacity at ORR is 805 MWe. The current reserve capacity is 1,295 MWe. A 56-cm (22-in) main from East Tennessee Natural Gas in Knoxville is available onsite. The current quantity of natural gas furnished to ORR upon demand is limited to 0.687 million m^3/day (24.3 million ft^3/day), with 0.42 million m^3/day (14.8 million ft^3/day) interruptible upon a 4-hour notice. The current natural gas consumption is approximately 95 million m^3/yr (3,350 million ft^3/yr). Oil and coal availability is unlimited, with current consumption of 416,000 l/yr (110,000 gal/yr) of oil and 16,300 t/yr (18,000 tons/yr), respectively. Steam is used and generated at approximately 150,000 kg/hr (330,000 lb/hr).

Oak Ridge Reservation is located in the Southeastern Electric Reliability Council regional power pool and draws its power from the TVA Subregion. Characteristics of this power pool are given in Table 3.6.2–2. The total system generation capacity is 33,370 MWe, with a peak demand of 28,127 MWe. The mix of fuels utilized in generating this power pool requirement is predominantly coal and nuclear with 49 and 39 percent, respectively, followed by hydroelectric power generation at 11 percent. Less than 1 percent of the electrical generation requirements is produced using oil and natural gas. TVA is typically a net exporter of power, with approximately 2.4 million megawatt-hours (MWh) exported annually.

Eight facilities at Y–12 are currently used to store enriched uranium or process it for storage. These facilities would continue to be used for the interim storage of HEU as described in the Y–12 EA. The buildings are all located within the existing controlled and secured protected area of Y–12. Buildings 9204-2, 9204-2E, and

Table 3.6.2–2. Tennessee Valley Authority Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	49%
Nuclear	39%
Hydro/geothermal	11%
Oil/gas	<1%
Other	0%
Total Annual Production	159,842,000 MWh
Total Annual Load	156,987,000 MWh
Energy Exported Annually[b]	2,407,000 MWh
Generating Capacity	31,840 MWe
Peak Demand	28,127 MWe
Capacity Margin[c]	4,550 MWe

[a] Percentages do not total 100 percent due to rounding.
[b] Energy exported is not the difference of production and load due to negative net pumped storage.
[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.
Source: NERC 1993a.

9204-4, located in the western portion of Y–12, are all large, multistory, industrial-type buildings that have been modified several times since their construction. Building 9204-2 is approximately 25,100 m^2 (270,000 ft^2), Building 9204-2E is approximately 14,100 m^2 (151,000 ft^2), and Building 9204-4 is approximately 25,400 m^2 (274,000 ft^2). Building 9206, centrally located within Y–12, is a 4,000 m^2 (43,000 ft^2) structure with a 1,900 m^2 (20,000 ft^2) second story in its central portion. Building 9212, centrally located within Y–12, is a multistory facility that spans approximately 9,300 m^2 (100,000 ft^2). Building 9215 is an approximately 11,800 m^2 (127,000 ft^2) two-story structure that is centrally located within Y–12. Building 9720-5 is a single-story warehouse that includes approximately 3,700 m^2 (40,000 ft^2) of storage space. This facility is the principal storage location for HEU as described in the Y–12 EA. Building 9998 is a multifloor structure with approximately 2,260 m^2 (24,000 ft^2). Buildings 9998 and 9215 are integrally connected and may be considered as a single-building complex. Buildings other than these eight may be modified for the interim storage of HEU as described in the Y–12 EA.

3.6.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The Cumberland and Great Smoky Mountains have a moderating influence on the climate at ORR. Winters are generally mild and summers warm, with no noticeable extremes in precipitation, temperature, or winds.

The average annual temperature at ORR is 13.7 °C (56.6 °F); temperatures vary from an average daily minimum of -3.8 °C (25.1 °F) in January to an average daily maximum of 30.4 °C (86.7 °F) in July. The average annual precipitation is approximately 136.6 cm (53.77 in). Prevailing wind directions at ORR tend to follow the orientation of the valley: upvalley, from west to southwest, or downvalley, from east to northeast. The average annual windspeed is approximately 2.0 m/s (4.4 mph) (NOAA 1994c:3). Additional information related to meteorology and climatology at ORR is presented in Appendix F.

Ambient Air Quality. The ORR is located in Anderson and Roane Counties in the eastern Tennessee and southwestern Virginia Interstate AQCR (#207). As of 1995, the areas within this AQCR were designated by EPA as in attainment (40 CFR 81.343) with respect to the NAAQS for criteria pollutants (40 CFR 50). Applicable NAAQS and Tennessee State ambient air quality standards are presented in Appendix F.

One PSD (40 CFR 52.21) Class I area can be found in the vicinity of ORR. This area, the Great Smoky Mountains National Park, is located approximately 48.3 km (30 mi) southeast of ORR. Since the creation of the PSD program in 1977, no PSD permits have been required for any emission source at ORR.

The primary emission sources of criteria pollutants are the steam plants at K–25, Y–12, and ORNL. Other emission sources include fugitive particulates from coal piles, the TSCA incinerator, other processes, vehicles, and temporary emissions from various construction activities (OR DOE 1987a:33-49). Appendix F presents emissions of criteria pollutants from ORR.

Table 3.6.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at ORR. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise emission sources within ORR include various industrial facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most ORR industrial facilities are at a sufficient distance from the site boundary that noise levels at the boundary from these sources would not be measurable or would be barely distinguishable from background noise levels.

Sound-level measurements have been recorded at various locations within and near ORR in the process of testing sirens and preparing support documentation for the Atomic Vapor Laser Isotope Separation site (ORR 1991a:2; ORR 1991a:6). The acoustic environment along the ORR site boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with the average DNL in the range of 35 to 50 dBA. Areas near the site within Oak Ridge are typical of a suburban area, with the average DNL in the range of 53 to 62 dBA (EPA 1974a:B-4,B-5). The primary source of noise at the site boundary and at residences located near roads is traffic. During peak hours, the plant traffic is a major contributor to traffic noise levels in the area.

The State of Tennessee has not established specific community noise standards applicable to ORR. The city of Oak Ridge has specific acceptable sound levels at property lines (Appendix F).

Table 3.6.3–1. ***Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Oak Ridge Reservation, 1992***

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] (μg/m³)	Baseline Concentration (μg/m³)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[b]	5
	1-hour	40,000[b]	11
Lead	Calendar Quarter	1.5[b]	0.05[c]
Nitrogen dioxide	Annual	100[b]	3
Ozone	1-hour	235[b]	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	1
	24-hour	150[b]	2
Sulfur dioxide	Annual	80[b]	2
	24-hour	365[b]	32
	3-hour	1,300[b]	80
Mandated by the State of Tennessee			
Total suspended particulates	24-hour	150[e]	2[f]
Gaseous fluoride (as hydrogen fluoride)	30-day	1.2[e]	0.2
	7-day	1.6[e]	0.3
	24-hour	2.9[e]	0.6[g]
	12-hour	3.7[e]	0.6[g]
	8-hour	250[e]	0.6
Hazardous and Other Toxic Compounds			
1,1,1-Trichloroethane	8-hour	[h]	[d]
Acetic Acid	8-hour	[h]	<0.01
Chlorine	8-hour	150[e]	4.1
Hydrogen chloride	8-hour	750[e]	57.0
Mercury	8-hour	5[e]	0.06[i]
Nitric acid	8-hour	[h]	78.0
Sulfuric acid	8-hour	100[e]	20.0

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Federal and State standard.
[c] Value is maximum for 24-hour period.
[d] Data not available from source document.
[e] State standard.
[f] Based on stack emissions of particulate matter only.
[g] 8-hour concentration was used.
[h] No State standard for indicated averaging time.
[i] Annual average (monitored value).

Note: Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

Source: 40 CFR 50; OR DOE 1993a; TN DEC 1994a; TN DHE 1991a.

3.6.4 WATER RESOURCES

Surface Water. The major surface water body in the immediate vicinity of ORR is the Clinch River, which borders the site to the south and west. There are four major sub-drainage basins on ORR that flow into the Clinch River and are affected by site operations: Poplar Creek, East Fork Poplar Creek, Bear Creek, and White Oak Creek. Several smaller drainage basins, including Ish Creek, Grassy Creek, Bearden Creek, McCoy Branch, Kerr Hollow Branch, and Raccoon Creek drain directly to the Clinch River. Each drainage basin takes the name of the major stream flowing through the area. Within each basin are a number of small tributaries. The natural surface water bodies in the vicinity of ORR are shown on Figure 3.6.4–1.

The three major facilities at ORR each affect different basins of the Clinch River. Drainage from Y–12 enters both Bear Creek and East Fork Poplar Creek; K–25 drains predominantly into Poplar Creek; and ORNL drains into the White Oak Creek drainage basin.

The Clinch River and connected waterways supply all raw water for ORR. The Clinch River has an average flow rate of 132 m^3/s (4,647 ft^3/s) as measured at the downstream side of Melton Hill Dam at mile 23.1 (OR USGS 1986a:161). The average flow rate of Grassy, Ish, and Bear Creeks in the ORR area are 0.08 m^3/s (2.8 ft^3/s), 0.05 m^3/s (1.8 ft^3/s), and 0.11 m^3/s (3.9 ft^3/s), respectively. The average flow rate at East Fork Poplar Creek is 1.46 m^3/s (51.4 ft^3/s). Y–12 uses approximately 7,530 million l/yr (2 billion gal/yr) of water, and ORR uses 14,210 million l/yr (3,754 million gal/yr). The ORR water supply system, which includes the DOE treatment facility and the K–25 treatment facility, has a capacity of 121.5 million l/day (32.1 million gal/day).

The Clinch River water levels in the vicinity of ORR are regulated by a system of dams operated by the TVA. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of ORR. Watts Bar Dam, on the Tennessee River near the lower end of the Clinch River, controls the flow of the Clinch River along the southwest side of ORR.

The TVA has conducted flood studies along the Clinch River, Bear Creek, and East Fork Poplar Creek (OR TVA 1991a:1). Portions of Y–12 lie within the 100- and 500-year floodplains of East Fork Poplar Creek (ORNL 1995d). Studies have not been performed to delineate the 100- or 500-year floodplain boundaries of Grassy, Ish, and Bear Creeks in the western half of the facility (OR TVA 1991a:1). A site-specific assessment would be required before constructing any new facility at ORR.

Surface Water Quality. The streams and creeks of Tennessee are classified by the Tennessee Department of Environmental Conservation (TDEC) and defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. The Clinch River is the only surface water body on ORR classified for domestic water supply. Streams at ORR are classified for fish, aquatic life, and livestock watering; irrigation; recreation; and wildlife. White Oak Creek and Melton Branch are the only streams not classified for irrigation. Portions of Poplar Creek, East Fork Poplar Creek, and Melton Branch are not classified for recreation.

Both routine and NPDES-required surface water monitoring programs (over 225 sites) are performed at Y–12 to assess the impacts of the plant effluents upon natural receiving water and to estimate the impacts of these effluents on human health and the environment. At Y–12, Bear Creek, McCoy Branch, Rogers Quarry, and East Fork Poplar Creek receive effluent from treated sanitary wastewater, industrial discharges, cooling water blowdown, stormwater, surface water runoff, and groundwater. The chemical water quality of Bear Creek has been affected by the infiltration of contaminated groundwater. Contaminants included high concentrations of dissolved salts, several metals, chlorinated solvents, and PCBs. DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA, because the creek was contaminated by past releases from Y–12. Significant cleanup activities are required onsite and offsite. Contaminants present in East Fork Poplar Creek included mercury, organics, PCBs, and radionuclides (OR DOE 1994d:5-9).

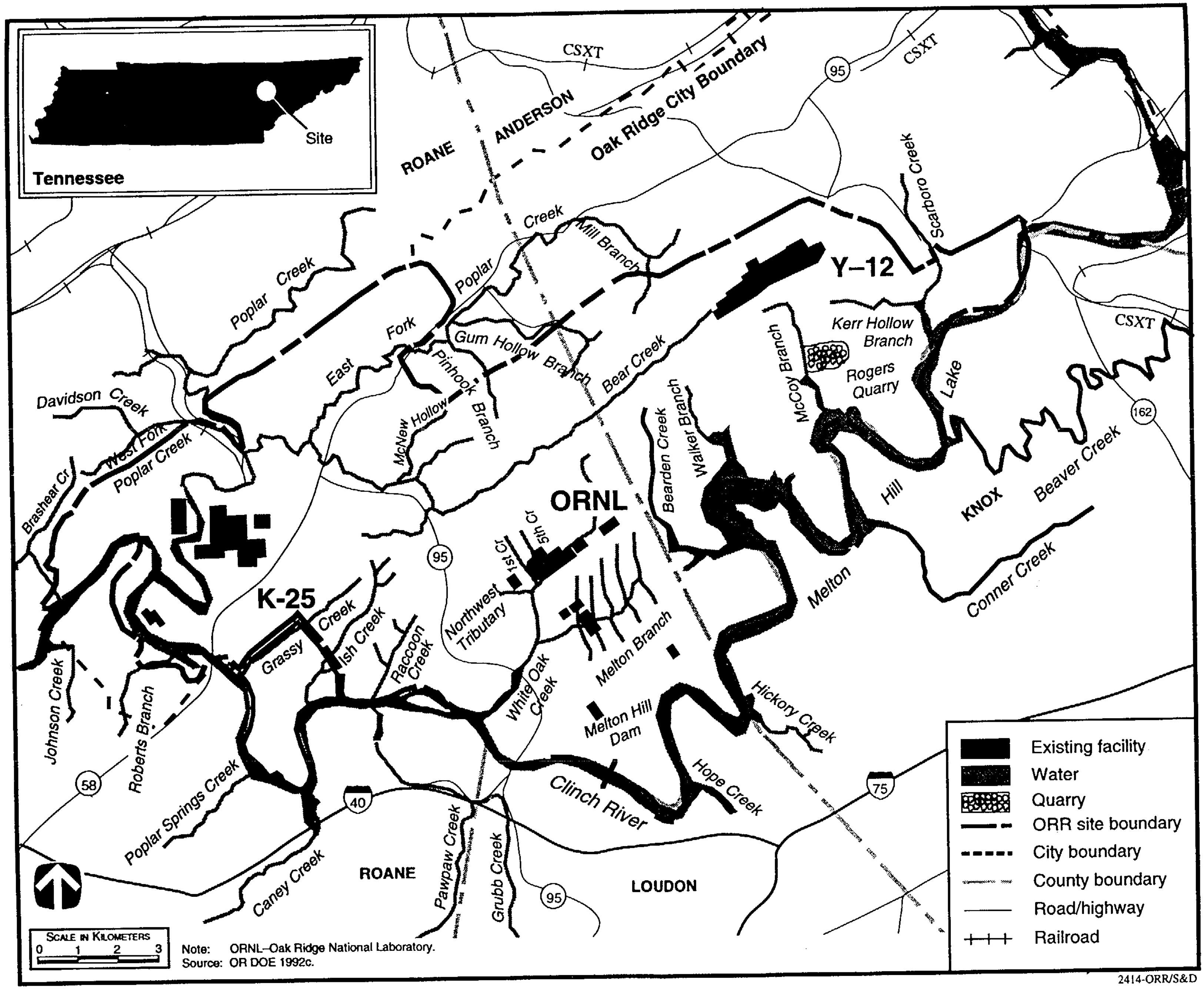


Figure 3.6.4–1. Surface Water Features at Oak Ridge Reservation.

Wastewater treatment facilities are located throughout ORR. At Y–12, there are six treatment facilities with NPDES-permitted discharge points to East Fork Poplar Creek. Y–12 also has a permit to discharge wastewater to the Oak Ridge Treatment Facility. At ORNL, there are three NPDES-permitted wastewater treatment facilities discharging into White Oak Creek basin. K–25 operates one sanitary sewage system discharging to Poplar Creek.

There are 455 NPDES-permitted outfalls associated with the three major facilities at ORR; many of these are stormwater outfalls. Approximately 57,000 NPDES laboratory analyses were completed in 1993, with a compliance rate of over 99 percent. Most excursions were associated with precipitation runoff (OR DOE 1994c:2-13). One Notice of Violation was issued by TDEC in 1993 for exceeding permit limits for total suspended solids at three outfalls at ORNL. An action plan was prepared addressing projects to mitigate the potential for future violations.

As shown in Table 3.6.4–1, maximum concentrations of all parameters except nitrate and manganese were within the various comparison water quality criteria where the Clinch River leaves ORR. Monitoring data from this sampling site were compared with data from the Melton Hill Dam sampling site, located upstream of all ORR discharges and therefore are representative of background water quality. The concentrations downstream of ORR discharges were lower than concentrations upstream in all cases except gross beta and total suspended solids. Concentrations at Melton Hill Dam were within applicable water quality criteria.

Surface Water Rights and Permits. In Tennessee, the State's water rights laws are established in the *Water Quality Control Act.* In effect, the water rights are similar to riparian rights, in that the designated usages of a water body cannot be impaired. The only requirement to withdraw water from available supplies would be a U.S. Army COE permit to construct intake structures.

Groundwater. The ORR is located in an area of sedimentary rocks of widely varying hydrological character. However, because of the topographic relief and a decrease in bedrock fracture density with depth, groundwater flow is restricted primarily to shallow depths and groundwater discharges primarily to nearby surface waters within ORR. Depth to groundwater is generally 5 to 9 m (16 to 30 ft), but is as little as 1.5 m (5 ft) in the area of Bear Creek Valley near State Route 95. No Class I sole source aquifers lie beneath ORR. All aquifers are considered Class II (current and potential sources of drinking water).

Aquifers at ORR include a surficial soil and regolith unit and bedrock aquifers. The surficial aquifer consists of manmade fill, alluvium, and weathered bedrock. Bedrock aquifers occur in carbonates and low-yield sandstones, siltstones, and shales. Groundwater flow in the surficial aquifer is controlled by bedding planes, joints, fracture and/or solution cavity distribution and orientation in limestones that store and transmit relatively large volumes of water. Bedding-plane and strike-parallel fracture orientation give rise to preferential groundwater movement along strike direction (OR DOE 1992c:5-7). In the bedrock aquifer, essentially all groundwater occurs in fractures and in a few larger cavities within the formation. Enlarged fractures and cavities are the primary water producing and solute transport features and are supplied by seepage through fractures in the rock matrix, which outnumber the enlarged fractures and cavities, are interconnected, and provide the continuity for groundwater flow paths. Movement of groundwater through fractures and solution conduits in some of the carbonate aquifers is quite rapid even where gradients are not particularly steep.

Recharge occurs over most of the area but is most effective where overburdened soils are thin or permeable. In the area near Bear Creek Valley, recharge into the carbonate rocks is mainly along Chestnut Ridge (OR DOE 1992c:5-5). Groundwater generally flows from the recharge areas to the center of Bear Creek Valley and discharges into Bear Creek and its tributaries. Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORR. Only one water supply well exists on ORR; it provides a supplemental water supply to an aquatics laboratory during extended droughts.

Table 3.6.4–1. Summary of Clinch River Surface Water Quality Monitoring at Oak Ridge Reservation, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Water Body Concentration	
			High	Low
Alpha (gross)	pCi/l	15[b]	1.6	-0.14
Beta (gross)	pCi/l	50[c]	6.8	3.8
Cesium-137	pCi/l	120[d]	4.1	-2.4
Chemical oxygen demand	mg/l	NA	21	<5.0
Fluoride	mg/l	4.0[b], 2.0[e]	0.10	<0.10
Manganese	mg/l	0.05[e]	0.068	0.0031
Nitrate	mg/l	10.0[b]	10.0	1.5
pH	pH units	6.5-8.5[f]	8.2	7.8
Sodium	mg/l	NA	4.9	3.3
Sulfate	mg/l	250[e]	27	15
Suspended solids	mg/l	NA	29	<5.0
Technetium-99	pCi/l	4,000[d]	5.9	-0.54
Total dissolved solids	mg/l	500[e]	170	150
Tritium	pCi/l	80,000[d]	540	-570
Uranium, Total	mg/l	0.02[c]	0.0010	<0.00010

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
[d] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.
[e] National Secondary Drinking Water Regulations (40 CFR 143).
[f] Tennessee drinking water quality standards.

Note: Data from 1993 sampling event at Station CRK16, located on the Clinch River, downstream from ORR. NA=not applicable.

Source: OR DOE 1994f; TN DEC 1991a.

Groundwater Quality. Groundwater samples are collected quarterly from more than 1,000 monitoring wells throughout ORR. Groundwater samples collected from the monitoring wells are analyzed for a standard suite of parameters and constituents, including trace metals, volatile organic compounds, radioactive materials, and pH. Background groundwater quality at ORR is generally good in the near-surface aquifer zones and poor in the bedrock aquifer at depths greater than 305 m (1,000 ft) due to high total dissolved solids.

Groundwater in Bear Creek Valley near Y–12 and in the ORNL and K–25 areas has been contaminated by hazardous chemicals and radionuclides (mostly uranium) from weapons production process activities. The contaminated sites include past waste disposal sites, waste storage tanks, spill sites, and contaminated inactive facilities. The groundwater quality as indicated by groundwater contamination monitoring wells at ORR is summarized in Table 3.6.4–2.

Groundwater Availability, Use, and Rights. Industrial and drinking water supplies in the area are primarily taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by the public water supply system (OR DOE 1992c:1-15). Most of the residential supply wells in the immediate area of ORR are south of the Clinch River. Most wells used for potable water are in the deeper principal carbonate

Table 3.6.4–2. Groundwater Quality Monitoring at Oak Ridge Reservation, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standard[a]	Existing Conditions[b]	
			High	Low
Alkalinity-CO_3	mg/l	NA	190	1
Alkalinity-HCO_3	mg/l	NA	540	2
Alpha (gross)	pCi/l	15[c]	490	-52
Aluminum	mg/l	0.05-0.2[d]	140	<0.019
Barium	mg/l	2.0[c]	33	0.0016
Beta (gross)	pCi/l	50[e]	11,000	-23
Boron	mg/l	NA	1.6	0.0041
Calcium	mg/l	NA	6,600	0.85
Chloride	mg/l	250[d]	3,900	0.1
Chromium	mg/l	0.1[c,f]	58	<0.0033
Copper	mg/l	1.0[d]	1.1	<0.0033
Fluoride	mg/l	2.0[d], 4.0[c]	6.0	<0.1
Iron	mg/l	0.3[d]	470	0.0050
Lead	mg/l	0.005[f]	1.7	<0.0012
Magnesium	mg/l	NA	430	0.019
Manganese	mg/l	0.05[d]	29	0.001
Nickel	mg/l	0.1[c]	5.8	<0.0042
Nitrate	mg/l	10.0[c]	5,500	0.2
pH	pH units	6.5-8.5[d]	12	4.5
Potassium	mg/l	NA	32	0.60
Sodium	mg/l	NA	2,100	0.23
Strontium-90	pCi/l	400[g]	7,600	-16
Sulfate	mg/l	250[d]	2,100	1.0
Total dissolved solids	mg/l	500[d]	26,000	32
Uranium-235	pCi/l	24[g]	200	-70
Uranium-238	pCi/l	24[g]	120	-18
Vanadium	mg/l	NA	1.1	<0.002
Zinc	mg/l	5.0[d]	3.8	0.0020

[a] For comparison purposes only.
[b] Data are from all wells on ORR.
[c] National Primary Drinking Water Regulations (40 CFR 141).
[d] National Secondary Drinking Water Regulations (40 CFR 143).
[e] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
[f] Tennessee drinking water standards.
[g] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.

Note: NA=not applicable.

Source: OR DOE 1994f; TN DEC 1991a.

aquifers (up to 305 m [1,000 ft]), while the groundwater contamination at Y–12 is primarily found at depths up to 84 m (276 ft).

Groundwater rights in the State of Tennessee are traditionally associated with the Reasonable Use Doctrine (VDL 1990a:725). Under this doctrine, landowners can withdraw groundwater to the extent that they must exercise their rights reasonably in relation to the similar rights of others.

3.6.5 GEOLOGY AND SOILS

Geology. The ORR is located in the Valley and Ridge physiographic province of east-central Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys; Y–12 is located in Bear Creek Valley between Pine and Chestnut Ridges. ORNL and K–25 are underlain primarily by calcareous siltstones and silty to clean limestones of the Chickamauga Group; Y–12 is underlain by the Conasauga Group, which is composed of shales, calcareous siltstones, and silty to clean limestones. Pine Ridge is underlain by the Rome Formations, which consist of sandstone with thin shale interbeds. Chestnut Ridge is underlain by the cherty dolostones of the Knox Group. The present topography of the valleys is a result of stream action preferentially eroding the softer shales and limestones; the ridges are composed of relatively more resistant sandstones and dolomites. No economically viable geologic resources have been identified at ORR.

Oak Ridge Reservation is underlain by many inactive faults formed during the Late Paleozoic Era. There is no evidence of capable faults, as defined in 10 CFR 100, Appendix A, in the immediate area of ORR. The nearest capable faults are located approximately 480 km (298 mi) northwest in the New Madrid fault zone (OR EG&G 1991a:3.6.2–6).

The Oak Ridge Reservation area is located at the boundary between Seismic Zones 1 and 2, indicating that minor to moderate damage could occur as a result of earthquakes (Figure 3.2.5–1). Since the New Madrid earthquakes of 1811–12, at least 27 other earthquakes with an MMI of III to VI have been felt in the Oak Ridge area (Table 3.2.5–1). The nearest seismic event occurred in 1930 approximately 8 km (5 mi) from ORR and had an MMI of V at the site (OR EG&G 1991a:3.6.2-1). The most recent significant earthquake (4.6 on the Richter scale) occurred on November 30, 1973 in Maryville, Tennessee, approximately 34 km (21 mi) southeast of ORR.

There is no volcanic hazard at ORR. The area has not experienced volcanic activity within the last 230 million years. Therefore, future volcanic activity is not anticipated.

Soils. Bear Creek Valley lies on well-drained to moderately well-drained soils underlain by shale, siltstone, and sandstone. Developed portions of the valley are designated as urban land. Soil erosion from past land uses has ranged from slight to severe. Erosion potential is very high in those areas with slopes greater than 25 percent and which have been eroded in the past. Erosion potential is lowest in nearly flat-lying permeable soils that have a loamy texture (ORNL 1988b:69). Additionally, wind erosion is slight, shrink-swell potential is low to moderate, and the soils are acceptable for standard construction techniques.

3.6.6 BIOLOGICAL RESOURCES

Terrestrial Resources. Plant communities at ORR are characteristic of the intermountain regions of central and southern Appalachia. Approximately 10 percent of ORR has been disturbed since it was withdrawn from public access; the remainder of the site has reverted to, or been planted with, natural vegetation (OR DOE 1989a:3-5). The vegetation of ORR has been categorized into seven plant communities (Figure 3.6.6–1).

Pine and pine-hardwood forest is the most extensive plant community on ORR. Important species of this community type include loblolly pine, shortleaf pine, and Virginia pine (ORNL 1987a:9). Another abundant plant community is the oak-hickory forest, which is commonly found on ridges throughout ORR. Northern hardwood forest and hemlock-white pine-hardwood forest are the least common forest community types on ORR. Forest resources on ORR are managed for maintaining multiple use of forest land and sustaining yield of quality timber products (OR DOE 1994e:2-113). Nine hundred eighty-three species, subspecies, and varieties of plants have been identified on ORR (OR NERP 1993b:2).

Animal species found on ORR include 26 amphibian, 33 reptile, 169 bird, and 39 mammal species (OR NERP nda:8-17). Animals commonly found on ORR include the American toad, eastern garter snake, Carolina chickadee, northern cardinal, white-footed mouse, and raccoon. Although the whitetail deer is the only species hunted onsite (OR DOE 1991c:4-6), other game animals are also present. Raptors, such as the northern harrier and great horned owl, and carnivores, such as the gray fox and mink, are ecologically important groups on ORR. A variety of migratory birds has been found at ORR. Migratory birds, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act*.

Vegetative communities in the area proposed for the consolidated Pu storage facility (which is also the assumed analysis site for immobilization facilities) are typical of ORR as a whole, with pine and pine-hardwood and oak-hickory forests being the predominant community types (Figure 3.6.6–1). Fauna of the proposed storage site would be similar to that found throughout ORR. The assumed site for the evolutionary LWR was originally dominated by pine and pine-hardwood forests. However, it was cleared for a previously proposed breeder reactor and thus, is presently in a highly disturbed state.

Wetlands. Wetlands on ORR include emergent, scrub and shrub, and forested wetlands associated with embayments of the Melton Hill and Watts Bar Lake, riparian areas bordering major streams and their tributaries, old farm ponds, and groundwater seeps. Well-developed communities of emergent wetland plants in the shallow embayments of the two reservoirs typically intergrade into forested wetland plant communities, which extend upstream through riparian areas associated with streams and their tributaries. Old farm ponds on ORR vary in size and support diverse plant communities and fauna. Although most riparian wetlands on ORR are forested, areas within utility rights-of-way, such as those in Bear Creek and Melton Valleys, support emergent wetland vegetation (OR NERP 1991a:4,18,26,41).

Within the vicinity of the site proposed for the consolidated Pu storage facility (which is also the assumed analysis site for immobilization facilities), most wetlands are forested and are located in riparian areas bordering headwater tributaries to Bear Creek, Grassy Creek, and Ish Creek (Figure 3.6.4-1). Forested wetlands also occupy several acres in the floodplain of Bear Creek as it flows through the area. Emergent wetlands are present where tributaries to Grassy Creek cross a power line paralleling Bear Creek Road.

Portions of the forested wetland in the Bear Creek floodplain located near the northern edge of the proposed consolidated Pu storage site are designated as an NERP Reference Area and Natural Area. This wetland area is uncommon because it is not subject to the changing water levels from the TVA dams, and it has a deep, organic substrate combined with a diversity of herbaceous plants. The springs, seeps, and old streambeds create a variety of habitats. This wetland supports a State-listed endangered plant species (tubercled rein-orchid). A portion of the Reference Area and the entire Natural Area have been designated as State Natural Areas (OR NERP

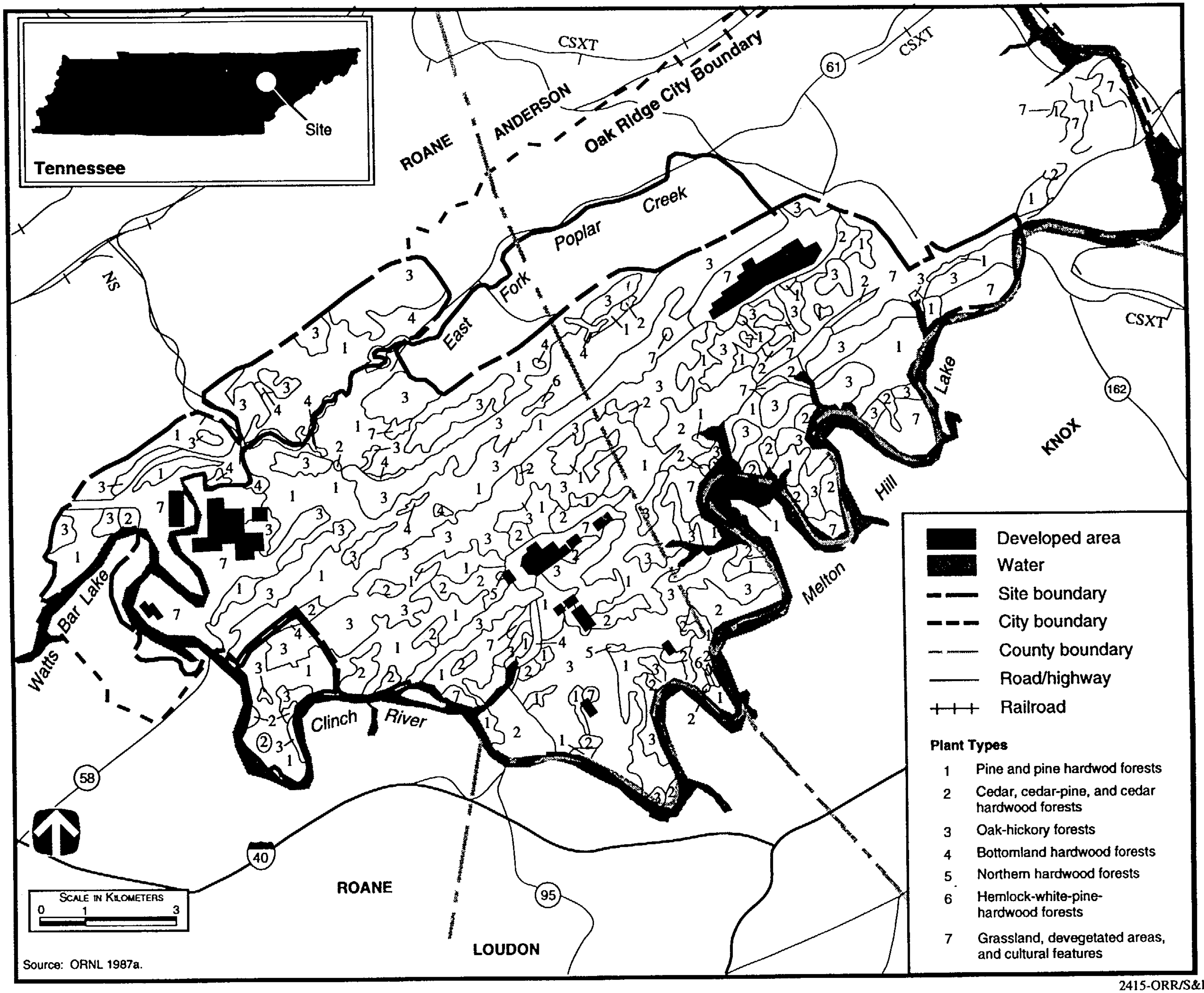


Figure 3.6.6–1. Distribution of Plant Communities at Oak Ridge Reservation.

1993a:13). The assumed location for the evolutionary LWR is highly disturbed and does not contain any wetlands.

Aquatic Resources. Aquatic habitat on or adjacent to ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas in ORR also include seasonal and intermittent streams.

Sixty-four fish species have been collected on or adjacent to ORR. The minnow family has the largest number of species and is numerically dominant in most streams (ORNL 1988c:0-43). Fish species representative of the Clinch River in the vicinity of ORR are shad, herring, common carp, catfish, bluegill, crappie, and freshwater drum (ORNL 1981b:138-149). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from Melton Hill Dam (TN WRA 1995a:1-5). Area recreational species consist of crappie, largemouth bass, sauger, sunfish, and catfish (TN DEC 1992e:1; TN WRA 1993a:1). Sport fishing is not permitted within ORR (TN WRA 1992a:1).

Fish species that have been recorded near the site of the proposed consolidated Pu storage facility (which is also the assumed analysis site for immobilization facilities) include 18 species in Bear Creek, 15 species in Grassy Creek, and 8 species in Ish Creek. Fish found in these streams include: blacknose dace, creek chub, shiner, Tennessee dace, banded sculpin, central stoneroller, bluntnose minnow, redbreast sunfish, and rock bass (OR DOE 1984a:3-30; ORNL 1988c:4-10; ORNL 1992c:4-5–4-7).

A NERP Aquatic Reference Area is located along Grassy Creek and its tributaries in the western portion of the proposed consolidated Pu storage site (OR NERP 1993a:16). Grassy Creek has a diverse assemblage of invertebrates and fish species for a stream its size. ORR uses Grassy Creek as a reference area for studies of other streams affected by site development. The assumed site for the evolutionary LWR is highly disturbed and does not contain any aquatic resources.

Threatened and Endangered Species. Eighty-four federally and State-listed threatened, endangered, and other special status species may be found on and in the vicinity of ORR (Table 3.6.6–1). Twenty-six of these species have records of occurrence on ORR or adjacent lakes. Seventeen of these are federally and/or State-listed as threatened or endangered, most of which are plant species located within NERP National Areas on ORR. Once a specific project site location has been determined, site surveys will verify the presence of special status species. No critical habitat for threatened or endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on ORR or adjacent lakes.

The bald eagle is the only federally listed threatened or endangered species observed near ORR on Melton Hill and Watts Bar Lakes. The peregrine falcon may occur in the area as a rare migrant or winter visitor. [Text deleted.] State-listed threatened or endangered species observed on ORR include the osprey and fourteen plant species (Table 3.6.6–1).

No federally listed threatened and endangered species are known to occur in the proposed storage site (which is also the assumed analysis site for immobilization facilities). [Text deleted.] East Fork Poplar Creek, north of the proposed storage site, contains suitable habitat for the Indiana bat. ORR lies within the geographic range of the gray bat, but suitable caves for this species are not known to occur on or near the proposed storage site. Neither of these bat species was collected during a limited survey conducted in 1992 (OR TT 1993a:1). [Text deleted.]

A number of State-listed threatened and endangered species are known to occur in the vicinity of the proposed consolidated Pu storage facility site (ORNL 1987b:11,12). These include Cooper's hawk, sharp-shinned hawk, pink lady's-slippers, tubercled rein-orchid, purple fringeless orchid, American ginseng, and fen orchid (OR NERP 1993a:6). One species listed by the State as in need of management (the Tennessee dace) occurs on the proposed site. The Tennessee dace is an inhabitant of Bear Creek and its tributaries. This stream system, which

Table 3.6.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Oak Ridge Reservation

Common Name	Scientific Name	Status[a] Federal	Status[a] State
Mammals			
Alleghany woodrat	*Neotoma magister*	NL	D
Eastern cougar[b]	*Felis concolor couguar*	E	E
Eastern small-footed bat	*Myotis leibii*	NL	D
Gray bat[b]	*Myotis grisescens*	E	E
Indiana bat[b]	*Myotis sodalis*	E	E
Rafinesque's big-eared bat	*Plecotus rafinesquii*	NL	D
River otter	*Lutra canadensis*	NL	T
Smoky shrew	*Sorex fumeus*	NL	D
Southeastern shrew	*Sorex longirostris*	NL	D
Birds			
American peregrine falcon[b]	*Falco peregrinus anatum*	E	E
Appalachian Bewick's wren	*Thryomanes bewickii altus*	NL	T
Arctic peregrine falcon	*Falco peregrinus tundrius*	E(S/A)	E
Bachman's sparrow	*Aimophila aestivalis*	NL	E
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	T
Barn owl[d]	*Tyto alba*	NL	D
Cooper's hawk[d,e]	*Accipiter cooperii*	NL	D
Grasshopper sparrow	*Ammodramus savannarum*	NL	D
Northern harrier	*Circus cyaneus*	NL	D
Osprey[d]	*Pandion haliaetus*	NL	T
Red-cockaded woodpecker	*Picoides borealis*	E	E
Sharp-shinned hawk[d,e]	*Accipiter striatus*	NL	D
Swainson's warbler	*Limnothlypis swainsonii*	NL	D
Reptiles			
Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	NL	D
Northern pine snake	*Pituophis melanoleucus melanoleucus*	NL	T
Amphibians			
[Text deleted.]			
Hellbender[d,e]	*Cryptobranchus alleganiensis*	NL	D
Tennessee cave salamander[f]	*Gyrinophilus palleucus*	NL	T
Fish			
Alabama shad	*Alosa alabamae*	NL	D
Amber darter[b]	*Percina antesella*	E	E
Blue sucker	*Cycleptus elongatus*	NL	T
Flame chub	*Hemitremia flammea*	NL	D
Frecklebelly madtom	*Noturus munitus*	NL	T
Highfin carpsucker	*Carpiodes velifer*	NL	D
Spotfin chub[b]	*Cyprinella monacha*	T	E
Tennessee dace[d,e]	*Phoxinus tennesseensis*	NL	D
Yellowfin madtom[b]	*Noturus flavipinnis*	T	E

Table 3.6.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Oak Ridge Reservation—Continued

Common Name	Scientific Name	Status[a] Federal	State
Invertebrates			
Alabama lampmussel[b]	*Lampsilis virescens*	E	E
Appalachian monkeyface pearlymussel[b]	*Quadrula sparsa*	E	E
Birdwing pearlymussel[b]	*Conradilla caelata*	E	E
Cumberland bean pearlymussel[b]	*Villosa trabalis*	E	E
Cumberland monkeyface pearlymussel[b]	*Quadrula intermedia*	E	E
Dromedary pearlymussel[b]	*Dromus dromas*	E	E
Fine-rayed pigtoe[b]	*Fusconaia cuneolus*	E	E
Green-blossom pearlymussel[b]	*Epioblasma torulosa gubernaculum*	E	E
Orange-footed pearlymussel[b]	*Plethobasus cooperianus*	E	E
Painted snake coiled forest snail	*Anguispira picta*	T	E
Pale lilliput pearlymussel[b]	*Toxolasma cylindrellus*	E	E
Pink mucket pearlymussel[b]	*Lampsilis abrupta*	E	E
Rough pigtoe[b]	*Pleurobema plenum*	E	E
Shiny pigtoe[b]	*Fusconaia cor*	E	E
Tan riffleshell[b]	*Epioblasma walkeri*	E	E
Tubercled-blossom pearlymussel[b]	*Epioblasma torulosa torulosa*	E	E
Turgid-blossom pearlymussel[b]	*Epioblasma turgidula*	E	E
White wartyback pearlymussel[b]	*Plethobasus cicatricosus*	E	E
Yellow-blossom pearlymussel[b]	*Epioblasma florentina florentina*	E	E
Plants			
American barberry	*Berberis canadensis*	NL	S
American ginseng[d,e]	*Panax quinquefolius*	NL	T
Appalachian bugbane[d]	*Cimicifuga rubifolia*	NL	T
Auriculate false-foxglove	*Tomanthera auriculata*	NL	E
Branching whitlowgrass	*Draba ramosissima*	NL	S
Butternut[d]	*Juglans cinerea*	NL	T
Canada (wild yellow) lily[d,e]	*Lilium canadense*	NL	T
Carey's saxifrage[d]	*Saxifraga careyana*	NL	S
Fen orchid[d,e]	*Liparis loeselii*	NL	E
Golden seal[d,e]	*Hydrastis canadensis*	NL	T
Gravid sedge[d,e]	*Carex gravida*	NL	S
Heartleaf meehania	*Meehania cordata*	NL	T
Heller's catfoot	*Gnaphalium helleri*	NL	S
Lesser ladies' tresses[d]	*Spiranthes ovalis*	NL	S
Michigan lily[d,e]	*Lilium michiganense*	NL	T
Mountain honeysuckle	*Lonicera dioica*	NL	S
Mountain witch alder[d]	*Fothergilla major*	NL	T
Northern bush honeysuckle[d]	*Diervilla lonicera*	NL	T
Nuttall waterweed[d]	*Elodea nuttallii*	NL	S
Pink lady's-slipper[d,e]	*Cypripedium acaule*	NL	E
Prairie goldenrod	*Solidago ptarmicoides*	NL	E
Purple fringeless orchid[d,e]	*Platanthera peramoena*	NL	T

Table 3.6.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Oak Ridge Reservation—Continued

Common Name	Scientific Name	Status[a] Federal	Status[a] State
Plants (continued)			
Slender blazing star	*Liatris cylindracea*	NL	E
Spreading false foxglove[d]	*Aureolaria patula*	NL	T
Swamp lousewort	*Pedicularis lanceolata*	NL	T
Tall larkspur[d]	*Delphinium exaltatum*	NL	E
Tennessee purple coneflower[b]	*Echinacea tennesseenis*	E	E
Tubercled rein-orchid[d,e]	*Platanthera flava var. herbiola*	NL	T
Virginia spiraea	*Spiraea virginiana*	T	E
Whorled mountainmint	*Pycnanthemum verticillatum*	NL	E-P

[a] Status codes: D=deemed in need of management; E=endangered; NL=not listed; P=possibly extirpated; S=species of special concern; S/A=protected under the similarity of appearances provision of the ESA; T=threatened.
[b] USFWS Recovery Plan exists for this species.
[c] Observed near ORR on Melton Hill and Watts Bar Lakes.
[d] Recent record of species occurrence on ORR.
[e] Species known to occur on or near proposed site for the New Pu Consolidated Storage Facility.
[f] Species collected on ORR in 1964.
Source: 50 CFR 17.11; 50 CFR 17.12; DOE 1995w; OR DOE 1990a; OR FWS 1992b; OR NERP 1993a; ORNL 1981a; ORNL 1984b; ORNL 1988c; TN DEC 1995a; TN DEC 1995b; TN DEC 1995c; TN DEC 1995d; TN WRC 1991a; TN WRC 1991b.

flows through the proposed site, is designated as a NERP Aquatic Natural Area. The habitat of this fish is protected by the State. Bear Creek is the site of life history studies of the Tennessee dace and may contain the greatest density of this species in the State (OR NERP 1993a:10,11). [Text deleted.]

The assumed location for the evolutionary LWR has been highly disturbed by land-clearing activities associated with the breeder reactor. It is unlikely that any species of special concern would reside on this site, although some listed birds and bats could use it to forage for food.

3.6.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. More than 20 cultural resources surveys have been conducted at ORR. About 90 percent of ORR has received at least some preliminary walkover or archival-level study, but less than 5 percent has been intensively surveyed. Most cultural resources studies have occurred along the Clinch River and adjacent tributaries. Prehistoric sites recorded at ORR include villages, burial mounds, camps, quarries, chipping stations, limited activity locations, and shell scatters. Over 45 prehistoric sites have been recorded at ORR to date. At least 13 prehistoric sites are considered potentially eligible for the NRHP, but most of these sites have not yet been evaluated. Site 40RE86 has been determined eligible for inclusion on the NRHP. Additional prehistoric sites may be identified in the unsurveyed portions of ORR. On May 6, 1994, a Programmatic Agreement concerning the management of historic and cultural properties at ORR was executed among the DOE Oak Ridge Operations Office, the Tennessee SHPO, and the Advisory Council on Historic Preservation. This agreement was administered to satisfy DOE's responsibilities regarding Sections 106 and 110 of the *National Historic Preservation Act* (NHPA), and requires DOE to develop a cultural resources management plan for ORR and to conduct cultural resources surveys as required.

Historic Resources. Several historic resources surveys have been conducted at ORR. Historic resources identified at ORR include both archaeological remains and standing structures. Documented log, wood frame, or fieldstone structures include cabins, barns, churches, gravehouses, springhouses, storage sheds, smokehouses, log cribs, privies, henhouses, and garages. Archaeological remains consist primarily of foundations, roads, and trash scatters. Sixty-nine pre-1942 cemeteries were located within the original ORR (OR Robinson 1950a:130). Today there are 32 known cemeteries within ORR because the size of the reservation has been reduced. More than 240 historic resources have been recorded at ORR, and 38 of those sites may be considered potentially NRHP-eligible. Freel's cabin and two church structures, George Jones Memorial Baptist Church and the New Bethel Baptist Church, are listed on the NRHP. These structures date from before the establishment of the Manhattan Project. NRHP sites associated with the Manhattan Project include the Graphite Reactor at ORNL, listed on the NRHP as a National Historic Landmark, and three traffic checkpoints, Bear Creek Road, Bethel Valley Road, and Oak Ridge Turnpike Checking Stations. Many other buildings and facilities at ORR are associated with the Manhattan Project and may be potentially eligible for the NRHP. Historic building surveys were completed during Fiscal Year 1994 at K–25 and ORNL. A similar survey was completed at Y–12, and the final document should be finished in Fiscal Year 1996. Based on this survey, approximately 100 additional buildings may be eligible for listing on the NRHP. Additional historic sites may be anticipated in the unsurveyed portions of ORR.

Native American Resources. The Overhill Cherokee occupied portions of the Tennessee, Hiwassee, Clinch, and Little Tennessee River Valley in the 1700s. Overhill Cherokee villages consisted of a large townhouse, a summer pavilion, and a plaza; residences had both summer and winter structures. Subsistence was based on hunting, gathering, and horticulture. The Cherokee were relocated to the Oklahoma territory in 1838; some Cherokee later returned to the area from Oklahoma. DOE has consulted with the Eastern Band of the Cherokee concerning activities at ORR. Resources that may be sensitive to Native American groups include remains of prehistoric and historic villages, ceremonial lodges, cemeteries, burials, and traditional plant gathering areas. Apart from prehistoric archaeological sites, no Native American resources have been identified to date at ORR.

Paleontological Resources. The majority of geological units with surface exposures at ORR contain paleontological materials. Paleontological materials consist primarily of invertebrate remains, and these assemblages have relatively low research potential.

3.6.8 SOCIOECONOMICS

Socioeconomic characteristics described for ORR include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 15 counties around ORR located in Tennessee (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a four-county area in which 90.8 percent of all ORR employees reside: Anderson County (29.5 percent), Knox County (41.3 percent), Loudon County (5.5 percent), and Roane County (13.8 percent). [Text deleted.] In 1995, ORR employed 18,010 persons.

Regional Economy Characteristics. Selected employment and regional economy statistics for the ORR REA are summarized in Figure 3.6.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 16.2 percent to the 1990 level of 412,803. The 1994 unemployment in the REA was 4.9 percent, which was about the same as the unemployment for Tennessee (4.8 percent). The region's per capita income of $17,652 in 1993 was approximately 4.3 percent less than the statewide per capita income of $18,439.

As shown in Figure 3.6.8–1, the composition of the REA economy parallels that of Tennessee. During 1993, the service sector constituted about 26 percent of the region's nonfarm private sector, while retail trade constituted 19 percent. Manufacturing represented about 18 percent of ORR REA employment. In Tennessee, the service sector comprised 26 percent of total employment, manufacturing 19 percent, and retail trade 17 percent.

Population and Housing. In 1994, the ROI population totaled 512,254. From 1980 to 1994, the ROI population grew by 10.4 percent, compared to 12.7 percent growth in Tennessee. Within the ROI, Loudon County experienced the greatest population increase, 22.9 percent, while Roane County's population increased by only 0.2 percent. Population and housing trends are summarized in Figure 3.6.8–2.

