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*Yucca Mountain Project*

# *Site Environmental Report for the Yucca Mountain Project Calendar Year 2006*

PGM-MGR-EC-000008

***October 2007***

*U.S. Department of Energy*
*Office of Civilian Radioactive Waste Management*
*Las Vegas, Nevada*

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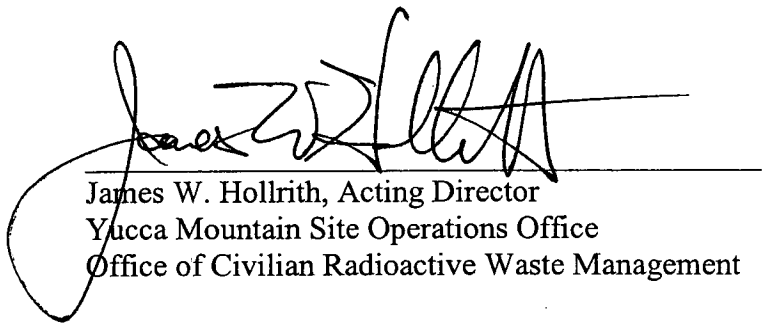
U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Las Vegas, Nevada

## PREFACE

As an operating unit of the U.S. Department of Energy (DOE), it is the policy and practice of the Office of Civilian Radioactive Waste Management to conduct its operations in a safe and environmentally sound manner. DOE Policy 450.4 requires the Department to systematically integrate safety into management and work practices so that missions are accomplished while protecting the public, the worker, and the environment. The Department has made it clear that protection of the public, the worker, and the environment is of paramount importance.

In accordance with DOE Order 231.1A and DOE Manual 231.1-1A, the status of the Yucca Mountain Project's 2006 environmental program is summarized in this annual site environmental report.



James W. Hollrith, Acting Director
Yucca Mountain Site Operations Office
Office of Civilian Radioactive Waste Management

10/23/07
Date

# EXECUTIVE SUMMARY

This site environmental report describes the environmental program conducted during 2006 by the U.S. Department of Energy, Office of Civilian Radioactive Waste Management. The report describes the environmental laws and regulations that were applicable to the Yucca Mountain Project in 2006, the actions taken to comply with those laws and regulations, and the Project's environmental program. The report also summarizes the data collected to monitor potential impacts of the Project on the environment.

Words and expressions that are underlined are defined in the Glossary at the end of the report.

**Mission and 2006 Accomplishments** – In 1982, Congress enacted the Nuclear Waste Policy Act. The Act established the federal government's responsibility to provide for the permanent disposal of the nation's spent nuclear fuel and high-level radioactive waste and set forth a process and schedule for the disposal of these materials in a geologic repository. In 1987, the Act was amended designating Yucca Mountain, Nevada, as the single candidate site for a repository. On July 23, 2002, the President signed into law a Congressional Joint Resolution approving Yucca Mountain for the development of a geologic repository per Section 115(c) of the Nuclear Waste Policy Act, as amended.

During 2006, the Department continued to prepare a license application that will be submitted to the U.S. Nuclear Regulatory Commission to construct and ultimately operate a geologic repository at Yucca Mountain, Nevada. Upon submittal, the Commission will have three years to review the application, conduct its licensing proceedings, and reach a decision on a construction authorization. Should the Commission grant the construction authorization, the Department will update the license application and request a license to receive and possess high-level radioactive waste as initial construction of the repository nears completion. If the Commission grants the license to receive and possess, the Department will begin placing waste into the repository. In the final phase of licensing, when the repository has stopped receiving waste for disposal, the Department will apply for a license amendment to permanently close the repository, which will address plans to decommission surface facilities.

Throughout 2006, the Office of Civilian Radioactive Waste Management continued to conduct field and laboratory tests and studies to further refine the understanding of how a repository at Yucca Mountain would perform far into the future. Some of these efforts may continue indefinitely or until the repository is permanently closed. Repository design and operating decisions could be modified based on the results of these tests and studies, as well as other technological and policy developments. This ongoing learning process is designed to challenge current models and assumptions about Yucca Mountain and lead to continuous improvement.

**Environmental Compliance** – During 2006, the Yucca Mountain Project had no violations of environmental permits or noncompliance actions; no reportable occurrences that required notification of a regulatory agency; and no notices of violations, deficiencies, announcements of intent to sue for noncompliance with environmental regulations, or other types of enforcement actions. The following actions were taken during 2006 to maintain environmental permits and comply with environmental regulations:

- Several actions were taken to improve the Project's Environmental Management System and further implement the requirements in Executive Order 13148 (65 Federal Register 24595) and DOE Order 450.1. In 2006, the Department established additional environmental objectives and targets and improved awareness of the Environmental Management System among project staff. No findings were made during the annual review of the Integrated Safety Management System.

- Reports on the following subjects were prepared and submitted to federal and state regulatory agencies and other organizations in compliance with regulatory requirements:

  - Hazardous materials and chemicals
  - Wastes generated and recycled, including efforts to minimize waste generation
  - Purchase and use of recycled materials
  - Use of sand and gravel
  - Desert tortoises/biological surveys
  - Air emissions
  - Drinking water
  - Reclamation
  - Underground injections

**Environmental Programs**–The following actions were taken as part of the environmental program conducted in 2006 to implement permit requirements, monitor for impacts, and protect the environment

- Nine requests for land access were reviewed by the Office of Civilian Radioactive Waste Management in 2006. One was canceled, 6 were approved, and 2 were on hold pending additional information.

- Approximately 25.9 acres of land were cleared of vegetation or soil in 2006; the total amount of land disturbed by the Project since 1991 is now 362.1 acres. This is 51.9 acres less than the total of 414 acres stipulated in the 'Biological Opinion' for the Yucca Mountain Project issued by the U.S. Fish and Wildlife Service.

- One desert tortoise was killed by Project activities in 2006. It was found dead on an access road at Yucca Mountain in May. This is the third tortoise to have been killed on an access road at Yucca Mountain since 1997. Tortoise burrows found during clearance surveys were inspected and, if no tortoises were found, collapsed prior to surface-disturbing activities. One tortoise was found in a burrow during a clearance survey; the proposed activity was moved to avoid disturbing the tortoise and the burrow. No tortoise eggs were found during these clearance surveys.

- To date, final reclamation has been implemented on about 93.5 acres of former Yucca Mountain Project disturbances.

- Five archaeological pre-activity surveys were conducted during 2006 in areas proposed for site activities. Thirteen new archaeological sites and 65 isolated artifacts were ident-

ified during these surveys. No previously documented historical properties at Yucca Mountain were monitored during 2006 and no new data-recovery plans were developed.

- The Project continued consultations and interactions with involved Native American tribes and organizations.

- Air quality was monitored at two sites at Yucca Mountain and meteorological measurements were taken at 12 sites. Concentrations of airborne particulate matter and other pollutants continued to be far below allowable maximum concentrations. Average precipitation in 2006 measured at the 12 meteorological sites ranged from about 4 inches to less that 7 inches; this was less than the preceding three years and slightly below long-term average precipitation.

- Groundwater levels were measured at 40 sites to monitor fluctuations in groundwater levels and evaluate potential regional effects from groundwater withdrawals at Yucca Mountain. Compared to the 1992 through 2005 baseline, 2006 median water levels increased in all monitored wells. The withdrawal of groundwater for Project activities has had no measurable effect on regional groundwater levels or spring flows.

- Compared to 2005, 2006 saw a decrease of 397 pounds of hazardous waste generated by the Project. The total quantity of hazardous waste collected during 2006 was 2,293 pounds; 284 pounds of universal waste were also collected. A total of 1,333 pounds of hazardous waste and 672 pounds of universal waste were shipped to a permitted treatment, storage, and disposal facility in 2006.

- The purchase of U.S. Environmental Protection Agency-designated recycled-content items was 98 percent in fiscal year 2006, up from 92 percent in fiscal year 2005.

- Two hundred and twenty two (222) environmental appraisal reports were completed in 2006. Thirteen of the appraisals required corrective action and 16 required on-the-spot fixes. There were no permit violations or reportable spills in 2006.

- There were no notable positive or negative trends in environmental performance in 2006 compared to 2005.

- Project personnel working at Yucca Mountain were instructed on the environmental and safety requirements that must be followed for field activities. Additional job-specific training was offered commensurate with job responsibilities. New employees must take a six-hour course titled General Employee Training that covers, among other things, requirements for environmental protection, pollution prevention, and safety and health. A computer-based annual refresher of these topics also is required of all employees. New employees who work unescorted at Yucca Mountain must attend site-access training. A computer-based training module that addresses the environmental compliance program was available to all managers and supervisors. When appropriate, Project personnel are trained in the management and transportation of hazardous waste, and in requirements for detecting and responding to releases of hazardous materials.

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## ABBREVIATIONS

| | |
|---|---|
| BLM | Bureau of Land Management |
| BSC | Bechtel SAIC Company, LLC (Limited Liability Company) |
| CAPP | Chemical Accident Prevention Program |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| CFR | Code of Federal Regulations |
| DOE | U.S. Department of Energy |
| EIS | Environmental Impact Statement |
| EMS | Environmental Management System |
| EPA | U.S. Environmental Protection Agency |
| EPCRA | Emergency Planning and Community Right-to-Know Act of 1986 |
| ES&H | Environmental, Safety and Health |
| ISO | International Organization for Standards |
| ISMS | Integrated Safety Management System |
| MSDS | Material Safety Data Sheet |
| NEPA | National Environmental Policy Act of 1969 |
| NRC | U.S. Nuclear Regulatory Commission |
| NWPA | Nuclear Waste Policy Act of 1982, as amended |
| OCRWM | Office of Civilian Radioactive Waste Management |
| ODS | ozone-depleting substances |
| QARD | Quality Assurance Requirements and Description |
| RCRA | Resource Conservation and Recovery Act of 1976 |
| ROWR | Right-of-Way Reservation |
| SER | Site Environmental Report |
| SHPO | State Historic Preservation Officer |
| TAD | transportation, aging, and disposal (waste canisters) |
| UIC | underground injection control |
| YMP | Yucca Mountain Project |

# 1. INTRODUCTION

This is the sixteenth annual Site Environmental Report (SER) prepared by the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM). The purpose of this report is to describe the OCRWM environmental program, compliance with environmental standards and requirements, and the environmental activities conducted during calendar year 2006.

This report was prepared in accordance with DOE Order 231.1A, DOE Manual 231.1-1A, and guidance from the DOE Office of Air, Water and Radiation Protection. The guidance emphasizes reporting emissions of, and human exposure to, radionuclides and other pollutants and hazardous substances. The Yucca Mountain Project (YMP) has not caused any public exposure to non-naturally-occurring radionuclides, nor is the YMP a major source of pollutants or hazardous substances. Therefore, this report does not emphasize those topics and differs from the content suggested in the guidance in the following ways:

- This report does not contain a chapter on environmental radiological monitoring, radiological doses, or releases from operation of facilities. The YMP does not manage radioactive materials except for a few sealed industrial sources. Moreover, there are no effluents that require monitoring. Thus, monitoring the environment or calculating potential doses to offsite or onsite populations is not applicable.

- A chapter identified in the guidance as *Environmental Non-Radiological Program Information* is reported in this site environmental report in Chapter 4, *Environmental Programs*. This was done because the non-radiological program information is best understood in the context of the YMP's environmental program.

- The YMP groundwater-monitoring program is included in Chapter 4 (instead of in a separate chapter as suggested in the guidance) because the Project does not release effluents into the groundwater. A description of the hydrology of Yucca Mountain and the surrounding region is contained in Section 1.1.3.

Yucca Mountain, which is the site for the repository, is in a sparsely populated part of southern Nye County, Nevada. The OCRWM operates other facilities in Nye and Clark Counties, Nevada, and one office building in Washington, DC. In Clark County, the OCRWM and its management and operating contractor, Bechtel SAIC Company, LLC (BSC), occupy 15 office buildings in a suburban business park in Las Vegas, Nevada. BSC also uses two warehouses in Las Vegas for receiving, storing, and distributing materials and equipment. A YMP Information Center is operated in Las Vegas to disseminate information on the YMP (this center was closed in 2007). Laboratory testing is conducted in two buildings at the DOE's National Nuclear Security Administration complex in North Las Vegas. Project activities conducted in offices in Las Vegas are primarily administration and technical support, management, scientific analyses and modeling, and engineering design. Similar activities are conducted by BSC in offices in

Washington, DC. In Nye County, the OCRWM operates Information Centers in Pahrump and Beatty (the Beatty Information Center was closed in 2007). All OCRWM facilities, except those at Yucca Mountain, are serviced by municipal utilities such as sewer, water, electrical,

telecommunications, and waste disposal. Utility services at Yucca Mountain are part of the operation and maintenance of that site and, therefore, the responsibility of the OCRWM.

Development of this report was not subject to the requirements of the OCRWM *Quality Assurance Requirements and Description* (QARD) (DOE 2006), as determined by the DOE. The report describes, however, the results of many activities that are subject to the OCRWM QARD (DOE 2006).

Finally, words and expressions that are underlined are defined in the Glossary at the end of the report.

## 1.1 SITE DESCRIPTION

The Yucca Mountain site ("the site") formally encompasses about 30,000 acres of land administered by the federal government in a remote part of the northern Mojave Desert. The site is in Nye County, south-central Nevada, about 100 miles northwest of Las Vegas, Nevada (Figure 1). The site is defined in 10 Code of Federal Regulations (CFR) Part 63.202 as the area recommended to the President by the Secretary of Energy on May 27, 1986 [section 112(b)(1)(B) of the Nuclear Waste Policy Act of 1982 (NWPA; 42 U.S.C. 10132(b)(1)(B)]. Congress did not change the boundary of the site when it enacted the Yucca Mountain Development Act on July 23, 2002. If there is a Congressional land withdrawal for a repository prior to or at the time of licensing by the U.S. Nuclear Regulatory Commission (NRC), then the withdrawn land would become the "new" Yucca Mountain site (10 CFR Part 63.202).

Yucca Mountain is an irregularly shaped, north-trending, volcanic upland, 4-6 miles wide and 25 miles long. The crest of that portion of the mountain being investigated by the OCRWM has an elevation of 4,600-4,950 feet. The main ridge in this area slopes steeply to the west into Crater Flat (elevation 3,900 feet) and gently eastward to Jackass Flats on the Nevada Test Site (elevation 3,600 feet).

The following sections briefly describe the physical, biological, cultural, and demographic settings of the Yucca Mountain area. More information about the site is contained in the *Yucca Mountain Site Description* (CRWMS M&O 2000) and in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002).

### 1.1.1 Climate and Meteorology

Typical of southwestern deserts, the climate at Yucca Mountain is warm and arid (CRWMS M&O 1999a; 2000, Section 2.3). Average minimum and maximum daily temperatures in Midway Valley near the Yucca Mountain site range from 72°F to 93°F in the summer and from 34°F to 51°F in the winter. Average annual precipitation at the network of Yucca Mountain meteorological stations ranges from 4 to 10 inches, depending on elevation and topography. Annual precipitation varies greatly among years because of differences in regional storm patterns. Occasional periods of persistent or heavy rains, particularly in the winter, have produced more than two inches of rain in a day. Summer thunderstorms can drop more than one

inch of rain in a matter of hours, sometimes resulting in flash floods along the usually dry washes that drain Yucca Mountain. Potential evaporation is almost 66 inches per year.

Winds in the region are influenced by nearby mountains and valleys, as well as large-scale weather systems. Winds near Yucca Mountain generally blow to the south or southeast during the day and to the north or northwest at night. Average hourly wind speeds range from 5.8 to 9.6 miles per hour, and calm periods are rare and short-lived. The strongest winds typically occur on exposed ridges. Maximum wind gusts have been recorded at more than 85 miles per hour on exposed ridges, and more than 60 miles per hour in valleys.

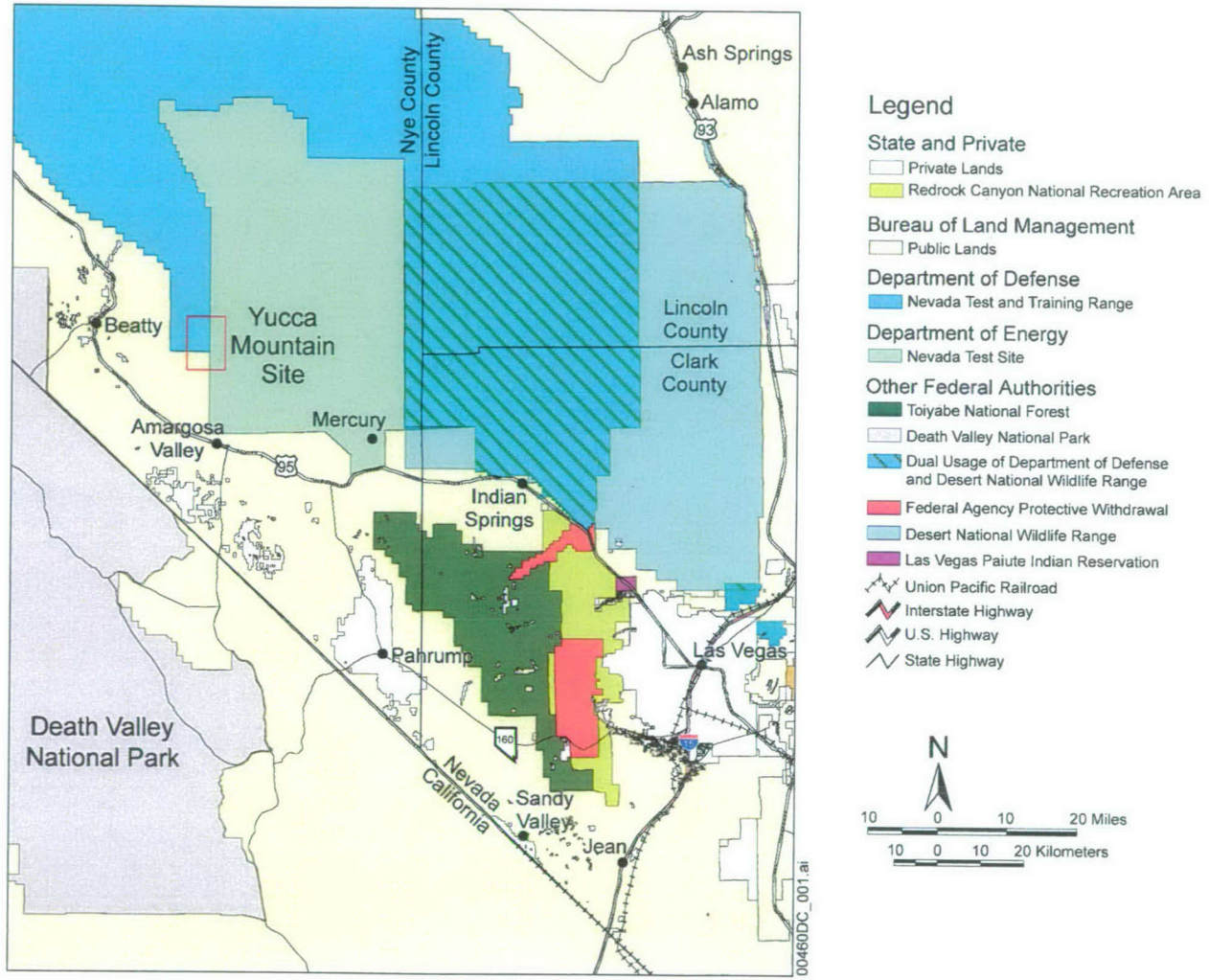



Figure 1. Land Use and Ownership Surrounding Yucca Mountain

### 1.1.2 Geology

The mountains and valleys visible today in the region of Yucca Mountain formed over the past 15 million years from movement along faults. Rock units in this region range in age from geologically old in some mountains (Precambrian era, or more than 570 million years old) to geologically recent in the valleys (Holocene epoch, or less than 10,000 years old). At Yucca Mountain, most rocks exposed at the surface originated from volcanic eruptions between 11.5 million and 14 million years ago.

