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U.S. DEPARTMENT OF ENERGY

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Nevada Nuclear Waste Storage Investigations PROJECT

Nevada
Nuclear Waste
Storage Investigations Project

ENVIRONMENTAL

MONITORING AND MITIGATION PLAN FOR SITE CHARACTERIZATION

REVISION 1

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Nevada Nuclear Waste Storage Investigations Project
Waste Management Project Office
U.S. Department of Energy
Nevada Operations Office
Las Vegas, Nevada

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Chapter 1

EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

The Nuclear Waste Policy Act (NWPA) stipulates in Section 113(a) that the U.S. Department of Energy (DOE) "to the maximum extent practicable and in consultation with the Governor of the State involved or the governing body of the affected Indian Tribe involved, conduct site characterization activities in a manner that minimizes any significant adverse environmental impacts identified...." As a result, the Office of Civilian Radioactive Waste Management has developed a site-specific Environmental Monitoring and Mitigation Plan (EMMP) to be implemented during site characterization at the Yucca Mountain site to document compliance with Section 113(a) of the NWPA.

In support of the process that led to the recommendation of the Yucca Mountain site for site characterization, the DOE prepared a site-specific Environmental Assessment (EA) as required by Section 112(b)(1)(E) of the NWPA. This EA concluded that no significant adverse environmental impacts are expected from site characterization activities at the Yucca Mountain site. That statement is still valid even though site characterization activities are defined in greater detail now than at the time the EA was published. The Yucca Mountain EMMP, prepared using the EA as a starting point, therefore focuses on the potential for significant adverse impacts from site characterization. Potential is established by: (1) explicit identification in Chapter 4 of the EA; (2) a DOE determination that a single activity or combination of activities has a sufficient degree of uncertainty associated with it and a resultant potential for significant adverse impact; or (3) changes in the planned activities described in the consultation draft of the Site Characterization Plan (SCP), resulting in a sufficient degree of uncertainty and resultant potential for significant adverse environmental impact.

The objective of the EMMP is to document compliance with Section 113(a) of the NWPA. In order to do so, a summary description of site characterization activities is provided, based on the consultation draft of the SCP. Subsequent chapters identify those technical areas having the potential to be impacted by site characterization activities and the monitoring plans proposed to identify whether those impacts actually occur. Should monitoring confirm the potential for significant adverse impact, mitigative measures will be developed. In the

context of site characterization, mitigation is defined as those changes in site characterization activities that serve to avoid or minimize, to the maximum extent practicable, any significant adverse environmental impacts.

Although site characterization activities involve both surface and subsurface activities, it is the surface-based aspect of site characterization that is addressed in detail by the EMMP. The schedule and duration of these activities is given in the consultation draft of the SCP. A brief summary of all proposed activities is given in the EMMP.

The surface-based geotechnical studies that will require site preparation include drilling, trenching, pavements, and infiltration studies. Current drilling plans call for 345 to 430 holes to be drilled at or near Yucca Mountain during the site characterization phase. Of these holes, only 45 to 80 of the drill sites will require surface preparation, including drill pads and mud-and-cuttings pits. However, many of these sites will require the construction of dirt access roads or trails.

Approximately 20 trenches will be dug by bulldozers or articulated shovels during site characterization. Specific locations of planned trenches are unknown at this time and are dependent, in large part, on field reconnaissance.

Pavements may be prepared for study of fracture patterns of rock surfaces. They will be prepared by spraying water or air under moderately high pressure to clean rock surfaces of debris, if needed. Displaced material will collect in areas adjacent to the cleared area.

Infiltration studies consist of natural and artificial studies. Natural infiltration studies will utilize 74 existing drill holes and 24 additional shallow holes to monitor infiltration from precipitation events. At 50 of these locations, small ponds will be constructed to induce infiltration artificially. The total land area expected to be disturbed as a result of ponding studies is approximately 1,160 m^2 (12,500 ft^2).

The surface-based studies that require minimal or no site preparation include numerous shallow borehole studies, geophysical surveys, and geological mapping. These activities may require the use of off-road vehicles and portable drilling rigs, but land disturbance is expected to be minimal.

It should be noted that all planned geotechnical studies include some specific standard operating procedures (good engineering practice) that will be implemented to minimize significant adverse environmental impacts. In addition to these specific impacts, some general practices will be followed for activities where applicable. These standard operating procedures include: stockpiling topsoil for future surface reclamation, engineering of slope angles to control slope erosion and encourage stability, and reduction of dust through spraying with water or other dust-binding fluids.

Subsurface construction and testing will be conducted in two exploratory shafts (ES-1 and ES-2) and associated testing drifts. The underground tests themselves are not considered in determining monitoring requirements for the EMMP, but the construction of the facilities and the ancillary surface components are so considered. The construction includes cut-and-fill operations and drilling and blasting at the Exploratory Shaft Facility. The ancillary surface components include prefabricated metal buildings and about twelve trailers which will be installed on the exploratory shaft pad. Surface preparation and access road construction will be required. Utility systems will include an electrical substation and an underground electric distribution system, water storage and distribution system, sanitary and industrial waste disposal systems, and telephone communication systems. The rock debris and mud created during excavation of the shafts will be hoisted to the surface and disposed of on a rock-storage pile at the site. Fluids will be disposed of in a waste-water pond. Some access road construction will be required, and a concrete-batch plant will be assembled at the site.

In determining which environmental factors are to be monitored, each of the conclusions from the EA were reexamined with respect to potential for significant adverse impact. For each environmental discipline, an analysis was conducted to decide whether monitoring was considered appropriate, and the technical areas to be monitored within that discipline were identified. It was

concluded that there are no potentially significant adverse environmental impacts that require monitoring in the following disciplines: land use, water quality, soils, noise, aesthetics, Native American cultural resources, and transportation and utilities. Areas which will require monitoring are air quality (total suspended particulates), archaeological resources and historic sites, terrestrial ecosystems, and radiological levels. Each of these are summarized below.

Total suspended particulate loading will be minimized to the maximum extent practicable through standard operating techniques such as watering or paving of roads, watering the rock-storage pile, and use of commercial line power in lieu of diesel generators. Because fugitive particulate emissions will be minimized through the techniques discussed above, residual impacts are not expected to be significant. However, ambient particulate monitoring is proposed to support the above assertion and because of the uncertainty associated with the type and extent of activities planned for site characterization. Particulate monitoring will be implemented at locations in the vicinity of the proposed activities. Should the monitoring indicate that site characterization activities are causing a significant adverse impact, then mitigation measures would be devised and implemented.

Direct and indirect impacts to archaeological resources and historic sites both on and around Yucca Mountain may occur during site preparation for exploratory drilling, geophysical surveys, or other activities that disturb the surface. Pre-construction surveys will be conducted to identify any archaeological resources and historic sites that may be affected by site characterization activities. If an archaeological or historic site is located, the site data will be recovered by controlled excavation. Where this is not possible, the planned site characterization activity will be relocated or altered wherever possible so that the site will not be disturbed.

It is a current DOE standard regional operating practice that all sites be surveyed with respect to ecological resources prior to the start of an activity. Under EMMP-related studies, all sites will be monitored both during the proposed site characterization activity, and after that site characterization activity is completed. A variety of survey methodologies will be

utilized, including aerial photography. In addition to general surveys, special attention will be paid to two species in the Yucca Mountain area: the desert tortoise and the Mojave fishhook cactus. The desert tortoise is considered a sensitive and rare species by the State of Nevada and the U.S. Fish and Wildlife Service and will be monitored periodically as discussed above to determine if site characterization is adversely affecting population size and distribution. The Mojave fishhook cactus is not considered a sensitive species by the State of Nevada or the U.S. Fish and Wildlife Service, but site characterization activities will be located to avoid the species whenever possible.

There are four potential avenues by which radioactive particulates may be introduced to the atmosphere at or near Yucca Mountain: mining activities such as excavation; pumping of ground water; disturbance of surface soils, resulting in resuspension of radioactive materials previously deposited as a result of a variety of Nevada Test Site activities; and potential fallout from worldwide emissions. Under EMMP-related monitoring, the concentration of radon and its daughter products and the presence of other radioactive particles and gases will be measured in air samples. Ground water, soils, drift, and biotic samples will be assayed for radioactivity.

EMMP Progress Reports will be issued semi-annually to document any changes to the individual monitoring programs and addition of monitoring programs in other technical areas. Such changes and/or additions can result from: changes in the site characterization program and changes warranted by the evaluation of monitoring data collected.

Chapter 2

INTRODUCTION

2. INTRODUCTION

This chapter describes the background, purpose, scope, and approach taken by the Department of Energy (DOE) in drafting an Environmental Monitoring and Mitigation Plan (EMMP) for the candidate repository site at Yucca Mountain. This report focuses on significant adverse environmental impacts of site characterization and the associated monitoring and mitigation programs. The DOE is also preparing a Socioeconomic Monitoring and Mitigation Plan, which has a purpose and scope similar to that of the EMMP.

2.1 BACKGROUND

The DOE Office of Civilian Radioactive Waste Management is responsible for implementing the Nuclear Waste Policy Act (NWPA) of 1982, which requires that the Federal Government develop the first geologic repository for permanent disposal of spent nuclear fuel and high-level radioactive waste.

The NWPA specifies a process for selecting a repository site that involves the participation of States, affected Indian Tribes, and the public. The DOE identified nine potentially acceptable sites for the repository in February 1983. The suitability of these sites for a repository was evaluated in accordance with the DOE's siting guidelines (10 CFR 960). The results of these evaluations were reported in draft Environmental Assessments (EAs) issued for public review and comment in December 1984 and in the final EAs prepared for the five sites nominated for site characterization. The final EAs were issued in May 1986 and incorporated responses to public comments made on the draft EAs.

The Secretary of Energy then recommended to the President three sites as suitable for characterization as candidate repository sites: Yucca Mountain site, Nevada; Deaf Smith County site, Texas; and Hanford site, Washington. On May 28, 1986, the President approved characterization at these three sites; this approval formally initiated the site characterization phase, which is expected to last about seven years. A consultation draft Site Characterization

Plan (SCP), which provides the details of field activities to be conducted during this phase, has been prepared for the candidate site at Yucca Mountain.

2.2 PURPOSE

Section 113(a) of the NWPA requires the DOE to conduct its site characterization activities in a manner that minimizes any significant adverse environmental impacts to the maximum extent practicable. These impacts are identified in Chapter 4 of the EA, which includes analyses of potential environmental impacts of site characterization activities. The EMMP also addresses potentially significant impacts identified in public comments received during the 1984 EA public hearing process, the EA public comment process, and consultations with affected parties. Any potentially significant adverse environmental impacts identified during the SCP public hearing process will also be included in the EMMP.

To document its compliance with the Section 113(a) requirement to minimize significant adverse impacts during site characterization to the maximum extent practicable, the DOE is developing an EMMP for the candidate site at Yucca Mountain. The document describes the DOE's monitoring and mitigation program for site characterization and focuses only on activities with a potential for causing significant adverse impacts. The EA addressed the DOE's proposed site characterization activities and their potential impacts as understood at the time of its issuance. The final EA documents that no significant adverse environmental impacts were expected from site characterization activities. In preparing the EMMP, updated site characterization activities are being considered, as well as information acquired since issuance of the EA. This information primarily concerns modification and additional detail on the scope and schedule of planned site characterization activities. The DOE will monitor those activities for which a sufficient degree of uncertainty in a single or combination of activities exists, along with a resultant potential for significant adverse impact.

Potential for significant adverse impacts can be established in one of two ways: (1) identification in Chapter 4 of the EA or (2) a determination by DOE that a single activity or combination of activities conducted during site characterization has a sufficient degree of uncertainty associated with it and therefore a resultant potential for significant adverse impact. Such a determination may come as a result of DOE's review of the comments on the EA and the SCP or after discussions with affected parties. Where an activity has a potential for a significant adverse impact, the EMMP will describe the monitoring that is to be conducted. Any significant adverse impacts identified in the future, through monitoring, through the SCP hearing and public comment process, or in discussions with affected parties will be described and procedures for developing mitigative action (i.e., adjustments in DOE's site characterization activities) will be addressed in subsequent EMMP Progress Reports.

2.3 SCOPE

The EMMP focuses only on the site characterization phase of the repository program and is one part of a total comprehensive and integrated environmental program. The EMMP does not represent all monitoring activities planned during site characterization. The DOE will also develop an Environmental Regulatory Compliance Plan, Environmental Field Activity Plans (EFAPs), and plans for the preparation of other program documents, including the Environmental Impact Statement required under Section 114(f) of the NWPA. The relationship of the EMMP to other proposed environmental studies and a summary of the associated plans and program documents are presented in the draft Environmental Program Overview.

The EMMP does not address repository construction, operations, closure, or decommissioning, nor does it address repository development issues--the issues to be addressed during the Environmental Impact Statement (EIS) preparation process. The scope of the EMMP is distinct from the EIS process and is not intended to describe how the DOE will gather data for the EIS. Such EIS data-gathering efforts will be described in an EIS Implementation Plan to be developed after the repository EIS scoping hearings. Rather, the EMMP outlines

the course of action to be followed subsequent to determination of potential for significant adverse impacts and addresses the process for conducting related monitoring and mitigation activities during site characterization.

2.4 APPROACH AND ORGANIZATION

Several steps are involved in the development of an effective monitoring and mitigation program. These steps include defining terms such as "significant" and "mitigation"; establishing impact thresholds that would lead to mitigation measures; developing mitigation measures; determining the process for gathering monitoring data; and updating and modifying the EMMP. A systematic approach to ensure that these steps are addressed in a comprehensive and consistent manner is outlined below.

Because the EMMP focuses only on those aspects of site characterization that have the potential for significant adverse impacts, the definition of "significant" is a key determinant in deciding which site characterization activities will be monitored. Determinations of significance for the EMMP are consistent with the definition of "significant" in Section 1508.27 of the Council on Environmental Quality (CEQ) regulations for implementation of the National Environmental Policy Act (NEPA) (Council on Environmental Quality, 1978). The range of impacts addressed in the EMMP is consistent with those impacts considered under the CEQ regulations for the implementation of NEPA.

The term "mitigation" should not be confused with the general procedures DOE will use to minimize the impacts of site characterization activities. For the purposes of this document, mitigation is defined as those changes in site characterization activities that serve to avoid or minimize, to the maximum extent practicable, any significant adverse environmental impacts. An example of mitigation includes rescheduling certain site characterization activities to avoid impacts to the terrestrial ecosystem during particular periods such as breeding seasons.

An important aspect of the EMMP development process will be the determination of thresholds that will indicate the need to begin more extensive monitoring or modification of particular site characterization activities. These threshold levels will be discussed with affected parties.

The discussion of site characterization activities in Chapter 3 of the EMMP includes discussions of measures that will be used to minimize impacts of site characterization activities. Examples include the use of water sprays during access road construction to aid soil compaction and dust suppression; establishment of a leachate monitoring program for the rock-storage pile and waste-water pond; and location of site facilities so as to reduce the potential for fire.

Chapter 4 discusses potentially significant impacts to be monitored under the EMMP. Chapter 5 of the EMMP contains a general discussion of proposed monitoring plans and possible mitigative measures that can be used to minimize significant impacts. The variables to be monitored, the techniques for sampling, and data collection and measurement are presented in the EFAPs. Mitigative measures for modifying particular site characterization activities or combinations of activities will be developed as monitoring and mitigation programs are implemented. These measures and their results will be discussed with affected parties and will be detailed in EMMP Progress Reports.

Chapter 6 of the EMMP outlines procedures for modifying the EMMP during site characterization in response to changes in site characterization activities, acquisition of new information on the site, or information obtained from the monitoring program itself. Periodic review of each monitoring program will be conducted to ensure the adequacy of indicators and techniques used to monitor site characterization activities and the effectiveness of any measures used to minimize significant adverse environmental impacts of site characterization. If the results of monitoring programs indicate that a single site characterization activity or combination of activities could lead to significant adverse environmental impacts, additional mitigative measures will be considered. Periodic monitoring reports will be prepared during site characterization to provide a feedback mechanism for establishing or modifying individual monitoring programs.

Chapter 3

SITE CHARACTERIZATION PROGRAM SUMMARY

3. SITE CHARACTERIZATION PROGRAM SUMMARY

This chapter describes the activities that are planned at and near Yucca Mountain during site characterization. The Yucca Mountain area is shown in Figure 3-1. The information presented is derived from two sources: (1) Chapter 4 of the Final Environmental Assessment (EA) for Yucca Mountain (DOE, 1986) and (2) the consultation draft of the Site Characterization Plan (SCP) for Yucca Mountain. The detail presented in this chapter is greater than that presented in the EA. Nevertheless, the reader should keep in mind that some of the information presented here, such as the proposed location and number of drillholes, is preliminary and subject to change upon publication of the SCP and subsequent documents. Additionally, those site characterization activities that trigger needs for regulatory requirements are presented in the Environmental Regulatory Compliance Plan (ERCP).

Site characterization activities will consist of ongoing and additional proposed studies. The existing and proposed components (e.g., drillholes, trenches, and infiltration sites) of the site characterization program are listed with location coordinates in Appendix A of this document. Additionally, Maps 1-4 are located at the back of this report and depict predisturbance conditions, existing activities and disturbed areas, activities proposed for site characterization, and an expanded view of the Exploratory Shaft Facility (ESF) site, respectively. The majority of site characterization activities referenced within this chapter can be located on these maps. There is the potential that regional field studies in California may be needed after completion of studies in the immediate vicinity of Yucca Mountain; these activities are not presently depicted on the described maps.

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project SCP contains a summary of schedule information for site characterization that includes sequencing, interrelationships, and relative durations of activities. Specific durations and start/finish dates are being developed as part of ongoing planning efforts. The schedule for activities at the ESF is reported in this chapter only in terms of duration (number of months to complete a particular activity) and is not tied to a specific date.

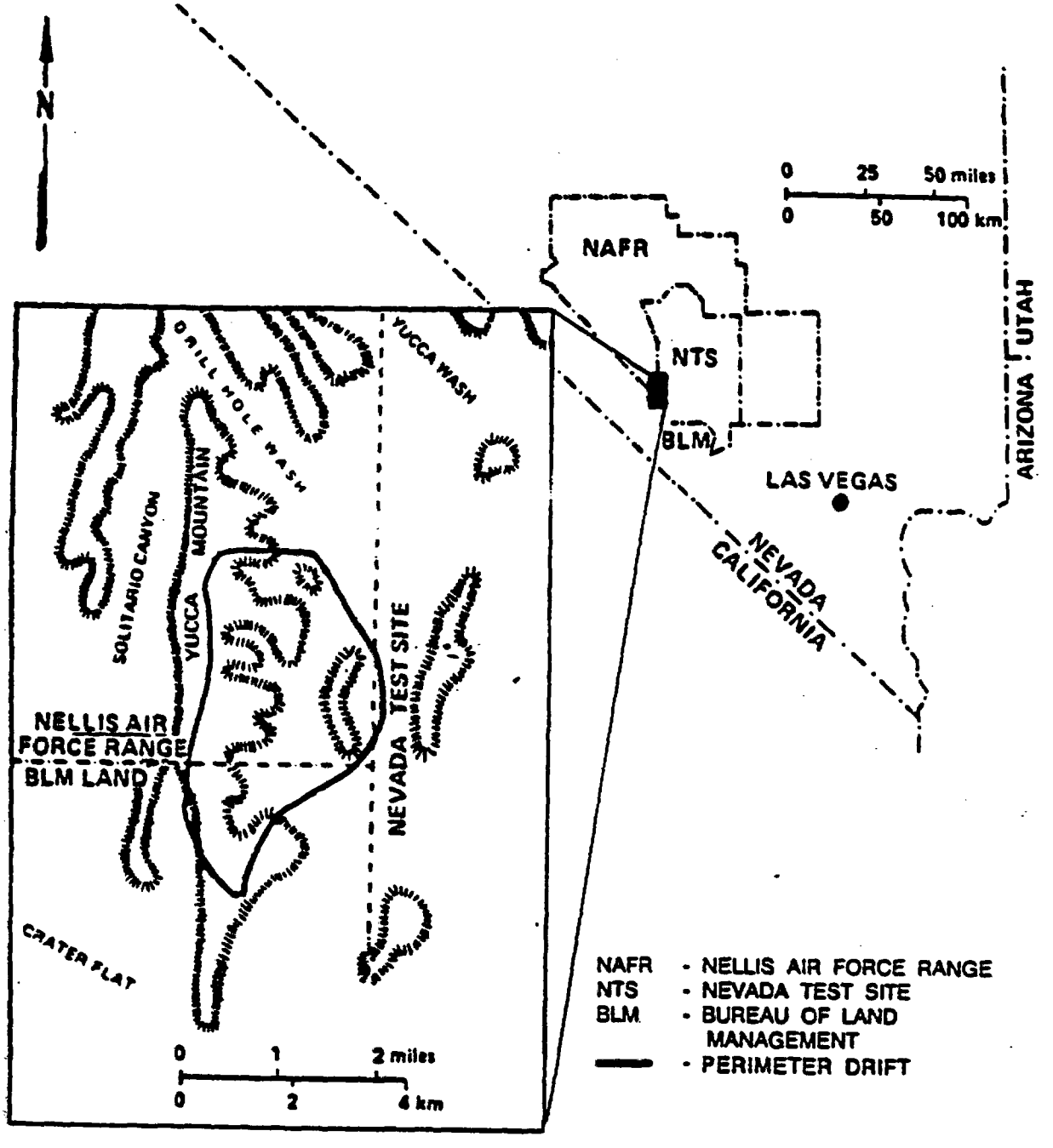

Figure 3-1. Location of the Yucca Mountain area.

3.1 FIELD ACTIVITIES

Field activities include all surface-based site characterization activities needed to evaluate the suitability of the Yucca Mountain site for the location of a repository. The information in this section has been organized to allow for evaluation of environmental impacts. This section includes information on site preparation; access road construction and improvement; exploratory drilling and testing; transportation, storage, and disposal of waste; geophysical surveys; and geological mapping.

In addition to the proposed field studies, several types of data-gathering activities were conducted as part of studies initiated prior to the start of site characterization. These ongoing activities were necessary to get an early start on data gathering when the NNWSI Project began to focus on tuff at Yucca Mountain as a potential repository host rock. Monitoring equipment for these ongoing studies has already been installed at and near Yucca Mountain, and this equipment will be utilized during site characterization. Some of the ongoing studies consist only of field observations and do not include the installation of equipment. The activities consist of (1) monitoring the hydrologic processes of the unsaturated zone, (2) monitoring the potentiometric (water table) level, (3) monitoring natural infiltration rates in the surficial units of the unsaturated zone, (4) streamflow monitoring, (5) debris flow monitoring, (6) monitoring erosion on hillslopes and in selected stream channels, (7) regional hydrologic studies, (8) ground water recharge analog studies, (9) seismic network monitoring, (10) biennial geodetic surveys, (11) soil and dust trap sampling for studying paleoenvironments, (12) sampling and mapping tectonic and paleoclimatic trenches and pits, (13) geologic and geomorphic mapping, (14) meteorological and precipitation monitoring, and (15) surface outcrop sampling for geologic, geomechanical and geochemical tests.

The field studies described in this section include some standard operating practices (good engineering practice) that will be implemented to minimize significant adverse environmental impacts caused by these studies.

These practices include the following:

1 Stockpiling topsoil that is removed during site preparation for the ESF and at selected field sites. Depending on the results of reclamation studies, the topsoil will be available for reclamation of these sites.

2. Engineering the slope angles on the sides of the rock-storage pile and at other sites where rock debris and mud will be piled to control slope erosion and encourage stability.

3. Reducing dust by spraying disturbed areas with water or other dust-binding fluids.

These standard operating practices may serve to minimize the potential impacts that site characterization activities may cause. Additionally, plans for site reclamation and habitat restoration for the affected area are now being developed.

3.1.1 Site Preparation

Site preparation will be required for drilling (includes drilling for geologic, hydrologic, and some geophysical studies), for studies related to trenching and soil pits, and for surface-infiltration tests. The total estimated surface area to be disturbed from these activities during site characterization is not expected to exceed 285 ha (705 acres). The subsections below describe the site preparation that will be done for each of these major activities. The applications of the major testing activities are presented in Sections 3.1.3, 3.1.5, and 3.1.6.

Drilling. The NNWSI Project is in the process of defining a comprehensive drilling program that may require changes in the descriptions presented herein. Current plans, however, call for approximately 345 to 430 holes to be drilled at and near Yucca Mountain during site characterization; of these holes, only 45 to 80 are considered deep holes that will require surface preparation. However, location of more than one of these deep drillholes on the same drill pad is a potential and will reduce the amount of surface preparation and

subsequent disturbance of the land. The number of drillholes now planned encompasses a range, because at this stage of planning some holes are tentative and their development depends on the results of other drilling and testing programs. Identification and location of existing and proposed holes are listed in Appendix A and depicted on Maps 2 and 3, respectively. The deep drillholes may be as deep as 1,500 m (5,000 ft) and will be up to 45 cm (17.5 in) in diameter near the surface. Each deep-hole site will require construction of (1) a raised and leveled dirt drill pad, (2) a parking area and equipment yard, and (3) a mud-and-cuttings pit. Approximately 1 ha (2.5 acres) will be disturbed for each deep drill site. Fill dirt will be excavated from adjacent or nearby areas for use in grading and leveling each site.

Little if any surface preparation will be required for the remaining 300 to 350 shallow drillholes or drillholes used for geophysical surveys. These holes will be drilled dry with portable rigs and will all typically be no more than 15 m (50 ft) deep, but occasionally as much as 46 m (150 ft) deep. Minor surface disturbance will still occur, and the small volume of material removed during preparation of these holes will be piled next to each drill site.

Trenching. Approximately 20 trenches will be dug by bulldozers or articulated shovels during site characterization. The specific locations of all planned trenches are unknown at this time and depend largely on the results of field reconnaissance. Nevertheless, the size of the trenches will probably range from 1.2 to 3 m (4 to 10 ft) deep, 1.8 to 3.7 m (6 to 12 ft) wide, and up to 152 m (500 ft) long. In addition to the trenches, several smaller soil pits are planned in conjunction with paleoclimatic studies. Material removed during construction of the trenches will be stored at the surface next to each trench and will be replaced in the trench when studies have been completed.

Pavements. Pavements are bedrock surfaces that have little or no regolith covering and that are further cleared of cover for study of fracture patterns. Each pavement may range up to 740 m^2 (8,000 ft^2) and will be prepared by spraying water or air under moderately high pressure to further clean the surface. Displaced material will collect in areas adjacent to the cleared area. The water, if used, will be hauled to each pavement site by truck. The amount of water used for clearing of pavements will vary with the degree to

which each pavement surface is covered with material. The specific number and locations of pavements are unknown at this time and are heavily dependent on field reconnaissance.

Infiltration Studies. These studies consist of natural-infiltration studies and artificial-infiltration studies. The natural-infiltration studies will require drilling 24 shallow holes to a depth of about 15 m (50 ft) in different hydrogeologic settings at the site in addition to the 74 holes that already exist at the site. These holes will be used to monitor natural infiltration from precipitation events. At about 50 of the locations where these holes will, or have already been drilled, small ponds will be constructed to induce infiltration artificially. An organic dye tracer that will adsorb on mineral surfaces will be added to the ponded water. After ponding studies are completed, several sites covering the range of infiltration rates for each hydrogeologic unit will be excavated and flow pathways mapped. Each pond will consist of a low berm enclosing an area of about 23 m^2 (250 ft^2). Approximately 1,160 m^2 (12,500 ft^2) of land will be disturbed for the ponding studies.

In addition to the ponding studies, surface preparation for 25 small-plot and 12 large-plot rainfall simulation tests will be required. At each small-plot site, 4 shallow monitoring holes will be drilled to a depth of 1.5 m (5 ft) and instrumented. Each test area will be approximately 1 m^2 (9 ft^2). At each large-plot site, 10 monitoring holes will be drilled to a depth of 9 to 15 m (30 to 50 ft) and instrumented. Each test area will disturb an area of 37 m^2 (400 ft^2). Each of the holes is drilled without a drill pad, using a portable all-terrain drill rig that minimizes surface disturbance. These infiltration studies are further described in Section 3.1.3.

3.1.2 Access Road Construction and Improvement

Many of the drillhole sites, trench sites, and infiltration sites will require the construction of dirt or gravel access roads. The roads will have an average width of 15 m (50 ft), will be up to 8 km (5 mi) long, and will be constructed as extensions from the nearest existing road. In some cases, 5-m (15-ft) wide one-lane dirt tracks or smaller access trails will be sufficient.

Where applicable, each road will be bladed smooth and, if needed, sprayed with water to aid in soil compaction and dust suppression. It is currently estimated that the total length of access road construction will be not more than 63 km (100 mi).

A one-lane dirt track from the nearest existing road will be required to each of the 20 trench sites. A one-lane dirt track will also be constructed to each of the infiltration sites from nearby existing roads.

3.1.3 Exploratory Drilling and Testing

Equipment that may be used at each deep drill site includes a diesel-powered drill rig, pumps for circulating drilling fluid, drilling and coring tools, and an air compressor. Tentative plans call for solid waste generated at drill sites to be hauled to and disposed of at a landfill on the Nevada Test Site (NTS). Water to be used for drilling, dust suppression and compaction, and human consumption will be trucked daily to each site. For each of the deep drillhole sites, a mud-and-cuttings pit a few feet deep and covering about 0.1 ha (.25 acre) will be constructed. Fluids and other materials from the drilling operations, such as air-foam circulation, bentonitic drilling muds, and rock cuttings, will be discharged into these pits. Where possible and necessary, drillholes will be drilled without fluids to minimize the potential of introducing additional liquids to the unsaturated zone; however, some holes will be drilled with fluids and are described in subsequent sections.

Each deep drillhole will be logged to evaluate the hole conditions during drilling operations. Data logs will be acquired using special, recoverable instruments that are lowered into the hole on a wireline cable. In some cases, radioactive sources emitting alpha or gamma radiation are fixed in the instrument. These radioactive sources include cesium-137, americium-241, and beryllium. In other cases, conservative chemical tracers and organic dyes may be used. The U.S. Department of Energy (DOE) will comply with all requirements concerning the handling of such substances. The details of these requirements are presented in the NNWSI Project ERCP.

