DOE/WIPP 96-2182

# Waste Isolation Pilot Plant

# Site Environmental Report

## For Calendar Year 199[illegible]


U.S. Department of Energy
Prepared by Westinghouse Electric Corp.
Waste Isolation Division

# 1995 WIPP Site Environmental Report
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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AA | Atomic Absorption |
| AEC | United States Atomic Energy Commission |
| AHPA | Archaeological and Historic Preservation Act |
| AMS | Ambient Air Monitoring Station |
| AQCR | Air Quality Control Regulation |
| ARA | Archaeological Recovery Act |
| ASER | Annual Site Environmental Report |
| ASME | American Society of Mechanical Engineers |
| BECR | Biennial Environmental Compliance Report |
| BMP | Best Management Practices |
| BLM | Bureau of Land Management |
| C and C | Consultation and Cooperation |
| CAA | Clean Air Act |
| CDC | Centers for Disease Control |
| CED | Committed Effective Dose |
| CEQ | Council on Environmental Quality |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |

# ACRONYMS AND ABBREVIATIONS

(continued)

| | |
|---|---|
| CMS | Central Monitoring System |
| CRRMP | Cooperative Raptor Research and Management Program |
| CRA | Carlsbad Resource Area |
| CRF | Central Records Facility |
| CWA | Clean Water Act |
| CY | Calendar Year |
| DMR | Discharge Monitoring Report |
| DOE | United States Department of Energy |
| DOL | Department of Labor |
| DOI | United States Department of the Interior |
| DOT | Department of Transportation |
| DP | Discharge Plan |
| ECAP | Environmental Compliance Assessment Program |
| EEG | Environmental Evaluation Group |
| ELP | Environmental Leadership Program |
| EML | Environmental Measurements Lab |
| EMP | Environmental Monitoring Plan |

# ACRONYMS AND ABBREVIATIONS

(continued)

| | |
|---|---|
| EO | Executive Order |
| EPA | United States Environmental Protection Agency |
| EPCRA | Emergency Planning Community Right-to-Know Act |
| ESA | Endangered Species Act |
| FIFRA | Federal Insecticide, Fungicide, and Rodenticide Act |
| ESH&RC | Environment, Safety, Health and Regulatory Compliance |
| FEIS | Final Environmental Impact Statement |
| FLPMA | Federal Land Policy and Management Act of 1976 |
| FSAR | Final Safety Analysis Report |
| GSP | Groundwater Surveillance Program |
| HAP | Hazardous Air Pollutant |
| HEPA | High Efficiency Particulate Air |
| HMP | Habitat Management Plan |
| HPIC | High Pressure Ionization Chamber |
| HSWA | Hazardous and Solid Waste Amendments of 1984 (to RCRA) |
| ICAP | Inductively Coupled Argon Plasma |
| LDR | Land Disposal Restrictions |

# ACRONYMS AND ABBREVIATIONS

(continued)

| | |
|---|---|
| LEPC | Local Emergency Planning Committee |
| LLCL | Low-Level Counting Laboratory |
| LMIP | Land Management Implementation Plan |
| LMP | Land Management Plan |
| LS | Liquid Scintillation |
| LWA | Land Withdrawal Act |
| MAP | Mitigation Action Plan |
| MBTA | Migratory Bird Treaty Act |
| MET | Meteorological Station |
| MOC | Management and Operating Contractor |
| MOU | Memorandum of Understanding |
| MSHA | Federal Mine Safety and Health Act |
| NAAQS | National Ambient Air Quality Standards |
| NCP | National Contingency Plan |
| NEPA | National Environmental Policy Act |
| NES | Nonradiological Environmental Surveillance |
| NESHAPS | National Emissions Standards for Hazardous Air Pollutants |

# ACRONYMS AND ABBREVIATIONS

(continued)

| | |
|---|---|
| NHPA | National Historic Preservation Act |
| NMD | No-Migration Determination |
| NMED | New Mexico Environment Department |
| NMIMT | New Mexico Institute of Mining Technology |
| NMVP | No-Migration Variance Petition |
| NOI | Notice of Intent |
| NPDES | National Pollutant Discharge Elimination System |
| NRC | Nuclear Regulatory Commission/National Response Center |
| NWPA | Nuclear Waste Policy Act |
| OSHA | Occupational Safety and Health Administration |
| PCB | Poly-chlorinated Biphenyl |
| PESP | Performance Evaluation Study Program |
| PI | Principal Investigator |
| PPOA | Pollution Prevention Opportunity Assessment |
| QA | Quality Assurance |
| QA/QC | Quality Assurance/Quality Control |
| QAP | Quality Assurance Program |

# ACRONYMS AND ABBREVIATIONS

(continued)

| | |
|---|---|
| QC | Quality Control |
| QSL | Qualified Suppliers List |
| RBP | Radiological Baseline Program |
| RCRA | Resource Conservation and Recovery Act |
| REMP | Radioactive Effluent Monitoring Program |
| RES | Radiological Environmental Surveillance |
| RIDS | Records Inventory and Disposition Schedule |
| RL | Radiochemistry Laboratory |
| RMP | Resource Management Plan |
| ROD | Record of Decision |
| RRMP | Raptor Research and Management Program |
| SAA | Satellite Accumulation Area |
| SARA | Superfund Amendments and Reauthorization Act |
| SERC | State Emergency Response Commission |
| SDWA | Safe Drinking Water Act |
| SEIS | Supplemental Environmental Impact Statement |
| SHPO | State Historic Preservation Officer |

# ACRONYMS AND ABBREVIATIONS

(continued)

| | |
|---|---|
| SNL | Sandia National Laboratories |
| SPDV | Site Preliminary Design and Validation |
| TDS | Total Dissolved Solids |
| TPY | Ton Per Year |
| TRU | Transuranic Waste |
| TRUPACT-II | Transuranic Package Transporter Model II |
| TSCA | Toxic Substances Control Act |
| TSDF | Treatment Storage Disposal Facility |
| TSP | Total Suspended Particulates |
| USF&WS | United States Department of the Interior, Fish and Wildlife Service |
| USGS | United States Geological Survey |
| VOC | Volatile Organic Compound |
| VPP | Voluntary Protection Program |
| WAC | Waste Acceptance Criteria |
| WIPP | Waste Isolation Pilot Plan |
| WQSP | WIPP Groundwater Quality Surveillance Program |

# 1995 WIPP Site Environmental Report
## Preface

This is the twelfth annual Site Environmental Report (SER), documenting the progress of environmental programs at the U.S. Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP).

Accounts of environmental activities, and the WIPP's ability to demonstrate compliance with both state and federal environmental compliance requirements, are presented in this report. Elements of this report were compiled, in their entirety through the cooperative efforts of Environmental Monitoring, Environmental/Regulatory Compliance, and Radiochemistry (onsite Low Level Counting Laboratory) personnel. Assessments of radiological data were accomplished with assistance from the Environmental Evaluation Group (EEG). Environmental Monitoring routines involve a standard practice of interaction with the DOE Oversight Bureau of the New Mexico Environment Department onsite office personnel.

This SER provides a compilation and summarization of environmental data collected at the WIPP site during the calendar year 1995. Should a reader of this report desire to obtain copies of the raw data used to generate this document, please write the U.S. Department of Energy, Manager of the Environment, Safety and Health Department, at P.O. Box 3090, Carlsbad, NM 88221-3090.

# Chapter 1
# Executive Summary

The U.S. Department of Energy (DOE) Order 5400.1 *General Environmental Protection Program*, requires DOE facilities, that conduct environmental protection programs, to annually prepare a Site Environmental Report (SER). The purpose of the SER is to provide an abstract of environmental assessments conducted in order to characterize site environmental management performance, to confirm compliance with environmental standards and requirements, and to highlight significant programs and efforts of environmental merit. The content of this SER is not restricted to a synopsis of the required data, in addition, information pertaining to new and continued monitoring and compliance activities during the 1995 calendar year are also included.

Data contained in this report are derived from those monitoring programs directed by the Waste Isolation Pilot Plant (WIPP) *Environmental Monitoring Plan* (EMP) (DOE/WIPP 94-024). The EMP provides inclusive guidelines implemented to detect potential impacts to the environment and to establish baseline measurements for future environmental evaluations. Surface water, groundwater, air, soil, and biotic matrices are monitored for an array of radiological and nonradiological factors. The baseline radiological surveillance program encompasses a broader geographic area that includes nearby ranches, villages, and cities. Most elements of nonradiological assessments are conducted within the geographic vicinity of the WIPP site.

To date, the WIPP remains in a preoperational phase. Accordingly, certain operational requirements specified in DOE Order 5400.1 and in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T) do not apply. This report does not address program modifications, new program implementation, and activities that will be developed to meet future (operational) requirements such as radionuclide emissions and effluents and respective impacts upon the public and the environment.

## 1.1 Compliance Summary

A summary of significant compliance-related activities at the WIPP during Calendar Year (CY) 1995 is presented in this chapter. Chapter 3 will address environmental statutes and executive orders. These important statutes and orders will be comprehensively discussed in terms of compliance status, significant issues, actions, and accomplishments specific to WIPP.

On January 13, 1994, the DOE recommended that the New Mexico Environmental Department (NMED) allow the DOE to modify the Resource Conservation and Recovery Act (RCRA) permit application to reflect disposal rather than test-phase operations. On September 2, 1994, the NMED rescinded the draft permit issued in August 1993 and ordered the submittal of a revised permit application. The revised permit was submitted during May of 1995.

The *No-Migration Determination Annual Report for the Period of September 1993 through August 1994* (DOE/WIPP 94-2029) was submitted to the Environmental Protection Agency (EPA) Region VI, and to EPA Headquarters on November 14, 1994. This report was prepared to satisfy the annual reporting requirements contained in the *Conditional No-Migration Determination for the U.S. Department of Energy Waste Isolation Pilot Plant* (NMD), published in the *Federal Register* on November 14, 1990. Although the NMD was written specifically for the WIPP test phase, compliance conditions mandated by the first WIPP NMD will continue until issuance of a Disposal Phase NMD. A No-Migration Variance Petition for the disposal phase is being developed, based on waste characterization data and applicable modeling results. It is expected to be submitted to the EPA in June 1996.

The Land Withdrawal Act (LWA), Section 8, requires the DOE to submit to EPA an application for certification of compliance with EPA's final disposal regulations. The EPA finalized disposal regulations (40 CFR 191) in December of 1993. Currently, the EPA is developing criteria for certifying compliance with these regulations. After EPA has finalized the compliance criteria, a compliance certification application, in accordance with the mandates of the WIPP LWA, will be developed.

### 1.1.1 The No-Migration Variance Petition

The *No-Migration Determination Annual Report for the Period of September 1994 through August 1995* (DOE/WIPP 95-2141) was submitted to the Environmental Protection Agency (EPA) Region VI, and to EPA Headquarters on November 6, 1995. This report was prepared to satisfy the annual reporting requirements contained in the *Conditional No-Migration Determination for the U.S. Department of Energy Waste Isolation Pilot Plant* (NMD), published in the *Federal Register* on November 14, 1990. Although the NMD was written specifically for the WIPP test phase, some of the compliance conditions mandated by the first WIPP NMD remain in effect until issuance of a Disposal Phase NMD. A Disposal Phase No-Migration Variance Petition is being developed, based on waste characterization data and applicable modeling results. It is expected to be submitted to the EPA in CY 1996.

### 1.1.2 NEPA Annual Mitigation Report

The *1995 Annual Mitigation Report for the Waste Isolation Pilot Plant* (NEPA ID# WIP:95:0002) was issued July 10, 1995, in accordance with the requirement of DOE Order 5440.1E, *National Environmental Policy Act Compliance Program*. On September 11, 1995, DOE Order 5440.1E was replaced with a revised NEPA Compliance Program and issued as DOE Order 0451.1. This order also requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation that is essential to render the impacts of a proposed action not significant or that is made in a record of decision.

### 1.1.3 SARA Title III Emergency and Hazardous Chemical Inventory

On January 30, 1995, the WIPP submitted the *Emergency and Hazardous Chemical Inventory Report* for CY 1994 to the Carlsbad Area Office of the Department of Energy for distribution to the New Mexico State Emergency Response Commission, the Eddy County Local Emergency Planning Committee, and the local fire department with jurisdiction over the WIPP site, as required by Section 312 of the *Superfund Amendments and Reauthorization Act* (SARA) Title III. In March 1994, the WIPP submitted the Emergency and Hazardous Chemical Inventory Report for CY 1993 to appropriate organizations.

### 1.1.4 New Mexico Air Quality Permit 310-M-2

On February 26, 1994, the WIPP completed the emission monitoring requirements established in the New Mexico Air Quality Permit 310-M-2. With the submittal of the *Final Compliance Sampling Report* on March 28, 1994, the DOE has fulfilled all monitoring and reporting requirements identified in the permit. The permit was modified on September 1, 1994 to allow one diesel generator to operate under load while the second diesel generator is at idle speed, in a warm up or cool down mode. This allows for greater operational flexibility.

### 1.1.5 NEPA Training

A computer-based National Environmental Policy Act (NEPA) training module was issued in December 1994 and has continued to be a productive tool in providing NEPA guidance to employees. This program is updated, as necessary, to ensure employees are kept abreast of current NEPA guidelines so that proper steps are taken in the planning, coordination, and performance of their work.

### 1.1.6 Environmental Compliance Assessments

During 1995, 8 environmental compliance assessments were conducted. Thirty-five (35) improvements were identified and implemented as a result of these assessments. The assessed areas included: Satellite Accumulation Areas and Hazardous Waste Staging Area; Sandia National Laboratories - Culebra Transport Program; Air, Waste, and Water Program; Annual Hazardous Waste Fee Regulations; Dosimetry and Analytical Laboratory; National Pollutant Discharge Elimination System (NPDES); RCRA Equipment Inspections; and Environmental Monitoring.

### 1.1.7 ISO 14000

The International Standards Organization (ISO) is establishing a new philosophy for environmental management that goes beyond regulatory compliance. ISO 14000 is the system of international environmental management standards designed to give a common management approach for parties trading products or services having impact on the environment. While the ISO 14000 standards are completely voluntary, many companies and countries are adopting them because the standards are agreed upon internationally. The WID views early ISO 14000 compliance as an important step towards becoming an industry leader. Compliance efforts are already underway aimed at certification assessments in March 1997.

### 1.1.8 Voluntary Release Assessment Program at Selected Solid Waste Management Units at the WIPP

The U.S. Department of Energy, Carlsbad Area Office (DOE-CAO) has completed a voluntary release assessment sampling program at 11 selected Solid Waste Management Units (SWMUs) at the WIPP. Data generated by the release assessment sampling program are being used to document voluntary release assessment/corrective action commitments contained in the *Voluntary Release Assessment/Corrective Action Work Plan (DOE/WIPP Draft 2115)* submitted to the EPA and NMED in July, 1995. The CAO made the decision to complete a voluntary release assessment/corrective action program at selected SWMUs described in Chapter J of the RCRA Part B permit because the proposed rules provide incentives for facilities willing to complete voluntary corrective actions.

A total of 264 release assessment samples were collected to determine if a release had occurred from any of the 11 SWMUs described in the release assessment work plan. Release assessment sampling data, and proposed corrective actions have been compiled into three data summary reports.

Data summary reports were submitted to the EPA Region VI, Hazardous Waste Management Division and the NMED Hazardous and Radioactive Materials Bureau.

Based on the results of voluntary release assessment sampling, the CAO has formally requested that a determination of No Further Action be granted for each of the 11 SWMUs. In the event the No Further Action determination is approved by the agencies, each of the 11 sites will be replanted with native vegetation in accordance with the guideline provided in the *WIPP Land Management Plan* (DOE WIPP 93-004).

### 1.1.9 Site Environmental Awareness Program

The Site Environmental Awareness Program was established in December 1995 to educate, inform, and increase the awareness of environmental issues to all Waste Isolation Division employees. The program provides an overview of all applicable environmental drivers. This general environmental awareness, cultivated by the Environmental Awareness Campaign and the Managers' Environmental Handbook, will lead to the implementation of the Management Environmental Awareness Program (MEAP).

### 1.1.10 Executive Order 12873 - *Federal Acquisition, Recycling, and Waste Prevention*

In January 1996, the WID implemented an Affirmative Procurement (AP) program driven by the Resource Conservation and Recovery Act Section 6002(i), Executive Order 12873, *Federal Acquisition, Recycling, and Waste Prevention*, and the Environmental Protection Agency guidelines. 40 CFR 248-250 and 252-253. The purpose of AP is to implement a systematic and cost-effective program for promoting and procuring materials and products made from recycled materials. AP is designed to "close a loop" in the waste minimization recycling process by supporting the market of recycled materials.

The WIPP must implement the four affirmative procurement program elements in order to be in compliance with the RCRA and EPA guidelines. These elements include the following:

- A preference program to purchase recycled products when it is determined to be technically and economically feasible.

- Recycled product promotion.

- A system for supplier certification of recovered material content.

- Annual reporting and program evaluation.

In January 1996, the WID held a series of three training sessions for all requisitioners acquainting them with the AP and their responsibilities when procuring specific items.

## 1.2 Environmental Monitoring Program Information

Site characterization and environmental baseline measurements at the WIPP were initiated during 1975. Many of these elements continue to be maintained on radiological and nonradiological databases. When the WIPP becomes operational, baseline measurements will be transitioned to the "operational phase" and will be constantly monitored throughout the life of the project.

### 1.2.1 Environmental Monitoring Plan (EMP)

The WIPP's EMP provides schedules and guidelines for monitoring a comprehensive set of parameters to detect and quantify present or potential environmental impacts, both nonradiologically and radiologically. Most nonradiological surveillance is conducted in the geographic vicinity of the WIPP site. Radiological surveillance covers a broader geographic area that includes nearby ranches, villages, and cities. Sampling activities conducted during CY 1995 were performed at locations identified in the EMP. Monitoring protocol is dynamic and requires modifications from time-to-time to sustain a contemporary and technically sound program. Environmental Monitoring will continue at the WIPP site during project operations and throughout decommissioning activities.

## 1.3 Environmental Radiological Program Information

The following presents monitoring topics for the subprograms of the EMP. These subprograms are consistent with guidance provided in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, (DOE/EH-0173T).

DOE Order 5400.1 requires the establishment of a radiological baseline during the preoperational phase. Once a radiological baseline has been established, applicable radiological sampling programs can be maintained or can be modified to improve sampling efficiency. As radiological sampling protocol evolves to reflect program requirements (e.g., DOE Orders, EPA directives), the continuation of baseline sampling is necessary to provide adequate and timely measurements prior to waste receipt. As specifically outlined in the EMP, five subprograms are being conducted to document the background levels of potential radionuclide pathways leading from the WIPP to the environment and the public. These five subprograms are presented in the *Statistical Summary of the Radiological Baseline Program (RBP) for the Waste Isolation Pilot Plant* (DOE/WIPP 92-037).

Results from the radiological analysis of environmental samples are provided in the attached appendices.

### 1.3.1 Airborne Particulate and Effluent Monitoring

The WIPP began sampling airborne aerosol particulates during 1985. This sampling activity continues to be an integral subprogram of the EMP. The *Safety Analysis Report* (SAR) (DOE/WIPP 95-2065) identifies the atmosphere pathway as the most credible exposure pathway for the public to radiation. To monitor this pathway, particulate aerosol samplers continuously operated at seven locations during 1995; three, within 1000 meters of the facility boundary; three, at local ranches and communities; and one, at a sample control site.

The continuous aerosol samplers employed to collect particulates, during 1995, maintain a regulated flow rate of 0.057 cubic meters per minute (approximately two cubic feet per minute) of air through a 47-millimeter (1.9 inch) fiber filter. Particulate filters are collected weekly (168 hour intervals) at all locations. Subsequent to collection, the filters are desiccated (or dried) for a minimum of 12 hours and transferred to the WIPP Site Low-Level Counting Laboratory (LLCL) for analysis of gross alpha and beta activity. Table 5-1 lists the quarterly alpha and beta concentrations for each sampling location. After samples are counted onsite, the filters are consolidated into 13-week or quarterly composites and transmitted to an offsite contract analytical laboratory for specific radionuclide analysis. These radionuclides with applicable data results, are provided in the attached appendices, and are presented as a calculated quarterly average.

### 1.3.2 Soil Sampling

Soil Samples were collected and analyzed in accordance with applicable guidance (e.g. DOE EH/0173T) and sampling procedures. Discussions pertaining to the radiological analysis of subject samples are provided in Chapter 5, *Environmental Radioactivity Monitoring*. Chapter 6, *Environmental Nonradiological Program Information*, discusses results from nonradiological analysis.

### 1.3.3 Groundwater

Groundwater surveillance activities during CY 1995 consisted of two separate programs: Groundwater Quality Sampling and Groundwater Level Surveillance Measurements. Groundwater quality samples were gathered from 10 well locations completed in the Culebra dolomite and one in the Dewey Lake. Sixty-nine groundwater level surveillance measurements were recorded quarterly at 64 well bores. Fifty-nine different measurements were recorded at 54 separate well bores. During CY 1994, seven new monitoring wells were drilled; six, in the Culebra dolomite; and one, into the Dewey Lake. Results and discussions pertaining to groundwater sampling activities are provided in Chapter 7, *Groundwater Surveillance*.

### 1.3.4 Surface Water and Sediment Sampling

Surface water was collected at 11 locations with concurrent sediment samples taken at 10. Analysis revealed no unusual levels of background radioactivity. Discussions pertaining to surface water and sediment sampling are provided in Chapter 5, *Environmental Radiological Program Information*.

### 1.3.5 Game Animals and Fish Samples

Because of profound drought conditions during CY 1995, quail and rabbit populations were drastically low. Quail sampling has been indefinitely postponed until the population increases to the capacity that sampling will not adversely affect the local population status. Sampling of rabbits was restricted to three individual road kills.

In prior years, sample matrices were restricted exclusively to single species (e.g., only desert cottontails as rabbit samples). During 1995, this restrictive sample protocol was revised to allow for the inclusion of a greater diversity of sample specimens. For example, rather than restricting the collection of "rabbit" to the desert cottontail (*Sylvilagus audoboni)*, blacktail jackrabbits (*Lepus californicus*) have been included as a sample matrix, due primarily to the frequency of sample availability (jackrabbits constitute a significant majority of road kills).

Discussions pertaining to the radiological analysis of game animals and fish are presented in Chapter 5, *Environmental Radiological Program Information*. Results from the laboratory analysis of tissue are contained in the attached appendices.

## 1.4 Nonradiological Environmental Monitoring Information

Nonradiological environmental surveillance was also conducted in accordance with the EMP. This program was preceded by the WIPP Biology Program (1975-1982). An extensive baseline of information describing the major ecological components of the Los Medaños, prior to the initiation of the WIPP site construction activities, was developed. Six universities participated in the initiation of the characterization and baseline surveillance programs.

A significant portion of the nonradiological surveillance investigated effects of fugitive salt dust, generated by the surface stockpiling activities, on the surrounding environment (e.g., Reith, et al., 1985). This study is described in the *Summary of the Salt Impact Studies at the Waste Isolation Pilot Plant 1984 to 1990* (DOE/WIPP 92-038).

### 1.4.1 Land Management

In accordance with Section 4 of the Waste Isolation Pilot Plant (WIPP) *Land Withdrawal Act* (LWA) (Public Law 102-579), the DOE prepared a Land Management Plan (LMP) as required by the Act. The development of this plan was in collaboration with the U.S. Department of Interior's (DOI) Bureau of Land Management (BLM) and the state of New Mexico. Changes or amendments to the LMP are done in consultation with the BLM, the state of New Mexico, and affected stakeholders, as appropriate.

The LMP, as required by LWA, was prepared to identify resource values, promote the concept of multiple-use management, and identify long-term goals for the management of DOE/WIPP lands until the culmination of the decommissioning phase. The Plan also provides the opportunity for participation in the land use planning process by the public, as well as local, state, and federal agencies.

During CY 1995, a reprint of the LMP, which incorporates elements of implementation previously provided in the WIPP *Land Management Implementation Plan* (LMIP) (DOE/WIPP 94-026), was developed. The reprint does not revise or amend the intent or scope of the original plan, but merges implementing actions from the LMIP to make the plan more helpful for those desiring to use WIPP lands. An additional reason for developing this reprint was to reduce document volume and redundancies in text, which results in the LMIP being superseded by the LMP. The new LMP was finalized for distribution and implementation on January 31, 1996.

The LMP was prepared through the integration of the WIPP *Land Withdrawal Act* of 1992 (Public Law 102-579), BLM planning regulations (43 CFR 1600) issued under the authority of the Federal Land Policy and Management Act (FLPMA) of 1976, the National Environmental Policy Act (NEPA) of 1969, as amended; and existing Memoranda of Understanding (MOU) among the DOE and local, state and/or federal agencies. The LMP is designed to provide a comprehensive framework for the management and coordination of WIPP land uses during the life of the project. The LMP, and any subsequent amendments, will continue through the decommissioning phase. Moreover, in accordance with section 13 of the WIPP *Land Withdrawal Act,* the DOE will develop, in consultation with the Secretary of the Interior and the State of New Mexico, a plan for the management and use of the WIPP Land Withdrawal Area following the decommissioning of WIPP. This plan must be developed by October 30, 1997.

The guidelines prescribed in the LMP provide for the management and oversight of WIPP lands under the jurisdiction of the DOE in addition to lands outside the WIPP boundary that are used in the operation of the WIPP (e.g., groundwater surveillance well pads outside the withdrawn area). Furthermore, this plan provides for multiagency involvement in the administration of DOE land management actions. Documents referenced in the LMP are available to any person and/or organization desiring to conduct activities on lands under the jurisdiction of the DOE/WIPP in addition to those involved in development and/or amending existing land management actions. Documents can be obtained from the U.S. Department of Energy, Carlsbad Area Office, P.O. Box 3090, Carlsbad, New Mexico 88221.

The LMP advocates direct communication among stakeholders, including federal and state agencies involved in managing the resources within, or activities impacting the areas adjacent to, the WIPP Land Withdrawal Area (WLWA). It sets forth cooperative arrangements and protocols for addressing WIPP-related land management actions. The DOE recognizes the guidelines for contemporary land management practices that pertain to rational adherence with edicts in the WIPP LWA and all applicable regulatory requirements contained therein. Commitments contained in current permits, agreements, or concurrent MOUs with other agencies (e.g., state of New Mexico, DOI), shall be adhered to when addressing/evaluating land use management activities and future amendments that affect the management of WIPP lands.

The LMP is reviewed on a biennial basis to assess the adequacy and effectiveness of the document, or as may be necessary to address emerging issues potentially affecting WIPP lands. Affected agencies, groups, and/or individuals may be involved in the review process.

Contents of the LMP focus on management protocols for the following issues: administration of the plan: environmental compliance; wildlife; cultural resources; grazing; recreation; energy and mineral resources; lands/realty; reclamation; security; industrial safety: emergency management: maintenance and work control. Each issue and its complementary planning/management criteria are described in respective document chapters.

### 1.4.2 Meteorology

The WIPP Nonradiological Environmental Surveillance (NES) includes a primary meteorological (MET) station that provides support for various programs at the WIPP. The primary function of the MET is to generate data to model atmospheric conditions for Radiological Environmental Surveillance (RES). The station records standard meteorological measurements for wind speed, wind direction, and temperatures at a radius of 3, 10, and 40 meters (10, 30, and 130-feet respectively) with dew point and precipitation monitored at ground level. These parameters are measured continuously, and the data are logged, at fifteen minute intervals, in the Central Monitoring System (CMS).

In 1995, the annual rate of precipitation at the WIPP site was 23.27 cm (9.16 inches), which is 6.68 cm (2.63 inches) above last year's rate. The cumulative precipitation for 1995 remains well below normal.

The wind direction at the WIPP site is predominately from the southeast vector. In CY 1995, the data collected on wind direction in the WIPP area were consistent with data previously collected on wind direction in the same area. Discussions pertaining to meteorological monitoring are contained in Chapter 6, *Environmental Nonradiological Program Information.*

### 1.4.3 Air Quality Monitoring

Weekly measurements of Total Suspended Particulates (TSP) were collected by the low-volume continuous air samplers at seven field locations.

### 1.4.4 Wildlife Population Monitoring

Population density measurements of various species of wildlife are performed annually to assess the effects of the WIPP's activities on transient and resident wildlife populations.

#### 1.4.4.1 Raptor Research and Management Program

During CY 1995, data were collected on resident birds of prey within an area of approximately 870 square miles in the vicinity of the WIPP, with the WIPP Site as the epicenter of the study area. The majority of this sector is managed under the authority of the U.S. Department of the Interior's Bureau of Land Management (BLM) Carlsbad Resource Area (CRA) with WIPP lands comprising the nucleus of the research area. This cooperative enterprise between the BLM and the DOE was commissioned through the bilateral development of an Interagency Agreement. The Agreement defines commitments on behalf of each respective agency to include deliverables and itemized timelines for the completion of each element.

The CY 1995 survey period was characterized by a severe drought that had dramatic ramifications throughout the study area. Observations indicate the drought suppressed population densities of both predators and prey, affected the number of inhabited territories, and brought about declines in nesting and production. The 1995 data contains descriptive information on the social hierarchy of the Harris' Hawk (*Parabuteo unicinctus)*, physiognomy of the study area, research protocol, territorial fidelity (to include territorial trials), sex ratios, prey base determinations, capture and banding results, and habitat preferences. In addition, an inventory of other raptor inhabitants of the area was conducted. Result comparisons between 1995 and 1992 (the last calendar year of normal to above-normal precipitation) data were conducted to evaluate responses of resident raptors to the prolonged drought (currently in its fourth year).

### 1.4.5 Reclamation of Disturbed Lands

Reclamation activities during CY 1995 consisted of the periodic inspections, supplemental seedings, and exclosure maintenance of several reclamation sites. During 1995, reclamation equipment was purchased that includes a 4-wheel drive tractor, a ten-foot tandem disk, a ripper, and a hole auger. In addition to post holes, the auger is also used to access different soil horizons for sample arrays.

### 1.4.6 Vegetation Monitoring

During CY 1995 ecological vegetation monitoring was postponed because the data indicated negligible effects of salt tailings on the peripheral environment. A pattern was observed from the 1989-1992 data which was repeated in the 1993 data. The pattern confirms an increased progression in shrub cover near salt tailings. This increase is a result of the colonization of more saline-tolerant species (e.g. 4-winged saltbush, *Atriplex canescens*) in close proximity to the salt piles. Cursory observations of peripheral effects resulting from salt-induced physiological stress near the salt tailings was not observed during 1993, 1994, or 1995. Responses of these plots to seasonal precipitation rates should reveal whether this pattern is reflecting the beginning of significant changes in the structure of the plant community or whether it is only a short-term effect caused by seasonal conditions. Successional dry conditions during CY 1995 (Figure 6-1) prohibited any validation of assumptions regarding repercussions of salt migration from the tailings piles into the adjacent environment.

## 1.5 Quality Assurance

Programs described in this document adhere to policies set forth by Quality Assurance (QA) guidance criteria including: American Society of Mechanical Engineers (ASME) NQA-1, Quality Assurance Program (QAP) Requirements for Nuclear Facilities (ASME, 1989) and EPA, QAMS-005/80, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA, 1980), and fulfills the requirements of the QA plans specified in DOE Orders 5400.1 (DOE, 1988d), 5400.3 (DOE, 1988e), 5700.6C (DOE, 1991) and the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T).

# Chapter 2
# Introduction

This 1995 Site Environmental Report (SER) is prepared in accordance with the guidance contained in the 1990 DOE Order 5400.1, *General Environmental Protection Program*; DOE/WIPP 91-054, *Environmental Protection Implementation Plan*, and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. The above orders and guidance documents require that DOE facilities submit a SER to DOE Headquarters, Office of the Assistant Secretary for Environment, Safety and Health.

The SER provides a comprehensive description of operational environmental monitoring activities at the WIPP during CY 1995. This report also discusses the Quality Assurance (QA) and Quality Control (QC) programs. QA/QC programs provide the oversight necessary to maintain sample integrity to include:

- Proceduralized (to industry standards) sample collection methodology
- Personnel training
- Scrutiny of analytical data.

These criteria ensure that data derived from environmental samples provide an accurate representation of environmental conditions at the WIPP site. The requirements and goals driving these activities are more fully described in the *Environmental Monitoring Plan for the Waste Isolation Pilot Plant* (DOE/WIPP 94-024).

The Environmental Monitoring Plan (EMP) was drafted in accordance with the guidelines contained in the *General Environmental Protection Program* (DOE Order 5400.1). The EMP defines the scope and extent of the WIPP Environmental Monitoring Programs and ensures that all appropriate sampling efforts are in place to generate the following: (1) The amount and type of naturally occurring radioactivity in the WIPP area prior to operational status. These quantitative data will support comparisons between preoperational and operational environmental conditions, once the WIPP site is operating as a waste repository for TRU waste; and (2) A comparison between preoperational and operational radiological emissions, once the WIPP site is operating as a waste repository for TRU waste.

Since waste has not yet been received, certain elements of DOE Order 5400.1 are not relevant to the WIPP Environmental Monitoring Program. For example, no discussion is included in this report of radionuclide emissions with subsequent calculation of doses to the public. The EMP is reviewed annually and updated every three years, as required by DOE Order 5400.1. The revisions/updates address general changes, improvements, and enhancements to be implemented based upon the data generated from the monitoring programs.

## 2.1 Description of the WIPP Project

The WIPP project is authorized by the DOE, National Security, and Military Applications of Nuclear Energy Authorization Act of 1980 (i.e., Public Law 96-164). The legislative mandate is to demonstrate the safe disposal of transuranic wastes resulting from national defense activities and programs. To fulfill this mandate, the WIPP has been designed to scientifically investigate: (1) the behavior of bedded salt and the interactions between the salt and radioactive wastes and (2) to demonstrate safe and efficient handling, transport, and emplacement of transuranic (TRU) waste in a fully operational disposal site.

The first radioactive wastes will be emplaced once permitting activities are completed. Subsequent to successful permit completion, the WIPP site will be designated as an operational facility. TRU wastes will then be transported from generator/storage sites throughout the United States to the WIPP site.

The TRU waste received from the generator sites will be transported to the WIPP site via tractor-trailer trucks. Each truck can carry up to three TRU Package Transporters (TRUPACT IIs), and each transporter may contain fourteen 55-gallon drums or two standard waste boxes. The TRUPACT II is a durable, reusable container that has been certified by the Nuclear Regulatory Commission (NRC) to transport contact-handled (waste containers that can be handled without additional shielding) transuranic waste to the WIPP.

Once TRU wastes have arrived at the WIPP, they are transported into the Waste Handling Building. The waste containers will be removed from the TRUPACT IIs, placed on the waste hoist, and lowered to the repository level of 655 m (2150 feet) below the surface. During the disposal phase, waste drums will be removed from the hoist and emplaced in excavated storage rooms in the Salado formation, a thick sequence of salt beds deposited approximately 250 million years ago in the Permian Age. After the disposal areas have been filled, specially designed closures will be placed in the excavated disposal rooms and seals will be placed in the shafts. The self-healing nature of the salt formation will aid in gradual closure causing encapsulation and isolation of the waste within the Salado formation.

During site operations, the underground area will be ventilated with ambient air that enters the Air Intake Shaft, the Salt Handling Shaft, the Waste Handling Shaft, and exits through the Exhaust Shaft. In the event of an underground accident involving radioactivity, exhaust air can be circulated at a reduced flow rate through the Exhaust Filter Building. This building contains banks of High Efficiency Particulate Air (HEPA) filters that remove contaminated particulates.

## 2.2 Affected Environment

The WIPP Site is located in Eddy County in Southeastern New Mexico (Figure 2.1). The site is 26 miles east of Carlsbad, New Mexico, in a region known as the Los Medaños, that represents the initial intergradation between the Llano Estacado and the Chihuahuan Desert. This region displays an exceptional diversity of plant and animal inhabitants.

Geographically, the region is regarded as a relatively flat, sparsely inhabited plateau with little surface water. The region is popular for recreation, providing opportunities for hunting, camping, hiking, and bird watching.

The majority of the lands outside the WIPP site boundary, are managed under the jurisdiction of the U.S. Department of the Interior's (DOI) Bureau of Land Management (BLM) Carlsbad Resource Area (CRA) local office. Land uses in the surrounding area include livestock grazing, potash mining, oil and gas exploration and production (including support services), and recreational uses.

The WIPP site boundary extends at least 1.6 kilometers or one mile beyond any of the WIPP underground developments and is defined on the surface by the 16-section (4,146 ha) Land Withdrawal Area. On October 30, 1992, the WIPP Land Withdrawal Act, Public Law 102-579, was signed into law, transferring the land from the Department of Interior (DOI) to the DOE. In accordance with edicts contained in the Land Withdrawal Act, a WIPP Land Management Plan (DOE/WIPP 93-004), was prepared and submitted to Congress.

Consisting of 16 sections (4,146 ha or 10,240 acres) of federal land, the WIPP site is located in Eddy County, New Mexico in Township 22 South, Range 31 East. With the exception of properties located within the boundaries of the posted 1454 acre (589 ha) Off Limits Area, the surface land uses remain largely unchanged and are managed in accordance with accepted practices for multiple land use. Mining and drilling for purposes other than those which support the WIPP project are prohibited within the 16-section (4,146 ha) area.

### 2.2.1 WIPP Property Areas

The WIPP site is divided into defined areas as represented in Figure 2.1. Descriptions of these WIPP areas are as follows:

#### 2.2.1.1 Property Protection Area

The interior core area of the facility (Figure 2.1) is a land area of approximately 34.16 surface acres surrounded by a chain link fence. This sector, formerly identified as "Zone I," is designated as the "Property Protection Area." All access control features are maintained with uniformed security personnel on duty 24 hours a day.

#### 2.2.1.2 Exclusive Use Area

The Exclusive Use Area (Figure 2.1) is comprised of approximately 277.14 acres within Sections 20, 21, 28, and 29 of Township 22 South, Range 31 East. It is surrounded by a five-strand barbed wire fence and is restricted exclusively for the use of the DOE, its contractors and subcontractors in support of the project. In addition, this area is defined as the point of closest public access for the purposes of performing accident consequences to the general public in the WIPP Safety Analysis Report (SAR). This area is marked by DOE "No Trespassing" signs and will be patrolled by WIPP security personnel to prevent unauthorized activities or uses.

#### 2.2.1.3 Off Limits Area

The Off Limits Area (Figure 2.1) is a sector comprised of 1453.9 acres, or 2.2 square miles (more or less), within Sections 20, 21, 28, and 29 of Township 22 South, Range 31 East. This sector is managed as an area wherein unauthorized entry and the unauthorized introduction of weapons and/or dangerous materials (as provided in 10 CFR 860.3 and 860.4) is prohibited. Pertinent prohibitions and subsequent penalties (10 CFR 860.5) are posted at consistent intervals along the perimeter as directed in 10 CFR 860.6. Grazing and public thoroughfare continue until such time that these activities present a threat to the security, safety, and/or environmental quality of the WIPP. This sector will be patrolled by WIPP security personnel to prevent unauthorized activity or use. While the subject sector is posted, the area is not fenced.

#### 2.2.1.4 Waste Isolation Pilot Plant Land Withdrawal Area

The WIPP Site Boundary distinguishes the perimeter of the 16 section (or 10,240 acres) WIPP Land Withdrawal Area (WLWA). This tract includes properties outlying the Property Protection Area, the Exclusive Use Area, and the Off Limits Area. This sector is designated at points of ingress and egress, as a Multiple Land Use Area, and is managed accordingly. Certain restrictions however do apply. Information regarding land use restrictions is available from the DOE on request.

### 2.2.1.5 Special Management Areas

There are property sectors used in the operation of the WIPP (e.g., reclamation sites, well pads, roads, etc.) that are (and may be) identified as Special Management Areas (SMA). A SMA designation is due to values, resources, and/or circumstances that meet criteria for protection and management under special management designations. Unique resources of value that are in danger of being lost or damaged, sectors wherein ongoing construction is occurring, fragile plant and/or animal communities, sites of archaeological significance, sectors containing imminent risks (safety hazards), or a sector(s) that may receive an unanticipated elevated security status would be suitable for designation as a SMA. Accordingly, the subject sector would receive special management emphasis under this stipulation. SMAs will be posted against trespass and shall be safeguarded commensurate with applicable laws governing property protection. WIPP security personnel will patrol these areas to prevent unauthorized access or use.

The first two aforementioned sectors are posted against trespass under the authority of Section 229 of the Atomic Energy Act, 42 U.S.C. 2278a, and pursuant to the regulations set forth in 10 CFR 860 and DOE Order 5632.6, *Physical Protection of DOE Property and Unclassified Facilities*. These sectors are patrolled by the WIPP security and regulations are enforced commensurate with laws pertaining to property protection. The WIPP site boundary (4 miles x 4 miles) provides a functional barrier of intact salt between the underground region defined by the Off Limits Area and the accessible environment.

## 2.2.2 Demographics Within the Affected Environment

There are approximately 26 residents at various locations within 10 miles of the WIPP site. The majority of the local population within 50 miles of the WIPP are concentrated in and around the communities of Carlsbad, Hobbs, Eunice, Jal, and Artesia, New Mexico. The nearest community is the village of Loving, New Mexico, 18 miles west-southwest of the WIPP. The population of Loving decreased from an estimated 1600 in 1980 to 1240 in 1990 with a current population estimate of 1291. The nearest major populated area is Carlsbad, New Mexico, 26 miles west of the WIPP. The population of Carlsbad decreased from an estimated 25,496 in 1980 to an estimated 24,952 in 1990 with a current estimated population of 26,974. [Population estimates are calculated by subtracting the number of deaths from the number of births and adding net migration.] The transient population within 10 miles of the WIPP is associated with ranching, oil and gas exploration/production, and potash mining.

The two nearby ranch residences (Smith Ranch and Mills Ranch) are continuously monitored as part of the Environmental Monitoring Program.

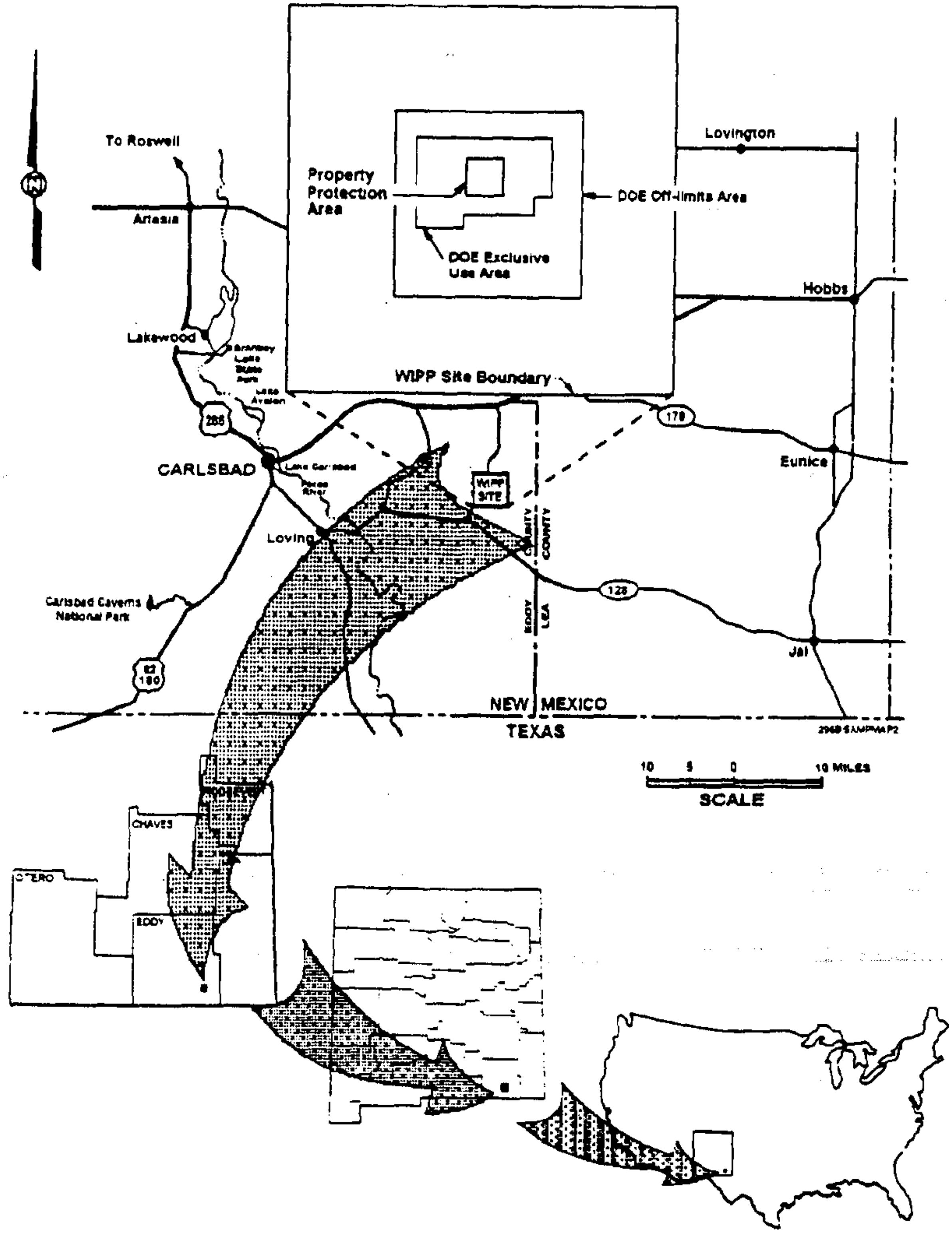


Figure 2-1
Regional Location Of The WIPP Site
Including WIPP Property Areas

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## Chapter 3
# Compliance Summary

The WIPP is required to comply with all applicable federal laws, state laws, and DOE Orders. Documentation of requisite federal and state permits, notifications, and applications for approval is maintained by the Environment, Safety, and Health (ES&H) Department of the current Managing and Operating Contractor. Regulatory requirements are incorporated in the facility plans and implementing procedures.

## 3.1 Compliance Assessment for Calendar Year 1995

In 1995 the WIPP maintained compliance with applicable federal and state environmental regulations. Section 3.2 lists the compliance status of each major environmental statute and executive order applicable to the WIPP, including significant issues generated by, and actions and accomplishments driven by these statutes and orders. Section 3.3 describes other significant compliance accomplishments at the WIPP facility in CY 1995.

## 3.2 Compliance Status

This section documents compliance with the following regulatory requirements at the WIPP:

- Atomic Energy Act of 1954 (AEA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (includes the Superfund Amendments and Reauthorization Act of 1986 )
- Resource Conservation and Recovery Act (RCRA)
- National Environmental Policy Act (NEPA)
- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Safe Drinking Water Act (SDWA)
- Toxic Substances Control Act (TSCA)
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Endangered Species Act (ESA)
- National Historic Preservation Act (NHPA)
- Floodplain Management Executive Order
- Protection of Wetlands Executive Order
- Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes

- Hazardous Materials Transportation Act (HMTA)
- Packaging and Transportation of Radioactive Materials
- Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980
- Waste Isolation Pilot Plant Land Withdrawal Act (LWA)
- Taylor Grazing Act
- Federal Land Policy and Management Act (FLPMA)
- Public Rangelands Improvement Act
- Grazing Fees Executive Order
- Materials Act of 1947
- Federal Mine Safety and Health Act of 1977 (MSHA)
- Occupational Safety and Health Administration Regulations (OSHA)
- Noise Control Act of 1972
- Bald and Golden Eagle Protection Act
- Migratory Bird Treaty Act (MBTA)
- National Defense Authorization Act - Fiscal Year 1989
- Protection and Enhancement of Environmental Quality Executive Orders
- Federal Compliance with Pollution Control Standards Executive Order
- Executive Order 12873 "Federal Acquisition, Recycling, and Waste Prevention"

### 3.2.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. § 9601 et seq.), (including the Superfund Amendments and Reauthorization Act of 1986 )

The CERCLA, or "Superfund," and the Superfund Amendments and Reauthorization Act (SARA) establish a comprehensive federal strategy for responding to, and establishing liability for, releases of hazardous substances from a facility to the environment. Hazardous substance cleanup procedures are specified in the National Contingency Plan (NCP), 40 CFR 300. No release sites have been identified at the WIPP that would require cleanup under the provisions of the CERCLA. Any spill of hazardous substances that exceeds a reportable quantity, must be reported to the National Response Center (NRC) under the provisions of Section 103 of CERCLA and 40 CFR 302.

#### 3.2.1.1 Accidental Releases of Reportable Quantities of Hazardous Substances

On July 2, 1995, there was one spill at the WIPP that exceeded the reportable quantity limits. Approximately 75 gallons of 35/65 Ethylene Glycol solution was spilled inside a diesel generator building. Of the 75 gallons, approximately 40 gallons was contained inside the building and on a concrete pad. The spill was immediately reported to the National Response Center (NRC), the State Emergency Response Commission (SERC), and the Local Emergency Planning Committee (LEPC). A follow-up report was sent to the SERC, the LEPC, and the NMED Hazardous and Radioactive Materials Bureau, NMED Groundwater Protection and Remediation Bureau, and the EPA Region 6. The spill was contained immediately, and clean-up was completed in a short period of time with containment of the contaminated soil and absorbant material accomplished by placing it in drums. Subsequent sampling of the containerized contaminated material was conducted on July 7,1995, in order to characterize the waste prior to disposal at an offsite disposal facility.

The WIPP facility is required to report such events under Sections 311 and 312 of SARA Title III, also known as the *Emergency Planning and Community Right-to-Know Act* (EPCRA). Reports required by these two sections are submitted to the SERC, the LEPC, and the local fire department. The WIPP also submits Section 311 data and Section 312 annual reports to the Carlsbad Fire Department, the Hobbs Fire Department, and the Otis Fire Department. For emergency response purposes, the DOE maintains Memoranda of Understanding (MOU) with each of these agencies.

The WIPP facility is currently exempt from the reporting requirements in Section 313 of the EPCRA. Section 313 lists the following toxic chemicals, currently in use at WIPP, that exceed the 10,000 pound threshold level: ethylene glycol, sulfuric acid, toluene, and xylene. Ethylene glycol and sulfuric acid meet the 10,000 pound reporting threshold, however, these chemicals are used as a structural component of the facility and are subject to the use exemption. Toluene and xylene are contained in unleaded gasoline and are subject to the vehicle maintenance exemption. Documentation of this exempt status is reviewed annually.

#### 3.2.1.2 Waste Minimization and Pollution Prevention Programs

In April, 1995, the WIPP hosted the Seventh Semiannual DOE Defense Programs' Technology Workshop. The focus of the workshop was "Hands-on Pollution Prevention". Approximately 90 people from various DOE sites attended the three day workshop. Workshop attendees participated in two days of benchmarking pollution prevention processes and a one day tour of the WIPP site facility.

The WIPP Project and the WIPP Waste Minimization Committee sponsored two "Waste-In-Place" Teachers' Workshops for area educators. Thirty teachers from the Artesia and Carlsbad school districts participated in a day-long workshop that enchanced awareness on environmental issues such as litter control, recycling, and waste prevention. It is anticipated that additional workshops will be scheduled in the future.

The WIPP celebrated the week of "Earth Day 1995" with a variety of employee awareness activities. Each day of the week of April 17-21 the WIPP Waste Minimization Committee presented recycling techniques, processes, possibilities and alternatives for plastic, paper, glass and aluminum.

The WIPP recycling programs continue to be a success. In 1995 the WIPP donated approximately 50 tons of paper and corrugated cardboard for recycling. All project participants, including the DOE, Westinghouse, Sandia National Laboratories, and minor subcontractors are involved in this recycling effort.

In 1995, the WIPP recharged 260 printer toner cartridges for a savings of almost $15,000. The WIPP printer toner cartridge recharging program recharges toner cartridges for a cost of $40 per recharge, instead of discarding them and purchasing new cartridges for $70-$130. After the cartridges have been recharged three times, they are sent for recycling.

In December, 1994, the aerosol can puncturing program began with surface operations, and in April, 1995, the program was expanded to include underground operations. This program allows cans to be punctured and emptied thereby reducing the amount of hazardous waste and saving on disposal costs. Since the program's inception, approximatley $6,800 has been saved on disposal costs.

### 3.2.2 Executive Order 12873 - *Federal Acquisition, Recycling, and Pollution Prevention*

The WIPP adopted a systematic and cost-effective Affirmative Procurement Plan for the promotion and procurement of certain products containing recovered materials in July 1995. Affirmative Procurement is designed to "close a loop" in the waste minimization recycling process by supporting the market for materials collected through recycling and salvage operations.

Affirmative procurement programs are mandated by RCRA Section 6002(i), which requires federal agencies and their procuring agencies to establish material preference programs targeted to purchase recycled materials. Executive Order (EO) 12873, *Federal Acquisition, Recycling, and Waste Prevention*, and the Enviromental Protection Agency 40 CFR 248-250; 252-253 provide additional guidance for implementing affirmative procurement programs at federal facilities.

Affirmative procurement programs must include four elements: (1) a preference program; (2) a promotion program; (3) estimation, certification, and verification procedures; and (4) procedures for annual review and monitoring. The purchase and use of recycled products at the WIPP will help foster markets for recovered materials and reduce the amount of solid waste requiring disposal through the purchase and use of products containing recovered materials.

### 3.2.3 Resource Conservation and Recovery Act (RCRA)
(42 U.S.C. § 3251 et seq.)

The RCRA was enacted in 1976, and implementing regulations were promulgated in May 1980. This body of regulations ensures that hazardous wastes are managed and disposed in an environmentally safe manner. Facilities that store, treat, or dispose of hazardous waste also must protect human health and the environment. The Hazardous and Solid Waste Amendments (HSWA) of 1984 prohibit land disposal of hazardous wastes unless certain treatment standards are satisfied or unless the EPA approves a petition to receive a variance from Land Disposal Restriction (LDR) standards. The HSWA also places increased emphasis on waste minimization activities and serves as a mechanism to enforce the RCRA cleanup requirements.

The WIPP facility is subject to the permitting requirements under the RCRA and the New Mexico Hazardous Waste Act. Title 40 CFR 264 outlines the technical standards for Treatment, Storage, and Disposal facilities that must be addressed in a permit application (as applicable). Title 40 CFR 270 outlines the requirements of the RCRA permitting program with respect to general format and content for applications, and the administrative aspects of the permitting and modification processes. The WIPP RCRA permit application addresses TRU mixed waste management activities for surface facilities and in the repository as required for disposal operations. This application was submitted to the NMED in May 1995. In general, programmatic changes reflected in this application center on the DOE decision to forego test phase activities at the WIPP. The RCRA permit is expected to be issued by the NMED in August 1996.

In order to permanently dispose of TRU mixed waste, the DOE has petitioned the EPA for a variance from the LDR of the RCRA, codified in 40 CFR 268. As defined in the provisions of 40 CFR § 268.6, the DOE must demonstrate "to a reasonable degree of certainty" that hazardous constituents will not migrate from the disposal unit in concentrations exceeding health-based levels. The WIPP is currently developing the final No Migration Variance Petition (NMVP) for the disposal phase. The Draft NMVP was submitted to the EPA in May 1995 and addresses a no-migration demonstration within the WIPP operational time frame (waste emplacement). The Final NMVP, which is near completion, all-inclusive of the first submittal, will demonstrate no migration after closure of the facility. The Final NMVP will be submitted to the EPA in June 1996, and a No-Migration Determination is expected to be issued by June 1997.

### 3.2.3.1 Mixed-Waste Management

In August 1993, the New Mexico Environment Department (NMED) issued, for public comment, a draft permit for the WIPP facility. In October 1993, the DOE made the decision not to conduct tests with radioactive wastes at the WIPP. At that time the DOE also requested an extension to the public comment period. On January 13, 1994, the DOE submitted a request to modify the RCRA permit application to reflect disposal, rather than test-phase operations. The NMED granted an extension to the public comment period until January 15, 1994. On September 2, 1994, NMED requested that a revised permit application be submitted by May 31, 1995, to accurately reflect future WIPP activities. Subject revisions were prepared and submitted to the NMED in phases as Revision 4 of the RCRA Part B permit application, and in May 1995, the revised permit application was submitted in its entirety as Revision 5. Revision 5 was determined to be administratively complete in July 1995. The NMED is currently conducting a technical review of the permit application.

### 3.2.3.2 Hazardous Waste Generator Compliance

Nonradioactive hazardous waste is currently generated through normal facility operations. These wastes are managed in Satellite Accumulation Areas (SAA) and "less than 90-day" storage areas. In addition, hazardous waste generated at the WIPP is characterized, packaged, labeled, and manifested prior to shipment to an offsite Treatment Storage Disposal Facility (TSDF) in accordance with those requirements as codified in 40 CFR 262. Various waste minimization activities have been implemented at the site. One such activity is the Aerosol Can Puncturing Program. Once a can is punctured and drained of the contents, it is then classified as RCRA "empty" and managed as nonhazardous. The remaining residual liquids are the only portion of the waste managed as hazardous, which substantially reduces the volume of this particular waste stream.

### 3.2.3.3 Voluntary Release Assessment Program at Selected Solid Waste Management Units at the WIPP

The U. S. Department of Energy, Carlsbad Area Office (DOE-CAO) has completed a voluntary release assessment sampling program at 11 selected Solid Waste Management Units (SWMUs) at the WIPP. Solid Waste Management Units are defined in the proposed Subpart S regulations as, "Any discernible unit at which solid waste has been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released", *Federal Register, Vol. 55, No. 145; July 27, 1990, VI (B) (3).*

The CAO made the decision to complete a voluntary release assessment/corrective action program at selected SWMUs described in Chapter J of the RCRA Part B permit because the proposed rules provide incentives for facilities willing to complete voluntary corrective actions. The Subpart S rules state: "The Agency intends to remove regulatory disincentives to independent action by facility owner/operators, and will encourage voluntary cleanups. EPA recognizes that it is important to allow willing and responsible owner/operators to begin corrective action promptly without unnecessary procedural delay."

The Voluntary Release Assessment/Corrective Action Program is intended to be the first phase in implementing the RCRA Facility Investigation corrective action process at the WIPP. The results of voluntary facility investigations will be used to focus on plausible concerns and expedite cleanup decisions as defined in the preamble of the proposed Subpart S Rule.

Data generated by the release assessment sampling program are being used to document voluntary release assessment/corrective action commitments contained in the *Voluntary Release Assessment Corrective Action Work Plan (DOE/WIPP Draft 2115)* submitted to the EPA and NMED in July, 1995. These data are also being used to update SWMU information contained in the 1994 RCRA Facility Assessment (RFA) for the WIPP (*Assessment of Solid Waste Management Units at the Waste Isolation Pilot Plant), NMED/DOE/AIP 94/1.*

A total of 264 release assessment samples were collected to determine if a release had occurred from any of the 11 SWMUs described in the release assessment work plan. Release assessment sampling data, and proposed corrective actions have been compiled into three data summary reports. Data summary reports were submitted to the EPA Region VI, Hazardous Waste Management Division and the NMED Hazardous and Radioactive Materials Bureau. Summary reports were submitted to the agencies as validated data became available. These "tiered" data submittals are designed to provide the agencies the with opportunity to review release assessment data prior to the issuance of the RCRA Part B permit for public review and comment.

Using the criteria provided in proposed *40 CFR § 264.514 FR Vol. 55, No. 145, VI(D), p. 30813*, and the October 1995, *EPA Region III Risk-Based Concentration Table, July - December 1995*, the analytical data collected at each of the 11 SWMUs demonstrates that no release of hazardous constituents has occurred. Thus, there is no potential for impacts to human health or the environment.

Based on these results the DOE-CAO has formally requested that a determination of No Further Action be granted for each of the 11 SWMUs. Because it is the EPA's intent to encourage voluntary corrective actions, the CAO has requested that after appropriate public review and agency approval, a No Further Action determination be granted for the each of the 11 SWMUs prior to the issuance of the RCRA Part B Permit for the WIPP. If this No Further Action determination is approved by the agencies, each of the 11 sites will be replanted with native vegetation in accordance with the guideline provided in the *WIPP Land Management Plan* (DOE/WIPP 93-004).

### 3.2.4 National Environmental Policy Act (NEPA)
(42 U.S.C. § 4321 et seq.)

The NEPA requires the federal government to use all practicable means to consider potential environmental impacts of proposed projects as part of the decision-making process. NEPA dictates that the public shall be allowed to review and comment on proposed projects that have the potential to significantly affect the environment. The NEPA also directs the federal government to use all practicable means to improve and coordinate federal plans, functions, programs, and resources relating to human health and the environment.

NEPA procedural objectives and public involvement requirements are detailed in the Council on Environmental Quality (CEQ) regulations implementing the NEPA in 40 CFR 1500-1508. DOE codified its requirements for implementing CEQ's regulations in 10 CFR 1021. Further procedural NEPA compliance guidance is provided in DOE Order O 451.1, *National Environmental Policy Act Compliance Program*. DOE Order O 451.1 superseded DOE Order 5440.1E on September 11, 1995.

Title 10 CFR 1021.331 requires that "...following the completion of each environmental impact statement and its associated Record of Decision (ROD), the DOE shall prepare a Mitigation Action Plan (MAP) that addresses mitigation commitments expressed in the ROD." DOE Order O 451.1 further requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation that is essential to render the impacts of a proposed action not significant or that is made in a ROD. The *1995 Annual Mitigation Report for the Waste Isolation Pilot Plant* (NEPA ID# WIP:95:0002) was issued July 10, 1995.

In December 1994, a computer-based NEPA training module was released for use at the WIPP. The training module provides specific instructions to workers for completing environmental checklists which assess the impacts of their proposed actions.

In 1980, the DOE prepared the *Final Environmental Impact Statement for the Waste Isolation Pilot Plant* (FEIS). The objective of the FEIS was to assess the potential impacts of developing WIPP in addition to the alternatives for the disposal and management of TRU waste. By 1990, following construction of the WIPP facilities, the DOE decided to prepare the *Final Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant* (SEIS-I) to the update the environmental record established in the FEIS (DOE 1990).

The preparation of the second Supplemental Environmental Impact Statement (SEIS-II) is underway. The DOE is now proposing to continue the phased development of WIPP by beginning the disposal of defense-related TRU waste. The SEIS-II document originated from new information relevant to environmental concerns and a commitment made in the Final Supplemental Environmental Impact Statement (FSEIS) to prepare another environmental impact statement prior to the decision to proceed with waste disposal activities at the WIPP site. Scoping meetings were held in Carlsbad, NM; Albuquerque, NM; Santa Fe, NM; Denver, CO; and Boise, ID. An implementation plan was prepared and made available to the public in DOE reading rooms. The Record of Decision for the SEIS-II is scheduled for March 1997.

### 3.2.5 Clean Air Act (CAA)
(42 U.S.C. § 7401 et seq.)

The CAA provides for the preservation, protection, and enhancement of air quality, particularly at locations of special interest such as areas of natural, recreational, scenic, or historic value. Under Section 109 of the Clean Air Act, the EPA established the National Ambient Air Quality Standards (NAAQS) for six "criteria" pollutants: sulfur dioxide, total suspended particulates, carbon monoxide, ozone, nitrogen oxide, and lead. These standards establish primary and secondary standards for ambient air quality that the EPA considers necessary to protect public health and welfare.

In 1993, Westinghouse Electric Corporation, Waste Isolation Division (WID), completed the WIPP Hazardous Air Pollutant (HAP) Emission Inventory. The 1993 HAPs inventory was developed as a baseline document to calculate maximum potential hourly and annual emissions of both hazardous and criteria air pollutants. In 1995 the HAPs inventory was repeated and compared to the baseline data. Emission estimates were used to determine if the WIPP is required to obtain an air permit as specified in the following regulations:

- Clean Air Act § 112 National Emission Standards for Hazardous Air Pollutants
- Clean Air Act Part C (Prevention of Significant Deterioration - Criteria Pollutants)
- New Mexico Air Quality Control Regulation 752
- New Mexico Air Quality Control Regulation 702.

The CAA. Section 112 establishes emission standards for Hazardous Air Pollutants. The 1990 Clean Air Act Amendments (CAAA) increased to 189 the number of hazardous air pollutants regulated under the CAA. Hazardous air pollutant emissions are regulated under 40 CFR 61, the *National Emission Standards for Hazardous Air Pollutants* (NESHAP). The NESHAP establishes permitting and reporting requirements for facilities that have the potential to emit hazardous air pollutants. At the WIPP, the majority of hazardous air pollutants are regulated in Subpart A of the NESHAP. Radionuclide emissions other than radon are regulated in Subpart H of the NESHAP.

Based on an MOU with the EPA, the DOE committed to compliance with the requirements of 40 CFR 61, Subpart H, through the disposal phase of operations at the WIPP. A revised standard for radionuclide emissions was promulgated by the EPA in a final ruling published in the *Federal Register*, effective December 15, 1989 (54 FR 51654).

The *1995 Safety Analysis Report* (SAR) establishes the adequacy of the WIPP safety bases regarding plant response to conditions considered to be "extremely unlikely." Waste containers accepted for disposal at the WIPP are expected to meet the WIPP *Radiological Control Manual* external contamination limits. Waste container contamination levels are thus at undetectable levels. WIPP normal operations do not involve or entail any planned or expected releases of airborne radioactive materials, therefore, no hazards exist to the public, worker, or environment for the airborne pathway as a result of normal operations. Radiological consequences to the offsite upblic from normal operations will therefore meet the criteria in 40 CFR 191, Subpart A in addition to 40 CFR 61. External doses to workers from the handling of contact handled waste containers were estimated to be well within DOE ALARA or "as low as reasonably acheivable" goals. Moreover, consequences to the public and worker as a result of the release of volitile organic compounds (VOCs) during disposal phase normal operations were shown to be many orders of magnitude below health based limits.

A revised data package will be submitted to the EPA prior to waste receipt. An emissions monitoring system was installed to comply with the periodic confirmatory monitoring compliance requirements established in NESHAP. On November 21, 1994, the EPA approved the use of a single-point source shrouded probe for compliance sampling. The shrouded probe will be used to conduct periodic confirmatory monitoring at the WIPP.

Based on the HAP's inventory, WIPP operations do not exceed the 10 ton per year emission limit for any individual HAP or the 25-tpy limit for any combination of HAPs emissions established in Subpart A. The WIPP does not have any NESHAP Subpart A permitting or reporting requirement at this time. However, 40 CFR 61, Subpart A, Section 61.09(a)(1), requires that the WIPP facility notify the EPA of its anticipated date of initial startup (i.e., receipt of wastes) not more than 60 days and not less than 30 days before actual startup date. In addition, the EPA required that notification of the actual date of initial startup must be made within 15 days after startup.

Based on emission estimates generated in the HAPs inventory, the WIPP site is not required to obtain any federal CAA permits. The WIPP, in consultation with the NMED Air Quality Bureau, working in concert with data provided in the first HAP's inventory, was required to obtain a New Mexico Air Quality Control Regulation (AQCR) 702 Operating Permit for two primary backup, diesel generators at the site. The only emission points where the WIPP site exceeds state threshold criteria is with the WIPP backup diesel generators. On June 18, 1993, the DOE submitted an AQCR 702 permit application for the WIPP backup diesel generators. On December 7, 1993, the New Mexico Air Quality Bureau issued Air Quality Permit 310-M-2. On February 26, 1994, the WIPP completed the emission monitoring requirements established in the permit. With the submittal of the *Final Compliance Sampling Report* on March 28, 1994, the DOE has fulfilled all monitoring and reporting requirements identified in the permit. The permit was modified on September 1, 1994 to allow one diesel generator to operate under load while the second diesel generator is at idle speed in a warm up or cool down mode. This allows for greater operational flexability.

### 3.2.6 Clean Water Act (CWA)

Section 402 of the CWA, establishes provisions for the issuance of permits for discharges into waters of the United States. Regulations promulgated to define this permitting process are contained in 40 CFR 122. Subpart A, Section (b)(1), and state that ". . . National Pollutant Discharge Elimination System (NPDES) program requires permits for the discharge of "pollutants" from any "point source" into "waters of the United States." The WIPP has no pollutant discharges from point sources and is currently exempted from obtaining a standard NPDES permit.

On September 9, 1992, the EPA issued the final requirements for NPDES *General Permits for Storm Water Discharges Associated with Industrial Activity*. The storm water regulations establish requirements for managing industrial storm water runoff that has the potential to discharge into waters of the United States. The WIPP submitted a Notice of Intent (NOI) to the EPA to obtain a NPDES Storm Water General Permit on December 31, 1992. The NOI describes how the WIPP site mitigates the discharge of contaminated storm water through the use of Best Management Practices (BMPs). These BMPs include engineering controls such as storm water retention basins, the covering of materials storage areas, and the reclamation of disturbed areas. The EPA issued a New Mexico NPDES Storm Water General Permit (NMR00A021) on January 31, 1992. As part of the Nationwide General Permit Program, the WIPP is included in the New Mexico General Permit.

No sampling is required to demonstrate compliance with the WIPP Storm Water Permit unless a release occurs from one of the BMPs. Operational permit compliance activities are limited to quarterly inspections of retention basins, spill containment devices, reclamation sites, and site housekeeping practices.

The NPDES sewage sludge regulations promulgated in 40 CFR 122.21 require all facilities that generate or dispose of sewage sludges to submit an information package describing sewage sludge management and disposal practices. This information is reviewed by the EPA to determine if a NPDES permit will be required for the disposal of sewage sludges at a facility.

