SAND REPORT
SAND2002-4098
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Printed December 2002

Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico

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Abstract

This report summarizes groundwater analytical results and aquifer test data collected at Sandia National Laboratories' Mixed Waste Landfill (MWL) from 1990 through 2001. The MWL is an inactive, 2.6-acre, low-level radioactive and mixed waste landfill located in north-central Technical Area 3. Groundwater occurs approximately 500 feet (ft) below ground surface within Santa Fe Group deposits. The MWL monitoring well network consists of seven wells completed within interfingering fine-grained alluvial fan deposits and coarse-grained ancestral Rio Grande deposits. Hydraulic conductivities average 1.64×10^{-2} ft/day in the alluvial fan deposits and 1.81 ft/day in the ancestral Rio Grande deposits. Groundwater flows westward at an average velocity of 0.17 ft/year in the alluvial fan deposits and 18.5 ft/year in the ancestral Rio Grande deposits.

Groundwater beneath the MWL has been characterized for major ion chemistry, volatile and semivolatile organic compounds, nitrate, metals, radionuclides, and perchlorate. Data collected to date indicate that groundwater beneath the MWL has not been contaminated. Groundwater monitoring is currently conducted annually for volatile organic compounds (VOCs), nitrate, metals, gamma-emitting radionuclides, gross alpha/beta activity, tritium, strontium-90, and isotopic uranium. Future groundwater monitoring at the MWL should focus on VOCs, tritium, gross alpha/beta activity, and major ion chemistry.

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Executive Summary

This report summarizes groundwater analytical results and aquifer test data collected at the Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill (MWL) from 1990 through 2001. The MWL is a 2.6-acre, low-level radioactive and mixed waste landfill located in the north-central portion of SNL/NM Technical Area 3. The MWL monitoring well network consists of one background well, one on-site well, and five downgradient wells.

Groundwater beneath the MWL occurs approximately 500 feet (ft) below ground surface within Santa Fe Group deposits. Groundwater is declining an average of 0.77 ft/year as a result of pumping from City of Albuquerque and Kirtland Air Force Base production wells. MWL monitoring wells are completed in two interfingering sedimentary deposits of the Santa Fe Group. Shallower wells are completed in fine-grained, alluvial fan deposits derived from the Manzanita Mountains to the east. Deeper wells are completed in course-grained, ancestral Rio Grande deposits derived from the north.

In July 2001, slug tests were conducted on MWL monitoring wells to measure the hydraulic conductivity of the aquifer and to estimate average linear groundwater flow velocities in the aquifer. Hydraulic conductivities in the alluvial fan deposits average 1.64×10^{-2} ft/day. Hydraulic conductivities in the ancestral Rio Grande deposits average 1.81 ft/day.

The horizontal gradient of the aquifer beneath the MWL averages 0.007 to the west. Groundwater flows westward in the alluvial fan deposits at velocities ranging from 0.07 to 0.74 ft/year, averaging 0.17 ft/year. Groundwater flows westward in the ancestral Rio Grande deposits at velocities ranging from 7.0 to 51.6 ft/year, averaging 18.5 ft/year.

Groundwater monitoring at the MWL has been conducted since September 1990, with 28 sampling events during the 11-year period through 2001. Groundwater beneath the MWL has been characterized for major ion chemistry and analyzed for a variety of constituents of concern that occur in the MWL disposal inventory, including volatile organic compounds (VOCs), semivolatile organic compounds, metals, radionuclides (tritium, uranium, plutonium, strontium-90, cobalt-60, cesium-137), nitrate, and perchlorate.

The extensive analytical data collected to date indicate that groundwater beneath the MWL has not been contaminated. VOCs such as toluene have been detected in groundwater, but are not attributed to contamination from the MWL. Elevated chromium and nickel concentrations have been detected in monitoring wells constructed with stainless steel screens. Uranium occurs naturally in groundwater beneath the MWL at concentrations that are within the background ranges observed in regional wells.

Future groundwater monitoring at the MWL will focus on specific monitoring parameters, including VOCs, tritium, gross alpha/beta activity, and major ion chemistry.

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Acronyms and Abbreviations

bgs	below ground surface
CFR	Code of Federal Regulations
cm/sec	centimeters per second
COC	constituent of concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ft	feet
g	gram(s)
gpm	gallons per minute
ICP-MS	inductively-coupled plasma mass spectrometry
KAFB	Kirtland Air Force Base
L	liter(s)
MCL	maximum contaminant level
MDL	method detection limit
µg	microgram(s)
mg	milligram(s)
MWL	Mixed Waste Landfill
ND	nondetection
NMED	New Mexico Environment Department
P&A	plugging and abandonment
PCB	polychlorinated biphenyl
pCi	picocurie(s)
PQL	practicable quantitation limit
PVC	polyvinyl chloride
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	reporting limit
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
SSAP	site-specific sampling and analysis plan
SVOC	semivolatile organic compound
TA	Technical Area
VOC	volatile organic compound

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1. Introduction

This report summarizes groundwater analytical results and aquifer test data collected at the Sandia National Laboratories/New Mexico (SNL/NM) Mixed Waste Landfill (MWL) from 1990 through 2001. Groundwater monitoring at the MWL has been conducted from September 1990 to the present, with 28 sampling events during the 11-year period through December 2001.

1.1 Report Objectives

The objective of this report is to provide the most current knowledge of groundwater quality and aquifer parameters at the MWL. Aquifer testing was conducted on all MWL monitoring wells to measure the hydraulic conductivity of the aquifer and to estimate average linear groundwater flow velocities. Water levels for MWL wells, as well as hydrographs and water table contour maps, are included in this report.

Chapter 2 of this report contains a description of the MWL monitoring well network and discusses the current groundwater monitoring program at the MWL. Chapter 3 summarizes the data from water-level measurements and slug testing at the MWL. Aquifer parameters and linear groundwater flow velocities are discussed. Chapter 4 summarizes the analytical results of samples obtained from groundwater beneath the MWL. A detailed discussion of early monitoring results of groundwater beneath the MWL is provided in the MWL Phase 2 Resource Conservation and Recovery Act (RCRA) Facility Investigation Report (RFI) (Peace et al. September 2002). Chapter 5 offers recommendations for future groundwater monitoring and sampling at the MWL. Chapter 6 presents the conclusions.

1.2 Site Background

SNL/NM is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of Albuquerque in Bernalillo County, New Mexico (Figure 1-1). SNL/NM research and administrative facilities are divided into five technical areas (TAs) (TA-1 through TA-5) and several remote test areas. The MWL occupies 2.6 acres in the north-central portion of TA-3 (Figure 1-2). The MWL was operated from March 1959 through December 1988 as the primary disposal site for SNL/NM technical and remote test areas involved in nuclear weapons research and development. A map of the MWL is provided in Figure 1-3.

Approximately 100,000 cubic feet (ft) of low-level radioactive waste and minor amounts of mixed waste containing approximately 6,300 curies of activity were disposed of at the MWL. Descriptions of the quantity and types of the wastes disposed of, and general waste management practices at the MWL are provided in previous MWL reports (SNL/NM September 1990; SNL/NM March 1993; and Peace et al. September 2002). Disposal of free liquids was not allowed at the MWL, with the exception of 204,000 gallons of coolant wastewater from the Sandia Engineering Reactor Facility in 1967. Liquids, such as acids, bases, and solvents, were solidified before containerization and disposal.

A Phase 1 RFI was conducted in 1989 and 1990 (SNL/NM September 1990) to determine if a release of contaminants had occurred at the MWL. Air, surface soil, and subsurface soil samples were collected and analyzed during Phase I RFI activities. The Phase I RFI indicated that tritium had been released to the environment. Air samples indicated that tritium activities were at or below background levels for tritium in air. Tritium was detected in the landfill in both surface and near-surface soil.

From 1992 to 1995, a Phase 2 RFI was conducted to investigate environmental impacts associated with disposal activities at the MWL. The RFI included radiological surveys, air sampling, soil sampling, geophysical surveys, soil gas surveys, installation of groundwater monitoring wells, groundwater sampling, vadose zone tests, and risk assessment. Tritium is the contaminant of primary concern. Tritium levels range from 1,100 picocuries (pCi)/gram (g) in surface soil to 206 pCi/g in subsurface soil. The highest tritium levels are found within 30 ft of the surface in soil adjacent to and directly below classified area disposal pits. Tritium also occurs as a diffuse air emission from the landfill releasing 0.294 curies/year to the atmosphere.

2. Groundwater Monitoring Program

The MWL monitoring well network consists of seven wells that serve as a detection monitoring system for potential contaminant releases to groundwater from the landfill. Five of these wells were installed between 1988 and 1993. Two wells were installed in 2000.

2.1 Regulatory Requirements for Groundwater Monitoring

The monitoring well network was designed to be consistent with groundwater monitoring requirements for interim status landfills (20.4.1.600 New Mexico Administrative Code, 40 Code of Federal Regulations [CFR] Part 265, Subpart F) (40 CFR 265). These requirements pertain to detecting releases of hazardous wastes to groundwater.

2.2 Monitoring Well Network

The locations of MWL monitoring wells are shown in Figure 2-1. Appendix A contains monitoring well completion diagrams. Monitoring wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 were installed in a one-upgradient, three-downgradient configuration, respectively, based upon regional groundwater flow direction determined in 1988. Monitoring well MWL-MW1 was installed in October 1988. Monitoring wells MWL-BW1, MWL-MW2, and MWL-MW3 were installed between June and September 1989.

Monitoring well MWL-BW1 is located approximately 500 ft southeast of the MWL. MWL-BW1 was established as the landfill's background monitoring well. Current groundwater flow direction at the MWL (west) indicates MWL-BW1 is actually cross-gradient to the MWL. However, MWL-BW1 is located far enough away from the landfill to provide background water quality.

Monitoring well MWL-MW4 was installed in 1993 directly beneath a disposal trench in which 204,000 gallons of coolant wastewater from the Sandia Engineering Reactor Facility were disposed of in 1967 (Peace et al. September 2002). MWL-MW4 was completed at an angle of 6 degrees from vertical and is screened at two discrete intervals 20 ft apart to evaluate vertical anisotropy, vertical potentiometric gradients, and changes in aquifer parameters with depth. An inflatable packer separates the screened intervals.

Monitoring wells MWL-MW5 and MWL-MW6 were installed in 2000 at a distance of 200 and 500 ft west of the landfill, respectively. Well drilling and installation summaries for MWL-MW5 and MWL-MW6 are available for review at the SNL/NM Environmental Restoration (ER) Records Center located at SNL/NM TA-1, Building 869.

All seven monitoring wells are constructed of 5-inch Schedule 80 polyvinyl chloride (PVC) casing. Wells MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3 have screens made of slotted Type 304 stainless-steel. Wells MWL-MW4, MWL-MW5, and MWL-MW6 have screens made of slotted Schedule 80 PVC. Table 2-1 presents well construction information and water levels measured in each MWL monitoring well.

2.3 Groundwater Monitoring Analytical Parameters

Appendix B presents a summary of groundwater sampling events at the MWL. The suite of analytical parameters for the first six years of groundwater monitoring (1990 through 1995) included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, radionuclides, and major ion chemistry. A complete Appendix IX (40 CFR 264) analysis for VOCs, SVOCs, dioxins, furans, pesticides, polychlorinated biphenyls (PCBs), and herbicides was conducted on samples from wells MWL-MW1, MWL-MW2, MWL-MW3, and MWL-BW1 in September 1990.

As additional groundwater quality data were collected over the years and baseline water quality was established, the suite of analytical parameters was gradually modified, with New Mexico Environment Department (NMED) approval. In April 2000, the suite of analytical parameters used for annual sampling included VOCs, metals, nitrate plus nitrite, gamma-emitting radionuclides, gross alpha/beta activity, tritium, strontium-90, and isotopic uranium. In addition, monitoring wells MWL-MW1 and MWL-MW2 were also sampled for perchlorates, and MWL-MW5 and MWL-MW6 were also sampled for SVOCs.

2.4 Analytical Methods

The MWL site-specific sampling and analysis plan (SSAP) (SNL/NM May 1994) specifies parameters, appropriate test methods, and target analyte quantitation limits for analytical parameters. Any variations in the test methods used are noted in the individual monitoring reports, which are listed in Table 2-2 and are available for review at the SNL/NM ER Records Center located at SNL/NM TA-1, Building 869.

2.4.1 Chemical Analytical Methods

Chemical analyses are performed in accordance with the U.S. Environmental Protection Agency (EPA) test methods (EPA March 1983, EPA November 1986, and EPA December 1989). Groundwater samples are submitted to off-site laboratories contracted by SNL/NM. Samples were analyzed for purgeable VOCs by EPA Test Method 8260, total and dissolved metals by EPA Test Methods 6010, 6020, and 7470, nitrate by EPA Method 353.1, extractable SVOCs by EPA Method 8270, and anions (bromide, fluoride, chloride, and sulfate) by EPA Method 300.

2.4.2 Radiological Analytical Methods

Radiological analyses include gross alpha/beta activity by EPA method 900.0, strontium-90 by EPA method 905.0, tritium by EPA Method 906.0, gamma-emitting radionuclides by EPA method 901.1, and isotopic uranium by inductively-coupled plasma mass spectrometry (ICP-MS).

2.4.3 Quality Assurance and Quality Control

Off-site laboratory results are subject to a contract verification review and an independent third-party verification/validation review. The laboratory results are verified/validated according to

the "Data Validation Procedure for Chemical and Radiochemical Data, Administrative Operating Procedure (AOP) 00-03" (SNL/NM December 1999) or its predecessor, Technical Operation Procedure 94-03. A contract verification review using the Sample Management Office (SMO)'s "Procedure for Completing the Contract Verification Review" (SMO-05-03) evaluates technical, quality control (QC), and reporting requirements imposed upon the analytical laboratory through the SMO contract statement of work (SNL/NM August 2000). Results from the quality assurance/QC reviews are summarized in the individual groundwater monitoring reports, which are listed in Table 2-2 and are available for review at the SNL/NM ER Records Center located at SNL/NM TA-1, Building 869.

2.5 Groundwater Monitoring Frequency

Groundwater monitoring at the MWL was initiated in September 1990 and continues to the present. A total of 28 groundwater sampling events have been conducted to date at the MWL (Table 2-2). Quarterly sampling was conducted from September 1990 through January 1992. Semiannual sampling was conducted from January 1992 through April 1999. Annual sampling has been conducted from April 1999 to the present. Groundwater sampling at the MWL is currently conducted annually in April of each year for monitoring wells MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, and MWL-BW1. Annual sampling of MWL-MW5 and MWL-MW6 is planned, starting in April 2003, once eight quarters of data have been collected.

2.6 Sampling Procedures and Measurements

Groundwater sampling was conducted in accordance with the SSAP for groundwater monitoring at the MWL (SNL/NM May 1994). Since 1990, numerous off-site laboratories have been contracted to provide analytical services to SNL/NM, including Quanterra Laboratory, St. Louis, Missouri; General Engineering Laboratories, Inc., Charleston, South Carolina; Lockheed Analytical Services, Las Vegas, Nevada; CORE Laboratories, Aurora, Colorado; Encotec, Ann Arbor, Michigan; Enseco, Arvada, Colorado; and TMA Eberline, Albuquerque, New Mexico. The Radiation Protection Sample Diagnostics Laboratory at SNL/NM has been used to perform analyses for gross alpha/beta activity, gamma-emitting radionuclides, and isotopic uranium.

Details of the field measurements and procedures are provided in the individual monitoring reports listed in Table 2-2. The ER Project maintains and follows field operating procedures for sampling activities that are available for review at the SNL/NM ER Records Center located at SNL/NM TA-1, Building 869. A brief description of sampling procedures is provided below.

Groundwater levels are measured prior to purging and sampling. A minimum of three casing volumes is removed from the well or, in the case of poor recharge, the well is purged to dryness and allowed to recover (90 percent) prior to sample collection. A Bennett™ pump is used to sample groundwater beneath the MWL. With the exception of MWL-MW4, which has a dedicated Bennett™ pump, the wells are sampled using the same pump. The sampling pump and tubing bundle are decontaminated prior to sampling each well. Equipment blank samples are collected to verify the effectiveness of the decontamination procedure used between well

samplings. All groundwater samples are collected directly from pump discharge into laboratory-prepared sample containers. Immediately after collection, all sample containers are custody-taped, sealed in plastic bags, and placed on ice in shipping containers. Analysis Request/Chain of Custody forms are completed at the time of collection and accompany the shipment to the laboratory. All purge and decontamination water is containerized and disposed of appropriately.

3. Hydrogeologic Setting

3.1 Regional Hydrogeology

KAFB/SNL/NM is located in the eastern portion of the Albuquerque basin. The Albuquerque metropolitan area, including KAFB/SNL/NM, relies on the groundwater in this basin as the principal water supply source. The basin is a segment of the Rio Grande rift, which extends from southern Colorado to southern New Mexico and west Texas (Hawley and Haase 1992).

The Albuquerque basin, located in central New Mexico, covers approximately 2,100 square miles. The basin is approximately 70 miles long and ranges in width from 10 to 40 miles. The vertical thickness of the basin-fill sediments exceeds 14,000 ft in some areas. The eastern boundary of the basin is a series of faults running parallel to the Sandia, Manzanita, and Manzano Mountains.

The stratigraphy of the basin-fill sediments is divided into the lower, middle, and upper Santa Fe Group. The major fresh-water aquifers in the basin are located within the upper Santa Fe Group. The late Pliocene to Pleistocene upper Santa Fe Group deposits are up to 1,200 ft thick. The upper Santa Fe Group consists of two first-order sediment types: an alluvial fan sequence derived from uplifts on the basin flanks, and a fluvial sequence derived from the north and deposited by an axial river, the ancestral Rio Grande. The alluvial fan deposits consist of poorly-sorted, weakly-stratified sand and conglomerate with a silt/clay matrix. The ancestral Rio Grande deposits include cross-stratified channel deposits characterized by thick zones of clean sand and well-rounded gravel as well as fine- to medium-grained overbank sediments. Upper Santa Fe basin aggradation probably ceased from 0.7 to 1.0 million years ago (Love et al. 2001).

Most of Albuquerque's water supply wells are completed in the upper Santa Fe Group. Some wells extend into the middle unit of the Santa Fe Group. Pumping in excess of recharge has led to local cones of depression and significant declines in the regional water table. This decline in the regional water table is not uniform and is most pronounced along the eastern edge of the basin (Thorn et al. 1993).

3.2 Local Hydrogeology

The MWL is located within a distinct hydrogeologic region governed by the Rio Grande rift basin fault system. The landfill rests on thin (<100 ft), late Pleistocene, post-Santa Fe Group alluvial fan deposits. The late Pleistocene alluvial fan deposits are underlain by a transition zone of two, first-order sedimentary components of the Santa Fe Group: to the west is a belt of fluvial sediments deposited by the axial ancestral Rio Grande flowing from north to south; to the east is a sequence of alluvial fan deposits derived from the uplands to the east.

The ancestral Rio Grande deposits are subdivided in ascending order into the "A," "B," and "C" zones based upon lithology and geophysical log characteristics (Figure 3-1). The transition zone

between the ancestral Rio Grande deposits and the alluvial fan deposits is characterized by a complex, sawtooth-like interfingering of the two that shifted westward through time. The lower ancestral Rio Grande unit, the "A," is therefore the most extensive and occurs near or below the completion depths of monitoring wells at the MWL (Figure 3-2). Only the distal part of the "B" is present at the MWL, occurring as a thin tongue of fluvial sands wedged into alluvial fan deposits.

The alluvial fan deposits are subdivided vertically into a relatively coarse-grained sequence above (tan in Figures 3-1 and 3-2) and an extremely fine-grained sequence below (green in Figures 3-1 and 3-2). The rather sharp change occurs at approximately 310 ft below ground surface (bgs), and likely records an abrupt change in climate. The fine-grained unit forms the lower part of the vadose zone and the upper part of the saturated zone. This unit is characterized by extremely low saturated hydraulic conductivities on the order of 10^{-7} centimeters/second (cm/sec) ($3x10^{-4}$ ft/day) or lower (Figure 3-3), calculated from grain-size analyses of core samples. A representative split-spoon sample taken at a depth of 400 ft in MWL-MW5 recovered what was described as plastic, brown clay. Five of the seven monitoring wells, MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and the upper screen of MWL-MW4, are screened in this fine-grained unit of alluvial fan deposits.

The fluvial sands of the ancestral Rio Grande deposits are characterized by lateral continuity and saturated hydraulic conductivities several orders of magnitude higher than the overlying fine-grained alluvial unit. Well MWL-MW6 is screened in the ancestral Rio Grande fluvial sands (Figure 3-2).

The vertical contact between the alluvial fan deposits and the ancestral Rio Grande deposits is quite sharp. Three wells (the lower screen of MWL-MW4, MWL-MW5, and MWL-MW6) are screened across this contact. In each of these wells, the influence of the conductive ancestral Rio Grande deposits completely overwhelms that of the overlying, less-conductive alluvial fan deposits in aquifer tests (Section 3.7).

3.3 Conceptual Model

The MWL is underlain by an extensive vadose zone consisting of gravels, sands, silts, and clays. These deposits are, relatively speaking, coarse-grained at and near the surface, and fine-grained at depth. Below approximately 310 ft bgs, fine-grained sediments predominate (Section 3.2). These silts and clays are characterized by saturated hydraulic conductivities on the order of 10^{-5} cm/sec ($3x10^{-2}$ ft/day) or lower (Figure 3-3).

Geochemically, the silts and clays are favorable for attenuation of organic compounds, metals, and radionuclides. Laboratory adsorption studies of soil at the MWL show strong adsorption properties for various metals and radionuclides, including cesium, strontium, lead, mercury, nickel, and cadmium (Persaud and Wierenga 1982).

Natural recharge to groundwater in the MWL area is negligible. The average annual precipitation for Albuquerque is 8.5 inches. Average annual pan evaporation at Albuquerque

International Sunport is 89 inches, more than 10 times average annual precipitation. Potential evapotranspiration is 75 inches/year (SNL/NM September 1999). Field studies at the MWL estimate recharge to be on the order of 10^{-9} to 10^{-10} cm/sec (Peace et al. September 2002).

Vadose zone soil beneath the MWL is quite dry, with average volumetric moisture contents of 4.6 percent (Peace et al. September 2002). Laboratory studies of core samples from MWL soil indicate that at *in situ* moisture contents, the unsaturated hydraulic conductivity is on the order of 10^{-10} cm/sec and lower (Peace et al. September 2002).

The extensive, dry vadose zone at the MWL, coupled with the favorable hydrologic and geochemical lithological properties, low annual precipitation, and high potential evapotranspiration effectively isolate the MWL from groundwater. The preponderance of silts and clays at depth act as a hydrologic and geochemical barrier between the landfill and groundwater.

3.4 Trends in Groundwater Level

Depth to groundwater beneath the MWL ranges from 465 to 496 ft bgs (4889 to 4916 ft above mean sea level). Water levels have declined by more than 7 ft since 1990. Figures 3-4 through 3-10 show water-level declines in MWL wells since 1990. Water levels were not measured regularly in MWL-MW4 because of the presence of the inflatable packer that separates the upper and lower screened intervals. The depths to groundwater in MWL wells are shown in Table 3-1.

Linear regression analyses were performed on MWL water level data, and average annual rates of decline were calculated for each well. The average annual rate of decline for all MWL wells is 0.77 ft/year.

MWL monitoring wells will eventually become ineffective due to declining groundwater levels. In general, for a 5-inch diameter well, at least 4 ft of standing water is required above the bottom of the well screen to properly purge and sample a well. Groundwater levels in MWL wells will be monitored until the wells are no longer effective. The wells will then be plugged and abandoned (Section 5.3).

3.5 Water Table Maps

Figure 3-11 depicts the regional water table beneath KAFB/SNL/NM in January 2000. Figure 3-12 depicts the regional water table beneath TA-3 and TA-5 in April 2000. Groundwater beneath TA-3 and TA-5 flows west, with a slight northwest component. West of TA-3 and TA-5 and the KAFB boundary, groundwater enters a prominent north-trending trough and flows north. This trough was created over several decades by the pumping of City of Albuquerque and KAFB production wells to the north (SNL/NM March 1996).

3.6 Horizontal and Vertical Hydraulic Gradients

The horizontal gradient of the aquifer beneath TA-3 and TA-5 ranges from 0.006 to 0.009. The horizontal gradient beneath the MWL is approximately 0.007, based upon the water table map in Figure 3-12.

The vertical gradient beneath the MWL was calculated using differences in water levels between individual well screens within the aquifer (Figure 3-13). Table 3-2 summarizes the vertical hydraulic gradient data for the aquifer beneath the MWL. Vertical hydraulic gradients range from 0.11 to 0.93.

3.7 MWL Aquifer Parameters

The hydraulic conductivities of alluvial fan and ancestral Rio Grande deposits in the aquifer beneath the MWL was measured during pumping tests conducted in 1994, and slug withdrawal tests conducted in 2001. The hydraulic conductivity data are presented in Table 3-3 and discussed below.

3.7.1 Pumping Tests

In 1994, pumping tests were conducted on the upper and lower screened intervals of MWL-MW4 to measure the hydraulic conductivity of the aquifer at each screened interval. During each test, an inflatable packer was used to hydraulically isolate the upper- and lower-screened intervals, and the water level in each interval was monitored using pressure transducers. A 52-hour pumping test was conducted on the lower-screened interval at flow rates ranging from 2.94 to 3.68 gallons per minute (gpm). No drawdown was observed in the upper-screened interval of MWL-MW4 or in adjacent observation wells, although 12,000 gallons of water were pumped from the aquifer.

A subsequent aquifer test was conducted on the upper-screened interval, again using the inflatable packer to isolate the upper- and lower-screened intervals. The test lasted 13.3 hours, and the upper-screened interval was pumped at flow rates ranging from 0.12 to 1.06 gpm. Again, water levels were monitored using pressure transducers. No drawdown was observed in the lower-screened interval of MWL-MW4 or in adjacent observation wells.

The results from both aquifer tests are presented in Table 3-3. Because no drawdown was measured in adjacent observation wells, storativity was not determined.

During April and May 1994, monitoring wells MWL-MW1, MWL-MW2, MWL-MW3, and MWL-BW1 were sampled for water quality as part of the ongoing groundwater monitoring program at the MWL. Water levels were monitored with pressure transducers during the purging and sampling of the wells, and hydraulic conductivity values were calculated from the drawdown and recovery data (SNL/NM June 1998). These results are also summarized in Table 3-3.

3.7.2 Slug Tests

In July 2001, slug withdrawal tests were conducted on all MWL wells, including MWL-MW4. The data from the tests were analyzed using the methods of Hvorslev (1951) and Bouwer and Rice (1976). The recovery data from the slug withdrawal tests, and the Hvorslev and Bouwer and Rice graphical solutions are presented in Appendix C of this report, and summarized in Table 3-3.

3.7.3 Average Hydraulic Conductivity Values

The aquifer pumping test and slug withdrawal test results indicate the hydraulic conductivity of the aquifer beneath the MWL varies significantly with depth. Wells completed in the upper alluvial fan deposits include MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and the upper-screened interval of MWL-MW4. Wells completed in the lower ancestral Rio Grande deposits include the lower-screened interval of MWL-MW4, MWL-MW5, and MWL-MW6. The hydraulic conductivities of the alluvial fan deposits range from 1.39×10^{-3} to 7.23×10^{-2} ft/day, averaging 1.64×10^{-2} ft/day. The hydraulic conductivities of the ancestral Rio Grande deposits range from 0.682 to 5.05 ft/day, averaging 1.81 ft/day (Table 3-3).

In each case, the geometric mean was used rather than an arithmetic average because hydraulic conductivity values frequently vary by several orders of magnitude. The geometric mean is more appropriate in such cases (Freeze and Cherry 1979).

3.7.4 Average Linear Groundwater Flow Velocity

The average linear groundwater flow velocity in the aquifer beneath the MWL was calculated using Darcy's law (Freeze and Cherry 1979), which states:

$$v = K\, i / n_e$$

where

- v = average linear flow velocity (distance/time),
- K = the average hydraulic conductivity (distance/time),
- i = the horizontal hydraulic gradient (unitless), and
- n_e = the effective porosity (unitless).

The average linear groundwater flow velocity was calculated for the shallower, alluvial fan deposits and for the deeper, ancestral Rio Grande deposits. The horizontal gradient of the aquifer beneath the MWL was approximated to be 0.007 (Section 3.6). An effective porosity, 0.25, was obtained from Freeze and Cherry (1979) for similar deposits. The horizontal linear flow velocity for the alluvial fan deposits ranges from 0.01 to 0.74 ft/year, averaging 0.17 ft/year. The horizontal linear flow velocity for the ancestral Rio Grande deposits ranges from 7 to 51.6 ft/year, averaging 18.5 ft/year. The results are presented in Table 3-4.

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4. Groundwater Analytical Results

4.1 Inorganic Chemistry

Inorganic (nonradiological) parameters that have been analyzed in groundwater samples include metals, major ion chemistry, total dissolved solids, and alkalinity.

4.1.1 Metals

Groundwater analytical results for metals are summarized in Tables 4-1 through 4-7. With few exceptions, metals have been analyzed for either the full suite of Target Analyte List metals or the abbreviated RCRA metals. The RCRA metals plus beryllium and nickel data are summarized by MWL monitoring well and date. The EPA maximum contaminant level (MCL) and NMED background concentrations for KAFB and SNL/NM (Dinwiddie September 1997a) are provided for comparison. Results exceeding the EPA MCL and NMED background concentrations are shown in boldface type. If a result is a nondetection (ND), the method detection limit (MDL) is shown in parentheses. In some cases, particularly with data from the early 1990s, the laboratory reported only the reporting limit (RL) or practicable quantitation limit (PQL). In these cases, the RL or PQL is italicized in parentheses next to the ND. Analyses were by EPA Methods 6010, 6010A, or 6020 for all metals except mercury, which was analyzed using EPA Method 7470.

During the early years of groundwater sampling at the MWL, samples were collected for analysis of both total and dissolved metals (Tables 4-1 through 4-7). In general, regulatory guidelines, such as the EPA MCLs, apply to total metals concentrations. However, dissolved metals concentrations are more useful for contaminant transport modeling and geochemical analyses. Samples for analysis of total metals were collected directly into acidified containers without filtration. Samples for analysis of dissolved metals were obtained by filtering samples using a 0.45 micron filter. Comparison of the total and dissolved metals fractions provides valuable information concerning the source of metals in groundwater, and their mobility in the aquifer (Appendix D).

The following discussion of analytical results refers to total metals (nonfiltered), rather than dissolved metals (filtered), unless otherwise specified.

Metals Analytical Results

Chromium concentrations exceeded the NMED background concentration of 0.043 milligrams (mg)/liter (L) in MWL-BW1 in April 2001 and in MWL-MW1 in April 1997, October 1997, April 1998, November 1998, and April 1999. Chromium concentrations exceeded the EPA MCL in MWL-MW1 in April 1997 and April 1998. There have been no exceedences of the EPA MCL since 1998.

Nickel concentrations exceeded the NMED background concentration of 0.028 mg/L in MWL-BW1, MWL-MW1, MWL-MW2 and MWL-MW3. Elevated nickel and chromium concentrations are attributed to corrosion of the stainless steel screens used in the construction of these monitoring wells (Appendix D). Elevated nickel and chromium concentrations in wells with stainless steel screens is widely documented in the literature (Oakley and Korte 1996, Hewitt 1993, and Hewitt 1994).

Barium concentrations exceeded the NMED background concentration of 0.12 mg/L in MWL-BW1 in September 1990. Barium exceeded the NMED background concentration in all three samples collected from MWL-MW5 in January, April, and July 2001. The range of barium concentrations in groundwater beneath the MWL is consistent with regional barium concentrations (USGS 2002).

Cadmium was detected in MWL-MW1, MWL-MW2, MWL-MW3, and MWL-BW1 in concentrations exceeding the EPA MCL of 0.005 mg/L in January 1993. The matrix spike recovery and the relative percent difference for the laboratory duplicate were out of QC limits for cadmium in the January 1993 samples. These results are attributed to laboratory error, since no cadmium has been detected in any of the monitoring wells in concentrations exceeding the EPA MCL or the NMED background concentration since 1993.

Lead was detected in MWL-MW1 in November 1993 at 0.018 mg/L, slightly above the EPA Action Level of 0.015 mg/L. No lead concentrations have exceeded the EPA Action Level in any MWL monitoring wells since November 1993.

Selenium was detected in MWL-MW1 in April 2000 at 0.0077 mg/L and in MWL-MW4 in April 1993 at 0.0071 mg/L. These levels are above the NMED background concentration level of 0.005 mg/L but below the EPA MCL of 0.05. Selenium concentrations have not exceeded the NMED background levels in MWL-MW1 since April 2000 or in MWL-MW4 since April 1993.

4.1.2 Nitrate

Nitrate concentrations for groundwater beneath the MWL are provided in Table 4-8 with all concentrations presented in mg/L (as nitrogen). Nitrate concentrations are below the EPA MCL of 10 mg/L and range from 1.07 to 6.75 mg/L. Nitrate concentrations in MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and MWL-MW6 exceed the NMED background concentration for nitrate of 4 mg/L. The highest nitrate concentrations were measured in MWL-BW1.

Lower nitrate concentrations (1 to 2 mg/L) are observed in wells screened deeper within the aquifer (MWL-MW4, MWL-MW5, and MWL-MW6). The range of nitrate concentrations in groundwater beneath the MWL is consistent with regional nitrate concentrations (USGS 2002). The source of nitrate is attributed to off-site natural- and man-made sources (IT April 1999).

4.1.3 Major Ions

Major ion chemistry data for groundwater beneath the MWL is summarized in Table 4-9. The parameters used to define major ion chemistry include the cations calcium, magnesium, potassium, sodium, and the anions bromide, chloride, sulfate and carbonate/bicarbonate (alkalinity).

An analysis of major ion chemistry data was presented in the MWL Phase 2 RFI Report (Peace et al. September 2002), which included Piper trilinear and Stiff diagrams showing major ion chemistry data from April 1993 to October 1995. These diagrams demonstrate that major ion chemistry was stable during this period, and that MWL monitoring wells contained geochemically similar groundwater.

Major ion chemistry analyses were discontinued in 1996. However, in 2001 major ion chemistry was evaluated again to determine if changes had occurred in the water chemistry since 1996. The results are summarized in Table 4-9. The Piper trilinear and Stiff diagrams in Figures 4-1 through 4-14 graphically depict the major ion chemistry. Both Table 4-9 and Figures 4-1 through 4-14 demonstrate that the major ion chemistry of groundwater beneath the MWL has been stable from 1993 through 2001.

Piper Trilinear Diagrams

Groundwater beneath the MWL is bicarbonate-type water with almost equal percentages of calcium and sodium. The Piper trilinear diagrams (Figures 4-1 through 4-5) demonstrate that water quality in the MWL wells has been stable since monitoring began. Piper trilinear diagrams for MWL wells in April 1996 and in April 2001 are presented in Figures 4-6 and 4-7, respectively.

The minor ion chemistry variations observed in MWL-MW4 (Figure 4-5) reflect commingling of groundwater from the upper- and lower-screened intervals in the well, which are separated by an inflatable packer (Figure 3-13). This packer has been removed from the well several times for servicing by the manufacturer, allowing commingling between the upper- and lower-screened intervals.

Stiff Diagrams

Stiff diagrams are also useful geochemical tools for major ion analysis (Figures 4-8 through 4-14). Five MWL wells monitored since 1993 show consistent water quality over time (Figures 4-8 through 4-12). Figures 4-13 and 4-14 present Stiff diagrams for all MWL monitoring wells in April 1996 and April 2001, respectively.

Figure 4-14 shows unique differences in the ionic strength of groundwater from wells completed in the upper alluvial fan deposits and wells completed in the lower ancestral Rio Grande deposits. The ionic strength, as indicated by the relative size (area) of the Stiff diagrams, of samples from MWL-MW5 and MWL-MW6 is significantly greater than the ionic strength (area)

of samples from MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and MWL-MW4. The difference in ionic strength is conclusive evidence that groundwater chemistry varies with depth in the aquifer.

4.2 Organic Compounds

Groundwater sampling for organic compounds has included RCRA Appendix IX (40 CFR 264) VOCs, SVOCs, dioxins, furans, chlorinated pesticides, PCBs, herbicides, total organic carbon, total organic halogen, and phenolics. Currently, all MWL groundwater monitoring wells are sampled annually for VOCs.

4.2.1 VOCs

VOCs detected in groundwater beneath the MWL and the corresponding EPA MCLs are presented in Table 4-10. In general, VOCs detected in groundwater beneath the MWL are above the MDL but below the laboratory RL or PQL. Detections below the laboratory RL or PQL are estimated and designated with J values.

Most of the VOCs detected in groundwater beneath the MWL are the common laboratory contaminants acetone, methylene chloride, and 2-butanone. According to the EPA "Rule of Ten" (EPA February 1994), detections should be reported unless the concentration in the sample is less than or equal to 10 times the concentration in the blank for the common laboratory contaminant, or 5 times the concentration in the blank for other VOCs. The "Rule of Ten" was applied to Table 4-10, and the VOCs listed do not include results where common laboratory contaminants were detected in the associated laboratory or method blanks.

VOC Analytical Results

Acetone has been detected in MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW4. All results were qualified as J values except for results from MWL-MW4 in October 1995 and April 1997.

Methylene chloride (the most common volatile laboratory contaminant) is often detected in MWL samples and associated trip or laboratory blanks. All of the methylene chloride detections in Table 4-10 were J qualified, which are estimated values and are above the MDL but below the laboratory RL. The EPA drinking water standard for methylene chloride (EPA July 2001) is 5 micrograms (µg)/L. No values have exceeded this EPA standard.

Toluene has been detected in all MWL wells except MWL-MW6. The highest concentration of toluene was detected in MWL-MW4 in November 1998 at 13 µg/L. The EPA drinking water standard for toluene is 1,000 µg/L (EPA July 2001). No values have exceeded this EPA standard.

Additional VOCs detected in MWL wells at low concentrations include trichloroethene, bromomethane, xylenes, and cis-1,2-dichloroethene (Table 4-10). All VOCs detected in

groundwater beneath the MWL are attributed to laboratory contamination, with the exception of the toluene detected in MWL-MW4, which is attributed to the inflatable packer separating the screened intervals of the well, because toluene is used in the manufacturing process of the packer.

4.2.2 SVOCs

SVOCs detected in groundwater beneath the MWL are presented in Table 4-11. Bis(2-ethylhexyl)phthalate, a plastic additive and common laboratory contaminant, was detected in MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW4 between 1990 and 1995, and in MWL-MW5 and MWL-MW6 in 2001. The July 2001 sample from MWL-MW6 showed many other polyaromatic compounds at low concentrations. SVOCs detected in groundwater beneath the MWL are attributed to laboratory contamination because of their common occurrence in associated trip or laboratory blanks.

4.3 Radionuclides

Groundwater beneath the MWL has been sampled extensively for radionuclides. These include tritium, isotopic uranium, total uranium, isotopic thorium, isotopic plutonium, strontium-90, cobalt-60, and cesium-137. Sampling for radionuclides includes screening for gamma-emitters and gross alpha/beta activity.

4.3.1 Naturally Occurring Radionuclides in Groundwater

Naturally occurring radionuclides in the earth's crust result in naturally occurring radionuclides in groundwater. Uranium, thorium, and radium, which occur naturally in the soil and rocks of the Albuquerque basin, are present in groundwater throughout KAFB and SNL/NM. Brookins (1992) states that potassium, uranium, and thorium in the Albuquerque soil are somewhat elevated compared to average values in the U.S. On average, in the U.S. a square mile of surface excavated to a depth of 1 ft would contain 1 ton of potassium-40, 3 tons of uranium-238, and 6 tons of thorium-232. These radionuclides can be detected in groundwater because of soil-to-water transfer mechanisms.

4.3.2 Gross Alpha/Beta Activity

Gross alpha/beta activities in groundwater are indicator parameters of possible radionuclide contamination. Groundwater beneath the MWL has been screened for gross alpha/beta activities since September 1990. Gross alpha/beta activities are shown in Tables 4-12 and 4-13, respectively.

The EPA MCL for gross alpha activity is 15 pCi/L, excluding the component of gross alpha activity that can be attributed to uranium. At the MWL, the average uranium activity in groundwater is 7.2 pCi/L, or 5.97 µg/L (Section 4.3.3.). Gross alpha activity in Table 4-12 is not corrected for the average uranium activity in groundwater beneath the MWL. A simple correction can be made by subtracting 7.2 pCi/L from the gross alpha activity values in Table 4-12, which shows that gross alpha activities of greater than 22.2 pCi/L exceed the EPA

MCL. In general, gross alpha activity in groundwater beneath the MWL does not exceed the EPA MCL.

Gross beta activities in groundwater beneath the MWL are shown in Table 4-13. The maximum gross beta activity, 72.8 pCi/L, was measured on a sample from MWL-BW1 in January 1993. Replicate analyses of the same sample yielded gross beta activities of 5.0, 6.06, and 5.25 pCi/L. The 72.8 pCi/L activity is attributed to laboratory error.

The EPA MCL for gross beta activity is site-specific and is determined by the activity that would result in an annual dose of 4 millirems per year to a potential receptor from a man-made source. Because no man-made sources are present in groundwater beneath the MWL, the MCL for gross beta activity is not applicable to the MWL.

4.3.3 Uranium

Uranium occurs naturally in groundwater at KAFB, and in groundwater within the Middle Rio Grande Basin. Bexfield (USGS 2002) analyzed samples from 288 wells in the Middle Rio Grande Basin for total uranium and found total uranium concentrations that ranged from 0.1 to 86 µg/L, and averaged 6 µg/L. At KAFB, a background study showed total uranium concentrations ranging from 0.5 to 14.9 µg/L in background wells across KAFB (IT March 1996).

Samples from groundwater beneath the MWL are routinely analyzed for total and isotopic uranium. Total uranium concentrations in groundwater beneath the MWL range from 1.34 to 9.23 µg/L, and average 5.97 µg/L (Table 4-14). An anomalous total uranium value of 2,690 µg/L was measured in a sample from MWL-MW4 in October 1994. The sum of this sample's isotopic constituents yields a total uranium value of 8.85 µg/L. The 2,690 µg/L value is attributed to a laboratory decimal error. Since October 1994, total uranium concentrations in groundwater beneath the MWL have been consistent with regional uranium concentrations (USGS 2002).

Total uranium concentrations in groundwater beneath the MWL (Table 4-14) are well within the total uranium ranges established by Bexfield in the Middle Rio Grande Basin (USGS 2002). Uranium concentrations in groundwater beneath the MWL are also considerably lower than the proposed EPA MCL of 20 µg/L.

By analyzing isotopic uranium in groundwater and by evaluating the ratios of the isotopes, one can obtain information on the possible source of the uranium. Table 4-15 presents isotopic uranium analyses for groundwater beneath the MWL. Isotopic uranium activities are within background ranges measured during the SNL/NM KAFB background study (IT March 1996).

Early isotopic uranium data were obtained using standard radiometric methods (gamma spectroscopy and alpha spectrometry). Although these data are adequate for evaluating the order of magnitude activities of the various isotopes in groundwater, they are not accurate enough for isotopic ratio analysis. Recent isotopic uranium data have been obtained using ICP-MS, which

provides sufficiently accurate data to allow ratio comparisons between uranium-238 and uranium-235 in groundwater (Halicz et al. July 2000).

Theoretically, the ratio between uranium-238 and uranium-235 should be 21.76 for naturally occurring uranium. Table 4-16 presents the uranium-238/uranium-235 ratios in groundwater beneath the MWL based upon ICP-MS data collected in 2001. The uranium-238/uranium-235 ratios range from 21.08 to 21.99, averaging 21.51, demonstrating that the uranium in groundwater beneath the MWL is naturally occurring.

4.3.4 Tritium

Tritium is the primary contaminant of concern at the MWL. Tritium has been a consistent finding at the MWL since environmental studies at SNL/NM were initiated in 1969. Tritium is present in both surface and near-surface soil at the landfill. Tritium activities range from 1,100 pCi/g in surface soil to 206 pCi/g in subsurface soil. The highest tritium activities were found within 30 ft of the surface in soil adjacent to and directly below the MWL classified area disposal pits. Below 30 ft, tritium activity falls off rapidly to a few pCi/g in soil.

Tritium results for groundwater beneath the MWL are presented in Table 4-17. Tritium has been detected at an activity greater than the background value of 420 pCi/L only once since 1990. Tritium was detected in MWL-MW3 in October 1991 at 906 $\pm$ 276 pCi/L, but was not detected in the duplicate sample. Tritium was detected at activities below the background value in MWL-BW1 and MWL-MW1 in October 1991 and in MWL-MW4 in May 1994. Tritium has not been detected in groundwater beneath the MWL since 1994.

4.3.5 Plutonium

Plutonium results for groundwater beneath the MWL are presented in Table 4-18. Plutonium-239 was detected in a sample from MWL-MW2 in October 1995 at 0.028 $\pm$ 0.024 pCi/L. The 2-sigma error in this sample is nearly equal to the given value. Subsequent sampling of MWL-MW2 has not indicated the presence of plutonium. The October 1995 MWL-MW2 detection is considered a false positive.

4.3.6 Strontium-90

Strontium-90 results for groundwater beneath the MWL are presented in Table 4-19. Strontium-90 has been detected 10 times at activities ranging from 0.253 to 5.7 pCi/L. Four of the ten detections are below the NMED background value of 1.6 pCi/L. The remaining six detections do not exceed the EPA drinking water standard for beta-gamma emitting radionuclides of 8 pCi/L (EPA July 2001). The strontium-90 detections in groundwater beneath the MWL are considered false positives.

4.3.7 Cobalt-60

Cobalt-60 results for groundwater beneath the MWL are presented in Table 4-20. Cobalt-60 was detected in a sample from MWL-MW2 in April 1998 at 4.66 $\pm$2.18 pCi/L. Subsequent

sampling of MWL-MW2 has not indicated the presence of cobalt-60. The April 1998 MWL-MW2 detection is considered a false positive.

Cobalt-60 is readily detected using gamma spectroscopy, which is conducted routinely on all samples from groundwater beneath the MWL. Results indicate no evidence of cobalt-60 contamination in groundwater beneath the MWL.

4.3.8 Cesium-137

Cesium-137 results for groundwater beneath the MWL are presented in Table 4-21. Cesium-137 was detected in MWL-BW1 in September 1990 at 3.75 pCi/L, and in March 1998 at 10.6 $\pm$ 3.84 pCi/L. Cesium-137 was detected in MWL-MW1 in May 1991 at 3.01 $\pm$ 2.81 pCi/L. Subsequent sampling of MWL-BW1 and MWL-MW1 has not indicated the presence of cesium-137. The 1990, 1991, and 1998 detections are considered false positives.

Cesium-137, like cobalt-60, is readily detected using gamma spectroscopy. Results indicate no evidence of cesium-137 contamination in groundwater beneath the MWL.

5. Recommendations

This section provides SNL/NM's recommendations for future groundwater monitoring at the MWL. The MWL is included in the U.S. Department of Energy (DOE)'s Long-Term Environmental Stewardship Responsibilities. The nature and frequency of long-term groundwater monitoring at the MWL will be determined in collaboration with the DOE and the NMED as part of remedy selection for the MWL.

5.1 Recommendations for Groundwater Monitoring

Groundwater beneath the MWL is currently sampled annually in all wells.

The DOE and SNL/NM recommend the following future groundwater sampling approach:

- Annual sampling of all MWL wells should continue for the foreseeable future. Future groundwater monitoring efforts should focus on detection monitoring rather than baseline characterization of groundwater quality in MWL wells.

- Water levels should be monitored quarterly in all MWL wells.

- As part of the remedy selection process for the MWL, groundwater sampling frequency, duration, and potential changes to the analytes suite should be determined in collaboration with the NMED.

5.2 Recommended Analytical Parameters for Detection Monitoring

The recommended analytical parameters for long-term monitoring of groundwater beneath the MWL are presented in the following sections. Included is a discussion of the parameters that should be eliminated from the current monitoring program.

Proposed parameters for detection monitoring are listed in Table 5-1. These parameters include major ion chemistry, tritium, gross alpha/beta activity and VOCs. Table 5-1 also lists recommended test methods and sampling frequency.

5.2.1 Proposed Analytical Parameters for Detection Monitoring

Future groundwater monitoring efforts should focus on detection monitoring in order to detect changes in groundwater major ion chemistry, which may occur if contaminants reach groundwater. Because major ion concentrations are excellent indicator parameters for detection monitoring, these should be included in future sampling activities at the MWL.

The most mobile contaminants, tritium and VOCs, would logically be the first contaminants to reach groundwater by any plausible pathway. Future monitoring efforts should focus on these two potential contaminants. If tritium or VOCs are not detected in groundwater beneath the

MWL, then less mobile constituents of concern (COCs) in the MWL disposal inventory are unlikely to be present.

Screening for radionuclides in groundwater should continue during detection monitoring by focusing on gross alpha/beta activity in groundwater. If gross alpha/beta activity exceeds baseline activity, the laboratory will be directed to analyze for specific radionuclides as appropriate.

5.2.2 Proposed Reduction of Analytical Parameters

By focusing future monitoring efforts on the detection monitoring parameters cited above and eliminating unnecessary parameters, analytical costs can be reduced significantly during long-term monitoring at the MWL without compromising the integrity or objectives of the monitoring program. Specifically, SNL/NM recommends that the following analytical parameters be eliminated from future groundwater monitoring at the MWL, beginning in April 2003:

- Gamma spectroscopy
- Strontium-90
- Isotopic and total uranium
- Nitrate
- RCRA metals plus nickel

Gamma spectroscopy and strontium-90 can be eliminated from groundwater monitoring parameters at the MWL because gross alpha/beta activity provides adequate screening for radionuclides. Strontium-90 contamination in groundwater would be detected by screening for gross alpha/beta activity.

Isotopic and total uranium can be eliminated from groundwater monitoring parameters at the MWL because the uranium in groundwater beneath the MWL is of natural origin and within background ranges for regional groundwater (USGS 2002). Uranium contamination in groundwater would be detected by screening for gross alpha/beta activity.

Nitrate can be eliminated from groundwater monitoring parameters at the MWL because nitrate is not a COC, and nitrate concentrations in groundwater beneath the MWL are within background ranges for regional groundwater (USGS 2002).

RCRA metals and nickel can be eliminated from groundwater monitoring parameters at the MWL because there is no evidence that metals have migrated from the MWL disposal cells. Metals are considerably less mobile than tritium and VOCs.

5.3 Plugging and Abandonment

Groundwater levels at the MWL are declining at an average rate of 0.77 ft/year (Section 3-4). This rapid rate of decline will limit the effective design life of MWL groundwater monitoring wells. Two wells, MWL-MW3 and MWL-BW1, will be ineffective within a few years and will

require plugging and abandonment (P&A). MWL wells that require P&A may have to be replaced at a current cost of approximately $75,000 per well.

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6. Conclusions

Groundwater monitoring at the MWL has included 28 sampling events conducted between September 1990 and July 2001. Groundwater beneath the MWL has been characterized for major ion chemistry and analyzed for numerous COCs that occur in the MWL disposal inventory. These COCs include VOCs, SVOCs, Appendix IX (40 CFR 264) compounds, metals, nitrate, perchlorate, uranium, tritium, plutonium, strontium-90, cobalt-60, and cesium-137.

Based upon the plethora of analytical data collected, groundwater beneath the MWL is free of contamination. Major ion chemistry conclusively demonstrates that groundwater quality has remained constant over time.

Some COCs, however, have been detected in groundwater beneath the MWL at low levels. Specifically,

- Toluene has been detected in MWL-MW4. The detections are attributed to the inflatable packer installed in the well.

- VOCs and SVOCs have been detected in groundwater beneath the MWL. These detections are attributed to laboratory contamination.

- Chromium and nickel have been detected in MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3. These detections are attributed to corrosion of the wells' stainless steel screens.

- Occasional detections of radionuclides in groundwater, including tritium, strontium-90, and plutonium, have occurred. These detections are attributed to laboratory error and are considered false positives.

Future groundwater monitoring at the MWL should focus on detection monitoring rather than baseline characterization. Detection monitoring analytical parameters should include major ion chemistry, tritium, gross alpha/beta activity, and VOCs. The elimination of unnecessary analytical parameters will reduce contract analytical costs during long-term monitoring at the landfill without compromising the integrity or the objectives of the groundwater beneath the MWL monitoring program.

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Figures

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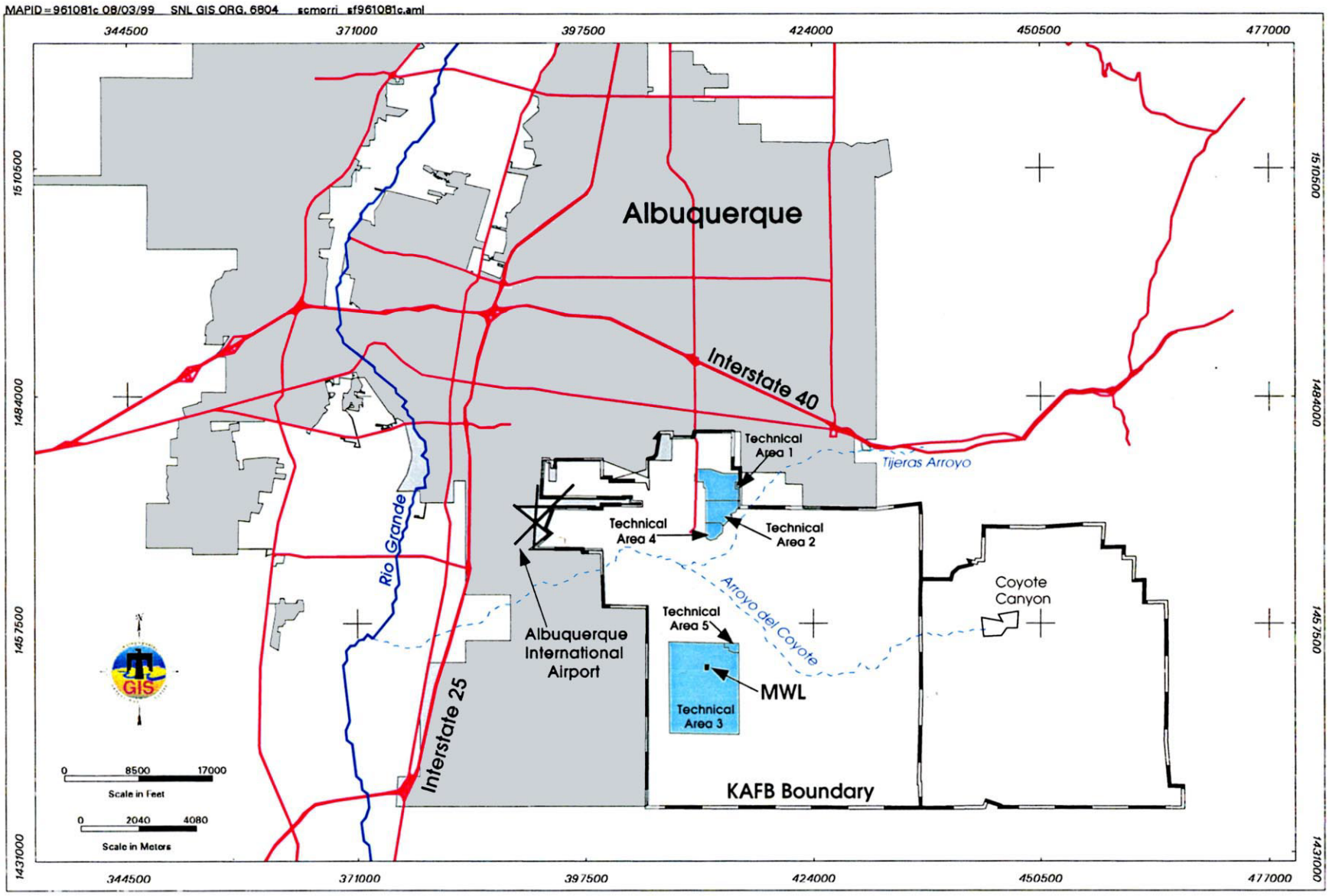

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Figure 1-1. Location of Kirtland Air Force Base and Sandia National Laboratories, New Mexico

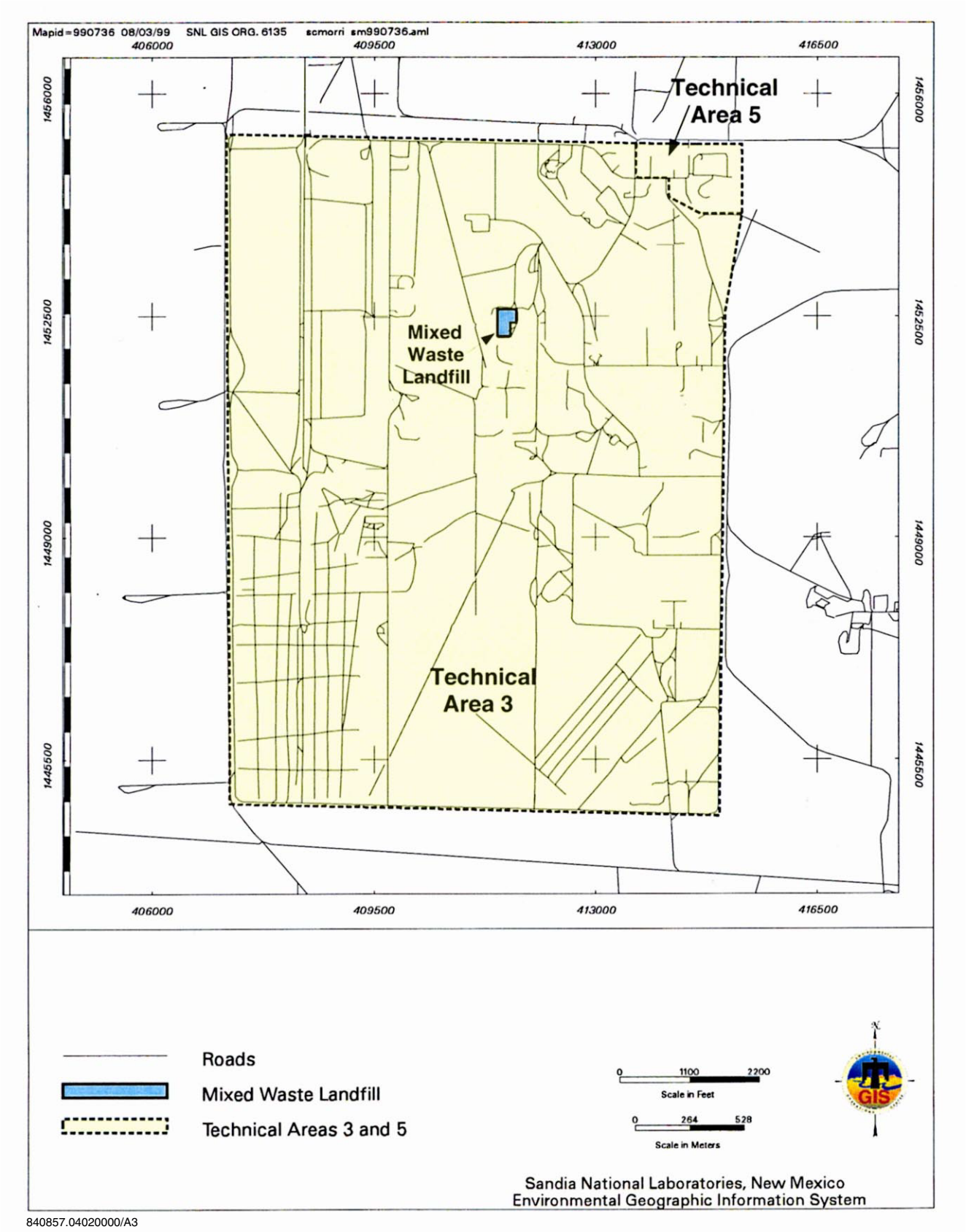

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Figure 1-2. Location of Technical Areas 3 and 5 and the Mixed Waste Landfill

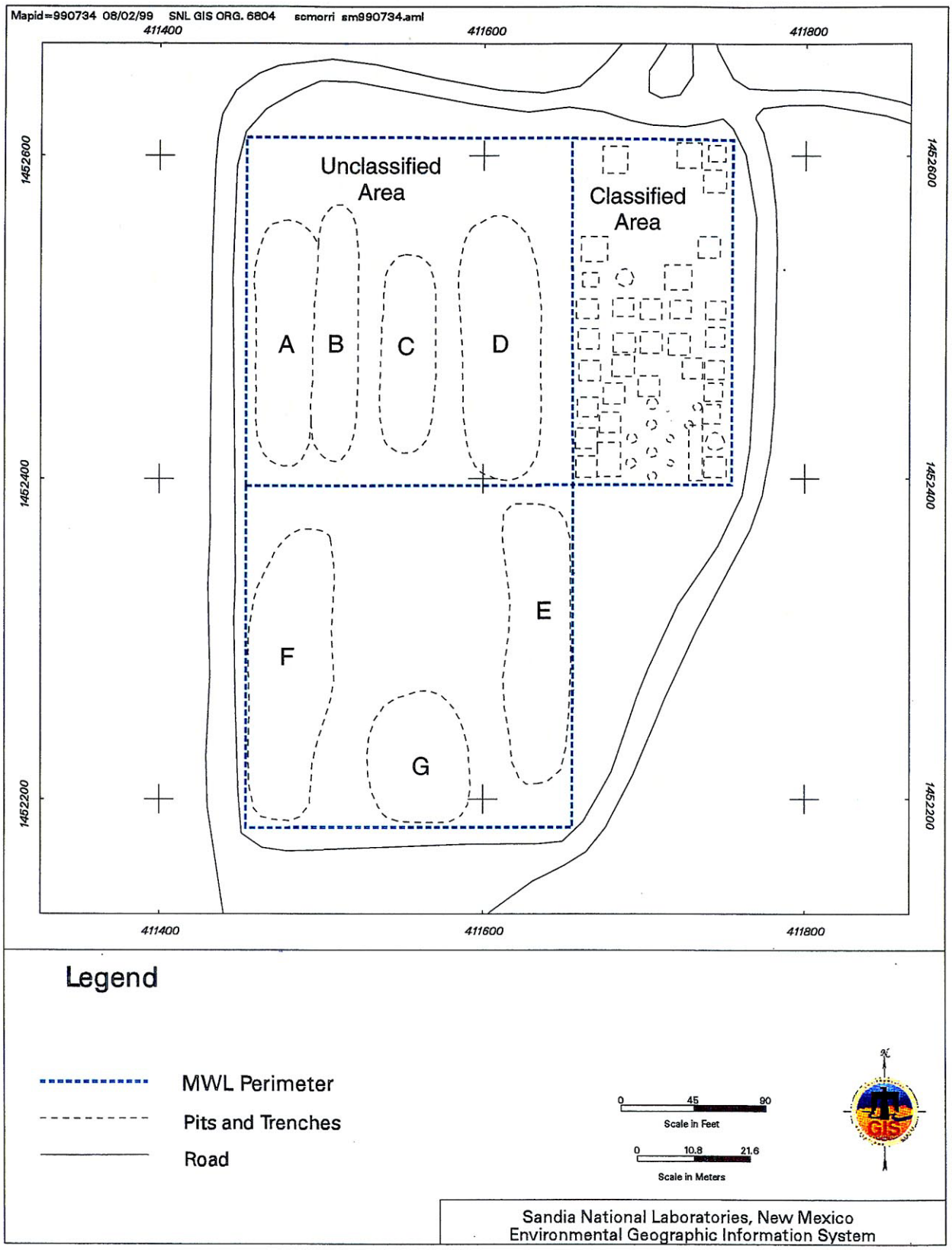

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Figure 1-3. Map of Mixed Waste Landfill

