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# Surface Water Quality Monitoring at Department of Energy Facilities in New Mexico

## 1992 -- 1993

Peter K. Monahan, Ralph Ford-Schmid, Harvey L. Decker

Department of Energy Oversight Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, NM 87502

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## EXECUTIVE SUMMARY

The primary purpose of this report is to present data compiled by AIP staff during 1992 and 1993. Limited interpretation of data is presented in this report. Water and sediment samples collected at the DOE facilities were either replicate or split with samples that were collected by the operations and management contractor of the specific facility.

Statistical analysis, comparing 1992 NMED and Santa Fe Engineering (contractor for LANL) analytical results, indicate a high degree of similarity. With the exception of one stormwater sampling event ( LA 4.1 - 930803), similar results were obtained when 1993 NMED and LANL results were compared. Differences in handling and storage, analytical techniques, and the fact that the samples were replicates not split samples, makes direct comparisons of this single sample's ( LA 4.1 - 930803) analytical results difficult.

The authors recommend that the sampling, processing and analytical techniques used by both NMED and DOE or its contractors be standardized. The DOE Oversight Bureau has implemented a process for stormwater analysis that quantifies the concentration of contaminants both in the dissolved phase and the suspended sediment load. By incorporating flow measurements and inexpensive total suspended solids (TSS) analysis, an accurate estimate of contaminant transport as a result of stormwater runoff can be obtained. This data would be invaluable for the prioritization of clean-up, corrective action effectiveness, environmental risk assessment, total maximum daily load calculation and compliance demonstration.

The detection of radionuclides and heavy metals in the above stormwater sample addresses one of NMED's concerns. NMED is concerned that heavy metals, radionuclides, and some organics (e.g. PCBs) are adsorbed or bound to sediments and transported past DOE facility boundaries during spring snowmelt and summer storm events. Transport of radionuclides in summer run-off (Purtymun, 1974), distribution of radionuclides in channel sediments of canyon effluent areas (Purtymun 1966 and 1971, Hakonson 1976B, Miera 1976, Nyhan 1980), and transport of plutonium in snowmelt run-off (Purtymun, Peters & Maes 1990) has been well documented.

The authors feel that increased stormwater monitoring would be appropriate. Stormwater monitoring should be initiated in canyons which have received effluent discharges, are contaminated from other DOE facility operations and/or historically have discharged off DOE property. Contaminant transport studies should be initiated and mitigation measures may need to be considered to prevent the movement of contaminants beyond DOE facility boundaries.

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## 1.0 INTRODUCTION

In October 1990, an Agreement-in-Principle (AIP) was entered into between the U.S. Department of Energy (DOE) and the State of New Mexico for the purpose of supporting State oversight activities at DOE facilities in New Mexico. The New Mexico Environment Department (NMED) is the State's lead agency for the Agreement. The DOE has agreed to provide New Mexico with resources to support State activities in environmental oversight, monitoring, and to ensure compliance with applicable federal, state, and local laws at Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL) the Inhalation Toxicology Research Institute (ITRI) and the Waste Isolation Pilot Plant (WIPP), The Agreement is designed to assure the citizens of New Mexico that public health, safety, and the environment are being protected through existing programs.

## 2.0 PROGRAM ORGANIZATION

The Department of Energy Oversight Bureau, under the Water/Waste Management division of the New Mexico Environment Department, is tasked with assessing and monitoring DOE and DOE subcontractor compliance with state and federal environmental regulations. Additionally, staff members augment the current regulatory and environmental protection activities being conducted by NMED at the four DOE facilities. DOE Oversight Bureau personnel are located on-site at all DOE facilities and at a central office located in Santa Fe, NM. Figure 2.0.1 illustrates the organizational and hierarchical relationships of staff members working in the Agreement in Principal Program.

Other bureaus within the NMED work in coordination with DOE Oversight Bureau personnel in order to adequately address all environmental issues at the four DOE facilities. The Ground Water Protection and Remediation Bureau (GWPRB), Hazardous and Radioactive Materials Bureau (HRMB), and Surface Water Quality Bureau (SWQB), all have concerns with water quality. The GWPRB is concerned with any discharges that may infiltrate into the ground and have the potential to impact ground water. The HRMB is concerned with the discharge of any hazardous contaminant into the environment and also oversees the Resource Conservation and Recovery Act (RCRA) regulations at the facilities. The SWQB monitors surface water quality for impacts from discharges, stormwater runoff, snowmelt, and spills. The Air Quality Bureau and Air pollution Bureau are concerned with all air quality issues associated with the facilities. DOE Oversight Bureau personnel have established a monitoring program to gather and analyze data on the quality of waters in the lakes, rivers, springs, and streams that may be impacted by DOE facilities in New Mexico. This program enables NMED to assess DOE's compliance with applicable environmental laws and regulations at each facility. This report is a compilation of water-quality data collected in 1992 and 1993 by NMED/DOE Oversight Bureau personnel.