On February 14, 1994, the DOE submitted an information package to the EPA Water Management Division and requested a written determination whether a NPDES permit would be required for sewage sludges generated at the WIPP. On March 31, 1994, the EPA Region VI Permits Issuance Section notified the DOE that they had received the information package. The agency determined that the information package was complete and stated they would notify the DOE if a full and complete sewage sludge permit application would be required at a future date.

On January 16, 1992, the NMED issued the Discharge Plan (DP-831) for the WIPP sewage facility. The approved Discharge Plan superseded an Emergency Discharge Permit issued on September 18, 1991. In addition to sewage effluent, the Discharge Plan allows for the disposal of a maximum of 1500 gallons a day of nonhazardous brines generated by seepage into shaft sumps and from pumping of observation wells at the site. [Note: Exceptions to the classifcation of "nonhazardous" are brine waters with lead concentrations exceeding regulatory levels, collected in the waste shaft sump and boreholes OH 224, 225, and 226, located between the waste shaft and the exhaust shaft. Subject waters were disposed of as RCRA hazardous waste in an approved and permitted treatement storage and disposal (TSD) facility. No brine from the exhaust shaft has shown a hazardous lead content.] Brine waters are collected in portable tanks and transported to the north sewage system evaporation basin. Characterization samples were collected throughout 1995 to demonstrate that site-generated brines are nonhazardous and can be disposed in the sewage evaporation pond. On August 28, 1995, the WID submitted a request to the NMED requesting a minor amendment to DP-831 increasing the amount of nonhazardous brine for disposal to 2000 gallons per day. On October 4, 1995, the NMED approved the amendment to the Discharge Plan. The increase was required, not because additional brine was being generated but, because on days the observation wells were pumped, greater than 1500 gallons was was produced necessitating that the brine be disposed of over two days time.

The DOE submits quarterly Discharge Monitoring Reports (DMR) to the NMED to demonstrate compliance with the inspection, monitoring, and reporting requirements identified in the plan.

### 3.2.7 Safe Drinking Water Act (SDWA)
(42 U.S.C. § 300f et seq.)

The SDWA of 1974 provides the regulatory strategy for protecting public water supply systems and underground sources of drinking water. The NMED notified the WIPP in a September 9, 1992, letter that the WIPP Public Water Supply was categorized as a nontransient, noncommunity system for reporting and testing requirements. At that time, the NMED determined that the WIPP was required to sample drinking water for total coliform bacteria, lead, copper, nitrate and nitrite. In a March 11, 1994, letter the NMED again modified compliance sampling requirements, stating that only lead, copper, and bacteriological samples are required. The modification was based upon New Mexico Water Supply Regulations which mandate that when a public water supply system supplements other systems, that water system is treated as a single system for compliance sampling purposes.

The Carlsbad Municipal Public Water Supply System is contracted to provide raw water to the WIPP from city-owned wells located 31 miles north of the site. Because of this contractual agreement, the city of Carlsbad completes the source or point-of-entry samples for the various chemical constituents at each wellfield source.

On June 2, 1994, lead and copper samples were collected from 20 locations to demonstrate compliance with the newly identified SDWA sampling requirements. Five of the 20 samples exceeded the SDWA lead action levels. At the direction of the NMED, these five locations were resampled on June 30, 1994. Based on the results of these five samples, three locations (site drinking fountains) were permanently taken out of service and the faucets at the two remaining locations were replaced. Follow-up sampling was conducted at each of these locations and all were below the SDWA action levels.

In January and again in July of 1995, lead and copper compliance samples were collected and submitted for analysis. All samples were below action levels with the exception of one sample that exceeded action levels for lead. This location was resampled and the sample analysis was returned significantly below action levels. It was determined that just prior to sampling this location, maintenance had been performed on the foot-operated valve for the faucet. Based on previous samples at this location and subsequent confirmatory sampling, it was decided that the maintenance activity had been the cause of the sample being above action levels.

On August 17, 1995 a request was submitted to the NMED requesting a reduction of lead and copper sampling activity. The request was based upon sampling results, in conjunction with administrative actions and resampling, that demonstrated the WIPP water supply system met the criteria for reduced sampling status. The number of samples was reduced from twenty to ten, and the period was increased from every six months to annually. The request was granted on August 23, 1995.

Bacterial samples were collected and reported monthly throughout 1995. All bacteriological/analytical results were below the SWDA regulatory limits.

### 3.2.8 National Historic Preservation Act (NHPA)
(16 U.S.C. § 470 et seq.)

The NHPA was enacted to protect the nation's cultural resources and to establish the National Register of Historic Places. Federal agencies are required to coordinate NEPA compliance with the responsibilities of the NHPA to ensure that historic and cultural properties are given proper consideration in the preparation of environmental assessments (EAs) and environmental impact statements (EIS's). Agency obligations, however, under the NHPA are independent from NEPA and must be complied with even when an EA or EIS is not required. That is, for proposed projects that are not classified as major federal actions with significant environmental impacts, DOE must still consider impacts to hisotoric properties and sites. Where both NEPA and the NHPA are applicable, draft EIS's must integrate NHPA considerations along with other environmental impact analysis and studies (see 40 CFR 1502.25)

#### 3.2.8.1 Summary

From man's first arrival in the Southwest about 10,000 B.C. to the late 1800s, southeastern New Mexico was inhabited by aboriginal hunters and gatherers who subsisted on various wild plants and animals. These people would have found a number of edible plants throughout the region, including mesquite beans, hackberries, walnuts, acorns, seed-producing grasses, agave and a variety of other succulents. Big and small game, including bison, deer, antelope, rabbits, reptiles, birds, and various invertebrates, could have been hunted or collected in the region.

From approximately 600 A.D. onward, as trade networks were established with Puebloan people to the west, domesticated plant foods and materials, including corn (or maize), beans, squash, and cotton, were acquired in exchange for dried meat, hides, and other products from the Pecos Valley and Plains. The indigenous population may also have practiced horticulture at favorable locales in the area, but only on an intermittent basis, since water for crops would have been scarce and unpredictable much of the time.

In the mid-1500s, the Spanish Conquistadors encountered Jumano and Apachean peoples in the region practicing hunting and gathering and engaging in trade with Puebloans. Later, as the natives acquired horses, and as Europeans began settling the land, this traditional way of life evolved into specialized bison hunting on the Llano Estacado and raiding both Spanish and Puebloan settlements to the west. In the late 1800s, the region was settled by ranchers and farmers.

The WLWA is situated in dune-covered, rolling-plains terrain in the eastern part of the BLM's Carlsbad Resource Area. Known archaeological sites within the area are primarily the remains of prehistoric camps and short-term settlements. These localities are generally marked by hearth features, scattered burned rock, flaked stone projectile points, and cutting and scraping tools, pottery fragments, and groundstone implements. Locations generally represent short-term, seasonal occupations by small, nomadic groups of hunters and gatherers who utilized the plants and animals in the dune lands east of the Pecos River. In a few cases within the WLWA, sites with evidence of structures have been reported. These sites probably hosted occupations of perhaps several weeks or months.

Many known historical sites in southeastern New Mexico consist primarily of early twentieth century homesteads that failed, or isolated features from late nineteenth and early twentieth century cattle or sheep ranching and military activities. Although the region was part of the Spanish and Mexican colonial empires, no related conquest or settlement sites have yet been identified.

Historic components (more than 50 years old) are rare, but are occasionally noted within the WLWA. These include features and debris related to ranching in the early years of the twentieth century. In addition, more modern ranching debris and facilities such as fence lines are present in the area, including some which are likely still in use. Ranch-related sites which date to the 1940s and 1950s are common in parts of the WLWA. These will be considered historical properties within the next several years and under current law, will have to be treated as such. The majority of the several sites recorded in the area typically include elements which can contribute to their eligibility for the National Register of Historic Places. With few exceptions, cultural properties known or anticipated for the WLWA are significant; they must be identified, recorded, assessed through inventory, and considered in any plan of development for the area.

Compared with most other parts of southeastern New Mexico. the locations and nature of cultural resources within the WLWA can be described relatively well. based on intensive inventory of portions of the area. along with limited excavation and some other work on some sites.

In 1976 four sections comprising the WIPP core area (Sections 20. 21, 28, and 29), along with associated rights-of-way and drilling pads within and outside the WLWA (Nielson 1976) were inventoried by the Agency for Conservation Archaeology (ACA) of Eastern New Mexico University. Additional rights-of-way within and outside the WLWA were inventoried in 1978 and 1979 by ACA (Schermer 1978; MacLennan and Schermer 1979). Sites identified in the core area were relocated and evaluated in 1980 by ACA. and management recommendations for those sites were prepared (Schermer 1980). Subsequently, in accordance with the ACA's recommendations. a number of sites within the WIPP core area were tested for eligibility and/or were excavated as mitigation (Lord and Reynolds 1985).

In 1987 Mariah Associates conducted an intensive study of portions of 45 sections surrounding the WIPP facility. Mariah's study included an inventory of 2,460 acres in 15 quarter-section units. Inventoried units were selected so as to be representative of the area as a whole. Within each of the sample units, all cultural resource sites encountered were recorded, certain selected sites were tested. and management recommendations were prepared (Mariah Associates, 1987).

Between 1989 and 1992, several seismic projects associated with oil and gas development provided cultural resource clearances within the WLWA. Numerous inventories have been conducted outside the withdrawal area, primarily for oil and gas exploration and ranching.

Inventories conducted to date within the withdrawal area have located 60 archaeological sites, along with 91 isolated occurrences (single or few artifacts, or isolated features which can be fully recorded in the field). Sites and isolates identified are almost exclusively prehistoric. Only one site with both prehistoric and historic components has been noted.

Of a total of 10,240 acres in the WLWA. 3,380 acres (37 percent) have been inventoried for cultural resources. The results have been the discovery of one site for every 65 acres surveyed, and one isolate in every 42 acres. Based on this information, and assuming environmental homogeneity and a fairly even distribution of sites. the remaining 6,410 uninventoried acres could contain approximately 99 sites and 153 isolates. The combined results of the several inventories conducted within the WLWA compare well with those from Mariah's 1987 inventory of selected units over a much larger area. Mariah's results show only a slightly higher frequency of cultural resources per acre. In 2,460 acres, 40 sites and 75 isolates were recorded, or one site for every 62 acres and one isolate in every 33 acres.

Of the 40 sites identified and evaluated on the Mariah inventory, 14 are eligible for the National Register of Historic Places, 24 are potentially eligible, and two are not eligible. [Note: A determination of eligibility can be made only after the site has been archaeologically tested.] None of the 75 isolates are considered eligible. While the data from the various researchers cited above are not always consistent with Mariah's explicit data on site significance, it appears that within the WLWA, the majority of sites either are or have the potential to be eligible for the National Register of Historic Places and will require consideration in future land disturbing activities.

Site significance is contingent on the number of manifestations encountered, their diversity in composition, the total number of each type of manifestation, and existing evidence suggesting whether or not a given site is datable. Previous limited cultural inventories indicate that WIPP represents a potentially significant cultural resource contributor to the discipline of archeology and shall be regarded as such when deliberating land management decisions.

The objectives of the DOE are to protect and preserve representatives of the full array of cultural resources, within the WLWA, for the benefit of scientific and socio-cultural use by present and future generations. This guidance will ensure that cultural resources are given full consideration in land use planning and management decisions.

On June 21, 1995, an investigation was conducted of a previously known site as several previously buried artifacts emerged at the surface. No regulatory actions were required following the investigation, since no surface disturbing activities are planned for the area in question. During 1995, no new archaeological sites were discovered. Avoidance remains to be the WIPP's primary mitigation measure for archaeological sites.

### 3.2.9 Federal Compliance with Pollution Control Standards (Executive Order 12088)

Executive Order (EO) 12088 advises the director of each federal agency to ensure that all necessary actions are taken for the prevention, control, and abatement of environmental pollution. Each agency is responsible for compliance with applicable pollution control standards established by such statutes as the CWA, the CAA, the AEA of 1954, and others. Each agency must submit an annual plan for the control of environmental pollution at its facilities. This EO mandates that the DOE control pollution at the WIPP facility.

The *Waste Minimization and Pollution Prevention Awareness Plan* was updated on May 31, 1994. This plan is reviewed annually and updated at least every three years. Pollution prevention awareness guidance is contained in the *Resource Conservation and Recovery Act Compliance Manual* (WP 02-6, 02-7) and its implementing procedures, as well as in the *Environmental Compliance Manual* (WP 02-5). These environmental compliance manuals are currently being revised to incorporate elements of the Waste Minimization and Pollution Prevention Awareness Program.

### 3.2.10 Hazardous Materials Transportation Act (HMTA)
(49 App. U.S.C. 1801 et seq.; 49 CFR 106-179)

The HMTA is the major transportation-related statute that affects the Department of Energy at the WIPP. It provides for safe intra and inter-state transportation of hazardous materials (including radioactive materials). The HMTA allows states to regulate the transport of hazardous/radioactive materials if regulations are consistent with the HMTA or U.S. Department of Transportation (DOT) regulations. In the second modification to the Agreement for Consultation and Cooperation, dated August 4, 1987, the DOE agreed to comply with all applicable DOT regulations and the corresponding NRC regulations. Therefore, the following regulations are applicable or potentially applicable to the WIPP.

The DOT regulations for hazardous/radioactive materials are contained in 49 CFR 171-177. Specifications for the kinds and designs of packages to be used for the transport of various types of radionuclides are contained in 49 CFR 173, Subpart I (and parallel Nuclear Regulatory Commission regulations in 10 CFR 71). The DOT regulations in 49 CFR 174 addresses the shipment of radioactive material by rail. 49 CFR 177 provides routing and training requirements for highway shipments of nuclear material.

### 3.2.11 Packaging and Transportation of Radioactive Materials
(10 CFR 71)

Regulations for shipping containers and safe packaging and transportation of radioactive materials are under the authority of the Nuclear Regulatory Commission (NRC) and the Department of Transportation (DOT). Packaging requirements for radioactive materials, including the Type B packages to be used to transport waste to the WIPP facility, are detailed in the DOT regulations (49 CFR 173, Subpart I). This citation also references the NRC regulations. Generally, the NRC does not have regulatory authority over the DOE. The only portion of the NRC's implementing regulations that applies to the WIPP is 10 CFR 71, Packaging and Transportation of Radioactive Material. These regulations pertain to the NRC's certification of packaging such as the TRUPACT-

II shipping container designed to transport TRU waste from the generator sites to the WIPP. The NRC certified the TRUPACT-II container August 30, 1989, after compliance with the 10 CFR 71 requirements for Type B packaging were demonstrated. On April 22, 1994, DOE submitted a subsequent application to the NRC requesting a revision to the existing Certificate of Compliance (C of C). Thus, on March 30, 1995, the NRC issued C of C No. 9218, Revision No. 6 to the DOE for the continued use of TRUPACT-IIs to ship radioactive material. Revision 6 supersedes in its entirety, C of C No. 9218, Revision No. 5, dated June 9, 1994.

## 3.3 Other Significant Accomplishments and Ongoing Compliance Activities for Calendar Year 1995

### 3.3.1 Environmental Compliance Assessment Program (ECAP)

The ECAP plays a major role in the overall program for environmental protection activities at the WIPP. The ECAP was developed to determine if impactive or potentially impactive facility activities protect human health and the environment and if these activities are in compliance with applicable federal, state, and local requirements; with permit condition/requirements; and with best management practices. This program provides a comprehensive system, not only to assess compliance with applicable environmental statutes and requirements at the WIPP, but also to identify operationally feasible and environmentally sound corrective action measures for nonconformances or observations identified. The ECAP is designed to address five compliance assessment processes: (1) environmental compliance appraisals; (2) environmental audits; (3) independent review group evaluations; (4) environmental event evaluations; and (5) environmental compliance status tracking and reporting process.

During 1995, eight environmental compliance assessments were conducted. Thirty-five (35) improvements were identified and implemented as a result of these assessments. The assessed areas included: Satellite Accumulation Areas and Hazardous Waste Staging Area; Sandia National Laboratories - Culebra Transport Program; Air, Waste, and Water Program; Annual Hazardous Waste Fee Regulations; Dosimetry and Analytical Laboratory; NPDES; RCRA Equipment Inspections; and Environmental Monitoring.

### 3.3.2 Site Environmental Management Program

In December 1995, the Site Environmental Awareness Program was initiated in order to increase employee awareness of environmental issues. The program has a three-phased approach and is aimed at WID Managers and Supervisors. However, many program elements target all WID Employees. The three phases include:

- Environmental Awareness Campaign
- Manager's Environmental Handbook
- Management Environmental Accountability Program (MEAP)

### 3.3.3 Environmental Awareness Campaign

The purpose of the Environmental Awareness Campaign is to increase the visibility of environmental issues for the employees. The campaign consists of various tools, forums, and educational opportunities for managers, supervisors, and the general employee.

### 3.3.4 Manager's Environmental Handbook

The purpose of the Manager's Environmental Handbook is to provide a brief overview of Corporate Charters and Policies; WIPP policies and procedures; DOE Orders; and the major environmental laws and regulations that directly apply to the WIPP. The Handbook will also contain segments on ISO 14000 Standards and the Environmental Leadership Program.

### 3.3.5 Management Environmental Accountability Program (MEAP)

The purpose of the MEAP is to educate employees and managers about current environmental issues and to encourage individual and line-management accountability. The program will consists of 12 training elements on a variety of environmental subjects. A managers training packet ensures that current environmental information is conveyed correctly and consistently. The packet contains appendices, experiential exercises and incident/events that are applicable to the particular lesson.

#### 3.3.5.1 Benefits of the MEAP

- Establishes the WIPP as a proactive, environmentally responsible citizen;

- Promotes individual responsibility;

- Aligns with the Westinghouse and the Department of Energy's Carlsbad Area Office's mission to protect human health and the environment;

- Enhances the WID's application to one of the Environmental Protection Agency's environmental management programs;

- Fulfills one of the elements for the implementation of ISO 14000.

### 3.3.6 ISO 14000 - STANDARDS FOR ENVIRONMENTAL MANAGEMENT

The *Organization de Standards International*, formed in Amsterdam in 1947, sets standards for a wide range of products and management operations. Following the success of the International Standards Organization (ISO) 9000 series for quality management, ISO introduced the 14000 series, which is a set of environmental management standards now under development. These environmental management standards will promote international trade and will foster economic growth.

ISO 14000 certifies that those businesses conducting worldwide trade have met internationally agreed upon policies and regulatory standards. These policies and regulatory standards prescribe a common baseline approach to environmental and managerial problem solving, system evaluation, product quality, and product labeling. Should differences arise among or between trade partners, the ISO 14000 will serve as a standardized methodology for solving problems or remediating differences.

All ISO standards are voluntary. However, governments and industries are adopting ISO standards, making them necessary to conduct business. ISO 14000 standards address the following five areas:

- Environmental Management Systems
- Environmental Performance Evaluations
- Environmental Auditing
- Life-Cycle Assessment
- Environmental Labeling

#### 3.3.6.1 Environmental Management Systems (EMS)

An EMS consists of three parts: a written statement; education and training; and knowledge of relevant government environmental regulations. The statement commits the company to seek the highest product quality with the lowest environmental impact. All employees will have access to the EMS through education and training. The EMS incorporates relevant government environmental regulations.

#### 3.3.6.2 Environmental Performance Evaluations

Environmental Performance Evaluations measure the impact a business is having on the environment. An inventory of air and waste discharges establishes a baseline. A business may then measure performance improvements over time.

#### 3.3.6.3 Environmental Auditing

An evaluation conducted by an independent third party constitutes an environmental audit. The results of the audit are provided to management to permit integration of changes and improvements in procedures and processes. Typically, audits are conducted yearly.

#### 3.3.6.4 Life-Cycle Assessment

A Life-Cycle Assessment is an analysis of the environmental effects of process inputs and wastes during the operational life of the company's product or service.

#### 3.3.6.5 Environmental Labeling

Environmental labeling identifies "environmentally friendly" products to consumers. ISO 14000 defines the characteristics of environmentally friendly products through standardized international product labeling. Companies planning to identify their products through labeling obtain a competitive advantage over nonlabeled competitors, attract new customers, and reduce liability.

### 3.3.7 Descriptive Titles of the ISO 14000 Series

The following is a list of descriptive titles of the ISO 14000 Series, which are divided into two categories: organizational evaluation and product evaluation. Only ISO 14001 is a specification standard. All others are guidance standards.

#### 3.3.7.1 Organizational Evaluation Standards

**14001:** Environmental Management Systems - Specifications
**14010:** General Principles of Environmental Auditing
**14011:** Audit Procedures
**14012:** Qualification Criteria for Environmental Auditors
**14015:** Environmental Site Assessments
**14031:** The Management System and Its Relationship to the Environment

#### 3.3.7.2 Product Evaluation Standards

**14020:** Goals and Principle of All Environmental Labeling
**14021:** Self-Declaration Environmental Claims
**14024:** Environmental Labeling - Guiding Principles
**14040:** Life-Cycle Assessment - Principles and Practices
**14041:** Life-Cycle Inventory Analysis
**14042:** Life-Cycle Impact Assessment
**14043:** Life-Cycle Improvement Assessment
**14060:** Guide for the Inclusion of Environmental Impacts in the Product Standards

### 3.3.8 Waste Minimization Committee

The Waste Minimization Committee was formed in 1993 with representatives from groups generating or working with hazardous and/or large volumes of waste. The Committee prepared a Waste Minimization Charter, which outlines the Committee's responsibilities.

The Waste Minimization Committee is split into separate subcommittees to concentrate on different areas of pollution prevention. These subcommittees are the Employee Awareness, Community Outreach, Waste Assessments, and Hazardous Solvent Substitution.

In January 1996, the Employee Awareness Subcommittee began its' Employee Awareness Campaign. Waste Minimization suggestion/nomination/idea forms were distributed by Subcommittee members the first week of January. Employees with waste minimization or pollution prevention ideas or suggestions can submit them to the subcommittee and receive a prize. Employees can also nominate others who practice waste minimization or pollution prevention in their day-to-day activities. Drawings are held each Friday for t-shirts with the waste minimization slogan printed on them. Articles are printed in the *TRU-News* periodically to educate employees on the importance of waste minimization and to announce prize winners in the awareness campaign.

A Pollution Prevention Opportunity Assessment (PPOA) was conducted in 1995 by the Waste Assessments Subcommittee. The PPOA Subcommittee investigated cafeteria operations for potential waste minimization and pollution prevention opportunities. The PPOA was completed in October, 1995 and concerns are being addressed by the subcommittee.

In 1994 a PPOA was performed on the process of disposing of fluorescent tubes onsite and alternatives to their disposal as hazardous waste. As a result of this PPOA, a contract was put into place with a flourscent tube recycling company to recycle WIPP's spent flourescent tubes.

Other waste minimization activities for 1995 include:

- Recycling of white bond paper, corrugated cardboard, and aluminum cans
- Recharging of toner cartridges
- Puncturing of aerosol cans to reduce hazardous waste volumes
- Recycling of waste oil offsite
- Reusing cold-degreasing solvents at six solvent stations used for cleaning parts
- Reclaiming cold-degreasing solvents offsite
- Using recycled janitorial paper products exclusively
- Recycling of lead-acid batteries offsite

### 3.3.9 Environmental Training

Environmental training was provided to personnel associated with environmental operations at the WIPP. Training courses ranged from technical topics (e.g. RCRA sampling), basic ES&H training, and general site-wide training such as the required General Employee training module. These courses were conducted both onsite by WIPP personnel and offsite by various contractors.

Table 3-1
Compliance Status with Major Environmental Regulations
Applicable to the WIPP Project

| Statute/Regulation | Status |
|---|---|
| Atomic Energy Act | No radioactive waste was received during CY 1995. |
| Clean Air Act | NESHAP data package and letter of notification submitted. No monitoring/reporting required until after receipt of waste. |
| Clean Water Act | Quarterly inspections of best management practices to comply with (stormwater retention basins) NPDB storm water general permit (NMR00A021). |
| Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act | No Land Disposal Units (LDUs) exist at the site. No CERCLA site cleanup required. Reports filed as required under SARA for hazardous substances are maintained onsite. |
| Endangered Species Act | Individual permits to collect biological samples and to band nonendangered species of raptors are maintained. |
| Federal Land Policy and Management Act | An MOU between the DOE and the BLM was issued in July 1994. This MOU outlines the responsibilities the BLM and the DOE have with regard to land use management for the withdrawal area. |
| Federal Insecticide, Fungicide, and Rodenticide Act | All use of pesticides is approved by Industrial Safety and is performed by subcontractors. |
| Hazardous Materials Transportation Act | Hazardous wastes to be sent offsite are reviewed to ensure compliance with HMTA. |

Table 3-1
Compliance Status with Major Environmental Regulations
Applicable to the WIPP Project

| Statute/Regulation | Status |
|---|---|
| National Environmental Policy Act (as supplemented by DOE Order O 451.1, and 10 CFR 1021) | The 1995 *Annual Mitigation Report for the Waste Isolation Pilot Plant* (NEPA ID# WIP:95:0002) was issued July 1995. This provides a status of the commitments made in the WIPP's Records of Decision. Purchase requisitions and engineering work packages which initiate changes and modifications to the WIPP facility, continue to be reviewed for potential environmental impacts. |
| National Historic Preservation Act | Activities requiring excavation in previously undisturbed areas are surveyed by licensed, permitted archaeologists. Required reports are submitted to the New Mexico State Historic Preservation Officer. |
| New Mexico Air Quality Control Act | The New Mexico Air Quality Bureau issued Air Quality Permit 310-M-2 on December 7, 1993. On February 26. 1994, the WIPP completed the emission monitoring requirements established in the permit. With the submittal of the *Final Compliance Sampling Report* on March 28, 1994, the DOE has fulfilled all monitoring and reporting requirements identified in the permit. New Mexico does not yet have primacy for NESHAP for radionuclide emissions from DOE facilities. New Mexico Hazardous Waste Management Regulations See "Resource Conservation and Recovery Act." NMED does not yet have primacy for all areas by the RCRA. |
| New Mexico Radioactive Materials Act | No radioactive wastes had been received at the WIPP in CY 1995. |
| New Mexico Water Quality Act | The DOE submits quarterly discharge monitoring reports to the NMED Groundwater Quality Bureau to comply with the requirements of the WIPP Discharge Plan. DP-831. |

Table 3-1
Compliance Status with Major Environmental Regulations
Applicable to the WIPP Project

| Statute/Regulation | Status |
|---|---|
| New Mexico Wildlife Conservation Act | See "Endangered Species Act." |
| Resource Conservation and Recovery Act | *Hazardous-waste generator compliance:* All site-generated hazardous wastes were transported off-site within the 90-day accumulation period.<br>*No-Migration Determination compliance:* The fourth annual report was submitted to EPA on November 14, 1994.<br>*Mixed-waste management:* On January 13, 1994, the DOE formally requested that the NMED allow the DOE to modify the RCRA permit application to reflect disposal operations. In September 1994, the NMED ordered the submittal of a complete revised permit application by May 31, 1995. DOE has submitted Chapters B, D, E, F, G, H, I, J & K to the NMED for their review.<br>*Underground Storage Tanks:* Annual registration fee paid. |
| Toxic Substances Control Act | Procurement of asbestos-/PCB-containing materials not allowed. Other portions of TSCA not applicable. |

Table 3-2

DOE Orders Affecting the WIPP Environmental Program

| ORDER NO. | DATE | TITLE | ANNOTATION |
|---|---|---|---|
| DOE 5400.1 | 11/09/88 Change 1- 06/29/90 | General Environmental Protection Program | Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with federal and state environmental protection laws and regulations, federal executive orders, and internal department policies. |
| DOE 5400.5 | 02/08/90 Change 2 01/07/93 | Radiation Protection of the Public and the Environment | Establishes standards and requirements for operations of the DOE and DOE contractors with respect to protection of the public and the environment against undue risk from radiation. |
| DOE O 451.1. | 09/11/95 | National Environmental Policy Act Compliance Program | Establishes DOE policy for implementation of the National Environmental Policy Act of 1969 (PL 91-190). |
| DOE O 460.1 | 09/27/95 | Packaging and Transportation Safety | Establishes safety requirements for the proper packaging and transportation of DOE offsite shipments and onsite transfers of hazardous materials and for model transportation. |
| DOE 5484.1 Paragraphs 1-5, 6a(1)-(10),6f(1)-(8), and the second misnumbered 6f, and Ch I and Ch II are cancelled and replaced by DOE O 225 | 09/29/95 | Accident Investigation | Prescribes requirements for conducting investigations of certain accidents occurring at DOE operations and sites, and to prevent recurrence of such accidents. |

| | | | |
|---|---|---|---|
| AL 5484.1 | 08/23/82 Change 1- 10/24/86 | Environmental Protection. Safety and Health Protection Information Reporting Requirements | Albuquerque Operations Office implementation of 5484.1.1E |
| DOE 5480.23 | 04/30/92 Change-1 3/10/94 | Nuclear Safety Analysis Reports | To establish uniform requirements for the preparation and review of safety analyses of DOE operations which include the following: identification of hazards, their elimination or control, assessment of the risk, and documented management authorization of their operation. |
| DOE 5482.1B | 9/23/86 Change-5 05/10/93 | Environmental, Safety and Health Appraisal Program | To establish the Environmental Protection, Safety, and Health (ES&H) appraisal program for the DOE. |
| DOE O 151.1. | Change 1 10/26/95 | Comprehensive Emergency Management System | Establishes requirements for comprehensive planning, preparedness, response, and recovery activities of emergency management programs for DOE or for programs requiring DOE assistance. |
| DOE 5700.6C | 08/21/91 | Quality Assurance | To provide DOE policy, set forth principles, and assign responsibilities for establishing, implementing, and maintaining programs of plans and actions to ensure quality achievement in DOE programs. |
| DOE 5820.2A | 09/26/88 | Radioactive Waste Management | Establishes policies and guidelines by which DOE manages radioactive waste, waste byproducts, and radioactively contaminated surplus facilities. |
| DOE O 430.1 Life-Cycle Assessment Management | 08/24/95 | Life-Cycle Assessemnt Management | To plan, acquire, operate, maintain, and dispose of physical assets as valuable national resources |

Table 3-3

Summary of Agreements Between the DOE and the State of New Mexico That Affect the WIPP Environmental Program

Stipulated Agreement on Civil Action No. 81-0363 JB - This agreement, approved by the U.S. District Court proceedings, held in abeyance in the lawsuit against the DOE by the State of New Mexico, was executed on July 1, 1981. The eight-page agreement assures that a binding, enforceable "consultation and cooperation" agreement will be entered into by the DOE and the state, and that the DOE will make a "good faith effort" to resolve certain state offsite concerns (which are covered in the Supplemental Stipulated Agreement). The Stipulated Agreement also addresses a number of additional studies and experiments to be conducted by the DOE for the Site Preliminary and Design Validation Phase of the WIPP facility. This agreement was signed by Jeff Bingaman (Attorney General, State of New Mexico) and Myles Flint (Attorney, U.S. Department of Justice), and was issued July 1, 1981, by Juan G. Burciaga (U.S. District Judge, District of New Mexico).

Agreement for Consultation and Cooperation -- Usually referred to as the "C&C Agreement," this agreement is contained in Appendix A to the Stipulated Agreement. It affirms the intent of the Secretary of Energy to consult and cooperate with New Mexico with respect to state public health and safety concerns. It was signed in July 1981 by Bruce King (Governor, State of New Mexico) and James B. Edwards (Secretary, U.S. Department of Energy).

Working Agreement for Consultation and Cooperation, Appendix B, Article IV, Revision I -- This agreement, Appendix B to the Stipulated Agreement, identifies in Article IV over 60 "key events" and "milestones" in the construction and operation of the WIPP facility that must be reviewed by the state before they are commenced. Many environmental items are included. It was signed in March 1983 by Robert McNeill (Chairman, Radioactive Waste Task Force), and R. G. Romotowski, (Manager, Albuquerque Operations Office, U.S. Department of Energy). (Article IV of the Working Agreement was revised on April 8, 1983).

Supplemental Stipulated Agreement Resolving Certain State Off-Site Concerns Over WIPP -- This agreement dated December 27, 1982, addresses five state concerns including the need for state "verification" of the WIPP Environmental Monitoring Program. The concerns addressed are: state liability for a nuclear incident, emergency response preparedness, transportation monitoring of the WIPP facility waste, the WIPP facility environmental monitoring by the state, and upgrading of state highways. It was signed in December 1982 by Bruce King (Governor, State of New Mexico) et al., and R. G. Romotowski (Manager, Albuquerque Operations Office, U.S. Department of Energy).

First Modification to the July 1, 1981, Agreement for Consultation and Cooperation on WIPP by the State of New Mexico and the U.S. Department of Energy -- This modification was signed November 30, 1984, wherein the DOE and the state agree to address certain concerns of the state regarding: (1) the specific mission of the WIPP Project, (2) a demonstration of retrievability prior to waste emplacement, (3) post-closure control and responsibility, (4) completion of certain additional scientific testing and reports, (5) compliance with applicable federal regulatory standards for waste repositories, and (6) a program for encouraging and reporting on the hiring of New Mexico residents at the WIPP Project. It was signed in November 1984 by Joseph Goldberg (Secretary, Health and Environment Department, State of New Mexico), and R. G. Romotowski (Manager, Albuquerque Operations Office, U.S. Department of Energy).

Second Modification to the July 1, 1981, Agreement for Consultation and Cooperation on the WIPP by the State of New Mexico and the U.S. Department of Energy -- Signed August 4, 1987, wherein the DOE and the state agree to address certain concerns of the state regarding: (1) surface and subsurface mining and drilling after closure of the WIPP site, (2) the disposal of salt tailings at the WIPP site, and (3) compliance with U.S. Environmental Protection Agency, U.S. Department of Transportation, and U.S. Nuclear Regulatory Commission regulations. It was signed in August 1987 by Garrey Carruthers (Governor, State of New Mexico) et al., and R.G. Romotowski, (Manager, Albuquerque Operations Office, U.S. Department of Energy).

1988 Modification to the Working Agreement of the Consultation and Cooperation Agreement Between the U.S. Department of Energy and the State of New Mexico on the Waste Isolation Pilot Plant -- This modification deleted the sorbing tracer test from the list of required reports and substituted additional tests. In addition, the state is allowed to operate a fixed-air sampler in the mine ventilation effluent air stream. It was signed in March 1988 by Kirkland Jones Deputy Director, New Mexico Environmental Improvement Division, State of New Mexico) et al., and R. G. Romotowski (Manager, Albuquerque Operations Office, U.S. Department of Energy).

Environmental Oversight and Monitoring Agreement -- This agreement states that the DOE will provide additional technical and financial support for state activities in environmental oversight, monitoring, access, and emergency response to ensure compliance with applicable federal, state, and local laws at several DOE facilities including the WIPP facility. It was signed in October 1990 by Garrey Carruthers (Governor, State of New Mexico; Dennis Boyd (Secretary, Health and Environment Department), and Bruce G. Twining (Manager, Albuquerque Operations Office, U.S. Department of Energy).

Site-Specific Protocol for Implementation of the Environmental Oversight and Monitoring Agreement -- Signed October 23, 1992, this protocol describes the site-specific protocol for day-to-day activities involving the NMED and the DOE contract personnel stationed at the WIPP. This protocol is a result of the "Environmental Oversight and Monitoring Agreement of 1990" between the State of New Mexico and the DOE. It is designed within the context of the unique nature and purpose of the WIPP.

Table 3-4
Active/Pending Permits for the Waste Isolation Pilot Plant During 1995

| Granting Agency | Type of Permit | Permit Number | Granted/ Submitted | Expiration | 1995 Permit Status |
|---|---|---|---|---|---|
| Department of the Interior, Bureau of Land Management | Right-of-Way for Water Pipeline | NM53809 | 8/17/83 | None | Active |
| Department of the Interior, Bureau of Land Management | Right-of-Way for the North Access Road | NM55676 | 8/24/83 | None | Active |
| Department of the Interior, Bureau of Land Management | Right-of-Way for Railroad | NM55699 | 9/27/83 | None | Active |
| Department of the Interior, Bureau of Land Management | Right-of-Way for Dosimetry and Aerosol Sampling Sites | NM63136 | 7/31/86 | None | Active |
| Department of the Interior, Bureau of Land Management | Right-of-Way for Seven Subsidence Monuments | NM65801 | 11/7/86 | None | Active |
| Department of the Interior, Bureau of Land Management | Right-of-Way for Aerosol Sampling Site | NM77921 | 8/18/89 | 8/18/2019 | Active |
| Department of the Interior, Bureau of Land Management | Right-of-Way for Ten Raptor Nesting Platforms | NM82212 | 9/12/89 | 12/13/2019 | Active |
| Department of the Interior, Bureau of Land Management | Right-of-Way for Survey Monument Installation | NM82245 | 12/13/89 | 12/13/2019 | Active |
| Department of the Interior, Bureau of Land Management | Approval to Drill 2 new test wells on existing pads at P-1 and P-2 | None | 9/18/86 | None | Active |
| Department of the Interior, Bureau of Land Management | Free Use Permit for Caliche | NM-FU5-94405 | 6/6/95 | 5/12/98 | Active |

Table 3-4
Active/Pending Permits for the Waste Isolation Pilot Plant During 1995

| Granting Agency | Type of Permit | Permit Number | Granted/ Submitted | Expiration | 1995 Permit Status |
|---|---|---|---|---|---|
| New Mexico Environment Department | Open Burning Permit to train fire control Crews | None | 2/20/95 | 12/25/95 | Cancelled Open burn training no longer conducted on site. |
| New Mexico Environment Department | Operating Permit for two backup generators | 310-M-2 | 12/7/93 | None | Active |
| New Mexico Environment Department | Submittal of Part B RCRA Permit Application | | Submitted to the NMED and EPA Region VI on 2/26/92 and on 2/27/92. Revisions were delivered to the NMED on 3/4/92 and 1/27/93. | | NMED declared permit administratively complete 7/22/92. Draft permit issued 8/24/93. Public comment period was held open to 7/14/94. |
| New Mexico Environment Department | Acknowledgement of Notification of Hazardous Waste Activity | NM4890139088 | 1/88 Latest report delivered on 2/28/92 | None - Contingent upon delivery of biennial report | Active |
| New Mexico Department of Game and Fish | Individual Banding | #1961 | 4/1/94 | 3/31/95 | Active |
| New Mexico Department of Game and Fish | Master Collecting | #1894 | 4/5/94 | 3/31/95 | Active |
| New Mexico Department of Game and Fish | Concurrence that WIPP construction activities will have no significant impact on State-listed threatened or endangered species | None 7/25/83 None Active | 5/26/89 | None | Active |
| U.S. Department of the Interior, Fish and Wildlife Service | Master Personal Banding | #22478 | 5/19/93 | 6/30/95 | Active |

Table 3-4
Active/Pending Permits for the Waste Isolation Pilot Plant During 1995

| Granting Agency | Type of Permit | Permit Number | Granted/ Submitted | Expiration | 1995 Permit Status |
|---|---|---|---|---|---|
| U.S. Department of the Interior, Fish and Wildlife Service | Concurrence that WIPP construction activities will have no significant impact on Federally-listed threatened or endangered species | None | 5/29/80 | None | Active |
| New Mexico Department of Finance and Administrative Planning Division, Historic Preservation Bureau | Concurrence that the DOE Archaeological Resources Protection Plan is adequate to mitigate any adverse impacts upon cultural resources resulting from construction of the WIPP facility | | | | |
| Protection Agency | Notification of the presence of 2 Underground Storage Tanks | None | 4/15/86 | None | Active |
| U.S. Environmental Protection Agency | New Mexico NPDES Storm Water General Permit | NMR00 A021 | 12/31/92 | 12/31/97 | Active |
| New Mexico Commissioner of Public Lands | Right-of-Way for High Volume Air Sampler | RW-22789 | 10/3/85 | 10/3/2020 | Active |

# Chapter 4
# Environmental Program Information

The WIPP's policy is to conduct its operations in a manner commensurate with all applicable environmental laws and regulations.

## 4.1 Environmental Monitoring Plan (EMP)

The WIPP's Environmental Monitoring Plan outlines a program that monitors a comprehensive set of parameters to detect and quantify present and future environmental impacts. Nonradiological portions of the plan focus on the immediate area surrounding the site.

The goal of the EMP is to identify what impacts may exist from the WIPP on the local ecosystem. Evaluation of the severity, geographic extent, and environmental significance of these impacts is important to the mission of the facility and future research. Although the WIPP has performed a detailed study of these impacts, additional samples will be collected and analyzed to investigate and explain trends or anomalies that may have a bearing on environmental impacts. The EMP sampling schedule is provided in Table 4-1.

As recommended in DOE/EP-0023 (i.e., Corley et al. 1981) and DOE/EH-0173T, the EMP describes the monitoring of naturally occurring and specific anthropogenic radionuclides. This surveillance has included the monitoring of world-wide fallout. The geographic scope of radiological sampling is based on projections of potential release pathways (see Figure 5-1, Primary Pathway Exposure model) from the stored waste at the WIPP. Surrounding population centers are also monitored. Future radionuclide monitoring will be confirmed to transuranic elements only, since these are the radionuclides of concern from the standpoint of a potential release.

Results and discussions pertaining to respective monitoring programs prescribed by the EMP are provided in Chapter 5 *Environmental Radiological Program Information*, and Chapter 6, *Environmental Nonradiological Program Information*.

As required by DOE Order 5400.1, the EMP is to be reviewed annually and updated every three years. The most recent EMP was updated in March 1994 (DOE/WIPP 94-024).

## 4.2 Baseline Data

Within the WIPP Environmental Monitoring section there are four programs currently in place: the Nonradiological Environmental Surveillance (NES) (Chapter 6), the Radiological Environmental Surveillance (RES) (Chapter 5), Land Management (to include the Cooperative Raptor Research and Management Program), and the WIPP Groundwater Surveillance Programs (Chapter 7). The purpose of these programs is to collect the data needed to detect and quantify possible impacts that construction and operational activities at the WIPP may have on the surrounding ecosystem and, when necessary, provide technical support for issues that require technical expertise in the disciplines of environmental science or land management. The data are used to assess impacts of WIPP operations on the environment and to demonstrate compliance with applicable standards for radiological and nonradiological programs.

Preliminary studies must be considered during environmental evaluations. These preliminary assessments have contributed to baseline data gathered during the construction phase, as well as provided much of the foundation for long-term monitoring programs. Examples of such investigations include the following:

- WIPP Site Characterization Program - instituted in 1976 by Sandia National Laboratories (SNL) to monitor air quality, background radiation levels, and groundwater quality (Pocalujka et al., 1979; 1980a, b, c; 1981a, b; Powers et al., 1978; Lappin, 1989).

- WIPP Biology Program - began in 1975 with site characterization studies of climate, soils, vegetation, arthropods, and vertebrates (Best, 1980).

- Investigations of the Site Geohydrology - conducted by the U.S. Geological Survey (USGS) at the request of the DOE. In addition, the Nuclear Regulatory Commission issued a contract to Columbia University to perform a study of radionuclide mobility in the highly saline groundwaters of the Delaware Basin (USGS, 1983).

- Radiological Monitoring of Air, Water, and Biological media - conducted by the Atomic Energy Commission (AEC) before and after the Project Gnome nuclear detonation (U.S. AEC, 1962a, b, c, d).

## 4.3 Land Management Programs

On October 30, 1992, the WIPP *Land Withdrawal Act* (P.L. 102-579) became law. This Act transferred the responsibility for the management of the WIPP Land Withdrawal Area from the Secretary of the Interior to the Secretary of Energy. In accordance with sections 3(a)(1) and (3) of the Act, these lands

> ". . . are withdrawn from all forms of entry, appropriation, and disposal under the public land laws . . ." and are reserved for the use of the Secretary of Energy ". . . for the construction, experimentation, operation, repair and maintenance, disposal, shutdown, monitoring, decommissioning, and other activities, associated with the purposes of WIPP as set forth in Section 213 of the Department of Energy National Security and Military Applications of Nuclear Energy Act of 1980 (P.L. 96-164; 93 Stat. 1259, 1265) and this Act."

In accordance with Section 4 of the WIPP *Land Withdrawal Act* (LWA) (Public Law 102-579), the DOE developed a Land Management Plan (LMP) as required by the Act. The development of this plan was in consultation and cooperation with the U.S. Department of Interior's (DOI) Bureau of Land Management (BLM) and the state of New Mexico. Changes or amendments to the plan require the involvement of the BLM, the state of New Mexico, and affected stakeholders, as appropriate.

The LMP, as required by LWA, was developed to identify resource values, promote the concept of multiple-use management, and identify long-term goals for the management of WIPP lands until the culmination of the decommissioning phase. The plan also provides the opportunity for participation in the land use planning process by the public, as well as local, state, and federal agencies.

The most recent version of the LMP, completed on January 31, 1996, is a reprint which incorporates elements of implementation previously provided in the WIPP *Land Management Implementation Plan* (LMIP) (DOE/WIPP 94-026). The reprint does not revise or amend the intent or scope of the original plan, but merges implementing actions from the LMIP to make the plan more helpful for those desiring to use WIPP lands. An additional reason for developing the reprint was to reduce document volume and redundancies in text, which results in the LMIP being superseded by the latest version of the LMP.

The LMP is prepared through the integration of the WIPP *Land Withdrawal Act* of 1992 (Public Law 102-579), BLM planning regulations (43 CFR 1600) issued under the authority of the Federal

Land Policy and Management Act (FLPMA) of 1976, the National Environmental Policy Act (NEPA) of 1969, as amended; and existing Memoranda of Understanding (MOU) among the DOE and local, state and/or federal agencies. The LMP is designed to provide a comprehensive framework for the management and coordination of WIPP land uses during the life of the project. The LMP, and any subsequent amendments, will continue through the decommissioning phase. Moreover, in accordance with section 13 of the WIPP *Land Withdrawal Act*, the DOE will develop, in consultation with the Secretary of the Interior and the State of New Mexico, a plan for the management and use of the WIPP Land Withdrawal Area following the decommissioning of WIPP. This plan must be developed by October 30, 1997.

Guidelines prescribed in the LMP provide for the management and oversight of WIPP lands under the jurisdiction of the DOE in addition to lands outside the WIPP boundary that are used in the operation of the WIPP (e.g., groundwater surveillance well pads outside the withdrawn area). Furthermore, this plan provides for multiagency involvement in the administration of DOE land management actions. The LMP, in addition to any documents referenced therein, are available to person(s) and/or organization(s) desiring to conduct activities on lands under the jurisdiction of the WIPP in addition to those involved in development and/or amending existing land management actions. These documents can be obtained from the U.S. Department of Energy, Carlsbad Area Office, P.O. Box 3090, Carlsbad, New Mexico 88221.

The LMP envisions and encourages direct communication among stakeholders, including federal and state agencies involved in managing the resources within, or activities impacting the areas adjacent to, the WIPP WLWA. It sets forth cooperative arrangements and protocols for addressing WIPP-related land management actions. The DOE recognizes the guidelines for contemporary land management practices that pertain to rational adherence with edicts in the WIPP LWA and all applicable regulatory requirements contained therein. Commitments contained in current permits, agreements, or concurrent MOUs with other agencies (e.g., state of New Mexico, DOI), shall be adhered to when addressing/evaluating land use management activities and future amendments that affect the management of WIPP lands.

The LMP is reviewed on a biennial basis to assess the adequacy and effectiveness of the document, or as may be necessary to address emerging issues potentially affecting WIPP lands. Affected agencies, groups, and/or individuals may be involved in the review process. Components of the LMP emphasize management protocols for the following issues: administration of the plan; environmental compliance; wildlife; cultural resources; grazing; recreation; energy and mineral resources; lands/realty; reclamation; security; industrial safety; emergency management;

maintenance and work control. Each issue and its complementary planning/management criteria are described in respective chapters of the document.

### 4.3.1 Land Management and Environmental Compliance

Parties who desire to conduct activities that impact lands under the jurisdiction of the WIPP, outside the inner core of the facility designated as the Property Protection Area, are required to prepare a Land Use Request (LUR). A LUR consists of a narrative description of the project, a completed Environmental Review, and a map depicting the location of the proposed activity. The LUR is used to determine if applicable regulatory requirements have been met prior to the approval of a proposed project. A LUR is submitted by any WIPP organization or outside entity wishing to complete any construction, rights-of-way, pipeline easements, or similar actions within the WIPP Site Boundary and on lands used in the operation of the WIPP, under the jurisdiction of the DOE.

During CY 1995, four LURs for construction were submitted to the WIPP LUC for review and determination. LURs submitted for the year received approval with contingencies (e.g., archeological clearance reports) as appropriate.

### 4.3.2 Grazing

The *Land Withdrawal Act* provides for the continuation of grazing practices, within the WLWA, in accordance with applicable grazing laws and policies, including the Act described as:

> "An Act to stop injury to public grazing lands by preventing overgrazing and soil deterioration, to provide for their orderly use, improvement, and development, to stabilize the livestock industry dependent upon the public range, and for other purposes..."

approved June 28, 1934 (43 U.S.C. 315 et seq., commonly referred to as the *Taylor Grazing Act*); title IV of the *Federal Land Policy and Management Act* of 1976 (43 U.S.C. 1751 et seq.); and the *Public Rangelands Improvement Act* of 1978 (43 U.S.C. 1901 et seq., and 43 CFR 4100).

The principles of multiple-use and sustained-yield are basic to the management of this program. Rangelands comprise a substantial portion of the WLWA and provide forage for livestock and valuable wildlife habitats.

The WLWA affects two grazing allotments administered by the BLM: the Livingston Ridge Allotment (No. 77027) and the Antelope Ridge Allotment (No. 77032).

The Livingston Ridge allotment begins 17 miles east of Carlsbad, New Mexico. The allotment is comprised of 55,581 acres in size and permitted to a livestock rancher operating a year-round cow/calf business. Land ownership is divided between federal, state, and private lands. Acreage distributed by ownership are as follows: (1) 41,608 acres of Federal ownership (2,880 acres within the WLWA), (2) 13,063 acres of State Trust lands, and (3) 910 acres of private (deeded) land. Although the allotment is 55,581 acres in size, only 5.18 percent of the allotment is situated within the WLWA.

Pasture rotation with some of the pastures being rested for at least a portion of the growing season, is standard management practice for this allotment. Vegetative monitoring studies to collect data on the utilization of the land, and the amount of precipitation by pasture from each study allotment are conducted annually to compare production with consumption. Should vegetative monitoring studies indicate a need for an allotment management plan, a plan will be developed in consultation with the BLM. The allotment is permitted for 6,483 Animal Unit Months (AUMs), which converts to 6.3 acres per AUM. (An AUM is the amount of forage necessary for the sustenance of a cow, or its equivalent, for a period of one month.)

The Antelope Ridge allotment begins 23 miles east of Carlsbad, New Mexico, and contains 77,574 acres. This allotment is permitted to a livestock rancher operating a year-round cow/calf business. Approximately 300 acres (more or less) within the Antelope Ridge allotment contain the WIPP facilities and are posted against trespass and fenced to prevent grazing. Land ownership of the subject allotment is divided between federal, state, and private (deeded) lands. Acreage distributed by ownership are as follows: (1) 66,757 acres of federal land (7,360 acres within the WLWA), (2) 8,749 acres of State Trust lands, and (3) 2,068 acres of private land. Of the 77,574 acres contained in this allotment, 9.49 percent is within the WLWA.

An allotment management plan has been developed for this allotment by the BLM. The plan includes a seven-pasture rotation system, with some pastures being rested for full years and others receiving growing season rest. The allotment is permitted for 13,236 AUMs which translates to 7.0 acres per AUM.

Both allotments consist of sandy and deep sand range sites. These sites have combined shin-oak/dune (SOD) and grassland (SG) aspects and include grasses such as Gramas (*Bouteloua* spp.), Bluestems (*Andropogon* spp.), and Dropseeds (*Sporobolus* spp.). Other key forage plant species include Havard Shin Oak (*Quercus havardii*) and Fourwing Salt-bush (or Chamiza) (*Atriplex canescens*).

During CY 1995, no incidents of non-compliance involving grazing allottees on WIPP lands were noted.

### 4.3.3 Wildlife Population Monitoring

The WIPP is involved in the planning of wildlife investigation and management projects. Recommendations for approaches, potential prospectuses, and proposed investigational plans are evaluated. Tools, techniques, and personnel available for conducting investigations and achieving management objectives are examined. These criteria are essential to wildlife objectives for effective planning as it relates to choice, between alternatives, establishment of realistic constraints (e.g., time, funding, manpower), practicality, and expediency in the development of efficient research methodology.

Wildlife within the WLWA are provided consideration during planning stages of projects involving the disturbance or encroachment of wildlife habitat inside DOE lands by way of the LUR process. Monitoring and research of specific wildlife populations occur in accordance with applicable laws, agreements, and regulations subject to funding and personnel constraints.

The WIPP conducts a number of general wildlife management activities. Each activity is mandated and/or supported by state and federal guidelines or by way of commitments created through interagency agreements (e.g., *Raptor Research and Monitoring Interagency Agreement)* and/or MOUs.

Examinations of wildlife species in the area reveals significant diversity and complexity. Management of indigenous wildlife incorporates the development of a logical sequence when programming activities. Solutions for problems (e.g., home-range, territoriality) serve the implementation of conservation and resource management objectives as they pertain to the management and operation of the WIPP site.

#### 4.3.3.1 Affected Biological and Wildlife Environment

The wildlife habitat around the WIPP is categorized in accordance with the BLM's standardized habitat sites subsequent to a detailed Integrated Habitat Inventory Classification System. WIPP lands comprise a small part of those lands grouped into major habitat types as described in Appendix L-2 of the *East Roswell Grazing Environmental Impact Statement*. Moreover, habitat types and species inventories were conducted for the DOE during initial site characterization studies as described in the WIPP Biology Program, the *Final Environmental Impact Statement* (FEIS)

(DOE/EIS-0026-FS), the Site and Preliminary Design Validation studies, and the *Environmental Monitoring Plan* (DOE/WIPP 92-040). Wildlife in the vicinity of the WIPP is characterized by a wide variety of insects, amphibians, reptiles, birds, and mammals.

The Chihuahuan desert has long been regarded for its extraordinary diversity of plant and animal communities. The location of the WIPP, situated in the Los Medaños region of the Chihuahuan desert, exemplifies this unusual array of biotic factors. The Los Medaños is located in an area of intergradation between the northern region of the Chihuahuan Desert and the Llano Estacado or Staked Plains. The region is characterized by aeolian and alluvial sedimentation on upland plains that form hummocks, dunes, sand ridges, and swales with the presence of Havard Shin Oak (or shinnery oak) as a prominent foliar factor. Although the abundance of Shin Oak has aided in the stabilization of the dunes, a number of them remain unstable and exhibit distinct signs of shifting. An additional predominant shrub is Honey Mesquite which has invaded what at one time was a short-grass, shinnery oak-dominated landscape.

As with many areas, the shinnery oak community has shifted from a dominant bluestem/grama grassland with varying amounts of shinnery oak, sand sage, and yucca to a composition dominated by Dropseeds, three-awns, and Gramas, with high densities of Plains Yucca, annual forbs, and Mesquite.

According to the BLM's Resource Management Plan, 15 percent of the wildlife species identified in the Resource Area utilize the Shin Oak habitat with 30 percent occupying areas consisting primarily of grass compositions with greater than 75 percent grasses in the description of the potential plant community.

The subtle blend of plant communities with Shin Oak/Dune habitat (SOD) that somewhat dominates Grassland (SG) affords a composition of factors that results in the diverse wildlife population of the Los Medaños.

Wildlife populations are characterized by numerous species of arthropods, amphibians, reptiles, birds, and mammals. Now and then, aquatic mollusks, inhabitants of local stock ponds and livestock drinking units, are observed. Jerusalem crickets (*Stenopelmatus fuscus*) are an example of one order of insects that occupy the locality of the WIPP.

Red-Spotted Toads (*Bufo punctatus*) and New Mexico Spadefoot Toads (*Spea hammondi*) are two examples of no fewer than ten different species of indigenous amphibians. Their significance is seldom recognized until spring or summer rains, at which time they appear in extraordinary numbers.

Reptiles comprise more conspicuous inhabitants due to the diurnal nature of numerous species. Ornate Box Turtles (*Terapene ornata)*, Desert Side-Blotched Lizards (*Uta stansburiana)*, and Texas Horned Lizards (*Phrynosoma cornutum*, a federal notice-of-review species listed under the Endangered Species Act) represent three of approximately 35 distinct species of indigenous reptiles. Moreover, three species of rattlesnake can be encountered in the area.

Bird densities vary according to preferable food and habitat availability. The habitat heterogeneity of the Los Medaños accounts for a wide assortment of bird species that inhabit the area either as seasonal transients or permanent residents. Large numbers of Mourning Dove (*Zenaida macroura*), Pyrrhuloxias (*Cardinalis sinuata)*, and Black-Throated Sparrows (*Amphispiza bilineata*) are frequently observed. A unique desert subspecies of the Northern Bobwhite (*Colinus virginianus*), Scaled Quail (*Callipepla squamata)*, and an occasional Lesser Prairie Chicken (*Typanuchus pallidicinctus)* depict the gallinaceous inhabitants. Due to a scarcity of surface waters in the immediate vicinity of the WIPP, migrating or breeding waterfowl are not considered common.

The area supports a particularly abundant and diverse population of Raptors, or birds of prey. Harris' Hawks (*Parabuteo unicinctus)*, Swainson's Hawks (*Buteo swainsoni)*, and Great Horned Owls (*Bubo virginianus)* illustrate species commonly found nesting in the area. The density of large avian-predator nests is generally regarded as a predominant raptor breeding population.

As is common in desert biomes, Black-Tailed Jackrabbits (*Lepus californicus)* and Desert Cottontails (*Sylvilagus audoboni)* are the most conspicuous mammals. Three species of Ground Squirrel (*Spermophilus spp.)* and numerous other rodents such as Kangaroo Rats (*Dipodomys spp.)* and Cactus Mice (*Peromyscus eremicus)* also occupy the area. Large piles of debris, that may consist of aluminum cans, cow dung and other rubbish (sometimes to a height of nearly five feet), clustered at the base of cactus or large mesquites characterize the houses (or "middens") of the Southern Plains Woodrat (*Neotoma micropus)*. Although specimens rarely exceed weights of 300 grams, several Woodrats that weighed nearly 500 grams have been captured, by WIPP biologists, near the WIPP. Big-game species, such as Desert Mule Deer (*Odocoileus hemionus)* and carnivores such as Coyotes (*Canis latrans)* and Badgers (*Taxidea taxis)* also frequent the area.

The DOE consulted with the United States Fish and Wildlife Service (USF&WS) in 1979 to determine the presence of threatened or endangered species at or near the WIPP site. At that time, the USF&WS listed the Lee Pincushion Cactus (*Coryphantha sneedi* var. *leei)*, the Black-Footed

Ferret (*Mustela nigripes*), the American Peregrine Falcon (*Falco peregrinus anatum*), and the Bald Eagle (*Haliaeetus leucocephalus*) as threatened or endangered that could occur on lands within or outlying the WIPP site. However, no critical habitat for endangered species was identified at the WIPP. In 1989, the DOE again consulted with the USF&WS to update the list of threatened and endangered species. The agency has advised the DOE that the list of species provided in 1979 is still valid.

During 1989, the DOE consulted with the NMDG&F regarding the state-listed endangered species in the vicinity of the WIPP. Based on NMDG&F Regulation 657, dated January 9, 1988, the NMDG&F listed seven birds and one reptile in one of two endangerment categories that occur or are likely to occur at the site.

During 1995, the USF&WS transmitted the April 24, 1995, updated list of threatened and endangered species (to include Notice of Review) for Eddy and Lea Counties. New Mexico: Inclusive were approximately 18 species that occur or are likely to occur on WIPP lands. Accordingly, the list was disseminated to pertinent WIPP departments for consideration and incorporation into applicable documents. The DOE currently operates under the assumption that activities associated with the operation of the WIPP will have no impact on any threatened or endangered species. Considerations pertaining to protected species are implemented in accordance with this management plan, during the deliberation and administration of projects conducted on WIPP lands.

Population density measurements of birds and small nocturnal mammals, initiated in 1985, were performed annually to assess the effects of WIPP surface activities (e.g. construction, salt piles) on wildlife populations. Customary protocol involved comparative data analysis between two outlying or "control" plots and two experimental plots situated in proximity to WIPP operations. A Hantavirus investigation during CY 1994, prompted the temporary postponement of small nocturnal mammal surveys. As previous years' investigations revealed no detectable detrimental impacts from salt encroachment on the peripheral environment, annual appraisals of small mammal populations have been discontinued indefinitely.

#### 4.3.3.2 Cooperative Raptor Research and Management Program

During CY 1995, data were collected on resident birds of prey within an area of approximately 870 square miles in the vicinity of the WIPP. The majority of this sector is managed under the authority of the BLM Carlsbad Resource Area (CRA) with WIPP lands comprising the nucleus of the research area. This cooperative enterprise between the BLM and the DOE was commissioned through the bilateral development of an Interagency Agreement. The Agreement defines commitments on behalf of each respective agency to include deliverables and itemized timelines for the completion of each element.

Raptor inhabitants have long been regarded as useful "environmental barometers ." Populations oscillate in response to changes in environmental conditions that include human caused or "anthropogenic" influences (e.g. habitat loss to industrial development, persecution), and non-anthropogenic limiting factors (e.g. climatic conditions, parasitism, predation, fratricide, prey availability).

The CY 1995 survey period represented the fourth consecutive year of drought that has had dramatic ramifications throughout the study area. Observations indicate the drought probably suppressed population densities in both predators and prey, effected the number of inhabited territories, and brought about declines in nesting and production. Data collected during this study includes descriptive information on the social behavior of the Harris' Hawk (*Parabuteo unicinctus*), physiognomy of the study area, territorial fidelity, sex ratios, nesting data, prey base determinations. capture and banding results, research protocol, phlebotomy data, results of territorial trials, habitat preferences and results from the inventory of other common raptors in the vicinity of the WIPP.

Significant changes occurred during CY 1995 in tenant raptor populations of the Los Medaños as compared to prior years' assessments, most notably, those years experiencing normal or above normal precipitation (e.g. CY 1992). For example, the ratio of immature hawks to breeding adults during 1992 (the last year of recorded near-normal precipitation) was approximately 1:1. Breeding proficiency during CY 1995, however, exhibited a significant reduction in fledging success as the ratio declined to less than four nestlings fledged per 45 adults observed. It can be presumed that these skewed age ratios are in correlation to an unusually high percentage of nest failures (91.1 percent) in the study area. Data correlation indicates that these failures are one of many repercussions of low prey densities; likely the result of the regional drought conditions.

In addition to nest observations, data were also collected to evaluate Harris' Hawk territories. The emphasis in this feature of the investigation was to evaluate territorial tenancy, territorial configuration, and territorial fidelity. Prior to 1990, Harris' Hawks in the Los Medaños had been assumed to be non-territorial (Bednarz 1987). Snyder and Snyder (1990), however disputed this assumption. asserting that such a conclusion resulted from the observer's inability to recognize related individuals of the same group or of peripheral groups in the near vicinity. The supposition of non-territoriality in Harris Hawks of the Los Medaños was also diametric to observations conducted on geographically segregated populations, most notably in Arizona (Dawson and Manaan 1990).

Numerous incidents of aggression were observed by WIPP researchers, between Harris' Hawks and other species of raptors, such as Red Tailed Hawks (*Buteo jamaicensis*). Although this type of interaction was common, the controversial intraspecific territorial behavior of the resident Harris' Hawks remained shrouded as conjecture. The first indication that the Los Medaños population was in fact, innately territorial, was in 1993 when an immature female who, as a nestling, fell from the nest during a windstorm and was remanded to a wildlife rehabilitator for rehabilitation. Subsequently, she was released into her original group after spending nearly a year in rehabilitation. The dominant or "alpha" male (most likely her father) and a subordinate "beta" male (both of whom were readily recognizable as they were color-banded) immediately drove the female to the ground and perched above her with arched necks, vocalizing for nearly an hour. She was ousted from the territory in less than one day. This incident prompted WIPP researchers to more closely examine territoriality in the Los Medaños Harris' Hawks.

In order to accurately evaluate territoriality, researchers released a non-related Harris' Hawk, trained as falconry bird, into sectors known to be occupied by Harris' Hawk clans. The degree of intraspecific territoriality, or the defense of preferred sectors from intruders of the same species, was measured by the number of incidents wherein residents would supplant intruders and the amount of time before those intruders would be driven from the territorial proximity. In addition, interactions between intruder and residents were observed and noted. Without exception, the intraspecific intruder was repeatedly supplanted and driven from territories within a brief period of time (usually less than an hour).

Posturing and vocalizations precluded any physical interaction but, if the intruder failed to leave the area, more aggressive reactions such as shoulder bumping, flogging with wings, or simply knocking the intruder from perches usually followed. Seldom do Harris' Hawks grab or mortally wound members of their own species, therefore, there was little, if any danger, of wounding the released bird. In one recorded event, the intruder was repeatedly displaced, or supplanted, from trees and other perches, six different times (with no injuries sustained to the released bird) before being called back to the handler.

This high degree of territorial demeanor provides a significant management aspect of the species. Dimensional assessments of territories are integrated into land management practices by diverting construction and other invasive practices into land sectors unoccupied by territorial species, or away from territorial epicenters (e.g. nests and/or nest trees) so as not to displace resident clans or create aberrant limiting factors that may adversely influence prey densities, loafing coverts, or potential nest substrates.

### 4.3.4 Reclamation of Disturbed Lands

The DOE recognizes responsibilities pursuant to applicable federal, state, and local environmental regulations to enhance and restore areas affected by the WIPP activities, to include areas disturbed prior to WIPP activities that were accepted as part of the land transfer from the BLM to the DOE. These obligations include protocols designed to be revised as needed and are no way limited, except by law, to revisions based on new techniques for reclamation and new plans which the WIPP may incorporate in the future.

WIPP reclamation activities are conducted in accordance with the *Environmental Protection Implementation Plan* (DOE/WIPP 90-050); DOE Order 5400.1, *General Environmental Protection Program Requirements*; the DOE *Organization Act* (42 U.S.C. 7112); *the Federal Land Policy and Management Act* of 1976 (Public Law 94-579); the *Final Supplement to the Environmental Impact Statement* (SEIS) WIPP (DOE/EIS-0026-FS, January 1990); the *Final Environmental Impact Statement,* (DOE/EIS-0026); and all applicable reclamation requirements by federal laws and regulations, Executive Orders, MOUs, DOE Orders, and state and local laws. These commitments encompass any unforeseeable future mandates or amendments to existing regulations.

In accordance with the LMP, the WIPP implements a contemporary reclamation program and corresponding long-range reclamation plans. As locations are identified for reclamation, WIPP personnel reclaim these areas by using the best acceptable reclamation practices. Seed mixes used reflect those species indigenous to the vicinity with priority given to those plant species which are conducive to soil stabilization, wildlife, and livestock needs.

Without an active reclamation program, the establishment of stable ecological conditions in arid environments may require decades or centuries to achieve, depending on natural and unnatural disturbance and environmental conditions present during the entirety of the reclamation process. Reclamation activities are intended to reduce soil erosion, increase the rate of plant colonization and succession, and provide habitat for wildlife in disturbed areas. In addition to maintaining the compliance posture of the WIPP with respective external entities, reclamation ultimately serves to mitigate the effects of WIPP-related activities on affected plant and animal communities.

The objective of the DOE reclamation program is to return lands used in the operation of the WIPP that are no longer commissioned for WIPP operations, to a stable ecological condition. Plant species and topography of the reclaimed area are indicative of the vicinity. It is the intent of the DOE to establish reclamation guidelines for land use requestors.

Reclamation activities during CY 1995 consisted of the continuation of decommissioning numerous existing fenced areas that had been constructed during much of the initial site characterization studies in the late 1970s. In addition to the exclosures, activities initiated during CY 1994, regarding the removal of re-bar (emplaced within numerous study areas to delineate sampling points) to alleviate safety hazards to personnel and livestock, were continued. Problem areas (e.g. drainages, eroded slopes, etc.) in existing reclamation sites received additional stabilization measures which include seeding and the spreading of straw. Existing fences left in place, were repaired as necessary. Roads, under the jurisdiction of the WIPP were evaluated to assess the usefulness of respective roads in the operation of the facility. One road in particular, the East Link Road, was regarded as having merit as an access route for emergency vehicles to the east. This road was closed due to safety concerns. Land management personnel administered the fabrication of a gate, warning signs, and requisite road surface repair to secure the road and make it functional for WIPP use only.

### 4.3.5 Oil and Gas Surveillance

Surveillances of oil and gas activities within one mile of the WIPP boundary, were conducted throughout the calendar year for 1995 in accordance with the BLM/DOE MOU. Oil and gas activities within the defined land sectors are monitored twice monthly to identify new activities associated with oil and gas exploration/production to include:

- drilling
- survey staking
- geophysical exploration
- pipeline construction
- work-overs
- changes in well status
- anomalous occurrences (e.g., leaks, spills, accidents, etc.)

The oil and gas industry is well established in the Los Medaños region of New Mexico (the vicinity of the WIPP), with producing oil and gas fields, support services, and compressor stations. Nearly all phases of oil and gas activities have occurred in the locality. These phases include seismic exploration, exploratory drilling, field development (comprised of production and injection wells) and other sundry activities associated with hydrocarbon extraction.

As identified in the BLM's *Oil and Gas Potential Occurrence Zones*, the Los Medaños region is located in a region designated as having a "high potential for oil and gas occurrence." This region, part of the Delaware Basin, is bordered by the Capitan Reef. The majority of hydrocarbon extraction has occurred outside the Basin, within the reef. Although the Delaware Basin accounts for approximately 32 percent of lands in Eddy County, only 17 percent of oil and gas wells are located within its boundaries.