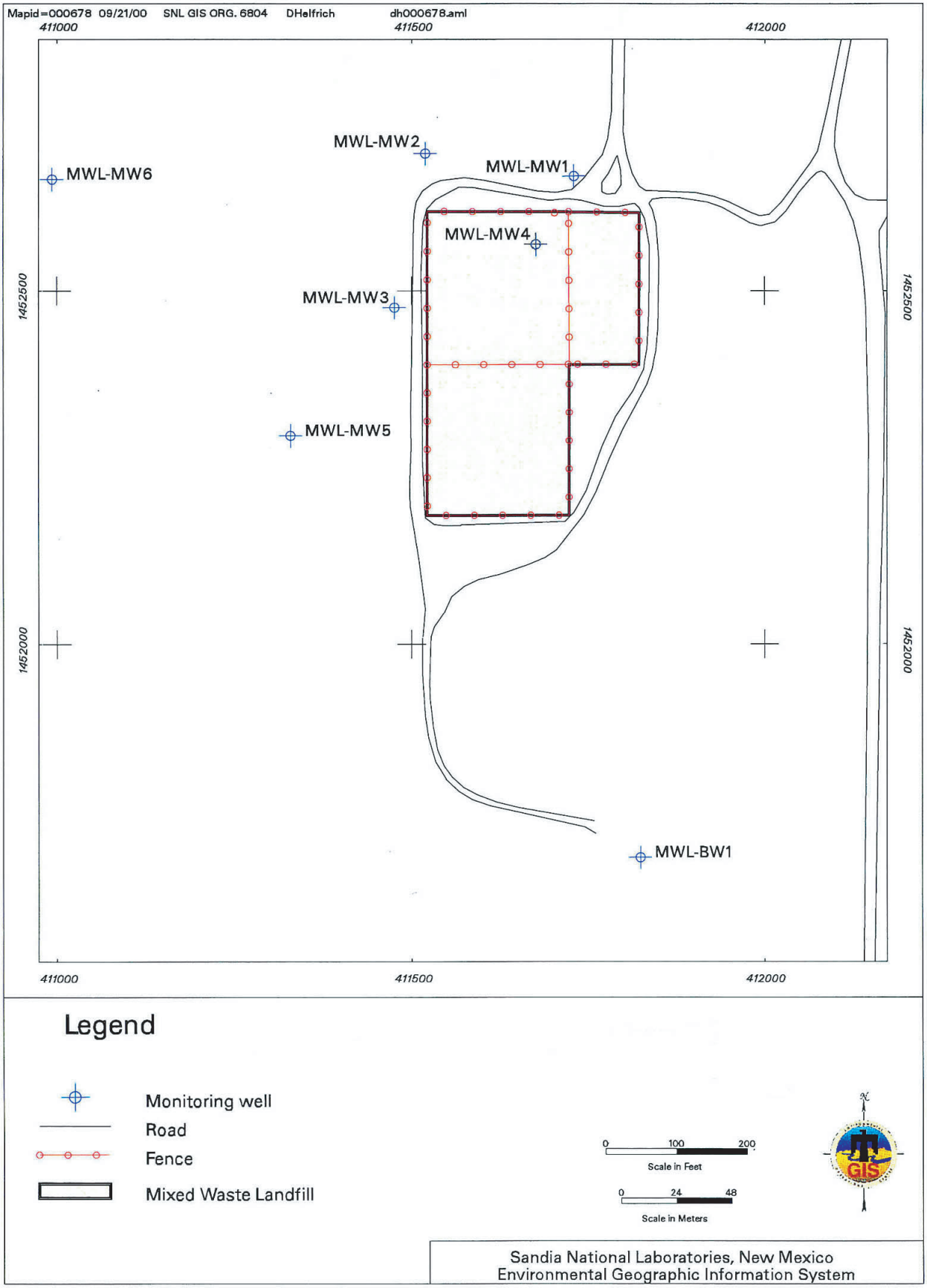

Figure 2-1. Monitoring Wells at the Mixed Waste Landfill

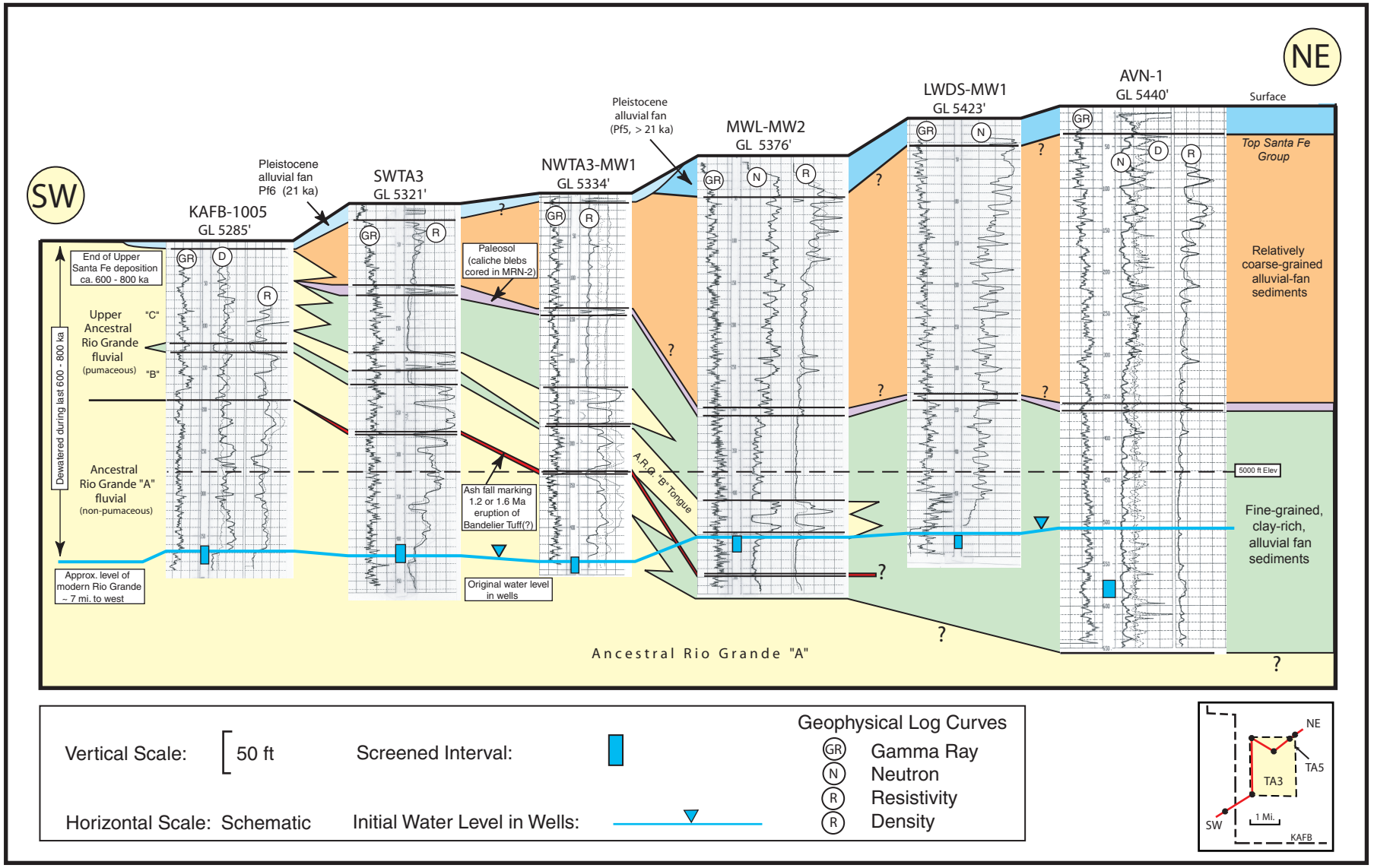

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Figure 3-1. Regional Well-Log Correlation Section Across the Mixed Waste Landfill

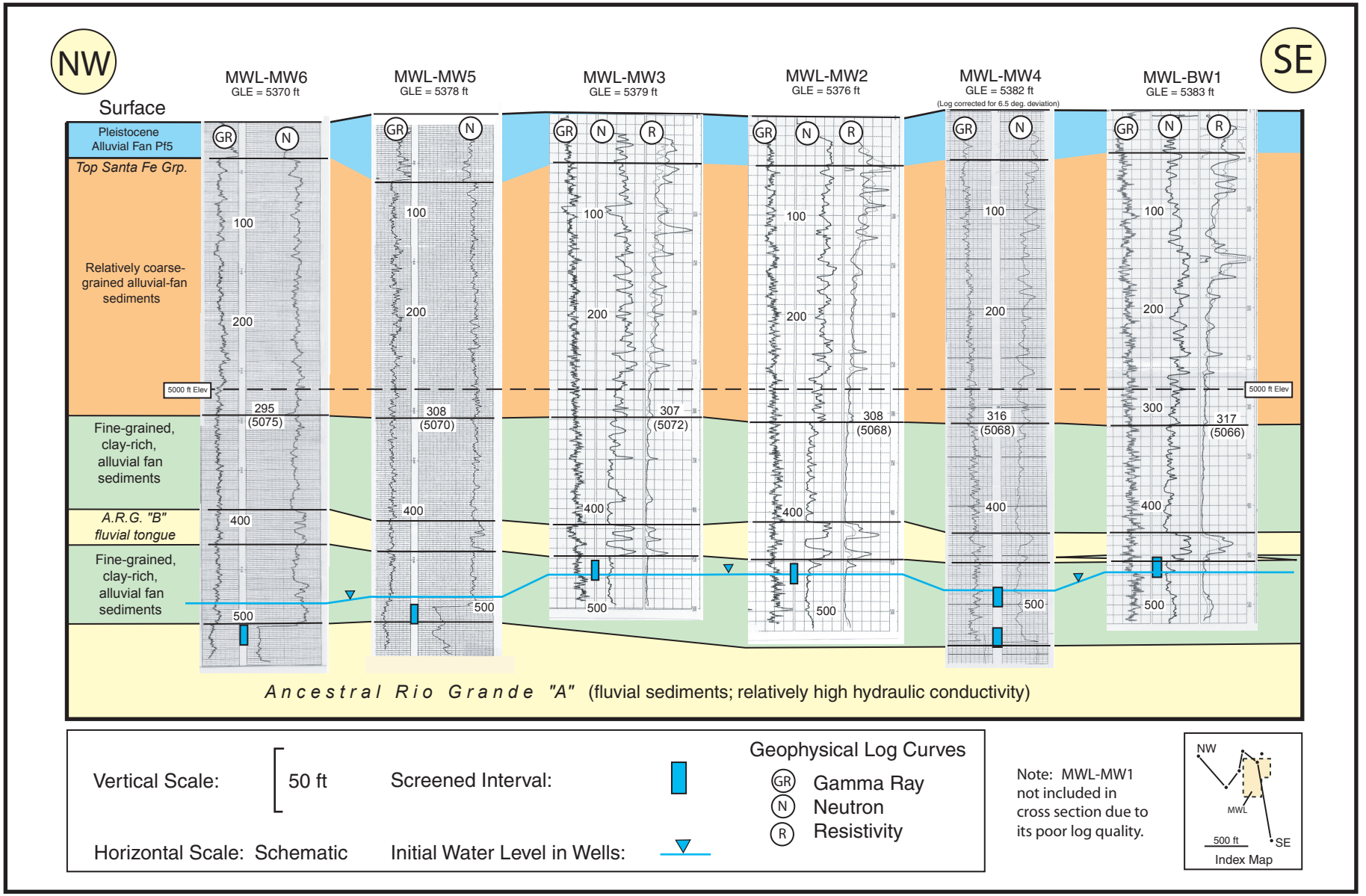

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Figure 3-2. Local Well-Log Correlation Section Across the Mixed Waste Landfill

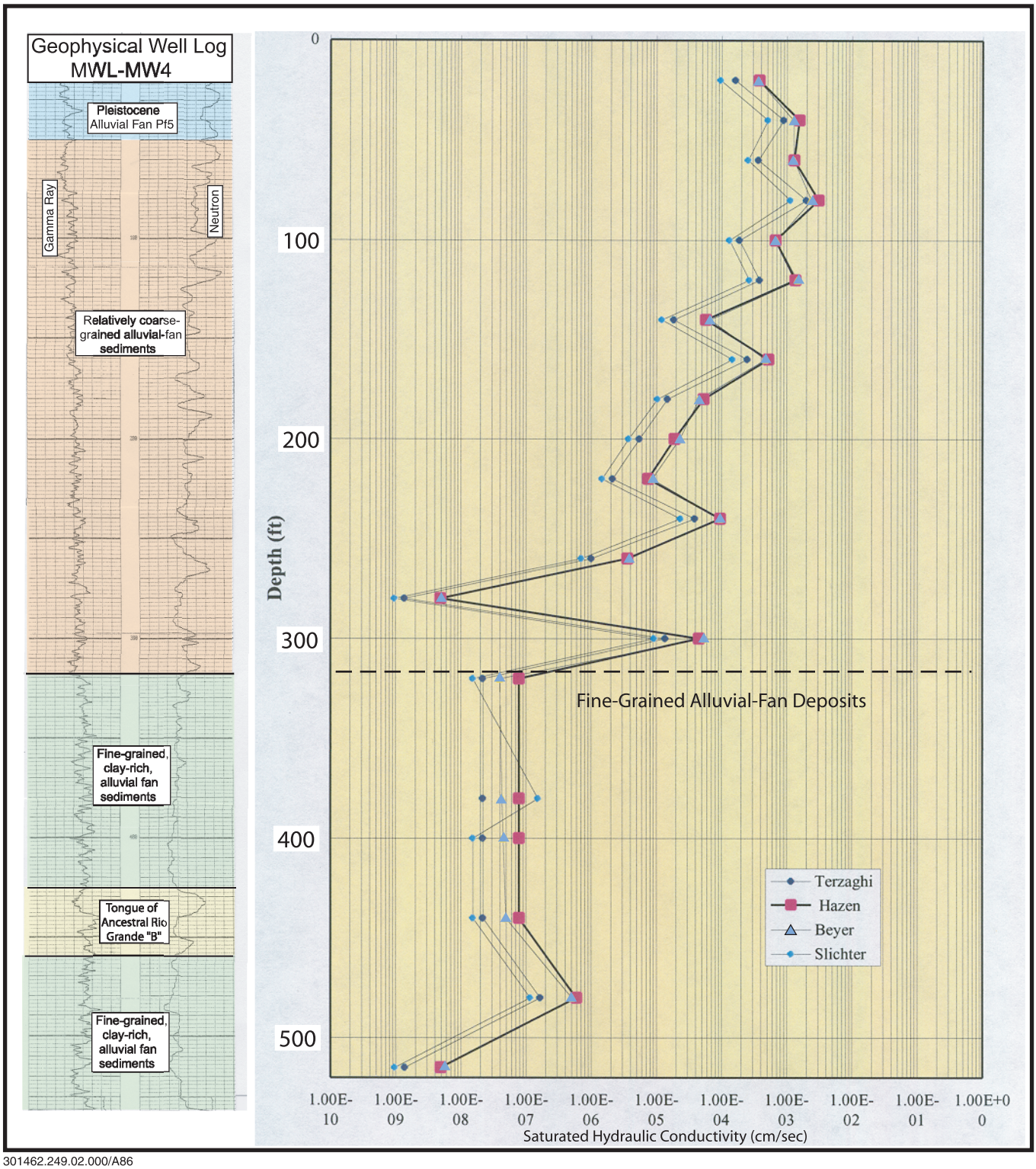

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Figure 3-3. Saturated Hydraulic Conductivities Calculated from Grain-size Analyses, MWL-MW4

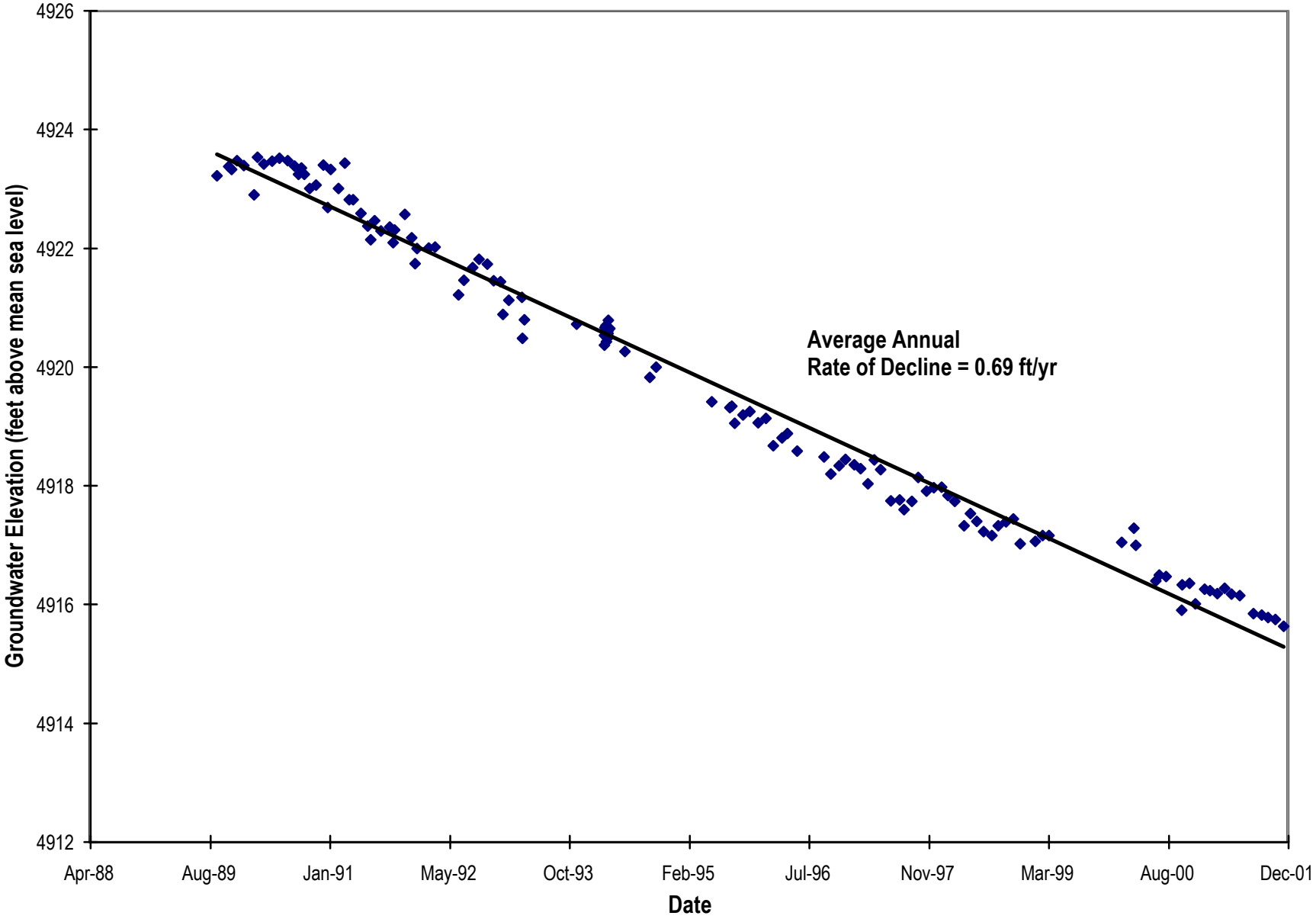

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Figure 3-4. Hydrograph of Water Levels in MWL-BW1

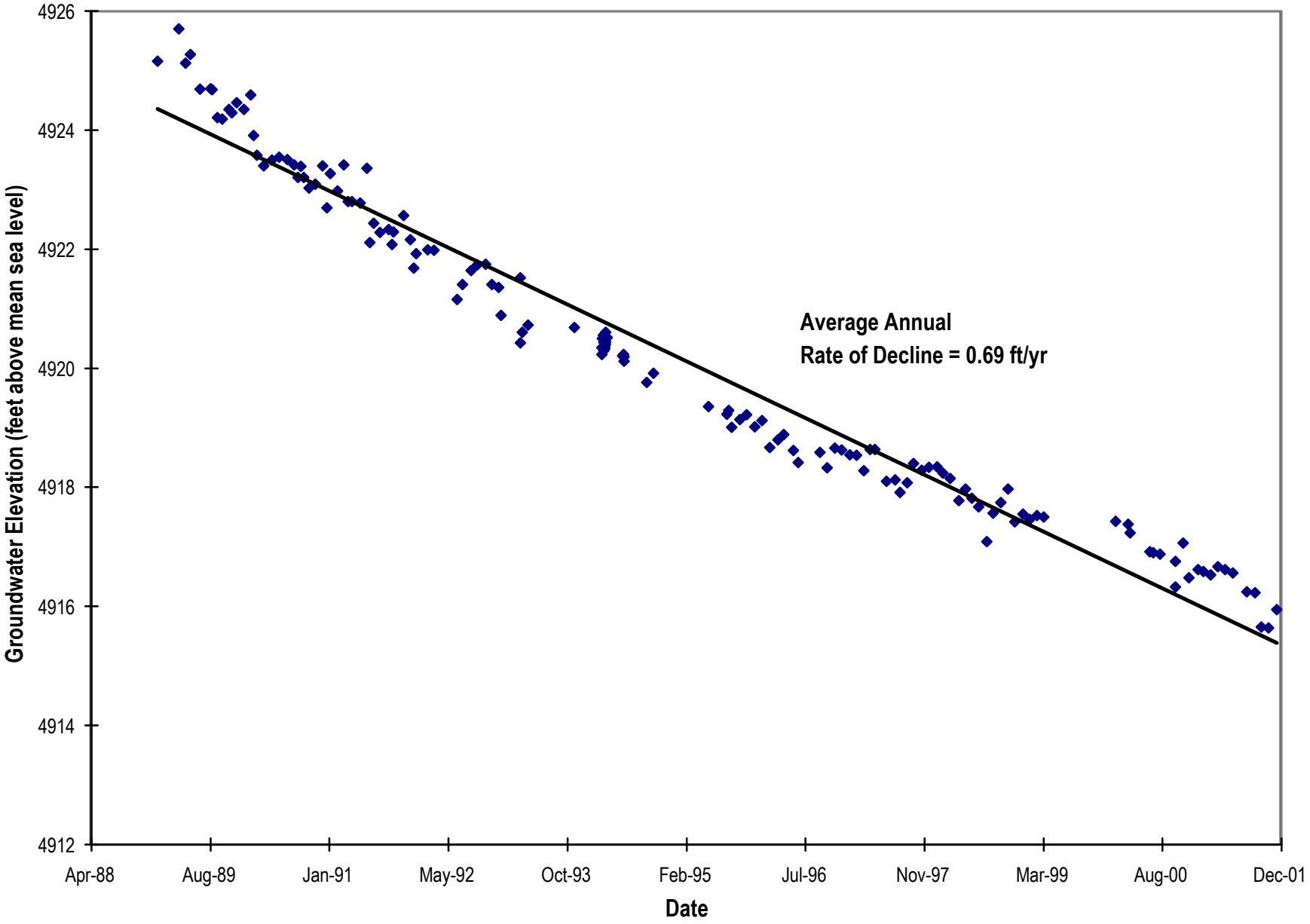

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Figure 3-5. Hydrograph of Water Levels in MWL-MW1

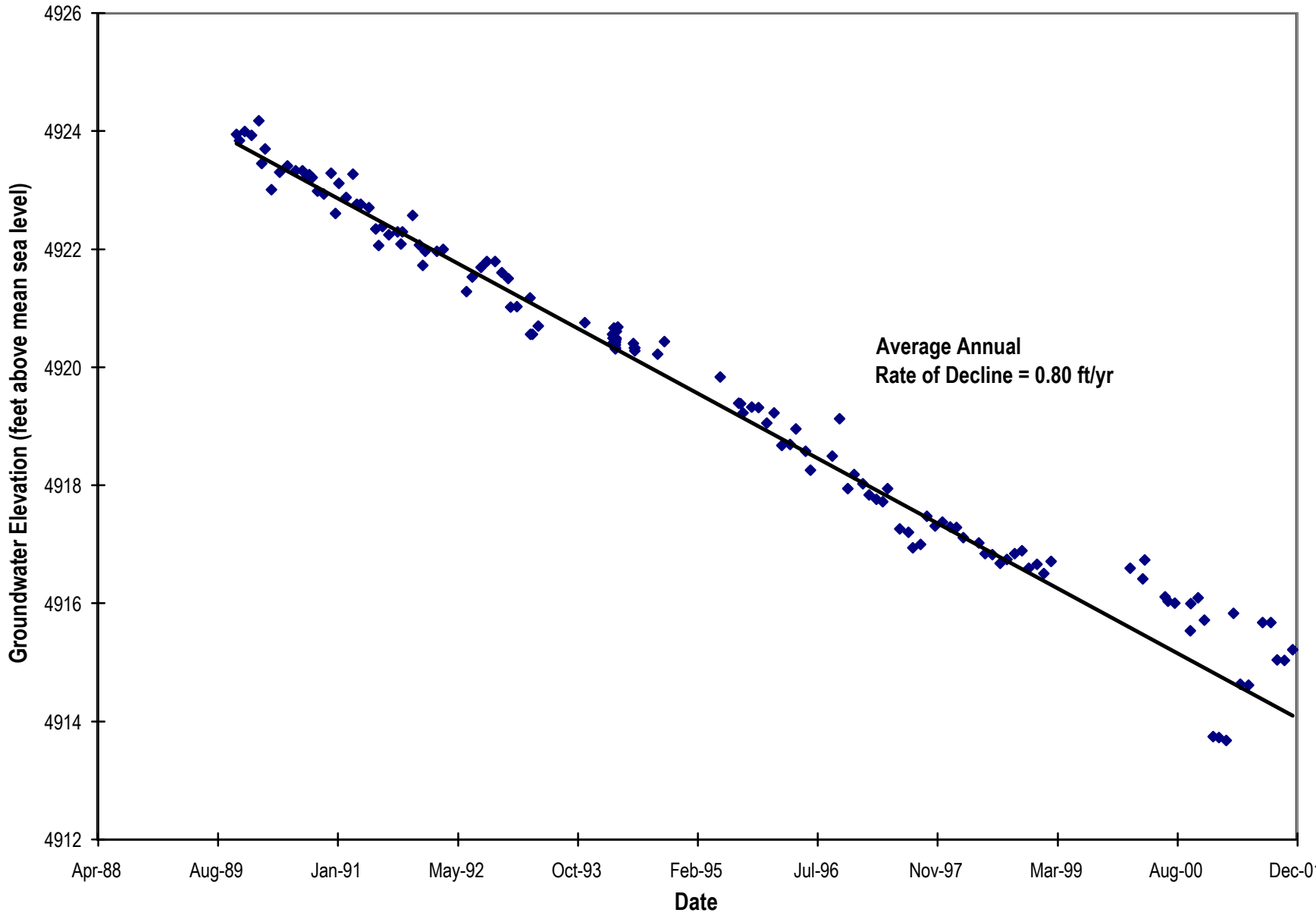

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Figure 3-6. Hydrograph of Water Levels in MWL-MW2

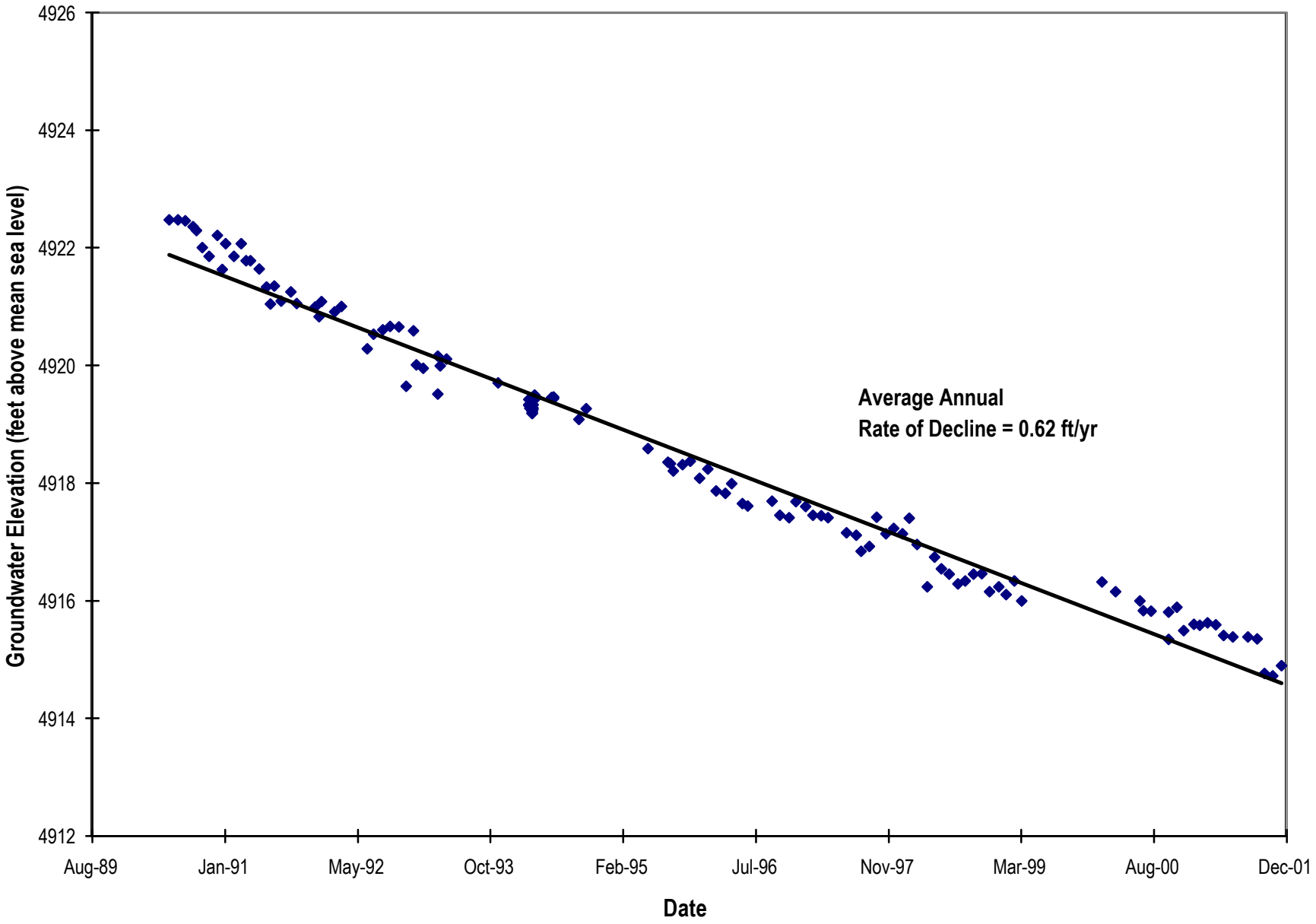

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Figure 3-7. Hydrograph of Water Levels in MWL-MW3

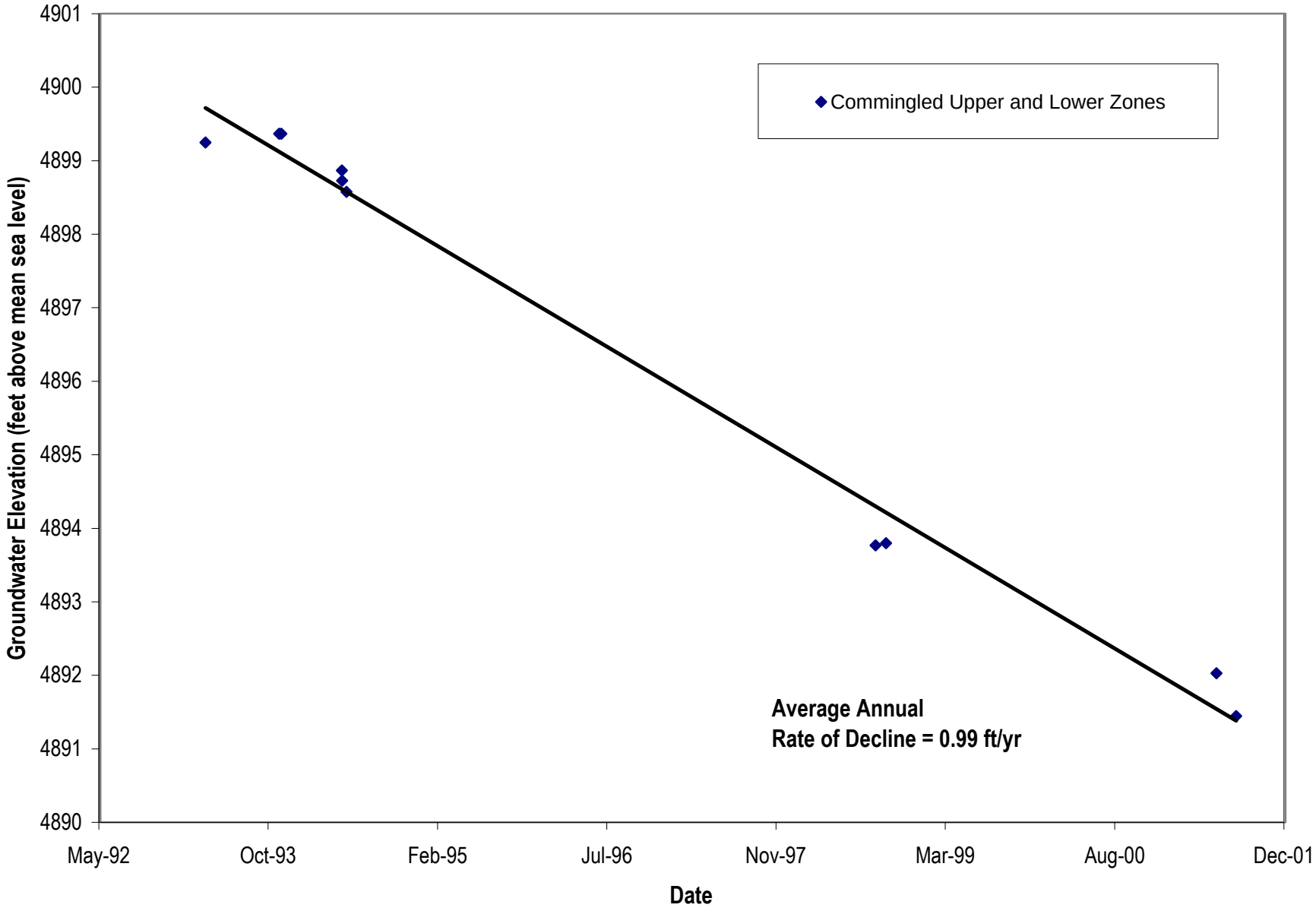

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Figure 3-8. Hydrograph of Water Levels in MWL-MW4

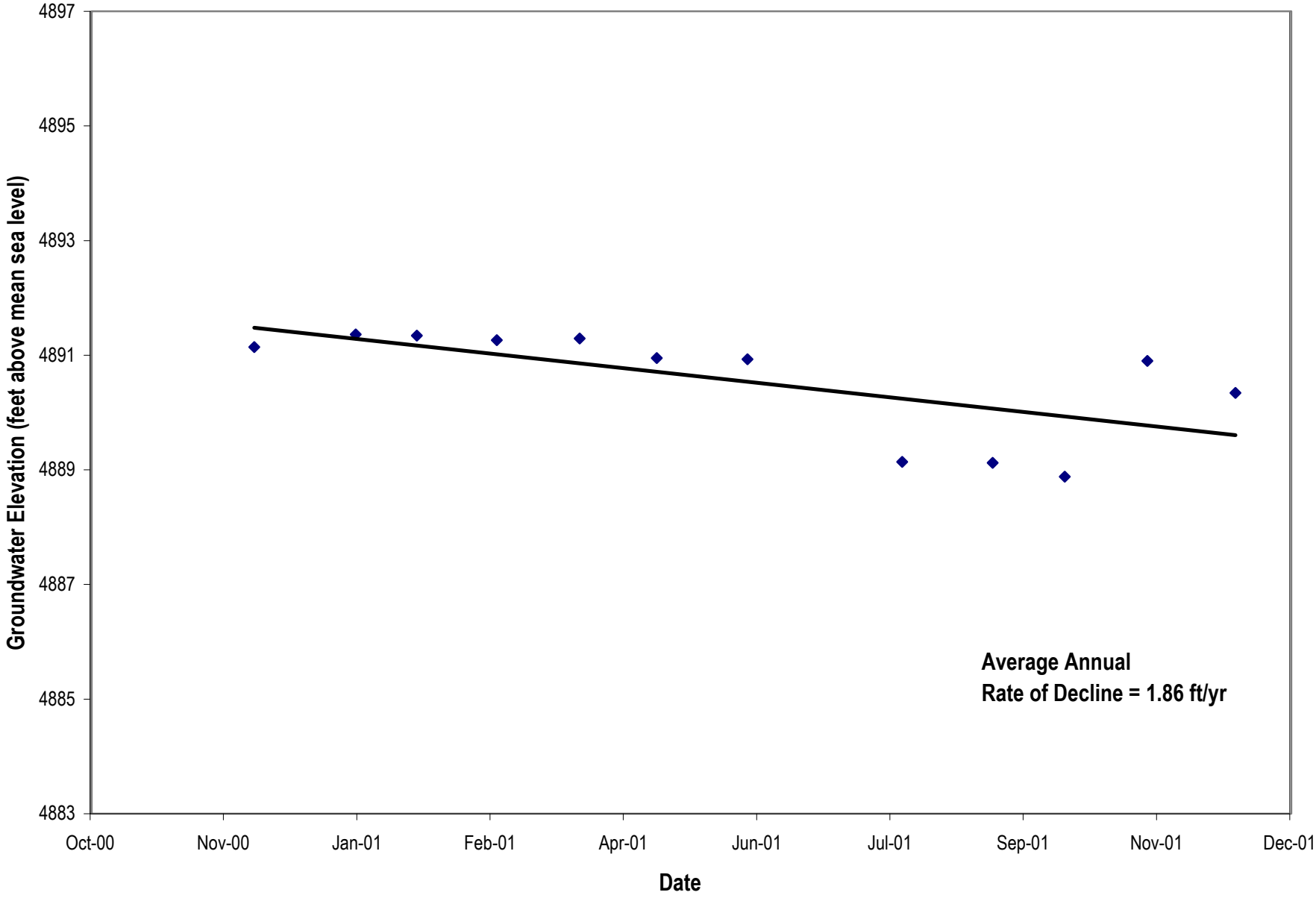

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Figure 3-9. Hydrograph of Water Levels in MWL-MW5

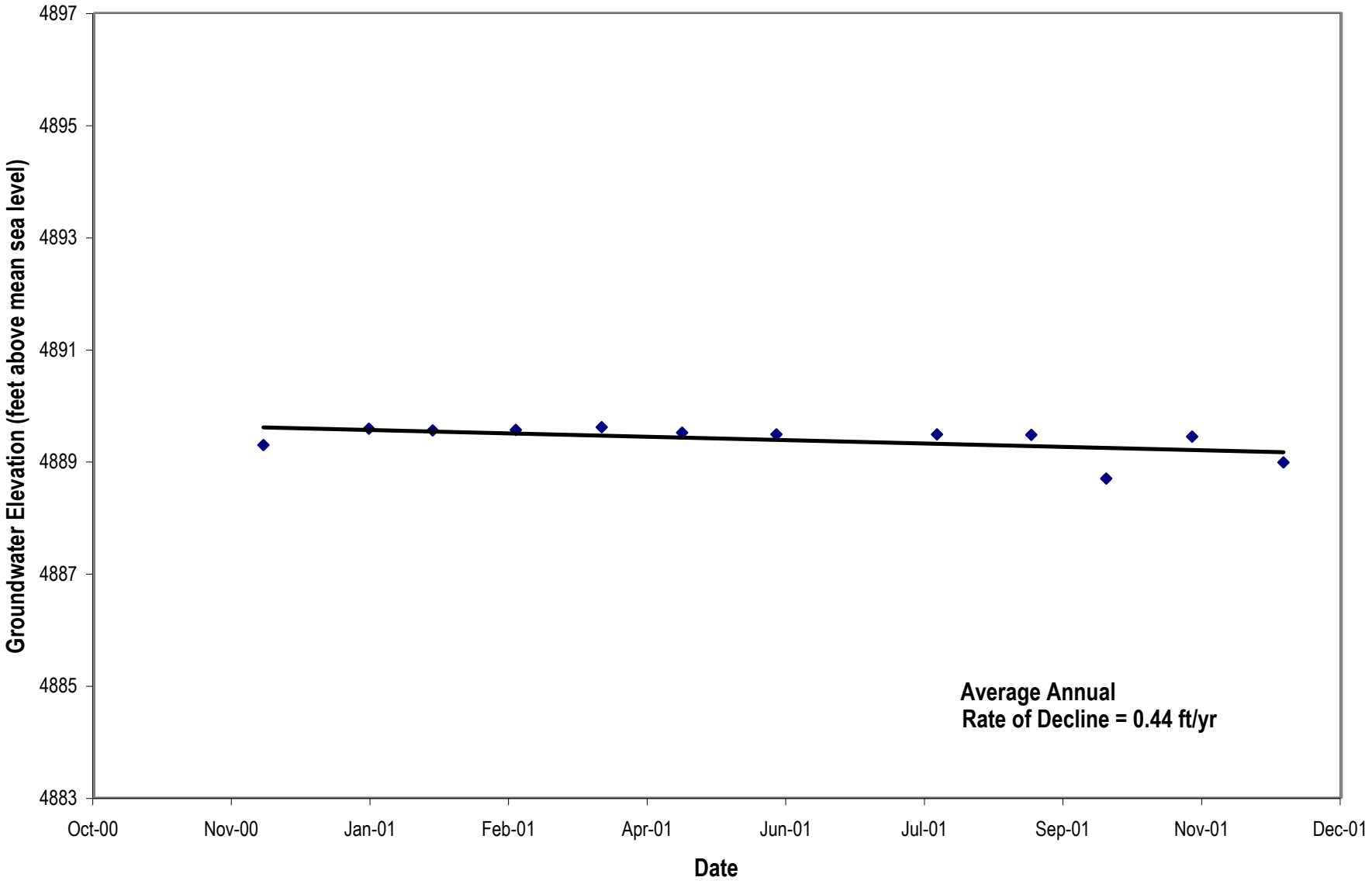

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Figure 3-10. Hydrograph of Water Levels in MWL-MW6

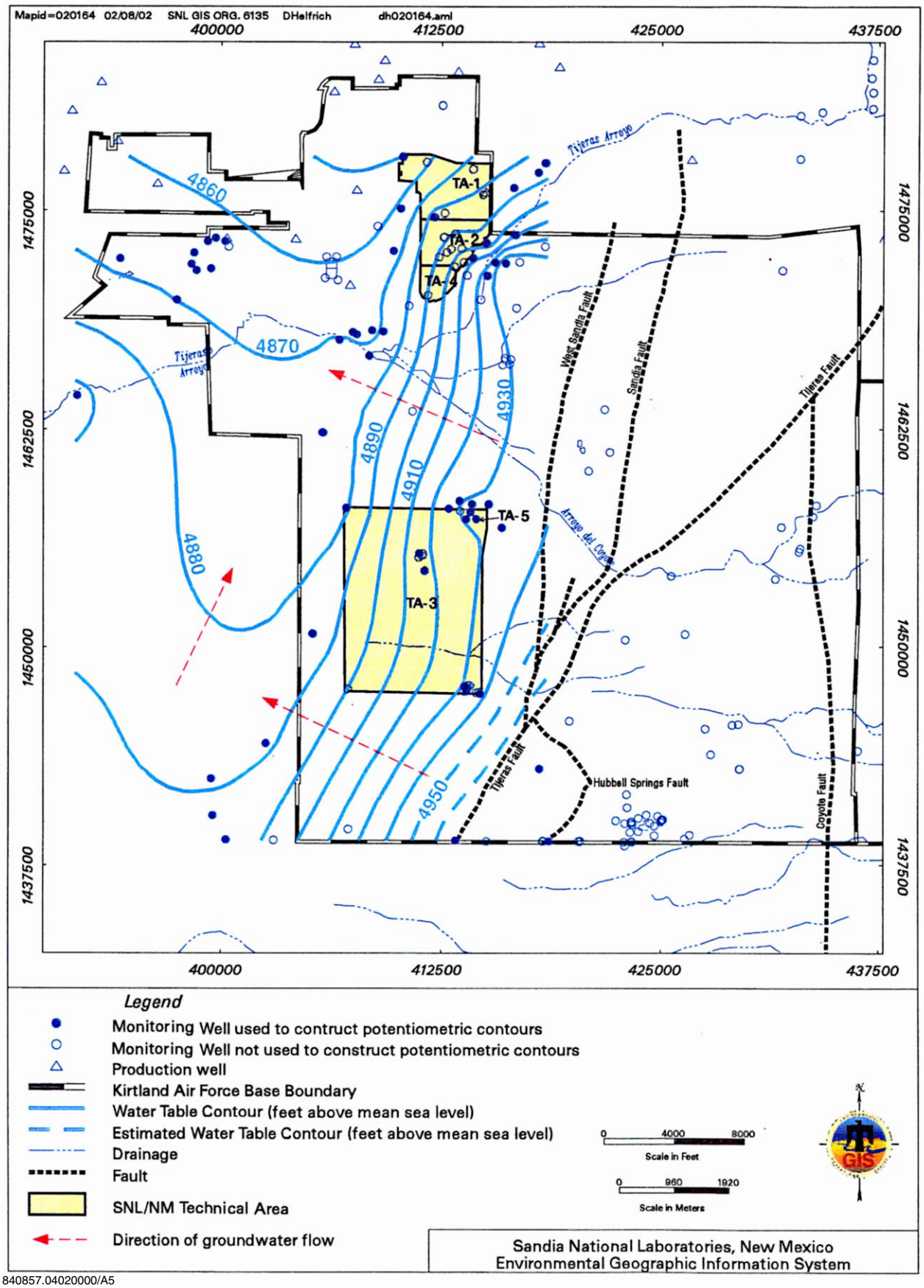

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Figure 3-11. Regional Water Table Map For Kirtland Air Force Base and Sandia National Laboratories, January 2000

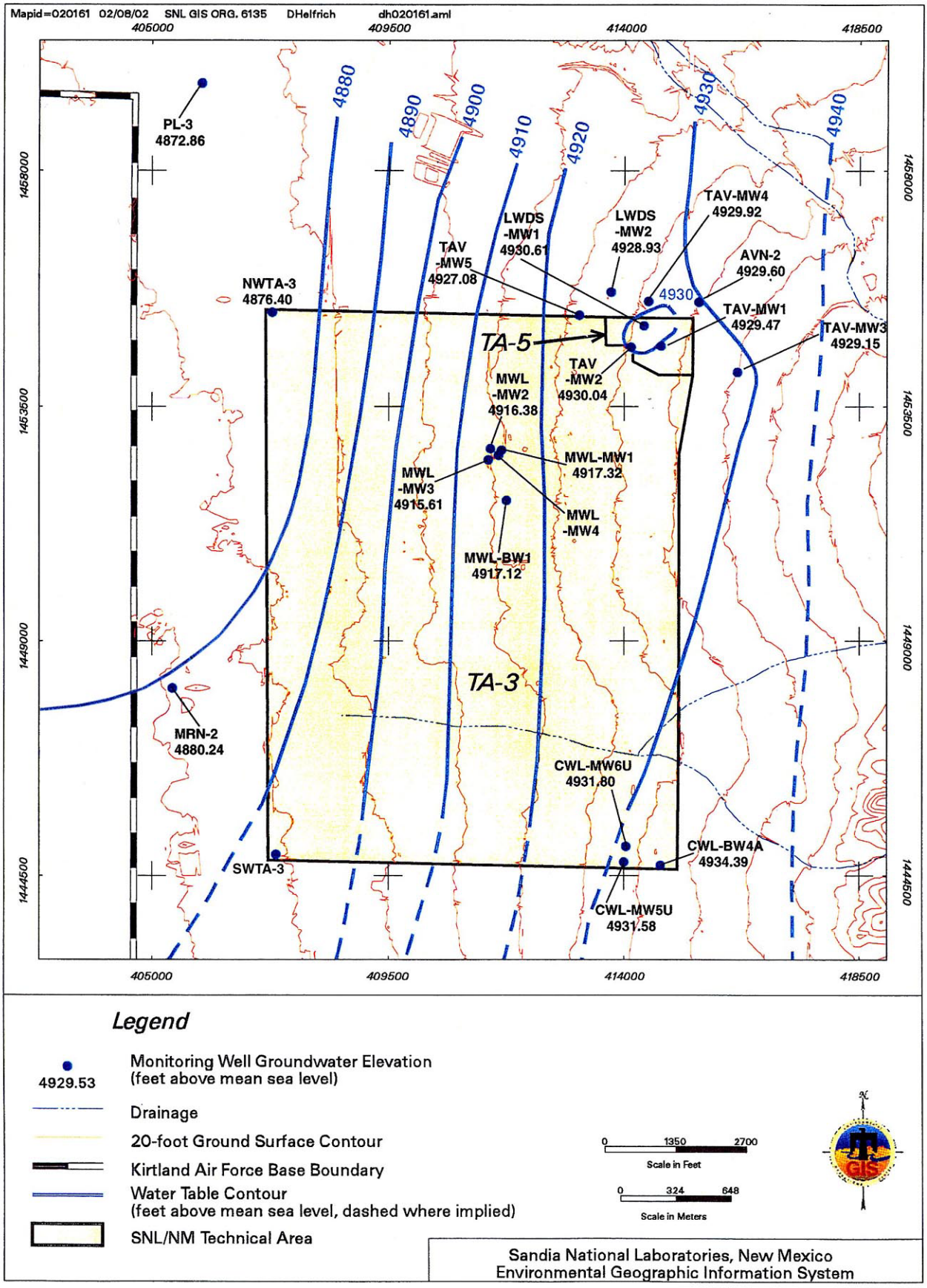

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Figure 3-12. Regional Water Table Map for Technical Areas 3 and 5, April 2000

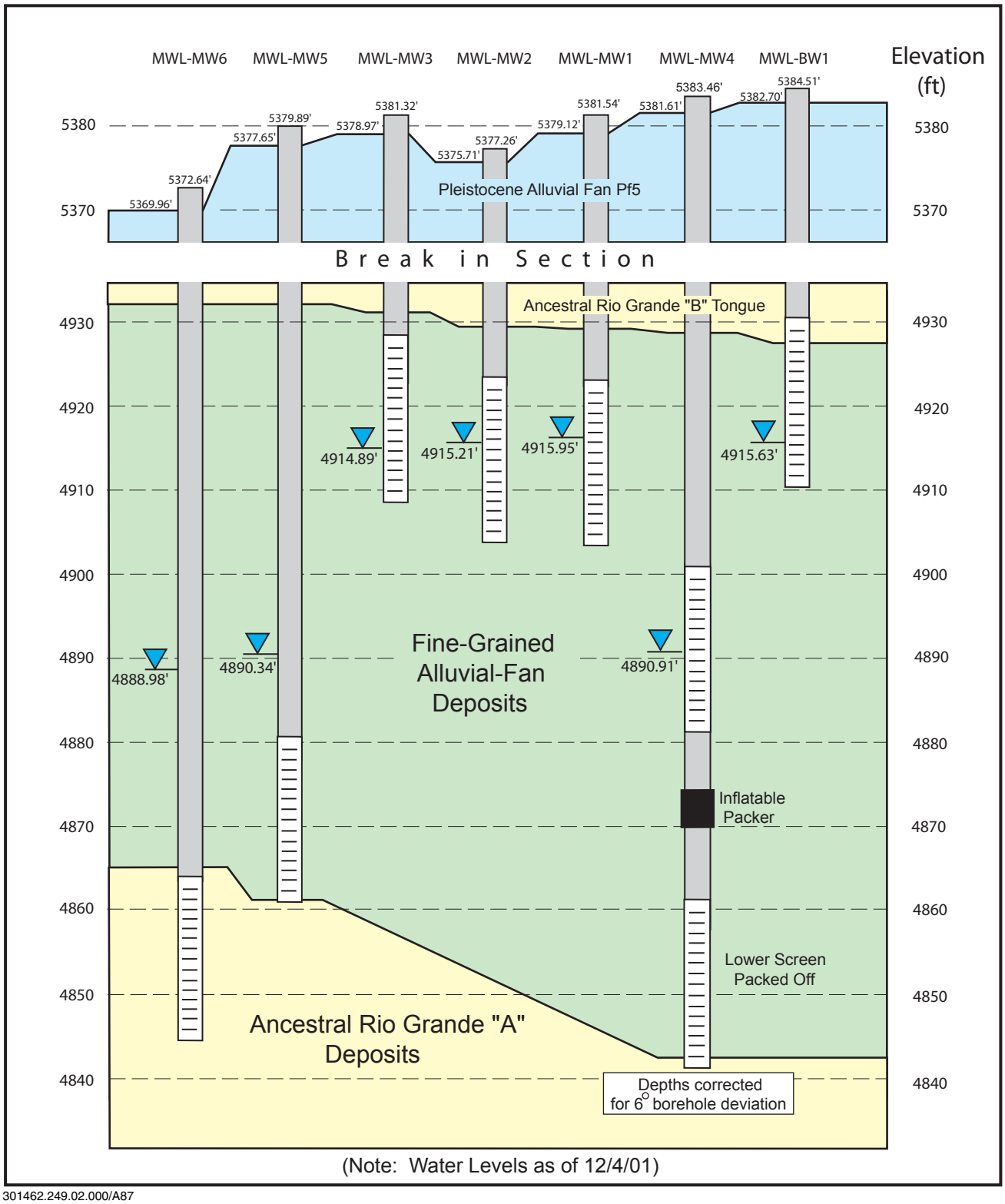

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Figure 3-13. Schematic of MWL Monitoring Well Completions

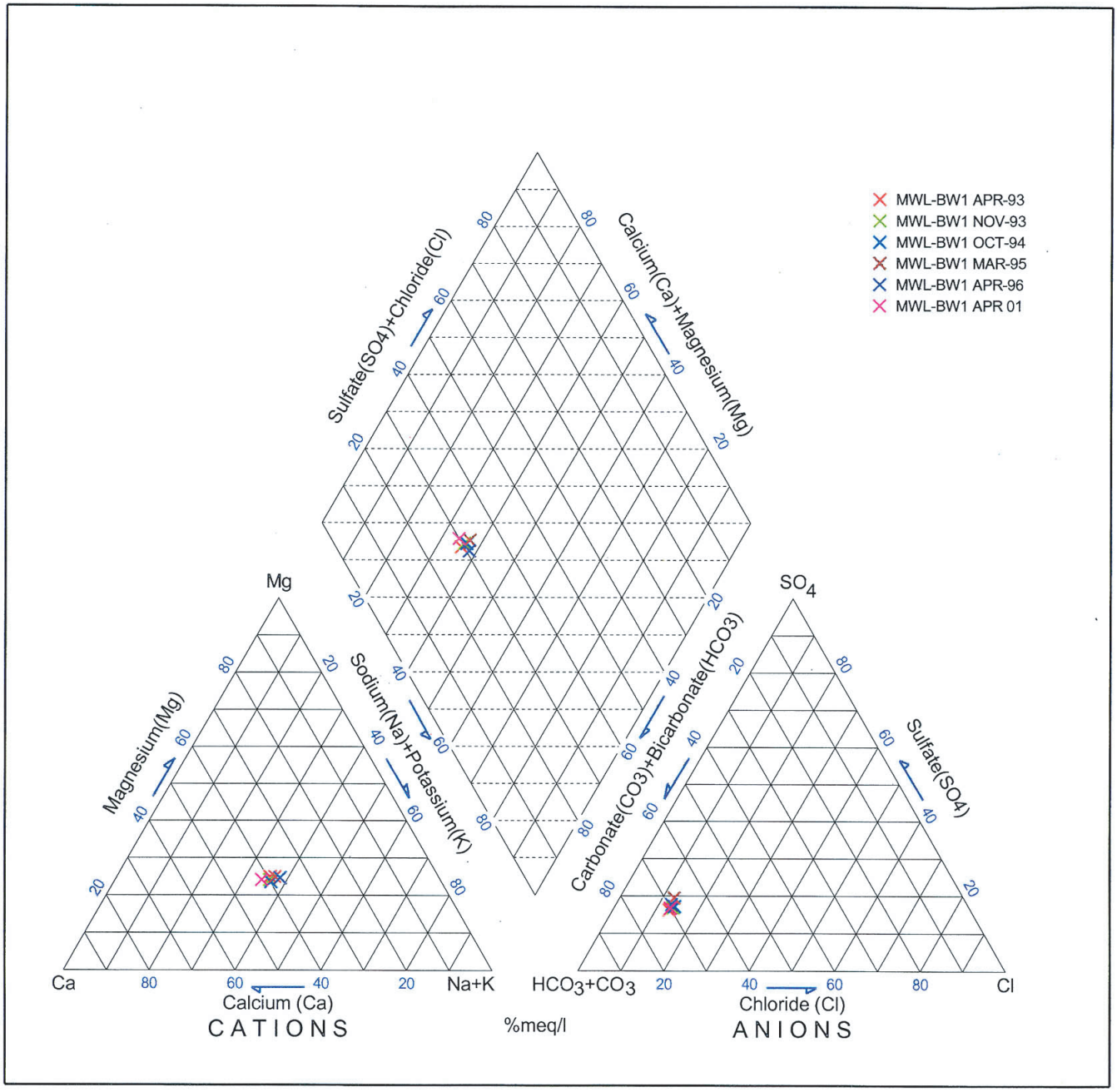

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Figure 4-1. Piper Trilinear Diagram of Major Ion Chemistry for MWL-BW1, 1993 through 2001

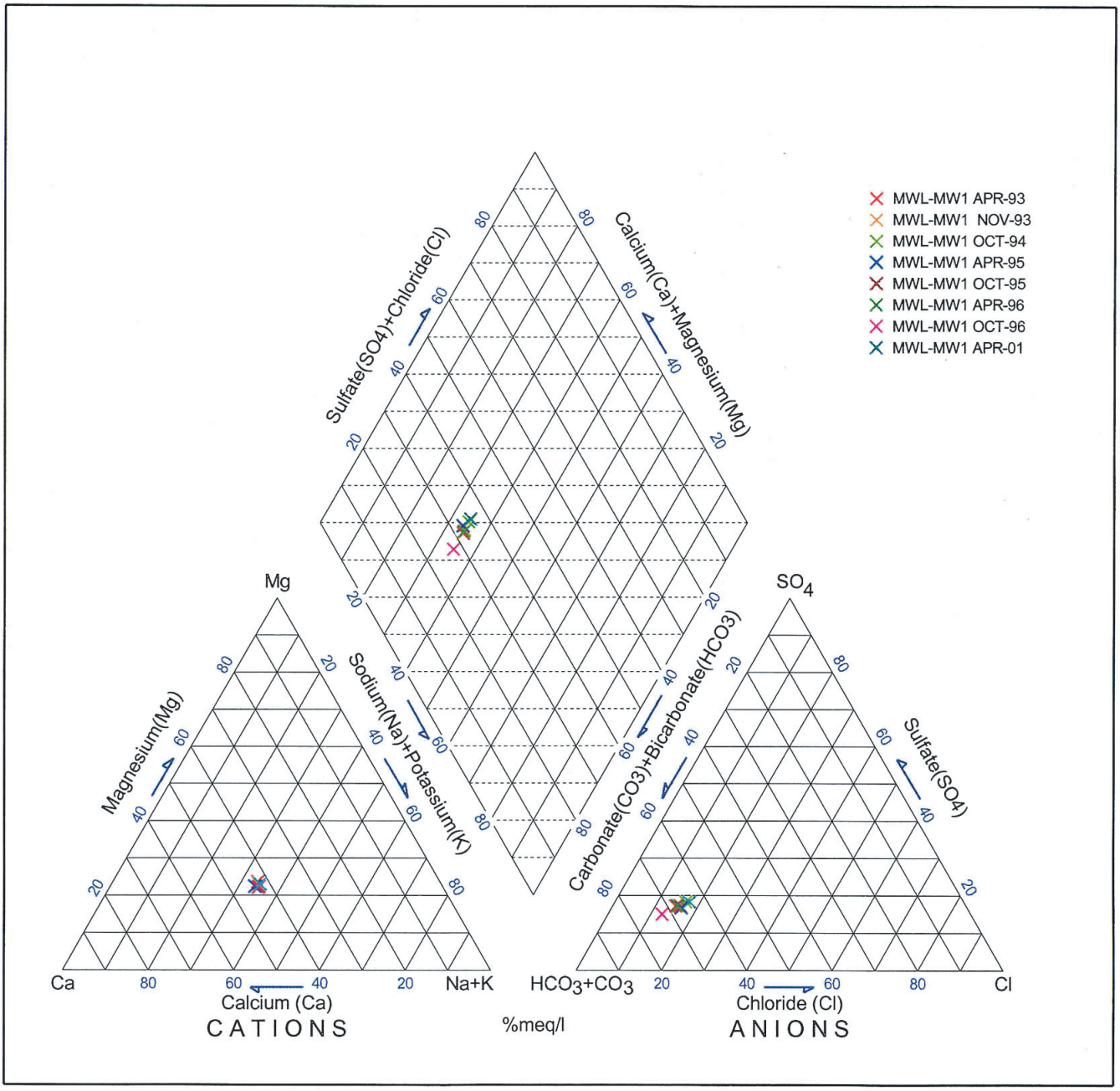

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Figure 4-2. Piper Trilinear Diagram of Major Ion Chemistry for MWL-MW1, 1993 through 2001

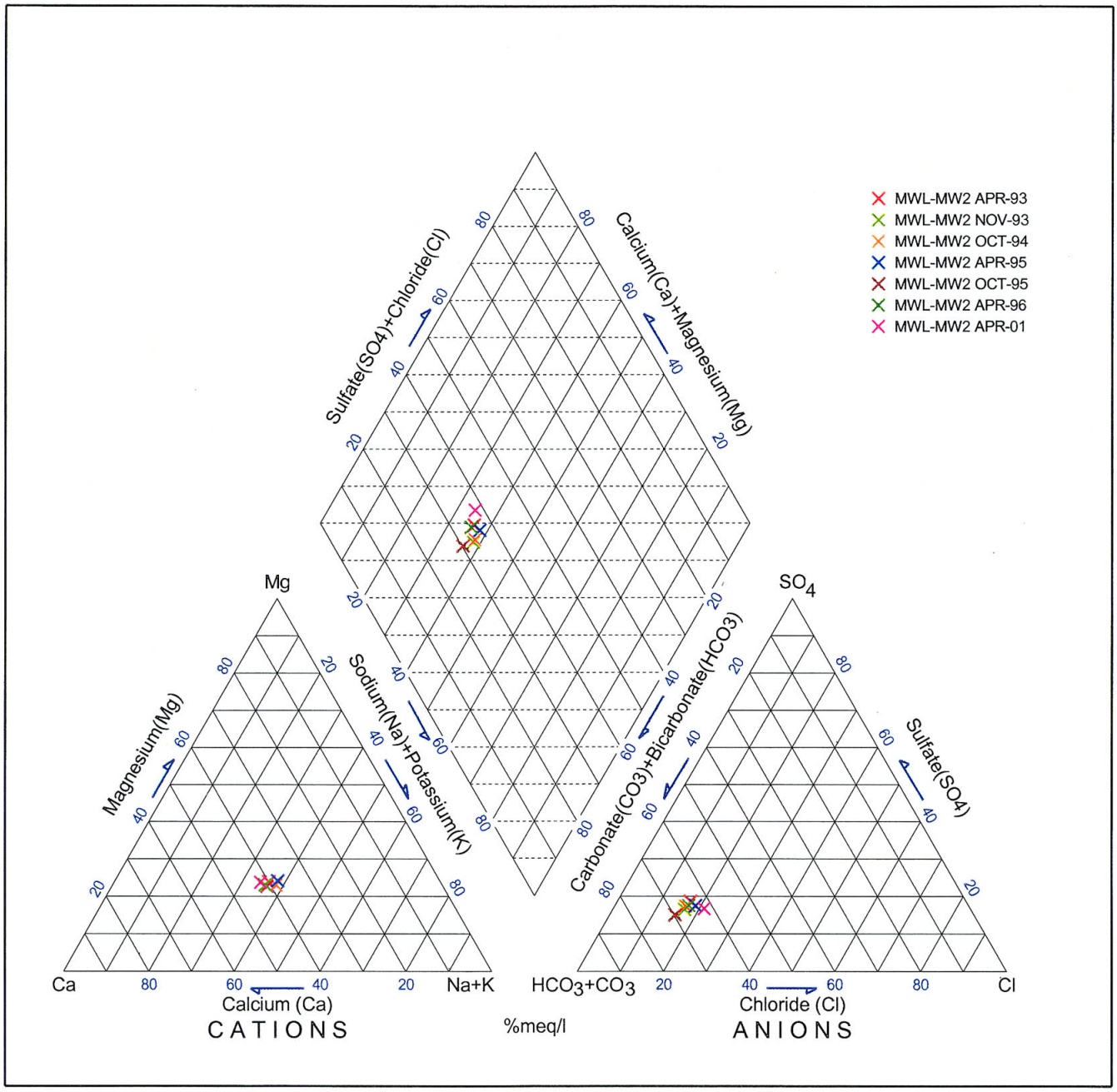

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Figure 4-3. Piper Trilinear Diagram of Major Ion Chemistry for MWL-MW2, 1993 through 2001

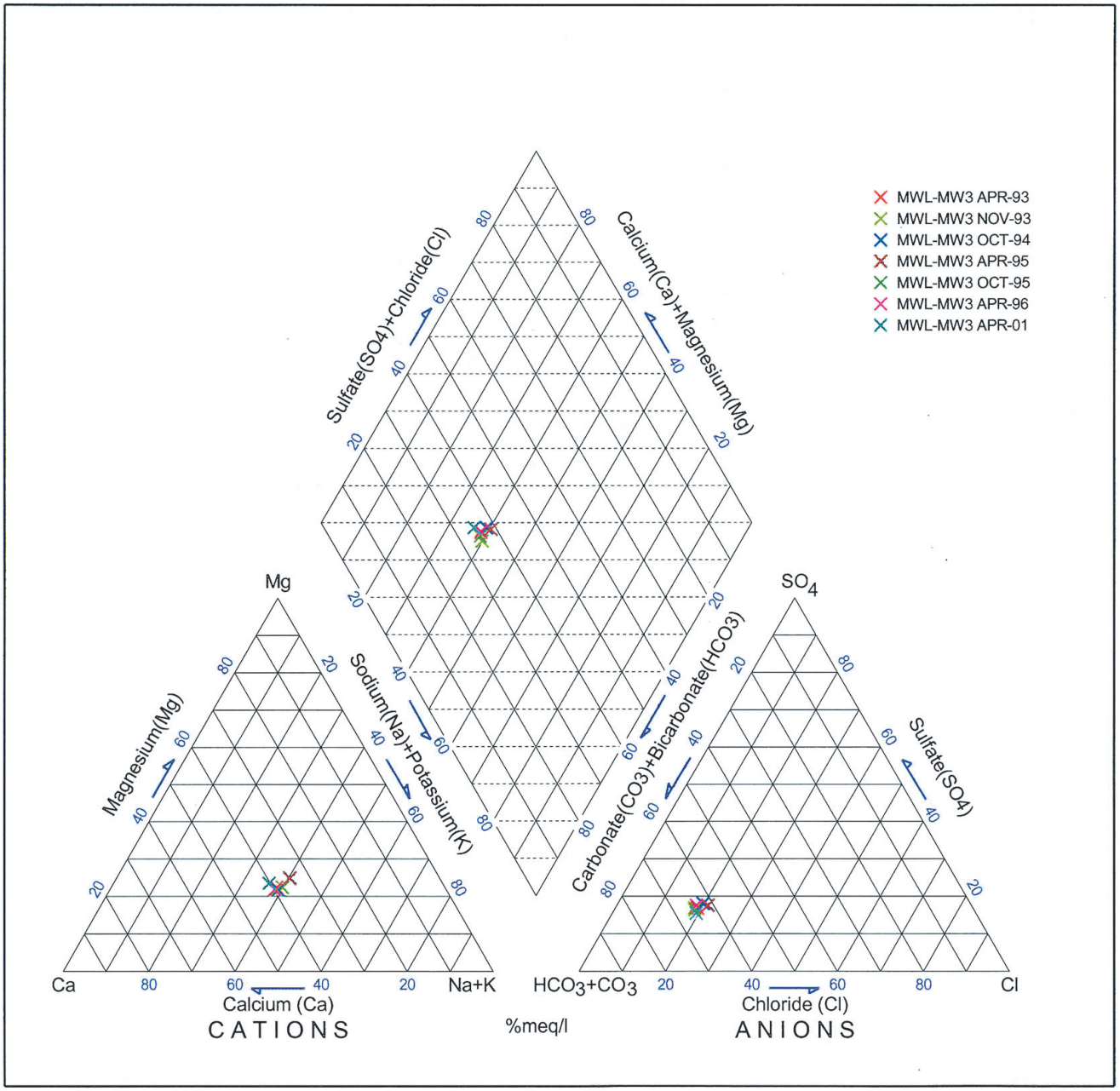

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Figure 4-4. Piper Trilinear Diagram of Major Ion Chemistry for MWL-MW3, 1993 through 2001

