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**1993 Environmental Report
for Pantex Plant**

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Prepared by
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EXECUTIVE SUMMARY

This report presents summaries and interpretations of the environmental monitoring data collected during 1993 at Pantex Plant. Additionally, it outlines site environmental management performance, summarizes compliance with applicable environmental regulations, and describes significant programs and achievements. It was prepared in accordance with the U.S. Department of Energy (DOE) Orders 5400.1 "General Environmental Protection Program," November 1988, and 5484.1 "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," February 1981.

Environmental monitoring is composed of two principal collection and analysis activities for radiological and nonradiological constituents: (1) effluent monitoring involving liquid and airborne effluents to characterize and quantify releases and (2) environmental surveillance involving water, soil, vegetation, and biota and measurement of external radiation to characterize environmental impacts of Pantex Plant. Data are used to assess impacts of operations to the public and the environment and to demonstrate compliance with applicable standards for both radiological and nonradiological contaminants. In 1993 more than 270 onsite and offsite locations were monitored regularly with 4000 samples collected and analyzed. Data from a location at the U.S. Department of Agriculture Bushland Agricultural Research Service and historical data are also presented for reference.

A variety of major environmental activities occurred during calendar year 1993. The most significant one resulted from Texas Senate Bill 2, whereby the Texas Water Commission and the Texas Air Control Board merged to form the Texas Natural Resource Conservation Commission (TNRCC). The TNRCC also acquired the responsibility of administering drinking water and landfill regulations from the Texas Department of Health.

The TNRCC conducted its drinking water inspection in December 1992 and issued a report in 1993 which cited no violations. The 1993 Resource Conservation and Recovery Act (RCRA) inspection reported two alleged violations of the solid waste regulations and five findings. Pantex Plant also continued the RCRA Closure of the 11-14 Pond, achieved partial closure of the tanks at Buildings 11-44 and 12-43, and closed the container storage unit located at Magazine 4-19B.

Pantex Plant started three RCRA Facility Investigations (RFIs) and completed the first phase of six RFIs started in 1991-93. As a result of the completed RFIs, it was recommended that no further actions were required on two of the units investigated.

Oversight of Pantex Plant was performed by the State of Texas through an Agreement in Principle (AIP) grant from the DOE. The AIP addresses waste management, environmental monitoring, and emergency preparedness issues. Only thermoluminescent dosimetry results from State of Texas co-sampling activities are not included in this report. The Texas Department of Health-Bureau of Radiation Control reported that environmental radiation levels at Pantex Plant parallel regional levels.

The State of Texas and Pantex implemented peer review protocols for all technical reports prepared through the AIP. Many of the recommendations provided by the State through the AIP have been incorporated into routine operations throughout Pantex Plant. The TNRCC has established five ambient air monitoring stations onsite and has completed air data collection for one full year.

Under an additional DOE Grant in Aid, research activities titled "Geologic and Hydrologic Site Characterization of the Pantex Plant" were initiated by the University of Texas at Austin Bureau of Economic Geology. Support in this activity is provided by the Water Resources

Center at Texas Tech University and the Department of Geological Sciences at the University of Texas at Austin. Activities included seismic surveys, drilling at offsite locations, conducting sampling activities, and installing hydrologic equipment. The Bureau of Economic Geology has identified 27 technical milestones to be completed to fully characterize the geology and hydrology in the Plant vicinity. Since September 1990, 10 have been completed and 36 milestone reports have been submitted. Milestone reports describe a range of investigations including geographic distribution of the perched aquifer beneath Pantex Plant.

Residents of the Pantex Plant include: (1) Mason & Hanger-Silas Mason Co., Inc. (M&H) as the management and operations contractor, (2) Battelle Memorial Institute (Battelle Pantex) as subcontractor to M&H for its environment, safety, and health and waste management divisions, (3) Sandia National Laboratory for select testing and evaluation activities, (4) DOE Safeguards Transportation Division, (5) U.S. Army Corps of Engineers for construction project and Environmental Restoration Program management, (6) Tri-Labs (Sandia, Los Alamos, and Lawrence Livermore National Laboratories) for programmatic support to dismantlement activities, and (7) Texas Tech University as overseer of farming operations.

Individual test data from the monitoring program are published in *Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December*. Data summaries are presented either in the text of this report or in the report appendices. Besides summary results from sampling, the report includes radiation doses to the public as calculated according to Environmental Protection Agency (EPA) requirements at 40 CFR 61, Subpart H ("Emissions of Radionuclides Other than Radon from Department of Energy Facilities"). The dose to the hypothetical maximally exposed individual at the Plant boundary was reported as 0.000057 mrem (5.7 E-5 mrem) (5.7 E-7 mSv), well below the EPA limit of 10 mrem/yr from the air pathway. All 1993 radiological monitoring

results were consistent with previous years' results and were well below the DOE-derived concentration guides (DCGs) specified in DOE Order 5400.5 "Radiological Protection of the Public and the Environment," February 1990. Average external penetrating radiation doses for the Plant area totalled 88 mrem (0.88 mSv), attributed to naturally occurring background terrestrial and cosmic radiation.

Pantex Plant and nearby areas are relatively free of nonradiological contaminants. No contamination has been found in the Ogallala aquifer. All Plant areas suspected of having contamination are included in the RCRA Part B Permit Corrective Action section for investigation and remediation. In general, monitoring results are similar to historical results for all media sampled. As of December 1993, no contamination from Pantex Plant operations was found in samples from offsite locations. No new locations or contaminants were observed during 1993 by the environmental monitoring program. Known contamination exists in the perched groundwater under Zone 12 (explosives, chromium, and solvents), in the soil near operations areas (solvents, fuels, explosives, metals, and trace uranium-238), and in the playas and ditches drainage system (explosives and metals). Results from the surface water and groundwater monitoring programs are included and present the levels of contaminants.

The final section of this report is a presentation of the quality assurance results obtained in support of the environmental monitoring program. Quality assurance was incorporated into all aspects of the monitoring program and included performance check samples, rigorous quality control checks, and intensive data management. A data validation review was performed for all samples and concluded that 96.34 percent of all analyses were valid per pre-selected requirements.

Section 1

INTRODUCTION

This report presents summary data for the environmental monitoring program at Pantex Plant. The report also discusses compliance with environmental standards and requirements and highlights significant environmental programs and efforts. It has been prepared in conformance with guidelines given in U.S. Department of Energy (DOE) Order 5400.1 "General Environmental Protection Program" and DOE Order 5484.1 "Environmental Protection, Safety, and Health Protection Information Reporting Requirements." It is provided to regulatory agencies and the public as a tool for assessing the environmental performance of Pantex Plant.

The report is organized into 10 sections:

Section 1 is an introduction and general description of Pantex Plant. Included within this section are discussions of the population, climate, geology, hydrogeology, seismology, and land and water uses.

Section 2 discusses regulatory requirements for environmental compliance during 1993. It presents the results of various regulatory inspections and environmental activities during 1993 and lists environmental permits issued to the Plant.

Section 3 describes the overall environmental monitoring program.

Section 4 describes the general environmental radiological monitoring program. The exposure of offsite populations to radionuclides as a result of Plant operations are discussed in this section. Also discussed are the results of the environmental thermoluminescent dosimetry program and other radiological monitoring programs that are not specific to the several individual environmental media (*i.e.*, air, groundwater, surface water, soil, flora, and fauna).

Sections 5 through 9 discuss the monitoring programs for the several individual environmental media. Section 5 discusses the air program. The groundwater protection program and the surface water program are discussed in Sections 6 and 7, respectively. Section 8 deals with the soil program. The programs dealing with flora and fauna are discussed in Section 9. Included within each section are a brief description of the monitoring program and an analysis of the results. Radiological and nonradiological data for samples collected from the several individual environmental media are presented in each section as appropriate.

Section 10 is a discussion of Pantex Plant's quality assurance program for the environmental monitoring program, as initiated in response to DOE Order 5700.6C "Quality Assurance". Results from the analysis of quality assurance samples and a data validation summary are included within this section.

Throughout this report, data tables and figures are normally placed immediately following their first mention. However, in several instances, clarity requires the data be placed at the end of the discussion section or in an appendix.

1.1 General

The ongoing environmental protection program at Pantex Plant is implemented by Mason & Hanger-Silas Mason Co., Inc. (M&H) in its day-to-day operations through its subcontractor, Battelle Memorial Institute (Battelle Pantex), with oversight by the DOE/Amarillo Area Office.

1.2 Site Location

Pantex Plant is located in the Texas Panhandle in Carson County on U.S. Highway 60, about 27

kilometers (17 miles) northeast of downtown Amarillo (Figure 1.1) at 101°34' west longitude and 33°19' north latitude. The Pantex Plant facility consists of 4,079 hectares (10,080 acres), including 3,643 hectares (9,002 acres) in the main Plant area and 436 hectares (1,078 acres) located approximately 4 kilometers (2.4 miles) northeast of the main Plant area. Additionally 2,370 hectares (5,856 acres) are leased from Texas Tech University for use as a safety and security buffer zone.

Pantex Plant lies on the Llano Estacado (staked plains) portion of the Great Plains. The topography at Pantex Plant is relatively flat, characterized by rolling grassy plains and numerous natural playa basins. The term "playa" refers here to the more than 17,000 ephemeral lakes in the Texas Panhandle, mostly less than 1 kilometer (0.6 mile) in diameter, that receive water runoff from the surrounding area. The region is a semiarid farming and ranching area. Pantex Plant is surrounded by agricultural land and several significant industrial facilities are located in the general area.

1.3 Facility History and Mission

Pantex Plant is a government-owned, contractor-operated facility. M&H has been the operating contractor since 1956. In 1991 the environmental, health, safety, and waste management programs were subcontracted to Battelle Pantex.

Pantex Plant was first used during World War II from 1942 to 1945 by the U.S. Army for loading conventional ammunition shells and bombs. In 1951, the Atomic Energy Commission (AEC) began rehabilitating portions of the original Plant and constructing new facilities for nuclear weapons operations. In 1974, the Energy Research and Development Administration (ERDA) superseded AEC with responsibility for operation of Pantex Plant, and in 1977 ERDA was superseded by the Cabinet-level DOE.

The principal operations presently performed at Pantex Plant are the assembly and disassembly of nuclear weapons in the active stockpile using components received from other DOE plants and

with chemical high explosive (HE) components fabricated at Pantex Plant; operation of an experimental HE synthesis and characterization group; surveillance testing of nuclear weapon components; obsolete nuclear weapons disassembly; open controlled burning of the HE components and HE-contaminated materials; and the storage, maintenance, modification, repair, and nonexplosive testing of nuclear weapons components. Weapons assembly, disassembly, and stockpile surveillance activities involve short-term handling (but not processing) of encapsulated uranium, plutonium, and tritium, as well as a variety of nonradioactive toxic chemicals.

1.4 Facility Description

The facility is composed of several functional areas, commonly referred to as numbered zones (Figure 1.1). Currently defined zones include a weapons assembly/disassembly area (Zone 12), a weapons staging area (Zone 4), an experimental HE development area (Zone 11), a potable water treatment plant (Zone 15), a sanitary wastewater treatment facility (WWTF) (Zone 13), and vehicle maintenance and administrative areas. Other functional areas include an HE test-fire site, an HE Burning Ground, and an inactive sanitary landfill area north of Zone 10. Overall there are more than 400 buildings at the Plant.

The weapons assembly area (Zone 12) covers approximately 80 hectares (200 acres) and contains more than 100 buildings. Nuclear components and other parts received from other facilities and HE and metal parts fabricated at Pantex Plant are assembled into nuclear weapons in this zone. Also, weapons are disassembled in this zone.

In 1993, Zone 4 was used for temporary staging of weapons and/or weapons components awaiting movement to the assembly area for modification, repair, or disassembly; awaiting shipment to other DOE facilities for reworking or disposal; or awaiting shipment to the military.

The HE development area (Zone 11) consists of facilities for synthesizing, formulating, and characterizing experimental HE.

Figure 1.1 Location of Pantex Plant.

The potable water treatment facility (Zone 15) consists of production wells, chlorination/pumping facilities, storage tanks, and associated distribution lines.

Sanitary wastewater generated at Pantex Plant is routed to a WWTF in Zone 13. The present WWTF was placed into service in 1988, replacing an older facility built in 1942. Effluent from the new WWTF is discharged to an open ditch that drains to Playa One. Two HE processing operations discharge wastewater after it has been processed through particulate filters and activated carbon filters for removal of residual HE material into open ditches that drain into onsite playas.

The test-fire site (Firing Site) includes several test shot stands and several small-quantity test-fire chambers, for measuring detonation properties of HE components. The Firing Site also includes supporting test-shot makeup facilities and data interpretational facilities.

The Burning Ground is used for processing HE, HE components, HE-contaminated materials, and waste via open, controlled burning. Prior to 1980, waste solvents were disposed in a chemical burn pit at the Burning Ground. From 1980 to 1989, these waste chemicals were placed in open metal tanks at the Burning Ground and allowed to evaporate. Currently, these chemicals are sent offsite for disposal at a permitted disposal facility in accordance with applicable regulations.

The land disposal area, which is north of Zone 10, is divided into two landfill sites. Prior to 1989, the Plant's domestic solid waste was sent to one onsite sanitary landfill for disposal. Since late 1989, domestic waste has been sent to an offsite landfill for burial, following removal of recyclable materials. Current practices preclude hazardous materials disposal in onsite landfills, and such materials are transported offsite for disposal in accordance with applicable regulations.

1.5 Climatology

The climate at Pantex Plant, located on the Texas High Plains, is typical of continental interiors. It is characterized by large variations in daily

temperature extremes, low relative humidity, and irregularly spaced rainfall of moderate amounts. The climate in the Texas Panhandle is mainly semiarid with mild winters and hot, dry summers. The Panhandle is in a windy area, with the prevailing wind direction being from the south to southwest. Rainfall averages approximately 50 centimeters (20 inches) per year. The average gross lake surface evaporation rate was 185 centimeters (73 inches) per year (as measured from 1950 through 1975). Thunderstorms occur about 49 days per year and can produce tornados. Pantex Plant is located in a moderate to high hazard zone for tornados.

Data presented in Table 1.1 represent annual averages for 1993 prepared from data collected at the Plant meteorological tower, located at the northeast corner of the Plant site. Wind speed data for 1993 are significantly higher than the National Weather Service (NWS) data presented in past site environmental reports. The temperature is significantly lower than historical NWS temperature data. This is to be expected, as the Plant's sensors are located 10 meters (33 feet) above the surface. The NWS temperature sensor is approximately 1.2 meters above the surface and their new Automated Surface Observing System wind speed sensor is approximately 6 meters (20 feet) above the surface.

Table 1.1 1993 Meteorological Information

Precipitation	51.5 cm	20.27 in.
Average Temperature	12.4°C	54.3 °F
Average Wind Speed	7.4 m/sec	16.6 mph

The greater height above the surface of the Pantex sensors would result in less effect of afternoon ground heating (resulting in a lower average temperature) than the NWS data, and in lower surface resistance to wind flow (resulting in higher wind speed averages).

Figure 1.2 is a wind rose showing the annual average wind speed and direction for the local area for 1993. The wind rose is based on data

Figure 1.2 Wind Rose, Pantex Plant, Amarillo, Texas.

from the Plant's meteorological tower. On the polar coordinates of the wind rose, the frequencies of various observed wind directions are proportional to the total length of the spokes. The distribution of wind speeds within each direction is indicated by the length of the individual sections of a particular spoke. Thus, local winds for 1993 were predominantly from a south to southwest direction approximately 42 percent of the time. Overall distribution of wind speeds and directions for 1993 is similar to that from previous years.

1.6 Geology

Pantex Plant is situated on the southern High Plains. The primary surface deposits at Pantex Plant are the Pullman and Randall soil series, which grade downward to the Blackwater Draw Formation. This formation consists of a sequence of buried soils with an upper unit of mostly silty clay and caliche, and a 6-meter-thick (20-foot) lower unit of silty sand with caliche.

The Ogallala Formation, consisting of sand, silt, clay, gravel, and some caliche, underlies the Blackwater Draw Formation. The base of the Ogallala is an irregular surface that represents the pre-Ogallala topography. As a result, depths to the base of the Ogallala vary. At Pantex Plant, the vertical distance to the base of the Ogallala varies from 90 meters (300 feet) at the southwest corner of the Plant to 220 meters (720 feet) at the northeast corner of the Plant.

Underlying the Ogallala Formation are the sedimentary rocks of the Lower Dockum Group. These rocks consist of shale, clayey siltstone, and sandstone. The Lower Dockum Group is less than 30 meters (100 feet) thick beneath Pantex Plant and is underlain by Permian rocks.

1.7 Hydrogeology

Two principal water-bearing units are beneath Pantex Plant and adjacent areas. These are the Ogallala and the underlying Dockum Group aquifers. The vadose, or unsaturated zone, consists of up to 140 meters (460 feet) of sediments that lie between the land surface and the Ogallala aquifer.

1.7.1 Ogallala Aquifer

Two water-bearing units are present in the Ogallala Formation at Pantex Plant. A discontinuous perched water zone is present in the middle of the Ogallala Formation, above the main zone of saturation. The perched water zone sits on a 7-to 12-meter-thick (25-to 40-foot) layer of fine-grained material that functions as a vertical barrier. Data collected from wells indicates that the zone of saturation in the perched zone varies in thickness from 0 to 30 meters (0 to 100 feet). The lateral extent of this perched water zone has not been completely defined. The perched zone is known to be discontinuous over the Plant and characterization of the lateral extent is ongoing.

The main Ogallala aquifer lies below this perched water zone. The Ogallala aquifer is defined as the basal water-saturated portion of the Ogallala Formation and is a principal water supply on the High Plains. It is an unconfined aquifer capable of yielding 2500 to 4500 liters per minute (700 to 1200 gallons per minute [gpm]) of high-quality water to wells in the Plant vicinity. At Pantex Plant, the Ogallala saturated zone is thickest to the northeast. The Plant's five production wells are located on the northeast portion of the Plant property, and the City of Amarillo's Carson County Well Field is located north and northeast of Pantex Plant's well field. The groundwater gradient in the Ogallala aquifer beneath Pantex Plant trends down to the northeast, toward the city's well field.

The water table level of the Ogallala in the vicinity of Pantex Plant is declining at a rate of approximately 0.6 to 1.5 meters (2 to 5 feet) per year.

1.7.2 Dockum Group Aquifer

The Dockum Group aquifer lies under the Ogallala Formation at Pantex Plant. Water contained in the sandstone layers within Lower Dockum Group rocks supplies domestic and livestock wells south and southeast of Pantex Plant. Other Dockum aquifer wells are located 16 kilometers (10 miles) south and west of the Plant. The Dockum aquifer may be semiconfined with respect to the overlying Ogallala aquifer because

of lateral variations in the Ogallala and shale layers within the Dockum. Regionally, Dockum aquifer wells yield an average of 400 liters (105 gallons) per minute, and water quality is typically poor. However, near Pantex Plant water quality is better, possibly due to recharge from the overlying Ogallala aquifer. No detailed information is available on the potentiometric surface of the Dockum aquifer for the Pantex Plant area, but the direction of the groundwater flow may be to the southwest along the dip of Triassic beds.

1.8 Seismology

The Pantex Plant and the surrounding area are relatively free of earthquakes. The Uniform Building Code places the Pantex Plant area in (earthquake) Zone 1, which rates second lowest in earthquake occurrence on a scale from Zone 0 to 4. Since 1882, there have only been four earthquakes in the Plant area. These seismic events occurred on March 27, 1917; July 25, 1925; June 19, 1931; and July 20, 1966. Their epicenters were 16 to 32 kilometers (10 to 20 miles) east-northeast of the Plant, and all were estimated to have intensities of V or VI on the modified Mercalli intensity scale.

1.9 Land Use

The area around Pantex Plant is semiarid. Land is used mainly for farming and ranching. Although dryland farming is dominant, some fields are irrigated from the Ogallala aquifer or, less commonly, from local playas. Ranching in the region is primarily cow-calf operations. Several significant industrial facilities are located in the general area such as two power plants, a copper refinery, a beef packaging plant, and the Amarillo International Airport and associated industries.

1.10 Population

A land use census of the residential population surrounding Pantex Plant showed that the majority of the population is located west-southwest of Pantex Plant in the Amarillo metropolitan area (Burns & McDonnell, 1991). Figure 1.3 shows the population distribution. Per the report the

total population within an 8-kilometer (5-mile) radius of Pantex Plant was 2,043; and the total population within 80 kilometers (50 miles) of the Plant was 273,900. Amarillo has about 156,000 residents. Pampa, Texas, located about 64 kilometers (40 miles) northeast of the Plant, is the second largest population concentration, with about 21,000 residents. The remaining population within the 80-kilometer (50-mile) circle is somewhat evenly distributed at a density of about three people per square mile.

1.11 Water Use

The major surface water source near Pantex Plant is the Canadian River, which flows into Lake Meredith 40 kilometers (25 miles) north of the Plant. Water from this man-made lake is used by many local communities for domestic purposes. The major groundwater source in the vicinity of the Plant is the Ogallala aquifer, which is used as a domestic source by municipalities and industry in the High Plains.

The City of Amarillo pumps water from the Carson County Well Field north and northeast of the Plant. From October 1992 through September 1993, the City of Amarillo produced 32.5 billion liters (8.58 billion gallons) of water from Lake Meredith, 3.16 billion liters (0.84 billion gallons) from the Southwest field, and 22.1 billion liters (5.84 billion gallons) from the Carson County Well Field.

Pantex Plant produces potable water from five wells in the northeast corner of the site. During 1993, Pantex Plant produced 919 million liters (243 million gallons) of water from the Ogallala aquifer well field onsite. Pantex Plant provided 235 million liters (62.2 million gallons) to Texas Tech University for irrigation and personal consumption. The remaining water, approximately 684 million liters (181 million gallons), was used for industrial and domestic purposes at the Plant. The Plant is actively implementing a water conservation program, with 1993 production representing a decrease of 9.5 percent.

Figure 1.3 Population in the 50-Mile Area.

Section 2

COMPLIANCE SUMMARY

Compliance Status—1993 Issues and Activities

The policy of Pantex Plant is to conduct its operations in compliance with all applicable environmental statutes and regulations. The following is a review of the applicable environmental requirements relevant to the operations of the Plant, including current issues and actions. Table 2.1 summarizes the major regulations applicable to Pantex Plant, and Table 2.2 summarizes the permits issued to Pantex Plant. Overall, Pantex is in compliance with the major environmental laws and regulations with no lawsuits pending.

On September 1, 1993, as a result of passage of "Senate Bill 2", the Texas legislature created the Texas Natural Resource Conservation Commission (TNRCC) and transferred to it the responsibilities of the Texas Water Commission and merged the Texas Air Control Board into the new agency. This agency is now organized to include the Office of Water Resource Management, Office of Air Quality, and Office of Waste Management, among others. Pantex Plant provides office space for TNRCC officials who are assigned to the Plant.

To maintain a common reference to the Texas regulatory agencies, this report will refer to the TNRCC as the regulatory agency instead of delineating which events occurred with the Texas Air Control Board, the Texas Water Commission, and/or the TNRCC.

Comprehensive Environmental Response, Compensation, and Liability Act

As a result of the U.S. Environmental Protection Agency (EPA) evaluation and ranking, Pantex

Plant was proposed in the Federal Register as a candidate for the National Priorities List (NPL) on July 29, 1991 (56FR858400-01). Upon notification of its proposed NPL listing, Pantex Plant completed two independent evaluations using the EPA's Hazardous Ranking System Packages. Both of the independent evaluations resulted in a scoring that was substantially less than the EPA's score. One of the independent evaluations was submitted as comments to the EPA for consideration within the 60-day public comment period. As of December 31, 1993, EPA had not responded to the comments.

The Emergency Planning and Community Right-to-Know Act was enacted as part of the Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III, and requires several reports to be filed annually. The information required by SARA Title III, Sections 311 and 312, for 1992, was filed in April 1993. The information required by SARA Title III, Section 313, the Toxic Chemical Release Inventory Form (Form R), for 1992 was submitted to the EPA in August 1993. Form R listed acetone as the only reportable substance. All acetone releases were in the form of air emissions.

On February 18, 1993, Pantex Plant reported to the National Spill Response Center and the TNRCC that approximately 15 gallons of gasoline had been released near Building 16-1 in excess of the reportable quantity limit of 25 gallons. As a result of this release an initial investigation was conducted to determine the lateral and horizontal extent of the release. Results of the investigation will be provided in a report scheduled for release in the first quarter of 1994.

Table 2.1 Review of Major Environmental Regulations Applicable to Pantex Plant

Authority	Codification	Regulatory Description	Status
Federal: U.S. Environmental Protection Agency State: Texas Natural Resource Conservation Commission	Federal: Code of Federal Regulations, 40 CFR 50-80 State: Texas Administrative Code, 30 TAC 101-125 & 305	<u>CLEAN AIR ACT</u> The Clean Air Act (CAA) and the Texas Clean Air Act (TCAA), through their implementing regulations, regulate the release of air pollutants through the use of permits and standard exemptions.	Pantex Plant has permits and standard exemptions issued by the Texas Natural Resource Conservation Commission.
Federal: U.S. Environmental Protection Agency State: Texas Natural Resource Conservation Commission	Federal: Code of Federal Regulations, 40 CFR 109-140, 230, 231, 401, 403 State: Texas Administrative Code, 30 TAC 305 & 308-325	<u>CLEAN WATER ACT</u> The Clean Water Act (CWA) and the Texas Water Code, through their implementing regulations, regulate the quantity and quality of industrial water discharges to waters of the United States and State of Texas.	Pantex Plant has submitted Wastewater and Stormwater National Pollutant Discharge Elimination System (NPDES) Permit applications to EPA Region 6. Those applications are pending. Pantex Plant has a wastewater no discharge permit from the TNRCC. A wastewater discharge amendment application was submitted to the TNRCC April 1992 and is pending.
Federal: U.S. Environmental Protection Agency State: Texas Natural Resource Conservation Commission	Federal: Code of Federal Regulations 40 CFR 300, 302, 355, & 370 State: Texas Administrative Code, 30 TAC 265-275	<u>COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT</u> Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides the regulatory framework for the remediation of releases of hazardous substances and cleanup of inactive hazardous substance disposal sites. CERCLA Section 107 provides for the protection of natural resources on publicly owned property through designation of Natural Resource Trustees.	Pantex Plant has been proposed for addition to the NPL by EPA Region 6. Independent evaluations question the proposed listing on the NPL. Pantex Plant has submitted notifications to potential co-trustees. Pantex Plant and other interested co-trustees are formulating plans to participate in the Natural Resource Damage Assessment process.
Federal: U.S. Fish and Wildlife Service State: Texas Parks and Wildlife Department	Federal: Code of Federal Regulations 50 CFR 11 et seq. State: Texas Parks and Wildlife Code 68.0001-68.021.	<u>ENDANGERED SPECIES ACT OF 1973</u> The Endangered Species Act regulates human and industrial activities in such a manner that does not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of a critical habitat.	Ongoing and proposed actions will be assessed as to the adverse effects on threatened and endangered species.
Federal: U.S. Environmental Protection Agency State: Texas Department of Agriculture	Federal: Code of Federal Regulations, 40 CFR 162-171 State: Texas Administrative Code 4 TAC 7.1-7.40	<u>FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT</u> The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) governs the manufacture and use of biocides, specifically the use, storage, and disposal of all pesticides and pesticide containers and residues.	For Pantex Plant operations, pesticides are applied in accordance with regulations by state-licensed personnel.

Table 2.1 Review of Major Environmental Regulations Applicable to Pantex Plant, Continued

Authority	Codification	Regulatory Description	Status
Federal: U.S. Department of Energy Council for Environmental Quality	Federal: Code of Federal Regulations, 10 CFR 1021 40 CFR 1500-1508	<u>NATIONAL ENVIRONMENTAL POLICY ACT</u> The National Environmental Policy Act (NEPA) establishes a broad national policy to conduct federal activities in ways that promote the general welfare and that are in harmony with the environment. NEPA procedures must ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken.	In 1993, Pantex Plant submitted four environmental assessments (EAs) for approval of major projects, 32 environmental checklists, and 23 NEPA-related documents in regard to smaller projects for approval.
Federal: Advisory Council on Historic Preservation State: Texas State Historic Preservation Office Texas Historical Commission	Federal: Code of Federal Regulations, 36 CFR 60, 63, 79, 800, & 1220. 43 CFR 7 State: Texas Natural Resources Code 191.001-.174	<u>NATIONAL HISTORIC PRESERVATION ACT</u> The National Historic Preservation Act (NHPA) through its implementing regulations, identifies, evaluates, and protects historic properties eligible for listing in the National Register of Historic Places. Historic Properties can be archaeological sites, historic structures, or historic documents, records, or objects.	Archaeology: Fifty sites have been identified but not evaluated. Some Plant areas have yet to be surveyed. Historic Buildings: World War II era structures in Plant Zones 4, 10, 11, & 12 have been recorded. Surveys are planned or in progress to complete the identification and evaluation of historic properties on the Plant. Historic Documents and Artifacts: Yet to be systematically included in NHPA compliance programs at the Plant.
Federal: U.S. Environmental Protection Agency State: Texas Natural Resource Conservation Commission	Federal: Code of Federal Regulations 40 CFR 260-280 State: Texas Administrative Code, 30 TAC 305, 334, & 335	<u>RESOURCE CONSERVATION & RECOVERY ACT</u> The Resource Conservation and Recovery Act as amended (RCRA) and the Texas Solid Waste Disposal Act, through their implementing regulations, govern the generation, storage, handling, treatment, and disposal of hazardous waste. Underground storage tanks and spill release cleanup are also regulated by these statutes and regulations.	Pantex Plant is defined as a large-quantity generator and has both permitted and interim status storage and treatment facilities. The Hazardous Waste Permit issued to the DOE-Pantex Plant includes a corrective action section.
Federal: U.S. Environmental Protection Agency State: Texas Natural Resource Conservation Commission	Federal: Code of Federal Regulations, 40 CFR 141-149 State: Texas Administrative Code, 30 TAC 290	<u>SAFE DRINKING WATER ACT</u> The Safe Drinking Water Act (SDWA) and the Texas Water Code, through their implementing regulations, govern public water supplies. Pantex is classified as a non-transient, non-community, public water supply system.	The Pantex Plant water supply meets all required primary and secondary drinking water standards and operational and maintenance regulations.
Federal: U.S. Environmental Protection Agency	Federal: Code of Federal Regulations, 40 CFR 700-766	<u>TOXIC SUBSTANCES CONTROL ACT</u> The Toxic Substances Control Act (TSCA) requires the characterization of toxicity and other harmful properties of manufactured substances and regulates the manufacture, distribution, and use of regulated materials.	The TSCA regulations impact Pantex Plant. The Plant is managing PCBs in compliance with applicable regulations.

Table 2.2 Permits Issued to Pantex Plant

Building or Activity	Permit Number	Issuing Agency	Effective Date	Expiration Date
Media: Air				
Building 16-13 Steam Plant	C-18379	TNRCC	07-21-1988	07-21-2003
Burning Grounds	Written Grant of Authority	TNRCC	Reissued 05-29-1991	None
Building 11-36	21233	TNRCC	03-11-1993	03-11-1998
Building 12-19	21233	TNRCC	03-11-1993	03-11-1998
High Explosive Synthesis Building (11-55)	21233	TNRCC	03-11-1993	03-11-1998
Media: Solid Waste				
Solid Waste Registration No.	TX-4890110527 30459	EPA TNRCC	10-30-1980	None
Hazardous Waste Permit	TX-4890110527 HW-50284	EPA TNRCC	04-25-1991	04-25-2001
Hazardous Waste Permit	Class III Modification	EPA TNRCC	Application Under Review	
Media: Water				
Wastewater No Discharge Permit	02296	TNRCC	5-19-1980	05-03-1993
Wastewater Discharge Permit	—	TNRCC	Amendment under review	
NPDES Permit	TX-0107107	EPA	Application under review	
NPDES Stormwater Discharge Permit	TX-0107107	EPA	Application under review	
CWA Section 404 Dredge and Fill Permit	Nationwide Permit for Survey Activities	U.S. Army Corps of Engineers (USACE)	01-23-1992	01-23-1994

Section 107 of CERCLA provides for the designation of federal and state trustees, who shall be responsible for, among other things, the assessment of damages for injury to, destruction of, and loss of natural resources. As Primary Federal Natural Resource Trustee (via Article 300.600(b)(3) of the National Oil and Hazardous Substances Pollution Contingency Plan), the DOE has the responsibility to notify and encourage the involvement of designated federal and state trustees.

In May 1993, Pantex Plant submitted notifications to potential co-trustees to participate in the Section 107 process. As of December 31, 1993, only the U.S. Fish & Wildlife Service (USFWS) and Texas General Land Office have expressed a commitment to participate in the process.

Resource Conservation and Recovery Act

Section 3006 of RCRA authorizes states to assume responsibility for carrying out the RCRA program. Texas has received partial authority for the RCRA program and exercises the authority through regulations promulgated under the Texas Solid Waste Disposal Act. Facilities that store, treat, or dispose of hazardous waste must comply with the regulations of both the EPA and the TNRCC.

Pantex Plant is registered with the State of Texas (TNRCC Solid Waste Registration Number 30459) and operates under a hazardous waste permit HW-50284 and EPA Identification Number TX4890110527. Pantex Plant currently operates units both under its hazardous waste permit and under interim status.

Active Waste Management. Routine operations at Pantex Plant generate solid waste, hazardous waste, low-level radioactive waste, medical waste, mixed waste, TSCA waste, and sanitary waste. This includes waste generated by other tenants at Pantex (USACE, Sandia

National Laboratories, and DOE Safeguards Transportation Division). Table 2.3 lists these waste types and the amounts that were generated in 1993.

Solid waste generated at Pantex Plant is regulated by the TNRCC. Some of the solid waste is not defined as hazardous waste, e.g., inert and essentially insoluble material such as scrap metals, paper, cardboard, bricks, glass, dirt, and certain plastics and rubber items that are not readily degradable; such waste is disposed onsite. The remainder of the solid waste generated at Pantex Plant is treated and disposed offsite at permitted landfills.

The sanitary waste generated from cafeteria operations at Pantex Plant is disposed in permitted landfills, if it cannot be used as animal feed.

The hazardous wastes generated at Pantex Plant include, but are not limited to, solvent-contaminated wastewater, explosive contaminated wastewater, and spent and explosive contaminated organic solvents. These wastes were managed onsite by storage and limited treatment, or shipped offsite for treatment and disposal at permitted treatment, storage, and disposal facilities. In addition, as described in Section 3, Pantex Plant has aggressive programs for pollution prevention and waste minimization.

All of the routinely generated radioactive waste at Pantex Plant as a result of routine operations was low-level radioactive waste (LLW). As a result of a nonroutine event in weapons dismantlement, approximately three 55-gallon drums of transuranic waste and approximately ten 55-gallon drums of low level plutonium waste was generated. LLW was generated in small quantities from the assembly and disassembly of weapons and consists of materials contaminated with depleted uranium or tritium. LLW is staged onsite pending shipment to the Nevada Test Site for disposal. During 1993, Pantex Plant shipped 12,981 cubic feet to the Nevada Test Site for disposal.

Table 2.3 Waste Volumes from Routine Operations

Waste Type*	1991	1992	1993	Percentage Change 1992-1993
Low-Level Waste	67.2 m ³	178 m ³	130 m ³	-27%
Mixed Waste **	39.7 m ³	50.5 m ³	37.5 m ³	-26%
Solid Waste (Non-Hazardous)	8,082 m ³	6,489 m ³	10,885 m ³	+68%
Hazardous Waste	619 m ³	589 m ³	369.6 m ³	-37%
TSCA Waste	64 m ³	95 m ³	112.9 m ³	+19%
Sanitary Waste	561 m ³	494 m ³	612 m ³	+24%
TOTAL	9,432.9	7,895.5	12,147.0	+54%

* Conversion of different waste types from weight to volume were made using 0.72 kg per liter (6 lb waste per gallon) of waste.

** Mixed waste is waste that contains both a radioactive and a hazardous waste component.

Mixed waste, having both radioactive and RCRA hazardous constituents, also results from assembly and disassembly of weapons. The majority of mixed waste generated consists of paper products contaminated with organic solvents and radionuclides.

Pursuant to the requirements of the Federal Facilities Compliance Act of 1992, the Department of Energy (DOE) prepared and submitted to the EPA and TNRCC an inventory of all mixed waste stored at Pantex Plant on April 23, 1993. Pantex Plant also submitted a Conceptual Plan to the TNRCC in October 1993 as required by the Federal Facilities Compliance Act of 1992. Pantex Plant is also preparing a Draft Site Treatment Plan scheduled for submission to the TNRCC in October 1994. The Final Site Treatment Plan is to be submitted to the State of Texas by October 1995.

TSCA wastes, including asbestos and materials contaminated with less than 50 parts per million polychlorinated biphenyls, are transported to permitted facilities for treatment and disposal.

Permit Modifications. On April 25, 1991, the TNRCC and EPA issued a permit to Pantex Plant to store containers and tanks and to treat hazardous waste in tanks. The permit specifically excluded 17 RCRA units at the Burning Grounds but continued the interim status of those units. In November 1991, the DOE formally submitted a request to the TNRCC for a Class 3 Modification to add the units at the Burning Ground to the permit. In October 1992, the DOE added 10 additional storage units to the Class 3 Modification request. Pursuant to the public notice published on October 31, 1991, interested parties requested a hearing before a Hearing Examiner on the Permit.

On December 31, 1992, the DOE requested a Class 1 Modification to treat waste in accordance with treatment standards for disposal of waste in or on the land. This modification to the Hazardous Waste Permit was approved on January 26, 1993.

On May 6, 1993, the DOE requested a Class 1 Modification to add three container storage units

to its permit. This modification to the Hazardous Waste Permit was approved on July 28, 1993.

On September 23, 1993, two local organizations were named as parties to the contested case hearing. As a result of meetings by all parties to the hearing, the TNRCC staff has requested additional information on the permit application. The hearing process is proceeding.

Corrective Actions. The hazardous waste permit issued by the TNRCC and EPA requires applicable investigation and remediation of 14 areas containing 144 solid waste management units where past releases of hazardous materials may have impacted the environment. This section of the hazardous waste permit is referred to as the "corrective action" section. Pursuant to the requirements of the RCRA Permit, the DOE submitted three RCRA Facility Investigation (RFI) Work Plans to the TNRCC in 1993. The fourteen unit groupings are listed in Table 2.4. As of December 31, 1993, the TNRCC had approved one of the plans.

During 1992 and 1993, the DOE submitted 10 RFI Work Plans, eight of which were approved. As of December 31, 1993, the DOE had begun implementation of nine of the approved plans and had completed Phase I of eight of those plans, and Phase II on one.

Annual Inspection. On August 6—10, 1993, the TNRCC conducted its annual RCRA inspection of Pantex Plant. The TNRCC notified the DOE of five areas of concern and two areas of alleged noncompliance, which are described in Table 2.5. Pantex Plant addressed the five areas of concern and submitted a response to alleged noncompliance issues on September 14, 1993. As of December 31, 1993, the DOE was awaiting a reply from the TNRCC. Pantex corrective actions were completed except for Area of Concern 3, relating to the prairie dog population at the Burning Ground.

In July 1992, the TNRCC conducted its annual RCRA inspection of the Plant. Pursuant to that inspection, five of the six alleged areas of non-compliance were corrected. The remaining one alleged that the Plant was storing mixed waste for a period of greater than one year, which is prohibited by the land disposal restrictions (LDR). The issue of mixed waste storage is being addressed through the Federal Facilities Compliance Act of 1993 and resulting Consent Order.

Closures. On October 28, 1992, the DOE notified the TNRCC that it was implementing the Closure Plan for the 4-19 container storage unit. The closure activities were conducted during the second quarter of 1993. The Report of Closure and Certification was submitted to the TNRCC on July 15, 1993. The TNRCC concurred with the Closure Certification by letter dated October 29, 1993.

A Closure Plan for the 11-14 Pond, an interim status RCRA unit, was implemented in March 1992. Residual contamination was observed during characterization efforts conducted in 1992 in accordance with the TNRCC-approved Closure Plan. The presence of residual contamination precluded "clean closure". In November 1992, Pantex Plant met with the TNRCC and requested closure of the unsaturated zone in accord with 30 TAC 335, Subchapter S. Pantex Plant additionally requested that contamination of the saturated zone be incorporated into the Zone 12 Groundwater RFI. In September 1993, upon finalization of TNRCC regulations on Risk Reduction Standards (30 TAC 335 Subchapter S) Pantex Plant submitted notification to TNRCC for performance of a human health risk assessment for the unsaturated zone in accordance with Standard No. 2. Pantex Plant completed the Hazard Assessment/Exposure Pathway Determination and presented its findings to the TNRCC on December 14, 1993. As of December 31, 1993, Pantex Plant was awaiting comment from the TNRCC.

Table 2.4 RFIs to be Performed at Pantex Plant

Unit Group	Title
AL-PX-1	Burning Ground
AL-PX-2	High Priority Release Sites
AL-PX-3	Cooling Tower Zone 12
AL-PX-4	Old Sewage Treatment Plant
AL-PX-5	Fire Training Burn Pits
AL-PX-6	Zone 12 Groundwater Assessment
AL-PX-7	Landfills
AL-PX-8	Ditches and Playas
AL-PX-9	Firing Sites
AL-PX-10	Leaking Underground Storage Tanks (USTs)
AL-PX-11	Miscellaneous High Explosive /Radiation Sites
AL-PX-12	Miscellaneous Chemical Spills
AL-PX-13	Supplemental Verification Sites
AL-PX-14	USTs at Other Locations

The Closure Plan for tanks located at Buildings 11-44 and 12-43 was implemented in July 1992. Clean closure of the tanks was not achievable due to contamination found in the soil surrounding the tanks. On August 20, 1993, the DOE submitted a request to the TNRCC to continue closure activities relating to the tanks in connection with the Miscellaneous High Explosive/Radiological Sites RFI. As of December 31, 1993, the DOE was awaiting approval from the TNRCC.

Underground Storage Tanks. UST Program activities continued during 1993. Two USTs are registered with the TNRCC and comply with current regulations. No removal or installation activities occurred during 1993. The status of the USTs for 1993 is shown in Table 2.6.

During the last quarter of 1993, the UST Borehole Drilling Program investigated 13 former UST locations, of which eight were USTs removed prior to 1988. Results of the investigation will be provided in a report scheduled for release in the first quarter of 1994.

National Environmental Policy Act

On December 1, 1992, the DOE published revised DOE Order 5440.1E which superseded DOE Order 5440.1D and supplemented SEN-15-90. DOE Order 5440.1E was published and revised to establish internal DOE responsibilities and procedures to implement NEPA requirements.