During 1995, oil and gas reserves in the immediate vicinity of the WLWA were evaluated by the New Mexico Bureau of Mines and Mineral Resources. Results from this evaluation were compiled in a report, *Evaluation of Mineral Resources at the Waste Isolation Pilot Plant (WIPP) Site*, March 31, 1995.

During CY 1995, WIPP surveillance teams conducted a total of 24 routine surveillances, four reciprocate inspections, and additional surveillances performed as required. One well, for example, designated as James Ranch Unit No. 16, was drilled by Enron Oil and Gas within 330 feet of the WIPP Site Boundary. In addition to Land Management personnel conducting onsite visits to the well location, customary stipulations for approval were requested on behalf of the DOE. Accordingly, Enron provided daily drilling records to the WIPP Office of Land Management. These records included all of the elements required to drill the subject well (e.g., date of well spudding, drilling rates, depths, degree of deviation, perforation horizons, initial production rates, etc.). These records were used as a means of correlating the horizontal displacement of the well bore with the WIPP Site Boundary. The subject well was drilled to a depth of 11,250 feet with a total maximum deviation from vertical of 196.57 feet.

To date, no wells drilled in the vicinity have exceeded the acceptable distance between bottom hole location and the WIPP Site Boundary. Routine oil and gas surveillance activities continue on a bi-monthly basis with supplementary oversight conducted as conditions warrant.

### 4.3.6 Recreation and Land Management

Recreational opportunities on WIPP lands continue in accordance with most traditional land uses. Examples of such land use concepts can be found in the *Carlsbad Resource Area Resource Management Plan and Environmental Impact Statement* (BLM-NM-PT-86-004-4410). Traditional land uses that conflict with the mission of responsible land management practices are restricted on WIPP lands at the discretion of the DOE in consultation with the LMC and affected stakeholders. Properties posted with DOE "no trespassing" signs are excluded from public use and are routinely patrolled by WIPP personnel to prevent unauthorized use. Violators are subject to prosecution in accordance with applicable laws and regulations governing property protection.

Due to the topography, climatic conditions, and wildlife in the area of the WIPP site, an extensive (non-facility based) variety of recreational opportunities are available to include: hunting for both big and small game animals; camping; horseback riding; hiking; watching wildlife (e.g., bird watching); and sightseeing. The WIPP area contains significant biodiversity in addition to historic and prehistoric sites. These offer rewarding opportunities for scientific study and interpretive recreation.

The objective of the DOE is to support a range of recreational outdoor activities for all segments of the public, commensurate with demand, access, safety, regulatory requirements, environmental protection, and liability. Visitors have a freedom of choice with minimal regulatory constraint regarding activities outside the boundary of the "Off Limits Area." Personnel from the WIPP office of Land Management routinely monitor recreational activities on WIPP lands to provide assistance to land users, interpretive programs, and as a matter of general policy.

### 4.3.7 Lands and Realty

Land use management responsibilities of the DOE pertain to general realty issues, access corridors, rights-of-way, and avoidance areas that affect, but are not solely contained within, the WLWA.

WIPP Lands are relatively well consolidated within the boundaries of the 10,240 acre WLWA. There are, however, additional properties outlying the WLWA boundary, used in the operation of the WIPP, that are managed under the custodial auspices of right-of-way reservations granted (typically) by the BLM or the state of New Mexico. Groundwater monitoring well pads, their access roads, and environmental monitoring sampling stations predominate this property category for lands under the jurisdiction of the WIPP.

Access to the WIPP site is from U.S. Highway 62/180, 13 miles to the north (North Access Road), and from Highway 128, four miles to the south (South Access Road). Rail access to the WIPP site is provided by a rail line connecting with a spur of the Atchison, Topeka, and Santa Fe railroad near the Western Ag-Minerals Nash Draw mine six miles southwest of the site.

WIPP lands may be designated, at the discretion of the Land Management Council (LMC), as right-of-way corridors or as avoidance areas to protect environmental and social values while optimizing economic efficiency for utilities and transportation facilities. The LMC will identify which lands will be avoided when routing future rights-of-way in order to protect sensitive resource values, and which areas may be designated as corridors. Major rights-of-way used in the operation of the WIPP, in addition to those that existed prior to land withdrawal, were acquired from the BLM. Existing rights-of-way are commonly associated with linear facility development (e.g., power lines, gas lines, water lines). Development and/or maintenance of adequate access routes within the WLWA represent significant concerns.

The objective of the DOE is to ensure proper management and maintenance of DOE/WIPP lands and realty (e.g., rights-of-way and access routes), in addition to providing safe and adequate access to the WIPP site while protecting the security of WIPP personnel, lands and realty (e.g., facilities). The DOE consults with BLM and the State of New Mexico, as appropriate, on future rights-of-way actions needed outside the WLWA.

#### 4.3.7.1 Proposals for New Access Routes, Easements, and Rights-of-Way

The DOE examines, by way of the LMC and in accordance with applicable laws and regulations, proposals from land users (WIPP and non-WIPP) that impact lands/realty, under the jurisdiction of the DOE to include: new access routes; easements; and rights-of-way when such access will not cause significant adverse impacts to other resources. In addition, the DOE:

1. Reviews and comments on applications or proposals received from the BLM for access routes, easements, and rights-of-way affecting, but not solely contained within, the WLWA.

2. Forwards to the New Mexico Environment Department (NMED) Hazardous and Radioactive Materials Bureau/DOE Oversight Bureau, within 30 days of receipt from or submittal to the BLM:

   A. Applications or proposals for any access routes, easements, and rights-of-way affecting, but not solely contained within, the WLWA; and

   B. Any DOE comments developed on such applications or proposals.

#### 4.3.7.2 Utility Development

In general, WIPP lands are available for utility and transportation facility development; however, applicants are encouraged to locate any new facilities within existing right-of-way corridors. Deviations from existing corridors may be permitted on the basis of the need of the proposal and lack of conflicts with other resource values and uses.

#### 4.3.7.2 Avoidance Areas

Right-of-way avoidance areas are defined as areas where future rights-of-way may be granted only when no feasible alternative route or designated right-of-way corridor is available. Terms and conditions of right-of-way grants depend on the sensitivity of the affected resources and existing laws and regulations established as protective measures for the area in question.

#### 4.3.7.3 Access Permits

The DOE does not grant permits for access when reasonable access already exists. Exceptions may be considered by the LMC only if the requestor presents, to the satisfaction of the LMC, a compelling need.

#### 4.3.7.4 Advertising

No commercial advertising signs are allowed on WIPP lands. Violations will result in prosecution of the violator commensurate with laws governing property protection. Directional and road signs are authorized by the DOE and conform with DOE specifications and configurations.

#### 4.3.7.5 Rights-of-Way, Rights-of-Way Corridors, and Realty Components

Realty components constructed, maintained, and/or utilized in the operation of WIPP, under existing custodial right-of-way reservations include, but are not limited to, the following:

**I. North Access Road**

The North Access Road is a private road granted, for perpetuity, under right-of-way reservation NM 55676 on August 24, 1983. The North Access Road is approximately 13 miles in length with an easement width of 120 feet. This road is restricted for use by the personnel, agents, and contractors of the DOE on official business related to the WIPP Project, or to personnel, permittees, licensees, or lessees of the BLM. Signs are placed and will be maintained at the turnout of Highway 62/180 stating the restrictions on access. Persons desiring access to Highway 128 should use the Lea County Line Road immediately to the east. Right-of-way NM 55676 was amended on April 22, 1988, to facilitate the construction of livestock fencing along either side of the subject road.

### II. South Access Road

Eddy County Road 802 is designated as the South Access Road. This road originates at the turnout of Highway 128 and terminates as the pavement ends at the confluence of Sections 28 and 29 in T.22 South, R.31 East. This is a county road constructed in accordance with BLM Right-of-Way permit NM 46130. Terms for the right-of-way are for ". . . 50 years after the date of grant." The road configuration consists of a right-of-way width of 80 feet, two 12 foot driving lanes, two-to-four foot shoulders, and parallel "bar" ditches. Multiple-use access will be allowed unless it is determined that access by industry or the general public represents a significant safety risk to WIPP personnel. Upon determination, general access on Eddy County Road 802 may be restricted at the boundary of the 1454-acre Off-Limits Area in accordance with DOE Order 5632.6, *Physical Protection of DOE Property and Unclassified Facilities.*

### III. Water Service Pipeline

Water service for the WIPP facility is furnished by a water line that originates 31 miles north of the facility. Maintenance and operation of the water line is performed in accordance with the conditions of Contract DE-AC04-86AL24138-M002 between the City of Carlsbad and the DOE under right-of-way reservation NM 53809 issued to the U.S. Army Corps of Engineers acting on behalf of the DOE. The volume capacity of the water line is such that it meets all water requirements for the operation of the WIPP facility, as well as provides the City of Carlsbad with untreated water.

The initial 16-mile segment of the line is a 24 inch diameter line that accommodates the city of Carlsbad deliveries in excess of that required by the WIPP facility. The city of Carlsbad is authorized to use capacity in the initial 16-mile segment that is in excess of 500 gallons per minute, provided that:

- Any such use of the excess capacity by the city of Carlsbad will be without any cost or liability to the DOE.

- The city of Carlsbad will notify the DOE not less than 30 days in advance of the installation of each new tap and/or service capacity commitment which the city of Carlsbad intends to serve from the DOE's line.

- Upon request by the DOE Contracting Officer, the city of Carlsbad will provide a monthly tabulation of deliveries by tap point for the preceding 24 months.

In the final 15-mile (10 inch diameter) segment, the DOE has authorized the 3/4 inch water tap lines to supply water to livestock drinking tanks. Additional tap points may be added from time to time with advance approval of the DOE. Water delivered at such tap points are metered and billed by the city of Carlsbad consistent with the city of Carlsbad's rates and procedures for providing service to its regular customers. Future use of the water pipeline within the WLWA will be determined at the time of decommissioning of the WIPP facility.

As specified in Contract DE-AC04-86AL24138-M002, the city of Carlsbad provides the DOE's water requirements free of consumption charge and maintain the water line, at its expense, during the initial term of the contract and any optional extension terms thereafter. Single maintenance projects involving repairs or replacements that cost in excess of $10,000 are considered abnormal and thus are funded by the DOE, provided that such repairs or replacements are not the result of the fault or negligence of the city of Carlsbad or its customers, and provided further that the city of Carlsbad first obtains the advance approval of the DOE Contracting Officer for any maintenance project requiring the DOE funding. This contract is renegotiated between the DOE and the city of Carlsbad every five years.

An operating committee, comprised of (no fewer than) two representatives from the DOE and other affected city, county, state, and federal agencies, has been formed. The responsibilities of the operating committee will be:

- To establish standard procedures and practices for the operation and maintenance of the water line.

- To review any technical studies that may be conducted during the term of the contract and keep the DOE Contracting Officer and the city of Carlsbad currently advised as to matters needing attention.

### IV. Access Railroad

Rail access to the WIPP site is provided by a rail line connecting with a spur of the Atchison, Topeka, and Santa Fe railroad near the Western-Ag Minerals Nash Draw Mine six miles southwest of the site. This section of rail was constructed under the auspices of right-of-way reservation NM 55699 granted on September 27, 1983, is approximately five miles in length and consists of an adjacent frontage road, in addition to the rail. Both railroad and service road were constructed on an easement width of 150 feet. The railroad and the concurrent easement road is inspected and maintained, in accordance with provisions in the WIPP Land Management Plan, until such time as the determination is made that the rail spur is identified for decommissioning.

### V. Transmission Line

The WIPP is serviced by an overhead electrical transmission line that traverses the WLWA for two miles to the north (right-of-way reservation NM 43203) and an additional two miles to the south (right-of-way reservation NM 91163). The southern terminal of the line is approximately five miles south of the WIPP at a location identified as the Southwest Public Service Company's Sand Dune Substation. Access to the power line easement is restricted to WIPP employees and SPS employees. Unauthorized access to the easement is prohibited and may result in DOE response commensurate with property protection.

### VI. High-Pressure Gas Line

A 12 inch, high-pressure, interstate gas line with a corresponding easement road traverses portions of Sections 15, 16, 17, 19, and 20 of the WLWA. Maintenance and operation of the line and the easement road are the proprietary responsibility of the El Paso Natural Gas Company (the owner/operator of the line) under right-of-way reservation LC 060762. The WIPP periodically uses the easement road for access to the east and, therefore, conducts inspections and maintenance activities (as needed and in accordance with WIPP maintenance protocol) to the road in order to provide adequate and safe access for WIPP vehicles (e.g., emergency response vehicles). Anomalous occurrences (e.g. spills, leaks) are addressed by way of mutual determination between the lessee and the WIPP Land Use Coordinator.

### VII. Salt Tailings Stockpiles

Salt from the underground mining operations is brought to the surface and stored in a bermed salt pile just north of the surface facilities. The salt storage pile contains approximately 408,000 cubic yards of material, with a capacity to store the estimated 2,116,400 cubic yards of material projected to be excavated during the lifetime of the WIPP project. There is also an inactive storage pile containing roughly 162,000 cubic yards within the DOE Exclusive Use Area, east of the Property Protection Area fence. This pile, referred to as the Site and Preliminary Design Validation (SPDV) pile, resulted from accumulation of material(s) extracted during the drilling of one 12-foot diameter and one 6-foot diameter shaft to the repository depth of 2,150 feet and the initial excavations underground.

Salt from the north stockpile, which is not needed for decommissioning will be disposed of under sections 2 and 3 of the Act of July 31, 1947 (30 U.S.C. 602, 603; commonly referred to as the "Materials Act of 1947"). After disposal of the salt, the stockpile area will be reclaimed in accordance with stipulations for reclamation contained in the WIPP LMP.

Daniel B. Stephens and Associates (1995) performed a field characterization of the SPDV salt pile from July 31, 1995 through September 8, 1995. The characterization employed a multiphase approach to identify and quantify potentially hazardous constituents within the pile. Nonintrusive reconnaissance sampling methods included a magnetometer and passive soil gas survey. Areas of concern identified during the nonintrusive surveys were investigated further by intrusive means. The location-specific sampling included trenching, drilling, and sampling for confirmatory chemical analysis.

The reconnaissance magnetometer survey discovered four magnetic anomalies below ground surface. Three of the magnetic anomalies corresponded with an area where elevated measurements of total petroleum hydrocarbons (TPH) were determined by the passive PETREX soil gas reconnaissance survey. The PETREX soil gas analysis identified responses above background in the eastern portion of the salt pile, characteristic off degraded waste oils and fuels.

The intrusive, location-specific investigation focused on areas identified as potential areas of concern during the areal reconnaissance surveys. Trenching operations determined that the identified magnetic anomalies resulted from miscellaneous pieces of scrap iron. No drums or containers that may have contained fuels and spent lubricants were encountered. The 10 soil borings advanced through the pile encountered uncontained salt and sand material.

Samples collected from field and laboratory analyses during the trenching and drilling program did not have detectable concentrations of volatile and semivolatile organic compounds, with the exception of one sample analyzed by field methods. TPH concentrations for the samples analyzed in the laboratory ranged from less than 10 mg/kg to 43 mg/kg. TPH concentrations were below regulatory guidelines set by the NMED. Metal concentrations in analyzed soils were also below applicable regulatory guidelines. Accordingly, no remedial measures are required according to NMED requirements.

Table 4-1

EMP SAMPLING SCHEDULE

| TYPE OF SAMPLE | SAMPLING LOCATIONS | SAMPLING FREQUENCY |
|---|---|---|
| Liquid Effluent | 1 | Annual |
| Liquid Effluent | 1 | Quarterly |
| Meteorology | 2 | Continuous |
| Atmospheric Particulates<br>@ CBD (Carlsbad)<br>MLR (Mills Ranch)<br>SMR (Smith Ranch)<br>WEE (WIPP East)<br>WFF (WIPP Far Field)<br>SEC (Southeast Control)<br>WSS (WIPP South) | 7 | Weekly |
| Vegetation | 4 | Annual |
| Beef/Deer/Game Birds/Rabbits | as available | Annually (as available) |
| Soil | 7 | Annual |
| Surface Water | 13 | Annually (as available) |
| Groundwater | 7 | Annual |
| Fish | 2 | Annual |
| Sediment | 10 | Annual |
| Aerial Photography | 1 | Annual |

Table 4-2

EMP Analytical Array

| Type of Sample | Analysis |
|---|---|
| Liquid Influent | Specific Radionuclides |
| Liquid Effluent | Specific Radionuclides, Chemical Constituents |
| Airborne Effluent | Gross $\alpha$, Gross $\beta$, Specific Radionuclides |
| Meteorology | Temperature, Wind Speed, Wind Direction, Precipitation, Dew Point, Barometric Pressure |
| Atmospheric Particulates | Gross $\alpha$, Gross $\beta$, TSP, Specific Radionuclide |
| Vegetation | Specific Radionuclides |
| Beef | Specific Radionuclides |
| Game Birds | Specific Radionuclides |
| Rabbits | Specific Radionuclides |
| Soil | Specific Radionuclides |
| Surface Water | Specific Radionuclides |
| Groundwater | Specific Radionuclides |
| Fish | Specific Radionuclides |
| Sediment | Specific Radionuclides |
| Aerial Photography | Area of Land Disturbed |
| Salt Impact Study<br>Soil Chemistry | pH, Na, Cl, Mg, Ca, K |
| Ecology Investigations<br>Wildlife Survey | Cooperative Raptor Research and Management Program |

TSS = Total Suspended Solids
TSP = Total Suspended Particulates
EC = Electrical Conductivity
pH = Hydrogen - Ion Activity

Specific Radionuclides = $^{238}Pu$, $^{239/240}Pu$, $^{241}Pu$, $^{233}U$, $^{235}U$, $^{241}Am$, $^{232}Th$, $^{226}Ra$, $^{228}Ra$, $^{210}Po$, $^{210}Pb$, $^{137}Cs$, $^{90}Sr$, $^{40}K$, $^{7}Be$, $^{60}Co$, $U_{nat}$ $TH_{nat}$

Chemical Constituents = Chloride, iron, magnesium, phenols, sodium, sulfate, pH, specific conductance, total organic carbon, total organic halogen, arsenic, barium, cadmium, chromium, fluoride, lead, mercury, nitrate, selenium, silver, alkalinity, bromide, iodide, orthophosphate, beryllium, calcium, boron, lithium, potassium, silica, carbon tetrachloride, methalene chloride, trichloroethylene, 1,1,1 trichloroethane, freon-113, TSS, TDS

# Chapter 5
# Environmental Radiological Program Information

The following subsections provide a description of the various radiological programs constituting the Environmental Monitoring Program at the WIPP. The media that are analyzed radiologically are airborne particulates, soil, surface water, groundwater, and biotics.

## 5.1 Radioactive Effluent Monitoring

The Radioactive Effluent Monitoring Program is described in the WIPP Environmental Monitoring Plan (EMP). This plan defines the scope of the WIPP's effluent and environmental monitoring programs during the operational life of the facility. Figure 5-1 illustrates the primary pathways to the public for radioactive releases from the WIPP site.

*The Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T), (DOE, 1991), establishes elements for radiological effluent monitoring and environmental surveillance programs considered acceptable to the DOE, and in support of DOE Order 5400.1, *General Environmental Protection Program.* These guidelines incorporate and expand the requirements embodied in germane DOE guidance (e.g. 5400.1). In CY 1995 no radioactive waste was received at the WIPP site, and as a result, no effluent sampling or release data are reported in this document.

## 5.2 Environmental Radioactivity Monitoring

The following subsections present the monitoring results of the EMP for CY 1995. These results include monitored subprograms such as aerosol, background radiation, terrestrial radioactivity, hydrologic radioactivity, and biotic radioactivity. Table 5-1 and figures 5-2 through 5-9 illustrate gross alpha and beta analysis of WIPP air filters conducted at the WIPP Radiochemistry Laboratory (RL). Table 5-2 lists the contract required detection limits (RDLs) for each element as they pertain to a specific sample medium. Reported analytical values that are less than the calculated RDLs should not be used in the determination of baseline activity levels. The subject RDLs provide the minimum level at which there is a degree of confidence that activity is present in measurable concentrations.

The attached appendices (A1-A6) provide analytical results from an offsite laboratory. Sample results coded with an asterisk indicate the nuclide was not identified by the Canberra Nuclear

Nuclide Identification Program (NID) program. Nuclide activity values reported in this data summary were calculated using industry standard criteria (e.g., Canberra Nuclear minimum activity or MINACT program) by the contract analytical laboratory.

### 5.2.1 Atmospheric Radiation Baseline

The WIPP, in alignment with virtually every nuclear facility, collects and analyzes air sampling program samples for particulates. Frame (1987) explains that the most commonly encountered airborne radionuclides are detectable by way of this sample medium.

Levels of these radionuclides in the environment may be so low that the activity collected over a period of approximately 168 hours (one week) will be insufficient for determination of the individual radionuclides. Therefore, it is standard practice at the WIPP to analyze filters first for gross alpha/beta activity as an indicator measurement. Subsequently, the filters are amassed into quarterly composites for analysis of specific radionuclides.

Performing a gross alpha/beta analysis requires ( by procedure) a minimum of 12 hours desiccation to provide a time period for the decay of natural radionuclides (e.g., radon daughters, 0.5 hour effective half-life).

During CY 1995, continuous particulate aerosol filtration samplers operated at seven locations; three, within 1000 meters of the facility; three, at local ranches and communities; and one, as a sample control site (Figure 5-0).

The continuous aerosol samplers presently in use maintain a regulated flow rate of approximately 950 milliliters per second (two cubic feet per minute) of air through a 47-millimeter (1.9-inch) glass fiber filter. Table 5-1 depicts the 1995 quarterly average concentrations of the alpha and beta activity on the low-volume aerosol filters from each location and illustrates the mean gross alpha concentrations for all seven sampling locations. Mean gross alpha concentration shows limited fluctuation throughout the year, as illustrated in Table 5-1. These fluctuations, graphically depicted in Figures 5-2 through 5-8, appeared to be consistent among all sampling locations.

Gross alpha and beta measurements provide an indication of naturally occurring or man-made radionuclide concentrations or changes in a specific radionuclide concentration. These measurements are screened to ensure that important radionuclides are not overlooked when measurements are performed.

Airborne particulate sampling was initiated in July 1985. Weekly filter collections and subsequent radiochemical analyses began in early 1986, except in the Far Field location where data collection began in October 1986. Particulate filters were collected weekly at all locations in CY 1995. These filters were analyzed at WIPP's RL where a weekly gross alpha and beta count of each filter was completed.

Appendix A1 provides results from the radiological analysis of CY 1995 air filters.

### 5.2.2 Background Radiation Baseline

During 1995, it was concluded that sufficient baseline data had been obtained. An assessment of the capabilities of the Reuter-Stokes with regard to the gamma source term of the WIPP-bound transuranic waste indicates that such a dose-rate instrument would be ineffective for detecting a radiological release. A determination was made that the likelihood of detecting a release with the transuranic alpha emitters from air samplers far exceeded the real-time dose rate capability of the Reuter-Stokes. Therefore, the Reuter-Stokes High Pressure Ion Chamber was permanently removed from service.

### 5.2.3 Radiological Soil Monitoring

Radiological soil samples were collected, during CY 1995, at six separate locations. A template insert allows for the collection of samples at three depths per location that includes:

1. 0 - 2 centimeters
2. 2 - 5 centimeters
3. 5 - 10 centimeters.

Each complete sample was a composite of 10 randomly selected subsamples. As illustrated in Appendix A2, data results do not indicate any unusual levels of environmental radioactivity.

### 5.2.4 Hydrologic Radioactivity

The hydrologic radioactivity subprogram is designed to establish characteristic radioactivity levels in surface water bodies, bottom sediments, and groundwater. The following discussion of the hydrologic program includes sampling locations, data collected, and time these data were collected during 1993. It also details refinements made to the program since the publication of the *Radiological Baseline Program Sampling Plan* (Reith and Daer, 1985).

#### 5.2.4.1 Radiological Surface Water and Sediment Monitoring

Surface water samples were collected at 12 locations during CY 95. Of these subject locations, sediment samples were collected at 10. The data from the analysis of these samples does not indicate any unusual levels of environmental radioactivity. Analytical results from surface water and sediment samples are illustrated in Appendix A3 and A4 respectively.

#### 5.2.4.2 Radiological Groundwater Characterization

Groundwater samples were collected in accordance with the Water Quality Sampling Program (WQSP). The primary objective of the WQSP is to obtain, using rigorous field and laboratory procedures and protocols, representative groundwater data from selected wells. At each wellsite, the well is purged and the groundwater serially analyzed for specific field parameters. Once the field parameters have stabilized denoting a chemical steady state with respect to those parameters analyzed, a final groundwater sample is collected and analyzed for radionuclides. The controlling document for the WQSP is the *WIPP Water Quality Sampling Plan and Procedures Manual* (WP 02-1, Rev 2).

The primary water-bearing units being evaluated by the WQSP are the Culebra and Magenta Dolomite members of the Rustler Formation. In 1995, groundwater data were gathered at 10 well locations completed in the Culebra dolomite and one in the Dewey Lake. Contrary to preceding years no water quality data were collected from privately owned wells in the area near the WIPP site. An in-depth discussion of groundwater hydrology and a figure showing well locations is presented in Chapter 7, *Groundwater Surveillance*. Results from the radiological analysis of groundwater are provided in Appendix A5.

### 5.2.5 Biotic Radioactivity

Keith (1991) asserts that sampling biota for radiological analysis provides diverse challenges due to variations between species, dissimilarities within given populations, species mobility, and tissue differentiation. WIPP environmental monitoring programs implements proceduralized protocols to ensure that samples collected are representative, random, and homogeneous for the particular matrix being sampled. Examples of available biotic media used for radiologic analysis are vegetation, fish, quail, rabbit, beef and deer.

### 5.2.5.1 Vegetation

Vegetation was collected at six locations that are analogous to soil and air sample locations. Local, native plants are universally accepted as a readily accessible and reliable sample medium for the evaluation of radionuclides. Vascular plants, in general, have distinctly different phsyiological characteristics, therefore it is imperative that individual sample location selection is random, in order to acquire a true representation of the plant community being sampled. Sparrow (1958) documented variables in the effect of ionizing radiation on plant communities by exposing tracts of densely vegetated lands to a known quantity from a stationary radioactive source. Results were profound and illustrated the predicted dissimilarities in responses of woody and herbaceous (soft tissue) plants to ionizing radiation. Investigations of this nature were precursors to contemporary standards of radiological vegetative evaluations.

The diversity in plant composition and the potential plant community of the region provides for an ample variety of vegetative medium from which to sample. Composite samples collected at predetermined locations include, but are not limited to, woody plants such as Havard Shin Oak (*Quercus havardii)* and Sand Sage (*Artemesia filifolia)* in addition to a variety of soft tissue plants consisting of grasses such as Mesa Dropseed (*Sporobolus flexuosus)* and forbes like Prairie Spurge (*Euphorbia missourica)*.

Results from the analysis of vegetative samples are illustrated in Appendix B. No abnormal levels of radiation were detected.

### 5.2.5.2 Quail and Rabbits

Data pertaining to radionuclide body-burdens in the muscular tissue of quail and rabbits has been collected, by WIPP biologists, since 1985. The popularity of these animals with local hunters prompted the inclusion of quail and rabbit as viable pathways to the local population (Figure 5.1). Quail species accessed for radiological appraisals are Scaled Quail (*Callipepla squamata)* and a desert subspecies of the Northern Bobwhite (*Colinus virginianus var. taylori)* (Robbins 1981). Prior to 1995, the use of rabbit as a biomonitor, was restricted to Desert Cottontails (*Sylvilagus auduboni)*. During 1995, however, population numbers of Desert Cottontails, like quail, sustained a drastic population decline. Accordingly, WIPP biologists incorporated the inclusion of tissue from Blacktail Jackrabbits (*Lepus californicus)*. Blacktail Jackrabbits are readily available as they constitute the vast majority of road kills in the vicinity of the WIPP. Three rabbits samples were collected and analyzed during CY 1995.

Unusually low numbers of resident quail precluded the capture of specimens for sampling. The collection of quail as a sample medium, has been indefinitely postponed until such time that the resident population can provide and sustain the numbers necessary to yield the amount of tissue necessary for analysis.

#### 5.2.5.3 Fish

Fish samples were collected at two locations; Brantley Lake and the Pecos River. The target species for fish samples are catfish, primarily of the genus *Ictalurus* (channel catfish) although several large specimens of the more predatory (or piscivorous) flathead catfish (*Pylodictis olivaris)* have been caught and sampled. Of the variety of indigenous fishes, catfish were selected as the preferable sample matrix due to their popularity with local fisherman. Moreover, catfish represent a multi-media consumer. Multi-media feeder refers to organisms which access a wide variety of food sources. Within an ecosystem, most catfish species serve as scavenger and predator, therefore, provide one of the most reliable values when assessing for the presence of background radionuclide concentrations in biota.

Two collection methods for fish were employed for the duration of the sample period. One method, utilizing trammel nets, was implemented for a period of approximately three weeks. Although the trammel nets are extremely efficient, the mechanics of capture are indiscriminate and usually fatal to smaller fish even though WIPP personnel inspected the nets every four hours. Deployment and supervision of trammel nets is labor intensive, however, the use of trammel nets is of merit and will be considered during future sampling deliberations.

The alternate, and preferred, method of collection was the utilization of trot lines. Trot lines or "long lines" employ lengths of small diameter cord, up to 100 feet in length, with hooks suspended approximately every two-to-three feet. Each hook is baited with sections of fish, beef liver, bait shrimp, or other forage coveted by catfish. Protocol was to inspect lines morning and evening. The use of trot lines provided the requisite sample aliquot of catfish tissue in approximately one week per sample location.

Appendix A6 provides results of the radiological analysis of biotic samples.

## 5.3 Assessment of Potential Dose to the Public

In 1995, no waste was received at the WIPP; therefore, the public could not be exposed to radiation due to WIPP operations. Documentation of naturally occurring background radiation is discussed in Chapter 5, *Environmental Radiological Program Information* and Chapter 7, *Ground Water Surveillance,* of this report.

# ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

## TABLE 5-1

## ACTIVITY CONCENTRATIONS IN QUARTERLY AVERAGES OF THE LOW VOLUME AEROSOL FILTERS (Bq/ml)

### FIRST QUARTER 1995

| LOCATION | ALPHA | BETA |
|---|---|---|
| Carlsbad | 9.10E-11 | 8.63E-10 |
| Smith Ranch | 8.28E-11 | 8.87E-10 |
| Mills Ranch | 8.98E-11 | 8.05E-10 |
| WIPP Far Field | 8.58E-11 | 8.03E-10 |
| WIPP South | 9.21E-11 | 8.45E-10 |
| WIPP East | 9.62E-10 | 8.45E-10 |
| South East Control | 7.51E-11 | 7.92E-10 |

### SECOND QUARTER 1995

| LOCATION | ALPHA | BETA |
|---|---|---|
| Carlsbad | 1.19E-10 | 7.67E-10 |
| Smith Ranch | 1.19E-10 | 7.69E-10 |
| Mills Ranch | 1.31E-10 | 7.45E-10 |
| WIPP Far Field | 1.24E-10 | 7.64E-10 |
| WIPP South | 1.28E-10 | 7.63E-10 |
| WIPP East | 1.34E-10 | 7.38E-10 |
| South East Control | 1.32E-10 | 6.77E-10 |

### THIRD QUARTER 1995

| LOCATION | ALPHA | BETA |
|---|---|---|
| Carlsbad | 1.28E-10 | 8.85E-10 |
| Smith Ranch | 1.40E-10 | 8.83E-10 |
| Mills Ranch | 1.34E-10 | 8.82E-10 |
| WIPP Far Field | 1.52E-10 | 8.48E-10 |
| WIPP South | 1.49E-10 | 8.53E-10 |
| WIPP East | 1.32E-10 | 8.57E-10 |
| South East Control | 1.47E-10 | 8.91E-10 |

TABLE 5-1
(CONTINUED)

FOURTH QUARTER 1995

| LOCATION | ALPHA | BETA |
|---|---|---|
| Carlsbad | 1.18E-10 | 1.48E-09 |
| Smith Ranch | 1.00E-10 | 1.34E-09 |
| Mills Ranch | 1.19E-10 | 1.34E-09 |
| WIPP Far Field | 1.26E-10 | 1.42E-09 |
| WIPP South | 1.11E-10 | 1.36E-09 |
| WIPP East | 1.10E-10 | 1.36E-09 |
| South East Control | 1.03E-10 | 1.29E-09 |

## ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

### TABLE 5-2

### RADIOLOGICAL ANALYTICAL CONTRACT REQUIRED DETECTION LIMITS

| ANALYTE NAME AIR SAMPLING | CONTRACT REQUIRED DETECTION LIMIT |
|---|---|
| Americium-241 | 7.00E-09 |
| Beryllium-7 | 1.00E+01 |
| Cesium-137 | 1.00E-01 |
| Cobalt-60 | 3.00E-02 |
| Lead-210 | 3.00E-04 |
| Plutonium-238 | 1.00E-08 |
| Plutonium-241 | 4.00E-07 |
| Plutonium-239/240 | 7.00E-09 |
| Polonium-210 | 4.00E-07 |
| Potassium-40 | 3.00E-01 |
| Radium-228 | 1.00E-03 |
| Radium-226 | 4.00E-04 |
| Strontium-90 | 3.00E-06 |
| Thorium-228 | 1.00E-08 |
| Thorium-230 | 1.00E-08 |
| Thorium-232 | 3.00E-09 |
| Uranium-233/234 | 3.00E-08 |
| Uranium-238 | 4.00E-08 |
| Uranium-235/236 | 4.00E-08 |

TABLE 5-2

(CONTINUED)

| ANALYTE NAME<br>BIOTIC SAMPLING | CONTRACT REQUIRED DETECTION LIMIT |
|---|---|
| Americium-241 | 4.00E-03 |
| Cesium-137 | 4.00E-03 |
| Cobalt-60 | 4.00E-03 |
| Lead-210 | 7.00E-02 |
| Plutonium-238 | 1.00E-02 |
| Plutonium-241 | 4.00E-01 |
| Plutonium-239/240 | 1.00E-02 |
| Polonium-210 | 7.00E-02 |
| Potassium-40 | 4.00E-03 |
| Radium-228 | 7.00E-02 |
| Radium-226 | 7.00E-03 |
| Strontium-90 | 7.00E-02 |
| Thorium-228 | 4.00E-03 |
| Thorium-230 | 4.00E-03 |
| Thorium-232 | 4.00E-03 |
| Uranium-233/234 | 4.00E-03 |
| Uranium-238 | 4.00E-02 |
| Uranium-235/236 | 4.00E-02 |

TABLE 5-2

(CONTINUED)

| ANALYTE NAME<br>SEDIMENT SAMPLING | CONTRACT REQUIRED DETECTION LIMIT |
|---|---|
| Americium-241 | 4.00E-03 |
| Cesium-137 | 4.00E-03 |
| Cobalt-60 | 4.00E-03 |
| Lead-210 | 7.00E-02 |
| Plutonium-238 | 1.00E-02 |
| Plutonium-241 | 4.00E-01 |
| Plutonium-239/240 | 7.00E-03 |
| Polonium-210 | 7.00E-02 |
| Potassium-40 | 4.00E-03 |
| Radium-228 | 7.00E-02 |
| Radium-226 | 7.00E-03 |
| Strontium-90 | 7.00E-02 |
| Thorium-228 | 4.00E-03 |
| Thorium-230 | 4.00E-03 |
| Thorium-232 | 4.00E-03 |
| Uranium-233/234 | 4.00E-02 |
| Uranium-238 | 4.00E-03 |
| Uranium-235/236 | 4.00E-02 |

TABLE 5-2

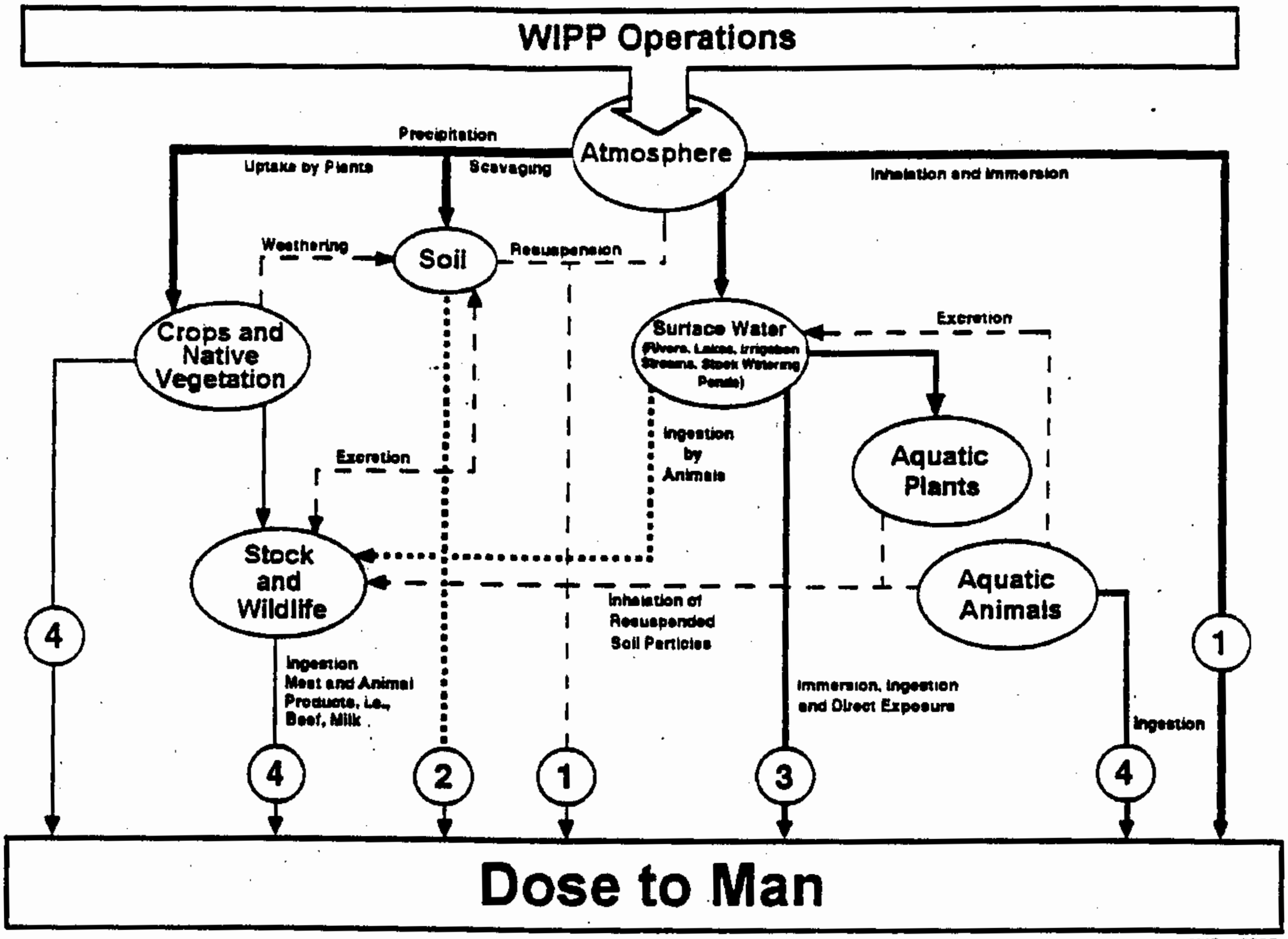
(CONTINUED)

| ANALYTE NAME<br>GROUND AND SURFACE WATER | CONTRACT REQUIRED DETECTION LIMIT |
|---|---|
| Americium-241 | 1.00E-02 |
| Cesium-137 | 1.00E+00 |
| Cobalt-60 | 2.00E+00 |
| Lead-210 | 4.00E-01 |
| Plutonium-238 | 1.00E-02 |
| Plutonium-241 | 7.00E-01 |
| Plutonium-239/240 | 1.00E-02 |
| Polonium-210 | 3.00E-02 |
| Potassium-40 | 3.00E+00 |
| Radium-228 | 4.00E-02 |
| Radium-226 | 4.00E-02 |
| Strontium-90 | 4.00E-01 |
| Thorium-228 | 1.00E-01 |
| Thorium-230 | 1.00E-01 |
| Thorium-232 | 2.00E-02 |
| Uranium-233/234 | 2.00E-01 |
| Uranium-238 | 2.00E-01 |
| Uranium-235/236 | 2.00E-01 |

TABLE 5-2

(CONTINUED)

| ANALYTE NAME SOIL SAMPLING | CONTRACT REQUIRED DETECTION LIMIT |
|---|---|
| Americium-241 | 4.00E-03 |
| Cesium-137 | 4.00E-03 |
| Cobalt-60 | 4.00E-03 |
| Lead-210 | 7.00E-02 |
| Plutonium-238 | 1.00E-02 |
| Plutonium-241 | 4.00E-01 |
| Plutonium-239/240 | 7.00E-03 |
| Polonium-210 | 7.00E-02 |
| Potassium-40 | 4.00E-03 |
| Radium-228 | 7.00E-02 |
| Radium-226 | 7.00E-03 |
| Strontium-90 | 7.00E-02 |
| Thorium-228 | 4.00E-03 |
| Thorium-230 | 4.00E-03 |
| Thorium-232 | 4.00E-03 |
| Uranium-233/234 | 4.00E-03 |
| Uranium-238 | 4.00E-03 |
| Uranium-235/236 | 4.00E-02 |




Possible radionuclide pathways leading from the WIPP Site to man:

The width of each line is proportional to the importance of the pathway in the Los Medanos ecosystem. The numbers in the pathways leading to man indicate which monitoring programs will intercept that pathway.

1. Airborne particulate and effluent monitoring
2. Soil and sediment sampling
3. Surface water and groundwater monitoring
4. Vegetation, beef, game animals and aquatic foodstuffs sampling

**Figure 5-1**

**Primary Pathways to Man for Radioacitive Releases from the WIPP Site**

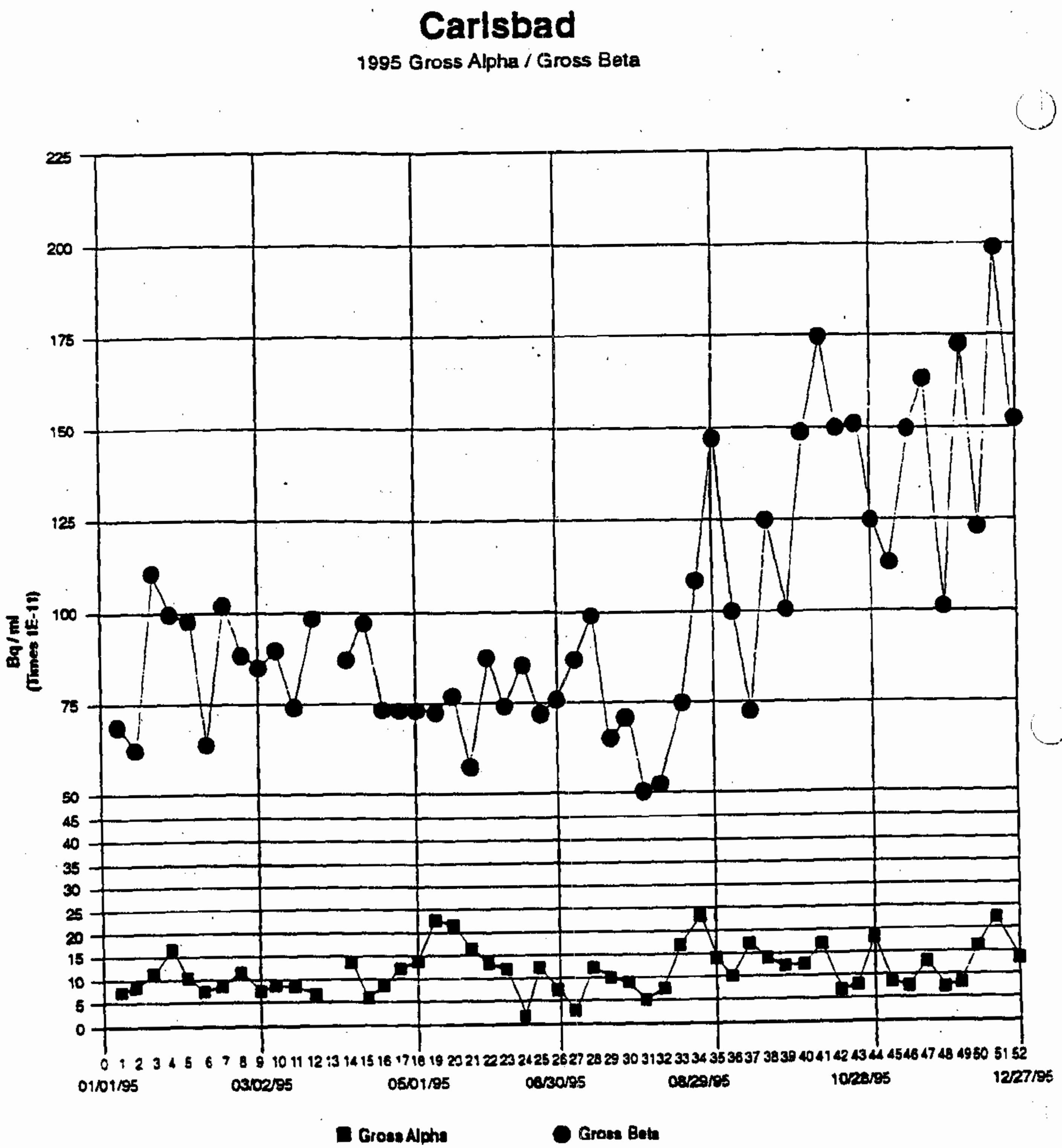



**Figure 5-2**
**1995 Gross Alpha/Beta**
**Carlsbad**

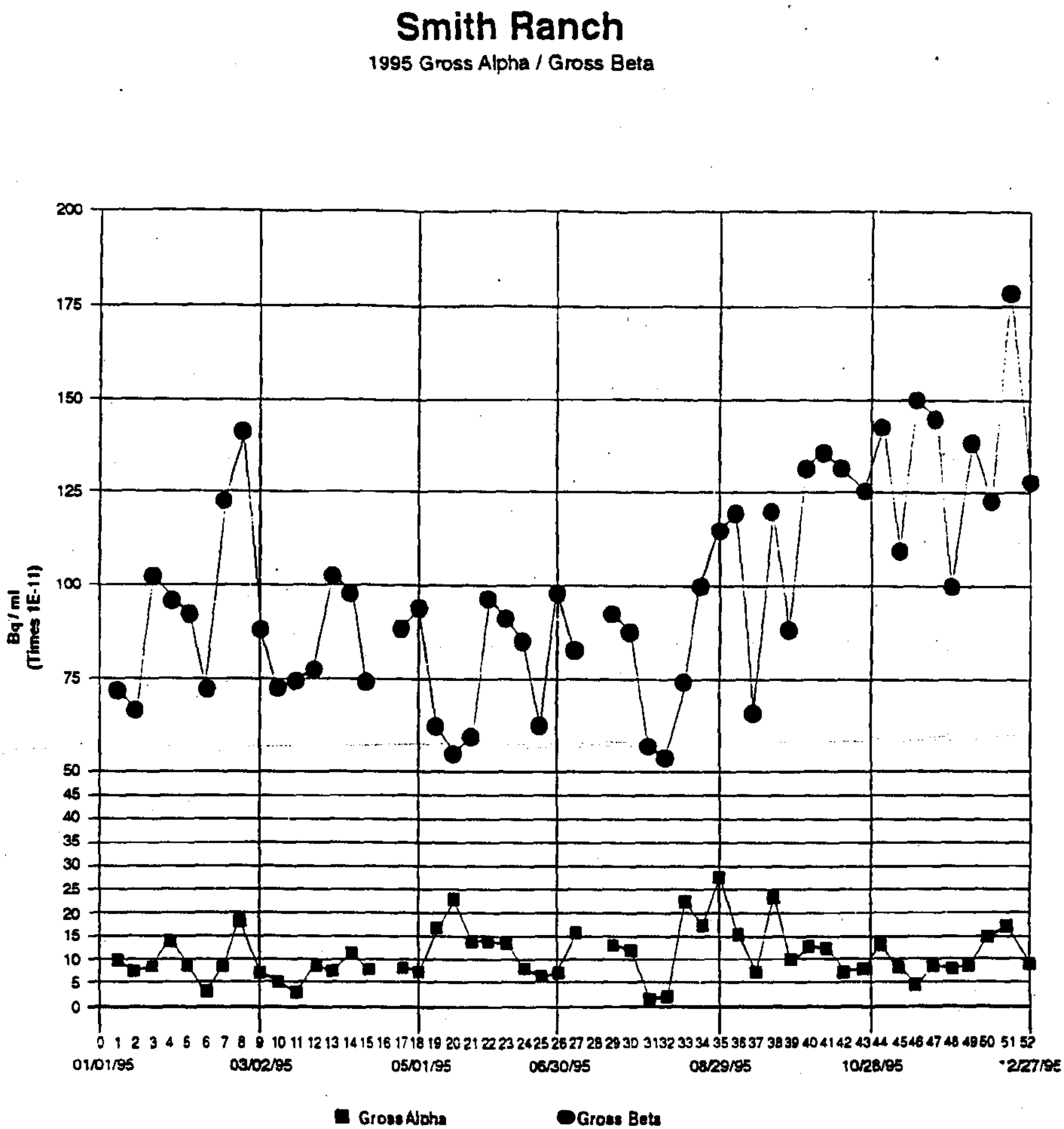



**Figure 5-3**
**1995 Gross Alpha/Beta**
**Smith Ranch**

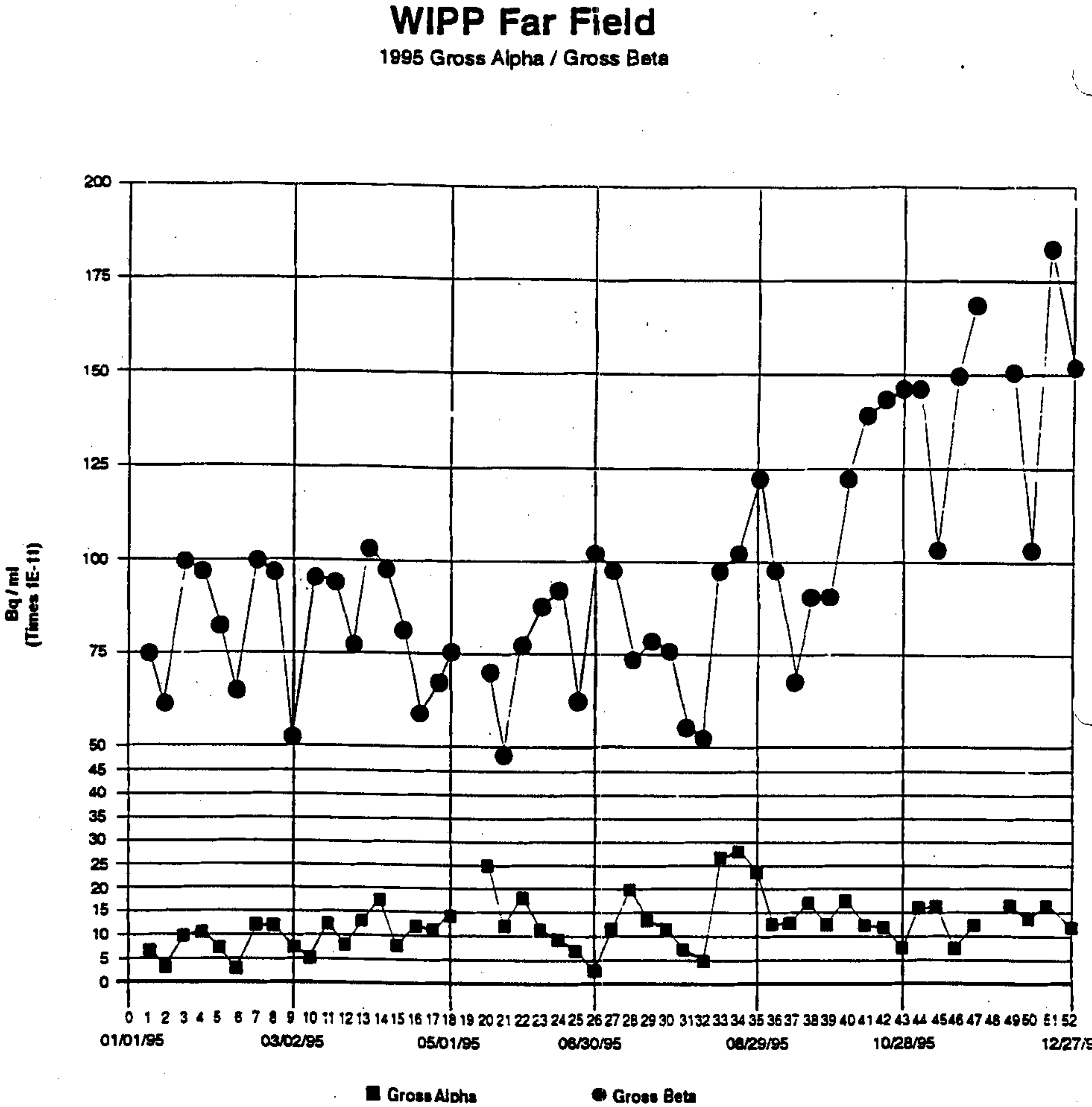



**Figure 5-4**
**1995 Gross Alpha/Beta**
**WIPP Far Field**

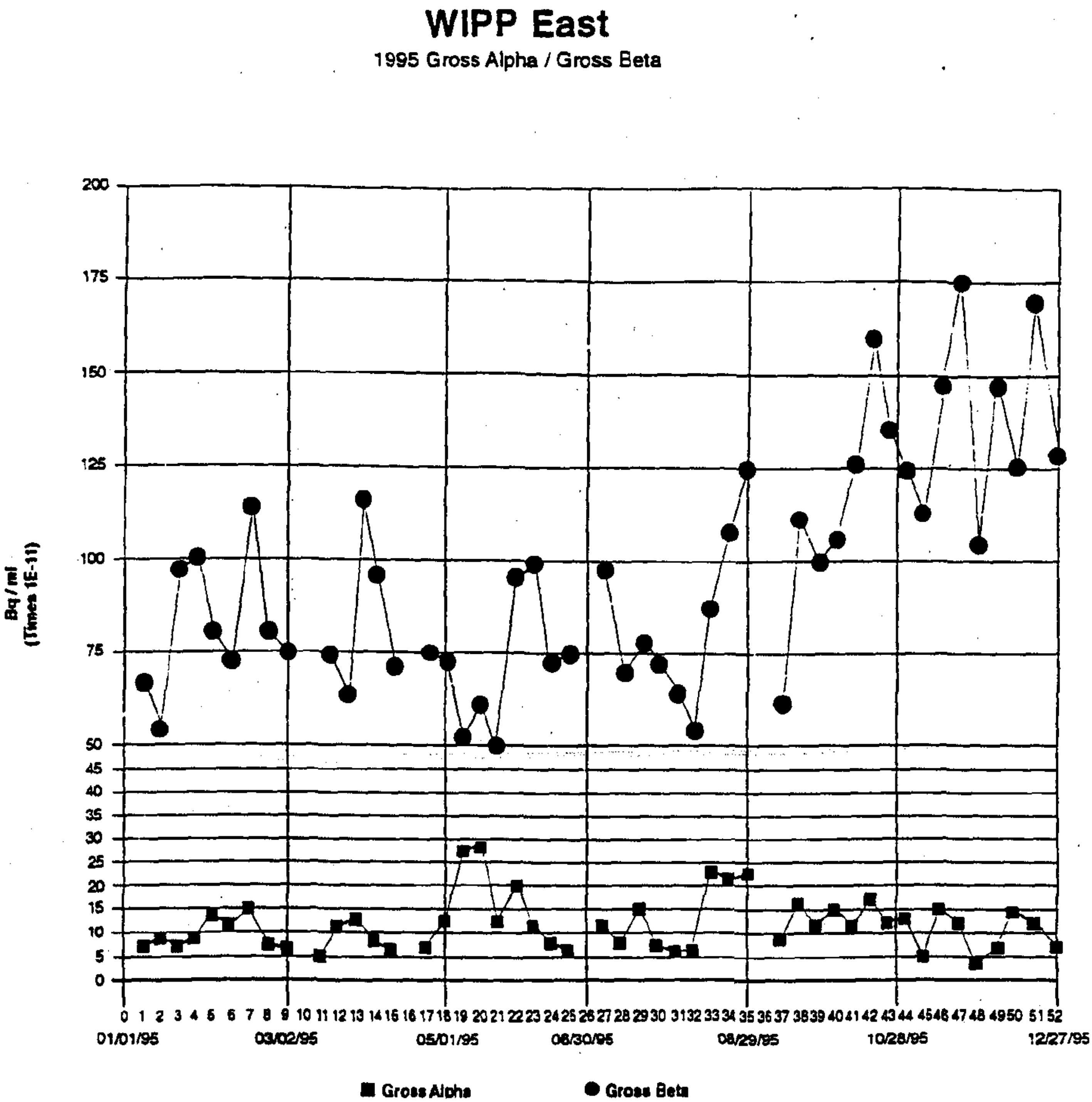



**Figure 5-5**
**1995 Gross Alpha/Beta**
**WIPP East**

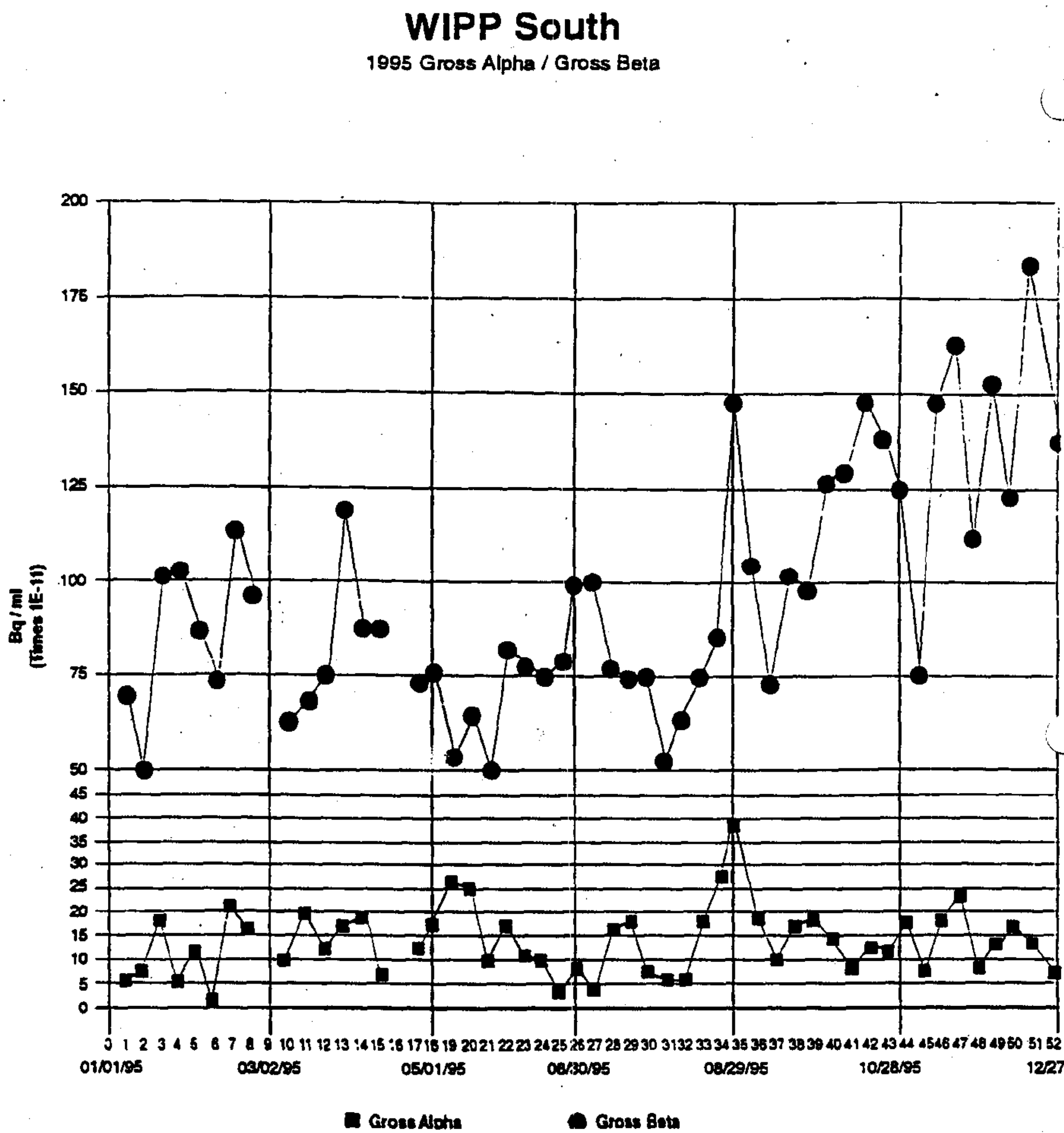



**Figure 5-6**
**1995 Gross Alpha/Beta**
**WIPP South**

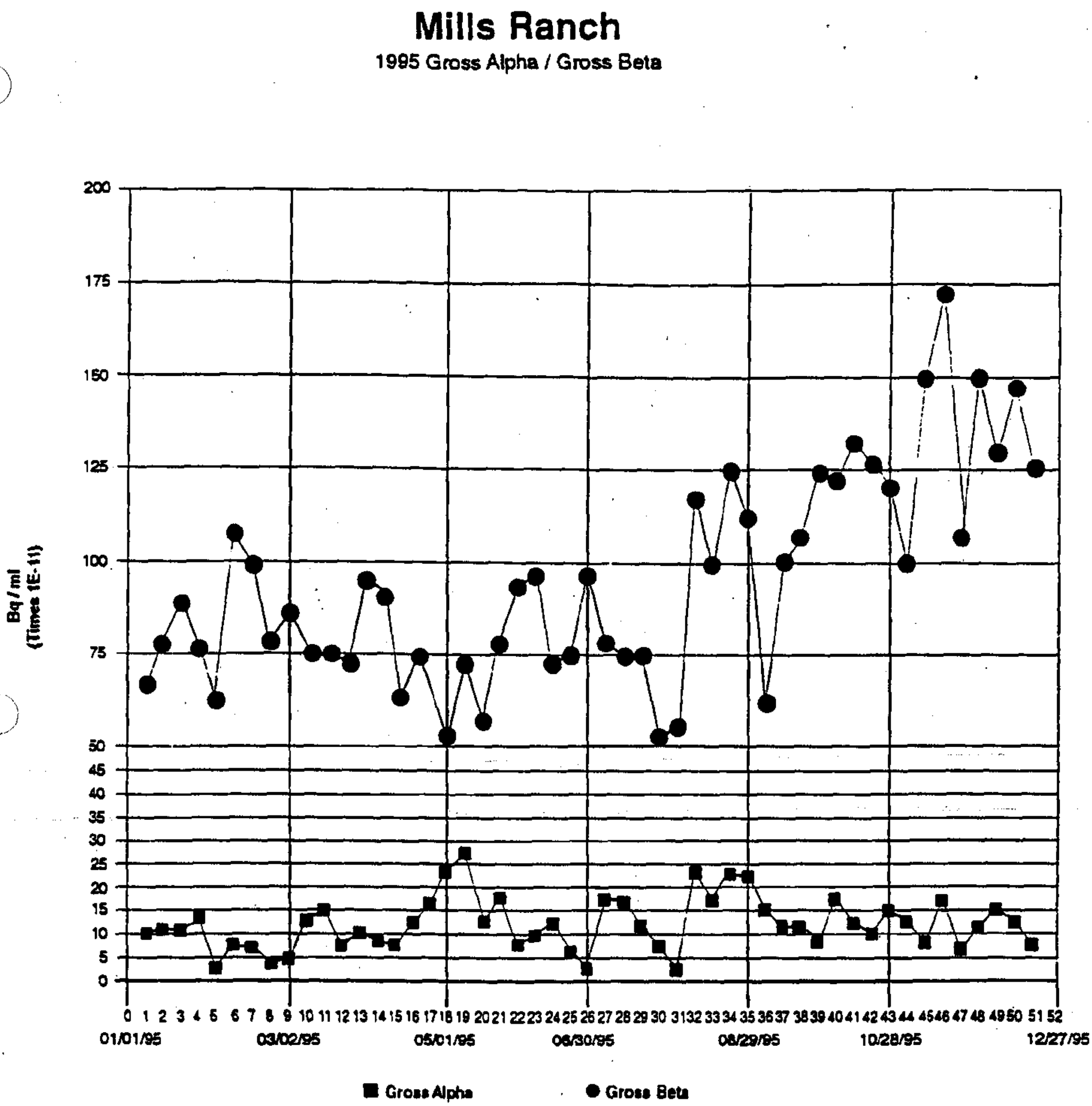



**Figure 5-7**
**1995 Gross Alpha/Beta**
**Mills Ranch**

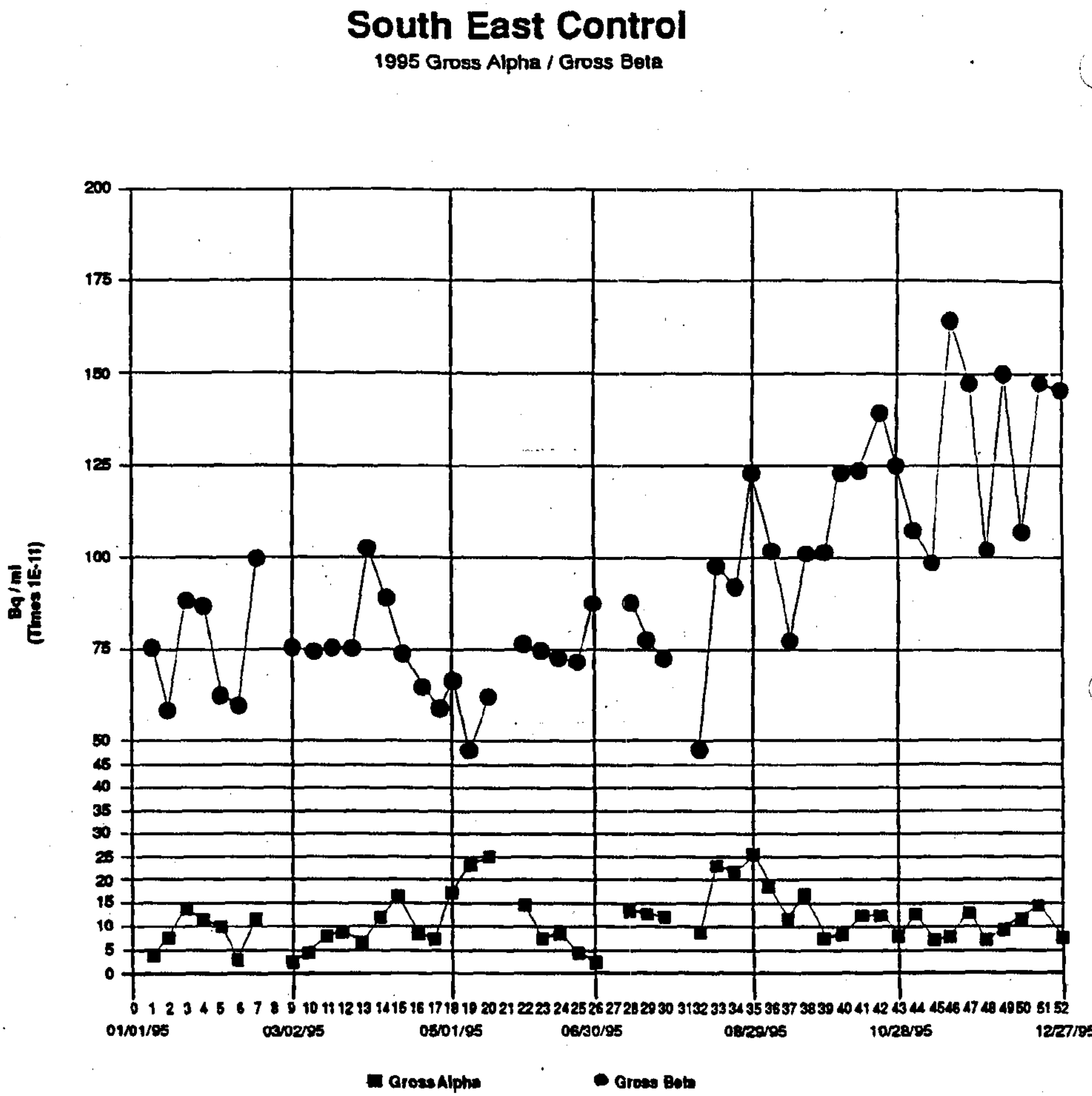



**Figure 5-8**
**1995 Gross Alpha/Beta**
**Southeast Control**

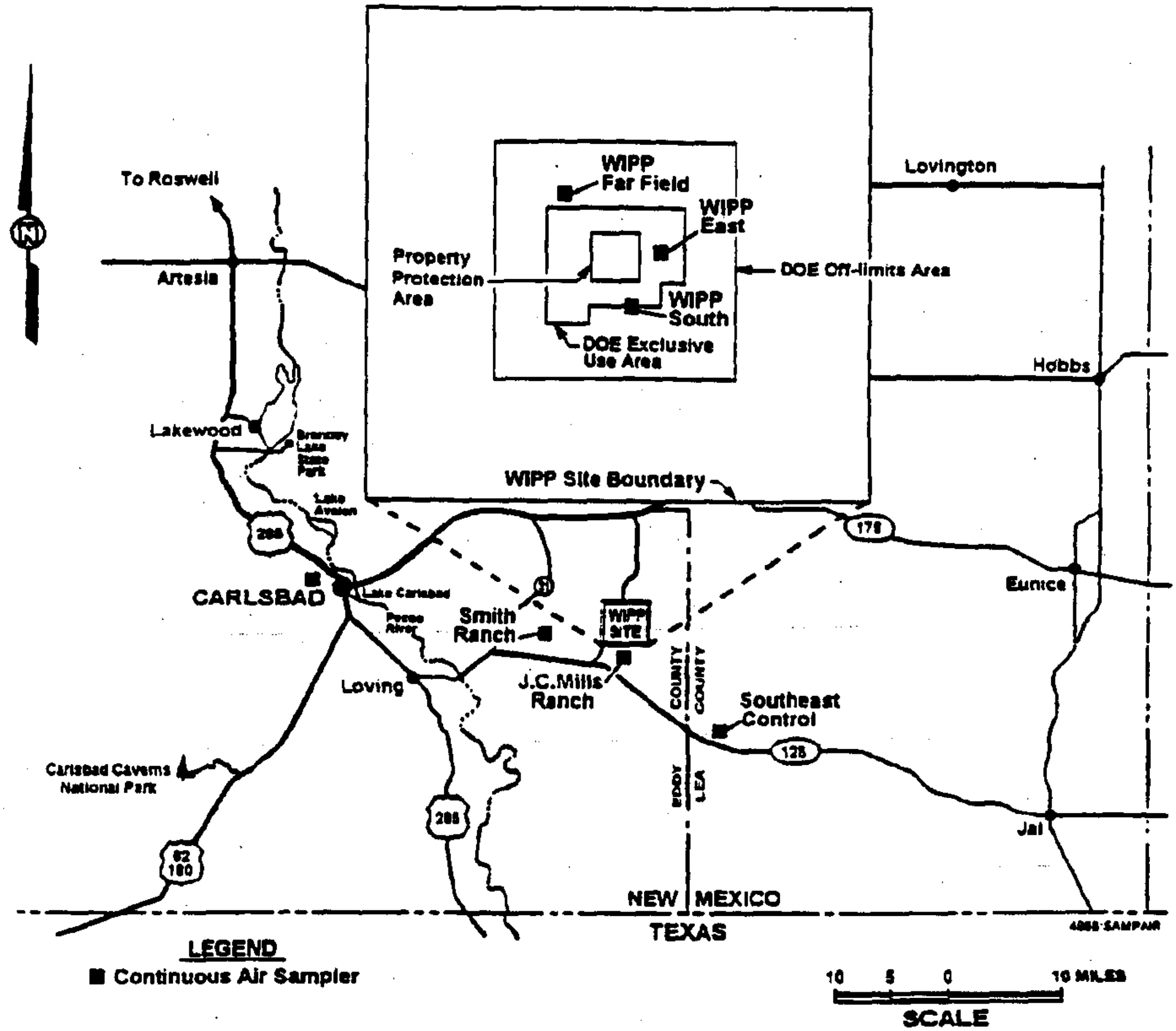



Figure 5-9
Continuous Air/Radiological Soil Sampling Locations

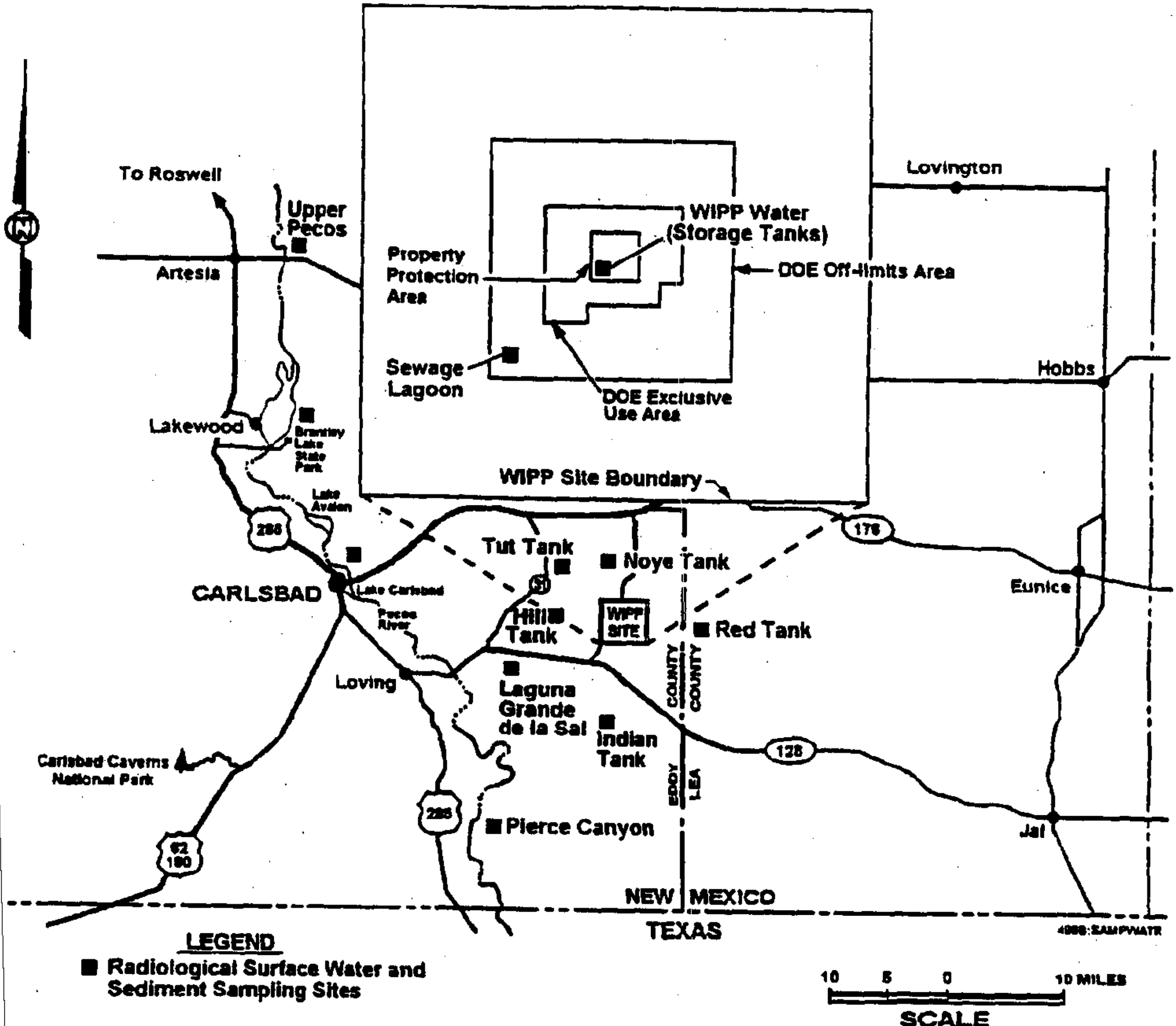



Figure 5-10
Radiological Surface Water and/or Bottom Sediment Sampling Sites

# Chapter 6
# Environmental Nonradiological Program Information

This chapter of the SER presents and discusses Nonradiological Environmental Sampling (NES) data collected between January 1, 1995, and December 31, 1995. Nonradiological programs at the WIPP include the following subprograms: land management to include reclamation/restoration of disturbed lands, oil and gas surveillance, and wildlife population monitoring (see Chapter 4 *Environmental Program Information*) and meteorological monitoring. In addition to the NES programs, Volatile Organic Compounds (VOCs) were monitored to comply with provisions of the WIPP's current No Migration Determination (NMD) and liquid effluent monitoring is conducted in accordance with *Sewage Systems Discharge Monitoring and Compliance* (DP-831) criteria. The results of the environmental monitoring activities and discussions of significant findings are presented in this report.