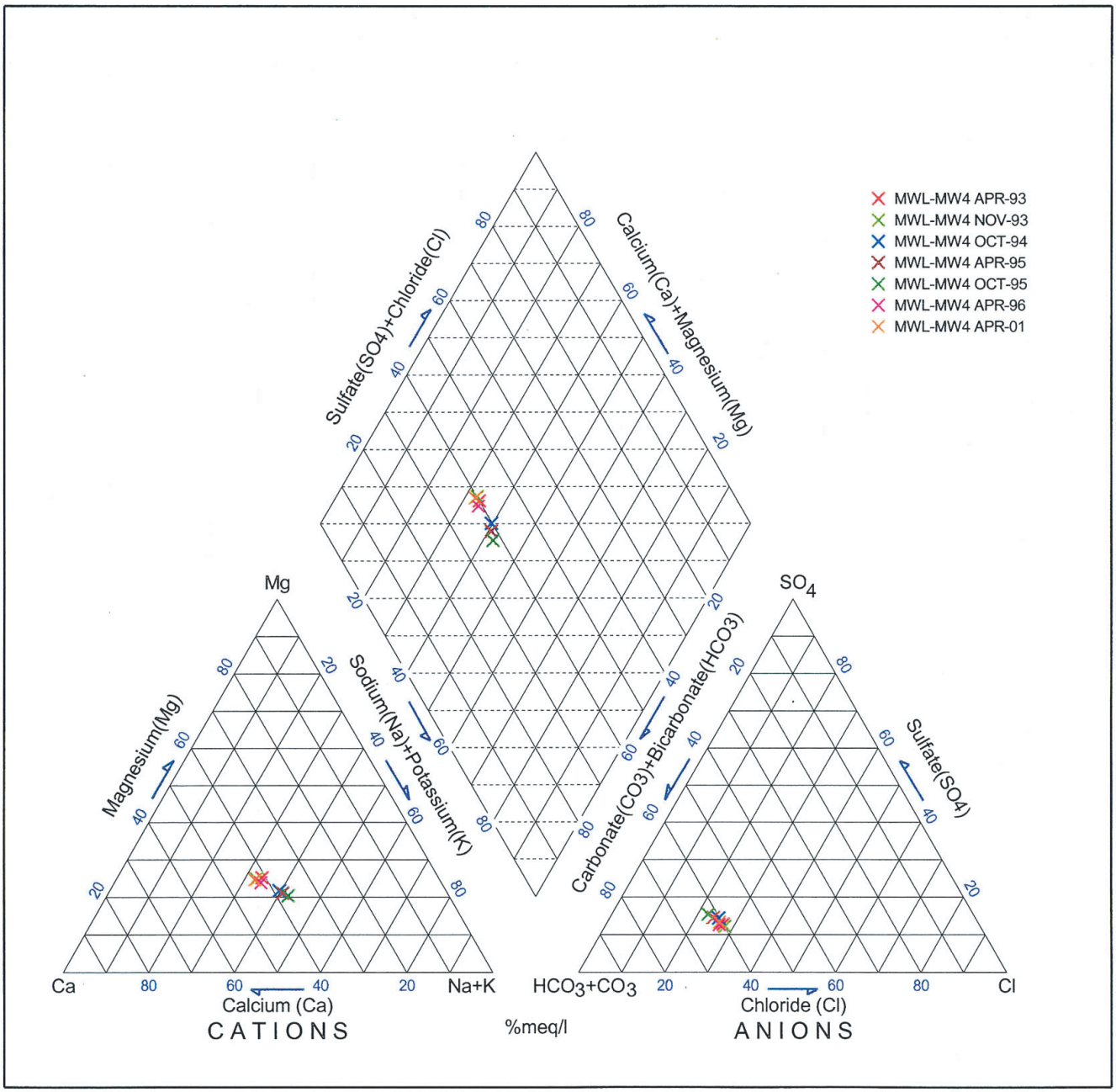

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Figure 4-5. Piper Trilinear Diagram of Major Ion Chemistry for MWL-MW4, 1993 through 2001

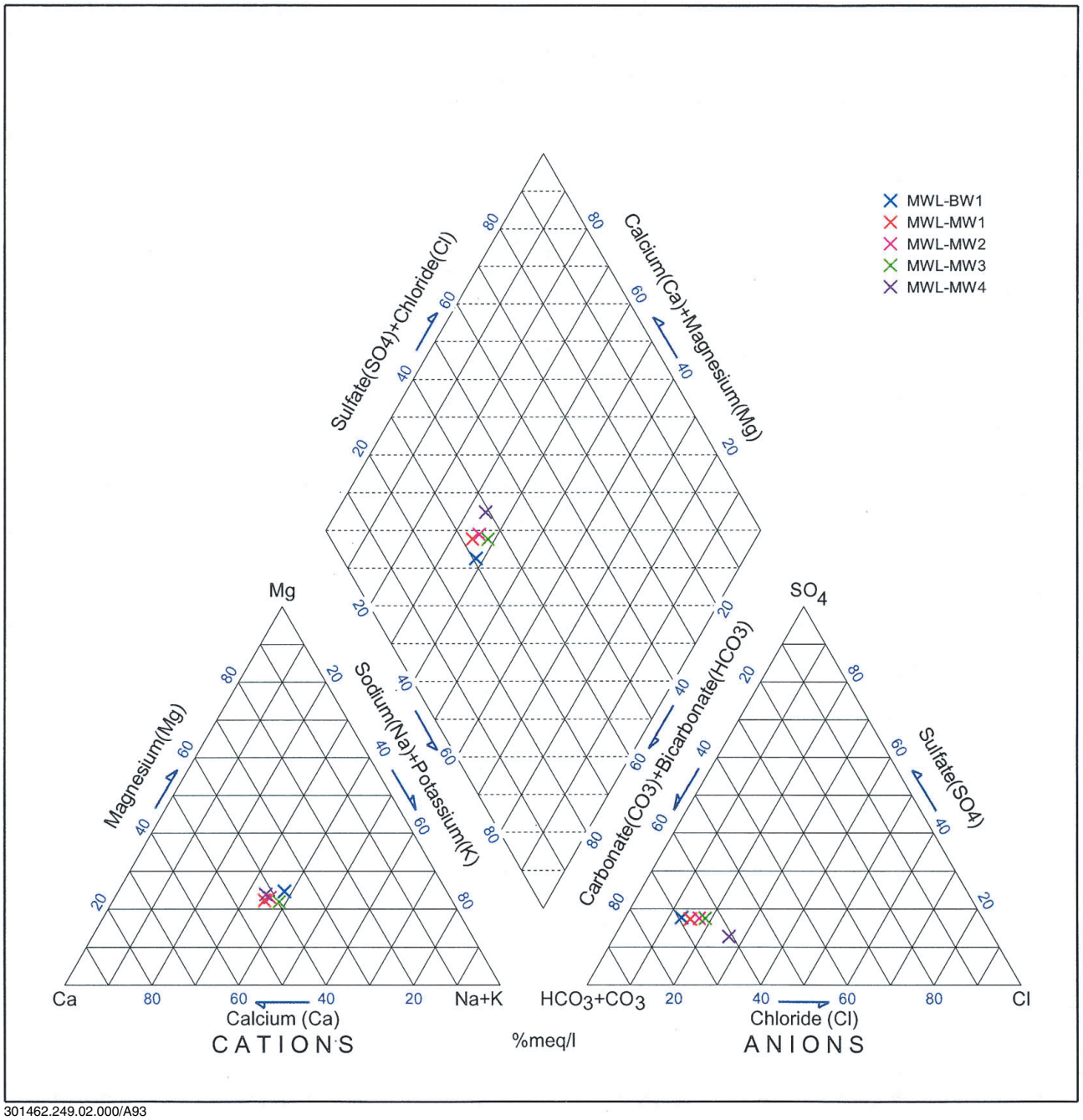

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Figure 4-6. Piper Trilinear Diagram of Major Ion Chemistry for all MWL Wells, April 1996

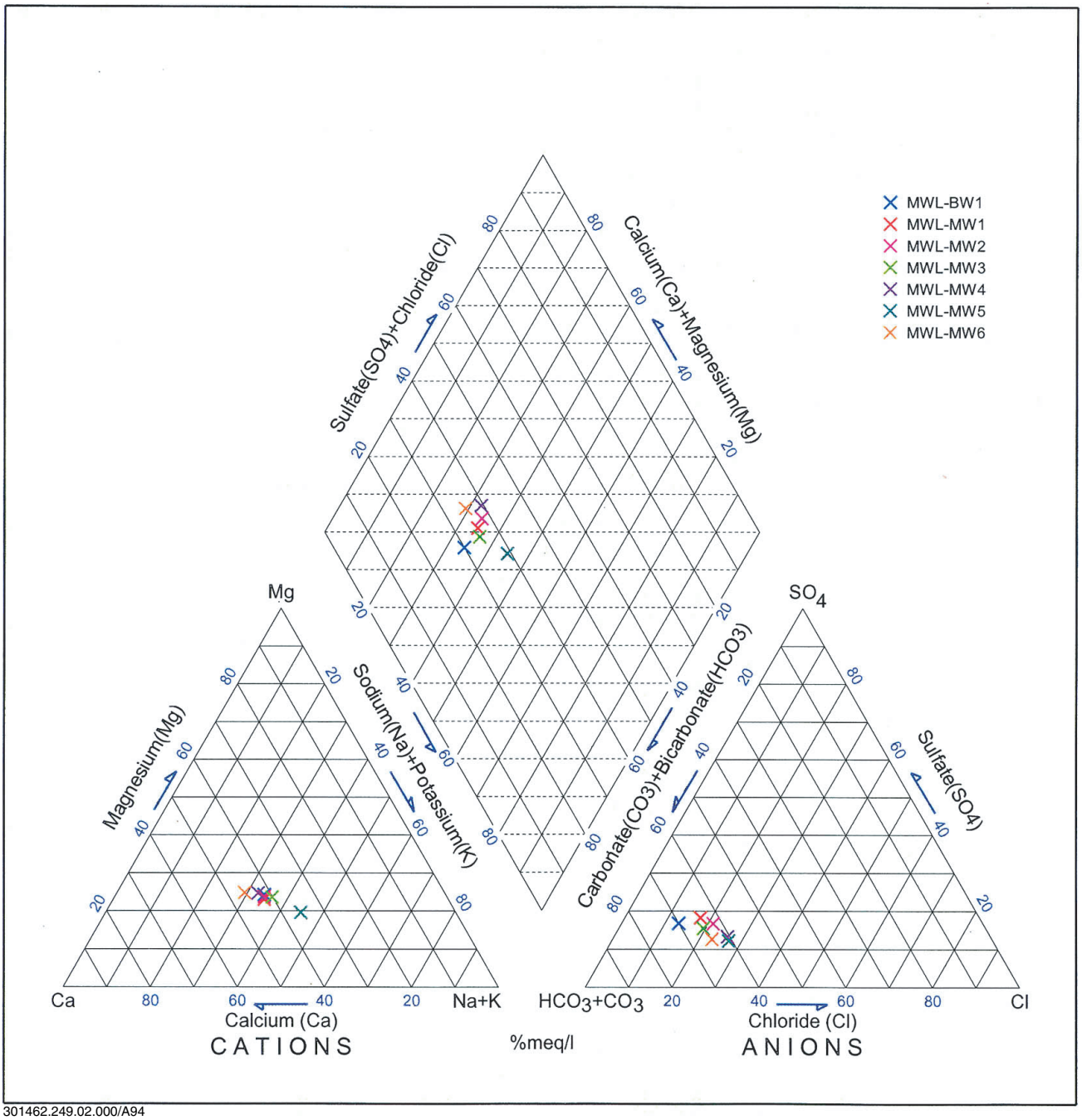

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Figure 4-7. Piper Trilinear Diagram of Major Ion Chemistry for all MWL Wells, April 2001

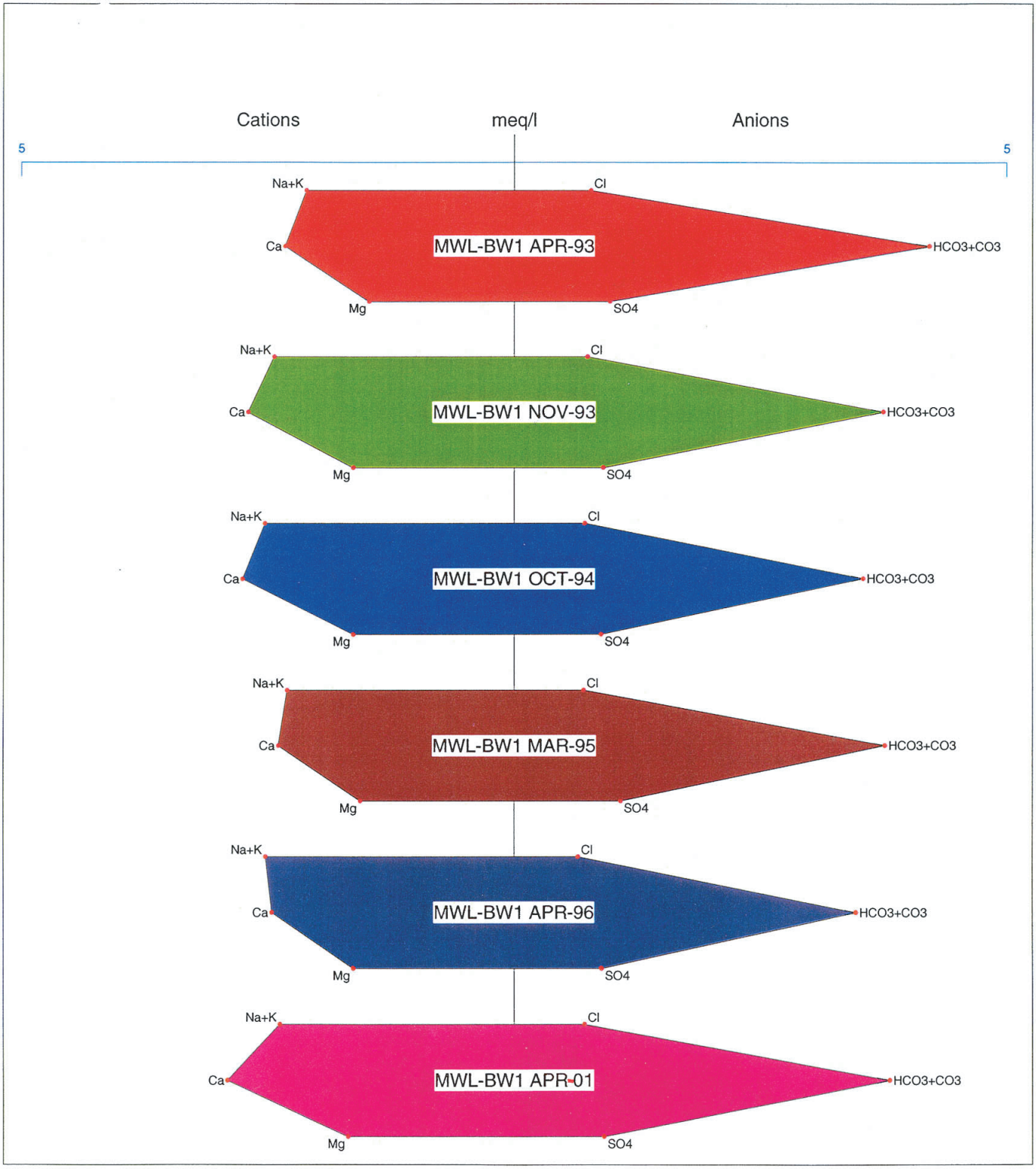

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Figure 4-8. Stiff Diagrams of Major Ion Chemistry for MWL-BW1, 1993 through 2001

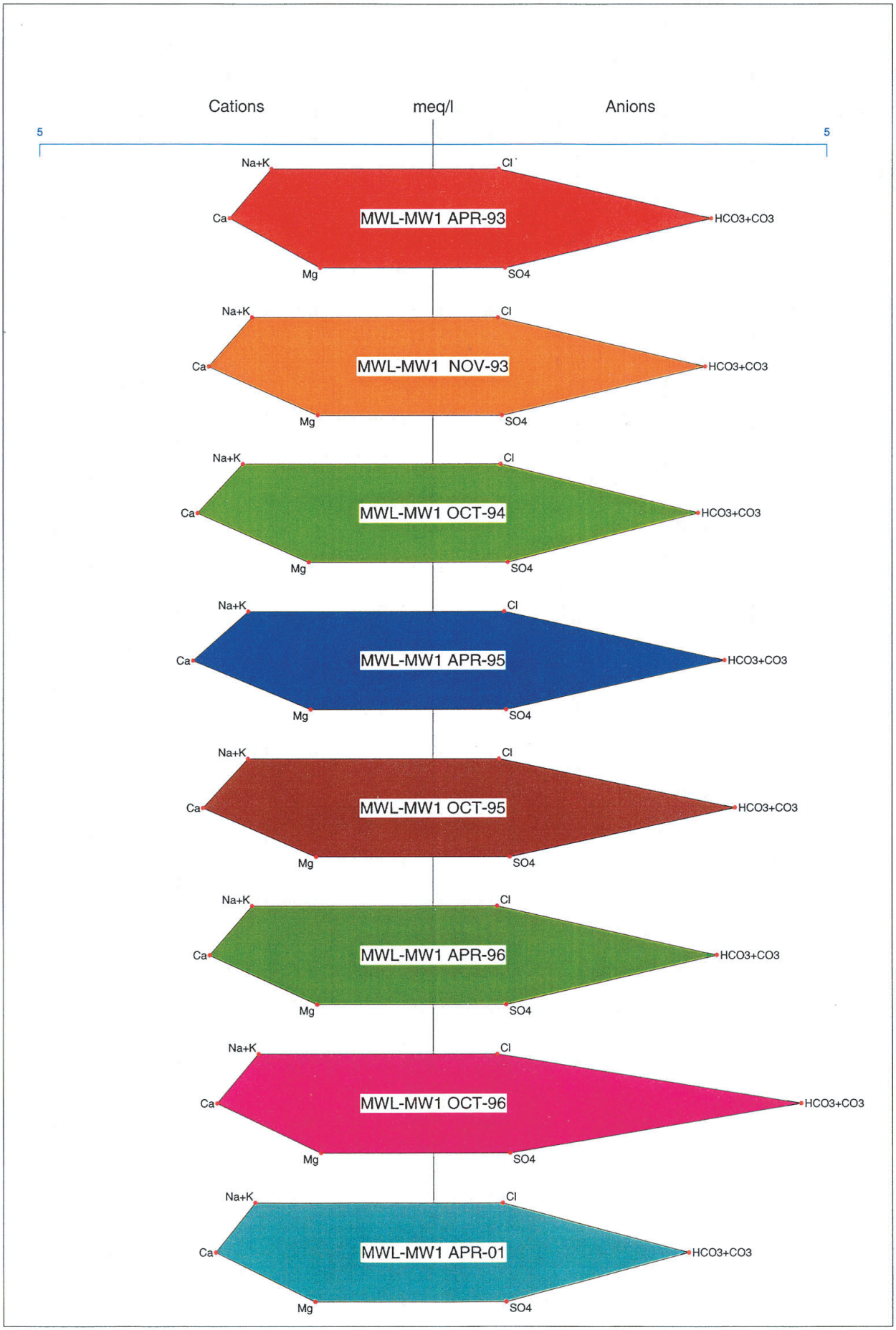

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Figure 4-9. Stiff Diagrams of Major Ion Chemistry for MWL-MW1, 1993 through 2001

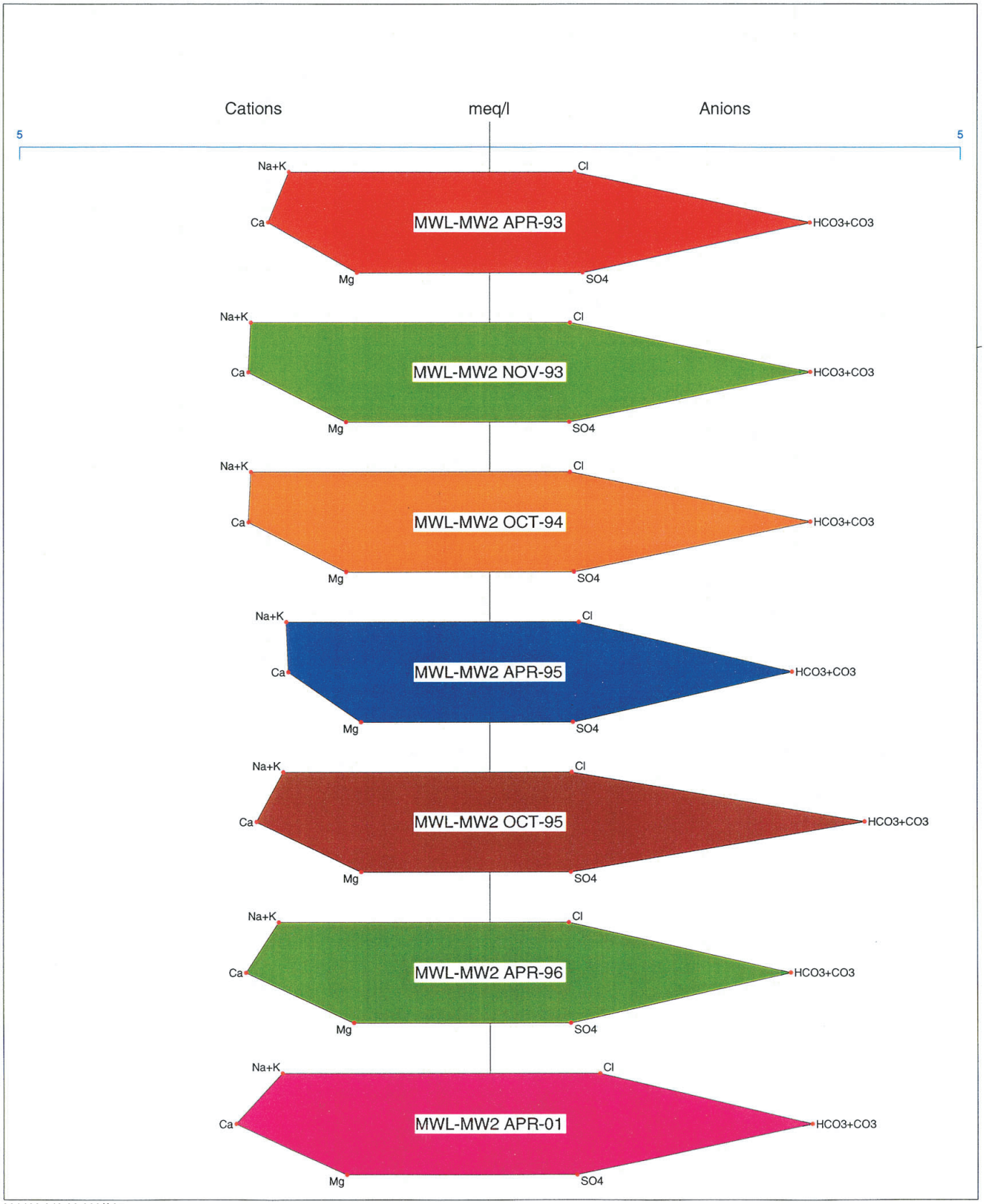

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Figure 4-10. Stiff Diagrams of Major Ion Chemistry for MWL-MW2, 1993 through 2001

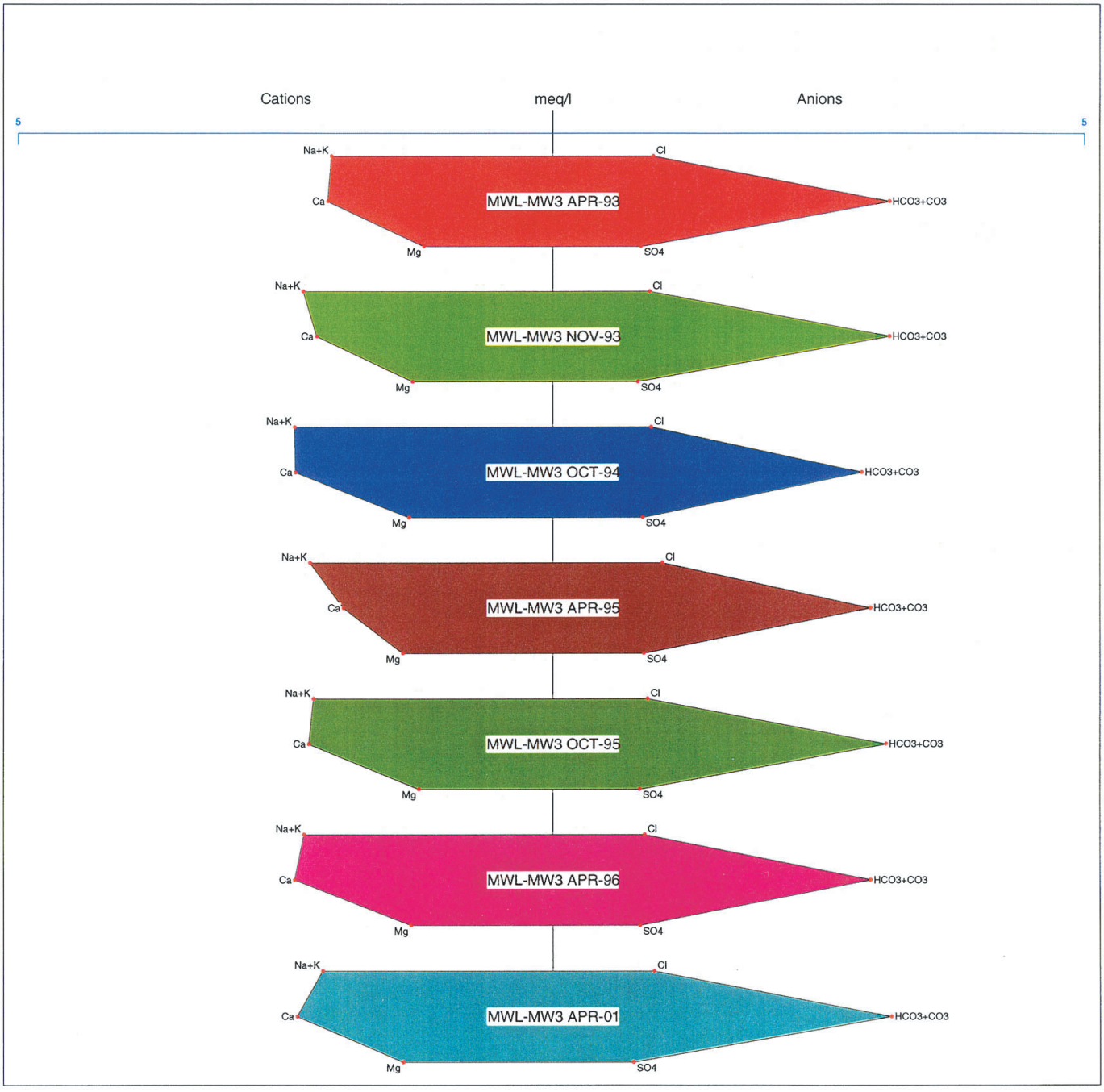

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Figure 4-11. Stiff Diagrams of Major Ion Chemistry for MWL-MW3, 1993 through 2001

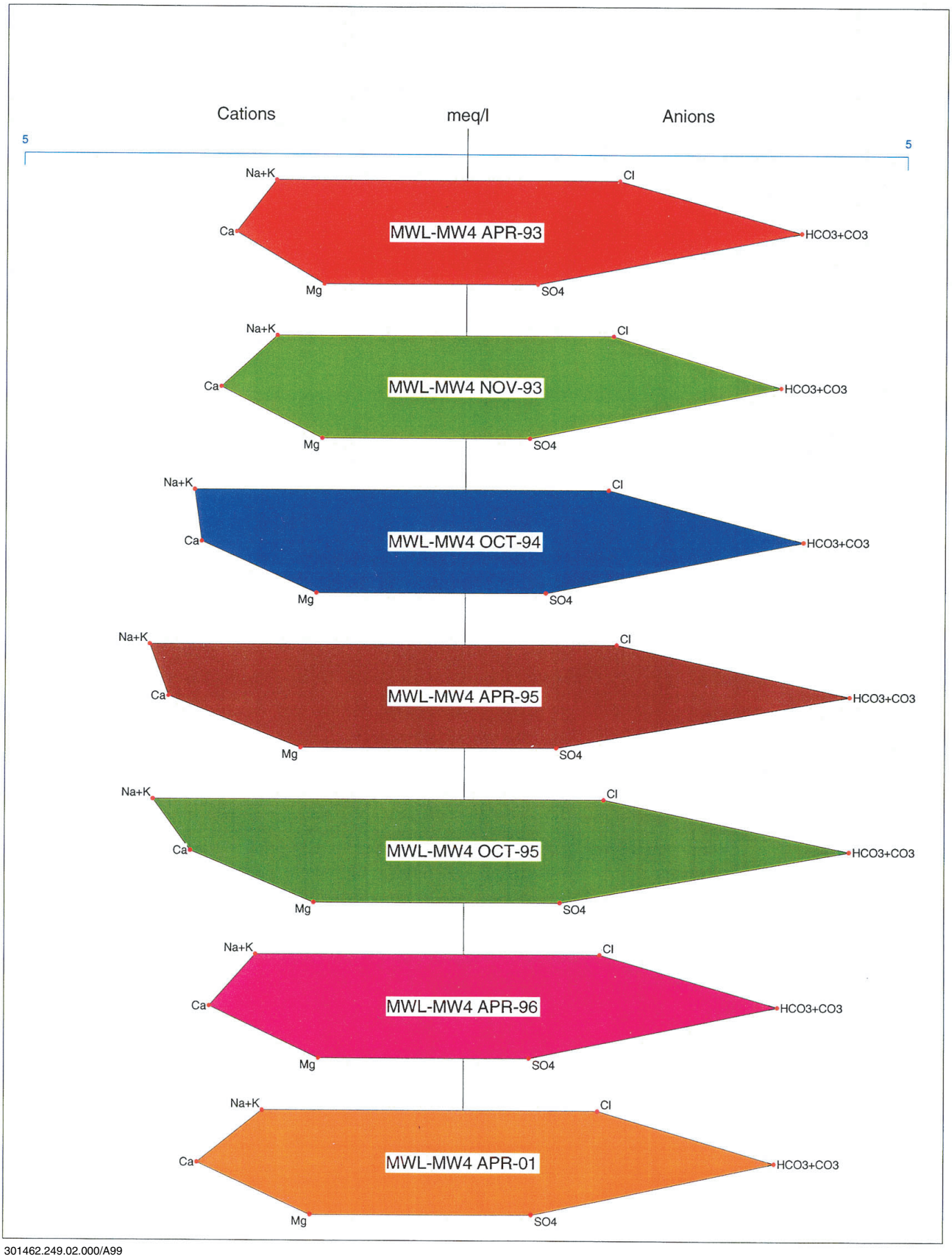

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Figure 4-12. Stiff Diagrams of Major Ion Chemistry for MWL-MW4, 1993 through 2001

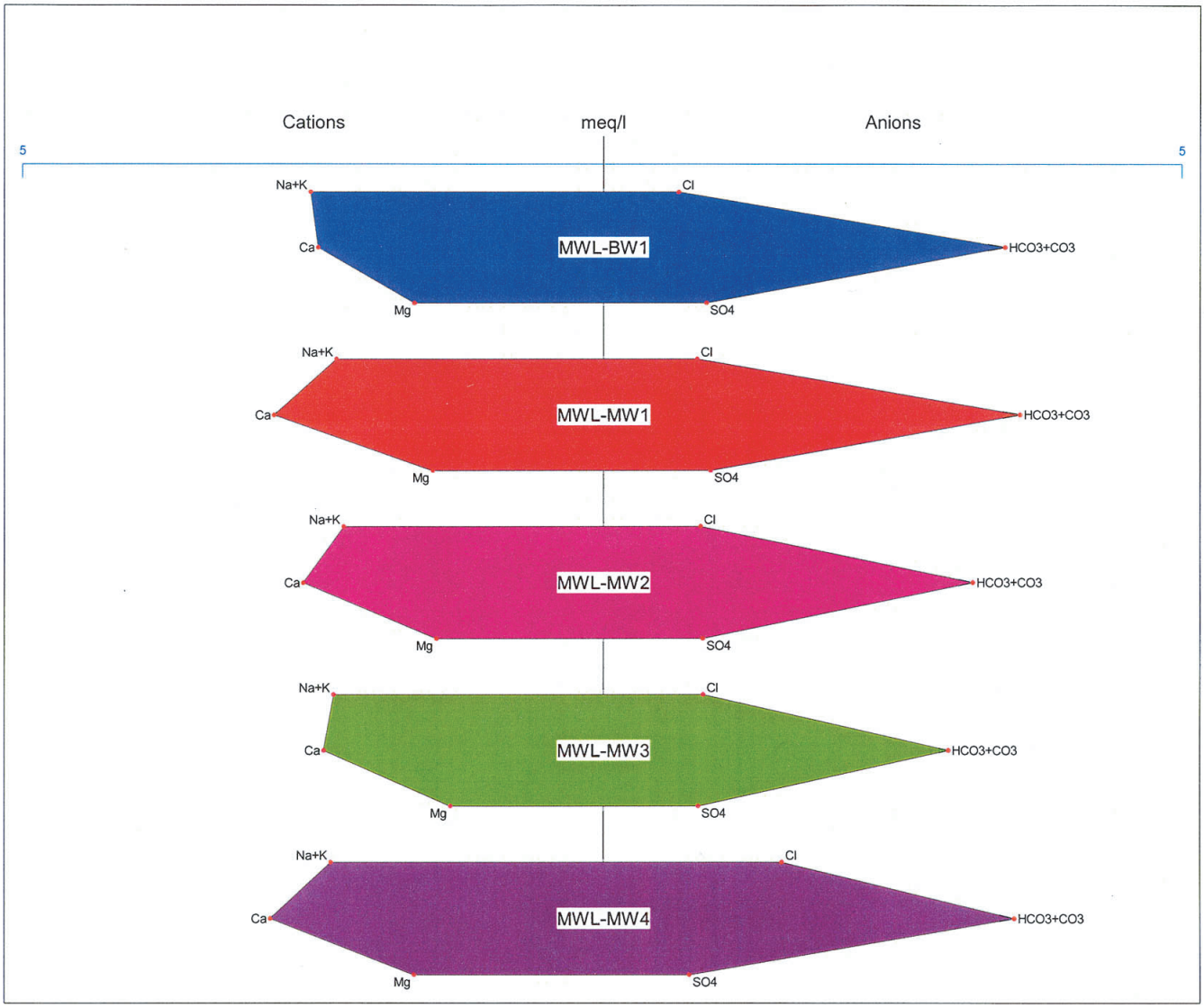

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Figure 4-13. Stiff Diagrams of Major Ion Chemistry for all MWL Wells, April 1996

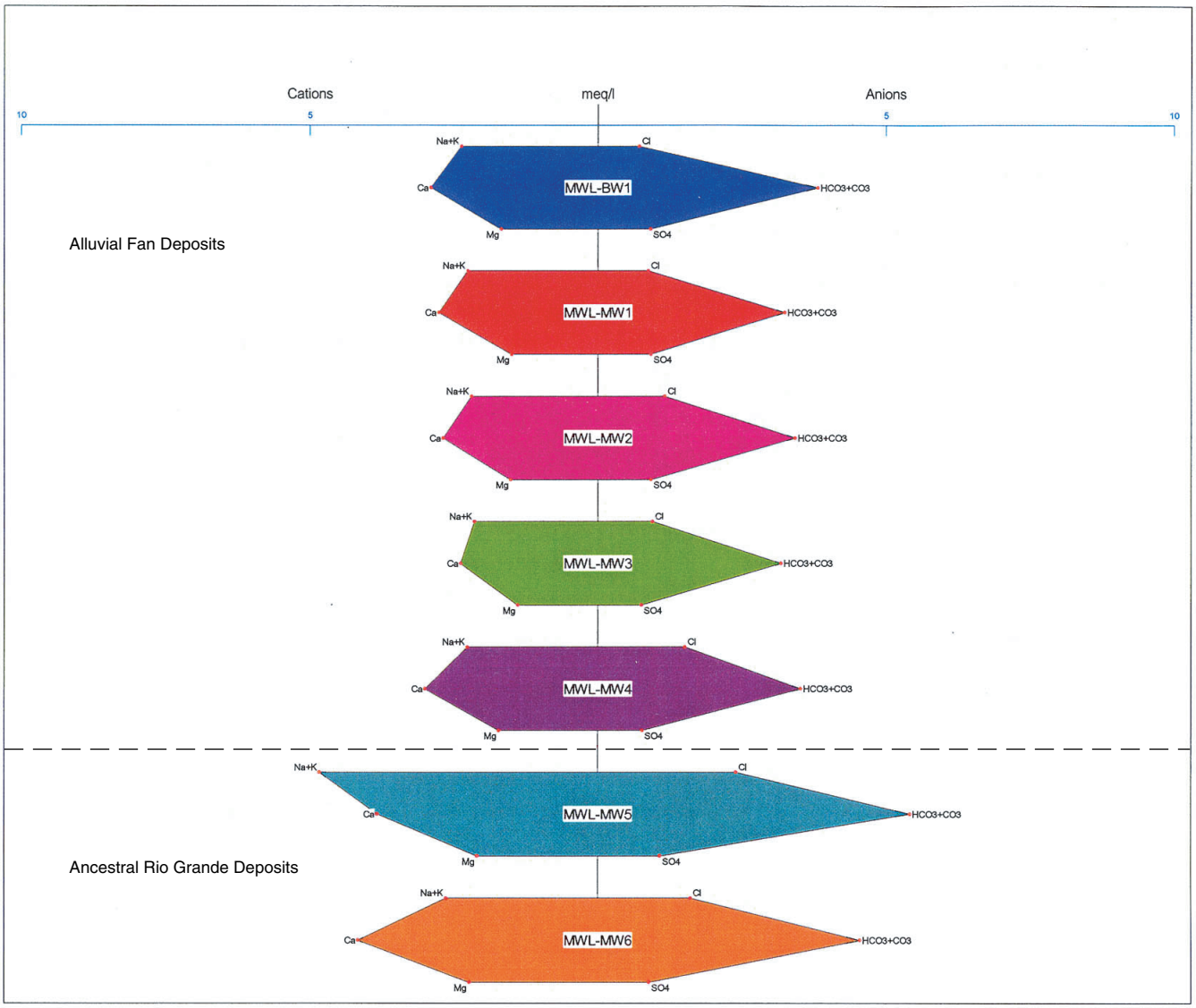

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Figure 4-14. Stiff Diagrams of Major Ion Chemistry for all MWL Wells, April 2001

Tables

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Table 2-1
MWL Monitoring Well Completion Information

Monitoring Well	Ground Surface Elevation (famsl)	Top of Inner Casing[a] (famsl)	Top of Screen (famsl)	Bottom of Screen (famsl)	Top of Filter Pack[b] (famsl)	Bottom of Filter Pack (famsl)	Recent Water Level[c] (famsl)	Screened Lithology
MWL-BW1	5382.70	5384.51	4930.53	4910.53	4939.70	4904.70	4915.63	Alluvial fan
MWL-MW1	5379.12	5381.54	4923.12	4903.12	4933.62	4900.45	4915.95	Alluvial fan
MWL-MW2	5375.71	5377.26	4923.71	4903.71	4931.71	4898.71	4915.21	Alluvial fan
MWL-MW3	5378.97	5381.32	4927.67	4907.67	4932.97	4902.97	4914.89	Alluvial fan
MWL-MW4 (upper)[d]	5381.61	5383.46	4901.75	4881.86	4911.20	4876.39	4890.91	Alluvial fan
MWL-MW4 (lower)[d]	5381.61	5383.46	4861.97	4842.08	4864.45	4832.13	NM	Alluvial fan/ ancestral Rio Grande
MWL-MW5	5377.65	5379.89	4881.15	4861.15	4888.65	4856.65	4890.34	Alluvial fan/ ancestral Rio Grande
MWL-MW6	5369.96	5372.64	4864.46	4844.46	4870.96	4832.96	4888.98	Ancestral Rio Grande

[a]Top of inner casing is the measurement point for well.

[b]Primary filter pack.

[c]Water levels measured on December 4, 2001. Borehole deviations accounted for to calculate water level elevations in MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and MWL-MW4.

[d]Well MWL-MW4 is screened at two intervals and is angled 6 degrees from vertical.

famsl feet above mean sea level
MWL Mixed Waste Landfill
NM not measured

Table 2-2
Groundwater Sampling Events at the MWL

Sampling Date	Wells Sampled	Reference
Sep-90	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), April 1991. “Report on Background Groundwater Sampling at the Mixed Waste Landfill, September 1990,” prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jan-91	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), July 1991. "Report on Quarterly Ground-Water Sampling at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, January 1991," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-91	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), October 1991. "Report on Quarterly Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, April 1991," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jul-91	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), May 1992a. "Report on Quarterly Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, July 1991," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Oct-91	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), May 1992b. "Report on Quarterly Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, October 1991," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jan-92	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), May 1992c. "Report on Semiannual Ground-Water Sampling at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, January 1992," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jul-92	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), January 1993. "Report on Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories, New Mexico, July 1992," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jan-93	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3	Sandia National Laboratories/New Mexico (SNL/NM), July 1993. "Report on Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, January 1993," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-93	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), February 1994. "Report on Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, April 1993," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Nov-93	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), May 1994b. "Report on Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, November 1993," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.

Table 2-2 (Continued)
Groundwater Sampling Events at the MWL

Sampling Date	Wells Sampled	Reference
Apr-94	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), February 1995. "Report on Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, March through May 1994," Vol. 1, prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Oct-94	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), May 1995. "Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, October 1994," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-95	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), September 1995. "Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, April 1995," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Oct-95	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), March 1996a. "Semiannual Groundwater Sampling at the Mixed Waste Landfill, Sandia National Laboratories/New Mexico, October 1995," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-96	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), July 1996. "Mixed Waste Landfill Semiannual Groundwater Monitoring Report, April 1996, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-97	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), August 1997. "Mixed Waste Landfill Annual Groundwater Monitoring Report, April 1997, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Oct-97	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), January 1998. "Mixed Waste Landfill Semiannual Groundwater Monitoring Report, October 1998, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-98	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), July 1998. "Mixed Waste Landfill Semiannual Groundwater Monitoring Report, April 1998, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Aug-98	MWL-MW1	Sandia National Laboratories/New Mexico (SNL/NM), April 1999b. "Comparison of Results from the Joint EPA/NMED and SNL/NM Sampling Event (August 1998) Using Low-Flow Pumping and Conventional Pumping Methods," Environmental Restoration Program, Sandia National Laboratories, Albuquerque, New Mexico.

Table 2-2 (Concluded)
Groundwater Sampling Events at the MWL

Sampling Date	Wells Sampled	Reference
Nov-98	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), April 1999a. "Mixed Waste Landfill Semiannual Groundwater Monitoring Report, November 1998/January 1999, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jan-99	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), April 1999a. "Mixed Waste Landfill Semiannual Groundwater Monitoring Report, November 1998/January 1999, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-99	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), August 1999. "Mixed Waste Landfill Semiannual Groundwater Monitoring Report, April 1999, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-00	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), March 2001. "Mixed Waste Landfill Annual Groundwater Monitoring Report, FY 2000, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Oct-00	MWL-BW1, MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), March 2001. "Mixed Waste Landfill Annual Groundwater Monitoring Report, FY 2000, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jan-01	MWL-MW5, MWL-MW6	Sandia National Laboratories/New Mexico (SNL/NM), June 2001. "Mixed Waste Landfill Quarterly Groundwater Monitoring Report, January 2001, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Feb-01	MWL-MW4	Sandia National Laboratories/New Mexico (SNL/NM), December 2001a. "Mixed Waste Landfill Annual Groundwater Monitoring Report, FY 2001, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Apr-01	MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, MWL-MW4, MWL-MW5, MWL-MW6	Sandia National Laboratories/New Mexico (SNL/NM), September 2001. "Mixed Waste Landfill Quarterly Groundwater Monitoring Report, April 2001, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico. Sandia National Laboratories/New Mexico (SNL/NM), December 2001a. "Mixed Waste Landfill Annual Groundwater Monitoring Report, FY 2001, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.
Jul-01	MWL-MW5, MWL-MW6	Sandia National Laboratories/New Mexico (SNL/NM), December 2001b. "Mixed Waste Landfill Quarterly Groundwater Monitoring Report for Monitoring Wells MWL-MW5 and MWL-MW6, July 2001, Sandia National Laboratories/New Mexico," prepared by IT Corporation for Sandia National Laboratories, Albuquerque, New Mexico.

Table 3-1
Depth to Water in MWL Monitoring Wells
1998 through 2001

Measurement Date	Depth to Water (fbtoc)						
	MWL-MW1	MWL-MW2	MWL-MW3	MWL-MW4	MWL-MW5	MWL-MW6	MWL-BW1
01-07-98	463.25	460.00	464.72	NA	NA	NA	466.70
02-02-98	463.36	460.01	464.46	NA	NA	NA	466.84
03-03-98	463.45	460.18	464.91	NA	NA	NA	466.94
04-10-98	463.82	461.21	465.63	NA	NA	NA	467.35
05-07-98	463.63	460.27	465.12	NA	NA	NA	467.14
06-02-98	463.78	460.45	465.32	NA	NA	NA	467.27
07-02-98	463.93	460.47	465.41	NA	NA	NA	467.45
08-04-98	464.51	460.62	465.58	NA	NA	NA	467.51
09-01-98	464.03	460.55	465.53	492.92	NA	NA	467.35
10-02-98	463.85	460.45	465.41	492.89	NA	NA	467.28
11-02-98	463.63	460.4	465.4	NA	NA	NA	467.23
12-01-98	464.18	460.7	465.71	NA	NA	NA	467.65
01-04-99	NA	460.63	465.63	NA	NA	NA	NA
02-01-99	464.14	460.79	465.76	NA	NA	NA	467.61
03-04-99	464.07	460.58	465.53	NA	NA	NA	467.51
04-01-99	464.1	NA	465.87	NA	NA	NA	467.51
01-28-00	464.17	460.7	465.54	NA	NA	NA	467.63
03-20-00	464.22	460.88	465.71	NA	NA	NA	467.39
03-28-00	464.36	460.56	NA	NA	NA	NA	467.68
06-20-00	464.68	461.18	465.87	NA	NA	NA	468.28
07-03-00	464.7	461.26	466.03	NA	NA	NA	468.18
08-01-00	464.72	461.29	466.04	NA	NA	NA	468.20
10-05-00	465.27	461.76	466.52	NA	NA	NA	468.77
10-06-00	464.84	461.3	466.06	NA	NA	NA	468.34
11-06-00	464.53	461.2	465.97	NA	NA	NA	468.32
12-01-00	465.12	461.58	466.37	NA	488.75	483.35	468.66
01-08-01	464.98	463.55	466.26	NA	488.53	483.06	468.42
01-31-01	465.01	463.57	466.28	NA	488.55	483.09	468.44
03-02-01	465.07	463.62	466.24	NA	488.63	483.08	468.49
04-02-01	464.93	461.46	466.27	NA	488.6	483.03	468.4
05-01-01	464.98	462.66	466.45	NA	488.94	483.13	468.5
06-04-01	465.04	462.68	466.48	494.66	488.96	483.16	468.52
08-01-01	465.35	461.62	466.48	495.24	490.75	483.16	468.83
09-04-01	465.37	461.62	466.51	495.86	490.77	483.17	468.85
10-01-01	465.94	462.25	467.1	495.92	491.01	483.95	468.89
11-01-01	465.96	462.26	467.14	495.94	488.99	483.2	468.93
12-04-01	465.65	462.08	466.97	495.78	489.55	483.66	469.04

Note: MWL-MW4 could not be measured from November 1998 through November 2000 due to the presence of a packer in the well. MWL-MW5 and MWL-MW6 were installed in 2000.
fbtoc feet below top of casing
MWL Mixed Waste Landfill
NA not applicable or not recorded

Table 3-2
Vertical Hydraulic Gradients in Groundwater Beneath the MWL

Date	Well	Groundwater Elevation (famsl)	Center of Saturated Filter Pack (famsl)	Well	Groundwater Elevation (famsl)	Center of Saturated Filter Pack (famsl)	Distance Between Centers of Well 1 and Well 2 (ft)	Difference in Water Levels Between Well 1 and Well 2 (ft)	Vertical Gradient	Direction
10-01-01	MWL-MW3	4914.76	4908.87	MWL-MW5	4888.88	4872.65	36.22	25.88	0.71	Downward
04-14-95	MWL-MW1	4921.20	4910.83	MWL-MW4 (lower zone)	4896.00	4848.29	62.53	25.20	0.40	Downward
04-14-95	MWL-MW1	4921.20	4910.83	MWL-MW4 (upper zone)	4900.43	4888.41	22.42	20.77	0.93	Downward
04-14-95	MWL-MW4 (lower zone)	4896.00	4848.29	MWL-MW4 (upper zone)	4900.43	4888.41	40.12	4.43	0.11	Downward

famsl feet above mean sea level
ft feet
MWL Mixed Waste Landfill

Table 3-3
Summary of Hydraulic Conductivity Data for MWL Wells

Well	Well Screen Interval (famsl)	Lithology	Date of Test	Type of Test	Analysis Method	K (ft/d)	Average K (ft/d)
MWL-BW1	4910.53–4930.53	Alluvial fan	07-03-01	Slug Test	Bouwer-Rice[a]	2.65×10^{-2}	3.81×10^{-2}
			07-03-01	Slug Test	Hvorslev[b]	4.14×10^{-2}	
			04-28-94	Pumping Test	Lai and Su[c]	5.03×10^{-2}	
MWL-MW1	4903.12–4923.13	Alluvial fan	06-29-01	Slug Test	Bouwer-Rice[a]	2.43×10^{-2}	3.48×10^{-2}
			06-29-01	Slug Test	Hvorslev[b]	3.17×10^{-2}	
			05-03-94	Pumping Test	Lai and Su[c]	5.48×10^{-2}	
MWL-MW2	4903.71–4923.72	Alluvial fan	06-21-01	Slug Test	Bouwer-Rice[a]	1.33×10^{-3}	1.39×10^{-3}
			06-21-01	Slug Test	Hvorslev[b]	1.98×10^{-3}	
			05-02-94	Pumping Test	Lai and Su[c]	1.02×10^{-3}	
MWL-MW3	4907.67–4927.68	Alluvial fan	06-25-01	Slug Test	Bouwer-Rice[a]	1.01×10^{-2}	8.88×10^{-3}
			06-25-01	Slug Test	Hvorslev[b]	1.35×10^{-2}	
			05-03-94	Pumping Test	Lai and Su[c]	5.10×10^{-3}	
MWL-MW4 (upper)	4881.86–4901.75	Alluvial fan	05-31-94	Pumping Test	Lai and Su[c]	7.23×10^{-2}	7.23×10^{-2}
MWL-MW4 (lower)	4842.02–4861.98	Alluvial fan/ancestral Rio Grande	06-21-01	Slug Test	Bouwer-Rice[a]	1.68	1.73
			06-21-01	Slug Test	Hvorslev[b]	2.09	
			03-14-94	Pumping Test	Moench and Ogata[d]	1.48	
MWL-MW5	4861.15–4881.15	Alluvial fan/ancestral Rio Grande	06-21-01	Slug Test	Bouwer-Rice[a]	5.92×10^{-1}	6.82×10^{-1}
			06-21-01	Slug Test	Hvorslev[b]	7.85×10^{-1}	
MWL-MW6	4844.46–4864.46	Ancestral Rio Grande	06-21-01	Slug Test	Bouwer-Rice[a]	4.56	5.05
			06-21-01	Slug Test	Hvorslev[b]	5.58	

Notes: The average K for wells completed in alluvial fan deposits is 1.64×10^{-2} ft/d. The average K for wells completed in ancestral Rio Grande deposits is 1.81 ft/d.

[a]Bouwer-Rice 1976.

[b]Hvorslev 1951.

[c]Lai and Su 1974.

[d]Moench and Ogata 1984.

famsl feet above mean sea level
ft/d foot (feet) per day
K hydraulic conductivity
MWL Mixed Waste Landfill

Table 3-4
Estimated Average Linear Groundwater Flow Velocities at the MWL

Lithology	Scenario	K (ft/d)	i	n_e[a]	V (ft/yr)
Alluvial fan	Minimum K (MWL-MW2)	1.39×10^{-3}	0.007	0.25	0.01
	Average[b] K (MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and MWL-MW4 [upper])	1.64×10^{-2}	0.007	0.25	0.17
	Maximum K (MWL-MW4 [upper])	7.23×10^{-2}	0.007	0.25	0.74
Ancestral Rio Grande	Minimum K (MWL-MW5)	6.82×10^{-1}	0.007	0.25	7.0
	Average[b] K (MWL-MW4 [lower], MWL-MW5, and MWL-MW6)	1.81	0.007	0.25	18.5
	Maximum K (MWL-MW6)	5.05	0.007	0.25	51.6

[a]Freeze and Cherry (1979).

[b]Geometric mean.

ft/d foot (feet) per day
ft/yr foot (feet) per year
i horizontal hydraulic gradient (ft/ft, dimensionless)
K hydraulic conductivity (ft/d)
MWL Mixed Waste Landfill
n_e effective porosity (unitless)
V average linear groundwater flow velocity (ft/yr)

Table 4-1
Summary of Metals Analytical Results for Groundwater Samples from MWL-BW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/ 7470/7740/3005[a]) (mg/L)			
NMED-Approved Background[b]			**0.014**		**0.12**	
EPA Drinking Water MCL[c]			**0.05**		**2**	
AR/COC Number	**Date Sampled**	**Lab**	**Arsenic**		**Barium**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.01)	ND (0.005)	0.12	0.12
1543	09-27-90	QSTL	ND (0.01)	ND (0.005)	0.12	**0.13**
2314	01-24-91	QSTL	ND (0.005)	ND (0.005)	0.11	0.1
1994	01-24-91	QSTL	ND (0.005)	ND (0.01)	0.11	0.1
2020	05-07-91	QSTL	ND (0.01)	ND (0.005)	0.08	0.1
2415	05-07-91	QSTL	ND (0.005)	ND (0.005)	0.093	0.098
2189	08-06-91	QSTL	ND (0.005)	ND (0.005)	0.09	0.081
2203	08-06-91	QSTL	ND (0.005)	ND (0.005)	0.097	0.082
2719	10-16-91	QSTL	ND (0.005)	ND (0.01)	0.097	0.092
2721	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
2725	10-16-91	QSTL	ND (0.01)	ND (0.005)	0.095	0.099
4096	07-29-92	QSTL	ND (0.005)	ND (0.005)	0.085	0.078
4133[d]	07-29-92	QSTL	ND (0.005)	ND (0.005)	0.087	0.084
5841	01-20-93	QSTL	ND (0.005)	NA	0.095	NA
5841 [d]	01-20-93	QSTL	ND (0.005)	NA	0.092	NA
6316	04-28-93	QSTL	0.0013 J (0.005)	ND (0.005)	0.073	0.077
6316 [d]	04-28-93	QSTL	0.0011 J (0.005)	0.001 J (0.005)	0.075	0.075
6997	11-10-93	QSTL	0.0015 J (0.005)	NA	0.078	NA
6997 [d]	11-10-93	QSTL	ND (0.005)	NA	0.081	NA
1014	10-27-94	QSTL	ND (0.01)	NA	0.085	NA
1015	10-27-94	QSTL	ND (0.01)	NA	0.085	NA
4397	10-23-95	GEL	0.00219 J (0.01)	NA	0.0882	NA
5030	04-16-96	GEL	ND (0.00186)	NA	0.0765	NA
06619	04-28-97	ERCL	ND (0.0034)	NA	0.083	NA
06882	10-17-97	GEL	ND (0.00293)	ND (0.00293)	0.0752 J,B (0.005)	0.0761
510607	03-31-98	QSTL	ND (0.0019)	NA	0.082 J (0.005)	NA
510612[e]	03-31-98	GEL	ND (0.00293)	ND (0.00293)	0.0764	0.0768
601044	11-05-98	GEL	0.0009 J (0.003)	0.00122	0.0873	0.0908
601388	04-13-99	GEL	0.00157 J (0.003)	ND (0.0009)	0.087	0.0873
602692	04-06-00	GEL	0.00298 J (0.005)	NA	0.0806	NA
603961	04-06-01	GEL	0.0023 J,B (0.003)	NA	0.0995	NA

Refer to footnotes at end of table.

Table 4-1 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-BW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/ 7470/7740/3005[a]) (mg/L)			
NMED-Approved Background[b]			0.004		0.00047	
EPA Drinking Water MCL[c]			0.004		0.005	
AR/COC Number	Date Sampled	Lab	Beryllium		Cadmium	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
1543	09-27-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
2314	01-24-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
1994	01-24-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2020	05-07-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2415	05-07-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2189	08-06-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2203	08-06-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2719	10-16-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2721	10-16-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2725	10-16-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4096	07-29-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
4133[d]	07-29-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5841	01-20-93	QSTL	ND (0.002)	NA	**0.031**	NA
5841 [d]	01-20-93	QSTL	ND (0.002)	NA	**0.023**	NA
6316	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6316 [d]	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6997	11-10-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
6997 [d]	11-10-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
1014	10-27-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
1015	10-27-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
4397	10-23-95	GEL	0.00009 J,B (0.005)	NA	0.00012 J,B (0.005)	NA
5030	04-16-96	GEL	ND (0.00001)	NA	ND (0.0001)	NA
06619	04-28-97	ERCL	ND (0.0001)	NA	0.00028 J,B (0.0009)	NA
06882	10-17-97	GEL	NA	NA	0.00024 J,B (0.005)	ND (0.00021)
510607	03-31-98	QSTL	NA	NA	ND (0.0006)	NA
510612[e]	03-31-98	GEL	NA	NA	ND (0.00021)	ND (0.00021)
601044	11-05-98	GEL	NA	NA	ND (0.00022)	ND (0.00022)
601388	04-13-99	GEL	ND (0.00002)	ND (0.00002)	ND (0.00022)	ND (0.00022)
602692	04-06-00	GEL	NA	NA	ND (0.00063)	NA
603961	04-06-01	GEL	0.00011 J (0.0002)	NA	0.00067 J,B (0.001)	NA

Refer to footnotes at end of table.

Table 4-1 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-BW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740/7470[a]) (mg/L)			
NMED-Approved Background[b]			0.043		0.01	
EPA Drinking Water MCL[c]			0.1		0.015	
AR/COC Number	Date Sampled	Lab	Chromium		Lead	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.005)
1543	09-27-90	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
2314	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
1994	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
2020	05-07-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2415	05-07-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2189	08-06-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.01)
2203	08-06-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.01)
2719	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2721	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2725	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
4096	07-29-92	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
4133[d]	07-29-92	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
5841	01-20-93	QSTL	0.017	NA	ND (0.01)	NA
5841 [d]	01-20-93	QSTL	0.012	NA	0.0012 J (0.01)	NA
6316	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.02)
6316 [d]	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.02)
6997	11-10-93	QSTL	0.0092 J (0.01)	NA	ND (0.01)	NA
6997 [d]	11-10-93	QSTL	0.011	NA	ND (0.01)	NA
1014	10-27-94	QSTL	0.0041 J (0.01)	NA	ND (0.003)	NA
1015	10-27-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
4397	10-23-95	GEL	0.00411 J (0.01)	NA	ND (0.00113)	NA
5030	04-16-96	GEL	0.00134 J,B (0.01)	NA	ND (0.00113)	NA
06619	04-28-97	ERCL	ND (0.0084)	NA	ND (0.0017)	NA
06882	10-17-97	GEL	0.00318 J,B (0.005)	0.00194 J,B (0.005)	ND (0.00068)	ND (0.00068)
510607	03-31-98	QSTL	0.0041 J (0.01)	NA	ND (0.0011)	NA
510612[e]	03-31-98	GEL	0.00101 J (0.005)	ND (0.00073)	ND (0.00068)	ND (0.00068)
601044	11-05-98	GEL	0.00223 J (0.003)	0.00317	0.00083 J (0.002)	ND (0.00031)
601388	04-13-99	GEL	0.00228 J (0.003)	0.00255	ND (0.00031)	ND (0.00031)
602692	04-06-00	GEL	0.00425 J (0.005)	NA	ND (0.00183)	NA
603961	04-06-01	GEL	**0.0942**	NA	0.00558	NA

Refer to footnotes at end of table.

Table 4-1 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-BW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470/7740/3005[a]) (mg/L)			
NMED-Approved Background[b]			0.002		0.028	
EPA Drinking Water MCL[c]			0.002		NE	
AR/COC Number	Date Sampled	Lab	Mercury		Nickel	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
1543	09-27-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
2314	01-24-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
1994	01-24-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2020	05-07-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2415	05-07-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2189	08-06-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2203	08-06-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2719	10-16-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2721	10-16-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2725	10-16-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4096	07-29-92	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
4133[d]	07-29-92	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
5841	01-20-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
5841 [d]	01-20-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
6316	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	0.012 J (0.04)	0.011
6316 [d]	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	0.0075	0.016
6997	11-10-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
6997 [d]	11-10-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
1014	10-27-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
1015	10-27-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
4397	10-23-95	GEL	0.00003 J,B (0.0002)	NA	0.00196 J (0.01)	NA
5030	04-16-96	GEL	ND (0.00001)	NA	ND (0.00081)	NA
06619	04-28-97	ERCL	ND (0.00022)	NA	NA	NA
06882	10-17-97	GEL	ND (0.0001)	ND (0.0001)	NA	NA
510607	03-31-98	QSTL	ND (0.0001)	NA	0.0029 J (0.04)	NA
510612[e]	03-31-98	GEL	ND (0.0001)	ND (0.0001)	ND (0.00227)	ND (0.00227)
601044	11-05-98	GEL	ND (0.00004)	ND (0.00004)	0.00719	0.00947
601388	04-13-99	GEL	ND (0.00004)	ND (0.00004)	0.0128	0.0143
602692	04-06-00	GEL	ND (0.00006)	NA	0.0165	NA
603961	04-06-01	GEL	ND (0.00007)	NA	**0.191**	NA

Refer to footnotes at end of table.

Table 4-1 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples from MWL-BW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/ 7470/7740/3005[a]) (mg/L)			
NMED-Approved Background[b]			**0.005**		**<0.01**	
EPA Drinking Water MCL[c]			**0.05**		**0.05**	
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**		**Silver**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.01)	ND (0.005)	ND (0.01)	ND (0.01)
1543	09-27-90	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2314	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
1994	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
2020	05-07-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2415	05-07-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2189	08-06-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2203	08-06-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2719	10-16-91	QSTL	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.01)
2721	10-16-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2725	10-16-91	QSTL	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.01)
4096	07-29-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
4133[d]	07-29-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5841	01-20-93	QSTL	0.004 J (0.005)	NA	ND (0.01)	NA
5841 [d]	01-20-93	QSTL	0.0043 J (0.005)	NA	ND (0.01)	NA
6316	04-28-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6316 [d]	04-28-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6997	11-10-93	QSTL	0.0017 J (0.005)	NA	ND (0.01)	NA
6997 [d]	11-10-93	QSTL	0.0017 J (0.005)	NA	ND (0.01)	NA
1014	10-27-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
1015	10-27-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
4397	10-23-95	GEL	0.0047 J (0.005)	NA	ND (0.00249)	NA
5030	04-16-96	GEL	ND (0.00143)	NA	ND (0.00249)	NA
06619	04-28-97	ERCL	0.0027 J (6.7)	NA	ND (0.0022)	NA
06882	10-17-97	GEL	ND (0.0014)	ND (0.0014)	ND (0.00062)	ND (0.00062)
510607	03-31-98	QSTL	ND (0.0031)	NA	ND (0.0007)	NA
510612[e]	03-31-98	GEL	ND (0.0014)	ND (0.0014)	ND (0.00062)	ND (0.00062)
601044	11-05-98	GEL	0.0022 J (0.005)	ND (0.00139)	ND (0.0003)	ND (0.0003)
601388	04-13-99	GEL	0.0025 J (0.005)	0.00262	ND (0.0003)	ND (0.0003)
602692	04-06-00	GEL	ND (0.00236)	NA	0.00102 J (0.005)	NA
603961	04-06-01	GEL	0.00284 J (0.005)	NA	0.00034 J (0.001)	NA

Note: Values right justified and in **bold** indicate concentration above the NMED-approved background level and/or the EPA drinking water MCL.