Table 2.5 1993 Annual RCRA Inspection

Areas of Alleged Noncompliance		Corrective Action
1	Aisle space in Conex containers is less than 24 inches.	Since each Conex contains only one double row of drums, Pantex Plant does not believe the permit provisions requiring 24-inch aisle spacing between double rows of drums is applicable.
2	Approximately 25 drums of barium nitrate stored/staged in the 11-7 pad for greater than 2 years with the intent of recycling.	The 25 drums were shipped to a permitted offsite facility for disposal.
Areas of Concern		Corrective Action
1	LDR waste exceeding one year storage. The waste vessels in question are identified by the following bar code numbers: 91024069, 91044733, 90102493, and 8810999.	Waste vessels 91024069, 90102493, and 8810999 were shipped to a treatment, storage, and disposal facility. Vessel 91044733 was transported to the Burning Ground after hazardous constituents were removed and the high explosive was burned.
2	Plant inspectors have noted potential violations at the Plant such as LDR problems but responses to memos sent from inspectors do not address problems noted.	Pantex Plant has addressed the issues such as storage facilities, and Burning Ground characterization. The Plant management will require that appropriate personnel promptly respond to issues raised by Plant inspectors.
3	The prairie dog population at the Burning Ground should be addressed as a potential problem due to the introduction of migratory pathways at this waste management facility.	Evidence was submitted to the TNRCC that the prairie dog burrows at the Burning Ground were improbable migratory pathways to the Ogallala aquifer. Additionally, the DOE plans to relocate the prairie dogs and fill in burrows in 1994.
4	Container storage east of the 11-7 pad exceeds 600 vessels. These drums are labeled nonregulated, hazardous, and empty containers.	Irrespective of labeling, only empty containers were stored in this area. A procedure is being drafted to better manage and label these empty containers.
5	Igloo 4-50 had in storage at least nine drums labeled as radiation and analysis required.	The vessels were determined to contain explosive components and not waste. These components carry a radioactive source. The containers were moved to an appropriate high explosive storage area pending development of procedures to remove the radioactive sources.

To comply with DOE Order 5440.1E, Pantex Plant resubmitted, after incorporating DOE comments, four EAs covering major projects in 1993. As of December 31, 1993, the Plant was awaiting approval of all EAs submitted during 1993. (See Table 2-7) To comply with DOE Order 5440.1E for minor projects, Pantex Plant submitted 32 environmental checklists in 1993 and 23 NEPA-Related Documents (abbreviated checklists based on previously approved NEPA documents). Of these 55 documents, 41 were approved, four, as determined by DOE Headquarters, are to be incorporated into the new Site-wide Environmental Impact Statement, and the resolution of 10 checklists was pending as of December 31, 1993.

Clean Air Act

The Federal CAA requirements are implemented in Texas under the TCAA. The National Emissions Standards for Hazardous Air Pollutants (NESHAP) Subpart H are regulated by the EPA. The TNRCC administers the TCAA.

Pantex Plant demilitarizes and sanitizes explosives, explosive components, and explosive-contaminated materials and thermally treats explosive waste and explosive-contaminated waste at the Burning Ground. The demilitarization and sanitization operations are required under the Atomic Energy Act of 1954 as amended. The Burning Ground operates as a RCRA Interim Status Unit and under a written Grant of Authority from the TNRCC.

On May 31, 1992, the TNRCC Office of Air Quality, recommended draft hazardous waste permit provisions for the Burning Ground. As of December 31, 1993, the TNRCC, the DOE, and parties to the hearing process were continuing discussions on terms of the proposed permit modification.

On December 10, 1991, Pantex Plant submitted a construction permit application to the TNRCC for the proposed High Explosives Synthesis Facility (Building 11-55). On December 17, 1991, Pantex Plant submitted to the TNRCC a permit application for Buildings 11-36 and 12-19 for operations not authorized under standard exemptions currently on file. The TNRCC issued a permit to construct Building 11-55 and for the operations of Buildings 11-36, 11-55 and 12-19 on March 11, 1993.

The emission of radionuclides from Pantex Plant is regulated under 40 CFR 61 Subpart H by EPA. The allowable level of emissions, according to 40 CFR 61 Subpart H, is that level of emission of radionuclides that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem or less. The effective dose equivalent to any member of the public from emission of radionuclides from Pantex Plant was less than 1 percent of 10 mrem (0.1 Sv). To demonstrate compliance with 40 CFR 61 Subpart H, Pantex Plant performed periodic confirmatory monitoring as prescribed in 40 CFR 61.93 for DOE facilities that emit less than 1 percent of the allowable limit.

In 1993, the Plant reviewed activities conducted in buildings to determine their compliance with 40 CFR 61 Subparts A and H. This review confirmed that all the buildings reviewed were in compliance with Subparts A and H.

In 1993, Pantex Plant prepared an Asbestos Management Plan in accordance with Subpart M of NESHAP. The Plant performed all notifications required by the TCAA in regard to asbestos removal projects.

Table 2.6 Underground Storage Tank Status at End of 1993

UST No.	Location	Action	Status
4	12-108	Upgraded 12-91	Operational
6	12-4	Removed 11-21-91	Awaiting clean closure letter (CCL) from the TNRCC.
11	12-20	Removed 09-03-91	Awaiting CCL from the TNRCC.
14	12-24E	Removed 08-21-91	Awaiting CCL from the TNRCC.
15	12-26E	Removed 08-30-91	Analytical results forwarded to TNRCC. Awaiting CCL from TNRCC.
22	12-37	Removed 08-26-91	Awaiting CCL from the TNRCC.
24	12-62	Removed 08-29-91	Awaiting CCL from the TNRCC.
30	16-1	Removed 11-27-91	RCRA Facility Investigation.
55	4-147	Installed 12-91	Operational

Table 2.7 Environmental Assessments For 1993

Project Title	Date Submitted or Resubmitted	Date Approved
Hazardous Waste Staging Facility	09-18-90	01-29-93
Hazardous Treatment and Processing Facility	01-24-91, 07-8-91, and 09-27-93	
Pit Reuse Project	01-06-92 & 09-27-93	
ES&H Analytical Laboratory	06-29-92 & 01-25-93	
Interim Storage of Plutonium Components at Pantex Plant	12-1-92 & 11-11-93	

Federal Water Pollution Control Act or Clean Water Act

The CWA's NPDES program is administered by the EPA in the State of Texas. In response to a request by the DOE, the EPA determined that an NPDES permit was applicable to operations conducted at Pantex Plant. Pursuant to that determination, a permit application was submitted in November 1990 and resubmitted in February 1991. The EPA determined the Pantex Plant was awaiting a draft permit.

On October 14, 1991, the DOE submitted to the EPA a NPDES storm water discharge permit application for storm water discharged by Pantex Plant. As of December 31, 1993, Pantex Plant was awaiting a draft permit.

Texas Water Code. Since 1980, pursuant to the Texas Water Code, the TNRCC has permitted Pantex Plant to discharge its wastewater under a no discharge wastewater permit (Permit Number 02296). No discharge permits allow wastewater discharges not going to "waters of the State." In 1980 the State did not consider playas to be "waters of the state." On December 26, 1990, the DOE filed a permit application to modify its permit. The permit application was resubmitted in May 1992 at the request of the TNRCC to change the permit from a no discharge to a discharge permit.

On April 1, 1993 the TNRCC issued a draft permit based on the DOE's May 1992 application. Subsequent draft permits were issued on June 11, 1993, and November 22, 1993. On May 3, 1993, Pantex Plant published, at the direction of the TNRCC, a public announcement that the Plant had applied for a modification to its permit, that a draft permit was prepared, and that affected persons could request a hearing on the application. Pursuant to the May 1993 public notice, several local organizations and individuals requested the TNRCC to hold a public hearing on the application.

A hearing was held on December 9, 1993, at which two local organizations and four individuals were named as parties of standing, contesting the issuance of the permit. As of December 31, 1993, the schedule for discovery and further hearings had not been established.

During 1993, Pantex Plant reported 16 excursions of the pH limitation stated in the permit issued to Pantex Plant. The TNRCC performed an official wastewater inspection in August 1993. No findings were issued.

Safe Drinking Water Act

In 1992 primacy for all regulation of public water supplies was transferred from the Texas Department of Health to the TNRCC.

Pantex Plant receives its drinking water from the Ogallala aquifer via five groundwater wells located on the northeast corner of the Plant. The water is treated onsite and tested in accordance with requirements for public drinking water systems.

The domestic water supply at Pantex Plant meets all of the national primary and secondary drinking water standards for non-community, nontransient public water supply systems. On December 30, 1992, TNRCC representatives inspected the domestic water supply system at Pantex Plant. The inspection revealed that the system is being operated and maintained in compliance with Texas statutes and regulations.

Toxic Substances Control Act

As of December 31, 1993, all equipment and parts used at Pantex Plant that contained polychlorinated biphenyls had concentrations of less than 50 parts per million; thus, most requirements of the TSCA do not apply.

Federal Insecticide, Fungicide and Rodenticide Act

FIFRA governs the manufacture and use of biocides. Regulations promulgated under this act govern the use, storage, and disposal of all pesticides and pesticide containers and residues. For Pantex Plant operations pesticides are applied in accordance with federal and state regulations by state-licensed personnel. Texas Tech also uses pesticides on DOE-owned property used by Texas Tech for agricultural purposes.

National Historic Preservation Act

During 1993, Packet 1 of the World War II Historic Buildings survey for Plant Zones 4, 10, 11, and 12 was submitted to the Texas State Historic Preservation Office (SHPO), without DOE determinations of eligibility for the National Register of Historic Places. The SHPO determined that 45 structures in Zones 11 and 12 were eligible, and several projects on these structures were managed on a case-by-case basis. Contracts were negotiated and begun for Packets 2 and 3 of the World War II Historic Buildings survey on the remaining Plant zones, and for initial development of a Pantex Plant Cultural Resource Management Plan. The USACE continued archaeological survey and testing work near playas and on Texas Tech land; a report is scheduled in early 1994.

Endangered Species Act

In 1992 Pantex Plant began an improved program to assess its natural resources. This plan was significantly expanded in 1993 and confirmed the presence of several species of concern at Pantex Plant, as well as the potential for others. Table 2.8 lists the significant species that reside or migrate through the Plant.

The bald eagle, a spring and fall migrant, winters in the Texas Panhandle. During 1993 the bald eagle was observed foraging among

playas and prairie dog towns onsite. The Texas horned lizard and the ferruginous hawk are resident species on Pantex Plant and were observed during 1993.

Several species of concern reside on Pantex Plant for temporary or extended periods during spring and fall migrations. These species include the white-faced ibis, the sandhill crane, and the long-billed curlew. The whooping crane and other species of concern are probable seasonal inhabitants, though not sighted on Pantex Plant during 1993.

Pantex Plant met with the USFWS in November 1993. In a letter dated December 1993, the USFWS deferred concurrence on a general conclusion that current Plant activities are not adversely affecting federally listed threatened or endangered species.

Executive Orders 11988 "Floodplain Management" and 11990 "Protection of Wetlands"

In response to a Tiger Team finding in 1989, a delineation of Pantex Plant wetlands was prepared. The delineation was forwarded to the USACE, who issued a letter in December 1991 determining that Pantex Plant's playas are jurisdictional wetlands and are now regulated by 10 CFR 1022 requiring DOE to enhance and protect wetlands and floodplains.

In February 1992, the USACE determined that the "Nation-Wide Permit for Survey Activities" applied to proposed investigatory activities identified in the Ditches and Playas RFI Work Plan. Pantex Plant is in compliance with the permit.

Summary of DOE Headquarters and Tiger Team Assessment

A Tiger Team Assessment was conducted at Pantex Plant October 2-31, 1989. The final report was published in February 1990 with 72 findings.

As of December 31, 1993, 67 findings were completed and 64 were closed. Of the eight open Tiger Team Findings, only three are environmental in nature. Finding Air/BMPF-2 addressed siting of ambient air stations with corrective actions completed in 1993 and evidence was submitted for closure. Finding SW/CF-2 required installation of chemical storage buildings with the units installed by the end of 1993. The finding will be submitted for closure after the units are connected to the Plant's fire alarm system. Finding WM/CF-4 addressed the RCRA closure of Buildings 11-44 and 12-43 sites.

Partial closure was achieved. Negotiations were started with TNRCC to add these sites to the Environmental Restoration program. In March 1993 a Progress Assessment Team visited Pantex as described in Section 3.4.

Permitted Facilities

Table 2.2 lists, by media, the permits issued to Pantex Plant. Table 2.2 also lists the permit applications submitted by Pantex Plant to various regulatory agencies. The permitting agencies are the TNRCC for air and the TNRCC and EPA for solid waste and water. The USACE controls permits for wetlands.

Table 2.8 Species of Concern Sighted At Pantex Plant

Species	Calendar Year Last Sighted	Federal Status	State Status
Bald eagle <i>Haliaeetus leucocephalus</i>	1993	Endangered	Endangered
Texas horned lizard <i>Phrynosoma cornutum</i>	1993	Candidate	Threatened
Ferruginous hawk <i>Buteo regalis</i>	1993	Candidate	Not listed
White-faced ibis <i>Plegadis chihi</i>	1993	Candidate	Threatened
Long-billed curlew <i>Numenius americanus</i>	1993	Candidate	Not listed
Whooping crane <i>Grus americana</i>	Unconfirmed sighting past years	Endangered	Endangered
Swift fox <i>Vulpes velox</i>	1970	Candidate	Not listed

Section 3

ENVIRONMENTAL PROGRAM DESCRIPTION

The environmental protection program at Pantex Plant is administered by several organizations. Mason & Hanger-Silas Mason Co., Inc. (M&H) is responsible to ensure protection of the environment. Regulatory compliance activities are described in Section 2. Monitoring activities are described in Section 3.1 with summaries of the results for 1993 provided in the remainder of this report. The U.S. Army Corps of Engineers (USACE), Tulsa District, under an Interagency Agreement serves as a DOE contractor to execute the Environmental Restoration Program as explained in Section 3.2. The active Waste Management program at Pantex is also presented in Section 3.2. The State of Texas exercises independent oversight of Pantex Plant environmental programs. DOE provides supplemental funds to the state through two programs: the Agreement in Principle (AIP) and the Grant in Aid (GIA). These programs are described in Section 3.3. Section 3.4 discusses appraisals, inspections, and assessments conducted at Pantex Plant during 1993. The Special Request Sampling Program and Occurrence Reports of an environmental nature are discussed in Sections 3.5 and 3.6, respectively.

3.1 Environmental Monitoring Program

The Environmental Monitoring Plan (EMP), as required by DOE Order 5400.1 "General Environmental Protection Program," was prepared in November 1991 and updated in July 1993. The EMP reflects the management philosophy and mission of the activities performed at Pantex Plant for the last 20 years. The underlying theme and purpose is continuous improvement of Pantex Plant activities while maintaining Plant mission issues in an environmentally protective and safe manner.

The EMP implements changes required by environmental regulations and advances in industry practices in a manner as cost efficient as is practicable.

Air, groundwater, surface water, soil, and vegetation are monitored for radiological and nonradiological constituents. The current environmental monitoring program is based on several design criteria, including regulatory requirements, potential for release, exposure pathways, and management directives. Future efforts will be directed toward defining and documenting the applicable program design rationale and criteria, and rigorously applying (with documentation) these rationale and criteria in constructing program elements, e.g., media, location, frequency, analyses, detection limits, and action levels.

The environmental monitoring program is responsible for the following:

- Establishing sampling criteria and operating guidelines for monitoring the environment at Pantex Plant and vicinity
- Collecting, analyzing, and documenting routine and special environmental samples and measurements
- Conducting radiological and nonradiological monitoring in accordance with applicable regulations
- Evaluating and reporting environmental data
- Applying appropriate quality assurance and quality control to environmental monitoring activities

- Estimating the amount of radionuclides released to air, water, and soil from routine Plant operations and evaluating via computer modeling the long-term effective dose equivalent to the public from such releases
- Publishing the Pantex Plant Annual Site Environmental Report
- Ensuring compliance with applicable DOE Orders.

Environmental monitoring consists of two major activities: effluent monitoring and environmental surveillance. Effluent monitoring for both radiological and nonradiological constituents is conducted to (1) comply with applicable federal, state, and local effluent regulations and DOE Orders and (2) provide representative measurements of the quantities and concentrations of pollutants in liquid and airborne discharges. Environmental surveillance is conducted to (1) verify compliance with applicable federal, state, and local environmental laws and regulations and (2) monitor the effects of Pantex Plant activities onsite and offsite. The active monitoring programs are discussed below and include the air, soil, vegetation, biota, meteorology, surface water, groundwater, and underground storage tank sampling activities.

Ambient air monitoring is designed to (1) establish background concentrations of chemicals released during routine Plant operations, (2) determine the concentrations of pollutants in the vicinity of the facility and at areas where public health is of concern, and (3) evaluate the effect of emissions on ambient concentrations of contaminants. Confirmatory measurements are achieved by sampling soil, vegetation, and biota.

Meteorological data are collected to support environmental monitoring and surveillance compliance activities. Data are used to define atmospheric transport and diffusion.

Surface water and groundwater quality monitoring serves to verify compliance with applicable federal and state regulations. Groundwater is monitored to determine and document possible effects of Plant operations on quality and quantity. A Groundwater Protection Management Program Plan has been developed, pursuant to Chapter III of DOE Order 5400.1, which describes the tasks necessary to develop a comprehensive groundwater management program. A four-pronged approach was developed to achieve an effective groundwater management program:

- Site characterization performed by the University of Texas at Austin Bureau of Economic Geology (TBEG)
- Routine monitoring performed by M&H
- Environmental protection achieved by continuing to modify Plant operations to approach zero discharge
- Remediation of solid waste management units via the Environmental Restoration (ER) Program implemented by the USACE.

Water monitoring has been conducted at Pantex Plant for 20 years. Groundwater and surface water samples are analyzed for a wide range of organic and inorganic chemicals as described in Sections 6 and 7, respectively. Throughout 1993 TBEG and USACE continued surface geophysical studies to gain information on the geologic conditions at Pantex Plant. In addition, a number of sampling activities were conducted by both organizations as described in Section 6.

An activity performed in addition to the monitoring requirements of DOE Order 5400.1 is the investigation of soils beneath petroleum storage tanks. Soil monitoring beneath underground petroleum storage tanks is required upon removal of a tank, in accordance with Texas Natural Resource Conservation Commission (TNRCC) regulations. Because many unforeseen delays can occur during the

Commission (TNRCC) regulations. Because many unforeseen delays can occur during the removal process, the monitoring program supports short lead-time requests to collect samples. The costs included in the budget to support this effort are based upon scheduled removals and investigating past removals where no samples were obtained.

3.2 Environmental Restoration and Waste Management Programs

The ER and Waste Management (WM) programs are described in detail in the Pantex Plant Five-Year Plan and the Pantex Plant ER/WM Site-Specific Plan. Both programs are governed by the Resource Conservation and Recovery Act (RCRA), as administered by the TNRCC and the Environmental Protection Agency (EPA).

The USACE is responsible for implementing the ER Program for the DOE under an Interagency Agreement. M&H provides oversight support to the Amarillo Area Office (AAO) for these activities. Fourteen RCRA Facility Investigations (RFIs) are to be performed to assess contamination at 144 locations. Active sampling was performed at the following sites: (1) playas and ditches, (2) gasoline leaks at Buildings 16-1 and 12-35, (3) sludge drying beds at the old sewage treatment plant, (4) Zone 12 groundwater, (5) former cooling tower, (6) the fire training area pits, (7) underground storage tanks (USTs) at other locations, (8) high priority release sites, and (9) supplemental verification sites. RFI Reports for the sludge drying beds at the old sewage treatment plant and the former cooling tower were submitted to the TNRCC.

The WM Program includes the treatment, storage, and/or disposal of all waste generated by the Plant. This is achieved via an integrated approach, which includes programs for pollution prevention awareness, waste minimization, and training. The pollution prevention awareness program is designed to develop an employee

awareness of environmental issues related to waste management. The program consists of the quarterly publication of the *Waste Minimizer* newsletter, articles in the *Pantexan* newsletter, and an employee incentive program. The waste minimization program includes a variety of program management, quality assurance, reporting, technology transfer, and computer tracking activities. Development and implementation of waste minimization techniques, with emphasis on recycling programs, is achieved via management commitment and employee awareness. All hazardous waste minimization certifications and waste reduction reports for waste generators were reported as required by RCRA. Training includes continued sessions in Occupational Safety and Health Administration worker safety (29 CFR 1910.120) and RCRA Generator Training.

3.3 State of Texas Activities

In 1989 the Secretary of Energy, in an unprecedented move, invited the host state of each DOE facility to independently determine and verify any and all Plant operational impacts to the environment. In response to this initiative, the DOE entered into an AIP with the State of Texas and also issued a GIA for hydrogeologic characterization studies.

The AIP focuses on three activities: (1) waste management, (2) emergency response, and (3) environmental monitoring. Four state agencies are involved: the Governor's Office, the TNRCC, the Texas Department of Public Safety Division of Emergency Management, and the Texas Department of Health Bureau of Radiation Control. A number of meetings were held in 1993 between the DOE and these various agencies. The DOE provided required information to the State of Texas, and the State conducted sampling and research activities.

A GIA was authorized for a hydrogeologic characterization study at the Plant with TBEG as

the lead agency. The Geosciences Department of the University of Texas at Austin and the Water Resources Center at Texas Tech University are supporting agencies.

3.4 Appraisals, Inspections, and Assessments

The Environmental Protection Program received several reviews during 1993. These reviews included a Progress Assessment Team (PAT) visit, review of the AIP management, and an official wastewater inspection by the TNRCC. In addition, a substantial self-assessment was conducted in support of the Operational Readiness Review (ORR) process for Zone 4.

The PAT visit was conducted by the DOE Office of Nuclear Safety March 15-26, 1993. This visit was a follow-up to the 1989 Tiger Team visit. Two concerns and one strength were identified. The concerns were the technical validity of monitoring procedures and the AAO day-to-day oversight of the Waste Management and Environmental Monitoring Programs. The area of strength was the subcontract analytical laboratory program. Actions were initiated immediately and completed in 1993 to revise the monitoring procedures and to implement an increased oversight program.

The AIP Implementation Review Team, led by the Office of Oversight and Self Assessment (DOE/HQ EM-20), conducted a review of the Texas AIP program activities at Amarillo and Austin, Texas on April 19-23, 1993. The review indicates that Texas has initiated several AIP program activities that are consistent with the DOE's policies to improve the DOE's accountability in the areas of environmental protection and public safety and health. The activities are also consistent with the contractual obligations of the Texas/DOE AIP.

Texas has established an organizational infrastructure to administer the State's AIP program; conducted environmental oversight and

monitoring activities, including document reviews, co-sampling, independent sampling, and monitoring system evaluations; initiated joint emergency response planning activities; and developed a public awareness program to educate the public about the purpose of the AIP and the State's involvement. Pantex Plant and Texas have made consistent and prompt joint efforts in addressing AIP issues raised by Texas.

TNRCC performed a wastewater inspection in August 1993 with no findings issued.

A significant self-assessment in support of the ORR for the Stage Right Operations in Zone 4 was performed. Twenty functional areas were identified for the M&H Operations Review conducted June 25-July 22. Seven findings were issued. All of the findings were corrected before the M&H ORR was performed. The M&H ORR was conducted from September 17-October 29 and focused on five functional areas. Three findings were identified with resolution for two being linked to the Zone 4 Environmental Assessment. The remaining finding was closed when a letter was received from TNRCC acknowledging the RCRA clean closure of Magazine 4-19B.

With respect to previous audits, inspections, and appraisals, 1993 was a productive year in closing findings. Thirteen of the eighteen "recommendations" by the Technical Safety Appraisal (January-February, 1992) were closed with significant progress made on the remaining five "recommendations." The two findings in regard to asbestos abatement compliance activities from the Air Programs Appraisal by the Albuquerque Operations Office (AL) (May 18-22, 1992) were completed by April, 1993. One finding and two observations from the Waste Management Appraisal by the AL (August 24-28, 1992) were closed and the majority of the subtasks for the other four findings and two observations were completed in 1993. One finding from the Monitoring and Air Programs-Radiation Appraisal by AL (September 14-18, 1992) was closed and activities

3.5 Special Request Sampling Program

The Special Request Sampling program has grown from 85 special sampling requests in 1992 to 101 such requests in 1993. They are taken as a check for regulatory compliance or as a response to a special event or investigation.

Fifty-two of the requests were in support of the ER/WM Programs. The ER Program had 29 requests ranging from co-sampling with the USACE, UST sampling, and sampling for waste characterization. The WM Program was supported with 23 sampling requests ranging from effluent monitoring from production buildings to sampling containerized waste. The AIP/GIA Program was supported with five co-sampling requests.

Four of the special request samples were for quality control purposes. This activity utilizes an outside contract to provide samples with a known concentration of the several constituents of interest. The DOE Environmental Measurements Laboratory then sends the specially identified samples with known concentrations to be analyzed. These samples are assigned sample numbers and analyzed in the same manner as routine environmental samples. The results of these quality control analyses are discussed in Section 10 of this report.

The remaining 40 requests were from the Environmental Monitoring Program. Soil, water, and vegetation were sampled for 33 of the requests, while seven requests were for changes and support of the existing routine EMP. The results are presented in appropriate chapters herein.

3.6 Occurrence Reports

Three occurrence reports of an environmental nature were filed in 1993. In February 1993, between 35 and 40 gallons of gasoline were spilled during a refueling operation. Required actions were taken so that the report was closed in 1993. In March, 1993, a pH discharge limit was exceeded at the wastewater treatment plant. In addition, the occurrence report was amended 15 times when the pH discharge limit was subsequently exceeded. In August, 1993, the fire protection deluge system was accidentally activated during a thunderstorm with no environmental contaminants detected.

Juvenile Swainson's Hawks at Pantex

Section 4

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

Pantex Plant conducts an environmental monitoring program in accordance with the Department of Energy (DOE) Order 5400.1 "General Environmental Protection Program." Pantex Plant currently evaluates air, groundwater, surface water, soil, flora, and fauna samples for the following radionuclides: plutonium-239, uranium-234, uranium-238, and hydrogen-3. Results for these media are presented in separate sections of this report. Penetrating radiation levels present at the Plant are also evaluated as presented herein after discussions of radiological emissions and doses and unplanned releases.

The scientific community has defined units of measurement for reporting radioactivity and radiation levels as shown in Table 4.1. Pantex reports the results in the following radiation units: (1) the individual doses from airborne emissions of radionuclides in units of millirem per year (mrem/yr) or millisievert per year (mSv/yr), (2) population doses in units of person-rem/yr or person-Sv/yr, (3) penetrating radiation measurements in units of millirem, (4) radioactivity measurements from air and water samples in terms of microcuries per milliliter ($\mu\text{Ci/ml}$), and (5) soil, flora, and fauna sample results in terms of microcuries per gram ($\mu\text{Ci/g}$). Separate sections list the sampling results of each currently existing monitoring program herein. The *Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December* details the raw data.

Because radionuclides in a sample randomly undergo radioactive decay, radioactivity measurements of a given sample will vary statistically. If the sample is repeatedly measured, the radiation detection instruments will register different results. Hence, the

accuracy of measured environmental concentrations depends upon counting error. Pantex Plant uses the national consensus 95-percent confidence level.

4.1 Radiological Emissions and Doses

Since no liquid effluent streams containing radioactive material have been released offsite during Plant operations in the past, the potential exposure of offsite receptors solely occurs through the air pathway.

The Environmental Protection Agency (EPA) has published regulations in 40 CFR 61 "National Emission Standards for Hazardous Air Pollutants" (NESHAP), Subpart H, which limits the allowable dose from DOE facilities via the air pathway. Subpart H imposes on all DOE facilities an allowable dose limit for any offsite individual from radioactive emissions of an annual effective dose equivalent (EDE) of 10 mrem (0.1 mSv) applicable to Pantex Plant. DOE Order 5400.5 "Radiation Protection of the Public and the Environment" also allows a dose equivalent to the public from radionuclide releases from DOE operations. DOE Order 5400.5 specifies a 100 mrem (1.0 mSv) limit from all pathways and 10 mrem (0.1 mSv) from the air pathway.

These dose values are small when compared with the average annual radiation dose from either natural background or man-made sources of radiation. The annual total dose to any citizen of the United States averages 360 mrem (3.6 mSv). Naturally occurring background radiation (i.e., the sun or materials in the earth's crust) in the entire Texas Panhandle results in an annual dose equivalent in humans of approximately 110 mrem (1.1 mSv). A typical

Table 4.1 Units for Radioactivity and Radiation Levels

Radioactivity	<ul style="list-style-type: none"> • CURIE (Ci) = 3.7E10 Disintegrations Per Second (DPS) • BECQUEREL (Bq) = 1 DPS (SI unit) 	
Radiation Levels	<ul style="list-style-type: none"> • Exposure 	ROENTGEN (R, mR) = specified amount of ionization in air
	<ul style="list-style-type: none"> • Adsorbed dose 	RAD (rad, mrad) = energy deposited in material equal to 100 ergs per gram GRAY (Gy, mGy) = energy deposited equal to 1 joule per kilogram; 1 Gy = 100 rad
	<ul style="list-style-type: none"> • Dose equivalent 	REM (rem, mrem) (Radiation Equivalent Man) = adsorbed dose multiplied by quality factor (QF) and by distribution factor (DF); corrects for relative effectiveness of different radiations for causing biological damage SIEVERT (Sv, mSv) = Gy × QF × DF; 1 Sv = 100 rem

chest x-ray provides an EDE of 10–20 mrem (0.1–2 mSv) of radioactivity. Subpart H mandates that the dose be determined by using one of three computer codes. The dose for maximally exposed individuals for 1993 from Pantex emissions was calculated by using the CAP88-PC Code. The 1993 source term consists of one radionuclide, tritium (half life of 12.3 years). The routine operations within the weapons assembly area (Zone 12 South) released approximately 0.16 curies (Ci) (6.0E9 Becquerel [Bq]) of tritium. Similarly, operations at the Burning Ground caused an estimated release of 0.14 Ci (5.33E9 Bq) tritium. The minimum distances of 1900 meters (2080 yards) ESE and 800 meters (875 yards) NE separates the

hypothetical maximally exposed individuals from the release points within Zone 12 South and the Burning Ground, respectively. Zone 12 South includes Building 12-53, Cell 12-44-1, and Cell 12-44-4. A 1990-meter distance, along an imaginary straight line, separates the closest release point (Zone 12 South) from the nearest offsite resident. The distance affects the calculated EDE at the facility's site boundary. As this distance increases, the EDE decreases. The nearest offsite neighbor's home actually lies 400 meters east-southeast further beyond the fence, but the distance was shortened for the CAP-88PC input file for the conservative estimate. Similarly, an 800-meter distance, along another imaginary straight line, separates

the release point (Burning Ground) from the nearest offsite resident. The nearest offsite neighbor's home actually lies 100 meters northeast beyond the fence, but again the distance was shortened for the CAP-88PC input file for a conservative estimate.

Pantex Plant's meteorological tower data replaced the previously used meteorological data from the National Weather Service. This change was made to use a monitoring location closer to the release points and which automatically records the average wind speed and direction every fifteen minutes in order to obtain the most representative data possible. Before the CAP88-PC model was used to compute the EDE, these parameters are incorporated into the mathematical model. This model's results indicate that the hypothetical maximally exposed individual NE would have incurred a $5.7\text{E-}5$ mrem/yr ($5.7\text{E-}7$ mSv/yr) EDE for a tritium release based on the information above; ESE, $1.3\text{E-}5$ mrem/yr ($1.3\text{E-}7$ m Sv/yr).

When the default wind rose file from EPA is used, an EDE of $6.89\text{E-}5$ mrem/yr ($6.8\text{E-}7$ mSv/yr) is calculated. Since no uranium-238 release occurred during 1993, no individual incurred a dose due to uranium-238.

The 10 mrem/yr (0.1 mSv/yr) NESHAP standard greatly exceeds both of these values. The calculated dose from the CAP88-PC only represents a potential dose. As discussed in Section 5, the air monitoring data substantiate that the dose at the indicated receptor locations would not be exceeded.

As noted in Table 4.2, during 1993 Pantex Plant had no releases of radionuclides to the ground, surface water, or groundwater. Tritium concentrations in surface water and groundwater at the Plant have historically average $<0.05\text{E-}6$ $\mu\text{Ci/ml}$ (<1850 Bq/ml), which are well below DOE Order 5400.5 "Ingested Water Derived Concentration Guide" limit of $2.0\text{E-}3$ $\mu\text{Ci/ml}$ (74 Bq/ml), and which equal the concentrations found at the control location at Bushland.

Table 4.3 lists the doses to the hypothetical maximally exposed individual and the population living within 80 kilometers (50 miles) of Pantex Plant. The term person-rem refers to the product of dose equivalent times population for the various receptor groups. The population dose was $1.02\text{E-}4$ person-rem ($1.02\text{E-}6$ person-Sv).

4.2. Unplanned Releases

No unplanned releases of radioactive material to the general public occurred at Pantex Plant during 1993.

4.3. Environmental Dosimetry

In conjunction with the Texas Department of Health-Bureau of Radiation Control (TDH-BRC), since the early 1980s the Plant has conducted an environmental dosimetry surveillance program to measure radiation levels in the site vicinity. Historically, the Pantex and TDH-BRC results have been comparable. During 1993 Pantex Plant co-sampled at nine locations, including two offsite, one onsite, and six on the perimeter fence.

Pantex Plant surveillance activities were also independently conducted at eight other offsite and six other onsite locations. The environmental dosimetry program uses thermoluminescent dosimeters (TLD) stations located mainly in areas adjacent to the air monitors as detailed in Section 5. Designations for these locations are similar to those used in the air monitoring program. For example, PA-AR-01 and PD-01 denote an "onsite" location with a co-located air monitoring station and dosimeter. OA-AR-08 and OD-08 are the designations for an "offsite" location with both an air monitoring station and dosimeter. Presently, six co-located surveillance locations are on the perimeter fence. Site designations at these locations differ from those used by the TDH-BRC only by the additional prefix "FD-".

Table 4.4 lists all surveillance locations. Figures 5.1 and 5.2 illustrate the locations of the air sampling stations. Figure 4.1 illustrates locations where both Pantex and TDH-BRC dosimeters are deployed.

The TLD uses lithium borate and calcium sulfate crystals. A hard plastic card encapsulates and

secures the four separate crystal elements adjacent to each filter. A hard plastic shell protects the card from the weather. A copper filter and/or different thicknesses of plastic selectively attenuate the various types of incident radiation. Incident ionizing radiation, which strikes the dosimeters, will create a change in the TLD crystalline structure in which the crystal

Table 4.2 Releases to Environmental Pathways During 1993

Pathway	Quantity Released	Radionuclide	Maximum Individual Dose
Surface Water/ Groundwater	0	None	0
Air	0.312 Ci (1.15E10 Bq)	Tritium	5.7E-5 mrem/yr (5.7E-7 mSv/yr)
	0	Uranium-238	0
Ground	0	None	0

Table 4.3 1993 Environmental Doses

Receptor	Dose	Comments
Maximally Exposed Individual	5.7E-5 mrem (5.7E-7 mSv)	Air Path, 800 meters northeast of HE Burning Ground (reported in annual NESHAP report)
Collective Population Dose	1.02E-4 person-rem (1.02E-6 Person-Sv)	Population of 275,000 within 80-kilometer (50-mile) radius
1993 Natural Background	88 mrem/year (0.88 mSv/year)	Penetrating Radiation as measured by TLD

Table 4.4 Thermoluminescent Dosimetry Monitoring Locations

Location ID	Description
Onsite	
PD-01	W of Water Well 17
PD-02	W of Old Water Treatment Building
PD-03	SW of Water Well 6
PD-04	Adjacent to N fence of E Side of Zone 4
PD-05	Adjacent to Pantex N fence on FM293
PD-06*	E of Building 12-42
PD-07	NE of Building 4-26, W side of Zone 4
Offsite	
OD-01	2.0 miles N of Intersection FM2373 & FM293, 3.0W, 0.2N, 0.2W
OD-02	2.0 miles N of Intersection FM2373 & FM293, 1.0W, 0.3N
OD-03	2.3 Miles N of Intersection FM2373 & FM293
OD-04*	2.0 miles N of Intersection FM2373 & FM293, 2.0E, 1.0N, 0.3W, SW Corner
OD-05	1.5 miles E of Intersection FM293 & FM2373, 0.4 Miles N
OD-06	4.1 miles E of Intersection FM2373 & US60, S fenceline
OD-08	2.3 miles S of Intersection FM2373 & US60, SE Corner of Intersection at fence
OD-09*	Intersection FM683 and US60, NW Corner
OD-10	2.2 miles N of Intersection of FM683 & FM245, N fence
OD-13	Bushland Agricultural Research Station
Fenceline	
FD-14*	0.6 mile west of intersection of FM 2373 and FM 293
FD-16*	2.1 miles west of intersection of FM 2373 and FM 293
FD-17*	Pantex West gate, barbed wire fence immediately south of large Plant sign
FD-19*	2.2 miles south of Pantex East gate on FM 2373, immediately north of RR tracks
FD-20*	0.8 mile south of Pantex East gate on FM 2373
FD-21*	2 miles north of Pantex East gate on FM 2373

* Indicates a co-sampling location with Texas Department of Health-Bureau of Radiation Control.

momentarily contains more energy than its normal state. An electric lamp anneals (or heats) the TLD crystals and frees the energy, which emerges from the crystal element as light. A photomultiplier converts the light into an amplified electrical pulse, which corresponds with the energy deposited in each crystal element. An algorithm containing correction factors is used to convert the digitized electrical pulse into a dose. The correction factors adjust for the various filter types, TLD crystal elements, and incident radiation.

Pantex Plant dosimeters are changed after every quarter and a UD710 reader processes the TLDs. Table 4.5 lists the results. The readings combine the "shallow" beta and "penetrating" gamma doses and reveal the dose that tissues at or near the skin surface absorb. These doses exemplify what a citizen might incur by standing at the location for a full quarter of a year. The average of the measured doses statistically varies (within an acceptable range) from the average of historical values acquired during previous years.

Figure 4.1 Locations of Texas Department of Health-Bureau of Radiation Control Thermoluminescent Detectors in the Vicinity of Pantex.

Table 4.5 Environmental Doses (mrem) from Thermoluminescent Dosimetry Badges

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total		1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
<u>Background</u>						<u>Offsite (cont'd)</u>					
OD-13	19	27	19	23	88	OD-04*	18	31	26	24	99
						OD-05	15	24	25	24	88
<u>Onsite</u>						OD-06	19	33	31	22	105
PD-01	25	29	35	24	113	OD-08	16	32	26	22	96
PD-02	24	24	35	25	108	OD-09*	18	26	25	22	91
PD-03	26	†	†	24	50	OD-10	17	28	22	22	89
PD-04	18	28	25	23	94	<u>Fenceline Locations</u>					
PD-05	36	28	28	25	117	FD-14*	23	27	28	23	101
PD-06*	31	30	31	21	113	FD-16*	20	34	34	25	113
PD-07	36	26	25	22	109	FD-17*	25	35	30	24	114
<u>Offsite</u>						FD-19*	33	28	30	24	112
OD-01	24	27	27	21	99	FD-20*	26	30	30	25	111
OD-02	21	31	31	23	106	FD-21*	35	30	32	24	121
OD-03	22	24	26	25	97						

* Texas Department of Health-Bureau of Radiation Control and Pantex Plant sampling locations coincide.

† Damaged or lost TLD produced no data.

Table 4.6 lists the results of measured doses that Pantex Plant and the TDH-BRC obtained from the dosimeters during 1993 at the co-sampled locations. Pantex Plant results agree, within an acceptable statistical range, with those TDH-BRC obtained at the same locations.

Table 4.6 Environmental Doses (mrem) at Pantex Plant and Texas Department of Health-Bureau of Radiation Control Co-sampling Locations*

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Avg.		1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Avg.
<u>Location PD-06/10 or 29**</u>						<u>Location OD-04/4a</u>					
Pantex	31	30	31	21	28.3	Pantex	18	31	26	24	24.8
TDH-BRC	25.2	31.7	24.7	34.0	28.9	TDH-BRC	23.8	29.2	31.1	32.5	29.2
<u>Location OD-09/8a</u>						<u>Location FD-14/14a</u>					
Pantex	18	26	25	22	22.8	Pantex	23	27	28	23	25.3
TDH-BRC	23.8	29.5	24.4	31.1	27.2	TDH-BRC	27.2	32.5	25.9	35.0	30.2
<u>Location FD-16/16a</u>						<u>Location FD-17/26</u>					
Pantex	20	34	34	25	28.3	Pantex	25	35	30	24	28.5
TDH-BRC	24.8	31.9	23.8	35.5	29.0	TDH-BRC	26.6	29.6	25.6	33.5	28.8
<u>Location FD-19/19a</u>						<u>Location FD-20/20a</u>					
Pantex	33	28	26	25	28	Pantex	26	30	30	25	27.8
TDH-BRC	24.5	30.3	25.4	33.7	28.5	TDH-BRC	26.7	31.6	25.1	34.0	29.4
<u>Location FD-21/21a</u>											
Pantex	35	30	32	24	30.3			<u>Qtr.</u>			<u>Total</u>
TDH-BRC	26.0	30.0	25.1	33.8	28.7			<u>Avg.</u>			
						Pantex		27			110
						TDH-BRC		28.9			115

*TDH-BRC data taken from letter reports dated May 17, 1993; September 15, 1993; December 14, 1993; and February 15, 1994.

**Pantex identifier/TDH-BRC Identifier

Section 5

AIR MONITORING

This section presents results for radiological monitoring of air, discusses nonradiological status, and presents proposed enhancements to the program.

5.1 Routine Radiological Air Monitoring

Ten offsite air sampling locations and seven onsite locations are used in the routine radiological air monitoring and sampling program. The sites are listed in Table 5.1 and the locations are shown on Figures 5.1 and 5.2. Nine of the 10 offsite units are located within an approximate 5-mile radius of Pantex Plant. A control site, used to collect background radiation air samples, is located 34 miles west of Pantex Plant at the Bushland Agricultural Research Station (see Figure 1.1).

Meteorological data are obtained from the Pantex Plant meteorological tower located at the northeast corner of Pantex Plant.

Each monitoring site is equipped with both a low- and high-volume air sampler. The low-volume air samplers obtain gross alpha/beta samples and sample for tritiated water vapor. The high-volume air samplers collect particulate samples that are later analyzed for isotopes of uranium-234 (U-234), uranium-238 (U-238), and plutonium-239/240 (Pu-239/240); samples are collected weekly. Operational characteristics of the samplers and the temperature and relative humidity at the time of sample collection are recorded.