The exploratory drilling and testing program will include (1) unsaturated zone exploration and monitoring, (2) water table monitoring and saturated zone testing, (3) water infiltration and recharge studies, (4) in situ stress testing, and (5) geological and geophysical borehole studies. The locations of most of these proposed boreholes and studies are shown on Map 3. Some holes are off the scale of the map. At many of these sites, such as the infiltration monitoring sites, numerous holes may be drilled as is explained in the following sections. This accounts for the difference in the number of sites shown on Map 3 and the 345 to 430 drillholes planned during site characterization.

Unsaturated zone exploration and monitoring. Several holes (designated UZ-1, UZ-4, UZ-5, UZ-6, UZ-6s, UZ-7, UZ-13) have already been drilled to measure and monitor moisture conditions in the deep unsaturated zone. The depths of these holes range from 122 to 550 m (400 to 1,800 ft). Hole UZ-1 is 380 m (1,250 ft) deep and has been fully instrumented to monitor certain hydrologic processes. This monitoring requires periodic visits to the hole for various reasons, including operation of a diesel generator. The other six existing holes will be instrumented and monitored in the near future. Hole UZ-8, which was only partially drilled, will be reentered, drilled to the planned depth, tested, and instrumented.

Additional boreholes in the unsaturated zone will be drilled, tested, instrumented, and monitored to investigate the movement of moisture. Their locations are shown on Map 3. Unconventional dry-drilling methods are required because of the importance of keeping the unsaturated zone free of fluids. These methods include pneumatic reverse-circulation drilling and pneumatic percussion drilling with a downhole hammer. Because these technologies are somewhat new, they may prove to be infeasible for the requirements of the drillholes. If this occurs, alternatives will be assessed that may include wet drilling.

Deep hole UZ-10 will be located near existing holes UZ-13 and G-3. Deep holes UZ-2 and UZ-3 will be located together near the existing holes UZ-6 and UZ-6s on Yucca Crest. Deep holes UZ-9, UZ-9a, and UZ-9b will be drilled in a closely-spaced pattern at a location on the eastern flank of Yucca Mountain.

Deep hole UZ-14 will be drilled north of Yucca Mountain, near existing deep hole UZ-1. These holes will be drilled using a combination of drilling methods in a program that has the following objectives: (1) drill dry without water or fluids of any kind; (2) produce an open hole to a depth of 460 to 550 m (1,500 to 1,800 ft), depending on the water table depth; (3) provide a reasonably smooth-walled hole at a diameter suitable for testing at some point during drilling operations; and (4) provide spot-core samples at regular intervals, cored dry without fluid.

At the conclusion of drilling and pressure testing, some deep holes will be filled and instrumented using such materials as silica sand, silica flour, and bentonite pellets to isolate selected stratigraphic intervals. Each interval will be instrumented using some combinations of sensors, including temperature measurement and gas sampling instruments. The sensors will then be monitored for several years, using an integrated data-acquisition system powered by a portable source at each hole location.

In addition to existing shallow holes (UZ-4, UZ-5, UZ-7, UZ-8, and UZ-13), additional shallow holes are planned. Holes UZ-11 and UZ-12 will be located together west of Yucca Mountain at the base of the Solitario Canyon fault scarp. Like the deep holes, these holes will be instrumented, filled, and monitored for several years to investigate moisture movement in the unsaturated zone.

Water-table monitoring and saturated zone testing. Several holes have been drilled into the uppermost 30 to 60 m (100 to 200 ft) of the water table for the purpose of measuring and monitoring the elevation of the water table. Their locations are listed in Appendix A and depicted on Map 2. The depths of these holes range from 490 to 610 m (1,600 to 2,000 ft). Long-term periodic monitoring is performed by automatic and manual systems, to record fluctuations of water level and pressure as a function of time. Present plans are to acquire water samples from some or all of these holes for analysis of natural tracers. Because these holes were drilled with air foam, the existing groundwater conditions were probably disturbed during drilling, although not significantly. Special sampling methods are therefore needed to obtain representative water samples. At each hole, the tubing that is in place will be

withdrawn, and a downhole pump will be installed at the end of a clean tubing string. This pump will have a lift capacity of 57 liters (15 gallons) per minute. The hole will be pumped for up to a week, or longer if necessary, until the water composition stabilizes. Repeated analysis of water samples will be performed as pumping proceeds to ascertain whether stable conditions have been achieved. The pumped water will be discharged to surface drainages; this technique should not interfere with other hydrologic investigations because the water table holes are located relatively far from the site. As many as three water table holes will be simultaneously sampled in order to make efficient use of a drilling crew.

Several additional water table holes are planned (Map 3), including two holes immediately to the west of Yucca Mountain along the Solitario Canyon fault (WT-8 and 9), and a water table hole northeast of Crater Flat near Yucca Mountain (WT-21). Two additional holes are planned near Drill Hole Wash, north of Yucca Mountain and west of the NTS boundary (WT-23 and 24), and two holes are planned south and east of Yucca Mountain on the NTS (WT-19 and 20). Depending on the results of testing in the unsaturated zone, these holes will be drilled using a simplified rotary drilling method with conventional circulation and air foam. Geophysical logs will be used to help determine the depth of the water table. The holes will be completed by installing a length of tubing with a well screen at the bottom of the hole. Access to some of these wells will be required for ongoing monitoring and possible water sampling and flow testing.

A series of pump and tracer tests are planned for several existing wells, including UE25 c#1, UE25 c#2, and UE25 c#3 (Appendix A and Map 2). A downhole pump with a lift capacity of 1,890 liters (500 gallons) per minute will be installed below the water table in one of these holes, and monitoring systems will be installed in the others. A series of single-well and multi-well pumping tests, as well as pumping tests using conservative tracers (e.g., 3-trifluoromethylbenzoate and lithium bromide), are also planned. Water produced during pump tests will be discharged to surface drainages, and a pipeline may be built to convey this discharge away from the site of the tests if there is the potential for the discharged water to interfere with test results.

The objectives of the testing program at the UE25c complex of wells are to determine hydraulic conductivity parameters and if tracer testing can be met through the use of single-well tests. Depending on the outcome of these tests, additional single-well hydrologic testing may be conducted in existing or planned water-table holes. These well tests will use tracers and a pumping rate of 57 to 1,890 liters (15 to 500 gallons) per minute, with disposal of the water at the surface. If multi-well testing is necessary, a second multiple-well complex may be drilled. The second complex would probably be located near Busted Butte on the NTS or on Bureau of Land Management (BLM) administered land near the site.

In addition to the testing described above, a multi-well pump test will be conducted across the Solitario Canyon fault to investigate the conductivity of the fault zone. A new hole (USW H-7) is planned for Yucca Crest, about 910 m (3,000 ft) east of existing hole H-6. The depth of hole H-7 will be at least 910 m (3,000 ft), and it will be drilled using conventional rotary circulation and air foam. Holes WT-8 and WT-9, described previously, will also be used to monitor changes in water table elevation resulting from this pump test. A downhole pump with a lift capacity of 1,890 liters (500 gallons) per minute may be installed in each well. Holes H-6 and H-7 may be used as pumping and observations wells to monitor such things as water table elevation. The water discharged at the surface will be tagged with a tracer, and if necessary a pipeline will be built to convey the discharge down Solitario Canyon toward Crater Flat.

Water infiltration and recharge studies. A series of shallow holes will be drilled to a depth of about 15 m (50 ft) in different hydrogeologic settings at the site to monitor natural infiltration associated with precipitation events (Appendix A and Map 3). In addition to the 74 holes that already exist at the site for these studies, an additional 24 shallow holes are planned during site characterization. Each infiltration-monitoring hole will be drilled without a drill pad, using a portable all-terrain drill rig. Approximately 23 of the planned infiltration-monitoring holes and 25 of the existing holes will also be used for artificial-infiltration ponding studies described below.

Small berms will be constructed to induce infiltration at approximately 50 locations where shallow holes have been drilled for monitoring natural infiltration. Each pond will consist of a low berm enclosing an area of about 23 m^2 (250 ft^2) and will be constructed using mechanized equipment. During infiltration testing, a static water level will be maintained in each pond for a prescribed period of time. The amount of water used will vary from site to site, but will probably not exceed 75,700 liters (20,000 gallons) at any site.

Twelve large-plot rainfall-simulation tests and 25 small-plot rainfall-simulation tests are also planned. At each of the rainfall-simulation test sites, a control plot will be established to monitor natural infiltration during testing. To the extent possible, artificial infiltration sites will be in close proximity to natural infiltration study sites to minimize cost and disturbance. The water used for these tests will be delivered to each site by truck.

At each of the 25 small-plot rainfall simulation sites, about four monitoring holes will be drilled to a depth of about 1.5 m (5 ft) and instrumented. A water distribution system similar to irrigation systems will be installed, and discrete rainfall events will be simulated. Present plans call for four tests at each of the 25 sites; each test will involve distribution of 454 liters (120 gallons) of water over an area of 1 m^2 (9 ft^2).

At each of the 12 large-plot rainfall-simulation sites, 10 monitoring holes will be drilled to a depth of 9 to 15 m (30 to 50 ft deep) and instrumented. Present plans call for five tests at each of the 12 sites; each test will require the distribution of 11,360 liters (3,000 gallons) of water over an area of 37 m^2 (400 ft^2).

Three holes, each 180 to 240 m (600 to 800 ft) deep, will be drilled in Fortymile Wash to study artificial infiltration and to monitor aquifer recharge during precipitation events. The holes will be drilled using air as a circulation medium. Spot core will be recovered using conventional or wireline coring systems. The total depth of each hole will be close to, but not intersecting, the water table. After each flooding event in the wash, the holes will be monitored periodically by using wireline geophysical tools. In

addition, a low berm will be constructed around the collar of each hole, enclosing a small pond. Artificial infiltration from the pond will be used to investigate near-surface response, particularly if major flooding does not occur during site characterization. Finally, 10 shallow holes will be drilled and instrumented with neutron-moisture tubes at key locations across Fortymile Wash.

Water samples will be collected from all available sources of groundwater and surface water at and near the site, including Amargosa Valley and the Amargosa Desert. Some sampling programs will be conducted in commercial drill holes and wells in the region. Discharge from the hydrologic system will be studied by means of surface sampling and shallow drilling to depths of generally less than 30 m (100 ft). About 50 to 100 such holes will be drilled using a truck-mounted portable rig.

In situ stress testing. In situ stress will be measured by the hydrofracturing method at two as yet undetermined locations in the vicinity of Yucca Mountain (Appendix A and Map 3). Hydrofracturing requires isolating a selected interval of borehole and injecting water into that interval until the surrounding walls fail and resultant stress measurements are obtained. This activity is expected to improve the understanding of previous stress measurements performed at Yucca Mountain. More than 20 additional locations have been identified in southwestern Nevada, including locations within the NTS, the Amargosa Desert, Bare Mountain, and Crater Flat. These additional locations may be tested depending on the nature of the data from the initial study near Yucca Mountain.

Holes used for hydrofracturing will be drilled to a depth of at least 305 m (1,000 ft) using conventional rotary-drilling methods with air foam or drilling mud as a circulating medium. The actual depth of each hole will be determined by the need to access several hundred feet of competent, relatively unfractured bedrock for testing. A small drill pad will be required at each location. The three locations selected will probably be more than 8 km (5 mi) from the Yucca Mountain site. A series of hydrofracturing stress measurements will be performed until valid measurements have been obtained from at least three different depths. A borehole television or an acoustic borehole televiewer will be used to locate natural and induced fractures.

Geological and geophysical borehole studies. Holes drilled during site characterization will be logged geophysically and on occasion by coring. This logging will usually occur during the course of drilling operations. Analysis of available cuttings and core samples will be used for interpretation of the well logs. Temperature logs will be used to further develop the heat-flow model of the site. Radioactive sources are often used in geophysical logging, as contained sources in sealed instruments. Furthermore, chemical tracers and organic dyes may be used as free substances injected into boreholes for some tests. The use of these substances during site characterization will comply with all applicable State and Federal regulations, as discussed in the ERCP.

Two coreholes, approximately 1,520 m (5,000 ft) deep, are planned in Yucca Wash and in Drill Hole Wash (G-5 and 6) to study subsurface formations. An additional deep corehole is planned south of Yucca Mountain on the NTS (G-7). Locations of these proposed holes are presented in Appendix A and shown on Map 3. These holes will require construction of drill pads and access roads. They will be fully cored using H-series or larger wireline coring equipment, which yields a core with a diameter of 6.35 cm (2.5 in). Mud or air foam will be used as the circulating medium. The uppermost 305 to 610 m (1,000 to 2,000 ft) of each hole may be reamed to a diameter of 16 to 31 cm (6.25 to 12 in), if necessary, to set steel casing for hole stability and circulation control. If drilling mud is used as a circulation medium, the amount of water necessary for each hole may vary because of differing subsurface conditions and hole depth at each drill site. Existing drillhole G-4, for example, was drilled with mud to a depth of 915 m (3,000 ft) using approximately 2.0×10^6 liters (530,000 gallons) of water. Although the amount of water that may potentially be used for the three holes described will vary with depth, fracture system, and hole conditions, it can be expected that a few million gallons may be used. This water will be trucked to the site at least twice daily.

Four exploratory holes are planned to investigate magnetic anomalies in southern Crater Flat and in the Amargosa Desert. They will be drilled using conventional rotary-drilling methods, using mud or air foam as a circulation medium, to a depth of roughly 305 m (1,000 ft). These holes will be drilled over magnetic anomalies that may be igneous intrusions or buried volcanic

rocks. Each hole will be drilled until igneous rock is reached or until sufficient depth is reached to explain the anomalies. Spot core will be acquired at geologic boundaries or where igneous or magnetic material is encountered. Where spot core is required, conventional or wireline coring equipment will be used with drilling mud as a circulating medium.

Several perennial lake systems in the Great Basin will be studied by backhoe trenching to depths of up to 4 m (12 ft), truck-mounted auger drilling, drive-tube sampling, or other portable drilling methods to depths of about 30 m (100 ft). The study areas have not yet been determined, although as many as 41 shallow test pits and trenches have been proposed as part of the paleoclimatic studies. Vehicle access to each sampling location will be required to transport the drilling and sampling equipment. The purpose of the study is to characterize the recent (500,000-year) variations in lake size, hydraulics, temperature, and chemical composition by the analysis of lake sediments. Core samples will be taken from various locations throughout Nevada for assay and dating of the organic material, fossils, and minerals recovered from the sediments.

Several shallow holes may be drilled in the vicinity of Trench 14 on the NTS to investigate the subsurface character of the Bow Ridge fault and the nature of various mineral deposits in the fault zone. A drill pad and a short access-road would be constructed on the western slope of Exile Hill. A series of shallow 15-m (50-ft) deep coreholes will be drilled using a truck-mounted rig normal to the surface indications of the fault zone. Based on the results, one or more deeper coreholes will be drilled at a steep angle to depths of 60 to 150 m (200 to 500 ft) to intersect the fault zone in the subsurface. Air foam and drilling mud will be used as circulation media.

A horizontal borehole is planned to penetrate the Solitario Canyon fault at a depth where the fault plane is bounded on both sides by the Topopah Spring welded tuff. The exact location has not yet been determined but is expected to be near the northwestern end of the proposed central repository block. The purpose of the hole is to examine the extent of fracturing and fault gouge and to evaluate the hydrogeologic significance of fault-related features on water movement within the fault zone.

A geostatistical-based drilling program is being proposed to systematically acquire site-specific subsurface information on the repository block. Locations of the holes are shown on Map 3. Three-dimensional models of rock characteristics indicate that representative sampling of the repository block should be systematic in both horizontal and vertical dimensions. Approximately 35 to 40 continuously-cored holes may be drilled on a semi-regular grid pattern. Drilling will be in three phases to evaluate data before proceeding further. The first phase will include drilling 12 continuously cored holes. The second phase, if undertaken, will require an additional 12 continuously cored holes generally located between the first-phase holes. The third phase is more speculative, with options including nine or more holes. Phases two and three are tentative and depend on the results from the first phase.

3.1.4 Transportation, Storage, and Disposal of Solid Waste

As noted in Section 3.1.3, rock cuttings, drilling fluids, and other wastes will be disposed of in the mud-and-cuttings pit at each deep drill site. Future reclamation programs may include filling the pits with stockpiled soils after the removal of drilling fluids and sludge, as appropriate. If removal is required, the material will be scooped up and sealed in steel drums or trucked to an appropriate fill site. Solid waste and trash will probably be hauled to a landfill on the NTS. Sanitary wastes will be collected at portable facilities and removed to an appropriate disposal site.

If any of the wastes prove to contain hazardous components, they will be disposed of according to the applicable regulatory requirements. Details of these requirements are discussed in the NNWSI Project ERCP.

3.1.5 Geophysical Surveys

The geophysical surveys being considered for the Yucca Mountain area include seismic reflection and refraction, gravity, magnetic, and electrical surveys. Each of these surveys will require land surveying and geologic reconnaissance either on foot, from off-road vehicles, or from helicopters.

Seismic monitoring is currently being conducted through the Southern Great Basin Seismic Network, which consists of 54 monitoring stations in a large array centered on Yucca Mountain. These stations consist of one or more seismometers with a solar-powered data-logging and telemetry system. The instruments and electronics have been installed within a small concrete vault. The seismometers are operated continuously, and data are recorded automatically. The stations were installed in 1978 and 1979 by the U.S. Geological Survey with permission from the National Park Service, BLM, and U.S. Forest Service. No new roads were constructed at that time for access to any of the sites. Presently, each site is visited every three to six months for inspection and maintenance.

The regional monitoring network is occasionally augmented by temporary deployment of portable instruments for monitoring ground motion at the surface and in existing drillholes. Motion from underground nuclear explosions is analyzed to develop the relationship between earthquakes and weapons testing to predict potential ground motion during repository operations.

Shallow seismic-reflection surveys will be performed using portable small-scale vibrator sources; these surveys will not be limited to existing roads, although off-road travel will be kept to a minimum. Shallow reflection surveys will be conducted in short, 1- to 5-km (0.6- to 3.1-mi) traverses. Up to ten survey lines are planned: two in Crater Flat, one in Rock Valley on the NTS, and seven aggregating 30 linear km (19 mi) in the immediate vicinity of Yucca Mountain (Map 3). All lines will use 9.1-m (30-ft) vibrator source points, with 12 geophones per group. The penetration of this method can be a few thousand feet depending on seismic propagation conditions.

A seismic-refraction survey will be performed across Yucca Wash using portable seismographs and repetitive hammer (sledgehammer) sources (Map 3). Site preparation is not required, and these surveys will not necessarily be limited to existing roads. This survey will be used to investigate seismic velocity contrasts in subsurface volcanic rocks and to delineate shallow subsurface structures.

A regional deep seismic-reflection study may be performed along existing roads and highways using conventional field equipment consisting of geophone cables, recording trucks, and truck-mounted vibrator sources. The "vibrators" may have off-road capability but will only be used as seismic sources near existing roads and highways. The design of the survey will seek to maximize the linearity of source and geophone cable locations. Acquisition parameters tentatively identified include 9.6-km (6-mi) geophone spreads, 24 geophones per group, 50-m (164-ft) group intervals, 240 groups per spread, 100-m (328-ft) vibrator interval, and 54,430-kg (120,000-lb) minimum peak vibrator force. This proposed survey will be evaluated further through prototype testing and peer review.

Deep, regional seismic-refraction studies will be performed along existing highways and roads and in rugged terrain by the use of helicopters, using discrete event recorders and explosive sources in accordance with standard practices for geophysical exploration. The receivers will be discrete, portable, battery-powered event recorders that do not require any excavation and can be readily deployed from a helicopter if necessary. Shot holes will be prepared at predetermined locations approximately every 9.6 km (6 mi) along each refraction line. Each shot hole will be drilled about 25 cm (10 in) in diameter and 46 m (150 ft) deep and filled with about 910 kg (2,000 lb) of ammonium nitrate explosive. The uppermost 15 m (50 ft) of each hole will be packed with gravel trucked to the site. Two or more such shot holes will be prepared together for larger shots up to approximately 1,810 kg (4,000 lb). The tendency for surface cratering will vary with the geologic conditions at each shot point; however, each shot will be conservatively designed to prevent cratering. Redundant systems will be used to reduce the possibility of misfire. The exact locations of these surveys have not yet been determined, but tentative plans include an east-west profile centered on Yucca Mountain with two or three cross profiles.

Several regional magnetotelluric (MT) surveys will be conducted. These surveys consist of measurements of conductivity structure of the earth made at stations located along a line. The MT method is passive, requiring two perpendicular dipole electrode arrays and a magnetometer on the surface. The dipoles are typically 100 to 1,000 m (328 to 3,280 ft) long. The magnetometer

sensor is a loop of wire 10 to 100 m (33 to 328 ft) in length, buried a few inches beneath the surface to decrease interference from wind. Off-road vehicle access is not a requirement for an MT survey. Proposed MT lines would follow NV Route 29 south from the town of Amargosa Valley and would also transect the Amargosa Desert in a north-south direction. The station spacing for MT surveys in Crater Flat and the Amargosa Desert would be 5 to 8 km (3 to 5 mi). Specific station locations have not been identified and will be determined through field reconnaissance.

Detailed geophysical surveys will be conducted on the land surface in the vicinity of Yucca Mountain, where aeromagnetic and other regional surveys indicate the possible existence of anomalous structures. Geophysical measurements, such as total natural magnetic intensity or the magnitude of gravitational acceleration, will be conducted at station locations distributed over, and adjacent to, possible anomalies. Ground magnetic data will be acquired using portable equipment, which must generally be transported to the sites by off-road vehicles. Detailed geophysical surveys are presently planned for a total area of less than 26 km^2 (10 mi^2). Station spacing will vary according to the type of survey and the local behavior of the results, but generally will range between 60 and 305 m (200 and 1,000 ft). Other types of surveys (including seismic, electrical, and electromagnetic, either airborne or ground-based) are not presently planned but may be required to evaluate mineral resource potential at the site or to determine the engineering properties of soil and bedrock at the site of the proposed repository surface facilities.

Vertical seismic profiling (VSP) is a seismic exploration method similar to seismic reflection whereby geophones are placed in boreholes or underground excavations to improve the quality of the acquired seismic image of the subsurface. Methods of interpretation that are possible with seismic sources located on the surface and with receivers underground allow enhanced vertical and lateral resolution of seismic structures. If feasibility testing shows that this technique is applicable in the unsaturated zone, VSP will be used at Yucca Mountain to image the subsurface at the proposed repository location. Seismic sources will be deployed on the surface of Yucca Mountain on and adjacent to existing roads and dirt tracks. Sources will be vibrator trucks.

3.1.6 Geological Mapping

Geologic mapping is continuing in the vicinity of Yucca Mountain as part of the geologic, tectonic, and volcanic studies. These studies include collection of samples for laboratory analysis and require some off-road vehicle travel. The specific studies involved are (1) surficial-deposits mapping; (2) geomorphic mapping; (3) surface-outcrop sampling; (4) surface-stratigraphic studies; (5) trenching studies; (6) pavement studies; (7) streamflow, debris flow, and erosion studies; and (8) geodetic surveys.

Surficial-deposits mapping. Mapping at a scale of 1:12,000 will be completed in a conterminous area of 20,230 ha (50,000 acres) surrounding the site. Existing roads will be used where practicable for access. Surficial mapping is similar to geologic mapping and will be performed by soil scientists. Some soil pits, up to 1.5 m (5 ft) deep and requiring mechanized digging equipment, are planned in conjunction with surface mapping.

Soil characteristics will be determined during these studies on a seasonal basis. Activities in the field include dust-trap sampling, testing and sampling of soils, and periodic measurement of carbon dioxide and soil gases. Dust traps are passive devices consisting of a simple mechanical trap mounted on a fence post. Off-road vehicular access is not required for trap installation, maintenance, or operation. Soil studies are performed as part of the climate modeling effort that evaluates the effects that a changing climate may have on the hydrologic characteristics of the site.

Geomorphic mapping. Surface mapping of geomorphic features will be conducted in a broad area encompassing Yucca Mountain, Fortymile Wash, and Crater Flat. This activity requires casual access without excavation, drilling, road construction, or off-road vehicular travel.

Detailed geomorphic mapping will be conducted along Fortymile Wash and its tributaries to study downcutting and erosion. This activity will require vehicular travel on existing roads.

Surface-outcrop sampling. Samples are occasionally acquired from surface outcrops for laboratory analysis of thermal and mechanical properties. Samples are required by ongoing low-strain-rate testing and other tests needed to predict the behavior of the repository host rock in response to the heat load generated by emplaced waste. Samples are also occasionally acquired from surface outcrops for laboratory analysis of geochemical interactions among the tuff material, groundwater, radionuclides, and microorganisms.

Surface-stratigraphic studies. These studies consist of detailed mapping of areas of exposed bedrock on ridges, outcrops, and in scoured stream channels. There will be no excavation or road construction associated with these studies, and off-road vehicular travel will be minimized.

Trenching studies. Several trenches at and near Yucca Mountain (Beatty, Cedar Mountain, Fairview Peak, Dixie Valley, and Rock Valley) have been excavated for geologic, tectonic, and paleoclimatic studies. The trenches are sampled and mapped on an ongoing basis. Occasionally, it may be necessary to widen, deepen, or lengthen existing trenches to collect additional data and to prevent trench degradation.

The study of regional paleolimnology, aeolian deposits, and terrestrial paleoecology will involve shallow test pits and trenches in the vicinity of Yucca Mountain, as well as the collection of small amounts of debris from packrat middens in the vicinity of Yucca Mountain. Trenching requirements will be coordinated with the tectonic trenching effort to minimize surface disturbance.

Pavement Studies. Fractures and joints will be mapped at selected exposures of bedrock in the immediate vicinity of Yucca Mountain. Natural exposures will be used when possible, augmented by exposing additional area by hydraulically or pneumatically stripping a thin layer of overburden.

Streamflow, debris flow, and erosion studies. Gauges have been installed at and near Yucca Mountain for purposes of studying streamflow, debris flow, and erosion processes. Additional networks are proposed for the Yucca Mountain area (Appendix A and Map 2).

Streamflow monitoring will be conducted to understand the characteristics of surface-water runoff during precipitation events. During and after surface runoff, debris flows will be observed in stream channels if they occur. The purpose of this study is to better understand the mechanisms of water and debris flows, and the climatic factors and their cause. Monitoring will also be conducted to characterize the present rates of erosion. Additionally, scour chains will be installed to monitor the amount of erosion that occurs in washes at times of heavy runoff. These experiments will be conducted by observations of events and equipment by scientists in the field.

Geodetic surveys. Geodetic benchmarks have been permanently installed on and around Yucca Mountain to monitor present-day tectonic adjustments in the vicinity of the site. A 70-km (43-mi) level line extends from Crater Flat on the west of Yucca Mountain to Rock Valley on the east side, and a quadrilateral network has been installed across several faults in the immediate vicinity of the site. Biennial resurveys are conducted.

3.2 EXPLORATORY SHAFT FACILITY

The ESF will consist of surface facilities and two shafts where a variety of subsurface tests will be conducted. These tests are essential to evaluate the suitability of the Yucca Mountain site for the location of a repository. The subsurface testing program is not expected to cause any significant adverse environmental impacts. This section includes information on design; site preparation; access road construction and improvement; utility services; construction of surface and support structures; construction of shafts; construction of underground rooms; and transportation, storage, and disposal of mined materials.

The standard operating practices (good engineering practice) that will be used during site preparation, construction, and operation of the ESF for minimizing significant adverse environmental impacts are the same as those described in Section 3.1. In addition, the DOE will:

1. Install a leachate-monitoring system at the rock-storage pile and the mine waste-water pond.

2. Locate borrow areas where impacts to the environment will be minimized.

3. Separate the surface facilities sufficiently apart to reduce the damage as a result of potential fires.

In addition to the standard operating practices identified in Section 3.1, these additional practices may also serve to minimize the potential impacts that site characterization activities may cause. Detailed plans for site reclamation and habitat restoration for the affected area are in the process of being developed.

3.2.1 Design Description

The ESF will consist of two vertical shafts, underground excavations constructed from the shafts, underground test facilities, and numerous facilities at the surface to support excavation of the shafts. Figure 3-2 shows the proposed location of the ESF. In addition, Map 4 presents an expanded view of the ESF location with associated roads and facilities.

The two exploratory shafts are designated ES-1 (the main test shaft) and ES-2, with ES-2 being excavated with relatively little or no associated testing to expedite access to the subsurface. ES-2 will also be used for ventilation, materials handling, and emergency egress. ES-1 will have an inside finished diameter of 3.7 m (12 ft) and a depth of 436 m (1,430 ft); it will contain several rooms, constructed horizontally from the shaft for testing and storage of equipment. ES-2 will also have an inside finished diameter of 3.7 m (12 ft) but a depth of 335 m (1,100 ft). The two shafts will be connected at the 320-m (1,055-ft) level. The shafts will provide access to approximately 1,219 m (4,000 ft) of drifts, test alcoves, and operations areas. The rock debris and mud created during excavation of the subsurface facilities will be hoisted to the surface and disposed of on a rock-storage pile at the site (Figure 3-3). Fluids will be disposed of in the mine waste-water pond (Figure 3-3).