[a]EPA November 1986.

[b]Dinwiddie September 1997.

[c]EPA July 2001.

[d]Duplicate sample.

[e]Split sample.

AR/COC analysis request/chain of custody record
B analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL report)
EPA U.S. Environmental Protection Agency
ERCL Environmental Restoration Chemical Laboratory, Sandia National Laboratories, New Mexico (on-site laboratory)
GEL General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
MWL Mixed Waste Landfill
NA not analyzed or not reported
NE not established
ND ( ) not detected above the method detection limit, shown in parentheses
NMED New Mexico Environment Department
QSTL Quanterra Laboratories, St. Louis (off-site laboratory)

Table 4-2
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)			
NMED-Approved Background[b]			0.014		0.12	
EPA Drinking Water MCL[c]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.005)	ND (0.005)	0.07	0.068
01990	01-24-91	QSTL	ND (0.005)	ND (0.005)	0.07	0.069
02416	05-07-91	QSTL	ND (0.005)	ND (0.01)	0.067	0.065
02187	07-31-91	QSTL	ND (0.005)	ND (0.005)	0.064	0.066
02731	10-15-91	QSTL	ND (0.005)	ND (0.01)	0.068	0.068
4097	07-28-92	QSTL	ND (0.005)	ND (0.005)	0.065	0.063
5839	01-19-93	QSTL	ND (0.005)	NA	0.076	NA
6312	04-27-93	QARV	ND (0.005)	ND (0.005)	0.057	0.056
6994	11-09-93	QSTL	ND (0.005)	NA	0.061	NA
00140	05-03-94	QSTL	ND (0.01)	NA	0.076	NA
00143[d]	05-04-94	QSTL	ND (0.01)	NA	0.076	NA
01010	10-25-94	QSTL	ND (0.01)	NA	0.071	NA
01012[d]	10-25-94	QSTL	ND (0.01)	NA	0.073	NA
03315	04-19-95	QARV	ND (0.003)	NA	0.067	NA
04407	10-20-95	GEL	ND (0.00186)	NA	0.0677	NA
5048	04-18-96	GEL	ND (0.00186)	NA	0.0678	NA
06617	04-23-97	ERCL	ND (0.0034)	NA	0.087	NA
06880	10-15-97	GEL	ND (0.00293)	ND (0.00293)	0.0674	0.0679
06880[d]	10-15-97	GEL	ND (0.00293)	ND (0.00293)	0.0672	0.0676
510613	04-01-98	GEL	ND (0.00293)	ND (0.00293)	0.0628	0.058
510608[e]	04-01-98	QSTL	ND (0.0019)	NA	0.072 J (0.2)	NA
601045	11-06-98	GEL	ND (0.003)	ND (0.003)	0.0654	0.0628
601388	04-14-99	GEL	0.00137 J (0.003)	ND (0.0009)	0.0598	0.0652
602682[e]	04-14-00	ERCL	ND (0.0034)	NA	0.064	NA
602683	04-14-00	GEL	ND (0.00257)	ND (0.00257)	0.0655	0.066
602683[d]	04-14-00	GEL	ND (0.00257)	NA	0.0666	NA
603962	04-13-01	GEL	ND (0.00457)	NA	0.0712	NA

Refer to footnotes at end of table.

Table 4-2 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)			
NMED-Approved Background[b]			**0.004**		**0.00047**	
EPA Drinking Water MCL[c]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.002)	ND (0.002)	0.046	0.043
01990	01-24-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02416	05-07-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02187	07-31-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02731	10-15-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4097	07-28-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5839	01-19-93	QSTL	ND (0.002)	NA	**0.0086**	NA
6312	04-27-93	QARV	0.0016 J (0.002)	ND	ND (0.005)	ND (0.005)
6994	11-09-93	QSTL	ND (0.002)	NA	ND (0.005)	ND (0.005)
00140	05-03-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00143[d]	05-04-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01010	10-25-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01012[d]	10-25-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
03315	04-19-95	QARV	ND (0.002)	NA	ND (0.0049)	NA
04407	10-20-95	GEL	0.00006 J,B (0.005)	NA	0.00013 J,B (0.005)	NA
5048	04-18-96	GEL	ND (0.00001)	NA	ND (0.0001)	NA
06617	04-23-97	ERCL	ND (0.001)	NA	0.00057 J (0.0009)	NA
06880	10-15-97	GEL	NA	NA	ND (0.00021)	ND (0.00021)
06880[d]	10-15-97	GEL	NA	NA	ND (0.00021)	ND (0.00021)
510613	04-01-98	GEL	NA	NA	ND (0.00021)	ND (0.00021)
510608[e]	04-01-98	QSTL	NA	NA	ND (0.0006)	NA
601045	11-06-98	GEL	NA	NA	0.000860 J (0.001)	0.000525 J (0.001)
601388	04-14-99	GEL	ND (0.00002)	ND (0.00002)	ND (0.00022)	ND (0.00022)
602682[e]	04-14-00	ERCL	ND (0.00011)	NA	ND (0.0023)	NA
602683	04-14-00	GEL	NA	NA	ND (0.00063)	ND (0.00063)
602683[d]	04-14-00	GEL	NA	NA	ND (0.000631)	NA
603962	04-13-01	GEL	ND (0.0002)	NA	ND (0.00025)	NA

Refer to footnotes at end of table.

Table 4-2 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)			
NMED-Approved Background[b]			**0.043**		**0.01**	
EPA Drinking Water MCL[c]			**0.1**		**0.015**	
AR/COC Number	**Date Sampled**	**Lab**	**Chromium**		**Lead**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
01990	01-24-91	QSTL	ND (0.01)	0.021	ND (0.01)	ND (0.005)
02416	05-07-91	QSTL	ND (0.01)	0.015	ND (0.005)	ND (0.005)
02187	07-31-91	QSTL	ND (0.01)	0.011	ND (0.01)	ND (0.005)
02731	10-15-91	QSTL	ND (0.01)	0.019	ND (0.005)	ND (0.01)
4097	07-28-92	QSTL	0.011	ND (0.01)	ND (0.005)	ND (0.005)
5839	01-19-93	QSTL	0.011	NA	ND (0.005)	NA
6312	04-27-93	QARV	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.05)
6994	11-09-93	QSTL	0.01	NA	**0.018**	NA
00140	05-03-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
00143[d]	05-04-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
01010	10-25-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
01012[d]	10-25-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
03315	04-19-95	QARV	ND (0.003)	NA	ND (0.031)	NA
04407	10-20-95	GEL	0.0428	NA	ND (0.00113)	NA
5048	04-18-96	GEL	0.0116 B	NA	ND (0.00113)	NA
06617	04-23-97	ERCL	**1.1**	NA	ND (0.0017)	NA
06880	10-15-97	GEL	**0.0474**	0.00194 J (0.005)	ND (0.00068)	ND (0.00068)
06880[d]	10-15-97	GEL	0.0405	0.00207 J (0.005)	ND (0.00068)	ND (0.00068)
510613	04-01-98	GEL	**0.326**	ND (0.00073)	ND (0.00068)	ND (0.00068)
510608[e]	04-01-98	QSTL	**0.26**	NA	ND (0.0011)	NA
601045	11-06-98	GEL	**0.0694**	0.00453	0.000315 J (0.002)	ND (0.002)
601388	04-14-99	GEL	**0.0634**	0.00422	ND (0.00031)	ND (0.00031)
602682[e]	04-14-00	ERCL	0.0113	ND (0.0085)	ND (0.00183)	ND (0.00183)
602683	04-14-00	GEL	0.00867	0.00239 J (0.005)	0.00292 J (0.005)	NA
602683[d]	04-14-00	GEL	0.0113	NA	ND (0.0017)	NA
603962	04-13-01	GEL	0.0349	NA	ND (0.00344)	NA

Refer to footnotes at end of table.

Table 4-2 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)			
NMED-Approved Background[b]			**0.002**		**0.028**	
EPA Drinking Water MCL[c]			**0.002**		**NE**	
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**		**Nickel**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.005)	ND (0.005)	**0.046**	**0.043**
01990	01-24-91	QSTL	ND (0.005)	ND (0.005)	NA	NA
02416	05-07-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02187	07-31-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02731	10-15-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4097	07-28-92	QSTL	ND (0.0002)	ND (0.0002)	**0.15**	**0.063**
5839	01-19-93	QSTL	ND (0.0002)	NA	**0.078**	**NA**
6312	04-27-93	QARV	ND (0.0002)	ND (0.0002)	**0.097**	**0.094**
6994	11-09-93	QSTL	ND (0.0002)	NA	**0.095**	NA
00140	05-03-94	QSTL	ND (0.0002)	NA	**0.15**	NA
00143[d]	05-04-94	QSTL	ND (0.0002)	NA	**0.13**	NA
01010	10-25-94	QSTL	ND (0.0002)	NA	**0.1**	NA
01012[d]	10-25-94	QSTL	ND (0.0002)	NA	**0.13**	NA
03315	04-19-95	QARV	ND (0.04)	NA	**0.12**	NA
04407	10-20-95	GEL	ND (0.00001)	NA	**0.107**	NA
5048	04-18-96	GEL	ND (0.00001)	NA	**0.145**	NA
06617	04-23-97	ERCL	ND (0.00022)	NA	NA	NA
06880	10-15-97	GEL	0.00032	0.00033	NA	NA
06880[d]	10-15-97	GEL	0.00035	0.00045	NA	NA
510613	04-01-98	GEL	ND (0.0001)	ND (0.0001)	**0.398**	**0.538**
510608[e]	04-01-98	QSTL	ND (0.0001)		**0.5**	NA
601045	11-06-98	GEL	ND (0.0002)	ND (0.0002)	**0.490**	**0.467**
601388	04-14-99	GEL	ND (0.00004)	ND (0.00004)	**0.266**	**0.313**
602682[e]	04-14-00	ERCL	0.00011 J (0.0002)	0.00011	**0.279**	**0.281**
602683	04-14-00	GEL	0.000132 J (0.0002)	NA	**0.228**	NA
602683[d]	04-14-00	GEL	ND (0.00023)	NA	**0.270**	NA
603962	04-13-01	GEL	ND (0.00007)	NA	**0.252**	NA

Refer to footnotes at end of table.

Table 4-2 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW1
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)			
NMED-Approved			0.005		<0.01	
EPA Drinking Water MCL[c]			0.05		0.05	
AR/COC Number	Date Sampled	Lab	Selenium		Silver	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
01990	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
02416	05-07-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02187	07-31-91	QSTL	ND (0.01)	ND (0.005)	ND (0.01)	ND (0.01)
02731	10-15-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
4097	07-28-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5839	01-19-93	QSTL	0.0045 J (0.005)	NA	ND (0.01)	NA
6312	04-27-93	QARV	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
6994	11-09-93	QSTL	0.0023 J (0.005)	NA	ND (0.01)	NA
00140	05-03-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
00143[d]	05-04-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01010	10-25-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01012[d]	10-25-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
03315	04-19-95	QARV	ND (0.005)	NA	ND (0.003)	NA
04407	10-20-95	GEL	0.00308 J (0.005)	NA	ND (0.00249)	NA
5048	04-18-96	GEL	ND (0.00143)	NA	ND (0.00249)	NA
06617	04-23-97	ERCL	0.0029 J (0.0067)	NA	ND (0.00022)	NA
06880	10-15-97	GEL	0.00412 J (0.005)	ND (0.0014)	0.00274 J (0.005)	0.00291
06880[d]	10-15-97	GEL	0.0027 J (0.005)	0.0022 J (0.005)	0.00287 J (0.005)	0.00272 J (0.005)
510613	04-01-98	GEL	ND (0.0014)	ND (0.0014)	ND (0.00062)	ND (0.00062)
510608[e]	04-01-98	QSTL	ND (0.0031)	NA	ND (0.0007)	NA
601045	11-06-98	GEL	0.00159 J (0.005)	ND (0.005)	ND (0.001)	ND (0.001)
601388	04-14-99	GEL	0.0025 J (0.005)	0.00297	ND (0.0003)	ND (0.0003)
602682[e]	04-14-00	ERCL	0.00389 J (0.005)	ND (0.00236)	0.0023 J (0.005)	0.00276
602683	04-14-00	GEL	0.00326 J (0.005)	NA	0.00479 J (0.005)	NA
602683[d]	04-14-00	GEL	**0.0077**	NA	ND (0.00023)	NA
603962	04-13-01	GEL	ND (0.00309)	NA	ND (0.0002)	NA

Note: Values right justified and in **bold** indicate concentration above the NMED-approved background level and/or the EPA drinking water MCL.

[a]EPA November 1986.
[b]Dinwiddie September 1997.
[c]EPA July 2001.
[d]Duplicate sample.
[e]Split sample.

AR/COC analysis request/chain of custody record
B analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL report)
EPA U.S. Environmental Protection Agency
ERCL Environmental Restoration Chemical Laboratory, Sandia National Laboratories, New Mexico (on-site laboratory)
GEL General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( ) Estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND ( ) not detected above the method detection limit, shown in parentheses
NE not established
NMED New Mexico Environment Department
QARV Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL Quanterra Laboratories, St. Louis (off-site laboratory).

Table 4-3
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW2
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/ 7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			0.014		0.12	
EPA Drinking Water MCL[c]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
01547	09-28-90	QSTL	ND (0.005)	ND (0.005)	0.099	0.1
01991	01-28-91	QSTL	ND (0.005)	ND (0.005)	0.11	0.11
02351	04-02-91	QSTL	ND (0.005)	ND (0.005)	0.11	0.099
02205	08-01-91	QSTL	ND (0.005)	ND (0.005)	0.098	0.081
02217	10-14-91	QSTL	ND (0.01)	ND (0.005)	0.1	0.095
4098	07-27-92	QSTL	ND (0.005)	ND (0.005)	0.094	0.092
5834	01-18-93	QSTL	0.002 J (0.005)	NA	0.11	NA
6314	04-26-93	QSTL	0.001 J (0.005)	0.0012 J (0.005)	0.074	0.078
6995	11-08-93	QSTL	ND (0.005)	NA	0.11	NA
00138	05-02-94	QSTL	ND (0.01)	NA	0.11	NA
01009	10-24-94	QSTL	ND (0.01)	NA	0.1	NA
03306	04-17-95	QSTL	ND (0.003)	NA	0.091	NA
5027	04-15-96	QSTL	ND (0.00186)	NA	0.0909	NA
06618	04-24-97	ERCL	ND (0.0034)	NA	0.1	NA
06881	10-16-97	GEL	0.00421 J (0.005)	ND (0.00293)	0.106	0.104
510614	04-02-98	GEL	ND (0.00293)	ND (0.00293)	0.0997	0.0999
510608[d]	04-02-98	QSTL	ND (0.005)	NA	0.1 J (0.2)	NA
601046	11-06-98	GEL	0.00112 J (0.003)	ND (0.0009)	0.107	0.108
601386	04-19-99	GEL	0.00171 J	0.00095 J (0.003)	0.105	0.104
602685	04-24-00	GEL	ND (0.00257)	NA	0.101	NA
603963	04-23-01	GEL	ND (0.00457)	NA	0.096	NA

Refer to footnotes at end of table.

Table 4-3 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW2
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/ 7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			**0.004**		**0.00047**	
EPA Drinking Water MCL[c]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
01991	01-28-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02351	04-02-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02205	08-01-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02217	10-14-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4098	07-27-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5834	01-18-93	QSTL	ND (0.002)	NA	**0.016**	NA
6314	04-26-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6995	11-08-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
00138	05-02-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01009	10-24-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
03306	04-17-95	QSTL	ND (0.002)	NA	ND (0.0049)	NA
5027	04-15-96	QSTL	0.0001 J,B (0.005)	NA	0.00017 J (0.005)	NA
06618	04-24-97	ERCL	ND (0.0001)	NA	0.00065 J (0.0009)	NA
06881	10-16-97	GEL	NA	NA	0.00045 J	0.00028 J (0.005)
510614	04-02-98	GEL	NA		0.00032 J (0.005)	ND (0.00021)
510608[d]	04-02-98	QSTL	NA	NA	ND (0.005)	ND
601046	11-06-98	GEL	NA	NA	0.00028 J (0.001)	ND (0.00022)
601386	04-19-99	GEL	ND (0.00002)	ND (0.00002)	0.00023 J (0.001)	ND (0.00022)
602685	04-24-00	GEL	NA	NA	**0.0011 J (0.005)**	NA
603963	04-23-01	GEL	ND (0.0002)	NA	0.0004 J (0.001)	NA

Refer to footnotes at end of table.

Table 4-3 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW2
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/ 7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			0.043		0.01	
EPA Drinking Water MCL[c]			0.1		0.015	
AR/COC Number	Date Sampled	Lab	Chromium		Lead	
			Total	Dissolved	Total	Dissolved
01547	09-28-90	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
01991	01-28-91	QSTL	0.017	ND (0.01)	ND (0.005)	ND (0.01)
02351	04-02-91	QSTL	0.014	ND (0.01)	ND (0.005)	ND (005)
02205	08-01-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
02217	10-14-91	QSTL	0.02	ND (0.01)	ND (0.005)	ND (0.005)
4098	07-27-92	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
5834	01-18-93	QSTL	0.014	NA	ND (0.01)	NA
6314	04-26-93	QSTL	0.016	0.0077 J (0.01)	ND (0.01)	ND (0.01)
6995	11-08-93	QSTL	ND (0.01)	NA	ND (0.005)	NA
00138	05-02-94	QSTL	(0.01)	NA	ND (0.003)	NA
01009	10-24-94	QSTL	0.0085 J (0.01)	NA	ND (0.003)	NA
03306	04-17-95	QSTL	ND (0.003)	NA	ND (0.031)	NA
5027	04-15-96	QSTL	0.0121 B (0.01)	NA	ND (0.001)	NA
06618	04-24-97	ERCL	0.014 J (0.034)	NA	ND (0.0017)	NA
06881	10-16-97	GEL	0.00669	0.00553	ND (0.00068)	ND (0.00068)
510614	04-02-98	GEL	0.00582	0.00468 J (0.005)	ND (0.00068)	ND (0.00068)
510608[d]	04-02-98	QSTL	0.0007 J (0.005)	NA	ND (0.003)	NA
601046	11-06-98	GEL	0.00652	0.00357	0.00083 J (0.002)	ND (0.00031)
601386	04-19-99	GEL	0.0211	0.003	0.00069 J (0.002)	ND (0.00031)
602685	04-24-00	GEL	0.0131	NA	ND (0.00183)	NA
603963	04-23-01	GEL	0.0241	NA	ND (0.00344)	NA

Refer to footnotes at end of table.

Table 4-3 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW2
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			**0.002**		**0.028**	
EPA Drinking Water MCL[c]			**0.002**		**NE**	
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**		**Nickel**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
01991	01-28-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02351	04-02-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02205	08-01-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02217	10-14-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4098	07-27-92	QSTL	0.0007	ND (0.0002)	ND (0.04)	ND (0.04)
5834	01-18-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
6314	04-26-93	QSTL	ND (0.0002)	ND (0.0002)	0.014 J (0.04)	0.013 J (0.04)
6995	11-08-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
00138	05-02-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
01009	10-24-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
03306	04-17-95	QSTL	ND (0.04)	NA	0.0075 J (0.04)	NA
5027	04-15-96	QSTL	ND (0.00001)	NA	0.00342 J (0.01)	NA
06618	04-24-97	ERCL	ND (0.00022)	NA	NA	NA
06881	10-16-97	GEL	ND (0.0001)	ND (0.0001)	NA	NA
510614	04-02-98	GEL	ND (0.0001)	ND (0.0001)	0.00351 J (0.005)	0.004
510608[d]	04-02-98	QSTL	ND	NA	0.005 J	NA
601046	11-06-98	GEL	ND (0.00004)	ND (0.00004)	0.00449	0.00342
601386	04-19-99	GEL	ND (0.00004)	ND (0.00004)	0.00531	0.00437
602685	04-24-00	GEL	ND (0.00006)	NA	**0.124**	NA
603963	04-23-01	GEL	ND (0.00007)	NA	**0.0882**	NA

Refer to footnotes at end of table.

Table 4-3 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW2
1990 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			**0.005**		**<0.01**	
EPA Drinking Water MCL[c]			**0.05**		**0.05**	
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**		**Silver**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
01991	01-28-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
02351	04-02-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02205	08-01-91	QSTL	ND (0.01)	ND (0.005)	ND (0.01)	ND (0.01)
02217	10-14-91	QSTL	ND (0.01)	**0.00710 J (0.1)**	ND (0.01)	ND (0.01)
4098	07-27-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5834	01-18-93	QSTL	0.0038 J (0.005)	NA	ND (0.01)	NA
6314	04-26-93	QSTL	ND (2.5)	ND (5)	ND (0.01)	ND (0.01)
6995	11-08-93	QSTL	0.004 J (0.005)	NA	ND (0.01)	NA
00138	05-02-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01009	10-24-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
03306	04-17-95	QSTL	ND (0.005)	NA	ND (0.003)	NA
5027	04-15-96	QSTL	ND (0.0014)	NA	ND (0.00259)	NA
06618	04-24-97	ERCL	0.003 J (0.0067)	NA	ND (0.0002)	NA
06881	10-16-97	GEL	0.00237 J (0.005)	0.00144 J (0.005)	0.00104 J	0.00085 J (0.005)
510614	04-02-98	GEL	0.00267 J (0.005)	0.00309	0.00179 J (0.005)	0.00203
510608[d]	04-02-98	QSTL	ND	NA	ND (0.001)	NA
601046	11-06-98	GEL	0.00149 J (0.005)	0.00204 J	ND (0.0003)	ND (0.0003)
601386	04-19-99	GEL	0.00284 J	0.00269 J (0.005)	ND (0.0003)	ND (0.0003)
602685	04-24-00	GEL	ND (0.00236)	NA	0.00103 J (0.005)	NA
603963	04-23-01	GEL	0.00456 J,B (0.005)	NA	0.0026 J,B (0.005)	NA

Note: Values right justified and in **bold** indicate concentration above the NMED-approved background level and/or the EPA drinking water MCL.

[a]EPA November 1986.

[b]Dinwiddie September 1997.

[c]EPA July 2001

[d]Split sample.

AR/COC analysis request/chain of custody record
B analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL quarterly report)
EPA U.S. Environmental Protection Agency
ERCL Environmental Restoration Chemical Laboratory, Sandia National Laboratories, New Mexico (on-Site laboratory)
GEL General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND ( ) not detected above the method detection limit, shown in parentheses
NE not established
NMED New Mexico Environment Department
QARV Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL Quanterra Laboratories, St. Louis (off-site laboratory)

Table 4-4
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW3
1990 through 2001

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			0.014		0.12	
EPA Drinking Water MCL[c]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
01549	09-28-90	QSTL	ND (0.005)	ND (0.005)	0.1	0.11
01992	01-28-91	QSTL	ND (0.005)	ND (0.005)	0.098	0.1
02352	04-02-91	QSTL	ND (0.005)	ND (0.005)	0.091	0.1
02204	08-05-91	QSTL	ND (0.01)	ND (0.01)	0.089	0.082
02728	10-15-91	QSTL	ND (0.005)	ND (0.005)	0.094	0.088
4099	07-28-92	QSTL	ND (0.005)	ND (0.005)	0.084	0.078
5837	01-19-93	QSTL	0.0021 J (0.005)	NA	0.097	NA
6315	04-27-93	QSTL	0.0016 J (0.005)	0.0019 J (0.005)	0.074	0.07
6994	11-09-93	QSTL	0.0015 J (0.005)	NA	0.085	NA
00141	05-02-94	QSTL	ND (0.01)	NA	0.1	NA
01011	10-25-94	QSTL	ND (0.01)	NA	0.094	NA
03306	04-17-95	QARV	ND (0.003)	NA	0.093	NA
04393	10-16-95	GEL	ND (0.00186)	NA	0.0934	NA
5027	04-18-96	GEL	ND (0.00186)	NA	0.0889	NA
06618	04-24-97	ERCL	ND (0.0034)	NA	0.093	NA
06881	10-15-97	GEL	ND (0.00293)	ND (0.00293)	0.0901	0.0939
510614	04-02-98	GEL	ND (0.00293)	ND (0.00293)	0.0783	0.0856
601047	11-06-98	GEL	0.00142 J (0.003)	0.00143 J (0.003)	0.0906	0.091
601388	04-12-99	GEL	0.00199 J (0.003)	0.00148 J (0.003)	0.0868	0.0875
602687	04-13-00	GEL	ND (0.00257)	NA	0.107	NA
603964	04-08-01	GEL	0.00247 J,B (0.003)	NA	0.0985	NA

Refer to footnotes at end of table.

Table 4-4 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW3
1990 through 2001

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			**0.004**		**0.00047**	
EPA Drinking Water MCL[c]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
01549	09-28-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
01992	01-28-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02352	04-02-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02204	08-05-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02728	10-15-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4099	07-28-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5837	01-19-93	QSTL	ND (0.002)	NA	**0.029**	NA
6315	04-27-93	QSTL	ND (0.002)	0.0024	ND (0.005)	ND (0.005)
6994	11-09-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
00141	05-02-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01011	10-25-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
03306	04-17-95	QARV	ND (0.002)	NA	ND (0.0049)	NA
04393	10-16-95	GEL	ND (0.00001)	NA	0.0002 J (0.005)	NA
5027	04-18-96	GEL	ND (0.00001)	NA	ND (0.0001)	NA
06618	04-24-97	ERCL	ND (0.0001)	NA	0.00046 J (0.0009)	NA
06881	10-15-97	GEL	NA	NA	0.00022 J (0.005)	0.00027
510614	04-02-98	GEL	NA	NA	ND (0.00021)	**0.00052 J**
601047	11-06-98	GEL	NA	NA	ND (0.00022)	ND (0.00022)
601388	04-12-99	GEL	ND (0.00002)	ND (0.00002)	ND (0.00022)	ND (0.00022)
602687	04-13-00	GEL	NA	NA	**0.00064 J (0.005)**	NA
603964	04-08-01	GEL	ND (0.00003)	NA	0.00011 J (0.001)	NA

Refer to footnotes at end of table.

Table 4-4 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW3
1990 through 2001

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			0.043		0.01	
EPA Drinking Water MCL[c]			0.1		0.015	
AR/COC Number	Date Sampled	Lab	Chromium		Lead	
			Total	Dissolved	Total	Dissolved
01549	09-28-90	QSTL	ND (0.01)	0.013	ND (0.005)	0.0058
01992	01-28-91	QSTL	0.021	0.016	ND (0.005)	ND (0.005)
02352	04-02-91	QSTL	0.017	ND (0.01)	ND (0.005)	ND (0.01)
02204	08-05-91	QSTL	0.027	0.015	ND (0.005)	ND (0.005)
02728	10-15-91	QSTL	0.018	ND (0.01)	ND (0.01)	ND (0.005)
4099	07-28-92	QSTL	0.056	ND (0.01)	ND (0.005)	ND (0.005)
5837	01-19-93	QSTL	0.026	NA	ND (0.01)	NA
6315	04-27-93	QSTL	0.029	0.011	ND (0.05)	ND (0.05)
6994	11-09-93	QSTL	0.01	NA	ND (0.005)	NA
00141	05-02-94	QSTL	0.0092 J (0.01)	NA	ND (0.003)	NA
01011	10-25-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
03306	04-17-95	QARV	ND (0.003)	NA	ND (0.031)	NA
04393	10-16-95	GEL	0.0369	NA	ND (0.00113)	NA
5027	04-18-96	GEL	0.0207 J,B (0.01)	NA	ND (0.00113)	NA
06618	04-24-97	ERCL	ND (0.0084)	NA	ND (0.0017)	NA
06881	10-15-97	GEL	0.00264 J (0.005)	0.0123	ND (0.00068)	ND (0.00068)
510614	04-02-98	GEL	0.00871	0.00227 J (0.005)	ND (0.00068)	ND (0.00068)
601047	11-06-98	GEL	0.00979	0.00398	0.00046 J (0.002)	0.00031 J (0.002)
601388	04-12-99	GEL	0.00506 B	0.00276 J,B (0.003)	ND (0.00031)	ND (0.00031)
602687	04-13-00	GEL	0.00849	NA	ND (0.00183)	NA
603964	04-08-01	GEL	0.0876	NA	0.00058 J (0.002)	NA

Refer to footnotes at end of table.

Table 4-4 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW3
1990 through 2001

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			**0.002**		**0.028**	
EPA Drinking Water MCL[c]			**0.002**		**NE**	
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**		**Nickel**	
			Total	**Dissolved**	**Total**	**Dissolved**
01549	09-28-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
01992	01-28-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02352	04-02-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02204	08-05-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02728	10-15-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4099	07-28-92	QSTL	ND (0.0002)	ND (0.0002)	0.066	**0.043**
5837	01-19-93	QSTL	ND (0.0002)	NA	0.026 J (0.04)	NA
6315	04-27-93	QSTL	ND (0.0002)	ND (0.0002)	**0.037 J (0.04)**	**0.033 J (0.04)**
6994	11-09-93	QSTL	ND (0.0002)	NA	0.014 J (0.04)	NA
00141	05-02-94	QSTL	ND (0.0002)	NA	0.011 J (0.04)	NA
01011	10-25-94	QSTL	ND (0.0002)	NA	0.0098 J (0.04)	NA
03306	04-17-95	QARV	ND (0.04)	NA	0.0093 J (0.04)	NA
04393	10-16-95	GEL	ND (0.00001)	NA	0.00799 J (0.01)	NA
5027	04-18-96	GEL	ND (0.00001)	NA	0.00367 J (0.01)	NA
06618	04-24-97	ERCL	ND (0.00022)	NA	NA	NA
06881	10-15-97	GEL	ND (0.0001)	ND (0.0001)	NA	NA
510614	04-02-98	GEL	ND (0.0001)	ND (0.0001)	**0.0362**	**0.0285**
601047	11-06-98	GEL	ND (0.00004)	ND (0.00004)	0.018	0.0183
601388	04-12-99	GEL	ND (0.00004)	ND (0.00004)	**0.031**	0.0313
602687	04-13-00	GEL	ND (0.00006)	NA	0.0251	NA
603964	04-08-01	GEL	ND (0.00007)	NA	0.0141	NA

Refer to footnotes at end of table.

Table 4-4 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW3
1990 through 2001

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
NMED-Approved Background[b]			0.005		<0.01	
EPA Drinking Water MCL[c]			0.05		0.05	
AR/COC Number	Date Sampled	Lab	Selenium		Silver	
			Total	Dissolved	Total	Dissolved
01549	09-28-90	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
01992	01-28-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
02352	04-02-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02204	08-05-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02728	10-15-91	QSTL	ND (0.01)	**0.0054**	ND (0.01)	ND (0.01)
4099	07-28-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5837	01-19-93	QSTL	0.004 J (0.005)	NA	ND (0.01)	NA
6315	04-27-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6994	11-09-93	QSTL	0.0023 J (0.005)	NA	ND (0.01)	NA
00141	05-02-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01011	10-25-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
03306	04-17-95	QARV	ND (0.005)	NA	ND (0.003)	NA
04393	10-16-95	GEL	0.00144 J (0.005)	NA	ND (0.00249)	NA
5027	04-18-96	GEL	ND (0.00143)	NA	ND (0.00249)	NA
06618	04-24-97	ERCL	0.0028 J (0.0067)	NA	ND (0.0022)	NA
06881	10-15-97	GEL	0.00243 J (0.005)	0.00338 J (0.005)	0.00083 J (0.005)	ND (0.00062)
510614	04-02-98	GEL	ND (0.0014)	0.00247 J (0.005)	ND (0.00062)	0.00173 J (0.005)
601047	11-06-98	GEL	0.00201 J (0.005)	0.00285 J (0.005)	ND (0.0003)	ND (0.0003)
601388	04-12-99	GEL	0.00242 J (0.005)	0.00275 J (0.005)	ND (0.0003)	ND (0.0003)
602687	04-13-00	GEL	0.00294 J (0.005)	NA	ND (0.00053)	NA
603964	04-08-01	GEL	0.00261 J (0.005)	NA	0.00013 J,B (0.001)	NA

Note: Values right justified and in **bold** indicate concentration above the NMED-approved background level and/or the EPA drinking water MCL.

[a]EPA November 1986.

[b]Dinwiddie September 1997.

[c]EPA July 2001.

AR/COC analysis request/chain of custody record
B analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL quarterly report)
EPA U.S. Environmental Protection Agency
ERCL Environmental Restoration Chemical Laboratory, Sandia National Laboratories, New Mexico (on-site laboratory)
GEL General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND ( ) not detected above the method detection limit, shown in parentheses
NE not established
NMED New Mexico Environment Department
QARV Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL Quanterra Laboratories, St. Louis (off-site laboratory)

Table 4-5
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW4
1993 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
NMED-Approved Background[b]			0.014		0.12	
EPA Drinking Water MCL[c]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
6302	04-28-93	QSTL	0.0015 J (0.01)	NA	0.042	NA
6316[d]	04-28-93	QSTL	0.0011 J (0.01)	0.001	0.075	0.075
6317[d]	04-28-93	QSTL	0.004 J (0.01)	0.0045	0.082	0.081
6996	11-10-93	QSTL	0.0047 J (0.01)	NA	0.085	NA
508662	03-14-94	QSTL	0.003 J (0.01)	NA	**0.13**	NA
00144	05-31-94	QSTL	0.0091 J (0.01)	NA	0.1	NA
00319	10-28-94	QSTL	ND (0.01)	NA	0.11	NA
03315	04-19-95	QARV	ND (0.01)	NA	0.11	NA
03315[d]	04-19-95	QARV	0.011	NA	0.1	NA
04407	10-20-95	GEL	0.00864 J (0.01)	NA	0.105	NA
5048	04-18-96	GEL	ND (0.00186)	NA	0.1	NA
5048[d]	04-18-96	GEL	ND (0.00186)	NA	0.0975	NA
06617	04-23-97	ERCL	ND (0.0034)	NA	0.11	NA
06880	10-17-97	GEL	ND (0.00293)	ND (0.00293)	0.11	0.111
510613	04-01-98	GEL	ND (0.00293)	0.00429 J (0.005)	0.094	0.102
510613[d]	04-01-98	GEL	ND (0.00293)	ND (0.005)	0.093	0.0924
510608[e]	04-01-98	QSTL	0.0032 J (0.01)	NA	0.1 J (0.2)	NA
601048	11-06-98	GEL	0.00262 J (0.003)	0.00291 J (0.003)	0.11	0.11
601048[d]	11-06-98	GEL	0.00269 J (0.003)	0.00255 J (0.003)	0.11	0.11
601388	04-14-99	GEL	0.00258 J (0.003)	0.00268	0.103	0.103
602690	04-07-00	GEL	0.00425 J (0.005)	NA	0.105	NA
603965	04-05-01	GEL	0.00371 J,B (0.05)	NA	0.106	NA
603965[d]	04-05-01	GEL	0.00371 J,B (0.05)	NA	0.102	NA

Refer to footnotes at end of table.

Table 4-5 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW4
1993 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
NMED-Approved Background[b]			**0.004**		**0.00047**	
EPA Drinking Water MCL[c]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
6302	04-28-93	QSTL	NA	NA	ND (0.005)	NA
6316[d]	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6317[d]	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6996	11-10-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
508662	03-14-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00144	05-31-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00319	10-28-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00319[d]	04-19-95	QSTL	ND (0.002)	NA	ND (0.005)	NA
03315	04-19-95	QARV	ND (0.002)	NA	ND (0.005)	NA
03315[d]	04-19-95	QARV	ND (0.002)	NA	ND (0.005)	NA
04407	10-20-95	GEL	0.00006 J (0.005)	NA	**0.00093 J (0.005)**	NA
5048	04-18-96	GEL	ND (0.00001)	NA	ND (0.0001)	NA
5048[d]	04-18-96	GEL	NA	NA	NA	NA
06617	04-23-97	ERCL	ND (0.0001)	NA	0.00031 ND (0.0009)	NA
06880	10-17-97	GEL	NA		0.00035 J (0.005)	ND (0.00021)
510613	04-01-98	GEL	NA	NA	ND (0.0002)	ND (0.0002)
510613[d]	04-01-98	GEL	NA	NA	ND (0.0002)	ND (0.0002)
510608[e]	04-01-98	QSTL	NA	NA	ND (0.0006)	NA
601048	11-06-98	GEL	NA	NA	0.00026 J	0.00025 J (0.001)
601048[d]	11-06-98	GEL	NA	NA	ND (0.00022)	ND (0.0002)
601388	04-14-99	GEL	ND (0.00002)	ND (0.00002)	0.00025 J (0.001)	ND (0.00022)
602690	04-07-00	GEL	NA	NA	**0.00066 J (0.005)**	NA
603965	04-05-01	GEL	0.00005 J (0.0002)	NA	0.00033 J (0.001)	NA
603965[d]	04-05-01	GEL	0.00005 J (0.0002)	NA	0.00037 J (0.001)	NA

Refer to footnotes at end of table.

Table 4-5 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW4
1993 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
NMED-Approved Background[b]			0.043		0.01	
EPA Drinking Water MCL[c]			0.1		0.015	
AR/COC Number	Date Sampled	Lab	Chromium		Lead	
			Total	Dissolved	Total	Dissolved
6302	04-28-93	QSTL	ND (0.01)	NA	0.0019 J (0.0067)	NA
6316[d]	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.02)
6317[d]	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.05)	ND (0.05)
6996	11-10-93	QSTL	0.003 J (0.01)	NA	0.0036 J (0.0067)	NA
508662	03-14-94	QSTL	ND (0.01)	NA	0.0056	NA
00144	05-31-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
00319	10-28-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
03315	04-19-95	QARV	ND (0.01)	NA	ND (0.003)	NA
03315[d]	04-19-95	QARV	ND (0.003)	NA	ND (0.003)	NA
04407	10-20-95	GEL	ND (0.0006)	NA	ND (0.00113)	NA
5048	04-18-96	GEL	0.0017 J (0.01)	NA	ND (0.00113)	NA
5048[d]	04-18-96	GEL	ND (0.01)	ND (0.01)	ND (0.00113)	NA
06617	04-23-97	ERCL	ND (0.0084)	NA	0.0018 J,B (0.0067)	NA
06880	10-17-97	GEL	0.00144 J (0.005)	ND (0.00073)	ND (0.00068)	ND (0.00068)
510613	04-01-98	GEL	ND (0.0007)	0.00093 J (0.005)	ND (0.00068)	ND (0.00068)
510613[d]	04-01-98	GEL	ND (0.0002)	ND (0.0007)	ND (0.00068)	ND (0.00068)
510608[e]	04-01-98	QSTL	0.0021 J (0.01)	NA	ND (0.0011)	NA
601048	11-06-98	GEL	0.00094 J (0.003)	0.00118 J	0.00071 J (0.002)	0.00054 J (0.002)
601048[d]	11-06-98	GEL	0.00089 J	0.00097 J	0.00642 J (0.002)	0.00531 J (0.002)
601388	04-14-99	GEL	0.00104 J (0.003)	0.00111	0.00085 J (0.002)	0.0007 J (0.002)
602690	04-07-00	GEL	ND (0.00106)	NA	0.00214 J (0.005)	NA
603965	04-05-01	GEL	0.00599 J,B (0.003)	NA	0.00335	NA
603965[d]	04-05-01	GEL	NA	NA	0.00294	NA

Refer to footnotes at end of table.

Table 4-5 (Continued)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW4
1993 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
NMED-Approved Background[b]			0.002		0.028	
EPA Drinking Water MCL[c]			0.002		NE	
AR/COC Number	Date Sampled	Lab	Mercury		Nickel	
			Total	Dissolved	Total	Dissolved
6302	04-28-93	QSTL	ND (0.0002)	NA	NA	NA
6316[d]	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	0.016 J (0.004)	0.0075
6317[d]	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	0.0082
6996	11-10-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
508662	03-14-94	QSTL	0.00034	NA	ND (0.04)	NA
00144	05-31-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
00319	10-28-94	QSTL	ND (0.0002)	NA	0.0082 J (0.04)	NA
03315	04-19-95	QARV	ND (0.04)	NA	ND (0.04)	NA
03315[d]	04-19-95	QARV	ND (0.04)	NA	0.0082 J (0.04)	NA
04407	10-20-95	GEL	ND (0.00001)	NA	0.00307 J (0.01)	NA
5048	04-18-96	GEL	ND (0.00001)	NA	0.004 J (0.01)	0.0032 J (0.01)
5048[d]	04-18-96	GEL	ND (0.00001)	NA	0.004 J (0.01)	NA
06617	04-23-97	ERCL	ND (0.0002)	NA	NA	NA
06880	10-17-97	GEL	0.00038	0.00048	NA	NA
510613	04-01-98	GEL	ND (0.0001)	ND (0.0001)	ND (0.00227)	ND (0.00227)
510613[d]	04-01-98	GEL	ND (0.0001)	ND (0.0001)	ND (0.00227)	ND (0.00227)
510608[e]	04-01-98	QSTL	ND (0.0001)	NA	ND (0.0016)	NA
601048	11-06-98	GEL	ND (0.00004)	ND (0.00004)	0.00189 J (0.002)	0.00263
601048[d]	11-06-98	GEL	ND (0.00004)	ND (0.00004)	0.00159 J (0.002)	0.00172 J (0.002)
601388	04-14-99	GEL	ND (0.00004)	ND (0.00004)	0.00093 J (0.002)	0.00085 J (0.002)
602690	04-07-00	GEL	ND (0.00006)	NA	ND (0.00309)	NA
603965	04-05-01	GEL	ND (0.00007)	NA	0.00355	NA
603965[d]	04-05-01	GEL	ND (0.00007)	NA	0.00305	NA

Refer to footnotes at end of table.

Table 4-5 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW4
1993 through 2001

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
NMED-Approved Background[b]			**0.005**		**<0.01**	
EPA Drinking Water MCL[c]			**0.05**		**0.05**	
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**		**Silver**	
			Total	**Dissolved**	**Total**	**Dissolved**
6302	04-28-93	QSTL	**0.0071**	NA	ND (0.01)	NA
6316[d]	04-28-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6317[d]	04-28-93	QSTL	ND (2.5)	ND (5)	ND (0.01)	ND (0.01)
6996	11-10-93	QSTL	0.002 J (0.0067)	NA	ND (0.01)	NA
508662	03-14-94	QSTL	0.0017 J (0.005)	NA	ND (0.01)	NA
00144	05-31-94	QSTL	ND (0.018)	NA	ND (0.01)	NA
00319	10-28-94	QSTL	ND (0.0062)	NA	ND (0.01)	NA
03315	04-19-95	QARV	ND (0.005)	NA	ND (0.003)	NA
03315[d]	04-19-95	QARV	ND (0.005)	NA	ND (0.003)	NA
04407	10-20-95	GEL	0.00191 J (0.005)	NA	ND (0.00249)	NA
5048	04-18-96	GEL	ND (0.00143)	NA	ND (0.00249)	NA
5048[d]	04-18-96	GEL	ND (0.00143)	NA	ND (0.00249)	NA
06617	04-23-97	ERCL	0.002 J (0.0067)	NA	0.00046 J,B	NA
06880	10-17-97	GEL	0.00194 J (0.005)	ND (0.0014)	0.00266 J	0.00336
510613	04-01-98	GEL	ND (0.0014)	ND (0.0014)	0.00136 J	ND (0.00062)
510613[d]	04-01-98	GEL	ND (0.0014)	ND (0.0014)	ND (0.00062)	0.00203 J
510608[e]	04-01-98	QSTL	ND (0.0031)	NA	ND (0.0007)	NA
601048	11-06-98	GEL	0.00151 J (0.005)	0.00223 J (0.005)	ND (0.0003)	ND (0.0003)
601048[d]	11-06-98	GEL	0.00188 J (0.005)	ND	ND	ND
601388	04-14-99	GEL	0.00186 J (0.005)	0.00164 J (0.005)	ND (0.0003)	ND (0.0003)
602690	04-07-00	GEL	ND (0.00236)	NA	ND (0.00053)	NA
603965	04-05-01	GEL	0.00201 J (0.005)	NA	0.00015 J	NA
603965[d]	04-05-01	GEL	0.00189 J (0.005)	NA	0.0016 J,B	NA

Note: Values right justified and in **bold** indicate concentration above the NMED-approved background level and/or the EPA drinking water MCL.

[a]EPA November 1986.

[b]Dinwiddie September 1997.

[c]EPA July 2001.

[d]Duplicate sample.

[e]Split sample.

AR/COC analysis request/chain of custody record
B analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL quarterly report)
EPA U.S. Environmental Protection Agency
ERCL Environmental Restoration Chemical Laboratory, Sandia National Laboratories, New Mexico (on-site laboratory)
GEL General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND ( ) not detected above the method detection limit, shown in parentheses
NE not established
NMED New Mexico Environment Department
QARV Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL Quanterra Laboratories, St. Louis (off-site laboratory)

Table 4-6
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW5
January 2001 through July 2001

Sample Attributes			Total Metals (EPA Method 6010/6020/3005/7470[a]) (mg/L)	
NMED-Approved Background[b]			**0.014**	**0.12**
EPA Drinking Water MCL[c]			**0.05**	**2**
AR/COC Number	**Date Sampled**	**Lab**	**Arsenic**	**Barium**
603605	01-17-01	GEL	ND (0.00457)	**0.133**
603966	04-16-01	GEL	ND (0.00457)	**0.134**
604121	07-24-01	GEL	ND (0.00457)	**0.133**
NMED-Approved Background[b]			**0.004**	**0.00047**
EPA Drinking Water MCL[c]			**0.004**	**0.005**
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**	**Cadmium**
603605	01-17-01	GEL	ND (0.0002)	ND (0.00025)
603966	04-16-01	GEL	ND (0.0002)	ND (0.00025)
604121	07-24-01	GEL	ND (0.0002)	ND (0.00025)
NMED-Approved Background[b]			**0.043**	**0.01**
EPA Drinking Water MCL[c]			**0.1**	**0.015**
AR/COC Number	**Date Sampled**	**Lab**	**Chromium**	**Lead**
603605	01-17-01	GEL	ND (0.00078)	ND (0.00344)
603966	04-16-01	GEL	0.00085 J (0.005)	ND (0.00344)
604121	07-24-01	GEL	0.0015 J (0.005)	ND (0.00344)
NMED-Approved Background[b]			**0.002**	**0.028**
EPA Drinking Water MCL[c]			**0.002**	**NE**
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**	**Nickel**
603605	01-17-01	GEL	ND (0.00007)	0.0023 J (0.005)
603966	04-16-01	GEL	ND (0.00007)	0.00122 J (0.005)
604121	07-24-01	GEL	ND (0.00007)	0.00129 J (0.005)
NMED-Approved Background[b]			**0.005**	**<0.01**
EPA Drinking Water MCL[c]			**0.05**	**0.05**
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**	**Silver**
603605	01-17-01	GEL	0.00316 J (0.005)	0.00026 J (0.005)
603966	04-16-01	GEL	ND (0.00309)	ND (0.0002)
604121	07-24-01	GEL	ND (0.00309)	ND (0.0002)

Note: Values right justified and in **bold** indicate concentration above the NMED-approved background level and/or the EPA drinking water MCL.

[a]EPA November 1986.

[b]Dinwiddie September 1997.

[c]EPA July 2001.

AR/COC analysis request/chain of custody record
EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
ND ( ) not detected above the method detection limit, shown in parentheses
NE not established
NMED New Mexico Environment Department

Table 4-7
Summary of Metals Analytical Results for Groundwater Samples from MWL-MW6
January 2001 through July 2001

Sample Attributes			Total Metals (EPA Method 6010/6020/3005/7470[a]) (mg/L)	
NMED-Approved Backgro nd[b]			**0.014**	**0.12**
EPA Drinking Water MCL[c]			**0.05**	**2**
AR/COC Number	**Date Sampled**	**Lab**	**Arsenic**	**Barium**
603607	01-16-01	GEL	ND (0.00457)	0.115
603967	04-17-01	GEL	ND (0.00457)	0.092
604120	07-23-01	GEL	ND (0.00457)	0.112
NMED-Approved Background[b]			**0.004**	**0.00047**
EPA Drinking Water MCL[c]			**0.004**	**0.005**
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**	**Cadmium**
603607	01-16-01	GEL	ND (0.0002)	0.00033 J (0.005)
603967	04-17-01	GEL	ND (0.0002)	ND (0.00025)
604120	07-23-01	GEL	ND (0.0002)	ND (0.00025)
NMED-Approved Background[b]			**0.043**	**0.01**
EPA Drinking Water MCL[c]			**0.1**	**0.015**
AR/COC Number	**Date Sampled**	**Lab**	**Chromium**	**Lead**
603607	01-16-01	GEL	ND (0.00078)	ND (0.00344)
603967	04-17-01	GEL	ND (0.00078)	ND (0.00344)
604120	07-23-01	GEL	ND (0.00078)	ND (0.00344)
NMED-Approved Background[b]			**0.002**	**0.028**
EPA Drinking Water MCL[c]			**0.002**	**NE**
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**	**Nickel**
603607	01-16-01	GEL	ND (0.00007)	0.00081 J (0.005)
603967	04-17-01	GEL	0.00018 J (0.0002)	ND (0.00074)
604120	07-23-01	GEL	NA	ND (0.00074)
NMED-Approved Background[b]			**0.005**	**0.014**
EPA Drinking Water MCL[c]			**0.05**	**0.05**
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**	**Silver**
603607	01-16-01	GEL	ND (0.00309)	0.0004 J (0.005)
603967	04-17-01	GEL	0.00361 J (0.005)	ND (0.0002)
604120	07-23-01	GEL	ND (0.00309)	ND (0.0002)

[a]EPA November 1986.
[b]Dinwiddie September 1997.
[c]EPA July 2001.

AR/COC analysis request/chain of custody record
EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
NA not analyzed or not reported
ND ( ) not detected above the method detection limit, shown in parentheses
NE not established
NMED New Mexico Environment Department

Table 4-8
Summary of Nitrate Analytical Results for Groundwater Beneath the MWL
1991 through 2001

Well	Sample Date	Result (mg/L as N)	Lab	Analytical Method[a]
MWL-BW1	10-16-91	**5.6**	QSTL	EPA 353.2
	10 16-91	**5.6**	QSTL	EPA 353.2
	11-10-93	**5.9**	QSTL	EPA 353.2
	11-10-93	**5.8**	QSTL	EPA 353.2
	10 27-94	**5.6**	QSTL	EPA 353.2
	10-27-94	**5.7**	QSTL	EPA 353.2
	10-31-94	**5.7**	QSTL	EPA 353.2
	04-16-96	**5.65 B**	GEL	EPA 353.1
	04-28-97	**5**	ERCL	HACH_NO3
	10-17-97	**5.75**	GEL	EPA 353.1
	03-31-98	**6.08**	GEL	EPA 353.1
	11-05-98	**5.36**	GEL	EPA 353.1
	04-13-99	**6.15**	GEL	EPA 353.1
	04-06-00	**5.55**	GEL	EPA 353.1
	04-06-01	**6.75**	GEL	EPA 353.1
MWL-MW1	10-15-91	**5.5**	QSTL	EPA 353.2
	11-09-93	**5.4**	QSTL	EPA 353.2
	05-03-94	**5**	QSTL	EPA 353.2
	05-04-94	**5.2**	QSTL	EPA 353.2
	10-25-94	**5.2**	QSTL	EPA 353.2
	10-25-94	**5.2**	QSTL	EPA 353.2
	04-19-95	**5.5**	QARV	EPA 353.2
	04-18-96	**5.15 B**	GEL	EPA 353.1
	04-23-97	**5.2**	ERCL	HACH_NO3
	10-15-97	**4.86**	GEL	EPA 353.1
	10-15-97	**5.1**	GEL	EPA 353.1
	04-01-98	**5.36**	GEL	EPA 353.1
	11-06-98	**5.4**	GEL	EPA 353.1
	04-14-99	**5.19**	GEL	EPA 353.1
	04-14-00	**4.5**	GEL	EPA 353.1
	04-14-00	**4.35**	GEL	EPA 353.1
	04-13-01	3	GEL	EPA 353.1
MWL-MW2	10-14-91	**5.1**	QSTL	EPA 353.2
	11-08-93	**4.9**	QSTL	EPA 353.2
	05-02-94	**4.7**	QSTL	EPA 353.2
	10-24-94	**4.9**	QSTL	EPA 353.2
	04-17-95	**5**	QARV	EPA 353.2
	04-15-96	**4.65 B**	GEL	EPA 353.1
	04-24-97	3.7	ERCL	HACH_NO3
	10-16-97	3.93	GEL	EPA 353.1
	04-02-98	3.44	GEL	EPA 353.1
	11-06-98	4	GEL	EPA 353.1
	04-19-99	3.72	GEL	EPA 353.1
	04-24-00	3.45	GEL	EPA 353.1
	04-23-01	3.35	GEL	EPA 353.1

Refer to footnotes at end of table.

Table 4-8 (Continued)
Summary of Nitrate Analytical Results for Groundwater Beneath the MWL
1991 through 2001

Well	Sample Date	Result (mg/L as N)	Lab	Analytical Method[a]
MWL-MW3	10-15-91	**4.3**	QSTL	EPA 353.2
	11-09-93	**4.2**	QSTL	EPA 353.2
	05-03-94	3.9	QSTL	EPA 353.2
	10-25-94	**4.3**	QSTL	EPA 353.2
	04-17-95	**4.7**	QARV	EPA 353.2
	04-15-96	**4.05 B**	GEL	EPA 353.1
	04-15-96	**4.05 B**	GEL	EPA 353.1
	04-24-97	2.8	ERCL	HACH_NO3
	10-16-97	**4.05**	GEL	EPA 353.1
	04-02-98	3.56	GEL	EPA 353.1
	11-06-98	**4.4**	GEL	EPA 353.1
	04-12-99	**4.08**	GEL	EPA 353.1
	04-13-00	**4.15**	GEL	EPA 353.1
	04-08-01	2.59	GEL	EPA 353.1
MWL-MW4	11-11-93	1.9	QSTL	EPA 353.2
	03-14-94	1.5	QSTL	EPA 353.2
	05-31-94	1.2	QSTL	EPA 353.2
	10-28-94	0.6	QSTL	EPA 353.2
	04-19-95	0.14	QARV	EPA 353.2
	04-19-95	0.15	QARV	EPA 353.2
	04-18-96	1.89B	GEL	EPA 353.1
	04-18-96	1.92 B	GEL	EPA 353.1
	04-23-97	1.2	ERCL	HACH_NO3
	04-23-97	1.3	ERCL	HACH_NO3
	10-15-97	1.81	GEL	EPA 353.1
	04-01-98	1.71	GEL	EPA 353.1
	04-01-98	1.92	GEL	EPA 353.1
	11-06-98	2	GEL	EPA 353.1
	11-06-98	2.05	GEL	EPA 353.1
	11-06-98	2.05	GEL	EPA 353.1
	04-14-99	1.9	GEL	EPA 353.1
	04-07-00	2	GEL	EPA 353.1
	04-05-01	1.59	GEL	EPA 353.1
	04-05-01	1.61	GEL	EPA 353.1
MWL-MW5	01-17-01	1.3	GEL	EPA 353.1
	04-16-01	1.11	GEL	EPA 353.1
	04-16-01	1.12	GEL	EPA 353.1
	07-24-01	1.07	GEL	EPA 353.1
	07-24-01	1.1	GEL	EPA 353.1

Refer to footnotes at end of table.

Table 4-8 (Concluded)
Summary of Nitrate Analytical Results for Groundwater Beneath the MWL
1991 through 2001

Well	Sample Date	Result (mg/L as N)	Lab	Analytical Method[a]
MWL-MW6	11-02-00	**4.6**	ERCL	HACH_NO3
	11-02-00	3.9	ERCL	HACH_NO3
	01-16-01	2.1	GEL	EPA 353.1
	01-16-01	2.05	GEL	EPA 353.1
	04-17-01	2.15	GEL	EPA 353.1

Notes: The NMED background concentration for nitrate is 4 mg/L (measured as N).
The EPA drinking water MCL for nitrate is 10 mg/L (measured as N).
Values right justified and in **bold** indicate concentration above the NMED-approved background.
No nitrate concentrations exceeded the EPA MCL.

[a]EPA November 1986.

[b]EPA July 2001.

B analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL quarterly report)
EPA U.S. Environmental Protection Agency
ERCL Environmental Restoration Chemistry Laboratory (on-site laboratory)
GEL General Engineering Laboratory (off-site laboratory)
HACH HACH Company, Loveland, Colorado
Lab laboratory
MCL maximum contaminant level
mg/L milligram(s) per liter
MWL Mixed Waste Landfill
N nitrogen
NA not analyzed or not reported
NMED New Mexico Environment Department
QARV Quanterra Arvada, Colorado Laboratory (off-site laboratory)
QSTL Quanterra St. Louis Laboratory (off-site laboratory)

Table 4-9
Summary of Major Ion Chemistry Data for Groundwater Beneath the MWL
1993 through 2001

Sample Attributes		Parameters[a]										
Well	Sample Date	Alkalinity as $CaCO_3$	Alkalinity as CO_3	Alkalinity as HCO_3	Bromide	Calcium	Chloride	Fluoride	Magnesium	Potassium	Sodium	Sulfate
MWL-BW1	04-28-93	257.3	NA	NA	NA	46.6	27.6	NA	17.9	2.7 J (5)	46.9	46.7
MWL-BW1-DU	04-28-93	NA	NA	NA	NA	47.8	27.9	NA	18.3	2.9 J (5)	47.4	46.7
MWL-BW1	11-10-93	229	ND (5)	229	NA	54.1	26.4	0.58	19.1	3.6 J (5)	56	43.5
MWL-BW1	10-27-94	217	ND (5)	217	ND (0.2)	55.8	25.6	0.79	20	3.5 J (5)	56.9	42.5
MWL-BW1	03-14-95	230	NA	NA	NA	48	25	0.8	19	3.4	51	52
MWL-BW1	10-23-95	229	NA	NA	NA	56.8	24.8	0.970	19.1	3.31 B	56.6 B	46.9
MWL-BW1	04-16-96	212	NA	NA	NA	49.2	23	1.18	19.7	3.32	55.5	42.7
MWL-BW1	04-06-01	233	NA	NA	0.245	58.3	25.4	0.724	20.5	3.71	52.5	44
MWL-MW1	04-27-93	215.7	NA	NA	NA	51.8	29.5	NA	17.4	2.5 J (5)	45.7	43.7
MWL-MW1	11-09-93	211	ND (5)	211	NA	57.1	29.1	0.72	17.8	3.3 J (5)	50.9	41.9
MWL-MW1	10-25-94	207	ND (5)	207	ND (0.2)	59.6	30	0.8	19	3.3 J (5)	53.6	45.4
MWL-MW1	04-19-95	226	ND (5)	226	NA	61.1	31.9	0.7	18.9	3.2 J (5)	52.1	44.4
MWL-MW1	10-20-95	234	NA	NA	NA	58.6	29.5	0.66	18.1	3.18	52.2	46.6
MWL-MW1	04-18-96	220	NA	NA	NA	55.1	28.7	0.935	17.4	2.91	49.4	44.4
MWL-MW1	04-13-01	198	NA	NA	0.238	55.5	31.1	0.865	18.3	3.42	50.1	44.3
MWL-MW2	04-26-93	207.7	NA	NA	NA	47.1	31.9	NA	17.1	3.6 J	45.7	47.3
MWL-MW2	11-08-93	208	ND (5)	208	NA	51.3	30.2	1	18.5	4.8 J	55.4	40.5
MWL-MW2	10-24-94	185	ND (5)	185	ND (0.2)	54.9	30.8	1	18.8	4.5 J	53.9	42.9
MWL-MW2	04-17-95	196	ND (5)	196	NA	42.8	33.5	0.7	16.6	4.8 J	46.8	42.4
MWL-MW2	10-16-95	199	NA	NA	NA	49.6	30.8	1.03	16.6	4.25	47.9	41.3
MWL-MW2	04-15-96	195	NA	NA	NA	51.2	29.7	1.32	17.6	4.07	49.5	41.2
MWL-MW2	04-23-01	209	NA	NA	0.38	54	41.3	0.949	18.5	4.62	49.6	44.3
MWL-MW3	04-27-93	193.4	NA	NA	NA	42.1	33.4	NA	14.6	3.1 J (5)	45.7	39.7
MWL-MW3	11-09-93	193	ND (5)	193	NA	44.2	32.2	0.83	15.9	3.6 J (5)	51.5	38.3
MWL-MW3	10-25-94	177	ND (5)	177	ND (0.2)	48.2	32.7	0.94	16.3	3.9 J (5)	53.2	40.5
MWL-MW3	04-17-95	182	ND (5)	182	NA	39.2	36.4	0.68	17	3.9 J (5)	49.9	41
MWL-MW3	10-16-95	191	NA	NA	NA	45.7	31.5	1.04	15.2	3.82	49.2	39.1
MWL-MW3	04-15-96	182	NA	NA	NA	47.9	30.5	1.34	16.2	3.69	50.8	39.3
MWL-MW3	04-08-01	194	NA	NA	0.315	47.9	33.7	0.757	17	3.98	47.1	36.3

Refer to footnotes at end of table.

Table 4-9 (Concluded)
Summary of Major Ion Chemistry Data for Groundwater Beneath the MWL
1993 through 2001

Sample Attributes		Parameters[a] Units all in mg/L										
Well	Sample Date	Alkalinity as $CaCO_3$	Alkalinity as CO_3	Alkalinity as HCO_3	Bromide	Calcium	Chloride	Fluoride	Magnesium	Potassium	Sodium	Sulfate
MWL-MW4	04-30-93	231.7	NA	NA	NA	52.1	61.2	NA	19.5	4.3 J (5)	46.9	38.7
MWL-MW4	11-11-93	218	ND (5)	218	NA	55.4	59.1	1	19.7	4.8 J (5)	46.2	34.8
MWL-MW4	10-28-94	234	ND (5)	234	ND (0.2)	59.7	57.4	0.85	20.4	5.5	67.1	43.9
MWL-MW4	04-19-95	266	ND (5)	266	NA	68.7	60.7	0.71	23	6.1	80.7	49.8
MWL-MW4-DU	04-19-95	267	ND (5)	267	NA	65.5	61	0.69	22	6	75.9	49.7
MWL-MW4	10-20-95	257	NA	NA	NA	61.1	56.2	0.51	20.3	5.61	76.6	52.2
MWL-MW4-DU	10-20-95	276	NA	NA	NA	62.9	55.6	0.43 J	20.9	5.77	78.5	52
MWL-MW4	04-18-96	217	NA	NA	NA	60	54.3	1.06	20.8	5.04	53.1	35.5
MWL-MW4	04-05-01	215	NA	NA	0.385	60.3	53.8	0.926	21	5.35	49.9	37.1
MWL-MW4-DU	04-05-01	NA	NA	NA	0.381	59.3	53.8	0.91	20.8	5.21	48.9	37.1
MWL-MW5	04-16-01	331	NA	NA	0.384	76.9	85.2	0.679	25.6	12.1	104	52
MWL-MW5-DU	04-16-01	NA	NA	NA	0.452	74.8	85.3	0.618	24.9	12.5	111	52.4
MWL-MW6	04-17-01	278	NA	NA	0.346	83.5	57.2	0.752	27.3	4.93	58	42.8

[a]EPA March 1983 and EPA December 1989.

$CaCO_3$ calcium carbonate
CO_3 carbonate
DU duplicate
HCO_3 bicarbonate
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
mg/L milligram(s) per liter
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND not detected
ND ( ) not detected at the method detection limit, shown in parentheses

Table 4-10
Summary of VOCs Detected in Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Result (g/L)	MCL[a] (g/L)	Analytical Method[b]	Laboratory
MWL-BW1	Acetone	10-27-94	2.5 J (10)	NE	8240	QSTL
	Methylene chloride	10-27-94	1.7 J (5)	5	8240	QSTL
		10-27-94	1.8 J (5)	5	8240	QSTL
		10-27-94	2 J (5)	5	8240	QSTL
	Toluene	04-28-97	0.83 J (2)	1000	8260	ERCL
		04-06-00	2.54	1000	8260	GEL
		04-06-01	0.31 J (1)	1000	8260	GEL
	Trichloroethene	04-06-01	0.332 J (1)	5	8260	GEL
	cis-1,2-Dichloroethene	04-06-01	0.284 J (1)	70	8260	GEL
MWL-MW1	Acetone	04-13-00	1.21 J (5)	NE	8260	GEL
	Toluene	11-06-98	0.59 J (1)	1000	8260	GEL
		04-13-01	0.246 J (1)	1000	8260	GEL
MWL-MW2	Acetone	10-24-94	3.2 J (10)	NE	8240	QSTL
		04-23-01	12.6 J (5)	NE	8260	GEL
	Bromomethane	05-02-94	1.9 J (10)	NE	8240	QSTL
	Methylene chloride	10-24-94	1.3 J (5)	5	8240	QSTL
		01-19-99	1.9 J (5)	5	8260	GEL
	Toluene	04-15-96	1.84 J (2)	1000	8260	GEL
		04-24-97	0.53 J (2)	1000	8260	ERCL
		04-19-99	0.57 J (1)	1000	8260	GEL
		04-23-01	0.537 J (1)	1000	8260	GEL
	Xylene	04-15-96	1.19 J (2)	10,000	8260	GEL
MWL-MW3	Methylene chloride	01-20-99	1.8 J (5)	5	8260	GEL
	Toluene	04-12-99	0.98 J (1)	1000	8260	GEL
MWL-MW4	Acetone	10-20-95	7.83	NE	8260	GEL
		04-23-97	ND (5)	NE	8260	ERCL
		04-23-97	11	NE	8260	ERCL
	Methylene Chloride	04-19-95	1.1 J (5)	5	8240	QARV
		04-19-95	1.0 J (5)	5	8240	QARV
		01-21-99	1.7 J (5)	NE	8260	GEL
		01-21-99	2.4 J (5)	NE	8260	GEL
	Toluene	05-31-94	0.54 J (5)	1000	8260	QSTL
		10-15-97	4.4	1000	8260	GEL
		11-06-98	13	1000	8260	GEL
		11-06-98	11	1000	8260	GEL
		04-14-99	4.2	1000	8260	GEL
		04-07-00	2.7	1000	8260	ERCL
		02-07-01	1.27	1000	8260	GEL
		02-07-01	1.36	1000	8260	GEL
		02-09-01	0.679 J (1)	1000	8260	GEL
		02-09-01	0.709 J (1)	1000	8260	GEL
		04-04-01	0.359 J (1)	1000	8260	GEL
		04-05-01	0.225 J (1)	1000	8260	GEL
	Trichloroethene	05-31-94	0.28 J (5)	5	8260	QSTL

Refer to footnotes at end of table.