The following types of data and methods are included:

1. Collection and analysis of samples taken during snowmelt and stormwater runoff events at LANL.

2. Collection and analysis of samples taken from springs located in or near DOE facilities.

3. Collection and analysis of samples taken from National Pollutant Discharge Elimination System (NPDES) permitted outfalls at LANL.

4. Collection and identification of macroinvertebrates in springs and perennial reaches in streams surrounding and within LANL.

5. Collection and analysis of samples taken from SNL sanitary waste discharge.

6. Collection and analysis of samples taken from the WIPP waste-water effluent pond.

## 3.0 OBJECTIVES OF NMED/DOE OVERSIGHT AND MONITORING PROGRAM

The NMED/DOE Oversight and Monitoring Program is designed to meet the criteria of the AIP through the following objectives:

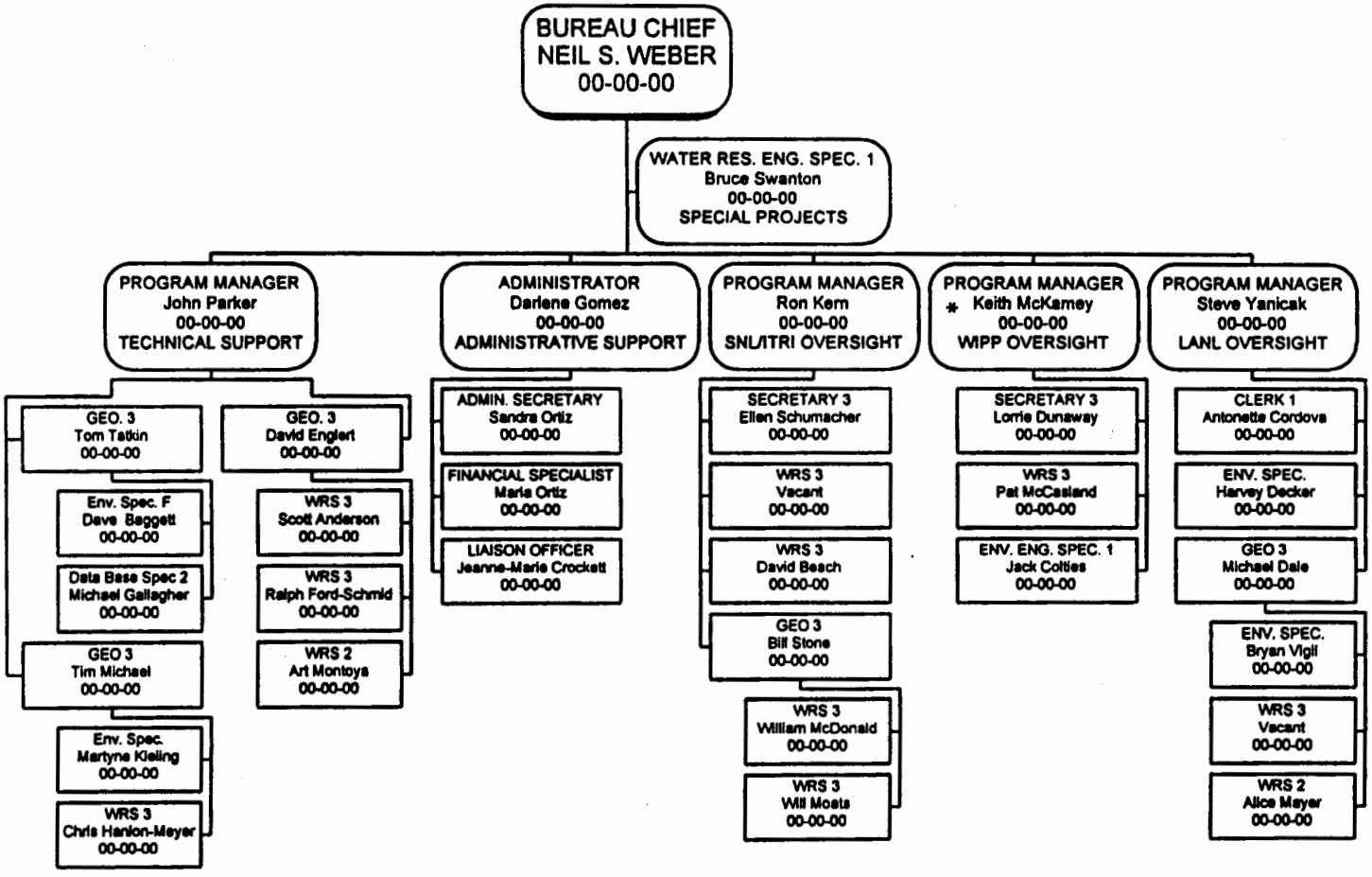
1) To assure DOE's compliance with applicable laws, including rules, regulations, and standards, such as NPDES permit requirements under the Federal Clean Water Act (CWA), New Mexico Water Quality Control Commission (WQCC) regulations and Water Quality Standards for Interstate and Intrastate Streams in New Mexico.