Each low-volume sampler contains a prefilter for gross alpha/beta screening analysis, which is placed before a silica gel column. The silica gel acts as a desiccant to remove water vapor from the airstream. Any tritiated water vapor present

in the sampled air is absorbed and recovered in analysis. Nominal airflow is 42.5 liters per minute (1.50 cubic feet per minute [cfm]). Silica gel samples are collected weekly and analyzed by an offsite laboratory.

Analysis results are converted to concentration in air by correcting for the average weight of the air sampled during the analysis period. The low-volume prefilters are delivered to an onsite laboratory for the determination of gross alpha/beta activity using a low-background proportional counting system.

The high-volume samplers are equipped with automatic flow-rate controllers and operated at a flow rate of approximately 1.1 cubic meters per minute. Particulate material is collected on 20 × 25 centimeter (8 × 10 inch) filters. The filters are changed weekly as weather permits. A weekly air sample represents about 11,400 cubic meters. Filters from each month are combined into one sample. The composite sample is sent offsite for laboratory analyses for uranium-234, uranium-238, and plutonium-239/240.

Analysis results are converted to concentration in air by dividing the reported quantity of analyte by the volume of air sampled during the analysis period. Analysis results are then compared to the Inhaled Air Derived Concentration Guide (DCG) listed in the Department of Energy (DOE) Order 5400.5 "Radiation Protection of the Public and the Environment." These values are summarized in Table 5.2. There is no DCG for gross alpha/beta activity. Gross alpha/beta measurements are compared to historical average gross alpha/beta activity at the control location at the USDA Agricultural Research Station at Bushland.

The *Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December* details the raw data. Results of analyses for tritiated water vapor in air at all locations are

summarized in graphic form. Figure 5.3 presents data for Site PA-AR-06, to be discussed later. Figures 5.4 and 5.5 present data for all other sites.

Table 5.1 Radiological Air Monitoring Sites

Location ID	Description
<u>Onsite</u>	
PA-AR-01	W of Water Well 17
PA-AR-02	W of Old Water Treatment Building
PA-AR-03	SW of Water Well 6
PA-AR-04	Adjacent to N fence of E Side of Zone 4
PA-AR-05	Adjacent to Pantex N fence on FM293
PA-AR-06	E of Building 12-42
PA-AR-07	NE of Building 4-26, W side of Zone 4
<u>Offsite</u>	
OA-AR-01	2.0 miles N of Intersection FM2373 & FM293, 3.0W, 0.2N, 0.2W
OA-AR-02	2.0 miles N of Intersection FM2373 & FM293, 1.0W, 0.3N
OA-AR-03	2.3 Miles N of Intersection FM2373 & FM293
OA-AR-04	2.0 miles N of Intersection FM2373 & FM293, 2.0E, 1.0N, 0.3W, SW Corner
OA-AR-05	1.5 miles E of Intersection FM293 & FM2373, 0.4 Miles N
OA-AR-06	4.1 miles E of Intersection FM2373 & US60, S fenceline
OA-AR-08	2.3 miles S of Intersection FM2373 & US60, SE Corner of Intersection at fence
OA-AR-09	Intersection FM683 and US60, NW corner
OA-AR-10	2.2 miles N of Intersection FM683 & FM245, N fence
OA-AR-13	Bushland Agricultural Research Station

Table 5.2 Inhaled Air Derived Concentration Guides

Radionuclide	DCG ($\mu\text{Ci/ml}$)
Tritium	1E-7
U-234	9E-14
U-238	1E-13
Pu-239/240	2E-14

Figure 5.1 Onsite Air Sampling Stations.

Figure 5.2 Offsite Air Sampling Stations.

Figure 5.3 1993 Tritium Activities at PA-AR-06.

Figure 5.4 1993 Average Offsite Tritium Activities.

Figure 5.5 1993 Average Onsite Tritium Activities.

The mean concentration at all sites is well below the DOE DCG for tritium in air ($1\text{E-}7 \mu\text{Ci/ml}$) and the concentration level for environmental compliance established by the Environmental Protection Agency (EPA) in Table 2, Appendix E, to 40 CFR 61 ($1.5\text{E-}9 \text{ Ci/m}^3$).

Table 5.3 summarizes the results of the gross alpha/beta screening analysis of the low-volume prefilters. The units are disintegrations per minute (dpm). During 1993, none of the air surveillance sites indicated gross alpha/beta activities that were elevated with respect to the historical average activity at the Bushland Agricultural Research Station control location.

Figures 5.6–5.11 summarize the 1993 air concentrations for uranium-234, uranium-238, and plutonium-239/240 for both offsite and onsite, respectively. In reviewing these graphs, extremely small concentrations are indicated and that the inherent variability of the counting process is comparable to the measurement in many cases.

The average concentrations of radionuclides in air at all 17 air surveillance locations were similar to both the historical average and the control station average. All measured concentration values were below the DCG values by several orders of magnitude. The measured concentration values were also less than the respective concentration levels for environmental compliance established by the EPA in Table 2, Appendix E, to 40 CFR 61 ($7.7\text{E-}15 \text{ Ci/m}^3$, $8.3\text{E-}15 \text{ Ci/m}^3$, and $2.0\text{E-}15 \text{ Ci/m}^3$).

Zone 12 South Tritium Surveillance. In 1993, tritium at one of 17 stations was the only radionuclide detected at levels statistically different than background. However, the amounts detected were well below the DCG for tritium. Station PA-AR-06, adjacent to Cell 12-44-1 (the structure contaminated during the unplanned release of tritium gas on May 17, 1989), recorded a maximum concentration of $5.00\text{E-}10 \mu\text{Ci/ml}$. This tritium is believed to be a result of fugitive emissions released from

residual contamination in the vicinity of Cell 12-44-1.

Concentration of tritium in air at site PA-AR-06 during 1993 is presented graphically in Figure 5.3. These values can be compared with similar data presented in the reports for 1990, 1991, and 1992. Relative peaks in tritium concentrations occur during the same seasons each year. These peaks are believed to result from meteorological factors. Although the same relative peaks occurred during 1993 as in 1989–1992, the highest measured concentration in 1993 is lower than any during the four previous years and is below the DCG for tritium.

5.2 Air Monitoring Program

Routine nonradiological ambient air monitoring was conducted at Pantex Plant during 1993 by the Texas Natural Resource Conservation Commission (TNRCC). Results of the sampling program are published in the TNRCC's *Pantex Nuclear Weapons Facility Ambient Air Monitoring* quarterly reports. In general, no significant levels of pollutants have been found. The Amarillo area is classified by the TNRCC as "Attainment" for all National Ambient Air Quality Standards except ozone, for which the area is "unclassified."

Fluoride concentration in vegetation is governed by the TNRCC Regulation III (31 TAC Chapter 113). Vegetation adjacent to the Burning Ground was sampled for fluoride during 1993. Those sampling results appear in Section 9 of this report.

5.3 Enhanced Monitoring Plan

Sixteen sites for enhanced monitoring of radionuclides are under construction at Pantex Plant (Figure 5.12). When completed in late 1994, these sites will provide even more comprehensive monitoring coverage for possible emissions of radionuclides. They will use

enhanced tritium monitoring systems currently under fabrication and high-volume samplers similar to those currently in use.

A comprehensive program of fluoride in vegetation sampling is planned for 1994. Pantex Plant has acquired an advanced analysis system for this purpose using Ion Chromatography.

Pantex Plant has consulted with chemists from the TNRCC in developing an analysis protocol which is among the most advanced available. Vegetation, which might become forage, will be sampled periodically to assure compliance with regulations and protection of public health and property.

Table 5.3 Gross Alpha and Beta Values

Site	Maximum	Gross Alpha dpm ^a		Maximum	Gross Beta dpm	
		Minimum	Average		Minimum	Average
PA-AR-01	3.94	0.44	1.58	42.27	9.66	21.63
PA-AR-02	3.90	0.02	1.74	54.38	1.80	24.33
PA-AR-03	3.39	0.00	1.66	48.64	0.00	4.61
PA-AR-04	3.21	-0.08	1.44	52.11	0.00	21.52
PA-AR-05	3.63	0.27	1.48	46.77	3.75	21.28
PA-AR-06	3.90	0.35	1.61	37.56	10.10	22.57
PA-AR-07	3.39	-0.34	1.73	57.72	-0.18	26.13
OA-AR-01	4.42	0.02	1.76	47.97	9.12	23.70
OA-AR-02	3.90	-0.09	1.18	57.32	-0.45	17.32
OA-AR-03	3.56	-0.25	1.63	56.92	1.71	22.79
OA-AR-04	3.12	0.09	1.62	55.85	9.53	24.28
OA-AR-05	4.42	0.53	1.69	58.39	11.41	25.47
OA-AR-06	3.90	0.09	1.69	65.87	9.15	24.18
OA-AR-08	3.77	0.00	1.17	39.18	0.00	17.29
OA-AR-09	3.08	0.35	1.61	51.98	8.95	21.69
OA-AR-10	3.56	-0.25	1.56	58.92	11.27	23.62
OA-AR-13	8.68	0.17	2.49	69.77	7.84	24.63

^aDisintegrations per minute.

Figure 5.6 1993 Average Offsite Uranium 234 Activities.

Figure 5.7 1993 Average Onsite Uranium 234 Activities.

Figure 5.8 1993 Average Offsite Uranium 238 Activities.

Figure 5.9 1993 Average Onsite Uranium 238 Activities.

Figure 5.10 1993 Average Offsite Plutonium 239/240 Activities.

Figure 5.11 1993 Average Onsite Plutonium 239/240 Activities.

Figure 5.12 Sites for Enhanced Monitoring of Radionuclides.

Section 6

GROUNDWATER MONITORING

Sections 6.1 and 6.2 give a brief overview of hydrologic site characterization and environmental restoration activities. Groundwater monitoring program information and 1993 results are described in Section 6.3. The 1993 results are divided into subsections describing sampling of the main Ogallala aquifer, the drinking water distribution system, and the perched groundwater. Historical trends are analyzed in Section 6.4. The 1993 data are summarized in tables in Section 6.5.

6.1 Site Characterization

The University of Texas at Austin Bureau of Economic Geology (TBEG) is conducting characterization studies for a 5-year period with total funding of approximately \$6 million. Ten of 27 technical milestones have been completed to date. Thirty-six milestone reports have been completed. Summaries of major activities are provided below.

Characterization studies have included investigations onsite and offsite. Offsite studies at nearby areas provide background data for comparison with observed conditions on the Plant. Maps of parts of the perched groundwater zone and a flow model of the water flow from the playas to the perched zone have been developed. Preliminary interpretation of the model simulations and mapping efforts indicate that the perched groundwaters do not flow offsite to the north or west. Values for hydrologic conductivity of the perching layer and the overlying zones have been developed and are being tested for verification. Preferential flow paths in the vadose were identified and are being studied. Preliminary microbiological degradation studies showed that there is a good potential for biological treatment

of organic compounds and nitrates. The geologic characterization of the subsurface at Pantex Plant has included studies of playa basin sediments; carbon-14 dating; seismic studies of the caprock, perched aquifer aquitard, and the base of the Ogallala; development of a preliminary recharge equation; and studies of flow in the unsaturated zone.

6.2 Environmental Restoration

Resource Conservation and Recovery Act Groundwater Activities. Four of the release or potential release site groupings specified in the Resource Conservation and Recovery Act (RCRA) Permit had groundwater specific activity in 1993. These include:

- Zone 12 groundwater
- Ditches and playas
- Underground storage tank (UST) investigations
- 11-14 Pond closure.

Additional monitoring wells are scheduled for drilling by U.S. Army Corps of Engineers (USACE) contractors as the RCRA Facility Investigation (RFI) program continues. Sampling of the wells installed in 1992 and 1993 by USACE personnel continued in 1993. The results verified contamination of the perched groundwater beneath Zone 12. The contaminants include high explosives, chromium, trichloroethane (TCE) and dichloroethane (DCA). The detailed analysis and reports are published separately as part of the RFI process. Monitoring by the USACE of the three Ogallala wells north of the Burning

Ground continued during 1993. The analysis results were similar to other Ogallala monitoring wells onsite and showed no indication of contamination. Additional sampling of the wells will be conducted as part of the RFI of the Burning Ground.

Unit Closure. Four perched zone groundwater monitoring wells were drilled in Zone 11 during 1992 as a part of closure activities at an inactive surface impoundment known as the 11-14 pond. Two rounds of groundwater sampling from the four wells were conducted in 1992. Four rounds of sampling were conducted in 1993. TCE and DCA were detected in the perched groundwater. TCE and DCA are also found in upgradient, downgradient, and crossgradient wells. This suggests a source other than the former 11-14 pond. No other contaminants of concern have been found. A request to include the investigations at the pond in the Zone 12 Groundwater RFI was submitted to the Texas Natural Resource Conservation Commission (TNRCC) in November 1993. A decision is pending. Quarterly sampling of the wells will continue in 1994.

Future Requirements. A draft groundwater monitoring plan for the Burning Ground was prepared for possible use in a revised RCRA permit.

6.3 Groundwater Monitoring

This section presents a program description in Section 6.3.1 and results for the routine monitoring program during 1993 in Section 6.3.2.

6.3.1 Program Description

The current network of groundwater sample sites consists of nine monitoring wells (three in the Ogallala aquifer and six in perched groundwater) and five onsite Ogallala aquifer production wells. Three onsite drinking water taps were sampled in 1993 as part of the groundwater

monitoring program. Twenty selected locations were sampled as part of the implementation of the Lead and Copper Rule of the Safe Drinking Water Act (SDWA). One offsite location is sampled monthly to provide background values. Table 6.1 lists the locations of wells sampled, dates of construction, and total depth. Figure 6.1 shows the sampling locations. These sample locations correspond to those used in past years. The frequency of sampling of monitoring wells varies monthly to quarterly for radiological and nonradiological analyses. Drinking water and production wells are sampled six times per year (bimonthly). Testing for chemical constituents in the water supply provides background values for existing compounds. The testing of production wells also serves as a secondary check against possible chemical migration into the aquifer and subsequently into the City of Amarillo's drinking water wells, which are downgradient from Pantex Plant. If contamination of the Ogallala aquifer occurred from Pantex Plant operations, it would first be discovered in the Plant's production wells. Table 6.2 lists constituents for which analysis is performed.

Data analysis is performed according to guidelines set by the Environmental Protection Agency (EPA) for RCRA-regulated facilities (EPA, 1989). A brief description of the data analysis methodology is included in this paragraph. The standard deviation is calculated using sample standard deviations for small sample groups. "No detects" are shown on the graphs as half the detection limit. In calculations with less than 15 percent "no detects," a value equal to half the detection limit was substituted for the "no detect." If the number of "no detects" was greater than 15 percent, but less than 50 percent, Cohen's Method (EPA, 1989) was used to adjust the mean and standard deviation. If the number of "no detects" was greater than 50 percent of the total samples taken or Cohen's Method was not applicable, no mean or standard deviation was calculated.

Table 6.1 Sample Location Descriptions

Pantex Sample Location ID	Date Constructed	Location/Description	Total Depth (feet)
Ogallala monitoring wells			
OM-39	10-85	NW of Playa One	707
OM-40	10-85	SW of Playa One	684
Perched zone monitoring wells			
PM-19	01-75	Playa One Test Well 1	350
PM-20	02-75	Zone 12 Test Well 2	350
PM-38	01-88	NE of Playa One	230
PM-44	07-88	UST Test Well NW of Zone 11	298
PM-45	07-88	UST Test Well N of Zone 12	275
Industrial/water supply wells			
PR-02	03-70	Production Well 15-17	847
PR-06	1942	Production Well 15-6	653
PR-16	11-70	Production Well 15-20	740
PR-18	06-66	Production Well 15-16	727
PR-41	10-85	Production Well 15-26	763
Drinking water			
DR-23		Building 12-2	
DR-28		12-6 Cafeteria	
DR-43		Firing Site One	
Offsite water supplies			
CO-33		Bushland Drinking Water

Figure 6.1 Groundwater Sampling Locations

Table 6.2 Groundwater Analytical Parameters

<u>Volatile Organics</u>	4,4'-DDE	2-Methylnaphthalene
Chloromethane	4,4'-DDD	Hexachlorocyclopentadiene
Bromomethane	Dieldrin	2,4,6-Trichlorophenol
Vinyl Chloride	alpha Endosulfan	2,4,5-Trichlorophenol
Chloroethane	beta Endosulfan	2-Chloronaphthalene
Methylene Chloride	Endosulfan sulfate	2-Nitroaniline
Acetone	Endrin	Dimethyl phthalate
Carbon Disulfide	Endrin aldehyde	Acenaphthylene
1,1-Dichloroethene	Heptachlor	3-Nitroaniline
1,1-Dichloroethane	Heptachlor epoxide	Acenaphthene
Total 1,2- Dichloroethene	PCB-1016	2,4-Dinitrophenol
Chloroform	PCB-1221	4-Nitrophenol
1,2-Dichloroethane	PCB-1232	Dibenzofuran
2-Butanone	PCB-1242	2,4-Dinitrotoluene
1,1,1-Trichloroethane	PCB-1248	2,6-Dinitrotoluene
Carbon Tetrachloride	PCB-1254	Diethylphthalate
Vinyl Acetate	PCB-1260	4-Chlorophenyl phenyl ether
Bromodichloromethane	Methoxychlor	Fluorene
1,1,2,2-Tetrachloroethane	Toxaphene	4-Nitroaniline
1,2-Dichloropropane		4,6-Dinitro-2-methylphenol
Trans-1,3-Dichloropropene	<u>Semivolatile Organics</u>	N-Nitrosodiphenylamine
Trichloroethene	Phenol	4-Bromophenyl phenyl ether
Dibromochloromethane	bis(2-Chloroethyl) ether	Hexachlorobenzene
1,1,2-Trichloroethane	2-Chlorophenol	Pentachlorophenol
Benzene	1,3-Dichlorobenzene	Phenanthrene
Cis-1,3-Dichloropropene	1,4-Dichlorobenzene	Anthracene
2-Chloroethyl Vinyl Ether	Benzyl Alcohol	Di-n-butylphthalate
Bromoform	1,2-Dichlorobenzene	Fluoranthene
2-Hexanone	2-Methylphenol	Pyrene
4-Methyl-2-Pentanone	bis(2-Chloroisopropyl)ether	Butyl benzyl phthalate
Tetrachloroethene	4-Methylphenol	3,3'-Dichlorobenzidine
Toluene	N-Nitroso-Di-N-propylamine	Benzo(a)anthracene
Chlorobenzene	Hexachloroethane	Bis(2-ethylhexyl)phthalate
Ethyl Benzene	Nitrobenzene	Chrysene
Styrene	Isophorone	Di-n-octyl phthalate
Total Xylenes	2-Nitrophenol	Benzo(b)fluoranthene
	2,4-Dimethylphenol	Benzo(k)fluoranthene
<u>Pesticides</u>	Benzoic Acid	Benzo(a)pyrene
Aldrin	bis(2-Chloroethoxy) methane	Indeno(1,2,3-cd)pyrene
alpha BHC	2,4-Dichlorophenol	Dibenz(a,h)anthracene
beta BHC	1,2,4-Trichlorobenzene	Benzo(g,h,i)pyrene
gamma BHC	Naphthalene	
delta BHC	4-Chloroaniline	<u>High Explosives</u>
Chlordane	Hexachlorobutadiene	
4,4'-DDT	4-Chloro-3-methylphenol	HMX, RDX, PETN, and TNT

Table 6.2 Groundwater Analytical Parameters, Continued

<u>Herbicides</u>	<u>Miscellaneous</u>	
2-4-D	Oil & Grease	trans-1,2-Dichloroethylene
2,4,5-TP (Silvex)	Ammonia (as N)	Ethylene Dibromide (EDB)
	Nitrite (as N)	Lindane
	Nitrate (as N)	Methoxychlor
	Orthophosphate (as P)	Tetrachloroethylene
<u>Metals</u>	Total Dissolved Solids	<u>To Be Added</u>
Barium-total	Total Suspended Solid	Aluminum
Cadmium-total	Chloride	Asbestos
Chromium-total	Cyanide-total	Antimony
Copper-total	Fluoride	Beryllium
Iron-total	Hexavalent Chromium	Nickel
Mercury-total	Sulfate (as SO ₄)	Thallium
Silver-total	Specific Conductance	Dalapon
Zinc-total	Total Organic Carbon	Dinoseb
Arsenic-total	Total Organic Halogen	Diquat
Lead-total	pH	Endothall
Selenium-total	<u>Added, 1993</u>	Glyphosate
<u>Radioactive Materials</u>	Alachlor	Oxamyl
Gross Alpha-dissolved	Aldicarb	Picloram
Gross Alpha-suspended	Aldicarb sulfoxide	Simazine
Gross Beta-dissolved	Aldicarb sulfone	Benzo(a)pyrene
Gross Beta-suspended	Atrazine	Di(2-ethylhexyl) adipate
Uranium-234-total	Carbofuran	Di(2-ethylhexyl) phthalate
Uranium-238-total	Chlordane	Hexachlorobenzene
Plutonium-239/240	Dibromochloropropane (DBCP)	Hexachlorocyclopentadiene (HEX)
Tritium-total	o-Dichlorobenzene	2,3,7,8-TCDD (dioxin)
Radium-226-total	cis-1,2-Dichloroethylene	
Radium-228-total		

The maximum and minimum are included, regardless of the percentage of "no detects". A feasibility analysis of the EPA-developed Ground Water Information Tracking System with Statistical Analysis Capability (EPA, 1992a) was initiated in 1993.

Pantex Plant is a permitted treatment, storage, and disposal (TSD) facility. On April 25, 1991, a RCRA permit was jointly issued by the State of Texas and EPA. DOE Order 5400.1, "General Environmental Protection Program," also requires that monitoring of groundwater be

conducted at DOE facilities. Where appropriate, the program must be at least as stringent as the programs described in 40 CFR 264 Subpart F (for permitted TSDs) or 265 Subpart F (interim TSDs). Groundwater monitoring at the Plant follows the guidelines required by RCRA. The current program at Pantex Plant includes sampling for the four indicator parameters prescribed by RCRA. Indicator parameters are those chemical parameters that should show a marked change if any contamination occurs. These parameters are pH, total organic carbon, total organic halogen, and conductivity. Each

sample is taken in quadruplicate. The 1993 sampling frequency was planned monthly, which is greater than the once per quarter sampling required by EPA guidance. Monthly results are averaged by quarter to achieve greater statistical control.

Groundwater sampling procedures follow guidelines found in EPA guidance documents (NWWA, 1986; EPA, 1990, 1991, 1992b). Three pore volumes of water (about 220 liters or 55 gallons) are pumped from each monitoring well to ensure that an adequate purge of standing well water has taken place. Special purging procedures have been developed for PM-106 due to the slow recharge rates in that well. The water pH, turbidity, conductivity, and temperature are monitored to determine when formation water is being pulled into the well. If these four parameters have not stabilized, additional pumping will be done until they have stabilized. Samples are taken after sufficient purging of each well.

All monitoring wells are sampled with air-operated double-acting piston pumps. These pumps were selected due to their ability to lift water from depths greater than 200 ft. The pumps are constructed so that there is no contact between the driving air and the sample to ensure that no aeration of the formation water occurs. Seven wells are currently sampled with dedicated pumps. The remaining two wells are sampled with a portable pump.

The Pantex Plant drinking water system is considered a non-transient, non-community public water supply system under the SDWA regulations. Non-transient, non-community is a category created by EPA to identify private systems that supply water to a small group of people continuously (e.g., in schools and factories). Water supplied by non-transient systems is consumed by the same group of people daily over long periods. The drinking water distribution system samples are analyzed for all of the current EPA and Texas drinking

water constituents. Additional constituents are scheduled to be added in the future. The former Texas Water Commission, now the TNRCC, performed sampling for regulatory requirements for the drinking water supply system in December 1992. All maximum contaminant levels (MCLs) were met for the results received in 1993. Pantex Plant currently samples drinking water at three locations. These are done as a best management practice and are included as part of routine groundwater sampling. Pantex Plant also obtains coliform samples at production wells and from the distribution system for regulatory compliance.

6.3.2 Results

The results from 1993 were similar to 1992. General trends are described and compared with previous data in Section 6.4 and analytical results are summarized in Section 6.5. The data used in this report have been reviewed and validated according to quality criteria described in Section 10. Analysis not meeting the quality criteria were not included in the data. *The Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December* details the raw data.

Ogallala Aquifer Water Supply Production Wells. All water supply production wells pump water from the Ogallala aquifer. The wells were sampled bimonthly and showed no reports of chemical or radiological contaminants exceeding the current MCL or the Maximum Contaminant Level Goals (MCLG) during 1993. There are naturally occurring radionuclides and metals present in the Ogallala aquifer in these wells.

Three bacteriological samples from the production wells during 1993 were positive. Positive reports were received twice from PR-02 and once from PR-16. Pursuant to TNRCC Regulations for Public Drinking Water Systems, repeat samples were taken until two consecutive samples showed negative results. One well

required three repeat samples to get two consecutive negative results. The remaining two were negative after one round of repeat sampling. Three of the water production wells are scheduled for rehabilitation.

There was no indication of contamination by high explosives, organic compounds, or radiological substances in the water supply production wells.

Ogallala Monitoring Wells. Three Ogallala aquifer monitoring wells (OM-39, OM-40, and OM-105) were sampled monthly for analyses of chemical and radiological constituents. Chemical and radiological analysis results are summarized in Section 6.4. Lead was reported at a level of 0.029 mg/l in OM-39 in July 1993. This value exceeds the drinking water action level for lead (0.015 mg/l). The seven previous and five subsequent samples from OM-39 were all below the action level for lead. The July lead result is considered an anomaly. Iron values for Ogallala monitoring wells OM-39 and OM-40 were as high as 0.72 mg/l, which are above the MCLG for iron (0.3 mg/l). These values may be attributed to well casing material in OM-39 and OM-40. OM-105 is constructed with PVC casing and did not show iron above 0.02 mg/l. A zinc concentration of 4.1 mg/l was reported in OM-39 in July 1993. The significance of this high concentration spike is unknown. A possible explanation is that some of the coating from the galvanized casing was scraped from the casing wall as the portable sample pump was lowered into the well. No biological samples were taken from the Ogallala monitoring wells. There was no indication of contamination by high explosives, organic compounds, other metals, or radiological substances in the Ogallala monitoring wells.

Offsite Ogallala Wells. Two private wells upgradient from Pantex Plant were sampled for chemical and radiological parameters in 1993. Both wells were sampled once. No unusual concentrations were seen, and there was no

evidence of contamination. Results of the analysis were furnished to the landowners.

Drinking Water Locations. Three drinking water taps onsite (DR-23, DR-28, and DR-43) were sampled bimonthly for both chemical and radioactive constituents. A fourth site, CO-33, at the USDA Agricultural Research Service Station at Bushland is used as a control site. A tap water sample is taken monthly from this site. At Pantex Plant, drinking water is 100 percent Ogallala well water produced from the production wells. The only treatment the drinking water receives is disinfection using chlorine. When drinking water analyses are compared to production well analyses, they indicate any chemical contamination that may have entered the water supply system through the water system piping or treatment.

All chemical constituents were below the MCLs. Chromium was detected in all of the drinking water samples from Pantex Plant and two of the Bushland samples. The levels detected (0.008 mg/l maximum at the Plant and 0.007 maximum mg/l at Bushland) were less than the MCL for drinking water (0.1 mg/l) and were detected near or at the limits of detection of the analysis equipment (0.005 mg/l). Mercury at the limit of detection concentrations (0.0001 mg/l) was found in one sample and at a concentration of 0.0002 mg/l in one other sample taken at Pantex Plant. These concentrations are below the MCL of 0.002 mg/l. Similar mercury and chromium concentrations are seen in the production well samples and the Ogallala monitoring wells. The source of the chromium and mercury is therefore believed to be the Ogallala aquifer and the mercury and chromium is naturally occurring.

Bromoform and dibromochloromethane were reported in DR-43 in November; Bromoform was reported in DR-23. These compounds are possible disinfection by-products formed by the reaction of chlorine with low concentrations of other organic compounds present in water.

Twenty drinking water taps were sampled for lead and copper concentrations in 1993. This sampling was required by the TNRCC as part of the implementation of the Lead Copper Rule of the SDWA. One of the 20 samples exceeded the MCL for lead. The sample location was in a newly constructed building that was not yet in use. Follow up sampling in the building was conducted that included sampling before and after flushing the water faucets. The analytical results were inconclusive due to problems with the laboratory. The water will not be used for drinking purposes until flushing and sampling indicate lower lead concentrations. The overall system met the requirements of the Lead Copper Rule. A second round of lead and copper sampling is scheduled for March 1994. The results of the March 1994 sample analysis will determine the frequency of future monitoring.

Samples were collected for the TNRCC and sent for analysis of nitrates and nitrites by their laboratory. The results indicated that the drinking water system was in compliance with the National Primary Drinking Water Regulations. Routine monitoring of the drinking water system by Plant personnel also confirmed compliance with these rules.

There was one positive occurrence of coliform in the drinking water distribution system during 1993. The location was an isolated building several miles from the main Plant system. Resampling at the sample location produced negative results. A flushing and testing program was started at the site to prevent reoccurrence. Analysis for radionuclides indicated no radioactive contamination in the drinking water system.

Perched Groundwater Monitoring Wells. A zone of perched water is located beneath the parts of the Plant production area and Playa One. As discussed in Section 6.1 studies by TBEG indicate localized recharge to this zone. Surface runoff from the buildings, streets, parking lots, and fields on the Plant accumulates

in playas. The water which is not lost to evapotranspiration can infiltrate at the playa. The perched water overlies the Ogallala and has water levels ranging from 209 ft to 280 ft below ground surface. Contaminants transported from the surface by infiltrating waters would appear in the perched water before transport into the Ogallala aquifer. Six perched groundwater wells were sampled monthly to monitor contaminant activity: PM-19, PM-20, PM-38, PM-44, PM-45 and PM-106. Well PM-106 was added to the sampling routine in June 1993. All wells were sampled for chemical and radiological constituents in 1993. The depths to water were also measured and recorded where possible.

The wells of greatest interest are PM-45 and PM-20, because several constituents were present that are not naturally occurring. These include the solvent TCE and the high explosives RDX and HMX. Analysis of PM-20 samples indicated the presence of three high explosives, two volatile compounds, and one regulated metal. Chromium has been found in all PM-20 samples taken since 1990. The concentrations in the 1993 samples ranged from 0.24 mg/l to 0.59 mg/l. These values are above the drinking water MCL (0.1 mg/l) for chromium. The reported concentrations increased steadily throughout the year. A graph of the trends is presented in Section 6.4. TCE was reported in PM-20 in seven of 10 valid VOC samples. The values detected ranged from 0.03 to 0.093 mg/l, which exceed the MCL of 0.005 mg/l. Tetrahydrofuran was reported in one sample at a concentration of 0.015 mg/l. There is no regulatory limit for tetrahydrofuran. HMX was detected at PM-20 in seven of nine valid samples. Reported values ranged from 0.024 to 0.08 mg/l. RDX was reported in eight of nine samples. The concentrations ranged from 0.49 to 1.0 mg/l. TNT was reported in one sample at a concentration of 0.035 mg/l. There are no regulatory limits for high explosives.

TCE was reported in 11 of 16 valid samples from PM-45. Concentrations ranged from 0.005 to 0.008 mg/l, which exceeded the MCL of

0.005 mg/l. Low levels of chromium were detected in eight of 16 valid samples. Concentrations ranged from 0.05 to 0.14 mg/l, which exceeds the MCL of 0.1 mg/l. Nickel was reported in 15 of 16 valid samples. The concentrations ranged from 0.10 to 0.14 mg/l, which exceeded the MCL of 0.1 mg/l. Manganese was reported in the last six of 16 samples. The concentrations reported (0.006 to 0.007 mg/l) were near the detection limits of the analytical equipment (0.005 mg/l) which does not exceed the MCLG of 0.05 mg/l. The source of these metals has not been determined. Corrosion of metal parts in the dedicated pumping system is a possible source.

In January 1993, HMX was reported in PM-19 at a concentration of 0.022 mg/l, slightly above the analytical detection limit of 0.020 mg/l. HMX was not detected in PM-19 in ten other samples.

Low levels of chromium were reported in all 11 valid samples from PM-38. The concentrations varied from 0.007 to 0.049 mg/l. RDX was reported in PM-38 at a concentration of 0.034 mg/l in February. RDX was previously reported in PM-38 in the February 1990 sample at a similar concentration (0.038 mg/l).

Thallium was added to the list of analytes in 1993. Initial analysis results showed thallium in the background samples from Bushland and in various monitoring wells. The reported concentrations were at or near the detection limit of the analysis procedure used. The detection limits used in the analysis did not conform to the detection limits specified in 40 CFR 141. A change in analytical procedures and detection limits has been requested and the concentrations of thallium, if any, will be verified after receiving analysis using the correct methods and detection limits.

Radionuclide analysis from all six wells showed no activities above historical levels. All reported concentrations were below the derived concentration guides in DOE Order 5400.5. No

biological samples were taken from the perched zone monitoring wells. Water from the perched zone would require treatment to remove organic and inorganic contaminants before it could be used as a source of drinking water.

6.4 Historical Comparisons

Quality control procedures, such as purging of wells, chain-of-custody records, and correct sampling techniques were implemented in 1989 to assure a high degree of reliability. Additional checking of reported laboratory holding times, sample recovery rates, and other procedures were implemented in 1992. Therefore, previous data comparison is limited.

Ogallala Aquifer Water Consumption Data. The trends are shown in Figure 6.2. Water pumped and not used by Pantex Plant was sold to Texas Tech University for irrigation use on their property south of the Plant.

Water Levels. The trends in water well levels are shown in Figure 6.3. Water elevations decreased slightly during 1993.

Chemical and Radiological Quality. Figure 6.4 shows zinc values from 1990 to 1993 in the Ogallala monitoring wells. The value of the spike in July 1993 was 4.1 mg/l. Zinc concentrations are monitored as a potential indication of metal corrosion within the well system.

Drinking Water Distribution System. No significant trends were noted.

Perched Zone. Analyses of water samples collected in 1990 from PM-45 showed values of chromium from 0.005 mg/l to 0.012 mg/l. In 1991 all samples from PM-45 indicated levels of chromium below detection limits. One of the 10 1992 samples indicated chromium at the detection limit of 0.005 mg/l. The remaining nine 1992 samples showed no detectable

Figure 6.2 Water Consumption.

Figure 6.3 Water Levels.

Figure 6.4 Zinc Concentration in Ogallala Wells.

chromium. In 1993, eight of 16 samples indicated Chromium at concentrations of 0.005 to 0.14 mg/l. Chromium values reported in PM-20 have increased since 1990. Figure 6.5 shows the chromium concentration trend in PM-20 during 1992–93. Chromium values in PM-38 have fluctuated since 1989. Results from 1990 were all below the MCL of 0.05 mg/l. Data from 1991 extended from this value to a maximum concentration of 0.12 mg/l. One minimum value was below the detection limit in both 1991 and 1992. The remaining 1992 values ranged from 0.017 mg/l to 0.078 mg/l. Figure 6.6 shows the chromium levels in PM-38.

The mean TCE concentration increased in PM-20 and PM-45. Analyses in 1990 indicated values of TCE ranging from 0.006 mg/l to 0.008 mg/l in six of the 11 samples taken from PM-45. Data from 1991 for TCE showed concentrations in eight of nine samples, with the highest concentration at 0.009 mg/l. The analytical detection limit for TCE is 0.005 mg/l, which is also the MCL. Both valid samples taken in 1992 showed TCE present in PM-45. Figure 6.7 shows the TCE concentrations in PM-45 during 1990–1993. In 1990, three of 11 PM-20 samples contained 1,2-dichloroethane (DCA) with the concentration ranging from 0.006 mg/l to 0.010 mg/l and a minimum detection limit of 0.005 mg/L, which is the MCL.

Figure 6.5 PM-20 Chromium Concentrations.

Figure 6.6 PM-38 Chromium Concentrations.

Analysis in 1991 indicated two samples with low levels of DCA at 0.005 mg/l and 0.006 mg/l. DCA was not detected in any 1992 or 1993 samples. Two samples showed TCE in PM-20 at the detection limit of 0.005 mg/l in 1990.

There was only one detectable value of TCE in 1991 at a concentration of 0.005 mg/l. Three of four 1992 samples showed TCE and eight of 10 1993 samples indicated TCE present. The trends of TCE concentrations in PM-20 are shown in Figure 6.8.

Figure 6.7 PM-45 TCE Concentrations.

Figure 6.8 PM-20 TCE Concentrations

Other Indicators. There are no regulatory limits for high explosives in water. RDX was found in all 11 samples collected from PM-20 in 1990. Figure 6.9 shows the RDX values for 1990–1993. It peaked in concentration in May and June 1990 with values of 2.1 mg/l and 2.4 mg/l, respectively. Other samples throughout 1991 showed RDX values between 0.73 mg/l and 1.0 mg/l. RDX was found in the 10 samples collected during 1991. These values ranged from a low 0.74 mg/l to a high 0.95 mg/l. Two of 12 samples collected in 1992 were below the detection limit of 0.020 mg/l. The remaining 10 values ranged from 0.036 mg/l to 0.92 mg/l. It is unlikely that the 1990 May and June peaks are representative values. The 1993 concentrations did not show a noticeable trend when graphed as individual values.

The mean value of RDX concentration in PM-20 increased slightly but did not return to the reported level of 1990. The mean concentration of HMX decreased slightly in 1993. One of nine samples reported TNT in 1993. In 1990 HMX was found in four of 11 samples in ranges from 0.037 mg/l to 0.083 mg/l, with a minimum detection limit of 0.020 mg/l. During 1991, HMX was found in all 10 of the samples collected. These values ranged from 0.038 mg/l to 0.057 mg/l. In 1992, nine of 12 samples contained HMX in concentrations ranging from 0.035 mg/l to 0.56 mg/l. Figure 6.10 shows the 1990–1993 average high explosive values.

Figure 6.9 PM-20 RDX Concentrations.

6.5 Summary Tables

The summary tables are on Pages 6-17 through 6-25. Abbreviations used are as follows:

BDL below detection limit
Max maximum

Min minimum
Std. Dev. standard deviation
N/A not applicable
<BG less than background

Figure 6.10 PM-20 High Explosive Concentrations.

