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April 2006
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Interim Facility-Wide Groundwater Monitoring Plan, Revision 1

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Prepared by
Environmental Stewardship Division–
Environmental Remediation and Surveillance Program

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Interim Facility-Wide Groundwater Monitoring Plan

April 2006

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EXECUTIVE SUMMARY

This “Interim Facility-Wide Groundwater Monitoring Plan” fulfills a requirement of the March 1, 2005, Compliance Order on Consent issued by the New Mexico Environment Department. Los Alamos National Laboratory will collect and analyze groundwater and surface water samples at specific locations and for specific constituents in order to fulfill the requirements of the Compliance Order on Consent. Groundwater level data will also be collected because they are critical to understanding groundwater occurrence and movement. Four modes of water will be monitored: base flow (persistent surface water), alluvial groundwater, intermediate perched groundwater, and regional aquifer groundwater.

This plan is comprehensive in that it includes monitoring to detect changes in ambient conditions, regulatory requirements monitoring to evaluate compliance with regulatory requirements, and remedial monitoring to evaluate remedy effectiveness. The monitoring is conducted both within and outside of current Laboratory boundaries. Monitoring within current Laboratory boundaries takes place in seven major watersheds or watershed groupings: Los Alamos Canyon/Pueblo Canyon, Sandia Canyon, Mortandad Canyon, Pajarito Canyon, Water Canyon/Cañon de Valle, Ancho/Chaquehui/Frijoles Canyons, and White Rock Canyon. Monitoring outside the Laboratory boundaries is conducted (1) in areas that Laboratory operations have affected in the past (e.g., Guaje Canyon and Rendija Canyon), and (2) in areas that historically have not been affected by Laboratory operations, thereby providing baseline data. To ensure that water leaving the Laboratory does not pose an unacceptable risk, this plan also includes monitoring in areas downgradient of the Laboratory and outside Laboratory boundaries (e.g., the Rio Grande and springs in White Rock Canyon).

Monitoring locations were selected to coincide with locations stipulated in Table XII-5 of the Compliance Order on Consent and for their ability to provide water representative of ambient conditions. The monitoring locations were selected from existing wells that are physically possible to sample and that produce water representative of the in situ conditions.

Monitoring data will be published in routine reports in both electronic and print formats and submitted to the New Mexico Environment Department.

CONTENTS

Appendices

Figures

Tables

Acronyms and Abbreviations

AOC	area of concern
bgs	below ground surface
Consent Order	Compliance Order on Consent
DDT	dichlorodiphenyltrichloroethane
DOE	U.S. Department of Energy
DOT	New Mexico Department of Transportation
DP	Delta Prime
DRO	diesel range organic
ECR	Environmental Characterization and Remediation Group
ENV	Environmental Stewardship Division
EPA	United States Environmental Protection Agency
ER	Environmental Restoration project
ERS	Environmental Remediation and Surveillance Program
ESP	Environmental Surveillance Program
FFCA	Federal Facility Corrective Action
FY05	fiscal year 2005
FY06	fiscal year 2006
FY07	fiscal year 2007
GRO	gasoline range organic
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (high-melting explosive)
HWP	Hydrogeologic Workplan
IDL	instrument detection limit
IDW	investigation-derived waste
Interim Plan	Interim Facility-Wide Groundwater Monitoring Plan
Laboratory	Los Alamos National Laboratory
LANL	Los Alamos National Laboratory
LACEF	Los Alamos Critical Experiments Facility
LANSCE	Los Alamos Neutron-Scattering Center
LASO	Los Alamos Site Office
LCMS/MS	liquid chromatography-mass spectroscopy/mass spectroscopy
LIR	Laboratory Implementation Requirement
MCL	maximum contaminant level
MDA	material disposal area

MDL	method detection limit
Model SOW	National Nuclear Security Administration Service Center's Analytical Management Program's Model Statement of Work
Module VIII	Module VIII of the Laboratory's Hazardous Waste Facility Permit
NMAC	New Mexico Administrative Code
NMED	New Mexico Environmental Department
NOI	Notice of Intent to Discharge
NPDES	National Pollutant Discharge Elimination System
ORP	oxygen-reduction potential
OU	operable unit
PCB	polychlorinated biphenyl
PETN	pentaerythritol tetranitrate
PPE	personal protective equipment
PRS	potential release site
QP	quality procedure
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5,trinitro-1,3,5-triazine (research department explosive [cyclonite])
RFI	RCRA facility investigation
RLWTF	Radioactive Liquid Waste Treatment Facility
SOP	standard operating procedure
SOW	statement of work
SR	sampling round
SVOC	semivolatile organic compound
SWMU	solid waste management unit
SWRC	Solid Waste Regulatory Compliance
SWSC	sanitary wastewater systems consolidation
SWWS	sanitary wastewater systems
TA	Technical Area
TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TNT	2,4,6 trinitrotoluene (dynamite)
TSS	total suspended solids
UC	University of California
USGS	U.S. Geological Survey

USFS	U.S. Forest Service
VOC	volatile organic compound
WCSF	waste stream characterization form
WQCC	Water Quality Control Commission
WQH	Water Quality and Hydrology Group
WWTP	waste water treatment plant

1.0 INTRODUCTION

This is the Interim Facility-Wide Groundwater Monitoring Plan (Interim Plan) for Los Alamos National Laboratory (the Laboratory or LANL). The Interim Plan fulfills the groundwater monitoring requirement IV.A.3.b of the March 1, 2005, Compliance Order on Consent (hereafter, the Consent Order) (NMED 2005, 88207) between the New Mexico Environment Department (NMED) and the U.S. Department of Energy (DOE) and the University of California (UC). Section IV.A.3.b is presented below:

> Within ninety (90) days after the effective date of this Consent Order, the Respondents shall submit to the Department for review and written approval an interim Facility-Wide Groundwater Monitoring Plan (Interim Plan). The Interim Plan, approved pursuant to the procedures in Section III.M of this Consent Order, shall provide for all groundwater and spring monitoring necessary to fulfill the requirements of this Consent Order. The Interim Plan shall state the proposed locations and frequency of groundwater sampling, the proposed parameters for analysis, and the proposed methods for sampling and analysis. The sampling schedule in Table XII-5 shall be used to develop the Interim Plan. Results of previous groundwater monitoring at the Facility may be used as guidance for development of the Interim Plan. All groundwater monitoring and sampling implemented pursuant to this Consent Order shall begin after, and in accordance with, an Interim Plan that has been approved by the Department pursuant to Section III.M. The Interim Plan shall comply with the investigation methods and procedures set forth in Section IX of this Consent Order. The plan shall be prepared in accordance with Section XI.B of this Consent Order. Submittal of the initial eight watershed-specific periodic monitoring reports may be staggered over the first year of groundwater monitoring conducted under this Consent Order. This may be accomplished by submitting two watershed-specific periodic monitoring reports for different watersheds to the Department per quarter starting 180 days after the Department's approval of the Interim Plan.
>
> The Respondents shall revise and update the Interim Plan annually to propose changes to the monitoring plan (e.g., to include newly installed monitoring wells; to remove wells not providing good quality data, if approved by the Department; and to make any other appropriate changes). The Respondents shall submit the revised and updated plan to the Department for approval ninety (90) days after each anniversary of the effective date of this Consent Order.
>
> After completing the installation of all additional monitoring wells in a canyon watershed as described in Section IV.B of this Consent Order, the Respondents shall submit to the Department for review and written approval a watershed-specific long-term groundwater monitoring plan for each watershed. Upon Department approval of a long-term monitoring plan for a specific watershed, the requirements of the long-term monitoring plan shall apply and shall supersede the requirements of the watershed-specific section of the Interim Plan.

The Interim Plan and subsequent long-term monitoring plans will fulfill the groundwater monitoring requirements of the Consent Order.

Groundwater monitoring has been conducted at the Laboratory for over 50 years starting with U.S. Geological Survey (USGS) water supply studies in 1945 and Laboratory groundwater quality monitoring in 1949. The first groundwater monitoring network consisted of water supply wells, several observation wells, and springs. The monitoring network continued to evolve through the years as various environmental programs installed additional wells, primarily in the shallow alluvial systems, as potential monitoring points.

Between 1997 and 2005 the Laboratory implemented a site-wide hydrogeologic characterization program, described in the Laboratory's "Hydrogeologic Workplan" (HWP) (LANL 1998, 59599). The primary objective of this characterization was to sufficiently refine the understanding of the area's hydrogeologic systems and improve the ability to design and implement an integrated site-wide groundwater monitoring plan. Thirty-three deep wells have been installed, and data collected from these wells provide information about alluvial, intermediate perched, and regional aquifer groundwater zones.

1.1 Purpose

The Interim Plan will monitor to

- determine the fate and transport of known legacy-waste contaminants,
- detect new releases,
- determine efficacies of remedies, and
- validate proposed corrective measures.

All of these objectives collectively assist the Laboratory in determining any potential adverse impacts to the regional aquifer that would affect the use of the aquifer as a drinking water source.

In addition, monitoring produces data that are required to evaluate risk and to assess regulatory compliance. Although the Interim Plan does not address how the data that are collected will be used in those evaluations, the design of the monitoring network is based on conceptual models of potential sources, hydrogeologic pathways, and receptors. The data collected are intended to be useful in risk-based decision making.

1.2 Scope

This plan describes the objective for monitoring, the proposed location of sampling stations, the frequency of sampling, the measurements taken at each location, and the analyses included in the groundwater monitoring plan. Four modes of water are monitored and are as follows:

- Base flow—persistent surface water that is maintained by precipitation, snowmelt, effluent, and other sources
- Alluvial groundwater—water within the alluvium in the bottom of the canyons
- Intermediate perched groundwater—localized saturated zones within the vadose zone
- Regional groundwater—deep, laterally continuous groundwater beneath the Pajarito Plateau

Groundwater will be routinely monitored by collecting samples at wells and springs and by analyzing for specific constituents. Groundwater monitoring refers to gathering data not only for water quality analysis but also for water level measurements. Water level data are critical to understanding groundwater occurrence, movement, and its relationship with recharge and municipal pumping.

Surface water at the Laboratory is divided into three types, or matrices. Each of the three flow types might be collected at a single location within a time span of as little as a week, depending on weather conditions. At times, the flow might represent a combination of these components. The three types are as follows:

- Base flow—persistent, but not necessarily perennial, stream flow. This stream flow is present for periods of weeks or longer. The water source may be effluent, springs, or shallow groundwater in canyons.
- Snowmelt—flowing water that is present because of melting snow. This type of water often may be present for several weeks or more (persistent) but in some years may not be present at all.
- Storm runoff—flowing water that is present in response to rainfall. These flow events are generally short-lived, with flows lasting from less than an hour to several days.

Storm runoff and snowmelt will be monitored by the Laboratory under the auspices of the 2005 Federal Facility Compliance Agreement (Administrative Order Docket No. CWA-06-2005-1701) (FFCA) entered into between the EPA and DOE on February 3, 2005, and the Administrative Order (Docket No. CWA-06-2005-1734) entered into between EPA and UC on March 14, 2005 and will not be monitored as part of the Interim Plan. Base flow (persistent water) and in some cases persistent flow derived from snowmelt will be monitored under the Interim Plan.

Monitoring under the Interim Plan will take place in seven major watersheds or watershed groupings and White Rock Canyon. These are Los Alamos Canyon/Pueblo Canyon, Sandia Canyon, Mortandad Canyon, Pajarito Canyon, Water Canyon/Cañon de Valle, and the combined watersheds of Ancho/Chaquehui/Frijoles Canyons. Monitoring outside the boundaries occurs in areas that Laboratory operations have affected in the past (e.g., Guaje Canyon and Rendija Canyon) or that have not been affected by Laboratory operations to provide baseline data. To ensure that water leaving the Laboratory does not pose an unacceptable risk, this plan also includes monitoring in areas outside the Laboratory that may be impacted by the Laboratory (e.g., the Rio Grande and springs in White Rock Canyon). Figure 1.2-1 is a map of the areas included in this Interim Plan.

1.3 Reporting

The data collected under this Interim Plan will be submitted to NMED in periodic monitoring reports in both electronic and print formats. The reports will be submitted within 120 days after the completion of field work on a watershed basis according to Section IV.A.6 of the Consent Order (NMED 2005, 88207). The reports submitted to NMED will be posted to the Internet as data are delivered from the analytical laboratory. Data that are not validated before posting will be marked as "provisional" until validation is completed.

Groundwater sampling and analysis reports, organized by watersheds, will present groundwater and base flow data, including both characterization (investigation) data and monitoring data. Reports will include tabular data (including field parameters), a brief discussion of the data, and select data trends.

1.4 Regulatory Context

This Interim Plan fulfills groundwater monitoring requirements of the Consent Order as described in the introduction. In addition to the Consent Order, the Laboratory is required to perform groundwater monitoring to satisfy other regulatory requirements. These other requirements are summarized below, including references to documentation of monitoring results. This Interim Plan does not include the activities needed to satisfy these other requirements (unless these other requirements can be satisfied by monitoring performed under the Interim Plan). As described in Section 1.6, the Laboratory has an integrated approach to groundwater monitoring. Activities needed to satisfy these other requirements, therefore, may be conducted in conjunction with monitoring performed under the Interim Plan.

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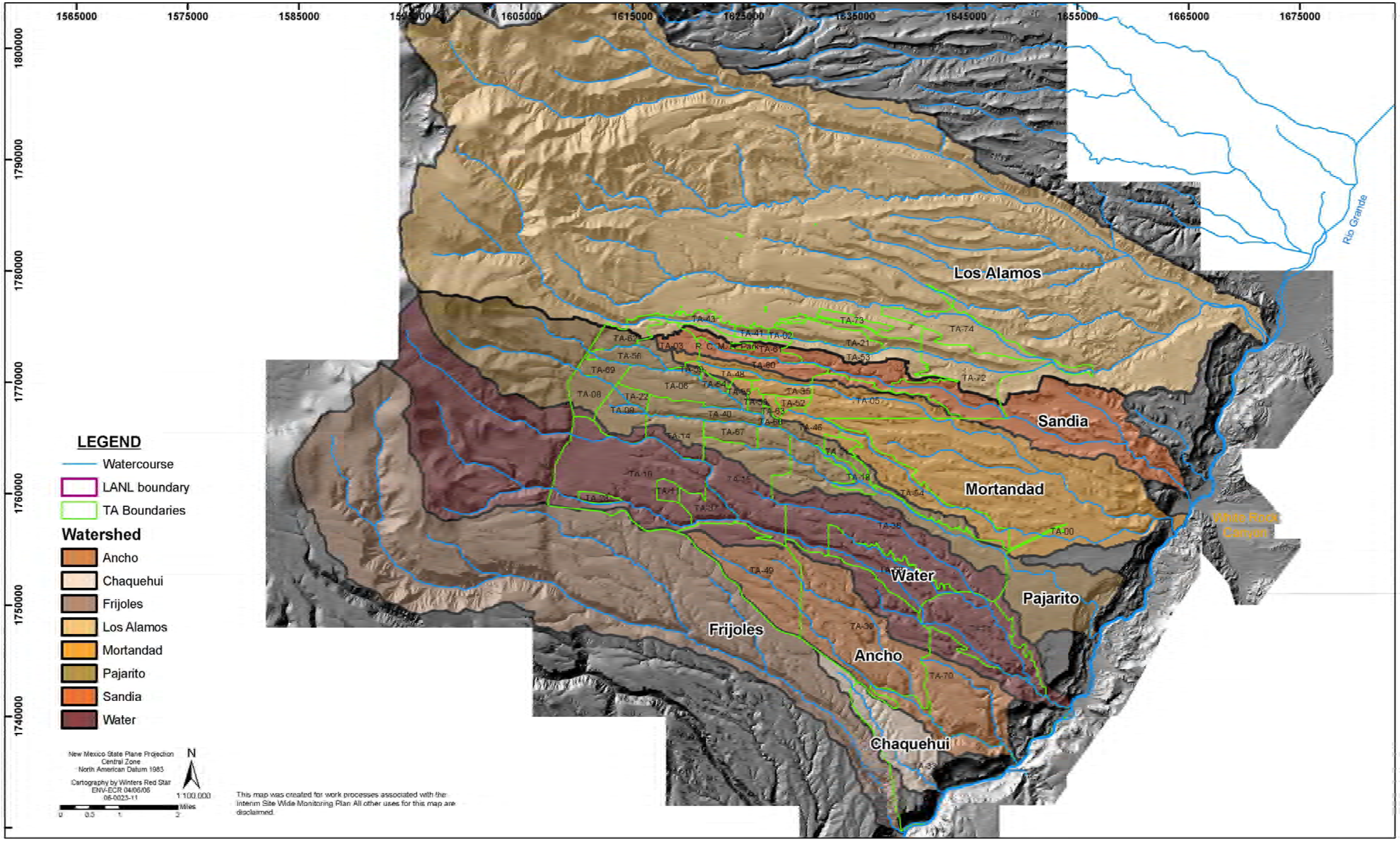

Figure 1.2-1. **Canyons of Los Alamos National Laboratory and the Pajarito Plateau**

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1.4.1 New Mexico Water Quality Control Commission Regulations

A 20.6.2. New Mexico Administrative Code [NMAC] Groundwater Discharge Permit currently exists at the Laboratory for the TA-46 Sanitary Wastewater Systems (SWWS) Plant (plan number DP-857). An application has been submitted for a second permit for the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF). Groundwater monitoring is performed at wells located in Cañada del Buey and Mortandad Canyon under the NMED approved plan (DP-857) and in support of the application (DP-1132), respectively. This monitoring began under DP-857 in 1992 and is expected to continue indefinitely with appropriate modification made as discharge conditions change over time (e.g., monitoring may be moved to Sandia Canyon since the TA-46 SWWS Plant has never discharged into Cañada del Buey). Quarterly reports of monitoring results are submitted to the NMED Groundwater Bureau for both the (DP-857) and the pending (DP-1132) plans.

1.4.2 DOE Environmental Protection Programs

Groundwater monitoring has been conducted in compliance with DOE orders related to environmental protection. DOE Order 450.1 requires an environmental management system at DOE facilities to include surveillance groundwater monitoring and reporting. Surveillance monitoring has been performed at the Laboratory since the 1970s under previous orders, and results are documented in annual reports. Currently, the Laboratory conducts groundwater surveillance monitoring from wells located within the Laboratory boundaries and at offsite locations. These wells include alluvial, intermediate perched, and regional aquifer wells. Some of the offsite monitoring is performed under an agreement with Los Alamos County, which owns and operates water supply wells within and near the Laboratory. Additional monitoring is performed under cooperative agreements with the San Ildefonso Pueblo and the City of Santa Fe. Results of surveillance monitoring are reported in annual environmental surveillance reports and are included in the calculation of radionuclide dose exposures found in those reports. These reports contain descriptions of the surveillance monitoring network, key results and trends, and quality assurance.

1.4.3 Hazardous Waste Facility Permit

Several of the waste management units at the Laboratory are regulated units under the Resource Conservation and Recovery Act (RCRA) and subject to groundwater monitoring requirements under 40 CFR 264 Subpart F, as administered through the Laboratory’s Hazardous Waste Facility Permit. Under Section IV.A.1 of the Consent Order (NMED 2005, 88207), these requirements will be met through implementation of the groundwater monitoring requirements of the Consent Order, including implementation of the Interim Plan.

Formerly, groundwater monitoring and sampling requirements were contained in Module VIII of the Laboratory’s Hazardous Waste Facility Permit (Module VIII), which was issued by EPA in 1990 (EPA 1990, 01585) and revised in 1994 (EPA 1994, 44146). Section C.1 of Module VIII required the Laboratory to install a total of 14 alluvial wells in Pueblo, Los Alamos, Sandia, Mortandad, Potrillo, Fence, and Water Canyons to determine the extent of downgradient saturation and contamination. In addition, Section C.2 of Module VIII required the Laboratory to continue the groundwater monitoring being conducted by the Environmental Surveillance Program to demonstrate protection of the regional aquifer. The investigation requirements of Module VIII required the Laboratory to conduct a program to characterize the hydrogeologic conditions at the Laboratory (Task III.A.1) and to conduct a groundwater investigation to characterize any plumes of contamination (Task III.C.1). In response to these investigation requirements, the Laboratory developed the Hydrogeologic Workplan (HWP) (LANL 1996, 55430), which was approved by NMED. Under the HWP, the

Laboratory installed regional wells and conducted four rounds of sampling following construction of new wells. Results of this sampling were reported in separate geochemistry reports for each well, in quarterly data reports submitted to NMED as formerly required by Module VIII, and in the Synthesis of Hydrogeologic Workplan Activities (1998-2004) (LANL 2005, 92028).

Groundwater sampling was also conducted as part of NMED approved investigation work plans prepared under Module VIII. Alluvial groundwater sampling was conducted under the NMED approved work plan addendum for the investigation of Los Alamos Canyon and Pueblo Canyon (LANL 2002, 70235). Sampling results were included in the "Los Alamos and Pueblo Canyons Investigation Report" submitted to NMED in April 2004 (LANL 2004, 87390). In addition, groundwater sampling has been conducted as part of the NMED approved investigation of Solid Waste Management Unit (SWMU) 16-021(c) (the 260 Outfall), with results reported in the investigation reports for that SMWU (LANL 1998, 59891; LANL 2003, 77965). The groundwater monitoring requirements of Module VIII have now been superseded and replaced by the requirements of the Consent Order.

1.5 Approach to Monitoring Network Design

The Consent Order lists sampling locations in Table XII-5 (NMED 2005, 88207) and requires that this list be used to develop the Interim Plan. Table XII-5 was used as a basis for development of the revised plan. The revised plan provides the rationale for the proposed sampling locations that differ from Table XII-5. The Interim Plan will be updated and resubmitted to NMED on an annual basis. The deadline for submittal of the annual updated plans is 90 days after each anniversary of the March 2005 effective date of the Consent Order, or May 31 of each year. The annual update will provide for addition of new wells as they are constructed, removal of old wells as they are abandoned, and optimization of monitoring locations, frequencies, and analytes based on results of the prior year. New wells will be constructed according to approved work plans. Old wells will be plugged and abandoned in accordance with 19.27.4 NMAC, Driller Licensing, Construction, Repair and Plugging of Wells and in accordance with Section X.D of the Consent Order. All wells scheduled for plugging and abandonment and included in the revised Interim Monitoring Plan will continue to be monitored until the wells have been plugged.

In addition to Consent Order requirements the Interim Plan used EPA guidance provided in "Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and Implementation" (EPA 2003, 88486). This guidance outlines a six-step process that covers planning, implementation, and completion of monitoring activities. However, the guidance is for monitoring at sites where remedial action is occurring or has been implemented and is therefore somewhat premature for the status of the corrective action program at the Laboratory. The Interim Plan generally follows the first four steps, which cover development and design. The first three steps involve defining the objective, plan hypothesis, and decision rules for the monitoring. The fourth step focuses on design of the monitoring network. The Consent Order calls for the monitoring network to be developed from those locations presented in Table XII.5. Monitoring frequency and determination of analytical suites are presented below.

A conceptual model has been developed for each watershed and presented in Appendix A. Conceptual models represent the current state of knowledge for each watershed and for the foundation for the monitoring strategy. The conceptual models will be updated annually using new information from canyons investigations and analysis of recent data collected during the previous year.

As shown in Figure 1.5-1, watershed monitoring on the Pajarito Plateau has been grouped into four categories

- Interim monitoring in watersheds that have not undergone investigation activities under the Canyons investigation process. Monitoring objectives are to collect data to identify and track contaminants and form a preliminary conceptual model for the watershed.
- Watersheds that are currently being investigated under the Canyons investigation process. Monitoring objectives are to determine the extent of contamination and develop a detailed conceptual model of the watershed.
- Watersheds for which the Canyons investigations process has been completed and which are undergoing post investigation interim monitoring. Monitoring objectives include tracking contaminant fate and transport and refining the conceptual model of the watershed.
- Long-term monitoring. Monitoring objectives include evaluating performance of corrective measures and evaluating long term trends of contaminants and their movement in groundwater. Currently, no watersheds are in long-term monitoring.

Recommendations for the analytical suites for each watershed and locations within the watershed were determined by evaluating past Laboratory operations, investigation derived information, and monitoring results. To evaluate analytical results, a screening was conducted to examine in detail which constituents should be monitored in each watershed. Data from 2000 through 2005 was screened and any result that occurred above ½ the lowest applicable standard (see Table 1.7-1) more than five percent of the time was included in the analytical suite for the watershed. LANL selected data from 2000 through 2005 to capture current conditions. The analytical data screening results are included on a CD in Appendix B. Bar plot figures showing exceedances for general inorganic chemistry (major cations, anions, and nutrients), metals, and organic constituents for each water type in each watershed are also included on the CD. They provide a graphical illustration of analytes that may be potential constituents for monitoring in the watershed.

The monitoring schedule in Figure 1.8-1 captures the range of hydrologic conditions. For sampling points where sufficient data exist to recognize variability or where no systematic variation exists, the monitoring schedule is set to represent the complete range of the variation. Where data are inadequate data to recognize variability, seasonal sampling is proposed for shallow groundwater and base flow and intermediate perched zones.

The majority of monitoring wells in watersheds throughout the Pajarito Plateau are equipped with pressure transducers to aid in understanding the hydrologic system. In addition, many of the regional wells are equipped with pressure transducers to examine the effect of municipal pumping throughout the year. Pressure transducers are set to measure pressure every hour. A synoptic watershed-wide groundwater level data set will be reported in each watershed monitoring report.

Sampling of alluvial groundwater and base flow will be performed simultaneously during the 21-day watershed sampling period stipulated in the Consent Order (NMED 2005, 88207).

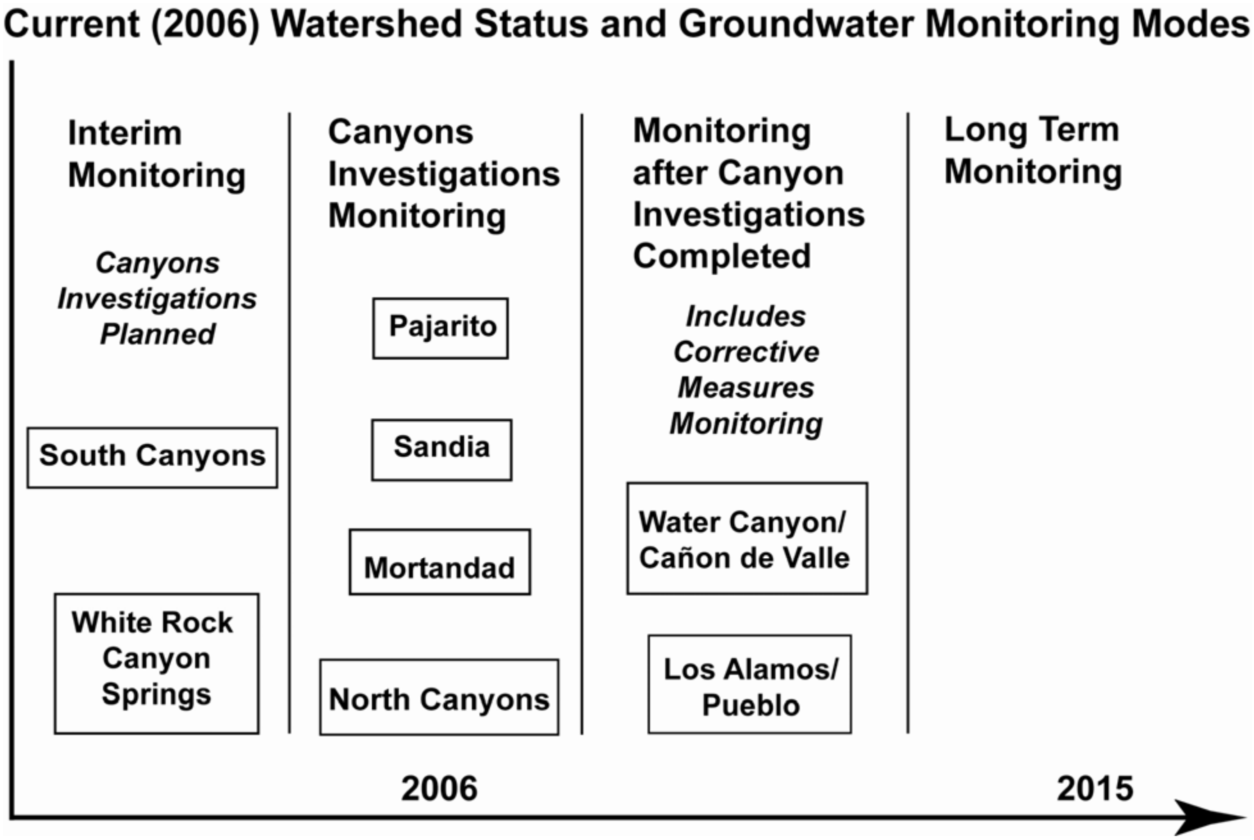

Figure 1.5-1. Watershed grouping and monitoring strategy

1.6 Integration of Groundwater Monitoring at the Laboratory

All groundwater monitoring is conducted as an integrated activity that uses the same operating procedures, lab analysis contracts, and data-management systems. All LANL groundwater data are available for public viewing on the web (http://wqdbworld.lanl.gov/) regardless of the regulatory authority under which it was gathered.

The Interim Plan will be updated annually to incorporate new information collected within a watershed. Locations, analytes, and sampling frequencies will be evaluated and updated appropriately to ensure adequate monitoring and avoid unreasonable budgetary expenditures. Information gained through characterization efforts, aquifer test results, optimization iteration models, and water quality data will be used to refine a long-term monitoring plan for each watershed.

1.7 Data Review Process

This section describes the results and implications of screening the 2000 to 2005 LANL monitoring data. The purpose of the screening is to determine the distribution of constituents that guide the choice of monitored analytes and monitoring frequency in each watershed.

1.7.1 Data Review, Analytical Methods, and Field Methods

Results of the data review process and statistical summaries are presented in Appendix B. The analytical methods used for each analyte are listed in Appendix C, Table C-1. Appendix C also includes the quality procedures followed for measuring water levels and collecting water samples (Tables C-2 and C-3) as well as investigation derived waste management procedures.

The data review process consists of compiling the water quality data set, determining detect status, screening the data against applicable standards, and producing summary statistics to identify constituents of concern in each watershed. Water quality data summary statistics and bar plots for each water type and constituent group (metals, general inorganics, and organics) are included in Appendix B.

Ephemeral and perennial surface water reaches and their respective standards were determined on the Pajarito Plateau by the NMED Surface Water Bureau. These two sets of standards are shown in Table 1.7-1 and were used to screen the appropriate locations presented in this Monitoring Plan. The numerical standards for each constituent are presented in Table B1, Appendix B.

The water quality data set is comprised of records originating in the Environmental Stewardship Division data bases. Analytical results with sampling dates between January 2000 and January 2005 were screened. Quality control samples including field duplicates and laboratory blanks, spikes, and replicates were removed. When there were multiple results for an analyte from a single sampling event (time and location) due to multiple analytical chemistry methods, the result from the preferred (most sensitive) method was selected. Remaining multiple results for an analyte at a single sampling event were combined by using the following. The average of the detected results was used, if any detects were available, and the average of the reported detection limits was used, if no detects were available. The entire data set used to develop the screen for all locations and generate the justification plots in each watershed is presented on a CD included in Appendix E.

The detection status for an analytical result was established using the combined set of validation qualifiers and reason codes assigned during data validation and the qualifier from the analytical laboratory. When available, a lab qualifier containing “U” was used to indicate a nondetect. In addition, quantification checks that follow the primary steps used in data validation were used to assign detection status. Results from any suite that were less than the method detection limit (MDL) or the instrument detection limit (IDL) were classified as nondetect.

Table 1.7-1 contains the regulatory standards for the various water samples by screening category. Data results were screened against the lowest applicable regulatory standard or risk based value. The standards apply to data depending on the type of field preparation applied during collection (filtered or nonfiltered) and the mode of the water, groundwater, ephemeral surface water, or persistent surface water. For example, the standard for mercury in surface water applies to total mercury. Each combination of water mode/field preparation is referred to as a screening category. Springs are appropriate to be screened as both ground water and surface water, so the smallest applicable standard from either mode was used for a given constituent.

Table 1.7-1
Applicable Standards Used in Watershed Screening

					Potentially applicable to			
					Surface water (WS, WGS)		Groundwater (WGA,WGI,WGR,WGS)	
Type	Group	Abbrev	Source	Standard	Filtered	Unfiltered	Filtered	Unfiltered
Standard	WQCC	LWF	NMAC 20.6.4	Livestock Watering (Filtered)	x			
Standard	WQCC	LWU	NMAC 20.6.4	Livestock Watering (Unfiltered)		x		
Standard	WQCC	WHU	NMAC 20.6.4	Wildlife Habitat (Unfiltered)		x		
Standard	WQCC	AqAcF	NMAC 20.6.4	Aquatic Life Acute (Filtered) 100 mg/L Hardness[1]	x			
Standard	WQCC	AqAcU	NMAC 20.6.4	Aquatic Life Acute (Unfiltered) 100 mg/L Hardness[1]		x		
Standard	WQCC	HHPF	NMAC 20.6.4	Human Health Persistent Toxics (Filtered)	x			
Standard	WQCC	HHPU	NMAC 20.6.4	Human Health Persistent Toxics (Unfiltered)		x		
Standard	WQCC	AqChrF	NMAC 20.6.4	Aquatic Life Chronic[2] (Filtered) 100 mg/L Hardness[1]	x			
Standard	WQCC	AqChrU	NMAC 20.6.4	Aquatic Life[2] (Unfiltered) 100 mg/L Hardness[1]		x		
Standard	WQCC	HHF	NMAC 20.6.4	Human Health[2] (Filtered)	x			
Standard	WQCC	HHU	NMAC 20.6.4	Human Health[2] (Unfiltered)		x		
Standard	WQCC	GWHH	NMAC 20.6.2	Groundwater Human Health			x	x
Standard	WQCC	GWDW	NMAC 20.6.2	Groundwater other stds for Domestic Water			x	x
Standard	EPA	MCL	CFR 264.94	RCRA MCLs			x	x
Standard	EPA	SDWA	www	Safe Drinking Water Act MCLs, MCLGs			x	x
Risk-human	DOE	DCG	Order 5400.5	DOE DCGs	x	x	x	x
Risk-human	EPA Reg 6	Reg6	www	EPA Region 6 Tap Water	x	x	x	x

Notes:

[1] Hardness-dependent criteria calculated using 100 mg/L CaCO3.

[2] Aquatic Life Chronic and Human Health standards apply to perennial surface waters in designated portions of listed canyons (NMAC 20.6.4 sections 126 & 127).

RCRA MCLs not in compliance order but are applicable.

- The EPA Region 6 Tap Water values for Cancer Endpoint have been adjust from 10-6 to 10-5 risk level.
- WGS is functionally the same as WS from an exposure standpoint. WGS is screened as both WG and WS.
- WGA is sampled everywhere it emerges, so no need to use WGA as surrogate for WS.
- WT samples are not included.
- Water screen steps:
  a) Assemble list of analytes by field preparation (F, NF) and by media code (WS, WGS, WGA, WGR, WGI)
  b) Compare to minimum standards that applies for the field preparation & media code (EPA Region VI Tap Water values in the absence of other standards)

A screen against regulatory standards was performed separately on each screening category from the combined set of samples for an individual watershed. Summary information is provided in each table including: the total number of samples for the analyte, the numbers and rates (fractions) of detects and nondetects, the range of reported detection limits, the count of detection limits greater than the standard, the minimum, maximum, average and median (50th percentile) detected concentration, the ratio of the maximum (and median) detected concentration to the regulatory standard. The screening tables for each water mode for each watershed are formatted in Excel and included on a CD in Appendix B. Pages in the file are labeled filtered metals, non filtered metals, filtered general inorganics, non filtered general inorganics, and non filtered organics. A description of the applicable standards used in the screen and abbreviations is included in the first two tabs of each file.

For chemical analysis of water samples, the Laboratory uses commonly accepted analytical methods that are called for under federal regulations (such as the Clean Water Act) and that are approved by EPA (Appendix C). Analytical methods and method detection limits are provided in Appendix C, Table C.4. The Laboratory is responsible for acquiring analytical services that support monitoring activities. The analytical laboratory statement of work (SOW) follows the National Nuclear Security Administration Service Center's Analytical Management Program's Model Statement of Work (Model SOW) for analytical services. The SOW provides contract laboratories the general quality assurance guidelines specified in the Model SOW and also includes specific requirements and guidelines for analyzing surface water, groundwater, and sediment samples.

Field methods follow the procedures listed in Appendix C, Tables C-2 and C-3. All of the procedures are available on the Laboratory's website (http://erproject.lanl.gov/documents/procedures/qps.html). Field procedures follow guidelines from USGS water sample collection methods and industrial standards common to environmental sample collection and field measurements.

1.7.1 Data Quality Implications of the Data Screening Results

LANL's screening of monitoring data identified constituents that exceed threshold levels and indicate a need for monitoring. These constituents fall into several categories, namely results that occur:

- in surface water and are of likely LANL origin,
- in groundwater and are of likely LANL origin,
- naturally, or are of other than LANL origin, or
- are due to sampling or analytical artifacts.

Table B.1 (Appendix B) lists these constituents by media for each watershed and indicates their likely category (LANL origin, natural, sampling artifact, etc.). This section describes analytical results that reflect sampling or analytical artifacts and were included in the screening results for each watershed. LANL proposes that although these analytical results exceeded screening thresholds, they do not require monitoring. Constituents that are naturally occurring or of non-LANL source also do not indicate a need for monitoring.

LANL environmental sampling results include many relatively high metals results that arise from sampling artifacts. Detections of high values (relative to thresholds) of aluminum, manganese, and iron found in well samples are in some cases due to effects on sample chemistry of turbidity or residual drilling fluids (LANL 2005, 91121). Further, many surface water, spring, and alluvial well samples have high aluminum, manganese, and iron (relative to thresholds), mostly in unfiltered samples, a reflection of sample turbidity. A number of locations also show very high values of these metals even in filtered samples.

Older LANL test wells have steel casings and galvanized metal well fittings that are subject to rust and metal flaking. Over time and with wear, corrosion, and work on the wells, water samples have shown increasing content of metals like iron, lead, manganese, and zinc.

A number of surface water and groundwater samples have selenium results that exceed screening thresholds. The selenium is of natural origin, based on analysis of background samples. Selenium concentrations in surface water, for example, increased substantially after the Cerro Grande fire as a result of ash content in the water, but have fallen in recent years. Constituents including arsenic and fluoride also occur naturally at values above screening thresholds, although not all arsenic may be of natural origin.

Most organic analytes indicated by the screening as requiring monitoring arise from sampling or analytical contamination, or documented analytical laboratory process issues (for example pesticide results). Organic analytes of known LANL origin include results for explosive compounds and chlorinated solvents in Cañon de Valle. Results for polycyclic aromatic hydrocarbon compounds such as benzo(a)pyrene are likely of urban rather than solely LANL origin.

Organic analytes may be detected in field quality control samples such as field blanks or equipment blanks, indicating that they are not truly present in associated groundwater samples. These analytes may be present in the quality control samples because of inadvertent contamination of sampling or analytical laboratory equipment by organic constituents that come from other sources.

Analytical methods require analysis of laboratory-prepared method blanks or instrument blanks with each batch of samples. Organic target analytes detected in these blanks indicate contamination from the sampling or analytical environments. Certain organic compounds used in analytical laboratories are frequently detected in laboratory blanks, that is, contamination introduced by the analytical process is common for these compounds. These compounds include acetone, methylene chloride, toluene, 2-butanone, di-n-butyl phthalate, di-n-octyl phthalate, and bis(2-ethylhexyl)phthalate (Fetter 1993, 88419). Numerous field, trip, and equipment blanks that LANL collects also contain toluene, acetone, butanone[2-], and hexanone[2-], which suggests inadvertent sample contamination in either the field or analytical laboratory.

In 2004, LANL identified several positive pesticide results, notably results for 4,4'-DDT and 4,4'-DDE, in samples. These results are not supported by previous data or by process knowledge at the sample locations. Subsequent examination of the analytical laboratory’s data revealed that some glassware used in the process was only rinsed, with no further cleaning, between uses. This finding indicates that pesticide contamination could be transferred from one sample to another during sample preparation. As a result, all pesticide results for 2004 are unusable.

The perchlorate screening threshold used for this Plan was the EPA region VI risk level of 3.7 ug/L. In January 2006 EPA issued new assessment guidance for perchlorate, specifying use of a drinking water equivalent level of 24.5 ug/L. The screening for perchlorate in this Plan also included a large number of ion chromatography results in surface water and groundwater that have documented analytical process errors, described below. A screening conducted on LANL’s perchlorate monitoring data, using a threshold based on the new EPA drinking water equivalent level and only more recent perchlorate data, would indicate this constituent only requires monitoring in Mortandad Canyon.

An important issue is the differing results of perchlorate by ion chromatography (EPA 314.0) and LC/MS/MS [SW-846 8321(M)]. Chromatographs for low-level detections by ion chromatography are often ambiguous for identification of perchlorate peaks. LC/MS/MS is less sensitive to matrix effects and more reliable for low-level perchlorate analysis. LANL were analyzed for perchlorate (ESP 2002, 73876).

Samples analyzed by one of our analytical laboratories prior to April 25, 2001 showed many false positives due to lack of all the anion removal steps possible in the EPA analytical method. Reanalysis of these samples that incorporated the additional steps gave nondetects. Thus many of the perchlorate results that are indicated in the screening are not valid.

1.8 Sampling Frequency and Schedule

Table XII-5 of the Consent Order calls for quarterly monitoring of all alluvial, intermediate perched, and regional wells. Based on the review of data, the interim plan sometimes proposes alternative monitoring frequencies where they will adequately meet monitoring objectives. Monitoring frequency will follow the watershed designation strategy presented in section 1.5 of this document. In watersheds where Canyons investigations have not occurred, a semiannual interim monitoring frequency is recommended. In watersheds where canyons investigations are underway monitoring will be quarterly to satisfy the need for additional information to determine risk and nature and extent of contamination. Monitoring in watersheds where an investigation has occurred will be on a semiannual frequency. In addition, all recently installed wells will be monitored quarterly for four successive quarters and evaluated annually. Discussion and data supporting monitoring frequency are presented in individual watershed sections of this Plan and in Appendix E.

The Consent Order (NMED 2005, 88207) calls for sampling the majority of the springs in White Rock Canyon annually. This will be accomplished during a raft trip planned for September/October. Additional springs will be sampled more frequently to address the need for more data as presented in section 8, White Rock Canyon Springs.

The sampling schedule for the Interim Plan (presented in Figure 1.8-1) is structured to capture the variability of groundwater, base flow, and contaminant transport with sampling scheduled for the wet and dry periods in each watershed. Each watershed will be sampled within 21 days; groundwater levels will be measured synoptically within 24 hours; and data will be reported to NMED 120 days after the last location has been sampled in each watershed.

1.9 Representative Monitoring Locations

Several intermediate perched and regional wells at the Laboratory have screens affected in different degrees by residual drilling fluids. Influence from these drilling fluids produces unreliable results for many constituents. Individual locations and screens are discussed and ranked with respect to reliability in the Well Screen Analysis Report (LANL 2005, 91121). A report recommending rehabilitation of existing screens or replacement of entire wells will be submitted to the NMED June 1, 2006.

Under the Interim Monitoring Plan, samples from individual screens rated as fair or poor in the Well Screen Analysis Report (LANL 2005, 91121) will be analyzed for a limited analytical suite. Only constituents that are not affected by residual drilling fluids will be collected to fulfill monitoring objectives in the individual watersheds. In addition, a suite of constituents used to determine the extent of impact from drilling fluids will be collected and analyzed (i.e., iron, manganese, sulfate, sulfide, sodium, barium, organic carbon, and others). This indicator suite is presented and described in Tables 2.3.1 through 8.3.1

Proposed Schedule of Sample Events
2006 Interim Monitoring Plan

Watershed	Frequency	* Proposed Sample Dates											
		2006								2007			
		May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April
Mortandad	Quarterly	May15-June 4											
(includes Sandia & Canada del Buey)					Aug 14-Sept 3								
								Nov 13- Dec 3					
											Feb 12-March 4, 2007		
Sandia	Quarterly		June 5 - June 25										
						Sept 4 - Sept 24							
									Dec 4 - Dec 24				
												March 5 - March 25, 2	
Pajarito	Quarterly					Sept 25 - Oct 15							
										Jan 2 - Jan 22, 2007			
												March 26 - April 15, 20	
Los Alamos/Pueblo (includes Bayo)	Semiannual		June 26 - July 16										
							Oct 23 - Nov 12						
													April 16 - M
White Rock Canyon Springs	Annual & Semiannual						Oct 16 - Oct 22						
CdV/Water	Semiannual			July 24 - Aug 13									
										Jan 23 - Feb 11, 2007			
Ancho	Semiannual					Sept 11 - Oct 1							
												March 12 - April 1, 200	

* Dates include weekends and holidays.

Figure 1.8-1. Schematic for the 2006 fiscal year Interim Plan schedule

1.10 Overview of Geology and Hydrogeology

The Laboratory is situated on the Pajarito Plateau on the eastern flanks of the Jemez Mountains in northern New Mexico. The plateau lies on the western margin of the Española Basin, a geologic feature of the Rio Grande Rift. The surface of the Pajarito Plateau is composed primarily of the eroded top of the Tshirege Member of the Bandelier Tuff, a large-volume, rhyolitic, ash-flow tuff (ignimbrite) erupted from the Valles Caldera of the Jemez volcanic field. A series of generally east-west trending canyons cut into the plateau, forming a number of isolated, finger-like mesas (see Figure 1.2-1).

The simplest hydrologic conceptual model for the Pajarito Plateau includes saturated porous media, with the surface of saturated zone(s) mimicking topography. For example, the regional water table slopes from a high recharge area in the Sierra de los Valles/Jemez Mountains west of the Laboratory downward to the Rio Grande on the east where groundwater discharges. Complicating this simple model, however, are zones of saturation perched above the regional water table.

Groundwater occurrence is generally described in terms of geography. For example, groundwater may be more accessible or plentiful in one area than in another, perhaps as a result of changes in aquifer thickness and sedimentary facies within the aquifer or the hydrogeologic unit. Although groundwater productivity in supply wells varies with the hydrogeologic unit making up the regional aquifer, depth to the water table is primarily the result of topography. The regional zone of saturation is more accessible in the canyons than it is on the mesas because there is less rock to drill through before reaching the regional water table in canyon bottoms.

The following sections address monitoring watershed-by-watershed across the Pajarito Plateau. Watersheds are addressed individually or in some cases by groupings. Chapters include Los Alamos Canyon/Pueblo Canyon, Sandia Canyon, Mortandad Canyon, Pajarito Canyon, Water Canyon/Cañon de Valle, Ancho/Chaquehui/Frijoles Canyons, and White Rock Canyon. Each watershed has a table with locations taken from Table XII-5 of the Consent Order, additional monitor locations, analytes and analytical suites, sampling frequency, and groundwater level/flow measurement frequency. These tables were designed to contain essential information regarding the sampling in each watershed.

LANL is also including three additional maps from the 2005 and 2006 General Facility Information submittal, which are provided at a larger scale. One of the additional maps depicts springs; the second depicts groundwater monitoring wells, supply wells, and vapor monitoring wells (including wells that have been abandoned); and the third depicts surface water gaging stations. These maps are located at the end of this Plan, before the appendices.

2.0 LOS ALAMOS WATERSHED

2.1 Introduction

The Los Alamos Canyon/Pueblo Canyon watersheds are located at the northern end of the Laboratory (Figure 1.2-1). The watershed heads on U.S. Forest Service (USFS) land in the Sierra de los Valles to the west and northwest of the Laboratory. The highest point in the watershed is at the summit of Pajarito Mountain at an elevation of 3182 m (10,441 ft). The watershed extends eastward from the headwaters across the Pajarito Plateau for about 30.4 km (18.9 mi) to its confluence with the Rio Grande at an elevation of 1678 m (5504 ft).

2.2 Background

The Los Alamos Canyon/Pueblo Canyon watershed encompasses approximately 57 sq mi. It includes Los Alamos, Pueblo, Delta Prime (DP), and Acid Canyons. Bayo, Guaje, Rendija, and Barrancas Canyons (collectively known as the North Canyons) are smaller tributary canyons in the watershed. The watershed contains numerous springs, perennial and ephemeral stream segments, and alluvial groundwater. Portions of Los Alamos townsite, Los Alamos County, Santa Fe County, and San Ildefonso Pueblo tribal lands are located within the Los Alamos Canyon/Pueblo Canyon watershed. Laboratory operations have been associated with the release of treated and untreated effluent into the watershed since the establishment of the Laboratory in the 1940s up to the present. Runoff from SWMUs and AOCs at former and current Technical Areas (TAs) 00, 01, 02, 03, 19, 21, 31, 41, 43, 53, 72, and 73 have contributed to contaminant releases within the watershed. Metals, perchlorate, nitrates, hydrocarbons, and radionuclides have been detected in groundwater within the watershed. DP Canyon joins Los Alamos Canyon east of TA-21. TA-02, -41, and -43 are located within Los Alamos Canyon south of the Los Alamos townsite. TA-21 and -73, and former TA-01, are located on the mesa north of Los Alamos Canyon. TA-62, -61, -53, and -72 are located south of Los Alamos Canyon.

Pueblo Canyon is located on the north side of the Los Alamos townsite and extends from the Jemez Mountains to its confluence with Los Alamos Canyon approximately 4.5 mi east of the Los Alamos townsite at the intersection of State Highways 502 and 4. TA-72 and -73 and former TA-01 and -45 are located from west to east along the mesa south of Pueblo Canyon. Acid Canyon joins Pueblo Canyon from the south opposite former TA-45. Documented discharges and releases into the watershed were primarily in the form of contaminated wastewater generated during research and manufacturing operations on the surrounding mesas in the vicinity of the Los Alamos townsite. In addition, discharges and releases of contaminants were documented in Los Alamos Canyon resulting from operations conducted at TA-02 and -41. Releases also originate from debris generated during TA-01 demolition activities and deposited on hillsides located above Los Alamos Canyon, opposite the townsite. Laboratory operations that have affected Pueblo Canyon include the release of contaminants to Pueblo Canyon via Acid Canyon from former TA-01 and -45. Activities at TA-02, -21, -41, -53 and former TA-01 released contaminants into Los Alamos Canyon and its tributary side canyons (DP Canyon and the undesignated canyon located east of TA-53). Past Laboratory operations released both hazardous constituents and radionuclides.

Bayo, Guaje, Rendija, and Barrancas Canyons are located north of Laboratory land. The only active TA in the canyons is TA-74, a portion of which is located in Bayo and Barrancas Canyons. The approximately 18 SWMUs and AOCs in these drainages are primarily related to mortar impact areas, firing ranges, and releases of treated effluent. Surface water flow in upper Guaje Canyon is perennial and extends for about 3 mi. In 1996, two shallow test holes were drilled approximately 3 mi east of the perennial flow between the Los Alamos and Guaje faults. Each borehole penetrated saturation from near ground surface to total depth (23 ft and 103 ft below ground surface [bgs], respectively). Regional aquifer water supply wells in Guaje Canyon were first installed in the early 1950s. In recent years there have been additional replacement wells drilled. The depths to water at these wells vary depending on their location. Depth to water in the lower portion of the canyon tends to be shallow (100–200 ft bgs), while water levels in the upper portion near the Rendija Canyon confluence have water table depths ranging from 400 to 500 ft bgs. Surface water flow in Rendija and Barrancas Canyons is ephemeral and normally flows only during the summer monsoon season. Contaminant sources are primarily associated with upper Rendija Canyon. The results of surface water sampling conducted in these canyons have periodically detected metals, organics, and radionuclides.

The primary Laboratory activities in these canyons have involved water supply: the Guaje reservoir is no longer operable, and the Guaje well field (now operated by Los Alamos County) currently includes five water supply wells. The wells in this field also extend to lower Rendija Canyon. Rendija Canyon contained a small-arms firing range and several sites used as mortar impact areas. Past Laboratory activities are described in more detail in the “RFI Work Plan for the North Canyons” (LANL 2001, 71060) and the “RFI Work Plan for OU 1071” (LANL 1992, 07667). TA-10 was used as a firing site from 1943 to 1961, for tests with explosive compounds and radioactive materials. The site included a radiochemistry laboratory. While in operation, the TA-10 sites in Bayo Canyon were investigated for environmental impacts. The site was decontaminated and decommissioned in 1960. TA-10 was the site of an extensive Formerly Utilized Sites Remedial Action Program investigation in 1976 (Mayfield et al. 1979, 11717). In the mid-1990s the site was studied under the “RFI Work Plan for Operable Unit 1079” (LANL 1992, 07668). RCRA facility investigation (RFI) activities included shrapnel removal and investigation, remediation, or deferred action for several potential release sites (PRSs). A second RFI work plan was written in 2001 (LANL 2001, 71060). Only one sampling location, base flow at Guaje Canyon, will be sampled under the Interim Plan. No groundwater or spring locations will be sampled in Guaje, Rendija, or Barrancas Canyon under the Interim Monitoring Plan.

A work plan for the investigation of Los Alamos Canyon and Pueblo Canyon was approved by NMED in 1997. An addendum to the Los Alamos Canyon and Pueblo Canyon investigation work plan was submitted to and approved by NMED in 2002. In accordance with the NMED approved investigation work plan and addendum, the Laboratory has conducted investigations of contamination in Los Alamos Canyon and Pueblo Canyon. In 2002, the Laboratory conducted an Interim Action in the South Fork of Acid Canyon (a tributary of Pueblo Canyon) in accordance with an Interim Action Plan approved by NMED in 2002.

Table A-1 in Appendix A summarizes the conceptual model for the Los Alamos Canyon/Pueblo Canyon watershed.

2.3 Monitoring Objectives

The monitoring for Los Alamos Canyon presented in this Interim Monitoring Plan is based in part on results and conclusions presented in the “Los Alamos and Pueblo Canyons Investigation Report” (LANL 2004, 87390). Data in the investigation report only address surface water and alluvial groundwater, thus the recommendations presented herein reflect an updated conceptual model presented for those zones. This monitoring frequency will provide sufficient data to evaluate long-term trends in contamination and provide the basis for assessing the conceptual model presented in the LA/Pueblo Report.

Monitoring of the intermediate-depth and regional groundwater is based on past results, number of sample rounds that have been collected and status of the well. Intermediate perched and regional depth wells that have been sampled four or more times will be monitored semiannually. Recently installed wells that have been sampled less than four times will be monitored quarterly until four sampling rounds have been collected. Screens of intermediate perched and regional well where the affect of residual drilling fluids has been detected will be sampled on the respective frequency presented above. Analytical suites for the impacted screens will consist of constituents not affected by the geochemical conditions surrounding the screen and of constituents used to measure the extent of impact (i.e., iron, manganese, sulfate, sulfide, sodium, barium, organic carbon, and others). An analysis of the impact of drilling fluids on screens of intermediate perched and regional wells installed within the past decade is presented in the Well Screen Analysis Report (LANL 2005, 91121) and will be used as a guide to determine analytes. The rationale for sampling frequencies for intermediate perched and regional wells is presented below.

Surface water and all groundwater zones will be sampled within 21-days of a field campaign upon entering the watershed.

2.4 Scope of Activities

2.4.1 Base Flow

Sampling locations, frequency, analytes, and the rationale for base flow monitoring are presented in Table 2.3-1. Locations are shown in Figure 2.3-1.

The screening conducted as described in Section 1.5 identified several metals constituents (aluminum, arsenic, copper, iron, lead, manganese, and selenium); two general inorganic constituents (amenable cyanide and perchlorate) and several organic constituents (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)anthracene, dibenz(a,h)anthracene 4,4-DDD, 4,4-DDT, indeno(1,2,3-cd)pyrene, methylene chloride chrysene) were detected above the screening threshold. These constituents are shown graphically as bar plots in Figures B.1 through B.6. The screening tables are presented electronically in the Los Alamos/Pueblo Watershed Surface Water files on a CD in Appendix B. The organic constituents (specifically PAHs) that are detected in surface water are those typical of drainage from paved and asphalted surfaces.

Base flow in upper Los Alamos Canyon will be sampled at six existing gaged sites: four in Los Alamos Canyon (E026, E030, E042, and E050) and two in DP Canyon (E038 and E039). Los Alamos Canyon location E026 is west of the Laboratory in a segment with persistent flow and is considered a background location. Sampling points E030 and E042 monitor water quality from former TAs and from DP Canyon. Location E050 is at the Laboratory boundary and monitors the quality of base flow leaving the Laboratory. DP Canyon sampling point E038 is upstream of the former SWMU 21-011(k) outfall and it is intended to document the quality of water draining from the Los Alamos townsite into DP Canyon including monitoring for diesel-range organics historically associated with the former DP tank farm located near the head of the canyon. DP Canyon sampling point (E039) will monitor water quality associated with Reach DP-2, down gradient from the former SWMU 21-011(k) outfall.

Base flow in Pueblo Canyon will be sampled at four locations. Pueblo above Acid (E055) monitors base flow above the Acid Canyon confluence and can be used for assessing the impacts of townsite runoff into Pueblo Canyon. Gage station E056 is located in Acid Canyon above the confluence with Pueblo Canyon monitors water quality at the mouth of Acid Canyon. “Pueblo 3” is located below the Bayo wastewater treatment plant, and results from this location will allow assessment of down canyon trends of contaminants originating in Acid Canyon. “Pueblo above State Highway 502” is a boundary monitoring station and will monitor for potential off site transport of contamination. Furan and dioxin analysis will be included in the suite at locations Pueblo 3 and E060 to monitor for potential contamination from the airport incinerator ash pile.

Base flow sampling station E110 in lower Los Alamos Canyon will be used to measure water quality above the confluence of Los Alamos Canyon with the Rio Grande.

2.4.2 Alluvial Groundwater

Sampling locations, frequency, analytes, and the rationale for alluvial groundwater monitoring are presented in Table 2.3-1. Locations are shown in Figure 2.3-1.

The screening conducted as described in Section 1.5 identified four metals constituents (arsenic, iron, manganese, and molybdenum); three general inorganic constituents (chloride, nitrate as N, and perchlorate); and two organic compounds (bis (2-ethylhexyl)phthalate and methylene chloride). These constituents are shown graphically in Figures B.7 through B.9. The screening tables are presented electronically in the Los Alamos/Pueblo Watershed Alluvial Groundwater files on a CD in Appendix B.

Eleven alluvial wells, LAO-B, LAO-0.3, LAO-0.6, LAO-1, LAO-1.6g, LAO-1.8, LAUZ-1, LAO-2, LAO-3a, LAO-4.5c, and LAO-5 (or LAO-6 or -6a dependent on saturation), will be monitored in upper Los Alamos Canyon. LAO-B monitors background conditions in Los Alamos Canyon. In Pueblo Canyon, five alluvial wells will be monitored: PAO-1, PAO-2, PAO-3, PAO-4, and APCO-1. Alluvial wells LLAO-1b and LLAO-4 will be used to monitor groundwater on the San Ildefonso reach below the confluence of Pueblo Canyon and Los Alamos Canyon.

The Interim Monitoring Plan Notice of Deficiency calls for monitoring additional wells that are spatially redundant with wells proposed in this Plan. The following discussion provides data and the rationale for choices presented in this Plan.

Locations LAO-0.91, LAO-1, and LAO-1.2 in upper Los Alamos are located within 1500 feet of each other and access groundwater of a similar chemistry as shown in Figure E.2.1, Appendix E. From this plot it is apparent that major ions magnesium, calcium, sodium, potassium, sulfate, and chloride are very similar. These major ions are used to illustrate the comparability because no significant contaminants are present at any of these wells. Of these wells, LAO-1 has by far the longest and most extensive historical data set dating back to the early 1970s. The long data record at LAO-1 and the comparable water chemistry supports continuation of monitoring at LAO-1 rather than the other nearby wells.

Locations LAUZ-1 and LAUZ-2 are located in DP Canyon reach DP-2 within approximately 200 meters of each other (Figure 2.4-1). Groundwater levels at LAUZ-1 in the upper reach are consistently higher and more stable than LAUZ-2. Additionally, groundwater levels in LAUZ-2 have historically dropped below the bottom of the screen of LAUZ-2 precluding collection of groundwater samples. Groundwater chemistry is similar between the two wells. The major ion chemistry is similar at both locations as illustrated by the plot in Figure E.2.3. In addition, the data set from LAUZ-1 is more extensive than the data set from LAUZ-2 (Figure E.2.2). The similarity indicates that inclusion of monitoring at LAUZ-2 would be spatially redundant with LAUZ-1. Additional justification for selection of LAUZ-1 is that it is located directly down gradient from the historical outfall at SWMU 21-011(k). Furthermore, LAUZ-1 is a key well for monitoring for diesel-range organics in upper DP Canyon in place of the quarterly DP Canyon visual inspection required per a compliance order issued by the NMED on June 8, 1998.

Alluvial wells LAO-5, LAO-6, and LAO-6a located in Los Alamos Canyon are commonly dry throughout much of the year. All three locations monitor for contamination associated with sources in the upper watershed, and there are no new contaminant sources between LAO-5 and LAO-6/LAO-6a. The monitoring strategy is to check all of the wells during the watershed sampling event and collect a sample from the well with the most groundwater. This Plan recommends that sampling one of these wells will sufficiently represent groundwater chemistry in this region of Los Alamos Canyon.

Pueblo Canyon alluvial wells PAO-5s, PAO-5n, and APCO-1 are within approximately 100 feet of each other and are screened in the same alluvial aquifer. The longest period of record exists for APCO-1, dating back to 1990. Groundwater chemistry is also similar between the two wells. Average groundwater chemistries of APCO-1 and PAO-5n are presented in Figure E.2.4. Major anions (calcium, chloride, sulfate and magnesium) as well as trace elements (iron, manganese, boron, and arsenic) are similar. APCO-1 is the recommended location for monitoring under this Plan based on it having the longer period of record and because of the similarity in groundwater chemistry between these closely situated wells.

In lower Los Alamos Canyon, the NOD calls for monitoring at alluvial wells LLAO-3 and LLAO-5 in addition to wells LLAO-1b and LLAO-4. Data presented in the Los Alamos and Pueblo Canyon Investigation report (LANL 2004, 87390) show that results from well LLAO-5 indicate substantial mixing of alluvial groundwater with regional groundwater. Thus that well is not fully representative of alluvial groundwater in that portion of lower Los Alamos Canyon. Monitoring well LLAO-3 is considered redundant with the bounding wells LLAO-1b and LLAO-4 because there are no new contaminant sources located in the lower Los Alamos Canyon reach.

A field survey recently conducted by the Laboratory and NMED Oversight Bureau determined that Highway Department wells MW-3, MW-5, MW-6, and MW-9 have been plugged and abandoned (apparently by the Highway Department) and are no longer available for monitoring. Therefore, these wells are not considered for this Plan.

2.4.3 Intermediate Perched Groundwater

Sampling locations, frequency, analytes, and the rationale for intermediate perched groundwater monitoring are described in this section and presented in Table 2.3-1. Locations are shown in Figure 2.3-1.

Intermediate perched groundwater data from 2000 to 2005 was screened against ½ the appropriate standard to identify constituents detected above a threshold in the watershed. When a constituent exceeded the threshold, it was flagged and included in the appropriate analytical suite. Several metals constituents (iron, manganese, nickel, and selenium); two general inorganic constituents (fluoride and perchlorate); and two organic compounds (bis(2-ethylhexyl)phthalate and phenol) were detected above the screening threshold. These constituents are shown graphically in Figures B.10 through B.12. The screening tables are presented electronically in the Los Alamos/Pueblo Watershed Intermediate Groundwater files on a CD in Appendix B.

Wells in upper Los Alamos Canyon, R-7, LAOI(a)-1.1, LAOI-3.2, LAOI-3.2a, LAOI-7, and R-9i, are screened in perched intermediate groundwater zones and will be sampled under the Interim Plan. No groundwater was found in intermediate depth borehole LADP-5 and the borehole was subsequently plugged and abandoned. In Pueblo Canyon, there are four wells screened in intermediate perched groundwater: R-5, TW-2A, POI-4, and TW-1A. Intermediate well TW-2a does not produce sufficient groundwater for sampling and is not part of the Interim Plan monitoring well network. TW-1a and TW-2a are scheduled for decommissioning and will be plugged and abandoned in accordance with 19.27.4 NMAC and Section X.D of the Consent Order. There are no wells screened in intermediate perched water in lower Los Alamos Canyon.

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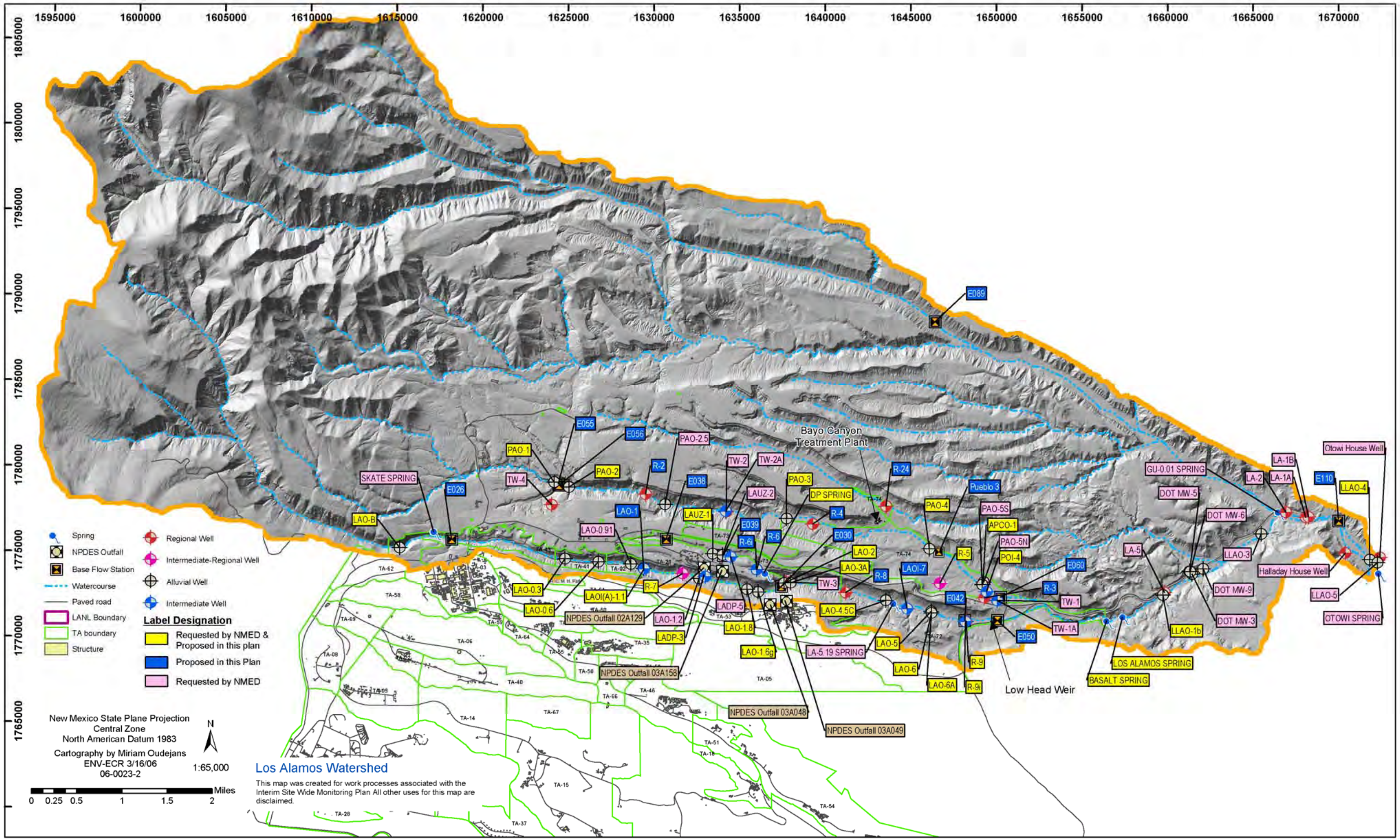

This map was created for work processes associated with the Interim Site Wide Monitoring Plan All other uses for this map are disclaimed.

Figure 2.3-1. **Los Alamos Watershed**

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Table 2.3-1
Los Alamos Watershed Interim Monitoring Plan

					Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Upper Los Alamos Canyon (includes DP Canyon)[l]																					
	Los Alamos below the Ice Rink (E026)	Typically persistent flow. Monitors background water quality and potential residual effects of Cerro Grande fire.	Base flow	C	S		A	A	S	S			A		S	S		S	A	S	S
	Los Alamos above DP Canyon (E030)	Seasonally intermittent flow. Persistent flow typically only during spring runoff. Monitors potential effects of TA-1, TA-2, and -41.	Base flow	C	S		A	A	S	S			A		S	S		S	A	S	S
	DP above TA-21 (E038)	Monitors baseline water quality in DP Canyon associated with townsite runoff. Background for reach DP-2. Monitors water quality up gradient from potential affects from SWMU 21-011(k) in reach DP-2.	Base flow	C	S		S	S+dro	S	S			A		S	S		S	A	S	S
	DP below Meadow at TA-21 (E039)	Monitors water quality associated with contaminants in reach DP-2 associated with SWMU 21-011(k).	Base flow	C	S		A	A	S	S			A		S	S		S	A	S	S
	Los Alamos above SR-4 (E042)	Ephemeral. Persistent flow uncommon, typically only during robust spring runoff. Monitors potential affects from DP and upper Los Alamos Canyons and water quality above the low head weir. Data from this location can be used to evaluate weir performance.	Base flow	C	S		A	A	S	S			A		S	S		S	A	S	S
	Los Alamos below LA Weir (E050)	Ephemeral. Monitors water quality at Laboratory boundary and influence of low-head weir on surface-water quality.	Base flow	C	S		A	A	S	S			A		S	S		S	A	S	S
Skate Rink		Questionable source.	Spring																		
DP	DP Spring	Monitors impact on water quality from secondary contaminant sources in DP Canyon sediments.	Alluvial Spring	S	S		S	S	S	S	S		A		S	S		S	A	S	S
LA-5.19[d]		No history of contamination. Flow is not consistent seasonally and possibly represents bank storage of surface water.	Alluvial Spring																		
LAO-B	LAO-B	Monitors background alluvial groundwater quality.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAO-0.3	LAO-0.3	Monitors baseline water quality downcanyon of townsite runoff, and provides baseline for assessing potential effects of TAs-1, -2, and -41.	Alluvial	C	A		A	A	S				A		S	S		S	A		S

Table 2.3-1
Los Alamos Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Upper Los Alamos Canyon (includes DP Canyon)[l]																					
LAO-0.6	LAO-0.6	LANL agrees that LAO-0.6 is the appropriate alluvial well for monitoring for potential affects from Technical Areas 41 and 2. At this time, LAO-0.3 will also be maintained in the monitoring network to characterize the potential affects of townsite runoff.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAO-0.91		Closely spaced with LAO-1, and no new sources of contamination between the two. Therefore considered Redundant with LAO-1.	Alluvial																		
	LAO-1	Monitors potential impact of TAs-1, -2, and -41, and sediment contamination in up canyon reaches. Long historical record supports choice of LAO-1 for ongoing monitoring.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAO-1.2[d]		Considered spatially redundant with LAO-0.91.	Alluvial																		
LAO-1.6g	LAO-1.6g	Monitors distal effects of historical molybdenum contamination associated with TA-53 outfall.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAO-1.8	LAO-1.8	LAO-1.8 is useful for monitoring trends in molybdenum contamination historically from TA-53 outfall.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAUZ-1	LAUZ-1	Monitors groundwater contamination associated w/contaminated sediments in Reach DP-2	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAUZ-2[d]		Redundant with LAUZ-1. LAUZ-1 shows consistently higher strontium-90 levels then LAUZ-2 and represents a more conservative choice. LAUZ-1 has a long going record of historical water quality data.	Alluvial																		

Table 2.3-1
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					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Upper Los Alamos Canyon (includes DP Canyon)[l]																					
LAO-2	LAO-2	Most downcanyon alluvial groundwater monitoring point in DP Canyon. Monitors cumulative affects of contaminants in DP Canyon. Shows some mixing of alluvial groundwater from upper portions of Los Alamos Canyon.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAO-3a	LAO-3a	Monitors net effect of mixing of groundwater from Los Alamos and DP Canyons.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAO-4.5c	LAO-4.5c	Monitors for indications of downcanyon migration of contamination below Los Alamos/DP Canyon confluence.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAO-5, LAO-6, & LAO-6a	LAO-5, LAO-6, & LAO-6a	Monitors potential contaminant migration from upper canyon and serves as facility boundary monitoring location. One or more of these wells may be dry so they are grouped as one location. The well with sufficient saturation will be sampled.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LAOI(a)-1.1	LAOI(a)-1.1	Analytical suite reflects contaminants in alluvial groundwater. Chemistry suggests fast path recharge from the alluvial system.	Intermediate	C	S		S	S	S				A		S	S		S	A		S
R-7	R-7, screen 1	Four rounds of characterization sampling completed with no contaminants detected.	Intermediate	C	S		S	S	S				A		S	S		S	A		S
R-7	R-7 screen 2[d]	Screen in this zone does not produce groundwater. No samples were collected during characterization phase sampling. The Screen will be checked and sampled if water is present.	Intermediate	C	S		S	S	S				A		S	S		S	A		S
LADP-5		No groundwater was encountered during drilling of LADP-5. The borehole was subsequently plugged and abandoned.	Intermediate																		
	LAOI-3.2	LAOI-3.2 new intermediate well. Currently under going four rounds of characterization sampling.	Intermediate	C	S		S	S	S				A		S	S		S	A		S

Table 2.3-1
Los Alamos Watershed Interim Monitoring Plan

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					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Upper Los Alamos Canyon (includes DP Canyon)[l]																					
R-9i	R-9i, screen 1	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Intermediate	C											S		S		A		S
R-9i	R-9i screen 2	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Intermediate	C											S		S		A		S
	R-6i	New well, quarterly characterization sampling underway as part of this plan	Intermediate	C	Q		Q	Q	Q	Q			Q		Q	Q		Q	Q		Q
	LAOI-7	New well. Characterization sampling underway as part of this plan	Intermediate	C	Q		Q	Q	Q	Q			Q		Q	Q		Q	Q		Q
R-7	R-7, screen 3	Screen in this zone is impacted by residual drilling fluids. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											S		S		A		S
	R-6	New well; characterization sampling underway as part of this plan.	Regional	C	Q		Q	Q	Q	Q			Q		Q	Q		Q	S		Q
TW-3[d]		Planned for plugging and abandonment. Sample was collected before P&A activities started.	Regional																		
	R-8, screen 1	Monitors regional groundwater. Results show no impact from laboratory activities.	Regional	C	S		S	S	S				A		S	S		S	A		S
	R-8, screen 2	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											S		S		A		S
R-9	R-9	Monitors regional groundwater at boundary.	Regional	C	S		S	S	S				A		S	S		S	A		S

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					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pueblo Canyon (includes Acid Canyon)																					
	Guaje above Rendija Canyon (E089)	Lower extent of perennial flow in Guaje Canyon. No contaminants present from the Laboratory or town site runoff, background base flow location.	Base flow	S	S		A	A	S				A		S	S		S	A	S	S
	Pueblo above Acid (E055)	Baseline for Pueblo Canyon. Monitoring for assessing impacts of townsite runoff.	Base flow	C	S		A	A	S				A		S	S		S	A	S	S
	Acid Above Pueblo (E056)	Monitors persistent surface water at mouth of Acid Canyon. Location historically shows elevated rad concentrations due to contaminated sediments in reach.	Base flow	C	S		A	A	S				A		S	S		S	A	S	S
	Pueblo 3	Baseline for water quality below Bayo WWTP. Monitors downcanyon trend of contaminants measured at Reach AC-3 SW (Acid Weir).	Base flow	S	S		A	A	S			S	A		S	S		S	A	S	S
	Pueblo above SR-502 (E060)	Boundary location. Measure potential impacts from erosion and sediment-bound plutonium transport in lower Pueblo Canyon.	Base flow	C	S		A	A	S			S	A		S	S		S	A	S	S
PAO-1	PAO-1	Monitors groundwater immediately above Acid Canyon, the dominant source of contamination in Pueblo Canyon. Also, monitors to evaluate trends in post-Cerro Grande fire perturbations (strontium-90 and plutonium).	Alluvial	C	A		A	A	S				A		S	S		S	A		S
PAO-2	PAO-2	Monitors groundwater immediately below Acid Canyon, the dominant source of contamination in Pueblo Canyon. Also, monitors to evaluate trends in post-Cerro Grande fire perturbations (strontium-90 and plutonium).	Alluvial	C	A		A	A	S				A		S	S		S	A		S
PAO-2.5[d]		No new sources of contamination in this portion of the canyon. Redundant with PAO-1, PAO-2, and PAO-3 with respect to water quality.	Alluvial																		
PAO-3	PAO-3	Monitoring at a location approximately midway between PAO-1 and PAO-4 to evaluate trend in post-Cerro Grande fire perturbation in strontium-90 and plutonium concentrations.	Alluvial	C	A		A	A	S			S	A		S	S		S	A		S

Table 2.3-1
Los Alamos Watershed Interim Monitoring Plan

					Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pueblo Canyon (includes Acid Canyon)																					
PAO-4	PAO-4	Monitoring below Bayo WWTP to evaluate influence of persistent saturation. Monitoring to evaluate trend in post-Cerro Grande fire perturbation in strontium-90 and plutonium concentrations.	Alluvial	C	A		A	A	S			S	A		S	S		S	A		S
PAO-5s[d]		APCO-1 represents groundwater chemistry in this portion of the watershed. PAO-5s and PAO-5n are very close to APCO-1 and have not yielded significantly different chemistry in the past. APCO-1 also has the longest record of data of the three wells and is the preferred location.	Alluvial																		
PAO-5n[d]		APCO-1 represents groundwater chemistry in this portion of the watershed. PAO-5s and PAO-5n are very close to APCO-1 and have not yielded significantly different chemistry in the past. APCO-1 also has the longest record of data of the three wells and is the preferred location.	Alluvial																		
APCO-1	APCO-1	Monitoring below Bayo WWTP to evaluate influence of persistent saturation and impact of nutrients associated with waste water discharge. Most down canyon monitoring point in Pueblo Canyon. Longest monitoring record in lower Pueblo Canyon. Collection of additional data will enable analysis of long term trends in water quality.	Alluvial	C	S		S	S	S			S	A		S	S		S	A		S
TW-2A[d]		Well not operable and well is planned for plugging and abandonment. A groundwater sample will be collected before P&A activities start.	Intermediate																		
POI-4	POI-4	Useful intermediate-depth monitoring point for this portion of Pueblo Canyon.	Intermediate	C	S		S	S	S				A		S	S		S	A		S
TW-1A[d]		Planned for plugging and abandonment. A groundwater sample will be collected before P&A activities start.	Intermediate																		
R-5[d]	R-5, screen 1	Screen dry, no available groundwater. A groundwater sample will be collected if water is detected.	Intermediate		S		S	S	S			S	A		S	S		S	A		S

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Los Alamos Watershed Interim Monitoring Plan

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					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pueblo Canyon (includes Acid Canyon)																					
R-5	R-5, screen 2	Monitor for trends in chemistry within intermediate groundwater. Four rounds of characterization sampling have been performed at this well.	Intermediate	C	S		S	S	S			S	A		S	S		S	A		S
TW-4[d]		Planned for plugging and abandonment. A groundwater sample will be collected before P&A activities start.	Regional																		
	R-2	R-2 is a new well and initial characterization has taken place. Semi-annual sampling will occur until four rounds have been collected.	Regional	C	S		S	S	S				A		S	S		S	A		S
TW-2[d]		Well planned for plugging and abandonment. A groundwater sample will be collected before P&A activities start.	Regional																		
	R-4	R-4 is a new well and initial characterization has occurred.	Regional	C	S		S	S	S			S	A		S	S		S	A		S
R-5	R-5, screen 3	Key monitoring point for regional aquifer in Pueblo Canyon.	Regional	C	S		S	S	S			S	A		S	S		S	A		S
R-5	R-5, screen 4	Key monitoring point for the regional aquifer in Pueblo Canyon. Screen In this zone is impacted by residual drilling fluids and is rated fair to poor. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											S			S	A		S
	R-3	Not installed to date. Characterization sampling will begin following construction.	Regional																		
	R-24	New well. Characterization sampling to be conducted under this plan.	Regional	C	Q		Q	Q	Q	Q	Q		Q		Q	Q		Q	Q		Q
TW-1[d]		Planned for plugging and abandonment. A groundwater sample will be collected before P&A activities start.	Regional																		

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					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Lower Los Alamos Canyon[l]																					
	Los Alamos above Rio (E110)	Measure water quality near confluence of Los Alamos Canyon and Rio Grande. Regional/local GW mixing.	Baseflow	S	S		S	S	S			S	A		S	S		S	A	S	S
Basalt	Basalt Spring	First monitoring point on San Ildefonso land. Geochemically similar to surface water and intermediate-depth water below Pueblo Canyon. Source of water is believed to be primarily Bayo WWTP in Pueblo Canyon.	Intermediate Spring	S	S		S	S	S			S	A		S	S		S	A	S	S
Los Alamos	Los Alamos Spring	Basalt Spring is thought to represent intermediate groundwater. This location will provide monitoring for the intermediate zone in lower Los Alamos Canyon.	Intermediate Spring	S	S		S	S	S			S	A		S	S		S	A	S	S
GU-0.01	GU-0.01 Spring	Located at confluence of Guaje and lower Los Alamos Canyon. NOD request. Monitor for up gradient contamination.	Spring	S	S		S	S	S			S	A		S	S		S	A	S	S
Otowi[d]		Redundant with LA Canyon surface water samples. No information will be gained by sampling this location.	Spring																		
Sacred	Sacred Spring	See the White Rock Canyon section of this plan.	Spring																		
LLAO-1b	LLAO-1b	Monitoring upper portion of San Ildefonso Pueblo reach. Water quality is consistent with Basalt Spring.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LLAO-3[d]		No new sources of contamination in this portion of the canyon. Redundant with proposed monitoring at LLAO-1b and LLAO-4.	Alluvial																		
LLAO-4	LLAO-4	Monitors lower San Ildefonso Pueblo reach near confluence with Rio Grande. Water quality appears to reflect mixing with regional groundwater near the river.	Alluvial	C	A		A	A	S				A		S	S		S	A		S
LLAO-5[d]		Spatially redundant with LLAO-4. Also sees mixing with regional groundwater from Española Basin, therefore not representative of alluvial groundwater.	Alluvial																		
MW-3[d] (same as DOT MW-3)		Well has been plugged and abandoned by NMDOT, not possible to sample.	Alluvial																		

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					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO ORP, pH,SC,T,Trb
Lower Los Alamos Canyon[l]																					
MW-5[d] (same as DOT MW-5)		Well has been plugged and abandoned by NMDOT, not possible to sample.	Alluvial																		
MW-6[d] (same as DOT MW-6)		Well has been plugged and abandoned by NMDOT, not possible to sample.	Alluvial																		
MW-9[d] (same as DOT MW-9)		Well has been plugged and abandoned by NMDOT, not possible to sample.	Alluvial																		
LA-1 (same as LA-1A), LA-1b, LA-2, LA-5		Old production wells transferred to San Ildefonso. Not able to monitor, access is questionable.	Regional																		
Halladay House well		San Ildefonso private well. Currently inoperative.	Regional???																		
Otowi House well		San Ildefonso private well. Currently inoperative.	Regional???																		

[a] Sampling frequency: C = continuous; Q= quarterly (4 times/year at set time periods); S= semiannual (2 times/year at set time periods); A = annual (one time a year);
Continuous monitoring for groundwater refers to the measurement of groundwater levels by a transducer placed in a well and programmed to collect groundwater-level measurements at highly frequent intervals (e.g., every 60 minutes daily throughout the year). Continuous stream-flow monitoring refers to the measurement of stream flow by a base-flow stream gage that is programmed to collect stream-flow measurements at highly frequent intervals.

[b] Semi annual sampling for select base flow, springs, intermediate, and regional groundwater is defined as one full analyte suite list and one target analyte list that includes the following: perchlorate, nitrate+nitrite (as nitrogen), low level tritium, general chemistry, gross alpha, gross beta, strontium-90 and isotopic uranium, Sampling frequency for wells undergoing characterization sampling is generally comprehensive with full suite analysis.

[c] The field preparation for all samples is non-filtered and filtered for samples to be analyzed for general inorganics (excluding anions), and metals. Anions and perchlorate samples will be filtered only. Samples collected for radionuclide analysis will be filtered and non-filtered for all water media, excluding tritium which is non-filtered only. Organic constituents are non-filtered for all water media. Stable isotope samples are non filtered. Hexavalent chromium may be filtered or non filtered. Field parameters pH, turbidity (Trb), specific conductance (SC), dissolved oxygen (DO), and temperature (T) will be measured for all samples. Oxidation reduction potential (ORP) will be measured if a flow through cell is used for parameter measurement

[d] Location differs from Table XII-5 due to duplication of wells, scheduled for abandonment, no historical contamination, redundant locations, or other reasons. See supplemental information in the watershed sections of the document and Appendix E for explanation and justification.

[dro] DRO (diesel range organics) will be analyzed by EPA Method 8015 modified.

[e] Rad (radiological)suite includes gross alpha, gross beta, isotopic uranium, strontium-90, low level tritium.

[f] General inorganic analytes include major ions, TDS, trace metals-trace elements; trace anions, silica, nitrogen species, TKN, low-level perchlorate (by LCMS/MS), total organic carbon; and TSS in base flow samples.

[g] Metals analysis includes the 23 TAL (target analyte list) metals, plus total cyanide and molybdenum where specified. Analyses of trace elements and metals will be the same as in the Environmental Surveillance Program (2001 and past years) plus additional analytes.

[h] VOCs (volatile organic compounds) will be analyzed by EPA methods 8260B.

[HMX] Designates analysis for explosive constituents hexahydro-1-nitro-3, 5-dinitro-1,3,5-trinizine (MNX), hexahydro-1,3-dinitroso-3-nitro-1,3,5-triazine (DNX), and hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX).

[i] PAHs (poly aromatic hydrocarbons) will be analyzed by EPA Method 8310.

[j] PCBs (poly chlorinated biphenols) will be analyzed using EPA Method 8082.

[k] Pesticides will be analyzed by EPA Method 8081A.

[l] SVOCs (semi volatile organic compounds) will be analyzed by EPA methods 8270C.

[m] Select regional wells (R-wells) contain residual drilling fluids in the aquifer adjacent to screens and produce groundwater samples that are not representative of natural conditions. These impacted wells and their respective screens are included as part of the Interim Monitoring Plan but the analytical suites only include constituents that are not affected by the affect of residual drilling fluids and a suite of constituents used to monitor the degree of impact from residual drilling fluids in the aquifer surrounding the screen (i.e., iron, manganese, sulfate, sulfide, sodium, barium, total organic carbon, and total kjeldahl nitrogen [EES-6 suite]).

[n] Dioxins and furans will be analyzed by EPA Method 1613B or 8290.

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2.4.4 Regional Aquifer Groundwater

Sampling locations, frequency, analytes, and the rationale for regional aquifer groundwater monitoring are presented in Table 2.3-1. Locations are shown in Figure 2.3-1.

Regional groundwater data from 2000 to 2005 was screened against ½ the appropriate standard to identify constituents detected above a threshold in the watershed. When a constituent exceeded the threshold, it was flagged and included in the appropriate analytical suite. Five metals constituents (arsenic, iron, lead, manganese, and nickel) and one general inorganic constituent (perchlorate); were detected above the screening threshold. No organic compounds were detected above the screening threshold. These constituents are shown graphically in Figures B.13 through B.15. The screening tables are presented electronically in the Los Alamos/Pueblo Watershed Regional Groundwater files on a CD in Appendix B.

Regional aquifer sampling in lower Los Alamos Canyon will be accomplished by sampling springs thought to represent the hydrochemical state of regional groundwater, described in Section 8, White Rock Canyon. Four wells, R-6, R-7, R-8, and R-9, are screened in the regional aquifer in upper Los Alamos Canyon and are included in the Interim Plan. Well R-3 is scheduled for installation and is included in this Plan under characterization sampling. Three different wells, R-2, R-4, and R-5, are screened in the regional aquifer in Pueblo Canyon and are included in the Interim Plan. TW-1, TW-2, TW-3, and TW-4 are scheduled for decommissioning and will be plugged and abandoned in accordance with 19.27.4 NMAC and Section X.D of the Consent Order.

Wells LA-1, LA-b, LA-2, LA-5, the Halladay house well, and the Otowi house well are not owned by the Department of Energy (DOE), are located on San Ildefonso property and, therefore, access to the wells is not assured. Well LA-1 was plugged and abandoned in 1993. Wells LA-1b and LA-2 are not functional and do not have pumps or electrical infrastructure. The Halladay house well is currently inoperative and the Otowi house well is inaccessible. The results from any future sampling of these wells under DOE's agreements with San Ildefonso Pueblo will be provided to NMED. Lastly, sampling at these wells may be added to the Interim Plan schedule at a future date if upgradient contamination is detected at sufficient levels to warrant making necessary upgrades to any of these wells, and if San Ildefonso Pueblo and the well owners are willing to enter into appropriate agreements with DOE and NMED to ensure access.

2.4.5 Springs

Sampling locations, frequency, analytes, and the rationale for spring monitoring are presented in Table 2.3-1. Locations are shown in Figure 2.3-1. groundwater sources, and estimated flow data for the springs in the Los Alamos Canyon/Pueblo Canyon Watershed can be found in Appendix D, Table D-4.

Springs data from 2000 to 2005 was screened against ½ the appropriate standard to identify constituents detected above a threshold in the watershed. When a constituent exceeded the threshold more than five percent of the time it was flagged and included in the appropriate analytical suite. Several metals constituents (aluminum, antimony, arsenic, copper, mercury, and thallium) and three general chemistry constituents (chloride, fluoride, nitrate and nitrite as nitrogen) were detected above the screening threshold. No organic constituents were detected above the threshold. These constituents are shown graphically in Figures B.17 and B.18. The screening tables are presented electronically in the Los Alamos/Pueblo Watershed Springs Water files on a CD in Appendix B.

DP Spring in upper Los Alamos Canyon and Basalt Spring, Los Alamos Spring, and GU-0-0.01 Spring in lower Los Alamos Canyon will be monitored as part of the Los Alamos/Pueblo watershed section of this Plan. Furan and Dioxin analysis will be added to Los Alamos Spring and Basalt Spring to monitor for the impact from the airport incinerator ash pile.

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3.0 SANDIA WATERSHED

3.1 Introduction

Sandia Canyon is located within the central part of the Laboratory (Figure 1.2-1) The canyon heads on Laboratory property within TA-03 at an elevation of approximately 7300 ft and trends east-southeast across the Laboratory, Bandelier National Monument, and San Ildefonso Pueblo. Sandia Canyon empties into the Rio Grande in White Rock Canyon at an elevation of 5450 ft.

3.2 Background

The Sandia Canyon watershed is approximately 5.5 sq mi in area. The head of the canyon is located on the Pajarito Plateau at TA-03. Perennial stream flow and saturated alluvial aquifer conditions occur in the upper and middle portions of the canyon system because of sanitary wastewater and cooling tower effluent to the canyon from operating facilities. A wetland of approximately seven acres has developed as a result of the wastewater and cooling tower effluent. Polychlorinated biphenyls (PCBs) and chromium have been detected in sediment samples obtained from the wetland area and mercury has been detected in surface water samples. The only known perennial spring in the watershed (Sandia Spring) is located in lower Sandia Canyon near the Rio Grande. TAs located in the Sandia Canyon watershed include TA-03, -20, -53, -60, -61, and -72. Approximately 264 SWMUs and AOCs are within these TAs. The types of SWMUs and AOCs vary from industrial outfalls to open-detonation firing sites. Table A-2 (Appendix A) summarizes the conceptual model for the Sandia Canyon Watershed.

The hydrologic and geochemical conceptual model for contamination in Sandia Canyon is not well constrained at this time because of the relatively small amount of data available for the sediment, alluvial groundwater, and vadose zone beneath the canyon. A significant advancement in the conceptual model is expected via implementation of the “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987). This scope of the work plan addresses further definition of the nature and extent of contamination in alluvial groundwater through the installation and monitoring of five new alluvial groundwater monitoring wells, and coring and sampling through approximately 300 ft of vadose zone in a segment of the canyon currently thought to be conducive to infiltration of surface water to the regional aquifer.

3.3 Monitoring Objectives

The objectives of the current monitoring for Sandia Canyon is to provide basic characterization information for the watershed and to refine the conceptual model and delineate the nature and extent of contaminants, including chromium, that were released in the past in the upper watershed. The monitoring scope presented in this work plan reflects the requirements of the NMED-approved “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987), as well as additional constituents necessary for basic watershed characterization. Surface water and all groundwater zones will be sampled quarterly and within 21-day sample collection events.

3.4 Scope of Activities

3.4.1 Base Flow

Sampling locations, frequency, analytes, and the rationale for base flow monitoring are presented in Table 3.3-1. Locations are shown in Figure 3.3-1.

The screening conducted as described in Section 1.5 identified several metals (aluminum, copper, cadmium, selenium, and zinc); one general inorganic (perchlorate); and one organic compound (Aroclor-1260) were detected above the threshold. These constituents are shown graphically in Figures B.19 through B.24. The screening tables are presented electronically in the Sandia Watershed Surface Water files on a CD in Appendix B.

Base flow sampling stations include the South Fork of Sandia Canyon at gage station E122, Sandia Canyon below the wetland at gage station E123, and a location approximately 2 mi down canyon at the terminus of persistent baseflow (approximately near the new location for gage station E124. These are the same locations included in the “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987).

The sampling locations at gage E122 and E123 bound the wetland and should provide information on potential changes in contamination attributable to conditions in the wetland. The next down canyon monitoring point will provide additional information on potential changes in contaminants along the flow path and also assesses potential contributions from TA-60 and TA-61.

3.4.2 Alluvial Groundwater

Sampling locations, frequency, analytes, and the rationale for alluvial groundwater monitoring are presented in Table 3.3-1. Locations are shown in Figure 3.3-1.

Because no monitoring locations access alluvial groundwater in the Sandia watershed, no analytical results from alluvial groundwater exist. An important objective of the Sandia watershed work plan is to further characterize the physical and chemical aspects of shallow alluvial groundwater with the new wells scheduled for installation.

Existing alluvial monitoring wells SCO-1 and SCO-2 are located in the lower portion of Sandia Canyon on Laboratory property and have not produced groundwater in sufficient quantities for analysis. However, SCO-1 and SCO-2 will continued to be monitored for the presence of groundwater and if water is present, samples will be collected for analysis.

Six additional alluvial monitoring wells are scheduled for installation in Sandia Canyon in the spring/summer of 2006 as part of the NMED-approved scope in the “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987). These wells will be monitored to address basic characterization needs with additional emphasis on a suite appropriate for supporting the chromium interim measures project.

3.4.3 Intermediate Perched Groundwater

Sampling locations, frequency, analytes, and the rationale for intermediate perched groundwater monitoring are presented in Table 3.3-1. Locations are shown in Figure 3.3-1.

The screening conducted as described in Section 1.5 identified three metals (iron, lead, and manganese) and one organic constituent (bis(2-ethylhexyl)pthalate) were detected above the threshold in the watershed. No general inorganic constituents were detected above the screening threshold. These constituents are shown graphically in Figures B.25 through B.27. The screening tables are presented electronically in the Sandia Watershed Intermediate Groundwater files on a CD in Appendix B.

Well R-12 is currently the only monitoring well that accesses intermediate-depth perched groundwater beneath Sandia Canyon. Of the two screens in the intermediate zone, testing and sample analysis shows that the upper screen has the higher permeability of the two (Broxton et al. 2001, 71252) and contains the higher tritium concentrations (Longmire 2002, 72800). The Interim Plan calls for both screens to be monitored. Screen 1 has been identified in the Well Screen Analysis Report (LANL 2005, 91121) as being affected by residual drilling fluids and will only be monitored for tritium and field parameters. Groundwater collected from screen 2 appears to be representative and will be processed for a full suite of analytes. Additional intermediate-depth perched groundwater zones may be encountered during implementation of the “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987). Under the work plan, an intermediate-depth perched groundwater monitoring well may be installed and will be added to the monitoring network in Sandia Canyon.

3.4.4 Regional Aquifer Groundwater

Sampling locations, frequency, analytes, and the rationale for monitoring the regional aquifer groundwater are presented in Table 3.3-1. Locations are shown in Figure 3.3-1.

The screening conducted as described in Section 1.5 identified four metals (iron, manganese, nickel, and selenium) were detected above the threshold in the watershed. No general inorganic or organic constituents were detected above the threshold. These constituents are shown graphically in Figures B.28 through B.30. The screening tables are presented electronically in the Sandia Watershed Regional Groundwater files on a CD in Appendix B.

Regional wells R-11 and R-12 screen 3 are screened in the regional aquifer in the middle portion of Sandia Canyon and will be monitored as part of the Interim Plan. Regional wells R-10 and R-10a are located in lower Sandia Canyon on San Ildefonso property. R-10a is currently being sampled as part of the post-installation characterization under an agreement with San Ildefonso pueblo. R-10 will be fitted with a special pump enabling collection of discrete groundwater samples from each screen. This system will be online by June 2006. These wells are part of the monitoring being conducted under the “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987).

3.4.5 Springs

Sandia Spring, the only spring located in the Sandia Canyon watershed, is described in section-8, White Rock Canyon of this Plan.