## 6.1 Principal Functions of Nonradiological Sampling

The principal functions of the NES are to:

- Assess the impacts of construction and operational activities from the WIPP on the surrounding ecosystem.
- Monitor ecological conditions in the Los Medaños Area.
- Investigate unusual or unexpected elements in the ecological databases.
- Provide environmental data that are important to the mission of the WIPP project, but which have not or will not be acquired by other programs.
- Comply with applicable commitments identified with existing agreements (e.g. BLM/DOE MOU, Interagency Agreements, Agreements in Principal, etc.)

## 6.2 Meteorology

A principle component of the NES is a primary meteorological (MET) station located 600 meters northeast of the Waste Handling Building. The main function of the MET is to generate data for modeling atmospheric conditions. The station documents standard meteorological measurements of wind speed, wind direction, and temperatures, with dew point and precipitation monitored at ground level. These parameters are measured continuously and the data are stored in the Central Monitoring System (CMS).

In addition to the primary meteorological station, the WIPP Far Field Station (WFF) is located 1000 meters northwest of the Waste Handling Building. At the WFF a secondary meteorological station measures and records temperature and barometric pressure at ground level and wind speed and wind direction at 10 meters (30 feet).

### 6.2.1 Climatic Data

The mean annual temperature for the WIPP area in 1995 was 17°C (63°F). The mean monthly temperatures for the WIPP area ranged from 6°C (42°F) during January to 28°C (83°F) in June. Generally, maximum temperatures occur in June through September, while minimum temperatures occur in December through February as illustrated in Figure 6-3, page 6-9.

The first freezing day of the 1995-96 winter season occurred November 11, with 0°C (32°F). The last freezing day of the 1995-96 winter season was April 4, with a temperature of 0°C (32°F). The maximum temperature recorded was 42°C (107°F) on July 26.

The annual rate of precipitation at the WIPP site for 1995 was 23.27 cm (9.16 in), which is 6.7 cm (2.63 in) above last year's rate. The annual precipitation for 1995 was 29 percent greater than that recorded for 1994 and 71 percent less than CY 1992, the last year of normal to above-normal precipitation. Profound drought conditions persisted during CY 1995, the conspicuous effects evident in tenant vegetative and wildlife communities. Figure 6-1, page 6-7, displays the monthly precipitation at the WIPP.

### 6.2.2 Wind Direction and Wind Speed

The predominate wind direction in the WIPP area was from the southeast sector (135°). However, winds occurring in late spring were primarily from the west. Various weather systems move through this area briefly altering the predominant southeasterly winds and sometimes resulting in violent convectional storms. Wind speed noted as calm (less than 0.5 meters per second [mps]) occurred 8.3 percent of the time. Winds of 1.4 through 2.8 mps were the most prevalent over 1995, accounting for 25.5 percent of the time. Figure 6-2, page 6-8, displays the annual wind data at the WIPP for CY 1995.

## 6.3 Air Quality Monitoring

Weekly measurements of Total Suspended Particulates (TSPs) (milligrams per cubic meter) are calculated from the particulates collected onto glass fiber filters, by the low-volume continuous air samplers at seven air sampling locations. These filters can load with dust particles due to the arid climate of this area; however, this poses no health concern.

## 6.4 Surface and Subsurface Soil Monitoring

Surface and subsurface soil monitoring was conducted during CY 1995. A detailed discussion of the nonradiological soil monitoring program is available in the report titled *Summary of the Salt Impact Studies at the WIPP, 1984 to 1990* (DOE/WIPP 92-038). Analytical results from the nonradiological soil sampling program are presented in Appendix B.

## 6.5 Vegetation Monitoring

Because of continuing drought conditions during CY 1995, the plant community of the Los Medaños globally exhibited distinctive signs of physiological stress (e.g. stem and leaf necrosis, chlorosis). As no discernable variations in stress could be identified, delineating subtle variations in plants growing near salt tailings piles in comparison to plants growing varying distances from the tailings, evaluations of the effects of salt on proximal plant communities has been indefinitely postponed. Data collected to date indicate "marginal" to "no negative" impacts on the surrounding plant communities in the form of eolian salt deposition from the mine tailings. The nature of the salt is to become compacted and solidified by the heavy machinery and moisture.

Runoff is collected in the catchment basin, where it evaporates into the atmosphere or is absorbed into the soil. Any resulting salt crust is then weathered and partially dispersed to the surrounding area. This represents only a minimal deposit. Interestingly, wildlife has been observed using the salt tailings as a source of salt, similar to cattle using salt licks.

## 6.6 Volatile Organic Compounds (VOC) Monitoring

As stated in Section 3.2.3, **Resource Conservation and Recovery Act (RCRA) page 3-7,** the WIPP has developed and implemented a VOC monitoring program to satisfy the air monitoring requirements of the NMD for the WIPP (55 FR 47700). The data resulting from this program are reported in the NMD annual reports submitted to the EPA.

ıe WIPP VOC Monitoring Program is referenced in the EMP for the WIPP (DOE/WIPP 94-024). ıplementing documents specific to the VOC monitoring program include the *VOC Monitoring Plan* VP 12-6) and *Volatile Organic Compounds Monitoring Quality Assurance Program Plan* VP 12-7). The *VOC Monitoring Plan* (WP 12-6) is currently under revision. These revisions will flect present VOC Monitoring activities to support the No-Migration Variance Petition for the isposal Phase.

## .7 Seismic Activity

ieologic structures and tectonism of the Permian Basin are associated with large-scale basin, inter-asin. and basin-margin subsidence or emergence that occurred during the Paleozoic era. The ʼiPP facility is about 60 miles from the western margin of the Permian Basin. The basin is a road structural feature made up of a series of Paleozoic sedimentary basins whose last episodes of ıajor subsidence occurred during late Permian time. The area today is characterized by the basin illed with thick evaporite layers and bordered by the Amarillo uplift to the north, the Marathon ırust belt to the south, and the Diablo Platform, Sacramento and Guadalupe Mountain orogenies to he west.

ll major tectonic elements of the Permian Basin were completely formed before deposition of the ermian salt-bearing rocks, and the region has been relatively stable since that time. Deep-seated aults are rare, except along the west margin of the basin and no indications of younger deep-seated aults are noted. On June 16, 1978, an earthquake near Snyder, Texas lead researchers to conclude hat the earthquake may have been induced from secondary oil recovery operations and hydrocarbon roduction. The depth of the earthquake closely approximated the bottom of the relatively shallow ıoles located in the oil and gas-producing area.

Historically, the seismic information for the WIPP facility region before 1962 was based on chronicles of the effects of those tremors on people, structures, and land forms. Seismicity, pri . 1962, reported in New Mexico, occurred in the Rio Grande area between Albuquerque and So ɪr and was associated with a structure known as the Rio Grande Rift. These earthquakes had intensities of Modified Mercalli V or greater, based upon the perceptions of people experien ng these quakes.

Since 1962, virtually all seismic information is based on instrumental data recorded at v seismograph stations. Currently, seismicity is being monitored at the New Mexico Inst ıte Mining and Technology (NMIMT), Socorro, using data from a seven-station network approximately centered on the WIPP site (Figure 6-4). Station signals are telemetere

NMIMT Seismological Observatory in Socorro. When appropriate, readings from the WIPP network stations are combined with readings from an additional New Mexico Tech network which is located in Socorro in the central Rio Grande rift. Occasionally, data are exchanged with the University of Texas at El Paso and Texas Tech, both of whom operate stations in West Texas. The annual mean for the operational efficiency of seismic monitoring stations during CY 1995 is approximately 88.2 percent.

From January 1, 1995 through December 31, 1995 locations for 108 seismic events were recorded within 300 kilometers of the WIPP. These data include origin times, epicenter coordinates, and magnitudes. During 1995, the strongest recorded event (with a magnitude of 5.3) was located approximately 241 km south of the WIPP site. This shock was the largest on record, within 300 km of the WIPP, since the Valentine, Texas earthquake on August 16, 1931. The Valentine quake registered an estimated magnitude of 6.4.

## 6.8 Liquid Effluent Monitoring

The WIPP sewage lagoon system is a zero-discharge facility consisting of two primary settling lagoons, two polishing lagoons, a chlorination system, and three evaporation basins. The entire facility is lined with 30 mil synthetic liners. The facility is designed to dispose of domestic sewage and site-generated brine waters from observation well pumping and from underground dewatering activities at the site.

The WIPP sewage facility is operated under the New Mexico Discharge Plan (DP-831) and managed in accordance with the EPA sewage sludge regulations (40 CFR 503), the New Mexico Solid Waste Management Regulations (Part 700), the New Mexico Water Quality Control Regulations (3-100), and the WIPP Sewage Sampling Procedure, WP 02-EM1001. These requirements provide guidance for disposal of domestic sewage, site generated brine waters, and site generated non hazardous waste waters.

A determination is made on a case-by-case basis to determine regulatory requirements for onsite or offsite disposal of sewage sludge. Sludges are useful as fertilizers and soil stabilizers when applied to reclamation areas, however, this particular technique has not been employed at the WIPP (although it remains one of many viable reclamation alternatives). In the event that sludges are considered for reclamation, they will be analyzed in accordance with regulatory requirements of 40 CFR 503 prior to application.

On January 16, 1992, the NMED issued the Discharge Plan (DP-831) for the WIPP sewage facility. The approved Discharge Plan superseded an Emergency Discharge Permit issued in January, 1992. In addition to sewage effluent, the Discharge Plan allows for the disposal of 1500 gallons a day of nonhazardous brines generated by seepage into shaft sumps and from the pumping of observation wells at the site. Characterization samples were collected throughout 1995 to demonstrate that site-generated brines are nonhazardous and can be disposed in the sewage evaporation pond. The DOE submits quarterly Discharge Monitoring Reports to the NMED to demonstrate compliance with the inspection, monitoring, and reporting requirements identified in the plan. No effluent limits were established in DP-831. The NMED Groundwater Protection and Remediation Bureau established a list of analytes to be sampled on a quarterly basis to be used as indicators of sewage system performance. Analytical results from DP-831 sampling activities are provided in Appendix B.

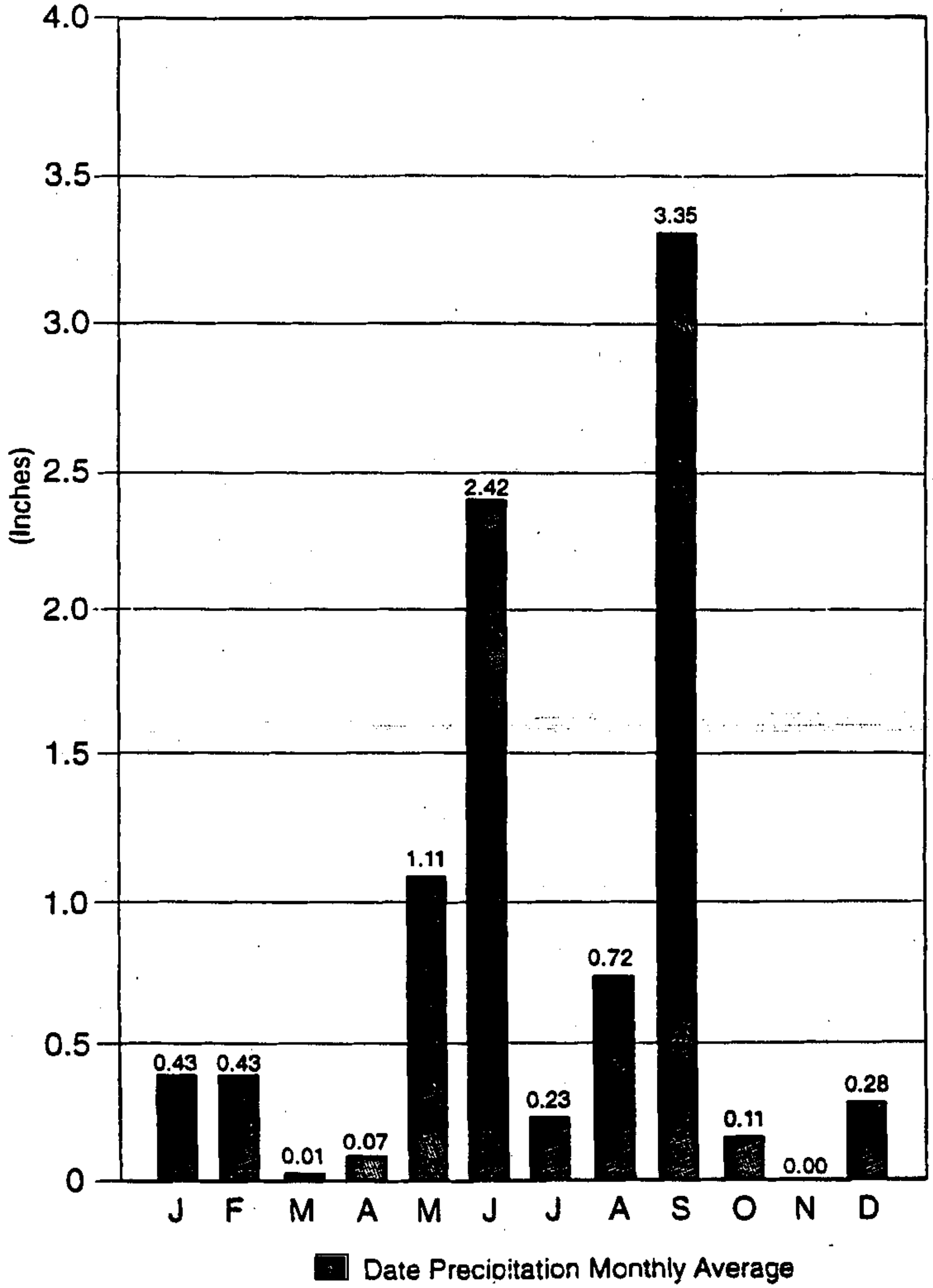



**Figure 6-1**
**1995 Precipitation**

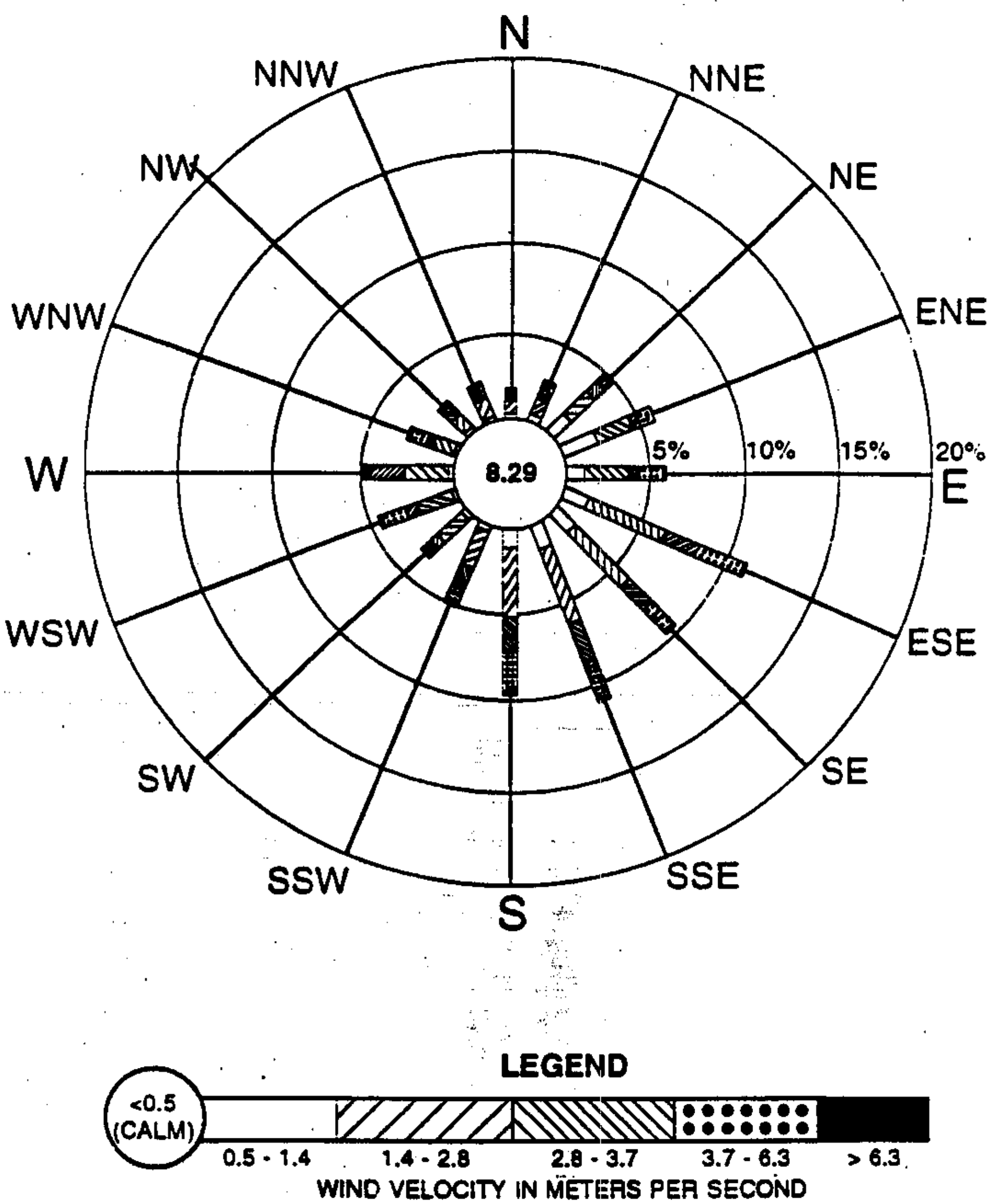



**Figure 6-2**
**Annual Windrose**

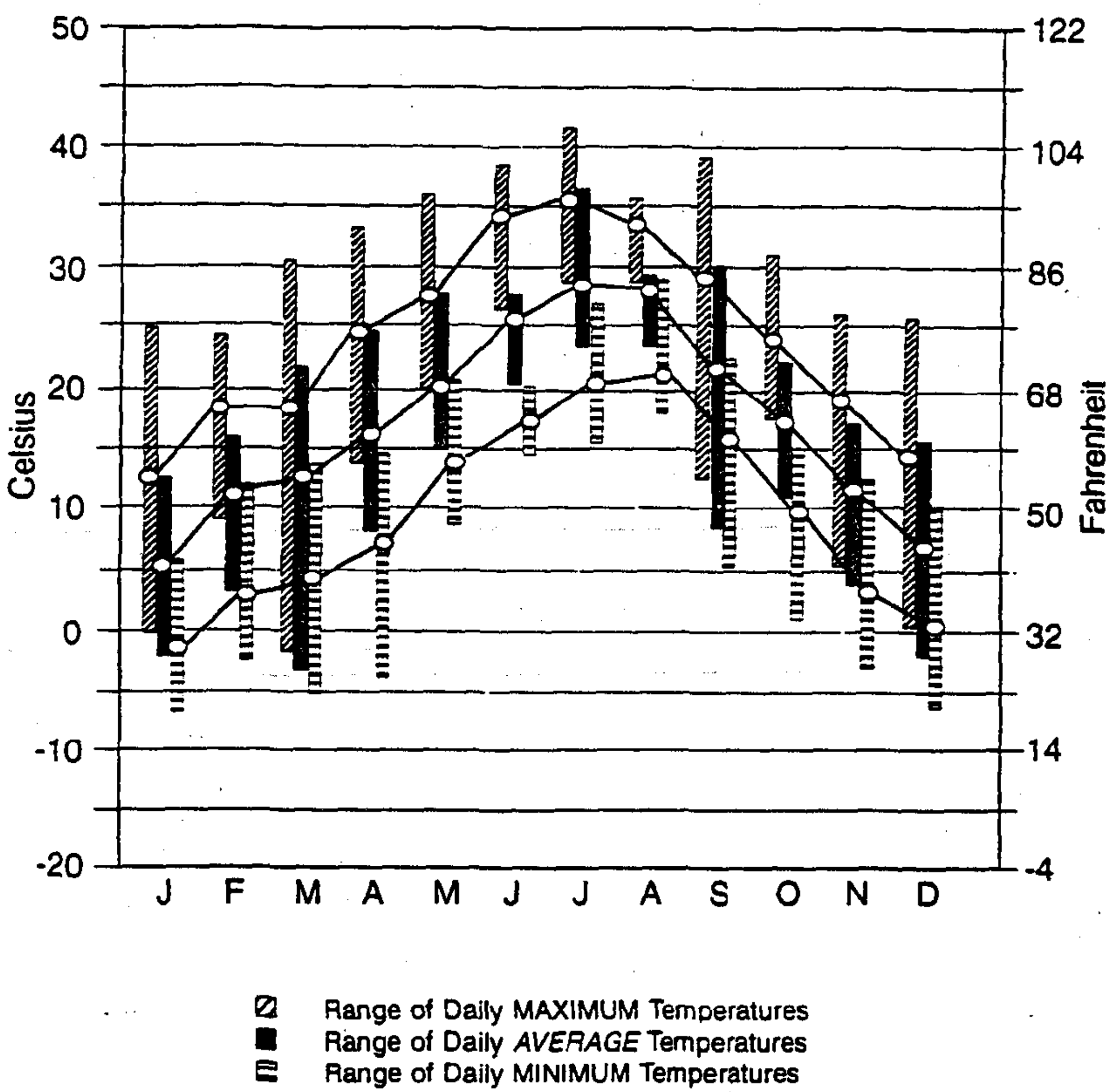
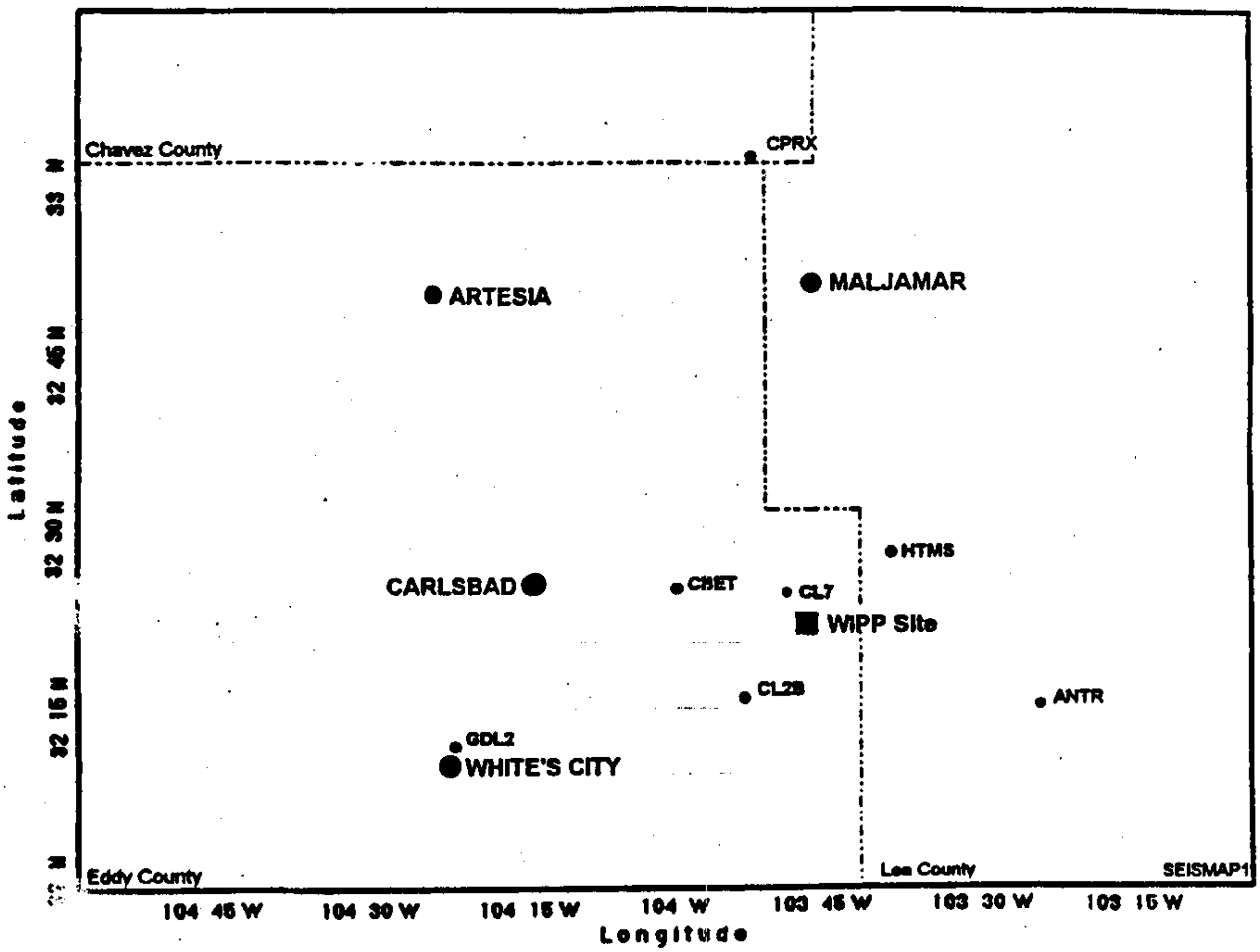



**Figure 6-3**
**1995**
**Average Monthly Temperatures**




Definitions of Acronyms

ANTR-Antelope Ridge
CBET-Carlsbad East Tower
CL2B-Carlsbad Station
CPRX-Caprock
GDL2-Guadalupe Mountains
2BHTMS-Hat Mesa
CL7-Carlsbad Station 7

**Figure 6-4**
**WIPP Seismograph Station Locations**

# Chapter 7
# Groundwater Surveillance

Current groundwater surveillance activities at the WIPP are outlined in the WIPP *Groundwater Monitoring Program Plan and Procedure Manual* (WP 02-1 Rev 2). This monitoring plan is a Quality Assurance (QA) document that contains program plans for each of the activities performed by groundwater surveillance personnel. In addition, WP 02-1, Rev 2 provides detailed procedures for performing specific activities such as pumping system installations, field parameter analysis and document, and QA records management. Groundwater surveillance activities are also defined in the EMP.

The objective of the Groundwater Surveillance Program (GSP) is to determine the physical and chemical characteristics of groundwater, maintain surveillance of groundwater levels surrounding the WIPP facility, both before and throughout the operational lifetime of the facility, and fulfill the requirements set forth in DOE order 5400.1, *General Environmental Protection Program*.

Background water quality data were collected from 1985 through the 1990 sampling period as reported in DOE/WIPP 92-013, *Background Water Quality Characterization Report for the Waste Isolation Pilot Plant*. This background data will be compared to water quality data collected throughout the operational life of the facility. Pre-operational data gathered in the interim period will be used to strengthen the background data, to evaluate the need to make adjustments to comparison criteria, and to determine future regulatory needs and land-use decisions.

The data obtained by the Water Quality Sampling Program (WQSP) in 1995 supported two major programs at the WIPP: Site Characterization and Performance Assessment in compliance with 40 CFR 191. Each of these programs requires a unique set of analyses and data.. Particular sample needs are defined by each program. In addition to the characterization of groundwater, the WQSP supported radionuclide monitoring for the Environmental Analysis and Compliance Section of WIPP. Results of radionuclide sampling are discussed in Chapter 5, *Environmental Radiological Program Information,* pages 5-3 through 5-4. The NMED and the EEG were on hand at each sampling event to collect samples for independent evaluation.

The WIPP is located within the Pecos Valley section of the Southern Great Plains physiographic province (Powers et al., 1978). Geologic and lithologic descriptions of the area surrounding the WIPP site can be found in documents such as the EMP, DOE/WIPP 90-008 *Groundwater Protection Management Program Plan*, and USGS 83-4016 (Mercer, 1983). Industries in the vicinity which could potentially contribute to the pollution of the groundwater are potash mining, oil and gas exploration/production, and agriculture.

The Culebra is the most significant water-bearing unit within the vicinity of the WIPP. No known hydrologic connection exists between the repository horizon and the Culebra. Surveillance of hydrological characteristics in the Culebra provides data which can be used to detect changes in water characterization. It also provides additional data for use in hydrologic models designed to predict long term performance of the repository. Data is gathered from 64 well bores; five of which are equipped with production-inflated packers to allow groundwater level surveillance of more than one producing zone through the same well bore.

Groundwater Quality data were gathered from ten wells completed in the Culebra member of the Rustler formation and one well completed in the Dewey Lake formation. The water quality sampling process has been developed using logistics from groundwater wells originally constructed for characterization, not intended for groundwater monitoring activities. Seven wells were drilled in the latter part of 1994 constructed for the explicit purpose of gathering water quality data. These wells are constructed with fiberglass casing and screens that will not bias sample collection. In 1995 samples were collected from old as well as new wells.

By virtue of a Groundwater Monitoring Waiver, prepared under 40 CFR 265, the WIPP Project is not required to monitor groundwater to comply with the U.S. Environmental Protection Agency (EPA) RCRA. The WIPP GSP provides a basis for future compliance to the RCRA, as well as any other groundwater protection-related regulations, should the need arise.

The original wells are constructed with J-55 or K-55 iron casing. In order to decrease the sampling bias created by well construction deficiencies, combined with the low transmissibilities of the formations involved, a labor intensive sampling process has been initiated.

Sampling episodes are referred to as a "sampling round". Each sampling round consists of the collection of two types of samples: (1) serial samples and (2) final samples. Serial samples are taken periodically while the well is being purged. Key physical and chemical parameters (known as field parameters) are analyzed and compared with past serial sampling data, when available, until a chemical steady state has been reached. A chemical steady state is usually defined as ± 5 percent of the average of the three to five preceding parameter measurements made on the final day of serial sampling from preceeding sampling rounds. Stabilization of these field parameters is a function of purging and is used as an indicator to determine if the groundwater is representative of the zone being sampled. A final sample is collected when it has been determined that the pumped groundwater has achieved a representative state. The sample is then sent off site to a contract laboratory for analysis.

Groundwater surveillance activities during CY 1995 consisted of two separate programs: Groundwater Quality Sampling and Groundwater Level Measurements.

## 7.1 Groundwater Quality

Sampling for groundwater quality was performed at 11 well sites during CY 1995 (Figure 7-1, page 7-6). Each of the iron cased wells were purged a minimum of 24 hours prior to the commencement of the serial sampling phase. The fiber glass cased wells were serially sampled as soon as possible after the pump was turned on to better observe early chemical reactions to pumping. Field analysis for Eh, pH, Specific Gravity, Specific Conductance, Alkalinity, Chloride, Divalent Cations, and Total Iron were performed on a periodic basis during the serial sampling. These field parameters were used as indicators, during the purging process to better determine when the formation water being pumped had reached a representative state. Normally this process required seven to ten days to complete for the iron cased wells and four-to-seven days for the fiber glass cased wells. Following the field analysis of the final serial sample, samples were collected and shipped to an independent, contracted, laboratory for analysis. Parameters of analysis by the contracted laboratory are listed in Table 7-1, page 7-10.

The total gallons of water removed from the Culebra as a result of groundwater surveillance activity was approximately 47,145 gallons throughout the year. The results of final sample analysis show relative consistency when compared to background data. Where background data are not available, analytical results are presented in tabular form. Tables 7-1.1 through 7-1.4, pages 7-11 through 7-14, contain average results of data collected from the Culebra dolomite during 1995 as compared to background data for major constituents of the background matrix. Tables 7-1.5 through 7-1.11, pages 7-15 through 7-28 contain first round data as reported by the contract laboratory. None of the waste stream Volatile Organic Compounds for which analysis were run showed any detectable concentrations.

Water quality of the Culebra in the vicinity of the WIPP is naturally poor and is not suitable for human consumption or for agricultural purposes. The water contains naturally high concentrations of total dissolved solids (TDS) and mineral constituents primarily of chloride, calcium, magnesium, sodium and potassium (Mercer, 1983). The high concentration of TDS results in water of generally poor quality. This has historically posed problems for laboratories performing analysis because the water interferes with the normal operation of standard laboratory equipment such as Atomic Absorption or Iductively Coupled Argon Plasma, causing detection limits to be inconsistent.

## 7.2 Groundwater Level Surveillance

In October 1988, WIPP was tasked with conducting a Groundwater Level Surveillance Program. Sixty four well bores were utilized to perform surveillance of seven water bearing zones in the WIPP area. The two zones of primary interest are the Culebra and Magenta. Fifty one measurements are taken in the Culebra; and ten, in the Magenta. Three measurements were taken in the Dewey Lake, two in the Rustler/Salado contact, one measurement each is taken in Bell Canyon, Forty-niner, and unnamed lower member. Locations of groundwater level surveillance sites are pictured in Figure 7-2, page 7-7.

Five wellbores are configured to allow monitoing of more than one formation. These are; H-01 Culebra/Magenta, H-03d Dewey Lake/Forty Niner, H-16 Dewey Lake/Unnamed Lower Member, Wipp-25 Culebra/Magenta, and WIPP-27 Culebra/Magenta.

Groundwater pump tests conducted by Sandia National Laboratories in support of the Culebra Transport Program have influenced groundwater level elevations for 1995. The pump tests primarily conducted southwest of the center of the site near WQSP-4 and DOE-1 have influenced groundwater elevations for virtually all Culebra wells located in the southwestern quadrant of the WIPP Land Withdrawal Area.

Groundwater elevation measurements in the Culebra indicate that the generalized directional flow of groundwater is north to south in the vicinity of WIPP (Figure 7-3, page 7-8). However, caution should be used when making assumptions based on groundwater level data alone. One should also be aware that the fractured media of the Culebra, coupled with variable fluid densities, can cause localized flow patterns to have little or no relationship to general flow patterns (Mercer 1983, Crawley 1988).

Regional groundwater levels taken in the Culebra show no significant increase or decrease in the water level elevation over the period of January 1995 through December 1995. Groundwater level elevations within the WIPP site boundaries were affected by groundwater quality sampling activities and the Culebra transport program pumping tests currently being conducted by Sandia National Laboratories.

Groundwater flow directions in the Magenta appear to be generally from an east to west direction across the WIPP site (Figure 7-4, page 7-9). No studies have been performed in the Magenta to determine spacial variations in the fluid densities of the magnitude studied in the Culebra. It is probable that density variations do occur in the Magenta; therefore, the potential may exist that flow patterns in the Magenta may be affected by variations in fluid density. Also, flow through the fractured media of the Magenta may dictate the behavior of localized flow patterns.

Regional groundwater level measurements taken in the Magenta dolomite indicate that water levels are increasing in wells located near the center of the site. While water levels near or outside the WIPP boundary appear to be relatively stable.

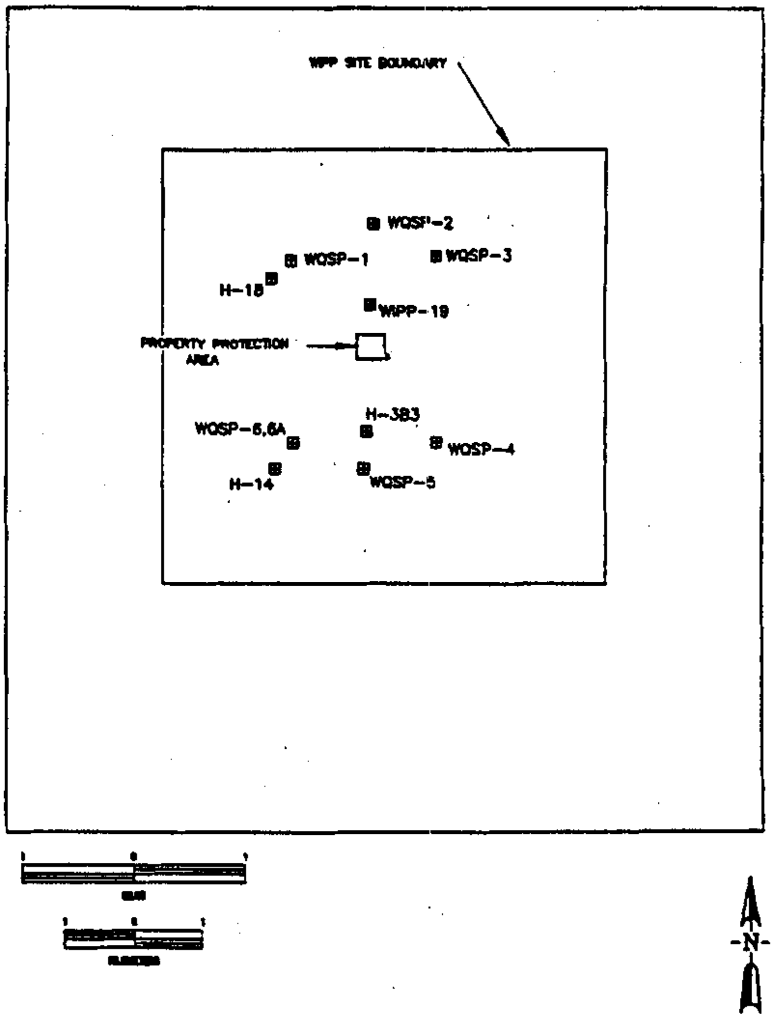



FIGURE 7-1 WATER QUALITY SAMPLING PROGRAM SAMPLE VELLS 1995

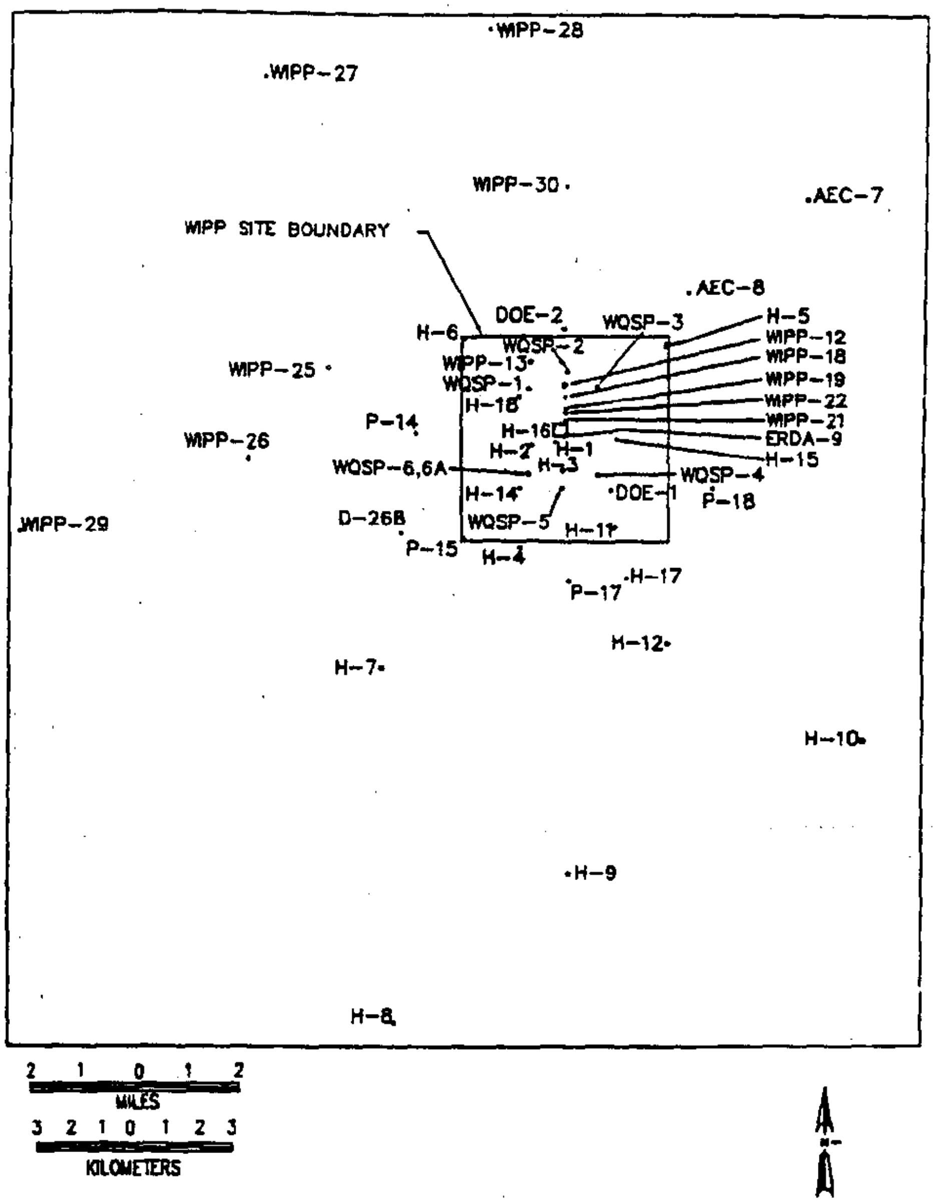



FIGURE 7-2 GROUND WATER LEVEL SURVEILLANCE WELLS

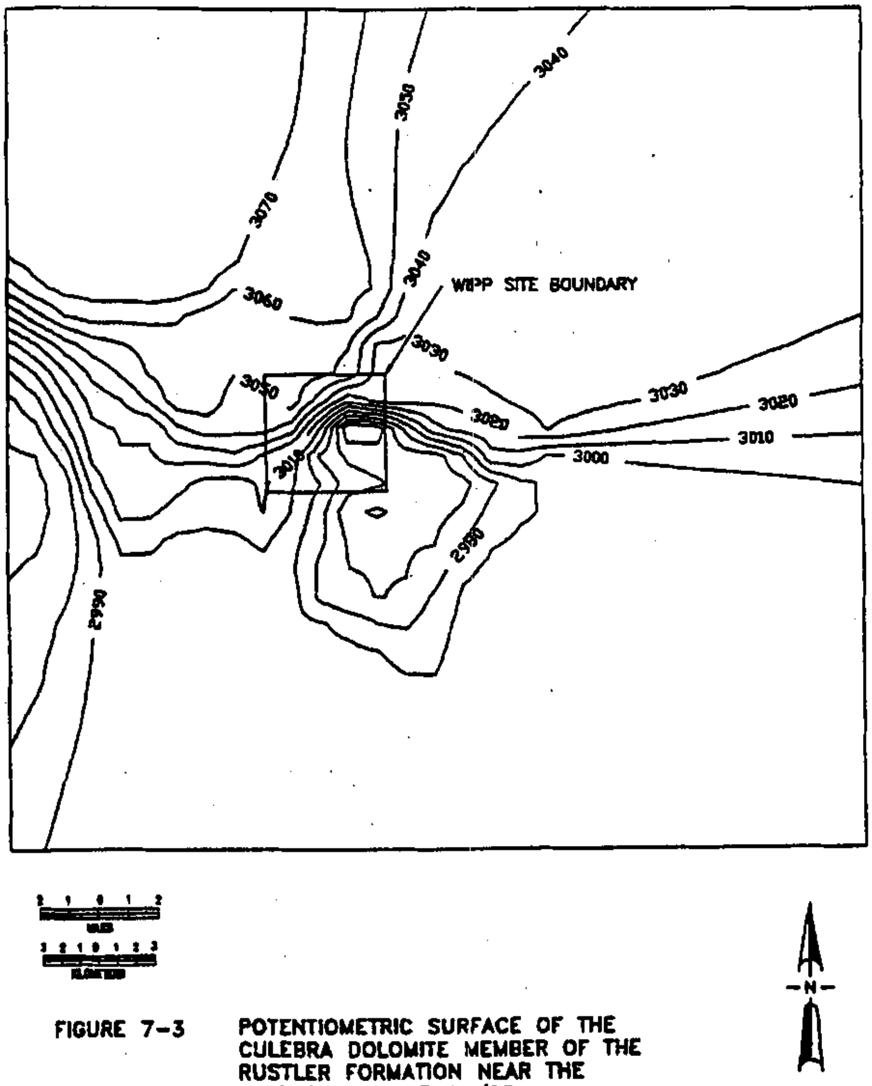



FIGURE 7-3 POTENTIOMETRIC SURFACE OF THE CULEBRA DOLOMITE MEMBER OF THE RUSTLER FORMATION NEAR THE WIPP SITE AS OF 12/95

NOTE: CONTOUR LINE ELEVATION IN FEET ABOVE MEAN SEA LEVEL

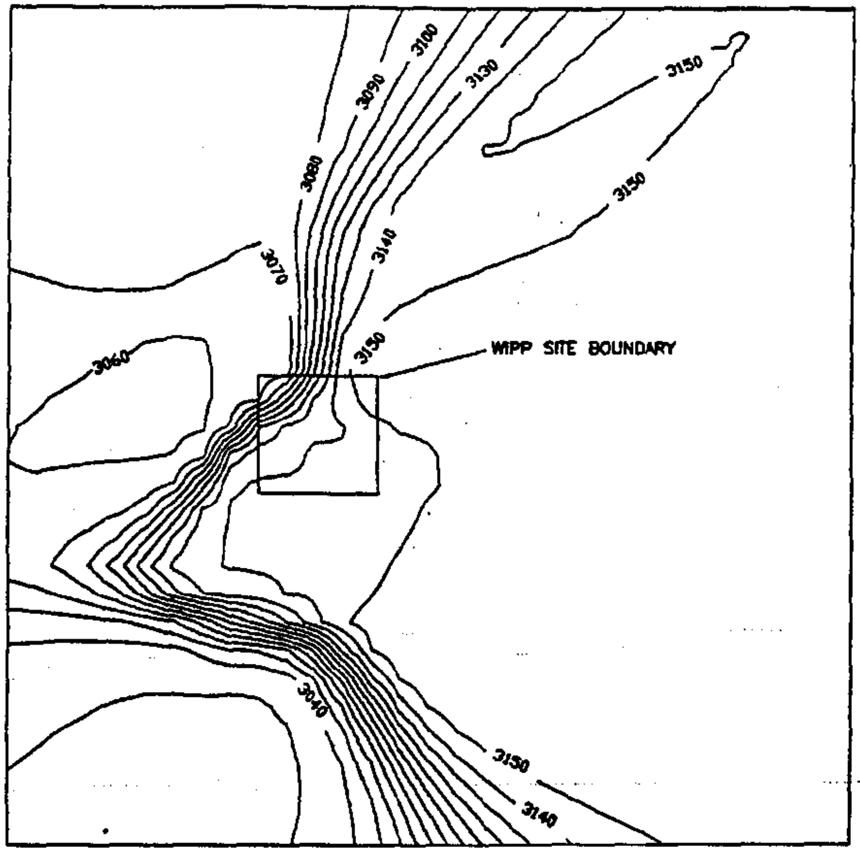



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FIGURE 7-4 POTENTIOMETRIC SURFACE OF THE MAGENTA DOLOMITE MEMBER OF THE RUSTLER FORMATION NEAR THE WIPP SITE AS OF 12/95

NOTE: CONTOUR LINE ELEVATION IN FEET ABOVE MEAN SEA LEVEL

TABLE 7-1
PARAMETERS ANALYZED
DURING
CALENDAR YEAR 1995

| | |
|---|---|
| SPECIFIC CONDUCTANCE | BORON |
| SULFATE | CADMIUM |
| TOTAL DISSOLVED SOLIDS | CALCIUM |
| TOTAL SUSPENDED SOLIDS | CHROMIUM |
| DENSITY | IRON |
| pH | LEAD |
| ALKALINITY | LITHIUM |
| BROMIDE | MAGNESIUM |
| CHLORIDE | MERCURY |
| FLUORIDE | POTASSIUM |
| IODIDE | SELENIUM |
| NITROGEN, NO3 (AS N) | SILICA |
| TOTAL ORGANIC CARBON | SILVER |
| TOTAL ORGANIC HALOGENS | SODIUM |
| PHENOL, TOTAL | CARBON TETRACHLORIDE |
| ORTHOPHOSPHATE (AS P) | METHYLENE CHLORIDE |
| ARSENIC | TRICHLOROETHYLENE |
| BARIUM | 1,1,1-TRICHLOROETHANE |
| BERYLLIUM | FREON-113 |

TABLE 7-1.1
H-03b3, CULEBRA
ROUND 10 COMPARISON TO BACKGROUND CHARACTERIZATION

| PARAMETER | 1995 AVERAGE CONCENTRATION mg/l | BACKGROUND CONCENTRATION INTERVAL mg/l |
|---|---|---|
| BORON | 24.05 | 19-32 |
| CALCIUM | 1,345 | 1,193-1,527 |
| IRON | <1.00 | 0.14-0.47 |
| LITHIUM | 0.356 | 0.15-0.82 |
| MAGNESIUM | 685 | 710-826 |
| POTASSIUM | 364 | 372-534 |
| SODIUM | 15,000 | 16,140-17,900 |
| ALKALINITY | 43.3 | 46-54 |
| BROMIDE | 26.15 | 7-41 |
| CHLORIDE | 28,950 | 26,742-30,838 |
| FLUORIDE | <3.00 | 1.5-1.6 |
| pH | 7.46 | 6.85-7.66 |
| SULFATE | 5,408 | 4,537-4,823 |
| TOTAL DISSOLVED SOLIDS | 55,600 | 53,130-55,170 |
| ARSENIC | <0.006 | <0.10 |
| BARIUM | <0.02 | ≤0.06 |
| BERYLLIUM | <0.01 | ≤0.15 |
| CADMIUM | <0.0057 | ≤0.07 |
| CHROMIUM | <0.0025 | 0.007-0.4 |
| LEAD | <0.013 | ≤0.50 |
| MERCURY | <0.002 | <0.001 |
| SELENIUM | <0.006 | <0.50 |
| SILICA | 16.5 | 4.5-13 |
| SILVER | 0.035 | ≤0.10 |
| IODIDE | <2.00 | <2.0 |
| NITRATE AS (N) | 0.22 | <0.20 |
| PHENOLICS | <0.10 | ≤0.033 |
| PHOSPHATE AS (P) | <0.02 | ≤0.06 |
| TOTAL ORGANIC CARBON | 0.98 | ≤2.0 |
| TOTAL ORGANIC HALOGEN | 0.079 | 0.14-0.42 |

TABLE 7-1.2
H-14, CULEBRA
ROUND 8 COMPARISON TO BACKGROUND CHARACTERIZATION

| PARAMETER | 1995 AVERAGE CONCENTRATION mg/l | BACKGROUND CONCENTRATION INTERVAL mg/l |
|---|---|---|
| BORON | 11.7 | 11 |
| CALCIUM | 1,770 | 1,504-2,129 |
| IRON | 1.12 | 0.1-0.8 |
| LITHIUM | 0.389 | .039-0.56 |
| MAGNESIUM | 527 | 451-613 |
| POTASSIUM | 217 | 233-257 |
| SODIUM | 3,200 | 2,750-4,184 |
| ALKALINITY | 29.9 | 35-43 |
| BROMIDE | 9.59 | 9-18 |
| CHLORIDE | 9,997 | 6,954-9,779 |
| FLUORIDE | <3.00 | 0.1-2.6 |
| pH | 7.59 | 5.89-8.50 |
| SULFATE | 2,112 | 1,209-2,291 |
| TOTAL DISSOLVED SOLIDS | 18,217 | 14,066-19,867 |
| ARSENIC | <0.002 | <0.05 |
| BARIUM | 0.024 | <0.05 |
| BERYLLIUM | <0.04 | <0.05 |
| CADMIUM | <0.0013 | ≤0.06 |
| CHROMIUM | <0.0025 | 0.2-0.4 |
| LEAD | <0.0125 | ≤0.5 |
| MERCURY | <0.0002 | ≤0.0004 |
| SELENIUM | <0.002 | <0.05 |
| SILICA | 10.08 | 5.5-14 |
| SILVER | <0.0025 | ≤0.1 |
| IODIDE | <2.00 | <2.0 |
| NITRATE AS (N) | <.10 | ≤0.40 |
| PHENOLICS | <0.10 | 0.068-0.14 |
| PHOSPHATE AS (P) | <0.2 | ≤0.05 |
| TOTAL ORGANIC CARBON | 1.58 | ≤2.0 |
| TOTAL ORGANIC HALOGEN | 0.106 | 0.08-1.1 |

TABLE 7-1.3
H-18, CULEBRA
ROUND 4 COMPARISON TO BACKGROUND CHARACTERIZATION

| PARAMETER | 1995 AVERAGE CONCENTRATION mg/l | BACKGROUND CONCENTRATION INTERVAL mg/l |
|---|---|---|
| BORON | 16.95 | 14-18 |
| CALCIUM | 1,180 | 820-1,367 |
| IRON | <1.0 | 0-0.7 |
| LITHIUM | 0.28 | 0.04-0.44 |
| MAGNESIUM | 511 | 452-555 |
| POTASSIUM | 192.8 | 207-270 |
| SODIUM | 7,420 | 5,967-9,266 |
| ALKALINITY | 53.9 | 46-61 |
| BROMIDE | 13.0 | 11-19 |
| CHLORIDE | 14,650 | 11,258-13,742 |
| FLUORIDE | <3.0 | 1.4-2.1 |
| pH | 7.67 | 4.87-8.98 |
| SULFATE | 4,035 | 2,150-6,317 |
| TOTAL DISSOLVED SOLIDS | 29,300 | 18,919-35,347 |
| ARSENIC | <0.001 | <0.05 |
| BARIUM | <0.04 | <0.05 |
| BERYLLIUM | <0.02 | <0.05 |
| CADMIUM | <0.0022 | <0.05 |
| CHROMIUM | 0.0036 | ≤0.2 |
| LEAD | <0.013 | <0.5 |
| MERCURY | <0.002 | <0.0002 |
| SELENIUM | <0.001 | <0.5 |
| SILICA | 9.98 | 5.1-13 |
| SILVER | 0.0063 | <0.1 |
| IODIDE | <2.00 | <2.0 |
| NITRATE AS (N) | <0.10 | ≤0.2 |
| PHENOLICS | <0.10 | ≤0.12 |
| PHOSPHATE AS (P) | <0.02 | ≤0.03 |
| TOTAL ORGANIC CARBON | 0.93 | ≤5.0 |
| TOTAL ORGANIC HALOGEN | 0.063 | ≤0.42 |

TABLE 7-1.4
WIPP-19, CULEBRA
ROUND 10 COMPARISON TO BACKGROUND CHARACTERIZATION

| PARAMETER | 1995 AVERAGE CONCENTRATION mg/l | BACKGROUND CONCENTRATION INTERVAL mg/l |
|---|---|---|
| BORON | 28.5 | 27-34 |
| CALCIUM | 1,440 | 1,441-1,919 |
| IRON | 1.76 | ≤2.0 |
| LITHIUM | 0.43 | 0.3-1.1 |
| MAGNESIUM | 900 | 961-2,239 |
| POTASSIUM | 486 | 565-913 |
| SODIUM | 23,000 | 23,962-32,658 |
| ALKALINITY | 43.3 | 51-70 |
| BROMIDE | 46.2 | 22-126 |
| CHLORIDE | 34,750 | 33,201-54,520 |
| FLUORIDE | <3.00 | 0.8-1.1 |
| pH | 7.60 | 6.75-7.33 |
| SULFATE | 6,590 | 5,097-5,763 |
| TOTAL DISSOLVED SOLIDS | 65,800 | 68,389-103,151 |
| ARSENIC | <0.005 | <0.5 |
| BARIUM | <0.04 | <0.50 |
| BERYLLIUM | <0.02 | <0.50 |
| CADMIUM | <0.0013 | <0.50 |
| CHROMIUM | <0.0025 | ≤2.0 |
| LEAD | <0.013 | <5.0 |
| MERCURY | <0.0002 | <0.002 |
| SELENIUM | <0.005 | <0.50 |
| SILICA | 9.20 | ≤4.40 |
| SILVER | 0.0035 | <1.0 |
| IODIDE | <2.00 | <2.0 |
| NITRATE AS (N) | <0.10 | ≤0.12 |
| PHENOLICS | <0.1 | ≤0.019 |
| PHOSPHATE AS (P) | <0.02 | ≤0.03 |
| TOTAL ORGANIC CARBON | 1.07 | 2-7 |
| TOTAL ORGANIC HALOGEN | 0.67 | 0.57-3.2 |

# TABLE 7-1.5
# WQSP-1, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| PARAMETER | VALUE | DUPLICATE | UNIT | AVERAGE |
|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 83400.0000 | 83800.0000 | umhos/cm | 83600.0000 |
| SULFATE | 5230.0000 | 5490.0000 | mg/l | 5360.0000 |
| TOTAL DISS SOLIDS | 77400.0000 | 77600.0000 | mg/l | 77500.0000 |
| TOTAL SUSP SOLIDS | <10.0000 | <10.0000 | mg/l | <10.0000 |
| DENSITY | 1.0530 | 1.0530 | g/mL | 1.0530 |
| pH | 7.0900 | 7.1100 | SU | 7.1000 |
| ALKALINITY | 46.5000 | 47.5000 | mg/l | 47.0000 |
| BROMIDE | 44.9000 | 45.1000 | mg/l | 45.0000 |
| CHLORIDE | 34500.0000 | 35000.0000 | mg/l | 34750.0000 |
| FLUORIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| IODIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| NITROGEN, NO3 (AS N) | <0.0100 | <0.0100 | mg/l | <0.0100 |
| TOTAL ORGANIC CARBON | 1.4900 | 1.4700 | mg/l | 1.4800 |
| TOTAL ORGANIC HALOGENS | 0.0290 | 0.0220 | mg/l | 0.0255 |
| PHENOL, TOTAL | <0.0100 | <0.0100 | mg/l | <0.0100 |
| ORTHOPHOSPHATE (AS P) | 0.0200 | 0.0200 | mg/l | 0.0200 |
| ARSENIC | <0.0100 | <0.0010 | mg/l | <0.0055 |
| BARIUM | <0.0400 | <0.0400 | mg/l | <0.0400 |
| BERYLLIUM | <0.0200 | <0.0200 | mg/l | <0.0200 |
| BORON | 14.0000 | 13.6000 | mg/l | 13.8000 |
| CADMIUM | <0.0013 | <0.0013 | mg/l | <0.0013 |
| CALCIUM | 1700.0000 | 1670.0000 | mg/l | 1685.0000 |
| CHROMIUM | <0.0025 | <0.0025 | mg/l | <0.0025 |
| IRON | <1.0000 | <1.0000 | mg/l | <1.0000 |
| LEAD | <0.0130 | <0.0130 | mg/l | <0.0130 |
| LITHIUM | 0.4170 | 0.4140 | mg/l | 0.4155 |
| MAGNESIUM | 1110.0000 | 1080.0000 | mg/l | 1095.0000 |
| MERCURY | <0.0002 | <0.0002 | mg/l | <0.0002 |
| POTASSIUM | 497.0000 | 474.0000 | mg/l | 485.5000 |
| SELENIUM | <0.0100 | <0.0100 | mg/l | <0.0100 |

# TABLE 7-1.5
# WQSP-1, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| | | | | |
|---|---|---|---|---|
| SILICA | 9.1800 | 9.4900 | mg/l | 9.3350 |
| SILVER | <0.0025 | <0.0025 | mg/l | <0.0025 |
| SODIUM | 20100.0000 | 19800.0000 | mg/l | 19950.0000 |
| CARBON TETRACHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| METHYLENE CHLORIDE | 0.0170 | 0.0160 | mg/l | 0.0165 |
| TRICHLOROETHYLENE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| 1,1,1-TRICHLOROETHANE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| FREON-113 | <0.0050 | <0.0050 | mg/l | <0.0050 |

# TABLE 7-1.6
# WQSP-2, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| PARAMETER | VALUE | DUPLICATE | UNIT | AVERAGE |
|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 80100.0000 | 79900.0000 | umhos/cm | 80000.0000 |
| SULFATE | 5540.0000 | 5470.0000 | mg/l | 5505.0000 |
| TOTAL DISS SOLIDS | 67600.0000 | 67600.0000 | mg/l | 67600.0000 |
| TOTAL SUSP SOLIDS | 38.0000 | 44.0000 | mg/l | 41.0000 |
| DENSITY | 1.0600 | 1.0500 | g/mL | 1.0550 |
| pH | 7.3300 | 7.3300 | SU | 7.3300 |
| ALKALINITY | 52.5000 | 5.2500 | mg/l | 28.8750 |
| BROMIDE | 33.3000 | 33.8000 | mg/l | 33.5500 |
| CHLORIDE | 38500.0000 | 38500.0000 | mg/l | 38500.0000 |
| FLUORIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| IODIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| NITROGEN, NO3 (AS N) | <0.1000 | <0.1000 | mg/l | <0.1000 |
| TOTAL ORGANIC CARBON | <4.0000 | <4.0000 | mg/l | <4.0000 |
| TOTAL ORGANIC HALOGENS | 24.4000 | 63.8000 | mg/l | 44.1000 |
| PHENOL, TOTAL | <0.1000 | <0.1000 | mg/l | <0.1000 |
| ORTHOPHOSPHATE (AS P) | <0.0200 | <0.0200 | mg/l | <0.0200 |
| ARSENIC | <0.0100 | <0.0100 | mg/l | <0.0100 |
| BARIUM | <0.0400 | <0.0400 | mg/l | <0.0400 |
| BERYLLIUM | <0.0200 | <0.0200 | mg/l | <0.0200 |
| BORON | 17.2000 | 17.2000 | mg/l | 17.2000 |
| CADMIUM | <0.0013 | <0.0013 | mg/l | <0.0013 |
| CALCIUM | 1460.0000 | 1450.0000 | mg/l | 1455.0000 |
| CHROMIUM | <0.0025 | <0.0025 | mg/l | <0.0025 |
| IRON | <1.0000 | <1.0000 | mg/l | <1.0000 |
| LEAD | <0.0130 | <0.0130 | mg/l | <0.0130 |
| LITHIUM | <0.3910 | <0.3870 | mg/l | <0.3890 |
| MAGNESIUM | 966.0000 | 960.0000 | mg/l | 963.0000 |
| MERCURY | <0.0010 | <0.0010 | mg/l | <0.0010 |
| POTASSIUM | 450.0000 | 446.0000 | mg/l | 448.0000 |
| SELENIUM | <0.0100 | <0.0100 | mg/l | <0.0100 |