1993 Groundwater Summary Data

Parameter	Units	Location: CD-33 (Bushland Drinking Water)						Location: DR-23 (Drinking Water 12-2)					
		Sample	No. BDL	Max	Min	Mean	Std. Dev.	Sample	No. BDL	Max	Min	Mean	Std. Dev.
Berkium -total	mg/l	12	4	0.06	<0.05	0.05	0.007	7	0	0.12	0.1	0.1	0.007
Cadmium -total	mg/l	12	12	<0.005	<0.005	--	--	7	7	<0.005	<0.005	--	--
Chromium -total	mg/l	12	6	0.007	<0.005	0.005	0.001	7	4	0.008	<0.005	--	--
Copper -total	mg/l	12	0	0.16	0.016	0.064	0.05	7	0	0.17	0.056	0.15	0.04
Iron -total	mg/l	12	0	0.16	0.01	0.05	0.04	7	3	0.05	<0.01	<0.01	0.02
Mercury -total	mg/l	12	11	0.0002	<0.0001	--	--	7	6	0.0001	<0.0001	--	--
Silver -total	mg/l	12	12	<0.005	<0.005	--	--	7	7	<0.005	<0.005	--	--
Zinc -total	mg/l	12	0	0.026	0.006	0.014	0.007	7	0	0.21	0.079	0.17	0.04
Arsenic -total	mg/l	12	11	0.006	<0.005	--	--	7	7	<0.005	<0.005	--	--
Lead -total	mg/l	12	12	<0.05	<0.005	--	--	7	6	0.017	<0.005	--	--
Selenium -total	mg/l	12	4	0.01	<0.005	0.006	0.002	7	7	<0.005	<0.005	--	--
Oil & Grease	mg/l	4	4	<1	<1	--	--	3	3	<1	<1	--	--
Ammonia (as N)	mg/l	11	11	<0.2	<0.1	--	--	7	7	<0.2	<0.2	--	--
Nitrite (as N)*	mg/l	11	11	<0.01	<0.01	--	--	7	7	<0.01	<0.01	--	--
Nitrate (as N)*	mg/l	10	0	2.04	1.2	1.6	0.3	5	0	2.06	1.1	1.5	0.4
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Total Dissolved Solids*	mg/l	8	0	410	360	365	15	5	0	320	286	301	14
Total Suspended Solids*	mg/l	8	6	12	<5	--	--	6	6	<5	<4	--	--
Chloride	mg/l	4	0	7	6	7	0.5	3	0	11	10	10	0.6
Cyanide -total	mg/l	3	3	<0.1	<0.005	--	--	3	3	<0.1	<0.005	--	--
Fluoride	mg/l	4	0	3.2	2.7	3	0.2	3	0	1.7	1.5	1.6	0.1
Hexavalent Chromium*	mg/l	2	2	<0.01	<0.01	--	--	0	N/A	N/A	N/A	--	--
Sulfate (as SO4)	mg/l	4	0	60	34	50	12	3	0	29	26	26	2
Specific Conductance	µmhos/cm	11	0	610	490	572	43	6	0	510	460	495	21
Total Organic Carbon	mg/l	7	0	6	1	3	1.6	6	1	4	<1	2.6	1.2
Total Organic Halogen*	µg/l	10	3	13	<5	6	3	6	0	20	9	16	5
pH*	pH units	12	N/A	7.5	5.6	7	0.4	6	N/A	7.3	6.4	7	0.3
HMX	mg/l	8	8	<0.020	<0.020	--	--	6	6	<0.020	<0.020	--	--
RDX	mg/l	8	8	<0.020	<0.020	--	--	6	6	<0.020	<0.020	--	--
1,2-Dichloroethane	mg/l	11	11	<0.005	<0.005	--	--	7	7	<0.005	<0.005	--	--
Trichloroethane	mg/l	11	11	<0.005	<0.005	--	--	7	7	<0.005	<0.005	--	--
Gross Alpha-dissolved	E - 09uCi/ml	12	0	12	2	6	3	5	0	10	5	7	2
Gross Alpha-suspended	E - 09uCi/ml	12	11	1	<BG	--	--	5	4	1	<BG	--	--
Gross Beta-dissolved	E - 09uCi/ml	12	0	13	5	9	2	5	0	10	7	8	1
Gross Beta-suspended	E - 09uCi/ml	12	7	2	<BG	--	--	5	3	3	<BG	--	--
Uranium-234-total	E - 09uCi/ml	12	0	5.3	3.3	4.3	0.5	5	0	4.4	3.4	4	0.4
Uranium-238-total	E - 09uCi/ml	12	0	3.3	2.3	2.8	0.3	5	0	2.2	1.8	2	0.1
Plutonium-239 + 240-total	E - 09uCi/ml	12	10	0.03	<BG	--	--	5	3	0.05	<BG	--	--
Tritium-total	E - 08uCi/ml	12	6	7.7	<BG	<BG	3.5	5	2	0.15	<BG	0.09	0.07
Radium-226-total	E - 09uCi/ml	4	1	0.4	<BG	0.1	0.2	2	0	0.2	0.2	0.2	0
Radium-228-total	E - 09uCi/ml	4	0	0.8	0.2	0.5	0.2	2	0	0.5	0.1	0.3	0.3

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data

Parameter	Units	Location: DR-28 (Drinking Water Bldg. 12-8)						Location: DR-43 (Drinking Water FS-1)					
		Samples	No. BDL	Max	Min	Mean	Std. Dev.	Samples	No. BDL	Max	Min	Mean	Std. Dev.
Barium -total	mg/l	6	0	0.11	0.1	0.11	0.005	6	0	0.11	0.09	0.1	0.007
Cadmium -total	mg/l	6	6	<0.005	<0.005	--	--	6	6	<0.005	<0.005	--	--
Chromium -total	mg/l	6	4	0.007	<0.005	--	--	6	4	0.005	<0.005	--	--
Copper -total	mg/l	6	0	0.022	0.007	0.013	0.006	6	0	0.047	0.005	0.02	0.02
Iron -total	mg/l	6	0	0.02	0.01	0.01	0.005	6	0	0.19	0.08	0.12	0.04
Mercury -total	mg/l	6	5	0.0001	<0.0001	--	--	6	6	<0.0001	<0.0001	--	--
Silver -total	mg/L	6	6	<0.005	<0.005	--	--	6	6	<0.005	<0.005	--	--
Zinc -total	mg/l	6	0	0.343	0.078	0.18	0.1	6	0	0.17	0.027	0.11	0.08
Arsenic - total	mg/l	6	6	<0.005	<0.005	--	--	6	6	<0.005	<0.005	--	--
Lead -total	mg/l	6	6	<0.05	<0.005	--	--	6	6	<0.05	<0.005	--	--
Selenium -total	mg/l	6	6	<0.005	<0.005	--	--	6	6	<0.005	<0.005	--	--
Oil & Grease	mg/l	2	2	<1	<1	--	--	2	2	<1	<1	--	--
Ammonia (as N)	mg/l	6	6	<0.2	<0.2	--	--	6	6	<0.2	<0.2	--	--
Nitrite (as N)*	mg/l	6	6	<0.01	<0.01	--	--	6	6	<0.01	<0.01	--	--
Nitrate (as N)*	mg/l	5	0	1.44	1.05	1.28	0.18	5	0	1.5	0.92	1.2	0.3
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Total Dissolved Solids*	mg/l	4	0	320	282	298	18	4	0	320	284	304	19
Total Suspended Solids*	mg/l	5	5	<5	<4	--	--	5	4	8	<4	--	--
Chloride	mg/l	2	0	10	11	11	0.7	2	0	11	10	11	0.7
Cyanide -total	mg/l	1	1	<0.2	<0.005	--	--	1	1	<0.005	<0.005	--	--
Fluoride	mg/l	2	0	1.8	1.8	1.8	0	2	0	1.7	1.7	1.7	0
Hexavalent Chromium*	mg/l	1	1	<0.01	<0.01	--	--	1	1	<0.01	<0.01	--	--
Sulfate (as SO4)	mg/l	2	0	27	27	27	0	2	0	28	28	27	1
Specific Conductance	µmhos/cm	6	0	510	460	496	18	6	0	520	450	488	28
Total Organic Carbon	mg/l	5	1	3	<1	2	1	5	1	4	<1	2	1
Total Organic Halogen*	µg/l	5	0	24	6	11	8	5	1	18	<5	9	6
pH*	pH units	6	N/A	7.4	7.1	7.2	0.1	6	N/A	7.4	5.9	7	0.6
HMX	mg/l	4	4	<0.020	<0.020	--	--	4	4	<0.020	<0.020	--	--
RDX	mg/l	4	4	<0.020	<0.020	--	--	4	4	<0.020	<0.020	--	--
1,2-Dichloroethane	mg/l	5	5	<0.005	<0.005	--	--	5	5	<0.005	<0.005	--	--
Trichloroethane	mg/l	5	5	<0.005	<0.005	--	--	5	5	<0.005	<0.005	--	--
Gross Alpha-dissolved	E - 09uCi/ml	5	0	10	4	6	2	5	0	8	6	7	0.8
Gross Alpha-suspended	E - 09uCi/ml	5	5	<BG	<BG	--	--	5	5	<BG	<BG	--	--
Gross Beta-dissolved	E - 09uCi/ml	5	0	12	7	9	2	5	0	9	7	8	0.8
Gross Beta-suspended	E - 09uCi/ml	5	0	2	1	1	0.4	5	1	3	<BG	1	1
Uranium-234-total	E - 09uCi/ml	5	0	4.9	3.9	4.4	0.4	5	0	4.9	4.1	4.4	0.3
Uranium-238-total	E - 09uCi/ml	5	0	2.5	1.7	2.1	0.3	5	0	2.2	1.9	2.1	0.1
Plutonium-239 + 240-total	E - 09uCi/ml	5	5	<BG	<BG	--	--	5	2	0.09	<BG	0.01	0.05
Tritium-total	E - 08uCi/ml	5	2	0.22	<BG	0.03	0.13	5	5	<BG	<BG	--	--
Radium-226-total	E - 09uCi/ml	2	0	0.4	0.1	0.3	0.2	2	0	0.4	0.1	0.3	0.2
Radium-228-total	E - 09uCi/ml	2	0	0.8	0.2	0.5	0.4	2	0	0.8	0.2	0.5	0.4

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data

Parameter	Units	Location: OM-39 (Ogallala Monitoring North Playa 1)						Location: OM-40 (Ogallala Monitoring SW Playa 1)					
		Samples	No. BDL	Max	Min	Mean	Std. Dev.	Samples	No. BDL	Max	Min	Mean	Std. Dev.
Barium -total	mg/l	13	0	0.16	0.12	0.14	0.01	13	0	0.16	0.13	0.14	0.008
Cadmium -total	mg/l	13	13	<0.005	<0.005	--	--	13	13	<0.005	<0.005	--	--
Chromium -total	mg/l	13	12	0.005	<0.005	--	--	13	9	0.006	<0.005	--	--
Copper -total	mg/l	13	9	0.011	<0.005	--	--	13	12	0.005	<0.005	--	--
Iron -total	mg/l	13	0	0.72	0.08	0.24	0.2	13	0	0.53	0.05	0.14	0.1
Mercury -total	mg/l	13	12	0.0003	<0.0001	--	--	12	11	0.0001	<0.0001	--	--
Silver -total	mg/l	13	13	<0.005	<0.005	--	--	13	13	<0.005	<0.005	--	--
Zinc -total	mg/l	13	0	4.1	0.57	1.1	0.1	13	0	0.09	0.03	0.04	0.02
Arsenic - total	mg/l	12	11	0.006	<0.005	--	--	13	12	0.005	<0.005	--	--
Lead -total	mg/l	13	10	0.029	<0.005	--	--	13	13	<0.005	<0.005	--	--
Selenium -total	mg/l	12	11	0.005	<0.005	--	--	13	13	<0.005	<0.005	--	--
Oil & Grease	mg/l	4	4	<1	<1	--	--	4	4	<1	<1	--	--
Ammonia (as N)	mg/l	11	11	<0.2	<0.2	--	--	13	13	<0.2	<0.1	--	--
Nitrite (as N)*	mg/l	9	8	0.08	<0.01	--	--	11	10	0.01	<0.01	--	--
Nitrate (as N)*	mg/l	5	0	1	0.3	0.7	0.3	8	0	1.6	0.94	1.1	0.2
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Total Dissolved Solids*	mg/l	10	0	300	240	268	19	10	0	310	290	301	7
Total Suspended Solids*	mg/l	11	8	8	<5	--	--	9	8	8	<5	--	--
Chloride	mg/l	5	0	11	6	9	2	4	0	9	8	9	0.6
Cyanide -total	mg/l	4	4	<0.005	<0.005	--	--	3	3	<0.005	<0.005	--	--
Fluoride	mg/l	5	0	1.8	1.4	1.6	0.2	4	0	2.3	1.8	1.9	0.3
Hexavalent Chromium*	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Sulfate (as SO ₄)	mg/l	5	0	28	8	19	9	4	0	22	18	20	2
Specific Conductance	µmhos/cm	12	0	480	390	441	33	12	0	521	400	475	33
Total Organic Carbon	mg/l	9	1	2	<1	2	0.7	13	4	4	<1	2	1
Total Organic Halogen*	µg/l	12	11	6	<3	--	--	12	10	21	<3	--	--
pH*	pH units	12	N/A	7.5	6.5	7.1	0.3	12	N/A	7.5	6.7	7.3	0.3
HMX	mg/l	11	11	<0.020	<0.020	--	--	11	11	<0.020	<0.020	--	--
RDX	mg/l	11	11	<0.020	<0.020	--	--	11	11	<0.020	<0.020	--	--
1,2-Dichloroethane	mg/l	12	12	<0.005	<0.005	--	--	12	12	<0.005	<0.005	--	--
Trichloroethane	mg/l	12	12	<0.005	<0.005	--	--	1,2	12	<0.005	<0.005	--	--
Gross Alpha-dissolved	E - 09uCi/ml	13	0	13	1	5	3	13	0	10	3	6	2
Gross Alpha-suspended	E - 09uCi/ml	13	11	1	<BG	--	--	13	12	1	<BG	--	--
Gross Beta-dissolved	E - 09uCi/ml	13	2	9	<BG	4	4	13	0	14	6	8	2
Gross Beta-suspended	E - 09uCi/ml	13	6	2	<BG	0.1	1	13	5	2	<BG	0.4	1
Uranium-234-total	E - 09uCi/ml	13	0	4.4	2.9	3.7	0.6	13	0	5.2	3.5	4.3	0.5
Uranium-238-total	E - 09uCi/ml	13	0	2.3	1.3	1.9	0.3	13	0	2.6	1.9	2.3	0.2
Plutonium-239+240-total	E - 09uCi/ml	13	9	0.02	<BG	--	--	13	9	0.06	<BG	--	--
Tritium-total	E - 08uCi/ml	13	9	0.03	<BG	--	--	13	9	0.13	<BG	--	--
Radium-226-total	E - 09uCi/ml	5	1	0.5	<BG	<BG	0.5	3	0	0.4	0.2	0.3	0.1
Radium-228-total	E - 09uCi/ml	5	0	0.7	0.1	0.4	0.2	3	0	0.5	0.2	0.4	0.2

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data													
		Location: PR-2 (Production Well 15-17)						Location: PR-6 (Production Well 15-6)					
Parameter	Units	Samples	No. BDL	Max	Min	Mean	Std. Dev.	Samples	No. BDL	Max	Min	Mean	Std. Dev.
Barium -total	mg/l	6	0	0.014	0.12	0.13	0.008	2	0	0.11	0.11	0.11	0
Cadmium -total	mg/l	5	5	<0.005	<0.005	--	--	2	2	<0.005	<0.005	--	--
Chromium -total	mg/l	6	3	0.012	<0.005	0.005	0.005	2	2	<0.005	<0.005	--	--
Copper -total	mg/l	6	4	0.008	<0.005	--	--	2	2	<0.005	<0.005	--	--
Iron -total	mg/l	6	3	0.04	<0.01	0.01	0.02	2	1	0.02	<0.01	0.02	--
Mercury -total	mg/L	5	4	0.0002	<0.0001	--	--	2	2	<0.0001	<0.0001	--	--
Silver -total	mg/l	6	6	<0.005	<0.005	--	--	2	2	<0.005	<0.005	--	--
Zinc -total	mg/l	6	3	0.007	<0.005	0.005	0.001	2	2	<0.005	<0.005	--	--
Arsenic -total	mg/l	6	6	<.01	<0.005	--	--	2	2	<0.01	<0.005	--	--
Lead -total	mg/l	6	6	<0.005	<0.005	--	--	2	2	<0.005	<0.005	--	--
Selenium -total	mg/l	6	6	<0.005	<0.005	--	--	2	2	<0.005	<0.005	--	--
Oil & Grease	mg/l	3	3	<1	<1	--	--	1	1	<1	<1	--	--
Ammonia (as N)	mg/l	6	6	<0.2	<0.1	--	--	2	2	<0.2	<0.2	--	--
Nitrite (as N)*	mg/l	5	5	<0.01	<0.005	--	--	2	2	<0.01	<0.01	--	--
Nitrate (as N)*	mg/l	4	0	5.02	0.97	3.2	2.1	2	0	5.13	5.01	5.1	0.1
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Total Dissolved Solids*	mg/l	4	0	300	282	283	16	2	0	300	290	295	5
Total Suspended Solids*	mg/l	6	6	<5	<4	--	--	2	2	<5	<5	--	--
Chloride	mg/l	3	0	11	9	10	1	1	0	12	12	12	0
Cyanide -total	mg/l	2	2	<0.005	<0.005	--	--	1	1	<0.005	<0.005	--	--
Fluoride	mg/l	3	0	1.8	1.4	1.6	0.2	1	0	2.2	2.2	2.2	0
Hexavalent Chromium*	mg/l	2	2	<0.01	<0.01	--	--	1	1	<0.01	<0.01	--	--
Sulfate (as SO4)	mg/l	3	0	20	15	17	3	1	0	26	26	26	0
Specific Conductance	µmhos/cm	6	0	488	380	450	40	2	0	480	470	475	5
Total Organic Carbon	mg/l	5	0	3	2	2	0.5	2	0	3	2	3	0.5
Total Organic Halogen*	µg/l	6	5	11	<3	--	--	2	2	<5	<5	--	--
pH*	pH units	6	N/A	7.4	6.4	6.8	0.4	6	N/A	7.2	5.8	6.5	0.1
HMX	mg/l	6	6	<0.020	<0.020	--	--	2	2	<0.020	<0.020	--	--
RDX	mg/l	6	6	<0.020	<0.020	--	--	2	2	<0.020	<0.020	--	--
1,2-Dichloroethene	mg/l	5	5	<0.005	<0.005	--	--	2	2	<0.005	<0.005	--	--
Trichloroethene	mg/l	5	5	<0.005	<0.005	--	--	2	2	<0.005	<0.005	--	--
Gross Alpha-dissolved	E - 09uCi/ml	5	0	8	1	6	3	2	1	3	<BG	1.5	--
Gross Alpha-suspended	E - 09uCi/ml	5	5	<BG	<BG	--	--	2	2	<BG	<BG	--	--
Gross Beta-dissolved	E - 09uCi/ml	5	0	9	5	7	1	2	0	3	3	3	0
Gross Beta-suspended	E - 09uCi/ml	5	5	<BG	<BG	--	--	2	0	2	1	2	0.5
Uranium-234-total	E - 09uCi/ml	5	0	4.2	3.6	3.8	0.2	2	0	3.7	2	2.9	1.1
Uranium-238-total	E - 09uCi/ml	5	0	2.1	1.6	1.9	0.2	2	0	4	2	3	1
Plutonium-239 + 240-total	E - 09uCi/ml	5	4	0.01	<BG	--	--	2	2	<BG	<BG	--	--
Tritium-total	E - 08uCi/ml	5	5	<BG	<BG	--	--	5	4	<BG	<BG	--	--
Radium-226-total	E - 09uCi/ml	3	1	0.3	<BG	0.1	0.2	1	0	0.1	0.1	0.1	0
Radium-228-total	E - 09uCi/ml	3	0	1.1	0.5	0.8	0.3	1	1	<BG	<BG	--	--

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data

		Location: PR-16 (Production Well 15-20)						Location: PR-18 (Production Well 15-18)					
		(PUMPING EQUIPMENT REMOVED FOR REPAIR)											
Parameter	Units	Samples	No. BDL	Max	Min	Mean	Std. Dev.	Samples	No. BDL	Max	Min	Mean	Std. Dev.
Barium -total	mg/l	6	0	0.1	0.09	0.1	0.05	0	--	--	--	--	--
Cadmium -total	mg/l	6	6	<0.005	<0.005	--	--	0	--	--	--	--	--
Chromium -total	mg/l	6	3	0.008	<0.005	0.005	0.0007	0	--	--	--	--	--
Copper -total	mg/l	6	1	0.076	<0.005	0.027	0.034	0	--	--	--	--	--
Iron -total	mg/l	6	0	0.08	0.01	0.03	0.03	0	--	--	--	--	--
Mercury -total	mg/l	6	5	0.0001	<0.0001	--	--	0	--	--	--	--	--
Silver -total	mg/l	6	6	<0.005	<0.005	--	--	0	--	--	--	--	--
Zinc -total	mg/l	6	2	0.011	<0.005	0.006	0.004	0	--	--	--	--	--
Arsenic - total	mg/l	6	6	<.01	<0.005	--	--	0	--	--	--	--	--
Lead -total	mg/l	6	4	0.009	<0.005	--	--	0	--	--	--	--	--
Selenium -total	mg/l	6	6	<0.005	<0.005	--	--	0	--	--	--	--	--
Oil & Grease	mg/l	3	3	<1	<1	--	--	0	--	--	--	--	--
Ammonia (as N)	mg/l	6	6	<0.2	<0.1	--	--	0	--	--	--	--	--
Nitrite (as N)*	mg/l	5	5	<0.01	<0.005	--	--	0	--	--	--	--	--
Nitrate (as N)*	mg/l	4	0	2.08	1.2	1.5	0.4	0	--	--	--	--	--
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--	--	0	--	--	--	--	--
Total Dissolved Solids*	mg/L	6	0	310	266	298	16	0	--	--	--	--	--
Total Suspended Solids*	mg/l	5	5	<5	<4	--	--	0	--	--	--	--	--
Chloride	mg/L	3	0	12	11	11	0.6	0	--	--	--	--	--
Cyanide -total	mg/l	2	2	<0.005	<0.005	--	--	0	--	--	--	--	--
Fluoride	mg/l	3	0	2.2	1.5	1.8	0.4	0	--	--	--	--	--
Hexavalent Chromium*	mg/l	2	2	<0.01	<0.01	--	--	0	--	--	--	--	--
Sulfate (as SO4)	mg/l	3	0	28	24	26	2	0	--	--	--	--	--
Specific Conductance	µmhos/cm	6	0	520	400	484	42	0	--	--	--	--	--
Total Organic Carbon	mg/l	5	1	3	<1	1.9	2	0	--	--	--	--	--
Total Organic Halogen*	µg/l	6	5	7	<3	--	--	0	--	--	--	--	--
pH*	pH units	6	N/A	7.4	6.7	7.2	0.2	0	--	--	--	--	--
HMX	mg/l	6	6	<0.020	<0.020	--	--	0	--	--	--	--	--
RDX	mg/l	6	6	<0.020	<0.020	--	--	0	--	--	--	--	--
1,2-Dichloroethane	mg/l	6	6	<0.005	<0.005	--	--	0	--	--	--	--	--
Trichloroethane	mg/l	6	6	<0.005	<0.005	--	--	0	--	--	--	--	--
Gross Alpha-dissolved	E - 09uCi/ml	6	0	9	4	7	2	0	--	--	--	--	--
Gross Alpha-suspended	E - 09uCi/ml	6	6	<BG	<BG	--	--	0	--	--	--	--	--
Gross Beta-dissolved	E - 09uCi/ml	6	0	11	7	9	2	0	--	--	--	--	--
Gross Beta-suspended	E - 09uCi/ml	5	5	<BG	<BG	--	--	0	--	--	--	--	--
Uranium-234-total	E - 09uCi/ml	6	0	5.5	1.8	4.6	1.4	0	--	--	--	--	--
Uranium-238-total	E - 09uCi/ml	6	0	2.6	1	2.2	0.6	0	--	--	--	--	--
Plutonium-239 + 240-total	E - 09uCi/ml	6	3	0.03	<BG	0.001	0.01	0	--	--	--	--	--
Tridium-total	E - 08uCi/ml	6	3	0.26	<BG	<BG	0.2	0	--	--	--	--	--
Radium-226-total	E - 09uCi/ml	3	0	0.3	0.2	0.3	0.08	0	--	--	--	--	--
Radium-228-total	E - 09uCi/ml	3	0	0.9	0.1	0.5	0.4	0	--	--	--	--	--

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data

		Location: PR-41 (Production Well 15-26)						Location: PM-19 (Perched Monitoring Northwest Plays One)					
Parameter	Units	Samples	No. BDL	Max	Min	Mean	Std. Dev.	Samples	No. BDL	Max	Min	Mean	Std. Dev.
Barium -total	mg/l	4	0	0.12	0.11	0.11	0.005	12	0	0.2	0.16	0.19	0.01
Cadmium -total	mg/l	4	4	<0.005	<0.005	--	--	12	12	<0.005	<0.005	--	--
Chromium -total	mg/l	4	3	0.005	<0.005	--	--	12	11	0.005	<0.005	--	--
Copper -total	mg/l	4	4	<0.005	<0.005	--	--	12	11	0.019	<0.005	--	--
Iron -total	mg/l	4	2	0.1	<0.01	<0.01	0.08	12	0	2.6	1.02	1.7	0.5
Mercury -total	mg/l	4	4	<0.0001	<0.0001	--	--	12	12	<0.0001	<0.0001	--	--
Silver -total	mg/l	4	4	<0.005	<0.005	--	--	12	11	0.005	<0.005	--	--
Zinc -total	mg/l	4	0	0.015	0.007	0.011	0.005	12	8	0.008	<0.005	--	--
Arsenic - total	mg/l	4	4	<0.01	<0.005	--	--	12	10	0.008	<0.005	--	--
Lead -total	mg/l	4	4	<0.005	<0.005	--	--	12	12	<0.05	<0.005	--	--
Selenium -total	mg/l	4	4	<0.005	<0.005	--	--	12	11	0.008	<0.005	--	--
Oil & Grease	mg/l	2	2	<1	<1	--	--	4	4	<1	<1	--	--
Ammonia (as N)	mg/l	4	4	<0.2	<0.2	--	--	12	12	<0.2	<0.1	--	--
Nitrite (as N)*	mg/l	4	4	<0.01	<0.01	--	--	9	9	<0.01	<0.01	--	--
Nitrate (as N)*	mg/l	3	0	1.62	1.2	1.4	0.2	7	0	1.43	1.05	1.31	0.13
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Total Dissolved Solids*	mg/l	3	0	320	290	307	15	11	0	500	440	478	20
Total Suspended Solids*	mg/l	3	3	<5	<5	--	--	11	6	8	<4	--	--
Chloride	mg/l	2	0	11	11	11	0	4	0	64	59	61	2
Cyanide -total	mg/l	2	2	<0.005	<0.005	--	--	3	3	<0.005	<0.005	--	--
Fluoride	mg/l	2	0	2.2	1.9	2.2	0.2	4	3	0.3	<0.5	--	--
Hexavalent Chromium*	mg/l	2	2	<0.01	<0.01	--	--	1	1	<0.01	<0.01	--	--
Sulfate (as SO4)	mg/l	2	0	27	25	26	1.4	4	0	40	31	36	4
Specific Conductance	µmhos/cm	4	0	490	410	458	39	12	0	820	620	760	39
Total Organic Carbon	mg/l	4	0	2	1	2	0.5	11	2	10	<1	3	4
Total Organic Halogen*	µg/l	4	3	7	<1	--	--	11	0	50	31	38	5
pH*	pH units	5	N/A	7.3	6.7	7.1	0.3	11	N/A	7	6.3	6.8	0.2
HMX	mg/l	3	3	<0.020	<0.020	--	--	11	10	0.022	<0.020	--	--
RDX	mg/l	3	3	<0.020	<0.020	--	--	11	11	<0.020	<0.020	--	--
1,2-Dichloroethane	mg/l	4	4	<0.005	<0.005	--	--	12	12	<0.005	<0.005	--	--
Trichloroethane	mg/l	4	4	<0.005	<0.005	--	--	12	12	<0.005	<0.005	--	--
Gross Alpha-dissolved	E - 09uCi/ml	3	0	14	4	8	5	12	1	8	<BG	4	2
Gross Alpha-suspended	E - 09uCi/ml	3	3	<BG	<BG	--	--	12	9	2	<BG	--	--
Gross Beta-dissolved	E - 09uCi/ml	3	0	15	7	11	4	12	0	9	4	6	2
Gross Beta-suspended	E - 09uCi/ml	3	2	1	<BG	--	--	12	9	3	<BG	--	--
Uranium-234-total	E - 09uCi/ml	3	0	15	4.4	8.3	6	12	1	1.4	<BG	0.9	0.4
Uranium-238-total	E - 09uCi/ml	3	0	15	1.8	6.4	7	12	0	0.7	0.1	0.6	0.2
Plutonium-239+240-total	E - 09uCi/ml	3	2	0.01	<BG	--	--	12	7	0.05	<BG	--	--
Tritium-total	E - 06uCi/ml	3	2	0.17	<BG	--	--	12	5	1.2	<BG	0.05	0.5
Radium-226-total	E - 09uCi/ml	1	0	0.1	0.1	0.1	0	4	3	0.1	<BG	--	--
Radium-228-total	E - 09uCi/ml	1	1	<BG	<BG	--	--	4	3	0.9	<BG	--	--

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data

Parameter	Units	Location: PM-20 (Perched Monitoring Zone 12 Sensor Bed)						Location: PM-38 (Perched Monitoring NE Playa 1)					
		Samples	No. BDL	Max	Min	Mean	Std. Dev	Samples	No. BDL	Max	Min	Mean	Std. Dev
Barium -total	mg/l	11	0	0.17	0.16	0.17	0.005	11	0	0.11	0.1	0.11	0.005
Cadmium -total	mg/l	11	11	<0.005	<0.005	--	--	11	11	<0.005	<0.005	--	--
Chromium -total	mg/l	11	0	0.594	0.24	0.45	0.1	11	0	0.048	0.008	0.024	0.01
Copper -total	mg/l	11	11	<0.005	<0.005	--	--	11	10	0.007	<0.005	--	--
Iron -total	mg/l	11	0	2.3	0.14	0.62	0.62	11	0	0.29	0.04	0.16	0.1
Mercury -total	mg/l	11	10	0.0002	<0.0001	--	--	11	10	0.0001	<0.0001	--	--
Silver -total	mg/l	11	11	<0.005	<0.005	--	--	11	11	<0.005	<0.005	--	--
Zinc -total	mg/l	11	9	0.007	<0.005	--	--	11	3	0.01	<0.005	0.008	0.001
Arsenic - total	mg/l	10	10	<0.005	<0.005	--	--	10	10	<0.005	<0.005	--	--
Lead -total	mg/l	11	11	<0.05	<0.005	--	--	11	11	<0.05	<0.005	--	--
Selenium -total	mg/l	10	10	<0.005	<0.005	--	--	10	10	<0.005	<0.005	--	--
Oil & Grease	mg/l	3	3	<1	<1	--	--	4	4	<1	<1	--	--
Ammonia (as N)	mg/l	8	8	<0.2	<0.2	--	--	10	10	<0.2	<0.2	--	--
Nitrite (as N)*	mg/l	9	7	0.01	<0.01	--	--	10	10	<0.01	<0.01	--	--
Nitrate (as N)*	mg/l	7	0	6.13	3.6	4.5	1	6	0	1.7	1.14	1.5	0.2
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Total Dissolved Solids*	mg/l	9	0	410	284	389	39	9	0	500	464	486	12
Total Suspended Solids*	mg/l	9	7	12	<4	--	--	9	8	8	<4	--	--
Chloride	mg/l	3	0	68	56	60	7	4	0	56	42	48	6
Cyanide -total	mg/l	2	2	<0.005	<0.005	--	--	3	3	<0.005	<0.005	--	--
Fluoride	mg/l	3	1	1.7	<0.5	1	0.8	3	2	0.7	<0.5	--	--
Hexavalent Chromium*	mg/l	1	0	0.44	0.44	0.44	0	2	2	<0.01	<0.01	--	--
Sulfate (as SO4)	mg/l	2	0	31	23	27	6	4	0	68	54	61	6
Specific Conductance	µmhos/cm	9	0	634	450	577	51	10	0	847	680	780	41
Total Organic Carbon	mg/l	10	2	4	<1	2	1	10	3	12	<1	3	5
Total Organic Halogen*	µg/l	9	0	101	34	58	22	10	0	32	24	27	3
pH*	pH units	12	N/A	7.5	6.7	7.2	0.2	12	N/A	7.3	6.4	6.9	0.3
HMX	mg/l	9	2	0.08	<0.02	0.04	0.03	11	11	<0.020	<0.020	--	--
RDX	mg/l	9	1	1	<0.02	0.6	0.3	11	10	0.034	<0.020	--	--
1,2-Dichloroethane	mg/l	10	10	<0.005	<0.005	--	--	10	10	<0.005	<0.005	--	--
Trichloroethane	mg/l	10	2	0.093	<0.005	0.036	0.03	10	10	<0.005	<0.005	--	--
Gross Alpha-dissolved	E - 09uCi/ml	10	0	6	2	4	1	9	0	9	2	5	2
Gross Alpha-suspended	E - 09uCi/ml	10	8	1	<BG	--	--	9	7	2	<BG	--	--
Gross Beta-dissolved	E - 09uCi/ml	10	0	9	6	7	1	9	0	18	5	10	4
Gross Beta-suspended	E - 09uCi/ml	10	2	2	<BG	1	0.8	9	5	3	<BG	--	--
Uranium-234-total	E - 09uCi/ml	10	0	3.3	2	2.8	0.4	9	0	5.5	1.5	2.2	1.2
Uranium-238-total	E - 09uCi/ml	10	0	1.8	1.2	1.5	0.2	9	0	3	0.7	1.2	0.7
Plutonium-239 + 240-total	E - 09uCi/ml	10	7	0.12	<BG	--	--	9	7	0.01	<BG	--	--
Tritium-total	E - 06uCi/ml	10	5	0.17	<BG	<BG	0.1	9	1	0.87	<BG	0.15	0.3
Radium-226-total	E - 09uCi/ml	3	0	0.2	0.1	0.1	0.08	3	0	0.1	0.1	0.1	0
Radium-228-total	E - 09uCi/ml	3	1	0.8	<BG	0.3	0.4	3	0	0.3	0.2	0.2	0.08

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data

Parameter	Units	Location: PM-44 (Perched Monitoring Bldg. 16-1)						Location: PM-45 (Perched Monitoring SE Bldg. 12-2)					
		Samples	No. BDL	Max	Min	Mean	Std. Dev.	Samples	No. BDL	Max	Min	Mean	Std. Dev.
Barium -total	mg/l	12	0	0.15	0.13	0.14	0.008	16	0	0.25	0.21	0.22	0.01
Cadmium -total	mg/l	12	12	<0.005	<0.005	--	--	16	16	<0.005	<0.005	--	--
Chromium -total	mg/l	12	11	0.005	<0.005	--	--	16	6	0.014	<0.005	<0.005	0.05
Copper -total	mg/l	12	12	<0.005	<0.005	--	--	16	15	0.008	<0.005	--	--
Iron -total	mg/l	12	1	0.08	<0.01	0.02	0.019	16	0	0.6	0.02	0.09	0.15
Mercury -total	mg/l	12	12	<0.0001	<0.0001	--	--	16	15	0.0001	<0.0001	--	--
Silver -total	mg/l	12	11	0.006	<0.005	--	--	16	15	0.015	<0.005	--	--
Zinc -total	mg/l	12	0	0.075	0.025	0.046	0.018	16	0	0.024	0.008	0.013	0.003
Arsenic - total	mg/l	11	11	<0.005	<0.005	--	--	16	15	0.005	<0.005	--	--
Lead -total	mg/l	12	12	<0.005	<0.005	--	--	16	16	<0.005	<0.005	--	--
Selenium -total	mg/l	11	11	<0.005	<0.005	--	--	16	16	<0.005	<0.005	--	--
Oil & Grease	mg/l	3	3	<1	<1	--	--	5	5	<1	<1	--	--
Ammonia (as N)	mg/l	11	11	<0.2	<0.2	--	--	16	14	21	<0.2	--	--
Nitrite (as N) *	mg/l	10	10	<0.1	<0.1	--	--	13	13	<0.01	<0.01	--	--
Nitrate (as N) *	mg/l	6	1	4.12	<0.1	1.5	1.47	9	0	3.21	1.06	1.55	0.88
Orthophosphate (as P) *	mg/l	0	N/A	N/A	N/A	--	--	0	N/A	N/A	N/A	--	--
Total Dissolved Solids *	mg/l	9	0	230	204	220	7.5	15	0	470	368	430	28
Total Suspended Solids *	mg/l	11	9	10	<4	--	--	14	14	<5	<5	--	--
Chloride	mg/l	4	2	11	<0.005	2	10	5	0	66	60	63	3
Cyanide -total	mg/l	3	3	<0.005	<0.005	--	--	3	3	<0.005	<0.005	--	--
Fluoride	mg/l	4	1	1.3	<0.1	0.8	0.6	5	0	1.2	0.9	1	0.1
Hexavalent Chromium *	mg/l	1	1	<0.01	<0.01	--	--	1	1	<0.01	<0.01	--	--
Sulfate (as SO4)	mg/l	4	2	18	<1	3	14	4	1	32	<1	12	18
Specific Conductance	µmhos/cm	12	0	392	300	355	22	12	0	772	650	712	33
Total Organic Carbon	mg/l	11	3	4	<1	2	1.5	12	3	5	<1	2	2
Total Organic Halogen *	µg/l	12	5	9	<5	--	--	12	0	16	4	10	4
pH *	pH units	12	N/A	7.7	6.3	7.1	0.39	12	N/A	7.7	6.4	7.1	0.4
HMX	mg/l	11	11	<0.020	<0.020	--	--	16	16	<0.020	<0.020	--	--
RDX	mg/l	11	11	<0.020	<0.020	--	--	16	16	<0.020	<0.020	--	--
1,2-Dichloroethane	mg/l	12	12	<0.005	<0.005	--	--	16	16	<0.005	<0.005	--	--
Trichloroethane	mg/l	12	12	<0.005	<0.005	--	--	16	5	0.008	<0.005	0.008	0.001
Gross Alpha-dissolved	E - 09uCi/ml	12	0	6	4	4.4	0.67	14	1	13	<BG	6	3
Gross Alpha-suspended	E - 09uCi/ml	12	12	<BG	<BG	--	--	14	14	<BG	<BG	--	--
Gross Beta-dissolved	E - 09uCi/ml	12	0	8	4	6.1	1.4	14	0	16	7	10	3
Gross Beta-suspended	E - 09uCi/ml	12	8	2	<BG	--	--	14	8	1	<BG	--	--
Uranium-234-total	E - 09uCi/ml	12	0	3.2	1.7	2.3	0.4	14	0	4.9	0.01	4.1	1.3
Uranium-238-total	E - 09uCi/ml	12	0	2.9	0.8	1.3	0.5	14	1	3.1	<BG	2.3	0.8
Plutonium-239 + 240-total	E - 09uCi/ml	12	6	0.03	<BG	0.001	0.02	14	10	0.07	<BG	--	--
Tritium-total	E - 08uCi/ml	12	11	0.52	<BG	--	--	14	6	0.94	<BG	0.01	0.35
Radium-226-total	E - 09uCi/ml	4	0	0.4	0.1	0.2	0.1	3	1	0.04	<BG	0.04	0.14
Radium-228-total	E - 09uCi/ml	4	1	0.4	<BG	0.2	0.2	3	0	1.8	0.2	0.8	0.9

Summary of radioactive results does not include counting error.

1993 Groundwater Summary Data						
Parameter	Units	Location: OM-105 (Ogallala Monitoring NE Zone 10)				
		Samples	No. BDL	Max	Min	Mean
Barium -total	mg/l	5	0	0.13	0.12	0.12
Cadmium -total	mg/l	5	5	<0.005	<0.005	--
Chromium -total	mg/l	5	3	0.005	<0.005	--
Copper -total	mg/l	5	5	<0.005	<0.005	--
Iron -total	mg/l	5	4	0.02	<0.01	--
Mercury -total	mg/l	5	5	<0.0001	<0.0001	--
Silver -total	mg/l	5	5	<0.005	<0.005	--
Zinc -total	mg/l	5	0	0.037	0.022	0.029
Arsenic - total	mg/l	5	5	<0.005	<0.005	--
Lead -total	mg/l	5	5	<0.005	<0.005	--
Selenium -total	mg/l	5	5	<0.005	<0.005	--
Oil & Grease	mg/l	2	2	<1	<1	--
Ammonia (as N)	mg/l	5	5	<0.2	<0.2	--
Nitrite (as N)*	mg/l	3	3	<0.01	<0.01	--
Nitrate (as N)*	mg/l	0	N/A	N/A	N/A	--
Orthophosphate (as P)*	mg/l	0	N/A	N/A	N/A	--
Total Dissolved Solids*	mg/l	5	0	280	200	251
Total Suspended Solids*	mg/l	4	4	<5	<4	--
Chloride	mg/l	2	0	8	7	7
Cyanide -total	mg/l	1	1	<0.005	<0.005	--
Fluoride	mg/l	2	0	2.2	2.1	2.2
Hexavalent Chromium*	mg/l	0	N/A	N/A	N/A	--
Sulfate (as SO ₄)	mg/l	2	0	18	18	18
Specific Conductance	µmhos/cm	5	0	500	410	459
Total Organic Carbon	mg/l	5	4	3	<1	--
Total Organic Halogen*	µg/l	5	3	7	<1	--
pH*	pH units	5	N/A	7.5	7.3	7.4
HMX	mg/l	3	3	<0.020	<0.020	--
RDX	mg/l	3	3	<0.020	<0.020	--
1,2-Dichloroethane	mg/l	4	4	<0.005	<0.005	--
Trichloroethane	mg/l	4	4	<0.005	<0.005	--
Gross Alpha-dissolved	E - 09uCi/ml	5	0	9	4	7
Gross Alpha-suspended	E - 09uCi/ml	5	5	<BG	<BG	--
Gross Beta-dissolved	E - 09uCi/ml	5	0	8	6	7
Gross Beta-suspended	E - 09uCi/ml	5	3	1	<BG	--
Uranium-234-total	E - 09uCi/ml	5	0	4.4	3	4
Uranium-238-total	E - 09uCi/ml	5	0	2.4	1.7	2.1
Plutonium-239 + 240-total	E - 09uCi/ml	5	4	0.06	<BG	--
Tritium-total	E - 08uCi/ml	5	4	0.02	<BG	--
Radium-226-total	E - 09uCi/ml	1	1	<BG	<BG	--
Radium-228-total	E - 09uCi/ml	1	0	0.2	0.2	0.2

Location: PM-106 (Patched Monitoring NE Plant)						
Samples	No. BDL	Max	Min	Mean	Std. Dev.	
6	0	0.18	0.08	0.11	0.03	
6	6	<0.005	<0.005	--	--	
6	0	0.018	0.007	0.01	0.003	
6	5	0.005	<0.005	--	--	
6	1	0.29	<0.01	0.13	0.12	
6	6	<0.0001	<0.0001	--	--	
6	6	<0.005	<0.005	--	--	
6	0	0.48	0.084	0.18	0.15	
6	6	<0.005	<0.005	--	--	
6	6	<0.05	<0.005	--	--	
6	6	<0.005	<0.005	--	--	
2	2	<1	<1	--	--	
6	6	<0.2	<0.2	--	--	
5	5	<0.01	<0.01	--	--	
1	0	3.22	3.22	3.22	0	
0	N/A	N/A	N/A	--	--	
5	0	220	152	169	86	
5	1	18	<4	8	7	
2	2	22	19	21	2	
1	1	<0.005	<0.005	--	--	
2	0	0.6	0.5	0.6	0.07	
0	N/A	N/A	N/A	--	--	
2	0	23	18	21	4	
6	0	421	280	331	42	
6	3	4	<1	1	2	
6	4	14	<3	--	--	
6	N/A	8.5	7.6	8	0.4	
2	2	<0.020	<0.020	--	--	
2	2	<0.020	<0.020	--	--	
6	6	<0.005	<0.005	--	--	
6	6	<0.005	<0.005	--	--	
5	0	3	2	3	0.5	
5	5	<BG	<BG	--	--	
5	0	8	5	6	1	
5	3	1	<BG	--	--	
5	0	1.3	0.8	1	0.2	
5	0	1.2	0.5	0.7	0.3	
5	2	0.02	<BG	0.005	0.01	
5	4	0.1	<BG	--	--	
1	0	0.1	0.1	0.1	0	
1	1	<BG	<BG	--	--	

Summary of radioactive results does not include counting error.

Collection of Surface Water at Playa One

Section 7

SURFACE WATER

The surface hydrology of Pantex Plant does not include any rivers or streams. All treated effluent from Plant activities are directed to the four onsite playas. Storm water runoff from the Plant and lands leased from Texas Tech University flows through ditches to onsite playas south, north, and west of the Plant. The treated industrial discharges from most of Zone 12 and the eastern portion of Zone 11 flow through ditches to Playa One. The runoff from western portions of Zone 11 are channeled to Playa Two. The runoff from southern portions of Zones 11 and 12 flow into Playa Four. Storm water runoff from the Burning Ground vicinity drains into Playa Three.

Samples for the surface water monitoring program are collected when flows occur and are therefore dependent on rainfall or discharge events. Sampling at the Wastewater Treatment Facility (WWTF) is conducted on a regular schedule because flows are continuous. The sampling at the WWTF is conducted in accordance with the existing Wastewater No Discharge Permit (WWDP) issued by the Texas Natural Resource Conservation Commission (TNRCC). Offsite surface water sampling is conducted at the playa at the USDA Agricultural Research Service Station at Bushland (Figure 1.1). This facility acts as a control or background point, and the data obtained are compared with Pantex Plant data to establish environmental performance criteria. Sampling site locations and identifications are given in Table 7.1 and Figures 7.1 and 7.2.

Results from radiological monitoring are presented in Section 7.1. Environmental surveillance results for discharges to the playas are discussed respective to the playa basin in Section 7.2.1. Effluent monitoring results for building discharges are discussed in Section

7.2.2. Finally, a description of the TNRCC permit is provided in Section 7.3.

7.1 Radiological Information

Radionuclide sampling is conducted monthly, subject to flow conditions, and sent to offsite laboratories for analysis. The radionuclide analyses are conducted for uranium-234, uranium-238, plutonium-239/240, radium-226, radium-228, tritium, and gross alpha/beta suspended and dissolved. These values are summarized in Appendix A.

Raw data for all sample locations are published in the *Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December*. Observed radionuclide concentrations were less than the Derived Concentration Guidelines (DCG) for ingested water in DOE Order 5400.5 "Radiation Protection of the Public and Environment." Although gross alpha/beta results are not associated with DCG values, levels observed in 1993 do not indicate that significant quantities of radionuclides exist in surface water.

7.2 Nonradiological Information

The surface water environmental surveillance program consists of monitoring WWDP locations and selected onsite and offsite locations. Permitted and selected sites are sampled for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), high explosives (HEs), herbicides, pesticides, polychlorinated biphenyls (PCBs), metals, nutrients, and other components reflecting water quality. Specific analytes are listed in Tables 7.2 and 7.3 for playas and ditches, respectively.