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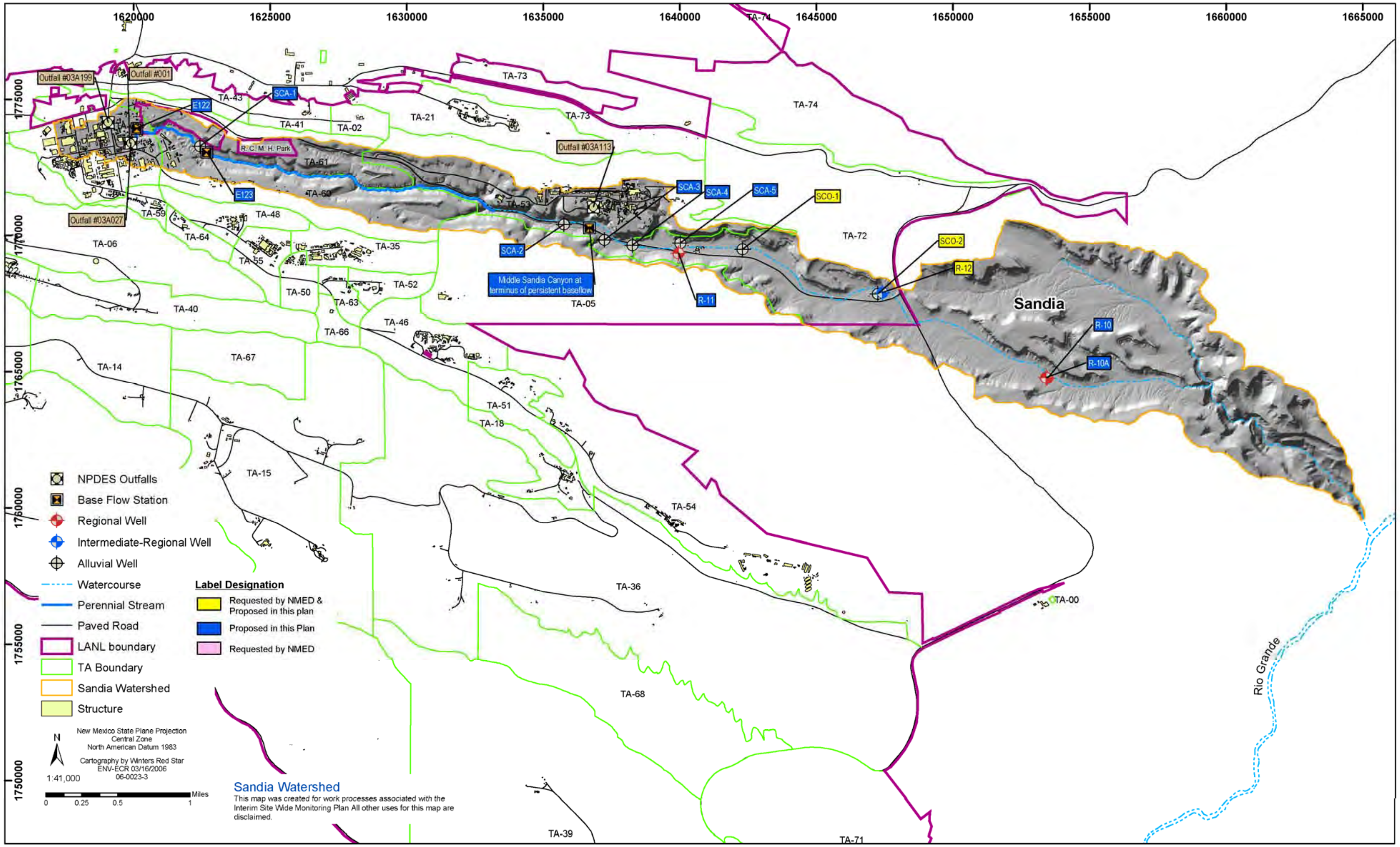

Figure 3.3-1. **Sandia Watershed**

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Table 3.3-1
Sandia Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Sandia Watershed[1]																					
	South Fork of Sandia Canyon at E122	Monitors water quality of baseflow that is predominantly from effluent from NPDES outfall 01A-001. Serves as baseline for comparison to down canyon changes in water quality.	Base flow	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A	Q	Q
	Sandia below Wetlands (E123)	Monitors water quality of flow from wetland.	Base flow	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A	Q	Q
	Middle Sandia Canyon at terminus of persistent baseflow	Most down canyon characterization of water quality before surface water infiltrates into alluvium.	Base flow	Q	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A	Q	Q
	SCA-1	One of a group of new alluvial wells installed under Chromium Interim Measures Work Plan. SCA-1 characterizes lower wetland area.	Alluvial	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	SCA-2	One of a group of alluvial wells installed under Chromium Interim Measures Work Plan. SCA-2 is located at the upper portion of the lower canyon where the valley floor first opens up and alluvial storage is available.	Alluvial	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	SCA-3	One of a group of alluvial wells installed under Chromium Interim Measures Work Plan. SCA-3 is located just below gage station E124.	Alluvial	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	SCA-4	One of a group of alluvial wells installed under Chromium Interim Measures Work Plan. SCA-4 is located approximately mid-way between SCA-3 and the eastern-most drainage from the TA-53 complex.	Alluvial	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	SCA-5	One of a group of alluvial wells installed under Chromium Interim Measures Work Plan. SCA-5 is located just down canyon of the eastern-most drainage from the TA-53 complex.	Alluvial	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q

Table 3.3-1 (cont.)

					Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Sandia Watershed[l]																					
SCO-1	SCO-1	Typically dry well since installed. Will be sampled if groundwater is present during sampling events.	Alluvial	Q	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
SCO-2	SCO-2	Typically dry well dry since installed. Will be sampled if groundwater is present during sampling events	Alluvial	Q	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
R-12	R-12, screen 1	This is the shallowest and most productive of the two intermediate screens at R-12.	Intermediate	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
R-12	R-12, screen 2	Water level data only. Water quality data from screen 1.	Intermediate	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	R-10, Screen 1	New well in far lower Sandia Canyon, characterization under the Interim Plan.	Regional	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	R-10, Screen 2	New well in far lower Sandia Canyon, characterization under the Interim Plan.	Regional	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	R-10a	New well in far lower Sandia Canyon, characterization under the Interim Plan.	Regional	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
	R-11	Monitors regional aquifer in lower Sandia Canyon.	Regional	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q
R-12	R-12, screen 3	Boundary and sentinel well for PM-1.	Regional	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q		Q	A		Q

[a] Sampling frequency: C = continuous; Q= quarterly (4 times/year at set time periods); S= semiannual (2 times/year at set time periods); A = annual (one time a year);
Continuous monitoring for groundwater refers to the measurement of groundwater levels by a transducer placed in a well and programmed to collect groundwater-level measurements at highly frequent intervals (e.g., every 60 minutes daily throughout the year). Continuous stream-flow monitoring refers to the measurement of stream flow by a base-flow stream gage that is programmed to collect stream-flow measurements at highly frequent intervals.

[b] Semi annual sampling for select base flow, springs, intermediate, and regional groundwater is defined as one full analyte suite list and one target analyte list that includes the following: perchlorate, nitrate+nitrite (as nitrogen), low level tritium, general chemistry, gross alpha, gross beta, strontium-90 and isotopic uranium, Sampling frequency for wells undergoing characterization sampling is generally comprehensive with full suite analysis.

[c] The field preparation for all samples is non-filtered and filtered for samples to be analyzed for general inorganics (excluding anions), and metals. Anions and perchlorate samples will be filtered only. Samples collected for radionuclide analysis will be filtered and non-filtered for all water media, excluding tritium which is non-filtered only. Organic constituents are non-filtered for all water media. Stable isotope samples are non filtered. Hexavalent chromium may be filtered or non filtered. Field parameters pH, turbidity (Trb), specific conductance (SC), dissolved oxygen (DO), and temperature (T) will be measured for all samples. Oxidation reduction potential (ORP) will be measured if a flow through cell is used for parameter measurement

[d] Location differs from Table XII-5 due to duplication of wells, scheduled for abandonment, no historical contamination, redundant locations, or other reasons. See supplemental information in the watershed sections of the document and Appendix E for explanation and justification.

[dro] DRO (diesel range organics) will be analyzed by EPA Method 8015 modified.

[e] Rad (radiological)suite includes gross alpha, gross beta, isotopic uranium, strontium-90, low level tritium.

[f] General inorganic analytes include major ions, TDS, trace metals-trace elements; trace anions, silica, nitrogen species, TKN, low-level perchlorate (by LCMS/MS), total organic carbon; and TSS in base flow samples.

[g] Metals analysis includes the 23 TAL (target analyte list) metals, plus total cyanide and molybdenum where specified. Analyses of trace elements and metals will be the same as in the Environmental Surveillance Program (2001 and past years) plus additional analytes.

[h] VOCs (volatile organic compounds) will be analyzed by EPA methods 8260B.

[HMX] Designates analysis for explosive constituents hexahydro-1-nitro-3, 5-dinitro-1,3,5-trinizine (MNX), hexahydro-1,3-dinitroso-3-nitro-1,3,5-triazine (DNX), and hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX).

[i] PAHs (poly aromatic hydrocarbons) will be analyzed by EPA Method 8310.

[j] PCBs (poly chlorinated biphenols) will be analyzed using EPA Method 8082.

[k] Pesticides will be analyzed by EPA Method 8081A.

[l] SVOCs (semi volatile organic compounds) will be analyzed by EPA methods 8270C.

[m] Select regional wells (R-wells) contain residual drilling fluids in the aquifer adjacent to screens and produce groundwater samples that are not representative of natural conditions. These impacted wells and their respective screens are included as part of the Interim Monitoring Plan but the analytical suites only include constituents that are not affected by the affect of residual drilling fluids and a suite of constituents used to monitor the degree of impact from residual drilling fluids in the aquifer surrounding the screen (i.e., iron, manganese, sulfate, sulfide, sodium, barium, total organic carbon, and total kjeldahl nitrogen [EES-6 suite]).

[n] Dioxins and furans will be analyzed by EPA Method 1613B or 8290.

4.0 MORTANDAD WATERSHED

4.1 Introduction

Mortandad Canyon is an east-to-southeast trending canyon that heads on the Pajarito Plateau near the main Laboratory complex at TA-03 at an elevation of 7380 ft (Figure 1.2-1). The drainage extends about 9.6 mi from its headwaters to its confluence with the Rio Grande at an elevation of 5440 ft. The canyon crosses San Ildefonso Pueblo land for several miles before joining the Rio Grande (LANL 1997, 56835). Figure 4.3-1 shows the location of the Mortandad Canyon watershed and its tributary canyons.

4.2 Background

The Mortandad Canyon watershed is located in the central portion of the Laboratory and covers approximately 10 sq mi. San Ildefonso Pueblo is directly adjacent to a portion of the Laboratory's eastern boundary and includes the eastern end of Mortandad Canyon. The Mortandad Canyon watershed contains several tributary canyons that have received contaminants released during Laboratory operations. The most prominent tributary canyons include Ten Site Canyon, Pratt Canyon, Effluent Canyon, and Cañada del Buey.

Current and former TAs located in the Mortandad Canyon watershed include TA-03, -04, -05, -18, -35, -42, -46, -48, -50, -51, -52, -54, -55, and -59. The primary sources of contamination in this watershed are attributed to past releases of contaminants from outfalls and spills at TA-35 and TA-50, including the RLWTF at TA-50. Metals and volatile organic compounds (VOCs), have historically been released into the canyon. Nitrates, perchlorate, molybdenum, and radionuclides, which are not addressed under the Consent Order, are some of the contaminants that have been detected in Mortandad Canyon alluvial groundwater. Perchlorate and nitrate contamination is present in the vadose zone beneath the portion of Mortandad Canyon below the confluence of Tensite Canyon. Nitrate, perchlorate, chromium,, and tritium are detected in intermediate-depth perched groundwater. Chromium, nitrate, perchlorate, and tritium occur in the regional groundwater.

Table A-3 in Appendix A summarizes the conceptual model for the Mortandad Canyon watershed. Surface water and alluvial groundwater in Mortandad Canyon are derived from three sources, the RLWTF outfall at TA-50, other outfalls, and runoff from precipitation. Persistent surface water generally occurs from the TA-50 outfall down canyon to a location above the sediment traps. Alluvial groundwater storage is limited in the upper reaches, but increases down canyon in wider and thicker alluvial deposits. Lesser sources in upper Effluent Canyon create localized areas of surface water and likely minor alluvial groundwater. The extent of alluvial saturation in Mortandad is dependent on variations in the runoff sources, and thus varies interannually. The underlying vadose zone and saturated zones have the same mobile constituents indicating a hydrologic connection with the alluvial groundwater.

Improvement in effluent quality from the RLWTF has had a direct effect on surface water and alluvial groundwater quality (e.g., Ref: 2004 Surveillance report). Nitrate, perchlorate, and tritium show rapid decline in concentration at the alluvial monitoring wells in the upper canyon where the aquifer volume is small indicating rapid flushing of the alluvium. Further down canyon changes in the contaminant concentrations in the alluvial groundwater are also declining but at a slower rate due to the larger volume of the aquifer in that portion of the canyon.

Changes in the intermediate-depth perched groundwater over time are less well known because monitoring has not been conducted for a sufficiently long period to evaluate trends.

4.3 Monitoring Objectives

The monitoring for Mortandad Canyon reflected in this work plan is currently driven by the NMED-approved “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987). The surface water and all groundwater zones are included in the scope of the chromium work plan and are included in this plan. The monitoring frequency presented in this work plan is quarterly and reflects the requirement in the chromium work plan. Surface water and all groundwater zones will be sampled quarterly and within 21-day sampling windows. Following implementation of the chromium work plan, semiannual monitoring of the alluvial groundwater is considered adequate for observing the declining trend in contamination associated with improvements in the water quality at the RLWTF. The monitoring frequency for the perched intermediate and regional groundwater will be dependent on the data from the chromium investigation.

4.4 Scope of Activities

4.4.1 Base Flow

Sampling locations, frequency, analytes, and the rationale for base flow monitoring are presented in Table 4.3-1. Locations are shown in Figure 4.3-1. These constituents are shown graphically in Figures B.31 through B.33. The screening tables are presented electronically in the Mortandad Watershed Surface Water Groundwater files on a CD in Appendix B.

The screening conducted as described in Section 1.5 identified several metals (aluminum, arsenic, copper, iron, lead, manganese, molybdenum, and zinc); two general inorganics (fluoride and perchlorate); and one organics (Aroclor-1260) were detected above the threshold. These constituents are shown graphically in Figures B.31 through B.33. The screening tables are presented electronically in the Mortandad Watershed Surface Water files on a CD in Appendix B.

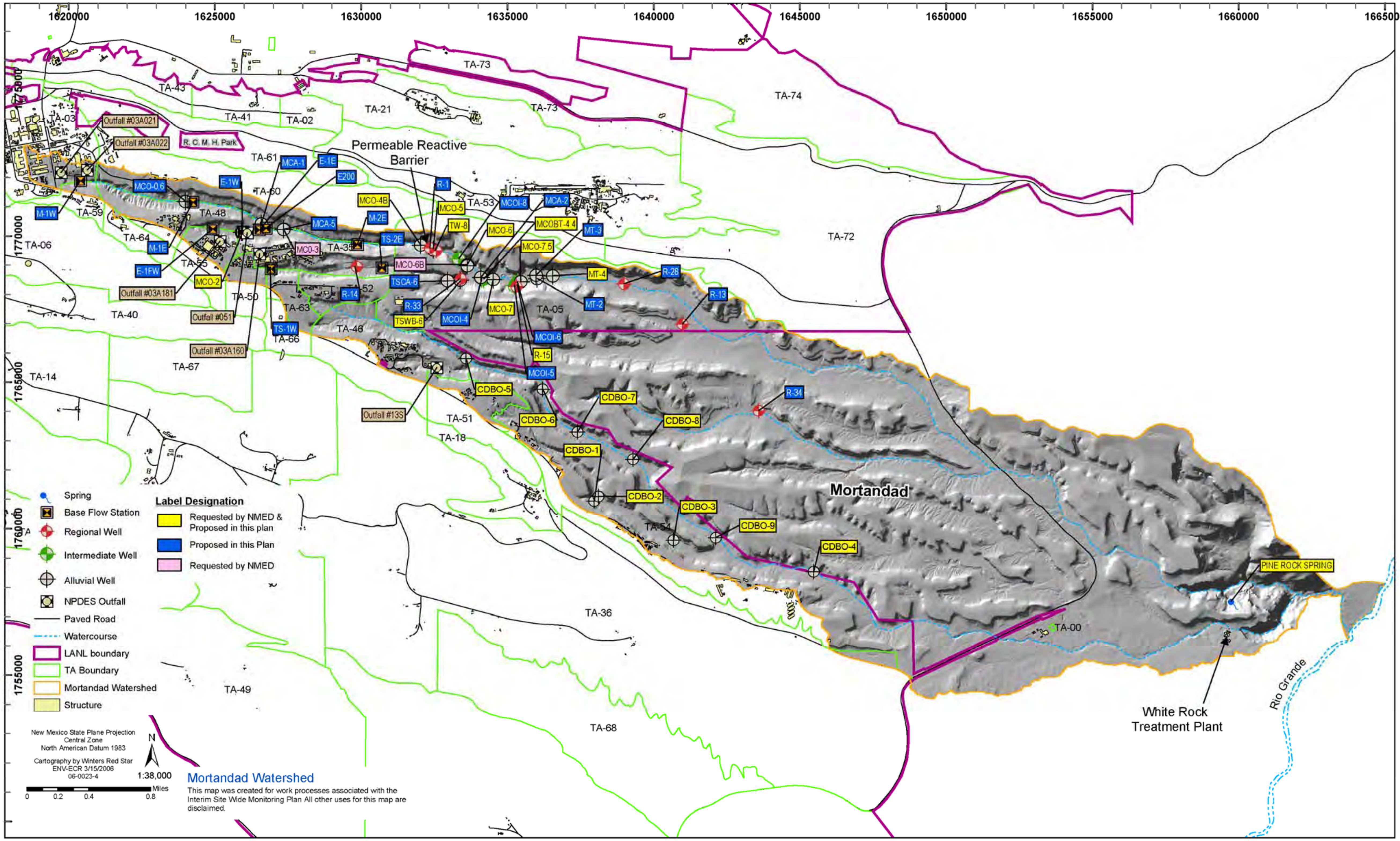
Baseflow will be sampled at the following locations in the Mortandad watershed: reaches E-1FW, E-1W, E-1E, in Effluent Canyon; TS-1W and TS-2E in Ten Site Canyon; and M-1W, M-1E, and two locations in reach M-2E in Mortandad Canyon including at gage station E200. This group of locations provides good coverage in the watershed for bounding potential SWMU or AOC contaminant sources.

4.4.2 Alluvial Groundwater

Sampling locations, frequency, analytes, and the rationale for alluvial groundwater monitoring are presented in Table 4.3-1. Locations are shown in Figure 4.3-1. These constituents are shown graphically in Figures B.34 through B.4.36. The screening tables are presented electronically in the Mortandad Watershed Alluvial Groundwater files on a CD in Appendix B.

The screening conducted as described in Section 1.5 identified five metals (iron, manganese, molybdenum, selenium, and uranium); four general inorganic constituents (fluoride, nitrite-nitrate as N, perchlorate, and total dissolved solids); and one organic constituent (bis(2-ethylhexyl)pthalate) were detected above the threshold in the watershed. These constituents are shown graphically in Figures B.34 through B.36. The screening tables are presented electronically in the Mortandad Watershed Alluvial Groundwater files on a CD in Appendix B.

Alluvial groundwater locations selected for monitoring under the FY06 Interim Plan include the following wells MCO-0.6, MCA-1, MCO-2, MCA-5, MCO-4B, MCO-5, MCO-6, MCO-7, MCO-7.5, MT-1, MT-2 (or MT-3 or MT-4, as appropriate) in Mortandad Canyon, TSCA-6 and TSWB-6 in Ten Site Canyon, and wells CDBO-1 through -9 in Cañada del Buey.



New Mexico State Plane Projection
Central Zone
North American Datum 1983

Cartography by Winters Red Star
ENV-ECR 3/15/2006
06-0023-4

Mortandad Watershed

This map was created for work processes associated with the Interim Site Wide Monitoring Plan All other uses for this map are disclaimed.

Figure 4.3-1. **Mortandad Watershed**

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Table 4.3-1
Mortandad Canyon Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Mortandad Canyon Watershed[l]																					
	E-1FW	Upper portion of Effluent Canyon. Surface water baseline for Effluent tributary to Mortandad Canyon.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	E-1W	Measures potential TA-55 influence and effects of wetland area.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	E-1E	Lower Effluent Canyon just above confluence with Mortandad Canyon. Measures TA-50 effluent after interaction with canyon sediment.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	Mortandad below Effluent Canyon (E200)	First surface water monitoring location in Mortandad below Effluent Canyon confluence.	Base flow	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	M-1W	Upper Mortandad Canyon. Surface water baseline for Mortandad Canyon.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	M-1E	Measures cumulative upper Mortandad potential impacts just above confluence of Effluent Canyon.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	M-2E	Addresses distal end of persistent surface water in watershed. Target west end of reach for more consistent water.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	TS-1W	Monitors head of Ten Site drainage and potential local impacts from MDA C.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
	TS-2E	Monitors cumulative impacts from TA-35 incl. Pratt Canyon.	Base flow	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
Pine Rock	Pine Rock Spring	May be lateral flow from White Rock wastewater treatment plant.	Unknown	S	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A	Q	Q
CDBO-1[d]	CDBO-1[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
CDBO-2[d]	CDBO-2[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
CDBO-3[d]	CDBO-3[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q

Table 4.3-1
Mortandad Canyon Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Mortandad Canyon Watershed[l]																					
CDBO-4[d]	CDBO-4[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
CDBO-5[d]	CDBO-5[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
CDBO-6[d]	CDBO-6[d]	Monitoring required in Sanitary Wastewater Systems (SWS) Discharge Permit and TA-54. No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
CDBO-7[d]	CDBO-7[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
CDBO-8[d]	CDBO-8[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
CDBO-9[d]	CDBO-9[d]	No water found since installation, no samples have been collected. Will collect sample if water is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	MCO-0.6	Alluvial groundwater baseline for upper Mortandad Canyon.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	MCA-1	New well. Lowest monitoring point in Mortandad Canyon before confluence of Effluent Canyon.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
MCO-2	MCO-2	Monitors potential contaminants in Effluent Canyon above the TA-50 outfall. MCO-2 was initially replaced by MCA-4 which was installed as part of the Mortandad Canyon Groundwater work plan. However, MCO-2 remains a better performing well than MCA-4.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	MCA-5	New well, replacement for MCO-3 per Consent Order Section IV.B.2.b.ii. Provides continuity with historical record. First groundwater monitoring point down canyon of TA-50 outfall.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q

Table 4.3-1
Mortandad Canyon Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Mortandad Canyon Watershed[l]																					
MCO-3 [d]		MCO-3 has been replaced by MCA-5 constructed as part of the Mortandad Canyon Groundwater Work Plan.	Alluvial																		
MCO-4B	MCO-4B	Measures down canyon changes in water quality from TA-50 outfall. Provides continuity with historical record.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
MCO-5	MCO-5	Provides continuity with historical water quality record. Measures downcanyon changes in water quality.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
MCO-6 or MCO-6B	MCO-6	MCO-6 is a better screen placement/configuration than MCO-6B.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	TSCA-6	New well in lower Ten Site Canyon. Integrates potential alluvial groundwater impacts from Ten Site Canyon.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
TSWB-6	TSWB-6	Potentially spatially redundant with new well TSCA-6, but will be sampled to evaluate potential redundancy.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	MCA-2	New well. Located between MCO-6 and MCO-7 near recent down canyon extent of alluvial groundwater.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
MCO-7	MCO-7	Near recent down canyon extent of alluvial saturation. Provides continuity with historical record.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
MCO-7.5	MCO-7.5	Monitors distal portion of alluvial groundwater saturation.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
MT-4	MT-2, MT-3, or MT-4	These wells may not have saturation, but sample one of the three (MT-2, MT-3, or MT-4) if groundwater is present.	Alluvial	C	Q		Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	MCOI-8	New intermediate-depth well. Appears to be producing only sump water. Not sufficient water to support collection of the complete analytical suite. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Intermediate	C	Q	Q	Q	Q	Q		Q	Q	A	Q		Q		Q	A		Q

Table 4.3-1
Mortandad Canyon Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Mortandad Canyon Watershed[l]																					
	MCOI-4	New intermediate-depth well. Low-yield well. Often insufficient water to support collection of the complete analytical suite. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Intermediate	C	Q	Q	Q	Q	Q		Q	Q	A	Q		Q		Q	A		Q
MCOBT-4.4	MCOBT-4.4	Two most recent sampling rounds did not produce sufficient water to sample. Will be sampled if possible.	Intermediate	C	Q	Q	Q	Q	Q		Q	Q	A	Q		Q		Q	A		Q
	MCOI-5	New intermediate-depth well. Low-yield well. Often insufficient water to support collection of the complete analytical suite. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Intermediate	C	Q	Q	Q	Q	Q		Q	Q	A	Q		Q		Q	A		Q
	MCOI-6	New intermediate well. Produces sufficient water to allow sampling with submersible pump. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Intermediate	C	Q	Q	Q	Q	Q		Q	Q	A	Q		Q		Q	A		Q
	R-1	New regional well. , characterization sampling will take place under this plan.	Regional	C	Q	Q	Q	Q	Q	Q	Q	Q	A		Q	Q		Q	A		Q
TW-8	TW-8	Will be sampled in support of the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation. Will remain on sampling schedule until plugged and abandoned at a future date.	Regional	C	Q	Q	Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q

Table 4.3-1
Mortandad Canyon Watershed Interim Monitoring Plan

					Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Mortandad Canyon Watershed[l]																					
	R-14, screen 1	Monitors for potential contaminants released into Pratt Canyon and other potential sources of contamination in Ten Site Canyon above the Pratt Canyon confluence. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Regional	C	Q	Q	Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	R-14, screen 2	Monitors for potential contaminants released into Pratt Canyon and other potential sources of contamination in Ten Site Canyon above the Pratt Canyon confluence. Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	Q								Q			Q		Q		A		Q
	R-33, screen 1	Monitors regional groundwater for potential impacts from upper part of Mortandad/Ten Site Canyons. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Regional	C								Q		Q			Q				Q
	R-33, screen 2	Monitors regional groundwater for potential impacts from upper part of Mortandad/Ten Site Canyons. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Regional	C								Q		Q			Q				Q

Table 4.3-1
Mortandad Canyon Watershed Interim Monitoring Plan

					Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Mortandad Canyon Watershed[l]																					
R-15	R-15	Monitors regional groundwater beneath lower Mortandad Canyon. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Regional	C	Q	Q	Q	Q	Q		Q	Q	A	Q		Q		Q	A		Q
R-16	R-16 Screen 2	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C								Q		Q			Q				Q
R-16	R-16 Screen 3	R-16 Screen 3 monitors regional groundwater in lower Mortandad Canyon Watershed.	Regional	C	Q	Q	Q	Q	Q		Q	Q	A	Q		Q		Q	A		Q
R-16	R-16 Screen 4	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C								Q		Q			Q				Q
	R-28	Monitors regional groundwater beneath lower Mortandad Canyon. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Regional	C	Q	Q	Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q
	R-13	Monitors regional groundwater beneath lower Mortandad Canyon. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Regional	C	Q	Q	Q	Q	Q		Q	Q	A		Q	Q		Q	A		Q

Table 4.3-1
Mortandad Canyon Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Mortandad Canyon Watershed[l]																					
	R-21	R-21 has one screen in the regional aquifer. Monitoring required for TA-54 landfill.	Regional	C	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q	Q	Q	A		Q
	R-34	Located on San Ildefonso land. Monitors regional groundwater beneath lower Mortandad Canyon. Sampled quarterly under the Chromium Interim Measures Groundwater Work Plan. Two of four rounds will be completed by May 2006. Will transition to semi-annual if not needed for ongoing Chromium investigation.	Regional	C	Q	Q	Q	Q	Q	Q	Q	Q	A		Q	Q		Q	A		Q

[a] Sampling frequency: C = continuous; Q= quarterly (4 times/year at set time periods); S= semiannual (2 times/year at set time periods); A = annual (one time a year);
Continuous monitoring for groundwater refers to the measurement of groundwater levels by a transducer placed in a well and programmed to collect groundwater-level measurements at highly frequent intervals (e.g., every 60 minutes daily throughout the year). Continuous stream-flow monitoring refers to the measurement of stream flow by a base-flow stream gage that is programmed to collect stream-flow measurements at highly frequent intervals.

[b] Semi annual sampling for select base flow, springs, intermediate, and regional groundwater is defined as one full analyte suite list and one target analyte list that includes the following: perchlorate, nitrate+nitrite (as nitrogen), low level tritium, general chemistry, gross alpha, gross beta, strontium-90 and isotopic uranium, Sampling frequency for wells undergoing characterization sampling is generally comprehensive with full suite analysis.

[c] The field preparation for all samples is non-filtered and filtered for samples to be analyzed for general inorganics (excluding anions), and metals. Anions and perchlorate samples will be filtered only. Samples collected for radionuclide analysis will be filtered and non-filtered for all water media, excluding tritium which is non-filtered only. Organic constituents are non-filtered for all water media. Stable isotope samples are non filtered. Hexavalent chromium may be filtered or non filtered. Field parameters pH, turbidity (Trb), specific conductance (SC), dissolved oxygen (DO), and temperature (T) will be measured for all samples. Oxidation reduction potential (ORP) will be measured if a flow through cell is used for parameter measurement

[d] Location differs from Table XII-5 due to duplication of wells, scheduled for abandonment, no historical contamination, redundant locations, or other reasons. See supplemental information in the watershed sections of the document and Appendix E for explanation and justification.

[dro] DRO (diesel range organics) will be analyzed by EPA Method 8015 modified.

[e] Rad (radiological)suite includes gross alpha, gross beta, isotopic uranium, strontium-90, low level tritium.

[f] General inorganic analytes include major ions, TDS, trace metals-trace elements; trace anions, silica, nitrogen species, TKN, low-level perchlorate (by LCMS/MS), total organic carbon; and TSS in base flow samples.

[g] Metals analysis includes the 23 TAL (target analyte list) metals, plus total cyanide and molybdenum where specified. Analyses of trace elements and metals will be the same as in the Environmental Surveillance Program (2001 and past years) plus additional analytes.

[h] VOCs (volatile organic compounds) will be analyzed by EPA methods 8260B.

[HMX] Designates analysis for explosive constituents hexahydro-1-nitro-3, 5-dinitro-1,3,5-trinizine (MNX), hexahydro-1,3-dinitroso-3-nitro-1,3,5-triazine (DNX), and hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX).

[i] PAHs (poly aromatic hydrocarbons) will be analyzed by EPA Method 8310.

[j] PCBs (poly chlorinated biphenols) will be analyzed using EPA Method 8082.

[k] Pesticides will be analyzed by EPA Method 8081A.

[l] SVOCs (semi volatile organic compounds) will be analyzed by EPA methods 8270C.

[m] Select regional wells (R-wells) contain residual drilling fluids in the aquifer adjacent to screens and produce groundwater samples that are not representative of natural conditions. These impacted wells and their respective screens are included as part of the Interim Monitoring Plan but the analytical suites only include constituents that are not affected by the affect of residual drilling fluids and a suite of constituents used to monitor the degree of impact from residual drilling fluids in the aquifer surrounding the screen (i.e., iron, manganese, sulfate, sulfide, sodium, barium, total organic carbon, and total kjeldahl nitrogen [EES-6 suite]).

[n] Dioxins and furans will be analyzed by EPA Method 1613B or 8290.

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4.4.3 Intermediate Perched Groundwater

Sampling locations, frequency, analytes, and the rationale for intermediate perched groundwater monitoring are presented in Table 4.3-1. Locations are shown in Figure 4.3-1. These constituents are shown graphically in Figures B.37 through B.39. The screening tables are presented electronically in the Mortandad Watershed Intermediate Groundwater files on a CD in Appendix B.

The screening conducted as described in Section 1.5 identified three metals (antimony, chromium, iron, lead, manganese, and nickel); two general inorganic constituents (nitrite-nitrate as N and perchlorate); and two organic constituents (bis(2-ethylhexyl)phthalate and 4-nitroaniline) were detected above the threshold in the watershed. These constituents are shown graphically in Figures B.37 through B.39. The screening tables are presented electronically in the Mortandad Watershed Intermediate Groundwater files on a CD in Appendix B.

Intermediate-depth perched groundwater will be sampled from wells MCOBT-4.4, MCOI-4, MCOI-5, MCOI-6, and MCOI-8. All of these wells except MCOBT-4.4 are poor producers, so sampling is dependent on sufficient water for sampling. Additionally, bailers may be necessary for sampling if appropriate pumps are unable to lift water to the surface.

4.4.4 Regional Aquifer Groundwater

Sampling locations, frequency, analytes, and the rationale for regional aquifer groundwater monitoring are presented in Table 4.3-1. Locations are shown in Figure 4.3-1. These constituents are shown graphically in Figures B.40 through B.42. The screening tables are presented electronically in the Mortandad Watershed Regional Groundwater files on a CD in Appendix B.

The screening conducted as described in Section 1.5 identified three metals (arsenic, chromium, iron, manganese, and selenium); one general inorganic constituent (perchlorate); and one organic constituent (bis(2-ethylhexyl)pthalate) were detected above the threshold in the watershed. These constituents are shown graphically in Figures B.40 through B.42. The screening tables are presented electronically in the Mortandad Watershed Regional Groundwater files on a CD in Appendix B.

Regional aquifer wells R-1, TW-8, R-13, R-14, R-15, R-16, R-21, R-28, R-33, and R-34 in the Mortandad Canyon watershed are included in this work plan and reflect the monitoring requirements in the “Interim Measures Work Plan for Chromium Contamination in Groundwater” (LANL 2006, 91987).

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5.0 PAJARITO CANYON WATERSHED

5.1 Introduction

Pajarito Canyon is located on the Pajarito Plateau in the central part of the Laboratory (Figure 1.2-1). The canyon heads in the Santa Fe National Forest approximately 4.6 km (2.9 mi) west of the Laboratory boundary at an elevation of approximately 10,434 ft (3180 m) and trends east-southeast across the Laboratory and Los Alamos County. It empties into the Rio Grande in White Rock Canyon at an elevation of 5422 ft (1653 m). The primary Laboratory use of the Pajarito Canyon watershed has been as the canyon-bottom location for the Los Alamos Critical Experiments Laboratory (LACEF) at TA-18 and for mesa-top surface and subsurface material disposal areas (MDAs) F and Q at TA-06, M at TA-09, and G, H, J, and L at TA-54. A detailed description and data summary for Pajarito Canyon potential contaminants is contained within the work plan for Pajarito Canyon (LANL, 1998, 58820).

5.2 Background

The Pajarito Canyon watershed is approximately 13 sq mi in area. The TAs located within this watershed include TA-03, -06, -07, -08, -09, -14, -15, -18, -22, -23, -27, -36, -40, -46, -50, -54, -55, -58, -59, -64, -65, -66, -67, and -69. The contaminant release history from approximately 379 SWMUs and AOCs includes releases from outfalls, septic systems, spills, open detonations from firing sites, and MDAs. Laboratory-related contamination has been detected in Pajarito Canyon water samples obtained from perennial and ephemeral streams, alluvial groundwater, and springs supplied by intermediate groundwater from the Bandelier Tuff. The Pajarito Canyon conceptual model is briefly discussed below and summarized in Table A-4 in Appendix A.

5.3 Monitoring Objectives

The monitoring for Pajarito Canyon reflected in the Interim Facility-wide Groundwater Monitoring Plan is consistent with the NMED-approved “Work Plan for Pajarito Canyon” (LANL 1998, 59577, and NMED 2005, 91288). The Pajarito Canyon work plan focuses on watershed-scale characterization of surface-water baseflow, springs, alluvial groundwater, intermediate-depth perched groundwater, and regional groundwater. The work plan calls for installation of thirteen new alluvial wells to provide coverage throughout the upper watershed, including the Twomile and Threemile basins. Additionally, six surface water baseflow locations and ten springs are included in the monitoring scope. The Pajarito Canyon Work Plan calls for two characterization sampling rounds. However, an additional two sampling rounds will be performed to provide sufficient data to support an evaluation of future monitoring needs. Therefore, a quarterly monitoring frequency is proposed for the Pajarito watershed. Existing and proposed monitoring locations are presented in Table 5.3-1 and Figure 5.3-1.

Regional groundwater monitoring wells R-20 screen 1, R-21, and R-32 screen 2 will be monitored quarterly to support performance evaluation of the disposal facility at TA-54, (Areas G and H).

Several intermediate perched and regional wells in the Pajarito watershed have screens affected in different degrees by residual drilling fluids that produce unreliable results for many constituents. Individual locations and screens are discussed in the Well Screen Analysis Report (LANL 2005, 91121). The Interim Monitoring Plan calls for collection of groundwater from these screens and subsequent analysis of discrete constituents that are not affected by residual drilling fluids (Table 5.3-1). Those constituents that are affected by residual drilling fluids are not considered in this Plan because the results are not representative of conditions in the aquifer.

Surface water and all groundwater zones will be sampled within a 21-day sampling window. Groundwater levels and surface water flow will be measured simultaneously.

5.4 Scope of Activities

5.4.1 Base Flow

Sampling locations, frequency, analytes, and the rationale for base flow monitoring are presented in Table 5.3-1. Locations are shown in Figure 5.3-1.

The screening conducted as described in Section 1.5 identified three metals (aluminum, arsenic, and selenium) and one general inorganic constituent (nitrite-nitrate as N) were detected above the screening threshold. No organic constituents were detected above the screening threshold. These constituents are shown graphically in Figures B.43 through B.48. The screening tables are presented electronically in the Pajarito Watershed Surface Water files on a CD in Appendix B.

Base flow in perennial and intermittent portions of Pajarito Canyon, Twomile Canyon, and Threemile Canyon will be monitored seasonally. Six base-flow sampling locations, Pajarito 0.5 mi above SR 501 (PBF-B) Pajarito below E242.5 (PBF-1), base flow in Twomile Canyon (PBF-2), base flow at stations E244 (PBF-3) and E243 (PBF-4), and base flow below TA-18 (PBF-5), are included in this Plan. These locations were selected based on proximity to (1) potential contaminant release sites; (2) gaging stations where long-term base flow patterns and water quality data can be compared; and (3) canyon segments lacking gaging stations, but where perennial or intermittent (>20 days/yr) flow is expected. Base flow samples will be collected quarterly under the Pajarito watershed work plan.

5.4.2 Alluvial Groundwater

Sampling locations, frequency, analytes, and the rationale for alluvial groundwater monitoring are presented in Table 5.3-1. Locations are shown in Figure 5.3-1.

The screening conducted as described in Section 1.5 identified two metals (iron, and manganese); two general inorganic constituents (chloride and total dissolved solids); and no organic constituents were detected above the screening threshold. These constituents are shown graphically in Figures B.49 through B.51. The screening tables are presented electronically in the Pajarito Watershed Alluvial Groundwater files on a CD in Appendix B.

Alluvial groundwater monitoring locations in the Pajarito watershed include thirteen new alluvial wells, PCAO-B, PCAO-2, PCAO-3, PCAO-4, PCAO-5, PCAO-6, PCAO-7a, PCAO-7b, PCAO-7c, 3MAO-1, 3MAO-2, TMO-1, and PCAO-8, and six existing wells 18-MW-8, 18-MW-9, 18-MW-11, 18-MW-18, PCO-2, and PCO-3. The inclusion of the group of 18-MW series wells is beyond that required in the NMED-approved “Work Plan for Pajarito Canyon” (LANL 1998, 59577, and NMED 2005, 91288), but are considered potentially useful for more specific monitoring near buildings or other structures associated with TA-18. The alluvial wells at TA-18 are screened at similar depths and are close together creating a high-density network with many duplicative locations (Figure 5.3-1). In order to avoid duplication of locations at TA-18, a transect of new wells (PCAO-7a, PCAO-7b, and PCAO-7c), located directly down gradient from TA-18 is scheduled for installation and will monitor for any contamination emanating from the facility.

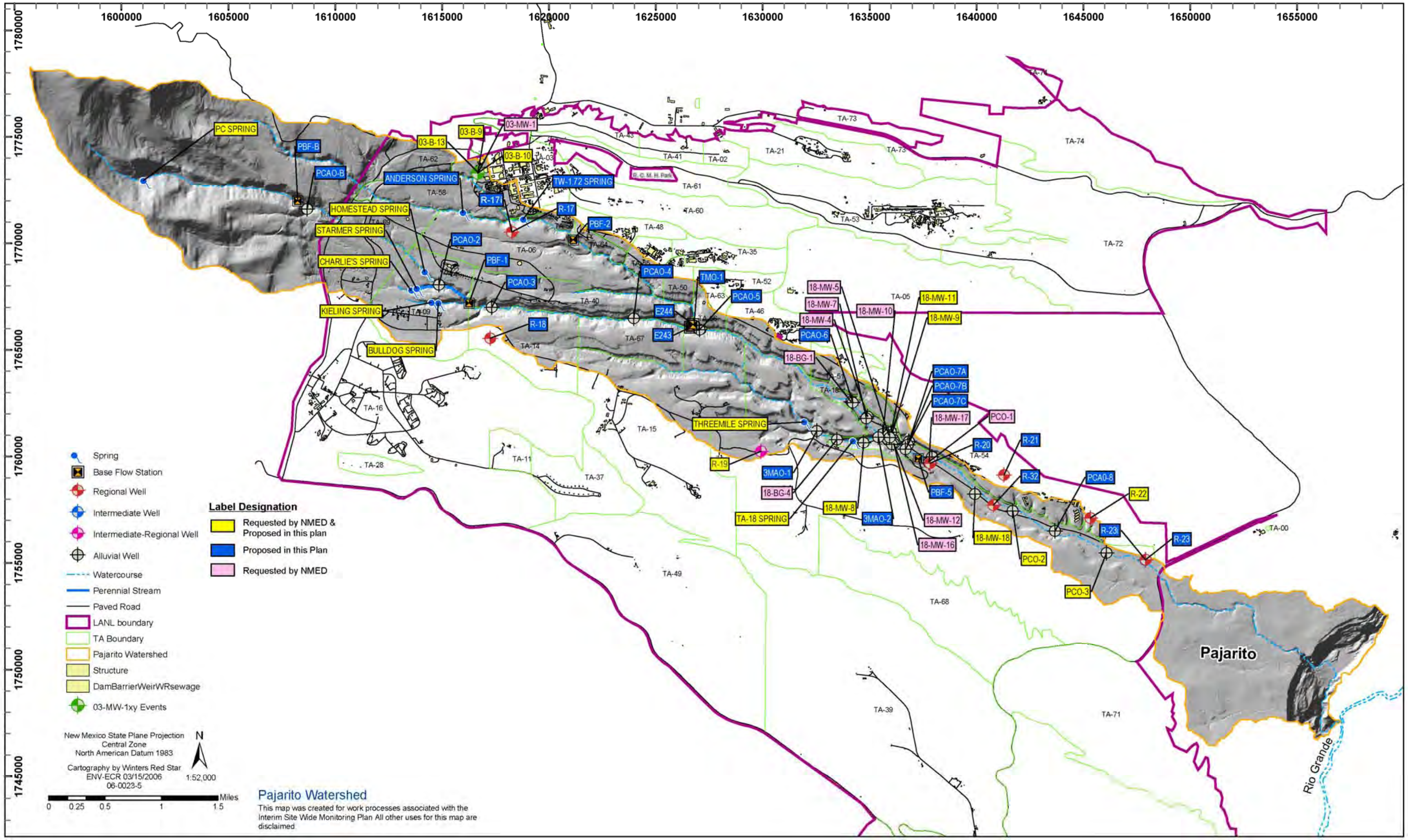

Figure 5.3-1. Pajarito Watershed

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Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

					Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
	PBF-B	Background location in Pajarito Canyon. Located approx. 0.5 miles above State Road 502. Provides a basis for comparison to data from downstream locations. Included in NMED-approved Work Plan for Pajarito Canyon.	Base Flow	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
	PBF-1	Surface water in Pajarito Canyon below the confluences of South and North Anchor East Basin (below E242.5). Location selected to monitor potential cumulative impacts of PRSs in Anchor East basin. Included in NMED-approved Work Plan for Pajarito Canyon.	Base Flow	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
	PBF-2	Surface water in Twomile Canyon below TA-59. Location selected to monitor potential cumulative impacts of PRSs in upper Twomile basin. Included in NMED-approved Work Plan for Pajarito Canyon.	Base Flow	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
	E244 (PBF-3)	Surface water base flow collected at gage station E244. Location selected to monitor potential cumulative impacts from upper Pajarito basin. Included in NMED-approved Work Plan for Pajarito Canyon.	Base Flow	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
	E243 (PBF-4)	Surface water baseflow collected at gage station E243. Location selected to monitor potential cumulative impacts from upper Twomile basin. Included in NMED-approved Work Plan for Pajarito Canyon.	Base Flow	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
	PBF-5	Surface water in Pajarito below TA-18. Location selected to monitor below TA-18 at road crossing near R-20. Included in NMED-approved Work Plan for Pajarito Canyon.	Base Flow	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
PC Spring	PC Spring	Probably regional groundwater. Provides background water quality.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
Homestead	Homestead Spring	Likely spring with largest discharge. Downgradient of TA-9 (MDA M).	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
Starmers	Starmer Spring	Speculated to be intermediate water in Bandelier Tuff. Provides baseline water quality upgradient of HE facilities.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
	Anderson Spring	Located in Twomile Canyon downgradient of TA-68 and above potential sources of contamination in TA-3.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
Kieling	Kieling Spring	Spring with history of HE contamination. Downgradient of TA-9.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
Charlie	Charlie's Spring	Monitors potential contamination from TA-08 area.		S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
Bulldog	Bulldog Spring	Spring with history of HE contamination. Downgradient of TA-9.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
	TW-1.72 Spring	In Twomile Canyon, downgradient of TA-3 facilities.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
Threemile A	Threemile Spring	In Threemile Canyon, upgradient of TA-18 and downgradient of TA-15 firing site facilities.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
Threemile B		Same spring as Threemile A.	Spring																	Q	
TA-18	TA-18 Spring	In Threemile Canyon, upgradient of TA-18 and downgradient of TA-16 firing site facilities.	Spring	S	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A	Q	Q
18-BG-1		New well (PCAO-6) will be installed near BG-1 per approved work plan for Pajarito Canyon. Better of two wells will be used for monitoring.	Alluvial																		
	18-BG-1/PCAO-6	Either use BG-1 or new well PCAO-6 to characterize baseline relative to TA-18, New well PCAO-6 will be installed a little east of BG-1. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
18-BG-4		New well (3MAO-1) will be installed near 18-BG-4 per approved work plan for Pajarito Canyon. Better of two wells will be used for monitoring.	Alluvial																		
	3MAO-1/18-BG-4	Either use existing BG-4 or new installation. New well 3MAO-1 will be located just east of confluence with South Fork Three Mile Canyon. Characterizes cumulative potential impacts of PRSs in Three Mile Canyon and is baseline relative to TA-18. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
18-MW-4		18-MW-4 not included due to spatial redundancy with other proposed wells. Not included in NMED-approved work plan for Pajarito Canyon.	Alluvial																		
18-MW-5		18-MW-5 not included due to spatial redundancy with other proposed wells. Not included in NMED-approved work plan for Pajarito Canyon.	Alluvial																		
18-MW-7		18-MW-7 not included due to spatial redundancy with other proposed wells. Not included in NMED-approved work plan for Pajarito Canyon.	Alluvial																		
18-MW-9	18-MW-9	18-MW-9 included to monitor for potential contaminants associated with bldgs 18-31, 18-189, 18-29, and 18-37.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
18-MW-10		18-MW-10 not included due to spatial redundancy with other proposed wells. Not included in NMED-approved work plan for Pajarito Canyon.	Alluvial																		
18-MW-11	18-MW-11	18-MW-11 included to monitor for potential contaminants associated with bldgs 18-147, 18-001, and 18-256.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
18-MW-12		18-MW-12 not included due to spatial redundancy with other proposed wells. Not included in NMED-approved work plan for Pajarito Canyon.	Alluvial																		

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
18-MW-16		18-MW-16 not included due to spatial redundancy with other proposed wells. Not included in NMED-approved work plan for Pajarito Canyon.	Alluvial																		
18-MW-8	18-MW-8	In Three Mile Canyon downgradient of Critical Assembly Building in TA-18	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
18-MW-17		Not necessary to monitoring because of spatial redundancy with pending PCAO-7(a,b,c)-series wells which are part of the NMED-approved work plan for Pajarito Canyon.	Alluvial																		
18-MW-18	18-MW-18	Useful monitoring point for potential releases associated with historical sewage lagoons on lower Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
PCO-1		Not necessary to monitoring because of spatial redundancy with new PCAO-7(a,b,c)-series wells which are part of the NMED-approved work plan for Pajarito Canyon..	Alluvial																		
PCO-2	PCO-2	Will be included to monitor distal extent of alluvial groundwater saturation in lower Pajarito watershed. Maintains long-term record at that location.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
PCO-3	PCO-3	Will be included to monitor distal extent of alluvial groundwater saturation in lower Pajarito watershed. Maintains long-term record at that location.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	PCAO-B	New background well planned for upper Pajarito Canyon. Located west of State Road 4. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	PCAO-2	New well planned in Pajarito Canyon below the confluence of Starmer's Gulch. Monitors potential impacts of group of PRSs in the upper basin. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
	PCAO-3	New well located in Pajarito Canyon below the confluence of South Anchor East Basin. Monitors potential impacts of group of PRSs in the upper basin (mostly within TA-08). Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	PCAO-4	New well located in Pajarito Canyon approx. 800 meters above confluence with Twomile Canyon. Monitors potential impacts from PRSs in TA-40. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	PCAO-5	New well in Pajarito Canyon located just below the confluence of Twomile Canyon. Also located above the flood retention structure. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	PCAO-7a, 7b, 7c	Transect of new wells to characterize potential impacts from TA-18. The wells will be installed in a transect to capture potential variability in saturation or water quality. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	3MAO-2	Location is within TA-18 at mouth of Three Mile Canyon. Characterizes potential impacts of TA-18 PRSs that are located within Three Mile Canyon. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	TMO-1	New well at mouth of Two Mile Canyon. Characterizes cumulative potential impacts of PRSs throughout Twomile Basin. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q			Q		Q	A		Q

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
	PCAO-8	New well located near PCTH-5 (between PCO-2 and PCO-3). Characterizes potential impacts from runoff associated with TA-54. Part of a group of new alluvial wells to be installed under NMED-approved work plan for Pajarito Canyon.	Alluvial	C	Q		Q	Q	Q	Q	Q^{HMX}		Q	Q		Q		Q	A		Q
03-MW-1	Well renamed 03-B-9	Near TA-3, SM-30. Thin zone of saturation, extent of contamination (VOCs, mercury, tritium).	Intermediate	Q	Q		Q	Q	Q	Q	Q^{HMX}		Q	Q		Q		Q	A		Q
03-MW-2	Well renamed 03-B-10	Near TA-3, SM-30. Thin zone of saturation, extent of contamination (VOCs, mercury, tritium).	Intermediate	Q	Q		Q	Q	Q	Q	Q^{HMX}		Q	Q		Q		Q	A		Q
03-MW-3	Well renamed 03-B-13	Near TA-3, SM-30. Thin zone of saturation, extent of contamination (VOCs, mercury, tritium).	Intermediate	Q	Q		Q	Q	Q	Q	Q^{HMX}		Q	Q		Q		Q	A		Q
R-19	R-19, screen 1	Dry. A sample will be collected if groundwater is present.	Intermediate	Q	Q		Q	Q	Q	Q	Q^{HMX}		Q	Q		Q		Q	A		Q
R-19	R-19, screen 2	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Intermediate	C											Q		Q		A		Q
	R-23i	Characterization sampling under the Interim Plan.	Intermediate	C	Q		Q	Q	Q	Q	Q^{HMX}		Q	Q		Q		Q	A		Q
	R-17i	Not installed. R-17i is contingent on the hydrologic conditions found in the R-17 regional well.	Intermediate	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	R-17, Screen 1	Not installed. To be drilled in CY06. Characterization sampling to be conducted under this plan.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	R-17, Screen 2	Not installed. To be drilled in CY06. Characterization sampling to be conducted under this plan.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	R-18	New well, characterization sampling planned under the Interim Plan.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
R-19	R-19, screen 3	Screen 3 is at the top of the regional aquifer. Previous sampling did not detect contaminants above screening level.	Regional	C							Q^{HMX}				Q		Q		A		Q
R-19	R-19, screen 4	Screen 4 is 230 ft below the top of the regional aquifer. Previous sampling did not detect contaminants above screening level.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
R-19	R-19 screen 5	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q
R-19	R-19 screen 6	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q
R-19	R-19 screen 7	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q
	R-20, screen 1	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q
	R-20, screen 2	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
	R-20, screen 3	In Pajarito Canyon downgradient of TA-18 and possibly downgradient of MDA-L. Initial characterization sampling has not been conducted. TA-54 regulatory.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q	Q	Q	A		Q
R-22	R-22, screen 1	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q
R-22	R-22, screen 2	Monitoring required for Area G approval authorization. Screen 2 is 64 ft below the top of the regional aquifer. No contaminants detected in 4 rounds of characterization sampling. MDA G regulatory.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
R-22	R-22, screen 3	Monitoring required for Area G approval authorization. Screen 3 is 390 ft below the top of the regional aquifer. Technetium detected in one out of four rounds of characterization sampling. MDA G regulatory.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
R-22	R-22, screen 4	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q
R-22	R-22 screen 5	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											Q		Q		A		Q
	R-23, screen 1	In Pajarito Canyon downgradient of MDA-G. Characterization sampling has been completed.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q

Table 5.3-1
Pajarito Canyon (includes Two Mile and Three Mile Canyons Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Pajarito Watershed (includes Two Mile and Three Mile Canyons)																					
	R-32, screen 1	In Pajarito Canyon downgradient of MDA-L and upgradient of MDA-G. Screen 1 is at the top of regional aquifer. Characterization sampling has been completed.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	R-32, screen 2	Port designed for pressure measurements only. Not able to collect sample.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q
	R-32, screen 3	Screen 3 is 200 ft below the top of regional aquifer. Characterization sampling has been completed.	Regional	C	Q		Q	Q	Q	Q	Q^{HMX}		Q		Q	Q		Q	A		Q

[a] Sampling frequency: C = continuous; Q= quarterly (4 times/year at set time periods); S= semiannual (2 times/year at set time periods); A = annual (one time a year);
Continuous monitoring for groundwater refers to the measurement of groundwater levels by a transducer placed in a well and programmed to collect groundwater-level measurements at highly frequent intervals (e.g., every 60 minutes daily throughout the year). Continuous stream-flow monitoring refers to the measurement of stream flow by a base-flow stream gage that is programmed to collect stream-flow measurements at highly frequent intervals.

[b] Semi annual sampling for select base flow, springs, intermediate, and regional groundwater is defined as one full analyte suite list and one target analyte list that includes the following: perchlorate, nitrate+nitrite (as nitrogen), low level tritium, general chemistry, gross alpha, gross beta, strontium-90 and isotopic uranium, Sampling frequency for wells undergoing characterization sampling is generally comprehensive with full suite analysis.

[c] The field preparation for all samples is non-filtered and filtered for samples to be analyzed for general inorganics (excluding anions), and metals. Anions and perchlorate samples will be filtered only. Samples collected for radionuclide analysis will be filtered and non-filtered for all water media, excluding tritium which is non-filtered only. Organic constituents are non-filtered for all water media. Stable isotope samples are non filtered. Hexavalent chromium may be filtered or non filtered. Field parameters pH, turbidity (Trb), specific conductance (SC), dissolved oxygen (DO), and temperature (T) will be measured for all samples. Oxidation reduction potential (ORP) will be measured if a flow through cell is used for parameter measurement

[d] Location differs from Table XII-5 due to duplication of wells, scheduled for abandonment, no historical contamination, redundant locations, or other reasons. See supplemental information in the watershed sections of the document and Appendix E for explanation and justification.

[dro] DRO (diesel range organics) will be analyzed by EPA Method 8015 modified.

[e] Rad (radiological)suite includes gross alpha, gross beta, isotopic uranium, strontium-90, low level tritium.

[f] General inorganic analytes include major ions, TDS, trace metals-trace elements; trace anions, silica, nitrogen species, TKN, low-level perchlorate (by LCMS/MS), total organic carbon; and TSS in base flow samples.

[g] Metals analysis includes the 23 TAL (target analyte list) metals, plus total cyanide and molybdenum where specified. Analyses of trace elements and metals will be the same as in the Environmental Surveillance Program (2001 and past years) plus additional analytes.

[h] VOCs (volatile organic compounds) will be analyzed by EPA methods 8260B.

[HMX] Designates analysis for explosive constituents hexahydro-1-nitro-3, 5-dinitro-1,3,5-trinizine (MNX), hexahydro-1,3-dinitroso-3-nitro-1,3,5-triazine (DNX), and hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX).

[i] PAHs (poly aromatic hydrocarbons) will be analyzed by EPA Method 8310.

[j] PCBs (poly chlorinated biphenols) will be analyzed using EPA Method 8082.

[k] Pesticides will be analyzed by EPA Method 8081A.

[l] SVOCs (semi volatile organic compounds) will be analyzed by EPA methods 8270C.

[m] Select regional wells (R-wells) contain residual drilling fluids in the aquifer adjacent to screens and produce groundwater samples that are not representative of natural conditions. These impacted wells and their respective screens are included as part of the Interim Monitoring Plan but the analytical suites only include constituents that are not affected by the affect of residual drilling fluids and a suite of constituents used to monitor the degree of impact from residual drilling fluids in the aquifer surrounding the screen (i.e., iron, manganese, sulfate, sulfide, sodium, barium, total organic carbon, and total kjeldahl nitrogen [EES-6 suite]).

[n] Dioxins and furans will be analyzed by EPA Method 1613B or 8290.

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5.4.3 Intermediate Perched Groundwater

Sampling locations, frequency, analytes, and the rationale for intermediate perched groundwater monitoring are presented in Table 5.3-1. Locations are shown in Figure 5.3-1.

The screening conducted as described in Section 1.5 identified several metals (thallium, iron, and manganese) and general inorganics (perchlorate). These constituents are shown graphically in Figures B.52 through B.54. The screening tables are presented electronically in the Pajarito Watershed Intermediate Groundwater files on a CD in Appendix B.

Monitoring of the intermediate-depth perched groundwater beneath Pajarito Canyon is currently being conducted in wells R-23i, R-19 screen 2, and the new wells installed during the summer of 2005 at SWMU-3-010(a) (03-B-9, 03-B-10, 03-B-13; previously identified as 03-MW-2, 03-MW-2, 03-MW-2, respectively). In accordance with 19.27.4 NMAC and Section X.D of the Consent Order, the existing monitoring well 03-MW-1 at SWMU 03-010(a) was plugged and abandoned by the DOE in 2005 as part of the work plan. These wells are currently being addressed under a NOD that directs the DOE to identify and control sources of recharge and contamination to the intermediate groundwater at SWMU 03-010(a). Sampling will take place when the NOD has been satisfied and if sufficient intermediate groundwater is available to produce a sample.

R-19 screen 1 has been dry but will be checked and a sample collected if sufficient groundwater is available. Groundwater from R-19 screen 2 as well as R-23i will be collected under the Interim Monitoring Plan.

5.4.4 Regional Aquifer Groundwater

Sampling locations, frequency, analytes, and the rationale for regional aquifer groundwater monitoring are presented in Table 5.3-1. Locations are shown in Figure 5.3-1.

The screening conducted as described in Section 1.5 identified three metals (arsenic, iron, and manganese); three general inorganics (fluoride, perchlorate, and total dissolved solids); and one organic (bis(2-ethylhexyl)phthalate) were detected above the screening threshold. These constituents are shown graphically in Figures B.55 through B.57. The screening tables themselves are presented electronically in the Pajarito Watershed Regional Groundwater files on a CD in Appendix B.

Seven wells penetrating the regional aquifer in the Pajarito Canyon watershed will be monitored: R-17, R-18, R-19, R-20, R-22, R-23, and R-32. Wells R-18, R-19 screen 4, R-20 screen 3, R-22 screens 2 and 3, R-23, and R-32 screens 1 and 3 were ranked good to very good in the Well Screen Analysis Report (LANL 2005, 91121) and will be monitored quarterly for the full analytical suite. Wells that are impacted by residual drilling fluids and are ranked fair to poor include R-19 screens 3, 5, and 6, R-20 screens 1 and 2, and R-22 screens 1, 4, and 5. These locations and screens will be sampled quarterly for constituents that are not impacted and for indicator constituents that track the chemical behavior of groundwater sampled from the screen. After the screens have been rehabilitated the full analytical suite will be reinstated. Table 5.3-1 presents the analytes and frequency and provides a brief summary of the rationale used to make decisions

5.4.5 Springs

Sampling locations, frequency, analytes, and the rationale for springs monitoring are presented in Table 5.3-1. Locations are shown in Figure 5.3-1. Geologic Units, groundwater sources, and estimated flow data for the springs in the Pajarito Canyon Watershed can be found in Appendix D, Table D-4.

The screening conducted as described in Section 1.5 identified six metals (aluminum, antimony, arsenic, iron, manganese, and selenium) and two general inorganic constituents (nitrate as N and perchlorate) were detected above the screening threshold. No organic constituents were detected above the screening threshold. These constituents are shown graphically in Figures B.58 through B.60. The screening tables are presented electronically in the Pajarito Watershed Springs Water files on a CD in Appendix B.

Ten spring locations, PC-Spring, Homestead Spring, Starmer Spring, Anderson Spring, Keiling Spring, Charlie Spring, Bulldog Spring, TW-1.72 Spring, Threemile Spring, and TA-18 Spring, are included in the Interim Monitoring Plan. These springs will be monitored for the full analytical suite required in the approved Pajarito work plan.

6.0 WATER CANYON/CAÑON DE VALLE WATERSHED

6.1 Introduction

The headwaters of the Water Canyon/Cañon de Valle watershed occur along the eastern flank of the Jemez Mountains, near the western margin of the Pajarito Plateau (Figure 1.2-1). The discharge point of the watershed is at the Rio Grande on the eastern edge of the Plateau. The major canyons in the watershed include Water Canyon, Cañon de Valle, Potrillo Canyon, and Fence Canyon. There are also numerous smaller canyons and arroyos.

6.2 Background

The Water Canyon/Cañon de Valle watershed is located in the southern portion of the Laboratory and encompasses an area of approximately 19 sq mi. Cañon de Valle, located on the western portion of the Pajarito Plateau, is the main tributary to Water Canyon. The heads of both canyons are located in the Sierra de Los Valles. The watershed includes numerous springs, ephemeral and perennial surface water flow, and alluvial groundwater systems. Tributaries that may contribute contamination to Water Canyon include Indio, Fence, and Potrillo Canyons which join Water Canyon on the eastern side of the Laboratory. The TAs located within this watershed include TA-09, -11, -14, -15, -16, -28, -36, -37, -39, -49, -67, -68, -70, and -71. This portion of the Laboratory has been used for weapons testing, explosives testing, and explosives production and has received effluent from outfalls containing explosive compounds, metals, and VOCs. Storm water runoff from firing sites, open burn/open detonation units, surface disposal sites, and other SWMUs and AOCs may have contributed to the contamination detected within the watershed. The contaminants detected in soil, rock, and sediment samples obtained from various locations within the watershed during previous investigations include barium and other RCRA metals, explosive compounds, VOCs, and radionuclides, which are not addressed under the Consent Order*.* Results of the 260 Outfall Corrective Measures Study (CMS) investigation show the drainage channel below the outfall, and the canyon bottom, as well as surface water, alluvial groundwater, and deep perched groundwater are contaminated with explosive compounds including RDX, HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine), TNT (2,4,6-trinitrotoluene), and barium (LANL 2003, 85531*)*. The barium contamination results from an explosive compound, baritol, which is a mixture of Ba(NO3)2 and TNT. Barium and RDX are chemicals of interest in this watershed because of the documented releases of these chemicals, and the spatial and temporal distributions help to interpret the site conceptual model.

Because the Water Canyon/Cañon de Valle watershed is so extensive, and potential sources of contaminants change across the Pajarito Plateau, the watershed conceptual model (Table A-5 in Appendix A) is described in three sections: (1) Upper Water Canyon & Cañon de Valle; (2) Middle Water Canyon (near TA-49); and (3) Lower Water, Fence, and Potrillo Canyons.

6.3 Monitoring Objectives

The objective of the current monitoring for Canyon de Valle and Water Canyon is to continue to provide CMS monitoring information for the watershed, to refine the conceptual model and delineate the nature and extent of contaminants that were released in the upper watershed. The monitoring scope presented in this work plan reflects the requirements of the NMED Consent Order as well as additional constituents necessary for basic watershed characterization. Surface water and groundwater zones, with the exception of recently installed wells, will be monitored semiannually and within a 21-day sample collection campaign.

Semiannual monitoring is recommended for the following reasons. Intensive quarterly monitoring over the past decade under characterization and corrective measure investigations has resulted in an extensive pool of data and the development of a detailed conceptual model of the watershed. The alluvial wells and springs in Cañon de Valle have been sampled on a quarterly basis from 1997 to 2006. Beginning in 2000, deeper monitoring wells were drilled into the intermediate and regional aquifers in the Cañon de Valle / Water Canyon watershed and have been sampled quarterly since their installation. The sampling conducted in this watershed has characterized contaminant spatial and temporal trends. A summary of contaminant trends for the springs, alluvial water, and regional groundwater is presented in their respective sections with supporting data in Appendix E, Figures E.5.1 through E.5.9. Because of the extensive data collected during the past decade, semiannual monitoring is recommended for surface water and all groundwater zones in the watershed with exception of new wells.

6.4 Scope of Activities

6.4.1 Base Flow

Sampling locations, frequency, analytes, and the rationale for base flow monitoring are presented in Table 6.3-1. Locations are shown in Figure 6.3-1.

The screening conducted as described in Section 1.5 identified several metals (aluminum, barium, and selenium) and a general inorganic constituent (perchlorate) were detected above the threshold. No organic constituents were detected above the threshold. These constituents are shown graphically in Figures B.61 through B.66. The screening tables are presented electronically in the Water Canyon/ Canyon de Valle (CdV) Watershed Surface Water files on a CD in Appendix B.

Base flow in perennial and intermittent portions of Water Canyon, Cañon de Valle, and Potrillo Canyon will be monitored seasonally twice a year to capture flow variability. The sampling locations, Water below SR 501 (E252), Cañon de Valle below MDA-P (E256), and Water at Beta, are from an existing network of gaging stations and surface water monitoring locations where long-term base flow patterns indicate perennial or intermittent (>20 days/year) flow. A new location recommended in the Notice of Deficiency and located between E252 and Water at Beta will be established and monitored. The seasonally based sampling will provide water quality and water level data associated with high water (spring and late summer) and low water (fall and winter) conditions. Base flow sampling will be coordinated with sampling of the alluvial wells.

6.4.2 Alluvial Groundwater

Sampling locations, frequency, analytes, and the rationale for alluvial groundwater monitoring are presented in Table 6.3-1. Locations are shown in Figure 6.3-1.

The screening conducted as described in Section 1.5 identified several metals (aluminum, arsenic, barium, beryllium, cadmium, chromium, iron, lead, manganese, nickel, silver, and uranium); a general inorganic constituent (total dissolved solids) and one organic constituent (pentochloralphenol) were detected above the threshold. These constituents are shown graphically in Figures B.67 through B.69. The screening tables are presented electronically in the Water Canyon/Canyon de Valle Watershed Alluvial Groundwater files on a CD in Appendix B.

The five alluvial wells installed in Cañon de Valle in December 1997 have been sampled quarterly since installation. This represents approximately 30 sample results from each location. Concentrations of RDX and barium over time are shown for these wells in Figures E.6.1 and E.6.2. Well 16-02657 showed spikes of significantly elevated RDX in June 1999 and March 2001. The overall average RDX concentrations were highest at well 16-02659. Figure E.6.3 shows well 16-02659 RDX concentrations as a function of the height of the water table. Wetter conditions (higher water table) were positively correlated with higher RDX concentrations. The concentrations of barium did not change with changes in the height of the water table (Figure E.6.3). Figure E.6.2 shows the concentrations of barium over time in the Cañon de Valle alluvial wells. Alluvial well 16-02658 shows a slightly decreasing barium trend and alluvial well 16-02659 shows a slightly increasing barium trend over time. LANL recommends semiannual sampling at these wells to continue monitoring trends.

Three alluvial wells were installed in Martin Spring Canyon in 2000. Monitoring well 16-02693 is typically dry and was sampled only 4 times from 2000 to 2005. Barium was detected in all 4 samples and RDX was detected in 3 samples. Monitoring well 16-06294 was sampled 10 times from 2000 to 2005. Monitoring well 16-06295 was sampled 18 times from 2000 to 2005. Alluvial well 16-06295 shows a slightly decreasing trend over time. RDX in alluvial well 16-06295 was detected in 3 of 16 samples, but it has not been detected since March 2003. The remaining four alluvial wells in the Cañon de Valle/ Water canyon watershed: FCO-1, WCO-1, WCO-2, and WCO-3 are typically dry. LANL recommends semiannual sampling at these wells to continue monitoring trends.

Alluvial groundwater monitoring locations are situated in Water Canyon and Cañon de Valle. Five alluvial wells in Cañon de Valle (16-2655, 16-2656, 16-2657, 16-2658, and 16-2659) as well as three alluvial wells in Martin Canyon (16-6293, 16-6294, and 16-6295) will be monitored. Three alluvial wells in lower Water Canyon (WCO-1, WCO-2, and WCO-3) and one in Fence Canyon (FCO-1) are typically dry but will be checked and sampled if they produce sufficient water. No wells in Potrillo Canyon are suitable for monitoring alluvial groundwater.

In conclusion, alluvial groundwater in the Cañon de Valle/Water canyon watershed has been extensively characterized during the last eight years with respect to the principle contaminants in the watershed. Therefore LANL recommends sampling the springs and alluvial system on a semiannual basis. The major trend that has been observed is an increase in concentration with increase in precipitation. The semiannual sampling should focus on wetter periods corresponding to spring snowmelt (March-April) and summer monsoon (August-September).

Pressure transducers with integrated data loggers are in place to collect continuous water level data from the alluvial wells with the exception of those in lower Water and Fence Canyons.

6.4.3 Intermediate Perched Groundwater

Sampling locations, frequency, analytes, and the rationale for intermediate perched groundwater monitoring are presented in Table 6.3-1. Locations are shown in Figure 6.3-1.

The screening conducted as described in Section 1.5 identified several metal constituents (arsenic, beryllium, chromium, iron, manganese, and nickel) were detected above the threshold. No general inorganic or organic constituents were detected above the threshold. These constituents are shown graphically in Figures B.70 through B.72. The screening tables are presented electronically in the Water Canyon/Canyon de Valle (CdV) Watershed Intermediate Groundwater files on a CD in Appendix B.

There are five wells, CdV-16-1(i), CdV-16-2(i), R-25, CdV-37-2, and CdV-15-3, in the upper Water Canyon watershed that are completed to access intermediate perched groundwater. These wells were originally sited to characterize an area where effluent containing explosive compounds was released into the canyons. CdV-R-37-2 screen 1 and CdV-R-15-3 screens 1, 2, and 3 have been dry since drilling. If pressure measurements suggest that groundwater is present, samples will be collected. Intermediate wells CdV-16-1(i) and CdV-16-2(i) are new wells and are currently undergoing characterization sampling. Four rounds of groundwater sampling have been collected from CdV-16-1(i) and it will transition to semiannual sampling under the Interim Monitoring Plan. Two characterization sampling rounds have been collected from CdV-16-2(i) and quarterly sampling will continue at CdV-16-2(i) until four rounds have been collected. Contaminants have been observed in intermediate perched groundwater at R-25 screens 1 and 2. This zone will be monitored for constituents not affected by drilling fluids and indicator constituents that infer changes in impacted groundwater in the vicinity of the screen.

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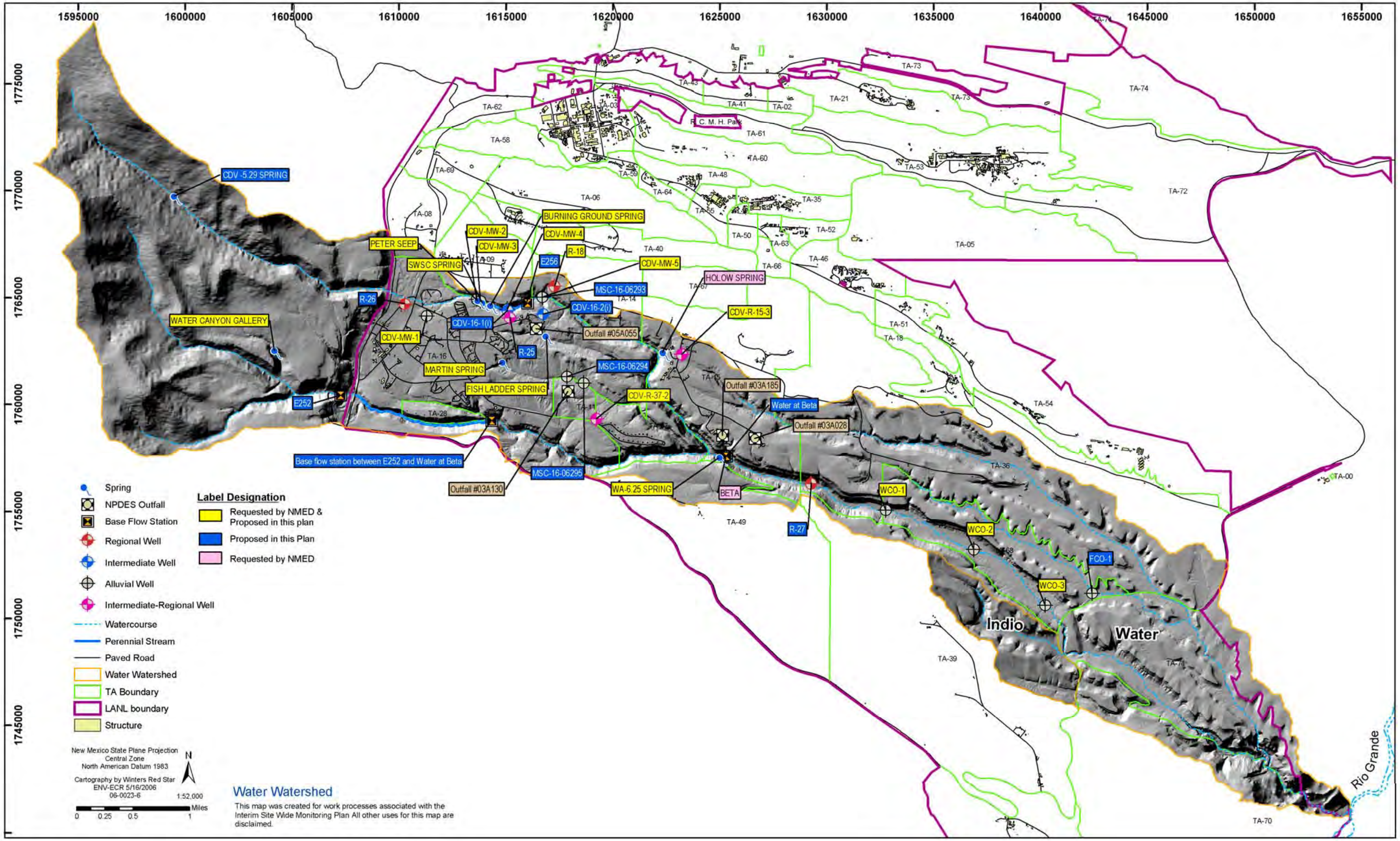

Figure 6.3-1. **Water Watershed**

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Table 6.3-1
Water (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon) Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Water Watershed (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon)																					
Cañon de Valle Headwaters baseflow	Water below SR-501 (E252)	Background location for water quality.	Base flow	C	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A	S	S
	Cañon de Valle below MDA P (E256).	Extent of contamination.	Base flow	S	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A	S	S
	Base flow station between E252 and Water at Beta	Extent of contamination	Base flow	S	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A	S	S
	Water at Beta.	Extent of contamination	Base flow	S	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A	S	S
	CdV-5.29 Spring	Provides background groundwater quality.	Spring	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A	S	S
Water Canyon Gallery	Water Canyon Gallery	Background location.	Spring	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A	S	S
Peter Seep	Peter Seep	Extent of contamination.	Spring	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A	S	S
SWSC Line	SWSC Spring	Extent of contamination.	Spring	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A	S	S
Burning Ground	Burning Ground Spring	Extent of contamination.	Spring	S	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A	S	S
Hollow		Questionable Source	Spring																		
Fish Ladder	Fish Ladder Seep	Extent of contamination.	Spring	S	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A	S	S
Martin	Martin Spring	Extent of contamination.	Spring	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A	S	S
WA-625	WA-625	Extent of contamination below confluence of CdV and Water drainages.	Spring	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A	S	S
16-2655	Well renamed CdV-MW-1	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
16-2656	Well renamed CdV-MW-2	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A		S
16-2657	Well renamed CdV-MW-3	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A		S
16-2658	Well renamed CdV-MW-4	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A		S
16-2659	Well renamed CdV-MW-5	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}	S	A		S	S		S	A		S
	MSC-16-06293	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	MSC-16-06294	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S

Table 6.3-1
Water (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon) Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Water Watershed (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon)																					
	MSC-16-06295	Extent of contamination.	Alluvial	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
WCO-1	WCO-1	Well dry since installed. Check for water during the wet seasons.	Alluvial	S	S		S	S	S	S	S^{HMX}		S		S	S		S	S		S
WCO-2	WCO-2	Well dry since installed (except for 2005). Check for water during the wet seasons.	Alluvial	S	S		S	S	S	S	S^{HMX}		S		S	S		S	S		S
WCO-3	WCO-3	Well dry since installed. Check for water during the wet seasons.	Alluvial	S	S		S	S	S	S	S^{HMX}		S		S	S		S	S		S
Beta Hole[d]		Open hole with no evidence of water.	Alluvial								S^{HMX}										
	FCO-1	Well dry since installed. Check for water during the wet seasons and sample if sufficient water is present.	Alluvial	S	S		S	S	S	S	S^{HMX}		S		S	S		S	S		S
	R-25, screen 1	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Intermediate	C							S^{HMX}				S		S		A		S
	R-25, screen 2	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Intermediate	C							S^{HMX}				S		S		A		S
CdV-37-2[d]	CdV-37-2[d]	Dry, no groundwater. Will collect a sample if water is present.	Intermediate	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	CdV-16-1(i), screen 1	R-CdV-16-1(i) is undergoing characterization sampling for extent of contamination.	Intermediate	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	CdV-16-2(i), screen 1	R-16-2(i) is undergoing characterization sampling for extent of contamination.	Intermediate	C	Q		Q	Q	Q	Q	Q^{HMX}		Q	Q	Q	Q		Q	A		Q
CdV-15-3[d]	CdV-15-3[d]	Dry, no groundwater. A sample will be collected if groundwater is present.	Intermediate	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S

Table 6.3-1
Water (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon) Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Water Watershed (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon)																					
CdV-15-3	CdV-15-3	Extent of contamination.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
CdV-15-3	CdV-15-3 screen 5	Extent of contamination.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
CdV-15-3	CdV-15-3 screen 6	Extent of contamination.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
R-18	R-18	Quarterly characterization sampling is currently being performed under the Interim Plan.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	R-26, screen 1	Characterization sampling will be performed under the Interim Plan.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	R-26, screen 2	Characterization under the Interim Plan. Port is clogged with drilling fluids, inoperable as of April 2005. May not be able to sample due to clogged port.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	R-25, screen 4	Sampling will cover both the recommendations of the R-25 evaluation report pending approval by the NMED and continued monitoring for contamination in the watershed.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	R-25, screen 5	Screen in this zone is impacted by residual drilling fluids. Only constituents not impacted by drilling fluids and an indicator suite (EES-6 screening) are included for analysis. Full analytical suites will be reinstated after well screen rehabilitation.	Regional	C											S		S		A		S
	R-25, screen 6	Sampling will cover both the recommendations of the R-25 evaluation report pending approval by the NMED and continued monitoring for contamination in the watershed.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S

Table 6.3-1
Water (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon) Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Water Watershed (includes Cañon del Valle, Potrillo Canyon, and Fence Canyon)																					
	R-25, screen 7	Sampling will cover both the recommendations of the R-25 evaluation report pending approval by the NMED and continued monitoring for contamination in the watershed.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	R-25, screen 8	Sampling will cover both the recommendations of the R-25 evaluation report pending approval by the NMED and continued monitoring for contamination in the watershed.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
	R-27	New well; characterization sampling will take place. Is this happening????	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
CdV-37-2	CdV-37-2	Extent of contamination.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
CdV-37-2	CdV-37-2 screen 3	Extent of contamination.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
CdV-37-2	CdV-37-2 screen 4	Extent of contamination.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S

[a] Sampling frequency: C = continuous; M= monthly; Q= quarterly (4 times/year at set time periods); S= semiannual; A = annual; B = biennial sampling, T = triennial sampling; continuous monitoring for groundwater refers to the measurement of groundwater levels by a transducer placed in a well and programmed to collect groundwater-level measurements at highly frequent intervals (e.g., every 60 minutes daily throughout the year). Continuous stream-flow monitoring refers to the measurement of stream flow by a base-flow stream gage that is programmed to collect stream-flow measurements at highly frequent intervals.

[b] Semi annual sampling for select base flow, springs, intermediate, and regional groundwater is defined as one full analyte suite list and one target analyte list that includes the following: perchlorate, nitrate+nitrite (as nitrogen), low level tritium, general chemistry, gross alpha, gross beta, strontium-90 and isotopic uranium, Sampling frequency for wells undergoing characterization sampling is generally comprehensive with full suite analysis.

[c] The field preparation for all samples is non-filtered and filtered for samples to be analyzed for general inorganics (excluding anions), and metals. Anions and perchlorate samples will be filtered only Samples for radionuclide analysis will be filtered and non-filtered for all water media (tritium is non filtered only); non-filtered for all other samples including organics. Field parameters pH, turbidity, specific conductance, dissolved oxygen, and temperature will be measured for all samples; ORP will be measured if a flow through cell is used for parameter measurement.

[d] Location differs from Table XII-5 due to duplication of wells, scheduled for abandonment, no historical contamination, or other reasons. See supplemental appendices (Appendix E) for explanation and justification.

[e] Rad suite includes gross alpha, gross beta, isotopic uranium, strontium-90, low level tritium.

[f] General inorganic analytes include major ions, TDS, trace metals-trace elements; trace anions, silica, nitrogen species, TKN, low-level perchlorate (by LCMS/MS), total organic carbon; and TSS in base flow samples.

[g] Metals analysis includes the 23 TAL metals, plus total cyanide and molybdenum where specified. Analyses of trace elements and metals will be the same as in the Environmental Surveillance Program (2001 and past years) plus additional analytes.

[h] VOCs will be analyzed by EPA methods 8260B.

[i] PAHs will be analyzed by EPA Method 8310.

[j] PCBs will be analyzed using EPA Method 8082.

[k] Pesticides will be analyzed by EPA Method 8081A.

[l] Select regional wells (R-wells) contain residual drilling fluids and included as part of the Interim Plan even though concentration and mobility of specific constituents may be affected.

6.4.4 Regional Aquifer Groundwater

Sampling locations, frequency, analytes, and the rationale for regional aquifer groundwater are presented in Table 6.3-1. Locations are shown in Figure 6.3-1.

The screening conducted as described in Section 1.5 identified several metal constituents (chromium, iron, and manganese) were detected above the threshold. No general inorganic or organic constituents exceeded the threshold. These constituents are shown graphically in Figures B.73-x through B.75. The screening tables are presented electronically in the Water Canyon/Canyon de Valle (CdV) Watershed Regional Groundwater files on a CD in Appendix B.

Wells that access regional groundwater include R-18, R-25, R-26, R-27, CdV-15-3, and CdV-37-2. Contaminants, including RDX and barium, have been detected in three of these wells (R-25, CdV-15-3, and CdV-37-2) and are used to illustrate trends in the data.

Monitoring Well R-25 was sampled eight times from 2000 to 2005. RDX and barium were detected in groundwater collected from all sampling depths in this well (Figures E.6.4 and E.6.5). RDX and barium have maximum concentrations of 65 ug/L and 34 ug/L, respectively. Concentrations vary slightly with time; however the concentrations do not follow seasonal trends. Screen 5 was ranked fair to poor in the Well Screen Analysis Report (LANL 2005, 91121) and will have an analyte list containing only constituents that are not affected by residual drilling fluids and constituents identified to track the geochemical behavior of the region surrounding the screen. The remaining screens in the regional aquifer were ranked good to very good and will have the full analytical suite identified for the watershed. LANL recommends semiannual monitoring under this Plan to identify trends at R-25.

Monitoring well CdV-R-15-3 has undergone extensive monitoring and was sampled 17 times from 2001 to 2005. The analytical data indicate that barium in groundwater is relatively constant with time at all sampling depths (Figure E.6.6). The highest concentration of barium (130 ug/L) is present in groundwater collected from 1350 ft depth. There was no RDX detected in groundwater from CdV-R-15-3. LANL recommends semiannual sampling at this well to continue monitoring trends.

Monitoring well CdV-R-37-2 was sampled eight times from 2002 to 2005 (Figure E.6.7). The highest concentration of barium (260 ug/L) is present in groundwater collected from 1200 ft depth. There was no RDX detected in groundwater from CdV-R-37-2. LANL recommends semiannual sampling at these wells to continue monitoring trends.

Monitoring well R-18 and R-26 are currently undergoing characterization sampling and were sampled three times in 2005. A semiannual sampling schedule will be initiated after the fourth round has been collected. Regional well R-27 will be sampled for four quarters after hydrotesting has taken place.

In conclusion, three regional wells in the Cañon de Valle/ Water canyon watershed (R-25, CdV-15-3, and CdV-37-2) have been characterized with respect to the principle contaminant in the watershed. The concentrations of the principle contaminant, barium, do not show trends that correspond with season of sampling. The concentrations are relatively constant with time for all sampling depths within well CdV-R-15-3. The concentrations are relatively constant with time for two of the three depths within well CdV-R-37-2. The variation observed within the 1200-ft depth of well CdV-R-37-2 does not correspond with season and shows a decrease in concentrations for the latter two years of sampling. LANL recommends sampling regional wells R-25, CdV-15-3, and CdV-37-2 on a semiannual basis. As suggested for the springs and alluvial system, the semiannual sampling should focus on wetter periods corresponding to spring snowmelt (March-April) and summer monsoon (August-September). Existing and new wells installed as part of the characterization effort will be monitored on a quarterly schedule until four successive rounds have been collected at which time they shall revert to a semiannual schedule.

6.4.5 Springs

Sampling locations, frequency, analytes, and the rationale for springs monitoring are presented in Table 6.3-1. Locations are shown in Figure 6.3-1. Geologic Units, groundwater sources, and estimated flow data for the springs in the Water Canyon/Cañon de Valle Watershed can be found in Appendix D, Table D-4.

The screening conducted as described in Section 1.5 identified several metal constituents (aluminum, arsenic, barium, boron, iron, manganese, selenium, and thallium); two general inorganic parameters (nitrite-nitrate as N, and perchlorate); and two organic constituents (tetrachloroethene and trichloroethene) were detected above the threshold. These constituents are shown graphically in Figures B.76 through B.78. The screening tables are presented electronically in the Water Canyon/Canyon de Valle (CdV) Watershed Springs Groundwater files on a CD in Appendix B.

Nine springs and seeps are present in the Water Canyon/Cañon de Valle Watershed. Eight of the springs, Peter Seep, SWSC, Burning Ground, Fish Ladder Seep, Hollow, Martin, and Water Canyon Gallery, are located in the upper portion of the watershed. Because of their proximity to PRSs and the presence of explosive compounds and barium contamination, Burning Ground Spring, Peter Seep, Fish Ladder Seep, SWSC Spring, and Martin Spring have been selected for monitoring. Hollow spring was not selected for monitoring because of irregular and small discharge volumes. Water Canyon Gallery and CdV Headwaters were selected as background spring locations.

The principle springs in the watershed are Burning Ground, SWSC, and Martin. These springs have been sampled on a quarterly basis since 1997. In total this represents up to 55 sample results for Burning Ground Spring. Over time the concentrations of RDX and barium are fairly consistent as shown in Figures E.6.8 and E.6.9. Martin Spring shows a slightly decreasing trend in RDX concentration over an extended period of time from 1997 to 2005. Burning Ground and SWSC springs show a slightly decreasing trend in barium concentration over this same time period. LANL recommends semiannual sampling at these springs to continue monitoring trends.

7.0 ANCHO/CHAQUEHUI/FRIJOLES CANYONS WATERSHEDS

7.1 Introduction

Ancho Canyon

Ancho Canyon is located in the southeastern part of the Laboratory (Figure 1.2-1). TA-33, located south of Ancho Canyon on a mesa near the Rio Grande, was used as a firing site and for tritium operations. PRSs include landfills and septic systems. TA-39 is located on the floor of middle Ancho Canyon, and it was used for open-air testing of explosive compounds. PRSs in this TA include five firing sites, a number of landfills, and septic systems. More detailed information about the operational history and the PRSs can be found in the “RFI Work Plans for Operable Unit 1122” (LANL 1992, 07671) and the “RFI Work Plan for Operable Unit 1132” (LANL 1993, 15316).

TA-49 is located on a mesa in the upper part of the Ancho Canyon drainage and part of the area drains into Water Canyon. TA-49 was used for underground hydronuclear testing in the early 1960s. The testing consisted of criticality, equation-of-state, and calibration experiments involving special nuclear materials. The testing produced large inventories of radioactive and hazardous materials, such as isotopes of uranium and plutonium, lead, and beryllium; explosives such as 2,4,6-trinitrotaluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (research department explosive, or RDX), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (high-melting explosive, or HMX); and barium nitrate. Much of this material remains in shafts on the mesa top. Further information about activities and PRSs at TA-49 can be found in Purtymun and Stoker (1987, 06688) and the “RFI Work Plan for Operable Unit 1144” (LANL 1992, 07670). The RFI work plan also describes the planned investigations that focus on identifying and quantifying migration of contaminants from the shafts.

Chaquehui Canyon

Chaquehui Canyon is situated south of the mesa occupied by TA-33. One monitoring location (Doe Spring) is located in the lower watershed at the mouth of the canyon. Doe Spring is presented in Section 8 (White Rock Canyon).

Frijoles Canyon

Frijoles Canyon lies on USFS and National Park Service lands south of the Laboratory. The canyon lies adjacent to the Laboratory boundary near the Rio Grande, but is separated from TA-33 by Chaquehui Canyon. Sampling locations are shown on Figure 7.3-1 and on the White Rock Canyon location map (Figure 8.3-1).

7.2 Background

Ancho Canyon is located in the southern portion of the Laboratory and is approximately 7 sq mi in area. The Ancho Canyon watershed is located entirely within TA-33, -39, -49, and -70 and contains approximately 33 SWMUs and AOCs. Contaminants that have been detected in sediments, surface water, or shallow groundwater during previous investigations conducted in the watershed include mercury and other metals, explosive compounds, organic constituents, and radionuclides, which are not addressed under the Consent Order.

The Chaquehui Canyon watershed is located in the southeast portion of the Laboratory at TA-33. There are approximately 61 SWMUs and AOCs in the watershed that vary from inactive industrial outfalls to

MDAs. Surface water flow is ephemeral; however, two springs are present along the south-facing wall of the main drainage. Contaminants above background levels have been detected in samples of sediments and surface water obtained in the canyon.

Indio Canyon, a south-entering sub-basin to Water Canyon, originates on Laboratory property and extends for about 3 mi to its confluence with Water Canyon. The drainage basin is located in TA-39. Contaminants above background levels have been detected in sediments and surface water samples obtained from the canyon.

Potrillo and Fence Canyons are part of the Water Canyon/Cañon de Valle watershed. The confluence of these two canyons is near State Highway 4. TA-15, -36, -68, and -71 are located within these canyons. There are approximately 53 SWMUs and AOCs within the watershed. The SWMUs and AOCs vary from inactive septic tanks to open-detonation firing sites. Contaminants above background levels have been detected in sediments and surface water samples obtained from the canyons.

7.3 Monitoring Objectives

The primary monitoring objective of 2006 interim monitoring in Ancho/Chaquehui/Frijoles Canyon is to provide information in advance of the detailed characterization to be conducted in the 2009–2010. Characterization results are to be reported in the Ancho, Chaquehui, Indio canyons investigation report due in 2011 under the Consent Order (NMED 2005, 88207). Monitoring purpose and scope will be reassessed in 2009 based on the need for support of the detailed characterization work scheduled in 2009 and 2010. Thereafter, monitoring will be refocused based on the results of the investigation report and the determination of whether further corrective action is required under the Consent Order. In addition, results from monitoring will provide information to refine the conceptual model and delineate the nature and extent of contaminants that were released in the watershed.

Semiannual monitoring is recommended for the Ancho, Chaquehui, and Frijoles watersheds under this Plan for the following reasons. The base flow station in the Ancho Canyon watershed shows no apparent impact from Laboratory activities conducted at TAs within and around the Ancho Canyon Watershed. In addition, the regional aquifer system in the Ancho Canyon watershed shows little or no apparent impact from Laboratory activities conducted at TAs within and around the Ancho Canyon Watershed. Concentrations do not show trends that correspond with seasonal variability of precipitation and infiltration; therefore, a more aggressive monitoring frequency is not expected to yield data substantially different from what has already been collected. Data to justify a semiannual schedule is presented in Appendix E and a detailed discussion is presented below. This information provides the rationale for semiannual monitoring under this Plan.

7.4 Scope of Activities

Ancho Canyon

Monitoring locations in Ancho Canyon are situated near or downstream from areas of past Laboratory weapons-testing activities. Most monitoring locations in Ancho Canyon access the regional aquifer. Three decades of water quality records from regional wells in this area (DT-5A, DT-9, and DT-10), and recent data from R-31, show no substantial changes in water chemistry or the presence of Laboratory contaminants in the regional aquifer.

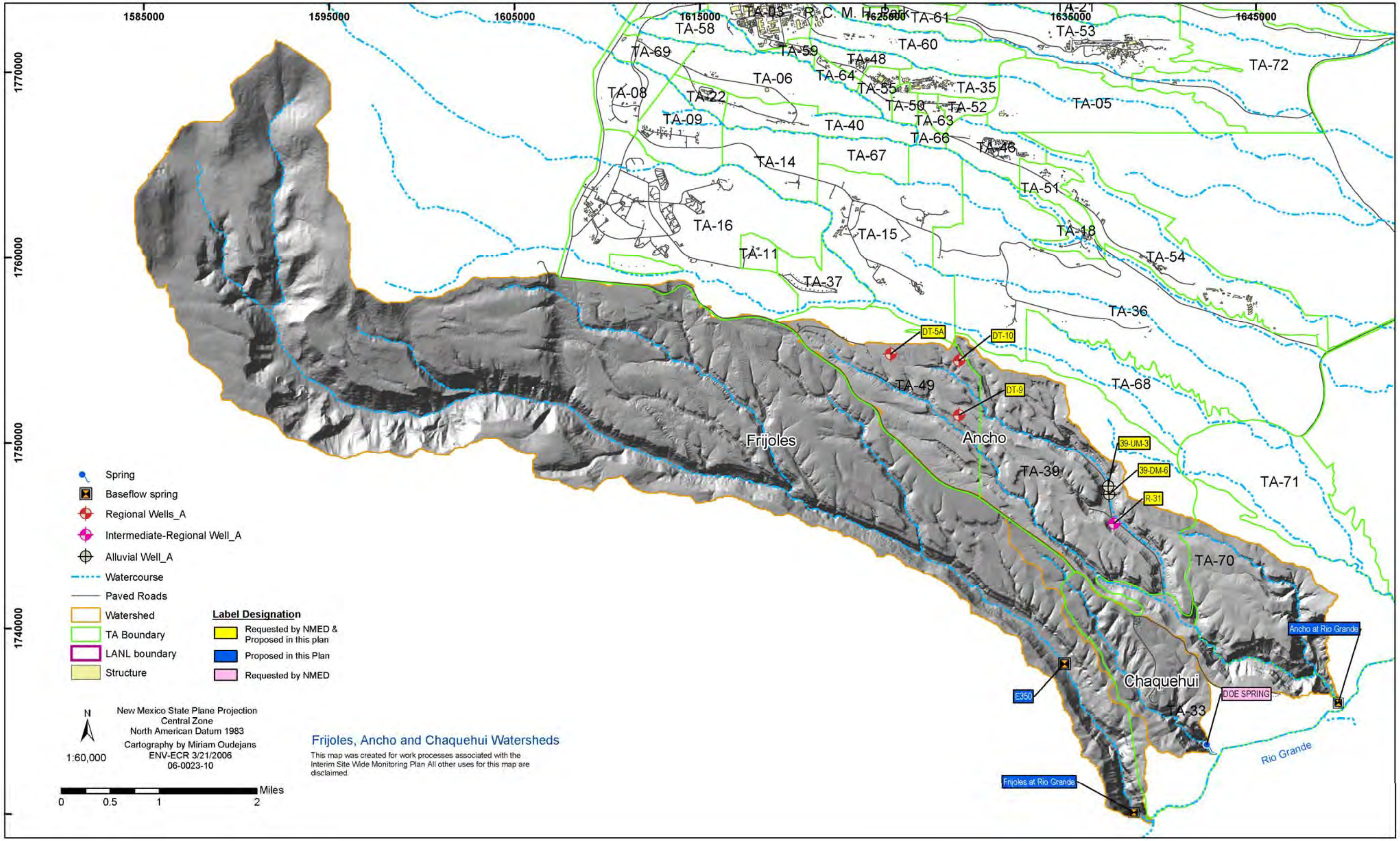

Figure 7.3-1. **Frijoles, Ancho and Chaquehui Watersheds**

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Table 7.3-1
Frijoles, Ancho and Chaquehui Watersheds Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Ancho Watershed[l]																					
	Ancho at Rio Grande	RCRA operating permit specifies annual sampling and analysis at this location. Ancho Spring must be sampled as base flow for safety reasons.	Base flow	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
Ancho Spring	Ancho Spring	See the White Rock Canyon and Rio Grande Watershed section in this plan	Spring	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A	S	S
39-1120	Well renamed 39-UM-3	Historically dry. Will collect groundwater sample in the event water is present.	Alluvial	S	S		S	S	S	S	S^{HMX}		S		S	S		S	S		S
39-1135	Well renamed 39-DM-6	Historically dry. Will collect groundwater sample in the event water is present.	Alluvial	S	S		S	S	S	S	S^{HMX}		S		S	S		S	S		S
R-31[d]	R-31,[d] screen 1	Dry. Will check each time well is sampled and collect a groundwater sample if water is present	Intermediate	S	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
DT-5A	DT-5A	Monitors regional aquifer near TA-49.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
DT-9	DT-9	Monitors regional aquifer near TA-50.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
DT-10	DT-10	Monitors regional aquifer near TA-51.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
R-31	R-31, screen 2	Screen 2 is at the top of the regional aquifer, monitors regional aquifer near TA-39. Characterization phase.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
R-31	R-31, screen 3	Screen 3 is 150 ft below the top of the regional aquifer, monitors regional aquifer near TA-39. Characterization phase.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
R-31	R-31, screen 4	Screen 4 is 310 ft below the top of the regional aquifer, monitors regional aquifer near TA-39. Characterization phase.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
R-31	R-31, screen 5	Screen 5 is 580 ft below the top of the regional aquifer, monitors regional aquifer near TA-39. Characterization phase.	Regional	C	S		S	S	S	S	S^{HMX}		A		S	S		S	A		S
Chaquehui Canyon																					
Doe	Doe Spring	See Table 8.3-1																			

Table 7.3-1
Frijoles, Ancho and Chaquehui Watersheds Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
Frijoles Canyon																					
	Rio de los Frijoles at Bandelier (E350)	RCRA operating permit specifies annual sampling and analysis at this location.	Base flow	S	S		S	S	S	S			A		S	S		S	A	S	S
	Frijoles at Rio Grande	Perimeter station for LANL	Base flow	A	A		A	A	A	A			A		A	A		A	A	S	A

[a] Sampling frequency: C = continuous; Q= quarterly (4 times/year at set time periods); S= semiannual (2 times/year at set time periods); A = annual (one time a year);
Continuous monitoring for groundwater refers to the measurement of groundwater levels by a transducer placed in a well and programmed to collect groundwater-level measurements at highly frequent intervals (e.g., every 60 minutes daily throughout the year). Continuous stream-flow monitoring refers to the measurement of stream flow by a base-flow stream gage that is programmed to collect stream-flow measurements at highly frequent intervals.

[b] Semi annual sampling for select base flow, springs, intermediate, and regional groundwater is defined as one full analyte suite list and one target analyte list that includes the following: perchlorate, nitrate+nitrite (as nitrogen), low level tritium, general chemistry, gross alpha, gross beta, strontium-90 and isotopic uranium, Sampling frequency for wells undergoing characterization sampling is generally comprehensive with full suite analysis.