The oldest and deepest rocks at Yucca Mountain are more than 570 million years old. They occur more than 4.7 miles below the surface in the immediate vicinity of the repository, but appear at the surface in several areas surrounding Yucca Mountain. Overlying these rocks are Paleozoic sedimentary rocks between 225 and 570 million years old. The lower part of these Paleozoic rocks, which are three miles thick and more than 1.1 miles below the surface, are part of a regional carbonate aquifer.

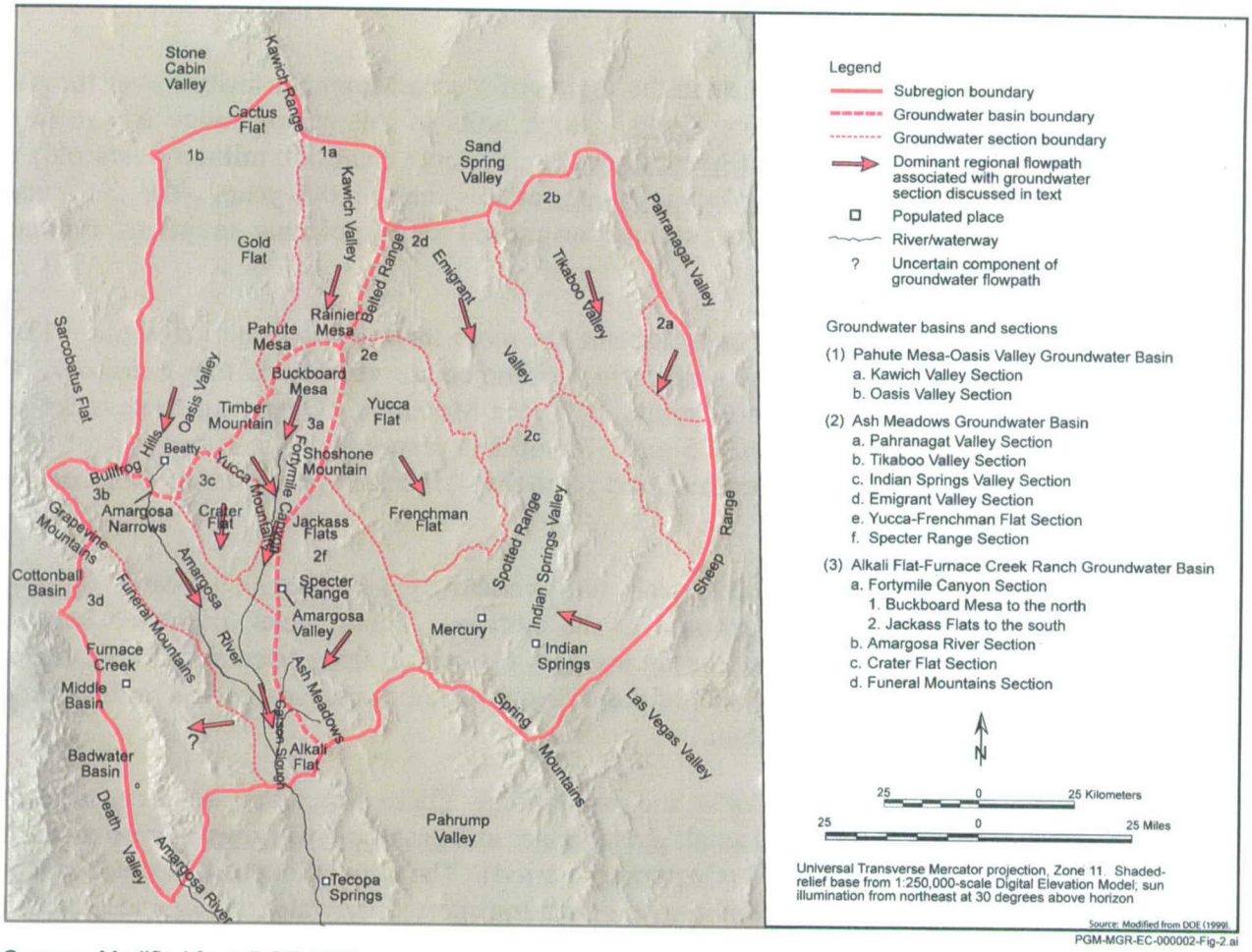
The Paleozoic rocks beneath Yucca Mountain are overlain by 1.6 miles of volcanic ash-flow tuffs and ashfalls that are widely exposed at the surface. These rocks originated between 11.5 million and 14 million years ago (during the Tertiary Period) from circular volcanic centers known as calderas. The eroded remnants of these calderas, some measuring many miles across, are still visible north of Yucca Mountain.

Overlying the Tertiary volcanic rocks at and surrounding Yucca Mountain are unconsolidated rocks known as alluvium and several small cinder cones and basaltic lava flows. These rocks are all younger than 1.6 million years old (Quaternary Period). The alluvial deposits developed from erosion of nearby highlands. The alluvium was then transported by water, wind, and gravity to lower elevations. Fans of alluvium form large aprons along the flanks of Yucca Mountain. Most of the alluvial deposits that are visible at the surface in the Yucca Mountain area probably formed within the last 100,000 years. In Crater Flat, west of Yucca Mountain, several small cinder cones and lava flows erupted between one million and 3.7 million years ago. The youngest volcanic center in the area is the Lathrop Wells cone, estimated to have erupted about 80,000 years ago. The cone is 9.3 miles southwest of Yucca Mountain.

Five earthquakes, with Richter magnitudes greater than 5.5, have been recorded within 60 miles of Yucca Mountain. Except for the Little Skull Mountain earthquake, all occurred near the Death Valley–Furnace Creek fault system more than 30 miles south of Yucca Mountain. The 1992 Little Skull Mountain earthquake occurred nine miles from Yucca Mountain and had a magnitude of 5.6 (CRWMS M&O 2000, Section 12.3).

### 1.1.3 Hydrology

Yucca Mountain is within the Alkali Flat–Furnace Creek Ranch Groundwater Basin of the Central Death Valley subregion (Figure 2). This groundwater system is closed, that is, water leaves the system only by evapotranspiration. Most recharge in this area is infiltration of precipitation on Pahute Mesa, Timber Mountain, and Shoshone Mountain in the central part of the subregion, and the Grapevine and Funeral Mountains in the southwestern part of the subregion (D'Agnese et al. 1997) (Figure 2).




Source: Modified from DOE 1999

Figure 2. Groundwater Basins in the Vicinity of Yucca Mountain

Groundwater in the saturated zone beneath the crest of Yucca Mountain occurs at a depth of 1,600 to 2,500 feet below the surface in volcanic aquifers and in a much deeper carbonate aquifer. This groundwater discharges naturally more than 50 miles south of Yucca Mountain at Alkali Flat (Franklin Lake Playa) and in Death Valley (Figure 2) (D'Agnese et al. 1997). Water used by the YMP is pumped from the volcanic aquifers in Crater Flat and Jackass Flats.

There are no springs, wetlands, or other natural sources of surface water at Yucca Mountain (Hansen et al. 1997). The usually dry washes in the area may contain flowing water after very heavy, sustained rain or snow. On rare occasions, water in the washes flows to the Amargosa River more than 25 miles to the south. Although referred to as a "river," the Amargosa is dry along most of its length. Exceptions include short stretches of the river near Beatty, Nevada; Tecopa, California; and southern Death Valley, California, where the river ends in the Badwater Basin, 260 feet below sea level (DOE 2002, Section 3.1.4.1.1).

### 1.1.4 Biological Resources

Plants typical of the Mojave Desert are most abundant at elevations below 4,000 feet. Common shrubs include white bursage *(Ambrosia dumosa)*, creosotebush (*Larrea tridentata)*, Nevada

jointfir (*Ephedra nevadensis*), littleleaf ratany (*Krameria erecta*), pale wolfberry (*Lycium pallidum*), California buckwheat (*Eriogonum fasciculatum*), and spiny hopsage (*Grayia spinosa*) (CRWMS M&O 1998a).

Species typical of the Great Basin Desert and the transition zone between the Great Basin Desert and Mojave Desert are most abundant at elevations above 4,000 feet, primarily in the northern part of the Project area. Blackbrush (*Coleogyne ramosissima*) is the most abundant shrub at mid- to high-elevations growing on gentle slopes. Steep slopes at high elevations are dominated by California buckwheat, heathgoldenrod (*Ericameria teretifolius*), Nevada jointfir, broom snakeweed (*Gutierezzia sarothrae*), and green ephedra (*Ephedra viridis*). Big sagebrush (*Artemisia tridentata*) is common on some steep north-facing slopes (CRWMS M&O 1998a).

Thirty-six species of mammals have been recorded at Yucca Mountain, none of which are classified as threatened or endangered. Rodents are the most abundant mammals, with 17 documented species (CRWMS M&O 1997). Seven species of bats have been recorded at Yucca Mountain (CRWMS M&O 1998b); two of these, the long-legged myotis (*Myotis volans*) and fringed myotis (*Myotis thysanodes*), are considered sensitive species in Nevada by the Bureau of Land Management (BLM). Three species of rabbits, seven carnivores, and two ungulates (mule deer [*Odocoileus hemionus*] and feral burros [*Equus asinus*]) also have been seen at Yucca Mountain (CRWMS M&O 1999b).

Twenty-seven species of reptiles have been found at Yucca Mountain, including 12 species of lizards, 14 species of snakes, and one specie of tortoise (CRWMS M&O 1998c). The desert-tortoise (*Gopherus agassizii*) is listed as threatened under the Endangered Species Act of 1973 (Section 2.3.1), and the western chuckwalla (*Sauromalus obesus*) is classified as a sensitive species in Nevada by the BLM.

More than 120 species of birds have been seen in the Yucca Mountain region, including 15 species of raptors (CRWMS M&O 1998d). Western burrowing owls (*Speotyto cunicularia hypugaea*), which are uncommon at the site, are classified as sensitive in Nevada by the BLM.

### 1.1.5 Cultural Resources

Archaeological resources discovered at and near Yucca Mountain indicate past use by small, mobile hunter-gatherer societies. This use may have lasted for several thousand years, followed by about 150 years of sporadic and transitory occupation by people of European extraction for limited prospecting and, possibly, ranching. The region was inhabited by Native American populations for at least 12,000 years. At first, most settlement seems to have centered along major drainages, which presumably were corridors for wild game and food plants. By 7,000 years ago, a second settlement pattern is discernible, with the establishment of temporary camps in the uplands of Yucca Mountain, some distance away from major drainages. A third shift in the pattern of settlement occurred about 1,500 years ago, indicated by the presence of sites, often with grinding stones, on alluvial fans or in small rock shelters in uplands. By that time, sites were no longer being established along major drainages, perhaps indicating that these waterways were dry. Instead, sites were located near small, seasonal water sources such as tanks or depressions in rock outcrops. A fourth and most recent period of settlement is associated with Euroamerican settlers and prospectors, indicated by rock cairns (piles of rock), tin cans, and

temporary camps. At the time of the first recorded arrival of Euroamericans in 1849, the area was inhabited by Southern Paiute and Western Shoshone Indians (Stoffle et al. 1990).

Many archaeological surveys have been conducted at Yucca Mountain. As a result, more than 900 archaeological and historic sites, ranging from single fragments of stone tools and potsherds to extensive campsites and quarries, have been identified in the main Yucca Mountain Archaeological Management Area.

### 1.1.6 Demography

Nye County and adjoining parts of neighboring counties is a rural, sparsely populated region where most residents are concentrated in a few small communities. Estimated populations within each of these Nevada counties in July 2006 were as follows: 41,302 in Nye County, 3,987 in Lincoln County, and 1,262 in Esmeralda County (NSDO 2007). The July 2006 estimated population of Inyo County, California, was 18,327 (California State Department of Finance 2006).

Near the Yucca Mountain site are the Nevada communities of Beatty, Amargosa Valley, and Pahrump in Nye County, and Indian Springs in Clark County. The July 2006 estimated populations of these communities are 1,025; 1,435; 36,645; and 1,907, respectively (NSDO 2007). Unofficially, about 48 people reside at Furnace Creek in Death Valley about 35 miles southwest of Yucca Mountain; about 52 people reside in the town of Shoshone about 65 miles south of Yucca Mountain; and about 145 people reside in the town of Tecopa about 75 miles south of Yucca Mountain.

### 1.1.7 Land Use

Land within the Yucca Mountain site is controlled by the DOE, the U.S. Air Force, and the BLM (Figure 1). Public access to DOE and U.S. Air Force lands is restricted. Some off-highway driving and other recreational activities occur on the BLM portion of the site.

Because of a lack of surface water and very deep groundwater, there is little agriculture in the region surrounding Yucca Mountain. The nearest farms are in the Amargosa Valley, 15 miles to the south. The Pahrump Valley, 47 miles to the southeast, also has some farming operations. There are a limited number of BLM-issued grazing leases for southern Nye County, and none have been issued for lands at or surrounding the site. Several mining operations occur near Yucca Mountain; the closest is a cinder mine about nine miles southwest of the site.

Areas to the south and southwest of Yucca Mountain are popular throughout the year for recreational activities such as camping, hiking, hunting, and nature study. Two that are particularly well known are Ash Meadows National Wildlife Refuge (about 25 miles south) and Death Valley National Park (about 20 miles southwest).

## 1.2 MISSION AND CURRENT ACTIVITIES

In 1982, Congress enacted the NWPA. The Act established the federal government's responsibility to provide for the permanent disposal of the nation's spent nuclear fuel and high-level radioactive waste and set forth a process and schedule for the disposal of these materials in

a geologic repository. In 1987, the Act was amended designating Yucca Mountain, Nevada, as the single candidate site for a repository. On July 23, 2002, the President signed into law a Congressional Joint Resolution approving Yucca Mountain for the development of a geologic repository per Section 115(c) of the Nuclear Waste Policy Act, as amended.

For the past several years, the Department has been preparing a license application that will be submitted to the NRC to construct and ultimately operate the repository. Upon submittal, the NRC will have three years to review the application, conduct its licensing proceedings, and reach a decision on a construction authorization. Should the NRC grant the construction authorization, the Department will update the license application and request a license to receive and possess high-level radioactive waste as initial construction of the repository nears completion. If the Commission grants the license to receive and possess, the Department will begin placing the waste into the repository. In the final phase of licensing, when the repository has stopped receiving waste for disposal, the Department will apply for a license amendment to permanently close the repository, which will address plans to decommission surface facilities.

During 2006, DOE interactions with the NRC continued to focus on addressing and resolving topics that the NRC considers important to evaluating the performance of a repository at Yucca Mountain. The DOE also continued to create and maintain a nuclear safety culture and to rigorously comply with quality-assurance procedures, which are two key elements necessary for successful licensing and safe operation of the repository.

During 2006, the OCRWM continued testing at Yucca Mountain to further refine an understanding of how a repository would perform far into the future. Some of these studies may continue indefinitely or until the repository is permanently closed. Design and operating decisions could be modified based on the results of these studies and tests, as well as other technological and policy developments. The ongoing learning process is designed to challenge current models and assumptions about Yucca Mountain and lead to continuous improvement.

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# 2. ENVIRONMENTAL COMPLIANCE

This section briefly describes the laws and regulations that applied to YMP activities conducted in 2006 (see the *Project Requirements Document* for more information [BSC 2003]). This section also summarizes actions taken by the OCRWM to comply with those laws and regulations, lists the environmental permits that were applicable to YMP activities in 2006 (Table 1), and summarizes permit-associated litigation (Section 2.10). Also included is a description of laws and regulations listed in the DOE guidance for preparing site environmental reports that were not applicable to YMP activities in 2006 and an explanation of why they were not applicable.

During 2006, the YMP had no violations of environmental permits or noncompliance actions; no reportable occurrences that required notification of a regulatory agency; and no notices of violations, deficiencies, or other types of enforcement actions concerning environmental compliance.

## 2.1 GENERAL REQUIREMENTS

### 2.1.1 Nuclear Waste Policy Act of 1982

The NWPA established a federal policy for the disposal of spent nuclear fuel and high-level radioactive waste in geologic repositories and assigned to the DOE the responsibility for carrying out that policy. The NWPA directs the DOE to determine, through site characterization, whether Yucca Mountain is a suitable site for a repository. On February 14, 2002, the Secretary of Energy recommended the Yucca Mountain site to the President, thereby ending the site characterization phase of the project. The recommendation process set forth in the NWPA, as amended, was followed, culminating in the enactment of the Yucca Mountain Development Act on July 23, 2002.

During the remainder of 2002 and through 2006, the OCRWM continued scientific studies at Yucca Mountain to further refine the understanding of how a repository at Yucca Mountain would perform far into the future. These studies and tests were conducted in a manner that minimizes, to the maximum extent practicable, adverse environmental impacts. To accomplish this, the OCRWM continued its comprehensive and integrated environmental program to ensure compliance with applicable laws and regulations, collect data and monitor impacts of site activities, and minimize those impacts.

### 2.1.2 National Environmental Policy Act of 1969

The National Environmental Policy Act of 1969 (NEPA), and the regulations that implement the Act (40 CFR Parts 1500-1508), establish a process that federal agencies must follow to evaluate and document the potential benefits and consequences of proposed major federal actions on human and natural environments. Those evaluations are conducted to assist agencies in making informed decisions about their proposed actions. The DOE has developed regulations (10 CFR Part 1021) for implementing NEPA requirements and to ensure compliance with Executive Order 11514, Protection and Enhancement of Environmental Quality (35 Federal Register 4247).