# TABLE 7-1.6
# WQSP-2, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| | | | | |
|---|---|---|---|---|
| SILICA | 7.3500 | 7.9700 | mg/l | 7.6600 |
| SILVER | <0.0025 | <0.0025 | mg/l | <0.0025 |
| SODIUM | 19100.0000 | 18400.0000 | mg/l | 18750.0000 |
| CARBON TETRACHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| METHYLENE CHLORIDE | <0.0050 | 0.0050 | mg/l | <0.0050 |
| TRICHLOROETHYLENE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| 1,1,1-TRICHLOROETHANE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| FREON-113 | <0.0050 | <0.0050 | mg/l | <0.0050 |

# TABLE 7-1.7
# WQSP-3, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| PARAMETER | VALUE | DUPLICATE | UNIT | AVERAGE |
|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 193000.0000 | 194000.0000 | umhos/cm | 193500.0000 |
| SULFATE | 6710.0000 | 6700.0000 | mg/l | 6705.0000 |
| TOTAL DISS SOLIDS | 218000.0000 | 219000.0000 | mg/l | 218500.0000 |
| TOTAL SUSP SOLIDS | 71.0000 | 74.0000 | mg/l | 72.5000 |
| DENSITY | 1.1400 | 1.1300 | g/mL | 1.1350 |
| pH | 7.1200 | 7.1100 | SU | 7.1150 |
| ALKALINITY | 44.0000 | 44.0000 | mg/l | 44.0000 |
| BROMIDE | 100.0000 | 105.0000 | mg/l | 102.5000 |
| CHLORIDE | 130000.0000 | 138000.0000 | mg/l | 134000.0000 |
| FLUORIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| IODIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| NITROGEN, NO3 (AS N) | <0.1000 | <0.1000 | mg/l | <0.1000 |
| TOTAL ORGANIC CARBON | 1.3800 | 1.3400 | mg/l | 1.3600 |
| TOTAL ORGANIC HALOGENS | 0.1660 | 0.1470 | mg/l | 0.1565 |
| PHENOL, TOTAL | <0.1000 | <0.1000 | mg/l | <0.1000 |
| ORTHOPHOSPHATE (AS P) | <0.0200 | <0.0200 | mg/l | <0.0200 |
| ARSENIC | <0.0100 | <0.0100 | mg/l | <0.0100 |
| BARIUM | <0.1600 | <0.1600 | mg/l | <0.1600 |
| BERYLLIUM | <0.0800 | <0.0800 | mg/l | <0.0800 |
| BORON | 50.1000 | 48.5000 | mg/l | 49.3000 |
| CADMIUM | <0.0013 | <0.0013 | mg/l | <0.0013 |
| CALCIUM | 1420.0000 | 1350.0000 | mg/l | 1385.0000 |
| CHROMIUM | 0.0027 | 0.0025 | mg/l | 0.0026 |
| IRON | <4.0000 | <4.0000 | mg/l | <4.0000 |
| LEAD | <0.0130 | <0.0130 | mg/l | <0.0130 |
| LITHIUM | <0.8000 | <0.8000 | mg/l | <0.8000 |
| MAGNESIUM | 2210.0000 | 2110.0000 | mg/l | 2160.0000 |
| MERCURY | <0.0010 | <0.0010 | mg/l | <0.0010 |
| POTASSIUM | 1380.0000 | 1310.0000 | mg/l | 1345.0000 |
| SELENIUM | <0.0100 | <0.0100 | mg/l | <0.0100 |

# TABLE 7-1.7
# WQSP-3, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| | | | | |
|---|---|---|---|---|
| SILICA | 4.4600 | 4.6800 | mg/l | 4.5700 |
| SILVER | <0.0025 | <0.0025 | mg/l | <0.0025 |
| SODIUM | 79100.0000 | 76700.0000 | mg/l | 77900.0000 |
| CARBON TETRACHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| METHYLENE CHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| TRICHLOROETHYLENE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| 1,1,1-TRICHLOROETHANE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| FREON-113 | <0.0050 | <0.0050 | mg/l | <0.0050 |

# TABLE 7-1.8
# WQSP-4, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| PARAMETER | VALUE | DUPLICATE | UNIT | AVERAGE |
|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 107000.0000 | 106000.0000 | umhos/cm | 106500.0000 |
| SULFATE | 7100.0000 | 7050.0000 | mg/l | 7075.0000 |
| TOTAL DISS SOLIDS | 108000.0000 | 108000.0000 | mg/l | 108000.0000 |
| TOTAL SUSP SOLIDS | 55.0000 | 59.0000 | mg/l | 57.0000 |
| DENSITY | 1.0800 | 1.0800 | g/mL | 1.0800 |
| pH | 7.1600 | 7.1700 | SU | 7.1650 |
| ALKALINITY | 40.0000 | 42.0000 | mg/l | 41.0000 |
| BROMIDE | 55.7000 | 52.6000 | mg/l | 54.1500 |
| CHLORIDE | 61200.0000 | 60700.0000 | mg/l | 60950.0000 |
| FLUORIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| IODIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| NITROGEN, NO3 (AS N) | <0.1000 | <0.1000 | mg/l | <0.1000 |
| TOTAL ORGANIC CARBON | 1.2000 | 1.1700 | mg/l | 1.1850 |
| TOTAL ORGANIC HALOGENS | 0.0590 | 0.0200 | mg/l | 0.0395 |
| PHENOL, TOTAL | <0.1000 | <0.1000 | mg/l | <0.1000 |
| ORTHOPHOSPHATE (AS P) | <0.0200 | <0.0200 | mg/l | <0.0200 |
| ARSENIC | <0.0080 | <0.0080 | mg/l | <0.0080 |
| BARIUM | <0.1600 | <0.1600 | mg/l | <0.1600 |
| BERYLLIUM | <0.0800 | <0.0800 | mg/l | <0.0800 |
| BORON | 33.7000 | 33.4000 | mg/l | 33.5500 |
| CADMIUM | <0.1300 | <0.0013 | mg/l | <0.0657 |
| CALCIUM | 1710.0000 | 1650.0000 | mg/l | 1680.0000 |
| CHROMIUM | <0.0025 | <0.0025 | mg/l | <0.0025 |
| IRON | <4.0000 | <4.0000 | mg/l | <4.0000 |
| LEAD | <0.0130 | <0.0130 | mg/l | <0.0130 |
| LITHIUM | <0.8000 | <0.8000 | mg/l | <0.8000 |
| MAGNESIUM | 1270.0000 | 1230.0000 | mg/l | 1250.0000 |
| MERCURY | <0.0010 | <0.0010 | mg/l | <0.0010 |
| POTASSIUM | 764.0000 | 732.0000 | mg/l | 748.0000 |
| SELENIUM | <0.0100 | <0.0100 | mg/l | <0.0100 |

# TABLE 7-1.8
# WQSP-4, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| | | | | |
|---|---|---|---|---|
| SILICA | 6.0500 | 6.1000 | mg/l | 6.0750 |
| SILVER | <0.0025 | <0.0025 | mg/l | <0.0025 |
| SODIUM | 35900.0000 | 34400.0000 | mg/l | 35150.0000 |
| CARBON TETRACHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| METHYLENE CHLORIDE | 0.0100 | 0.0100 | mg/l | 0.0100 |
| TRICHLOROETHYLENE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| 1,1,1-TRICHLOROETHANE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| FREON-113 | <0.0050 | <0.0050 | mg/l | <0.0050 |

# TABLE 7-1.9
# WQSP-5, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| PARAMETER | VALUE | DUPLICATE | UNIT | AVERAGE |
|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 43100.0000 | 43200.0000 | umhos/cm | 43150.0000 |
| SULFATE | 5370.0000 | 5380.0000 | mg/l | 5375.0000 |
| TOTAL DISS SOLIDS | 43800.0000 | 44100.0000 | mg/l | 43950.0000 |
| TOTAL SUSP SOLIDS | <10.0000 | <10.0000 | mg/l | <10.0000 |
| DENSITY | 1.0300 | 1.0280 | g/mL | 1.0290 |
| pH | 7.8000 | 7.8000 | SU | 7.8000 |
| ALKALINITY | 52.0000 | 50.0000 | mg/l | 51.0000 |
| BROMIDE | 21.3000 | 21.7000 | mg/l | 21.5000 |
| CHLORIDE | 15000.0000 | 14800.0000 | mg/l | 14900.0000 |
| FLUORIDE | <3.0000 | <3.0000 | mg/l | <3.0000 |
| IODIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| NITROGEN, NO3 (AS N) | <0.1000 | <0.1000 | mg/l | <0.1000 |
| TOTAL ORGANIC CARBON | 1.8700 | 2.0200 | mg/l | 1.9450 |
| TOTAL ORGANIC HALOGENS | 0.0549 | 0.0526 | mg/l | 0.0538 |
| PHENOL, TOTAL | <0.1000 | <0.1000 | mg/l | <0.1000 |
| ORTHOPHOSPHATE (AS P) | <0.0200 | <0.0200 | mg/l | <0.0200 |
| ARSENIC | <0.0130 | <0.0130 | mg/l | <0.0130 |
| BARIUM | <0.0400 | <0.0400 | mg/l | <0.0400 |
| BERYLLIUM | <0.0200 | <0.0200 | mg/l | <0.0200 |
| BORON | 30.3000 | 30.1000 | mg/l | 30.2000 |
| CADMIUM | <0.0025 | <0.0025 | mg/l | <0.0025 |
| CALCIUM | 987.0000 | 982.0000 | mg/l | 984.5000 |
| CHROMIUM | <0.0130 | <0.0130 | mg/l | <0.0130 |
| IRON | <1.0000 | <1.0000 | mg/l | <1.0000 |
| LEAD | <0.0130 | <0.0130 | mg/l | <0.0130 |
| LITHIUM | 0.3500 | 0.3640 | mg/l | 0.3570 |
| MAGNESIUM | 434.0000 | 432.0000 | mg/l | 433.0000 |
| MERCURY | <0.0010 | <0.0010 | mg/l | <0.0010 |
| POTASSIUM | 286.0000 | 286.0000 | mg/l | 286.0000 |
| SELENIUM | <0.0130 | <0.0130 | mg/l | <0.0130 |

# TABLE 7-1.9
# WQSP-5, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| | | | | |
|---|---|---|---|---|
| SILICA | 11.0000 | 10.9000 | mg/l | 10.9500 |
| SILVER | <0.0130 | <0.0130 | mg/l | <0.0130 |
| SODIUM | 8880.0000 | 8900.0000 | mg/l | 8890.0000 |
| CARBON TETRACHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| METHYLENE CHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| TRICHLOROETHYLENE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| 1,1,1-TRICHLOROETHANE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| FREON-113 | <0.0050 | <0.0050 | mg/l | <0.0050 |

# TABLE 7-1.10
# WQSP-6, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| PARAMETER | VALUE | DUPLICATE | UNIT | AVERAGE |
|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 27200.0000 | 27100.0000 | umhos/cm | 27150.0000 |
| SULFATE | 5590.0000 | 5340.0000 | mg/l | 5465.0000 |
| TOTAL DISS SOLIDS | 21600.0000 | 21600.0000 | mg/l | 21600.0000 |
| TOTAL SUSP SOLIDS | 15.0000 | 14.5000 | mg/l | 14.7500 |
| DENSITY | 0.9990 | 1.0000 | g/mL | 0.9995 |
| pH | 7.8100 | 7.8000 | SU | 7.8050 |
| ALKALINITY | 52.5000 | 52.5000 | mg/l | 52.5000 |
| BROMIDE | 11.2000 | 10.7000 | mg/l | 10.9500 |
| CHLORIDE | 15800.0000 | 15800.0000 | mg/l | 15800.0000 |
| FLUORIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| IODIDE | 1.4300 | 1.5900 | mg/l | 1.5100 |
| NITROGEN, NO3 (AS N) | <0.1000 | <0.1000 | mg/l | <0.1000 |
| TOTAL ORGANIC CARBON | 1.1100 | 1.1600 | mg/l | 1.1350 |
| TOTAL ORGANIC HALOGENS | 0.0600 | 0.0310 | mg/l | 0.0455 |
| PHENOL, TOTAL | <0.1000 | <0.1000 | mg/l | <0.1000 |
| ORTHOPHOSPHATE (AS P) | <0.0200 | <0.0200 | mg/l | <0.0200 |
| ARSENIC | <0.0040 | <0.0040 | mg/l | <0.0040 |
| BARIUM | <0.0400 | <0.0400 | mg/l | <0.0400 |
| BERYLLIUM | <0.0200 | <0.0200 | mg/l | <0.0200 |
| BORON | 16.6000 | 16.9000 | mg/l | 16.7500 |
| CADMIUM | <0.0013 | <0.0013 | mg/l | <0.0013 |
| CALCIUM | 719.0000 | 731.0000 | mg/l | 725.0000 |
| CHROMIUM | <0.0025 | <0.0027 | mg/l | <0.0026 |
| IRON | <1.0000 | <1.0000 | mg/l | <1.0000 |
| LEAD | <0.0130 | <0.0130 | mg/l | <0.0130 |
| LITHIUM | 0.2490 | 0.2720 | mg/l | 0.2605 |
| MAGNESIUM | 250.0000 | 253.0000 | mg/l | 251.5000 |
| MERCURY | <0.0010 | <0.0010 | mg/l | <0.0010 |
| POTASSIUM | 182.0000 | 184.0000 | mg/l | 183.0000 |
| SELENIUM | <0.0040 | <0.0040 | mg/l | <0.0040 |

# TABLE 7-1.10
# WQSP-6, CULEBRA
# ROUND ONE ANALYTICAL RESULTS

| | | | | |
|---|---|---|---|---|
| SILICA | 10.3000 | 10.6000 | mg/l | 10.4500 |
| SILVER | <0.0025 | <0.0032 | mg/l | <0.0029 |
| SODIUM | 6070.0000 | 6050.0000 | mg/l | 6060.0000 |
| CARBON TETRACHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| METHYLENE CHLORIDE | <0.0050 | <0.0080 | mg/l | <0.0065 |
| TRICHLOROETHYLENE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| 1,1,1-TRICHLOROETHANE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| FREON-113 | <0.0050 | <0.0050 | mg/l | <0.0050 |

# TABLE 7-1.11
# WQSP-6a, DEWEY LAKE
# ROUND ONE ANALYTICAL RESULTS

| PARAMETER | VALUE | DUPLICATE | UNIT | AVERAGE |
|---|---|---|---|---|
| SPECIFIC CONDUCTANCE | 4968.0000 | 4968.0000 | umhos/cm | 4968.0000 |
| SULFATE | 1905.0000 | 1905.0000 | mg/l | 1905.0000 |
| TOTAL DISS SOLIDS | 11000.0000 | 11000.0000 | mg/l | 11000.0000 |
| TOTAL SUSP SOLIDS | 91.0000 | 91.0000 | mg/l | 91.0000 |
| DENSITY | 0.9772 | 0.9772 | g/ml | 0.9772 |
| pH | 7.6600 | 7.6600 | SU | 7.6600 |
| ALKALINITY | 111.0000 | 111.0000 | mg/l | 111.0000 |
| BROMIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| CHLORIDE | 1040.0000 | 1040.0000 | mg/l | 1040.0000 |
| FLUORIDE | <3.0000 | <3.0000 | mg/l | <3.0000 |
| IODIDE | <2.0000 | <2.0000 | mg/l | <2.0000 |
| NITROGEN, NO3 (AS N) | 7.6200 | 7.6200 | mg/l | 7.6200 |
| TOTAL ORGANIC CARBON | 1.1000 | 1.1000 | mg/l | 1.1000 |
| TOTAL ORGANIC HALOGENS | 0.0880 | 0.0880 | mg/l | 0.0880 |
| PHENOL, TOTAL | <0.1000 | <0.1000 | mg/l | <0.1000 |
| ORTHOPHOSPHATE (AS P) | <0.0200 | <0.0200 | mg/l | <0.0200 |
| ARSENIC | <0.0060 | <0.0060 | mg/l | <0.0060 |
| BARIUM | <0.0200 | <0.0200 | mg/l | <0.0200 |
| BERYLLIUM | <0.0100 | <0.0100 | mg/l | <0.0100 |
| BORON | 0.4290 | 0.4290 | mg/l | 0.4290 |
| CADMIUM | <0.0013 | <0.0013 | mg/l | <0.0013 |
| CALCIUM | 681.0000 | 681.0000 | mg/l | 681.0000 |
| CHROMIUM | <0.0025 | <0.0025 | mg/l | <0.0025 |
| IRON | <0.4000 | <0.4000 | mg/l | <0.4000 |
| LEAD | <0.0125 | <0.0125 | mg/l | <0.0125 |
| LITHIUM | 0.0950 | 0.0950 | mg/l | 0.0950 |
| MAGNESIUM | 181.0000 | 181.0000 | mg/l | 181.0000 |
| MERCURY | <0.0002 | <0.0002 | mg/l | <0.0002 |
| POTASSIUM | 4.8200 | 4.8200 | mg/l | 4.8200 |
| SELENIUM | <0.0060 | <0.0060 | mg/l | <0.0060 |

# TABLE 7-1.11
# WQSP-6a, DEWEY LAKE
# ROUND ONE ANALYTICAL RESULTS

| | | | | |
|---|---|---|---|---|
| SILICA | 24.2700 | 24.2700 | mg/l | 24.2700 |
| SILVER | 0.0028 | 0.0028 | mg/l | 0.0028 |
| SODIUM | 347.0000 | 347.0000 | mg/l | 347.0000 |
| CARBON TETRACHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| METHYLENE CHLORIDE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| TRICHLOROETHYLENE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| 1,1,1-TRICHLOROETHANE | <0.0050 | <0.0050 | mg/l | <0.0050 |
| FREON-113 | <0.0050 | <0.0050 | mg/l | <0.0050 |

## Chapter 8

# Quality Assurance

The purpose of the Quality Assurance/Quality Control (QA/QC) program is to ensure that processes, activities, and products that potentially impact health, safety, and the environment are appropriately planned, implemented, and assessed. The goal of the QA/QC program is twofold: (1) to provide confidence that the data used in demonstrating regulatory compliance are adequate and (2) to promote continuous improvement in WIPP's operations. The QA program is successful when risks and environmental impacts are identified and minimized, and when safety, reliability, and performance are maximized.

This chapter outlines the QA processes applicable to the radiological and nonradiological environmental monitoring programs. The QA Program is used to monitor the reliability, accuracy, and precision of environmental data, and to detect and correct problems in the sample collection, preparation, analysis, and the data evaluation phases.

A comprehensive QA program has been implemented to ensure that the data collected reflect selected parameters of the environment. The data have been obtained prior to commencement of operations, providing a sound baseline for comparison with operational-phase data. The data will be evaluated to determine future impacts of the WIPP on the environment.

The focus of this program includes the following areas:

- Sample collection at specified locations in accordance with approved procedures. These procedures are based on established and accepted practices.

- Procedure review and revision to minimize uncertainties introduced through sampling and analysis, while maintaining comparability and continuity between past and future data.

- Verification of data through a continuing program of analytical laboratory quality control, including the performance of interlaboratory cross-checks, duplicate and split sample radiological analysis, and sample splits provided to the EEG, and to the NMED.

Requirements and guidance sources for QA Program content include the following: Title 10 CFR 830.120, *Nuclear Safety Management, Quality Assurance*; (CAO-94-1012), *DOE Carlsbad Area Office Quality Assurance Program Description*; (ASME NQA-1), *Quality Assurance Program Requirements for Nuclear Facilities*; (DOE Order 5700.6C), *Quality Assurance*. (DOE/EH-0173T), *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, and SW-846, *Test Methods for Evaluating Solid Waste*.

## 8.1 Sample Collection Methodologies

The WID follows approved sampling plans and procedures in the collection and handling of samples used in environmental monitoring. The sampling plans and procedures specify proper sampling techniques for the particular sample medium.

Elements of sample QA include specifying the following:

- Method used to select sampling sites
- Specific sampling methods to be used
- Containers, preservatives, transportation, and storage requirements
- Labeling requirements
- Preparatory measures for sampling equipment and containers
- Preservation methods and allowable hold times, including transportation
- Sample chain-of-custody
- Documentation used to record sample history, sampling conditions, and analyses

Sampling procedures are contained in the following documents:

- *WIPP Groundwater Monitoring Program Plan and Procedure Manual* (WP 02-1)
- *WIPP Environmental Procedures Manual* (WP 02-3)
- *Nonradioactive Hazardous Materials Environmental Compliance Manual* (WP 02-5)
- *Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling* (WP 02-EM1)
- *WIPP Site Effluent and Hazardous Materials Sampling Plan* (WP 02-EM2)
- *WIPP VOC Operating Procedures Manual* (WP 12-VC)
- *Quality Assurance Project Plan for Sampling Emissions of Radionuclides to the Ambient Air at the WIPP* (DOE-WIPP 93-042)

Chapter 11 of the EMP defines the policies and practices that are followed to ensure the data are accurate, complete, representative, and comparable. The data collected in the Nonradiological Environmental Surveillance monitoring programs are analyzed as stated in DOE/EH-0023 (Corley et al., 1981). Section 8.0 of the EMP discusses, at length, the statistical procedures used to analyze the data.

## 8.2 Revision of Procedures

Written procedures are essential in providing instruction to field personnel for sample collection. As data are collected, and records are generated, these procedures form the basis for an auditable program. The Q&RA Department and the Environmental Compliance Assessment Program (ECAP) periodically conduct assessments of environmental monitoring activities to determine the degree of compliance and effectiveness in implementation of the procedures.

In addition to independent assessment, one of the responsibilities of data collection personnel is to assess collection and analysis methodologies on a routine and ongoing basis. Field procedures, analytical procedures, and laboratory methodologies are periodically assessed for adequacy and effectiveness. Processes that require improvement are modified according to established document control procedures. The EEG and the NMED act as the performance based check-point to ensure that radiological sampling procedures are adequately implemented and that data are comparable among the WIPP, EEG, and the NMED samples.

## 8.3 Interlaboratory Comparisons

In 1995 the WIPP completed installation of a radiochemistry laboratory to perform sample preparation and chemical separations. Currently members of the radiochemistry laboratory are in the process of validating sample preparation and chemical separation methods.

The WIPP Radiochemistry Laboratory (RL) participated in both the DOE Environmental Measurements Laboratory Quality Assessment Program (DOE-EML QAP) and the Environmental Protection Agency's Performance Evaluation Study Program (EPA PESP) during 1995. Participation in these programs provides a means for the RL staff to upgrade analytical methodology, as well as provide hands-on experience in analysis of environmental samples for radionuclides. These programs provide simulated environmental samples which contain known amounts of one or more radionuclides. The samples are prepared and distributed to participating laboratories by the sponsoring agencies. Each laboratory performs the analysis for which they have the capabilities. Using standard analytical methods specific to that laboratory, the samples are analyzed and the results are reported electronically. The results for each laboratory participating in the programs are compared with known values then statistically analyzed. Results from the statistical analysis and the known values are then made available to participating laboratories.

Because the installation of the RL was not completed until the middle of 1995 the RL staff was unable to complete validation sample preparation and chemical separations methods during 1995. For this reason the capability of the RL to perform a wide variety of analysis on differing sample matrices was limited.

The WIPP RL submitted analysis results to DOE-EML for both rounds of the QAP in 1995. Results reported were from the analysis for gamma emitting radionuclides in a simulated air filter and in a water sample.

The WIPP RL used evaluation criteria from ANSI N13.30, "Performance Criteria for Radiobioassay", as a reference. The criteria is:

$$-0.25 \leq Br \leq 0.5$$

where Br is the relative bias and is defined as:

$$Br = (\text{reported result - known value}) \div (\text{known value})$$

The EML has recently established evaluation criteria based on historical reported values for each nuclide/matrix. Three ranges have been established for judging a laboratories performance. These ranges are "acceptable", "acceptable with warning", and "not acceptable". The criteria for acceptable performance has been chosen to be between the 15$^{th}$ and the 85$^{th}$ percentile of the cumulative normalized distribution. This can be viewed as the middle 70% of all measurements reported to EML. The acceptable interval is an analog to the one sigma interval of a normal distribution. The "acceptable with warning" criterium, is between the 5$^{th}$ and the 15$^{th}$ percentile on the low end. On the high end, it is between the 85$^{th}$ and 95$^{th}$ percentile. The "not acceptable" criteria is established at less than the 5$^{th}$ percentile or greater than the 95th percentile.

Acceptable performance ranges for each matrix and the WIPP Radiochemistry Laboratory analysis are not available from DOE-EML at this time. However, as shown in Table 2, the WIPP analytical results are well within the acceptance criteria listed in ANSI N13.30.

As in the DOE-EML QAP the WIPP RL used evaluation criteria from ANSI N13.30, "Performance Criteria for Radiobioassay" to evaluate its performance. The Br values are well within the limits of the reference criteria with the exception of the gross alpha/beta in water. This was the RL's first attempt at performing the analysis for gross alpha/beta in water. After the results were obtained from the EPA an extensive review of the analysis methods was performed and the root cause of the RL's poor performance were identified. Measures are being implemented to prevent a reoccurrence of the problem.

Table 8-1. WIPP Analytical Results for DOE-EML QAP, 1st Round CY-95

Evaluation Using EML Criteria

| Matrix | Nuclide | EML Known Value | WIPP Reported Value | WIPP Performance | Acceptable Performance | WIPP Performance (Acceptable yes/no) |
|---|---|---|---|---|---|---|
| Air Filter | $^{54}$Mn | 4.71 Bq/filter | 3.88 Bq/filter | 0.82 | 0.74 to 1.36 | yes |
| Air Filter | $^{57}$Co | 12.70 Bq/filter | 10.11 Bq/filter | 0.80 | 0.64 to 1.45 | yes |
| Air Filter | $^{60}$Co | 3.76 Bq/filter | 3.22 Bq/filter | 0.86 | 0.71 to 1.29 | yes |
| Air Filter | $^{125}$Sb | 9.42 Bq/filter | 8.72 Bq/filter | 0.93 | 0.50 to 1.50 | yes |
| Air Filter | $^{134}$Cs | 5.75 Bq/filter | 5.78 Bq/filter | 1.01 | 0.65 to 1.22 | yes |
| Air Filter | $^{137}$Cs | 5.28 Bq/filter | 4.39 Bq/filter | 0.83 | 0.69 to 1.32 | yes |
| Air Filter | $^{144}$Ce | 91.20 Bq/filter | 67.49 Bq/filter | 0.74 | 0.59 to 1.36 | yes |
| Water | $^{54}$Mn | 43.50 Bq/liter | 46.7 Bq/liter | 1.07 | 0.81 to 1.25 | yes |
| Water | $^{60}$Co | 196.0 Bq/liter | 212.0 Bq/liter | 1.08 | 0.79 to 1.18 | yes |
| Water | $^{134}$Cs | 83.5 Bq/liter | 93.6 Bq/liter | 1.12 | 0.74 to 1.29 | yes |
| Water | $^{137}$Cs | 76.8 Bq/liter | 84.9 Bq/liter | 1.11 | 0.82 to 1.29 | yes |

Notes: 1. WIPP Performance = $\frac{\text{WIPP Reported Value}}{\text{EML Known Value}}$

| Table 8-2. WIPP Analytical Results for DOE-EML QAP 2nd Round CY 1995<br>Evaluation Using Draft ANSI 13.30 Criteria | | | | |
|---|---|---|---|---|
| Nuclide | Matrix | Reported Result | Known Value | BR |
| $^{54}$Mn | Air Filter | 5.27 Bq/filter | 5.34 Bq/filter | -0.01 |
| $^{57}$Co | Air Filter | 14.91 Bq/filter | 14.70 Bq/filter | 0.01 |
| $^{60}$Co | Air Filter | 34.72 Bq/filter | 32.60 Bq/filter | -0.07 |
| $^{125}$Sb | Air Filter | 11.42 Bq/filter | 11.40 Bq/filter | -0.00 |
| $^{134}$Cs | Air Filter | 17.30 Bq/filter | 17.90 Bq/filter | -0.03 |
| $^{137}$Cs | Air Filter | 6.74 Bq/filter | 7.25 Bq/filter | -0.07 |
| $^{144}$Ce | Air Filter | 52.66 Bq/filter | 52.10 Bq/filter | 0.01 |
| $^{54}$Mn | Water | 55.58 Bq/liter | 44.90 Bq/liter | 0.24 |
| $^{60}$Co | Water | 233.77 Bq/liter | 196.00 Bq/liter | 0.19 |
| $^{137}$Cs | Water | 88.94 Bq/liter | 75.20 Bq/liter | 0.18 |

| Table 8-3. WIPP Analytical Results for EPA PESP, 1st Quarter CY-95 | | | | |
|---|---|---|---|---|
| Matrix | Analysis Performed | Reported Result | Known Value | Relative Bias (Br) |
| Water | $^{131}$I | 106.2 pCi/liter | 100.0 pCi/liter | 0.06 |

| Table 8-4. WIPP Analytical Results for EPA PESP, 2nd Quarter CY-95 | | | | |
|---|---|---|---|---|
| Matrix | Analysis Performed | Reported Result | Known Value | Relative Bias (Br) |
| Water | $^{3}$H | 7913.67 pCi/liter | 7435.0 pCi/liter | 0.06 |

| Table 8-5. WIPP Analytical Results for EPA PESP, 3rd Quarter CY-95 | | | | |
|---|---|---|---|---|
| Matrix | Analysis Performed | Reported Result | Known Value | Relative Bias (Br) |
| Water | $^{60}Co$ | 40.19 pCi/liter | 40.00 pCi/liter | 0.00 |
| Water | $^{65}Zn$ | 80.62 pCi/liter | 76.00 pCi/liter | 0.06 |
| Water | $^{134}Cs$ | 47.23 pCi/liter | 50.00 pCi/liter | -0.06 |
| Water | $^{137}Cs$ | 37.59 pCi/liter | 35.00 pCi/liter | 0.07 |
| Water | $^{133}Ba$ | 75.22 pCi/liter | 79.00 pCi/liter | -0.05 |
| Water | $^{3}H$ | 5049.85 pCi/liter | 4872.00 pCi/liter | -0.04 |

| Table 8-6. WIPP Analytical Results for EPA PESP, 4th Quarter CY-95 | | | | |
|---|---|---|---|---|
| Matrix | Analysis Performed | Reported Result | Known Value | Relative Bias (Br) |
| Air Filter | gross alpha | 26.11 pCi/filter | 25.00 pCi/liter | 0.04 |
| Air Filter | Gross beta | 93.59 pCi/filter | 86.00 pCi/liter | 0.09 |
| Air Filter | $^{137}Cs$ | 25.00 pCi/filter | 25.00 pCi/liter | 0.00 |
| Water | $^{131}I$ | 155.90 pCi/liter | 148.00 pCi/liter | 0.05 |
| Water | Gross alpha | 8.53 pCi/liter | 51.20 pCi/liter | -0.83 |
| Water | gross beta | 19.15 pCi/liter | 24.80 pCi/liter | -0.23 |

## 8.4 Analytical Laboratory Quality Assurance and Quality Control

During CY 1995 the WIPP extended contracts to the following analytical laboratories: Ross Analytical Services Inc. in Strongsville, Ohio; Accu-Labs in Golden, Colorado; and Datachem Laboratories in Salt Lake City, Utah. The contract laboratories are required to follow established QA/QC procedures as specified in the contract statement of work. Successful bidders performing environmental analyses are required to be on the Qualified Suppliers List and must undergo program reviews and assessments.

Laboratory QA/QC includes the following:

- Reviewing and approving of the laboratory QA plan
- Qualifying and training staff
- Specifying acceptable tolerances in data quality
- Performing internal laboratory QC
- Analyzing blind samples
- Calibrating and maintaining analytical equipment
- Reporting on the performance of measurement systems and data quality
- Reporting the performance of demonstration programs

### 8.5 Data Handling

Field data are collected and recorded in data books, organized by sample location and sampling round. Separate data books are prepared for sampling, field notes, and contract laboratory data. If samples are sent to more than one laboratory for analysis, then each lab has its own data book. Samples are collected and sent to the laboratory for analysis, accompanied by QC samples. Analytical results are verified through specifying method blanks, duplicates, spikes, and trip blanks. The Principle Investigator reviews the QC data against specified limits to determine whether the data set is suitable for inclusion in the report. The data are reported in the ASER.

## 8.6 Records Management

Documents and records generated under the CAO QA program are specified, prepared, reviewed, approved, controlled, and maintained in accordance with the *Carlsbad Area Office Quality Assurance Program Description* (QAPD) (CAO 94-1012). The QAPD provides a single reference for all WIPP project participants in meeting records management requirements as specified in DOE orders and regulations. Further records management requirements and procedures are provided in the *Carlsbad Area Office Information Management Plan* (CAO-94-1001).

All original records are maintained in fire resistant file cabinets until they are transmitted to the CAO Central Records Facility for permanent filing. All records, including raw data, calculations, computer programs, or other data manipulation media are subject to review and verification under the WIPP QAP and the ECAP. The Environmental Monitoring Section is responsible for validating these records before transmitting them to the CAO Central Records Facility in accordance with an approved Records Inventory Disposition Schedule.

Records (i.e., reports of analyses and sample receipt forms transmitted by contract analytical laboratories) are dated upon receipt and a copy made for QC review. Specific record and data management procedures including those referencing data manipulations are implemented according to the approved quality assurance project plan or work plan.

The WIPP complies with the *National Emission Standards for Hazardous Air Pollutants* record-keeping requirements issued under 40 CFR 61, Subpart H, which addresses atmospheric radionuclide emissions. Unless regulations are amended in the future, records developed pursuant to these criteria (i.e., Medical, Health and Safety Records) will be maintained at least 30 years as specified in DOE Order 1324.2A, *Records Disposition* (DOE, 1992), Chapter V, Attachment 1, Schedule 25.

Consistent record keeping for all aspects of the Environmental Monitoring Programs is a part of QA requirements. The EMP lists the required records, reports, and laws, regulations, or DOE Orders that contain the requirements.

# Chapter 9
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# APPENDIX A1
# RADIOLOGICAL ANALYSIS
# AIR

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-CBD 1.1<br>Air Sampling<br>1st Quarter<br>Carlsbad | Americium-241 | 3.59E-05 | 1.07E-05 |
| | Beryllium-7 | 2.70E-04 | 1.50E-04 |
| | Cesium-137 | -5.80E-06 | 1.00E-05 |
| | Cobalt-60 | -4.90E-06 | 8.50E-06 |
| | Lead-210 | 9.10E-04 | 2.10E-04 |
| | Plutonium-238 | -7.05E-07 | 4.15E-06 |
| | Plutonium-241 | 1.15E-03 | 2.44E-04 |
| | Plutonium-239/240 | 7.04E-07 | 2.39E-06 |
| | Polonium-210 | 4.11E-04 | 1.21E-05 |
| | Potassium-40 | 3.50E-04 | 1.20E-04 |
| | Radium-228 | 2.90E-05 | 3.40E-05 |
| | Radium-226 | 8.00E-04 | 2.70E-04 |
| | Strontium-90 | -1.40E-05 | 1.10E-05 |
| | Thorium-228 | 6.37E-06 | 6.62E-06 |
| | Thorium-230 | 2.52E-05 | 8.81E-06 |
| | Thorium-232 | 5.75E-06 | 4.45E-06 |
| | Uranium-233/234 | 1.62E-05 | 7.68E-06 |
| | Uranium-238 | 9.88E-06 | 5.53E-06 |
| | Uranium-235/236 | -8.70E-07 | 3.81E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-CBD 2.1 Air Sampling 2nd Quarter Carlsbad | Americium-241 | 4.43E-05 | 1.20E-05 |
| | Beryllium-7 | 8.40E-04 | 2.10E-04 |
| | Cesium-137 | 3.30E-06 | 1.10E-05 |
| | Cobalt-60 | 5.60E-06 | 9.30E-06 |
| | Lead-210 | 1.50E-04 | 1.70E-04 |
| | Plutonium-238 | 2.35E-06 | 4.61E-06 |
| | Plutonium-241 | 2.13E-03 | 2.45E-04 |
| | Plutonium-239/240 | -7.82E-07 | 2.66E-06 |
| | Polonium-210 | 7.03E-05 | 5.78E-06 |
| | Potassium-40 | 2.80E-04 | 1.10E-04 |
| | Radium-228 | 5.00E-05 | 3.70E-05 |
| | Radium-226 | 8.40E-04 | 2.90E-04 |
| | Strontium-90 | 6.10E-06 | 1.40E-05 |
| | Thorium-228 | 8.29E-06 | 7.44E-06 |
| | Thorium-230 | 1.91E-05 | 9.08E-06 |
| | Thorium-232 | 1.66E-06 | 3.26E-06 |
| | Uranium-233/234 | 1.63E-05 | 7.34E-06 |
| | Uranium-238 | 1.31E-05 | 5.73E-06 |
| | Uranium-235/236 | 4.03E-06 | 5.24E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-CBD 3.1 Air Sampling 3rd Quarter Carlsbad | Americium-241 | 3.20E-06 | 1.34E-06 |
| | Beryllium-7 | 6.90E-04 | 1.80E-04 |
| | Cesium-137 | 2.50E-07 | 8.70E-06 |
| | Cobalt-60 | 1.90E-06 | 7.30E-06 |
| | Lead-210 | 9.70E-04 | 2.10E-04 |
| | Plutonium-239/240 | 3.24E-07 | 4.50E-07 |
| | Plutonium-241 | -7.17E-04 | 8.22E-05 |
| | Plutonium-238 | 3.25E-07 | 1.19E-06 |
| | Polonium-210 | 3.12E-04 | 8.01E-06 |
| | Potassium-40 | 3.20E-05 | 1.70E-04 |
| | Radium-226 | 1.10E-04 | 1.70E-04 |
| | Radium-228 | 7.90E-05 | 3.20E-05 |
| | Strontium-90 | 2.40E-06 | 1.10E-05 |
| | Thorium-230 | 7.32E-06 | 1.93E-06 |
| | Thorium-228 | 3.21E-06 | 1.48E-06 |
| | Thorium-232 | 3.97E-06 | 1.44E-06 |
| | Uranium-238 | 9.03E-06 | 2.19E-06 |
| | Uranium-233/234 | 7.67E-06 | 2.09E-06 |
| | Uranium-235/236 | 9.98E-07 | 1.13E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-CBD 4.1<br>Air Sampling<br>4th Quarter<br>Carlsbad | Americium-241 | 2.56E-06 | 1.15E-06 |
| | Beryllium-7 | 2.90E-03 | 4.30E-04 |
| | Cesium-137 | 4.20E-06 | 8.50E-06 |
| | Cobalt-60 | -1.40E-06 | 7.40E-06 |
| | Lead-210 | 1.70E-03 | 2.70E-04 |
| | Plutonium-238 | 0.00E+00 | 5.15E-07 |
| | Plutonium-241 | -5.73E-04 | 6.79E-05 |
| | Plutonium-239/240 | 5.25E-07 | 6.30E-07 |
| | Polonium-210 | 2.92E-04 | 6.49E-06 |
| | Potassium-40 | 1.60E-04 | 1.70E-04 |
| | Radium-226 | 1.70E-05 | 1.70E-04 |
| | Radium-228 | 2.00E-05 | 3.00E-05 |
| | Strontium-90 | 1.10E-05 | 1.10E-05 |
| | Thorium-228 | 2.10E-06 | 1.11E-06 |
| | Thorium-230 | 6.15E-06 | 1.85E-06 |
| | Thorium-232 | 1.55E-06 | 9.07E-07 |
| | Uranium-233/234 | 4.96E-06 | 1.80E-06 |
| | Uranium-235/236 | 1.66E-07 | 5.63E-07 |
| | Uranium-238 | 2.55E-06 | 1.32E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-SMR 1.1 Air Sampling 1$^{st}$ Quarter Smith Ranch | Americium-241 | 3.95E-05 | 1.12E-05 |
| | Beryllium-7 | 4.00E-04 | 1.60E-04 |
| | Cesium-137 | 4.90E-06 | 8.10E-06 |
| | Cobalt-60 | 2.80E-07 | 6.60E-06 |
| | Lead-210 | 9.20E-04 | 2.20E-04 |
| | Plutonium-238 | 6.32E-06 | 6.86E-06 |
| | Plutonium-241 | 1.35E-03 | 2.73E-04 |
| | Plutonium-239/240 | 3.61E-06 | 5.00E-06 |
| | Polonium-210 | 4.09E-04 | 1.17E-05 |
| | Potassium-40 | 7.30E-05 | 1.80E-04 |
| | Radium-228 | 5.80E-05 | 3.00E-05 |
| | Radium-226 | 3.60E-04 | 1.50E-04 |
| | Strontium-90 | 1.40E-06 | 1.10E-05 |
| | Thorium-228 | 1.14E-05 | 9.75E-05 |
| | Thorium-230 | 1.78E-05 | 8.42E-06 |
| | Thorium-232 | 7.48E-06 | 6.35E-06 |
| | Uranium-233/234 | 1.34E-05 | 6.89E-06 |
| | Uranium-238 | 4.23E-06 | 5.17E-06 |
| | Uranium-235/236 | 8.69E-07 | 2.95E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-SMR 2.1 Air Sampling 2nd Quarter Smith Ranch | Americium-241 | 4.04E-05 | 1.13E-05 |
| | Beryllium-7 | 8.70E-04 | 2.10E-04 |
| | Cesium-137 | 3.10E-06 | 8.30E-06 |
| | Cobalt-60 | -4.60E-06 | 7.80E-06 |
| | Lead-210 | 1.90E-04 | 1.50E-04 |
| | Plutonium-238 | -8.45E-07 | 4.38E-06 |
| | Plutonium-241 | 2.62E-03 | 2.87E-04 |
| | Plutonium-239/240 | 8.44E-07 | 3.70E-06 |
| | Polonium-210 | 9.54E-05 | 5.37E-06 |
| | Potassium-40 | 1.00E-04 | 1.60E-04 |
| | Radium-228 | 7.50E-05 | 6.00E-05 |
| | Radium-226 | 7.00E-05 | 1.80E-04 |
| | Strontium-90 | 1.90E-06 | 1.20E-05 |
| | Thorium-228 | 1.28E-05 | 1.02E-05 |
| | Thorium-230 | 3.23E-05 | 1.04E-05 |
| | Thorium-232 | 1.90E-05 | 8.74E-06 |
| | Uranium-233/234 | 2.35E-05 | 8.48E-06 |
| | Uranium-238 | 1.78E-05 | 7.26E-06 |
| | Uranium-235/236 | 7.03E-06 | 4.87E-06 |

| SAMPLE ANALYSIS BY LOCATION· | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-SMR 3.1<br>Air Sampling<br>3rd Quarter<br>Smith Ranch | Americium-241 | 9.29E-06 | 2.17E-06 |
| | Beryllium-7 | 7.90E-04 | 1.70E-04 |
| | Cesium-137 | 2.50E-06 | 7.60E-06 |
| | Cobalt-60 | -4.80E-06 | 6.70E-06 |
| | Lead-210 | 9.90E-04 | 1.90E-04 |
| | Plutonium-239/240 | 1.53E-05 | 2.88E-06 |
| | Plutonium-241 | -6.26E-04 | 6.76E-05 |
| | Plutonium-238 | 5.56E-07 | 8.62E-07 |
| | Polonium-210 | 1.98E-04 | 6.81E-06 |
| | Potassium-40 | 1.60E-04 | 1.30E-04 |
| | Radium-226 | 1.90E-04 | 1.60E-04 |
| | Radium-228 | 5.60E-05 | 4.00E-05 |
| | Strontium-90 | -3.50E-06 | 8.90E-06 |
| | Thorium-230 | 2.13E-04 | 9.77E-06 |
| | Thorium-228 | 4.85E-06 | 1.78E-06 |
| | Thorium-232 | 4.18E-06 | 1.40E-06 |
| | Uranium-238 | 3.08E-04 | 1.24E-05 |
| | Uranium-233/234 | 5.24E-05 | 5.27E-06 |
| | Uranium-235/236 | 7.89E-06 | 2.30E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-SMR 4.1 Air Sampling 4th Quarter Smith Ranch | Americium-241 | 1.33E-06 | 1.13E-06 |
| | Beryllium-7 | 2.40E-03 | 4.00E-04 |
| | Cesium-137 | -7.10E-07 | 7.80E-06 |
| | Cobalt-60 | -8.50E-07 | 5.90E-06 |
| | Lead-210 | 1.60E-03 | 2.60E-04 |
| | Plutonium-238 | -4.17E-07 | 7.21E-07 |
| | Plutonium-241 | -4.53E-04 | 7.30E-05 |
| | Plutonium-239/240 | 8.33E-07 | 8.61E-07 |
| | Polonium-210 | 2.18E-04 | 6.60E-06 |
| | Potassium-40 | 2.10E-04 | 1.60E-04 |
| | Radium-226 | 1.10E-04 | 1.70E-04 |
| | Radium-228 | 1.70E-05 | 4.70E-05 |
| | Strontium-90 | 6.50E-06 | 9.20E-06 |
| | Thorium-228 | 2.80E-06 | 1.21E-06 |
| | Thorium-230 | 1.02E-05 | 2.25E-06 |
| | Thorium-232 | 2.03E-06 | 1.08E-06 |
| | Uranium-233/234 | 1.77E-06 | 1.36E-06 |
| | Uranium-235/236 | 0.00E+00 | 6.12E-07 |
| | Uranium-238 | 3.29E-06 | 1.49E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WFF 1.1 Air Sampling 1st Quarter WIPP Far Field | Americium-241 | 3.76E-05 | 9.84E-06 |
| | Beryllium-7 | 3.80E-04 | 1.50E-04 |
| | Cesium-137 | -1.10E-05 | 9.40E-06 |
| | Cobalt-60 | 5.20E-06 | 8.01E-06 |
| | Lead-210 | 9.50E-04 | 2.20E-04 |
| | Plutonium-238 | 2.13E-06 | 3.11E-06 |
| | Plutonium-241 | 1.25E-03 | 2.35E-04 |
| | Plutonium-239/240 | 1.42E-06 | 1.97E-06 |
| | Polonium-210 | 3.86E-04 | 1.08E-05 |
| | Potassium-40 | 2.30E-05 | 1.70E-04 |
| | Radium-228 | 3.60E-05 | 3.30E-05 |
| | Radium-226 | 7.70E-04 | 2.60E-04 |
| | Strontium-90 | 1.60E-05 | 1.40E-05 |
| | Thorium-228 | 1.26E-05 | 6.55E-06 |
| | Thorium-230 | 2.85E-05 | 9.05E-06 |
| | Thorium-232 | 4.27E-06 | 3.90E-06 |
| | Uranium-233/234 | 2.83E-05 | 1.21E-05 |
| | Uranium-238 | -1.57E-06 | 6.90E-06 |
| | Uranium-235/236 | 0.00E+00 | 6.59E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WFF 1.2<br>1st Quarter<br>Air Sampling<br>WIPP Far Field | Americium-241 | 5.64E-05 | 1.43E-05 |
| | Beryllium-7 | 5.40E-04 | 2.30E-04 |
| | Cesium-137 | -8.40E-08 | 1.10E-05 |
| | Cobalt-60 | 1.50E-05 | 9.30E-06 |
| | LEad-210 | 9.90E-04 | 2.60E-04 |
| | Plutonium-238 | -1.79E-06 | 4.31E-06 |
| | Plutonium-241 | 1.85E-03 | 3.01E-04 |
| | Plutonium-239/240 | 1.79E-06 | 3.51E-06 |
| | Polonium-210 | 3.54E-04 | 1.28E-05 |
| | Potassium-40 | 6.40E-05 | 2.40E-04 |
| | Radium-228 | 7.20E-05 | 3.80E-05 |
| | Radium-226 | 5.30E-04 | 2.00E-04 |
| | Strontium-90 | -4.40E-05 | 1.60E-05 |
| | Thorium-228 | 5.11E-06 | 9.17E-06 |
| | Thorium-230 | 2.68E-05 | 1.07E-05 |
| | Thorium-232 | 3.68E-06 | 4.42E-06 |
| | Uranium-233/234 | 1.18E-05 | 9.63E-06 |
| | Uranium-238 | 6.75E-06 | 6.19E-06 |
| | Uranium-235/236 | -2.08E-06 | 5.77E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WFF 2.1<br>2nd Quarter<br>Air Sampling<br>WIPP Far Field | Americium-241 | 3.51E-05 | 1.09E-05 |
| | Beryllium-7 | 5.90E-04 | 2.00E-04 |
| | Cesium-137 | 6.50E-06 | 1.10E-05 |
| | Cobalt-60 | -4.90E-06 | 1.10E-05 |
| | Lead-210 | 3.60E-04 | 2.00E-04 |
| | Plutonium-238 | -2.90E-06 | 4.01E-06 |
| | Plutonium-241 | 2.79E-03 | 2.54E-04 |
| | Plutonium-239/240 | -2.17E-06 | 3.75E-06 |
| | Polonium-210 | 1.13E-04 | 6.44E-06 |
| | Potassium-40 | 4.60E-04 | 1.40E-04 |
| | Radium-228 | 7.50E-05 | 5.30E-05 |
| | Radium-226 | 9.00E-04 | 3.10E-04 |
| | Strontium-90 | 1.40E-05 | 1.20E-05 |
| | Thorium-228 | 9.42E-06 | 7.22E-06 |
| | Thorium-230 | 5.75E-05 | 1.25E-05 |
| | Thorium-232 | 6.38E-06 | 5.01E-06 |
| | Uranium-233/234 | 3.33E-05 | 1.20E-05 |
| | Uranium-238 | 1.51E-05 | 8.39E-06 |
| | Uranium-235/236 | 7.85E-06 | 6.08E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WFF 2.2<br>Air Sampling<br>2nd Quarter<br>WIPP Far Field | Americium-241 | 1.22E-04 | 4.20E-05 |
| | Beryllium-7 | -3.40E-05 | 3.90E-04 |
| | Cesium-137 | 8.80E-05 | 5.50E-05 |
| | Cobalt-60 | 1.10E-05 | 3.10E-05 |
| | Lead-210 | 3.20E-03 | 5.40E-04 |
| | Plutonium-238 | 0.00E+00 | 1.76E-05 |
| | Plutonium-241 | 1.11E-02 | 1.07E-03 |
| | Plutonium-239/240 | 6.35E-06 | 1.52E-05 |
| | Polonium-210 | 2.48E-05 | 6.26E-06 |
| | Potassium-40 | 1.20E-05 | 7.30E-04 |
| | Radium-228 | 3.60E-04 | 1.30E-04 |
| | Radium-226 | 1.80E-03 | 6.80E-04 |
| | Strontium-90 | -1.30E-05 | 4.00E-05 |
| | Thorium-228 | 1.88E-05 | 2.86E-05 |
| | Thorium-230 | 1.94E-04 | 5.13E-05 |
| | Thorium-232 | 2.04E-05 | 1.89E-05 |
| | Uranium-233/234 | 1.12E-04 | 4.01E-05 |
| | Uranium-238 | 9.48E-05 | 3.78E-05 |
| | Uranium-235/236 | 1.77E-05 | 2.08E-05 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WFF 3.1<br>Air Sampling<br>3rd Quarter<br>WIPP Far Field | Americium-241 | 2.06E-06 | 1.24E-06 |
| | Beryllium-7 | 8.10E-04 | 1.90E-04 |
| | Cesium-137 | -2.00E-06 | 7.70E-06 |
| | Cobalt-60 | -5.00E-07 | 6.70E-06 |
| | Lead-210 | 3.40E-03 | 8.00E-04 |
| | Plutonium-239/240 | -1.39E-07 | 8.16E-07 |
| | Plutonium-241 | -5.99E-04 | 6.93E-05 |
| | Plutonium-238 | 0.00E+00 | 6.67E-07 |
| | Polonium-210 | 2.50E-04 | 8.00E-06 |
| | Potassium-40 | 8.70E-05 | 1.30E-04 |
| | Radium-226 | 1.30E-03 | 3.70E-04 |
| | Radium-228 | 2.80E-05 | 2.80E-05 |
| | Strontium-90 | -4.40E-06 | 9.90E-06 |
| | Thorium-230 | 8.49E-06 | 2.33E-06 |
| | Thorium-228 | 3.81E-06 | 1.62E-06 |
| | Thorium-232 | 5.18E-06 | 1.63E-06 |
| | Uranium-238 | 3.57E-05 | 4.21E-06 |
| | Uranium-233/234 | 2.19E-05 | 3.36E-06 |
| | Uranium-235/236 | 1.25E-06 | 9.72E-07 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WFF 4.1 Air Sampling 4th Quarter WIPP Far Field | Americium-241 | 1.48E-07 | 1.20E-06 |
| | Beryllium-7 | 2.40E-03 | 3.80E-04 |
| | Cesium-137 | -1.60E-06 | 9.10E-06 |
| | Cobalt-60 | -2.90E-06 | 7.70E-06 |
| | Lead-210 | 1.40E-03 | 2.50E-04 |
| | Plutonium-238 | -1.45E-07 | 6.35E-07 |
| | Plutonium-241 | -3.31E-04 | 7.86E-05 |
| | Plutonium-239/240 | 7.23E-07 | 8.51E-07 |
| | Polonium-210 | 2.40E-04 | 7.71E-06 |
| | Potassium-40 | 1.80E-04 | 1.50E-04 |
| | Radium-226 | 7.10E-04 | 2.30E-04 |
| | Radium-228 | 3.40E-06 | 3.30E-05 |
| | Strontium-90 | 2.60E-06 | 1.20E-05 |
| | Thorium-228 | 3.07E-06 | 1.59E-06 |
| | Thorium-230 | 6.38E-06 | 2.09E-06 |
| | Thorium-232 | 3.49E-06 | 1.36E-06 |
| | Uranium-233/234 | 6.29E-06 | 2.10E-06 |
| | Uranium-235/236 | 1.24E-06 | 1.04E-06 |
| | Uranium-238 | 2.58E-06 | 1.43E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-MLR 4.1<br>Air Sampling<br>4th Quarter<br>Mills Ranch | Americium-241 | 1.80E-06 | 1.23E-06 |
| | Beryllium-7 | 2.50E-03 | 4.10E-04 |
| | Cesium-137 | 1.40E-06 | 6.90E-06 |
| | Cobalt-60 | 4.70E-07 | 6.40E-06 |
| | Lead-210 | 1.50E-03 | 2.30E-04 |
| | Plutonium-238 | -6.64E-07 | 8.63E-07 |
| | Plutonium-241 | -7.85E-03 | 6.88E-04 |
| | Plutonium-239/240 | 6.64E-07 | 1.96E-06 |
| | Polonium 210 | 3.28E-04 | 7.76E-06 |
| | Potassium-40 | 8.40E-05 | 1.10E-04 |
| | Radium-226 | 3.60E-05 | 1.50E-04 |
| | Radium-228 | 2.50E-05 | 2.70E-05 |
| | Strontium-90 | 1.20E-05 | 9.20E-06 |
| | Thorium-228 | 4.08E-06 | 1.35E-06 |
| | Thorium-230 | 1.14E-05 | 2.30E-06 |
| | Thorium-232 | 2.94E-06 | 1.25E-06 |
| | Uranium-233/234 | 5.14E-06 | 1.76E-06 |
| | Uranium-235/236 | -4.53E-07 | 6.62E-07 |
| | Uranium-238 | 5.76E-06 | 1.75E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-MLR 3.1<br>Air Sampling<br>3[rd] Quarter<br>Mills Ranch | Americium-241 | 1.05E-06 | 7.31E-07 |
| | Beryllium-7 | 9.60E-04 | 2.10E-04 |
| | Cesium-137 | -2.80E-06 | 8.60E-06 |
| | Cobalt-60 | -2.80E-06 | 7.80E-06 |
| | Lead-210 | 9.50E-04 | 2.310E-04 |
| | Plutonium-239/240 | 1.40E-07 | 7.28E-07 |
| | Plutonium-241 | -8.75E-04 | 7.09E-05 |
| | Plutonium-238 | 0.00E+00 | 6.74E-07 |
| | Polonium 210 | 3.72E-04 | 9.40E-06 |
| | Potassium-40 | 4.00E-05 | 1.50E-04 |
| | Radium-226 | 8.20E-05 | 1.60E-04 |
| | Radium-228 | 6.30E-05 | 3.20E-05 |
| | Strontium-90 | 7.80E-06 | 9.70E-06 |
| | Thorium-230 | 7.67E-05 | 7.08E-06 |
| | Thorium-228 | 6.47E-06 | 2.50E-06 |
| | Thorium-232 | 7.70E-06 | 2.27E-06 |
| | Uranium-238 | 4.93E-06 | 1.71E-06 |
| | Uranium-233/234 | 6.52E-06 | 1.97E-06 |
| | Uranium-235/236 | 8.22E-07 | 9.67E-07 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-MLR 2.2<br>Air Sampling<br>2nd Quarter<br>Mills Ranch | Americium-241 | 2.88E-05 | 8.49E-06 |
| | Beryllium-7 | 3.20E-04 | 1.90E-04 |
| | Cesium-137 | 2.80E-06 | 9.70E-06 |
| | Cobalt-60 | -3.10E-06 | 8.20E-06 |
| | Lead-210 | 1.00E-04 | 1.90E-04 |
| | Plutonium-238 | -1.31E-06 | 2.57E-06 |
| | Plutonium-241 | 1.51E-03 | 2.21E-04 |
| | Plutonium-239/240 | -6.54E-07 | 1.28E-06 |
| | Polonium-210 | 4.86E-05 | 7.57E-06 |
| | Polonium-210 | 1.54E-02 | 9.15E-03 |
| | Potassium-40 | 2.30E-04 | 9.80E-05 |
| | Radium-226 | 7.20E-04 | 2.50E-04 |
| | Radium-228 | 5.60E-05 | 3.90E-05 |
| | Strontium-90 | -2.60E-06 | 1.10E-05 |
| | Thorium-230 | 2.47E-05 | 1.01E-05 |
| | Thorium-228 | 1.07E-05 | 7.89E-06 |
| | Thorium-232 | 6.17E-06 | 5.73E-06 |
| | Uranium-233/234 | 1.36E-05 | 7.82E-06 |
| | Uranium-238 | 1.13E-05 | 7.10E-06 |
| | Uranium-235/236 | 9.32E-07 | 4.08E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m⁻³ | COUNTING ERROR |
|---|---|---|---|
| AC-MLR 2.1<br>Air Sampling<br>2nd Quarter<br>Mills Ranch | Americium-241 | 3.69E-05 | 1.09E-05 |
| | Beryllium-7 | 4.40E-04 | 1.50E-04 |
| | Cesium-137 | 1.10E-05 | 7.80E-06 |
| | Cobalt-60 | 5.80E-07 | 7.00E-06 |
| | Lead-210 | 9.00E-05 | 1.50E-04 |
| | Plutonium-238 | 6.64E-07 | 3.44E-06 |
| | Plutonium-241 | 1.01E-03 | 2.19E-04 |
| | Plutonium-239/240 | 1.33E-06 | 2.60E-06 |
| | Polonium-210 | 4.23E-05 | 3.86E-06 |
| | Potassium-40 | 2.40E-05 | 1.40E-04 |
| | Radium-228 | 3.10E-05 | 2.80E-05 |
| | Radium-226 | 3.60E-05 | 1.90E-04 |
| | Strontium-90 | -4.10E-05 | 1.40E-05 |
| | Thorium-228 | 3.99E-06 | 5.19E-06 |
| | Thorium-230 | 2.74E-05 | 9.80E-06 |
| | Thorium-232 | 2.88E-06 | 3.46E-06 |
| | Uranium-233/234 | 1.89E-05 | 8.76E-06 |
| | Uranium-238 | 8.50E-06 | 5.58E-06 |
| | Uranium-235/236 | 1.61E-06 | 2.23E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-MLR 1.1<br>Air Sampling<br>1st Quarter<br>Mills Ranch | Americium-241 | 3.57E-05 | 1.01E-05 |
| | Beryllium-7 | 5.40E-04 | 2.10E-04 |
| | Cesium-137 | 3.80E-07 | 1.10E-05 |
| | Cobalt-60 | -8.00E-06 | 1.10E-05 |
| | Lead-210 | 1.00E-03 | 2.20E-04 |
| | Plutonium-238 | -7.63E-07 | 2.59E-06 |
| | Plutonium-241 | 1.13E-03 | 2.48E-04 |
| | Plutonium-239/240 | 7.62E-07 | 4.48E-06 |
| | Polonium-210 | 3.47E-04 | 1.48E-05 |
| | Potassium-40 | 3.80E-04 | 1.30E-04 |
| | Radium-228 | 6.10E-05 | 3.50E-05 |
| | Radium-226 | 8.20E-04 | 2.80E-04 |
| | Strontium-90 | -8.40E-06 | 1.10E-05 |
| | Thorium-228 | 7.16E-06 | 7.15E-06 |
| | Thorium-230 | 2.88E-05 | 9.35E-06 |
| | Thorium-232 | 3.59E-06 | 3.15E-06 |
| | Uranium-233/234 | 8.50E-05 | 2.04E-05 |
| | Uranium-238 | 1.06E-05 | 8.36E-06 |
| | Uranium-235/236 | 5.84E-06 | 5.72E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m⁻³ | COUNTING ERROR |
|---|---|---|---|
| AC-WSS 4.1<br>Air Sampling<br>4th Quarter<br>WIPP South | Americium-241 | 1.40E-07 | 7.28E-07 |
| | Beryllium-7 | 2.60E-03 | 4.40E-04 |
| | Cesium-137 | 4.40E-06 | 7.90E-06 |
| | Cobalt-60 | 1.80E-06 | 6.40E-06 |
| | Lead-210 | 1.40E-03 | 2.40E-04 |
| | Plutonium-238 | 3.70E-07 | 5.40E-07 |
| | Plutonium-241 | -6.95E-03 | 6.30E-04 |
| | Plutonium-239/240 | 3.69E-07 | 6.39E-07 |
| | Polonium 210 | 2.95E-04 | 7.27E-06 |
| | Potassium-40 | 1.30E-04 | 1.80E-04 |
| | Radium-226 | 8.50E-05 | 1.70E-04 |
| | Radium-228 | 5.20E-05 | 3.00E-05 |
| | Strontium-90 | -5.80E-07 | 7.70E-06 |
| | Thorium-228 | 2.90E-06 | 1.23E-06 |
| | Thorium-230 | 6.24E-06 | 1.71E-06 |
| | Thorium-232 | 2.14E-06 | 1.10E-06 |
| | Uranium-233/234 | 2.08E-05 | 3.22E-06 |
| | Uranium-235/236 | 1.66E-06 | 1.07E-06 |
| | Uranium-238 | 2.78E-05 | 3.67E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WSS 3.2<br>Air Sampling<br>3rd Quarter<br>WIPP South | Americium-241 | 1.88E-06 | 1.24E-06 |
| | Beryllium-7 | 9.30E-05 | 8.80E-05 |
| | Cesium-137 | 2.90E-06 | 7.70E-06 |
| | Cobalt-60 | 1.70E-06 | 6.70E-06 |
| | Lead-210 | 3.10E-03 | 8.50E-04 |
| | Plutonium-239/240 | 1.07E-06 | 8.99E-07 |
| | Plutonium-241 | -8.18E-04 | 7.96E-05 |
| | Plutonium-238 | -4.59E-07 | 5.19E-07 |
| | Polonium 210 | 2.78E-04 | 9.90E-06 |
| | Potassium-40 | -5.70E-05 | 5.60E-05 |
| | Radium-226 | 6.10E-05 | 7.40E-04 |
| | Radium-228 | -2.40E-05 | 2.80E-05 |
| | Strontium-90 | 2.70E-06 | 8.90E-06 |
| | Thorium-230 | 1.06E-05 | 2.29E-06 |
| | Thorium-228 | 5.02E-06 | 1.73E-06 |
| | Thorium-232 | 4.80E-06 | 1.58E-06 |
| | Uranium-238 | 5.99E-06 | 1.77E-06 |
| | Uranium-233/234 | 7.61E-06 | 2.13E-06 |
| | Uranium-235/236 | 3.36E-07 | 9.32E-07 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WSS 3.1<br>Air Sampling<br>3rd Quarter<br>WIPP South | Americium-241 | 1.83E-06 | 1.46E-06 |
| | Beryllium-7 | 8.20E-04 | 1.90E-04 |
| | Cesium-137 | 4.30E-06 | 8.10E-06 |
| | Cobalt-60 | -9.10E-06 | 7.30E-06 |
| | Lead-210 | 8.70E-04 | 1.80E-04 |
| | Plutonium-239/240 | 6.59E-07 | 6.46E-07 |
| | Plutonium-241 | -9.01E-04 | 8.50E-05 |
| | Plutonium-238 | 1.65E-07 | 5.60E-07 |
| | Polonium 210 | 2.80E-04 | 1.01E-05 |
| | Potassium-40 | 2.40E-04 | 1.60E-04 |
| | Radium-226 | 7.00E-04 | 2.40E-04 |
| | Radium-228 | 4.50E-05 | 2.90E-05 |
| | Strontium-90 | -5.70E-06 | 1.20E-05 |
| | Thorium-230 | 1.07E-05 | 2.54E-06 |
| | Thorium-228 | 5.34E-06 | 1.88E-06 |
| | Thorium-232 | 4.40E-06 | 1.69E-06 |
| | Uranium-238 | 8.28E-06 | 2.28E-06 |
| | Uranium-233/234 | 6.64E-06 | 2.07E-06 |
| | Uranium-235/236 | 0.00E+00 | 8.76E-07 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WSS 2.1<br>Air Sampling<br>2nd Quarter<br>WIPP South | Americium-241 | 3.33E-05 | 1.01E-05 |
| | Beryllium-7 | 2.00E-04 | 1.60E-04 |
| | Cesium-137 | -2.60E-06 | 8.70E-06 |
| | Cobalt-60 | 1.20E-05 | 8.30E-06 |
| | Lead-210 | 6.80E-05 | 2.10E-04 |
| | Plutonium-238 | 0.00E+00 | 3.37E-06 |
| | Plutonium-241 | 7.28E-04 | 2.33E-04 |
| | Plutonium-239/240 | 3.51E-06 | 3.07E-06 |
| | Polonium-210 | 4.34E-05 | 4.72E-06 |
| | Potassium-40 | 1.00E-03 | 2.20E-04 |
| | Radium-228 | 7.60E-05 | 6.10E-05 |
| | Radium-226 | 3.50E-04 | 1.50E-04 |
| | Strontium-90 | -6.80E-06 | 1.20E-05 |
| | Thorium-228 | 5.77E-06 | 5.36E-06 |
| | Thorium-230 | 3.36E-05 | 1.04E-05 |
| | Thorium-232 | 5.95E-06 | 4.61E-06 |
| | Uranium-233/234 | 1.87E-05 | 1.32E-05 |
| | Uranium-238 | 7.89E-06 | 7.23E-06 |
| | Uranium-235/236 | 1.22E-06 | 5.33E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WSS 1.1<br>Air Sampling<br>1st Quarter<br>WIPP South | Americium-241 | 4.96E-05 | 1.17E-05 |
| | Beryllium-7 | 3.20E-04 | 1.60E-04 |
| | Cesium-137 | -6.90E-06 | 8.10E-06 |
| | Cobalt-60 | -5.50E-06 | 7.60E-06 |
| | Lead-210 | 8.90E-04 | 2.00E-04 |
| | Plutonium-238 | 1.49E-06 | 2.92E-06 |
| | Plutonium-241 | 1.84E-03 | 2.56E-04 |
| | Plutonium-239/240 | 0.00E+00 | 5.06E-06 |
| | Polonium-210 | 4.03E-04 | 1.39E-05 |
| | Potassium-40 | 1.40E-04 | 1.60E-04 |
| | Radium-228 | 4.30E-05 | 3.10E-05 |
| | Radium-226 | 5.40E-05 | 1.70E-04 |
| | Strontium-90 | -4.30E-06 | 1.30E-05 |
| | Thorium-228 | 1.45E-05 | 8.67E-06 |
| | Thorium-230 | 3.28E-05 | 1.04E-05 |
| | Thorium-232 | 4.37E-06 | 4.04E-06 |
| | Uranium-233/234 | 2.07E-05 | 9.36E-06 |
| | Uranium-238 | 7.85E-06 | 6.10E-06 |
| | Uranium-235/236 | 2.64E-06 | 3.86E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WEE Air Sample 4th Quarter WIPP East | Americium-241 | 9.30E-07 | 1.13E-06 |
| | Beryllium-7 | 2.40E-03 | 3.80E-04 |
| | Cesium-137 | -2.60E-06 | 8.10E-06 |
| | Cobalt-60 | -3.90E-06 | 7.50E-06 |
| | Lead-210 | 1.50E-03 | 2.60E-04 |
| | Plutonium-238 | -2.63E-07 | 5.15E-07 |
| | Plutonium-241 | -4.20E-03 | 6.84E-04 |
| | Plutonium-239/240 | 5.25E-07 | 6.31E-07 |
| | Polonium 210 | 3.56E-04 | 7.22E-06 |
| | Potassium-40 | 1.50E-04 | 1.60E-04 |
| | Radium-226 | 9.50E-05 | 1.70E-04 |
| | Radium-228 | 4.80E-05 | 3.10E-05 |
| | Strontium-90 | -4.40E-07 | 9.20E-06 |
| | Thorium-228 | 2.87E-06 | 1.28E-06 |
| | Thorium-230 | 4.91E-06 | 1.56E-06 |
| | Thorium-232 | 2.90E-06 | 1.18E-06 |
| | Uranium-233/234 | 3.81E-06 | 1.58E-06 |
| | Uranium-235/236 | -1.57E-07 | 1.11E-06 |
| | Uranium-238 | 4.58E-06 | 1.54E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WEE 4.1<br>Air Sample<br>4th Quarter<br>WIPP East | Americium-241 | 5.39E-07 | 9.87E-07 |
| | Beryllium-7 | 2.60E-03 | 4.40E-04 |
| | Cesium-137 | 7.60E-06 | 8.00E-06 |
| | Cobalt-60 | 1.10E-06 | 6.30E-06 |
| | Lead-210 | 1.70E-03 | 2.70E-04 |
| | Plutonium-238 | 3.89E-07 | 6.73E-07 |
| | Plutonium-241 | -3.15E-04 | 6.61E-05 |
| | Plutonium-239/240 | 5.19E-07 | 6.23E-07 |
| | Polonium 210 | 2.16E-04 | 5.30E-06 |
| | Potassium-40 | 1.10E-04 | 1.50E-04 |
| | Radium-226 | 6.30E-05 | 1.70E-04 |
| | Radium-228 | 5.00E-05 | 2.90E-05 |
| | Strontium-90 | -5.30E-07 | 2.00E-06 |
| | Thorium-228 | 2.75E-06 | 1.35E-06 |
| | Thorium-230 | 6.55E-06 | 1.86E-06 |
| | Thorium-232 | 2.67E-06 | 1.09E-06 |
| | Uranium-233/234 | 3.50E-06 | 1.51E-06 |
| | Uranium-235/236 | 0.00E+00 | 7.70E-07 |
| | Uranium-238 | 2.21E-06 | 1.27E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WEE 3.2<br>Air Sample<br>3rd Quarter<br>WIPP East | Americium-241 | 1.11E-06 | 9.35E-07 |
| | Beryllium-7 | 6.00E-04 | 1.80E-04 |
| | Cesium-137 | 2.90E-07 | 1.00E-05 |
| | Cobalt-60 | 2.00E-06 | 8.60E-06 |
| | Lead-210 | 9.80E-04 | 2.50E-04 |
| | Plutonium-239/240 | 3.68E-07 | 8.83E-07 |
| | Plutonium-241 | -9.98E-04 | 9.36E-05 |
| | Plutonium-238 | 3.68E-07 | 7.21E-07 |
| | Polonium 210 | 3.16E-04 | 8.97E-06 |
| | Potassium-40 | 1.00E-04 | 2.10E-04 |
| | Radium-226 | 8.50E-05 | 2.00E-04 |
| | Radium-228 | 7.30E-05 | 5.50E-05 |
| | Strontium-90 | 5.00E-06 | 1.30E-05 |
| | Thorium-230 | 9.79E-06 | 2.48E-06 |
| | Thorium-228 | 5.69E-06 | 1.87E-06 |
| | Thorium-232 | 3.77E-06 | 1.42E-06 |
| | Uranium-238 | 5.76E-05 | 6.13E-06 |
| | Uranium-233/234 | 4.69E-05 | 5.55E-06 |
| | Uranium-235/236 | 3.75E-06 | 1.83E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m⁻³ | COUNTING ERROR |
|---|---|---|---|
| AC-WEE 3.1 Air Sample 3rd Quarter WIPP East | Americium-241 | 3.05E-06 | 1.42E-06 |
| | Beryllium-7 | 8.20E-04 | 2.20E-04 |
| | Cesium-137 | -4.30E-06 | 9.60E-06 |
| | Cobalt-60 | -9.70E-06 | 8.70E-06 |
| | Lead-210 | 8.30E-04 | 2.10E-04 |
| | Plutonium-239/240 | 4.97E-07 | 1.08E-06 |
| | Plutonium-241 | -8.45E-04 | 8.52E-05 |
| | Plutonium-238 | 0.00E+00 | 6.50E-07 |
| | Polonium 210 | 2.81E-04 | 9.33E-06 |
| | Potassium-40 | 5.20E-05 | 1.70E-04 |
| | Radium-226 | 1.40E-06 | 1.80E-04 |
| | Radium-228 | 3.40E-05 | 3.50E-05 |
| | Strontium-90 | -2.20E-06 | 1.40E-05 |
| | Thorium-230 | 1.28E-05 | 2.58E-06 |
| | Thorium-228 | 3.47E-06 | 1.51E-06 |
| | Thorium-232 | 2.92E-06 | 1.38E-06 |
| | Uranium-238 | 1.21E-04 | 8.25E-06 |
| | Uranium-233/234 | 7.83E-05 | 6.63E-06 |
| | Uranium-235/236 | 6.44E-06 | 2.16E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WEE 2.2<br>Air Sample<br>2nd Quarter<br>WIPP East | Americium-241 | 4.11E-05 | 1.21E-05 |
| | Beryllium-7 | 5.20E-04 | 1.70E-04 |
| | Cesium-137 | 1.10E-05 | 1.00E-05 |
| | Cobalt-60 | -2.40E-06 | 9.10E-06 |
| | Lead-210 | 5.90E-05 | 2.10E-04 |
| | Plutonium-238 | -2.27E-06 | 3.92E-06 |
| | Plutonium-241 | 1.00E-03 | 2.55E-04 |
| | Plutonium-239/240 | 1.51E-06 | 2.96E-06 |
| | Polonium-210 | 7.08E-05 | 5.71E-06 |
| | Potassium-40 | 2.20E-04 | 1.10E-04 |
| | Radium-228 | 4.20E-06 | 3.60E-05 |
| | Radium-226 | 8.90E-04 | 3.00E-04 |
| | Strontium-90 | -1.10E-05 | 1.30E-05 |
| | Thorium-228 | 6.02E-06 | 7.72E-06 |
| | Thorium-230 | 3.65E-05 | 1.13E-05 |
| | Thorium-232 | 0.00E+00 | 3.04E-06 |
| | Uranium-233/234 | 2.23E-05 | 9.83E-06 |
| | Uranium-238 | 1.24E-05 | 8.41E-06 |
| | Uranium-235/236 | 1.02E-06 | 2.00E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WEE 2.1<br>Air Sampling<br>2nd Quarter<br>WIPP East | Americium-241 | 3.47E-05 | 1.10E-05 |
| | Beryllium-7 | 2.60E-04 | 1.60E-04 |
| | Cesium-137 | 3.20E-05 | 1.60E-05 |
| | Cobalt-60 | -3.40E-07 | 8.70E-06 |
| | Lead-210 | 1.40E-04 | 1.50E-04 |
| | Plutonium-238 | -1.65E-06 | 3.95E-06 |
| | Plutonium-241 | 2.45E-03 | 2.89E-04 |
| | Plutonium-239/240 | 0.00E+00 | 3.94E-06 |
| | Polonium-210 | 5.28E-05 | 4.83E-06 |
| | Potassium-40 | 2.00E-04 | 1.10E-04 |
| | Radium-226 | 6.30E-05 | 1.80E-04 |
| | Radium-228 | 3.30E-05 | 3.70E-05 |
| | Strontium-90 | -4.00E-06 | 1.60E-05 |
| | Thorium-230 | 4.55E-05 | 1.30E-05 |
| | Thorium-228 | 8.39E-06 | 7.54E-06 |
| | Thorium-232 | 5.05E-06 | 4.66E-06 |
| | Uranium-233/234 | 2.92E-05 | 1.09E-05 |
| | Uranium-238 | 2.25E-05 | 8.31E-06 |
| | Uranium-235/236 | 4.62E-06 | 4.05E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WEE 1.2 Air Sampling 1[st] Quarter WIPP East | Americium-241 | 6.46E-04 | 1.64E-04 |
| | Beryllium-7 | 7.30E-04 | 1.20E-03 |
| | Cesium-137 | -5.40E-05 | 1.10E-04 |
| | Cobalt-60 | 8.00E-05 | 8.20E-05 |
| | Lead-210 | 1.70E-03 | 2.40E-03 |
| | Plutonium-238 | -1.83E-05 | 4.40E-05 |
| | Plutonium-241 | 2.20E-02 | 3.06E-03 |
| | Plutonium-239/240 | 4.57E-05 | 4.01E-05 |
| | Polonium-210 | 4.37E-04 | 5.05E-05 |
| | Potassium-40 | 1.20E-02 | 2.50E-03 |
| | Radium-228 | 9.80E-04 | 3.90E-04 |
| | Radium-226 | 5.40E-03 | 2.00E-03 |
| | Strontium-90 | -6.40E-05 | 1.50E-04 |
| | Thorium-228 | 0.00E+00 | 4.63E-05 |
| | Thorium-230 | 1.92E-04 | 9.04E-05 |
| | Thorium-232 | 8.70E-06 | 3.81E-05 |
| | Uranium-233/234 | 3.07E-04 | 1.18E-04 |
| | Uranium-238 | 4.99E-05 | 6.91E-05 |
| | Uranium-235/236 | 3.08E-05 | 4.49E-05 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT $Bq/m^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WEE 1.1 Air Sampling 1st Quarter WIPP East | Americium-241 | 5.35E-05 | 1.25E-05 |
| | Beryllium-7 | 4.50E-04 | 1.60E-04 |
| | Cesium-137 | -4.80E-06 | 8.10E-06 |
| | Cobalt-60 | 4.40E-07 | 7.60E-06 |
| | Lead-210 | 9.00E-04 | 2.00E-04 |
| | Plutonium-238 | 0.00E+00 | 2.25E-06 |
| | Plutonium-241 | 2.00E-03 | 2.86E-04 |
| | Plutonium-239/240 | 8.11E-07 | 4.77E-06 |
| | Polonium-210 | 3.68E-04 | 1.05E-05 |
| | Potassium-40 | 1.30E-04 | 1.70E-04 |
| | Radium-228 | 2.70E-05 | 3.10E-05 |
| | Radium-226 | 3.90E-05 | 1.70E-04 |
| | Strontium-90 | 8.60E-06 | 1.10E-05 |
| | Thorium-228 | 9.09E-07 | 6.42E-06 |
| | Thorium-230 | 3.04E-05 | 1.06E-05 |
| | Thorium-232 | 4.10E-06 | 5.33E-06 |
| | Uranium-233/234 | 1.47E-05 | 8.12E-06 |
| | Uranium-238 | 8.07E-06 | 6.59E-06 |
| | Uranium-235/236 | -5.43E-06 | 4.35E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-SEC 1.1<br>Air Sampling<br>1st Quarter<br>South East Control | Americium-241 | 3.55E-05 | 1.06E-05 |
| | Beryllium-7 | 4.00E-04 | 1.60E-04 |
| | Cesium-137 | 1.70E-06 | 9.60E-06 |
| | Cobalt-60 | 1.20E-05 | 8.40E-06 |
| | Lead-210 | 9.60E-04 | 2.40E-04 |
| | Plutonium-238 | 0.00E+00 | 3.57E-06 |
| | Plutonium-241 | 2.32E-03 | 3.28E-04 |
| | Plutonium-239/240 | 0.00E+00 | 2.65E-06 |
| | Polonium-210 | 3.54E-04 | 1.45E-05 |
| | Potassium-40 | 2.00E-04 | 2.20E-04 |
| | Radium-228 | 7.40E-05 | 3.40E-05 |
| | Radium-226 | 5.60E-04 | 2.00E-04 |
| | Strontium-90 | 1.80E-06 | 1.30E-05 |
| | Thorium-228 | 7.64E-06 | 4.99E-06 |
| | Thorium-230 | 3.15E-05 | 1.01E-05 |
| | Thorium-232 | 3.06E-06 | 4.75E-06 |
| | Uranium-233/234 | 1.38E-05 | 7.93E-06 |
| | Uranium-238 | 7.30E-06 | 6.16E-06 |
| | Uranium-235/236 | -1.00E-06 | 1.96E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-SEC 1.2<br>Air Sampling<br>1st Quarter<br>South East Control | Americium-241 | 5.07E-05 | 1.20E-05 |
| | Beryllium-7 | 4.30E-04 | 1.50E-04 |
| | Cesium-137 | 4.90E-06 | 8.10E-06 |
| | Cobalt-60 | 1.30E-06 | 7.80E-06 |
| | Lead-210 | 9.60E-04 | 2.00E-04 |
| | Plutonium-238 | -1.51E-06 | 4.19E-06 |
| | Plutonium-241 | 2.56E-03 | 2.71E-04 |
| | Plutonium-239/240 | 0.00E+00 | 3.62E-06 |
| | Polonium-210 | 3.95E-04 | 1.09E-05 |
| | Potassium-40 | 1.50E-04 | 1.60E-04 |
| | Radium-228 | 3.70E-05 | 3.10E-05 |
| | Radium-226 | 3.70E-05 | 6.40E-04 |
| | Strontium-90 | 1.90E-05 | 1.50E-05 |
| | Thorium-228 | 7.79E-07 | 4.04E-06 |
| | Thorium-230 | 2.18E-05 | 7.69E-06 |
| | Thorium-232 | 2.11E-06 | 3.08E-06 |
| | Uranium-233/234 | 1.74E-05 | 9.00E-06 |
| | Uranium-238 | 5.82E-06 | 6.37E-06 |
| | Uranium-235/236 | 8.97E-07 | 4.65E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-SEC 2.1 Air Sampling 2[nd] Quarter South East Control | Americium-241 | 2.56E-05 | 9.66E-06 |
| | Beryllium-7 | 5.90E-04 | 2.10E-04 |
| | Cesium-137 | 3.20E-06 | 1.00E-05 |
| | Cobalt-60 | 4.20E-06 | 9.30E-06 |
| | Lead-210 | 1.10E-04 | 2.30E-04 |
| | Plutonium-238 | -1.57E-06 | 3.78E-06 |
| | Plutonium-241 | 2.81E-03 | 2.73E-04 |
| | Plutonium-239/240 | 1.57E-06 | 3.77E-06 |
| | Polonium-210 | 5.60E-05 | 3.95E-06 |
| | Potassium-40 | 1.20E-03 | 2.50E-04 |
| | Radium-228 | 7.90E-05 | 4.30E-05 |
| | Radium-226 | 7.40E-05 | 2.50E-04 |
| | Strontium-90 | -1.30E-05 | 1.50E-05 |
| | Thorium-228 | 7.98E-06 | 7.58E-06 |
| | Thorium-230 | 2.89E-05 | 9.68E-06 |
| | Thorium-232 | 2.40E-06 | 3.51E-06 |
| | Uranium-233/234 | 3.05E-05 | 1.10E-05 |
| | Uranium-238 | 1.80E-05 | 7.38E-06 |
| | Uranium-235/236 | 9.68E-07 | 3.29E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-SEC 3.1 Air Sampling 3rd Quarter South East Control | Americium-241 | 2.38E-06 | 1.37E-06 |
| | Beryllium-7 | 8.50E-04 | 2.10E-04 |
| | Cesium-137 | 9.70E-06 | 9.50E-06 |
| | Cobalt-60 | 8.90E-06 | 7.80E-06 |
| | Lead-210 | 9.70E-04 | 2.20E-04 |
| | Plutonium-239/240 | 1.46E-06 | 9.07E-07 |
| | Plutonium-241 | -9.32E-04 | 7.09E-05 |
| | Plutonium-238 | -2.93E-07 | 7.03E-07 |
| | Poloniun 210 | 3.99E-04 | 9.92E-06 |
| | Potassium-40 | 1.20E-04 | 1.90E-04 |
| | Radium-226 | 9.10E-05 | 1.80E-04 |
| | Radium-228 | 5.90E-05 | 5.90E-05 |
| | Strontium-90 | 3.70E-06 | 9.50E-06 |
| | Thorium-230 | 1.03E-05 | 2.40E-06 |
| | Thorium-228 | 4.90E-06 | 2.04E-06 |
| | Thorium-232 | 5.50E-06 | 1.88E-06 |
| | Uranium-238 | 6.53E-06 | 2.16E-06 |
| | Uranium-233/234 | 3.10E-06 | 1.97E-06 |
| | Uranium-235/236 | 7.67E-07 | 1.06E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-SEC 4.1<br>Air Sampling<br>4th Quarter<br>South East Control | Americium-241 | 2.72E-06 | 1.35E-06 |
| | Beryllium-7 | 2.80E-03 | 4.10E-04 |
| | Cesium-137 | 6.60E-06 | 7.90E-06 |
| | Cobalt-60 | -5.90E-06 | 7.00E-06 |
| | Lead-210 | 5.90E-03 | 1.10E-03 |
| | Plutonium-238 | -4.09E-07 | 4.63E-07 |
| | Plutonium-241 | -6.13E-03 | 7.29E-04 |
| | Plutonium-239/240 | 8.18E-07 | 6.55E-07 |
| | Polonium 210 | 3.26E-04 | 7.51E-06 |
| | Potassium-40 | 2.10E-04 | 1.50E-04 |
| | Radium-226 | 1.30E-03 | 3.70E-04 |
| | Radium-228 | 4.00E-05 | 2.80E-05 |
| | Strontium-90 | 2.70E-06 | 9.90E-06 |
| | Thorium-228 | 2.93E-06 | 1.40E-06 |
| | Thorium-230 | 7.55E-06 | 2.06E-06 |
| | Thorium-232 | 3.06E-06 | 1.20E-06 |
| | Uranium-233/234 | 1.06E-05 | 2.45E-06 |
| | Uranium-235/236 | 7.79E-07 | 6.83E-07 |
| | Uranium-238 | 5.10E-05 | 4.99E-06 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WAB 1.1<br>Air Sampling<br>1st Quarter<br>Blank Filter Analysis | Americium-241 | 5.58E-05 | 1.08E-01 |
| | Beryllium-7 | -1.48E-04 | 7.00E-01 |
| | Cesium-137 | 1.48E-06 | 6.70E-02 |
| | Cobalt-60 | -1.75E-06 | 6.80E-02 |
| | Lead-210 | 7.69E-05 | 1.10E+00 |
| | Plutonium-238 | 6.70E-07 | 9.75E-03 |
| | Plutonium-241 | 2.21E-03 | 1.78E+00 |
| | Plutonium-239/240 | 4.02E-06 | 2.75E-02 |
| | Polonium-210 | 6.77E-07 | 5.80E-03 |
| | Potassium-40 | 2.56E-04 | 8.30E-01 |
| | Radium-228 | 2.16E-05 | 2.80E-01 |
| | Radium-226 | 7.86E-04 | 2.00E+00 |
| | Strontium-90 | 1.08E-05 | 9.60E-02 |
| | Thorium-228 | 2.16E-06 | 2.34E-02 |
| | Thorium-230 | 6.50E-07 | 6.14E-02 |
| | Thorium-232 | 2.35E-05 | 2.50E-02 |
| | Uranium-233/234 | 6.50E-07 | 5.85E-02 |
| | Uranium-238 | 1.58E-05 | 4.29E-02 |
| | Uranium-235/236 | 0.00 | 3.91E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WAB 1.2<br>Air Sampling<br>1st Quarter<br>Blank Filter Anlaysis | Americium-241 | 3.61E-05 | 7.36E-02 |
| | Beryllium-7 | 2.70E-05 | 6.80E-01 |
| | Cesium-137 | 8.22E-07 | 5.80E-02 |
| | Cobalt-60 | 6.88E-06 | 5.00E-02 |
| | Lead-210 | 7.42E-04 | 9.00E-01 |
| | Plutonium-238 | 0.00E+00 | 4.28E-02 |
| | Plutonium-241 | 4.15E-03 | 3.19E+00 |
| | Plutonium-239/240 | 2.40E-06 | 3.49E-02 |
| | Polonium-210 | 2.70E-07 | 6.26E-03 |
| | Potassium-40 | 9.71E-04 | 1.50E+00 |
| | Radium-228 | 4.31E-05 | 2.00E-01 |
| | Radium-226 | 3.64E-04 | 1.10E+00 |
| | Strontium-90 | -2.16E-05 | 9.30E-02 |
| | Thorium-228 | 2.98E-06 | 3.42E-02 |
| | Thorium-230 | 1.82E-05 | 5.79E-02 |
| | Thorium-232 | 2.01E-06 | 2.18E-02 |
| | Uranium-233/234 | 1.02E-05 | 5.66E-02 |
| | Uranium-238 | 4.76E-06 | 3.56E-02 |
| | Uranium-235/236 | 0.00E+00 | 2.99E-02 |