[c] The field preparation for all samples is non-filtered and filtered for samples to be analyzed for general inorganics (excluding anions), and metals. Anions and perchlorate samples will be filtered only. Samples collected for radionuclide analysis will be filtered and non-filtered for all water media, excluding tritium which is non-filtered only. Organic constituents are non-filtered for all water media. Stable isotope samples are non filtered. Hexavalent chromium may be filtered or non filtered. Field parameters pH, turbidity (Trb), specific conductance (SC), dissolved oxygen (DO), and temperature (T) will be measured for all samples. Oxidation reduction potential (ORP) will be measured if a flow through cell is used for parameter measurement

[d] Location differs from Table XII-5 due to duplication of wells, scheduled for abandonment, no historical contamination, redundant locations, or other reasons. See supplemental information in the watershed sections of the document and Appendix E for explanation and justification.

[dro] DRO (diesel range organics) will be analyzed by EPA Method 8015 modified.

[e] Rad (radiological)suite includes gross alpha, gross beta, isotopic uranium, strontium-90, low level tritium.

[f] General inorganic analytes include major ions, TDS, trace metals-trace elements; trace anions, silica, nitrogen species, TKN, low-level perchlorate (by LCMS/MS), total organic carbon; and TSS in base flow samples.

[g] Metals analysis includes the 23 TAL (target analyte list) metals, plus total cyanide and molybdenum where specified. Analyses of trace elements and metals will be the same as in the Environmental Surveillance Program (2001 and past years) plus additional analytes.

[h] VOCs (volatile organic compounds) will be analyzed by EPA methods 8260B.

[HMX] Designates analysis for explosive constituents hexahydro-1-nitro-3, 5-dinitro-1,3,5-trinizine (MNX), hexahydro-1,3-dinitroso-3-nitro-1,3,5-triazine (DNX), and hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX).

[i] PAHs (poly aromatic hydrocarbons) will be analyzed by EPA Method 8310.

[j] PCBs (poly chlorinated biphenols) will be analyzed using EPA Method 8082.

[k] Pesticides will be analyzed by EPA Method 8081A.

[l] SVOCs (semi volatile organic compounds) will be analyzed by EPA methods 8270C.

[m] Select regional wells (R-wells) contain residual drilling fluids in the aquifer adjacent to screens and produce groundwater samples that are not representative of natural conditions. These impacted wells and their respective screens are included as part of the Interim Monitoring Plan but the analytical suites only include constituents that are not affected by the affect of residual drilling fluids and a suite of constituents used to monitor the degree of impact from residual drilling fluids in the aquifer surrounding the screen (i.e., iron, manganese, sulfate, sulfide, sodium, barium, total organic carbon, and total kjeldahl nitrogen [EES-6 suite]).

[n] Dioxins and furans will be analyzed by EPA Method 1613B or 8290.

7.4.1 Base Flow

Frequency, analytes, and the rationale for base flow monitoring at Ancho at the Rio Grande is presented in Table 7.3-1. The location is shown in Figure 7.3-1.

The screening conducted as described in Section 1.5 identified no metals, general inorganic, or organic constituents above the screening threshold. These results are shown graphically in B.79 through B.81. The screening tables are presented electronically in Ancho Watershed Surface Water files on a CD in Appendix B.

One base flow monitoring point, Ancho at Rio Grande, is sampled in the Ancho Canyon watershed. The Ancho at Rio Grande monitoring station was sampled 6 times from 2000 to 2005. VOCs were sporadically detected in surface water. Acetone, tetryl, chloromethane, and methylene chloride were detected once from 2000 to 2005. Several metals were detected in surface water from the Ancho at Rio Grande monitoring station, but all detections were well below the screening standard used for this report (½ the appropriate standard more than 5 percent of the time). Time series plots indicate that metals concentrations, represented by barium, in surface water are fairly consistent with time (Figure E.7.1). Barium concentrations over a six year period (n=6) range from 26.3 to 30.0 ug/L with a standard deviation of 1.3 ug/L. Cations and anions detected in surface water samples from Ancho at Rio Grande also indicate that there is little, if any, seasonal variability in surface water (Figure E.7.2). These constituents show consistency from 2000 to 2005 (n=6) with chloride concentrations ranging from 2.3 to 2.8 mg/L; potassium concentrations from 1.7 to 2.1 mg/L; calcium concentrations from 12.4 to 15.1 mg/L; and sodium concentrations ranging from 10.4 to 12.2 mg/L. Standard deviations are in most cases less then 1 mg/L indicating little variability or little affect from seasonal variability.

Semiannual monitoring is recommended under the Interim Monitoring Plan for the following reasons. The base flow station in the Ancho Canyon watershed shows no apparent impact from Laboratory activities conducted at TAs within and around the Ancho Canyon Watershed. Concentrations of inorganic constituents (cation and anions) and barium, the one metal that was detected consistently for all sampling events, are relatively constant with time. Although the base flow samples were generally collected in September and October, the range of seasonal conditions over six years captures variability in environmental conditions. Base flow will be collected semiannually from Ancho Canyon at one existing monitoring point, Ancho at the Rio Grande.

7.4.2 Alluvial Groundwater

No data is available to evaluate the alluvial groundwater system in the Ancho Canyon watershed. Two locations at TA-39 (39-1120 and 39-1135) were recommended in the 2005 Interim Monitoring Plan notice of deficiency (NOD) and will be included in this Plan. These locations will be checked for groundwater semiannually and samples collected if water is present.

7.4.3 Intermediate Perched Groundwater

The upper screen of R-31 (screen 1) was set in an intermediate perched groundwater that has produced no water. This screen will be checked semiannually and a sample collected if water is present.

7.4.4 Regional Aquifer Groundwater

Sampling locations, frequency, analytes, and the rationale for regional aquifer groundwater monitoring are presented in Table 7.3-1. Locations are shown in Figure 7.3-1.

The screening conducted as described in Section 1.5 identified two metals constituents (iron and manganese) and several organic constituents [Aroclor-1254 bis(2-ethylhexyl)phthalate, and 4,4-DDT] were detected above the threshold. No general inorganic constituents exceeded the threshold. These constituents are shown graphically in Figures B.82 through B.84. The screening tables are presented electronically in Ancho Watershed regional groundwater files on a CD in Appendix B.

Test Wells DT-5A, DT-9, DT-10 and R-31 are regional monitoring wells. A Westbay monitoring system was installed in R-31 and three sample rounds collected before the sampling mechanism malfunctioned. Although R-31 is currently under assessment, it will be included in this Plan. Organic compounds bis 2-ethylhexyl phthalate, and 4,4-DDT were detected above the threshold at R-31. The test wells were sampled 5 to 6 times from 2000 to 2005. VOCs including acetone, acetonitrile, 1,3 dichlorobenzene, 1,4 dichlorobenzene, methylene chloride, and toluene were sporadically detected in Test Wells DT-5A and DT-9; no VOCs were detected in DT-10 (Figure E.7.3). None of the aforementioned organic carbon compounds exceeded the screening threshold rate. No pesticides were detected in the test wells, however, Aroclor 1254, a PCB, was detected once in Test Well DT-9 at a concentration of 0.44 µg/L. Explosive compounds are not present in Test Wells DT-5A, DT-9, and DT-10 or R-31. Several metals were detected in Test Wells DT-5A, DT-9, and DT-10, but all detections were well below screening thresholds. Cations and anions detected in ground water samples from Ancho Canyon monitoring wells indicate that there is little, if any, seasonal variability in ground water (Figure E.7.4). In addition, time series plots of metals, represented by barium in the test wells, show that metals in groundwater are consistent with time (Figure E.7.5).

A semiannual monitoring schedule is recommended for regional groundwater in the Ancho watershed for the following reasons. The regional aquifer system in the Ancho Canyon watershed shows little or no apparent impact from Laboratory activities conducted at TAs within and around the Ancho Canyon Watershed. The analytical data indicate that VOC detections in Ancho Canyon monitoring wells are sporadic; Aroclor 1254, a PCB, was only detected once in Test Well DT-9; no pesticides were detected in ground water samples collected from Ancho Canyon monitoring wells; and concentrations of inorganic constituents (cations and anions), are relatively constant with time. The concentrations of these constituents do not show trends that correspond with seasonal variability of precipitation and infiltration; therefore, a more aggressive monitoring frequency is not expected to yield data substantially different from what has already been collected. In addition, groundwater flow in the regional aquifer occurs at a sufficiently slow rate, annual sampling will capture any water quality changes. Therefore, this Plan recommends that regional Test Wells DT-5A, DT-9, DT-10, and well R-31will be monitored semiannually.

7.5 Springs

Ancho Canyon

Ancho Spring is discussed in Section 8, White Rock Canyon.

Chaquehui Canyon

There are no base flow or groundwater sampling locations within Chaquehui Canyon. Chaquehui Canyon Springs are described in Section 8, White Rock Canyon.

Frijoles Canyon

Locations in Frijoles Canyon are for the most part remote from potential contaminant sources and serve as boundary or water supply monitoring points. Sampling locations in Frijoles Canyon are for base flow only with no groundwater locations included in the Interim Plan. The three-decade water quality record for base flow in this area shows no substantial changes or Laboratory contaminants.

Water quality monitoring over several decades in the Frijoles Canyon watershed shows no impact exceeding screening criteria from Laboratory sources.

7.5.1 Base Flow

Sampling locations, frequency, analytes, and the rationale for regional base flow monitoring are presented in Table 7.3-1. Locations are shown in Figures 7.3-1 and 8.3-1.

The screening conducted as described in Section 1.5 identified one metal constituent (selenium), one general inorganic constituent (cyanide), and one organic constituent [bis(2-ethylhexyl)phthalate, a contaminant associated with the analytical process] were detected above the threshold. These constituents are shown graphically in Figures B.85 through 87. The screening tables are presented electronically in Frijoles Watershed Surface Water files on a CD in Appendix B.

The stream in Frijoles Canyon serves as a boundary monitoring point for the Laboratory. Annual or semiannual monitoring maintains a record of any impact the Laboratory might have on water quality in Bandelier National Monument.

Base flow in Frijoles Canyon is not near any potential Laboratory sources of contaminants. Flow in Frijoles Canyon is perennial. Base flow will be monitored semiannually at the gaging station Rio de los Frijoles at Bandelier (E350) and annually in the stream just above the Rio Grande.

8.0 WHITE ROCK CANYON

8.1 Introduction

The White Rock Canyon springs are located along the Rio Grande at the eastern border of the Laboratory and on Los Alamos County and San Ildefonso Pueblo lands (Figure 1.2-1). The springs serve as monitoring points to detect possible discharge of contaminated groundwater from beneath the Laboratory into the Rio Grande.

8.2 Background

In the southern portion of the canyon tritium operations took place at TA-33 that borders the Rio Grande to the east. The "RFI Work Plan for OU 1122" (LANL 1992, 07671) describes environmental concerns at TA-33. To the north of TA-33 lies TA-70, a buffer area where no Laboratory activities have occurred. Adjoining TA-70 to the north is low- to moderate-density residential areas in White Rock a mix of private property and Los Alamos County land. A municipal sanitary treatment plant discharges effluent into Mortandad Canyon just above the river at the northern county boundary. San Ildefonso Pueblo property borders Los Alamos County on the north; this land is undeveloped. San Ildefonso Pueblo operates numerous water supply wells on both sides of the Rio Grande, and the City of Santa Fe operates the Buckman well field on the east side of the Rio Grande across from White Rock. Table A-6 in Appendix A summarizes the conceptual model for the White Rock Canyon watershed.

8.3 Monitoring Objectives

The monitoring objectives for the White Rock Canyon springs are to track the trend of chemical constituents including contaminants, in groundwater. Groundwater from the regional aquifer beneath the Pajarito Plateau discharges at the springs creating a point of exposure for humans and animals. Therefore, the springs will continue to be monitored to detect any impact from Laboratory operations.

The White Rock springs are one of the most intensely monitored locations in or adjacent to the Laboratory. Sixty percent of the springs have had over 25 sample collection rounds from 1980 to 2005. An analysis of the data shows that there is stability of chemical parameters in the twenty-five-year sampling record of White Rock Canyon Springs. The discussion presented below provides a foundation for recommending annual monitoring at the majority of the springs and semiannual monitoring at the remaining springs. This schedule will enable adequate monitoring of major ion chemistry to ensure relative stability as well as identification of any contamination.

8.4 Scope of Activities

Locations in White Rock Canyon are for the most part remote from potential contaminant sources and serve as boundary monitoring points. Most locations in White Rock Canyon sample the regional aquifer, where flow rates are low and little variation occurs beyond cyclical annual changes. In addition, a twenty-five-year record of water quality data for the springs shows little l change. Figure 8.3-1 shows the White Rock Canyon, the Laboratory boundary, and sampling locations.

Water quality monitoring over several decades in the White Rock Canyon watershed shows little or no impact from Laboratory sources. The analytes selected for monitoring are chosen based on data screening against applicable standards (threshold rate), on possible source terms from Laboratory activities, and the need to conduct annual monitoring for a broad range of analytes to determine trends.

8.4.1 Base Flow

Base flow locations entering White Rock Canyon are discussed in their respective watersheds.

8.4.2 Springs

The springs in White Rock Canyon are largely remote from potential contamination and serve as boundary monitoring points for Laboratory impact. Little chemical variation occurs in the White Rock Canyon springs, which, along with chemical similarities, suggests that much of the groundwater is derived from the regional aquifer. Sampling locations, frequency, analytes, and the rationale for monitoring springs are presented in Table 8.3-1. Locations are shown in Figure 8.3-1. Geologic Units, groundwater sources, and estimated flow data for the springs in White Rock Canyon can be found in Appendix D, Table D-4.

The screening conducted as described in Section 1.5 identified several metals constituents (arsenic, iron, and manganese) and one organic constituent [bis(2-ethylhexyl)phthalate] were detected above the screening threshold. These constituents are shown graphically in Figures B.88 through B.90. The screening tables are presented electronically in White Rock Canyon Springs files on a CD in Appendix B. A detailed discussion of chemical constituents identified by the data screen to justify analytical constituents and suites and monitoring frequency is presented below.

Iron and manganese were both identified to be above the screening threshold. Spring 10 and Spring 2 each had a single water sample with manganese concentration above the screening threshold (filtered and unfiltered respectively). In unfiltered samples iron was detected above the screening threshold. The detections of iron were at three different sampling locations (Spring 1, Spring 2, and Spring 3). Both metals are naturally occurring and most likely derived from the dissolution of silicate minerals common beneath the Pajarito Plateau (LANL, 2005a; LANL 2005b). Considering that manganese and iron have natural sources and that each detection occurs at different locations, these elevated concentrations are likely a result of natural geochemical conditions rather than a laboratory influenced contamination.

Selenium was detected above one-half the screening threshold once in the series of filtered samples and four times in unfiltered samples. According to the 2004 Environmental Surveillance Report (LANL, 2005a) selenium is of natural origin and is detected across the laboratory, more commonly in groundwater with a long residence time. After the recent Cerro Grande fire there was a substantial increase in selenium concentrations in surface water as a result of ash content in the water. Since the fire, the concentrations have decreased. All selenium results identified by the statistical screen were at different locations and on different sampling dates.

Review of all the White Rock spring data from 1980 to 2005 revealed that perchlorate was twice detected above the screening threshold. However, both results were analyzed using a method that has since been replaced, and are documented to result from analyses that did not include all steps possible in that method. The two values (8.49 ug/L and 6.62 ug/L) are from different sampling locations (Spring 4 and Spring 4B respectively). The older method (EPA:314.0, Ion Chromatography (IC), with detection limit of 4 ug/L) has been superseded by a method with a much lower detection limit (SW-846:8321A(M)); liquid chromatography/mass spectrometry/mass spectrometry, having detection limit 0.05 ug/L) (LANL, 2004). Aside from the two samples identified in the screening, only one additional sample was detected above this background threshold (1.29 ug/L in Spring 5, also an older suspect IC value).

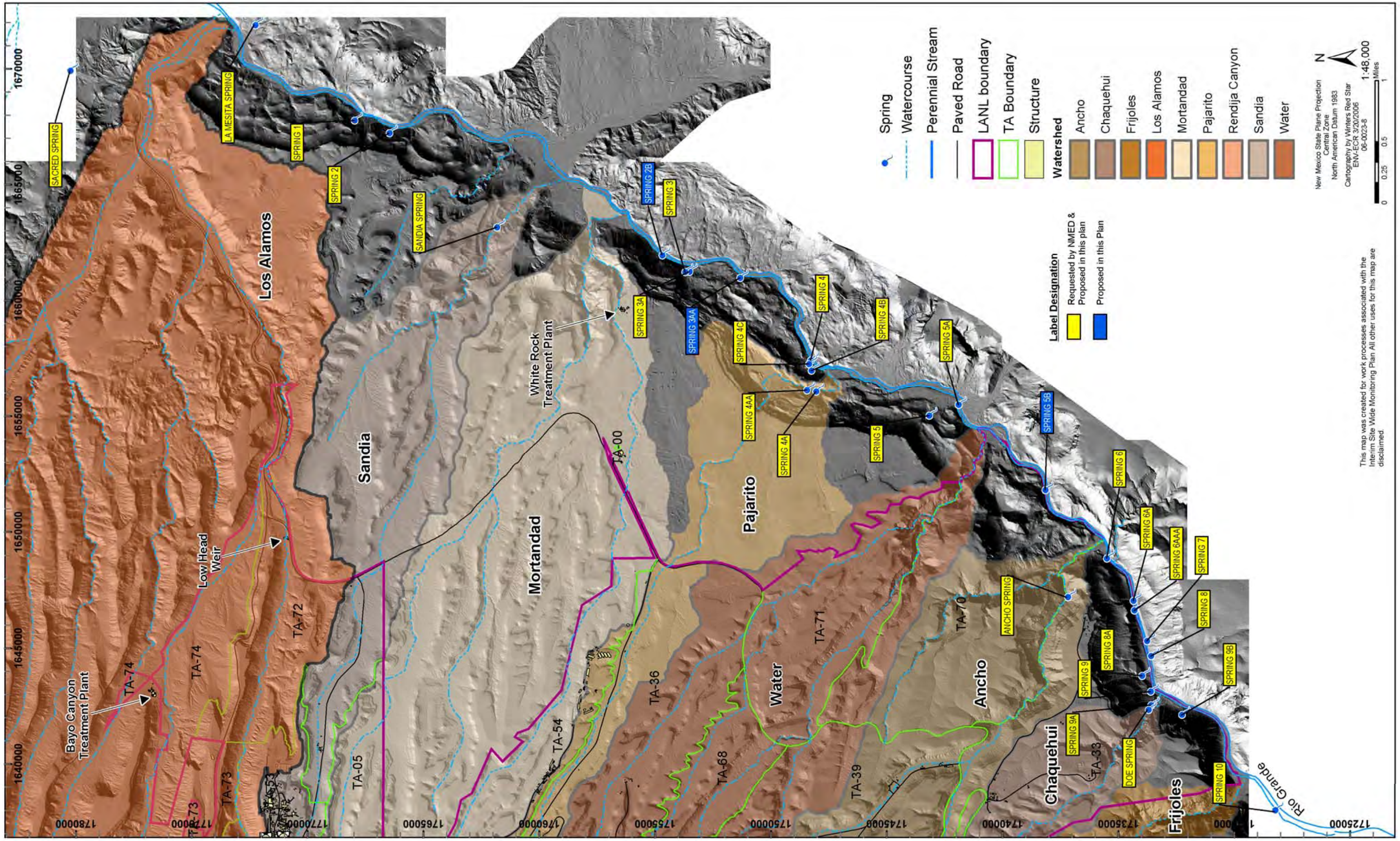

Figure 8.3-1. White Rock Canyon

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Table 8.3-1
White Rock Canyon and Rio Grande Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
White Rock Canyon and Rio Grande																					
Sacred	Sacred Spring	Offsite spring, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
La Mesita	La Mesita Spring	White Rock Canyon spring group IV, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
1	Spring 1	White Rock Canyon spring group III, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
2	Spring 2	White Rock Canyon spring group III, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}		A		S	S		S	A	S	A
Sandia	Sandia Spring (new location)	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
Spring 2B	Spring 2B	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
3	Spring 3	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}		A		S	S		S	A	S	A
3A	Spring 3A	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}		A		S	S		S	A	S	A
	Spring 3AA	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
4	Spring 4	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}		A		S	S		S	A	S	A
4B	Spring 4B	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}		A		S	S		S	A	S	A
4C	Spring 4C	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}		A		S	S		S	A	S	A
4A	Spring 4A	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}	A	A		S	S		S	A	S	A
4AA	Spring 4AA	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}	A	A		S	S		S	A	S	A
5	Spring 5	White Rock Canyon spring group I, monitors regional aquifer downgradient from LANL.	Spring	S	S		S	S	A	A	S^{HMX}	A	A		S	S		S	A	S	A

Table 8.3-1
White Rock Canyon and Rio Grande Watershed Interim Monitoring Plan

Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
					TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
White Rock Canyon and Rio Grande																					
Ancho[d]	Ancho Spring	Have identified new spring in the immediate vicinity.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
5A	Spring 5A	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}	A	A		A	A		A	A	A	A
	Spring 5B	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}	A	A		A	A		A	A	A	A
6	Spring 6	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}	A	A		A	A		A	A	A	A
6A	Spring 6A	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
6AAA	Spring 6AAA	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
7	Spring 7	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
8	Spring 8	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
8A	Spring 8A	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
9	Spring 9	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
9A	Spring 9A	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
9B[d]	Spring 9B[d]	Low flow, unreliable yield, better locations in the immediate vicinity.	Spring	A	A		A	A	A	A	A^{HMX}		A		A	A		A	A	A	A
Doe	Doe Spring	White Rock Canyon spring group II, monitors regional aquifer downgradient from LANL.	Spring	A	A		A	A	A	A	A^{HMX}		A	A	A	A		A	A	A	A

Table 8.3-1

White Rock Canyon and Rio Grande Watershed Interim Monitoring Plan

					Analytical Suites																
					Metals		Organics						Radionuclides			General Inorganics					Field Data
Consent Order Table XII-5 and Notice of Disapproval	Interim Monitoring	Rationale for Selection of Locations	Surface-water Body or Source Aquifer	Water level or Flow	TAL Metals + Cyanide & Mo	Hexavalent Chromium	VOC +TICs	SVOC +TICs	Pesticides	PCB	HEXP	Dioxins/Furans	RAD	Tritium	Low Level Tritium	Gen Inorganics	EES6 Screening Suite	Low Level Perchlorate (LCMSMS)	Stable Isotopes	Suspended Sediment Concentration	DO,ORP, pH,SC,T,Trb
White Rock Canyon and Rio Grande																					
10	Spring 10	Adjacent to Rio, too little flow to sample.	Spring	A	A		A	A	A	A	HMX		A		A	A		A	A	A	A

[a] Sampling frequency: C = continuous; Q= quarterly (4 times/year at set time periods); S= semiannual (2 times/year at set time periods); A = annual (one time a year); Continuous monitoring for groundwater refers to the measurement of groundwater levels by a transducer placed in a well and programmed to collect groundwater-level measurements at highly frequent intervals (e.g., every 60 minutes daily throughout the year). Continuous stream-flow monitoring refers to the measurement of stream flow by a base-flow stream gage that is programmed to collect stream-flow measurements at highly frequent intervals.

[b] Semi annual sampling for select base flow, springs, intermediate, and regional groundwater is defined as one full analyte suite list and one target analyte list that includes the following: perchlorate, nitrate+nitrite (as nitrogen), low level tritium, general chemistry, gross alpha, gross beta, strontium-90 and isotopic uranium, Sampling frequency for wells undergoing characterization sampling is generally comprehensive with full suite analysis.

[c] The field preparation for all samples is non-filtered and filtered for samples to be analyzed for general inorganics (excluding anions), and metals. Anions and perchlorate samples will be filtered only. Samples collected for radionuclide analysis will be filtered and non-filtered for all water media, excluding tritium which is non-filtered only. Organic constituents are non-filtered for all water media. Stable isotope samples are non filtered. Hexavalent chromium may be filtered or non filtered. Field parameters pH, turbidity (Trb), specific conductance (SC), dissolved oxygen (DO), and temperature (T) will be measured for all samples. Oxidation reduction potential (ORP) will be measured if a flow through cell is used for parameter measurement

[d] Location differs from Table XII-5 due to duplication of wells, scheduled for abandonment, no historical contamination, redundant locations, or other reasons. See supplemental information in the watershed sections of the document and Appendix E for explanation and justification.

[dro] DRO (diesel range organics) will be analyzed by EPA Method 8015 modified.

[e] Rad (radiological)suite includes gross alpha, gross beta, isotopic uranium, strontium-90, low level tritium.

[f] General inorganic analytes include major ions, TDS, trace metals-trace elements; trace anions, silica, nitrogen species, TKN, low-level perchlorate (by LCMS/MS), total organic carbon; and TSS in base flow samples.

[g] Metals analysis includes the 23 TAL (target analyte list) metals, plus total cyanide and molybdenum where specified. Analyses of trace elements and metals will be the same as in the Environmental Surveillance Program (2001 and past years) plus additional analytes.

[h] VOCs (volatile organic compounds) will be analyzed by EPA methods 8260B.

[HMX] Designates analysis for explosive constituents hexahydro-1-nitro-3, 5-dinitro-1,3,5-trinizine (MNX), hexahydro-1,3-dinitroso-3-nitro-1,3,5-triazine (DNX), and hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX).

[i] PAHs (poly aromatic hydrocarbons) will be analyzed by EPA Method 8310.

[j] PCBs (poly chlorinated biphenols) will be analyzed using EPA Method 8082.

[k] Pesticides will be analyzed by EPA Method 8081A.

[l] SVOCs (semi volatile organic compounds) will be analyzed by EPA methods 8270C.

[m] Select regional wells (R-wells) contain residual drilling fluids in the aquifer adjacent to screens and produce groundwater samples that are not representative of natural conditions. These impacted wells and their respective screens are included as part of the Interim Monitoring Plan but the analytical suites only include constituents that are not affected by the affect of residual drilling fluids and a suite of constituents used to monitor the degree of impact from residual drilling fluids in the aquifer surrounding the screen (i.e., iron, manganese, sulfate, sulfide, sodium, barium, total organic carbon, and total kjeldahl nitrogen [EES-6 suite]).

[n] Dioxins and furans will be analyzed by EPA Method 1613B or 8290.

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Perchlorate concentrations measured with LC/MS/MS at a wide range of sites by the NMED Oversight Bureau range from non-detects (<0.05 ug/L) to 0.85 ug/L (LANL, 2005a). The NMED has determined that this data set suggests a background reference value of 0.60 ug/L. Springs with more recent perchlorate concentrations above this background reference value (Spring 4 and Spring 4B) will be sampled on a semiannual basis under this Plan.

Naturally occurring fluoride was detected above one-half the screening threshold in Spring 2 on three separate sampling dates. Arsenic (of natural origin) has been detected at Spring 2 above the screening threshold twice in filtered samples, and once in unfiltered samples.

Time series plots of potential LANL contaminants from White Rock springs results reveal little information because concentrations tend to be near or below analytic detection limits. However, major anion or cation concentrations viewed through time allow for analysis of long-term trends that provide information on chemical variability of groundwater discharging from the springs on the eastern boundary of the Laboratory.

Table E.8.1 (Appendix E) shows analytical suites and sample collection dates and Table E.8.2 (Appendix E) summarizes the frequency of sample collection in White Rock Canyon over the past 25 years. The consistency in the long term (1980 to present) monitoring record indicates that a robust data set exists for most of the locations in White Rock Canyon. Naturally occurring chemical constituents such as chloride and total dissolved solids (TDS) show little variability and no apparent trends in the long-term record indicating that the chemical composition of groundwater has been relatively stable over the past 25 years (Figures E.8.1 and E.8.2). The variability in chemical data may be attributed to analytical error or some mixing with groundwater from other sources. For example, there appears to be a small increase in chloride concentration in 1981 and 1996 as well as a small decrease in 1984 across all sites (Figures E.8.3 and E.8.4). Although difficult to explain, this variation does not represent a consistent chemical variation throughout all spring locations.

Elevated nitrate concentrations, if present, would indicate anthropogenic influence, in particular sewage effluent or Laboratory processes. Figures E.8.5 through E.8.7 show representative nitrate (as N) trends for the White Rock Canyon Springs. The majority of the springs show no significant trend with the majority of the values below 1 mg/L, much lower than the 10 mg/L nitrate (as N) EPA maximum contaminant level (MCL). Nitrate concentrations in Spring 5, Spring 4, Spring 3A, and Spring 3 appear to increase from roughly 0.5 mg/L to 1 mg/L over the twenty-five year record (Figure E.8.7). On the east side of the Rio Grande, La Mesita Spring shows higher nitrate values than other springs, although no appreciable trend is identified.

Trends in sulfate concentration can also be indicative of chemical variability in groundwater chemistry and of anthropogenic influence. Figures E.8.8 through E.8.10 show sulfate data representative of the White Rock Canyon Springs. All sulfate concentrations are well below the EPA MCL of 250 mg/L. Sulfate concentrations appear to be decreasing over time in Spring 1, Spring 2, Spring 4A, and Spring 4. This is the only appreciable trend identified in the sulfate data. The sulfate values are decreasing and the highest values are approximately 1/10th the screening threshold, suggesting that annual sampling is sufficient to capture hydrologic variability.

A discussion of recent developments in analytical techniques used to detect perchlorate is presented above. All data obtained using the LC/MS/MS technique are presented in Table E.8.3 (Appendix E). While the dataset is not robust enough to identify long-term trends, all values are within the range of concentrations measured in the NMED study (non-detect to 0.85 ug/L).

Stability of chemical parameters in the twenty-five year sampling record of White Rock Canyon Springs suggests little annual variability in the chemical composition of groundwater. The locations with perchlorate concentrations above the NMED reference background of 0.60 ug/L will be sampled on a semiannual schedule (Spring 4 and Spring 4B). Nearby Springs 4A, 4AA, and 4C will also be sampled semiannually.

In addition, automated flow measurement stations will be installed at select springs to determine the affect of annual variability, precipitation, and recharge on spring discharge.

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9.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the ENV-ERS Program Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the ENV-ERS Program master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the ENV-ERS Program. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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Appendix A

Watershed Conceptual Models

Appendix A
Tables

Table A-1
Los Alamos Canyon and Pueblo Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
Surface Water	Flow	Perennial flow originates from springs and interflow through hillslope soils in the upper watershed. The downcanyon extent of perennial flow is variable, but generally terminates in the upper portions of Los Alamos Canyon west of TA-41. The magnitude of snowmelt runoff is the predominant factor affecting the duration and extent of surface water flow. The remainder of upper Los Alamos Canyon down to its confluence with Pueblo Canyon has intermittent surface water flow. Segments that have persistent flow for most of the year or during periods of extended snowmelt runoff sometimes exhibit interrupted flow. DP Canyon is ephemeral, although some persistent surface water is sometimes observed in small, shallow bedrock pools, generally less than a few meters across, which are filled by runoff originating in the southeastern portion of the Los Alamos townsite. Flow sometimes exists for very short distances in Reach DP-2 because of discharge of groundwater stored within alluvium, and immediately above, in Reach DP-4, where groundwater discharges at DP Spring.	Surface water flow in upper Pueblo and Acid Canyons is generally ephemeral with runoff events caused by summer storms. Locally persistent surface water flow in the upper canyon is associated with townsite runoff and snowmelt runoff. Gage data (E055) are available for 2002 and 2003, showing that surface water rarely flows through the length of upper Pueblo Canyon; only 14 days of this flow occurred in 2002. In the South Fork of Acid Canyon, the channel is bedrock dominated, and storm water runoff and periodic releases of water from the Walkup Center swimming facility result in small pools of water that persist for several weeks or even months in narrow and confined and/or shaded canyon areas. In lower Pueblo Canyon, effluent-dependent flow is present for about 3 km in lower Pueblo Canyon from the discharge from the Los Alamos County Wastewater Treatment Plant (WWTP). The flow extends to the confluence with Los Alamos Canyon. In water year 2002, gaging station E060 below the WWTP measured 357 days of flow (Shaull et al. 2002, 85499).	Surface water flow in lower Los Alamos Canyon is from Basalt Spring and a lesser amount from LA Spring. The flow from Basalt Spring and the downcanyon extent of surface water flow depends on the amount of water that is discharged from the WWTP. At times of high discharge, flow can be continuous for approximately 7.5 km to the confluence with the Rio Grande. During periods of low discharge, flow may only extend from 1 to 3 km. Within approximately 1–2 km of the confluence with the Rio Grande, surface water flow is common and believed to be related to discharge of deep groundwater to the surface.

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
Surface Water (cont.)	Quality	Key contaminants in upper Los Alamos Canyon surface water include nitrate, polycyclic aromatic hydrocarbons (PAHs), strontium-90, and plutonium-239/240. The plutonium-239 is related to outfalls (likely Hillsides 137 and 138) in former TA-01. Strontium-90 originated from the outfall at TA-21, which ceased operation in 1986. PAHs may come from automobile exhaust and other urban combustion sources.	Key contaminants in Acid Canyon surface water include PAHs (e.g., benzo_a_pyrene, dibenz_a_h_anthracene), and radionuclides (plutonium-239/240 and strontium-90). The PAHs are believed to be associated with runoff from developed areas within the Los Alamos townsite. The radionuclides were detected in bedrock pools in the South Fork of Acid Canyon and are consistent with contaminants found in sediment within the canyon from historical releases from TA-45. The radionuclide contamination generally does not extend beyond the Acid/Pueblo Canyon confluence in detectable concentrations, with the exception of plutonium-239/240 in unfiltered samples. Surface water in Pueblo Canyon above the confluence with Acid Canyon also has PAHs that are considered to have a source in townsite runoff. Surface water in Pueblo Canyon below the confluence with Acid Canyon shows organic contaminants (PAHs) that are both likely from townsite, national forest, or Cerro Grande fire sources. Radionuclides include plutonium-239/240.	Key contaminants in surface water and springs in lower Los Alamos Canyon include PAHs (benzo_k_fluoranthene), and, only from unfiltered surface water, strontium-90. Strontium-90 could be from either Los Alamos Canyon or Pueblo Canyon, but based on estimated inventories of strontium-90, it is most likely associated with Los Alamos Canyon, specifically Solid Waste Management Unit (SWMU) 21-011(k).

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
Surface Water (cont.)	Quality (cont.)	Key contaminants in DP Canyon surface water and springs include strontium-90. The radionuclides are contaminants only for the unfiltered samples indicating the potential that the detections are related to the presence of suspended sediment in the samples. DP Spring consistently shows elevated strontium-90 concentrations related to surface water and alluvial groundwater discharge from Reach DP-2 where strontium-90 is present throughout the sediment due to historical releases from SWMU 21-011(k).		
Springs	Flow	Discharge at DP Spring is highly variable, generally ranging from 0 to less than 1 gal./min, and has been observed to respond rapidly to storm water runoff from upper DP Canyon. Surface water flow generally extends for less than 50 ft downcanyon from the point where spring flow joins the stream channel.	There are no springs in Pueblo Canyon.	Basalt Spring is recharged by water from the WWTP in Pueblo Canyon. It has variable estimated discharge rates ranging from 1 to 10 gal./min. LA Spring discharges along the south slope of the canyon approximately 300 m downstream of Basalt Spring.
	Quality	Strontium-90 and gross beta are present above applicable standards.		Nitrate is occasionally present above regulatory standards.

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
Alluvial Groundwater	Extent/Hydrology	Alluvial saturation extends from west of the Laboratory boundary downcanyon for variable distances. During dry years, and especially during years with limited spring snowmelt runoff, saturation may not extend to LAO-4c. Alluvial monitoring wells as far down upper Los Alamos Canyon as LAO-4.5c had water for sampling for the first three of four RFI sampling rounds conducted in 2001 and 2002. LAO-6a, the most downcanyon alluvial monitoring well in upper Los Alamos Canyon, only had water sufficient for sampling during the round of sampling conducted in the spring of 2001. Monitoring well LAO-B, located on U.S. Forest Service (USFS) land approximately 0.7 km west of the Laboratory boundary, shows very consistent water levels throughout the year with little interannual variability.	Alluvial groundwater occurs in two distinct modes. Wells located upcanyon of the WWTP show groundwater level variations closely tied to precipitation and associated flood events and to winter and spring snowmelt. The extent of saturation is seasonally variable, but often extends downcanyon to the portion of the canyon where effluent from the Bayo WWTP is discharged into the canyon. Below the WWTP, saturated conditions occur year-round, but the degree of saturation is variable because of changes in runoff and the volume of effluent released throughout the year. The variation in water level elevations downcanyon of the WWTP is controlled primarily by seasonal routing of effluent for uses such as irrigation for the municipal golf course.	Groundwater saturation in most of lower Los Alamos Canyon down to the area around LLAO-4 is related to infiltration of surface water discharged from Basalt Spring, which is hydrologically linked to surface water discharged from the Bayo WWTP into Pueblo Canyon (LANL 1995, 50290). Groundwater levels in the upper portion of lower Los Alamos Canyon are highly variable and are related to seasonal variations in discharge rates from the WWTP and to floods from upper Los Alamos and Pueblo Canyons. In the lowermost portion of lower Los Alamos Canyon, the water level record from LLAO-5 shows relatively constant saturation with much less variability than is exhibited in the upper portions of lower Los Alamos Canyon. The geochemistry of groundwater from LLAO-5 indicates that alluvial groundwater in the lower-most portion of the watershed represents mixing of waters from Los Alamos Canyon and regional groundwater discharging to the Rio Grande.

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
	Extent/Hydrology (cont.)	Further downcanyon, alluvial groundwater levels show rapid response to heavy precipitation in the summer and fall. Water levels also rise in response to late winter and early spring snow melt runoff. This recharge mechanism is not entirely due to infiltration from the stream bed, but may also be related to underflow within the alluvium. In DP Canyon, two separate alluvial saturated zones exist; one in Reach DP-2 and the other in Reach DP-4. In general, groundwater level variations in DP Canyon are directly related to runoff generated in the Los Alamos townsite throughout the year. Alluvial groundwater monitoring wells in Reach DP-2 consistently show some amount of saturation. The second saturated zone is separated from Reach DP-2 by a bedrock-dominated portion of the canyon. Intermittent flow from DP Spring recharges the alluvium in Reach DP-4. This alluvial groundwater is a component of the groundwater observed in well LAO-2 at the confluence of DP and Los Alamos Canyons. Contaminants unique to the portion of upper Los Alamos Canyon above the confluence with DP Canyon (e.g., molybdenum) are detected in LAO-2, indicating that mixing of groundwater from distinct sources occurs in this area.		
	Depth/Thickness			

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
	Quality	Key contaminants in alluvial groundwater above the confluence with DP Canyon include molybdenum, gross beta, and strontium-90. Molybdenum is related to discharge from National Pollutant Discharge Elimination System (NPDES)-permitted outfalls from TA-53 where sodium molybdate was used as a water treatment chemical in cooling towers (ESP 2002, 73876). The use of molybdate has been discontinued. The strontium-90 is related to contamination in a septic leach field east of the Omega West Reactor at TA-02. Below the confluence with DP Canyon the contaminants include strontium-90. Concentrations of strontium-90 in Los Alamos Canyon initially increase below the confluence with DP Canyon indicating that in DP Canyon SWMU 21-011(k) is a more significant source of strontium-90 than is TA-02.	The key contaminants in Pueblo Canyon alluvial groundwater include nitrate from the WWTP.	No contaminants exceed regulatory standards.
	Quality (cont.)	Key alluvial groundwater contaminants in DP Canyon include strontium-90 from SWMU 21-011(k). Strontium-90 has been present in DP Canyon alluvial groundwater for years and concentrations do not show significant decline.		

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
Intermediate Groundwater	Extent/Hydrology	Intermediate depth perched groundwater beneath Los Alamos Canyon has variable depth and lithology of the saturated zones. Intermediate depth groundwater was encountered near the top of the Puye Formation (below the Guaje Pumice Bed) at approximately 680 ft bgs in R-7 in the Guaje Pumice Bed, at 325 ft in LADP-3, and at 295 ft in LAOI(A)-1.1. Deeper saturation was also encountered at about 317 ft in the Puye Formation in borehole LAOI(A)-1.1 within the Guaje Pumice Bed. Intermediate depth perched groundwater was also encountered during drilling of supply well O-4 near the confluence with DP Canyon (Stoker et al. 1992, 58718). Zones of intermediate depth perched groundwater occur within Cerros del Rio Basalts at approximately 179 ft and 264 ft at well R-9i in the lower portion of upper Los Alamos Canyon.	Intermediate depth groundwater occurs beneath Pueblo Canyon. At Test Well 2A, in the middle portion of Pueblo Canyon, the perched groundwater occurs within the Puye Formation at a depth of approximately 120 ft bgs. In lower Pueblo Canyon, in TW-1A and POI-4 perched groundwater was encountered within Cerros del Rio basalts at a depth of about 188 ft bgs. This intermediate perched zone may be one source of water contributing to the flow from Basalt Spring in Los Alamos Canyon.	.
	Depth/Thickness			
	Quality	No contaminants exceed regulatory standards.	No contaminants exceed regulatory standards.	
Regional Aquifer	Depth/Hydrology	Depth to the regional aquifer in upper Los Alamos Canyon is about 900 ft bgs in the Puye Formation at R-7 in the upper portion of the canyon and 688 ft bgs in Santa Fe Group basalts at R-9 in the lower portion of upper Los Alamos Canyon (LANL 2002, 72717, LANL 2000, 71250).	Depth to the regional aquifer is known from several locations in Pueblo Canyon and ranges from approximately 890 ft bgs at R-2 in upper Pueblo Canyon to approximately 650 ft bgs at TW-1 in lower Pueblo Canyon. Historical data indicates that recharge pathways between alluvial groundwater and deeper zones of saturation exist beneath Pueblo Canyon. A discussion of the data is presented below.	Discussions of regional groundwater beneath lower Los Alamos Canyon are presented in a section of the monitoring plan that addresses San Ildefonso Pueblo and White Rock Canyon.
	Quality	No contaminants exceed regulatory standards.	No contaminants exceed regulatory standards.	
Contaminants	Potential Sources	TA-01, TA-02, TA-41, TA-21	TA-00, TA-01 and TA-45	

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
	Type	TA-01 Hillsides 137, 138, and 140 received discharges from septic tank outfalls from 1943 until the late 1950s. Radionuclides are the primary contaminants at these hillside sites, although some metals contamination is also present. TA-02 housed a series of research nuclear reactors, including the Omega West Reactor, which was a source of tritium releases into alluvial groundwater. Other SWMUs at TA-02 include leach fields for water boiler reactors. Cesium-137 and strontium-90 are the primary contaminants associated with the leach fields, and strontium-90 has historically been detected in alluvial groundwater monitoring wells downcanyon of the site. TA-41 was used for weapons development and long-term studies of weapon subsystems. The primary contaminant sources are a septic system and a sewage treatment plant. Initial data from these SWMUs indicate radionuclides at levels above background, but characterization of TA-41 is incomplete. TA-21 was the site of a plutonium processing plant and polonium and tritium research laboratories. Outfalls were the primary source of radionuclide contaminants in DP and upper Los Alamos Canyons. Radionuclides, particularly cesium-137 and strontium-90, are the primary contaminants discharged from this outfall.		

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
	Type (cont.)	TA-53 includes a proton accelerator and associated experimental and support buildings used for research with subatomic particles; it is the current site of the Los Alamos Neutron Science Center (LANSCE) (LANL 1994, 34756). The accelerator became fully operational in 1974. Occasional releases occurred from three surface impoundments at the east end of TA-53, referred to as consolidated unit 53-002(a)-99. These releases have contributed contamination to an unnamed tributary drainage to Los Alamos Canyon. The impoundments received sanitary, radioactive, and industrial wastewater from various TA-53 buildings as well as septic tank sludge from other Laboratory buildings. The northern impoundments were active from the early 1970s until 1993. The southern impoundment was active from 1985 until 1998. Inorganic chemicals, organic chemicals, and radionuclide contaminants have been identified at the impoundments and in the drainage (LANL 1998, 58841; LANL 2004).		

Table A-1 (continued)

Conceptual Model Element	Characteristic	Upper Los Alamos Canyon (including DP Canyon)	Pueblo Canyon (including Acid Canyon)	Lower Los Alamos Canyon
	Type (cont.)	SWMU 21-018(a), Material Disposal Area (MDA) V received liquid waste effluent from laundry operations and includes three absorption beds on the south side of DP Mesa that sometimes overflowed into Los Alamos Canyon (LANL 1991, 07529; LANL 1996, 54969). Sediment sampling in 1946 documented that plutonium from this source was entering the main channel in Los Alamos Canyon (Kingsley 1947, 04186). Additional outfalls that discharged off the south rim of DP Mesa include those from SWMUs 21-023(c), 21-024(b), 21-024(c), 21-024(i), and 21-027(a) (LANL 1991, 07529; LANL 1995, 52350). SWMU 21-029, the DP Tank Farm, was a fuel distribution station with above ground and underground fuel tanks from 1946 to 1985. Diesel range organic (DRO) and gasoline range organic (GRO) hydrocarbon contamination was identified at two areas of bedrock seeps in the DP Canyon channel and observed to periodically form a sheen in surface water adjacent to the site. (LANL 1996, 52270; LANL 2001, 71303; LANL 2001, 73436). The other MDAs at TA-21 are not considered to contribute important releases into the canyons.	Septic tank outfall occurred on the south rim of Acid Canyon in the 1940s and contained plutonium-239/240 and PCBs. Former Pueblo Canyon WWTP operated from 1951 until 1991. Sludge from the Pueblo Canyon WWTP contained metals at levels above background. Former Central WWTP operated from 1947 until 1961. Metals and organic chemicals, including mercury and dichlorodiphenyl-trichloroethane (DDT), were contaminants identified at the outfalls. Outfalls from former TA-01 and former TA-45 were the most significant sources of radionuclide and other contamination in Acid and Pueblo Canyons. TA-45 was the site of the first radioactive liquid waste treatment facility (RLWTF). TA-01 outfalls into Acid Canyon were not treated. Plutonium-239/240 is the primary contaminant, although other radionuclides, metals, and some organic chemicals are also present	

Table A-2
Sandia Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Upper Sandia Canyon (from TA-03 to bottom of State Highway 4 hill, west TA-53)	Middle Sandia Canyon (bottom of Truck Route hill to State Highway 4)	Lower Sandia Canyon (State Highway 4 to Rio Grande)
Surface Water	Flow	Flow is mainly from effluent discharges (about 330,000 gal./day). Flow is perennial for 2 to 2.5 mi from TA-03 (gage E123) to the western edge of TA-53. Intermittent for short reach near bottom of Truck Route hill and stream flow loss pronounced.	Ephemeral at gage stations E124 and E125.	Lower Sandia Canyon is ephemeral except for an intermittent reach of a few hundred yards supported by Sandia Spring approximately 0.5 mile from the Rio Grande.
	Quality	Nitrate is the only contaminant that has occasionally exceeded regulatory standards. Water quality mostly reflects sewage effluent.		
Springs	Name	There are no springs in this reach.	There are no springs in this reach.	Sandia Spring discharges ~1gal./min approximately 0.5 miles from Rio Grande.
	Quality			No contaminants exceed regulatory standards. Contaminant levels at detection or background levels.
Alluvial Groundwater	Extent	No alluvial wells presently in this reach. Alluvial saturation is likely within limited alluvial sediments because of effluent discharges.	Absent in eastern portion of reach. Test drilling in western portion suggests saturation in canyon south of LANSCE, but no alluvial wells are currently located in this portion of the canyon. Several new wells are planned for installation in 2006.	Not known; likely dry except below Sandia Spring.
	Depth/Thickness			
	Quality			

Table A-2 (cont.)

Conceptual Model Element	Characteristic	Upper Sandia Canyon (from TA-03 to bottom of Truck Route hill, west TA-53)	Middle Sandia Canyon (bottom of Truck Route hill to SR-4)	Lower Sandia Canyon (SR-4 to Rio Grande)
Intermediate Groundwater	Extent/Hydrology	No information available. Some intermediate water likely to be present beneath stream channel because of perennial flow conditions.	Lateral extent not certain, however R-11, R-12 and PM-1 encountered an intermediate perched zone. Test drilling suggests limited saturation in Cerro Toledo south of LANSCE at 30 to 60 ft depth.	R-10 and R-10a identified intermediate water in this area.
	Depth/Thickness		Zone in R-12 from 443 to 519 ft depth. Water level stabilized at 424 ft.	Interemediate zone was encountered at approximately 340 ft bgs.
	Quality		No definitive data available.	
Regional Aquifer	Depth/Hydrology	No regional aquifer wells in this reach of canyon.	Penetrated by four wells in this reach: R-12, PM-1, PM-3, and R-11. Encountered at 805 ft in R-12. Higher static water level in PM-1 suggests upward flow near State Highway 4. Large-scale pumping at PM-1 and PM-3 may pull water in from adjacent canyons: Los Alamos or Mortandad.	R-10 and R-10a shows regional groundwater at approximately 671 ft bgs.
	Quality		No contaminants exceed regulatory standards. R-11 shows chromium at approximately 26 ug/L.	
Contaminants	Potential Sources	TA-03 and former TA-20.	TAs-3, 53, -60, -61, and -72, Los Alamos Canyon, Mortandad Canyon	No known surface sources.
	Type	Nitrate, perchlorate, chromium, copper, polychlorinated biphenyls (PCBs) in sediments, high explosives (??) from former TA-20	Tritium, nitrate, perchlorate, chromium, isotopes of uranium and plutonium, lead in surface soils.	

Table A-3
Mortandad Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Description
Surface Water	**Flow**	Mortandad Canyon and its tributaries are ephemeral. With the exception of gaging station E200, which measures flow created by discharge of treated effluent from the TA-50 RLWTF, all other gaging stations measured flow only in response to precipitation. In the period 1995–2002, gage E200 measured flow 64% of the year, where the other gages (E202, E203, E204) measured no flow. Operating NPDES-permitted outfalls associated with Mortandad Canyon include 051 associated with the TA-50 RLWTF; 03A-021 associated with the CMR Laboratory at TA-03; 03A-022 associated with the Sigma Building at TA-03; 03A-045 associated with the Rad Chem Laboratory at TA-48; 03A-160 associated with Antares Target Hall at TA-35; 03A-181 associated with a utility building at TA-55; and 04A-166 associated with water supply well Pajarito Mesa #5. Cañada del Buey within the Laboratory boundary is ephemeral in character, based on flow data from three gages; E218, E230, and E225. In the period from 1995 to 2002, the number of days of flow per year ranged from 38 at the gage near TA-46 to zero near MDA G. Cañada del Buey east of the Laboratory has effluent-supported flow from the Los Alamos County sewage treatment plant in White Rock, which discharges into Cañada del Buey about 2 mi upstream of its confluence with Mortandad Canyon, and results in effluent-supported surface flow that regularly extends to the Rio Grande. Operational NPDES-permitted outfalls associated with Cañada del Buey include 13S associated with the TA-46 Sanitary Wastewater Systems Consolidation (SWSC) Plant (effluent is sampled at 13S but not discharged; all SWSC effluent is routed to TA-03) and 04A-118 associated with water supply well Pajarito Mesa #4.
	Quality	Key contaminants include americum-241, plutonium-238, plutonium-239/240, strontium-90, fluorine, nitrate, and perchorate.
	Name	No springs are present in the Mortandad Canyon.
	Quality	Not applicable
Alluvial Groundwater	**Extent**	Based on water levels observed in Mortandad Canyon alluvial wells, a saturated zone in the alluvium extends downstream from the TA-50 RLWTF outfall for approximately 2.2 mi. The easternmost extent of saturation in the alluvium is estimated near wells MCO-8 and MCO-8.2. In Cañada del Buey, nine alluvial wells were installed, but only two occasionally contain groundwater.
	Depth/Thickness	The saturated portion of the Mortandad Canyon alluvium is generally less than 10 ft thick and there is considerable variation in saturated thickness depending on the amount of precipitation and runoff in any particular year. Groundwater flow velocity in the alluvium varies from about 60 ft/day in the upper canyon to about 7 ft/day in the lower canyon and has been estimated to be 30 to 40 ft/day between MCO-5 and MCO-8.2.
	Quality	Key contaminants include americum-241, gross alpha, gross beta, plutonium-238, plutonium-239/240, strontium-90, H-3, fluorine, nitrate, and perchlorate. Effluent releases have had a major impact on water quality.

Table A-3 (cont.)

Conceptual Model Element	Characteristic	Description
Intermediate Groundwater	**Extent/Hydrology**	Perched groundwater was encountered during drilling of R-15 and MCOBT-4.4 in two different stratigraphic levels within the Cerros del Rio basalt. The lateral extent of these intermediate depth perched zones is unknown.
	Depth/Thickness	At MCOBT-4.4, a single screen set in a perched zone within the upper Puye Formation/Cerros del Rio basalt at a depth of 524 ft below ground surface (bgs). In R-15, perched groundwater was encountered at a depth of 646 ft bgs in the lower portion of the Cerros del Rio basalt.
	Quality	Key contaminants include nitrate, chromium, and perchlorate. Water quality shows the impact of historical effluent releases.
Regional Aquifer	**Depth/Hydrology**	The regional water table occurs within the Puye Formation in the Mortandad Canyon watershed. In Ten Site Canyon, approximately 3700 ft west of the confluence with Mortandad Canyon, the regional aquifer was encountered at a depth of 1182 ft in well R-14. In Test Well 8, located in Mortandad Canyon approximately 1300 ft west of the confluence with Ten Site Canyon, the regional aquifer occurs at a depth of 994 ft. The regional aquifer was encountered at a depth of 964 ft in R-15, located in Mortandad Canyon approximately 2000 ft east of the confluence with Ten Site Canyon. In well R-13, located approximately 5800 ft east-southeast of R-15, the regional aquifer was encountered at a depth of 833 ft. Flow in the regional aquifer is generally west to east with some deviation due to pumping the Pajarito Mesa well field. However, the flow tends to come back toward the east due to pumping of other wells. Average flow velocity for the regional aquifer in the vicinity of Mortandad Canyon is estimated to be about 95 ft/yr.
	Quality	Wells R-13 and R-14 have not shown contamination in the regional aquifer during drilling and/or subsequent characterization sampling. Key contaminants include perchlorate in well R-15.
Contaminants	**Potential Sources**	A description of potential release sites (PRSs) in the Mortandad watershed is provided in Work Plan for Mortandad Canyon. The canyon passes through or is adjacent to current Laboratory Technical Areas (TAs) 03, 05, 35, 46, 48, 50, 51, 52, 54, 55, 59, 60, and 63. PRSs in Cañada del Buey are provided in the “Work Plan for Sandia Canyon and Cañada del Buey.” Cañada del Buey has been a buffer zone for surface and subsurface material disposal areas at TA-54 and for effluent disposal, mostly from former TA-04. It also received discharges from TA-46, -51, and -52. Outfall discharges into Mortandad Canyon are described in the “Work Plan for Mortandad Canyon.” Mortandad Canyon and its tributaries have received effluent from the Laboratory since the early 1950s. Outfall discharges into the Cañada del Buey drainage are described in the Work Plan for Sandia Canyon and Cañada del Buey. Cañada del Buey received effluent from the Laboratory from the 1950s to the 1990s.

Table A-3 (cont.)

Conceptual Model Element	Characteristic	Description
	Type	TA-03 activities include administrative offices and support facilities plus various division laboratories and technical shops. TA-05 contains some physical support facilities, tests wells, and environmental monitoring and buffer areas. TA-35 activities include research laboratories for nuclear safeguards research and development, reactor safety, laser fusion, optical sciences, pulsed-power systems, high energy physics, tritium fabrication, metallurgy, ceramic technology, and chemical plating. TA-46 activities include research laboratories for applied photochemistry and organic and materials chemistry plus environmental management operations and the Sanitary Wastewater System Facility. TA-48 activities include research on nuclear and radiochemistry, geochemistry, biochemistry, and actinide chemistry. TA-50 activities include management and processing of industrial liquid and radioactive liquid wastes and it houses the RLWTF. TA-51 activities include environmental research and experimental studies for radioactive waste storage. TA-52 activities include research on nuclear reactor performance and safety. TA-54 activities include radioactive solid and hazardous chemical waste management and disposal operations. TA-55 activities include plutonium processing and research on plutonium metallurgy. TA-59 activities include occupational health and safety management, environmental management, and emergency management. TA-60 contains physical support and infrastructure facilities including the Test Fabrication Facility and Rack Assembly and the Alignment Complex. TA-63 contains physical support facilities and activities include environmental and waste management functions and facilities. The effluent discharged from TA-03, TA-35, TA-48, and TA-50 has contained a variety of contaminants, including nitrate, perchlorate, chromium, tritium, cesium-137, strontium-90, americium-241, and several isotopes of uranium and plutonium.

Table A-4
Pajarito Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Pajarito Canyon	Twomile Canyon	Threemile Canyon
Surface Water	Flow	Surface water occurs in Pajarito Canyon mostly as intermittent flow. Short reaches of perennial flow occur downstream of spring discharges in Starmers Gulch and below the 4-series springs in White Rock Canyon. Surface water flow is ephemeral in central Pajarito Canyon between the confluences with Twomile and Threemile Canyons. Flow is also ephemeral through White Rock.	Flow is ephemeral west of TA-03 and is possibly intermittent from TA-03 to the confluence with Pajarito Canyon.	Threemile Canyon is ephemeral except for a possibly intermittent reach supported by springs above the confluence of Threemile and Pajarito Canyons.
	Quality	Key contaminants include RDX and possibly mercury and nitrate.	There are no surface water chemistry results for Twomile Canyon except for a small tributary below building SM-30 in TA-03. Samples from the tributary show elevated mercury in unfiltered samples.	Contaminants include RDX .
Springs	Name	In the western portion of Pajarito Canyon, springs issue from canyon slopes above the alluvium. The probable source of these springs is the upper part of the Tshirege Member of the Bandelier Tuff. Typical discharge rates are approximately 1 to 15 gal./min. Springs include PC, Homestead, Upper Starmer, Charlies, Garvey, Perkins, Starmer, and Josie Springs, Keiling and Bulldog Springs.	Springs issue from the canyon floor of upper Twomile Canyon in TA-03 and 58. These springs include Hanlon, Anderson, SM-30, SM-30A, and TW-1.72 Springs.	There are two springs on the floor of Threemile Canyon. These springs include Threemile and TA-18 Springs.
	Quality	Contaminants include RDX and perchlorate, which have been detected in spring water at TA-08 and TA-09.	There are no screening data for springs in Twomile Canyon.	No contaminants exceed regulatory standards.

Table A-4 (cont.)

Conceptual Model Element	Characteristic	Pajarito Canyon	Twomile Canyon	Threemile Canyon
Alluvial Groundwater	Extent	There are no alluvial wells in western Pajarito Canyon, so information about the nature and extent of alluvial groundwater is limited. Most likely, infiltration of surface water creates a saturated zone where alluvium is present from the Pajarito fault zone across the Laboratory to White Rock. Alluvial wells have been installed between TA-18 and State Highway 4. These wells demonstrate the presence of alluvial groundwater in this part of Pajarito Canyon. The drilling of seven test holes in 1985 showed that the saturation in lower Pajarito Canyon does not extend laterally under Mesita del Buey near MDAs G and L (Devaurs 1985, 7416; Devaurs 1985, 07415). Three of the alluvial test holes were completed as groundwater monitoring wells (PCO-1, -2, and -3). An additional 20 alluvial wells were installed between 1990 and 1998 by the Environmental Restoration Project as part of the RCRA facility investigation (RFI) for TA-18.	There are no alluvial wells in Twomile Canyon and the extent of alluvial groundwater, if present, is unknown.	Alluvial groundwater has been documented in lower Threemile Canyon at 18-BG-1 and 18-MW-8.
	Depth/Thickness	Wells PCO-1, -2, and -3 are probably representative of alluvial groundwater between TA-18 and State Highway 4. When installed, depth to water was 1.3 ft in PCO-1, 6.3 ft in PCO-2, and 3.1 ft in PCO-3 (Purtymun 1995, 45344). Assuming continuous saturation in the alluvium, the saturated thickness is about 9.7 ft in PCO-1, 2.7 ft in PCO-2, and 8.9 ft in PCO-3. The saturated thickness varies seasonally, with no water present in dry years.	No Data.	In well 18-BG-4, the water level was 2.5 ft bgs.
	Quality	Contaminants include hexahydro-1,3,5,trinitro-1,3,5-triazine (RDX) and possibly beryllium, lead, and plutonium-239/240.	No Data.	No contaminants exceed regulatory standards.

Table A-4 (cont.)

Conceptual Model Element	Characteristic	Pajarito Canyon	Twomile Canyon	Threemile Canyon
Intermediate Groundwater	Extent/Hydrology	Intermediate perched water is likely to occur beneath Pajarito Canyon, but knowledge of its extent and quality is incomplete. Perched water was indicated during the drilling of PM-2 and SHB-4 in the vicinity of TA-18. At PM-2, a "show of water at 335 ft" was noted in the Otowi Member of the Bandelier Tuff during the cable-tool drilling (Cooper et al. 1965, 8582). In SHB-4, the core tube and core from the top of the Otowi Member from about 125 ft to 145 ft came out of the hole wet (Gardner et al. 1993, 12582). Test Holes 5 and 6 were drilled in 1950 to detect perched groundwater in Pajarito Canyon south of TA-54. Test Hole 5 was drilled through the Bandelier Tuff and into basalts at a total depth of 263 ft. Test Hole 6 was also drilled through the tuff and into basalts to a total depth of 300 ft (Griggs 1955, 08795). These dry test holes indicate that perched water does not occur in the upper part of the vadose zone in this part of the canyon. Between 2000 and 2002 regional wells R-20, R-22, R-23, and R-32 were installed in lower Pajarito Canyon. Perched intermediate water was not identified during the drilling of wells R-20, R-22, and R-32. However, at R-23, near the eastern Laboratory boundary, there were indications that perched intermediate water may be present in Cerros del Rio basalt. However, R-23 is only screened in the regional aquifer.	Well 03-MW-1 is a 28-ft-deep mesa top well that samples shallow intermediate perched water near building SM-30 at TA-03. A thin zone of saturation occurs in tuffs of the upper Tshirege Member.	Characterization well R-19, located on the mesa south of Threemile Canyon, had indications of possible perched water at depths of 834 to 840 ft and 894 to 912 ft (Broxton et al. 2001, 71253). Both zones were screened in the completed well, but only the 894 to 912 ft interval (screen 2) in the Puye Formation yields water.
	Depth/Thickness	See above	Depth to water in well 03-MW-1 is 20 ft.	See above

Table A-4 (cont.)

Conceptual Model Element	Characteristic	Pajarito Canyon	Twomile Canyon	Threemile Canyon
	Quality	No Data.	Characterization sampling for 03-MW-1 found elevated concentrations of mercury, tritium, and volatile organic compounds (VOCs). A Groundwater Investigation Work Plan is being prepared to determine the extent of this perched zone.	No contaminants exceed regulatory standards. Samples from well R-19 indicate there are impacts to the intermediate perched water from Laboratory operations.
Regional Aquifer	Depth/Hydrology	Based on Laboratory water level maps, the general direction of groundwater flow in the regional aquifer is east to southeast in the vicinity of Pajarito Canyon. Depth to the regional aquifer is known in Pajarito Canyon at supply well PM-2 and in characterization wells R-20, -22, -23, and -32. The nonpumping water level for PM-2 in 2001 was at a depth of 855 ft. In 2002, the top of the regional water table was at a depth of 826 ft in R-20, 890 ft in R-22, 828 ft in R-23, and 776 ft in R-32. R-23 is completed with a single well screen, R-20 and R-32 have three well screens, and R-22 has five well screens. The upper portion of the regional aquifer probably discharges at Spring 4A in White Rock Canyon.	There are no regional aquifer wells associated with Twomile Canyon.	Well R-19 is located on the mesa south of Threemile Canyon. It is downgradient from firing site IJ in TA-36 and is upgradient of TA-18. In addition to two screens in the vadose zone (described above), R-19 has five screens in the regional aquifer.
	Quality	No contaminants exceed regulatory standards. Water quality of the regional aquifer beneath eastern Pajarito Canyon shows little, if any, impacts from LANL operations. Sampling at R-22 above background tritium in several screens. Routine surveillance sampling of PM-2 shows the groundwater meets regulatory standards.	No data.	No contaminants exceed regulatory standards . Sampling at R-19 indicates no impacts to the regional groundwater from Laboratory operations.
Contaminants	Potential Sources	TAs -08, -09, -15, -22, -36, -36, -40, and -54	TAs -03, -06, -40, -48, -55, -59, -64, and -69	TAs -15, -18, and -36
	Type	Metals, radionuclides, high explosives, VOCs, and anions	mercury, tritium, and VOCs	HE, VOCs

Table A-5
Water Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Upper Water Canyon & Cañon de Valle	Middle Water Canyon	Lower Water, Fence, and Potrillo Canyons
Surface Water	Flow	*Water Canyon*: Perennial from State Highway 501 to the eastern edge of TA-28. Intermittent surface water occurs in upper Water Canyon (gage E252) primarily in the spring. *Cañon de Valle:* Perennial from Peter Seep to gage E256. Intermittent surface water exists from natural and anthropogenic sources to gage E262.	Ephemeral at gage station E265.2.	Lower Water Canyon is ephemeral, except for a perennial reach supported by Spring 5AA near the confluence of Water and Potrillo canyons. Potrillo Canyon and Fence Canyon are entirely ephemeral.
	Quality	*Cañon de Valle*: Contaminants include barium (2–3 ppm) and the high explosive RDX (>100 ppb), trinitrotoluene[2,4,6-], perchlorate, and possibly mercury	Surface water chemistry results show contaminant levels at detection or background levels.	No contaminants exceed regulatory standards. Uranium is significantly greater than background in surface water (11.9 ppb) near the firing sites, yet no significant elevation in concentrations at State Highway 4.
Springs	Flow	Armistead Spring and American Spring, west of LANL, and SWSC, Burning Ground, Martin, and the Hollow (on LANL property) and others in the upper reaches of Cañon de Valle	There are no springs in the vicinity of TA-49, except for the seep near the Beta hole.	Spring 5AA in lower Water Canyon. No springs in Potrillo Canyon or in Fence Canyon.
	Quality	Contaminants include RDX, barium, dichloroethane[1,2-], tetrachloroethene, trichloroethene, perchlorate, and possibly mercury.		
Alluvial Groundwater	Extent/Hydrology	*Water Canyon*: Some alluvial groundwater may be present near the headwaters. Because of the limited addition of water, lack of springs and seeps, and rare discharge from tributary canyons, the occurrence and duration of alluvial groundwater likely decreases downcanyon. *Cañon de Valle*: Alluvial groundwater system near SWSC and Burning Ground Springs is perennial. Alluvial water in Martin Canyon and the Fishladder drainage is intermittent.	Alluvial groundwater is in WCM-1 and WCM-2, but no water is present in WCO-1, WCO-2, and WCO-3, though water was found in WCO-2 in 2005. In most years, the downstream extent of alluvial groundwater may be between the WCM-2 and WCO-1.	*Potrillo*: one known occurrence of alluvial groundwater in Potrillo Canyon in moisture access hole POTM-2. Several other boreholes have been drilled near this area to define the extent of the groundwater found in POTM-2 but all are dry. *Fence:* No occurrences of alluvial groundwater have been documented for Fence Canyon. However, only one well was installed, well FCO-1, located near State Highway 4. Based on physiography, no alluvial water is expected.

Table A-5 (cont.)

Conceptual Model Element	Characteristic	Upper Water Canyon & Cañon de Valle	Middle Water Canyon	Lower Water, Fence, and Potrillo Canyons
	Depth/Thickness	Alluvium is typically less than10 ft thick, however, saturation does extend into the tuff		
	Quality	*Cañon de Valle* : contaminants include barium, RDX, dinitrobenzene[1,3-], trinitrotoluene[2,4,6-], and perchlorate.		
Intermediate Groundwater	Extent/Hydrology	Lateral extent of the deep perched zone has not been determined, however in R-25 and SHB-3 a thick perched zone was encountered. Shallower, disconnected, and transient zones of perched saturation have been identified elsewhere within the TA-16 mesa.	No perched water was encountered in any of the holes and all holes have remained dry with the exception of core hole CH-2. DT-5, DT-5P, and four core holes (CH-1, CH-2, CH-3, and CH-4) were drilled to depths of 300 to 500 ft at the main experimental area and more than 50 experimental holes were drilled as deep as 142 ft in Areas 1, 2, 2A, 2B, 3, and 4 from 1959 to 1961. CH-2 may have an undetected natural perched zone; however, this seems unlikely because this recharge pathway apparently developed more than a decade after the hole was completed.	*Water*: None found in the two existing CDV wells (CDV-R-15 and CDV-R-37). *Potrillo and Fence*: The presence of perched water can not be determined from available data.
	Depth/Thickness	R-25: 711-1132 ft		
	Quality	Contaminants include RDX, trinitrotoluene[2,4,6-], trichloroethene, and possibly lead.		
Regional Aquifer	Depth/Hydrology	R-25 encountered the regional aquifer at 1286 ft.		Water supply well PM-2: 730 ft below the bottom of Potrillo Canyon and 620 ft below the bottom of Fence Canyon.
	Quality	RDX has been detected,, although this may have been from cross contamination from the perched zone above. HE concentrations are decreasing in the regional aquifer with time, while they are remaining relatively constant in the perched zone.		
Contaminants	Potential Sources	TAs -08, -09, -11, -14, -15, and -16	TA-49	TAs -14, -15, -36

Table A-5 (cont.)

Conceptual Model Element	Characteristic	Upper Water Canyon & Cañon de Valle	Middle Water Canyon	Lower Water, Fence, and Potrillo Canyons
	Type	HE, barium, solvents	Isotopes of uranium and plutonium, lead, beryllium, and explosives such as TNT, RDX, HMX, and barium nitrate	Nitrated organic compounds such as TNT, nitrocellulose, trinitramines, and pentaerythritol tetranitrate (PETN). Metals may also be associated with the explosives (uranium, barium, beryllium, lithium hydride, lead, mercury, copper, and zinc). Soils in several of these operational areas have high levels of uranium contamination.

Table A-6
White Rock Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Description
Surface Water	Flow	Flow from regional aquifer springs supports perennial surface water flow in several canyons just above where they reach the Rio Grande: Sandia, Pajarito, Ancho, and Chaquehui Canyons. Except for Sandia Canyon, these flows reach the Rio Grande. A municipal sanitary treatment plant discharges effluent into Mortandad Canyon just above the river at the northern county boundary.
	Quality	Barium is the only constituent that has been detected above regulatory standards in surface water (in 2 of 28 samples). Water quality of the other streams is mainly determined by the chemistry of their contributing springs (summarized in the regional aquifer description below). The discharge from the municipal sanitary treatment plant is the primary surface water source and has a strong impact on the chemistry of the water that enters the Rio Grande from Mortandad Canyon, leading to higher total dissolved solids (TDS), nitrate, chloride, sulfate, and some metals.
Springs	Name	Springs near the Rio Grande represent natural discharge from the regional aquifer. Regional aquifer springs are present just above the Rio Grande in Sandia, Pajarito, Ancho, and Chaquehui canyons. Los Alamos Canyon and Water Canyon do not have significant springs in their lower reaches. A small seep (Otowi Spring) emerges along the Rio Grande bank south of Los Alamos Canyon. A small seep (Spring 5AA) issues from the Totavi Lentil in lower Water Canyon, but seldom has sufficient water for sampling. Springs discharge from two geologic units: the Tesuque Formation and the Totavi Lentil (the lower part of the Puye Formation). The Tesuque Formation consists of sandstones, siltstones, and interbedded basalts. The Totavi Lentil is a channel-fill deposit made up of grain sizes ranging from gravel to boulders. Purtymun divided the springs into four groups based on geologic unit and chemistry. Group I springs discharge from the Totavi Lentil on the west side of the river. Water is dominated by calcium bicarbonate with sulfate and chloride of about 4 mg/L and TDS averages 163 mg/L. These springs follow the outcrop of the Totavi Lentil, increasing their elevation above the river in a downstream direction. These higher elevation springs generally occur on the flanks of or in the bottom of canyons where erosion has exposed the Totavi Lentil. Group II springs discharge from coarse-grained Tesuque Formation sediments on both sides of the river. These springs have sodium bicarbonate water with about 3 mg/L of sulfate and chloride, and TDS averages 183 mg/L. Group III springs discharge from fine-grained Tesuque Formation sediments on the west side of the river. These springs also have sodium bicarbonate water with about 10 mg/L of sulfate, 3 mg/L of chloride and TDS averages 215 mg/L. Group IV springs discharge from fine-grained Tesuque Formation sediments on the east side of the river near faults and basalt flows. These springs have varied chemistry with higher TDS than the other springs, of 270 to 500 mg/L. Most of the springs discharge close to the elevation of the Rio Grande, though some springs discharge at elevations several tens of feet above the Rio Grande. There are different hypotheses about the meaning of the elevation of springs above the river. One hypothesis is the elevations could reflect channeling of discharge from the regional aquifer along the higher-permeability Totavi Lentil, combined with the increase in elevation of the water table with distance west of the river. Another hypothesis of spring occurrence is that the elevation of springs above the river could reflect local variations in permeability and geology related to numerous landslides along the canyon walls. A third hypothesis is that the elevation of some springs above the river indicates that they discharge from perched groundwater located above the regional aquifer.

Table A-6 (cont.)

Conceptual Model Element	Characteristic	Description
	Quality	The U.S. Geological Survey and the Laboratory have monitored chemistry of the White Rock Springs since the 1960s; the springs show no clear impact of Laboratory contamination. One sample of 67 from all springs (and 1 of 8 from this spring) showed RDX, trinitrotoluene[2,4,6-], and HMX above regulatory standards.
Alluvial Groundwater	Extent	Alluvial groundwater is not present in the White Rock Canyon area. However, household wells in Los Alamos Canyon (Halladay and Otowi) and household wells nearer the Rio Grande probably draw their water from Santa Fe Group sediments but may draw water in part from alluvium in these drainages.
	Depth/Thickness	Not applicable.
	Quality	Not applicable
Intermediate Groundwater	Extent/Hydrology	Perched intermediate groundwater may not be present in the White Rock Canyon area. However, an alternative hypothesis about White Rock Canyon spring origin is that the elevation of some springs above the river indicates that they discharge from perched groundwater located above the regional aquifer.
	Depth/Thickness	Not applicable.
	Quality	Not applicable.
Regional Aquifer	Depth/Hydrology	The Rio Grande is the major groundwater discharge point for the regional aquifer underlying the Pajarito Plateau. The river gains flow through White Rock Canyon (Purtymun 1995, 45344) indicating that the local water table lies above the river. The Buckman well field lies adjacent to the Rio Grande on the east bank and includes eight pumping wells. These wells draw their water from Santa Fe Group sediments. Water in these wells is quite old, having passed through the deeper portion of the basin fill sediments where it acquired a higher load of dissolved solutes. San Ildefonso Pueblo draws water from more than 10 community and household wells located on both sides of the Rio Grande. Little information on depth or geology for these wells is available. Many of these wells probably draw their water from Santa Fe Group sediments. At least two of the San Ildefonso wells are uncapped artesian wells.
	Quality	Except for naturally occurring constituents, no constituents exceed regulatory standards. Some Buckman wells have exceptionally high uranium (up to 230 ppm, compared to the new EPA MCL of 30 ppm). Such naturally occurring uranium is common in the Pojoaque and Tesuque area. The Buckman wells also have high sodium, alkalinity, and total dissolved solids. San Ildefonso Pueblo household wells also produce older water from deep within the basin, and have high sodium, chloride, alkalinity, and TDS, as well as uranium, arsenic, and boron.
Contaminants	Potential Sources	TA-33 borders the Rio Grande, a site where tritium activities formerly occurred. The low- to moderate-density residential area of White Rock borders the Rio Grande to the north of the Laboratory boundary in White Rock Canyon. A municipal sanitary treatment plant discharges effluent into Mortandad Canyon just above the river at the northern county boundary.

Table A-6 (cont.)

Conceptual Model Element	Characteristic	Description
	Type	TA-33 was used as a firing site and for production of tritium. PRSs include landfills, septic systems, and burn areas It is situated on a mesa top and is being investigated by the Environmental Restoration (ER) Project as Operable Unit (OU) 1122. If contaminants are released from TA-33, they may impact Ancho Canyon, Chaquehui Canyon, or the Rio Grande. The discharge from the municipal treatment plant is the primary surface water source and has a strong impact on the chemistry of the water that enters the Rio Grande from Mortandad Canyon, leading to higher TDS, nitrate, chloride, sulfate, and some metals.

Table A-7
Guaje Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Description
Surface Water	Flow	Guaje Canyon heads in the Sierra de los Valles and is part of the Los Alamos Canyon watershed. Guaje Canyon contains an interrupted stream with a perennial reach extending from springs located upstream of Guaje Reservoir to some distance downstream of the reservoir. An intermittent reach extends farther downstream to the confluence with lower Los Alamos Canyon. Snowmelt runoff does not reach the Rio Grande. Guaje Canyon crosses San Ildefonso Pueblo land and continues to its confluence with lower Los Alamos Canyon approximately a mile west of the Rio Grande. Rendija Canyon heads on the flanks of the Sierra de los Valles and contains an ephemeral stream. Barrancas Canyon heads on the Pajarito Plateau and has intermittent and ephemeral flow. No springs have been found in any of these canyons. Base flow has been monitored at the station Guaje Canyon located below the reservoir for several decades. Gaging stations in these canyons include Guaje above Rendija, Rendija above Guaje, and Guaje at SR-502. For many gages, flow information is not available. These gages do not yet have an established rating curve.
	Quality	No constituents exceed regulatory standards.
Springs	Name	none
	Quality	N/A
Alluvial Groundwater	Extent	Only two alluvial wells have been installed in Guaje Canyon to investigate the presence of alluvial groundwater. These wells were completed in the perennial reach of the canyon and alluvial groundwater was encountered near the stream level. For Rendija and Barrancas Canyons, no alluvial wells have been installed and no alluvial groundwater is known.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable
Intermediate Groundwater	Extent/ Hydrology	No intermediate groundwater wells have been installed and no groundwater is known to exist in these canyons. Drilling of the water supply wells in Rendija and Guaje canyons has not found any intermediate groundwater.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.

Table A-7 (continued)

Conceptual Model Element	Characteristic	Description
Regional Aquifer	Depth/ Hydrology	The regional aquifer occurs in the Puye Formation and the Santa Fe Group near Guaje Canyon. The regional aquifer probably includes rocks of the Tschicoma Formation in the western part of the canyons. The regional aquifer supplies water to the wells of the Guaje well field. Groundwater flow in the regional aquifer is from the northwest, so no Laboratory contaminant sources are located upgradient of Guaje Canyon sites. The aquifer lies at depths of about 230 to 570 ft in the Guaje well field.
	Quality	No constituents exceed regulatory standards except for high levels of naturally occurring arsenic up to 40 µg/L in older, now-abandoned wells. The EPA maximum contaminant level (MCL) for arsenic is 10 µg/L.
Contaminants	Potential Sources	These canyons are north of the Laboratory and likely not affected by contamination. However, Rendija Canyon contained a small arms firing range and several sites used as mortar impact areas.
	Type	Metals, high explosives (HE)

Table A-8
Bayo Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Description
Surface Water	Flow	Bayo Canyon is part of the Los Alamos Canyon watershed. Bayo Canyon heads on the Pajarito Plateau on land owned by Los Alamos County and extends across the northeast portion of the Laboratory (TA-74), crosses San Ildefonso Pueblo land to the east, and terminates at its confluence with lower Los Alamos Canyon near Totavi. Surface water flow in Bayo Canyon is ephemeral and intermittent and there are no springs in the vicinity. Stream loss caused by infiltration into the underlying alluvium and evapotranspiration typically prevents surface flow from discharging to Los Alamos Canyon. The only gaging station in Bayo Canyon is Bayo below TA-10.
	Quality	None.
Springs	Name	None.
	Quality	N/A
Alluvial Groundwater	Extent	No alluvial groundwater was encountered during drilling of about 90 boreholes at the TA-10 site in upper Bayo Canyon.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable
Intermediate Groundwater	Extent/ Hydrology	None known.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.
Regional Aquifer	Depth/ Hydrology	The regional aquifer occurs in the Puye Formation and the Santa Fe Group in the vicinity of Bayo Canyon. The regional aquifer probably includes rocks of the Tschicoma Formation in the western part of the canyons. The regional aquifer supplies water to the wells of the Guaje well field. The aquifer lies at depths of about 230 to 570 ft in the Guaje well field.
	Quality	No constituents exceed regulatory standards except for high levels of naturally occurring arsenic up to 40 µg/L in older, now-abandoned wells.
Contaminants	Potential Sources	Former radiochemistry laboratory and firing sites at Bayo Canyon Site, TA-10
	Type	Strontium-90 and other constituents

Table A-9
Ancho Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Description
Surface Water	Flow	Ancho Canyon heads on the Pajarito Plateau and for the most part has ephemeral flow. The canyon has two main branches, the northern one known as North Ancho Canyon. Gaging stations include Ancho above north fork Ancho, Ancho north fork below SR-4, and Ancho below SR-4. These stations have shown little flow. The average discharge for Ancho below SR-4 from seven years of record is 0.005 cfs or 3.6 ac-ft/yr. No other information on surface water quality or flows is available. The only perennial section of the canyon is near the Rio Grande.
	Quality	No constituents exceed regulatory standards.
Springs	Name	Beginning less than a mile above the Rio Grande, Ancho Canyon is perennial, with flow fed by Ancho Spring, a regional aquifer spring.
	Quality	N/A
Alluvial Groundwater	Extent	Little is known about the presence of alluvial groundwater in Ancho Canyon. Ancho Canyon contains thick alluvium that could host perched groundwater, and three boreholes (ASC-15, ASC-16, and ASC-18) drilled by the ER Project encountered 4 ft to 9 ft of saturation in alluvium below MDA Y. Several boreholes drilled downgradient of MDA Y encountered no alluvial groundwater, suggesting the occurrence of alluvial groundwater in this area is limited in extent.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.
Intermediate Groundwater	Extent/ Hydrology	No intermediate perched zones have been found beneath Ancho Canyon, although further borehole information may change this. ER borehole DMB-1, drilled between Building 69 and the administrative area at TA-39, penetrated 119 ft of Bandelier Tuff and 5 ft of Cerros del Rio basalts. No intermediate-depth perched water was encountered in this hole, but clay-lined fractures and vesicles in the basalt suggest that periodic passage of groundwater through these rocks may occur. A test hole (TH-7) drilled 10 ft into basalts in Ancho Canyon below State Highway 4 was dry. The hole was drilled in 1950 and has since been plugged. R-31 was drilled in TA-39 in the north fork of Ancho Canyon. A screen was placed from 439 to 454 ft at a possible perched zone, based on water seen in a borehole video. The zone has been dry since and no water samples have been collected from it.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.

Table A-9 (continued)

Conceptual Model Element	Characteristic	Description
Regional Aquifer	Depth/ Hydrology	Groundwater flow in the regional aquifer beneath Ancho Canyon is to the east and southeast, towards the Rio Grande. The regional aquifer lies at about 1000 to 1170 ft beneath the mesa at TA-49, and is within the Cerros del Rio basalt, the underlying Puye Fanglomerate, “Totavi” gravels, and possibly the Santa Fe Group. Regional aquifer characterization well R-31 in TA-39 found the regional aquifer at about 530 ft within the Cerros del Rio basalt, the underlying Puye Fanglomerate, and “Totavi” gravels. Postdrilling water quality sampling has not been completed at this well.
	Quality	No constituents exceed regulatory standards. Three regional aquifer wells at TA-49 have been sampled since the 1960s to monitor for effects of testing at that site. In general no effects have been found. High metal concentrations (lead, zinc, iron, manganese) in samples are related to metal well casing and fittings. Occasional detections of organic compounds are not supported by follow up sampling. Analysis of water at Ancho Spring by the Environmental Surveillance Program indicates occasional presence of explosives and trace levels of depleted uranium. Because the spring issues from the canyon floor, it is uncertain whether these contaminants are being transported by groundwater or if they are being mobilized from sediments in the canyon. Ancho Spring is downgradient of explosives testing sites. Spring sampling is covered in a separate part of the monitoring plan.
Contaminants	Potential Sources	Firing sites and underground testing sites at TA-49 and TA-39.
	Type	HE, radionuclides, metals.
	Quality	N/A
	Quality	N/A
	Depth/ Thickness	Not applicable.
	Quality	Not applicable
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.

Table A-10 Chaquehui Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Description
Surface Water	Flow	Chaquehui Canyon heads on the Pajarito Plateau and contains an ephemeral stream in its upper portion. About 0.5 mi above the Rio Grande, Doe Spring, a regional aquifer spring, maintains a short perennial reach. Farther down the drainage, Springs 9 and 9A maintain perennial flow that extends 0.25 mi to the Rio Grande. Gaging stations in Chaquehui Canyon include Chaquehui at TA-33 and Chaquehui tributary at TA-33. No flow data were available in 2002. The gaging stations have insufficient data to establish flow-rating curves.
	Quality	No constituents exceed regulatory standards.
Springs	Name	Springs issue from basalts near the Rio Grande in the area of Chaquehui Canyon (Springs 8A, 9, 9A, 9B, and Doe). These springs are located 130–200 ft above the Rio Grande, and they may represent discharge points for intermediate depth perched water bodies. Alternatively, these springs may represent discharge from the regional aquifer in White Rock Canyon. Spring sampling is covered in the White Rock Canyon spring portion of the Interim Plan.
	Quality	No particular contamination has been found in these springs. Spring sampling is covered in the White Rock Canyon spring portion of this plan.
Alluvial Groundwater	Extent	Little is known about the presence of alluvial groundwater in Chaquehui Canyon. Much of Chaquehui Canyon is unlikely to contain perched alluvial groundwater because most of its course forms a steep narrow drainage through basalts that are swept free of alluvium by runoff. Purtymun reported that there was water perched locally in the alluvium but provided no basis for this statement. Purtymun probably refers to alluvium downstream of Doe Spring and Springs 9 and 9A.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable
Intermediate Groundwater	Extent/ Hydrology	No intermediate groundwater is known in Chaquehui Canyon; however there has been no drilling in the area.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.

Table A-10 (continued)

Conceptual Model Element	Characteristic	Description
Regional Aquifer	Depth/ Hydrology	Characterization well R-31 in TA-39 (Ancho Canyon) found the regional aquifer at about 530 ft within the Cerros del Rio basalt, the underlying Puye Fanglomerate, and “Totavi” gravels.
	Quality	Post-drilling water quality sampling has not been completed at R-31.

Table A-10 (continued)

Conceptual Model Element	Characteristic	Description
Contaminants	Potential Sources	TA-33 was used as a firing site and for production of tritium. PRSs include landfills, septic systems, and burn areas.
	Type	Tritium

Table A-11
Frijoles Canyon Watershed Conceptual Model

Conceptual Model Element	Characteristic	Description
Surface Water	Flow	Frijoles Canyon lies south of Laboratory land and heads within the Sierra de los Valles. Rito de los Frijoles is a perennial stream that originates in the upper canyon and extends to the Rio Grande. The stream originates from springs in upper Frijoles Canyon. A gaging station in Frijoles Canyon is Rito de los Frijoles at Bandelier. In 2002 there were 365 days with flow, a total volume of 439 acre-feet, and a maximum flow of 19 cfs.
	Quality	No constituents exceed regulatory standards. The Laboratory has monitored surface water quality at two locations for several decades, one near the Bandelier National Monument headquarters, and one just above the Rio Grande. In general, sampling shows no Laboratory-derived contamination in Rito de los Frijoles. The National Park Service has monitored surface water quality extensively in Frijoles Canyon. Fecal coliform count and other constituents related to septic systems are a major issue in surface water quality. Some hints of HE compounds were found in samples in upper Frijoles Canyon in the late 1990s but these results have not been repeated.
Springs	Name	One regional aquifer spring, Spring 10, discharges at the edge of the Rio Grande south of Frijoles stream. The spring has a very low discharge and is difficult to sample separately from river water.
	Quality	Spring 10 chemistry has not shown any LANL impact. No constituents exceed regulatory standards.
Alluvial Groundwater	Extent	No wells have been drilled into the alluvium in Frijoles Canyon. Purtymun and Adams note that the alluvium is probably thin, on the order of 6 m or less. The presence of perennial surface flow suggests a large extent of alluvial saturation.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.
Intermediate Groundwater	Extent/ Hydrology	No intermediate groundwater is known to exist in the area of Frijoles Canyon, however no wells have been drilled.
	Depth/ Thickness	Not applicable.
	Quality	Not applicable.

Table A-11 (continued)

Conceptual Model Element	Characteristic	Description
Regional Aquifer	Depth/Hydrology	No regional aquifer wells are located in Bandelier National Monument. The nearest wells are in Ancho Canyon and are described in that part of the plan.
	Quality	No regional aquifer wells are located in Bandelier National Monument. The nearest wells are in Ancho Canyon and are described in that part of the plan.
Contaminants	Potential Sources	Septic systems at Bandelier National Monument
	Type	Fecal coliform.

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Appendix B

Screening Information

Appendix B
Tables

Figures

Table B.1
Analytes that Exceeded 1/2 Screening Threshold in > 5% of Samples by Watershed and Media

Watershed	Media	Analyte (filtered)	Analyte (unfiltered)	Note
Los Alamos/Pueblo Canyon	Ephemeral Surface Water	Al	Al	Sampling artifact
Los Alamos/Pueblo Canyon	Ephemeral Surface Water		As	
Los Alamos/Pueblo Canyon	Ephemeral Surface Water	Cu		
Los Alamos/Pueblo Canyon	Ephemeral Surface Water		Fe	Sampling artifact
Los Alamos/Pueblo Canyon	Ephemeral Surface Water		Pb	Anthropogenic
Los Alamos/Pueblo Canyon	Ephemeral Surface Water	Mn	Mn	Sampling artifact
Los Alamos/Pueblo Canyon	Ephemeral Surface Water		Se	Natural
Los Alamos/Pueblo Canyon	Ephemeral Surface Water		CN (am)	
Los Alamos/Pueblo Canyon	Ephemeral Surface Water	ClO4	ClO4	Analytical artifact
Los Alamos/Pueblo Canyon	Ephemeral Surface Water		DDD[4,4'-]	Analytical artifact
Los Alamos/Pueblo Canyon	Ephemeral Surface Water		DDT[4,4'-]	Analytical artifact
Los Alamos/Pueblo Canyon	Perennial Surface Water	Al		Sampling artifact
Los Alamos/Pueblo Canyon	Perennial Surface Water	As	As	
Los Alamos/Pueblo Canyon	Perennial Surface Water	Cu		
Los Alamos/Pueblo Canyon	Perennial Surface Water		Pb	Anthropogenic
Los Alamos/Pueblo Canyon	Perennial Surface Water		Se	Natural
Los Alamos/Pueblo Canyon	Perennial Surface Water		Benzo(a)anthracene	Anthropogenic
Los Alamos/Pueblo Canyon	Perennial Surface Water		Benzo(a)pyrene	Anthropogenic
Los Alamos/Pueblo Canyon	Perennial Surface Water		Benzo(b)fluoranthene	Anthropogenic
Los Alamos/Pueblo Canyon	Perennial Surface Water		Benzo(k)fluoranthene	Anthropogenic
Los Alamos/Pueblo Canyon	Perennial Surface Water		Chrysene	Anthropogenic
Los Alamos/Pueblo Canyon	Perennial Surface Water		Dibenz(a,h)anthracene	Anthropogenic
Los Alamos/Pueblo Canyon	Perennial Surface Water		Indeno(1,2,3-cd)pyrene	Anthropogenic
Los Alamos/Pueblo Canyon	Alluvial Groundwater	As	As	
Los Alamos/Pueblo Canyon	Alluvial Groundwater	Fe	Fe	Sampling artifact
Los Alamos/Pueblo Canyon	Alluvial Groundwater	Mn	Mn	Sampling artifact
Los Alamos/Pueblo Canyon	Alluvial Groundwater	Mo	Mo	LANL
Los Alamos/Pueblo Canyon	Alluvial Groundwater	Cl(-1)		Anthropogenic
Los Alamos/Pueblo Canyon	Alluvial Groundwater	NO3-N	NO3-N	Anthropogenic
Los Alamos/Pueblo Canyon	Alluvial Groundwater	ClO4		
Los Alamos/Pueblo Canyon	Alluvial Groundwater		Bis(2-ethylhexyl)phthalate	Sampling artifact
Los Alamos/Pueblo Canyon	Alluvial Groundwater		Methylene Chloride	Sampling artifact
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater	Fe	Fe	Sampling artifact
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater	Mn	Mn	Sampling artifact
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater	Ni	Ni	
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater		Se	Natural

Table B.1 (cont.)

Watershed	Media	Analyte (filtered)	Analyte (unfiltered)	Note
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater	F(-1)	F(-1)	
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater	ClO4	ClO4	
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater		Bis(2-ethylhexyl)phthalate	Sampling artifact
Los Alamos/Pueblo Canyon	Intermediate Perched Groundwater		Phenol	Sampling artifact
Los Alamos/Pueblo Canyon	Regional Aquifer		As	Natural
Los Alamos/Pueblo Canyon	Regional Aquifer	Fe	Fe	Sampling artifact
Los Alamos/Pueblo Canyon	Regional Aquifer		Pb	Sampling artifact
Los Alamos/Pueblo Canyon	Regional Aquifer	Mn	Mn	Sampling artifact
Los Alamos/Pueblo Canyon	Regional Aquifer	Ni		
Los Alamos/Pueblo Canyon	Regional Aquifer	ClO4	ClO4	LANL
Los Alamos/Pueblo Canyon	Springs	Al		Sampling artifact
Los Alamos/Pueblo Canyon	Springs	Sb	Sb	
Los Alamos/Pueblo Canyon	Springs	As	As	
Los Alamos/Pueblo Canyon	Springs	Cu		
Los Alamos/Pueblo Canyon	Springs		Hg	
Los Alamos/Pueblo Canyon	Springs	Tl	Tl	
Los Alamos/Pueblo Canyon	Springs	Cl(-1)		Anthropogenic
Los Alamos/Pueblo Canyon	Springs	F(-1)		Anthropogenic
Los Alamos/Pueblo Canyon	Springs	NO3-N	NO3-N	Anthropogenic
Sandia Canyon	Ephemeral Surface Water	Cu		
Sandia Canyon	Perennial Surface Water	Al		Sampling artifact
Sandia Canyon	Perennial Surface Water	Cd		LANL
Sandia Canyon	Perennial Surface Water	Cu		
Sandia Canyon	Perennial Surface Water		Se	Natural
Sandia Canyon	Perennial Surface Water	Zn		
Sandia Canyon	Perennial Surface Water		ClO4	
Sandia Canyon	Perennial Surface Water		Aroclor-1260	Analytical artifact?
Sandia Canyon	Intermediate Perched Groundwater	Fe	Fe	Sampling artifact
Sandia Canyon	Intermediate Perched Groundwater	Mn	Mn	Sampling artifact
Sandia Canyon	Intermediate Perched Groundwater		Pb	Sampling artifact
Sandia Canyon	Intermediate Perched Groundwater		Bis(2-ethylhexyl)phthalate	Sampling artifact
Sandia Canyon	Regional Aquifer	Fe	Fe	Sampling artifact
Sandia Canyon	Regional Aquifer	Mn	Mn	Sampling artifact
Sandia Canyon	Regional Aquifer		Ni	
Sandia Canyon	Regional Aquifer	Se		Natural

Table B.1 (cont.)

Watershed	Media	Analyte (filtered)	Analyte (unfiltered)	Note
Mortandad Canyon	Ephemeral Surface Water	Al	Al	Sampling artifact
Mortandad Canyon	Ephemeral Surface Water		As	
Mortandad Canyon	Ephemeral Surface Water	Cu		
Mortandad Canyon	Ephemeral Surface Water	Fe	Fe	Sampling artifact
Mortandad Canyon	Ephemeral Surface Water		Pb	Anthropogenic
Mortandad Canyon	Ephemeral Surface Water	Mn	Mn	Sampling artifact
Mortandad Canyon	Ephemeral Surface Water		Mo	LANL
Mortandad Canyon	Ephemeral Surface Water	Zn		
Mortandad Canyon	Ephemeral Surface Water	F(-1)		LANL
Mortandad Canyon	Ephemeral Surface Water	ClO4	ClO4	LANL
Mortandad Canyon	Ephemeral Surface Water		Aroclor-1260	Analytical artifact?
Mortandad Canyon	Alluvial Groundwater	Fe	Fe	Sampling artifact
Mortandad Canyon	Alluvial Groundwater	Mn	Mn	Sampling artifact
Mortandad Canyon	Alluvial Groundwater	Mo	Mo	LANL
Mortandad Canyon	Alluvial Groundwater	Se		Natural
Mortandad Canyon	Alluvial Groundwater	U		
Mortandad Canyon	Alluvial Groundwater	F(-1)	F(-1)	LANL
Mortandad Canyon	Alluvial Groundwater	NO3-N		LANL
Mortandad Canyon	Alluvial Groundwater	ClO4	ClO4	LANL
Mortandad Canyon	Alluvial Groundwater		TDS	LANL
Mortandad Canyon	Alluvial Groundwater		Bis(2-ethylhexyl)phthalate	Sampling artifact
Mortandad Canyon	Intermediate Perched Groundwater		Sb	
Mortandad Canyon	Intermediate Perched Groundwater	Cr	Cr	LANL
Mortandad Canyon	Intermediate Perched Groundwater		Fe	Sampling artifact
Mortandad Canyon	Intermediate Perched Groundwater		Pb	Sampling artifact
Mortandad Canyon	Intermediate Perched Groundwater	Mn	Mn	Sampling artifact
Mortandad Canyon	Intermediate Perched Groundwater	Ni	Ni	
Mortandad Canyon	Intermediate Perched Groundwater	NO3-N	NO3-N	LANL
Mortandad Canyon	Intermediate Perched Groundwater	ClO4		LANL
Mortandad Canyon	Intermediate Perched Groundwater		Bis(2-ethylhexyl)phthalate	Sampling artifact
Mortandad Canyon	Intermediate Perched Groundwater		Nitroaniline[4-]	
Mortandad Canyon	Regional Aquifer	As	As	Natural

Table B.1 (cont.)