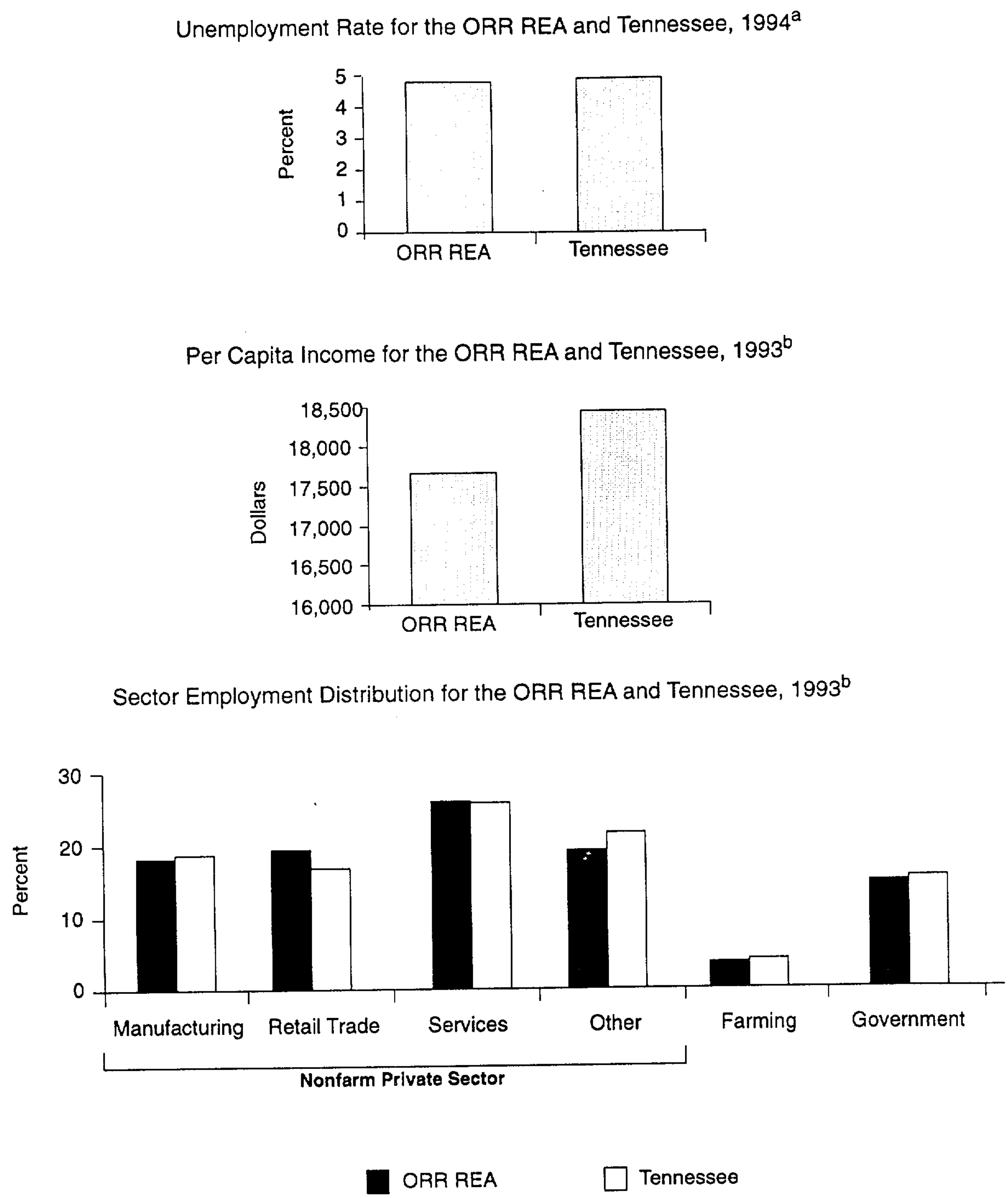
The 13.8-percent increase in the number of housing units between 1980 and 1990 for the ROI was nearly 2 percent less than the increase in the number of housing units for the entire State. The total number of housing units in the ROI for 1990 was 206,067. The 1990 ROI homeowner and renter vacancy rates were 1.7 and 8.5 percent, respectively. These rates were comparable to the statewide rates.

Community Services. Education, public safety, and health care characteristics were used to assess the level of community services in the ORR ROI. Figure 3.6.8–3 presents school district characteristics for the ORR ROI. Figure 3.6.8–4 summarizes public safety and health care services.

Education. In 1994, eight school districts provided public education services and facilities in the ORR ROI. As seen in Figure 3.6.8–3, these school districts operated at between 74.7-percent (Harriman School District) and 100-percent (Anderson, Knox, and Loudon Counties) capacity. The average student-to-teacher ratio for the ORR ROI in 1994 was 16.2:1. The Lenoir City School District had the highest ratio at 17.2:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents of the ROI. In 1994, a total of 885 sworn police officers served the four-county area. The city of Knoxville employed the largest number of officers (337), while Anderson County had the highest officer-to-population ratio (3.7 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 1.7 officers per 1,000 persons. Figure 3.6.8–4 compares police force strengths across the ROI.

Fire protection services in the ORR ROI were provided by 1,120 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was located in the city of Kingston, 7.1 firefighters per 1,000 persons, as indicated in Figure 3.6.8–4. Knoxville employed the greatest number of firefighters (357). The average firefighter-to-population ratio in the ROI was 2.2 firefighters per 1,000 persons.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.6.8–1. ***Employment and Local Economy for the Oak Ridge Reservation Regional Economic Area and the State of Tennessee.***

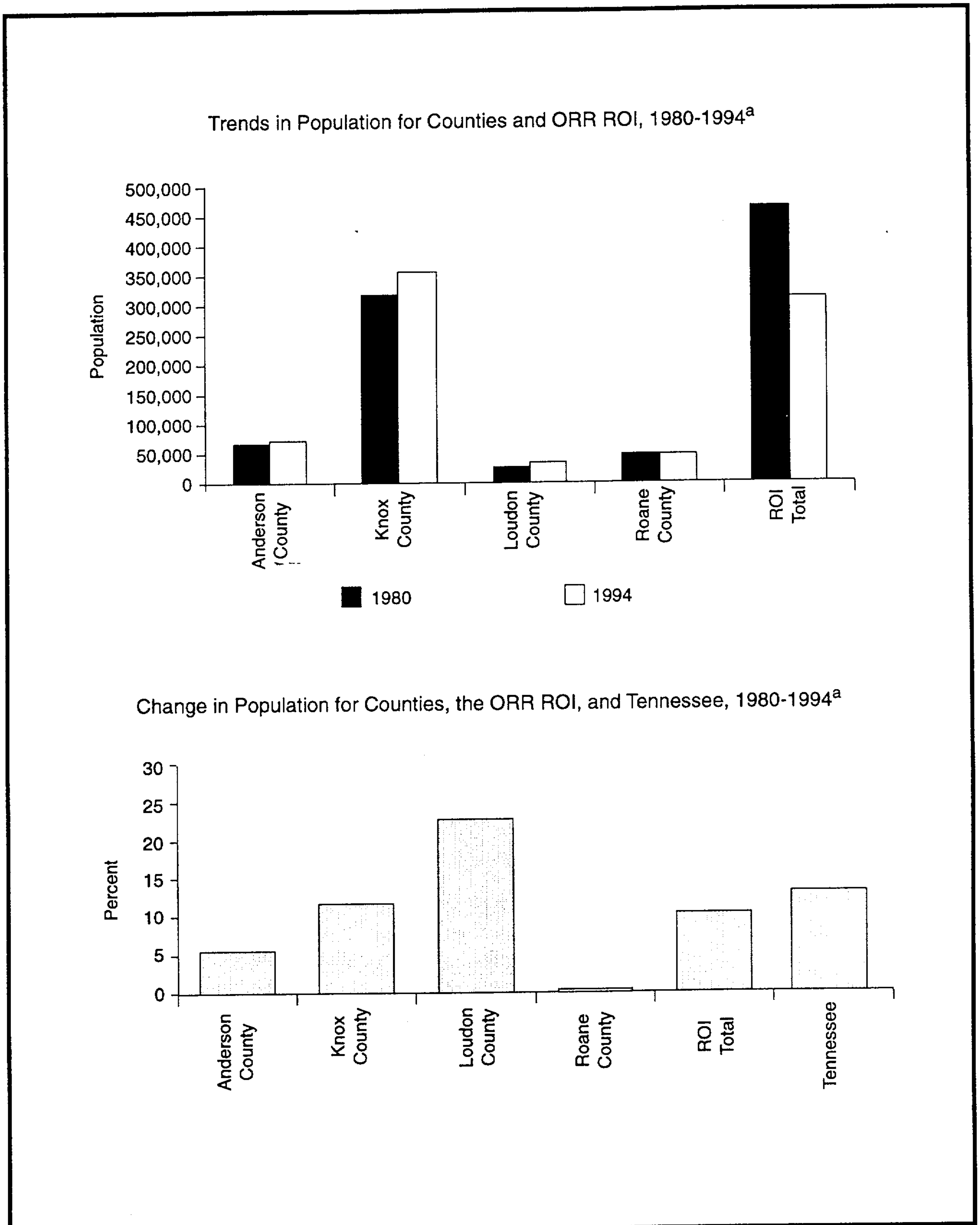
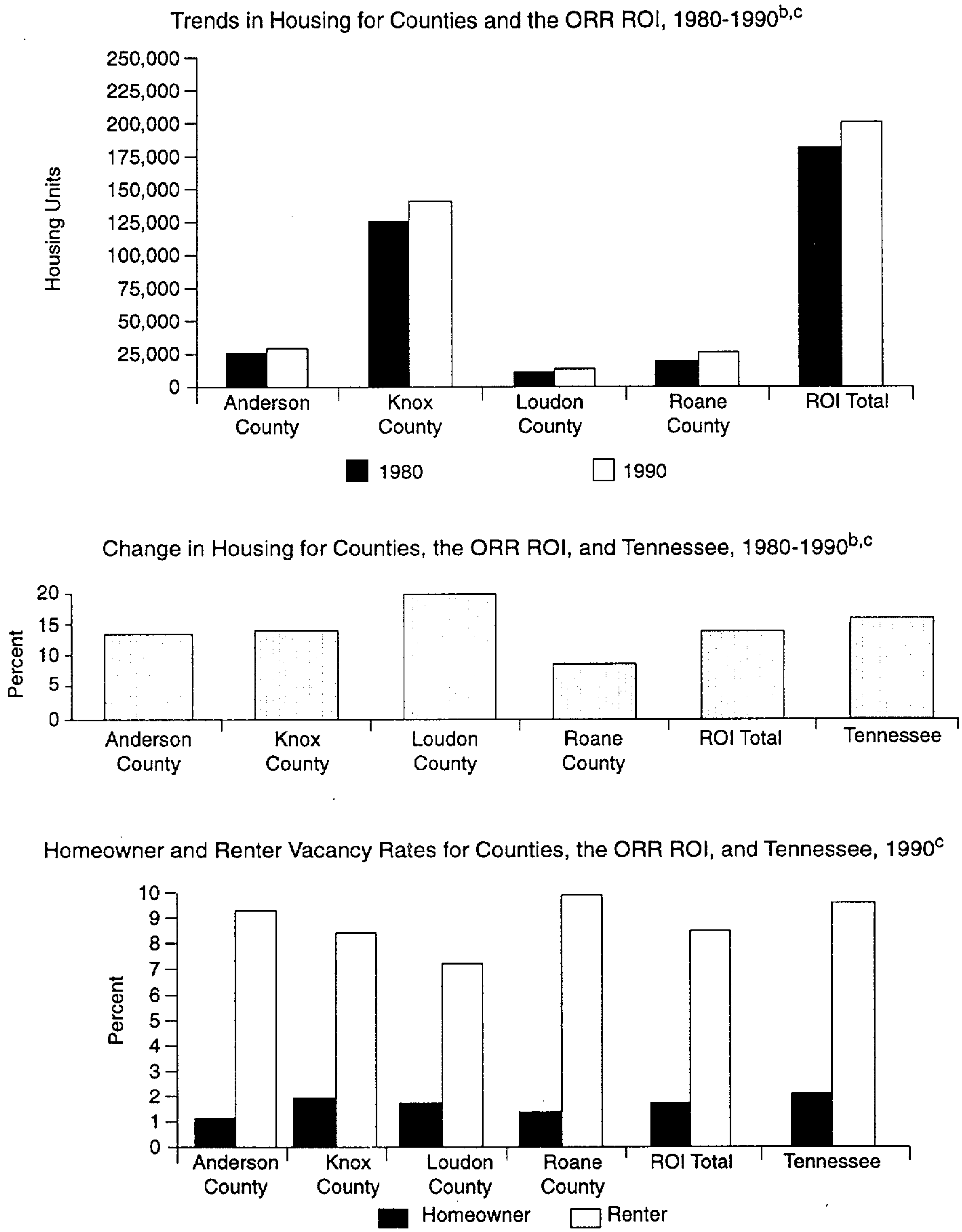
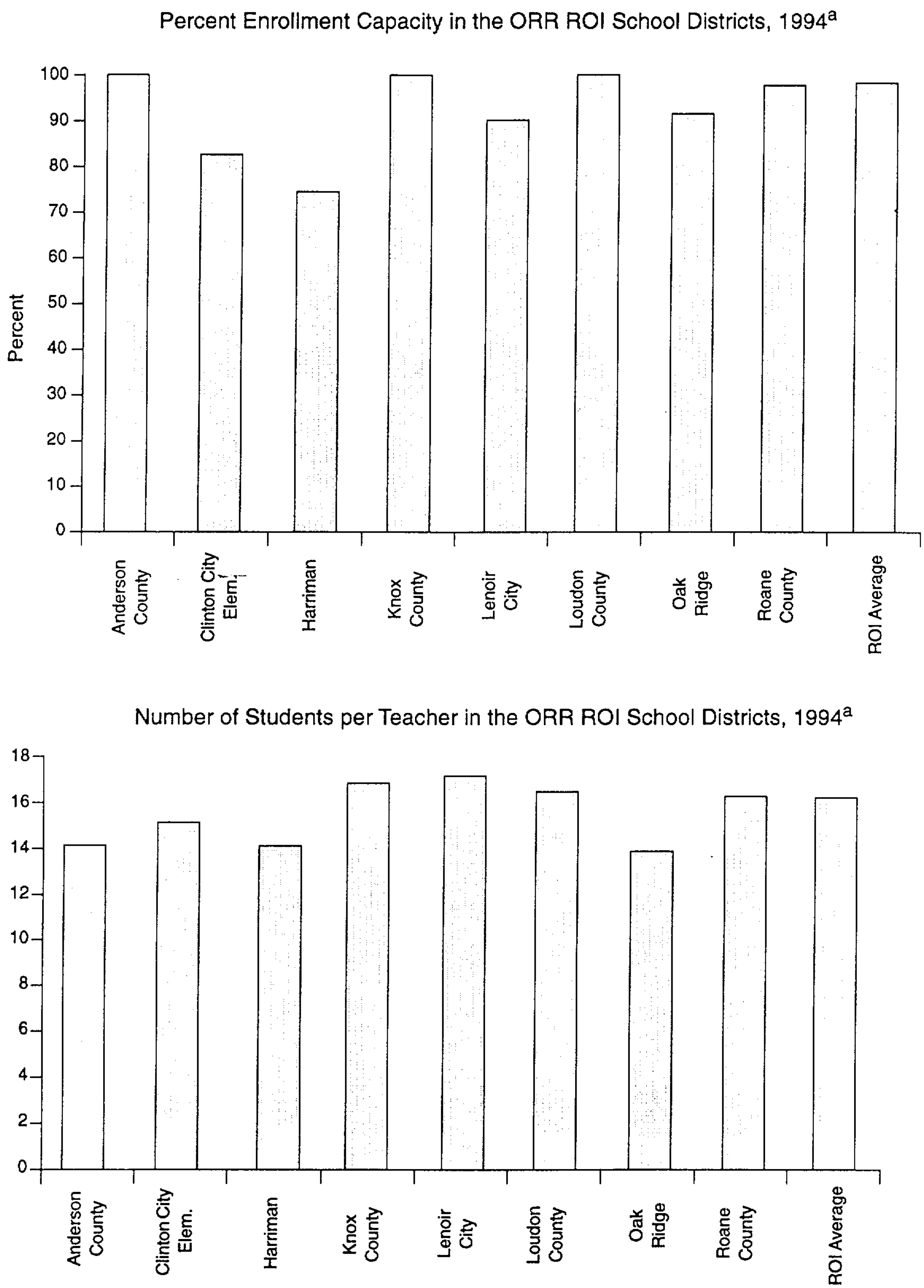


Figure 3.6.8–2. Population and Housing for the Oak Ridge Reservation Region of Influence and the State of Tennessee.



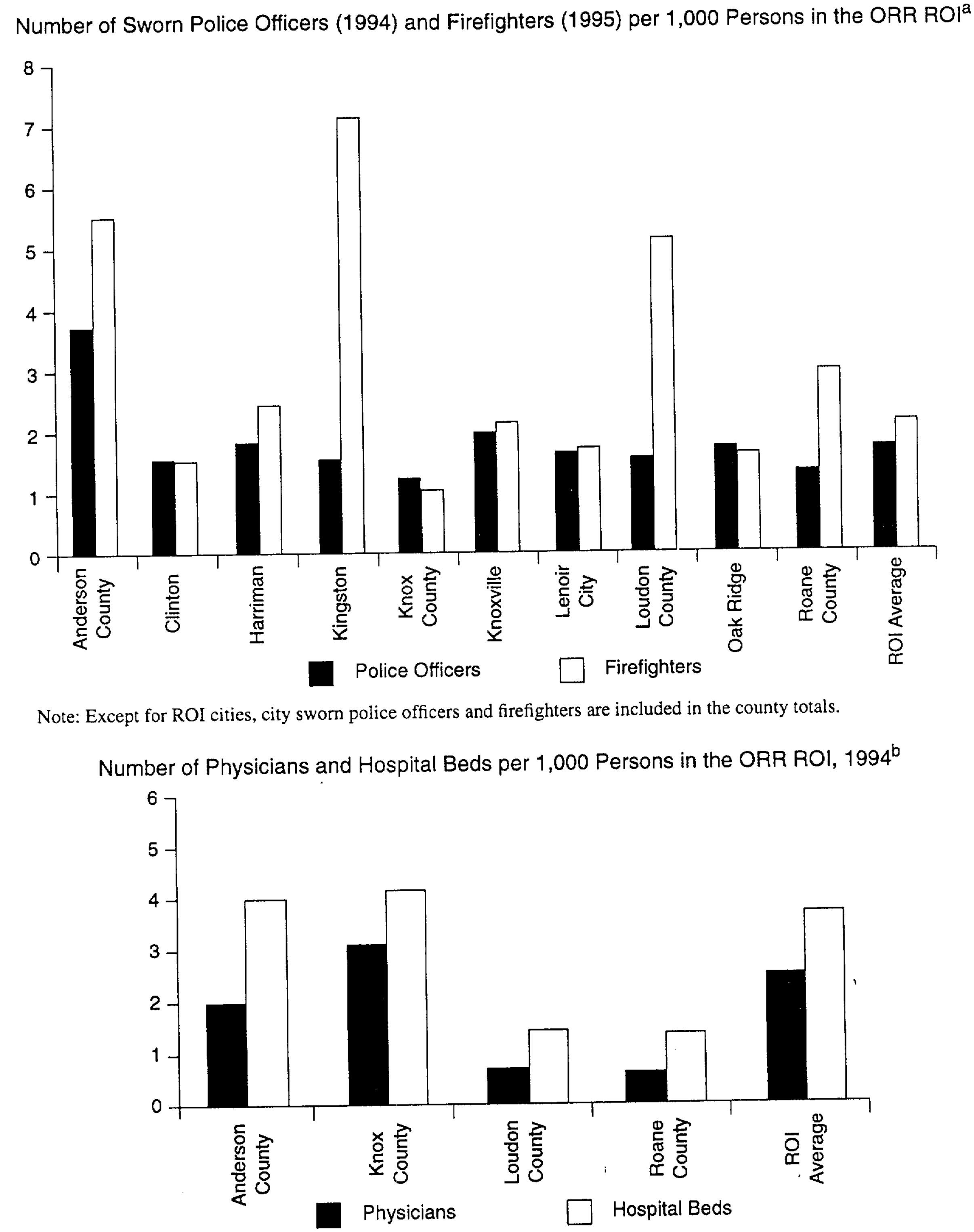
[a] Census 1983q; Census 1995a.
[b] Census 1982d.
[c] Census 1991c.

Figure 3.6.8–2. Population and Housing for the Oak Ridge Reservation Region of Influence and the State of Tennessee—Continued.



[a] Socio 1996a.

Figure 3.6.8–3. School District Characteristics for the Oak Ridge Reservation Region of Influence.



[a] Census 1993b; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.6.8–4. Public Safety and Health Care Characteristics for the Oak Ridge Reservation Region of Influence.

Health Care. There were 10 hospitals serving the four-county ROI in 1994. Over 78 percent of the hospital beds capacity was located in six hospitals in Knox County. Figure 3.6.8–4 displays the hospital bed-to-population ratios for the ORR ROI counties. During 1994, all 10 hospitals operated at below capacity, with bed occupancy rates ranging from 32.0 percent in Loudon County to 65.3 percent in Anderson County.

There were 1,306 physicians in the ROI during 1994, with the majority (1,109) practicing in Knox County. Figure 3.6.8–4 shows that the physician-to-population ratios ranged from 0.6 physicians per 1,000 persons in Roane County to 3.1 physicians per 1,000 persons in Knox County. The average ROI physician-to-population ratio was 2.5 physicians per 1,000 persons.

Local Transportation. Interstates and State Routes provide access between ORR and metropolitan areas (see Figure 2.2.5-1 and Figure 2.2.5-2). The east-west highway, Interstate 40, located 3 km (2 mi) south of the reservation boundary, provides access to the cities of Nashville and Knoxville, Tennessee. The north-south highway, Interstate 75, is located 5 km (3 mi) east of ORR and serves as a major route to the south, passing through the cities of Chattanooga, Tennessee, and Atlanta, Georgia.

Vehicular access to ORR is provided by three State Routes. State Route 95 forms an interchange with Interstate 40 and enters the reservation from the south. State Route 58 enters the reservation from the west and passes just south of K–25. State Route 162 extends from Interstate 75 and Interstate 40 just west of Knoxville and provides eastern access to the ORR.

Within ORR, several routes are used to transfer traffic from the State Routes to the main plant areas. Bear Creek Road, located north of Y–12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with State Route 95 and State Route 58. Bear Creek Road has restricted access around Y–12 and is not a public thoroughfare. Bethel Valley Road, a public roadway, extends from the east end of the ORR at State Route 62 to the west end at State Route 95. Blair Road provides access to K–25 from the north.

There are two current road improvement projects affecting access to ORR. The first is the construction of two box bridges on State Route 61 near Oak Ridge. The second is the repavement of State Route 62 from Tuskegee Drive to north of Union Valley Road. There are two planned road improvement projects that could affect access to ORR in the near future. The first is the reconstruction of State Route 9 in Lake City. The second is the construction of State Route 58 from Interstate 40 to State Route 95 in Oak Ridge (TN DOT 1995a:3).

Five road segments in the ROI could be affected by the storage and disposition alternatives. The first is I-275 from I-40 at Knoxville to I-75/640 at Knoxville. This segment operated at level of service D in 1995. The second is I-640 from I-75 at Knoxville to I-40. This segment operated at level of service D in 1995. The third is U.S. 70 from U.S. 321 to U.S. 11. This segment operated at level of service B in 1995. The fourth is Tennessee State Route 58 from Tennessee State Route 95 to I-40. The segment operated at level of service E in 1995. The fifth is Tennessee State Route 62 from Tennessee 95 at Oak Ridge to Tennessee State Route 170. This segment operated at level of service F in 1995.

Two main line branches provide rail service for ORR. The CSX Transportation line at Elza (just east of Oak Ridge) serves the Y–12 Plant and the Office of Science and Technological Information in east Oak Ridge. The Norfolk Southern main line from Blair provides easy access to K–25. The Clinch River has a barge facility located on the west end of ORR near K–25 and is occasionally used for the receipt of shipments that are too large or heavy to be transported by rail or truck. McGhee Tyson Airport, located 37 km (23 mi) from ORR, is the nearest airport serving the region with major carriers providing passenger and cargo service. A private airport, Atomic Airport, Inc., is the closest air transportation facility to Oak Ridge. Oak Ridge has a part-time public transportation system (ORR 1995a:7).

3.6.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of ORR are shown in Table 3.6.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to ORR operations.

Table 3.6.9–1. ***Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Oak Ridge Reservation Operation***

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic radiation	27
External terrestrial radiation	28
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fall out	<1
Air travel	1
Consumer and industrial products	10
Total	360

[a] OR DOE 1994c.
[b] NCRP 1987a.
Source: Value of radon is an average for the United States.

Releases of radionuclides to the environment from ORR operations provide another source of radiation exposure to individuals in the vicinity of ORR. Types and quantities of radionuclides released from operations in 1993 are listed in the *Oak Ridge Reservation Environmental Report for 1993* (ES/ESH-47). Doses to the public resulting from these releases and direct radiation are presented in Table 3.6.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment (No Action) radiological releases and resulting impacts at ORR in the year 2005 (Section 4.2.5.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from ORR operations in 1993 is estimated to be 1.5×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of ORR operations is less than 2 in 1 million. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 0.014 excess fatal cancers are projected in the population living within 80 km (50 mi) of ORR from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national rate, the number of fatal cancers expected to occur during 1993 from all causes was 1,760 for the population living within 80 km (50 mi) of ORR. This number of expected fatal cancers is much higher than the estimated 0.014 fatal cancers that could result from ORR operations in 1993.

Table 3.6.9–2. Radiation Doses to the Public From Normal Oak Ridge Reservation Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	1.4	4	0.60[b]	100	3.0[c]
Population within 80 km[d] (person-rem)	None	26	None	2.0	100	28.0
Average individual within 80 km[e] (mrem)	None	0.030	None	0.0023	None	0.032

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] These doses are mainly from drinking water and eating fish from the Clinch River section of Poplar Creek.

[c] This total dose includes 1 mrem/yr from direct radiation exposure to a cesium field near the Clinch River.

[d] In 1993, this population was approximately 880,000.

[e] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: OR DOE 1994c.

Oak Ridge Reservation workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.6.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to ORR workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to ORR workers from normal operations in 1992 is estimated to be 0.027.

Table 3.6.9–3. Radiation Doses to Workers From Normal Oak Ridge Reservation Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	4.0
Maximally exposed worker (mrem)	5,000	2,000
Total workers[b] (person-rem)	ALARA	68

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 17,150.

Source: 10 CFR 835; DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Oak Ridge Reservation Environmental Report for 1993* (ES/ESH-47). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in the same report.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in previous sections of this PEIS, particularly Section 3.6.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations via inhalation of air containing hazardous chemicals released to the atmosphere by ORR operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.6.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to ORR workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. ORR workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements (DOE O 440.1) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at ORR are expected to be substantially better than required by the standards.

Health Effects Studies. Two epidemiologic studies were conducted to determine whether ORR contributed to any excess cancers in communities surrounding the facility. One study found no excess cancer mortality in the population living in counties surrounding ORR when compared to the control populations located in other nearby counties and elsewhere in the United States. The other found slight excess cancer incidences of several types in the counties near ORR, but none of the excess risks were statistically significant.

A pilot study on mercury contamination conducted by the Tennessee Department of Health and Environment showed no difference in urine or hair mercury levels between individuals with potentially high mercury exposures compared to those with little potential for exposure. However, soil analysis showed that the mercury in soil was inorganic, which decreases the likelihood of bioaccumulation and health effects. Studies are continuing on the long-term effects of exposure to mercury and other hazardous chemicals.

More epidemiologic studies have been conducted to assess the health effect of the population working at ORR than any other site reviewed for this document. Excess cancer mortalities have been reported and linked to specific job categories, age, and length of employment, as well as to the levels of exposure to radiation. For a more detailed description of the studies reviewed and the findings, refer to Section M.4.6.

Accident History. There have been no accidents with a measurable impact on offsite population during nearly 50 years of Y–12 operations at ORR. The most noteworthy accident in Y–12 history was a 1958 criticality accident. The impact from this accident resulted in temporary radiation sickness for a few ORR employees. In 1989, there was a one-time accidental release of xylene into the ORR sewer system with no offsite impacts.

Accidental releases of anhydrous hydrogen fluoride occurred in 1986, 1988, and 1992, with little onsite and negligible offsite impacts. The hydrogen fluoride system where these accidents occurred is being modified to reduce the probability of future releases and to minimize the potential consequences if a release does occur (ORR 1992a:6).

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The Department has overall responsibility for emergency planning and operations at ORR. However, DOE has delegated primary authority for event response to the operating contractor. Although the contractor's primary response is onsite, the contractor does provide offsite assistance if requested under the terms of existing mutual aid agreements. If a hazardous materials event with offsite impacts occurs at a DOE ORR facility, elected officials and local governments are responsible for the State's response efforts. The Governor's Executive Order No. 4 established the Tennessee Emergency Management Agency as the agency responsible for coordinating State emergency services. When a hazardous materials event occurring at DOE facilities is beyond the capability of local government, and assistance is requested, the Tennessee Emergency Management Agency Director may direct State agencies to provide assistance to the local governments. To accomplish this task and ensure prompt initiation of emergency response actions, the Director may cause the State Emergency Operations Center and Field Coordination Center to be activated. City or county officials may activate local Emergency Operations Centers in accordance with existing emergency plans.

3.6.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for ORR. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.5. Tables 3.6.10–1 (Y–12), 3.6.10–2 (ORNL), and 3.6.10–3 (K–25) present a summary of waste management activities at ORR for 1994.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at ORR. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed-upon milestones.

The EPA placed ORR on the NPL on November 21, 1989. DOE, EPA Region IV, and the TDEC completed a Federal Facility Agreement effective January 1, 1992. This agreement coordinates ORR inactive site assessment and remedial action. Portions of the Federal Facility Agreement are applicable to operating waste management systems. Existing actions are conducted under RCRA and applicable State laws, which minimize duplication, expedite response actions, and achieve a comprehensive remediation of the site. ORR generates and manages spent nuclear fuel and the following waste categories: TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. The ORR generates and manages a relatively small quantity of spent nuclear fuel. The only operating reactor is the ORNL High-Flux Isotope Reactor, which is used to produce isotopes for medical and industrial applications, neutron scattering experiments, and various materials irradiation experiments. ORR has also received some offsite shipments of reactor irradiated nuclear material. Most of the fuel and irradiated nuclear material is stored in numerous buildings and hot cells at ORNL and one building at Y–12. Some of the fuel still remains in the core of the inactive research reactors. Irradiated fuel and its associated fission products are stored in dry wells at ORNL in Solid Waste Storage Area-5N. A small amount of irradiated spent nuclear fuel is stored in wells and trenches in Solid Waste Storage Areas-5S and -6. The interim management of the spent nuclear fuel will be in accordance with the ROD published in the *Federal Register* (60 FR 28680) on June 1, 1995, for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F) as amended on March 8, 1996 (61 FR 9441).

High-Level Waste. The ORR does not generate or manage HLW.

Transuranic Waste. The ORNL is the only generator of TRU waste at ORR. Solid TRU waste consisting of filters, paper, metals, and other items was generated at ORNL through laboratory, pilot plant, and reactor operations. This includes both contact-handled and remote-handled TRU waste contaminated with lead and, in some cases, mercury. Contact-handled waste is TRU waste that contains mainly Pu, which emits alpha particles and low-energy photons. The packaging is designed to provide sufficient containment and shielding to minimize personnel exposure. Remote-handled TRU waste contains activation materials and fission products that decay and emit beta and gamma radiation on the surface of the packaging that exceeds 200 mrem/hr.

As of December 31, 1994, approximately 1,360 m^3 (1,790 yd^3) of TRU wastes were in retrievable drum storage. The amount of remote-handled waste was about 1,420 m^3 (1,860 yd^3) (OR LMES 1996a:4-4b). Current activities center around certification of contact-handled waste, planning/designing of a repackaging and certification facility for remote-handled wastes, and planning for shipment of wastes to a suitable repository that can provide for the disposal of TRU wastes.

Low-Level Waste. Solid LLW, consisting primarily of radioactively-contaminated construction debris, wood, paper, asbestos, trapping media, personnel protection equipment, process equipment, and radioactive materials

Table 3.6.10–1. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge Reservation, Y–12 Plant

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	None	NA	NA	Storage vaults[a]	4[b]	None-Ship to INEL or SRS	NA
Low-Level							
Liquid	898	Activated sludge	12,900[c]	Stored onsite	Included in liquid mixed LLW	NA	NA
Solid	5,230[d]	Stabilization and compaction, incineration and smelting by commercial vendor	19,300[e]	Stored onsite at Y–12 or K–25	16,200[f]	None—stored pending availability of offsite disposal or planned onsite LLW disposal facilities	NA
Mixed Low-Level							
Liquid	1,390	Neutralization, activated sludge, oxidation, adsorption, and incineration at K–25	12,300[g]	Tanks and drums	2,660[h]	NA	NA
Solid	306	Incineration at K–25 or offsite commercial vendors	NA	Staged for shipment	11,700[i]	Offsite	NA
Hazardous							
Liquid	9,450	Managed as mixed LLW	30,300[j]	Tanks	751[k]	Offsite	NA
Solid	Included in hazardous liquid[l]	None	NA	Staged for shipment	170[m]	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	2,460 m^3/day[n]	Offsite[o]	5,300 m^3/day	None	NA	Offsite	NA
Solid	41,700[p]	Compaction	41,700[q]	None	NA	Industrial and Sanitary Landfill V, offsite at municipal site	1,100,000[r]

Table 3.6.10–1. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge Reservation, Y–12 Plant—Continued

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Other)							
Liquid	228,000[s]	Evaporation, neutralization, and precipitation	251,000[t]	None	NA	Offsite-NPDES outfall	NA
Solid	Included in solid sanitary	None	NA	None	NA	Construction Demolition Landfill VI	119,000[r]

[a] Building 9720-5.

[b] Based on conversion factor of 52 kg/m^3(DOE 1995kk). [Text deleted.]

[c] West End Treatment Facility and Central Pollution Control Facility.

[d] Includes 2,500 m^3 of contaminated scrap metal.

[e] Waste Feed Preparation Facility and the Uranium Chip Oxidizer Facility (design feed rate).

[f] Includes the Depleted Uranium Oxide Storage Vaults, Above Grade Storage Facility, salvage yard, Sludge Basin and the Containerized Waste Storage Area.

[g] Includes Waste Coolant Processing Facility, Acid Waste Neutralization and Recovery Facility, Cyanide Treatment Facility, and Groundwater Treatment Facility. The West End Treatment Facility, the Plating Rinsewater Treatment Facility, and the Central Pollution Control Facility can process mixed waste and LLW.

[h] OD7, OD8, OD9, and OD10, Liquid Storage Facility, 9212 Tank Farm, and Building 9720-9 (western half).

[i] RCRA and PCB Container Storage Area (9720-58), Container Storage Facility (Bldg. 9720-12), PCB Drum Storage Facility (9404-7), Buildings (9201-4, 9206, and 9212), and the West End Tank Farm.

[j] Plating Rinsewater Treatment Facility and Stream Plant Wastewater Treatment Facility.

[k] Building 9720-9 (eastern half).

[l] Currently, all RCRA-hazardous wastes are stored at the Y–12 plant or the K–25 Site awaiting further disposal.

[m] RCRA Storage and Staging Area (Bldg. 9720-31).

[n] Storm runoff does not include sewage waste.

[o] Oak Ridge Sewage Treatment Plant.

[p] Includes trash, debris, scrap metal, treatment residue, and classified waste.

[q] The 1994 generation rate was used as an estimate for the capacity of the Building 9720-25 Baler Facility.

[r] Serves all three sites. Value provided is design capacity. Projected utilization is 39,600 m^3/yr for Industrial and Sanitary Landfill V and 27,500 m^3/yr for Construction Demolition Landfill VI.

[s] Includes industrial wastes such as oils and solvents, liquid waste and wastewater from Y–12 Plant operations, contractors and waste management.

[t] Approximate Central Pollution Control Facility, West End Treatment Facility, and Steam Plant Wastewater Treatment Facility NPDES permit annual discharge volume limits for East Fork Poplar Creek.

Note: NA=not applicable.

Source: DOE 1994d; DOE 1994n; DOE 1995gg; DOE 1995kk; OR DOE 1992c; OR DOE 1995g; OR LMES 1996a; OR MMES 1995c; ORR 1993a:4.

Table 3.6.10–2. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge National Laboratory

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	2[a]	None	NA	Pools	53[b]	None-Ship to INEL or SRS	NA
Transuranic (Solid)							
Contact handled	103[c]	None	NA	Staged for shipment[d]	1,760	None, WIPP or alternate facility in future	NA
Remote handled	64	None	NA	Staged for shipment[e]	856	None, WIPP or alternate facility in future	NA
Low-Level							
Liquid	2,070	Ion exchange, filtration, evaporation, and solidification	390,000[f]	Stored onsite in tanks	3,230[g]	NA	NA
Solid	1,640[h]	Compaction (compaction, incineration and smelting by commercial vendor)	11,300[i]	Stored onsite	7,850[j]	Onsite	3,590[k]
Mixed Low-Level							
Liquid	Included in solid mixed LLW[l]	Incineration at K–25	Offsite	Tank and drums	393[m]	None	NA
Solid	92[n]	Incineration at K–25 or offsite commercial vendors	Offsite	Staged for shipment	Include in liquid mixed LLW	Offsite	NA
Hazardous							
Liquid	23,800[o]	Neutralization/ sedimentation and evaporation, treat offsite[p]	Included in nonhazardous (other) liquid capacity	Staged for shipment	Included in solid hazardous	Offsite	NA
Solid	55[p]	Open-burning[q], treat offsite	Variable	Staged for shipment	130[r]	Storage/incineration (K–25) and landfill (Y–12)	NA

Table 3.6.10–2. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge National Laboratory—Continued

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Sanitary)							
Liquid	360,000	Extended aeration-activated sludge treatment	414,000[s]	None	NA	NPDES outfall	NA
Solid	4,820	None[t]	NA	None	NA	Y–12 landfill, offsite to municipal site	See Table 3.6.10–1
Nonhazardous (Other)							
Liquid	718,000[u]	Neutralization, precipitation, and filtration	1,510,000[v]	None	NA	Offsite	NA
Solid	Included in solid sanitary	None	NA	None	NA	Y–12 landfill and SWSA 6 burial	Included in sanitary

[a] The HFIR research reactor generates 12 fuel assemblies per year (9.4 kg U-235 per assembly). Based on conversion factor of 52 kg/m^3 (DOE 1995kk).

[b] Includes 820 kg of available spent fuel capacity at the HFIR pool (43% full). Reracking of positions under way. Based on conversion factor of 52 kg/m^3, and the size of all fuel elements is assumed to be the same (DOE 1995kk).

[c] Does not include 8 m^3 of mixed TRU waste.

[d] Stored in various buildings (Bldg. 7826, 7834, 7842, 7878, 7879, and 7934).

[e] Stored in tanks, bunkers, and earthen trenches (Bldg. 7855 and SWSA 5N trenches).

[f] Process Waste Treatment Plant, Melton Valley Low-Level Waste Immobilization Facility and Liquid Low-Level Waste Evaporation Facility.

[g] Liquid LLW System.

[h] Includes radioactive scrap metal.

[i] Waste Compaction Facility (Bldg. 7831).

[j] As of June 30, 1995.

[k] Interim Waste Management Facility.

[l] May include 19 m^3 of mixed waste oil treated at TSCA incinerator in 1994.

[m] Buildings 7654, 7507W, 7823 and Tank 7830a.

[n] Includes waste oils, organic wastes, carcinogenic wastes, mercury-contaminated solid wastes, solvents, corrosives, poisons, and other process wastes.

[o] Projected Steam Plant regenerate in 1994 (may be coal yard runoff).

[p] Includes PCB and asbestos. May include some liquid hazardous waste.

[q] The Chemical Detonation Facility treats small amounts of hazardous waste that would be dangerous to transport offsite. Explosives such as aged picric acid are detonated in this facility.

[r] Hazardous Waste Storage Facility (Bldg. 7652 Part B permit - 57,200 l and Bldg. 7507 Part A permit - 31,200 l), and Buildings 7651 and 7653.

[s] Sanitary Waste Water Treatment Facility design capacity.

[t] Loaded in boxes and stored at Interim Waste Management Facility.

[u] May include coal yard runoff which is hazardous waste.

[v] Nonradiological Wastewater Treatment Facility.

Note: NA=not applicable.

Table 3.6.10–3. Waste Management Activities at Oak Ridge Reservation, K–25 Site

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3/yr)
Low-Level							
Liquid	55	Incineration	15,700[a]	Stored onsite	Included in solid LLW[b]	NA	NA
Solid	4,480[c]	Compaction/ incineration and smelting by commercial vendor	Offsite	Stored onsite	44,000[d]	None–stored pending availability of offsite disposal or planned onsite LLW disposal facilities	NA
Mixed Low-Level							
Liquid	148,000[e]	Neutralization and incineration	221,000[f]	Stored onsite	97,000[g]	NA	NA
Solid	222[h]	Incineration or offsite by commercial vendors	Offsite[i]	Stored onsite	120,000[j]	Offsite	1,130[k]
Hazardous							
Liquid	Included in liquid mixed low-level[l]	Treated as mixed LLW	Included in liquid mixed LLW	Treated as mixed LLW	Included in liquid mixed LLW	Offsite	NA
Solid	743[m]	Treated as mixed LLW	Offsite[n]	Treated as mixed LLW	Included in solid mixed LLW	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	416,000	Extended aeration	829,000 - sewage[o]	None	NA	NPDES outfall	NA
Solid	2,950[p]	None	NA	None	NA	Oak Ridge landfill (offsite)	NA

Table 3.6.10–3. *Waste Management Activities at Oak Ridge Reservation, K–25 Site—Continued*

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3/yr)
Nonhazardous (Other)							
Liquid	69,300[q]	Neutralization settling; and filtration	221,000[r]	None	NA	NPDES outfall	NA
Solid	Included in solid sanitary	None	NA	Stockpiled at scrap yard	Unspecified capacity	Y–12 landfill and metal sold to public	See Table 3.6.10–1

[a] TSCA Incinerator (K-1435). Also treats mixed waste.
[b] Liquid LLW stored in Building K–25 vaults.
[c] Includes 103 m^3 of contaminated scrap metal.
[d] Based on solid LLW stored in Building K–25, outside areas, K-1313A, and K-33.
[e] Includes TSCA waste waters and density assumption is equal to 1 kg/l.
[f] Central Neutralization Facility permitted operating capacity.
[g] Includes current permitted container (solid/sludges/liquid wastes) and tank (liquids) storage capacity.
[h] Includes contaminated asbestos/beryllium oxide (BeO), RCRA and state regulated waste, and may include some PCB-tainted waste.
[i] Sludge Fixation Facility may be used after engineering problems are solved.
[j] Total current permitted waste pile unit storage capacity.
[k] Waste sent to commercial vendor in 1994.
[l] Hydrogen softener blowdown from the steam plant.
[m] Managed as mixed waste.
[n] Sludge Fixation Facility may be used after engineering problems are solved
[o] Sewage treatment plant capacity (Bldg. K-1203).
[p] Includes waste shipped to Y–12 Sanitary Landfill.
[q] Includes nonhazardous Steam Plant waste water.
[r] Central Neutralization Facility permitted capacity.
Note: NA=not applicable.
Source: DOE 1995gg; OR DOE 1993a; OR LMES 1996a; ORR 1993a:4.

removed from liquid and airborne discharges, is generated at ORR. ORNL operates the only LLW disposal facility at ORR. This disposal facility only accepts LLW generated at ORNL. Solid LLW is being stored at K–25 and Y–12 for future disposal. Contaminated scrap metal is stored above ground at the K-770 scrap metal facility and the Y–12 old salvage yard until further disposal methods are evaluated.

The management of LLW at ORR has been affected by three recent events: declines in ORR disposal capacity, changes in regulatory and operational conditions, and evolution of the radioactive waste disposal-class concept. The previous strategy classified LLW according to its isotopic content, concentration, and the performance of a disposal facility. In some instances, these classifications are used to describe the type of LLW or a disposal technology. For example, L-I refers to low concentration LLW or a landfill disposal facility, while L-II refers to low to moderate concentration LLW or a tumulus disposal facility. A revised classification system has been proposed. Exempt LLW would have contaminant levels sufficiently low to be disposed of in a sanitary or industrial landfill with State concurrence. Disposable LLW would be suitable for disposal on the ORR as determined by facility performance assessments. Offsite LLW would be that LLW which would not meet the criteria of exempt or disposable. The long-range strategy is to rely on the combination of onsite and offsite facilities. Plans for a replacement onsite disposal facility will continue to be pursued with the most likely candidate site for a tumulus disposal facility being Bear Creek Valley. That portion of the LLW that cannot be disposed of onsite consistent with DOE Order 5820.2A, *Radioactive Waste Management*, will be stored until disposal offsite becomes available.

Mixed Low-Level Waste. The RCRA mixed, radioactive land disposal restricted waste is in storage at Y–12, K–25, and ORNL. Because prolonged storage of these wastes exceeded the one-year limit imposed by RCRA, ORR entered into a Federal Facility Compliance Agreement (FFCA) for RCRA Land Disposal Restriction wastes with EPA on June 12, 1992. This agreement was terminated with issuance of the TDEC Commissioner's Order, effective October 1, 1995, which requires DOE to comply with the Site Treatment Plan prepared by ORR. The plan contains milestones and target dates for DOE to characterize and treat its inventory of mixed wastes at ORR.

Sludges contaminated with low-level radioactivity are generated by settling and scrubbing operations, and in the past were stored in K-1407-B and 1407-C ponds at K–25. Sludges have been removed from these ponds and a portion has been fixed in concrete at the K-1419 Sludge Treatment Facility and stored at the K-33 Building. The concreted sludges are being shipped offsite for disposal. The raw sludges are stored in the in the K–1065 building pending further treatment. Mixed waste sludges are also generated at Y–12 in the treatment of nitrate waste from purification and recycling of uranium and in the treatment of plating shop waste.

The primary facility generator of liquid mixed waste is the K-1435 TSCA Incinerator from the wet scrubber blowdown. This waste is currently being treated at the Central Neutralization Facility, which provides pH adjustment and chemical precipitation. Treated effluents are discharged through an NPDES outfall. The contaminated sludges are stored at K–25 as mixed waste.

The K–25 TSCA incinerator has a design capacity to incinerate 909 kg/hr (2,000 lb/hr) of mixed liquid waste and up to 455 kg/hr (1,000 lb/hr) of solids and sludge (91 kg/hr [200 lb/hr] maximum sludge content) (ORR 1993a:2). The TSCA incinerator is capable of incineration of both TSCA- and RCRA-mixed wastes. DOE guidance currently does not allow incineration of solids/sludges. Because of permit limits (TSCA, RCRA, State of Tennessee), the incinerator is not running at full capacity. In 1994, approximately 2,590 m^3 (683,000 gals) of mixed liquid waste was incinerated (OR LMES 1996a:7-6).

Uranium wastes contaminated with PCBs (that is, mixed wastes) are being stored in excess of the 1-year limit imposed by TSCA because of the lack of treatment and disposal capacities. DOE and EPA have signed an FFCA, effective February 20, 1992, to bring K–25 associated with the Uranium Enrichment Program into compliance with TSCA regulations for use, storage, and disposal of PCBs. It also addressed the approximately 10,000 pieces of nonradioactive PCB-containing dielectric equipment associated with the shutdown of diffusion plant operations. An additional FFCA related to TSCA compliance is currently being discussed by DOE and EPA for ORR.

Hazardous Waste. The RCRA-regulated waste are generated by ORR in laboratory research, electroplating operations, painting operations, descaling, demineralizer regeneration, and photographic processes. Certain other wastes (for example, spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport and have been certified as having no radioactivity added are shipped offsite to RCRA-permitted commercial treatment and disposal facilities. Small amounts of reactive chemical explosives that would be dangerous to transport offsite, such as aged picric acid, are processed onsite in the Chemical Detonation Facility at ORNL.

Nonhazardous Waste. Nonhazardous wastes are generated from ORR maintenance and utilities. For example, the steam plant produces nonhazardous sludge. Scrap metals are discarded from maintenance and renovation activities and are recycled when appropriate. Construction and demolition projects also produce nonhazardous industrial wastes. All nonradioactive medical wastes are autoclaved to render them noninfectious and are sent to the Y–12 Sanitary Landfill. Remedial action projects also produce wastes requiring proper management. The State of Tennessee permitted landfill (Construction Demolition Landfill VI) receives nonhazardous industrial materials such as fly ash and construction debris. Asbestos and general refuse are managed in Industrial and Sanitary Landfill V located at Y–12.

3.7 SAVANNAH RIVER SITE

The SRS is located approximately 19 km (12 mi) south of Aiken, South Carolina (see Figure 2.2.6–1). First established in 1950, SRS has been involved for more than 40 years in tritium operations and other nuclear material production. Today the site includes 16 major production, service, research, and development areas, not all of which are currently in operation.

There are more than 3,000 facilities at SRS, including 740 buildings with 511,000 m^2 (5,500,000 ft^2) of floor area. Major nuclear facilities at SRS include fuel and Pu storage facilities and target fabrication facilities, nuclear material production reactors, chemical separations plants, a uranium fuel processing area, liquid HLW tank farms, a waste vitrification facility, and the Savannah River Technology Center. SRS processes nuclear materials into forms suitable for continued safe storage, use, or transportation to other DOE sites. In accordance with the ROD for the *F-Canyon Plutonium Solutions Environmental Impact Statement* (60 FR 9824), and the *Environmental Impact Statement, Interim Management of Nuclear Materials* (60 FR 65300 and 61 FR 6633) Pu solutions have been stabilized and targets have been dissolved and processed in the F-Canyon. A second supplemental ROD announcing DOE's decision for the stabilization of Pu-239 solutions by conversion to metal at F-Canyon and the FB-Line was published September 13, 1996 (61 FR 48474). Tritium recycling facilities at SRS empty tritium from expired reservoirs, purify it to eliminate the helium decay product, and fill replacement reservoirs with specification tritium for nuclear stockpile weapons. Filled reservoirs are delivered to Pantex for weapons assembly and directly to DoD to replace expired reservoirs. Historically, DOE has produced tritium at SRS, but has not produced any since 1988.

Department of Energy Activities. The current missions at SRS are shown in Table 3.7–1. [Text deleted.] In the past, the SRS complex produced nuclear materials. The complex consisted of various Pu storage facilities, five reactors (the C-, K-, L-, P-, and R-Reactors) (all inactive), a fuel and target fabrication plant, two chemical separation plants, a tritium-target processing facility, a heavy water rework facility, and waste management facilities. The K-Reactor (the last operational reactor) has been shut down with no planned provision for restart. SRS is still conducting tritium recycling operations in support of stockpile requirements using retired weapons as the tritium supply source. The Separations Facilities, and the F- and H-Canyons, are planned to be used through the year 2002 to complete DOE's commitment to the DNFSB regarding stabilization of site inventories of legacy nuclear materials.

The DOE Office of Environmental Management is pursuing a 30-year plan to achieve full compliance with all applicable laws, regulations, and agreements to treat, store, and dispose of existing wastes; reduce generation of new wastes; clean up inactive waste sites; remediate contaminated groundwater; and dispose of surplus facilities.

The Savannah River Technology Center provides technical support to all DOE operations at SRS. In this role, it provides process engineering development to reduce costs, waste generation, and radiation exposure. SRS has an expanding mission to transfer unique technologies developed at the site to industry. SRS is also an active participant in the Strategic Environmental R&D Program formulated to develop technologies to mitigate environmental hazards at DoD and DOE sites.

Non-Department of Energy Activities. Non-DOE facilities and operations at SRS include the Savannah River Forest Station, the Savannah River Ecology Laboratory, and the Institute of Archaeology and Anthropology. The Savannah River Forest Station is an administrative unit of the U.S. Forest Service, which provides timber management, research support, soil and water protection, wildlife management, secondary roads management, and fire management to DOE. The Savannah River Forest Station manages 62,300 ha (154,000 acres), comprising approximately 80 percent of the site area. It has been responsible for reforestation and manages an active timber business. The Savannah River Forest Station assists with the development and updating of sitewide land use and provides continual support with site layout and vegetative management. It also assists in long-term wildlife management and soil rehabilitation projects.

Table 3.7–1. Current Missions at Savannah River Site

Mission	Description	Sponsor
Pu storage	Maintain F-Area Pu storage facilities	Assistant Secretary for Environmental Management
Tritium recycling	Operate H-Area tritium facilities	Assistant Secretary for Defense Programs
Stabilize targets, spent nuclear fuels, and other nuclear materials	Operate F- and H-Canyons	Assistant Secretary for Environmental Management
Waste management	Operate waste processing facilities	Assistant Secretary for Environmental Management
Environmental monitoring and restoration	Operate remediation facilities	Assistant Secretary for Environmental Management
Research and development	Savannah River Technology Center technical support of DP, EM, and Nuclear Energy programs	Assistant Secretary for Defense Programs; Assistant Secretary for Environmental Management; Office of Nuclear Energy
Other non-DOE missions	Various, as described in text	Various

Source: SRS 1995a:2.