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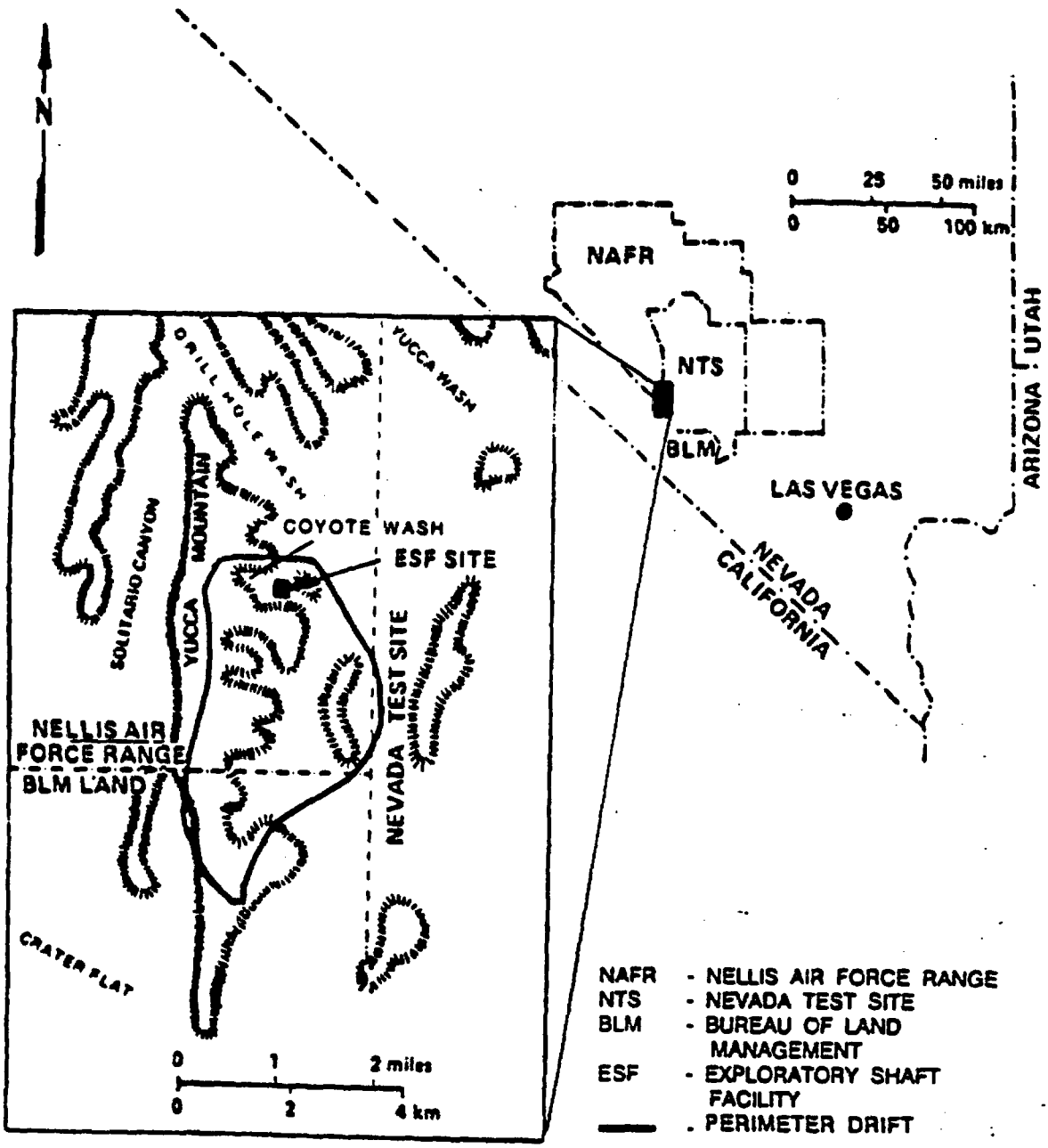

Figure 3-2. Relationship of Yucca Mountain site to exploratory shaft facility.

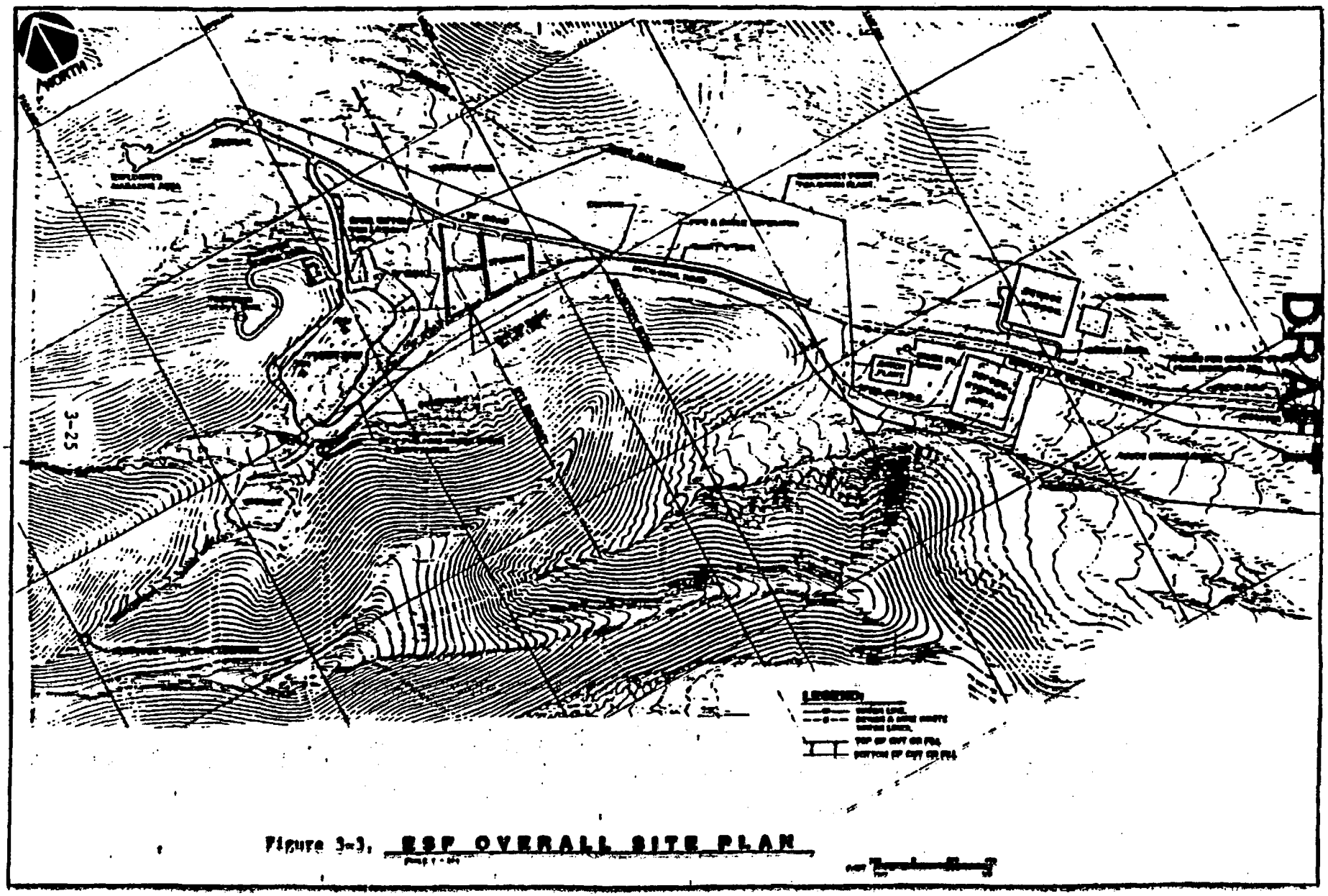

Figure 3-3. ESF OVERALL SITE PLAN

The surface facilities will include hoist houses, warehouses, repair shops, trailers, parking areas, water- and electrical-distribution systems (includes an electrical substation), a sewage system, a communication system, areas for storing explosives, a borrow area, a rock-storage pile, a mine waste-water pond, a concrete-batch plant, and a topsoil storage area. Roads, pipelines, and electrical transmission and communication lines will be extended to the ESF from existing roads and facilities on the NTS.

Transport of workers to and from Yucca Mountain during site characterization will be chiefly along U.S. Highway 95. Estimates of the number of workers that will be employed during site characterization are included in the EA for the Yucca Mountain Site (DOE, 1986). Due to some changes in site characterization plans, however, those estimates may change. Nevertheless, because most of the workers at Yucca Mountain will already work for the DOE or its contractors in southern Nevada, a substantial increase in traffic congestion along U.S. Highway 95 is not expected. The Socioeconomic Monitoring and Mitigation Plan outlines a program to determine the actual number of workers expected to be employed during site characterization.

Transport of materials to Yucca Mountain during site characterization is expected to peak at an average of one truck shipment per day during construction of the ESF. The materials that will be transported to the site include gasoline, diesel fuel, explosives, cement, steel, copper wire, and wooden power poles.

3.2.2 Site Preparation

The ESF will be located in Coyote Wash on the east side of Yucca Mountain at an elevation of about 1,260 m (4,130 ft); the actual shafts will be located above the wash on the side of a ridge. Figure 3-3 shows the site layout, and Figure 3-4 is a three-dimensional illustration of the entire ESF. Because no facilities or access roads currently exist at the ESF site to support heavy construction, access roads must first be constructed, and the surface of the site must be prepared (road construction is described in Section 3.2.3).

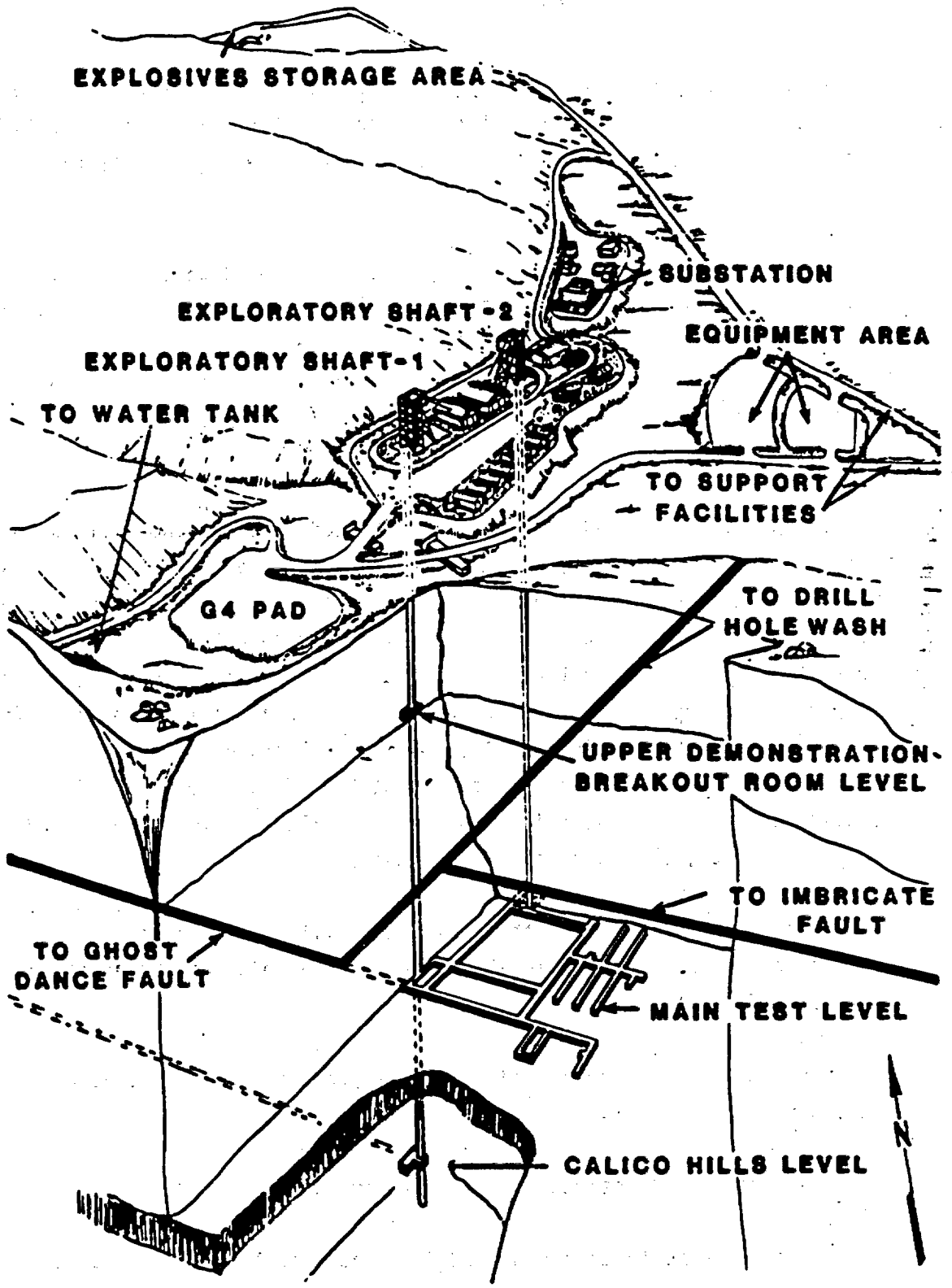

Figure 3-4. Conceptual illustration of the exploratory shaft facility.

Approximately 8 ha (21 acres) will be disturbed at the site for road construction and the surface facilities for the ESF. The site must first be cleared of vegetation, graded, and then stabilized with about 15 cm (6 in) of gravel.

Several leveled pads will be required to accommodate the various facilities needed at the site. Pads will be required for the exploratory shafts and their associated buildings, the water tank, equipment storage areas, the explosive storage area, the mine waste-water pond, the sewage collection system, and the rock-storage area. An existing pad will be used for the concrete-batch plant.

The pad for ES-1 and ES-2 will be situated on a cut-and-fill rock shelf approximately 60 m (200 ft) north of and above the confluence of two small dry washes that are tributaries of Coyote Wash. The location of Coyote Wash is shown on Figure 3-2. Site preparation will require cut and fill to provide level pads for the two exploratory shafts, the surface structures, and the parking and storage areas. Additional fill material will be obtained from borrow areas on the NTS (Figure 3-3). The total amount of cut-and-fill material required will be approximately 51,230 m^3 (67,000 yd^3). Topsoil removed during site preparation will be stockpiled for future use in decommissioning the site, if necessary (Figure 3-3).

Surface preparation for the other pads will require clearing vegetation and grading the site into a level pad that is large enough to accommodate the particular facility.

Figure 3-5 shows the duration of site preparation activities and surface construction at the ESF.

3.2.3 Access Road Construction and Improvement

An access road leading westward from Jackass Flats to the boundary of the NTS can currently accommodate heavy equipment. The road is approximately 7 m (24 ft) wide, has 2.5-m (8-ft) shoulders, and is surfaced with a double oil-and-chip layer. This road will be extended 400 m (1,300 ft) to the ESF.

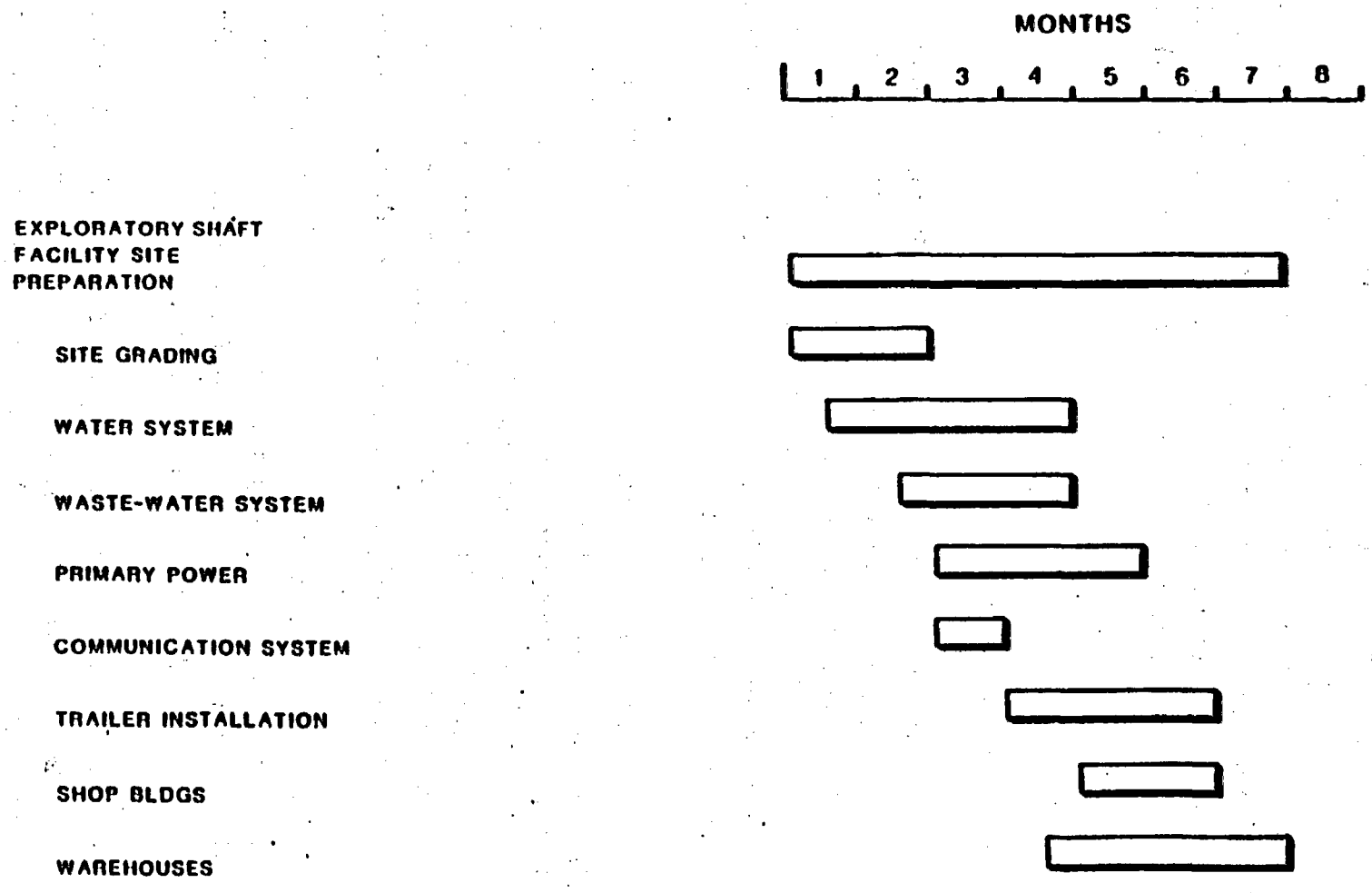

Figure 3-5. Duration of Site Preparation Activities at the ESF.

It will be constructed on fill material and to the same standards as the existing road. Construction of the road will disturb up to a 50-m (160-ft) wide path in some locations due to modification of the dry washes along the route to protect the road during flash floods. Additional roads to the pad of the exploratory shafts, the explosives storage area, and the water storage tank will also be constructed. In addition, a road dedicated to hauling rock debris to and from the exploratory shafts and rock-storage area will be constructed (Figure 3-3).

3.2.4 Utility Services

The utility and communication systems will provide electrical power, water, sewage, and communications that are necessary to support the surface and subsurface operations at the ESF. The communications systems will provide surface communications facilities, fire protection, and life safety support system monitoring. The length of time needed to install these services at the ESF is shown in Figure 3-5.

The aboveground electrical supply and power for the underground distribution system will be provided by a surface substation to be constructed at the ESF. The substation will be supplied from a 400-m (1,300-ft) extension of an existing 69-kV overhead power line that now extends from the Canyon Substation in Jackass Flats to the NTS boundary (Figure 3-6 and Map 4). The substation will be equipped with transformers to supply power to the hoists, air compressors, ventilation fans, and to the balance of the site.

A power line will be added to the existing power poles to provide power to the water-supply booster-pump station from the site substation. Night lighting will be provided by pole-mounted area floodlights. Standby electrical supply will be provided by two diesel generators.

The water supply will be distributed from well J-13 on the NTS through an existing 10-km (6.1-mi) long, 15-cm (6-in) diameter polyvinyl-chloride pipe buried about 0.6 m (2 ft) below the surface (Figure 3-6 and Map 4). Well J-13 is located approximately 6 km (4 mi) from the pad of the exploratory shafts.

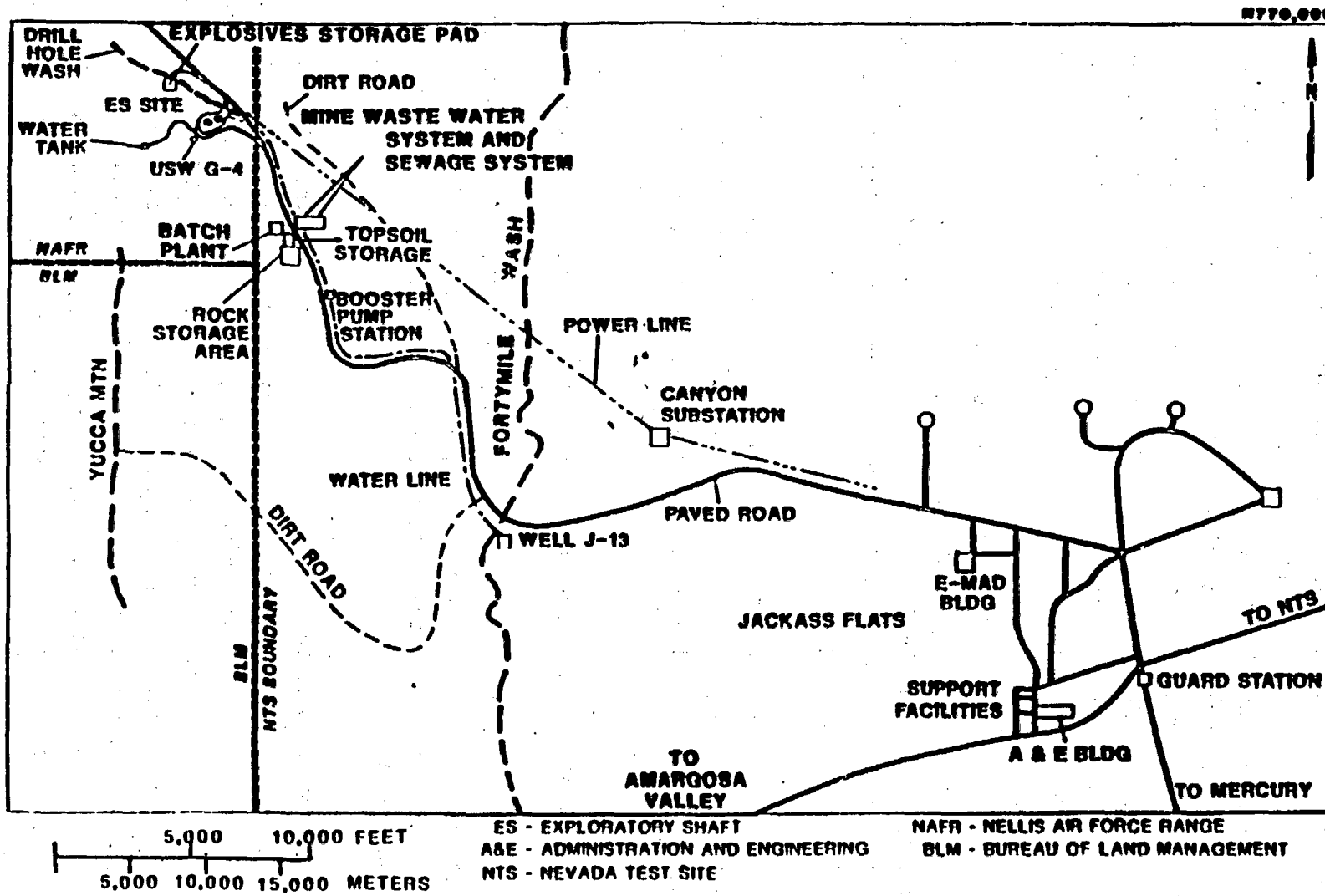

Figure 3-6. Location of facilities required during construction of the exploratory shaft facility.

The pipeline, which has already been constructed in the bed of an old access road to the NTS boundary, is adjacent to the new road. One pumping station is at well J-13, and a booster pumping station will be installed about halfway (based on elevation) to the site. Water will be pumped to a 600-m^3 (150,000-gal) water tank to be located west of the site at an elevation of approximately 1,320 m (4,330 ft). The tank will supply water for all needs at the ESF including fire protection. The water supply system will be designed to accommodate reasonable changes in the surface and underground facilities.

Sanitary waste will be collected and disposed of in a sewage system located to the east beyond the proposed repository boundary. The sewage system will be conservatively designed to accommodate sewage from approximately 200 persons during a 24-hour period. An underground sewer line will connect all trailers and buildings to the sanitary waste system.

The communications system includes telephone service, monitoring systems, integrated data-system interfaces, and equipment for transmitting data to the existing Administration and Engineering (A&E) building at Jackass Flats (Figure 3-6).

3.2.5 Construction of Surface and Support Structures at the ESF

Numerous surface facilities, in addition to those described in previous sections, will be assembled or constructed at the site of the ESF; some facilities will be on the shaft pad, and some will be away from the pad (Figure 3-6).

Temporary buildings will be assembled or moved to the ESF as they are needed during the construction and operations phases. The site pad will accommodate a limited number of buildings, and as one construction phase is completed, buildings may be converted for different uses or removed from the site. Prefabricated metal buildings will be assembled to provide space for a shop with repair facilities, a warehouse, and a hoist house. Trailers will be located on the ESF pad and used for change rooms, offices and sample-preparation space, and a first aid station. Most functions not directly in

support of shaft construction will be conducted from the A&E building (Figure 3-6), which will have a visitors' center and office space.

Three magazines will be required for the storage of explosive materials; one for explosives, one for detonators, and one for primer makeup. The magazines will be located away from the exploratory shaft site as shown on Figure 3-3.

A mine plant and associated facilities will be constructed at the surface to support the subsurface construction. Major equipment in the mine plant will include ventilation fans and surface duct work in the shaft collar; air compressors and supply lines to the shaft collar; and water-supply piping controls and waste-water piping from the shaft collar to the mine waste-water pond. Major support facilities will include a concrete-batch plant, a rock-storage area, a mine waste-water storage pond, and lay-down areas for supplies and equipment.

Ventilation, exhaust, and distribution facilities will be designed to supply and remove conditioned air to and from underground working areas to maintain adequate health and safety of personnel. Systems will be installed to monitor radon, methane, oxygen, carbon dioxide, temperature, humidity, and air speed in the underground facility.

A concrete-batch plant will be assembled at the ESF to store and mix materials for concrete and grout during construction of the ESF. Concrete will be used for building foundations and the shaft collars and liners. Approximately 0.4 ha (1 acre) will be required for the batch plant, which will be located beyond the proposed repository boundary (Figure 3-3). Crushed rock, sand, and cement will be stored at the batch plant.

The mine waste-water pond, located east of the exploratory shafts (Figure 3-3) and beyond the repository boundary, will be bermed and lined to minimize seepage of fluids into the ground or to the surface drainage. Fluids that will be used during construction of the shafts will include air-water mist, bentonitic mud with water-control agents, polymer foam, and other waste fluids that will all be pumped from the underground facility to this pond. The

design life of the pond will be a minimum of 25 years, and will have the capacity to hold approximately 1.4 x 10^6L (375,000 gal) of liquid waste.

The rock-storage area will be located east of the exploratory shaft and beyond the proposed repository boundary (Figure 3-3). The rock debris removed during construction of the shafts, the testing rooms, and the exploratory drifts will be transported to the surface and hauled by truck to the rock-storage area. The site of the rock-storage area was selected because it does not constrain the size of the rock-storage pile in the event that additional mining is necessary. The rock-storage area will accommodate approximately 127,000 m^3 (166,000 yd^3) of rock debris which is the amount (swollen volume) of rock debris currently planned to be disposed of in the rock-storage area. This volume will be accommodated in an area of approximately 3.4 ha (8.5 acres), with 2:1 side slopes and a total depth of rock of 4 m (14 ft). Recompaction of the rock debris in the rock-storage area is a possibility and would, to some extent, reduce the size of the disturbed area. Dust generated from the dumping operation will be minimized by appropriate dust suppression techniques.

3.2.6 Construction of Shafts

ES-1 will have a finished inside diameter of 3.7 m (12 ft) and a total depth of 436 m (1,430 ft). A breakout room at 183 m (600 ft), the main test facility at 320 m (1,055 ft) below the surface, and a drill room near the bottom of the shaft at a depth of 415 m (1,360 ft) will be constructed as drifts from ES-1. ES-2 will also have a finished inside diameter of 3.7 m (12 ft) but a depth of 335 m (1,100 ft); it will be used for ventilation, materials handling, and emergency egress.