Watershed	Media	Analyte (filtered)	Analyte (unfiltered)	Note
Mortandad Canyon	Regional Aquifer	Cr	Cr	LANL
Mortandad Canyon	Regional Aquifer	Fe	Fe	Sampling artifact
Mortandad Canyon	Regional Aquifer	Mn	Mn	Sampling artifact
Mortandad Canyon	Regional Aquifer		Se	Natural
Mortandad Canyon	Regional Aquifer	ClO4		LANL
Mortandad Canyon	Regional Aquifer		Bis(2-ethylhexyl)phthalate	Sampling artifact
Pajarito Canyon	Ephemeral Surface Water	Al		Sampling artifact
Pajarito Canyon	Ephemeral Surface Water		As	
Pajarito Canyon	Ephemeral Surface Water		Se	Natural
Pajarito Canyon	Ephemeral Surface Water	NO3-N		LANL
Pajarito Canyon	Perennial Surface Water	Al		Sampling artifact
Pajarito Canyon	Perennial Surface Water		As	
Pajarito Canyon	Perennial Surface Water	NO3-N		LANL
Pajarito Canyon	Alluvial Groundwater	Fe	Fe	Sampling artifact
Pajarito Canyon	Alluvial Groundwater	Mn	Mn	Sampling artifact
Pajarito Canyon	Alluvial Groundwater	Cl(-1)		LANL
Pajarito Canyon	Alluvial Groundwater	TDS		LANL
Pajarito Canyon	Intermediate Perched Groundwater		Fe	Sampling artifact
Pajarito Canyon	Intermediate Perched Groundwater	Mn	Mn	Sampling artifact
Pajarito Canyon	Intermediate Perched Groundwater		Tl	
Pajarito Canyon	Regional Aquifer	As	As	Natural
Pajarito Canyon	Regional Aquifer	Fe	Fe	Sampling artifact
Pajarito Canyon	Regional Aquifer	Mn	Mn	Sampling artifact
Pajarito Canyon	Regional Aquifer	F(-1)		Natural
Pajarito Canyon	Regional Aquifer	ClO4		
Pajarito Canyon	Regional Aquifer	TDS		
Pajarito Canyon	Regional Aquifer		Bis(2-ethylhexyl)phthalate	Sampling artifact
Pajarito Canyon	Springs	Al		Sampling artifact
Pajarito Canyon	Springs	Sb	Sb	
Pajarito Canyon	Springs		As	
Pajarito Canyon	Springs	Fe	Fe	Sampling artifact
Pajarito Canyon	Springs	Mn	Mn	Sampling artifact
Pajarito Canyon	Springs		Se	Natural
Pajarito Canyon	Springs	NO3-N		LANL
Pajarito Canyon	Springs		ClO4	
Water Canyon/Cañon de Valle	Ephemeral Surface Water	Al		Sampling artifact
Water Canyon/Cañon de Valle	Ephemeral Surface Water		Se	Natural

Table B.1 (cont.)

Watershed	Media	Analyte (filtered)	Analyte (unfiltered)	Note
Water Canyon/Cañon de Valle	Ephemeral Surface Water		ClO4	
Water Canyon/Cañon de Valle	Perennial Surface Water	Ba	Ba	LANL
Water Canyon/Cañon de Valle	Alluvial Groundwater		Al	Natural
Water Canyon/Cañon de Valle	Alluvial Groundwater	As	As	
Water Canyon/Cañon de Valle	Alluvial Groundwater	Ba	Ba	LANL
Water Canyon/Cañon de Valle	Alluvial Groundwater		Be	LANL
Water Canyon/Cañon de Valle	Alluvial Groundwater		Cd	LANL
Water Canyon/Cañon de Valle	Alluvial Groundwater		Cr	LANL
Water Canyon/Cañon de Valle	Alluvial Groundwater	Fe	Fe	Sampling artifact
Water Canyon/Cañon de Valle	Alluvial Groundwater		Pb	Anthropogenic
Water Canyon/Cañon de Valle	Alluvial Groundwater	Mn	Mn	Sampling artifact
Water Canyon/Cañon de Valle	Alluvial Groundwater		Ni	
Water Canyon/Cañon de Valle	Alluvial Groundwater		Ag	LANL
Water Canyon/Cañon de Valle	Alluvial Groundwater		U	
Water Canyon/Cañon de Valle	Alluvial Groundwater	TDS		LANL
Water Canyon/Cañon de Valle	Alluvial Groundwater		Pentachlorophenol	LANL
Water Canyon/Cañon de Valle	Intermediate Perched Groundwater	As	As	
Water Canyon/Cañon de Valle	Intermediate Perched Groundwater	Be		LANL
Water Canyon/Cañon de Valle	Intermediate Perched Groundwater		Cr	LANL
Water Canyon/Cañon de Valle	Intermediate Perched Groundwater	Fe	Fe	Sampling artifact
Water Canyon/Cañon de Valle	Intermediate Perched Groundwater	Mn	Mn	Sampling artifact
Water Canyon/Cañon de Valle	Intermediate Perched Groundwater	Ni	Ni	
Water Canyon/Cañon de Valle	Regional Aquifer		Cr	LANL
Water Canyon/Cañon de Valle	Regional Aquifer	Fe	Fe	Sampling artifact
Water Canyon/Cañon de Valle	Regional Aquifer	Mn	Mn	Sampling artifact
Water Canyon/Cañon de Valle	Springs	Al		Sampling artifact
Water Canyon/Cañon de Valle	Springs		As	
Water Canyon/Cañon de Valle	Springs		Ba	LANL
Water Canyon/Cañon de Valle	Springs	B	B	LANL
Water Canyon/Cañon de Valle	Springs	Fe	Fe	Sampling artifact
Water Canyon/Cañon de Valle	Springs		Mn	Sampling artifact
Water Canyon/Cañon de Valle	Springs		Se	Natural
Water Canyon/Cañon de Valle	Springs		Tl	
Water Canyon/Cañon de Valle	Springs		NO3-N	LANL
Water Canyon/Cañon de Valle	Springs		ClO4	LANL
Water Canyon/Cañon de Valle	Springs		Tetrachloroethene	LANL

Table B.1 (cont.)

Watershed	Media	Analyte (filtered)	Analyte (unfiltered)	Note
Water Canyon/Cañon de Valle	Springs		Trichloroethene	LANL
Ancho Canyon	Regional Aquifer	Fe	Fe	Sampling artifact
Ancho Canyon	Regional Aquifer	Mn	Mn	Sampling artifact
Ancho Canyon	Regional Aquifer		Aroclor-1254	Analytical artifact?
Ancho Canyon	Regional Aquifer		Bis(2-ethylhexyl)phthalate	Sampling artifact
Ancho Canyon	Regional Aquifer		DDT[4,4'-]	Analytical artifact
Frijoles Canyon	Ephemeral Surface Water		Se	Natural
Frijoles Canyon	Ephemeral Surface Water		CN (am)	
Frijoles Canyon	Ephemeral Surface Water		Bis(2-ethylhexyl)phthalate	Sampling artifact
White Rock Canyon	Springs		As	Natural
White Rock Canyon	Springs		Fe	Sampling artifact
White Rock Canyon	Springs		Mn	Sampling artifact
White Rock Canyon	Springs		Bis(2-ethylhexyl)phthalate	Sampling artifact

Table B.2
Standard Values

Analyte Description	Analyte Code	Anyl Suite Code	Uom	WSF LVL	Nam WSF	WSU LVL	Nam WSU	WSF peren LVL	Nam WSFp	WSU peren LVL	Nam WSUp	GW	Nam GW	GWre	Nam GWre	LWF	LWU	WHU	AqAcF	AqAcU	HHPF	HHPU	AqChrF	AqChrU	HHF	HHU	GWHH	GWDW	MCL	SDWA	DCGsal	DCG	Reg6	Type	Reg6<
Hexachlorodibenzodioxins (Total)	34465-46-8	DIOX/FUR	ug/L	0.00011	Reg6	0.00011	Reg6	0.00011	Reg6	0.00011	Reg6	0.00011	Reg6	0.00011	Reg6																		0.00011	ca	
Tetrachlorodibenzodioxin [2,3,7,8-]	1746-01-6	DIOX/FUR	ug/L	0.0000045	Reg6	0.0000045	Reg6	0.0000045	Reg6	0.000000051	HHU	0.00003	SDWA	0.00003	SDWA											0.000000051				0.00003			0.0000045	ca	Tetrachlorodibenzodioxin[2,3,7,8-]
Ammonia as Nitrogen	NH3-N	GENINORG	ug/L	NA		39100	AqAcU	NA		8190	AqChrU	NA		NA						39100				8190											Ammonia as Nitrogen
Chloride	CL(-1)	GENINORG	ug/L	NA		NA		NA		NA		250000	GWDW	250000	GWDW													250000							Chloride
Chlorine, Total Residual	Cl2TOTRES	GENINORG	ug/L	NA		11	WHU	NA		11	WHU	NA		NA				11		19				11											Chlorine, Total Residual
Cyanide, Amenable	CN (amen)	GENINORG	ug/L	730	Reg6	5.2	WHU	730	Reg6	5.2	WHU	200	SDWA	200	SDWA			5.2		22				5.2		220000				200			730		Cyanide, Amenable
Cyanide, Total	CN(-1)	GENINORG	ug/L	NA		NA		NA		NA		200	GWHH	200	GWHH												200								Cyanide, Total
Cyanide, Weak Acid Dissociable	CN	GENINORG	ug/L	NA		5.2	WHU	NA		5.2	WHU	NA		NA				5.2		22				5.2											Cyanide, Weak Acid Dissociable
Fluoride	F(-1)	GENINORG	ug/L	2200	Reg6	2200	Reg6	2200	Reg6	2200	Reg6	1600	GWHH	1600	GWHH												1600			4000			2200	nc	Fluoride
Nitrate-Nitrite as N	NO3+NO2-N	GENINORG	ug/L	132000	LWF	132000	LWU	132000	LWF	132000	LWU	NA		NA		132000	132000																		Nitrate-Nitrite as N
Nitrogen, Nitrate (Expressed as NO3)	NO3(-1)	GENINORG	ug/L	10000	Reg6	10000	Reg6	10000	Reg6	10000	Reg6	10000	Reg6	10000	Reg6																		10000	nc	Nitrogen, Nitrate (Expressed as NO3)
Nitrogen, Nitrite (Expressed as NO2)	NO2(-1)	GENINORG	ug/L	1000	Reg6	1000	Reg6	1000	Reg6	1000	Reg6	1000	Reg6	1000	Reg6																		1000	nc	Nitrogen, Nitrite (Expressed as NO2)
Perchlorate	CLO4(-1)	GENINORG	ug/L	3.7	Reg6	3.7	Reg6	3.7	Reg6	3.7	Reg6	3.7	Reg6	3.7	Reg6																		3.7	nc	Perchlorate
Solids, Total Dissolved	TDS	GENINORG	ug/L	NA		NA		NA		NA		1000000	GWDW	1000000	GWDW													1000000							Solids, Total Dissolved
Sulfate	SO4(-2)	GENINORG	ug/L	NA		NA		NA		NA		600000	GWDW	600000	GWDW													600000							Sulfate
Aluminum	Al	METALS	ug/L	750	AqAcF	37000	Reg6	87	AqChrF	37000	Reg6	37000	Reg6	37000	Reg6	5000			750				87										37000	nc	Aluminum
Antimony	Sb	METALS	ug/L	15	Reg6	15	Reg6	640	HHF	15	Reg6	6	SDWA	6	SDWA										640					6			15	nc	Antimony
Arsenic	As	METALS	ug/L	200	LWF	0.45	Reg6	9	HHF	0.45	Reg6	10	SDWA	10	SDWA	200			340				150		9		100		50	10			0.45	ca	Arsenic
Barium	BA	METALS	ug/L	2600	Reg6	2600	Reg6	2600	Reg6	2600	Reg6	1000	MCL	1000	GWHH												1000		1000	2000			2600	nc	Barium
Beryllium	BE	METALS	ug/L	73	Reg6	73	Reg6	73	Reg6	73	Reg6	4	SDWA	4	SDWA															4			73	nc	Beryllium
Boron	B	METALS	ug/L	5000	LWF	3300	Reg6	5000	LWF	3300	Reg6	3300	Reg6	3300	Reg6	5000																	3300	nc	Boron
Cadmium	Cd	METALS	ug/L	2	AqAcF	18	Reg6	0.2	AqChrF	18	Reg6	5	SDWA	5	SDWA	50			2				0.2				10		10	5			18	nc	Cadmium
Chromium	Cr	METALS	ug/L	570	AqAcF	NA		74.1	AqChrF	NA		50	MCL	50	GWHH	1000			570				74.1				50		50	100					Chromium
Cobalt	Co	METALS	ug/L	1000	LWF	NA		1000	LWF	NA		NA		NA		1000																			Cobalt
Copper	Cu	METALS	ug/L	13.4	AqAcF	1400	Reg6	9	AqChrF	1400	Reg6	1000	GWDW	1000	GWDW	500			13.4				9					1000		1300			1400	nc	Copper
Iron	FE	METALS	ug/L	11000	Reg6	11000	Reg6	11000	Reg6	11000	Reg6	1000	GWDW	1000	GWDW													1000					11000	nc	Iron
Lead	Pb	METALS	ug/L	64.6	AqAcF	NA		2.5	AqChrF	NA		15	SDWA	15	SDWA	100			64.6				2.5				50		50	15					Lead
Lithium	LI	METALS	ug/L	730	Reg6	730	Reg6	730	Reg6	730	Reg6	730	Reg6	730	Reg6																		730	nc	Lithium
Manganese	MN	METALS	ug/L	1700	Reg6	1700	Reg6	1700	Reg6	1700	Reg6	200	GWDW	200	GWDW													200					1700	nc	Manganese
Mercury	Hg	METALS	ug/L	1.4	AqAcF	0.77	WHU	0.77	AqChrF	0.77	WHU	2	SDWA	2	SDWA		10	0.77	1.4				0.77				2		2	2			11	nc	Mercury
Molybdenum	MO	METALS	ug/L	180	Reg6	180	Reg6	180	Reg6	180	Reg6	180	Reg6	180	Reg6																		180	nc	Molybdenum
Nickel	Ni	METALS	ug/L	467	AqAcF	730	Reg6	52	AqChrF	730	Reg6	100	SDWA	100	SDWA				467				52		4600					100			730	nc	Nickel
Selenium	Se	METALS	ug/L	50	LWF	5	WHU	50	LWF	5	WHU	10	MCL	50	SDWA	50		5		20				5	4200		50		10	50			180	nc	Selenium
Silver	Ag	METALS	ug/L	3.2	AqAcF	180	Reg6	3.2	AqAcF	180	Reg6	50	MCL	50	GWHH				3.2								50		50				180	nc	Silver

Table B.2 (cont.)

Analyte Description	Analyte Code	Anyl Suite Code	Uom	WSF LVL	Nam WSF	WSU LVL	Nam WSU	WSF peren LVL	Nam WSFp	WSU peren LVL	Nam WSUp	GW	Nam GW	GWre	Nam GWre	LWF	LWU	WHU	AqAc F	AqAc U	HHPF	HHPU	AqChr F	AqChr U	HHF	HHU	GWHH	GWDW	MCL	SDWA	DCG sal	DCG	Reg6	Type	Reg6<
Strontium	SR	METALS	ug/L	22000	Reg6	22000	Reg6	22000	Reg6	22000	Reg6	22000	Reg6	22000	Reg6																		22000	nc	Strontium
Thallium	Tl	METALS	ug/L	NA		NA		6.3	HHF	NA		2	SDWA	2	SDWA										6.3					2					Thallium
Tin	SN	METALS	ug/L	22000	Reg6	22000	Reg6	22000	Reg6	22000	Reg6	22000	Reg6	22000	Reg6																		22000	nc	Tin
Vanadium	V	METALS	ug/L	100	LWF	260	Reg6	100	LWF	260	Reg6	260	Reg6	260	Reg6	100																	260	nc	Vanadium
Zinc	Zn	METALS	ug/L	117.2	AqAcF	11000	Reg6	117.2	AqAcF	11000	Reg6	10000	GWDW	10000	GWDW	25000			117.2				118		26000			10000					11000	nc	Zinc
Aldrin	309-00-2	PEST/PCB	ug/L	0.04	Reg6	3	AqAcU	0.04	Reg6	0.0005	HHU	0.04	Reg6	0.04	Reg6					3						0.0005							0.04	ca	Aldrin
Aroclor-1016	12674-11-2	PEST/PCB	ug/L	2.6	Reg6	0.014	WHU	2.6	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			2.6	ca	Aroclor-1016
Aroclor-1221	11104-28-2	PEST/PCB	ug/L	0.34	Reg6	0.014	WHU	0.34	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			0.34	ca	Aroclor-1221
Aroclor-1232	11141-16-5	PEST/PCB	ug/L	0.34	Reg6	0.014	WHU	0.34	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			0.34	ca	Aroclor-1232
Aroclor-1242	53469-21-9	PEST/PCB	ug/L	0.34	Reg6	0.014	WHU	0.34	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			0.34	ca	Aroclor-1242
Aroclor-1248	12672-29-6	PEST/PCB	ug/L	0.34	Reg6	0.014	WHU	0.34	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			0.34	ca	Aroclor-1248
Aroclor-1254	11097-69-1	PEST/PCB	ug/L	0.34	Reg6	0.014	WHU	0.34	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			0.34	ca	Aroclor-1254
Aroclor-1260	11096-82-5	PEST/PCB	ug/L	0.34	Reg6	0.014	WHU	0.34	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			0.34	ca	Aroclor-1260
Aroclor-1262	37324-23-5	PEST/PCB	ug/L	0.34	Reg6	0.014	WHU	0.34	Reg6	0.00064	HHU	0.5	SDWA	0.5	SDWA			0.014						0.014		0.00064	1			0.5			0.34	ca	Aroclor-1262
Aroclor-1268	11100-14-4	PEST/PCB	ug/L	NA		0.014	WHU	NA		0.00064	HHU	NA		NA				0.014						0.014		0.00064									Aroclor-1268
Aroclors (Mixed)	1336-36-3	PEST/PCB	ug/L	NA		NA		NA		0.00064	HHU	NA		NA										0.014		0.00064									Aroclors (Mixed)
BHC[alpha-]	319-84-6	PEST/PCB	ug/L	0.11	Reg6	0.11	Reg6	0.11	Reg6	0.049	HHU	0.11	Reg6	0.11	Reg6											0.049							0.11	ca	BHC[alpha-]
BHC[beta-]	319-85-7	PEST/PCB	ug/L	0.37	Reg6	0.37	Reg6	0.37	Reg6	0.17	HHU	0.37	Reg6	0.37	Reg6											0.17							0.37	ca	BHC[beta-]
BHC[gamma-]	58-89-9	PEST/PCB	ug/L	0.52	Reg6	0.95	AqAcU	0.52	Reg6	0.63	HHU	0.2	SDWA	0.2	SDWA					0.95						0.63			4	0.2			0.52	ca	BHC[gamma-]
Chlordane(alpha/gamma)	57-74-9	PEST/PCB	ug/L	NA		2.4	AqAcU	NA		0.0043	AqChrU	NA		NA						2.4				0.0043		0.0081									Chlordane(alpha/gamma)
Chlordane[alpha-]	5103-71-9	PEST/PCB	ug/L	1.9	Reg6	1.9	Reg6	1.9	Reg6	1.9	Reg6	2	SDWA	2	SDWA															2			1.9	ca	Chlordane[alpha-]
Chlordane[gamma-]	5103-74-2	PEST/PCB	ug/L	1.9	Reg6	1.9	Reg6	1.9	Reg6	1.9	Reg6	2	SDWA	2	SDWA															2			1.9	ca	Chlordane[gamma-]
DDD[4,4'-]	72-54-8	PEST/PCB	ug/L	2.8	Reg6	0.001	WHU	2.8	Reg6	0.001	WHU	2.8	Reg6	2.8	Reg6			0.001		1.1				0.001		0.0022							2.8	ca	DDD[4,4'-]
DDE[4,4'-]	72-55-9	PEST/PCB	ug/L	2	Reg6	0.001	WHU	2	Reg6	0.001	WHU	2	Reg6	2	Reg6			0.001		1.1				0.001		0.0022							2	ca	DDE[4,4'-]
DDT[4,4'-]	50-29-3	PEST/PCB	ug/L	2	Reg6	0.001	WHU	2	Reg6	0.001	WHU	2	Reg6	2	Reg6			0.001		1.1				0.001		0.0022							2	ca	DDT[4,4'-]
Dieldrin	60-57-1	PEST/PCB	ug/L	0.042	Reg6	0.24	AqAcU	0.042	Reg6	0.00054	HHU	0.042	Reg6	0.042	Reg6					0.24				0.056		0.00054							0.042	ca	Dieldrin

Table B.2 (cont.)

Analyte Description	Analyte Code	Anyl Suite Code	Uom	WSF LVL	Nam WSF	WSU LVL	Nam WSU	WSF peren LVL	Nam WSFp	WSU peren LVL	Nam WSUp	GW	Nam GW	GWre	Nam GWre	LWF	LWU	WHU	AqAc F	AqAc U	HHPF	HHPU	AqChr F	AqChr U	HHF	HHU	GWHH	GWDW	MCL	SDWA	DCG sal	DCG	Reg6	Type	Reg6<
Endosulfan	115-29-7	PEST/PCB	ug/L	220	Reg6	220	Reg6	220	Reg6	220	Reg6	220	Reg6	220	Reg6																		220	nc	Endosulfan
Endosulfan I	959-98-8	PEST/PCB	ug/L	220	Reg6	0.22	AqAcU	220	Reg6	0.056	AqChrU	220	Reg6	220	Reg6					0.22				0.056		89							220	nc	Endosulfan I
Endosulfan II	33213-65-9	PEST/PCB	ug/L	220	Reg6	0.22	AqAcU	220	Reg6	0.056	AqChrU	220	Reg6	220	Reg6					0.22				0.056		89							220	nc	Endosulfan II
Endosulfan Sulfate	1031-07-8	PEST/PCB	ug/L	220	Reg6	220	Reg6	220	Reg6	89	HHU	220	Reg6	220	Reg6											89							220	nc	Endosulfan Sulfate
Endrin	72-20-8	PEST/PCB	ug/L	11	Reg6	0.086	AqAcU	11	Reg6	0.036	AqChrU	0.2	MCL	2	SDWA					0.086				0.036		0.81			0.2	2			11	nc	Endrin
Endrin Aldehyde	7421-93-4	PEST/PCB	ug/L	11	Reg6	11	Reg6	11	Reg6	0.3	HHU	0.2	MCL	2	SDWA											0.3			0.2	2			11	nc	Endrin Aldehyde
Endrin Ketone	53494-70-5	PEST/PCB	ug/L	11	Reg6	11	Reg6	11	Reg6	11	Reg6	0.2	MCL	2	SDWA														0.2	2			11	nc	Endrin Ketone
Heptachlor	76-44-8	PEST/PCB	ug/L	0.15	Reg6	0.52	AqAcU	0.15	Reg6	0.00079	HHU	0.4	SDWA	0.4	SDWA					0.52				0.0038		0.00079				0.4			0.15	ca	Heptachlor
Heptachlor Epoxide	1024-57-3	PEST/PCB	ug/L	0.074	Reg6	0.52	AqAcU	0.074	Reg6	0.00039	HHU	0.2	SDWA	0.2	SDWA					0.52				0.0038		0.00039				0.2			0.074	ca	Heptachlor Epoxide
Methoxychlor[4,4'-]	72-43-5	PEST/PCB	ug/L	180	Reg6	180	Reg6	180	Reg6	180	Reg6	40	SDWA	40	SDWA														100	40			180	nc	Methoxychlor[4,4'-]
Toxaphene (Technical Grade)	8001-35-2	PEST/PCB	ug/L	0.61	Reg6	0.73	AqAcU	0.61	Reg6	0.0002	AqChrU	3	SDWA	3	SDWA					0.73				0.0002		0.0028			5	3			0.61	ca	Toxaphene (Technical Grade)
Americium-241	Am-241	RAD	pCi/L	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG															15	30	1.2			
Cesium-134	CS-134	RAD	pCi/L	80	DCG	80	DCG	80	DCG	80	DCG	80	SDWA	80	SDWA															80		80			
Cesium-137	Cs-137	RAD	pCi/L	120	DCG	120	DCG	120	DCG	120	DCG	120	DCG	120	DCG															200	3000	120			
Cobalt-60	Co-60	RAD	pCi/L	200	DCG	200	DCG	200	DCG	200	DCG	100	SDWA	100	SDWA															100	10000	200			
Europium-152	EU-152	RAD	pCi/L	800	DCG	800	DCG	800	DCG	800	DCG	200	SDWA	200	SDWA															200		800			
Gross Alpha	GROSSA	RAD	pCi/L	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG		15														30	1.2			
Gross Beta	GROSSB	RAD	pCi/L	40	DCG	40	DCG	40	DCG	40	DCG	40	DCG	40	DCG																1000	40			
Lead-210	Pb-210	RAD	pCi/L	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG																30	1.2			
Neptunium-237	Np-237	RAD	pCi/L	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG																30	1.2			
Plutonium-238	Pu-238	RAD	pCi/L	1.6	DCG	1.6	DCG	1.6	DCG	1.6	DCG	1.6	DCG	1.6	DCG															15	40	1.6			
Plutonium-239	PU-239	RAD	pCi/L	NA		NA		NA		NA		15	SDWA	15	SDWA															15					
Plutonium-239/240	Pu-239,240	RAD	pCi/L	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG	1.2	DCG																30	1.2			
Polonium-210	PO-210	RAD	pCi/L	NA		NA		NA		NA		NA		NA																					
Potassium-40	K-40	RAD	pCi/L	280	DCG	280	DCG	280	DCG	280	DCG	280	DCG	280	DCG																7000	280			
Radium-226	Ra-226	RAD	pCi/L	4	DCG	4	DCG	4	DCG	4	DCG	4	DCG	4	DCG		30														100	4			
Radium-226 + Radium 228	Ra-226,228	RAD	pCi/L	NA		30	LWU	NA		30	LWU	NA		NA			30																		
Radium-228	Ra-228	RAD	pCi/L	4	DCG	4	DCG	4	DCG	4	DCG	4	DCG	4	DCG		30														100	4			
Ruthenium-106	RU-106	RAD	pCi/L	240	DCG	240	DCG	240	DCG	240	DCG	30	SDWA	30	SDWA															30		240			
Sodium-22	Na-22	RAD	pCi/L	400	DCG	400	DCG	400	DCG	400	DCG	400	SDWA	400	SDWA															400	10000	400			
Strontium-90	Sr-90	RAD	pCi/L	40	DCG	40	DCG	40	DCG	40	DCG	8	SDWA	8	SDWA															8	1000	40			

Table B.2 (cont.)

Analyte Description	Analyte Code	Anyl Suite Code	Uom	WSF LVL	Nam WSF	WSU LVL	Nam WSU	WSF peren LVL	Nam WSFp	WSU peren LVL	Nam WSUp	GW	Nam GW	GWre	Nam GWre	LWF	LWU	WHU	AqAc F	AqAc U	HHPF	HHPU	AqChr F	AqChr U	HHF	HHU	GWHH	GWDW	MCL	SDWA	DCG sal	DCG	Reg6	Type	Reg6<
Technetium-99	TC-99	RAD	pCi/L	4000	DCG	4000	DCG	4000	DCG	4000	DCG	4000	DCG	4000	DCG																667000	4000			
Thorium-228	Th-228	RAD	pCi/L	16	DCG	16	DCG	16	DCG	16	DCG	16	DCG	16	DCG																400	16			
Thorium-230	Th-230	RAD	pCi/L	12	DCG	12	DCG	12	DCG	12	DCG	12	DCG	12	DCG																300	12			
Thorium-232	Th-232	RAD	pCi/L	2	DCG	2	DCG	2	DCG	2	DCG	2	DCG	2	DCG																50	2			
Tritium	H-3	RAD	pCi/L	80000	DCG	20000	LWU	80000	DCG	20000	LWU	20000	SDWA	20000	SDWA		20000													20000	2000000	80000			
Uranium	U	RAD	pCi/L	32	DCG	32	DCG	32	DCG	32	DCG	30	SDWA	30	SDWA												5000			30	800	32			
Uranium-232	U-232	RAD	pCi/L	4	DCG	4	DCG	4	DCG	4	DCG	4	DCG	4	DCG																100	4			
Uranium-233,234	U-233,234	RAD	pCi/L	20	DCG	20	DCG	20	DCG	20	DCG	20	DCG	20	DCG																500	20			
Uranium-234	U-234	RAD	pCi/L	20	DCG	20	DCG	20	DCG	20	DCG	20	DCG	20	DCG																500	20			
Uranium-235	U-235	RAD	pCi/L	24	DCG	24	DCG	24	DCG	24	DCG	24	DCG	24	DCG																600	24			
Uranium-235,236	U-235,236	RAD	pCi/L	24	DCG	24	DCG	24	DCG	24	DCG	24	DCG	24	DCG																600	24			
Uranium-238	U-238	RAD	pCi/L	24	DCG	24	DCG	24	DCG	24	DCG	24	DCG	24	DCG																600	24			
Acenaphthene	83-32-9	SVOA	ug/L	370	Reg6	370	Reg6	370	Reg6	990	HHU	370	Reg6	370	Reg6											990							370	nc	
Aniline	62-53-3	SVOA	ug/L	120	Reg6	120	Reg6	120	Reg6	120	Reg6	120	Reg6	120	Reg6																		120	ca	
Anthracene	120-12-7	SVOA	ug/L	1800	Reg6	1800	Reg6	1800	Reg6	40000	HHU	1800	Reg6	1800	Reg6											40000							1800	nc	
Azobenzene	103-33-3	SVOA	ug/L	6.1	Reg6	6.1	Reg6	6.1	Reg6	6.1	Reg6	6.1	Reg6	6.1	Reg6																		6.1	ca	
Benzidine	92-87-5	SVOA	ug/L	0.0029	Reg6	0.0029	Reg6	0.0029	Reg6	0.002	HHU	0.0029	Reg6	0.0029	Reg6											0.002							0.0029	ca	
Benzo(a)anthracene	56-55-3	SVOA	ug/L	0.92	Reg6	0.92	Reg6	0.92	Reg6	0.18	HHU	0.92	Reg6	0.92	Reg6											0.18							0.92	ca	
Benzo(a)pyrene	50-32-8	SVOA	ug/L	0.092	Reg6	0.092	Reg6	0.092	Reg6	0.18	HHU	0.2	SDWA	0.2	SDWA											0.18	0.7			0.2			0.092	ca	
Benzo(b)fluoranthene	205-99-2	SVOA	ug/L	0.92	Reg6	0.92	Reg6	0.92	Reg6	0.18	HHU	0.92	Reg6	0.92	Reg6											0.18							0.92	ca	
Benzo(g,h,i)perylene	191-24-2	SVOA	ug/L	180	Reg6	180	Reg6	180	Reg6	180	Reg6	180	Reg6	180	Reg6																		180	nc	
Benzo(k)fluoranthene	207-08-9	SVOA	ug/L	9.2	Reg6	9.2	Reg6	9.2	Reg6	0.18	HHU	9.2	Reg6	9.2	Reg6											0.18							9.2	ca	
Benzoic Acid	65-85-0	SVOA	ug/L	150000	Reg6	150000	Reg6	150000	Reg6	150000	Reg6	150000	Reg6	150000	Reg6																		150000	nc	
Benzyl Alcohol	100-51-6	SVOA	ug/L	11000	Reg6	11000	Reg6	11000	Reg6	11000	Reg6	11000	Reg6	11000	Reg6																		11000	nc	
Bis(2-chloroethyl)ether	111-44-4	SVOA	ug/L	0.098	Reg6	0.098	Reg6	0.098	Reg6	5.3	HHU	0.098	Reg6	0.098	Reg6											5.3							0.098	ca	
Bis(2-chloroisopropyl)ether	108-60-1	SVOA	ug/L	NA		NA		NA		65000	HHU	NA		NA												65000									
Bis(2-ethylhexyl)phthalate	117-81-7	SVOA	ug/L	48	Reg6	48	Reg6	48	Reg6	22	HHU	6	SDWA	6	SDWA											22				6			48	ca	
Butylbenzylphthalate	85-68-7	SVOA	ug/L	7300	Reg6	7300	Reg6	7300	Reg6	1900	HHU	7300	Reg6	7300	Reg6											1900							7300	nc	
Carbazole	86-74-8	SVOA	ug/L	34	Reg6	34	Reg6	34	Reg6	34	Reg6	34	Reg6	34	Reg6																		34	ca	
Chloro-3-methylphenol[4-]	59-50-7	SVOA	ug/L	NA		NA		NA		NA		5	GWDW	5	GWDW													5							
Chloroaniline[4-]	106-47-8	SVOA	ug/L	150	Reg6	150	Reg6	150	Reg6	150	Reg6	150	Reg6	150	Reg6																		150	nc	
Chloronaphthalene[2-]	91-58-7	SVOA	ug/L	490	Reg6	490	Reg6	490	Reg6	1600	HHU	490	Reg6	490	Reg6											1600							490	nc	
Chlorophenol[2-]	95-57-8	SVOA	ug/L	30	Reg6	30	Reg6	30	Reg6	150	HHU	5	GWDW	5	GWDW											150		5					30	nc	
Chrysene	218-01-9	SVOA	ug/L	92	Reg6	92	Reg6	92	Reg6	0.18	HHU	92	Reg6	92	Reg6											0.18							92	ca	
Dibenz(a,h)anthracene	53-70-3	SVOA	ug/L	0.092	Reg6	0.092	Reg6	0.092	Reg6	0.18	HHU	0.092	Reg6	0.092	Reg6											0.18							0.092	ca	
Dibenzofuran	132-64-9	SVOA	ug/L	24	Reg6	24	Reg6	24	Reg6	24	Reg6	24	Reg6	24	Reg6																		24	nc	

Table B.2 (cont.)

Analyte Description	Analyte Code	Anyl Suite Code	Uom	WSF LVL	Nam WSF	WSU LVL	Nam WSU	WSF peren LVL	Nam WSFp	WSU peren LVL	Nam WSUp	GW	Nam GW	GWre	Nam GWre	LWF	LWU	WHU	AqAc F	AqAc U	HHPF	HHPU	AqChr F	AqChr U	HHF	HHU	GWHH	GWDW	MCL	SDWA	DCG sal	DCG	Reg6	Type	Reg6<
Dibutyl phthalate	84-74-2	SVOA	ug/L	NA		NA		NA		4500	HHU	NA		NA												4500									
Dichlorobenzene[1,2-]	95-50-1	SVOA	ug/L	61	Reg6	61	Reg6	61	Reg6	17000	HHU	600	SDWA	600	SDWA											17000				600			61	nc	
Dichlorobenzene[1,3-]	541-73-1	SVOA	ug/L	18	Reg6	18	Reg6	18	Reg6	960	HHU	18	Reg6	18	Reg6											960							18	nc	
Dichlorobenzene[1,4-]	106-46-7	SVOA	ug/L	4.7	Reg6	4.7	Reg6	4.7	Reg6	2600	HHU	75	SDWA	75	SDWA											2600				75			4.7	ca	
Dichlorobenzidine[3,3'-]	91-94-1	SVOA	ug/L	1.5	Reg6	1.5	Reg6	1.5	Reg6	0.28	HHU	1.5	Reg6	1.5	Reg6											0.28							1.5	ca	
Dichlorophenol[2,4-]	120-83-2	SVOA	ug/L	110	Reg6	110	Reg6	110	Reg6	290	HHU	5	GWDW	5	GWDW											290		5					110	nc	
Diethylphthalate	84-66-2	SVOA	ug/L	29000	Reg6	29000	Reg6	29000	Reg6	44000	HHU	29000	Reg6	29000	Reg6											44000							29000	nc	
Dimethyl Phthalate	131-11-3	SVOA	ug/L	370000	Reg6	370000	Reg6	370000	Reg6	1100000	HHU	370000	Reg6	370000	Reg6											1100000							370000	nc	
Dimethylphenol[2,4-]	105-67-9	SVOA	ug/L	730	Reg6	730	Reg6	730	Reg6	850	HHU	730	Reg6	730	Reg6											850							730	nc	
Di-n-butylphthalate	84-74-2	SVOA	ug/L	3700	Reg6	3700	Reg6	3700	Reg6	4500	HHU	3700	Reg6	3700	Reg6											4500							3700	nc	
Dinitro-2-methylphenol[4,6-]	534-52-1	SVOA	ug/L	NA		NA		NA		280	HHU	NA		NA												280									
Dinitrophenol[2,4-]	51-28-5	SVOA	ug/L	73	Reg6	73	Reg6	73	Reg6	5300	HHU	73	Reg6	73	Reg6											5300							73	nc	
Dinitrotoluene[2,4-]	121-14-2	SVOA	ug/L	73	Reg6	73	Reg6	73	Reg6	34	HHU	73	Reg6	73	Reg6											34							73	nc	
Dinitrotoluene[2,6-]	606-20-2	SVOA	ug/L	37	Reg6	37	Reg6	37	Reg6	37	Reg6	37	Reg6	37	Reg6																		37	nc	
Di-n-octylphthalate	117-84-0	SVOA	ug/L	730	Reg6	730	Reg6	730	Reg6	730	Reg6	730	Reg6	730	Reg6																		730	nc	
Diphenylamine	122-39-4	SVOA	ug/L	910	Reg6	910	Reg6	910	Reg6	910	Reg6	910	Reg6	910	Reg6																		910	nc	
Diphenylhydrazine[1,2]	122-66-7	SVOA	ug/L	0.84	Reg6	0.84	Reg6	0.84	Reg6	0.84	Reg6	0.84	Reg6	0.84	Reg6																		0.84	ca	
Diphenylhydrazine[1,2-]	122-66-7	SVOA	ug/L	NA		NA		NA		2	HHU	NA		NA												2									
Fluoranthene	206-44-0	SVOA	ug/L	1500	Reg6	1500	Reg6	1500	Reg6	140	HHU	1500	Reg6	1500	Reg6											140							1500	nc	
Fluorene	86-73-7	SVOA	ug/L	240	Reg6	240	Reg6	240	Reg6	5300	HHU	240	Reg6	240	Reg6											5300							240	nc	
Hexachlorobenzene	118-74-1	SVOA	ug/L	0.42	Reg6	0.42	Reg6	0.42	Reg6	0.0029	HHU	1	SDWA	1	SDWA											0.0029				1			0.42	ca	
Hexachlorobutadiene	87-68-3	SVOA	ug/L	7.3	Reg6	7.3	Reg6	7.3	Reg6	180	HHU	7.3	Reg6	7.3	Reg6											180							7.3	ca/nc	
Hexachlorocyclopentadiene	77-47-4	SVOA	ug/L	220	Reg6	220	Reg6	220	Reg6	17000	HHU	50	SDWA	50	SDWA											17000				50			220	nc	
Hexachloroethane	67-72-1	SVOA	ug/L	37	Reg6	37	Reg6	37	Reg6	33	HHU	37	Reg6	37	Reg6											33							37	ca	
Indeno(1,2,3-cd)pyrene	193-39-5	SVOA	ug/L	0.92	Reg6	0.92	Reg6	0.92	Reg6	0.18	HHU	0.92	Reg6	0.92	Reg6											0.18							0.92	ca	
Isophorone	78-59-1	SVOA	ug/L	710	Reg6	710	Reg6	710	Reg6	9600	HHU	710	Reg6	710	Reg6											9600							710	ca	
Methylnaphthalene[2-]	91-57-6	SVOA	ug/L	6.2	Reg6	6.2	Reg6	6.2	Reg6	6.2	Reg6	30	GWHH	30	GWHH												30						6.2	nc	
Methylphenol[2-]	95-48-7	SVOA	ug/L	1800	Reg6	1800	Reg6	1800	Reg6	1800	Reg6	5	GWDW	5	GWDW													5					1800	nc	
Methylphenol[4-]	106-44-5	SVOA	ug/L	180	Reg6	180	Reg6	180	Reg6	180	Reg6	180	Reg6	180	Reg6																		180	nc	
Nitroaniline[2-]	88-74-4	SVOA	ug/L	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6																		2.2	nc	
Nitroaniline[3-]	99-09-2	SVOA	ug/L	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6																		2.2	nc	
Nitroaniline[4-]	100-01-6	SVOA	ug/L	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6	2.2	Reg6																		2.2	nc	
Nitrobenzene	98-95-3	SVOA	ug/L	3.4	Reg6	3.4	Reg6	3.4	Reg6	690	HHU	3.4	Reg6	3.4	Reg6											690							3.4	nc	
Nitrophenol[2-]	88-75-5	SVOA	ug/L	290	Reg6	290	Reg6	290	Reg6	290	Reg6	5	GWDW	5	GWDW													5					290	nc	
Nitrophenol[4-]	100-02-7	SVOA	ug/L	290	Reg6	290	Reg6	290	Reg6	290	Reg6	5	GWDW	5	GWDW													5					290	nc	
Nitrosodimethylamine[N-]	62-75-9	SVOA	ug/L	0.013	Reg6	0.013	Reg6	0.013	Reg6	30	HHU	0.013	Reg6	0.013	Reg6											30							0.013	ca	
Nitroso-di-n-propylamine[N-]	621-64-7	SVOA	ug/L	0.096	Reg6	0.096	Reg6	0.096	Reg6	5.1	HHU	0.096	Reg6	0.096	Reg6											5.1							0.096	ca	
Nitrosodiphenylamine[N-]	86-30-6	SVOA	ug/L	140	Reg6	140	Reg6	140	Reg6	60	HHU	140	Reg6	140	Reg6											60							140	ca	

Table B.2 (cont.)

Analyte Description	Analyte Code	Anyl Suite Code	Uom	WSF LVL	Nam WSF	WSU LVL	Nam WSU	WSF peren LVL	Nam WSFp	WSU peren LVL	Nam WSUp	GW	Nam GW	GWre	Nam GWre	LWF	LWU	WHU	AqAc F	AqAc U	HHPF	HHPU	AqChr F	AqChr U	HHF	HHU	GWHH	GWDW	MCL	SDWA	DCG sal	DCG	Reg6	Type	Reg6<
Pentachlorophenol	87-86-5	SVOA	ug/L	5.6	Reg6	19	AqAcU	5.6	Reg6	15	AqChrU	1	SDWA	1	SDWA					19				15		30		5		1			5.6	ca	
Phenol	108-95-2	SVOA	ug/L	11000	Reg6	11000	Reg6	11000	Reg6	1700000	HHU	5	GWDW	5	GWDW											1700000		5					11000	nc	
Pyrene	129-00-0	SVOA	ug/L	180	Reg6	180	Reg6	180	Reg6	4000	HHU	180	Reg6	180	Reg6											4000							180	nc	
Pyridine	110-86-1	SVOA	ug/L	37	Reg6	37	Reg6	37	Reg6	37	Reg6	37	Reg6	37	Reg6																		37	nc	
Trichlorobenzene[1,2,4-]	120-82-1	SVOA	ug/L	190	Reg6	190	Reg6	190	Reg6	940	HHU	70	SDWA	70	SDWA											940				70			190	nc	
Trichlorophenol[2,4,5-]	95-95-4	SVOA	ug/L	3700	Reg6	3700	Reg6	3700	Reg6	3700	Reg6	5	GWDW	5	GWDW													5					3700	nc	
Trichlorophenol[2,4,6-]	88-06-2	SVOA	ug/L	0.61	Reg6	0.61	Reg6	0.61	Reg6	24	HHU	5	GWDW	5	GWDW											24		5					0.61	ca	
Acetone	67-64-1	VOA	ug/L	610	Reg6	610	Reg6	610	Reg6	610	Reg6	610	Reg6	610	Reg6																		610	nc	
Acrolein	107-02-8	VOA	ug/L	NA		NA		NA		290	HHU	NA		NA												290									
Acrylonitrile	107-13-1	VOA	ug/L	NA		NA		NA		2.5	HHU	NA		NA												2.5									
Benzene	71-43-2	VOA	ug/L	3.5	Reg6	3.5	Reg6	3.5	Reg6	510	HHU	5	SDWA	5	SDWA											510	10			5			3.5	ca	
Bromobenzene	108-86-1	VOA	ug/L	23	Reg6	23	Reg6	23	Reg6	23	Reg6	23	Reg6	23	Reg6																		23	nc	
Bromochloromethane	74-97-5	VOA	ug/L	43	Reg6	43	Reg6	43	Reg6	43	Reg6	43	Reg6	43	Reg6																		43	ca	
Bromodichloromethane	75-27-4	VOA	ug/L	1.8	Reg6	1.8	Reg6	1.8	Reg6	170	HHU	100	SDWA	100	SDWA											170				100			1.8	ca	
Bromoform	75-25-2	VOA	ug/L	85	Reg6	85	Reg6	85	Reg6	1400	HHU	100	SDWA	100	SDWA											1400				100			85	ca	
Bromomethane	74-83-9	VOA	ug/L	8.7	Reg6	8.7	Reg6	8.7	Reg6	1500	HHU	8.7	Reg6	8.7	Reg6											1500							8.7	nc	
Butanone[2-]	78-93-3	VOA	ug/L	1900	Reg6	1900	Reg6	1900	Reg6	1900	Reg6	1900	Reg6	1900	Reg6																		1900	nc	
Butylbenzene[n-]	104-51-8	VOA	ug/L	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6																		61	nc	
Butylbenzene[sec-]	135-98-8	VOA	ug/L	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6																		61	nc	
Butylbenzene[tert-]	98-06-6	VOA	ug/L	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6																		61	nc	
Carbon Disulfide	75-15-0	VOA	ug/L	1000	Reg6	1000	Reg6	1000	Reg6	1000	Reg6	1000	Reg6	1000	Reg6																		1000	nc	
Carbon Tetrachloride	56-23-5	VOA	ug/L	1.7	Reg6	1.7	Reg6	1.7	Reg6	16	HHU	5	SDWA	5	SDWA											16	10			5			1.7	ca	
Chlorobenzene	108-90-7	VOA	ug/L	110	Reg6	110	Reg6	110	Reg6	21000	HHU	100	SDWA	100	SDWA											21000				100			110	nc	
Chlorodibromomethane	124-48-1	VOA	ug/L	1.3	Reg6	1.3	Reg6	1.3	Reg6	130	HHU	100	SDWA	100	SDWA											130				100			1.3	ca	
Chloroethane	75-00-3	VOA	ug/L	39	Reg6	39	Reg6	39	Reg6	39	Reg6	39	Reg6	39	Reg6																		39	ca	
Chloroform	67-66-3	VOA	ug/L	0.62	Reg6	0.62	Reg6	0.62	Reg6	4700	HHU	100	SDWA	100	SDWA											4700	100			100			0.62	ca/nc	
Chloromethane	74-87-3	VOA	ug/L	15	Reg6	15	Reg6	15	Reg6	15	Reg6	15	Reg6	15	Reg6																		15	ca	
Chlorotoluene[2-]	95-49-8	VOA	ug/L	120	Reg6	120	Reg6	120	Reg6	120	Reg6	120	Reg6	120	Reg6																		120	nc	
Chlorotoluene[4-]	106-43-4	VOA	ug/L	120	Reg6	120	Reg6	120	Reg6	120	Reg6	120	Reg6	120	Reg6																		120	nc	
Dibromo-3-chloropropane[1,2-]	96-12-8	VOA	ug/L	0.35	Reg6	0.35	Reg6	0.35	Reg6	0.35	Reg6	0.2	SDWA	0.2	SDWA															0.2			0.35	ca	
Dibromoethane[1,2-]	106-93-4	VOA	ug/L	0.0076	Reg6	0.0076	Reg6	0.0076	Reg6	0.0076	Reg6	0.05	SDWA	0.05	SDWA												0.1			0.05			0.0076	ca	
Dibromomethane	74-95-3	VOA	ug/L	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6																		61	nc	
Dichlorodifluoromethane	75-71-8	VOA	ug/L	390	Reg6	390	Reg6	390	Reg6	390	Reg6	390	Reg6	390	Reg6																		390	nc	
Dichloroethane[1,1-]	75-34-3	VOA	ug/L	810	Reg6	810	Reg6	810	Reg6	810	Reg6	25	GWHH	25	GWHH												25						810	nc	
Dichloroethane[1,2-]	107-06-2	VOA	ug/L	1.2	Reg6	1.2	Reg6	1.2	Reg6	370	HHU	5	SDWA	5	SDWA											370	10			5			1.2	ca	
Dichloroethene[1,1-]	75-35-4	VOA	ug/L	340	Reg6	340	Reg6	340	Reg6	32	HHU	5	GWHH	5	GWHH											32	5			7			340	nc	
Dichloroethene[cis-1,2-]	156-59-2	VOA	ug/L	61	Reg6	61	Reg6	61	Reg6	61	Reg6	70	SDWA	70	SDWA															70			61	nc	
Dichloroethene[trans-1,2-]	156-60-5	VOA	ug/L	120	Reg6	120	Reg6	120	Reg6	140000	HHU	100	SDWA	100	SDWA											140000				100			120	nc	
Dichloropropane[1,2-]	78-87-5	VOA	ug/L	1.6	Reg6	1.6	Reg6	1.6	Reg6	150	HHU	5	SDWA	5	SDWA											150				5			1.6	ca	

Table B.2 (cont.)

Analyte Description	Analyte Code	Anyl Suite Code	Uom	WSF LVL	Nam WSF	WSU LVL	Nam WSU	WSF peren LVL	Nam WSFp	WSU peren LVL	Nam WSUp	GW	Nam GW	GWre	Nam GWre	LWF	LWU	WHU	AqAc F	AqAc U	HHPF	HHPU	AqChr F	AqChr U	HHF	HHU	GWHH	GWDW	MCL	SDWA	DCG sal	DCG	Reg6	Type	Reg6<
Dichloropropane[1,3-]	142-28-9	VOA	ug/L	1.6	Reg6	1.6	Reg6	1.6	Reg6	1.6	Reg6	5	SDWA	5	SDWA															5			1.6	ca	
Dichloropropane[2,2-]	594-20-7	VOA	ug/L	1.6	Reg6	1.6	Reg6	1.6	Reg6	1.6	Reg6	5	SDWA	5	SDWA															5			1.6	ca	
Dichloropropene[1,1-]	563-58-6	VOA	ug/L	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6																		4	ca	
Dichloropropene[1,3-]	542-75-6	VOA	ug/L	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6																		4	ca	
Dichloropropene[cis/trans-1,3-]	542-75-6	VOA	ug/L	NA		NA		NA		1700	HHU	NA		NA												1700									
Dichloropropene[cis-1,3-]	10061-01-5	VOA	ug/L	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6																		4	ca	
Dichloropropene[trans-1,3-]	10061-02-6	VOA	ug/L	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6	4	Reg6																		4	ca	
Ethylbenzene	100-41-4	VOA	ug/L	13000	Reg6	13000	Reg6	13000	Reg6	29000	HHU	700	SDWA	700	SDWA											29000	750			700			13000	ca	
Hexanone[2-]	591-78-6	VOA	ug/L	1900	Reg6	1900	Reg6	1900	Reg6	1900	Reg6	1900	Reg6	1900	Reg6																		1900	nc	
Iodomethane	74-88-4	VOA	ug/L	8.7	Reg6	8.7	Reg6	8.7	Reg6	8.7	Reg6	8.7	Reg6	8.7	Reg6																		8.7	nc	
Isopropylbenzene	98-82-8	VOA	ug/L	660	Reg6	660	Reg6	660	Reg6	660	Reg6	660	Reg6	660	Reg6																		660	nc	
Isopropyltoluene[4-]	99-87-6	VOA	ug/L	660	Reg6	660	Reg6	660	Reg6	660	Reg6	660	Reg6	660	Reg6																		660	nc	
Methyl-2-pentanone[4-]	108-10-1	VOA	ug/L	160	Reg6	160	Reg6	160	Reg6	160	Reg6	160	Reg6	160	Reg6																		160	nc	
Methylene Chloride	75-09-2	VOA	ug/L	43	Reg6	43	Reg6	43	Reg6	5900	HHU	5	SDWA	5	SDWA											5900	100			5			43	ca	
Propylbenzene[1-]	103-65-1	VOA	ug/L	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6	61	Reg6																		61	nc	
Styrene	100-42-5	VOA	ug/L	1600	Reg6	1600	Reg6	1600	Reg6	1600	Reg6	100	SDWA	100	SDWA															100			1600	nc	
Tetrachloroethane[1,1,1,2-]	630-20-6	VOA	ug/L	4.3	Reg6	4.3	Reg6	4.3	Reg6	4.3	Reg6	4.3	Reg6	4.3	Reg6																		4.3	ca	
Tetrachloroethane[1,1,2,2-]	79-34-5	VOA	ug/L	0.55	Reg6	0.55	Reg6	0.55	Reg6	40	HHU	10	GWHH	10	GWHH											40	10						0.55	ca	
Tetrachloroethene	127-18-4	VOA	ug/L	5.9	Reg6	5.9	Reg6	5.9	Reg6	33	HHU	5	SDWA	5	SDWA											33	20			5			5.9	ca	
Toluene	108-88-3	VOA	ug/L	720	Reg6	720	Reg6	720	Reg6	200000	HHU	750	GWHH	750	GWHH											200000	750			1000			720	nc	
Trichloro-1,2,2-trifluoroethane[1,1,2-]	76-13-1	VOA	ug/L	59000	Reg6	59000	Reg6	59000	Reg6	59000	Reg6	59000	Reg6	59000	Reg6																		59000	nc	
Trichlorobenzene[1,2,3-]	87-61-6	VOA	ug/L	190	Reg6	190	Reg6	190	Reg6	190	Reg6	70	SDWA	70	SDWA															70			190	nc	
Trichloroethane[1,1,1-]	71-55-6	VOA	ug/L	790	Reg6	790	Reg6	790	Reg6	790	Reg6	60	GWHH	60	GWHH												60			200			790	nc	
Trichloroethane[1,1,2-]	79-00-5	VOA	ug/L	2	Reg6	2	Reg6	2	Reg6	160	HHU	5	SDWA	5	SDWA											160	10			5			2	ca	
Trichloroethene	79-01-6	VOA	ug/L	0.28	Reg6	0.28	Reg6	0.28	Reg6	300	HHU	5	SDWA	5	SDWA											300	100			5			0.28	ca	
Trichlorofluoromethane	75-69-4	VOA	ug/L	1300	Reg6	1300	Reg6	1300	Reg6	1300	Reg6	1300	Reg6	1300	Reg6																		1300	nc	
Trichloropropane[1,2,3-]	96-18-4	VOA	ug/L	0.016	Reg6	0.016	Reg6	0.016	Reg6	0.016	Reg6	0.016	Reg6	0.016	Reg6																		0.016	ca	
Trimethylbenzene[1,2,4-]	95-63-6	VOA	ug/L	12	Reg6	12	Reg6	12	Reg6	12	Reg6	12	Reg6	12	Reg6																		12	nc	
Trimethylbenzene[1,3,5-]	108-67-8	VOA	ug/L	12	Reg6	12	Reg6	12	Reg6	12	Reg6	12	Reg6	12	Reg6																		12	nc	
Vinyl Chloride	75-01-4	VOA	ug/L	0.43	Reg6	0.43	Reg6	0.43	Reg6	5300	HHU	1	GWHH	1	GWHH											5300	1			2			0.43	ca	
Xylene (Total)	1330-20-7	VOA	ug/L	1400	Reg6	1400	Reg6	1400	Reg6	1400	Reg6	620	GWHH	620	GWHH												620			10000			1400	nc	
Xylene[1,2-]	95-47-6	VOA	ug/L	1400	Reg6	1400	Reg6	1400	Reg6	1400	Reg6	1400	Reg6	1400	Reg6																		1400	nc	
Xylene[1,3-]+Xylene[1,4-]	XYL1314	VOA	ug/L	1400	Reg6	1400	Reg6	1400	Reg6	1400	Reg6	620	GWHH	620	GWHH												620			10000			1400	nc	
Naphthalene	91-20-3	VOA/SVOA	ug/L	6.2	Reg6	6.2	Reg6	6.2	Reg6	6.2	Reg6	30	GWHH	30	GWHH												30						6.2	nc	

Headers in Table	**Description**
Analyte Description	Analyte Name
Analyte Code	Cass Number Or Abbreviation
Anyl Suite Code	Analytical Suite
Uom	Unit of Measure
WSF LVL	screening level for WSF (surface water, filtered), minimum among applicable
Nam WSF	abbreviation for name of standard applied to WSF
WSU LVL	screening level for WSU (surface water, unfiltered), minimum among applicable
Nam WSU	abbreviation for name of standard applied to WSU
WSF peren LVL	screening level for WSFperen (perennial surface water, filtered), minimum among applicable
namWSFp	abbreviation for name of standard applied to WSFperen
WSU peren LVL	screening level for WSFperen (perennial surface water, filtered), minimum among applicable
Nam WS Up	abbreviation for name of standard applied to WSFperen
GW	screening level for GW (groundwater, filtered or unfiltered), minimum among applicable
Nam GW	abbreviation for name of standard applied to GW
GWre	screening level for GW (groundwater, filtered or unfiltered), minimum among applicable excluding RCRA MCLs (just for comparison)
Nam GWre	abbreviation for name of standard applied to Gwre

Abbr	**Description**	**Source**	**applied to**
LWF	screening level for Livestock Watering (filtered)	NMAC 20.6.4, July 2005	all SW
LWU	screening level for Livestock Watering (unfiltered)	NMAC 20.6.4, July 2005	all SW
WHU	screening level for ildlife habitat (unfiltered)	NMAC 20.6.4, July 2005	all SW
AqAcF	screening level for Aquatic Life Acute (filtered) 100 mg/L	NMAC 20.6.4, July 2005	all SW
AqAcU	screening level for Aquatic Life Acute (unfiltered) 100 mg/L	NMAC 20.6.4, July 2005	all SW
HHPF	screening level for Human Health Persistent Toxics (filtered)	NMAC 20.6.4, July 2005	all SW
HHPU	screening level for Human Health Persistent Toxics (unfiltered)	NMAC 20.6.4, July 2005	all SW
AqChrF	screening level for Aquatic Life Chronic (filtered) 100 mg/L	NMAC 20.6.4, July 2005	perennial SW & E060
AqChrU	screening level for Aquatic Life Chronic (unfiltered) 100 mg/L	NMAC 20.6.4, July 2005	perennial SW & E060
HHF	screening level for Human Health (filtered)	NMAC 20.6.4, July 2005	perennial SW & E060
HHU	screening level for Human Health (unfiltered)	NMAC 20.6.4, July 2005	perennial SW & E060
GWHH	screening level for Ground Water Human Health	NMAC 20.6.4	all GW
GWDW	screening level for GW other standards for Domestic Water	NMAC 20.6.4	all GW
MCL	screening level for RCRA MCLs	CFR 264.94	all GW
SDWA	screening level for Safe Drinking Water Act MCLs, MCLGs	http://www.epa.gov/	all GW
DCGsal	screening level for DOE DCG 100 mR/y	Order 5400.5	for comparison
DCG	screening level for DOE DCG 4 mR/y	Order 5400.5	all water
Reg6	screening level for EPA Region VI Tap Water*	http://www.epa.gov/	all water

* Cancer Endpoint have been adjusted from 10-6 to 10-5 risk level

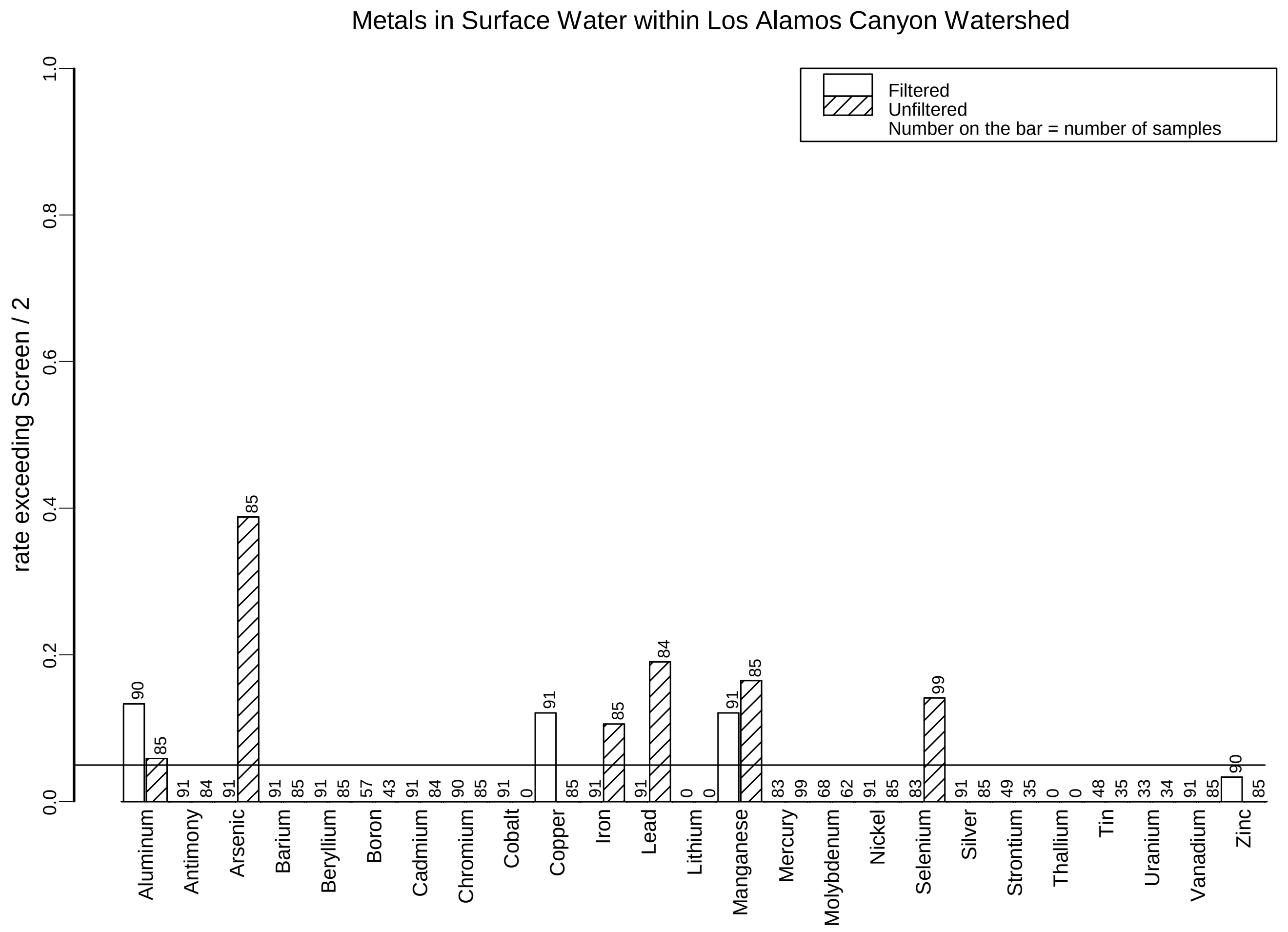


Figure B.1. **Rate exceeding Screen/2 for Metals in Los Alamos Canyon Ephemeral Surface Water.**

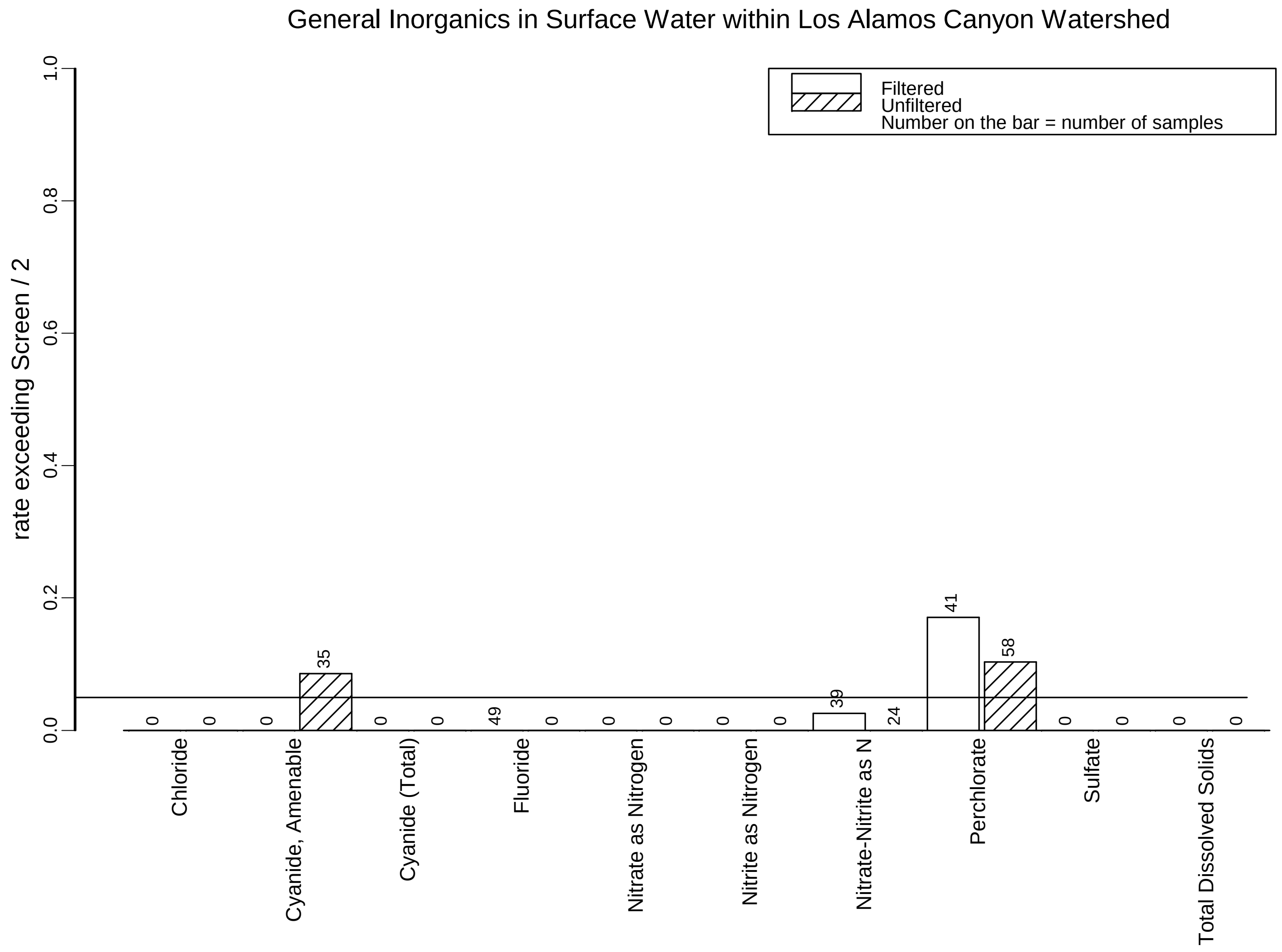


Figure B.2. **Rate exceeding Screen/2 for Inorganics in Los Alamos Canyon Ephemeral Surface Water.**

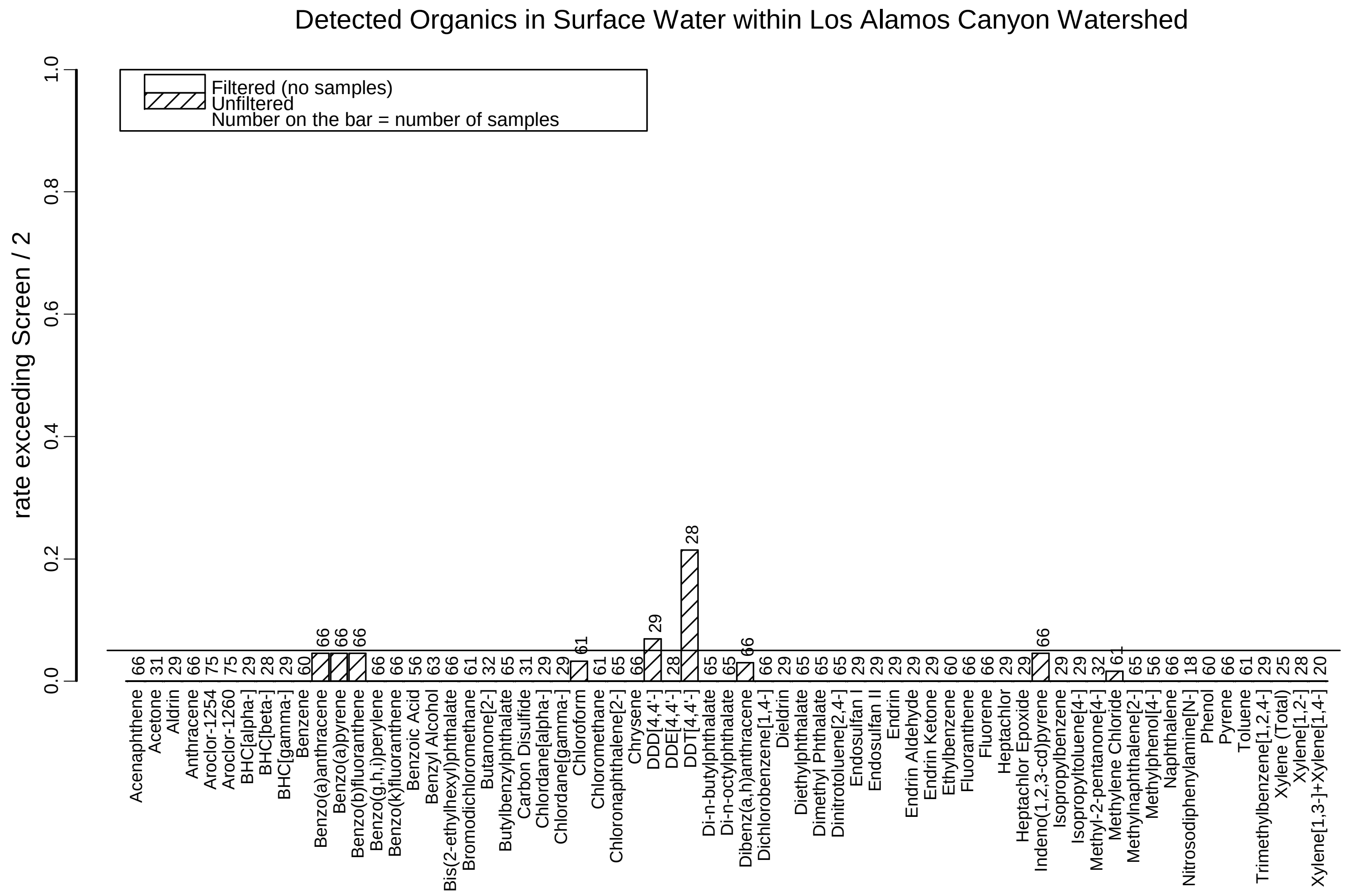


Figure B.3. **Rate exceeding Screen/2 for Organics in Los Alamos Canyon Ephemeral Surface Water.**

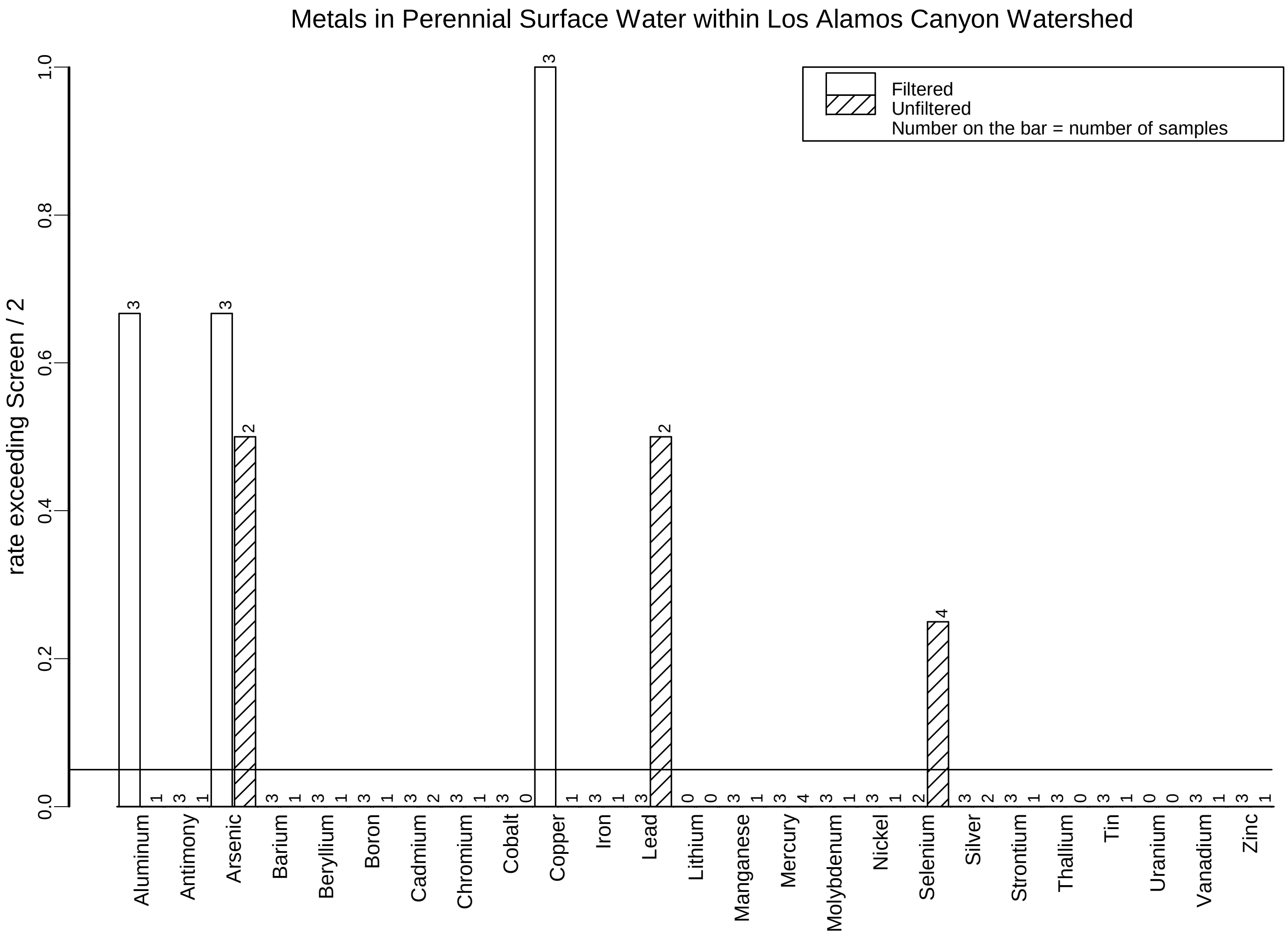


Figure B.4. **Rate exceeding Screen/2 for Metals in Los Alamos Canyon Perennial Surface Water.**

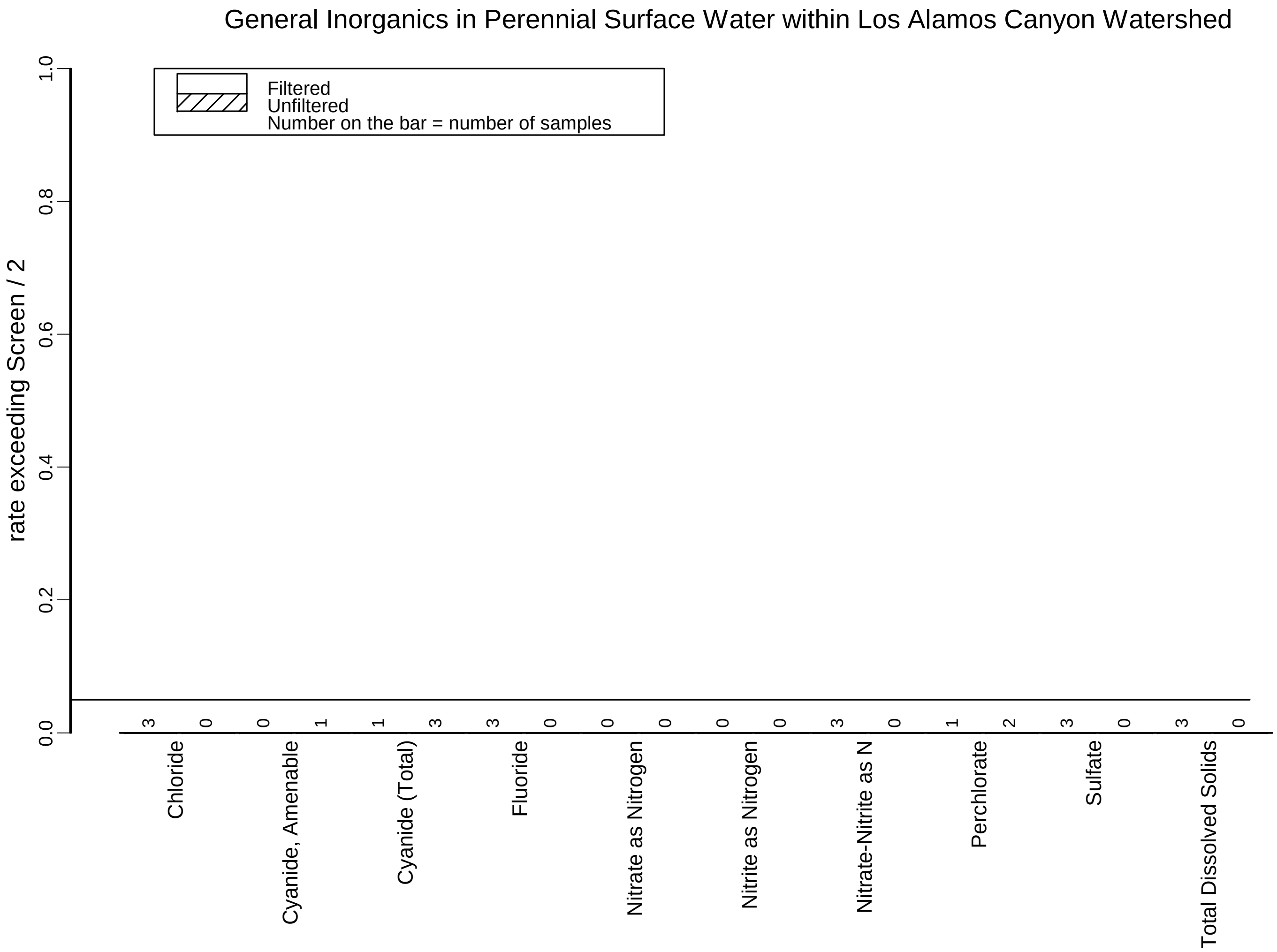


Figure B.5. **Rate exceeding Screen/2 for Inorganics in Los Alamos Canyon Perennial Surface Water.**

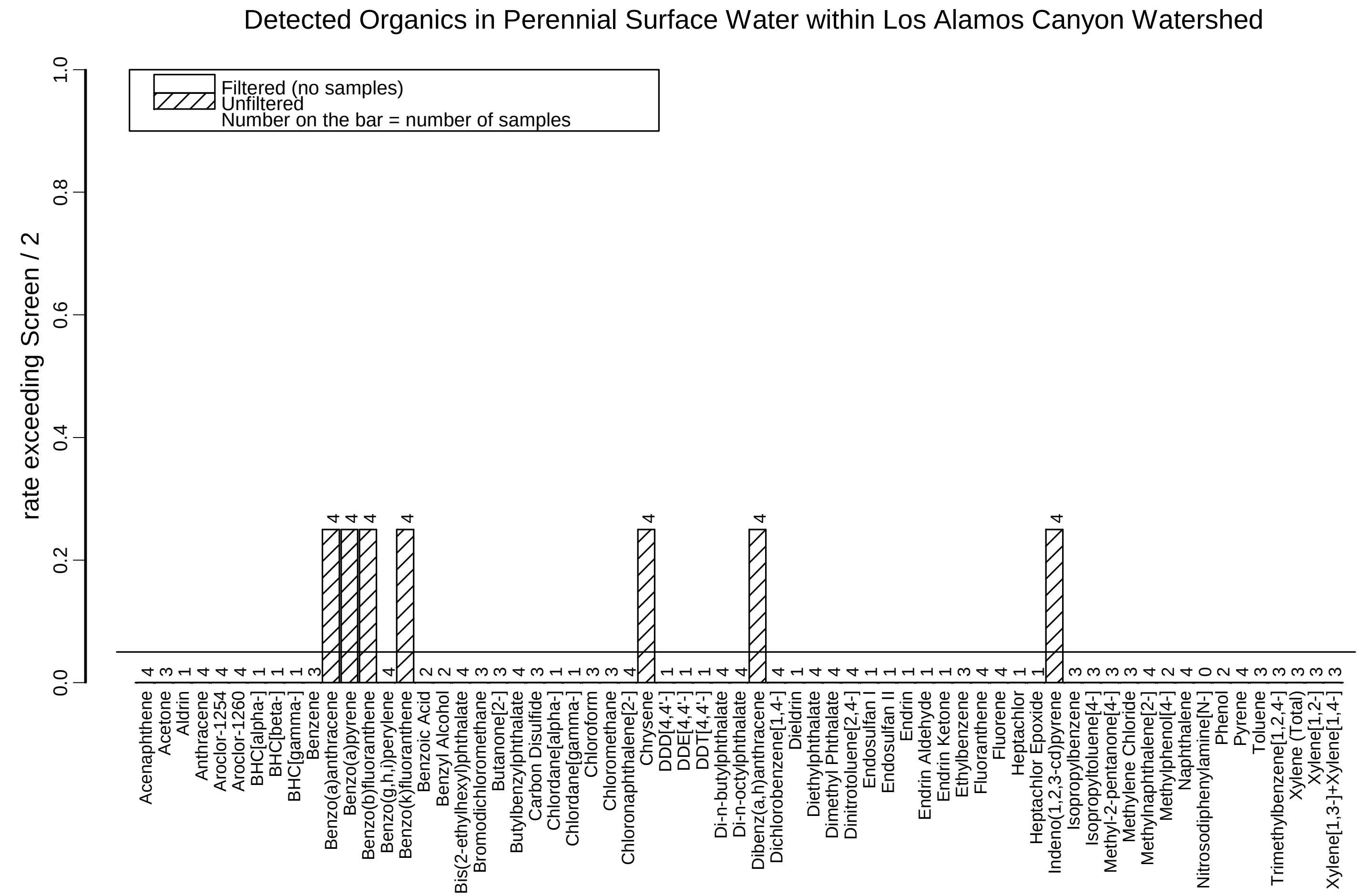


Figure B.6. **Rate exceeding Screen/2 for Organics in Los Alamos Canyon Perennial Surface Water.**

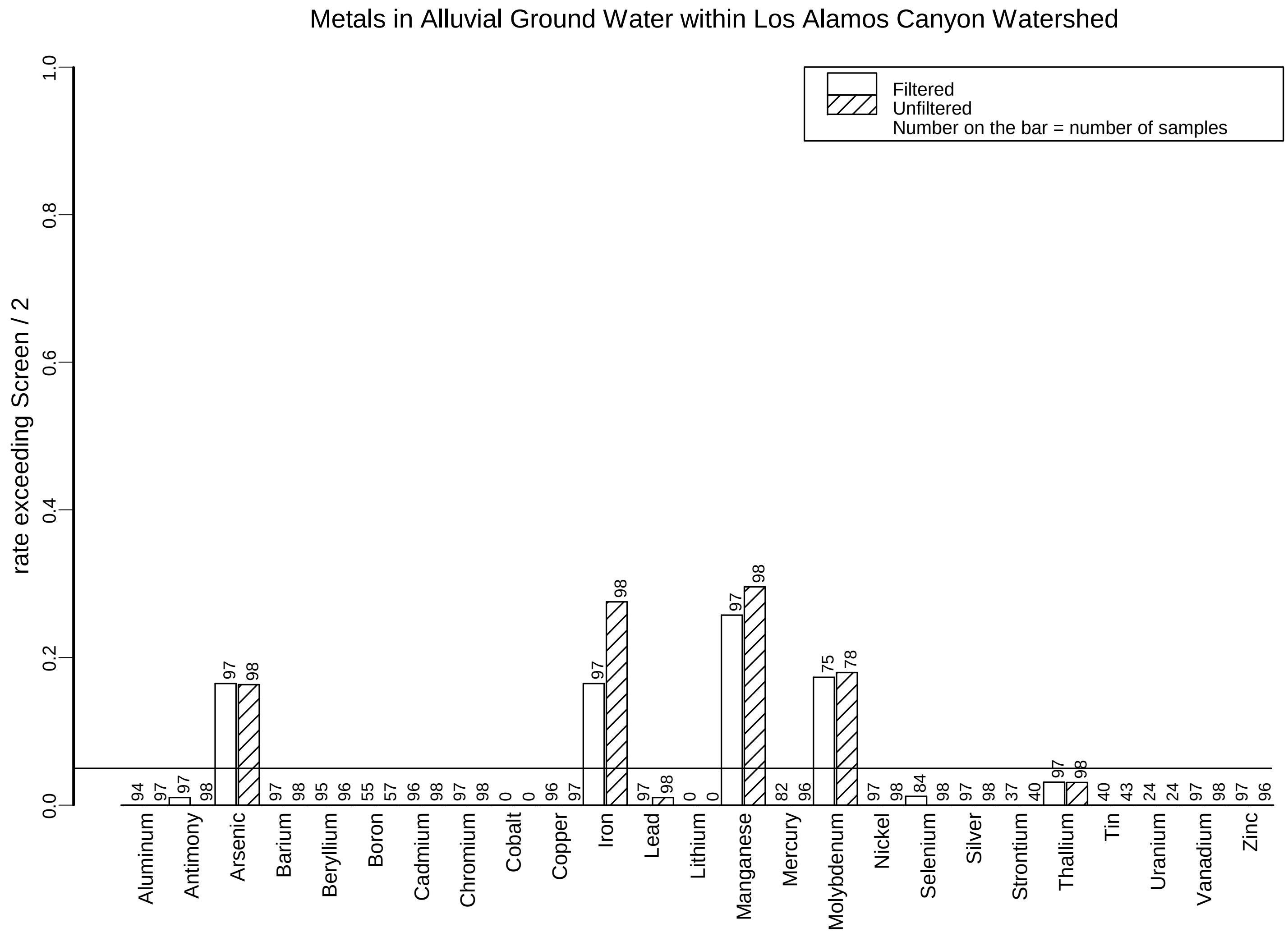


Figure B.7. **Rate exceeding Screen/2 for Metals in Los Alamos Canyon Alluvial Ground Water.**

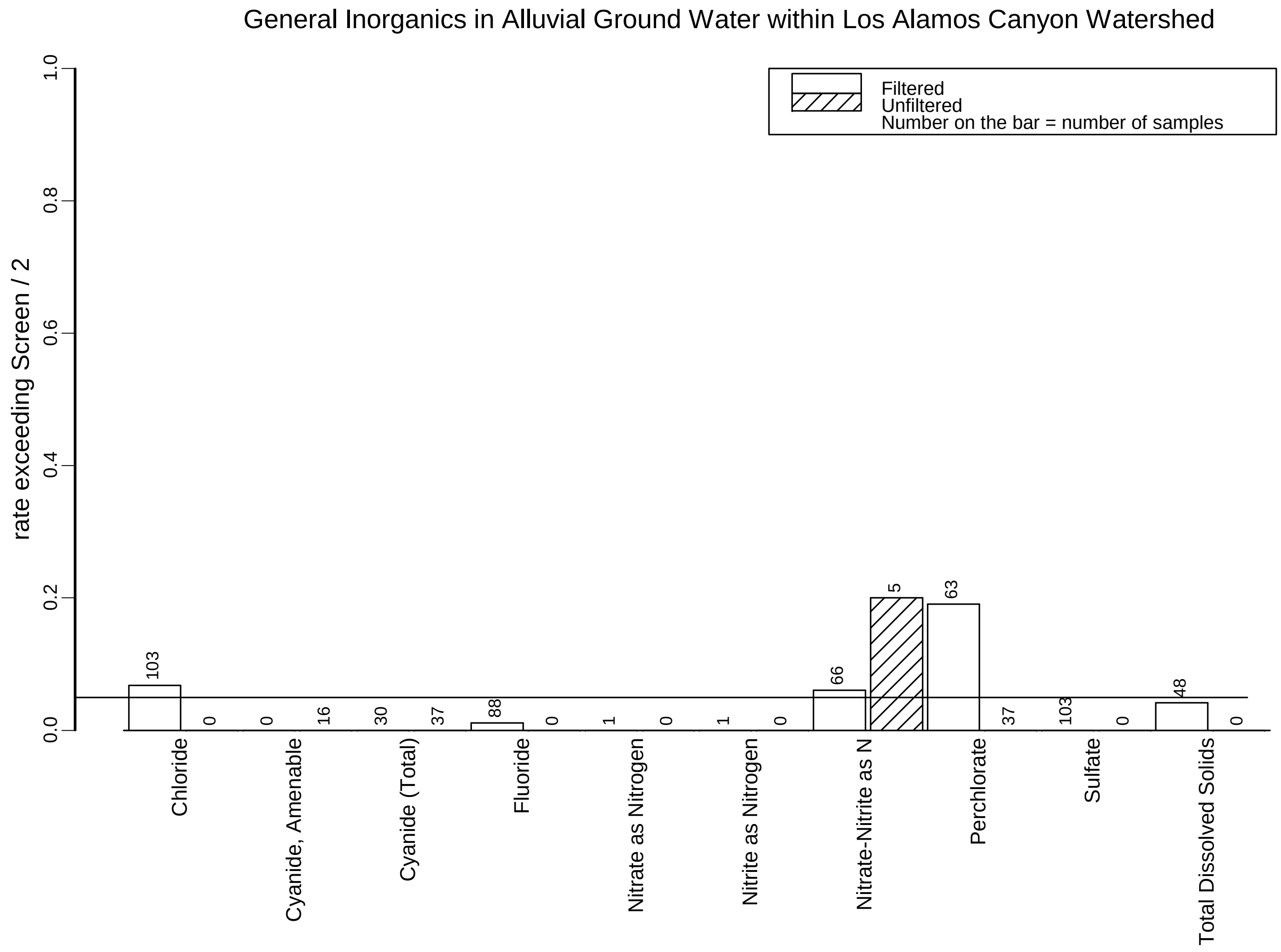


Figure B.8. Rate exceeding Screen/2 for Inorganics in Los Alamos Canyon Alluvial Ground Water.