The Savannah River Ecology Laboratory is operated for DOE by the Institute of Ecology of the University of Georgia. It has established a center of ecological field research where faculty, staff, and students perform interdisciplinary field research and provide an understanding of the impact of energy technologies on the ecosystems of the southeastern United States. This information is communicated to the scientific community, government agencies, and the general public. In addition to Savannah River Ecology Laboratory studies, the Institute of Archaeology and Anthropology is operated by the University of South Carolina to survey the archaeological resources of SRS. These surveys are used by DOE when planning new facility additions or modifications, and are used as reference documents by site management.

3.7.1 LAND RESOURCES

Land Use. The SRS occupies approximately 80,130 ha (198,000 acres) in portions of Aiken, Barnwell, and Allendale Counties in southwestern South Carolina, approximately 40 km (25 mi) southeast of Augusta, Georgia (SR DOE 1995e:5-11). All of the land within SRS is owned by the Federal Government and is administered, managed, and controlled by DOE.

Existing Land Use. Generalized existing land uses at SRS and in the vicinity are shown in Figure 3.7.1–1. SRS land use can be grouped into three major categories: forest/undeveloped, water, and developed facility locations. Forest/undeveloped lands (for example, open fields and pine or hardwood forests) make up approximately 58,500 ha (144,500 acres) or 73 percent; water (for example, wetlands, streams, and lakes) comprising approximately 17,600 ha (43,500 acres) or 22 percent; and developed facility (for example, production and support areas, roads, and utility corridors) accounts for approximately 4,000 ha (9,900 acres) or 5 percent of the total land area of SRS. A forest management program has been in effect at SRS since 1952, when it was formed through an interagency agreement between DOE, then the AEC, and the U.S. Forest Service (WSRC 1993a:317). The majority of the woodlands area is in revenue producing, managed timber production. Soil map units that meet the soil requirements for prime farmland soils exist on SRS. However, U.S. Department of Agriculture, Natural Resources Conservation Service does not identify these lands as prime farmland due to the nature of site use (that is, the lands are not available for the production of food or fiber) (SR USDA 1995a:1).

In 1972, DOE designated the entire SRS as a NERP. The NERP is used by the national scientific community to study the impact of human activities on the cypress swamp and southeastern pine and hardwood forest ecosystems (DOE 1985a:1).

Land use bordering SRS is primarily forest and agricultural, although there is a substantial amount of open water and nonforested wetland along the Savannah River Valley. Incorporated and industrial areas are the only other significant land uses in the vicinity. There is a small amount of urban and residential development bordering SRS. The closest residences include several located to the west, north, and northeast that are within 61 m (200 ft) of the site boundary.

Land-Use Planning. Through Act 489, as amended in 1994, the State of South Carolina requires local jurisdictions (that is, counties and cities) to undertake comprehensive planning. Regional-level planning also occurs within the State, with the State divided into 10 planning districts guided by regional advisory councils. The councils provide technical planning assistance to local jurisdictions at their request. SRS is located within the counties of Aiken, Allendale, and Barnwell, which together constitute part of the Lower Savannah River Council of Governments (SR RCG 1995a:1).

Visual Resources. The SRS landscape is characterized by wetlands and upland hills. The vegetation is composed of bottomland hardwood forests, scrub oak and pine woodlands, and wetland forests. DOE facilities are scattered throughout SRS and are brightly lit at night. The developed areas and utility corridors (transmission lines and aboveground pipelines) of SRS are consistent with a BLM VRM Class 5 designation. The remainder of SRS generally ranges from VRM Class 3 to Class 4 designation.

The viewshed consists mainly of agricultural and heavily forested land, with some limited residential and industrial areas. Views are limited by rolling terrain, normally hazy atmospheric conditions, and heavy vegetation. DOE facilities are generally not visible from offsite. The only areas with visual sensitivity levels that are presently impacted by DOE facilities are the view corridors of State Highway 125 and SRS Road 1. The few other areas that have views of SRS facilities are quite distant (8 km [5 mi] or more) and have low visual sensitivity levels.

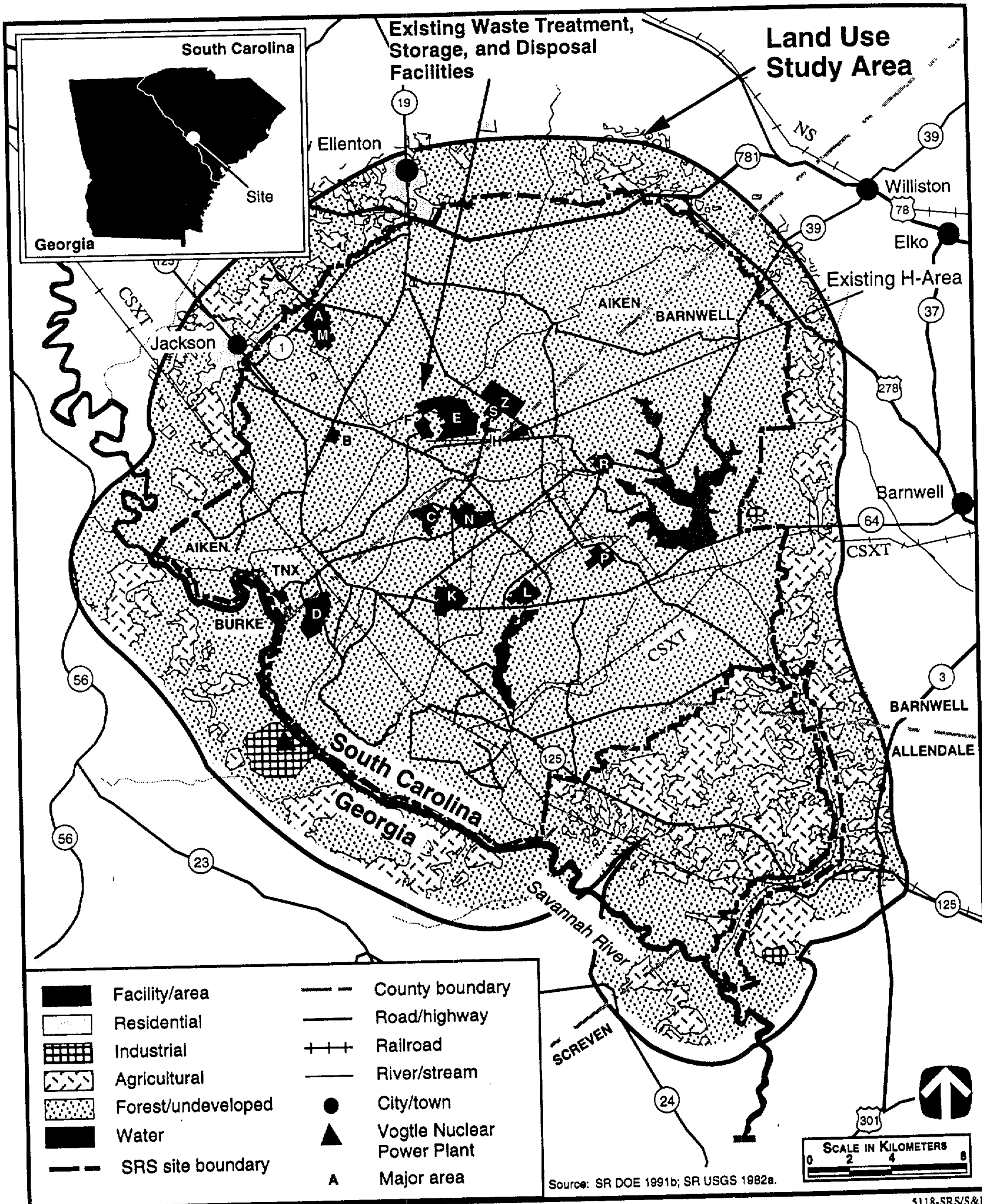


Figure 3.7.1–1. Generalized Land Use at Savannah River Site and Vicinity.

3.7.2 SITE INFRASTRUCTURE

Baseline Characteristics. The SRS contains extensive production, service, and research facilities. Not all of these facilities are in operation or needed today. To support current missions and functions, an extensive infrastructure exists, as shown in Table 3.7.2–1. Pu is currently stored in two vaults within the FB-line and three vaults in the 235-F Facility. Under No Action, APSF will be constructed to provide consolidated storage of all SRS nuclear materials. The road infrastructure is used for extensive intrasite transportation requirements. The railroad infrastructure is used to support large volume deliveries of coal and oversized structural components. SRS does not have a connection to the local natural gas lines.

Table 3.7.2–1. Savannah River Site Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	230	230
Railroads (km)	103	103
Electrical		
Energy consumption (MWh/yr)	659,000	1,672,000
Peak load (MWe)	130	330
Fuel		
Natural gas (m^3/yr)	0	0
Oil (l/yr)	28,400,000	28,400,000
Coal (t/yr)	210,000	244,000
Steam (kg/hr)	748,440,000	748,440,000

Source: SRS 1993a:3.

The electrical power infrastructure is of critical importance to the proposed actions involving construction of new facilities. The sub-regional electrical power pool area in which SRS is located and from which it draws its power is the Virginia-Carolina Sub-Region, a part of the Southeastern Electric Reliability Council. SRS draws its electrical power predominately from coal-fired plants and from 17 nuclear-powered generating plants. Characteristics of this power pool are given in Table 3.7.2–2.

Table 3.7.2–2. Virginia-Carolinas Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	50%
Nuclear	36%
Hydro/geothermal	2%
Oil/gas	3%
Other[b]	8%
Total Annual Production	272,155,000 MWh
Total Annual Load	284,556,000 MWh
Energy Imported Annually[c]	13,846,000 MWh
Generating Capacity	61,932 MWe
Peak Demand	55,477 MWe
Capacity Margin[d]	10,443 MWe

[a] Percentages do not total 100 percent due to rounding.
[b] Includes power from nonutility sources only.
[c] Energy imported is not the difference of production and load due to negative net pumped storage.
[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.7.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The SRS region has a temperate climate with short, mild winters and long, humid summers. Throughout the year, the climate is frequently affected by warm and moist maritime air masses. The average annual temperature at SRS is 17.3 °C (63.2 °F); temperatures vary from an average daily minimum of 0.0 °C (32 °F) in January to an average daily maximum of 33.2 °C (91.7 °F) in July. The average annual precipitation at SRS is 113.4 cm (44.66 in). Precipitation is distributed fairly evenly throughout the year, with the highest precipitation in summer and the lowest in autumn. There is no predominant wind direction at SRS. The average annual windspeed at Augusta NWS Station is 2.9 m/s (6.5 mph) (NOAA 1994c:3). Additional information related to meteorology and climatology at SRS is presented in Appendix F.

Ambient Air Quality. The SRS is located near the center of the Augusta-Aiken Interstate AQCR #53. As of 1995, the areas within SRS and its surrounding counties were in attainment with respect to the NAAQS for criteria pollutants (40 CFR 50; 40 CFR 81.311; 40 CFR 81.341). Applicable NAAQS and the ambient air quality standards for South Carolina and Georgia are presented in Appendix F.

Since the creation of the PSD program in 1977, PSD permits have not been required for any new SRS emission sources, nor have modifications been required to existing permits. There are no known PSD Class I areas within 100 km (62 mi) of SRS.

The emissions inventory for sources at SRS for criteria pollutants are presented in Appendix F. Historically, the primary emission sources of criteria air pollutants at SRS have been the nine coal-burning and four fuel oil-burning boilers that produce steam and electricity (A-, D-, H-, K-, and P-Areas), the fuel and target fabrication facilities (M-Area), and processing facilities (F- and H-Areas). Other emissions and sources include fugitive particulates from coal piles and coal-processing facilities, vehicles, and temporary emissions from various construction-related activities.

Hazardous and toxic air pollutant standards have been adopted by the South Carolina Department of Health and Environmental Control. (No ambient standards for hazardous and toxic air pollutants have been proposed or established by the State of Georgia.) The annual emission rates of hazardous and toxic air pollutants from existing SRS facilities during 1990 are listed in Appendix F.

Table 3.7.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at SRS. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise sources at SRS are primarily located in developed or active areas and include various industrial facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations. Existing SRS-related noise sources of importance to the public are those related to transportation of people and materials to and from the site, including trucks, private vehicles, helicopters, and trains.

Traffic from SRS operations is an important contributor to noise levels along site access highways through the nearby towns of New Ellenton, Jackson, and Aiken. Noise measurements recorded during 1989 and 1990 along State Route 125 in the town of Jackson at a point about 15 m (50 ft) from the roadway indicate that the 1-hour equivalent sound level from traffic ranged from 48 to 72 dBA. The estimated DNL average along this route was 66 dBA for summer and 69 dBA for winter. Similarly, noise measurements along State Route 19 in the town of New Ellenton at a point about 15 m (50 ft) from the roadway indicate that the 1-hour equivalent sound level from traffic ranged from 53 to 71 dBA. The estimated average DNL along this route was 68 dBA for summer and 67 dBA for winter (SR NUS 1990a:Appendices C and D).

Table 3.7.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Savannah River Site, 1990

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[b]	22
	1-hour	40,000[b]	171
Lead	Calendar Quarter	1.5[b]	0.0004
Nitrogen dioxide	Annual	100[b]	5.7
Ozone	1-hour	235[b]	[c]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	3.0
	24-hour	150[b]	50.6
Sulfur dioxide	Annual	80[b]	14.5
	24-hour	365[b]	196
	3-hour	1,300[b]	823
Mandated by the State of South Carolina			
Total suspended particulates	Annual	75[d]	12.6
Gaseous fluorides	30-day	0.8[d]	0.09
	7-day	1.6[d]	0.39
	24-hour	2.9[d]	1.04
	12-hour	3.7[d]	1.99
Hazardous and Other Toxic Compounds			
3,3-Dichlorobenzidine	24-hour	0.15[d]	0.002
Acrolein	24-hour	1.25[d]	0.016
Benzene	24-hour	150.00[d]	31.711
Bis (chloromethyl) ether	24-hour	0.03[d]	0.002
Cadmium oxide	24-hour	0.25[d]	0.021
Chlorine	24-hour	75.00[d]	7.630
Chloroform	24-hour	250.00[d]	4.957
Cobalt	24-hour	0.25[d]	0.206
Formic acid	24-hour	225.00[d]	2.420
Manganese	24-hour	25.00[d]	0.821
Mercury	24-hour	0.25[d]	0.014
Nickel	24-hour	0.50[d]	0.271
Nitric acid	24-hour	125.00[d]	50.960
Parathion	24-hour	0.50[d]	0.007
Phosphoric acid	24-hour	25.00[d]	0.462

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Federal and State standard.
[c] Data not available from source document.
[d] State standard.

Note: Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

Source: 40 CFR 50; SC DHEC 1991a; SC DHEC 1992b; SR DOE 1995b.

Most industrial facilities at SRS are at a sufficient distance from the site boundary that noise levels at the boundary from these sources would not be measurable or would be barely distinguishable from background noise levels.

The States of Georgia and South Carolina, and the counties in which SRS is located, have not established any noise regulations that specify acceptable community noise levels, with the exception of a provision in the Aiken County Zoning and Development Standards Ordinance which limits daytime and nighttime noise by frequency band (Appendix F).

3.7.4 WATER RESOURCES

Surface Water. The most prominent hydrologic feature at SRS is the Savannah River, bordering the site for 32 km (19.9 mi) to the southwest. Six major streams flow through SRS to the Savannah River: Upper Three Runs Creek, Beaver Dam Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek. Upper Three Runs has two tributaries, Tims Branch and Tinker Creek; Pen Branch has one tributary, Indian Grave Branch; and Steel Creek has one tributary, Meyers Branch. These surface water features are shown in Figure 3.7.4–1.

The SRS withdraws surface water from the Savannah River mainly for industrial cooling water purposes. A small quantity is also removed for drinking water supplies. Total water withdrawn from the Savannah River is currently 140,438 million l/yr (37,100 million gal/yr). Most of the water withdrawn is returned to the Savannah River through its onsite tributaries. Streams, especially Fourmile Branch, that received discharges from reactors in the past are still recovering from scouring or erosion impacts. The average flow rate of the Savannah River is 283 m^3/s (9,990 ft^3/s). The lowest recorded flow rate, 183 m^3/s (6,500 ft^3/s), occurred during a drought period from 1985 to 1988 (SR DOE 1990a:3-18). The minimum flow of Fourmile Branch is 0.16 m^3/s (5.8 ft^3/s).

The Savannah River also supplies potable water to several municipalities (SR DOE 1995e:3-8). Upstream from SRS, the Savannah River supplies domestic and industrial water needs to Augusta, Georgia; and North Augusta, South Carolina. The river also receives sewage treatment plant effluent from Augusta, Georgia; North Augusta, Aiken, and Horse Creek Valley, South Carolina; and, as described above, from a variety of SRS operations via onsite stream discharges. Approximately 203 km (126 mi) downstream from SRS, the river supplies domestic and industrial water needs for the Cherokee Hill Water Treatment Plant at Port Wentworth, Georgia, and for Beaufort and Jasper Counties in South Carolina.

There are two manmade water bodies on SRS: L-Lake, which discharges to Steel Creek; and Par Pond, which empties into Lower Three Runs Creek. Naturally-occurring surface water bodies include approximately 190 Carolina bays scattered throughout the site. Carolina bays are closed depressions that may hold water. There are no direct discharges to the bays, but some do receive stormwater runoff.

Average annual treated sanitary discharge volume from SRS to the Savannah River is approximately 700 million l/yr (185 million gal/yr), which is approximately 50 percent of the new centralized sanitary wastewater treatment facility capacity. Wastewater from the treatment plant is discharged to Fourmile Branch.

The proposed facilities are to be located outside of the 100-year floodplain. Sitewide information concerning 500-year floodplains at SRS is not available, but site-specific 500-year floodplain assessments would be completed prior to modifications and/or construction of individual project proposals.

Surface Water Quality. In the vicinity of SRS, the Savannah River and onsite streams are classified as fresh water suitable for the following: primary and secondary contact recreation; a source of drinking water, after conventional treatment in accordance with the requirements of the South Carolina Department of Health and Environmental Control; fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora; and industrial and agricultural uses (SC DHEC 1992a:29). Table 3.7.4–1 lists the surface water monitoring results for 1993 for the Savannah River downstream of SRS. The only parameters that exceeded Federal or State water quality criteria were aluminum, manganese, and turbidity.

In addition to water quality monitoring, SRS conducts monitoring to ensure compliance with NPDES permit limits. SRS has two NPDES permits for industrial wastewater discharge that cover 81 outfalls as part of the permit requirements and 1 general stormwater discharge permit that covers 48 outfalls. SRS collects and analyzes water from these outfalls to ensure compliance with NPDES permit limits. Of the 8,000 analyses performed at the industrial outfalls in 1993, 10 exceeded permit limits, for a compliance rate of 99.9 percent. Noncompliances were noted mainly for pH and total suspended solids with one noncompliance each for oil and

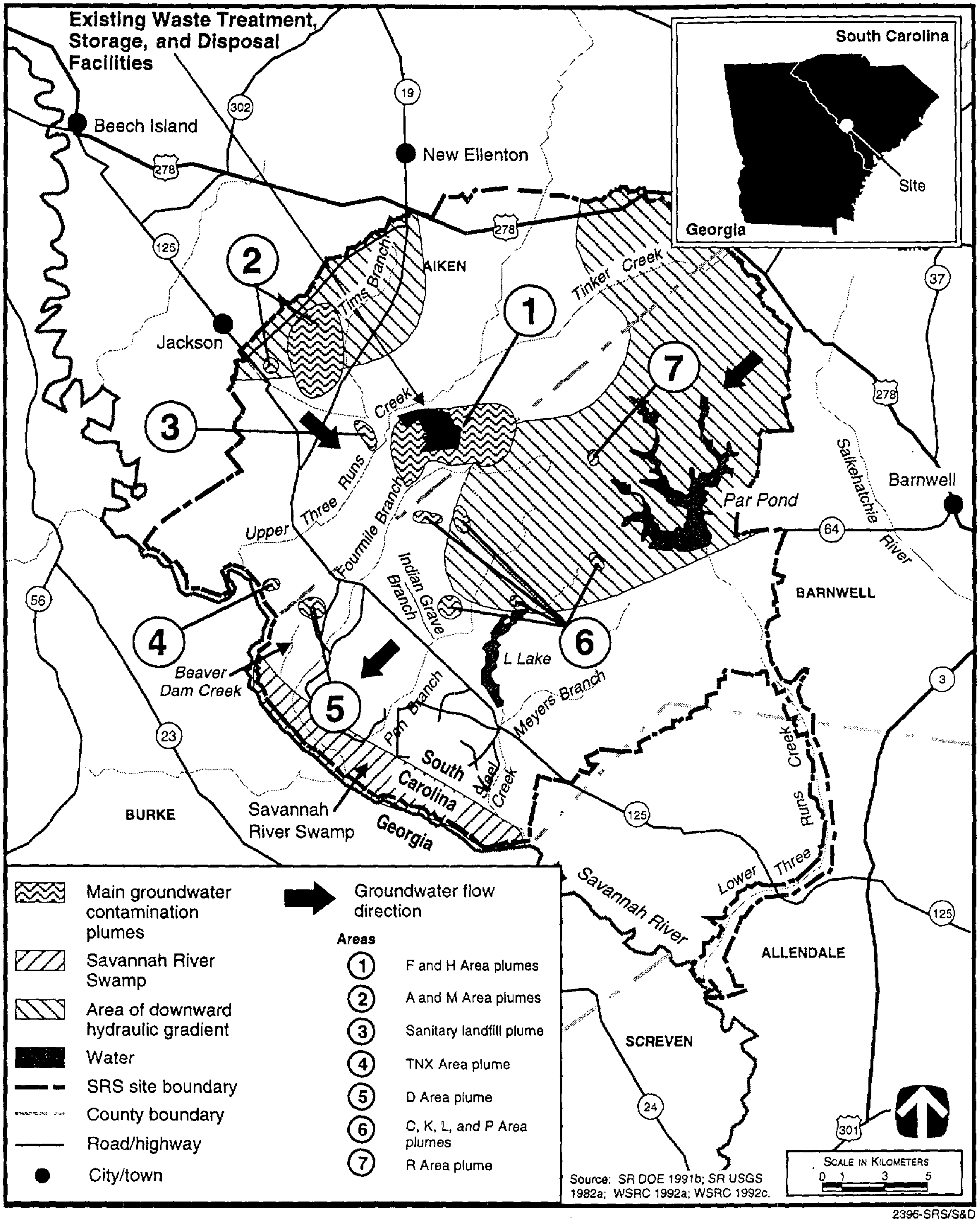


Figure 3.7.4–1. Surface Water Features and Groundwater Contamination Areas at Savannah River Site.

Table 3.7.4–1. Summary of Surface Water Quality Monitoring at Savannah River Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Water Body Concentration	
			High	Low
Alkalinity	mg/l	NA	24	13
Alpha (gross)	pCi/l	15[b]	0.51	-0.2
Aluminum	mg/l	0.05 to 0.2[c]	0.838	0.182
Ammonia (nitrogen)	mg/l	NA	0.11	0.02
Beta (gross)	pCi/l	50[d]	3.41	0.9
Calcium	mg/l	NA	5.09	3.25
Chemical oxygen demand	mg/l	NA	<dL	<dL
Chromium	mg/l	0.1[b,e]	<dL	<dL
[Text deleted.]				
Dissolved oxygen	mg/l	>5.0[e]	10.5	6.2
Iron	mg/l	0.3[c]	1.15	0.516
Lead	mg/l	0.015[b]	0.003	<dL
Magnesium	mg/l	NA	1.34	1.11
Manganese	mg/l	0.05[c]	0.064	0.04
Nitrogen (as NO_2/NO_3)	mg/l	NA	0.31	0.18
pH	pH units	6.5 to 8.5[c]	6.8	6.0
Phosphate	mg/l	NA	<dL	<dL
Plutonium-238	pCi/l	1.6[f]	0.001	-0.001
Plutonium-239	pCi/l	1.2[f]	0.001	0.0009
Sodium	mg/l	NA	12.7	5.28
Strontium-90	pCi/l	400[f]	0.24	0.0017
Sulfate	mg/l	250[c]	9	4
Suspended solids	mg/l	NA	16	5
Temperature	°C	<32.2[e]	25.7	9.1
Total dissolved solids	mg/l	500[c]	90	49
Tritium	pCi/l	80,000[f]	5,690	-147
Turbidity	turbidity unit	1 to 5[e]	28	3.6
Zinc	mg/l	5.0[c]	0.012	<dL

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] National Secondary Drinking Water Regulations (40 CFR 143).
[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
[e] South Carolina State water quality criteria.
[f] DOE's DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem/yr; however, because the drinking water maximum contaminant level is based on 4 mrem/yr, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.

Note: All nonradiological data from station R-10, downstream of SRS; all radiological data from station R-3B (below Vogtle); NA=not applicable; dL=detection limit.

Source: WSRC 1994d; WSRC 1994f.

grease and biological oxygen demand (WSRC 1994d:116). In all cases, either corrective actions or an administrative review were taken to prevent future noncompliances.

Surface Water Rights and Permits. Surface water rights for the Savannah River are determined by the Doctrine of Riparian Rights. Under this doctrine, users of water must not adversely effect the quantity or quality of water available for downstream users.

Groundwater. Several aquifer system naming schemes have been used at SRS. For this document, the most shallow aquifer will be referred to as the water table aquifer. This aquifer is supported by the leaky "Green Clay" aquitard, which confines the Congaree Aquifer. Below the Congaree Aquifer is the leaky Ellenton aquitard, which contains the Cretaceous (also known as the Tuscaloosa) aquifer. In general at SRS, groundwater in the water table aquifer flows downward to the Congaree Aquifer or discharges to nearby streams that intersect the water table. Flow in the Congaree Aquifer is downward to the Cretaceous Aquifer or horizontal to Upper Three Runs Creek or the Savannah River, depending on the location at SRS. Groundwater in the Cretaceous Aquifer discharges predominantly along the Savannah River. However, Upper Three Runs Creek also receives groundwater from the Cretaceous Aquifer. This flow creates an upward gradient between the Cretaceous and Congaree Aquifer over a significant portion of SRS (Figure 3.7.4–1).

The Cretaceous Aquifer is an abundant and important water resource for the SRS region. Some of the local cities (Aiken, for example) also obtain groundwater from the Cretaceous, but most of the rural population in the SRS region draws water from either the Congaree or water table aquifer. All groundwater at SRS is classified by the EPA as a Class II water source (current and potential source of drinking water). Depth to groundwater ranges from at or very near the ground surface (near streams) to approximately 46 m (151 ft). In 1993, SRS withdrew 13,247 million l/yr (3,500 million gal/yr) of groundwater in support of site operations.

Groundwater Quality. Groundwater quality data have been obtained from SRS monitoring wells for the past several years. Groundwater quality at SRS ranges from excellent (soft and slightly acidic) to below EPA drinking water standards for several constituents in the vicinity of some waste sites. The Cretaceous Aquifer is generally unaffected except for a small portion of the A-Area where trichloroethylene has been detected. The Congaree Aquifer is contaminated with trichloroethylene in much of the A- and M-Areas, with trichloroethylene and also some low levels of tritium in the General Separations Area. The water table aquifer is contaminated with solvents, metals, and low levels of radionuclides at several waste sites and facilities at SRS (Figure 3.7.4–1). All contaminated groundwater at SRS discharges to streams on the SRS or the Savannah River. Groundwater quality monitoring data is presented in Table 3.7.4–2.

Groundwater Availability, Use, and Rights. Groundwater is a domestic, municipal, and industrial water source throughout the Upper Coastal Plain. Most municipal and industrial water supplies in Aiken County are from the Cretaceous Aquifer. Domestic water supplies are primarily from the Congaree Aquifer and the water table. In Barnwell and Allendale Counties, the Congaree Aquifer supplies some municipal users. Groundwater production from these wells is approximately 13,247 million l/yr (3,500 million gal/yr), which is similar to the volume pumped for industrial and municipal production within 16 km (9.9 mi) of the site.

Groundwater rights in South Carolina are traditionally associated with absolute ownership rule. Originating in English common law doctrine, the owners of land overlying a groundwater resource are allowed to withdraw from their wells all the water they desire (VDL 1990a:725); however, the *Water Use Reporting and Coordination Act* requires all users of 379,000 l/day (100,000 gal/day) or more per day (138.3 million l/yr [36.5 million gal/yr]) of water to report their withdrawal rates to the South Carolina Water Resources Commission. SRS groundwater use exceeds this amount, and, consequently, its withdrawal rates are reported to the commission.

Table 3.7.4–2. Groundwater Quality Monitoring at Savannah River Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Existing Conditions	
			High	Low
Alpha (gross)	pCi/l	15[b]	77.61	0.96
Barium	mg/l	2.0[b]	0.09	0.0017
Beta (gross)	pCi/l	50[c]	75.88	1.00
Chloride	mg/l	250[d]	14.69	1.3
Iron	mg/l	0.3[d]	75.0	0.004
Lead	mg/l	0.015[b]	0.05	0.0015
Manganese	mg/l	0.05[d]	0.038	0.0018
Nitrate	mg/l	10[b]	2.37	0.03
pH	pH units	6.5-8.5[d]	11.6	4.7
[Text deleted.]				
Sulfate	mg/l	250[d]	118.1	0.5
Total dissolved solids	mg/l	500[d]	1,879.4	5.8
Total organic halogens	mg/l	NA	0.84	0.0025
Total phosphates	mg/l	NA	4.7	0.023
Total radium	pCi/l	5.0[c]	0.52	0.00628
Tritium	pCi/l	80,000[e]	1,162,810	350

[a] For comparison only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
[d] National Secondary Drinking Water Regulations (40 CFR 143).
[e] DOE's DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.

Note: NA=not applicable.
Source: SRS 1995a:6.

3.7.5 GEOLOGY AND SOILS

Geology. The SRS is located in the Aiken Plateau portion of the Upper Atlantic Coastal Plain approximately 32 km (20 mi) east of the Fall Line, a major physiographic and structural feature that separates the Piedmont and Coastal Plain physiographic provinces, in southeastern South Carolina. The plateau is highly dissected, with narrow, steep-sided valleys separated by broad, flat areas.

Coastal Plain sediments underlying SRS consist of sandy clays and clayey sands, although occasional beds of clean sand, gravel, clay, or carbonate occur. The Coastal Plain sediments overlie a basement complex composed of Paleozoic crystalline and Triassic sedimentary formations of the Dunbarton Basin.

Small and discontinious thin calcareous sand zones, potentially subject to dissolution by water, have been located in some parts of SRS. If dissolution occurs in these zones, potential underground subsidence resulting in settling of the ground surface could occur. No settling as a result of dissolution of these zones has been identified. No economically viable geologic resources have been identified at SRS.

In the immediate region of SRS, there are no known capable faults as defined by 10 CFR 100, Appendix A. Several faults have been identified from subsurface mapping and seismic surveys within the Paleozoic and Triassic basement beneath SRS. The largest of these is the Pen Branch fault. However, there is no evidence of movement within the last 38 million years along this fault (DOE 1991c:4-108).

The SRS is located within Seismic Zone 2, indicating moderate damage could occur as a result of earthquakes (Figure 3.2.5–1). Since 1985, three earthquakes, all of Richter magnitude 3.2 or less, have occurred in the immediate area of SRS (Table 3.2.5–1). None of these earthquakes produced any damage at SRS. Historically, two large earthquakes have occurred within 300 km (186 mi) of SRS. The largest of these, the Charleston earthquake of 1886, had an estimated Richter magnitude ranging from 6.5 to 7.5. Earthquakes capable of producing structural damage to buildings are not likely to occur in the vicinity of SRS (SR DOE 1995e:3-4). There is no volcanic hazard at SRS; the area has not experienced volcanic activity within the last 230 million years.

Soils. The soils at SRS are primarily sands and sandy loams. The somewhat excessively drained soils have a thick, sandy surface layer that extends to a depth of 2 m (6.6 ft) or more in some areas (SR USDA 1990a:17-25). Many of the soils are subject to erosion, flooding, ponding, and cutbank caving. The soils at SRS are considered acceptable for standard construction techniques.

3.7.6 BIOLOGICAL RESOURCES

Terrestrial Resources. Most of SRS has remained undeveloped since it was established in 1950. Only about 5 percent of the site is occupied by DOE facilities. Five major plant communities have been identified at SRS (Figure 3.7.6–1). Of these, the largest is the loblolly, longleaf, slash pine community, which covers approximately 65 percent of the site. This community type, as well as upland hardwood-scrub oak, occurs primarily in upland areas. Swamp forests and bottomland hardwood forests are found along the Savannah River and the numerous streams that traverse SRS. More than 1,300 species and variations of vascular plants have been identified on the site (DOE 1992e:4-126,4-128).

Because of the variety of plant communities on the site, as well as the region's mild climate, SRS supports a diversity and abundance of wildlife, including 43 amphibian, 58 reptile, 213 bird, and 54 mammal species. Common species at SRS include the slimy salamander, eastern box turtle, Carolina chickadee, common crow, eastern cottontail, and gray fox (DOE 1992e:4-128; WSRC 1993b:3-5,3-39). A number of game animals are found on SRS, but only the whitetail deer and feral hog are hunted onsite (DOE 1992e:4-128). Raptors, such as the Cooper's hawk and black vulture, and carnivores, such as the gray fox and raccoon, are ecologically important groups on SRS. A variety of migratory birds have been found at SRS. Migratory birds, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Four of the five major plant communities at SRS are found on the proposed collocated storage site (Figure 3.7.6–1). The most common of these plant communities is the loblolly-longleaf-slash pine, followed by upland hardwood-scrub oak, pine/hardwood, and bottomland hardwood. Although not shown on Figure 3.7.6–1, cleared fields are also common on the proposed site. A 5.5 ha (13.6 acres) NERP oak-hickory forest set-aside area, which has an unusual composition of flora, is located near the northwest corner of the proposed site (SR DOE 1991b:4.3,4.26). Although specific studies of plant and animal communities found on the proposed collocated storage site have not been conducted, the occurrence of species on the site is expected to be the same as found in similar habitats elsewhere on SRS.

Ecological studies of the assumed analysis site for the MOX fuel fabrication facility have not been conducted, but the site is located within an area that primarily contains the loblolly, longleaf, and slash pine forest type (Figure 3.7.6–1). Some bottomland hardwood forest is located along the drainages that feed Par Pond. Wildlife species found in the area of the assumed site would be expected to be similar to those found in similar habitat throughout SRS.

The assumed analysis site for the evolutionary LWR is located in an area that is classified as loblolly, longleaf, and slash pine forest (Figure 3.7.6–1). Previous studies of the site area determined that pine plantations were the predominant plant cover. Other vegetation types present include old-field, bottomland hardwood forest, mixed forest, upland deciduous forest, grassland (under powerline rights-of-way), and emergent wetland. The assumed site has not been surveyed to determine the presence and abundance of wildlife (DOE 1992e:4-128). Animals present would be expected to be similar to those found in similar habitat throughout SRS.

Wetlands. The SRS contains approximately 19,800 ha (49,000 acres) of wetlands, most of which are associated with floodplains, streams, and impoundments (DOE 1992e:4-128). Wetlands on the site may be divided into the following categories: bottomland hardwoods, cypress-tupelo, scrub-shrub, emergent, and open water (WSRC 1993b:4-6). The most extensive wetland type on SRS is swamp forest associated with the Savannah River floodplain. Approximately 3,800 ha (9,390 acres) of these wetlands are found on SRS. Past releases of cooling water effluent into site streams and the Savannah River Swamp have resulted in shifts in plant community composition. Changes have included the replacement of bald cypress by scrub-shrub and emergent vegetation in the swamp and reduction in bottomland forests along streams (DOE 1992e:4-128; WSRC 1989e:3-4).

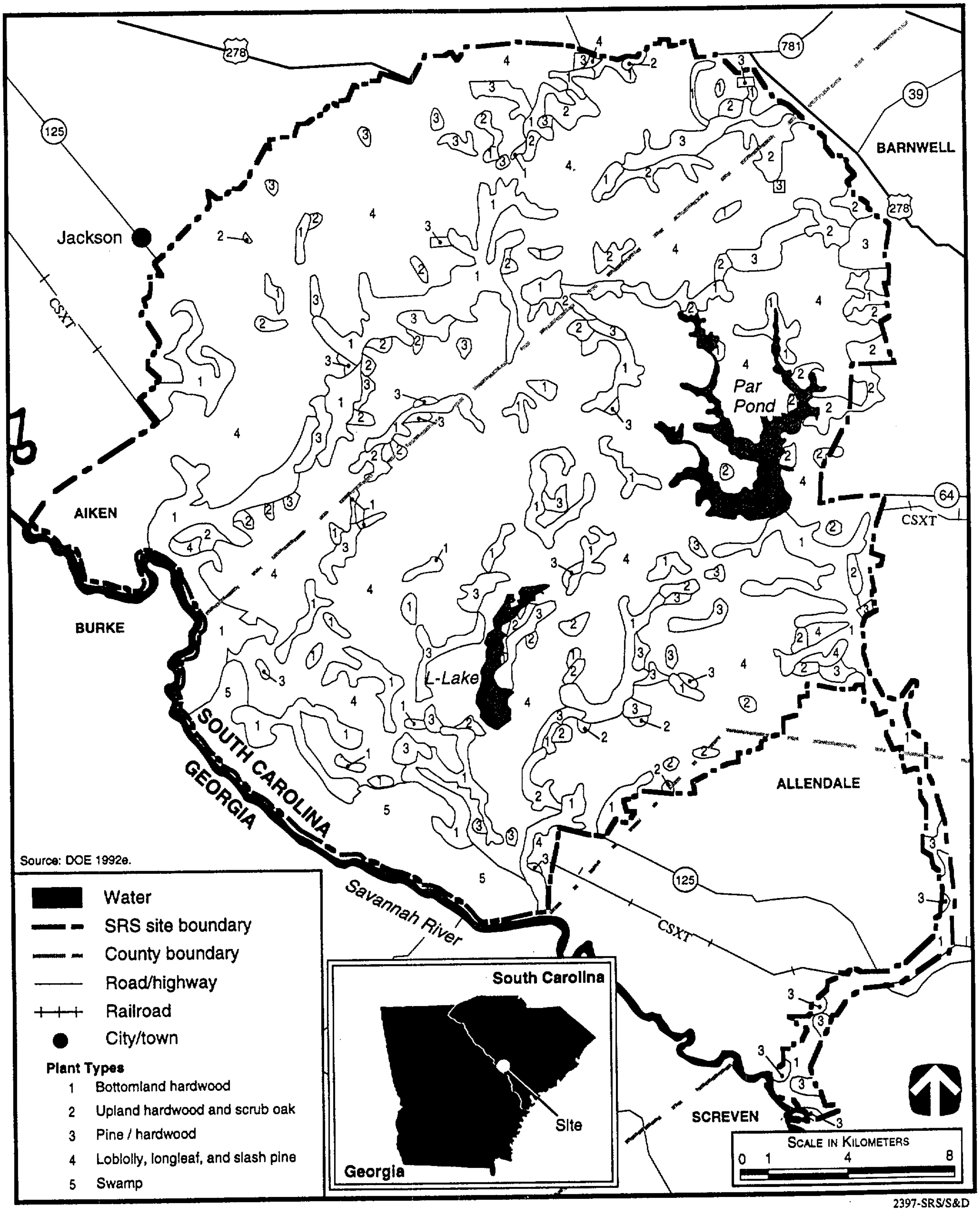


Figure 3.7.6–1. Distribution of Plant Communities at Savannah River Site.

Carolina bays, a type of wetland unique to the southeastern United States, are also found on SRS. Approximately 190 Carolina bays have been identified on the site. These natural shallow depressions occur on interstream areas of SRS and range from lakes to shallow marshes, herbaceous bogs, shrub bogs, or swamp forests (SR NERP 1989a:9).

Wetlands found on the proposed collocated storage site include bottomland hardwoods and three Carolina bays. Bottomland hardwood areas occur along tributaries to Upper Three Runs Creek. The three Carolina bays on the proposed site are typical of the smaller bays found on the SRS (SR DOE 1991b:4.3). All show evidence of previous draining and agricultural use. The larger of the bays is about 1 ha (2.5 acres) in size and is surrounded by oaks and sweet gum. Jurisdictional wetlands subject to COE regulation have not been delineated on this site using the U.S. Army COE *Wetlands Delineation Manual* (Y-87-1).

Wetlands found within the assumed analysis site for the MOX fuel fabrication facility include bottomland hardwoods associated with drainages that feed Par Pond. There are no Carolina bays located on the site. Par Pond, located to the east of the assumed site, supports a well-developed wetland community along its shores. The suitability of habitat in Par Pond for wetland vegetation is indicated by the extensive development of wetland vegetation on the lake and the spread of wetland vegetation from its shore into the lake (DOE 1992e:4-130).

The assumed analysis site for the evolutionary LWR contains a number of wetland areas. Several wetlands are associated with intermittent tributaries to Pen Branch and Fourmile Branch. Isolated wetlands are also found in the site area. Rainbow Bay, a 2.4-ha (5.9-acre) Carolina bay, occurs in the northeastern portion of the assumed site. Other isolated wetlands in the site area are upland depressions. Unlike Rainbow Bay, these wetlands do not have standing water for long periods of time (DOE 1992e:4-129).

Aquatic Resources. Aquatic habitat on SRS includes manmade ponds, Carolina bays, reservoirs, and the Savannah River and its tributaries. There are more than 50 manmade impoundments located throughout the site that support populations of bass and sunfish (SR DOE 1982a:4-22; SRS 1992a:8). Fewer than 20 Carolina bays have permanent fish populations. Species present in these bays include redfin pickerel, mud sunfish, lake chubsucker, and mosquitofish (SR NERP 1983a:40–42; SR NERP 1989a:37). Par Pond and L-Lake support similar fish populations including largemouth bass, black crappie, and various species of pan fish (DOE 1992e:4-131; SRS 1992a:8). Sport and commercial fishing is not allowed on the SRS site (DOE 1992e:4-132).

The Savannah River is used for both commercial and sport fishing. Important commercial species are American shad, hickory shad, and striped bass, all of which are anadromous. The most important warm-water game fish found in the Savannah River are bass, pickerel, crappie, bream, and catfish (SR DOE 1982a:4-28). In the past, water intake structures for C- and K-Reactors and the D-Area powerhouse caused annual estimated entrainment of approximately 10 percent of the fish eggs and larvae passing the intake canals during the spawning season. In addition, estimated impingement losses were approximately 7,600 fish per year (SR DOE 1987b:3-31,C-61).

Aquatic habitat in the vicinity of the proposed storage facility site consists of Upper Three Runs Creek and its tributaries and three Carolina bays (see Figure 3.7.4–1). Streams in the vicinity of the proposed site support largemouth bass, black crappie, and various species of pan fish. Upper Three Runs Creek has never received thermal effluents, but has received industrial pollutants from Tim's Branch. The creek has a rich fauna and is minimally affected by pollutants (SR NERP 1983a:11,13). Upper Three Runs Creek may also be an important spawning area for the blueback herring, and may be seasonally important as a nursery habitat for a number of important Savannah River species, including American shad, blueback herring, and striped bass (SR DOE 1982a:4-28). Information concerning aquatic resources in the three Carolina bays on the proposed site is unavailable (SR DOE 1991b:4.3).

Aquatic resources in the vicinity of the assumed analysis site for the MOX fuel fabrication facility area include Par Pond, precooling ponds 2 and 5, as well as the canal that connects these three water bodies. Also present are a number of drainages that feed Par Pond. Par Pond drains into Lower Three Runs Creek. A total of 30 species of fish, including chubsucker, largemouth bass, bluegill, and black crappie, have been recorded in Par Pond (DOE 1992e:4-131). The same species have been recorded in Lower Three Runs Creek (WSRC 1993b:15-64). During operation of P-Reactor, heated effluent was discharged into an arm of Par Pond (Pond C) via the above-mentioned canal and precooling ponds. Since the shutdown of the P-Reactor, the precooling ponds and Pond C have undergone substantial recovery (DOE 1992e:4-131).

The principal aquatic resources in the vicinity of the assumed analysis site for the evolutionary LWR include Fourmile Branch, Par Branch, and Rainbow Bay. Rainbow Bay does not contain standing water year-round. In the past, Fourmile Branch and Pen Branch have received thermal effluents from C- and K-Reactors, respectively. During reactor operations, fish populations in warmed portions of the streams were greatly reduced, with the mosquitofish being the most abundant species. With the cessation of reactor operation, a more diverse fish population has recolonized both streams (WSRC 1993b:12-44,13-42). Above the reactor outfalls, both Fourmile Branch and Pen Branch are small streams that have been relatively unaffected by past SRS operation. The dominant fish in the un-heated upper reaches of Pen Branch include sunfish, bullheads, and chubsuckers (SR DOE 1987b:3-51); species composition of the upper portion of Fourmile Branch would be expected to be similar.

Threatened and Endangered Species. Sixty-one federally and State-listed threatened, endangered, and other special status species may be found on and in the vicinity of SRS (Table 3.7.6–1). Fifty-seven of these species have records of occurrence on SRS, twelve of which are federally or State-listed as threatened or endangered. Once specific project locations have been determined, site surveys will verify the presence of special status species. No critical habitat for threatened or endangered species, as defined in ESA (50 CFR 17.11; 50 CFR 17.12), exists on SRS.

The smooth coneflower is the only endangered plant species found on SRS. Two colonies exist on SRS, but suitable habitat for this species occurs throughout the site. Bald eagles nest near Par Pond and L-Lake and forage on these reservoirs. Wood storks forage in the Savannah River Swamp and the lower reaches of Steel Creek, Pen Branch, Beaver Dam Creek, and Fourmile Branch. Red-cockaded woodpeckers inhabit open pine forests with mature trees (older than 70 years for nesting and 30 years for foraging). Peregrine falcons have been reported in the past as rare winter visitors on SRS. The American alligator is a common inhabitant of Par Pond, Beaver Dam Creek, and the Savannah River Swamp. The shortnose sturgeon spawns in the Savannah River both up and downstream of SRS. This fish has not been collected in the tributaries of the Savannah River that drain SRS, but sturgeon ichthyoplankton have been collected in the river near SRS (SR DOE 1995b:3-44). The Kirtland's warbler is a migrant species which historically occurred on SRS. The State-listed Rafinesque's big-eared bat, common ground dove, and Appalachian Bewick's wren have also been observed on SRS.

There are no federally listed threatened and endangered species known to occur on the proposed storage facility site, but several may exist in the general vicinity. Active bald eagle nests are located about 13.7 km (8.5 mi) southwest of the proposed site in an area of Pen Branch and approximately 12.1 km (7.5 mi) southeast of the site just south of Par Pond. Wood storks have been observed near the Fourmile Branch delta (WSRC 1993b:21-42,21-43) about 21 km (13 mi) from the proposed site. Although suitable forage habitat for the red-cockaded woodpecker exists on the proposed storage facility site, the closest colony is located approximately 4.8 km (3 mi) away. Occurrences of the American alligator are all located about 6.4 km (4 mi) or more from the site (WSRC 1993b:21-11,21-32,21-41,21-42,21-43). The shortnose sturgeon spawns in the Savannah River upstream of SRS, and larvae of this species have been collected in or near the water intake canals on the river. However, entrainment or impingement of this species at SRS water intake structures has not been documented (DOE 1992e:4-132). The smooth coneflower has not been recorded in affected areas but could be found on the proposed site. Several State special status species have also been found in the proposed storage site area.

Table 3.7.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Savannah River Site

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
Meadow vole	*Microtus pennsylvanicus*	NL	SC
Rafinesque's big-eared bat[b]	*Plecotus rafinesquii*	NL	SE
Southern Appalachian eastern woodrat[b]	*Neotoma floridana haematoreia*	NL	SC
Spotted skunk[b]	*Spilogale putorius*	NL	SC
Star-nosed mole[b]	*Condylura cristata parva*	NL	SC
Swamp rabbit	*Sylvilagus aquaticus*	NL	SC
Birds			
American peregrine falcon[b,c]	*Falco peregrinus anatum*	E	SE
American swallow-tailed kite	*Elanoides forficatus*	NL	SE
Appalachian Bewick's wren[b]	*Thryomanes bewickii altus*	NL	ST
Arctic peregrine falcon[b]	*Falco peregrinus tundrius*	E (S/A)	ST
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	SE
Barn owl[b]	*Tyto alba*	NL	SC
Common ground dove[b]	*Columbina passerina*	NL	ST
Cooper's hawk[b]	*Accipiter cooperii*	NL	SC
Kirtland's warbler[b]	*Dendroica kirtlandii*	E	SE
[Text deleted.]			
Mississippi kite[b]	*Ictinia mississippiensis*	NL	SC
Red-cockaded woodpecker[b,c]	*Picoides borealis*	E	SE
Red-headed woodpecker[b]	*Melanerpes erythrocephalus*	NL	SC
Swainson's warbler[b]	*Limnothlypis swainsonii*	NL	SC
Wood stork[b,d]	*Mycteria americana*	E	SE
Reptiles			
American alligator[b]	*Alligator mississippiensis*	T (S/A)	NL
Carolina swamp snake[b]	*Seminatrix pygaea*	NL	SC
Eastern coral snake[b]	*Micrurus fulvius fulvius*	NL	SC
Green water snake[b]	*Nerodia cyclopion*	NL	SC
[Text deleted.]			
Spotted turtle[b]	*Clemmys guttata*	NL	SC
Amphibians			
Carolina crawfish frog[b]	*Rana areolata capito*	NL	SC
Eastern bird-voiced treefrog[b]	*Hyla avivoca ogechiensis*	NL	SC
Eastern tiger salamander[b,d]	*Ambystoma tigrinum tigrinum*	NL	SC
Northern cricket frog[b]	*Acris crepitans crepitans*	NL	SC
Pickerel frog[b,d]	*Rana palustris*	NL	SC
Upland chorus frog[b]	*Pseudacris triseriata feriarum*	NL	SC

Table 3.7.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Savannah River Site—Continued

Common Name	Scientific Name	Status[a] Federal	Status[a] State
Fish			
[Text deleted.]			
Shortnose sturgeon[b,c,d]	*Acipenser brevirostrum*	E	SE
Invertebrates			
Brother spike mussel	*Elliptio fraterna*	NL	E
Plants			
[Text deleted.]			
Beak-rush[b,d]	*Rhynchospora inundata*	NL	SC
Beak-rush[b,d]	*Rhynchospora tracyi*	NL	SC
Bog spice bush[b]	*Lindera subcoriacea*	NL	RC
[Text deleted.]			
Cypress stump sedge[b,d]	*Carex decomposita*	NL	SC
Durand's white oak[b]	*Quercus durandii*	NL	SC
Dwarf bladderwort[b]	*Utricularia olivacea*	NL	SC
Dwarf burhead[b]	*Echinodorus parvulus*	NL	SC
Elliott's croton[b]	*Croton elliottii*	NL	SC
Few-fruited sedge[b]	*Carex oligocarpa*	NL	SC
Florida bladderwort[b]	*Utricularia floridana*	NL	SC
Florida false loosestrife[b]	*Ludwigia spathulata*	NL	SC
Gaura[b]	*Gaura biennis*	NL	SC
Green-fringed orchid[b,d]	*Platanthera lacera*	NL	SC
Leafy pondweed[b]	*Potamogeton foliosus*	NL	SC
Loose water-milfoil[b]	*Myriophyllum laxum*	NL	RC
Milk-pea[b]	*Astragalus villosus*	NL	SC
Nailwort[b,d]	*Paronychia americana*	NL	SC
Nestronia[b]	*Nestronia umbellula*	NL	SC
Nutmeg hickory[b]	*Carya myristiciformis*	NL	RC
Oconee azalea[b]	*Rhododendron flammeum*	NL	SC
Pink tickseed[b]	*Coreopsis rosea*	NL	RC
Quill-leaved swamp potato[b]	*Sagittaria isoetiformis*	NL	SC
Sandhill lily[b]	*Nolina georgiana*	NL	SC
Smooth coneflower[b]	*Echinacea laevigata*	E	SE
Trepocarpus[b]	*Trepocarpus aethusae*	NL	SC
Wild water-celery[b]	*Vallisneria americana*	NL	SC
Yellow cress[b]	*Rorippa sessiliflora*	NL	SC
Yellow wild indigo[b]	*Baptisia lanceolata*	NL	SC

[a] Status codes: E=endangered; NL=not listed; RC=regional of concern (unofficial plants only); S/A=protected under the similarity of appearance provision of the ESA; SC=State of concern; SE=State endangered (official state list-animals only); ST=State threatened (official State list-animals only); and T=threatened.