Table 1. Permits Applicable to Project Activities in 2006

| Regulation Permit Type | Permit Number or Case File | Permit Period | Comments |
|---|---|---|---|
| Materials Act of 1947<br>Free Use Permit | N-63370, Borrow Pit #1 | 12/3/99 - 1/6/08 | Issued for a ten-year period. |
| | N-51530, Coyote Wash Borrow Pit | 10/26/90 - N/A | Expires when construction ends. |
| | N-82254, Muck Pile | 7/19/06 - 7/21/11 | Issued in 2006. |
| Federal Land Policy and Management Act of 1976<br>Right-of-Way Reservation [a] | N-47748 | 1/6/88 - 1/6/08 | Renewed January 2001. |
| | N-48602 | 10/10/89 - 1/6/08 | Renewed January 2001 (and again on April 8, 2004). |
| | N-82646 | 12/22/06 -1/01/27 | Communications Use Lease. |
| | N82646-01 | 12/22/06-12/31/08 | Temporary Use Permit. |
| Public Land Withdrawal | N-50250 | 9/17/90 - 1/31/10 | Withdrawal extended in August 2002. |
| Endangered Species Act of 1973<br>Biological Opinion | 1-5-96-F-307R | 7/23/97 - N/A | Covers scientific testing and site confirmation investigations before repository construction. |
| Biological Opinion | 1-5-00-F-518 | 8/28/01 - N/A | Covers effects of construction, operation, and monitoring of a geologic repository at Yucca Mountain. |
| NAC 503<br>Scientific Collection Permit | S24382 | 1/12/06 - 12/31/06 | New permit obtained every year. |
| Clean Air Act/NAC 445B<br>Air Quality Operating Permit | AP9199 - 0573.01 (Rev. 01) | 7/23/01 - 7/23/06 | New permit obtained every five years (Rev. 01 of permit was in effect until Rev. 02 was issued). |
| | AP9199 - 0573.02 (Rev. 02) | 8/8/06 - 7/23/11 | |
| Clean Water Act of 1977/NAC 445A<br>General Discharge Permit | NVR100000-35258, Construction Stormwater General Permit | 9/16/02-9/15/07 | |
| | GU9201 - 40037, Large Capacity Septic Tank General Permit to Operate and Discharge | 7/22/04 - 7/22/09 | |
| Safe Drinking Water Act/<br>NAC 445A<br>Public Water System Permit | NV0000867 | 9/30/05 – 9/30/06 | Permit renewed annually. |
| | | 9/30/06 - 9/30/07 | |
| Underground Injection Control Permit | UNEV89031 | 1/30/96 - 1/26/01 | Renewal application filed July 2000; existing permit remains in effect until state issues a new permit. |

Table 1. Permits Applicable to Project Activities in 2006 (continued)

| Regulation Permit Type | Permit Number or Case File | Permit Period | Comments |
|---|---|---|---|
| NRS 533<br>Water Appropriation Permits | 63262-63267 | N/A | Permit applications for permanent water rights: applications denied. Decision is being appealed. |
| | J-12 and J-13 - Joint Stipulation and 2004 agreement between the DOE and the State of Nevada<br>57375, VH-1 | Undefined | Potable and non-potable water for ongoing site maintenance, operations and testing. Withdrawals for potable water are limited to 420,000 gallons per year; withdrawals of non-potable water are as necessary to maintain the status quo of the site. |
| | | 4/2/92 - N/A | Permanent water right. Proof of Application of Water to Beneficial Use for 2.3 acre-feet submitted April 5, 2002. |
| NAC 477<br>Hazardous Materials Storage Permit | 1403/2796 | 3/1/06 – 2/28/07 | Permit reissued annually. |

[a] Does not include five Right-of-Way Reservations for small sites in Nevada and California.

As required by Section 114(f) of the NWPA, a Final Repository Environmental Impact Statement (EIS) (DOE 2002) was submitted with the Secretary of Energy's site recommendation to the President on February 14, 2002. The preferred alternative was to proceed with the Proposed Action, which is to construct, operate and monitor, and eventually close a geologic repository at Yucca Mountain. The Final Repository EIS identified the use of mostly rail, both nationally and in Nevada, as the preferred way to transport spent nuclear fuel and high-level radioactive waste to the repository. Major conclusions of the Final Repository EIS were that the construction, operation, and closure of a repository at Yucca Mountain would cause small, short-term impacts to public health. These impacts would occur primarily from nonradiological traffic fatalities during transport of the waste to the repository from existing commercial and DOE sites. The Final Repository EIS found that long-term impacts to public health from the repository would be very small.

Since publication of the Final Repository EIS in 2002, the design of the repository has evolved, along with the plans to construct and operate the repository. For example, newly designed surface and subsurface facilities would allow most commercial spent nuclear fuel to be packaged at the reactor sites in transportation, aging, and disposal (TAD) canisters. Commercial spent nuclear fuel arriving at the repository in packages other than TAD canisters would be repackaged by the DOE into TAD canisters at the repository. The DOE would construct these facilities over several years to accommodate the increased rate of receipt of spent nuclear fuel and high-level radioactive waste as the repository reaches its design capacity. Because of these changes, the DOE announced on October 13, 2006 (71 Federal Register 60490), its intent to prepare a Supplement to the 2002 Final Repository EIS, consistent with the NEPA and the NWPA, to

evaluate the potential environmental impacts of the proposed current design and operation of the repository.

On April 8, 2004, the DOE issued a Record of Decision on the Final Repository EIS (69 Federal Register 18557). It announced the DOE's selection, both nationally and in the State of Nevada, of the mostly rail scenario as the method for transporting waste to the repository. Under this scenario, the DOE would rely on a combination of rail, truck and possibly barge to transport up to 70,000 metric tons of radioactive waste to Yucca Mountain. Most of the waste, however, would be transported by rail. The DOE's decision to select the mostly rail scenario in Nevada would require the construction of a rail line to connect Yucca Mountain to an existing rail line in the State of Nevada. To that end, in the same Record of Decision for the Final Repository EIS (69 Federal Register 18557), the DOE also selected the Caliente corridor to study possible alignments for a rail line

On July 6, 2006, the Department issued a notice of availability for public review and comment on a draft *Environmental Assessment for the Proposed Infrastructure Improvements for the Yucca Mountain Project, Nevada* (DOE/EA-1566) (71 Federal Register 38391). The assessment examined the impacts of a proposal by the Department to repair, replace, or improve certain facilities, structures, roads, and utilities (collectively referred to as infrastructure) at Yucca Mountain. The proposed action would enhance safety at Yucca Mountain and enable the Department to safely continue ongoing operations, scientific testing, and maintenance until the NRC decides whether to authorize construction of a repository. The activities proposed in the Environmental Assessment, and their effects on the environment, are being re-examined in the Supplement to the 2002 Final Repository EIS (previously discussed).

In accordance with DOE Order 451.1B, an annual summary of NEPA activities conducted by the DOE during 2006 and planned for 2007 was completed in 2007 (Sproat 2007).

### 2.1.3 Atomic Energy Act of 1954

The Atomic Energy Act of 1954 gives authority to the DOE and to the NRC to regulate the use of nuclear materials by the government and by commercial entities. The Act ensures proper management, production, possession, and use of radioactive materials. It grants to the DOE the authority to develop generally applicable standards for protecting workers, the public, and the environment from radioactive materials. In accordance with the Atomic Energy Act of 1954, the DOE has established a system of requirements issued as DOE directives and codified federal regulations.

There are no work processes on the YMP that require monitoring of radioactive effluents. The Project maintains an inventory of sealed-instrument check sources and moisture/density tools for moisture/density measurements and some limited well-logging activities.

### 2.1.4 Executive Order 13148, Greening the Government through Leadership in Environmental Management

Executive Order 13148 (65 Federal Register 24595) requires federal agencies to integrate environmental accountability into day-to-day decision-making and long-term planning. One

goal of this Order is to ensure that strategies are established that support environmental leadership programs, policies, and procedures by requiring the implementation of Environmental Management Systems (EMSs) at applicable federal facilities by December 31, 2005. The EMS for the YMP is described in Chapters 3 and 4.

### 2.1.5 Executive Order 13101, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition

Executive Order 13101 (63 Federal Register 49643) establishes purchasing guidelines and reporting requirements for federal agencies. It expands and strengthens the federal government's commitment to recycling and requires that, whenever possible, federal agencies procure environmentally preferable products and services and purchase recycled-content products identified by the U.S. Environmental Protection Agency (EPA). The Project's efforts to comply with this Executive Order are described in Chapters 3 and 4.

### 2.1.6 Executive Order 13123, Greening the Government through Efficient Energy Management

Executive Order 13123 (64 Federal Register 30851) requires federal facilities to reduce emissions of greenhouse gases, improve energy efficiency and water conservation, and expand the use of renewable energy. This Executive Order requires that sustainable-design principles be applied to the siting, design, and construction of new facilities. The Project's efforts to comply with this Executive Order are described in Section 4.8.3 and Chapters 3 and 4.

### 2.1.7 Executive Order 13149, Greening the Government through Federal Fleet and Transportation Efficiency

Executive Order 13149 (65 Federal Register 24607) requires federal facilities to reduce the consumption of petroleum fuels by using alternative fuels and by acquiring vehicles that are fuel efficient. Efforts to implement this Order on the YMP include the purchase and use of fuel-efficient vehicles.

## 2.2 LAND USE

### 2.2.1 Federal Land Policy and Management Act of 1976

The Federal Land Policy and Management Act of 1976 establishes federal policy for government-owned lands administered by the BLM. The Act mandates that these lands be managed in a way that will protect environmental quality, preserve certain lands in their natural condition, and provide for outdoor recreation and human occupancy and use. Because some YMP activities are conducted on BLM-administered public land, the OCRWM must comply with BLM requirements for access to and use of that land.

Access to BLM-administered land and U.S. Air Force-administered BLM land at Yucca Mountain for site activities is via Right-of-Way Reservations (ROWRs) issued and subsequently renewed by the BLM (BLM 1988, 1989, 1994; Wells 2001a, 2001b, 2001c). In 1990, the BLM withdrew 4,256 acres of public land at Yucca Mountain from the mining and mineral-leasing laws, including the filing of new mining claims; this withdrawal is valid until January 31, 2010

(67 Federal Register 53358). During 2006, BLM issued OCRWM a Communications Use Lease and a Short-Term Right-of-Way for a new communications site (Spence 2006). Over the years, the OCRWM has acquired 48 ROWRs from the BLM for scattered sites throughout Nevada and southern California for seismic, radiation, and stream-flow monitoring stations, pits to study volcanism and faulting, and communications sites. Most of these sites are less than 0.3 acres. Seven of the ROWRs were still active at the end of 2006. The other 41 ROWRs were either transferred to other agencies or the equipment was dismantled, the site reclaimed, and the ROWR identified to the BLM for relinquishment.

All BLM ROWRs require that the YMP comply with applicable environmental laws and regulations. Environmental program activities described in Section 4 are, therefore, conducted on all ROWRs, as applicable. BLM also requires the DOE to recontour and revegetate disturbed sites before relinquishing them, and to monitor the growth of vegetation on those sites until reclamation is successful.

### 2.2.2 Materials Act of 1947

The Materials Act of 1947 authorizes the BLM and other land management agencies to issue free-use permits to federal and state agencies for use of common varieties of sand, stone, and gravel on public lands. Since 1990, the BLM has issued the OCRWM four free-use permits to excavate sand and gravel. One of the permits is for a borrow pit in Coyote Wash that has not been developed. The second permit, for a borrow pit near Fortymile Wash, was allowed to expire in 2001 after recontouring and reclamation had been completed. The third, for Borrow Pit #1 east of Fran Ridge, was to expire in 2001; the OCRWM applied to the BLM for a renewal in 1999. A renewal of that permit was granted in February 2000 and is valid until January 6, 2008 (Drais 2000). About 637 cubic yards of material were removed from this pit in 2006. The fourth permit was granted on July 19, 2006, for use of the excavated rock at the muck pile at Yucca Mountain (Peterson 2006).

## 2.3 BIOLOGICAL RESOURCES

### 2.3.1 Endangered Species Act of 1973

The Endangered Species Act of 1973 requires federal agencies to consult with the U.S. Fish and Wildlife Service to ensure that their actions do not jeopardize the continued existence of threatened or endangered species, or destroy or adversely modify their critical habitats. This Act also prohibits killing, injuring, or otherwise taking a threatened or endangered species, unless that taking is incidental to an otherwise lawful act and conducted in accordance with an incidental-take provision issued by the Service. The desert tortoise is the only threatened or endangered species at Yucca Mountain. The Yucca Mountain site is not classified as critical habitat for this threatened species.

In 1989, the DOE consulted with the U.S. Fish and Wildlife Service about the effects of site characterization activities on desert tortoises. The Service concluded in a 1990 biological opinion that it was unlikely that site characterization and related activities would jeopardize the desert tortoise (McNatt 1990). In 1996, the OCRWM reinitiated formal consultation to allow the Service to clarify its interpretation of take, revise the incidental-take limit, and reevaluate terms

and conditions for relocating tortoises. In a 1997 biological opinion, the Service again concluded that it was unlikely that completion of site characterization and related activities would jeopardize the desert tortoise. Consequently, the Service revised the terms and conditions the YMP must follow to legally and incidentally take desert tortoises (Buchanan 1997). That biological opinion and the incidental-take provision were applicable to all YMP activities conducted during 2006.

The 1997 incidental-take provision requires the YMP to (1) minimize harm to tortoises by conducting pre-activity and clearance surveys, (2) remove tortoises and tortoise nests from construction sites, (3) design and monitor escapable trenches, (4) control litter, (5) set speed limits, (6) reclaim habitat, and (7) implement a worker-education program. Many parts of the integrated environmental program described in Section 4 are conducted to comply with these requirements. For example, litter control, design of trenches, and other requirements are incorporated into projects during land access evaluations (Section 4.1). Surveys are conducted to find and protect tortoises (Section 4.2). Reclamation of desert tortoise habitat is conducted as described in Section 4.3. The training program described in Section 4.11 includes information about the conservation and protection of desert tortoises.

One desert tortoise was killed by Project activities in 2006. It was found dead on an access road at Yucca Mountain in May. This is the third tortoise to have been killed on an access road at Yucca Mountain since 1997. An annual report of activities conducted to comply with the incidental-take provision was submitted to the U.S. Fish and Wildlife Service in February 2007 (Spence 2007a).

The OCRWM also consulted with the U.S. Fish and Wildlife Service on the effects of construction, operation, monitoring, and closure of a geological repository at Yucca Mountain. The Service concluded that those actions are not likely to jeopardize the continued existence of the desert tortoise (Williams 2001). No actions were conducted under that Biological Opinion in 2006.

### 2.3.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act implements various treaties and conventions between the U.S. and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Taking, killing, or possessing migratory birds is unlawful under this Act unless permitted by the U.S. Fish and Wildlife Service.

Surveys at Yucca Mountain are conducted before clearing vegetation (Section 4.2), in part to ensure that migratory birds are not harmed during those activities. In addition, facilities such as water tanks are inspected during appraisals (Section 4.10) to ensure that migratory birds are not being trapped or otherwise harmed.

### 2.3.3 Nevada State Wildlife Statutes

The NAC 503 prohibits capturing or harming species classified as protected by Nevada without a permit. The desert tortoise is classified in Nevada as threatened with extinction and has been placed on the state list of fully protected species. Because the YMP is required to remove desert tortoises that may be harmed by Project activities, BSC maintains a permit issued by the Nevada

Department of Wildlife for the capture and relocation of desert tortoises (Nevada Department of Wildlife 2006). That permit also allows BSC to capture and possess other species for wildlife monitoring studies at Yucca Mountain. No tortoises or other wildlife were captured or possessed under this permit in 2006. An annual report was submitted to the Nevada Department of Wildlife in January 2007 (Green 2007).

### 2.3.4 Executive Order 13112, Invasive Species

Executive Order 13112 (64 Federal Register 6183) was developed to prevent and control the introduction of invasive, nonnative species to minimize economic, ecological, and human-health impacts. Applicable portions of the Executive Order require the YMP to prevent the introduction of invasive species, monitor and control those species, restore native species, and exercise care when taking actions that could promote the introduction or spread of invasive species.

In order to implement this Executive Order, disturbed sites are revegetated as soon as possible after decommissioning to reduce the time available for invasive plant species to become established. Native perennial species are seeded or planted during reclamation to reduce colonization of invasive plants. The abundance of nonnative species on reclaimed sites is then monitored periodically, and control efforts such as weeding and reseeding of native perennials may be implemented to reduce the abundance of invasive species. Reclamation activities conducted during 2006 are described in Section 4.3.

## 2.4 CULTURAL RESOURCES

The National Historic Preservation Act is the principal law regulating the protection of historic properties and cultural resources at Yucca Mountain. Others include the Archaeological Resources Protection Act of 1979; Antiquities Act of 1906; American Indian Religious Freedom Act (as amended), and Native American Graves Protection and Repatriation Act. In addition, the YMP operates to Executive Order 11593 (36 Federal Register 8921), Executive Order 13007 (61 Federal Register 26771), Executive Order 13084, (63 Federal Register 27655), and the *American Indian and Alaska Native Tribal Government Policy* (DOE 2000). Many of these Executive Orders and policies address cultural values and beliefs of Native Americans, and protect and preserve their religious rights and practices. The goal of these laws and policies is to ensure that historic properties and cultural and religious values are considered when planning and conducting federal activities, and to consult with state and federal agencies, Native Americans, and other interested parties when appropriate.

Compliance with most of these statutes, implementing regulations, and executive orders is through DOE Policy 141.1. The YMP provides all survey reports, data recovery plans, and annual reports to the State Historic Preservation Office (SHPO) for comment and review. In 2006, representatives of the SHPO participated in oversight and review of the YMP program, commenting on survey reports and participating in discussions of future work plans at Yucca Mountain.

The OCRWM has developed and implemented a comprehensive program for identifying, evaluating, and (if necessary) treating effects of project activities on historic properties. For

example, any proposed land-disturbing activity must have a pre-construction inventory survey conducted prior to the disturbance. If cultural resources are discovered, they are evaluated for their importance and eligibility for inclusion in the *National Register of Historic Places*. To the extent possible, effects to these sites are avoided. When avoidance is not possible, potential effects on historic properties are minimized or mitigated through data recovery or other means in accordance with Section 106 of the National Historic Preservation Act. Activities conducted in 2006 to implement that program are described in Section 4.4.1.

All personnel working at Yucca Mountain are informed of their responsibilities for protecting archaeological resources. That training is described in Section 4.11.

The OCRWM consults with certain Native American tribes and organizations regarding religious and cultural concerns about historical properties. The OCRWM conducts a Native American Interaction Program with 16 tribes and one Native American organization that have traditional ties to the Yucca Mountain area. Interactions conducted during 2006 are described in Section 4.4.3.

## 2.5 AIR QUALITY

The Clean Air Act of 1977, as amended, regulates activities affecting air quality at Yucca Mountain. That Act requires, among other things, compliance with national air-quality standards, permits for operating air pollution sources, and limits on emissions of certain hazardous air pollutants.

40 CFR Part 63 did not apply to YMP activities conducted in 2006. These federal regulations set forth emission limits and other requirements for activities that generate emissions of certain types of hazardous air pollutants. No pollutants covered by these regulations have been emitted by YMP activities to date.

