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DOE/WIPP 94-024

WASTE ISOLATION PILOT PLANT

Environmental Monitoring Plan

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DOE CONTRACT NUMBER: DE-AC04-86AL31950

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
AIBS	American Institute of Biological Scientists
ANSI	American National Standards Institute
ASER	Annual Site Environmental Report
ASTM	American Society for Testing and Materials
BLM	Bureau of Land Management
CAM	continuous air monitor
CAP88-PC	Clean Air Act Associated Package, 1988
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH	contact-handled
CMS	Central Monitoring System
DOE	Department of Energy
DOE/AL	DOE Albuquerque Operations Office
DOT	Department of Transportation
EC	electrical conductivity
EDE	effective dose equivalent
EEG	Environmental Evaluation Group
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
FAS	fixed air sampler
FEIS	Final Environmental Impact Statement

LIST OF ACRONYMS
(CONTINUED)

FSAR	Final Safety Analysis Report
HEPA	high efficiency particulate air
HPIC	high pressure ionization chamber
ICRP	International Commission on Radiological Protection
LD	limit of detection
LoVol	low volume air sampler
LWA	Land Withdrawal Act
NBS	National Bureau of Standards
NCR	Nonconformance Report
NCRP	National Commission on Radiation Protection and Measurements
NES	Nonradiological Environmental Surveillance
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Testing
NMD	No-Migration Determination
NMED	New Mexico Environment Department
NMVP	No-Migration Variance Petition
NRC	Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act
OEMP	Operational Environmental Monitoring Plan
PDR	Program Deficiency Report
QA/QC	Quality Assurance/Quality Control
RBP	Radiological Baseline Program

LIST OF ACRONYMS
(CONTINUED)

RCA	Request for Corrective Action
RCRA	Resource Conservation and Recovery Act
RES	Radiological Environmental Surveillance
RH	remote-handled
SEIS	Final Supplement Environmental Impact Statement
SES	storage exhaust shaft
SNL	Sandia National Laboratories
SOP	standard operating procedure
STAR	Stability and Array File
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TKN	total kjeldahl nitrogen
TLD	thermoluminescent dosimeter
TRU	transuranic
TRUPACT	Transuranic Package Transporters
TSP	total suspended particulates
TSS	total suspended solids
USBM	United States Bureau of Mines
USGS	United States Geological Survey
VOC	volatile organic compound
WHB	Waste Handling Building

LIST OF ACRONYMS
(CONTINUED)

WID	Westinghouse, Waste Isolation Division
WIPP	Waste Isolation Pilot Plant
WSB	WIPP Site Branch
WQSP	Water Quality Sampling Program

PREFACE

DOE Order 5400.1 (1990) requires each DOE site to prepare an Environmental Monitoring Plan (EMP). This document is to be reviewed annually and updated every three years. This is the first update of the EMP, formally known as the Operational Environmental Monitoring Plan (OEMP) (DOE/WIPP 88-025).

There is significant discussion throughout this EMP in reference to established environmental baselines that are the results of OEMP activities initiated in 1985. These baselines are noted below:

DOE/WIPP 92-037
Statistical Summary of the Radiological Baseline for the WIPP, 1992

DOE/WIPP 92-038
Summary of the Salt Impact Studies at the WIPP, 1984 to 1990, and 1992

DOE/WIPP 92-039
A Study of Disturbed Land Reclamation Techniques for the WIPP, 1992

DOE/WIPP 92-013
Background Water Quality Characterization Report for the WIPP, 1992

These documents may be obtained by referring to the DOE/WIPP number, or they may be found as attachments to the Annual Site Environmental Report for the WIPP for Calendar Year 1991, DOE/WIPP 92-007, 1992.

This EMP will be reviewed annually and will document any proposed changes in the environmental monitoring program. Changes to the environmental monitoring program may be necessary to allow the use of advanced technology and new data collection techniques.

The fundamental purpose of this document is to describe the programs established to evaluate long term effects of the WIPP on the environment. This plan should not be evaluated from the standpoint that monitoring is being conducted for release detection from the WIPP facility, but rather, for recorded historical trends.

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1.0 INTRODUCTION

U.S. Department of Energy (DOE) Order 5400.1, General Environmental Protection Program Requirements (DOE, 1990a), requires each DOE facility to prepare an Environmental Monitoring Plan (EMP). This document is prepared for the Waste Isolation Pilot Plant (WIPP) in accordance with the guidance contained in DOE Order 5400.1 (DOE, 1990a); DOE Order 5400.5, Radiation Protection of the Public and Environment (DOE, 1990b); and the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T, 1991). The WIPP project is operated by Westinghouse Electric Corporation, Waste Isolation Division (WID), for the DOE.

This plan defines the extent and scope of the WIPP effluent and environmental monitoring programs during the facility's preoperational and operational life. This document also discusses the WIPP's quality assurance/quality control programs.

This plan provides a comprehensive description of environmental activities at WIPP including:

- A summary of environmental programs including the status of environmental permits and monitoring activities (Section 1.0);
- A description of the WIPP project and its mission (Section 2.0);
- A description of the local environment including demographics (Section 3.0);
- An overview of the methodology used to assess radiological consequences to the public including brief discussions of potential exposure pathways, routine and accidental releases, and their consequences (Section 4.0);
- A summary of preoperational environmental monitoring and assessment activities (Section 5.0); and
- Responses to the requirements described in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T).

This document extensively references DOE Orders and other federal and state regulations affecting effluent and environmental monitoring programs at the site. WIPP procedure manuals, which implement the requirements of this program plan, are also referenced.

The DOE regulates its own activities for radiation protection of the public under the authority of the Atomic Energy Act of 1954, as amended. The effluent and environmental monitoring activities prescribed by DOE Order 5400.5 and the DOE/EH-0173T guidance manual are designed to ensure that DOE facilities collect the information required to estimate potential and actual radiation doses to site personnel and the surrounding population. Effluent and environmental monitoring also provide the data necessary to demonstrate compliance with applicable environmental protection regulations.

Other federal agencies, such as the U.S. Environmental Protection Agency (EPA), are empowered through specific legislation to regulate certain aspects of DOE activities potentially affecting public health and safety or the environment. Presidential Executive Order 12088, "Federal Compliance with Pollution Control Standards," requires the heads of executive agencies to ensure that all federal facilities and activities comply with applicable pollution control standards and to take all necessary actions for the prevention, control, and abatement of environmental pollution.

Beyond statutory requirements, the DOE has established a general environmental protection policy. The "Environmental Policy Statement" (issued by then Secretary Herrington on January 8, 1986, and extended on January 7, 1987) describes the DOE's commitment to national environmental protection goals by conducting operations "in an environmentally safe and sound manner . . . in compliance with the letter and spirit of applicable environmental statutes, regulations, and standards" (DOE, 1986a). This Environmental Policy Statement also states the DOE's commitment to "good environmental management in all of its programs and at all of its facilities in order to correct existing environmental problems, to minimize risks to the environment or public health, and to anticipate and address potential environmental problems before they pose a threat to the quality of the environment or public welfare." Additionally, "it is DOE's policy that efforts to meet environmental obligations be carried out consistently across all operations and among all field organizations and programs" (DOE, 1986a).

The WIPP complies with the terms of the Agreement for Consultation and Cooperation established in 1981 with the State of New Mexico. This agreement, required by the federal legislation which authorized the WIPP project (Public Law 96-164, 1980), specifies that DOE notify the State of New Mexico prior to commencement of key events. The Supplemental Stipulated Agreement requires DOE to provide the State with sufficient information to conduct an independent review of WIPP activities.

The 1992 WIPP Land Withdrawal Act (LWA), Public Law 102-579, requires the DOE to prepare and implement a Land Management Plan and Cooperative Agreement with the Bureau of Land Management (BLM). The primary objectives of the Land Management Plan are to preserve the ecological condition of the wildlife habitat within the WIPP withdrawal area, protect special status species, preserve cultural resources, manage rangeland resources, and monitor drilling and mining activity within one mile of the WIPP boundary.

Environmental activities at the WIPP project generally fall into three categories: (1) the performance of analyses and preparation of documents to address DOE requirements, as well as applicable regulations of the EPA and other federal and state agencies; (2) the conduct of environmental studies to monitor site impacts; and (3) the implementation of measures to mitigate adverse impacts.

A number of provisions taken to mitigate potential environmental impacts appear in Statements of Work issued to all contractors involved in the construction of the WIPP facility. These provisions are listed below:

- Protection of environmental resources including the avoidance of unnecessary damage to vegetation, wildlife, and soil by controlling traffic, minimizing disturbance zones, and cleaning up spills.

- Protection of air resources including the control of hydrocarbon emissions by using proper fuels, the suppression of dust by spraying with water, and the monitoring and control of noise.

- Protection of water resources including the use of retention ponds for controlling suspended materials, solutes, and other pollutants.

- Preservation and recovery of historical, archaeological, and cultural resources including the interruption of construction activities as necessary to investigate and mitigate impacts to historical or archaeological resources.

- Post-construction cleanup including the removal of temporary construction facilities, haul roads, stockpiles, and work areas, as well as the restoration of all damaged landscape features outside the limits of approved work areas.

WIPP must also comply with specified permitting and approval requirements of several federal and state regulating agencies. A database is maintained of all required permits, notices, and approvals which apply to the WIPP project. This database enables environmental personnel to anticipate commitments such as renewal dates, fee payments, and reclamation requirements. This database is updated annually and is available in the Annual Site Environmental Report (ASER) produced for the WIPP. The latest issued permit matrix is listed in the Site Environmental Report for the WIPP for Calendar Year 1991 (DOE/WIPP 92-007).

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2.0 PROJECT DESCRIPTION

The purpose of WIPP is to provide a research and development facility to demonstrate the safe disposal of TRU waste generated by the defense activities of the U.S. Government. The preoperational radiological and ecological environmental monitoring programs were detailed in earlier documents entitled: "Radiological Baseline Program for the Waste Isolation Pilot Plant" (Reith and Daer, 1985) and "Ecological Monitoring Program for the Waste Isolation Pilot Plant, Semi-annual Report" (Reith et al., 1985). A summary of those programs is presented in Section 5.0 of this document. The environmental monitoring program continues the established preoperational environmental monitoring efforts as appropriate and adds monitoring of the airborne and liquid effluent discharges. Details regarding the design and operation of the WIPP facility are in the Final Safety Analysis Report (FSAR) (DOE, 1990c).

Both contact handled (CH) and remote handled (RH) waste will be received and stored at the WIPP facility. CH waste consists of transuranic (TRU) waste that has a relatively low surface dose rate and therefore lends itself to direct handling. RH waste is TRU waste that, due to higher levels of penetrating radiation, must be shielded and handled remotely. Waste will be classed as CH or RH based on whether surface dose rates are less than or greater than 200 mrem/hr, respectively. TRU waste is radioactive waste that, without regard to source or form, is contaminated with alpha-emitting TRU radionuclides having atomic numbers larger than 92 and half-lives longer than 20 years in concentrations greater than 100 nanocuries per gram of waste. The CH and RH waste contain both alpha and beta-gamma emitting nuclides. Isotopes of plutonium, americium, and curium will be the predominant radionuclides contaminating the TRU waste. The waste will be in a variety of forms such as concrete stabilized sludges, decommissioned machine tools, glove boxes, etc. All wastes received by the WIPP will be restricted according to specific Waste Acceptance Criteria (WAC Rev. 4, 1991) which prohibit pressurized gases and explosives, and limits free liquids to less than one percent of the volume of each container. General criteria defining the various categories of radioactive waste, including TRU waste, appear in DOE Order 5820.2A and DOE/AL Order 5820.2. A portion of the waste that will be emplaced will also be contaminated with hazardous materials. The hazardous waste component is subject to regulation by the Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA), and consists largely of toxicity characteristic metals, halogenated organic compounds, and nonhalogenated organic compounds.

Waste will be delivered to the WIPP Waste Handling Building (WHB) via semi-trailer trucks. CH wastes will arrive in shipping containers known as TRUPACT IIs (TRansUranic PACkage Transporters). TRUPACT IIs are durable, Type B, Department of Transportation certified (DOT) transport containers, designed to accommodate both waste boxes and drums. The DOE has received a certificate of compliance from the Nuclear Regulatory Commission (NRC) for use of the TRUPACT II. Remote-handled transuranic (RH TRU) wastes will be packaged in waste canisters and shipped to WIPP in special transportation casks. The remote-handled casks are awaiting NRC approval.

The storage rooms prepared for the waste have been excavated from the Salado Formation, a thick sequence of salt beds deposited 250 million years ago (Permian age). The emplacement horizon is located at a depth of 655 meters (2,150 feet). The waste containers within the WHB will be removed from their shipping containers, placed on the waste-handling hoist, and lowered to the emplacement horizon. Waste containers will then be removed from the hoist and emplaced within the storage rooms. Eventually, specially designed seals and plugs will be placed in the excavated drifts and in the shafts. Geologic pressures and the plasticity of the salt will result in the excavation's gradual closure due to creep. This closure will encapsulate and isolate any waste within the Salado.

The underground area is ventilated by air entering via the Salt Handling, Air Intake, and Waste Handling Shafts and exiting through the Exhaust Shaft. In the event of an accident involving waste in the underground, air from the Exhaust Shaft will be directed, at a reduced flow rate, through the Exhaust Filter Building containing banks of high efficiency particulate air (HEPA) filters in order to remove potentially contaminated particulates. Exhaust ventilation from the WHB is continuously HEPA filtered and is not expected to represent a significant release point. Effluent monitoring is discussed in Section 5.3.2.

3.0 SITE CHARACTERISTICS

3.1 GEOGRAPHY

The WIPP site is located in Eddy County in southeastern New Mexico (Figure 3-1) within the Pecos Valley section of the southern Great Plains physiographic province (Powers et al., 1978). The site is 42 km (26 miles) east of Carlsbad in an area known as Los Medanos (the dunes). Los Medanos is a relatively flat, sparsely inhabited plateau with little water and limited land uses.

The WIPP site (Figure 3-2) consists of 16 sections of federal land in Township 22 South, Range 31 East. The 16 sections of federal land were withdrawn from the application of public land laws by the WIPP Land Withdrawal Act (LWA), Public Law 102-579, that was signed on October 30, 1992. The LWA transferred the responsibility for the administration of the 16 sections from the Department of Interior, Bureau of Land Management, to the Department of Energy. This law specified that mining and drilling for purposes other than support of the WIPP project are restricted within this 16 section area with the exception of Section 31. Oil and gas activities are restricted in Section 31 from the surface down to 6,000 feet.

3.2 GEOLOGY

Los Medanos soils are sandy and well drained with a well developed caliche layer occurring below one meter. There are no integrated natural surface drainage features at the site. Scattered throughout the local area are numerous livestock watering ponds (tanks) and seasonally wet, shallow lakes (playas) which are located approximately 6 miles southeast of the site. Geologically, the site is located in the northern portion of the Delaware Basin, one of the westernmost sedimentary basins known collectively as the Permian Basin. Approximately 3,960 meters (13,000 feet) of strata are present in the Delaware Basin (Bachman, 1984) including hundreds of meters of evaporite sequences composed in part of halite, anhydrite, and gypsum. Figure 3-3 illustrates the local stratigraphy.

3.3 CLIMATOLOGY

Regional climate is semi-arid with generally warm temperatures. Approximately half the average annual precipitation, about 31 centimeters (12 inches), is received from summer thunderstorms during June through September. Daytime summer temperatures consistently exceed 32°C (90°F) and occasionally rise above 38°C (100°F). Winter temperatures often rise as high as 21°C (70°F) during the afternoon. Night time lows during winter average near -5°C (23°F), occasionally dipping below -10°C (14°F). Prevailing winds are from the southeast; however, strong winds are common and can blow from any direction creating potentially violent windstorms which carry large volumes of dust and sand. The wind test data have remained essentially the same from year to year. Detailed compilations of climatic data have appeared in the Ecological Monitoring Reports (Fischer et al., 1985; 1987) and in the Annual Site Environmental Reports for calendar years 1988, 1989, 1990, 1991, and 1992 (DOE/WIPP 89-005, DOE/WIPP 90-003, DOE/WIPP 91-008, DOE/WIPP 92-007, DOE/WIPP 93-017, respectively). Additional climatic information appears in the Final Environmental Impact Statement (FEIS) (DOE, 1980), Final Supplement Environmental Impact Statement (SEIS) (DOE, 1990d), and the FSAR (DOE, 1990c).

3.4 HYDROLOGY

Surface water is absent at the WIPP site. The nearest large surface water body, Laguna Grande de la Sal, is located approximately 13 kilometers (8 miles) west-southwest of the WIPP site in Nash Draw where shallow brine ponds occur. The Pecos River is located 22.4 kilometers (14 miles) southwest of the WIPP site.

Several water-bearing zones have been studied near the WIPP. The most significant are the Culebra and Magenta Dolomite Members of the Rustler Formation, which consist of interbedded anhydride, dolomite, siltstone, and halitic claystone. The dolomite units produce brackish to saline water. Limited amounts of potable water are found in the Dewey Lake Redbeds and the overlying Triassic Dockum Group. Another saline water-bearing zone identified is the Rustler-Salado contact, which contains very little water at the WIPP site. It was exposed during shaft construction and produced only small brine seepages. Other water bearing zones that have been evaluated as part of site characterization include the Bell Canyon and Castile Formations.

The Dewey Lake Formation is comprised of alternating thin, even beds of siltstone and mudstone with lenticular interbeds of fine-grained sandstone. Exploratory drilling during site hydrogeologic evaluation did not identify a continuous zone of saturation within the Dewey Lake. The few Dewey Lake wells yielding water for domestic and stock purposes are believed to be completed in the thin, discontinuous lenticular sands where favorable groundwater recharge occurs (Mercer, 1983). A more complete discussion of both the regional and site-specific groundwater hydrology is contained in the WIPP FSAR.

3.5 ECOLOGY

The biota of Los Medanos represent a transition between the northern Chihuahuan Desert and the southern Great Plains. The soils at the site include sandy surface soils with wind-blown particles, a thin soil crust, and a layer of moist subsoil. These sandy soils form stabilized coppice dunes interspersed with swales.

Shrubs and grasses are the most prominent components of the local flora. The development of specific plant communities is dependent on such factors as the infiltration rate of the surface soil, depth to a restrictive layer (e.g., caliche), and the extent to which the surface soil has been reworked by wind or water erosion. The area is dominated by the shinnery oak, mesquite, sand sage, and perennial grasses. Typical grassland and shrubland species dominate the fauna of the area. The primary mammals found at the site include the lagomorphs (rabbits and hares), desert dwelling rodent species, and carnivore species such as the coyote, gray fox, badger, and striped skunk.

A large variety of bird species are also found in the region. The following avian species are present in greatest densities: scaled quail, mourning dove, mocking bird, loggerhead shrike, pyrrhuloxia, black-throated sparrow, wester meadowlark, the lark bunting, vesper sparrow, Cassin's sparrow, and the white-crowned sparrow. The Harris hawk, the Chihuahuan raven, Swainson's hawk, the Northern Harrier, and the American kestrel are also found at the site.

Twenty-nine species of amphibians and reptiles are observed in the site vicinity. Characteristic reptiles in the region include the western box turtle, side-blotched lizard, western whiptail, bullsnake, and western rattlesnake. The primary amphibians are the tiger salamander, green toad, and plain's spadefoot.

A brief summary of the ecological baseline surveys appears in Appendix H of the FEIS (DOE, 1980). If there are any changes observed in the area ecology they will be noted in the WIPP ASERs.

3.6 DEMOGRAPHY

The distribution of the local 1990 population within 50 miles of the WIPP site is provided in Table 4-10. The nearest residents to the site include eight individuals living at the Mills Ranch, 5.8 km (3.5 miles) south-southwest of the center of the site, and two individuals living at the Smith Ranch, 10 km (6 miles) west-northwest of the center of the site (DOE/WIPP 93-017). Both neighboring ranches have been and will continue to be monitored as part of WIPP's environmental surveillance program. Detailed demographic summaries and projections are in the WIPP SEIS (DOE, 1990d) and WIPP FSAR (DOE, 1990c).