Table 7.1 Effluent and Surveillance Surface Water Sampling Locations

Playa Surveillance Locations	Ditches and Building Discharge Effluent Locations
Playa One	<p>Wastewater Treatment Facility Influent Lagoon Composite Sampler at Chlorinator Effluent</p> <p>Zone 12 East at Pantex Drive* Zone 12 East at Washington Drive Building 12-17 North Flume Building 12-17 South Flume Building 12-19 North Flume Building 12-19 South Flume Building 12-24N monitored at Building 12-43 Building 12-21 and 12-24N monitored at ditch NE of 12-24N</p> <p>Zone 12 West at Pantex Drive* 11-44 discharge, 50 yards northeast of Building 11-44</p> <p>Zone 12 Washington Drive at Substation</p> <p>Zone 4 East</p>
Playa Two	<p>16-1 Weir* Building 11-50 discharge North Ditch</p>
Playa Three	
Playa Four	<p>Zone 12 South Zone 11 South—west ditch* Building 11-36 ditch Zone 11 South—east ditch</p>
Pantex Lake	
Bushland Playa	

*Weir location. Indented entries are discharge locations to this ditch.

Figure 7.1 Plant-Wide Surface Water Sampling Locations

Figure 7.2 Surface Water Sampling Locations in Zones 11 and 12.

Table 7.2 Routine Monitored Parameters—Playas

<u>Volatile Organics</u>		
Chloromethane	4,4'-DDE	2-Methylnaphthalene
Bromomethane	4,4'-DDD	Hexachlorocyclopentadiene
Vinyl Chloride	Dieldrin	2,4,6-Trichlorophenol
Chloroethane	alpha Endosulfan	2,4,5-Trichlorophenol
Methylene Chloride	beta Endosulfan	2-Chloronaphthalene
Acetone	Endosulfan sulfate	2-Nitroaniline
Carbon Disulfide	Endrin	Dimethyl phthalate
1,1-Dichloroethene	Endrin aldehyde	Acenaphthylene
1,1-Dichloroethane	Heptachlor	3-Nitroaniline
Total 1,2- Dichloroethene	Heptachlor epoxide	Acenaphthene
Chloroform	PCB-1016	2,4-Dinitrophenol
1,2-Dichloroethane	PCB-1221	4-Nitrophenol
2-Butanone	PCB-1232	Dibenzofuran
1,1,1-Trichloroethane	PCB-1242	2,4-Dinitrotoluene
Carbon Tetrachloride	PCB-1248	2,6-Dinitrotoluene
Vinyl Acetate	PCB-1254	Diethylphthalate
Bromodichloromethane	PCB-1260	4-Chlorophenyl phenyl ether
1,1,2,2-Tetrachloroethane	Methoxychlor	Fluorene
1,2-Dichloropropane	Toxaphene	4-Nitroaniline
trans-1,3-Dichloropropene		4,6-Dinitro-2-methylphenenol
Trichloroethene	<u>Semivolatile Organics</u>	N-Nitrosodiphenylamine
Dibromochloromethane	Phenol	4-Bromophenyl phenyl ether
1,1,2-Trichloroethane	bis(2-Chloroethyl) ether	Hexachlorobenzene
Benzene	2-Chlorophenol	Pentachlorophenol
cis-1,3-Dichloropropene	1,3-Dichlorobenzene	Phenanthrene
2-Chloroethyl Vinyl Ether	1,4-Dichlorobenzene	Anthracene
Bromoform	Benzyl Alcohol	Di-n-butylphthalate
2-Hexanone	1,2-Dichlorobenzene	Fluoranthene
4-Methyl-2-Pentanone	2-Methylphenol	Pyrene
Tetrachloroethene	bis(2-Chloroisopropyl)ether	Butyl benzyl phthalate
Toluene	4-Methylphenol	3,3'-Dichlorobenzidine
Chlorobenzene	N-Nitroso-Di-N-propylamine	Benzo(a)anthracene
Ethyl Benzene	Hexachloroethane	bis(2-ethylhexyl)phthalate
Styrene	Nitrobenzene	Chrysene
Total Xylenes	Isophorone	Di-n-octyl phthalate
	2-Nitrophenol	Benzo(b)fluoranthene
	2,4-Dimethylphenol	Benzo(k)fluoranthene
	Benzoic Acid	Benzo(a)pyrene
<u>Pesticides</u>	bis(2-Chloroethoxy) methane	Indeno(1,2,3-cd)pyrene
Aldrin	2,4-Dichlorophenol	Dibenz(a,h)anthracene
alpha BHC	1,2,4-Trichlorobenzene	Benzo(g,h,i)pyrene
beta BHC	Naphthalene	
gamma BHC	4-Chloroaniline	
delta BHC	Hexachlorobutadiene	
Chlordane	4-Chloro-3-methylphenol	<u>High Explosives</u>
4,4'-DDT		HMX, RDX, PETN, and TNT

Table 7.2 Routine Monitored Parameters—Playas (Continued)

<u>Metals</u>	<u>Miscellaneous</u>
Barium-total	Oil & Grease
Cadmium-total	Ammonia (as N)
Chromium-total	Nitrite (as N)
Copper-total	Nitrate (as N)
Iron-total	Orthophosphate (as P)
Manganese-total	Total Dissolved Solids
Mercury-total	Total Suspended Solids
Silver-total	Chloride
Zinc-total	Cyanide-total
Arsenic-total	Fluoride
Lead-total	Hexavalent Chromium
Selenium-total	Sulfate (as SO ₄)
	Specific Conductance
<u>Radioactive Materials</u>	Total Organic Carbon
Gross Alpha-dissolved	Total Organic Halogen
Gross Alpha-suspended	pH
Gross Beta-dissolved	Temperature
Gross Beta-suspended	Turbidity
Uranium-234-total	Specific Conductance
Uranium-238-total	Dissolved Oxygen
Plutonium-239/240	Chemical Oxygen Demand
Tritium-total	Phenol
Radium-226-total	
Radium-228-total	

Table 7.3 Routine Monitored Parameters—Ditches

<u>Volatile Organics</u>	<u>High Explosives</u>	<u>Radioactive Materials</u>
Chloromethane	HMX, RDX, PETN, and TNT	Gross Alpha-dissolved
Bromomethane		Gross Alpha-suspended
Vinyl Chloride	<u>Metals</u>	Gross Beta-dissolved
Chloroethane		Gross Beta-suspended
Methylene Chloride	Aluminum-total	Uranium-234-total
Acetone	Antimony-total	Uranium-238-total
Carbon Disulfide	Arsenic-total	Plutonium-239/240
1,1-Dichloroethene	Barium-total	Tritium-total
1,1-Dichloroethane	Beryllium-total	Radium-226-total
Total 1,2- Dichloroethene	Boron-total	Radium-228-total
Chloroform	Cadmium-total	
1,2-Dichloroethane	Calcium-total	
2-Butanone	Chromium-hexavalent	<u>Miscellaneous</u>
1,1,1-Trichloroethane	Chromium-total	Oil & Grease
Carbon Tetrachloride	Cobalt-total	Ammonia (as N)
Vinyl Acetate	Copper-total	Total Dissolved Solids
Bromodichloromethane	Iron-total	Total Suspended Solid
1,1,2,2-Tetrachloroethane	Lead-total	Chloride
1,2-Dichloropropane	Magnesium-total	Hexavalent Chromium
trans-1,3-Dichloropropene	Manganese-total	Sulfate (as SO ₄)
Trichloroethene	Mercury-total	Total Organic Carbon
Dibromochloromethane	Molybdenum-total	pH
1,1,2-Trichloroethane	Nickel-total	Temperature
Benzene	Potassium-total	Chemical Oxygen Demand
cis-1,3-Dichloropropene	Scandium-total	
2-Chloroethyl Vinyl Ether	Selenium-total	
Bromoform	Silica-total	
2-Hexanone	Silver-total	
4-Methyl-2-Pentanone	Sodium-total	
Tetrachloroethene	Strontium-total	
Toluene	Thallium-total	
Chlorobenzene	Tin-total	
Ethyl Benzene	Titanium-total	
Styrene	Vanadium-total	
Total Xylenes	Zinc-total	

Sampling frequency varies due to availability of water to generate enough flow for sampling. Wastewater discharged from the WWTF is monitored closely. Data tables for sampled locations for which analytes were above detection limits are presented in Appendix A "Surface Water Results." They include minimum and maximum values, calculated means, and standard deviation. Means were calculated by

substituting the detection limit for those samples with values below the detection limit. This method overestimates the mean value and is recorded as a "less than" calculated mean. Validated data for 1993 surface water programs are provided in the *Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December*.

Results were compared to TNRCC Maximum Contaminant Levels (MCLs) when possible. When no MCL was available, the results were compared to values previously observed at Pantex Plant and which serve as a historic limit. These comparisons to historic limits were primarily for metals, HEs, and inorganic constituents. None of the historic limits has ever been recognized as an area of concern, but rather serve as a technical indicator of Plant conditions.

7.2.1 Playas and Playa Basins

Five playas are associated with Pantex Plant, four onsite and one offsite (see Figure 1.1). In addition, the Bushland Playa is sampled as a control location. A system of ditches carries the treated building discharges, WWTF-treated waters, and storm waters to Playas One, Two, and Four. Storm water runoff flows to Playa Three and Pantex Lake. Playa Three receives runoff storm water from the Burning Ground along with the runoff from agricultural lands. At this time, each of the playas and portions of the ditch system are under investigation by the U.S. Army Corps of Engineers, Tulsa District, as solid waste management units. These areas are being evaluated to determine the extent of contamination from past Pantex Plant operations.

Playa One receives treated effluent from the WWTF and remains wet all year due to the discharge. Playas Two, Three, and Four and Pantex Lake are ephemeral lakes. Although the general water quality is acceptable, it is not an appropriate measure of current Plant activities. Because materials released in the past cannot be removed from our sampling data, the effects on the current sampling program reflects both past and present operations.

7.2.1.1 Playa One Basin

Playa One receives water from five small channels, three of which are associated with Plant activities while the other two receive storm

runoff. The channel from the WWTF is the only one with continuous flow and is responsible for keeping the playa wet all year. Channels along the south edge of Playa One are WWDP Outfall 002 (Zone 12 East at Pantex Drive), WWDP Outfall 001 (discharge from WWTF), and WWDP Outfall 003 (Zone 12 West at Pantex Drive). Channels at the western edge of Playa One receive runoff from Zone 4 and the north channels receive runoff from the agricultural areas.

Playa One also receives stormwater, which is collected in a tailwater pit at the northeast boundary of the Plant. This water is pumped to the ditch adjacent to the WWTP. Samples are obtained using a composite sampler. Pesticides and HEs were not detected. With respect to metals, no previous data exists for comparison to historic limits and no MCLs were exceeded.

VOCs, SVOCs, pesticides, and PCBs were not detected in Playa One for 1993. RDX was detected at 0.038 mg/l in July of 1993. RDX was also detected in a ditch to Playa One at that time. There are no regulatory limits for high explosives in water. The pesticide 2,4-D was detected at 0.18 mg/l in May 1993. Metals and other constituents were within TNRCC MCLs or, if no MCL, then below historic limits, except for fluoride. Fluoride concentrations were equal to or greater than the MCL of 2.2 mg/l in February (2.2 mg/l), April (3.1 mg/l) and May (2.7 mg/l). This does not present a concern as the water is not used for drinking purposes.

Wastewater Treatment Facility. The wastewater treatment system consists of a lagoon divided into two treatment types: an aerated section (about 60 percent of the lagoon) and a facultative section. Aerated treatment is conducted by aerobic bacterial action and facultative treatment continues with aerobic and anaerobic bacterial action. Prior to release, the treated water is chlorinated for disinfection and retained in a chlorine contact chamber for more than 30 minutes. In accordance with state

Table 7.4 1993 Effluent pH Excursions*

Date	pH Value	Temperature (°C)
March 16	9.1	8
March 17	9.1	7
March 18	9.3	8
March 24	9.1	11
March 25	9.1	14
April 13	9.1	14
April 20	9.2	13
April 21	9.1	13
April 22	9.2	13
April 23	9.1	14
April 27	9.1	15
April 28	9.1	15
May 12	9.1	14
May 14	9.1	17
July 26	9.1	25
December 23	9.2	2

*Permit limits are pH 6.0 to pH 9.0.

requirements, chlorine residual in release waters ranges between 1 and 4 mg/l.

During 1993, pH values exceeded permit limits 16 times and remedial action was initiated. In September 1993 a sulfuric acid injection system was installed and operated to monitor and control the effluent pH. The pH limit was only exceeded once after operation began, which was due to temporary depletion of sulfuric acid. Table 7.4 lists the date and recorded pH values at the effluent point. In addition, all results for 5-day biochemical oxygen demand (BOD) and

chemical oxygen demand (COD) were met. During June and July 1993, sampling at the WWTF effluent point, toluene was detected at low levels. There was no detection within the lagoon or influent point for toluene. Selenium, lead, mercury, arsenic, chromium, cadmium, and mercury were detected but each occurred at the detection limits or below the TNRCC drinking water MCLs. No persistent problem is evident for these metals. Other sampling data were within historic limits.

Zone 12 East at Pantex Drive (Permit Location 002). Flows to this location originate in Zone 12 east (Z-12-E) and include discharges from the following buildings:

- 12-17 North
- 12-17 South
- 12-19 North
- 12-19 South
- 12-43 (filter facility for Building 12-24 North)
- 12-21 and 12-24 North (noncontact cooling waters).

These flows are monitored at the Z-12-E at Washington Drive (Z-12-E at Washington) location and discharge into Playa One.

The 1993 sampling results at Z-12-E yielded anomalous concentrations of the HEs RDX and HMX in July and August. Upstream samples did not show detections of HE for the same period, so this anomaly is considered an isolated event, and no persistent problem is evident. The concentrations were below 0.22 mg/l and 0.18 mg/l, respectively. There are no regulatory limits for high explosives in water. Permit requirements for pH and COD sampling were met. Metals and other constituents were within TNRCC MCLs or, if no MCL, then below historic limits.

Zone 12 West at Pantex Drive (Permit Location 003). The discharge from this location flows into Playa One and receives storm water and formerly received treated effluent from Building 11-44. In the absence of a storm event, water from Plant operations does not reach Playa One.

The sampling at Zone 12 West did not detect VOCs or HEs. Permit requirements for pH and COD sampling were met. Metals and other constituents were within TNRCC MCLs and/or historic limits or, if no MCL, then below historic limits.

Zone 12 at Washington Drive Substation. This location receives only storm water runoff,

and measurable flows occur infrequently. The discharge from Zone 12 at Washington Substation flows into Playa One along with the flow from the WWTF.

There were detections of lead in August 1993 at or close to the detection limits of 0.005 mg/l, but the values (0.007 and 0.005 mg/l) were well below TNRCC MCLs of 0.05 mg/l for lead. The sampling did not detect VOC or HE constituents with other constituents within the TNRCC MCLs or, if no MCL, then below historic limits.

Zone 12 East at Washington Drive. This location is directly upstream from the Z-12-E at Pantex Drive permit location and receives the same discharges. Flows come through the permitted site and continue onward to Playa One. Sampling in 1993 showed no detections of VOCs. However, the HEs RDX and HMX were detected at combined concentrations of 0.082 mg/l in June 1993. As noted in the Z-12-E discussion, the same components were detected the following month at that site. Subsequent sampling in July and August did not detect either RDX or HMX.

Metals and other constituents were within the TNRCC MCLs or, if no MCL, then below historic limits.

Zone 4 East. Flow through this channel is generated by storm water and enters Playa One along its western edge. The drained area does not contain industrial activities, so no industrial pollutants are expected to be present in the water. Sampling at this location did not detect VOCs or HEs. Metals and other constituents were within TNRCC MCLs or, if no MCL, then below historic limits.

7.2.1.2 Playa Two Basin

Playa Two receives runoff from the west side of Zone 11, north side of Zone 10, the Vehicle

Maintenance facility, and a small area of plowed fields. Monitoring activities at Playa Two are conducted at two influent points within the playa. Sampling is controlled by intermittent flow conditions as reflected by the sampling schedule. No samples were obtained from this playa other than one COD sample, which was within historic limits.

Weir 16-1 (Permit Location 004). This channel receives storm water and discharges from the Vehicle Maintenance Facility and buildings in Zone 11.

Neither VOCs or HEs were detected at this location. Permit requirements for pH and COD sampling were met. Metals and other constituents were within TNRCC MCLs or, if no MCL, then below historic limits.

North Ditch (Proposed Permit Location 005). Flows from this location are due entirely to storm water. The drainage area includes open and agricultural land from the north central portions of the Plant. Neither VOCs or HEs were detected at this location. Permit requirements for pH and COD sampling were met. Metals and other constituents were within TNRCC MCLs or, if no MCL, then below historic limits.

7.2.1.3 Playa Three Basin

Playa Three receives storm water from agricultural land and portions of the Burning Ground. As there are no well-defined channels feeding into the playa, runoff occurs primarily as sheet flow. Neither VOCs, SVOCs, HEs, pesticides, or PCBs were detected at the sample site. Texas Tech agricultural lands were sprayed with herbicide 2,4-D and a detection was noted at a concentration of 0.17 mg/l.

7.2.1.4 Playa Four Basin

Playa Four, which is owned by Texas Tech,

receives storm water and some discharges from Zone 12, which are mainly non-contact water and steam condensates. Two primary channels from the Plant area feed the playa. Additional flows to Playa Four come from the open land bounding the playa on the west, south, and east. Playa Four was dry for most of 1993. Samples taken did not detect VOCs, SVOCs, HEs, herbicides, pesticides, or PCBs. Other data collected were consistent with historic results.

Zone 12 South (Proposed Permit Location 006). Water monitored at this site flows to Playa Four and include potential building discharges from the south end of Zone 12 and storm runoff water. Neither VOCs or HEs were detected during 1993. Permit requirements for pH and COD sampling were met. Remaining analyses were within historic limits.

Zone 11 South-West Ditch. The ditch usually does not have significant flow for sampling, but when flows occur, it discharges into Playa Four. Building 11-36 discharges steam condensate to this ditch in small quantities. Enough flow is present for sampling during storm events, and neither VOCs nor HEs were detected in 1993. Other sampling data were within historic levels.

Zone 11 South-East Ditch. This location receives only storm water flow from the south end of Zone 11 so there are no industrial components. Sampling occurred when storm water was present. Results from the monitoring samples showed no detections of VOCs or HEs. All other results were within historic limits.

7.2.1.5 Pantex Lake

There is no contribution to Pantex Lake due to Plant activities because discharges have been discontinued to the playa for several years. Monitoring activities are conducted because of past uses of the lake. Currently, storm water is the only contributor to water in the lake. The area surrounding the lake is used for private

agricultural purposes. The monitoring results detected no VOCs, SVOCs, HEs, pesticides, herbicides, or PCBs. The other analyses were within historic limits.

7.2.1.6 Bushland Playa

The playa located at the USDA Agricultural Research Service Station at Bushland is sampled as a control location. Water was present in July and September, and samples were obtained. The monitoring results detected no VOCs, SVOCs, HEs, pesticides, herbicides, or PCBs. The other analyses were within historic limits.

7.2.2 Building Discharges

Surface discharges from Buildings 12-17, 12-19, 12-24, and 11-44 are mainly steam condensates and noncontact process cooling water which drain to Playa One. Waste streams from HE processes are treated by filtration prior to release. Process water from Buildings 12-24 North and 12-78 is diverted to Building 12-43 for processing before it drains to Playa One. Noncontact cooling water from 12-24 North drains to Playa One. Building 11-50 has an internal system to handle water treatment prior to release to Playa Two.

Building 12-17 North and South. Building 12-17 is located along the east side of Zone 12 and primarily discharges rainwater and steam condensate. August 1993 samples did not detect HE but did detect acetone at 0.16 mg/l. There is no persistent problem because follow-up sampling during September–December 1993 did not detect acetone again. All other analyses are within historic limits.

Building 12-19 North and South. Building 12-19 is located along the east side of Zone 12 and discharges steam condensate, noncontact cooling water, and rainwater. No detections of VOCs or HEs were made in 1993. There were detections of lead, arsenic, chromium, and

selenium at levels below the levels of maximum contaminant for metal discharges (30 Texas Administrative Code 319.22). All other analyses are within historic limits.

Building 12-43. Building 12-43 is the wastewater filtering facility for process water from Building 12-24-N and 12-78. There was one detection of the VOC tetrahydrofuran (0.62 mg/l in January). It is contained in a solvent used to repair piping into the facility and does not represent the waste stream of operations. HE components RDX and HMX were detected in July at 0.11 mg/l and in August at 0.14 mg/l. September through December sampling results did not detect these components. Chromium (0.007 mg/l) was found in March samples, and mercury (0.0002 mg/l) and arsenic (0.022 mg/l) were detected in July samples. All three metals were well below TNRCC MCLs. All other analyses are within historic limits.

Building 12-24 North. All process water from 12-24N is diverted to 12-43 for treatment. The rainfall runoff and noncontact cooling water are released to the ditch system. No detections of VOCs or HEs were made in the runoff ditch system during 1993. Other samples were within historic limits.

Building 11-44. The sampling location, which is next to Building 11-44, consists of two tanks and associated piping and pumps. Steam condensate and rainfall water are the only discharges collected in the lined ditch system. No samples were taken due to the absence of sufficient flows at this location.

Building 11-50. Building 11-50 processes HE and is located in the western portion of Zone 11. It has an internal process water treatment system for HE machining water. This facility discharges treated process water, steam condensates, and rainfall runoff. The 1993 sampling did not detect VOCs and the HE results were well within historic limits. Arsenic was detected at this site in concentrations no

greater than half of the TNRCC MCLs of 0.05 mg/l. All other analyses are within historic limits.

Building 11-36. Building 11-36 is located in the western portion of Zone 11. The only discharges during 1993 were steam condensates and rainwater. Flow conditions for this location were very modest, allowing for only one sample in June. This sample did not contain VOCs. The analysis for arsenic and selenium were at detection limits, and well below TNRCC MCLs. The HE component HMX was detected at 0.061 mg/l. All other components were within historic limits.

7.3 Texas Natural Resource Conservation Commission Wastewater No Discharge Permit

The WWDP was reissued in 1988 and regulates Pantex Plant discharges to Playas One and Two. The permit controls

1. Volumes of water discharged to Playas One and Two (average daily flow not to exceed 650,000 gallons)
2. pH of effluent between 6.0 and 9.0
3. BOD not to exceed 50 mg/l for a 30 day average or single grab sample not to exceed 150 mg/l
4. COD not to exceed 300 mg/l for any grab sample
5. Identification of four permit outfalls into Playas One and Two
 - a. WWTF outfall to Playa One (Permit location 001)
 - b. Zone 12 East at Pantex Drive (Z-12-E) outfall to Playa One (Permit Location 002)

- c. Zone 12 West at Pantex Drive (Z-12-W) outfall to Playa One (Permit Location 003)
- d. Weir 16-1, which discharges to Playa Two (Permit Location 004).

The permit locations are monitored daily. If a permit limit is exceeded, the message is immediately forwarded to the Operations Center in accordance with DOE Order 5000.3B. Verbal notice will be given to the TNRCC within 24 hours and written notice within 5 days. The only permit limit exceeded in 1993 involved the pH maximum limit of 9.0. This upper limit was exceeded 16 times during 1993. Remedial action to control the WWTF effluent pH was implemented in the form of an acid injection system at the discharge point. The limit was exceeded on December 23, 1993, after the placement of the system. The problem occurred due to temporary depletion of sulfuric acid at the controller position. Protocol for inspection of the system was modified to preclude future occurrences. Table 7.4 lists date, pH value, and temperature when the permit limit was exceeded.

An application for amendment of the WWDP to allow discharge is pending. The amended permit will contain additional requirements for water quality and include two additional permit locations. These locations are North Ditch (Proposed Permit Location 005) and Zone 12 South (Proposed Permit Location 006). For further discussion, see Section 2.

Collection of Soil Samples for Radionuclide Analysis

Section 8

SOIL

Section 8 addresses the results of the 1993 routine surface soils radionuclide monitoring program at Pantex Plant. Results for onsite and offsite monitoring are presented. During 1993 soil samples were collected at two area playas. Analytical results for radionuclides and selected metals are presented here.

8.1 Soil Monitoring Program

Routine Soil Surveillance. Environmental monitoring is an important aspect of assessing the impact of operations at a nuclear production facility such as Pantex Plant. Soil surveillance is considered to be a direct measure of environmental impact (contamination) because soil is a medium that can over time accumulate radioactive materials from airborne deposition.

Thirty-two offsite and 19 onsite soil surveillance locations were sampled during 1993. The sampling location site identifier numbers and site location descriptions are listed in Table 8.1 and illustrated in Figures 8.1 and 8.2. One of the offsite sampling stations (OS-SS-32) is located at the USDA Agricultural Research Service Station at Bushland as illustrated in Figure 1.1 and is considered the control sample.

Soil samples were collected according to sampling procedures outlined in Internal Operating Procedure D-4235 "Soil Sampling Procedures." Routine surveillance soil samples were obtained from Pullman soils (Torrertic Paleustolls). Prior to 1991 no data were published for uranium concentrations in the predominant soils of the High Plains. To characterize levels of soil radioactivity due to worldwide fallout and natural sources, 13-year averages for total uranium and 3-year averages

for uranium-234 and uranium-238 for 20 offsite sampling locations were tabulated and published by Honea and Gabocy (1991). The following ranges were established for the Pullman soils:

U-234 0.54 to 0.85×10^{-6} $\mu\text{Ci/gram dry wt.}$

U-238 0.52 to 0.89×10^{-6} $\mu\text{Ci/gram dry wt.}$

Total Uranium 0.91 to 1.24×10^{-6} $\mu\text{Ci/gram dry wt.}$

This publication will be updated during 1994 using 6-year averages (1988–1993) for uranium-234 and uranium-238 for 32 offsite sampling locations. Currently, the historical averages for the individual sample sites, 1988–1992, are used in comparisons with Pantex Plant production area soil samples to determine if uranium originating from Pantex Plant operations (i.e., not of natural origin) is present.

Onsite soil samples and the control sample at Bushland were collected monthly, and the remaining offsite soil samples were collected quarterly. Samples were collected from the surface of the ground using a 3.5-inch diameter by 2-inch-deep soil sampler. After collection, the soil samples were sent to an offsite laboratory and analyzed for uranium-234, uranium-238, and plutonium-239/240, according to procedures outlined in Section 10.

The annual summaries for uranium-234, uranium-238, and plutonium-239/240 are listed in Tables 8.2 and 8.3 for the onsite and offsite soil samples, respectively. These summary tables are based upon the raw data as published in *Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December*.

Table 8.1 Routine Onsite and Offsite Soil Sampling Locations

Sample #	Location
<u>Onsite</u>	
Burning Ground:	
BG-SS-01	330 feet NW of NW pad, 36 feet E of W fence line
BG-SS-02	150 feet NE of BG-SS-01
BG-SS-03	100 feet S of SW pad
BG-SS-04	200 feet S of SW pad
Firing Site 4:	
FA-SS-01	100 feet E of E Bunker
Firing Site 5:	
FB-SS-01	30 feet N of NW corner of bunker
FB-SS-02	130 feet N of NW corner of bunker
FB-SS-03	230 feet N of NW corner of bunker
FB-SS-04	330 feet N of NW corner of bunker
FB-SS-05	150 feet NE of NE corner of bunker
FB-SS-06	250 feet NE of NE corner of bunker
FB-SS-07	350 feet NE of NE corner of bunker
FB-SS-08	450 feet NE of NE corner of bunker
FB-SS-09	100 feet S of SW corner of bunker
Firing Site 10:	
FC-SS-01	150 feet N of N bunker
FC-SS-02	280 feet N of N bunker
FC-SS-03	400 feet N of N bunker
FC-SS-04	100 feet NE of NE corner of bunker
FC-SS-05	230 feet NE of NE corner of bunker
<u>Offsite</u>	
OS-SS-01	SW corner of intersect. of FM683 & FM293, at survey marker
OS-SS-02	0.5 miles S of intersect. of FM683 & FM293, W fence at gate
OS-SS-03	1.0 miles S of intersect. of FM683 & FM293, W fence at gate
OS-SS-04	1.5 miles S of intersect. of FM683 & FM293, W fence at gate
OS-SS-05	NW corner of intersect. of FM2373 & FM293, N fence
OS-SS-06	0.5 miles S of intersect. of FM2373 & FM293, E fence at gate
OS-SS-07	0.5 miles W of intersect. of FM2373 & FM293, N fence at gate
OS-SS-08	1.0 mile W of intersect. of FM2373 & FM293, N fence at survey marker
OS-SS-09	1.5 miles W of intersect. of FM2373 & FM293, N fence at gate
OS-SS-10	2.1 miles W of intersect. of FM2373 & FM293, fenceline W of house
OS-SS-11	1.0 mile N of intersect. of FM2373 & FM293, SE corner of intersect.
OS-SS-12	2.0 miles N of intersect. of FM2373 & FM293, 0.5 miles W, N fence
OS-SS-13	2.0 miles N of intersect. of FM2373 & FM293, 0.5 miles E, N fence at gate
OS-SS-14	2.0 miles N of intersect. of FM2373 & FM293, 1.5 miles E, N fence
OS-SS-15	2.0 miles N of intersect. of FM2373 & FM293, 2.5 miles E, S fence
OS-SS-16	2.0 miles N of intersect. of FM2373 & FM293, 3.0 miles E, SW corner at fence
OS-SS-17	1.0 mile N of intersect. of FM2373 & FM293, 0.9 miles E, S fence
OS-SS-18	1.6 miles W of intersect. of FM683 & FM245, N fence
OS-SS-19	1.0 mile W of intersect. of FM683 & FM293, N fence
OS-SS-20	0.3 mile E of intersect. of FM683 & FM293, 1.6 miles N, W fence
OS-SS-21	2.0 miles N of intersect. of FM2373 & FM293, 1.0 mile W, 0.3 miles N, E fence
OS-SS-22	2.3 miles N of intersect. of FM2373 & FM293, NW corner, (OA-3)
OS-SS-23	3.4 miles E of intersect. of FM2373 & FM293, S fence
OS-SS-24	2.0 miles S of intersect. of FM2373 & FM293, 2.0 miles E, SW corner
OS-SS-25	4.1 miles E of intersect. of FM2373 & US60, S fence (OA-6)
OS-SS-26	2.7 miles S of intersect. of US60 & FM2161, E fence at survey marker
OS-SS-27	2.4 miles S of intersect. of US60 & FM2373, SE corner at fence
OS-SS-28	1.5 miles E of intersect. of US60 & FM683, 1.0 mile S, W fence
OS-SS-29	4.2 miles S of intersect. of FM245 & FM683, fence N of R.R. tracks
OS-SS-30	2.0 miles N of intersect. of FM2373 & FM293, 2.0 E, 1.0 N, 0.3 W, NW corner
OS-SS-31	1.5 miles E of intersect. of FM2373 & FM293; 0.4 miles N, (OA-5)
OS-SS-32	Bushland Agricultural Research Station, near air monitor

Figure 8.1 Routine Onsite Pantex Plant Soil Surveillance Locations.

Figure 8.2 Routine Offsite Pantex Plant Soil Surveillance Locations.

Table 8.2 Radionuclide Activities in Onsite Soils

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average ^{1,2}
		Average	Maximum	Minimum	
BG-SS-01					
Uranium-234	13	0.40 ± 0.07	0.77 ± 0.10	0.09 ± 0.02	0.59 ± 0.14
Uranium-238	13	0.42 ± 0.07	0.82 ± 0.09	0.09 ± 0.02	0.76 ± 0.14
Plutonium-239/240	13	0.01 ± 0.01	0.05 ± 0.03	0.00 ± 0.01	0.01 ± 0.02
BG-SS-02					
Uranium-234	12	0.48 ± 0.07	1.10 ± 0.10	0.11 ± 0.02	0.58 ± 0.13
Uranium-238	12	0.45 ± 0.07	0.75 ± 0.13	0.13 ± 0.02	0.69 ± 0.14
Plutonium-239/240	12	0.01 ± 0.01	0.03 ± 0.02	0.00 ± 0.02	0.01 ± 0.02
BG-SS-03					
Uranium-234	12	0.46 ± 0.07	0.79 ± 0.11	0.11 ± 0.02	0.66 ± 0.14
Uranium-238	12	0.57 ± 0.08	1.00 ± 0.10	0.19 ± 0.03	0.82 ± 0.15
Plutonium-239/240	12	0.03 ± 0.02	0.17 ± 0.05	0.00 ± 0.01	0.01 ± 0.02
BG-SS-04					
Uranium-234	13	0.47 ± 0.07	1.00 ± 0.10	0.10 ± 0.02	0.73 ± 0.15
Uranium-238	13	0.47 ± 0.07	0.69 ± 0.10	0.10 ± 0.02	1.30 ± 0.17
Plutonium-239/240	13	0.02 ± 0.02	0.07 ± 0.05	0.00 ± 0.00	0.02 ± 0.02
FA-SS-01					
Uranium-234	13	0.83 ± 0.08	1.20 ± 0.10	0.41 ± 0.04	6.01 ± 0.64
Uranium-238	13	3.99 ± 0.22	5.49 ± 0.41	2.37 ± 0.19	44.0 ± 3.02
Plutonium-239/240	13	0.01 ± 0.01	0.04 ± 0.03	0.00 ± 0.01	0.01 ± 0.02
FB-SS-01					
Uranium-234	13	3.06 ± 0.25	12.0 ± 1.00	0.79 ± 0.07	4.06 ± 0.35
Uranium-238	13	21.4 ± 0.67	98.0 ± 1.00	0.80 ± 0.20	27.4 ± 1.17
Plutonium-239/240	13	0.00 ± 0.01	0.02 ± 0.01	0.00 ± 0.04	0.01 ± 0.02
FB-SS-02					
Uranium-234	12	1.10 ± 0.10	1.90 ± 0.10	0.64 ± 0.06	1.80 ± 0.23
Uranium-238	12	6.03 ± 0.38	11.0 ± 1.00	4.00 ± 0.10	10.0 ± 0.67
Plutonium-239/240	12	0.01 ± 0.01	0.06 ± 0.03	0.00 ± 0.01	0.01 ± 0.02
FB-SS-03					
Uranium-234	12	0.88 ± 0.09	1.70 ± 0.10	0.02 ± 0.04	1.47 ± 0.20
Uranium-238	12	4.66 ± 0.27	11.0 ± 1.00	1.07 ± 0.09	7.46 ± 0.47
Plutonium-239/240	12	0.01 ± 0.02	0.03 ± 0.01	-0.01 ± 0.03	0.02 ± 0.02

¹Activities expressed as E - 06 µCi/g.

²(±): Counting error at 95% confidence level.

Table 8.2 Radionuclide Activities in Onsite Soils (Continued)

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average
		Average	Maximum	Minimum	
FB-SS-04	13	0.86 ± 0.08	1.30 ± 0.10	0.25 ± 0.03	1.43 ± 0.20
Uranium-234	13	4.00 ± 0.20	6.10 ± 0.30	1.31 ± 0.11	6.53 ± 0.40
Uranium-238	13	0.02 ± 0.01	0.06 ± 0.05	0.00 ± 0.01	0.02 ± 0.02
Plutonium-239/240					
FB-SS-05	13	6.89 ± 1.06	67.0 ± 11.0	0.69 ± 0.06	2.10 ± 0.25
Uranium-234	13	54.1 ± 3.07	560 ± 30.0	4.30 ± 0.20	12.0 ± 0.80
Uranium-238	13	0.02 ± 0.02	0.07 ± 0.05	-0.01 ± 0.01	0.01 ± 0.02
Plutonium-239/240					
FB-SS-06	12	3.74 ± 0.19	33.0 ± 1.00	0.16 ± 0.02	1.17 ± 0.18
Uranium-234	12	8.64 ± 0.56	39.0 ± 1.00	0.30 ± 0.04	6.54 ± 0.37
Uranium-238	12	0.01 ± 0.02	0.05 ± 0.05	-0.01 ± 0.03	0.02 ± 0.02
Plutonium-239/240					
FB-SS-07	12	0.70 ± 0.09	1.10 ± 0.10	0.21 ± 0.03	1.06 ± 0.17
Uranium-234	12	2.57 ± 0.17	5.10 ± 0.20	0.96 ± 0.10	3.41 ± 0.32
Uranium-238	12	0.01 ± 0.02	0.05 ± 0.03	-0.01 ± 0.04	0.01 ± 0.02
Plutonium-239/240					
FB-SS-08	12	0.52 ± 0.07	0.94 ± 0.11	0.06 ± 0.10	0.90 ± 0.16
Uranium-234	12	1.15 ± 0.10	2.10 ± 0.20	0.09 ± 0.01	2.28 ± 0.25
Uranium-238	12	0.01 ± 0.02	0.04 ± 0.03	-0.02 ± 0.04	0.01 ± 0.02
Plutonium-239/240					
FB-SS-09	12	1.51 ± 0.12	2.10 ± 0.20	0.84 ± 0.08	3.37 ± 0.29
Uranium-234	12	9.20 ± 0.61	13.0 ± 1.00	6.69 ± 0.53	21.1 ± 1.15
Uranium-238	12	0.01 ± 0.02	0.04 ± 0.07	-0.01 ± 0.03	0.01 ± 0.02
Plutonium-239/240					
FC-SS-01	13	0.62 ± 0.08	0.89 ± 0.09	0.27 ± 0.03	0.91 ± 0.15
Uranium-234	13	1.79 ± 0.13	3.00 ± 0.20	1.00 ± 0.10	2.19 ± 0.23
Uranium-238	13	0.02 ± 0.02	0.09 ± 0.08	0.00 ± 0.04	0.02 ± 0.02
Plutonium-239/240					
FC-SS-02	12	0.51 ± 0.07	0.94 ± 0.12	0.15 ± 0.02	0.84 ± 0.15
Uranium-234	12	0.88 ± 0.08	1.50 ± 0.10	0.27 ± 0.04	1.67 ± 0.22
Uranium-238	12	0.05 ± 0.02	0.27 ± 0.04	-0.02 ± 0.04	0.02 ± 0.02
Plutonium-239/240					

Table 8.2 Radionuclide Activities in Onsite Soils (Continued)

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average
		Average	Maximum	Minimum	
FC-SS-03					
Uranium-234	12	0.46 ± 0.07	0.70 ± 0.10	0.14 ± 0.03	0.94 ± 0.17
Uranium-238	12	0.66 ± 0.08	1.10 ± 0.10	0.18 ± 0.03	1.42 ± 0.17
Plutonium-239/240	12	0.01 ± 0.02	0.04 ± 0.05	-0.02 ± 0.04	0.02 ± 0.02
FC-SS-04					
Uranium-234	12	0.86 ± 0.10	1.20 ± 0.10	0.24 ± 0.03	1.24 ± 0.17
Uranium-238	12	3.45 ± 0.21	5.70 ± 0.20	1.10 ± 0.09	4.80 ± 0.35
Plutonium-239/240	12	0.00 ± 0.02	0.05 ± 0.05	-0.01 ± 0.03	0.01 ± 0.02
FC-SS-05					
Uranium-234	12	0.64 ± 0.08	1.00 ± 0.10	0.25 ± 0.03	2.04 ± 0.19
Uranium-238	12	1.55 ± 0.11	2.20 ± 0.10	0.72 ± 0.06	14.9 ± 0.46
Plutonium-239/240	12	0.01 ± 0.02	0.04 ± 0.02	-0.01 ± 0.04	0.02 ± 0.03

Table 8.3 Radionuclide Activities in Offsite Soils

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average ^{1,2}
		Average	Maximum	Minimum	
OS-SS-01					
Uranium-234	5	0.50 ± 0.08	0.69 ± 0.09	0.12 ± 0.02	0.73 ± 0.13
Uranium-238	5	0.49 ± 0.08	0.67 ± 0.08	0.12 ± 0.02	0.72 ± 0.13
Plutonium-239/240	3	0.01 ± 0.02	0.01 ± 0.00	0.00 ± 0.02	0.01 ± 0.02
OS-SS-02					
Uranium-234	4	0.44 ± 0.07	0.59 ± 0.09	0.10 ± 0.02	0.69 ± 0.13
Uranium-238	4	0.46 ± 0.06	0.64 ± 0.09	0.10 ± 0.02	0.74 ± 0.14
Plutonium-239/240	3	0.00 ± 0.01	0.00 ± 0.00	0.00 ± 0.02	0.01 ± 0.02
OS-SS-03					
Uranium-234	4	0.40 ± 0.09	0.57 ± 0.09	0.16 ± 0.04	0.61 ± 0.13
Uranium-238	4	0.42 ± 0.09	0.54 ± 0.09	0.14 ± 0.04	0.62 ± 0.13
Plutonium-239/240	3	0.01 ± 0.02	0.03 ± 0.04	0.00 ± 0.03	0.01 ± 0.02
OS-SS-04					
Uranium-234	4	0.44 ± 0.06	0.62 ± 0.09	0.09 ± 0.02	0.69 ± 0.13
Uranium-238	4	0.48 ± 0.07	0.69 ± 0.09	0.07 ± 0.02	0.79 ± 0.14
Plutonium-239/240	3	0.01 ± 0.02	0.01 ± 0.03	0.00 ± 0.01	0.01 ± 0.01
OS-SS-05					
Uranium-234	4	0.41 ± 0.07	0.57 ± 0.12	0.09 ± 0.02	0.64 ± 0.13
Uranium-238	4	0.43 ± 0.06	0.57 ± 0.07	0.09 ± 0.02	0.69 ± 0.13
Plutonium-239/240	4	0.00 ± 0.01	0.00 ± 0.01	0.00 ± 0.03	0.01 ± 0.02
OS-SS-06					
Uranium-234	4	0.57 ± 0.07	0.97 ± 0.10	0.15 ± 0.03	0.73 ± 0.13
Uranium-238	4	0.55 ± 0.06	0.80 ± 0.09	0.17 ± 0.03	0.73 ± 0.13
Plutonium-239/240	4	0.01 ± 0.02	0.05 ± 0.02	-0.01 ± 0.02	0.00 ± 0.02
OS-SS-07					
Uranium-234	4	0.47 ± 0.09	0.79 ± 0.18	0.13 ± 0.03	0.64 ± 0.13
Uranium-238	4	0.48 ± 0.09	0.70 ± 0.15	0.17 ± 0.03	0.68 ± 0.13
Plutonium-239/240	4	0.01 ± 0.02	0.01 ± 0.03	0.00 ± 0.02	0.02 ± 0.02
OS-SS-08					
Uranium-234	4	0.51 ± 0.09	0.74 ± 0.17	0.14 ± 0.02	0.67 ± 0.12
Uranium-238	4	0.53 ± 0.08	0.68 ± 0.06	0.14 ± 0.02	0.79 ± 0.15
Plutonium-239/240	4	0.01 ± 0.02	0.04 ± 0.04	0.00 ± 0.01	0.01 ± 0.03

¹Activities expressed as E - 06 $\mu\text{Ci/g}$.