The Nevada Division of Environmental Protection is responsible for implementing and enforcing most other requirements of the Clean Air Act of 1977 in Nevada. State regulations (NAC 445B) require an air-quality operating permit for large generators and other point sources of air pollution and for activities that are projected to disturb more than five acres. The OCRWM has held an operating permit for land disturbances since 1991 and has obtained permits, as needed, for the operation of generators and other emission sources. In mid-1995, the state consolidated those permits into a single Class-II air-quality operating permit (Johnson 1995). The permit is issued by the state for a five-year period and it was renewed, with several modifications, on August 8, 2006 (DeBurle 2006).

Six systems were permitted under the renewed Class-II air-quality operating permit. As required, an annual report summarizing emissions during 2006 was submitted to the Nevada Division of Environmental Protection in February 2007 (Wade 2007a).

Because of a reduction in site activities, less than one ton of reportable air pollutants were emitted from the six permitted systems during 2006. The maximum amount of air pollutants that is allowed under a Class-II permit is 100 tons.

The air-quality operating permit requires the YMP to control fugitive dust. This was done throughout 2006 by applying water to unpaved roads and disturbed areas. In addition, disturbed areas no longer required for the YMP were reclaimed (Section 4.3).

Before 1999, the air-quality operating permit stipulated that the DOE must sample ambient air for respirable particulate matter 10 micrometers or less in diameter (known as $PM_{10}$). Although no longer required by the permit, the YMP continues to monitor $PM_{10}$ because of its importance in establishing trends and detecting changes in air quality. The number of monitoring sites remained at two during 2006. Section 4.5 describes the results of monitoring in 2006.

The Clean Air Act of 1977 also regulates the service, maintenance and repair, and disposal of appliances and air conditioning systems from motor vehicles that contain Class I and Class II ozone-depleting substances (ODS) (40 CFR Part 82). YMP technicians who service these systems are certified and follow procedures to minimize releases of ODS.

## 2.6 WATER QUALITY AND AVAILABILITY

### 2.6.1 Clean Water Act of 1977

The Clean Water Act of 1977, as amended, establishes federal policy for restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. Regulations that implement the Act address effluent discharges, water quality standards, and discharges of oil and hazardous substances into surface water. Only those parts of the Act that regulate discharge of liquid effluents to the surface (including stormwater) and discharge of dredged or fill material were applicable to the YMP in 2006.

Permits to discharge liquid effluents are issued under the National Pollutant Discharge Elimination System (40 CFR Part 122). Implementation and enforcement of this part of the Clean Water Act of 1977 are delegated to the Nevada Division of Environmental Protection (NAC 445A). During 2006, the YMP operated under general discharge permits issued in September 2002 for stormwater discharges from construction sites (Lawson 2002) and in July 1995 and July 2004 for sanitary sewage discharges to a septic tank and leachfield (Saunders 1995 and Leger 2004). The current large-capacity septic tank permit was issued by the State of Nevada on July 22, 2004, and expires on July 22, 2009.

Section 404 of the Clean Water Act of 1977 requires that a permit from the U.S. Army Corps of Engineers is required before placing dredge or fill materials into washes that are classified as waters of the United States (33 CFR Part 320). To ensure compliance with this requirement, all new surface-disturbing activities are evaluated as part of the land access process (Section 4.1).

### 2.6.2 Safe Drinking Water Act of 1974

The Safe Drinking Water Act gives the EPA responsibility and authority to regulate public drinking water supplies. The EPA does this by establishing drinking water standards, delegating to states the authority for enforcing those standards, and protecting aquifers from such things as injection of wastes and other materials into wells.

The Nevada Bureau of Safe Drinking Water, Division of Environmental Protection, enforces drinking water standards (NAC 445A). The water supply system at Yucca Mountain is classified as a public water supply, and an annual permit to operate that system was first granted in April 1996. The permit is renewed annually (Nevada Division of Environmental Protection 2005).

All drinking water for the site comes from Wells J-12 and J-13. In 2006, by agreement with the State of Nevada, water was pumped periodically from Wells J-12 and J-13 to replenish the water in the distribution system.

As required by the public water-system permit, quarterly results of sampling for coliform bacteria were submitted to the state; all samples were negative. The results of annual sampling for nitrate, fluoride, total trihalomethane, and haloacetic acid were submitted to the state in 2006. Sampling and other activities conducted during 2006 were summarized in an annual report submitted to the Nevada Division of Environmental Protection in February 2007 (Spence 2007b).

On January 23, 2006, the EPA enacted a new arsenic standard for public water systems. The standard was lowered from 50 parts per billion (ppb) to 10 ppb. Arsenic levels in Wells J-12 and J-13 have varied over the years between 9 ppb and 12 ppb or just slightly above the new standard. To meet the new standard, the YMP installed an arsenic treatment system at Yucca Mountain on January 16, 2006. The new system reduces arsenic levels in the water to below 1 ppb. The results of arsenic sampling (pre- and post-treatment) were submitted to the state in 2006.

Another component of the Safe Drinking Water Act of 1974 that is applicable to the YMP in 2006 is the underground injection control (UIC) program (40 CFR Part 144). This program was established to prevent contamination of underground sources of drinking water from improper design, construction, and operation of injection wells. The State of Nevada has EPA-granted authority to administer this program (NAC 445A), which requires a permit before tracers can be injected into drill holes or used in infiltration studies. To comply with this program, the YMP has a permit issued by the Nevada Division of Environmental Protection (Land 1998). This permit authorizes (1) the injection of water and various tracers, including gas, into 103 boreholes; (2) discharges from the concrete batch plant to a lined pond; (3) discharges to an infiltration basin; and (4) the use of filtered waste water from the Exploratory Studies Facility for dust suppression.

As required by the UIC permit, quarterly reports were submitted to the Nevada Division of Environmental Protection. These reports list the volume of fluid produced or discharged per month; the type, quantity, and concentration of tracer(s) injected per month; summaries of tracer tests; the results of chemical analyses from the oil-water separator; and the results of semiannual sampling of drinking water from Wells J-12 and J-13. An annual report summarizing all 2006 activities for this permit was submitted in January 2007 (Spence 2007c).

The UIC permit expired on January 26, 2001. An application to renew the permit was submitted in 2000 (Wade 2000) and was deemed complete by the Nevada Division of Environmental

Protection. As provided in Nevada regulations, the YMP will continue to operate legally under the expired permit until a new permit is issued.

### 2.6.3 Nevada Statute for Appropriation of Public Waters

Use of water in Nevada requires a permit from the Nevada State Engineer. The Nevada State Engineer reviews permit applications to determine whether the requested water is available at the source, whether the proposed use conflicts with existing water rights, whether the proposed use or change conflicts with protected interests of existing domestic wells, and whether the proposed use threatens to prove detrimental to the public interest (NRS 533).

In March 1992, the Nevada State Engineer issued temporary water-appropriation permits to the DOE for up to 430 acre-feet per year from Wells J-12 and J-13 (Turnipseed 1992a, 1992b, 1992c). On July 22, 1997, the DOE applied for permanent rights for this water to meet the DOE's responsibilities under the NWPA for possible construction and operation of a repository at Yucca Mountain. The DOE's application was denied on February 2, 2000, based on a finding by the State Engineer that the requested use threatened to prove detrimental to the public interest (Turnipseed 2000). In April 2002, the temporary permits for the 430 acre-feet per year expired. To avoid harming ongoing operations and scientific testing, the DOE and the State of Nevada entered into joint agreements in 2002 and 2003 to allow the DOE to pump a specified amount of water per year for potable and non-potable purposes, including dust control, maintenance, and scientific testing. During 2006, the DOE pumped about 9 acre-feet from these wells. Meanwhile, legal actions by the DOE are proceeding over the Nevada State Engineer's denial of the DOE's water-appropriation request (see Section 2.10 for additional information).

A permanent water-appropriation permit was issued to the DOE in October 1992 for Well VH-1 for approximately 61 acre-feet per year (Turnipseed 1992d). During 2006, no water was pumped from Well VH-1. According to a stipulation in the Well VH-1 permit documentation, the DOE had 10 years to prove beneficial use of the water. On April 5, 2002, a Proof of Application of Water to Beneficial Use for 2.3 acre-feet was submitted to the State Engineer (Wade 2002). To date, no response has been received from the state.

### 2.6.4 Executive Order 11988, Floodplain Management

Executive Order 11988 (42 Federal Register 26951) requires that federal agencies develop regulations to evaluate the potential effects of their actions on flood hazards and floodplain management and avoid floodplain impacts to the extent practicable. The DOE has developed regulations to implement this Executive Order (10 CFR Part 1022). These regulations require a public notice of all activities that are proposed within a floodplain, an evaluation of practical alternatives and design changes, a floodplain assessment, and a published statement of findings.

The DOE published a Notice of Floodplain/Wetlands Involvement for site characterization activities in 1989 (54 Federal Register 6318). Two floodplain assessments for YMP activities at Yucca Mountain were then prepared (YMP 1991, 1992), and the associated statements-of-finding were published in the Federal Register (56 Federal Register 49765 and 57 Federal Register 48363). These actions meet the requirements of Executive Order 11988 (42 Federal Register 26951) for all activities that occurred at Yucca Mountain during 2006.

In June 1999, the DOE published 64 Federal Register 31554 for activities associated with construction of a geologic repository at Yucca Mountain. A "Floodplain/Wetlands Assessment for the Proposed Yucca Mountain Geologic Repository" was included as Appendix L of the final EIS (DOE 2002).

On July 6, 2006, the Department issued a notice of availability for public review and comment on the draft *Environmental Assessment for the Proposed Infrastructure Improvements for the Yucca Mountain Project, Nevada* (DOE/EA-1566) (71 Federal Register 38391). The assessment examined the impacts of a proposal by the Department to repair, replace, or improve certain facilities, structures, roads, and utilities (collectively referred to as infrastructure) at Yucca Mountain. Because the proposed action would affect floodplains at Yucca Mountain, a floodplain assessment was included in the Environmental Assessment.

### 2.6.5 Executive Order 11990, Protection of Wetlands

Executive Order 11990 (42 Federal Register 26961) requires federal agencies to develop regulations for considering wetlands protection during the decision-making process for their proposed actions. The DOE's regulations for implementing this Executive Order are at 10 CFR Part 1022.

There are no wetlands at Yucca Mountain (DOE 2002, Appendix L); therefore, the regulations in 10 CFR Part 1022 did not apply to site activities conducted during 2006.

## 2.7 HAZARDOUS MATERIALS

This section describes the various federal and State of Nevada regulations that pertain to hazardous-material release reporting; planning, notification, reporting, and permitting; and registration and certification. Hazardous materials, as it is used in this section, include hazardous substances, extremely hazardous and highly hazardous substances, oil, hazardous chemicals, toxic chemicals, regulated substances, and pesticides.

### 2.7.1 Release Reporting

- **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) establishes a framework for direct federal response to releases or threatened releases of hazardous substances and the cleanup of sites containing hazardous wastes that present a substantial danger to the public. As amended in 1986 by the Superfund Amendments and Reauthorization Act, it also requires emergency notification and response for release of a hazardous substance that exceeds threshold quantities. Executive Order 12580 (52 Federal Register 2923) delegates to heads of executive departments and agencies the responsibility for undertaking remedial actions for releases or threatened releases that are not on the National Priority List. It also requires removal actions other than emergencies where the release is from any facility under the jurisdiction or control of executive departments and agencies. The release reporting regulations that implement CERCLA are promulgated in 40 CFR Part 302. The YMP did not have any releases subject to the requirements of this section in 2006.

- **Emergency Planning and Community Right-to-Know Act of 1986**

Section 304 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires owners/operators of facilities at which a hazardous substance, an extremely hazardous substance, and/or a CERCLA hazardous substance, is produced, used, or stored, to notify the State Emergency Response Commission and the Local Emergency Planning Committee within 24 hours of a release that exceeds the substance's reportable quantity. These emergency-release notification requirements do not apply to releases that are federally permitted or result in exposures to persons solely within the boundaries of the facility, such as pesticide and fertilizer applications. Regulations implementing Section 304 are promulgated in 40 CFR Part 355.40. The YMP did not have any releases subject to the requirements of this section in 2006.

- **Clean Water Act of 1977**

Section 311 (b)(3) of the Clean Water Act of 1977 prohibits, among other things, the discharge of oil or hazardous substances into or upon navigable waters of the United States. Section 311 (b)(5) requires that, among other things, any person in charge of an onshore facility to notify the appropriate agency of the United States Government as soon as he/she has knowledge of a discharge of oil or a hazardous substance in violation of (b)(3). The federal agency shall immediately notify the appropriate state agency of the discharge. Regulations implementing Sections 311 (b)(3) and (5) are promulgated in 40 CFR Part 110. The YMP did not have any releases subject to the requirements of this section in 2006.

- **Nevada Administrative Code 445A.345 to 445A.348**

NAC 445A requires facility owners/operators to notify the Nevada Division of Environmental Protection by telephone as soon as possible after a release, but not later than the end of the first working day after the release. The following releases are subject to the notice requirements: (1) a release in a quantity equal to or greater than that which is required to be reported to the National Response Center pursuant to 40 CFR Part 302; (2) a release consisting of any quantity of pollutants, hazardous waste, or contaminants not listed in 40 CFR Part 302.4; and (3) releases of 25 gallons or more of a petroleum product to the soil or other surfaces of land; or is discovered on or in the groundwater or in at least three cubic yards of soil during excavation of soil, subsurface exploration, monitoring of groundwater or any other subsurface activity. The YMP did not have any releases subject to the requirements of this section in 2006.

### 2.7.2 Planning, Notification, Reporting, and Permitting

- **Emergency Planning and Community Right-to-Know Act of 1986**

EPCRA Sections 302, 311, and 312, and NAC 477 establish the planning, notification, reporting, and permitting requirements for hazardous materials that are produced, used, stored, handled, or transported by the YMP. To alleviate duplication of reporting requirements, the State Emergency Response Commission and the State Fire Marshal consolidated their reporting format into the Nevada Combined Agency Hazardous Materials Facility Report package. All information on hazardous materials contained in the package is submitted to the Nevada State

Fire Marshal, State Emergency Response Commission, Local Emergency Planning Committee, and local fire department.

EPCRA Section 302 is designed to assist state and local officials to prepare for and respond to emergencies involving extremely hazardous substances. The emergency planning sections of EPCRA cover any facility that has an extremely hazardous substance in an amount equal to or greater than the substance's threshold planning quantity. These "covered" facilities must notify the State Emergency Response Commission and the Local Emergency Planning Committee. The information obtained and submitted to these agencies identifies potential chemical hazards, which in turn allows them to plan for the protection of vulnerable areas and to prepare for accidental releases in the community and environment. Regulations implementing Section 302 are promulgated in 40 CFR Part 355.30. In 2006, the YMP had extremely hazardous substances on site in excess of threshold planning quantities and reported this information through submittal of the Nevada Combined Agency Hazardous Materials Facility Report.

EPCRA Sections 311 and 312 require owners/operators of facilities that are required to maintain a Material Safety Data Sheet (MSDS) to submit the MSDS to state and local agencies if the chemical is present in an amount equal to or greater than its established threshold level. In addition, if a hazardous chemical is present at a facility in an amount equal to or greater than its established threshold level, the facility is required to prepare and submit an inventory form to state and local agencies. Regulations implementing Sections 311 and 312 are promulgated in 40 CFR Part 370. In 2006, the YMP had hazardous chemicals on site in excess of threshold quantities and reported this information through submittal of the Nevada Combined Agency Hazardous Materials Facility Report.

NAC 477 (subpart 323) states that a person shall not store a hazardous material in excess of the amount specified in the *International Fire Code*, as adopted by NAC 477 (subpart 281), unless the person has been issued a permit by the State Fire Marshal to store the material. Each permit must be renewed annually. In 2006, the YMP exceeded specified storage amounts for certain hazardous materials and therefore obtained the required permit from the Nevada State Fire Marshal's Office through submittal of the Nevada Combined Agency Hazardous Materials Facility Report.

EPCRA Section 313 requires the owner/operator of a facility to complete a toxic chemical release form for each toxic chemical manufactured, processed, or otherwise used at the facility in quantities that exceed the annual Toxic Chemical Activity Threshold. The toxic-chemical release reports are prepared for the preceding calendar year and are submitted annually to the EPA and designated state agencies by 1 July. Reports must contain information on toxic chemicals released to the air, land, and/or water. Section 313 also requires the reporting of information on offsite transfers of toxic chemicals for proper treatment, recycling, or disposal. Regulations implementing EPCRA Section 313 are promulgated in 40 CFR Part 372. In 2006, the YMP did not manufacture, process, or otherwise use any toxic chemicals in excess of applicable thresholds.

- **NAC 459, Hazardous Materials**

The State of Nevada Chemical Catastrophe Act of 1991, codified in NAC 459, requires facility owners and operators that produce, use, store, or handle highly hazardous substances in amounts that equal or exceed threshold quantities to register with the Nevada Division of Environmental Protection and develop a management program for these substances. The requirements for a Chemical Accident Prevention Program (CAPP) fall into one of three categories: accident prevention, emergency response, or public right-to-know.

Through the accident prevention program of the CAPP facilities are required to evaluate and mitigate hazards, understand the design parameters of their processes and operate within the appropriate design limits, prepare comprehensive operating procedures, thoroughly train operators in those procedures, and maintain the facility equipment and instruments to prevent premature failure. Through the emergency response program of the CAPP, facilities are required to develop an action plan for dealing with potential emergency situations and they are further required to coordinate emergency response activities with local responders, to ensure that the responders are prepared to deal with the emergencies appropriately. Through the public right-to-know program of the CAPP, all information disseminated by the facilities is available to the public, as are all site inspection reports generated by CAPP staff. There are provisions to protect trade secrets under the CAPP, but submission requirements have been structured to generally preclude the need to submit such information. The YMP did not exceed a threshold quantity for any highly hazardous substances subject to this section in 2006.

- **Clean Air Act Amendments of 1990**

When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule was written to implement Section 112(r) of these amendments. The rule requires companies that use certain flammable and toxic substances to develop a Risk Management Program, which includes the following:

1. A hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases.

2. A prevention program that includes safety precautions and maintenance, monitoring, and employee-training measures.

3. An emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies if an accident occurs.

By June 21, 1999, a summary of the regulated facility's risk management program was to be submitted to EPA. The plans must be revised and resubmitted every five years.

The List of Regulated Substances under Section 112(r) of the Clean Air Act is in 40 CFR Part 68 and includes their synonyms and threshold quantities. The YMP did not exceed a threshold quantity for any regulated substance subject to this section in 2006.

- **Toxic Substances Control Act of 1977**

The Toxic Substances Control Act of 1977 authorizes the EPA to require testing of new chemical substances that enter the environment and to regulate those chemicals when necessary. This Act complements and expands existing toxic substance laws such as Section 112 of the Clean Air Act and Section 307 of the Clean Water Act of 1977. This Act also regulates certain toxic substances, specifically polychlorinated biphenyls, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium. In 2006, there were no YMP activities subject to this Act.