Construction of ES-1. After the headframe, sinking deck, and associated equipment are in place (Figure 3-7), the shaft-sinking operation will be generally routine to the upper-demonstration breakout room, except for testing conducted in the shaft. A typical sequence of operations includes drilling a number of small-diameter blast holes into the rock; the number, depth, and location of the holes will be determined by rock conditions and previous blasting results. The blast holes will then be loaded with explosives and

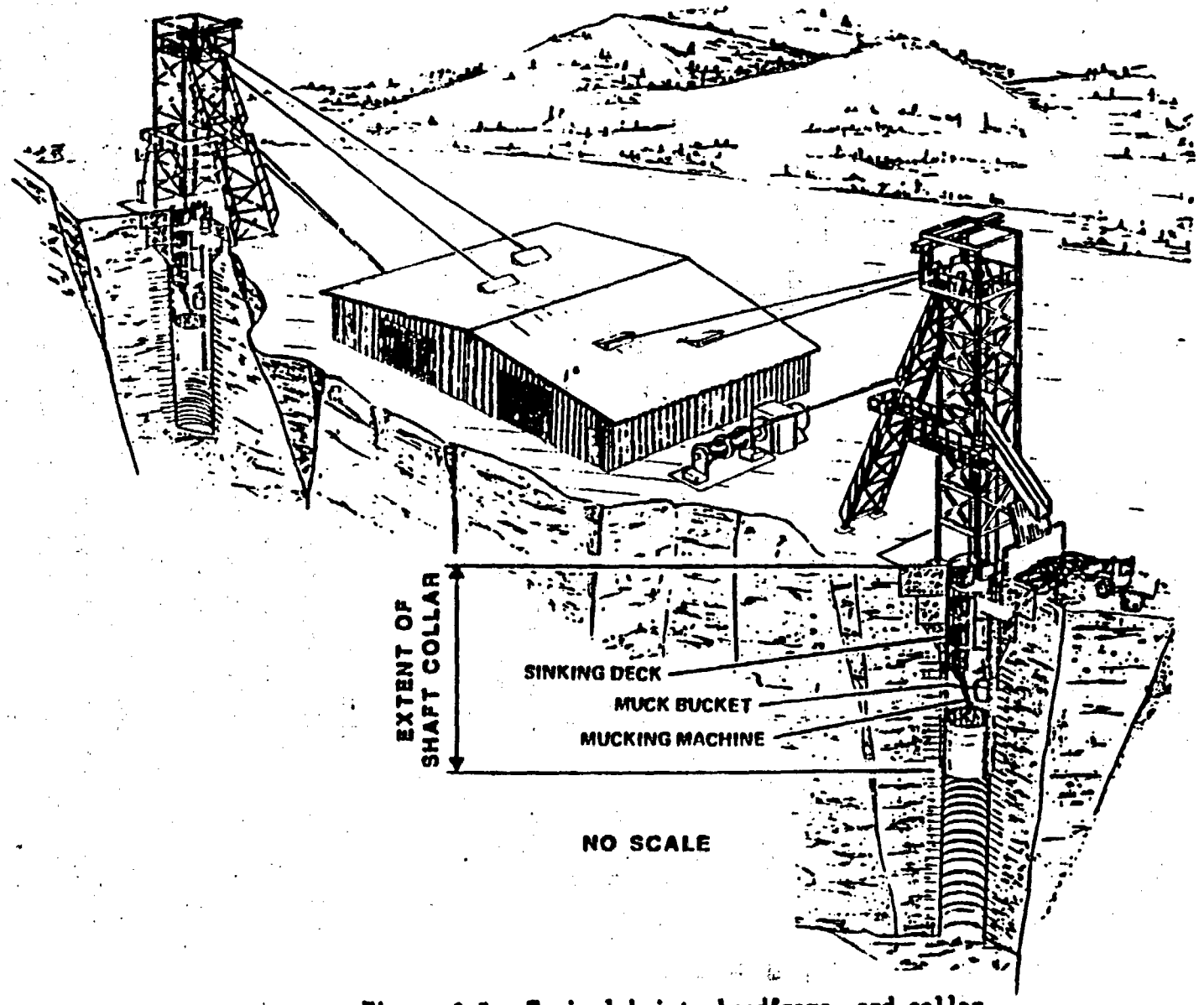

Figure 3-7. Typical hoist, headframe, and collar.

detonated in such a way that the blast is controlled (i.e., to enhance the vertical advance, limit damage to rock zone, and produce acceptable-sized rock fragments). Once the blast holes are prepared, the sinking deck and associated equipment will be raised to protect them from damage. The miners will then exit the shaft, and the explosives will be detonated. Following each blast, air will be exhausted to remove smoke, dust, and fumes before the miners enter the shaft to muck out the rubble.

The shaft miners will usually spray the rubble with water for additional dust control before mucking. Water usage will be minimized in ES-1, however, to limit any potential impact on geologic and hydrologic tests conducted in the shaft. All water used for dust suppression will be tagged with a suitable tracer to distinguish it from natural water. Humidity in the supply and exhaust ventilation will be monitored and recorded.

After the removal of smoke, dust, and fumes, the miners will reenter the shaft and start to remove the muck with a mucking machine hung below the sinking deck and a muck bucket suspended from the main hoist as shown on Figure 3-7. After the shaft has been advanced 2 m (6.5 ft) or more, all the rubble has been mucked out, and any loose rock cleaned off the walls, the miners will stow their equipment. Scientists will then enter the shaft to conduct shaft-wall mapping, sampling, and other tests in the freshly exposed interval of wall rock.

When the scientists have completed their work, they will exit the shaft, and the miners will prepare the next blast round. After several blast rounds, a concrete shaft-liner will be poured in 6-m (20-ft) segments to protect workers in the shaft. When specified by the scientists, blockouts will be installed to protect necessary instruments and equipment before the liner is poured. The unreinforced concrete liner is expected to be at least 0.3 m (1 ft) thick through the welded tuff units. While the freshly placed concrete is setting, the miners will move up the shaft approximately 18 m (60 ft) and install a 6-m (20-ft) section of steel liner and other equipment, including manway ladders and landings, conveyance guides, utility piping, and instrument conduits (Figure 3-7). When this work is completed, the miners will move back down the shaft and muck out the rubble remaining from the previous blasting

round. The scientists will then conduct their tests, and this sequence of activities will be repeated down to the proposed total depth with interim construction and mining activities at the specified levels for breakout rooms and testing.

Construction of ES-2. ES-2 will be sunk continuously (with little or no testing) using a method similar to that used for ES-1. A connecting drift to the lower demonstration break-out room of ES-1 will be constructed after ES-2 is completed. Although no tests are planned for ES-2, significant structural, hydrologic, and stratigraphic features may be mapped.

3.2.7 Construction of Underground Rooms

ES-1 will have a breakout room for testing, a main-testing level, and a drill room near the bottom of the shaft. The upper breakout room and a landing will be excavated at a depth of about 183 m (600 ft) below the surface. The room will be approximately 29.2 m long, 6.4 m wide, and 4.3 m high (96 ft long, 21 ft wide, and 14 ft high). It will be mined by the drill-blast-muck technique already described. The rock debris and muck from the room will be hauled by vehicle to the main shaft, loaded into the muck bucket, and hoisted to the surface for disposal on the rock-storage pile. Fluids will be disposed of in the mine waste-water pond.

Landings and approximately 1,219 m (4,000 ft) of drifts will be constructed at the main-testing level at a depth of 320 m (1,055 ft). After a landing is constructed, a muck-holding pocket about 12 m (40 ft) deep and a muck chute that will discharge directly into a scoop in the shaft will be constructed. Upon completion of the station, the connecting drift from ES-2 will be completed.

A drill room near the bottom of ES-1 (referred to as the "Calico Hills station") will be constructed at a depth of approximately 415 m (1,360 ft) in the same manner as the main-testing level and upper breakout room. Some testing will also take place in the drill room.

3.2.8 Transport, Storage, and Disposal of Mined Materials

The rock debris removed during construction of ES-1, ES-2, and the ESF drifts will be hoisted to the surface and deposited next to ES-1. The rock will then be hauled by truck to the rock-storage pile on the east side of the ESF (Figure 3-3). The pit will be lined and bermed to minimize percolation of fluids into the ground. Dust from the dumping operations would be minimized by appropriate wet-suppression techniques. Waste-water and other fluids will be disposed of in a bermed and lined mine waste-water pond.

Chapter 4

POTENTIALLY SIGNIFICANT ADVERSE ENVIRONMENTAL CONSEQUENCES IDENTIFIED FOR SITE CHARACTERIZATION ACTIVITIES

4. POTENTIALLY SIGNIFICANT ADVERSE ENVIRONMENTAL CONSEQUENCES IDENTIFIED FOR SITE CHARACTERIZATION ACTIVITIES

This chapter provides a summary of potentially significant environmental consequences that may result from site characterization activities and identifies which of these consequences further warrant the implementation of a monitoring and mitigation program to satisfy the intent of Section 113(a) of the Nuclear Waste Policy Act (NWPA). The Environmental Assessment (EA) (DOE, 1986) served as the basis for identification of impacts in this chapter.

With regard to the analyses contained in the Yucca Mountain EA, uncertainty may be derived as a result of changes being considered in site characterization activities since publication of the EA. In order to establish what environmental impacts are candidates for monitoring as a result of uncertainty in site characterization activities, each of the impact analyses presented in Chapter 4 of the EA were reviewed by technical discipline, and a list was created of all potentially significant environmental impacts discussed in those analyses. This uncertainty was listed as (1) nonexistent; (2) insignificant, i.e., that resulting in little or no change to EA conclusions; and (3) significant, i.e., that resulting in a range of values that warrants monitoring. It is the last set of results that were reviewed for potential monitoring under Section 113(a) of the NWPA. In no cases were the results of this analysis found to be so great as to indicate changes to the overall findings of the EA.

As noted in Chapter 2 of this document, the Environmental Monitoring and Mitigation Plan (EMMP) represents only one set of environmental field studies to be implemented under the overall repository siting program. Accordingly, those impact analyses found to have a potential degree of uncertainty relative to site characterization activities were also reviewed with respect to their involvement in other potential monitoring requirements, including environmental regulatory compliance and other field study needs. Hence, the environmental

factors chosen for inclusion under the Nevada Nuclear Waste Storage Investigations (NNWSI) Project EMMP represent those NNWSI Project disciplines that show a potential for significant adverse impact and that are not specifically stipulated in other requirements for field monitoring.

Chapter 3 of this document contains a summary of proposed site characterization activities, based on a similar discussion provided in the EA and modified by recent changes to those activities as listed in the consultation draft of the NNWSI Project Site Characterization Plan (SCP). As described in Section 8.3 of the SCP, regional studies may be needed after completion of studies in the immediate vicinity of Yucca Mountain. Because the regional studies are as yet not determined to be necessary, specific impact assessment and monitoring programs are not discussed in this document. As these potential activities are better defined, monitoring and mitigation programs, if applicable, will be discussed in the NNWSI Project EMMP.

Figure 4-1 presents a matrix that links planned site characterization activities to categories of environmental impacts usually addressed in other environmental documents, such as those required by the National Environmental Policy Act. The figure illustrates which areas may be potentially affected by current site activities and serves as a summary of what impact analyses were considered for the purpose of the EMMP. The conclusions resulting from these considerations are consistent with those of the EA. No significant adverse environmental impacts are predicted even though site characterization activities are defined in greater detail now than at the time the EA was published. Nevertheless, some degree of impact may occur to soils (through land disturbance), ecosystems (through habitat disturbance), air quality, water quality, noise, radiological levels, and archaeological and historic sites. The degree of impact for some of the above disciplines may increase as a result of potential uncertainties in the scheduling, location, or extent of site characterization activities. These uncertainties could result in significant adverse environmental impacts which would warrant monitoring in certain disciplines.

Figure 4-1. Matrix showing planned site characterization activities and areas of possible impact ("X" = impact may occur; "-" = no impact expected)

Planned Site Characterization Activity \ Area of Potential Impact	Land Use	Terrestrial Ecosystems	Air Quality	Water Quality	Soil	Noise	Aesthetics	Archeological Resources and Historic Sites	Native American Cultural Resources	Radiological Levels (b)	Transportation & Utilities
Exploratory Shaft Facilities											
Site Preparation	-	X	X	-	X	-	-	X	-	X	-
Construction and use of main access road	-	X	X	-	X	-	-	X	-	X	-
Extend and Install Utility Services	-	X	X	-	X	-	-	X	-	X	-
Construction and use of Surface Facilities	-	X	X	X	X	-	-	X	-	X	-
Excavation of shafts and disposal of mined debris	-	X	X	X	X	X	-	X	-	X	-
Field Activities											
Site preparation for drill sites, some geophysical studies, trenches, pavements, and infiltration studies	-	X	X	-	X	X	-	X	-	X	-
Construction of access roads to activity sites (listed above)	-	X	X	-	X	-	-	X	-	X	-
Exploratory drilling and testing, including transport and disposal of drill-site wastes	-	X	X	X	-	X	-	X	-	X	-
Geophysical surveys	-	X	X	-	X	X	-	X	-	X	-
Geological mapping	-	X	X	-	X	-	-	X	-	X	-
Monitoring of existing sites	-	X	X	-	(a)	-	-	-	-	X	-

(a) Disturbance of soils already exists.
(b) In most cases, impacts are probably insignificant; however, due to the uncertainty associated with existing radiological levels in the soil at and near the Yucca Mountain site, conservative assumptions were used.

Subsequent sections in this Chapter discuss each of the technical areas or disciplines addressed by the EA:

1. Land Use
2. Terrestrial Ecosystems
3. Air Quality
4. Water Quality
5. Soils
6. Noise
7. Aesthetics
8. Archaeological Resources and Historic Sites
9. Native American Cultural Resources
10. Radiological Levels
11. Transportation and Utilities

A discussion for each area is provided that gives the analysis for that discipline according to the general philosophy and methodology described above, that defines whether monitoring is considered appropriate, and that identifies in what technical areas monitoring is proposed. The general details of monitoring plans are described in Chapter 5, and specific details will be provided in associated Environmental Field Activity Plans (EFAPs).

4.1 LAND USE

As discussed in the Yucca Mountain EA (DOE, 1986), proposed site characterization activities will take place in part on public land administered by the Bureau of Land Managment (BLM). This land is not currently used for other purposes, such as farming, ranching and grazing, commercial mining, private commercial development, wildlife habitat protection, or organized recreational uses. However, there are 9 mill sites and 5 lode claims on file for the immediate Yucca Mountain area. There are also 10 additional lode claims that have been filed for in June of 1987 on the crest of Yucca Mountain. To date, the filing status with the BLM for these claims is unknown. Mill sites constitute plots of unappropriated public domain land of a nonmineral character, used for the erection of a mill, or reduction works. Lode claims include deposits of classic veins or lodes having well-defined boundaries. They also include other rock bearing valuable minerals and may even include broad zones of mineralization. At present, site characterization activities will not interfere with the operation of these sites. Accordingly, no significant adverse environmental impacts to those lands have been projected as

a result of site characterization activities at Yucca Mountain. The U.S. Department of Energy (DOE) will seek to obtain a right-of-way for use of those public BLM lands and BLM-administered Nellis Air Force Range lands needed for site characterization activities. The remainder of site characterization activities will take place on Nevada Test Site (NTS) lands.

A change in the location of site characterization activities may introduce an element of uncertainty to the above conclusions. Should future site characterization activities occur on lands that have significant prior uses, the program will be reevaluated as to the significance and adversity of impact. At present, no monitoring is proposed.

4.2 TERRESTRIAL ECOSYSTEMS

As discussed in the Yucca Mountain EA (DOE, 1986), adverse environmental impacts to wildlife may occur during site characterization as a result of wildlife habitat removal. Drill pads, roads, utility lines, trenches, geophysical surveys, and off-road driving would result in either removal or compaction of soil and in destruction of vegetation, with the subsequent disturbance or destruction of indigenous wildlife. Based on the site characterization activities projected at the time the EA was compiled, approximately 285 ha (705 acres) of habitat would be disturbed throughout the study area. The total area to be used for site characterization at the site is currently under review; therefore, the total land area to be disturbed may yet vary. Trenching activities are not expected to restrict wildlife movements in the area. The ends of trenches are frequently sloped or ramped to allow access. Additionally, trenching studies are not permanent; they will be filled in during reclamation. Geophysical surveys will utilize explosive materials for seismic studies. The explosions are very short-lived and do not represent a significant adverse impact to wildlife in the surrounding area Precon-struction surveys will be conducted to identify any wildlife that may be at the explosion site. Increased human activity may contribute indirectly to the destruction of essential habitat through the increase in potential for range fires although it is not expected to be a potentially significant adverse impact.

As a result of the above discussion, special attention should be paid to species, such as the desert tortoise, that are considered sensitive and rare by the State of Nevada and the U.S. Fish and Wildlife Service when considering impacts. The Mojave fishhook cactus does not hold any special standing by the State or federal government. However, the species is a resource of interest and will be considered in the preconstruction surveys under the ecosystems study program. In light of the sensitive nature of desert habitats, it is recommended that monitoring be implemented in two areas: (1) pre- and post-construction and (2) monitoring of sensitive species, such as the desert tortoise. These monitoring plans are discussed in further detail under Section 5.2.

4.3 AIR QUALITY

Gaseous and particulate air pollutant emissions will be generated during site characterization activities, but these levels are not predicted to cause significant adverse environmental impacts, as discussed in the Yucca Mountain EA. The majority of these emissions would occur during site preparation, shaft excavation, and underground drifting although the surface-based testing program would also contribute to project emissions. Particulate matter, such as dust, is the primary pollutant of concern during site characterization because so many of the activities associated with characterizing the site have the potential to emit particulate matter. Examples of such activities or processes are drilling, blasting, rock handling, concrete batching, surface grading and leveling, wind erosion, and vehicle travel on paved and unpaved roads. Gaseous pollutants consisting mostly of carbon monoxide (CO), nitrogen oxides (NO_x), sulfur oxides (SO_x), and hydrocarbons (HC) would be produced by diesel- and gasoline-powered construction equipment, motor vehicles, diesel-powered drilling engines, and back-up electric generators. However, these pollutants are not emitted in sufficient amounts to warrant monitoring.

The air quality analysis presented in the EA for impacts resulting from site characterization was focused on determining whether Prevention of Significant Deterioration (PSD) regulations would be applicable. That analysis showed that nonfugitive emissions (emissions that pass through a stack,

chimney, vent, or a functionally equivalent opening) would not exceed the regulatory PSD threshold value of 250 tons per year. Site characterization activities were therefore not considered a major stationary source and did not require regulatory review and permitting. It was further concluded (through analogy to the analysis for repository construction) that ambient concentrations of the various pollutants would not exceed applicable ambient regulatory standards.

While the analysis in the EA was appropriate in light of the information available at the time, some of the information used was not specific to Yucca Mountain nor directly applicable to site characterization activities. Further, the impact of fugitive emissions and in particular fugitive dust, which is excluded from the PSD applicability determination discussed above, have not yet been quantified for site characterization activities and were not included in the analysis presented in the EA.

The standard operating procedures that will minimize fugitive particulate emissions during site characterization are discussed in terms of individual activities in Chapter 3 of this EMMP. Examples of such practices are watering or paving of roads, water misting during mucking, watering the rock-storage pile, and use of commercial line power in lieu of diesel generators.

Fugitive particulate emissions will be minimized through the techniques discussed above and residual impacts are not expected to be significant. However, ambient particulate monitoring is proposed under the EMMP to support the above assertion and because of the uncertainty associated with the type and extent of activities planned for site characterization. For example, if additional mining of the Exploratory Shaft Facility (ESF) occurs, the rock-storage pile may increase in size with a resultant increase in dust emissions. Although it is unlikely that any such changes would alter the conclusions reached in the EA, establishment of a particulate monitoring program at the site will provide verification of the conclusion that site characterization will not significantly impact the air quality at Yucca Mountain.

4.4 WATER QUALITY

As discussed in the Yucca Mountain EA (DOE, 1986), site characterization activities at Yucca Mountain are not expected to cause any significant impacts to the quality or availability of water in the region. There are site characterization plans to conduct saturated zone and water table tests using reactive conservative chemical tracers (e.g., 3-trifluoromethylbenzoate and lithium bromide). The object of the tests will be to recover the tracers so that various parameters may be measured. There is the possibility that a small amount of tracer may not be recovered, but will not constitute a significant adverse impact to the water quality. No perennial sources of surface water exist at Yucca Mountain; the occasional runoff from heavy precipitation is not used by humans for any purpose. Fluids seeping into the ground from the sewage disposal system or from the lined rock-storage pile have virtually no chance of percolating downward 450 m (1,500 ft) to the water table. Groundwater pumped from wells for use during site characterization may cause drawdown near the well. The effects of this drawdown on the availability of water for other potential users in the area should be immeasurable.

Monitoring the water quality for significant adverse impacts is not proposed for the EMMP program given the above assertions. However, an EFAP for water quality is being prepared and will present scientific data gathering, confirmatory, or ranging studies that will identify potential information not known at this time.

4.5 SOILS

As discussed in the Yucca Mountain EA (DOE, 1986), no significant impacts to soils are expected as a result of site characterization activities at Yucca Mountain. Soils would be disturbed (removed and/or compacted) as a result of the following activities:

1. Site preparation for the ESF;

2. Construction of the main access road to the ESF;

3. Extension of utility lines to the site;

4. Construction and use of surface facilities;

5. Excavation of shafts and disposal of mined debris;

6. Site preparation for drill sites, some geophysical studies, trenches, and infiltration studies;

7. Construction of access roads to field activity sites;

8. Off-road travel for some geophysical and geological studies;

9. Travel on existing dirt roads to monitor equipment already installed.

In total, less than 400 ha (1,000 acres) of soil will be removed and/or compacted by planned site characterization activities. The stockpiling of soil for later reclamation at the ESF and some drill sites, along with disking and ripping of unpaved roads that are no longer being used, will minimize the impact to soils at Yucca Mountain. Furthermore, the soils in the Yucca Mountain area are not a unique or particularly significant resource compared to other similar desert environments in southern Nevada. Therefore, soil impacts caused by site characterization are judged to be insignificant. This conclusion would be reached even if the volume of soils disturbed was greatly increased because of changes to plans for site characterization. Thus, monitoring of soils is not proposed as part of this EMMP program. However, an EFAP for soils is being prepared and will present scientific data gathering, confirmatory, or ranging studies that will identify potential information not known at this time.

4.6 NOISE

As stated in the Yucca Mountain EA (DOE, 1986), no significant impacts to wildlife are expected from noise generated by site characterization activities.

In addition, the DOE is required to abide by noise standards established by the Occupational Safety and Health Administration.

Uncertainties exist regarding the effects of noise on wildlife. The conservative analysis in the EA concluded that wildlife within 0.6 km (0.4 mi) of the exploratory shaft site may be affected during construction activities. Residents of the nearest town (Amargosa Valley) are not expected to be affected by noise produced by site characterization activities. Although the effects of the noise on the physical and behavioral aspects of wildlife are poorly understood, the magnitude of any impacts is judged to be minor because the mining program at the ESF is considered a temporary activity. Therefore, monitoring the impacts of noise on wildlife in the immediate vicinity of the ESF is not warranted as part of this EMMP. However, an EFAP for noise and acoustics is being prepared and will present scientific data gathering, confirmatory, or ranging studies that will identify potential information not known at this time.

4.7 AESTHETICS

The Yucca Mountain EA (DOE, 1986) concluded that since the site characterization activities as proposed would be subject to limited public visual exposure, their visual impacts would not be considered to present a significant adverse impact. Changes in the details of site characterization activities since the publication of the NNWSI Project EA have not introduced a significant degree of uncertainty to the impact analysis of the EA, since most site characterization activities will still not be visible from population centers or public recreation areas. Some of these activities may be visible from public highways and from some portions of the town of Amargosa Valley, and some volcanic hole drilling may occur nearer to Amargosa Valley and thus be visible to residents and travellers, but neither of these situations are considered to be significantly adverse conditions. Monitoring aesthetics for significant adverse impacts is not proposed for the EMMP program given the above assertions. However, an EFAP for aesthetics is being prepared and will present scientific data gathering, confirmatory, or ranging studies that will identify potential information not known at this time.

4.8 ARCHAEOLOGICAL RESOURCES AND HISTORIC SITES

Four significant cultural resource sites were identified in the vicinity of the proposed ESF as it was identified during the EA process, and unrestricted access as a result of site preparation and ESF operations would significantly and adversely impact these resources. All four sites were eligible for nomination to the National Register, and as a result of consultations with the Nevada Division of Historic Preservation and Archaeology, it was decided that the systematic collection of all cultural remains at all four archaeological sites would adequately mitigate these potential adverse impacts. Surface collections were conducted during 1984.

However, direct and indirect impact to sites both on and around Yucca Mountain may occur during site preparation for exploratory drilling, geophysical surveys, or other surface-disturbing activities. It is unknown to what extent changes to existing site characterization activities may affect other archaeological and historic sites in the area. However, all sites that have the potential to be impacted will be monitored as part of the EMMP process.

Given the current layout for the ESF and the proposed location for other site characterization activities, the potential exists for a significant impact to other, as yet unidentified, archaeological resources and/or historic sites. According to the terms of the latest draft of a PA (DOE, 1987) between the DOE, the Advisory Council on Historic Preservation, and the State Historic Preservation Officer for Nevada, the DOE will conduct preconstruction surveys of areas that may be disrupted by site characterization activities to identify sites that may be considered significant. Such monitoring and subsequent mitigation determination will be conducted under the auspices of this document. Further detail regarding the proposed monitoring is provided in Section 5.8.

4.9 NATIVE AMERICAN CULTURAL RESOURCES

Native American cultural resources may be located in the vicinity of Yucca Mountain. Although the physical aspects of such resources (i.e., archaeological and historic sites) will be monitored for significant adverse impacts as described in Section 4.8 of this document, any consultations with Native American groups will not be initiated as part of the EMMP process. These consultations will be part of ongoing negotiations of the PA and the environmental regulatory compliance program, which specifically address the American Indian Religious Freedom Act, the National Historic Preservation Act, and the requirements stemming from these laws. Although the EMMP program does not present a monitoring program relative to the cultural and religious values of the Native Americans, an EFAP does. Data will be collected for scientific, confirmatory, or ranging studies to provide additional potential information not known at this time.

4.10 RADIOLOGICAL LEVELS

The Yucca Mountain EA only discussed the impacts of radiological levels at the site from repository construction. The release of radioactive elements from repository construction was estimated in Chapter 5 of the EA. Those releases were predicted to be a small fraction of natural background radiation and were not considered a significant adverse environmental impact. A brief summary of the impact analyses done in support of the EMMP is provided here.

Radon species (Rn-222 and Rn-224) are present in all rocks, soils, and groundwater due to the decay of trace amounts of uranium and thorium in these soils. Radon diffuses through soil and rock until it decays in this rock matrix or until it reaches the atmosphere. If the radon decays in the rock, the radioactive particulates produced are trapped and pose no health hazard. Should the radon reach the atmosphere prior to decay, the resultant daughter products become airborne radioactive particulates that, in sufficient concentrations, may constitute a health hazard. This health hazard can be significant for subsurface mined facilities and less significant for surficial land disturbances. Activities that can change the permeability of the soil or

rock matrix would increase the radon release rate, thus increasing the concentration of radioactive particulates. Such activities include mining, excavation, and land disturbance. It is expected therefore that, due to the mining of the ESF, the radon and resultant daughter products are expected to increase, the degree to which will only be identified through a monitoring program.

There are four potential sources of radioactive particulates at the Yucca Mountain site:

1. Release of naturally occurring radionuclides due to mining activities such as excavation.

2. Pumping of groundwater containing radionuclides.

3. Resuspension of radioactive materials previously deposited as a result of a variety of NTS activities.

4. All other potential radionuclide fallout from worldwide emissions.

Since relatively smaller amounts of rock are expected to be mined during site characterization than during repository construction, releases due to site characterization activities will be a much smaller fraction of the natural background radiation and will not constitute a significant impact. However, since no monitoring has occurred at the site and since site characterization may involve extensive earth-moving operations with the potential for resuspension of radionuclides, these assumptions must be supported through a monitoring program. Monitoring is therefore proposed in the following areas: (1) radioactive material concentrations in air, soils, biota, and groundwater and (2) gamma/x-ray radiation background field. These areas are further detailed under Section 5.10.

4.11 TRANSPORTATION AND UTILITIES

Significant impacts to traffic congestion in southern Nevada are not expected as a result of site characterization activities at Yucca Mountain, as discussed in the Yucca Mountain EA (DOE, 1986). Workers and materials transported to and from Yucca Mountain would cause some increase in traffic on U.S. Highway 95. Even if workers drove private automobiles to and from the site (a worst case), the resulting increase of vehicles during the evening peak hour from 5 p.m. to 6 p.m. would not cause the service levels to change on any segment of U.S. Highway 95, which would be the most heavily impacted road.

Uncertainties in the impact analysis to transportation are associated with estimated changes since issuance of the EA in the number of workers and shipments travelling to and from Yucca Mountain. Since any changes in these estimates are estimated to be less than an order of magnitude, it is not likely that significant impacts to transportation would occur even if the number of workers and shipments were to increase. Thus, monitoring of impacts to the local transportation network as a result of site characterization activities is not proposed.

Utilities will be provided by the DOE facilities on the NTS and are not expected to cause significant impact to the services provided by the NTS or to similar services provided off the NTS. No monitoring is proposed.

Chapter 5

ENVIRONMENTAL MONITORING AND MITIGATION

5. ENVIRONMENTAL MONITORING AND MITIGATION

Chapter 4 identified those technical areas or disciplines within which monitoring is proposed; this chapter continues that theme by providing greater detail on the proposed environmental monitoring activities. Monitoring related to the Environmental Monitoring and Mitigation Plan (EMMP) is proposed for four disciplines:

1. Terrestrial Ecosystems.
2. Air Quality.
3. Archaeological Resources and Historic Sites.
4. Radiological Levels.

The other disciplines are briefly identified, but no monitoring is proposed.

For each of the above four areas, a number of information points are given. A brief description of the proposed data collection program is presented, including the parameters to be monitored, types of measurements needed, and general analysis methodologies to be employed. Since the objective of the studies identified by this Plan is to ensure that site characterization activities are conducted in a way that minimizes, to the maximum extent practicable, significant adverse environmental impacts, the design and implementation of appropriate mitigation measures where a significant adverse impact is detected is an important component of the Plan. As a result, the studies proposed herein will also address the formulation and implementation of mitigation measures. It should be stressed that the phrase "mitigation measures" in the context of the EMMP refers to changes in site characterization activities to the extent practicable. When possible, the discussion of approaches to mitigation will include reference to standards, thresholds, or significant levels used to indicate the need for mitigation. The specific details of all monitoring efforts will be described in separate Environmental Field Activity Plans (EFAPs), which will be released in approximately the same timeframe as the EMMP. Should additional monitoring needs be identified as site characterization activities progress, these will be outlined in the semiannual EMMP Progress Reports and detailed in the EFAPs.

The monitoring programs identified in this chapter and further detailed in associated EFAPs are prepared, reviewed, modified, and approved in accordance with a quality assurance program approved by the U.S. Department of Energy (DOE).

5.1 LAND USE

As described under Section 4.1, no potential significant adverse environmental impacts to land use are predicted. Therefore, no land use monitoring is proposed. Some land use considerations will be investigated under the category of Terrestrial Ecosystems, but only as they relate to the study of habitat use by sensitive species. Should site characterization plans change, requiring that activities be conducted off federally administered lands, the conclusion that no monitoring is required would be reassessed.

5.2 TERRESTRIAL ECOSYSTEMS

As stated in Section 4.2, site characterization activities will result in the destruction of areas of wildlife habitat, with a potential resultant adverse impact on species considered rare and sensitive by the State of Nevada and the U.S. Fish and Wildlife Service (USFWS), such as the desert tortoise. In order to devise adequate mitigation measures to protect these resources, monitoring is proposed in two essential areas:

1. Pre- and Post-Construction.
2. Sensitive Species.

Each of these are briefly discussed below.

It should also be noted that in some cases, standard operating procedures or good engineering practices are being instituted as in-place procedures for DOE operations in the region. For example, impacts may be minimized by the implementation of mitigation measures that are considered good engineering practices, such as revegetation or habitat restoration. These practices will

be followed whenever applicable and will be incorporated into the overall EMMP. Whenever appropriate, these are identified in the following discussions.