²($\pm$): Counting error at 95% confidence level.

Table 8.3 Radionuclide Activities in Offsite Soils (Continued)

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average
		Average	Maximum	Minimum	
OS-SS-09					
Uranium-234	4	0.45 ± 0.08	0.68 ± 0.14	0.17 ± 0.03	0.68 ± 0.12
Uranium-238	4	0.50 ± 0.08	0.66 ± 0.08	0.18 ± 0.03	0.73 ± 0.12
Plutonium-239/240	4	0.00 ± 0.02	0.02 ± 0.03	-0.01 ± 0.02	0.01 ± 0.02
OS-SS-10					
Uranium-234	4	0.45 ± 0.06	0.63 ± 0.09	0.11 ± 0.02	0.65 ± 0.12
Uranium-238	4	0.46 ± 0.06	0.70 ± 0.09	0.12 ± 0.03	0.71 ± 0.14
Plutonium-239/240	4	0.00 ± 0.02	0.02 ± 0.03	-0.01 ± 0.01	0.01 ± 0.02
OS-SS-11					
Uranium-234	4	0.43 ± 0.10	0.65 ± 0.11	0.18 ± 0.03	0.65 ± 0.13
Uranium-238	4	0.45 ± 0.07	0.66 ± 0.09	0.17 ± 0.02	0.69 ± 0.13
Plutonium-239/240	4	0.00 ± 0.01	0.01 ± 0.02	-0.01 ± 0.01	0.01 ± 0.02
OS-SS-12					
Uranium-234	4	0.45 ± 0.08	0.58 ± 0.09	0.14 ± 0.02	0.61 ± 0.13
Uranium-238	4	0.49 ± 0.08	0.68 ± 0.10	0.15 ± 0.02	0.68 ± 0.13
Plutonium-239/240	4	0.01 ± 0.02	0.06 ± 0.06	0.00 ± 0.02	0.01 ± 0.02
OS-SS-13					
Uranium-234	4	0.41 ± 0.09	0.65 ± 0.10	0.09 ± 0.02	0.62 ± 0.13
Uranium-238	4	0.46 ± 0.06	0.62 ± 0.07	0.12 ± 0.02	0.67 ± 0.14
Plutonium-239/240	4	0.05 ± 0.03	0.17 ± 0.07	0.00 ± 0.01	0.01 ± 0.02
OS-SS-14					
Uranium-234	4	0.52 ± 0.12	0.66 ± 0.13	0.22 ± 0.03	0.72 ± 0.14
Uranium-238	4	0.48 ± 0.09	0.65 ± 0.08	0.19 ± 0.02	0.75 ± 0.15
Plutonium-239/240	4	0.01 ± 0.01	0.03 ± 0.02	0.00 ± 0.02	0.01 ± 0.02
OS-SS-15					
Uranium-234	4	0.34 ± 0.10	0.53 ± 0.08	0.22 ± 0.03	0.57 ± 0.15
Uranium-238	4	0.42 ± 0.08	0.69 ± 0.09	0.18 ± 0.03	0.64 ± 0.15
Plutonium-239/240	4	0.02 ± 0.02	0.04 ± 0.04	0.00 ± 0.00	0.01 ± 0.02
OS-SS-16					
Uranium-234	4	0.37 ± 0.10	0.46 ± 0.19	0.14 ± 0.02	0.60 ± 0.11
Uranium-238	4	0.47 ± 0.09	0.65 ± 0.10	0.17 ± 0.02	0.57 ± 0.13
Plutonium-239/240	4	0.02 ± 0.02	0.04 ± 0.02	0.00 ± 0.00	0.01 ± 0.02

Table 8.3 Radionuclide Activities in Offsite Soils (Continued)

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average
		Average	Maximum	Minimum	
OS-SS-17					
Uranium-234	4	0.50 ± 0.10	0.72 ± 0.09	0.18 ± 0.02	0.79 ± 0.14
Uranium-238	4	0.53 ± 0.07	0.71 ± 0.08	0.14 ± 0.02	0.77 ± 0.14
Plutonium-239/240	4	0.01 ± 0.02	0.05 ± 0.04	0.00 ± 0.02	0.00 ± 0.02
OS-SS-18					
Uranium-234	4	0.44 ± 0.08	0.71 ± 0.09	0.10 ± 0.02	0.71 ± 0.14
Uranium-238	4	0.45 ± 0.08	0.63 ± 0.08	0.11 ± 0.02	0.68 ± 0.14
Plutonium-239/240	3	0.00 ± 0.01	0.01 ± 0.00	0.00 ± 0.00	0.01 ± 0.02
OS-SS-19					
Uranium-234	4	0.31 ± 0.07	0.47 ± 0.05	0.08 ± 0.02	0.60 ± 0.13
Uranium-238	4	0.38 ± 0.07	0.59 ± 0.10	0.06 ± 0.02	0.63 ± 0.13
Plutonium-239/240	3	0.01 ± 0.02	0.01 ± 0.01	0.00 ± 0.00	0.02 ± 0.03
OS-SS-20					
Uranium-234	4	0.49 ± 0.08	0.94 ± 0.11	0.18 ± 0.03	0.75 ± 0.13
Uranium-238	4	0.54 ± 0.08	0.73 ± 0.10	0.16 ± 0.03	0.80 ± 0.14
Plutonium-239/240	4	0.00 ± 0.02	0.02 ± 0.02	-0.02 ± 0.02	0.02 ± 0.02
OS-SS-21					
Uranium-234	5	0.48 ± 0.08	0.66 ± 0.12	0.31 ± 0.04	0.59 ± 0.14
Uranium-238	5	0.43 ± 0.07	0.57 ± 0.09	0.21 ± 0.03	0.56 ± 0.12
Plutonium-239/240	5	0.02 ± 0.02	0.04 ± 0.05	0.00 ± 0.02	0.02 ± 0.03
OS-SS-22					
Uranium-234	4	0.40 ± 0.10	0.52 ± 0.10	0.14 ± 0.02	0.64 ± 0.15
Uranium-238	4	0.41 ± 0.08	0.58 ± 0.08	0.11 ± 0.02	0.66 ± 0.14
Plutonium-239/240	4	0.03 ± 0.02	0.07 ± 0.04	0.00 ± 0.00	0.02 ± 0.02
OS-SS-23					
Uranium-234	4	0.37 ± 0.09	0.50 ± 0.07	0.14 ± 0.02	0.63 ± 0.14
Uranium-238	4	0.42 ± 0.06	0.62 ± 0.08	0.15 ± 0.02	0.63 ± 0.15
Plutonium-239/240	4	0.00 ± 0.01	0.00 ± 0.02	0.00 ± 0.00	0.01 ± 0.02
OS-SS-24					
Uranium-234	4	0.38 ± 0.09	0.56 ± 0.13	0.13 ± 0.03	0.59 ± 0.13
Uranium-238	4	0.36 ± 0.08	0.58 ± 0.11	0.10 ± 0.03	0.65 ± 0.14
Plutonium-239/240	4	0.03 ± 0.03	0.06 ± 0.05	0.00 ± 0.00	0.01 ± 0.02

Table 8.3 Radionuclide Activities in Offsite Soils (Continued)

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average
		Average	Maximum	Minimum	
OS-SS-25					
Uranium-234	4	0.45 ± 0.07	0.63 ± 0.08	0.14 ± 0.02	0.62 ± 0.13
Uranium-238	4	0.44 ± 0.07	0.64 ± 0.10	0.13 ± 0.02	0.65 ± 0.13
Plutonium-239/240	4	0.02 ± 0.02	0.04 ± 0.02	0.00 ± 0.00	0.02 ± 0.02
OS-SS-26					
Uranium-234	4	0.38 ± 0.07	0.53 ± 0.09	0.10 ± 0.03	0.64 ± 0.14
Uranium-238	4	0.39 ± 0.07	0.54 ± 0.08	0.10 ± 0.03	0.68 ± 0.15
Plutonium-239/240	4	0.01 ± 0.01	0.02 ± 0.01	0.00 ± 0.00	0.01 ± 0.02
OS-SS-27					
Uranium-234	4	0.33 ± 0.07	0.45 ± 0.09	0.09 ± 0.02	0.61 ± 0.13
Uranium-238	4	0.33 ± 0.06	0.45 ± 0.06	0.08 ± 0.02	0.64 ± 0.13
Plutonium-239/240	4	0.02 ± 0.03	0.04 ± 0.06	0.00 ± 0.00	0.01 ± 0.02
OS-SS-28					
Uranium-234	4	0.36 ± 0.07	0.47 ± 0.09	0.10 ± 0.03	0.56 ± 0.11
Uranium-238	4	0.37 ± 0.07	0.53 ± 0.07	0.09 ± 0.03	0.59 ± 0.13
Plutonium-239/240	4	0.00 ± 0.01	0.01 ± 0.00	0.00 ± 0.01	0.01 ± 0.01
OS-SS-29					
Uranium-234	4	0.45 ± 0.08	0.64 ± 0.11	0.14 ± 0.03	0.74 ± 0.14
Uranium-238	4	0.48 ± 0.08	0.68 ± 0.07	0.17 ± 0.03	0.79 ± 0.14
Plutonium-239/240	4	0.01 ± 0.02	0.03 ± 0.02	0.00 ± 0.03	0.02 ± 0.02
OS-SS-30					
Uranium-234	5	0.37 ± 0.09	0.55 ± 0.08	0.16 ± 0.02	0.68 ± 0.12
Uranium-238	5	0.41 ± 0.07	0.60 ± 0.08	0.15 ± 0.02	0.72 ± 0.14
Plutonium-239/240	5	0.01 ± 0.02	0.03 ± 0.02	0.00 ± 0.02	0.01 ± 0.02
OS-SS-31					
Uranium-234	4	0.45 ± 0.10	0.58 ± 0.08	0.18 ± 0.03	0.63 ± 0.13
Uranium-238	4	0.50 ± 0.08	0.66 ± 0.08	0.17 ± 0.03	0.63 ± 0.14
Plutonium-239/240	4	0.06 ± 0.02	0.18 ± 0.05	0.00 ± 0.00	0.01 ± 0.02
OS-SS-32					
Uranium-234	12	0.46 ± 0.07	0.65 ± 0.09	0.14 ± 0.02	0.65 ± 0.13
Uranium-238	12	0.52 ± 0.08	0.85 ± 0.09	0.13 ± 0.02	0.87 ± 0.12
Plutonium-239/240	12	0.01 ± 0.02	0.04 ± 0.02	-0.02 ± 0.03	0.02 ± 0.02

Table 8.4 lists the averages for uranium-234, uranium-238, and plutonium-239/240 for the entire soil surveillance program in 1993. The average 1993 concentrations of plutonium-239/240 were comparable to historical and Bushland averages, indicating that no plutonium-239/240 contamination from Pantex Plant operations is detectable in area soils. Of the radionuclides present in the soils at Pantex Plant, uranium-238 appears to be the most prevalent. The highest measurements occur mostly in the soils at Firing Site 5 and can be attributed to the use of depleted uranium hemispheres during past high explosive test firings.

Depleted uranium is uranium that has been depleted of two of its uranium isotopes, uranium-235 and uranium-234. In the depleted state, uranium-238 (which is not readily fissionable) is the major constituent with less than 0.7 percent uranium-235. Test firings utilizing depleted uranium ceased in 1984. These Firing Sites are units scheduled for investigation and remediation under the Pantex Plant Hazardous Waste Permit via the Environmental Restoration Program.

The test firings probably released fine particles that might have been dispersed downwind, with the residual heavier particles settling near the pads. Due to past test activities at these Firing Sites, an occasional sample containing discrete particles of metal composed primarily of uranium-238 is expected.

The presence of depleted uranium in an environmental sample can be confirmed by calculating the uranium-234:uranium-238 isotopic activity ratio for a given sample (Lide, 1993). The ratio should be about 1.0 for natural uranium and significantly less than 1.0 for areas that have been contaminated with depleted uranium. The activity ratios listed in summary Table 8.4 are significantly less than 1.0 for Firing Sites 4, 5, and 10 (indicating uranium-238 contamination in these areas), and about 1.0 for the offsite sampling stations. The 1993 averages for uranium-234 and uranium-238 were

compared to established ranges and illustrated in Figure 8.3.

The 1993 averages of uranium-234 and uranium-238 activities for the Firing Site 5 area were slightly above the historical averages. However, all other area averages were well below the historical averages for the respective areas.

The elevated 1993 averages at Firing Site 5 are the result of two extreme values at sampling locations FB-SS-05 and FB-SS-06 occurring on July 26, 1993, and June 7, 1993, respectively. These extreme values are attributable to the discrete particles of depleted uranium metal described above.

8.2 Special Soil Surveillance

During 1993 two soil cores (0.5 m and 2.0 m from soil surface) were obtained from the floor of Pantex Lake, which historically received effluent from Pantex Plant. Two reference soil cores (0.9 m and 1.2 m from soil surface) were also obtained from a playa lake located approximately 2 miles north of Pantex Lake on land owned by the Texas Department of Criminal Justice (TDCJ). It is believed that the soils of this playa have not been affected by Pantex Plant operations. The four cores were divided into 10-cm subsections and analyzed for uranium 234, uranium-238, plutonium-239/240, silver, arsenic, barium, chromium, and lead. Comparison of the results from the respective playa lakes, with all depths combined, showed Pantex Lake to have elevated levels of chromium, lead, uranium-234, and uranium-238 (Figure 8.4 and Table 8.5). Plutonium activities at both playa lakes were considered to be at or below the lower detection limit. Pantex Lake is a unit scheduled for investigation and remediation under the Pantex Plant Hazardous Waste Permit via the Environmental Restoration Program.

Table 8.4 Comparative 1993 Averages for Radionuclide Activities in Soils

Area	Uranium-234 ^{1,2}	Uranium-238 ^{1,2}	Uranium-234:Uranium-238 Ratio	Plutonium-239/240 ^{1,2}
Firing Site 4	0.83 ± 0.08	3.99 ± 0.22	0.22	0.01 + 0.01
Firing Site 5	2.18 ± 0.24	12.8 ± 0.69	0.26	0.01 + 0.02
Firing Site 10	0.62 ± 0.08	1.67 ± 0.12	0.46	0.02 + 0.02
Burning Ground	0.45 ± 0.07	0.48 ± 0.07	0.95	0.02 + 0.02
Offsite	0.43 ± 0.08	0.46 ± 0.07	0.97	0.01 + 0.02
Bushland	0.46 ± 0.07	0.52 ± 0.08	0.92	0.01 + 0.02

¹Activities expressed as E - 06 $\mu\text{Ci/g}$.

²($\pm$): Counting error at 95% confidence level.

Figure 8.3 Comparative Uranium-234 and Uranium-238 Activities in Soils; Historical, 1992, 1993 Averages

Figure 8.4 A comparison of concentrations (activities) in Pantex Lake Soils; a historic Pantex Plant effluent receptor; and a playa on Texas Department of Criminal Justice land, which is expected to be unaffected by Pantex Plant operations.

Table 8.5 Comparative Statistics for Pantex Lake and TDCJ Playa

Analyte	Number of Samples	Mean	Standard Deviation	Coefficient of Variation
Pantex Lake				
Uranium-234	25	0.66	±0.21*	---
Uranium-238	25	0.86	±0.20*	---
Plutonium-239/240	8	0.02	±0.02*	---
Silver	23	1.22	1.92	157%
Arsenic	23	10.4	3.55	34%
Barium	25	204	51.3	25%
Chromium	25	24.4	4.78	20%
Lead	25	30.5	3.82	13%
TDCJ Playa				
Uranium-234	21	0.52	±0.13*	---
Uranium-238	21	0.57	±0.14*	---
Plutonium-239/240	6	0.01	±0.03*	---
Silver	11	0.58	0.10	17%
Arsenic	21	12.0	3.67	31%
Barium	21	221	43.9	20%
Chromium	21	20.4	1.60	8%
Lead	21	27.0	2.77	10%

*Counting error at the 95% confidence interval, 1.96σ

Section 9

FLORA AND FAUNA

Section 9 provides results of the 1993 routine and nonroutine flora and fauna surveillance program at Pantex Plant. Results for onsite and offsite monitoring are presented, including analytical results for radionuclides and fluoride in vegetation.

9.1 Flora Surveillance Program

9.1.1 Routine Radiological Surveillance of Vegetation

Environmental surveillance of vegetation is important to understanding and assessing impacts that Plant operations may have on the environment. Interpreting results of vegetation surveillance is complex because elemental uptake is different under varying conditions for both species and individuals. Therefore, vegetation surveillance results should be considered and evaluated together with other media results.

Five onsite and 17 offsite surveillance locations were sampled during 1993. The sampling location site identifier numbers and site location descriptions are listed in Table 9.1 and illustrated in Figures 9.1 and 9.2. One of the offsite sampling stations (OS-VS-17) is located at the USDA Agricultural Research Service Station at Bushland as illustrated in Figure 1.1 and is considered the control sample. It was initially selected for its distance from Pantex Plant, ease of access for sampling, and as a typical example of Southern High Plains vegetation, unaffected by industrial activities.

Vegetation samples are collected monthly at the Bushland and five onsite locations and collected from the offsite locations quarterly. These samples are taken in accordance with the procedures in Internal Operating Procedure D-4260 "Vegetation Sampling Procedures" and consist of

native, exotic, and domestic grasses, but also includes small amounts of other vascular plants.

Vegetation samples are analyzed for uranium-234, uranium-238, and tritium at an offsite laboratory. In addition, the 1993 monitoring regime for the Bushland and onsite location samples includes plutonium-239/240 analysis. No historic values exist for plutonium 239/240. Analytical procedures are essentially the same as for analyses of radionuclides in soil as presented in Section 8. Radionuclide analyses of vegetation are used to determine whether unusual uptake and biological concentrations of uranium-234, uranium-238, plutonium-239/240, and/or tritium from air or soil have occurred. Currently, no regulatory limits for uranium or tritium concentrations in vegetation have been established. Table 9.2. provides annual summaries of onsite vegetation sampling locations. Similarly, Table 9.3 provides respective results from offsite locations for uranium-234, uranium-238, and tritium analyses. Summary tables are based on raw data published in *Pantex Plant Environmental Monitoring 1993 Data Compilation for January through December*. The results for 1993 are consistent with historical results.

9.1.2 Fluoride in Vegetation Monitoring

Pantex Plant's current operations involve processing of machining scrap and high explosives at the Burning Ground, potentially releasing fluoride into the atmosphere. Texas Natural Resource Conservation Commission (TNRCC) Office of Air Quality Regulation III (30 TAC 113) "Control of Air Pollution from Toxic Materials" establishes requirements to monitor and designates upper limits for fluoride concentrations in forage.

These requirements are imposed because floral species intake gaseous fluoride and concentrate it within vegetative parts.

Some animals, particularly bovines, are more sensitive to high fluoride concentrations than are humans and may develop fluorosis. Winter wheat samples were collected from areas adjacent to the Burning Ground during the growing season March through June 1993. These results are listed in Table 9.4. Concentrations were below the limits specified in TNRCC Regulation III.

9.2 Fauna Surveillance Program

The 1993 fauna surveillance program consisted of nonroutine sampling of dead or injured animals discovered on Pantex Plant. Necropsies and toxicological studies are conducted to identify cause of death and to provide warning of widespread disease potential. Table 9.5 provides information regarding such investigations during 1993. No relationships between the investigations and Plant operations were observed.

Table 9.1 Routine Onsite and Offsite Vegetation Sampling

Sample No.	Location
<u>Onsite</u>	
Burning Ground:	
BG-VS-01	330 feet NW of NW pad, 36 feet E of W fence line
Firing Site 5:	
FB-VS-01	300 feet NW of NW corner of bunker
FB-VS-02	250 feet N of NW corner of bunker
FB-VS-03	400 feet S of SW corner of bunker
Firing Site 10:	
FC-VS-01	300 feet NE of NE corner of bunker
<u>Offsite</u>	
OS-VS-01	NW corner of intersection of FM683 & FM245
OS-VS-02	2 miles N of intersection of FM2373 & FM293, 2 miles E at cattle guard
OS-VS-03	2 miles W of intersection of FM683 & FM245, N fence
OS-VS-04	1 mile W of intersection of FM683 & FM293, N fence
OS-VS-05	0.3 miles E of intersection of FM683 & FM293, 1.6 miles N, W fence
OS-VS-06	2 miles N of intersection of FM2373 & FM293, 1 W, 0.3 N, E fence
OS-VS-07	2.3 miles N of intersection of FM2373 & FM293, NW corner
OS-VS-08	3.4 miles E of intersection of FM2373 & FM293, S fence
OS-VS-09	2 miles S of intersection of FM2373 & FM293, 2 miles E, SW corner
OS-VS-10	4.1 miles E of intersection of FM2373 & U.S. 60, S fence
OS-VS-11	2.7 miles S of intersection of U.S. 60 & FM2161, E fence at survey marker
OS-VS-12	2.4 miles S of intersection of U.S. 60 & FM2373, SE corner of intersection
OS-VS-13	1.5 miles E of intersection of U.S. 60 & FM683, 1 mile S, W fence
OS-VS-14	4.2 miles S of intersection of FM245 & FM683, fence N of RR tracks
OS-VS-15	2 miles N of intersection of FM2373 & FM293, 2 E, 1 N, 0.3 W
OS-VS-16	1.5 miles E of intersection of FM2373 & FM293, 0.4 miles N
OS-VS-17	Bushland Agricultural Research Station, near air monitor

Figure 9.1 Routine Onsite Pantex Plant
Vegetation Surveillance Locations.

Figure 9.2 Routine Offsite Pantex Plant Vegetation Surveillance Locations.

Table 9.2 Radionuclide Activities in Onsite Vegetation

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average ^{1,2}
		Average	Maximum	Minimum	
BG-VS-01					
Uranium-234	6	0.03 ± 0.02	0.07 ± 0.01	0.00 ± 0.01	0.14 ± 0.04
Uranium-238	6	0.03 ± 0.02	0.07 ± 0.01	0.00 ± 0.01	0.14 ± 0.04
Plutonium-239/240	4	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	— ³
Tritium	2	0.02 ± 0.16	0.06 ± 0.18	-0.03 ± 0.14	0.51 ± 0.17
FB-VS-01					
Uranium-234	5	0.01 ± 0.01	0.06 ± 0.01	-0.01 ± 0.01	0.12 ± 0.04
Uranium-238	5	0.04 ± 0.01	0.11 ± 0.01	0.00 ± 0.01	0.50 ± 0.07
Plutonium-239/240	3	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	— ³
Tritium	2	-0.04 ± 0.16	0.00 ± 0.14	-0.07 ± 0.14	0.23 ± 0.17
FB-VS-02					
Uranium-234	5	0.01 ± 0.01	0.02 ± 0.01	0.00 ± 0.01	0.13 ± 0.04
Uranium-238	5	0.06 ± 0.02	0.14 ± 0.08	0.03 ± 0.01	0.51 ± 0.08
Plutonium-239/240	3	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	— ³
Tritium	2	-0.02 ± 0.16	0.00 ± 0.17	-0.03 ± 0.14	1.19 ± 0.22
FB-VS-03					
Uranium-234	5	0.02 ± 0.01	0.05 ± 0.01	0.00 ± 0.01	0.54 ± 0.07
Uranium-238	5	0.11 ± 0.01	0.29 ± 0.02	0.00 ± 0.01	3.67 ± 0.23
Plutonium-239/240	3	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	— ³
Tritium	2	0.03 ± 0.17	0.04 ± 0.15	0.02 ± 0.18	0.59 ± 0.18
FC-VS-01					
Uranium-234	6	0.01 ± 0.01	0.02 ± 0.01	0.00 ± 0.01	0.06 ± 0.06
Uranium-238	6	0.02 ± 0.01	0.08 ± 0.01	0.00 ± 0.01	0.15 ± 0.04
Plutonium-239/240	4	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	— ³
Tritium	2	0.00 ± 0.14	0.00 ± 0.14	0.00 ± 0.14	7.77 ± 0.26

¹Activity expressed as E - 06 $\mu\text{Ci/g}$.²(±): Counting error at 95% confidence level.³No historic averages exist.

Table 9.3 Radionuclide Activities in Offsite Vegetation

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average ^{1,2}
		Average	Maximum	Minimum	
OV-VS-01					
Uranium-234	3	0.04 ± 0.01	0.10 ± 0.01	0.01 ± 0.01	0.08 ± 0.03
Uranium-238	3	0.04 ± 0.01	0.10 ± 0.01	0.00 ± 0.01	0.09 ± 0.03
Tritium	3	-0.03 ± 0.16	0.02 ± 0.17	-0.06 ± 0.14	0.12 ± 0.17
OV-VS-02					
Uranium-234	2	0.03 ± 0.02	0.03 ± 0.02	0.02 ± 0.01	0.08 ± 0.03
Uranium-238	2	0.04 ± 0.02	0.05 ± 0.02	0.02 ± 0.01	0.07 ± 0.03
Tritium	2	0.03 ± 0.16	0.04 ± 0.14	0.02 ± 0.17	0.17 ± 0.18
OV-VS-03					
Uranium-234	2	0.01 ± 0.01	0.01 ± 0.01	0.00 ± 0.01	0.06 ± 0.03
Uranium-238	2	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.06 ± 0.01
Tritium	2	-0.03 ± 0.16	-0.01 ± 0.17	-0.04 ± 0.14	0.21 ± 0.19
OV-VS-04					
Uranium-234	2	0.01 ± 0.01	0.02 ± 0.01	0.00 ± 0.01	0.16 ± 0.06
Uranium-238	2	0.00 ± 0.01	0.00 ± 0.01	0.00 ± 0.01	0.15 ± 0.04
Tritium	2	-0.04 ± 0.16	0.00 ± 0.14	-0.07 ± 0.17	0.18 ± 0.18
OV-VS-05					
Uranium-234	1	0.13 ± 0.02	0.13 ± 0.02	0.13 ± 0.02	0.09 ± 0.02
Uranium-238	1	0.12 ± 0.02	0.12 ± 0.02	0.12 ± 0.02	0.12 ± 0.05
Tritium	1	0.02 ± 0.17	0.02 ± 0.17	0.02 ± 0.17	0.50 ± 0.19
OV-VS-06					
Uranium-234	1	0.06 ± 0.01	0.06 ± 0.01	0.06 ± 0.01	0.04 ± 0.02
Uranium-238	1	0.05 ± 0.01	0.05 ± 0.01	0.05 ± 0.01	0.05 ± 0.01
Tritium	1	-0.04 ± 0.17	-0.04 ± 0.17	-0.04 ± 0.17	0.25 ± 0.19
OV-VS-07					
Uranium-234	2	0.01 ± 0.01	0.02 ± 0.01	0.00 ± 0.01	0.08 ± 0.06
Uranium-238	2	0.01 ± 0.01	0.02 ± 0.01	0.00 ± 0.01	0.10 ± 0.02
Tritium	2	0.04 ± 0.16	0.09 ± 0.14	-0.01 ± 0.17	0.18 ± 0.19
OV-VS-08					
Uranium-234	2	0.05 ± 0.01	0.09 ± 0.01	0.00 ± 0.01	0.07 ± 0.03
Uranium-238	2	0.05 ± 0.02	0.10 ± 0.02	0.00 ± 0.01	0.09 ± 0.02
Tritium	2	0.04 ± 0.16	0.08 ± 0.14	0.00 ± 0.17	0.18 ± 0.19

¹Activities expressed as E - 06 $\mu\text{Ci/g}$.

²($\pm$): Counting error at 95% confidence level.

Table 9.3 Radionuclide Activities in Offsite Vegetation (Continued)

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average
		Average	Maximum	Minimum	
OV-VS-09					
Uranium-234	2	0.03 ± 0.02	0.06 ± 0.02	0.00 ± 0.01	0.22 ± 0.07
Uranium-238	2	0.04 ± 0.01	0.07 ± 0.01	0.01 ± 0.01	0.22 ± 0.06
Tritium	2	0.00 ± 0.16	0.00 ± 0.17	0.00 ± 0.014	0.45 ± 0.22
OV-VS-10					
Uranium-234	2	0.11 ± 0.02	0.22 ± 0.03	0.00 ± 0.01	0.14 ± 0.03
Uranium-238	2	0.10 ± 0.02	0.20 ± 0.03	0.00 ± 0.01	0.14 ± 0.03
Tritium	2	0.05 ± 0.16	0.12 ± 0.14	-0.03 ± 0.17	0.23 ± 0.19
OV-VS-11					
Uranium-234	2	0.01 ± 0.01	0.02 ± 0.01	0.00 ± 0.01	0.13 ± 0.03
Uranium-238	2	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.18 ± 0.05
Tritium	2	0.01 ± 0.16	0.17 ± 0.14	0.03 ± 0.18	0.38 ± 0.19
OV-VS-12					
Uranium-234	2	0.07 ± 0.02	0.13 ± 0.02	0.01 ± 0.01	0.08 ± 0.04
Uranium-238	2	0.07 ± 0.02	0.13 ± 0.02	0.01 ± 0.01	0.11 ± 0.04
Tritium	2	0.01 ± 0.16	0.06 ± 0.18	-0.05 ± 0.14	0.28 ± 0.19
OV-VS-13					
Uranium-234	2	0.03 ± 0.02	0.05 ± 0.02	0.01 ± 0.01	0.15 ± 0.04
Uranium-238	2	0.05 ± 0.02	0.07 ± 0.02	0.02 ± 0.01	0.13 ± 0.04
Tritium	2	-0.01 ± 0.16	0.03 ± 0.17	-0.04 ± 0.14	0.21 ± 0.19
OV-VS-14					
Uranium-234	2	0.04 ± 0.01	0.07 ± 0.01	0.00 ± 0.01	0.05 ± 0.02
Uranium-238	2	0.04 ± 0.01	0.07 ± 0.01	0.00 ± 0.01	0.05 ± 0.02
Tritium	2	0.08 ± 0.16	0.20 ± 0.18	-0.04 ± 0.14	0.63 ± 0.18
OV-VS-15					
Uranium-234	2	0.07 ± 0.02	0.13 ± 0.02	0.01 ± 0.01	0.11 ± 0.05
Uranium-238	2	0.06 ± 0.02	0.10 ± 0.02	0.01 ± 0.01	0.10 ± 0.04
Tritium	2	-0.04 ± 0.16	0.08 ± 0.14	-0.15 ± 0.17	0.15 ± 0.19
OV-VS-16					
Uranium-234	2	0.12 ± 0.01	0.02 ± 0.01	0.01 ± 0.01	0.12 ± 0.43
Uranium-238	2	0.03 ± 0.01	0.05 ± 0.01	0.00 ± 0.01	0.11 ± 0.03
Tritium	2	0.02 ± 0.16	0.07 ± 0.14	-0.04 ± 0.17	0.20 ± 0.19

Table 9.3 Radionuclide Activities in Offsite Vegetation (Continued)

Location/ Isotope	Number of Samples	1993 ^{1,2}			Historical Average ¹
		Average	Maximum	Minimum	
OV-VS-17 (Bushland)					
Uranium-234	6	0.09 ± 0.03	0.26 ± 0.04	0.01 ± 0.01	0.26 ± 0.06
Uranium-238	6	0.11 ± 0.02	0.27 ± 0.05	0.00 ± 0.01	0.47 ± 0.06
Plutonium-239/240	3	0.00 ± 0.05	0.00 ± 0.05	0.00 ± 0.05	— ³
Tritium	3	0.09 ± 0.16	0.26 ± 0.16	-0.02 ± 0.14	0.18 ± 0.17

³No historic averages exist.

Table 9.4 Average Fluoride Concentration in Winter Wheat

Month	Concentration Parts per Million
March	14.7
April	8.00
May	7.26
June	43.4

Table 9.5 Fauna Surveillance Program Investigations

Date	Summary
2/9/93	A dead female ferruginous hawk was found under an electrical line at Playa One. The U.S. Fish & Wildlife determined the cause of death as electrocution.
3/93	A burrowing owl was found dead at Building 16-12. Apparently it flew into the window glass and sustained a broken neck. The U.S. Fish & Wildlife approved donation of the specimen to West Texas State University at Canyon, Texas.
3/5/93	A dead jackrabbit was found in Zone 12 South. A Texas A&M necropsy reported that cystic structures impinging on lung parenchyma resulted in collapse. The toxicology report was negative for four hydroxycoumarins.
3/23/93	A cottontail rabbit was found dead at Playa Two. A Texas A&M necropsy reported hemorrhagic shock, possibly induced by rodenticide anticoagulant. The toxicology report was negative for four hydroxycoumarins.
4/20/93	A raccoon was found dead at the Old Sewage Treatment Facility. A Texas A&M necropsy reported cachexia; histopathology reported chronic granulomatous pneumonia, lymphoid depletion of the lymph nodes and spleen, minimal multifocal exudative enterocolitis with minimal cryptitis and enterocolonic nematodes.
6/28/93	A juvenile barn owl was found injured in an abandoned warehouse. The Timbercreek Veterinary Clinic determined that the compound fracture in the leg was not repairable. The bird was then euthanized.
12/2/93	A male ferruginous hawk with an injured wing was found. The Timbercreek Veterinary Clinic determined that the wing was not repairable. The bird was then euthanized.

**Weekly servicing at air station. Flow measurement in process at high-volume sampler on left.
Pre-filter being installed on low-volume (tritium) sampler on right.**

Section 10

QUALITY ASSURANCE

Pantex Plant maintains a quality assurance/quality control program to ensure the accuracy, precision, and reliability of analysis results generated within the environmental monitoring program. The overall program of systematic actions taken to ensure the credibility of monitoring and measurement data (including documentation, plans, procedures, training, records, etc.) is defined as quality assurance (QA). Those individual actions within the QA program that control and verify the quality of the data are known as quality control (QC) activities. Department of Energy (DOE) Order 5400.1 "General Environmental Protection Program" requires that a QA program consistent with the requirements of DOE Order 5700.6C "Quality Assurance" be established for each element of Pantex Plant's environmental monitoring program. Procedures for sampling various environmental media at Pantex Plant are set forth in the Plant's Internal Operating Procedures (IOPs). Figure 10.1 is a depiction of the hierarchical organization of the QA procedures for the environmental monitoring activities.

The QA Program for Pantex Plant environmental monitoring program requires that QA/QC features be present in all aspects of the monitoring program. Since the first element of the monitoring program is the collection of samples, QA/QC methods are used in all activities during the collection of environmental samples. QA/QC in the field is described in Section 10.1. To ensure that the integrity of a sample is maintained between collection of the sample and its delivery to the analyzing laboratory, a sample custody control process is employed. Section 10.2 describes the sample custody control process used for the environmental monitoring program.

The next element of the environmental monitoring program is the analysis of the samples to obtain results that may be compared against regulatory standards, results from separate concurrent sampling events, and results from previous and future sampling events. To perform these comparisons, the analysis of the samples must be performed in a consistent manner. Each of the analytical laboratories used by Pantex Plant during 1993 to perform the analyses was required to have an internal QA program that ensured the consistent, repeatable performance and documentation of the analyses. All samples were analyzed by methods approved by the Environmental Protection Agency (EPA) when available. The analysis procedures are discussed in Section 10.3. QA programs associated with each laboratory are discussed in Section 10.4.

Independent verification of the quality of analytical laboratories used to perform the environmental measurements represents the next element of the environmental monitoring QA program. The several programs and activities used as external checks on the laboratories' performance are discussed in Section 10.5. Following data validation, the analysis results were entered into databases and provided to those persons responsible for the interpretation of the results. Section 10.6 discusses the sample tracking and data management processes used during 1993. The final part of the section discusses performance indicators that have been developed during 1993 as tools to determine when laboratory quality or monitoring program problems occur.

Figure 10.1 Quality Assurance Hierarchy.

10.1 Quality Assurance in the Field

Samples of various environmental media were routinely collected for analysis as described in Sections 4 through 9. Field sampling crews that collected these samples are experienced, trained, and knowledgeable in sampling. To ensure comparability of data results between sampling events, all sampling activities were performed according to documented procedures. At the time of sample collection, a logbook entry was made describing the sampling event. The entry included assignment of a blind sample number, date, time of sampling, sample location, analyses to be run, media, weather conditions while sampling, and the initials of the sampler(s). The

blind sample number was provided to the analytical laboratory as the sole sample identifier, so that the sample location is not known to the laboratory. Good field sampling QA was further ensured through the collection of field QC samples. These included duplicate samples, decontamination rinsates, trip blanks, and field blanks. These samples were assigned blind sample numbers and shipped to the laboratory with the environmental samples. Thus, the analyzing laboratory could not distinguish the QC samples from the environmental samples.

Duplicate samples were randomly collected to check the consistency of the environmental

monitoring/analysis process. Decontamination rinsates from "clean" sampling equipment were analyzed to identify whether cross-contamination of sequential samples occurred due to inadequately decontaminated equipment. Trip blanks were sent with each shipment of water samples that were analyzed for volatile organic compounds (VOCs) to assure the sample was not cross-contaminated with VOCs during the shipping process. Field blanks were collected to assure the sample was not contaminated with VOCs during the sampling process.

Repeatability between duplicate sample analytes was determined by calculating the relative percent difference (%RPD) which is defined by the following equation:

$$\%RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100\%$$

where D_1 and D_2 represent analytical measurements on duplicate samples.

Duplicate analytes for which the %RPD was less than 20 percent were considered in control. The number of duplicate samples collected, duplicate analytes measured, and the number of duplicate analytes exceeding the acceptance criteria for each of several environmental contaminant classifications are presented in Table 10.1.

Measurement results for blanks and rinsates were also analyzed to determine if cross-contamination of samples had occurred. The number of blanks and rinsates obtained, analytes measured, and analyte measurement results exceeding the required method detection limit are presented in Table 10.2.

10.2 Sample Custody Control Process

Sample custody was controlled to ensure the

integrity of the samples between collection and analysis. Figure 10.2 is a schematic of the custody control process.

At the time of the sampling event, the sampling personnel attached a custody seal to the sampling container. The seals are controlled by Plant personnel and initialed by the responsible technician as it is attached. The seal was placed so that the sample container could not be opened without breaking the seal. The sample was placed in a cooler in the sampling crew vehicle. The cooler of samples remained with the crew or in the locked vehicle while sampling continued. Following collection, the samples were taken to an appropriate locked storage area until ready for delivery to a laboratory.

When samples were removed from storage for forwarding to a laboratory, a Chain-of-Custody (COC) form was initiated, and the custody form number was listed in the sampling logbook. The samples and the COC forms were sealed in a cooler with a custody label and delivered to a Pantex Plant laboratory or to the Plant's General Stores for shipment to offsite laboratories. The person releasing the samples returned a copy for tracking purposes as discussed at Section 10.6. Pantex Plant personnel kept track of all bills of lading for each shipment.

The receiving laboratory personnel reviewed the COC form to ensure that listed samples were received and verified the integrity of the custody seals on each sample container. The person receiving the samples signed the COC form and noted the condition of each sample. A sample acknowledgment was then sent from the laboratory to Pantex Plant, acknowledging the receipt of the samples and noting any discrepancies. The sample acknowledgment was checked for completeness when received. When analyses were completed, a copy of the COC form was sent with the analytical results from the contract or Pantex Plant laboratory.

Table 10.1 Summary of Results from Analysis of Duplicate Samples

Analysis	No. of Samples	No. of Analytes	No. Exceeding 20% RPD^a
Volatiles	42	1423	0
Semivolatiles	13	791	5
Pesticides	6	110	0
Polychlorinated Biphenyls	7	49	0
Herbicides	6	12	0
High Explosives	29	116	1
Metals	37	857	44
Miscellaneous	65	438	28
Radionuclides	34	211	15

^a % RPD. Relative Percent Difference. The absolute difference between duplicate values divided by the average of the two values expressed as a percent.

Table 10.2 Summary of Results above Detection Limit for Blanks and Rinsates

Analysis	No. of Samples	No. of Analytes	No. Exceeding DL^a
Volatiles	220	7920	27
Semivolatiles	5	325	0
Pesticides	5	95	0
Polychlorinated Biphenyls	5	35	0
Herbicides	5	10	0
High Explosives	9	36	0
Metals	12	348	13
Miscellaneous	14	308	4
Radionuclides	49	490	22

^a Number of blank or rinsate analyses with reported values exceeding the required method detection limit (DL).

Figure 10.2 Change of Custody Process.

10.3 Analytical Laboratory Procedures

Sampling, handling, and analyses procedures used in 1993 were consistent with procedures used in previous years to ensure that sample results can be compared with previous data. To ensure the comparability of the analytical results with previous studies and future studies, all samples were analyzed by EPA-approved methods and associated QA/QC procedures where these methods are available. EPA-approved methods were employed during 1993 by the primary laboratory, Accu-Labs Research, Inc. (ALR) of Golden, Colorado, for all nonradiological analyses except high explosives (HEs). EPA-approved methods for radionuclides do not exist. The methods used for these analytes are summarized below.

Effective October 1993, contracts for analytical services were initiated with several other laboratories. These laboratories, which were contractually required to use the same (or equivalent methods) to those used by ALR, were Barringer Laboratories, Inc. located in Golden, Colorado; IEA, Inc. of Cary, North Carolina; and Southwest Laboratory of Oklahoma, Inc., located in Broken Arrow, Oklahoma.

During the majority of 1993, ENRECO Laboratories Group, located in Amarillo, Texas, was used to perform short-holding-times analyses (those analyses for which the EPA method requires sample testing be initiated within 48 hours of sampling). In December 1993 these analyses were performed at the City of Amarillo River Road Waste Water Treatment Plant Laboratory.

Analysis of Nonradionuclide Analytes Except High Explosives. The EPA-approved methods used for each nonradioactive analyte are listed in Table 10.3.

Analysis of High Explosives. A major chemical analytical problem involves the analysis of HEs in various media. EPA method 8330 for

the analysis of HEs is presently in draft form; however, it does not address the analysis for pentaerythritol tetranitrate (PETN), an HE used at Pantex Plant. The method used by the analytical laboratories was a liquid chromatography procedure developed from Jenkins (1986). The procedure measured the concentration of an explosive up to the solubility of the explosive in water under the laboratory conditions during the analysis.

Analysis of Air Samples for Radionuclides.