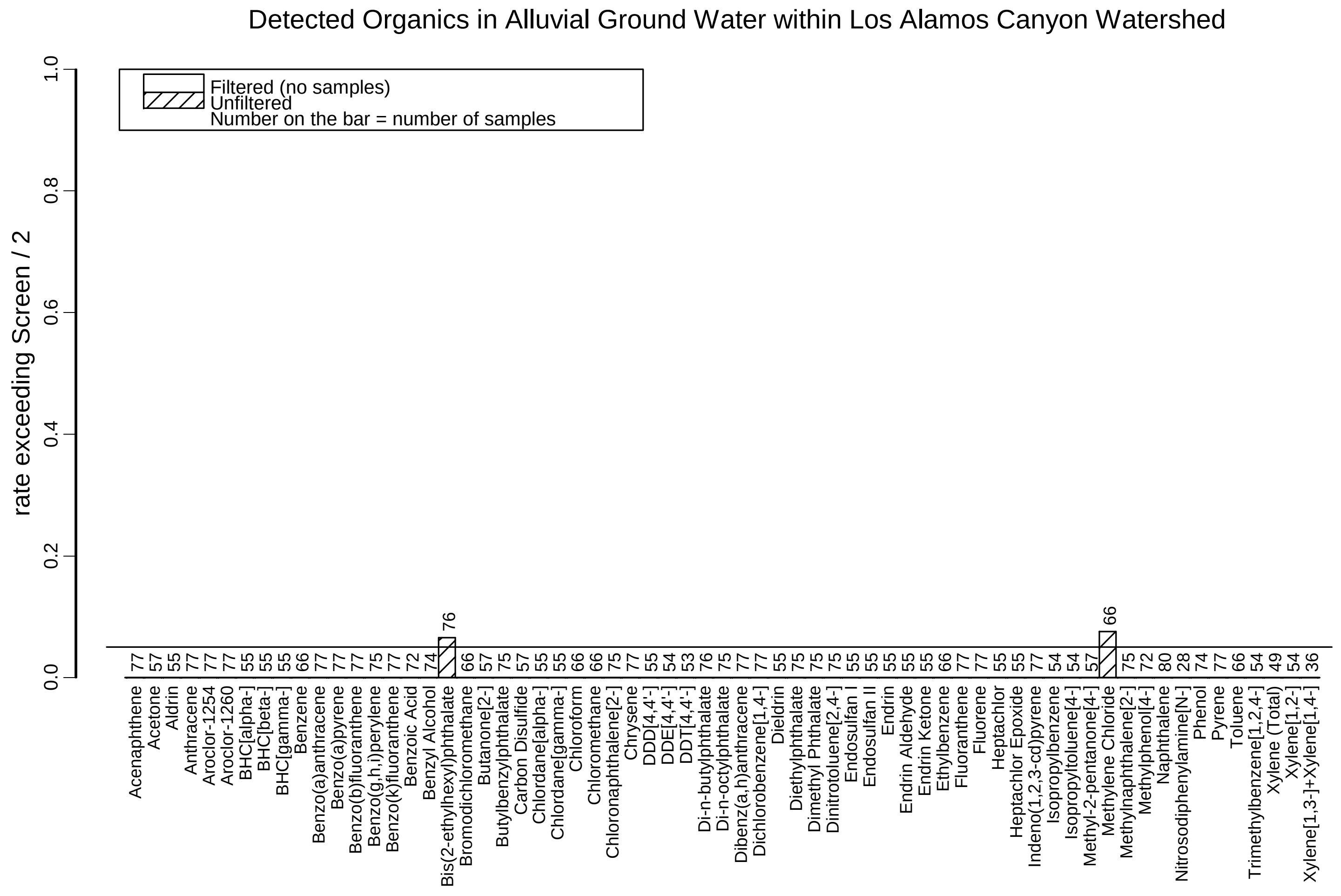


Figure B.9. **Rate exceeding Screen/2 for Organics in Los Alamos Canyon Alluvial Ground Water.**

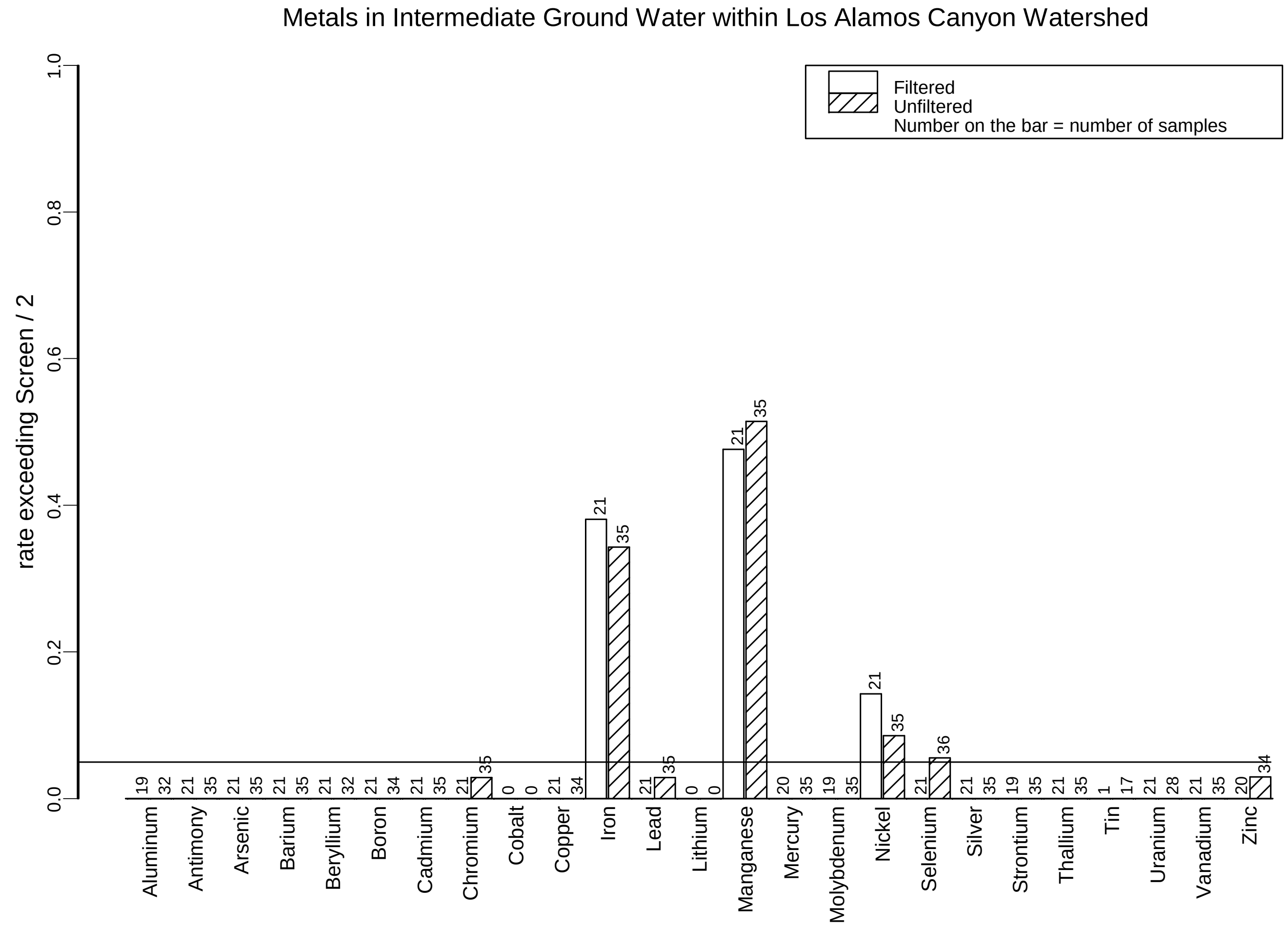


Figure B.10. **Rate exceeding Screen/2 for Metals in Los Alamos Canyon Intermediate Ground Water.**

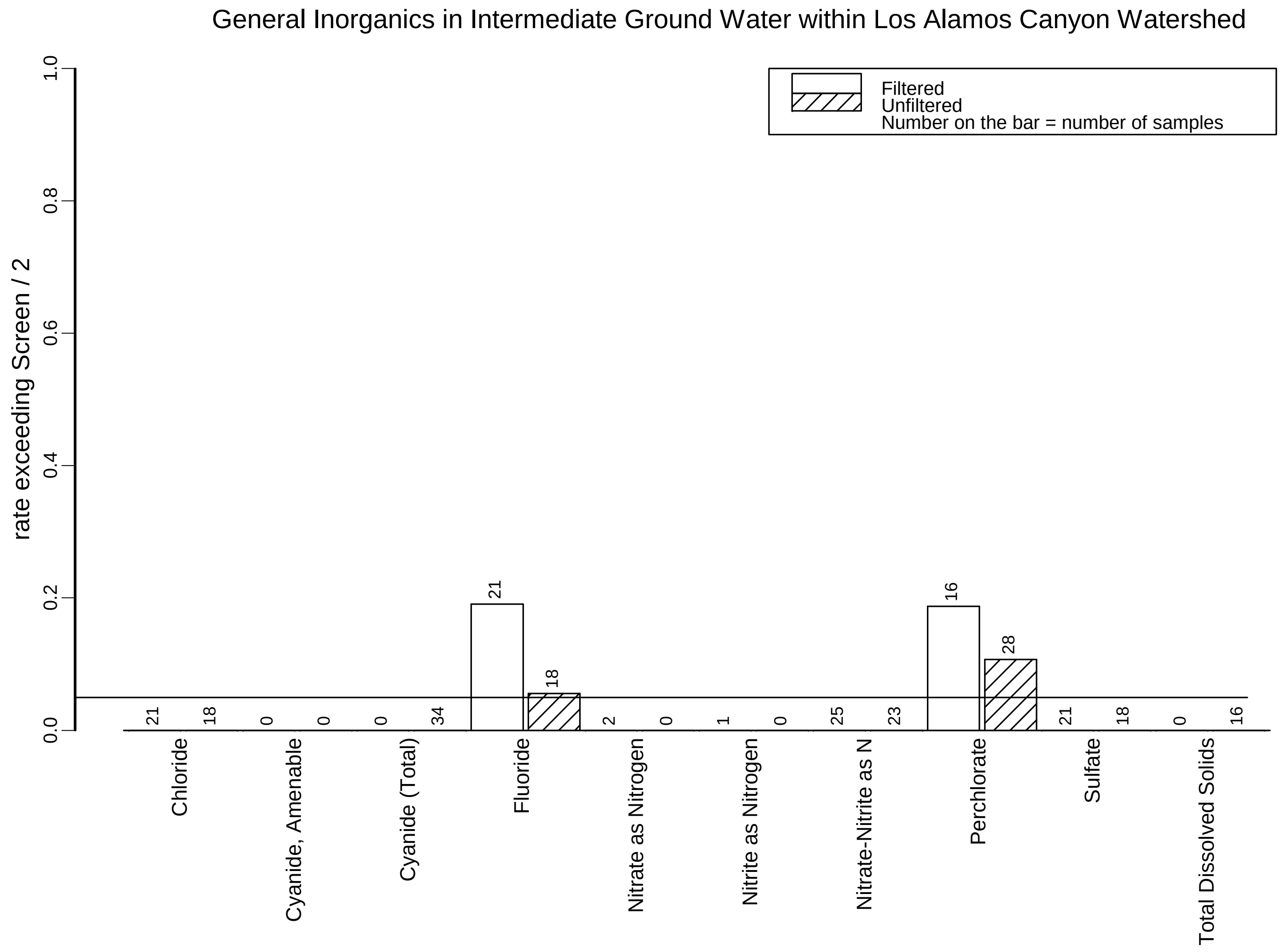


Figure B.11. **Rate exceeding Screen/2 for Inorganics in Los Alamos Canyon Intermediate Ground Water.**

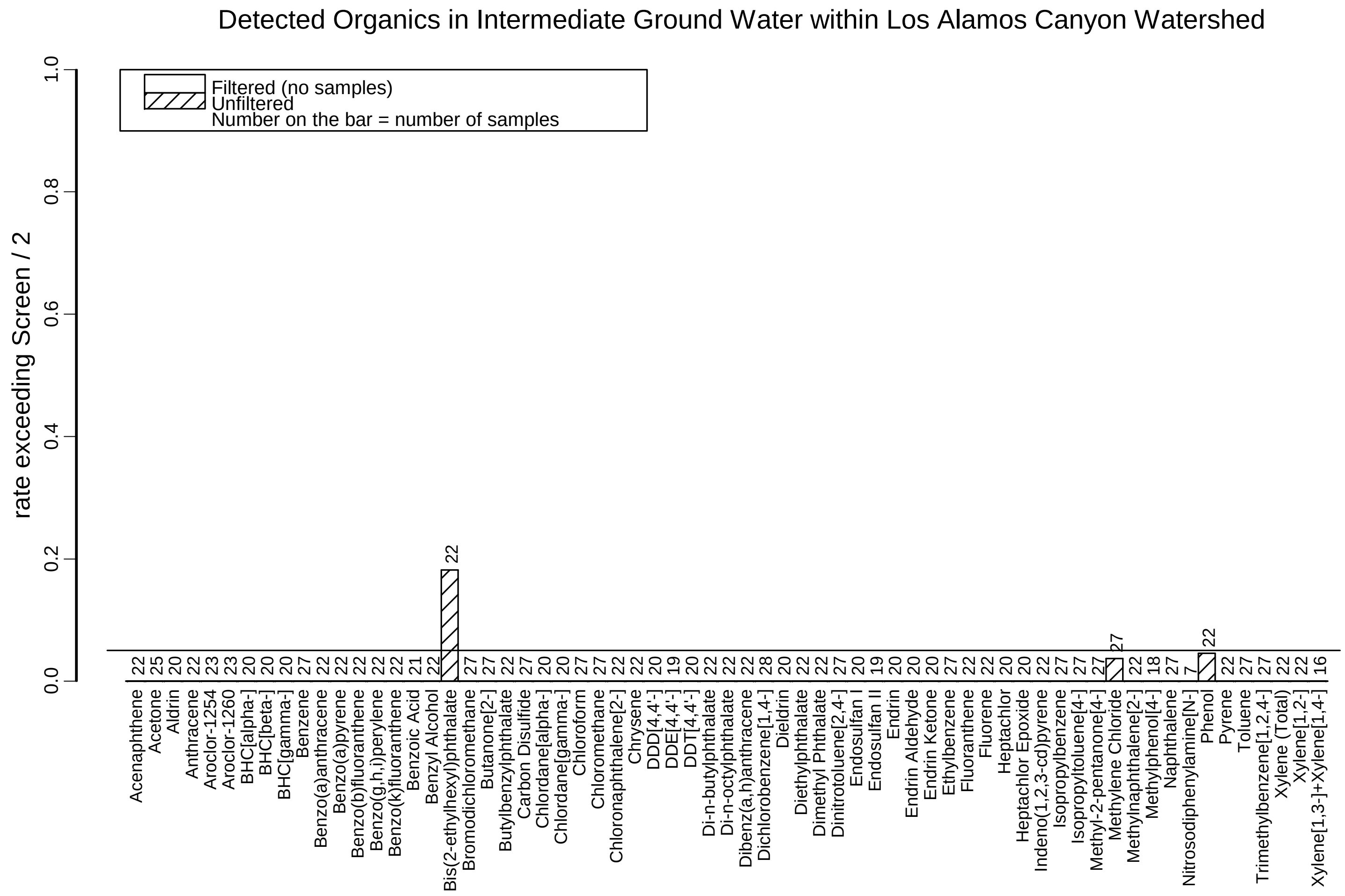


Figure B.12. **Rate exceeding Screen/2 for Organics in Los Alamos Canyon Intermediate Ground Water.**

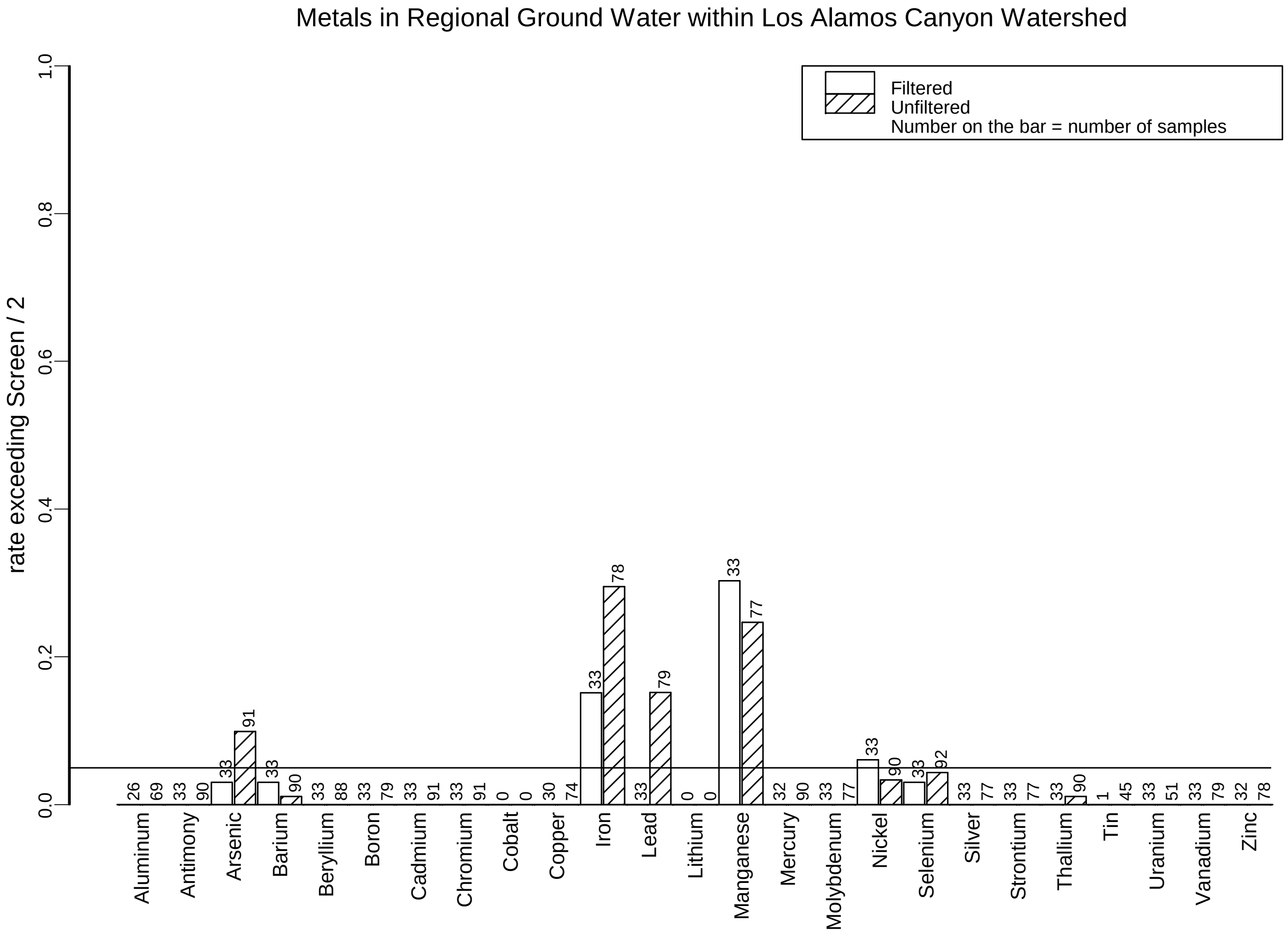


Figure B.13. **Rate exceeding Screen/2 for Metals in Los Alamos Canyon Regional Ground Water.**

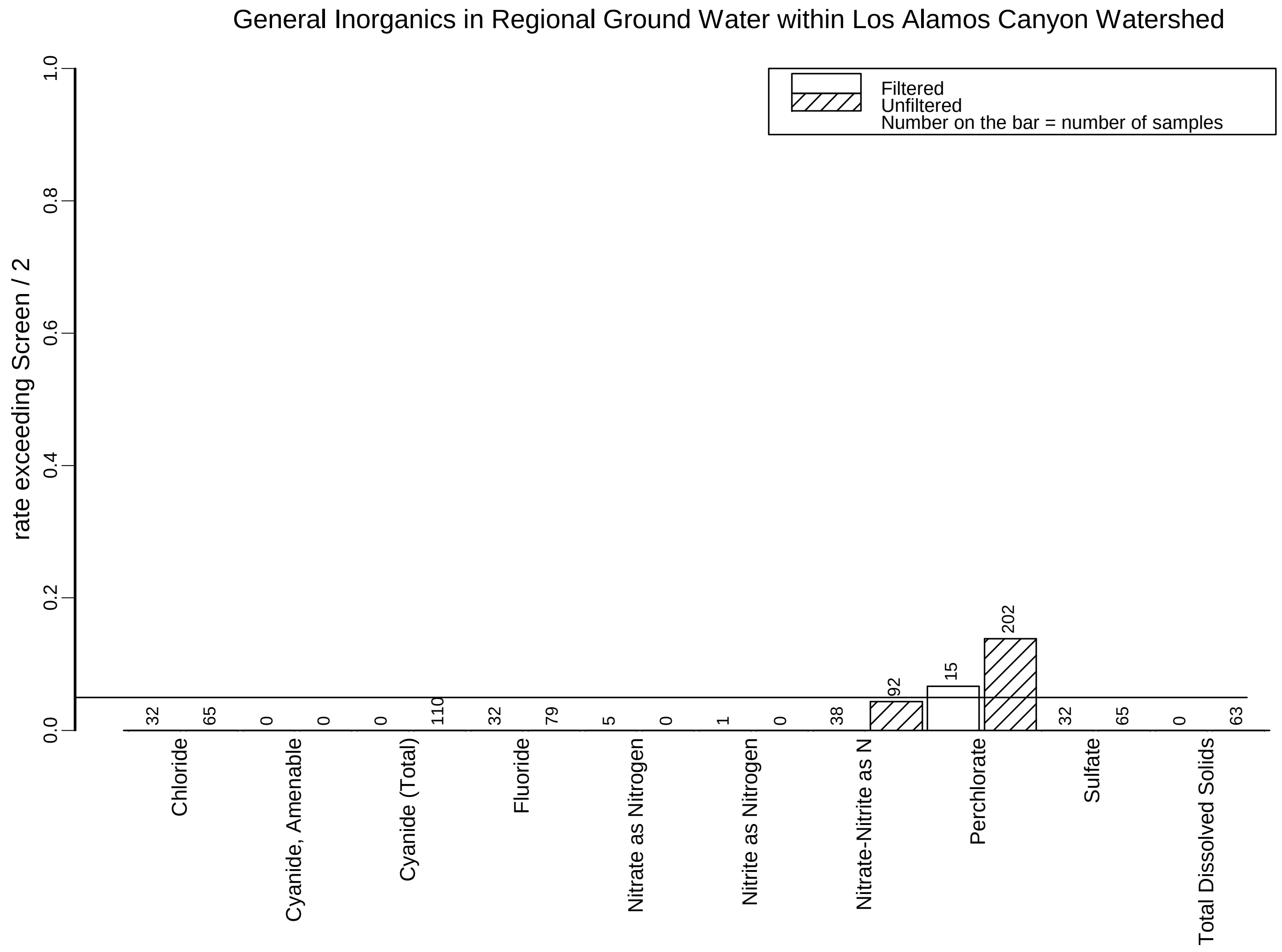


Figure B.14. **Rate exceeding Screen/2 for Inorganics in Los Alamos Canyon Regional Ground Water.**

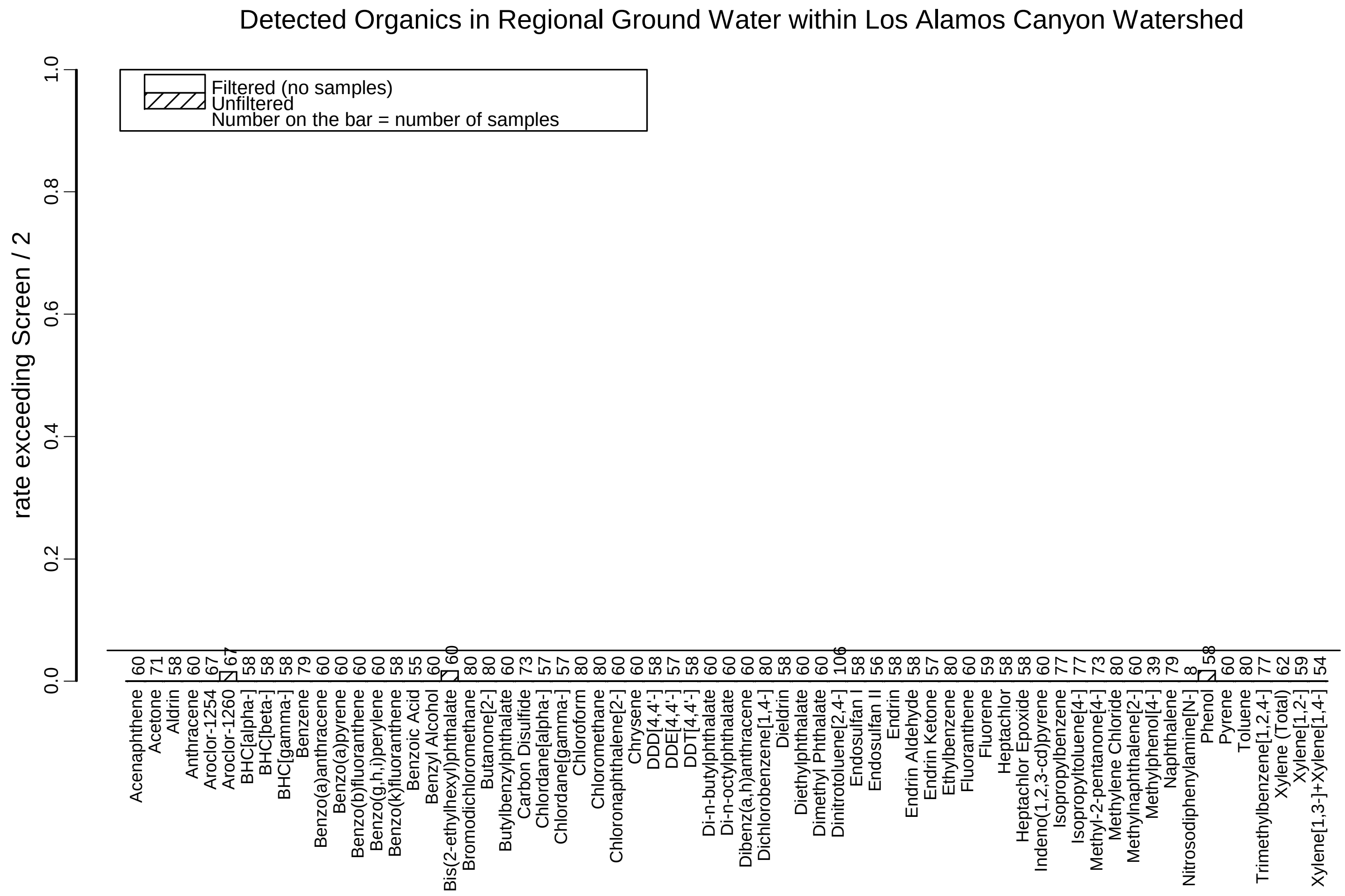


Figure B.15. **Rate exceeding Screen/2 for Organics in Los Alamos Canyon Regional Ground Water.**

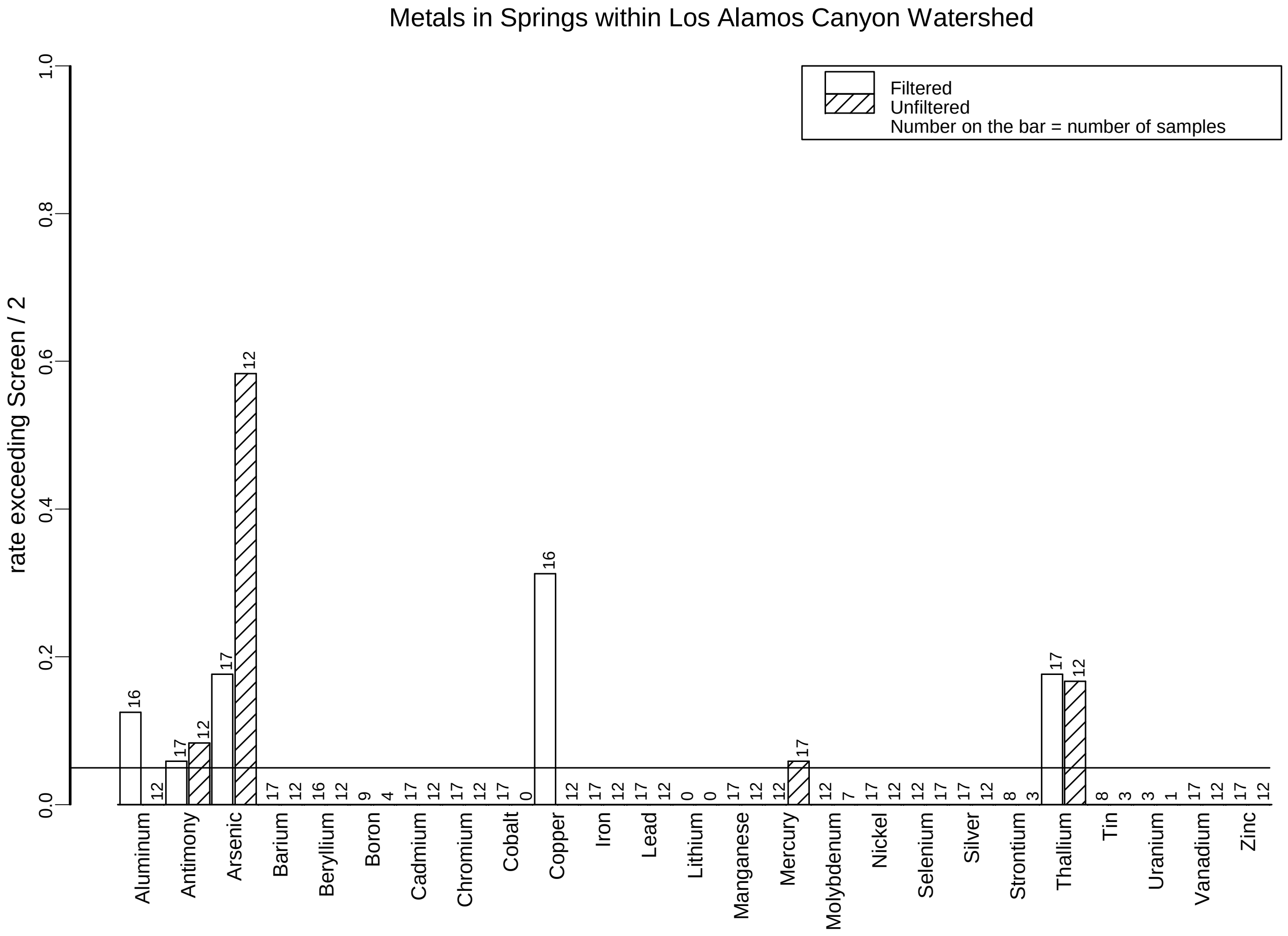


Figure B.16. **Rate exceeding Screen/2 for Metals in Los Alamos Canyon Springs.**

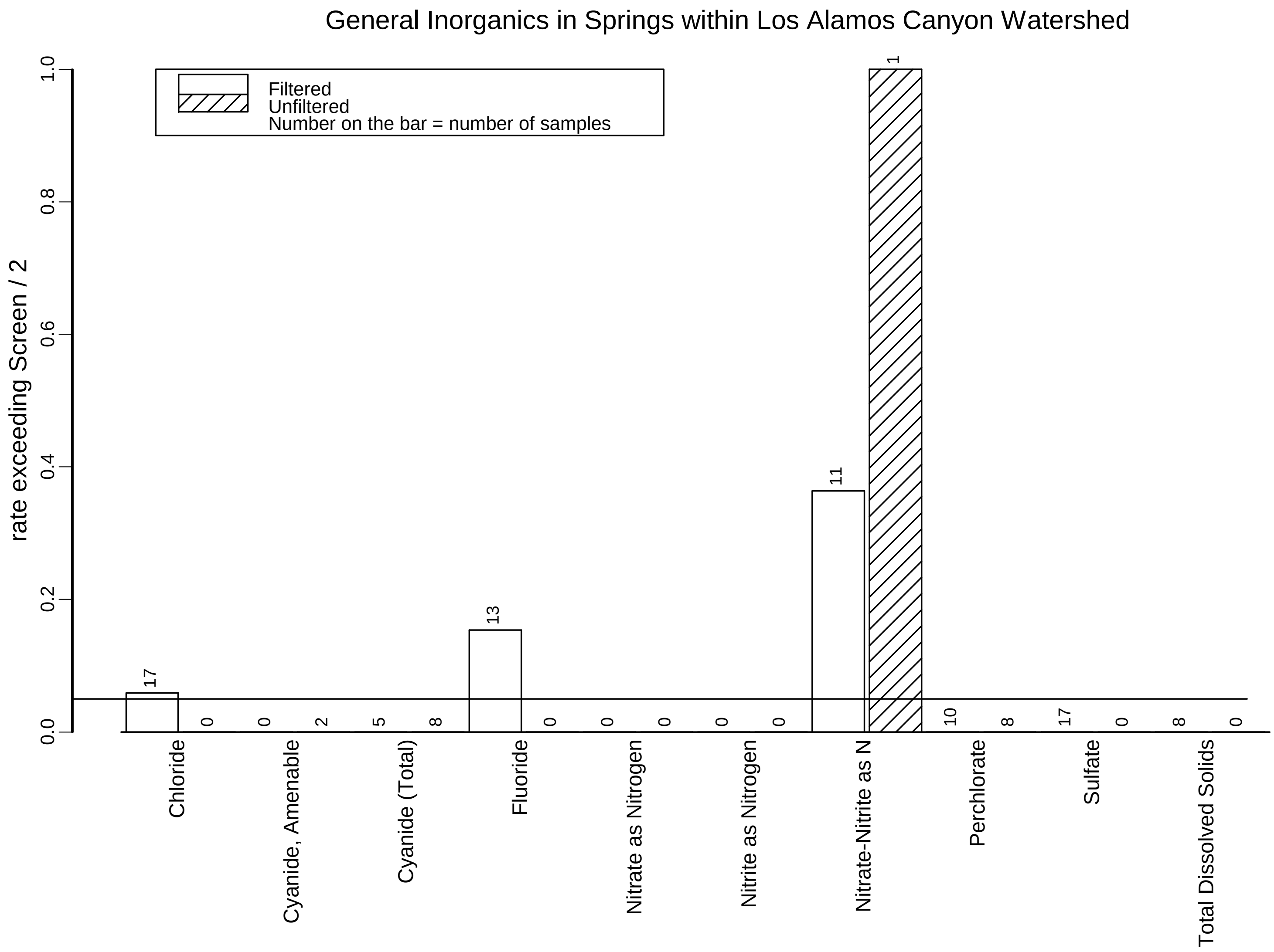


Figure B.17 **Rate exceeding Screen/2 for Inorganics in Los Alamos Canyon Springs.**

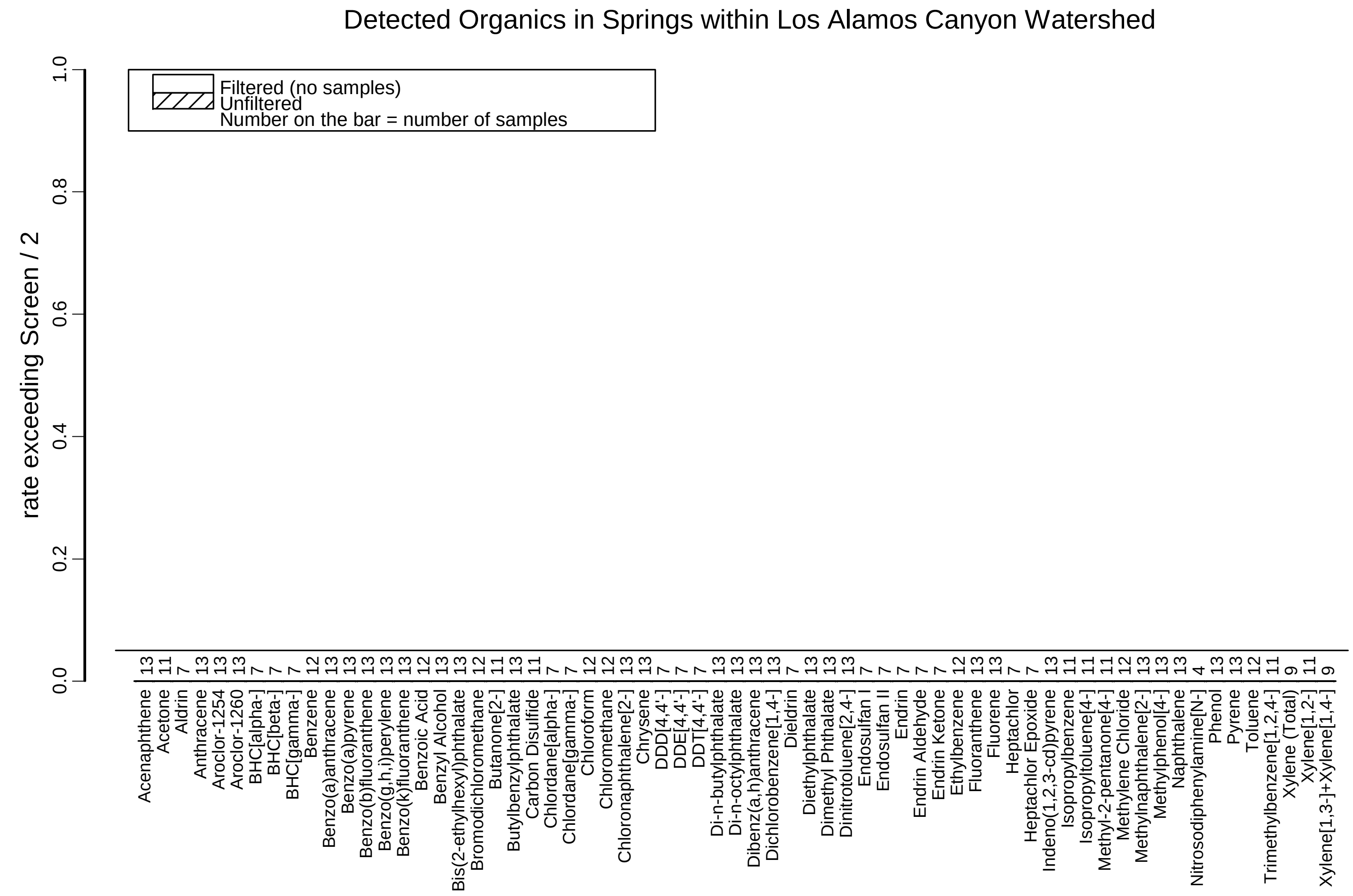


Figure B.18. **Rate exceeding Screen/2 for Organics in Los Alamos Canyon Springs.**

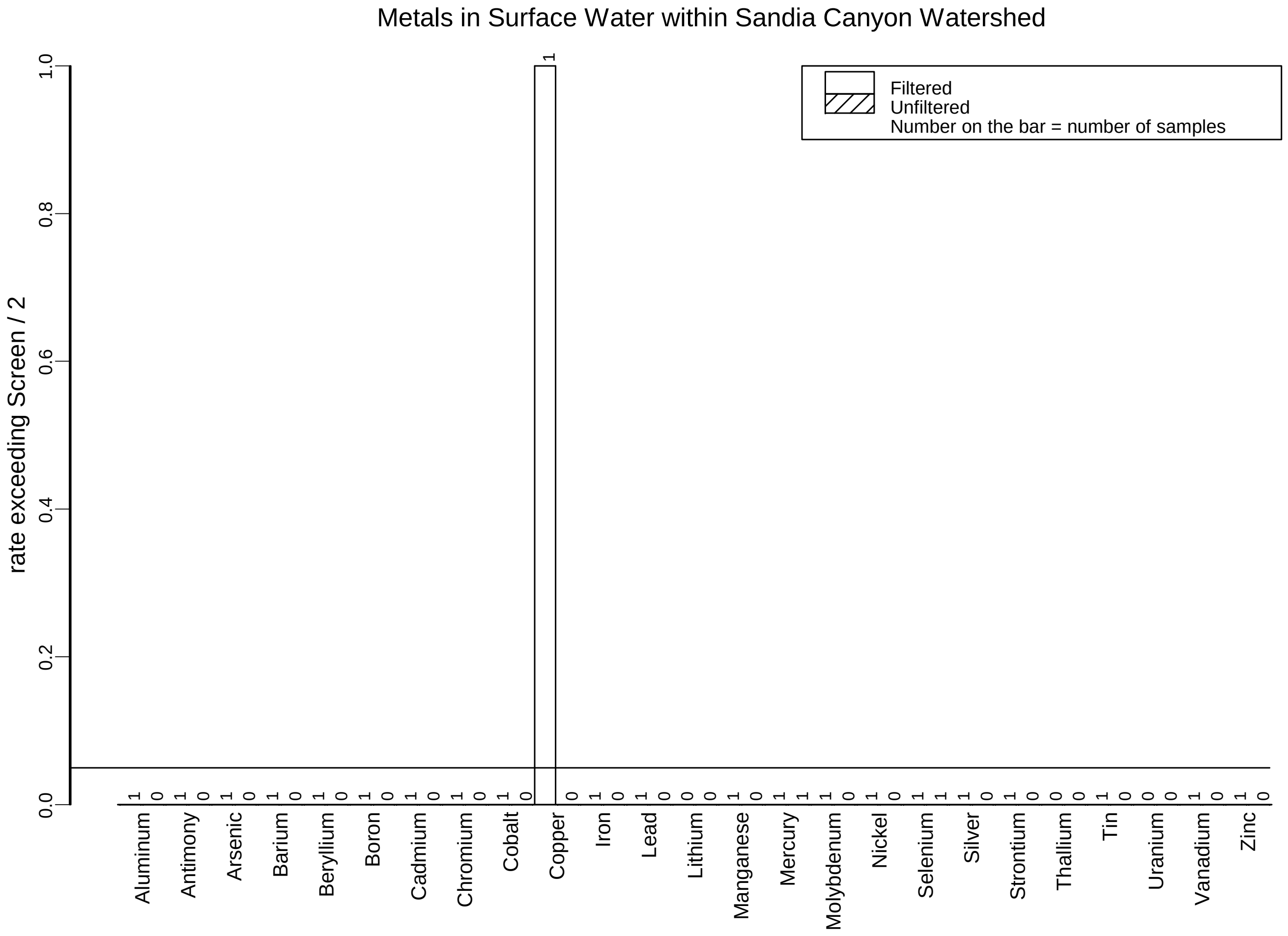


Figure B.19. **Rate exceeding Screen/2 for Metals in Sandia Canyon Ephemeral Surface Water.**

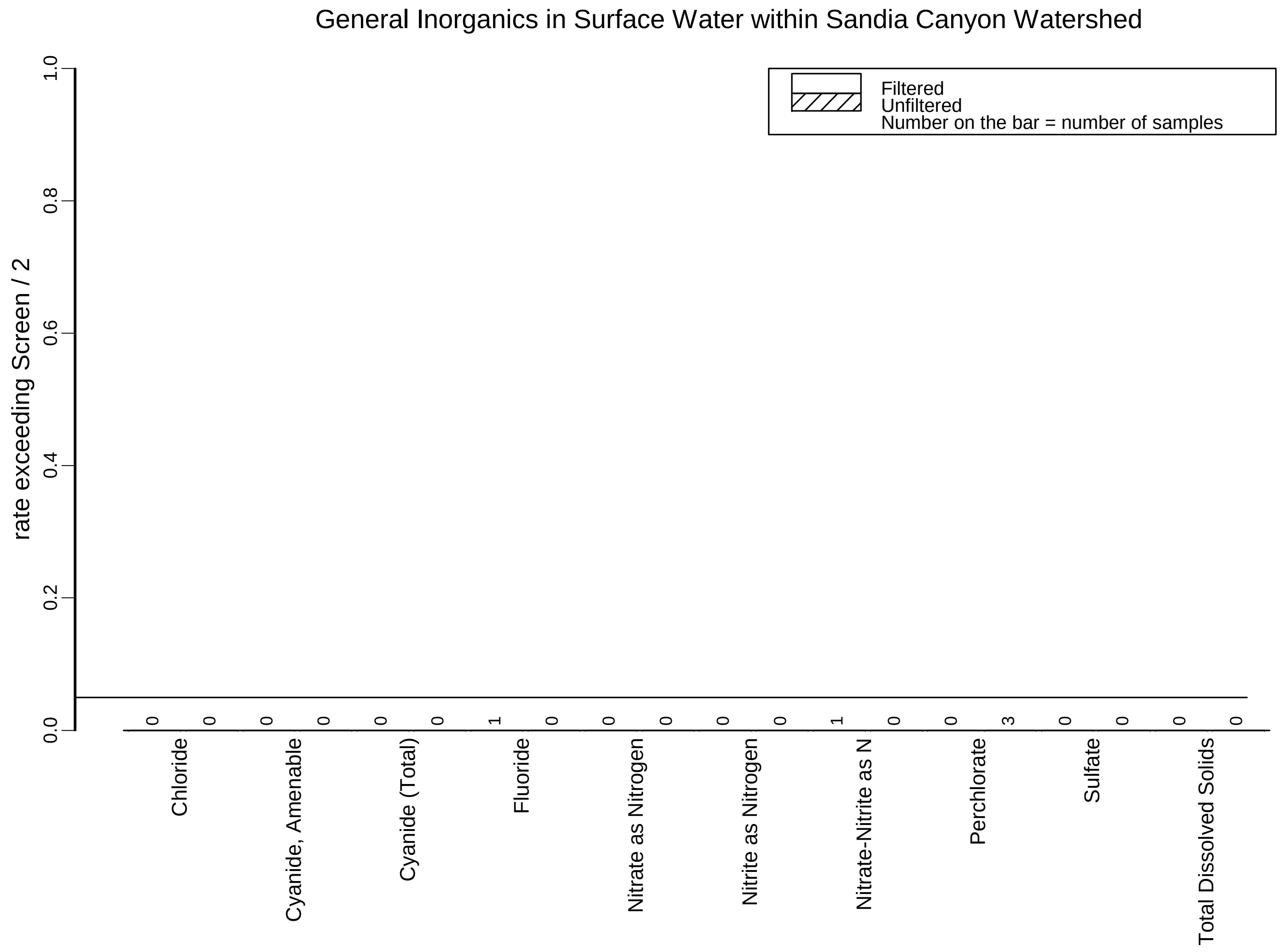


Figure B.20. **Rate exceeding Screen/2 for General Inorganics in Sandia Canyon Ephemeral Surface Water.**

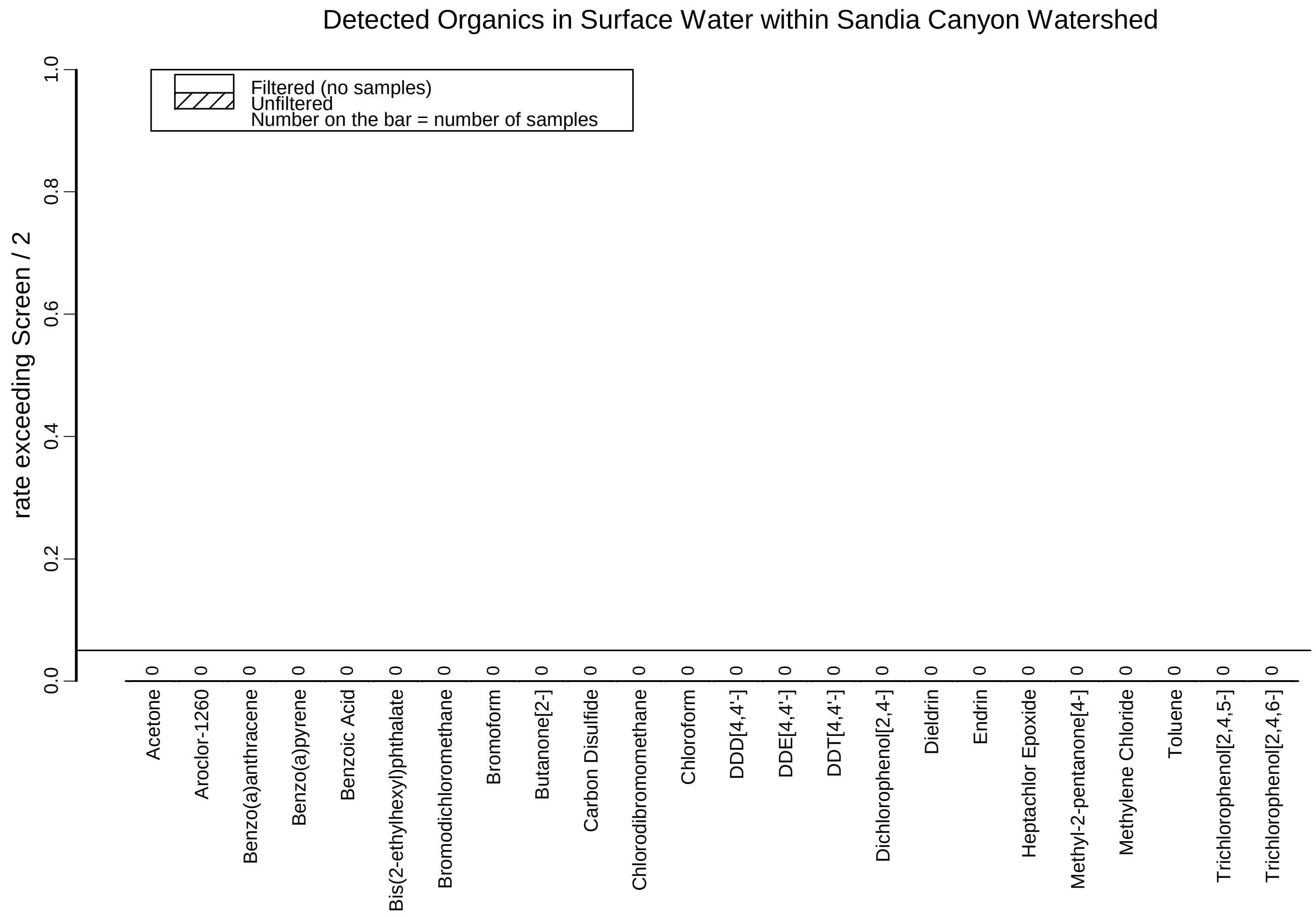


Figure B.21. **Rate exceeding Screen/2 for General organics in Sandia Canyon Ephemeral Surface Water.**

NOTE – all zeroes is accurate – no organics have been analyzed at SCS-3 (the only Surface Water location outside of the perennial section. May want to take this plot our? And just make a caption?)

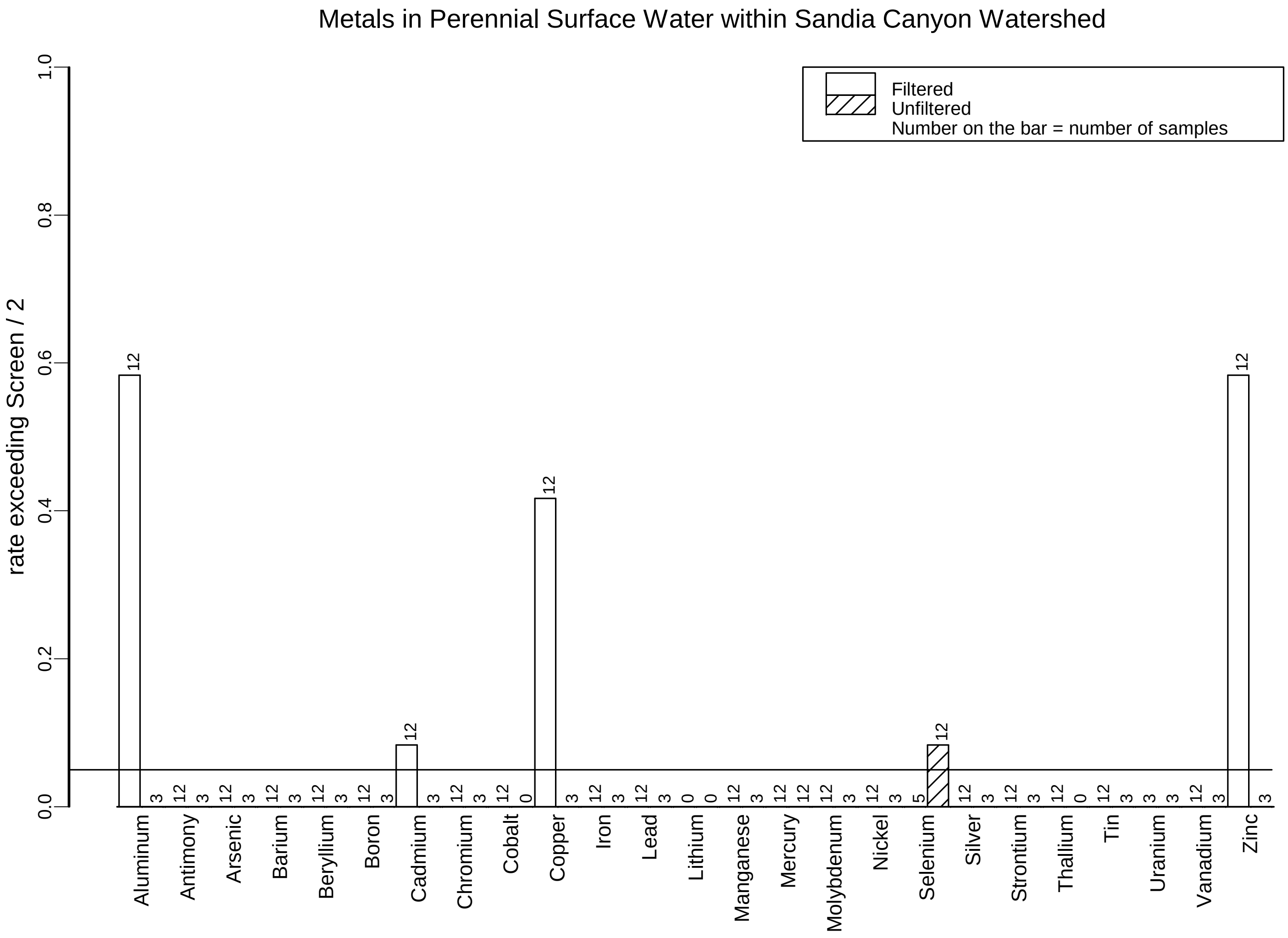


Figure B.22. **Rate exceeding Screen/2 for Metals in Sandia Canyon Perennial Surface Water.**

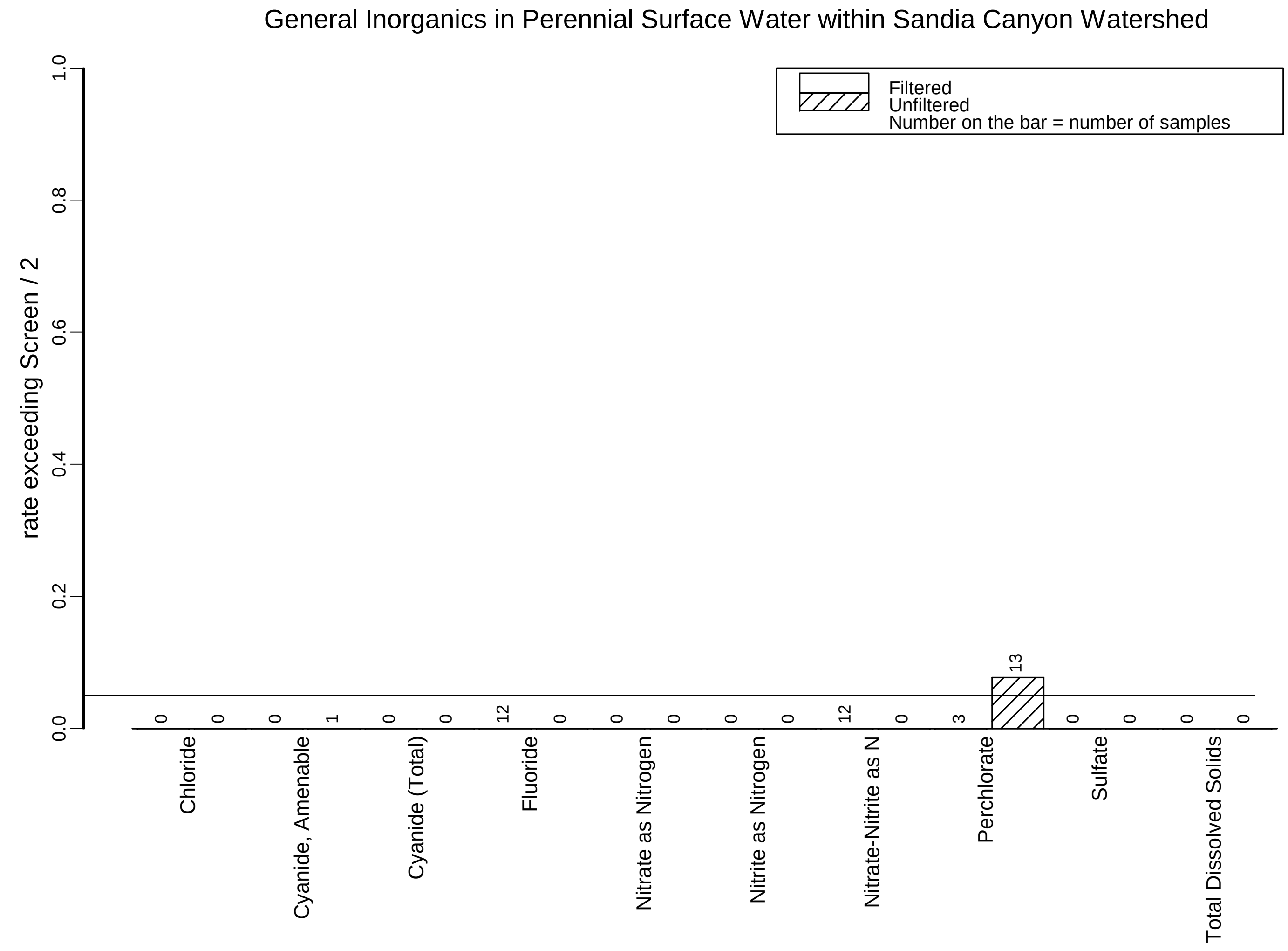


Figure B.23. **Rate exceeding Screen/2 for General Inorganics in Sandia Canyon Perennial Surface Water.**

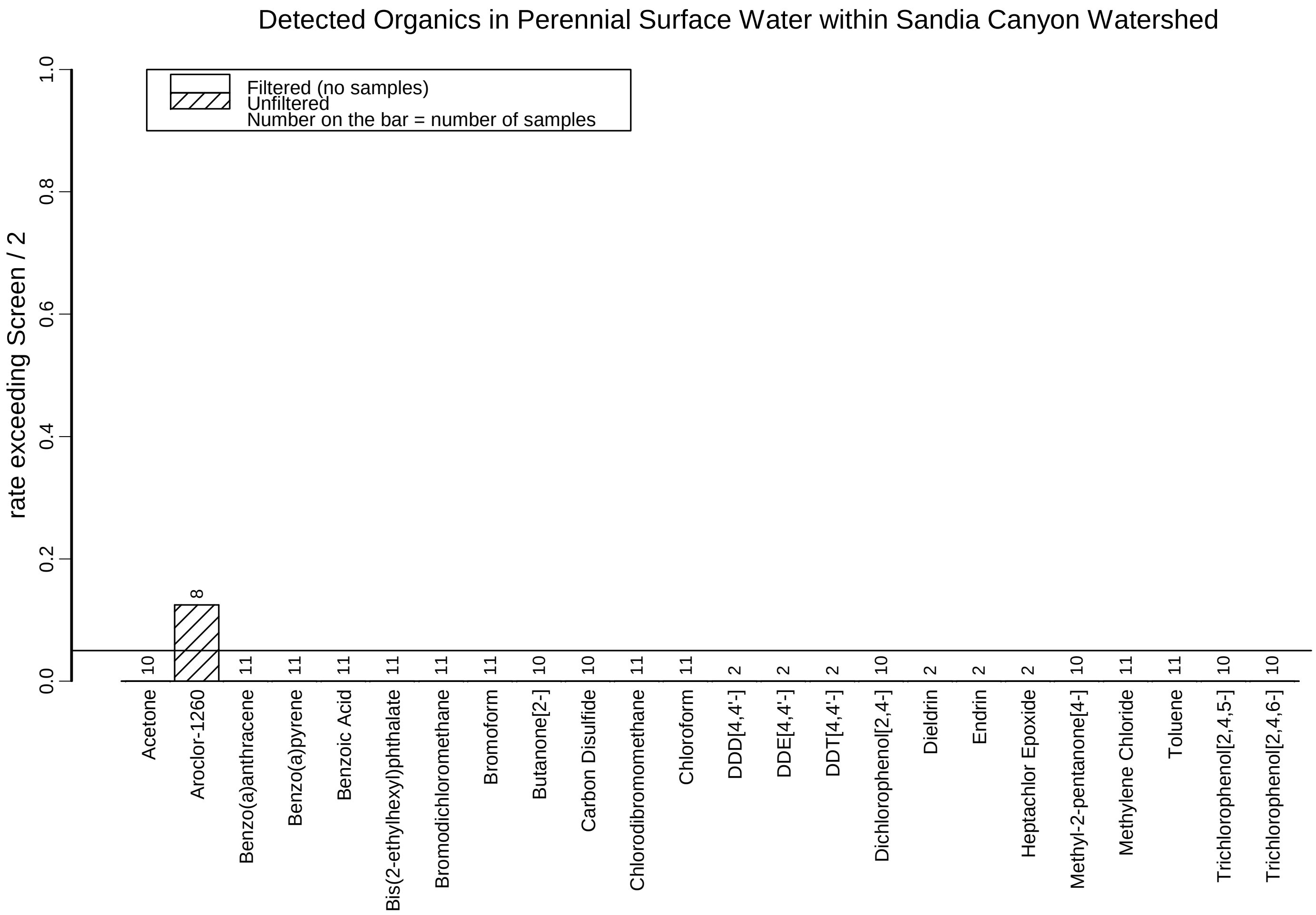


Figure B.24. **Rate exceeding Screen/2 for General organics in Sandia Canyon Perennial Surface Water.**

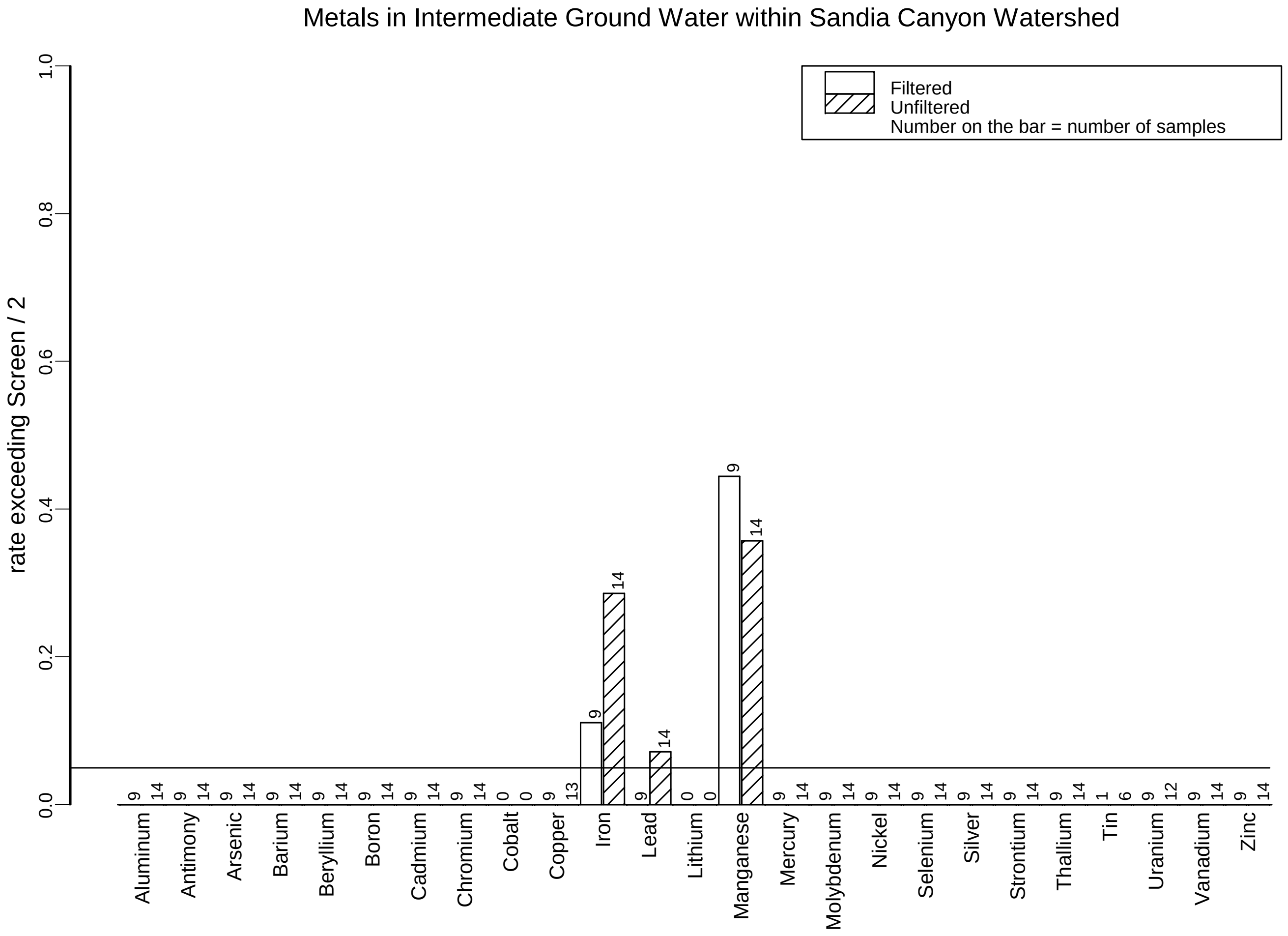


Figure B.25. Rate exceeding Screen/2 for Metals in Sandia Canyon Intermediate Groundwater.

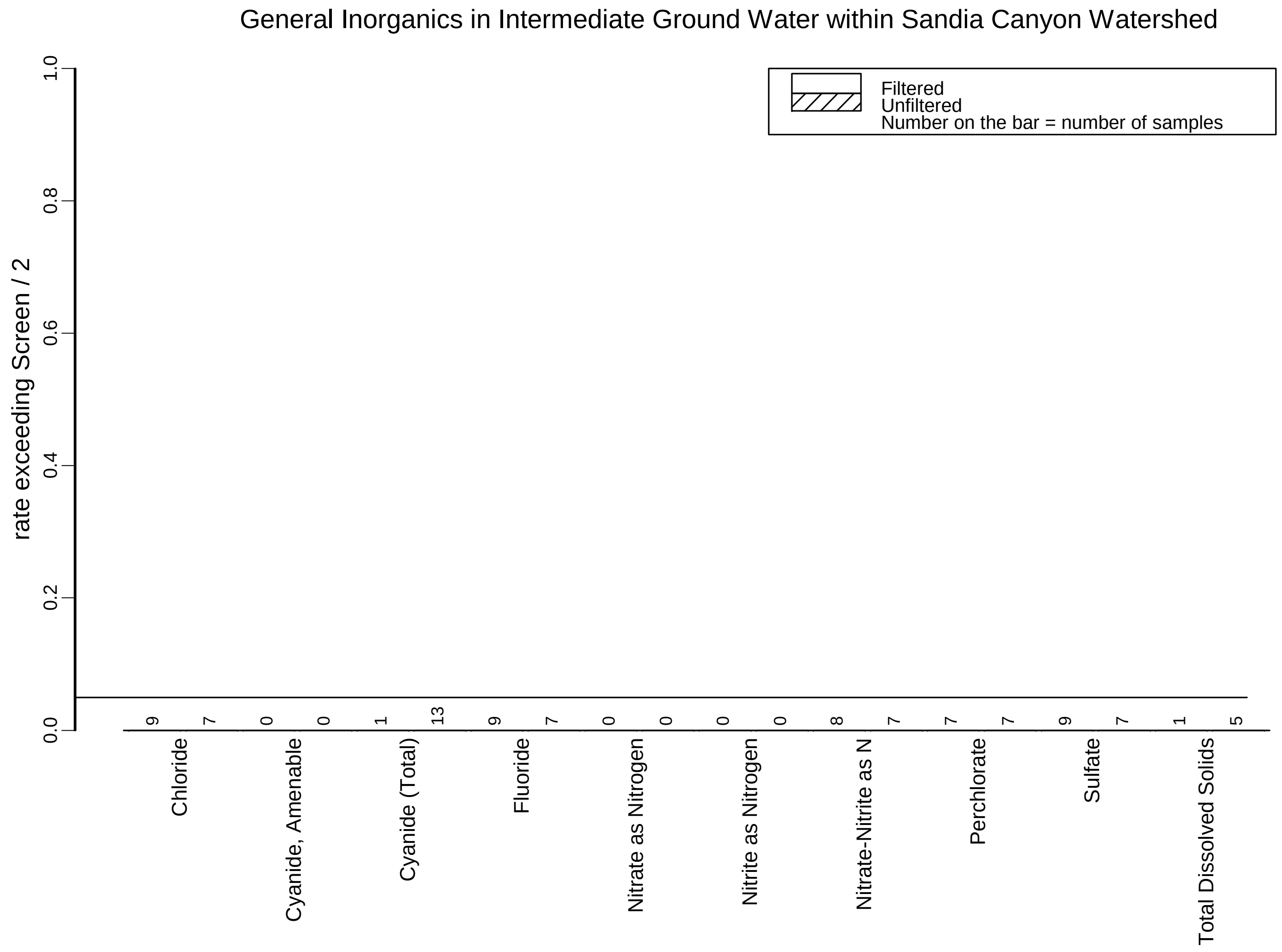


Figure B.26. **Rate exceeding Screen/2 for General Inorganics in Sandia Canyon Intermediate Ground Water.**

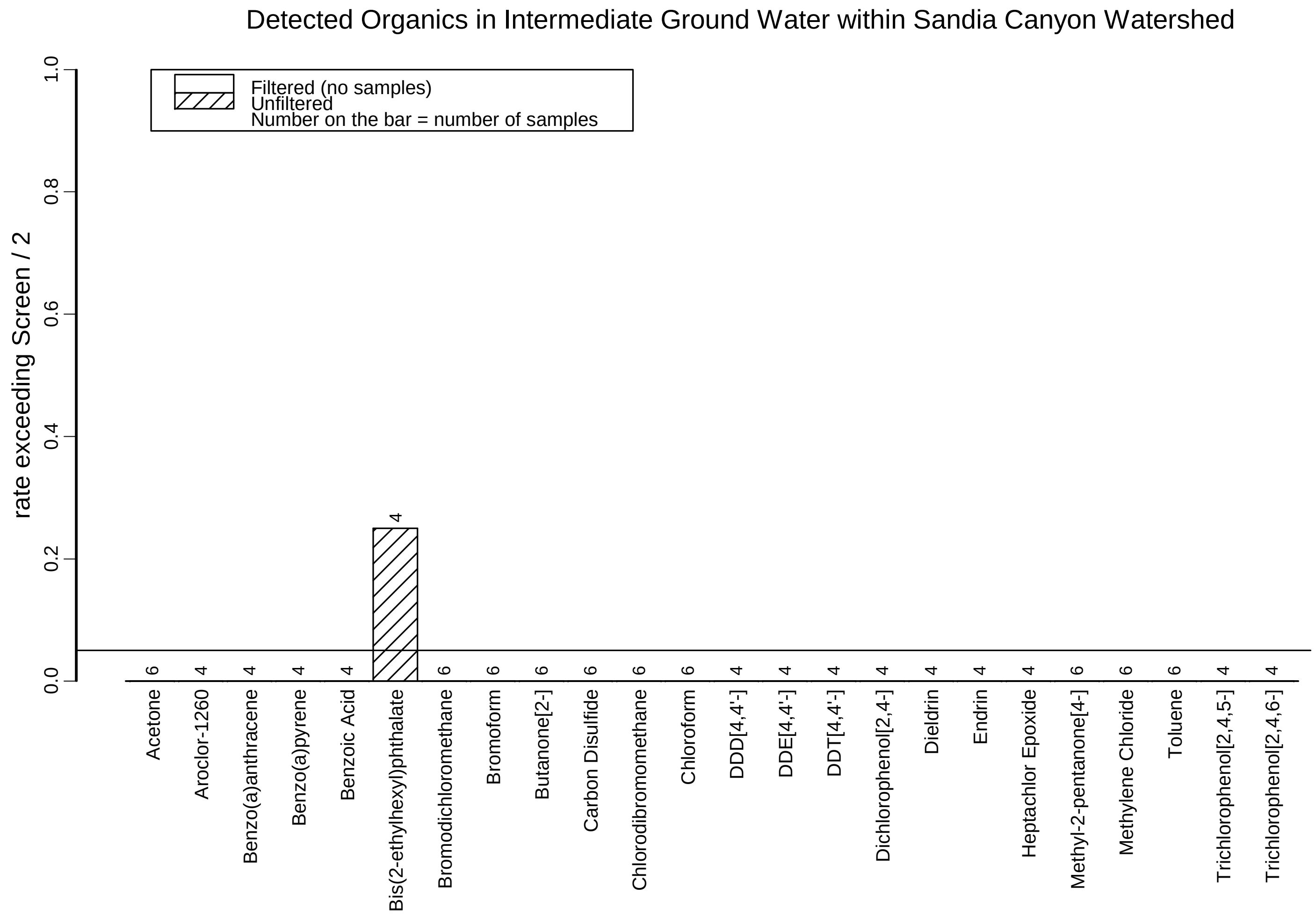


Figure B.27. **Rate exceeding Screen/2 for General organics in Sandia Canyon Intermediate Ground Water.**

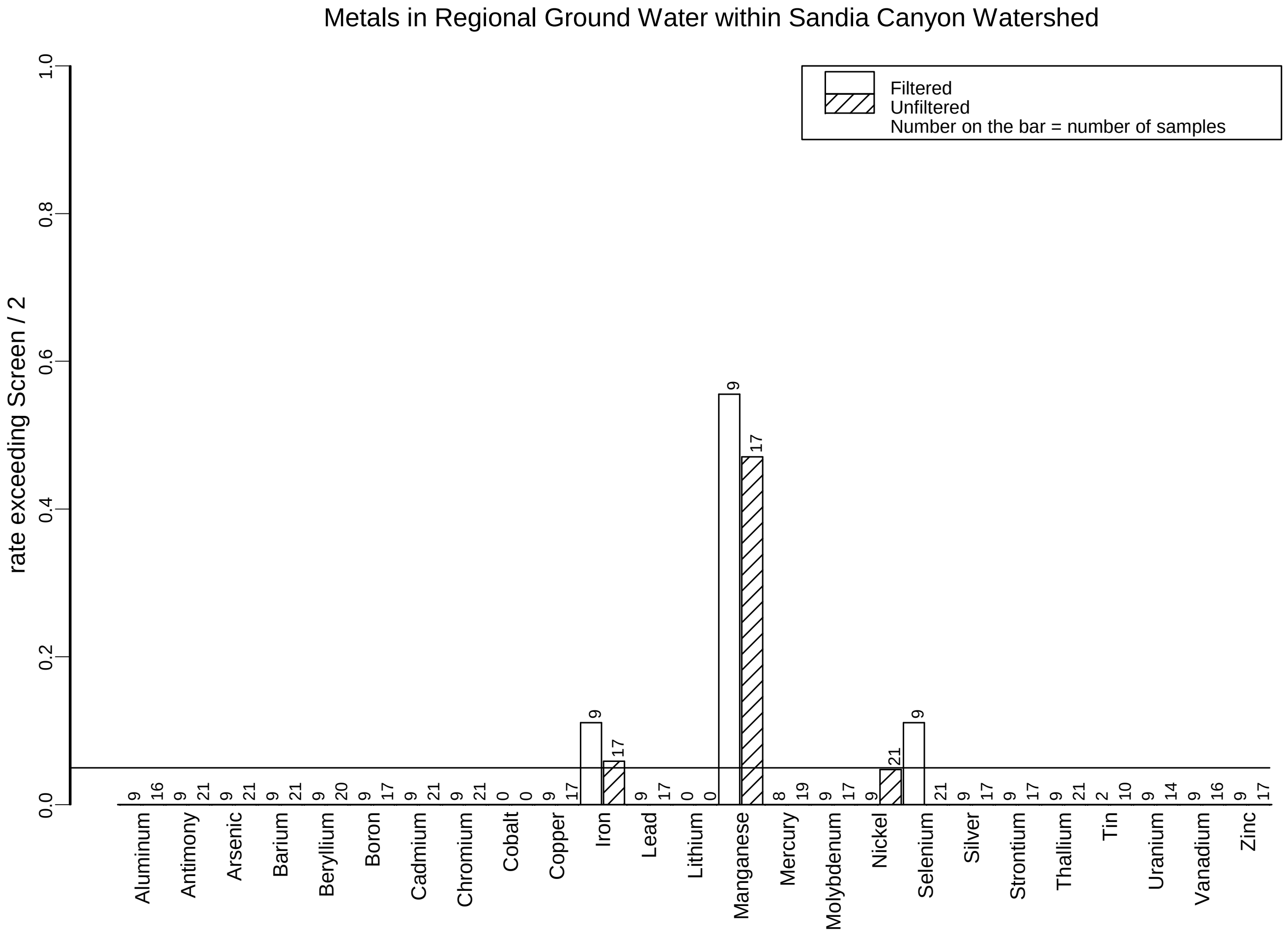


Figure B.28. **Rate exceeding Screen/2 for Metals in Sandia Canyon Regional Ground Water.**

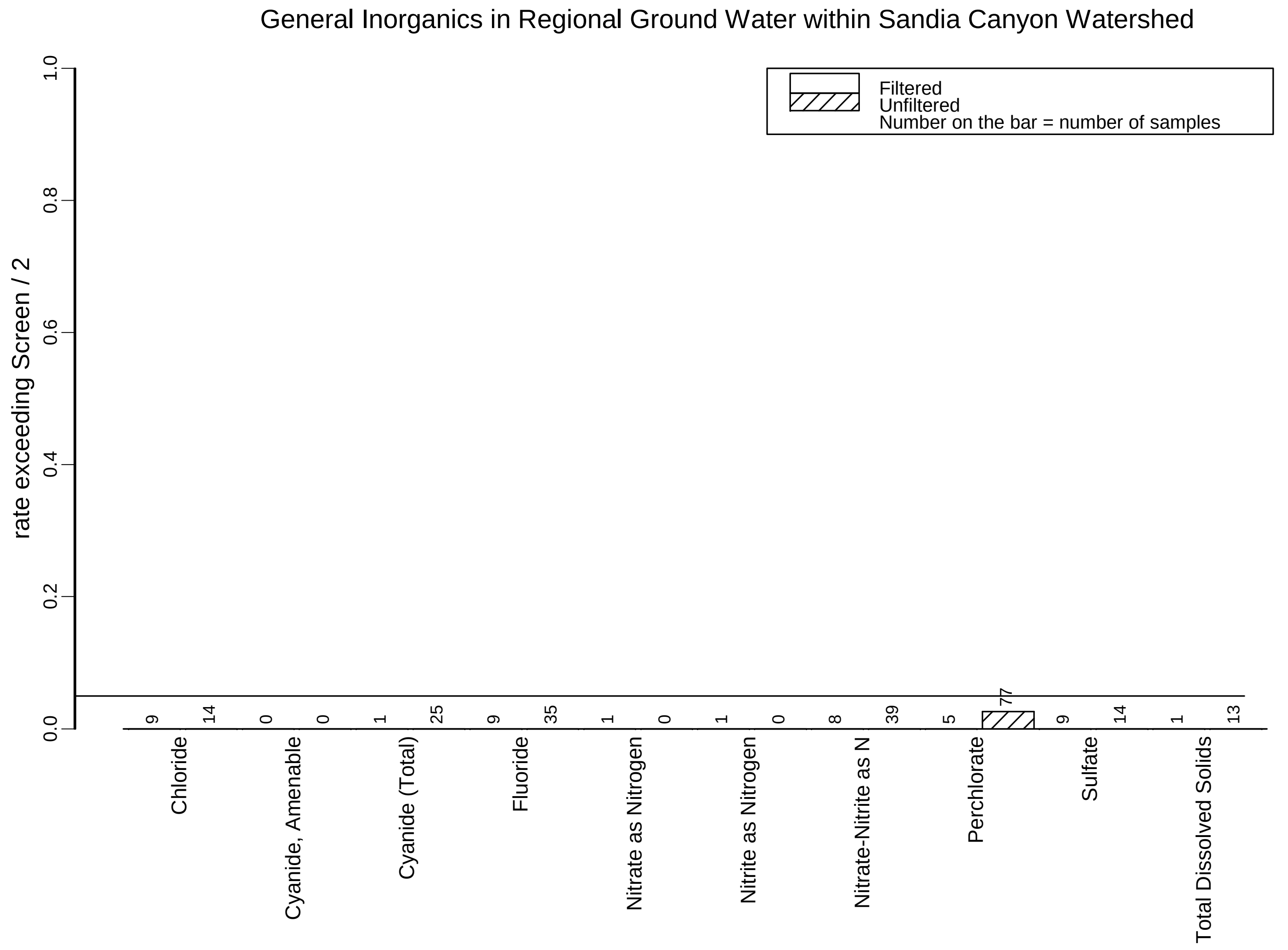


Figure B.29. **Rate exceeding Screen/2 for General Inorganics in Sandia Canyon Regional Ground Water.**

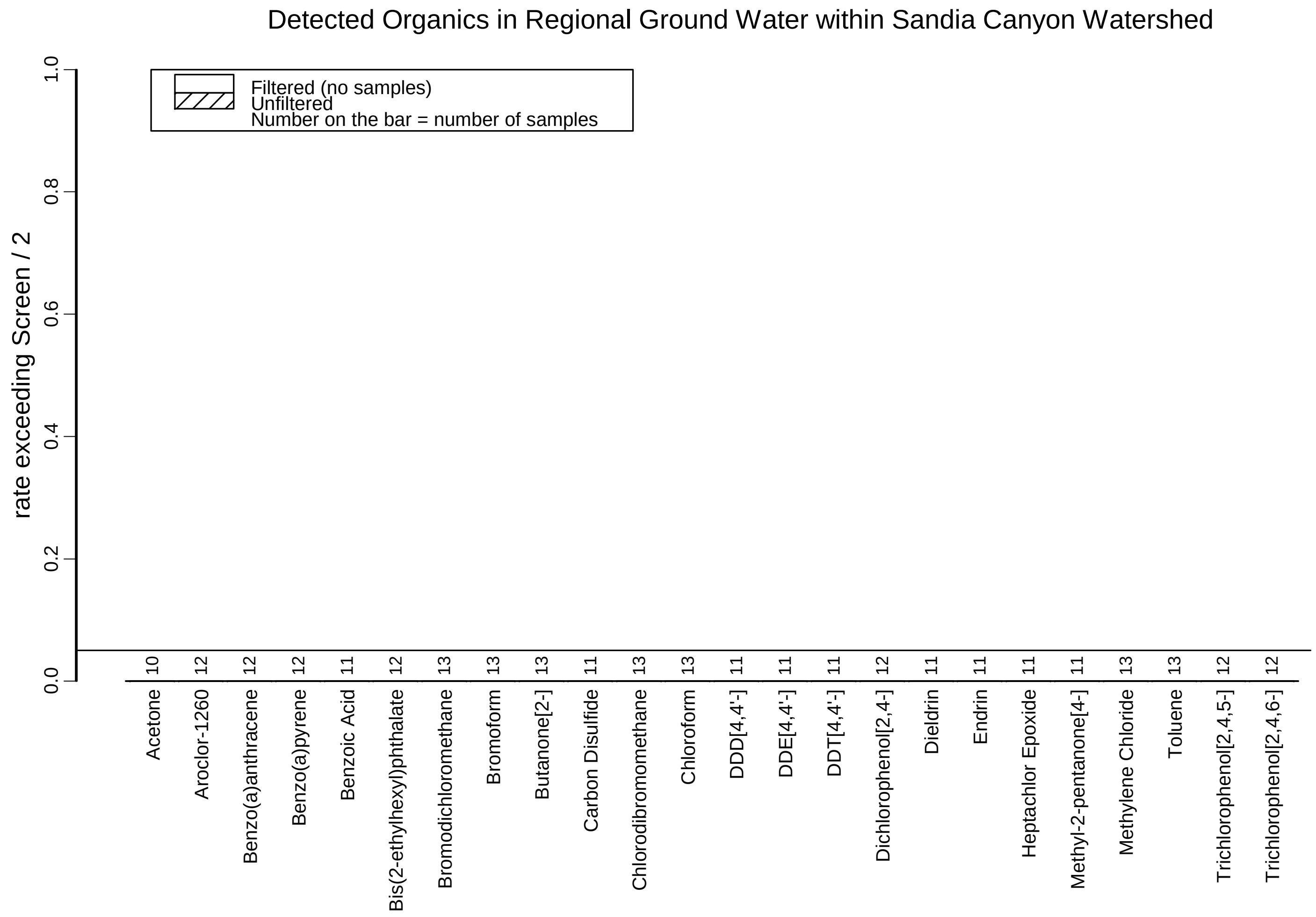


Figure B.30. **Rate exceeding Screen/2 for General organics in Sandia Canyon Regional Ground Water.**

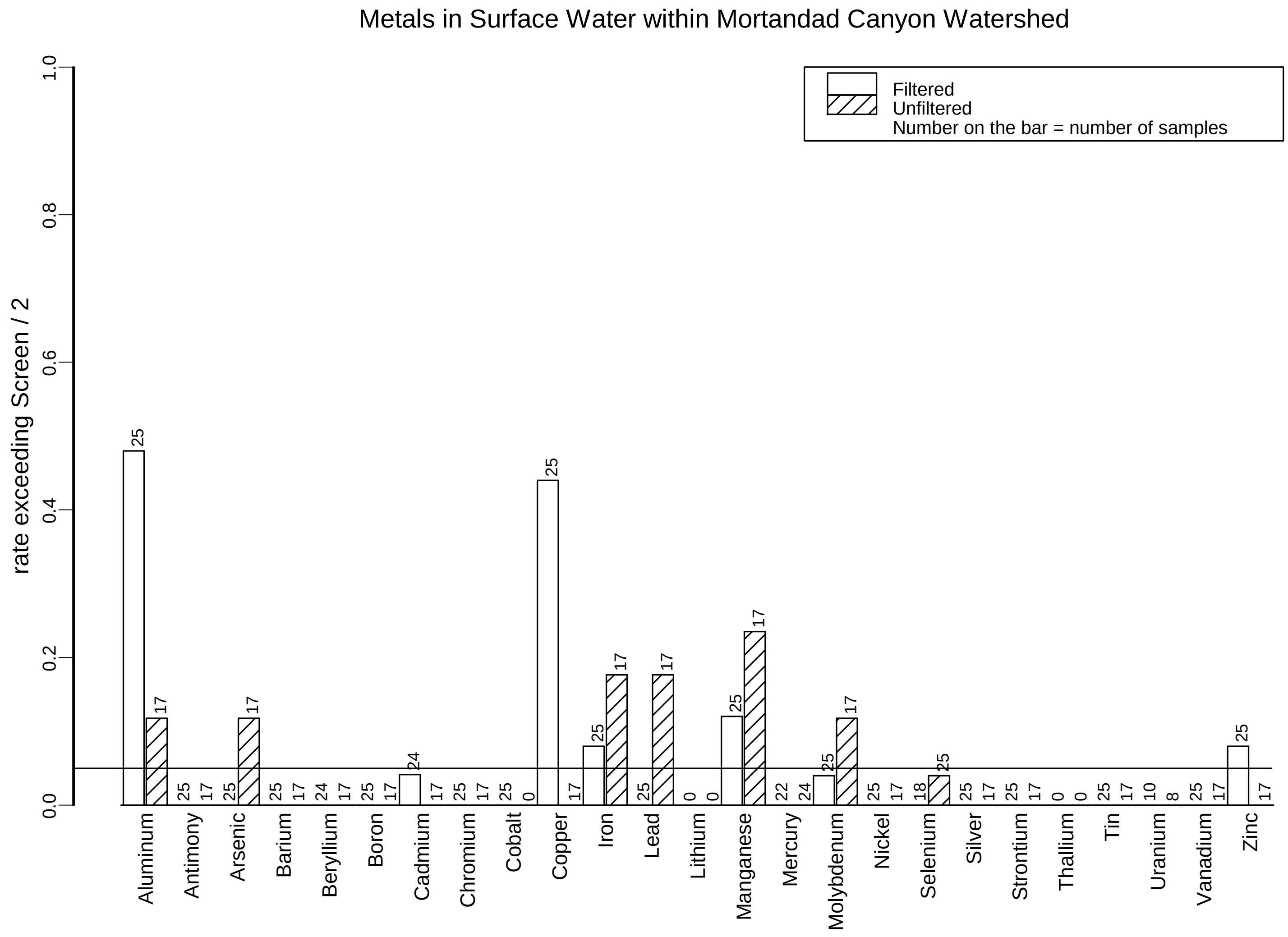


Figure B.31. **Rate exceeding Screen/2 for Metals in Mortandad Canyon Ephemeral Surface Water.**

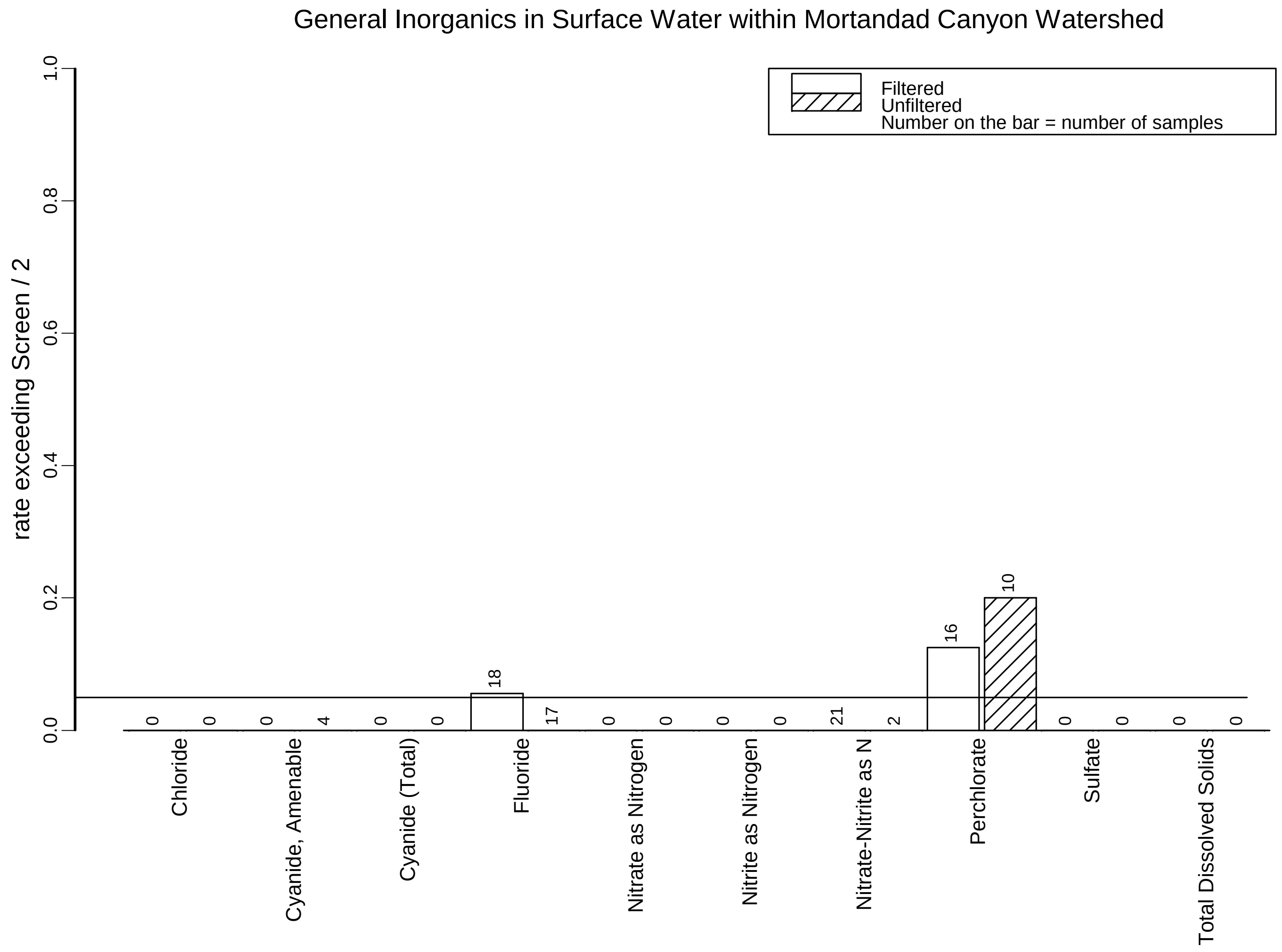


Figure B.32. **Rate exceeding Screen/2 for Inorganics in Mortandad Canyon Ephemeral Surface Water.**

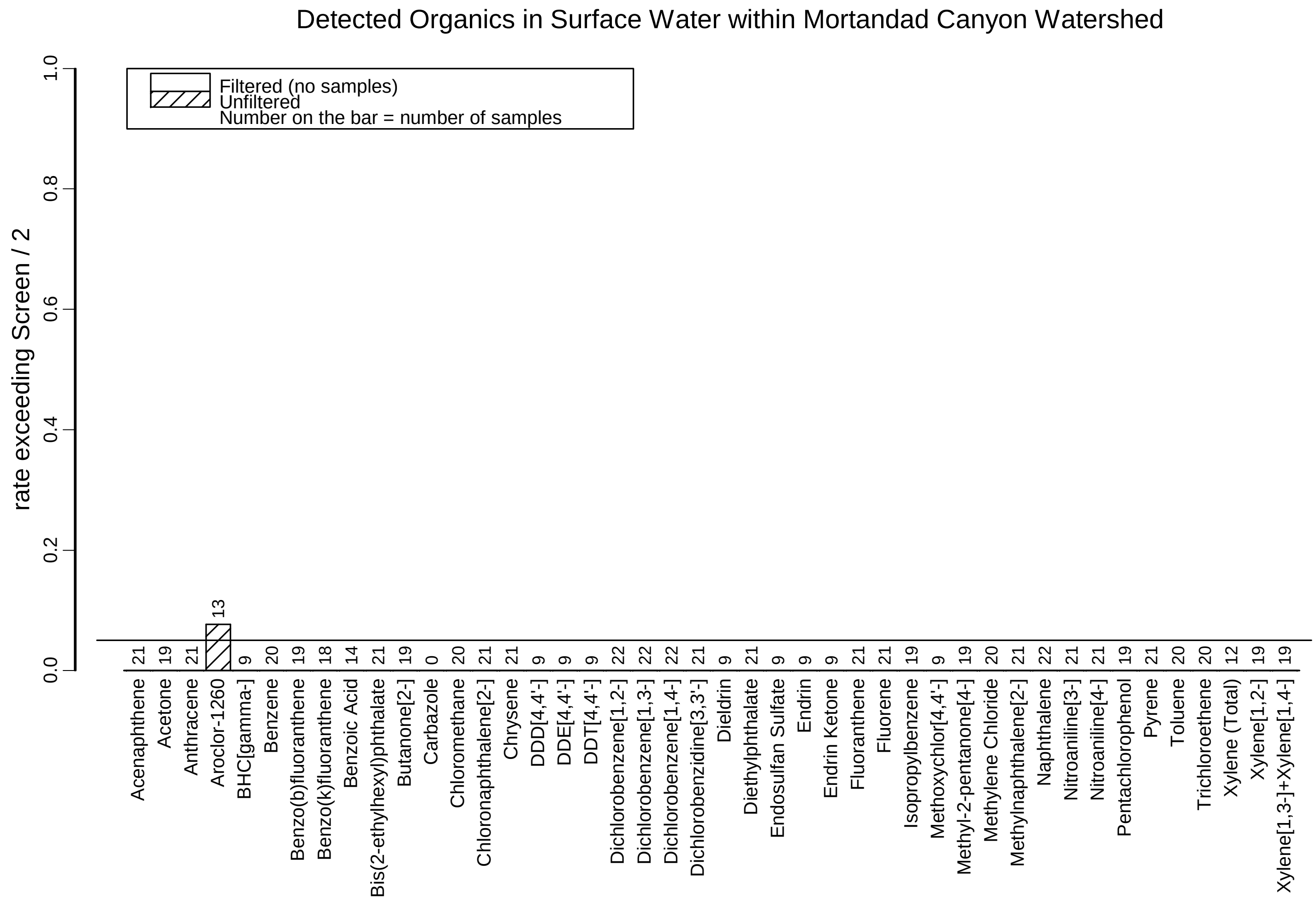


Figure B.33. **Rate exceeding Screen/2 for Organics in Mortandad Canyon Ephemeral Surface Water.**

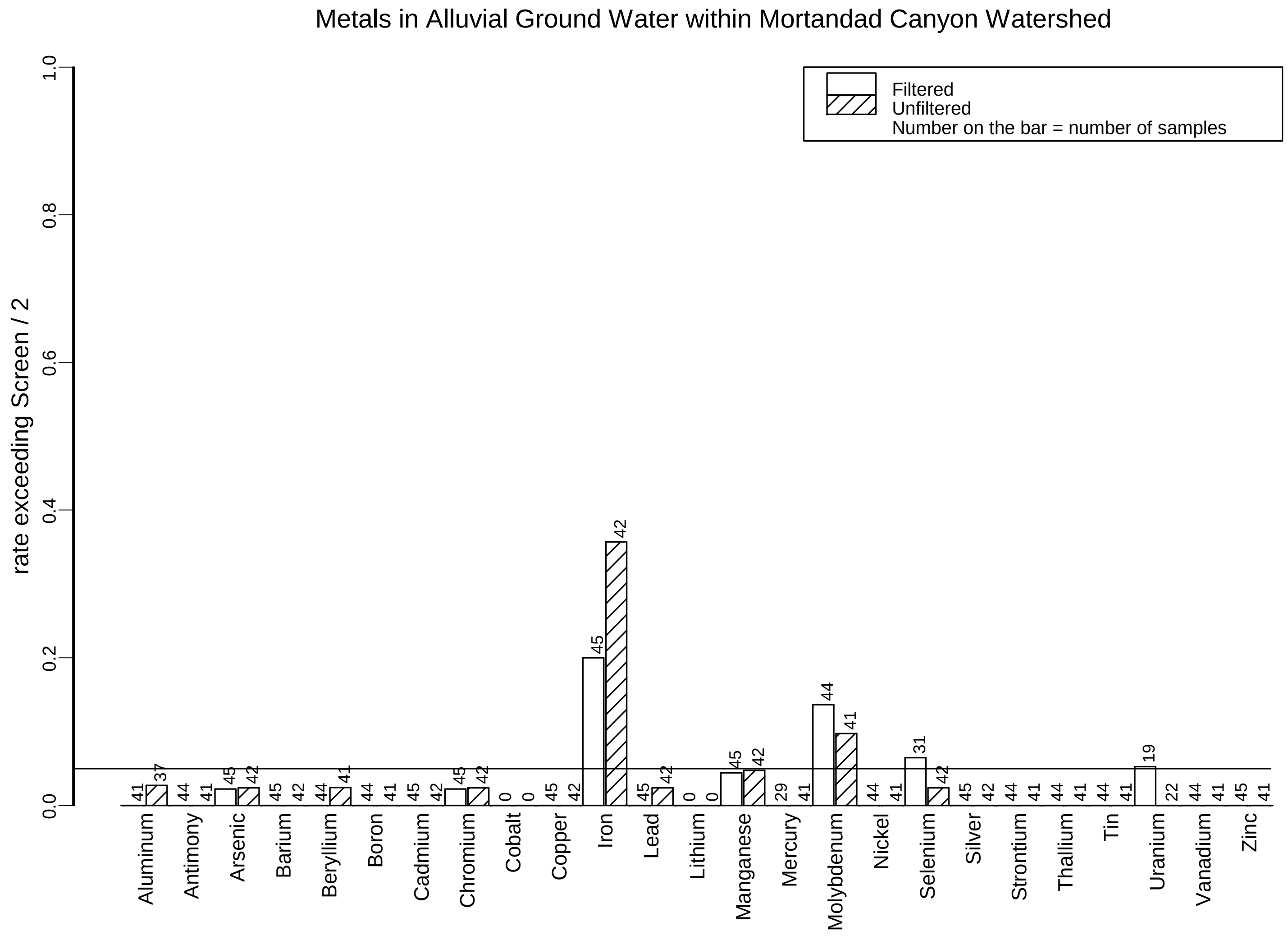


Figure B.34. **Rate exceeding Screen/2 for Metals in Mortandad Canyon Alluvial Ground Water.**

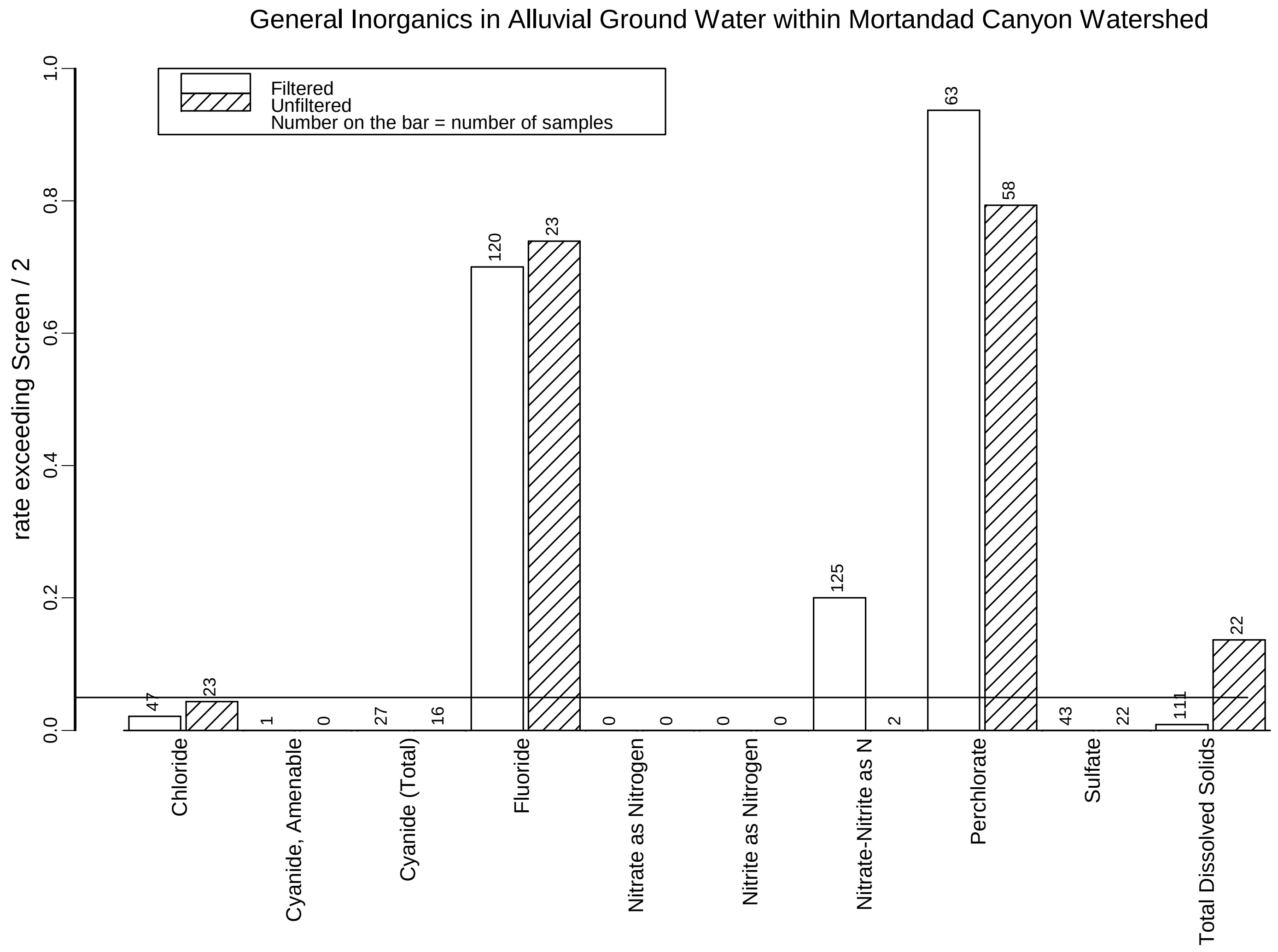


Figure B.35. **Rate exceeding Screen/2 for Inorganics in Mortandad Canyon Alluvial Ground Water.**

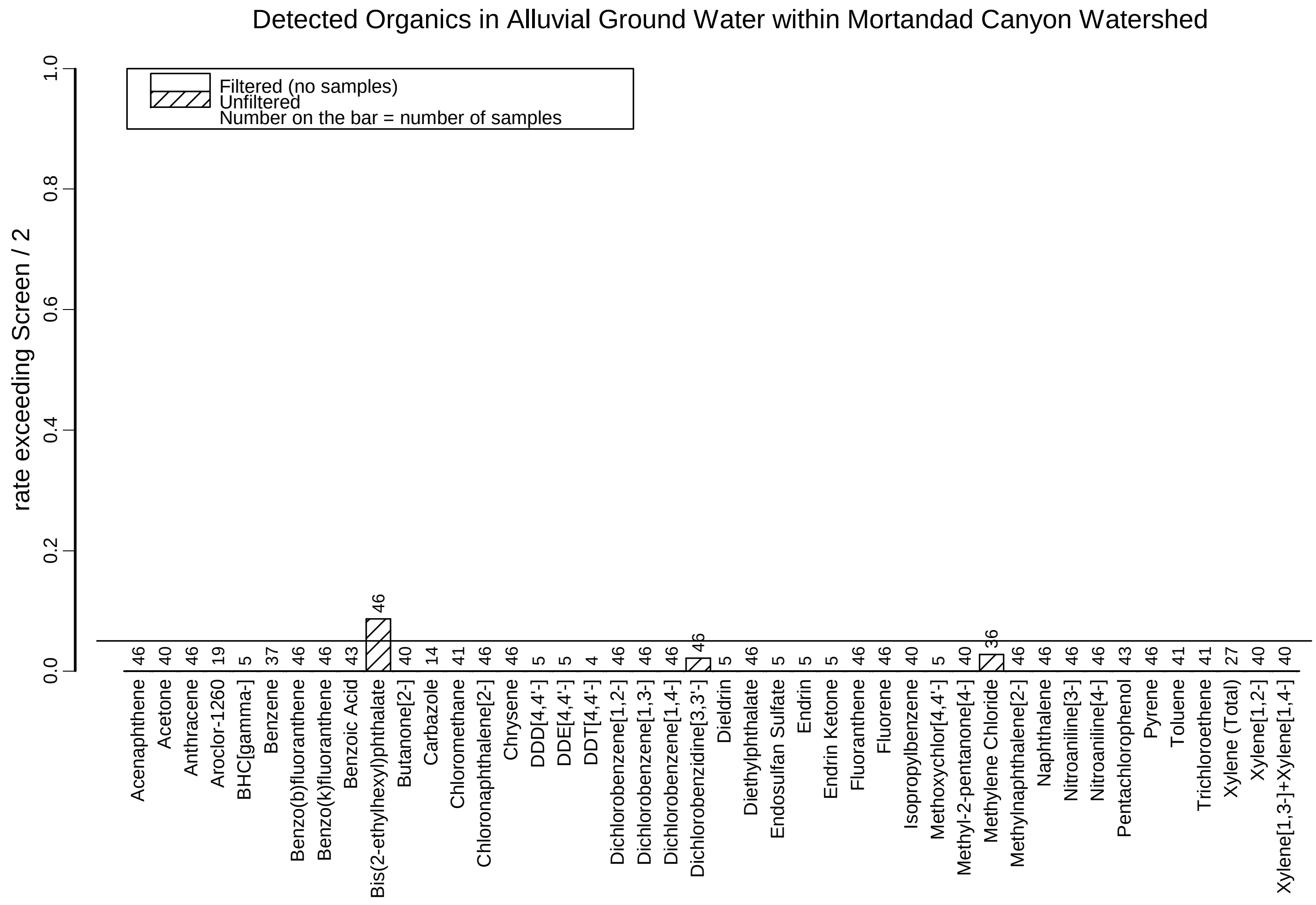


Figure B.36. Rate exceeding Screen/2 for Organics in Mortandad Canyon Alluvial Ground Water.