2) To monitor stormwater runoff for Constituents of Concern (COCs) from, Solid Waste Management Units (SWMUs), and from planned and unplanned releases for determination of the extent of contaminant impact to surface waters.

3) To obtain data representative of current conditions of the water, biological communities, and sediments.

4) To review DOE and DOE contractor generated data and reports.

Figure 2.0.1 DOE Oversight Bureau Organizational Chart




* As of September 30, 1996, the WIPP site office was closed.

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## 4.0 DATA COLLECTION METHODS

Water samples are collected by either grab sampling or through the use of automatic collection devices. The methods and equipment used to collect water and aquatic invertebrate samples are described in the following sections.

## 4.1 Water-Quality Monitoring Equipment

**Flow Meter**

Stormwater flows are measured with the ISCO 3200 series flow meter. The flow meter provides on-site hardware that measures flow rate, stores the data in a temporary memory, and controls the operation of the automated water-quality sampler. The flow meter can be accessed via cellular phone with any office computer by NMED staff in Santa Fe or White Rock, who in turn can control the monitoring equipment remotely. A schematic of this process is shown in Figure 4.1.1. The computer operator can communicate with the flow meter in real-time to determine the current monitoring status or can simply trigger the local memory to transmit stored data into the office computer.

Data transmitted to the computer are communicated through ISCO's FLOWLINK software. Monitoring results are then printed as a hydrograph or a summary. A sample graph is shown in Figure 4.1.2.

Two types of sensors are used for flow: an ultrasonic transducer and a pressure transducer. The ultrasonic transducer measures water depth by bouncing ultrasonic pulses off the surface of the water and measuring the time it takes for them to return. The flow meter converts the water level into a flow measurement and can be programmed to activate an automatic water-quality sampler.

The pressure transducer is commonly called the bubbler system. The bubbler system detects changes in the level of the stream by measuring the amount of air pressure required to force an air bubble through the end of a submerged tube. As flow increases in the channel, the rise of the water increases the amount of air pressure required to force the bubble from the tube. The flow meter converts the pressure output to a flow measurement and can be programmed to activate an automatic water-quality sampler.