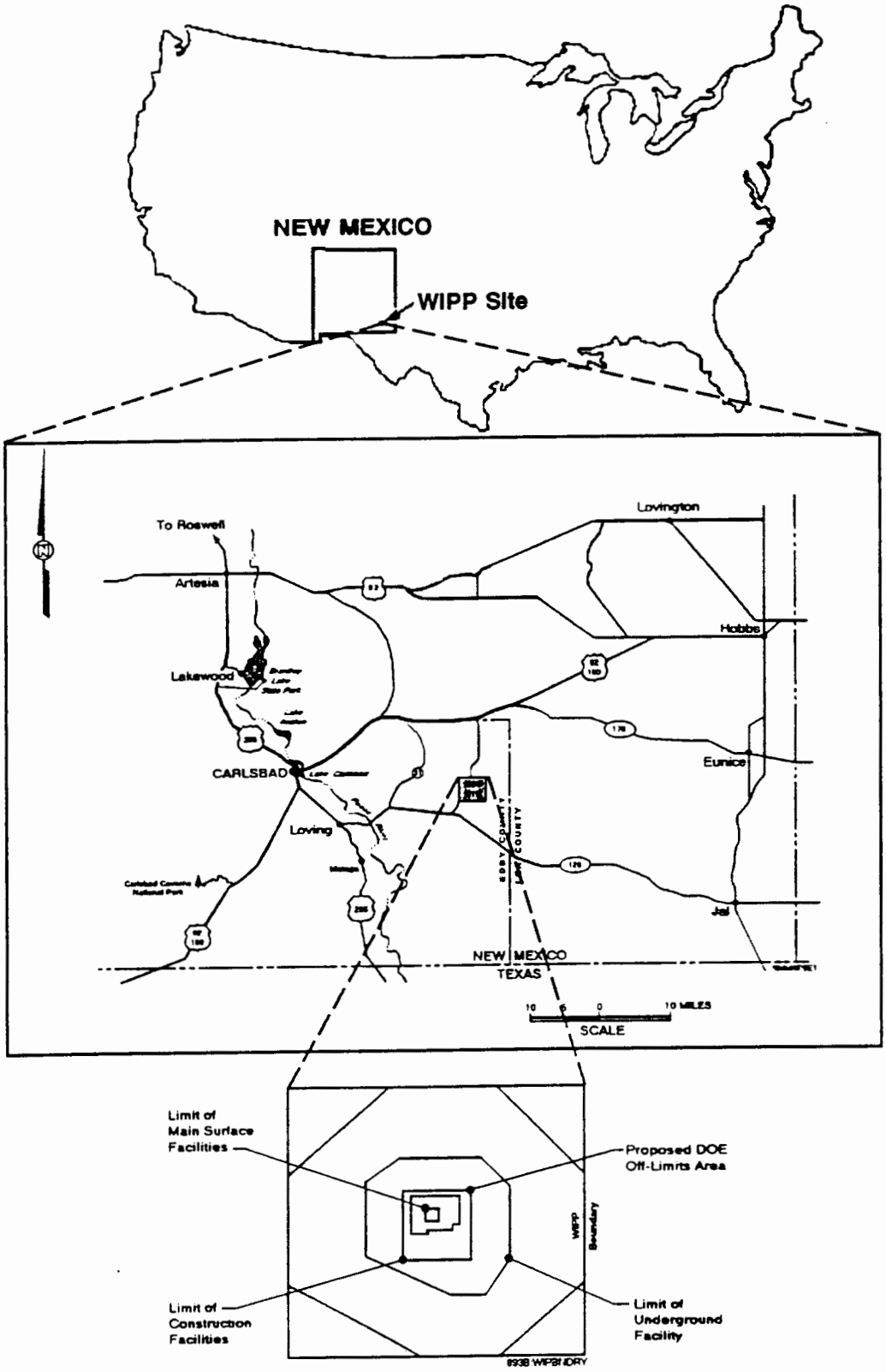

Figure 3-1 Location of the WIPP Site

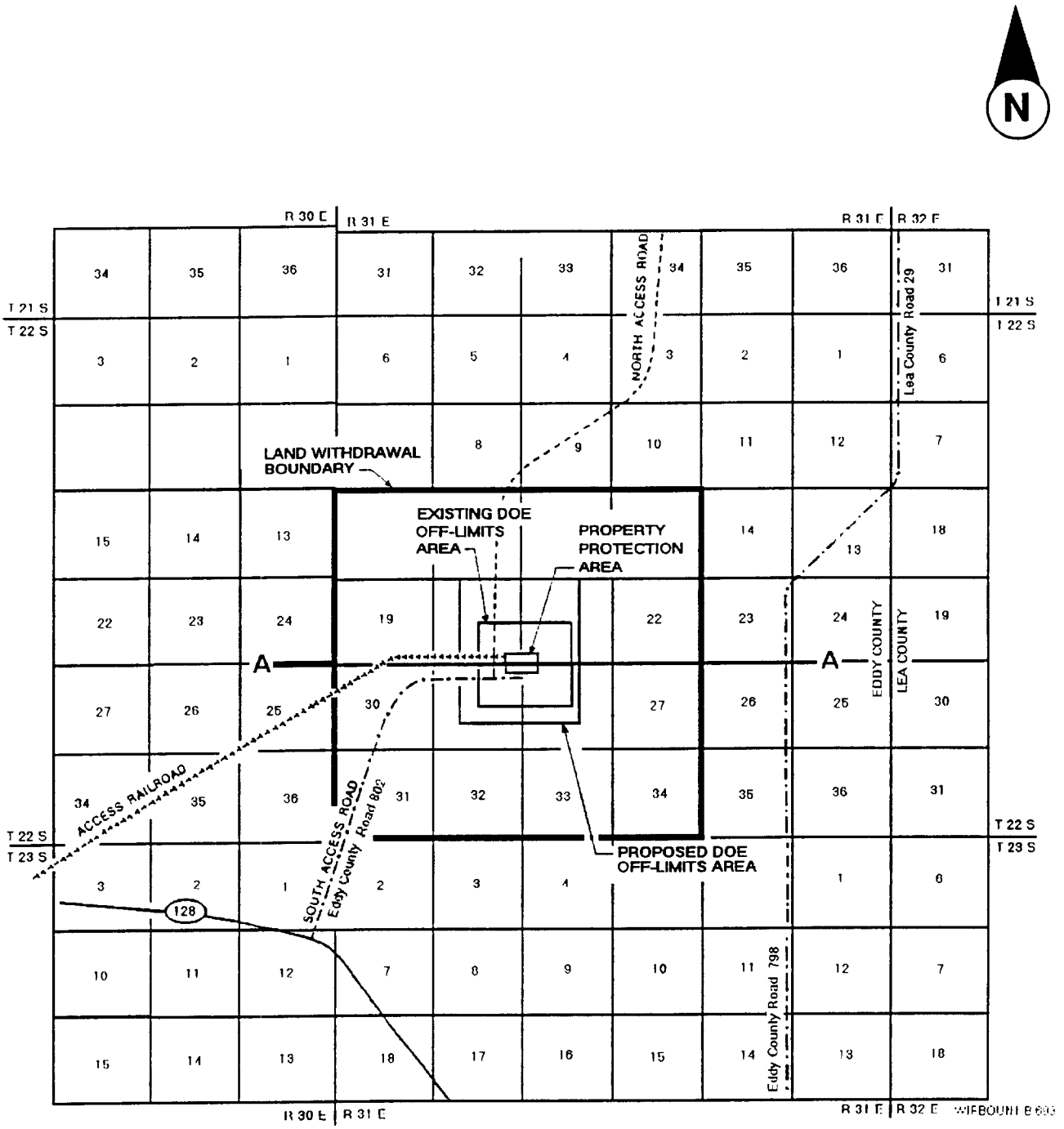

Figure 3-2 Plat of WIPP Site

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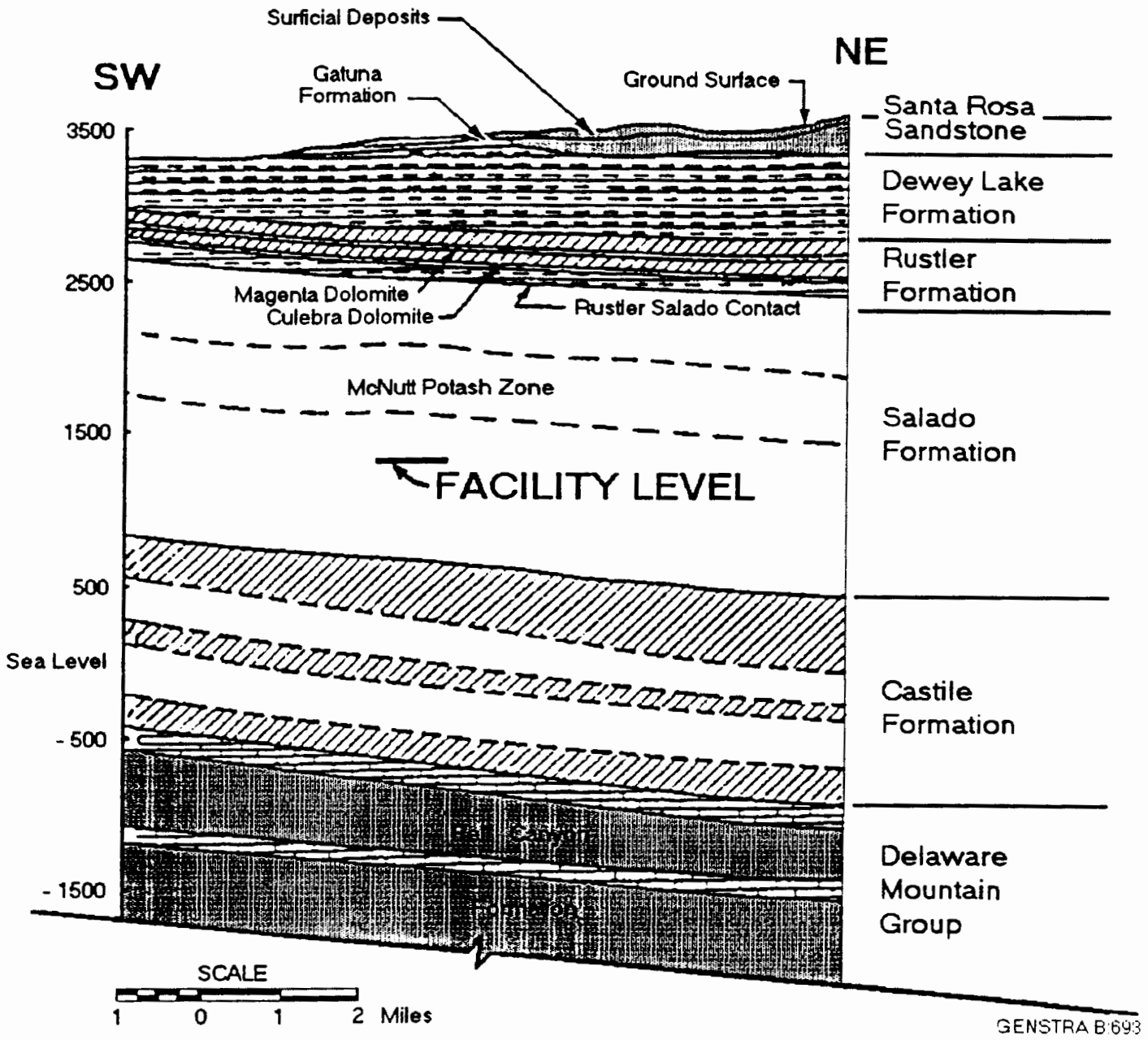

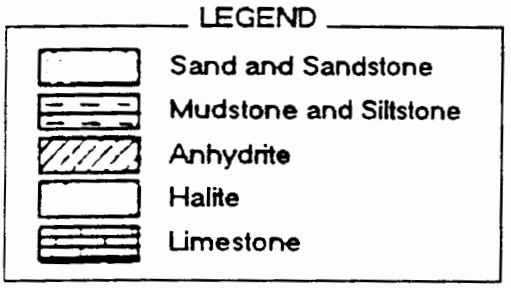

Figure 3-3 Generalized Stratigraphy of the WIPP Site

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3.6 DEMOGRAPHY

The distribution of the local 1990 population within 50 miles of the WIPP site is provided in Table 4-10. The nearest residents to the site include eight individuals living at the Mills Ranch, 5.8 km (3.5 miles) south-southwest of the center of the site, and two individuals living at the Smith Ranch, 10 km (6 miles) west-northwest of the center of the site (DOE/WIPP 93-017). Both neighboring ranches have been and will continue to be monitored as part of WIPP's environmental surveillance program. Detailed demographic summaries and projections are in the WIPP SEIS (DOE, 1990d) and WIPP FSAR (DOE, 1990c).

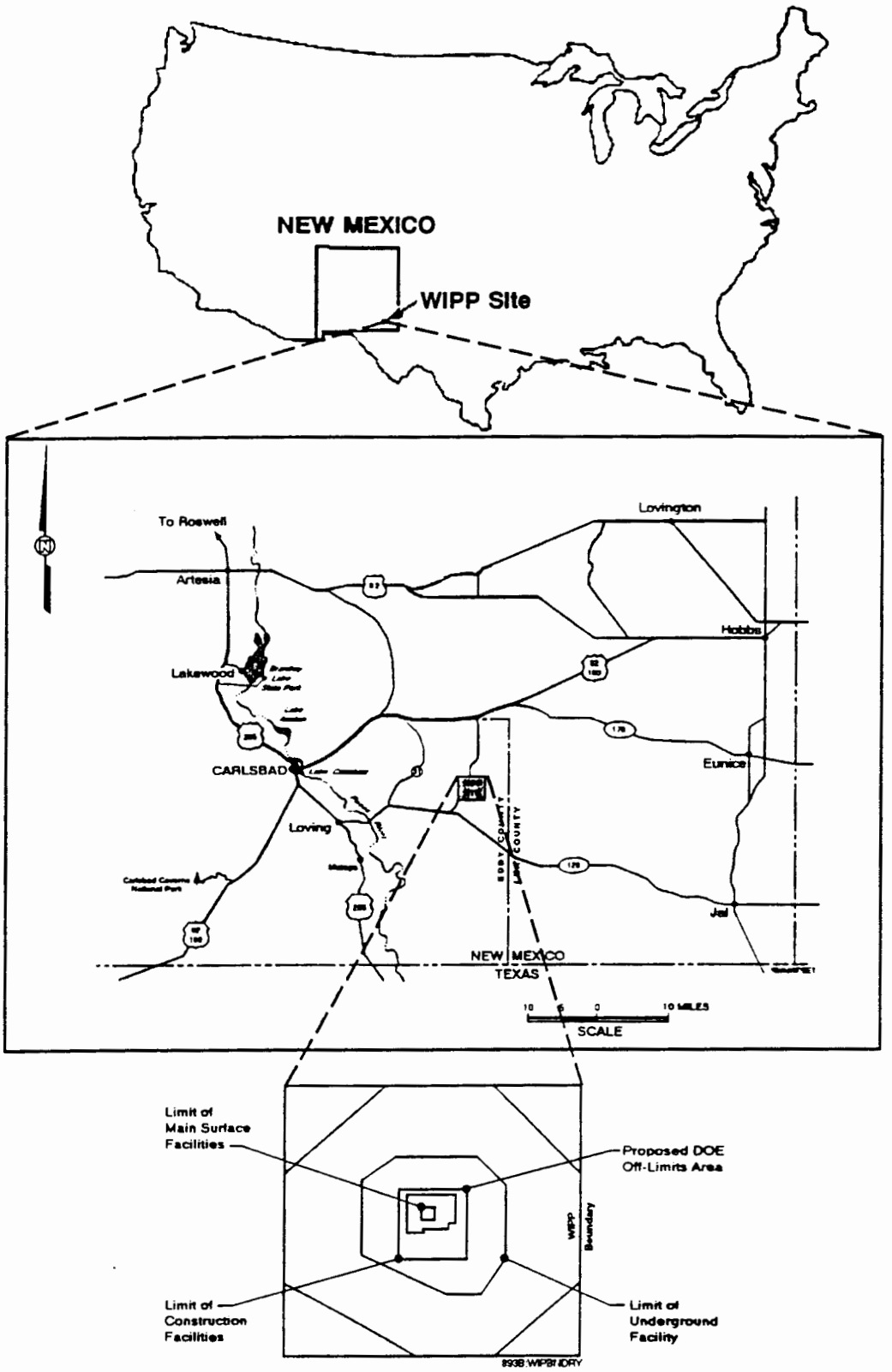

Figure 3-1 Location of the WIPP Site

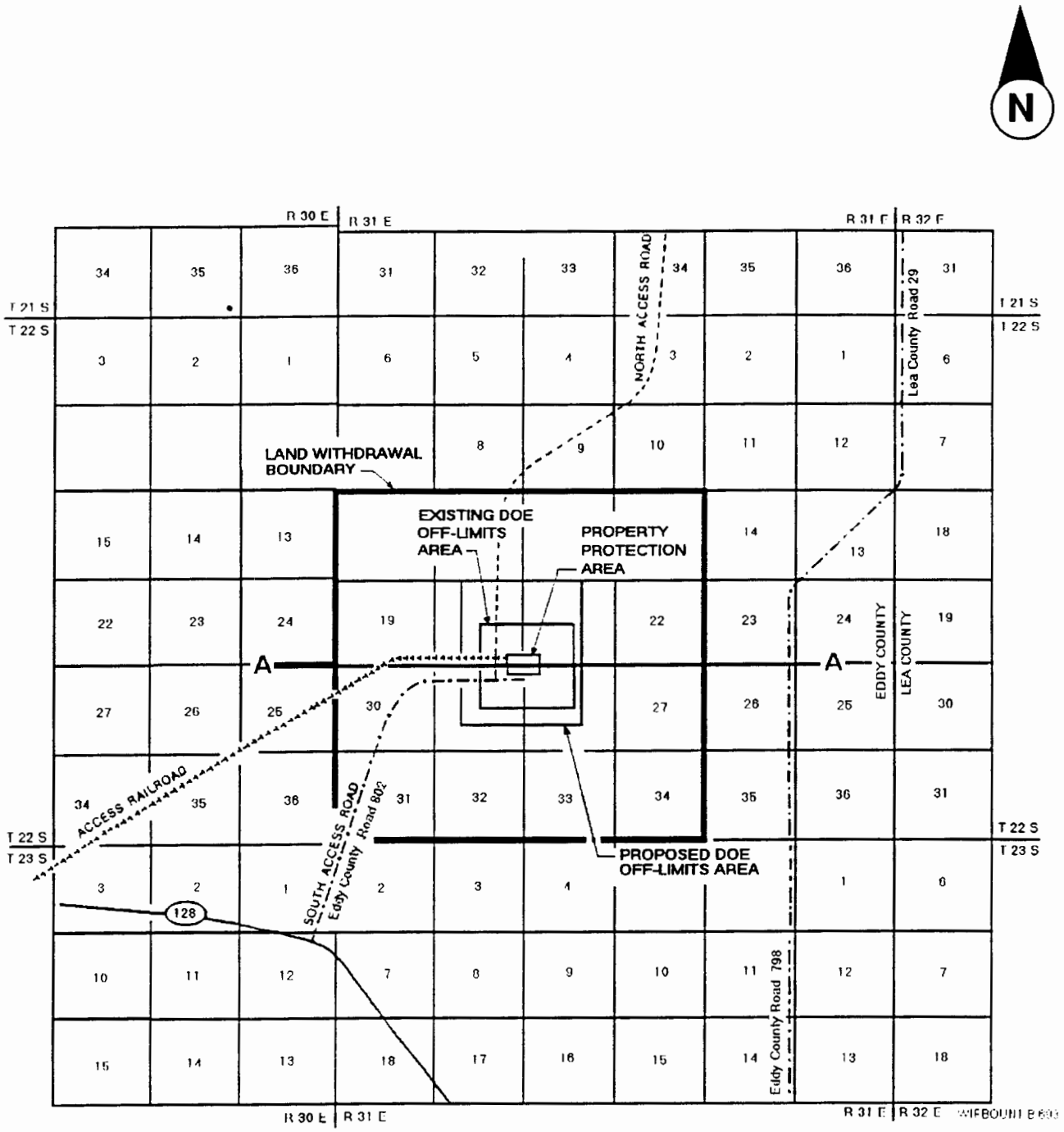

Figure 3-2 Plat of WIPP Site

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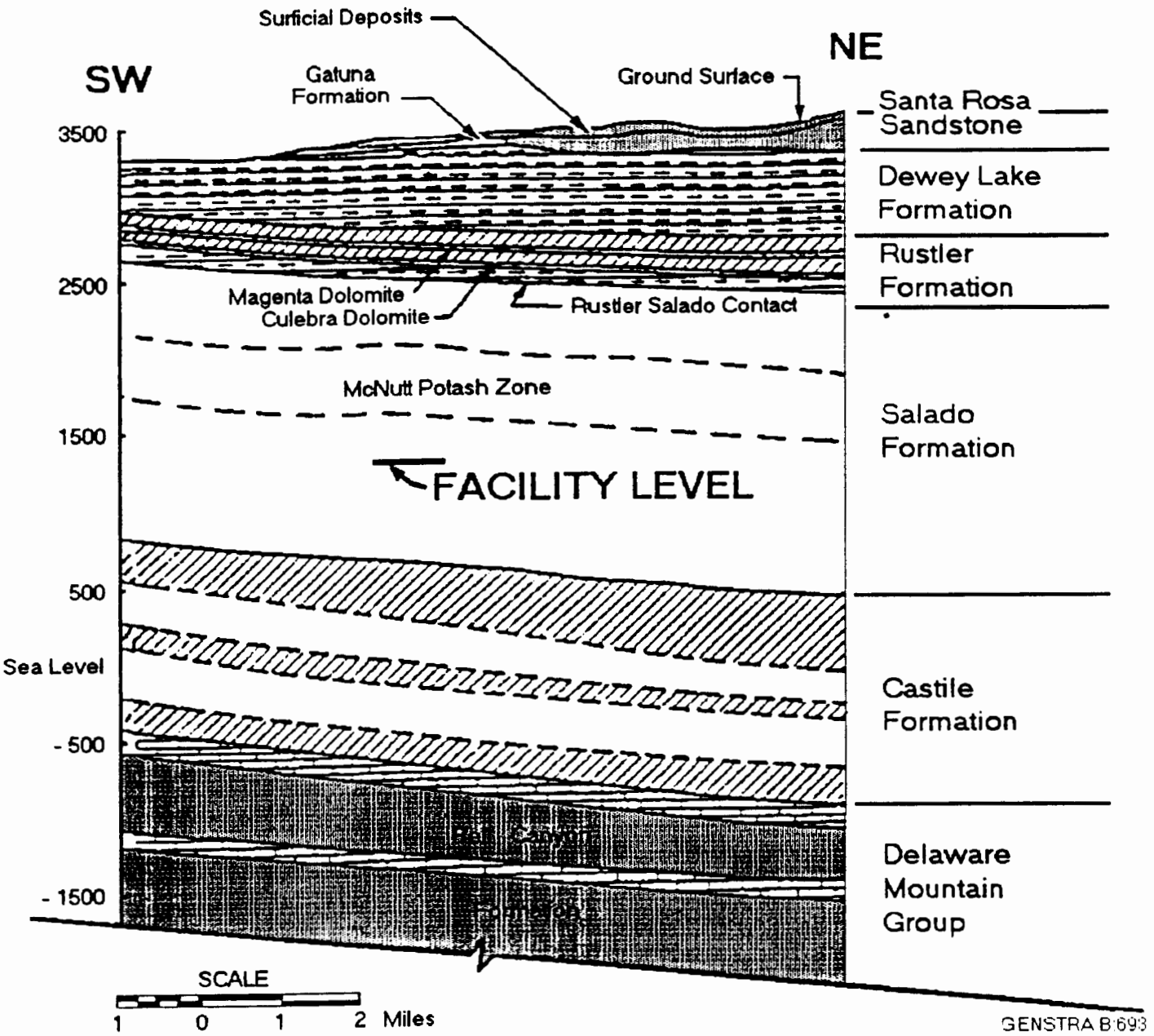

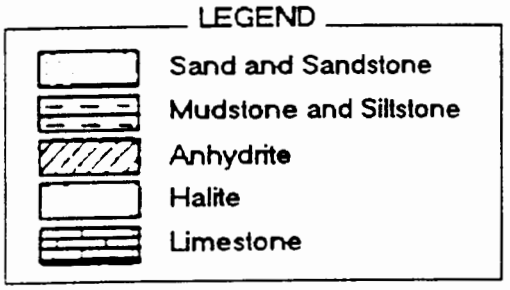

Figure 3-3 Generalized Stratigraphy of the WIPP Site

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4.0 DOSE CALCULATIONS

This section provides an overview of the methodology and assumptions used to assess the radiological consequences to members of the public from potential releases of airborne radioactivity from the WIPP facility during normal operations. As discussed in Section 4.2, Pathway Analysis, it is determined that the air pathway is the only significant biosphere release and exposure pathway from the WIPP during normal operations. Determination of environmental transport and exposure pathways and estimates of dose consequences from routine operations may then be examined to verify the suitability and extent of the operational environmental monitoring program.

Nonradiological consequences to members of the public associated with potential airborne chemical releases from the WIPP facility during normal operations are assumed to be *de minimus*. This assumption is based on (1) extensive site exposure measurements and calculations which indicate that employee exposures are being maintained below Occupational Safety and Health Administration Permissible Exposure Limits (as stipulated in 29 CFR 1910.1000), (2) all chemicals used on site must receive approval prior to purchase, with approval based on the minimization of personnel exposure and environmental impact, and (3) the site Nonradiological Environmental Program which has been monitoring for nonradiological emissions from the time of the site's inception.

4.1 GENERAL

The dose assessment methodology used in this section evaluates radiation doses to the public from normal operations at the WIPP and assesses anticipated compliance with applicable regulations for radiation protection of the public and the environment. The WIPP's "Emergency Plan and Procedures" (WP 12-9) supplies basic methods for approximating doses resulting from emergency and accident situations.

The regulatory compliance assessment is based on evaluation of compliance with the radiation dose standards for the public in DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE, 1990b). As required by DOE Order 5400.5, the assessment determines the effective dose equivalent (EDE) to the maximally exposed individual for comparison with public dose limits and the collective population EDE within a radius of 80 km (50 mi) from the center of the WIPP.

The dose assessment methodology used is divided into the following steps:

1) Identify hazards considering physical characteristics of the waste;

2) Evaluate operations that may result in a release of radioactive material;

3) Conduct an exposure assessment by evaluating migration pathways and estimating concentrations of radiological and/or hazardous materials to which receptors are subjected;

4) Compare the resultant exposure consequences to appropriate compliance limits; and

5) Determine expected consequences of exposures.

Dose assessments using the above methodology for normal operations have been performed in the FSAR and SEIS. Additionally, a full characterization and evaluation of hazards, release scenarios for routine operations, and migration pathways were performed in the FSAR and SEIS. Section 4.2

discusses the pathway analysis. Section 4.3 discusses the methodology used for estimating radionuclide concentrations at receptor locations, the resulting radiological dose consequences, and the analyses of anticipated releases and consequences from routine operations.

4.2 PATHWAY ANALYSIS

As stated in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance, DOE/EH-0173T (DOE, 1991), a critical pathway analysis should be performed to determine specific environmental sampling and analysis needs. Pathway analysis determines which environmental media might lead to a measurable annual dose of site origin to members of the public. Following pathway analysis, routine sampling and analysis (for the critical radionuclides to dose) and penetrating radiation measurements are performed for those identified media as part of an environmental monitoring and surveillance program.

4.2.1 Exposure Pathways

Potential exposure pathways to man involve direct exposure to radioactive materials in the air or materials deposited on the ground. Exposure to internal organs can occur by the ingestion of intermediary organisms or water, or by inhalation of contaminated air. The facility is designed to limit the amount of radioactivity or hazardous chemicals that could potentially reach the environment, as well as the available pathways to man. The mechanism for transporting radionuclides through the potential pathways depends on the mobility of their chemical forms in the environment. For example, some radionuclides deposited on the soil move from the soil through microbial populations to plant roots and concentrate in edible leaves. Other radionuclides may concentrate in the organs of animals which eat the plants and in soil clinging to the roots. The release pathways are characterized by five parameters:

1. Physical properties of the released material;
2. Radionuclide content of the released material;
3. Location of the release;
4. Process by which the release occurs; and
5. Depletion of the released radioactivity before it enters the biosphere.

For the WIPP facility, characterization of the above parameters requires consideration of WIPP operations, waste container design, quality control, handling procedures, transfer procedures, and storage methods.

The WIPP facility will receive and store radioactive waste in containers (drums and boxes). In addition to these wastes, small quantities of solid wastes generated on site as a result of waste handling operations are collected and disposed of as solid wastes. Site-generated solid wastes which meet the WIPP Waste Acceptance Criteria are emplaced at WIPP in the same manner as wastes received from off site and do not represent a source of radioactivity release during normal operations.

For the purposes of this assessment, it is assumed that the waste containers carry the maximum surface contamination allowed by the Waste Acceptance Criteria. During normal handling and storage operations at the WIPP facility, very small amounts of this external contamination may be released. Additionally, vapors and suspended particulates may be dispersed through the air due to off-gassing from the waste drums or boxes. If a release occurs by any of the above mechanisms,

the air transport pathway presents the most rapid and pervasive dispersion mechanism, whether the release occurs above or below ground. Deposition of radioactive particulates from airborne releases may also result in contamination of soils and surface waters.