5.2.1 Construction Surveys

A most important key to minimizing and monitoring the impacts of site characterization activities on the environment is the current standard DOE regional operating procedure of surveying all sites to be disturbed prior to the start of an activity. However, to monitor the actual impact of activities, it is important to also visit sites during construction and after construction is completed. These surveys would document any changes to the original plans, determine actual areal extent of habitat disturbed, and determine if recommendations made for conserving biological resources based on preconstruction surveys were followed. Most importantly, construction surveys would help keep a record of the amount of habitat disturbed during site characterization and would document the approximate date that disturbance took place.

Aerial photography is one method of monitoring impacts to the environment. Given the amount of habitat to be disturbed, it is proposed that baseline photographs be acquired before the onset of site characterization activities, if impacts are to be adequately addressed.

Habitat restoration is considered a good engineering practice to be followed as a standard operating procedure and therefore not a requirement of this EMMP. Plans for site reclamation and habitat restoration for the affected area are now being developed.

5.2.2 Sensitive Species

The desert tortoise is a State of Nevada protected species and is being considered by the USFWS as a candidate for the endangered species listing. It should be monitored periodically to determine if site characterization is adversely affecting population size and distribution. Preconstruction surveys will help to guide activities that will minimize direct impacts to the tortoise. The frequency, methods, and location of surveys to assess indirect impacts will be determined when plans for site activities are finalized.

The Mojave fishhook cactus is not considered a sensitive species by the State of Nevada, but construction activities would be sited to avoid the species whenever possible, as a standard operating procedure. Should other State of Nevada sensitive species be identified during the preconstruction surveys, similar monitoring plans will be developed to address each species of concern.

5.3 AIR QUALITY

As described in Section 4.3, the air pollutant of concern during site characterization is particulate matter (dust) generated or released from a variety of activities (e.g., exploratory shaft excavation and site preparation). Therefore, a monitoring program will be implemented in the vicinity of Yucca Mountain to monitor ambient particulate concentrations [both total suspended particulate and particulate matter less than 10 microns (PM_{10}) in size]. Ambient particulate monitoring may also be required to satisfy regulatory compliance requirements and may dictate additional monitors or monitoring in different locations. Any such changes in the monitoring program will be reflected in the EFAP for air quality.

The air quality monitoring program has been developed to help in identifying whether measured particulate concentrations are a result of site characterization activities or are a naturally occurring event in the area. To accomplish this goal, monitors will be placed at the proposed location of the repository surface facilities (located along with radiological monitoring equipment), which is an area that has the potential to be impacted by site characterization activities. Monitors will also be placed at a site in Fortymile Wash, which is an area that is relatively far-removed from most proposed site characterization activities, particularly Exploratory Shaft Facility site preparation and shaft sinking (based on information from the meteorological monitoring program at Yucca Mountain). Although this arrangement of the monitors will not allow for a quantitative determination of which sources are contributing to any given measurement value, a comparison between the monitoring sites should give an indication of whether the monitors closer

to the particulate-generating activities are measuring concentrations above background levels. Typical background levels for the area will be determined by monitoring at both sites before any site characterization activities begin and by correlating the data between the sites under presumably pristine conditions. The monitoring program will be designed to meet or exceed applicable State of Nevada or U.S. Environmental Protection Agency monitoring requirements and guidelines.

After site characterization activities have begun, comparing the data from the site closer to particulate-generating activities to the site in Fortymile Wash and looking at the meteorological conditions that occurred during the sampling day will give a general indication for whether site characterization activities are contributing to higher than background concentrations. Should monitoring indicate that site characterization is contributing to unacceptable increases over background levels, additional mitigation will be implemented. Mitigation would include, but not be limited to, watering disturbed areas or increasing the frequency of areas already being watered and paving roads. A complete emission inventory will be prepared and submitted to the State when permits for these activities are required and will identify which sources are the highest contributors to total emissions. The categories of sources with the highest emission rates will be targeted for increased mitigation.

5.4 WATER QUALITY

As discussed under Section 4.4, no significant adverse environmental impacts are predicted; therefore, no monitoring is proposed under the EMMP program.

5.5 SOILS

As discussed under Section 4.5, no significant adverse environmental impacts are predicted; therefore, no monitoring is proposed under the EMMP program.

5.6 NOISE

As described in Section 4.6, no significant adverse environmental impacts are predicted; therefore, no monitoring is proposed under the EMMP program.

5.7 AESTHETICS

As discussed under Section 4.7, no significant adverse environmental impacts are predicted; therefore, no monitoring is proposed under the EMMP program.

5.8 ARCHAEOLOGICAL RESOURCES AND HISTORIC SITES

The DOE, the Advisory Council on Historic Preservation, and the Nevada State Historic Preservation Officer are negotiating a Programmatic Agreement (PA) (DOE, 1987). According to the terms of the latest draft of the PA, preconstruction surveys will be implemented under this EMMP to identify any archaeological resources and historic sites that may be affected by the conduct of site characterization activities. If an archaeological or historic site is located, the site data will be recovered by controlled excavation. Where this is not possible, the planned site characterization activity will be relocated or altered wherever possible so that the site will not be disturbed. Impacts to sites may occur through direct and indirect means, and all sites that have the potential to be impacted will be monitored as part of the EMMP process. Worker education programs are stipulated in the PA and will serve to minimize any significant adverse impacts that might occur. The location, extent, and timing of these surveys will be dependent upon the final Site Characterization Plan (SCP) description of the proposed site characterization activities.

A professional archaeologist will be on call during site characterization activities. If an archaeological or historical site (historic property) is discovered on the surface or in the subsurface, all activities will stop, and the site will be evaluated against the criteria of significance of the National

Register of Historic Places. If the site is considered significant, a mitigation or data recovery plan will be developed, and no further destructive site characterization activities will take place in the immediate area until the site has been appropriately treated. Implementation of these types of mitigation measures according to the terms of the PA will seek to prevent any potential significant adverse impacts to the archaeological, cultural, or historical resources at the site during site characterization. The Environmental Regulatory Compliance Plan outlines these requirements in greater detail.

5.9 NATIVE AMERICAN CULTURAL RESOURCES

Consultations with Native American groups regarding cultural and religious values are stipulated in the latest draft of the PA (DOE, 1987) and are part of the environmental regulatory compliance process. A monitoring program for this subject is not part of the EMMP.

5.10 RADIOLOGICAL LEVELS

Environmental radiological monitoring activities in support of the EMMP will be started prior to the initiation of significant surface-disturbing activities and continue through the site characterization phase into the post-characterization period. The data gathered as a result of these monitoring activities will be used to formulate a background of conditions existing at the site prior to the initiation of significant site characterization activities. As site characterization progresses, the data taken will reflect whether site characterization activities are contributing to an elevation of that background measurement.

Monitoring technical design includes field activities for the evaluation of potential sources of radioactivity from soil and sediment samples, groundwater samples, airborne particulate and radioiodine samples, biota sampling, and radon emanation monitoring and ambient radiation levels. The overall study area for these sampling programs is described by a circle with a radius of

84 km (52 mi) whose center is located at the proposed Yucca Mountain site. Each of the above sampling programs is summarized below, with greater detail provided in an EFAP for radiological studies.

Soil and sediment sampling. Soil samples will be obtained from all air sampling locations, from areas selected for indicator species (biota) sampling, and future areas of intense construction activity. Sediment samples will also be collected from Fortymile Wash because it provides the major ephemeral drainage in the area. Analyses conducted on these samples will include gross alpha and beta counts, gamma spectral analyses, and specific analyses for selected radionuclides.

Water sampling. The water sampling program includes the collection of well-water, surface-water, and ephemeral-water sources. Surface-water samples will be collected at those limited locations where surface water occurs. A survey of catch basins will be conducted and those serving as water locations for wildlife will be included in the sampling program. Locations of well-water samples is dependent on finalization of the drilling program described in the SCP. Finally, ephemeral surface-water flows in Fortymile Canyon will be sampled as they occur.

Air sampling. This program will include (1) continuous collection of airborne particulate and iodine samples using a particulate filter and charcoal cartridge attached to a flow-controlled vacuum pump, (2) intermittent airborne particulate collection, (3) airborne tritium and noble gas sampling, and (4) radon and daughter products monitoring.

Biota sampling. Samples of locally collected plants of importance to the human food chain exposure pathway or plants that may be indicative of localized conditions will be collected. In addition, distribution of local graze, local produce, and local meat and poultry production will be evaluated for inclusion in the sampling program. A milk sampling program already exists and will not be duplicated.

Ambient radiation monitoring. Thermoluminescent dosimeters will be used at radiological environmental monitoring locations to provide data on time integrated ambient radiation exposure. A limited number of pressurized ion chambers will be used to continuously monitor ambient radiation exposure rates.

5.11 TRANSPORTATION AND UTILITIES

As discussed under Section 4.11, no significant adverse environmental impacts are predicted; therefore, no monitoring is proposed.

Chapter 6

METHODOLOGY FOR MODIFYING THE ENVIRONMENTAL MONITORING AND MITIGATION PLAN

6. METHODOLOGY FOR MODIFYING THE ENVIRONMENTAL MONITORING AND MITIGATION PLAN

6.1 INTRODUCTION

This Environmental Monitoring and Mitigation Plan (EMMP) contains the most current information available regarding activities to be conducted during site characterization. As site characterization activities are conducted, the U.S. Department of Energy (DOE) may need to modify the EMMP in response to changes in the schedule or scope of site characterization activities, changes in site characterization activities warranted by the collection of environmental monitoring data, acquisition of new information on the site environment, or new methods of impact analysis. The DOE will issue periodic EMMP Progress Reports that will reflect these modifications. Additional or alternative monitoring plans proposed by the DOE will be reviewed and discussed with affected parties. The specific mechanisms for modifying the monitoring program are presented in this chapter.

6.2 MODIFICATION OF THE ENVIRONMENTAL MONITORING AND MITIGATION PLAN

The EMMP describes a process that will be implemented over a number of years during which new or more detailed information will become available. Because changes in planned site characterization activities may occur, the monitoring and mitigation activities will need to be evaluated on a regular basis.

6.2.1 Modification due to Changes in Site Characterization Activities

Approximately every six months, the DOE will issue Site Characterization Plan (SCP) Progress Reports that will document completed and planned site characterization activities and describe revisions to previously planned activities. Such revisions may include changes in the schedule, location, or equipment to be used for various site characterization activities. If changes in site characterization activities result in the potential for significant adverse impacts, appropriate monitoring strategies will be developed and be

documented in EMMP Progress Reports to be issued subsequent to each SCP Progress Report. Concerns raised by affected parties regarding changes to monitoring and mitigation plans will also be addressed in EMMP Progress Reports.

6.2.2 Modifications due to Evaluation of Monitoring Data

If monitoring data indicate that an established impact threshold will be exceeded during site characterization, mitigation measures will be used to reduce or minimize, to the extent practicable, the level of impact. Evaluation of monitoring results may enable the DOE to modify its site characterization activities before any significant adverse environmental impacts occur or will allow the DOE to minimize the level of such impacts to the maximum extent practicable. Evaluation of monitoring data may reveal a need to modify the existing monitoring program through changes to schedule, equipment, location, or data-gathering techniques. Should this need occur, the DOE will expand or reduce the monitoring effort and document this revision in the EMMP Progress Reports.

6.2.3 Modification due to Other Factors

Factors other than those discussed above, such as inclement weather and destruction or malfunction of monitoring equipment, may require minor changes in monitoring and mitigation plans. Implementation of mitigation measures may also necessitate alterations to the monitoring plans. Any modification will be discussed with affected parties and will be documented in EMMP Progress Reports.

References

REFERENCES

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Appendix A

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APPENDIX A

LOCATIONS, BY COORDINATES, OF EXISTING SITES AND PLANNED SITE CHARACTERIZATION ACTIVITIES AT YUCCA MOUNTAIN

January 1988

APPENDIX A
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NOTE: The majority of activities identified in this appendix are presented on Maps 1-4.

Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 1 of 8)

Activity		Location
EXISTING DRILLHOLES OVER 1000 FEET IN DEPTH		
Exploratory Holes/Coreholes		
UE25 a#1	N764900.15	E566349.98
UE25 a#7	N766249.86	E565468.51
UE25 b#1	N765243.37	E566416.39
UE25 p#1	N756171.20	E571484.52
USW G-1	N770500.20	E561000.48
USW G-2	N778824.18	E560503.88
USW G-3	N752779.84	E558483.12
USW G-4	N765807.07	E563081.62
USW GU-3	N752690.10	E558501.32
25a#3	N769321.1	E602938.8
25a#4	N767971.92	E564471.64
25a#5	N766956.36	E564755.11
25a#6	N765899.48	E564500.73
Saturated Zone Hydrologic Holes		
USW H-1	N770254.32	E562387.96
USW H-3	N756542.10	E558451.65
USW H-4	N761643.62	E563911.11
USW H-5	N766634.27	E558908.72
USW H-6	N763298.86	E554074.94
UE25 c#1	N757095.85	E569680.44
UE25 c#2	N756848.8	E569633.8
UE25 c#3	N756909.9	E569554.9
29a#1	N797729.01	E585574.86
29a#2	N797744.95	E585546.92
Volcanic/Hydrologic Multiple Purpose Holes		
USW VH-1	N743355.50	E533625.96
USW VH-2	N748319.43	E526264.21
Unsaturated Zone Hydrologic Holes		
USW UZ-1	N771275.82	E560220.80
USW UZ-6	N759731	E558325

Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 2 of 8)

Activity	Location	
Water Table Holes		
USW WT-1	N753940.57	E563739.18
USW WT-2	N760660.54	E561923.56
UE25 WT#3	N745995.09	E573384.41
UE25 WT#4	N768511.75	E568040.15
UE25 WT#5	N761826.0	E574249.7
UE25 WT#6	N780575.8	E564523.9
USW WT-7	N755569.8	E553891.3
USW WT-10	N748770.9	E553302.1
USW WT-11	N739070.4	E558376.8
UE25 WT#12	N739725.9	E567011.0
UE25 WT#13	N756715.0	E578756.7
UE25 WT#14	N761650.6	E575210.1
UE25 WT#15	N766116.6	E579805.7
UE25 WT#16	N774419.66	E570394.88
UE25 WT#17	N748419.6	E566211.9
UE25 WT#18	N771167.1	E564855.0
EXISTING DRILLHOLES LESS THAN 1000 FEET DEEP		
Exploratory Holes/Coreholes		
UE25 a#4	N767971.92	E564471.64
UE25 a#5	N766956.36	E564755.11
UE25 a#6	N765899.48	E564500.73
USW GA-1	N779365.42	E559246.98
Horizontal Prototype Hole		
UE25 h#1	N748353.08	E574461.38
(horizontal hole plunging ~2 degrees west from collar)		
Unsaturated Zone Hydrologic Holes		
UE25 UZ#4	N768715.6	E566139.3
UE25 UZ#5	N768591.0	E566135.2
USW UZ-6s	N759909.3	E558050.4

Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 3 of 8)

Activity		Location
Unsaturated Zone Hydrologic Holes (continued)		
USW UZ-7	N760836.1	E562911.3
USW UZ-8	N760762.2	E562293.5
USW UZ-13	N751953.2	E558488.7
Waterwell Holes		
J-13	N749209.3	E579650.5
J-12	N733508.2	E581011.7
J-11	N740968.2	E611746.1
Repository Surface Facilities Site Exploratory Holes		
UE25 RF#1	N762189.7	E570889.9
UE25 RF#2	N758800.0	E570334.8
UE25 RF#3	N765575.1	E571100.0
UE25 RF#3B	N765695.3	E571065.6
UE25 RF#4	N762090.8	E572063.2
UE25 RF#5	N759198.7	E568097.7
UE25 RF#7	N768804.0	E571170.9
UE25 RF#7A	N768767.8	E570268.8
UE25 RF#8	N765630.8	E568789.9
UE25 RF#9	N765945.0	E570643.3
UE25 RF#10	N765307.7	E570229.9
UE25 RF#11	N765621.5	E570434.6
Natural Infiltration Monitoring Holes		
UE25 UZN#1	N769328.9	E565224.3
UE25 UZN#2	N768605.5	E566113.6[a]
UE25 UZN#3	N768630.4	E566119.4
UE25 UZN#4	N768663.4	E566127.1
UE25 UZN#5	N768689.4	E566133.8
UE25 UZN#6	N768705.6	E566136.6
UE25 UZN#7	N768724.1	E566141.2
UE25 UZN#8	N768743.0	E566146.5
UE25 UZN#9	N768781.5	E566155.9
UE25 UZN#10	N769868.6	E564744.1[a]
UE25 UZN#12	N768650.9	E566695.2
UE25 UZN#13	N768024.6	E568255.1

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Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 4 of 8)

Activity		Location
Natural Infiltration Monitoring Holes (continued)		
UE25 UZN#14	N767967.2	E568232.9
UE25 UZN#18	N766472.4	E565246.5[a]
UE25 UZN#19	N763688.9	E564570.6[a]
UE25 UZN#20	N763759.9	E564579.3
UE25 UZN#21	N763806.1	E564591.0
UE25 UZN#22	N763880.3	E564604.5[a]
UE25 UZN#23	N763973.1	E564545.4[a]
USW UZ-N24	N768005.4	E562054.2[a]
USW UZ-N25	N768430.4	E561218.9[a]
USW UZ-N26	N768757.2	E561022.9[a]
UE25 UZN#28	N763091.2	E565319.7[a]
UE25 UZN#29	N762613.1	E565173.3[a]
UE25 UZN#30	N762047.6	E565232.8[a]
USW UZ-N40	N766175.8	E564221.3
USW UZ-N41	N765867.2	E563520.9[a]
USW UZ-N42	N765728.6	E562858.5[a]
USW UZ-N43	N765997.0	E563263.6[a]
USW UZ-N44	N766192.5	E563139.6[a]
USW UZ-N45	N765976.7	E563429.2[a]
USW UZ-N46	N772262.3	E559747.7[a]
USW UZ-N47	N771967.5	E559783.5[a]
USW UZ-N48	N760834.9	E562413.6[a]
USW UZ-N49	N760860.4	E562321.8[a]
USW UZ-N50	N760775.9	E562911.7
USW UZ-N51	N760860.8	E562909.4
USW UZ-N52	N760893.8	E562908.8
UE25 UZN#56	N760393.5	E565480.0
UE25 UZN#60	N759756.9	E566567.0[a]
USW UZ-N65	N758627.1	E562537.1[a]
USW UZ-N66	N758433.5	E561881.1[a]
USW UZ-N67	N753634.2	E563799.0
USW UZ-N68	N753962.4	E564005.8
USW UZ-N69	N754460.9	E564401.7
USW UZ-N70	N769250.7	E560164.7[a]
USW UZ-N71	N761025.9	E558405.6[a]
USW UZ-N72	N761067.9	E558626.1[a]
USW UZ-N73	N761049.1	E558926.0[a]
USW UZ-N74	N761362.2	E558559.9[a]
USW UZ-N75	N761462.4	E559075.9[a]
USW UZ-N76	N761353.2	E559047.7[a]

Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 5 of 8)

Activity	Location	
Natural Infiltration Monitoring Holes (continued)		
USW UZ-N77	N755526.1	E554397.2
USW UZ-N78	N757557.8	E556262.3
USW UZ-N79	N757733.2	E556333.9
USW UZ-N80	N757634.3	E557201.1[a]
USW UZ-N81	N757807.1	E555595.1
USW UZ-N82	N757498.1	E554689.7
USW UZ-N83	N760624.2	E556349.0
USW UZ-N84	N760717.0	E555887.8
UE25 UZN#85	N750715.8	E577567.8
USW UZ-N86	N760614.5	E556460.3
USW UZ-N87	N760714.1	E555887.1
USW UZ-N88	N760796.9	E556551.2
USW UZ-N89	N760610.4	E555588.7
USW UZ-N90	N760608.4	E555587.2
UE29 UZN#91	N797275.0	E585340.9
UE25 UZN#92	N778009.5	E583558.5
USW UZ-N93	N759584.3	E558320.7
USW UZ-N94	N759723.5	E558236.2[a]
USW UZ-N95	N759899.0	E558172.3
USW UZ-N96	N759445.8	E558403.1[a]
UE25 UZN#97	N763093.8	E565320.6
USW UZ-N98	N767996.2	E562083.5
Misc. Additional Shallow Drillholes		
UE25 UZNC#1	N764670.6	E566158.9
UE25 UZNC#2	N764668.4	E566157.5
UE25 TC#1	N756482.7	E612896.7
UE25 TC#2	N756485.1	E612898.2
UE25 TC#3	N756806.0	E613079.1
UE25 TC#4	N756860.0	E613094.6
UE25 TCI#1	N756778.0	E613450.1
UE25 TCI#2	N756775.8	E613451.7
UE25 TCI#3	N756781.8	E613435.4
UE25 TCI#4	N756783.1	E613437.6

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Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 6 of 8)

Activity	Location	
MISC. ADDITIONAL FACILITIES		
Test Pits and Excavations		
SHAFT MAPPING TEST PIT #1	N748401	E574452
SHAFT MAPPING TEST PIT #2	N748459	E574454
SHAFT MAPPING TEST PIT #3	N745753	E573385
Meteorological Monitoring Stations		
PRECIP. STATION SANDY	N771853.9	E558845.8
PRECIP. STATION CAROLYN	N752689.1	E558514.0
PRECIP. STATION #3	(to be included)	
PRECIP. STATION #4	(to be included)	
PRECIP. STATION #5	(to be included)	
Trenches		
TRENCH #1	N751300	E559800[b]
TRENCH #2	N770100	E561900
TRENCH #4A	N762500	E562300
TRENCH #4B	N764200	E562300
TRENCH #6	N755000	E560400
TRENCH #7	N772800	E558400
TRENCH #8	N747500	E554500
TRENCH #9	N757800	E561300
TRENCH #10	N759600	E557600
TRENCH #11	N779300	E562200
TRENCH #12	N778100	E559500
TRENCH #13	N782700	E559600
TRENCH #14	N766000	E569300
TRENCH #15	N752400	E566800
TRENCH #16A	N754000	E572400
TRENCH #16B	N754900	E572200

Location of other trenches to be supplied

Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 7 of 8)

Activity		Location	
Precipitation Monitoring Stations			
Unnamed Tributary to Fortymile Wash	RRG[c]	N865,620	E616,670
Fortymile Wash at Narrows	PRG[d]	N778,010	E583,580
Yucca Wash	PRG	N770,320	E579,750
Exile Hill	RRG	N764,990	E569,340
North Fork Coyote Wash	PRG	N766,120	E563,030
Drillhole Wash	PRG	N753,630	E578,750
Fortymile Wash at J-13	PRG	N749,400	E577,890
Dune Wash	PRG	N743,770	E575,700
Fortymile Wash near US 95	PRG	N699,320	E568,200
Topopah Wash	PRG	N736,070	E602,410
Cane Springs Wash Tributary	PRG	N749,390	E667,300
Skull Mountain Pass on Jackass Flats Highway	PRG	N723,750	E627,060
Rock Valley on Jackass Flats Highway	PRG	N704,400	E651,830
Rock Valley at US 95	PRG	N683,380	E604,810
Amargosa River Tributary near Mercury	PRG	N659,900	E666,890
Stockade Pass	PRG	N878,700	E635,610
Streamflow Monitoring Stations			
Amargosa River near Beatty	CSG[e]	N780,900	E472,880
Tributary to Fortymile Wash	RSG[f]	N865,620	E616,670
Fortymile Wash at Narrows	RSG	N778,010	E583,580
Yucca Wash	CSG	N770,320	E579,750
Drillhole Wash	CSG	N753,630	E578,750
Fortymile Wash at J-13	RSG	N749,400	E577,890
Dune Wash	CSG	N743,770	E575,700
Fortymile Wash near US 95	RSG	N699,320	E568,200
Topopah Wash	CSG	N736,070	E602,410
Cane Spring Wash Tributary	CSG	N749,390	E667,300
Amargosa River Tributary near Mercury	CSG	N659,900	E666,890
Amargosa River Tributary #1 near Johnnie	CSG	N622,800	E664,360
Amargosa River Tributary #2 near Johnnie	CSG	N614,160	E674,320

Table A-1. Nevada Central Grid (State Plane Coordinate System) coordinates of existing drillholes, trenches, and other facilities at or near Yucca Mountain. (source: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 8 of 8)

Activity			Location
Streamflow Monitoring Stations (continued)			
Indian Springs Valley Tributary	CSG	N661,500	E432,950
Other Test Pits and Trenches (to be included)			
Scour Chains (to be included)			

[a] = planned ponding study.
[b] Trench locations are taken from letter WMPO:MMB (June 1985).
[c] RRG = Recording Rain Gage (Tipping bucket).
[d] PRG = Plastic Rain Gage.
[e] CSG = Crest-stage Stream Gage
[f] RSG = Recording Stream Gage

Table A-2. Nevada Central Grid (State Plane Coordinate System) coordinates of proposed drillholes, shafts, artificial infiltration experiments, and other facilities at Yucca Mountain. (sources: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 1 of 6)

Activity	Location		Comments
Shafts			
USW ES-1	N766255	E563630	
USW ES-2	N766405	E563890	
DEEP DRILLHOLES REQUIRING DRILL PADS			
Unsaturated Zone Hydrologic Holes			
USW UZ-2	N759769	E558180	(use existing drill pad)
USW UZ-3	N759625	E558220	(use existing drill pad)
USW UZ-9	N760000	E566250	
USW UZ-9A	N760000	E566250	(share drill pad w/ UZ-9)
USW UZ-9B	N760000	E566250	(share drill pad w/ UZ-9)
USW UZ-10			(not surveyed; near USW UZ-13)
USW UZ-11	N757400	E555800	
USW UZ-12	N757400	E555800	(share drill pad w/ UZ-11)
USW UZ-14			(not surveyed; near USW UZ-1)
USW VSP-1	(close to UZ-6)		(prototype drilling method; vertical seismic profiling support)
Exploratory Holes			
UE25 ph#1	(close to Trench 14)		(May be more than one hole on the same pad; for planning purposes assume 1 hole)
Geologic Coreholes			
USW G-5	N781930	E563008	
USW G-6	N778722	E548922	
UE25 G#7	N724586	E566090	
Volcanic Holes			
USW V-1	N729600	E518000	
USW V-2	N682450	E572900	
USW V-3			(not surveyed; ~8 km SW of V-2)
USW V-4			(not surveyed; ~8 km SW of V-2)

Table A-2. Nevada Central Grid (State Plane Coordinate System) coordinates of proposed drillholes, shafts, artificial infiltration experiments, and other facilities at Yucca Mountain. (sources: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 2 of 6)

Activity	Location		Comments
In Situ Stress Study Holes			
USW ISS-1	(to be determined)		(locations to be selected from >20 tentative sites distributed regionally in S. Nevada)
USW ISS-2	(to be determined)		
Fortymile Wash Recharge Study Holes			
UE25 FM#1			(not surveyed; located in the wash near J-12 and J-13, on the NTS)
UE25 FM#2			
UE25 FM#3			
Shallow infiltration monitoring neutron holes	(to be determined)		(plans for up to 10 holes)
Water-Table Holes			
USW WT-8	N762283	E557049	
USW WT-9	N769477	E557642	
UE25 WT#19	N747978	E589973	
UE25 WT#20	N728303	E565143	
USW WT-21	N760086	E550328	
USW WT-22	N778858	E528373	
USW WT-23			(not surveyed; north of UZ-1, in Drill Hole Wash)
USW WT-24			(not surveyed; between G-2 & WT-16)
Southern Tracer Complex Holes, if needed			(location not yet determined)
Saturated Zone Hydrologic Holes			
USW H-7			(not surveyed; 3000 feet east of H-6, on Yucca Crest)
Horizontal Borehole			(location has yet to be determined, but near the northwest end of the repository block)

Table A-2. Nevada Central Grid (State Plane Coordinate System) coordinates of proposed drillholes, shafts, artificial infiltration experiments, and other facilities at Yucca Mountain. (sources: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 3 of 6)

Activity	Location		Comments
Geostatistical Drilling Program			
Phase I - 12 holes Phase II - 12 holes Phase III - 9 or more holes			(Exact location of holes has yet to be determined, but will consist of a grid over the repository block)
SHALLOW DRILLHOLES NOT REQUIRING DRILL PADS			
Natural Infiltration Monitoring Holes			
USW UZ-N11	N760000	E556400[a]	
USW UZ-N15	N760150	E556600[a]	
UE25 UZN#16	N765500	E565300[a]	
USW UZ-N17	N759350	E556250[a]	
USW UZ-N27	N770450	E562300[a]	
USW UZ-N31	N757550	E560450[a]	
USW UZ-N32	N757200	E559990[a]	
USW UZ-N33	N751400	E559100[a]	
USW UZ-N34	N750150	E559300[a]	
USW UZ-N35	N750350	E559850[a]	
USW UZ-N36	N765700	E557675[a]	
USW UZ-N37	N765450	E557600[a]	
USW UZ-N38	N765500	E557950[a]	
USW UZ-N39	N765750	E557960[a]	
USW UZ-N53	N766450	E560110[a]	
USW UZ-N54	N760550	E564250[a]	
USW UZ-N55	N757500	E561600	
USW UZ-N57	N754950	E560500[a]	
USW UZ-N58	N754800	E560650[a]	
USW UZ-N59	N755300	E560100[a]	
USW UZ-N61	N755550	E560150[a]	
USW UZ-N62	N755350	E560300[a]	
USW UZ-N63	N755550	E560450[a]	
USW UZ-N64	N767000	E559300[a]	
Large-plot Rainfall Simulation Tests (Approx. 10 holes at each location)			
LPRS-1	N751400	E559300	(designations are tentative)
LPRS-2	N761353	E559048	

Table A-2. Nevada Central Grid (State Plane Coordinate System) coordinates of proposed drillholes, shafts, artificial infiltration experiments, and other facilities at Yucca Mountain. (Sources: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 4 of 6)

Activity	Location		Comments
Large-plot Rainfall Simulation Tests (approx. 10 holes at each location) (continued)			
LPRS-3	N757200	E559990	
LPRS-4	N760434	E561881	
LPRS-5	N760860	E562321	
LPRS-6	N765500	E565300	
LPRS-7	N755550	E560150	
LPRS-8	N770450	E562300	
LPRS-9	N765500	E557950	
LPRS-10	N765750	E557950	
LPRS-11	N763091	E565320	
LPRS-12	N762048	E565233	
Small-plot Rainfall Simulation Tests (Approx. 4 holes at each location)			
SPRS-1	N751400	E559300	(designations are tentative)
SPRS-2	N761026	E558406	
SPRS-3	N759446	E558403	
SPRS-4	N761353	E559048	
SPRS-5	N757200	E559990	
SPRS-6	N765700	E557675	
SPRS-7	N760434	E561881	
SPRS-8	N760860	E562321	
SPRS-9	N765500	E565300	
SPRS-10	N762613	E565173	
SPRS-11	N760550	E564250	
SPRS-12	N763973	E564545	
SPRS-13	N766400	E560100	
SPRS-14	N765729	E562859	
SPRS-15	N755550	E560150	
SPRS-16	N770450	E562300	
SPRS-17	N760150	E556600	
SPRS-18	N760000	E556400	
SPRS-19	N765500	E557950	
SPRS-20	N759350	E556250	
SPRS-21	N755120	E560400	
SPRS-22	N763091	E565320	
SPRS-23	N762048	E565233	
SPRS-24			(to be determined)
SPRS-25			(to be determined)

Table A-2. Nevada Central Grid (State Plane Coordinate System) coordinates of proposed drillholes, shafts, artificial infiltration experiments, and other facilities at Yucca Mountain. (sources: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 5 of 6)

Activity	Location		Comments
Amargosa Desert Recharge Holes (Number not yet determined)			(locations to be determined)
Playa Coring (Number not yet determined)			(location to be determined)
ADDITIONAL PLANNED ACTIVITIES			
Trenches			
146	N757000	E572000	
YW-23	N774000	E573500	
Eastside of Bare Mountain			
1)	N770500	E509000	
2)	N749500	E511700	
3)	N741000	E509000	
Additional Trenches (to be included)			
Pavements (to be included)			
Shallow Seismic Refraction Surveys			
Crater Flat Study Area	N748000	E530000	(center only)
Fortymile Wash Study Area	N757500	E580000	(center only)
Shallow Seismic Reflection Surveys			
	West End		East End
1	N762000	E562000	N752000 E578000
2	N721000	E553000	N738000 E579000
3a	N761000	E562000	N767000 E567000

Table A-2. Nevada Central Grid (State Plane Coordinate System) coordinates of proposed drillholes, shafts, artificial infiltration experiments, and other facilities at Yucca Mountain. (sources: Holmes & Narver Survey Report No. DDD:TPO:87-003) (page 6 of 6)

Activity	Location			Comments
Shallow Seismic Reflection Surveys (continued)				
	3b E571000	N767000	E567000	N777000
	4 E552000	N746000	E532000	N757000
	5 E572000	N769000	E561000	N776000
	6a E578000	N757000	E570000	N676000
	6b E582000	N767000	E578000	N779000
	7 E562000	N754000	E558000	N753000
	8 E565000	N783000	E557000	N786000
	9 E566000	N778000	E559000	N782000

[a] = ponding study planned.