[b] Species occurrence recorded on SRS.

[c] USFWS Recovery Plan exists for this species.

[d] Species known to occur on Upper Three Runs Creek downstream from the proposed site for the new consolidated storage facility or in areas affected by the project.

Source: 50 CFR 17.11; 50 CFR 17.12; DOE 1992e; SC WD 1995a; SR NERP 1990b; WSRC 1993b.

A population of nailwort has been found within the central portion of the site and the green-fringed orchid has been collected in an area adjacent to the site (SR NERP 1990b:64-65).

Bald eagles have been seen on numerous occasions in the vicinity of Par Pond, and an eagle nest is located about 5.6 km (3.5 mi) southeast of the assumed analysis site for the MOX fuel fabrication facility. Although suitable forage habitat for the red-cockaded woodpecker exists in the site area, the nearest known red-cockaded colony is located about 8 km (5 mi) to the southeast. The American alligator is also a common inhabitant of Par Pond, located less than 1.6 km (1 mi) from the assumed site (WSRC 1993b:21-11,21-26,21-32).

There are no federally listed threatened and endangered species known to occur on the assumed analysis site for the evolutionary LWR, but several may exist in the general vicinity. Bald eagles have been observed at several locations on SRS, particularly in the vicinity of Par Pond and L-Lake. Active bald eagle nests are located 8 km (5 mi) southwest of the site in the area of Pen Branch and 11.3 km (7 mi) southeast of the site just south of Par Pond (WSRC 1993b:21-26). Although suitable forage habitat for the red-cockaded woodpecker exists on the assumed analysis site for the evolutionary LWR, the closest colony is located 11.3 km (7 mi) away. The American alligator is a common inhabitant of Par Pond, Beaver Dam Creek, and the Savannah River swamp, all located 8 km (5 mi) or more from the assumed site (WSRC 1993b:21-11,21-32,21-41,21-43). The federally listed smooth purple coneflower has not been recorded in the site but could be present. [Text deleted.] Several State special status species have also been found near Rainbow Bay, including the Cooper's hawk, two species of beak-rush, Florida false loosestrife, and green-fringed orchid.

3.7.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric resources at SRS consist of villages, base camps, limited activity sites, quarries, and workshops. An extensive archaeological survey program began at SRS in 1974 and includes numerous field studies such as reconnaissance surveys, shovel test transects, and intensive site testing and excavation. More than 60 percent of SRS has received some level of cultural resources evaluation. More than 800 prehistoric sites have been identified, some of which may fall within the locations of the proposed storage facilities. Fewer than 8 percent of these sites have been evaluated for NRHP eligibility. To date 67 prehistoric and historic sites are considered potentially eligible for listing on the NRHP.

A Programmatic Agreement was signed by the DOE Savannah River Operations Office, the South Carolina SHPO, and the Advisory Council on Historic Preservation on August 24, 1990. Its purpose is to ensure that appropriate measures are taken to inventory, evaluate, protect, and enhance archaeological sites on SRS. In addition, an Archaeological Resource Management Plan for SRS is in place.

Historic Resources. Types of historic sites include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. Approximately 400 historic sites or sites with historic components have been identified within SRS, some of which may fall within the locations of the proposed storage facilities. To date, approximately 10 percent have been evaluated for NRHP eligibility.

Most historic structures were demolished during the initial establishment of SRS in 1950. Two 1951 buildings are currently in use. SRS has been involved in tritium operations and other nuclear material production for more than 40 years. Therefore, some of the facilities at SRS may be eligible for listing on the NRHP.

Native American Resources. Native American groups with traditional ties to the area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from the French, Spanish, or other Native American groups. Main villages of both the Cherokee and Creek were located southwest and northwest of SRS, but both groups may have used the area for hunting and gathering activities. During the early 1800s, most of the remaining Native Americans residing in the region were relocated to the Oklahoma territory.

Native American resources in the region include remains of villages or townsites, ceremonial lodges, burials, cemeteries, and areas containing traditional plants used for religious ceremonies. 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, including some sensitive Native American resources and several plants traditionally used in ceremonies (SR DOE 1991e:19,21).

Paleontological Resources. Paleontological materials at SRS include fossil plants, numerous invertebrate fossils, deposits of giant oysters (*Crassostrea gigantissima*), mollusks, and bryozoa. All paleontological materials from SRS are marine invertebrate deposits and, with the exception of the giant oysters, are relatively widespread common fossils; therefore the assemblages have low research potential.

3.7.8 SOCIOECONOMICS

Socioeconomic characteristics addressed at SRS include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 15 counties around SRS located in Georgia and South Carolina (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a six-county area in which 90.1 percent of all SRS employees reside: Aiken County (51.9 percent), Allendale County (1.1 percent), Bamberg County (1.7 percent), and Barnwell County (7.3 percent) in South Carolina and Columbia County (10.6 percent) and Richmond County (17.5 percent) in Georgia (Table L.1–7). In 1993, SRS employed 23,351 persons which decreased to 16,562 persons in 1996.

Regional Economy Characteristics. Selected employment and regional economy statistics for the SRS REA are summarized in Figure 3.7.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 21.4 percent to the 1990 level of 248,239. The 1994 unemployment in the REA was 6.7 percent, which was approximately 0.4 and 1.5 percent higher than the unemployment for South Carolina and Georgia, respectively. The region's per capita income of $17,212 in 1993 was approximately 2.1 percent greater than South Carolina's per capita income of $16,861 and 10.6 percent lower than Georgia's per capita income of $19,249.

In 1993, the percentage of total employment involving the private sector activity of retail trade in the REA (16 percent) was comparable to the statewide economies of South Carolina and Georgia, as shown in Figure 3.7.8–1. Service employment in the region (22 percent of total employment) represented a 3-percent smaller share of the total employment in the region than in Georgia but was similar to that of South Carolina. The manufacturing sector in the region (21 percent) represented a 1- and 6-percent greater share of the total employment than in South Carolina (20 percent) and Georgia (15 percent), respectively.

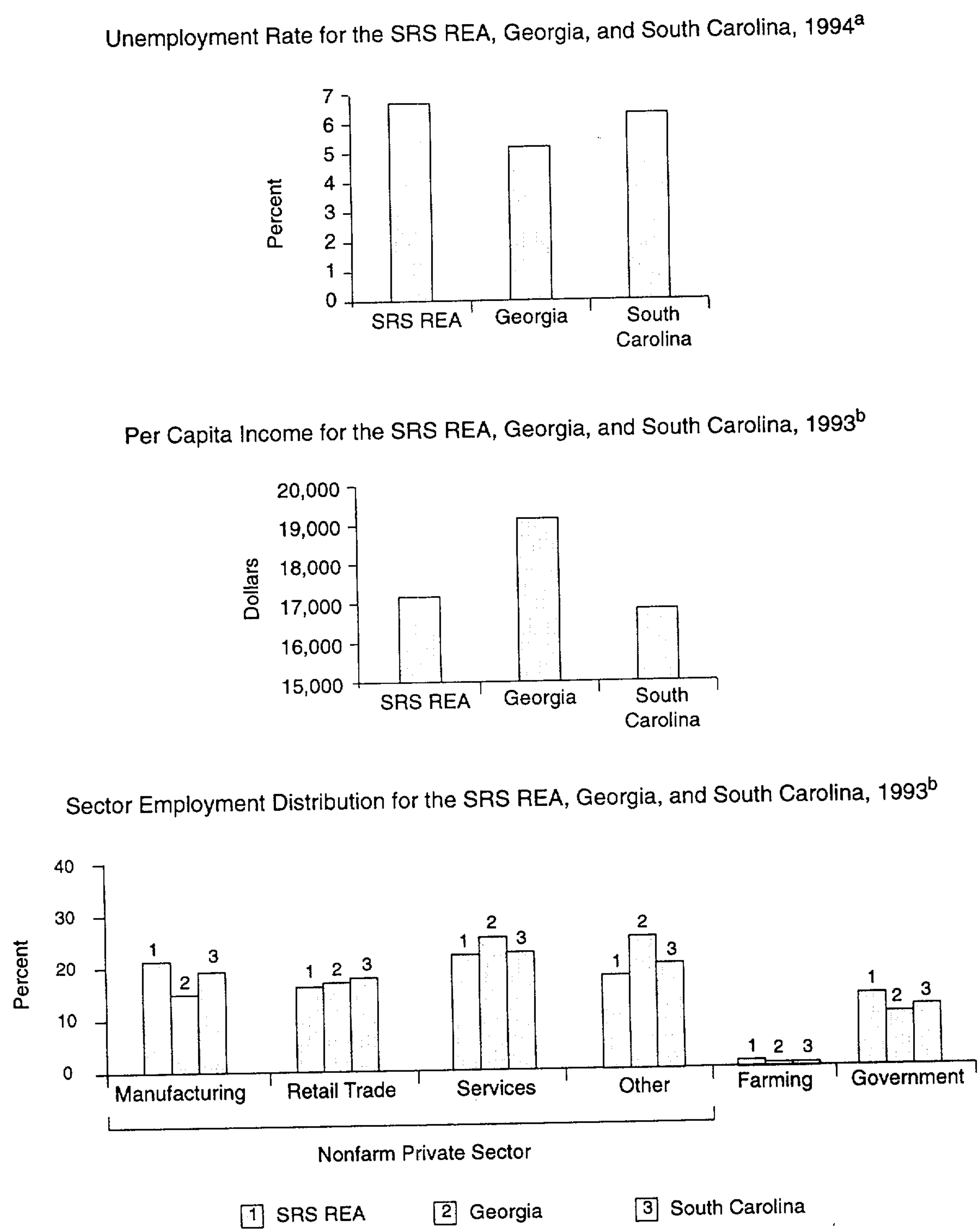
Population and Housing. In 1994, the ROI population totaled 457,812. From 1980 to 1994, the ROI population grew by 21.7 percent, compared to 29.1 percent in Georgia and 17.4 percent in South Carolina. Within the ROI, Columbia County experienced the largest increase, 99.2 percent, while Bamberg County's population decreased 7.8 percent. Population and housing trends are summarized in Figure 3.7.8–2.

The increase in number of housing units in the ROI between 1980 and 1990, 23.8 percent, was similar to the increase in South Carolina, but approximately 6 percent less than the increase in Georgia. The total number of housing units for 1990 was 168,803. The 1990 homeowner vacancy rate for the ROI, 2.2 percent, was comparable to the statewide rates for South Carolina and Georgia. The renter vacancy rate for the ROI counties, nearly 10 percent, was approximately 2 percent less than the renter vacancy rates for both States.

Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the SRS ROI. Figure 3.7.8–3 presents school district characteristics for the SRS ROI. Figure 3.7.8–4 presents public safety and health care characteristics.

Education. In 1994, nine school districts provided public education services and facilities in the SRS ROI. As shown in Figure 3.7.8–3, these school districts operated at between 58.7-percent (Allendale County) and 100-percent (Columbia County School District) capacity. The average student-to-teacher ratio for the SRS ROI in 1994 was 17.5:1. The Aiken County School District had the highest ratio at 19:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents in the ROI. In 1994, a total of 954 sworn police officers were serving the six-county ROI. Richmond County employed the greatest number of sworn police officers (325), while the city of Augusta, Georgia had the highest officer-to-population ratios (3.9 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 2.1 officers per 1,000 persons. Figure 3.7.8–4 compares police force strengths across the ROI.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.7.8–1. Employment and Local Economy for the Savannah River Site Regional Economic Area and the States of Georgia and South Carolina.

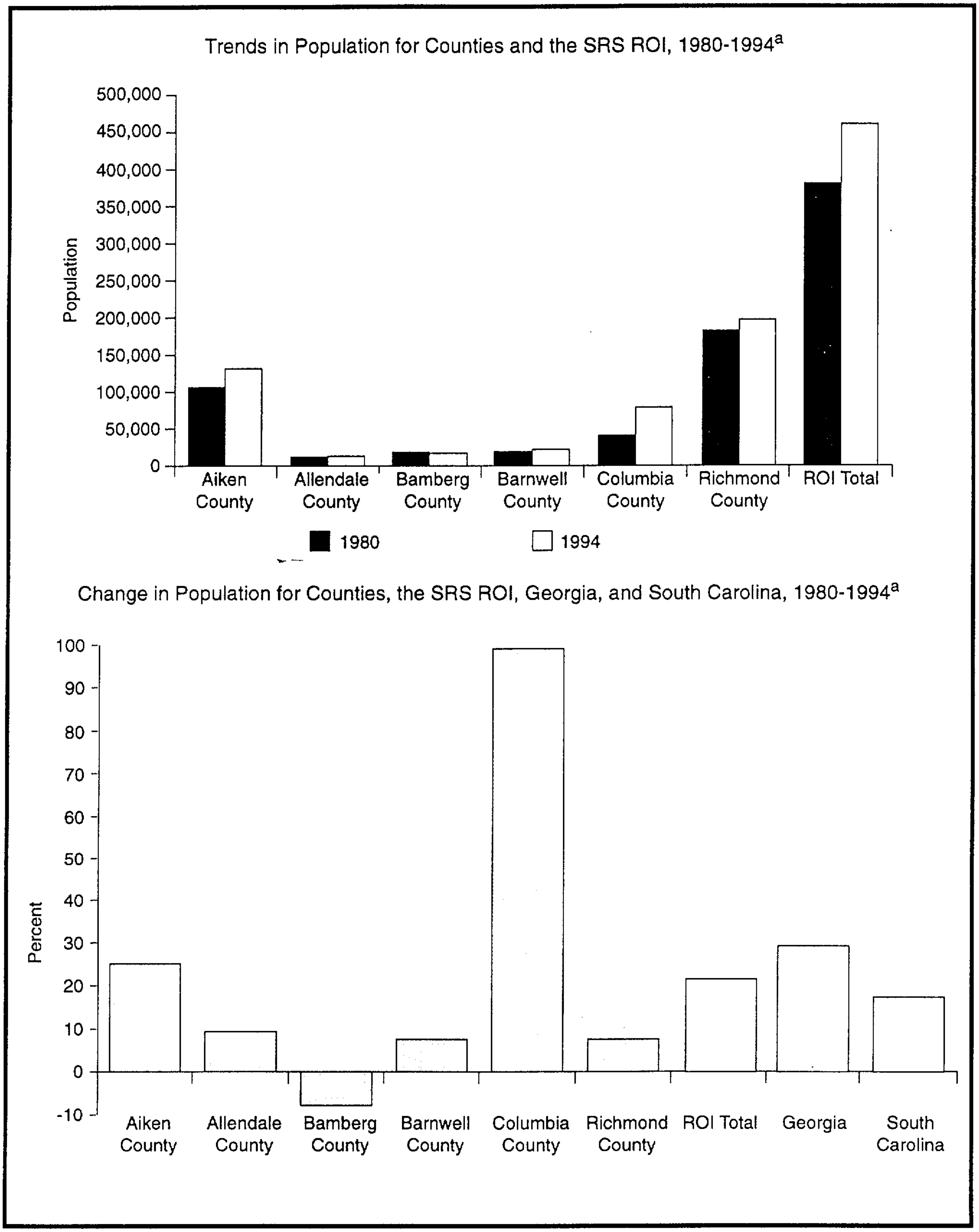
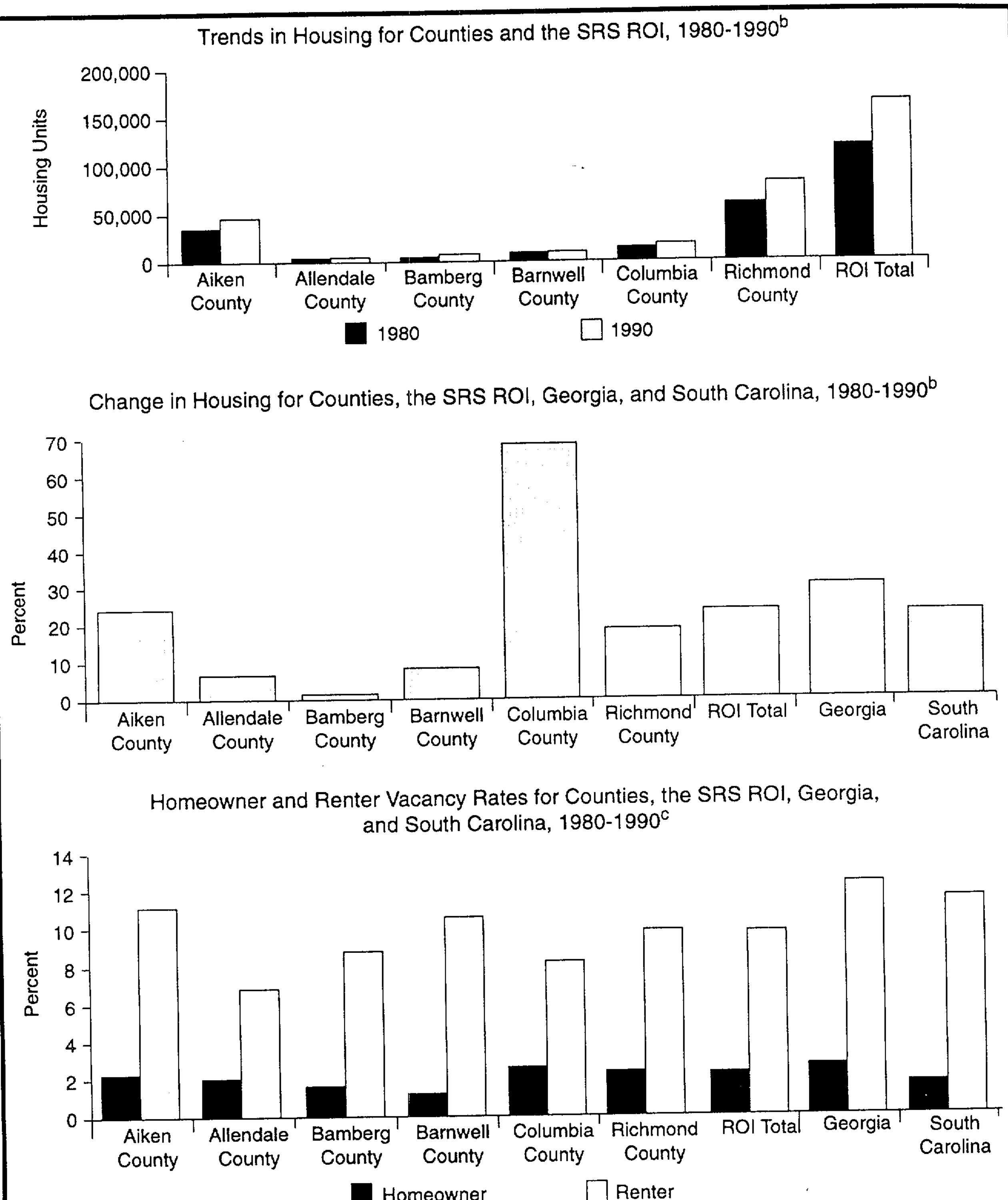


Figure 3.7.8–2. Population and Housing for the Savannah River Site Region of Influence and the States of Georgia and South Carolina.

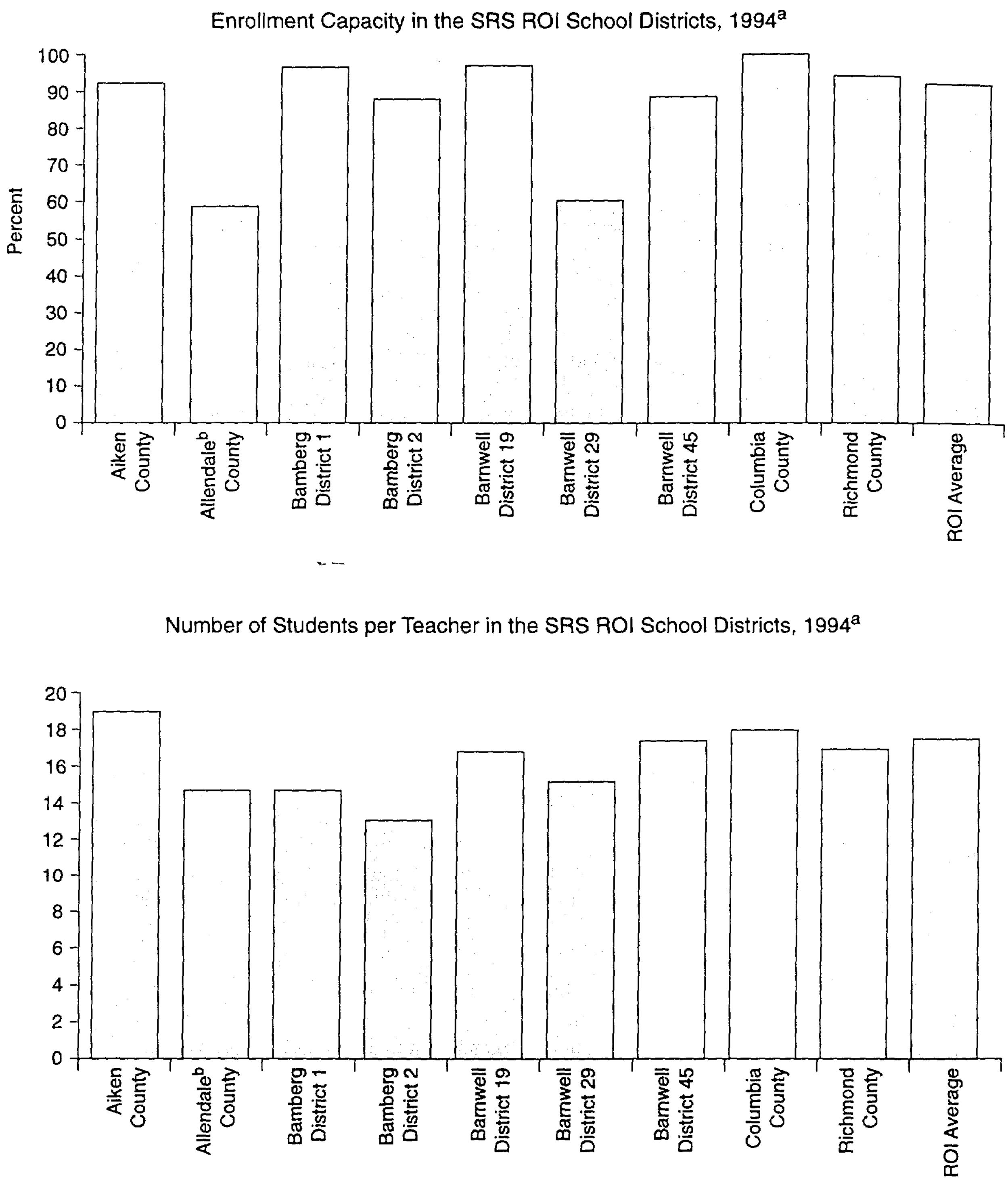


[a] Census 1983b; Census 1983c; Census 1995a.

[b] Census 1982c; Census 1982j; Census 1991a; Census 1991b.

[c] Census 1991a; Census 1991b.

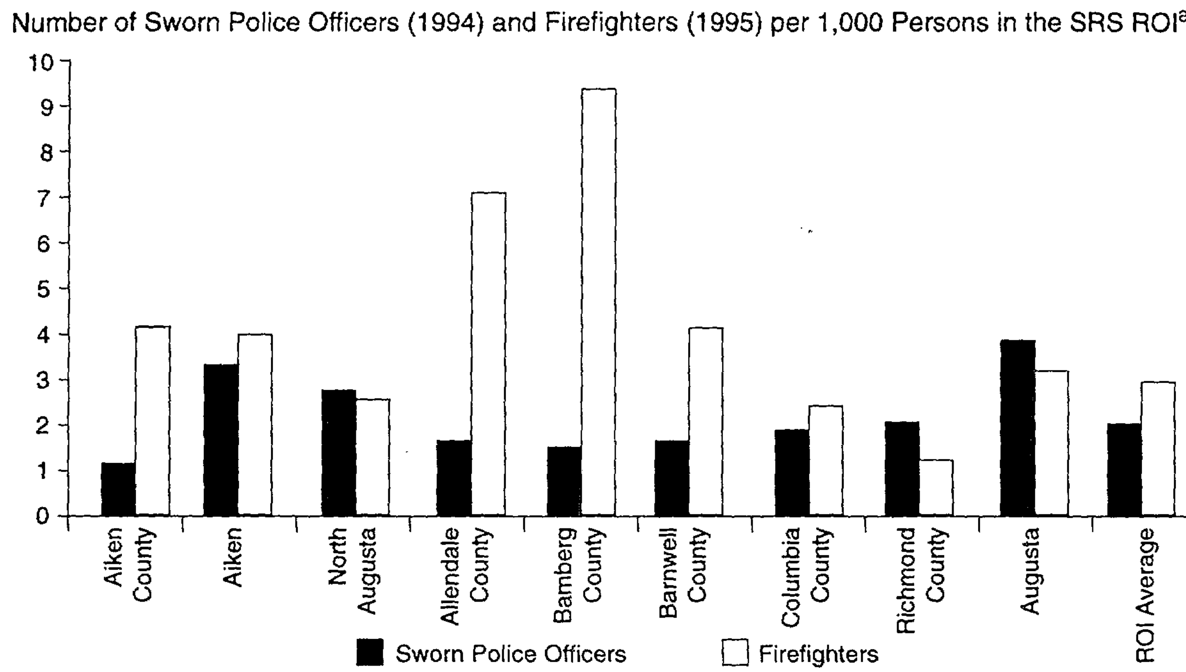
Figure 3.7.8–2. Population and Housing for the Savannah River Site Region of Influence and the States of Georgia and South Carolina—Continued.



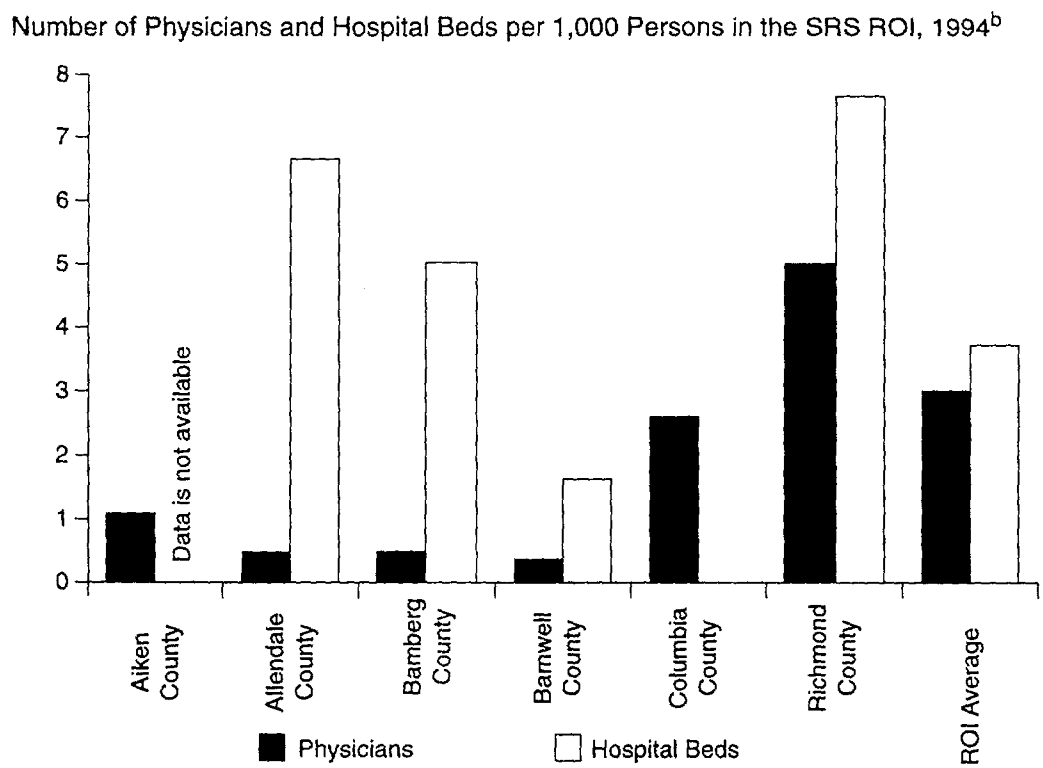
[a] Socio 1996a.

[b] Maximum capacity was unobtainable from local government. The calculated maximum capacity was based on the student-to-teacher ratio recommended by the state.

Figure 3.7.8–3. School District Characteristics for the Savannah River Site Region of Influence.



Note: Except for ROI cities, city sworn police officers and firefighters are included in the county totals.



[a] Census 1993c; Census 1993e; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.7.8–4. Public Safety and Health Care Characteristics for the Savannah River Site Region of Influence.

Fire protection services in the SRS ROI were provided by 1,363 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was located in Bamberg County, 9.3 firefighters per 1,000 persons, as indicated in Figure 3.7.8–4. Aiken County employed the greatest number of firefighters (375). The average firefighter-to-population ratio in the ROI was 3.0 firefighters per 1,000 persons.

Health Care. There were eight hospitals serving the six-county ROI in 1994. Figure 3.7.8–4 displays the hospital bed-to-population ratios for the SRS ROI counties. During 1994, all hospitals were operating below capacity, with hospital occupancy rates ranging from 45.7 percent in Barnwell County to 73.8 percent in Bamberg County.

In 1994, a total of 1,360 physicians served the ROI, with the majority (985) located in Richmond County. Figure 3.7.8–4 shows that the physician-to-population ratios for the ROI ranged from 0.4 physicians per 1,000 persons in Barnwell County to 5.0 physicians per 1,000 persons in Richmond County. The average ROI physician-to-population ratio was 3.0 physicians per 1,000 persons.

Local Transportation. The SRS is served by more than 322 km (200 mi) of primary roads and more than 1,609 km (1,000 mi) of unpaved secondary roads (see Figure 2.2.6–1 and Figure 2.2.6–2). The primary highways used by SRS commuters are State Routes 19, 64, and 125. There are no current or planned road improvements that would affect SRS.

Two road segments in the ROI could be affected by the storage and disposition alternatives. The first is South Carolina State Route 19 from U.S. 1/78 at Aiken to U.S. 278. This segment operated at level of service E in 1995. The second is South Carolina State Route 230 from U.S. 25 Business at North Augusta to U.S. 1/25/78/278. This segment operated at level of service E in 1995.

There is no public transportation to SRS (SR DOT 1995a:1). Rail service in the ROI is provided by the Norfolk Southern Corporation and CSX Transportation. SRS is provided rail access via Robbins Station on the CSX Transportation line. In addition, SRS maintains 101 km (63 mi) of onsite track for internal uses (DOE 1993j:4-60).

Waterborne transportation is available via the Savannah River. Currently, the Savannah River is used primarily for recreation (DOE 1993j:4-60). SRS has no commercial docking facilities, but it has a boat ramp that has accepted large transport barge shipments (SRS 1995a:9.)

Columbia Metropolitan Airport in the city of Columbia, South Carolina and Bush Field in the city of Augusta, Georgia, receive jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located in the ROI.

3.7.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of SRS are shown in Table 3.7.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to SRS operations.

Table 3.7.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Savannah River Site Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and cosmogenic radiation	29
External radiation	29
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	363

[a] WSRC 1994d.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from SRS operations provide another source of radiation exposure to individuals in the vicinity of SRS. Types and quantities of radionuclides released from SRS operations in 1993 are listed in the *Savannah River Site Environmental Report* for 1993 (WSRC-TR-94-075). The doses to the public resulting from these releases are presented in Table 3.7.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment (No Action) radiological releases and resulting impacts at SRS in the year 2005 (Section 4.2.6.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from SRS operations in 1993 is estimated to be 1.6×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of SRS operations is less than 2 in 10 million. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 0.011 excess fatal cancers are projected in the population living within 80 km (50 mi) of SRS from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1993 in the population living within 80 km (50 mi) of SRS was 1,240. This number of expected fatal cancers is much higher than the estimated 0.011 fatal cancers that could result from SRS operations in 1993.

Table 3.7.9–2. Radiation Doses to the Public From Normal Savannah River Site Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual[b]	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.18	4	0.14	100	0.32
Population within 80 km[c] (person-rem)	None	20.0	None	1.5	100	21.5
Average individual within 80 km[d] (mrem)	None	0.032	None	0.0022	None	0.034

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] The actual dose value given in the column under liquid releases conservatively includes all water pathways, not just the drinking water pathway. The population dose includes contributions to Savannah River users downstream of SRS to the Atlantic Ocean.

[c] In 1993, this population was approximately 620,100. For liquid releases, an additional 65,000 water users in Port Wentworth, Georgia and Beaufort, South Carolina (approximately 160 km downstream) are included in the assessment.

[d] Obtained by dividing the population dose by the number of people living within 80 km of the site for atmospheric releases; for liquid releases the number of people includes water users who live more than 80 km downstream of the site.

Source: WSRC 1994d.

The SRS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.7.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to SRS workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to SRS workers from normal operations in 1992 is estimated to be 0.14.

Table 3.7.9–3. Radiation Doses to Workers From Normal Savannah River Site Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	17.9
Maximally exposed worker (mrem)	5,000	3,000
Total workers[b] (person-rem)	ALARA	350

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 19,500.

Source: 10 CFR 835, DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Savannah River Site Environmental Report* for 1993 (WSRC-TR-94-075).

The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.7.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at SRS via inhalation of air containing hazardous chemicals released to the atmosphere by SRS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water, or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.7.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to SRS workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a detailed estimation and summation of these impacts. However, the workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. SRS workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at SRS are expected to be substantially better than required by the standards.

Health Effects Studies. Only one published epidemiological study on the general population in communities surrounding SRS has been conducted. No evidence of excess cancer mortality, congenital anomalies, birth defects, early infancy deaths, strokes, or cardiovascular deaths was reported. An excess in leukemia deaths has been reported among hourly workers at SRS; no other health effects for workers were reported in the literature and reports reviewed. For a more detailed description of the studies reviewed and the findings, refer to Section M.4.7.

Accident History. Between 1974 and 1988, there were 13 inadvertent tritium releases from the tritium facilities at SRS. These releases have been traced to aging equipment in the tritium processing facility and are one of the reasons for the construction of a Replacement Tritium Facility at SRS. A detailed description and study of these incidents and their consequences to the offsite population has been documented by SRS. The most significant were in 1981, 1984, and 1985 when 32,934, 43,800, and 19,403 Ci of tritiated water vapor, respectively, were released (WSRC 1991a:41). In the period 1989 through 1992 there were 20 inadvertent releases, all with little or no offsite dose consequences. The largest of these recent releases occurred in 1992 when 12,000 Ci of tritium were released (WSRC 1993a:260).

In 1993, an inadvertent release of Pu-238 and Pu-239 took place. Westinghouse Savannah River Company (WSRC) emergency response models estimated a hypothetical exposure of 0.0019 mrem at the site boundary (WSRC 1994d:182).

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The Emergency Preparedness Facility at SRS provides overall direction and control for onsite responses to emergencies and coordinates with Federal, State, and local agencies and officials on the technical aspects of the emergency.

The SRS Emergency Operations Facility consists of several centers, described below, that provide distinct emergency response support functions:

- The SRS Operations Center coordinates the initial response to all SRS emergencies and is equipped to function as the heart of SRS's emergency response communications network.

- The Technical Support Center provides command and control of emergency response activities for the affected facility or operational area.

- The Emergency Operations Center provides command and control of emergency response activities for SRS locations outside of the affected area.

- The Security Management Center coordinates activities relating to the security and safeguarding of materials by providing security staff in the affected area and contractor management in the Emergency Operations Center.

- The Dose Assessment Center is responsible for assessing the health and environmental consequences of any airborne or aqueous releases of radioactivity or toxic chemicals and recommends onsite and offsite protective actions to other centers.

3.7.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for SRS. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.6. Table 3.7.10–1 presents a summary of waste management activities at SRS for 1993.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at SRS. The DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed-upon milestones.

The EPA has placed SRS on the NPL and has identified approximately 150 potential operable units. In accordance with CERCLA, DOE entered into an FFCA with the EPA and the State of South Carolina, effective January 15, 1993, to coordinate cleanup activities at SRS under one comprehensive strategy. The FFCA combines the RCRA Facility Investigation Program Plan (under RCRA) with a CERCLA cleanup program entitled the RCRA Facility Investigation/Remedial Investigation Program Plan.

The Savannah River Site has an aggressive waste minimization program in progress to vastly improve the operation of existing and planned liquid and solid waste generating, treatment, and storage facilities. A disciplined approach to these activities is being developed based on technology and experience from the commercial nuclear industry. This approach already has significantly reduced the generation of TRU waste (48 percent), LLW (13 percent), mixed waste (96 percent), and hazardous waste (58 percent) (DOE 1993e:I-18). SRS generates and manages spent nuclear fuel and the following waste categories: high-level, TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. With the shutdown of the production reactors at SRS, no new spent nuclear fuel is expected to be generated from existing SRS operations. Future receipt and management of spent nuclear fuel at SRS will be made in accordance with the ROD published in the *Federal Register* (60 FR 28680) on June 1, 1995, and amended on March 8, 1996 (61 FR 9441) for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F), and the ROD (61 FR 25092) for the EIS on the *Proposed Policy for the Acceptance of U.S. Origin Foreign Research Reactor Spent Nuclear Fuel* (DOE/EIS-0218F).

High-Level Waste. Liquid HLW at SRS is made up of many waste streams generated during the recovery and purification of TRU products and unburned fissile material from spent reactor fuel elements. These wastes are separated by waste form, radionuclide, and heat content before their transfer to underground storage tanks in the F- and H-Area tank farms. Processes used routinely to treat liquid HLW are separation, evaporation, and ion exchange. Evaporation produces a Cs-contaminated condensate. Cesium is removed from the condensate resulting in a LLW stream that is treated in the ETF. The remaining HLW stream salts are precipitated, and some can be decontaminated. The decontaminated salt solution is sent with residues from the ETF to the Defense Waste Processing Z-Area Saltstone Facility where it is mixed with a blend of cement, flyash, and blast furnace slag to form grout. The grout is pumped into disposal vaults where it hardens for permanent disposal as solid LLW. The remaining high-level salt and sludge is permanently immobilized as a glass solid cast in stainless steel containers at the DWPF Vitrification Plant. The stainless-steel containers are decontaminated to DOT standards, welded closed, and temporarily stored onsite for eventual transport to and disposal in a permanent Federal repository. Future HLW generation could result from the processing and stabilization of spent fuel for long-term storage as a result of 60 FR 28680, and from remediation or materials recovery activities performed in the F- and H-Canyons.

Table 3.7.10–1. Spent Nuclear Fuel and Waste Management Activities at Savannah River Site

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	None	Stabilization[a]	None[a]	Pools	Sized to current inventory	None–High-Level Waste Program in the future	NA
High-Level							
Liquid	1,561	Settle,separate, evaporate	53,700[b]	F- & H- Area Tank Farm	133,000[c]	NA[d]	NA
Solid	None	Vitrification[e]	None	Air Cooled Shielded Facility	2,286 canisters[f]	None–High-Level Waste Program in the future	NA
Transuranic							
Liquid	None	NA	NA	NA	NA	NA	NA
Solid	391	None	None	Pads, buildings	14,600[g]	None–WIPP or alternate facility in the future	None
Low-Level							
Liquid	None	Absorption, evaporation, filtration, neutralization, saltstone	503,000[h]	Ponds, tanks-awaiting processing	NA	NA	NA
Solid	14,100	Compaction	3,980[i]	NA	NA	Burial vaults and trenches	2,578,000[j]
Mixed Low-Level							
Liquid	115	Stabilization, adsorption, neutralization, precipitation, filtration, ion exchange, evaporation	511,000[k]	RCRA permit Bldgs. E, 600, 700, M-Area Liquid Effluent Treatment Facility	11,500[l]	None	None
Solid	18	None	NA	RCRA permit Bldg. 600	1,990[m]	None	None
Hazardous							
Liquid	None	None	None	DOT containers	Included in solid	Offsite	NA
Solid	74[n]	None	None	DOT containers	2,618[o]	Offsite	NA

Table 3.7.10–1. Spent Nuclear Fuel and Waste Management Activities at Savannah River Site—Continued

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Sanitary)							
Liquid	700,000[p]	Filter, settle, strip	1,451,000[q]	Flowing ponds	NA	Permitted discharge	Varies by each permitted outfall
Solid	6,670	Compaction	Expandable, as required	NA	NA	Landfill (onsite and offsite)	Expandable, as required
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	NA	Included in sanitary	Included in sanitary
Solid	Included in sanitary	Included in sanitary	Included in sanitary	NA	NA	Included in sanitary	Included in sanitary

[a] Some fuel will be processed in the F- and H-Canyons in accordance with the Final Environmental Impact Statement, *Interim Management of Nuclear Materials*.
[b] SRTC ion exchange, evaporators.
[c] F- and H-Area Tank Farms.
[d] Treatment removes the high level constituents (salt and sludge) from the liquids. The salt and sludge are vitrified.
[e] DWPF started operation in 1995.
[f] Defense Waste Processing Facility.
[g] TRU storage pads.
[h] Includes F- and H-Area Effluent Treatment Facility.
[i] Onsite compactors.
[j] Saltstone vaults, E-Area vaults, slit trenches.
[k] Includes F- and H-Area Effluent Treatment Facility, M-Area Effluent Treatment Facility, and Savannah River Technology Center Ion-exchange Treatment.
[l] Hazardous Waste Storage Facility, mixed waste storage buildings, Process Waste Interim Treatment, DWPF organic waste storage tank, burial ground storage tank, SRTC mixed waste storage.
[m] Hazardous Waste Storage Facility, mixed waste storage buildings.
[n] SRS generated 64.93 t of RCRA-regulated and 8.90 t TSCA-regulated hazardous wastes; thus, the sum is approximately 74 t. Assuming a density of 1,000 kg/m^3, a volume of 74 m^3 was calculated.
[o] Pads and buildings in B-, M-, and N-Areas.
[p] 1991 data.
[q] Centralized Sanitary Wastewater Treatment Facility.
Note: NA=not applicable.
Source: DOE 1995kk; SR DOE 1993c; SR DOE 1994b; SR DOE 1994c; SR DOE 1995b; SR DOE 1995c; SR MMES 1993a; SRS 1995a:2; WSRC 1995a.

Transuranic Waste. Under the FFCA on RCRA, LDRs signed by EPA and DOE on March 13, 1991, SRS is required to prepare TRU waste for shipment. SRS will begin discussions with the South Carolina Department of Health and Environmental Control on alternative treatment options in January 1998 if the Secretary of Energy does not decide to operate WIPP by that time. If a delayed opening date for WIPP is determined, DOE will propose modifications to the *SRS Site Treatment Plan* for approval by the State of South Carolina. Status of the WIPP readiness schedule will be included in the updates. Certified TRU waste is stored on TRU waste storage pads until it can be shipped to an approved TRU waste disposal facility. Should additional treatment be necessary for disposal, SRS would develop the appropriate treatment capability. All TRU waste currently generated is stored in containers on aboveground pads.

The Experimental TRU Waste Assay and Certification Facility began operations in 1986 to certify newly generated TRU waste. It since has been shut down. A new TRU waste characterization and certification facility is planned, and would provide extensive containerized waste processing certification capabilities. The facility is needed to prepare TRU waste for treatment and to certify TRU waste for disposal at WIPP. Drums that can be certified for shipment to WIPP are placed in interim storage on concrete pads in E-Area. Buried and stored waste containing concentrations of TRU nuclides between 10 and 100 nanocuries (nCi)/g (referred to as alpha-contaminated LLW or alpha waste) is managed like TRU waste because its physical and chemical properties are similar, and because similar procedures will be used to determine its final disposition. Because all of the TRU waste placed on the aboveground pads prior to January 1990 is suspected of having hazardous constituents, a RCRA Part B permit application has been submitted for the TRU waste storage pads and the Experimental TRU Waste Assay Certification Facility. The waste is currently being stored under RCRA interim status.

Low-Level Waste. The bulk of liquid LLW is aqueous process waste, including effluent cooling water, decontaminated salt solutions, purge water, water from storage basins for irradiated reactor fuel or target elements, distillate from the evaporation of process waste streams, and surface water runoff from areas where there is a potential for radioactive contamination. Liquids are processed to remove and solidify the radioactive constituents and to release the balance of the liquids to permitted discharge points within standards established by the regulatory permit. Solid LLW includes operating plant and laboratory waste, contaminated equipment, reactor and reactor-fuel hardware, spent lithium-aluminum targets, and spent deionizer resin from reactor coolant treatment. Solid LLW is separated by radiation levels into low and intermediate categories. Solid LLW that radiates less than 200 mrem/hr at 5 cm (1.97 in) from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem/hr at 5 cm (1.97 in), it is considered intermediate-activity waste. Intermediate-activity tritium waste is intermediate-activity waste with greater than 10 Ci of tritium per container. The disposal mode for solid LLW is disposal in earthen trenches and concrete vaults. Saltstone generated in the solidification of decontaminated salts extracted from HLW is disposed of as LLW in separate vaults. Saltstone is the highest volume of solid LLW disposed of at SRS. Disposal facilities are projected to meet solid LLW storage/requirements and to include LLW from offsite DOE facilities for the next 20 years.

Mixed Low-Level Waste. The FFCA signed by EPA and DOE on March 13, 1991, addresses SRS compliance with RCRA LDRs pertaining to past, ongoing, and future generation of mixed LLW (mostly solvents, dioxin, and California list wastes contaminated with tritium). SRS is allowed to continue to operate, generate, and store mixed wastes subject to LDRs; in return, SRS will report to EPA the characterization of all solid waste streams disposed of in land disposal units at SRS and has submitted its waste minimization plan to EPA for review. Schedules for measures to provide compliance through construction of the Consolidated Incineration Facility and the Hazardous Waste and Mixed Waste Storage Facility are included in the FFCA.

The Consolidated Incineration Facility will treat mixed LLW and hazardous waste. The Hazardous Waste and Mixed Waste Disposal Vaults are scheduled to be available in 2002. Mixed waste is currently placed in interim storage in the E-Area Solid Waste Disposal Facility and in two buildings in G-Area. These RCRA-permitted facilities will be used until completion of the Consolidated Incineration Facility and the Hazardous Waste and Mixed Waste Storage Facility. The FFCA requires DOE facilities storing mixed waste to develop site-specific treatment plans and to submit the plans for approval. The FFCA formed the basis for the *SRS Proposed Site Treatment Plan.*

Hazardous Waste. Lead, mercury, cadmium, 1,1,1-trichloroethane, leaded oil, trichlorotrifluoroethane, benzene, and paint solvents are typical hazardous wastes generated at SRS. All hazardous wastes are stored onsite in DOT-approved containers in RCRA-permitted facilities in three RCRA-permitted hazardous waste storage buildings and on three interim status storage pads in the B- and N-Areas. Most of the waste is shipped offsite to commercial RCRA-permitted treatment and disposal facilities using DOT-certified transporters. Eight to nine percent of the hazardous waste (organic liquids, sludge and debris) will be incinerated in the Consolidated Incineration Facility. Hazardous chemicals are stripped from aqueous liquids collected during groundwater monitoring in the M-Area Stripper, and the treated wastewater is discharged in accordance with discharge limits of appropriate NPDES permits.

Nonhazardous Waste. In 1994, the centralization and upgrading of the sanitary wastewater collection and treatment systems at Savannah River were completed. The program included the replacement of 14 aging treatment facilities (out of 20) scattered across the site with a new 3,975 m^3/day (1.05 million gal/day) central treatment facility and connecting them with a new 29-km (18-mi) primary sanitary collection system. The collection system intercepts wastewater at points prior to discharge into old sanitary wastewater treatment facilities. The new central treatment facility treats sanitary wastewater by the extended aeration activated sludge process utilizing the oxidation ditch method. The treatment facility separates the wastewater into two forms, clarified effluent and sludge. The liquid effluent is further treated by non-chemical methods of ultraviolet light disinfection to meet NPDES discharge limitations. The sludge goes through a volume reduction process to reduce pathogen levels to meet proposed land application criteria (40 CFR 503). The remaining existing sanitary wastewater treatment facilities are being upgraded as necessary to meet demands by replacing existing chlorination treatment systems with non-chemical ultraviolet light disinfection systems to meet NPDES limitations. SRS-generated municipal solid waste is sent to a permitted offsite disposal facility. DOE is evaluating a proposal to participate in an interagency effort to establish a regional solid waste management center at SRS (DOE/EA-0989, DOE/EA-1079).

3.8 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Rocky Flats Environmental Technology Site was established in 1952 by the AEC and is located in rural northern Jefferson County, Colorado, 26 km (16 mi) northwest of downtown Denver and about 19 km (12 mi) south of Boulder. Once a remote site, RFETS is now adjacent to a large and growing metropolitan area that includes the communities of Boulder, Arvada, Westminster, Broomfield, and Golden. The Rocky Flats Industrial Area occupies approximately 155 ha (384 acres) in the middle of the site. The remaining 2,495 ha (6,165 acres) form a buffer zone around the active part of RFETS. The buffer zone provides a distance of more than 1.6 km (1 mi) between the developed portion of the site and any public road or private property.

The RFETS mission is to transition from a production-dominated site to an environmental restoration, cleanup, and waste management-dominated site. The contingency status of buildings that could have been used to manufacture new Pu components has been removed. The site will retain a Pu storage mission pending decisions and actions regarding long-term Pu storage and disposition based on this PEIS. The DOE property boundaries for the site are illustrated in Figure 2.2.7–1. The locations of major Pu facilities at RFETS are shown in Figure 2.2.7–2. Current activities at RFETS are all related to DOE activities. RFETS missions are listed in Table 3.8–1.

Table 3.8–1. Current Missions at Rocky Flats Environmental Technology Site

Mission	Description	Sponsor
Interim Pu storage	Maintain Buildings 371, 559, 707, 776/777, and 771 for interim Pu storage, with eventual consolidation into a single facility.	Assistant Secretary for Environmental Management
RFETS environmental restoration and waste management	As buildings are released from DP control, decontaminate and decommission; remove all Pu and other toxic and/or hazardous materials; prepare Pu wastes for final transport to long-term storage facility.	Assistant Secretary for Environmental Management

Source: RFETS 1995a:1.