Table 4-10 (Concluded)
Summary of VOCs Detected in Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Result (g/L)	MCL[a] (g/L)	Analytical Method[b]	Laboratory
MWL-MW5	Toluene	01-17-01	0.765 J (1)	1000	8260	GEL

[a]EPA July 2001.

[b]EPA November 1986.

CFR Code of Federal Regulations
EPA U.S. Environmental Protection Agency
ERCL Environmental Restoration Chemistry Laboratory (on-site laboratory)
GEL General Engineering Laboratory (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
MCL Maximum contaminant level, EPA Drinking Water Standards, 40 CFR 141, Subparts B and G
g/L microgram(s) per liter
MWL Mixed Waste Landfill
ND not detected
NE not established
QARV Quanterra Arvada Colorado Laboratory (off-site laboratory)
QSTL Quanterra, St. Louis Laboratory (off-site laboratory)
VOC volatile organic compound

Table 4-11
Summary of SVOCs Detected in Groundwater Beneath the MWL
1990 through 2001

Well	Analyte EPA Method 8270[a]	Sample Date	Result (g/L)	Lab
MWL-BW1	bis(2-Ethylhexyl)phthalate	09-27-90	13	QSTL
MWL-MW1	bis(2-Ethylhexyl)phthalate	05-04-94	160	QSTL
MWL-MW2	bis(2-Ethylhexyl)phthalate	04-17-95	89	QARV
	bis(2-Ethylhexyl)phthalate	04-17-95	89	QARV
MWL-MW4	bis(2-Ethylhexyl)phthalate	04-19-95	6.9 J (10)	QARV
MWL-MW5	bis(2-Ethylhexyl)phthalate	07-24-01	0.368 J (0.98)	GEL
	bis(2-Ethylhexyl)phthalate	07-24-01	0.258 J (0.98)	GEL
MWL-MW6	2-Methylnaphthalene	07-23-01	0.244 J (1)	GEL
	Acenaphthylene	07-23-01	0.241 J (1)	GEL
	Anthracene	07-23-01	0.252 J (1)	GEL
	Benzo(a)anthracene	07-23-01	0.444 J (1)	GEL
	Benzo(a)pyrene	07-23-01	0.357 J (1)	GEL
	Benzo(b)fluoranthene	07-23-01	0.396 J (1)	GEL
	Benzo(k)fluoranthene	07-23-01	0.354 J (1)	GEL
	Chrysene	07-23-01	0.33 J (1)	GEL
	Dibenz[a,h]anthracene	07-23-01	4.29	GEL
	Fluoranthene	07-23-01	0.235 J (1)	GEL
	Fluorene	07-23-01	0.253 J (1)	GEL
	Phenanthrene	07-23-01	0.297 J (1)	GEL
	bis(2-Ethylhexyl)phthalate	07-23-01	0.529 J (1)	GEL

Note: No EPA MCLs are established for the SVOCs listed on this table.

[a]EPA November 1986.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
g/L microgram(s) per liter
MCL Maximum contaminant level
MWL Mixed Waste Landfill
QARV Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
SVOC semivolatile organic compound

Table 4-12
Summary of Gross Alpha Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-BW1	09-01-90	6.04	3.57	ITAS-O
	09-01-90	7.26	4.08	ITAS-O
	09-01-90	6.93	4.33	ITAS-O
	09-01-90	7.64	3.13	ITAS-O
	01-24-91	3.7±2.5	5	ITAS-O
	01-24-91	5.2±2.8	6	ITAS-O
	01-24-91	3.2±2.4	6	ITAS-O
	01-24-91	5.0±2.6	6	ITAS-O
	01-24-91	4.4 ±2.6	5	ITAS-O
	01-24-91	ND	3	ITAS-O
	01-24-91	ND	5	ITAS-O
	01-24-91	5.4±2.8	5	ITAS-O
	04-07-91	7.4±4.1	NA	QUANTE
	04-07-91	9.7±4.6	NA	QUANTE
	04-07-91	11±5	NA	QUANTE
	04-07-91	14±5	NA	QUANTE
	04-07-91	8.9 ±4.6	NA	QUANTE
	04-07-91	6.5 ±4.2	NA	QUANTE
	04-07-91	8.4 ±4.4	NA	QUANTE
	04-07-91	7.8±4.3	NA	QUANTE
	08-06-91	3.48±2.29	NA	ITAS-O
	08-06-91	5.52±3.14	NA	ITAS-O
	08-06-91	5.08±2.65	NA	ITAS-O
	08-06-91	6.30±2.98	NA	ITAS-O
	08-06-91	9.62±3.99	NA	ITAS-O
	08-06-91	8.05±3.49	NA	ITAS-O
	08-06-91	4.75±2.74	NA	ITAS-O
	08-06-91	6.06±3.23	NA	ITAS-O
	08-06-91	7.64±3.77	NA	ITAS-O
	08-06-91	1.17±0.706	NA	ITAS-O
	08-06-91	10.5±4.34	NA	ITAS-O
	08-06-91	7.61±3.32	NA	ITAS-O
	08-06-91	12.1±4.52	NA	ITAS-O
	08-06-91	4.56±2.61	NA	ITAS-O
	08-06-91	7.61±3.06	NA	ITAS-O
	08-06-91	8.52±3.67	NA	ITAS-O
	01-15-92	4.9±2.61	NA	ITAS-O
	01-15-92	5.92±2.27	NA	ITAS-O
	01-15-92	7.81±2.97	NA	ITAS-O
	01-15-92	7.62±3.93	NA	ITAS-O
	01-15-92	6.73±3.84	NA	ITAS-O
	01-15-92	7.84±3.78	NA	ITAS-O
	01-15-92	4.43±2.45	NA	ITAS-O
	01-15-92	4.47±1.9	NA	ITAS-O
	01-15-92	4.59±2.35	NA	ITAS-O

Refer to footnotes at end of table.

Table 4-12 (Continued)
Summary of Gross Alpha Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-BW1 (cont.)	01-15-92	6.25±2.42	NA	ITAS-O
	01-15-92	4.72±2.5	NA	ITAS-O
	01-15-92	13.9±4.15	NA	ITAS-O
	07-29-92	9.87±4.73	NA	ITAS-O
	07-29-92	29.8±8.3	NA	ITAS-O
	07-29-92	11±5	NA	ITAS-O
	07-29-92	6.99±4.05	NA	ITAS-O
	01-20-93	6.2±1.82	1.5	ITRSL
	01-20-93	37.2±5.4	1.3	ITRSL
	01-20-93	7.57±2.05	1.5	ITRSL
	01-20-93	6.84±1.95	1.6	ITRSL
	11-10-93	8.7±3.7	2.5	TMA EB
	04-28-94	7.8±3.2	2.2	TMA EB
	10-27-94	11±1.7	1	QUANTE
	10-23-95	8.9±4.4	6.2	LAS
	04-28-97	6.1±3.1	1.5	LAS
	10-17-97	9.9±3.2	0.79	LAS
	03-31-98	9.92±2.18	0.76	GEL
	11-05-98	8.86±1.65	0.594	GEL
	04-13-99	8.11±1.48	0.539	GEL
	04-06-00	10.6±2.8628	0.829	GEL
	04-06-01	9.63±1.51	0.428	GEL
MWL-MW1	09-01-90	6.01	3.36	ITAS-O
	09-01-90	5.10	3.66	ITAS-O
	01-24-91	5.0±2.7	6	ITAS-O
	01-24-91	4.2±2.3	5	ITAS-O
	01-24-91	ND	5	ITAS-O
	01-24-91	3.0±2.0	5	ITAS-O
	05-07-91	5.6±3.8	NA	QUANTE
	05-07-91	7.2±4.2	NA	QUANTE
	05-07-91	12±5	NA	QUANTE
	05-07-91	7.5±4.3	NA	QUANTE
	07-31-91	6.06±2.82	NA	ITAS-O
	07-31-91	7.56±3.42	NA	ITAS-O
	07-31-91	7.22±3.3	NA	ITAS-O
	07-31-91	6.73±2.93	NA	ITAS-O
	07-31-91	6.6±3.04	NA	ITAS-O
	07-31-91	7.09±3.33	NA	ITAS-O
	07-31-91	8.33±3.8	NA	ITAS-O
	07-31-91	8.06±3.67	NA	ITAS-O
	10-14-91	8.5±5.21	NA	ITAS-O
	01-14-92	5±2.75	NA	ITAS-O
	01-14-92	7.97±3.72	NA	ITAS-O
	01-14-92	4.54±2.48	NA	ITAS-O
	01-14-92	8.26±3.02	NA	ITAS-O
	01-14-92	7.65±3.09	NA	ITAS-O
	01-14-92	6.14±2.87	NA	ITAS-O

Refer to footnotes at end of table.

Table 4-12 (Continued)
Summary of Gross Alpha Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW1 (cont.)	01-14-92	5.14±2.85	NA	ITAS-O
	01-14-92	5.41±3.41	NA	ITAS-O
	07-28-92	13.52±-.65	NA	ITAS-O
	07-28-92	4.44±2.84	NA	ITAS-O
	07-28-92	12.3±5.5	NA	ITAS-O
	07-28-92	10.5±4.9	NA	ITAS-O
	07-28-92	5.44±3.44	NA	ITAS-O
	01-19-93	11.7±4	3.5	ITRSL
	01-19-93	10.9±3.8	3.3	ITRSL
	01-19-93	13.9±4.2	2	ITRSL
	01-19-93	10.7±3.8	3.2	ITRSL
	04-27-93	11±4.4	1.9	TMA EB
	04-27-93	7.8±3.5	2.6	TMA EB
	04-27-93	9.6±4.1	2.7	TMA EB
	04-27-93	8.6±3.8	2.5	TMA EB
	11-09-93	11±4.1	2.1	TMA EB
	05-03-94	6.9±3.4	3.1	TMA EB
	05-04-94	10±4.3	3.1	TMA EB
	10-25-94	7.3±1.41	1.19	QUANTE
	10-20-95	4.9±3.5	6.5	LAS
	04-18-96	3.4±2.9	1.6	LAS
	04-18-96	10.4±4.2	1.6	LAS
	04-18-96	4.9±3.3	1.7	LAS
	04-23-97	4.3±2.8	1.6	LAS
	04-23-97	4.3±2.8	1.6	LAS
	10-15-97	7.9±3.1	0.84	LAS
	10-15-97	11.6±3.6	0.78	LAS
	04-01-98	11.6±2.29	0.646	GEL
	11-06-98	7.55±1.47	0.57	GEL
	04-14-99	6.28±1.24	0.431	GEL
	04-14-00	6.68±0.9024	0.314	GEL
	04-14-00	3.24±0.598	0.26	GEL
	04-13-01	7±1.46	0.583	GEL
MWL-MW2	09-01-90	13.9	6.03	ITAS-O
	09-01-90	7.42	4.38	ITAS-O
	01-28-91	ND	3	ITAS-O
	01-28-91	4.2±2.2	5	ITAS-O
	01-28-91	3.7±2.2	5	ITAS-O
	01-28-91	ND	5	ITAS-O
	05-02-91	ND	NA	QUANTE
	05-02-91	7.8±4.3	NA	QUANTE
	05-02-91	11±5	NA	QUANTE
	05-02-91	13±5	NA	QUANTE
	08-01-91	9.55±4.02	NA	ITAS-O
	08-01-91	6.21±3.53	NA	ITAS-O
	08-01-91	3.98±2.75	NA	ITAS-O
	08-01-91	5.92±3.16	NA	ITAS-O

Refer to footnotes at end of table.

Table 4-12 (Continued)
Summary of Gross Alpha Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW2 (cont.)	08-01-91	3.75±2.36	NA	ITAS-O
	08-01-91	9.08±4.16	NA	ITAS-O
	08-01-91	2±1.85	NA	ITAS-O
	08-01-91	4.42±2.66	NA	ITAS-O
	10-11-91	0.736±0.768	NA	ITAS-O
	01-13-92	5.43±2.72	NA	ITAS-O
	01-13-92	7.87±3.39	NA	ITAS-O
	01-13-92	6.15±3.03	NA	ITAS-O
	01-13-92	9.53±3.61	NA	ITAS-O
	01-13-92	8.16±3.26	NA	ITAS-O
	01-13-92	7.35±2.8	NA	ITAS-O
	01-13-92	9.69±3.86	NA	ITAS-O
	01-13-92	7.11±3.11	NA	ITAS-O
	07-27-92	16.2±6	NA	ITAS-O
	07-27-92	10.8±4.9	NA	ITAS-O
	07-27-92	18.7±6.6	NA	ITAS-O
	07-27-92	11.5±4.8	NA	ITAS-O
	01-18-93	7.34±1.98	1.5	ITRSL
	01-18-93	8.34±2.09	1.5	ITRSL
	01-18-93	13.4±2.8	1.5	ITRSL
	01-18-93	11.6±2.5	1.2	ITRSL
	04-26-93	12±4.7	2.5	TMA EB
	04-26-93	10±4.3	3.1	TMA EB
	04-26-93	13±5.3	4.3	TMA EB
	04-26-93	19±6.8	3.5	TMA EB
	11-08-93	9.7±3.8	2.5	TMA EB
	05-02-94	6.8±3.4	3	TMA EB
	10-19-94	0.26±0.24	0.36	QUANTE
	10-24-94	11.3±1.9	1.3	QUANTE
	04-17-95	3.7±2.4	1.1	LAS
	10-16-95	3.2±2.8	5.7	LAS
	04-24-97	5.9±2.9	1.4	LAS
	10-16-97	10.1±3.3	0.78	LAS
	04-02-98	10.8±1.87	0.707	GEL
	11-06-98	8.66±1.84	0.889	GEL
	04-19-99	9.81±2.08	0.57	GEL
	04-24-00	5.26±1.16	0.489	GEL
	04-23-01	17.9±4.36	1.07	GEL
MWL-MW3	09-01-90	10.2	5.02	ITAS-O
	09-01-90	5.28	3.54	ITAS-O
	09-01-90	5.68	3.83	ITAS-O
	09-01-90	12.2	5.23	ITAS-O
	01-28-91	ND	3	ITAS-O
	01-28-91	2.9±1.9	5	ITAS-O
	01-28-91	3.3±2.1	5	ITAS-O
	01-28-91	4.7±2.4	5	ITAS-O
	05-02-91	6.9±4.2	NA	QUANTE

Refer to footnotes at end of table.

Table 4-12 (Continued)
Summary of Gross Alpha Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW3 (cont.)	05-02-91	10±5	NA	QUANTE
	05-02-91	8.5±4.4	NA	QUANTE
	05-02-91	9.3±4.4	NA	QUANTE
	08-05-91	4.95±2.59	NA	ITAS-O
	08-05-91	4.77±2.57	NA	ITAS-O
	08-05-91	6.58±2.88	NA	ITAS-O
	08-05-91	5.71±2.77	NA	ITAS-O
	08-05-91	9.79±4.01	NA	ITAS-O
	08-05-91	5.91±2.68	NA	ITAS-O
	08-05-91	5.39±2.71	NA	ITAS-O
	08-05-91	9.56±3.97	NA	ITAS-O
	10-11-91	0.881±0.83	NA	ITAS-O
	01-14-92	7.17±3.11	NA	ITAS-O
	01-14-92	6.86±3.27	NA	ITAS-O
	01-14-92	5±2.45	NA	ITAS-O
	01-14-92	1.55±0.878	NA	ITAS-O
	01-14-92	7.6±2.85	NA	ITAS-O
	01-14-92	5.85±2.78	NA	ITAS-O
	01-14-92	6.75±2.85	NA	ITAS-O
	01-14-92	1.19±3.6	NA	ITAS-O
	07-28-92	6.14±3.32	NA	ITAS-O
	07-28-92	8.06±4.08	NA	ITAS-O
	07-28-92	12.1±4.7	NA	ITAS-O
	07-28-92	5.83±3.75	NA	ITAS-O
	01-19-93	8.82±2.09	1.2	ITRSL
	01-19-93	9.92±2.27	1.5	ITRSL
	01-19-93	10.3±2.3	1.3	ITRSL
	01-19-93	9.85±2.24	1.4	ITRSL
	04-27-93	11±4.2	1.6	TMA EB
	04-27-93	7.1±3.3	2.3	TMA EB
	04-27-93	6.3±3.2	2.7	TMA EB
	04-27-93	8.8±3.7	2.3	TMA EB
	11-09-93	12±4.3	2.4	TMA EB
	05-03-94	9.8±3.8	2.1	TMA EB
	10-25-94	5.11±1.55	1.85	QUANTE
	10-25-94	5.3±1.24	1.23	QUANTE
	04-17-95	2.6±2.2	1.1	LAS
	10-16-95	2.2±2.6	5.6	LAS
	04-24-97	6.2±2.9	1.4	LAS
	10-16-97	7.5±3	0.86	LAS
	04-02-98	9.89±1.52	0.513	GEL
	11-06-98	9.96±1.67	0.605	GEL
	04-12-99	9.98±1.42	0.317	GEL
	04-13-00	7.91±1.3355	0.575	GEL
	04-08-01	8.59±1.41	0.427	GEL

Refer to footnotes at end of table.

Table 4-12 (Continued)
Summary of Gross Alpha Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW4	02-08-93	1.5±1.2	NA	QUANTE
	04-21-93	17±6.3	2.7	TMA EB
	04-28-93	12±5.2	3.4	TMA EB
	04-28-93	16±6.1	3.3	TMA EB
	04-28-93	12±5.3	4.1	TMA EB
	04-28-93	9.8±4.4	2.3	TMA EB
	04-30-93	8.5±4.4	3.7	TMA EB
	04-30-93	12±5.2	3.5	TMA EB
	04-30-93	7.2±3.8	2.8	TMA EB
	04-30-93	8.7±4.4	3.5	TMA EB
	11-11-93	9.3±3.9	2.4	TMA EB
	03-14-94	11±4.5	2.6	TMA EB
	05-31-94	6.5±4.1	5.2	TMA EB
	10-28-94	5.37±1.51	1.74	QUANTE
	04-19-95	7.1±3.9	1.5	LAS
	04-19-95	6.1±3.4	1.3	LAS
	10-20-95	3.5±3.6	7.5	LAS
	10-20-95	2.3±3.6	7.7	LAS
	04-23-97	3.0±2.5	1.5	LAS
	04-23-97	6.0±3.1	1.6	LAS
	04-23-97	3.0±2.5	1.5	LAS
	04-23-97	6±3.1	1.6	LAS
	10-15-97	7.8±3.3	0.95	LAS
	04-01-98	10.3±2.26	0.803	GEL
	04-01-98	9.44±2.21	0.834	GEL
	11-06-98	9.39±1.67	0.64	GEL
	11-06-98	8.89±2.05	0.909	GEL
	04-14-99	9.41±1.39	0.342	GEL
	04-07-00	8.08±1.2983	0.533	GEL
	04-05-01	7.86±1.46	0.478	GEL
	04-05-01	6.77±1.48	0.559	GEL
MWL-MW5	01-17-01	14.7±13.1	0.0568	GEL
	04-16-01	8.04±1.63	0.647	GEL
	04-16-01	8.41±1.89	0.738	GEL
	07-24-01	16±2.91	0.511	GEL
	07-24-01	15.8±3.37	0.886	GEL

Refer to footnotes at end of table.

Table 4-12 (Concluded)
Summary of Gross Alpha Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW6	01-16-01	7.7±3.21	0.0697	GEL
	01-16-01	6.63±6.54	0.057	GEL
	04-17-01	11.3±5.5	2.07	GEL

Note: The EPA drinking water MCL for gross alpha activity is 15 pCi/L (excluding activity from uranium).
[a]Analysis by EPA Method 900.0. Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MCL maximum contaminant level
MDA minimum detectable activity
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND not detected at 2 sigma error
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)

Table 4-13
Summary of Gross Beta Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-BW1	09-01-90	5.97	2.68	ITAS-O
	09-01-90	6.17	2.69	ITAS-O
	09-01-90	4.73	2.53	ITAS-O
	09-01-90	5.40	2.59	ITAS-O
	01-24-91	ND	5	ITAS-O
	01-24-91	8.2±4.1	6	ITAS-O
	01-24-91	ND	6	ITAS-O
	01-24-91	9.4±3.7	6	ITAS-O
	01-24-91	6.5±3.6	5	ITAS-O
	01-24-91	7.0±3.6	3	ITAS-O
	01-24-91	11±4.0	5	ITAS-O
	01-24-91	6.6±4.0	5	ITAS-O
	04-07-91	3.4±4.1	NA	QUANT
	04-07-91	4.4±3.3	NA	QUANT
	04-07-91	4.2±3.4	NA	QUANT
	04-07-91	3.9±3.3	NA	QUANT
	04-07-91	8.3±4.1	NA	QUANT
	04-07-91	5.3±3.7	NA	QUANT
	04-07-91	3.6±3.5	NA	QUANT
	04-07-91	ND	NA	QUANT
	08-06-91	6.92±2.16	NA	ITAS-O
	08-06-91	6.15±1.89	NA	ITAS-O
	08-06-91	5.87±1.91	NA	ITAS-O
	08-06-91	9.02±2.24	NA	ITAS-O
	08-06-91	6.37±2.02	NA	ITAS-O
	08-06-91	9.79±2.38	NA	ITAS-O
	08-06-91	7.22±2.13	NA	ITAS-O
	08-06-91	9.36±2.44	NA	ITAS-O
	08-06-91	4.68±1.97	NA	ITAS-O
	08-06-91	5.72±2.05	NA	ITAS-O
	08-06-91	6.27±2.07	NA	ITAS-O
	08-06-91	7.46±2.27	NA	ITAS-O
	08-06-91	4.88±1.36	NA	ITAS-O
	08-06-91	6.69±2.19	NA	ITAS-O
	08-06-91	6.91±2.17	NA	ITAS-O
	10-11-91	1.61±1.07	NA	ITAS-O
	01-15-92	6.15±2.42	NA	ITAS-O
	01-15-92	5.43±2.3	NA	ITAS-O
	01-15-92	4.42±1.43	NA	ITAS-O
	01-15-92	5.76±1.54	NA	ITAS-O
	01-15-92	5.57±1.73	NA	ITAS-O
	01-15-92	7.83±2.07	NA	ITAS-O
	01-15-92	6.24±2.17	NA	ITAS-O
	01-15-92	6.51±2.23	NA	ITAS-O

Refer to footnotes at end of table.

Table 4-13 (Continued)
Summary of Gross Beta Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-BW1 (cont.)	01-15-92	6.96±1.86	NA	ITAS-O
	01-15-92	7.21±1.93	NA	ITAS-O
	01-15-92	6.6±1.74	NA	ITAS-O
	01-15-92	6.6±1.73	NA	ITAS-O
	01-15-92	3.5±1.37	NA	ITAS-O
	01-15-92	4.6±1.43	NA	ITAS-O
	01-15-92	7±1.74	NA	ITAS-O
	01-15-92	5.85±1.59	NA	ITAS-O
	01-15-92	-0.33±.665	NA	ITAS-O
	07-29-92	7.27±2.48	NA	ITAS-O
	07-29-92	5.5±2.39	NA	ITAS-O
	07-29-92	4.08±1.87	NA	ITAS-O
	07-29-92	7.54±1.95	NA	ITAS-O
	07-29-92	6.97±1.96	NA	ITAS-O
	07-29-92	7.02±2.05	NA	ITAS-O
	01-20-93	7.03±2.59	3.6	ITRSL
	01-20-93	4.56±2.25	3.3	ITRSL
	01-20-93	7.45±2.55	3.5	ITRSL
	01-20-93	6.95±2.53	3.5	ITRSL
	01-20-93	5.25±2.53	3.8	ITRSL
	01-20-93	6.06±2.68	3.9	ITRSL
	01-20-93	5±2.4	3.5	ITRSL
	01-20-93	72.8±8.9	4	ITRSL
	04-28-93	6.3±1.9	2.3	TMA EB
	04-28-93	5.9±1.8	2.1	TMA EB
	04-28-93	6.5±2	2.1	TMA EB
	04-28-93	5.3±1.9	2.3	TMA EB
	11-10-93	8±2.1	2	TMA EB
	11-10-93	4.5±1.8	2.5	TMA EB
	04-27-94	ND	2.2	TMA EB
	10-27-94	3.89±0.73	0.98	QUANTE
	10-27-94	5.05±0.8	1.01	QUANTE
	10-23-95	5.4±2.5	3.5	LAS
	04-28-97	4.8±2.1	1.5	LAS
	10-17-97	3.2±2	1.4	LAS
	03-31-98	4.94±1.04	0.727	GEL
	11-05-98	4.66±1.06	0.813	GEL
	04-13-99	5.55±1.36	1.06	GEL
	04-06-00	5.84±1.3244	1	GEL
	04-06-01	6.72±1.15	0.741	GEL
MWL-MW1	09-01-90	4.75	2.54	ITAS-O
	09-01-90	4.84	2.57	ITAS-O
	01-24-91	ND	6	ITAS-O

Refer to footnotes at end of table.

Table 4-13 (Continued)
Summary of Gross Beta Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW1 (cont.)	01-24-91	6.6±3.7	5	ITAS-O
	01-24-91	14±5	5	ITAS-O
	01-24-91	8.0±3.7	5	ITAS-O
	05-07-91	5.7±3.8	NA	QUANTE
	05-07-91	11±5	NA	QUANTE
	05-07-91	7.4±4.3	NA	QUANTE
	05-07-91	7.3±4.1	NA	QUANTE
	07-31-91	4.24±1.83	NA	ITAS-O
	07-31-91	11.4±2.56	NA	ITAS-O
	07-31-91	5.26±2.07	NA	ITAS-O
	07-31-91	4.1±1.96	NA	ITAS-O
	07-31-91	7±2.04	NA	ITAS-O
	07-31-91	6.18±2.06	NA	ITAS-O
	07-31-91	4.66±1.91	NA	ITAS-O
	07-31-91	6.42±2.03	NA	ITAS-O
	10-14-91	14.3±6.75	NA	ITAS-O
	01-14-92	4.58±1.54	NA	ITAS-O
	01-14-92	7.22±1.89	NA	ITAS-O
	01-14-92	6±1.82	NA	ITAS-O
	01-14-92	5.8±1.7	NA	ITAS-O
	01-14-92	6.14±1.75	NA	ITAS-O
	01-14-92	4.12±1.49	NA	ITAS-O
	01-14-92	5.01±2.06	NA	ITAS-O
	01-14-92	5.29±1.95	NA	ITAS-O
	07-28-92	101.54±0.1	NA	ITAS-O
	07-28-92	110.15±1.59	NA	ITAS-O
	07-28-92	4.83±2.65	NA	ITAS-O
	07-28-92	6.96±2.36	NA	ITAS-O
	07-28-92	4.04±2.13	NA	ITAS-O
	07-28-92	4.66±2.57	NA	ITAS-O
	01-19-93	4.24±2.67	4.2	ITRSL
	01-19-93	5.8±2.63	3.9	ITRSL
	01-19-93	6.46±2.98	4.4	ITRSL
	01-19-93	5.53±2.7	4	ITRSL
	04-27-93	4.5±1.8	2.4	TMA EB
	04-27-93	5.3±1.7	2	TMA EB
	04-27-93	4.8±1.8	2.1	TMA EB
	04-27-93	5.2±1.7	2	TMA EB
	11-09-93	5.9±1.8	2.2	TMA EB
	05-03-94	4.4±1.6	2	TMA EB
	05-04-94	5.6±1.8	2.2	TMA EB
	10-25-94	4.92±0.73	0.84	QUANTE
	10-20-95	5.8±2.7	3.8	LAS
	04-18-96	4.4±2.4	1.8	LAS

Refer to footnotes at end of table.

Table 4-13 (Continued)
Summary of Gross Beta Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW1 (cont.)	04-18-96	8.1±2.6	1.8	LAS
	04-18-96	6.4±2.5	1.8	LAS
	04-23-97	6.3±2.3	1.6	LAS
	04-23-97	6.3±2.3	1.6	LAS
	10-15-97	3.6±2.4	1.7	LAS
	10-15-97	5.8±2.4	1.6	LAS
	11-06-98	3.61±1.01	0.805	GEL
	04-14-99	4.25±1.39	1.08	GEL
	04-14-00	4.73±0.781	0.537	GEL
	04-14-00	2.12±0.6815	0.517	GEL
	04-13-01	4.39±1.65	1.13	GEL
MWL-MW2	09-01-90	7.28	2.82	ITAS-O
	09-01-90	4.97	2.56	ITAS-O
	01-28-91	ND	6	ITAS-O
	01-28-91	7.5±3.6	5	ITAS-O
	01-28-91	9.8±3.8	5	ITAS-O
	01-28-91	10±5	5	ITAS-O
	05-02-91	7.5±4	NA	QUANTE
	05-02-91	8.1±4.5	NA	QUANTE
	05-02-91	9.2±4.3	NA	QUANTE
	05-02-91	7.9±4	NA	QUANTE
	08-01-91	4.23±1.79	NA	ITAS-O
	08-01-91	10.4±2.48	NA	ITAS-O
	08-01-91	10.4±2.65	NA	ITAS-O
	08-01-91	7.98±2.31	NA	ITAS-O
	08-01-91	5.69±2.07	NA	ITAS-O
	08-01-91	6.94±1.96	NA	ITAS-O
	08-01-91	5.64±1.88	NA	ITAS-O
	08-01-91	6.61±1.97	NA	ITAS-O
	10-11-91	0.806±0.874	NA	ITAS-O
	01-13-92	8.17±1.87	NA	ITAS-O
	01-13-92	6.08±1.67	NA	ITAS-O
	01-13-92	6.53±1.68	NA	ITAS-O
	01-13-92	5.5±1.63	NA	ITAS-O
	01-13-92	5.87±1.6	NA	ITAS-O
	01-13-92	7.17±1.71	NA	ITAS-O
	01-13-92	4.88±1.55	NA	ITAS-O
	01-13-92	5.78±1.7	NA	ITAS-O
	07-27-92	9.39±2.32	NA	ITAS-O
	07-27-92	7.73±2.43	NA	ITAS-O
	07-27-92	7.59±2.25	NA	ITAS-O
	07-27-92	7.92±2.4	NA	ITAS-O

Refer to footnotes at end of table.

Table 4-13 (Continued)
Summary of Gross Beta Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW2 (cont.)	01-18-93	6.14±2.71	4	ITRSL
	01-18-93	6.16±2.63	3.8	ITRSL
	01-18-93	6.46±2.76	4	ITRSL
	01-18-93	4.77±2.53	3.8	ITRSL
	04-26-93	6.8±2	2.1	TMA EB
	04-26-93	7.6±2	2.1	TMA EB
	04-26-93	7.6±2.1	2.3	TMA EB
	04-26-93	9.9±2.3	2.1	TMA EB
	11-08-93	5.5±1.8	2.1	TMA EB
	05-02-94	6.3±2	2.4	TMA EB
	10-24-94	5.25±0.81	1	QUANTE
	04-17-95	5.5±2.4	1.7	LAS
	10-16-95	6.3±2.6	3.6	LAS
	04-24-97	6.3±1.9	1.3	LAS
	10-16-97	6.5±2.5	1.6	LAS
	04-02-98	6.29±1.17	0.808	GEL
	11-06-98	6.38±1.17	0.821	GEL
	04-19-99	4.34±1.87	1.64	GEL
	04-24-00	6.58±0.836	0.534	GEL
	04-23-01	14.9±4.27	2.49	GEL
MWL-MW3	09-01-90	4.48	2.49	ITAS-O
	09-01-90	4.81	2.54	ITAS-O
	01-28-91	ND	7	ITAS-O
	01-28-91	8.0±3.6	5	ITAS-O
	01-28-91	8.4±3.6	5	ITAS-O
	01-28-91	6.7±3.6	5	ITAS-O
	05-02-91	4.8±3.7	NA	QUANTE
	05-02-91	8±4.2	NA	QUANTE
	05-02-91	8.4±4.1	NA	QUANTE
	05-02-91	6±3.8	NA	QUANTE
	08-05-91	9.24±2.21	NA	ITAS-O
	08-05-91	5.81±1.86	NA	ITAS-O
	08-05-91	9.17±2.16	NA	ITAS-O
	08-05-91	5.52±1.95	NA	ITAS-O
	08-05-91	7.18±2.03	NA	ITAS-O
	08-05-91	4.64±1.79	NA	ITAS-O
	08-05-91	6.45±2.02	NA	ITAS-O
	08-05-91	5.6±1.91	NA	ITAS-O
	10-11-91	0.954±0.923	NA	ITAS-O
	01-14-92	7.19±1.76	NA	ITAS-O
	01-14-92	4.51±1.44	NA	ITAS-O
	01-14-92	6.58±1.69	NA	ITAS-O
	01-14-92	6.49±1.49	NA	ITAS-O

Refer to footnotes at end of table.

Table 4-13 (Continued)
Summary of Gross Beta Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW3 (cont.)	01-14-92	4.35±1.28	NA	ITAS-O
	01-14-92	5.17±1.63	NA	ITAS-O
	01-14-92	5.66±1.42	NA	ITAS-O
	01-14-92	6.59±1.57	NA	ITAS-O
	07-28-92	5.5±1.82	NA	ITAS-O
	07-28-92	7.14±1.88	NA	ITAS-O
	07-28-92	6.18±1.98	NA	ITAS-O
	07-28-92	7.23±1.84	NA	ITAS-O
	01-19-93	7.35±2.6	3.6	ITRSL
	01-19-93	5.49±2.45	3.6	ITRSL
	01-19-93	7.01±2.6	3.7	ITRSL
	01-19-93	4.54±2.27	3.4	ITRSL
	04-27-93	4.5±1.8	2.4	TMA EB
	04-27-93	7.4±2	2	TMA EB
	04-27-93	7.3±2	2	TMA EB
	04-27-93	7.6±2	2.1	TMA EB
	11-09-93	4.3±1.7	2.2	TMA EB
	05-03-94	7±1.9	2.1	TMA EB
	10-25-94	3.84±0.68	0.91	QUANTE
	10-25-94	3.67±0.66	0.88	QUANTE
	04-17-95	6.1±2.7	1.9	LAS
	10-16-95	7±2.6	3.5	LAS
	04-24-97	5.5±2	1.4	LAS
	10-16-97	4.7±2.6	1.8	LAS
	04-02-98	5.9±0.799	0.509	GEL
	11-06-98	5.89±1.16	0.829	GEL
	04-12-99	6.01±1.39	1.07	GEL
	04-13-00	6.88±1.9912	1.54	GEL
	04-08-01	6.07±1.18	0.766	GEL
MWL-MW4	04-30-93	8.5±2.1	2	TMA EB
	04-30-93	13±2.6	0.8	TMA EB
	04-30-93	8.9±2.3	2.3	TMA EB
	04-30-93	6.4±2	2.1	TMA EB
	11-11-93	9.7±2.4	2.2	TMA EB
	03-14-94	10±2.5	2.4	TMA EB
	05-31-94	8.3±2.3	2.5	TMA EB

Refer to footnotes at end of table.

Table 4-13 (Concluded)
Summary of Gross Beta Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Lab
MWL-MW4 (cont.)	10-28-94	5.69±0.94	1.17	QUANTE
	04-19-95	10.3±3.6	2.5	LAS
	04-19-95	7.9±3.1	2.3	LAS
	10-20-95	6.8±3.2	4.5	LAS
	10-20-95	7.5±3.7	5.2	LAS
	04-23-97	6.2±2	1.4	LAS
	04-23-97	5.4±2.1	1.5	LAS
	04-23-97	6.2±2	1.4	LAS
	04-23-97	5.4±2.1	1.5	LAS
	10-15-97	6.1±2.9	2	LAS
	11-06-98	6.07±1.09	0.776	GEL
	11-06-98	4.82±1.77	1.5	GEL
	04-14-99	5.75±1.28	1.02	GEL
	04-07-00	5.19±1.9202	1.54	GEL
	04-05-01	7.12±1.19	0.751	GEL
	04-05-01	7.59±1.58	1.03	GEL
MWL-MW5	01-17-01	8.65±1.84	0.128	GEL
	04-16-01	6.14±1.55	1.03	GEL
	04-16-01	14.4±2.36	1.16	GEL
	07-24-01	14.4±2.16	1.1	GEL
	07-24-01	13.5±2.7	1.45	GEL
MWL-MW6	01-16-01	6.46±1.99	0.134	GEL
	01-16-01	7.57±3.4	0.133	GEL
	04-17-01	10.4±6.52	4.38	GEL

Note: The EPA drinking water MCL for beta particles from anthropogenic radionuclides is 4 millirems per year.
[a]Analysis by EPA Method 900.0. Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2-sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MCL maximum contaminant level
MDA minimum detectable activity
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND not detected at 2 sigma error
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)

Table 4-14
Summary of Total Uranium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Total Uranium[a] (µg/L)	MDL (µg/L)	Lab	Analytical Method[b]
MWL-BW1	10-27-94	5.09	1	QUANTE	ASTM D5174
MWL-BW1	04-06-01	5.9	0.02	GEL	EPA 6020
MWL-MW1	10-24-94	1.34	1	QUANTE	ASTM D5174
MWL-MW1	10-25-94	5.48	1	QUANTE	ASTM D5174
MWL-MW1	04-13-01	5.27	0.02	GEL	EPA 6020
MWL-MW2	10-24-94	7.84	1	QUANTE	ASTM D5174
MWL-MW2	04-17-95	6.64	0.14	LAS	LAL-0168
MWL-MW3	10-25-94	4.82	1	QUANTE	ASTM D5174
MWL-MW3	04-17-95	5.49	0.14	LAS	LAL-0168
MWL-MW3	04-08-01	4.61	0.02	GEL	EPA 6020
MWL-MW4	10-28-94	2690	1	QUANTE	ASTM D5174
MWL-MW4	04-19-95	6.17	0.14	LAS	LAL-0168
MWL-MW4	04-19-95	6.5	0.14	LAS	LAL-0168
MWL-MW4	04-05-01	5.37	0.02	GEL	EPA 6020
MWL-MW4	04-05-01	5.53	0.02	GEL	EPA 6020
MWL-MW5	04-16-01	9.23	0.02	GEL	EPA 6020
MWL-MW5	04-16-01	9.03	0.02	GEL	EPA 6020
MWL-MW6	04-17-01	7.17	0.02	GEL	EPA 6020

Notes: The proposed EPA drinking water MCL for total uranium is 20 g/L.
The background range of total uranium concentrations across KAFB is 0.5 g/L to 14.9 g/L.

[a]Average Total Uranium Concentration is 5.97 µg/L (7.2 pCi/L, converted) excluding the MWL-MW4 data outlier of October 1994, which is an analytical error.

[b]EPA November 1986 for EPA Method 6020 analyses. ASTM D5174 and LAL-0168 are laboratory specific methods using kinetic phosphorescence analysis.

ASTM American Society for Testing and Materials
EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory (off-site laboratory)
Lab laboratory
LAL [To be provided.]
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MCL maximum contaminant level
MDL method detection limit
g/L microgram(s) per liter
MWL Mixed Waste Landfill
pCi/L picocurie(s) per liter
QUANTE Quanterra (off-site laboratory)

Table 4-15
Summary of Isotopic Uranium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Activity 2 [a] pCi/L	MDA pCi/L	Qualifier	Analytical Method	Lab
MWL-BW1	Uranium-234	09-01-90	6.6	0.662	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.94	0.703	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.38	0.646	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.19	0.632	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0629	0.0229	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0782	0.0266	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0833	0.0276	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0909	0.0289	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.38	0.262	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.43	0.272	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.36	0.262	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.28	0.257	--	Radiometric	ITAS-O
	Uranium-235	04-28-93	34	34	ND	Radiometric	TMA EB
	Uranium-238	04-28-93	1100	1100	ND	Radiometric	TMA EB
	Uranium-234	11-10-93	6.8±0.9	0.1	--	Radiometric	TMA EB
	Uranium-234	11-10-93	6.3±0.7	0.056	--	Radiometric	TMA EB
	Uranium-235	11-10-93	0.071±0.064	0.039	--	Radiometric	TMA EB
	Uranium-235	11-10-93	0.11±0.066	0.025	--	Radiometric	TMA EB
	Uranium-238	11-10-93	3±0.5	0.1	--	Radiometric	TMA EB
	Uranium-238	11-10-93	3±0.41	0.025	--	Radiometric	TMA EB
	Uranium-234	04-27-94	0.099±0.062	0.058	B	Radiometric	TMA EB
	Uranium-235	04-27-94	-0.011±0.002	0.067	ND	Radiometric	TMA EB
	Uranium-238	04-27-94	0.041±0.04	0.058	ND	Radiometric	TMA EB
	Uranium-234	10-26-94	0.05±0.076	0.111	ND	Radiometric	QUANTE
	Uranium-235	10-26-94	0.029±0.066	0.137	ND	Radiometric	QUANTE
	Uranium-238	10-26-94	0±0	0.072	ND	Radiometric	QUANTE
	Uranium-234	10-27-94	7.97±1.7	0.19	--	Radiometric	QUANTE
	Uranium-234	10-27-94	7.36±1.57	0.07	--	Radiometric	QUANTE
	Uranium-235	10-27-94	0.43±0.26	0.24	--	Radiometric	QUANTE
	Uranium-235	10-27-94	0.26±0.19	0.14	--	Radiometric	QUANTE
	Uranium-238	10-27-94	3.05±0.8	0.23	--	Radiometric	QUANTE
	Uranium-238	10-27-94	3.18±0.81	0.07	--	Radiometric	QUANTE
	Uranium-234	04-19-95	6.4±1.2	0.28	--	Radiometric	TMA EB
	Uranium-235	04-19-95	0.089±0.13	0.21	ND	Radiometric	TMA EB
	Uranium-238	04-19-95	2.2±0.59	0.24	--	Radiometric	TMA EB
	Uranium-234	10-23-95	5.81±0.42	0.027	--	Radiometric	LAS
	Uranium-235	10-23-95	-13±34	23	ND	Radiometric	LAS
	Uranium-235	10-23-95	0.187±0.055	0.011	--	Radiometric	LAS
	Uranium-238	10-23-95	2.21±0.22	0.021	--	Radiometric	LAS
	Uranium-235	04-28-97	13±19	13	ND	Radiometric	LAS
	Uranium-235	10-17-97	-21±24	16	ND	Radiometric	LAS
	Uranium-235	03-31-98	12.5±19.6	12.7	ND	Radiometric	GEL
	Uranium-235	03-31-98	7.3±23.9	12.4	ND	Radiometric	GEL

Refer to footnotes at end of table.

Table 4-15 (Continued)
Summary of Isotopic Uranium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Activity 2 [a] pCi/L	MDA pCi/L	Qualifier	Analytical Method	Lab
MWL-BW1 (cont.)	Uranium-238	03-31-98	108±115	69.6	--	Radiometric	GEL
	Uranium-238	03-31-98	127±191	79.8	--	Radiometric	GEL
	Uranium-235	04-06-00	96.5	96.5	ND	Radiometric	RPSD
	Uranium-238	04-06-00	223	223	ND	Radiometric	RPSD
	Uranium-235	04-06-01	14.4±13.9	10.1	ND	Radiometric	GEL
	Uranium-238	04-06-01	134±197	80.5	ND	Radiometric	GEL
	Uranium-235	04-06-01	0.066±0.006	0.002	--	ICP-MS	RPSD
	Uranium-238	04-06-01	1.431±0.087	0.005	--	ICP-MS	RPSD
MWL-MW1	Uranium-234	09-01-90	5.69	0.58	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	5.93	0.616	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.963	0.0291	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.105	0.0326	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.10	0.237	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.01	0.239	--	Radiometric	ITAS-O
	Uranium-235	04-27-93	34	34	ND	Radiometric	TMA EB
	Uranium-238	04-27-93	1100	1100	ND	Radiometric	TMA EB
	Uranium-234	11-09-93	6.1±0.82	0.085	--	Radiometric	TMA EB
	Uranium-235	11-09-93	0.064±0.064	0.085	ND	Radiometric	TMA EB
	Uranium-238	11-09-93	3±0.49	0.085	--	Radiometric	TMA EB
	Uranium-234	04-26-94	0.029±0.034	0.026	--	Radiometric	TMA EB
	Uranium-235	04-26-94	0±0	0.026	ND	Radiometric	TMA EB
	Uranium-238	04-26-94	0.034±0.04	0.058	ND	Radiometric	TMA EB
	Uranium-234	05-03-94	5.5±1.1	0.053	B	Radiometric	TMA EB
	Uranium-235	05-03-94	0.094±0.062	0.053	--	Radiometric	TMA EB
	Uranium-238	05-03-94	1.8±0.42	0.053	--	Radiometric	TMA EB
	Uranium-234	05-04-94	5.4±1.1	0.065	--	Radiometric	TMA EB
	Uranium-235	05-04-94	0.1±0.06	0.048	--	Radiometric	TMA EB
	Uranium-238	05-04-94	1.9±0.42	0.078	--	Radiometric	TMA EB
	Uranium-234	10-24-94	0.056±0.08	0.076	ND	Radiometric	QUANTE
	Uranium-235	10-24-94	0±0	0.094	ND	Radiometric	QUANTE
	Uranium-238	10-24-94	-0.002±0.006	0.117	ND	Radiometric	QUANTE
	Uranium-234	10-25-94	7.28±1.51	0.13	--	Radiometric	QUANTE
	Uranium-235	10-25-94	0.38±0.22	0.17	--	Radiometric	QUANTE
	Uranium-238	10-25-94	2.45±0.64	0.12	--	Radiometric	QUANTE
	Uranium-234	04-19-95	5.51±0.41	1.1	--	Radiometric	LAS
	Uranium-235	04-19-95	0.207±0.060	0.014	--	Radiometric	LAS
	Uranium-238	04-19-95	1.85±0.20	0.025	--	Radiometric	LAS
	Uranium-234	10-20-95	5.9±0.46	0.034	--	Radiometric	LAS
	Uranium-235	10-20-95	-15±21	19	ND	Radiometric	LAS
	Uranium-235	10-20-95	0.176±0.065	0.019	--	Radiometric	LAS
	Uranium-238	10-20-95	2.23±0.25	0.027	--	Radiometric	LAS
	Uranium-234	04-18-96	5.77±0.42	0.028	--	Radiometric	LAS
	Uranium-234	04-18-96	4.72±0.36	0.029	--	Radiometric	LAS
	Uranium-234	04-18-96	4.66±0.37	0.033	--	Radiometric	LAS
	Uranium-235	04-18-96	-6±22	17	ND	Radiometric	LAS

Refer to footnotes at end of table.

Table 4-15 (Continued)
Summary of Isotopic Uranium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Activity 2 [a] pCi/L	MDA pCi/L	Qualifier	Analytical Method	Lab
MWL-MW1 (cont.)	Uranium-235	04-18-96	5±27	18	ND	Radiometric	LAS
	Uranium-235	04-18-96	0.133±0.047	0.013	--	Radiometric	LAS
	Uranium-235	04-18-96	0.121±0.045	0.014	--	Radiometric	LAS
	Uranium-235	04-18-96	0.253±0.067	0.013	--	Radiometric	LAS
	Uranium-238	04-18-96	2.18±0.22	0.019	--	Radiometric	LAS
	Uranium-238	04-18-96	1.92±0.21	0.023	--	Radiometric	LAS
	Uranium-238	04-18-96	1.73±0.19	0.019	--	Radiometric	LAS
	Uranium-235	04-23-97	-17±31	28	ND	Radiometric	LAS
	Uranium-235	10-15-97	8±27	17	ND	Radiometric	LAS
	Uranium-235	10-15-97	-8±29	19	ND	Radiometric	LAS
	Uranium-235	04-01-98	23.6±20.7	13.3	--	Radiometric	GEL
	Uranium-238	04-01-98	165±101	81.2	--	Radiometric	GEL
	Uranium-235	04-14-00	<110	110	ND	Radiometric	RPSD
	Uranium-238	04-14-00	<301	301	ND	Radiometric	RPSD
	Uranium-235	04-13-01	5.26±11.7	10.4	ND	Radiometric	GEL
	Uranium-238	04-13-01	34.2±132	72.5	ND	Radiometric	GEL
	Uranium-235	04-13-01	0.079±0.001	0.002	--	ICP-MS	RPSD
	Uranium-238	04-13-01	1.67±0.047	0.005	--	ICP-MS	RPSD
MWL-MW2	Uranium-234	09-01-90	6.98	0.712	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.61	0.678	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.129	0.0358	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.101	0.0313	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.84	0.314	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.57	0.289	--	Radiometric	ITAS-O
	Uranium-235	04-26-93	35	35	ND	Radiometric	TMA EB
	Uranium-238	04-26-93	1200	1200	ND	Radiometric	TMA EB
	Uranium-234	11-08-93	5.5±0.74	0.08	--	Radiometric	TMA EB
	Uranium-235	11-08-93	0.12±0.082	0.036	--	Radiometric	TMA EB
	Uranium-238	11-08-93	2.6±0.44	0.095	--	Radiometric	TMA EB
	Uranium-234	04-27-94	1.8±0.41	0.062	--	Radiometric	TMA EB
	Uranium-235	04-27-94	0.079±0.054	0.024	--	Radiometric	TMA EB
	Uranium-238	04-27-94	1.1±0.29	0.062	--	Radiometric	TMA EB
	Uranium-234	05-02-94	6.5±1.3	0.076	--	Radiometric	TMA EB
	Uranium-235	05-02-94	0.23±0.1	0.025	--	Radiometric	TMA EB
	Uranium-238	05-02-94	2.2±0.49	0.025	--	Radiometric	TMA EB
	Uranium-234	10-19-94	0.073±0.105	0.1	ND	Radiometric	QUANTE
	Uranium-235	10-19-94	0.041±0.091	0.19	ND	Radiometric	QUANTE
	Uranium-238	10-19-94	0.033±0.074	0.153	ND	Radiometric	QUANTE
	Uranium-234	10-24-94	7.34±1.66	0.09	--	Radiometric	QUANTE
	Uranium-235	10-24-94	0.2±0.18	0.11	--	Radiometric	QUANTE
	Uranium-238	10-24-94	2.33±0.7	0.09	--	Radiometric	QUANTE
	Uranium-234	04-17-95	6.28±0.48	0.035	--	Radiometric	LAS
	Uranium-235	04-17-95	0.184±0.062	0.015	--	Radiometric	LAS
	Uranium-238	04-17-95	2.41±0.25	0.029	--	Radiometric	LAS
	Uranium-234	10-16-95	6.61±0.47	0.025	--	Radiometric	LAS
	Uranium-235	10-16-95	7±15	10	ND	Radiometric	LAS
	Uranium-235	10-16-95	0.169±0.054	0.013	--	Radiometric	LAS
	Uranium-238	10-16-95	2.26±0.22	0.021	--	Radiometric	LAS

Refer to footnotes at end of table.

Table 4-15 (Continued)
Summary of Isotopic Uranium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Activity 2 [a] pCi/L	MDA pCi/L	Qualifier	Analytical Method	Lab
MWL-MW2 (cont.)	Uranium-235	04-24-97	-10±27	21	ND	Radiometric	LAS
	Uranium-235	10-16-97	5±29	19	ND	Radiometric	LAS
	Uranium-235	04-02-98	0.0994±21	13.7	ND	Radiometric	GEL
	Uranium-238	04-02-98	156±119	88.3	--	Radiometric	GEL
	Uranium-235	04-24-00	102	102	ND	Radiometric	RPSD
	Uranium-238	04-24-00	225	225	ND	Radiometric	RPSD
	Uranium-235	04-23-01	3.24±18	8.87	ND	Radiometric	GEL
	Uranium-238	04-23-01	16.2±145	72.6	ND	Radiometric	GEL
	Uranium-235	04-23-01	0.095±0.003	0.002	--	Radiometric	RPSD
	Uranium-238	04-23-01	2.028±0.118	0.005	--	Radiometric	RPSD
MWL-MW3	Uranium-234	09-01-90	5.49	0.569	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	5.63	0.587	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0779	0.0271	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0483	0.0226	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.07	0.239	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.27	0.261	--	Radiometric	ITAS-O
	Uranium-235	04-27-93	34	34	ND	Radiometric	TMA EB
	Uranium-238	04-27-93	1200	1200	ND	Radiometric	TMA EB
	Uranium-234	11-09-93	5.2±0.65	0.079	--	Radiometric	TMA EB
	Uranium-235	11-09-93	0.099±0.066	0.03	--	Radiometric	TMA EB
	Uranium-238	11-09-93	2.5±0.39	0.079	--	Radiometric	TMA EB
	Uranium-234	04-27-94	0.55±0.16	0.021	B	Radiometric	TMA EB
	Uranium-235	04-27-94	0±0	0.021	ND	Radiometric	TMA EB
	Uranium-238	04-27-94	0.17±0.08	0.046	--	Radiometric	TMA EB
	Uranium-234	05-03-94	5.2±1.1	0.074	--	Radiometric	TMA EB
	Uranium-235	05-03-94	0.089±0.064	0.062	--	Radiometric	TMA EB
	Uranium-238	05-03-94	2±0.46	0.095	--	Radiometric	TMA EB
	Uranium-234	10-17-94	0.15±0.3	0.41	ND	Radiometric	QUANTE
	Uranium-235	10-17-94	0±0	0.5	ND	Radiometric	QUANTE
	Uranium-238	10-17-94	0±0	0.41	ND	Radiometric	QUANTE
	Uranium-234	10-25-94	6.19±1.51	0.25	--	Radiometric	QUANTE
	Uranium-235	10-25-94	0.32±0.25	0.19	--	Radiometric	QUANTE
	Uranium-238	10-25-94	2.2±0.71	0.21	--	Radiometric	QUANTE
	Uranium-234	04-17-95	5.29±0.41	0.032	--	Radiometric	LAS
	Uranium-235	04-17-95	0.163±0.058	0.017	--	Radiometric	LAS
	Uranium-238	04-17-95	2.02±0.22	0.028	--	Radiometric	LAS
	Uranium-234	10-16-95	4.85±0.37	0.028	--	Radiometric	LAS
	Uranium-235	10-16-95	-11±28	19	ND	Radiometric	LAS
	Uranium-235	10-16-95	0.146±0.05	0.012	--	Radiometric	LAS
	Uranium-238	10-16-95	1.86±0.2	0.019	--	Radiometric	LAS
	Uranium-235	04-24-97	11±19	13	ND	Radiometric	LAS
	Uranium-235	10-16-97	-10±10	13	ND	Radiometric	LAS
	Uranium-235	04-02-98	22±20.5	15.9	--	Radiometric	GEL
	Uranium-238	04-02-98	38.1±211	114	ND	Radiometric	GEL
	Uranium-235	04-13-00	92.8	92.8	ND	Radiometric	RPSD
	Uranium-238	04-13-00	201	201	ND	Radiometric	RPSD
	Uranium-235	04-08-01	9.3±13.2	9.98	ND	Radiometric	GEL
	Uranium-238	04-08-01	137±182	71	ND	Radiometric	GEL
	Uranium-235	04-08-01	0.065±0.004	0.002	--	ICP-MS	RPSD
	Uranium-238	04-08-01	1.373±0.086	0.005	--	ICP-MS	RPSD

Refer to footnotes at end of table.

Table 4-15 (Continued)
Summary of Isotopic Uranium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Activity 2 [a] pCi/L	MDA pCi/L	Qualifier	Analytical Method	Lab
MWL-MW4	Uranium-234	02-08-93	0.12±0.1	NA	--	Radiometric	QUANTE
	Uranium-235	02-08-93	-0.004±0.05	NA	ND	Radiometric	QUANTE
	Uranium-235	02-08-93	13.6	13.6	ND	Radiometric	QUANTE
	Uranium-238	02-08-93	0.108±0.095	NA	--	Radiometric	QUANTE
	Uranium-235	04-28-93	33	33	ND	Radiometric	TMA EB
	Uranium-238	04-28-93	1200	1200	ND	Radiometric	TMA EB
	Uranium-235	04-30-93	35	35	ND	Radiometric	TMA EB
	Uranium-238	04-30-93	1100	1100	ND	Radiometric	TMA EB
	Uranium-234	11-11-93	5.4±0.39	0.021	--	Radiometric	TMA EB
	Uranium-235	11-11-93	0.13±0.042	0.021	--	Radiometric	TMA EB
	Uranium-238	11-11-93	2.4±0.21	0.008	--	Radiometric	TMA EB
	Uranium-234	03-14-94	7.7±1.2	0.019	B	Radiometric	TMA EB
	Uranium-235	03-14-94	0.21±0.082	0.019	--	Radiometric	TMA EB
	Uranium-238	03-14-94	2.8±0.49	0.056	B	Radiometric	TMA EB
	Uranium-234	05-31-94	5.1±1	0.023	B	Radiometric	TMA EB
	Uranium-235	05-31-94	0.061±0.048	0.023	--	Radiometric	TMA EB
	Uranium-238	05-31-94	2.1±0.48	0.023	--	Radiometric	TMA EB
	Uranium-234	10-28-94	5.24±1.3	0.17	--	Radiometric	QUANTE
	Uranium-235	10-28-94	0.22±0.2	0.19	--	Radiometric	QUANTE
	Uranium-238	10-28-94	2.94±0.85	0.1	--	Radiometric	QUANTE
	Uranium-234	04-19-95	4.21±0.35	0.034	--	Radiometric	LAS
	Uranium-234	04-19-95	3.92±0.35	0.035	--	Radiometric	LAS
	Uranium-235	04-19-95	0.142±0.056	0.021	--	Radiometric	LAS
	Uranium-235	04-19-95	0.171±0.062	0.016	--	Radiometric	LAS
	Uranium-238	04-19-95	1.81±0.22	0.031	--	Radiometric	LAS
	Uranium-238	04-19-95	1.81±0.21	0.029	--	Radiometric	LAS
	Uranium-234	10-20-95	3.95±0.32	0.025	--	Radiometric	LAS
	Uranium-234	10-20-95	3.34±0.3	0.029	--	Radiometric	LAS
	Uranium-235	10-20-95	15±27	16	ND	Radiometric	LAS
	Uranium-235	10-20-95	0.116±0.048	0.017	--	Radiometric	LAS
	Uranium-235	10-20-95	1±15	10	ND	Radiometric	LAS
	Uranium-235	10-20-95	0.139±0.051	0.012	--	Radiometric	LAS
	Uranium-238	10-20-95	1.72±0.2	0.02	--	Radiometric	LAS
	Uranium-238	10-20-95	1.76±0.19	0.02	--	Radiometric	LAS
	Uranium-235	04-23-97	-17.1±7.4	24	ND	Radiometric	LAS
	Uranium-235	04-23-97	-14±14	16	ND	Radiometric	LAS
	Uranium-235	10-15-97	15±29	18	ND	Radiometric	LAS
	Uranium-235	04-01-98	5.65±22.5	13	ND	Radiometric	GEL
	Uranium-235	04-01-98	16.8±17.5	12.2	--	Radiometric	GEL
	Uranium-238	04-01-98	0±122	79.6	ND	Radiometric	GEL
	Uranium-238	04-01-98	0±136	79.8	ND	Radiometric	GEL
	Uranium-235	04-07-00	96.4	96.4	ND	Radiometric	RPSD
	Uranium-238	04-07-00	254	254	ND	Radiometric	RPSD
	Uranium-235	02-09-01	82.8	82.8	ND	Radiometric	RPSD
	Uranium-238	02-09-01	212	212	ND	Radiometric	RPSD
	Uranium-235	04-05-01	3.71±13.8	9.87	ND	Radiometric	GEL
	Uranium-235	04-05-01	16.4±22.3	11.2	ND	Radiometric	GEL

Refer to footnotes at end of table.

Table 4-15 (Concluded)
Summary of Isotopic Uranium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Analyte	Sample Date	Activity 2 [a] pCi/L	MDA pCi/L	Qualifier	Analytical Method	Lab
MWL-MW4 (cont.)	Uranium-238	04-05-01	143±171	67.7	ND	Radiometric	GEL
	Uranium-238	04-05-01	151±161	69.7	ND	Radiometric	GEL
	Uranium-235	04-04-01	0.072±0.002	0.002	--	ICP-MS	RPSD
	Uranium-238	04-04-01	1.546±0.041	0.005	--	ICP-MS	RPSD
MWL-MW5	Uranium-234	10-04-00	-0.00122±0.0679	0.0587	ND	Radiometric	GEL
	Uranium-235	10-04-00	0.00916±0.0577	0.0389	ND	Radiometric	GEL
	Uranium-238	10-04-00	-0.00669±0.0353	0.0367	ND	Radiometric	GEL
	Uranium-235	01-17-01	-0.141±12.4	11.1	ND	Radiometric	GEL
	Uranium-238	01-17-01	0±112	84.6	ND	Radiometric	GEL
	Uranium-235	01-17-01	0.151±0.003	0.002	--	ICP-MS	RPSD
	Uranium-238	01-17-01	3.249±0.091	0.005	--	ICP-MS	RPSD
	Uranium-235	04-16-01	17.5±19.5	11.2	ND	Radiometric	GEL
	Uranium-235	04-16-01	15.2±22	11.2	ND	Radiometric	GEL
	Uranium-238	04-16-01	134±145	69.3	--	Radiometric	GEL
	Uranium-238	04-16-01	116±134	69.2	ND	Radiometric	GEL
	Uranium-235	04-16-01	0.113±0.009	0.002	--	ICP-MS	RPSD
	Uranium-238	04-16-01	2.444±0.183	0.005	--	ICP-MS	RPSD
	Uranium-235	07-24-01	-8.74±23.1	20.5	ND	Radiometric	GEL
	Uranium-235	07-24-01	3.61±27.5	19.8	ND	Radiometric	GEL
	Uranium-238	07-24-01	75±210	152	ND	Radiometric	GEL
	Uranium-238	07-24-01	59±158	144	ND	Radiometric	GEL
MWL-MW6	Uranium-235	01-16-01	10.9±23.2	10.9	ND	Radiometric	GEL
	Uranium-235	01-16-01	0.194±21.4	10.4	ND	Radiometric	GEL
	Uranium-238	01-16-01	0±144	88.3	ND	Radiometric	GEL
	Uranium-238	01-16-01	12.4±284	123	ND	Radiometric	GEL
	Uranium-235	01-16-01	0.134±0.008	0.002	--	ICP-MS	RPSD
	Uranium-238	01-16-01	2.853±0.114	0.005	--	ICP-MS	RPSD
	Uranium-235	04-17-01	11.5±20.4	9.18	ND	Radiometric	GEL
	Uranium-238	04-17-01	0.103±0.009	0.002	ND	ICP-MS	RPSD
	Uranium-238	04-17-01	2.207±0.183	0.005	ND	ICP-MS	RPSD

Notes: The NMED background activity for uranium-234 is 7 pCi/L
The NMED background activity for uranium-235 is 0.41 pCi/L.
The NMED background activity for uranium-238 is 3.0 pCi/L.
Radiometric analytical methods primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a]Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

B Analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL report).
EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ICP-MS inductively coupled plasma-mass spectroscopy
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDA minimum detectable activity
MWL Mixed Waste Landfill
ND not detected
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri (off-site laboratory).
RPSD Radiation Protection Sample Diagnostics (on-site laboratory)
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
-- isotope detected above MDA or 2 error

Table 4-16
Isotopic Uranium Ratios Derived from ICP-MS Data for Groundwater Beneath the MWL 2001

Well	Sampling Date	Uranium-238 Activity ±2 [b] (pCi/L)	Uranium-235 Activity ± 2 [b] (pCi/L)	Uranium-238/ Uranium-235 Ratio
MWL-MW5	01-17-01	3.249±0.091	0.151±0.003	21.46
MWL-MW6	01-16-01	2.853±0.114	0.134±0.008	21.27
MWL-BW1	04-05-01	1.431±0.087	0.066±0.006	21.79
MWL-MW1	04-09-01	1.670±0.047	0.079±0.001	21.13
MWL-MW2	04-18-01	2.028±0.118	0.095±0.003	21.30
MWL-MW3	04-06-01	1.373±0.086	0.065±0.004	21.18
MWL-MW4	04-04-01	1.546±0.041	0.072±0.002	21.57
MWL-MW5	04-16-01	2.444±0.278	0.113±0.013	21.58
MWL-MW6	04-17-01	2.207±0.183	0.103±0.009	21.49
MWL-MW5	07-24-01	3.142±0.271	0.146±0.011	21.52
MWL-MW5-DU	07-24-01	2.937±0.146	0.138±0.009	21.28
MWL-MW6	07-23-01	2.782±0.248	0.132±0.011	21.08
MWL-MW4	11-13-01	1.700±0.129	0.078±0.006	21.79
MWL-MW4-DU	11-13-01	1.693±0.139	0.077±0.007	21.99
MWL-MW5	10-08-01	2.886±0.213	0.133±0.010	21.70
MWL-MW6	10-09-01	2.597±0.184	0.121±0.008	21.46
MWL-MW6-DU	10-09-01	2.617±0.257	0.119±0.011	21.99
Albuquerque tap water A	01-18-01	0.867±0.021	0.041±0.003	21.09
Albuquerque tap water B	01-18-01	0.827±0.049	0.039±0.002	21.23
Average Ratio for groundwater beneath the MWL				**21.51**
Average Ratio for Albuquerque Tap Water				**21.16**
Theoretical Ratio for Naturally-Occurring Uranium in Tap Water				**21.76**

Note: The NMED background activity for uranium-235 is 0.41 pCi/L.
The NMED background activity for uranium-238 is 3.0 pCi/L.
Uranium-235 MDA is 0.0022 pCi/L.
Uranium-238 MDA is 0.005 pCi/L.