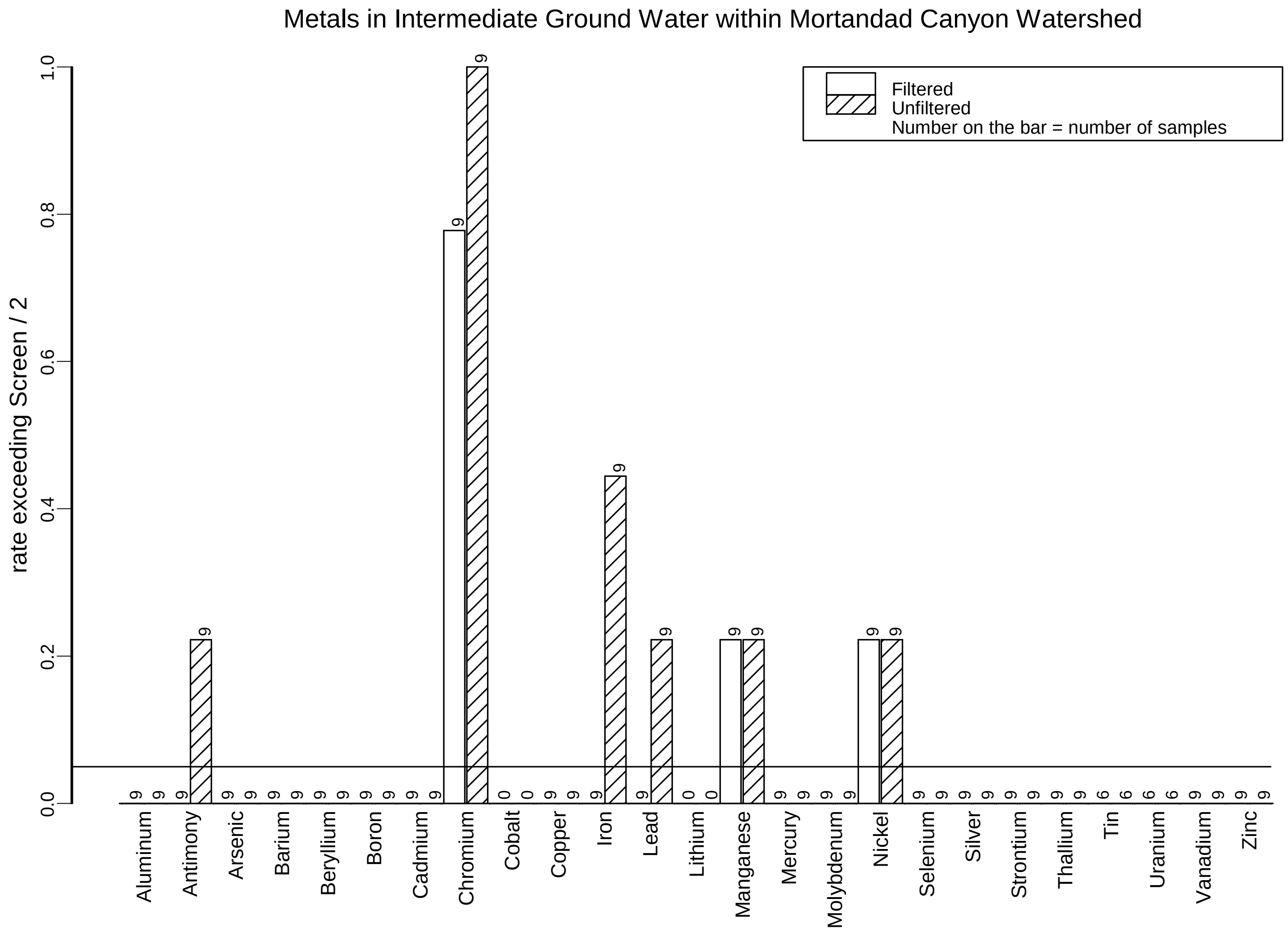


Figure B.37. **Rate exceeding Screen/2 for Metals in Mortandad Canyon Intermediate Ground Water.**

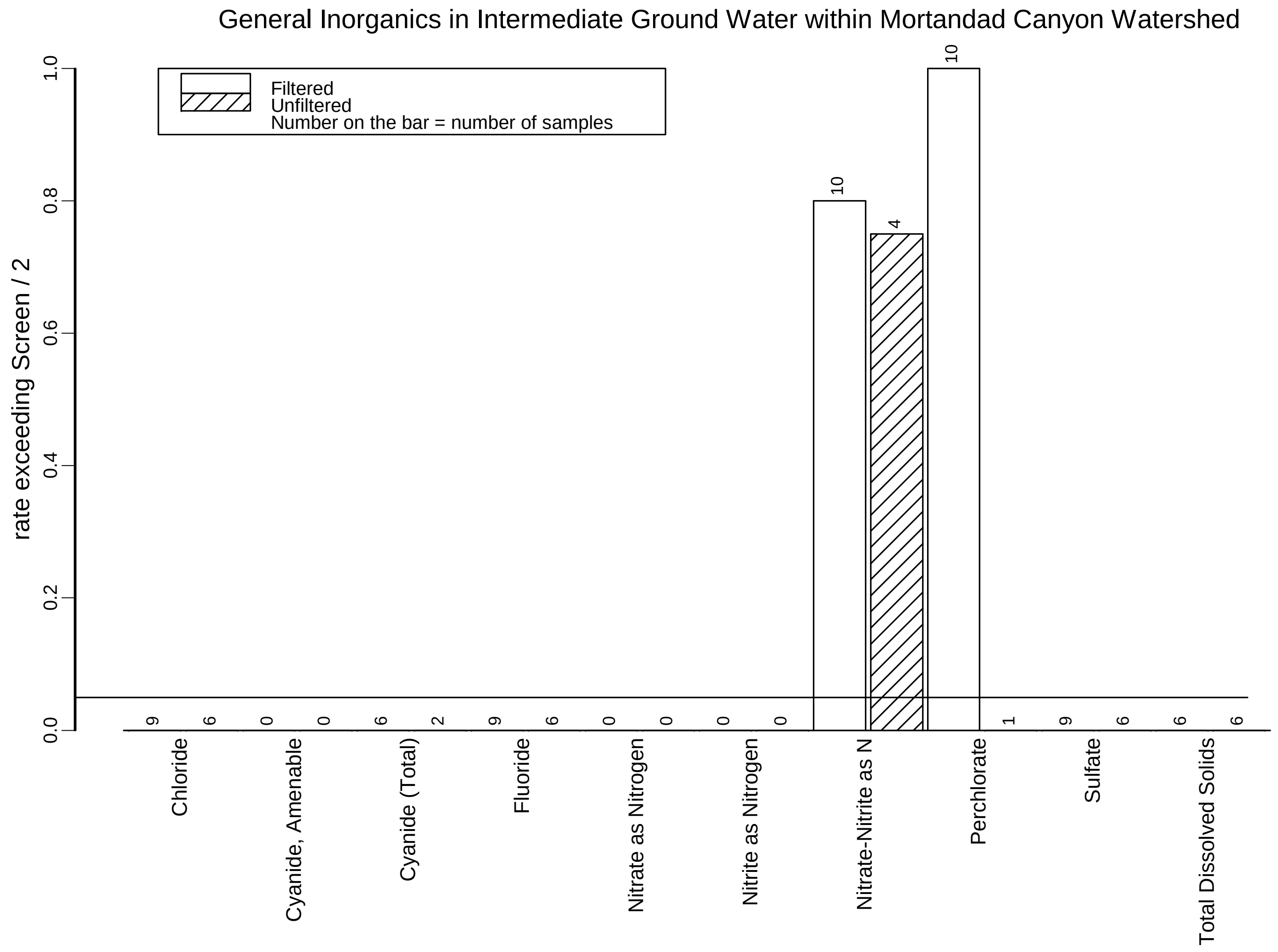


Figure B.38. **Rate exceeding Screen/2 for Inorganics in Mortandad Canyon Intermediate Ground Water.**

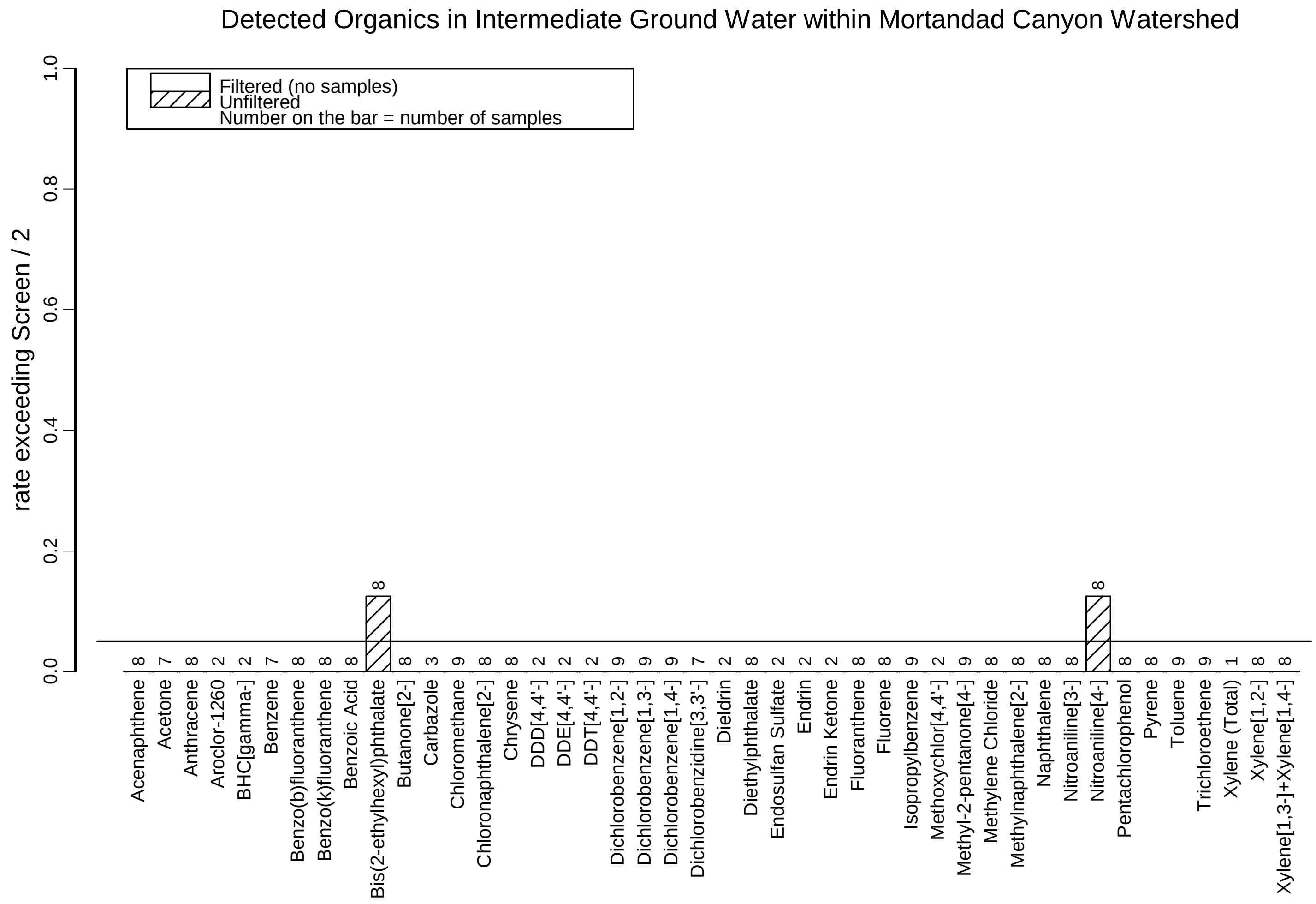


Figure B.39. **Rate exceeding Screen/2 for Organics in Mortandad Canyon Intermediate Ground Water.**

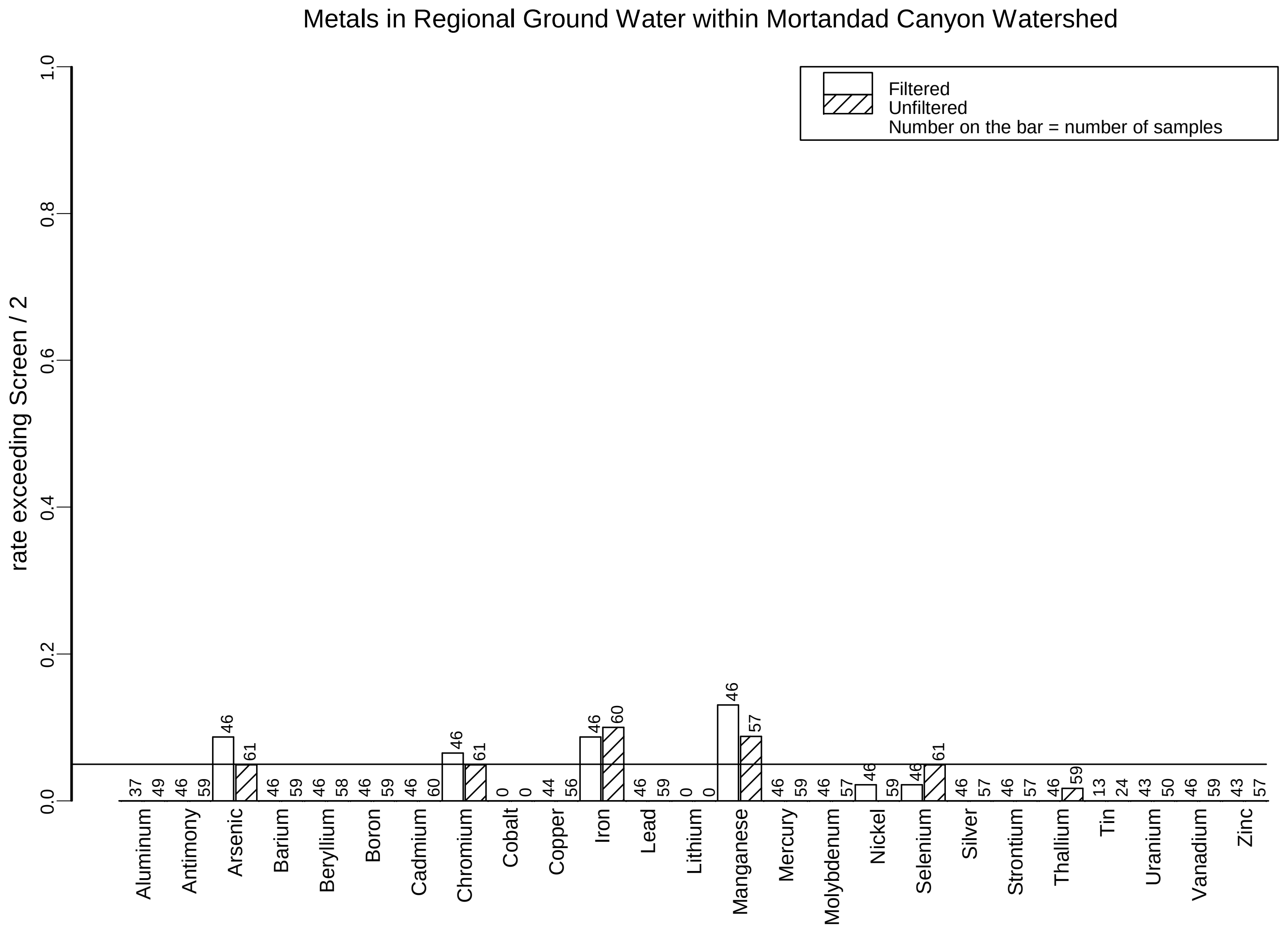


Figure B.40. **Rate exceeding Screen/2 for Metals in Mortandad Canyon Regional Ground Water.**

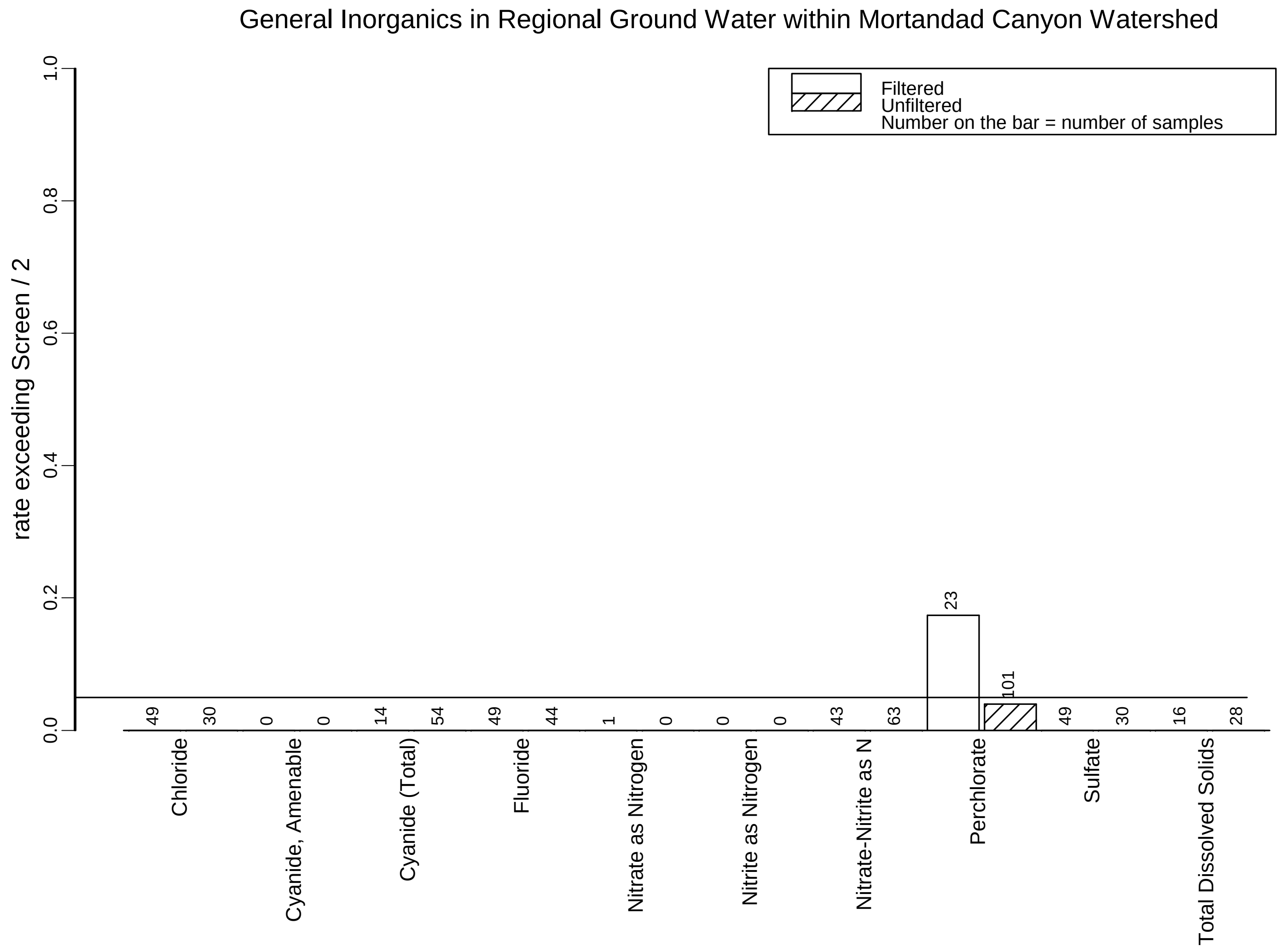


Figure B.41. **Rate exceeding Screen/2 for Inorganics in Mortandad Canyon Regional Ground Water.**

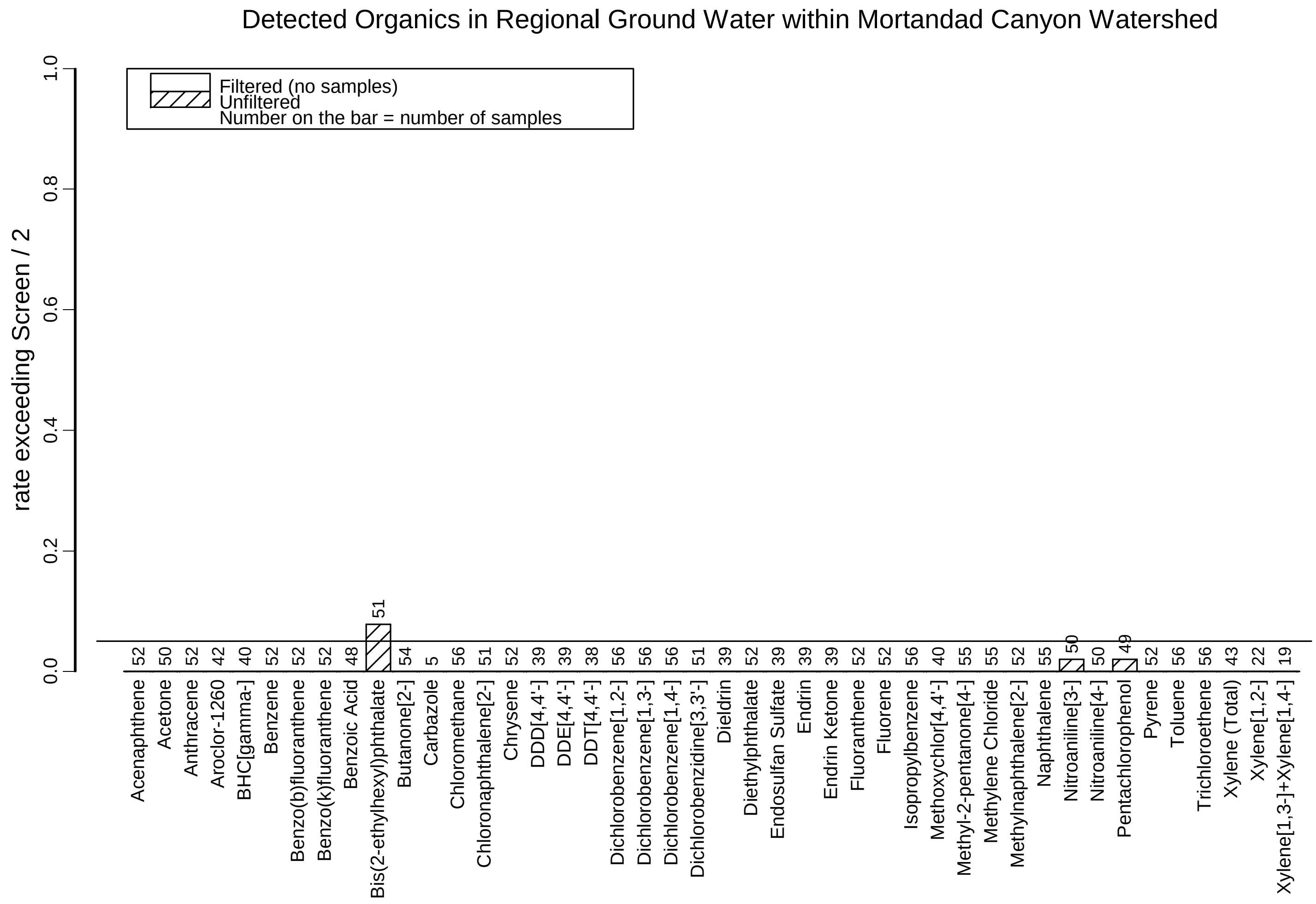


Figure B.42. **Rate exceeding Screen/2 for Organics in Mortandad Canyon Regional Ground Water.**

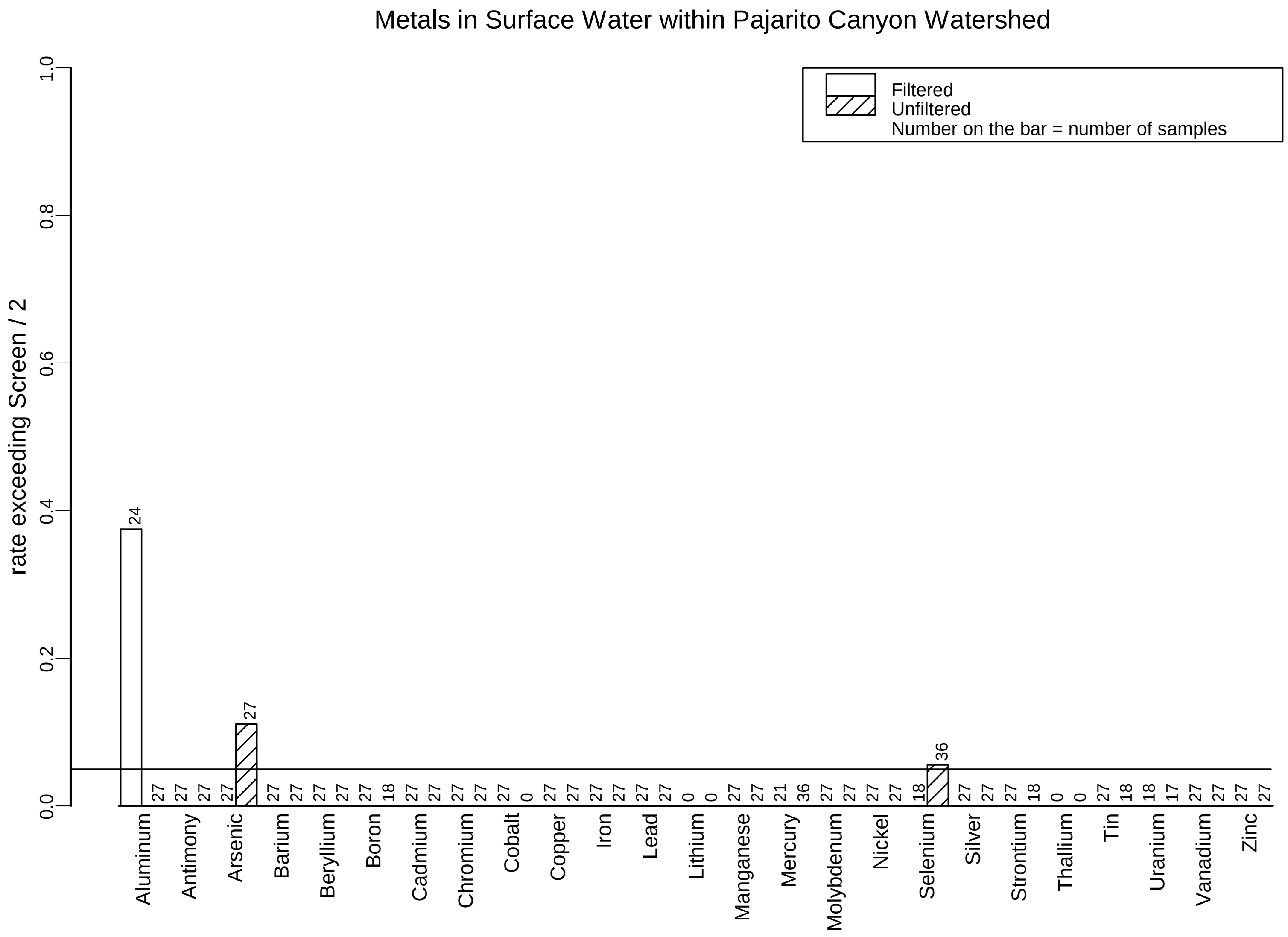


Figure B.43. **Rate exceeding Screen/2 for Metals in Pajarito Ephemeral Surface Water.**

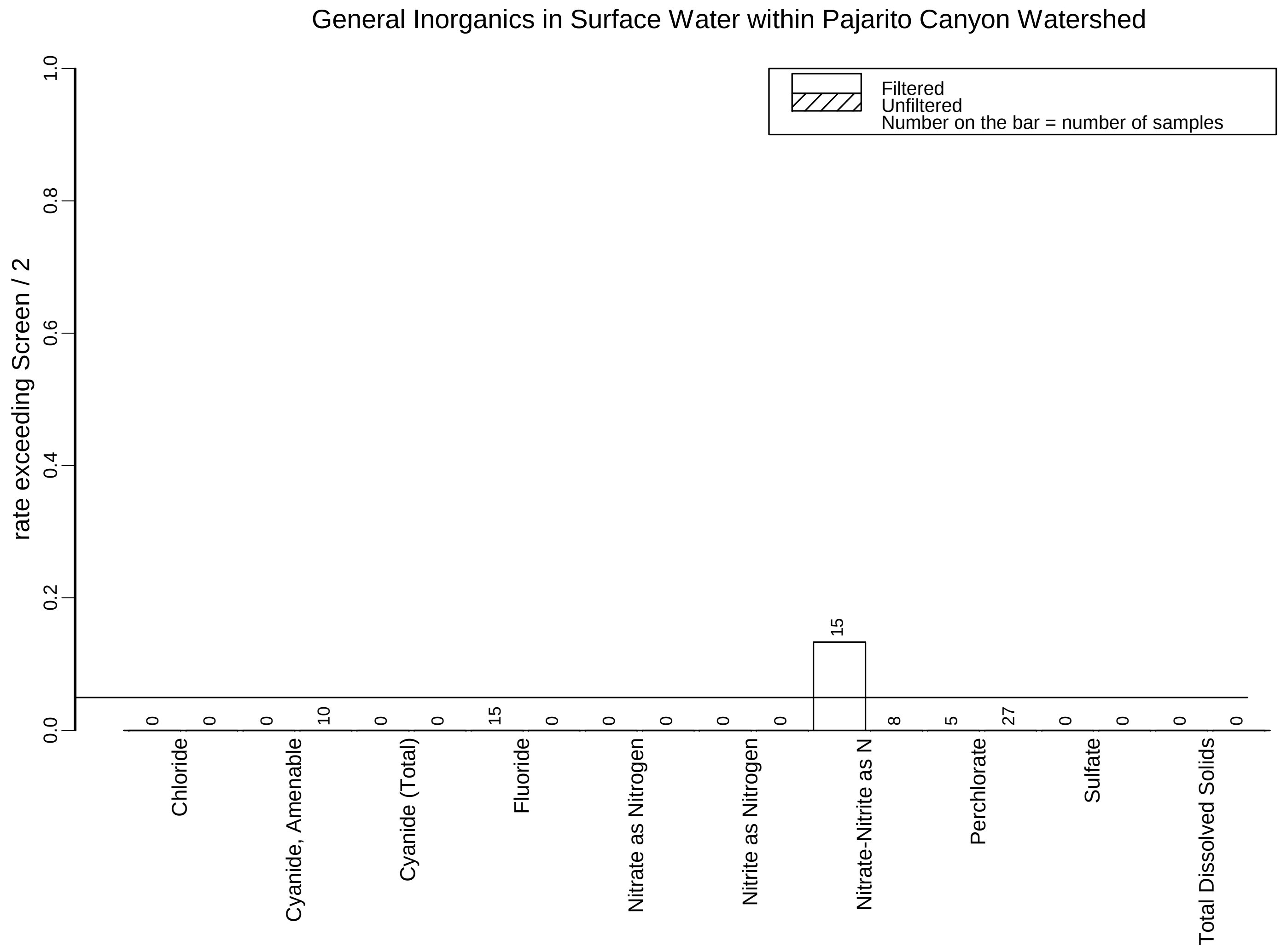


Figure B.44. **Rate exceeding Screen/2 for General Inorganics in Pajarito Ephemeral Surface Water.**

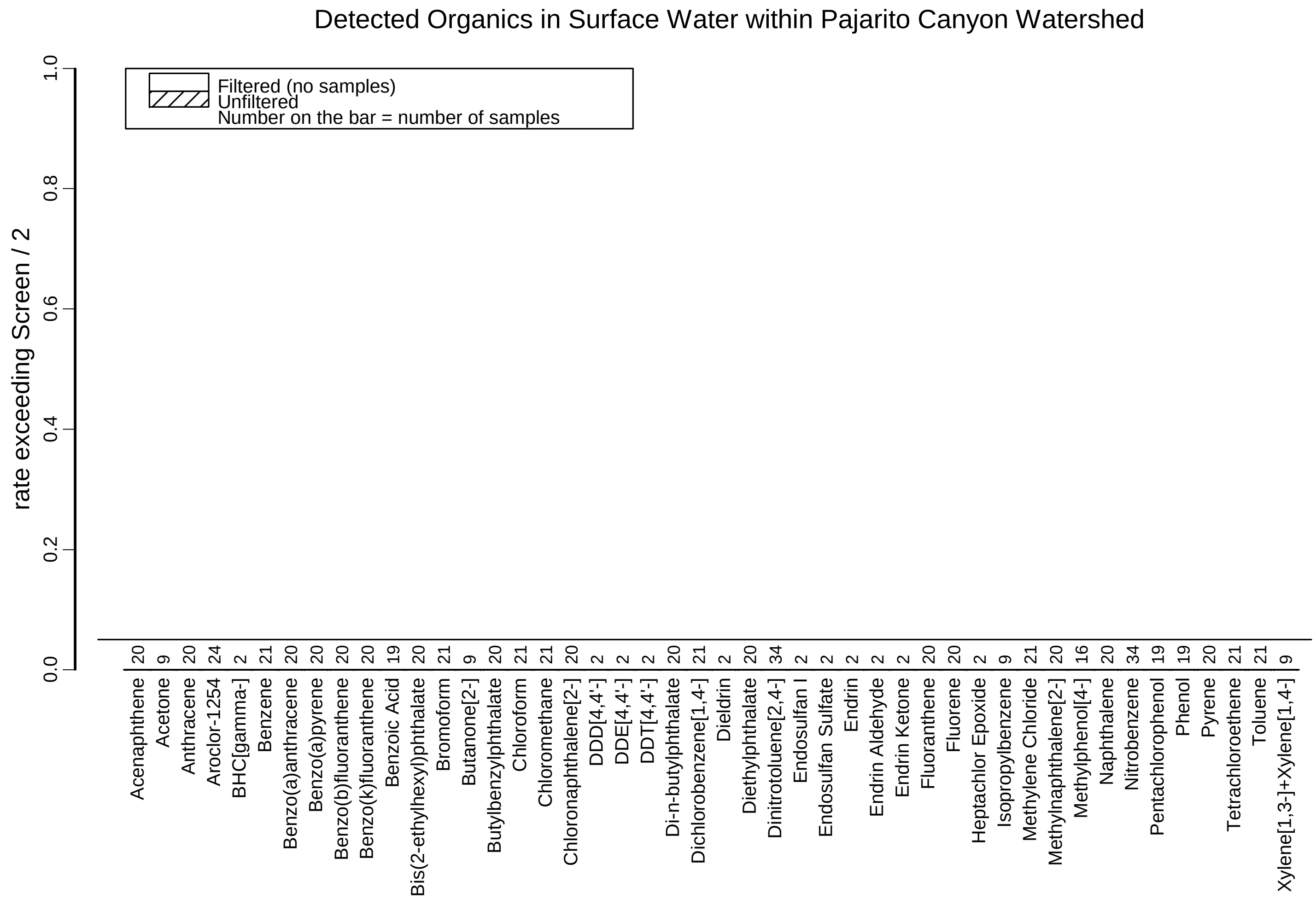


Figure B.45. **Rate exceeding Screen/2 for Organics in Pajarito Ephemeral Surface Water.**

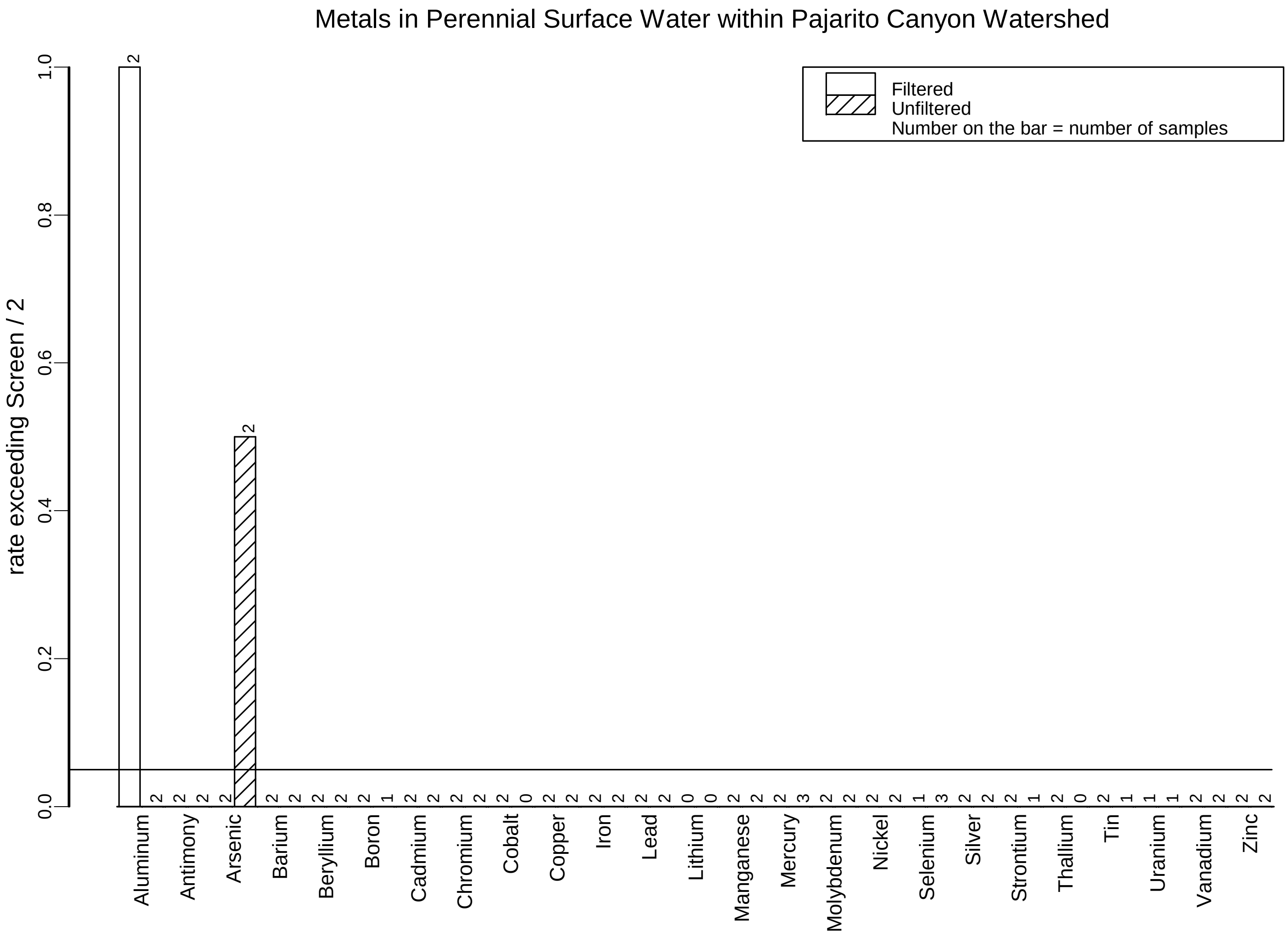


Figure B.46. **Rate exceeding Screen/2 for Metals in Pajarito Perennial Surface Water.**

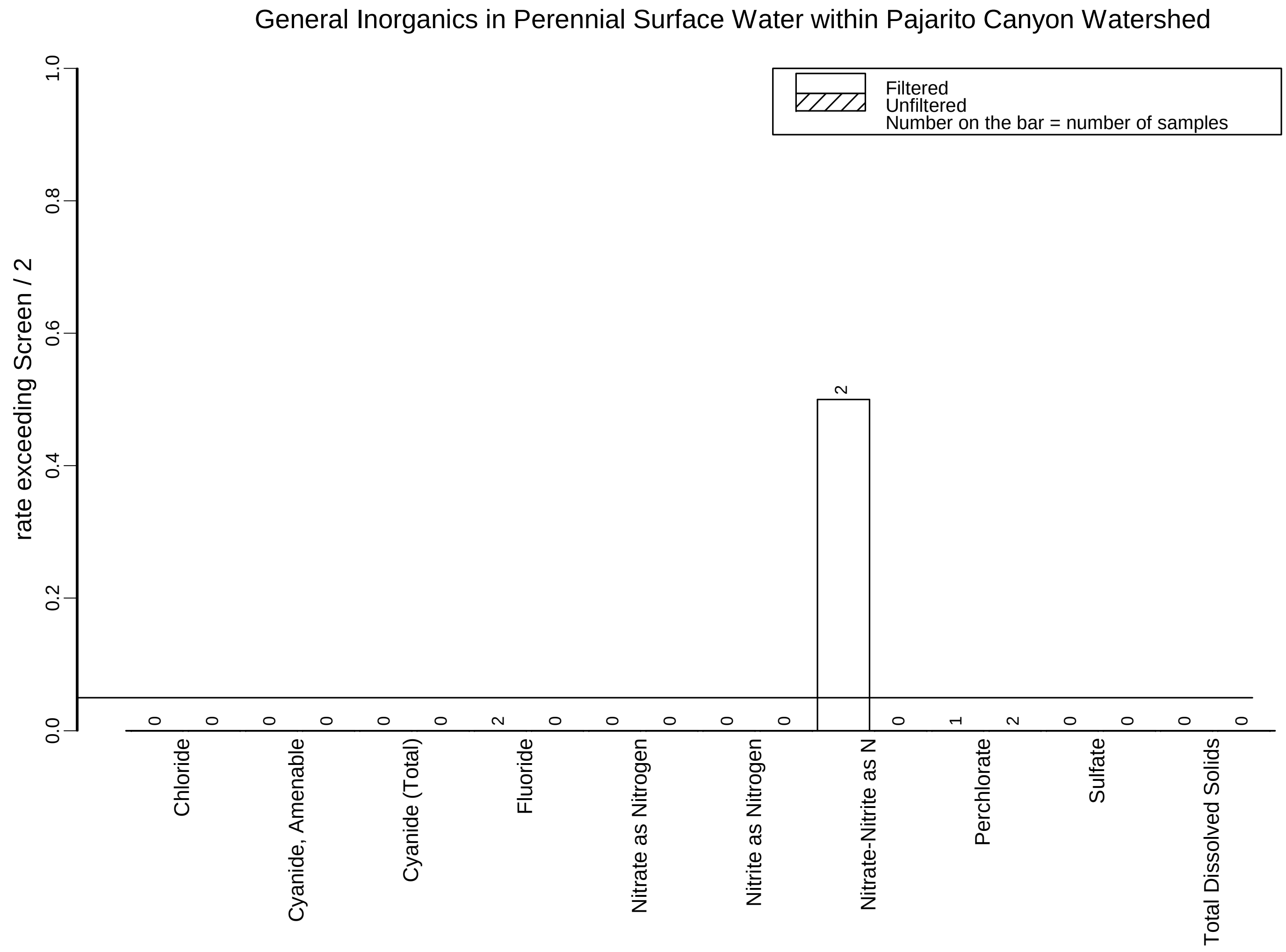


Figure B.47. **Rate exceeding Screen/2 for General Inorganics in Pajarito Perennial Surface Water.**

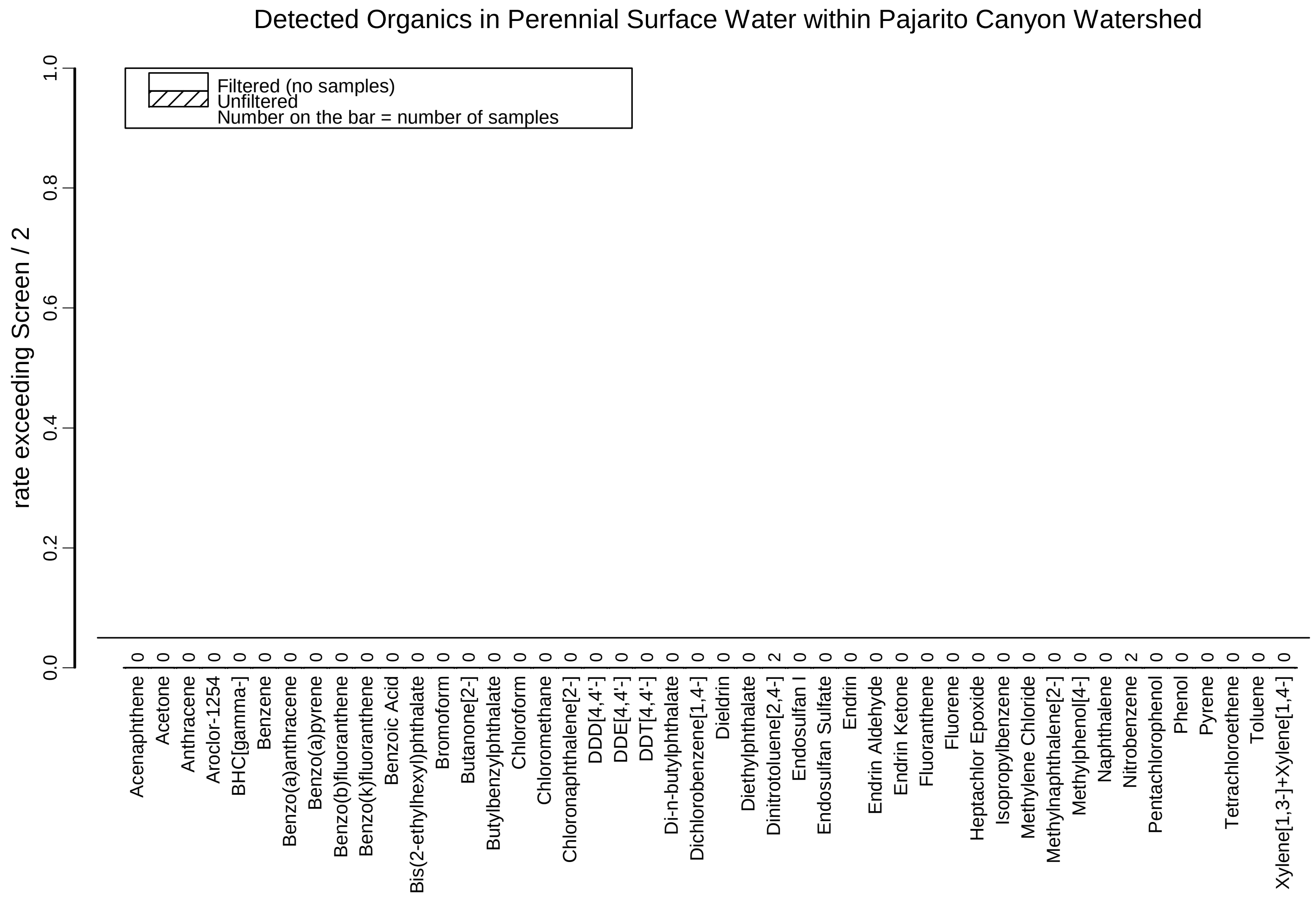


Figure B.48. **Rate exceeding Screen/2 for Organics in Pajarito Perennial Surface Water.**

Note: This is correct. There are only n=2 analytes (Dinitrotoluene[2,4-] and Nitribenzene) that were analyzed n=2 times each.

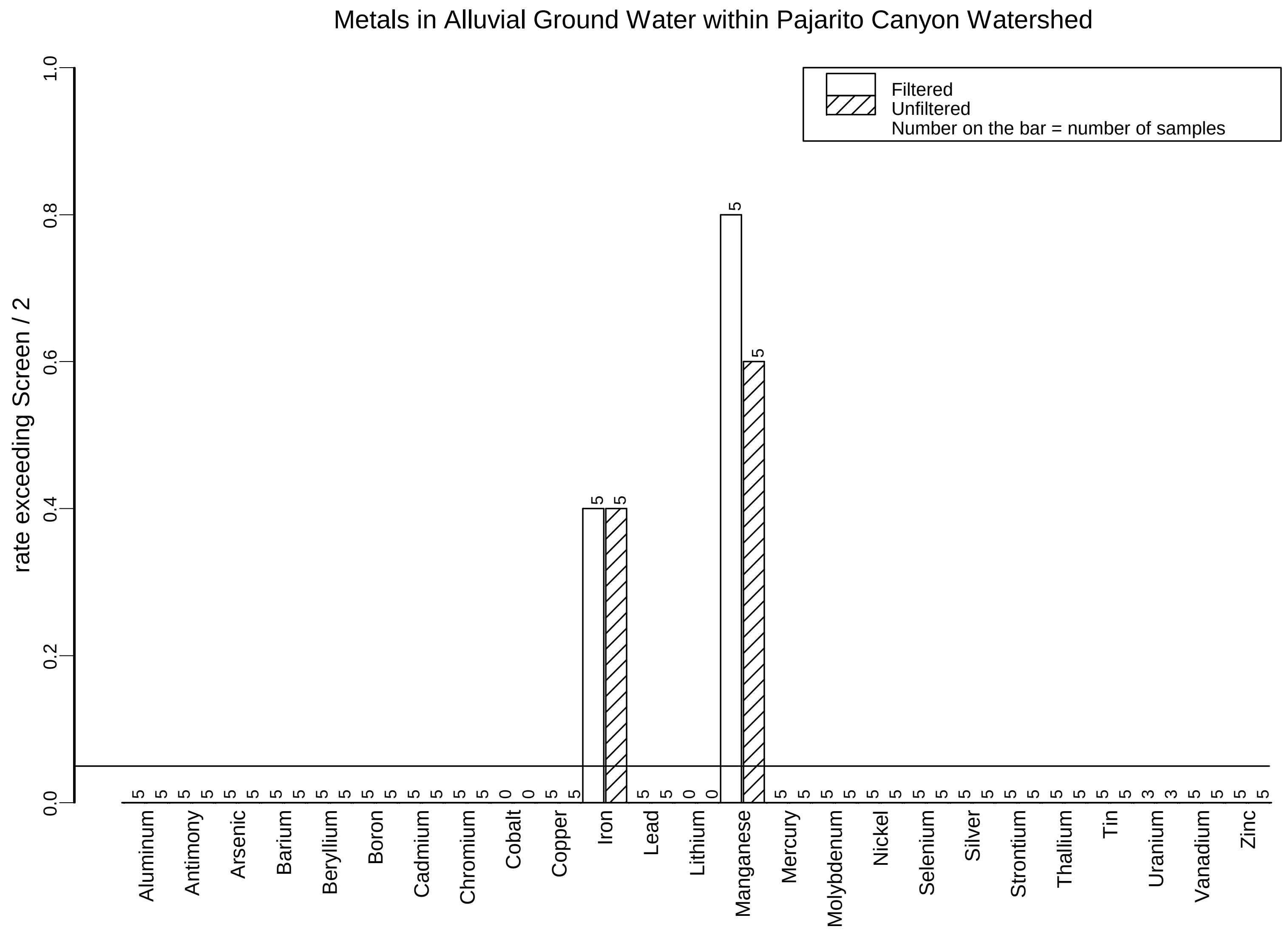


Figure B.49. **Rate exceeding Screen/2 for Metals in Pajarito Alluvial Ground Water.**

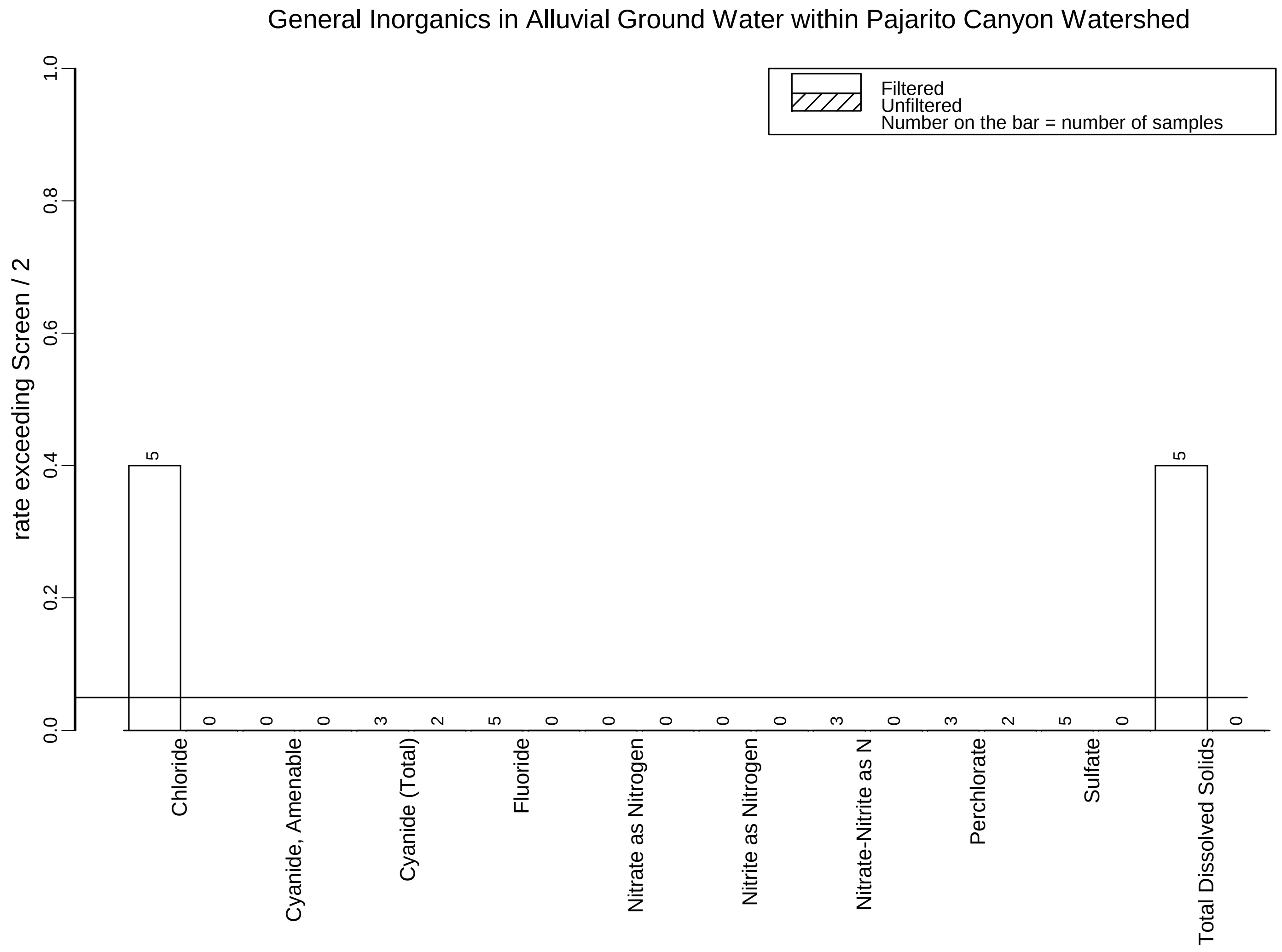


Figure B.50. **Rate exceeding Screen/2 for General Inorganics in Pajarito Alluvial Ground Water.**

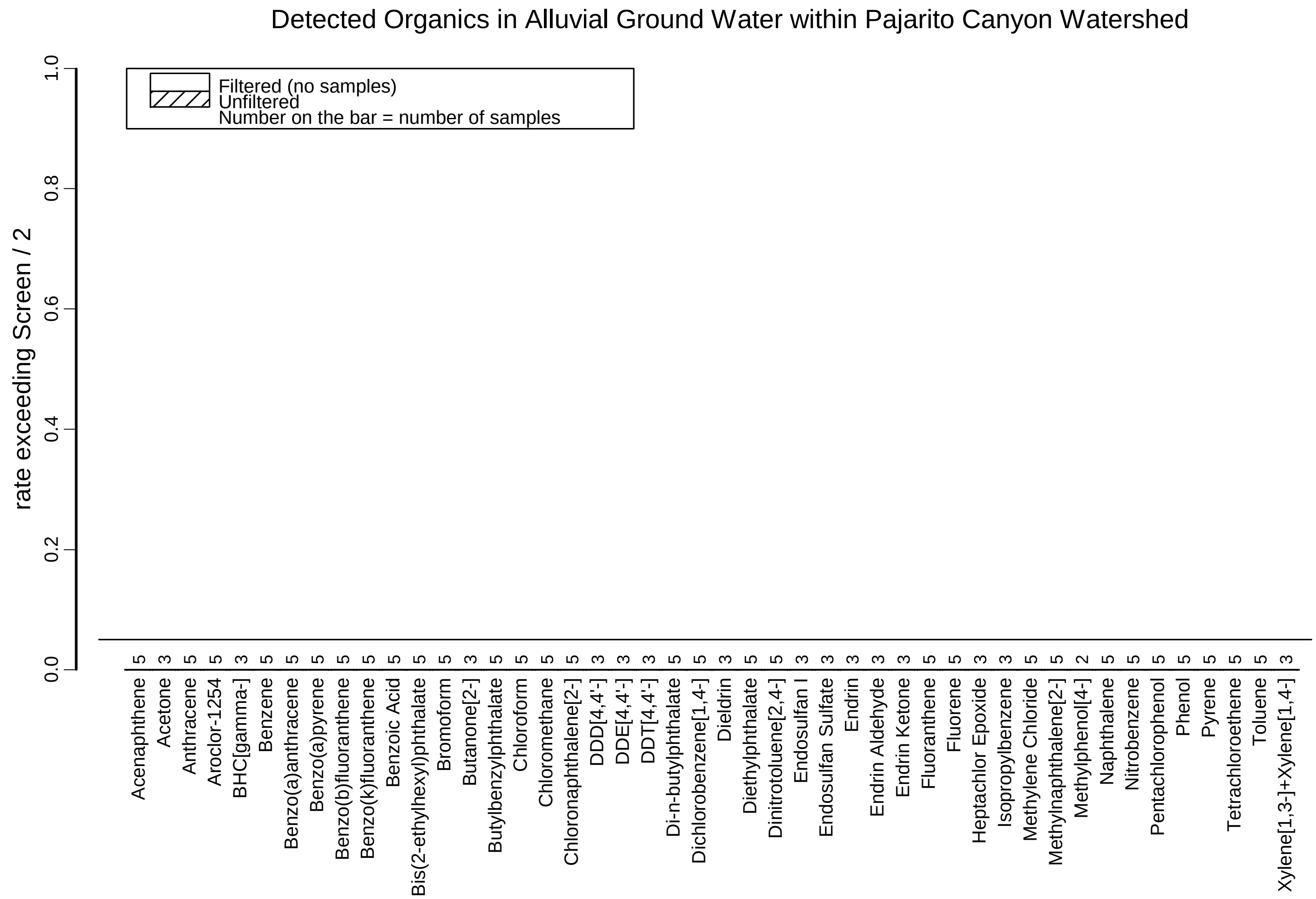


Figure B.51. **Rate exceeding Screen/2 for Organics in Pajarito Alluvial Ground Water.**

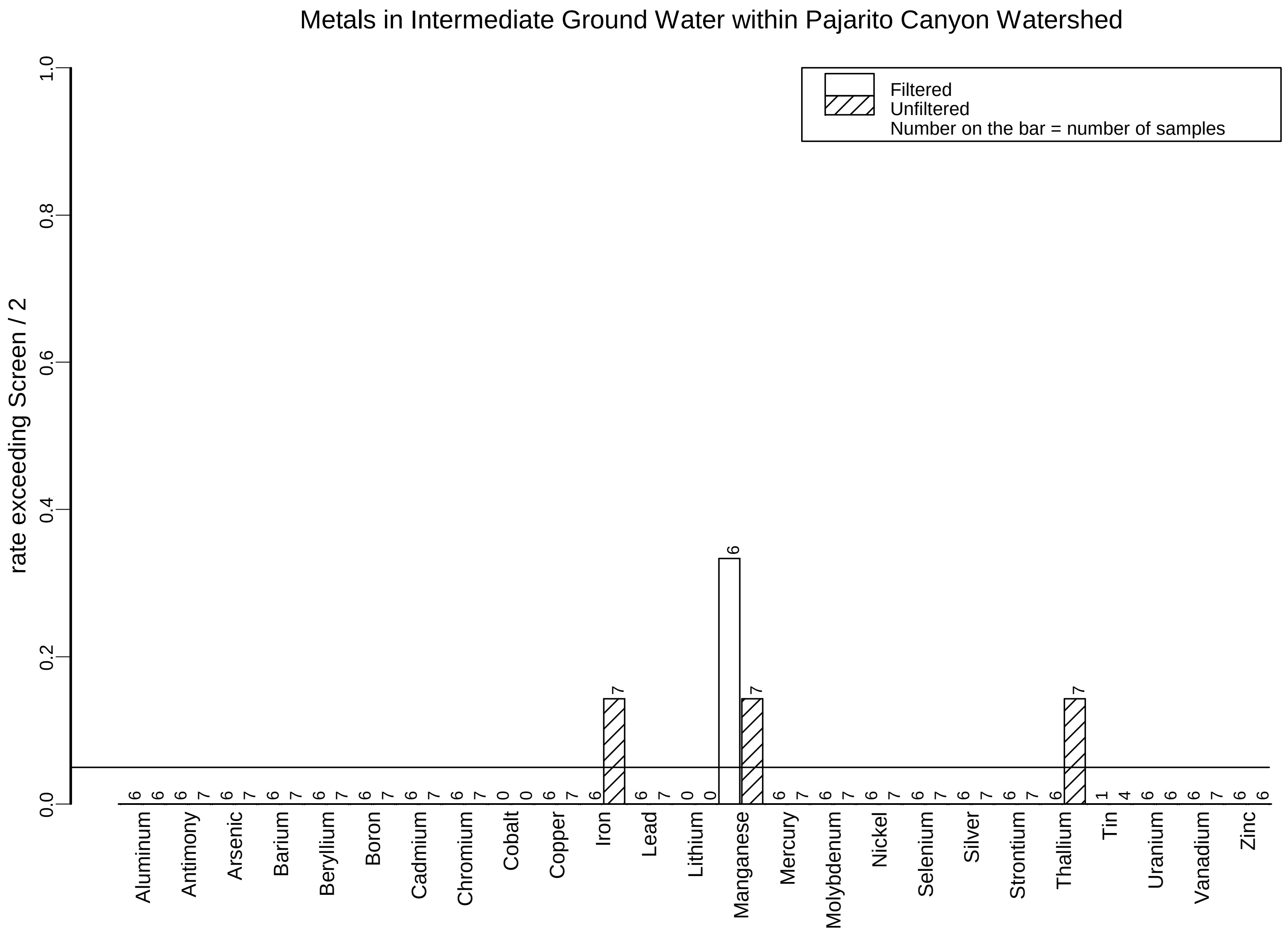


Figure B.52. **Rate exceeding Screen/2 for Metals in Pajarito Intermediate Ground Water.**

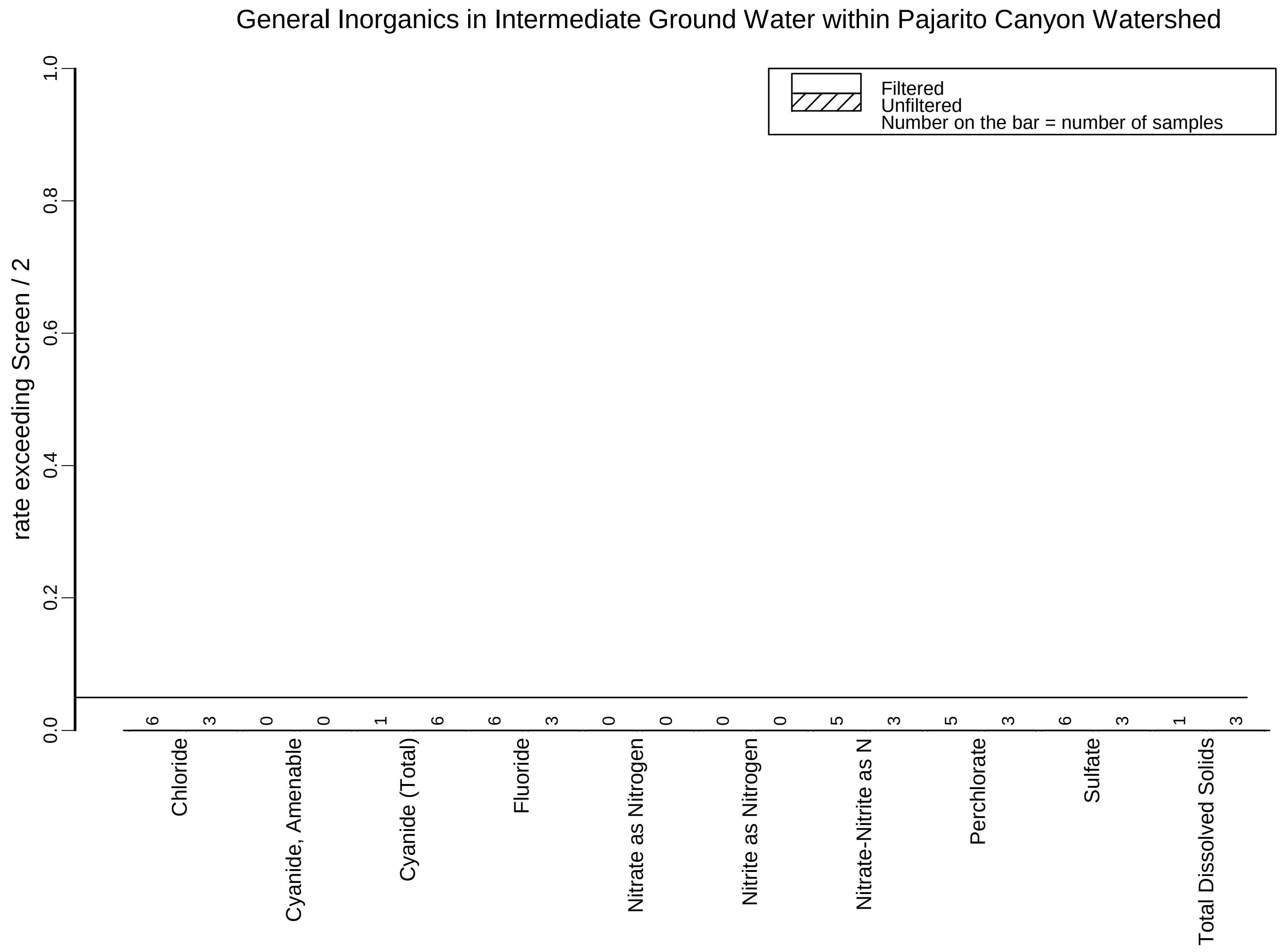


Figure B.53. **Rate exceeding Screen/2 for General Inorganics in Pajarito Intermediate Ground Water.**

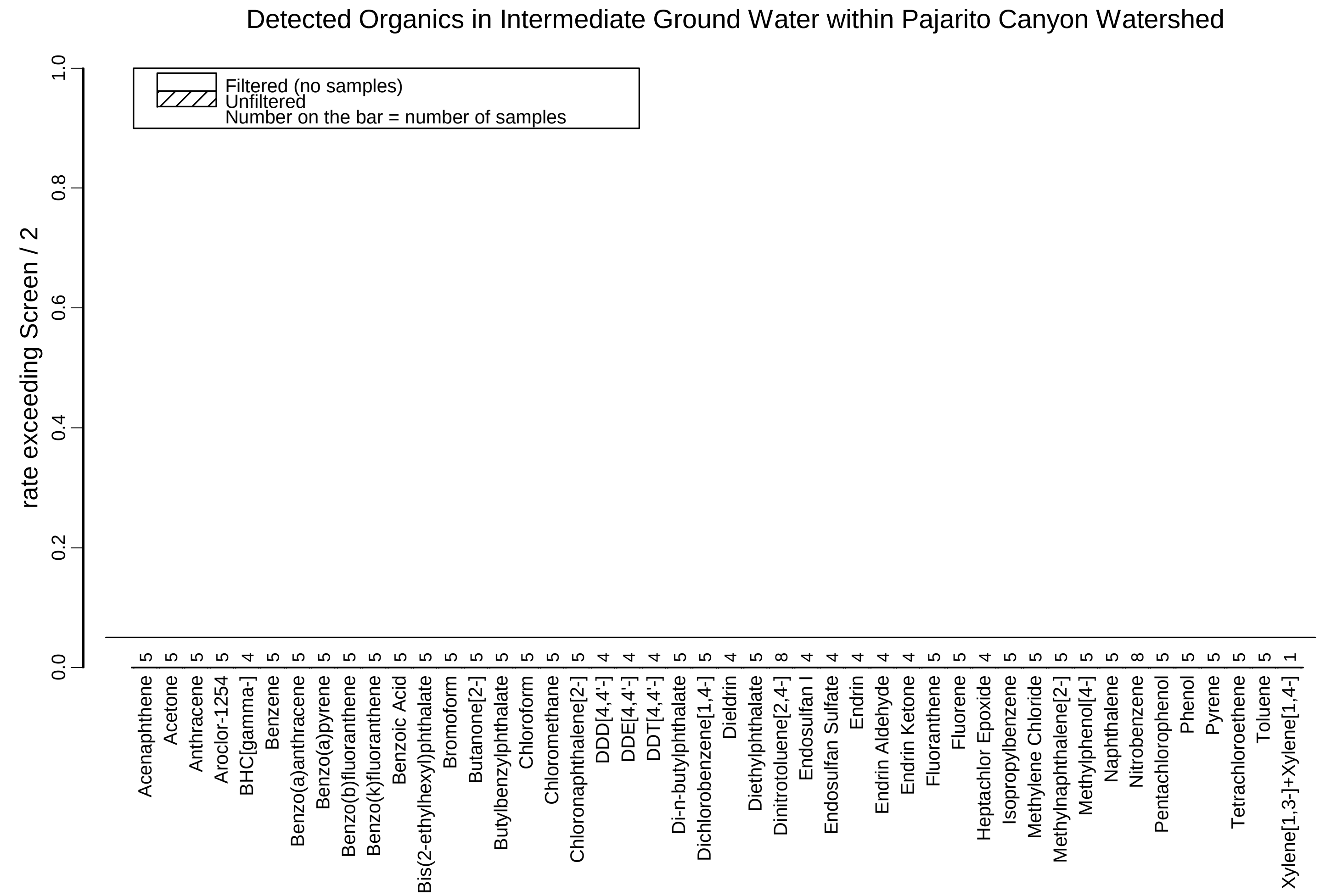


Figure B.54. **Rate exceeding Screen/2 for Organics in Pajarito Intermediate Ground Water.**

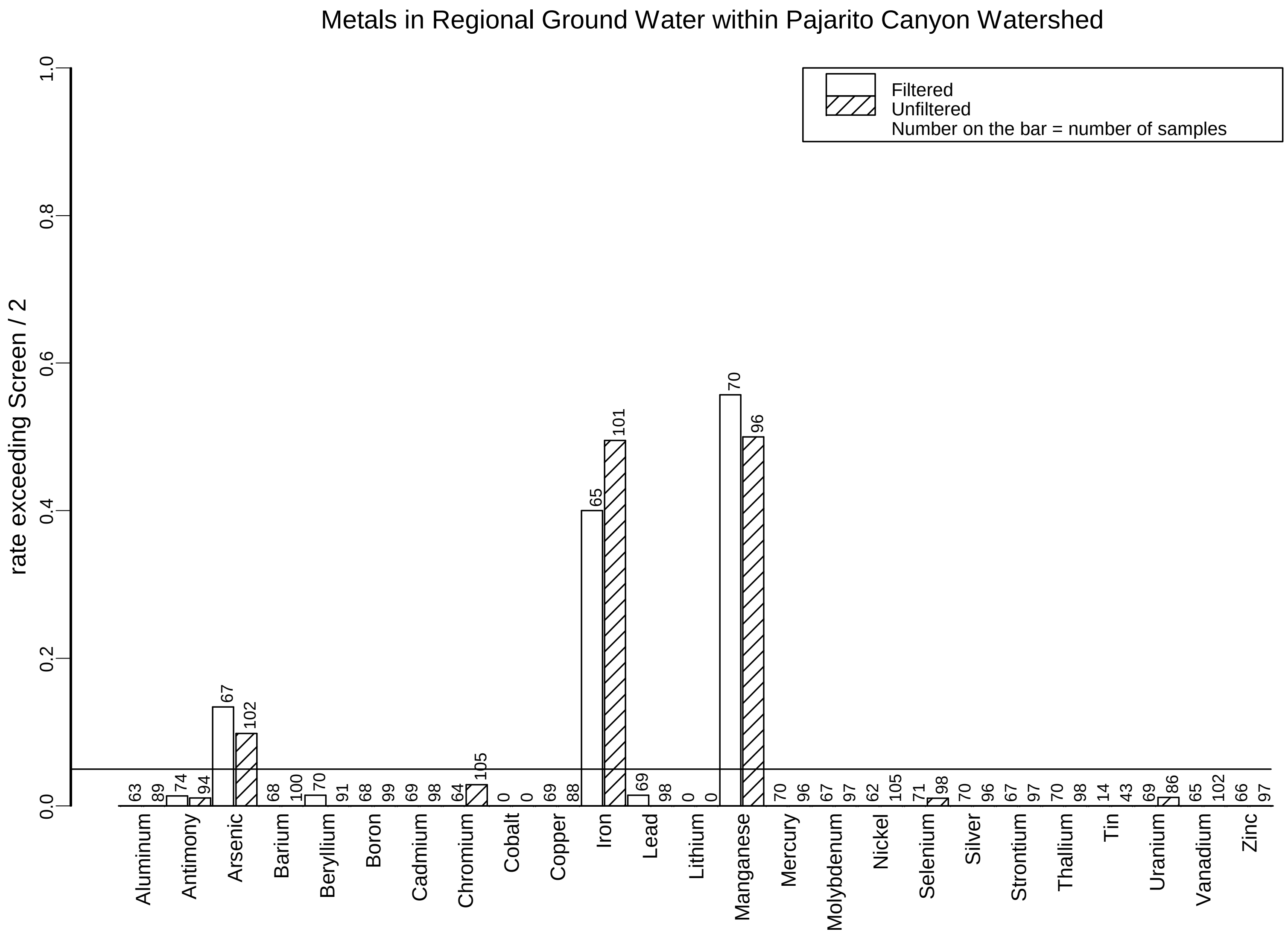


Figure B.55. **Rate exceeding Screen/2 for Metals in Pajarito Regional Ground Water.**

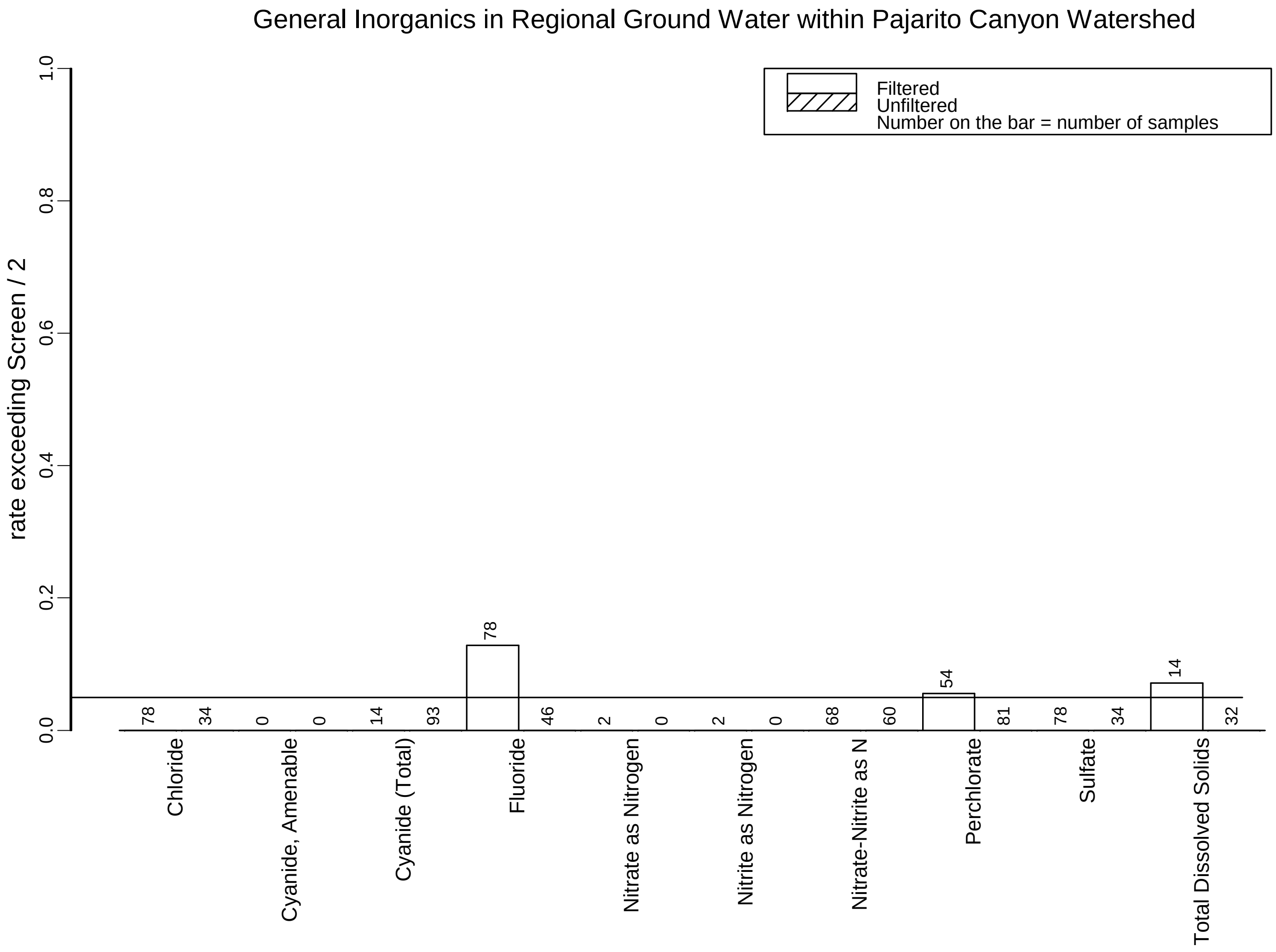


Figure B.56. **Rate exceeding Screen/2 for General Inorganics in Pajarito Regional Ground Water.**

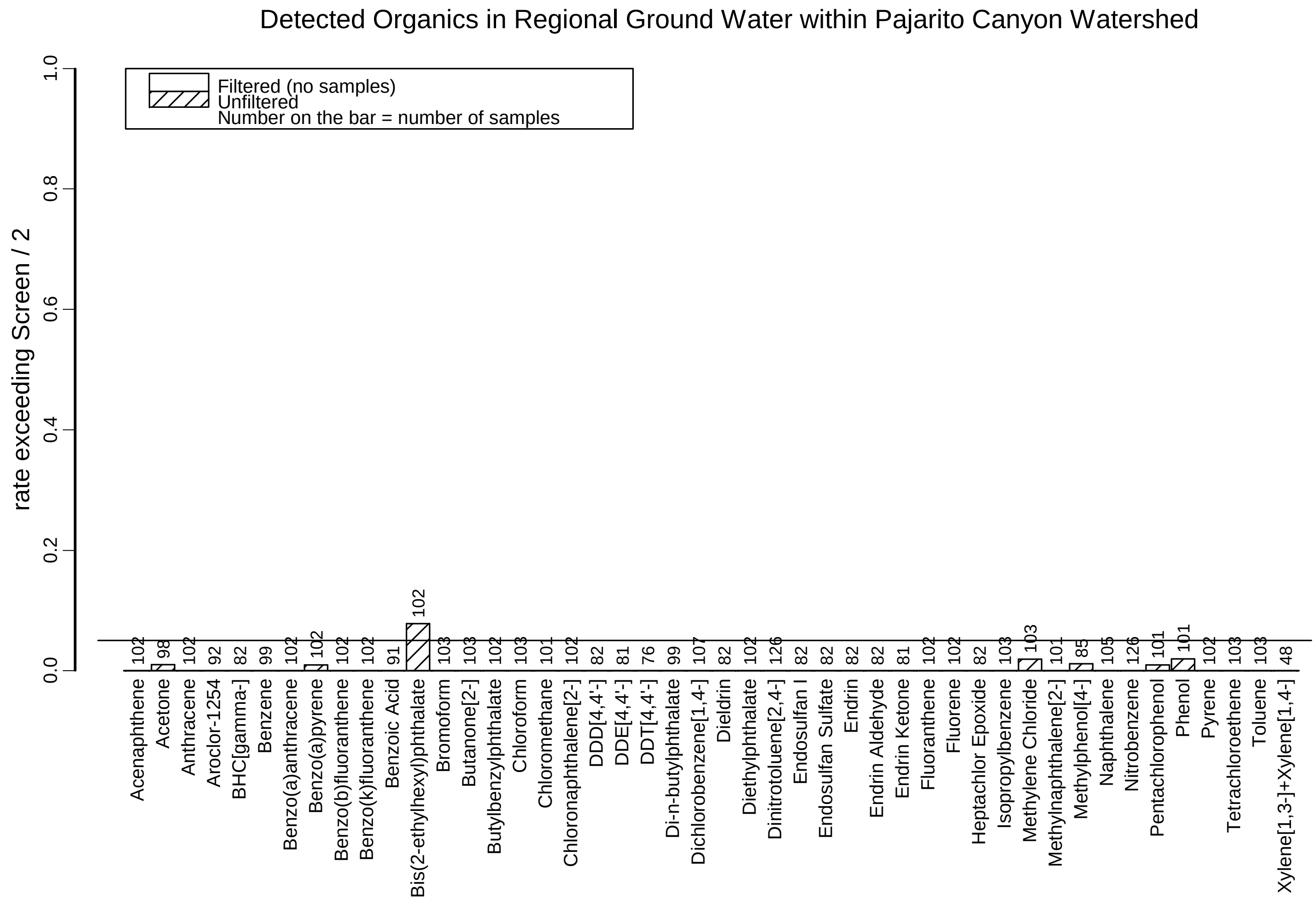


Figure B.57. **Rate exceeding Screen/2 for Organics in Pajarito Regional Ground Water.**

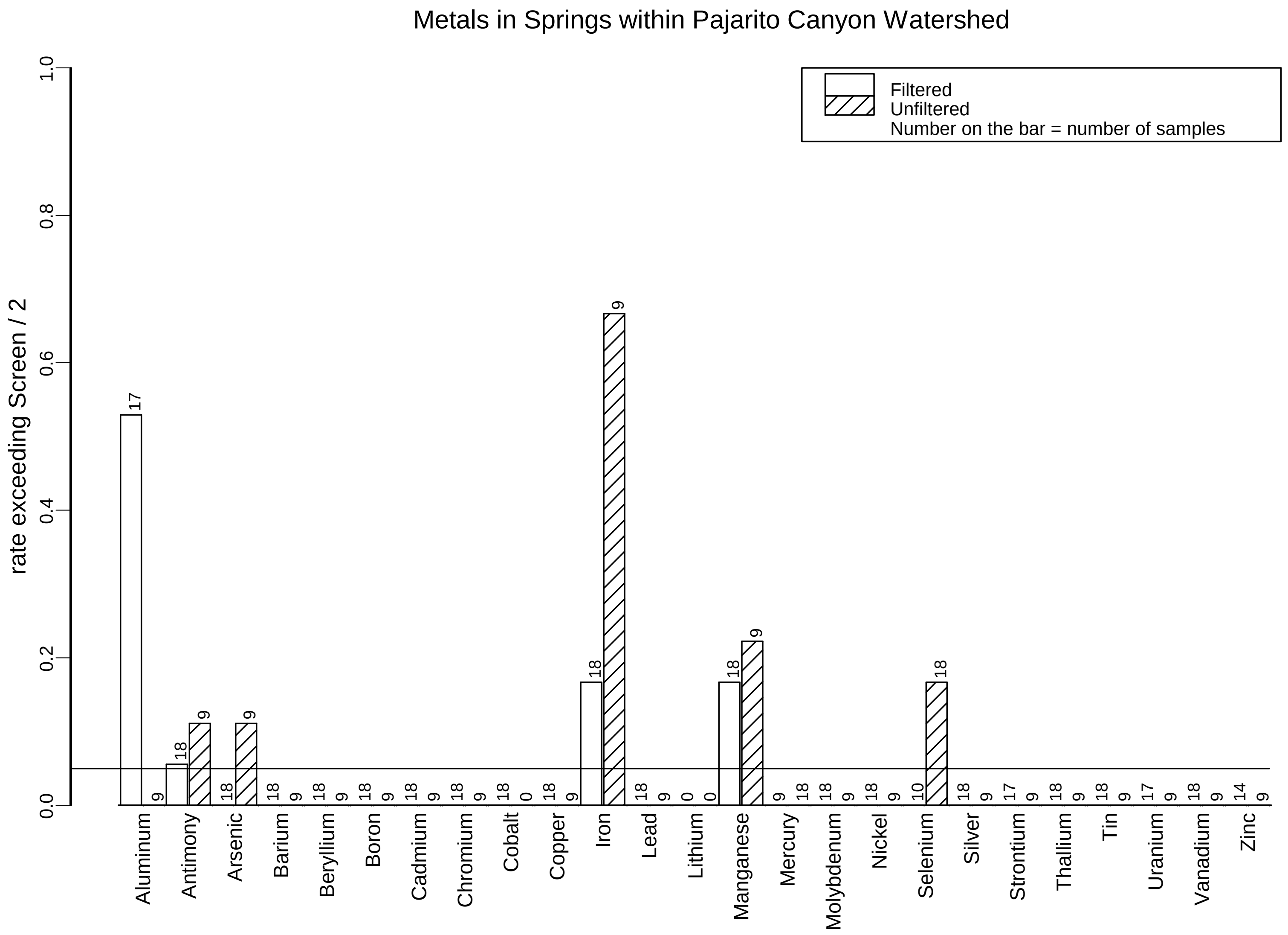


Figure B.58. **Rate exceeding Screen/2 for Metals in Pajarito Springs.**

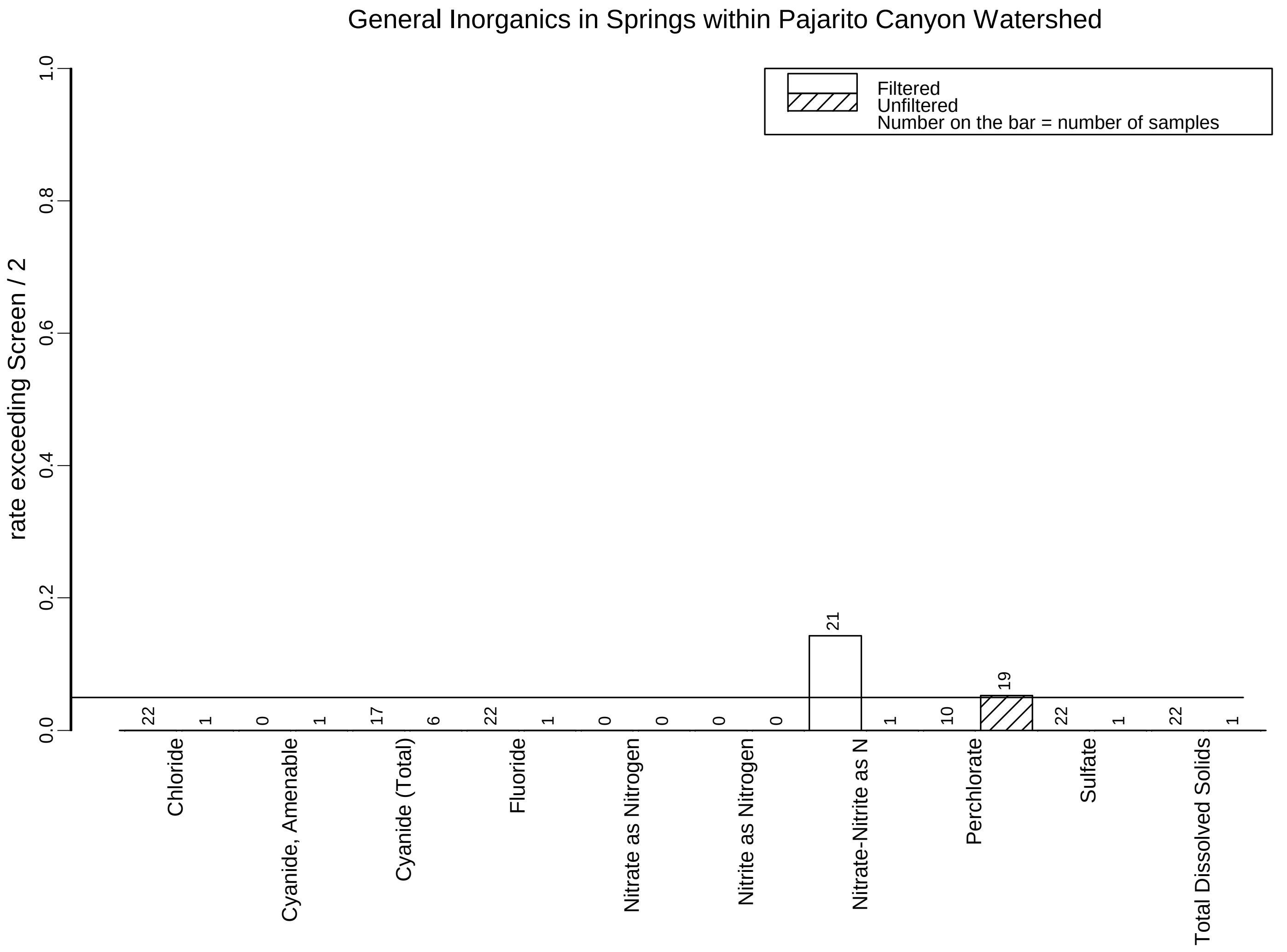


Figure B.59. **Rate exceeding Screen/2 for General Inorganics in Pajarito Springs.**

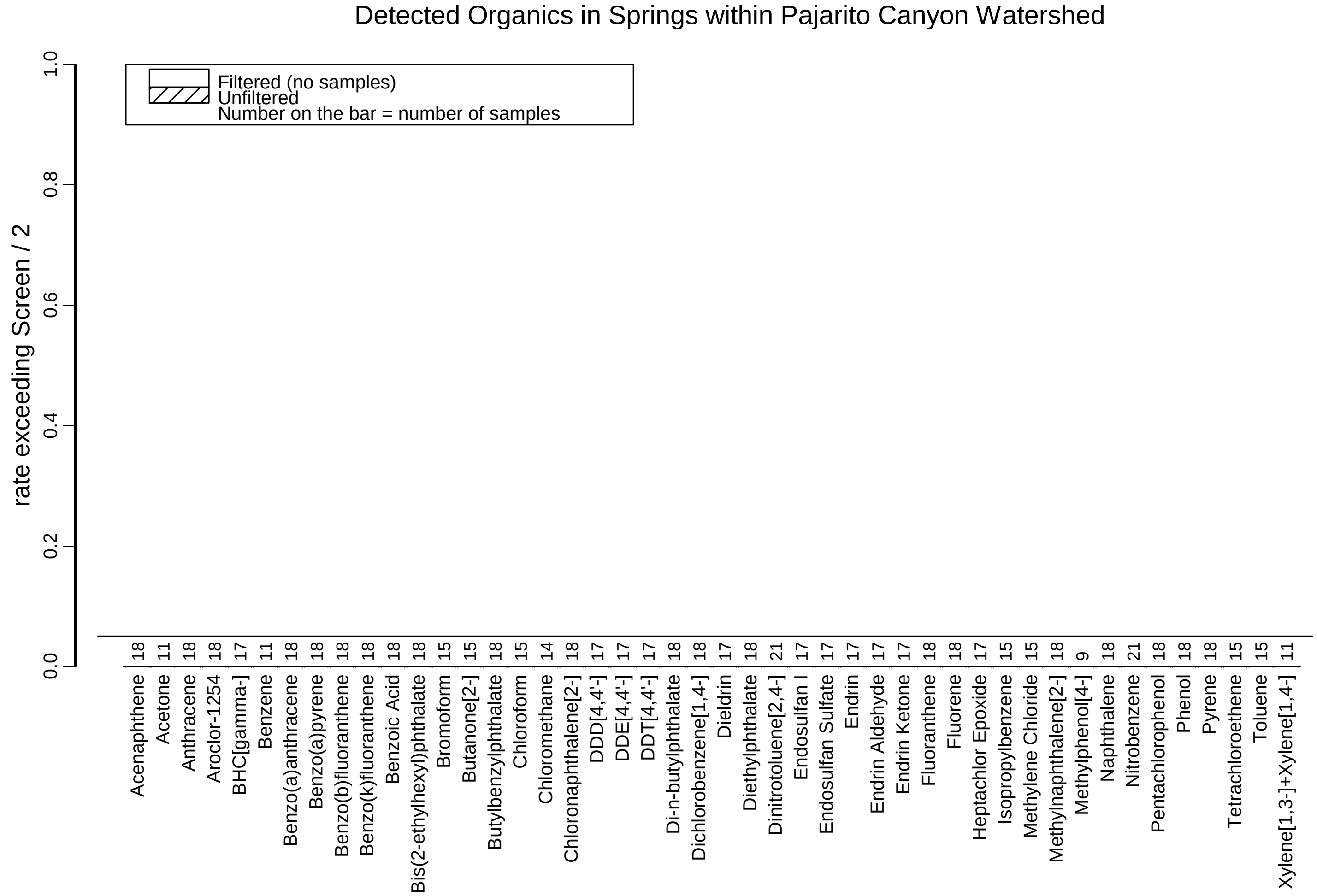


Figure B.60. **Rate exceeding Screen/2 for Organics in Pajarito Springs.**

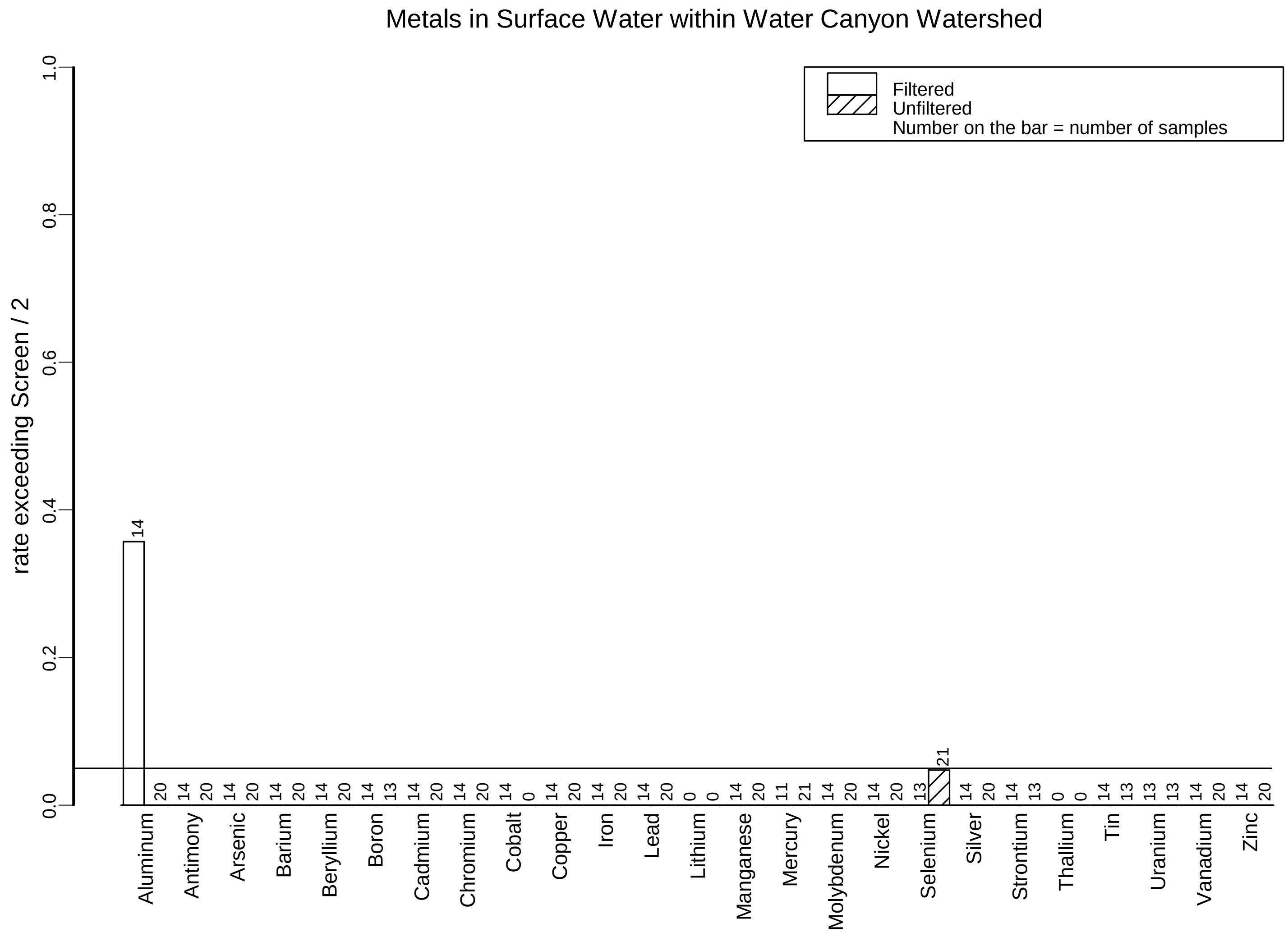


Figure B.61. **Rate exceeding Screen/2 for Metals in Water Canyon Ephemeral Surface Water.**

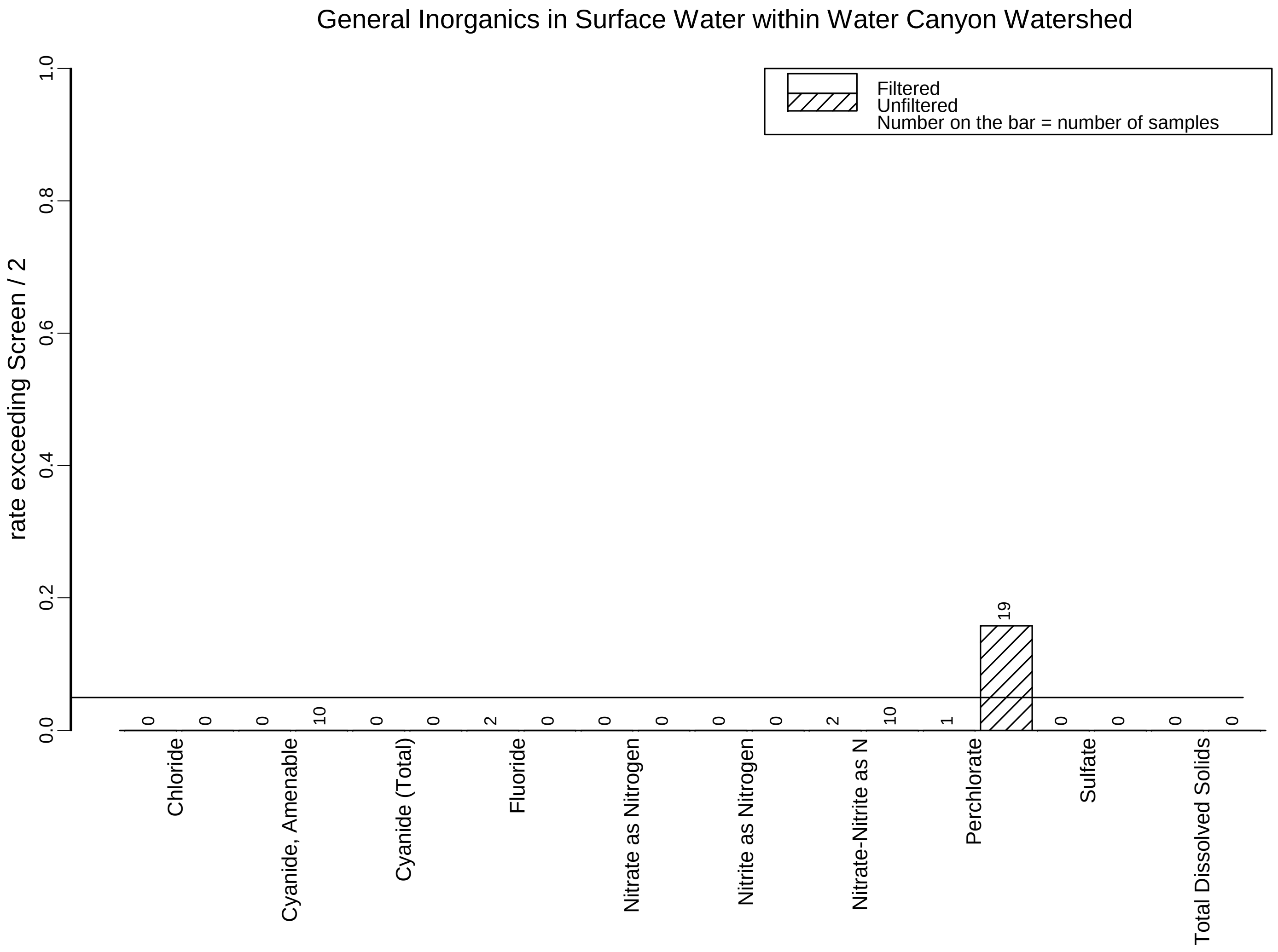


Figure B.62. **Rate exceeding Screen/2 for Inorganics in Water Canyon Ephemeral Surface Water.**