### 2.7.3 Registration and Certification

- **Federal Insecticide, Fungicide, and Rodenticide Act and NRS 586, Pesticides**

The primary focus of this law and the Nevada statute is to provide federal and state control of pesticide distribution, sale, and use. The EPA was given authority under the Act to study the consequences of pesticide usage and to require users such as farmers and utility companies to register when purchasing pesticides. Pesticide users, those that commercially apply pesticides, also must take exams for certification as applicators of pesticides. All pesticides used in the United States must be registered (licensed) by the EPA. Registration assures that pesticides will be properly labeled and, if in accordance with specifications, will not cause unreasonable harm to the environment. The YMP did not purchase any pesticides in 2006, and pesticide applications for the YMP site were performed by the Management and Operating contractor for the Nevada Test Site or a licensed contractor in accordance with the Act.

## 2.8 HAZARDOUS AND NON-HAZARDOUS WASTES

### 2.8.1 Federal Facility Compliance Act of 1992

The Federal Facility Compliance Act of 1992 amends parts of the Resource Conservation and Recovery Act of 1976 (RCRA) to require compliance by federal facilities with federal, state, and local laws and regulations related to solid and hazardous wastes. In addition, the Federal Facility Compliance Act of 1992 waives the federal government's sovereign immunity for violations of federal, state, and local laws and regulations related to solid and hazardous wastes. The YMP complies with all applicable laws and regulations related to solid and hazardous wastes.

### 2.8.2 Resource Conservation and Recovery Act of 1976

The RCRA is a comprehensive program for regulating and managing hazardous wastes (Subtitle C), nonhazardous solid wastes (Subtitle D), and underground storage tanks (Subtitle I), and promoting the use of recycled and recovered materials (Subtitle F). The RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner. The RCRA sets a federal policy of restricting land disposal of untreated hazardous wastes in favor of environmentally preferred alternatives such as treatment, source reductions, and recycling. Regulations promulgated under the RCRA define hazardous wastes and specify requirements for

their transport, handling, treatment, storage, and disposal. Section 6001 of the RCRA requires federal agencies to comply with all federal, state, interstate, and local requirements relating to the control and abatement of solid- and hazardous-waste disposal.

**Subtitle C**–In 1985 the EPA authorized Nevada to administer Subtitle C of the RCRA (managing hazardous waste). The Nevada Division of Environmental Protection is the agency responsible for administering this part of the RCRA (NAC 444). Activities at the Yucca Mountain site generate more than 220 pounds but less than 2,204 pounds per month of RCRA-defined hazardous wastes; therefore, the site is regulated under the Act as a small-quantity generator. The YMP submitted a "Notification of Hazardous Waste Activity" to the Nevada Division of Environmental Protection for the generation of hazardous waste at the Yucca Mountain site in 1989 and received EPA identification number NV7890090023. Activities at the YMP's Las Vegas office facilities generate less than 220 pounds per month of RCRA-defined hazardous wastes; therefore, the site is regulated under the Act as a conditionally exempt small-quantity generator.

State of Nevada regulations require small quantity generators to complete a biennial hazardous waste report. The report identifies the types and quantities of hazardous wastes that are generated and transported offsite for treatment, storage, or disposal and is used to track national trends in waste management practices. A biennial hazardous-waste report was not required in 2006.

**Subtitle D**–Nonhazardous solid waste is regulated by Nevada under Subtitle D of the RCRA (NAC 444). Refuse, along with salvageable, industrial, and special non-hazardous waste, were recycled or disposed of during 2006 in accordance with these regulations (Section 4.8.2, Table 5).

**Subtitle F**–Subtitle F of the RCRA requires that federal agencies comply with all federal, state, interstate, and local requirements stemming from the RCRA, unless exempted by the President. The YMP complies with the requirements of the RCRA as described above. Subtitle F also encourages the federal government to institute a procurement policy that encourages the purchase of recoverable materials which, because of their performance, can be substituted for virgin material at a reasonable price. YMP compliance with the procurement policy is discussed in Section 4.8.3.

**Subtitle I**–Management of the RCRA underground-storage-tank program has been delegated to Nevada (NAC 459). Because YMP activities do not require the use of underground storage tanks regulated by Subtitle I, this section is not applicable.

## 2.9 DOE DIRECTIVES

The following DOE Directives were directly applicable to the environmental program conducted by the OCRWM during 2006.

DOE Guide 450.1-1A provides background information, an overview of the integration process, and guidance relating to the preliminary steps that DOE sites should undertake in order to meet the requirements of DOE Order 450.1.

DOE Manual 231.1-1A contains detailed requirements for implementing DOE reporting requirements, including time schedules for reporting and data elements to be reported.

DOE Order 231.1A establishes requirements to ensure that Environmental, Safety and Health (ES&H) information required by law or regulation, or essential for evaluating operations and identifying opportunities for improvements, is collected and reported. This site environmental report and an annual NEPA planning summary (Section 2.1.2) are the reporting requirements of this Order that are applicable to the YMP environmental program.

DOE Order 413.3A provides DOE project-management direction for the acquisition of capital assets that are delivered on schedule, within budget, and fully capable of meeting mission performance and environmental, safety and health standards.

DOE Order 430.2A establishes requirements and responsibilities for managing DOE energy and utility supplies and services.

DOE Order 450.1 implements sound stewardship practices that protect the air, water, land, and other natural and cultural resources affected by DOE operations. It also requires DOE to meet or exceed compliance with applicable environmental; public health; and resource protection laws, regulations, and DOE requirements in a cost-effective manner. These objectives must be accomplished by implementing EMSs at DOE sites. An EMS is a continuing cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental goals.

DOE Order 451.1B describes DOE's requirements and responsibilities for implementing the NEPA, the Council on Environmental Quality Regulations Implementing the Procedural Provisions of the NEPA (40 CFR Parts 1500-1508), and the DOE NEPA Implementing Procedures (10 CFR Part 1021). Section 2.1.2 includes a summary of actions taken by the OCRWM to comply with the NEPA and this Order.

DOE Order 5400.5 establishes limits and requirements for a variety of scenarios involving potential exposure to radiation. Also covered are the radiological monitoring requirements for the sale or release of equipment or material potentially contaminated by radioactivity. Project equipment that was historically transferred from the Nevada Test Site or other DOE sites with no documented radiation survey, and which is scheduled for release to the general public, is surveyed in accordance with this Order. In 2006, the Project did not release any item having levels of residual radioactive contamination greater than those listed in this Order. Consequently, the requirement in the guidelines for the preparation of site environmental reports to discuss approved release limits, dose estimates, radionuclide concentrations, and expected end-use scenarios are not applicable.

DOE Order 5480.4 specifies requirements for mandatory ES&H standards applicable to all DOE and DOE-contractor operations, lists reference ES&H standards, and identifies the sources of the mandatory environmental standards. The mandatory standards listed in this Order that were applicable to the YMP during 2006 are the laws and regulations described in this section.

DOE Policy 141.1 ensures that DOE programs and field elements integrate cultural resources management into their missions and activities.

DOE Policy 450.4 describes objectives, guiding principles, and core functions of an Integrated Safety Management System (ISMS) to be implemented throughout the DOE complex. DOE acquisition regulations (48 CFR Part 970) require contractors to manage and perform work in accordance with a documented ISMS. BSC documents its processes and mechanisms for implementing ISMS in an *Integrated Safety Management Description Document* (Sorensen 2006). That document describes the implementation of ISMS objectives throughout BSC operations.

# 3. ENVIRONMENTAL MANAGEMENT SYSTEM

Based on the objectives of DOE Order 450.1, all DOE sites must develop an EMS that protects the air, water, land, and other natural and cultural resources that could potentially be affected by site operations. The YMP had a fully functioning EMS in 2006 that was integrated into the site's ISMS established by DOE Policy 450.4. This chapter describes the activities conducted in 2006 to maintain and implement the EMS.

The YMP's EMS is based on the International Organization for Standards (ISO) 14001, which is the international EMS standardization developed by ISO (ISO 2004). In December 2005, YMP conducted a second-party review (persons independent of the site or facility) and verified that the EMS was fully established in accordance with the requirements of DOE Order 450.1. However, the review suggested opportunities for improvement that were addressed in 2006 through the Project's Corrective Action Program. These improvements included establishing additional environmental objectives and targets and improving EMS awareness among project staff. Four additional environmental objectives and targets were established and posted on the EMS webpage. Employee-training modules were reviewed and EMS information was integrated into General Employee Training and Site Access Training. No findings were made during the annual ISMS review.

The Environmental Aspects Baseline document was reviewed and revised based on the approved Fiscal Year (FY) 2006 project work scope, work activities, and facilities. The electronic EMS documentation was maintained through quarterly reviews of the information and electronic web links. Monitoring information on several environmental aspects were summarized in graphs or tables and posted on the EMS webpage to provide project workers easier access to the information.

Several of the environmental objectives and targets established under the EMS address the pollution prevention and sustainable environmental stewardship goals in DOE Order 450.1 and efforts by DOE to reduce energy and water use. One goal is to minimize the water pumped and used from Wells J-12 and J-13 at Yucca Mountain. A target was set at 420,000 gallons of potable water use and only the necessary gallons of non-potable water use (e.g., dust control, fire protection, science & engineering) to maintain operational uses. In 2006, the potable water-use target was exceeded by only 8,000 gallons. Water use is managed under the *Dust Control and Water Conservation Plan,* Standing Order-2002-01 (BSC 2002). Conservation measures implemented through this plan include replacing showerheads with low-flow heads; performing daily inspections to detect leaks; minimizing travel on dirt roads (dust suppression); decreased travel speeds on dirt roads; and approving, monitoring, and reporting all water use.

As part of the YMP effort to reduce waste and promote reuse of material, a goal was established to collect unused office supplies during larger organizational office moves and to redistribute them for use. In 2006, excess and unused office supplies were collected from four office buildings during organizational moves. The estimated value of these supplies was approximately $51,000. About 40 percent of those supplies had been recycled back for use by the end of 2006. From 2001 through 2006, costs of contractor office procurements had been reduced by 75 percent.

To promote integration of sustainable design into new facility designs, a goal was established to integrate sustainable building criteria into new non-nuclear facility design documents or major facility renovations. In 2006, OCRWM decided on sustainable design criteria for non-nuclear facilities based on the U.S. Green Building Council's Leadership in Energy and Environmental Design rating system (Hamilton-Ray 2006). Sustainable design criteria have been integrated into the Project Design Criteria Document (BSC 2006a).

Other parts of the YMP EMS comply with requirements of DOE Order 450.1. For example, all requests for authorization to purchase and use chemicals are reviewed to ensure that the least hazardous materials are selected for use and that the possibility of releases of toxic chemicals is reduced or eliminated. Whenever possible, wastes are reduced using recycling and source reduction. Environmental compliance is evaluated through formal assessments (Section 4.9) and appraisals (Section 4.10). Environmental accountability is integrated into daily functions and planning as part of the YMP ISMS and by instilling environmental and pollution-prevention awareness during training (Section 4.11) and presentations (Section 4.8.3). Protection of resources while conducting YMP activities is achieved through land-access reviews (Section 4.1), biological surveys and reclamation (Sections 4.2 and 4.3), identification and conservation of cultural resources (Section 4.4), environmental regulatory compliance (Sections 4.5 through 4.8), and assessment and appraisal programs (Sections 4.9 and 4.10).

# 4. ENVIRONMENTAL PROGRAMS

This section describes the YMP environmental program conducted during 2006 to implement the requirements of the environmental permits described in Section 2, monitor impacts of the Project, and protect the environment at Yucca Mountain.

All aspects of the YMP environmental program are conducted in accordance with the YMP ISMS. During the planning stage for all Project activities, potential impacts to the environment are identified and measures to mitigate those impacts are developed. These measures, including clear roles and responsibilities for conducting work and ensuring compliance, as well as environmental training, are incorporated into written procedures (i.e., work instructions) that describe how the work must be conducted. For maintenance and other ongoing projects, environmental review is conducted during planning and development of work instructions. For new activities at Yucca Mountain, a review also occurs as part of the land-access review and control process (Section 4.1). Assessments (Section 4.9) and appraisals (Section 4.10) are conducted to ensure that work is performed within controls and to provide feedback for improvement.

## 4.1 LAND-ACCESS REVIEW AND CONTROL

All new YMP activities, as well as all ongoing activities that are to be substantially modified or require access to additional land, must undergo a review before being approved. This process is initiated when principal investigators or responsible managers submit a land access request. The request is evaluated to determine whether the activity (1) is covered under existing ROWRs and other land-use agreements; (2) will result in land use conflicts; (3) will be in compliance with applicable federal, state, and local environmental laws and regulations; (4) will require any new regulated or hazardous materials; (5) will impact cultural resources, and (6) will require additional environmental permits or modifications to existing permits. If new permits are required, they are applied for at this time. Reviews or pre-activity surveys for biological and cultural resources (Sections 4.2 and 4.4) are conducted to identify potential impacts to those resources and prepare for future reclamation. Surveys for radiological hazards and residual radiological contamination also are conducted for activities planned in certain areas on the Nevada Test Site.

If the activity can be conducted in compliance with environmental regulations and is acceptable to the OCRWM, a land-access approval letter is issued. The letter contains permit requirements and other stipulations that must be incorporated into planning and implementation procedures as part of the YMP ISMS.

Clearance surveys for tortoises are conducted before the start of any ground-disturbing activity that would remove vegetation (Section 4.2). Topsoil, if it exists in sufficient quantities, is then removed and stored onsite or at one of the Project's existing topsoil stockpiles. During activities, appraisals are conducted to evaluate compliance with environmental stipulations (Section 4.10). After activities are completed, the amount of land disturbed is measured to track compliance with the biological opinion for the YMP (Buchanan 1997). If the site is no longer required, a reclamation plan is developed (Section 4.3).

During 2006, nine land-access requests were received. The requests were evaluated with respect to land access authorization; cultural, biological, and radiological impacts; and compliance with environmental regulations. Of the nine requests, one was canceled, six were approved, and two were on hold pending additional information. Biological evaluations, which included five field surveys, were conducted for eight sites. Archaeological evaluations were conducted for all nine sites. No new environmental permits were required for any of these activities. Radiological evaluations were conducted at 14 sites and one evaluation was pending. No radiological issues were identified.

In 2006 the following activities required clearing of vegetation or removal of topsoil from about 25.9 acres of previously undisturbed desert tortoise habitat:

- Modification of the Gate 510 Complex and installation of a power line and fiber-optic line to that site, as well as installation of a 2-mile security fence
- Installation of three telecommunication towers and three geodetic stations
- Collection of aggregate samples (off-road driving)
- Excavation of soil test pits
- Drilling boreholes for possible repository facilities (access roads and drill pads)
- Collecting topsoil in Midway Valley for use on reclamation sites

The total amount of land disturbed at Yucca Mountain since 1991 is now 362.1 acres. This is 51.9 acres less than the total of 414 acres stipulated in the biological opinion for the YMP (Buchanan 1997). Of the 362.1 acres disturbed since 1991, 271 acres were disturbed before 1996. The amount of land disturbed annually over the past eight years has generally decreased until 2005, with 5.9 acres disturbed in 1999, two acres in 2000, zero acres in 2001, 0.4 acres in 2002, zero acres in 2003, one acre in 2004, 16.4 acres in 2005, and 25.9 acres in 2006. Additional acres are likely to be disturbed during the next several years as part of OCRWM's proposed effort to upgrade older facilities and access roads, and as more geotechnical studies are performed to gather engineering and scientific data.

## 4.2 BIOLOGICAL SURVEYS

Biological surveys are conducted to comply with the Endangered Species Act of 1973 (Section 2.3.1), the Migratory Bird Treaty Act (Section 2.3.2), and Section 404 of the Clean Water Act of 1977 (Section 2.6.1) and to develop methods for minimizing the impacts of YMP activities on plants and animals.

The biological opinion for the YMP (Buchanan 1997) requires pre-activity surveys for desert tortoises prior to clearing vegetation. During these surveys, biologists evaluate potential impacts to tortoises from the proposed activity and, if necessary, identify ways to modify the activity to avoid harming tortoises and their burrows. Project biologists also evaluate potential impacts to migratory birds and other plant and animal species classified as sensitive by the BLM (or other land management agencies). In addition, biologists determine whether activities will need a permit to place dredged or fill material into waters of the United States. The biological opinion also requires clearance surveys to move tortoises or tortoise nests if they are in danger. Those surveys must be conducted before ground-disturbing activities, off-road driving, or trench filling can commence.

Pre-activity and clearance surveys were conducted for the following activities in 2006 (a total of about 215 acres were surveyed):

- Modification of the Gate 510 Complex and installation of a power line and fiber-optic line to that site, as well as installation of a 2-mile security fence
- Installation of three telecommunication towers and three geodetic stations
- Collection of aggregate samples (off-road driving)
- Excavation of soil test pits
- Drilling boreholes for possible repository facilities (access roads and drill pads)
- Collecting topsoil in Midway Valley for use on reclamation sites

One desert tortoise was killed by Project activities in 2006. It was found dead on an access road at Yucca Mountain in May. This is the third tortoise to have been killed on an access road at Yucca Mountain since 1997. Tortoise burrows found during clearance surveys were inspected and, if no tortoises were found, collapsed prior to surface-disturbing activities. One tortoise in a burrow was found during a clearance survey. The proposed surface-disturbing activity was moved to avoid disturbing the tortoise and the burrow. No tortoise eggs were found during clearance surveys.

Development of access roads to boreholes drilled in Midway Valley required placing fill materials at three crossings of ephemeral streams that may be classified as waters of the United States, as defined in 33 CFR Part 328. Placement of fill in waters of the United States is regulated under Section 404 of the Clean Water Act. Less than 100 square feet of ephemeral stream channel were filled for each crossing. Fill of less than 0.5 acres for linear transportation crossings is covered by a nationwide permit issued by the U.S. Army Corps of Engineers (67 FR 2080).

No activities conducted at Yucca Mountain during 2006 resulted in direct harm to migratory birds.

## 4.3 HABITAT RECLAMATION

Habitat is reclaimed for a variety of reasons:

- Comply with the terms and conditions of the biological opinion for site characterization (Buchanan 1997)
- Meet requirements in the Project's ROWRs (e.g., BLM 1988, 1989)
- Implement requirements in the Project's air-quality operating permit (DeBurle 2006)
- Reduce the spread of exotic plant species as required by Executive Order 13112 (64 Federal Register 6183) (see Section 2.3.4)
- Implement commitments in the environmental assessment for site characterization (DOE 1986, Sections 4.1.1.4 and 4.1.2.6)

- Minimize impacts of site characterization, as required by Section 113 of the NWPA (Section 2.1.1)

Reclamation is conducted in accordance with the *Reclamation Implementation Plan* (YMP 2001). The long-term goal of the reclamation program is to reestablish processes on disturbed sites that will eventually lead to self-sustaining plant communities. Planning inventories, reclamation surveys, implementation, monitoring, remediation, and site-release evaluations are conducted to accomplish this goal. The planning process includes pre- and post-disturbance surveys and evaluations of past reclamation trials at Yucca Mountain. This information is used to identify implementation techniques for establishing structural and physical plant-community components, controlling soil erosion, and facilitating the establishment of native vegetation. After implementation, monitoring is conducted to evaluate plant growth, identify remediation needs, and make a final determination regarding reclamation success so that sites can be released from further DOE input.