The 47 mm prefilters from the low-volume air samplers were counted for gross alpha/beta emitters on a low background internal flow proportional counter located onsite. Appropriate corrections were applied for absorption and counter efficiency. The 20- × 25-cm (8- × 10-inch) particulate filters from the high-volume air samplers were analyzed for uranium-234, uranium-238, and plutonium-239/240. Uranium-232 and plutonium-236 tracers were added. The samples were digested to dryness with nitric/hydrofluoric acid and then redissolved in nitric acid. The uranium and plutonium salts were then adsorbed onto an ion exchange resin. The plutonium was then eluted off the ion exchange column, coprecipitated with a neodymium salt, and microprecipitated onto filters. A solid-state alpha spectrometer was utilized to determine the activity of plutonium on the filters. Chemical recovery was determined from the tracer peak. The adsorbed uranium salt on the ion exchange column from the above plutonium analysis was then analyzed for uranium-234 and uranium-238. The uranium salt was eluted off the column, and microprecipitated onto filters. A solid-state alpha spectrometer was utilized to determine the activity of the indicated uranium isotopes on the planchet. Chemical recovery was determined from the tracer peak.

Table 10.3 Analytical Methods Used in 1993

Analyte	EPA Method
Volatiles	8260
Semivolatiles	8270
Pesticides, Polychlorinated Biphenyls	8080
Herbicides	8150
High Explosives	8330 (modified by ALR)
Arsenic	206.2
Lead	239.2
Mercury	245.1
Selenium	270.2
All Other Metals	6010 or 200.7
Hexavalent Chromium	218.5
TOC (Total Organic Carbon)	415.1 (ASTM D4129)
TOX (Total Organic Halogen)	450.1
Ammonia	350.3
Nitrate/Nitrite	353.2
Cyanide	335.3
TSS (Total Suspended Solids)	160.2
TDS (Total Dissolved Solids)	160.1
Oil and Grease	413.2
Sulfate	375.4
Chloride	325.2
Fluoride	340.2
Phenol	420.1
Phosphate & Orthophosphate	365.2

Analysis of tritiated water vapor was performed on silica gel collected from the low-volume air samplers. Moisture extracted from the air during sampling was vacuum-distilled from the silica gel. A portion of the distillate was mixed with a scintillation solution and counted in a liquid scintillation spectrometer. The atmospheric tritium concentration is related to the tritium concentration of the distillate through the average absolute humidity for the period during which the sample was collected.

Analysis of Water Samples for Radionuclides.

After thorough agitation of the water sample, a suitable aliquot was taken for the analysis of gross alpha/beta dissolved solids. The aliquot was acidified and evaporated to dryness on a hot plate, after which the residue was dissolved in 1N (normal) nitric acid and transferred to a tared planchet. Gross alpha/beta activity was determined by counting the planchet in an internal flow proportional counter. The result was corrected for counter efficiency and self-absorption.

A suitable aliquot of the water was filtered through a Millipore 0.45 μm filter for the analysis of gross alpha/beta suspended solids. The filter was counted by an internal flow proportional counter. Corrections were applied for self-absorption.

An aliquot of the total water sample was acidified for the analysis of uranium-234, uranium-238, and plutonium-239/240. Uranium-232 and plutonium-236 tracers were added to the aliquot, and the liquid was brought to dryness. The residue was ashed and dissolved in nitric acid. The uranium and plutonium salts were then adsorbed onto an ion exchange column, and the plutonium salt was eluted off the column. The plutonium was coprecipitated with a neodymium salt and microprecipitated onto a filter. The filter was counted for alpha activity on a solid-state alpha spectrometer. Chemical recovery was determined from the tracer peak. Uranium-234 and uranium-238 salts adsorbed on the ion

exchange resin from the plutonium analysis were eluted from the column, coprecipitated with a neodymium salt, and filtered from the solution. The filter was then counted for alpha activity on a solid-state alpha spectrometer. Chemical recovery was determined from the tracer peak.

For the analysis of tritium in water, the water sample was distilled to remove quenching materials and nonvolatile radioactive materials. Distillation was carried to dryness to ensure complete transfer of the tritium to the distillate. A portion of the distillate was mixed with scintillation cocktail and counted in a liquid scintillation spectrometer. Standard tritium and background samples were prepared and counted.

Analysis of Soil Samples for Radionuclides.

The soil samples were totally dissolved using a 40 percent hydrofluoric solution for the analysis of uranium-234, uranium-238, and plutonium-239/240. Uranium-232 and plutonium-236 tracers were added. After fuming with hydrofluoric acid, the sample was redissolved with nitric acid. The uranium and plutonium salts were then adsorbed onto an ion exchange column, and the plutonium salt was eluted off the column. The plutonium was coprecipitated with a neodymium salt and microprecipitated onto a filter. The filter was counted for alpha activity on a solid-state alpha spectrometer. Chemical recovery was determined from the tracer peak.

The effluent from the above plutonium analysis was analyzed for uranium-234 and uranium-238. The uranium was separated using an ion exchange resin, eluted off the column, and electroplated onto a stainless-steel planchet. A solid-state alpha spectrometer was utilized to count the planchet. Chemical recovery was determined from the tracer peak.

Analysis of Vegetation Samples for Radionuclides. The water was extracted from the vegetation samples by freeze-drying distillation for tritium analysis. The distillation was carried to dryness to ensure complete

transfer of the tritium. A portion of the distillate was mixed with scintillation cocktail and counted on a liquid scintillation spectrometer. Standard tritium and background samples were prepared and counted.

The dry vegetation was ashed in a muffle furnace for the analysis of uranium-234 and uranium-238. A uranium-232 tracer was added, and the samples were digested to dryness with a nitric/hydrofluoric acid and redissolved in hydrochloric acid. The uranium salt was then adsorbed onto an ion exchange column, and the adsorbed salt was eluted from the column, coprecipitated with a neodymium salt, and filtered from the solution. The filter was then counted for alpha activity on a solid-state alpha spectrometer. Chemical recovery was determined from the tracer peak.

10.4 Quality Assurance in the Laboratory

During 1993 samples collected under the environmental monitoring program were analyzed by both offsite and onsite laboratories. Most analyses for radiological and organic/inorganic constituents were performed at offsite laboratories operating under contract to Pantex Plant. Onsite laboratories performed certain short-holding-time analyses.

Quality Assurance in Onsite Laboratories. Onsite analyses in 1993 included screening of environmental air filters for gross alpha/beta activity by the Pantex Plant Radiation Safety Department (RSD) laboratory and analysis of wastewaters for chemical oxygen demand (COD) by the Environmental Protection Department (EPD) laboratory. To ensure QC in the operation of the low background alpha/beta counter, the RSD laboratory determined the alpha/beta radiation backgrounds and efficiencies immediately prior to performing the screening measurement. Furthermore, a blank filter and an empty planchet were counted with each set of filters. To ensure QA of the COD analysis, the

EPD laboratory ran duplicate solutions of an externally procured COD standard with each batch of environmental wastewater samples.

Quality Assurance in Offsite Contract Laboratories. Offsite contract laboratories were contractually required to maintain a QA/QC program meeting the requirements of the EPA manual, SW-846 (EPA, 1986). These QA/QC requirements include the following:

- Running analytical splits/spiked samples on each batch of environmental samples or on every 20 samples, whichever is the greater frequency
- Running a reagent blank with each analytical batch
- Spiking each blank, standard, and environmental sample for organic analysis with surrogate compounds prior to purging or extraction
- Running an analytical check sample with each batch of metal analytes.

For inorganic analyses, standardization calibration curves were required to be prepared daily and verified by running a verification sample with each batch of samples. The verification sample was required to repeat the original calibration curve within ± 10 percent.

Quality control procedures covering instrument calibration and adjustment or tuning procedures are specific to the individual test method, and are incorporated into the specific procedure. Additionally, other QC features such as accuracy limits or repeatability requirements, are incorporated into many of the analytical procedures.

10.5 Verification of Quality Assurance

To verify that contractual QA requirements were being met, Pantex conducted a QA program.

Elements of the program included quality audits at the laboratories, validation of data packages by Pantex personnel, and required participation of the contract laboratories in performance evaluation programs.

Audits of Laboratories. Semiannual audits were conducted by the Pantex Plant personnel at each laboratory during the year to assure that operations relevant to Pantex Plant requirements were being conducted according to the specified terms. Results of the audits were forwarded to the affected laboratories, and responses from the laboratories were evaluated to ensure that they addressed the audit findings.

Data Validation. Data packages on all environmental samples were evaluated by the Pantex Plant to guarantee that laboratory results were within the quality guidelines of the contract. Items, evaluated during 1993, included:

- Proper test methods, holding times within SW-846 (EPA, 1986) limits
- Calibrations conducted according to procedural requirements
- Achievement of detection limits
- Proper performance of calculations and calibrations
- Quality control of matrix spikes and blanks
- Yield/recovery of internal standards added to the sample.

Samples/packages not meeting the validation standards are not incorporated into the environmental database.

Performance Evaluation Programs. Laboratories performing testing of environmental samples for radionuclides are required to participate in the DOE Environmental Measurements Laboratory (EML) Performance

Evaluation Program. In this program, participating laboratories analyze air filters and water, soil, vegetation, and tissue samples for radionuclides prepared by EML. Results of the 1993 evaluation are provided in Tables 10.4 and 10.5. With respect to Table 10.4, the ALR value is high for the analysis of uranium for air filters due to inherent variability of the preparation of air filters. The water medium provides the best comparison of data in that true replicate samples can be prepared. With respect to Table 10.5, the analysis of uranium for soil was accepted and it appears that the replicate sample analyzed by EML had higher activities than was in the samples shipped to all the participants.

10.6 Sample Tracking and Data Management

An internally developed database, the Environmental Monitoring Tracking System (EMTS), was used to maintain current status of samples forwarded to all analytical laboratories during 1993.

Information tracked using the EMTS included:

- The sample number
- COC number
- Location of the sampling event
- Date of the sampling event
- Date samples were shipped to the analysis laboratory
- Date analysis began at analysis laboratory
- Date analysis results are received from laboratory
- Validated analysis results

- Analyses requested
- Laboratory sample "batch" number.

Another database is used to track the number and dates of "batch" validation and invoicing information.

The EMTS database was also used to store all validated analysis results. Data tables prepared from the computer database reporting function were incorporated into monthly, quarterly, and

annual data compilation reports of environmental monitoring data. The reports were then provided to individual media managers for interpretation of the data.

All relevant documentation associated with each sample batch is retained by Pantex Plant. This documentation includes all laboratory sample results, laboratory QA/QC results, any notations that validate or invalidate data, and laboratory audit results.

Table 10.4 EML Performance Evaluation Program, March 1993

Media	Isotope	*ALR Value	**EML Value	ALR/EML Ratio
Air Filter	Pu-239/240	0.025 ± 0.007	0.023 ± 0.002	1.09
Air Filter	U-234	0.073 ± 0.012	0.022 ± 0.001	3.32
Air Filter	U-238	0.045 ± 0.010	0.024 ± 0.001	1.88
Soil	Pu-239/240	19.4 ± 3.9	11.6 ± 0.81	1.67
Soil	U-234	29.8 ± 2.6	37.8 ± 2.27	0.79
Soil	U-238	30.5 ± 2.6	37.6 ± 0.38	0.81
Vegetation	Pu-239/240	0.243 ± 1.06	0.323 ± 0.016	0.75
Water	H-3	96.2 ± 7.40	97.0 ± 2.91	0.99
Water	U-234	0.163 ± 0.063	0.151 ± 0.002	1.08
Water	U-238	0.126 ± 0.052	0.147 ± 0.009	0.86
Water	Pu-239/240	0.962 ± 0.185	0.828 ± 0.025	1.16

Data are presented in units of becquerel/filter for the air filters, becquerel/kilogram for soil and vegetation samples, and becquerel/liter for water samples.

Table 10.5 EML Performance Evaluation Program, October 1993

Media	Isotope	*ALR Value	**EML Value	ALR/EML Ratio
Air Filter	Pu-239/240	0.132 ± 0.009	0.080 ± 0.002	1.65
Air Filter	U-234	0.058 ± 0.006	0.065 ± 0.003	0.89
Air Filter	U-238	0.065 ± 0.007	0.065 ± 0.005	1.00
Soil	Pu-239/240	2.97 ± 0.38	1.52 ± 0.319	1.95
Soil	U-234	6.23 ± 0.94	24.8 ± 0.74	0.25
Soil	U-238	6.85 ± 0.96	25.5 ± 1.02	0.27
Vegetation	Pu-239/240	1.01 ± 0.38	0.965 ± 0.039	1.05
Water	H-3	270 ± 7.0	270 ± 6.8	1.00
Water	Pu-239/240	0.367 ± 0.031	0.338 ± 0.017	1.09
Water	U-234	0.942 ± 0.069	1.06 ± 0.053	0.89
Water	U-238	0.893 ± 0.060	1.08 ± 0.022	0.83

Data are presented in units of becquerel/filter for the air filters, becquerel/kilogram for soil and vegetation samples, and becquerel/liter for water samples.

* ALR - Accu-Labs Research, Inc., Golden, Colorado

** EML - Environmental Measurements Laboratory, New York City, New York

10.7 Sampling and Analysis Performance Indicator Program

During 1993 Pantex Plant initiated a program to track the performance of the laboratories providing sample analysis. The sum of individual analysis which failed one or more of several quality criteria were obtained for each month for individual laboratories and for all laboratories. The performance criteria were:

1. **Holding Time Missed.** The analysis was not started within the time frame established by the EPA or required by the Pantex Plant.
2. **Incorrect Test Method.** The analysis was not performed according to a method established by the EPA or required by the Pantex Plant.
3. **Poor Recoveries.** Compounds and/or radioisotopes added to the sample prior to laboratory processing were not recovered at the anticipated ratio of recovery required by the Plant.

4. **Insufficient QA/QC Data.** Insufficient QA/QC data were received from the analytical laboratory to allow validation of results.

5. **Wrong Minimum Detectable Limit (MDL).** The laboratory reported extremely low levels of analytes as "less than minimum detectable," but did not use required MDL in reporting these results.

Table 10.6 shows the total number of missed analyses for all causes and in each of several categories for the 15,144 analyses obtained during 1993. Use of this performance indicator allowed the Plant to identify and correct a continuing problem with missed holding times. Monthly trending indicated that approximately one-third of the 3.66 percent invalid analyses occurred during the last quarter of the calendar year after contracts were established with several laboratories that had not previously analyzed samples for the Pantex Plant.

Table 10.6 Causes of Invalid Data for All Laboratories, 1993

Parameter	Number Invalid Analyses	% Invalid Analyses
Holding Time Missed	298	1.97
Wrong Test Method	56	0.37
Poor Recoveries	3	0.02
Insufficient QA/QC	126	0.86
Wrong MDL	71	0.47
All Causes	554	3.66

Section 11

POSTSCRIPTS

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11.2 Abbreviations and Acronyms

AAO Amarillo Area Office of the U.S. Department of Energy

AEC Atomic Energy Commission

AIP Agreement in Principle

AL Albuquerque Operations Office of the U.S. Department of Energy

ALR Accu-Labs Research Laboratory in Golden, Colorado

<BG Less Than Background

BDL Below Detection Limit

BOD Biochemical Oxygen Demand

Bq Becquerels (2.7×10^{-11} Ci)

CAA Clean Air Act

CERCLA Comprehensive Environmental Response Compensation and Liability Act

CCL Clean Closure Letter

cfm Cubic Feet per Minute

CFR Code of Federal Regulations

Ci Curie

COC Chain of Custody

COD Chemical Oxygen Demand

CWA Clean Water Act

DCA Dichloroethane

DCG Derived Concentration Guide

DL	Detection Limit
DOE	U.S. Department of Energy
dpm	Disintegrations per Minute
EA	Environmental Assessment
EDE	Effective Dose Equivalent
EML	Environmental Measurements Laboratory, DOE Laboratory in New York City, NY
EMP	Environmental Monitoring Plan
EMTS	Environmental Monitoring Tracking System
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Department
ERDA	Energy Research and Development Administration
ER	Environmental Restoration
ES&H	Environment, Safety and Health
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FM	Farm-to-Market Road
g	Gram
GIA	Grant in Aid
HE	High Explosive
HMX	A Crystalline High Explosive Used at Pantex Plant
IOP	Internal Operating Procedure
LDR	Land Disposal Restricted
LLW	Low-level Radioactive Waste
M&H	Mason & Hanger-Silas Mason Co., Inc.
Max	Maximum
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
ml	Milliliter
Min	Minimum
N	Normal, in Reference to Chemical Solution Strength
N/A	Not Applicable

NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NWS	National Weather Service
ORR	Operational Readiness Review
PAT	Progress Assessment Team
PCBs	Polychlorinated Biphenyls
PETN	Pentaerythritol Tetranitrate, a High Explosive Used at Pantex Plant
Pu-239	Plutonium Isotope with Atomic Weight of 239
QA	Quality Assurance
QC	Quality Control
QTR	Quarter
RCRA	Resource Conservation and Recovery Act
RDX	A Crystalline High Explosive Used at Pantex Plant
rem	Radiation Equivalent Man
RFI	RCRA Facility Investigation
%RPD	Relative Percent Difference
RSD	Radiation Safety Department
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEN	Secretary of Energy Notice
SHPO	State Historic Preservation Officer
Std. Dev.	Standard Deviation
Sv	Seivert
SVOC	Semi-volatile organic compounds
TAC	Texas Administrative Code
TBEG	Texas Bureau of Economic Geology
TCAA	Texas Clean Air Act

TCE	Trichloroethylene
TDCJ	Texas Department of Criminal Justice
TDH-BRC	Texas Department of Health-Bureau of Radiation Control
TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimeter
TNRCC	Texas Natural Resource Conservation Commission
TNT	Trinitrotoluene, a Crystalline High Explosive Used at Pantex Plant
TOC	Total Organic Carbon
TOX	Total Organic Halogen
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
TSS	Total Suspended Solids
TTU	Texas Tech University
U-234	Uranium Isotope with Atomic Weight of 234
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USC	United States Code
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
YR	Year
WM	Waste Management
WWDP	Wastewater Discharge Permit
WWTF	Wastewater Treatment Facility

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APPENDIX A SURFACE WATER RESULTS

RADIONUCLIDES*				
Location	Variable	Mean	Minimum	Maximum
<u>11-50</u>	<u>1 Sample</u>			
	Uranium 234	5.0 ± 0.4	5.0 ± 0.4	-
	Uranium 238	2.2 ± 0.3	2.2 ± 0.3	-
	Plutonium	0.0 ± 0.0	0.0 ± 0.01	-
	Tritium	1.3 ± 0.2	1.3 ± 0.2	-
	Radium 226	0.1 ± 0.2	0.1 ± 0.2	-
	Radium 228	-0.1 ± 0.7	-0.1 ± 0.7	-
	Gross Alpha, dissolved	3.0 ± 2.0	3 ± 2	-
	Gross Alpha, suspended	1.0 ± 1.0	1 ± 1	-
	Gross Beta, dissolved	9.0 ± 3.0	9 ± 3	-
	Gross Beta, suspended	2.0 ± 2.0	2 ± 2	-
<u>12-43</u>	<u>2 Samples</u>			
	Uranium 234	4.3 ± 0.6	4.1 ± 0.4	4.4 ± 0.8
	Uranium 238	1.8 ± 0.4	1.5 ± 0.5	2.0 ± 0.2
	Plutonium	0.0 ± 0.0	0.0 ± 0.01	0.01 ± 0.02
	Tritium	-0.1 ± 0.1	-0.12 ± 0.15	-0.08 ± 0.14
	Radium 226	0.2 ± 0.2	0.1 ± 0.2	0.2 ± 0.1
	Radium 228	-0.6 ± 0.9	-0.8 ± 1.3	-0.3 ± 0.5
	Gross Alpha, Dissolved	6.0 ± 2.5	6 ± 3	6 ± 2
	Gross Alpha, Suspended	0.5 ± 1.0	0 ± 1	1 ± 1
	Gross Beta, Dissolved	7.5 ± 2.5	6 ± 2	9 ± 3
	Gross Beta, Suspended	1.0 ± 2.0	0 ± 2	2 ± 2
<u>16-1</u>	<u>6 Samples</u>			
	Uranium 234	0.2 ± 0.2	0.0 ± 0.1	0.8 ± 0.3
	Uranium 238	0.2 ± 0.1	0.0 ± 0.02	0.7 ± 0.3
	Plutonium	0.0 ± 0.0	-0.01 ± 0.02	0.04 ± 0.08
	Tritium	0.0 ± 0.2	-0.04 ± 0.14	0.07 ± 0.16
	Radium 226	0.2 ± 0.3	-0.1 ± 0.3	0.3 ± 0.2
	Radium 228	0.7 ± 0.7	0.4 ± 0.6	0.9 ± 0.6
	Gross Alpha, Dissolved	0.7 ± 1.0	0 ± 1	2 ± 1
	Gross Alpha, Suspended	1.5 ± 1.0	1 ± 1	2 ± 1
	Gross Beta, Dissolved	7.8 ± 1.2	4 ± 1	16 ± 1
	Gross Beta, Suspended	3.8 ± 1.0	1 ± 1	7 ± 1

* Units of reporting are $\mu\text{Ci E-9/ml}$, except for tritium which is $\mu\text{Ci E-6/ml}$

Radionuclides*, Continued				
Location	Variable	Mean	Maximum	Minimum
<u>WWTP</u>	<u>14 Samples</u>			
<u>Discharge</u>	Uranium 234	5.1 ± 0.4	3.8 ± 0.3	6.1 ± 0.5
<u>After Chlorination</u>	Uranium 238	2.5 ± 0.3	2.0 ± 0.2	3.0 ± 0.1
	Plutonium	-1.2 ± 0.0	-0.08 ± 0.09	0.05 ± 0.06
	Tritium	0.0 ± 0.2	-0.14 ± 0.14	0.76 ± 0.16
	Radium 226	0.3 ± 0.3	-0.1 ± 0.4	0.5 ± 0.7
	Radium 228	0.4 ± 0.8	-0.2 ± 0.6	1.3 ± 0.8
	Gross Alpha, Dissolved	7.9 ± 3.5	4 ± 4	14 ± 3
	Gross Alpha, Suspended	0.1 ± 1.0	0 ± 1	1 ± 1
	Gross Beta, Dissolved	11.5 ± 3.6	7 ± 5	17 ± 3
	Gross Beta, Suspended	1.2 ± 1.3	0 ± 1	3 ± 3
<u>WWTP</u>	<u>13 Samples</u>			
<u>Incoming</u>	Uranium 234	5.0 ± 0.5	3.8 ± 0.4	5.8 ± 0.5
	Uranium 238	2.4 ± 0.3	1.8 ± 0.3	2.8 ± 0.3
	Plutonium	-0.0 ± 0.0	-0.08 ± 0.10	0.07 ± 0.08
	Tritium	0.1 ± 0.2	-0.09 ± 0.14	.89 ± 0.19
	Radium 226	0.2 ± 0.3	0.0 ± 0.2	0.9 ± 0.5
	Radium 228	0.4 ± 1.2	-0.20 ± 1.7	1.50 ± 1.5
	Gross Alpha, Dissolved	6.2 ± 2.4	3 ± 1	12 ± 4
	Gross Alpha, Suspended	0.8 ± 1.0	0 ± 1	3 ± 1
	Gross Beta, Dissolved	11.2 ± 2.5	7 ± 3	21 ± 4
	Gross Beta, Suspended	1.1 ± 1.2	0 ± 1	3 ± 1
<u>WWTP</u>	<u>13 Samples</u>			
<u>Lagoon</u>	Uranium 234	5.3 ± 0.4	4.4 ± 0.4	6.4 ± 0.3
	Uranium 238	2.7 ± 0.3	2.0 ± 0.2	3.6 ± 0.2
	Plutonium	0.0 ± 0.1	-0.08 ± 0.10	0.21 ± 0.12
	Tritium	-0.0 ± 0.2	-0.15 ± 0.15	0.15 ± 0.16
	Radium 226	0.2 ± 0.2	-0.10 ± 0.2	0.30 ± 0.3
	Radium 228	0.4 ± 0.9	-0.2 ± 0.7	1.2 ± 1.3
	Gross Alpha, Dissolved	6.2 ± 3.2	4 ± 3	9 ± 3
	Gross Alpha, Suspended	0.2 ± 1.0	0 ± 1	2 ± 1
	Gross Beta, Dissolved	11.2 ± 3.6	7 ± 3	18 ± 4
	Gross Beta, Suspended	1.7 ± 1.2	0 ± 1	4 ± 2
<u>Pantex Lake</u>	<u>5 Samples</u>			
	Uranium 234	2.1 ± 0.3	0.8 ± 0.2	4.0 ± 0.4
	Uranium 238	1.8 ± 0.2	0.4 ± 0.1	4.3 ± 0.2
	Plutonium	-0.0 ± 0.0	-0.03 ± 0.05	0.00 ± 0.01
	Tritium	-0.1 ± 0.2	-0.14 ± 0.15	-0.02 ± 0.14
	Radium 226	0.2 ± 0.3	0.1 ± 0.6	0.5 ± 0.4
	Radium 228	0.6 ± 0.9	-0.2 ± 1.0	1.2 ± 0.9
	Gross Alpha, Dissolved	5.0 ± 1.8	0 ± 1	12 ± 3
	Gross Alpha, Suspended	2.0 ± 1.4	0 ± 2	4 ± 2
	Gross Beta, Dissolved	11.8 ± 1.6	5 ± 2	16 ± 2
	Gross Beta, Suspended	4.8 ± 1.4	3 ± 2	8 ± 2

* Units of reporting are $\mu\text{Ci E-9/ml}$, except for tritium which is $\mu\text{Ci E-6/ml}$

Radionuclides*, Continued				
Location	Variable	Mean	Maximum	Minimum
<u>Playa One</u>	<u>8 Samples</u>			
	Uranium 234	4.9 ± 0.4	0.1 ± 0.1	9.0 ± 0.5
	Uranium 238	2.5 ± 0.3	0.1 ± 0.1	4.6 ± 0.4
	Plutonium	-0.0 ± 0.0	-0.04 ± 0.05	0.01 ± 0.02
	Tritium	-0.0 ± 0.2	-0.12 ± 0.15	0.11 ± 0.15
	Radium 226	0.3 ± 0.3	-0.1 ± 0.6	1.0 ± 0.4
	Radium 228	0.2 ± 1.2	-0.5 ± 0.9	1.2 ± 0.6
	Gross Alpha, Dissolved	7.1 ± 2.9	1 ± 1	13 ± 4
	Gross Alpha, Suspended	3.3 ± 1.4	1 ± 1	6 ± 3
	Gross Beta, Dissolved	17.8 ± 3.1	13 ± 1	26 ± 4
	Gross Beta, Suspended	7.4 ± 1.5	2 ± 1	15 ± 3
<u>Bushland</u>	<u>4 Samples</u>			
	Uranium 234	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1
	Uranium 238	0.2 ± 0.1	0.0 ± 0.1	0.2 ± 0.1
	Plutonium	-0.0 ± 0.0	-0.02 ± 0.04	0.02 ± 0.04
	Tritium	-0.0 ± 0.1	-0.06 ± 0.14	0.02 ± 0.17
	Radium 226	0.4 ± 0.2	0.2 ± 0.2	0.4 ± 0.2
	Radium 228	0.7 ± 0.7	0.2 ± 0.6	0.9 ± 0.7
	Gross Alpha, Dissolved	0.8 ± 1.0	0 ± 1	1 ± 1
	Gross Alpha, Suspended	1.0 ± 1.0	1 ± 1	1 ± 1
	Gross Beta, Dissolved	38.3 ± 2.0	33 ± 2	40 ± 2
	Gross Beta, Suspended	3.5 ± 1.0	2 ± 1	4 ± 1
<u>Playa Three</u>	<u>3 Samples</u>			
	Uranium 234	0.3 ± 0.1	0.1 ± 0.1	0.4 ± 0.1
	Uranium 238	0.3 ± 0.1	0.1 ± 0.1	0.4 ± 0.1
	Plutonium	0.0 ± 0.0	-0.01 ± 0.01	0.07 ± 0.06
	Tritium	0.0 ± 0.2	0.02 ± 0.16	0.02 ± 0.16
	Radium 226	2.2 ± 1.0	0.5 ± 0.4	4.6 ± 2.1
	Radium 228	2.3 ± 1.7	1.4 ± 1.8	4.0 ± 1.3
	Gross Alpha, Dissolved	1.0 ± 1.3	0 ± 1	2 ± 1
	Gross Alpha, Suspended	18.7 ± 7.0	3 ± 3	39 ± 12
	Gross Beta, Dissolved	13.7 ± 2.0	11 ± 3	18 ± 2
	Gross Beta, Suspended	48.0 ± 7.3	17 ± 3	93 ± 13
<u>Z-12-E</u>	<u>2 Samples</u>			
	Uranium 234	0.5 ± 0.1	0.4 ± 0.1	0.5 ± 0.1
	Uranium 238	0.3 ± 0.1	0.2 ± 0.1	0.3 ± 0.1
	Plutonium	-0.0 ± 0.0	-0.02 ± 0.03	-0.01 ± 0.02
	Tritium	-0.1 ± 0.2	-0.16 ± 0.16	-0.01 ± 0.16
	Radium 226	0.6 ± 0.4	0.1 ± 0.4	1.0 ± 0.4
	Radium 228	0.7 ± 1.5	0.5 ± 2.4	0.8 ± 0.6
	Gross Alpha, Dissolved	1.5 ± 1.0	1 ± 1	2 ± 1
	Gross Alpha, Suspended	5.0 ± 1.5	3 ± 1	7 ± 2
	Gross Beta, Dissolved	10.5 ± 1.0	9 ± 1	12 ± 1
	Gross Beta, Suspended	8.5 ± 1.5	3 ± 1	14 ± 2

* Units of reporting are $\mu\text{Ci E-9/ml}$, except for tritium which is $\mu\text{Ci E-6/ml}$

Radionuclides*, Continued				
Location	Variable	Mean	Maximum	Minimum
<u>Z-12-EN</u>	<u>3 Samples</u>			
	Uranium 234	0.2 ± 0.1	0.2 ± 0.1	0.3 ± 0.1
	Uranium 238	0.1 ± 0.1	0.1 ± 0.1	0.2 ± 0.1
	Plutonium	0.0 ± 0.0	0.00 ± 0.03	0.01 ± 0.02
	Tritium	-0.0 ± 0.2	-0.05 ± 0.17	0.01 ± 0.17
	Radium 226	0.4 ± 0.3	0.0 ± 0.4	0.7 ± 0.3
	Radium 228	0.6 ± 0.7	0.1 ± 0.9	0.9 ± 0.6
	Gross Alpha, Dissolved	3.3 ± 2.0	2 ± 1	5 ± 4
	Gross Alpha, Suspended	2.3 ± 1.3	0 ± 1	4 ± 2
	Gross Beta, Dissolved	10.3 ± 2.0	9 ± 1	12 ± 4
	Gross Beta, Suspended	7.7 ± 1.7	1 ± 1	12 ± 2
<u>Z-12-S</u>	<u>8 Samples</u>			
	Uranium 234	2.6 ± 0.4	0.2 ± 0.1	4.7 ± 0.5
	Uranium 238	1.4 ± 0.3	0.1 ± 0.1	2.4 ± 0.3
	Plutonium	-0.0 ± 0.1	-0.03 ± 0.05	0.05 ± 0.06
	Tritium	0.3 ± 0.2	-0.16 ± 0.17	2.00 ± 0.20
	Radium 226	0.2 ± 0.3	-0.1 ± 0.2	0.3 ± 0.3
	Radium 228	0.5 ± 0.8	-0.2 ± 1.1	1.5 ± 1.3
	Gross Alpha, Dissolved	4.1 ± 1.8	1 ± 1	8 ± 2
	Gross Alpha, Suspended	0.9 ± 1.0	0 ± 1	3 ± 1
	Gross Beta, Dissolved	7.0 ± 1.5	5 ± 2	11 ± 2
	Gross Beta, Suspended	4.1 ± 1.1	1 ± 1	11 ± 1
<u>Z-12-W</u>	<u>6 Samples</u>			
	Uranium 234	1.5 ± 0.2	0.1 ± 0.1	4.1 ± 0.3
	Uranium 238	0.7 ± 0.2	0.0 ± 0.1	2.1 ± 0.3
	Plutonium	-0.0 ± 0.0	-0.20 ± 0.03	2.02 ± 0.08
	Tritium	0.0 ± 0.2	-0.04 ± 0.17	0.10 ± 0.16
	Radium 226	0.2 ± 0.3	0.0 ± 0.3	0.4 ± 0.4
	Radium 228	0.9 ± 0.8	0.2 ± 0.8	1.7 ± 1.5
	Gross Alpha, Dissolved	2.7 ± 1.5	0 ± 1	6 ± 2
	Gross Alpha, Suspended	1.0 ± 1.0	0 ± 1	2 ± 1
	Gross Beta, Dissolved	7.7 ± 1.8	5 ± 1	11 ± 2
	Gross Beta, Suspended	3.0 ± 1.2	2 ± 2	5 ± 1

* Units of reporting are $\mu\text{Ci E-9/ml}$, except for tritium which is $\mu\text{Ci E-6/ml}$

Volatiles					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>11-20</u>	<u>6 Samples</u>	-----No Detections-----			
<u>11-36</u>	<u>1 Sample</u>	-----No Detections-----			
<u>11-50</u>	<u>10 Samples</u>	-----No Detections-----			
<u>12-17-N</u>	<u>5 Samples</u>	-----No Detections-----			
<u>12-17-S</u>	<u>11 Samples</u>				
	Acetone	0.007	0.16	0.088	0.044
<u>12-19-N</u>	<u>10 Samples</u>	-----No Detections-----			
<u>12-19-S</u>	<u>10 Samples</u>	-----No Detections-----			
<u>12-24-NE</u>	<u>1 Sample</u>	-----No Detections-----			
<u>12-43</u>	<u>7 Samples</u>				
	Acetone	0.099	0.17	0.109	0.027
	2-Butanone	0.099	0.19	0.112	0.034
	Tetrahydrofuran	0.004	0.62	0.093	0.232
<u>16-1</u>	<u>6 Samples</u>	-----No Detections-----			
<u>WWTP Discharge After Chlor- ination</u>	<u>14 Samples</u>				
	Toluene	0.002	0.012	0.006	0.003
<u>WWTP Incoming</u>	<u>13 Samples</u>				
	Acetone	0.012	0.029	0.068	0.075
<u>WWTP Lagoon</u>	<u>14 Samples</u>	-----No Detections-----			
<u>North Ditch</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Pantex Lake</u>	<u>5 Samples</u>	-----No Detections-----			
<u>Playa One</u>	<u>9 Samples</u>	-----No Detections-----			
<u>Playa Two</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Playa Three</u>	<u>2 Samples</u>	-----No Detections-----			
<u>Z-11-SE</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Z-11-SW</u>	<u>2 Samples</u>	-----No Detections-----			

Volatiles, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Z-12-E</u>	<u>5 Samples</u>		-----No Detections-----		
<u>Z-12-EN</u>	<u>3 Samples</u>		-----No Detections-----		
<u>Z-12-S</u>	<u>9 Samples</u>		-----No Detections-----		
<u>Z-12-SUB</u>	<u>2 Samples</u>		-----No Detections-----		
<u>Z-12-W</u>	<u>6 Samples</u>		-----No Detections-----		
<u>Z-4-E</u>	<u>3 Samples</u>		-----No Detections-----		
<u>Bushland</u>	<u>2 Samples</u>		-----No Detections-----		

Semi-Volatiles					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Pantex Lake</u>	<u>4 Samples</u>				
	3,3-Dichlorobenzidine	0.019	0.0400	0.034	0.010
	4-Methylphenol	0.002	0.0090	0.007	0.003
<u>Playa One</u>	<u>8 Samples</u>				
	3,3-Dichlorobenzidine	0.019	0.0400	0.034	0.009
	Benzoic Acid	0.001	0.0400	0.035	0.013
<u>Bushland</u>	<u>1 Sample</u>		-----No Detections-----		
<u>Playa Three</u>	<u>2 Samples</u>		-----No Detections-----		

High Explosives					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>11-20</u>	<u>5 Samples</u>				
	HMX	0.019	0.110	0.037	0.040
<u>11-36</u>	<u>1 Sample</u>	-----No Detections-----			
<u>11-50</u>	<u>11 Samples</u>				
	HMX	0.019	0.028	0.136	0.085
	RDX	0.019	0.450	0.107	0.149
	PENT	0.390	0.790	0.426	0.120
	TNT	0.019	0.039	0.020	0.006
<u>12-17-N</u>	<u>5 Samples</u>	-----No Detections-----			
<u>12-17-S</u>	<u>9 Samples</u>	-----No Detections-----			
<u>12-19-N</u>	<u>9 Samples</u>				
	RDX	0.019	0.067	0.024	0.016
<u>12-19-S</u>	<u>10 Samples</u>	-----No Detections-----			
<u>12-24-NE</u>	<u>1 Sample</u>	-----No Detections-----			
<u>12-43</u>	<u>6 Samples</u>				
	HMX	0.019	0.014	0.050	0.051
	RDX	0.019	0.027	0.020	0.003
<u>16-1</u>	<u>14 Samples</u>				
	HMX	0.012	0.019	0.017	0.002
	RDX	0.013	0.019	0.018	0.002
	PENT	0.014	0.390	0.327	0.153
	TNT	0.006	0.019	0.016	0.005
<u>WWTP</u>	<u>14 Samples</u>				
<u>Discharge</u>	HMX	0.012	0.019	0.018	0.002
<u>After</u>	RDX	0.012	0.019	0.018	0.002
<u>Chlor-</u>	PENT	0.013	0.039	0.336	0.136
<u>ination</u>	TNT	0.006	0.019	0.017	0.004
<u>WWTP</u>	<u>13 Samples</u>				
<u>Incoming</u>	HMX	0.012	0.096	0.024	0.021
	RDX	0.013	0.019	0.018	0.001
	PENT	0.013	0.390	0.361	0.104
	TNT	0.006	0.019	0.018	0.003
<u>Lagoon</u>	<u>12 Samples</u>				
	HMX	0.012	0.019	0.018	0.002
	RDX	0.013	0.019	0.018	0.001
	PENT	0.013	0.039	0.358	0.108
	TNT	0.006	0.019	0.017	0.003
<u>North</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Ditch</u>					

High Explosives, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Pantex Lake</u>	<u>5 Samples</u>				
	HMX	0.012	0.019	0.017	0.003
	RDX	0.013	0.019	0.017	0.002
	PENT	0.014	0.390	0.314	0.168
	TNT	0.006	0.019	0.016	0.005
<u>Playa One</u>	<u>10 Samples</u>				
	HMX	0.012	0.019	0.017	0.002
	RDX	0.013	0.038	0.019	0.006
	PENT	0.014	0.390	0.314	0.158
	TNT	0.006	0.019	0.016	0.005
<u>Playa Two</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Bushland</u>	<u>2 Samples</u>	-----No Detections-----			
<u>Playa Three</u>	<u>3 Samples</u>	-----No Detections-----			
<u>Tailwater</u>	<u>2 Samples</u>	-----No Detections-----			
<u>Z-11-SE</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Z-11-SW</u>	<u>2 Samples</u>	-----No Detections-----			
<u>Z-12-E</u>	<u>5 Samples</u>				
	HMX	0.012	0.055	0.025	0.017
	RDX	0.013	0.027	0.019	0.004
	PENT	0.014	0.039	0.314	0.168
	TNT	0.006	0.019	0.016	0.006
<u>Z-12-EN</u>	<u>3 Samples</u>				
	HMX	0.059	0.087	0.068	0.016
	RDX	0.120	0.130	0.123	0.005
<u>Z-12-S</u>	<u>9 Samples</u>				
	HMX	0.012	0.019	0.018	0.002
	RDX	0.013	0.019	0.018	0.002
	PENT	0.014	0.039	0.348	0.125
	TNT	0.006	0.019	0.017	0.004
<u>Z-12-Sub</u>	<u>2 Samples</u>	-----No Detections-----			
<u>Z-12-W</u>	<u>5 Samples</u>				
	HMX	0.012	0.019	0.018	0.003
	RDX	0.013	0.019	0.018	0.002
	PENT	0.014	0.390	0.315	0.168
	TNT	0.006	0.019	0.016	0.005
<u>Z-4-E</u>	<u>3 Samples</u>	-----No Detections-----			

METALS					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>11-20</u>	<u>6 Samples</u>				
	Aluminum	0.099	0.200	0.116	0.041
	Barium	0.049	10.00	1.74	4.04
	Boron-ICP	0.099	0.300	0.166	0.081
	Cadmium	0.004	0.009	0.005	0.002
	Calcium	15.00	44.00	28.50	11.91
	Chromium	0.004	0.007	0.005	0.001
	Cobalt	0.004	0.190	0.035	0.07
	Copper	0.008	0.047	0.020	0.01
	Iron	0.040	0.130	0.082	0.04
	Magnesium	4.900	37.00	17.45	11.71
	Manganese	0.004	0.055	0.015	0.01
	Molybdenum	0.004	0.009	0.008	0.002
	Nickel	0.009	0.019	0.014	0.005
	Potassium	2.300	30.00	8.78	10.47
	Silica-ICP	3.100	18.00	10.33	5.69
	Sodium	6.200	76.00	27.87	25.02
	Thallium	0.090	0.200	0.108	0.044
	Strontium	0.200	1.300	0.650	0.413
	Tin	0.029	0.049	0.042	0.010
	Vanadium	0.004	0.027	0.013	0.007
	Zinc	0.004	0.075	0.027	0.025
	Arsenic	0.004	0.007	0.005	0.001
	Selenium	0.004	0.007	0.005	0.001
<u>11-36</u>	<u>1 Sample</u>	-----No Detections-----			
<u>11-50</u>	<u>11 Samples</u>				
	Aluminum	0.099	0.800	0.236	0.237
	Barium	0.100	0.310	0.214	0.063
	Boron-ICP	0.100	0.300	0.182	0.060
	Cadmium	0.004	0.009	0.006	0.002
	Calcium	29.00	49.00	37.54	5.90
	Cobalt	0.004	0.190	0.038	0.07
	Copper	0.004	0.005	0.004	0.00004
	Iron	0.170	11.00	3.46	3.12
	Magnesium	11.00	25.00	19.27	4.56
	Manganese	0.019	0.210	0.105	0.060
	Molybdenum	0.004	0.010	0.007	0.002
	Nickel	0.009	0.019	0.013	0.005
	Potassium	6.200	16.00	8.41	2.69
	Silica-ICP	9.200	23.00	14.01	3.43
	Sodium	17.00	33.00	26.45	5.46
	Thallium	0.090	0.100	0.090	0.003
	Strontium	0.490	0.970	0.735	0.160
	Tin	0.029	0.049	0.041	0.010