[a]Analyses performed at Radiation Protection Sample Diagnostics (on-site laboratory).

[b]EPA Method 901.1. Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

DU duplicate
MDA minimum detectable activity
MWL Mixed Waste Landfill
pCi/L picocurie(s) per liter

Table 4-17
Summary of Tritium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	<206	206	ND	ITAS-O
	09-01-90	<202	202	ND	ITAS-O
	09-01-90	<202	202	ND	ITAS-O
	09-01-90	<203	203	ND	ITAS-O
	05-07-91	86.8±188	NA	ND	ITAS-O
	05-07-91	66.2±187	NA	ND	ITAS-O
	05-07-91	180±193	NA	ND	ITAS-O
	05-07-91	127±190	NA	ND	ITAS-O
	08-06-91	61.6±207	NA	ND	ITAS-O
	08-06-91	27.4±205	NA	ND	ITAS-O
	08-06-91	-59.7±200	NA	ND	ITAS-O
	08-06-91	-160±196	NA	ND	ITAS-O
	10-16-91	404±244	NA	--	ITAS-O
	10-16-91	207±233	NA	ND	ITAS-O
	10-16-91	120±228	NA	ND	ITAS-O
	10-16-91	386±243	NA	--	ITAS-O
	01-15-92	23.1±228	NA	ND	ITAS-O
	01-15-92	-16.6±226	NA	ND	ITAS-O
	01-15-92	-146±229	NA	ND	ITAS-O
	01-15-92	-135±220	NA	ND	ITAS-O
	07-29-92	-88±116	NA	ND	ITAS-O
	07-29-92	-146±114	NA	ND	ITAS-O
	07-29-92	-100±115	NA	ND	ITAS-O
	07-29-92	-159±113	NA	ND	ITAS-O
	07-29-92	-143±114	NA	ND	ITAS-O
	07-29-92	-164±113	NA	ND	ITAS-O
	07-29-92	-109±115	NA	ND	ITAS-O
	07-29-92	-163±113	NA	ND	ITAS-O
	01-20-93	-126±111	200	ND	ITRSL
	01-20-93	-180±108	200	ND	ITRSL
	01-20-93	-125±112	200	ND	ITRSL
	01-20-93	-80±112	200	ND	ITRSL
	01-20-93	-33±183	310	ND	ITRSL
	01-20-93	-378±177	310	ND	ITRSL
	01-20-93	-370±178	310	ND	ITRSL
	01-20-93	-268±176	310	ND	ITRSL
	04-28-93	58±220	370	ND	TMA EB
	04-28-93	150±230	370	ND	TMA EB
	04-28-93	-20±220	370	ND	TMA EB
	04-28-93	-150±210	370	ND	TMA EB
	04-28-93	160±230	370	ND	TMA EB
	04-28-93	140±210	330	ND	TMA EB
	04-28-93	290±220	330	ND	TMA EB
	04-28-93	300±240	370	ND	TMA EB
	11-10-93	13±220	360	ND	TMA EB
	11-10-93	78±220	360	ND	TMA EB
	04-27-94	210±160	260	ND	TMA EB
	10-26-94	-20±104	180	ND	QUANTE
	10-27-94	-27±104	180	ND	QUANTE

Refer to footnotes at end of table.

Table 4-17 (Continued)
Summary of Tritium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-BW1 (cont.)	10-27-94	-32±104	180	ND	QUANTE
	10-27-94	-103±102	180	ND	QUANTE
	08-31-95	60±220	290	ND	LAS
	10-23-95	70±200	110	ND	LAS
	04-28-97	51±64	51	ND	LAS
	10-17-97	-7±64	64	ND	LAS
	03-31-98	124±217	183	ND	GEL
	11-05-98	32.8±175	151	ND	GEL
	04-13-99	-284±135	118	ND	GEL
	04-06-00	-82.9±128.6	110	ND	GEL
	04-06-01	-95.9±109	99.2	ND	GEL
MWL-MW1	05-07-91	72.8±107	NA	ND	ITAS-O
	05-07-91	50.4±186	NA	ND	ITAS-O
	07-31-91	108±209	NA	ND	ITAS-O
	07-31-91	76.4±207	NA	ND	ITAS-O
	10-15-91	122±228	NA	ND	ITAS-O
	10-15-91	410±246	NA	--	ITAS-O
	01-14-92	0.967±189	NA	ND	ITAS-O
	01-14-92	-82.2±222	NA	ND	ITAS-O
	07-28-92	-41±113	NA	ND	ITAS-O
	07-28-92	-1±115	NA	ND	ITAS-O
	07-28-92	-79±112	NA	ND	ITAS-O
	07-28-92	-65±113	NA	ND	ITAS-O
	01-19-93	-45±109	190	ND	ITRSL
	01-19-93	42±111	190	ND	ITRSL
	04-27-93	160±230	370	ND	TMA EB
	04-27-93	370±240	370	ND	TMA EB
	04-27-93	270±240	370	ND	TMA EB
	04-27-93	35±220	370	ND	TMA EB
	11-09-93	-9±220	360	ND	TMA EB
	04-26-94	160±160	260	ND	TMA EB
	05-03-94	230±160	260	ND	TMA EB
	05-04-94	230±160	260	ND	TMA EB
	10-24-94	-14±157	274	ND	QUANTE
	10-25-94	-37±103	180	ND	QUANTE
	10-20-95	20±190	110	ND	LAS
	04-19-95	-40±160	97	ND	LAS
	04-18-96	-30±110	62	ND	LAS
	04-18-96	-10±110	61	ND	LAS
	04-18-96	30±110	62	ND	LAS
	04-23-97	-32±61	49	ND	LAS

Refer to footnotes at end of table.

Table 4-17 (Continued)
Summary of Tritium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW1 (cont.)	10-15-97	-13±64	65	ND	LAS
	10-15-97	6±65	64	ND	LAS
	04-01-98	283±212	347	ND	GEL
	11-06-98	-17.7±187	163	ND	GEL
	04-14-99	-497±134	122	ND	GEL
	04-14-00	32.6±128.5	107	ND	GEL
	04-14-00	61.5±128.6	107	ND	GEL
	04-13-01	-32.2±113	99.8	ND	GEL
MWL-MW2	05-02-91	49.5±186	NA	ND	ITAS-O
	05-02-91	87.8±188	NA	ND	ITAS-O
	08-01-91	2.94±204	NA	ND	ITAS-O
	08-01-91	-54.8±201	NA	ND	ITAS-O
	10-14-91	127±229	NA	ND	ITAS-O
	10-14-91	151±230	NA	ND	ITAS-O
	01-13-92	-12±226	NA	ND	ITAS-O
	01-13-92	3.69±227	NA	ND	ITAS-O
	07-27-92	-165±113	NA	ND	ITAS-O
	07-27-92	-209±112	NA	ND	ITAS-O
	07-27-92	-160±114	NA	ND	ITAS-O
	07-27-92	-145±114	NA	ND	ITAS-O
	01-18-93	-89±177	310	ND	ITRSL
	01-18-93	-159±172	300	ND	ITRSL
	01-18-93	-183±176	310	ND	ITRSL
	01-18-93	-130±175	300	ND	ITRSL
	04-26-93	270±240	370	ND	TMA EB
	04-26-93	98±220	370	ND	TMA EB
	04-26-93	130±230	370	ND	TMA EB
	04-26-93	240±230	370	ND	TMA EB
	11-08-93	120±230	360	ND	TMA EB
	04-27-94	210±160	260	ND	TMA EB
	05-02-94	170±160	260	ND	TMA EB
	10-19-94	11±158	274	ND	QUANTE
	10-24-94	105±163	274	ND	QUANTE
	10-24-94	124±163	274	ND	QUANTE
	04-17-95	40±170	95	ND	LAS
	10-16-95	-40±190	110	ND	LAS
	04-24-97	0±65	50	ND	LAS
	10-16-97	14±65	64	ND	LAS
	04-02-98	227±209	347	ND	GEL
	11-06-98	89.7±173	148	ND	GEL
	04-19-99	-133±138	128	ND	GEL
	04-24-00	-45.3±172	144	ND	GEL
	04-23-01	0±164	138	ND	GEL
MWL-MW3	05-02-91	87.8±188	NA	ND	ITAS-O
	05-02-91	85.9±188	NA	ND	ITAS-O

Refer to footnotes at end of table.

Table 4-17 (Continued)
Summary of Tritium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW3 (cont.)	08-05-91	-68.5±200	NA	ND	ITAS-O
	08-05-91	46±206	NA	ND	ITAS-O
	10-15-91	906±276	NA	--	ITAS-O
	10-15-91	5.81±222	NA	ND	ITAS-O
	01-14-92	70.2±230	NA	ND	ITAS-O
	01-14-92	41.6±228	NA	ND	ITAS-O
	07-28-92	-165±113	NA	ND	ITAS-O
	07-28-92	-136±114	NA	ND	ITAS-O
	07-28-92	-106±115	NA	ND	ITAS-O
	07-28-92	-109±115	NA	ND	ITAS-O
	01-19-93	-74±107	190	ND	ITRSL
	01-19-93	1±113	210	ND	ITRSL
	01-19-93	-216±188	330	ND	ITRSL
	01-19-93	-268±187	330	ND	ITRSL
	01-19-93	-354±184	320	ND	ITRSL
	01-19-93	-380±183	320	ND	ITRSL
	04-27-93	280±240	370	ND	TMA EB
	04-27-93	58±220	370	ND	TMA EB
	04-27-93	77±220	370	ND	TMA EB
	04-27-93	-14±220	370	ND	TMA EB
	11-09-93	4.9±220	360	ND	TMA EB
	04-27-94	130±160	260	ND	TMA EB
	05-03-94	110±150	260	ND	TMA EB
	10-17-94	153±165	274	ND	QUANTE
	10-17-94	105±163	274	ND	QUANTE
	10-25-94	-48±103	180	ND	QUANTE
	10-25-94	-90±102	180	ND	QUANTE
	04-17-95	-60±160	95	ND	LAS
	10-16-95	70±200	110	ND	LAS
	04-24-97	-46±62	51	ND	LAS
	10-16-97	93±73	120	ND	LAS
	04-02-98	253±239	396	ND	GEL
	11-06-98	14.5±179	156	ND	GEL
	04-12-99	-411±138	124	ND	GEL
	04-13-00	-70.7±126	108	ND	GEL
	04-08-01	-128±108	99.4	ND	GEL
MWL-MW4	02-08-93	110±240	NA	ND	QUANTE
	04-30-93	280±220	330	ND	TMA EB
	04-30-93	160±230	370	ND	TMA EB
	04-30-93	180±230	370	ND	TMA EB
	04-30-93	88±220	370	ND	TMA EB

Refer to footnotes at end of table.

Table 4-17 (Concluded)
Summary of Tritium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW4 (cont.)	03-04-94	230±150	240	ND	TMA EB
	05-31-94	270±160	260	--	TMA EB
	10-28-94	-80±102	180	ND	QUANTE
	04-19-95	-50±160	96	ND	LAS
	04-19-95	-60±160	96	ND	LAS
	10-20-95	-10±190	110	ND	LAS
	10-20-95	10±190	110	ND	LAS
	04-23-97	40.0±70	52	ND	LAS
	04-23-97	-6.0±65	51	ND	LAS
	04-23-97	40±70	52	ND	LAS
	04-23-97	-6.0±65	51	ND	LAS
	10-15-97	-20.0±80	81	ND	LAS
	04-01-98	21.7±199	173	ND	GEL
	04-01-98	42.3±220	190	ND	GEL
	11-06-98	-85.0±178	157	ND	GEL
	11-06-98	89.9±193	166	ND	GEL
	04-14-99	-565±134	124	ND	GEL
	04-07-00	-15.8±129.7	110	ND	GEL
	04-05-01	-96.9±111	100	ND	GEL
	04-05-01	-64.7±112	100	ND	GEL
MWL-MW5	01-17-01	-25.4±196	160	ND	GEL
	04-16-01	-62.7±109	97.2	ND	GEL
	07-24-01	0±88.9	74.6	ND	GEL
	04-16-01	54.4±94.2	76	ND	GEL
	07-24-01	26.4±89.7	73.9	ND	GEL
	10-04-00	-191±116	100	ND	GEL
MWL-MW6	01-16-01	-47.2±198	162	ND	GEL
	04-17-01	0±165	138	ND	GEL
	07-23-01	26.6±90.2	74.3	ND	GEL
	01-16-01	-112±196	162	ND	GEL

Notes: The SNL/NM background activity for tritium is 420 pCi/L.
The radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a]Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDA minimum detectable activity
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND not detected
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
SNL/NM Sandia National Laboratories/New Mexico
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
-- isotope detected above MDA or 2 error

Table 4-18
Summary of Plutonium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Radionuclide	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-BW1	Plutonium-238	09-01-90	<0.0153	0.0153	ND	ITAS-O
		09-01-90	<0.017	0.017	ND	ITAS-O
		09-01-90	<0.00248	0.00248	ND	ITAS-O
		09-01-90	<0.0019	0.0019	ND	ITAS-O
		11-10-93	0.012±0.014	0.011	ND	TMA EB
		11-10-93	0±0.001	0.026	ND	TMA EB
		10-26-94	0.008±0.017	0.031	ND	QUANTE
		10-27-94	0.019±0.056	0.147	ND	QUANTE
		10-27-94	0.057±0.074	0.117	ND	QUANTE
		03-14-95	<0.001±0.041	0.11	ND	TMA EB
		10-23-95	0.0028±0.01	0.0052	ND	LAS
	Plutonium-239	09-01-90	<0.018	0.018	ND	ITAS-O
		09-01-90	<0.0122	0.0122	ND	ITAS-O
		09-01-90	<0.0103	0.0103	ND	ITAS-O
		09-01-90	<0.0157	0.0157	ND	ITAS-O
		11-10-93	0±0.001	0.01	ND	TMA EB
		11-10-93	-0.008±0.011	0.036	ND	TMA EB
		10-26-94	-0.013±0.011	0.031	ND	QUANTE
		10-27-94	0.006±0.04	0.132	ND	QUANTE
		10-27-94	-0.008±0.009	0.125	ND	QUANTE
		03-14-95	-0.014±0.028	0.11	ND	TMA EB
		10-23-95	0.01±0.014	0	ND	LAS
MWL-MW1	Plutonium-238	09-01-90	<0.017	0.017	ND	ITAS-O
		09-01-90	<0.00248	0.00248	ND	ITAS-O
		11-09-93	0.011±0.012	0.01	ND	TMA EB
		04-26-94	0.004±0.02	0.059	ND	TMA EB
		05-03-94	-0.005±0.012	0.054	ND	TMA EB
		05-04-94	<0.007±0.022	0.06	ND	TMA EB
		10-24-94	0.016±0.021	0.035	ND	QUANTE
		10-25-94	0.004±0.026	0.052	ND	QUANTE
		10-20-95	0.001±0.012	0.0078	ND	LAS
		04-18-96	-0.0044±0.0061	0.008	ND	LAS
		04-18-96	0.003±0.012	0.0062	ND	LAS
		04-18-96	0.005±0.011	NA	ND	LAS
	Plutonium-239	11-09-93	-0.007±0.01	0.033	ND	TMA EB
		04-26-94	-0.002±0.02	0.068	ND	TMA EB
		05-03-94	-0.008±0.012	0.058	ND	TMA EB
		05-04-94	-0.006±0.013	0.06	ND	TMA EB
		10-24-94	-0.01±0.011	0.035	ND	QUANTE
		10-25-94	0.013±0.015	0.013	ND	QUANTE
		10-20-95	0±0	0	ND	LAS
		04-18-96	0.00000±0	0.012	ND	LAS
		04-18-96	-0.00490±0.0068	0.016	ND	LAS
		04-18-96	0.00300±0.011	0.014	ND	LAS

Refer to footnotes at end of table.

Table 4-18 (Continued)
Summary of Plutonium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Radionuclide	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW2	Plutonium-238	11-08-93	-0.004±0.007	0.026	ND	TMA EB
		04-27-94	<0.002±0.026	0.081	ND	TMA EB
		05-02-94	<0.024±0.026	0.042	ND	TMA EB
		10-19-94	0.004±0.012	0.024	ND	QUANTE
		10-24-94	0.008±0.013	0.022	ND	QUANTE
		04-17-95	-0.015±0.021	0.031	ND	LAS
		10-16-95	0.003±0.012	0.0059	ND	LAS
	Plutonium-239	11-08-93	-0.007±0.01	0.033	ND	TMA EB
		04-27-94	<0.008±0.016	0.021	ND	TMA EB
		05-02-94	-0.006±0.001	0.042	ND	TMA EB
		10-19-94	0±0.009	0.021	ND	QUANTE
		10-24-94	0.006±0.009	0.015	ND	QUANTE
		04-17-95	-0.008±0.015	0.058	ND	LAS
		10-16-95	0.028±0.024	0	--	LAS
MWL-MW3	Plutonium-238	11-09-93	0.003±0.01	0.022	ND	TMA EB
		04-27-94	<0.009±0.024	0.06	ND	TMA EB
		05-03-94	-0.006±0.001	0.048	ND	TMA EB
		10-17-94	0.003±0.02	0.039	ND	QUANTE
		10-25-94	-0.017±0.017	0.039	ND	QUANTE
		04-17-95	-0.009±0.013	0.018	ND	LAS
		10-16-95	0.002±0.017	0.011	ND	LAS
	Plutonium-239	11-09-93	0.006±0.012	0.022	ND	TMA EB
		04-27-94	-0.023±0.002	0.088	ND	TMA EB
		05-03-94	-0.025±0.002	0.078	ND	TMA EB
		10-17-94	-0.005±0.017	0.039	ND	QUANTE
		10-25-94	-0.011±0.015	0.035	ND	QUANTE
		04-17-95	-0.0045±0.0089	0.034	ND	LAS
		10-16-95	-0.0044±0.0061	0.008	ND	LAS
MWL-MW4	Plutonium-238	11-11-93	0.016±0.022	0.036	ND	TMA EB
		03-14-94	-0.034±0.056	0.11	ND	TMA EB
		05-31-94	-0.016±0.001	0.067	ND	TMA EB
		10-28-94	-0.001±0.003	0.06	ND	QUANTE
		04-19-95	-0.0037±0.0073	0.011	ND	LAS
		04-19-95	-0.006±0.011	0.016	ND	LAS
		10-20-95	-0.0022±0.0042	0.0055	ND	LAS
		10-20-95	-0.0023±0.0044	0.0058	ND	LAS
	Plutonium-239	11-11-93	0.016±0.022	0.036	ND	TMA EB
		03-14-94	-0.011±0.017	0.046	ND	TMA EB
		05-31-94	<0±0.014	0.049	ND	TMA EB
		10-28-94	0±0	0.04	ND	QUANTE
		04-19-95	0.007±0.023	0.028	ND	LAS
		04-19-95	0.052±0.059	0.04	--	LAS
		10-20-95	-0.0022±0.0042	0.0055	ND	LAS

Refer to footnotes at end of table.

Table 4-18 (Concluded)
Summary of Plutonium Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Radionuclide	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW4 (cont.)	Plutonium-239 (cont.)	10-20-95	0.003±0.012	0.0058	ND	LAS
		04-07-00	0.165	0.165	ND	RPSD
		02-09-01	0.143	0.143	ND	RPSD

Note: The radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a]Alpha spectrometry after chemical separation. Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDA minimum detectable activity
MWL Mixed Waste Landfill
ND not detected
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
RPSD Radiation Protection Sample Diagnostics (on-site laboratory)
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
-- isotope detected above MDA or 2 error

Table 4-19
Summary of Strontium-90 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	<0.228	0.228	ND	ITAS-O
	09-01-90	<0.214	0.214	ND	ITAS-O
	09-01-90	<0.249	0.249	ND	ITAS-O
	09-01-90	<0.228	0.228	ND	ITAS-O
	01-20-93	0.446±0.95	1.69	ND	ITRSL
	04-28-93	4±1.6	1.8	--	TMA EB
	04-27-94	1.8±0.87	1.3	--	TMA EB
	10-26-94	0.44±0.48	0.81	ND	QUANTE
	10-27-94	0.5±0.5	0.85	ND	QUANTE
	10-27-94	0.02±0.4	0.77	ND	QUANTE
	10-23-95	0.3±0.32	0.26	ND	LAS
	04-28-97	<0.21±0.26	0.21	ND	LAS
	10-17-97	0.00±0.23	0.2	ND	LAS
	03-31-98	-0.240±0.282	0.234	ND	GEL
	01-20-99	-0.0553±0.812	0.526	ND	GEL
	04-13-99	-0.0382±0.299	0.187	ND	GEL
	04-06-00	0.266±0.7486	0.84	ND	GEL
	04-06-01	1.41±1.69	1.62	ND	GEL
MWL-MW1	04-27-93	5.7±2.7	3.2	--	TMA EB
	04-26-94	-0.54±0.78	1.4	ND	TMA EB
	05-03-94	-0.58±0.79	1.4	ND	TMA EB
	05-04-94	-0.3±0.82	1.5	ND	TMA EB
	10-24-94	0.69±0.55	0.88	ND	QUANTE
	10-25-94	0.43±0.48	0.81	ND	QUANTE
	10-20-95	0.15±0.3	0.25	ND	LAS
	04-18-96	-0.01000±0.31	0.27	ND	LAS
	04-18-96	0.15000±0.32	0.26	ND	LAS
	04-18-96	0.16000±0.32	0.26	ND	LAS
	04-23-97	0.06000±0.25	0.21	ND	LAS
	04-23-97	0.06±0.25	0.21	ND	LAS
	10-15-97	-0.15±0.23	0.2	ND	LAS
	10-15-97	0.03±0.21	0.18	ND	LAS
	04-01-98	0.0304±0.348	0.275	ND	GEL
	01-18-99	0.0596±0.416	0.268	ND	GEL
	04-14-99	-0.273±0.484	0.305	ND	GEL
	04-14-00	0.239±0.916	0.685	ND	GEL
	04-14-00	0.0356±0.905	0.691	ND	GEL
	04-13-01	-0.0594±0.336	0.329	ND	GEL
MWL-MW2	04-26-93	2.2±1.2	1.6	--	TMA EB
	04-27-94	<0.12±0.91	1.6	ND	TMA EB
	05-02-94	-0.57±0.82	1.5	ND	TMA EB
	10-19-94	0.11±0.48	0.94	ND	QUANTE
	10-24-94	0.36±0.43	0.73	ND	QUANTE

Refer to footnotes at end of table.

Table 4-19 (Continued)
Summary of Strontium-90 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW2 (cont.)	04-17-95	-0.01±0.14	0.12	ND	LAS
	10-16-95	-0.09±0.29	0.25	ND	LAS
	04-24-97	0.14±0.27	0.22	ND	LAS
	10-16-97	0.1±0.23	0.19	ND	LAS
	04-02-98	-0.0580±0.531	0.423	ND	GEL
	11-06-98	0.676±1.75	1.36	ND	GEL
	04-19-99	1.04±0.706	0.175	--	GEL
	04-24-00	0.193±0.463	0.414	ND	GEL
	04-23-01	-0.107±0.329	0.279	ND	GEL
MWL-MW3	04-27-93	2.5±1.2	1.5	--	TMA EB
	04-27-94	<0.49±0.74	1.2	ND	TMA EB
	05-03-94	-0.47±0.73	1.3	ND	TMA EB
	10-17-94	0.27±0.35	0.56	ND	QUANTE
	10-25-94	0.36±0.41	0.72	ND	QUANTE
	04-17-95	-0.04±0.12	0.1	ND	LAS
	10-16-95	0.03±0.31	0.26	ND	LAS
	04-24-97	0.19±0.27	0.21	ND	LAS
	10-16-97	-0.15±0.27	0.23	ND	LAS
	04-02-98	-0.0244±0.227	0.181	ND	GEL
	01-20-99	-0.680±0.453	0.258	ND	GEL
	04-12-99	0.0216±0.433	0.269	ND	GEL
	04-13-00	-0.161±0.3355	0.444	ND	GEL
	04-08-01	0.731±0.862	0.82	ND	GEL
MWL-MW4	04-28-93	<0.83±1.2	1.9	ND	TMA EB
	04-30-93	<1.9±1.4	2	ND	TMA EB
	05-31-94	-0.66±0.76	1.4	ND	TMA EB
	10-28-94	0.06±0.49	0.92	ND	QUANTE
	04-19-95	0.05±0.13	0.11	ND	LAS
	04-19-95	0.01±0.12	0.1	ND	LAS
	10-20-95	-0.15±0.3	0.27	ND	LAS
	10-20-95	0.16±0.31	0.26	ND	LAS
	04-23-97	-0.04±0.25	0.21	ND	LAS
	04-23-97	0.07±0.26	0.21	ND	LAS
	04-23-97	-0.04±0.25	0.21	ND	LAS
	04-23-97	0.07±0.26	0.21	ND	LAS
	10-15-97	0.10±0.25	0.21	ND	LAS
	04-01-98	-0.188±0.324	0.264	ND	GEL
	04-01-98	-0.023±0.291	0.232	ND	GEL
	01-21-99	-0.0596±0.48	0.268	ND	GEL
	01-21-99	0.155±0.318	0.202	ND	GEL
	04-14-99	-0.619±0.633	0.416	ND	GEL
	04-07-00	0.159±0.335	0.405	ND	GEL
	04-05-01	0.814±0.75	0.703	--	GEL
	04-05-01	-0.0532±0.877	0.767	ND	GEL

Refer to footnotes at end of table.

Table 4-19 (Concluded)
Summary of Strontium-90 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW5	01-17-01	0.271±0.331	0.278	ND	GEL
	04-16-01	4.85±0.476	0.233	--	GEL
	04-16-01	0.554±0.413	0.336	--	GEL
	07-24-01	-0.0731±0.49	0.46	ND	GEL
	07-24-01	-0.151±0.482	0.428	ND	GEL
	10-04-00	0.108±0.313	0.245	ND	GEL
MWL-MW6	01-16-01	-0.0424±0.153	0.137	ND	GEL
	01-16-01	0.253±0.224	0.166	--	GEL
	04-17-01	0.0739±0.386	0.303	ND	GEL

Notes: The NMED background activity for strontium-90 is <1.6 pCi/L.
The radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a]Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDA minimum detectable activity
MWL Mixed Waste Landfill
ND not detected
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
-- isotope detected above MDA or 2 error

Table 4-20
Summary of Cobalt-60 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	4.55	4.55	ND	ITAS-O
	09-01-90	3.17	3.17	ND	ITAS-O
	09-01-90	3.83	3.83	ND	ITAS-O
	09-01-90	3.63	3.63	ND	ITAS-O
	04-28-93	29	29	ND	TMA EB
	10-23-95	-1.9±2.2	7.4	ND	LAS
	04-28-97	1.9±0.5	1.9	ND	LAS
	10-17-97	1.5±4.4	3.8	ND	LAS
	03-31-98	-0.668±2.75	2.26	ND	GEL
	03-31-98	-0.87±2.6	2.7	ND	GEL
	04-06-00	282	282	ND	RPSD
	04-06-01	0.416±2.3	1.75	ND	GEL
MWL-MW1	04-27-93	32	32	ND	TMA EB
	10-20-95	-2.7±3.1	4.6	ND	LAS
	04-18-96	-0.6±2.9	4.6	ND	LAS
	04-18-96	0.1±1.4	1.2	ND	LAS
	04-18-96	-3.9±4.3	4.1	ND	LAS
	04-23-97	-0.8±1.5	6.2	ND	LAS
	04-23-97	-0.8±1.5	6.2	ND	LAS
	10-15-97	-5±3.2	3.3	ND	LAS
	10-15-97	2.6±3.8	3.9	ND	LAS
	04-01-98	2.13±2.59	1.99	--	GEL
	04-14-00	173	173	ND	RPSD
	04-13-01	0.929±2.03	1.81	ND	GEL
MWL-MW2	04-26-93	26	26	ND	TMA EB
	10-16-95	-0.7±1	1.7	ND	LAS
	04-24-97	-1.7±3.9	6	ND	LAS
	10-16-97	-0.3±1.6	4.5	ND	LAS
	04-02-98	4.66±2.18	2.06	ND`	GEL
	04-24-00	259	259	ND	RPSD
	04-23-01	-0.945±1.9	1.61	ND	GEL
MWL-MW3	04-27-93	27	27	ND	TMA EB
	10-16-95	-1.5±2.5	4	ND	LAS
	04-24-97	0.6±2	1.5	ND	LAS
	10-16-97	-0.04±0.64	1.4	ND	LAS
	04-02-98	-3.07±4.81	3.06	ND	GEL
	04-13-00	227	227	ND	RPSD
	04-08-01	1.29±2.62	1.73	ND	GEL
MWL-MW4	02-08-93	5.57	5.57	ND	QUANTE
	04-21-93	19	19	ND	TMA EB
	04-28-93	24	24	ND	TMA EB
	04-30-93	33	33	ND	TMA EB
	10-20-95	1.2±1.3	1.3	ND	LAS

Refer to footnotes at end of table.

Table 4-20 (Concluded)
Summary of Cobalt-60 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW4 (cont.)	10-20-95	0.6±4.2	3.4	ND	LAS
	04-23-97	1.2±2	1.5	ND	LAS
	04-23-97	-4.8±3.8	6.1	ND	LAS
	04-23-97	1.2±2	1.5	ND	LAS
	04-23-97	-4.8±3.8	6.1	ND	LAS
	10-15-97	0.9±3.8	3	ND	LAS
	04-01-98	-0.591±3.07	2.04	ND	GEL
	04-01-98	0.388±2.81	1.94	ND	GEL
	04-07-00	253	253	ND	RPSD
	02-09-01	255	255	ND	RPSD
	04-05-01	0.742±2.7	1.71	ND	GEL
	04-05-01	-0.00096±1.98	1.8	ND	GEL
MWL-MW5	01-17-01	-0.918±2.55	2.17	ND	GEL
	04-16-01	-0.178±2.29	1.79	ND	GEL
	04-16-01	-1.04±2.21	1.79	ND	GEL
	07-24-01	-0.326±3.39	3.17	ND	GEL
	07-24-01	0.318±3.56	3.06	ND	GEL
MWL-MW6	01-16-01	0.173±2.29	2.11	ND	GEL
	01-16-01	1.93±3.31	1.95	ND	GEL
	04-17-01	0.0801±1.77	1.71	ND	GEL

Note: Radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a]Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDA minimum detectable activity
MWL Mixed Waste Landfill
ND not detected
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
RPSD Radiation Protection Sample Diagnostics
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
-- isotope detected above MDA or 2 error

Table 4-21
Summary of Cesium-137 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	4.86	4.86	ND	ITAS-O
	09-01-90	3.75	3.48	--	ITAS-O
	09-01-90	4.72	4.72	ND	ITAS-O
	09-01-90	5.42	5.42	ND	ITAS-O
	01-24-91	12	12	ND	ITAS-O
	01-24-91	14	14	ND	ITAS-O
	01-24-91	14	14	ND	ITAS-O
	01-24-91	16	16	ND	ITAS-O
	05-07-91	-1.26±3.41	NA	ND	ITAS-O
	05-07-91	-1.56±3.73	NA	ND	ITAS-O
	05-07-91	0.0932±3.7	NA	ND	ITAS-O
	05-07-91	2±2.89	NA	ND	ITAS-O
	08-06-91	27	27	ND	TMA EB
	01-15-92	-0.0435±2.77	NA	ND	ITAS-O
	01-15-92	0.606±3.51	NA	ND	ITAS-O
	01-15-92	1.52±3.05	NA	ND	ITAS-O
	01-15-92	-2.68±3.15	NA	ND	ITAS-O
	07-29-92	17.6	17.6	ND	ITAS-O
	07-29-92	15	15	ND	ITAS-O
	01-20-93	13.446	13.446	ND	ITRSL
	01-20-93	13.317±5.3	13.317	ND	ITRSL
	04-28-93	31	31	ND	TMA EB
	10-23-95	1.4±6.8	5.5	ND	LAS
	04-28-97	1.9±1.6	1.9	ND	LAS
	10-17-97	1.8±6	3.5	ND	LAS
	03-31-98	0.89±2.54	1.83	ND	GEL
	03-31-98	10.6±3.84	2.03	--	GEL
	04-06-00	21.2	21.2	ND	RPSD
	04-06-01	1.03±2.15	1.6	ND	GEL
MWL-MW1	01-24-91	12	12	ND	ITAS-O
	01-24-91	13	13	ND	ITAS-O
	05-07-91	3.01±2.81	NA	--	ITAS-O
	05-07-91	-2.48±3.38	NA	ND	ITAS-O
	08-01-91	0±24	NA	ND	TMA EB
	01-14-92	0.504±2.47	NA	ND	ITAS-O
	01-14-92	0±0.0001	NA	ND	ITAS-O
	07-28-92	16	16	ND	ITAS-O
	07-28-92	16	16	ND	ITAS-O
	01-19-93	17.619	17.619	ND	ITRSL
	04-27-93	29	29	ND	TMA EB
	10-20-95	-1.7±3.3	4.1	ND	LAS
	04-18-96	-2.1±5.4	4.6	ND	LAS
	04-18-96	0.5±1.7	1.4	ND	LAS
	04-18-96	2.1±5.2	4	ND	LAS

Refer to footnotes at end of table.

Table 4-21 (Continued)
Summary of Cesium-137 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW1 (cont.)	04-23-97	-3.3±7	6.3	ND	LAS
	04-23-97	-3.3±7	6.3	ND	LAS
	10-15-97	-3.6±3.1	4.1	ND	LAS
	10-15-97	-4±3.8	4.9	ND	LAS
	04-01-98	-1.25±2.34	1.84	ND	GEL
	04-14-00	16.7	16.7	ND	RPSD
	04-13-01	0.722±2.03	1.67	ND	GEL
MWL-MW2	01-28-91	15	15	ND	ITAS-O
	01-28-91	13	13	ND	ITAS-O
	05-02-91	-2.22±3.42	NA	ND	ITAS-O
	05-02-91	-2.83±2.82	NA	ND	ITAS-O
	08-01-91	0±26	NA	ND	TMA EB
	01-13-92	0.478±2.87	NA	ND	ITAS-O
	01-13-92	0.544±2.45	NA	ND	ITAS-O
	07-27-92	13.7	13.7	ND	ITAS-O
	01-18-93	19.5	19.5	ND	ITRSL
	04-26-93	27	27	ND	TMA EB
	10-16-95	0.7±2.4	1.3	ND	LAS
	04-24-97	0.3±7.3	6	ND	LAS
	10-16-97	-1.3±5.3	4.5	ND	LAS
	04-02-98	-0.288±1.97	1.89	ND	GEL
	04-24-00	22.7	22.7	ND	RPSD
	04-23-01	0.692±1.69	1.43	ND	GEL
MWL-MW3	01-28-91	12	12	ND	ITAS-O
	01-28-91	13	13	ND	ITAS-O
	05-02-91	2.8±3.26	NA	ND	ITAS-O
	05-02-91	-1.61±3.57	NA	ND	ITAS-O
	08-05-91	33	33	ND	TMA EB
	01-14-92	-0.311±3.27	NA	ND	ITAS-O
	01-14-92	0.466±2.95	NA	ND	ITAS-O
	07-28-92	14	14	ND	ITAS-O
	01-19-93	13.889	13.889	ND	ITRSL
	04-27-93	29	29	ND	TMA EB
	10-16-95	-0.7±4.3	3.6	ND	LAS
	04-24-97	-1.2±1.9	2.1	ND	LAS
	10-16-97	0.6±3	1.8	ND	LAS
	04-02-98	0.355±3.91	2.75	ND	GEL
	04-13-00	21.6	21.6	ND	RPSD
	04-08-01	2.02±2.11	1.59	ND	GEL
MWL-MW4	02-08-93	8.74	8.74	ND	QUANTE
	04-21-93	24	24	ND	TMA EB
	04-28-93	31	31	ND	TMA EB
	04-30-93	28	28	ND	TMA EB
	10-20-95	-1.4±1.1	1.5	ND	LAS

Refer to footnotes at end of table.

Table 4-21 (Concluded)
Summary of Cesium-137 Analytical Results for Groundwater Beneath the MWL
1990 through 2001

Well	Sample Date	Activity 2 [a] (pCi/L)	MDA (pCi/L)	Qualifier	Lab
MWL-MW4 (cont.)	10-20-95	1.2±4.9	3.9	ND	LAS
	04-23-97	-2.4±1.9	2.3	ND	LAS
	04-23-97	-0.7±4.3	5	ND	LAS
	04-23-97	-2.4±1.9	2.3	ND	LAS
	04-23-97	21.1	21.1	ND	RPSD
	10-15-97	-0.7±4.3	5	ND	LAS
	04-01-98	-6.2±3.4	4.4	ND	LAS
	04-01-98	-1.3±2.06	1.58	ND	GEL
	04-07-00	0.355±2.44	1.88	ND	GEL
	02-09-01	0.744±2.72	1.8	ND	GEL
	04-05-01	21.8	21.8	ND	RPSD
	04-05-01	-0.31±2.06	1.65	ND	GEL
MWL-MW5	01-17-01	0.641±2.36	1.95	ND	GEL
	04-16-01	0.911±2.06	1.65	ND	GEL
	07-24-01	0.284±2.01	1.65	ND	GEL
	04-16-01	0.219±2.97	3.1	ND	GEL
	07-24-01	1.61±3.68	3	ND	GEL
MWL-MW6	01-16-01	0.625±2.23	1.88	ND	GEL
	04-17-01	0±3.11	1.76	ND	GEL
	01-16-01	0.0954±1.67	1.52	ND	GEL

Notes: The NMED background activity for cesium-137 is 9.3 pCi/L.
Radiometric analytical methods primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a]Laboratory results have an uncertainty of 2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory, Charleston, South Carolina (off-site laboratory)
ITAS-O IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab laboratory
LAS Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDA minimum detectable activity
MWL Mixed Waste Landfill
NA not analyzed or not reported
ND not detected
pCi/L picocurie(s) per liter
QUANTE Quanterra Laboratory, St. Louis, Missouri
RPSD Radiation Protection Sample Diagnostics (on site, Sandia National Laboratories)
TMA EB Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico
-- isotope detected above MDA or 2 error

Table 5-1
Proposed Long-Term Monitoring at the MWL

Parameter	Test Method	Target Quantitation Limit	Frequency
Field parameters: pH, temperature, specific conductance, turbidity, E_h, dissolved oxygen	FOP 94-46 (Field Analytical Measurement of Groundwater); 9040, 120.1	NA (pH, temperature), 1.0 mhos/cm (specific conductance), 0.1 NTU (turbidity), 5 mV (E_h), 2% saturation (dissolved oxygen)	Annually
Major cations: Na, K, Ca, Mg	EPA 6010B, EPA 6020	1.0 mg/L (Na, K, Ca), 0.02 mg/L (Mg)	Annually
Major anions: field alkalinity, Cl, SO_4	EPA 300.0, EPA 310.1	5.0 mg/L (alkalinity), 0.5 mg/L (Cl), 1.0 mg/L (SO_4)	Annually
Tritium	EPA 906.0	76—111 pCi/L	Annually
Gross alpha	EPA 900.0	0.589—1.94 pCi/L	Annually
Gross beta	EPA 900.0	0.784—6.52 pCi/L	Annually
VOCs	EPA 8260	1—5 g/L	Annually

Ca	calcium
Cl	chloride
E_h	oxidation/reduction potential
EPA	U.S. Environmental Protection Agency
FOP	field operating procedure
K	potassium
Mg	magnesium
mg/L	milligram(s) per liter
g/L	microgram(s) per liter
mhos/cm	micromhos per centimeter
mV	millivolt
MWL	Mixed Waste Landfill
Na	sodium
NA	not applicable
NTU	nephelometric turbidity units
pCi/L	picocurie(s) per liter
pH	potential of hydrogen
SO_4	sulfate
VOC(s)	volatile organic compound(s)

Appendix A

Monitoring Well Completion Diagrams for Mixed Waste Landfill Wells

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WELL DATABASE SUMMARY SHEET

Project Name: MIXED WASTE LANDFILL
ER ADS #: 1289
Well Name: MWL-BW1
Owner Name: SNL/NM
Date Drilling Started: 24-JUN-89
Drilling Contractor: STEWART BROTHERS
Drilling Method: MUD ROTARY
Borehole Depth: 519
Casing Depth: 477.17

Geo Location: TA III
Well Completion Date: 01-JUL-89
Completion Zone: SAND AND GRAVEL
Formation of Completion: SANTA FE
Well Comment: WATER LEVEL MEASURED ON 5/14/90

Survey Data

Survey Date: 12-APR-90
Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411756.001
(Y) Northing: 1451698.73

Surveyed Elevations (FAMSL)

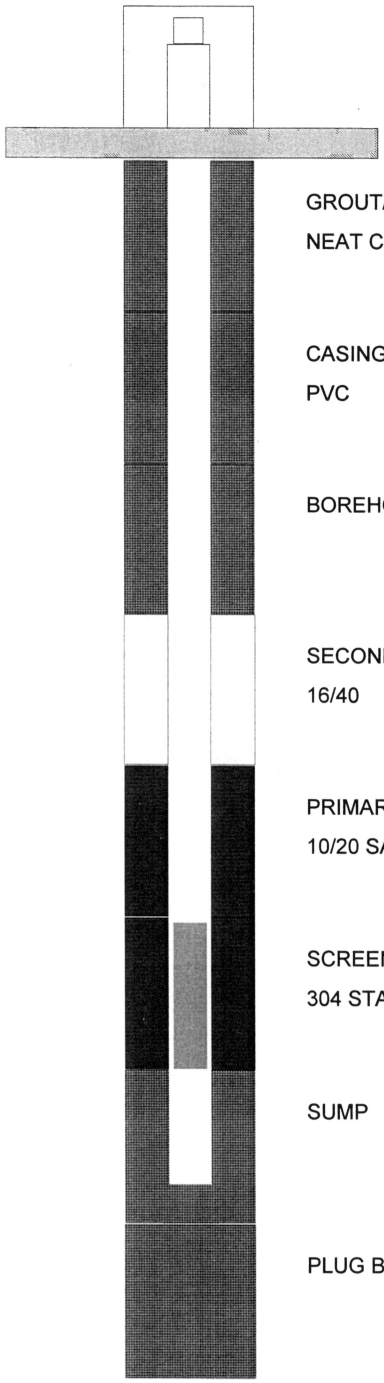
Protective Casing: 5385.05
Top of Inner Well Casing: 5384.51
Concrete Pad: 5383.35
Ground Surface: 5382.7

Calculated Depths and Elevations

Initial Water Elevation (FAMSL): 4923.3
Initial Depth To Water (FBGS): 461.21

Last measured water level was measured on 4918.54 **FASL** 06-AUG-96

Date Updated: 28-NOV-01
Date Printed: 03-JAN-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.16

Interval	Start	Stop
GROUT/BACKFILL	0'	433'
NEAT CEMENT		

Interval	Start	Stop
CASING	0'	477.17'
PVC	**I.D.** 5"	

Interval	Start	Stop
BOREHOLE	0'	519'
	O.D. 12.25"	

Interval	Start	Stop
SECONDARY PACK	441'	443'
16/40		

Interval	Start	Stop
PRIMARY PACK	443'	478'
10/20 SAND		

Interval	Start	Stop
SCREEN	452.17'	472.17'
304 STAINLESS STEEL		
	Slot Size .01"	

Interval	Start	Stop
SUMP	472.17'	477.17'

Interval	Start	Stop
PLUG BACK	477.17'	519'

WELL DATABASE SUMMARY SHEET

Project Name: MIXED WASTE LANDFILL
ER ADS #: 1289
Well Name: MWL-MW1
Owner Name: SNL
Date Drilling Started: 28-SEP-88
Drilling Contractor: WATER DEVELOPMENT
Drilling Method: AIR ROTARY
Borehole Depth: 478.67
Casing Depth: 478

Geo Location: MIXED WASTE LANDFILL
Well Completion Date: 01-OCT-88
Completion Zone: SILTY SAND
Formation of Completion: SANTA FE GROUP
Well Comment: BOREHOLE DIAM IS 14" TO 200' - 10" TO 478.67 - WATER LEV ELEV 8/16/90

Survey Data

Survey Date: 01-JAN-90
Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411661.747
(Y) Northing: 1452661.099

Surveyed Elevations (FAMSL)

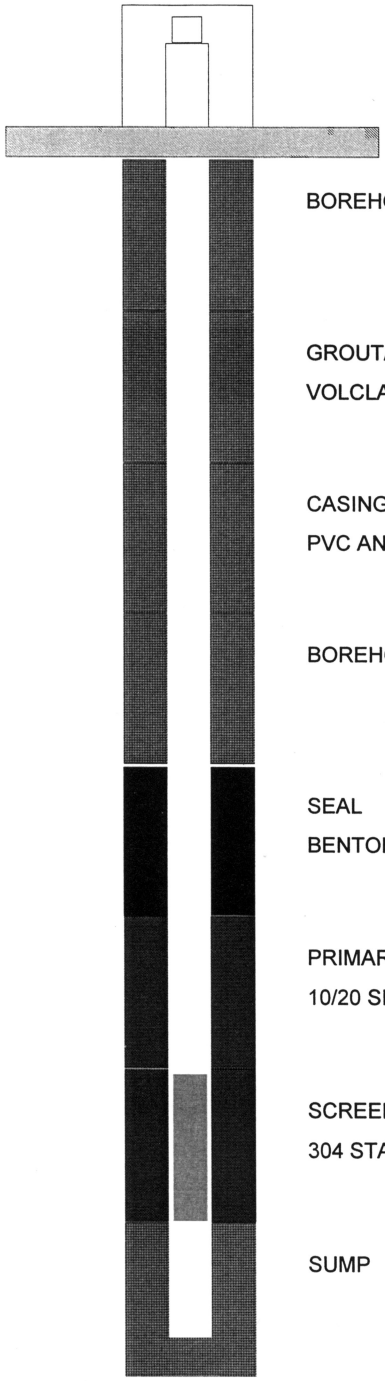
Protective Casing:	5382.2
Top of Inner Well Casing:	5381.54
Concrete Pad:	5379.56
Ground Surface:	5379.12

Calculated Depths and Elevations

Initial Water Elevation (FAMSL):	4923.36
Initial Depth To Water (FBGS):	458.18

Last measured water level was 4918.82 **FASL**
measured on 06-AUG-96

Date Updated: 28-NOV-01
Date Printed: 03-JAN-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.98

Interval	Start	Stop
BOREHOLE	0'	200'
O.D.	14"	

Interval	Start	Stop
GROUT/BACKFILL	0'	434.9'
VOLCLAY		

Interval	Start	Stop
CASING	0'	478'
PVC AND STEEL **I.D.**	5"	

Interval	Start	Stop
BOREHOLE	200'	478.67'
O.D.	10"	

Interval	Start	Stop
SEAL	434.9'	445.5'
BENTONITE PELLETS		

Interval	Start	Stop
PRIMARY PACK	445.5'	478.67'
10/20 SILICA SAND		

Interval	Start	Stop
SCREEN	456'	476'
304 STAINLESS STEEL		
Slot Size	.01"	

Interval	Start	Stop
SUMP	476'	478'

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-AUG-89
Well Name:	MWL-MW2	**Completion Zone:**	SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE
Date Drilling Started:	21-JUL-89	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	521		
Casing Depth:	477		

Survey Data

Survey Date: 12-APR-90

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411451.366

(Y) Northing: 1452692.592

Surveyed Elevations (FAMSL)

Protective Casing:	5378.18
Top of Inner Well Casing:	5377.26
Concrete Pad:	5376.49
Ground Surface:	5375.71

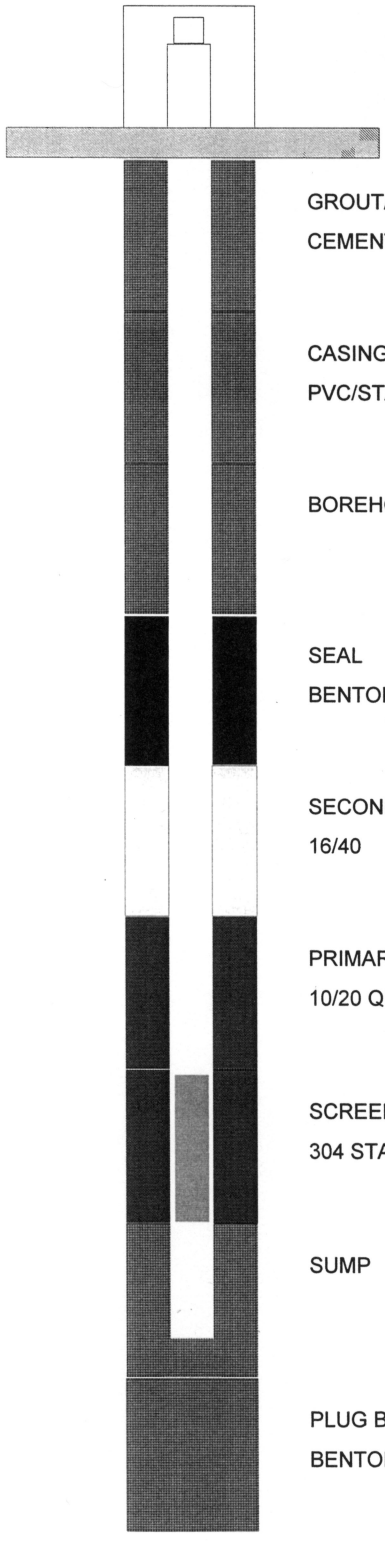
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.27
Initial Depth To Water: (FBGS)	453.99

Last measured water level was 4918.78 **FASL**
measured on 06-AUG-96

Date Updated: 28-NOV-01

Date Printed: 03-JAN-02



Completion Data Measured Depths (FBGS)

Casing Stickup: .77

Interval	Start	Stop
GROUT/BACKFILL	0'	430'
CEMENT/BENTONITE		

Interval	Start	Stop
CASING	0'	477'
PVC/STAINLESS STEEL	**I.D.**	5"

Interval	Start	Stop
BOREHOLE	0'	521'
	O.D.	12.25"

Interval	Start	Stop
SEAL	431'	442'
BENTONITE		

Interval	Start	Stop
SECONDARY PACK	442'	444'
16/40		

Interval	Start	Stop
PRIMARY PACK	444'	477'
10/20 QUARTZ SAND		

Interval	Start	Stop
SCREEN	452'	472'
304 STAINLESS STEEL		
	Slot Size	.01"

Interval	Start	Stop
SUMP	472'	477'

Interval	Start	Stop
PLUG BACK	477'	521'
BENTONITE		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA-III
ER ADS #:	1289	**Well Completion Date:**	22-AUG-89
Well Name:	MWL-MW3	**Completion Zone:**	SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE
Date Drilling Started:	20-AUG-89	**Well Comment:**	BOREHOLE TD AT 501', BACKFILL WITH .4 BENTONITE/CEMENT PLUG TO 478' ABOUT 1' OF 16/40 FN SIL SAND AT TOP OF FILTER PACK
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	501		
Casing Depth:	476.3		

Survey Data

Survey Date: 16-AUG-90

Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411407.995

(Y) Northing: 1452476.617

Surveyed Elevations (FAMSL)

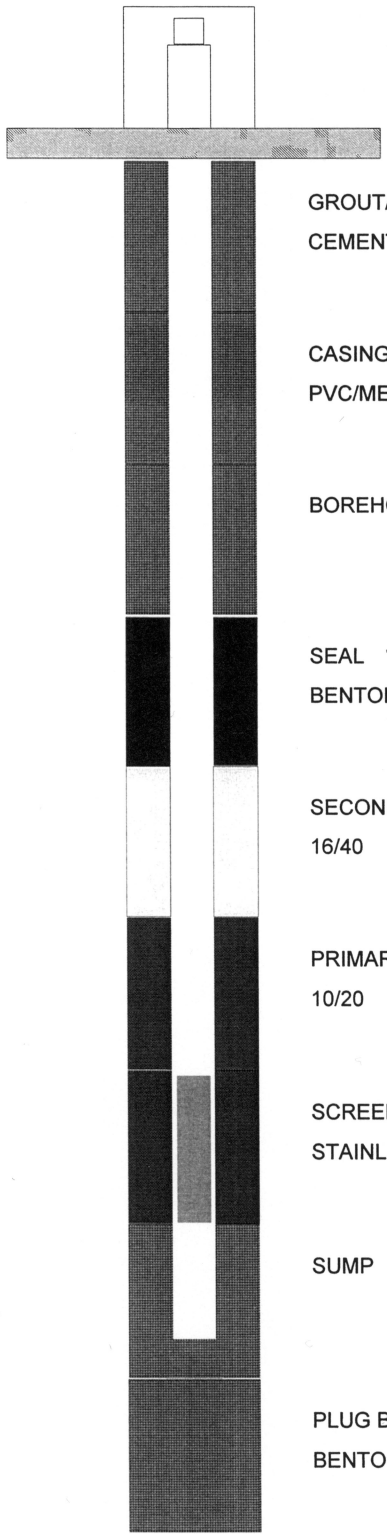
Protective Casing:	5381.78
Top of Inner Well Casing:	5381.32
Concrete Pad:	5379.41
Ground Surface:	5378.97

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4921.1	
Initial Depth To Water: (FBGS)	460.22	
Last measured water level was	4917.35	**FASL**
measured on	06-AUG-96	

Date Updated: 28-NOV-01

Date Printed: 03-JAN-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.91

Interval	Start	Stop
GROUT/BACKFILL	0'	429'
CEMENT/BENTONITE		

Interval	Start	Stop
CASING	0'	478.8'
PVC/METAL	**O.D.**	5"

Interval	Start	Stop
BOREHOLE	0'	501'
	O.D.	12.25"

Interval	Start	Stop
SEAL	429'	444'
BENTONITE		

Interval	Start	Stop
SECONDARY PACK	444'	446'
16/40		

Interval	Start	Stop
PRIMARY PACK	446'	476'
10/20		

Interval	Start	Stop
SCREEN	451.3'	471.3'
STAINLESS STEEL		
	Slot Size	.01"

Interval	Start	Stop
SUMP	471.3'	476.3'

Interval	Start	Stop
PLUG BACK	479'	501'
BENTONITE		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	10-FEB-93
Well Name:	MWL-MW4	**Completion Zone:**	FINE MEDIUM SAND/GRAVELLY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	16-DEC-92	**Well Comment:**	2 SCREENED INTERVALS
Drilling Contractor:	WATER DEVELOPMENT CORPOR		
Drilling Method:	SONIC/DRY		
Borehole Depth:	552.5		
Casing Depth:	548		

Survey Data

Survey Date: 15-MAY-94

Surveyed By: GREINER,INC.

State Plane Coordinates

(X) Easting: 411608.044

(Y) Northing: 1452565.255

Surveyed Elevations (FAMSL)

Protective Casing: 5384.05

Top of Inner Well Casing: 5383.46

Concrete Pad: 5381.35

Ground Surface: 5381.61

Calculated Depths and Elevations

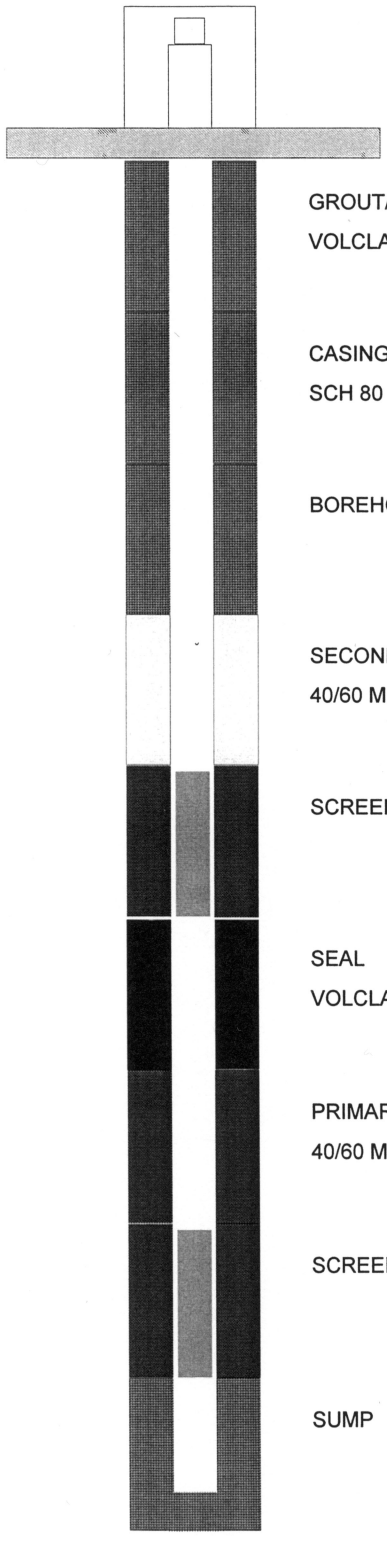
Initial Water Elevation (FAMSL): 4896.46

Initial Depth To Water (FBGS): 487

Last measured water level was measured on FASL

Date Updated: 28-NOV-01

Date Printed: 03-JAN-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.11

Interval	Start	Stop
GROUT/BACKFILL	0'	473'
VOLCLAY		

Interval	Start	Stop		
CASING	0'	548'		
SCH 80 PVC			**I.D.** 4.768"	**O.D.** 5.563"

Interval	Start	Stop	
BOREHOLE	0'	552.5'	
			O.D. 11"

Interval	Start	Stop
SECONDARY PACK	473'	508'
40/60 MESH		

Interval	Start	Stop
SCREEN	482.5'	502.5'
		Slot Size .01"

Interval	Start	Stop
SEAL	503'	520'
VOLCLAY/BENTONITE		

Interval	Start	Stop
PRIMARY PACK	520'	552.5'
40/60 MESH		

Interval	Start	Stop
SCREEN	522.5'	542.5'
		Slot Size .01"

Interval	Start	Stop
SUMP	542.5'	548'

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TAIII
ER ADS #:	1289	**Well Completion Date:**	19-NOV-00
Well Name:	MWL-MW5	**Completion Zone:**	SILTY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	03-OCT-00	**Well Comment:**	
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	ARCH		
Borehole Depth:	550		
Casing Depth:	496.5		

Survey Data

Survey Date: 26-JAN-01

Surveyed By: ALBUQUERQUE SURVEYING CO.

State Plane Coordinates

(X) Easting: 411261.94

(Y) Northing: 1452294.82

Surveyed Elevations (FAMSL)

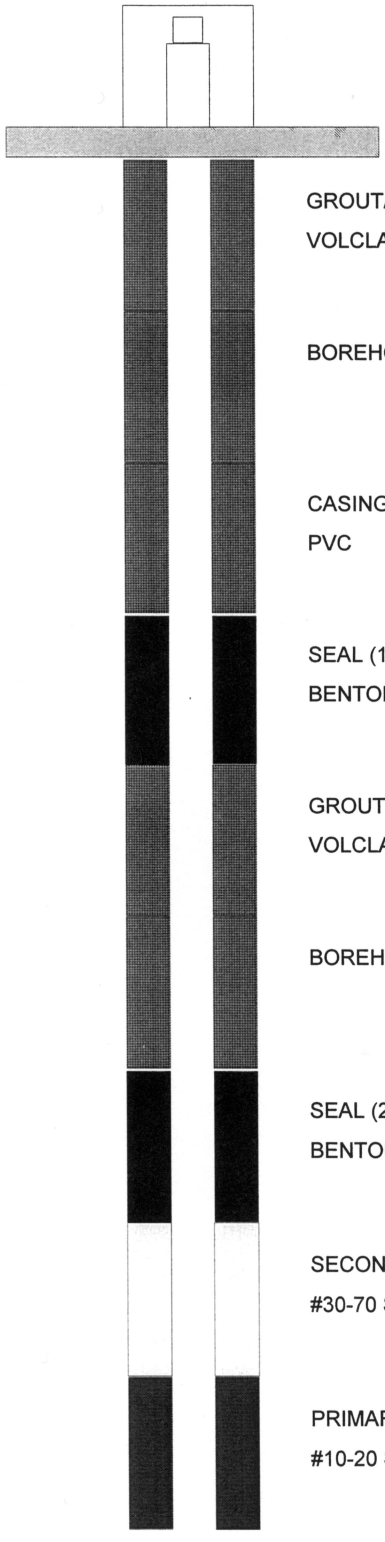
Protective Casing:	5380.53
Top of Inner Well Casing:	5379.89
Concrete Pad:	5377.97
Ground Surface:	5377.65

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	486.59	
Initial Depth To Water: (FBGS)	4893.3	
Last measured water level was measured on		**FASL**

Date Updated: 28-NOV-01

Date Printed: 03-JAN-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.24

Interval	Start	Stop
GROUT/BACKFILL (1)	0'	171'
VOLCLAY		

Interval	Start	Stop
BOREHOLE (1)	0'	300'
O.D.		11.75"

Interval	Start	Stop
CASING	0'	496.5'
PVC		

Interval	Start	Stop
SEAL (1)	171'	192'
BENTONITE PELLETS		

Interval	Start	Stop
GROUT/BACKFILL (2)	192'	465'
VOLCLAY		

Interval	Start	Stop
BOREHOLE (2)	300'	550'
O.D.		9.625"

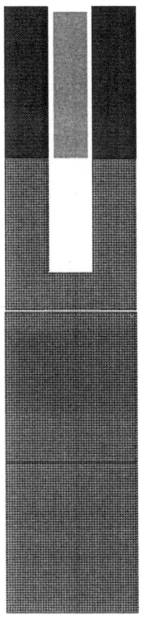
Interval	Start	Stop
SEAL (2)	465'	487'
BENTONITE PELLETS		

Interval	Start	Stop
SECONDARY PACK	487'	489'
#30-70 SAND		

Interval	Start	Stop
PRIMARY PACK	489'	521'
#10-20 SAND		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TAIII
ER ADS #:	1289	**Well Completion Date:**	19-NOV-00
Well Name:	MWL-MW5	**Completion Zone:**	SILTY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	03-OCT-00	**Well Comment:**	
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	ARCH		
Borehole Depth:	550		
Casing Depth:	496.5		



Interval	Start	Stop
SCREEN	496.5'	516.5'
5" PVC		
Slot Size	.02"	
Interval	**Start**	**Stop**
SUMP	516.5'	521.5'
Interval	**Start**	**Stop**
PLUG BACK (1)	521'	527'
BENTONITE PELLETS		
Interval	**Start**	**Stop**
PLUG BACK (2)	527'	546'
#10-20 SAND		

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	19-OCT-00
Well Name:	MWL-MW6	**Completion Zone:**	SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	07-SEP-00	**Well Comment:**	
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	ARCH		
Borehole Depth:	550		
Casing Depth:	505.5		

Survey Data

Survey Date: 26-JAN-01

Surveyed By: ALBUQUERQUE SURVEYING CO.