### 4.3.1 Reclamation Inventories

Reclamation inventories are conducted to identify methods for reducing the impact of construction activities and to assess site conditions and resources for final reclamation. Vegetation associations, plant species and their abundance, and the presence of exotic species are measured during these inventories. Stipulations may be developed for depth and location of topsoil stockpiles, chemical or vegetative stabilization of stockpiles, plant salvage, and practices to reduce wind or water erosion. Stipulations from the inventories are incorporated into approval letters for land access.

During 2006, reclamation inventories were conducted for three projects where surface disturbances were proposed.

- Lower Muck Yard (geotechnical soil investigations and development of facilities and infrastructure)
- Geotechnical investigations of the planned locations of the surface repository facilities in Midway Valley
- Gate 510 Complex

Recommendations were made for salvaging topsoil during construction of the road and drill pads for the geotechnical investigations of the planned locations of the surface repository facilities, twelve of which were completed in 2006. Topsoil was windrowed along the edges of the access roads and perimeters of the pads.

### 4.3.2 Reclamation Surveys

Reclamation surveys are conducted to assess reclamation requirements at disturbed areas no longer needed for the YMP. Survey information is gathered on slope, aspect, disturbance area, disturbance severity, site preparation need for revegetation, and intensity of reclamation required. Based on this information, a final reclamation plan is written, which describes the actions needed for site preparation and reclamation. Site decommissioning is completed before reclamation,

including the removal of waste and aboveground man-made structures, filling of trenches, and the closing and sealing of boreholes.

In 2006, no reclamation surveys were required because reclamation surveys and final reclamation plans had been completed for the backfilling of trenches.

### 4.3.3 Reclamation Implementation

Reclamation is considered short-term when topsoil that is removed from disturbed sites is stockpiled for less than one year, and trenches or pits are backfilled outside of the usual planting season (October through December). Stabilization of surface soil with an organic tackifier is commonly used in these circumstances. Final reclamation is implemented on long-term topsoil stockpiles and on sites that are no longer needed for the YMP and have been decommissioned. Final reclamation includes spreading and contouring topsoil; creating erosion-control structures; ripping, seeding, spreading and anchoring mulch; and fencing to reduce loss of new vegetation to herbivores.

Topsoil windrows that were created during road and pad construction for 19 geotechnical investigations were stabilized in 2006 using an organic tackifier, wood fiber, and water mixture. Seven of those 19 locations were constructed in 2005. Initial reclamation was completed at 14 open trenches in 2006. These trenches were backfilled and recontoured in preparation for revegetation treatments. Topsoil salvaged during road and drill pad construction for geotechnical investigations was respread on a subset of the 14 trenches that were backfilled in 2006. Final reclamation (i.e., revegetation treatments) is expected to be completed on these sites in 2007 and 2008. The land area for these sites will be added to the total amount reclaimed when revegetation treatments have been applied. To date, final reclamation has been implemented on 93.5 acres of former YMP disturbances. This value is slightly higher than that reported last year due to evaluation and updates to the reclamation database.

### 4.3.4 Reclamation Monitoring and Remediation

To evaluate reclamation progress, sites are monitored periodically using qualitative methods. If progress is not satisfactory, remediation is conducted (e.g., re-seeding, transplanting, erosion-control efforts). Because of budget constraints, yearly progress was not monitored on reclaimed sites in 2006.

To determine if reclamation is successful and whether sites can be released from further monitoring, quantitative monitoring methods are used as described in the *Reclamation Implementation Plan* (YMP 2001, Section 6.1). Reclamation is considered successful if plant cover, density, and species richness of native perennial vegetation are equal to, or exceed, 60 percent of the value of the same parameters in undisturbed reference areas. If reclaimed sites meet these criteria, they can be released from further monitoring. During 2006, 14 sites were monitored for release. Those 14 sites, which totaled 6.43 acres, met the success standards for release. A report was prepared in 2006 that summarized the monitoring results for four of the sites that were located on land under the jurisdiction of the BLM. A report summarizing the monitoring results for the remaining 10 sites was prepared in 2007. To date, 119 disturbed sites totaling 42.96 acres have been successfully reclaimed and released from monitoring. Note that

corrections made in the reclamation database resulted in higher values for the number of sites and acres released than those reported in last year's SER.

## 4.4 CULTURAL RESOURCES AND NATIVE AMERICAN INTERACTIONS

Surveys for archeological resources, educational initiatives, and interactions with Native Americans were conducted to meet the requirements of the laws and regulations described in Section 2.4.

### 4.4.1 Survey, Data Recovery, and Research

The YMP conducts pre-activity surveys for cultural resources before sites are disturbed. Survey activities, findings, and related data-recovery efforts are reported to various state and federal agencies. In addition, the condition of known archaeological sites is monitored periodically. Artifact inventories are submitted to the U.S. Department of the Interior in compliance with reporting requirements of the Native American Graves Protection and Repatriation Act. Artifacts are maintained in a curation facility in Las Vegas, Nevada, in accordance with 36 CFR Part 79.

Five archaeological pre-activity surveys were conducted during 2006 in areas proposed for site activities. Thirteen new archaeological sites and 65 isolated artifacts were identified during these surveys. Seven survey reports were prepared in 2006 for Project review prior to eventual submittal to the SHPO and the Advisory Council on Historic Preservation. No previously documented historical properties at Yucca Mountain were monitored during 2006 and no new data-recovery plans were developed.

### 4.4.2 Educational Initiatives

The Project has developed educational displays to inform YMP workers and the public about the YMP archaeological program and the kinds of historical properties at the site. These displays are located at the Yucca Mountain Information Centers in Las Vegas, Beatty, and Pahrump, and at the Site Information Center at Yucca Mountain for use during public tours. Items displayed include maps of southern Nevada depicting areas historically occupied by various tribes; biographical sketches of local Native Americans; artifacts and written explanations of their manufacture; examples of basket weaving and animal traps; traditional stories about plants and animals; and descriptions of plants as religious objects and sources of food, clothing, and medicine. A portable display and slide show has been developed for other presentations.

### 4.4.3 Native American Interactions

The OCRWM continued interactions with involved Native American tribes in 2006, as directed by the laws and regulations summarized in Section 2.4. Currently, the YMP Native American Interaction Program involves 17 concerned tribes and organizations (comprised of Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone) located in Nevada, California, Utah, and Arizona.

In March and September of 2006, YMP staff accompanied tribal representatives from the Moapa Paiute Tribe, the Las Vegas Paiute Colony, and the Timbisha Shohsone Tribe to Washington

D.C. and Green Bay, Wisconsin, to attend the bi-annual meetings of the DOE's Transportation External Coordination working group. The meetings focus on national transportation planning and preparation. Invitees to the meetings include about 40 tribes across the country located on or near proposed waste-transport routes. Of the 40 tribes, four are also part of the Yucca Mountain Native American Interaction Program. One of these four, the Paiute Indian Tribe of Utah, was unable to send a representative to the meetings.

In April 2006, the YMP held an American Indian Writers Subgroup meeting focusing on that part of the proposed rail line at Yucca Mountain and on proposed infrastructure upgrades at Yucca Mountain. The Subgroup includes representatives from all three ethnic groups associated with the YMP Native American Interaction Program. The YMP held the April meeting to allow the group an opportunity to discuss plans for the rail line that were not covered during previous meetings with the Subgroup. Additionally, the Subgroup was given the opportunity to view and discuss the proposed infrastructure upgrades at Yucca Mountain.

In November 2006, the DOE held a Tribal Update Meeting in Pahrump, Nevada. Tribal representatives associated with the YMP Native American Interaction Program attended the meeting held at the new Pahrump YMP Information Center. The meeting addressed information relating to the Draft Supplemental Repository EIS. Presentations were made and an extensive question and answer session was held. A court reporter was present to receive comments but tribal representatives opted to send comments to the DOE after the conclusion of the meeting. The comments were received by the DOE and entered into the administrative record.

Throughout the year, support was also given to DOE Headquarters to ensure continued implementation of the DOE American Indian and Alaska Native Tribal Government Policy. In addition, the DOE sponsored educational workshops, speaking engagements, and site tours at which the YMP Native American program was explained to the public.

## 4.5 AIR QUALITY

Ambient air-particulate matter has been sampled since 1989 using standard methods. From 1991 to 1999, the Project's air-quality operating permit required the DOE to measure $PM_{10}$-inhalable particulate matter 10 micrometers or less in diameter at Yucca Mountain. Monitoring has continued since then to demonstrate continued compliance with federal (40 CFR Part 50) and Nevada (NAC 445B) ambient air-quality standards.

Air quality was monitored at two sites during 2006. Site 1 is in Midway Valley near the Exploratory Studies Facility (Figure 3); it represents conditions near most of the surface-disturbing activity at Yucca Mountain. Site 9 is at Gate 510 on the Nevada Test Site about 13 miles south of the Exploratory Studies Facility. This site, located near the community of Amargosa Valley, is used as an indicator of "ambient" air quality. Two $PM_{10}$ samplers were operated simultaneously at Site 1 to assess the precision of measurements for quality assurance requirements. $PM_{10}$ has been sampled at Site 1 since April 1989 and at Site 9 since October 1992.

As in previous years, 24-hour sampling was scheduled every sixth day. Site 1 and Site 9 each had valid sampling results for 58 and 60 days, respectively, out of 61 possible scheduled days.

The sampling and analysis program was conducted in accordance with EPA and Nevada standards, monitoring requirements, and guidance.

Concentrations of airborne particulate matter were generally low. Summaries of the last five years of sampling are shown in Table 2. The highest 24-hour concentrations of $PM_{10}$ in 2006 at Sites 1 and 9 were 20 and 69 micrograms per standard cubic meter ($\mu g/m^3$), respectively. All measurements were much lower than the maximum allowable 24-hour concentration of 150 $\mu g/m^3$. The unusually high concentration at Site 9 occurred on November 7, 2006 during excavation for a communication tower within less than 100 meters of the sampler. The next two highest concentrations at Site 9 were 40 and 26 $\mu g/m^3$, which also occurred during the excavation period. Arithmetic mean concentrations were 7 and 9 $\mu g/m^3$ at Sites 1 and 9, respectively, which are less than 20 percent of the maximum allowable annual arithmetic mean of 50 $\mu g/m^3$. These annual average concentrations are similar to those from previous years (Table 2).

Table 2. Summary of Ambient Particulate Matter $PM_{10}$ Sampling, 2002 through 2006 ($\mu g/m^3$)

| Site | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|
| Highest 24-hour average | | | | | |
| 1 | 52 | 33 | 24 | 32 | 20 |
| 9 | 43 | 38 | 27 | 26 | 69 |
| Second-highest 24-hour average | | | | | |
| 1 | 37 | 17 | 19 | 29 | 19 |
| 9 | 39 | 35 | 21 | 26 | 40 |
| Arithmetic mean of 24-hour average | | | | | |
| 1 | 10 | 8 | 8 | 9 | 7 |
| 9 | 10 | 9 | 9 | 9 | 9 |

## 4.6 METEOROLOGICAL MONITORING

Local meteorology has been monitored at Yucca Mountain since 1986 to characterize environmental conditions, study mechanisms of airborne transport of contaminated materials, and provide input to the design of surface facilities (per the data-collection requirements of DOE 2006).

Meteorological parameters, including wind, temperature, humidity, precipitation, barometric pressure, and atmospheric stability, were measured at four sites during 2006 (Sites 1, 2, 4, and 9) (Figure 3). Precipitation, air temperature, and humidity were measured at five other sites (Sites 3, 5, 6, 7, 8) around Midway Valley and in Jackass Flats. Rain and snow also were measured at three other locations (Sites 401, 405, and 415) on the crest of Yucca Mountain.

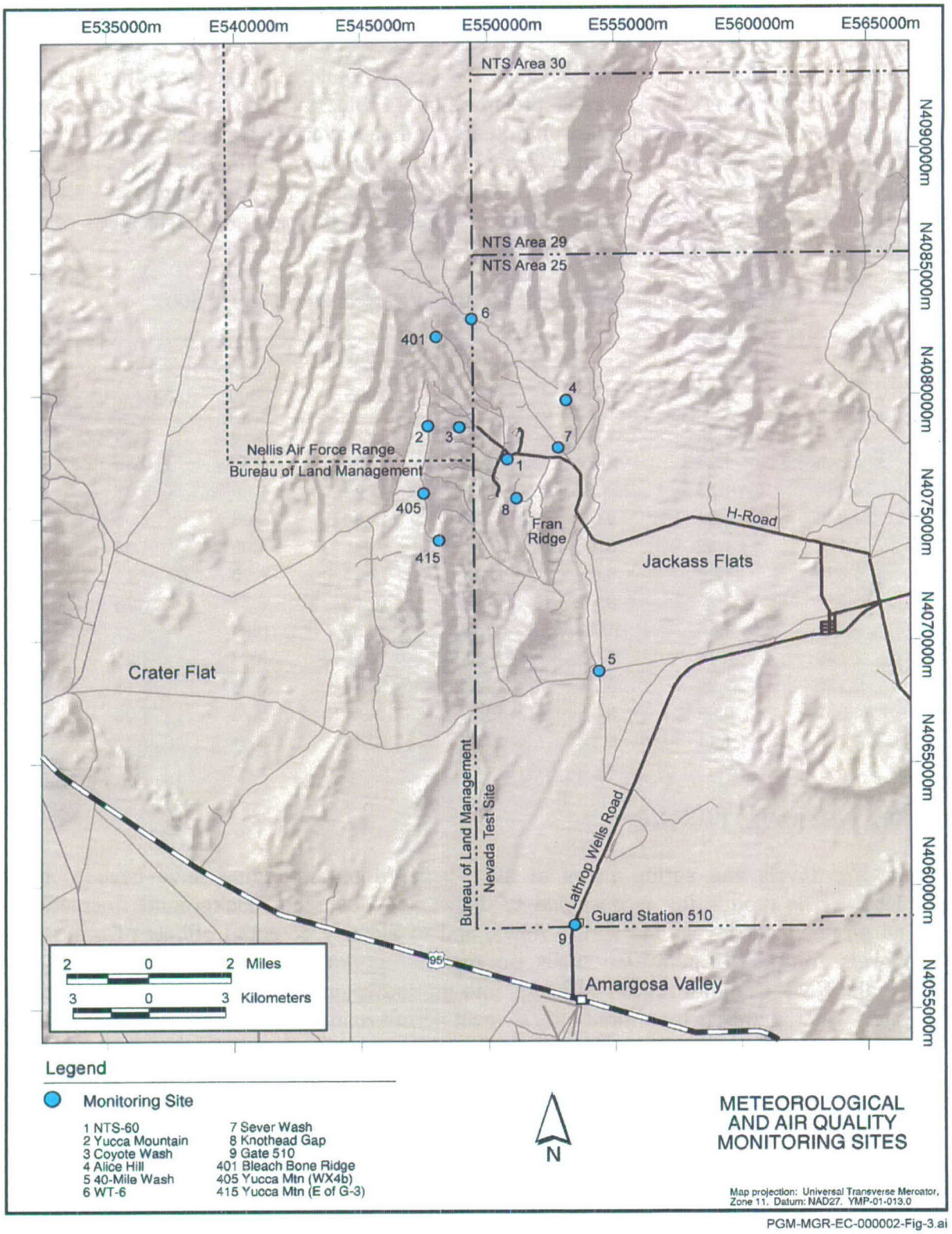



Figure 3. Air Quality and Meteorology Monitoring Sites

Annual data tabulations are available from the Project's Technical Data Management System. Precipitation measurements at storage gauges are made at all 12 sites.

Total precipitation during 2006 was less than the annual totals from the preceding three years and slightly below long-term average precipitation (Table 3). The annual totals from the last five years, averages from the last five years, and the average from the ten full years of measurements (1996-2006) are shown in Table 3. Precipitation totals in 2006 varied among sites in a similar pattern to previous years. Sites 5 and 9 in Jackass Flats and Amargosa Valley have the least precipitation each year whereas Sites 3 and 6 on the east and north sides of Yucca Mountain generally have the most precipitation.