As a result of analyses performed in the WIPP FSAR (DOE, 1990c) and the SEIS (DOE, 1990d), a complete characterization of the above five parameters was completed, concluding that the air pathway is the only credible biosphere release and exposure pathway from the WIPP during normal operations (DOE, 1990d). Direct releases of radionuclides to ground and surface waters and to soil during normal operations are not credible (DOE, 1990d). As a result of airborne radioactive particulates, dose to the public may result 1) internally from direct inhalation of airborne contaminants and ingestion of contaminated food or water, and 2) externally from ground-plane irradiation from contaminated soil and direct radiation as a result of immersion in contaminated air. For routine operations, air concentrations and surface deposition levels are calculated using annual average site meteorological conditions. Radiological exposures to members of the public are calculated by summing the exposures from the internal and external pathways. Dose calculations and applicable dose standards are fully discussed in Section 4.3.

The potential pathways for human exposure from WIPP activities form the basis for selection of environmental media to be monitored and the analytical methods to be used in the environmental monitoring program discussed in Section 5.0. Off-site radiation doses to members of the public may be estimated using measurements of emitted radionuclide concentrations in air, soil, water, vegetation, and biotic samples. Typically, the concentrations are quite low and challenge the sensitivity of analytical techniques. For this reason, radiation doses to the off-site collective population and to a maximally exposed individual are estimated using radionuclide emission rates, measured in the in-stack Fixed Air Sampler (FAS), as a source term. The Effluent Monitoring Program is discussed in Section 5.0.

Demonstration of compliance with requirements of DOE Order 5400.5 for routine releases from the WIPP are based upon calculations which make use of information obtained from the WIPP Effluent Monitoring and Environmental Surveillance Programs. Based on the pathway analysis above, the WIPP will primarily rely on the in-place effluent monitoring just discussed, monitoring of environmental transport and diffusion conditions, and its emergency monitoring capabilities to detect, quantify, and adequately respond to unplanned releases of radioactive material to the environment.

The Effluent Monitoring and Environmental Surveillance Programs (Section 5.0) evaluate both radiological and non-radiological parameters near effluent release points on site and at specific off-site locations. This monitoring, in conjunction with meteorological measurements, assists in establishing the relationships between radioactive effluent emissions and projected radiation doses to individuals off site via the potential internal and external exposure pathways discussed above.

4.3 CONSEQUENCE ANALYSIS

4.3.1 Overview of CAP88-PC

The total estimated annual airborne radioactivity released (source term), by isotope, is determined for each of the release locations as discussed in Section 4.3.8. The computer code Clean Air Act Associated Package, 1988 (CAP88-PC) is used to model the atmospheric transport of the calculated annual source terms. CAP88-PC uses a modified Gaussian plume model to estimate the average dispersion of radionuclides released. Using input of source term, stack information, and site specific annual meteorological conditions, the code estimates radionuclide concentrations in air, rates of deposition on ground surfaces, and ground surface and soil concentrations. In addition, using inputs of agricultural data, the code computes the concentrations in food and intake rates to humans from ingestion of food produced in the assessment area.

Dose and risk are estimated by combining the inhalation and ingestion intake rates, the computed air and ground surface concentrations, and dose and risk conversion factors. The effective dose equivalent is calculated using the weighting factor in the International Commission on Radiological Protection (ICRP) 26. Risks are based on lifetime risk from lifetime exposure, with a nominal value of 4E-04 cancers/rem. Dose and risk are tabulated by the code as a function of radionuclide, pathway, location, and organ. CAP88-PC also tabulates the frequency distribution of risk, showing the number of people at various levels of risk.

4.3.2 Stack Effluent Monitoring and Modeling

Based on the pathway analysis discussed in Section 4.2, the WIPP will primarily rely on the in-place effluent monitoring to determine radionuclide emission rates from the Waste Handling Building stack and/or the Storage Exhaust stack. The total annual airborne radioactivity released (source term), by isotope, is determined for each of the release locations as input to CAP88-PC. Table 4-1 lists the estimated total annual radioactivity released as a result of normal operations as presented in the FSAR. Measurements of radionuclide concentrations in effluent air streams will be made periodically during operations. Radionuclide concentrations are determined by laboratory analyses of FAS samples.

Additionally, CAP88-PC requires input describing the area or point of release. Because the air discharged from the stacks is released at a relatively high velocity, the release effectively takes place at a height above the physical stack heights. Input specified to the code and describing these stacks is summarized in Table 4-2.

4.3.3 Meteorological Modeling

The area surrounding the WIPP site is modeled as an 80-kilometer (50-mile) radius circular grid system with the site located at the center. Site-specific meteorological data, typical of annual average conditions, are used in the assessment of routine annual releases (See Table 4-3). Data are accumulated on a yearly basis for input to CAP88-PC in the form of Stability and Array File (STAR). Data are accumulated by frequency of occurrence that the wind is blowing from a particular direction, at a particular stability, at a particular wind speed in knots. A utility code supplied with CAP88-PC converts this STAR file to a format usable by the code.

CAP88-PC determines the frequency of atmospheric stability classes (Table 4-4), frequencies of wind directions and true-average wind speeds (Table 4-5), and frequencies of wind directions and reciprocal-average wind speeds (Table 4-6) for each of the 16 compass directions starting at the north and then proceeding counterclockwise. CAP88-PC uses reciprocal-averaged wind speeds in the atmospheric dispersion equations, which permit a single calculation for each wind speed category.

The average depth of the atmospheric mixing layer (lid) for the area is specified to limit the vertical dispersion of the plume after it travels some distance downwind of the source. The value used for the lid height is 1,435 m (4,735.5 ft) [the average of the 470 m (1,551 ft) mean morning lid and the 2,400 m (7,920 ft) mean afternoon lid].

4.3.4 Dispersion Modeling

The basic equation used by CAP88-PC to estimate plume dispersion in the downwind direction is a modified Gaussian plume model of Pasquill as modified by Gifford. The values of the horizontal and vertical dispersion coefficients (σ_y and σ_z) used for dispersion and depletion calculations are those recommended by Briggs. The code maintains a mass balance along the plume to reduce the concentration of the plume by accounting for removal of radionuclides due to deposition. With respect to deposition of radionuclides on ground surfaces, the code permits considering both dry

deposition and precipitation scavenging. Radionuclides are depleted from the plume by precipitation scavenging, dry deposition, and radionuclide decay.

Dry deposition is the process by which particles deposit on grass, leaves, and other surfaces by impingement, electrostatic deposition, chemical reactions, or chemical reactions with surface components. The rate of deposition on earth surfaces is proportional to the ground-level concentrations of the radionuclides in air:

$$R_d = V_d x$$

where:

R_d = Surface deposition rate, pCi/cm^2-s,
x = Ground level concentration in air, pCi/cm^3, and
V_d = Deposition velocity, cm/s.

Defaults for deposition velocity used by CAP88-PC are 1.8E-03 m/sec for particulates, and zero for gases.

The rate of deposition by scavenging is a function of the precipitation rate and is principally a mechanism of washout of particles from a plume by rain or snow. The scavenging coefficient is an average value for the entire year and includes all periods without rain or snowfall; i.e., the model treats scavenging as a continuous depletion, at a constant rate, of contaminants from the plume over the entire year. The scavenging coefficient has units of s^{-1}. The scavenging rate (R_s), in pCi/cm^2-s, is:

$$R_s = r x_{ave} L$$

where:

r = Scavenging coefficient, s^{-1}
x_{ave} = Average concentration of nuclide in a column of air to the lid height, pCi/cm^3
L = Height of the lid, cm.

The scavenging coefficient is calculated in CAP88-PC by multiplying the rainfall rate by 1E-07 yr/cm-s. Refer to Tables 4-7, 4-8, and 4-9 for values for radionuclide-dependent parameters used by CAP88-PC.

4.3.5 Terrestrial Modeling

As previously discussed, the area surrounding the WIPP site is modeled as an 80-kilometer (50-mile) radius circular grid system with the site located at the center. WIPP-specific data for population are used and are summarized in Table 4-10. Beef and dairy cattle, and vegetable crop productivity data used in the dose assessment is CAP88-PC default for the State of New Mexico and are summarized in Tables 4-11, 4-12, and 4-13. Table 4-14 summarizes radionuclide-independent default data used by CAP88-PC.

4.3.6 Dose Modeling

Radiation dose is calculated by multiplying radioactivity concentrations in air and water or on contaminated ground surfaces, by assumed human intake rates (for internal exposure) or exposure times (for external exposure to penetrating radiation), and then by the appropriate radiation dose conversion factors. That is:

Radiation Dose = (Radioactivity Concentration) x (Intake Rate/Exposure Time) x (Dose Conversion Factor)

Radioactivity concentrations may be determined by direct environmental measurements or by calculating them using computer models. Typically, the concentrations as a result of WIPP operations and/or background are quite low and challenge the sensitivity of analytical techniques. For this reason, radioactivity concentrations at off-site receptor locations, resulting of the atmospheric transport of radionuclides released from WIPP, are estimated by computer air dispersion modeling. As required by DOE Order 5400.5 and 40 CFR Part 61, the computer code used at WIPP is CAP88-PC (Clean Air Act Associated Package, 1988).

Using the calculated concentrations, the code then estimates the resulting annual EDE to the maximum individual and to the collective population that may result 1) internally from direct inhalation of airborne contaminants and ingestion of contaminated food or water, and 2) externally from ground-plane irradiation from contaminated soil and direct radiation as a result of immersion in contaminated air.

Dose and risk are estimated by CAP88-PC by multiplying the calculated concentrations by 1) the code default inhalation and calculated ingestion intake rates and external exposure rates and 2) by dose and risk conversion factors. Internal dose conversion factors are for a 50-yr dose commitment resulting from 1 year of chronic exposure. Continuous exposure for 1 year is assumed in calculating external exposure from ground-surface and air immersion irradiation. DOE Order 5400.5 allows the option of using dose conversions factors from DOE/EH-0070 and -0071 (DOE, 1988a,b) or using factors published by the EPA in EPA-520/1-88-020 (EPA,1988). CAP88-PC incorporates separate approved EPA dose conversion factors, and comparison indicates they are the most conservative.

The EDE is calculated using the weighting factors in ICRP Publication 26 (ICRP, 1977). Risks are based on lifetime risk from lifetime exposure, with a nominal value of 4E-04 cancers/rem of exposure.

4.3.7 Regulatory Compliance

Dose evaluations are conducted to the extent required by DOE 5400.5 for compliance with applicable DOE public dose standards and with 40 CFR Part 61 and 40 CFR Part 191. However, since it was determined in the FSAR that the air pathway is the only credible biosphere release and exposure pathway from the WIPP during operations, and the 40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAPs) dose limit of 10 mrem EDE (applies to airborne pathways only) is the most restrictive, the 10 mrem EDE NESHAPS limit is designated as the off-site limit for WIPP (DOE, 1991b).

The public dose limits, against which compliance is assessed, apply to doses from exposures to radiation sources from routine activities only. The public dose limits do not apply to doses from medical exposures or consumer products, naturally occurring radiation sources, or from accidents where controls of exposures cannot be maintained.

Compliance with the DOE 5400.5 standards (and 40 CFR Part 61 and Part 191 standards contained within) is demonstrated through an annual assessment of radiation dose to the public documented in the WIPP Site Environmental Report.

4.3.8 Release and Dose Consequence Assessment

Very small amounts of contamination may be present on the surface of the waste containers when received at the WIPP. The WIPP FSAR discusses the development of radioactivity release quantities from normal operations (Table 4-1). The AIRDOS-EPA computer code was then used to estimate the radiation dose to man resulting from the atmospheric releases of radionuclides from the facility. Site-specific meteorological data typical of annual average conditions were used in the above calculations.

The FSAR conservatively estimates the Adult Maximum Individual Dose resulting from normal operations during the disposal phase to be 1.7E-06 rem/year effective dose equivalent (50 year dose commitment). These doses are far below the limits established by DOE Order 5400.5 and 40 CFR Parts 61 and 191. Additionally, the population dose was calculated to be 5.3E-04 person-rem/year (50-year dose commitment).

The locations where potentially contaminated air is discharged from the WIPP facilities are the WHB exhaust and the exhaust from the underground storage exhaust shaft (SES). The WHB exhaust is continuously filtered through two stages of HEPA filters. The SES exhaust flows through HEPA filters only when air monitors in the storage area or the shaft detect airborne radioactivity in excess of preset limits. If the air monitors detect sufficient activity, the underground ventilation air flow is reduced and diverted through HEPA filters in the Exhaust Filter Building.

TABLE 4-1

PROJECTED ANNUAL RADIOACTIVITY RELEASED AS A RESULT OF NORMAL CH AND RH OPERATIONS[1]

CH & RH Radionuclide	Waste Handling Building (Ci/yr)	Exhaust Shaft (Ci/yr)
Co-60	3.08E-15	3.88E-10
Sr-90	9.25E-14	1.16E-08
Ru-106	6.35E-16	7.99E-11
Sb-125m	2.00E-17	2.51E-12
Cs-137	7.80E-14	9.82E-09
Ce-144	6.17E-15	7.76E-10
Th-232	1.10E-18	2.34E-13
U-233	3.33E-14	8.99E-09
U-235	6.10E-17	1.57E-11
U-238	3.15E-17	1.90E-12
Np-237	8.00E-17	8.65E-11
Pu-238	1.53E-11	1.90E-06
Pu-239	2.02E-12	6.10E-07
Pu-240	5.25E-13	1.75E-07
Pu-241	7.19E-11	9.43E-05
Pu-242	9.28E-17	3.29E-11
Am-241	7.47E-12	8.72E-06
Cm-244	5.05E-14	6.37E-09
Cf-252	1.23E-14	1.07E-09

1. Data from FSAR (DOE,1990c, Table 6.1-12)

TABLE 4-2

STACK INFORMATION[1]

PARAMETER	WASTE HANDLING BUILDING	STORAGE EXHAUST FILTER BUILDING
Number of stacks	1	2
Stack Height	14.9 m	8.2 m
Stack Diameter	2.4 m^2	4.4 m
Velocity of Stack Gas	9.5 m/s	6.7 m/s

1. Data from SEIS (DOE, 1990d)

2. Equivalent diameter

TABLE 4-3

METEOROLOGICAL DATA[1]

PARAMETER	VALUE
Lid Height	1,435 m
Average Temperature	15.56 °C
Average Rainfall	24.13 cm/yr
Frequency of Atmospheric Stability Classes	Table 4-4
Frequencies of Wind Directions and True-Average Wind Speeds	Table 4-5
Frequencies of Wind Directions and Reciprocal-Average Wind Speeds	Table 4-6

Pasquill Category	Vertical Temperature Difference (°C/100m)	Sigma Theta (degrees)
A	$\Delta T/\Delta Z \leq -1.9$	$\sigma\Theta \geq 22.5$
B	$-1.9 < \Delta T/\Delta Z \leq -1.7$	$22.5 > \sigma\Theta \geq 17.5$
C	$-1.7 < \Delta T/\Delta Z \leq -1.5$	$17.5 > \sigma\Theta \geq 12.5$
D	$-1.5 < \Delta T/\Delta Z \leq -0.5$	$12.5 > \sigma\Theta \geq 7.5$
E	$-0.5 < \Delta T/\Delta Z \leq 1.5$	$7.5 > \sigma\Theta \geq 3.8$
F	$1.5 < \Delta T/\Delta Z \leq 4.0$	$3.8 > \sigma\Theta \geq 2.1$
G	$4.0 < \Delta T/\Delta Z$	$2.1 > \sigma\Theta$

1. Data from SEIS (DOE, 1990d).

TABLE 4-4

FREQUENCY OF ATMOSPHERIC STABILITY CLASSES FOR EACH DIRECTION

Fraction of time in each stability class

Wind Direction	A	B	C	D	E	F	G
N	0.5740	0.0084	0.0042	0.0391	0.0705	0.0517	0.2521
NNW	0.3376	0.0084	0.0038	0.0287	0.0738	0.1937	0.3540
NW	0.2030	0.0071	0.0034	0.0240	0.0907	0.1979	0.4740
WNW	0.1869	0.0098	0.0045	0.0548	0.1209	0.1794	0.4437
W	0.2813	0.0246	0.0086	0.1044	0.1597	0.1413	0.2801
WSW	0.2627	0.0208	0.0091	0.1053	0.1756	0.1144	0.3121
SW	0.2320	0.0044	0.0132	0.0485	0.1498	0.1175	0.4347
SSW	0.2981	0.0154	0.0154	0.0615	0.1231	0.0712	0.4154
S	0.3701	0.0168	0.0037	0.0299	0.1252	0.1121	0.3421
SSE	0.4469	0.0163	0.0041	0.0265	0.0898	0.0714	0.3449
SE	0.5295	0.0153	0.0088	0.0306	0.0722	0.0481	0.2954
ESE	0.4420	0.0122	0.0020	0.0326	0.0570	0.0855	0.3686
E	0.5465	0.0178	0.0076	0.0293	0.0561	0.0726	0.2701
ENE	0.5657	0.0046	0.0061	0.0428	0.0413	0.0428	0.2966
NE	0.5731	0.0134	0.0134	0.0403	0.0538	0.0336	0.2723
NNE	0.6558	0.0061	0.0048	0.0400	0.0461	0.0218	0.2255

TABLE 4-5

FREQUENCIES OF WIND DIRECTIONS AND TRUE-AVERAGE WIND SPEEDS

		Wind speeds for each stability class (m/s)						
Wind Toward	Frequency	A	B	C	D	E	F	G
N	0.091	3.90	2.62	2.62	3.69	3.29	3.58	2.40
NNW	0.151	4.36	3.91	3.25	3.94	4.79	5.54	3.03
NW	0.188	3.94	3.77	3.85	3.86	4.18	4.54	2.94
WNW	0.085	3.28	4.00	3.87	3.95	3.93	3.32	2.45
W	0.052	4.46	5.32	6.61	5.33	5.39	4.80	3.01
WSW	0.049	4.67	5.10	6.25	5.65	6.18	5.16	2.93
SW	0.043	4.40	2.98	3.05	4.17	4.90	4.04	2.65
SSW	0.033	4.06	3.38	4.36	4.23	4.29	3.57	2.65
S	0.034	4.25	4.28	3.15	3.87	4.40	3.74	2.70
SSE	0.031	4.02	2.26	2.25	3.16	3.52	3.97	2.94
SE	0.029	3.57	2.26	2.76	3.31	3.41	4.54	2.79
ESE	0.031	4.28	3.18	0.85	3.08	4.88	5.21	3.36
E	0.050	5.64	3.37	5.11	4.74	5.10	6.01	3.57
ENE	0.042	4.84	0.85	4.10	3.73	3.40	5.39	3.01
NE	0.038	3.75	3.60	4.08	2.73	3.58	2.90	2.63
NNE	0.053	3.54	2.27	3.15	2.74	2.75	2.11	2.23

TABLE 4-6

FREQUENCIES OF WIND DIRECTIONS AND RECIPROCAL-AVERAGE WIND SPEEDS

		Wind speeds for each stability class (m/s)						
Wind Toward	Frequency	A	B	C	D	E	F	G
N	0.091	3.11	2.00	2.00	2.71	2.58	2.78	2.40
NNW	0.151	3.46	2.74	2.99	2.76	3.35	4.45	3.03
NW	0.188	3.04	2.46	3.21	3.09	3.04	3.55	2.94
WNW	0.085	2.51	3.20	3.37	2.84	2.93	2.50	2.45
W	0.052	3.31	4.09	5.99	4.08	3.68	3.64	3.01
WSW	0.049	3.11	3.59	5.55	3.81	4.16	3.69	2.93
SW	0.043	3.12	1.80	2.80	2.85	3.46	2.57	2.65
SSW	0.033	2.84	2.28	2.84	2.75	3.21	2.34	2.65
S	0.034	3.00	2.12	2.89	1.99	2.70	2.08	1.91
SSE	0.031	2.75	1.47	2.25	1.71	2.04	2.51	2.02
SE	0.029	2.52	1.40	3.10	1.99	2.30	2.76	2.01
ESE	0.031	2.68	1.96	0.85	1.47	1.94	2.55	2.11
E	0.050	3.57	1.76	2.64	2.39	2.71	4.35	2.15
ENE	0.042	3.14	0.85	2.02	1.99	1.71	4.23	2.11
NE	0.038	2.50	2.42	2.05	1.62	2.19	1.76	1.83
NNE	0.053	2.70	1.21	2.89	2.04	1.83	1.46	1.63

TABLE 4-7

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS TABLE A

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
Co-60	Y	1.0	2.41E-06	1.80E-03
Sr-90	Y	1.0	2.41E-06	1.80E-03
Ru-106	Y	1.0	2.41E-06	1.80E-03
Sb-125	W	1.0	2.41E-06	1.80E-03
Cs-137	D	1.0	2.41E-06	1.80E-03
Ce-144	Y	1.0	2.41E-06	1.80E-03
Th-232	Y	1.0	2.41E-06	1.80E-03
U-233	Y	1.0	2.41E-06	1.80E-03
U-235	Y	1.0	2.41E-06	1.80E-03
U-238	Y	1.0	2.41E-06	1.80E-03
Np-237	W	1.0	2.41E-06	1.80E-03
Pu-238	W	1.0	2.41E-06	1.80E-03
Pu-239	W	1.0	2.41E-06	1.80E-03
Pu-240	W	1.0	2.41E-06	1.80E-03
Pu-241	W	1.0	2.41E-06	1.80E-03
Pu-242	W	1.0	2.41E-06	1.80E-03
Am-241	W	1.0	2.41E-06	1.80E-03
Cm-244	W	1.0	2.41E-06	1.80E-03
Cf-252	Y	1.0	2.41E-06	1.80E-03

TABLE 4-8

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS TABLE B

	DECAY CONSTANT (PER DAY)		TRANSFER COEFFICIENT		
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3)
Co-60	0.00E+00	5.48E-05	0.00E+00	2.00E-03	2.00E-02
Sr-90	0.00E+00	5.48E-05	0.00E+00	1.50E-03	3.00E-04
Ru-106	0.00E+00	5.48E-05	0.00E+00	6.00E-07	2.00E-03
Sb-125	0.00E+00	5.48E-05	0.00E+00	1.00E-04	1.00E-03
Cs-137	0.00E+00	5.48E-05	0.00E+00	7.00E-03	2.00E-02
Ce-144	0.00E+00	5.48E-05	0.00E+00	2.00E-05	7.50E-04
Th-232	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-06
U-233	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
U-235	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
U-238	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
Np-237	0.00E+00	5.48E-05	0.00E+00	5.00E-06	5.50E-05
Pu-238	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-239	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-240	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-241	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-242	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Am-241	0.00E+00	5.48E-05	0.00E+00	4.00E-07	3.50E-06
Cm-244	0.00E+00	5.48E-05	0.00E+00	2.00E-05	3.50E-06
Cf-252	0.00E+00	5.48E-05	0.00E+00	0.00E+00	0.00E+00

FOOTNOTES: (1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

Table 4-9

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS TABLE C

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
Co-60	2.00E-02	3.00E-03	5.00E-02	3.00E-01
Sr-90	2.50E+00	1.07E-01	1.00E-02	3.00E-01
Ru-106	7.50E-02	8.56E-03	5.00E-02	5.00E-02
Sb-125	2.00E-01	1.28E-02	1.00E-02	1.00E-01
Cs-137	8.00E-02	1.28E-02	9.50E-01	9.50E-01
Ce-144	1.00E-02	1.71E-03	3.00E-04	3.00E-04
Th-232	8.50E-04	3.64E-05	2.00E-04	2.00E-04
U-233	8.50E-03	1.71E-03	2.00E-03	2.00E-01
U-235	8.50E-03	1.71E-03	2.00E-03	2.00E-01
U-238	8.50E-03	1.71E-03	2.00E-03	2.00E-01
Np-237	1.00E-01	4.28E-03	1.00E-03	1.00E-03
Pu-238	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-239	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-240	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-241	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-242	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Am-241	5.50E-03	1.07E-04	1.00E-03	1.00E-03
Cm-244	8.50E-04	6.42E-06	1.00E-03	1.00E-03
Cf-252	0.00E+00	0.00E+00	1.00E-03	1.00E-03

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pastu and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

TABLE 4-10

POPULATION DATA[1]

Direction	Distance (m) 1650	5500	9200	13700	25000	41650	58350	75000
N	0	0	0	0	29	23	195	28
NNW	0	0	0	0	17	6	237	11
NW	0	0	0	0	28	17	61	15080
WNW	0	0	10	0	6	164	50	44
W	0	0	0	0	66	24952	39	33
WSW	0	0	0	0	1707	171	55	72
SW	0	5	0	0	0	17	11	44
SSW	0	0	0	8	6	28	105	17
S	0	0	0	0	6	16	56	17
SSE	0	0	0	0	0	29	12	47
SE	0	0	0	0	6	23	29	35
ESE	0	0	0	0	6	12	2150	315
E	0	0	0	0	6	18	2500	186
ENE	0	0	0	0	12	82	216	29115
NE	0	0	0	0	0	29	82	8224
NNE	0	0	0	0	29	5	58	6418