Department of Energy Activities. With the January 1992 Presidential decision to cancel W88 warhead production, there are currently no weapons-related Pu operations scheduled for RFETS. The site will continue its Pu storage function, employing existing buildings for nonsurplus and surplus Pu materials. Pu component fabrication and production support activities have been permanently stopped; any such future activities would take place at other DOE sites. Other RFETS DOE activities that have been relocated under the nonnuclear manufacturing consolidation include the following:

- Manufacturing, fabrication, and repair support for the safe secure tractors, trailers, and railcars of the DOE transportation safeguards activities
- Fabrication of nuclear weapon component and assembly training devices, used by both DOE and the DoD
- Reservoir production that involves fabricating, assembling, testing, inspecting, and shipping of gas reservoir assemblies
- Metrology services
- Nuclear-grade steel

The expected reduction in stockpile requirements would have allowed Pu recovered from retired weapons to be recycled for all new production needs. Current stockpile projections anticipate that larger quantities of Pu will be returned from weapon disassembly activities. Consequently, all existing residues, wastes, and Pu oxides do not need to be reprocessed for future weapon production at this time. These materials would only be processed to the extent necessary to ensure their stability for long-term monitored, retrievable storage or transport off the RFETS site in a Pu metal or oxide form. Selection of disposition options for residues would be based on minimizing waste disposal costs.

The current RFETS long-term mission is to prepare Pu processing and fabrication facilities for D&D with final disposition by EM. The Pu storage mission involves materials designated as either strategic reserve for current or anticipated program needs, surplus that can be converted to stable metal or oxide forms for storage and transport, or residue that is destined for disposal as waste. Pu storage capabilities would be maintained in Buildings 371, 707, 771, 776/777, and 559, with eventual consolidation into a single facility.

While preparing for PEIS ROD implementation, this interim period without Pu processing will permit operating selected RFETS Pu processing facilities to support the environmental restoration mission. Individual buildings and facilities will be D&D in accordance with EM plans.

The primary mission of RFETS was to produce components for nuclear weapons from materials such as Pu, uranium, beryllium, and various alloys of stainless steel. Production was stopped in 1989, and up until that time plant operations and purposes were kept secret, with little mission and management information given to the public. The site was off-limits to the general public. In 1992, the plant's production of nuclear weapon components was officially discontinued with the end of the Cold War.

Rocky Flats Environmental Technology Site now has a new mission focusing on environmental restoration, waste management, management of special nuclear materials onsite (one of which is Pu), D&D of facilities, and economic development. Although the site remains off-limits to the general public due to health and safety considerations, DOE now provides extensive information to the public concerning management and operations and works closely with the public on many issues related to RFETS.

Non-Department of Energy Activities. The RFETS has no non-DOE activities at this time.

3.8.1 Land Resources

Land Use. The 2,650-ha (6,550-acre) RFETS is located in northern Jefferson County, Colorado, approximately 26 km (16 mi) northwest of downtown Denver. All land within RFETS is owned by the Federal Government and is administered, managed, and controlled by DOE.

Existing Land Use. Generalized land uses within RFETS and the immediate vicinity are shown in Figure 3.8.1–1. Land uses surrounding the site are primarily open space, industrial, and rural residential and agricultural (grazing and hay production) (RF EG&G 1993a:2-1). RFETS contains two major categories of land use: industrial and undeveloped. Production facilities occupy approximately 155 ha (384 acres), or 6 percent of the site, and are centrally located on the site (RF DOE 1994a:2). The approximately 2,495 ha (6,165 acres) that remains is utilized as a security buffer zone while most of this area is open space (undeveloped); however, there are several other uses, including approximately 8 ha (20 acres) of production support facilities, approximately 45 ha (111 acres) of sanitary waste disposal, and 211 ha (523 acres) of aggregate and clay mining. No prime farmland exists onsite. There are no public recreation facilities onsite.

Land-Use Planning. Planning does not occur at the state level within Colorado, however, regional planning within the RFETS vicinity occurs through advisory Denver Regional Council of Governments (DRCOG). RFETS is located within Jefferson County, one of six counties that compromise the DRCOG. Jefferson County does not currently have a countywide comprehensive plan, however, the county has adopted community plans. Community plans function as land-use plans for specific areas of the county and their recommendations are used for making and granting future land-use decisions. The North Plains Community Plan designates RFETS as a "Special Use Area." The zoning resolution for Jefferson County classifies RFETS land with the following zoning districts: agricultural, industrial, and special use.

Visual Resources. The RFETS lays amid a landscape that is mostly grazing land with low hills and ridges. Construction and operation of the DOE facilities has heavily disturbed the character of the landscape. The most dominant features of the site include two large stacks and a water tank. The existing facilities are separated from public roads by the open land in the buffer area. The Rocky Mountains start to rise approximately 3.2 km (2 mi) to the west of RFETS. Because access to the site is limited to authorized personnel, public visual access is limited to views from the outside (RF EG&G 1993a:3-22). The facilities are brightly lit at night and are highly visible from many areas within a 4.8- to 8-km (3- to 5-mi) radius of the site. The area within the central developed area is consistent with a VRM Class 5 designation. The remainder of the site ranges from VRM Class 3 to Class 4.

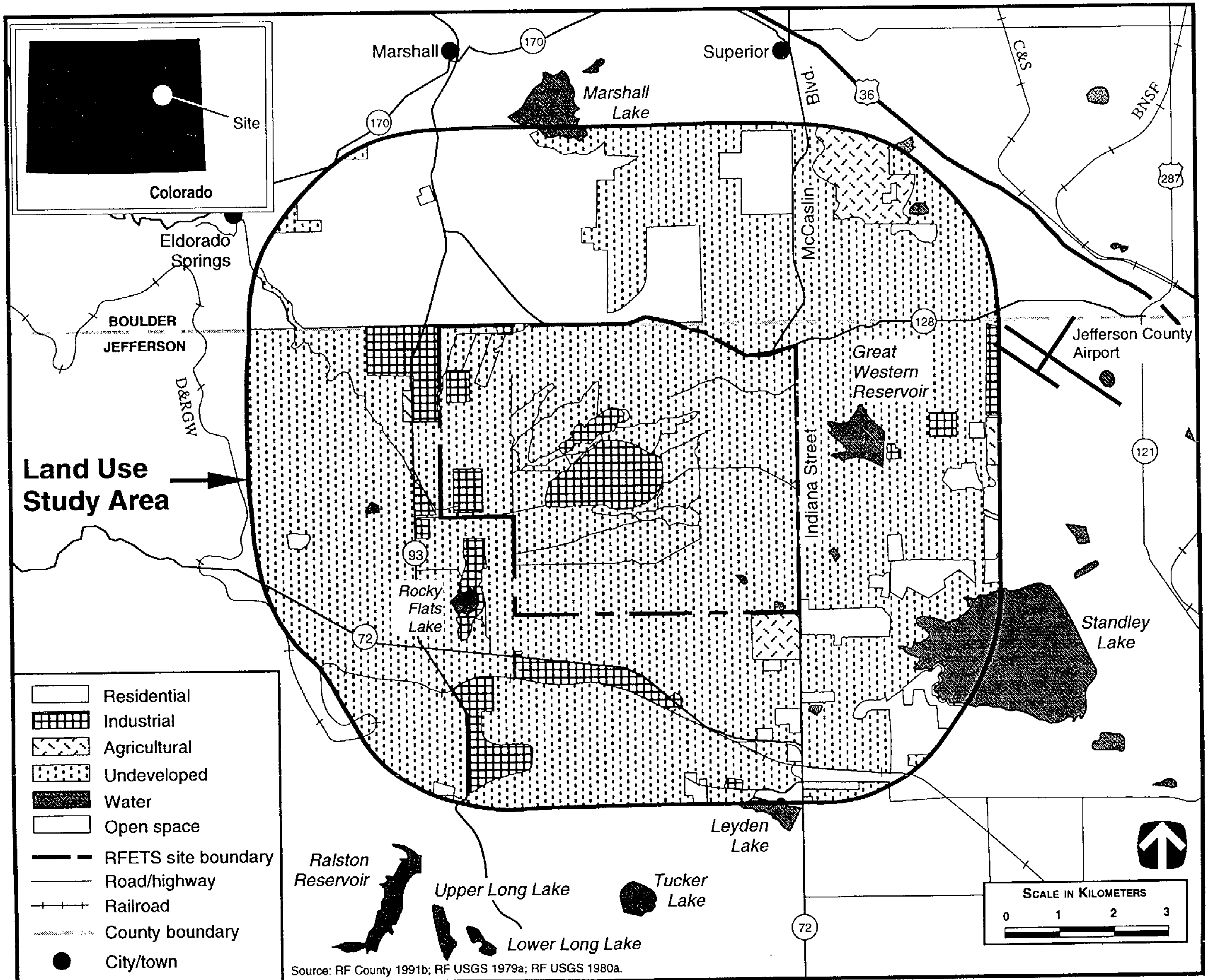


Figure 3.8.1–1. Generalized Land Use at Rocky Flats Environmental Technology Site and Vicinity.

3.8.2 SITE INFRASTRUCTURE

Baseline Characteristics. Activities at RFETS are concentrated in facilities in the middle of the site. To support these activities, an extensive infrastructure exists. Baseline site infrastructure characteristics are shown in Table 3.8.2–1.

Table 3.8.2–1. Rocky Flats Environmental Technology Site Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	40	40
Railroads (km)	5	5
Electrical		
Energy consumption (MWh/yr)	184,000	184,000
Peak Load (MWe)	26	26
Fuel		
Natural gas (m^3/yr)	18,600,000	18,600,000
Oil (l/yr)	8,140,000	8,140,000
Coal (t/yr)	0	0
Steam (kg/hr)	41,000	41,000

Source: RFETS 1995a:1.

Two-lane county and State highways circumvent the site and include State Route 93 to the west, State Route 128 to the north, and Indiana Street to the east. No roads exist along the southern boundary and no public access roads traverse the site. RFETS has controlled access gates to the east and west with a paved road running through the middle of the site connecting Route 93 to Indiana Street. The site also has numerous dirt firebreak and access roads for management. Nuclear wastes from RFETS are transported by truck primarily along the interstate highway system. Nuclear shipments are restricted to off-peak periods when traffic activity is low.

Normal and alternate power is supplied from the Public Service Company of Colorado through two electrical switching stations. Currently, one station (to the north of the site) is used for primary services, and the other (just outside the west gate) is used to supply a small portion of the western side of the site and as backup electrical power. Emergency diesel generators provide backup power capabilities should normal and alternate power be lost. The sub-regional electric power pool from which RFETS draws its power is the Rocky Mountain Power Area. Capabilities of this power pool are summarized in Table 3.8.2–2.

The site is connected to a Public Service Company natural gas line. The line passes through the site and continues west to serve residential customers in the Coal Creek canyon area.

There are two methods by which the site acquires water; the method used at any particular time is at the discretion of the Denver Water Board. The preferred supply comes from a diversionary canal between Gross and Ralston Reservoirs. The canal passes the site between the west gate and Route 93, and provides gravity-fed flow to a holding pond, also to the west of the site. The second method involves pumping water directly from Ralston Reservoir to the holding pond, overcoming more than 300 ft of head pressure.

Table 3.8.2–2. Rocky Mountain Area Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel	
Coal	71%
Nuclear	0%
Hydro/geothermal	15%
Oil/gas	5%
Other[a]	9%
Total Annual Production	52,781,000 MWh
Total Annual Load	49,936,000 MWh
Energy Exported Annually[b]	2,753,000 MWh
Generating Capacity	10,691 MWe
Peak Demand	7,861 MWe
Capacity Margin[c]	2,357 MWe

[a] Includes power from both utility and nonutility sources.

[b] Energy exported is not the difference of production and load due to negative net pumped storage.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

The locations of buildings at RFETS are shown in Figure 2.2.7–2; the buildings that play a role in the site EA's proposed Category I and II special nuclear material consolidation and interim storage program are highlighted. Buildings 371 and 707 would play the most active role in the proposed site-specific action while Buildings 771, 776/777, 779, and 991 would perform consolidation support functions. The remainder of this section provides a description of these buildings. With the exception of Building 371, all of the buildings were built to commercial industrial standards. Building 371 was built to strict nuclear design standards.

Building 371 currently stores Category I and II special nuclear material and is proposed to be the primary special nuclear material consolidation and interim storage facility until long-term storage and disposition actions are decided and implemented. Portions of the RFETS Pu residues, TRU waste, and RCRA waste inventories currently are stored in Building 371. The four-level facility has approximately 17,300 m^2 (186,000 ft^2) of floor space and contains six Pu storage vaults and vault-type rooms. The stacker/retriever moves radioactive materials between the central storage vault and the input and output stations. In addition to this transport capability, the central storage vault was designed for storage of Category I and II special nuclear material.

Building 707 is a two-story facility with 6,897 m^2 (74,240 ft^2) per floor. A single-story portion with 1,724 m^2 (18,560 ft^2) composes the east side of the building. The building contains 10 modules in which various manufacturing activities have taken place in the past. Building 707 is connected directly, through other buildings or by tunnels, to Buildings 776/777, 771, 778, and 779.

Building 771 is a two-level facility with approximately 14,000 m^2 (151,000 ft^2) of floor space and stores Pu that requires stabilization. The building is connected by a tunnel to Building 776/777, which is directly connected to Buildings 779 and 707. The tunnel between Buildings 771 and 776 is concrete-lined and is equipped with a HEPA filtration ventilation system.

Building 776/777 is a two-story facility with approximately 14,500 m^2 (156,200 ft^2) of floor space and contains special nuclear material that requires stabilization. The building is connected to Building 779 by an enclosed hallway, to Building 771 by tunnel, and to Building 707 via Building 778.

Building 779 is a research and development facility originally built to support proauction and recovery processes. The facility was completed in 1965, and the external structure was subsequently improved to withstand an earthquake of 6.0 on the Richter scale.

Building 991 was built in 1952 and is used primarily for shipping special nuclear material and other certified product materials (including nonnuclear materials). The facility and its associated underground tunnels and vaults are also used for storing special nuclear material and other certified product materials.

3.8.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The RFETS region is characterized as a dry climate, middle-latitude steppe, with mild, sunny, semiarid conditions and few temperature extremes. The average annual temperature at RFETS is 10.2 °C (50.3 °F); temperatures vary from an average daily minimum of -8.8 °C (16.1 °F) in January to an average daily maximum of 31.2 °C (88.2 °F) in July. The average annual precipitation at RFETS is 39.1 cm (15.4 in). The average annual windspeed at Denver National Weather Service Station is 3.8 m/s (8.6 mph) (NOAA 1994a:3). Additional information related to meteorology and climatology at RFETS is presented in Appendix F.

Ambient Air Quality. The RFETS is located within the Metropolitan Denver Intrastate AQCR #36. This AQCR is designated nonattainment with respect to the NAAQS for PM_{10}, O_3, and CO, and listed as attainment for SO_2 and NO_2 (40 CFR 81.306). The PM_{10} standard is exceeded primarily due to fugitive dust. Vehicular traffic is a major contributor to the high concentrations of O_3 and CO in the region. Applicable NAAQS and the ambient air quality standards for Colorado are presented in Appendix F.

Since the creation of the PSD program in 1977, PSD permits have not been required for any new RFETS emission sources. There are several PSD (40 CFR 52.21) Class I areas near RFETS. The closest, Rocky Mountain National Park, is located approximately 46 km (30 mi) northwest of RFETS.

The emissions inventory from sources at RFETS is presented in Appendix F. Historically the principal sources of criteria pollutants at RFETS are the steam plant boilers. Minor combustion sources include various small boilers and diesel generators. Other sources of criteria pollutants include coating operations and particulate matter from various manufacturing operations.

National hazardous and toxic air pollutant standards have not been adopted by the State of Colorado Department of Public Health and Environment. The annual emission rates of hazardous/toxic air pollutants from existing RFETS facilities for the period 1991 through 1993 are listed in Appendix F.

Table 3.8.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at RFETS. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise sources at RFETS include various facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). No sound-level measurements have been made around RFETS to determine background sound levels. Most RFETS industrial facilities are at a sufficient distance from the site boundary to make noise levels at the boundary from these sources barely distinguishable from background noise.

The acoustic environment along the RFETS boundary and at nearby residences away from traffic noise is typical of a rural location or quiet suburban residential area, with DNL in the range of 35 to 52 dBA (EPA 1974a:B-4). Traffic is the primary source of noise at the site boundary and at nearby residences. Plant traffic contributes little to overall traffic noise. However, traffic noise is expected to dominate sound levels along major roads in the area. Except for the prohibition of nuisance noise, neither the State of Colorado nor its local governments have established environmental noise standards applicable to RFETS.

Table 3.8.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Rocky Flats Environmental Technology Site, 1991-1994

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Baseline Concentration[b] ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[c]	145
	1-hour	40,000[c]	534
Lead	Calendar Quarter	1.5[c]	[d]
	30-day	1.5[e]	[d]
Nitrogen dioxide	Annual	100[c]	4.14
Ozone	1-hour	160[e]	[f]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	0.235
	24-hour	150[c]	17.4
Sulfur dioxide	Annual	80[c]	0.295
	24-hour	365[c]	21.8
	3-hour	700[e]	64.6
Mandated by the State of Colorado			
Hydrogen sulfide	1-hour	142[e]	<0.01
Total suspended particulates	Annual	75[e]	0.284
	24-hour	150[e]	21.0
Hazardous and Other Toxic Compounds			
1,1,2-Trichloro-1,2,2 Trifluoroethane	Annual	[g]	0.01
Carbon tetrachloride	Annual	[g]	0.01
Dioctyl phthalate	Annual	[g]	<0.01
Methylene chloride	Annual	[g]	<0.01
Nitric acid	Annual	[g]	<0.01
Trichloroethane	Annual	[g]	<0.01

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Modeled concentration based on permit data.
[c] Federal and State standard.
[d] Data not available from the source document.
[e] State standard.
[f] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.
[g] No State standard for indicated averaging time.
Source: 40 CFR 50; CO DPHE 1994a; RFETS 1995a:1.

3.8.4 WATER RESOURCES

Surface Water. The main surface water features at RFETS are Walnut Creek, North Walnut Creek, South Walnut Creek, and Woman Creek (Figure 3.8.4–1). The streams at RFETS are considered part of the Big Dry Creek drainage basin, although Big Dry Creek is not directly affected by RFETS activities. Rock Creek flows through the northwestern portion of the site and is physically separate from the operational plant complex; as such, Rock Creek is unaffected by site activities. Rock Creek has been maintained in an undisturbed condition since 1952.

The RFETS lies on the divide between Walnut Creek and Woman Creek drainage basins. North Walnut Creek and South Walnut Creek drain the central and northern areas of RFETS, and Woman Creek drains the southern areas. The confluence of South and North Walnut Creeks forms Walnut Creek. Walnut Creek flows downstream from RFETS and empties into the Broomfield Diversion Ditch. The Broomfield Diversion Ditch routes water around the Great Western Reservoir, which is a public water supply, then into Big Dry Creek, and eventually into the South Platte River.

Woman Creek flows east across the southern portion of RFETS into Standley Lake, which provides irrigation storage and municipal water for surrounding communities. Woman Creek may also be diverted into Mower Reservoir which also flows into Standley Lake. Standley Lake flows into Big Dry Creek, which flows into the South Platte River.

All natural surface water flow on RFETS occurs in ephemeral channels that flow only as a result of precipitation, discharge of site effluents, surface seeps, or release of water from storage areas west of the site to supplement water supplies in the Great Western Reservoir or Standley Lake. On North Walnut Creek, South Walnut Creek, and Woman Creek, a series of unlined ponds serve to impound waters from the site. Along North Walnut Creek, the ponds are numbered A–1 through A–4; on South Walnut Creek, the ponds are numbered B–1 through B–5; and on Woman Creek, the ponds are numbered C–1 and C–2. Pond C–2 is off channel from Woman Creek and does not receive direct flow. Flow into Pond C–2 is from runoff into South Interception Ditch and then into Pond C–2.

Wastewater from industrial processes is treated at a treatment plant that is isolated from other sources and does not discharge to surface water features. Existing sanitary wastewater generation is estimated at approximately 150 million l/yr (39.6 million gal/yr). Sanitary wastewater is treated and discharged to Pond B–3. Stormwater runoff from the plant is conveyed in storm sewers that discharge to creeks on the undeveloped portion of the site. Discharges from Ponds A–3, A–4, B–3, B–5 and C–2 are monitored under the NPDES-permit program.

Terminal ponds (A–4, B–5, and C–2) are designed to capture the flow from a 100-year storm if maintained at less than 10 percent of capacity. However, RFETS has been unable to maintain the 10-percent capacity limit due to the treatment of large quantities of water and delays in receiving approval for certain discharges.

The primary source of flood potential at RFETS is from flash flooding in seasonal streams. Of these, Woman Creek and North and South Walnut Creek drain the part of the site occupied by plant facilities. A recent study evaluating flooding potential at RFETS indicated that even in the most extreme circumstances it is unlikely that flows on Woman Creek could pose a hazard to facilities. The stream is at least 24 m (79 ft) below the elevation of structures in proximity to the stream (LLNL 1988a:3-1). Because evidence suggested that Walnut Creek may be subject to excessive flows during periods of high rainfall and runoff, a probabilitic flood analysis was performed. The 500-year floodplain of Walnut Creek corresponds to an elevation of approximately 1,806 m (5,925 ft). The majority of RFETS facilities are located between elevations of 1,814 and 1,844 m (5,952 and 6,050 ft) mean sea level. Therefore, these facilities lie outside the 500-year floodplain.

The RFETS does not withdraw any water from streams on or near the site. All water for the plant is obtained from surface waters from the city of Denver via the South Boulder Diversion Canal from the South Boulder Creek and

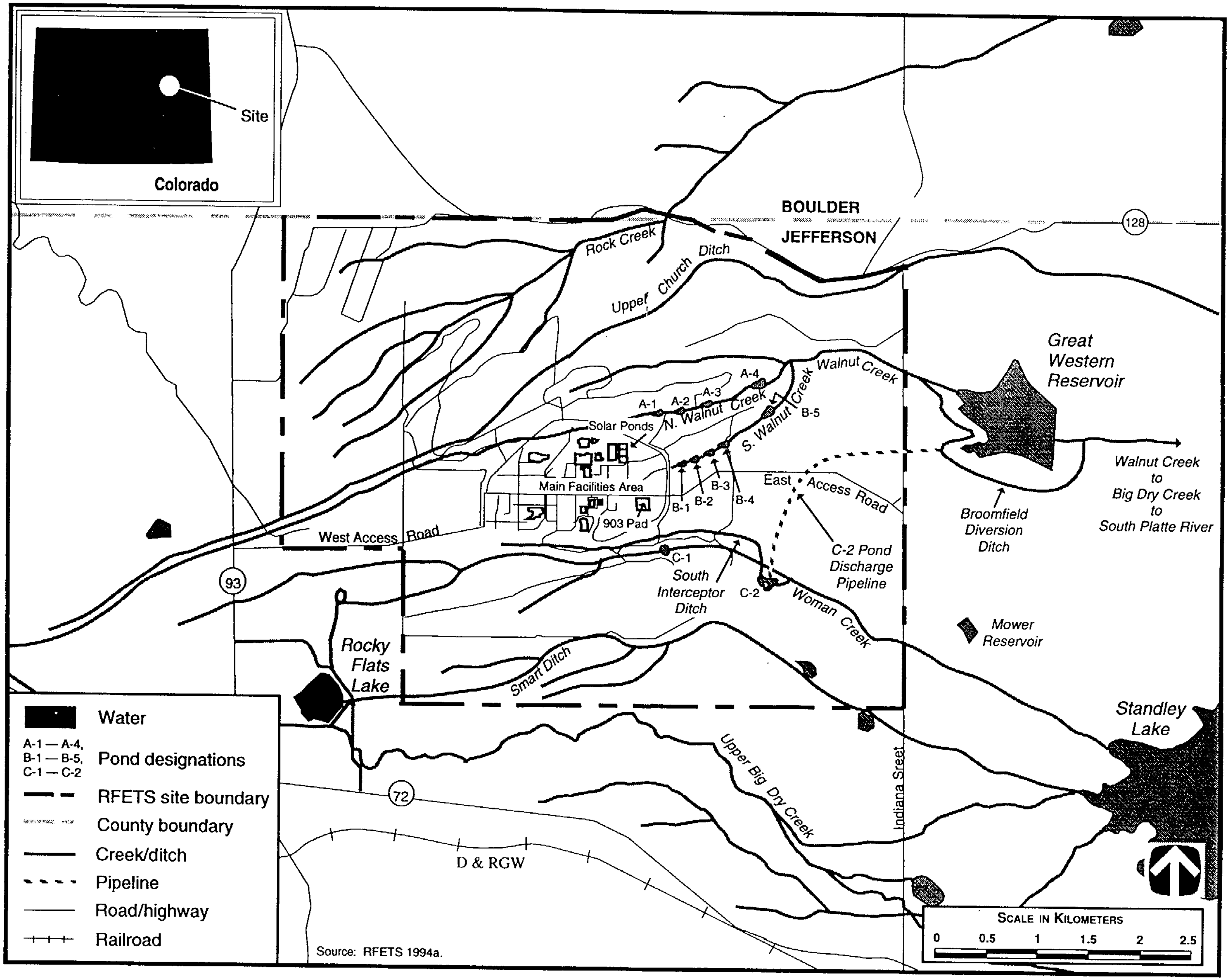


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Figure 3.8.4–1. Surface Water Features at Rocky Flats Environmental Technology Site

Ralston Reservoir. The water supply contract with the city and county of Denver through the Denver Water Board is for an unguaranteed supply of up to 5.7 million l/day (1.5 million gal/day). The current average water consumption is approximately 485 million l/yr (128 million gal/yr). Raw water is stored in a 5.7 million l (1.5 million gal) storage pond west of the plant.

Surface Water Quality. The water from Woman Creek, North Walnut Creek, and South Walnut Creek flows into ponds that restrict offsite discharges and allow water testing and, if necessary, treatment to meet water quality standards. A treatment facility is located at Pond A–4. Water from Pond B–5 is transferred to Pond A–4. Treatment consists of filtration and carbon absorption to reduce potential radionuclides and organic chemical contaminants. With concurrence from the Colorado Department of Health, water is released from Pond A–4 to Walnut Creek, and from Pond C–2 to the Broomfield Diversion Ditch, or in an emergency, to Ponds A–4 or B–5.

Discharges from Ponds A–4 and B–5 enter Walnut Creek and are diverted around the Great Western Reservoir by the Broomfield Diversion Ditch. Water is discharged untreated from Pond C–2 through a 2,438 m (7,999 ft) pipeline into the Broomfield Diversion Ditch and around the Great Western Reservoir. The release of untreated discharge from Pond C–2 has been approved by EPA because sampling indicates that the discharge meets all Woman Creek standards except for gross beta. The gross beta standards for Walnut Creek, the eventual destination of the piped discharge are higher, and no standard is exceeded.

An unlined surface water control pond exists immediately downstream and downgradient of the landfill and current waste disposal operations at the eastern end of the landfill. The landfill is considered a hazardous waste management landfill due to past disposal of some materials that may now qualify as regulated hazardous wastes. The landfill pond routinely exceeds the RFETS standard for strontium and has exceeded standards for copper, iron, lithium, manganese, mercury, nickel, Pu, and zinc. The landfill pond does not discharge to natural surface waters.

Water quality monitoring results for Walnut Creek and Woman Creek are presented in Table 3.8.4–1. These results indicate that concentrations were less than the water quality criteria listed. No Notices of Violations were received by RFETS in 1993 for NPDES limitations.

Surface Water Rights and Permits. Surface water rights are not an issue at RFETS because RFETS facilities do not withdraw surface water for use. As previously mentioned, the water supply contract with the city and county of Denver is for an unguaranteed supply of up to 5.7 million l/day (1.5 million gal/day).

Groundwater. Two nonhydraulically connected groundwater systems are present at RFETS. The upper unit exists as an unconfined aquifer and the lower unit as a confined aquifer. The contact separating the two units is identified as the base of the weathered zone.

The unconfined aquifer at RFETS is primarily unconsolidated alluvial material. The average depth to the water table in the unconsolidated surficial deposits range from about 21 m (70 ft) at the western boundary of RFETS to less than 3 m (10 ft) in the industrial area. Seeps are common along stream drainage. Groundwater flow direction is generally toward the east. Recharge to the unconfined aquifer occurs from infiltration of precipitation and as seepage from ditches, creeks, and ponds. In addition, retention ponds along South Walnut and Woman Creeks probably recharge this unit.

In the confined aquifer, groundwater is in the sandstone lenses below most of the plant. Flow within the sandstones is assumed to be from west to east. In some places, the sandstones are in contact with the alluvium so that the unit is part of the unconfined system at those places. Recharge to the sandstones occurs where they are in direct contact with the alluvium and valley fill of the upper aquifer or by leakage through claystones in contact with alluvium. The sandstone units discharge along the South Platte River, about 47 km (29 mi) east of RFETS.

Table 3.8.4–1. Summary of Surface Water Quality Monitoring at Rocky Flats Environmental Technology Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Existing Water Body Concentration: Average	Existing Water Body Concentration: Maximum
Receiving Water: Walnut Creek				
Alpha (gross)	pCi/l	11[b]	2.4	2.9
Americium-241	pCi/l	0.05[b]	0.001	0.013
Beryllium	mg/l	0.004[c]	<0.001	<0.001
Beta (gross)	pCi/l	19[b]	2.0	3.0
Copper	mg/l	1.0[d]	0.008	0.010
Lead	mg/l	0.015[c]	<0.002	<0.047
Plutonium-239/240	pCi/l	1.2[e]	0.002	0.024
Total dissolved solids	mg/l	500[d]	325	350
Tritium	pCi/l	500[b]	0	250
Uranium-233/234	pCi/l	10[b]	0.65	1.00
Uranium-238	pCi/l	10[b]	0.69	1.17
Receiving Water: Woman Creek				
Americium-241	pCi/l	0.05[b]	0.017	0.017
Beryllium	mg/l	0.004[c]	<0.001	<0.001
Copper	mg/l	1.0[d]	0.004	0.004
Lead	mg/l	0.015[c]	<0.050	<0.050
Plutonium-239/240	pCi/l	1.2[e]	0.010	0.010
Total dissolved solids	mg/l	500[d]	328	328
Tritium	pCi/l	500[b]	67	110
Uranium-233/234	pCi/l	5[b]	2.74	2.74
Uranium-235	pCi/l	5[b]	0.08	0.08
Uranium-238	pCi/l	5[b]	2.32	2.32

[a] For comparison purposes only, except for parameters that have Colorado State Water Quality Standards. [Text deleted.]
[b] Colorado State Water Quality Standards, specific for Walnut and Woman Creeks.
[c] National Primary Drinking Water Regulations (40 CFR 141).
[d] National Secondary Drinking Water Regulations (40 CFR 143).
[e] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.
Source: RFETS 1994a.

Groundwater Quality. Groundwater monitoring has been conducted at RFETS since 1960. By the end of 1994, about 300 wells were monitored for the purpose of determining groundwater quality and to determine the distribution of contaminant constituents in groundwater at RFETS. Groundwater quality in uncontaminated portions in surficial materials (alluvium, colluvium, valley fill, and weathered bedrock) is relatively good and can be classified as calcium bicarbonate water. The unweathered bedrock groundwater system can be distinguished from the surficial system by relatively higher sodium and sulfate content. Background groundwater quality for the upper and lower hydrostratigraphic units beneath RFETS is summarized in Table 3.8.4–2.

The unconfined aquifer contains both radiological and nonradiological contaminants. To date, the understanding of the hydrogeologic relationships indicate that there are no known bedrock pathways through which

Table 3.8.4–2. Groundwater Quality Monitoring at Rocky Flats Environmental Technology Site, 1994

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Existing Conditions	
			Upper Hydrostatic Unit	Lower Hydrostatic Unit
Alpha (gross)	pCi/l	15[b]	8.354	3.127
Americium-241	pCi/l	1.2[c]	0.011	0.028
Beryllium	mg/l	0.004[b]	0.00222	0.00204
Beta (gross)	pCi/l	50[d]	4.892	3.234
Cadmium	mg/l	0.005[b]	0.00245	0.00240
Cesium-137	pCi/l	120[c]	0.420	0.217
Chloride	mg/l	250[e]	12.8	100.108
Copper	mg/l	1.0[e]	0.01085	0.00970
Lead	mg/l	0.015[b]	0.00855	0.00272
pH	pH Units	6.5-8.5[e]	7.14	7.85
Radium-226	pCi/l	5[b]	0.258	1.723
Strontium-89/90	pCi/l	800[c]/400[c]	0.338	0.473
Sulfate	mg/l	250[e]	86.230	123.943
Total dissolved solids	mg/l	500[e]	354.151	545.138
Tritium	pCi/l	80,000[c]	101.702	56.881
Uranium-233/234	pCi/l	20[c]	6.914	1.643
Uranium-235	pCi/l	24[c]	0.195	0.033
Uranium-238	pCi/l	24[c]	4.832	0.768

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] DOE DCG for Water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.
[d] Proposed National Drinking Water Regulations; Radionuclides (56 FR 33050).
[e] National Secondary Drinking Water Regulations (40 CFR 143).
Source: RFETS 1995a:3.

groundwater contamination can directly leave RFETS and migrate into the confined aquifer system offsite (RFETS 1994a:123).

There are five principle areas where groundwater has been affected by plant activities at RFETS (Figure 3.8.4–2). The first plume is associated with the solar evaporation ponds, which were used to store radioactive/hazardous waste. The main contamination from this plume surrounds 207A and 207B ponds. Groundwater flow data across the solar evaporation ponds area diverges along two flow paths. One flow path is northeasterly toward North Walnut Creek and the other is southeasterly toward South Walnut Creek. Groundwater quality data from 1993 indicate that the solar ponds contributed nitrate/nitrite, sodium, TDSs, fluoride, bicarbonate, sulfate, dissolved radionuclides, several dissolved metals, and VOCs to the groundwater in surficial material and weathered bedrock immediately north, east, and southeast of the ponds (RFETS 1994a:130). The radionuclides include tritium, Pu-239, -240, Americium-241, and U-233,-234, -235, and -238.

The second plume, the 903 Pad, Mound, and Trench plume, is located in the southeastern-central portion of RFETS. The 903 Pad and Mound areas were historically used for storage and burial, respectively, of radioactively contaminated wastes. The plume located in the upper hydrostratigraphic unit is contaminated with

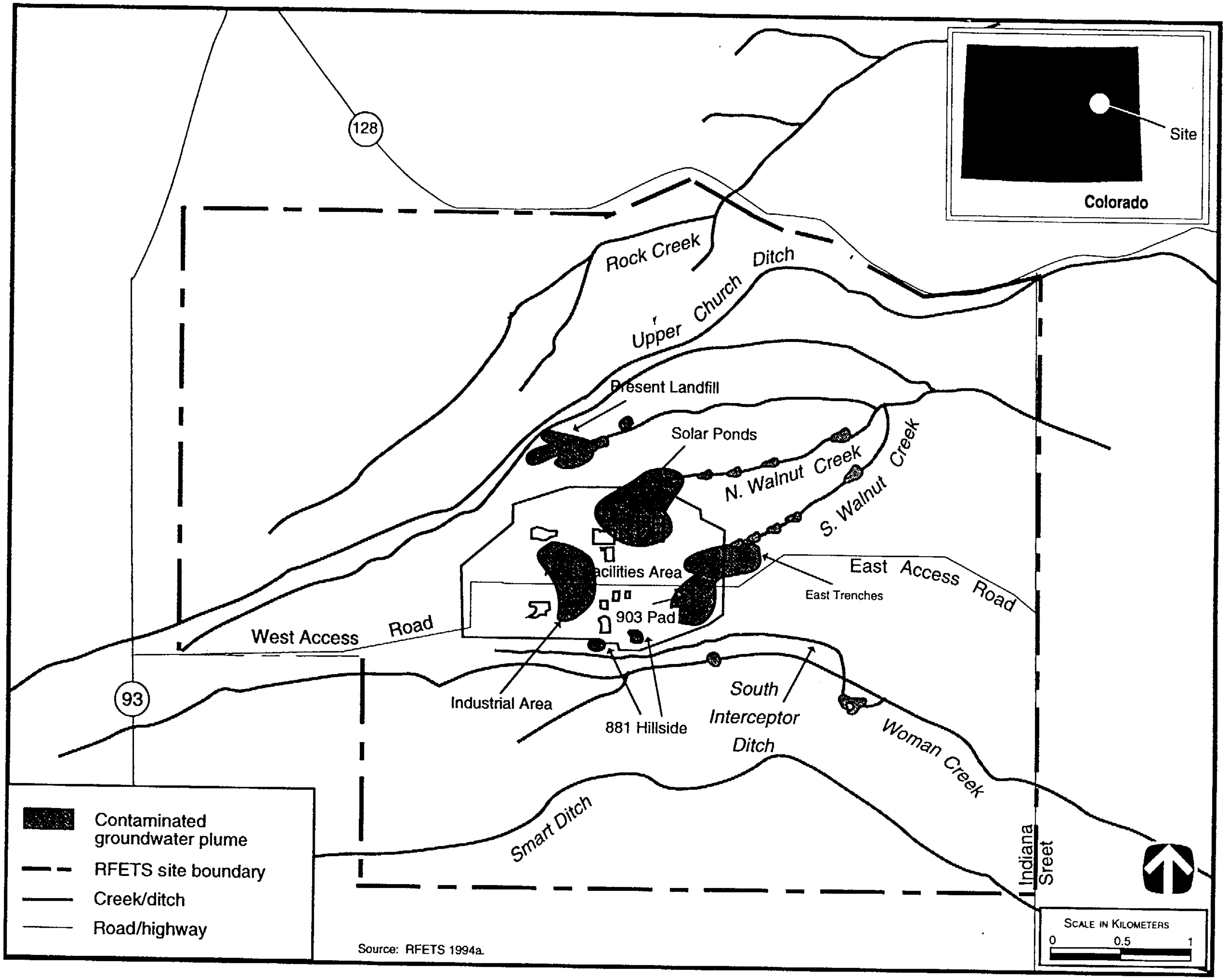


Figure 3.8.4–2. Groundwater Contamination Areas at Rocky Flats Environmental Technology Site.

VOCs, inorganics, dissolved metals, and some radionuclides (RFETS 1994a:127). The plume does not lie beneath buildings that house DOE activities.

The third plume is associated with the present landfill and is located at the western end of an unnamed drainage channel which discharges to North Walnut Creek. [Text deleted.] The plume contains inorganic analytes, dissolved metals, dissolved radionuclides, and VOCs, as well as nitrate and nitrite above standard levels (RFETS 1994a:136). The plume does not lie beneath buildings that house DOE activities.

The fourth plume is the 881 Hillside plume, located in the south-central portion of RFETS in the shallow groundwater system. Based on the most recently completed Phase III remedial investigation, VOCs (that is, carbon tetrachloride, perchloroethylene, and trichloroethylene) pose the most public health risk (RFETS 1994a:127). This area was used for the storage of drums containing cleaning solvents from 1967 to 1972. The plume also contains elevated levels of total dissolved solids, metals (nickel, Sr, selenium, zinc, and copper), and uranium. The plume does not lie beneath any buildings housing DOE activities.

The fifth plume is associated with the Western Industrial Area, with primary contamination occurring in the western portion of the RFETS buffer zone. Within and adjacent to the Western Industrial Area, groundwater quality has been impacted by carbon tetrachloride, tetrachloroethene, and trichloroethene. This plume does not lie beneath buildings that house DOE activities.

Groundwater Availability, Use, and Rights. Currently, no groundwater is used for potable purposes by the facility. However, approximately 10.6 million l/yr (2.8 million gal/yr) of groundwater is withdrawn from the site as part of the environmental restoration program, for contaminant removal.

In general, the rights to groundwater resources in Colorado are unrelated to ownership of the land under which those groundwater resources are located. However, for the Denver Basin aquifers, which include the lower aquifers at the RFETS, the right to groundwater resources derives from land ownership as long as the water is not tributary to any surface water supplies.

3.8.5 GEOLOGY AND SOILS

Geology. The RFETS is located on the western edge of the Colorado Piedmont section of the Great Plains physiographic province. The site is located on the west flank of the Denver Basin, an extensive sedimentary basin bordered on the west by the base of the Colorado Front Range. The site is located on a geomorphic surface comprised of a gravel-capped pediment surface identified as the Rocky Flats alluvial surface.

The surficial geology at RFETS consists of Quaternary alluvial, colluvial, eolian, and landslide deposits that range in thickness from several centimeters to over 30.5 m (100 ft). The most important unit is the Rocky Flats Alluvium, which consists of poorly sorted deposits of sand, gravel, and cobbles in a clay matrix that thins from west to east across the site (RF DOE 1985a:21). The Arapahoe Formation (Cretaceous-age), which immediately underlies the Rocky Flats Alluvium at RFETS, is approximately 0 to 36.5 m (0 to 120 ft) thick and consists of fluvial claystones with interbedded lenticular sandstones and siltstones (RF DOE 1985a:20; RF EG&G 1994a:G-1,G-2).

The RFETS lies in Seismic Zone 1, indicating minor damage could occur as a result of earthquakes (Figure 3.2.5–1). Occasional earthquakes with MMI of V to VI occur in Colorado. No major faults cut the Arapahoe Formation or overlying alluvium in the vicinity of RFETS (RF DOE 1985a:20). The Livingston fault, located approximately 5 km (3 mi) to the west, and the Golden fault, located approximately 8 km (5 mi) to the south, are the mountain-front faults closest to the facility. Neither fault is recognized as a capable fault according to 10 CFR 100, Appendix A. No other capable faults are present in the immediate vicinity of RFETS. There are no known areas of active volcanism in the Denver Basin.

Landslides and other mass earth movements are present as shallow features where slopes are steep. Nearly all of the site, however, has slopes averaging only 2 percent. Slopes may be greater than 2 percent along the sides of washes.

Soils. The RFETS is underlain mainly by soils of the Denver-Kutch and Flatirons-Velscamp soil associations. Erosion potential of the Denver-Kutch soil is low to moderate and shrink-swell potential is moderate to high. The Flatirons-Velscamp soil does not pose an erosion hazard, and its shrink-swell potential is low to moderate.

3.8.6 BIOLOGICAL RESOURCES

Terrestrial Resources. The RFETS is located at an elevation of 1,829 m (6,000 ft) above sea level, at the approximate elevation where plains grassland vegetation meets lower montane forest (RF DOE 1980a:2-93). Plant facilities occupy about 6 percent of the total site area. Vegetative communities on RFETS have been divided into four basic types; those within the central portion of the site are shown on Figure 3.8.6–1. Plant communities include grassland, marshland, woodland, and shrubland. Grassland is the most common community onsite, with mesic and zeric grasslands being the predominant subtypes. Marshland occurs along several creeks that traverse the site. Woodlands and shrublands are not common communities on RFETS. Habitats that are considered important to wildlife (especially waterfowl and passerine birds) include riparian zones along creeks and trees on south facing slopes (RFP 1992b:3). A total of 362 species of vascular plants have been identified on the site (RF DOE 1991i:23).

It appears that vegetation is recovering from the grazing that occurred before Government acquisition of the land. Recent studies have indicated that plant succession has progressed since the 1970s. Most areas formerly mapped as annual weed communities now qualify as perennial grassland. Indicator species for perennial grassland such as western wheatgrass and Canada bluegrass have increased in abundance and now dominate over much of the site (RF DOE 1991i:4).

Animals identified on the RFETS include 4 amphibian, 8 reptile, 167 bird, and 36 mammal species (RF DOE 1995a:2). Common animals of the site include the common bullsnake, prairie rattlesnake, western meadowlark, mourning dove, coyote, and mule deer (RF DOE 1991i:4,5,23,24). A variety of game animals occur on the site; however, hunting is not permitted. Numerous raptors, such as the red-tailed hawk and rough-legged hawk, and carnivores, such as the coyote and long-tailed weasel, are found on RFETS. Migratory birds and their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Wetlands. Rocky Flats Environmental Technology Site contains a variety of wetlands including intermittent streams, ditches, ponds, and hillside seeps. Most wetlands that occur onsite are found along ephemeral streams and are classified on NWI maps as palustrine. There are several manmade wetlands on the site including vegetated sections of ditches, such as the South Interceptor Ditch, the A, B, and C-series ponds, and the landfill pond. Wetlands also occur at various locations around the site that are fed by drains and stormwater from paved areas and other surface runoff (RFP 1991c:4). Numerous seeps are scattered on the hillsides of the site. Vegetation typical of wetlands at RFETS includes sandbar willow, American watercress, plains cottonwood, broad-leaf cattail, and bulrush. In total there are about 43 ha (107 acres) of aerial wetlands and 25.9 km (16.1 mi) of narrow wetlands along streambeds within RFETS (RF DOE 1990b:18,19,22).

Aquatic Resources. Aquatic habitat on RFETS consists of ephemeral streams, ditches, ponds, and springs. Four streams flow within the site boundaries; North Walnut Creek, South Walnut Creek, Woman Creek, and Rock Creek (Figure 3.8.4-1). Each of these streams supports a series of on-channel retention reservoirs or ponds which collect surface water runoff and wastewater. North and South Walnut Creek, which are located in the northeast portion of the site, flow eastward offsite and into Great Western Reservoir. Fathead minnows are found in these streams. There are three holding ponds along North Walnut Creek and four ponds along South Walnut Creek. These ponds support crayfish and various other macroinvertebrates; fathead minnows are found in at least one of the ponds (RF DOE 1980a:2-96).

Woman Creek, which is located in the southern portion of the site, flows eastward offsite and into Standley Lake. Seven species of fish have been identified in Woman Creek and include several minnows, largemouth bass, green sunfish, and the white sucker (RF DOE 1991b:4). Redside dace and bluegill occur in holding ponds located along Woman Creek (RF DOE 1980a:2-97).

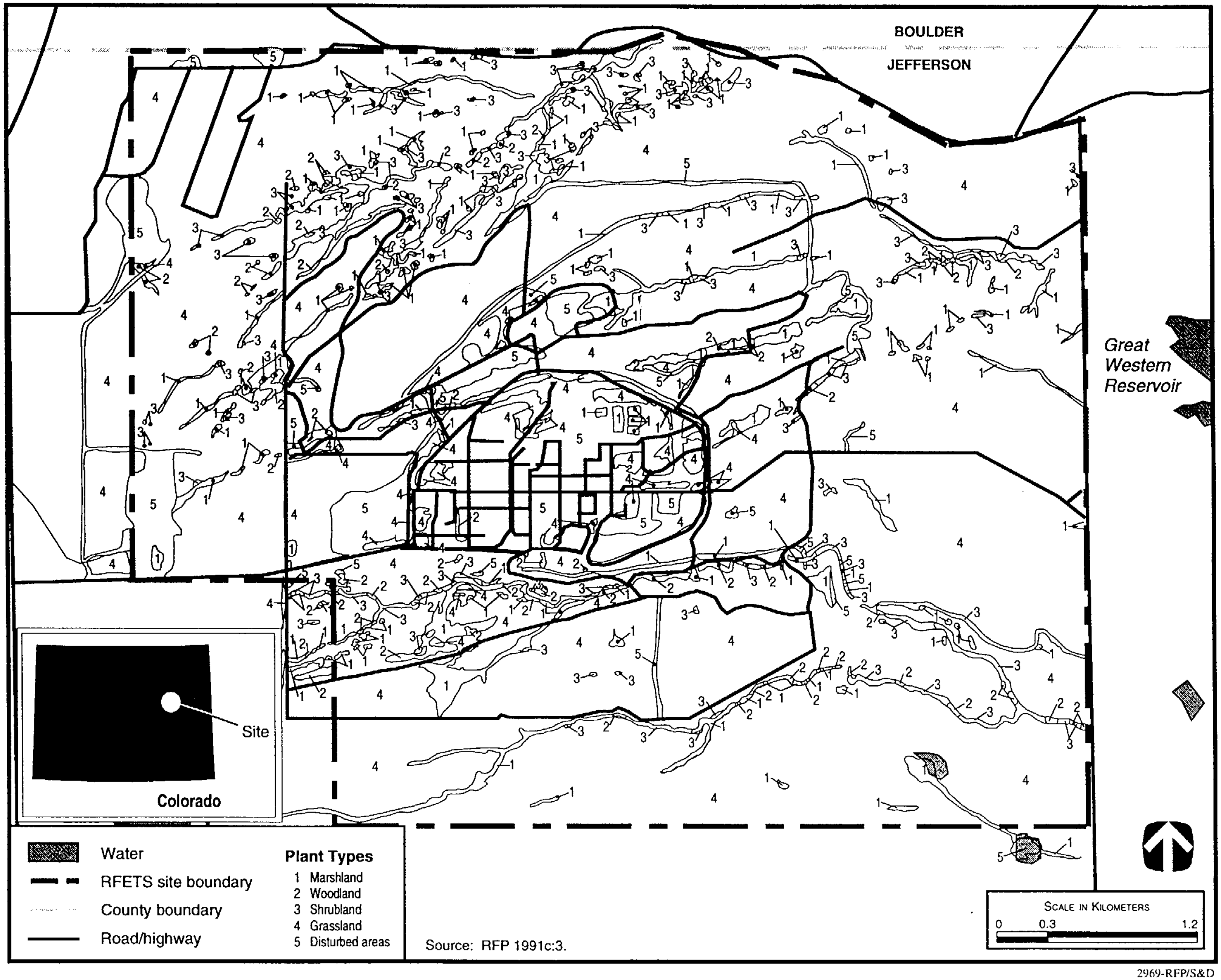


Figure 3.8.6–1. Distribution of Plant Communities at Rocky Flats Environmental Technology Site.

Rock Creek is located in the northwest portion of the site and is unlikely to support a large number of fish. However, Lindsay Pond, located on Rock Creek, does provide habitat for redside dace and largemouth bass (RF DOE 1980a:2-96).

Ditches located on RFETS convey stormwater runoff to holding ponds. These ditches do not support any fish populations. There are several permanent and temporary ponds located throughout the site, and a number of springs are found in the southwest portion of the site. Information is not available on the aquatic organisms found in these habitats (RFP 1992b:4).

Threatened and Endangered Species. The 35 federally and State-listed threatened, endangered, and other special-status species that may be found on or in the vicinity of the RFETS area are listed in Table 3.8.6–1. Twelve of these species have been observed on or in close proximity to the site. Potential suitable habitat for the remaining 23 species exists on RFETS. No critical habitat for threatened or endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on RFETS.