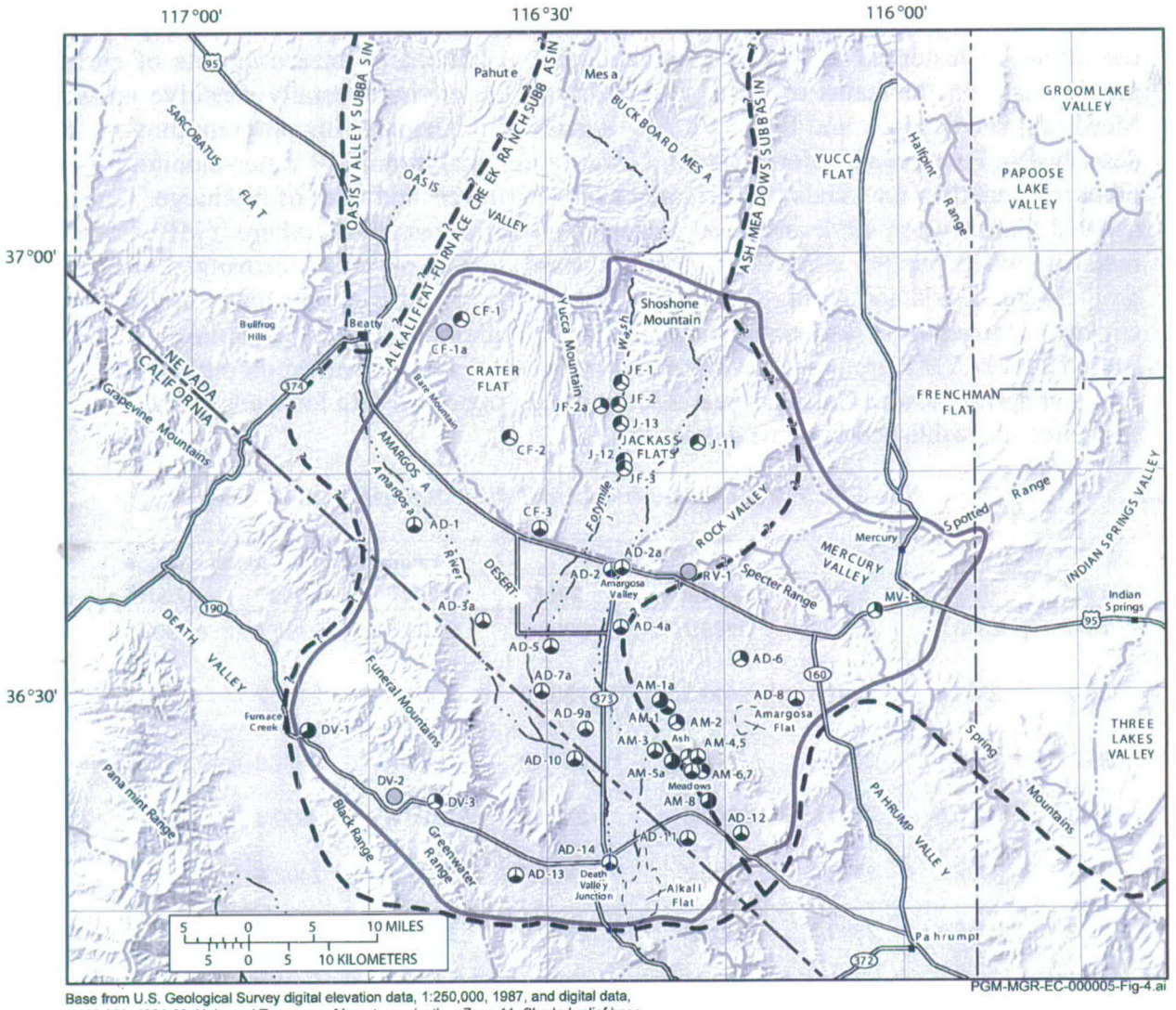
Table 3. Annual Precipitation at Meteorological Sites through 2006

| Site | Elevation (feet) | Precipitation (inches) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2002 | 2003 | 2004 | 2005 | 2006 | 2002-2006 | 1996-2006 |
| 1 | 3,750 | 1.56 | 9.65 | 11.25 | 11.32 | 6.19 | 7.99 | 8.16 |
| 2 | 4,849 | 1.26 | 10.94 | 12.63 | 10.98 | 5.94 | 8.35 | 7.97 |
| 3 | 4,196 | 1.33 | 11.59 | 12.46 | 12.27 | 6.58 | 8.85 | 8.88 |
| 4 | 4,049 | 1.31 | 9.03 | 11.23 | 10.84 | 6.06 | 7.69 | 7.89 |
| 5 | 3,127 | 1.32 | 8.44 | 9.11 | 7.50 | 4.05 | 6.08 | 5.91 |
| 6 | 4,315 | 1.16 | 8.95 | 12.81 | 12.35 | 6.76 | 8.41 | 8.75 |
| 7 | 3,547 | 1.26 | 9.50 | 11.25 | 10.53 | 6.21 | 7.75 | 8.03 |
| 8 | 3,711 | 1.06 | 10.03 | 11.10 | 10.85 | 6.37 | 7.88 | 7.89 |
| 9 | 2,749 | 0.74 | 6.03 | 7.26 | 6.84 | 3.66 | 4.91 | 4.68 |
| 401 | 5,125 | 1.20 | 8.79 | 12.23 | 12.11 | 6.33 | 8.13 | - |
| 405 | 4,882 | 0.99 | 8.34 | 10.37 | 9.97 | 5.75 | 7.08 | - |
| 415 | 4,725 | 1.11 | 9.12 | 10.06 | 10.15 | 5.41 | 7.17 | - |

## 4.7 WATER MONITORING

Groundwater levels and spring flows in the Yucca Mountain region have been monitored since 1992. The monitoring is designed to detect and document background fluctuations in regional groundwater levels and spring flows, and to identify potential effects of groundwater withdrawals from YMP-permitted wells on regional groundwater levels and spring flows. Because the YMP does not release effluents into groundwater or otherwise affect the quality of that water, water quality is monitored only to meet permit requirements described in Section 2.6.

During 2006, groundwater levels and spring flows were monitored at 34 wells, one flowing well, and 5 springs (Figure 4). Water levels were measured monthly at wells, and discharge rates at springs were measured quarterly.




Base from U.S. Geological Survey digital elevation data, 1:250,000, 1987, and digital data, 1:100,000, 1981-89; Universal Transverse Mercator projection, Zone 11. Shaded-relief base from 1:250,000-scale Digital Elevation Model; sun illumination from northwest at 30 degrees above horizon

EXPLANATION

- Study-area boundary
- Ground-water subbasin boundary – From Laczniak and others (1996, pl. 1). Queried where location uncertain
- Hydrographic-area boundary

Data-collection site – Site number (table1) and primary contributing unit are indicated

- AD-6 Carbonate rock
- CF-2 Volcanic rock
- AD-1 Valley fill
- DV-2 Undifferentiated sedimentary rock
- DV-1 Combined carbonate rock and valley fill

Source: Modified from DOE 1999

Figure 4. Groundwater Monitoring Wells and Springs

The potential effects of water withdrawals from YMP wells are assessed by comparing current conditions to historical and baseline conditions. Additionally, measurements of spring flow provide data on the status of water availability in the environmentally sensitive areas of Ash Meadows, Devils Hole, and Death Valley. Results of this monitoring program through 2000 are described in Fenelon and Moreo (2002). That report analyzed YMP water-monitoring data and other regional data for trends or fluctuations in water levels and rates of discharge. The analysis showed that between 1992 and 2000, water levels in Jackass Flats, where YMP withdraws the majority of its water, either had slight upward trends or were unchanged. Changes in groundwater levels and spring flows elsewhere in the region were attributed to factors such as climatic change, local and regional groundwater withdrawals, and earthquakes (Fenelon and Moreo 2002). YMP groundwater withdrawals had no measurable effect on regional groundwater levels or spring flows. Calendar year 2006 groundwater-level data for wells in Jackass Flats are compared to established baseline data in Table 4.

Table 4. Water Level Altitudes in Wells in Jackass Flats (in feet)

| | 2006[a] | | | Previous Years – Median Value | | | | |
|---|---|---|---|---|---|---|---|---|
| Well | Min | Max | Median | 2005[b] | 2004[b] | 2003[b] | 2002[b] | Baseline[c] |
| JF-1 | 2393.5 | 2393.9 | 2393.7 | 2393.6 | 2393.4 | 2393.3 | 2393.1 | 2392.5 |
| JF-2 | 2393.2 | 2393.4 | 2393.3 | 2393.0 | 2392.7 | 2392.7 | 2392.1 | 2392.1 |
| JF-2a | 2471.4 | 2471.8 | 2471.6 | 2471.3 | 2471.8 | 2471.9 | 2470.8 | 2468.6 |
| J-13 | 2390.6 | 2391.5 | 2390.9 | 2390.3 | 2390.0 | 2390.8 | 2389.7 | 2390.0 |
| J-11 | 2402.4 | 2402.9 | 2402.7 | 2402.7 | 2402.5 | 2402.6 | 2402.3 | 2402.2 |
| J-12 | 2388.8 | 2389.2 | 2389.0 | 2388.9 | 2388.9 | 2388.8 | 2388.6 | 2388.3 |
| JF-3 | 2388.7 | 2389.7 | 2389.0 | 2388.9 | 2388.8 | 2388.7 | 2388.5 | 2388.3 |

[a] Arthur, 2006a; Arthur 2006b; Arthur 2006c; Wade 2007b
[b] See previous *Site Environmental Reports* (YMP 2006; YMP 2005; YMP 2004; YMP 2003; YMP 2002)
[c] Locke 2001. Table 10 (baseline years are 1985-1991 for JF-2, JF-2, and JF-2a; 1989-1991 for J-13; 1990-1991 for J-1 and J-12; and 1992-1993 for J-3)

Well JF-3 was installed in 1992 and has been routinely measured since then to monitor the effects of groundwater withdrawals from Wells J-12 and J-13 (Figure 4). The depth to water in Well JF-3 and most other YMP monitoring and water-supply wells in Basin 227A (Wells J-11, J-12, J-13, JF-1, JF-2, and JF-2a) was slightly higher in 2006 than baseline water levels (Table 4). Compared to the baseline, 2006 median water levels have increased in all monitored wells. Wells J-12 and J-13 are the primary water-supply wells at Yucca Mountain (see Section 2.10 for additional information). Since April 2002, water withdrawals from these wells decreased from about 40 acre-feet per year to about 9 acre-feet in 2006.

## 4.8 HAZARDOUS MATERIALS, HAZARDOUS AND NON-HAZARDOUS WASTES, AND POLLUTION PREVENTION

### 4.8.1 Management of Hazardous Materials

To minimize potential hazards to personnel and the environment, review and approval of each hazardous material is required before it can be purchased or used on the Project. General information on the amount of hazardous materials to be stored and used, storage locations, and a description of how the material will be used, along with a copy of the MSDS, is submitted for review. The review comprises environmental, industrial hygiene, safety, and fire-protection disciplines. When available, suitable less-hazardous or environmentally friendly substitutes are discussed with the requester. If no substitute is available, authorization to use the material may be denied, or requirements are developed for use of the material to minimize risks (e.g., storage methods, personal protective equipment and handling requirements, training, spill prevention methods, and waste disposal).

All chemicals stored at Yucca Mountain and other sites operated by the Project are inventoried and tracked. This information is used to comply with the requirements identified in Section 2.7.2.

### 4.8.2 Management of Hazardous and Non-Hazardous Wastes

- **Hazardous and Universal Wastes**

To meet the requirements of the RCRA (Section 2.8.2), all hazardous and universal wastes are accumulated, packaged, transported, and disposed of offsite in accordance with federal and state requirements. These wastes were generated from sources such as laboratory studies, routine cleaning and maintenance, construction, expired chemicals, and excess supplies from discontinued equipment. There was one offsite shipment of these wastes during 2006.

- **Non-Hazardous Waste**

During 2006, refuse, industrial, salvageable, and other non-hazardous wastes were recycled, reused, or disposed of (Table 5) in accordance with federal and state requirements (Section 2.8.2). As part of the YMP pollution-prevention program (Section 4.8.3), efforts were made to recycle rather than dispose of waste whenever possible.

Table 5. Types and Amounts of Wastes Recycled, Reused, or Disposed of in 2006

| Material | Method | Amount[a] |
|---|---|---|
| Batteries (lithium ion, Ni-Cad, alkaline | Recycled | 0.71 metric tons |
| Aluminum cans | Recycled | 2.51 metric tons |
| Copy machine and printer toner cartridges | Recycled | 0.45 metric tons |
| Ferrous and non-ferrous metals (does not include aluminum cans) | Recycled | 6.35 metric tons |
| Lead-acid batteries | Recycled | 5.58 metric tons |
| Paper | Recycled | 207.9 metric tons |

| Material | Method | Amount[a] |
|---|---|---|
| Used oil from equipment maintenance | Recycled | 4,015 gal |
| Used oil total | Recycled | 4,015 gal |
| Water (oil/water separator) | Recycled | 64,700 gal |
| Used computers and other electronic desktop equipment[b] | Recycled | 795 items |

[a] Values for solid materials are presented in the unit of measure reported to regulatory agencies.
[b] Represents fiscal year values.

### 4.8.3 Pollution Prevention

The YMP's pollution prevention program is defined and described in BSC's Environmental Protection Policy and Environmental Protection and Compliance Directive. The policy states that BSC will integrate pollution prevention, the use of environmentally preferred materials, and sustainable design principles into project planning and work activities to reduce waste generation, conserve natural resources and energy, and minimize environmental impacts. The directive identifies implementing methods for the pollution prevention program.

- **Reporting and Record-Keeping Requirements**

Executive Order 13101 (63 Federal Register 49643) (see Section 2.1.5) requires that each federal agency purchase, to the greatest extent practicable, EPA-designated products containing recycled materials (40 CFR Part 247). The YMP has an environmentally-preferable purchasing program that supports the federal goal to purchase these products unless they are not readily available, not competitively priced, or do not meet performance specifications.

Executive Order 13148 (65 Federal Register 24595) (see Section 2.1.4) requires an annual fiscal year progress report on pollution prevention. YMP has a recycling program that includes office items, automotive fluids, industrial wastewater, construction debris, and electronic items. Data on recycling are compiled and submitted each fiscal year through the DOE Pollution Prevention Website.

- **Pollution Prevention Opportunity Assessments**

Because of budget constraints, no Pollution Prevention Opportunity Assessments were conducted in 2006.

- **Employee Awareness Initiatives**

Numerous initiatives were undertaken in 2006 to raise employee awareness and increase participation in pollution prevention efforts.

- The pollution prevention web site was improved by periodically updating the existing information and related links.

- Pollution prevention articles were published in the YMP's *BSC Today, The Crest,* and the *Porcelain Press* on management of office supplies, Earth Day 2006, recycling of

copper and tin wiring during office renovation, use of sustainable or green products in renovated facilities, support for the DOE Energy Star "Change a Light, Change the World" initiative, recognition of outstanding pollution-prevention efforts, and the preference for black and white copiers instead of color copiers.

- An employee award program recognized both small and large efforts in pollution prevention.

The YMP was also a recipient of the "Best in Class" award for the *Reuse and Recycle Electronic Equipment Program.* A nomination for a pollution-prevention award titled "Sustainability at the YMP – Genuine Efforts Lead to Life-Cycle Enhancements" was submitted to DOE Headquarters for consideration in the White House Closing-the-Circle awards..

Continuous effort was made in 2006 to reduce paper use and continue to recycle paper on the YMP, as an on-going pollution-prevention initiative for the Project.

- **Environmentally Preferable Purchasing Program**

This program requires that goods and services be reviewed for compliance with EPA's Energy Star program, EPA's Consumer Products Guidelines (40 CFR Part 247), other procurement guidelines that stress environmentally-preferable products and services, the use of non-Class I ODS, and hazardous-materials purchasing requirements..

- **Sustainable Design**

Sustainable design is a set of principles to ensure that the design, construction, operation, and eventual decommissioning of facilities are safe, energy efficient, and environmentally responsible. DOE Order 413.3A requires that sustainable-design principals be applied to new facilities. DOE Order 430.2A identifies the reporting requirements of sustainable design.

Sustainable design has been incorporated into engineering design requirements for the Project. New facilities will be constructed to meet the silver-rating criterion of the U.S. Green Building Council Leadership in Energy and Environmental Design.

- **Secretarial Pollution Prevention and Energy Efficiency Goals**

DOE Order 450.1 was revised in December 2005 to replace the 1999 Secretarial goals and baselines with pollution prevention and sustainable environmental stewardship goals. These new goals are incorporated, as appropriate, into site-specific goals that are established using the EMS Environmental Aspect Analysis process outlined in EV-PRO-1001, *Maintenance of the Environmental Management System.* This process identifies and establishes environmental objectives and targets that are applicable to the YMP (BSC 2006b). See Chapter 3 for additional information on the YMP's EMS and Project efforts to:

- reduce the generation of wastes, hazardous and toxic substances, and greenhouse gases
- reduce the consumption of energy and water
- reduce the use of ozone-depleting substances

- recycle and use materials with recycled content
- increase the use of fuel-efficient vehicles

The results of some of these efforts are as follows: The YMP's 2006 recycling rate for non-hazardous waste was about 60 percent, similar to last year's recycling rate. The procurement of EPA-designated recycled-content items was 98 percent in FY06, up 6 percent from FY05. Compared to 2005, 2006 saw a decrease of 397 pounds of hazardous waste generated by the Project. In 2006, the total quantity of hazardous waste collected was 2,293 pounds; 284 pounds of universal waste was also collected in 2006. A total of 1,333 pounds of hazardous waste and 672 pounds of universal waste were shipped to a permitted treatment, storage, and disposal facility in 2006. The YMP purchases and uses fuel-efficient vehicles. Alternative-fuel vehicles, however, were not used during 2006 due to lack of refueling stations, difficulty with the operation of refueling equipment, and the limited space for passengers and cargo associated with the vehicles.

## 4.9 ENVIRONMENTAL, SAFETY, AND HEALTH ASSESSMENTS

The ES&H assessment program is conducted as addressed in GM-POL-1, *Management Description* (BSC 2006c) to provide programmatic oversight of YMP activities and help ensure full compliance with regulations and excellence in the ES&H and ISMS programs. This is accomplished through independent evaluations of YMP ES&H activities and programs for compliance with applicable federal and state laws; DOE policy; permit stipulations; and YMP plans, policies, and procedures. The assessment process, which includes verification of completed corrective actions, enhances the effectiveness and implementation of ES&H roles, responsibilities, and interfaces among YMP organizations.

Assessment topics are selected based on requirements for periodic program reviews, the potential for noncompliance conditions, management requests, adverse trends, or the need to evaluate newly implemented or changed programs. Assessments are conducted through document reviews, observation of work practices, and interviews to evaluate compliance with the governing regulatory and procedural requirements. Assessment results are documented in an assessment report. Any adverse and/or opportunity-for-improvement conditions noted from the assessment are tracked via the Corrective Action Program. Assessment items are closed when completed corrective actions have been verified by the lead assessor in accordance with Corrective Action Program business processes.

During 2006, eight assessments were conducted to evaluate compliance with ES&H and ISMS program requirements (Table 6).

## 4.10 ENVIRONMENTAL APPRAISAL PROGRAM

In September 2006 the Environmental Surveillance program was revised and, among other things, the term "surveillance" was replaced with the term "appraisal." In addition, the procedure for appraisals was modified to include a new category termed "on-the-spot-fix." The original categories of "corrective action required" and "no corrective action required" were retained. The new category of "on-the-spot-fix" allows for small items noted during an appraisal

to be fixed by the end of the same workday. These on-the-spot-fixes are tracked along with "corrective action required" and "no corrective action required."

Environmental appraisals are conducted to confirm that activities are planned, managed, and implemented in a manner that protects environmental quality, minimizes threats to the environment, and complies with programmatic requirements and permit stipulations. Appraisals can investigate, among other things, procedural requirements (e.g., DOE directives, YMP plans and procedures), permit conditions, land access stipulations, and environmental regulations. Most appraisals are planned; however, appraisal reports and associated corrective actions can be written whenever an environmental compliance issue is noted or reported.

Two hundred and twenty two (222) appraisals were conducted in 2006. Thirteen appraisals required corrective action. The corrective actions applied to procedures, repair of spill liners, material storage, and fencing. There were 16 on-the-spot fixes. These fixes involved housekeeping activities such as labeling, trash, and secondary containment. There were no permit violations or reportable spills in 2006.