1. Data from SEIS (DOE, 1990d).

TABLE 4-11

NUMBER OF BEEF CATTLE[1]

	Distance (meters)							
Direction	1650	5500	9200	13700	25000	41650	58350	75000
N	9	39	45	133	673	1128	1580	2019
NNW	9	39	45	133	673	1128	1580	2019
NW	9	39	45	133	673	1128	1580	2019
WNW	9	39	45	133	673	1128	1580	2019
W	9	39	45	133	673	1128	1580	2019
WSW	9	39	45	133	673	1128	1580	2019
SW	9	39	45	133	673	1128	1580	2019
SSW	9	39	45	133	673	1128	1580	2019
S	9	39	45	133	673	1128	1580	2019
SSE	9	39	45	133	673	1128	1580	2019
SE	9	39	45	133	673	1128	1580	2019
ESE	9	39	45	133	673	1128	1580	2019
E	9	39	45	133	673	1128	1580	2019
ENE	9	39	45	133	673	1128	1580	2019
NE	9	39	45	133	673	1128	1580	2019
NNE	9	39	45	133	673	1128	1580	2019

1. CAP88-PC Default data for New Mexico; using Beef Cattle Density of 4.130E-2 (#/km^2)

TABLE 4-12

NUMBER OF MILK CATTLE[1]

	Distance (meters)							
Direction	1650	5500	9200	13700	25000	41650	58350	75000
N	0	1	1	4	19	31	44	56
NNW	0	1	1	4	19	31	44	56
NW	0	1	1	4	19	31	44	56
WNW	0	1	1	4	19	31	44	56
W	0	1	1	4	19	31	44	56
WSW	0	1	1	4	19	31	44	56
SW	0	1	1	4	19	31	44	56
SSW	0	1	1	4	19	31	44	56
S	0	1	1	4	19	31	44	56
SSE	0	1	1	4	19	31	44	56
SE	0	1	1	4	19	31	44	56
ESE	0	1	1	4	19	31	44	56
E	0	1	1	4	19	31	44	56
ENE	0	1	1	4	19	31	44	56
NE	0	1	1	4	19	31	44	56
NNE	0	1	1	4	19	31	44	56

1. CAP88-PC Default data for New Mexico; using Milk Cattle Density of 1.14E-03 (#/km^2)

TABLE 4-13

AREA OF VEGETABLE CROP PRODUCTION[1]

Distance (meters)

Direction	1650	5500	9200	13700	25000	41650	58350	75000
N	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
NNW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
NW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
WNW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
W	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
WSW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
SW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
SSW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
S	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
SSE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
SE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
ESE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
E	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
ENE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
NE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
NNE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05

1. CAP88-PC Default data for New Mexico; using land fraction cultivated for vegetable crops of 1.380E-03.

TABLE 4-14

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/m^2, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (y)	1.00E+02
For radionuclides deposited on ground/water (d)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transpr time from animal feed-milk-man (d)	2.00E+00
Time from slaughter to consumption (d)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/l vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/m^2)	2.80E-01
Produce/leafy veg for human consumption (kg/m^2)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

TABLE 4-14

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS
Continued

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/d, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/d)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (d)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	1.00E+00
Meat	1.00E+00
Milk	1.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Actual fractions of food types from outside area can be greater than the minimum fractions listed below.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

5.0 ENVIRONMENTAL MONITORING PROGRAM

As required by DOE Order 5400.1, each facility is required to perform a "preoperational study to begin not less than one year, and preferably two years before start-up to evaluate seasonal changes." The DOE WIPP has complied with this requirement by compiling five years of preoperational environmental data. An analysis of the preoperational data is contained in the following documents: 1) Statistical Summary of the Radiological Baseline for the WIPP (DOE/WIPP 92-037), 2) Summary of the Salt Impact Studies at the WIPP, 1984 to 1990, (DOE/WIPP 92-038), 3) A Study of Disturbed Land Reclamation Techniques for the WIPP (DOE/WIPP 92-039), and 4) Background Water Quality Characterization Report for the WIPP (DOE/WIPP 92-013).

The environmental sampling programs used to establish the preoperational study are defined in Chapter 5 of the OEMP (DOE/WIPP 88-025). This is an update of the OEMP. This plan describes the environmental monitoring efforts at the WIPP as the project moves from the predisposal phase into the disposal phase.

The Westinghouse, Waste Isolation Division (WID) Environmental Monitoring Section at the WIPP is administered by the Environment, Safety, Health and Regulatory Compliance Department to ensure compliance with pertinent environmental regulations as required by DOE Order 5400.1. DOE Order 5400.1 states that environmental surveillance shall be conducted to monitor the effects, if any, of DOE activities on-site and off-site. An environmental surveillance program shall be undertaken at DOE sites to determine the need for a permanent surveillance program. In addition, environmental surveillance programs and components should be determined on a site-specific basis by the field organization. Programs should reflect facility characteristics; applicable regulations; hazard potential; quantities and concentrations of materials released; the extent and use of affected air, land, and water; and specific local public interest or concern (DOE, 1990a).

5.1 GUIDELINES

Under the Atomic Energy Act of 1954, as amended, the DOE is obligated to regulate its own activities so as to provide radiation protection for both workers and the public. Presidential Executive Order 12088, "Federal Compliance with Pollution Control Standards," further requires the heads of executive agencies to ensure that all Federal facilities and activities comply with applicable pollution control standards and to take all actions necessary for the prevention, control, and abatement of environmental pollution.

It is the policy of the DOE to conduct effluent monitoring and environmental surveillance programs that are appropriate for determining adequate protection of the public and the environment during DOE operations and to assure that operations are in compliance with DOE and other applicable Federal, State, and local radiation standards and requirements. It is also DOE policy that departmental monitoring and surveillance programs be capable of detecting and quantifying unplanned releases, while meeting high standards of quality and credibility. It is DOE's objective that all DOE operations properly and accurately measure radionuclides in effluent streams and in the ambient environmental media.

A Guide for Environmental Radiological Surveillance at DOE Installations (DOE/EP-0023) (Corley et al., 1981) states that the factors which should be considered in determining the relative level of environmental surveillance required at a facility include:

(1) the potential hazard of the materials released, considering both expected quantities and relative radiotoxicities;

(2) the extent to which facility operations are routine and unchanging;

(3) the need for supplementing and complementing effluent monitoring;

(4) the size and distribution of the exposed population;

(5) the cost-effectiveness of increments to the environmental surveillance program; and

(6) the availability of measurement techniques which will provide sufficiently sensitive comparisons with applicable standard and background measurements.

The above guidance, the risk analysis in the WIPP FSAR, and the dose criteria in DOE Order 5400.5 indicate that operational dose estimates for the WIPP are significantly below dose criteria. However, the purpose of the WIPP is to demonstrate that the long-term disposal of TRU waste in bedded salt can be accomplished safely, and that the natural environment will not be significantly impacted as a result of the construction and operation of the disposal facility. To this end, the WIPP EMP encompasses a comprehensive set of parameters that detect and quantify environmental impacts. As required in DOE Order 5400.1, the EMP is reviewed annually and updated every three years. The EMP scope and intensity is adjusted in response to changing facility processes, environmental parameters, and program results.

Parameters measured include ambient radiation levels, atmospheric conditions, air and water quality, soil properties, and the status of the local biological community. Nonradiological portions of the program focus on the immediate area surrounding the site, whereas radiological surveillance generally covers a broader geographical area including nearby ranches, villages, and cities. Environmental monitoring will continue at the site during project operations and through decommissioning activities. The Radiological Baseline Program (RBP) and the Ecological Monitoring Program have been incorporated, as appropriate, into the EMP.

The goal of the EMP is to determine if the local ecosystem has been impacted during the predisposal and disposal phases of the WIPP, and if so, to evaluate their severity, geographic extent, and environmental significance. Tables 5-1 and 5-2 summarize the EMP sampling schedule and analytical array. These tables list the sample types, number of sampling stations, approximate sampling schedule and the environmental/ecological parameters monitored or analyzed. It is important to emphasize the need for flexibility in the design and implementation of the EMP. Additional or different types of samples will be collected and analyzed as necessary to investigate and explain trends or anomalies that may have a bearing on the WIPP's environmental impacts. The EMP radiological sampling and analysis schedule is less extensive than that of the RBP. Baseline conditions were characterized by the RBP prior to waste emplacement at the WIPP and are summarized in the Statistical Summary of the Radiological Baseline for the WIPP (DOE/WIPP 92-037). RBP sampling was extensive because additional baseline data cannot be collected after wastes arrive. Environmental and ecological sampling during operations will be increased if warranted.

As recommended in DOE/EH-0173T, the EMP provides the guidance for monitoring levels of naturally occurring radionuclides, those associated with world-wide fallout, and those expected in the WIPP wastes. The geographic scope of radiological sampling is based on projections of potential release pathways for the types of radionuclides in the WIPP wastes. Also, the surrounding population centers are monitored even though release scenarios involving radiation doses to residents of those population centers are improbable. Ecological sampling activities will continue to be performed at the permanent ecological monitoring plots. These sampling locations are unchanged from those reported in the OEMP.

Sampling and related activities (sample logging, packaging, and shipping) are conducted in accordance with the procedures and instructions described in the WIPP Procedures. Standard sampling practices and techniques are used (see Section 6.0). Most samples are analyzed by a commercial laboratory selected using a prequalifying program.

Sample splits are made available to the Environmental Evaluation Group (EEG) and the NMED. The EEG has developed and implemented an environmental monitoring program at WIPP which provides independent verification of the WIPP's environmental monitoring results. The EEG environmental surveillance program has provided independent data verification for the WIPP Project during the preoperational phase to date. NMED oversight at the WIPP includes independent verification of environmental sampling, effluent and spill sampling, oversight of cleanup and environmental restoration activities, data validation/verification, and comprehensive program evaluations.

The Carlsbad Environmental Monitoring and Research Center, operated by New Mexico State University, is a research organization which also conducts independent environmental monitoring in the WIPP vicinity. The Center currently operates one underground and two surface aerosol monitoring sites at the WIPP. Studies are now being conducted to determine the size distribution for atmospheric aerosols as well as their chemical and radionuclide composition. The results of these studies will provide the basis for identifying the various sources of atmospheric aerosols (e.g., oil and gas, potash mining, soil, and WIPP). Additionally, the Center will be conducting in vivo bioassay monitoring of the general public and WIPP radiation workers starting in the summer of 1994.

Quality assurance/quality control has been established within the framework of the overall WID Quality Assurance Manual (WP 13-1) and is described in Section 8 of this EMP. When the WIPP data are received they are evaluated and presented in the WIPP Site Environmental Report.

5.2 SITE CHARACTERIZATION

Characterization studies were initiated to begin evaluating the adequacy of the site as a long-term repository and to obtain information necessary for modeling. These earlier studies have influenced the current WIPP environmental monitoring efforts described below.

5.2.1 WIPP Biology Program

The WIPP Biology Program (Best and Neuhauser, 1980) began in August 1975 with baseline studies of climate, soils, vegetation, arthropods, and vertebrates. The program was expanded in late 1977 to include studies of floristics, primary productivity, plant succession, microbial biogeochemistry, and the aquatic ecosystem of the lower Pecos River. The major objectives were: 1) to acquire baseline data on the WIPP environment, including information for environmental documentation; 2) to provide data useful in the determination of possible radionuclide pathways between the WIPP facility and humans; and 3) to aid in the establishment of a long-term ecological monitoring program.

In 1980, the program was re-oriented to emphasize studies that would help predict specific environmental impacts associated with construction and operations. Soils were experimentally treated with salt, and plants were trampled and grazed in order to make quantitative predictions of the effects of these potential impacts. The effects of salt on population of arthropods and decomposition of leaf litter were also studied because of the relatively high sensitivity of these ecosystem components and processes as possible indicators of chemical impacts. In 1984, the WIPP Biology Program was succeeded by the Ecological Monitoring Program.

5.2.2 United States Geological Survey (USGS) Studies

Before the WIPP project was proposed, the region was studied intensively by the USGS because of its potential potash (USBM, 1977; AIM, 1979) and oil and gas (Keesey, 1979) resources. At the request of DOE, the USGS has conducted investigations of the geohydrology of the WIPP area. Their research documented naturally occurring radionuclide levels in subsurface water of the three major members of the Rustler Formation. Data on gross alpha/beta, radium, and uranium levels in each member from a total of 20 well locations were obtained (USGS, 1983). Also, the USGS

maintains a routine surface sampling program on the Pecos River (USGS, 1978-1984). Summaries of the USGS mineral, petroleum, and geohydrology studies are presented in the WIPP FEIS (DOE, 1980).

Additionally, Columbia University personnel under Nuclear Regulatory Commission (NRC) contract performed a study of radionuclide mobility in the highly saline groundwater of the Delaware Basin, which is the area underlying the WIPP (Simpson et al., 1985). This study documented radium, uranium, thorium, and plutonium levels in groundwater and surface waters of the Delaware Basin. A summary of the data from the Columbia University study is presented in Bradshaw and Louderbough (1987).

5.2.3 Project Gnome

Although not a part of the WIPP studies, Project Gnome is also of interest when considering environmental monitoring at the WIPP and the radiological history of southeastern New Mexico. In December 1961, as part of the Plowshare Program sponsored by the Atomic Energy Commission (AEC), a three-kiloton nuclear device was detonated underground approximately 12 km (7.5 miles) southwest of the present WIPP Site (USAEC, 1962a; Lantz and Berry, 1978). The detonation and subsequent activities released some radionuclides into the surrounding environment. Radiological monitoring of air, water, and biological media was conducted by the AEC before and after the Gnome detonation (USAEC, 1962a, b, c, d).

In 1963, the AEC initiated a study of the mobility of radionuclides in the Salado Formation. As part of this study, two wells at the Gnome Site were intentionally contaminated with ^{3}H, ^{131}I, ^{90}Sr, and ^{137}Cs. The EPA annually samples these wells and others in the area of Project Gnome. Tritium values in the two wells (USGS Wells 4 and 8) are still elevated, as are levels of Strontium-90 and Cesium-137 (USAEC, 1973).

The EPA established a program in 1972 to monitor radionuclide levels in surface water and groundwater in the area potentially affected by the Project Gnome activities. Included in the program are several USGS wells, municipal water supplies for Carlsbad and Loving, New Mexico, and the Pecos River. Other wells in the area show radionuclide levels consistent with normal background activity. Results are published in EPA's "Off-Site Environmental Monitoring Reports for Nuclear Test Areas Around the United States" (EPA, 1984 and 1985c). An aerial radiological survey of the area in 1981 indicated that the AEC's post-shot decontamination efforts had reduced radioactivity (DOE, 1981b).

In 1988, an additional aerial gamma survey was conducted (AMO-8809). A machine-aided search of the data for man-made radiation sources indicated the presence of Cs-137 at the Gnome Site, which was expected from previous work done in the area. No other sources of man-made radiation were found.

5.3 RADIOLOGICAL ENVIRONMENTAL MONITORING

The environmental surveillance program will continue to measure, with some modifications, the preoperational program and parameters monitored during the RBP and Ecological Monitoring Program. Each sampling subprogram of the EMP is described below.

5.3.1 Effluent Monitoring - Liquid Releases

The Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T) requires that monitoring of liquid waste effluent streams be adequate to demonstrate compliance with dose limits in DOE Order 5400.5, Radiation Protection of the Public and the Environment. Liquid effluent monitoring is also required to quantify radionuclides released and to alert operators of process inconsistences and malfunction of emission controls.

The only credible source of waste-generated liquid contamination at the WIPP is the WHB. There is no direct connection between the WHB and the sewage treatment system; therefore, there is no direct pathway for radioactive or hazardous contaminants associated with the TRU wastes to enter the WIPP sewage treatment system. There is a sump in the WHB that collects liquids from throughout the WHB. Should there ever be any liquid accumulation in the drains or sump as a result of stored TRU mixed waste leaking or fire-suppression water collection, the water in the sump will be sampled and analyzed for contamination as shown in Table 5-2. The following would then be performed in order to assure proper management of the waste:

- If the fire water is radioactive, it will be assumed to be TRU mixed waste and will be managed as derived waste. Solidification will occur as the water is transferred to the derived waste drum. Characterization will be in accordance with the Resource, Conservation, and Recovery Act Part B Permit Application.

- If the fire water is nonradioactive, a determination will be made if the water is hazardous waste. The determination will include sampling and analysis. Any waste determined to be nonradioactive hazardous waste will be managed in accordance with WIPP facility procedures for such waste.

- If the fire water is nonhazardous, as described in the New Mexico Environment Department (NMED) Discharge Plan for the WIPP (DP-831), it will be discharged to the WIPP facility sewage lagoon.

If the sump contents are radioactive or hazardous, or both, the WIPP will use a qualified contractor to remove and solidify the contents of the sump.

The WIPP sewage treatment system is a zero discharge facility made up of parallel synthetically lined settling and polishing cells that gravity flows treated effluent into a chlorination system, and then flows through lined evaporation ponds. The facility is designed to accommodate normal sewage effluent and to provide for disposal of nonhazardous brine waters.

Although the sewage treatment facility is a zero discharge facility, when it was expanded in 1993 the NMED required that a Discharge Plan be prepared which would stipulate monitoring requirements for water quality, and effluent volume. WP 02-EM1001, "Sewage Discharge Monitoring" incorporates the requirements of the Discharge Plan. Sewage system effluent water samples are collected quarterly from the primary settling ponds and evaporation ponds. Samples are analyzed for Nitrates (NO_3), Total Kjeldahl Nitrogen (TKN), Total Dissolved Solids (TDS), and Radium 226 and 228.

The volume of site generated and Water Quality Sampling Program brine waters are pumped into the evaporation basin. Brine waters discharged into the sewage evaporation basin result from observation well pumping around the WIPP site. The drinking water supplied to the WIPP is also sampled annually to monitor differences between the influent and effluent.

The WIPP conducts oversight sampling twice annually for nitrates, TKN, ammonia, total metals, dissolved metals, biological oxygen demand, chemical oxygen demand, cyanide, total organic compounds, oil/grease, phenols, pesticides, semi-volatiles, volatiles, pH, hexavalent chromium, total suspended solids, and total dissolved solids. The EMP radiological sampling is completed annually for specific radionuclides (constituents are listed in Table 5-2).

The level of sludges accumulating in the sewage system are monitored by WID operations as part of routine maintenance. If sludges accumulate in the sewage lagoon to a level that could impact facility storage capacity, representative samples of the solids will be collected and analyzed for

the parameters defined in 40 CFR 503, "Standards for the use of Disposal of Sewage Sludge." Based on the analytical results, the sludge will be handled and disposed in accordance with 40 CFR Part 503.

5.3.2 Effluent Monitoring - Airborne Emissions

Airborne effluent monitoring is especially important to the WIPP EMP. There are two potential sources of contaminated airborne emissions from the WIPP operations: releases generated above ground in WHB operations, and those generated underground which are released through the Exhaust Shaft (Figure 5-1). As recommended by DOE/EH-0173T both potential sources are sampled as appropriate.

Two effluent monitoring stations, A and B, sample exhaust from the underground operations. Sample extraction probes sample the unfiltered exhaust stream in the Exhaust Shaft (Station A), the filtered exhaust down stream of the Exhaust Filter Building (Station B), and the filtered exhaust of the Waste Handling Building (Station C). The filtered exhaust passes through HEPA filter banks prior to reaching the sample extraction probes at Stations B and C.

Because significant concentrations of salt dust are potentially present in the airstream at Station A, standard isokinetic sampling probes have been demonstrated to be ineffective. Therefore, an anisokinetic, shrouded probe system has been designed, developed and tested specifically for use at the WIPP. The Station A sampling array is composed of the anisokinetic shrouded probe, a flow controlling device, and a sample-collection filter. Station B, in the Exhaust Filter Building, is configured similarly. The exhaust air from the WHB is continuously routed through two stages of HEPA filters. After the air is filtered, it is sampled with an isokinetic sampling array connected to a flow-control and sampling system as at Stations A and B.

After Transuranic waste is received at the WIPP, filters (samples) from the systems at Stations A, B, and C will be collected each working day, and counted for gross alpha and gross beta activity, after a 72-hour period to allow for the decay of radon progeny. Selected effluent air samples will be analyzed for specific radionuclides on site (Table 5-2) or at an off-site lab if significant gross alpha or beta activity is indicated.

Gross alpha and beta counting are performed in gas-flow proportional counters. These counters provide a Minimum Detectable Activity level of 1 E^{-14} μCi/ml for a ten-minute count. If a sample is counted and activity is recorded equal to, or less than 2 E^{-13} μCi/ml alpha, or 2 E^{-10} μCi/ml beta, the sample is classified as nonradioactive.

Quality assurance in this process is rigorous and extensive. The components of quality assurance are described in the document DOE/WIPP 93-042, Final Quality Assurance Project Plan for Sampling Emissions of Radionuclides to the Ambient Air at the Waste Isolation Pilot Plant.

5.3.3 External Radiation

Thermoluminescent Dosimetry

Environmental dosimetry was conducted at the WIPP site beginning in 1976 and concluding in 1990. From 1985 (when the WIPP initiated the Radiological Baseline Program) until 1990 the WIPP employed a network of 44 TLDs located in two rings encompassing the WIPP site, at local points of interest, and in neighboring communities. These TLDs were used to measure penetrating radiation levels, and were processed on a quarterly basis to support the RBP.

Originally, it was intended that the program be continued through the operational period of the WIPP. However, in 1990 a decision was made to discontinue the environmental dosimetry program. The rationale for this decision was based on an internal study and a University of

Michigan study performed for the Environmental Evaluation Group in 1987. Both studies concluded that the WIPP Environmental Dosimetry Program could be discontinued since: 1) Environmental dosimetry is used to quantify levels of external penetrating radiation (i.e., gamma ray or x-ray sources). The TRU wastes that will be accepted at the WIPP are primarily alpha emitters, therefore environmental dosimetry would not be expected to be a very good indicator of offsite impacts. 2) The effluent sampling program and offsite airborne particulate sampling program are much more sensitive than an environmental dosimetry program for assessing potential offsite impacts of postulated releases from the WIPP.

There are no plans to reinitiate environmental dosimetry at the WIPP.

Continuous Exposure Rate Measurements

DOE/EH-0173T recommends:

> "For the monitoring of intermittent or unplanned releases, and for better identification of source terms, exposure-rate instrumentation should be available. . . . The deployment of at least one continuously-recording exposure-rate instrument is recommended, preferably near the site boundary, in the expected direction of a plume. Effluent monitors should provide detection and approximate magnitude of sudden changes in ambient radiation levels."

A High Pressure Ionization Chamber (HPIC) was established at the northwest corner of zone 1 in 1985. In 1988 the HPIC was moved to the WIPP Far Field site. The Far Field site is the primary environmental monitoring location for the WIPP releases. The HPIC provides a detection range of 1 μR/h to 100 μR/h.

5.3.4 Airborne Particulates

The WIPP SEIS identifies the atmospheric pathway as the most credible exposure pathway to man from the WIPP. Therefore, airborne particulate sampling for alpha-emitting radionuclides is emphasized in the EMP. Air sampling results are used to trend environmental radiological levels and determine if there has been a deviation from established background radiological levels. The inhalation of airborne radionuclides, either directly from the source (facility) or from resuspension following deposition, may result in their absorption from the lung, the gastro-intestinal tract, or the skin. Absorption and subsequent distribution in the human body depends on the particle size and the chemical state of the radionuclide. DOE/EH-0173T and DOE/EP-0023 provide guidance on deployment, operations, and program management of an airborne particulate monitoring program.

DOE/EH-0173T recommends that:

> "Air sampling locations should be selected to represent radionuclide concentrations breathed by the population surrounding the nuclear facility. Selection of background sampling and measurement locations for air must be made with special care. For measurements to be compared with the effects of airborne releases, a minimum distance of 15 to 20 km from the larger sites and 10 to 15 km from the smaller sites in the least prevalent wind direction is suggested for background sampling.
>
> Off-site air samplers should be employed at each DOE site having potential airborne releases that could result in an annual effective dose equivalent greater than 1 mrem to the maximally exposed individual. Sample locations should include the

following: a background or control location; locations of maximum predicted ground-level concentration from stack (or vent) releases, averaged over a period of 1 year where members of the public reside or abide; and locations in the nearest community within a 15-km radius of the site.