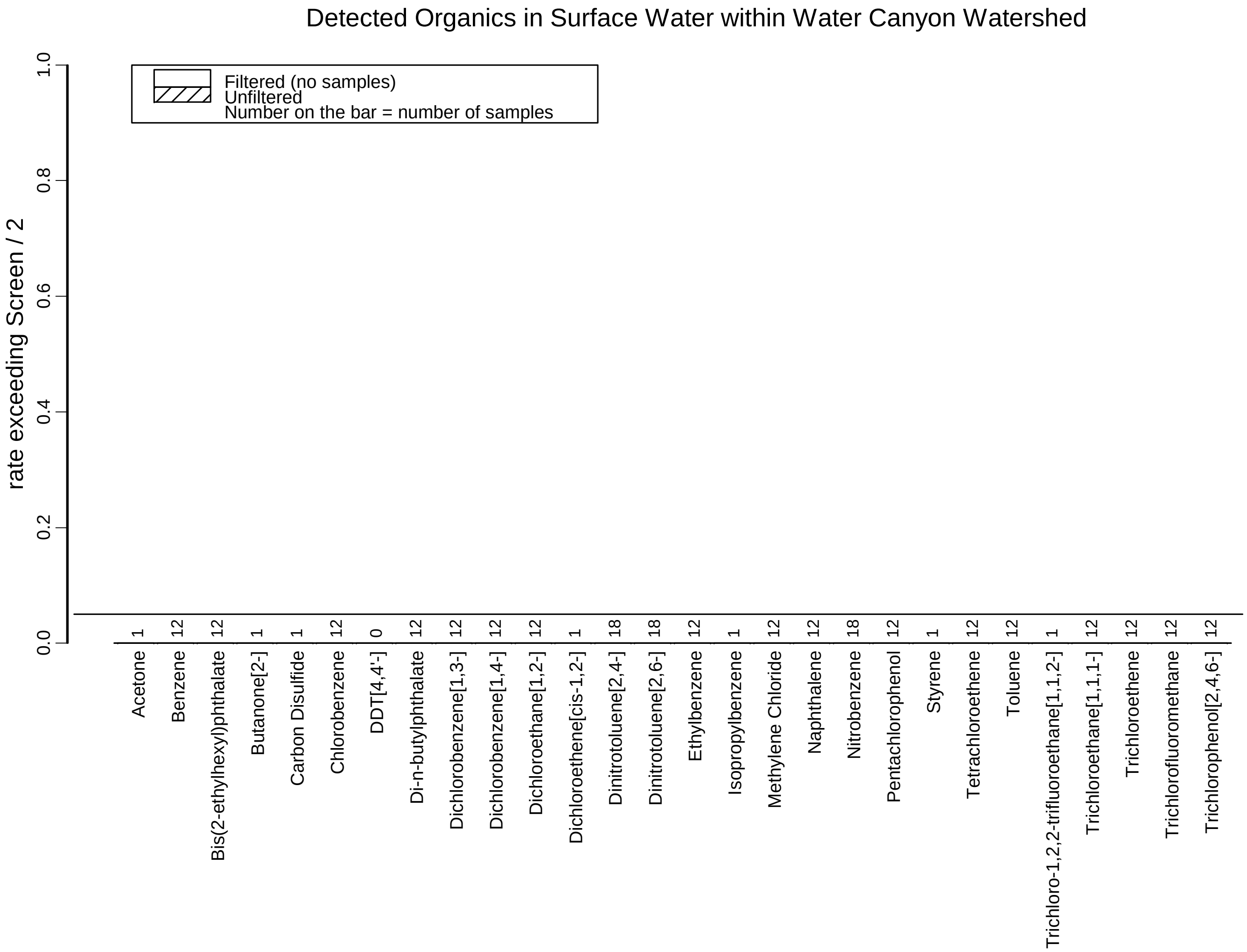


Figure B.63. **Rate exceeding Screen/2 for Inorganics in Ephemeral Water Canyon Surface Water.**

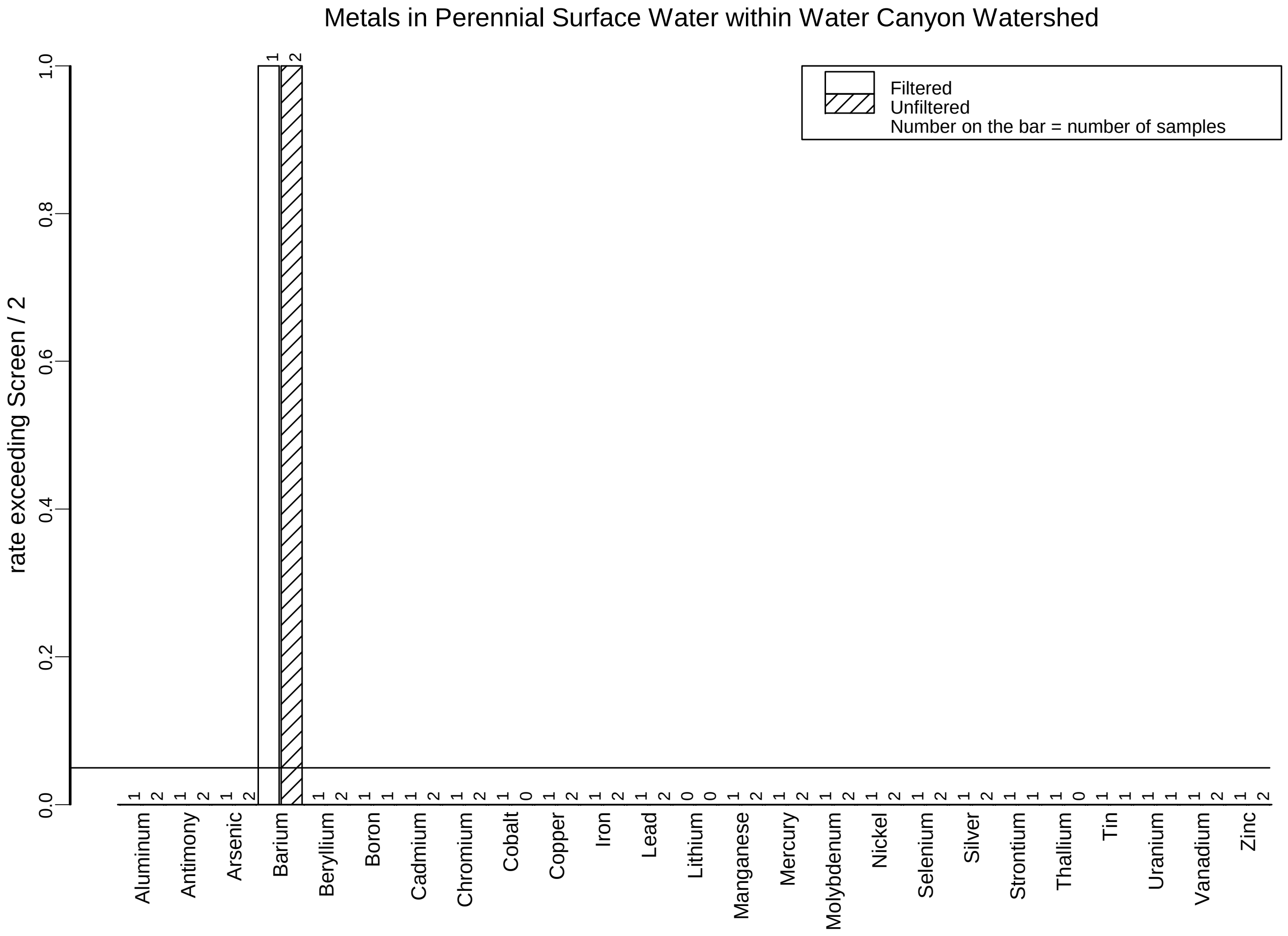


Figure B.64. **Rate exceeding Screen/2 for Metals in Water Canyon Perennial Surface Water.**

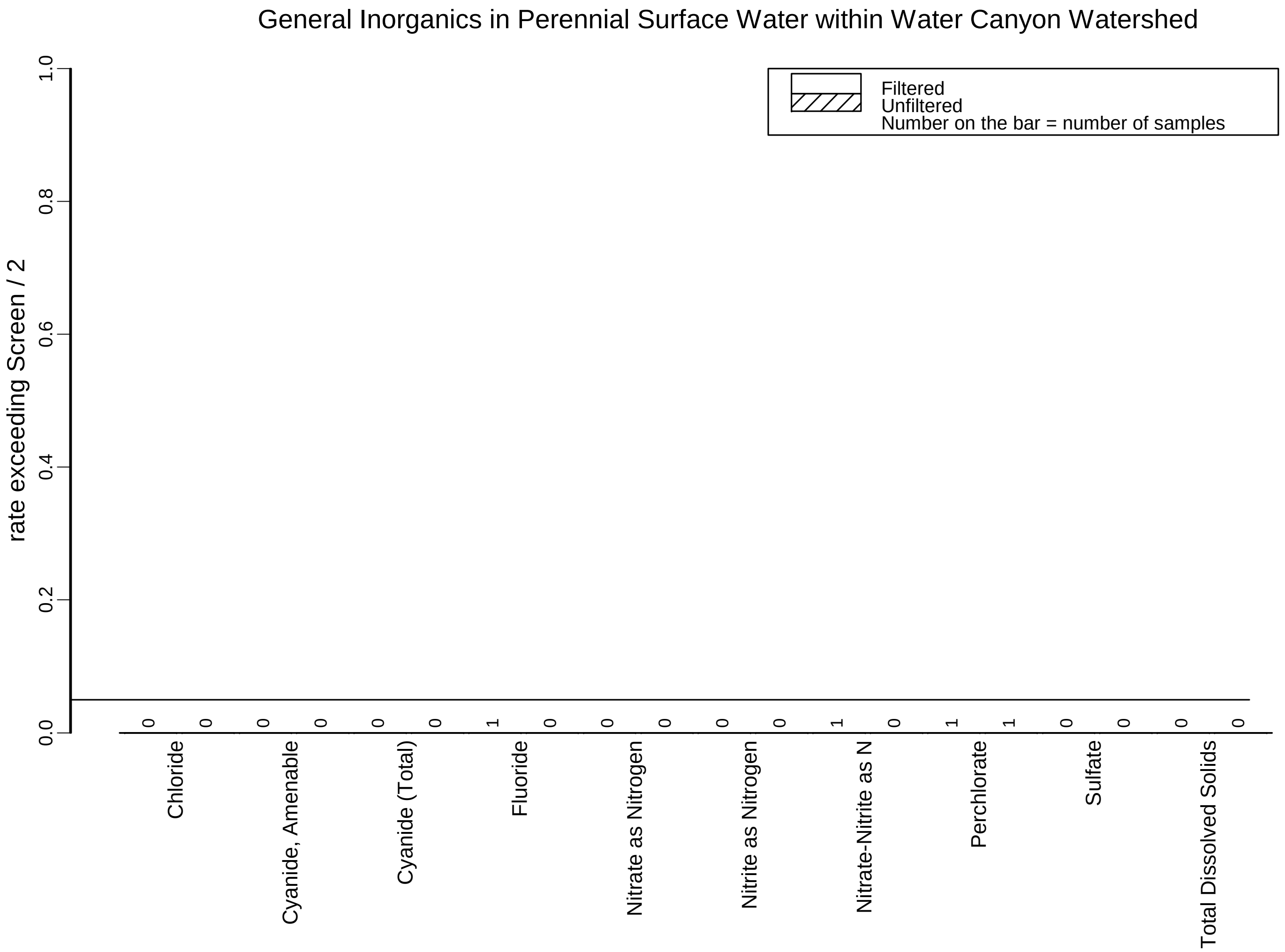


Figure B.65. **Rate exceeding Screen/2 for Inorganics in Water Canyon Perennial Surface Water.**

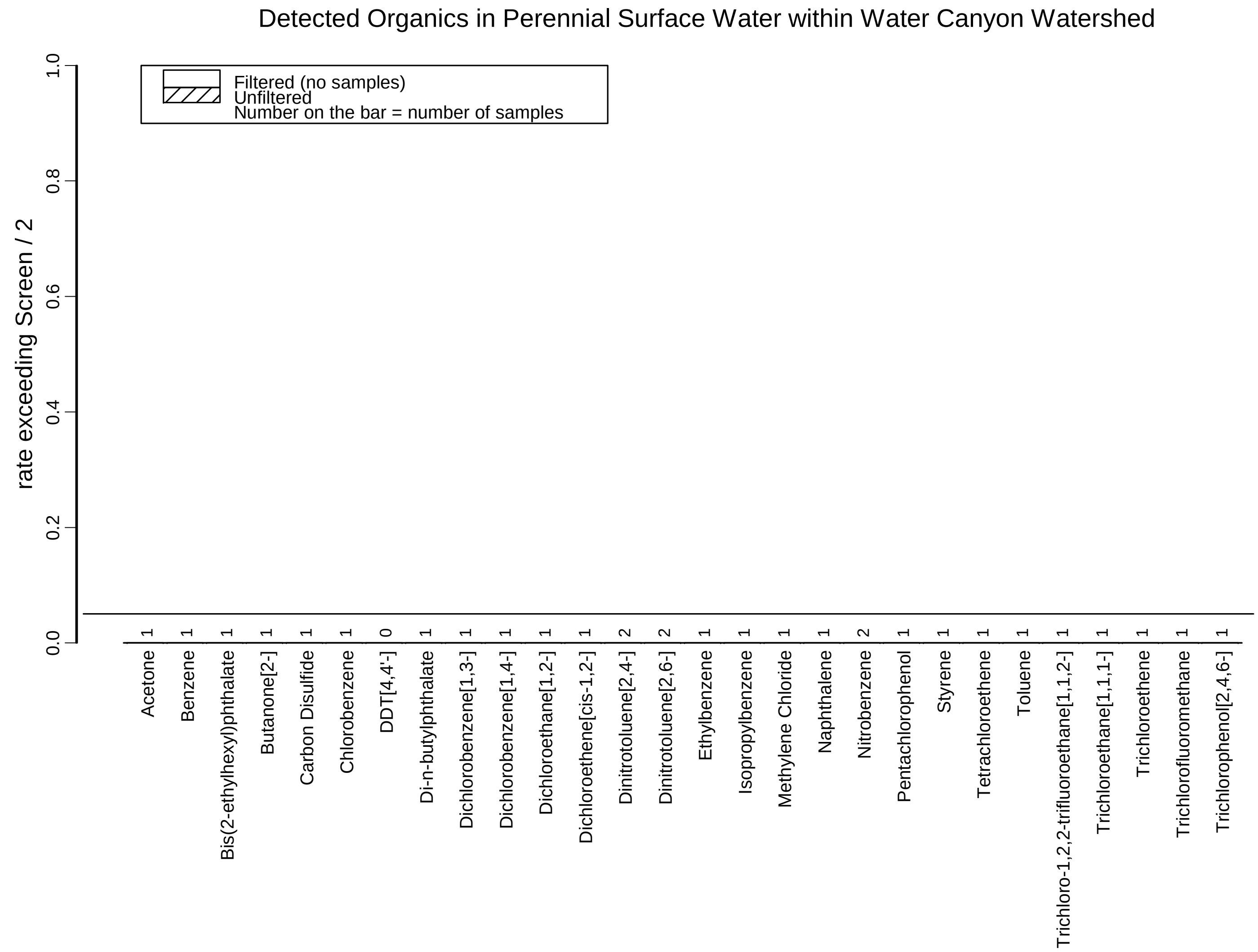


Figure B.66. **Rate exceeding Screen/2 for Inorganics in Water Canyon Perennial Surface Water.**

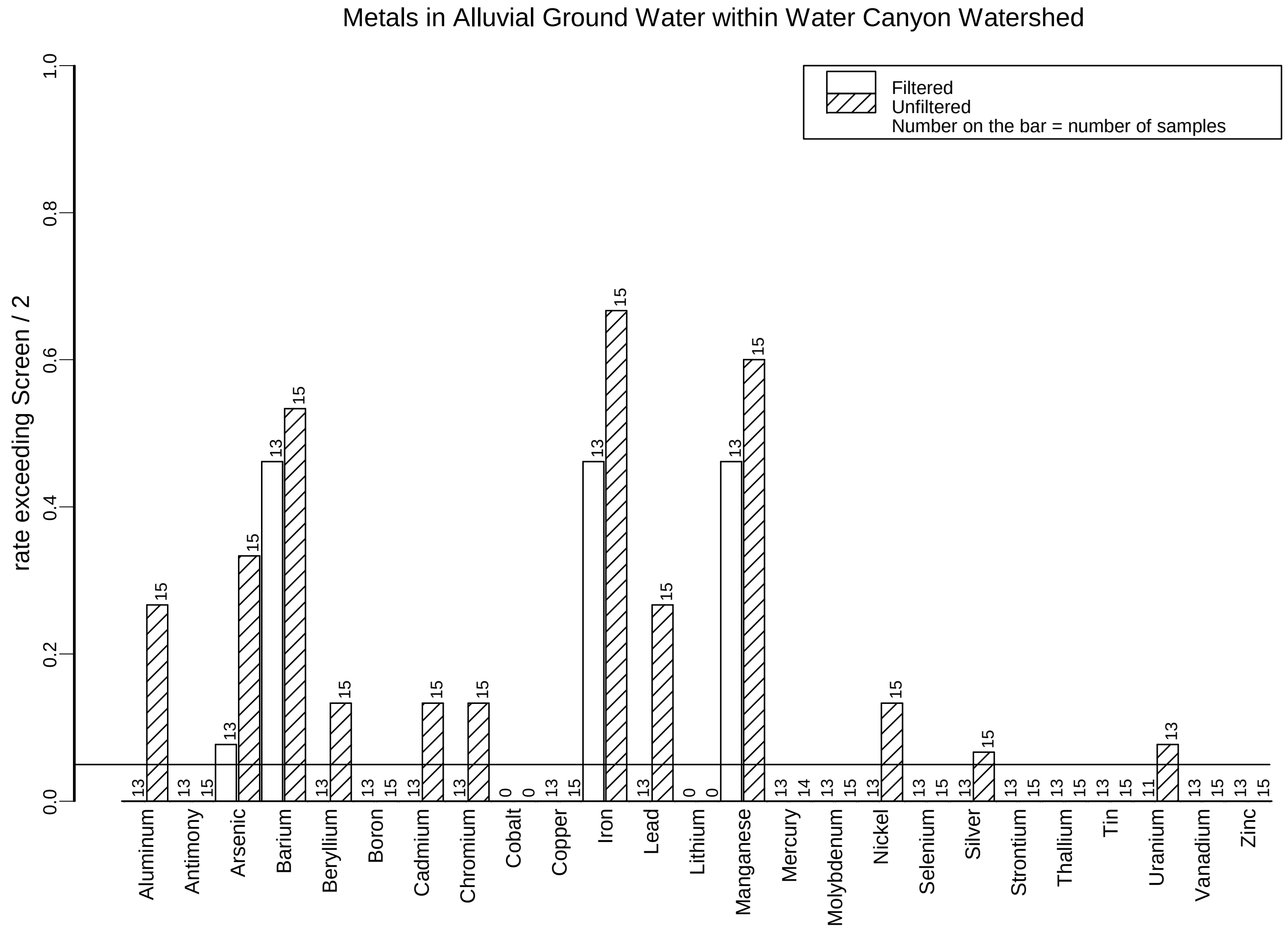


Figure B.67. **Rate exceeding Screen/2 for Metals in Water Canyon Alluvial Ground Water.**

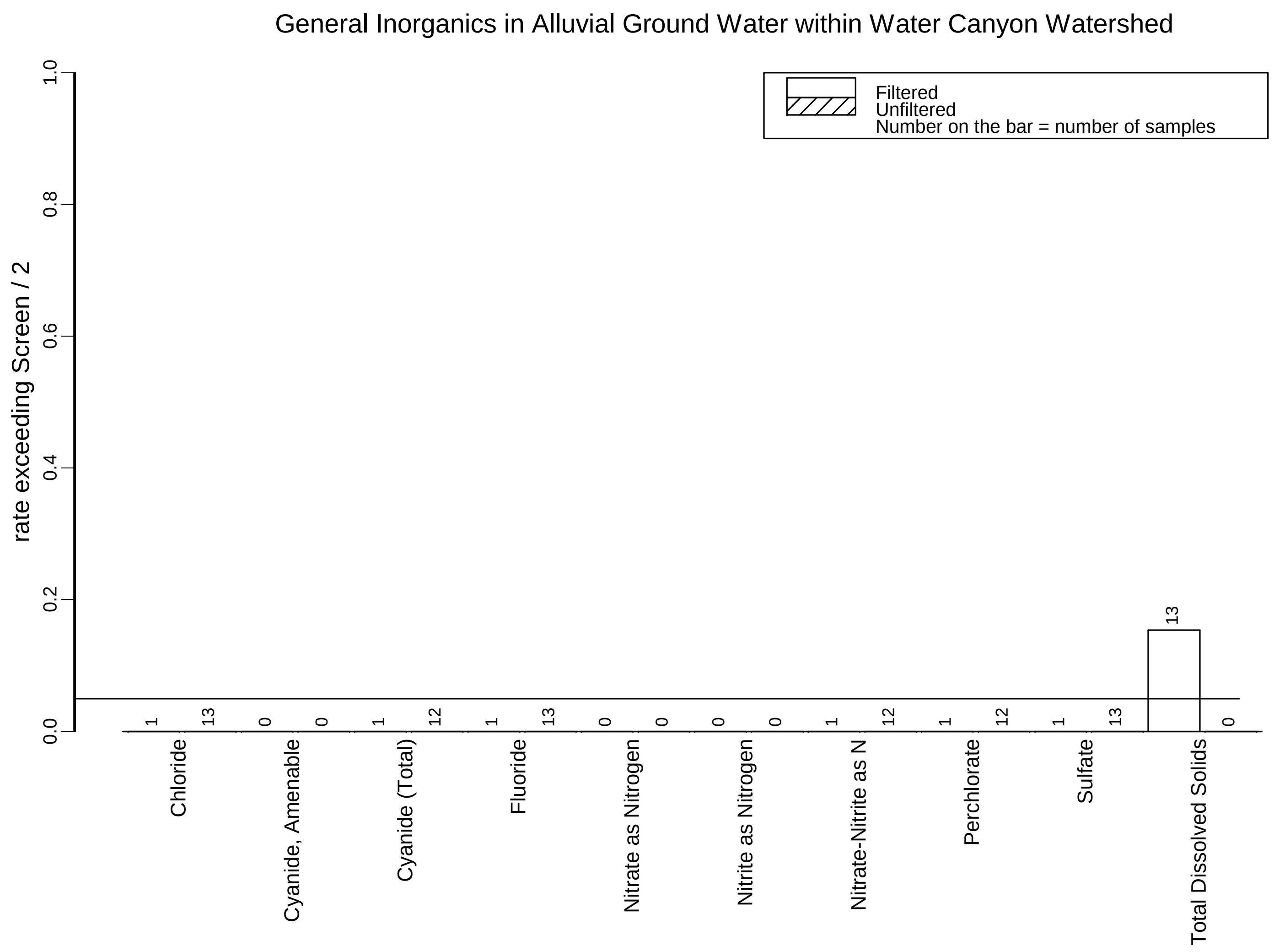


Figure B.68. **Rate exceeding Screen/2 for Inorganics in Water Canyon Alluvial Ground Water.**

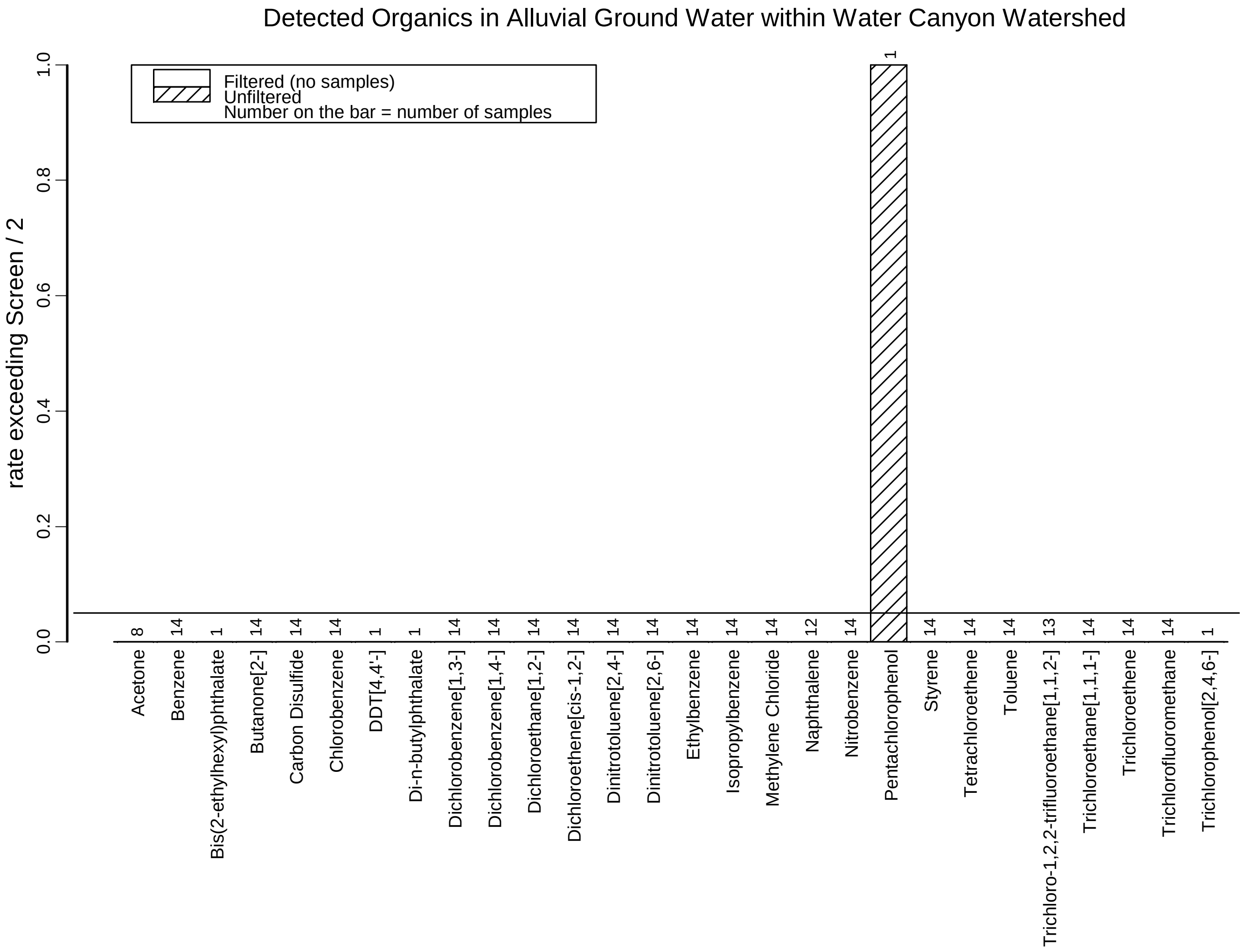


Figure B.69. **Rate exceeding Screen/2 for organics in Water Canyon Alluvial Ground Water.**

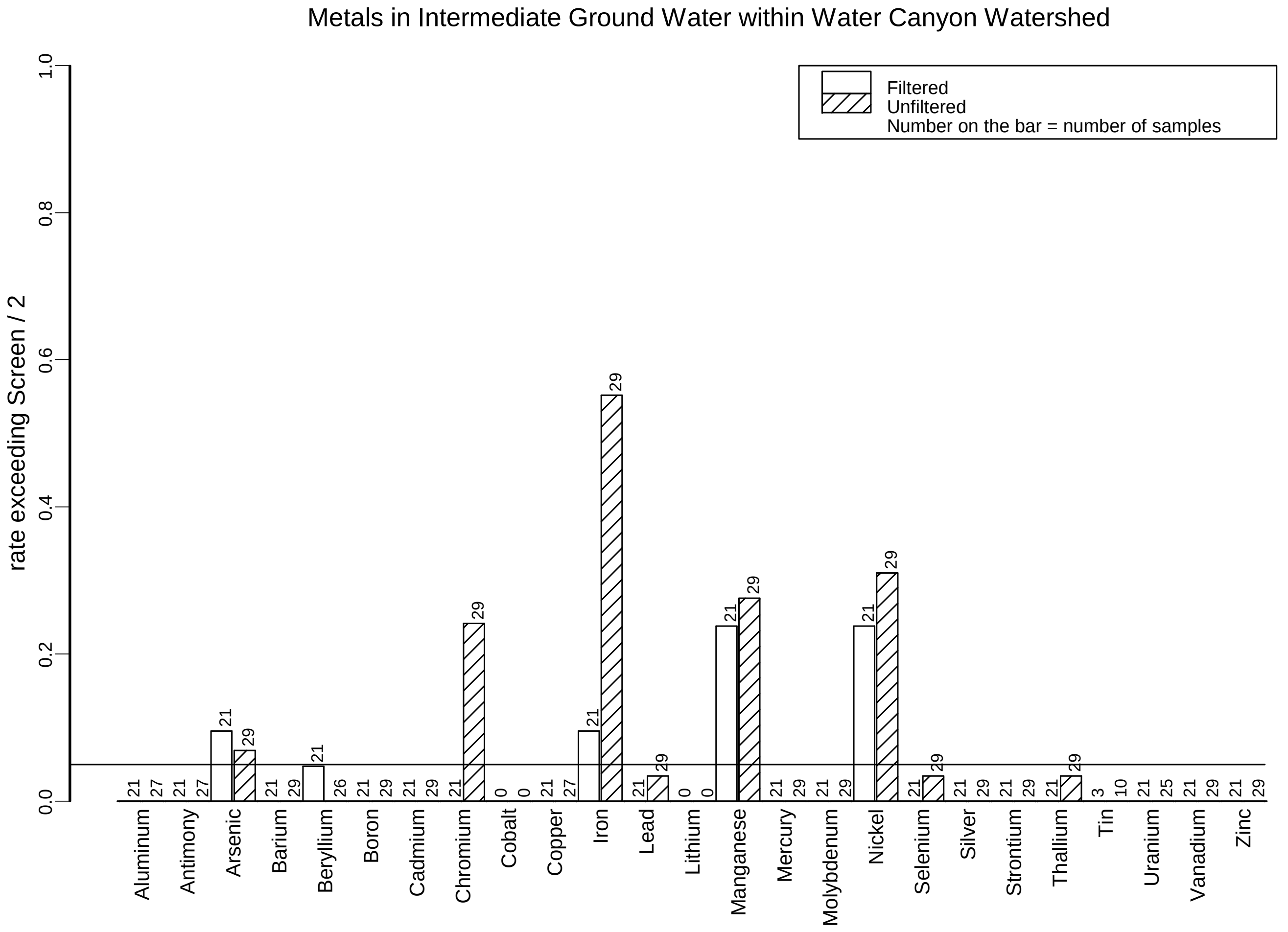


Figure B.70. **Rate exceeding Screen/2 for Metals in Water Canyon Intermediate Ground Water.**

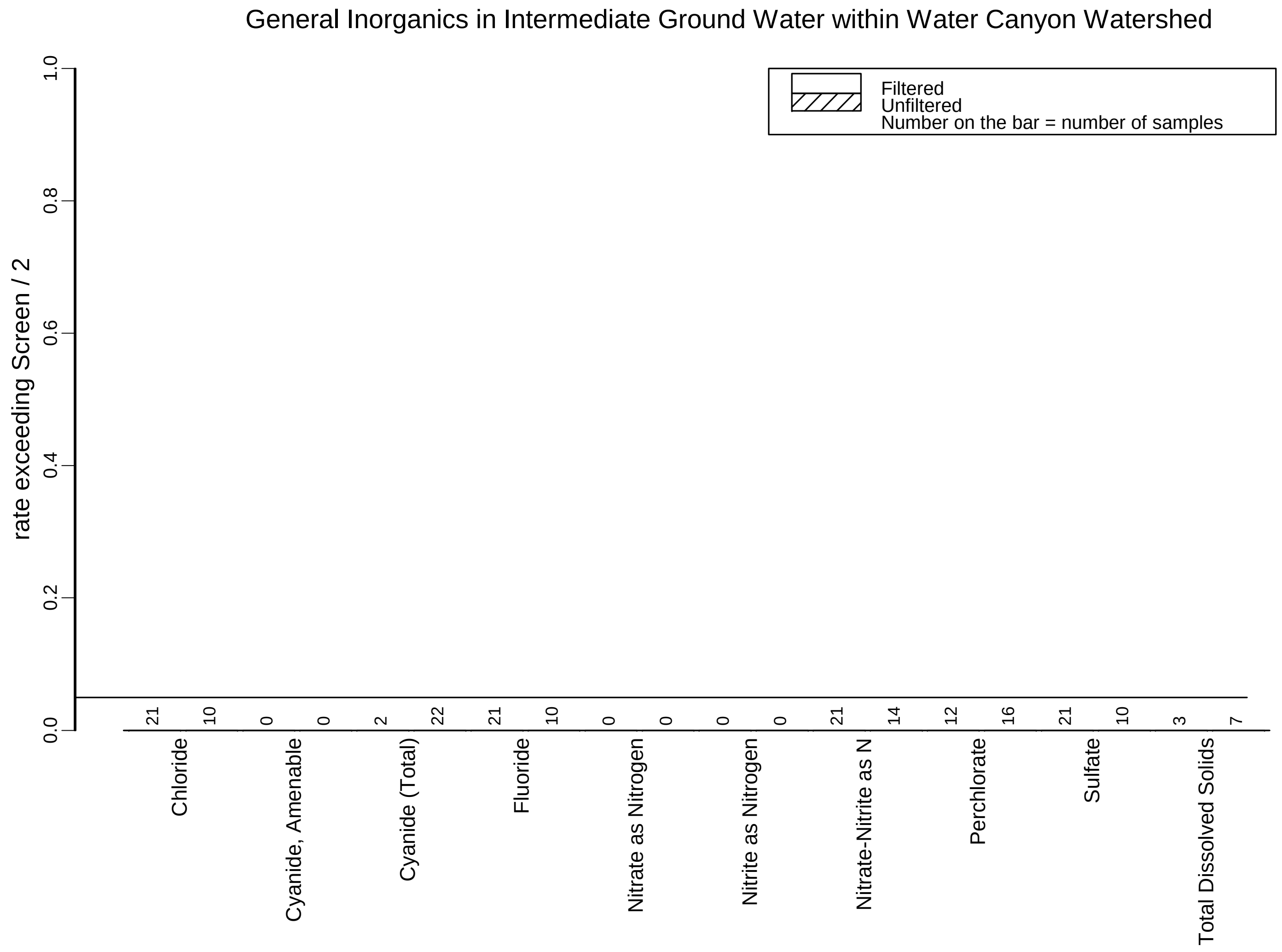


Figure B.71. **Rate exceeding Screen/2 for Inorganics in Water Canyon Intermediate Ground Water.**

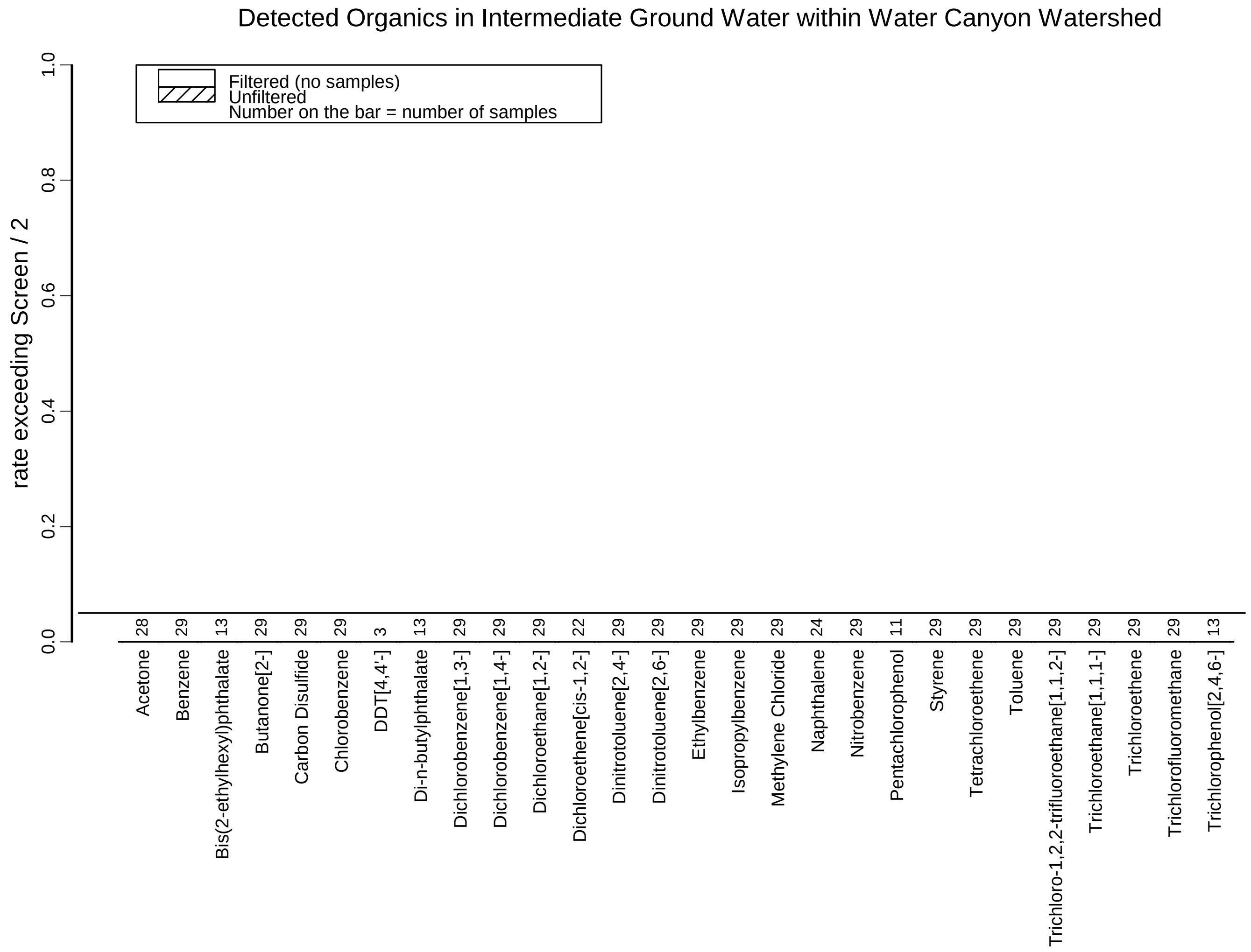


Figure B.72. **Rate exceeding Screen/2 for organics in Water Canyon Intermediate Ground Water.**

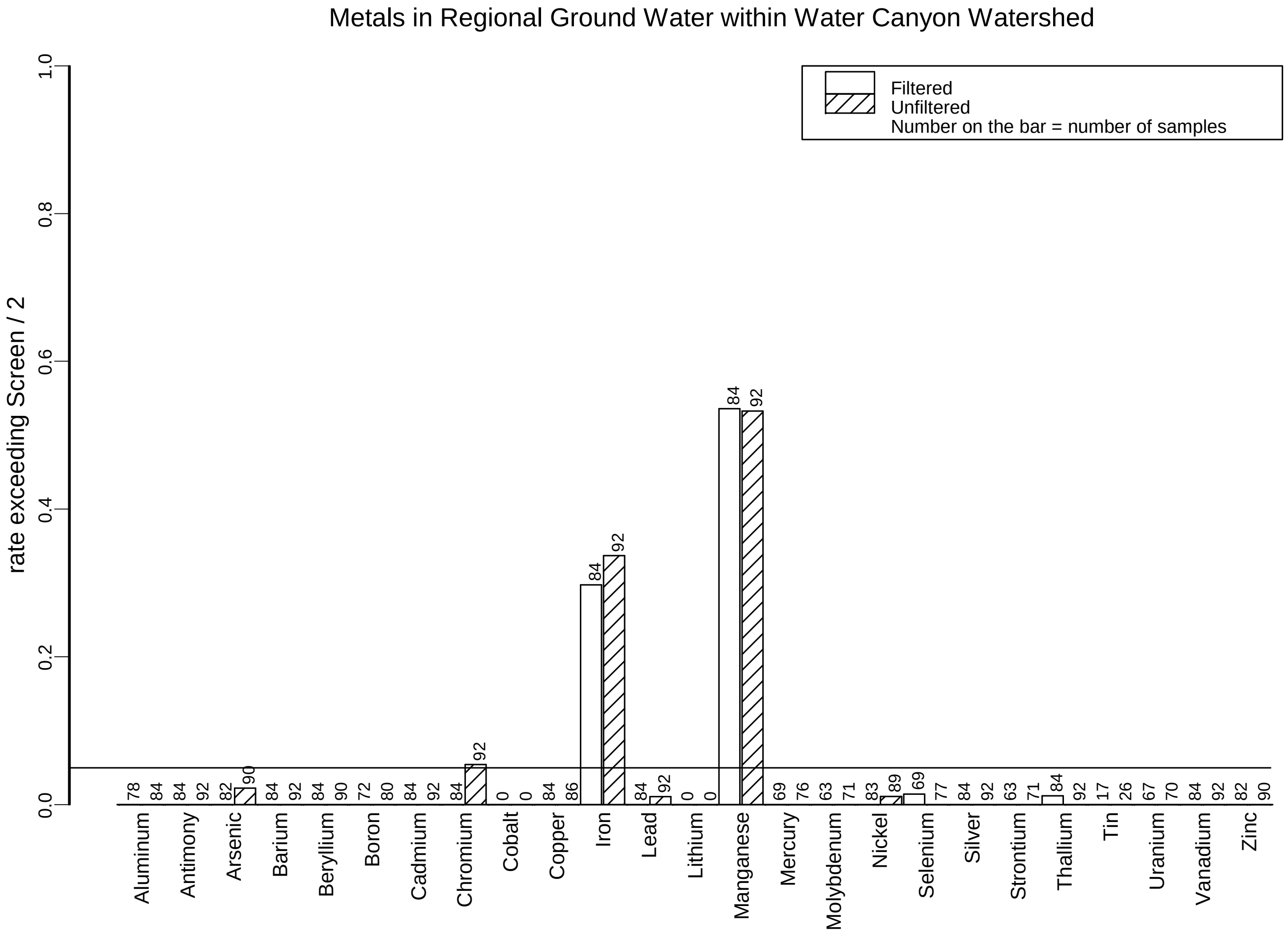


Figure B.73. **Rate exceeding Screen/2 for Metals in Water Canyon Regional Ground Water.**

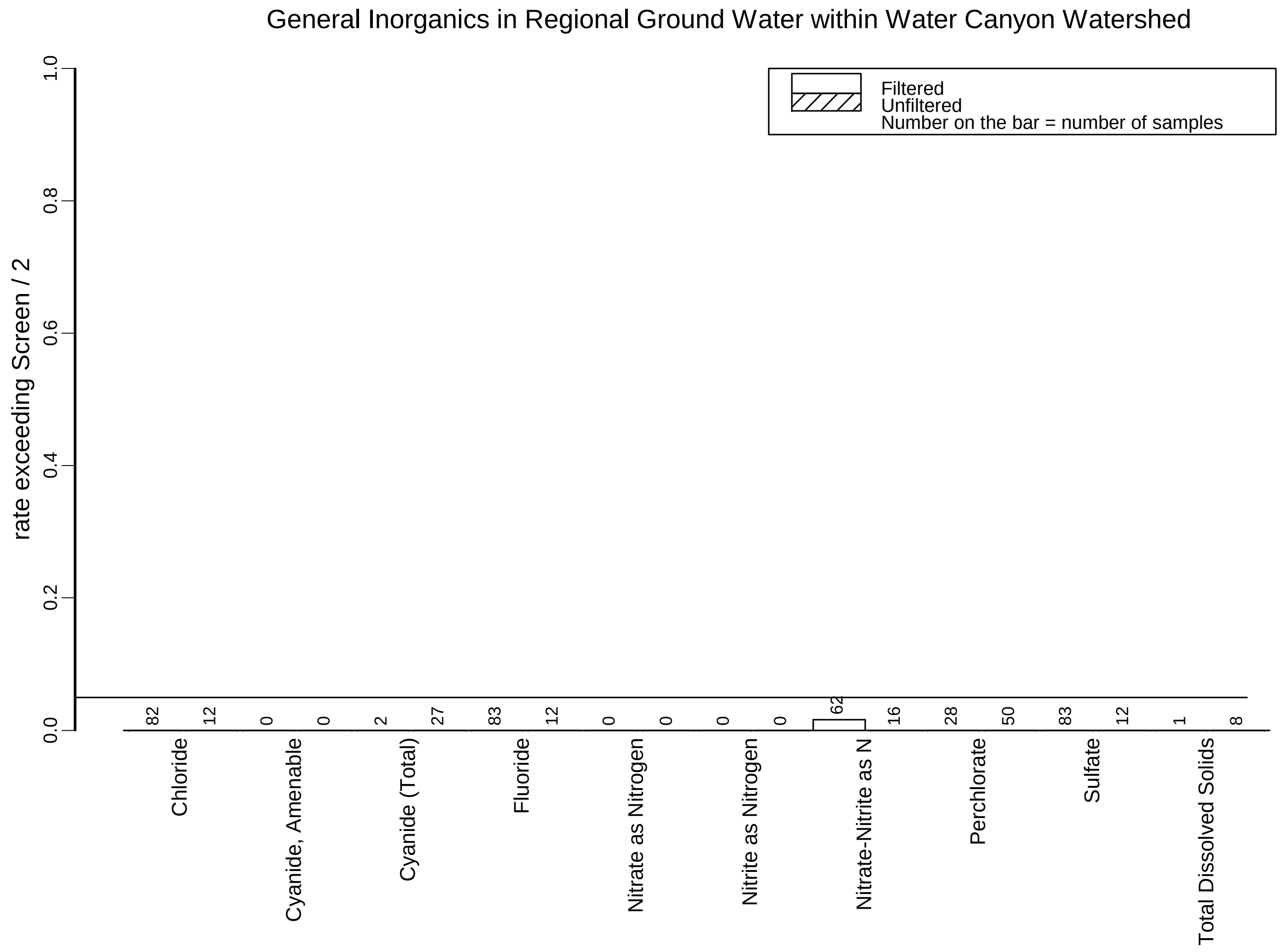


Figure B.74. **Rate exceeding Screen/2 for Inorganics in Water Canyon Regional Ground Water.**

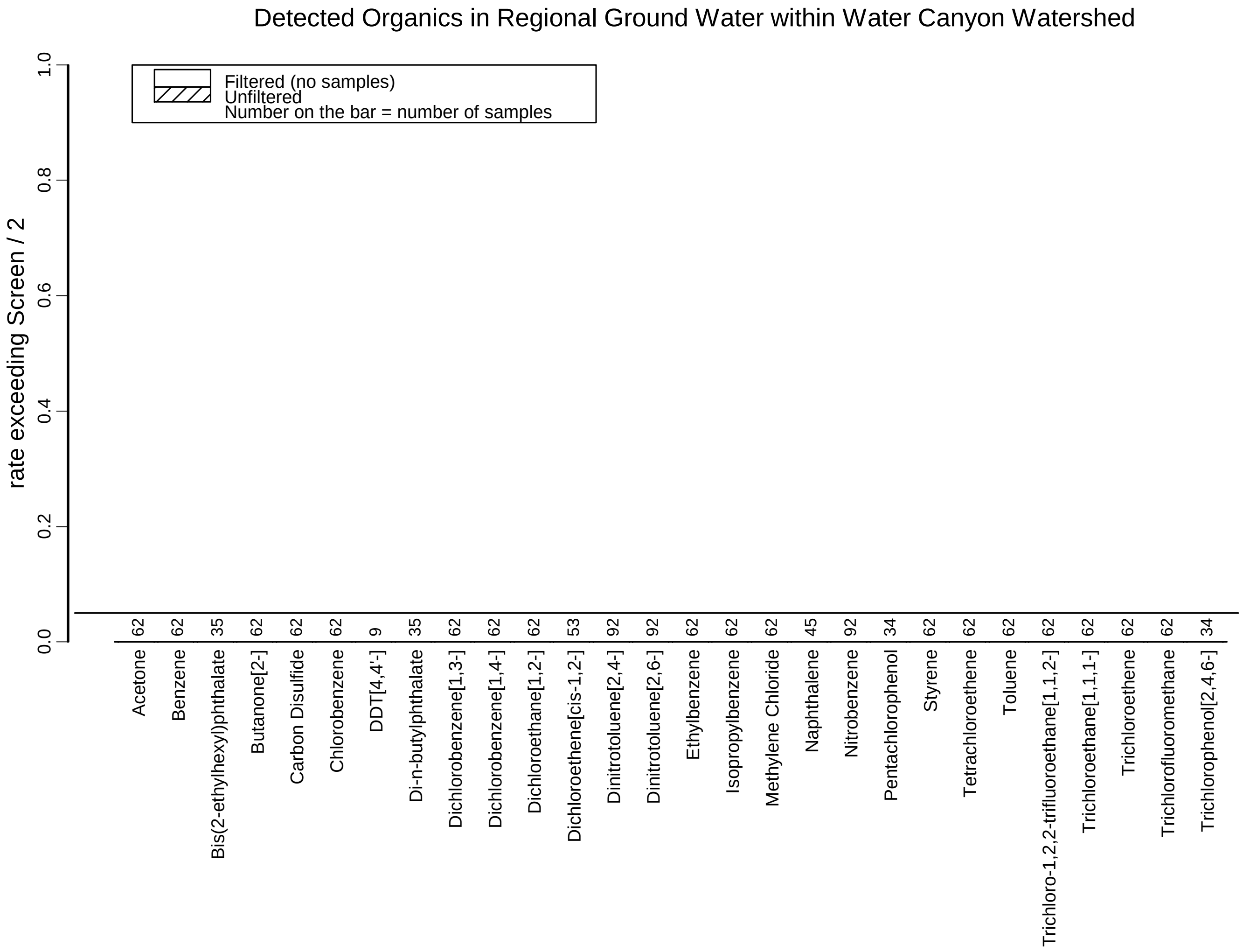


Figure B.75. **Rate exceeding Screen/2 for organics in Water Canyon Regional Ground Water.**

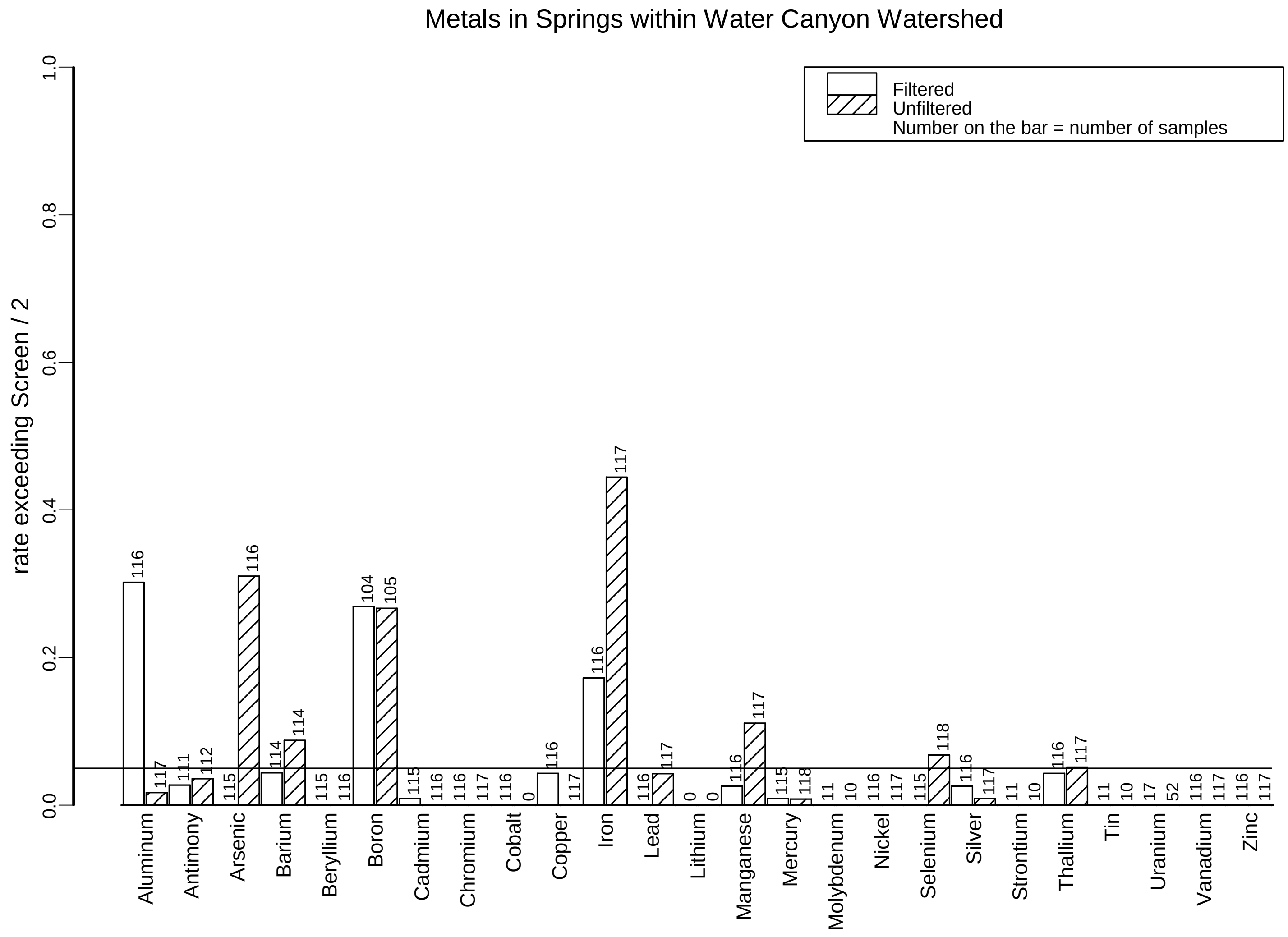


Figure B.76. **Rate exceeding Screen/2 for Metals in Water Canyon Springs.**

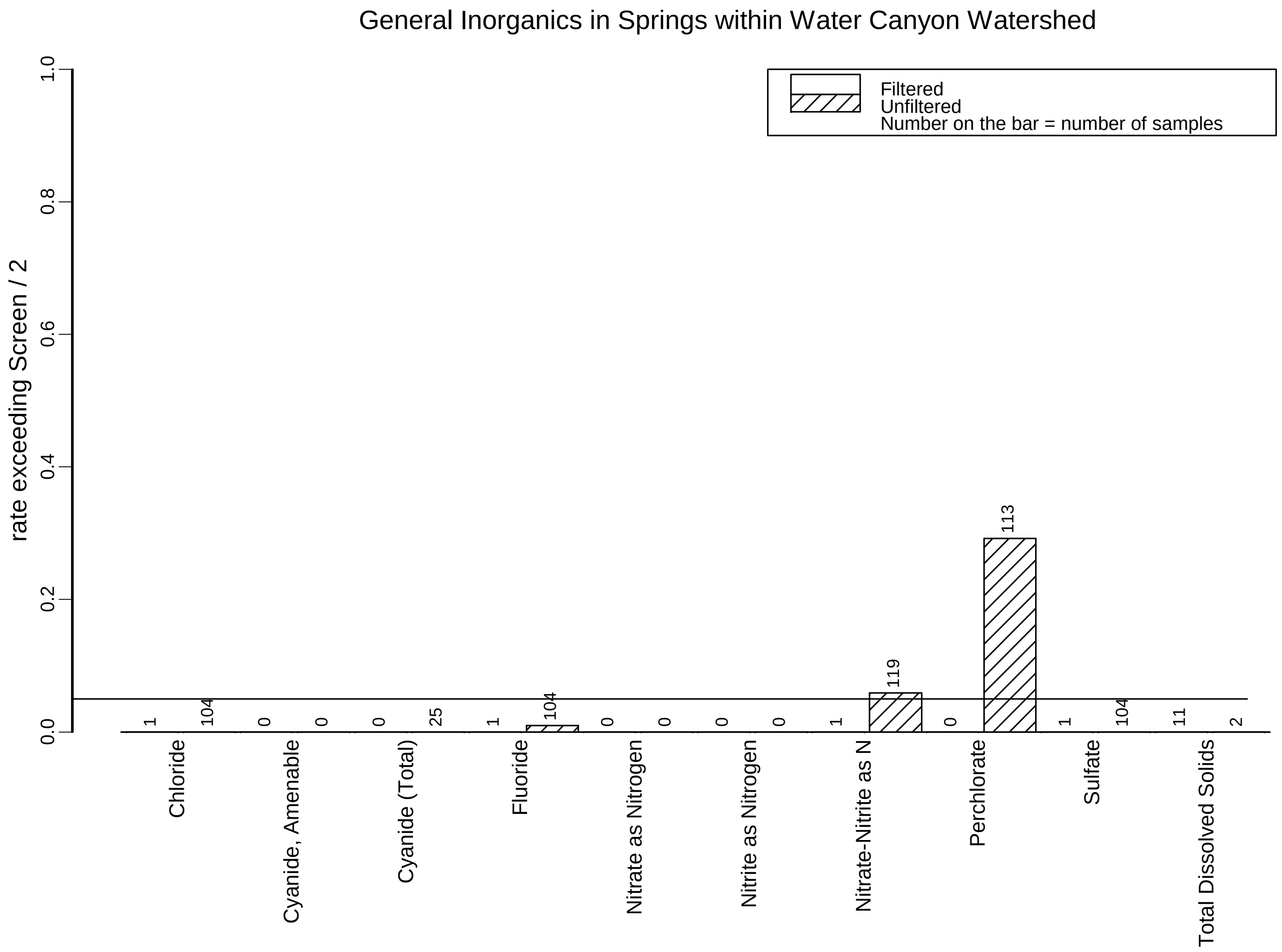


Figure B.77. **Rate exceeding Screen/2 for Inorganics in Water Canyon Springs.**

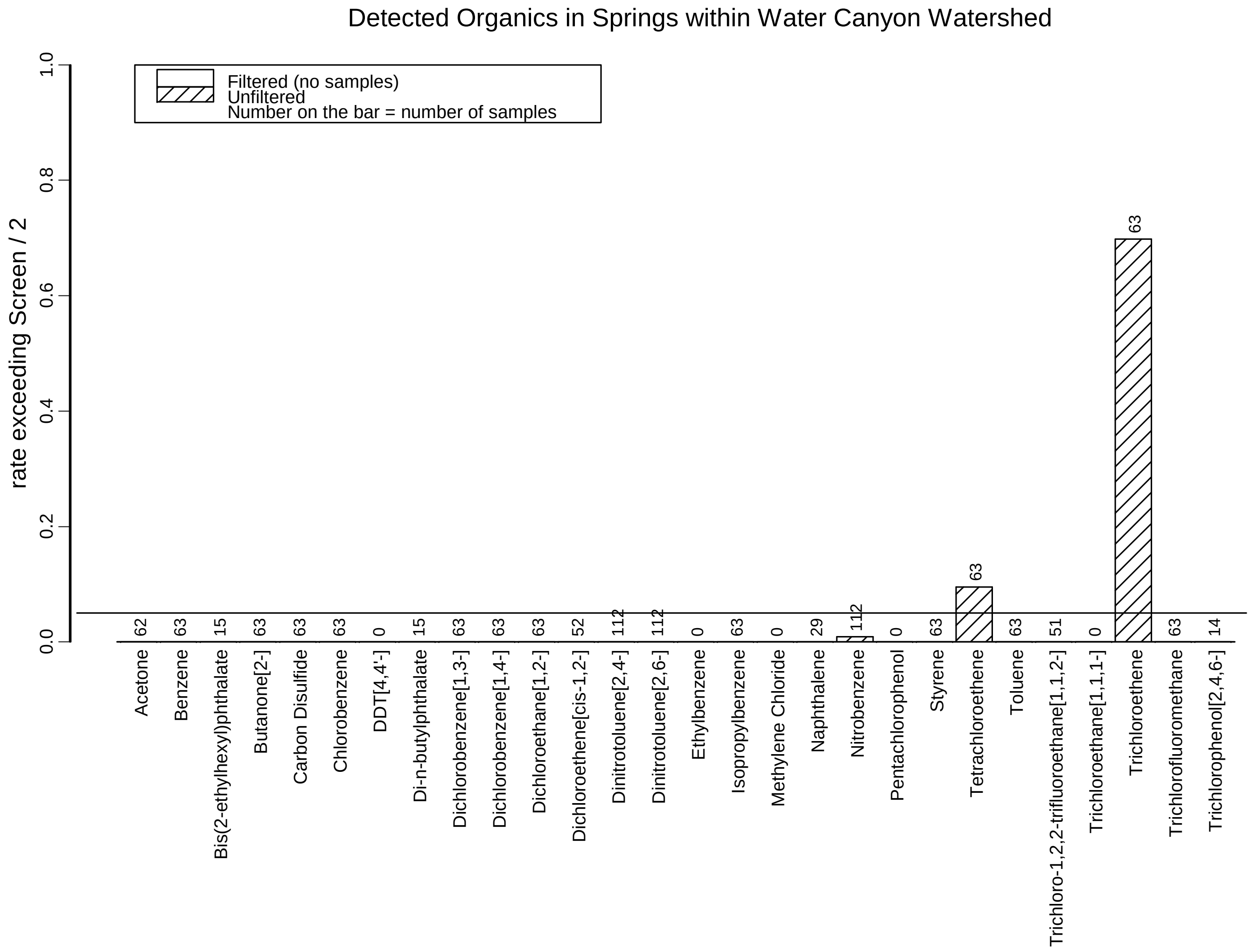


Figure B.78. Rate exceeding Screen/2 for organics in Water Canyon Springs.

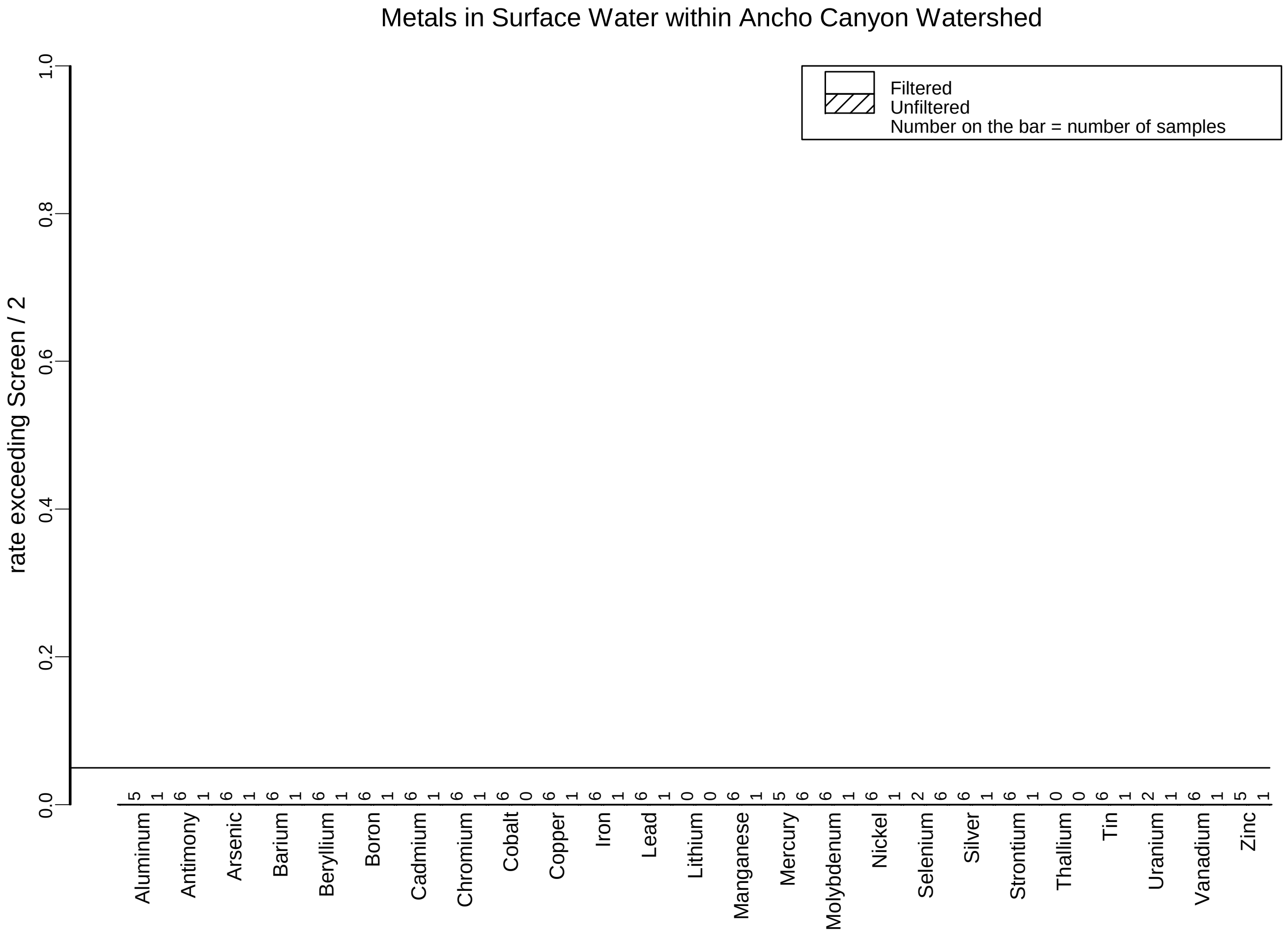


Figure B.79. **Rate exceeding Screen/2 for Metals in Ancho Canyon Ephemeral Surface Water.**

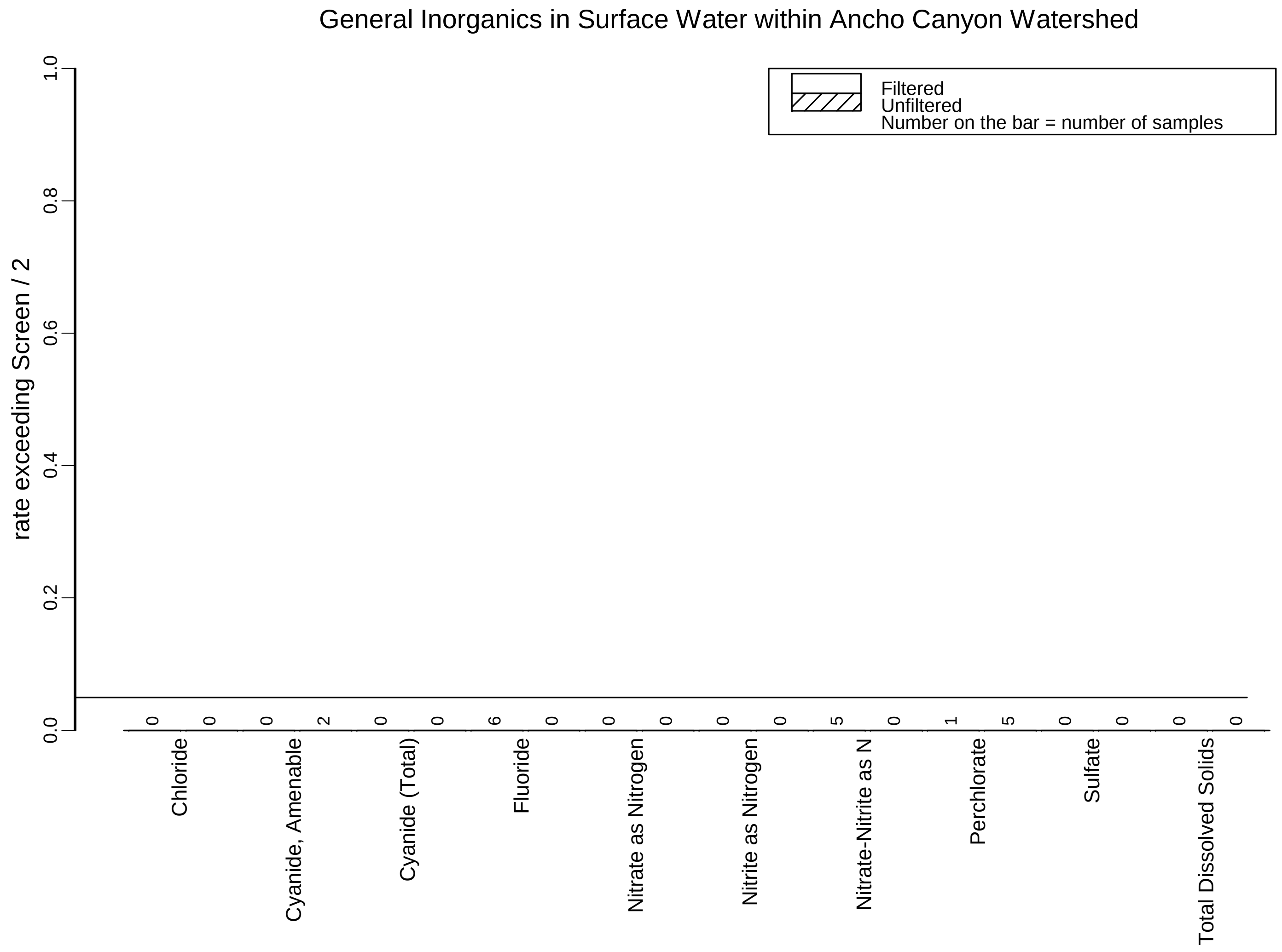


Figure B.80. **Rate exceeding Screen/2 for Inorganics in Ancho Canyon Ephemeral Surface Water.**

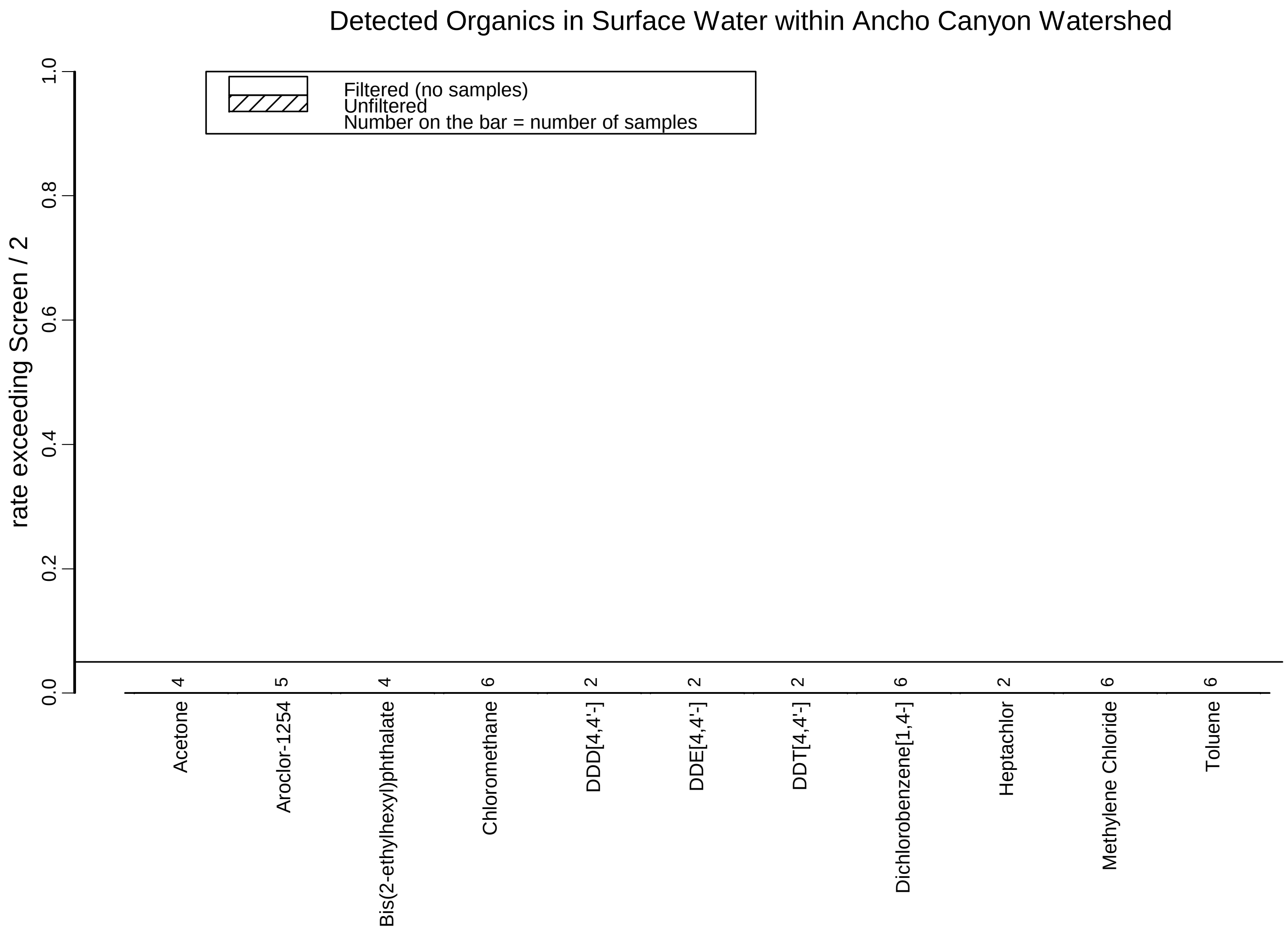


Figure B.81. **Rate exceeding Screen/2 for Organics in Ancho Canyon Ephemeral Surface Water.**

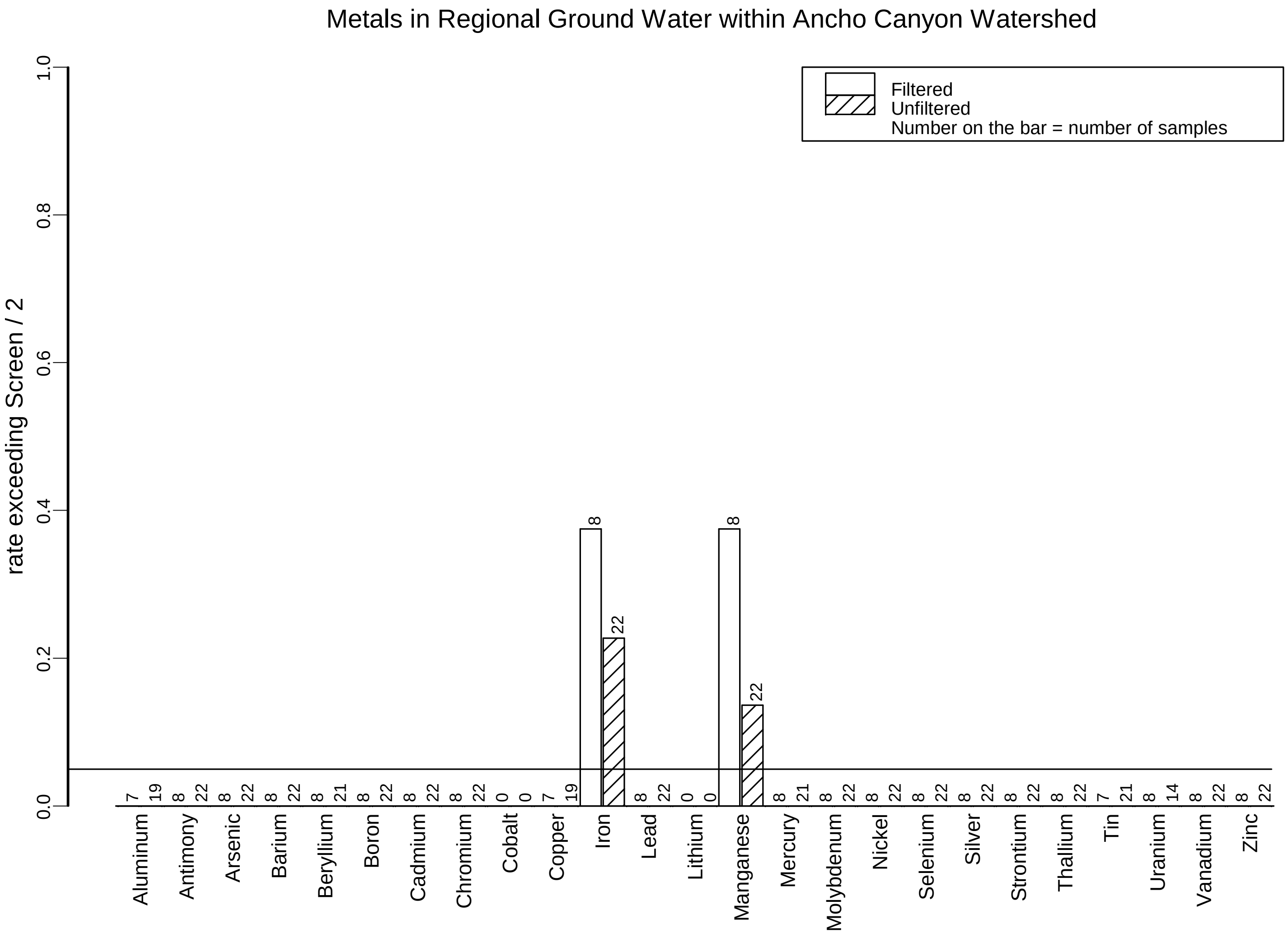
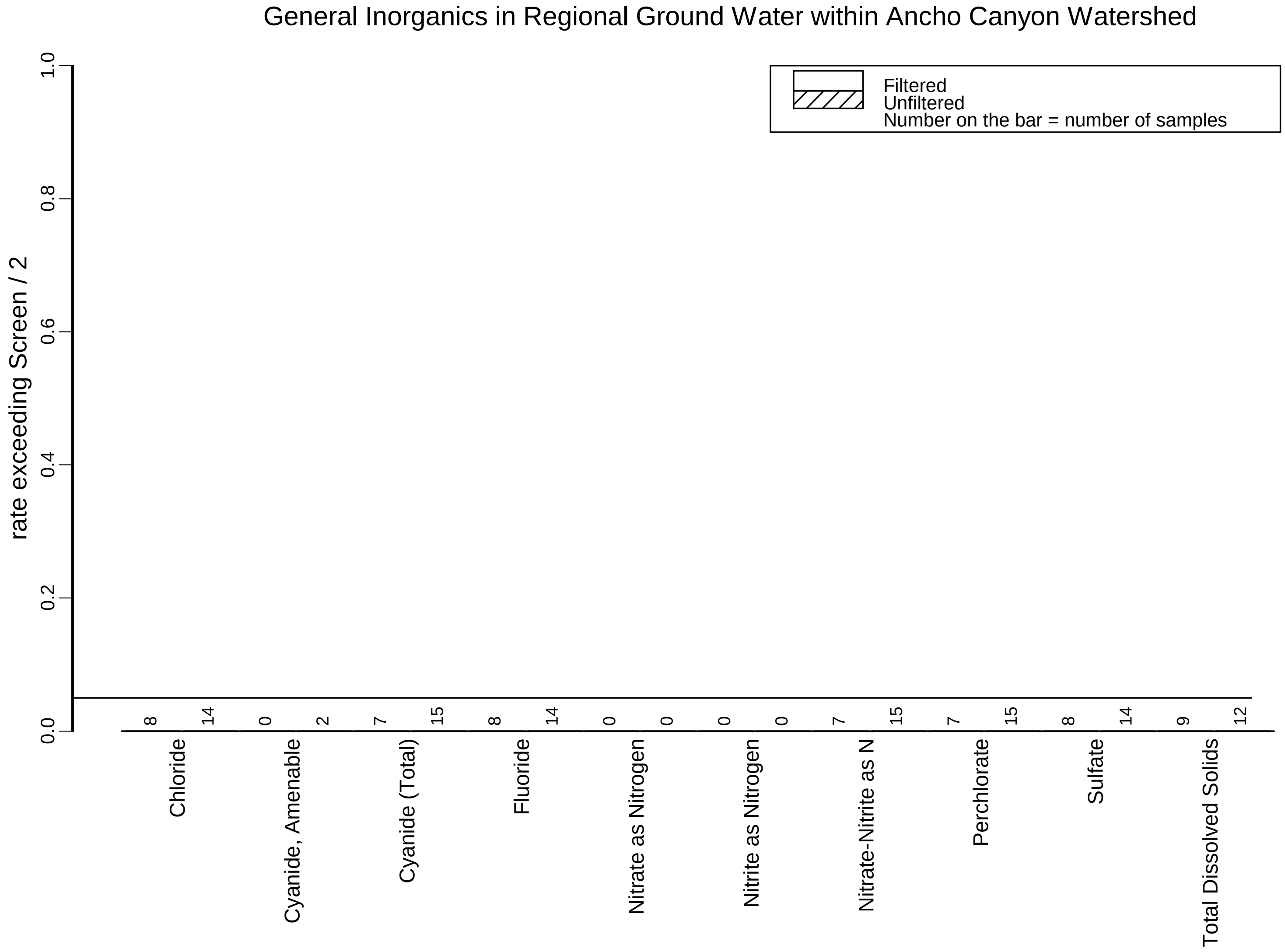


Figure B.82. **Rate exceeding Screen/2 for Metals in Ancho Canyon Regional Ground Water.**



General Inorganics in Regional Ground Water within Ancho Canyon Watershed

Figure B.83. Rate exceeding Screen/2 for Inorganics in Ancho Canyon Regional Ground Water.

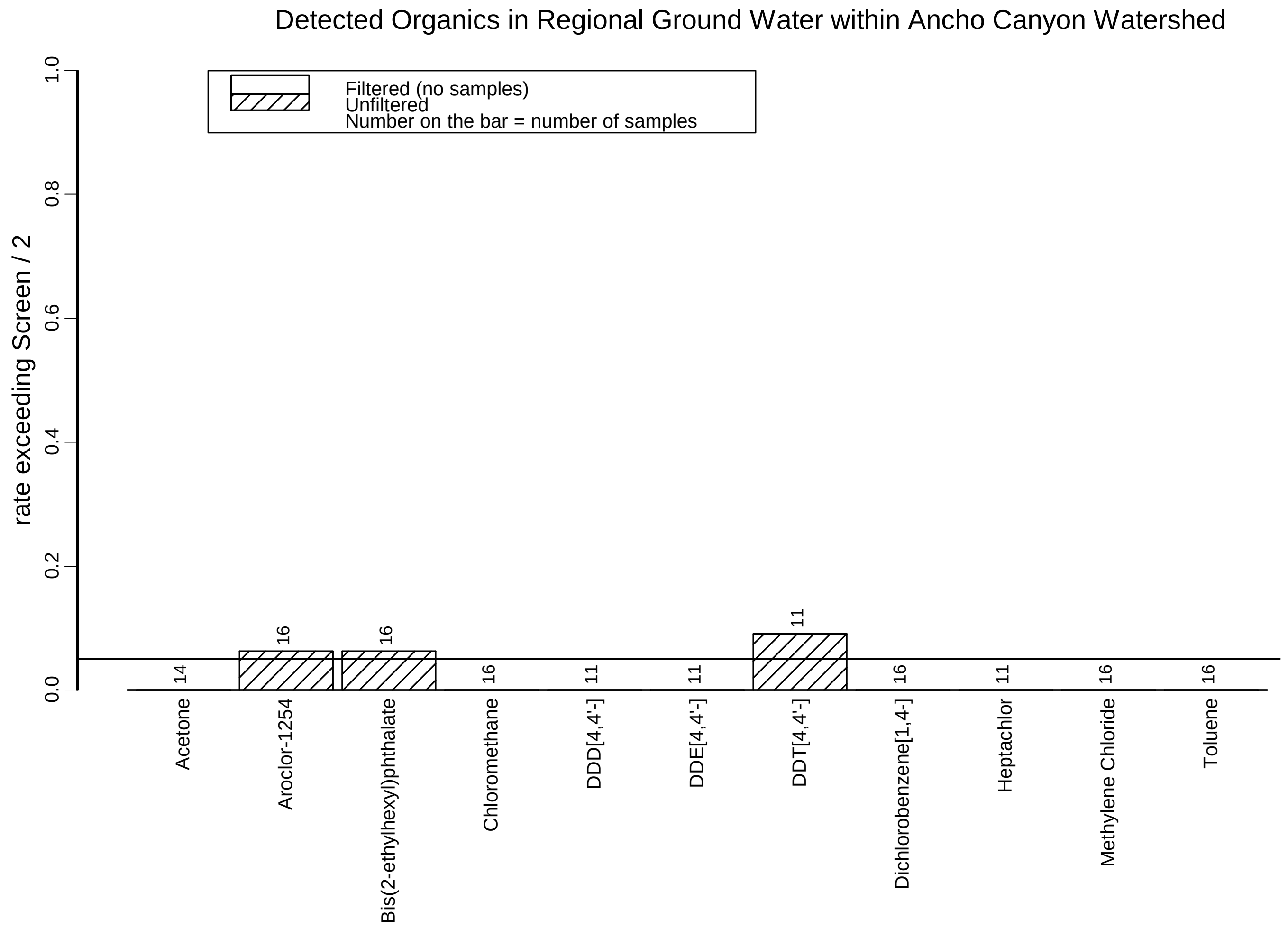


Figure B.84. **Rate exceeding Screen/2 for Organics in Ancho Canyon Regional Ground Water.**

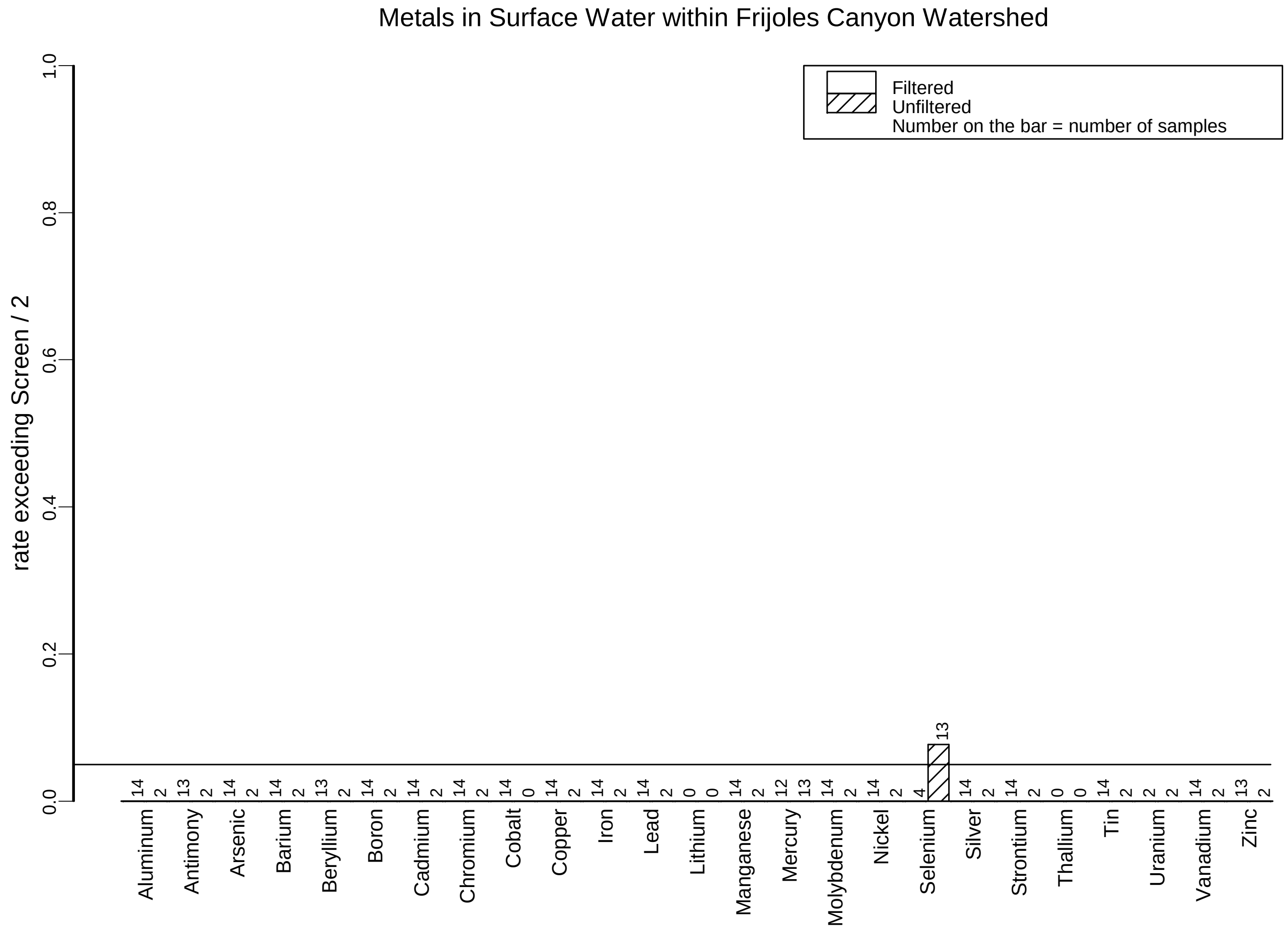


Figure B.85. **Rate exceeding Screen/2 for Metals in Frijoles Canyon Perennial Surface Water.**

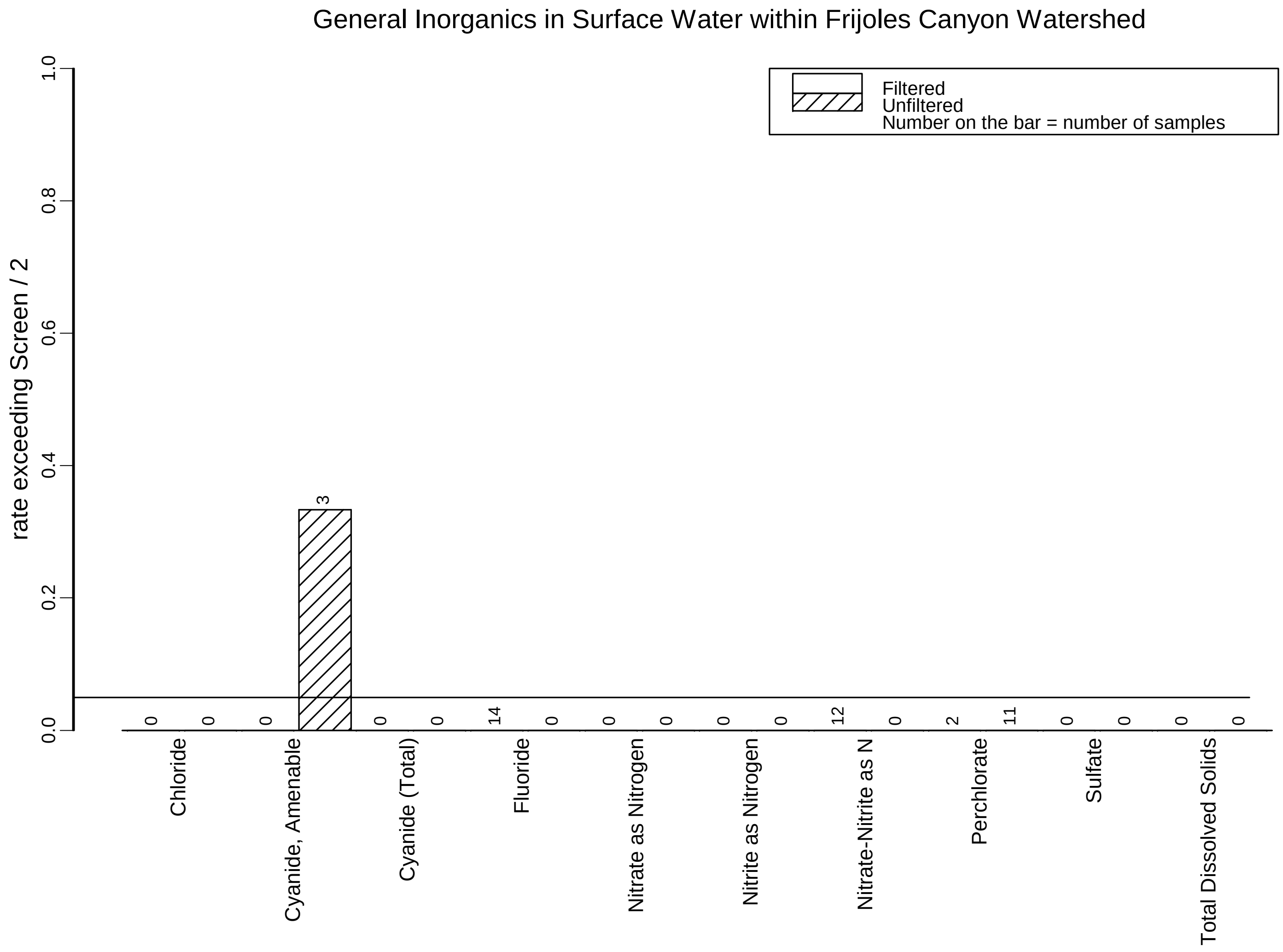


Figure B.86. **Rate exceeding Screen/2 for Inorganics in Frijoles Canyon Perennial Surface Water.**

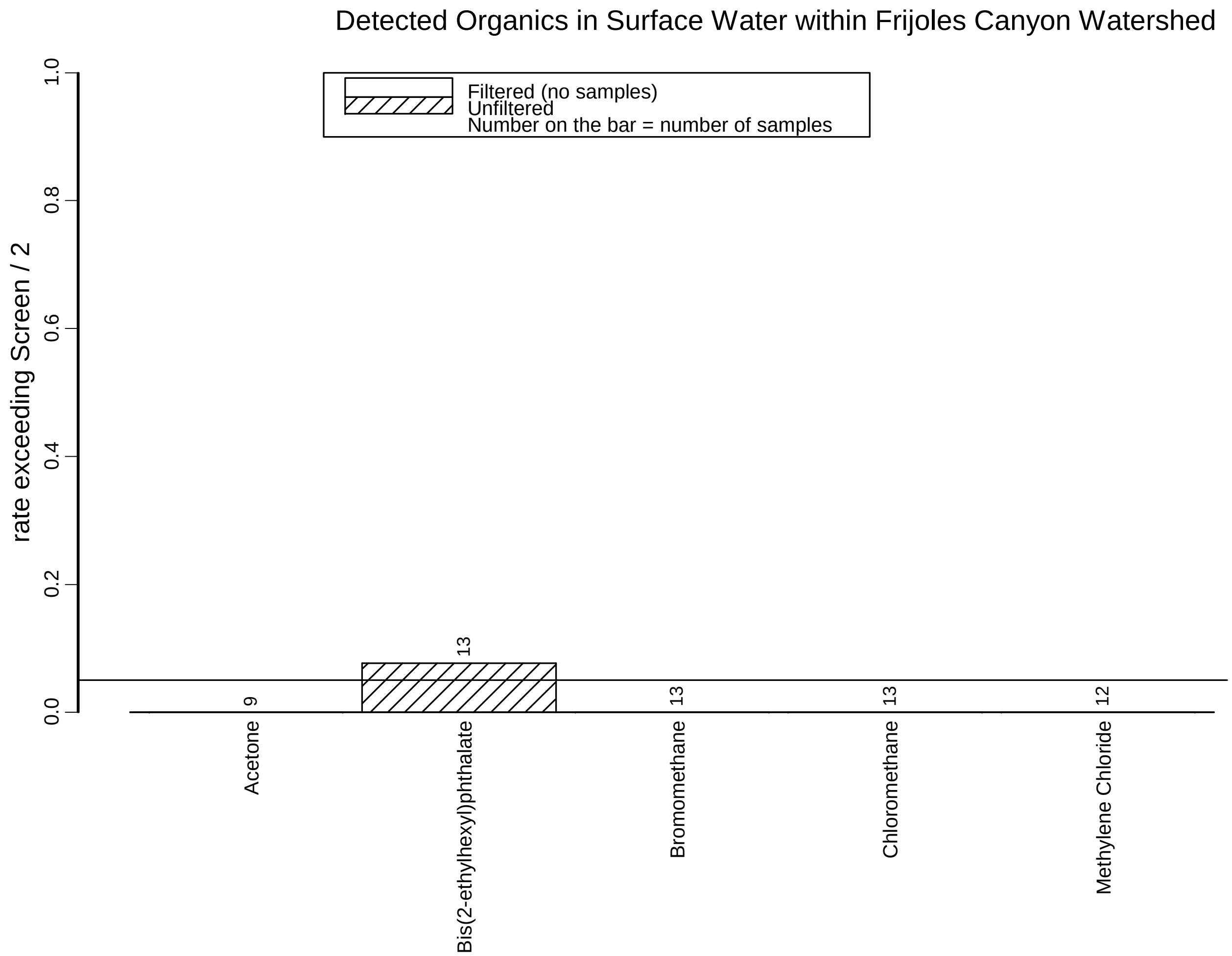


Figure B.87. **Rate exceeding Screen/2 for Organics in Frijoles Canyon Perennial Surface Water.**

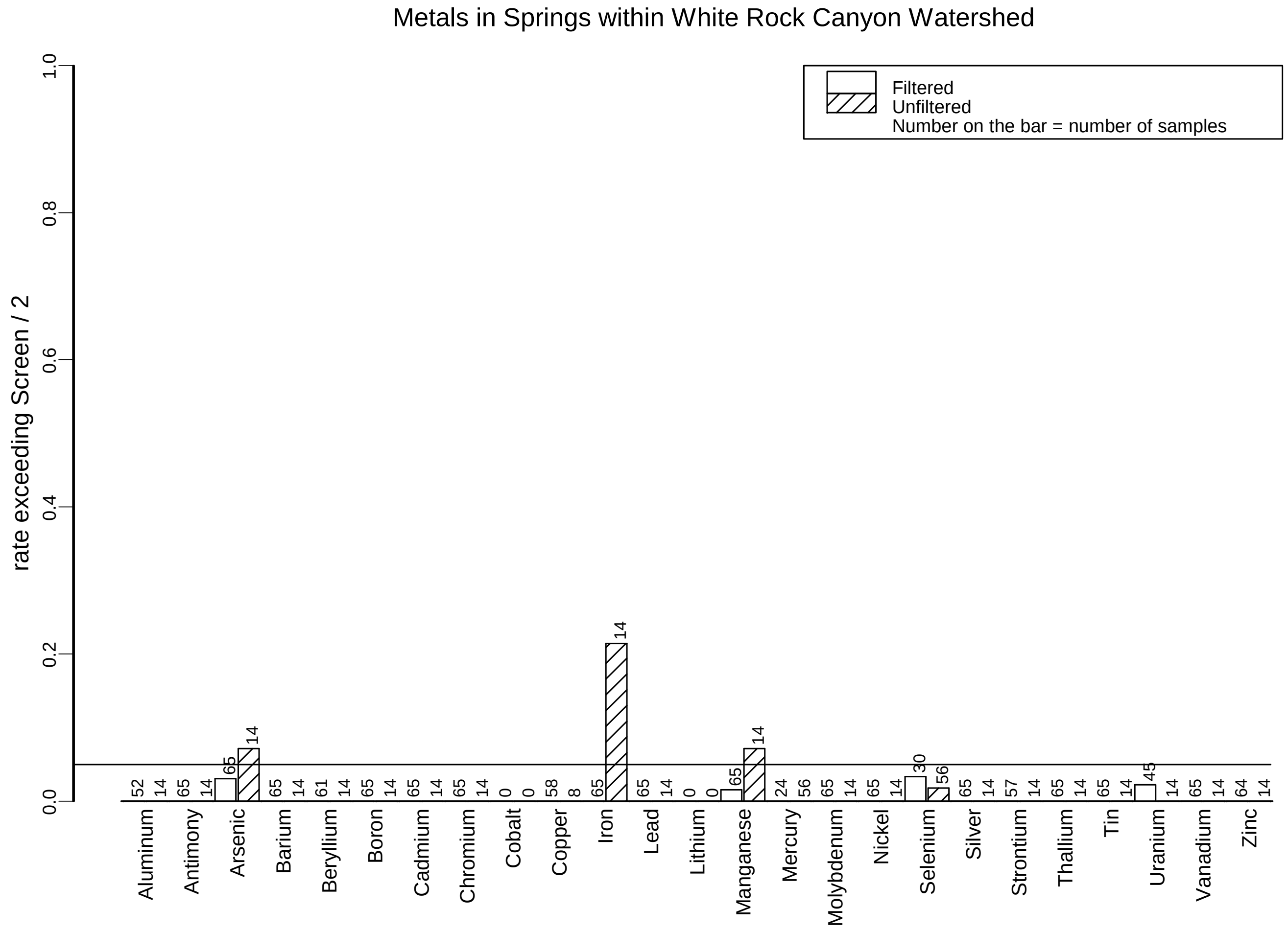


Figure B.88. Rate exceeding Screen/2 for Metals in White Rock Canyon Springs.