Table 3.8.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Rocky Flats Environmental Technology Site

Common Name	Scientific Name	Status[a] Federal	State
Mammals			
[Text deleted.]			
Preble's meadow jumping mouse[b]	*Zapus hudsonius preblei*	NL	SC
[Text deleted.]			
Spotted bat	*Euderma maculatum*	NL	U
Swift fox	*Vulpes velox*	C	U
Birds			
American peregrine falcon[b,c]	*Falco peregrinus anatum*	E	T
American white pelican[b]	*Pelecanus erythrorhynchos*	NL	SC
Arctic peregrine falcon[c]	*Falco peregrinus tundrius*	E (S/A)	T
[Text deleted.]			
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	T
Barrow's goldeneye	*Bucephala islandica*	NL	SC
[Text deleted.]			
Black-throated gray warbler[b]	*Dendroica nigrescens*	NL	SC
Blue grosbeak[b]	*Guiraca caerulea*	NL	SC
Ferruginous hawk[b]	*Buteo regalis*	NL	SC
Greater sandhill crane[b]	*Grus canadensis tibida*	NL	T
Least tern[c]	*Sterna antillarum*	E	E
[Text deleted.]			
Long-billed curlew[b]	*Numenius americanus*	NL	SC
Mountain plover	*Charadrius montanus*	C	SC
[Text deleted.]			
Piping plover[c]	*Charadrius melodus*	T	T
Plains sharp-tailed grouse	*Tympanuchus phasianellus jamesi*	NL	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	NL
Western burrowing owl[b]	*Athene cunicularia hypugea*	NL	U

Table 3.8.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Rocky Flats Environmental Technology Site—Continued

Common Name	Scientific Name	Status[a] Federal	State
Western snowy plover	*Charadrius alexandrinus nivosus*	NL	SC
White-faced ibis	*Plegadis chihi*	NL	U
Whooping crane[c]	*Grus americana*	E	E
[Text deleted.]			
Fish			
Common shiner	*Notropis comutus*	NL	SC
[Text deleted.]			
Stonecat	*Noturus flavus*	NL	SC
Plants			
Adder's mouth orchid	*Malaxis brachypoda*	NL	SC
Bell's twinpod	*Physaria bellii*	NL	SC
Black spleenwort	*Aspelenium adiantum-nigrum*	NL	SC
Colorado butterfly plant	*Guara neomexicana coloradensis*	C	SC
Forktip three-awn[b]	*Aristida basiramea*	NL	SC
Gay-feather	*Liatris ligulistylus*	NL	SC
Sedge[b]	*Carex oreocharis*	NL	SC
Toothcup	*Rotala ramosior*	NL	SC
Tulip gentian	*Eustoma grandiflora*	NL	SC
Ute ladies'-tresses	*Spiranthes diluvialis*	T	SC
Yellow stargrass	*Hypoxis hirsuta*	NL	SC

[a] Status codes: C=Federal candidate; E=endangered; NL=not listed; S/A=protected under the similarity of appearance provision of the *Endangered Species Act*; SC=State species of concern; T=threatened; U=State undetermined species.
[b] Species observed on RFETS.
[c] USFWS Recovery Plan exists for this species.
Source: 50 CFR 17.11; 50 CFR 17.12; CO NHP 1994a; RF DOE 1995d.

Three federally listed threatened or endangered species (the bald eagle, peregrine falcon [both subspecies], and Ute ladies'-tresses) occur or are likely to occur on the RFETS site. Bald eagles have been observed flying over and occasionally foraging on RFETS and are known to roost at Standley Lake and Great Western Reservoir, approximately 1.8 km (1.1 mi) and less than 0.5 km (0.3 mi), respectively, from the site. Peregrine falcons have been observed flying over and hunting onsite. Two historical nest sites are within 16 km (10 mi) of the site. Ute ladies'-tresses are known to occur approximately 12.9 km (8 mi) north of the site in Boulder County (RF DOE 1995a:2,3). Suitable habitat exists on RFETS for this species, but no specimens were found during site surveys. Although the complex of prairie dog towns on the site provides suitable habitat for the endangered black-footed ferret, occurrence of the ferret is highly unlikely (RF DOE 1991j:5), and the area has been cleared of the requirement for verifying surveys.

[Text deleted.] The State-listed greater sandhill crane and several other special status species have been observed on RFETS. Continued site surveys may determine the occurrence of other special status species listed in Table 3.8.6–1.

3.8.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Three surface examination surveys have been conducted at RFETS resulting in complete coverage of the undisturbed portions of the facility (RF EG&G 1991a:3-2). No prehistoric sites were identified. However, two sites with rock alignments and four isolated cairns were recorded and are most likely prehistoric sites. The two sites have not been evaluated to determine their NRHP eligibility, and these sites are considered potentially NRHP eligible pending additional work. The four isolated features are not considered NRHP eligible. DOE is currently preparing a cultural resources management plan for RFETS to ensure compliance with Sections 106 and 110 of the NHPA.

Historic Resources. Thirty-five historic sites have been identified at RFETS. All undisturbed portions of RFETS have been intensively surveyed. Most of the historic resources in the area are archaeological sites or standing structures associated with ranching or transportation routes. Historic site types in the vicinity include trails, railroad grades, homesteads, cattle camps, line shacks, ranch complexes, irrigation ditches, stock ponds, and windmills. Historic sites recorded at RFETS include a railroad grade, stock ponds and tanks, irrigation ditches, corrals, a fence, a dump, a spring house, and homesteads. None of the historic sites or features have been recommended as eligible for the NRHP. There are 123 buildings at RFETS associated with the Cold War mission. Of these, 64 are considered potentially eligible for listing on the NRHP as contributing elements to the Rocky Flats Plant Historic District (RF DOE 1995a:26).

Native American Resources. Several Native American groups, including the Plains Apache, Comanche, Ute, Arapaho, and Cheyenne, historically occupied or traversed the foothills around RFETS. Tribal locations have been estimated for the Protohistoric and Historic periods. The Plains Apache occupied the region east of the Rockies prior to 1700. By 1750, the Ute and Comanche were in the area. The Ute moved back into the mountains and the Comanche were located on the Plains by 1820. From 1820 through 1870, the Cheyenne and Arapaho groups were using the area. All of these groups were highly mobile hunters and gatherers whose primary subsistence was based on bison procurement and seasonal plant gathering.

Important sites, such as burial or vision quest locations, may be of concern to Native American groups. Several unidentified rock features and alignments that have been recorded on RFETS may also be of concern to Native American groups. Consultation with the Comanche, Cheyenne, Arapaho, Southern Ute, Mountain Ute, and Apache tribes has been initiated by DOE. Important Native American resources may be identified through consultation with potentially affected groups.

Paleontological Resources. Surface geology at RFETS includes Rocky Flats alluvium and Arapahoe sandstone. The Arapahoe sandstone consists of claystone, silty claystones, and sandstones, and is not fossiliferous. Arapahoe sandstone outcrops occur along the edges of Walnut and Woman Creeks. The rest of RFETS is covered by Rocky Flats alluvium, which consists of gravely clays, sands, and gravels. No paleontological materials have been recovered from the RFETS alluvium, and it is considered nonfossiliferous.

3.8.8 SOCIOECONOMICS

Socioeconomic characteristics described for RFETS include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 49 counties around RFETS located in Colorado, Nebraska, and Kansas (Table L.1–1). Statistics for the remaining socioeconomic characteristics are presented for the ROI, a five-county area (located in Colorado) in which 90.6 percent of all RFETS employees reside: Adams County (20 percent), Arapahoe County (3.6 percent), Boulder County (25.6 percent), Denver County (6.2 percent), and Jefferson County (35.2 percent) (Table L.1–8). In 1995, RFETS employed 4,435 persons.

Regional Economy Characteristics. Selected employment and regional economy statistics for the RFETS REA are summarized in Figure 3.8.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 39.9 percent to the 1990 level of 1,868,628. The 1994 unemployment in the REA was 4.1 percent, which parallels the unemployment for Colorado. The unemployment for Kansas is about 1 percent higher than that of the REA and Nebraska is about 1 percent lower than the REA unemployment rate. The region's per capita income of $21,958 in 1993 was approximately 2 percent greater than Colorado's per capita income of $21,498. Kansas' per capita income ($19,849) was 9.6 percent lower than the region's, and Nebraska's per capita income ($19,673) was 10.4 percent lower.

As shown in Figure 3.8.8–1, the composition of the REA economy was similar to that of the statewide economy of Colorado. During 1993, the services sector constituted over 31 percent of the region's total employment followed by retail trade (about 17 percent) and manufacturing (about 9 percent). For Colorado, the service sector accounted for slightly over 30 percent of the total employment, while retail trade accounted for 17 percent and manufacturing, 8 percent. Kansas and Nebraska parallel each other, with the service sector representing 25 and 26 percent of total employment, retail trade representing 17 percent for both States, and manufacturing representing 12 and 10 percent, respectively.

Population and Housing. In 1994, the ROI population totaled 1,957,797. From 1980 to 1994, the ROI population grew by 22.9 percent, compared to 26.5 percent for Colorado. Within the ROI, Arapahoe County experienced the greatest population increase, 51.2 percent, while Denver County's population increased by only 0.2 percent. Population and housing trends are summarized in Figure 3.8.8–2.

The increase in number of housing units in the ROI between 1980 and 1990, 22.5 percent, was about 1 percent less than the increase in Colorado housing units. The total number of housing units in the ROI for 1990 was 788,480. The 1990 ROI homeowner and renter vacancy rates, 3.2 and 11.7 percent, respectively, were similar to those in Colorado.

Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the RFETS ROI. Figure 3.8.8–3 presents school district characteristics for the RFETS ROI. Figure 3.8.8–4 summarizes public safety and health care services.

Education. In 1994, 18 school districts provided public education services and facilities in the RFETS ROI. As seen in Figure 3.8.8–3, these school districts operated at between 67.5-percent (Denver County School District) and 102.5-percent (Byers School District) capacity. The average student-to-teacher ratio for the RFETS ROI in 1994 was 19:1. The Jefferson County School District had the highest ratio at 23.7:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents of the ROI. In 1994, a total of 3,811 sworn police officers were serving the five-county ROI. The city of Denver employed the largest number of officers (1,378) and had the highest officer-to-population ratio (2.8 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 2.0 officers per 1,000 persons. Figure 3.8.8–4 compares police force strengths across the ROI.

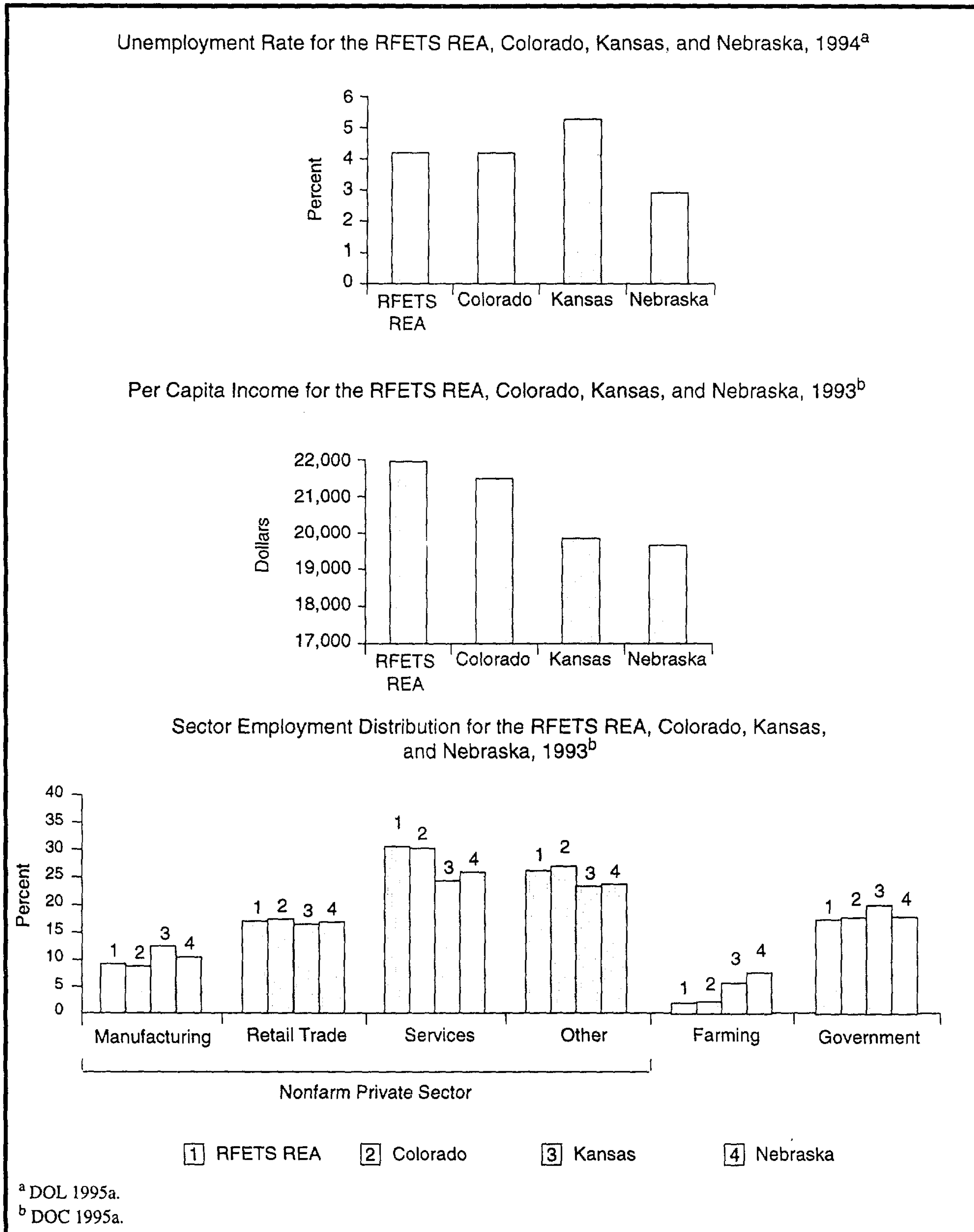


Figure 3.8.8–1. Employment and Local Economy for the Rocky Flats Environmental Technology Site Regional Economic Area and the States of Colorado, Kansas, and Nebraska.

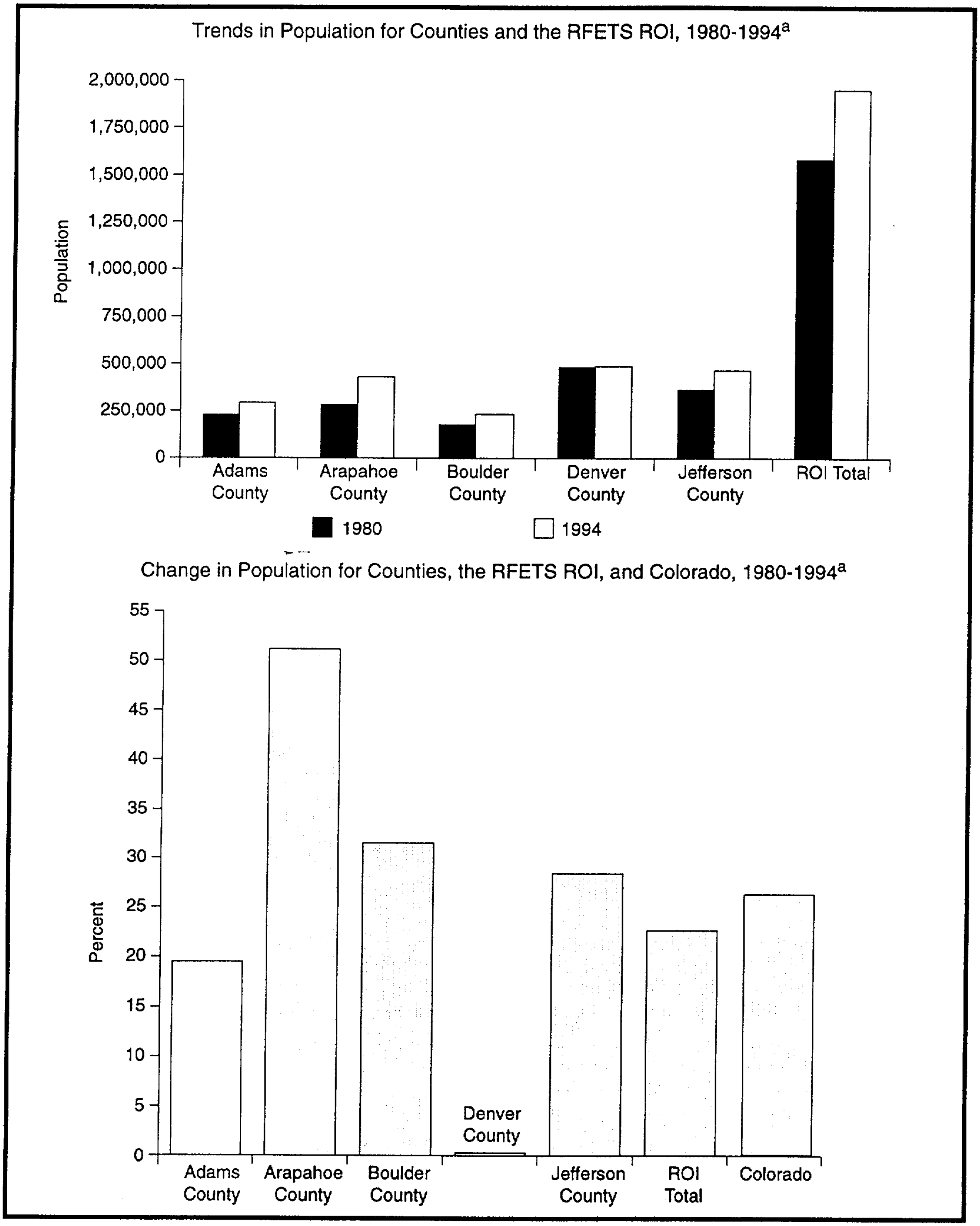
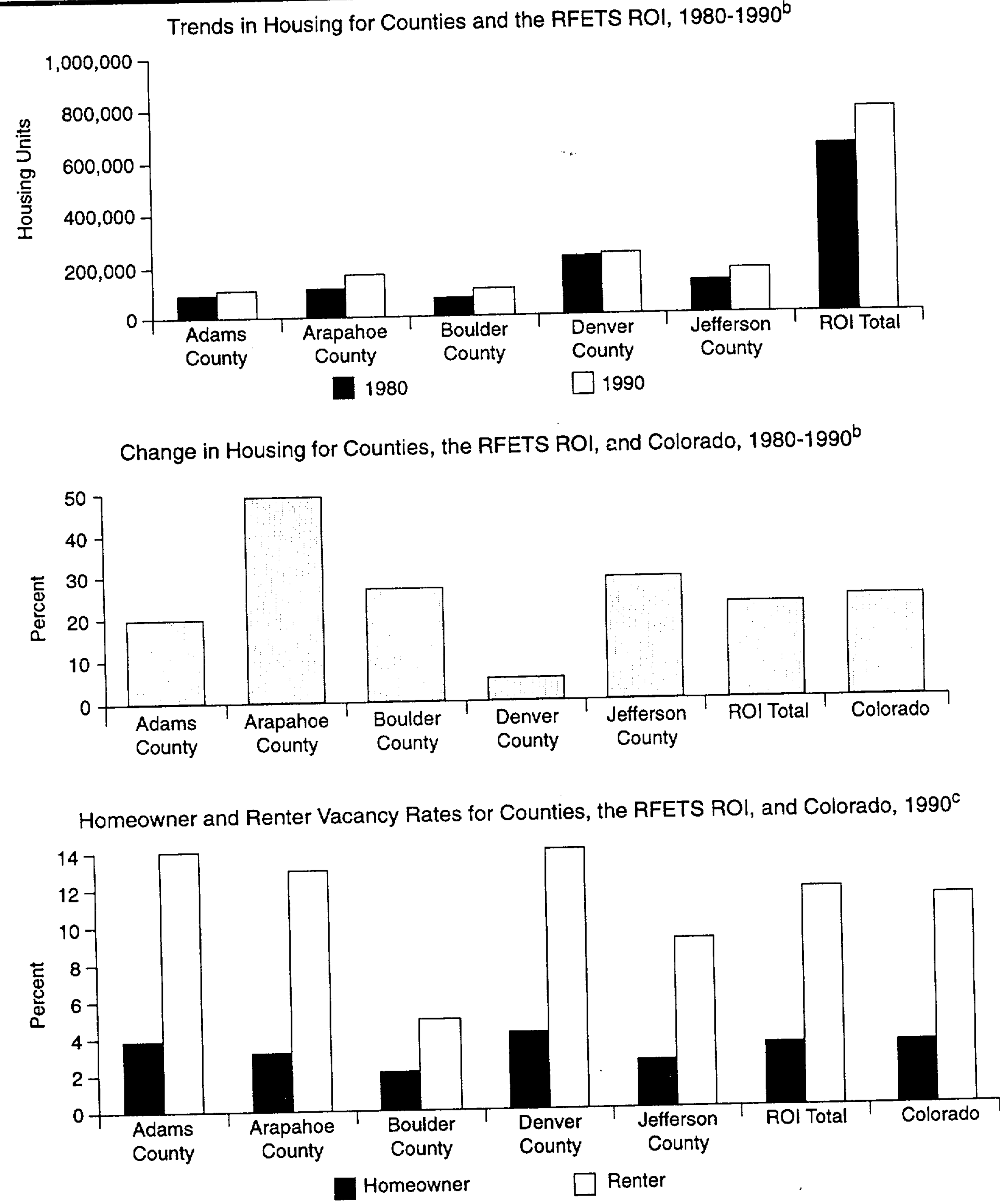
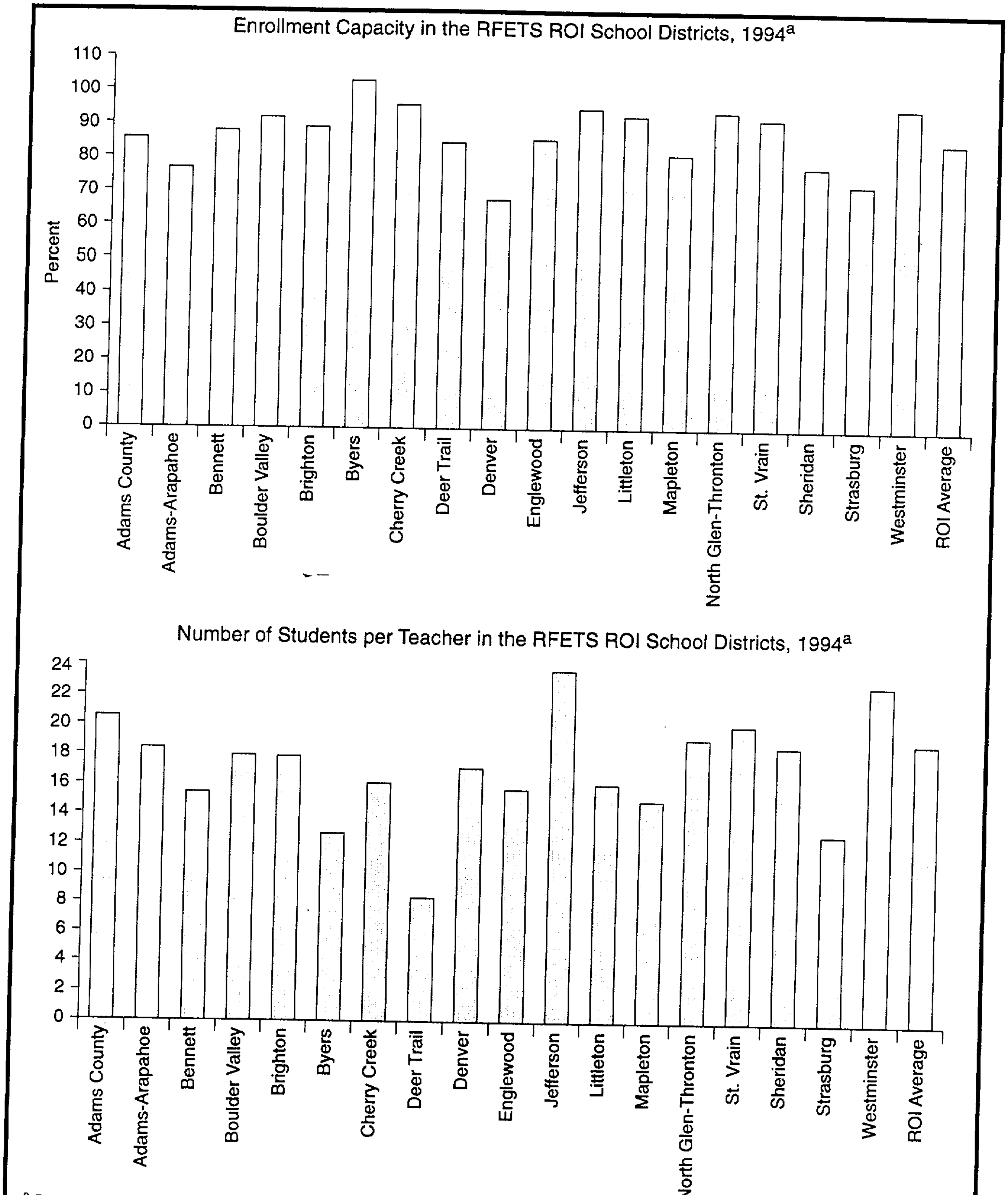


Figure 3.8.8–2. Population and Housing for the Rocky Flats Environmental Technology Site Region of Influence and the State of Colorado.



[a] Census 1983u; Census 1995a.
[b] Census 1982s; Census 1991k.
[c] Census 1991k.

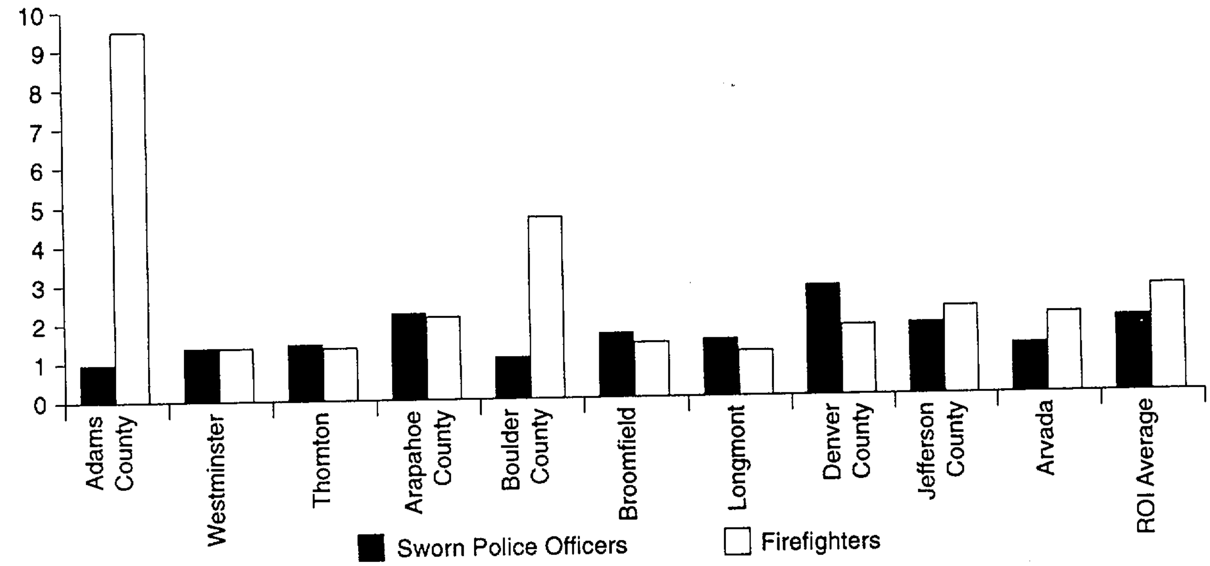
Figure 3.8.8–2. Population and Housing for the Rocky Flats Environmental Technology Site Region of Influence and the State of Colorado—Continued.



[a] Socio 1996a.

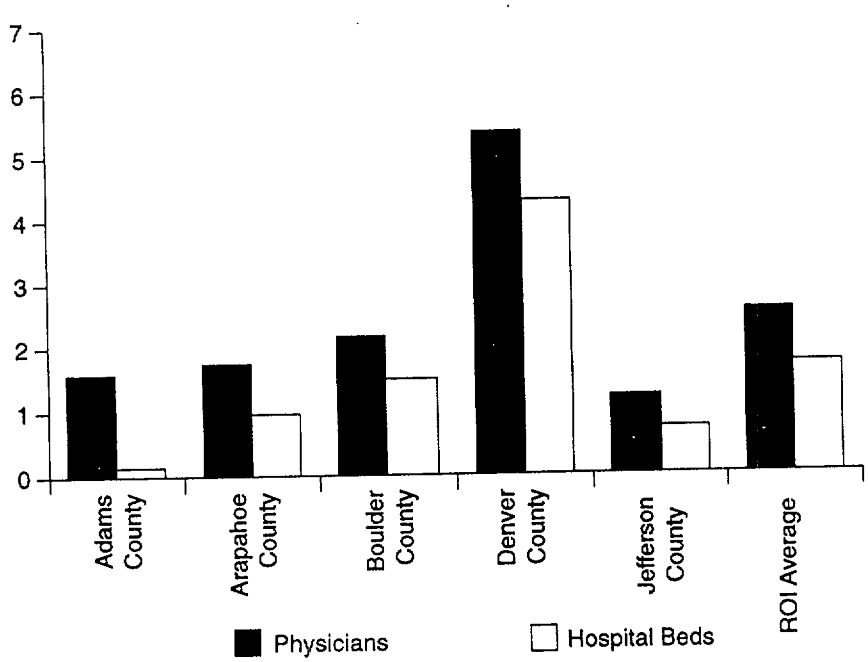
Figure 3.8.8–3. School District Characteristics for the Rocky Flats Environmental Technology Site Region of Influence.

Number of Sworn Police Officers (1994) and Firefighters (1995) per 1,000 Persons in the RFETS ROI[a]



Note: Except for ROI cities, sworn police officers and firefighters are included in county totals.

Number of Physicians and Hospital Beds per 1,000 Persons in the RFETS ROI, 1994[b]



[a] Census 1993v; Census 1995a; CO DIS 1994a; DOC 1994j; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.

[b] AHA 1995a; AMA 1995a; Census 1995a.

Note: The following fire departments were not included in the analysis because data was unavailable; Lefthand Fire District, Pinewood Springs Fire Protection District, Sugarloaf Fire District, and Sunshine Fire District.

Figure 3.8.8–4. Public Safety and Health Care Characteristics for the Rocky Flats Environmental Technology Site Region of Influence.

Fire protection services in the RFETS ROI were provided by 5,408 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was Adams County, with 9.5 firefighters per 1,000 persons, as indicated in Figure 3.8.8–4. Adams County also employed the greatest number of firefighters (1,396). The average firefighter-to-population ratio in the ROI was 2.7 firefighters per 1,000 persons.

Health Care. There were 19 hospitals serving the five-county ROI in 1994. Over 64 percent of the hospital bed capacity was located in 9 hospitals in the city of Denver. Figure 3.8.8–4 displays the hospital bed-to-population ratios for the RFETS ROI counties. During 1994, all 19 hospitals operated at below capacity, with bed occupancy rates ranging from 22.4 percent in Adams County to 60.2 percent in Denver County.

There were 5,017 physicians in the ROI during 1994, with the majority (2,649) practicing in Denver County. Figure 3.8.8–4 shows that the physician-to-population ratio ranged from 1.2 physicians per 1,000 persons in Jefferson County to 5.4 physicians per 1,000 persons in Denver County. The average ROI physician-to-population ratio was 2.6 physicians per 1,000 persons.

Local Transportation. Vehicular access to RFETS is provided by Colorado State Route 93 to the west and Jefferson County Road 17 (Indiana Street) to the east (see Figure 2.2.7–1 and Figure 2.2.7–2).

Road improvements for segments providing access to RFETS include bridge replacement and reconstruction along Colorado State Route 93 prior to the year 2000. There are no current road improvements that would affect access to RFETS. There is no public transportation to RFETS (RFETS 1995a:4).

Major railroads in the ROI include the Denver and Rio Grande Western Railroad; the Burlington Northern and Santa Fe Railroad; and the Union Pacific Railroad. A single-track spur from the Denver and Rio Grande Western Railroad mainline accesses RFETS from the west. No navigable waterways within the ROI are capable of accommodating waterborne transportation of material shipments to RFETS (DOE 1993j:4-190,4-191). The Denver International Airport, which began operations in 1995, provides passenger and cargo service in the ROI on national and international carriers.

3.8.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of RFETS are shown in Table 3.8.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to RFETS operations.

Table 3.8.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Rocky Flats Environmental Technology Site Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and cosmogenic radiation	51
External terrestrial radiation	63
Internal terrestrial radiation	39
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	418

[a] RFETS 1994a.

[b] NCRP 1987a.

Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from RFETS operations provide another source of radiation exposure to individuals in the vicinity of RFETS. Types and quantities of radionuclides released from RFETS operations in 1993 are listed in the *Site Environmental Report for 1993* (RFP-ENV-93). The doses to the public resulting from these releases are presented in Table 3.8.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The doses given in the 1993 report were assumed to be representative of the reference environment (No Action) doses from RFETS operations in the year 2005 (Section 4.2.7.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases and resulting impacts from RFETS operations in 1993 is estimated to be 2.4×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of RFETS operations is about 2 in 10 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same risk estimator, 5.0×10^{-5} excess fatal cancers are projected in the population living within 80 km (50 mi) of RFETS from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1993 in the population living within 80 km (50 mi) of RFETS was 4,400. This number of expected fatal cancers is much higher than the estimated 5×10^{-5} fatal cancers that could result from RFETS operations in 1993.

Table 3.8.9–2. Radiation Doses to the Public From Normal Rocky Flats Environmental Technology Site Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.13	4	0.35	100	0.48
Population within 80 km[b] (person-rem)	None	0.1	None	0[c]	100	0.1
Average individual within 80 km[d] (mrem)	None	4.5×10^{-5}	None	0[c]	None	4.5×10^{-5}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] In 1993, this population was approximately 2,200,000.

[c] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.

[d] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: RFETS 1994a.

The RFETS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.8.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to RFETS workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to RFETS workers from normal operations in 1992 is estimated to be 0.32.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Site Environmental Report for 1993* (RFP-ENV-93). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.8.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at RFETS via inhalation of air containing hazardous chemicals released to the atmosphere by RFETS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Table 3.8.9–3. Radiation Doses to Workers From Normal Rocky Flats Environmental Technology Site Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	122
Maximally exposed worker (mrem)	5,000	>10,000[b]
Total workers[c] (person-rem)	ALARA	800

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] Three workers received doses that exceeded the standard. Only one worker received a dose greater than 10,000 mrem.

[c] The number of badged workers in 1992 was approximately 6,550.

Source: 10 CFR 835, DOE 1993n:7.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.8.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to RFETS workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a detailed estimation and summation of these impacts. However, the workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. RFETS workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes, ensures that these standards are not exceeded. Additionally, DOE requirements (DOE O 440.1) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at RFETS are expected to be substantially better than required by the standards.

Health Effects Studies. Several epidemiologic studies have been conducted on communities surrounding RFETS. The studies of surrounding populations have found no substantiated evidence of increased risk of cancers related directly to RFETS. Mixed findings have been reported from studies of workers, with some studies reporting increases in risk of some cancers, others finding no associations, and one reporting a significant deficit in numbers of lung cancers. For a more detailed description of the study findings reviewed, refer to Section M.4.8.

Accident History. A review of recent RFETS annual environmental and accident reports indicates that there have been no radiological or chemical releases that resulted in impacts to workers, members of the public, or the environment. The review was performed to support the affected environment presentation in the *Nonnuclear Consolidation Environmental Assessment* published in June 1993 (DOE/EA-0792).

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The RFETS has comprehensive emergency plans that provide guidance and procedures that are designed to protect life and property within the facility, the health and welfare of surrounding metropolitan communities, and the defense interests of the nation during any credible emergency situation. Mutual assistance and coordination with Federal, State, and local agencies is ensured on a cooperative basis.

The DOE Rocky Flats Area Office Manager coordinates activities for emergencies affecting offsite personnel or property and is responsible for communication with the supporting Federal, State, and local agencies. The DOE Rocky Flats Area Office Manager may obtain further assistance through the Interagency Radiological Assistance Plan, which provides that each of the signatory Federal agencies will assist one another in the event of a major emergency involving radioactivity.

The Rocky Flats Emergency Plan expresses the philosophy that RFETS be as self-sufficient as possible in handling onsite emergency situations. Assistance may be requested from outside sources through written agreements with St. Anthony Hospital, St. Luke's Hospital, University of Colorado, Jefferson County Sheriff's Office, and the Federal Bureau of Investigation.

In the event of an offsite emergency, the *Rocky Flats Radiological Assistance Plan* interfaces with the *DOE Radiological Assistance Plan*, the *Interagency Radiological Assistance Plan*, and the Joint Nuclear Accident Coordinating Center through the DOE Rocky Flats Area Office at Rocky Flats. Also, in the event of an incident at RFETS involving the release of radioactive material that may endanger the health and safety of the general public, the *Colorado Radiological Emergency Response Plan* would be activated.

3.8.10 WASTE MANAGEMENT

This section outlines the major environmental compliance program and ongoing waste management activities for RFETS. Table 3.8.10–1 presents a summary of waste management activities at RFETS for 1995.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at RFETS. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed-upon milestones.

The focus of the RFETS mission is on environmental restoration and possible economic development. The legal framework establishing the scope and schedule for projects in the environmental restoration program is the Interagency Agreement. The agreement integrates the actions required under the authority and jurisdiction of CERCLA and RCRA. Therefore, the investigative phase at each operable unit is referred to as a RCRA Facility Investigation/Remedial Investigation, and the selection of remedial alternatives is referred to as a Corrective Measures Study/Feasibility Study. The primary objective of the environmental restoration program is to assess and clean up RFETS in compliance with applicable environmental laws and regulations. The approach being taken is to reduce health risk and accelerate cleanup.

There have been, 177 contaminated sites previously identified and prioritized that are located both on RFETS and offsite. These sites were grouped into 16 operable units according to location and type of contamination. Per the new Cleanup Agreement, dated July 19, 1996, DOE, the State of Colorado, and EPA have proposed defining the existing 16 operable units into 7. The primary benefit of consolidating operable units is the reduced process and administrative requirements. The resulting cost saving can then be applied to environmental remediation or other higher priority tasks at RFETS.

Waste disposal activities include the shipment of saltcrete to an offsite commercial facility for disposal, LLW for shipment to NTS and Hanford; the preparation, transportation, and disposal of hazardous and other regulated wastes by commercial vendors; and the disposal of sanitary waste in the onsite landfill. RFETS manages the following waste categories: TRU, low-level, hazardous, mixed, and nonhazardous. A discussion of the waste management operations associated with each of these waste categories follows.

Spent Nuclear Fuel. The RFETS does not generate or manage spent nuclear fuel.

High-Level Waste. The RFETS does not generate or manage HLW.

Transuranic Waste. Transuranic waste at RFETS was generated as a result of Pu operations and its supporting functions such as Pu metal purification. TRU and mixed TRU waste generated at RFETS before 1970 was shipped to INEL and disposed of underground. After 1970, this waste was shipped to INEL for interim storage until a permanent disposal facility became available. As a result of delays in opening WIPP in Carlsbad, New Mexico, the Governor of the State of Idaho placed a moratorium on out-of-State waste shipments to INEL in October 1988, forcing RFETS to store TRU and mixed TRU waste onsite. However, this storage was found to violate RCRA storage provisions and led to several interim agreements.

Storage of TRU and mixed TRU wastes at RFETS is governed by the provisions of the Colorado Department of Health Settlement Agreement and Compliance Order on Consent, Number 89-07-10-01, related to mixed wastes, that was signed on July 14, 1989. The Order required RFETS to submit a Part A Permit Application for all its interim status mixed TRU and mixed LLW storage and treatment units. The Order also granted interim status to all mixed TRU waste units, except unit 60, included in applications filed by July 1, 1988. It also granted interim status to units used for storage and treatment of hazardous and mixed LLW identified in an August 2, 1988, Part A Application.

Table 3.8.10–1. Waste Management Activities at Rocky Flats Environmental Technology Site

Waste Category	1995 Generation[a] (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity
Transuranic							
Liquid	<1	Solidification	Included in liquid mixed LLW	None	NA	NA	NA
Solid	54	Compaction	Included in solid mixed LLW	Drums on pads	1,500[b]	None - WIPP or alternate facility in the future	NA
Transuranic (Mixed)							
Liquid	<1	Solidification	Included in liquid mixed LLW	None	NA	NA	NA
Solid	23	Compaction	Included in solid mixed LLW	Drums on pads	1,300[c]	None - WIPP or alternate facility in the future	NA
Low-Level							
Liquid	4	Evaporation and Solidification	Included in liquid mixed LLW	Staged	105[d]	NA	NA
Solid	752	None	None	Staged	4,540[d]	Offsite - DOE	NA
Hazardous							
Liquid	2	Neutralization & Precipitation	None	Staged in DOT containers	Included in solid hazardous waste	Offsite	NA
Solid	24	None	None	Staged in DOT containers	263[e]	Offsite	NA
Mixed (Low-Level)							
Liquid	165	Solidification	47,700[f]	Staged for treatment	Included in solid mixed LLW	None	NA
Solid	676	None	7,100[g,h]	DOT containers	13,600[i]	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	457,600[j]	Sedimentation	568,000	None	NA	Surface water	NA
Solid	11,400	None	None	None	NA	Onsite landfill	Expandable

Table 3.8.10–1. Waste Management Activities at Rocky Flats Environmental Technology Site—Continued

Waste Category	1995 Generation[a] (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity
Nonhazardous (Other)							
Liquid	Included in liquid sanitary	Sedimentation	Included in sanitary	None	NA	Included in sanitary	Included in sanitary
Solid	73	None	None	None	NA	Included in sanitary	Included in sanitary

[a] Values per *RFETS Comprehensive Waste Management Plan*

[Text deleted.]

[b] Value taken from *Draft Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste.*

[Text deleted.]

[c] Value taken from *RFETS Proposed Site Treatment Plan* dated March 1995 and is based on the sum of the current mixed-TRU storage and the expected 20-year generation.

[Text deleted.]

[d] Cumulative volume of LLW stored at the end of 1993 as per a memorandum from McGlochlin, EG&G to Reece, DOE on updated information for nonnuclear consolidation EA.

[Text deleted.]

[e] Value based on the 1991 Waste Storage Inventory Report and the memorandum from McGlochlin, EG&G to Reece, DOE on updated information for nonnuclear consolidation EA.

[f] Based on the operating capacities of Buildings 374 and 774 as described in the 1995 Mixed Waste Inventory Report.

[g] Based on the operating capacities of Building 776 as described in the 1995 Mixed Waste Inventory Report.

[h] Value calculated using the conversion ratio of 1,500 kg/m^3.

[i] Value taken from *RFETS Proposed Site Treatment Plan* dated March 1995 and is based on the mixed-LLW in storage at RFETS.

[j] Value taken from *1993 RFETS Site Environmental Report* and Reflects Annual Discharge From Main Collection Pond 68 (Pond A-4).

Note: NA=not applicable.

Source: DOE 1995cc; DOE 1995gg; RF DOE 1995b; RF DOE 1995c; RF EG&G 1992e; RFETS 1995a:1; RFETS 1995a:2; RFP 1993a:1.

Finally, the order set total capacity limit for interim status container storage for mixed TRU waste at 1,220 m^3 (1,601 yd^3) (RF DOH 1989b:7), yet a capacity exists for 1,500 m^3 (1,960 yd^3). The *Federal Facility Compliance Act* of 1992 requires DOE to develop site-specific mixed waste treatment plans and to submit the plans to EPA or the authorized State for approval. The final proposed plan was published in March, 1995.

As a temporary solution to the 1,220 m^3 (1,601 yd^3) limit, the Supercompaction and Repackaging Facility in Building 776 is used to compact and package solid TRU and mixed TRU wastes generated during various site operations. This facility processes both soft, combustible waste (such as paper and plastic) and hard, noncombustible waste (such as metal and glass). Supercompaction and Repackaging Facility equipment is contained in a single, large glovebox. The Supercompaction and Repackaging Facility allows repackaging operations to be performed inside the glovebox, reducing exposure to workers. An overall 5-to-1 volume reduction of waste by this facility is being achieved.

Residues at RFETS are Pu recovery byproducts (for example, salts and contaminated materials) that were determined to contain enough Pu to justify further processing for recovery. In the past, DOE has not considered residues at RFETS to be a waste form. Events at RFETS have led to the classification of these Pu residues as waste. A very limited quantity of the Pu residues at RFETS are considered to be mixed waste based upon a court judgement. These mixed residues have been managed under a series of compliance orders, agreements, settlements, and judicial orders.

The need to treat mixed TRU waste is being assessed as part of the WIPP test phase. If the no-migration exemption for WIPP is granted, mixed TRU wastes going to WIPP would only need to meet hazardous substance transportation requirements and WIPP WAC before shipment. If not approved, then treatment of mixed TRU waste would be required under 40 CFR 191 (disposal standards) to remove or reduce to acceptable levels the land disposal restriction constituents in the waste before shipment and disposal.

Low-Level Waste. The baler located in Building 889 processes solid LLW (soft combustibles) generated outside the PA. The baler is also being evaluated for volume-reducing beryllium and mixed LLW generated outside the PA, but some or all of the following improvements will be required in order to meet the following applicable requirements: equipment must be upgraded and rearranged; ventilation must be upgraded; and building modifications must be made to meet safety requirements.

Mixed Low-Level Waste. A great deal of the solid radioactive waste at RFETS consists of mixed LLW. Mixed LLW shipments to NTS were suspended in May 1990 when the RCRA LDR went into effect. In order to transport and receive wastes, NTS has to meet certain regulatory requirements. They must be either adequately characterized or treated to prove that hazardous constituents in these wastes are below treatment standards.

The Department and EPA entered into an FFCA for LDR wastes on May 20, 1991. This agreement requires DOE to submit the following: a Comprehensive Treatment and Management Plan addressing treatment proposed for RFETS nonresidue mixed wastes so as to come into compliance with the treatment and storage requirements of RCRA; a Waste Minimization Plan identifying process changes proposed to minimize or eliminate wastes; and an Annual Progress Report evaluating Rocky Flats' progress in achieving compliance with the RCRA LDR.

Negotiations began in June 1992 for a new agreement (FFCA). However, the intervening FFCA and its requirement for a site treatment plan compliance order will most likely obviate the need for an FFCA. Pending any new agreement, DOE will continue to manage its mixed waste compliance program in accordance with the existing FFCA. For example, the Waste Minimization Program Plan, Waste Stream and Residue Identification and Characterization Report, and the Annual Progress Report continue to be updated and submitted on an annual basis. However, because the FFCA gives the State primacy in approval of the site treatment plan and issuance of a compliance order, Colorado Department of Health is now considered the lead regulatory agency in regard to the DOE mixed waste compliance program. Current plans call for the disposal of saltcrete at Envirocare of

Utah. Disposal of saltcrete is planned in a proposed RCRA Subtitle C disposal cell. The remaining mixed LLW will either be disposed of at commercial facilities or at NTS.

Residues are process byproducts that contain radioactive materials in concentrations greater than the economic discard limit, and were destined for recycle to recover the radioactive materials. Those residues that contain hazardous constituents are undergoing characterization to determine how to comply with RCRA and court orders. DOE is presently determining how and where to store those residues it decides to retain. It is planned to remove all mixed residues by 1999.

The Department and the State signed the Residue Compliance Agreement and Consent Order on November 3, 1989, which requires DOE to submit a plan for removing all mixed residue inventory at RFETS by January 1, 1999. Also, the U.S. District Court, Colorado, issued a Judgment and Order on August 13, 1991, which declared that RFETS mixed residues were hazardous materials and must be managed in accordance with RCRA and further ordered that DOE must obtain a permit for the mixed residues currently stored without a RCRA permit. If no such permit is obtained, RFETS may not continue operations which generate hazardous or mixed waste, save certain limited exceptions.

The plan for removal of mixed residues from RFETS contains four primary ways of dealing with these residues: ship as waste or product, remove the RCRA characteristic, remove actinides and ship the resultant wastes, and remove stored solutions (RF DOE 1992a:8). All of the Pu-bearing residues in the backlog will undergo inspection and segregation so that the particular process path to be used can be identified or verified.

[Text deleted.]

Hazardous Waste. Treatment of hazardous wastes at RFETS is limited to organic liquid wastes. Hazardous wastes are shipped to various RCRA-permitted, commercial vendors for disposal. In 1991, DOE and the Colorado Department of Health agreed on radioactivity limits for waste garage oils; this waste form is now being shipped to a commercial vendor for recycle.

Nonhazardous Waste. The DOE and EPA agreed to, and signed on March 25, 1991, an *Federal Facility Compliance Act* for the NPDES program. The agreement requires the following actions:

- Upgrade the sewage treatment plant and change sewer sludge and spray irrigation management practices
- Enhance groundwater monitoring for the sewage sludge drying beds
- Prepare a compliance plan describing those actions necessary for the RFETS to remain in compliance with the NPDES permit
- Submit to EPA a variety of new reports and studies describing the status of compliance

The sanitary landfill on RFETS accepts all solid nonhazardous wastes. Liquid nonhazardous waste is treated and released to surface waters.

3.9 LOS ALAMOS NATIONAL LABORATORY

Los Alamos National Laboratory was established in 1943 as a nuclear weapons design laboratory and was formerly known as the Los Alamos Scientific Laboratory. Its facilities are located in north central New Mexico about 40 km (25 mi) northwest of Santa Fe. Figure 2.2.8–1 indicates the regional location of LANL and Figure 2.2.8–2 shows the locations of the technical areas which contain the major facilities within the site boundaries. LANL is owned by DOE and operated by the University of California under contract to DOE.

The central mission of LANL has evolved from developing the first atomic bomb during World War II to developing nuclear weapons for deterrence during the Cold War. With the recent easing of international tensions, the central mission of LANL has been redefined to one of developing a multidisciplinary science and technology research facility that is engaged in a variety of programs for DOE and other Government agencies and applying this expertise to the Nation's security and well being. Current missions at LANL are listed in Table 3.9–1.

Table 3.9–1. Current Missions at Los Alamos National Laboratory

Mission	Description	Sponsor
Nuclear weapons	Stockpile stewardship and management, materials support, fissile materials disposition	Assistant Secretary for Defense Programs
Environmental management	Environmental restoration, waste management, pollution prevention, technology development	Assistant Secretary for Environmental Management
Nonproliferation and international security	Nonproliferation and verification R&D, nuclear safeguards and security, arms control and nonproliferation, intelligence	Office of Intelligence and National Security
Energy research	Nuclear physics, biological and environmental research, basic energy sciences, magnetic fusion, high energy physics	Office of Energy Research
Energy technology	Enhanced energy production, improved energy efficiency, environmental consequences, medical radioisotope production	Assistant Secretary for Energy Efficiency and Renewable Energy; Assistant Secretary for Fossil Energy; Offices of Nuclear Energy and Civilian Radioactive Waste Management
Work for others	Conventional weapons technology, modeling and simulation, beams and sensors, high performance computing	DoD, NRC, other Federal and non-Federal entities.

Source: LANL 1995b:1.

Department of Energy Activities. The major DOE program activities at LANL include defense, environmental management, nonproliferation and international security, and energy research and technology. These programs, as well as others at LANL, are interdependent and have considerable overlap. Defense programs address nuclear weapons technology, nuclear materials and reconfiguration technology, and programs conducted by the Los Alamos Neutron Scattering Center (LANSCE) and Energy Research Program Office. Environmental management programs are primarily focused on restoration activities and attaining and maintaining compliance with all Federal and State regulations and permits for waste management. The nonproliferation and international security programs respond to the scientific and technological needs to assure the effective reduction in the proliferation of nuclear weapons, the means to deliver them, and to ensure U.S. and international security.

Energy research and technology programs principally address basic science and technology issues that contribute significantly to defense, national security, industrial competitiveness, and energy resources.