The exact number of samplers will be determined by meteorology, demography, and the magnitude of projected doses to the surrounding population. Unless documented site-specific evidence exists to justify otherwise, the sample(s) at each air sampling station should be collected at a height of 2 m above ground level (approximately the height of inhalation for adults), in a location free from unusual localized effects or other conditions (e.g., in proximity to a large building, vehicular traffic, or trees) that could result in artificially high or low concentrations. Locations should be selected to avoid areas where large-particle (nonrespirable) fugitive dusts can dominate the sample (Ludwig 1976)."

A method similar to that developed (Waite 1973b) and evaluated by Waite (1973a) was used to determine the number of air sampling stations and their placement. Waite's method entails examining demographic and meteorologic data for the site to determine the distance to local population centers, their population, and the wind frequency distribution and weighing factors that are scaled to equal the desired number of sampling locations.

Continuous Low volume (two cubic feet per minute) fixed air samplers (Lo-Vols) are used to collect airborne particulates. As recommended in DOE/EH-0173T, the samplers are, where possible, located approximately 2 meters (6.5 feet) above ground level in sites free from unusual micrometeorological or other conditions (e.g., proximity of large buildings, vehicular traffic) that could result in air concentration measurements that are artificially high or low. The Carlsbad and Eunice stations are currently located on top of municipal buildings, primarily to provide greater equipment security.

The current Lo-Vol sampling array (Figure 5-2) consists of eight sampling stations, the locations of which are based primarily on meteorological and demographic considerations and the need to provide as much continuity as possible between baseline and operational data. Lo-Vol samplers are at Carlsbad, Eunice, Smith Ranch, Mills Ranch, WIPP South, WIPP East, and the WIPP Far Field sites. The original WIPP northwest location was discontinued due to its location being in a high vehicular traffic area. This location received heavy filter loading from dusts being resuspended by the traffic. As recommended in DOE/EH-0173T, a sampling station was added to incorporate a control site in the predominant upwind direction of the WIPP (the southeast control location approximately 12 miles southeast of the WIPP).

Lo-Vol filters are exchanged weekly, weighed to calculate total suspended particulates and individually counted for gross alpha and beta activity levels. Quarterly composites of filters from each location undergo specific radionuclide analysis in accordance with Table 5-2. Analyses are performed by a qualified contract laboratory.

Modifications have been proposed to the airborne emissions monitoring program. These changes would include incorporating a ring of High volume air samplers around the WIPP site, and increasing the number of samplers used in the program. An environmental health physicist was recently contracted to conduct a study of the potential benefits of these program modifications, both for environmental monitoring and dose assessment, and to point out suitable locations for the new air samplers. This study should be completed and a determination made based on study recommendations by the end of 1994. Any changes to the air sampling program will be documented and approved in the EMP.

5.3.5 Vegetation

Collection and analysis of vegetation samples serves three useful purposes: evaluating the potential radiation doses received by people consuming such vegetation; predicting the possible concentrations in meat, eggs, and milk from animals consuming contaminated forage (and resultant radiation doses to consumers of the animal products); and monitoring trends in environmental contamination and possible long-term accumulation of radionuclides.

EMP vegetation samples are collected from the permanent locations shown in Figure 5-3. In addition, if vegetable gardens are grown at the Smith and/or Mills Ranches, a leafy vegetable sample may be collected annually, and analyzed as specified in Table 5-2. Each sample will be collected as specified in the Environmental Procedures Manual (WP 02-3). Sufficient material will be collected to meet the needs of the analytical laboratory. The sample will be analyzed for the specific radionuclides indicated in Table 5-2.

5.3.6 Beef

The WIPP SEIS indicates beef is not a significant pathway at the WIPP facility. Samples of meats are not good indicator materials because of the time delay for transfer of radionuclides from the point of release through vegetation to beef, pork, and poultry. Therefore, frequent sampling of meat is normally required only when it is necessary to evaluate the radiation doses received via this foodstuff. With a few exceptions, radiation doses from ingestion of radionuclides are a measure of secondary importance.

Annual muscle samples are taken from locally grown beef, preferably from one animal that has been grazed northwest of the WIPP site and from one animal grazed at a control station. Since beef is not a significant pathway, the samples are collected only if they are readily available. The samples will be analyzed as indicated in Table 5-2.

5.3.7 Game Animals

As previously stated, muscle tissue is not a significant exposure pathway. However, DOE/EH-0173T indicates that game birds and mammals hunted locally should be sampled during the hunting season in the vicinity (within 25 km) of the site.

Rabbits and quail are collected annually. Quail are trapped at the facility, while rabbits are collected when found on roads in the WIPP site vicinity. A composite sample of muscle tissue from each type of animal is analyzed as shown in Table 5-2. Tissue samples acquired are provided to the state for independent analysis.

5.3.8 Soil Sampling

EMP surface soil samples are collected annually from the six locations shown in Figure 5-4. Sampling sites are co-located at air particulate sampling locations as recommended in HASL-300 and DOE/EH-0173T. The frequency of sampling also follows the guidance contained in DOE/EH-0173T for obtaining long-term accumulation trends. Samples are collected at each site at depths of 2 to 5 cm and 5 to 10 cm. Samples are collected as described in the Environmental Procedures Manual (WP 02-3), and analyzed as indicated in Table 5-2.

5.3.9 Surface/Drinking Water

Surface water is absent within the WIPP site. The EMP surface water samples are collected annually from the 12 locations in the WIPP vicinity specified in Figure 5-5. These locations comprise the major bodies of surface water in the WIPP vicinity and provide adequate data

concerning the surface water pathway. Analyses are performed as specified in Table 5-2. The practice of long-term storage of replicate water samples as was done for the RBP will no longer be conducted, in accordance with procedures recommended by EPA (1986b).

Drinking water is collected through "end of pipe" sampling from the WIPP water line which brings fresh water to the site. The drinking water is sampled annually and analyzed for constituents in Table 5-2.

5.3.10 Groundwater

DOE 5400.1 requires that groundwater that may potentially be affected by DOE operations be monitored to detect and document the effects of such operations on groundwater quality and quantity and to show compliance with applicable Federal and State laws and regulations. The groundwater monitoring programs should be conducted on-site and in the vicinity of DOE facilities to:

- Obtain data to determine baseline conditions of groundwater quality and quantity;
- Demonstrate compliance with and implementation of all applicable regulations and DOE Orders;
- Provide data for the early detection of groundwater pollution or contamination;
- Identify existing and potential groundwater contamination sources and to maintain surveillance of these sources; and
- Provide data upon which decisions can be made concerning land disposal practices and the management of groundwater resources.

The WIPP Groundwater Surveillance Program supports Performance Assessment and the EMP. The Groundwater Surveillance Program consists of two subprograms, the Groundwater Level Monitoring Program and the Water Quality Sampling Program. The protocols specified in the Groundwater Monitoring Program Plan and Procedures Manual (WP 02-1) are followed in collecting water samples from existing wells around the WIPP site. Eight groundwater samples are collected each year from the Culebra dolomite. Samples taken from the Culebra dolomite are analyzed for chemical and physical parameters, as well as specific radionuclides (Table 5-2).

Groundwater has been sampled and analyzed at the WIPP site since 1985. In 1991 the number of wells monitored was reduced to 10, and in 1994 the number of wells was further reduced to 8, eliminating those wells not within the WIPP sixteen sections (with the exception of the H-4 well which is just outside the WIPP boundary). The area between the waste storage horizon boundary and the Dewey Lake Redbeds, where the monitoring was discontinued, does not contain a continuous zone of saturation.

It is currently being proposed that the existing monitoring wells be replaced with six new wells equipped with fiberglass casings (fully grouted) and well screens (refined silica gravel packed). The monitoring wells now in use at the WIPP pose some problems to obtaining quality data. These monitoring wells, the majority of which are over 13 years old, were designed and drilled for the short term characterization of the Rustler Formation, and were not intended for use in a water quality surveillance program extending throughout the life of the WIPP. The existing wells utilize mild steel casings. Since the formation waters are corrosive in nature, they react with the well casings which results in artificially high iron readings in chemical analyses. Furthermore, most of the completions in the monitored formations are either perforations in the casings or open hole. Many existing wells that have perforated openings are beginning to close due corrosion or bacterial

growth, and the wells with open holes are beginning to collapse below the casing. Although these wells are not rendered useless, their efficiency is very limited. Continued use of the existing wells will result in increased equipment replacement and maintenance costs, and gaps in test data.

Since discontinuance of groundwater sampling is not an option due to site commitments, replacement of the existing monitoring seems the only viable option. Fiberglass construction will enhance the quality of the groundwater data collected, and provide a monitoring well life expectancy of 35 to 40 years. Contingent upon funding, new well construction should begin in May 1994. Specific locations for the new monitoring wells will be provided in the EMP.

5.3.11 Aquatic Foodstuffs

Fish are analyzed to quantify the dietary radionuclide intake by humans, and secondarily, as indicators of radioactivity in the ecosystem. In fresh water the principal nuclides to be expected in fish or shellfish (in addition to the naturally occurring K-40 and U-nat) include ^{3}H, ^{137}Cs, and ^{90}Sr, although any nuclide present in the water will be present in the fish.

Although aquatic foodstuffs are not considered a significant pathway from the WIPP operations, catfish are collected annually from the Pecos River near Carlsbad and from a control location at Brantley Lake which is located on the Pecos River between Artesia and Carlsbad, New Mexico. The samples are composited and analyzed for gross alpha and beta activity and the specific radionuclides indicated in Table 5-2. Catfish are appropriate for analysis in this program because they dwell and feed in bottom sediments where transuranic radionuclides may accumulate. Again, replicate samples are available for analysis to the NMED.

5.3.12 Sediment Sampling

Sediment samples are collected annually from Hill and Indian tanks and on the Pecos River near Artesia and Malaga, New Mexico (Figure 5-7). The Hill and Indian tanks primarily collect sediments from large surface drainage areas, whereas the river collection locations are monitored to detect changes in the Pecos river drainage. Sediments will also be collected from the sewage lagoon outfall when sediment buildup is sufficient to sample. Data results will be presented in the ASER.

5.4 NONRADIOLOGICAL ENVIRONMENTAL MONITORING

Nonradiological environmental monitoring activities at the WIPP consist of a comprehensive set of sampling programs designed to detect and quantify impacts of construction and operational activities, and surface storage of salt on the local ecosystem. The requirements and objectives of both preoperational and operational nonradiological environmental monitoring are described in the WIPP FEIS (DOE, 1980). The ecological monitoring program functions as an "operational program" prior to waste emplacement, because it focuses on nonradiological effects which are ongoing.

Section 2.5 of Appendix J of the FEIS states:

> "The operational ecological monitoring program, building on the foundation established through preoperational ecological monitoring, will document the ecological effects of construction and operation . . . and will focus primarily on indicator organisms and selected abiotic parameters."

Primary guidance for ecological monitoring was derived from the WIPP FEIS and the American Institute of Biological Scientists (AIBS) evaluation of the WIPP Biology Program.

Projected construction impacts on the ecosystem include the deposition of fugitive dust generated by the handling of materials such as salt, caliche, and topsoil at the site, as well as noise and other unnatural conditions associated with human activities at the site (Figure 5-8). A detailed

description of the rationale and sampling strategy for the ecological studies appears in the first semiannual Ecological Monitoring Program Report (Reith et al., 1985). Table 5-2 lists parameters which will be monitored by the EMP for evidence of possible site impacts. Results of these studies are published in the ASER.

5.4.1 Meteorological Monitoring

The DOE/EH-0173T guidance manual lists guidance for each DOE site to establish a meteorological monitoring program appropriate for the activities at the site and the local topography and demography. Weather data must be monitored and recorded to supplement characterization of the local environment and facilitate the interpretation of data from other environmental monitoring activities at the WIPP.

Meteorological conditions were monitored by SNL at the WIPP from 1975 through 1980. Between 1984 and 1988, temperature, wind speed, and wind direction were continuously monitored from a 10-meter (33 feet) tower at the northwest corner of Zone I. Equipment to monitor precipitation and barometric pressure were added to this station during that period.

Use of the 10-meter (33 feet) tower as the primary meteorological monitoring station was discontinued in 1988, and the 10-meter station was relocated to the WIPP Far Field sampling location along with the air quality monitoring station and the Reuter-Stokes pressurized ionization chamber. The WIPP Far Field site is in the predominantly downwind direction from the WIPP exhaust releases and is the principal air quality sampling location for the EMP.

The primary meteorological monitoring station, is a 40-meter (132 feet) tower located northeast of the WIPP as shown in Figure 5-1. Temperature, wind speed, and wind direction are monitored at 3, 10, and 40 meters (10, 33, and 132 feet). Barometric pressure, dew point, and precipitation are also monitored at this location. Measurements are recorded at the Central Monitoring Station (CMS), which tracks numerous real-time parameters on a centralized computer system.

The meteorological data as well as supplementing characterization of the local environment is applied to the CAP-88 program to perform radiological dose assessments in the event of a radiological release from the WIPP site.

5.4.2 Volatile Organic Compound Monitoring Program

The Volatile Organic Compound (VOC) Monitoring Program was established at the WIPP as required by the EPA. The EPA defined the requirements for the program published in the Federal Register, Volume 55, No. 220 (November 14, 1990), "Conditional No-Migration Determination (NMD) for the WIPP". The DOE's decision to cancel the Bin-Scale and Alcove Test Phase activities has resulted in amending the VOC Monitoring Program's objectives.

In support of the Accelerated Waste Disposal Decision, the Volatile Organic Compound (VOC) Monitoring Program will redefine the Disposal Phase VOC Monitoring system criteria based on baseline field and analytical VOC data. The criteria will consist of precision, accuracy, system recovery, method detection limits, cleaning/certification criteria which will be required in performing the design, testing, manufacturing, and installation of Disposal Phase VOC Monitoring stations. A minimum of one year data is needed to measure background VOC concentration variances.

REGULATORY REQUIREMENTS

The EPA has determined that air migration at the WIPP would be a potential concern during both testing and operations at the facility. Federal Register, Volume 55, No. 67 (April 1990), requires a no-migration variance be obtained before mixed waste could be placed in the WIPP for purposes

other than testing or experimentation. No-Migration Variance for Disposal Phase and/or operations demonstration would take place according to the full variance approval procedures of 40 CFR 268.6(g).

EPA further stated in the Federal Register, Volume 55, No. 220 (November 1990), that the results of the test phase monitoring will be critical for the Agency's review of the Disposal Phase No-Migration Variance petition. The needed results are not available due to the cancellation of the Bin-scale and Alcove tests. The WIPP plans to submit a petition for Disposal Phase No-Migration Variance in early 1995. Preliminary design and testing of disposal phase VOC monitoring will be needed for the petition. Surface and underground VOC baseline data will be required to determine system criteria which would otherwise not be obtained and available for use in the preparation of the petition.

VOC MONITORING PLAN

As part of the initial No-Migration Variance Petition (NMVP) for Test Phase, the DOE submitted a VOC Monitoring Plan for the WIPP (January 1990). This program is intended to fulfill the monitoring requirements of 40 CFR 268.6.

Five VOC sampling stations were installed for Test Phase at the WIPP facility. Four of the locations are designated to be air monitoring stations which use commercially available portable VOC sampling equipment. The fifth one is designated to be a source monitoring station. The four air monitoring stations are defined as follows:

- Station VOC-1 is located at Station A near the top of the exhaust shaft
- Station VOC-2 is located on the surface near the air intake shaft
- Station VOC-8 is located in the Panel 1 ventilation air intake passageway
- Station VOC-9 is located in the Panel 1 ventilation air outlet passageway

Station VOC-10 is located in Room 1 of Panel 1, and is designated as a source monitoring station. The sampler deployed at station VOC-10 directly monitored gas released from the bins included in the bin-scale experiments. However, due to the cancellation of the Bin-Scale test this station is abandoned in place and deactivated.

With the exceptions of stations VOC-9 and VOC-10, existing instrumentation at VOC-1 (exhaust shaft), VOC-2 (air intake shaft), and VOC-8 (underground) are being used for this baseline monitoring. Results of VOC-1 will be used to define baseline concentrations at the top of the exhaust shaft. Data obtained at VOC-2 will be used to define ambient VOC concentrations. Operation of the VOC-8 station will provide baseline data for the underground.

VOC sampling and analysis are performed at the WIPP using guidance in the EPA Compendium Method TO-14, "Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Summa® Passivated Canister Sampling and Gas Chromatographic Analysis", as a basis. The VOC samplers are operated by the WIPP facility personnel, and sample analyses performed by a contract laboratory. Laboratory analyses are designed to routinely quantify five VOC target compounds:

- Carbon tetrachloride
- Methylene chloride
- Trichloroethylene (TCE)
- 1,1,1-Trichloroethane (TCA)
- 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)

Once every other week, six-liter SUMMA® passivated stainless-steel canisters are used to collect an integrated sample at all locations over a 24-hour sample period. In addition, field quality assurance samples (duplicates, matrix spike and matrix duplicates) are collected and analyzed at a frequency of twenty percent at each monitoring station.

The VOCs in the air sample are separated by gas chromatography and quantified and quantitated by mass spectroscopy. The limits of detection of the methods are less than 1 ppbv, so extremely low concentrations can be quantified.

The VOC Monitoring program will continue baseline monitoring throughout the duration of 1994 calendar year. Design, installation, testing, procedure development, and personnel training/qualification for Disposal Phase VOC Monitoring stations will be completed prior to Disposal Phase readiness review.

To date, as required by the Conditional No-Migration Determination for the WIPP, the following three annual reports have been submitted to the EPA: DOE/WIPP 93-062, No-Migration Determination Annual Report for the Period September 1992 through August 1993; DOE/WIPP 92-057, No-Migration Determination Annual Report for the Period October 1991 through August 1992; and DOE/WIPP 91-059, No-Migration Determination Annual Report for the period of November 1990 through September 1991.

5.4.3 Airborne Gases

The decision to initiate the WIPP facility requires that air quality parameters, which may be influenced by construction and the WIPP operations, be monitored in the preoperational and the operational environmental programs. Total suspended particulates, carbon monoxide, hydrogen sulfide, sulfur dioxide, ozone, and nitrogen oxides are to be monitored at the WIPP. These gases are monitored at the WIPP site using ambient gas monitoring instruments. Data are logged in 15-minute, hourly, and daily averages.

5.4.4 Ecological Monitoring Plot Selection

Sampling for the nonradiological environmental portions of the EMP focus on components of the ecosystem immediately surrounding the site and on the ecological parameters most likely to reflect the impact of construction and operational activities (see Section 3.5 for a discussion of the ecosystem at the WIPP). Sampling activities are performed at seven permanently marked ecological monitoring plots whose locations are unchanged from the preoperational EMP. An identification sign located at the center of each plot serves as a permanent reference for the selection of sampling locations. Each plot is approximately 150 meters (492 feet) by 150 meters (492 feet), although the size of some plots are slightly restricted by roads and other barriers.

Ecological monitoring plots have been located with several criteria in mind:

- Some plots are in areas not directly disturbed by construction, but where the probability and extent of ecological impacts is greatest;
- Controls have been cited where potential impacts from the site are small or negligible; and
- Comparability among the plots has been maximized by situating them where soil, vegetation, and general appearance are judged to be as similar as possible.

Figure 5-9 illustrates the location of the permanent ecological monitoring plots. The plots likely to be impacted by site activities are Southeast 1 (SE1), Northwest 1 (NW1), and East 1 (E1). These three plots are adjacent to the two stockpiles where excavated salt is stored. NW1 is downwind

from the facility and the active salt pile according to the prevailing winds, that blow from the southeast. Westerly winds tend to blow during the spring, and can be strong and persistent. During the spring westerlies, E1 is downwind of the site and the active storage pile. SE1 is adjacent to the smaller salt pile, but is outside the path of either primary or secondary wind directions.

Both SE1 and NW1 have counterparts (SE2 and NW2 respectively) located approximately 150 meters (492 feet) farther from the site and the salt piles to help determine the range of any ecological impacts. Finally, Control 1 (CT1) and Control 2 (CT2) are located more than two kilometers (1.2 miles) from the center of the WIPP activities. These are believed to be sufficiently distanced from the facility to minimize exposure, and be an effective "control" site to evaluate and compare ecological impacts.

5.4.5 Aerial Photography

The most conspicuous and readily documented impacts of the WIPP on the local ecology occur because of the removal of native habitat due to construction of roads, parking lots, buildings, and salt storage piles. The extent of this habitat replacement is documented in aerial photographs. These photographs are taken annually.

Aerial photographic missions produce color stereo-pair photographs for stereoscopic examination as well as enlarged "spot photos" of the WIPP installation. The large-negative spot photographs are enlarged in both color and black and white, and used for planimetric and/or dot-matrix evaluation of the displacement of native habitat by the WIPP facilities. Project personnel and local emergency response agencies are also provided with spot photos for their own use. Selected key locations are temporarily flagged with conspicuous plastic sheeting to facilitate their recognition on the aerial photographs. Mission parameters may be altered as necessary to investigate phenomena of special interest.

5.4.6 Salt Impact Studies

The surface photography, soil chemistry, vegetation sampling, and vertebrate census subprograms make up the salt-impact studies of the ecological monitoring activities. The salt-impact studies define salt impacts on the living components of the ecosystem. A summary report of the EMP salt-impact studies and resulting data has been prepared and is entitled, Summary of the Salt Impact Studies at the WIPP, 1984 to 1990 (DOE/WIPP 92-038). This report indicated that there have been no significant salt-related impacts to the surrounding environment. Therefore, the soil sampling frequency has been reduced from quarterly to annually. The continuance of each segment of the salt-impact studies will be evaluated on a year-to-year basis. Any further changes to these studies will be reviewed and approved in the EMP.

5.4.6.1 Surface Photography

Surface photography is used to monitor visually detectable impacts of the facility on the landscape and provides a long-term chronological record of those impacts. Oblique (taken at a height of about five feet above ground level) photographs are taken annually at each ecological monitoring plot (see Figure 5-9), as recommended by the AIBS in their 1980 evaluation of the WIPP Biology Program. Environmental photography activities are conducted in accordance with the Nonradiological Environmental Surveillance (NES) Procedure WP 02-340, Environmental Photography. Photographs are taken from the central sign post in each of eight directions (N, NE, E, SE, S, SW, W, NW). Each exposure centers on a permanent marker installed five meters away from the central sign to ensure comparability among photos from one season to the next. Each photograph is identified for plot, direction, and date. A 24-mm wide-angle lens is used to ensure photo overlap, and a color chart on the permanent marker provides seasonal comparability.

5.4.6.2 Soil Chemistry

The goal of the soil subprogram is to monitor for changes in properties of the sandy dune soil around the WIPP site using the Ecological Monitoring plots shown in Figure 5-9. Of significant interest are changes in salt-related parameters such as electrical conductivity, pH, and ion concentrations. These are indicators of salt transport from initial storage areas to surrounding soils. Sampling activities are conducted according to WP 02-336, the NES Soil Sampling Procedure. Sample analyses are performed by a laboratory using standard EPA-approved analytical methods.

5.4.6.3 Vegetation Survey

The deposition of salt on vegetation or soil may affect plant and soil chemistry to the extent that normal biological processes are inhibited. For example, elevated levels of soluble salt in the soil can osmotically inhibit the germination and growth of seedlings. These changes in chemistry and osmotic potential may affect the soil microbial community which in turn affects decomposition and nutrient flow within the ecosystem. The FEIS (DOE, 1980) predicts these impacts may be present, but minor based on observations of salt piles at local potash mines and at the nearby Project Gnome Site where Salado salt was excavated prior to an underground nuclear test.

The vegetation within each of the permanent monitoring plots (Figure 5-9) is surveyed annually to detect possible impacts of salt transport and the resultant changes in soil chemistry on extant vascular plants. Although measurement of vegetation parameters is not as sensitive an indicator of salt deposition as the direct measurement of ion concentrations in the soil, the importance of vegetation as a soil stabilizer and wildlife habitat requires that it be monitored closely for trends which may develop as the result of salt impacts.

The vegetation parameters measured in each plot include foliar cover for all species, density of annual species, species richness, and the structure of the vegetative community. The NES Vegetation Sampling Procedure (WP 02-337) and the Plant Specimen Collection and Herbarium Management Procedure (WP 02-346) define the survey activities. Changes in community structure are documented by means of the fixed-location comparative photographs. Field data is compiled and averaged for each species in each plot.

5.4.6.4 Vertebrate Census

Birds and mammals comprise the upper levels of the food chain in the natural ecosystem around the WIPP. These organisms may be impacted by noise and human presence as well as by changes in habitat structure due to salt impacts. Population densities are monitored annually to define normal cycles of abundance and to detect major changes in populations or communities which may be due to activities at the WIPP facility.

The FEIS (DOE, 1980) suggests that local animal populations may be affected by activities in addition to the destruction of a small portion of their natural habitat. Some species may be frightened or otherwise repulsed by the noise and light generated by the project and by associated vehicular traffic. Other animal species exploit man-made structures and may invade the environment around the WIPP. Some of the above impacts (e.g., habitat removal) were projected with relative certainty by the FEIS; others (e.g., salt effects) were projected tentatively in terms of likelihood and severity.