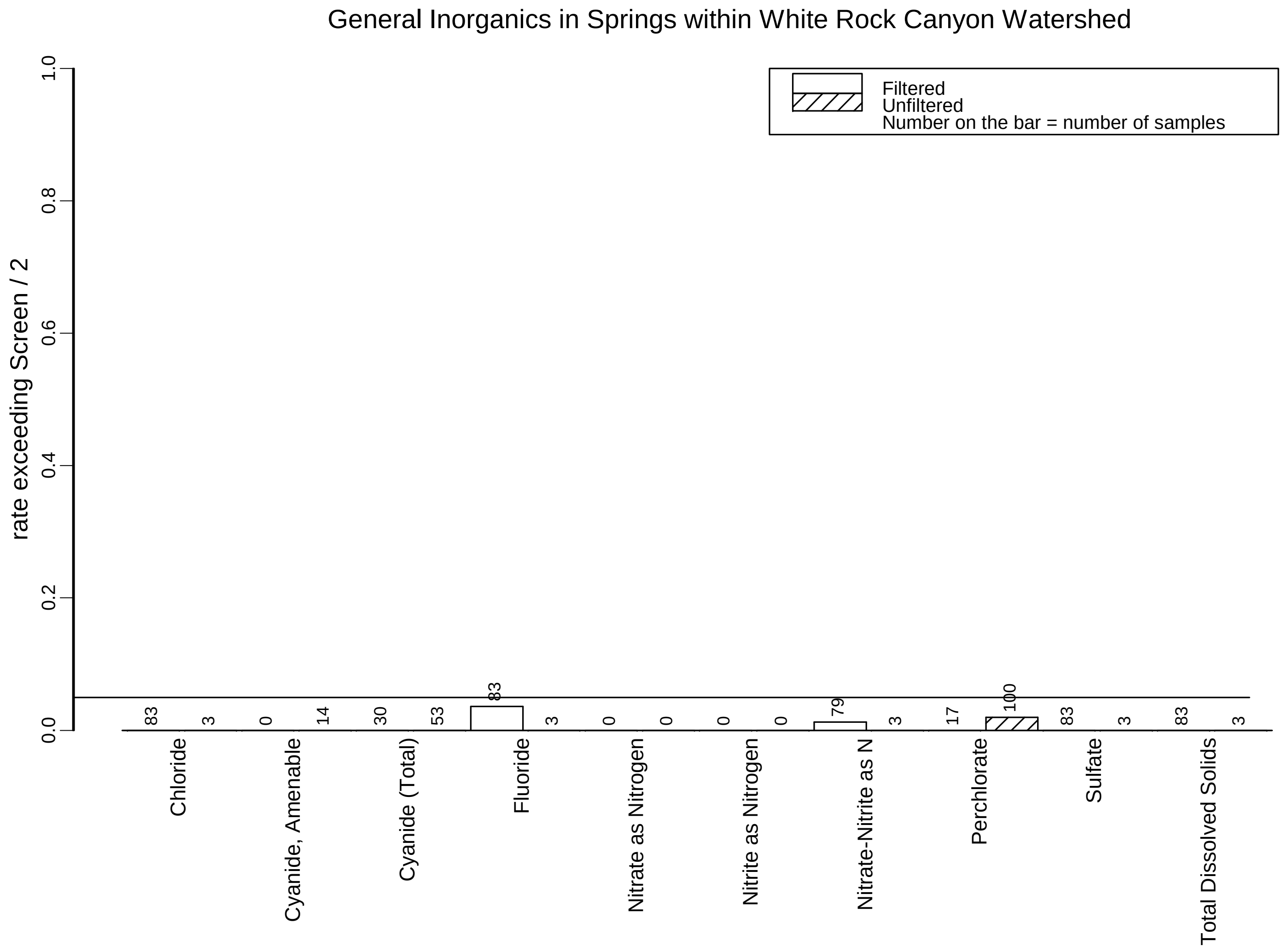


Figure B.89. **Rate exceeding Screen/2 for General Inorganics in White Rock Canyon Springs.**

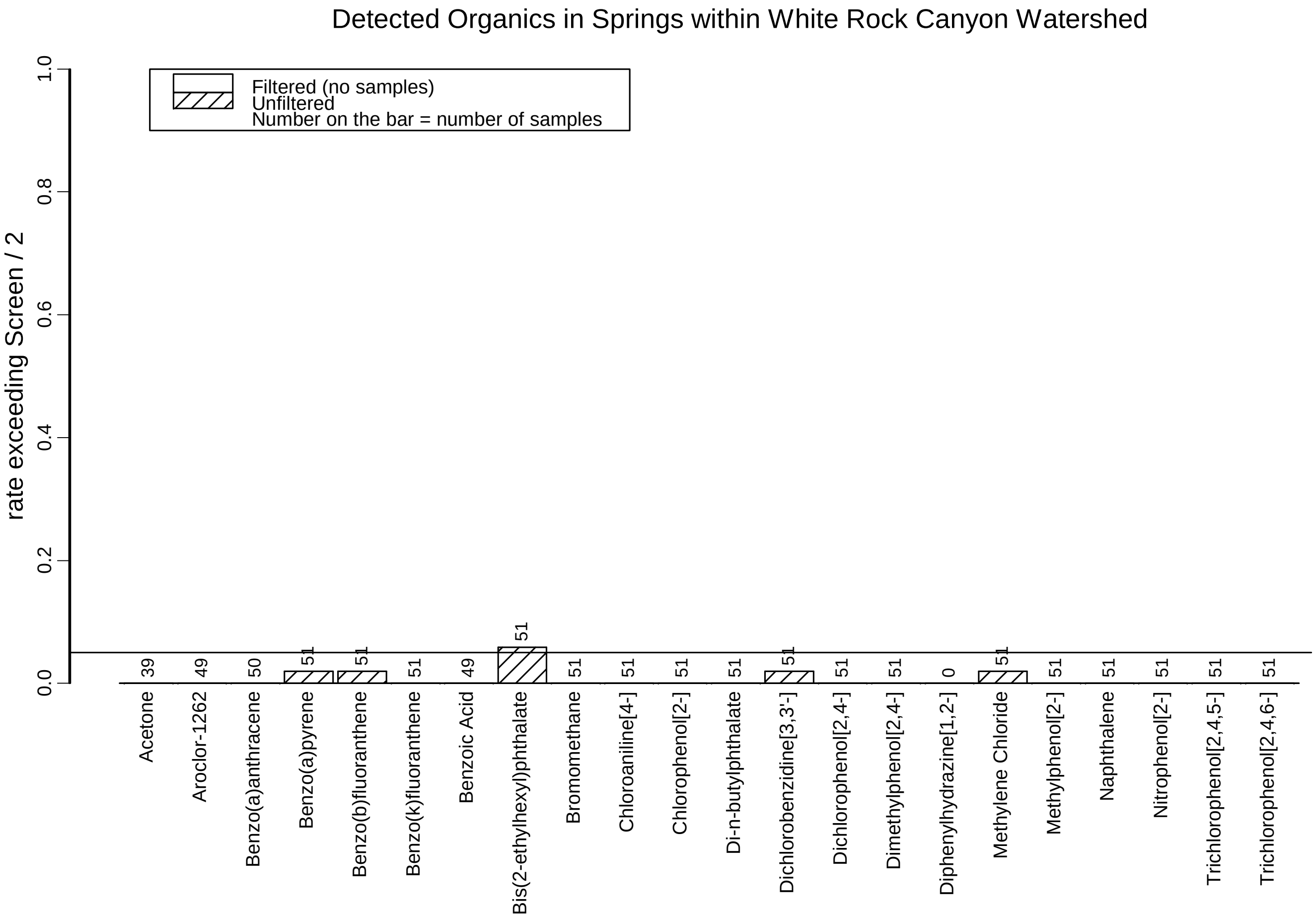


Figure B.90. **Rate exceeding Screen/2 for organics in White Rock Canyon Springs.**

Appendix E

Justification Information and Data

Appendix E
Figures

Tables

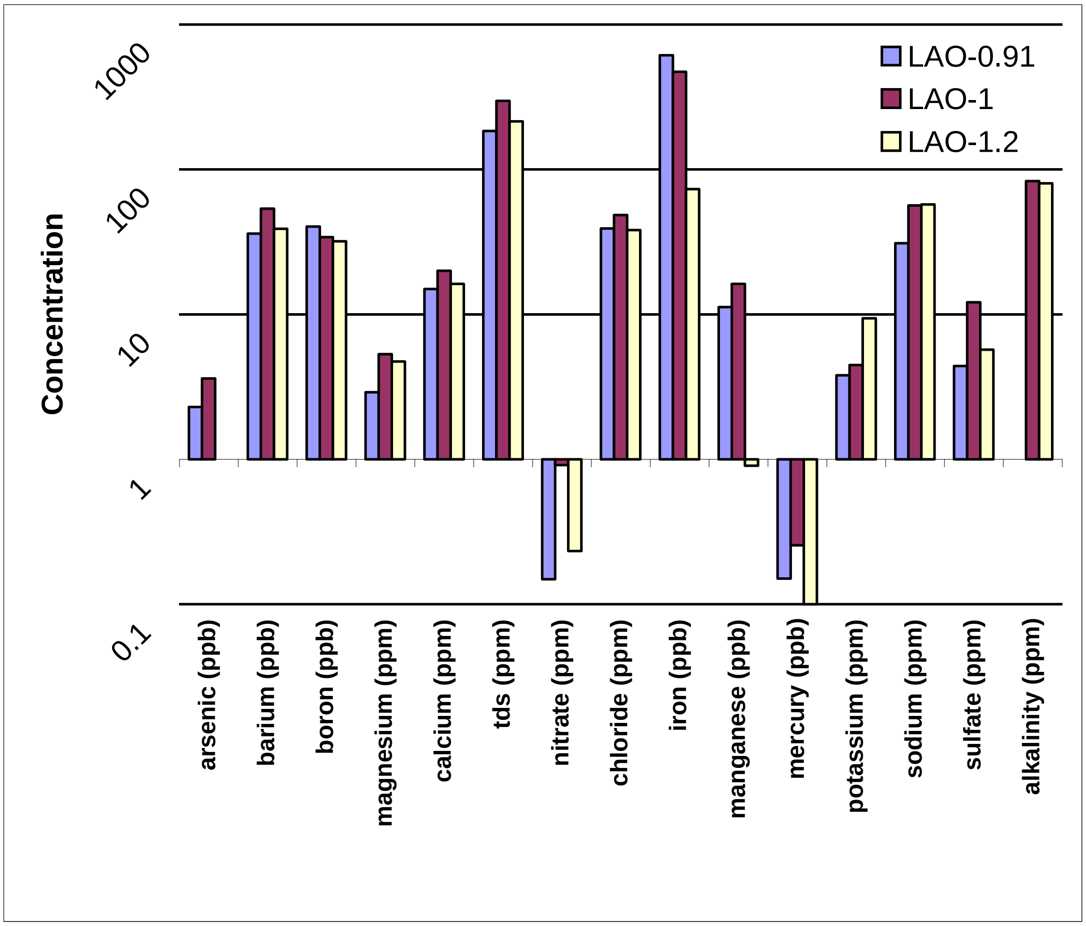
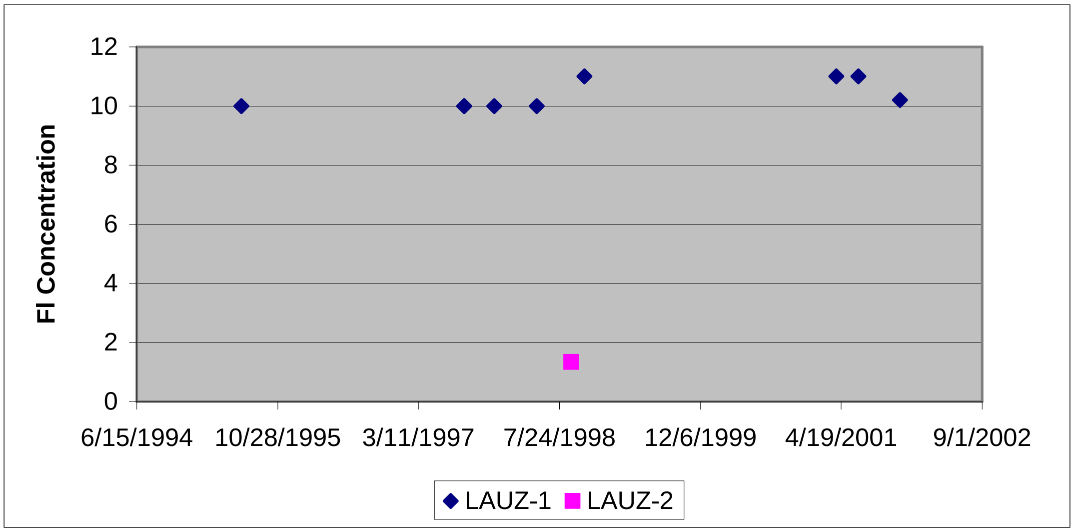


Figure E.2.1 **RedLoc_1. Redundant locations in upper Los Alamos Canyon LAO-0.91, LAO-1, and LAO-1.2.**



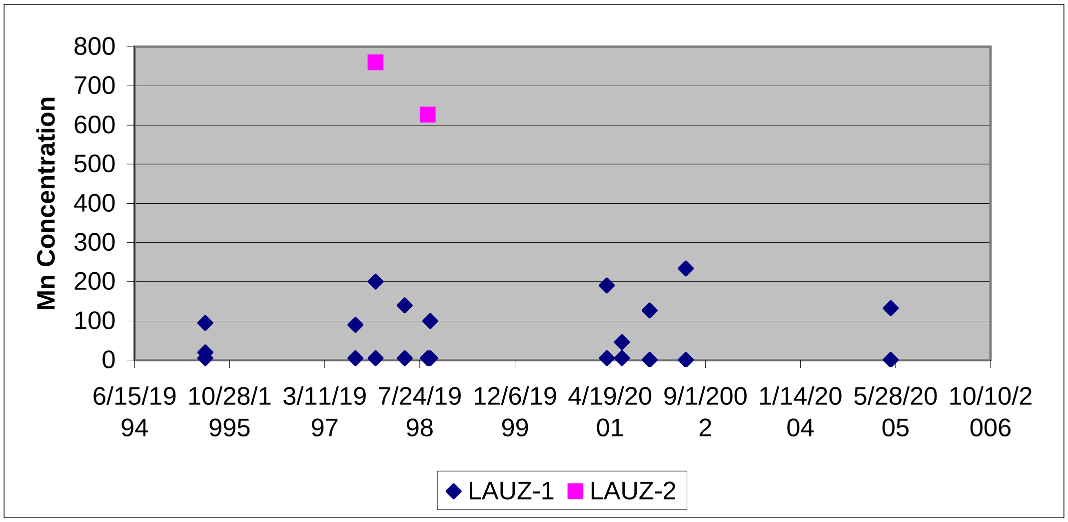


Figure E.2.2. **Comparison of manganese and fluoride concentrations at LAUZ-1 and LAUZ-2. Note that LAUZ-1 has a more extensive data set over a longer breadth of time then LAUZ-2.**

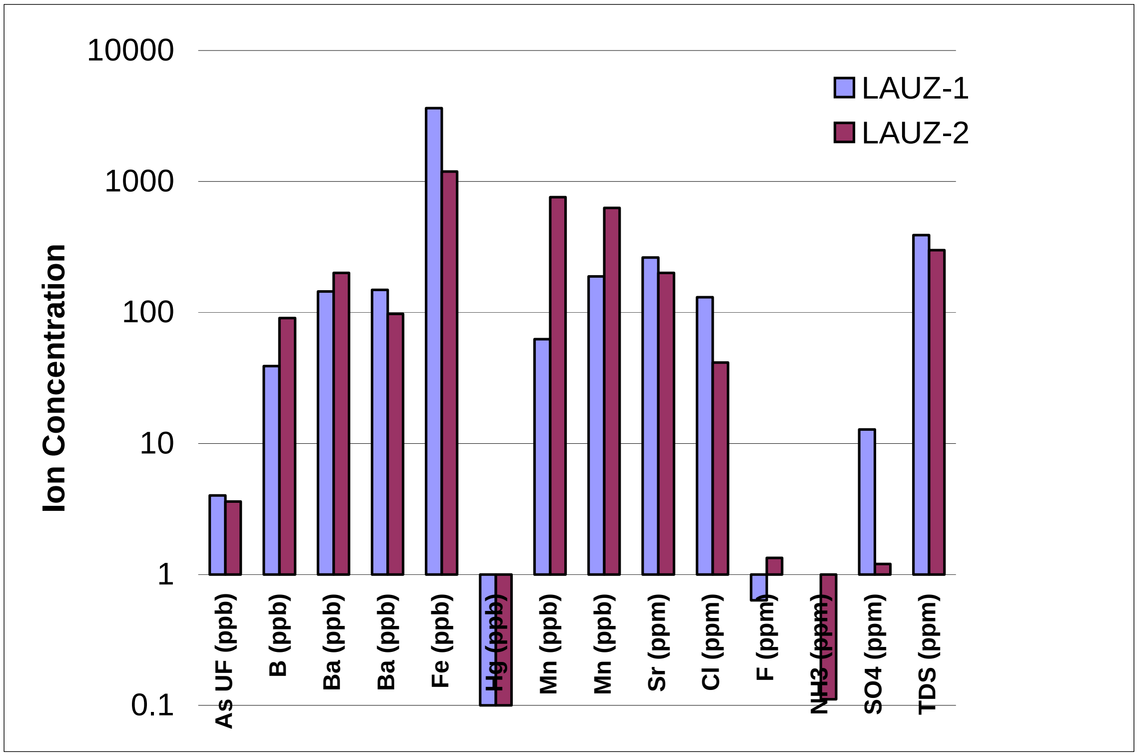


Figure E.2.3. **Comparison of average values of select ion chemistry results from LAUZ-1 and LAUZ-2.**

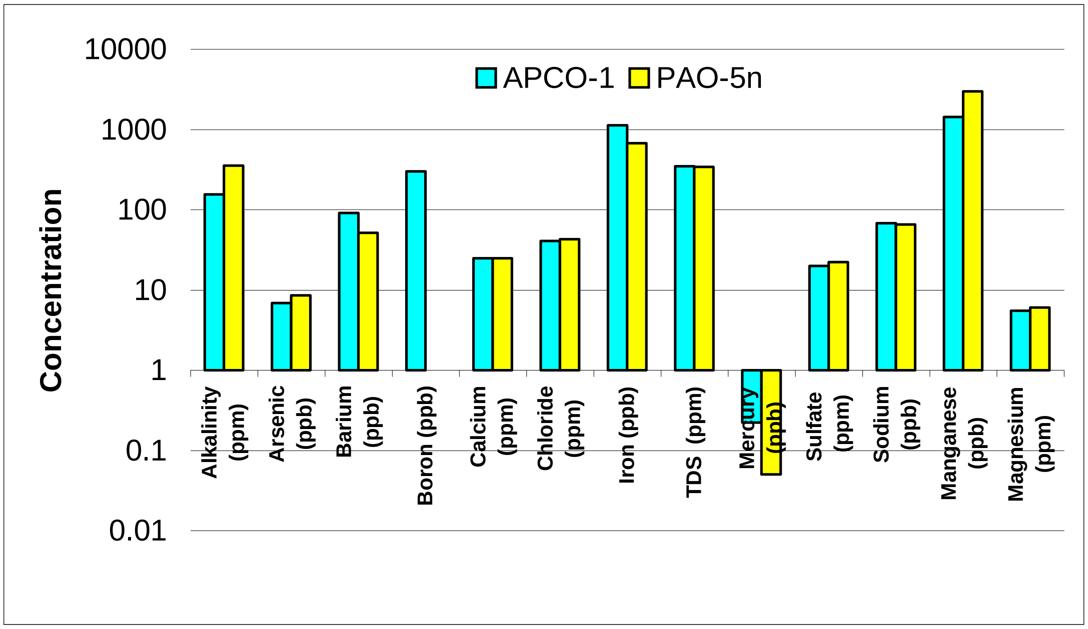


Figure E.2.4. **Comparison of average groundwater analytical results from Pueblo Canyon alluvial wells APCO-1 and PCO-5n.**

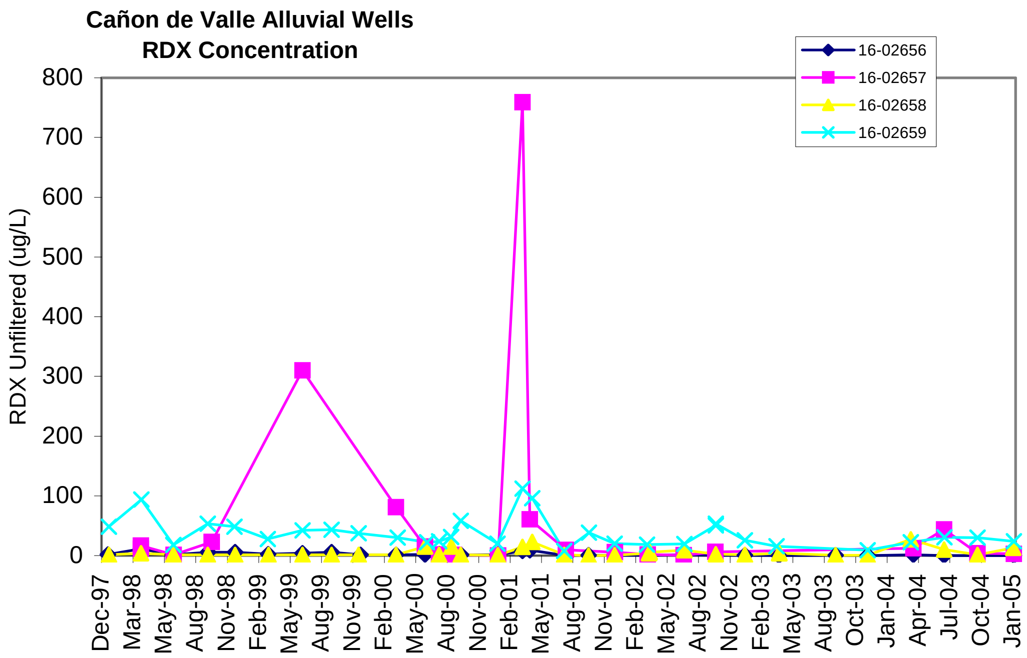


Figure E.6.1. **RDX concentrations in Canon de Valle alluvial groundwater from 1998 through 2005.**

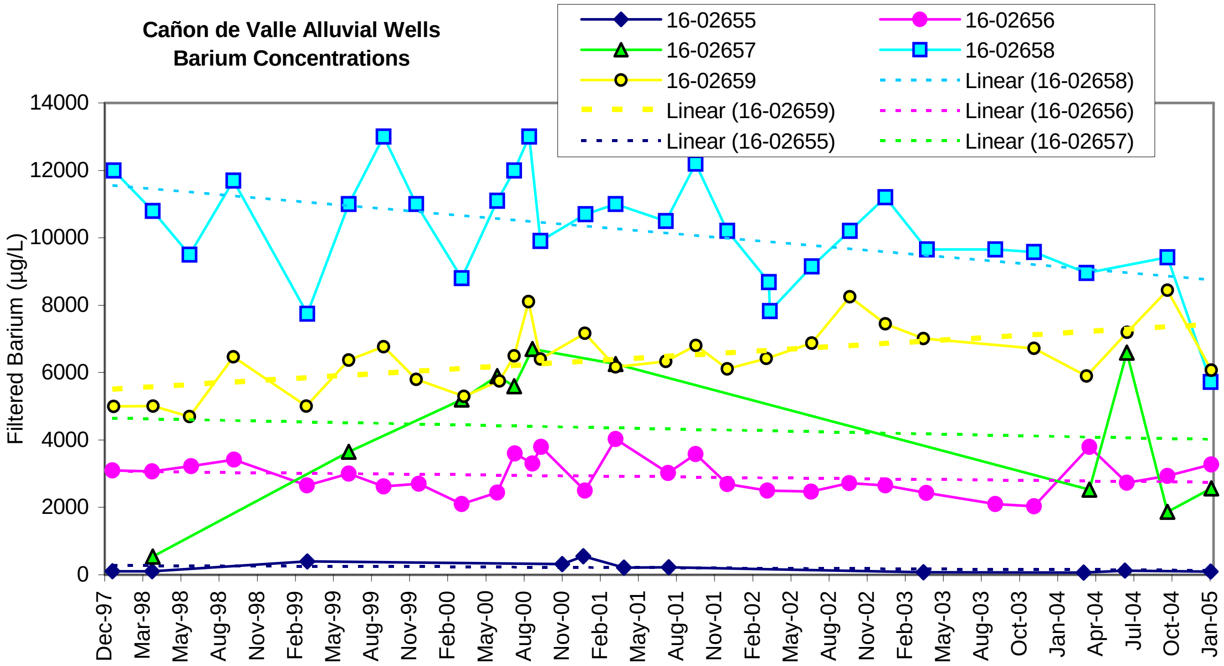


Figure E.6.2. **Barium concentrations in Canon de Valle alluvial groundwater from 1998 through 2005.**

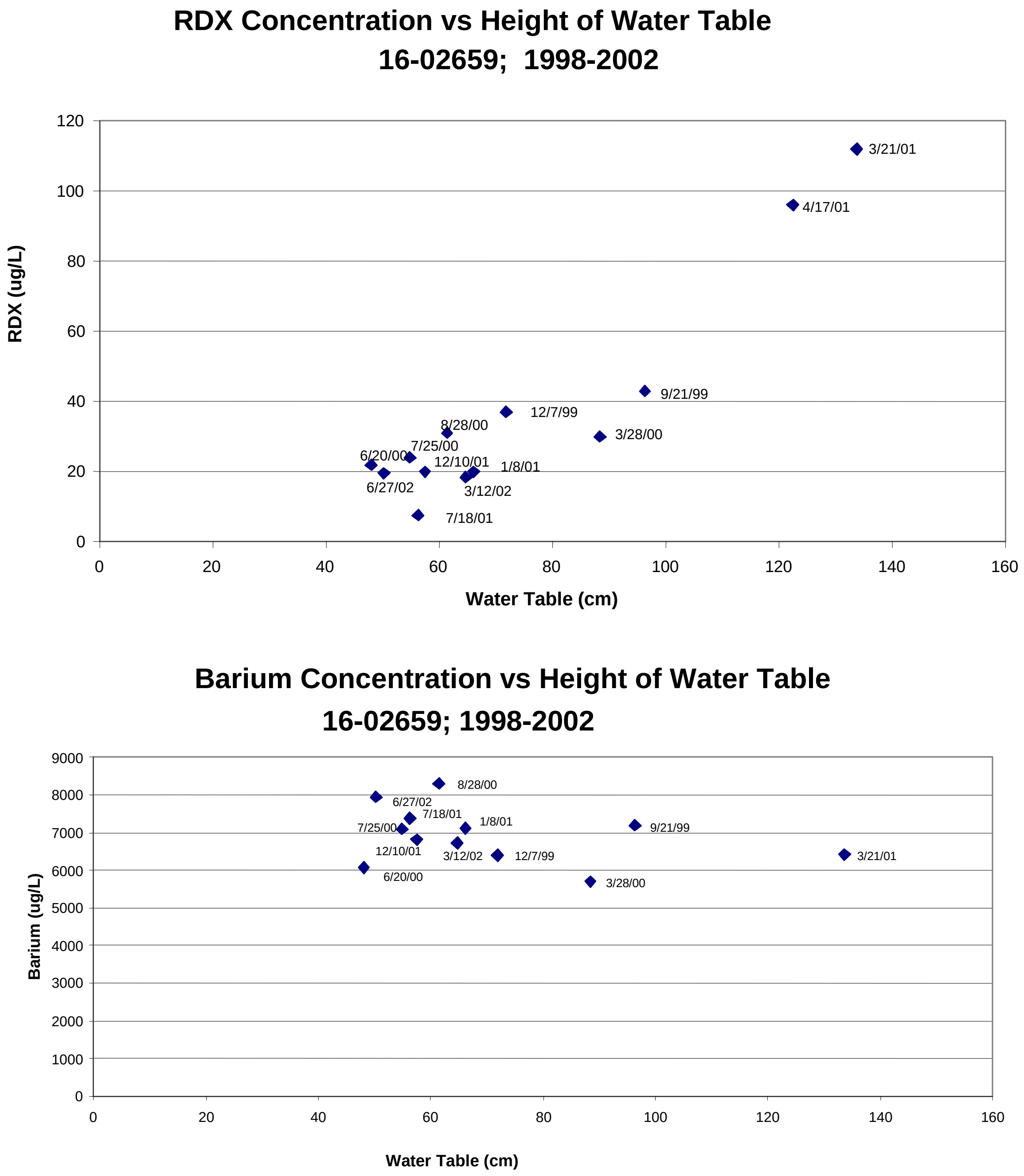


Figure E.6.3. **Barium concentrations versus the height of the water table in Canon de Valle alluvial groundwater from 1998 through 2005.**

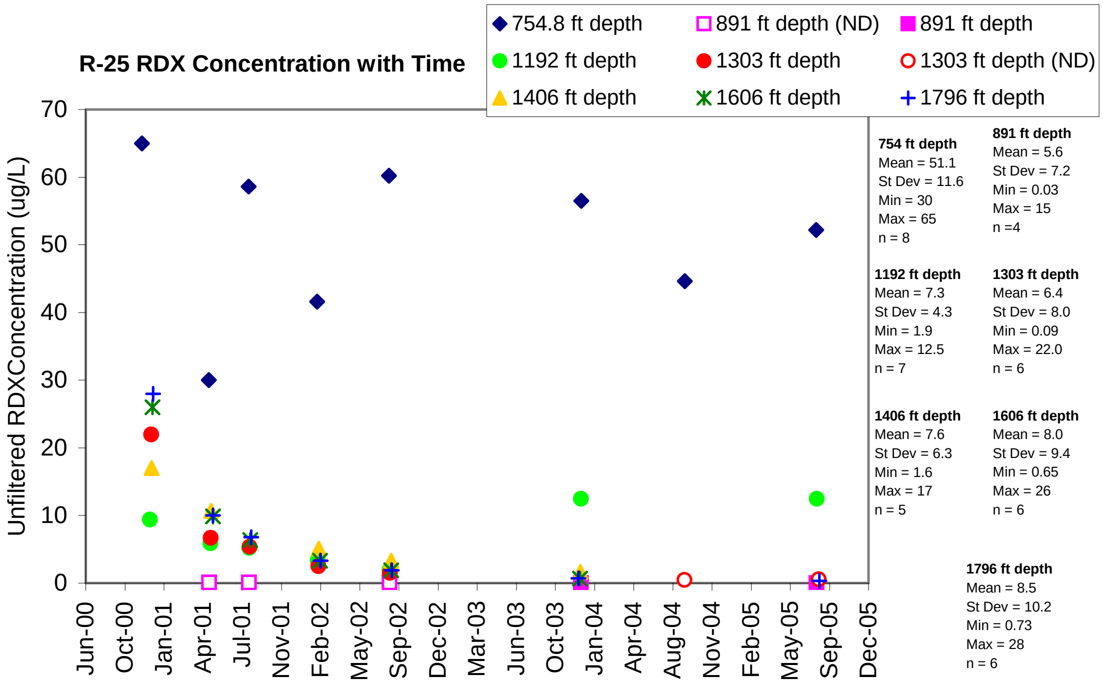


Figure E.6.4. RDX concentrations in regional groundwater well R-25.

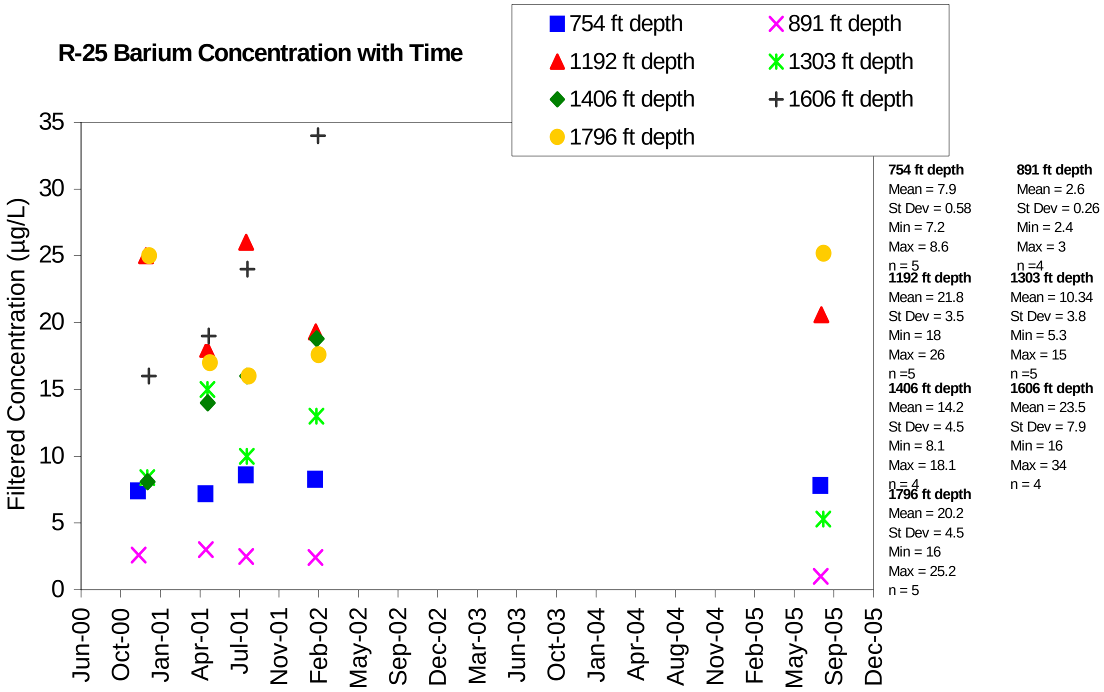


Figure E.6.5. Barium concentrations in regional groundwater well R-25.

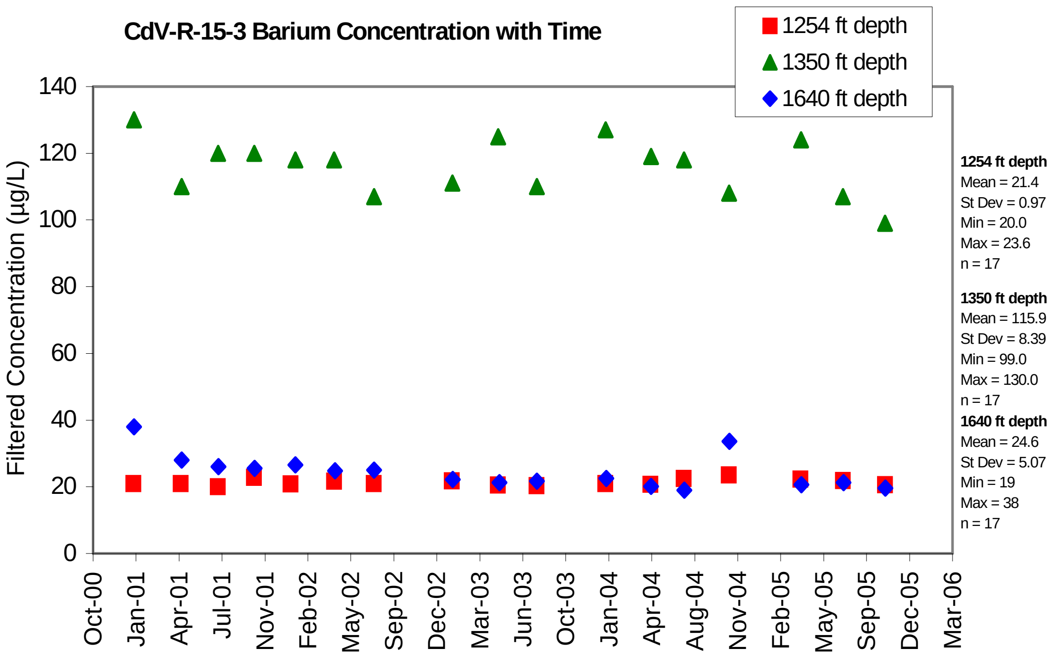


Figure E.6.6. Barium concentrations in regional groundwater well CdV-R-15-3.

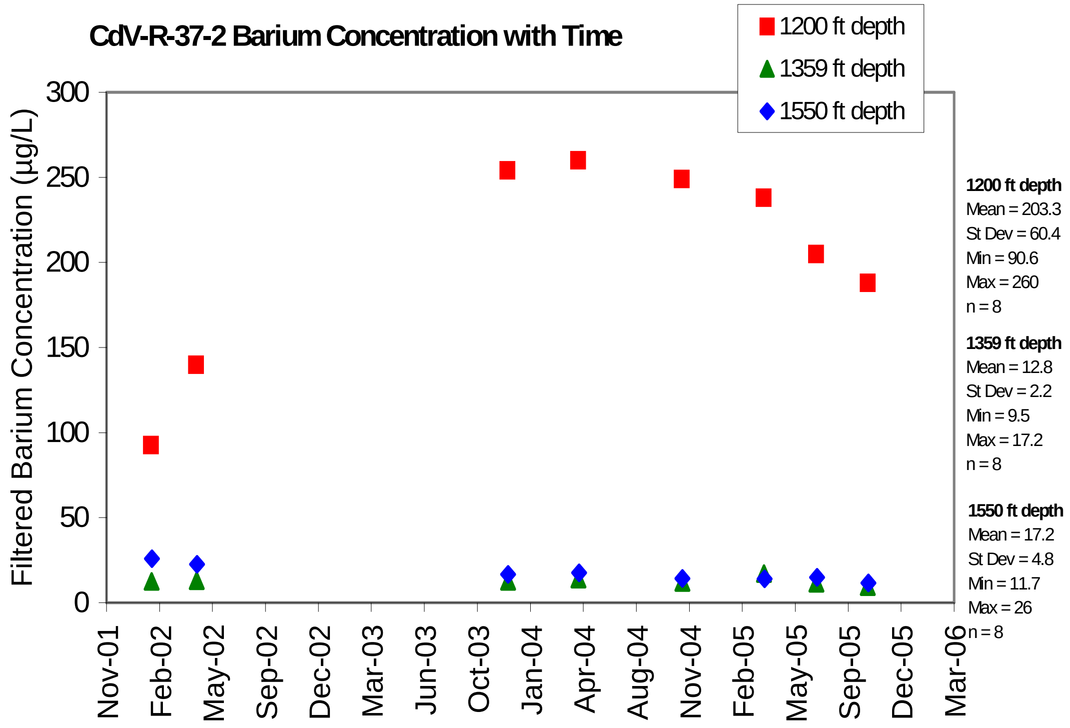


Figure E.6.7. Barium concentrations in regional groundwater well CdV-R-37-2.

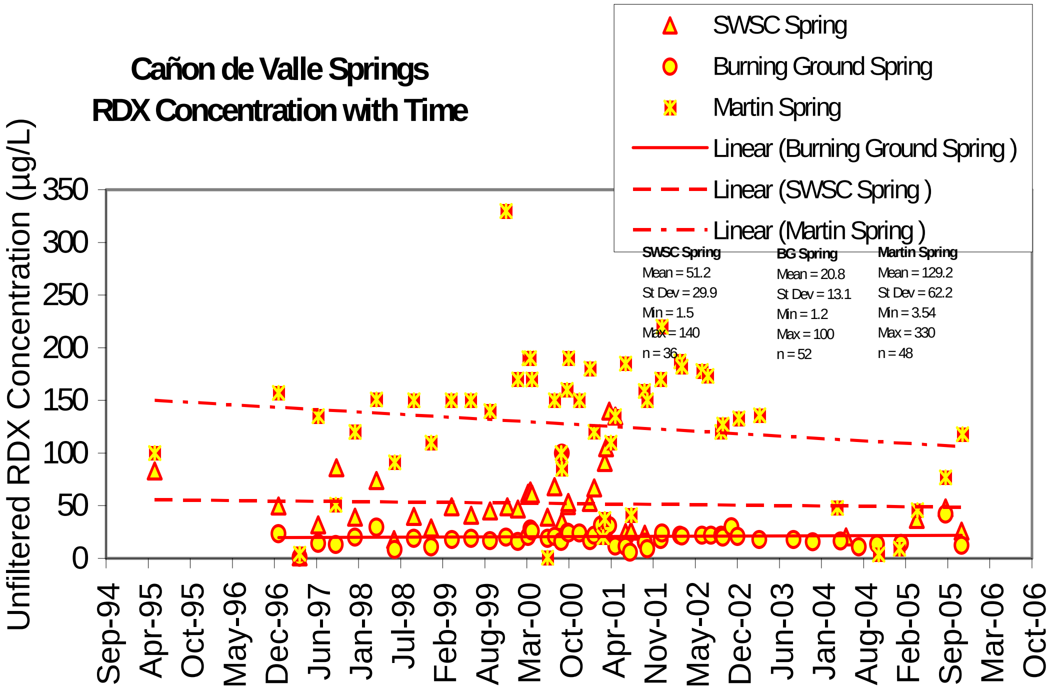


Figure E.6.8. RDX concentrations in Canon de Valle Spring groundwater from 1995 through 2005.

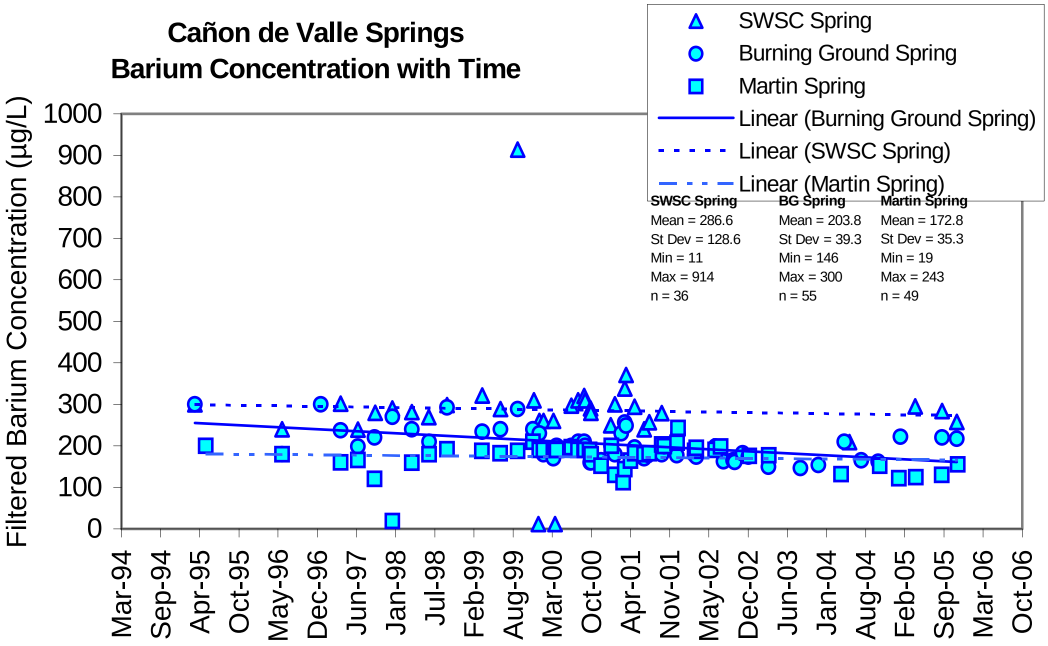


Figure E.6.9. Barium concentrations in Canon de Valle Spring groundwater from 1995 through 2005.

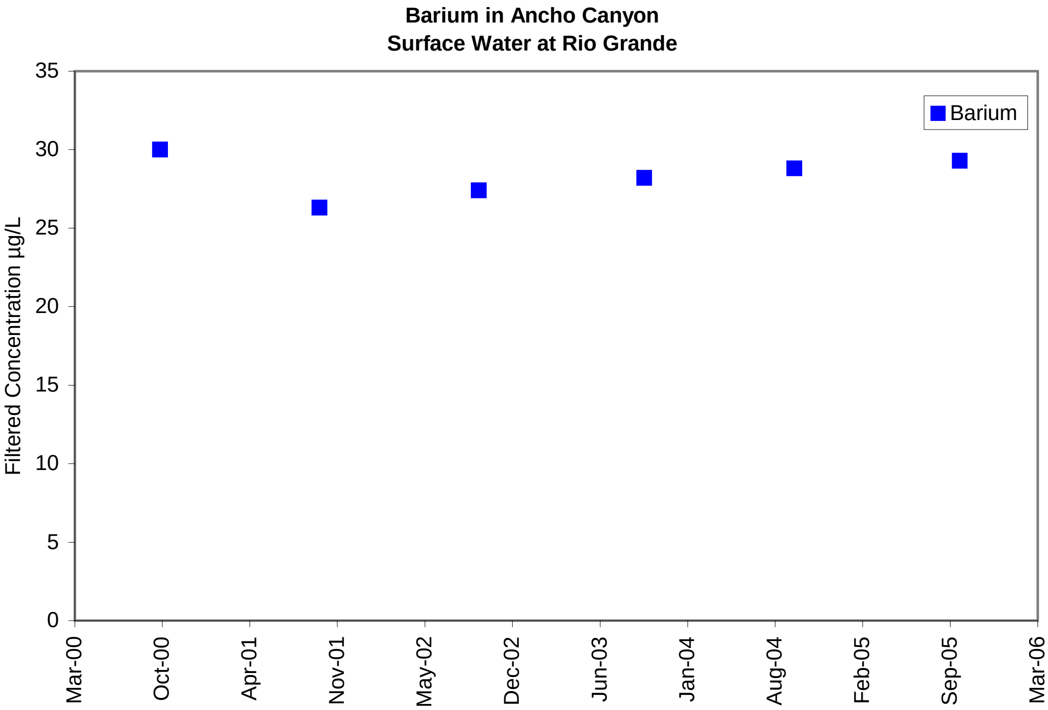


Figure E.7.1. **Barium in surface water in lower Ancho Canyon (Ancho at Rio Grande).**

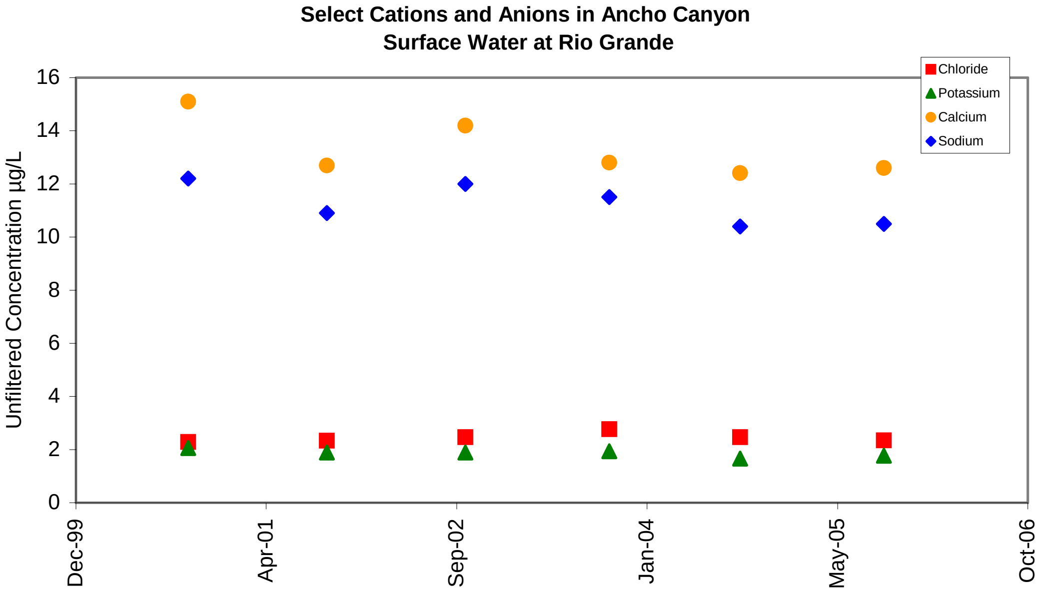


Figure E.7.2. **Major anions in surface water in lower Ancho Canyon (Ancho at Rio Grande).**

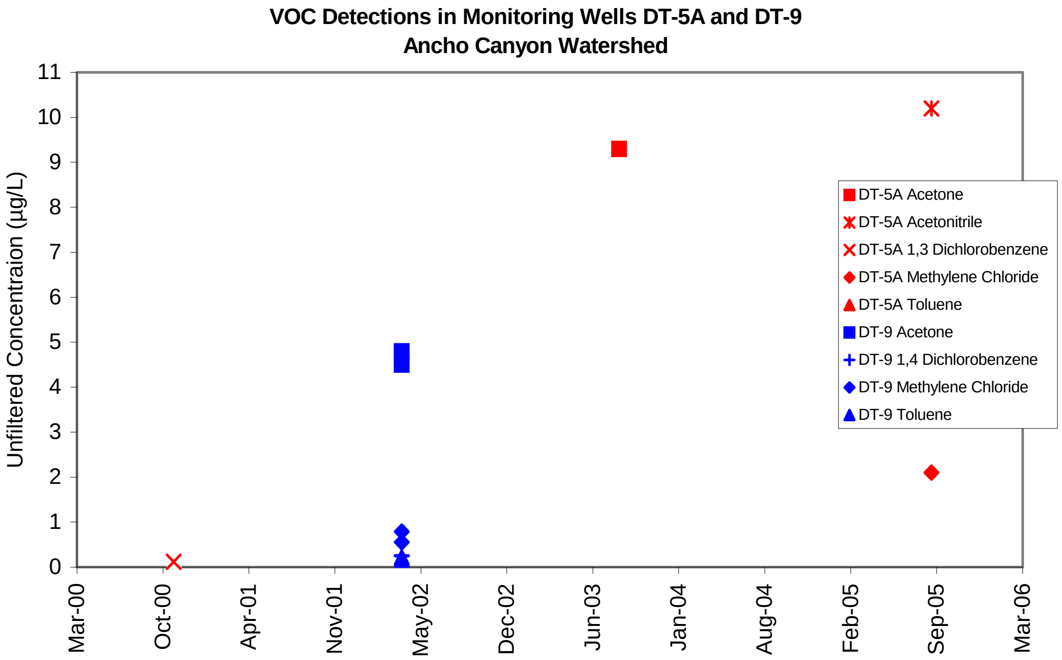


Figure E.7.3 VOCs detected in Ancho Canyon groundwater.

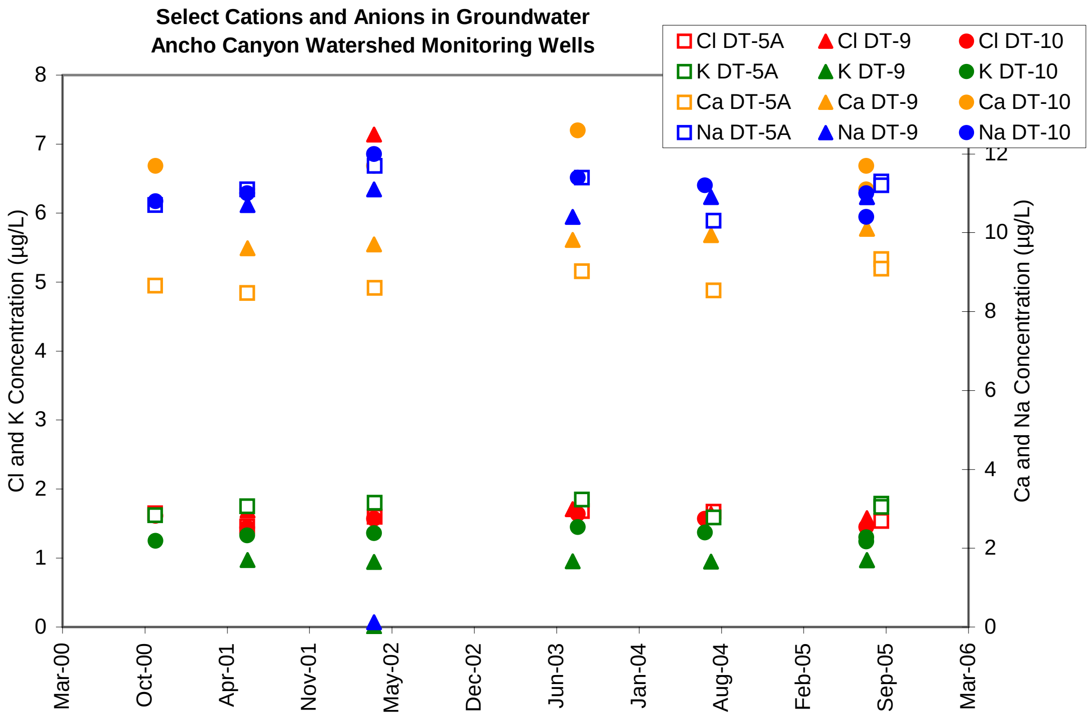


Figure E.7.4. Major ions in Ancho Canyon groundwater.

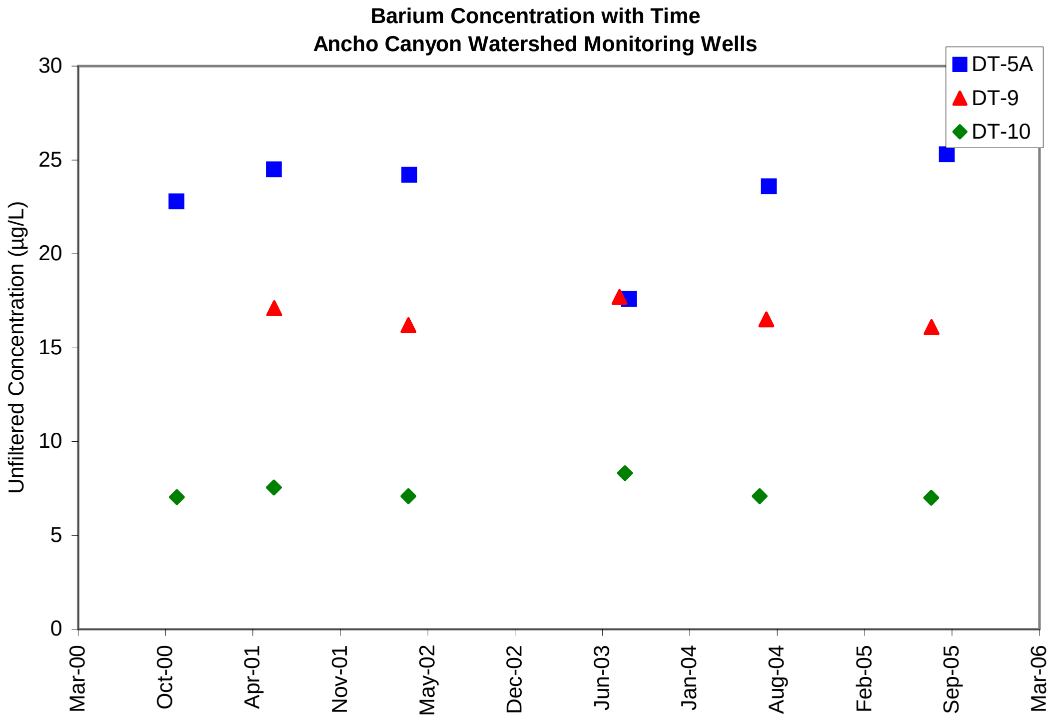


Figure E.7.5. **Barium detected in Ancho Canyon groundwater.**

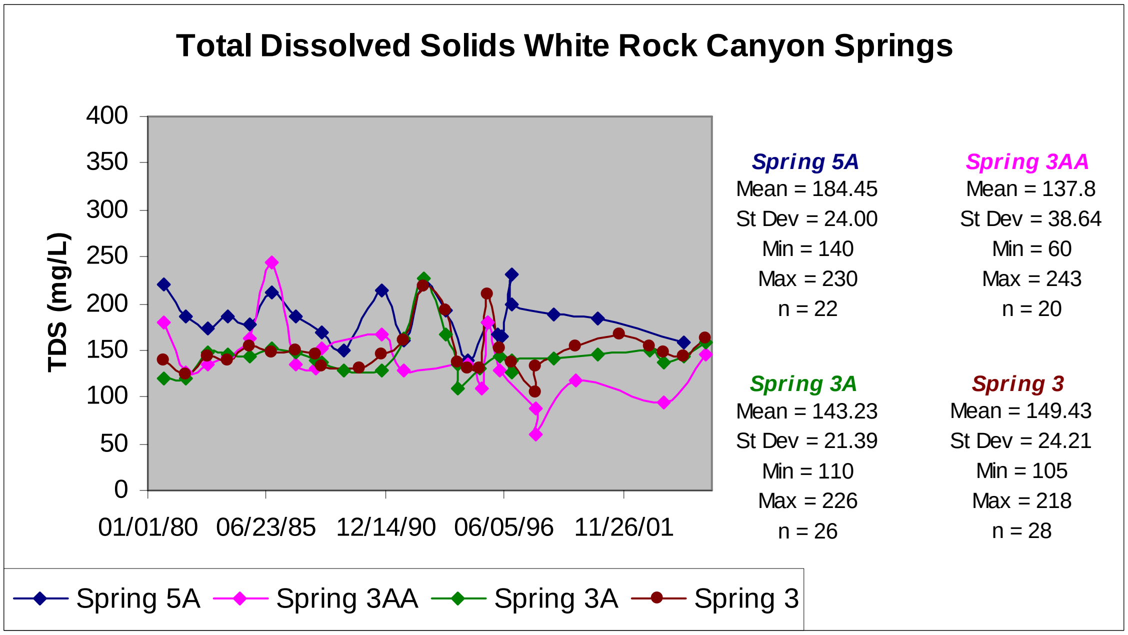


Figure E.8.1. **TDS in White Rock Springs groundwater, springs 3, 3A, 3AA, and 5A.**

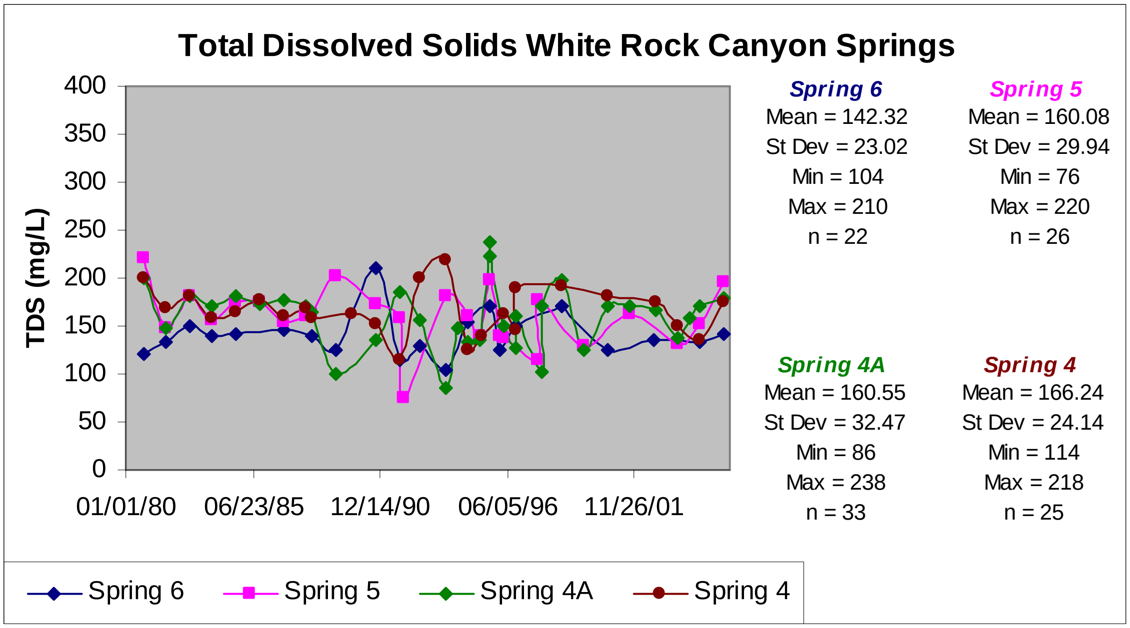


Figure E.8.2. TDS in White Rock Springs groundwater, springs 4, 4A, 5, and 6.

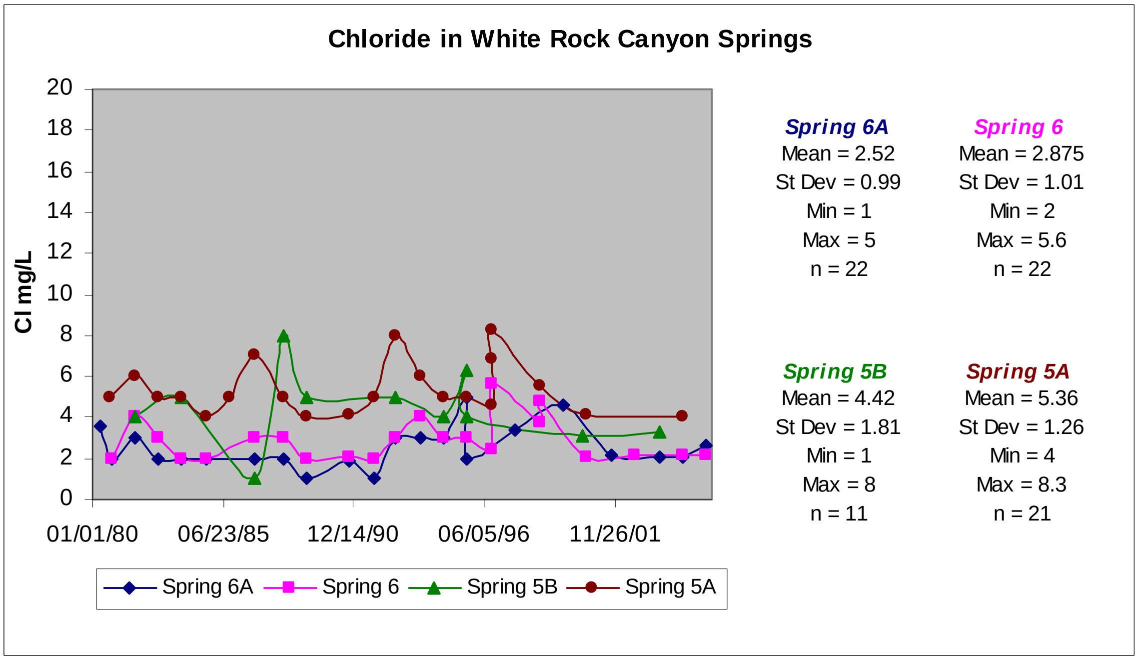


Figure E.8.3. Chloride in White Rock Springs groundwater; springs 5A, 5B, 6, and 6A.

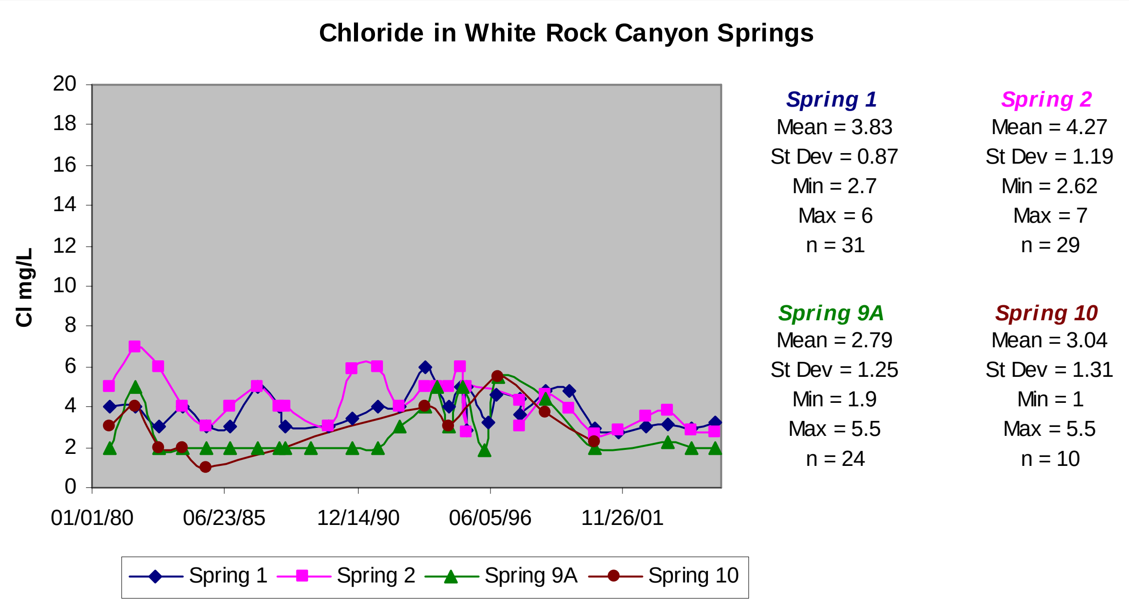


Figure E.8.4. **Chloride in White Rock Springs groundwater; springs 1, 2, 9A, and 10.**

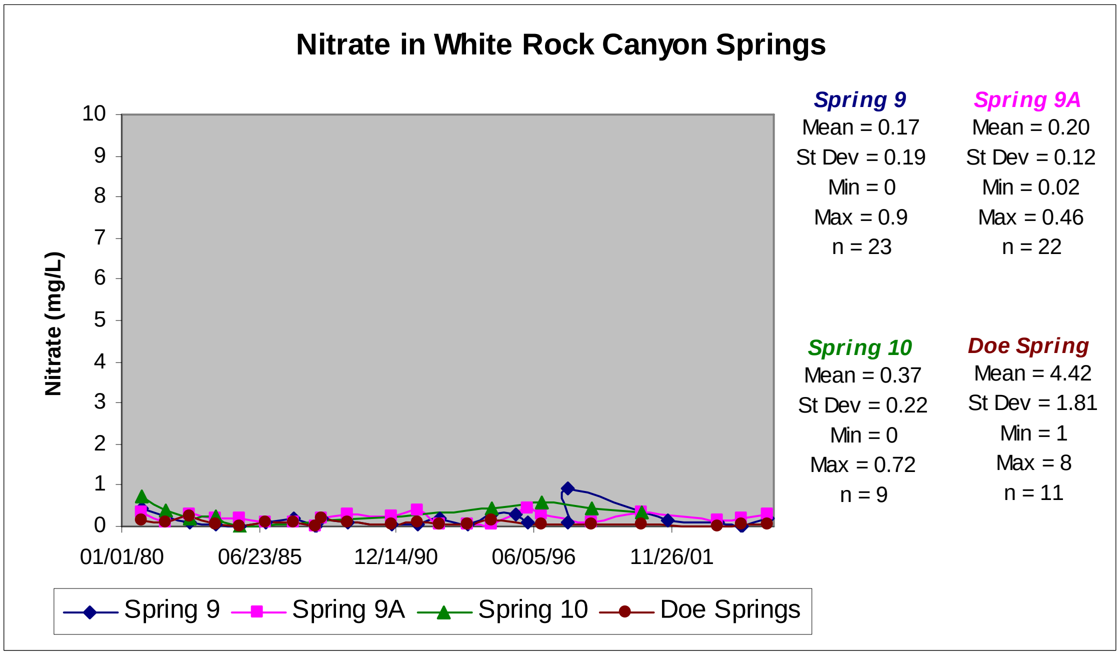


Figure E.8.5. **Nitrate in White Rock Springs groundwater; springs 9, 9A,10, and Doe.**

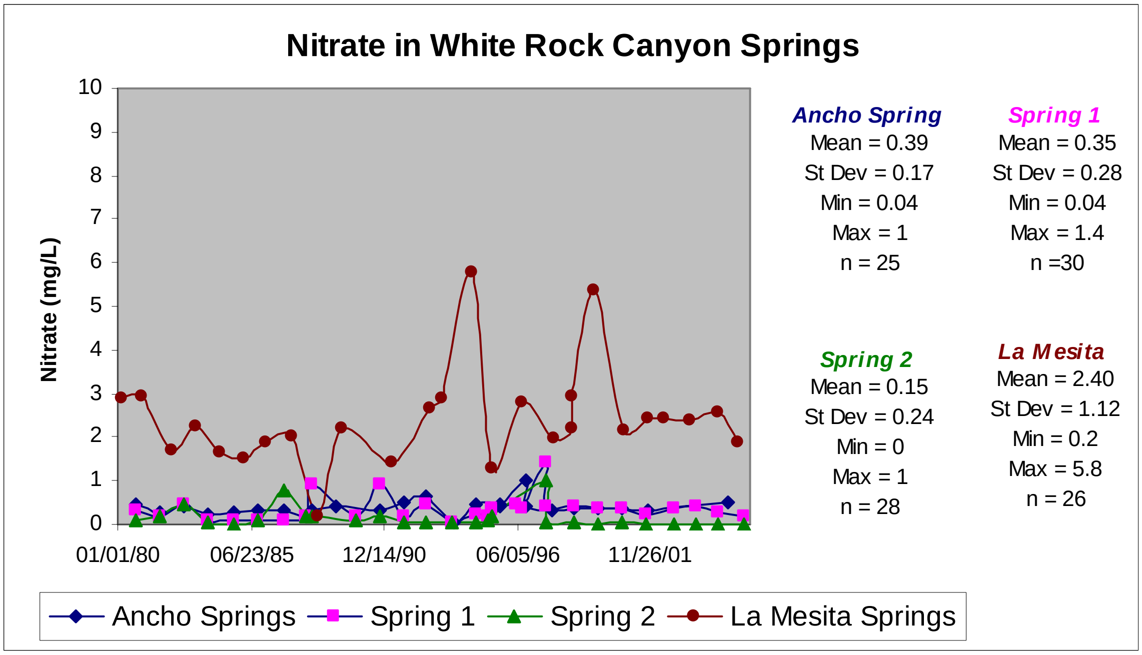


Figure E.8.6. Nitrate in White Rock Springs groundwater; springs Ancho, 1, 2, and La Mesita.

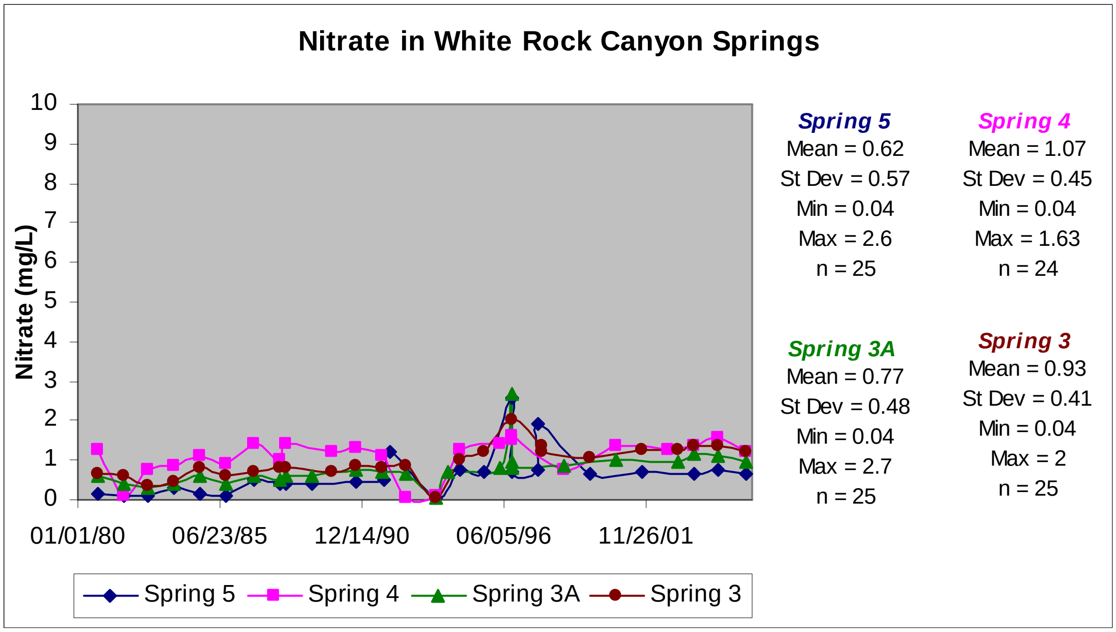


Figure E.8.7. Nitrate in White Rock Springs groundwater; springs 3, 3A, 4, and 5.

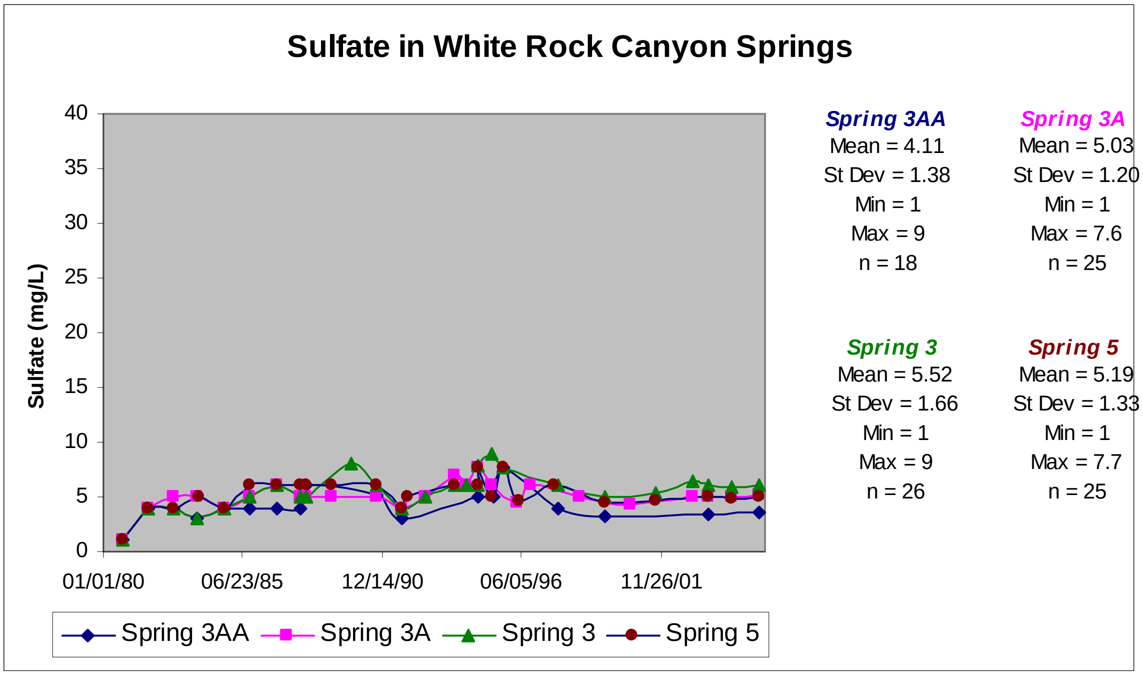


Figure E.8.8. **Sulfate in White Rock Springs groundwater; springs 3, 3A, 3AA, and 5.**

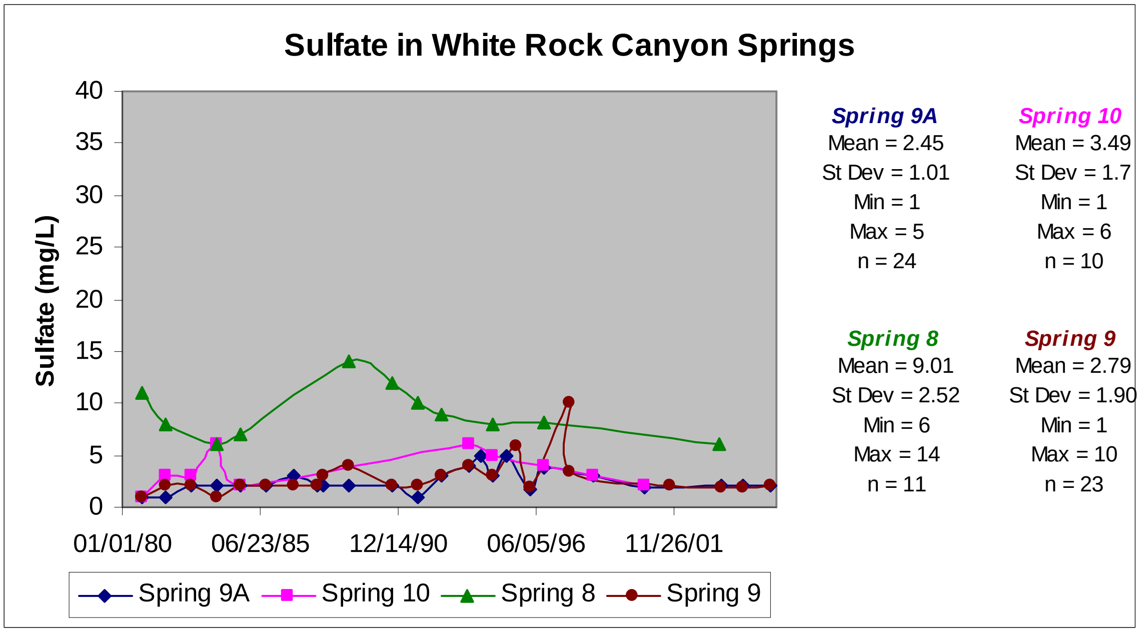


Figure E.8.9. **Sulfate in White Rock Springs groundwater; springs 8, 9, 9A, and 10.**

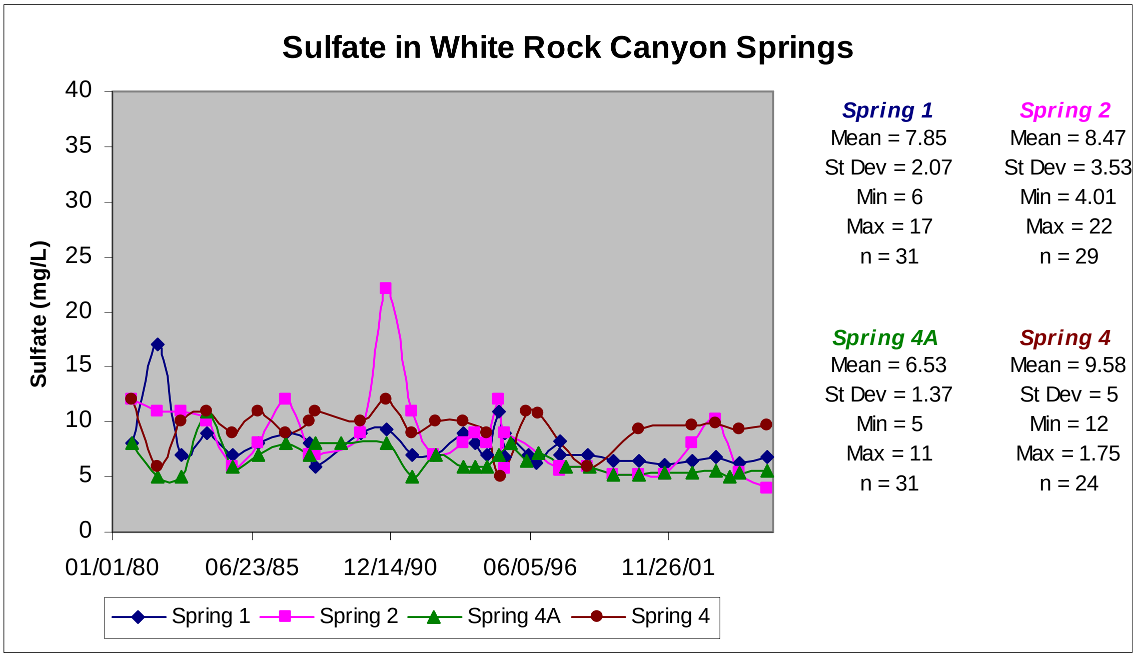


Figure E.8.10. **Sulfate in White Rock Springs groundwater; springs 1, 2, 4, and 4A.**

Table E.8.1
White Rock Springs locations, analytical suites, and sample collection dates

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
Ancho Spring	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			2		2		
	1995	1	1		1		1		
	1996	2	1		1		1	1	1
	1997	2	2		1		1		
	1998	1	1		1		1		
	1999	1	1		1	1	1	1	1
	2000	1	1		1		1		
	2001	1	1		1	1	1	1	1
	2005	1	1		1	1	1	1	1
Doe Spring	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	3			2		3		
	1995	2			1		1		
	1996	1	1		1	1	1	1	1
	1997	1							
	1998	1	1		1		1		
	2000	1	1		1	1	1	1	1

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	2003	1	1		1	1	1	1	1
	2004	2	1		1		1		
	2005	1	1		1		1		
La Mesita Spring	1980	1			1		2		
	1981	1			1		2		
	1982	1					1		
	1983	1			1		2		
	1984	1			1		2		
	1985	1					2		
	1986	1			1		2		
	1987	1			1		2		
	1988	1			1		1		
	1989	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	1			1		1		
	1996	1	1		1	1	1	1	1
	1997	1			1		1		
	1998	1	1		1		1		
	1999	1	1		1	1	1	1	1
	2000	1					1		
	2001	2			2	1	2	1	1
	2002	1			1		1		
	2003	1					1		
	2004	1			1	1	1	1	1
	2005	1			1	1	1	1	1
Sacred Spring	1980	1			1		2		
	1982	1					1		
	1983	1			1		2		
	1984	1			1		2		
	1985	1			1		2		
	1986	1			1		2		
	1987	2			2		3		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	1	1		1	1	1	1	1
	1996	1	1		1	1	1	1	1
	1997	1			1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1998	1	1		1		1		
	1999	1	1		1		1		1
	2000	1					1		
	2001	2			2	2	2	2	3
	2002	1					1		
	2003	1					1		
	2004	1			1	1	1	1	1
	2005	1			1	1	1	1	1
Sandia Spring	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			2		2		
	1995	1			1		1		
	1996	1	1		1	1	1	1	1
	1997	1			1		1		
	1998	1	1		1		1		
	1999	1	1		1	1	1	1	
	2000	1					1		
	2001	1	1		1	1	1	1	1
	2002	1					1		
	2003	1					1		
	2004	1			1	1	1	1	1
	2005	2			2	2	2	2	2
Spring 1	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			2		2		
	1995	2			2		2		
	1996	2	1		2	1	2	1	1
	1997	2			2		1		
	1998	1	1		1		1		
	1999	1	1		1	1	1	1	1
	2000	1			1		1		
	2001	2			2	1	2	1	1
	2002	1					1		
	2003	1					1		
	2004	1			1		1		
	2005	1			1	1	1	1	1
Spring 10	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1992				1		1		
	1993	1			1		1		
	1994	1			1		1		
	1996	1	1		1	1	1	1	1
	1998	1	1		1		1		
	2000	1	1		1	1	1	1	1
Spring 2	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			2		2		
	1995	2			2		2		
	1996	1							
	1997	1			1		1		
	1998	1	1		1	1	1	1	

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1999	1	1		1		1		
	2000	1					1		
	2001	2			2	1	2	1	1
	2002	1					1		
	2003	1					1		
	2004	1			1	1	1	1	1
	2005	1			1	1	1	1	1
Spring 2A	1989	1			1		1		
Spring 2B	2003	1			1		1		
	2005	2		2	2				
Spring 3	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			2		2		
	1995	2			2		2		
	1996	2							
	1997	1			1	1	1	1	1
	1999	1	1		1	1	1	1	1
	2000	1				1		1	1
	2001	2			2	2	2	2	2
	2002	1				1	1	1	1
	2003	2			2	1	2	1	1
	2004	2			1		1		
	2005	5		4	5	1	1	1	1
Spring 3A	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			2		2		
	1995	2			1		1		
	1996	2	1		2	1	2	1	1
	1998	1	1		1	1	1	1	
	2000	1			1	1	1	1	1
	2003	2			2	1	2	1	1
	2004	2			1		1		
	2005	6		5	6		1		
Spring 3AA	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1994	1			1		1		
	1995	2			2		2		
	1996	1							
	1997	1			1	1	1	1	1
	1999	1	1		1	1	1	1	1
	2003	1			1	1	1	1	1
	2004	1							
	2005	1			1		1		
Spring 3B	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1994	1			1		1		
Spring 3C	2004	1							
	2005	1		1	1				
Spring 4	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	2			1		1		
	1996	2	1		2	1	2	1	1
	1998	1	1		1	1	1	1	
	2000	1	1		1	1	1	1	1
	2001	3	1		2	1	2	1	2
	2002	2	1		1	1	2	1	1
	2003	1	1		1	1	1	1	1
	2004	2			1		1		
	2005	4		3	4	1	1	1	1
Spring 4A	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			2		2		
	1995	2			2		2		
	1996	2	1		2	1	2	1	1
	1997	1	1		1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1998	1	1		1		1		
	1999	1	1		1	1	1	1	1
	2000	1	1				1		
	2001	3	1		2	1	2	1	1
	2002	2	1				2		
	2003	1	1				1		
	2004	3	2		2	2	2	2	2
	2005	5	1	4	5	1	1	1	1
Spring 4AA	1995	1							
	2001	1							
	2002	1					1		
	2004	2							
	2005	5		4	4				
Spring 4B	1995	2			1		1		
	1996	1							
	2001	2							
	2002	1					1		
	2004	2							
	2005	5		4	4				
Spring 4C	1995	1							
	1996	2							
	2001	1							
	2002	1					1		
	2004	2							
	2005	5		4	4				
Spring 5	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	2			2		2		
	1996	3			1		1		
	1997	1	1		1	1	1	1	1
	1999	1	1		1	1	1	1	1
	2001	1	1		1	1	1	1	1

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	2003	1	1		1	1	1	1	1
	2004	3	2		2		2		
	2005	5		4	5		1		
Spring 5A	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	1			1		1		
	1996	3	1		1	1	1	1	1
	1998	1	1		1		1		
	2000	1	1		1	1	1	1	1
	2004	1	1		1	1	1	1	1
Spring 5AA	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1991	1			1		1		
Spring 5B	1981	1			1		1		
	1983	1			1		1		
	1986	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1992	1			1		1		
	1994	1			1		1		
	1995	1			1		1		
	2000	1	1		1	1	1	1	1
	2003	1	1		1	1	1	1	1
Spring 6	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1983	1			1		1		
	1984	1			1		1		
	1986	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	1			1		1		
	1996	2	1		1	1	1	1	1
	1997	1			1				
	1998	1	1		1		1		
	2000	2	2		2	2	2	1	2
	2002	1	1		1	1	1	1	1
	2004	2	1		1	1	1	1	1
	2005	4	1	3	4	1	1	1	1
Spring 6A	1980	2			2		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1986	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	1			1		1		
	1997	1	1		1	1	1	1	1
	1999	1	1		1		1		
	2001	2	1		2	1	2	1	1
	2003	1	1		1	1	1	1	1
	2004	2	1		1		1		
	2005	1	1		1		1		
Spring 7	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1988	1			1		1		
	1989	1			1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	1			1		1		
	1995	1			1		1		
	1997	1	1		1	1	1	1	1
	1999	1	1		1	1	1	1	1
	2001								1
Spring 8	1980	1			1		1		
	1981	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1994	1			1		1		
	1996	1	1		1	1	1	1	1
	2003	1	1		1	1	1	1	1
Spring 8A	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	3			2		3		
	1995	1							
	1996	2	1		2	1	2	1	1
	1997	1			1		1		
	1998	1	1		1		1		
	2000	1	1		1	1	1	1	1
	2003	1	1		1	1	1	1	1
	2004	1							
	2005	1	1		1	1	1	1	1
Spring 8B	1990	1			1		1		
	1994	1			1		1		

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	1995	1			1		1		
	1996						1		
	1997	1	1		1	1	1	1	1
	1999	1	1		1		1		
Spring 9	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	2			1		2		
	1995	2	1		1		1		
	1996	1	1		1		1		
	1997	1	1		1	1	1	1	1
	2001	2	1		2	1	2	1	1
	2003	1	1		1	1	1	1	1
	2004	2	1		1		1		
	2005	1	1		1		1		
Spring 9A	1980	1			1		1		
	1981	1			1		1		
	1982	1			1		1		
	1983	1			1		1		
	1984	1			1		1		
	1985	1			1		1		
	1986	1			1		1		
	1987	1			1		1		
	1988	1			1		1		
	1989	1			1		1		
	1990	1			1		1		
	1991	1			1		1		
	1992	1			1		1		
	1993	1			1		1		
	1994	3			2		3		
	1995	2			1				
	1996	2	1		2	1	2	1	1
	1998	1	1		1		1		
	2000	1	1		1	1	1	1	1

Location Name	Sample Year	General Inorganics	Explosive Compounds	Stable Isotopes	Metals	Pesticides/ PCBs	RAD	SVOCs	VOCs
	2003	1	1		1	1	1	1	1
	2004	2	1		1		1		
	2005	5	1	4	5		1		
Spring 9B	1980	1			1		1		
	1990	1			1		1		
	1995	2	1		2		2		
	1996	1	1		1	1	1	1	1
	1997	1							
	1998	1	1		1		1		
Spring 9D	1995	1							

Table E.8.2.
Sampling Frequency by Year for White Rock Canyon Springs

Year	Ancho Spring	Doe Spring	Spring 9A	Spring 4A	Spring 4AA	La Mesita Spring	Sacred Spring	Spring 1	Spring 2	Spring 2B	Spring 3	Spring 3A	Spring 3AA	Spring 3C	Spring 4	Spring 4B	Spring 4C	Spring 5	Spring 5A	Spring 5B	Spring 6	Spring 6A	Spring 7	Spring 8	Spring 8A	Spring 9	Spring 9B	Sandia Spring	Spring 10	Spring 2A	Spring 3B	Spring 5AA	Spring 8B	Spring 9D
1980	2	1	1	1		2	2	1	1		1	1	1		1			1	1		1	2	1	1	1	1	1	1	1		1	1		
1981	1	1	1	1		3		1	1		1	1	1		1			1	1	1	1	1	1	1	1	1		1	1		1	1		
1982	1	1	1	1		1	1	1	1		1	1	1		1			1	1		1	1	1		1	1		1	1		1	1		
1983	1	1	1	1		2	2	1	1		1	1	1		1			1	1	1	1	1	1	1	1	1		1	1		1	1		
1984	1	1	1	1		2	2	1	1		1	1	1		1			1	1		1	1	1	1	1	1		1	1		1	1		
1985	1	1	1	1		2	2	1	1		1	1	1		1			1	1						1	1		1			1	1		
1986	1	1	1	1		2	2	1	1		1	1	1		1			1	1	1	1	1			1	1		1			1	1		
1987	1	1	1	1		2	3	1	1		1	1	1		1			1							1	1		1			1	1		
1988	1	1	1	1		1	1	1	1		1	1	1		1			1	1	1	1	1	1		1	1		1			1	1		
1989	1	1	1	1		1	1	1	1		1	1			1			1	1	1	1	1	1	1	1	1		1		1	1			
1990	1	1	1	1			1	1	1		1	1	1		1			1	1		1	1	1	1	1	1	1	1			1		1	
1991	1	1	1	1		1	1	1	1		1	1	1		1			1	1		1	1	1	1	1	1		1			1	1		
1992	1	1	1	1		1	1	1	1		1	1			1			1	1	1	1	1	1	1	1	1		1	1		1			
1993	1	1	1	1		1	1	1	1		1	1			1			1	1		1	1	1		1	1		1	1		1			
1994	2	3	3	2		1	1	2	2		2	2	1		1			1	1	1	1	1	1	1	3	2		2	1		1		1	
1995	1	2	2	2	1	1	1	2	2		2	2	2		2	2	1	2	1	1	1	1	1		1	2	2	1					1	1
1996	2	1	2	2		1	1	2	1		2	2	1		2	1	2	3	3		2			1	2	2	1	1	1				1	
1997	2	1		1		1	1	2	1		1		1					1			1	1	1		1	1	1	1					1	
1998	1	1	1	1		1	1	1	1			1			1				1		1				1		1	1	1					
1999	1			1		1	1	1	1		1		1					1				1	1					1					1	
2000	1	1	1	1		1	1	1	1		1	1			1				1	1	2				1			1	1					
2001	1			3	1	2	3	2	2		2				4	2	1	1				2	1			2		1						
2002				2	1	1	1	1	1		1				2	1	1				1							1						
2003		1	1	1		1	1	1	1	1	2	2	1		1			1		1		1		1	1	1		1						
2004		2	2	3	2	1	1	1	1		2	2	1	1	2	2	2	3	1		2	2			1	2		1						
2005	1	1	5	5	5	1	1	1	1	2	5	6	1	1	4	5	5	5			4	1			1	1		2						
sum	27	27	31	38	10	34	34	31	29	3	35	32	20	2	34	13	12	32	21	10	27	23	16	11	26	27	7	28	11	1	15	10	6	1

Table E.8.3
LC-MSMS Perchlorate Results for Springs in White Rock Canyon

Location Name	Start Date	Field Prep Code	Symbol	Result	Method Detection Limit	Unit of Measure	Sample Identifier
Ancho Spring	03/16/04	UF	<	0.2		ug/L	GU04030GACA01
Ancho Spring	02/02/05	UF		0.439	0.05	ug/L	GU05010GSAW01
Doe Spring	03/18/04	UF		0.232		ug/L	GU04030GSDW01
Doe Spring	09/15/04	UF		0.131	0.05	ug/L	GU04090GSDW01
Doe Spring	09/28/05	F		0.223	0.05	ug/L	GF05080GSDW01
La Mesita Spring	08/24/04	UF		0.854	0.05	ug/L	GU04080GSML01
La Mesita Spring	07/12/05	F		0.894	0.05	ug/L	GF05070GSML01
Sacred Spring	08/24/04	UF		0.154	0.05	ug/L	GU04080GSDS01
Sacred Spring	07/13/05	F		0.122	0.05	ug/L	GF05070GSDS01
Sandia Spring	09/13/04	UF		0.149	0.05	ug/L	GU04090GSSW01
Sandia Spring	01/28/05	UF		0.451	0.05	ug/L	GU05010GSSW01
Sandia Spring	09/08/05	F		0.317	0.05	ug/L	GF05090GSSW01
Spring 1	09/13/04	UF		0.288	0.05	ug/L	GU04090G1SW01
Spring 1	09/26/05	F		0.275	0.05	ug/L	GF05090G1SW01
Spring 2	09/13/04	UF	<	0.05	0.05	ug/L	GU04090G2SW01
Spring 2	09/26/05	F	<	0.05	0.05	ug/L	GF05090G2SW01
Spring 3	03/08/04	UF		0.424		ug/L	GU04030G3SW01
Spring 3	09/13/04	UF		0.455	0.05	ug/L	GU04090G3SW01
Spring 3	09/26/05	F		0.419	0.05	ug/L	GF05090G3SW01
Spring 3A	03/08/04	UF		0.398		ug/L	GU04030GA3S01
Spring 3A	09/13/04	UF		0.5	0.05	ug/L	GU04090GA3S01
Spring 3A	09/26/05	F		0.425	0.05	ug/L	GF05090GA3S01
Spring 3AA	03/08/04	UF		0.43		ug/L	GU04030GAA301
Spring 3AA	09/26/05	F		0.424	0.05	ug/L	GF05090GAA301
Spring 3C	03/08/04	UF		0.403		ug/L	GU04030GS3C01
Spring 4	03/05/04	UF		0.609		ug/L	GU04030G4SW01
Spring 4	09/13/04	UF		0.619	0.05	ug/L	GU04090G4SW01
Spring 4	09/26/05	F		0.619	0.05	ug/L	GF05090G4SW01
Spring 4A	03/05/04	UF		0.463		ug/L	GU04030GA4S01
Spring 4A	04/15/04	UF		0.496		ug/L	GU04040GA4S01
Spring 4A	09/14/04	UF		0.524	0.05	ug/L	GU04090GA4S01
Spring 4A	09/27/05	F		0.509	0.05	ug/L	GF05090GA4S01
Spring 4AA	03/05/04	UF		0.497		ug/L	GU04030GAA401
Spring 4AA	09/14/04	UF		0.548	0.05	ug/L	GU04090GAA401
Spring 4AA	09/27/05	F		0.563	0.05	ug/L	GF05090GAA401
Spring 4B	03/05/04	UF		0.445		ug/L	GU04030GB4S01
Spring 4B	09/14/04	UF		0.295	0.05	ug/L	GU04090GB4S01
Spring 4B	09/26/05	F		0.321	0.05	ug/L	GF05090GB4S01
Spring 4C	03/05/04	UF		0.646		ug/L	GU04030GC4S01
Spring 4C	09/14/04	UF		0.622	0.05	ug/L	GU04090GC4S01
Spring 4C	09/27/05	F		0.643	0.05	ug/L	GF05090GC4S01
Spring 5	03/11/04	UF		0.404		ug/L	GU04030G5SW01
Spring 5	09/14/04	UF		0.423	0.05	ug/L	GU04090G5SW01
Spring 5	09/27/05	F		0.405	0.05	ug/L	GF05090G5SW01

Location Name	Start Date	Field Prep Code	Symbol	Result	Method Detection Limit	Unit of Measure	Sample Identifier
Spring 5A	09/14/04	UF		0.334	0.05	ug/L	GU04090GA5S01
Spring 6	03/12/04	UF		0.352		ug/L	GU04030G6SW01
Spring 6	09/14/04	UF		0.349	0.05	ug/L	GU04090G6SW01
Spring 6	09/27/05	F		0.311	0.05	ug/L	GF05090G6SW01
Spring 6A	03/12/04	UF		0.293		ug/L	GU04030GA6S01
Spring 6A	09/14/04	UF		0.323	0.05	ug/L	GU04090GA6S01
Spring 6A	09/27/05	F		0.306	0.05	ug/L	GF05090GA6S01
Spring 8A	03/18/04	UF		0.26		ug/L	GU04030GA8S01
Spring 8A	01/26/05	UF		0.237	0.05	ug/L	GU05010GA8S01
Spring 9	03/18/04	UF		0.281		ug/L	GU04030G9SW01
Spring 9	09/14/04	UF		0.143	0.05	ug/L	GU04090G9SW01
Spring 9	09/28/05	F		0.263	0.05	ug/L	GF05090G9SW01
Spring 9A	03/18/04	UF		0.293		ug/L	GU04030GA9S01
Spring 9A	09/14/04	UF		0.26	0.05	ug/L	GU04090GA9S01
Spring 9A	09/28/05	F		0.27	0.05	ug/L	GF05090GA9S01