The Nuclear Weapons Technology Program is the principal defense program at LANL and is devoted to providing technology stewardship for the nuclear stockpile. Important aspects of stockpile stewardship at LANL include stockpile surveillance, surety, and aboveground experiments, all of which help in the absence of underground nuclear testing. The Nuclear Materials and Stockpile Management (NMSM) Program addresses a wide spectrum of activities in nuclear materials handling, processing, and fabrication in support of the DOE objectives of reducing the nuclear danger and addressing cleanup issues across the DOE complex. Two major interfaces for NMSM are the stockpile support and reconfiguration/nuclear materials management programs. LANL continues to support DOE's stockpile evaluation and pit rebuild efforts. Stockpile evaluation is currently focused on surveillance of milliwatt radioisotopic thermoelectric generators, surveillance of selected gas systems, and the pit surveillance effort, which was formerly conducted at RFETS.

The LANSCE and L/ER conduct several programs in the areas of science and technology that contribute to a wide spectrum of fundamental and strategic research. In addition to research activities, L/ER programs operate a major user facility for neutron research and applications supporting research by DP users, among others.

Environmental Management Program activities at LANL consist of environmental restoration, waste management, pollution prevention, independent technical assessments and environmental technology development. The major environmental management effort at LANL is assessing and remediating over 2,000 sites that may have been contaminated over the past 50 years and have been designated for corrective action investigations. One component of the environmental restoration program is the D&D of sites and facilities such as nuclear reactors and surplus contaminated facilities. Waste management activities are directed at attaining and maintaining compliance with all regulations and permits.

The Nonproliferation and International Security Program was created at LANL to develop and apply the science and technology capabilities needed to deter, detect, and respond to proliferation of weapons of mass destruction and thereby to help ensure U.S. and international security. Those LANL programs to control and prevent the proliferation of nuclear weapons throughout the world that are funded within the nuclear weapons research, development, and technology program are focused primarily on nuclear counterproliferation and emergency response issues.

In addition to the neutron research and applications at LANSCE, other related energy research includes nuclear and high energy physics, basic energy sciences, biological and environmental research, and fusion energy. Energy technology programs at LANL include energy production, energy utilization, and the environmental consequences of energy production and utilization. Energy production programs are funded by the Assistant Secretary for Defense Programs as well as the other DOE energy-source-specific program offices. The type of effort performed for the Assistant Secretary for Defense Programs is in the area of nuclear safety review work for both reactor and nonreactor facilities.

Non-Department of Energy Activities. Non-DOE activities at LANL include support to DoD, NRC, other Federal agencies (National Aeronautics and Space Administration, National Institutes of Health, NOAA, National Science Foundation, and others), and various other institutions and industries. For DoD and branches of the military, LANL provides support in the areas of conventional weapons technology; modeling and simulation; beams and sensors; high performance computing; and advanced concepts in structures and materials, nonlethal technologies, unmanned aerial vehicles, missiles, micromachines, and other state-of-the-art technological applications.

3.9.1 LAND RESOURCES

Land Use. The LANL is located in north-central New Mexico, 97 km (60 mi) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Española in Los Alamos and Santa Fe Counties. The associated communities of Los Alamos and White Rock are in Los Alamos County. The 11,300-ha (28,000-acre) LANL site and adjacent communities are situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons that run from the Jemez Mountains on the west toward the Rio Grande Valley on the east. Mesa tops range in elevation from approximately 2,400 m (7,800 ft) on the west to about 1,900 m (6,200 ft) on the east (LANL 1994a:II-1,II-2).

Existing Land Use. The developed acreage of LANL consists of 30 active TAs. These TAs consist of laboratory facilities and support infrastructure. They account for only a small portion of the total land area at LANL. Most of LANL is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL as a NERP, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on the pinyon-juniper woodland ecosystems (DOE 1985a:3,21).

Most developments within Los Alamos County are confined to mesa tops. Generalized land uses are shown in Figure 3.9.1–1. The surrounding land is largely undeveloped with large tracts north, west, and south of the LANL site administered by the U.S. Forest Service (Santa Fe National Forest), the National Park Service (Bandelier National Monument), and Los Alamos County. The San Ildefonso Pueblo borders the LANL site to the east (LANL 1994a:II-1,II-2). The closest offsite residences to LANL are approximately 3 m (10 ft) from the northern boundary.

Land-Use Planning. The *Site Development Plan Annual Update 1993* Master Plan designates TA-55 as Special Nuclear Material Research and Development. The *Site-Wide Environmental Impact Statement for Los Alamos National Laboratory* (LANL Site-Wide EIS) is currently being prepared and analyzes four future alternatives for LANL's operation over the next 5 to 10 years. An analysis of future operation, facilities, and buffer zones would be anticipated to be included (LANL 1996e:4).

Land-use planning occurs at the local level in New Mexico, with counties and cities preparing future land-use plans called comprehensive plans or general plans. Los Alamos County has a comprehensive plan and a development code that contains zoning. However, LANL is autonomous from a planning perspective and therefore, is not addressed in the county plan and code (NM County 1996a:1). The *Santa Fe County General Plan* land-use designations are based on groundwater protection goals. Therefore, the Plan designates LANL as "Agricultural and Residential" (NM County 1996a:2).

Visual Resources. Development and operation of DOE facilities has disturbed the character of the landscape in their respective areas. The DOE facilities are generally brightly lit at night and highly visible from nearby viewpoints, and are visible from as far away as southeast Santa Fe (approximately 48 km [30 mi]). The developed areas of LANL are consistent with a VRM Class 5 designation. The remainder of LANL ranges from VRM Class 3 to Class 4 designation.

Offsite viewpoints affected by DOE facilities are primarily associated with the Los Alamos townsite and New Mexico State Highways 4, 501, and 502. On a clear day, views can exceed 80 km (50 mi). Topographic relief and heavy vegetation provide significant visual screening of LANL facilities, especially from mid- and long-distance viewpoints.

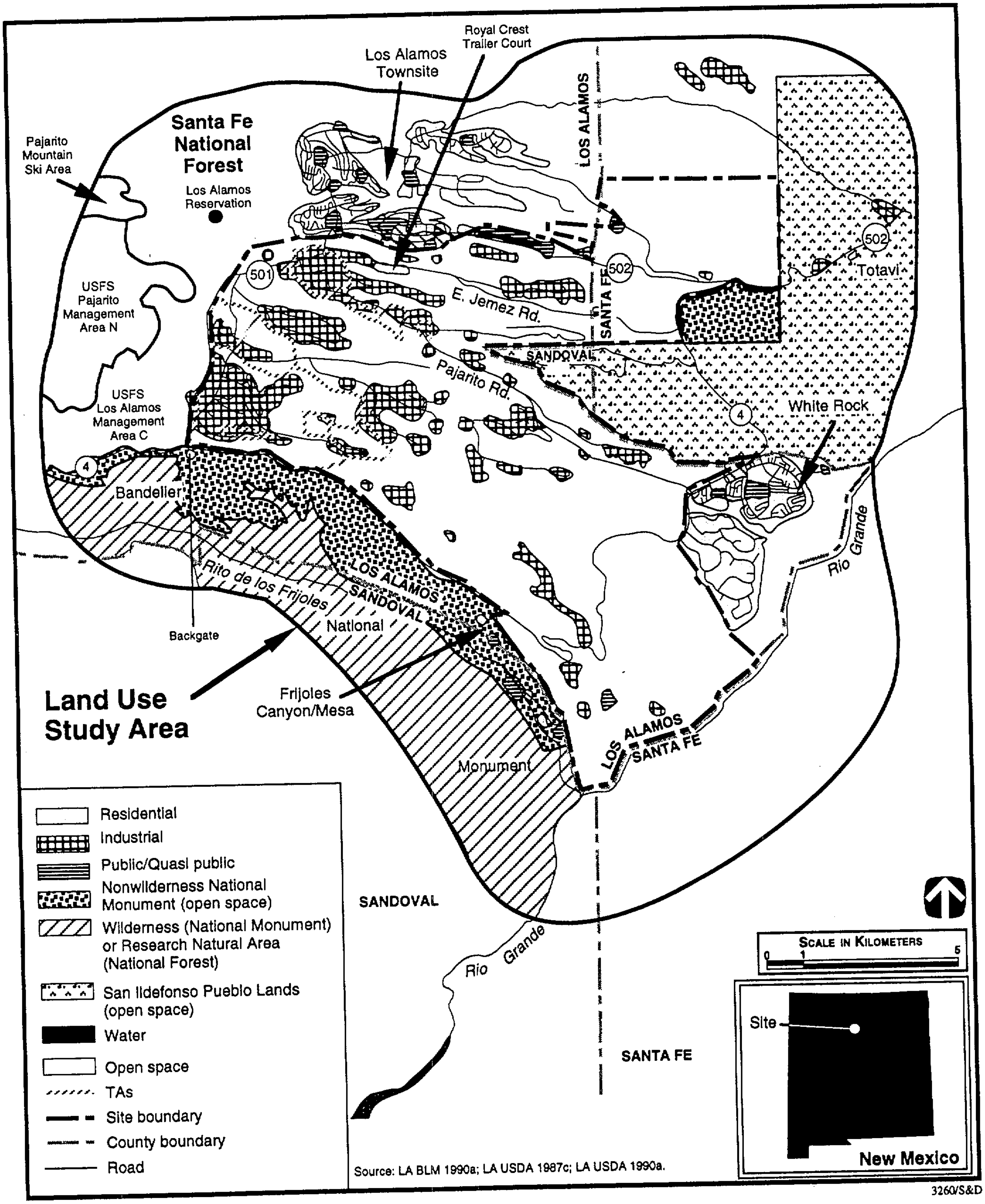


Figure 3.9.1–1. Generalized Land Use at Los Alamos National Laboratory and Vicinity.

3.9.2 SITE INFRASTRUCTURE

Baseline Characteristics. Section 3.9 describes the current LANL missions. Baseline characteristics are shown in Table 3.9.2–1.

Table 3.9.2–1. Los Alamos National Laboratory Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	137	137
Railroads (km)	0	0
Electrical		
Energy consumption (MWh/yr)	381,425	500,000
Peak load (MWe)	87	100
Fuel		
Natural gas (m^3/yr)	43,414,560	103,368,000
Oil (l/yr)	0[a]	0[a]
Coal (t/yr)	0	0
Steam (kg/hr)	33,554	234,000

[a] Oil is stored as a backup fuel source for natural gas.
Source: LANL 1990b; LANL 1995b:1.

The major existing highways that serve LANL are depicted on Figure 2.2.8–1. LANL is served by an extensive system of roads and parking facilities. Roadways are aligned with the predominant topography of east/west canyons and mesas. Cross-canyon travel is limited to the Los Alamos Canyon Bridge, West Road, and State Route 4 to the southeast. There are approximately 137 km (85 mi) of paved roads and 113 km (70 mi) of dirt or gravel roads and fire lanes. All materials shipped from locations outside LANL are first received or shuttled through TA-3. The nearest rail service is in Santa Fe, approximately 40 km (25 mi), southeast of LANL.

Locally, LANL is supplied with electricity by a Los Alamos County/DOE power pool. It also has a 20 MWe gas-fired generating plant in TA-3. Electricity is transmitted to the site and the County over two 115 kV lines, one from Santa Fe (Norton Generating Station) and one from Albuquerque (Reeves Generating Station). These lines enter LANL near TA-5 (Eastern Technical Area substation). Electricity is distributed throughout the site via 13.2 kV lines. The 115 kV system includes a loop that ties substations at TAs -3, -5, and -53 together. This looping ensures a power supply throughout LANL should outages occur in any major line. The total annual power consumption is considerably below the transmission capacity of the system. The sub-regional electric power pool from which LANL draws its power is the Arizona-New Mexico Power Area. Capabilities of this power pool are summarized in Table 3.9.2–2.

Table 3.9.2–2. Arizona-New Mexico Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	57%
Nuclear	24%
Hydro/geothermal	4%
Oil/gas	15%
Other[b]	0.3%
Total Annual Production	79,491,000 MWh
Total Annual Load	83,794,000 MWh
Energy Imported Annually[c]	4,325,000 MWh
Generating Capacity	17,023 MWe
Peak Demand	15,679 MWe
Capacity Margin[d]	3,081 MWe

[a] Percentages do not total 100 percent due to rounding.
[b] Includes power from both utility and nonutility sources.
[c] Energy imported is not the difference of production and load due to negative net pumped storage.
[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.
Source: NERC 1993a.

Natural gas is supplied to LANL from the San Juan Basin in northwest New Mexico. The lines are owned by DOE but operated and maintained by the Gas Company of New Mexico under contract to DOE. LANL depends on natural gas for most space heating requirements. Gas-fired forced air furnaces, hot water boilers, and steam boilers are some of the equipment used. Natural gas is distributed to buildings directly, or to three central steam plants (TAs -3, -16, and -21), and a standby plant for fueling the heating system. All plants also maintain reserves of fuel oil.

Water for LANL and adjacent areas (including Los Alamos townsite, White Rock, and Bandelier National Monument) primarily comes from three DOE-owned well fields and surface water from the Jemez Mountains. The system depends on gravity flow for distribution from high elevation terminal storage facilities.

Plutonium is stored in approximately 9,400 packages at 24 facilities within LANL. More than 90 percent of LANL's Pu inventory is located in 7,700 packages stored at the TA-55 facility. Research at the TA-55 facility includes Pu recovery processes, Pu metal fabrication, Pu-238 general purpose heat source and radioisotope thermoelectric generator production, and advanced fuel fabrication. Renovation of the Nuclear Materials and Storage Facility at TA-55 has been proposed to correct design and construction deficiencies that have prevented the use of this facility and to ensure that the facility can be operated safely and effectively. Operation of this facility would provide a centralized capability for consolidation and intermediate and long-term storage for LANL nuclear material inventories.

Plutonium analytical operations are conducted in the TA-3 CMR Building (SM-29), which has laboratories, hot cells, a waste assay facility and a vault. The Los Alamos Critical Experiments Facility, remotely located in TA-18, uses Pu in nuclear criticality experiments. These experiments generate insignificant quantities of fission and activation products. The critical assemblies are in buildings called kivas. Pu in metal and oxide forms is stored in vaults in each kiva and also in the Hillside Vault. There are also 21 other technical areas that store small quantities of Pu materials.

3.9.3 AIR QUALITY AND NOISE

Meteorology and Climatology. Los Alamos has a semiarid, temperate mountain climate. The climate averages for atmospheric variables such as temperature, pressure, moisture, and precipitation are based on observations made at the TA-59 LANL weather station from 1961 through 1993. The meteorological conditions described here are representative of conditions on the Pajarito Plateau at an elevation of approximately 2,250 m (7,400 ft) above sea level (LANL 1995s:II-8). In July, the average daily high temperature is 27.2 °C (81 °F), and the average nighttime low temperature is 12.8 °C (55 °F). The average January daily high is 4.4 °C (40 °F), and the average nighttime low is -8.3 °C (17 °F). The highest recorded temperature is 35 °C (95 °F), and the lowest recorded temperature is -27.8 °C (-18 °F). The large daily range in temperature of approximately 13 °C (23 °F) results from the site's relatively high elevation and dry, clear atmosphere, which allows high insolation during the day and rapid radiative losses at night (LANL 1995s:II-8). Additional information related to meteorology and climatology at LANL is presented in Appendix F.

The average annual precipitation is 47.6 cm (18.7 in) but is quite variable from year to year. The lowest recorded annual precipitation is 17.3 cm (6.8 in), and the highest is 77.1 cm (30.3 in). The maximum precipitation recorded for a 24-hour period is 8.8 cm (3.5 in) (LANL 1995s:II-11). Because of the eastward slope of the terrain, there is a large east-to-west gradient in precipitation across the plateau. White Rock often receives about 13 cm (5 in) less annual precipitation than the TA-59 weather station, and the eastern flanks of the Jemez Mountains often receive about 13 cm (5 in) more (LANL 1994a:II-11).

Los Alamos winds are generally light, averaging 2.8 m/s (6.3 mph). Strong winds are most frequent during the spring when peak gusts often exceed 22 m/s (50 mph). The highest recorded wind gust was 34.4 m/s (77 mph). The semiarid climate promotes strong surface heating by day and strong radiative cooling by night. Because the terrain is complex, heating and cooling rates are uneven over the LANL area, which results in local thermally generated winds (LANL 1995s:II-11).

Ambient Air Quality. The LANL is located within the New Mexico Intrastate AQCR 157. None of the areas within LANL and its surrounding counties are designated as nonattainment areas with respect to any of the NAAQS (40 CFR 81.332). A nonattainment area is an area that has air quality worse than designated by NAAQS for one or more criteria pollutants. Applicable NAAQS and New Mexico State ambient air quality standards are presented in Appendix F.

The criteria pollutants—NO_2, CO, hydrocarbons, PM_{10}, and SO_2—make up approximately 79 percent of the stationary source emissions at LANL. The source of these criteria pollutants is combustion in power plants, steam plants, asphalt plants, and local space heaters. Toxic and other hazardous pollutants represent the remaining 21 percent of emissions from stationary sources at LANL. These emissions are generated by equipment surface cleaning, coating processes, and acid baths, and include gases, vapors, metal dusts, and miscellaneous emissions, such as wood dust, hazardous gases, and plastics (LANL 1994a:VI-1,VI-3).

One PSD Class I Area, the Bandelier National Monument's Wilderness Study Area, borders LANL to the south. To date, LANL has not been subject to PSD requirements (LANL 1993b:III-20).

Ambient concentration limits for hazardous/toxic air pollutants (to be used by the State as one of the criteria in evaluating construction permit applications for a new emission source) have been approved by the New Mexico Environmental Improvement Board. The estimated 2005 No Action annual emission rates from LANL facilities are listed in Table F.1.2.9–1. Estimates of maximum ground-level concentrations at or beyond the LANL boundary are listed in Table 3.9.3–1. Concentrations of criteria and hazardous/toxic air pollutants are in compliance with applicable guidelines and regulations. The hazardous/toxic air pollutant limits are one-hundredth of the recognized occupational exposure levels (for example, 8-hour time-weighted threshold limit values).

Table 3.9.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Los Alamos National Laboratory, 1990 and 1992

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	7,689[a]	115
	1-hour	11,578[a]	630
Lead	Calendar quarter	1.5[b]	<0.01
Nitrogen dioxide	Annual	73[a]	3.8
	24-hour	145[a]	c
Ozone	1-hour	235[b]	d
Particulate matter less than or equal to 10 microns in diameter[e]	Annual	50[b]	8
	24-hour	150[b]	21
Sulfur dioxide	Annual	40[a]	1.3
	24-hour	202[a]	c
	3-hour	1,300[b]	c
Mandated by the State of New Mexico			
Hydrogen sulfide	1-hour	11[a]	c
Total reduced sulfur	30-minute	3[a]	c
Total suspended particulate[e]	Annual	60[a]	8
	30-day	90[a]	<21
	7-day	110[a]	<21
	24-hour	150[a]	21
Hazardous and Other Toxic Compounds[f]			
Acetic acid	8-hour	250[a]	2.87
Ammonia	8-hour	180[a]	4.27
2-Butoxyethanol	8-hour	1,200[a]	0.66
Chlorine	8-hour	g	0.07
Chloroform	8-hour	500[a]	2.92
Ethyl acetate	8-hour	14,000[a]	0.49
Ethylene glycol	8-hour	g	0.39
Formaldehyde	8-hour	15[a]	0.27
Heavy metals	8-hour	g	0.62
Heptane (n-heptane)	8-hour	g	10.12
Hexane (n-hexane)	8-hour	g	0.41
Hydrogen chloride	8-hour	g	3.41
Hydrogen fluoride	8-hour	g	1.29
Isopropyl alcohol	8-hour	9,800[a]	2.88
Kerosene	8-hour	g	1.42
Methyl alcohol	8-hour	g	3.14
Methyl ethyl ketone	8-hour	g	9.95
Methylene chloride	8-hour	g	5.90
Nickel	8-hour	10[a]	0.30
Nitric acid	8-hour	50[a]	3.53

Table 3.9.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Los Alamos National Laboratory, 1990 and 1992—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Hazardous and Other Toxic Compounds[f] (Continued)			
Nitrogen oxide	8-hour	g	2.29
Nonmethane hydrocarbons	8-hour	g	15.83
Propane sultone	8-hour	400[a]	1.12
Stoddard solvent	8-hour	5,250[a]	1.41
Toluene	8-hour	g	13.2
1,1,2-Trichloroethane	8-hour	g	4.95
Trichloroethylene	8-hour	g	1.12
Tungsten (as W)	8-hour	50[a]	0.60
VM&P Naphtha	8-hour	13,500[a]	3.27
Welding fumes	8-hour	g	2.8
Xylene	8-hour	g	9.41

[a] State standard. The conversion from ppm to $\mu g/m^3$ for the ambient air quality standard is calculated with the corrections for temperature (530 °Rankine) and pressure (elevation) 2,255 m mean sea level.
[b] Federal standard.
[c] No monitoring data available; baseline concentrations assumed less than applicable standard.
[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.
[e] It is assumed that all particulate matter concentrations are total suspended particulate concentrations.
[f] Compounds listed are the major pollutants (11.34 kg/yr or more) of concern.
[g] No standard.
Source: 40 CFR 50; DOE 1995hh; LANL 1993b; LANL 1994a; NM EIB 1995a; NM EIB 1996a.

Table 3.9.3–1 presents the baseline ambient air concentrations for criteria pollutants for 1992 and other pollutants of concern for 1990 at LANL. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. The major noise sources at LANL include various facilities, equipment, and machines (for example, cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, vehicles, pistol and rifle firing range, and explosives detonation). No LANL environmental noise survey data are available. At the LANL boundary, away from most of the industrial facilities, noise from most of these sources is barely distinguishable from background noise levels.

Impulsive noise from explosive testing can be heard occasionally in Los Alamos Townsite, White Rock Communities, and Bandelier National Monument. The acoustic environment along the LANL boundary away from traffic noise, although not measured, is expected to be that of a rural location with typical DNL levels in the range of 35 to 50 dBA (EPA 1974a:B-4). Traffic is the primary source of noise at the site boundary and residences near roads. The acoustic environment in the town of Los Alamos is similarly expected to be that of a suburban location with typical DNL in the range of 53 to 62 dBA (EPA 1974a:B-5).

The State of New Mexico has not established specific numeric environmental noise standards applicable to LANL. Los Alamos County has adopted a noise ordinance that specifies maximum sound levels in residential areas. (This ordinance is discussed in Appendix F.) Although the maximum levels specified by the ordinance and the EPA guideline may be exceeded occasionally at the LANL boundary, this is expected to be attributable to traffic noise and not to sources at LANL; the ordinance does not apply to traffic noise.

3.9.4 WATER RESOURCES

Surface Water. The Rio Grande is the major surface water feature in north-central New Mexico. All surface water drainage and groundwater discharge from the Pajarito Plateau ultimately arrives at the Rio Grande. The Rio Grande at Otowi, just east of Los Alamos, has a drainage area of 37,037 km^2 (14,300 mi^2) in southern Colorado and northern New Mexico.

The major canyons that contain reaches of ephemeral streams within LANL are Pajarito, Water, Ancho, and Chaquehui Canyons (Figure 3.9.4–1). Ephemeral streams in the lower portions of Ancho and Chaquehui Canyons extend to the Rio Grande without being depleted. In lower Water Canyon, the ephemeral stream is very short and does not extend to the Rio Grande. In Pajarito Canyon, Homestead Spring feeds an ephemeral stream 3.2- to 4.8-km (2- to 3-mi) long.

Springs between 2,408- and 2,713-m (7,900- and 8,900-ft) elevation on the eastern slope of the Jemez Mountains supply base flow throughout the year to the upper reaches of Cañon de Valle, Los Alamos, Pajarito, and Water Canyons. These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 0.0001 to 0.0085 m^3/s (0.0035 to 0.30 ft^3/s). The volume of flow from the springs is insufficient to maintain surface flow within more than the western third of the canyons before it is depleted by evaporation, transpiration, and infiltration (DOE 1995hh:4-26).

Eleven drainage areas, with a total area of 212 km^2 (82 mi^2) pass through the eastern boundary of LANL. Runoff from heavy thunderstorms and heavy snowmelt reaches the Rio Grande several times a year from some drainages. Los Alamos, Pajarito, and Water Canyons have drainage areas greater than 26 km^2 (10 mi^2). Pueblo Canyon has a drainage area of 21 km^2 (8 mi^2), while all others have less than 13 km^2 (5 mi^2). 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 1995hh:4-76). No surface water is withdrawn at LANL for either drinking water or facility operations (DOE 1993j:4-76).

Los Alamos, Sandia, and Mortandad Canyons currently receive treated industrial or sanitary effluent. Pueblo Canyon does not receive LANL effluents. Surface waters in these canyons are not a source of municipal, industrial, or agricultural water supply. Several times during the year heavy precipitation or snowmelt would cause waters from several canyons to extend beyond LANL boundaries and reach the Rio Grande (LANL 1995s:II-7).

In Mortandad Canyon, no surface runoff to LANL's boundary has occurred since studies were initiated in 1960. Pueblo Canyon received both untreated and treated industrial effluents from 1944 to 1964. It currently receives treated sanitary effluents from Los Alamos County treatment plants in its upper and middle reaches (DOE 1993j:4-76).

Existing wastewater generation from LANL is approximately 693 million l/yr (183 million gal/yr) (DOE 1993j:4-76). Permitted effluent discharges at LANL emerge from 2 sanitary wastewater treatment facilities and 130 industrial outfalls. These outfalls include power plant discharges (1 outfall), boiler blowdown (2 outfalls), treated cooling water (38 outfalls), noncontact cooling wastewater (51 outfalls), radioactive waste treatment plant (1 outfall), HE wastewater (21 outfalls), photographic laboratory rinse wastewater (13 outfalls), printed circuit board process wastewater (1 outfall), and sanitary wastewater (2 outfalls) (LANL 1995s:D-3).

Surface Water Quality. The 1993 surface water quality monitoring results for the five onsite canyons are presented in Table 3.9.4–1. The overall compliance for sanitary and industrial discharges during 1993 was 100 percent and 99.1 percent, respectively.

Water Rights and Permits. Water rights in New Mexico fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriated water for a beneficial use has priority to use available water supply

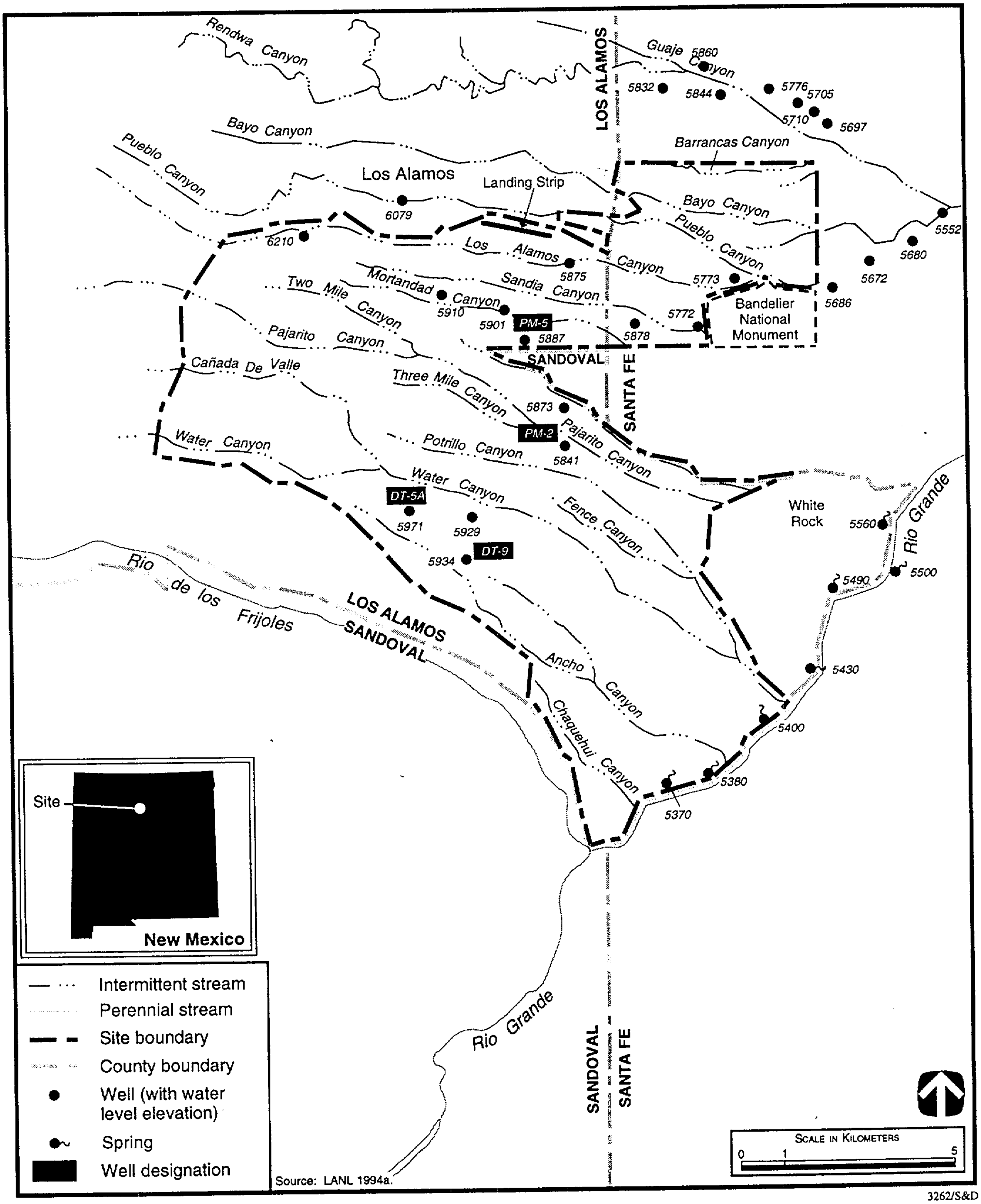


Figure 3.9.4–1. Surface Water Features at Los Alamos National Laboratory.

Table 3.9.4–1. Summary of Surface Water Quality Monitoring at Los Alamos National Laboratory, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Pajarito Canyon[b]	Pueblo Canyon[c]	Los Alamos Canyon[d]	Sandia Canyon[e]	Mortandad Canyon[f]
Bicarbonate	mg/l	NA	68	141	138	146	138
Calcium	mg/l	NA	28	.15	36	22	38
Carbonate	mg/l	NA	<5	<5	<5	<5	<5
Cesium-137	pCi/l	120[g]	1.0±1.5	2.3±1.3	3.0±1.3	3.0±1.2	NA
Chloride	mg/l	250[h]	58	34	111	70	9
Fluoride	mg/l	4.0[i],2.0[h]	0.1	0.4	0.7	0.9	0.6
Magnesium	mg/l	NA	7.1	2.6	2.5	4.6	3.5
Nitrate	mg/l	10.0[i]	0.04	4.53	<0.04	2.8	18
pH	pH units	6.8-8.5[h]	7.9	7.3	7.8	8.6	8.2
Phosphate	mg/l	NA	0	5.3	0.1	2.5	0.6
Plutonium-238	pCi/l	1.6[g]	-0.005±0.042	- 0.019±0.030	-0.036±0.030	0.004±0.030	748±0.058
Plutonium-239/240	pCi/l	1.2[g]	0.006±0.028	0.006±0.020	0.118±0.024	0.012±0.020	493±0.046
Potassium	mg/l	NA	5	N/A	7	N/A	5
Sodium	mg/l	NA	28	40	87	110	60
Strontium-90	pCi/l	400[g]	0±0.7	2.2±0.7	0±0	1.0±0.9	33.7±2.2
Sulfate	mg/l	250[h]	13	23	12	100	9
Total dissolved solids	mg/l	500[h]	228	404	356	558	302
Total hardness as $CaCO_3$	mg/l	NA	106	55	104	72	110
Tritium	pCi/l	80,000[g]	600±400	600±300	800±300	600±300	13,100±1,100
Uranium, Total	mg/l	0.02[j]	<0.2±0	<1.0±0	<1.0±0	<1.0±0	N/A

[a] For comparison purposes only.

[b] Mean of multiple samples.

[c] Surface water is monitored at two locations in Pueblo Canyon. The monitoring results presented are from Pueblo 3.

[d] Two locations are normally monitored in Los Alamos Canyon; however, one location was dry at the time of sampling. Results are reported for location DPS-1.

[e] Three locations are monitored in Sandia Canyon. The monitoring results presented are from the sampling location with the highest concentration of the given parameter.

[f] Only one location in Mortandad Canyon is sampled (GS-1).

[g] DOE DCG for drinking water (DOE Order 5400.5). Values are based on a committed effective dose of 100 mrem per year. However, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored concentrations. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level.

[h] National Secondary Drinking Water Regulations (40 CFR 143).

[i] National Primary Drinking Water Regulations (40 CFR 141).

[j] Proposed National Primary Drinking Water Regulation, Radionuclides (56 FR 33050).

Note: NA=not applicable; N/A=not analyzed.

Source: LANL 1995s.

over a user claiming rights at a later time. All natural water flowing in streams and water courses in New Mexico is considered to be public and subject to appropriation for beneficial use. Beneficial use is the basis, measure, and limit of the right to use water. No water right, therefore, may be granted or claimed for more than the amount that can be beneficially used. DOE owns combined surface and groundwater rights. These rights include the withdrawal of 6,835 million l/yr (1,806 million gal/yr) from a variety of wells and surface diversions under licenses RG–485 through RG–488, 1503, 1802, and 1802–B. DOE also owns a contract for 1,480 million l/yr (391 million gal/yr) of San Juan/Chama Diversion water.

Groundwater. Groundwater in the LANL area exists in three modes—in shallow alluvium in canyons, perched groundwater, and in the main aquifer. The main aquifer consists mostly of clastic sediments within the Santa Fe Group and the Puye Formation. Nearly all groundwater at LANL is obtained from deep wells that produce water from this aquifer. A minor amount of groundwater at LANL is obtained from springs. Most aquifers that lie beneath LANL, with the exception of perched zones, are considered Class II aquifers, having current sources of drinking water and other beneficial uses (DOE 1993j:4-77).

The Santa Fe Group consists of, in ascending order, the Tesuque Formation, Puye Conglomerate, and basaltic rocks of Chino Mesa. The Tesuque Formation contains thin, jointed, interbedded basalt flows that may yield large amounts of water. Some units have lower permeabilities that restrict the movement of water within the formation. The Puye Conglomerate overlies the Tesuque Formation and is highly permeable. When saturated, it yields large amounts of water to wells (LANL 1984a:3).

The depth to the top of the aquifer ranges from about 366 m (1,200 ft) on the west to about 183 m (600 ft) on the east. The total saturated thickness penetrated by production wells ranges up to approximately 518 m (1,700 ft). The most productive area lies in the central portion of the Pajarito Plateau and includes the Pajarito well field. The average drawdown for these wells is 12 m (39.4 ft). The rate of movement of water in the aquifer is approximately 12 to 29 m (39.4 to 95.1 ft) per year (LANL 1984a:7,8).

Groundwater Quality. Most of the wells in the Pajarito Plateau yield fresh water (TDSs less than 500 milligrams [mg]/l or parts per million [ppm]), although some wells east of the site have a higher total dissolved solids content (1,000 mg/l or more). The primary, secondary, and radiochemical groundwater quality, as measured from wells and springs in the main aquifer were below the DOE derived concentration guides or the New Mexico standards applicable to a DOE drinking water system (DOE 1993j:4-77). As shown in Table 3.9.4–2, parameters were below the applicable water quality criteria or standard in the main aquifer in 1993.

Groundwater Availability, Use and Rights. The LANL, the nearby communities of Los Alamos and White Rock, and Bandelier National Monument are entirely dependent on groundwater for their water supply. The water supply is primarily obtained from well fields. During 1993, total production from the wells for potable and nonpotable use was 5,519 million l/yr (1,458 million gal/yr) (LANL 1995r:4). LANL's water system had an average demand equal to about 81 percent of its current allotment of 6,800 million l/yr (1,800 million gal/yr).

Two wells have been drilled recently at LANL, one of which began pumping in the summer of 1992. The newer wells are expected to supplant the now abandoned Los Alamos field. Water is taken from depths of 245 to 550 m (804 to 1,805 ft).

Over the next 50 years, increases in water use may require one of the following: use of the 1,500 million l/yr (396 million gal/yr) San Juan-Chama water (releasing the water in exchange for excess pumping) and/or establishment of credit for return flow (DOE 1993j:4-79).

Table 3.9.4–2. Groundwater Quality Monitoring at Los Alamos National Laboratory, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[b]	1993 Existing Conditions[a]			
			Test Well DT-9	Test Well DT-5A	Water Supply Well PM-5	Water Supply Well PM-2
Cesium-137	pCi/L	120[c]	2.1 (1.2)	2.3 (1.4)	0.2 (0.5)	1.4 (1.2)
Chloride	mg/L	250[d,e]	2	2	4	2
Fluoride	mg/L	2.0[e],4.0[f]	0.3	0.3	0.3	0.2
Nitrate	mg/L	10[f]	0.32	0.44	0.10	<0.04
pH	pH units	6.8-8.5[e]	8.2	8.0	7.6	8.2
Plutonium-238	pCi/L	1.6[c]	-0.014(0.030)	-0.014 (0.030)	<0.1 (0)	0.004 (0.030)
Plutonium-239/240	pCi/L	1.2[c]	0.008 (0.030)	0.032 (0.030)	0.03 (0.03)	0.127 (0.024)
Sulfate	mg/L	250[d]	3	3	3	4
Total dissolved solids	mg/L	500[d]	112	104	320	136
Tritium	pCi/L	80,000[c]	300 (300)	400 (300)	400 (300)	500 (300)
Uranium, Total	mg/L	0.02[g]	<2.0 (0)	<2.0 (0)	<1.0 (0)	<1.0 (0)

[a] All data come from groundwater from onsite stations. Samples were collected in 1993.
[b] For comparison purposes only.
[c] DOE DCG for drinking water (DOE Order 5400.5). Values are based on a committed effective dose of 100 mrem per year. However, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionucleotides are determined by subtracting the instrument background environmental levels from the monitored concentrations. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level.
[d] New Mexico State water quality criteria.
[e] National Secondary Drinking Water Regulations (40 CFR 143).
[f] National Primary Drinking Water Regulations (40 CFR 141).
[g] Proposed National Drinking Water Regulations, Radionuclides (56 FR 33050).
Note: Well locations are shown in Figure 3.9.4–1; Parentheses indicate standard error of the mean.
Source: LANL 1995s.

Based on No Action projections, the net growth in overall use is about 0.4 percent per year. Based on this growth rate, the present allotment would be fully used by about 2052. If San Juan-Chama water is added, the limit to the total available supply would be reached by about 2072.

3.9.5 GEOLOGY AND SOILS

Geology. The LANL is located on the Pajarito Plateau, which lies between the Jemez Mountains on the west and the Rio Grande River on the east. The surface of the plateau slopes gently eastward and is dissected by deep, southwest-trending canyons separated by long, narrow mesas. The Pajarito Plateau terminates along its eastern edge along the Puye Escarpment and White Rock Canyon.

The primary controlling feature in the region is the Rio Grande rift that begins in Northern Mexico, trends northwest across central New Mexico, and ends in central Colorado. The rift comprises a series of basins formed by faulting that are filled with sediments derived from highlands to the east and west as well as occasional lake deposits and lava flows. The rift basin in the Los Alamos and Santa Fe area is the Española Basin.

The Pajarito Plateau is capped by the Bandelier Tuff, which consists of a series of ash fall and ash flow tuff (LANL 1984a:6). The major portion of LANL is underlain by the Tshirege member of the Bandelier Tuff, a sequence of cliff-forming welded ash flows with ash fall basal units. The Bandelier Tuff is underlain by sedimentary and volcanic rocks of the Santa Fe Group, which includes the Tesuque Formation, Puye Conglomerate, and basaltic rocks of Chino Mesa (LANL 1984a:3-7).

The LANL lies within Seismic Zone 2 (Figure 3.2.5–1). The strongest earthquake in the last 100 years within an 80-km (50-mi) radius was estimated to have a Richter magnitude of 5.5 to 6 and a MMI of VII. Studies suggest that several faults have produced seismic events with Richter magnitudes of 6.5 to 7.8 in the last 500,000 years (LANL 1987c:ix). LANL operates a seismic hazards program that monitors seismicity through a seismic network and conducts studies in paleoseismology.

The Pajarito Fault system, part of which crosses the western boundary of LANL, is a major, active structural element of the Rio Grande rift. Recent studies have determined that faults within the Pajarito Fault system are capable in accordance with 10 CFR 100, Appendix A (LANL 1987c:ix). Major faults at LANL include the Pajarito, Water Canyon, Rendija Canyon, and Guaje Mountain Faults (Figure 3.9.5–1). The Pajarito Fault is thought to mark the active western boundary of the Española Basin and has evidence of multiple movement in the past 100,000 to 200,000 years. The Rendija Canyon and Guaje Mountain Faults are shorter and secondary to the Pajarito Fault and had movement approximately 8,000 to 9,000 years ago and 4,000 to 6,000 years ago, respectively (DOE 1995hh:4-19).

The 100-year earthquake at Los Alamos is regarded as having a Richter magnitude of 5, with an event of Richter magnitude 7 being the maximum credible earthquake. These values are currently used in design considerations at LANL (LANL 1987c:43,53,54,58).

Geological concerns associated with the LANL area include potential downslope movements in association with regional seismic activity. Although isolated rockfalls commonly occur from the canyon rims, landslides are an unlikely hazard at Los Alamos because of the dry climate, deep water table, and rock characteristics. Although the area has the potential for future volcanic eruptions, the periodicity and structural development of past eruptions indicate a very low probability of an event occurring within the next 1,000 years (LA DOE 1979a:3-17).

Soils. The LANL is underlain by soil types varying in texture from clay and clay loam to gravel. Over 95 percent of the soils are developed on acidic volcanic rocks (LANL 1978a:6,7). Because of the topographic relief of the Pajarito Plateau, rock outcrops occur on greater than 50 percent of the site area.

Water and wind erosion of these soils varies from slight to severe depending on slope, soil grain size, amount of disturbance, and degree of protection. Shrink-swell potential ranges from low to high, correlating with the amount of swelling clays present (LANL 1978a:80). The soils are acceptable for standard construction techniques.

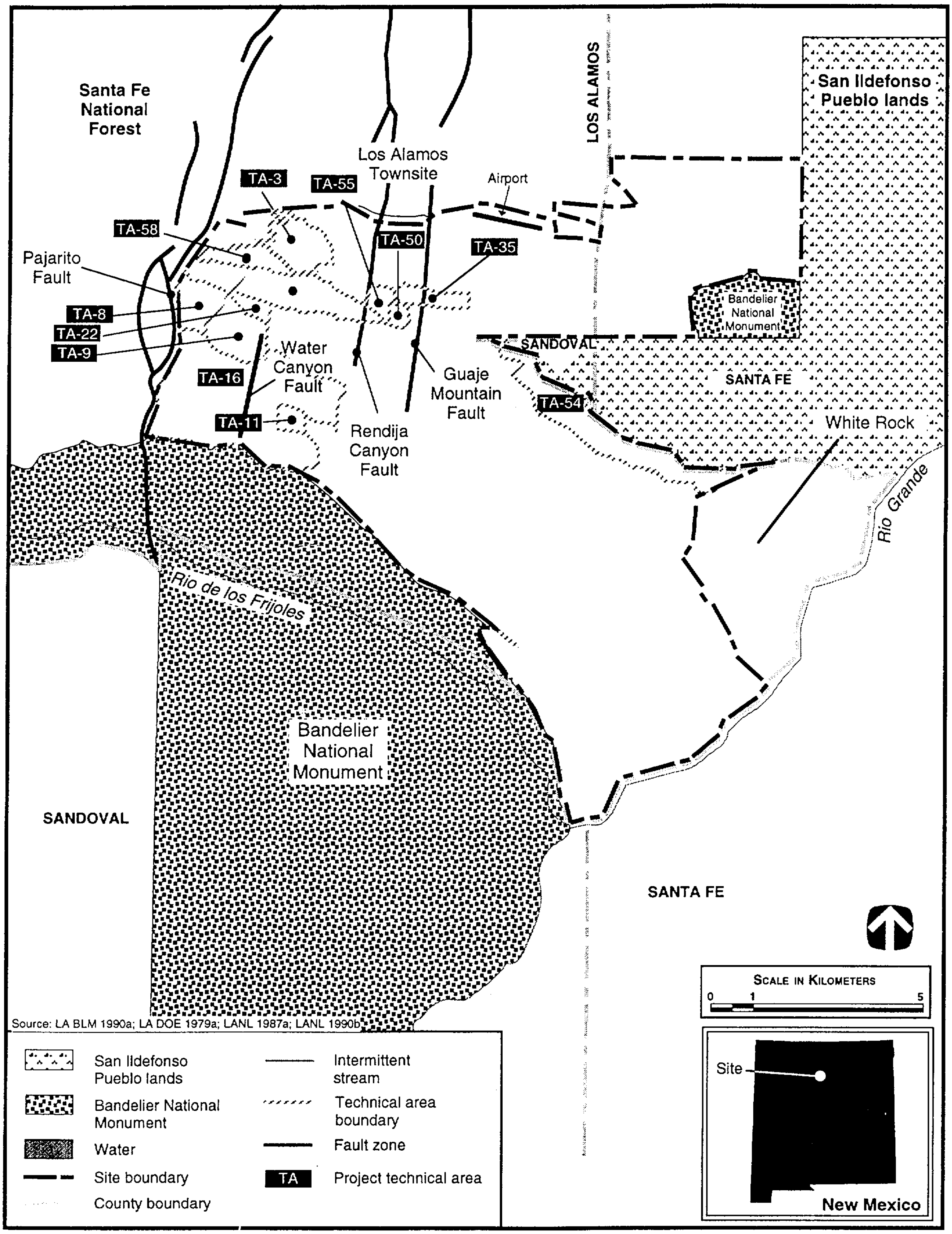


Figure 3.9.5–1. Major Fault Systems in the Los Alamos National Laboratory Region.

3.9.6 BIOLOGICAL RESOURCES

Terrestrial Resources. The LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site itself are quite diverse due partly to the 1,500-m (5,000-ft) elevational gradient from the Rio Grande River on the southeastern boundary to the Jemez Mountains, 20 km (12.4 mi) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed. The remaining land has been classified into seven major vegetative communities as shown in Figure 3.9.6–1.

Within LANL, the predominant community types are juniper grassland in the eastern one-third, pinyon-juniper in the central one-third, and ponderosa pine in the western one-third. The juniper-grassland community is found along the Rio Grande on the eastern border of the Pajarito Plateau and extends upward on the south-facing sides of the canyons at 1,700 to 1,900 m (5,600 to 6,200 ft). The pinyon-juniper community, generally found in the 1,900- to 2,100-m (6,200- to 6,900-ft) elevation range, includes large portions of the mesa tops and north-facing slopes at the lower elevations. The ponderosa pine community is found in the western portion of the plateau and on mesa tops in the 2,100- to 2,300-m (6,900- to 7,500-ft) elevation range. Coniferous trees are the dominant vegetation in the LANL environs, with pinyon pine and one-seed juniper predominate below 2,100 m (6,900 ft), and ponderosa pine and Douglas fir predominate above that elevation (DOE 1995hh:4-39–4-42). Almost 350 vascular plant species have been found, or are likely to be found, on LANL (LA DOE 1979a:3-39).

Terrestrial animal species that can be found on or near LANL include 1 amphibian, 9 reptile, 189 bird, and 45 mammal species (LA DOE 1979a:3-46, C-1–C-3). Undeveloped areas within LANL provide habitat for a diversity of terrestrial wildlife. Species lists have been compiled from observational data and published data, but the occurrence of some species has not been verified (DOE 1995hh:4-42). Among vertebrates, the collared lizard, eastern fence lizard, and whiptail lizard are some of the reptiles found at LANL. Typically, these are found at elevations between 1,910 and 2,134 m (6,265 and 7,000 ft). Bird species that nest in the area include the Mexican spotted owl, great-horned owl, and red-tailed hawk among the raptors, and Say's phoebe, lesser goldfinch, and American robin among other types. Overwintering species include the scrub jay, common raven, and house finch (DOE 1995hh:4-42). Migratory birds and their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Some of the larger mammals at LANL are the black bear, coyote, and raccoon, while the smaller species include the Mexican woodrat, deer mouse, Abert's squirrel, and mountain cottontail (DOE 1995hh:4-42). The most important and prevalent big game species at LANL are mule deer and elk. LANL lands have traditionally been a transitional area for wintering elk and mule deer. More recently, these two species have been using LANL property on a year-round basis.

Throughout LANL's history, developments within various TAs have caused significant alterations in the terrain and the general landscape of the Pajarito Plateau. These alterations have resulted in significant changes in land use by most groups of wildlife species, particularly birds and larger mammals that have large seasonal and/or daily ranges. Certain projects required the segregation of large areas such as mesa tops, and, in some cases, project areas were secured by virtually impenetrable fences around their perimeters. These alterations have undoubtedly caused some species of wildlife, such as elk and deer, to alter their land-use patterns by cutting off or altering seasonal or daily travel corridors to wintering areas, breeding habitats, foraging habitats, and bedding areas, as well as other necessary habitats.

In 1980, elk were primarily using the southwestern portion of LANL. In addition, critical calving areas and important high-use areas were identified, all of which were primarily in the west and southwest part of LANL. Since 1980, the number of elk using LANL lands increased significantly. Studies of elk conducted from 1991 to 1993 revealed increased use of habitats north and northeast of previously documented high-use areas. There have also been recent concerns about increases in motor vehicle accidents involving elk and deer in the LANL

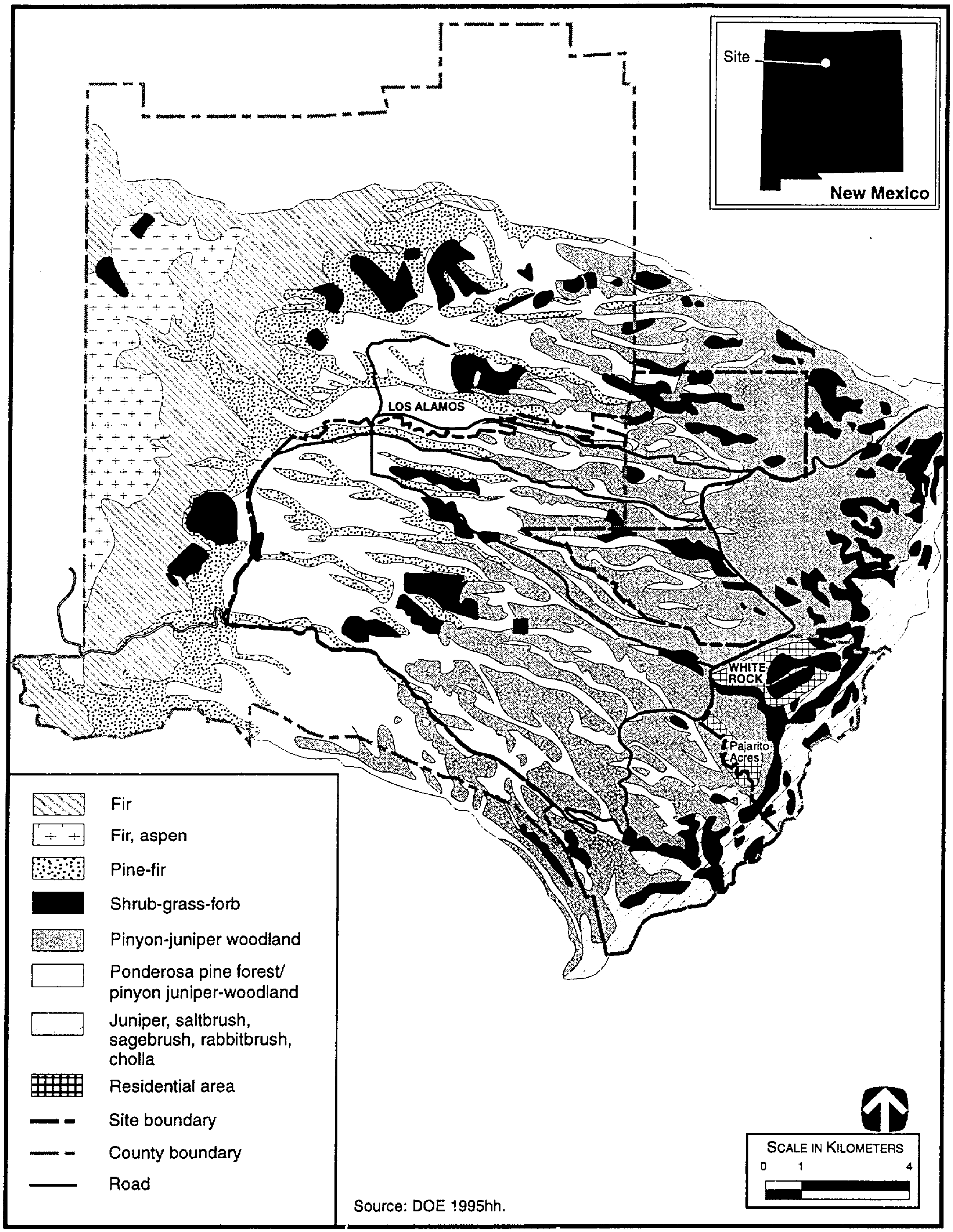


Figure 3.9.6–1. Distribution of Plant Communities at Los Alamos National Laboratory.

area. In general, however, little is known of habitat use patterns, population trends, and characteristics of elk on the Pajarito Plateau (DOE 1995hh:4-43).