Selected wildlife populations are surveyed annually to determine the effects of the WIPP construction activities and consequent habitat modifications on natural populations of wildlife species. Survey methods are based on standard techniques such as described by Emlen (1971) for birds and Hayne (1949) for mammals. Wildlife species are generally more dispersed than the other populations monitored in the EMP, necessitating the use of survey techniques that sample larger areas than encompassed by the ecological monitoring plots. Therefore, the wildlife surveys are

performed in association with the established monitoring plots, but are not necessarily contained within them. Field activities are detailed in the WIPP Procedures WP 02-362 (NES Bird Census) and WP 02-363 (NES Small Mammal Census).

Results of the Emlen transects (breeding bird densities) are calculated separately for each bird species. Breeding densities of birds are reported for each species in the ASER.

Currently the small mammal studies have been discontinued due to the outbreak of the deadly Hanta virus. This virus has been recently found in deer mice, pinon mice, chipmunks, woodrats, and the common house mouse. Since the mammal studies require the trapping and tagging of several of the above rodents, personnel will be trained to properly handle potentially infected rodents prior to resuming these studies.

TABLE 5-1

EMP SAMPLING SCHEDULE

TYPE OF SAMPLE	SAMPLING LOCATIONS	SAMPLING FREQUENCY
Liquid Influent	1	Annual
Liquid Effluent		
DP-831	1	Quarterly
WIPP Oversight	1	Biannual
Airborne Effluent	3	Continuous
Meteorology	2	Continuous
Exposure Rate Meter	1	Continuous
Atmospheric Particulate	8	Weekly
Air Quality	1	Continuous
Vegetation	4	Annual
Beef	WIPP Vicinity	Annual
Game Birds	WIPP Vicinity	Annual
Rabbits	WIPP Vicinity	Annual
Soil	6	Annual
Surface Water	12	Annual
Groundwater	8	Annual
Fish	2	Annual
Sediment	4	Annual
Aerial Photography	Site Wide	Annual
Salt Impact Studies		
Surface Photography	7	Annual
Soil Chemistry	7	Annual
Vegetation Survey	7	Annual
Ambient Air (to quantify VOCs)	3	Biweekly

TABLE 5-2
EMP ANALYTICAL ARRAY

TYPE OF SAMPLE	ANALYSIS
Liquid Influent	(1) Specific Radionuclides
Liquid Effluent	(1) Specific Radionuclides
DP-831	(3) DP-831 Constituents
WIPP Oversight	(4) Oversight Constituents
Airborne Effluent (Stations A, B, and C)	Gross α, Gross β, ^{238}Pu, ^{239}Pu, ^{241}Am
Meteorology	Temperature, Wind Speed, Wind Direction, Precipitation, Dew Point, Barometric Pressure
Thermoluminescent Dosimeters	Penetrating Radiation
Exposure Rate Meter	Penetrating Radiation
Atmospheric Particulate	Gross α, Gross β, Total Suspended Particulates (TSP), (2) Specific Radionuclides
Air Quality	O_3, CO, H_2S, SO_2, NO_x
Vegetation	(1) Specific Radionuclides
Beef/Deer	(1) Specific Radionuclides
Game Birds	(1) Specific Radionuclides
Rabbits	(1) Specific Radionuclides
Soil	(1) Specific Radionuclides
Surface Water	(1) Specific Radionuclides
Sediment	(1) Specific Radionuclides
Groundwater	(1) Specific Radionuclides, (5) Chemical Analysis, (6) Physical Properties
Fish	(1) Specific Radionuclides
Aerial Photography	Area of Land Disturbed

TABLE 5-2

EMP ANALYTICAL ARRAY (continued)

TYPE OF SAMPLE	ANALYSIS
Salt Impact Study	
Surface Photography	Visual Impacts
Soil Chemistry	pH
Vegetation Survey	Foliar Coverage, Species Richness, Annual Plant Density
Wildlife Survey	Bird Population Densities

BOD5 = Biochemical Oxygen Demand (5 days)
COD = Chemical Oxygen Demand
TDS = Total Dissolved Solids
TOC = Total Organic Compounds
TKN = Total Kjeldahl Nitrogen
TSP = Total Suspended Particulates
TSS = Total Suspended Solids

(1) Specific Radionuclides: ^{241}Am, ^{60}Co, ^{137}Cs, ^{40}K, ^{210}Pb, ^{210}Po, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{226}Ra, ^{228}Ra, ^{90}Sr, ^{228}Th, ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, and ^{238}U.

(2) Specific Radionuclides: ^{241}Am, ^{7}Be, ^{60}Co, ^{137}Cs, ^{40}K, ^{210}Pb, ^{210}Po, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, and ^{238}U.

(3) DP-831 Constituents: NO_3, TKN, ^{226}Ra, ^{228}Ra, and TDS.

(4) WIPP Oversight Constituents: pH, NH_3, BOD5, COD, TOC, oil, grease, metals, dissolved metals, cyanide, phenols, volatiles, semi-volatiles, pesticides, TSS, TDS, TKN

(5) Chemical Analysis: alkalinity, bromide, chloride, fluoride, iodide, nitrate, phenolics, phosphate, sulfate, total organic halogens, TOC, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, iron, lead, lithium magnesium, mercury, potassium, selenium, silica, silver, sodium, carbon tetrachloride, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, and 1,1,2-trichloro-1,2,2-trifluoroethane.

(6) Physical Properties: pH, specific gravity, specific conductance, TDS, and TSS.

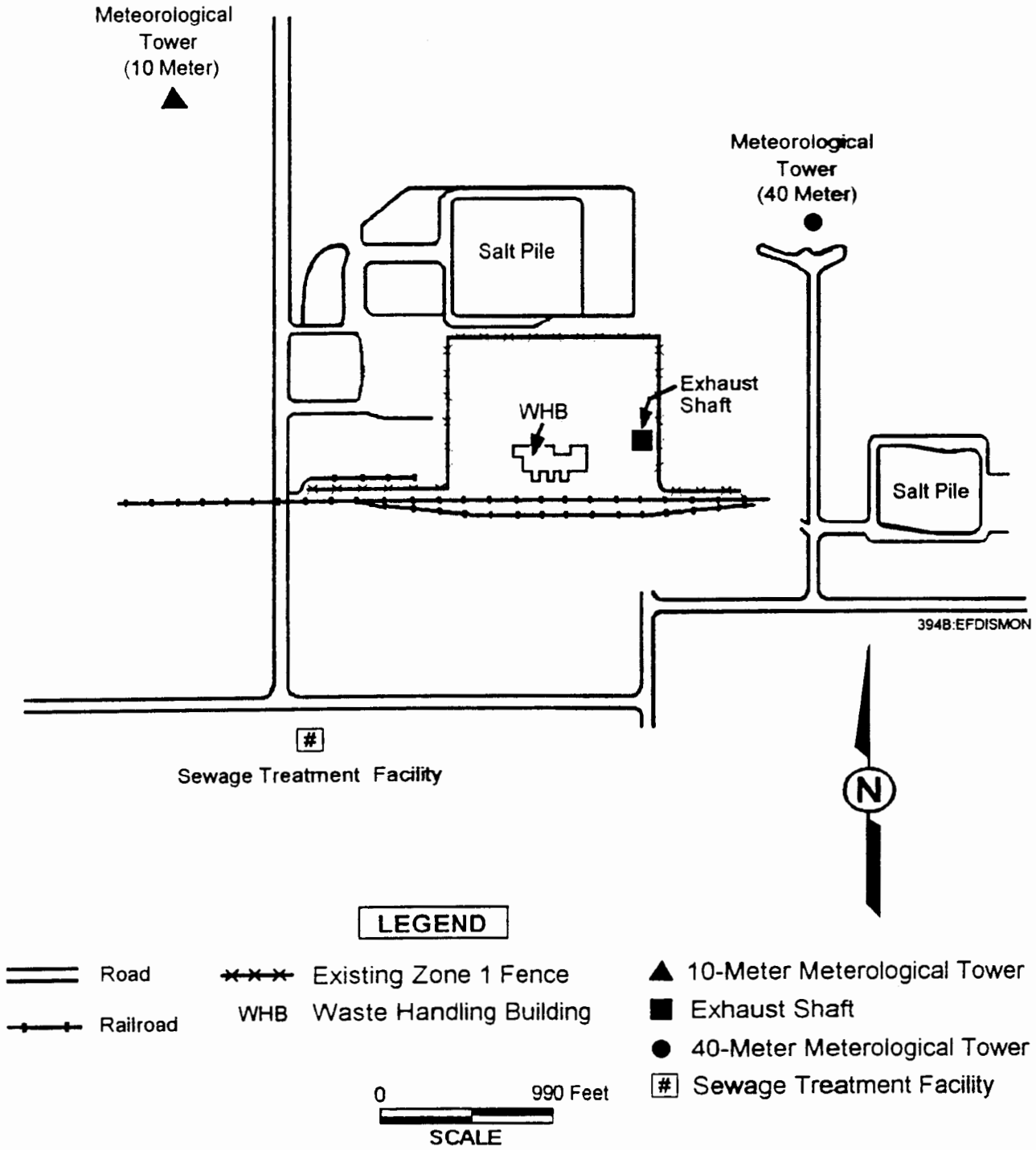

Figure 5-1 EMP Effluent Discharge and Meterological Monitoring Locations

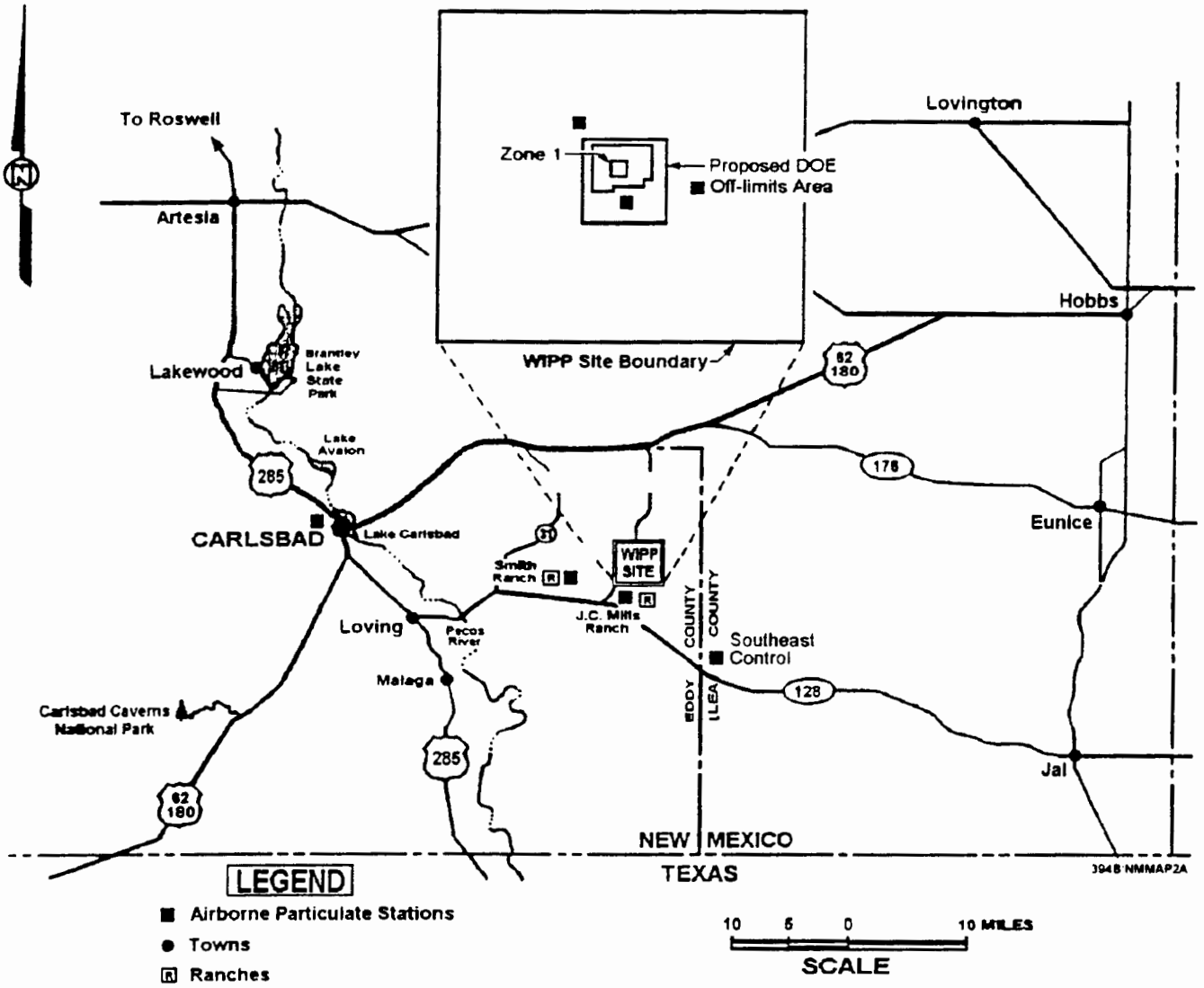

Figure 5-2 EMP Airborne Particulate Sampling Stations

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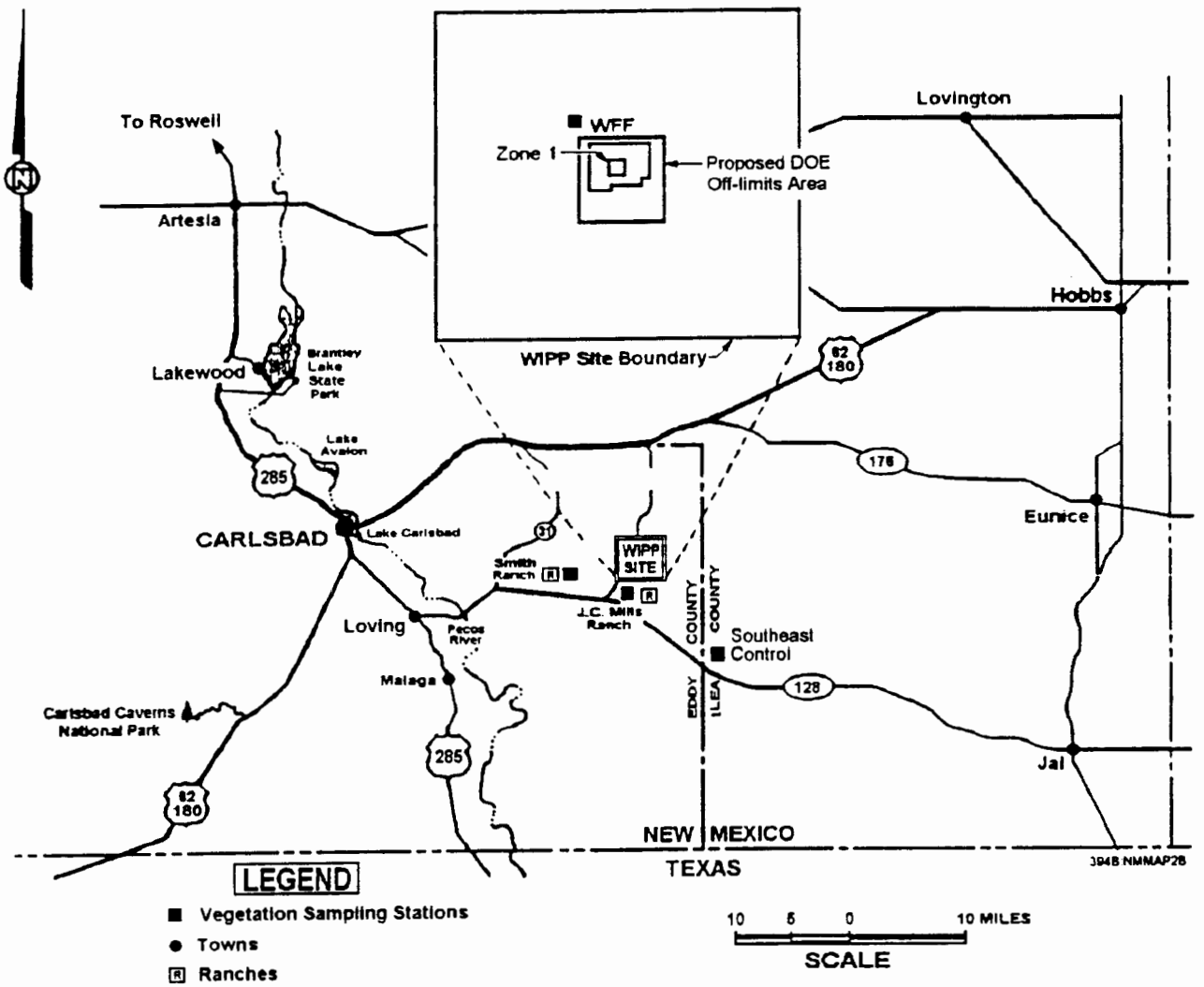

Figure 5-3 EMP Vegetation Sampling Stations for Radioanalysis

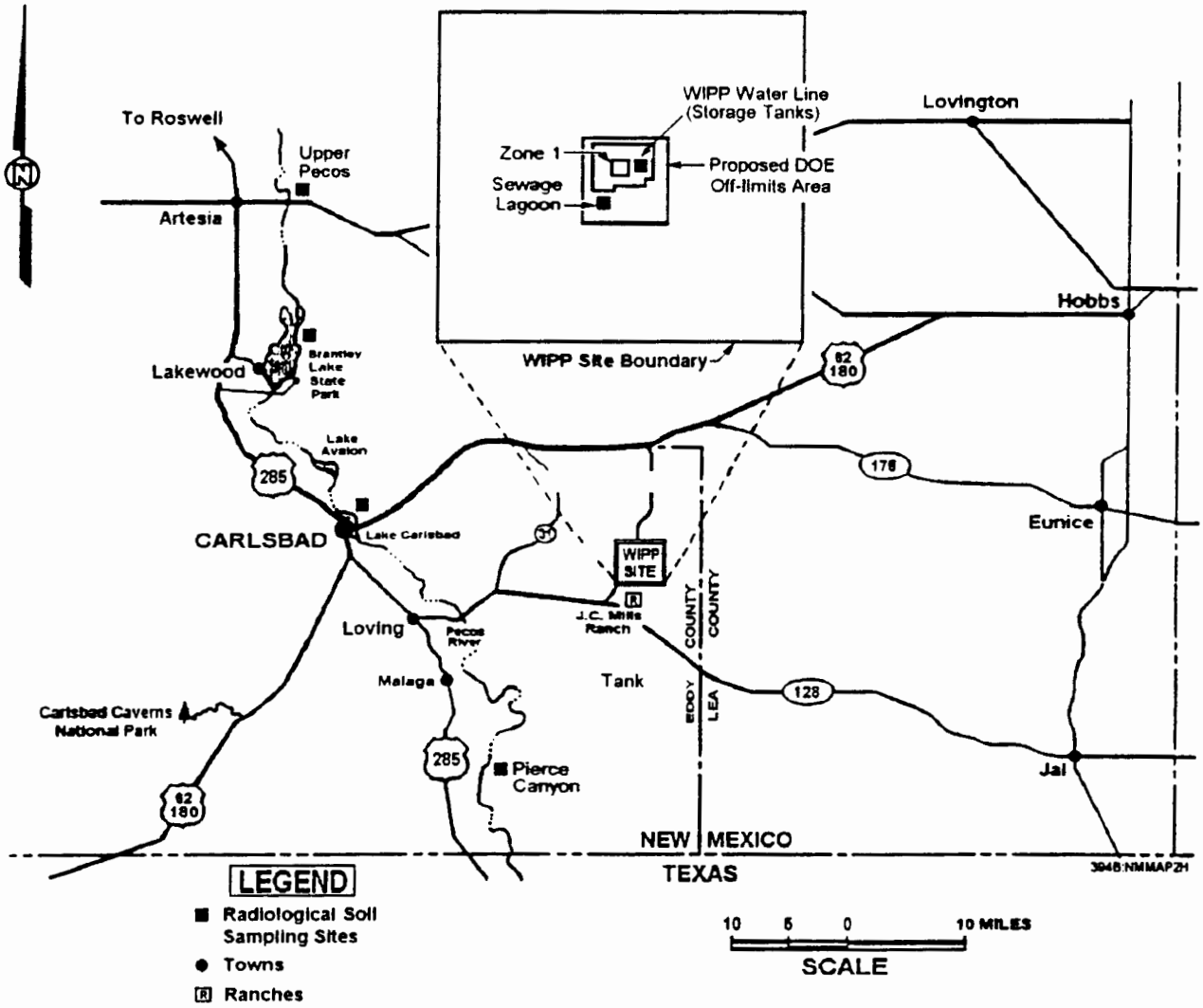

Figure 5-4 EMP Radiological Soil Sampling Sites

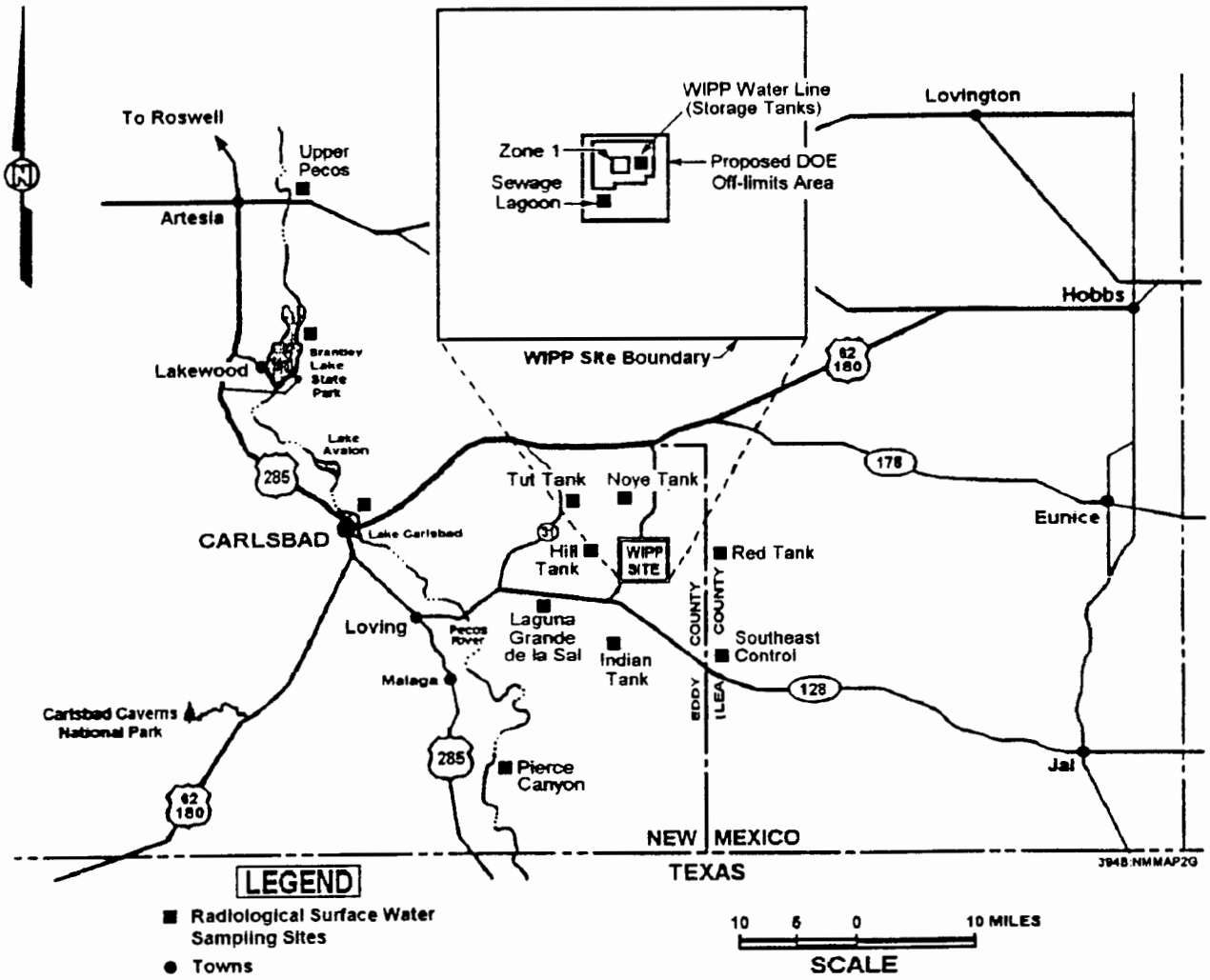

Figure 5-5 EMP Radiological Surface Water Sampling Sites

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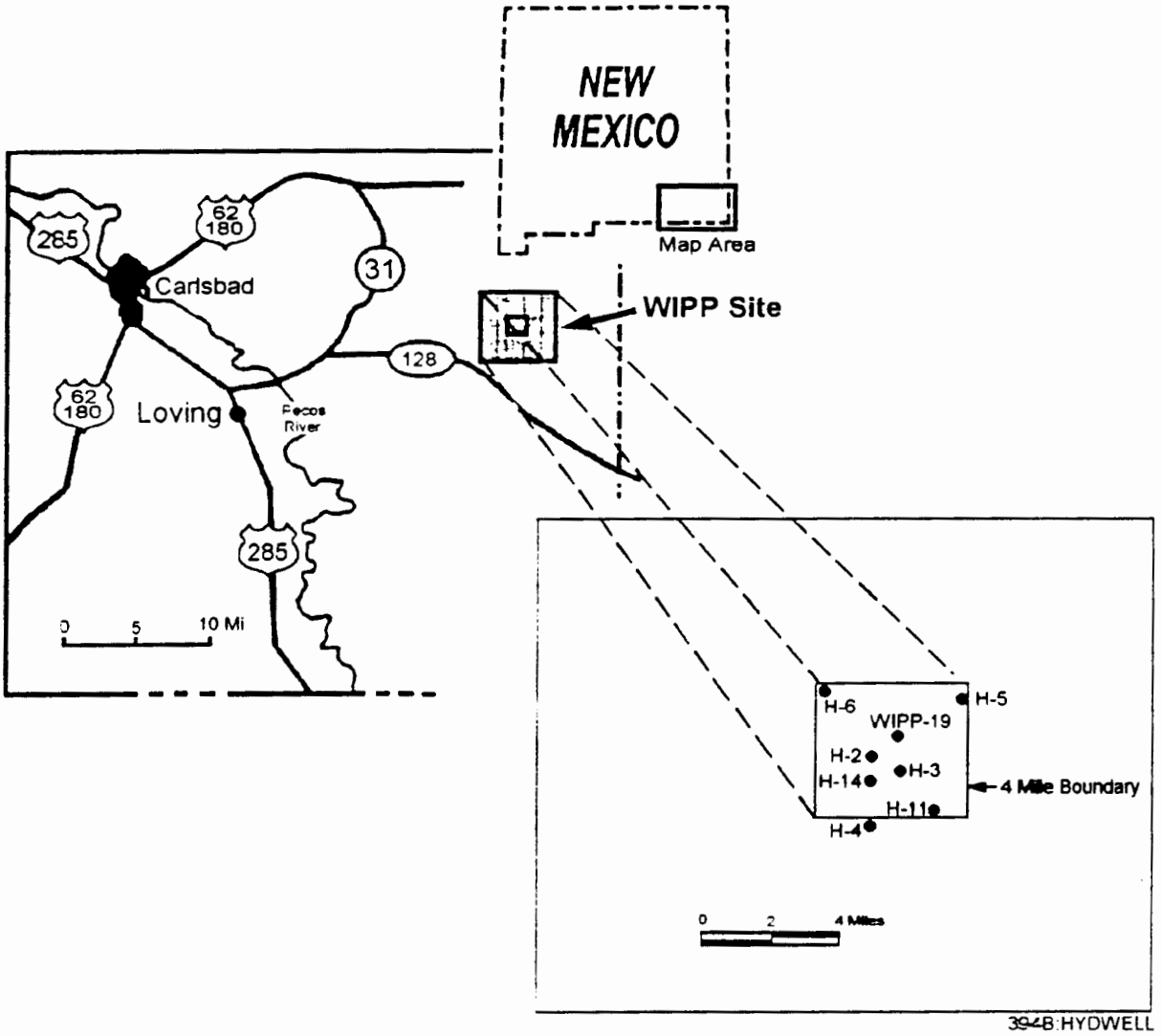