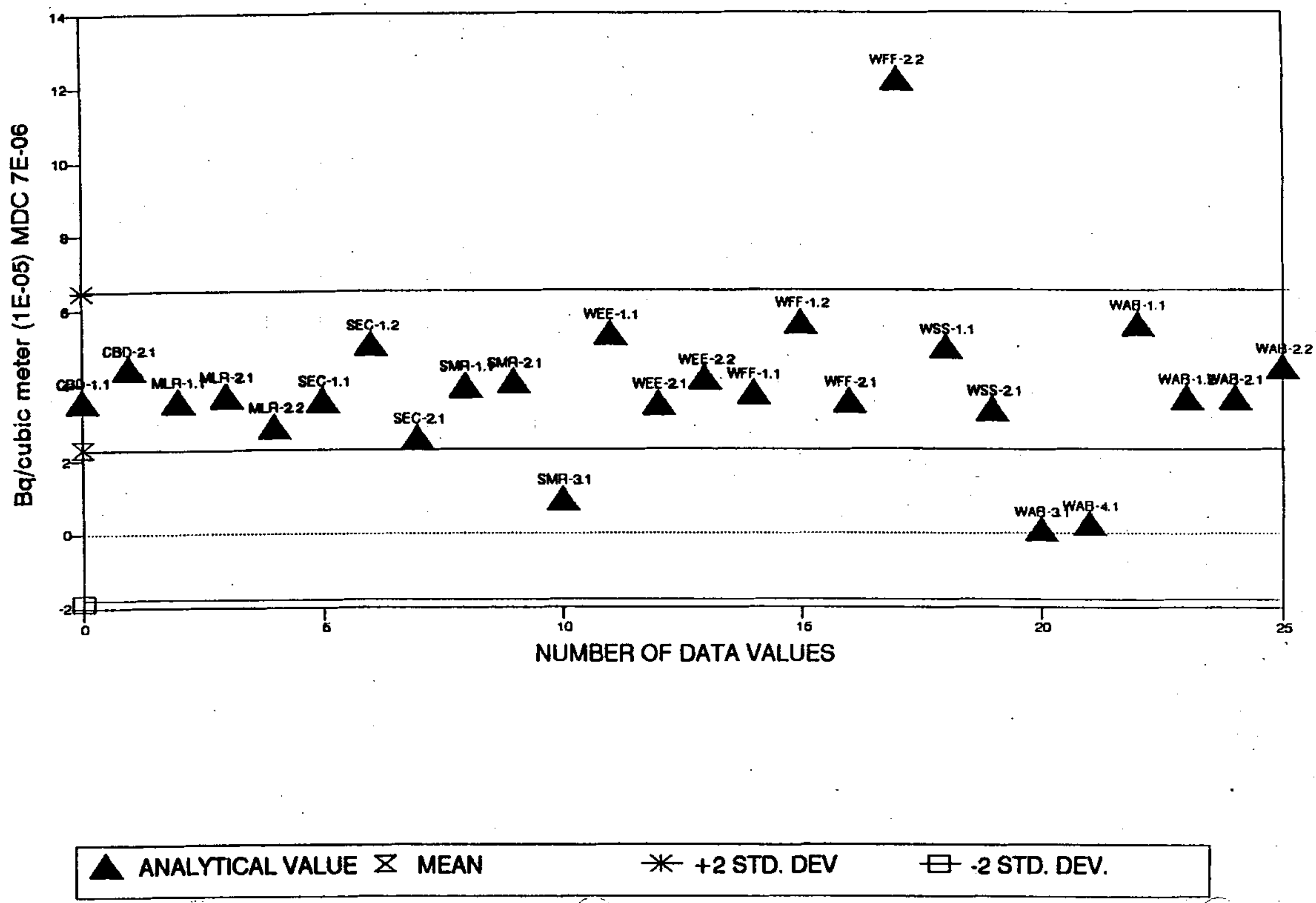
| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WAB 2.1 Air Sampling 2nd Quarter Blank Filter Analysis | Americium-241 | 3.60E-05 | 7.34E-02 |
| | Beryllium-7 | 2.97E-05 | 5.80E-01 |
| | Cesium-137 | -5.26E-07 | 5.40E-02 |
| | Cobalt-60 | 2.70E-06 | 5.20E-02 |
| | Lead-210 | 5.66E-05 | 1.00E+00 |
| | Plutonium-238 | -6.84E-07 | 2.22E-02 |
| | Plutonium-241 | 4.26E-04 | 1.66E+00 |
| | Plutonium-239/240 | 6.82E-07 | 2.22E-02 |
| | Polonium-210 | -2.72E-07 | 8.40E-03 |
| | Potassium-40 | 1.19E-04 | 1.10E+00 |
| | Radium-228 | 2.83E-05 | 2.10E-01 |
| | Radium-226 | 6.61E-04 | 1.8OE+00 |
| | Strontium-90 | -3.64E-06 | 7.10E-02 |
| | Thorium-228 | 4.00E-06 | 4.20E-02 |
| | Thorium-230 | 2.02E-05 | 5.76E-02 |
| | Thorium-232 | 0.00E+00 | 2.97E-02 |
| | Uranium-233/234 | 1.86E-05 | 5.78E-02 |
| | Uranium-238 | 7.95E-06 | 4.09E-02 |
| | Uranium-235/236 | -1.63E-06 | 2.91E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WAB 2.2<br>Air Sampling<br>WIPP<br>2nd Quarter<br>Blank Filter Analyis | Americium-241 | 4.41E-05 | 8.08E-02 |
| | Beryllium-7 | 6.34E-05 | 7.30E-01 |
| | Cesium-137 | 4.45E-06 | 6.30E-02 |
| | Cobalt-60 | 1.89E-06 | 4.90E-02 |
| | Lead-210 | 7.28E-04 | 8.70E-01 |
| | Plutonium-238 | -6.66E-07 | 2.17E-02 |
| | Plutonium-239/240 | 3.99E-06 | 2.73E-02 |
| | Plutonium-241 | 6.23E-04 | 1.66E+00 |
| | Polonium-210 | 2.08E-06 | 9.15E-03 |
| | Potassium-40 | 9.44E-04 | 1.50E+00 |
| | Radium-228 | 6.88E-05 | 2.90E-01 |
| | Radium-226 | 1.29E-04 | 1.50E+00 |
| | Strontium-90 | -3.64E-06 | 7.50E-02 |
| | Thorium-228 | -8.05E-07 | 3.10E-02 |
| | Thorium-230 | 2.25E-05 | 6.43E-02 |
| | Thorium-232 | 2.90E-06 | 2.59E-02 |
| | Uranium-238 | 4.54E-06 | 3.89E-02 |
| | Uranium-235/236 | 1.60E-06 | 2.33E-02 |
| | Uranium-233/234 | 1.43E-05 | 5.16E-02 |

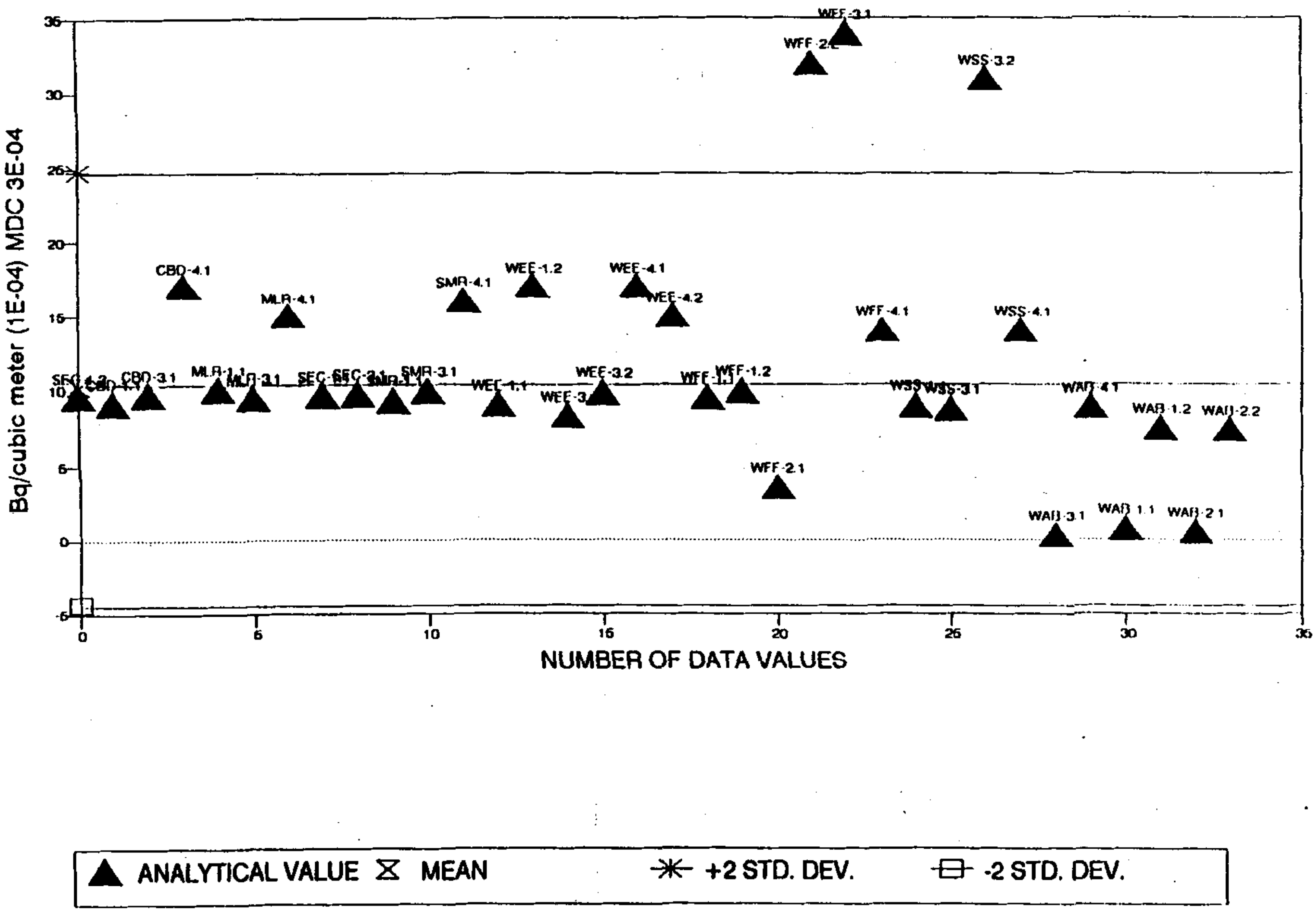
| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m^-3 | COUNTING ERROR |
|---|---|---|---|
| AC-WAB 3.1 Air Sampling 3[rd] Quarter Blank Filter Anslysis | Americium-241 | 6.47E-07 | 8.20E-03 |
| | Beryllium-7 | 2.83E-05 | 5.10E-01 |
| | Cesium-137 | -2.16E-06 | 5.60E-02 |
| | Cobalt-60 | -1.17E-06 | 5.80E-02 |
| | Lead-210 | 2.97E-05 | 1.00E+00 |
| | Plutonium-239/240 | 5.54E-07 | 4.03E-03 |
| | Plutonium-241 | -1.00E-03 | 5.20E-01 |
| | Plutonium-238 | -2.78E-07 | 5.71E-03 |
| | Polonium 210 | 6.44E-07 | 2.39E-03 |
| | Potassium-40 | 2.70E-05 | 5.30E-01 |
| | Radium-226 | 1.89E-04 | 1.40E+00 |
| | Radium-228 | 7.28E-06 | 2.20E-01 |
| | Strontium-90 | -3.64E-06 | 8.10E-02 |
| | Thorium-230 | 5.62E-06 | 1.40E-02 |
| | Thorium-228 | 1.58E-06 | 1.04E-02 |
| | Thorium-232 | 2.74E-07 | 4.88E-03 |
| | Uranium-238 | 3.06E-06 | 1.14E-02 |
| | Uranium-233/234 | 3.45E-06 | 1.44E-02 |
| | Uranium-235/236 | 8.21E-07 | 1.19E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/m$^{-3}$ | COUNTING ERROR |
|---|---|---|---|
| AC-WAB 4.1<br>Air Sampling<br>WIPP<br>4th Quarter<br>Blank Filter Anlaysis | Americium-241 | 2.39E-06 | 8.91E-03 |
| | Beryllium-7 | -2.02E-05 | 6.10E-01 |
| | Cesium-137 | -6.34E-06 | 6.20E-02 |
| | Cobalt-60 | -3.51E-06 | 5.60E-02 |
| | Lead-210 | 8.67E-04 | 1.00E+00 |
| | Plutonium-238 | 2.71E-07 | 4.83E-03 |
| | Plutonium-241 | -4.77E-04 | 5.12E-01 |
| | Plutonium-239/240 | 3.92E-06 | 1.16E-02 |
| | Polonium 210 | 1.30E-06 | 2.07E-03 |
| | Potassium-40 | 2.83E-04 | 1.20E+00 |
| | Radium-226 | 3.24E-06 | 1.30E+00 |
| | Radium-228 | 3.37E-05 | 2.20E-01 |
| | Strontium-90 | 1.32E-05 | 8.90E-02 |
| | Thorium-228 | 1.97E-06 | 9.47E-03 |
| | Thorium-230 | 7.94E-06 | 1.49E-02 |
| | Thorium-232 | 4.06E-06 | 1.07E-02 |
| | Uranium-233/234 | 4.76E-06 | 1.49E-02 |
| | Uranium-235/236 | 0.00E+00 | 4.75E-03 |
| | Uranium-238 | 8.47E-06 | 1.59E-02 |