Table 6. Calendar Year 2006 BSC ES&H Assessment Results

| Assessment | Results |
|---|---|
| Radon Protection Monitoring and Tracking (06-02) | This assessment evaluated compliance of the BSC radon protection program with the applicable requirements of 29 CFR Part 1910.1096, *Ionizing Radiation*; DOE Order 440.1A, *Worker Protection for DOE Federal and Contractor Employees*; and YMP radon-protection implementing documents. Results indicated that increased attention was needed in maintaining dosimeter data documentation, questioning/evaluating data inconsistencies and anomalies, reviewing/updating awareness training, and ensuring full compliance with procedural requirements. |
| Inspection Program Effectiveness (06-04) | This assessment evaluated the effectiveness of formal BSC inspection programs that included safety criteria as part of the facility inspection processes. Needed improvements were noted in regard to updating procedural references and distribution of the inspection results. |
| Occurrence Reporting and Processing of Operations Information (06-05) | This assessment evaluated BSC processes for complying with DOE regulatory and BSC procedural requirements for identifying and reporting reportable conditions. Several recommendations were identified to improve the means by which these conditions should be tracked and trended in Project programs. |
| Integration of ES&H Requirements in Engineering, Procurement, and Construction Processes (06-07) | This assessment examined the integration of ES&H expertise in the engineering document-development and review processes. Recommendations were made to clarify ES&H roles, responsibilities, and authorities in the review processes and to establish a more consistent methodology for issuing design documents for ES&H review. |
| Radiation Protection Program (06-08) | This assessment was performed to meet a requirement in 10 CFR Part 835 for a tri-annual internal audit of the Project's radiation protection program. BSC efforts in reducing the radiological source inventory were commended and recommendations were made in regard to expanding selected procedural processes, improving source posting, and standardizing methods for transmitting semi-annual source inventory reports. |
| Zero Accident Philosophy Program Performance (06-09) | Implementation of BSC's Zero Accident Philosophy program was reviewed and suggestions were identified for improving the overall administration and control of program initiatives and incentives. |
| Review of Facility Fire Protection Systems (06-10) | This DOE-requested effort identified the types of fire protection systems installed in each YMP facility to ensure that they met or exceeded local building and National Fire Protection Association codes and standards. This review identified one facility that should be equipped with smoke detectors. |

| Assessment | Results |
|---|---|
| Worker Safety and Health Plan Review (07-01) | This assessment reviewed the BSC draft Worker Safety and Health plan to determine if its contents met the intent of 10 CFR Part 851, *Worker Safety and Health Program*. Gaps were identified and improvements were recommended to ensure regulatory requirements were adequately addressed in the WSAP plan. |

Trends in corrective actions for permit compliance, spills and waste management, and procedural deficiencies are tracked as measures of environmental performance of the YMP. There were no notable positive or negative trends in 2006 compared to 2005. The relatively small number of appraisal reports requiring action during 2006 and 2005 suggests that changes in the process for planning and implementing work have been successful in recent years, as well as closer attention to compliance with procedures and work instructions and greater worker involvement in the planning and conduct of work.

## 4.11 TRAINING

Worker training on environmental compliance, pollution prevention, and all other aspects of ISMS is an important part of the YMP environmental program. All Project personnel working at Yucca Mountain are instructed on the environmental and safety requirements that must be followed for field activities. Additional job-specific training commensurate with job responsibilities is also offered.

All new employees must take General Employee Training. This six-hour course covers, among other things, the Project's environmental protection requirements, pollution prevention, and safety and health requirements. A computer-based annual refresher of these topics is also required of all employees.

All new employees who work unescorted at Yucca Mountain must take Site Access Training. This three-hour class describes the employees' responsibilities for land access, protecting biological and cultural resources, hazardous and non-hazardous waste management, and environmental permit compliance. Computer-based, annual refresher training is also required.

Environmental Compliance Awareness for Managers and Supervisors was available for all BSC managers and supervisors. This computer-based training informs managers and supervisors of their responsibilities for maintaining environmental compliance and protecting the environment, and the consequences of not taking environmental concerns seriously. Managers are instructed to minimize environmental impacts; comply with environmental regulations; and mitigate impacts through prevention, corrective action, reclamation, and other measures.

Employees whose work involves the transport of hazardous materials are required to attend a three-day training class on the basics of hazardous materials transport and to attend additional job-specific classes. Personnel also are required to attend a three-day advanced class if their work involves the certification of shipping papers for hazardous and radioactive materials and hazardous waste.

Additionally, information on environmental issues is disseminated to Project employees to improve the YMP safety program and protect the environment. This consists of "safety or

quality topics" at meetings, topical briefings at quarterly departmental safety meetings, articles published in electronic media such as *The Crest* and *BSC Today*, articles published and strategically posted Project-wide in *The Porcelain Press*, and via Project web sites on BSC*connect* such as "Environmental Management System," "Environmental Compliance," "Pollution Prevention," "ES&H Electronic Manual," and "Zero Accident Philosophy."

## 4.12 PERMIT-ASSOCIATED LITIGATION

In February 2000, the Nevada State Engineer denied DOE's water-appropriation request for permanent rights to 430 acre-feet per year for use at Yucca Mountain (Turnipseed 2000). Shortly thereafter, the DOE filed suit to overturn the State Engineer's ruling. In September 2000, the U.S. District Court granted the state's motions to dismiss the DOE's suit. The DOE appealed, and in October 2001, the Ninth U.S. Circuit Court of Appeals ordered a federal judge to hear the DOE's suit.

While this court case proceeded, in December 2002 the State of Nevada and the DOE agreed to a joint stipulation that allowed DOE to re-supply the potable water-storage tanks at Yucca Mountain, as needed.

In July 2003, the State of Nevada agreed to let the DOE pump water from Wells J-12 and J-13 for non-potable purposes, including dust suppression and continuing scientific studies.

In November 2003, following a remand from the Federal District Court, the State Engineer again denied DOE's water-appropriation request for 430 acre-feet per year for use at Yucca Mountain (Ricci 2003). In December 2003, the DOE appealed the State Engineer's ruling.

In May 2004, the DOE informed the State of Nevada that it needed additional non-potable water for road repairs, permit obligations, and obligations under the NWPA.

In February 2005, the DOE informed the Nevada State Engineer of its intent to continue the use of non-potable water to maintain the status quo at Yucca Mountain, per previous agreements between DOE and the State of Nevada.

During 2006, DOE used additional non-potable water to support the drilling program; this effort continued into 2007. There is nothing additional new to report for 2006; however, the DOE continues to pursue its water appropriation request to obtain permanent rights to 430 acre-feet per year for use on the YMP.

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# 5. QUALITY ASSURANCE

The quality of environmental data and results presented in this report were ensured through quality assurance practices. Appropriate industry standards and accepted laboratory and field monitoring practices were used to establish quality assurance practices. These practices are compliant with environmental compliance requirements applicable to collection and analysis of environmental data as identified in applicable sections of the *Augmented Quality Assurance Program* document (DOE 2004). These quality assurance practices were applied to the appropriate aspects of monitoring, sampling, analysis, data reduction, and reporting operations to produce data of known quality.

The quality assurance practices were implemented through the systematic application of quality assurance policies, standardized procedures, and independent assessments. Quality assurance controls included the following:

- Personnel training was conducted and documented before work was initiated.
- Work instructions and procedures were developed and reviewed before they were approved for use.
- A verbatim compliance policy for work performance, in accordance with approved procedures, was mandated for all work.
- Standards traceable to the National Institute of Standards and Technology were used to calibrate and check measuring and test equipment.
- Equipment used for monitoring, sampling, analysis, and counting was regularly calibrated at prescribed intervals.
- Operational status and accuracy of equipment were independently and routinely checked by trained personnel.
- Discrepancies and nonconforming conditions were documented and evaluated in accordance with a structured and approved corrective action process.
- Technical data were reviewed before data reduction and analysis and reporting.
- Computer software used for data reduction and analysis were evaluated and controlled.
- Monitoring, sampling, analysis, and subsequent data reduction were periodically evaluated to verify effective implementation.
- Compliance with quality assurance procedures for meteorological monitoring was verified by independent assessments.

## 5.1 SAMPLE CONTROL

All environmental samples were controlled in accordance with approved work instructions and procedures. These controlled procedures specified approved methods and processes for sample collection, sample handling, chain-of-custody control, and analysis and data reporting.

Technicians were trained to ensure that samples were properly labeled, stored, and protected against loss or contamination. Samples were uniquely identified by markings on either the sample or its packaging. Sample transactions were documented on either a Chain-of-Custody form for external transfers or a Sample Transfer form if transferred internally. Transfer recipients were required to verify that proper conditions and identification of samples were provided and maintained before accepting custody of the samples.

## 5.2 SAMPLE ANALYSIS

Analyses of samples were conducted in accordance with approved protocols, based on standard and approved methods. Personnel performing analyses and measurements were specifically trained for these work assignments before initiating work.

As prescribed by a scope of work, analysis programs selectively used sample blanks, spikes, and replicates to better determine accuracy and precision of methods and to eliminate bias. Subcontractors who measured or analyzed samples were required to establish an equivalent quality assurance control system. Results of measurements and analyses were reviewed and approved by qualified personnel.

## 5.3 INSTRUMENT CONTROL

Instruments used to measure, monitor, test, or sample environmental conditions were procured, calibrated, controlled, and maintained in accordance with approved procedures. Equipment and calibration standards used to ensure instrumentation accuracy were traceable to the National Institute of Standards and Technology. Frequency of equipment calibration and maintenance were prescribed in approved procedures, based on manufacturers' recommendations.

Performance of all calibrated equipment was periodically checked to verify its adherence to operational specifications. Field technicians routinely checked calibrated equipment, and adjustments were made to optimize its performance. Out-of-tolerance conditions were documented, and resolution was determined by recalibration, rework, or replacement. Data affected by out-of-tolerance conditions were reported and identified as "indeterminate" until resolution of the condition had been evaluated to determine if the data could be validated.

## 5.4 DATA MANAGEMENT

To preserve data integrity, monitoring and sampling data were recorded and handled in accordance with approved procedures. The efficiency of data reduction software was verified through formal acceptance tests before use. During data reduction and compilation, data were validated to identify inconsistencies and anomalies. Data validation was performed by comparing the data to expected or predetermined ranges and past results. Decisions to include or eliminate suspect or unverifiable data were determined during technical reviews by qualified personnel.

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# 7. GLOSSARY

(NOTE: Several terms in this Glossary emphasize their specific relationship to the Yucca Mountain Project.)

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| **alluvial fan** | A relatively flat to gently sloping mass of loose rock, shaped like an open fan, deposited by a stream or streams on a plain or broad valley. |
| **alluvium** | Unconsolidated rock debris deposited by flowing water during relatively recent geologic time; generally unsorted to semi-sorted. |
| **ambient** | Undisturbed, natural conditions, such as ambient temperature caused by climate; surrounding conditions. In addition, the geographic area in which the public has free access and where the ambient air quality standards apply. |
| **aquifer** | Subsurface saturated rock of sufficient permeability to transmit groundwater and yield usable quantities of water to wells and springs; a rock formation, group of formations, or part of a formation with these characteristics. |
| **arid** | Areas where mean annual evaporation exceeds mean annual precipitation. Arid regions typically have high rainfall variability, with annual amounts ranging between four and 12 inches. |
| **ashfall** | The descent through the atmosphere of ash from a volcanic eruption; volcanic ash resulting from an ash fall and lying on the ground surface. |
| **ash-flow tuff** | A tuff deposited by a turbulent blend of unsorted volcanic debris and high-temperature gas ejected explosively from fissures or a crater. |
| **basaltic lava flow** | Fine-grained, dark-colored volcanic rocks erupted onto or near the land surface from a volcano or fissures. |
| **borehole** | A hole drilled into the earth's crust to collect hydrologic and geologic data. |
| **borrow pit** | An excavated area where earth materials such as sand and gravel are obtained. |
| **caldera** | A large, basin-shaped volcanic depression formed by violent eruptions and collapse of the crust. |
| **carbonate aquifer** | An aquifer in limestone and/or dolomite. Carbonate aquifers typically produce hard water, that is, water containing relatively high concentrations of calcium and magnesium. |

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| **chain-of-custody** | A form that documents collection, transport, and analysis of samples (e.g., water, rock). |
| **cinder cone** | A conical hill formed by the accumulation of cinders and other ejected debris around a volcanic vent. |
| **clearance survey** | A survey conducted to find and remove desert tortoises prior to land-disturbing activities. |
| **coliform bacteria** | Bacteria that originate as organisms in soil or vegetation and in the intestinal tract of warm-blooded animals (fecal coli). This group of bacteria has long been an indicator of the contamination of water and possible presence of intestinal parasites and pathogens. |
| **decommission** | The process of removing from service a facility in which nuclear materials are handled. This usually involves decontaminating the facility so that it can be dismantled or dedicated to other purposes. |
| **effluent** | A liquid or gaseous waste that is discharged to the environment. |
| **Euroamerican** | A person whose ancestry can be traced to Europe, but who immigrated to the United States and became either a naturalized or a legal citizen. |
| **evapotranspiration** | The combined processes of evaporation and plant transpiration that remove water from the soil and return it to the air. |
| **fault** | A fracture or zone of fractures along which there has been displacement. |
| **fault system** | Two or more sets of faults that are mostly parallel and that developed during a particular deformational episode. |
| **floodplain** | The strip of relatively smooth land adjacent to a river or stream channel or dry wash that is covered by water when the river or stream overflows its banks. |
| **fugitive dust** | Airborne particulate matter, emitted into the atmosphere from wind erosion of exposed soils or from vehicles traveling over unpaved roads |
| **geologic repository** | A facility for the long-term isolation of spent nuclear fuel and high-level radioactive waste in excavated geologic media. |
| **germination** | The process whereby seeds or spores sprout and begin to grow. |

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| **greenhouse gases** | Greenhouse gases are natural and man-made substances that trap outgoing infrared energy emitted by the earth, warming the atmosphere and the earth. Common examples include water vapor, carbon dioxide, methane, some hydrofluorocarbons and perfluorocarbons. |
| **groundwater** | Water contained in pores or fractures in either the unsaturated zone or saturated zone below the surface. |
| **high-level radioactive waste** | (1) The highly radioactive material that is produced from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing, and any solid material derived from such liquid waste that contains fission products in sufficient concentrations. (DOE would vitrify liquid high-level radioactive waste before shipping it to the repository.), and (2) other highly radioactive material that the NRC, consistent with existing law, determines by rule requires permanent isolation. |
| **Holocene epoch** | The most recent epoch of geologic time that extends from the end of the Pleistocene to the present, or approximately the past 10,000 years; also the rocks and deposits formed during this time. |
| **human exposure** | The condition of a human being subject to some effect or influence from a hazardous material, pollutant, or ionizing radiation generally considered as potentially resulting in an adverse physical response. |
| **hydrology** | The study of the occurrence, distribution, movement, and chemistry of water. |
| **injection well** | A deep well into which water, pressurized gas, or other material is pumped to test specific properties of the rock through which groundwater flows. |
| **invasive species** | An alien plant or animal species whose introduction does or is likely to cause economic or environmental harm or harm to human health. |
| **leachfield** | A component of a sanitary sewage system that uses soil for the disposal of effluent discharged from a septic tank. The leachfield consists of a series of perforated pipes buried in trenches that distribute the effluent below the surface. |
| **Material Safety Data Sheets** | A manufacturer's summary of the chemical characteristics of a material, including information about the material's toxicity, storage, handling, first aid procedures, cleanup of spills, and disposal. |

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| **Native American** | A person having origin in any of the original peoples of North America and who maintains cultural identification through tribal affiliation or community recognition. |
| **native species** | Plant or animal species that occur naturally (without introduction by humans) in the region. |
| **ozone-depleting substances** | Ozone is the triatomic form of oxygen. In the stratosphere (6 - 12 miles to about 33 miles above the surface), natural ozone protects the Earth from the sun's ultraviolet radiation. Ozone-depleting substances are certain compounds that contribute to the depletion of this protective ozone layer. |
| **Paleozoic** | A geologic era extending from the end of the Precambrian to the beginning of the Mesozoic, dating from between 570 and 225 million years ago. |
| **particulate matter** | Small airborne solid particles such as dust, smoke, fumes, or smog, that occur naturally or from human activities. |
| **perennial** | A plant that lives or continues more than two years, whether it retains its leaves in winter or not. |
| **potsherd** | A fragment of a ceramic vessel such as a bowl or jar. |
| **pre-activity surveys** | A biological, archaeological, and/or radiological survey conducted before granting approval to use land by Project participants. These surveys are designed to identify, preserve, and protect biological and archaeological resources, and identify and protect personnel from radiation sources. |
| **Precambrian** | All geologic time, and its corresponding rocks, before the Paleozoic. It is equivalent to about 90 percent of geologic time and marked by the appearance of primitive forms of life. |
| **quality assurance** | All those planned and systematic actions necessary to provide adequate confidence that a program or item will perform satisfactorily. |
| **radiation** | The emitted particles or photons from the nuclei of radioactive atoms. Some elements are naturally radioactive; others are induced to become radioactive by irradiation in a reactor. Naturally-occurring radiation is indistinguishable from induced radiation. |
| **radionuclide** | A radioactive atom with an unstable nucleus that spontaneously decays, emitting ionizing radiation in the process. |
| **recharge** | The movement of water from an unsaturated zone to a saturated zone. |

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| **reclamation** | The conversion of disturbed land to a pre-disturbed condition. |
| **recontour** | Grading soil or loose rock debris on a disturbed site to match the natural slope and drainage of the surrounding landscape. |
| **remediation** | Action taken to permanently remedy a release or threatened release of a hazardous substance to the environment. |
| **sample transfer** | A form used on the Yucca Mountain Project for documenting the transfer of samples (e.g., water, rock) from one person to another. |
| **saturated zone** | The area below the water table where all spaces (fractures and rock pores) are completely filled with water. |
| **sedimentary rocks** | Rock resulting from the consolidation of loose sediment that has accumulated in layers. |
| **site characterization** | All activities associated with the determination of the suitability of the Yucca Mountain site for a geologic repository. On February 14, 2002, the Yucca Mountain site was recommended by the Secretary of Energy to the President as a suitable site for a repository. |
| **spent nuclear fuel** | Fuel that has been withdrawn from a nuclear reactor following irradiation, the component elements of which have not been separated by reprocessing. For this Project, this refers to: (1) intact, nondefective fuel assemblies; (2) failed fuel assemblies in canisters; (3) fuel assemblies in canisters; (4) consolidated fuel rods in canisters; (5) nonfuel assembly hardware inserted in pressurized-water reactor fuel assemblies; (6) fuel channels attached to boiling-water reactor fuel assemblies; and (7) nonfuel assembly hardware and structural parts of assemblies resulting from consolidation in canisters. |
| **Tertiary** | The first of two geologic periods of the Cenozoic Era extending from the end of the Mesozoic Era to the beginning of the Quaternary Period, covering a time span approximately from 65 million to two million years ago. |
| **tracer** | A substance (liquid or gas) usually injected through a well to determine the direction and speed of groundwater flow, as well as the characteristics of the rock through which the tracer travels. |
| **verbatim compliance policy** | Compliance with all procedures to the letter. |
| **volcanic aquifer** | A water-bearing unit of volcanic rock or volcanic sediment that yields water in a useable quantity to a well or spring. |

**well-logging** All operations involving the lowering and raising of measuring devices or tools into wells for the purpose of obtaining information about the well or adjacent formations.