Figure 5-6 EMP Groundwater Sampling Sites

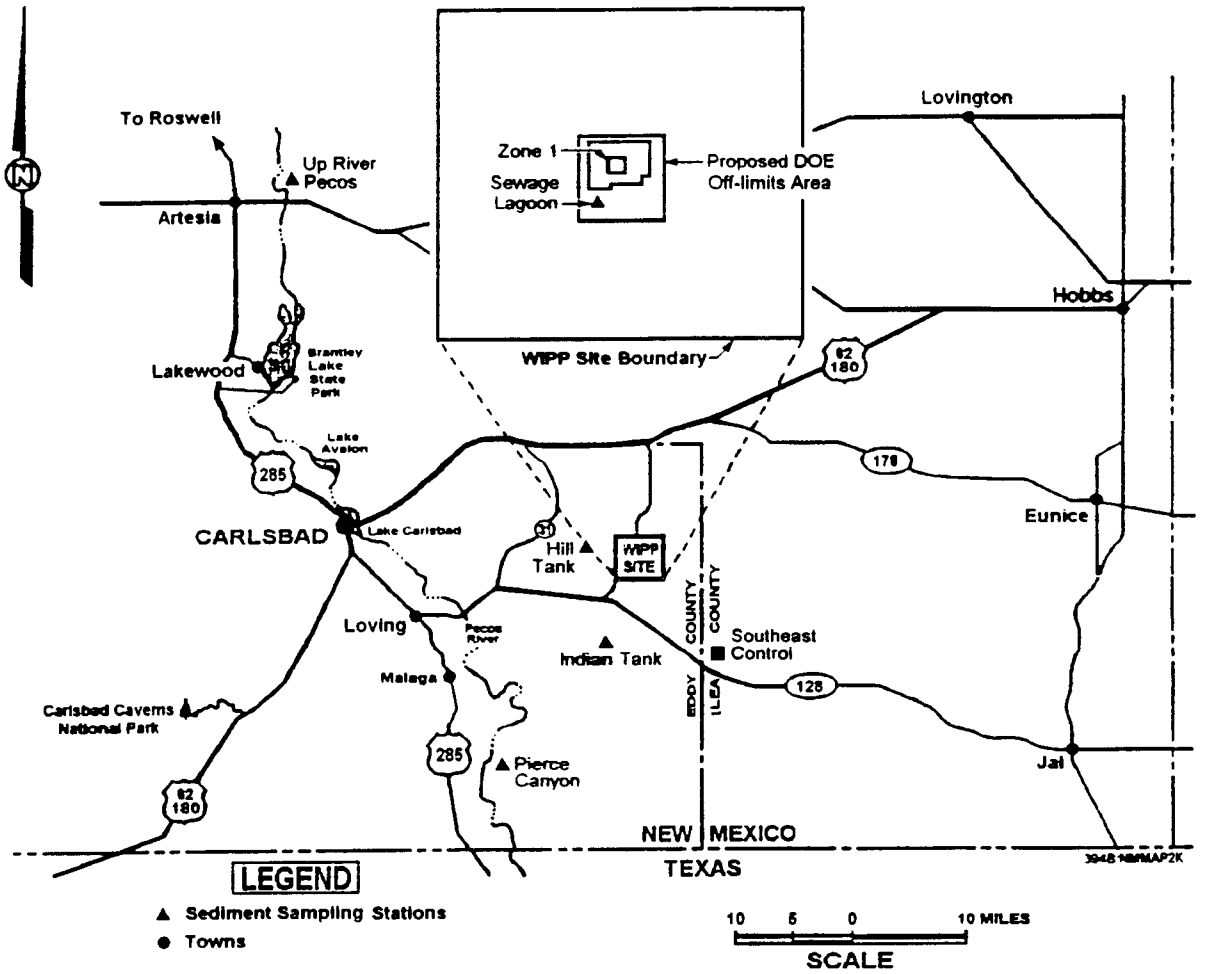

Figure 5-7 EMP Sediment Sampling Locations

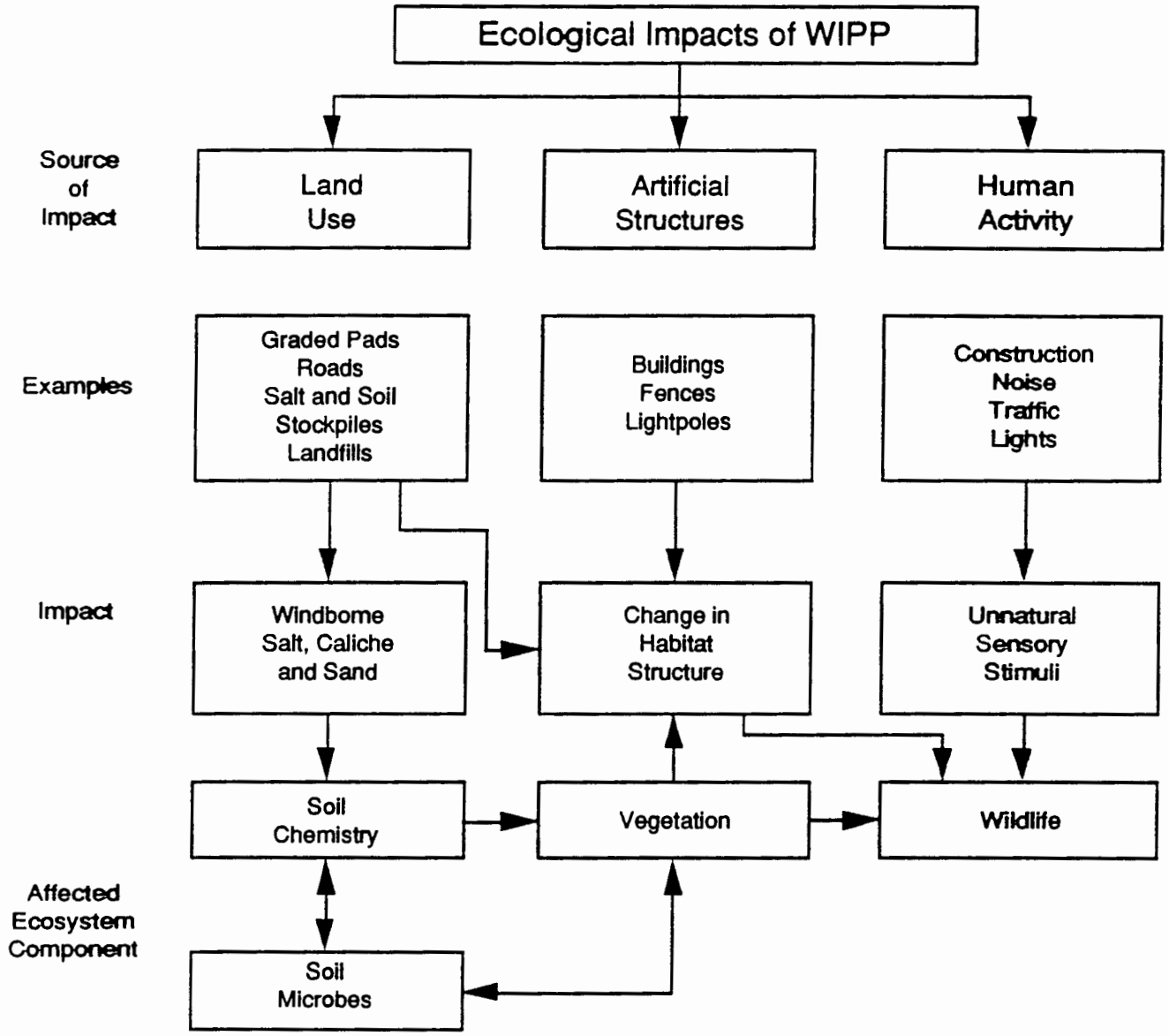

Figure 5-8 Ecological Impacts of WIPP

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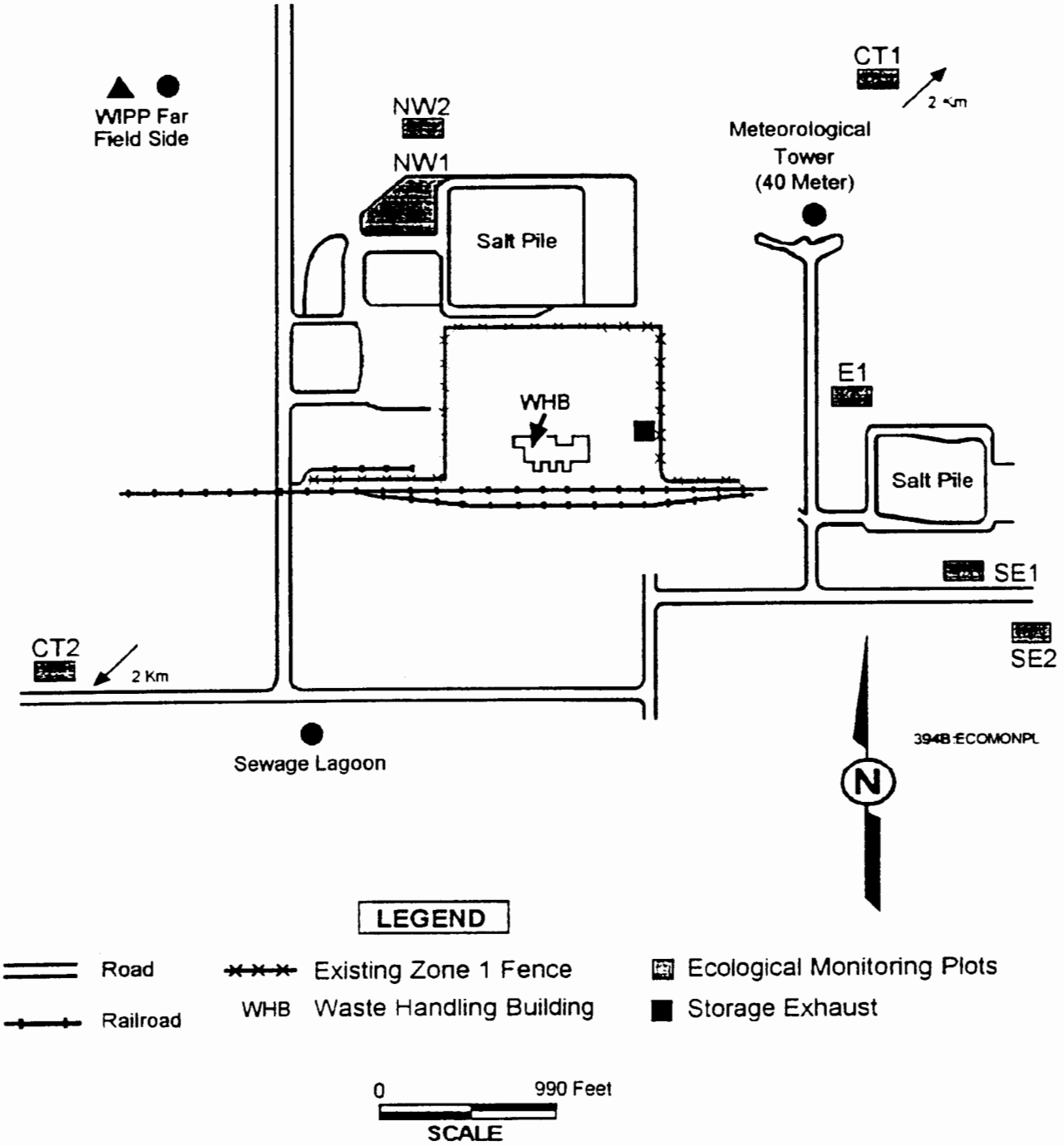

Figure 5-9 EMP Locations of Ecological Monitoring Plots

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6.0 SAMPLE HANDLING AND LABORATORY PROCEDURES

Environmental sampling and analytical laboratory procedures used to obtain quality results for the WIPP are contained and/or described in the following documents:

- Environmental Procedures Manual (WP 02-3)
- Groundwater Monitoring Program Plan and Procedures Manual (WP 02-1)
- Radiation Safety Manual (WP 12-5)
- WID Quality Assurance Program Description (WP 13-1)

The WIPP has field analytical capabilities as well as subcontracted analytical support. Each laboratory is responsible for maintaining an approved quality assurance program.

6.1 SAMPLE HANDLING

Sample Identification

The sample identity codes used in the EMP Radiological Environmental Surveillance (RES) and the NES are unique to each sample collected. A four-tiered hierarchy of sample-specific information is used to accurately identify sample type, sample location, date, and sequence of sampling event. A detailed description of the sample identification for radiological and nonradiological samples, including sample identification, calculations, computer inputs, and other applicable reviews are described in the Environmental Procedures Manual (WP 02-3). Radioactive source control and calibration of equipment are discussed in the Low Level Counting Laboratory Manual (WP 12-LL).

Environmental Activity Levels

During operations, all TRU wastes will remain in sealed containers. Therefore, radionuclide levels in environmental samples are expected to remain minute during operations. All environmental samples are collected in accordance with accepted practices and widely recognized methodologies and criteria for environmental monitoring (WP 02-3).

Packaging and Shipping of Samples Off-Site

Environmental samples sent off-site for analysis are packaged according to the specific sampling procedures (i.e., soil, water, vegetation, etc.) listed in the Environmental Procedures Manual (WP 02-3). The NES/RES Sample Tracking Procedure (WP 02-304) outlines the chain-of-custody requirements that insure the integrity of samples. The WIPP does not handle high-activity samples in the environmental monitoring programs. Contract laboratories are required to follow Quality Assurance/Quality Control (QA/QC) procedures to ensure cross-contamination of high and low activity samples does not occur. The quality of the data from analytical contract laboratories is verified by 1) participation in interlaboratory cross-checks, 2) duplicate, spike, and blank sample analysis, and 3) occasional comparison of results from sample splits that are provided to the NMED and the EEG.

Quality Assurance

A comprehensive QA program has been implemented to assure that the data collected are representative of actual concentrations in the environment. Each contract laboratory is responsible for maintaining an approved quality assurance program detailing the following:

1) routine calibration of instruments;

2) frequent source and background checks (as appropriate);
3) routine yield determinations of radiochemical procedures;

4) replicate/ duplicate analyses to check precision;

5) standard and spike analyses to check accuracy; and

6) analyses of reagents to ensure chemical purity that could affect the results of the analytical process.

The accuracy of radionuclide determination is ensured through the use of standards traceable to the National Institute of Standards and Testing, participation in the Environmental Protection Agency Cross-check Interlaboratory Comparison Program, and other interlaboratory analytical assessment programs, when available.

6.2 RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

A detailed explanation and justification of all radiological and non-radiological Environmental Surveillance is in accordance with Chapter 5 of this document.

External Radiation

The Environmental Radiation Monitoring Procedure (WP 02-313) provides instructions for obtaining measurements of ambient gamma radiation using the Reuter-Stokes RSS-1012, Environmental Monitoring System. This instrument is located at the WIPP Far Field station and records continuous data that is printed hourly in 15 minute averages with the peak value noted for the 15 minute intervals. This data is summarized in the ASER.

Airborne Particulates

Continuous Low Volume air samplers are used at WIPP for particulate collection. These samplers have a regulated flow rate of 950 ml per second (two cubic feet per minute) of air through a 47-mm (1.9 inch) glass fiber filter. Filters are collected weekly and sent to the analytical laboratory in accordance with the Low-Volume Airborne Particulate Sampling Procedures (WP 02-312). A gross alpha and gross beta count of each weekly filter is completed prior to compositing filters from each location for each sampling quarter. This analyses is conducted by the WIPP low-level counting lab in accordance with operation and calibration of the Canberra Model 2400 2, B counting system (WP 12-516). The quarterly composite is then analyzed using gamma spectrometry for representative gamma-emitting radionuclides typically present in the environment and those expected to occur in the waste received at WIPP. Finally, the composite sample undergoes destructive chemical analysis for the specific alpha and beta activity.

Biological Materials

Samples of native mammals, birds, fish, locally-produced beef and vegetation are collected and prepared for radionuclide analyses as described in the Biotic Sampling Procedures (WP 02-310).

Methods of analyses of all samples are performed in accordance with appropriate EPA approved methods or the U.S. Department of Energy, Environmental Measurements Laboratory Procedure Manual, HASL-300.

Soil Sampling

Soil sampling procedures used at the WIPP are given in the RES Soil Sampling Procedures (WP 02-307). Methods of analyses of all samples are performed in accordance with appropriate EPA approved methods or the U.S. Department of Energy, Environmental Measurements Laboratory procedure manual, HASL-300.

Surface Water and Sediments

Surface water and sediment samples for radionuclides are collected and handled according to the RES Surface Water and Sediment Sampling Procedures (WP 02-309). This procedure describes methods for collecting, preserving, and packaging representative water and sediment samples. Laboratory methods for analyses of all samples are performed in accordance with appropriate EPA approved methods or the U.S. Department of Energy, Environmental Measurements Laboratory Procedure Manual, HASL-300.

Groundwater

Groundwater sampling for radiological analyses is conducted according to the Groundwater Monitoring Program Plan and procedures manual (WP 02-1). This sampling plan includes detailed procedures on collecting a representative sample by measurement of field parameters to determine a chemical steady-state with respect to those constituents. Included in this plan are the procedures associated with the pumping of groundwater, the serial sampling and analysis program, and the final sample collection and preparation for shipment to contract laboratories. Samples are analyzed in accordance with appropriate EPA approved methods, or the U.S. Department of Energy Environmental Measurements Laboratory Procedure Manual, HASL-300.

6.3 NONRADIOLOGICAL ENVIRONMENTAL MONITORING

Soil Sampling

Soil sampling and handling procedures are given in the NES Soil Sampling Procedures (WP 02-336). Samples are collected annually at random locations from each ecological study plot. The methods of analyses of all samples are performed in accordance with appropriate EPA methods.

Surface Water and Sediments

Surface water and sediment sampling and handling procedures for nonradionuclide analyses are conducted according to the NES Surface Water and Sediment Sampling Procedure (WP 02-345) and the Guidance Manual: "Surface Water and Sediment Sampling for the Environmental Monitoring Program at WIPP" (Prill and Buckle, 1986). The methods of analysis of all samples are performed in accordance with appropriate EPA methods.

Groundwater

Groundwater sampling and handling procedures for nonradionuclide analyses are conducted in accordance with the Groundwater Monitoring Program Plan and Procedures manual (WP 02-1). Field parameters for nonradiological analyses include pH, EC, specific gravity, specific conductance, temperature, flow volumes and rates, chloride, calcium, magnesium, total sulfide as H_2S, alkalinity, and dissolved iron. Samples are also collected and sent to a contract laboratory for more extensive analyses performed in accordance with appropriate EPA methods.

VOC Monitoring

VOC sampling and analysis are performed at the WIPP using guidance in the EPA Compendium Method TO-14, "Determination of Volatile Organic Compounds in Ambient Air Using Summa® Passivated Canister Sampling and Gas Chromatographic Analysis." Presently, there are five VOC sampling stations installed at the WIPP facility. Existing instrumentation at stations VOC-1 (exhaust shaft), VOC-2 (air intake shaft), and VOC-8 (underground) will be used for this baseline monitoring. Samples collected at VOC-1 will be used to define baseline concentrations at the top of the exhaust shaft. Data obtained at VOC-2 will be used to define ambient VOC concentrations. Operation of the VOC-8 station will provide baseline data for the underground. These three stations are designated to be air monitoring stations which use commercially available portable VOC sampling equipment. The other two monitoring stations (VOC-9 and VOC-10) will not be activated.

The VOC samplers are operated by the WIPP facility personnel, and sample analyses are performed by a contract laboratory. Laboratory analyses are designed to routinely quantify five VOC target compounds: Carbon tetrachloride, Methylene chloride, Trichloroethylene, 1,1,1-Trichloroethane, and 1,1,2-Trichloro-1,2,2-trifluoroethane. Sample results are compared to the health-based standards established by the EPA in the NMD.

Airborne Gases

The Atmospheric Monitoring Station is used to continuously monitor potential pollutant gas concentrations. The station is composed of seven analyzers which monitor SO_2, H_2S, O_3, CO, NO, NO_2, and NO_x gases. The station is operated in accordance with the draft Ambient Air Quality Monitoring Procedure (WP 02-341). Calibration and maintenance of monitoring equipment are performed in accordance with their respective operation and maintenance manual.

7.0 DATA ANALYSES

This section describes the criteria and methods used for statistically analyzing data collected in the EMP. The goal of statistical data analyses is to provide an objective and reliable means for interpreting data in relation to the objectives of the data collection program. For the EMP the principal goal of data analyses is the comparison of a data point or data set to equivalent data collected at another location and time (such as preoperational baseline data or data collected at a control location), or to a fixed standard.

For the data results of the sample media, each data point will be correlated to the "Statistical Summary of the Radiological Baseline for the WIPP", (DOE/WIPP 92-037). During this review should a discrepancy be noted, an in depth evaluation will be performed to identify the source of the deviation, (i.e. statistical outlier or analytical technique).