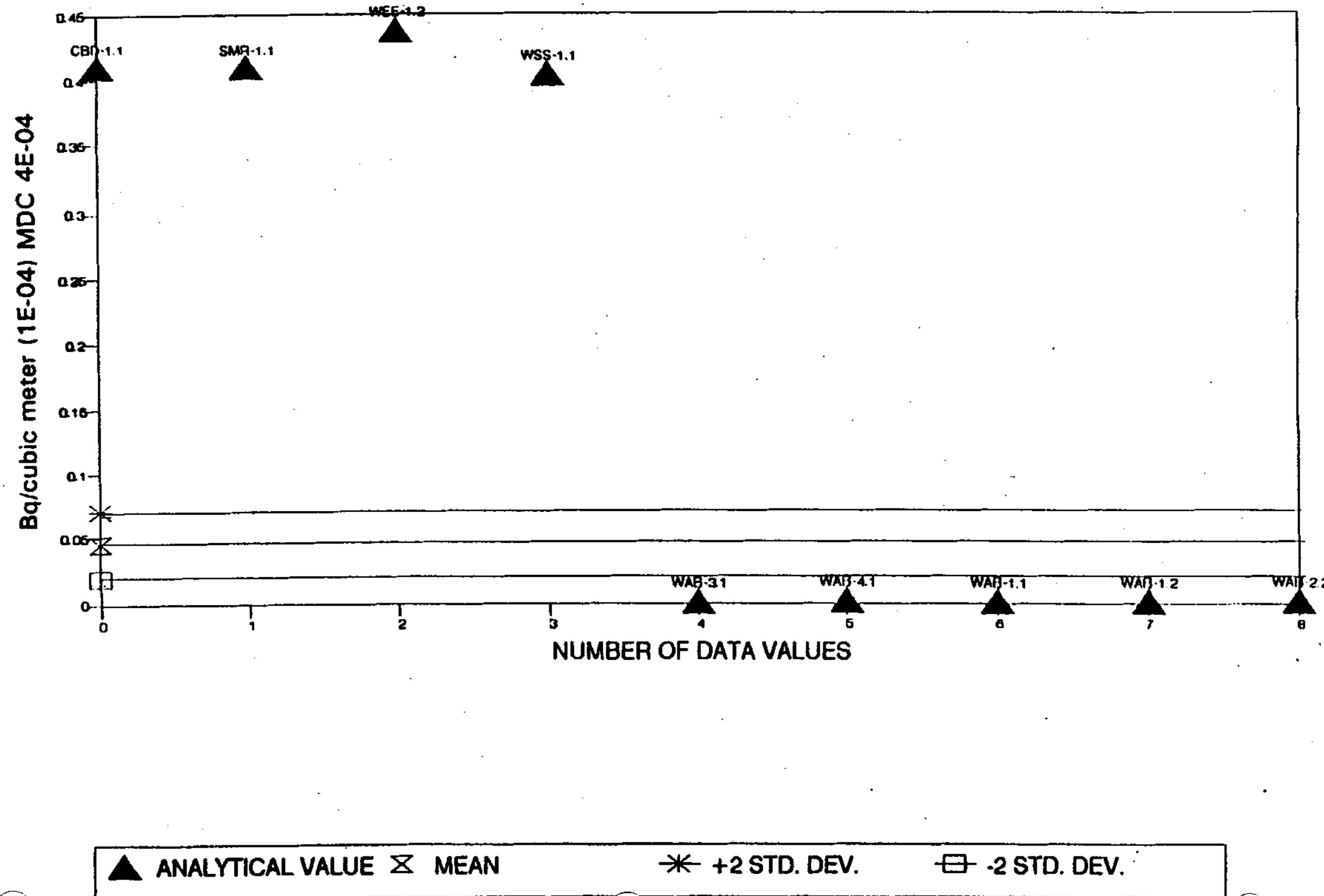
# 1995
## Am-241 IN AIR



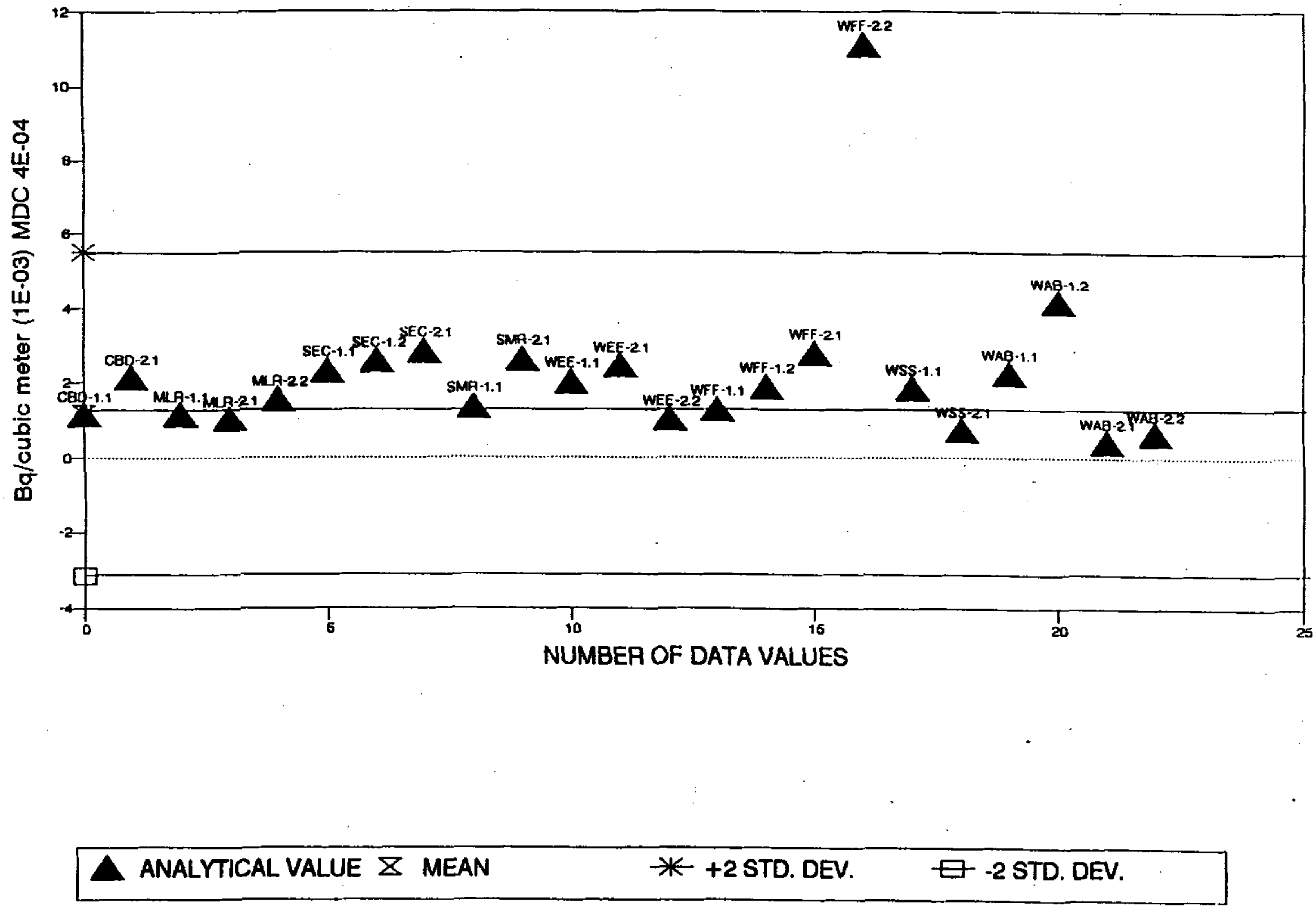
# 1995
## Pb-210 IN AIR



# 1995
## Po-210 IN AIR

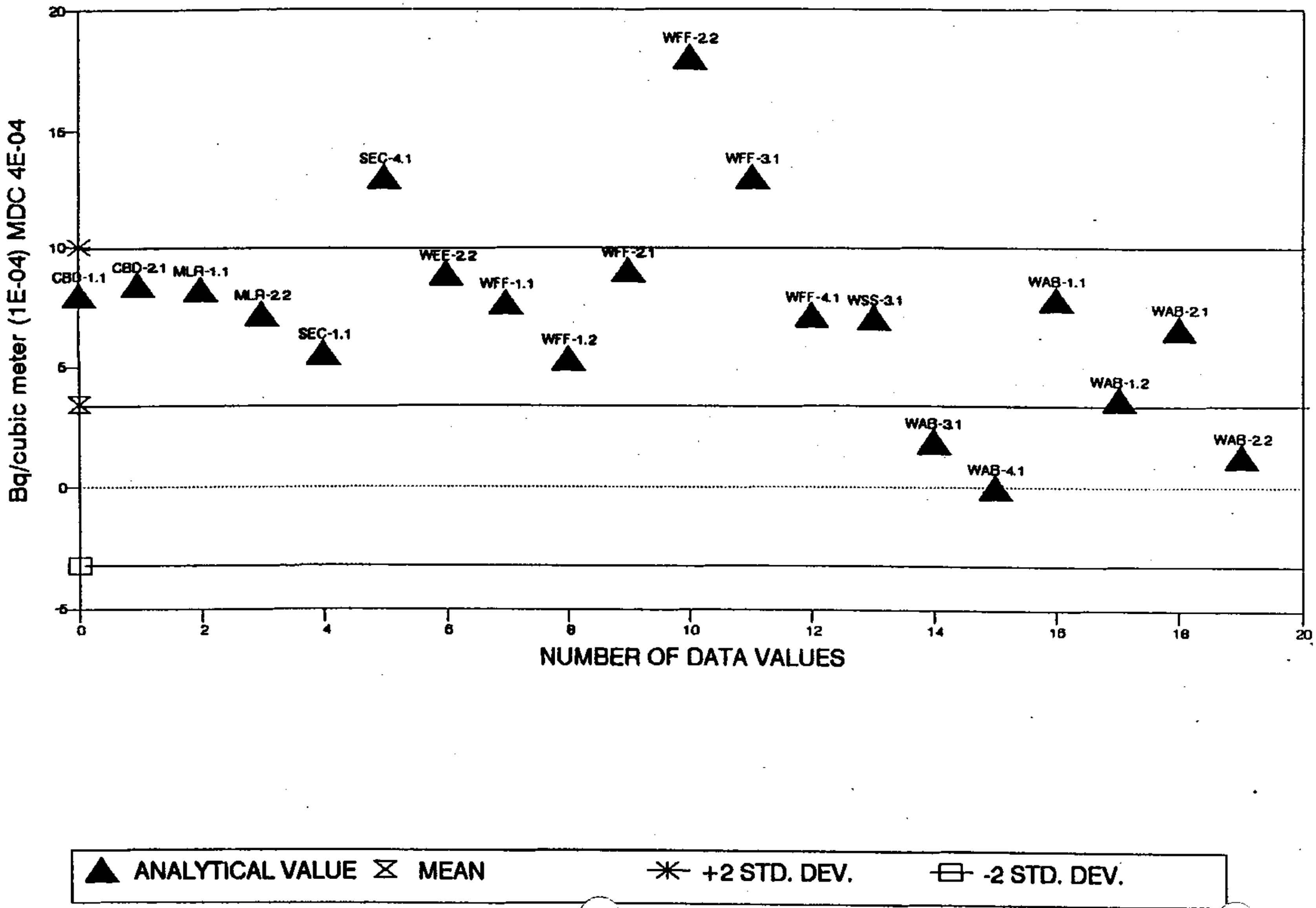


# 1995
## Pu-241 IN AIR

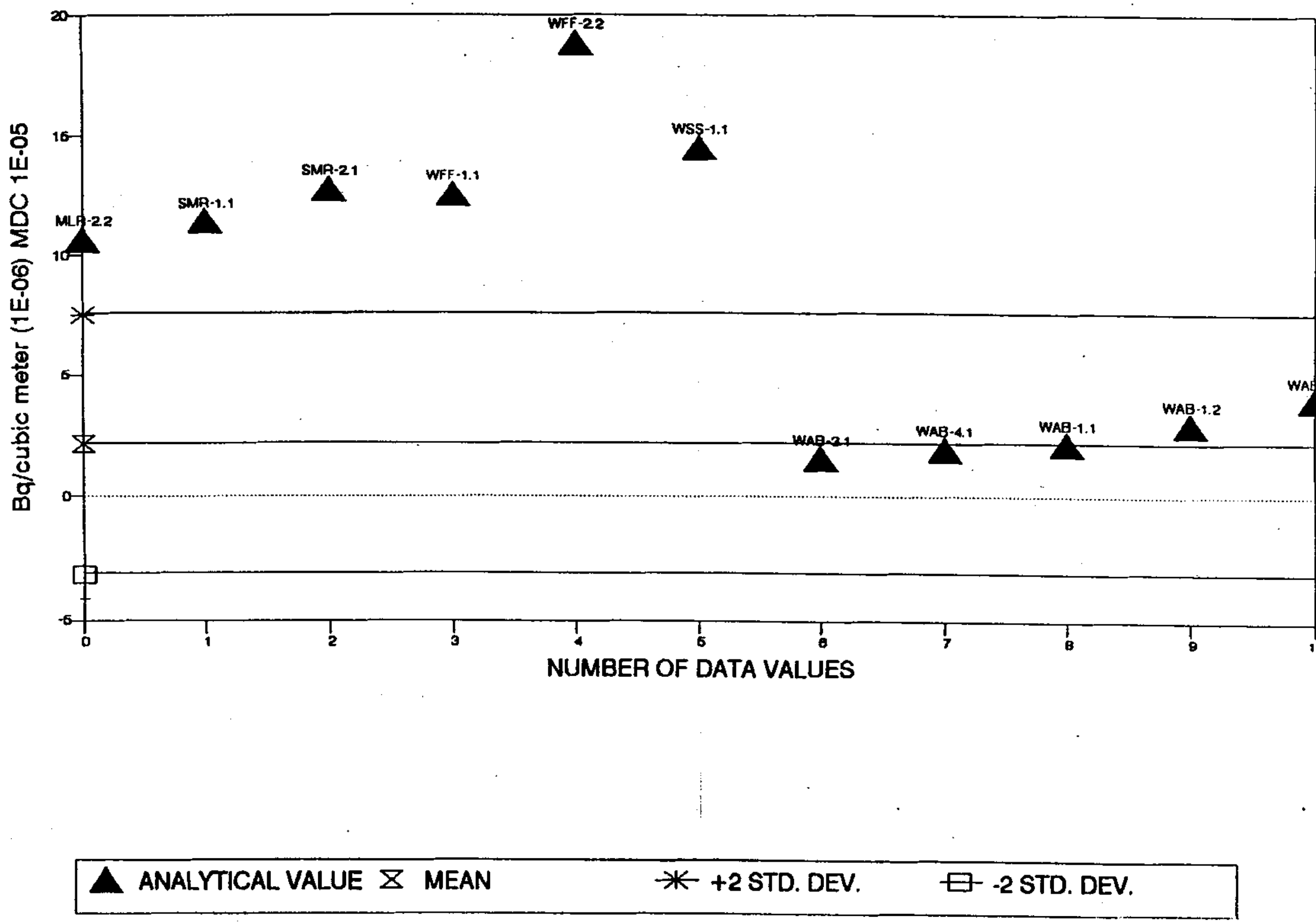


# 1995

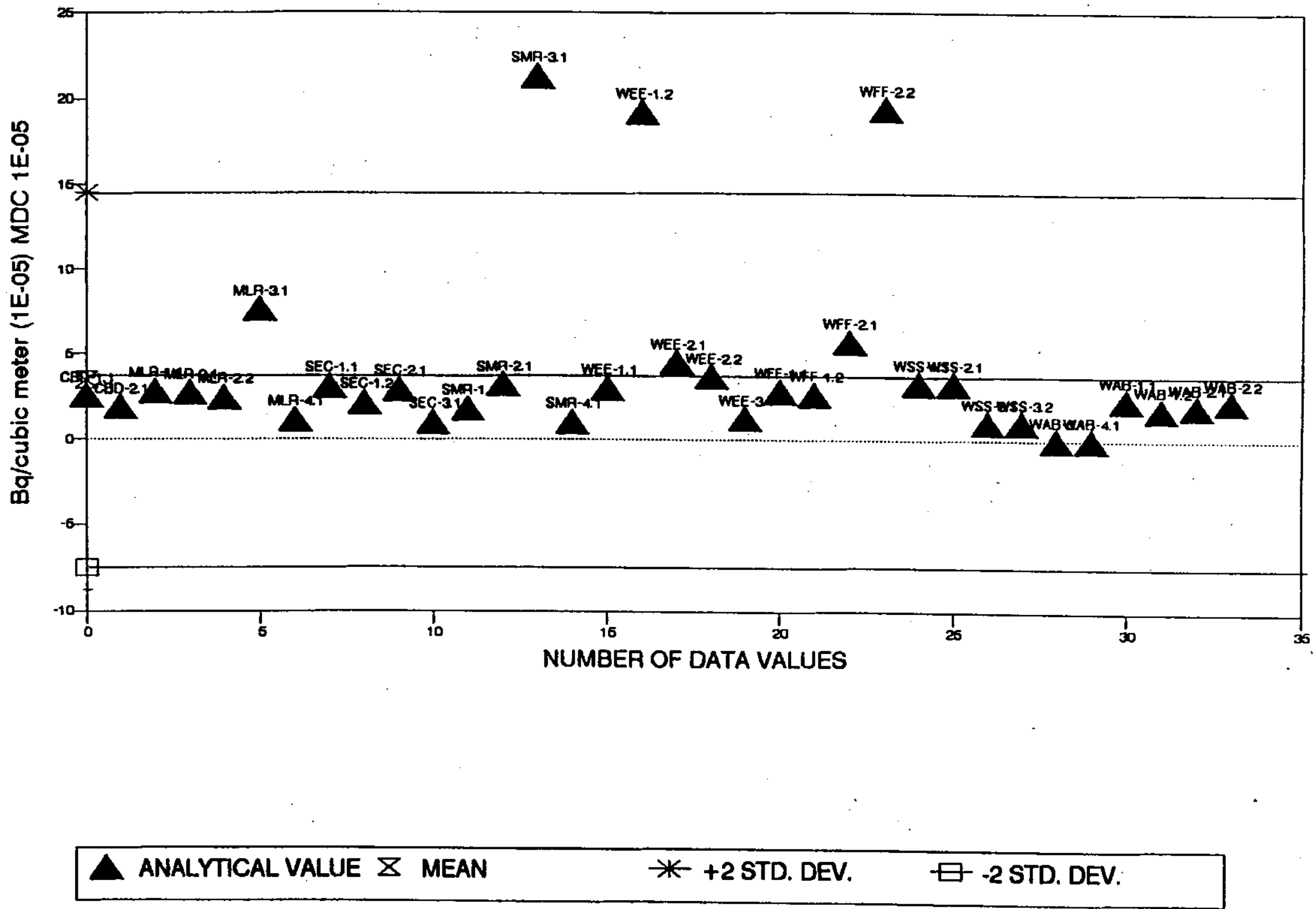
## Ra-226 IN AIR



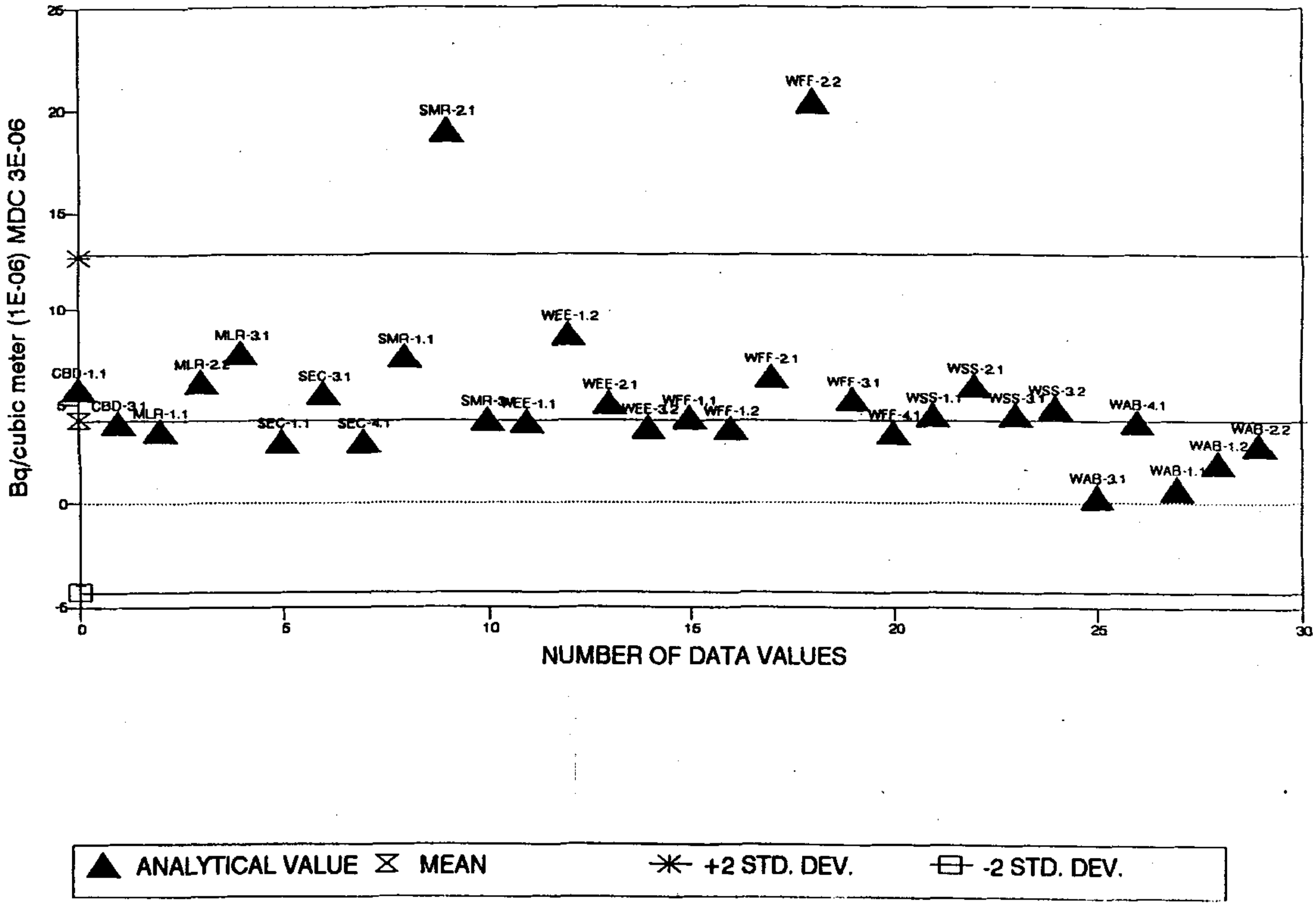
# 1995
## Th-228 IN AIR



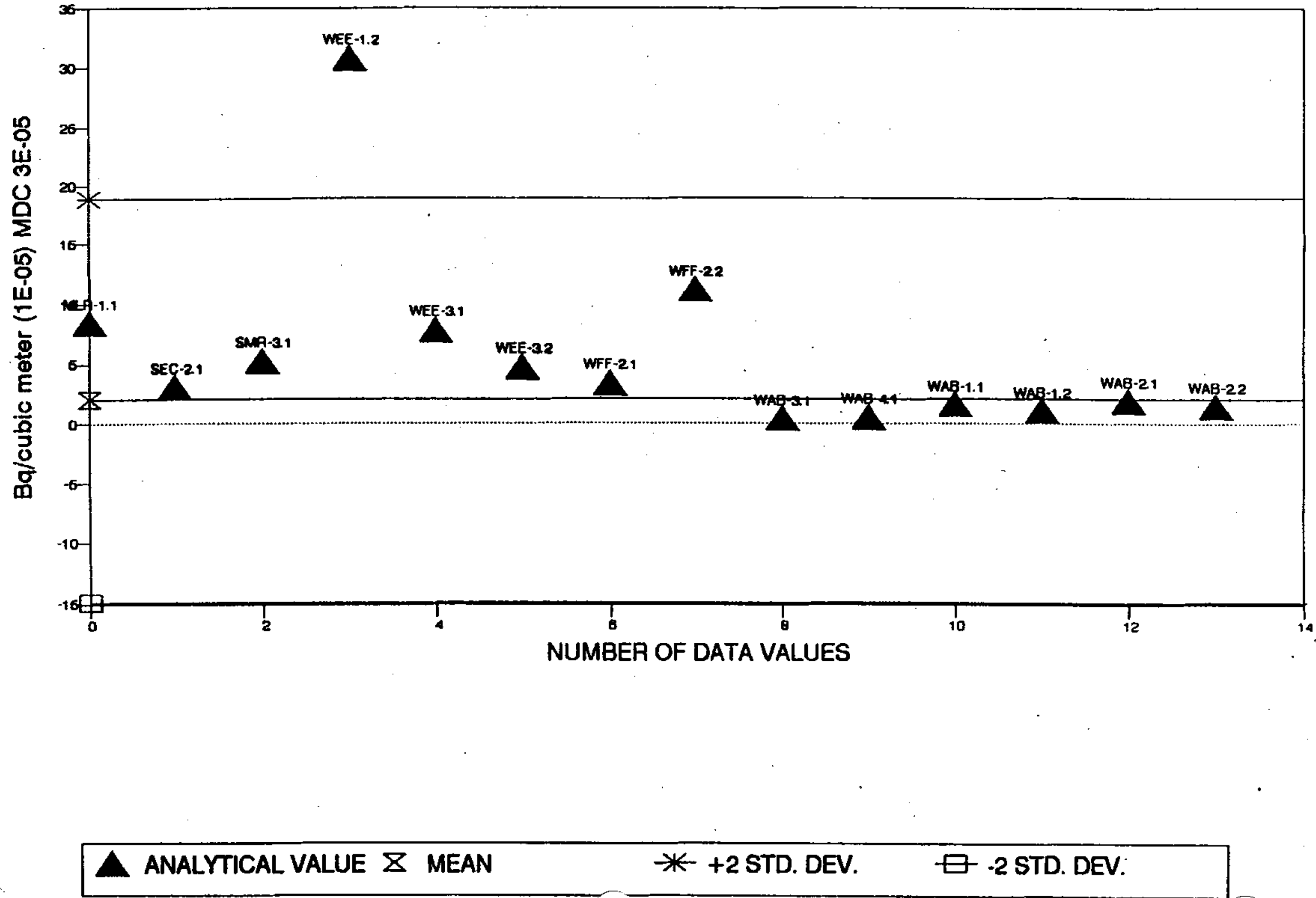
# 1995
## Th-230 IN AIR



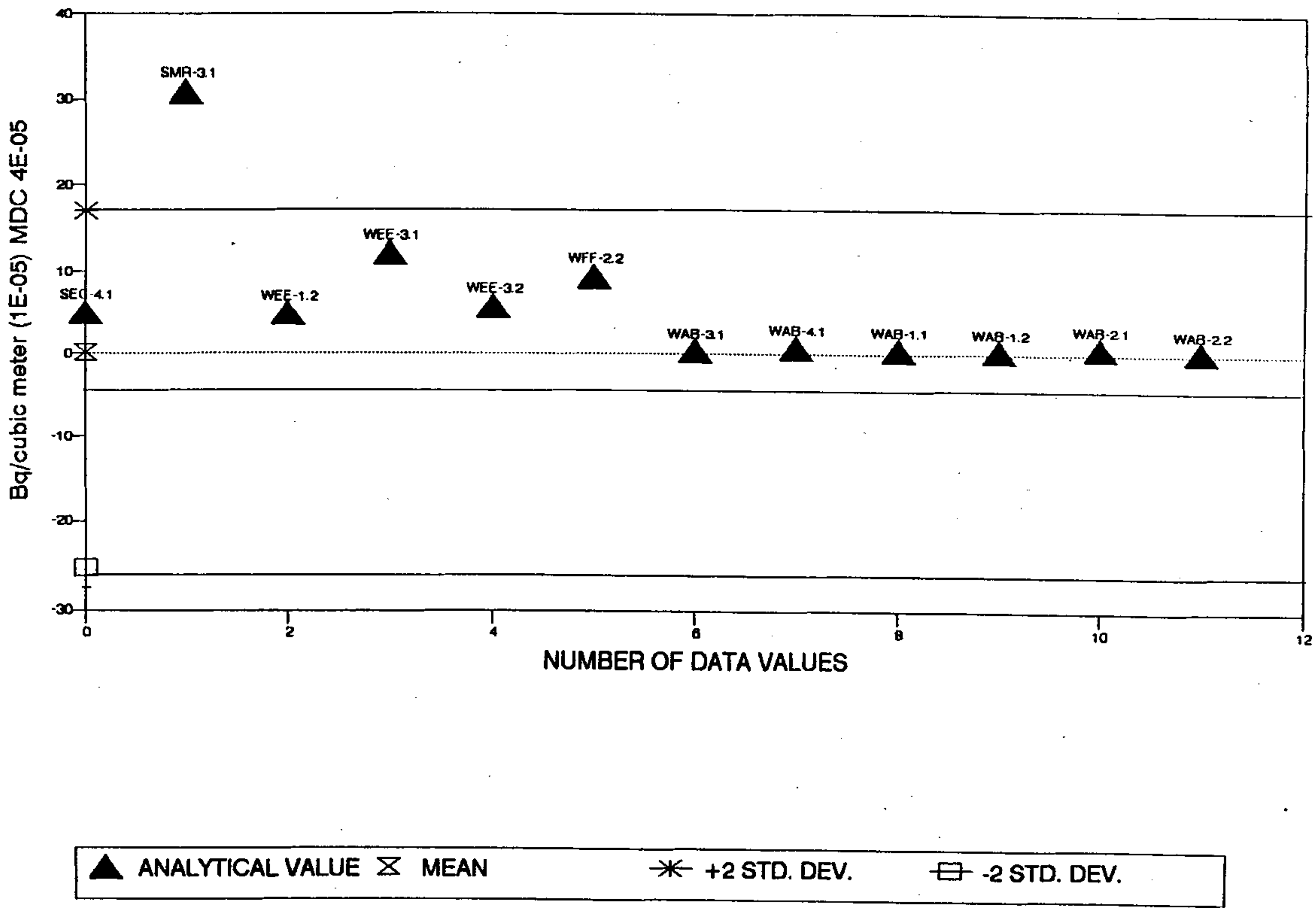
# 1995
## Th-232 IN AIR



# 1995
## U-233/234 IN AIR



# 1995
## U-238 IN AIR



# APPENDIX A2
# RADIOLOGICAL ANALYSIS
# SOILS

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TS-MLR Terrestrial Surface Mills Ranch | Americium-241 | 6.36E-03 | 1.67E-03 |
| | Cesium-137 | 1.10E-02 | 2.40E-03 |
| | Cobalt-60 | *-2.30E-05 | 3.60E-04 |
| | Lead-210 | 5.20E-02 | 4.20E-02 |
| | Plutonium-241 | 5.63E-02 | 3.22E-02 |
| | Plutonium-238 | 1.09E-03 | 7.02E-04 |
| | Plutonium-239/240 | 2.98E-04 | 5.15E-04 |
| | Polonium-210 | 3.20E-02 | 1.20E-02 |
| | Potassium-40 | 4.50E-01 | 6.40E-02 |
| | Radium-226 | 1.10E-02 | 4.00E-02 |
| | Radium-228 | 2.40E-02 | 4.50E-03 |
| | Strontium-90 | 1.30E-03 | 1.40E-03 |
| | Thorium-232 | 1.73E-02 | 2.50E-03 |
| | Thorium-228 | 1.68E-01 | 7.76E-03 |
| | Thorium-230 | 2.58E-02 | 3.04E-03 |
| | Uranium-233/234 | 2.48E-02 | 5.71E-03 |
| | Uranium-238 | 2.08E-02 | 5.09E-03 |
| | Uranium-235/236 | 1.89E-03 | 1.66E-03 |
| TI-MLR Terrestrial Intermediate Mills Ranch | Americium-241 | 5.55E-03 | 1.67E-03 |
| | Cesium-137 | 5.40E-03 | 9.50E-04 |
| | Cobalt-60 | *-2.00E-04 | 3.20E-04 |
| | Lead-210 | 2.90E-02 | 9.20E-03 |
| | Plutonium-241 | 6.16E-02 | 3.18E-02 |
| | Plutonium-238 | 7.86E-04 | 6.09E-04 |
| | Plutonium-239/240 | 5.89E-04 | 6.09E-04 |
| | Polonium-210 | 2.00E-02 | 1.20E-02 |
| | Potassium-40 | 4.30E-01 | 9.60E-02 |
| | Radium-226 | 3.40E-02 | 1.80E-02 |
| | Radium-228 | 2.40E-02 | 4.40E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TI-MLR Terrestrial Intermediate Mills Ranch (continued) | Strontium-90 | 1.10E-03 | 1.30E-03 |
| | Thorium-232 | 1.41E-02 | 2.25E-03 |
| | Thorium-228 | 1.69E-01 | 7.78E-03 |
| | Thorium-230 | 2.34E-02 | 2.87E-03 |
| | Uranium-233/234 | 1.22E-01 | 7.37E-03 |
| | Uranium-238 | 9.25E-02 | 6.40E-03 |
| | Uranium-235/236 | 1.59E-02 | 3.11E-03 |
| TD-MLR Terrestrial Deep Mills Ranch | Americium-241 | 7.37E-03 | 1.73E-03 |
| | Cesium-137 | 6.60E-03 | 1.80E-03 |
| | Cobalt-60 | *-1.5E-04 | 3.80E-04 |
| | Lead-210 | *5.80E-02 | 4.90E-02 |
| | Plutonium-241 | 2.48E-02 | 3.23E-02 |
| | Plutonium-238 | 7.15E-04 | 7.22E-04 |
| | Plutonium-239/240 | 9.19E-04 | 7.22E-04 |
| | Polonium-210 | 1.70E-02 | 1.10E-02 |
| | Potassium-40 | 4.80E-01 | 7.40E-02 |
| | Radium-226 | 4.10E-02 | 1.10E-02 |
| | Radium-228 | 2.60E-02 | 4.80E-03 |
| | Strontium-90 | 1.90E-03 | 1.40E-03 |
| | Thorium-232 | 1.96E-02 | 2.68E-03 |
| | Thorium-228 | 1.67E-01 | 7.82E-03 |
| | Thorium-230 | 2.32E-02 | 2.90E-03 |
| | Uranium-233/234 | 1.71E-02 | 3.12E-03 |
| | Uranium-238 | 1.76E-02 | 3.09E-03 |
| | Uranium-235/236 | 1.55E-03 | 1.30E-03 |
| TS-SEC Terrestrial Surface South East Control | Americium-241 | 6.97E-03 | 1.63E-03 |
| | Cesium-137 | 4.40E-03 | 1.20E-03 |
| | Cobalt-60 | *4.30E-05 | 2.70E-04 |
| | Lead-210 | 1.50E-02 | 4.30E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TS-SEC Terrestrial Surface South East Control (continued) | Plutonium-241 | 4.83E-02 | 3.43E-02 |
| | Plutonium-238 | 3.00E-03 | 1.17E-03 |
| | Plutonium-239/240 | 1.00E-03 | 7.23E-04 |
| | Polonium-210 | 1.20E-02 | 1.30E-02 |
| | Potassium-40 | 2.10E-01 | 3.40E-02 |
| | Radium-226 | 1.90E-02 | 8.30E-03 |
| | Radium-228 | 1.30E-02 | 2.90E-03 |
| | Strontium-90 | 1.10E-04 | 1.30E-03 |
| | Thorium-232 | 7.41E-03 | 1.68E-03 |
| | Thorium-228 | 1.50E-01 | 7.48E-03 |
| | Thorium-230 | 1.43E-02 | 2.34E-03 |
| | Uranium-233/234 | 1.59E-02 | 3.39E-03 |
| | Uranium-238 | 8.72E-03 | 2.34E-03 |
| | Uranium-235/236 | 7.55E-04 | 9.06E-04 |
| TI-SEC Terrestrial Intermediate South East Control | Americium-241 | 6.07E-03 | 1.63E-03 |
| | Cesium-137 | 4.20E-03 | 1.10E-03 |
| | Cobalt-60 | *1.30E-04 | 2.90E-04 |
| | Lead-210 | *3.70E-02 | 3.50E-02 |
| | Plutonium-241 | 6.99E-02 | 3.95E-02 |
| | Plutonium-238 | 7.84E-04 | 1.20E-03 |
| | Plutonium-239/240 | -1.31E-04 | 6.77E-04 |
| | Polonium-210 | 2.10E-02 | 1.10E-02 |
| | Potassium-40 | 2.30E-01 | 3.30E-02 |
| | Radium-226 | 2.10E-02 | 7.50E-03 |
| | Radium-228 | 1.10E-02 | 2.60E-03 |
| | Strontium-90 | 3.30E-03 | 1.80E-03 |
| | Thorium-232 | 6.40E-03 | 1.96E-03 |
| | Thorium-228 | 1.57E-01 | 7.90E-03 |
| | Thorium-230 | 1.16E-02 | 2.34E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TI-SEC Terrestrial Intermediate South East Control (continued) | Uranium-233/234 | 9.40E-03 | 2.23E-03 |
| | Uranium-238 | 1.02E-02 | 2.32E-03 |
| | Uranium-235/236 | 6.46E-04 | 7.75E-04 |
| TD-SEC Terrestrial Deep South East Control | Americium-241 | 7.58E-03 | 1.71E-03 |
| | Cesium-137 | 4.70E-03 | 7.80E-04 |
| | Cobalt-60 | *1.20E-05 | 2.80E-04 |
| | Lead-210 | 1.80E-02 | 6.70E-03 |
| | Plutonium-239/240 | 1.01E-04 | 4.42E-04 |
| | Plutonium-241 | -8.53E-03 | 3.16E-02 |
| | Plutonium-238 | 9.08E-04 | 7.13E-04 |
| | Polonium-210 | 1.10E-02 | 1.00E-02 |
| | Potassium-40 | 2.10E-01 | 4.60E-02 |
| | Radium-226 | 2.20E-02 | 1.20E-02 |
| | Radium-228 | 1.20E-02 | 2.90E-03 |
| | Strontium-90 | 4.70E-04 | 1.40E-03 |
| | Thorium-230 | 1.29E-02 | 2.23E-03 |
| | Thorium-232 | 8.72E-03 | 1.85E-03 |
| | Thorium-228 | 1.61E-01 | 7.67E-03 |
| | Uranium-233/234 | 1.01E-02 | 2.36E-03 |
| | Uranium-238 | 6.12E-03 | 1.88E-03 |
| | Uranium-235/236 | 8.20E-04 | 7.19E-04 |
| TS-SMR Terrestrial Surface Smith Ranch | Americium-241 | 7.28E-03 | 1.77E-03 |
| | Cesium-137 | 3.20E-03 | 1.10E-03 |
| | Cobalt-60 | *2.20E-04 | 3.70E-04 |
| | Lead-210 | *1.20E-02 | 4.70E-02 |
| | Plutonium-241 | 1.01E-01 | 3.55E-02 |
| | Plutonium-238 | 1.07E-04 | 9.59E-04 |
| | Plutonium-239/240 | 1.28E-03 | 7.83E-04 |
| | Polonium-210 | 1.60E-02 | 1.20E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TS-SMR Terrestrial Surface Smith Ranch (continued) | Potassium-40 | 4.50E-01 | 7.00E-02 |
| | Radium-226 | 4.30E-02 | 1.20E-02 |
| | Radium-228 | 2.10E-02 | 4.10E-03 |
| | Strontium-90 | 1.60E-04 | 1.60E-03 |
| | Thorium-232 | 1.41E-02 | 2.28E-03 |
| | Thorium-228 | 1.66E-01 | 7.72E-03 |
| | Thorium-230 | 2.15E-02 | 2.80E-03 |
| | Uranium-233/234 | 1.36E-02 | 2.65E-03 |
| | Uranium-238 | 1.06E-02 | 2.38E-03 |
| | Uranium-235/236 | 1.46E-03 | 9.54E-04 |
| TI-SMR Terrestrial Intermediate Smith Ranch | Americium-241 | 6.25E-03 | 1.61E-03 |
| | Cesium-137 | 2.90E-03 | 7.70E-04 |
| | Cobalt-60 | *5.80E-05 | 2.90E-04 |
| | Lead-210 | 2.90E-02 | 8.00E-03 |
| | Plutonium-241 | -2.60E-03 | 3.37E-02 |
| | Plutonium-238 | 1.27E-03 | 7.77E-04 |
| | Plutonium-239/240 | 3.18E-04 | 6.22E-04 |
| | Polonium-210 | 1.10E-02 | 1.40E-02 |
| | Potassium-40 | 4.20E-01 | 7.90E-02 |
| | Radium-226 | 7.30E-03 | 3.40E-02 |
| | Radium-228 | 2.00E-02 | 4.00E-03 |
| | Strontium-90 | -9.60E-05 | 1.50E-03 |
| | Thorium-232 | 1.31E-02 | 2.17E-03 |
| | Thorium-228 | 1.60E-01 | 7.65E-03 |
| | Thorium-230 | 2.06E-02 | 2.73E-03 |
| | Uranium-233/234 | 1.29E-02 | 2.91E-03 |
| | Uranium-238 | 1.36E-02 | 2.76E-03 |
| | Uranium-235/236 | 4.90E-04 | 8.47E-04 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TD-SMR Terrestrial Deep Smith Ranch | Americium-241 | 8.38E-03 | 1.92E-03 |
| | Cesium-137 | 4.90E-03 | 1.20E-03 |
| | Cobalt-60 | *-1.50E-04 | 3.80E-04 |
| | Lead-210 | *4.30E-02 | 4.20E-02 |
| | Plutonium-241 | 3.39E-02 | 3.28E-02 |
| | Plutonium-238 | 1.23E-03 | 1.06E-03 |
| | Plutonium-239/240 | 5.11E-04 | 6.65E-04 |
| | Polonium-210 | 1.30E-02 | 1.00E-02 |
| | Potassium-40 | 4.90E-01 | 7.00E-02 |
| | Radium-226 | 4.50E-02 | 1.20E-02 |
| | Radium-228 | 2.40E-02 | 4.60E-03 |
| | Strontium-90 | 9.60E-05 | 2.00E-03 |
| | Thorium-232 | 1.81E-02 | 2.59E-03 |
| | Thorium-228 | 1.62E-01 | 7.82E-03 |
| | Thorium-230 | 2.16E-02 | 2.85E-03 |
| | Uranium-233/234 | 5.17E-02 | 5.07E-03 |
| | Uranium-238 | 3.89E-02 | 4.38E-03 |
| | Uranium-235/236 | 5.84E-03 | 2.12E-03 |
| TS-WEE Terrestrial Surface WIPP East | Americium-241 | 7.06E-03 | 1.68E-03 |
| | Cesium-137 | 6.90E-03 | 1.50E-03 |
| | Cobalt-60 | *-2.60E-04 | 2.90E-04 |
| | Lead-210 | *2.80E-02 | 3.40E-02 |
| | Plutonium-241 | -9.79E-03 | 3.38E-02 |
| | Plutonium-238 | 0.00E+00 | 4.21E-04 |
| | Plutonium-239/240 | 1.07E-03 | 7.29E-04 |
| | Polonium-210 | 2.70E-02 | 1.20E-02 |
| | Potassium-40 | 2.90E-01 | 4.10E-02 |
| | Radium-226 | *2.50E-02 | 9.00E-03 |
| | Radium-228 | 1.20E-02 | 3.00E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TS-WEE Terrestrial Surface WIPP East (continued) | Strontium-90 | 6.10E-04 | 1.40E-03 |
| | Thorium-232 | 7.13E-03 | 1.62E-03 |
| | Thorium-228 | 1.55E-01 | 7.61E-03 |
| | Thorium-230 | 1.16E-02 | 2.10E-03 |
| | Uranium-233/234 | 2.78E-02 | 3.70E-03 |
| | Uranium-238 | 1.45E-02 | 2.66E-03 |
| | Uranium-235/236 | 2.49E-03 | 1.30E-03 |
| TI-WEE Terrestrial Intermediate WIPP East | Americium-241 | 5.63E-03 | 1.42E-03 |
| | Cesium-137 | 6.60E-03 | 1.10E-03 |
| | Cobalt-60 | *-1.20E-04 | 2.90E-04 |
| | Lead-210 | 2.20E-02 | 6.90E-03 |
| | Plutonium-241 | 4.91E-02 | 3.35E-02 |
| | Plutonium-238 | 3.16E-04 | 3.58E-04 |
| | Plutonium-239/240 | 7.37E-04 | 5.46E-04 |
| | Polonium-210 | 1.70E-02 | 1.10E-02 |
| | Potassium-40 | 2.60E-01 | 5.80E-02 |
| | Radium-226 | 2.00E-02 | 1.20E-02 |
| | Radium-228 | 1.20E-02 | 2.70E-03 |
| | Strontium-90 | 2.60E-04 | 1.30E-03 |
| | Thorium-232 | 7.96E-03 | 1.70E-03 |
| | Thorium-228 | 1.57E-01 | 7.52E-03 |
| | Thorium-230 | 1.32E-02 | 2.26E-03 |
| | Uranium-233/234 | 2.12E-02 | 3.50E-03 |
| | Uranium-238 | 1.97E-02 | 3.25E-03 |
| | Uranium-235/236 | 4.31E-03 | 1.69E-03 |
| TD-WEE Terrestrial Deep WIPP East | Americium-241 | 5.95E-03 | 1.60E-03 |
| | Cesium-137 | 1.10E-02 | 2.10E-03 |
| | Cobalt-60 | *3.50E-04 | 1.80E-03 |
| | Lead-210 | 4.50E-02 | 1.40E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TD-WEE Terrestrial Deep WIPP East (continued) | Plutonium-241 | 4.17E-02 | 3.04E-02 |
| | Plutonium-238 | 4.86E-04 | 6.87E-04 |
| | Plutonium-239/240 | 4.86E-04 | 5.04E-04 |
| | Polonium-210 | 1.50E-02 | 1.10E-02 |
| | Potassium-40 | 3.70E-01 | 6.90E-02 |
| | Radium-226 | 3.60E-02 | 1.90E-02 |
| | Radium-228 | 1.80E-02 | 3.80E-03 |
| | Strontium-90 | 1.40E-04 | 1.50E-03 |
| | Thorium-232 | 9.42E-03 | 1.83E-03 |
| | Thorium-228 | 1.58E-01 | 7.54E-03 |
| | Thorium-230 | 1.43E-02 | 2.29E-03 |
| | Uranium-233/234 | 2.33E-02 | 3.32E-03 |
| | Uranium-238 | 1.65E-02 | 2.77E-03 |
| | Uranium-235/236 | 1.00E-03 | 8.42E-04 |
| TS-WFF Terrestrial Surface WIPP Far Field | Americium-241 | 7.60E-03 | 1.69E-03 |
| | Cesium-137 | 5.60E-03 | 9.50E-04 |
| | Cobalt-60 | *7.80E-5 | 2.70E-04 |
| | Lead-210 | 2.90E-02 | 7.40E-03 |
| | Plutonium-241 | 1.91E-02 | 3.32E-02 |
| | Plutonium-238 | 4.33E-04 | 8.49E-04 |
| | Plutonium-239/240 | 9.74E-04 | 7.65E-04 |
| | Polonium-210 | 1.50E-02 | 1.60E-02 |
| | Potassium-40 | 2.10E-01 | 4.80E-02 |
| | Radium-228 | 9.80E-03 | 2.50E-03 |
| | Radium-226 | *1.90E-02 | 1.10E-02 |
| | Strontium-90 | 2.7E-04 | 1.40E-03 |
| | Thorium-232 | 6.68E-03 | 1.72E-03 |
| | Thorium-228 | 1.52E-01 | 8.08E-03 |
| | Thorium-230 | 1.20E-02 | 2.25E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TS-WFF Terrestrial Surface WIPP Far Field (continued) | Uranium-233/234 | 9.25E-03 | 2.29E-03 |
| | Uranium-238 | 9.00E-03 | 2.24E-03 |
| | Uranium-235/236 | 1.18E-03 | 9.89E-04 |
| TI-WFF Terrestrial Intermediate WIPP Far Field | Americium-241 | 8.44E-03 | 1.80E-03 |
| | Cesium-137 | 5.40E-03 | 1.10E-03 |
| | Cobalt-60 | *2.40E-05 | 2.40E-04 |
| | Lead-210 | 1.80E-02 | 6.80E-03 |
| | Plutonium-241 | 3.04E-02 | 3.18E-02 |
| | Plutonium-238 | 4.15E-04 | 6.43E-04 |
| | Plutonium-239/240 | 2.07E-04 | 6.42E-04 |
| | Polonium-210 | 1.70E-02 | 1.40E-02 |
| | Potassium-40 | 2.00E-01 | 3.90E-02 |
| | Radium-226 | 5.20E-03 | 2.00E-02 |
| | Radium-228 | 8.90E-03 | 2.20E-03 |
| | Strontium-90 | -2.20E-04 | 1.40E-03 |
| | Thorium-232 | 5.96E-03 | 1.50E-03 |
| | Thorium-228 | 1.52E-01 | 7.50E-03 |
| | Thorium-230 | 1.22E-02 | 2.12E-03 |
| | Uranium-233/234 | 6.63E-03 | 2.08E-03 |
| | Uranium-238 | 9.13E-03 | 2.07E-03 |
| | Uranium-235/236 | 1.02E-03 | 9.51E-04 |
| TD-WFF Terrestrial Deep WIPP Far Field | Americium-241 | 5.72E-03 | 1.41E-03 |
| | Cesium-137 | 5.80E-03 | 1.30E-03 |
| | Cobalt-60 | *2.50E-04 | 3.10E-04 |
| | Lead-210 | *1.20E-02 | 2.90E-02 |
| | Plutonium-241 | 4.83E-02 | 3.29E-02 |
| | Plutonium-238 | 1.47E-03 | 9.21E-04 |
| | Plutonium-239/240 | -1.05E-04 | 3.57E-04 |
| | Polonium-210 | 1.10E-02 | 1.30E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TD-WFF Terrestrial Deep WIPP Far Field (continued) | Potassium-40 | 2.50E-01 | 3.70E-02 |
| | Radium-226 | 1.30E-02 | 8.30E-03 |
| | Radium-228 | 9.90E-03 | 2.70E-03 |
| | Strontium-90 | 1.00E-03 | 1.40E-03 |
| | Thorium-232 | 6.37E-03 | 1.55E-03 |
| | Thorium-228 | 1.62E-01 | 7.86E-03 |
| | Thorium-230 | 1.09E-02 | 2.03E-03 |
| | Uranium-233/234 | 1.37E-02 | 3.53E-03 |
| | Uranium-238 | 7.06E-03 | 3.03E-03 |
| | Uranium-235/236 | -1.78E-04 | 1.67E-03 |
| TS-WSS Terrestrial Surface WIPP South | Americium-241 | 4.63E-03 | 1.35E-03 |
| | Cesium-137 | 4.00E-03 | 7.50E-04 |
| | Cobalt-60 | *-3.80E-05 | 2.80E-04 |
| | Lead-210 | 2.50E-02 | 7.20E-03 |
| | Plutonium-241 | 2.59E-02 | 3.08E-02 |
| | Plutonium-238 | 1.07E-03 | 6.32E-04 |
| | Plutonium-239/240 | 6.80E-04 | 5.71E-04 |
| | Polonium-210 | 2.10E-02 | 9.40E-03 |
| | Potassium-40 | 2.30E-01 | 5.20E-02 |
| | Radium-226 | 1.40E-02 | 8.60E-03 |
| | Radium-228 | 9.50E-03 | 2.60E-03 |
| | Strontium-90 | 8.50E-04 | 1.40E-03 |
| | Thorium-232 | 9.20E-03 | 1.87E-03 |
| | Thorium-228 | 1.65E-01 | 7.76E-03 |
| | Thorium-230 | 1.32E-02 | 2.20E-03 |
| | Uranium-233/234 | 1.16E-02 | 2.66E-03 |
| | Uranium-238 | 9.84E-03 | 2.45E-03 |
| | Uranium-235/236 | 3.42E-04 | 1.06E-03 |

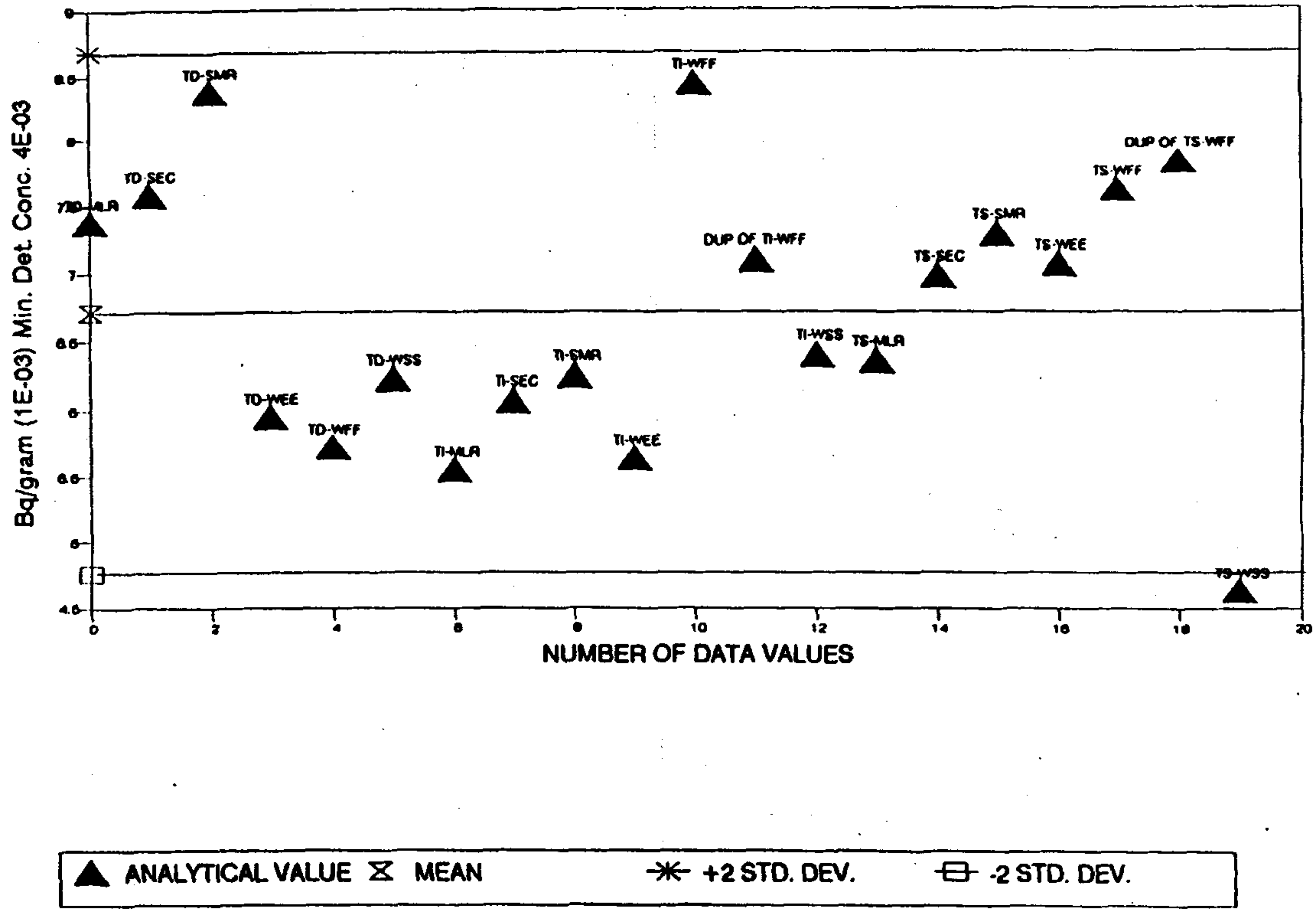
| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TI-WSS Terrestrial Intermediate WIPP South | Americium-241 | 6.41E-03 | 1.74E-03 |
| | Cesium-137 | 5.80E-03 | 1.60E-03 |
| | Cobalt-60 | *1.10E-04 | 3.00E-04 |
| | Lead-210 | 7.60E-03 | 3.90E-02 |
| | Plutonium-241 | 7.01E-02 | 3.27E-02 |
| | Plutonium-238 | 4.01E-04 | 3.93E-04 |
| | Plutonium-239/240 | 3.01E-04 | 4.40E-04 |
| | Polonium-210 | 1.80E-02 | 1.10E-02 |
| | Potassium-40 | 2.60E-01 | 4.10E-02 |
| | Radium-226 | 2.50E-02 | 8.90E-03 |
| | Radium-228 | 1.10E-02 | 2.50E-03 |
| | Strontium-90 | 8.60E-04 | 1.50E-03 |
| | Thorium-232 | 8.79E-03 | 1.77E-03 |
| | Thorium-228 | 1.57E-01 | 7.60E-03 |
| | Thorium-230 | 1.30E-02 | 2.18E-03 |
| | Uranium-233/234 | 6.85E-03 | 2.13E-03 |
| | Uranium-238 | 6.60E-03 | 2.04E-03 |
| | Uranium-235/236 | 1.14E-03 | 8.44E-04 |
| TD-WSS Terrestrial Deep WIPP South | Americium-241 | 6.22E-03 | 1.66E-03 |
| | Cesium-137 | 4.80E-03 | 1.10E-03 |
| | Cobalt-60 | *2.70E-05 | 2.70E-04 |
| | Lead-210 | 1.50E-02 | 6.70E-03 |
| | Plutonium-241 | 2.48E-02 | 3.41E-02 |
| | Plutonium-238 | 5.32E-04 | 7.52E-04 |
| | Plutonium-239/240 | -2.13E-04 | 5.10E-04 |
| | Polonium-210 | 1.40E-02 | 9.80E-03 |
| | Potassium-40 | 2.60E-01 | 4.90E-02 |
| | Radium-226 | 2.70E-02 | 1.40E-02 |
| | Radium-228 | 1.30E-02 | 2.80E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TD-WSS Terrestrial Deep WIPP South (continued) | Strontium-90 | 7.10E-04 | 1.30E-03 |
| | Thorium-232 | 1.05E-02 | 1.94E-03 |
| | Thorium-228 | 1.65E-01 | 7.78E-03 |
| | Thorium-230 | 1.10E-02 | 2.01E-03 |
| | Uranium-233/234 | 3.94E-02 | 4.57E-03 |
| | Uranium-238 | 3.01E-02 | 4.01E-03 |
| | Uranium-235/236 | 2.84E-03 | 1.43E-03 |
| TS-WNW Terrestrial Surface Note: Acronym WNW denotes duplicate sample collected at North West 1 | Americium-241 | 7.82E-03 | 1.71E-03 |
| | Cesium-137 | 6.20E-03 | 1.30E-03 |
| | Cobalt-60 | *1.80E-05 | 2.40E-04 |
| | Lead-210 | 2.40E-02 | 7.30E-03 |
| | Plutonium-241 | 2.47E-02 | 3.58E-02 |
| | Plutonium-238 | 2.29E-04 | 7.76E-04 |
| | Plutonium-239/240 | 3.43E-04 | 5.92E-04 |
| | Polonium-210 | 1.70E-02 | 1.60E-02 |
| | Potassium-40 | 2.30E-01 | 4.40E-02 |
| | Radium-226 | 1.80E-02 | 1.10E-02 |
| | Radium-228 | 1.10E-02 | 2.50E-03 |
| | Strontium-90 | -1.70E-03 | 1.40E-03 |
| | Thorium-232 | 5.62E-03 | 1.55E-03 |
| | Thorium-228 | 1.65E-01 | 7.92E-03 |
| | Thorium-230 | 1.23E-02 | 2.17E-03 |
| | Uranium-233/234 | 1.12E-02 | 2.67E-03 |
| | Uranium-238 | 7.52E-03 | 2.27E-03 |
| | Uranium-235/236 | 1.89E-04 | 9.82E-04 |
| TI-WNW Terrestrial Intermediate Note: Acronym WNW denotes duplicate sample collected at North West 1 | Americium-241 | 7.10E-03 | 1.61E-03 |
| | Cesium-137 | 5.30E-03 | 1.20E-03 |
| | Cobalt-60 | *3.30E-05 | 2.70E-04 |

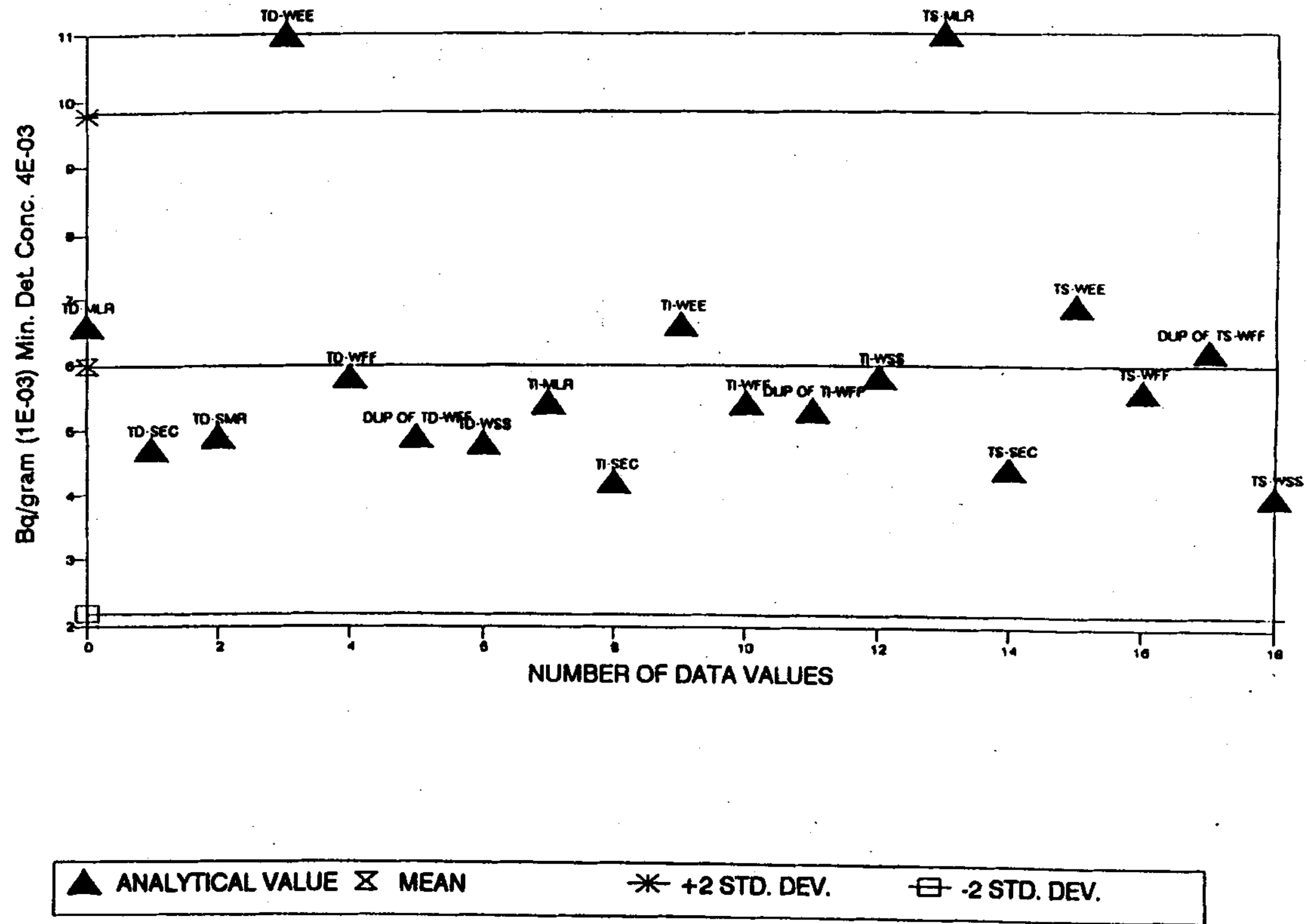
| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TI-WNW<br>Terrestrial Intermediate Note: Acronym WNW denotes duplicate sample collected at North West 1 | Lead-210 | 2.50E-02 | 3.60E-02 |
| | Plutonium-241 | 4.44E-02 | 3.47E-02 |
| | Plutonium-238 | 8.07E-04 | 7.50E-04 |
| | Plutonium-239/240 | 3:46E-04 | 5.05E-04 |
| | Polonium-210 | 1.50E-02 | 1.20E-02 |
| | Potassium-40 | 2.30E-01 | 3.30E-02 |
| | Radium-226 | 2.10E-02 | 8.50E-03 |
| | Radium-228 | 8.90E-03 | 2.30E-03 |
| | Strontium-90 | 5.60E-04 | 1.40E-03 |
| | Thorium-232 | 7.57E-03 | 1.67E-03 |
| | Thorium-228 | 1.56E-01 | 7.40E-03 |
| | Thorium-230 | 1.38E-02 | 2.20E-03 |
| | Uranium-233/234 | 1.64E-02 | 3.18E-03 |
| | Uranium-238 | 9.59E-03 | 2.38E-03 |
| | Uranium-235/236 | 7.17E-04 | 1.11E-03 |
| TD-WNW<br>Terrestrial Deep<br>Note: Acronym WNW denotes duplicate sample collected at North West 1 | Americium-241 | 3.04E-01 | 9.90E-03 |
| | Cesium-137 | 4.90E-03 | 7.90E-04 |
| | Cobalt-60 | *1.30E-04 | 2.60E-04 |
| | Lead-210 | 1.60E-02 | 6.20E-03 |
| | Plutonium-239/240 | 0.00E+00 | 5.89E-04 |
| | Plutonium-241 | -1.77E-02 | 3.67E-02 |
| | Plutonium-238 | 3.68E-04 | 7.22E-04 |
| | Polonium-210 | 8.30E-03 | 1.90E-02 |
| | Potassium-40 | 1.90E-01 | 4.40E-02 |
| | Radium-226 | *1.40E-02 | 9.80E-03 |
| | Radium-228 | 6.90E-03 | 2.10E-03 |
| | Strontium-90 | -4.90E-04 | 1.30E-03 |
| | Thorium-232 | 5.08E-03 | 1.50E-03 |
| | Thorium-228 | 1.53E-01 | 7.78E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| TD-WNW<br>Terrestrial Deep<br>Note: Acronym WNW denotes duplicate sample collected at North West 1 | Thorium-230 | 8.49E-03 | 1.85E-03 |
| | Uranium-233/234 | 6.62E-03 | 2.11E-03 |
| | Uranium-238 | 6.11E-03 | 1.86E-03 |
| | Uranium-235/236 | 1.44E-03 | 9.44E-04 |

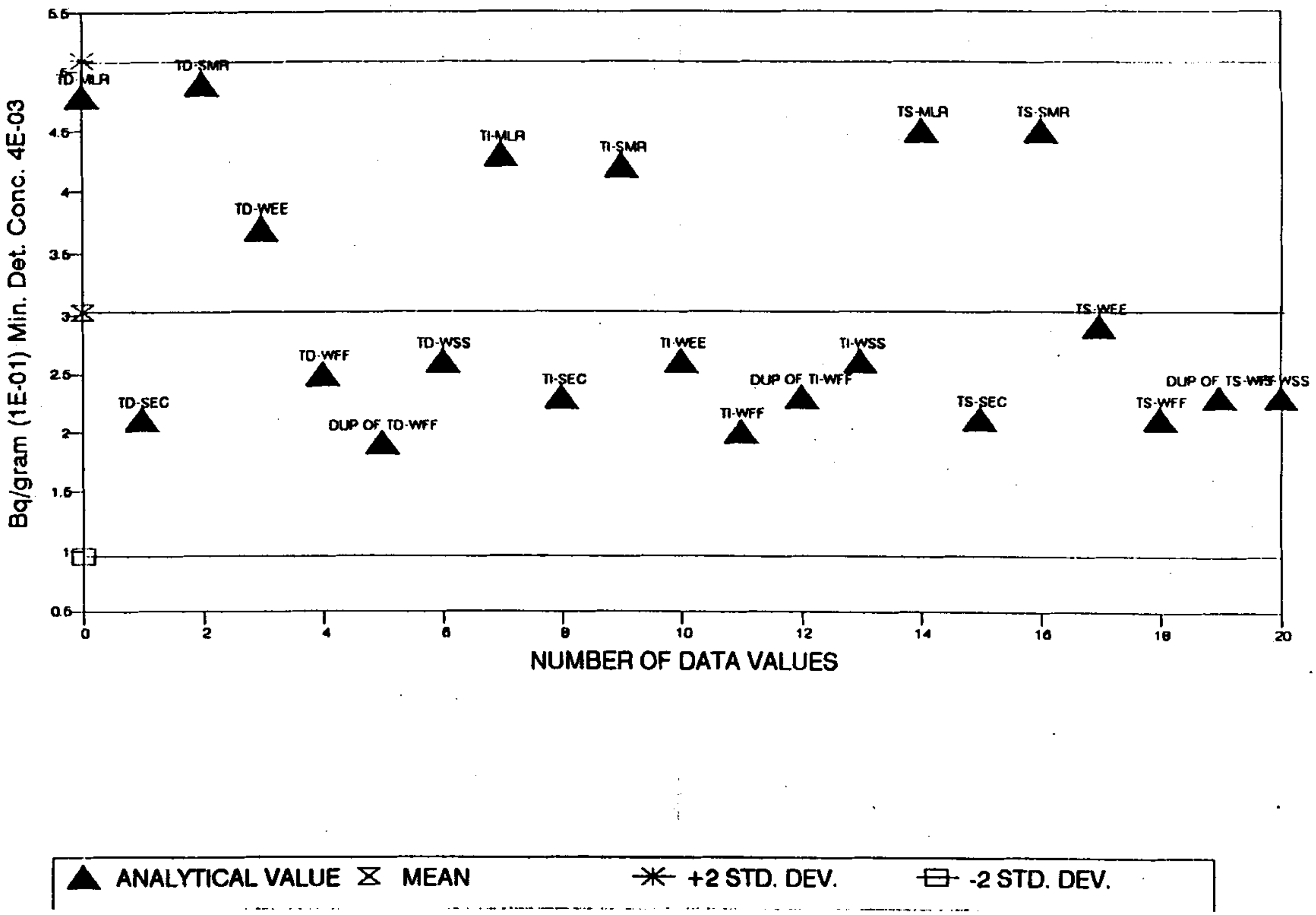
# 1995
## Am-241 IN SOIL



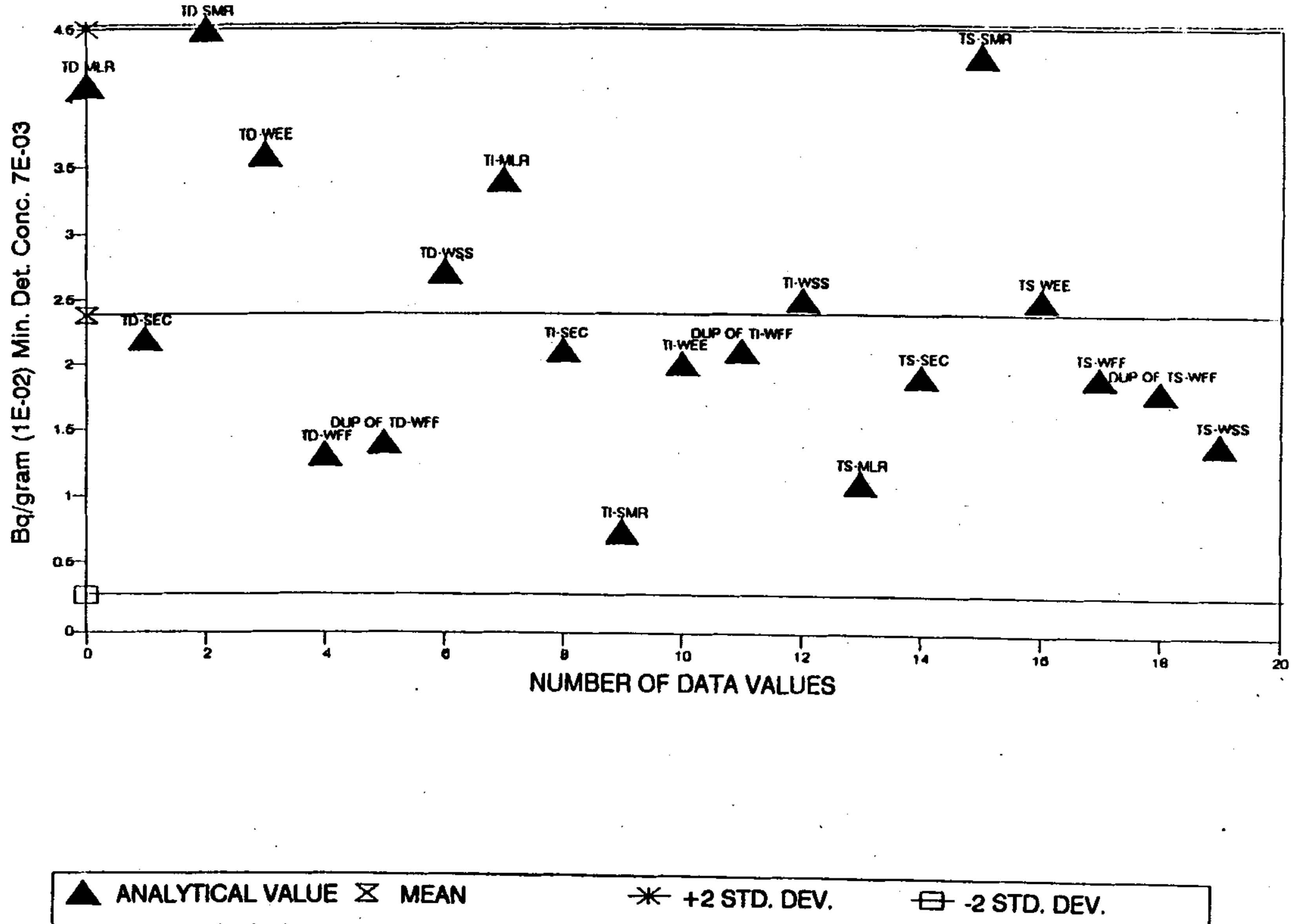
# 1995
## Cs-137 IN SOIL



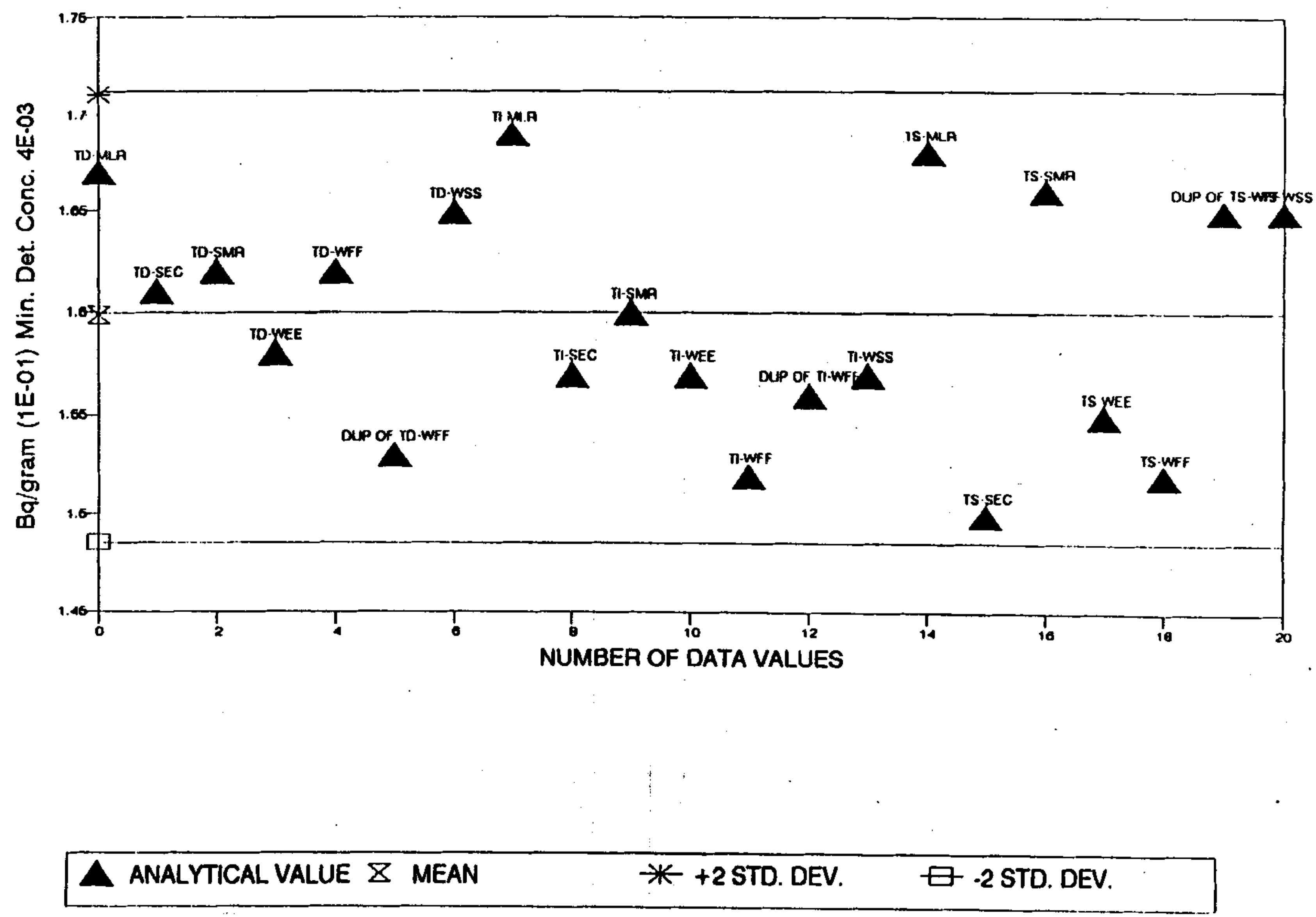
# 1995
## K-40 IN SOIL



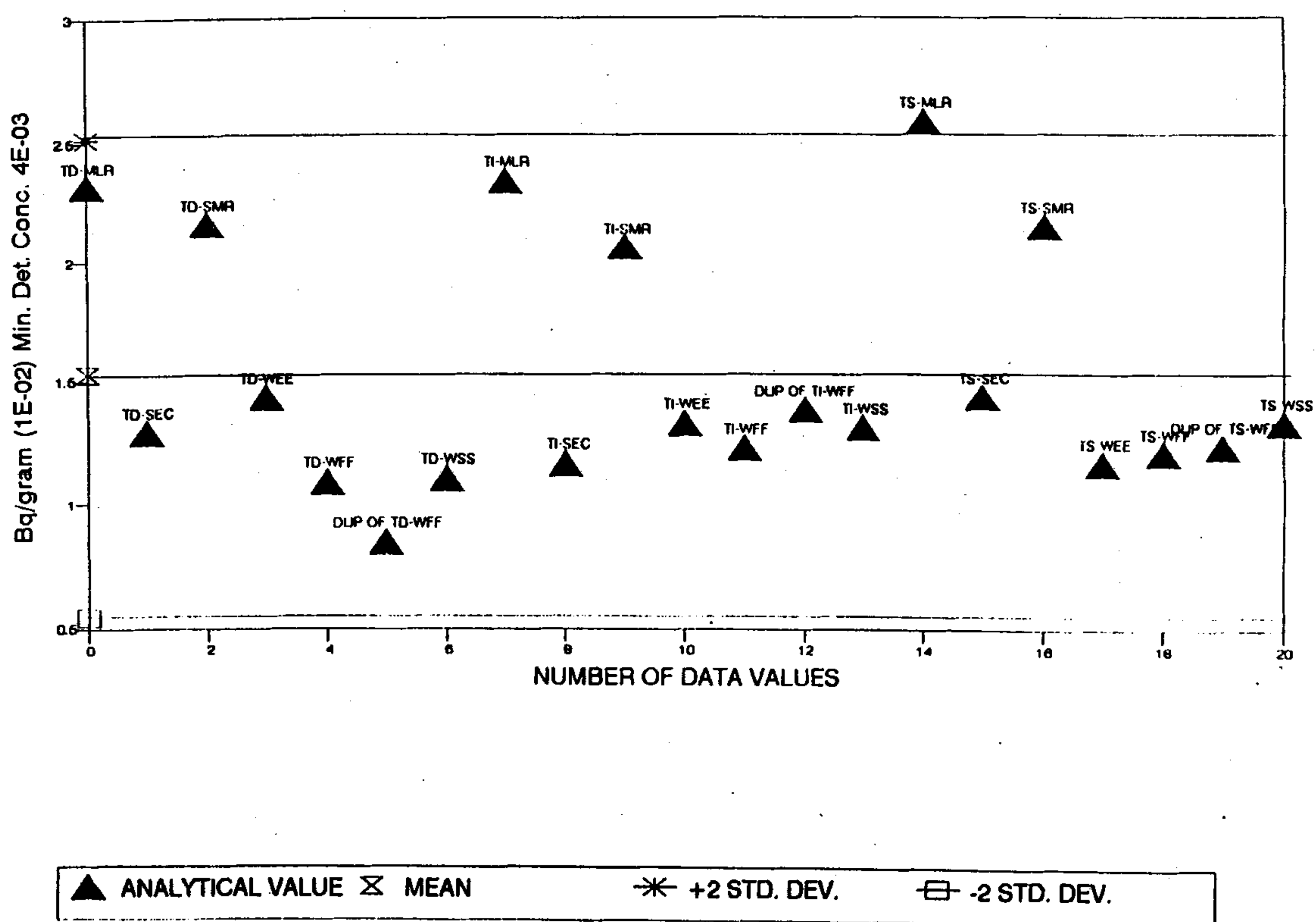
# 1995
## Ra-226 IN SOIL



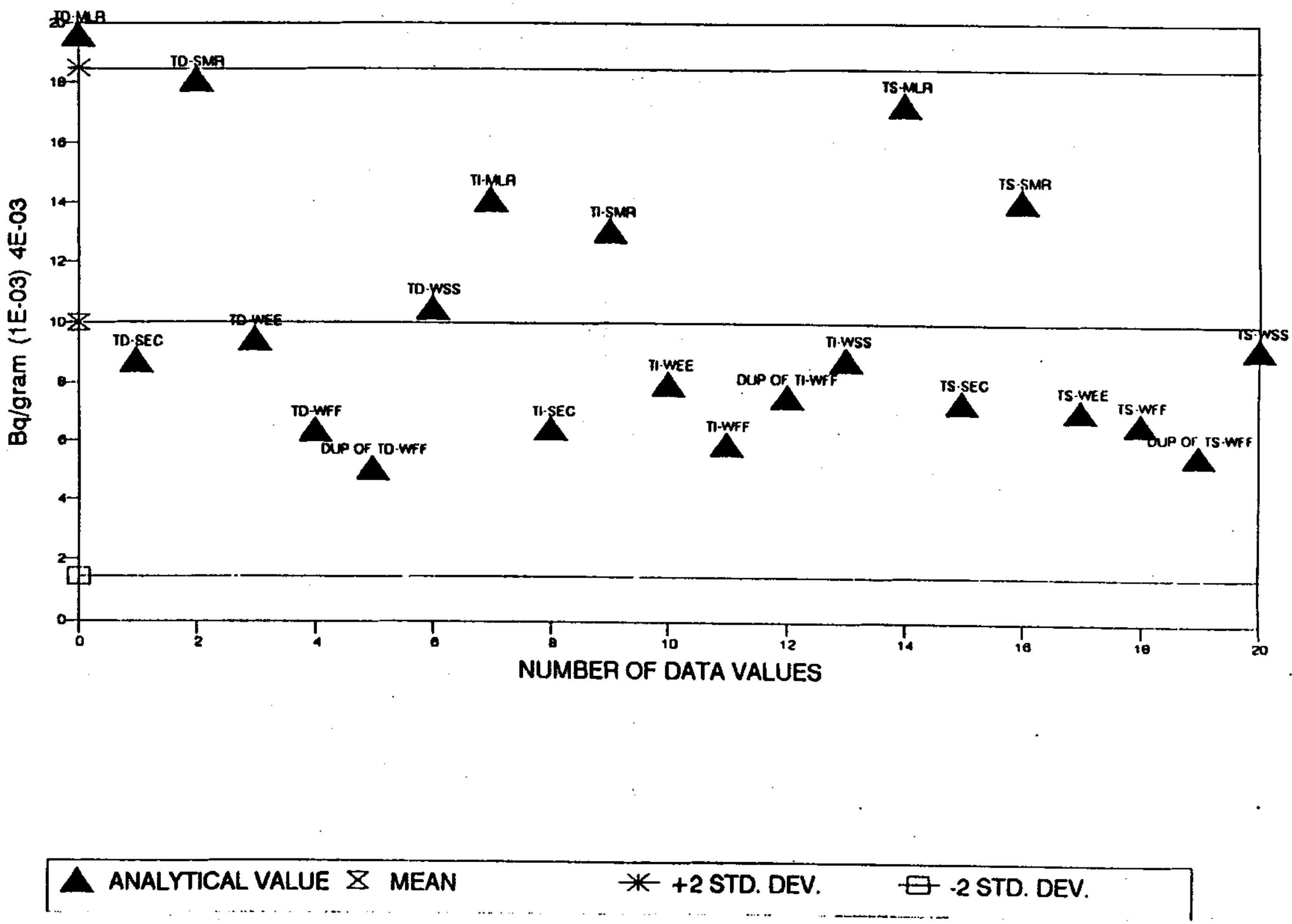
# 1995
## Th-228 IN SOIL



# 1995
## Th-230 IN SOIL

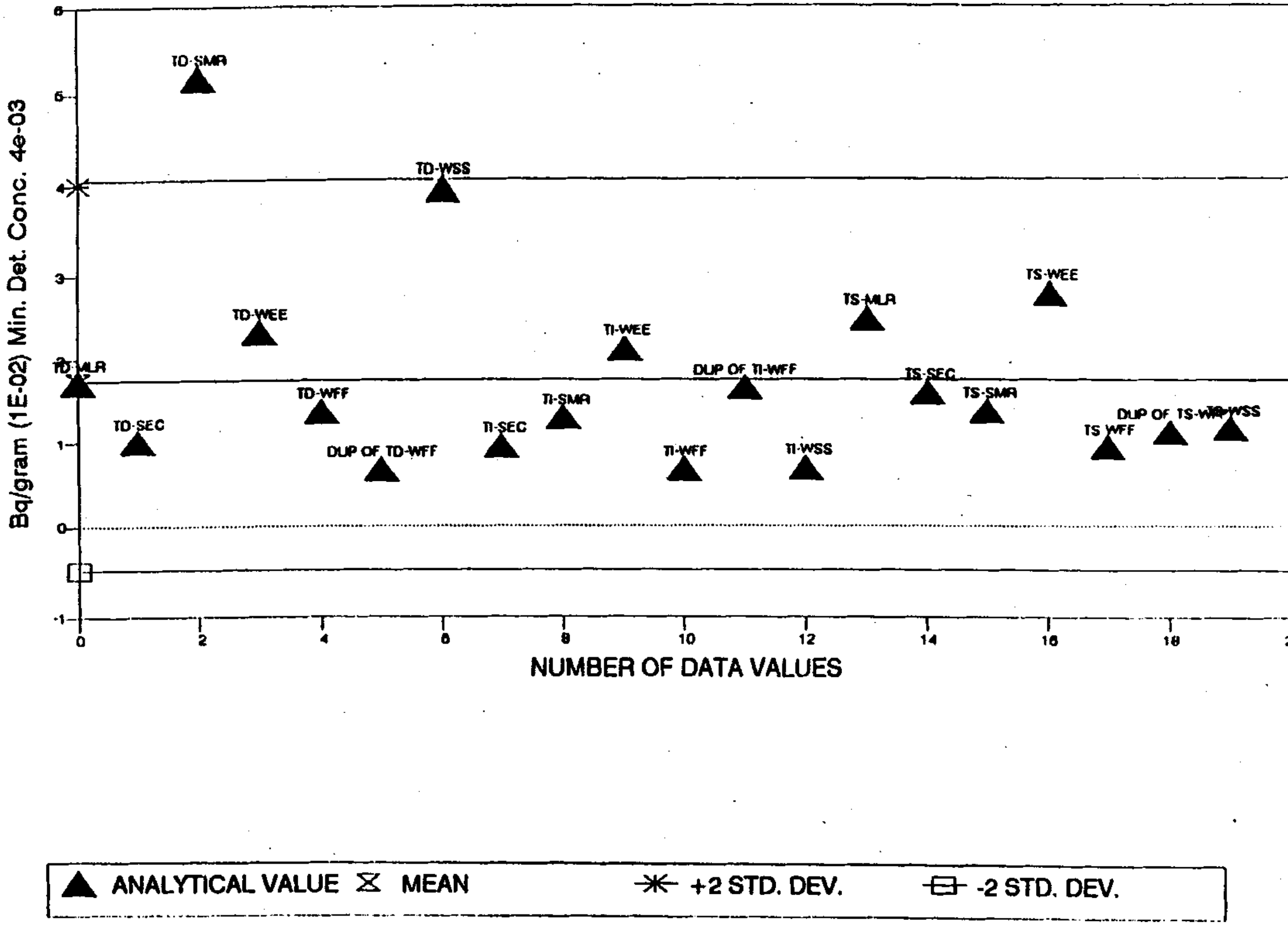


# 1995
## Th-232 IN SOIL

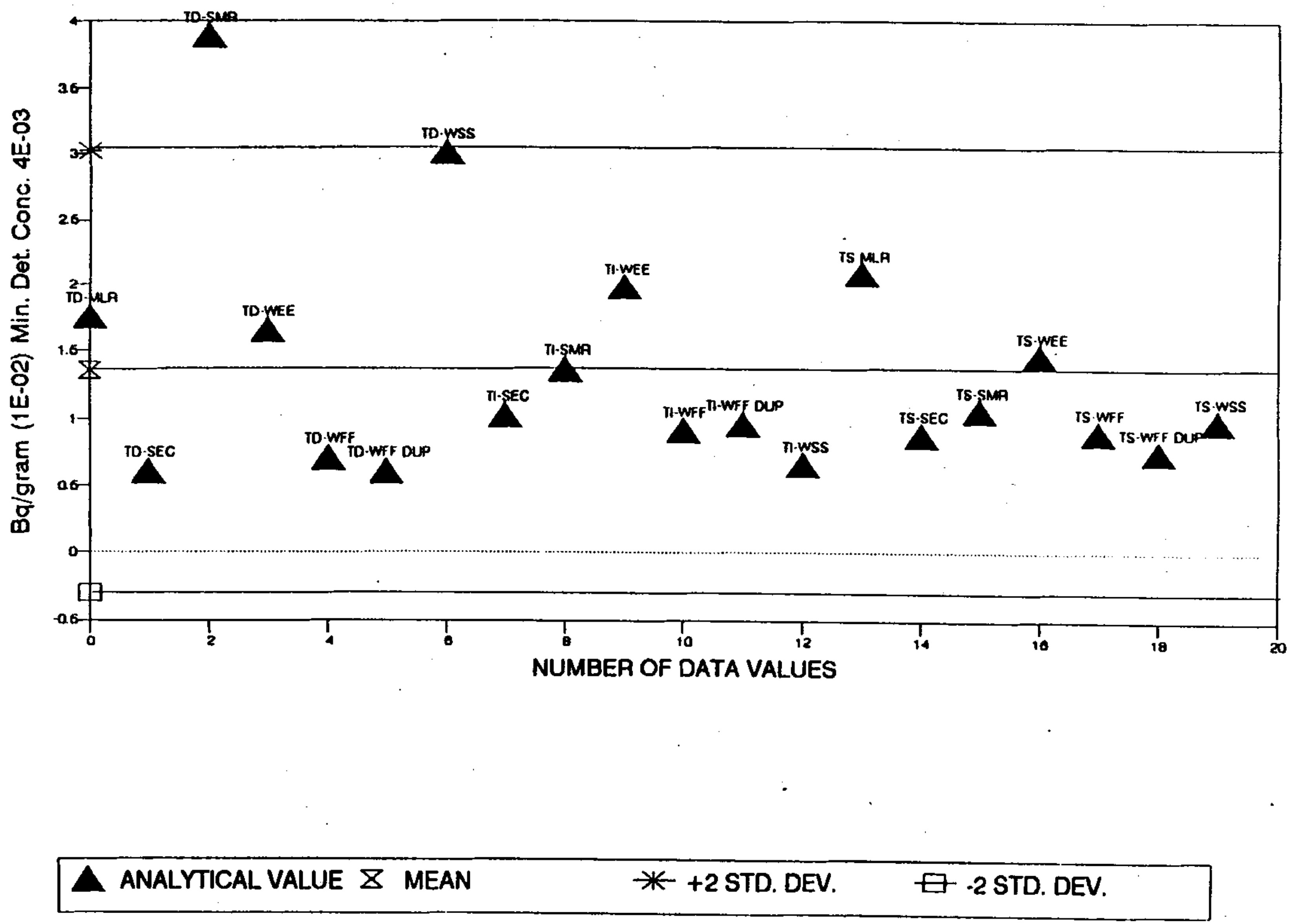


# 1995

## U-233/234 IN SOIL



# 1995
## U-238 IN SOIL



# APPENDIX A3
# RADIOLOGICAL ANALYSIS
# SURFACE WATER

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-UPR Surface Water Upper Pecos River | Americium-241 | 1.75E-02 | 5.82E-03 |
| | Cesium-137 | *-9.30E-2 | 1.60E-01 |
| | Cobalt-60 | *-7.40E-2 | 1.70E-01 |
| | Lead-210 | 6.30E-01 | 3.10E+00 |
| | Plutonium-239/240 | 2.66E-03 | 2.33E-03 |
| | Plutonium-241 | -7.90E-01 | 3.57E-01 |
| | Plutonium-238 | 0.00E+00 | 1.48E-03 |
| | Polonium-210 | 2.20E-03 | 7.50E-02 |
| | Potassium-40 | *3.60E0 | 1.90E+00 |
| | Radium 228 | 8.60E-03 | 2.60E-02 |
| | Radium 226 | 1.74E-02 | 3.10E-03 |
| | Strontium-90 | -2.10E-02 | 2.00E-02 |
| | Thorium-230 | 3.63E-02 | 8.77E-03 |
| | Thorium-232 | 1.98E-03 | 2.75E-03 |
| | Thorium-228 | 6.71E-03 | 3.92E-03 |
| | Uranium-238 | 3.25E-02 | 7.95E-03 |
| | Uranium-235/236 | 4.86E-03 | 3.76E-03 |
| | Uranium-234 | 6.83E-02 | 1.15E-02 |
| | Uranium-233 | 6.83E-02 | 1.15E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-PCN Surface Water Pierce Canyon | Americium-241 | 2.48E-02 | 7.25E-03 |
| | Cesium-137 | *3.30E-2 | 1.50E-01 |
| | Cobalt-60 | *1.70E-2 | 1.60E-01 |
| | Lead-210 | *5.10E0 | 2.20E+00 |
| | Plutonium-239/240 | 3.94E-03 | 4.55E-03 |
| | Plutonium-238 | 1.13E-03 | 2.21E-03 |
| | Plutonium-241 | -4.87E-01 | 3.76E-01 |
| | Polonium-210 | 5.10E-03 | 8.30E-02 |
| | Potassium-40 | 1.60E+00 | 3.40E+00 |
| | Radium 228 | -1.01E-02 | 2.70E-02 |
| | Radium 226 | 8.67E-03 | 2.20E-03 |
| | Strontium-90 | -4.10E-03 | 2.20E-02 |
| | Thorium-230 | 3.52E-02 | 8.41E-03 |
| | Thorium-228 | 5.29E-04 | 3.44E-03 |
| | Thorium-232 | 2.54E-03 | 2.64E-03 |
| | Uranium-233 | 2.51E-01 | 2.20E-02 |
| | Uranium-235/236 | 1.10E-02 | 5.89E-03 |
| | Uranium-238 | 1.11E-01 | 1.47E-02 |
| | Uranium-234 | 2.51E-01 | 2.20E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-IDN Surface Water Indian Tank | Americium-241 | 2.59E-02 | 7.03E-03 |
| | Cesium-137 | *-1.40E-1 | 1.70E-01 |
| | Cobalt-60 | *6.90E-2 | 1.50E-01 |
| | Lead-210 | *6.40E0 | 2.10E+00 |
| | Plutonium-238 | -7.10E-04 | 3.68E-03 |
| | Plutonium-241 | 1.33E-02 | 5.00E-01 |
| | Plutonium-239/240 | 2.13E-03 | 3.11E-03 |
| | Polonium-210 | 2.00E-02 | 1.20E-01 |
| | Potassium-40 | *3.10E0 | 1.90E+00 |
| | Radium 228 | 1.97E-03 | 2.50E-02 |
| | Radium 226 | 1.69E-02 | 3.00E-03 |
| | Strontium-90 | 2.50E-02 | 2.40E-02 |
| | Thorium-228 | 4.94E-03 | 3.87E-03 |
| | Thorium-230 | 1.81E-02 | 6.04E-03 |
| | Thorium-232 | 9.49E-04 | 2.63E-03 |
| | Uranium-238 | 1.35E-02 | 5.49E-03 |
| | Uranium-235/236 | 5.93E-04 | 1.16E-03 |
| | Uranium-234 | 1.97E-02 | 6.45E-03 |
| | Uranium-233 | 1.97E-02 | 6.45E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-HIL Surface Water Hill Tank | Americium-241 | 2.15E-02 | 6.26E-03 |
| | Cesium-137 | *1.30E-1 | 1.40E-01 |
| | Cobalt-60 | *1.80E-2 | 1.60E-01 |
| | Lead-210 | 2.50E+00 | 3.30E+00 |
| | Plutonium-238 | -9.33E-03 | 7.16E-03 |
| | Plutonium-239/240 | -6.66E-03 | 5.22E-03 |
| | Plutonium-241 | -4.07E-01 | 4.42E-01 |
| | Polonium-210 | 2.80E-02 | 1.10E-01 |
| | Potassium-40 | *4.00E0 | 1.80E+00 |
| | Radium 226 | 6.85E-03 | 2.40E-03 |
| | Radium 228 | 2.18E-02 | 2.90E-02 |
| | Strontium-90 | 3.40E-02 | 2.20E-02 |
| | Thorium-230 | 2.73E-02 | 7.97E-03 |
| | Thorium-228 | 6.30E-03 | 4.94E-03 |
| | Thorium-232 | 1.21E-03 | 2.91E-03 |
| | Uranium-234 | 2.02E-02 | 6.86E-03 |
| | Uranium-233 | 2.02E-02 | 6.86E-03 |
| | Uranium-235/236 | 2.70E-03 | 2.65E-03 |
| | Uranium-238 | 6.02E-03 | 3.87E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-FWT Surface Water Fresh Water Tanks | Americium-241 | 2.13E-02 | 6.53E-03 |
| | Cesium-137 | *9.70E-03 | 1.70E-01 |
| | Cobalt-60 | *1.10E-02 | 1.60E-01 |
| | Lead-210 | 1.30E+00 | 3.50E+00 |
| | Plutonium-238 | -1.28E-03 | 3.55E-03 |
| | Plutonium-241 | -7.29E-01 | 3.89E-01 |
| | Plutonium-239/240 | 2.56E-03 | 3.55E-03 |
| | Polonium-210 | 6.60E-03 | 8.90E-02 |
| | Potassium-40 | *2.00E0 | 2.00E+00 |
| | Radium 228 | 3.03E-02 | 2.60E-02 |
| | Radium 226 | 3.74E-03 | 1.70E-03 |
| | Strontium-90 | -2.20E-02 | 2.50E-02 |
| | Thorium-228 | 3.39E-03 | 3.15E-03 |
| | Thorium-230 | 2.38E-02 | 6.91E-03 |
| | Thorium-232 | 9.32E-04 | 1.29E-03 |
| | Uranium-238 | 2.42E-02 | 7.53E-03 |
| | Uranium-235/236 | 2.49E-03 | 3.45E-03 |
| | Uranium-234 | 6.24E-02 | 1.14E-02 |
| | Uranium-233 | 6.24E-02 | 1.14E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-SEW Surface Water Sewage Lagoon | Americium-241 | 2.39E-02 | 7.92E-03 |
| | Cesium-137 | *2.90E-02 | 1.30E-01 |
| | Cobalt-60 | *-8.90E-02 | 1.70E-01 |
| | Lead-210 | 1.10E+00 | 3.10E+00 |
| | Plutonium-238 | 5.16E-04 | 1.01E-03 |
| | Plutonium-241 | -5.45E-01 | 3.46E-01 |
| | Plutonium-239/240 | 6.70E-03 | 4.17E-03 |
| | Polonium-210 | 4.60E-03 | 9.50E-02 |
| | Potassium-40 | 6.10E+00 | 3.30E+00 |
| | Radium 228 | 1.44E-02 | 2.70E-02 |
| | Radium 226 | 3.85E-02 | 4.70E-03 |
| | Strontium-90 | 3.50E-02 | 2.30E-02 |
| | Thorium-228 | -1.47E-03 | 4.54E-03 |
| | Thorium-230 | 1.00E-01 | 1.68E-02 |
| | Thorium-232 | -2.82E-03 | 2.76E-03 |
| | Uranium-238 | 3.77E-03 | 3.80E-03 |
| | Uranium-235/236 | -1.33E-03 | 1.84E-03 |
| | Uranium-234 | 3.22E-02 | 8.55E-03 |
| | Uranium-233 | 3.22E-02 | 8.55E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-BRA Surface Water Brantley Lake | Americium-241 | 2.20E-02 | 6.72E-03 |
| | Cesium-137 | *-2.30E-02 | 1.60E-01 |
| | Cobalt-60 | *-6.20E-02 | 1.70E-01 |
| | Lead-210 | *6.09E00 | 2.10E+00 |
| | Plutonium-238 | 5.99E-04 | 2.03E-03 |
| | Plutonium-241 | -8.59E-01 | 4.11E-01 |
| | Plutonium-239/240 | 2.99E-03 | 3.10E-03 |
| | Polonium-210 | 3.70E-03 | 8.90E-02 |
| | Potassium-40 | *2.20E00 | 2.10E+00 |
| | Radium 228 | 2.88E-02 | 2.60E-02 |
| | Radium 226 | 9.11E-03 | 2.50E-03 |
| | Strontium-90 | 1.80E-02 | 2.50E-02 |
| | Thorium-228 | 6.41E-03 | 3.79E-03 |
| | Thorium-230 | 2.24E-02 | 6.95E-03 |
| | Thorium-232 | 2.24E-03 | 3.10E-03 |
| | Uranium-238 | 4.12E-02 | 8.97E-03 |
| | Uranium-235/236 | 2.51E-03 | 3.01E-03 |
| | Uranium-234 | 1.00E-01 | 1.43E-02 |
| | Uranium-233 | 1.00E-01 | 1.43E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-NOY Noya Tank Surface Water | Americium-241 | 2.13E-02 | 7.38E-03 |
| | Cesium-137 | *5.80E-02 | 1.60E-01 |
| | Cobalt-60 | *9.50E-02 | 1.70E-01 |
| | Lead-210 | 1.40E+00 | 3.20E+00 |
| | Plutonium-238 | 5.26E-04 | 3.09E-03 |
| | Plutonium-241 | -6.23E-01 | 3.71E-01 |
| | Plutonium-239/240 | 2.63E-03 | 3.09E-03 |
| | Polonium-210 | 8.10E-03 | 8.70E-02 |
| | Potassium-40 | *2.70E00 | 2.00E+00 |
| | Radium 226 | 9.07E-03 | 2.50E-03 |
| | Radium 228 | 3.23E-02 | 2.60E-02 |
| | Strontium-90 | 4.00E-02 | 2.20E-02 |
| | Thorium-230 | 1.73E-02 | 7.31E-03 |
| | Thorium-228 | 7.76E-03 | 4.83E-03 |
| | Thorium-232 | 2.30E-03 | 2.76E-03 |
| | Uranium-238 | 1.47E-02 | 5.43E-03 |
| | Uranium-235/236 | 1.29E-03 | 3.10E-03 |
| | Uranium-234 | 2.77E-02 | 8.51E-03 |
| | Uranium-233 | 2.77E-02 | 8.51E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-LGS<br>Surface Water<br>Laguna Grande de la Sol | Americium-241 | 7.42E-02 | 5.45E-02 |
| | Cesium-137 | *1.20E-01 | 2.70E-01 |
| | Cobalt-60 | *9.80E-02 | 3.80E-01 |
| | Lead-210 | *4.60E00 | 4.00E+00 |
| | Plutonium-238 | -5.94E-04 | 2.60E-03 |
| | Plutonium-239/240 | 3.56E-03 | 3.29E-03 |
| | Plutonium-241 | -4.92E-01 | 3.94E-01 |
| | Polonium-210 | 6.00E-02 | 1.40E-01 |
| | Potassium-40 | 1.40E+03 | 1.60E+02 |
| | Radium 228 | 1.51E-01 | 5.20E-02 |
| | Radium 226 | 2.99E-01 | 1.50E-03 |
| | Strontium-90 | 5.20E-02 | 2.60E-02 |
| | Thorium-232 | 2.36E-03 | 3.44E-03 |
| | Thorium-228 | 8.17E-03 | 6.79E-03 |
| | Thorium-230 | 1.73E-02 | 8.16E-03 |
| | Uranium-238 | 1.11E+00 | 5.40E-02 |
| | Uranium-235/236 | 7.52E-02 | 1.58E-02 |
| | Uranium-233 | 2.34E+00 | 7.86E-02 |
| | Uranium-234 | 2.34E+00 | 7.86E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-COY Surface Water<br>Note: Acronym COY denotes duplicate sample collected at Pierce Canyon | Americium-241 | 1.98E-02 | 6.64E-03 |
| | Cesium-137 | *4.30E-02 | 1.30E-01 |
| | Cobalt-60 | *3.10E-02 | 1.60E-01 |
| | Lead-210 | 1.10E+00 | 2.70E+00 |
| | Plutonium-238 | 1.99E-03 | 3.90E-03 |
| | Plutonium-241 | -3.87E-01 | 4.43E-01 |
| | Plutonium-239/240 | 1.98E-03 | 2.25E-03 |
| | Polonium-210 | 6.70E-03 | 9.00E-02 |
| | Potassium-40 | 1.20E+00 | 3.20E+00 |
| | Radium 228 | 2.19E-02 | 4.30E-02 |
| | Radium 226 | 5.96E-03 | 2.60E-03 |
| | Strontium-90 | -1.20E-02 | 2.00E-02 |
| | Thorium-228 | 1.64E-03 | 4.41E-03 |
| | Thorium-230 | 4.26E-02 | 9.50E-03 |
| | Thorium-232 | -1.05E-03 | 1.46E-03 |
| | Uranium-238 | 9.84E-02 | 1.38E-02 |
| | Uranium-235/236 | 1.28E-02 | 5.73E-03 |
| | Uranium-234 | 2.13E-01 | 2.04E-02 |
| | Uranium-233 | 2.13E-01 | 2.04E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-COW Surface Water Note: Acronym COW denotes sample blank | Americium-241 | 5.22E-02 | 1.12E-02 |
| | Cesium-137 | *-1.30E-02 | 1.40E-01 |
| | Cobalt-60 | *-2.10E-02 | 1.70E-01 |
| | Lead-210 | *6.60E00 | 2.10E00 |
| | Plutonium-238 | -2.10E-03 | 2.51E-03 |
| | Plutonium-241 | -6.12E-01 | 3.44E-01 |
| | Plutonium-239/240 | 1.10E-02 | 5.33E-03 |
| | Polonium-210 | 3.30E-02 | 7.90E-02 |
| | Potassium-40 | *2.40E00 | 2.00E00 |
| | Radium 228 | -1.87E-02 | 2.50E-02 |
| | Radium 226 | 6.85E-03 | 1.90E-03 |
| | Strontium-90 | 2.20E-02 | 2.20E-02 |
| | Thorium-228 | 1.06E-03 | 2.53E-03 |
| | Thorium-230 | 3.35E-02 | 8.45E-03 |
| | Thorium-232 | -1.01E-03 | 1.41E-03 |
| | Uranium-238 | 4.05E-03 | 3.14E-03 |
| | Uranium-235/236 | 1.25E-03 | 1.73E-03 |
| | Uranium-234 | 1.01E-02 | 5.05E-03 |
| | Uranium-233 | 1.01E-02 | 5.05E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| HS-CBD Surface Water Carlsbad | Americium-241 | 2.25E-02 | 6.43E-03 |
| | Cesium-137 | *1.10E-02 | 1.50E-01 |
| | Cobalt-60 | *1.0E-01 | 1.50E-01 |
| | Lead-210 | 3.60E-01 | 3.20E00 |
| | Plutonium-238 | 0.00E+00 | 1.66E-03 |
| | Plutonium-241 | -8.35E-01 | 4.15E-01 |
| | Plutonium-239/240 | -1.80E-03 | 2.03E-03 |
| | Polonium-210 | 3.10E-03 | 7.80E-02 |
| | Potassium-40 | *2.40E00 | 1.90E00 |
| | Radium 228 | 6.20E-03 | 2.50E-02 |
| | Radium 226 | 4.48E-03 | 1.70E-03 |
| | Strontium-90 | -1.20E-02 | 2.20E-02 |
| | Thorium-228 | 1.57E-03 | 3.40E-03 |
| | Thorium-230 | 2.27E-02 | 7.19E-03 |
| | Thorium-232 | 2.01E-03 | 1.97E-03 |
| | Uranium-238 | 6.51E-02 | 1.17E-02 |
| | Uranium-235/236 | 4.39E-03 | 4.08E-03 |
| | Uranium-234 | 1.52E-01 | 1.75E-02 |
| | Uranium-233 | 1.52E-01 | 1.75E-02 |