Table A-3. Nevada Central Grid coordinates of proposed precipitation, streamflow, and meteorological monitoring stations. (Source: Section 8.1.3.1.2 of the SCP) (page 1 of 3)

	Instrumentation	Location	
Planned Site Precipitation and Streamflow Stations			
S1	Wren Wash - Below UE-25 UZN-98, just below lower confluence	N767,900	E562,250
S2	Wren Wash - Above UE-25 UZN-26, just below upper confluence	N768,890	E560,450
S3	Wren Wash - Above USW UZ N-70, near top of drainage	N769,450	E559,830
S4	Drill Hole Wash - Just above USW UZN-46	N772,250	E559,700
S5	Drill Hole Wash - Just below UE 25 UZ N18	N766,350	E565,240
S6	Coyote Wash - North Fork, 100 ft downstream from trench	N766,300	E562,500
S7	Coyote Wash - South Fork, just upstream from USW UZ-N42	N765,650	E562,700
S8	Coyote Wash - South Fork, just below crest of Yucca Mountain	N766,150	E559,675
S9	Pagany Wash - Just below UE25 UZ N12	N768,550	E566,800
S10	Pagany Wash - Just above UE25 UZ N10	N770,050	E564,650
S11	Split Wash - 500 ft above UE25 UZ N19	N763,910	E564,125
S12	H4 Canyon - 1,000 ft above USW H4	N762,275	E563,150
S13	WT-2 Canyon - Just below USW UZ-7	N760,850	E563,000
S14	WT-2 Canyon - North Fork, just below USW UZ N73	N760,950	E559,010
S15	Ghost Dance Wash - North Fork, west of QTec deposit	N758,700	E559,600

Table A-3. Nevada Central Grid coordinates of proposed precipitation, streamflow, and meteorological monitoring stations. (Source: Section 8.1.3.1.2 of the SCP) (page 2 of 3)

	Instrumentation	Location	
Planned Site Precipitation and Streamflow Stations (continued)			
S16	Ghost Dance Wash - South Central Fork, lower part of	N757,480	E560,375
S17	Abandon Wash - Just below Ghost Dance fault trench	N755,050	E560,500
S18	Drainage South of USW UZ13 - Just below USW UZ N-33	N750,300	E559,350
S19	Solitario Canyon - Near USW UZ N35	N754,525	E556,875
S20	Solitario Canyon - Canyon Mouth near USW WT-7	N755,300	E554,225
S21	Solitario Canyon - Mid-part of canyon just above USW H6 road	N762,750	E556,190
S22	Solitario Canyon - Upper part of canyon-due west of Wren Wash	N768,780	E557,725
S23	Solitario Canyon - Unnamed tributary between UZ N81 and USW UZ N79	N757,675	E566,000
S24	Solitario Canyon - Unnamed tributary just above USW UZ N36	N765,800	E557,775
P1	Yucca Crest-north end (Precip. only)	N772,100	E558,670
P2	Yucca Crest near top of Split Wash (Precip. only)	N763,920	E559,300
P3	Yucca Crest, near USW H3 (Precip. only)	N756,540	E558,450
P4	Yucca Crest, near USW G3 (Precip. only)	N765,780	E558,480

Table A-3. Nevada Central Grid coordinates of proposed precipitation, streamflow, and meteorological monitoring stations. (Source: Section 8.1.3.1.2 of the SCP) (page 3 of 3)

	Instrumentation	Location	
Meteorological Monitoring Stations			
W2	USW-UZ1	N771,270	E560,220
W3	USW H5	N766,630	E558,900
W4	ES-1	N765,995	E563,260
W5	USW H-6	N763,300	E554,070
W6	USW UZ-6	N759,730	E558,320
W7	UE25 9A, 9B	N760,450	E564,760
W8	USW UZ N58	N754,850	E560,700
W9	USW UZ N33	N750,400	E559,310
W10	USW WT-7	N755,520	E554,400
W1	Southeast of Area 25, subdock, Coexisting station	N761,250	E568,950

Appendix B

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COMMENT ANALYSIS DOCUMENT FOR DECEMBER 1986 ENVIRONMENTAL MONITORING AND MITIGATION PLAN

January 1988

Nevada Nuclear Waste Storage Investigations Project
Waste Management Project Office
U.S. Department of Energy
Nevada Operations Office
Las Vegas, Nevada

DRAFT

EMMP
COMMENT ANALYSIS DOCUMENT
TABLE OF CONTENTS

1. INTRODUCTION

This document presents an analysis of all comments received from the State of Nevada and Clark County addressing the December 1, 1986, working draft of the Environmental Monitoring and Mitigation Plan (EMMP). Both the State and the County submitted comments in two categories: general, those that addressed the document as a whole, and specific, those that addressed individual chapters in the EMMP.

The U.S. Department of Energy's (DOE) responses to those comments are presented in the following text, organized in approximately the same manner as they were presented in the reviewers' submittals. Section 2 of this document addresses the State of Nevada and Clark County general comments and Section 3 addresses the State of Nevada and Clark County specific comments. The categories of general and specific comments are further subdivided by the topic that they address; the title of the topics was based on the general content of the comment made and was assigned by the DOE.

In order to facilitate tracking of the response to the comment, a paraphrasing of the comment immediately precedes the response. In addition, a two-digit alpha-numerical coding follows each topic or issue title. The first digit of the code corresponds to the document containing the comment--the State of Nevada is Document A, and the Clark County submittal is Document B. The second digit of the code represents the comment is addressed within each individual document. As a guide, the documents themselves have been included as Section 4 of this response package, with the individual comments physically delineated and numbered. This methodology parallels that used to correspond to comments on the Nevada Nuclear Waste Storage Investigations Project Environmental Assessment.

2. STATE OF NEVADA AND CLARK COUNTY GENERAL COMMENTS

The following sections address general comments received on the Environmental Monitoring and Mitigation Plan (EMMP) and fall into five categories: absence of a site-specific environmental data base, incomplete Site Characterization

Plan (SCP), lack of a comprehensive and integrated environmental program, citations of regulations, and Council on Environmental Quality (CEQ) definitions.

2.1 Absence of a Site-Specific Environmental Data Base

Limited Data Availability (Comment A-1)

The State of Nevada contends that a limited amount of data specific to the Yucca Mountain site is available for planning environmental protection programs. Therefore, in the State's view, the EMMP relies on information in the literature about environments similar or proximate to Yucca Mountain.

Analysis of Comment

Section 112(b)(3) of the Nuclear Waste Policy Act (NWPA) directed the U.S. Department of Energy (DOE) to prepare an Environmental Assessment (EA) that was based on the historical record; no site-specific environmental studies directly in support of the EA were required. This EA was subject to extensive public and agency review. The majority of comments received addressed repository-related construction and operation issues and not site characterization issues. A full, site-specific environmental baseline investigation program will be implemented to address those issues through the Environmental Impact Statement (EIS) preparation process. However, such an extensive investigation is not required to address Section 113(a) of the NWPA. The EMMP is not being prepared in response to a regulatory requirement but as a matter of DOE policy to ensure compliance with Section 113(a) of the NWPA. The EMMP is based on public comments and the analysis and conclusions of the EA, as required by the NWPA. The environmental data that exists currently for the Yucca Mountain area is considered adequate for the EMMP and its stated objective. However, the DOE will implement additional environmental monitoring programs aside from those identified in the EMMP for the purpose of enhancing the current understanding of the environment and in support of planning efforts for EIS baseline monitoring.

Environmental Data (Comment A-2)

The State of Nevada contends that there is little or no comprehensive information on soil characteristics, associated site conditions, species occurrence, and other environmental conditions.

Analysis of Comment

The information that currently exists on the soils at the Yucca Mountain site as documented in the EA is sufficient to draw the conclusion that site characterization activities would produce insignificant impacts to the soils. The soils in the Yucca Mountain area are not a unique or particularly significant resource compared to other similar desert environments in the region.

Biological species of special interest will be the subject of EMMP-related monitoring during the site characterization phase. Chapter 3 of the EA presented a sufficient baseline against which to assess any potentially significant adverse impacts. A complete terrestrial ecosystem study and impact assessment as a result of siting a repository at Yucca Mountain will be undertaken during the EIS process.

EMMP mitigation measures will consist of changes in the way site characterization activities are conducted. Section 113(c)(4) of the NWPA does state that reasonable and necessary steps should be taken to reclaim the site if determined to be unsuitable for a repository. Reclamation studies will be undertaken for the affected area as part of good engineering practice, the decontamination and decommissioning phases of site characterization, and as required by Bureau of Land Management agreements for land access. These plans are now being developed. EMMP monitoring is proposed in the area of air quality; specifically, the measurement of total suspended particulates. Predisturbance data will be collected for comparison with conditions during and following site characterization.

Site-Specific Baseline (Comments A-3 and B-5)

The State of Nevada and Clark County contend that without a description of baseline environmental conditions at the site prior to the initiation of site characterization activities, environmental impacts and monitoring requirements cannot be adequately addressed.

Analysis of Comments

The EA does adequately establish the pre-site characterization environmental baseline conditions as required by the NWPA. This baseline is derived from field studies in many technical areas, analogy or extrapolation in some areas, and expert judgement in other areas.

With regard to the governing legislation, the NWPA requires that a National Environmental Policy Act (NEPA) EIS be prepared for repository construction and operation based on a full environmental baseline program in all applicable disciplines. However, such is not the case with the site characterization phase of the program. In fact, Section 113(d) of the NWPA indicates that site characterization and associated activities are considered preliminary decision-making activities and not major federal actions. As such, these activities do not require the implementation of a site-specific environmental baseline investigations program, and assessment of impacts due to site characterization may be based solely on public comments and the conclusions reached in the EA.

However, in its interpretation of the requirements of Section 113(a) of the NWPA, the DOE has decided to go beyond the explicit requirements of NWPA and develop, in consultation with the State of Nevada, site-specific EMMPs that will provide for active monitoring of those site characterization activities judged to have a potential to produce significant adverse environmental impacts. If, during consultations with the State on the EMMP, the DOE concludes that additional data should be collected to address some specific potential impact, such data will be collected in a timely manner.

2.2 Incomplete Site Characterization Plan

Site Characterization Data (Comment A-4)

The State of Nevada contends that an insufficient level of detail is available relative to planned site characterization activities, and the EMMP should be deferred until the information is collected upon which to determine impacts and mitigation strategies.

Analysis of Comment

The development of site characterization activities and the development of the SCP has been an evolving process. Throughout the process, the EMMP has been updated as the SCP underwent changes. With the issuance of the consultation draft of the SCP, the plans for site characterization activities presented therein are the most up-to-date and complete plans that have been generated thus far. The EMMP is consistent with those plans and will be revised subsequent to public hearings on the SCP and as site characterization activities are modified in the future. These modifications will be documented in semi-annual SCP progress reports and further reported along with any changes to the site characterization environmental monitoring program in semi-annual EMMP progress reports.

Deferment of the EMMP is not a realistic approach because the preliminary planning and consultation process is expected to provide for a policy-consistent and scientifically justifiable program. It is essential to review and modify the EMMP as the SCP is reviewed and modified so that changes in site characterization activities and any potential subsequent changes to the environmental monitoring program will be adequately addressed.

2.3 Lack of a Comprehensive and Integrated Environmental Program

Environmental Planning (Comment A-5)

The State of Nevada believes that the DOE is approaching environmental planning on a piecemeal basis and that work on the EMMP should cease until a comprehensive planning approach exists.

Analysis of Comment

A comprehensive approach has been formulated, and implementation of that approach is well under way. Upon recommendation of the Yucca Mountain site for the site characterization phase, the Nevada Nuclear Waste Storage Investigations (NNWSI) Project staff began simultaneous preparation of a number of documents related to this phase of the overall high-level nuclear waste repository program. All of these documents have an "environmental" aspect.

The Environmental Field Activity Plans (EFAPs) will describe in detail the actual field work to be undertaken in support of the EMMP, the Environmental Regulatory Compliance Plan (ERCP), and other confirmatory and scientific data-gathering activities. The SCP describes geotechnical and other related activities that will be undertaken to characterize the site. The EMMP describes those monitoring activities that will be initiated to monitor potential significant adverse environmental impacts resulting from site characterization. The ERCP outlines all environmental regulatory compliance requirements that must be fulfilled in order for the SCP to be implemented and provides a plan for satisfying these requirements. All documents are currently in preparation and are scheduled to be issued in the same timeframe as the SCP. A draft Environmental Program Overview has been prepared that explains the relationship of the EMMP to other proposed environmental studies and contains a summary of the associated plans and program documents.

With respect to the repository construction and operation phase, a programmatic EIS will be generated by DOE Headquarters, using technical input from the project office. The NNWSI Project will provide support to DOE Headquarters for any NEPA-related activities as needed. In order to successfully direct this effort at the Project level, the NNWSI Project will publish and distribute an NNWSI Project EIS Implementation Plan that will delineate technical plans for acquisition and compilation of EIS materials. This project-specific EIS Implementation Plan will be a separate document from the DOE Headquarters EIS Implementation Plan, will be issued after the EIS scoping hearings, and will address only those NNWSI Project activities that will be undertaken in support of the programmatic EIS effort.

The discipline-specific NNWSI Project EFAPs will be amended to include NNWSI Project EIS-related studies and will be distributed for review. An ERCP, separate from that developed to support site characterization, will be prepared to address regulatory requirements during construction and operation of the potential repository at Yucca Mountain.

2.4 Citations of Regulations

NEPA, NWPA, and Other Applicable References (Comment B-1)

Clark County suggested that full citations of pertinent sections of regulations be included as appendices to the EMMP in order to provide the appropriate context of the regulations.

Analysis of Comment

The EMMP will not be a publicly distributed document and as such does not have to be a "self-contained" document relative to the regulations. The portions of sections as quoted from the regulations are fairly straight forward with respect to interpreting the law; however, the references quoted in the text of the EMMP are always available for review by any

interested party. Additionally, the NNWSI Project ERCP addresses all applicable environmental regulations for the site characterization program.

2.5 Council on Environmental Quality Definitions

Definition of Significance (Comments B-2, B-3, and B-4)

Clark County contends that the EMMP is not consistent with the rigorous review required by CEQ Section 1508.27 relative to determinations of impacts.

Analysis of Comments

As stated previously, site characterization activities are considered only preliminary decision-making activities and are not subject to NEPA and CEQ regulations, which are specifically designed for addressing major federal actions. The EMMP simply states that the definition of significance is consistent with that used by CEQ regulations relative to impacts.

3. STATE OF NEVADA AND CLARK COUNTY SPECIFIC COMMENTS

The following text has been prepared in response to specific comments prepared by the State of Nevada and Clark County on specific chapters of the Environmental Monitoring and Mitigation Plan (EMMP). Many sections of the EMMP have changed since it was issued in December 1986; an attempt was made to respond to the subject of concern rather than comment on a specific quote from the EMMP. In cases where a response to a specific comment duplicates a response given previously, the reader is referred to the preceding text.

3.1 EMMP Chapter 2

Coordination with Overall DOE Environmental Program (Comment A-6)

The State of Nevada contends that the EMMP is not coordinated with an overall U.S. Department of Energy (DOE) environmental program.

Analysis of Comment

As discussed in Section 2.3 of this document, the EMMP is indeed part of an overall DOE environmental program that is responsive to the requirements of the Nuclear Waste Policy Act (NWPA) and other legislation. This program began with the preparation of the Environmental Assessment (EA) and culminates with the preparation of the Environmental Impact Statement (EIS). A draft Environmental Program Overview (EPO) has been prepared that explains the comprehensive environmental program.

Unplanned SCP Monitoring Activities (Comment A-7)

The State of Nevada contends that other Site Characterization Plan (SCP) monitoring activities yet unplanned may influence the contents and direction of the EMMP and views this as a deficiency of the document.

Analysis of Comment

It is the published intent of DOE to amend the EMMP as future situations dictate. It is not expected that the EMMP, which responds to a changing characterization document, would remain static over a period of several years. As SCP-related geotechnical investigations are initiated, DOE intends to review their results and to alter concomitant monitoring activities as necessary. By amending the EMMP through the semi-annual progress reports, the EMMP-related monitoring program will remain as dynamic as the SCP activities and remain responsive to DOE's intent of conducting site characterization activities in a manner that minimizes significant adverse environmental impacts to the maximum extent practicable.

Absence of Critical Information (Comment A-8)

The State of Nevada contends that details on monitoring procedures cannot yet be specified because of the absence of critical information on "other DOE activities." It is assumed by DOE that the phrase "other DOE activities" refers to SCP-related studies.

Analysis of Comment

It is true that the SCP was in the compilation stage as the first draft of the EMMP was released for review; however, preparation of the EMMP has been integrated with preparation of the SCP, and as SCP plans are finalized, the text of the EMMP has been reviewed for consistency. In addition, the EMMP is the appropriate document for identification and general description of environmental monitoring and mitigation activities; however, the details of EMMP activities and other scientific data gathering activities will be developed in associated Environmental Field Activity Plans (EFAPs) that are now being drafted and will be finalized upon issuance of the SCP.

Reclamation as a Mitigation Measure (Comment A-9)

The State of Nevada contends that an attempt has been made to exclude site reclamation as a mitigation measure in the EMMPs and questions whether any reclamation plans exist.

Analysis of Comment

It is the DOE's policy that mitigation measures in the context of the EMMP either consist of changes in the site characterization activity that may cause an impact or avoidance by complete relocation of the activity. Site restoration and reclamation are therefore not mitigation measures in the context of the EMMP.

However, restoration and reclamation plans are being formulated for the affected area with respect to good engineering practices and decommissioning and decontamination of the site should Yucca Mountain not be selected for repository construction. In addition, a habitat restoration and reclamation plan must be filed with the Bureau of Land Management (BLM) in support of land access agreements with that agency. As part of that plar, the DOE intends to develop and implement a separate habitat restoration EFAP, which will investigate habitat restoration methodologies. The habitat restoration EFAP will address other studies that may be needed in addition to those studies needed in support of the BLM land access agreement. Finally, field studies in support of the EIS will consider habitat restoration and reclamation as mitigation measures under the National Environmental Policy Act (NEPA).

Cumulative Impacts (Comment A-10)

The State of Nevada contends that the DOE should address cumulative impacts in the EMMP as a part of compliance with Section 113(a) of the NWPA and that the discussion of cumulative impacts should consider impacts due to Nevada Test Site (NTS) and Nellis Air Force Base operations. The State of Nevada contends that this position is justified on the basis that Council on Environmental Quality (CEQ) regulations are proposed in the EMMP as determinants of impact significance.

Analysis of Comment

Although the DOE has proposed the CEQ regulations as guidelines in determining impact significance, it must be noted that, in the context of NWPA, the activities planned for site characterization are not judged to constitute a major federal action but rather preliminary decision-making activities (Section 113(d)), and as such are specifically excluded from consideration under the NEPA. Accordingly, the question of cumulative impact is not appropriate for inclusion in the EMMP. The statement in the EMMP that refers to CEQ guidelines simply presents the point that the term "significant," as used in the EMMP, is consistent with CEQ definitions.

Public Comments (Comment B-6)

Clark County has stated that the DOE "addressed" all public comments on the EA but did not answer many of them.

Analysis of Comment

The comment is noted, however, the Comment Response Document for the EA (Volume III) attempted to respond to public comments as broad issues rather than specific responses.

SCP Hearings Comment Incorporation (Comment B-7)

Clark County asked how public comments received at an SCP hearing would be incorporated into the EMMP.

Analysis of Comment

Pertinent environmental comments, received at an SCP hearing would be assessed according to their relevance to the EMMP process and be reflected in EMMP revisions or progress reports.

Interactions with Local Government (Comment B-8)

Clark County asked if interactions would occur with local government on the EMMP process.

Analysis of Comment

It is the DOE's intention that environmental interactions will take place with all affected parties. Comments such as these that are being addressed on the EMMP are always welcome whether they are part of a State of Nevada submission or separate from that process.

Determination of Significance (Comment B-9)

Clark County asked who and what determines significance of impacts in the EMMP.

Analysis of Comment

This comment has been addressed previously. Refer to Sections 2.5 and 3.1 of this document.

Regulatory and Programmatic Requirements (Comment B-10)

Clark County requested that applicable regulatory requirements be added as appendices to the EMMP.

Analysis of Comment

This comment has been addressed previously as part of the "general comments" submitted by Clark County. Refer to Section 2.4 of this document.

Intention of CEQ Regulations (Comment B-11)

Clark County contends that the process for identifying impacts and monitoring programs in the EMMP does not seem to meet the intent of CEQ 1508.27.

Analysis of Comment

This comment has been addressed previously. Refer to Sections 2.5 and 3.1 of this document.

EMMP General Approach Flow Diagram (Comment B-12)

Clark County contends that the flow diagram in Chapter 2 of the EMMP that explains the EMMP process needs to include a link between the states and

other parties throughout the environmental program rather than just a review of the EA in the early stages of the Project.

Analysis of Comment

Interactions with the State, the public, and others appeared not only in the previous EA review process but also further down in the flow diagram in Chapter 2 of the EMMP. However, that particular flow diagram has been deleted from the EMMP. Nevertheless, the input by the State and others involves a review of data needs associated with the complete EMMP process.

EA Conclusions (Comment B-13)

Clark County contends that the EMMP should contain an explanation of the Yucca Mountain EA conclusions.

Analysis of Comment

The EA contains thorough explanations of the conclusions presented therein. The EA can be referred to by any interested party and is a permanent part of the public record. The EA conclusions are merely a starting point from which to identify those areas that warrant monitoring. That starting point was that site characterization activities were determined not to cause any significant adverse environmental impact in any discipline. However, due to some potential uncertainties in site characterization activities, a monitoring program is warranted in certain disciplines.

Definition of Terms (Comment B-14)

Clark County contends that a glossary of all pertinent terms should be included in the introductory parts of the EMMP.

Analysis of Comment

The pertinent environmental terms that are included in the EMMP are defined in the text where appropriate and in the context of what is being presented to the reader. In addition, an exhaustive list of definitions of all pertinent technical and policy terms associated with the Nevada Nuclear Waste Storage Investigations (NNWSI) Project can be referred to in the Yucca Mountain EA and the consultation draft of the SCP.

Review Process (Comment B-15)

Clark County asked who would participate in the review process associated with changing site characterization activities and subsequent potential changes to monitoring programs.

Analysis of Comment

DOE Headquarters and the NNWSI Project environmental staff will periodically review the site characterization program as plans are modified. Any modifications will be presented in semi-annual EMMP progress reports. These reports will be made available to the affected parties.

3.2 EMMP Chapter 3

Premature EMMP (Comment A-11)

The State of Nevada contends that the EMMP is "premature" and argues strongly for the deferment of further work on the document until more definitive site characterization plans are available.

Analysis of Comment

Deferment of monitoring and mitigation considerations is not a viable course of action given the timeframe within which site characterization activities must be completed. Preparation of the SCP, as mentioned

previously, has been closely monitored by the preparers of the EMMP and includes up-to-date descriptions of the proposed investigations. The EMMP is consistent with the site characterization activities presented in the consultation draft of the SCP.

Map Scales (Comment A-12)

The State of Nevada requested that all maps and figures in the EMMP contain scales, locations of access roads (real or proposed), and definition of the amount of land to be disturbed.

Analysis of Comment

Scales for maps and figures in the EMMP have been added to the current version of the EMMP. All applicable structures are also shown to the extent that they are known. Lastly, the exact acreage of land to be disturbed as a result of site characterization activities is not known at this time; however, the number presented in the EA (705 acres) is still a good approximation. Some acreages are known, but specifics will be presented as plans are finalized.

Chemical Characteristics of Waste Fluids (Comment A-13)

The State of Nevada commented that the section discussing the "approved landfill" in the EMMP does not address the chemical characteristics of the waste fluids that will be disposed of there.

Analysis of Comment

The approved landfill that is discussed in the EMMP is a landfill for solid wastes (trash) only. This point is presented in Sections 3.1.3 and 3.1.4 of the EMMP. Waste fluids recovered from exploratory drilling of holes that will require fluids as a circulation medium will be contained in a mud-and-cuttings pit at each drill site. The chemical makeup of these fluids will depend on the manner in which the drilling was performed (e.g., bentonitic drilling muds and air foam). Fluids that are recovered

from the Exploratory Shaft Facility (ESF) (e.g., groundwater, water used in testing) will be disposed of in a mine waste-water pond. These points are addressed in Sections 3.1.3, 3.2.1, 3.2.5, and 3.2.8 of the EMMP.

Chemical Tracers (Comment A-14)

The State of Nevada contends that the chemical tracer and well injection programs do not contain enough information to evaluate impacts.

Analysis of Comment

Although the specific tracers to be used during site characterization are not definitely known at this time, an example is provided (3-trifluoromethylbenzoate). Specific plans for tracer use will not be finalized until various laboratory studies are conducted to evaluate the most useful tracers for the required tests at the site. The DOE will comply with all DOE orders and other applicable regulations on the use of radioactive materials during site characterization. The well injection programs are also presented in more detail in Revision 1 of the EMMP.

Pump Tests and Discharges (Comment A-15)

The State of Nevada requested that more information be provided regarding water pumping and discharge testing during site characterization and that that information be reviewed relative to water supply and water rights in the area.

Analysis of Comment

Section 3.1.3 of Revision 1 of the EMMP discusses the pumping and discharge testing in considerable more detail than was presented previously. The DOE plans to apply for a groundwater appropriation permit from the State of Nevada for purposes of pumping and testing the aquifer. An EFAP relative to water quality, supply, and rights will address associated programmatic and technical positions on the subject.

Hydrofracturing (Comment A-16)

The State of Nevada contends that more detailed information on the hydrofracturing program including locations of tests are needed in the EMMP and that potential impacts from these activities were not evaluated.

Analysis of Comment

The hydrofracturing program for determination of in situ stress in the subsurface is more fully explained in Section 3.1.3 of Revision 1 of the EMMP. Hydrofracturing tests themselves are relatively short-lived and frequently utilize only water as the pressure fluid, although muds can also be used. Impacts from these specific tests were considered and judged not to be a significant adverse impact as the testing is in the subsurface and involves only the fracturing of rock at depth. These tests are not planned in close proximity to any subsurface water supplies.

Drilling Fluids and Waste Discharge (Comment A-17)

The State of Nevada contends that more information is needed on the disposal of drilling fluids and on the plans for containing those substances in pits. Additionally, it was stated that reclamation plans for the pits were not presented and that the DOE needs to present the chemical nature of the waste fluids and handle any materials that are classified as hazardous, accordingly.

Analysis of Comment

Additional information has been added to Revision 1 of the EMMP relative to the disposition of drilling fluids and other wastes at each drillhole site that requires such activities. Plans for reclamation of pits as well as other land disturbing activities in the affected area are being undertaken as part of the land access agreements with the BLM and as part of the decontamination and decommissioning phase of the program if Yucca Mountain is not selected as a repository site. As for the potential of

wastes being classified as hazardous, that is part of the assessments being addressed for regulatory purposes and is outlined in the Environmental Regulatory Compliance Plan (ERCP).