Several levels of analyses are required for each parameter before statistically valid interpretation can be achieved. The type of analysis used at each level varies among parameters due to the particular characteristics of parameters and the specific objectives of monitoring. Five general levels of data analyses are described here. Analyses at each of these levels is considered for each parameter. The levels are:

(1) Determination of accuracy for each point measurement by quantification and control of precision and bias;

(2) Evaluation of the effects of auto-correlation on the expected value of the point measurement due to location and time of sampling;

(3) Identification of the appropriate model of variability (i.e., a probability density distribution) for each point measurement and the calculation of descriptive statistics based on the chosen model;

(4) Treatment of data anomalies; and

(5) Interpretation of data through statistically valid comparisons (tests) and trend analysis.

Each of these levels of data analyses are described below and with the requirements for application to the EMP.

7.1 ACCURACY

Accuracy is the closeness of a measurement to its actual, or true, value. Since the true value cannot be determined independently, accuracy cannot be absolutely determined. However, accuracy is controlled by two basic elements: bias (consistent over or underestimation of the true value) and precision, [concentration of repeated measurements around a central (expected) value]. Accuracy is maximized when bias is minimized and precision is maximized.

To some extent precision and bias are controlled by strict adherence to sample collection, handling, and measurement protocols. EMP procedures specify the protocols for those functions performed at the WIPP (WP 02-3) and quality control procedures establish control on precision and bias for contractors (see Section 8.0).

The remaining element of precision and bias is quantitatively estimated through periodic performance of the following measurements:

- measurement of replicate samples;
- measurement of duplicate samples or the repeated measurement of the same sample;
- measurement of blank samples; and
- measurement of standard pseudo-samples (samples of an equivalent medium containing a known amount of the target species).

The measurement of replicate samples is used for estimation of the amount of imprecision incurred through the entire process of sample collection, handling, and measurement. The measurement of duplicates and repeated measurements are used to determine the amount of imprecision attributable to measurement. Blanks and pseudo-samples are used to evaluate bias incurred through measurement processes. Measurements of replicate samples and repeated measurements have been made in the RBP, particularly in the low volume air sampling program. Results of the EPA cross-check Interlaboratory Comparison Program indicate that laboratories supporting the WIPP environmental monitoring program are within specified control limits. As required by DOE Order 5400.1, contract laboratories performing radiological analysis on WIPP samples, and the WIPP low-level counting lab will participate in the DOE interlaboratory QA program coordinated by the DOE Environmental Measurements Laboratory of New York, New York.

The methods for satisfying these requirements will be dependent upon the sampling and measurement characteristics of each parameter. Generally, the following specifications will be followed:

- one replicate sample is collected for each ten samples collected;
- at least one duplicate or one repeated measurement is made for each discrete set of samples analyzed, or for each tenth sample analyzed, whichever is more frequent;
- one blank sample is analyzed for each discrete set of samples analyzed (for radioactivity counts, the background count is not considered a blank); and
- measurements of pseudo-samples is performed once per year.

Variations from these specifications may be required due to peculiarities of the individual parameters, and is stated in the procedure for that parameter.

7.2 TEMPORAL AND SPATIAL ANALYSIS

Environmental parameters vary with space and time. The effect of one or both of these two factors on the expected value of a point measurement is statistically evaluated through spatial analysis and time series analysis; however, these methods often require extensive sampling efforts which are in excess of the practical requirements of the WIPP EMP. The application of these methods to a particular parameter must, therefore, be limited by consideration of its significance in the final interpretation of the data.

In particular, spatial analysis has limited use in this program, although the effect of spatial auto-correlation on the interpretation of the data is considered for each parameter. Spatial variability is accounted for by the use of predetermined key sampling locations. Data analysis is performed on a location-specific basis, or data from different locations is combined only when the data have been determined to be statistically homogeneous.

Time series analysis plays a more important role in data analysis for the EMP. Parameters are reported as time series, either in tabular form or as time plots. For key time series parameters, these plots are in the form of control charts on which control levels will be identified based on preoperational data base, fixed standards, control location data bases, or other standards for comparison (*Statistical Summary of the Radiological Baseline for the WIPP* (DOE/WIPP 92-037)). Where significant seasonal changes in the expected value of the parameter are identified in the preoperational data base or in the control locations, corrections in the control levels which reflect the seasonal change are made.

7.3 DISTRIBUTIONS AND DESCRIPTIVE STATISTICS

For data sets which include more than ten data points that are homogeneous in space and time (including seasonal homogeneity), and have less than ten percent missing data, a test for conformance to the normal distribution is performed. A probability plot is an accepted method for performing this test; however, more powerful tests of normality, such as the W Test, or D'Agostino's Test (Gilbert, 1987) are more accurate. Any standard best fit test is acceptable, provided the assumptions of the test are met.

If normality is not met, the data will be log-transformed and retested for normality. If the transformed data fit a normal distribution, the original data will be accepted as having log-normal distribution. If normality is still not found, two courses may be taken. One is to continue to test the fit to standard families of distributions, such as the gamma, beta, and Weibull, with proper modifications to subsequent analyses based on the these results. The other course is to use nonparametric methods of data analysis.

For data sets smaller than ten, but homogeneous and complete, the log-normal distribution is assumed. Data sets with more than ten percent missing data are analyzed using nonparametric methods. Nonhomogeneous data sets are subdivided into homogeneous sets and each of these analyzed individually.

Descriptive statistics are calculated for each homogeneous data set. At a minimum, these include a central value and a range of variation. The central value is the arithmetic mean of the untransformed data if the data are not censored at either end. If the data are censored, either a trimmed mean or the median is used as the central value (which may be within the censored range). If the data set is greater than ten and is uncensored, the standard deviation is calculated and used as a basis for the reported range in variation. If these criteria are not met, the range between the 0.25 and 0.75 quartiles is used.

7.4 DATA ANOMALIES

Data anomalies include data points reported as being below the limit of detection (LD) or otherwise censored over a specific range of values, missing data points occurring randomly in the data set, and outliers which cannot be ascribed to a known source of variation.

Whenever possible, values which are below detection limits are obtained and incorporated into the data base for statistical analysis. When values are not available, alternative methods of analysis, as described in previous sections, are used. In particular, the use of nonparametric statistics is required.

Missing data points comprising less than 10 percent of the data set do not affect data analyses. Results based on data in which more than 10 percent is missing are identified as such at the time of reporting. Consideration of the potential effect of missing data must be made when the majority of the data are missing from a discrete time span.

An outlier is defined as any data point occurring in either extreme upper or lower range of the data distribution for which there is less than 0.01 probability of occurrence. For normally distributed data, this is roughly 2.3 or more standard deviations above or below the mean. When no probability model is identified, outliers may only be found through visual inspection of the data.

If outside source of variation are not identified to account for outliers in a data set, it is included in the data set and all subsequent analyses. If the inclusion of such outliers is found to affect the final results of the analyses significantly, both results (with and without outliers) are reported.

7.5 COMPARISONS AND REPORTING

Comparisons between data sets are performed using standard statistical tests. The selection of the specific test is dependent upon the relative power of the test and the degree to which the underlying requirements of the test are met. In addition to tests comparing data from distinct locations and times, trend analyses are performed on time series where sufficient data exist. A 95 percent confidence level will be used for the final interpretation of results.

Citation of the source of the test method or the software used to perform the tests will be made when results are reported. Data and subsequent calculated values are reported in the annual site environmental report in accordance with standard rules for significant figures.

Note: There has been no attempt in this section to define standard statistical terminology nor to reference common statistical formulae and derivations. Many satisfactory statistical texts and handbooks, in addition to those given in the reference, are available for this purpose.

8.0 QUALITY ASSURANCE

8.1 INTRODUCTION

This section defines the policies and procedures that have been implemented at the WIPP to provide confidence in the quality of the environmental data that are generated. Quality assurance (QA) practices that cover monitoring activities at the WIPP are consistent with applicable elements of the 18-element format in ANSI/ASME NQA-I, which are as follows:

- Organization of participants
- Quality assurance program
- Design control and analysis
- Procurement document control
- Instructions procedures and drawings
- Document control
- Control of purchased items and services
- Identification and control of materials and samples
- Control of process
- Inspections
- Test control
- Control of measuring and test equipment
- Handling, packaging, storage, and shipping
- Inspection, test, and operating status
- Control of nonconformances
- Corrective actions
- Quality assurance records
- Audits

The WID Quality Assurance Program Description (QAPD), WP 13-1, defines QA requirements and responsibilities that apply to WID work. The format of Revision 14 of WP 13-1 is based on the eighteen QA criteria of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities". Both the requirements of NQA-1 and the ten criteria of DOE Order 5700.6C are addressed. Because QA requirements of data collection for compliance with environmental regulations are less detailed than those usually applied to nuclear facilities, the WID QAPD also addresses EPA QA requirements extracted from the EPA's QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans". For the WIPP project, these EPA QA requirements apply to Environmental Data Operations (EDOs); that is, compliance activities associated with collection and analysis of environmental samples, including data reduction, handling, reporting, and records management. Examples of EDOs at the WIPP include the monitoring programs for compliance with the No-Migration Variance, NESHAPS, and RCRA hazardous waste characterization. Table 8-1 demonstrates the relationship between QA requirements from DOE Order 5700.6C, ASME NQA-1, and EPA QAMS-005/80.

8.2 GOAL

The Westinghouse Waste Isolation Division (WID) quality assurance policy sets a goal to perform all work in such manner that the required quality is attained or exceeded. To attain this goal the WID has developed and implemented a formal QA program that is tailored for activities associated with receipt of TRU waste, including operational safety, environmental compliance, and performance assessment.

TABLE 8-1

DOE 5700.6C CROSS REFERENCE TO ASME NQA-1 AND EPA QAMS-005/80

	DOE ORDER 5700.6C CRITERION	ASME NQA-1 BASIC REQUIREMENT	EPA QAMS-005/80 ELEMENT
MANAGEMENT	1. Program	1. Organization 2. Quality Assurance Program	3. Project Description 4. Project Organization & Responsibility 16. Quality Assurance Reports to Management
	2. Personnel Training and Qualification	2. Quality Assurance Program	3. Project Description 16. Quality Assurance Reports to Management
	3. Quality Improvement	15. Control of Nonconforming Items 16. Corrective Action	15. Corrective Action
	4. Documents and Records	6. Document Control 17. Quality Assurance Records	1. Title Page 2. Table of Contents
PERFORMANCE	5. Work Processes	5. Instructions, Procedures and Drawings 8. Identification and Control of Items 9. Control of Processes 12. Control of Measuring and Test Equipment 13. Handling, Storage and Shipping	6. Sampling Procedures 7. Sample Custody 8. Calibration 9. Analytical Procedures 13. Preventive Maintenance
	6. Design	3. Design Control	5. Data Quality Objectives 6. Sampling Procedures 10. Data Reduction 11. Internal Quality Control 14. Routine Procedures to Assess Data Quality
	7. Procurement	4. Procurement Document Control 7. Control of Purchased Items and Services	N/A
	8. Inspection and Acceptance Testing	10. Inspection 11. Test Control 12. Control of Measuring and Test Equipment 14. Inspection, Test and Operating Status	8. Calibration 13. Preventive Maintenance
ASSESS	9. Management Assessment	2. Quality Assurance Program	3. Project Description 14. Routine Procedures to Assess Data Quality 16. Quality Assurance Reports to Management
	10. Independent Assessment	18. Audits	12. Audits 14. Routine Procedures to Assess Data Quality

8.3 PROGRAM ELEMENTS/CRITERIA

The specific WIPP QA program elements/criteria that are applicable to the performance of the EMP are listed below by DOE Order 5700.6C criterion. These elements establish the applicable QA requirements that are required for compliance activities associated with the collection and analysis of environmental samples, including data reduction, handling, reporting, and records management.

8.3.1 Program

This element includes programmatic practices and procedures that include QA project plans for EDOs that consider and address the 16 essential elements described in Section 5 of the EPA QAMS-005/80. Project descriptions for specific EDOs are provided in project-specific QA project plans (QAPjPs). These project-specific QA project plans include explanations for exclusion of any of the 16 elements that would not be relevant to a specific project. The project descriptions include an experiment design description in sufficient detail for stand-alone review and approval of the plan. EDO project descriptions incorporate the following elements, as appropriate:

- Flow diagrams, tables, and charts;
- Dates anticipated for start and completion; and
- Intended end use of acquired data.

Each WIPP organization involved with activities and operations affecting environmental data quality will specify QA/QC responsibilities in departmental or project-specific QA project plans. The QA project plans include tables or charts showing the project organization and line authority. Key individuals, including the designated QA officer, who are responsible for ensuring the collection of valid data and the routine assessment of measurement systems for precision and accuracy, are listed.

Precision and accuracy of all environmental monitoring data are routinely assessed and reported. Project-specific QA project plans associated with EDOs provide the mechanism for periodic reports to the DOE WIPP project management on the performance of measurement systems and data quality. These reports include:

- Periodic assessment of measurement data accuracy, precision, and completeness;
- Results of performance audits;
- Results of system audits;
- Significant QA problems which if uncorrected could have a serious effect on the health and safety of WIPP workers and the public, seriously impact the operation of the WIPP, or have a noticeable adverse impact on the environment;
- Recommended corrective actions;
- Identification of individuals responsible for report preparation; and
- Provisions in the final report for a separate QA section that summarizes data quality information contained in the periodic reports.

8.3.2 Personnel Training and Qualification

The WIPP training program has been designed to ensure that personnel performing work are capable of performing their assigned task in a proficient manner. Personnel who perform work that requires special skills or abilities are required to meet the qualification requirements for that specific task unless directly supervised by a qualified person.

8.3.3 Quality Improvement

The quality improvement process has been established and implemented to improve quality and provide corrective action procedures. Corrective action procedures for activities associated with environmental data collection are identified in project-specific QA project plans. At a minimum, the following elements are addressed:

- Predetermined limits for data acceptability beyond which corrective action is required;
- Procedures for corrective action; and
- Identification of individuals responsible for initiating corrective action and individuals responsible for verifying and approving implementation of the corrective action.

Corrective action may be initiated through routine operations, performance audits, system audits, inter/intralaboratory comparison studies, or performance demonstrations conducted by DOE-WSB.

8.3.4 Documents and Records

Procedures are established that control the preparation, review, approval, issuance, use, and revision of documents that establish policies, prescribe work, specify requirements, establish design, or that are being used for the performance of quality-related activities. Each project-specific QA implementation plan for EDOs includes documentation of approval, in the form of a title page.

Procedures are also in place to ensure that records are specified, prepared, reviewed, approved, and maintained to accurately reflect completed work. This process is described in DOE/WIPP 89-013, "WIPP Project Records Management Handbook". The WIPP record management program provides a project-wide records management system that coordinates the collection, maintenance, identification, and preservation of WIPP project records, in accordance with standards mandated by DOE Order 1324.5 "Records Management Program".

8.3.5 Work Processes

Work is performed to established technical standards and administrative controls. For each major measurement parameter, the design of sampling methodology, equipment, and procedures are documented and approved. The following requirements for sample design are addressed in project-specific technical and/or QA plans, as applicable:

- Description of techniques or guidelines used to select sampling sites;
- Inclusion of specific sampling procedures to be used, either by reference in the case of approved standard operating procedures (SOPs), or in entirety if the procedures are nonstandard;

- Charts, flow diagrams, or tables delineating sampling program operations;
- A description of containers, procedures, reagents, etc., used for sample collection, preservation, transportation, and storage;
- Special conditions for the preparation of sampling equipment and containers to avoid sample contamination;
- Sample preservation methods and holding times;
- Time considerations for shipment of samples to the laboratory;
- Sample custody or chain-of-custody procedures; and
- Forms, notebooks, databases, and procedures to be used to document sample history, sampling conditions, and required analyses.

Samples collected for environmental compliance activities or for site validation are controlled by approved chain-of-custody procedures. The actual practices used are documented in project-specific QA implementation plans. The following sample custody procedures are specified in the QA project plan:

- For field sampling operations:
  - Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample;
  - Procedures and forms for recording the exact location and specific considerations associated with sample acquisition;
  - Documentation of specific sample preservation methods; and
  - Sample labels containing all information necessary for effective sample tracking.
- For laboratory operations:
  - Identification of responsible party to act as sample custodian at the laboratory facility authorized to sign for incoming field samples, obtain documents of shipment, and verify the data entered onto the same custody records;
  - A laboratory sample custody log consisting of serially numbered standard lab-tracking report sheets; and
  - Specification of laboratory sample custody procedures for sample handling, storage, and dispersement for analysis.

Custody records are treated as permanent QA records by the recipient upon final transmission of the analytical data.

Calibration procedures and frequency for EDO activities are specified in project specific QA implementation plans. The plans include:

- A reference to the applicable SOP, or written description of the calibration procedures used for each major measurement parameter;

- Frequency of calibration; and
- Calibration standards to be used, as well as their sources and traceability.

Preventive maintenance of equipment used for collection and measurement of environmental data are identified in project specific QA implementation plans. The following types of preventive maintenance items are addressed:

- A schedule for preventive maintenance tasks; and
- A list of critical spare parts that should be available.

Procedures used for controlling the analysis of samples collected for EDO activities are specified in project-specific QA implementation or technical plans. For each measurement parameter the applicable procedure is either described in writing, or referenced as an SOP.

8.3.6 Design

Each major measurement parameter, the design of sampling methodology, equipment and procedures are documented and approved. The following requirements for sample design are addressed in project-specific plans and/or QA plans:

- Description of techniques or guidelines used to select sampling sites;
- Inclusion of specific sampling procedures to be used, either by reference in the case of approved SOPs, or in entirety if the procedures are nonstandard;
- Charts, flow diagrams, or tables delineating sampling program operations;
- Description of containers, procedures, reagents, etc., used for sample collection, preservation, transport, and storage;
- Special conditions for the preparation of sampling equipment and containers to avoid sample contamination;
- Sample preservation methods and holding times;
- Time considerations for shipment of samples to the laboratory;
- Sample custody or chain-of-custody procedures; and
- Forms, notebooks, databases, and procedures to be used to document sample history, sampling conditions, and required analyses.

8.3.7 Procurement

The control of procurement documents ensures that procured items and services meet established requirements and specifications. Basic procurement requirements include:

- Applicable design specifications and other order requirements are \or referenced in documents for procurement of items and services;
- That the supplier have a QA program consistent with applicable requirements; and

- That all procurement actions be performed in accordance with written procedures that describe the actions involved in the preparation, review, approval, control and changes of procurement documents.

8.3.8 Inspection and Acceptance Testing

Inspection and acceptance testing of specified items and processes are conducted using established acceptance and performance criteria.

Equipment used for inspections and tests are calibrated and maintained. Calibration procedures and frequency for EDO activities are specified in project specified QA implementation plans. These plans will include:

- A reference to the applicable SOP, or written descriptions of the calibration procedures used for each major measurement parameter;
- Frequency of calibration; and
- Calibration standards to be used, as well as their sources and traceability.

8.3.9 Management Assessment

Senior management assembles input from the following sources to form the basis of management assessment:

- Line management's self-assessment reports;
- Independent assessment reports; and
- Corrective action reports including conditions adverse to quality, nonconformance reports (NCRs), program deficiency reports (PDRs), audit reports, and requests for corrective action (RCAs).

Following the assessment, the effectiveness of the QA program is documented. Further, areas for quality improvement root cause analysis (for severe nonconformances or high-risk items/activities), preventive or corrective actions, milestones for completion, responsibility assignments, trend analysis, and lessons learned are documented and transmitted to the DOE.

8.3.10 Independent Assessment

Independent Assessment is performed to verify procedure compliance. Independent assessment is also used to prove independent oversight of the self-assessment process performed by line management. Independent assessment focuses on improving items and processes by emphasizing line organization's achievement of quality. Results from independent assessments are transmitted to senior management as input for determination of the effectiveness of the integrated QA program. In this regard, personnel performing independent assessments act in a management advisory function.

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9.0 REQUIRED RECORDS AND REPORTS

The record-keeping and reporting requirements applicable to the radiological and nonradiological environmental surveillance programs at the WIPP are identified in the WIPP Environmental Procedures Manual (WP 02-3), and the Groundwater Monitoring Program Plan and Procedure Manual (WP 02-1). These program plans define and delineate the responsibilities for compliance with DOE Orders 1324.2A (DOE, 1988), 5400.1 (DOE, 1990), 5484.1 (DOE, 1981a), and 5700.6C (DOE, 1991c). The final due dates and distribution of routine reports are also indicated in WP 02-3. The following sections identify the WIPP record-keeping and reporting procedures for compliance with applicable DOE orders.

9.1 RECORD KEEPING

Records generated by operational effluent and environmental surveillance activities are controlled and maintained in accordance with DOE Order 1324.2A (DOE, 1988), WIPP Records Management Procedures (WP 15-030), and WIPP Document Control Procedures (WP 15-006). All original records are maintained in a fire retardant file cabinets at the WIPP until transmitted to the WIPP Project Records Services for permanent filing. All records, including raw data, calculations, computer programs or other data manipulation, are subject to review and verification under the WIPP Quality Assurance Program.

Records (such as analyses reports and sample receipt forms transmitted by contract analytical laboratories) are dated upon receipt and a copy made for QC review as specified in NES/RES QA/QC Implementation Procedures (WP 02-302). Specific record and data management procedures including the recording and referencing of data manipulations are implemented according to the WP 02-1, RES Data Management Procedure (WP 02-305), and NES Data Management Procedure (WP 02-334).

Interpretive rule 10 CFR Part 962 Radioactive Waste, By-product Material (DOE, 1987), states that the hazardous component of radioactive mixed waste is subject to regulation under the RCRA. In accordance with 10 CFR Part 962, the WIPP must comply with all applicable regulations specified in 40 CFR Parts 260-268 and 270 (EPA 1980a-f, 1985d, 1981, 1986a, 1983a). The WIPP complies with applicable hazardous waste regulations regarding operating records, reporting, and availability and retention of records as determined by DOE and EPA.

The WIPP voluntarily complies with record-keeping requirements as promulgated under 40 CFR Part 61, Subpart H (EPA, 1985b), which pertain to atmospheric radionuclide emissions (WP 02-301). In addition, unless regulations are amended in the future, records development pursuant to these criteria are maintained at least 30 years, as specified in DOE 1324.2A (DOE, 1988), Chapter V, Attachment 1, Schedule 25 (Medical, Health and Safety Records).

9.2 REPORTING

The WIPP Environmental Monitoring Plan is reviewed annually and updated at least every three years in accordance with DOE Order 5400.1 (DOE, 1988d). Changes are made as new regulations are promulgated which specify record-keeping and reporting requirements applicable to the environmental monitoring program at the WIPP.

The WIPP Annual Site Environmental Report is prepared according to DOE Order 5400.1 (DOE, 1988d). This report summarizes the facility's compliance with applicable environmental regulations and informs the public as to the impact of the operations at WIPP on the surrounding environment.

The Environmental Protection Implementation Plan (EPIP) is revised annually in accordance with DOE Order 5400.1 (DOE, 1988d). This document delineates how the WIPP implements the provisions of DOE Order 5400.1. The EPIP identifies compliance strategies and manpower allocations, and describes the WIPP organizational structure.

The Annual Mitigation Report (AMR), required by DOE Order 5440.1E, is issued each July. This document describes the progress made in implementing the commitments made in the FEIS and SEIS Records of Decision. Several of the commitments that are being tracked pertain to environmental monitoring and environmental compliance.

The No-Migration Determination Annual Report is submitted annually to the EPA in November. This document meets the requirements of the "Conditional No-Migration Determination for the Department of Energy Waste Isolation Plant" (55 FR 47700). This report contains summaries of air monitoring and waste characterization data, as well as VOC monitoring results.

When WIPP begins to receive TRU waste, Radioactive Effluent and On-site Discharge Data Reports will be prepared and submitted to the Waste Information System Branch of EG&G Idaho, Inc., by April 1 of each year. DOE Order 5480.14 specifies instructions for implementing a DOE Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program (DOE, 1985c). No inactive hazardous-waste disposal sites requiring remedial action under CERCLA exist at WIPP. WIPP notifies the National Response Center in the case of a release of "reportable quantities" of radionuclides or other hazardous substances at the WIPP as required by CERCLA §102(a) (DOE, 1985c).

The EPA has promulgated environmental standards for the management and disposal of transuranic radioactive wastes under the authority of the EPA and the Nuclear Waste Policy Act (NWPA). The EPA has not specified reporting requirements applicable to the WIPP under this regulation.

The Office of Management and Budget Circular A-106, "Reporting Requirements in Connection with the Prevention, Control, and Abatement of Environmental Pollution at Existing Federal Facilities" (OMB, 1975), has established a semiannual reporting requirement for implementing Sections 1 through 4 of Presidential Executive Order 12088 and Presidential Executive Order 11752 pertaining to the control of environmental pollution from existing federal facilities. The plans, to be submitted on December 31 and June 30, identify projects necessary to bring federal facilities into compliance with applicable environmental standards.

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