State Plane Coordinates

(X) Easting: 410925.5

(Y) Northing: 1452656.51

Surveyed Elevations (FAMSL)

Protective Casing:	5372.87
Top of Inner Well Casing:	5372.64
Concrete Pad:	5370.21
Ground Surface:	5369.96

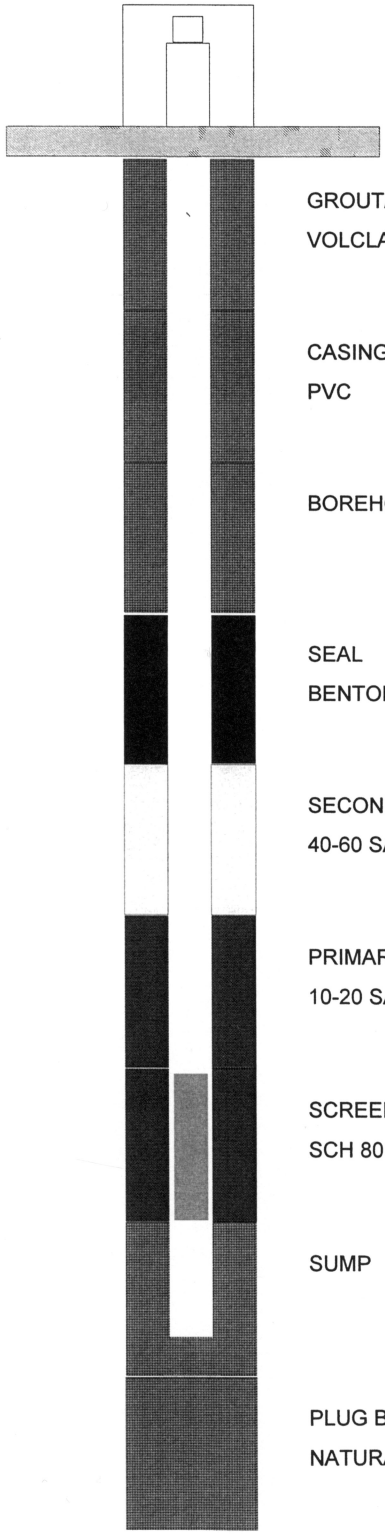
Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	483.84
Initial Depth To Water: (FBGS)	4888.8

Last measured water level was **FASL**
measured on

Date Updated: 28-NOV-01

Date Printed: 03-JAN-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.68

Interval	Start	Stop
GROUT/BACKFILL	0'	478'
VOLCLAY		

Interval	Start	Stop
CASING	0'	505.5'
PVC	**O.D.**	5"

Interval	Start	Stop
BOREHOLE	0'	550'
	O.D.	9.625"

Interval	Start	Stop
SEAL	478'	493'
BENTONITE PELLETS		

Interval	Start	Stop
SECONDARY PACK	493'	499'
40-60 SAND		

Interval	Start	Stop
PRIMARY PACK	499'	537'
10-20 SAND		

Interval	Start	Stop
SCREEN	505.5'	525.5'
SCH 80 PVC		
	Slot Size	.02"

Interval	Start	Stop
SUMP	525.5'	530.5'

Interval	Start	Stop
PLUG BACK	537'	550'
NATURAL BACKFILL		

Appendix B

Summary of Groundwater Sampling Events at the Mixed Waste Landfill

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Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Inorganics, and Organics

Sampling Date	Wells Sampled	Radionuclides		Inorganics		Organics	Laboratories
Sep-90	MW-1	Am-241	Ra-226	Sb	Se	-- Appendix IX VOCs (Method 8240)	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO
	MW-2	Be-7	Ra-228	As	Ag		
	MW-3	C-14	Sr-90	Ba	Tl	-- Appendix IX SVOCs (Method 8270)	
	BW-1	Cs-134	Th-230	Be	Sn		Radiochemical - IT Analytical Services, Richland, WA
		Cs-137	Th-232	Cd	V	-- Appendix IX Dioxins and Furans	
		Co-60	H-3	Cr	Zn		
		I-129	U-234	Co		-- Appendix IX Chlorinated Pesticides and PCBs (Method 8080)	
		Fe-55	U-235	Cu			
		Mn-54	U-238	Pb			
		Pu-238	Zn-65	Hg		-- Appendix IX Herbicides (Method 8150)	
		Pu-239/240	gross alpha	Ni			
		Po-210	gross beta			-- Total Organic Carbon (TOC) (Method 9060)	
		-- Filtered and Unfiltered		-- Total and Dissolved -- Method 6010 / 7060, 7421, 7470, 7740, and 7841		-- Total Organic Halogen (TOX) (Method 9020)	
						-- Phenolics	

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides		Inorganics		Organics	Laboratories
Jan-91	MW-1	Am-241	Ra-226	As	Mn	-- Chlorinated Pesticides (Method 8080)	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO
	MW-2	Cs-137	Ra-228	Ba	Hg	-- Herbicides (Method 8150)	
	MW-3	I-129	Sr-90	Cd	Se	-- TOC (Method 9060)	Radiochemical - IT Analytical Services, St. Louis, MO and IT Analytical Services, Oak Ridge, TN
	BW-1	Fe-55	gross alpha	Cr	Ag	-- TOX (Method 9020)	
		Po-210	gross beta	Fe	Na	-- Phenolics	
				Pb			
		-- Filtered and Unfiltered		-- Total and Dissolved			
				-- Method 6010 / 7060, 7421, 7470, and 7740			

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides		Inorganics		Organics	Laboratories
Apr-91	MW-1	Am-241	Ra-228	As	Mn	-- Chlorinated Pesticides (Method 8080)	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO
	MW-2	Cs-137	Sr-90	Ba	Hg	-- Herbicides (Method 8150)	Radiochemical - IT Analytical Services, Richland, WA
	MW-3	I-129	H-3	Cd	Se	-- TOC (Method 9060)	
	BW-1	Fe-55	gross alpha	Cr	Ag	-- TOX (Method 9020)	
		Po-210	gross beta	Fe	Na	-- Phenolics	
		Ra-226		Pb			
		-- Filtered and Unfiltered		-- Total and Dissolved -- Method 6010 / 7060, 7421, 7470, and 7740			

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Jul-91	MW-1 MW-2 MW-3 BW-1	I-129 gross alpha H-3 gross beta -- Filtered and Unfiltered -- Samples collected for Am-241, Cs-137, Fe-55, Po-210, Ra-226, Ra-228, and Sr-90 analysis were invalidated because they were not preserved.	As Mn Ba Hg Cd Se Cr Ag Fe Na Pb -- Total and Dissolved -- Method 6010 / 7060, 7421, 7470, and 7740	-- Chlorinated Pesticides (Method 8080) -- Herbicides (Method 8150) -- TOC (Method 9060) -- TOX (Method 9020) -- Phenolics	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO Radiochemical - IT Analytical Services, Richland, WA

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Oct-91	MW-1 MW-2 MW-3 BW-1	I-129 H-3 -- Filtered and Unfiltered -- Samples collected for Am-241, Cs-137, Fe-55, Po-210, Ra-226, Ra-228, and Sr-90, and gross alpha/beta analysis were invalidated because they were not preserved.	As Mn Ba Hg Cd Se Cr Ag Fe Na Pb -- Total and Dissolved -- Method 6010 / 7060, 7421, 7470, and 7740	-- Chlorinated Pesticides (Method 8080) -- Herbicides (Method 8150) -- TOC (Method 9060) -- TOX (Method 9020) -- Phenolics	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO Radiochemical - IT Analytical Services, Richland, WA

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Jan-92	MW-1 MW-2 MW-3 BW-1	Am-241 Ra-228 Cs-137 Sr-90 I-129 H-3 Fe-55 gross alpha Po-210 gross beta Ra-226 -- Filtered and Unfiltered	-- No samples collected for metals analysis.	-- TOC (Method 9060) -- TOX (Method 9020)	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO Radiochemical - IT Analytical Services, Richland, WA

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Metals	Organics	Laboratories
Jul-92	MW-1 MW-2 MW-3 BW-1	Am-241 Ra-228 Cs-137 Sr-90 I-129 H-3 Fe-55 gross alpha Po-210 gross beta Ra-226 gamma spec -- Filtered and Unfiltered	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb -- Total and Dissolved TAL metals -- Method 6010 / 7060, 7421, 7470, 7740, and 7841	-- Appendix IX VOCs (Method 8240) -- Target Compound List (TCL) for VOCs (Method 8240) -- Target Compound List (TCL) for SVOCs (Method 8270) -- TOC (Method 9060) -- TOX (Method 9020) -- Phenolics	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO Radiochemical - IT Analytical Services, Oak Ridge, TN

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides		Inorganics		Organics	Laboratories
Jan-93	MW-1	Am-241	Ra-228	Al	Mg	-- TOC	Chemical - Enseco/Rocky Mountain
	MW-2	Cs-137	Sr-90	Sb	Mn	(Method 9060)	Analytical (RMAL), Arvada, CO
	MW-3	I-129	H-3	Ar	Hg	-- TOX	
	BW-1	Fe-55	gross alpha	Ba	Ni	(Method 9020)	Radiochemical - IT Analytical Services,
		Po-210	gross beta	Be	K	-- Phenolics	Oak Ridge, TN
		Ra-226	gamma spec	Cd	Se		
				Ca	Ag		
		-- All samples unfiltered		Cr	Na		
				Co	Tl		
				Cu	V		
				Fe	Zn		
				Pb			
				-- Total TAL metals			
				-- Method 6010 / 7060, 7421, 7470, 7740, and 7841			

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides		Inorganics		Organics	Laboratories
Apr-93	MW-1 MW-2 MW-3 BW-1 MW-4(ul)[a]	Am-241 Cs-137 I-129 Fe-55 Po-210 Ra-226 -- All samples unfiltered	Ra-228 Sr-90 H-3 gross alpha gross beta gamma spec	Al Sb Ar Ba Be Cd Ca Cr Co Cu Fe Pb -- Total and Dissolved TAL metals -- Method 6010 / 7060, 7421, 7470, 7740, and 7841	Mg Mn Hg Ni K Se Ag Na Tl V Zn	-- TOC (Method 9060) -- TOX (Method 9020) -- Phenolics	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO Radiochemical -TMA / Eberline, Albuquerque, NM

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Nov-93	MW-1 MW-2 MW-3 BW-1 MW-4(ul)[a]	H-3 gross alpha Isotopic U gross beta Isotopic Th gamma spec Isotopic Pu -- All samples unfiltered -- Sr-90 anlyzed for in MW-4 only.	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb -- Total TAL metals -- Method 6010 / 7060, 7421, 7470, 7740, and 7841 -- Total cations	-- TOC (Method 9060) -- TOX (Method 9020) -- VOCs (Method 8240) analyzed for in MW-4 only. -- Phenolics	Chemical - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO Radiochemical -TMA / Eberline, Albuquerque, NM

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Apr-94	MW-1 MW-2 MW-3 BW-1[b] MW-4(u)[c] MW-4(l)[d]	H-3 Sr-90 Isotopic U gross alpha Isotopic Th gross beta Isotopic Pu gamma spec -- All samples unfiltered -- Ra-226 and Ra-228 analyzed for only in BW-1. -- Only H-3 and gamma spec analyzed for in MW-4 (l).	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb -- Total TAL metals -- Method 6010 / 7470 -- Select TAL metals analyzed for in BW-1 only: As, Ba, Cd, Cr, Fe, Pb, Mg, Mn, Hg, K, Se, Ag, and Na. -- Total cations	-- Target Compound List (TCL) for VOCs (Method 8240) -- Target Compound List (TCL) for SVOCs (Method 8270) -- Tentatively Identified Compounds (TIC) -- TOC (Method 9060) -- TOX (Method 9020) -- Hazardous Substance List VOCs (Method 8260) analyzed for in BW-1 only. -- Pesticides (Method 8080) analyzed for in BW-1 only. -- Herbicides (Method 8150) analyzed for in BW-1 only. -- Phenolics	Chemical - Quanterra Analytical Laboratory, Arvada, CO; and Environmental Controls Technology Corp. (ENCOTEC), Ann Arbor, MI Radiochemical -TMA / Eberline, Albuquerque, NM

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Metals	Organics	Laboratories
Oct-94	MW-1 MW-2 MW-3 BW-1[b] MW-4(u)[c]	H-3 Sr-90 Isotopic U gross alpha Isotopic Th gross beta Isotopic Pu gamma spec Total U -- All samples unfiltered -- Hydrogen / Deuterium analyzed for in BW-1 only.	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb -- Total TAL metals -- Method 6010 / 7470	-- Target Compound List (TCL) for VOCs (Method 8240) -- Target Compound List (TCL) for SVOCs (Method 8270) -- Tentatively Identified Compounds (TIC) -- TOC (Method 9060) -- TOX (Method 9020) -- Pesticides (Method 8080) analyzed for in BW-1 only. -- Herbicides (Method 8150) analyzed for in BW-1 only. -- Phenolics	Chemical - Quanterra Analytical Laboratory, Arvada, CO Radiochemical - Quanterra Analytical Laboratory, St. Louis, MO Chemical - Environmental Controls Technology Corp. (ENCOTEC), Ann Arbor, MI (BW-1 only) Radiochemical - Thermo Analytical, Albuquerque, NM (BW-1 only) Geochron Laboratories, Cambridge, MA (hydogen / deuterium sample for for BW-1 only).

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Metals	Organics	Laboratories
Apr-95	MW-1 MW-2 MW-3 BW-1[b] MW-4(u)[c]	H-3 Sr-90 Isotopic U gross alpha Isotopic Th gross beta Isotopic Pu gamma spec Total U -- All samples unfiltered	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb -- Total TAL metals -- Method 6010 / 7470	-- Target Compound List (TCL) for VOCs (Method 8260) -- Target Compound List (TCL) for SVOCs (Method 8270) -- Tentatively Identified Compounds (TIC) -- TOC (Method 9060) -- TOX (Method 9020) -- Phenolics	Chemical - Quanterra Analytical Laboratory, Arvada, CO Radiochemical - Lockheed Analytical Services (LAS), Las Vegas, NV Chemical - Environmental Controls Technology Corp. (ENCOTEC), Ann Arbor, MI (BW-1 only) Radiochemical - Thermo Analytical, Albuquerque, NM (BW-1 only) General Engineering Laboratory (GEL), Charleston, SC (a split sample from MW-4 (u) was analyzed at GEL for VOCs)

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Metals	Organics	Laboratories
Oct-95	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 Sr-90 Isotopic U gross alpha Isotopic Th gross beta Isotopic Pu gamma spec Total U -- All samples unfiltered	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb -- Total TAL metals -- Method 6010A / 7470	-- Target Compound List (TCL) for VOCs (Method 8240/8260) -- Target Compound List (TCL) for SVOCs (Method 8250/8270) -- TOC (Method 9060) -- TOX (Method 9020) -- Phenolics	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - Lockheed Analytical Services (LAS), Las Vegas, NV

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Apr-96	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 Isotopic U Isotopic Th Isotopic Pu Total U -- All samples unfiltered Sr-90 gross alpha gross beta gamma spec	Al Sb Ar Ba Be Cd Ca Cr Co Cu Fe Pb Mg Mn Hg Ni K Se Ag Na Tl V Zn -- Total TAL metals -- Method 6010A / 7470 -- The following major dissolved cations were analyzed for: Ca, Fe, K, Mg, and Na.	-- Target Compound List (TCL) for VOCs (Method 8240/8260) plus library search for Tentatively Identified Compounds (TIC) -- Target Compound List (TCL) for SVOCs (Method 8250/8270) plus library search for Tentatively Identified Compounds (TIC) -- TOC (Method 9060) -- TOX (Method 9020) -- Phenolics	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - Lockheed Analytical Services (LAS), Las Vegas, NV

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Apr-97	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 gross beta Sr-90 gamma spec gross alpha -- All samples unfiltered	As Pb Ba Hg Be Se Cd Ag Cr -- Total RCRA metals plus Be -- Method 6020	-- VOCs (Method 8260)	Chemical - Environmental Restoration Chemical Laboratory (ERCL), SNL/NM, Albuquerque, NM Radiochemical - Lockheed Analytical Services (LAS), Las Vegas, NV

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Oct-97	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 gross beta Sr-90 gamma spec gross alpha -- All samples unfiltered	As Pb Ba Hg Cd Se Cr Ag -- Total and Dissolved RCRA metals -- Method 6010A / 7470	-- VOCs (Method 8260)	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - Lockheed Analytical Services (LAS), Las Vegas, NV

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Apr-98	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 gross beta Sr-90 gamma spec gross alpha -- All samples unfiltered	As Hg Ba Ni Cd Se Cr Ag Pb -- Total and Dissolved RCRA metals plus Ni -- Method 6010 / 7470	-- VOCs (Method 8260)	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC Quanterra Environmental Services, Earth City, MO (split samples from MW-1, MW-2, MW-3, MW-4 (u), and BW-1 were analyzed at Quanterra for VOCs and total metals)

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Aug-98	MW-1	H-3 gross alpha gross beta alpha spec gamma spec	Al Sb Ar Ba Be Cd Ca Cr Co Cu Fe Pb Mg Mn Hg Ni K Se Ag Na Tl V Zn -- Total and Dissolved TAL metals -- Method 6010 / 7470	-- No samples analyzed for organics.	Chemical - Environmental Restoration Chemical Laboratory (ERCL), SNL/NM, Albuquerque, NM (used by SNL/NM for split samples collected from MW-1) EPA-certified laboratory selected by TechLaw, Inc. (used by EPA/NMED for split samples collected from MW-1)

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Nov-98	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 gross alpha Sr-90 gross beta -- All samples unfiltered	As Hg Ba Ni Cd Se Cr Ag Pb -- Total and Dissolved RCRA metals plus Ni -- Method 6020 / 7470	-- VOCs (Method 8260)	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Jan-99	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	Sr-90 -- All samples unfiltered -- Samples collected for Sr-90 reanalysis.	-- No samples collected for metals reanalysis.	-- VOCs (Method 8260) -- Samples collected for VOCs reanalysis.	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Apr-99	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 gross alpha Sr-90 gross beta -- All samples unfiltered	As Hg Ba Ni Cd Se Cr Ag Pb -- Total and Dissolved RCRA metals plus Ni -- Method 6020 / 7470	-- VOCs (Method 8260)	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Apr-00	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c]	H-3 gross alpha Sr-90 gross beta gamma spec -- All samples unfiltered -- Gamma Spec analysis performed onsite at RPSD	As Hg Ba Ni Cd Se Cr Ag Pb -- Dissolved RCRA metals plus Ni for MW-1 only -- Total RCRA metals plus Ni for MW-1, MW-2, MW-3, and MW-4 (u)[c] -- Method 6020 / 7470 -- Dissolved Ni and Cr using Hach field kit for MW-1 only	-- VOCs (Method 8260)	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC Gamma Spec - RPSD Laboratory, Building 881, SNL/NM

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Oct-00	BW-1 MW-4(u)[c]	-- No radiochemical analyses performed	-- No metals analyses performed	-- VOCs (Method 8260)	Chemical - General Engineering Laboratory (GEL), Charleston, SC

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Jan-01	MW-5 MW-6	H-3 gross alpha Sr-90 gross beta gamma spec -- All samples unfiltered -- Gamma spec samples from MW-5 and MW-6 analyzed onsite at RPSD and also offsite at GEL -- Tritium samples from MW-5 and MW-6 analyzed onsite at RPSD and also offsite at GEL	-- Total TAL metals plus uranium Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb U -- Method 6020	-- VOCs (Method 8260)	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC Gamma Spec and Tritium - RPSD Laboratory, Building 881, SNL/NM

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Feb-01	MW-4(u)[c]	H-3 gamma spec -- All samples unfiltered -- Gamma spec and H-3 analyses performed onsite at RPSD on MW-4 (u)[c] only (samples collected after 3 purge volumes)	-- No metals analyses performed	-- VOCs (Method 8260) -- Samples collected form MW-4 (u)[c] only -- One set of samples collected prior to purging and analyzed offsite at GEL -- One set of samples collected after 3 purge volumes and analyzed offsite at GEL	Chemical - General Engineering Laboratory (GEL), Charleston, SC Gamma Spec and Tritium - RPSD Laboratory, Building 881, SNL/NM

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (concluded)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Apr-01	MW-1 MW-2 MW-3 BW-1 MW-4(u)[c] MW-5 MW-6	H-3 gross alpha Sr-90 gross beta isotopic U gamma spec -- All samples unfiltered -- Isotopic U analyses performed onsite at RPSD -- All other radiochemical analyses performed offsite at GEL	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb U -- Total TAL metals plus uranium -- Method 6020	-- VOCs (Method 8260) -- SVOCs (method 8270) -- SVOC analysis performed on samples collected from MW-5 and MW-6 only	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC Isotopic uranium - RPSD Laboratory, Building 881, SNL/NM

see footnotes at the end of the table

Mixed Waste Landfill Historical Groundwater Sampling Record
Radionuclides, Metals, and Organics (continued)

Sampling Date	Wells Sampled	Radionuclides	Inorganics	Organics	Laboratories
Jul-01	MW-5 MW-6	Tritium gross alpha Sr-90 gross beta gamma spectroscopy -- All samples unfiltered -- Gamma spec samples from MW-5 and MW-6 analyzed onsite at RPSD and also offsite at GEL -- Tritium samples from MW-5 and MW-6 analyzed onsite at RPSD and also offsite at GEL	Al Mg Sb Mn Ar Hg Ba Ni Be K Cd Se Ca Ag Cr Na Co Tl Cu V Fe Zn Pb U -- Method 6010B	VOCs (Method 8260) SVOCs (Method 8270)	Chemical - General Engineering Laboratory (GEL), Charleston, SC Radiochemical - General Engineering Laboratory (GEL), Charleston, SC Gamma Spec and Tritium - RPSD Laboratory, Building 881, SNL/NM

Analytical methods from EPA 1986 and EPA 1983.
Appendix IV - Resource and Conservation Recovery Act
[a] MW-4 (ul) - Sample collected from the combined upper and lower screened intervals of monitoring well MW-4.
[b] Monitoring well BW-1 sampled under the SNL/NM Ground Water Surveillance Program (GWSP).
[c] MW-4 (u) - Sample collected from the upper screened interval of monitoring well MW-4.
[d] MW-4 (l) - Sample collected from the lower screened interval of monitoring well MW-4.
H3 - Tritium
MW - Monitoring Well
MWL - Mixed Waste Landfill
RPSD - Radiation Protection Sample Diagnostics
SVOCs - Semivolatile Organic Compounds
TAL - Target Analyte List
TCL - Target Compound List
TOC - Total Organic Compounds
TOX - Total Halogenated Compounds
VOCs - Volatile Organic Compounds

Mixed Waste Landfill Historical Groundwater Sampling Record
Groundwater Field Measurements, Inorganic Analysis, and Bacteriological Analysis

Sampling Date	Wells Sampled	Field Measurements	Inorganic Analysis	Bacteriological Analysis	Laboratories
Aug-86	MW-1, MW-2, MW-3, BW-1	pH, Temperature, Specific Conductivity	Cl, F, NO_3 as N, SO_4, CN, total S	Coliform Bacteria	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO; Bacteriological - Assaigai Analytical Laboratory, Albuquerque, NM
Dec-86	MW-1, MW-2, MW-3, BW-1	pH, Temperature, Specific Conductivity	Cl, F, NO_3 as N, SO_4	Coliform Bacteria	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO; Bacteriological - Assaigai Analytical Laboratory, Albuquerque, NM
Mar-87	MW-1, MW-2, MW-3, BW-1	pH, Temperature, Specific Conductivity	Cl, F, NO_3 as N, SO_4	Coliform Bacteria	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO; Bacteriological - Assaigai Analytical Laboratory, Albuquerque, NM
Jun-87	MW-1, MW-2, MW-3, BW-1	pH, Temperature, Specific Conductivity	Cl, F, NO_3 as N, SO_4	Coliform Bacteria	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO; Bacteriological - Assaigai Analytical Laboratory, Albuquerque, NM
Sep-87	MW-1, MW-2, MW-3, BW-1	pH, Temperature, Specific Conductivity	Cl, F, NO_3 as N, SO_4	Coliform Bacteria	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO; Bacteriological - Assaigai Analytical Laboratory, Albuquerque, NM
Dec-87	MW-1, MW-2, MW-3, BW-1	pH, Temperature, Specific Conductivity	No samples collected for inorganic analysis	No samples collected for bacteriological analysis	

Mixed Waste Landfill Historical Groundwater Sampling Record
Groundwater Field Measurements, Inorganic Analysis, and Bacteriological Analysis (continued)

Sampling Date	Wells Sampled	Field Measurements	Inorganic Analysis	Bacteriological Analysis	Laboratories
Jun-88	MW-1, MW-2, MW-3, BW-1	pH, Temperature, Specific Conductivity	Cl, SO_4	No samples collected for bacteriological analysis	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO
Dec-88	MW-1, MW-2, MW-3, BW-1	Eh, Turbidity, pH, Temperature, Specific Conductivity	Cl, SO_4	No samples collected for bacteriological analysis	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO
Mar-89	MW-1, MW-2, MW-3, BW-1, MW-4 (ul)	Eh, pH, Temperature, Specific Conductivity	Cl, SO_4, NO_3 as N, Alkalinity	No samples collected for bacteriological analysis	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO
Oct-89	MW-1, MW-2, MW-3, BW-1, MW-4 (ul)	Eh, pH, Temperature, Specific Conductivity	Cl, F, SO_4, Ammonia, NPN, Alkalinity, total anions, TDS	No samples collected for bacteriological analysis	Inorganics - Enseco/Rocky Mountain Analytical (RMAL), Arvada, CO
Mar-90	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	pH, Turbidity, Temperature, Specific Conductivity	Br,Cl,F, SO_4, Ammonia, Nitrate, NPN, Alkalinity, Phosphorus, total anions, TDS	No samples collected for bacteriological analysis	Inorganics - Quanterra Inc., Arvada, CO
Sep-90	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	pH, Temperature, Specific Conductivity	Br, Cl, F, SO_4, Ammonia, NPN, Alkalinity, Phosphorous, TDS	No samples collected for bacteriological analysis	Inorganics - Quanterra Inc, Arvada, CO

Mixed Waste Landfill Historical Groundwater Sampling Record
Groundwater Field Measurements, Inorganic Analysis, and Bacteriological Analysis (continued)

Sampling Date	Wells Sampled	Field Measurements	Inorganic Analysis	Bacteriological Analysis	Laboratories
Mar-91	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	Alkalinity, Cl, F, Br, SO_4, Ammonia, NPN, Nitrate, TDS	No samples collected for bacteriological analysis	Inorganics - Quanterra Inc, Arvada, CO
Sep-91	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	Alkalinity, Cl, F, SO_4, Ammonia, NPN, Nitrate	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Mar-92	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	Alkalinity, Cl, F, SO_4, Ammonia, NPN, Nitrate	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Mar-93	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	Nitrate (as N), NO_3 as N	No samples collected for bacteriological analysis	Inorganics - Environmental Restoration Project Chemistry Laboratory (ERCL), SNL/NM, Albuquerque, NM
Sep-93	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	NPN	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Mar-94	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	NPN	No samples collected for bacteriological analysis	Inorganics - Quantera Inc, St. Louis, MO

Mixed Waste Landfill Historical Groundwater Sampling Record
Groundwater Field Measurements, Inorganic Analysis, and Bacteriological Analysis (continued)

Sampling Date	Wells Sampled	Field Measurements	Inorganic Analysis	Bacteriological Analysis	Laboratories
Aug-94	MW-1	pH, Turbidity, Temperature, Specific Conductivity	No samples collected for inorganic analysis	No samples collected for bacteriological analysis	
Oct-94	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	NPN	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Dec-94	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	No samples collected for inorganic reanalysis	No samples collected for bacteriological analysis	
Mar-95	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	NPN	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Mar-96	MW-1, MW-2, MW-3, BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	NPN	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Sep-96	BW-1, MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	No samples collected for inorganic analysis	No samples collected for bacteriological analysis	

Mixed Waste Landfill Historical Groundwater Sampling Record
Groundwater Field Measurements, Inorganic Analysis, and Bacteriological Analysis (concluded)

Sampling Date	Wells Sampled	Field Measurements	Inorganic Analysis	Bacteriological Analysis	Laboratories
Dec-96	MW-5, MW-6	Eh, pH, Turbidity, Temperature, Specific Conductivity	Alkalinity, Cl, F, Br, SO4, NPN, Perchlorate	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Jan-97	MW-4 (upper)	Eh, pH, Turbidity, Temperature, Specific Conductivity	Perchlorate, TDS	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Mar-97	MW-1, MW-2, MW-3, BW-1, MW-4 (upper), MW-5, MW-6	Eh, pH, Turbidity, Temperature, Specific Conductivity	Cl, F, Br, SO4, NPN [Perchlorate (MW-1 and MW-2 only)][a]	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC
Jun-97	MW-5, MW-6	Eh, pH, Turbidity, Temperature, Specific Conductivity	Alkalinity, Cl, F, Br, SO4, NPN	No samples collected for bacteriological analysis	Inorganics - General Engineering Laboratories (GEL), Charleston, SC

MW-4 (upper) - Sample collected from the upper screened interval of monitoring well MW-4.

[a] Split with NMED

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Appendix C

Slug Test Results from Mixed Waste Landfill Wells, 2001

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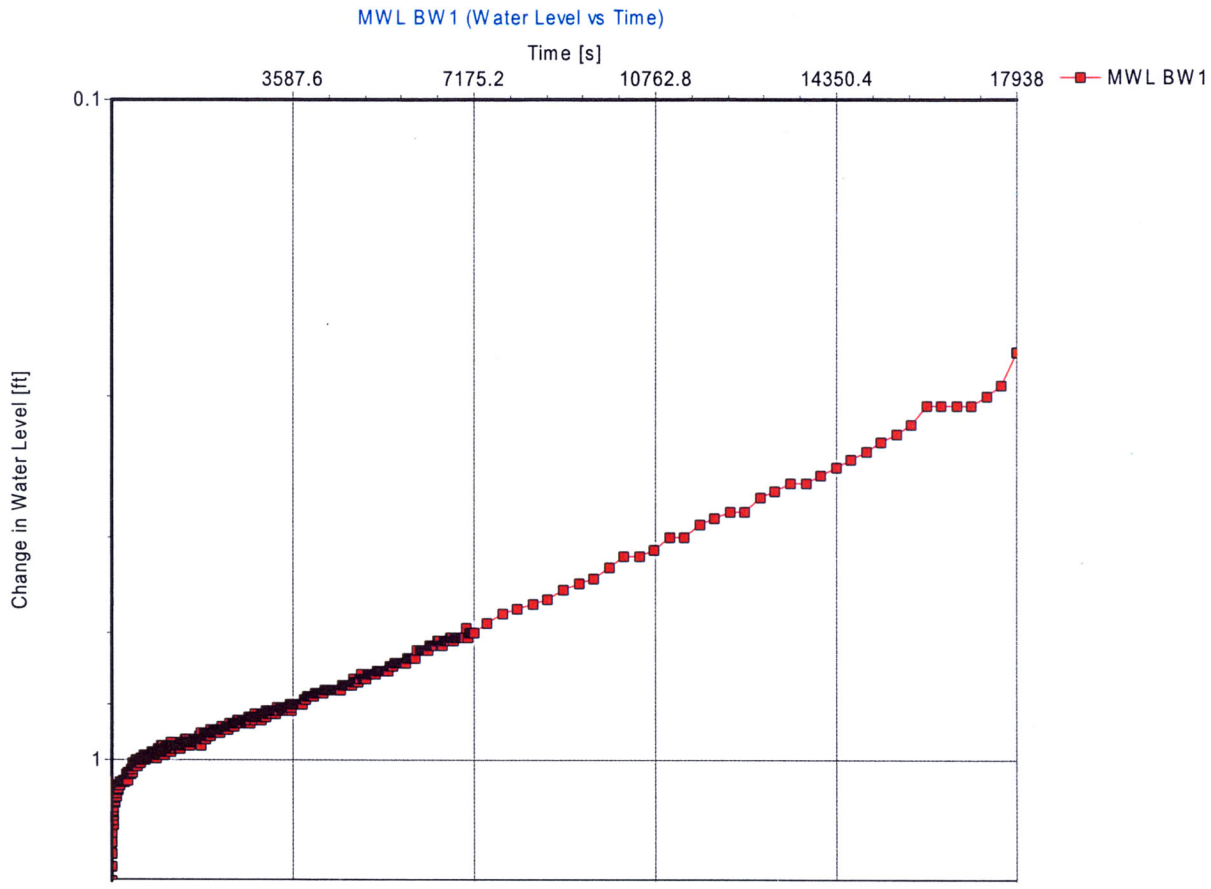
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL BW1**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:				
	Test well:	MWL BW1	Aquifer thickness:	10.88 [ft]
	Screen radius:	0.51 [ft]		
	Screen length:	10.88 [ft]		
	Casing radius:	0.21 [ft]		

Comments:

Evaluated by:

Date: 07/11/20

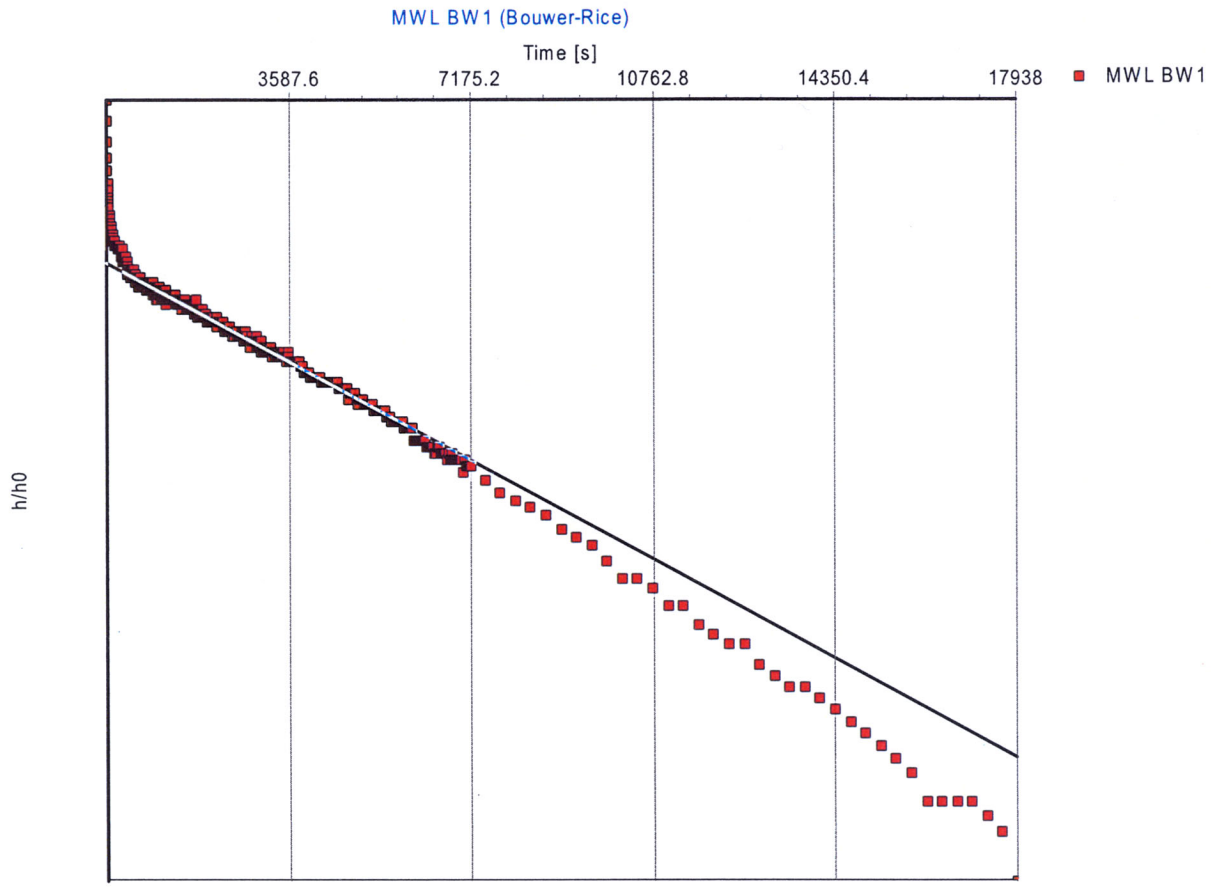
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL BW1**

Analysis method: **Bouwer-Rice**

Analysis results:

Conductivity: 9.34E-6 [cm/s]

Test parameters:				
	Test well:	MWL BW1	Aquifer thickness:	10.88 [ft]
	Screen radius:	0.51 [ft]	Gravel pack Porosity (%)	25
	Screen length:	10.88 [ft]		
	Casing radius:	0.21 [ft]		
	r(eff):	0.313 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

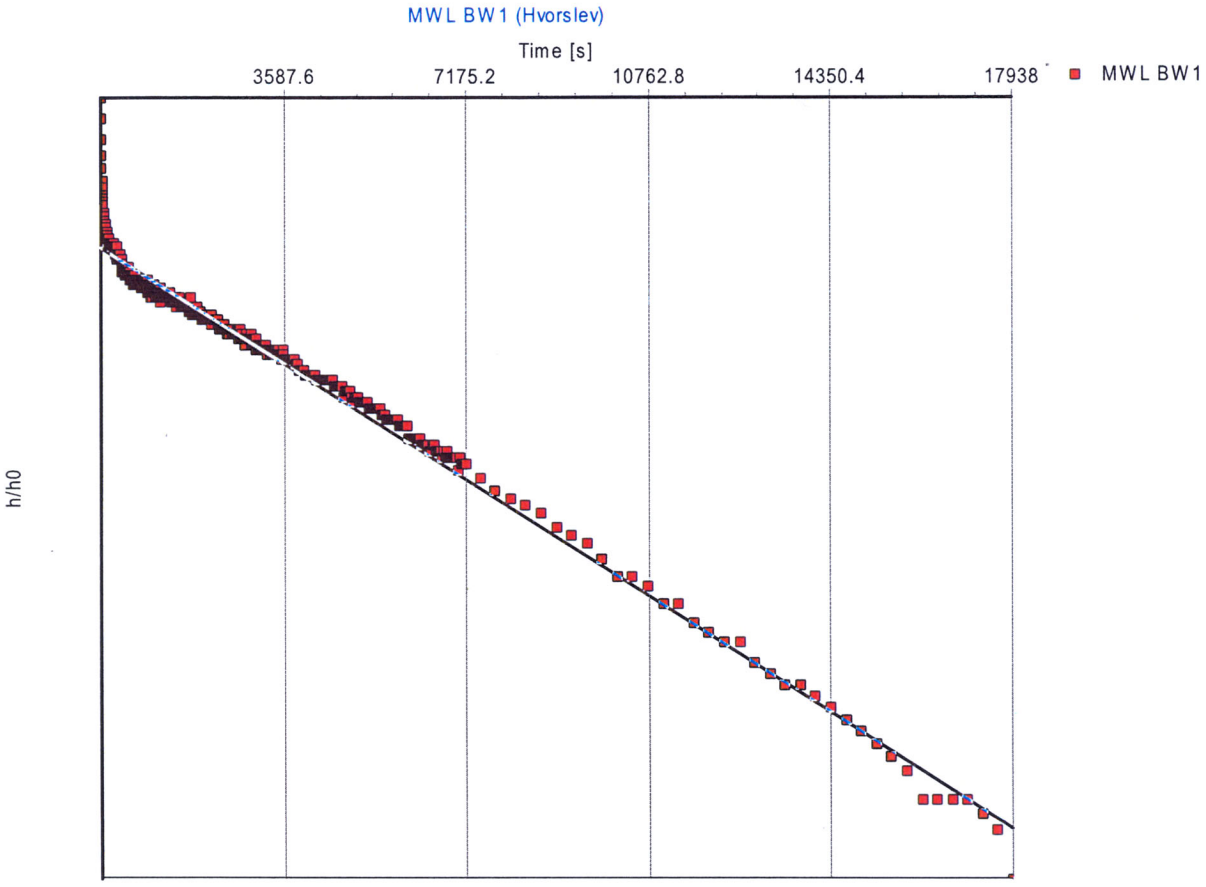
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL BW1**

Analysis method: **Hvorslev**

Analysis results:

Conductivity: 1.46E-5 [cm/s]

Test parameters:

Test well:	MWL BW1	Aquifer thickness:	10.88 [ft]
Screen radius:	0.51 [ft]		
Screen length:	10.88 [ft]		
Casing radius:	0.21 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

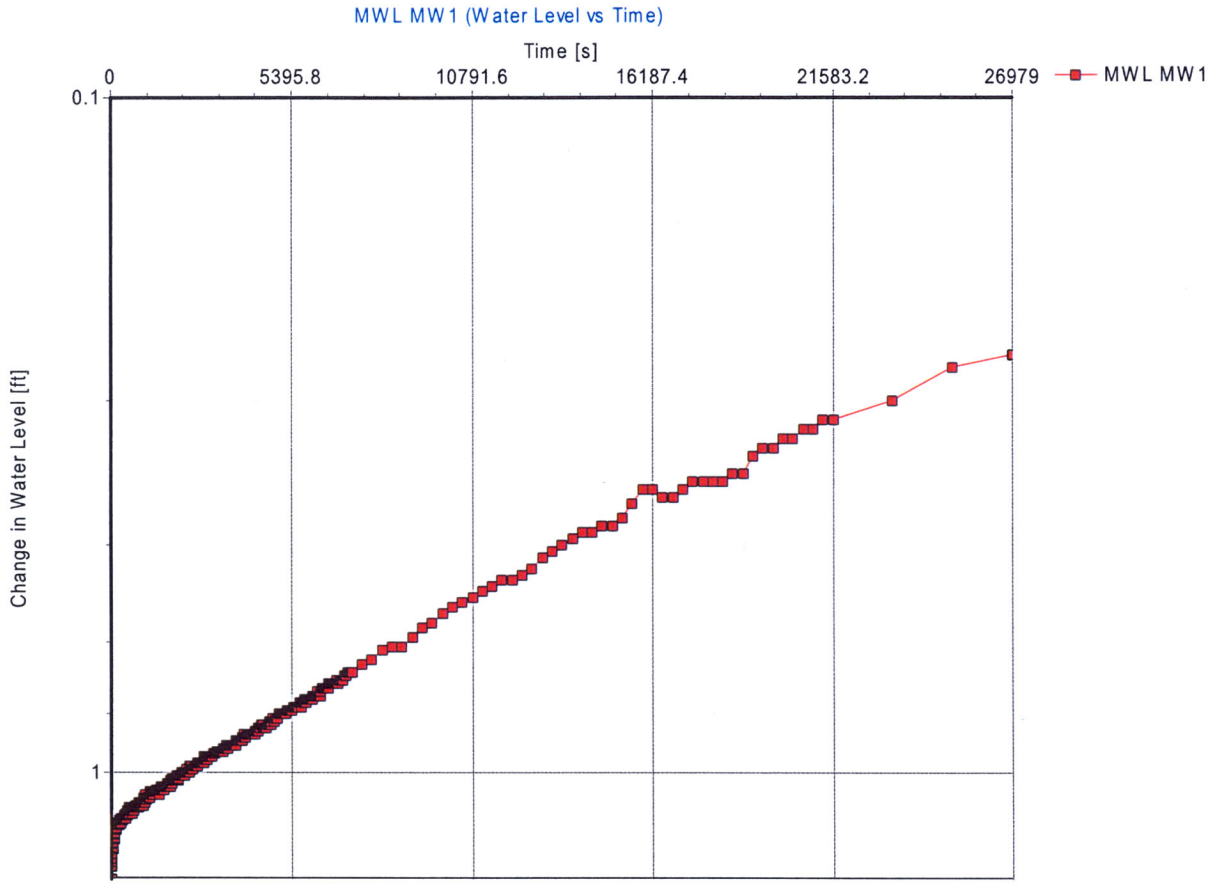
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW1**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:				
	Test well:	MWL MW1	Aquifer thickness:	15.01 [ft]
	Screen radius:	0.417 [ft]		
	Screen length:	15.01 [ft]		
	Casing radius:	0.21 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

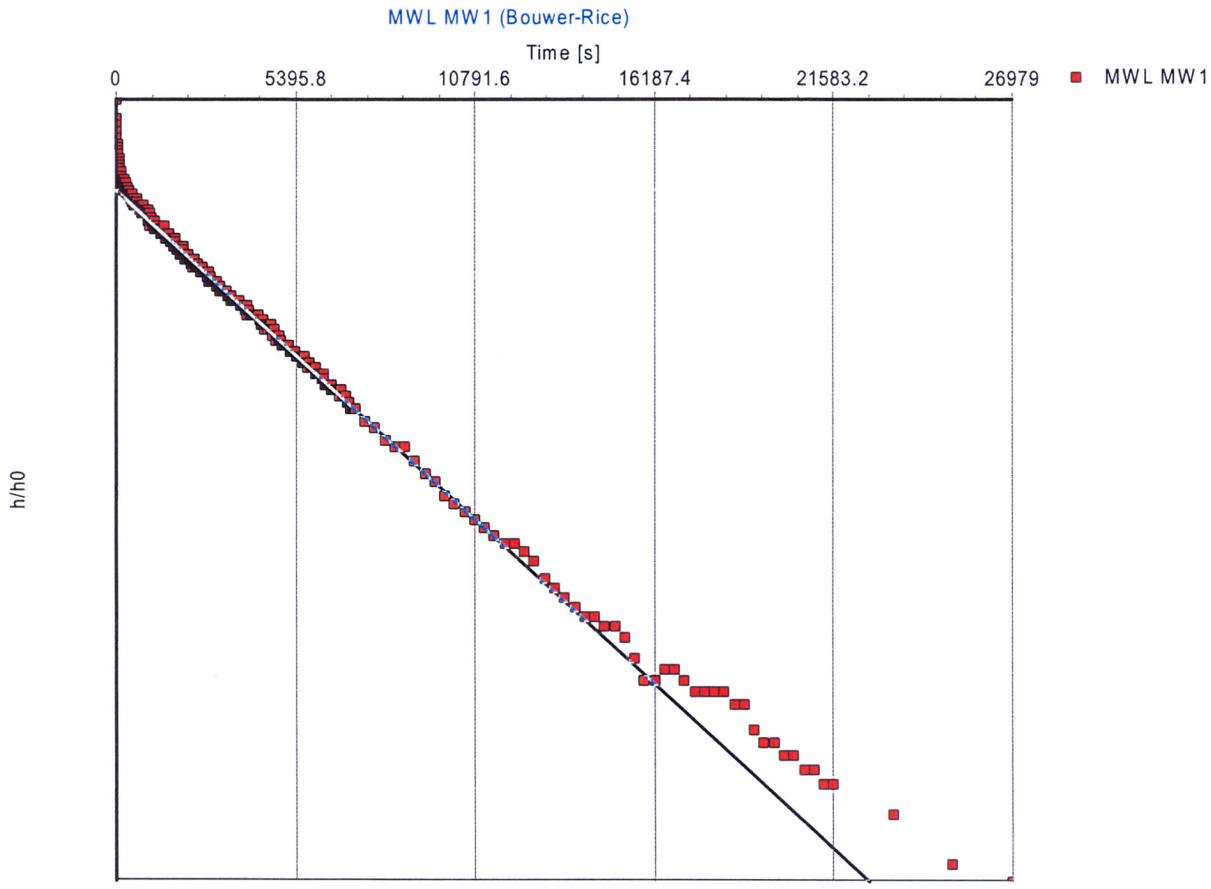
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW1**

Analysis method: **Bouwer-Rice**

Analysis results:

Conductivity: 8.58E-6 [cm/s]

Test parameters:

Test well:	MWL MW1	Aquifer thickness:	15.01 [ft]
Screen radius:	0.417 [ft]	Gravel pack Porosity (%)	25
Screen length:	15.01 [ft]		
Casing radius:	0.21 [ft]		
r(eff):	0.277 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

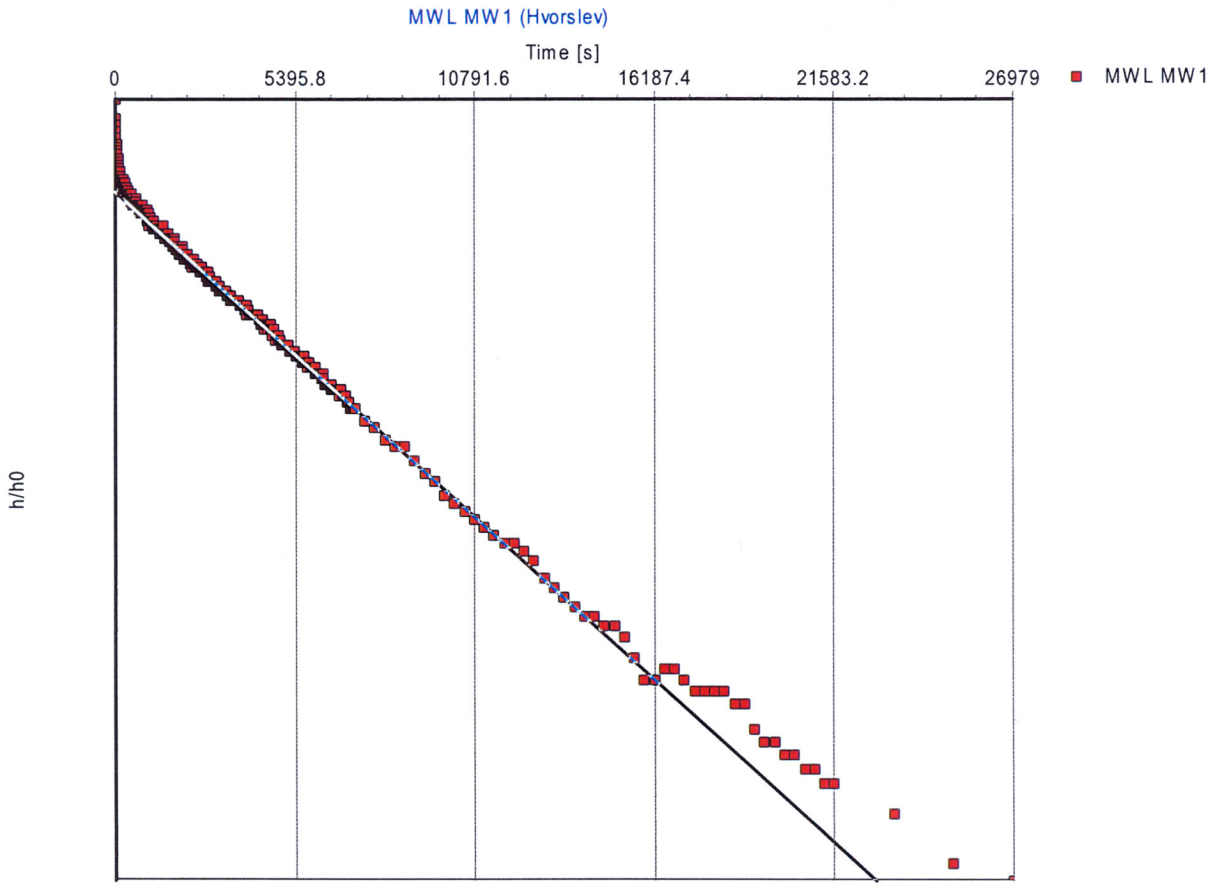
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW1**

Analysis method: **Hvorslev**

Analysis results:

Conductivity: 1.12E-5 [cm/s]

Test parameters:

Test well:	MWL MW1	Aquifer thickness:	15.01 [ft]
Screen radius:	0.417 [ft]		
Screen length:	15.01 [ft]		
Casing radius:	0.21 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

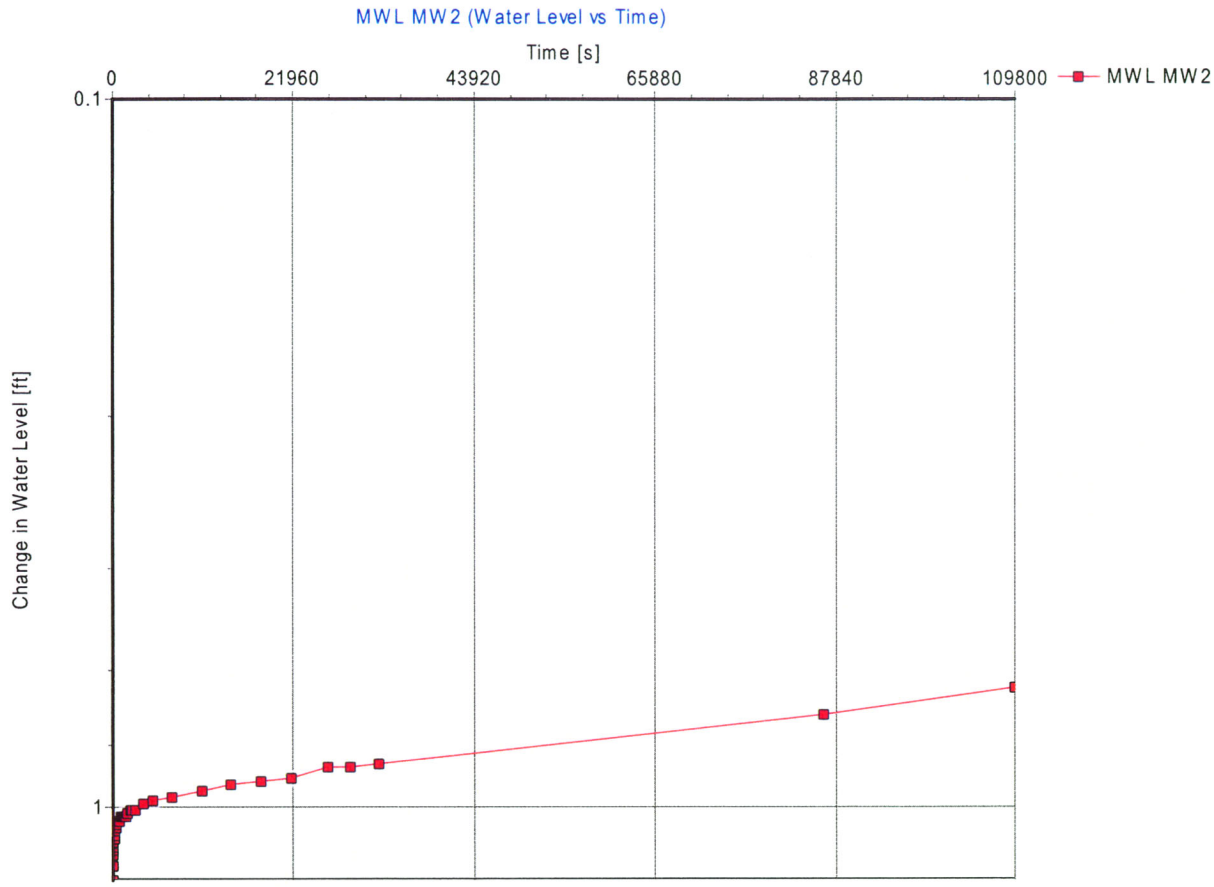
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW2**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:				
	Test well:	MWL MW2	Aquifer thickness:	17.14 [ft]
	Screen radius:	0.51 [ft]		
	Screen length:	17.14 [ft]		
	Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

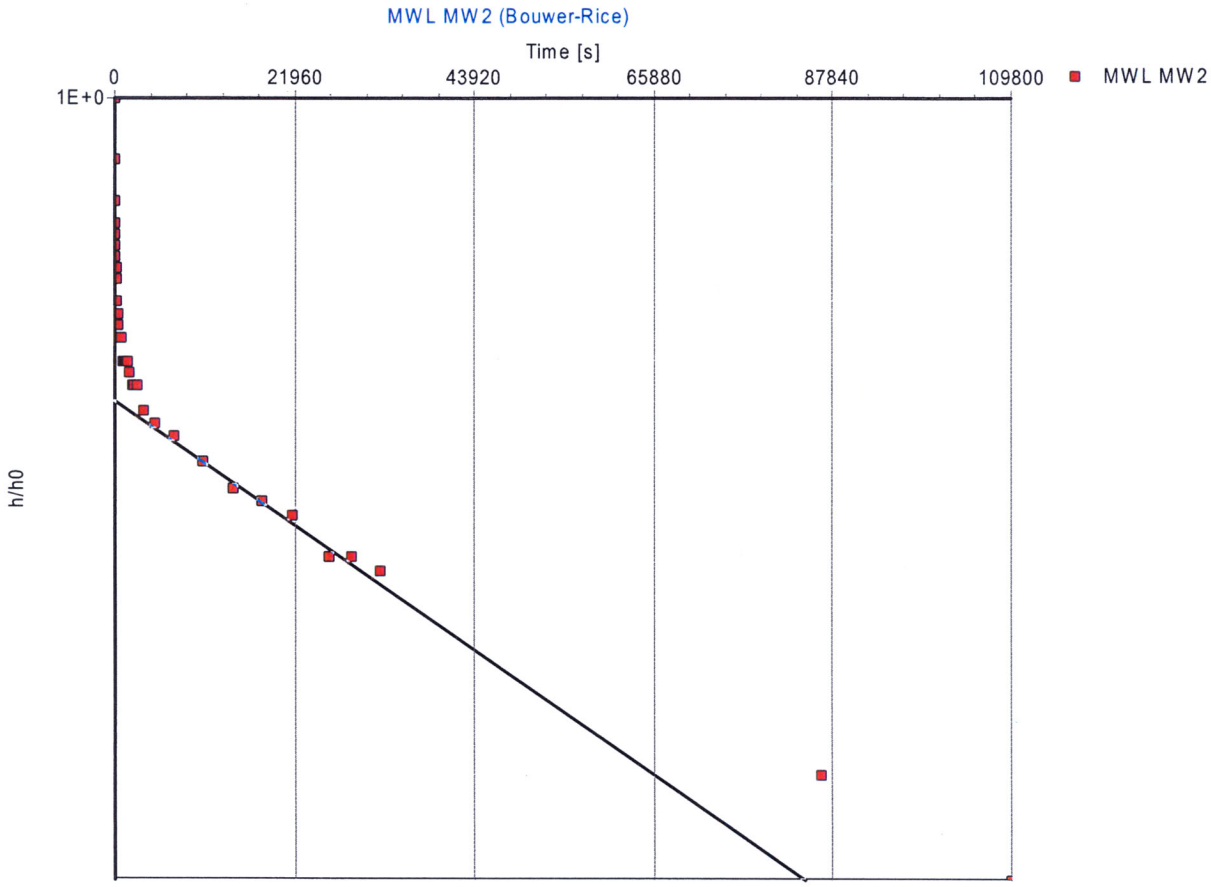
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW2**

Analysis method: **Bouwer-Rice**

Analysis results:

Conductivity: 4.70E-7 [cm/s]

Test parameters:

Test well:	MWL MW2	Aquifer thickness:	17.14 [ft]
Screen radius:	0.51 [ft]	Gravel pack Porosity (%)	25
Screen length:	17.14 [ft]		
Casing radius:	0.208 [ft]		
r(eff):	0.312 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

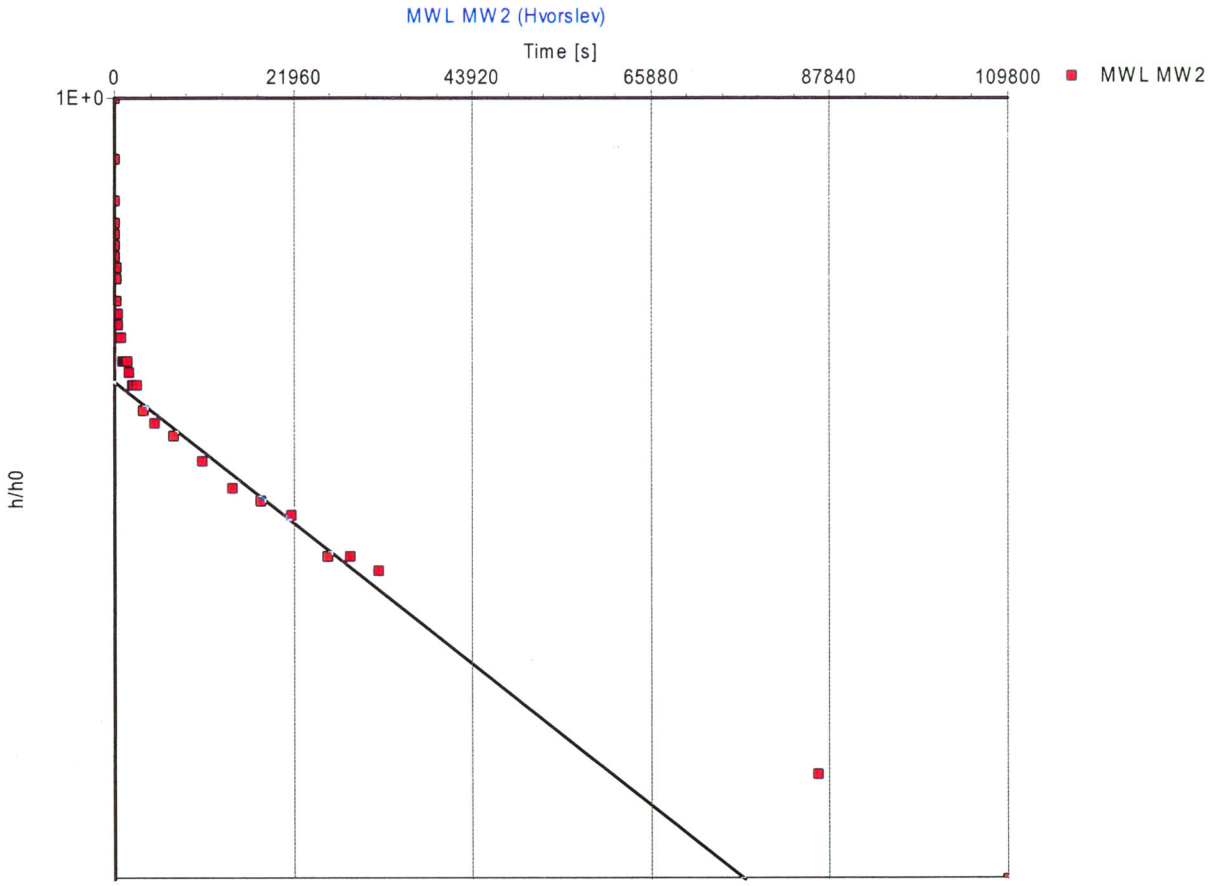
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW2**

Analysis method: **Hvorslev**

Analysis results:

Conductivity: 6.99E-7 [cm/s]

Test parameters:

Test well:	MWL MW2	Aquifer thickness:	17.14 [ft]
Screen radius:	0.51 [ft]		
Screen length:	17.14 [ft]		
Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

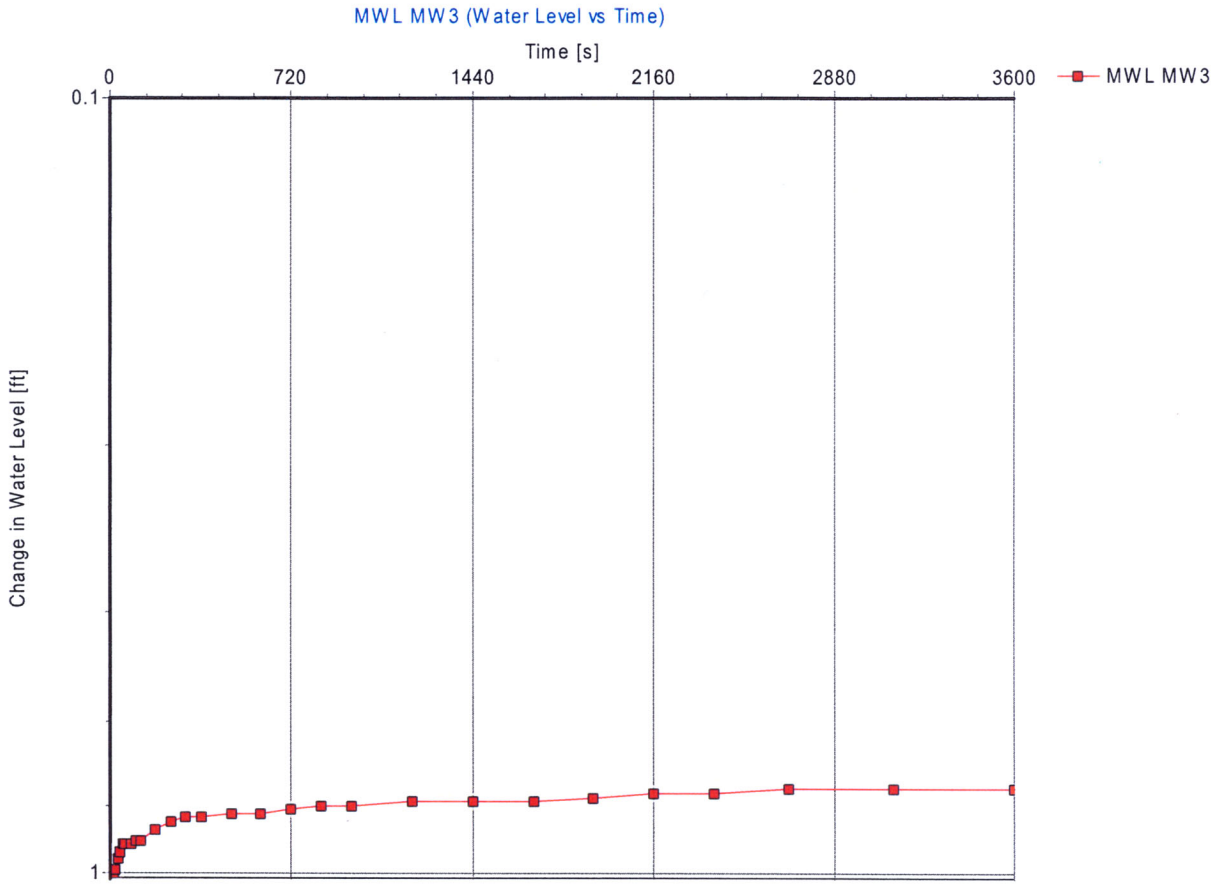
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW3**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:				
	Test well:	MWL MW3	Aquifer thickness:	14.4 [ft]
	Screen radius:	0.51 [ft]		
	Screen length:	14.4 [ft]		
	Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

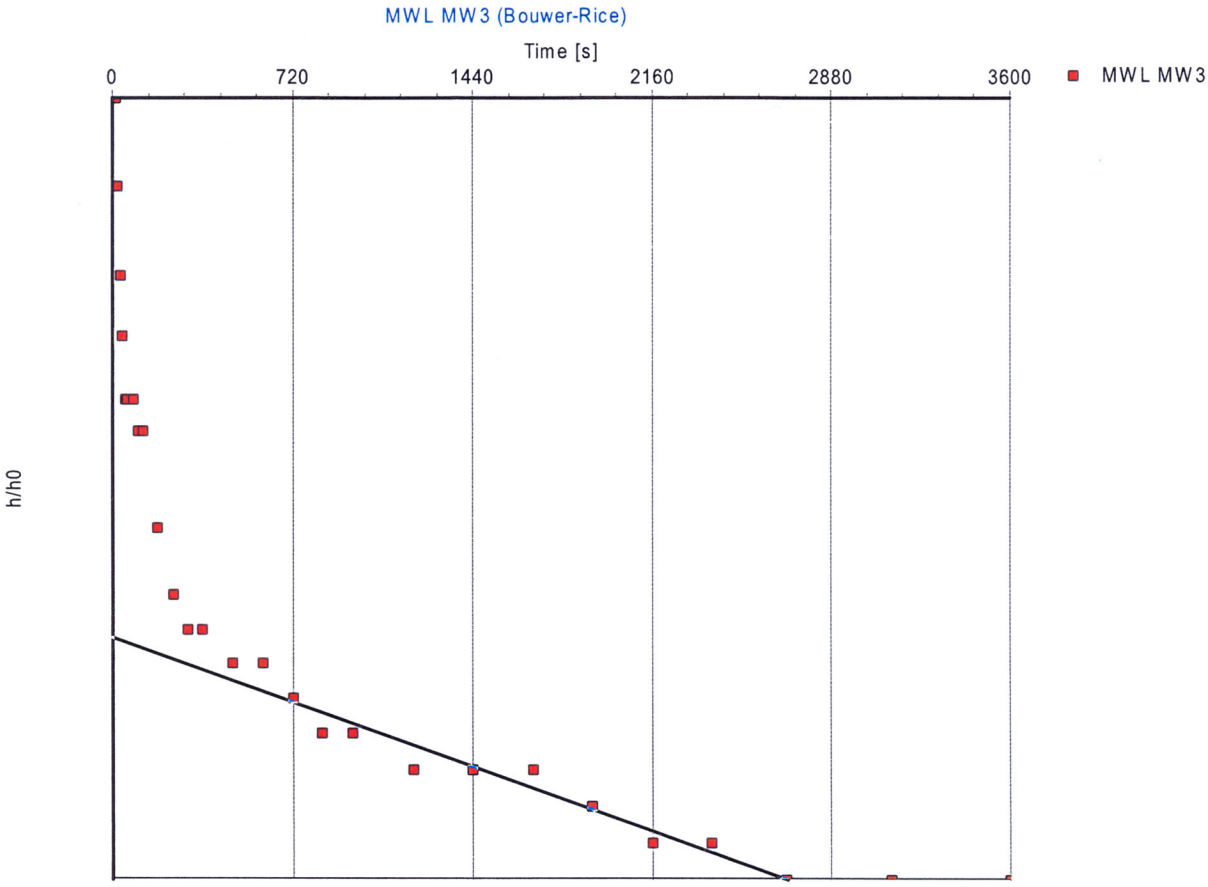
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW3**