# APPENDIX A4
# RADIOLOGICAL ANALYSIS
# BOTTOM SEDIMENT

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB-UPR Bottom Sediment Upper Pecos River | Americium-241 | 2.46E-02 | 3.12E-03 |
| | Cesium-137 | 1.20E-03 | 1.20E-03 |
| | Cobalt-60 | *3.80E-04 | 6.40E-04 |
| | Lead-210 | 2.60E-02 | 1.50E-02 |
| | Plutonium-238 | -1.22E-04 | 4.15E-04 |
| | Plutonium-241 | 1.93E-01 | 6.91E-02 |
| | Plutonium-239/240 | 6.11E-04 | 5.36E-04 |
| | Polonium-210 | 1.55E-02 | 1.96E-03 |
| | Potassium-40 | 3.60E-01 | 6.80E-02 |
| | Radium-226 | 3.60E-02 | 1.80E-02 |
| | Radium-228 | 2.30E-02 | 5.80E-03 |
| | Strontium-90 | 3.40E-02 | 4.40E-03 |
| | Thorium-228 | 3.28E-02 | 3.79E-03 |
| | Thorium-232 | 2.95E-02 | 3.47E-03 |
| | Thorium-230 | 6.62E-02 | 5.19E-03 |
| | Uranium-238 | 3.33E-02 | 3.56E-03 |
| | Uranium-235/236 | 2.82E-03 | 1.15E-03 |
| | Uranium-234 | 4.53E-02 | 4.20E-03 |
| | Uranium-233 | 4.53E-02 | 4.20E-03 |
| HB-PCN Bottom Sediment Pierce Canyon | Americium-241 | 1.64E-02 | 2.64E-03 |
| | Cesium-137 | *-1.80E-04 | 6.80E-04 |
| | Cobalt-60 | *2.70E-04 | 5.90E-04 |
| | Lead-210 | 1.50E-02 | 1.20E-02 |
| | Plutonium-238 | 0.00E+00 | 3.89E-04 |
| | Plutonium-241 | -2.10E-02 | 8.85E-02 |
| | Plutonium-239/240 | 4.20E-04 | 4.76E-04 |
| | Polonium-210 | 1.07E-02 | 2.27E-03 |
| | Potassium-40 | 1.90E-01 | 3.90E-02 |
| | Radium-226 | 2.40E-02 | 1.50E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB-PCN Pierce Canyon Bottom Sediment (continued) | Radium-228 | *1.30E-02 | 4.10E-03 |
| | Strontium-90 | 4.80E-03 | 3.10E-03 |
| | Thorium-228 | 2.05E-02 | 2.97E-03 |
| | Thorium-232 | 1.67E-02 | 2.59E-03 |
| | Thorium-230 | 5.39E-02 | 4.68E-03 |
| | Uranium-238 | 2.96E-02 | 3.42E-03 |
| | Uranium-235/236 | 3.35E-03 | 1.31E-03 |
| | Uranium-234 | 3.62E-02 | 3.79E-03 |
| | Uranium-233 | 3.62E-02 | 3.79E-03 |
| HB_IDN Bottom Sediment Indian Tank | Americium-241 | 5.50E-02 | 5.41E-03 |
| | Cesium-137 | 1.20E-02 | 2.30E-03 |
| | Cobalt-60 | *7.10E-04 | 7.70E-04 |
| | Lead-210 | 6.20E-02 | 1.70E-02 |
| | Plutonium-238 | 1.23E-04 | 4.18E-04 |
| | Plutonium-241 | 6.41E-02 | 8.06E-02 |
| | Plutonium-239/240 | 4.92E-04 | 6.82E-04 |
| | Polonium-210 | 5.31E-02 | 3.90E-03 |
| | Potassium-40 | 4.90E-01 | 9.30E-02 |
| | Radium-226 | 3.30E-02 | 1.90E-02 |
| | Radium-228 | 3.60E-02 | 8.80E-03 |
| | Strontium-90 | 5.80E-03 | 2.90E-03 |
| | Thorium-228 | 2.05E-02 | 2.91E-03 |
| | Thorium-232 | 1.91E-02 | 2.72E-03 |
| | Thorium-230 | 3.43E-02 | 3.63E-03 |
| | Uranium-238 | 2.80E-02 | 3.16E-03 |
| | Uranium-235/236 | 1.14E-03 | 9.48E-04 |
| | Uranium-234 | 3.14E-02 | 3.39E-03 |
| | Uranium-233 | 3.14E-02 | 3.39E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB-HIL Bottom Sediment Hill Tank | Americium-241 | 5.57E-02 | 6.45E-03 |
| | Cesium-137 | 1.30E-02 | 2.80E-03 |
| | Cobalt-60 | *4.90E-05 | 7.60E-04 |
| | Lead-210 | 5.90E-02 | 1.70E-02 |
| | Plutonium-239/240 | 1.12E-03 | 6.93E-04 |
| | Plutonium-241 | 9.44E-02 | 7.27E-02 |
| | Plutonium-238 | -1.12E-04 | 3.80E-04 |
| | Polonium-210 | 5.00E-02 | 2.98E-03 |
| | Potassium-40 | 7.20E-01 | 1.30E-01 |
| | Radium-228 | 3.50E-02 | 7.80E-03 |
| | Radium-226 | 4.80E-02 | 2.50E-02 |
| | Strontium-90 | 8.90E-03 | 2.70E-03 |
| | Thorium-228 | 4.19E-02 | 4.50E-03 |
| | Thorium-232 | 3.89E-02 | 4.20E-03 |
| | Thorium-230 | 5.09E-02 | 4.85E-03 |
| | Uranium-238 | 2.51E-02 | 3.04E-03 |
| | Uranium-235/236 | 2.22E-03 | 1.14E-03 |
| | Uranium-234 | 3.04E-02 | 3.37E-03 |
| | Uranium-233 | 3.04E-02 | 3.37E-03 |
| HB-CBD Bottom Sediment Carlsbad | Americium-241 | 1.56E-02 | 2.39E-03 |
| | Cesium-137 | 4.20E-03 | 1.60E-03 |
| | Cobalt-60 | *2.70E-02 | 2.10E-02 |
| | Lead-210 | 4.80E-02 | 2.00E-02 |
| | Plutonium-238 | 2.37E-04 | 4.65E-04 |
| | Plutonium-241 | 1.82E-02 | 7.44E-02 |
| | Plutonium-239/240 | 4.73E-04 | 4.64E-04 |
| | Polonium-210 | 2.97E-02 | 7.46E-03 |
| | Potassium-40 | 2.90E-01 | 5.80E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB-CBD Bottom Sediment Carlsbad (continued) | Radium-226 | 2.90E-02 | 2.20E-02 |
| | Radium-228 | *2.50E-02 | 6.90E-03 |
| | Strontium-90 | 2.30E-03 | 1.90E-03 |
| | Thorium-228 | 1.81E-02 | 2.76E-03 |
| | Thorium-232 | 1.80E-02 | 2.67E-03 |
| | Thorium-230 | 5.50E-02 | 4.66E-03 |
| | Uranium-238 | 2.86E-02 | 3.45E-03 |
| | Uranium-235/236 | 2.08E-03 | 1.02E-03 |
| | Uranium-234 | 3.74E-02 | 3.96E-03 |
| | Uranium-233 | 3.74E-02 | 3.96E-03 |
| HB-TUT Bottom Sediment Tut Tank | Americium-241 | 5.68E-02 | 7.24E-03 |
| | Cesium-137 | 3.40E-03 | 1.50E-03 |
| | Cobalt-60 | *2.90E-03 | 2.30E-02 |
| | Lead-210 | 5.70E-02 | 2.00E-02 |
| | Plutonium-238 | -4.10E-04 | 4.02E-04 |
| | Plutonium-239/240 | 1.02E-04 | 3.48E-04 |
| | Plutonium-241 | 2.56E-02 | 6.38E-02 |
| | Polonium-210 | 3.40E-02 | 2.96E-03 |
| | Potassium-40 | 7.00E-01 | 1.80E-01 |
| | Radium-226 | 3.70E-02 | 2.10E-02 |
| | Radium-228 | 3.90E-02 | 1.10E-02 |
| | Strontium-90 | 3.30E-03 | 2.80E-03 |
| | Thorium-230 | 3.43E-02 | 3.64E-03 |
| | Thorium-232 | 2.43E-02 | 3.07E-03 |
| | Thorium-228 | 2.51E-02 | 3.21E-03 |
| | Uranium-235/236 | 5.23E-03 | 1.74E-03 |
| | Uranium-234 | 5.14E-02 | 4.64E-03 |
| | Uranium-238 | 4.88E-02 | 4.48E-03 |
| | Uranium-233 | 5.14E-02 | 4.64E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB -NOY<br>Bottom Sediment<br>Noya Tank | Americium-241 | 1.65E-02 | 2.45E-03 |
| | Cesium-137 | 1.00E-03 | 1.10E-03 |
| | Cobalt-60 | *4.50E-04 | 9.50E-04 |
| | Lead-210 | 2.70E-02 | 1.30E-02 |
| | Plutonium-238 | 4.43E-04 | 4.34E-04 |
| | Plutonium-241 | 3.87E-02 | 6.97E-02 |
| | Plutonium-239/240 | 5.53E-04 | 4.84E-04 |
| | Polonium-210 | 1.13E-02 | 1.42E-03 |
| | Potassium-40 | 3.20E-01 | 6.20E-02 |
| | Radium-226 | 1.70E-02 | 1.40E-02 |
| | Radium-228 | 1.80E-02 | 4.50E-03 |
| | Strontium-90 | 4.90E-03 | 2.70E-03 |
| | Thorium-228 | 1.33E-02 | 2.32E-03 |
| | Thorium-232 | 1.42E-02 | 2.37E-03 |
| | Thorium-230 | 4.20E-02 | 4.04E-03 |
| | Uranium-238 | 1.30E-02 | 2.43E-03 |
| | Uranium-235/236 | 1.72E-03 | 1.05E-03 |
| | Uranium-234 | 1.31E-02 | 2.54E-03 |
| | Uranium-233 | 1.31E-02 | 2.54E-03 |
| HB_LGS<br>Bottom Sediment<br>Laguna Grande de la Sol | Americium-241 | 9.49E-03 | 2.48E-03 |
| | Cesium-137 | *8.20E-05 | 7.10E-04 |
| | Cobalt-60 | *7.10E-05 | 5.40E-04 |
| | Lead-210 | 1.10E-02 | 1.00E-02 |
| | Plutonium-238 | 2.27E-04 | 4.46E-04 |
| | Plutonium-241 | 6.15E-02 | 7.37E-02 |
| | Plutonium-239/240 | 4.54E-04 | 5.45E-04 |
| | Polonium-210 | 1.95E-02 | 1.76E-03 |
| | Potassium-40 | 2.70E-01 | 5.20E-02 |
| | Radium-226 | 2.80E-02 | 1.80E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB_LGS Bottom Sediment Laguna Grande de la Sol (continued) | Radium-228 | *5.90E-03 | 4.20E-03 |
| | Strontium-90 | 2.70E-03 | 1.90E-03 |
| | Thorium-228 | 1.45E-02 | 2.53E-03 |
| | Thorium-232 | 4.08E-03 | 1.29E-03 |
| | Thorium-230 | 4.86E-02 | 4.40E-03 |
| | Uranium-238 | 3.66E-02 | 3.80E-03 |
| | Uranium-235/236 | 5.14E-03 | 1.61E-03 |
| | Uranium-234 | 6.06E-02 | 4.91E-03 |
| | Uranium-233 | 6.06E-02 | 4.91E-03 |
| HB-COY Note: Acronym COY denotes duplicate sample collected at Pierce Canyon | Americium-241 | 3.51E-02 | 3.75E-03 |
| | Cesium-137 | *2.10E-04 | 6.00E-04 |
| | Cobalt-60 | *1.40E-04 | 5.10E-04 |
| | Lead-210 | 1.10E-02 | 9.80E-03 |
| | Plutonium-238 | 3.51E-04 | 6.07E-04 |
| | Plutonium-241 | 1.13E-01 | 7.53E-02 |
| | Plutonium-239/240 | 5.84E-04 | 5.12E-04 |
| | Polonium-210 | 1.48E-02 | 2.17E-03 |
| | Potassium-40 | 2.00E-01 | 3.90E-02 |
| | Radium-226 | 3.60E-02 | 1.40E-02 |
| | Radium-228 | *1.30E-02 | 7.70E-03 |
| | Strontium-90 | 1.00E-02 | 2.90E-03 |
| | Thorium-228 | 1.69E-02 | 2.76E-03 |
| | Thorium-232 | 1.69E-02 | 2.68E-03 |
| | Thorium-230 | 4.49E-02 | 4.38E-03 |
| | Uranium-238 | 1.88E-02 | 2.84E-03 |
| | Uranium-235/236 | 0.00E+00 | 1.18E-03 |
| | Uranium-234 | 2.30E-02 | 3.22E-03 |
| | Uranium-233 | 2.30E-02 | 3.22E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB-RED Bottom Sediment Red Tank | Americium-241 | 1.68E-02 | 2.52E-03 |
| | Cesium-137 | 5.30E-03 | 2.00E-03 |
| | Cobalt-60 | *4.50E-04 | 7.40E-04 |
| | Lead-210 | 6.20E-02 | 1.80E-02 |
| | Plutonium-238 | 0.00E+00 | 5.12E-04 |
| | Plutonium-241 | 6.21E-02 | 6.82E-02 |
| | Plutonium-239/240 | 7.46E-04 | 5.53E-04 |
| | Polonium-210 | 3.59E-02 | 2.54E-03 |
| | Potassium-40 | 3.90E-01 | 7.60E-02 |
| | Radium-226 | 3.10E-02 | 1.90E-02 |
| | Radium-228 | 3.00E-02 | 7.40E-03 |
| | Strontium-90 | 6.90E-03 | 2.90E-03 |
| | Thorium-228 | 3.82E-02 | 4.11E-03 |
| | Thorium-232 | 3.26E-02 | 3.69E-03 |
| | Thorium-230 | 5.50E-02 | 4.79E-03 |
| | Uranium-238 | 2.47E-02 | 3.11E-03 |
| | Uranium-235/236 | 1.08E-03 | 8.46E-04 |
| | Uranium-234 | 2.81E-02 | 3.32E-03 |
| | Uranium-233 | 2.81E-02 | 3.32E-03 |
| HB-BRA Bottom Sediment Brantley Lake | Americium-241 | 1.82E-02 | 2.89E-03 |
| | Cesium-137 | *-1.20E-05 | 7.50E-04 |
| | Cobalt-60 | *5.30E-04 | 5.50E-04 |
| | Lead-210 | 1.70E-02 | 1.30E-02 |
| | Plutonium-238 | 2.22E-04 | 3.07E-04 |
| | Plutonium-241 | 5.60E-02 | 6.96E-02 |
| | Plutonium-239/240 | 6.64E-04 | 6.14E-04 |
| | Polonium-210 | 6.84E-03 | 1.22E-03 |
| | Potassium-40 | 2.90E-01 | 5.60E-02 |
| | Radium-226 | 3.00E-02 | 1.70E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| HB-BRA Bottom Sediment Brantley Lake | Radium-228 | 1.90E-02 | 5.40E-03 |
| | Strontium-90 | 4.10E-03 | 2.50E-03 |
| | Thorium-228 | 2.80E-02 | 3.61E-03 |
| | Thorium-232 | 2.29E-02 | 3.16E-03 |
| | Thorium-230 | 7.37E-02 | 5.61E-03 |
| | Uranium-238 | 6.21E-02 | 4.77E-03 |
| | Uranium-235/236 | 8.05E-03 | 1.95E-03 |
| | Uranium-234 | 9.10E-02 | 5.78E-03 |
| | Uranium-233 | 9.10E-02 | 5.78E-03 |

# APPENDIX A5
# RADIOLOGICAL ANALYSIS
# GROUND WATER

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| H-03B3 Ground Water Round 10 | Americium-241 | 3.51E-02 | 7.29E-03 |
| | Cesium-137 | -3.90E-03 | 7.10E-02 |
| | Cobalt-60 | -1.90E-02 | 8.10E-02 |
| | Lead-210 | 5.60E+00 | 1.30E+00 |
| | Plutonium-239/240 | 2.69E-03 | 2.28E-03 |
| | Plutonium-241 | -6.02E-02 | 1.16E-01 |
| | Plutonium-238 | 2.03E-03 | 2.09E-03 |
| | Polonium-210 | 1.63E-02 | 7.71E-03 |
| | Potassium-40 | 1.50E+01 | 2.70E+00 |
| | Radium-226 | 4.40E+00 | 4.70E-02 |
| | Radium-228 | 5.67E-01 | 7.00E-02 |
| | Strontium-90 | -6.90E-03 | 3.10E-02 |
| | Thorium-228 | 1.27E-01 | 1.44E-02 |
| | Thorium-232 | 1.00E-03 | 2.17E-03 |
| | Thorium-230 | 2.55E-02 | 5.95E-03 |
| | Uranium-235/236 | 1.16E-02 | 4.82E-03 |
| | Uranium-238 | 7.62E-02 | 1.10E-02 |
| | Uranium-233/234 | 4.82E-01 | 2.70E-02 |
| H14 Ground Water Round 8 | Americium-241 | 1.30E-02 | 4.22E-03 |
| | Cesium-137 | -6.20E-02 | 7.00E-02 |
| | Cobalt-60 | 5.90E-02 | 8.10E-02 |
| | Lead-210 | 1.10E+00 | 1.80E+00 |
| | Plutonium-241 | -1.88E-01 | 1.38E-01 |
| | Plutonium-238 | -8.30E-04 | 1.99E-03 |
| | Plutonium-239/240 | 1.24E-03 | 1.40E-03 |
| | Polonium-210 | 8.63E-03 | 9.92E-03 |
| | Potassium-40 | 7.80E+00 | 2.10E+00 |
| | Radium-228 | 8.04E-01 | 7.80E-02 |
| | Radium-226 | 3.10E+00 | 3.90E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| H14 Ground Water Round 8 (continued) | Strontium-90 | -6.40E-04 | 1.70E-02 |
| | Thorium-230 | 1.61E-02 | 4.87E-03 |
| | Thorium-228 | 6.52E-02 | 1.02E-02 |
| | Thorium-232 | -9.85E-04 | 1.11E-03 |
| | Uranium-233/234 | 3.27E-01 | 2.26E-02 |
| | Uranium-238 | 3.88E-02 | 8.10E-03 |
| | Uranium-235/236 | 3.94E-03 | 3.06E-03 |
| H18 Ground Water Round 4 | Americium-241 | 1.91E-02 | 5.31E-03 |
| | Cesium-137 | 1.00E-02 | 7.00E-02 |
| | Cobalt-60 | 4.20E-02 | 7.60E-02 |
| | Lead-210 | 6.80E+00 | 1.40E+00 |
| | Plutonium-241 | -1.17E-01 | 1.17E-01 |
| | Plutonium-238 | 0.00E+00 | 1.98E-03 |
| | Plutonium-239/240 | 1.43E-03 | 1.40E-03 |
| | Polonium-210 | N/A | N/A |
| | Potassium-40 | 7.70E+00 | 2.10E+00 |
| | Radium-228 | 5.07E-01 | 6.70E-02 |
| | Radium-226 | 3.70E+00 | 4.30E-02 |
| | Strontium-90 | -2.10E-02 | 2.70E-02 |
| | Thorium-230 | 2.18E-02 | 6.54E-03 |
| | Thorium-228 | 1.18E-01 | 1.63E-02 |
| | Thorium-232 | 1.81E-03 | 2.51E-03 |
| | Uranium-233/234 | 6.20E-01 | 2.99E-02 |
| | Uranium-238 | 9.97E-02 | 1.20E-02 |
| | Uranium-235/236 | 1.32E-02 | 4.97E-03 |
| WIPP19 Ground Water Round 10 | Americium-241 | 2.00E-02 | 6.03E-03 |
| | Cesium-137 | -7.90E-02 | 7.60E-02 |
| | Cobalt-60 | 9.40E-02 | 8.40E-02 |
| | Lead-210 | 1.80E-01 | 1.90E+00 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| WIPP19 Ground Water Round 10 (continued) | Plutonium-241 | -2.29E-01 | 1.24E-01 |
| | Plutonium-238 | 0.00E+00 | 1.41E-03 |
| | Plutonium-239/240 | 0.00E+00 | 9.94E-04 |
| | Polonium-210 | 1.40E-02 | 1.09E-02 |
| | Potassium-40 | 1.90E+01 | 3.30E+00 |
| | Radium-228 | 1.59E+00 | 1.10E-01 |
| | Radium-226 | 5.00E+00 | 5.00E-02 |
| | Strontium-90 | 1.60E-03 | 1.80E-02 |
| | Thorium-230 | 3.76E-02 | 1.16E-02 |
| | Thorium-228 | 2.14E-01 | 2.88E-02 |
| | Thorium-232 | 3.68E-03 | 3.81E-03 |
| | Uranium-233/234 | 6.36E-01 | 4.57E-02 |
| | Uranium-238 | 9.92E-02 | 1.85E-02 |
| | Uranium-235/236 | 3.32E-02 | 1.19E-02 |
| WQSP-1 Ground Water Round 1 | Americium-241 | 1.98E-02 | 8.91E-03 |
| | Cesium-137 | -1.90E-02 | 7.30E-02 |
| | Cobalt-60 | 1.70E-01 | 8.00E-02 |
| | Lead-210 | 9.20E+00 | 1.60E+00 |
| | Plutonium-241 | -2.99E-01 | 1.55E-01 |
| | Plutonium-238 | 1.44E-03 | 3.12E-03 |
| | Plutonium-239/240 | -9.55E-04 | 2.65E-03 |
| | Polonium-210 | -5.47E-03 | 1.47E-02 |
| | Potassium-40 | 1.60E+01 | 2.80E+00 |
| | Radium-228 | 1.46E+00 | 1.00E-01 |
| | Radium-226 | 6.00E+00 | 5.50E-02 |
| | Strontium-90 | 2.70E-02 | 2.70E-02 |
| | Thorium-230 | 3.65E-02 | 7.80E-03 |
| | Thorium-228 | 1.02E-01 | 1.45E-02 |
| | Thorium-232 | 8.47E-04 | 1.66E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| WQSP-1 Ground Water Round 1 (continued) | Uranium-233/234 | 1.42E+00 | 4.79E-02 |
| | Uranium-238 | 2.36E-01 | 1.96E-02 |
| | Uranium-235/236 | 2.60E-02 | 7.90E-03 |
| WQSP-2 Ground Water Round 1 | Americium-241 | 2.09E-02 | 5.46E-03 |
| | Cesium-137 | -1.10E-01 | 7.60E-02 |
| | Cobalt-60 | 1.20E-01 | 8.20E-02 |
| | Lead-210 | 4.10E-01 | 2.20E+00 |
| | Plutonium-241 | -2.73E-01 | 1.72E-01 |
| | Plutonium-238 | -5.71E-04 | 3.36E-03 |
| | Plutonium-239/240 | -5.68E-04 | 2.95E-03 |
| | Polonium-210 | 8.79E-03 | 7.71E-03 |
| | Potassium-40 | 1.70E+01 | 3.10E+00 |
| | Radium-228 | 7.52E-01 | 9.30E-02 |
| | Radium-226 | 3.70E+00 | 4.40E-02 |
| | Strontium-90 | -3.10E-02 | 2.40E-02 |
| | Thorium-230 | 4.02E-02 | 7.74E-03 |
| | Thorium-228 | 3.97E-02 | 8.38E-03 |
| | Thorium-232 | -3.20E-03 | 2.87E-03 |
| | Uranium-233/234 | 1.21E+00 | 4.06E-03 |
| | Uranium-238 | 1.91E-01 | 1.64E-02 |
| | Uranium-235/236 | 3.24E-02 | 8.50E-03 |
| WQSP-3 Ground Water Round 1 | Americium-241 | 4.40E-02 | 1.03E-02 |
| | Cesium-137 | -1.00E-01 | 7.90E-02 |
| | Cobalt-60 | -1.60E-02 | 7.80E-02 |
| | Lead-210 | 1.50E-01 | 2.10E+00 |
| | Plutonium-241 | -1.34E-01 | 1.26E-01 |
| | Plutonium-238 | 7.72E-04 | 2.62E-03 |
| | Plutonium-239/240 | 1.54E-03 | 1.84E-03 |
| | Polonium-210 | 9.56E-02 | 2.06E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| WQSP-3 Ground Water Round 1 (continued) | Potassium-40 | 4.90E+01 | 6.40E+00 |
| | Radium-228 | 1.71E+00 | 1.10E-01 |
| | Radium-226 | 7.80E+00 | 6.00E-02 |
| | Strontium-90 | 2.40E-03 | 3.30E-02 |
| | Thorium-230 | 1.85E-02 | 7.34E-03 |
| | Thorium-228 | 6.47E-02 | 1.48E-02 |
| | Thorium-232 | 6.60E-04 | 2.24E-03 |
| | Uranium-233/234 | 3.21E-01 | 2.64E-02 |
| | Uranium-238 | 3.75E-02 | 9.86E-03 |
| | Uranium-235/236 | 6.90E-03 | 5.06E-03 |
| WQSP-4 Ground Water Round 1 | Americium-241 | 2.47E-02 | 5.32E-03 |
| | Cesium-137 | -3.30E-02 | 7.80E-02 |
| | Cobalt-60 | 8.60E-02 | 8.40E-02 |
| | Lead-210 | 5.40E-01 | 2.10E+00 |
| | Plutonium-241 | -2.17E-01 | 1.29E-01 |
| | Plutonium-238 | 0.00E+00 | 1.09E-03 |
| | Plutonium-239/240 | 3.91E-04 | 2.03E-03 |
| | Polonium-210 | 0.00E+00 | 4.72E-03 |
| | Potassium-40 | 2.50E+01 | 4.00E+00 |
| | Radium-228 | 2.03E+00 | 1.30E-01 |
| | Radium-226 | 9.10E+00 | 7.00E-02 |
| | Strontium-90 | -1.20E-02 | 2.20E-02 |
| | Thorium-230 | 2.14E-02 | 9.23E-03 |
| | Thorium-228 | 5.96E-02 | 1.65E-02 |
| | Thorium-232 | 3.05E-03 | 4.73E-03 |
| | Uranium-233/234 | 6.83E-01 | 5.02E-02 |
| | Uranium-238 | 1.07E-01 | 2.07E-02 |
| | Uranium-235/236 | 1.77E-02 | 8.93E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| WQSP-6A Ground Water Round 1 | Americium-241 | 1.67E-02 | 5.36E-03 |
| | Cesium-137 | 1.40E-02 | 7.00E-02 |
| | Cobalt-60 | 6.50E-02 | 8.40E-02 |
| | Lead-210 | 7.00E+00 | 1.30E+00 |
| | Plutonium-241 | -8.18E-03 | 1.11E-01 |
| | Plutonium-238 | -6.70E-04 | 2.63E-03 |
| | Plutonium-239/240 | 1.33E-03 | 1.31E-03 |
| | Polonium-210 | N/A | N/A |
| | Potassium-40 | 2.70E+00 | 9.30E-01 |
| | Radium-228 | 1.84E-02 | 3.30E-02 |
| | Radium-226 | 9.00E-02 | 6.90E-03 |
| | Strontium-90 | -2.10E-02 | 3.20E-02 |
| | Thorium-230 | 3.16E-02 | 6.59E-03 |
| | Thorium-228 | 1.62E-02 | 5.59E-03 |
| | Thorium-232 | -3.35E-04 | 1.14E-03 |
| | Uranium-233/234 | 2.32E-01 | 1.74E-02 |
| | Uranium-238 | 1.28E-01 | 1.30E-02 |
| | Uranium-235/236 | 1.46E-02 | 5.11E-03 |
| B-2 Ground Water Note: Acronym B-2 denotes sample blank | Americium-241 | 2.00E-02 | 5.59E-03 |
| | Cesium-137 | -6.60E-02 | 8.00E-02 |
| | Cobalt-60 | -3.00E-03 | 7.60E-02 |
| | Lead-210 | 7.10E+00 | 1.50E+00 |
| | Plutonium-241 | 5.85E-02 | 1.18E-01 |
| | Plutonium-238 | -1.70E-03 | 1.49E-03 |
| | Plutonium-239/240 | 1.02E-03 | 1.48E-03 |
| | Polonium-210 | -2.02E-03 | 5.59E-03 |
| | Potassium-40 | 2.50E+01 | 3.80E+00 |
| | Radium-228 | 1.89E+00 | 1.10E-01 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| B-2 Ground Water Note: Acronym B-2 denotes sample blank (continued) | Radium-226 | 8.60E+00 | 6.30E-02 |
| | Strontium-90 | -1.50E-02 | 2.00E-02 |
| | Thorium-230 | 3.07E-02 | 8.11E-03 |
| | Thorium-228 | 5.57E-02 | 1.21E-02 |
| | Thorium-232 | 0.00E+00 | 1.94E-03 |
| | Uranium-233/234 | 6.21E-01 | 4.86E-02 |
| | Uranium-238 | 8.60E-02 | 1.88E-02 |
| | Uranium-235/236 | 1.21E-02 | 8.19E-03 |
| WQSP-5 Ground Water Round 1 | Americium-241 | 2.05E-02 | 6.44E-03 |
| | Cesium-137 | -6.20E-02 | 1.30E-01 |
| | Cobalt-60 | 2.50E-02 | 1.50E-01 |
| | Lead-210 | 8.00E+00 | 2.40E+00 |
| | Plutonium-238 | 5.51E-04 | 1.87E-03 |
| | Plutonium-241 | -5.92E+00 | 2.78E-01 |
| | Plutonium-239/240 | 3.84E-03 | 3.22E-03 |
| | Polonium-210 | 4.54E-02 | 9.96E-03 |
| | Potassium-40 | 1.20E+01 | 3.20E+00 |
| | Radium-226 | 2.70E+00 | 4.00E-02 |
| | Radium-228 | 2.90E-01 | 5.00E-02 |
| | Strontium-90 | 2.50E-01 | 6.00E-02 |
| | Thorium-228 | 7.22E-02 | 1.32E-02 |
| | Thorium-232 | 4.94E-04 | 1.68E-03 |
| | Thorium-230 | 1.53E-02 | 6.21E-03 |
| | Uranium-233/234 | 5.64E-01 | 4.09E-02 |
| | Uranium-235/236 | 1.04E-02 | 7.17E-03 |
| | Uranium-238 | 8.57E-02 | 1.60E-02 |
| WQSP-6 Ground Water Round 1 | Americium-241 | 1.59E-02 | 5.61E-03 |
| | Cesium-137 | 1.40E-02 | 7.00E-02 |
| | Cobalt-60 | 6.50E-02 | 8.40E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/L | COUNTING ERROR |
|---|---|---|---|
| WQSP-6 Ground Water Round 1 (continued) | Lead-210 | 7.00E+00 | 1.30E+00 |
| | Plutonium-239/240 | 6.26E-03 | 4.85E-03 |
| | Plutonium-238 | 7.86E-04 | 2.66E-03 |
| | Plutonium-241 | -6.90E+00 | 3.95E-01 |
| | Polonium-210 | N/A | N/A |
| | Potassium-40 | 2.70E+00 | 9.30E-01 |
| | Radium-228 | 1.84E-02 | 3.30E-02 |
| | Radium-226 | 9.00E-02 | 6.90E-03 |
| | Strontium-90 | 1.80E-01 | 4.50E-02 |
| | Thorium-228 | 3.24E-02 | 9.11E-03 |
| | Thorium-232 | 0.00 | 2.22E-03 |
| | Thorium-230 | 2.32E-02 | 7.15E-03 |
| | Uranium-238 | 7.80E-02 | 1.44E-02 |
| | Uranium-233/234 | 6.05E-01 | 4.04E-02 |
| | Uranium-235/236 | 5.96E-03 | 6.02E-03 |

# APPENDIX A6
# RADIOLOGICAL ANALYSIS
# BIOTICS

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BV-WE1 Biotic Vegetation WIPP East | Americium-241 | 7.16E-03 | 1.81E-03 |
| | Cesium-137 | 2.90E-04 | 5.10E-04 |
| | Cobalt-60 | 3.10E-04 | 5.60E-04 |
| | Lead-210 | 2.20E-02 | 1.20E-02 |
| | Plutonium-241 | -9.96E-02 | 3.89E-02 |
| | Plutonium-238 | 2.26E-04 | 4.42E-04 |
| | Plutonium-239/240 | -2.25E-04 | 3.12E-04 |
| | Polonium-210 | 7.90E-03 | 2.57E-03 |
| | Potassium-40 | 3.80E-01 | 4.70E-02 |
| | Radium-228 | 7.70E-03 | 2.80E-03 |
| | Radium-226 | 1.90E-02 | 1.60E-02 |
| | Strontium-90 | 8.86E-04 | 2.86E-03 |
| | Thorium-232 | 2.89E-03 | 1.19E-03 |
| | Thorium-228 | 1.16E-02 | 2.26E-03 |
| | Thorium-230 | 8.38E-03 | 1.86E-03 |
| | Uranium-233/234 | 4.60E-03 | 1.77E-03 |
| | Uranium-238 | 3.64E-03 | 1.54E-03 |
| | Uranium-235/236 | 5.98E-04 | 5.86E-04 |
| BV-SE1 Biotic Vegetation South East 1 | Americium-241 | 5.08E-03 | 1.48E-03 |
| | Cesium-137 | -1.70E-04 | 7.60E-04 |
| | Cobalt-60 | 4.30E-04 | 1.40E-03 |
| | Lead-210 | 2.10E-02 | 2.00E-02 |
| | Plutonium-241 | -1.74E-01 | 3.89E-02 |
| | Plutonium-238 | 2.31E-04 | 4.53E-04 |
| | Plutonium-239/240 | 5.76E-04 | 8.15E-04 |
| | Polonium-210 | 1.17E-02 | 2.69E-03 |
| | Potassium-40 | 5.40E-01 | 6.70E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BV-SE1 Biotic Vegetation South East 1 (continued) | Radium-228 | 6.30E-03 | 2.90E-03 |
| | Radium-226 | 3.10E-03 | 2.40E-02 |
| | Strontium-90 | 3.45E-03 | 2.64E-03 |
| | Thorium-230 | 7.53E-03 | 1.71E-03 |
| | Thorium-228 | 1.20E-02 | 2.16E-03 |
| | Thorium-232 | 3.85E-03 | 1.21E-03 |
| | Uranium-233/234 | 5.04E-03 | 1.65E-03 |
| | Uranium-238 | 4.74E-03 | 1.41E-03 |
| | Uranium-235/236 | 3.74E-04 | 4.23E-04 |
| BV-SE2 Biotic Vegetation South East 2 | Americium-241 | 1.10E-02 | 2.29E-03 |
| | Cesium-137 | 2.00E-04 | 6.10E-04 |
| | Cobalt-60 | 2.20E-04 | 6.90E-04 |
| | Lead-210 | 2.60E-02 | 1.70E-02 |
| | Plutonium-241 | -1.59E-01 | 3.34E-02 |
| | Plutonium-238 | -9.94E-05 | 5.15E-04 |
| | Plutonium-239/240 | 0.00E+00 | 3.89E-04 |
| | Polonium-210 | 5.21E-03 | 2.15E-03 |
| | Potassium-40 | 4.00E-01 | 5.20E-02 |
| | Radium-228 | 5.80E-05 | 2.30E-03 |
| | Radium-226 | 7.90E-02 | 1.40E-02 |
| | Strontium-90 | 9.71E-04 | 2.02E-03 |
| | Thorium-230 | 1.04E-02 | 2.09E-03 |
| | Thorium-228 | 3.03E-02 | 3.57E-03 |
| | Thorium-232 | 5.69E-03 | 1.48E-03 |
| | Uranium-233/234 | 5.05E-03 | 1.83E-03 |
| | Uranium-238 | 4.94E-03 | 1.63E-03 |
| | Uranium-235/236 | 1.45E-04 | 7.52E-04 |
| BV-NW1 Biotic Vegetation North West 1 | Americium-241 | 8.49E-03 | 1.87E-03 |
| | Cesium-137 | -3.80E-06 | 7.20E-04 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BV-NW1 Biotic Vegetation North West 1 (continued) | Cobalt-60 | 3.90E-05 | 7.60E-04 |
| | Lead-210 | 4.60E-02 | 1.70E-02 |
| | Plutonium-241 | -1.49E-01 | 3.83E-02 |
| | Plutonium-238 | 1.09E-04 | 3.69E-04 |
| | Plutonium-239/240 | -2.17E-04 | 4.25E-04 |
| | Polonium-210 | 1.03E-02 | 2.54E-03 |
| | Potassium-40 | 3.90E-01 | 5.00E-02 |
| | Radium-228 | 3.10E-03 | 2.60E-03 |
| | Radium-226 | 2.30E-02 | 2.10E-02 |
| | Strontium-90 | 5.46E-03 | 2.65E-03 |
| | Thorium-230 | 9.33E-03 | 2.10E-03 |
| | Thorium-228 | 9.72E-03 | 2.43E-03 |
| | Thorium-232 | 3.58E-03 | 1.56E-03 |
| | Uranium-233/234 | 5.50E-03 | 1.63E-03 |
| | Uranium-238 | 4.61E-03 | 1.42E-03 |
| | Uranium-235/236 | 3.71E-04 | 4.19E-04 |
| BV-NW2 Biotic Vegetation North West 2 | Americium-241 | 6.82E-03 | 1.88E-03 |
| | Cesium-137 | -3.70E-05 | 1.10E-03 |
| | Cobalt-60 | -7.10E-04 | 1.20E-03 |
| | Lead-210 | 2.20E-02 | 3.00E-02 |
| | Plutonium-241 | -7.12E-02 | 3.65E-02 |
| | Plutonium-238 | -5.30E-04 | 4.64E-04 |
| | Plutonium-239/240 | 1.06E-04 | 4.64E-04 |
| | Polonium-210 | 1.05E-02 | 2.85E-03 |
| | Potassium-40 | 3.90E-01 | 5.70E-02 |
| | Radium-228 | 5.40E-03 | 4.40E-03 |
| | Radium-226 | 1.50E-01 | 2.60E-02 |
| | Strontium-90 | 9.56E-04 | 2.55E-03 |
| | Thorium-230 | 8.95E-03 | 2.01E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BV-NW2 Biotic Vegetation North West 2 (continued) | Thorium-228 | 1.75E-02 | 2.78E-03 |
| | Thorium-232 | 2.58E-03 | 1.20E-03 |
| | Uranium-233/234 | 7.25E-03 | 1.82E-03 |
| | Uranium-238 | 3.99E-03 | 1.31E-03 |
| BV-CT1 Biotic Vegetation Control 1 | Uranium-235/236 | 1.01E-03 | 7.82E-04 |
| | Americium-241 | 6.40E-03 | 1.93E-03 |
| | Cesium-137 | 2.20E-04 | 6.60E-04 |
| | Cobalt-60 | -3.80E-04 | 7.70E-04 |
| | Lead-210 | 2.80E-02 | 1.60E-02 |
| | Plutonium-241 | -1.84E-01 | 4.09E-02 |
| | Plutonium-238 | -5.88E-04 | 6.10E-04 |
| | Plutonium-239/240 | -1.17E-04 | 6.90E-04 |
| | Polonium-210 | 1.83E-02 | 3.99E-03 |
| | Potassium-40 | 5.90E-01 | 7.10E-02 |
| | Radium-228 | 2.30E-03 | 3.10E-03 |
| | Radium-226 | 6.60E-03 | 2.20E-02 |
| | Strontium-90 | 4.85E-03 | 2.67E-03 |
| | Thorium-230 | 1.04E-02 | 2.01E-03 |
| | Thorium-228 | 6.68E-03 | 1.75E-03 |
| | Thorium-232 | 3.35E-03 | 1.23E-03 |
| | Uranium-233/234 | 8.97E-03 | 3.08E-03 |
| | Uranium-238 | 9.63E-03 | 3.05E-03 |
| | Uranium-235/236 | 1.85E-03 | 1.55E-03 |
| BV-CT2 Biotic Vegetation Control 2 | Americium-241 | 2.04E-02 | 4.06E-03 |
| | Cesium-137 | -1.10E-05 | 7.80E-04 |
| | Cobalt-60 | -1.80E-04 | 9.20E-04 |
| | Lead-210 | 2.10E-02 | 2.10E-02 |
| | Plutonium-241 | -1.45E-01 | 3.17E-02 |
| | Plutonium-238 | 0.00E+00 | 2.69E-04 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BV-CT2 Biotic Vegetation Control 2 (continued) | Plutonium-239/240 | 1.94E-04 | 3.81E-04 |
| | Polonium-210 | 8.60E-03 | 2.01E-03 |
| | Potassium-40 | 4.90E-01 | 6.50E-02 |
| | Radium-228 | 2.60E-03 | 3.10E-03 |
| | Radium-226 | 8.40E-03 | 2.60E-02 |
| | Strontium-90 | 3.56E-03 | 2.94E-03 |
| | Thorium-230 | 1.15E-02 | 2.47E-03 |
| | Thorium-228 | 2.20E-03 | 1.75E-03 |
| | Thorium-232 | -1.43E-03 | 1.63E-03 |
| | Uranium-233/234 | 5.65E-03 | 1.77E-03 |
| | Uranium-238 | 3.20E-03 | 1.32E-03 |
| | Uranium-235/236 | 6.07E-04 | 5.95E-04 |
| BR-NAR Biotic Rabbit North Access 12081.1 | Americium-241 | 5.15E-05 | 1.75E-04 |
| | Cesium-137 | 1.50E-04 | 3.90E-04 |
| | Cobalt-60 | 1.00E-04 | 3.60E-04 |
| | Lead-210 | 2.50E-02 | 4.80E-03 |
| | Plutonium-241 | -1.77E-02 | 8.36E-03 |
| | Plutonium-238 | 1.00E-04 | 1.41E-04 |
| | Plutonium-239/240 | 1.60E-04 | 1.36E-04 |
| | Polonium-210 | 3.10E-03 | 4.75E-03 |
| | Potassium-40 | 1.10E-01 | 2.90E-02 |
| | Radium-228 | 1.60E-03 | 1.50E-03 |
| | Radium-226 | 1.40E-03 | 6.80E-03 |
| | Strontium-90 | 3.90E-03 | 4.40E-03 |
| | Thorium-230 | 5.31E-04 | 2.41E-04 |
| | Thorium-228 | 1.03E-04 | 1.35E-04 |
| | Thorium-232 | -1.90E-05 | 8.30E-05 |
| | Uranium-233/234 | 2.44E-04 | 1.77E-04 |
| | Uranium-238 | 1.13E-04 | 1.04E-04 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BR-NAR Biotic Rabbit North Access 12081.1 (continued) | Uranium-235/236 | 4.65E-05 | 1.12E-04 |
| BR-NAR Biotic Rabbit North Access 11141.1 | Americium-241 | 2.57E-04 | 1.30E-04 |
| | Cesium-137 | 7.60E-05 | 3.80E-04 |
| | Cobalt-60 | -5.00E-04 | 3.30E-04 |
| | Lead-210 | 6.20E-03 | 2.50E-02 |
| | Plutonium-241 | -2.46E-02 | 6.93E-03 |
| | Plutonium-238 | 1.72E-05 | 3.37E-05 |
| | Plutonium-239/240 | 1.72E-05 | 7.52E-05 |
| | Polonium-210 | 2.50E-03 | 2.29E-03 |
| | Potassium-40 | 9.60E-02 | 2.90E-02 |
| | Radium-228 | 2.00E-03 | 1.30E-03 |
| | Radium-226 | 5.60E-02 | 1.60E-02 |
| | Strontium-90 | 5.30E-03 | 4.20E-03 |
| | Thorium-230 | 5.52E-04 | 2.12E-04 |
| | Thorium-228 | 1.95E-05 | 8.51E-05 |
| | Thorium-232 | 5.33E-05 | 7.79E-05 |
| | Uranium-233/234 | 3.19E-04 | 2.06E-04 |
| | Uranium-238 | -7.98-05 | 1.11E-04 |
| | Uranium-235/236 | 1.23E-04 | 1.28E-04 |
| BR-LWA Biotic Rabbit Land Withdrawl Area 12121.2 | Americium-241 | 1.92E-04 | 1.51E-04 |
| | Cesium-137 | -5.60E-04 | 1.40E-03 |
| | Cobalt-60 | -1.30e-04 | 1.20E-03 |
| | Lead-210 | 1.50E-01 | 2.30E-02 |
| | Plutonium-241 | -2.74E-02 | 8.30E-03 |
| | Plutonium-238 | -2.19E-04 | 1.61E-04 |
| | Plutonium-239/240 | 0.00E+00 | 9.52E-05 |
| | Polonium-210 | 3.97E-03 | 2.87E-03 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BR-LWA<br>Biotic Rabbit<br>Land Withdrawl Area<br>12121.2<br>(continued) | Potassium-40 | 1.20E-01 | 4.10E-02 |
| | Radium-228 | 2.80E-03 | 4.80E-03 |
| | Radium-226 | 1.20E-01 | 3.80E-02 |
| | Strontium-90 | 3.60E-04 | 3.60E-03 |
| | Thorium-230 | 1.11E-03 | 2.90E-04 |
| | Thorium-228 | 2.11E-05 | 2.20E-04 |
| | Thorium-232 | -3.79E-05 | 1.98E-04 |
| | Uranium-233/234 | 4.36E-04 | 2.06E-04 |
| | Uranium-238 | -5.96E-05 | 1.17E-04 |
| | Uranium-235/236 | -7.35E-05 | 8.32E-05 |
| BR-LWA<br>Biotic Rabbit<br>Land Withdrawl Area<br>12122.2 | Americium-241 | 3.41E-04 | 1.77E-04 |
| | Cesium-137 | 3.60E-04 | 5.60E-04 |
| | Cobalt-60 | 4.30E-04 | 4.60E-04 |
| | Lead-210 | 5.30E-02 | 8.70E-03 |
| | Plutonium-241 | -4.18E-02 | 7.51E-03 |
| | Plutonium-238 | 3.73E-05 | 1.16E-04 |
| | Plutonium-239/240 | 1.12E-04 | 1.03E-04 |
| | Polonium-210 | 4.98E-03 | 3.82E-03 |
| | Potassium-40 | 1.20E-01 | 3.70E-02 |
| | Radium-228 | 1.30E-03 | 3.70E-03 |
| | Radium-226 | 9.60E-03 | 1.30E-02 |
| | Strontium-90 | 6.10E-03 | 4.10E-03 |
| | Thorium-230 | 1.20E-03 | 3.26E-04 |
| | Thorium-228 | 1.51E-04 | 1.74E-04 |
| | Thorium-232 | -1.98E-05 | 1.16E-04 |
| | Uranium-233/234 | 2.85E-04 | 2.14E-04 |
| | Uranium-238 | 5.72E-05 | 1.12E-04 |
| | Uranium-235/236 | 7.06E-05 | 1.22E-04 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BF-PEC Biotic Fish Pecos River | Americium-241 | 6.90E-05 | 8.29E-05 |
| | Cesium-137 | 9.20E-05 | 4.20E-04 |
| | Cobalt-60 | 1.30E-04 | 4.10E-04 |
| | Lead-210 | 2.90E-02 | 5.10E-03 |
| | Plutonium-241 | -2.32E-02 | 3.31E-03 |
| | Plutonium-238 | 1.97E-05 | 4.74E-05 |
| | Plutonium-239/240 | 0.00E+00 | 3.86E-05 |
| | Polonium-210 | 1.72E-03 | 9.37E-04 |
| | Potassium-40 | 1.10E-01 | 3.30E-02 |
| | Radium-228 | 1.40E-03 | 1.50E-03 |
| | Radium-226 | 3.80E-03 | 8.00E-03 |
| | Strontium-90 | -1.72E-03 | 2.27E-03 |
| | Thorium-230 | 7.37E-04 | 1.73E-04 |
| | Thorium-228 | 2.20E-05 | 4.32E-05 |
| | Thorium-232 | -2.04E-05 | 2.83E-05 |
| | Uranium-233/234 | 3.63E-04 | 1.30E-04 |
| | Uranium-238 | 1.59E-04 | 9.50E-05 |
| | Uranium-235/236 | 1.15E-05 | 6.76E-05 |
| BF-BRA Biotic Fish Brantley Lake | Americium-241 | 0.00E+00 | 4.67E-05 |
| | Cesium-137 | -3.40E-04 | 4.30E-04 |
| | Cobalt-60 | 7.90E-04 | 4.10E-04 |
| | Lead-210 | 3.80E-02 | 6.30E-03 |
| | Plutonium-241 | -2.03E-02 | 3.15E-03 |
| | Plutonium-238 | 0.00E+00 | 5.46E-05 |
| | Plutonium-239/240 | -9.84E-06 | 4.31E-05 |
| | Polonium-210 | 5.34E-03 | 1.69E-03 |
| | Potassium-40 | 8.80E-02 | 1.80E-02 |
| | Radium-228 | 3.40E-04 | 2.90E-03 |
| | Radium-226 | 8.80E-03 | 1.00E-02 |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULT/UNIT Bq/g | COUNTING ERROR |
|---|---|---|---|
| BF-BRA Biotic Fish Brantley Lake (continued) | Strontium-90 | 1.19E-03 | 2.41E-03 |
| | Thorium-230 | 7.31E-04 | 1.70E-04 |
| | Thorium-228 | -4.19E-05 | 5.81E-05 |
| | Thorium-232 | 2.92E-05 | 4.26E-05 |
| | Uranium-234 | 8.04E-04 | 1.80E-04 |
| | Uranium-238 | 9.33E-04 | 1.92E-04 |
| | Uranium-235/236 | 6.06E-05 | 6.28E-05 |

# APPENDIX B1
# DP-831
# LIQUID EFFLUENT ANALYSIS

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| HE-COM DP-831 1ST Quarter Sewage Samples | Radium 226 | < 0.3 | pCi/L |
| | Radium 228 | < 2 | pCi/L |
| | Nitrate/Nitrite | 1.0 | mg/L |
| | Nitrogen/Kjeldahl | 76 | mg/L |
| | Total Dissolved Solids | 1600 | mg/L |
| | Total Dissolved Solids | 16000 | mg/L |
| | Total Dissolved Solids | 15000 | mg/L |
| HE-COM DP-831 2ND Quarter Sewage Samples | Radium 226 | < 0.6 | pCi/L |
| | Radium 228 | 2.7+/-1.0 | pCi/L |
| | Nitrate/Nitrite | 0.2 | mg/L |
| | Nitrogen/Kjeldahl | 46 | mg/L |
| | Total Dissolved Solids | 1700 | mg/L |
| | Total Dissolved Solids | 12000 | mg/L |
| | Total Dissolved Solids | 12000 | mg/L |
| HE-COM DP-831 3RD Quarter Sewage Samples | Radium 226 | 4.0+/-0.6 | pCi/L |
| | Radium 228 | < 2 | pCi/L |
| | Nitrate/Nitrite | < 0.1 | mg/L |
| | Nitrogen/Kjeldahl | 48 | mg/L |
| | Total Dissolved Solids | 30000 | mg/L |
| | Total Dissolved Solids | 31000 | mg/L |
| | Total Dissolved Solids | 5500 | mg/L |
| HE-COM DP-831 4TH Quarter Sewage Samples | Radium 226 | < 0.6 | pCi/L |
| | Radium 228 | 1.1+/-0.6 | pCi/L |
| | Nitrate/Nitrite | 0.1 | mg/L |
| | Nitrogen/Kjeldahl | 71 | mg/L |
| | Total Dissolved Solids | 24 | mg/L |
| | Total Dissolved Solids | 16000 | mg/L |
| | Total Dissolved Solids | 15000 | mg/L |

# APPENDIX B2
# NONRADIOLOGICAL
# SOIL ANALYSIS

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-NW1<br>Terrestrial Surface<br>Non-Radiological<br>North West 1 | Saturation Percent | 27 | % |
| | Conductivity | .19 | mmhos/cm |
| | Chloride | 8 | mg/kg |
| | pH | 8.5 | pH |
| | Calcium, total | 58 | mg/kg |
| | Potassium, total | 26 | mg/kg |
| | Magnesium, total | 6 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 30 | % |
| | Conductivity | .22 | mmhos/cm |
| | Chloride | 24 | mg/kg Dry |
| | pH | 8.2 | pH |
| | Calcium, total | 60 | mg/kg |
| | Potassium, total | 32 | mg/kg |
| | Magnesium, total | 7 | mg/kg |
| | Sodium, total | 9 | mg/kg |
| | Sodium Absorption Ratio | .29 | SAR |
| | Saturation Percent | 27 | % |
| | Conductivity | .13 | mmhos/cm |
| | Chloride | 28 | mg/kg Dry |
| | pH | 8.0 | pH |
| | Calcium, total | 32 | mg/kg |
| | Potassium, total | 14 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .13 | SAR |
| | Saturation Percent | 29 | % |
| | Conductivity | .15 | mmhos/cm |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-NW1 Terrestrial Surface Non-Radiological North West 1 (continued) | Chloride | 20 | mg/kg Dry |
| | pH | 7.7 | pH |
| | Calcium, total | 37 | mg/kg |
| | Potassium, total | 27 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 4 | mg/kg |
| | Sodium Absorption Ratio | .17 | SAR |
| | Saturation Percent | 15 | % |
| | Conductivity | .1 | mmhos/cm |
| | Chloride | 11 | mg/kg Dry |
| | pH | 8.2 | pH |
| | Calcium, total | 23 | mg/kg |
| | Potassium, total | 12 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 7 | mg/kg |
| | Sodium Absorption Ratio | .36 | SAR |
| | Saturation Percent | 28 | % |
| | Conductivity | .15 | mmhos/cm |
| | Chloride | 6 | mg/kg Dry |
| | pH | 8.8 | pH |
| | Calcium, total | 36 | mg/kg |
| | Potassium, total | 22 | mg/kg |
| | Magnesium, total | 9 | mg/kg |
| | Sodium, total | 4 | mg/kg |
| | Sodium Absorption Ratio | .15 | SAR |
| TS-NW2 Terrestrial Surface Non-Radiological North West 2 | Saturation Percent | 32 | % |
| | Conductivity | .10 | mmhos/cm |
| | Chloride | 8 | mg/kg Dry |
| | pH | 7.0 | pH |
| | Calcium, total | 21 | mg/kg |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-NW2<br>Terrestrial Surface<br>Non-Radiological<br>North West 2<br>(continued) | Potassium, total | 18 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .16 | SAR |
| | Saturation Percent | 33 | % |
| | Conductivity | .12 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.9 | pH |
| | Calcium, total | 25 | mg/kg |
| | Potassium, total | 25 | mg/kg |
| | Magnesium, total | 5 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .14 | SAR |
| | Saturation Percent | 34 | % |
| | Conductivity | .09 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.6 | pH |
| | Calcium, total | 21 | mg/kg |
| | Potassium, total | 16 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .16 | SAR |
| | Saturation Percent | 30 | % |
| | Conductivity | .07 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.8 | pH |
| | Calcium, total | 16 | mg/kg |
| | Potassium, total | 14 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 2 | mg/kg |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-NW2<br>Terrestrial Surface<br>Non-Radiological<br>North West 2<br>(continued) | Sodium Absorption Ratio | .12 | SAR |
| | Saturation Percent | 30 | % |
| | Conductivity | .11 | mmhos/cm |
| | Chloride | 6 | mg/kg Dry |
| | pH | 7.1 | pH |
| | Calcium, total | 24 | mg/kg |
| | Potassium, total | 20 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .15 | SAR |
| | Saturation Percent | 30 | % |
| | Conductivity | .06 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.0 | pH |
| | Calcium, total | 11 | mg/kg |
| | Potassium, total | 11 | mg/kg |
| | Magnesium, total | 2 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .15 | SAR |
| TS-SE1<br>Terrestrial Surface<br>Non-Radiological<br>South East 1 | Saturation Percent | 27 | % |
| | Conductivity | .14 | mmhos/cm |
| | Chloride | 10 | mg/kg Dry |
| | pH | 8.1 | pH |
| | Calcium, total | 42 | mg/kg |
| | Potassium, total | 13 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .12 | SAR |
| | Saturation Percent | 30 | % |
| | Conductivity | .13 | mmhos/cm |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-SE1<br>Terrestrial Surface<br>Non-Radiological<br>South East 1<br>(continued) | Chloride | 6 | mg/kg Dry |
| | pH | 7.3 | pH |
| | Calcium, total | 31 | mg/kg |
| | Potassium, total | 16 | mg/kg |
| | Magnesium, total | 5 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .13 | SAR |
| | Saturation Percent | 27 | % |
| | Conductivity | .10 | mmhos/cm |
| | Chloride | <6 | mg/kg Dry |
| | pH | 7.7 | pH |
| | Calcium, total | 27 | mg/kg |
| | Potassium, total | 12 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .14 | SAR |
| | Saturation Percent | 31 | % |
| | Conductivity | .17 | mmhos/cm |
| | Chloride | 6 | mg/kg Dry |
| | pH | 8 | pH |
| | Calcium, total | 58 | mg/kg |
| | Potassium, total | 23 | mg/kg |
| | Magnesium, total | 6 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 29 | % |
| | Conductivity | .10 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.5 | pH |
| | Calcium, total | 24 | mg/kg |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-SE1 Terrestrial Surface Non-Radiological South East 1 (continued) | Potassium, total | 13 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 30 | % |
| | Conductivity | .11 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.5 | pH |
| | Calcium, total | 30 | mg/kg |
| | Potassium, total | 13 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 4 | mg/kg |
| | Sodium Absorption Ratio | .18 | SAR |
| TS-SE2 Terrestrial Surface Non-Radiological South East 2 | Saturation Percent | 29 | % |
| | Conductivity | .09 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.9 | pH |
| | Calcium, total | 21 | mg/kg |
| | Potassium, total | 15 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 31 | % |
| | Conductivity | .11 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.9 | pH |
| | Calcium, total | 28 | mg/kg |
| | Potassium, total | 14 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-CT1<br>Terrestrial Surface<br>Non-Radiological<br>Control 1<br>(continued) | Potassium, total | 8 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .12 | SAR |
| | Saturation Percent | 32 | % |
| | Conductivity | .08 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.6 | pH |
| | Calcium, total | 15 | mg/kg |
| | Potassium, total | 19 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 1 | mg/kg |
| | Sodium Absorption Ratio | .62 | SAR |
| | Saturation Percent | 32 | % |
| | Conductivity | .10 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.3 | pH |
| | Calcium, total | 21 | mg/kg |
| | Potassium, total | 36 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 29 | % |
| | Conductivity | .06 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7 | pH |
| | Calcium, total | 13 | mg/kg |
| | Potassium, total | 23 | mg/kg |
| | Magnesium, total | 2 | mg/kg |
| | Sodium, total | 2 | mg/kg |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-CT1 Terrestrial Surface Non-Radiological Control 1 (continued) | Sodium Absorption Ratio | .14 | SAR |
| TS-CT2 Terrestrial Surface Non-Radiological Control 2 | Saturation Percent | 25 | % |
| | Conductivity | .07 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.9 | pH |
| | Calcium, total | 18 | mg/kg |
| | Potassium, total | 6 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .11 | SAR |
| | Saturation Percent | 32 | % |
| | Conductivity | .19 | mmhos/cm |
| | Chloride | 9 | mg/kg Dry |
| | pH | 7.1 | pH |
| | Calcium, total | 52 | mg/kg |
| | Potassium, total | 24 | mg/kg |
| | Magnesium, total | 10 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 29 | % |
| | Conductivity | .12 | mmhos/cm |
| | Chloride | 9 | mg/kg Dry |
| | pH | 7.0 | pH |
| | Calcium, total | 32 | mg/kg |
| | Potassium, total | 17 | mg/kg |
| | Magnesium, total | 6 | mg/kg |
| | Sodium, total | 3 | mg/kg |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-SE2<br>Terrestrial Surface<br>Non-Radiological<br>South East 2<br>(continued) | Sodium Absorption Ratio | .09 | SAR |
| | Saturation Percent | 27 | % |
| | Conductivity | .06 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.3 | pH |
| | Calcium, total | 16 | mg/kg |
| | Potassium, total | 7 | mg/kg |
| | Magnesium, total | 2 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .12 | SAR |
| | Saturation Percent | 31 | % |
| | Conductivity | .10 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.0 | pH |
| | Calcium, total | 24 | mg/kg |
| | Potassium, total | 21 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .09 | SAR |
| | Saturation Percent | 28 | % |
| | Conductivity | .09 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.0 | pH |
| | Calcium, total | 21 | mg/kg |
| | Potassium, total | 12 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .11 | SAR |
| | Saturation Percent | 27 | % |
| | Conductivity | .07 | mmhos/cm |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-SE2 Terrestrial Surface Non-Radiological South East 2 (continued) | Chloride | < 6 | mg/kg Dry |
| | pH | 6.8 | pH |
| | Calcium, total | 16 | mg/kg |
| | Potassium, total | 11 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .12 | SAR |
| TS-CT1 Terrestrial Surface Non-Radiological Control 1 | Saturation Percent | 27 | % |
| | Conductivity | .06 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 6.9 | pH |
| | Calcium, total | 11 | mg/kg |
| | Potassium, total | 13 | mg/kg |
| | Magnesium, total | 2 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .15 | SAR |
| | Saturation Percent | 33 | % |
| | Conductivity | .11 | mmhos/cm |
| | Chloride | 7 | mg/kg Dry |
| | pH | 6.7 | pH |
| | Calcium, total | 25 | mg/kg |
| | Potassium, total | 13 | mg/kg |
| | Magnesium, total | 5 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 31 | % |
| | Conductivity | .12 | mmhos/cm |
| | Chloride | 12 | mg/kg Dry |
| | pH | 6.9 | pH |
| | Calcium, total | 16 | mg/kg |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-CT2<br>Terrestrial Surface<br>Non-Radiological<br>Control 2<br>(continued) | Sodium Absorption Ratio | .13 | SAR |
| | Saturation Percent | 25 | % |
| | Conductivity | .09 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.5 | pH |
| | Calcium, total | 23 | mg/kg |
| | Potassium, total | 8 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .10 | SAR |
| | Saturation Percent | 17 | % |
| | Conductivity | .13 | mmhos/cm |
| | Chloride | 7 | mg/kg Dry |
| | pH | 7.2 | pH |
| | Calcium, total | 30 | mg/kg |
| | Potassium, total | 24 | mg/kg |
| | Magnesium, total | 6 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .09 | SAR |
| | Saturation Percent | 32 | % |
| | Conductivity | .11 | mmhos/cm |
| | Chloride | 13 | mg/kg Dry |
| | pH | 7.2 | pH |
| | Calcium, total | 30 | mg/kg |
| | Potassium, total | 13 | mg/kg |
| | Magnesium, total | 5 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .09 | SAR |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-WE1<br>Terrestrial Surface<br>Non-Radiological<br>WIPP East 1 | Saturation Percent | 27 | % |
| | Conductivity | .10 | mmhos/cm |
| | Chloride | 9 | mg/kg Dry |
| | pH | 7.4 | pH |
| | Calcium, total | 28 | mg/kg |
| | Potassium, total | 10 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 4 | mg/kg |
| | Sodium Absorption Ratio | .19 | SAR |
| | Saturation Percent | 27 | % |
| | Conductivity | .09 | mmhos/cm |
| | Chloride | 7 | mg/kg Dry |
| | pH | 7.8 | pH |
| | Calcium, total | 23 | mg/kg |
| | Potassium, total | 9 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 4 | mg/kg |
| | Sodium Absorption Ratio | .21 | SAR |
| | Saturation Percent | 29 | % |
| | Conductivity | .12 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.6 | pH |
| | Calcium, total | 32 | mg/kg |
| | Potassium, total | 12 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 2 | mg/kg |
| | Sodium Absorption Ratio | .09 | SAR |
| | Saturation Percent | 33 | % |
| | Conductivity | .10 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |

| SAMPLE ANALYSIS BY LOCATION | PARAMETER | RESULTS | UNIT |
|---|---|---|---|
| TS-WE1<br>Terrestrial Surface<br>Non-Radiological<br>WIPP East 1<br>(continued) | pH | 8.0 | pH |
| | Calcium, total | 30 | mg/kg |
| | Potassium, total | 9 | mg/kg |
| | Magnesium, total | 3 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .14 | SAR |
| | Saturation Percent | 29 | % |
| | Conductivity | .15 | mmhos/cm |
| | Chloride | 6 | mg/kg Dry |
| | pH | 7.9 | pH |
| | Calcium, total | 44 | mg/kg |
| | Potassium, total | 15 | mg/kg |
| | Magnesium, total | 5 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .11 | SAR |
| | Saturation Percent | 25 | % |
| | Conductivity | .09 | mmhos/cm |
| | Chloride | < 6 | mg/kg Dry |
| | pH | 7.8 | pH |
| | Calcium, total | 22 | mg/kg |
| | Potassium, total | 10 | mg/kg |
| | Magnesium, total | 4 | mg/kg |
| | Sodium, total | 3 | mg/kg |
| | Sodium Absorption Ratio | .15 | SAR |