Water, Sewage, and Electrical Systems (Comment A-18)

The State of Nevada contends that detailed engineering design plans for all ESF area components, including types and quantities of liquid wastes and atmospheric emissions, are necessary for impact determinations.

Analysis of Comment

Although the exact types and quantities of wastes are not known at this time, the types of materials used and wastes generated by activities similar to site characterization are known. Until final design of the ESF is complete, best estimates will be used. As mentioned previously, rock waste will be placed on the rock-storage pile. The rock debris is not expected to contain any hazardous materials. All liquid wastes other than sewage will be contained in a lined mine waste-water pond. Sewage will be disposed of in a sewage treatment system. All of these components are discussed in the EMMP and the SCP, and specific engineering design plans will be presented in future documents.

Environmental Protection Planning (Comment A-19)

The State of Nevada commented that an environmental protection plan cannot go forward until detailed information relative to engineering and environmental conditions are presented in the EMMP.

Analysis of Comment

The details of the site characterization program are presented in the SCP with the environmentally pertinent descriptions addressed in summary form in the EMMP. An environmental plan must go forward with the information that is known at present. The EMMP is subject to revision and can be

augmented as necessary through the semi-annual progress reports as site characterization, engineering design, and environmental monitoring activities dictate.

Construction Materials (Comment B-16)

Clark County has commented that the amounts of construction materials to be transported from off-site should be discussed in the EMMP.

Analysis of Comment

A brief description of the approximate amount of the materials expected to be required for construction of the ESF is included in Section 4.2.2.1.2 of the Yucca Mountain EA. However, as Section 3.2 of the EMMP now indicates, some modifications of the design for the ESF have occurred. Specific information concerning the effect of these design changes on material resource requirements and transport of those materials is not yet available, but will be provided in future documentation.

Good Engineering Practice (Comment B-17)

Clark County has commented that the terms "least damage" presented under good engineering practices of siting borrow pits is not clear as to the intended meaning.

Analysis of Comment

Siting borrow pits where the least damage would occur means that they will be sited where impacts to the environment will be minimized. This clarification has been added to Section 3.2.1 of Revision 1 of the EMMP.

3.3 EMMP Chapter 4

Uncertainty of Impact Analysis (Comment A-20)

The State of Nevada contends that, in the absence of baseline information, all impac: analyses should be considered uncertain and subject to a high degree of variability. Taken with the uncertainty regarding site characterization activities, the State believes that the DOE approach to planning for impact monitoring and mitigation is discredited.

Analysis of Comment

The DOE position regarding baseline studies has been discussed under Section 2.1 of this document. With respect to uncertainty in the definition of site characterization activities, the SCP and EMMP preparation efforts are coordinated and interactive. The definition of uncertainty with regard to EMMP impact analysis is based on the conclusions of the EA taken in the context of the most current description of site characterization activities. It represents a starting point for EMMP-related work, but it must be stressed that additions to monitoring programs could occur if conditions so indicate.

Re-analysis of Impacts (Comment A-21)

The State of Nevada requested that the EMMP document changes in site characterization activities and that the document present the evaluation of their consequences. Similarly, the State requested that the EMMP provide a discussion of how the EA impact analyses were reexamined and a description of any new analyses that were performed.

Analysis of Comment

As stated in Chapter 2 of the EMMP, the EMMP is intended to document DOE's compliance with Section 113(a) of the NWPA, which requires DOE to conduct site characterization activities in a manner that minimizes significant adverse environmental impacts to the maximum extent practicable. It is

not the role of the EMMP to document all changes in site characterization activities, nor to present a reexamination of EA findings. The EMMP does present a summary of site characterization activities as presented in the SCP, and focuses on those activities with the potential for producing significant adverse environmental impacts. The identification of areas of potential significant adverse environmental impact continues to be based on the impact assessments presented in Chapter 4 of the Yucca Mountain EA and potential uncertainties in site characterization activities. The EMMP will be revised based on any applicable changes in the SCP and reflected in EMMP progress reports. Additionally, appropriate comments made during the SCP hearings will be considered, as required by Section 113(a) of the NWPA.

After reexamination of the EA impact categories, four disciplines were chosen for development of monitoring programs under the EMMP: terrestrial ecosystems (sensitive species), air quality (total suspended particulates), archaeological resources and historic sites, and radiological levels. Identification of these monitoring programs was justified on the basis of potential uncertainties in site characterization activities with resultant uncertainties in impacts.

Additional Environmental Studies (Comment A-22)

The State of Nevada again contends that the EMMP is out of context with the overall environmental program in that it presents one set of environmental field studies but provides no insights on additional studies.

Analysis of Comment

As discussed in responses to State of Nevada comments on EMMP Chapter 2 (Section 3.1 of this document), the EMMP is part of a comprehensive plan of environmental studies. The reader is referred to that response and to the draft EPO for additional detail.

Environmental Factors not Addressed through Mitigation (Comment A-23)

The State of Nevada, in referring to the introduction pages of Chapter 4 of the EMMP, questioned the reference to "environmental factors not covered by monitoring requirements," and what these requirements are.

Analysis of Comment

As explained in the introductory text to the EMMP, the EMMP presents only one set of monitoring requirements in the overall DOE program: those related to implementation of Section 113(a) of the NWPA. Other monitoring requirements, such as those motivated by permitting requirements are described in other plans. In the case of permitting, the corresponding plan is the NNWSI Project ERCP. For requirements related to compilation of the Environmental Impact Statement (EIS), it will be the NNWSI Project EIS Implementation Plan. This latter plan is a project-specific internal document that delineates those activities that the NNWSI Project will undertake and complete in order to fulfill the requirements of the DOE Headquarters programmatic EIS Implementation Plan.

Land-Use Monitoring (Comment A-24)

The State of Nevada states that the remote aerial photographic monitoring of terrestrial ecosystems also serves in land-use monitoring, and this factor should be acknowledged.

Analysis of Comment

Land use as defined in the Yucca Mountain EA and Section 4.1 of the EMMP consists of uses such as commerical, industrial, and agricultural. Given that definition, no aerial photographic monitoring for those purposes are warranted because significant land uses are not present at the Yucca Mountain site. However, the terrestrial ecosystems program will monitor habitats and surface disturbance with aerial photographic methods.

Exploratory Shaft Emissions (Comment A-25)

The State of Nevada states that exploratory shaft emissions are mentioned, but no estimates of quality or quantity are given. Further, the State requests that the comparative impacts of various methods of dust suppression be discussed in the EMMP.

Analysis of Comment

It is not the objective of the EMMP to present extensive details on the technical parameters of all site characterization activities or details on monitoring methodologies. The EMMP serves as a plan that identifies the requirements for environmental monitoring and mitigation. The specific technical details and comparison of study methodologies called for by the State are presented in the EFAPs.

Monitoring of Disposal Ponds and Septic Leach Field (Comment A-26)

The State of Nevada states that no monitoring is proposed for either disposal ponds and the septic leach field or for consequent impacts to groundwater. The State also contends that statements in Chapter 4 saying that no potential impacts will occur do not agree with the impact analysis matrix. Finally, the State calls for a comparison of the merits of a septic leach field versus an evaporation pond for disposal of sewage effluent.

Analysis of Comment

An EFAP with regard to water quality will present appropriate monitoring programs for site characterization activities. With respect to statements on potential impact, the impact analysis matrix in Chapter 4 of the EMMP states that impacts may occur to the water quality, but does not present a significance factor. Section 4.4 of the EMMP does not state that no impacts would occur, but that any impacts that may occur would not be potentially significant or adverse. Lastly, the EMMP is not the

appropriate document for the proposed engineering technical comparison requested by the State. Those comparisons are presented in engineering special studies and title design documents.

Impacts to Soils (Comment A-27)

The State of Nevada contends that the EMMP text regarding impacts to soils is inconsistent with the impact analysis matrix of the EMMP. The State further contends that soils monitoring is essential to the EMMP, particularly with regard to stockpiling.

Analysis of Comment

The DOE has not stated that there will be no impacts to soils, but rather that such impacts are not considered to be of a significant nature given that the soils at Yucca Mountain are not a particularly significant or unique resource when compared to soils in surrounding regions. Figure 4-1 in the EMMP presents the fact that impacts may occur, but with no reference to significance. Nevertheless, a soils EFAP will identify monitoring studies for scientific data gathering and confirmatory studies.

Aesthetics (Comment A-28)

The State of Nevada contends that, since no viewshed analysis of the site has been performed to date, the finding of no aesthetic impact is not warranted.

Analysis of Comment

The nearest population center to the Yucca Mountain area is the very small town of Amargosa Valley, south of the site. Due to the limited number of individuals viewing site characterization activities, of which only the drill rigs for deep boreholes will occasionally be visible, it was judged that aesthetic impact would be minimal. However, an aesthetics EFAP will present monitoring activities to confirm the above assertion.

Archaeological Resources (Comment A-29)

The State of Nevada concludes that monitoring (and subsequent recovery of resources) will take place only at those archaeological sites occurring specifically at locations to be disturbed and that such monitoring will not protect resources located off-site, but close enough to be subject to vandalism resulting from increased worker levels at Yucca Mountain.

Analysis of Comment

The intent of monitoring plans in the area of archaeological resources was to include a reasonable "buffer zone" in the physical area to be monitored to account for increased human activity at the various sites. Since access to these areas of scientific investigation will be controlled, this "buffer zone" monitoring is deemed sufficient. Section 4.8 of Revision 1 of the EMMP has been modified to acknowledge that indirect impacts may occur to sites in the vicinity of site characterization activities. All sites that have the potential to be impacted will be monitored as part of the EMMP process.

Native American Resources (Comment A-30)

The State of Nevada disagrees with the statement that no significant impacts on Native American resources are expected, since in the State's view, the DOE has yet to consult with Native Americans or to undertake research to confirm the presence or absence of the resources at Yucca Mountain.

Analysis of Comment

The Native Americans are not an affected Indian Tribe with respect to the definitions in NWPA because no site characterization activities are planned within any Native American reservation boundary. Protection of the physical aspects of Native American cultural resources is addressed as part of the Archaeological Resources and Historic Sites section of the

EMMP. Consultations with the Native Americans relative to cultural and religious values will occur as delineated in the current draft of the Programmatic Agreement on cultural resources and the ERCP.

Utilities (Comment A-31)

The State of Nevada does not agree that the construction of facilities at Yucca Mountain related to site characterization will have no environmental impact. The State contends that DOE must demonstrate that all utility facilities construction and operation at the NTS were designed and are being operated in accordance with sound environmental protection practices and standards.

Analysis of Comment

The DOE has not stated that no environmental impacts would occur from utility use or construction for site characterization. Any new utility construction was deemed to have only minor impacts to the environment, and therefore, no monitoring was warranted at this time. All new construction projects related to site characterization will entail good engineering practices in the construction and design procedures, which will help minimize even further the minor impacts expected. Any new utility projects that require regulatory agency approval are delineated in the NNWSI Project ERCP. A review of all prior NTS utility-related construction and operation procedures is not considered a requisite to this compliance process.

Impact Analyses (Comment B-18)

Clark County requested to know what other impact analyses were reviewed for potential variability of results.

Analysis of Comment

Some environmental monitoring efforts may come under the purview of other requirements such as regulatory or permitting processes or future data

collection efforts for the EIS. There may be uncertainties involved relative to site characterization activities when organizing monitoring efforts. The subjects chosen for monitoring in the EMMP at this point are specifically those disciplines where a potential exists for significant adverse impacts only.

Baseline Information (Comment B-19)

Clark County contends that a broad spectrum of baseline information gathering is necessary for the EMMP process.

Analysis of Comment

This issue has been addressed previously; refer to Section 2.1 of this document.

Use of Lands (Comment B-20)

Clark County asked if the public lands (BLM) associated with the Yucca Mountain site could be used in the future.

Analysis of Comment

If Yucca Mountain is not chosen as a site for a repository and once land access agreements with the BLM expire, those areas that are public lands may be used. This issue is a subject for the decontamination and decommissioning phases of the site characterization program and BLM land access agreements.

3.4 EMMP Chapter 5

Credibility of Monitoring Activities/Mitigation Measures (Comment A-32)

The State of Nevada contends that the monitoring activities and mitigation measures proposed by DOE in the EMMP are lacking in credibility because they are based on analyses presented in the EA that were conducted in the

absence of baseline information and complete descriptions of site characterization activities.

Analysis of Comment

It is the objective of the EMMP to account for the very point made in the above comment. All impact assessments listed in the EA that had the potential to result in significant adverse environmental impact resulted in concomitant monitoring programs in the EMMP. Since environmental monitoring plans are based on the contents of the SCP, exact plans for monitoring will indeed change as studies planned for site characterization change. Changes in site characterization activities that have the potential to cause significant adverse environmental impacts will be documented in the EMMP semi-annual progress reports.

Radiological Monitoring (Comment A-33)

The State of Nevada comments that it has never received nor reviewed the draft NNWSI Project Radiological Monitoring Plan (RMP).

Analysis of Comment

As the EMMP states, EMMP-related radiological monitoring is considered a specific subset of overall radiological monitoring on the NNWSI Project. The draft RMP is still in preparation. However, review of the NNWSI Project RMP is not required in order to review the EMMP intention regarding radiological monitoring. As stated in the EMMP, an EFAP on radiological activities will provide the details of the proposed monitoring.

Information Sharing (Comment A-34)

The State of Nevada contends that no further work on its part is warranted until more information on site characterization, monitoring, and other program planning is shared with the State.

Analysis of Comment

The State has, as part of the EA publication process, been given all supporting documentation used in the preparation of that document. Other planning documents prepared by the NNWSI Project have been made available to the State once the documents have been formulated and internally reviewed. Other reports pertinent to the environmental program (i.e., ERCP and EFAPs) will be provided to the State. A draft version of the EPO, which contains a description of the overall program planning, has been transmitted to the State. In addition, the consultation draft of the SCP detailing site characterization activities will be available in the same timeframe as the EMMP.

Good Engineering Practice (Comment A-35)

The State of Nevada contends that the good engineering practices referred to in the EMMP have not been adequately discussed or delineated.

Analysis of Comment

The objective of the EMMP is solely to identify and discuss those aspects of site characterization activities that warrant monitoring and mitigation. Mitigation for the EMMP program is defined as those changes in site characterization activities that serve to avoid or minimize, to the maximum extent practicable, any significant adverse environmental impacts. A detailed discussion of good engineering practices is outside the purview of the EMMP; however, these practices are generally described in the EA and EMMP.

3.5 EMMP Chapter 6

Timing of EMMP Modifications (Comment A-36)

The State of Nevada contends that a final EMMP must not be issued until after the SCP has been evaluated, a site-specific environmental baseline for Yucca Mountain established, and potential impacts reviewed.

Analysis of Comment

It is DOE's stated intention (see Chapter 6 of the EMMP) that the EMMP remain a dynamic document, subject to change as indicated. As stated in Chapter 6, there exists a mechanism to modify the EMMP, if so required, following public review of the consultation draft of the SCP. The requirement for a site-specific environmental baseline prior to implementation of site characterization activities and concomitant environmental monitoring is not specified in the NWPA. In addition, refer to general comment Section 2.1 for further clarification.

Semi-annual Progress Reports (Comment A-37)

The State of Nevada disagrees with the proposed methodology for modification of the EMMP, saying that this proposal condones and perpetuates the segregated and fragmented approach to environmental protection that currently exists in DOE. Further comments contend that the lack of a site-specific baseline and the lack of an opportunity to review plans for site characterization activities are prevalent.

Analysis of Comment

Since this comment reiterates statements expressed earlier, the reader is referred to responses to general comments, Chapter 2 of this document.

Overall Environmental Planning (Comment A-38)

The State of Nevada recommends that work on the EMMP cease until the DOE develops an integrated environmental program that demonstrates a responsible and credible approach to protecting the environment at the Yucca Mountain site.

Analysis of Comment

Such an approach exists and is described in the draft EPO.

4. STATE OF NEVADA AND CLARK COUNTY COMMENTS SUBMITTED ON THE EMMP

AGENCY FOR NUCLEAR PROJECTS
NUCLEAR WASTE PROJECT OFFICE
Capitol Complex
Carson City, Nevada 89710
(702) 885-3744

February 23, 1987

Dr. Donald Vieth, Director
U.S. Department of Energy
Nevada Operations Office
P.O. Box 14100
Las Vegas, NV 89114-4100

Dear Dr. Vieth:

We appreciate the opportunity afforded by your correspondence of November 26, 1986 to review and comment upon the working draft of "Environmental Monitoring and Mitigation Plan for Site Characterization", dated December 1, 1986. Copies of the EMMP were distributed by my Office to relevant State agencies, representatives of which attended the briefing by your staff on site characterization and the monitoring and mitigation plan process on January 23 in Carson City. We have now received comments on the EMMP from interested State agencies and have consolidated them with our own review, enclosed herewith.

Our principal impression of the EMMP is that it is premature at this juncture of the NNWSI Project for three reasons. First, like the EA, the EMMP is not based upon comprehensive environmental information specific to the Yucca Mountain site. Second, complete and reliable descriptions of field activities to be conducted during site characterization are not yet available. Third, the EMMP is but one of several pieces of the overall DOE environmental program for the NNWSI Project. It is our understanding that the overall program has yet to be formulated and made available.

It is unfortunate that DOE believes that it must propose monitoring activities and mitigation measures in the face of inadequate environmental information and incomplete project descriptions upon which to base credible assessments of potential impacts. Not having a comprehensive understanding of either the existing environment that DOE proposes to monitor or the attributes of the NNWSI project that could result in impacts tends to discredit the agency's attempts at environmental protection. This plus the lack of an integrated approach to environmental program planning is cause for critics to have little confidence in the capabilities of DOE to conduct a scientifically sound appraisal of the environmental consequences of the Yucca Mountain project.

Accordingly, the State of Nevada believes that it cannot presently assure its citizens that reasonable measures are being taken by DOE to protect the environment. For this reason it is recommended that DOE terminate environmental program planning, including work on the EMMP, until a comprehensive environmental baseline has been established and complete, reliable descriptions are available for site characterization activities. At that time DOE can develop and implement an integrated environmental protection program encompassing monitoring and mitigation.

Without having agreement on the need to establish an environmental baseline and better project descriptions there is little, if any, room for additional dialogue on the EMMP or on other aspects of DOE's piecemeal environmental program. If the concepts, conclusions, and recommendations embodied in our review of the EMMP are unclear we would be pleased to discuss them further.

If you have any questions, please do not hesitate to call upon me.

Sincerely,

Robert R. Loux
Executive Director

RRL:CRM/rjc

Enclosure

STATE OF NEVADA COMMENTS ON THE DECEMBER 1, 1986 WORKING DRAFT ENVIRONMENTAL MONITORING AND MITIGATION PLAN (EMMP) FOR SITE CHARACTERIZATION

1.0 Introduction

This review of the draft EMMP incorporates comments of other State of Nevada agencies with those of the Nuclear Waste Project Office (NWPO). Remarks are organized into two categories, the first consisting of views on the concept and approach taken by DOE in preparing the EMMP, and the second providing comments on individual sections of the document.

2.0 General Comments

The EMMP is constrained by three fundamental limitations that compromise its goal of contributing to environmental protection at the Yucca Mountain site. These weaknesses point to the premature nature of the EMMP as a useful component of the NNWSI Project, as discussed below.

2.1 Absence of a Site Specific Environmental Data Base

A-1 A limited amount of data specific to the Yucca Mountain site are available for planning environmental protection programs. With the exception of partial biotic surveys, insights to hydrology, and a reconnaissance of archeological resources reported in the Final Environmental Assessment (EA), existing environmental conditions at the site are not known. The EMMP, as was true of the EA, relies largely upon information in the literature about environments similar or proximate to Yucca Mountain. In particular there is little or no comprehensive information on soil characteristics and erosion potential, seasonal and area-wide occurrences of all species of special interest to the State of Nevada, conditions important to site reclamation, air and potable water quality characteristics, environmental noise, and visual aesthetics.

Without a description of baseline environmental conditions at the site prior to initiation of site characterization activities:

A-2
1. sensitive components of the environment that may be particularly susceptible to impact cannot be identified; and

2. monitoring specifically addressed to such issues cannot be developed.

Not only will it be impossible to know where to monitor impacts but significant impacts that may occur cannot readily be recognized because no basis will exist for distinguishing them from non-impact conditions. Likewise, mitigation and site reclamation cannot be effective because without knowledge of the conditions to be maintained or restored, only those actions derived in a subjective manner can be implemented.

On this basis, the State of Nevada believes that the first step to be taken toward environmental protection at Yucca Mountain is to establish a comprehensive site specific baseline that describes the existing environment prior to any disturbances being incurred during site characterization. A-3

2.2 Incomplete Site Characterization Plan (SCP)

While the EMMP provides more information than was available in the EA with regard to the nature of site characterization activities, there remains an insufficient amount of detail on location, schedule, sources of contaminants, extent of areas to be disturbed, and numerous other kinds of essential project design plans. The absence of such information prevents definitive planning for environmental protection because the degree of potential perturbation to the environment cannot be predicted with adequate confidence to know where, when, and how to design impact monitoring and mitigation measures. A-4

The State of Nevada believes that DOE should defer further planning on impact monitoring and mitigation until dependable insights exist into the full extent and nature of activities to be conducted during site characterization. This will be achieved when the SCP is issued.

2.3 Lack of a Comprehensive and Integrated Environmental Program

Although no details are provided the EMMP acknowledges that impact monitoring and mitigation comprise only one component of a multi-faceted environmental program eventually to be implemented by DOE for the Yucca Mountain project. It even is stated in the document that monitoring in addition to that alluded to in the EMMP will be performed under other components of the environmental program. It is impossible to comment on the adequacy of the proposed environmental protection measures proposed in the EMMP without first having an understanding of the scope of all components of the DOE program. An example of this is in regard to radiological monitoring which will be addressed in the DOE "Project Radiological Monitoring Plan" currently in preparation. A-5

Accordingly, the State of Nevada believes (as stated in Section 2.2) that the current DOE approach to environmental planning on a piecemeal basis is inadequate and that work on the EMMP should cease. In its place should be a comprehensive environmental protection plan that integrates monitoring and mitigation within the context of acquiring baseline information and planning for regulatory compliance and site reclamation as intended by Section 113 of the Nuclear Waste Policy Act (NWPA).

3.0 Specific Comments by EMMP Section

Below are addressed comments on individual sections of the draft EMMP. Most of the points raised are related to the three issues discussed above. Particular attention is called to additional issues outside the context of the preceding section.

3.2 "Introduction" - EMMP Section 2

The Introduction to the EMMP abundantly supports the conclusions that the EMMP is premature due to the lack of insights to other important aspects of environmental protection and because it is out of context with the remainder of the program. This issue arises on page 2-4 where it is stated that "the EMMP is only one part of a total comprehensive environmental program and does not represent all monitoring activities planned". Again, on page 2-8 the EMMP states that later it "could include data acquired from monitoring activities conducted during site characterization under other parts of the environmental field program." Further, on page 2-8 the following statement is made: "The plan will specify monitoring details to be used during site characterization." It is therefore clear that:

A-6 1. at this time the EMMP is not coordinated with the overall DOE environmental program;

A-7 2. other monitoring activities yet unplanned may subsequently influence the EMMP; and

A-8 3. details on monitoring procedures cannot yet be specified because of the absence of critical information on other DOE activities.

An attempt is made in the EMMP to exclude site reclamation as a mitigation measure with a statement at the bottom of page 2-8 that mitigation will be limited to "those changes in site characterization activities that serve to avoid or minimize . . . impacts." Yet page 2-9 acknowledges that if residual impacts persist "additional mitigative measures" will be considered. It is difficult to conceive of additional steps toward mitigation beyond avoidance and minimization that would not involve reclamation. A-9 This argues strongly for the concept of reclamation to be incorporated as a mitigation measure. Otherwise a reclamation component eventually will have to be added to the already overly fractionated environmental program.

A-10 Aside from the issue of prematurity, the Introduction to the EMMP gives rise to the question of cumulative impacts by adopting Council on Environmental Quality (CEQ) regulations for determining impact significance. This occurs on the last paragraph on page 2-3 which references 40 CFR 1508.27. Section 1508.27(b)(7) of the CEQ regulations addresses cumulative impacts, which for the Yucca

Mountain site should cover combined impacts from present and future actions at NTS and Nellis AFB as well as impacts from BLM activities. Cumulative impacts to ground-water resources from piecemeal planning by USAF, BLM, and DOE in the vicinity of Yucca
A-10 Mountain have never been addressed and constitute a weakness in the environmental review process for the site. The State of Nevada believes that DOE should address cumulative impacts when it complies with the requirement of NWPA Section 113(a) to include environmental impact assessment in the SCP.

3.3 "Site Characterization Program Summary" - EMMP Section 3

As noted in Section 2.2 of these comments, the EMMP adds to the information available on descriptions of site characterization activities. However, this remains inadequate for developing reliable plans for monitoring and mitigation as DOE recognizes in the first paragraphs on page 3-1 where the EMMP cautions the reader
A-11 to "bear in mind" that some of the information in the EMMP is preliminary and subject to change. This is another of the indications that the EMMP is premature and argues strongly for deferring additional consideration of monitoring and mitigation until more definitive site characterization plans are available. Other instances in Section 3 of the EMMP where this issue arises are as follows:

1. Scales for maps are needed in Figures 3-1 and 3-2. The access
A-12 roads discussed on page 3-7 are not shown on the maps and this is crucial for considering the location and extent of surface area to be disturbed. This issue arises throughout Section 3 of the EMMP because of confusing and conflicting information on the amount of land to be disturbed.

2. The second sentence under Section 3.1.3 on page 3-8 refers to
A-13 "an approved landfill on the NTS." Information on the chemical characteristics of the waste fluids approved for disposal in the landfill during site characterization is needed as is a description of leachate monitoring approved for the landfill.

3. Chemical tracers and well injections are mentioned on page 3-9
A-14 but there is no information on the nature and quantity of materials involved. Potential impacts of such practices could not have been reliably evaluated by DOE without such information.

4. Pump tests and discharges are discussed on pages 3-9 and 3-11.
A-15 No attempt is made to estimate the total amount of water to be pumped and to evaluate its significance in the context of water usage estimates reported in the EA. Water supply and water rights for NNWSI are of vital concern to the State of Nevada and DOE has yet to provide accurate information concerning locations of existing and planned wells, estimated

A-15 annual water demand, and methods and plans for drilling and constructing new wells.

5. Hydrofracturing via injection of muds is mentioned on page 3-11 but there is no information on where it will occur and the
A-16 nature and quantity of muds to be used. This gives rise to suspicion that the potential impacts were not fully evaluated by DOE but instead were dismissed in a cavalier manner as seems to be the case with the aforementioned chemical tracers.

6. Page 3-12 discusses drilling fluids and wastes to be disposed of in pits but fails to mention whether or not the pits will be lined, how many there will be, whether or not the pits will be reclaimed, whether or not wastes will be removed, the
A-17 chemical nature of the fluids, and whether or not the wastes are classified as hazardous materials. If DOE is ignorant on these matters it stands to reason that environmental impacts of the wastes involved could not have been fully evaluated.

7. Water, sewage, and electrical systems are mentioned on page 3-15 as are a rock-storage pile, a mine wastewater pond, and a concrete-batch plant. Detailed engineering design plans are needed to evaluate the pollution and impact potential of all these facilities; an atmospheric emissions inventory is needed for the concrete plant; and, descriptions of the quantity and
A-18 quality of liquid wastes to be disposed of in the pile and pond are needed. If any chemical or industrial wastes will be disposed of in the sewage system those wastes should be described in detail. The fact that this information is not discussed in the EMMP strongly implies that DOE has not properly considered it in its impact evaluation and planning for appropriate monitoring measures.

The types of information noted above must be on hand for NWPO to evaluate the DOE impacts analyses and proposed monitoring activities and mitigation measures. It is irresponsible for DOE to expect that any environmental protection plan could go forward
A-19 without such information, and the fact that it has leads the State of Nevada to suspect that DOE failed to utilize such information for the draft EMMP. The State of Nevada therefore believes that work on monitoring and mitigation plans as well as on other aspects of environmental protection should cease until such details are available in the SCP.

3.4 "Potentially Significant Adverse Environmental Consequences Identified for site Characterization Activities" - EMMP Section 4

It is acknowledged on page 4-1 of the EMMP that there is a
A-20 lack of site specific environmental baseline data to support both the EA and the EMMP. On page 4-3 the issue of variability in impact analyses is raised to denote the degree of uncertainty that

A-20 exists due to several factors. The State of Nevada believes that in the face of an absence of baseline information all impact analyses are uncertain and subject to an unacceptably high degree of variability. When the uncertainty associated with the lack of descriptions of site characterization activities is also considered, the potentially inherent variability discredits the draft EMMP and the current DOE approach to planning for impact monitoring and mitigation.

A-21 Page 4-2 in the EMMP refers to changes in site characterization plans and states that conclusions in the EA regarding environmental impacts were re-examined. The EMMP should document the changes and evaluate their consequences. Similarly, there should be discussion of how the impact analyses were re-examined. Any additional analyses performed in light of changes in the proposed site characterization activities should be described in detail. As it now stands there is no evidence to support the contention on the part of DOE that a re-examination of potential impacts actually occurred.

A-22 The issue of the EMMP being out of context with the overall environmental program arises on pages 4-2 and 4-3. In the first instance it is noted that the EMMP "represents only one set of environmental field studies to be implemented", but no insights are provided to the additional studies. In the second case, mention is made of environmental factors not covered by monitoring

A-23 requirements but there is no indication as to what these factors are or how they will be addressed in DOE's overall environmental protection program. The State of Nevada believes that in light of such statements there is little need to proceed with evaluating the EMMP and other piecemeal components of the DOE environmental protection program until a comprehensive view is available.

As to the validity and adequacy of the results of the impact analyses for individual components of the environment discussed in Sections 4.1 through 4.9 of the EMMP, NWPO cannot comment in detail until a site specific baseline and the SCP are available. The following observations, however, are made.