Analysis method: **Bouwer-Rice**

Analysis results:

Conductivity: 3.58E-6 [cm/s]

Test parameters:

Test well:	MWL MW3	Aquifer thickness:	14.4 [ft]
Screen radius:	0.51 [ft]	Gravel pack Porosity (%)	25
Screen length:	14.4 [ft]		
Casing radius:	0.208 [ft]		
r(eff):	0.312 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

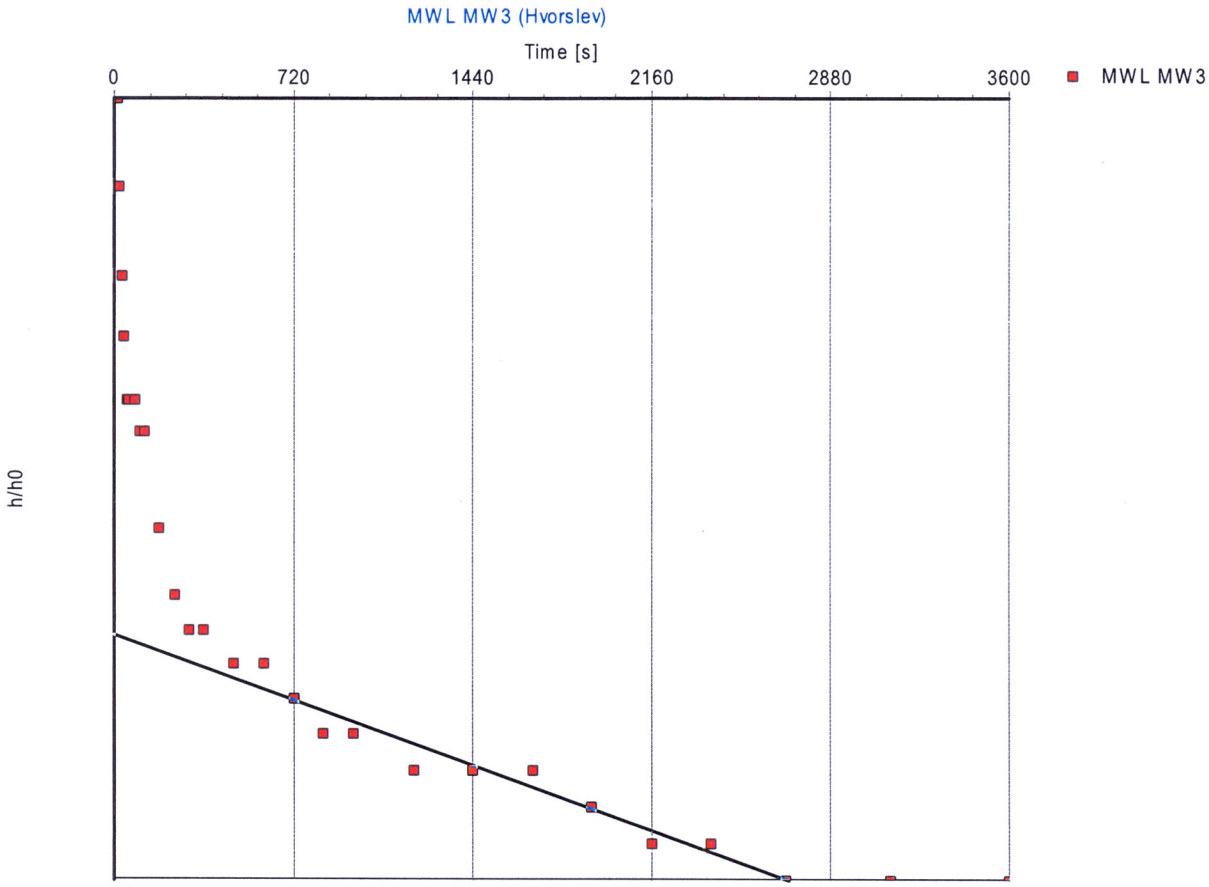
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW3**

Analysis method: **Hvorslev**

Analysis results:

Conductivity: 4.77E-6 [cm/s]

Test parameters:

Test well:	MWL MW3	Aquifer thickness:	14.4 [ft]
Screen radius:	0.51 [ft]		
Screen length:	14.4 [ft]		
Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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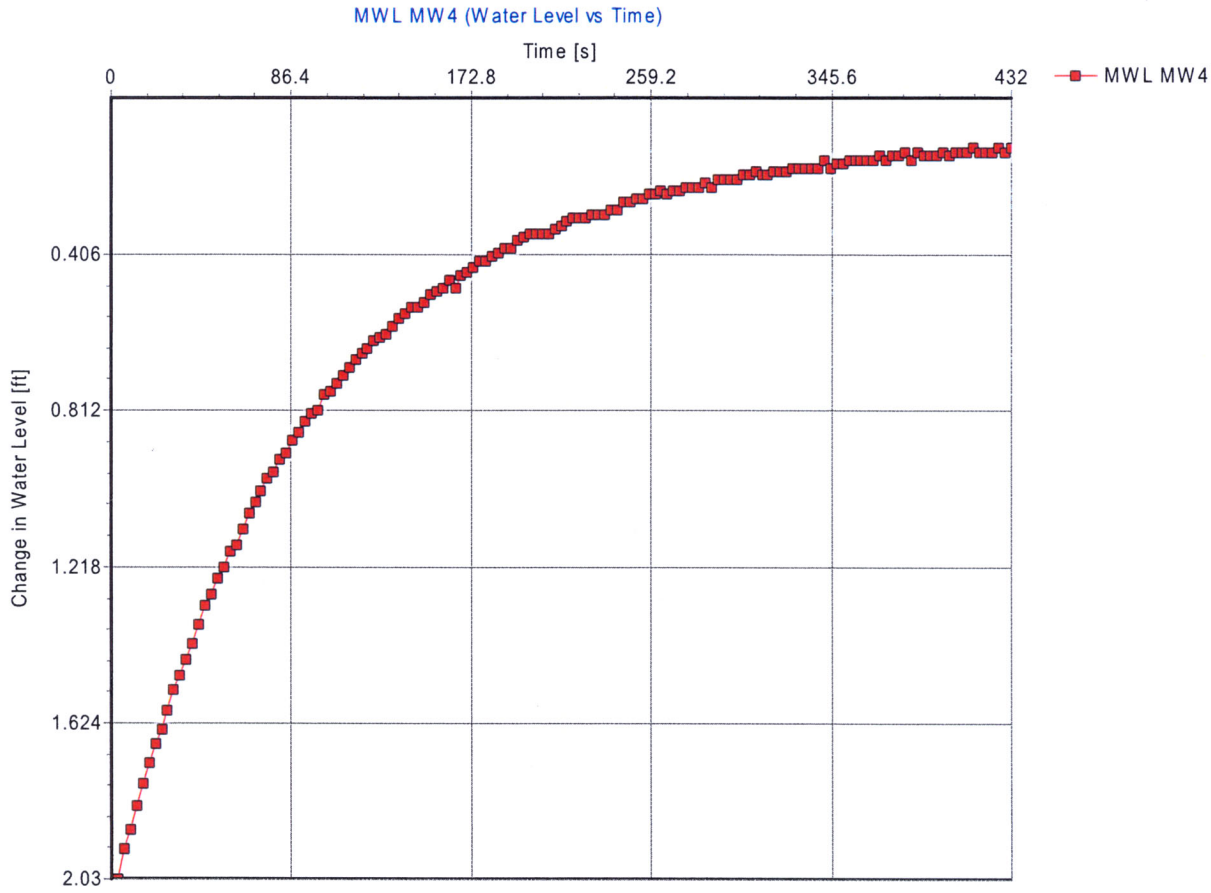
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW4 Early Time Data**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:				
	Test well:	MWL MW4	Aquifer thickness:	38.94 [ft]
	Screen radius:	0.458 [ft]		
	Screen length:	30 [ft]		
	Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 07/11/20

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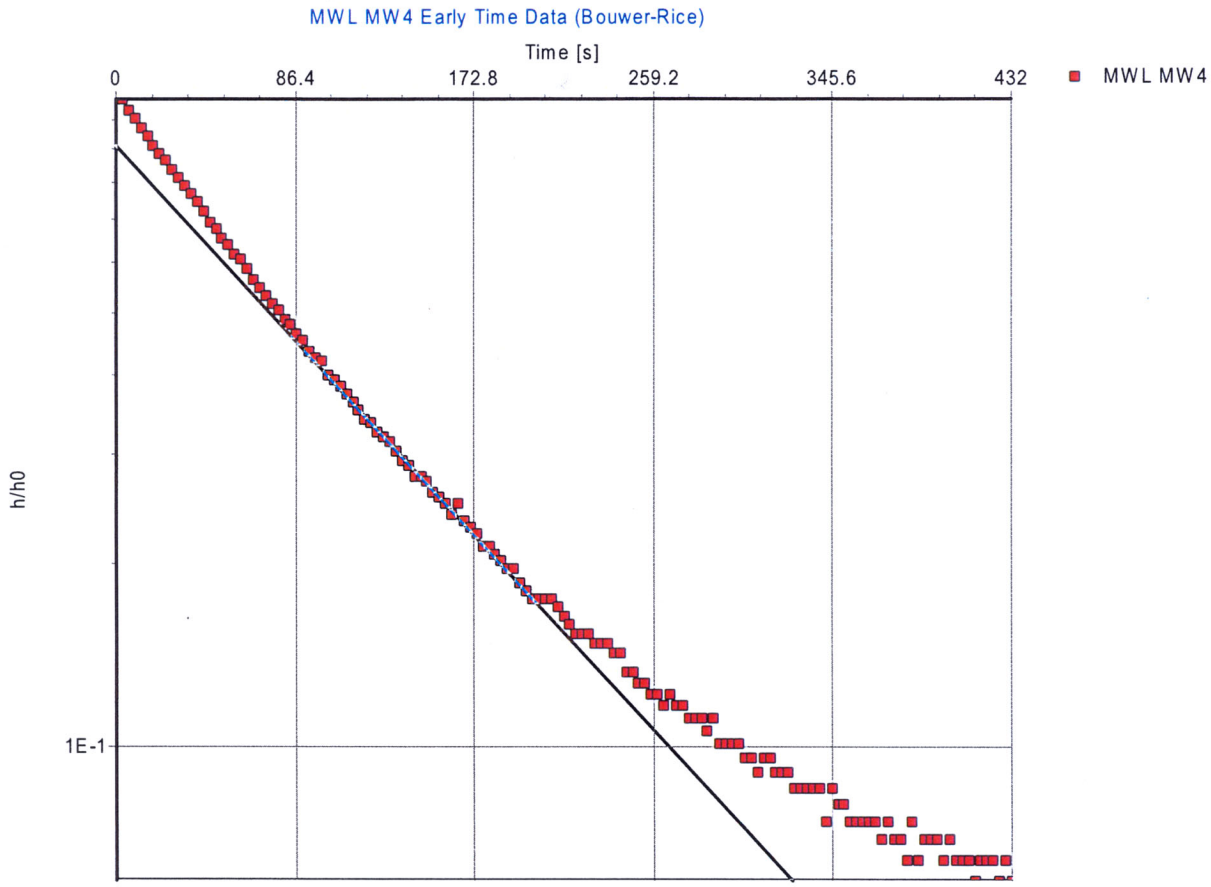
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW4 Early Time Data**

Analysis method: **Bouwer-Rice**

Analysis results:

Conductivity: 5.92E-4 [cm/s]

Test parameters:				
	Test well:	MWL MW4	Aquifer thickness:	38.94 [ft]
	Screen radius:	0.458 [ft]	Gravel pack Porosity (%)	25
	Screen length:	30 [ft]		
	Casing radius:	0.208 [ft]		
	r(eff):	0.291 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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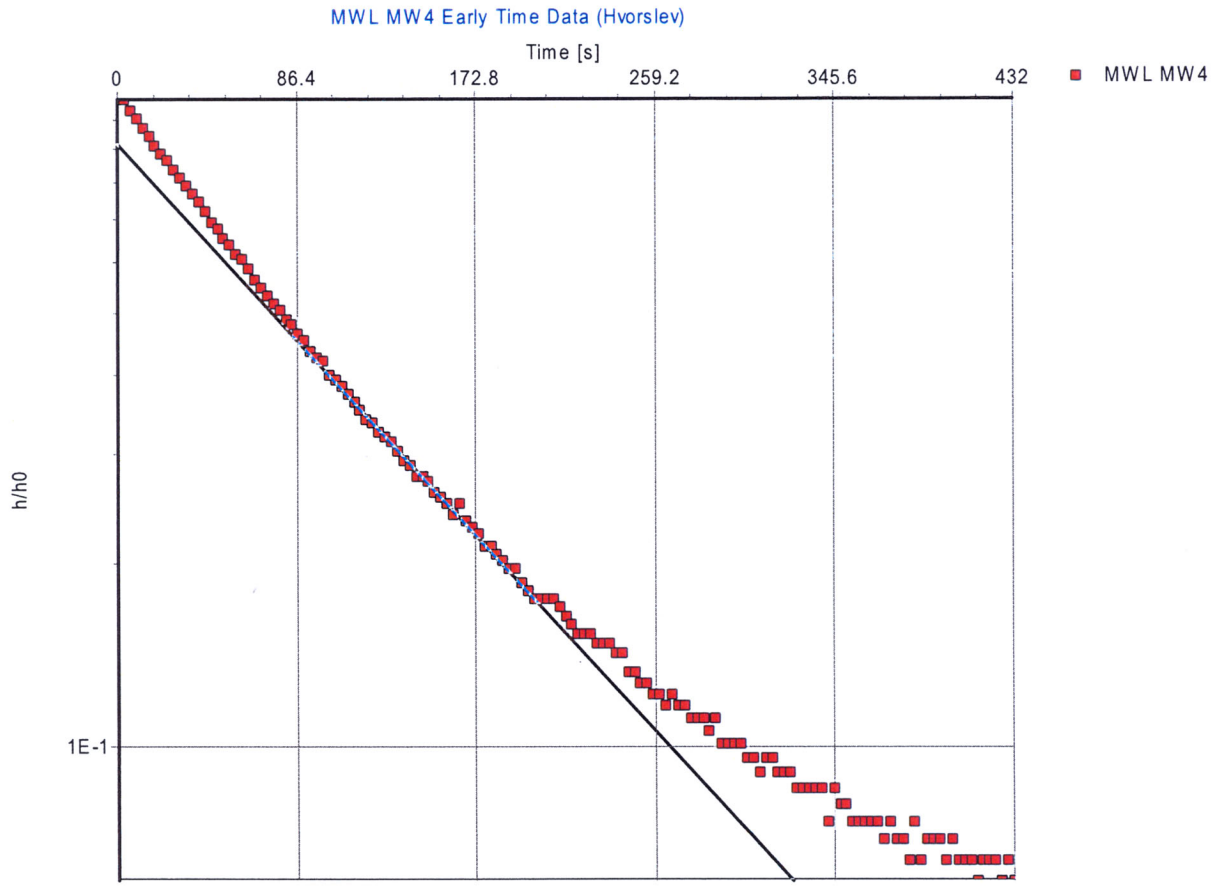
Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW4 Early Time Data**

Analysis method: **Hvorslev**

Analysis results:

Conductivity: 7.36E-4 [cm/s]

Test parameters:

Test well:	MWL MW4	Aquifer thickness:	38.94 [ft]
Screen radius:	0.458 [ft]		
Screen length:	30 [ft]		
Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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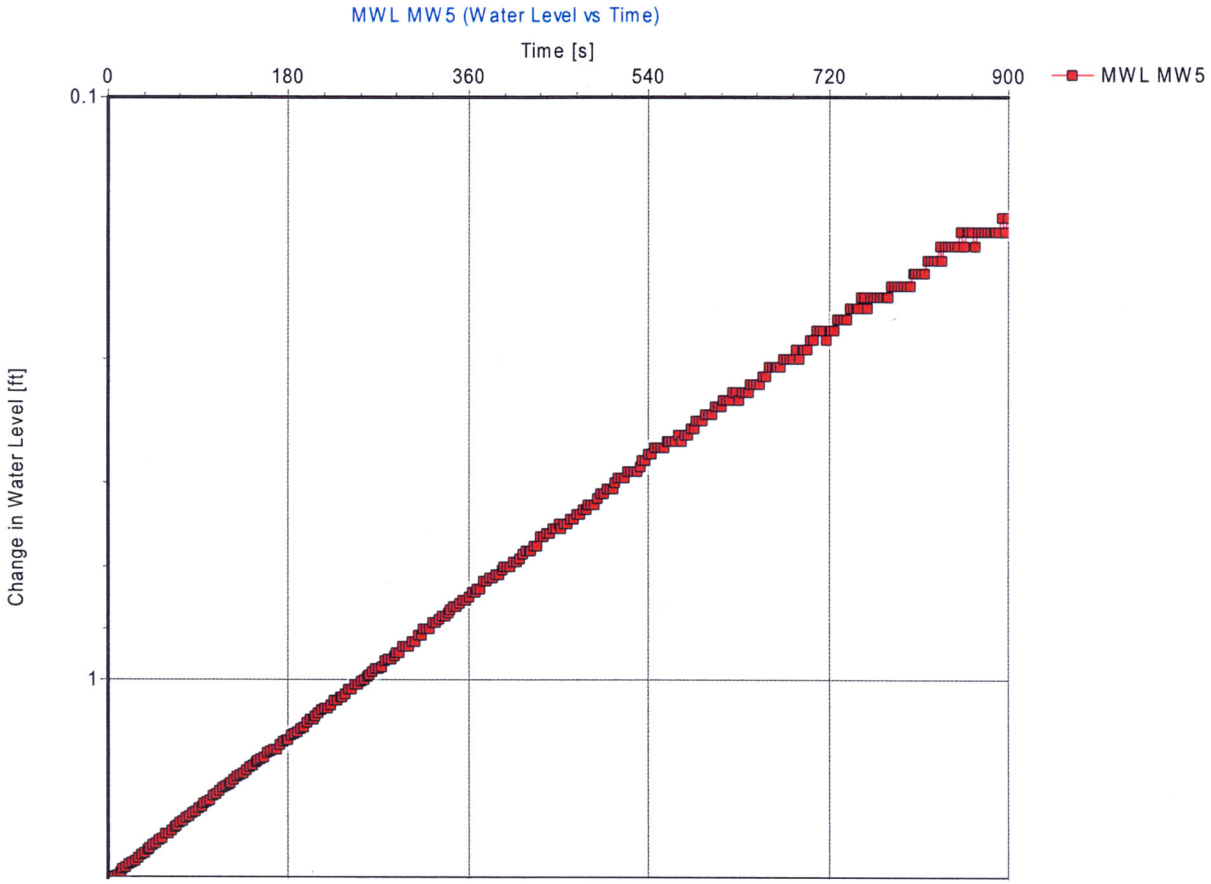
Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW5**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:				
	Test well:	MWL MW5	Aquifer thickness:	33.34 [ft]
	Screen radius:	0.401 [ft]		
	Screen length:	32 [ft]		
	Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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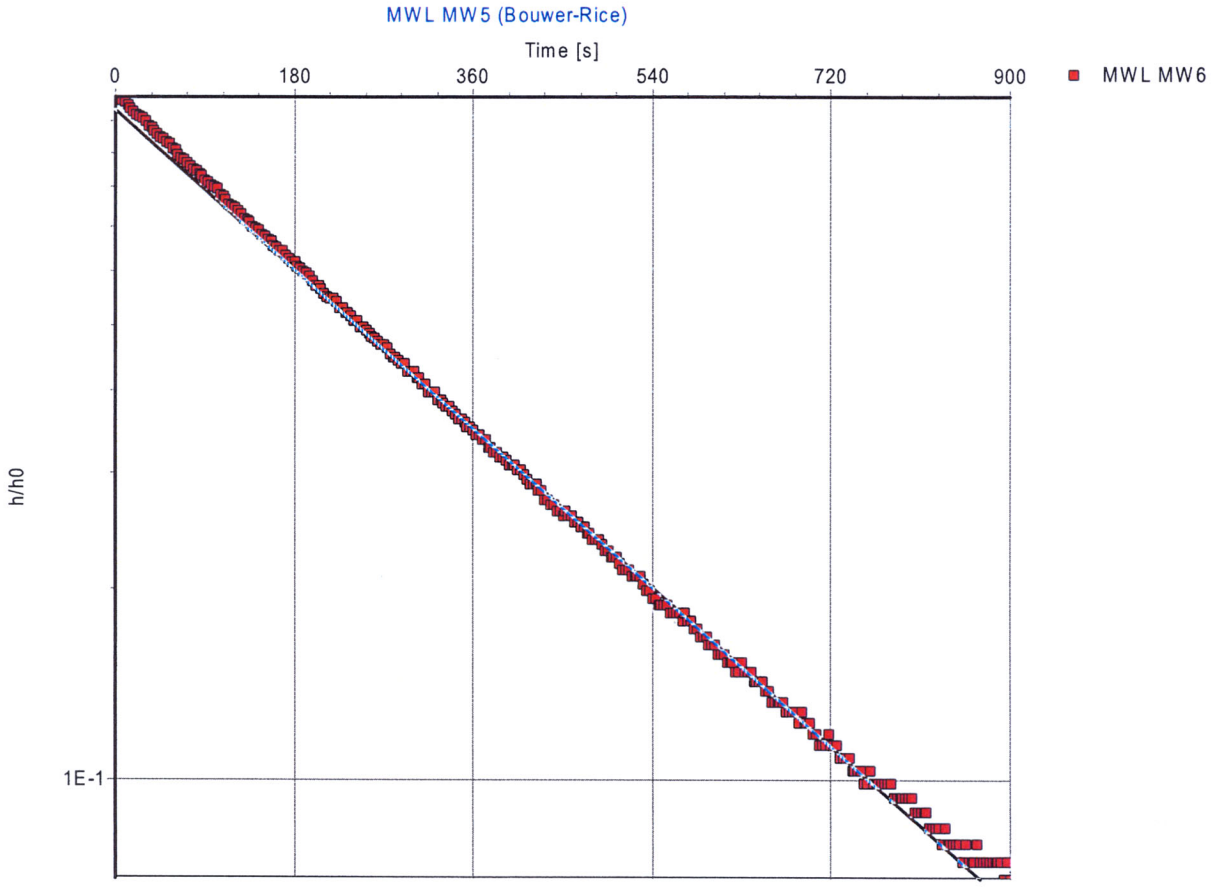
Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW5**

Analysis method: **Bouwer-Rice**

Analysis results:

Conductivity: 2.09E-4 [cm/s]

Test parameters:

Test well:	MWL MW5	Aquifer thickness:	33.34 [ft]
Screen radius:	0.401 [ft]	Gravel pack Porosity (%)	25
Screen length:	32 [ft]		
Casing radius:	0.208 [ft]		
r(eff):	0.270 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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Pumping Test Analysis Report

Project: MWL Slug Tests

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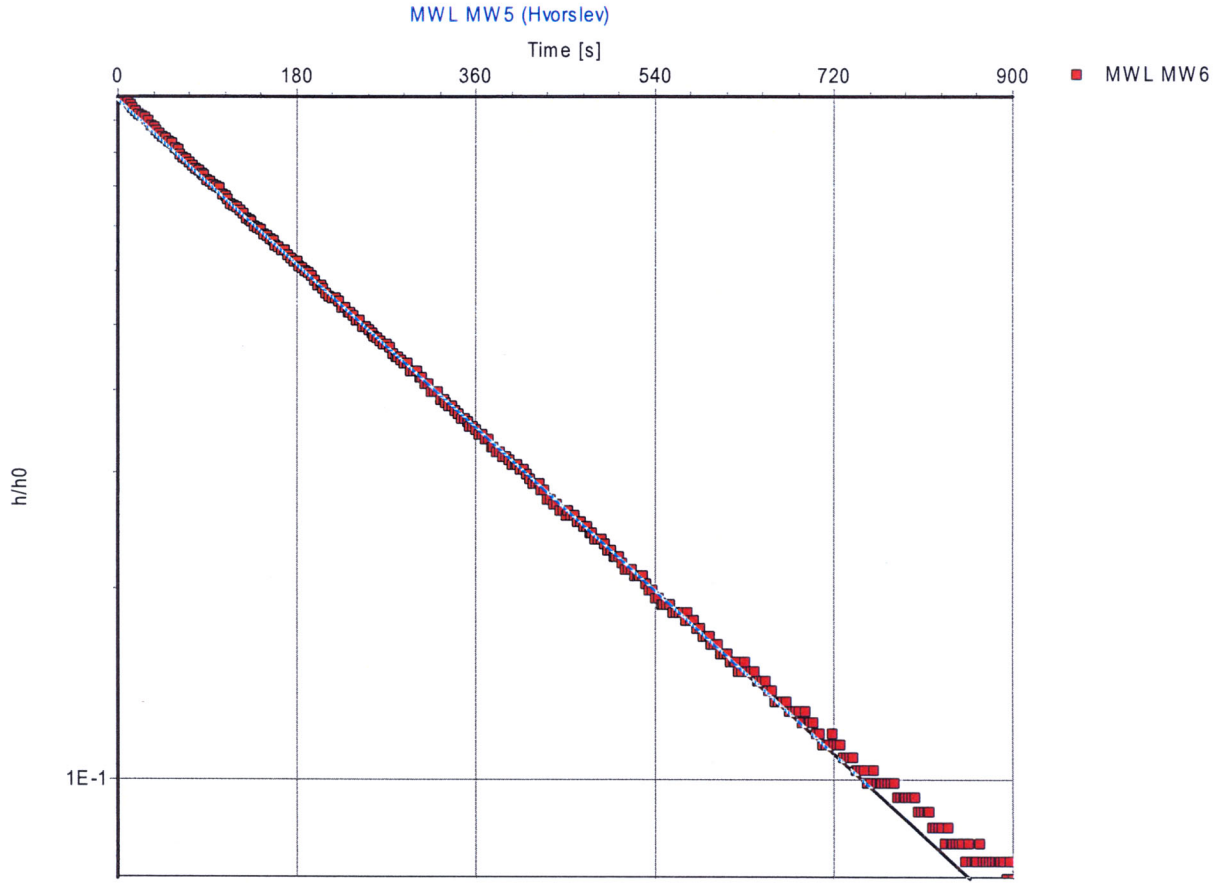
Client:



Test name: **MWL MW5**

Analysis method: **Hvorslev**

Analysis results:

Conductivity: 2.77E-4 [cm/s]

Test parameters:

Test well:	MWL MW5	Aquifer thickness:	33.34 [ft]
Screen radius:	0.401 [ft]		
Screen length:	32 [ft]		
Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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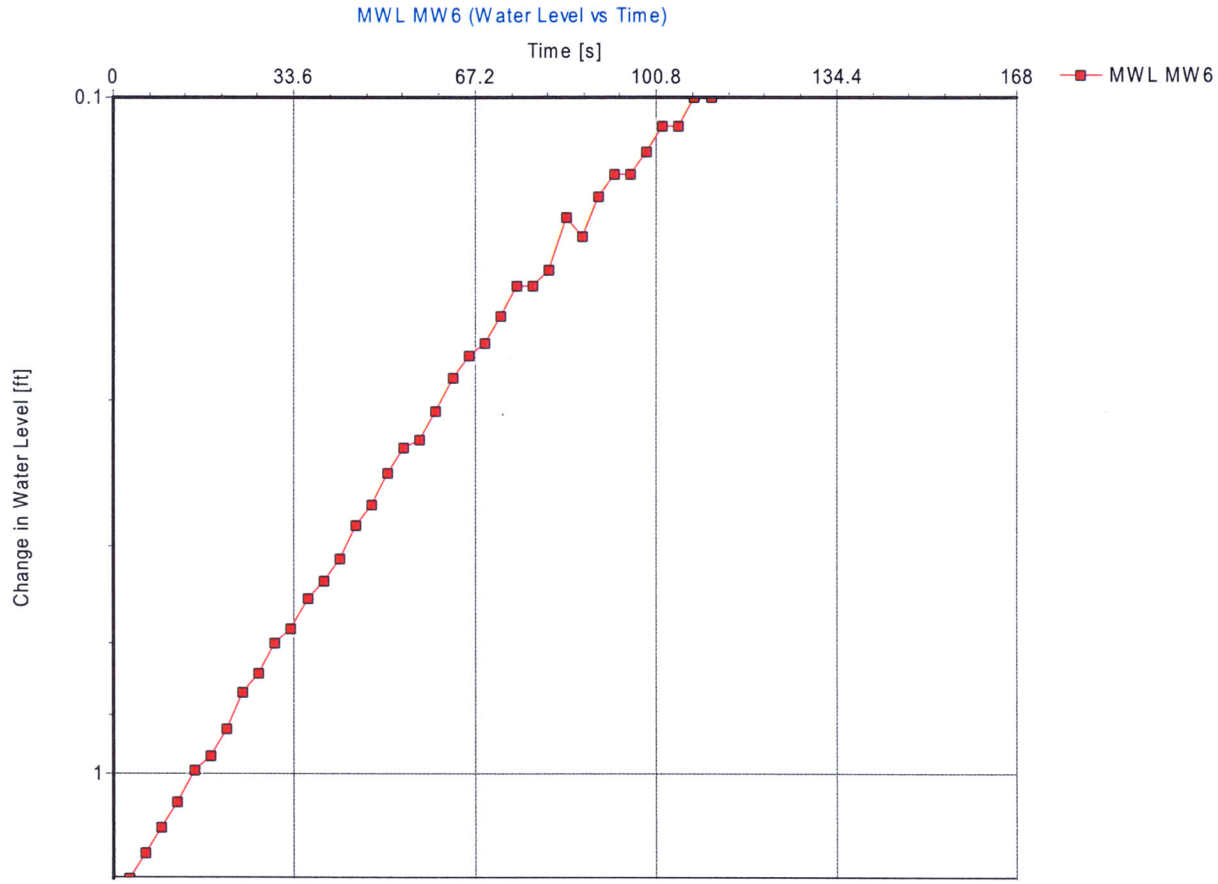
Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW6**

Analysis method: **Water Level vs Time**

Analysis results:

Test parameters:				
	Test well:	MWL MW6	Aquifer thickness:	55.91 [ft]
	Screen radius:	0.401 [ft]		
	Screen length:	38 [ft]		
	Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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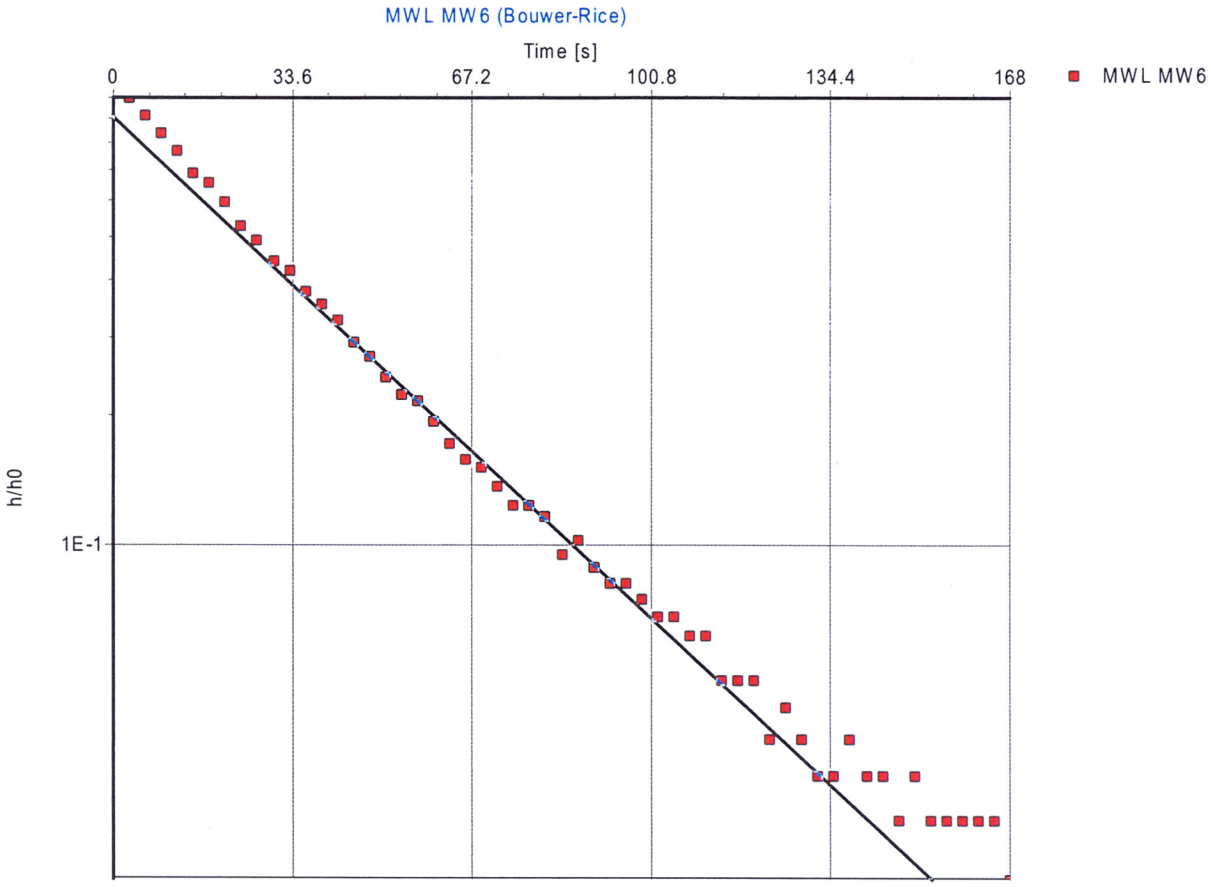
Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW6**

Analysis method: **Bouwer-Rice**

Analysis results:

Conductivity: 1.61E-3 [cm/s]

Test parameters:

Test well:	MWL MW6	Aquifer thickness:	55.91 [ft]
Screen radius:	0.401 [ft]	Gravel pack Porosity (%)	25
Screen length:	38 [ft]		
Casing radius:	0.208 [ft]		
r(eff):	0.270 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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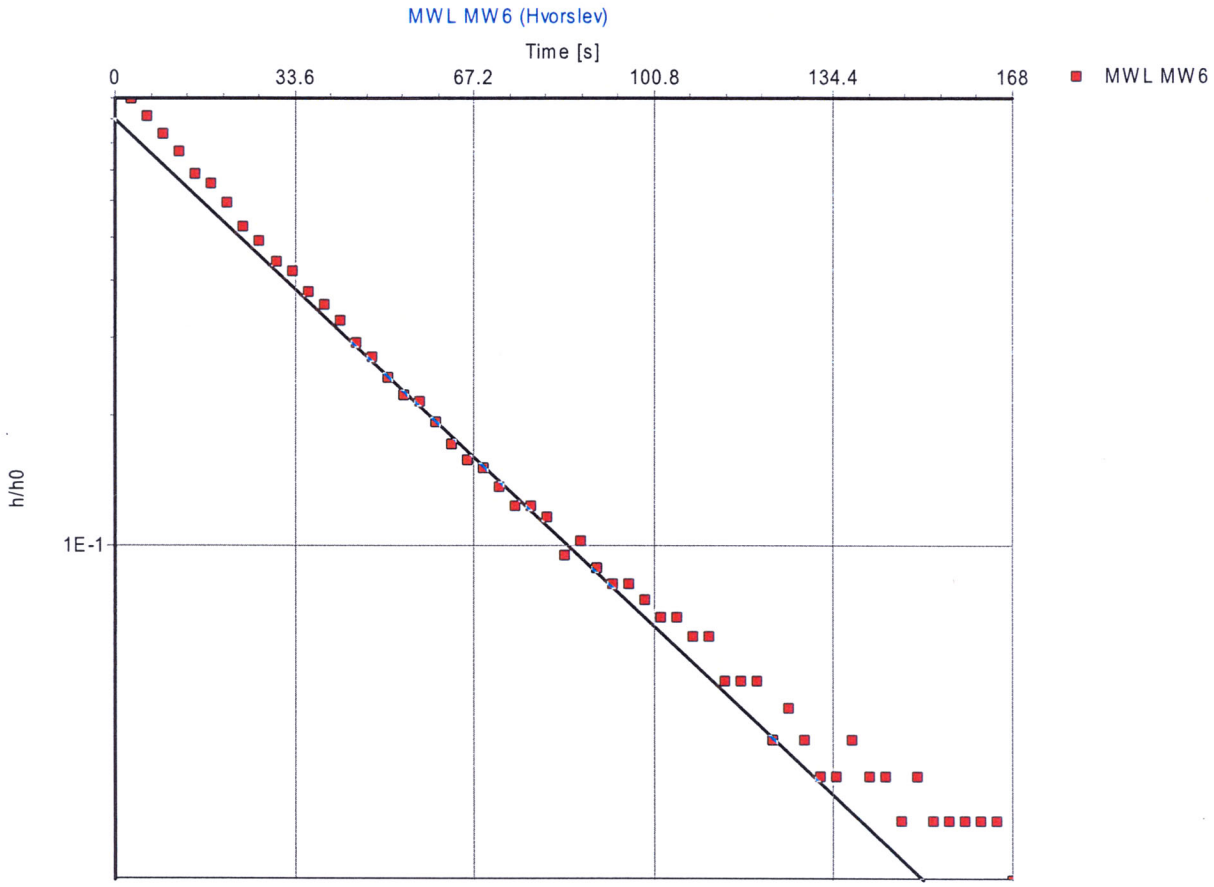
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: MWL Slug Tests

No:

Client:



Test name: **MWL MW6**

Analysis method: **Hvorslev**

Analysis results:

Conductivity: 1.97E-3 [cm/s]

Test parameters:

Test well:	MWL MW6	Aquifer thickness:	55.91 [ft]
Screen radius:	0.401 [ft]		
Screen length:	38 [ft]		
Casing radius:	0.208 [ft]		

Comments:

Evaluated by:

Date: 12/04/20

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Appendix D

Chromium and Nickel in Groundwater at the Mixed Waste Landfill

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CHROMIUM AND NICKEL IN MWL GROUNDWATER

This appendix provides additional details on the elevated chromium and nickel concentrations detected in MWL wells with stainless steel screens, particularly MWL-MW1. Unless otherwise mentioned, the text refers to total concentrations of chromium and nickel, rather than dissolved concentrations. The EPA MCLs for metals apply to total, rather than dissolved, concentrations. Total and dissolved chromium and nickel analytical results for MWL groundwater are presented in Tables 4-1 through 4-7.

Chromium and nickel concentrations are occasionally detected above NMED-approved background concentrations in MWL wells with stainless steel screens including MWL-BW1, MWL-MW1, MWL-MW2, and MWL-MW3. Elevated chromium and nickel concentrations have not been detected in wells with PVC screens, which include MWL-MW4, MWL-MW5, and MWL-MW6.

Elevated chromium and nickel concentrations are most problematic in MWL-MW1 (Table 4-2), and chromium concentrations have exceeded the EPA MCL of 0.1 mg/L several times in this well. Chromium was detected at a concentration of 1.1 mg/L in April 1997, and at concentrations of 0.326 and 0.26 mg/L in April 1998 in MWL-MW1. However, subsequent samples from this well show chromium within background concentrations (less than 0.043 mg/L) and considerably below the EPA MCL (Table 4-2). Nickel concentrations in MWL-MW1 are considerably elevated above the NMED-approved background concentration of 0.028 mg/L (Table 4-2).

Occasionally, chromium and/or nickel concentrations above the NMED-approved background concentrations have also been detected in MWL-BW1, MWL-MW2, and MWL-MW3 (Tables 4-1, 4-3, and 4-4). Chromium concentrations do not exceed the EPA MCL in these wells.

Figures D-1 and D-2 show trends of chromium and nickel concentrations in the five older MWL monitoring wells (MWL-BW1, MWL-MW1, MWL-MW2, MWL-MW3, and MWL-MW4). Figures D-3 and D-4 present historical chromium and nickel trends in MWL-MW1. Figures D-3 and D-4 differentiate between total and dissolved concentrations of these metals.

Occurrence of Chromium and Nickel in Natural Waters

Neither chromium nor nickel occurs naturally in groundwater at the concentrations measured in monitoring well MWL-MW1. Chromium has two common valences, trivalent chromium (III) and hexavalent chromium (VI). Chromium III occurs naturally in groundwater, but the precipitation kinetics are so rapid and the dissolution kinetics are so slow that chromium concentrations in groundwater remain well below drinking water standards (Rai et al. 1989). Any chromium VI (hexavalent) that migrates to groundwater from anthropogenic sources rapidly reduces and precipitates (Bartlett 1991, Puls et al. 1992).

Nickel occurs in nature primarily as insoluble hydroxides or sulfides (Allen et al. 1993), which originate only at extreme pHs. Hence, nickel never occurs naturally in groundwater at high concentrations. However, when a contaminated source containing nickel is in contact with groundwater, the nickel is easily mobilized as it readily desorbs, and it does not precipitate under groundwater's neutral pH conditions (Bubb and Lester 1991).

Identification of the Source of Elevated Chromium and Nickel at the MWL

The elevated chromium and nickel in MWL-MW1 (and to a lesser extent, in the other wells with stainless steel screens) is attributed to corrosion of the well's Type 304 stainless-steel screen, which contains 18% chromium and 8% nickel. Corrosion of Type 304 stainless steel has been observed in groundwater with relatively low chloride contents, causing elevated concentrations of chromium and nickel (Oakley and Korte 1996). Hewitt (1993 and 1994) has reported that corrosion of Type 304 stainless steel may contribute nickel and chromium in concentrations high enough to exceed the EPA MCLs. Elevated chromium concentrations attributed to stainless-steel casing have been documented extensively in the literature. The coexistence of chromium and nickel is indicative of corrosion of stainless steel casing and screens.

All four of the MWL monitoring wells installed in the late 1980's have Type 304 stainless-steel well screens (MWL-MW1, MWL-MW2, MWL-MW3, and MWL-BW1). Elevated concentrations of chromium and nickel are most problematic in MWL-MW1. However, chromium and/or nickel above NMED background concentrations have occasionally been detected in the other MWL wells with Type 304 stainless-steel screens.

Comparison of Chromium and Nickel Results

To determine the source of the elevated concentrations of chromium and nickel in MWL-MW1, total and dissolved fractions of chromium and nickel in the monitoring well were compared. Figure D-3 shows a comparison of total and dissolved chromium concentrations in monitoring well MWL-MW1. Total chromium concentrations are significantly higher than dissolved chromium concentrations, with total chromium concentrations ranging up to 1.1 mg/L, while dissolved concentrations of chromium ranged only up to 0.0453 mg/L. This strongly suggests that chromium is associated with particulate matter > 0.45 microns.

Figure D-4 shows a comparison of total nickel concentrations to dissolved nickel concentrations in monitoring well MWL-MW1. Total nickel concentrations are only slightly greater than dissolved nickel concentrations, indicating that nickel is dissolved and/or associated with particulate matter <0.45 microns.

These divergences in geochemical behaviors between nickel and chromium in groundwater have been noted elsewhere. In a study of chromium and nickel contamination in groundwater at Tinker Air Force Base, Oklahoma, Myers found that field filtration with a 0.45 micron filter was highly effective for removing total chromium, but not for nickel (Myers July 1999). Myers concluded that this was due to nickel's higher solubility and the fact that nickel sorbs more readily on clays in the <0.45 micron fraction.

Concentrations of chromium in samples from monitoring well MWL-MW1 are directly correlated to the turbidity of the samples, further suggesting that the elevated chromium in MWL-MW1 may be due to corrosion of the stainless-steel screen. Figure D-5 presents the relationship between total chromium and turbidity in samples collected from monitoring well MWL-MW1. In general, samples with high turbidity levels (turbidity >5 nephelometric turbidity units) contained high chromium levels (chromium >0.05 mg/L), while samples with low turbidity levels contained low chromium levels.

These findings are consistent with those for other Type 304 stainless-steel wells discussed in the literature. Oakley and Korte (1996) found that samples with the highest turbidity levels contained the highest total chromium concentrations, and recommended that elevated levels of nickel and chromium in groundwater collected from Type 304 stainless-steel wells be carefully evaluated. Oakley and Korte (1996) also found that low-flow purging and sampling significantly reduced the chromium levels found in groundwater samples because such sampling minimized the collection of artificially-entrained particulates. However, low-flow sampling did not significantly reduce total nickel concentrations, suggesting no such relationship between nickel and turbidity exists.

In summary, the evidence strongly suggests that elevated chromium and nickel concentrations in monitoring well MWL-MW1 and in other MWL wells with Type 304 stainless-steel screens are not due to contamination originating from the MWL, but rather, are a result of corrosion of the Type 304 stainless-steel screen. There are no sources of mobile chromium or nickel in the MWL. Furthermore, chromium and nickel would have to migrate through nearly 500 feet of vadose zone to groundwater, an unlikely scenario given the lack of a viable transport mechanism, and given chromium's propensity to sorb to the fine-grained clays and silts of the vadose zone. For these reasons, it is concluded that the elevated chromium and nickel in monitoring well MWL-MW1 and in other MWL wells is due to corrosion of the wells' Type 304 stainless-steel screen.

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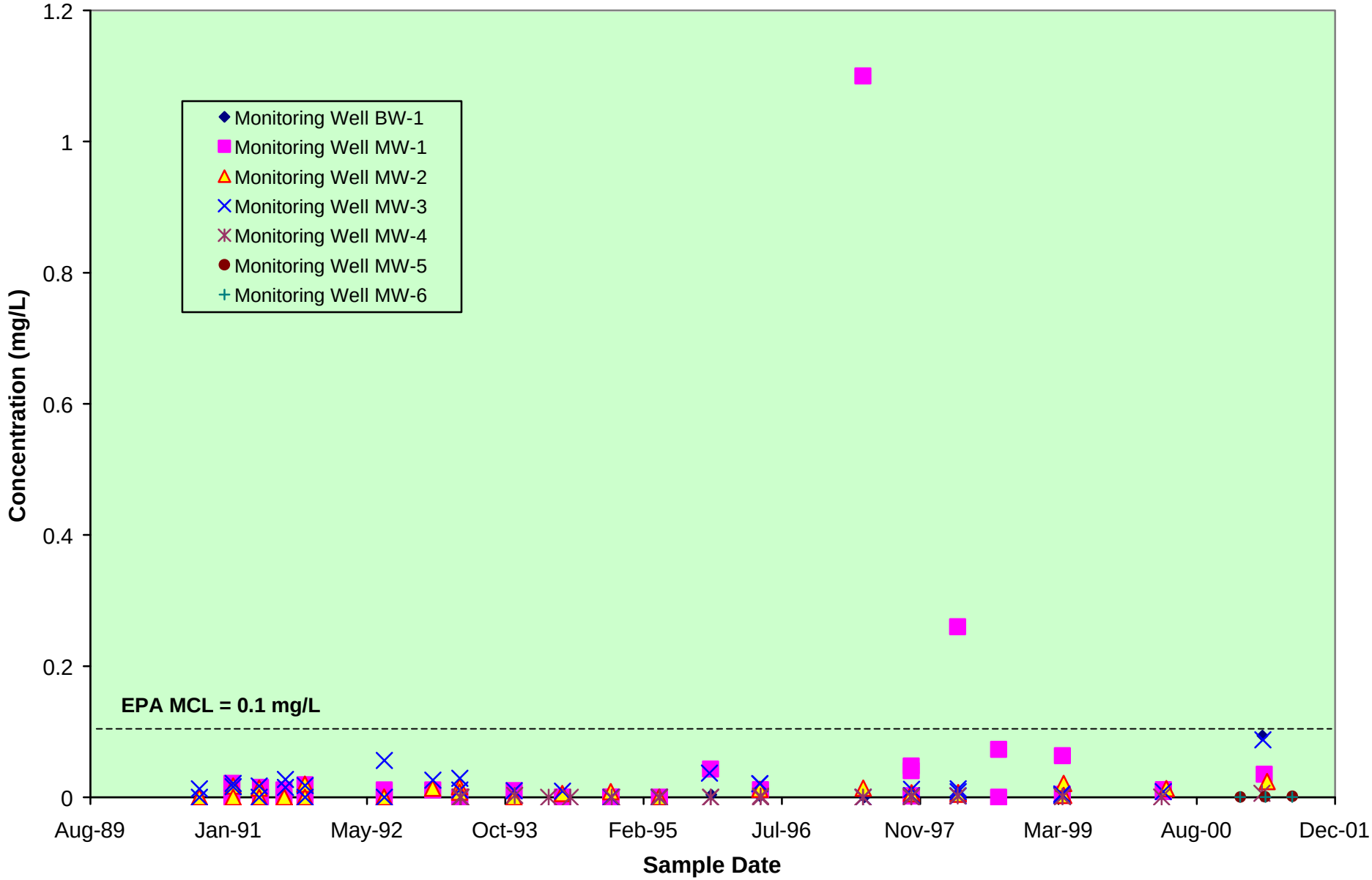
Figure D-1. Chromium Concentrations in MWL Monitoring Wells, 1990 through 2001



AL/01-02/WP/SNL:R5074-D.XLS

Figure D-2. Nickel Concentrations in MWL Monitoring Wells, 1990 through 2001

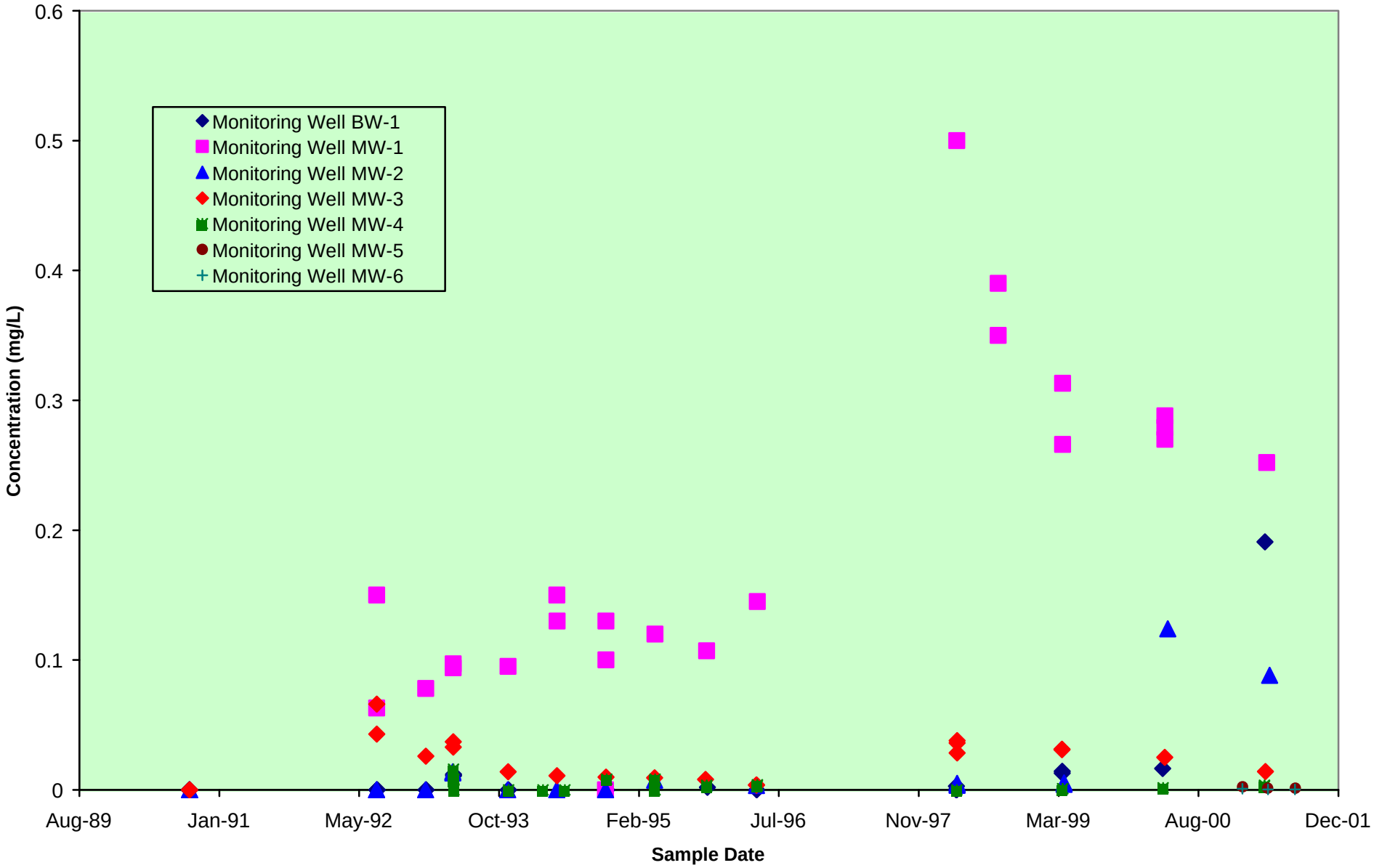


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Figure D-3. Comparison of Total and Dissolved Chromium Concentrations in Monitoring Well MW-1

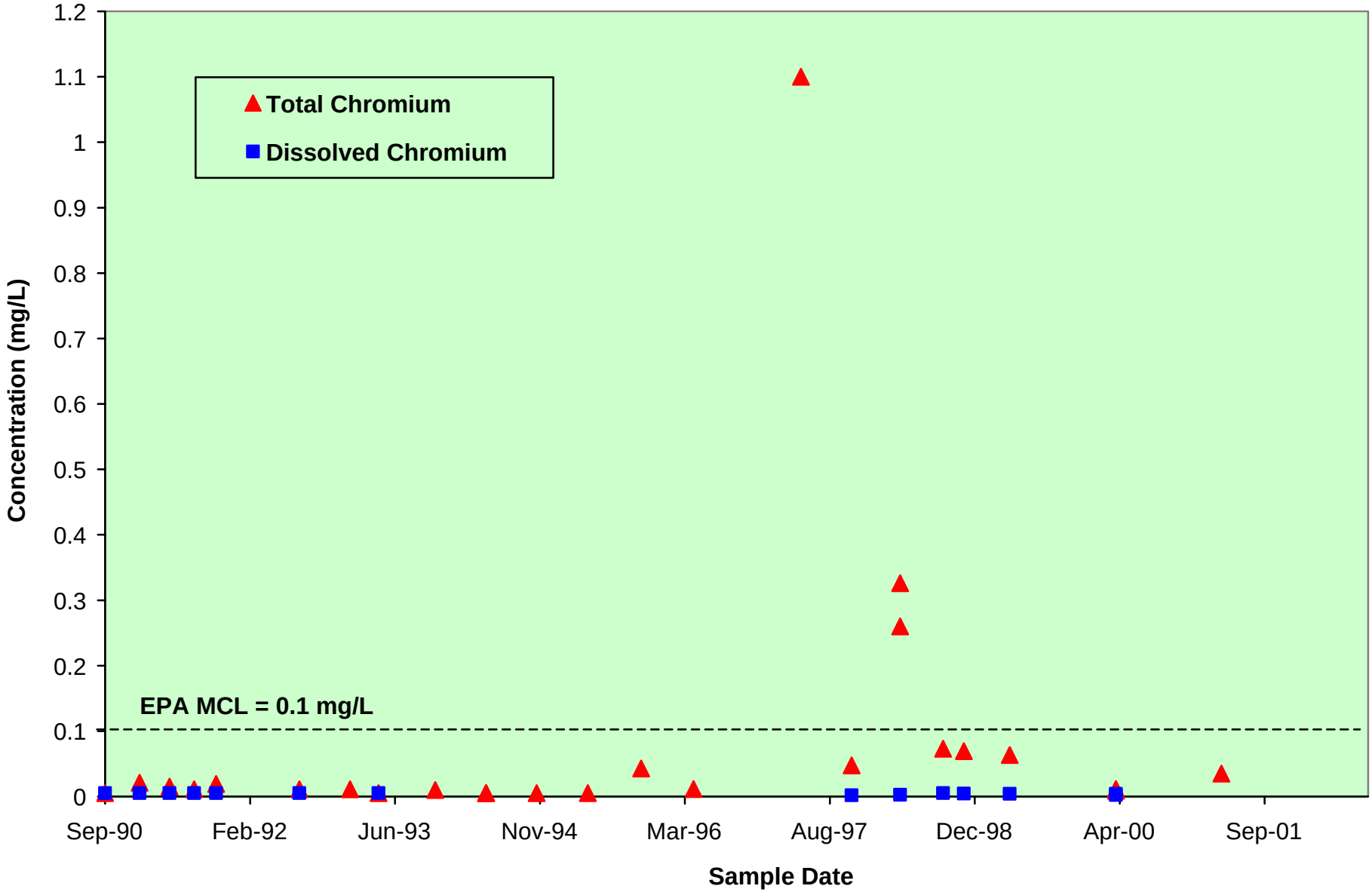

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Figure D-4. Comparison of Total and Dissolved Nickel Concentrations in Monitoring Well MW-1

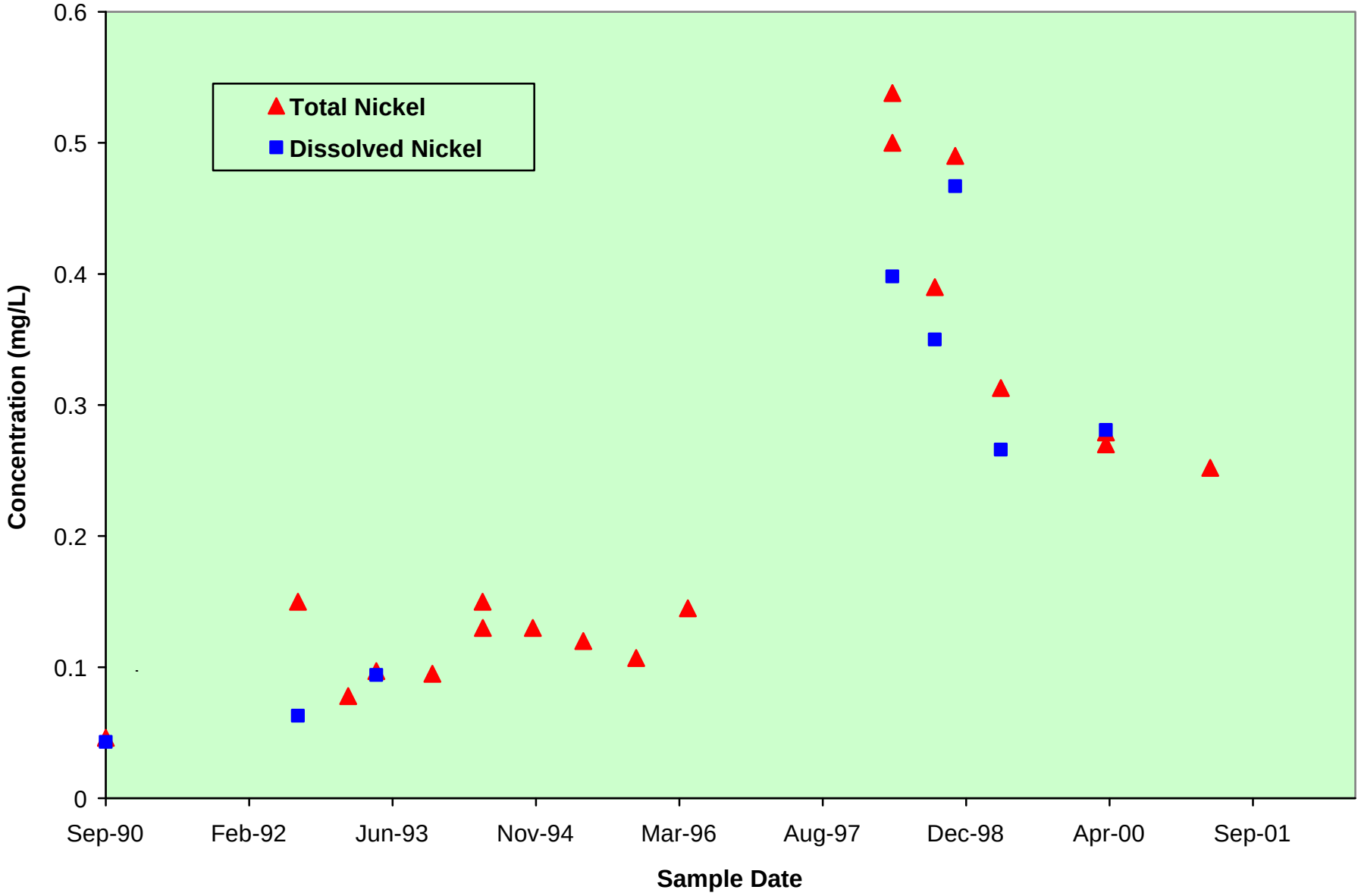

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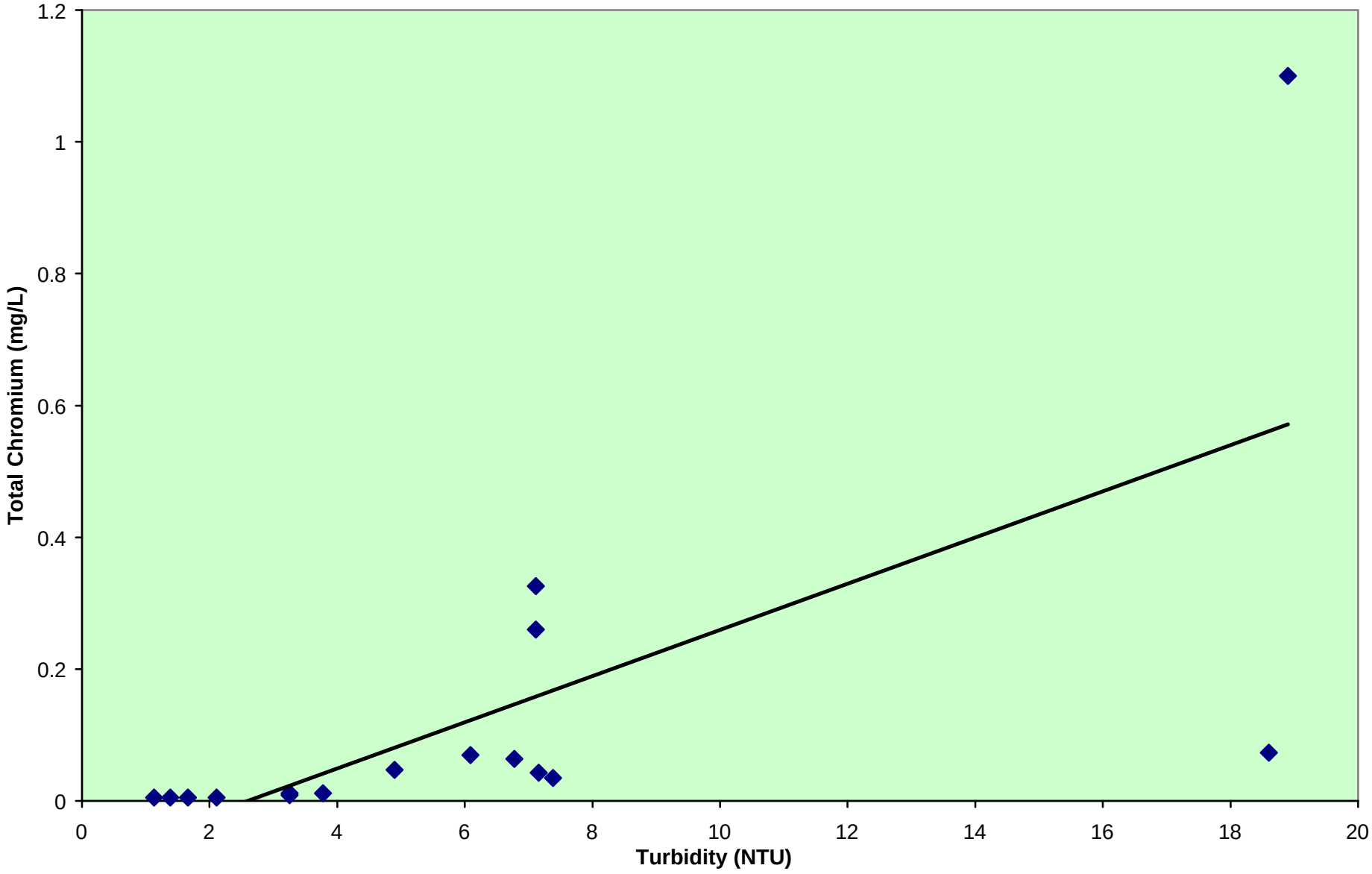
Figure D-5. Relationship Between Total Chromium Concentration and Turbidity in Monitoring Well MW-1



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