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>11-50, Continued</u>	Vanadium	0.004	0.014	0.006	0.002
	Zinc	0.006	0.043	0.021	0.012
	Arsenic	0.004	0.026	0.007	0.006
	Mercury	0.00009	0.0001	0.00009	0.000004
<u>12-17-N</u>	<u>5 Samples</u>				
	Aluminum	0.099	0.300	0.159	0.089
	Barium	0.049	0.110	0.077	0.027
	Boron-ICP	0.099	0.200	0.119	0.045
	Calcium	8.6	38.0	19.7	12.0
	Copper	0.005	0.045	0.018	0.016
	Iron	0.020	0.670	0.182	0.275
	Magnesium	0.250	24.00	5.27	10.4
	Manganese	0.004	0.018	0.009	0.005
	Molybdenum	0.004	0.009	0.006	0.002
	Nickel	0.009	0.019	0.013	0.005
	Potassium	0.290	5.30	1.72	2.11
	Silica-ICP	0.490	16.0	4.10	6.67
	Sodium	0.100	29.00	6.22	12.74
	Strontium	0.020	0.880	0.208	0.376
	Tin	0.029	0.049	0.037	0.010
	Vanadium	0.004	0.017	0.007	0.005
	Zinc	0.023	0.073	0.039	0.019
	Lead	0.004	0.009	0.005	0.002
<u>12-17-S</u>	<u>11 Samples</u>				
	Aluminum	0.099	0.200	0.108	0.030
	Barium	0.020	0.070	0.051	0.013
	Boron-ICP	0.009	0.099	0.091	0.027
	Cadmium	0.004	0.009	0.006	0.002
	Calcium	0.80	9.30	3.34	2.80
	Cobalt	0.004	0.190	0.038	0.075
	Copper	0.010	0.051	0.033	0.012
	Iron	0.030	0.220	0.109	0.058
	Magnesium	0.100	0.330	0.210	0.097
	Manganese	0.004	0.037	0.013	0.011
	Molybdenum	0.004	0.009	0.007	0.002
	Nickel	0.009	0.019	0.014	0.005
	Potassium	0.290	0.700	0.465	0.128
	Silica-ICP	0.490	0.600	0.530	0.055
	Sodium	0.090	140.0	12.8	42.1
	Strontium	0.009	0.030	0.013	0.007
	Tin	0.029	0.049	0.041	0.010
	Vanadium	0.004	0.009	0.006	0.002
	Zinc	0.006	0.027	0.015	0.007

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>12-19-N</u>	<u>10 Samples</u>				
	Aluminum	0.100	1.800	0.450	0.516
	Barium	0.049	0.320	0.137	0.078
	Boron-ICP	0.099	1.500	0.329	0.419
	Calcium	8.1	70.0	39.5	15.9
	Chromium	0.004	0.091	0.015	0.027
	Copper	0.007	0.093	0.025	0.026
	Iron	0.080	1.300	0.344	0.369
	Magnesium	2.9	130.0	34.4	35.5
	Manganese	0.004	0.033	0.010	0.010
	Molybdenum	0.004	0.080	0.014	0.023
	Nickel	0.009	0.130	0.025	0.037
	Potassium	1.4	110.0	17.2	32.9
	Silica-ICP	2.3	33.0	16.2	8.8
	Sodium	3.8	710.0	100.8	215.0
	Strontium	0.120	3.000	1.092	0.796
	Tin	0.029	0.049	0.039	0.010
	Thallium	0.020	0.090	0.077	0.027
	Vanadium	0.004	0.190	0.034	0.055
	Zinc	0.012	0.073	0.037	0.018
	Arsenic	0.004	0.016	0.006	0.004
	Lead	0.004	0.019	0.006	0.004
	Selenium	0.004	0.055	0.010	0.015
<u>12-19-S</u>	<u>10 Samples</u>				
	Aluminum	0.099	4.700	0.849	1.559
	Barium	0.049	0.260	0.106	0.081
	Boron-ICP	0.099	0.200	0.109	0.031
	Cadmium	0.004	0.009	0.005	0.0016
	Calcium	1.40	36.00	7.64	10.52
	Chromium	0.004	0.049	0.011	0.014
	Cobalt	0.004	0.190	0.023	0.058
	Copper	0.008	0.260	0.061	0.076
	Iron	0.090	5.600	0.997	1.780
	Magnesium	0.190	19.00	2.88	5.81
	Manganese	0.007	0.071	0.024	0.023
	Molybdenum	0.004	0.009	0.006	0.002
	Nickel	0.009	0.019	0.013	0.005
	Potassium	0.18	5.60	1.19	1.67
	Silica-ICP	0.400	13.00	3.94	5.29
	Sodium	0.170	27.00	3.92	8.44
	Thallium	0.090	0.100	0.091	0.003
	Strontium	0.009	0.700	0.108	0.212
	Tin	0.029	0.049	0.039	0.010

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>12-19-S,</u> <u>Continued</u>	Titanium	0.060	0.100	0.088	0.010
	Vanadium	0.004	0.014	0.007	0.003
	Zinc	0.005	0.180	0.036	0.054
	Mercury	0.00009	0.00010	0.00009	.0000044
	Lead	0.004	0.050	0.011	0.014
<u>12-24-NE</u>	<u>1 Sample</u>	-----No Detections-----			
<u>12-43</u>	<u>7 Samples</u>				
	Aluminum	0.099	0.600	0.185	0.186
	Barium	0.080	0.680	0.208	0.212
	Boron-ICP	0.099	0.300	0.185	0.069
	Calcium	17.00	41.00	35.00	8.14
	Chromium	0.004	0.007	0.005	0.0007
	Copper	0.004	0.065	0.020	0.02
	Iron	0.009	1.200	0.215	0.43
	Magnesium	0.910	24.00	19.27	8.17
	Manganese	0.004	0.052	0.027	0.01
	Molybdenum	0.004	0.009	0.006	0.002
	Nickel	0.009	0.019	0.013	0.005
	Potassium	2.6	6.3	5.3	1.2
	Silica-ICP	2.4	16.0	12.77	4.64
	Sodium	4.7	32.0	26.67	9.73
	Strontium	0.150	0.840	0.712	0.248
	Tin	0.029	0.049	0.037	0.011
	Vanadium	0.004	0.014	0.010	0.003
	Zinc	0.006	0.190	0.058	0.077
	Arsenic	0.004	0.022	0.007	0.006
	Mercury	0.00009	0.0002	0.0001	0.00004
	Lead	0.004	0.013	0.006	0.003
<u>16-1</u>	<u>9 Samples</u>				
	Aluminum	0.700	5.800	3.715	1.623
	Antimony	0.039	0.049	0.048	0.003
	Barium	0.080	0.100	0.091	0.008
	Beryllium	0.001	0.004	0.004	0.001
	Boron-ICP	0.068	0.100	0.095	0.010
	Cadmium	0.002	0.004	0.005	0.0006
	Calcium	21.00	28.00	24.80	2.42
	Chromium	0.004	0.007	0.005	0.0007
	Cobalt	0	0.004	0.004	0.002
	Copper	0	0.008	0.005	0.002
	Iron	0.410	3.900	2.411	1.118
	Magnesium	2.90	3.800	3.427	0.341
	Manganese	0.011	0.077	0.047	0.022
	Molybdenum	0	0.010	0.007	0.003
	Nickel	0.009	0.019	0.013	0.005
	Potassium	3.60	14.00	7.05	3.91

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>16-1, Continued</u>	Silica-ICP	4.60	14.00	10.65	3.47
	Sodium	0.800	8.300	4.043	2.857
	Thallium	0.049	0.100	0.088	0.015
	Strontium	0.080	0.160	0.117	0.028
	Tin	0	0.049	0.034	0.016
	Titanium	0	0.110	0.059	0.038
	Vanadium	0.010	0.015	0.012	0.001
	Zinc	0.004	0.032	0.019	0.008
	Arsenic	0.004	0.006	0.005	0.0004
	Lead	0.002	0.007	0.005	0.001
<u>WWTP Discharge After Chlor- ination</u>	<u>15 Samples</u>				
	Aluminum	0	0.200	0.099	0.053
	Antimony	0.039	0.049	0.048	0.003
	Barium	0.110	0.130	0.122	0.006
	Beryllium	0.0009	0.004	0.004	0.001
	Boron-ICP	0.198	0.205	0.200	0.001
	Cadmium	0.002	0.004	0.005	0.0007
	Calcium	40.00	49.00	44.69	2.17
	Chromium	0.004	0.008	0.005	0.0007
	Cobalt	0	0.004	0.004	0.001
	Copper	0.004	0.015	0.009	0.003
	Iron	0.040	0.200	0.096	0.047
	Magnesium	26.00	29.00	27.50	0.86
	Manganese	0.006	0.016	0.010	0.002
	Molybdenum	0	0.04	0.01	0.01
	Nickel	0.009	0.019	0.013	0.005
	Potassium	8.50	10.00	9.37	0.47
	Silica-ICP	15.00	18.90	16.83	1.18
	Sodium	87.00	145.00	117.80	17.01
	Thallium	0.009	0.090	0.079	0.024
	Strontium	0.940	1.100	1.004	0.043
	Tin	0	0.049	0.037	0.017
	Titanium	0	0.090	0.078	0.032
	Vanadium	0.014	0.02	0.01	0.001
	Zinc	0.012	0.04	0.02	0.008
	Arsenic	0.004	0.006	0.004	0.0003
	Mercury	0.00009	0.0002	0.00009	0.00002
	Lead	0.002	0.01	0.005	0.001
	Selenium	0.004	0.006	0.004	0.0003
<u>WWTP Incoming</u>	<u>14 Samples</u>				
	Aluminum	0	0.600	0.192	0.154
	Antimony	0.039	0.049	0.049	0.003
	Barium	0.090	0.200	0.109	0.026
	Beryllium	0.0009	0.004	0.005	0.001
	Boron-ICP	0.176	0.200	0.198	0.006
	Cadmium	0.002	0.004	0.004	0.0005

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>WWTP</u>	<u>14 Samples</u>				
<u>Incoming,</u>	Calcium	3.00	37.00	34.79	1.31
<u>Continued</u>	Chromium	0.004	0.012	0.007	0.002
	Cobalt	0	0.007	0.004	0.001
	Copper	0.014	0.540	0.068	0.136
	Iron	0.150	0.800	0.303	0.172
	Magnesium	18.00	24.00	21.38	1.53
	Manganese	0.005	0.017	0.010	0.004
	Molybdenum	0	0.010	0.008	0.002
	Nickel	0.009	0.019	0.014	0.005
	Potassium	6.90	12.00	8.79	1.62
	Silica-ICP	15.00	21.00	17.06	1.68
	Silver	0.004	0.005	0.004	0.00002
	Sodium	35.00	99.00	63.65	20.62
	Thallium	0.049	0.090	0.087	0.010
	Strontium	0.680	0.850	0.785	0.051
	Tin	0	0.049	0.039	0.014
	Titanium	0	0.090	0.072	0.035
	Vanadium	0.013	0.025	0.016	0.003
	Zinc	0.025	0.110	0.056	0.023
	Arsenic	0.004	0.007	0.005	0.0006
	Mercury	0.00009	0.0002	0.0001	0.00003
	Lead	0.002	0.013	0.005	0.002
	Selenium	0.004	0.005	0.004	0.00003
<u>WWTP</u>	<u>98 Samples</u>				
<u>Time</u>	Aluminum	0	0.400	0.117	0.071
<u>Integrated</u>	Antimony	0.004	0.049	0.049	0.005
<u>Sample</u>	Barium	0.100	0.150	0.125	0.009
<u>From</u>	Beryllium	0.0009	0.004	0.004	0.001
<u>Chlor-</u>	Boron-ICP	0.190	0.300	0.209	0.027
<u>inator</u>	Cadmium	0.002	0.020	0.005	0.001
	Calcium	40.00	55.00	45.54	2.67
	Chromium	0.004	0.008	0.005	0.0006
	Cobalt	0	0.190	0.008	0.026
	Copper	0.004	0.023	0.011	0.004
	Iron	0.030	10.0	0.25	1.00
	Magnesium	25.00	35.30	27.91	1.56
	Manganese	0.006	0.027	0.011	0.004
	Molybdenum	0	0.030	0.010	0.007
	Nickel	0.009	0.019	0.014	0.004
	Potassium	0.10	12.00	9.44	1.13
	Silica-ICP	3.90	22.70	17.22	1.89
	Silver	0.004	0.049	0.005	0.004
	Sodium	16.60	177.00	115.15	21.52
	Thallium	0.049	0.200	0.091	0.025

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Continued</u>	Strontium	0.013	1.20	1.00	0.116
	Tin	0	0.05	0.04	0.013
	Titanium	0	0.090	0.084	0.022
	Vanadium	0.010	0.025	0.017	0.003
	Zinc	0.015	0.460	0.035	0.049
	Arsenic	0.004	0.016	0.005	0.001
	Mercury	0.00009	0.0002	0.00009	0.00001
	Lead	0.002	0.018	0.005	0.001
	Selenium	0.004	0.010	0.005	0.0009
<u>WWTP</u>	<u>14 Samples</u>				
<u>Lagoon</u>	Aluminum	0	0.800	0.192	0.220
	Antimony	0.039	0.049	0.049	0.003
	Barium	0.120	0.140	0.125	0.006
	Beryllium	0.0009	0.004	0.004	0.001
	Boron-ICP	0.198	0.200	0.200	0.0005
	Cadmium	0.002	0.004	0.004	0.0005
	Calcium	40.00	49.00	44.63	2.239
	Chromium	0.004	0.008	0.005	0.001
	Cobalt	0	0.004	0.004	0.001
	Copper	0.004	0.018	0.010	0.004
	Iron	0.040	0.400	0.168	0.114
	Magnesium	26.00	29.00	27.50	0.759
	Manganese	0.006	0.017	0.012	0.003
	Molybdenum	0	0.040	0.010	0.009
	Nickel	0.009	0.019	0.013	0.005
	Potassium	8.30	10.00	9.44	0.534
	Silica-ICP	16.00	22.00	17.76	1.46
	Silver	0.004	0.005	0.004	0.00002
	Sodium	88.00	144.00	116.00	16.47
	Thallium	0.049	0.100	0.087	0.011
	Strontium	0.920	1.040	0.990	0.032
	Tin	0	0.049	0.039	0.014
	Titanium	0	0.090	0.078	0.028
	Vanadium	0.013	0.022	0.018	0.002
	Zinc	0.012	0.035	0.024	0.007
	Arsenic	0.004	0.007	0.005	0.0005
	Mercury	0.00009	0.0002	0.0001	0.00003
	Lead	0.002	0.007	0.004	0.0008
	Selenium	0.004	0.006	0.004	0.0002
<u>North</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Ditch</u>					

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Pantex Lake</u>	<u>5 Samples</u>				
	Aluminum	0.529	12.0	7.42	4.43
	Antimony	0.039	0.04	0.04	0.004
	Barium	0.100	0.25	0.20	0.05
	Beryllium	0.0009	0.004	0.004	0.001
	Boron-ICP	0.078	0.09	0.09	0.009
	Cadmium	0.002	0.004	0.004	0.0008
	Calcium	18.00	62.2	39.24	17.24
	Chromium	0.004	0.009	0.006	0.001
	Cobalt	0	0.009	0.005	0.003
	Copper	0	0.01	0.006	0.005
	Iron	0.300	7.90	4.76	2.87
	Magnesium	4.800	21.0	13.18	6.80
	Manganese	0.040	0.86	0.39	0.41
	Molybdenum	0	0.009	0.004	0.003
	Nickel	0.009	0.03	0.01	0.009
	Potassium	6.00	13.0	11.56	3.10
	Silica-ICP	9.99	27.0	18.79	7.59
	Sodium	3.20	21.9	12.08	8.04
	Thallium	0.049	0.09	0.08	0.01
	Strontium	0.110	0.54	0.31	0.17
	Tin	0	0.04	0.02	0.01
	Titanium	0	0.17	0.11	0.06
	Vanadium	0.013	0.02	0.02	0.006
	Zinc	0.005	0.03	0.01	0.01
	Arsenic	0.004	0.008	0.005	0.001
	Lead	0.002	0.007	0.004	0.001
<u>Playa One</u>	<u>10 Samples</u>				
	Aluminum	1.400	20.00	5.829	6.025
	Antimony	0.039	0.049	0.047	0.004
	Barium	0.130	0.330	0.215	0.061
	Beryllium	0.090	0.004	0.004	0.002
	Boron-ICP	0.100	0.300	0.188	0.056
	Cadmium	0.002	0.004	0.004	0.0008
	Calcium	25.00	65.00	50.29	12.50
	Chromium	0.004	0.031	0.010	0.008
	Cobalt	0	0.007	0.004	0.002
	Copper	0	0.012	0.006	0.003
	Iron	0.105	12.00	3.618	3.675
	Magnesium	7.00	31.00	24.71	9.32
	Manganese	0.110	0.556	0.310	0.161
	Molybdenum	0	0.009	0.005	0.003
	Nickel	0.009	0.020	0.014	0.005
	Potassium	12.00	23.00	17.79	3.92

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Playa One, Continued</u>	Silica-ICP	5.40	48.00	18.24	14.15
	Sodium	12.0	160.0	101.6	51.4
	Thallium	0.049	0.100	0.082	0.018
	Strontium	0.260	1.100	0.798	0.279
	Tin	0	0.049	0.036	0.016
	Titanium	0	0.270	0.080	0.085
	Vanadium	0.011	0.036	0.025	0.008
	Zinc	0.004	0.064	0.022	0.017
	Arsenic	0.004	0.006	0.005	0.0005
	Mercury	0.00009	0.0001	0.00009	0.000031
	Lead	0.004	0.006	0.005	0.0003
<u>Playa Two</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Bushland</u>	<u>2 Samples</u>				
	Aluminum	1.60	2.20	1.90	0.42
	Barium	0.090	0.180	0.135	0.064
	Calcium	8.00	46.00	37.00	12.72
	Iron	1.30	2.30	1.80	0.70
	Magnesium	5.20	10.00	7.60	3.39
	Manganese	0.06	0.35	0.20	0.20
	Nickel	0.01	0.02	0.01	0.0007
	Potassium	37.0	41.0	39.0	2.82
	Silica-ICP	13.0	15.0	14.0	1.41
	Sodium	1.00	1.40	1.2	0.28
	Thallium	0.090	0.200	0.145	0.077
	Strontium	0.10	0.20	0.15	0.07
	Titanium	0.030	0.040	0.035	0.007
	Vanadium	0.010	0.015	0.015	0.003
	Zinc	0.005	0.020	0.012	0.010
	Arsenic	0.008	0.017	0.012	0.006
<u>Playa Three</u>	<u>3 Samples</u>				
	Aluminum	20.0	130.0	70.0	55.67
	Barium	0.23	1.10	0.64	0.43
	Boron-ICP	0.09	0.10	0.09	0.0005
	Calcium	26.00	60.00	40.33	17.61
	Chromium	0.01	0.08	0.04	0.03
	Cobalt	0.006	0.03	0.01	0.01
	Copper	0.01	0.07	0.04	0.02
	Iron	16.00	92.00	51.33	38.27
	Magnesium	6.90	27.00	15.96	10.19
	Manganese	0.18	0.920	0.54	0.37
	Nickel	0.01	0.07	0.04	0.02
	Potassium	16.00	48.00	30.33	16.25

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Playa Three, Continued</u>	Silica-ICP	41.0	100.0	80.0	33.77
	Silver	0.004	0.006	0.005	0.0006
	Sodium	0.620	1.500	0.97	0.46
	Thallium	0.090	0.300	0.16	0.12
	Strontium	0.090	0.250	0.16	0.08
	Titanium	0.290	0.930	0.62	0.32
	Vanadium	0.025	0.160	0.09	0.06
	Zinc	0.063	0.440	0.24	0.18
	Arsenic	0.004	0.022	0.01	0.008
	Mercury	0.00009	0.0002	0.0001	0.00006
	Lead	0.010	0.065	0.03	0.02
<u>Tailwater</u>	<u>2 Samples</u>				
	Aluminum	80.00	86.00	83.00	4.24
	Barium	0.440	0.540	0.490	0.070
	Calcium	16.00	23.00	19.50	4.949
	Chromium	0.066	0.650	0.358	0.412
	Cobalt	0.015	0.240	0.127	0.159
	Copper	0.032	0.042	0.037	0.007
	Magnesium	15.0	16.0	15.5	0.70
	Manganese	0.800	1.400	1.100	0.424
	Nickel	0.030	0.050	0.040	0.014
	Potassium	22.00	29.00	25.50	4.949
	Silica-ICP	56.00	84.00	70.00	19.79
	Sodium	1.20	1.80	1.50	0.42
	Thallium	0.40	0.50	0.45	0.07
	Tin	0.140	0.180	0.160	0.028
	Titanium	0.590	0.730	0.660	0.098
	Zinc	0.220	0.240	0.230	0.014
	Arsenic	0.016	0.017	0.016	0.0007
	Lead	0.032	0.044	0.038	0.008
<u>Z-11-SE</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Z-11-SW</u>	<u>2 Samples</u>				
	Aluminum	3.40	6.80	5.10	2.404
	Barium	0.08	0.09	0.08	0.007
	Calcium	20.00	28.00	24.00	5.656
	Chromium	0.005	0.008	0.006	0.002
	Copper	0.004	0.006	0.005	0.0007
	Iron	2.200	4.40	3.30	1.556
	Magnesium	3.100	3.40	3.250	0.212
	Manganese	0.039	0.071	0.055	0.022
	Potassium	7.800	12.00	9.90	2.969
	Silica-ICP	12.00	15.00	13.50	2.121
	Sodium	1.200	2.500	1.850	0.919
	Thallium	0.090	0.200	0.145	0.077
	Tin	0.080	0.120	0.10	0.028

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Z-11-SW,</u> <u>Continued</u>	Titanium	0.050	0.090	0.070	0.028
	Vanadium	0.012	0.017	0.014	0.003
	Zinc	0.016	0.022	0.019	0.004
	Mercury	0.00009	0.0001	0.00009	0.000007
<u>Z-12-E</u>	<u>5 Samples</u>				
	Aluminum	3.47	27.00	10.17	9.66
	Antimony	0.039	0.049	0.047	0.004
	Barium	0.090	0.310	0.156	0.089
	Beryllium	0.0009	0.004	0.004	0.001
	Boron-ICP	0.099	0.190	0.117	0.040
	Cadmium	0.002	0.004	0.004	0.0008
	Calcium	21.00	47.00	31.82	10.04
	Chromium	0.004	0.023	0.010	0.007
	Cobalt	0	0.006	0.004	0.002
	Copper	0.004	0.018	0.01	0.005
	Iron	1.95	18.00	6.69	6.54
	Magnesium	2.80	9.30	4.76	2.63
	Manganese	0.040	0.280	0.117	0.095
	Molybdenum	0	0.009	0.005	0.003
	Nickel	0.009	0.019	0.013	0.005
	Potassium	3.50	17.00	7.49	5.48
	Silica-ICP	8.73	50.00	21.15	16.50
	Sodium	1.40	6.70	4.55	2.14
	Thallium	0.049	0.100	0.084	0.019
	Strontium	0.080	0.180	0.125	0.050
	Tin	0	0.049	0.031	0.020
	Titanium	0	0.440	0.158	0.170
	Vanadium	0.011	0.047	0.021	0.014
	Zinc	0.019	0.097	0.061	0.029
	Arsenic	0.004	0.011	0.006	0.002
	Mercury	0.00009	0.0009	0.0002	0.0003
	Lead	0.004	0.012	0.007	0.003
<u>Z-12-EN</u>	<u>4 Samples</u>				
	Aluminum	2.80	20.00	11.95	8.82
	Barium	0.120	0.190	0.162	0.034
	Boron-ICP	0.099	0.100	0.099	0.0005
	Calcium	26.00	35.00	32.25	4.27
	Chromium	0.005	0.017	0.011	0.006
	Cobalt	0.004	0.005	0.004	0.00005
	Copper	0.004	0.010	0.007	0.002
	Iron	1.70	13.00	7.87	5.97
	Magnesium	3.50	5.90	4.95	1.17
	Manganese	0.076	0.211	0.143	0.077
	Potassium	8.10	13.00	9.80	2.18

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Z-12-EN,</u> <u>Continued</u>	Silica-ICP	12.0	28.0	20.0	8.16
	Sodium	2.70	4.30	3.45	0.65
	Thallium	0.090	0.300	0.222	0.100
	Tin	0.110	0.180	0.137	0.029
	Titanium	0.020	0.220	0.095	0.090
	Vanadium	0.018	0.034	0.027	0.008
	Zinc	0.015	0.060	0.039	0.023
	Arsenic	0.004	0.005	0.004	0.00005
	Lead	0.004	0.006	0.005	0.0006
<u>Z-12-S</u>	<u>37 Samples</u>				
	Aluminum	0.20	21.00	4.39	5.63
	Antimony	0.029	0.049	0.049	0.003
	Barium	0.090	0.450	0.205	0.103
	Beryllium	0.0009	0.004	0.004	0.0006
	Boron-ICP	0.049	0.200	0.155	0.052
	Cadmium	0.002	0.004	0.004	0.0003
	Calcium	24.00	70.00	40.31	12.07
	Chromium	0.004	0.016	0.006	0.002
	Cobalt	0	0.004	0.004	0.0008
	Copper	0	0.013	0.005	0.002
	Iron	0.150	14.00	2.70	3.55
	Magnesium	3.60	32.00	18.73	8.28
	Manganese	0.004	0.260	0.067	0.073
	Molybdenum	0	0.009	0.006	0.002
	Nickel	0.009	0.020	0.012	0.004
	Potassium	4.49	11.00	6.49	1.45
	Silica-ICP	1.50	38.00	15.02	8.39
	Sodium	1.50	42.00	23.79	12.11
	Thallium	0.049	0.300	0.104	0.046
	Strontium	0.128	1.100	0.634	0.279
	Tin	0	0.290	0.043	0.043
	Titanium	0	0.290	0.085	0.072
	Vanadium	0.007	0.042	0.019	0.008
	Zinc	0.004	0.088	0.025	0.025
	Arsenic	0.004	0.009	0.005	0.002
	Mercury	0.00009	0.0001	0.00009	0.000002
	Lead	0.0008	0.010	0.005	0.001
	Selenium	0.004	0.005	0.004	0.00001
<u>Z-12-SUB</u>	<u>2 Samples</u>				
	Aluminum	9.80	16.00	12.90	4.38
	Barium	0.160	0.20	0.180	0.028
	Calcium	32.00	38.00	35.00	4.24
	Chromium	0.011	0.016	0.013	0.003
	Copper	0.007	0.011	0.009	0.003
	Iron	6.50	10.00	8.25	2.47
	Magnesium	5.20	6.60	5.90	0.98

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Z-12-SUB</u>	Manganese	0.14	0.20	0.17	0.04
	Potassium	6.00	7.40	6.70	0.98
	Silica-ICP	20.00	32.00	26.00	8.48
	Strontium	0.12	0.14	0.13	0.01
	Titanium	0.16	0.24	0.20	0.05
	Vanadium	0.020	0.028	0.024	0.006
	Zinc	0.060	0.080	0.070	0.014
	Lead	0.005	0.007	0.006	0.001
<u>Z-12-W</u>	<u>9 Samples</u>				
	Aluminum	0.099	9.00	2.676	3.041
	Antimony	0.039	0.049	0.048	0.004
	Barium	0.047	0.162	0.105	0.037
	Beryllium	0.0009	0.004	0.004	0.001
	Boron-ICP	0.099	0.203	0.124	0.044
	Cadmium	0.002	0.004	0.004	0.0008
	Calcium	14.00	55.70	32.07	12.48
	Chromium	0.004	0.008	0.006	0.001
	Cobalt	0	0.004	0.004	0.002
	Copper	0	0.010	0.005	0.002
	Iron	0.06	5.60	1.70	1.96
	Magnesium	2.56	22.0	8.93	7.70
	Manganese	0.004	0.062	0.027	0.018
	Molybdenum	0	0.009	0.006	0.003
	Nickel	0.009	0.019	0.015	0.005
	Potassium	5.26	9.96	6.85	1.36
	Silica-ICP	3.52	24.0	13.38	6.09
	Sodium	1.10	31.00	11.06	13.08
	Thallium	0.049	0.100	0.083	0.019
	Strontium	0.084	0.780	0.310	0.265
	Tin	0	0.049	0.034	0.021
	Titanium	0	0.140	0.052	0.048
	Vanadium	0.005	0.016	0.011	0.003
	Zinc	0.005	0.035	0.020	0.010
	Arsenic	0.004	0.005	0.004	0.00003
	Mercury	0.00009	0.0003	0.0001	0.00007
	Lead	0.003	0.005	0.004	0.0007
	Selenium	0.004	0.005	0.004	0.00006

Metals, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Z-4-E</u>	<u>3 Samples</u>				
	Aluminum	17.00	23.00	20.66	3.21
	Barium	0.170	0.220	0.196	0.023
	Calcium	33.00	36.00	34.33	1.52
	Chromium	0.013	0.019	0.016	0.003
	Cobalt	0.005	0.009	0.007	0.002
	Copper	0.008	0.013	0.009	0.002
	Iron	12.00	15.00	14.00	1.73
	Magnesium	6.10	6.40	6.30	0.173
	Manganese	0.210	0.340	0.276	0.065
	Potassium	9.40	11.00	10.13	0.808
	Silica-ICP	36.0	40.0	38.0	2.0
	Sodium	0.90	2.80	1.60	1.04
	Thallium	0.090	0.40	0.230	0.157
	Strontium	0.110	0.150	0.126	0.021
	Titanium	0.280	0.380	0.343	0.055
	Vanadium	0.038	0.047	0.042	0.0046
	Zinc	0.053	0.069	0.063	0.008
	Arsenic	0.006	0.009	0.007	0.001
	Lead	0.004	0.008	0.006	0.001

MISCELLANEOUS					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>11-20</u>	<u>6 Samples</u>				
	Oil and Grease	0.90	10.00	2.41	3.71
	Ammonia	0.19	0.60	0.36	0.17
	Chloride	2.9	34.0	11.6	11.5
	Total Suspended Solids	4.9	10.0	6.6	2.6
	Total Dissolved Solids	130.0	570.0	265.0	162.8
	Total Organic Carbon	2.0	16.0	6.7	6.3
	Sulfate	7.0	44.0	21.5	12.7
<u>11-36</u>	<u>1 Sample</u>	-----No Detections-----			
<u>11-50</u>	<u>11 Samples</u>				
	Ammonia	0.5	12.0	3.2	3.1
	Chloride	7.0	17.0	12.7	3.00
	Total Suspended Solids	4.9	66.0	18.7	17.4
	Total Dissolved Solids	200.0	330.0	293.	40.0
	Total Organic Carbon	3.0	21.0	8.7	5.1
	Sulfate	4.9	29.0	18.4	7.2
<u>12-17-N</u>	<u>5 Samples</u>				
	Ammonia	0.1	0.5	0.3	0.1
	Chloride	2.9	12.0	4.7	4.1
	Total Suspended Solids	4.9	6.0	5.1	0.5
	Total Dissolved Solids	32.0	290.0	111.5	121.7
	Total Organic Carbon	3.0	10.0	6.0	3.5
	Sulfate	4.9	17.0	9.2	5.5
<u>12-17-s</u>	<u>11 Samples</u>				
	Oil and Grease	0.9	1.0	0.9	0.03
	Ammonia	0.4	1.8	0.8	0.4
	Total Suspended Solids	4.9	16.0	7.3	4.0
	Total Dissolved Solids	4.9	26.0	15.2	7.5
	Total Organic Carbon	2.0	10.0	5.3	2.1
	Sulfate	0.9	9.0	5.3	2.1
<u>12-19-N</u>	<u>10 Samples</u>				
	Ammonia	0.2	0.4	0.2	0.01
	Chloride	2.9	280.0	40.8	84.5
	Total Suspended Solids	4.9	90.0	21.9	27.1
	Total Dissolved Solids	62.0	2800.0	593.5	845.1
	Total Organic Carbon	1.0	15.0	4.7	4.2
	Sulfate	4.9	610.0	87.1	184.6

Miscellaneous, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>12-19-S</u>	<u>10 Samples</u>				
	Oil and Grease	0.9	2.0	1.0	0.3
	Ammonia	0.2	1.8	0.9	0.5
	Chloride	2.9	10.0	3.6	2.2
	Total Suspended Solids	4.9	44.0	10.6	12.9
	Total Dissolved Solids	10.0	270.0	54.6	83.2
	Total Organic Carbon	3.0	8.0	5.6	2.1
	Sulfate	4.9	29.0	7.7	7.6
<u>12-24-NE</u>	<u>1 Sample</u>	-----No Detections-----			
<u>12-43</u>	<u>7 Samples</u>				
	Oil and Grease	0.9	1.0	0.9	0.03
	Ammonia	0.2	0.7	0.3	0.2
	Chloride	2.9	15.0	11.1	3.8
	Total Suspended Solids	4.9	20.0	10.3	6.1
	Total Dissolved Solids	100.0	340.0	275.0	87.3
	Total Organic Carbon	0.9	12.0	3.1	3.9
	Sulfate	14.0	32.0	23.7	6.4
<u>16-1</u>	<u>4 Samples</u>				
	Ammonia	0.19	0.9	0.3	0.3
	Chloride	4.0	8.0	6.6	2.3
	Total Suspended Solids	82.0	94.0	87.3	6.1
	Total Dissolved Solids	104.0	150.0	133.5	20.2
	Total Organic Carbon	5.2	14.0	11.0	4.0
	Sulfate	0.9	11.0	6.7	4.6
<u>WWTP</u>	<u>15 Samples</u>				
<u>Discharge</u>	Oil and Grease	0.5	0.9	0.8	0.1
<u>After</u>	Ammonia	1.4	6.5	2.4	1.3
<u>Chlor-</u>	Chloride	110.0	200.0	147.7	25.9
<u>ination</u>	Total Suspended Solids	6.0	36.0	22.3	8.4
	Total Dissolved Solids	500.0	704.0	594.9	55.9
	Total Organic Carbon	0	15.0	8.8	4.1
	Total Organic Halogen	0.1	0.1	0.1	0.007
	Sulfate	21.0	61.0	42.9	10.1
	Biochemical Oxygen Demand	1.0	94.0	14.7	11.5
<u>WWTP</u>	<u>14 Samples</u>				
<u>Incoming</u>	Oil and Grease	0.9	17.0	6.1	5.0
	Ammonia	1.8	12.0	5.8	3.0
	Chloride	18.0	42.0	26.1	6.9
	Total Suspended Solids	18.0	370.0	77.1	92.4
	Total Dissolved Solids	330.0	460.0	393.2	49.3
	Total Organic Carbon	9.0	49.0	21.2	12.4
	Sulfate	24.0	50.0	36.9	7.3

Miscellaneous, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>WWTP</u>	<u>14 Samples</u>				
<u>Lagoon</u>	Oil and Grease	0.9	16.0	2.1	4.0
	Ammonia	1.1	6.6	2.6	1.4
	Chloride	24.0	190.0	135.7	39.8
	Total Suspended Solids	18.0	64.0	37.2	13.5
	Total Dissolved Solids	540.0	720.0	593.1	51.5
	Total Organic Carbon	6.0	11.0	9.0	1.6
	Sulfate	32.0	60.0	42.7	7.3
<u>North Ditch</u>	<u>1 Sample</u>	-----No Detections-----			
<u>South Ditch</u>	<u>7 Samples</u>	-----No Detections-----			
<u>Pantex Lake</u>	<u>7 Samples</u>				
	Oil and Grease	0.4	0.9	0.8	0.2
	Ammonia	0.1	0.9	0.3	0.3
	Nitrate	0.9	16.4	8.7	10.9
	Phenols	0	0.004	0.003	0.002
	Chloride	2.9	14.9	10.4	4.9
	Fluoride	0.4	1.1	0.6	0.3
	Cyanide	0.004	0.009	0.005	0.001
	Total Suspended Solids	76.0	260.0	158.7	93.4
	Total Dissolved Solids	120.0	401.0	242.7	118.3
	Total Organic Carbon	6.0	19.0	11.5	5.4
	Total Organic Halogen	12.0	28.0	19.0	8.2
	Sulfate	4.9	31.0	14.4	12.2
	Specific Conductance	150.0	423.0	286.5	193.0
	Biochemical Oxygen Demand	9.0	26.0	17.5	12.0
	Bromine	0.19	2.10	0.93	0.72
<u>Playa One</u>	<u>13 Samples</u>				
	Oil and Grease	0.4	0.9	0.9	0.1
	Ammonia	0.1	4.1	1.4	1.7
	Nitrate	0.1	0.4	0.2	0.1
	Phenols	0	0.004	0.004	0.002
	Chloride	14.0	220.0	132.5	72.4
	Fluoride	0.4	3.1	1.7	0.7
	Cyanide	0.004	0.009	0.005	0.001
	Total Suspended Solids	42.0	120.0	68.0	30.2
	Total Dissolved Solids	230.0	736.0	517.7	231.8
	Total Organic Carbon	8.0	24.0	12.5	4.8

Miscellaneous, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Playa One, Continued</u>	Total Organic Halogen	16.0	68.0	33.4	19.2
	Sulfate	8.0	91.0	45.7	28.1
	Hexavalent Chromium	0.009	0.020	0.010	0.007
	Specific Conductance	830	1035	953.	89.
	Nitrate	0.009	0.030	0.010	0.010
	Biochemical Oxygen Demand	13.0	31.0	21.0	8.5
	Bromine	0.49	3.2	1.1	0.8
<u>Playa Two</u>	<u>1 Sample</u>	-----No Detections-----			
<u>Bushland</u>	<u>3 Samples</u>				
	Ammonia	0.2	1.7	0.9	1.1
	Phenols	0.004	0.01	0.007	0.003
	Chloride	3.0	5.0	4.0	1.4
	Total Suspended Solids	25.0	100.0	62.5	53.
	Total Dissolved Solids	220.0	280.0	250.0	42.4
	Total Organic Carbon	20.0	22.0	21.0	1.4
	Total Organic Halogen	11.0	15.0	13.0	2.8
<u>Playa Three</u>	<u>5 Samples</u>				
	Ammonia	0.19	0.5	0.4	0.1
	Nitrate	3.2	5.9	4.6	2.0
	Chloride	2.9	19	9.0	8.7
	Total Suspended Solids	180	2900	1316.	1413
	Total Dissolved Solids	420	540	480	84.8
	Total Organic Carbon	9	16	13	3.6
	Total Organic Halogen	45	51000	17035.	29413
	Sulfate	4.9	16.0	9.6	5.7
	Hexavalent Chromium	0.009	0.030	0.010	0.014
	Specific Conductance	125	228.0	176.5	72.8
	Nitrite	0.01	0.02	0.01	0.007
	Biochemical Oxygen Demand	7.0	27.0	17.0	14.1
	Bromine	0.5	3.2	1.7	1.4
<u>Z-11-SE</u>	<u>2 Samples</u>	-----No Detections-----			
<u>Z-11-SW</u>	<u>2 Samples</u>				
	Total Dissolved Solids	110	140	125	21.2
	Total Organic Carbon	8	13	10.5	3.5

Miscellaneous, Continued					
Location	Analyte	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>Z-12-E</u>	<u>5 Samples</u>				
	Oil and Grease	0.8	0.9	0.9	0.04
	Ammonia	0.2	0.9	0.4	0.3
	Chloride	2.9	12.0	5.2	4.5
	Total Suspended Solids	66	170	118.	52.
	Total Dissolved Solids	98	420	191.6	132.7
	Total Organic Carbon	5	23	10.1	7.5
	Sulfate	0.9	18	9.2	7.7
<u>Z-12-EN</u>	<u>3 Samples</u>				
	Chloride	4	5	4.3	0.5
	Total Dissolved Solids	180	190	186.	5.7
	Total Organic Carbon	6	15	9	5.2
	Sulfate	6	14	8.7	4.6
<u>Z-12-S</u>	<u>8 Samples</u>				
	Oil and Grease	0.7	0.9	0.8	0.1
	Ammonia	0.2	0.9	0.3	0.2
	Chloride	2.9	13	9.4	4.7
	Total Suspended Solids	12	202	65	81.5
	Total Dissolved Solids	108	330	227.2	94.1
	Total Organic Carbon	2	8	4.6	2.1
	Sulfate	0.9	37	19.5	13.8
<u>Z-12-SUB</u>	<u>2 Samples</u>	-----No Detections-----			
<u>Z-12-W</u>	<u>6 Samples</u>				
	Oil and Grease	0.8	1.0	0.9	0.1
	Ammonia	0.2	0.9	0.3	0.3
	Chloride	2.9	12.0	6.8	4.8
	Total Suspended Solids	8.0	46.0	28.6	16.9
	Total Dissolved Solids	92.0	320.0	213.7	94.1
	Total Organic Carbon	3.0	16.0	7.9	4.8
	Sulfate	0.9	32.0	13.3	13.3
<u>Z-4-3</u>	<u>3 Samples</u>				
	Ammonia	0.2	0.2	0.2	0.005
	Total Suspended Solids	24.0	480.0	252.0	322.4
	Total Dissolved Solids	120.0	170.0	150.0	26.4
	Total Organic Carbon	7.0	12.0	9.3	2.5

COD					
Location	Number of Samples	Minimum mg/l	Maximum mg/l	Mean mg/l	Standard Deviation
<u>11-20</u>	12	1.0	39.0	11.6	10.2
<u>11-36</u>	1	48.0	48.0	48.0	0
<u>11-50</u>	48	0	61.0	18.7	16.5
<u>12-17-N</u>	19	0	49.0	15.5	12.9
<u>12-17-S</u>	42	0	41.0	13.2	9.2
<u>12-19-N</u>	39	0	43.0	7.2	9.7
<u>12-19-S</u>	44	0	47.0	16.5	11.1
<u>12-24-NE</u>	1	25.0	25.0	25.0	0
<u>12-43</u>	20	0	40.0	4.2	9.8
<u>16-1</u>	16	13.0	42.0	30.3	8.5
<u>Discharge After Chlorination</u>	118	10.0	106.0	46.3	17.3
<u>WWTP Incoming</u>	112	0	120.0	42.2	31.9
<u>Lagoon</u>	111	9.0	172.0	49.6	22.0
<u>North Ditch</u>	1	38.0	38.0	38.0	0
<u>Pantex Lake</u>	7	1.0	35.0	14.2	13.2
<u>Playa One</u>	16	30.0	66.0	49.3	12.2
<u>Playa Two</u>	4	58.0	85.0	66.7	12.3
<u>Playa Four</u>	1	62.0	62.0	62.0	0
<u>Playa Three</u>	4	25.0	54.0	40.5	11.9
<u>Tail-Water</u>	6	41.0	54.0	47.5	7.1
<u>Z-11-SE</u>	2	23.0	26.0	24.5	2.1
<u>Z-11-SW</u>	2	27.0	39.0	33.0	8.4
<u>Z-12-E</u>	9	8.0	50.0	22.6	14.2
<u>Z-12-EN</u>	5	28.0	42.0	31.0	6.1
<u>Z-12-S</u>	36	0	79.0	12.1	13.1
<u>Z-12-SUB</u>	3	20.0	28.0	23.6	4.0
<u>Z-12-W</u>	13	1.0	38.0	19.5	12.5
<u>Z-4-E</u>	4	19.0	46.0	33.5	13.5