A-24 1. In Section 4.1 no monitoring of land use is proposed, yet in Section 4.2 there are plans to do aerial photographic monitoring of terrestrial ecosystems. Because the land at Yucca Mountain is all natural ecosystem and that is its sole use, the remote monitoring proposed for ecosystems also serves as land use monitoring. This fact should be acknowledged.

A-25 2. Exploratory shaft emissions are mentioned on page 4-8 but no estimates of quality or quantity are given. The lack of a comprehensive emissions inventory for Section 4.3 renders the discussion of air quality pointless. Also, comparative impacts of various methods of dust suppression, e.g., water sprinkling versus use of chemical agents, should be discussed.

A-26 3. In Section 4.4 no monitoring is proposed either for disposal ponds and the septic leach field or for consequent impacts to ground water. The lack of ground-water monitoring in both the saturated and unsaturated zones is not acceptable to the State of Nevada. Statements in Section 4.4 of the EMMP that no potential impacts will occur do not agree with the impact analysis matrix on page 4-4. A comparison should be made of the merits of a septic leach field versus an evaporation pond for disposal of sewage effluent.

A-27 4. Section 4.5 concludes that there will be no impacts to soils, which is inconsistent with Figure 4.1, page 4-4. Soil cannot be removed and stockpiled without seriously disrupting its composition, nature, structure, and chemical and biological integrity. Impacts will occur, and without the proper baseline analyses of soil characteristics the consequences cannot be predicted. Moreover, soils cannot be reclaimed without detailed information on their pre-disturbance nature. For these reasons failure to characterize and monitor soils is not acceptable.

A-28 5. Section 4.7, page 4-12, proposes no monitoring for aesthetics. However, no viewshed analysis of the site has been performed to support the finding of no impact upon which the decision not to monitor was based.

A-29 6. Section 4.8 states that the Memorandum of Agreement being negotiated for archeological resources will embody monitoring. That is true only if resources occur at locations to be disturbed, in which case excavation and recovery will take place. All other known archeological sites will not be recovered or protected from potential vandalism resulting from an increase in people at Yucca Mountain and enhanced accessibility to the site. To protect such resources determinations of eligibility must be made on all sites, either individually or as a district, prior to initiating site characterization. In consultation with the State of Nevada DOE can then prepare and implement data recovery plans that mitigate impacts to sites that will be directly and indirectly impacted by any further activities at Yucca Mountain.

A-30 7. On page 5-9 there is a statement which predicts no significant impacts on Native American resources. The State of Nevada finds no basis of support for that position because DOE has yet to consult with Native Americans and to undertake research to confirm the presence or absence of significant sites at Yucca Mountain.

A-31 8. Section 4.11 states on page 4-17 that utilities for NNWSI will be provided by DOE facilities on the Nevada Test Site (NTS) and are not expected to cause significant impacts. However,

EMMP Section 3.2.4 and Figure 3-4 describe new utility construction at the Yucca Mountain site for water supply distribution, sewage disposal, and electrical transmission. There apparently has been no evaluation of the consequences of these operations to such issues as allocated water rights, leaching and ground-water contamination from the septic field, and construction of new electrical transmission facilities. The State of Nevada does not agree that the existence of utilities at NTS implies that new facilities at the Yucca Mountain site will have no environmental impact. At a minimum the design plans for the facilities to be constructed must be reviewed and DOE must demonstrate through its prior acquisition of appropriate permits and other regulatory approvals that the utilities at NTS were designed and are being operated in accordance with sound environmental protection practices and standards.

A-31

3.5 "Environmental Monitoring and Mitigation" - EMMP Section 5

The monitoring activities and mitigation measures proposed by DOE in Section 5 of the EMMP are lacking in credibility because they are based upon the preliminary environmental impact analyses reported in the EA that were conducted in the absence of baseline information and complete descriptions of site characterization activities. Without information on where surface disturbance and other environmental perturbations will occur monitoring measures cannot be taken. This dilemma is acknowledged in the EMMP on page 5-4 where it is noted that survey procedures for sensitive species "will be determined when plans for site activities are finalized."

A-32

Another example of incomplete information occurs in EMMP Section 5.10, Radiological Levels, which for more detail on radiological monitoring plans references a draft NNWSI Project Preliminary Site Characterization Radiological Monitoring Plan and a NNWSI Project Radiological Monitoring Plan that is being prepared. The State of Nevada has never received and reviewed the draft plan and therefore has had no input to the final plan being prepared to replace it nor has there been an indication that the State would be asked for comments.

A-33

Such difficulties are encountered throughout the subsections of EMMP Section 5 that address monitoring plans for individual components of the environment. Consequently, the State of Nevada believes that there is no point to further work on impact monitoring and mitigation until more information on site characterization, monitoring, and other program planning that DOE currently has underway is available and shared with the State.

A-34

A particularly weak aspect of Section 5 that bears commenting on is with respect to the discussion on page 5-3 of "in-place procedures for DOE operations in the region" and "good engineering practices." Revegetation and habitat restoration are mentioned as

A-35

examples of where DOE is practicing such measures, but no details are provided on how this would be accomplished for NNWSI. The State of Nevada is not aware that DOE has taken steps to implement the recommendations of its ecological field contractor, EG&G, for further biological studies including site restoration practices. This is one of the few areas where DOE has some site specific data available to it, and it has not followed the recommendations that resulted from the investigations.

A-35

Such oversights as this, the lack of baseline information and complete descriptions of proposed actions, and the superficial measures proposed for monitoring mitigation render the proposed measures in the EMMP inadequate and unacceptable to the State of Nevada.

3.6 "Methodology for Modifying the Environmental Monitoring and Mitigation Plan" - EMMP Section 6

The first paragraph of Section 6 of the EMMP implies that the document will be issued in final form along with the SCP. A statement also is made that discussions will be held on "the need to modify current monitoring studies or mitigation procedures." The State of Nevada believes that a final EMMP must not be issued until after the SCP has been evaluated, a site specific environmental baseline for Yucca Mountain has been established, and potential impacts have been reviewed on the basis of those sets of information. There is no point in discussing modifications to the December 1, 1986 working draft EMMP because it is completely without validity and there currently are no means for overcoming its deficiencies.

A-36

The scheme proposed by DOE for modifying "individual monitoring programs as warranted" via semi-annual progress reports for the EMMP is unacceptable because it condones and continues to perpetuate the segregated and fragmentary approach to environmental protection that currently exists in DOE. While it is recognized by the State of Nevada that modifications to monitoring activities and mitigation measures will be essential, there is no foundation for considering what the minimal requirements are. Moreover, there is no basis for establishing a point of departure for such considerations because adequate baseline environmental information and reliable description of proposed site characterization activities do not exist. That theme is consistently repeated throughout these comments. A corollary theme is that DOE must address environmental protection in a comprehensive and integrated manner by having a composite program that considers not only monitoring and mitigation but also a review of the preliminary impact assessments reported in the EA, plans for complying with environmental regulations, and plans for site reclamation.

A-37

This view is consistent with the requirements of NWPA Section 113 which mandates that environmental assessment and

A-38

decommissioning and decontamination planning be part of the SCP. It is in the context of the SCP that the State of Nevada believes DOE must address environmental protection, and to this end it is recommended that DOE cease work on the EMMP as it presently is conceived, undertake steps to obtain the needed baseline information and descriptions of site characterization activities, and develop an integrated environmental program that demonstrates a responsible and credible approach to protecting the environment at the Yucca Mountain site. This view stands as the conclusion of the State of Nevada review of the draft EMMP.

A-38

February 27, 1987
njc

AGENCY FOR NUCLEAR PROJECTS
NUCLEAR WASTE PROJECT OFFICE
Capitol Complex
Carson City, Nevada 89710
(702) 885-3744

1987

March 2, 1987

Dr. Donald Vieth, Director
U.S. Department of Energy
Nevada Operations Office
P.O. Box 14100
Las Vegas, NV 89114-4100

Dear Dr. Vieth:

On February 23, 1987, I forwarded comments on the Department of Energy's draft Environmental Monitoring and Mitigation Plan (EMMP). Since that time, Clark County has provided additional comments, which I am enclosing with this letter. The Clark County comments should be considered as part of the State's response to the draft EMMP and incorporated with the comments contained in my February 23, 1987 letter.

Should you have any questions or require additional information, please let me know.

Sincerely,

Robert R. Loux
Executive Director

RRL:JCS/njc

Enclosures

COMMENTS BY CLARK COUNTY COMPREHENSIVE PLANNING TO THE DRAFT DOE ENVIRONMENTAL MONITORING AND MITIGATION PLAN (EMM) FOR SITE CHARACTERIZATION

FEBRUARY 20, 1987

GENERAL COMMENTS

B-1 There is considerable discussion in the EMM document concerning applicable regulations and sections of the National Environmental Policy Act (NEPA) and the Nuclear Waste Policy Act (NWPA) being met in the draft plan. Because of the emphasis placed, it might be helpful for DOE to provide full citations of pertinent sections of regulations, etc. in the appendices in order to provide a context for what is provided (or will be provided) in the final document. This will also facilitate an understanding of what can be expected IN the EMM as site characterization proceeds.

B-2 One item of major concern is the reference in the EMM to CEQ Section 1508.27 on Page 2-3, or the definition for "significantly". The plan notes that "determinations of significance are consistent with the definition in Section 1508.27 of the CEQ regulations..." The term as used in CEQ sets out the "context" (1508.27(a)) in which the significance of an action must be analyzed and provides criteria by which the "intensity (1508.27(b)) of an impact should be determined.

B-3 "Context" is extremely relevant to the discussion. Among the items noted, 1508.27 indicates that "short and long-term effects are relevant." Site characterization is potentially one step in the final development of a repository. Potential impacts should be considered as part of a continuum rather than as isolated elements. What may not be an impact in the site characterization phase may in fact be a potential impact item to be considered if Yucca Mountain is selected. Baselines should be established now.

B-4 The "intensity" section (1508.27(b)) is likewise comprehensive in its statement of what should be considered in determining "significance". I'm certain that what has been presented in this document does not meet this rigorous review. There is mention of inter-relationship among actions (b)(7), establishing precedents for future actions (b))6), as well as the realization that there is more than one agency which may have interest in the impacts of an action (introduction).

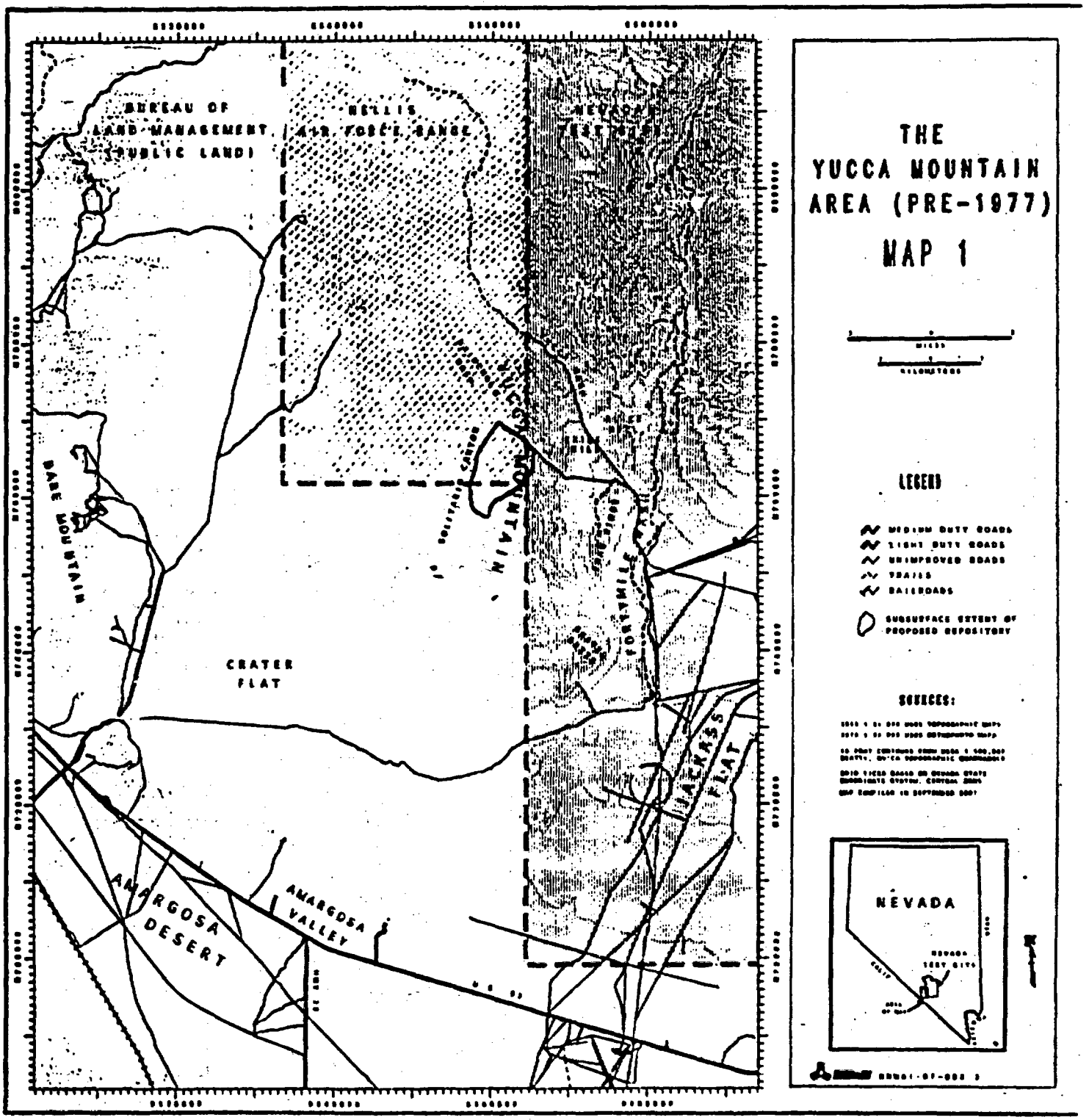
B-5 The Environmental Assessment (EA) appears to be the basis for determining which factors are analyzed in the plans. Rather than assuming that impacts are not present based on the results of the EA, DOE should, as it states it will do in the plan, discuss potential impacts from any functional area. This will be in keeping with the spirit of the various laws and regulations cited in Chapter 2. Let a comprehensive monitoring program determine whether impacts will occur rather than accepting the results of a document (the EA) that has generated much controversy relative to its comprehensiveness and accuracy.

SPECIFIC COMMENTS - ENVIRONMENTAL MONITORING AND MITIGATION PLAN

	Page	Para	
B-6	2-2, 2-3	2	DOE "addressed" all public comments but in many instances did not answer them.
B-7	2-3	top of page	How will public comments presented at a site characterization hearing be incorporated into these documents?
B-8	2-3	1	Interactions with local government?
B-9	2-4	1	See General Comments. Who and what determine significance?
B-10	2-4, 2-5	list	What are these requirements? These should be placed in appendices.
B-11	2-6	2	Does not seem to meet the intent of CEQ 1508.27.
B-12	2-7	Fig. 2-1	There needs to be a link between the States, public, etc. throughout the program and not merely as a result of EA review.
B-13	2-8 or elsewhere	--	There needs to be a statement somewhere in the document explaining the conclusions of the EA document.
B-14	2-8	1	Mitigation is defined here. There should be a glossary in the introductory parts of the plan summarizing pertinent terms used in the document.
B-15	2-9	1	Who will be participants in this review?
B-16	3-12	3.1.4	Discussion of the amount of construction materials to be transported from off-site should be discussed here or somewhere (also see Page 3-18, paragraph 2).
B-17	3-14	No.2	Least damage? What does this mean?
	4-1	2	See General Comments.
B-18	4-2, 4-3	bottom top	What are the impact analyses reviewed to determine potential variability in results?
B-19	4-3	2	A good argument for having a broad spectrum of baseline information now.
	4-4	Fig. 4-1	See General Comments.
B-20	4-6	1	Can the public land be used in the future? This is not considered.

Maps 1 - 4

DRAFT


BUREAU OF LAND MANAGEMENT PUBLIC LANDS
NELLIS AIR FORCE RANGE
NEVADA TEST SITE
YUCCA MOUNTAIN
BARE MOUNTAIN
CRATER FLAT
FORTYMILE CANYON
JACKASS FLAT
AMARGOSA DESERT
AMARGOSA VALLEY
U.S. 95
THE YUCCA MOUNTAIN AREA (PRE-1977)
MAP 1
LEGEND
MEDIUM DUTY ROADS
LIGHT DUTY ROADS
UNIMPROVED ROADS
TRAILS
RAILROADS
SUBSURFACE EXTENT OF PROPOSED REPOSITORY
SOURCES:
NEVADA
NEVADA TEST SITE

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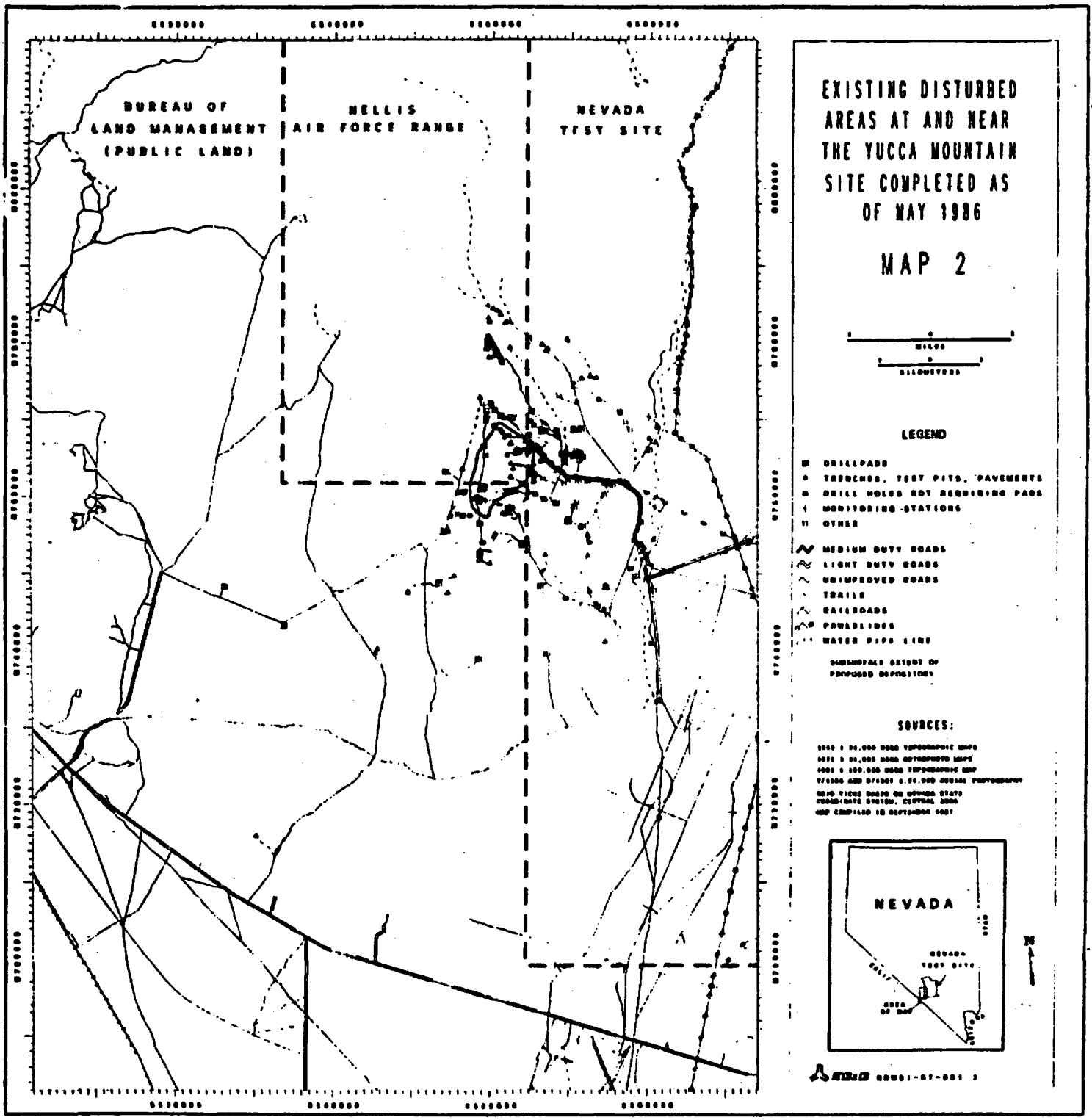
BUREAU OF LAND MANAGEMENT (PUBLIC LAND)
NELLIS AIR FORCE RANGE
NEVADA TEST SITE
EXISTING DISTURBED AREAS AT AND NEAR THE YUCCA MOUNTAIN SITE COMPLETED AS OF MAY 1986
MAP 2
LEGEND
SOURCES:
NEVADA

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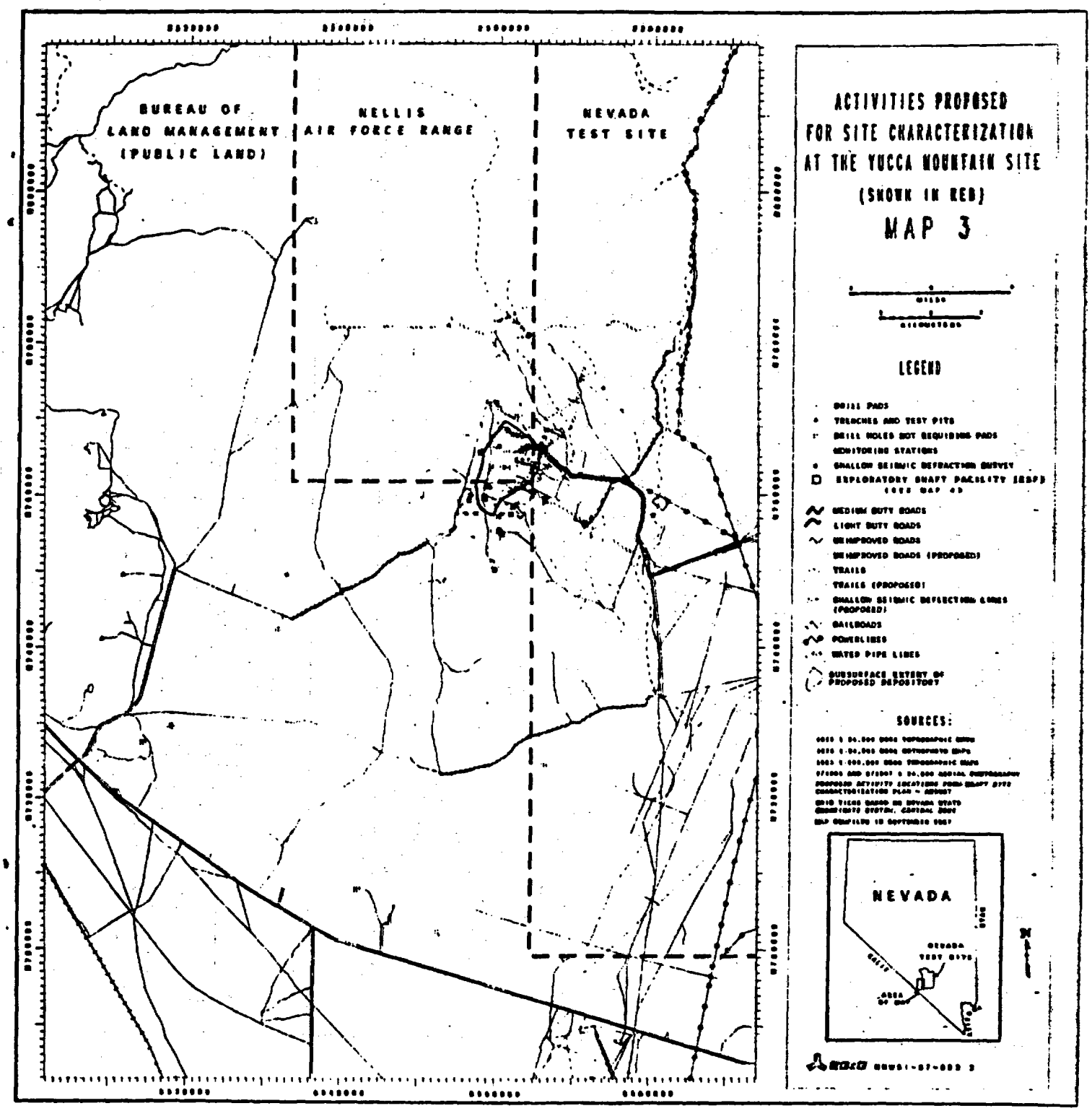
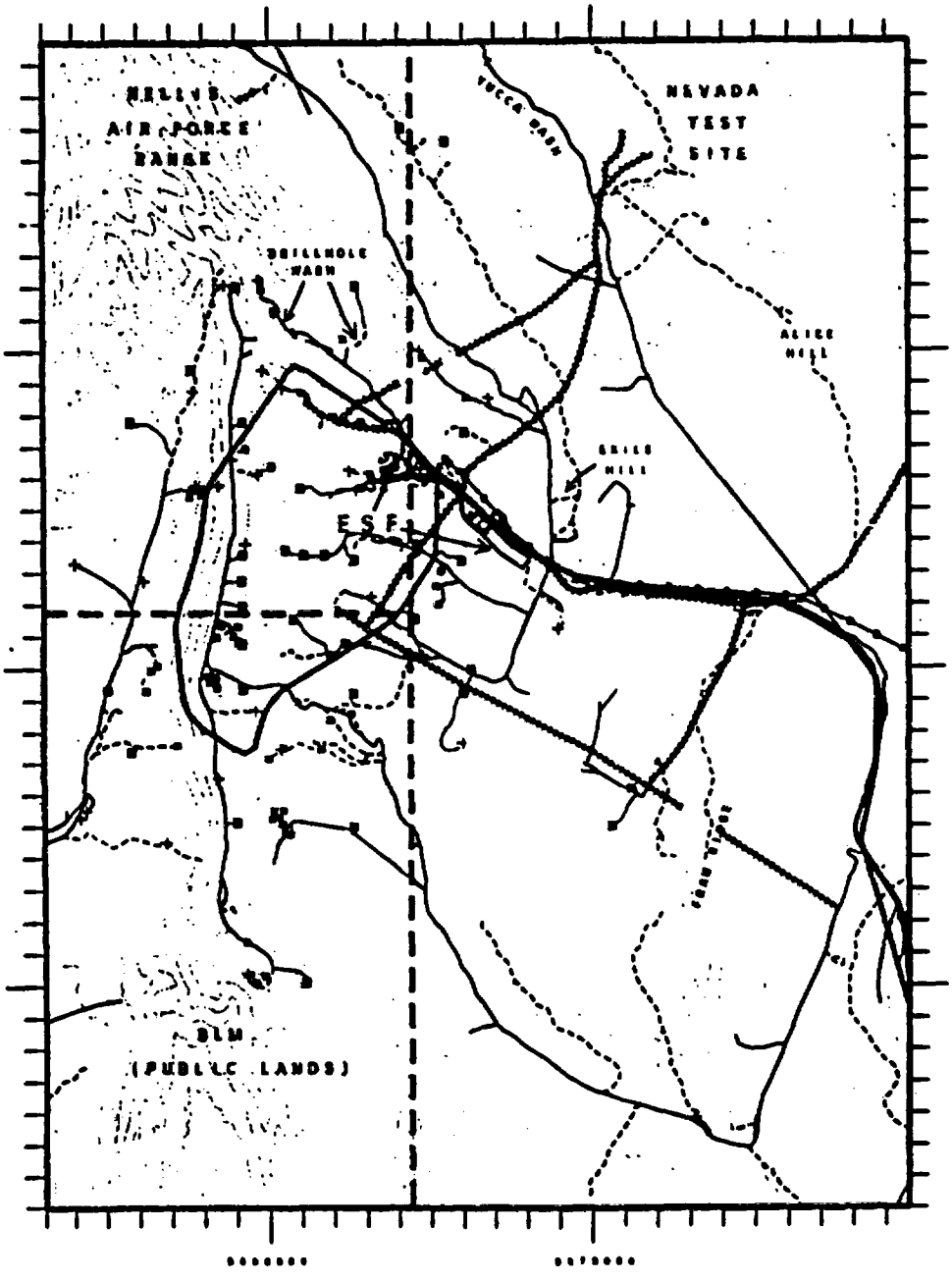

BUREAU OF LAND MANAGEMENT (PUBLIC LAND)
NELLIS AIR FORCE RANGE
NEVADA TEST SITE
ACTIVITIES PROPOSED FOR SITE CHARACTERIZATION AT THE YUCCA MOUNTAIN SITE (SHOWN IN RED)
MAP 3
LEGEND
DRILL PADS
TRENCHES AND TEST PITS
DRILL HOLES NOT REQUIRING PADS
MONITORING STATIONS
SHALLOW SEISMIC REFRACTION SURVEY
EXPLORATORY SHAFT FACILITY (ESF)
MEDIUM DUTY ROADS
LIGHT DUTY ROADS
UNIMPROVED ROADS
UNIMPROVED ROADS (PROPOSED)
TRAILS
TRAILS (PROPOSED)
SHALLOW SEISMIC REFLECTION LINES (PROPOSED)
RAILROADS
POWERLINES
WATER PIPE LINES
SUBSURFACE EXTENT OF PROPOSED REPOSITORY
SOURCES:
NEVADA
NEVADA TEST SITE

DRAFT



EXPANDED VIEW OF ESF SHOWN ON MAP 3

MAP 4

MILES

KILOMETERS

LEGEND

- DRILL PADS
- TRENCHES AND TEST PITS
- DRILL HOLES NOT REQUIRING PADS
- MONITORING STATIONS
- SHALLOW SEISMIC REFRACTION SURVEY
- EXPLORATORY SHAFT FACILITY (ESF)
- MEDIUM DUTY ROADS
- LIGHT DUTY ROADS
- UNIMPROVED ROADS
- UNIMPROVED ROADS (PROPOSED)
- TRAILS
- TRAILS (PROPOSED)
- SHALLOW SEISMIC REFRACTION LINES (PROPOSED)
- RAILROADS
- POWERLINES
- WATER PIPE LINES
- SUBSURFACE EXTENT OF PROPOSED REPOSITORY

SOURCES:

[illegible]

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