Wetlands. National Wetland Inventory maps show that most LANL wetlands occur in canyons that drain to the Rio Grande River. Wetlands are found in most of the canyons on the laboratory site including Pueblo, Los Alamos, Sandia, Mortendad, Pajarito, Water, Ancho, Chaquchi, and White Rock (Rio Grande) Canyons. Wetlands have also developed in the vicinity of outfalls from LANL facilities. Most wetlands are classified as riverine intermittent, meaning they may contain flowing water part of the year and may contain pooled water or be dry the remainder of the year. Palustrine emergent and/or scrub-shrub wetlands are also indicated in sections of Pueblo, Los Alamos, Sandia, Pajarito, and Ancho Canyons. Most of the riverine and palustrine wetlands known to exist at LANL are designated as temporary or seasonal by the NWI maps.

Aquatic Resources. Aquatic habitats at LANL are limited to the Rio Grande and several springs and intermittent streams in the canyons. Some of these habitats currently receive NPDES-permitted wastewater discharges. The springs and streams at LANL do not support fish; however, many other aquatic species thrive in these waters (DOE 1995hh:4-43).

The Rio Grande is located along the southeastern property boundary and supports populations of common carp, chub, white sucker, and carpsucker. Game fish inhabiting the Rio Grande River in the vicinity of LANL include the channel catfish and brown trout (LANL 1992a:3).

Threatened and Endangered Species. Twenty federally or State-listed threatened, endangered, and other special status species may be found on and in the vicinity of LANL (Table 3.9.6–1). Four of these species have been observed on LANL. The federally listed species recorded onsite include the Mexican spotted owl, which has recently been observed nesting near TA-15 (two young were fledged from this nest during the 1995 breeding season) (DOE 1995hh:4-45), the bald eagle, which winters along the Rio Grande River, and peregrine falcon, which historically nested onsite and occasionally still forages there. The State-threatened Jemez Mountain salamander has also been observed onsite. LANL canyons provide suitable nesting, roosting, and foraging habitats for the Mexican spotted owl. No critical habitat for threatened or endangered species, as defined in ESA (50 CFR 17.11; 50 CFR 17.12), exists on LANL; however, critical habitat for the Mexican spotted owl has been designated in areas bordering the northern and western boundaries of LANL (60 FR 29914).

Table 3.9.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Los Alamos National Laboratory

Common Name	Scientific Name	Status[a] Federal	State
Mammals			
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	NL	T
Spotted bat	*Euderma maculatum*	NL	T
Birds			
Baird's sparrow	*Ammodramus bairdii*	NL	T
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	T
Broad-billed hummingbird	*Cynanthus latirostris*	NL	T
Common black-hawk	*Beuteogallus anthracinus*	NL	T
Gray vireo	*Vireo vicinior*	NL	T
Mexican spotted owl[c]	*Strix occidentalis lucida*	T	NL
Peregrine falcon[b,c]	*Falcon peregrinus*	E (S/A)	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	T
Whooping crane[b]	*Grus americana*	E	E
Amphibians			
Jemez Mountain salamander[c]	*Plethodon neomexicanus*	NL	T
Fish			
Rio Grande silvery minnow	*Hybognathus amarus*	E	T
Invertebrates			
Say's pond snail	*Lymnaea caperata*	NL	E
Plants			
Checker lily	*Fritillaria atropurpurea*	NL	R
Giant helleborine orchid	*Epipactis gigantea*	NL	RS
Golden lady's slipper	*Cypripedium pubescens*	NL	E
Sandia alumroot	*Heuchera pulchella*	NL	RS
Santa Fe cholla	*Opuntia viridiflora*	NL	E
Wood lily	*Lilium philadelphicum var. andinum*	NL	E

[a] Status codes: E=endangered; NL=not listed; R=State rare plant review list; RS=State rare and sensitive plant species; S/A=protected under the similarity of appearances provision of the *Endangered Species Act*; T=threatened.

[b] USFWS Recovery Plan exists for this species.

[c] Species recorded on LANL.

Source: 50 CFR 17.11; 50 CFR17.12; DOE 1995hh; LANL 1996e:2; NM DGF 1990b; NM DGF 1995a; NM FRCD 1995a.

3.9.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric site types identified in the vicinity of LANL include large multiroom pueblos, field houses, talus houses, shrines, rock shelters, animal traps, hunting blinds, water control features, agricultural fields and terraces, quarries, rock art, trails, campsites, windbreaks, rock rings, and limited activity sites. Approximately 75 percent of LANL has been inventoried for cultural resources. Coverage for many inventories has been less than 100 percent; however, approximately 60 percent of LANL has received 100-percent coverage. More than 1,300 prehistoric sites have been recorded at LANL, and approximately 95 percent of these sites are considered eligible or potentially eligible for the NRHP. Two areas in the vicinity of LANL have been established as NRHP sites or districts: Bandelier National Monument (named as a monument in 1916) and Puye Cliffs Historical Ruins.

Historic Resources. Historic resources consist of homesteads, corrals, ditches, trash scatters, roads and trails, railroads, ranches, mines, remains of commercial ventures, and buildings associated with the Manhattan Project and the Cold War era. More than 80 historic resources have been recorded at LANL, and about 90 percent of the resources are considered eligible or potentially eligible for the NRHP.

The existing LANL facilities have been extensively modified and refurbished since 1943 when major construction occurred after World War II. The existing facilities are not likely to be considered NRHP eligible because they lack architectural integrity and may not be representative of a particular style. However, some of the facilities may be NRHP eligible based on their association with the broad historic theme of the Manhattan Project and initial nuclear production.

Portions of a number of TAs have been surveyed. NRHP-status buildings exist in TAs -3, -8, -9, -16 (74 individual buildings); TA-22 (TA-22-1); TA-28; and TA-55. Structures at the front and back gates are also eligible for the NRHP. Additional NRHP-eligible historic resources may exist in other TAs.

Native American Resources. Native Americans in the area with concerns include the six Tewa-speaking Pueblos of the northern Rio Grande Valley (San Ildefonso, San Juan, Santa Clara, Nambe, Tesuque, and Pojoaque), and the Cochiti and Jemez Pueblos.

Cultural resources are of special importance to Native Americans. These resources located on the LANL site may consist of prehistoric sites with ceremonial features such as kivas, village shrines, petroglyphs, or burials, or traditional cultural properties with no observable manmade features. Consultations by DOE with local Native Americans to identify any such cultural resources have been conducted in the past and are ongoing. An ethnographic study is currently being conducted to identify traditional cultural properties in the area as part of a sitewide EIS for LANL.

Paleontological Resources. The Pajarito Plateau consists primarily of Pleistocene volcanic tuffs and compacted pumice and ashfalls of the Bandelier Formation. None of the formations within LANL are known to be fossiliferous.

3.9.8 SOCIOECONOMICS

Socioeconomic characteristics addressed at LANL include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses seven counties around LANL located in New Mexico (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a three-county area in which 88.1 percent of all LANL employees reside: Los Alamos County (48.3 percent), Rio Arriba County (20.8 percent), and Santa Fe County (19.0 percent) (Table L.1–9). More than half of the Los Alamos County employees reside in the unincorporated communities of Los Alamos and White Rock. In 1995, LANL employed 8,655 persons.

Regional Economy Characteristics. Selected employment and regional economy statistics for the LANL REA are summarized in Figure 3.9.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 34.1 percent to the 1990 level of 100,300. The 1994 unemployment rate in the REA was 6.2 percent, which was about the same as the unemployment in New Mexico (6.3 percent). The region's per capita income of $17,689 in 1993 was approximately 8.2 percent higher than New Mexico's per capita income of $16,346.

As shown in Figure 3.9.8–1, the REA and New Mexico have similar employment patterns. The service sector accounts for the largest share of employment in both the region (31.2 percent) and in New Mexico (28.3 percent). Retail trade employment was approximately the same for the region (18.2 percent) and New Mexico (18.1 percent). Manufacturing employment accounted for 4.0 percent of the total regional employment but 5.8 percent of the total State employment.

Population and Housing. In 1994, the ROI population totaled 166,788. From 1980 to 1994, the ROI population grew by 36.6 percent, compared to 26.9 percent for New Mexico. Within the ROI, Santa Fe County experienced the largest increase at 48.6 percent. Population and housing trends are summarized in Figure 3.9.8–2. The unincorporated communities of Los Alamos and White Rock in Los Alamos County are included in the county population and housing analysis.

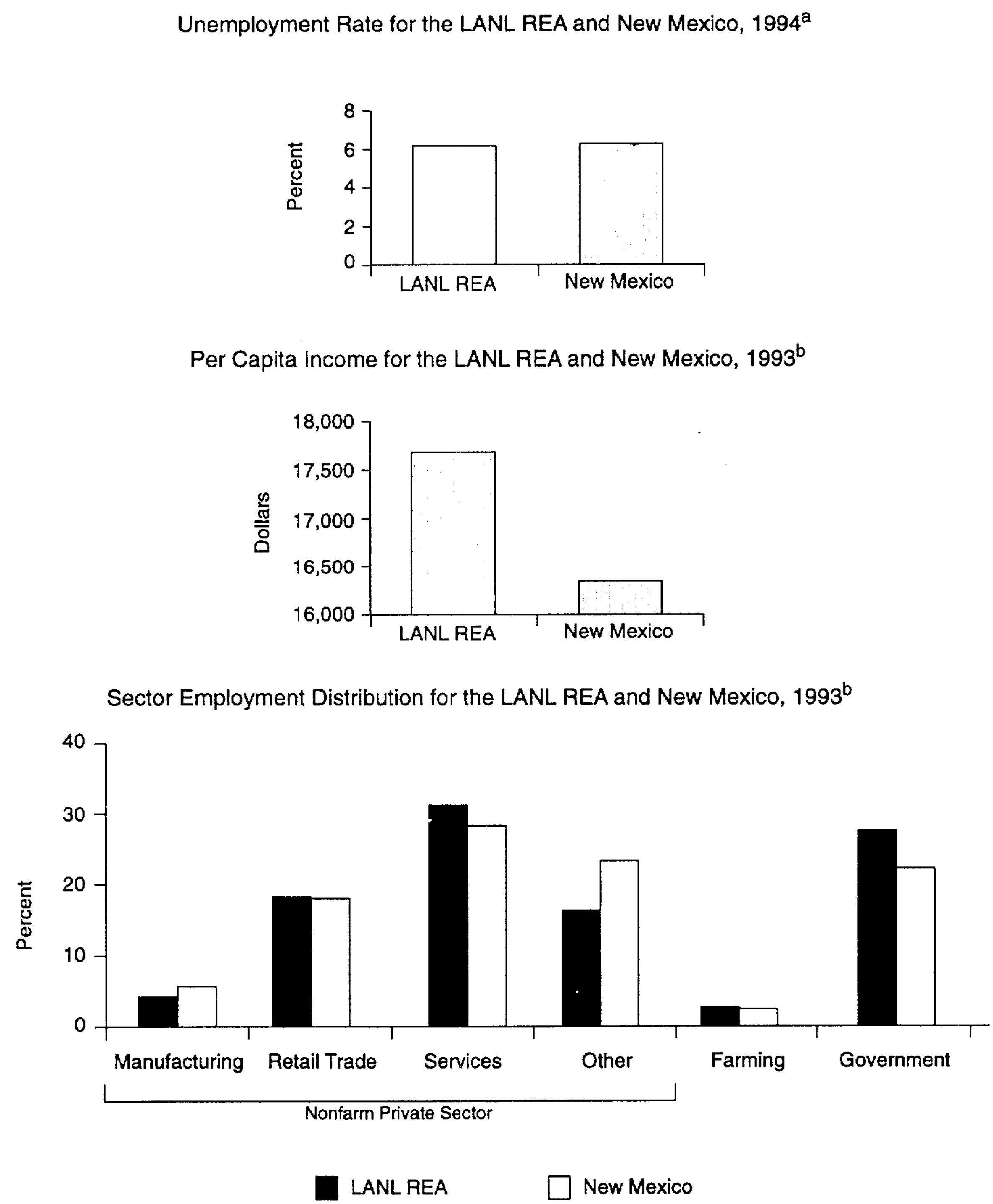
The 37.8-percent increase in the number of housing units between 1980 and 1990 for the ROI was much greater than the percent increase for New Mexico (24.5 percent). The total number of housing units for 1990 was 63,386. The 1990 homeowner vacancy rate in the ROI, 2.3 percent, was the same as New Mexico's homeowner vacancy rate. The rental vacancy rate for the ROI counties, 7.7 percent, was much less than New Mexico's rental vacancy rate (11.4 percent).

Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the LANL ROI. Figure 3.9.8–3 presents school district characteristics for the LANL ROI. Figure 3.9.8–4 presents public safety and health care characteristics.

Education. In 1994, seven school districts provided public education services and facilities in the LANL ROI. As shown in Figure 3.9.8–3, these school districts operated at between 57.4 percent (Chama Valley Independent School District) and 75.7 percent (Espanola Public School District) capacity. The average student-to-teacher ratio for the LANL ROI in 1994 was 17.3:1. The Espanola Public School District had the highest ratio at 18.9:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents in the ROI. In 1994, a total of 263 sworn police officers were serving the three-county ROI. The City of Santa Fe employed the greatest number of sworn police officers (104), while the City of Espanola had the highest officer-to-population ratios (2.5 sworn officers per 1,000 persons). The ROI average officer-to-population ratio was 1.6 officers per 1,000 persons. Figure 3.9.8–4 compares police force strengths across the ROI.

Fire protection services in the LANL ROI were provided by 800 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was located in Rio Arriba County, 10.2 firefighters per



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.9.8–1. Employment and Local Economy for the Los Alamos National Laboratory Regional Economic Area and the State of New Mexico.

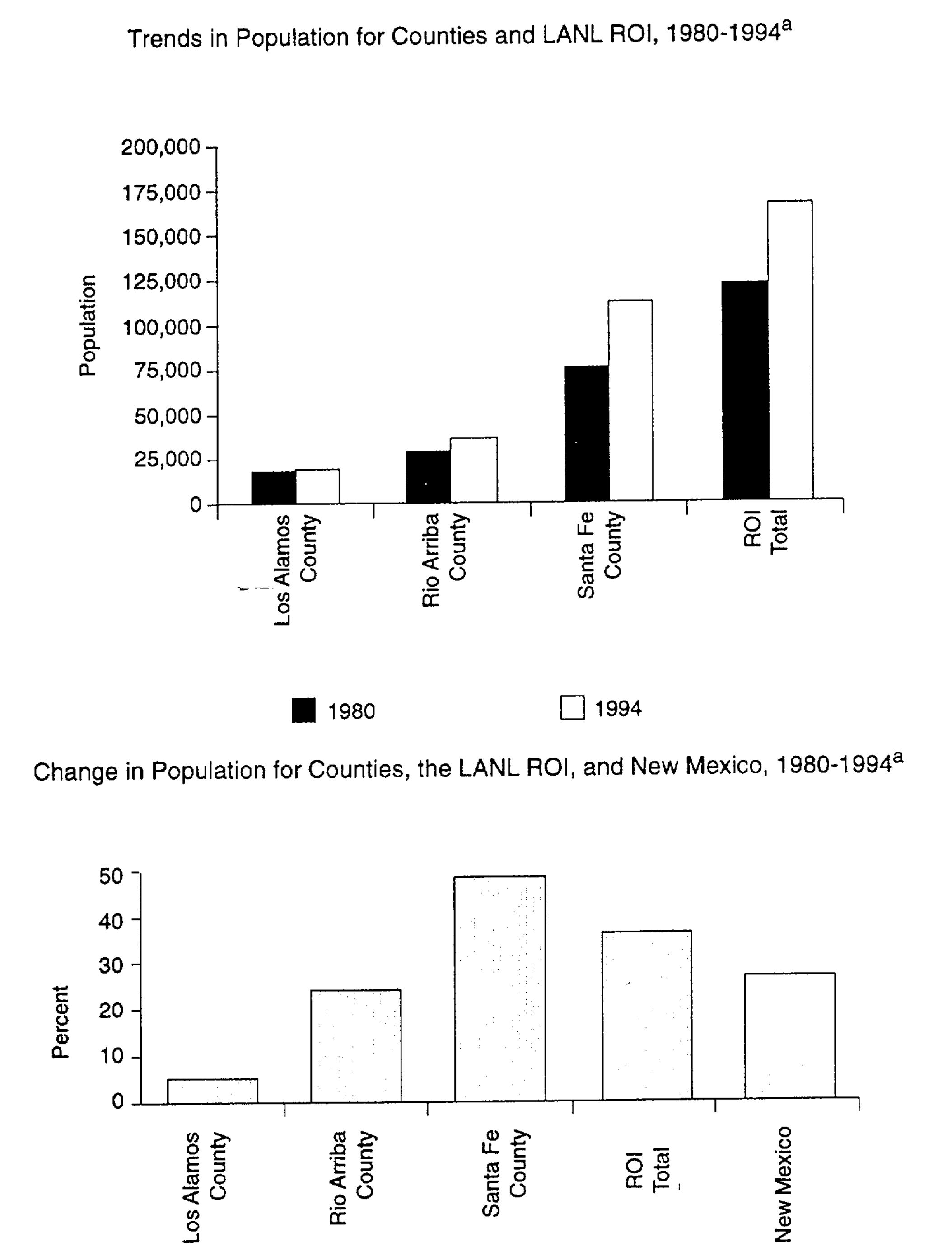
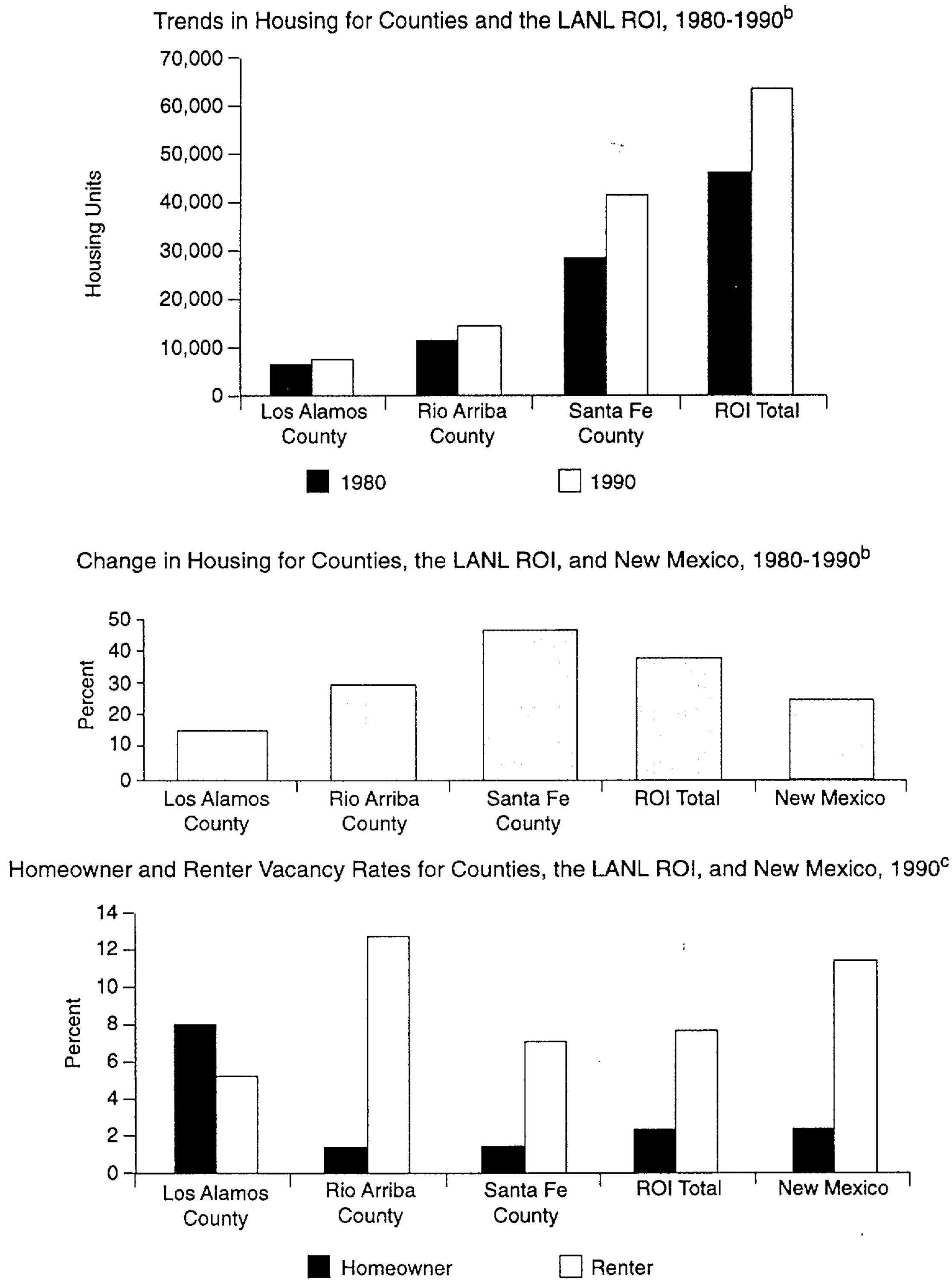
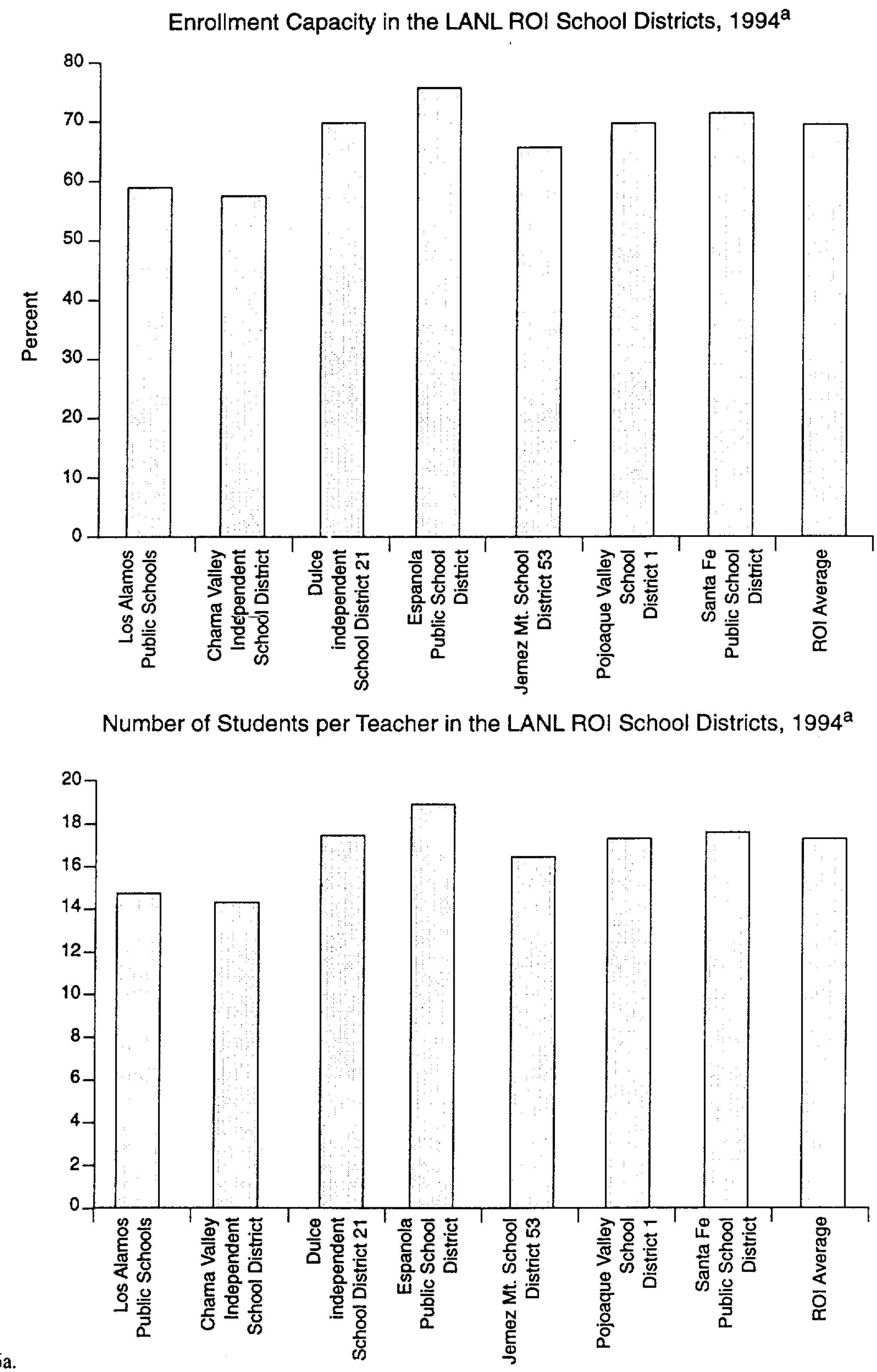


Figure 3.9.8–2. Population and Housing for the Los Alamos National Laboratory Region of Influence and the State of New Mexico.



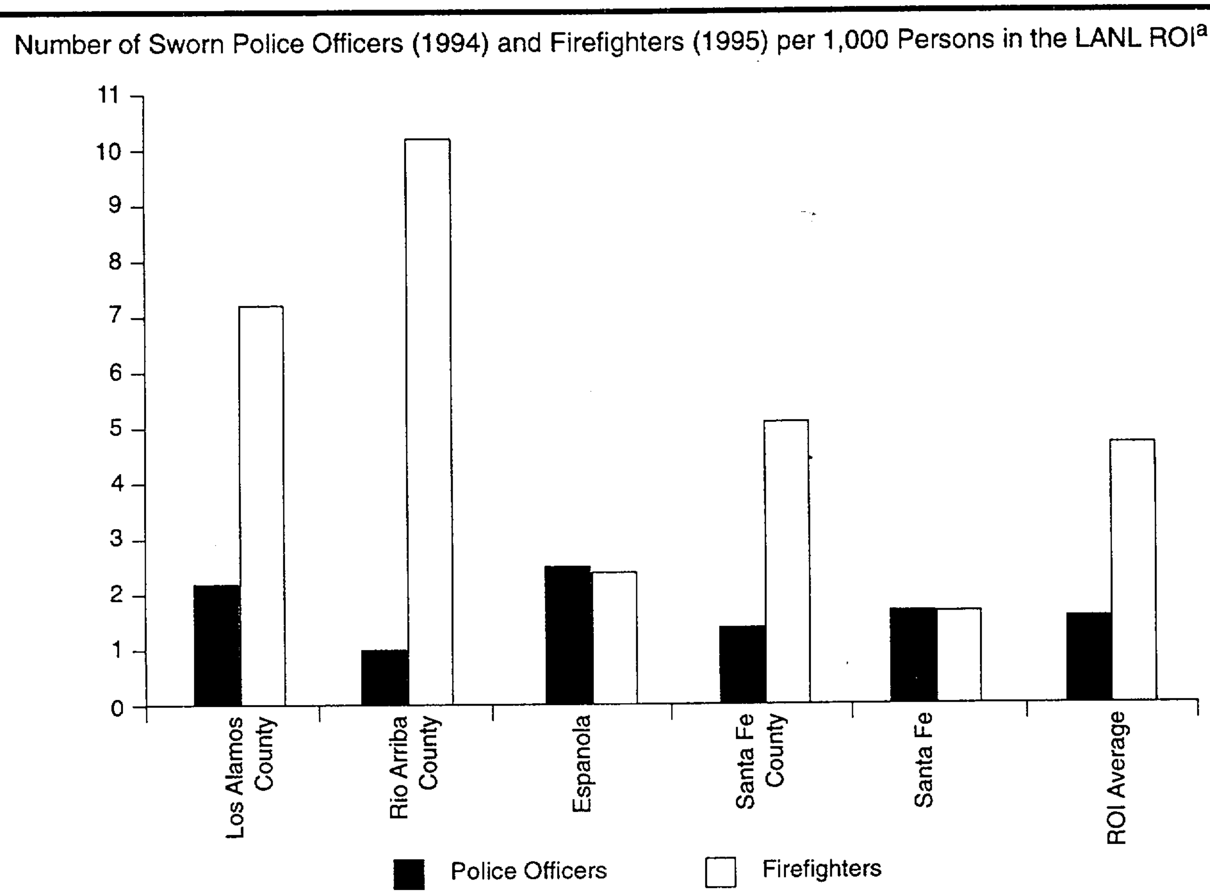
[a] Census 1983g; Census 1995a.
[b] Census 1982o; Census 1991h.
[c] Census 1991h.

Figure 3.9.8–2. Population and Housing for the Los Alamos National Laboratory Region of Influence and the State of New Mexico—Continued.

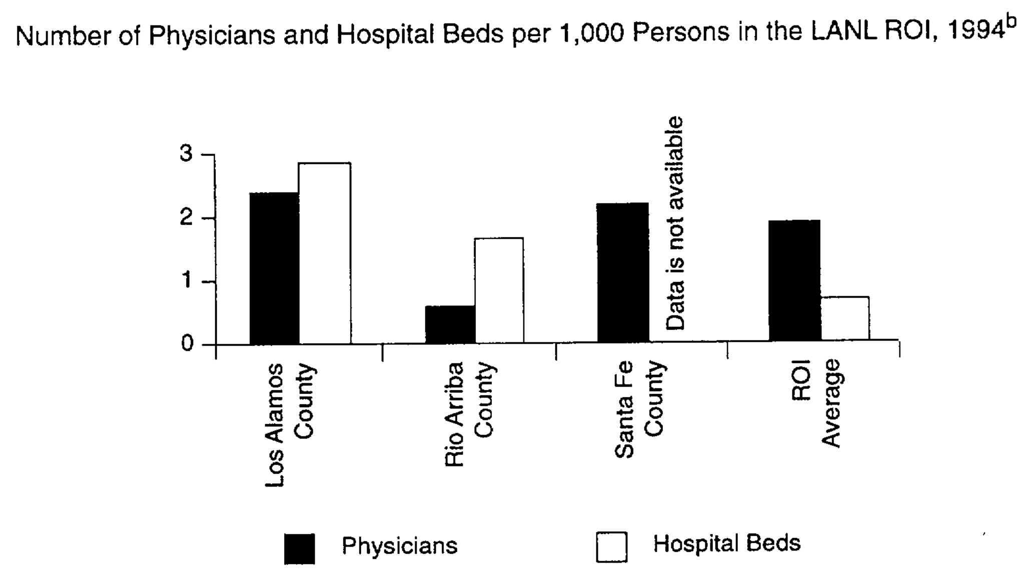


[a] Socio 1996a.

Figure 3.9.8–3. School District Characteristics for the Los Alamos National Laboratory Region of Influence.



Note: Except for ROI cities, city sworn police officers and firefighters are included in the county totals.



[a] Census 1993m; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.9.8–4. Public Safety and Health Care Characteristics for the Los Alamos National Laboratory Region of Influence.

1,000 persons, as indicated in Figure 3.9.8–4. Rio Arriba County employed the greatest number of firefighters (276). The average firefighter-to-population ratio in the ROI was 4.7 firefighters per 1,000 persons.

Health Care. There were four hospitals serving the three-county ROI in 1994. Figure 3.9.8–4 displays the hospital bed-to-population ratios for the LANL ROI counties. During 1994, all hospitals were operating at below capacity, with hospital occupancy rates ranging from 28.3 percent in Los Alamos County to 31.1 percent in Rio Arriba County.

In 1994, a total of 311 physicians served the ROI, with the majority (244) located in Santa Fe County. Figure 3.9.8–4 shows that the physician-to-population ratio for the ROI ranged from 0.6 per 1,000 persons in Rio Arriba County to 2.4 per 1,000 persons in Los Alamos County. The ROI average physician-to-population ratio was 1.9 physicians per 1,000 persons.

Local Transportation. Regional transportation routes provide access to LANL (see Figure 2.2.8–1 and Figure 2.2.8–2 for maps of regional and local roads near LANL). Interstate 25 provides access to Denver, CO, to the north and Albuquerque, NM, to the south. Interstate 40 and Interstate 25 intersect at Albuquerque, NM. Interstate 40 provides access to Amarillo, TX, to the east and Flagstaff, AZ, to the west. U.S. 285 meets Interstate 25 at Santa Fe. U.S. 285 is to the east of LANL.

Vehicular access to LANL is provided by New Mexico Route 502 to the east and New Mexico Route 4 to the west. New Mexico Route 502 intersects U.S. 285 at Pojoaque, New Mexico. New Mexico Route 4 intersects New Mexico Route 44 at San Ysidro.

There are no current or planned (within 1 to 2 years) road improvement projects that would affect access to LANL (NM DOT 1995a:1). There is no public bus service at LANL. There is a non-profit bus service between White Rock, LANL, and Los Alamos (LA DOE 1995a:1.)

The only major railroad in the ROI is the Burlington Northern and Santa Fe. A spur of this railroad extends to Santa Fe, NM, from the south. There are no navigable waterways within the ROI that are capable of accommodating waterborne transportation of material shipments to LANL. The Albuquerque International Airport provides passenger and cargo service in the ROI on national and international carriers (DOT 1992a:7-214–7-217). There are other smaller airports in the ROI.

3.9.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of LANL are shown in Table 3.9.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to LANL operations.

Table 3.9.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Los Alamos National Laboratory Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic radiation	48
External terrestrial radiation	44
Neutron cosmic radiation	10
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[a,b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	**407**

[a] LANL 1995s.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from LANL operations provide another source of radiation exposure to individuals in the vicinity of LANL. Types and quantities of radionuclides released from LANL operations in 1993 are listed in *Environmental Surveillance at Los Alamos During 1993* (LA-12973-ENV). The doses to the public resulting from these releases are presented in Table 3.9.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The doses given in the 1993 report were assumed to be representative of the reference environment (No Action) doses from LANL operations in the year 2005 (Section 4.2.8.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases and resulting impacts from LANL operations in 1993 is estimated to be 3.3×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of LANL operations is about 3 in 1 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same risk estimator, 1.5×10^{-3} excess fatal cancers are projected in the population living within 80 km (50 mi) of LANL from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1993 in the population living within 80 km (50 mi)

Table 3.9.9–2. Radiation Doses to the Public From Normal Los Alamos National Laboratory Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual[b]	Standard[a]	Actual
Maximally exposed individual (mrem)	10	5.7	4	0.8	100	6.5
Population within 80 km[c] (person-rem)	None	3.0	None	~0[d]	100	3.0
Average individual within 80 km[e] (mrem)	None	0.014	None	~0[d]	None	0.014

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] The actual dose values given in this column conservatively include all water pathways, not just the drinking water pathway.

[c] In 1993, this population was approximately 219,000.

[d] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.

[e] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: LANL 1995s.

of LANL was 438. This number of expected fatal cancers is much higher than the estimated 1.5×10^{-3} fatal cancers that could result from LANL operations in 1993.

The LANL workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.9.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to LANL workers from operations in 1992. Except for the dose to one worker, these doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to LANL workers from normal operations in 1992 is estimated to be 0.077.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Environmental Surveillance at Los Alamos During 1993* (LA-12973-ENV). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which can be ingested; and other environmental media with which people may come in contact (for example, soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in previous sections of this PEIS, particularly Sections 3.9.3 on air quality and 3.9.4 on water resources.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operation at LANL via inhalation of air containing hazardous chemicals released to the atmosphere from LANL operations. Risks to the public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Table 3.9.9–3. Radiation Doses to Workers From Normal Los Alamos National Laboratory Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	34
Maximally exposed worker (mrem)	5,000	~7,000[b]
Total workers[c] (person-rem)	ALARA	194

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] Only one worker exceeded the worker dose standard.

[c] The number of badged workers in 1992 was approximately 5,700.

Source: 10 CFR 835, DOE 1993n:7.

Baseline air emission concentrations for hazardous air pollutants and their applicable standards are presented in Section 3.9.3. These concentrations are estimates of the highest existing offsite concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations. Information about estimating health impacts is presented in Section M.3.

Exposure pathways to LANL workers during normal operation may include inhaling the workplace atmosphere, drinking LANL potable water and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to OSHA and EPA occupational standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Health Effects Studies. Recent epidemiological studies have been conducted in the communities surrounding LANL. Epidemiologic mortality and incidence studies assessing health effects in these communities have reported statistically significant elevated risks of melanoma, bladder cancers, and leukemia. Elevated risks of prostate, stomach, colon, rectum, lung, thyroid, and pancreatic cancers have also been reported in the total population, and elevated risks of breast and ovarian cancer incidence have been reported in females.

No statistically significant excess cancer was reported for male workers exposed to Pu. However, statistically significant excesses in kidney cancer and lymphomatic leukemia were observed in male workers exposed to external radiation (HP 1994a:577-588). An excess of death from suicides was reported among female radiation workers (LA Wiggs 1987a). More detailed descriptions of the studies reviewed and the findings are found in Section M.4.9.

Accident History. A review of recent LANL annual environmental and accident reports indicates that there have been no significant impacts to workers, the public, or the environment. This review was performed to provide an indication of the site's accident history. During the review period, from 1986 to 1990, site operations were much higher than in previous years and also higher than what is anticipated in the future.

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. The LANL Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public.

3.9.10 Waste Management

This section outlines the major environmental regulatory structure and waste management activities for LANL. Table 3.9.10–1 presents a summary of waste management activities at LANL for 1993.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations of LANL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in permits and negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed upon milestones.

The LANL is not listed on the NPL. As a function of obtaining a RCRA permit, however, the *Hazardous and Solid Waste Amendments* of 1984 mandate that permits for treatment, storage, and disposal facilities include provisions for corrective action to mitigate releases from solid and hazardous waste facilities in operation and to clean up contamination in areas designated as solid waste management units at LANL. By the end of 1995, over 60 of the approximately 2,100 potential release sites identified had been remediated, no further action was proposed for 575 sites, and 1,100 sites were slated for investigation or cleanup; for the remaining sites, action is still pending. All cleanup activities are expected to be completed by 2010 (LANL 1996e:1).

Through its research activities, LANL manages a small quantity of spent nuclear fuel and the following waste categories: TRU, low-level, mixed, hazardous, and nonhazardous wastes. Because there is no spent nuclear fuel or HLW associated with Pu storage at LANL, there is no discussion in this PEIS of spent nuclear fuel or HLW generation and management at LANL. A discussion of the waste management activities associated with each of these waste categories follows.

Spent Nuclear Fuel. Because there is no spent nuclear fuel associated with Pu storage at LANL, there is no discussion in this PEIS of spent nuclear fuel generation and management at LANL.

High Level Waste. Because there is no HLW associated with Pu storage at LANL, there is no discussion in this PEIS of HLW generation and management at LANL.

Transuranic Waste. The Plutonium Facility (TA-55) is the principal generator of liquid TRU wastes at LANL. Process acidic and caustic wastewaters, evaporator distillates from the nitrate recovery area, cooling water from gloveboxes, and wet vacuum seal water are the principal sources. Sludges that remain after treatment through filtration and residual evaporator bottoms are loaded into 208-l (55-gal) drums, solidified, and transported to Area G for storage. The liquid wastes remaining after filtration are transferred from TA-55 to the Radioactive Liquid Waste Treatment Facility (TA-50) by gravity drain in double-wall pipelines. After treatment at TA-50 through sedimentation, clarification, and flocculation, the residual radioactive sludge is loaded into drums, solidified, and transported to Area G for storage. Most of LANL's TRU waste is currently stored on asphalt pads. TRU wastes are currently being stored, until they can be shipped to WIPP if that facility can demonstrate compliance with the requirements of 40 CFR 191 and 40 CFR 268. Shipment of waste to WIPP also depends on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste. Should additional treatment be necessary for disposal at WIPP, LANL would develop the appropriate treatment to meet the WIPP WAC and package the wastes in accordance with DOE, NRC, and DOT requirements for transport to WIPP for disposal. LANL is presently upgrading TRU storage facilities to comply with RCRA requirements under the terms of a consent order with the State of New Mexico.

The LANL generates mixed TRU wastes. Newly generated mixed TRU wastes are identified, characterized, and stored in compliance with RCRA. The *Federal Facility Compliance Act* of 1992 requires DOE to provide specific information to EPA and the State of New Mexico on LANL's mixed TRU waste streams, treatment

Table 3.9.10–1. Waste Management Activities at Los Alamos National Laboratory

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Transuranic							
Liquid	0.1	Pretreatment at TA-50: neutralization, clariflocculation, filtration, precipitate, cement mixing	48,800	NA	NA	NA	NA
Solid	54	Volume reduction	1,080	Storage pads at TA-54, modified LLW burial pits and shafts	24,355	None: Federal repository in the future	None
Mixed Transuranic							
Liquid	None	See TRU	Included in TRU	NA	NA	NA	NA
Solid	255	See TRU	Included in TRU	NA	Included in TRU	See TRU	None
Low-Level							
Liquid	21,400	Chemical treatment and ion-exchange, solidification; and volume reduction (vial crusher)	45 m^3/hour	Chemical and Ion-Exchange Plant at TA-50 and the Chemical Plant at TA-21	663	Treated effluent is discharged to the environment. Residual sludge is solidified and disposed of at TA-54, Area G, as solid LLW	None
Solid	2,690	Compaction	76	TA-54 in Area G	Variable	Currently solid LLW goes to TA-54, Area G for burial. Continued construction at Area G under evaluation in site wide EIS	Estimated available capacity is 25,000 m^3
Mixed Low-Level							
Liquid	0	Neutralization, precipitation, oxidation, thermal treatment; solidification; volume reduction; liquid scintillation cocktail vials	Capabilities under development per site treatment plan	RCRA-permitted Bldgs. (not built yet) and interim status container storage areas	583	NA	None

Table 3.9.10–1. Waste Management Activities at Los Alamos National Laboratory—Continued

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Mixed Low-Level (continued)							
Solid	45	None	Capabilities under development per site treatment plan	RCRA-permitted Bldgs. (not built yet) and interim status container storage areas	583	Capabilities under development as per Site Treatment Plan for Mixed Wastes	None
Hazardous							
Liquid	273	Thermal treatment, treatment tanks, neutralization, precipitation, and evaporation	Varies depending on the waste stream	Thermal treatment TAs-14, -15, -16, -36, and -39 and storage and treatment TA-54, Area L	1,864	Offsite	NA
Solid	669[a]	Thermal treatment and flashpad	Varies depending on the waste stream	See above	See above	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	692,857	Filtration, settling, and stripping	1,060,063	NA	NA	Permitted discharge sanitary tile fields	2,271 m^3/day
Solid	5,453[b]	None	None	NA	NA	Offsite county landfill and onsite landfill Area J	NA
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	NA	NA	Included in sanitary	Included in sanitary
Solid	Included in sanitary	None	None	NA	NA	Included in sanitary	NA

[a] Includes 84 t RCRA-regulated, 460 t State-regulated, and 124 t of TSCA-regulated solid hazardous wastes. Density of 1,500 kg/m^3 was used to convert to volume units.

[b] Density of 1,500 kg/m^3 was used to convert 8,180 t to cubic meters.

Note: NA=not applicable.

Source: LANL 1990a; LANL 1994b.

facilities, and technology development activities. This waste category covers a broad range of physical matrix categories for LANL. The Federal Facility Compliance Order for the Site Treatment Plan requires treatment of all mixed TRU waste not in compliance with LDR. This order is the implementation of the *Federal Facility Compliance Act* at LANL. The WIPP WAC specifies limiting parameters for waste containers, waste form, waste packaging, accompanying data, and miscellaneous requirements for packaging and RCRA. It is anticipated that some technology required for additional treatment of TRU wastes to attain additional treatment standards can be adapted from the technologies that must be brought online for mixed LLW. If DOE is successful in obtaining a no-migration petition for the disposal of mixed TRU wastes at WIPP, adherence with treatment standards under the land disposal restrictions would not be required.

Low-Level Waste. Both liquid and solid LLW are generated and managed by LANL. Liquid LLW is generated from many areas throughout LANL. There are two onsite wastewater treatment facilities used for treatment of aqueous LLW, one of which uses ion-exchange technology. As part of a new radioactive liquid waste treatment facility project, a facility for the solidification and subsequent volume reduction of the radioactive liquid waste treatment plant sludge containing Pu, americium, and other radionuclides is proposed, but not funded at LANL.

Solid LLW is generated from many areas throughout LANL. Solid LLW such as paper, plastic, glassware, and rags are separated into compactible and noncompactible materials by the waste generators. Compactible bales are banded, wrapped and sealed in plastic, and moved to Area G for disposal in landfill pits, located at TA-54 (Figure 2.2.8–2). LLW noncompactible items, such as large equipment and much of the D&D wastes, generally are not packaged but delivered to the burial site in covered or enclosed vehicles. Continued construction at Area G is dependent on decisions made in conjunction with the sitewide EIS being prepared by LANL.

Mixed Low-Level Waste. Mixed LLW includes solvents, pyrophoric substances, spray cans, scintillation vials, uranium-contaminated lithium hydride, miscellaneous reagent chemicals, vacuum pump oil contaminated with mercury, gas cylinders, and other contaminated material. It is stored at TA-54 Areas L and G. Currently, LANL does not dispose of mixed LLW. In accordance with the *Federal Facility Compliance Act*, LANL has developed a site treatment plan which covers management of all mixed waste at LANL. The State of New Mexico Environment Department issued a compliance order in the Site Treatment Plan for Mixed Waste in October 1995. The compliance order addresses land disposal restricted mixed waste. For mixed waste with identified treatment technologies, the plan provides a schedule for submitting permit applications, entering into contracts, initiating construction, conducting systems testing, starting operations, and processing mixed wastes. For mixed waste without an identified treatment technology, the plan includes a schedule for identifying and developing technologies, identifying the funding requirements for R&D, submitting treatability study notifications, and submitting R&D permit applications.

Mixed waste treatment skids are being designed to treat onsite hazardous and mixed waste streams that are not amenable to offsite treatment. Examples of the waste streams potentially amenable to skid treatment are reactive metals, plating wastes, acids, bases, ignitable liquids, spent solvents, and decontamination debris. Not all of the technologies to be included have been chosen. The mixed waste treatment skids would be housed in an existing LANL structure. An environmental restoration high-energy plasma technology is being tested as a technique for total destruction of mixed LLW that has been treated to land disposal restrictions standards. This technique will allow LANL to stay in compliance with the *Federal Facility Compliance Act*

Hazardous Waste. The LANL received a permit for treatment, storage, and disposal of hazardous waste under RCRA in November 1989, and for the *Hazardous and Solid Waste Amendments* of 1984 provisions from EPA on March 8, 1990. All hazardous waste treatment and storage facilities at LANL are either fully permitted or are operating under interim status, while other waste management facilities are being developed.

The LANL produces a wide variety of hazardous wastes. Small volumes of almost all wastes listed under 40 CFR 261 are generated as a result of a wide variety of ongoing research. HE waste is generated during the processing and testing of various HE materials. All HE hazardous waste and potentially contaminated HE waste is picked up from the generating facility and treated by open detonation, open burning, or incineration at TAs -14, -15, -16, -36, and -39. Ash residue is then treated and, when its hazardous characteristic can be removed and it is determined that this residue does not contain radioactive constituents, it is disposed of onsite in the landfill, TA-54, Area J. The HE wastewater is treated by gravity settlement in a sump and discharged from NPDES-permitted outfalls. LANL is developing an HE wastewater treatment facility that will collect and treat these wastewaters with stepped filtration.

The LANL does not landfill RCRA-hazardous waste onsite, but contracts with certified transporters to deliver hazardous waste to commercial offsite RCRA-permitted treatment, storage, and disposal facilities. Before waste is sent offsite, the potential treatment or disposal facility is inspected by LANL personnel. Operating records and permits are also reviewed. LANL has an EPA Letter of Authorization allowing disposal of solid PCB-contaminated articles at the TA-54, Area G landfill. Other PCB waste and liquid PCB-contaminated articles are sent offsite to TSCA-regulated disposal facilities. Asbestos mixed waste is buried at TA-54, Area G. Asbestos waste is shipped offsite to an approved disposal site in accordance with TSCA and NESHAP regulations. Infectious wastes are managed according to State of New Mexico regulations.

Nonhazardous Waste. Solid sanitary wastes are generated routinely and include general facility refuse such as paper, cardboard, glass, wood, plastics, scrap, metal containers, dirt, and rubble. Solid sanitary wastes are segregated and recycled whenever possible. Trash is accumulated onsite in dumpsters, which are emptied on a regular basis by a commercial waste disposal firm and taken to the county sanitary landfill. The Los Alamos County landfill is located on property owned by DOE and is operated under a special-use permit. Approximately one-third of the solid sanitary waste disposed of at the county landfill originates from LANL. The Area J special waste landfill, which is operated by and is under the administrative control of LANL, receives only administratively controlled solid sanitary waste. Solid sanitary waste will be managed and disposed of at LANL until 2007, the year the existing sanitary landfill is expected to reach the end of its useful life. At that time, either a new landfill will have to be constructed or provisions made for offsite disposal.

A new sanitary wastewater treatment plant and collection system to replace 7 existing wastewater treatment facilities and 30 existing septic tanks has been completed. The new treatment plant will enable reuse of the treated wastewater for nondrinking water uses such as cooling and irrigation. The plant and collection system is designed to meet the requirements of LANL's existing Federal Facility Compliance Agreement and is expected to meet all of LANL's needs for the next 20 years.