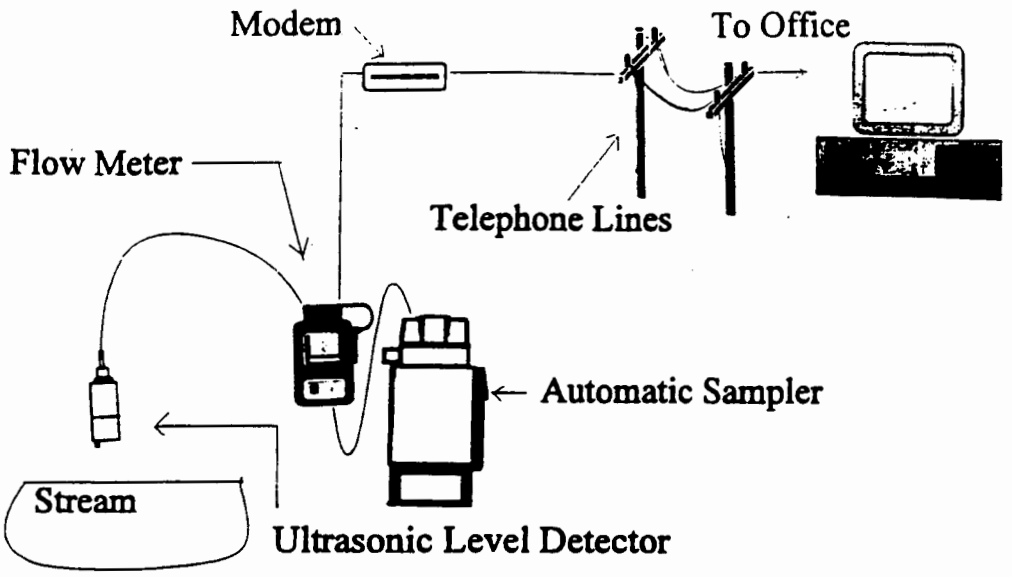


Figure 4.1.1 Schematic of Flow Monitoring and Sampling System

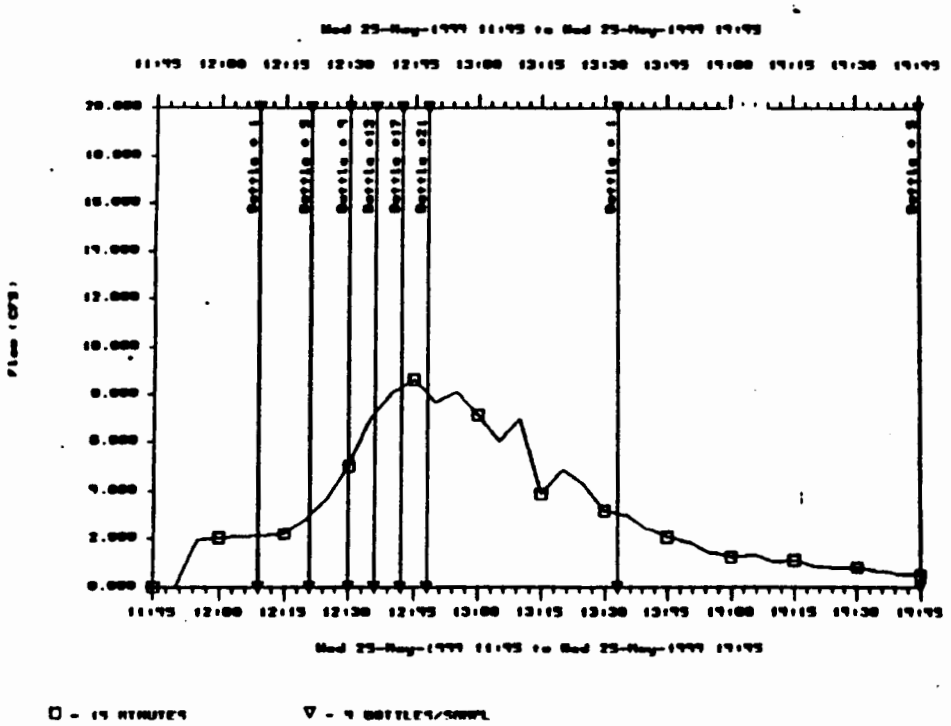

Figure 4.1.2 Typical Hydrograph

**Water-Quality Samplers**
The ISCO 3700 portable automatic sampler is used in the field to collect stormwater runoff. Water is collected through vinyl or Teflon tubing by a peristaltic pump and distributed to 24 individual one-liter polypropylene or glass bottles. The sampler can be programmed to take either sequential or composite samples. Samples are collected at either timed intervals or flow-paced intervals using flow-pulse inputs from the flow meter.

The flow meter and sampler are powered by a 12 VDC lead/acid battery. Voltage is maintained by a photovoltaic charging system (PVC).

**Conductivity Meter**
Conductivity is measured in the field using a Yellow Springs Instruments (YSI) model 33 S-C-T meter. Conductivity is a measure of the ability of water to conduct an electric current, thereby indirectly measuring the amount of total dissolved solids.

**Dissolved-Oxygen Meter**
Dissolved oxygen is measured in the field using the YSI model 58-B temperature compensating dissolved-oxygen meter.

**pH Meter**
The pH is measured in the field using an Orion model 290A ion-specific pH meter with an automatic temperature-compensated pH electrode.

## 4.2 Sampling Procedures

Water temperature, conductivity, dissolved oxygen, and pH are measured on-site using EPA approved (e.g. 40 CFR 136) methods. The field equipment is calibrated according to the manufacturer's and or method specifications prior to use. Grab water samples for analysis of ammonia, nitrate+nitrite, Kjeldahl nitrogen, phosphorus, major cations and anions, radionuclides, and metals are collected in clean, one-liter, single-use, polyethylene cubitainers.

Water samples collected by the automatic sampler are collected in acid-washed one-liter polypropylene or glass bottles. The collected water samples are then transferred to one-liter, single-use, polyethylene cubitainers. At the site, each container is thoroughly rinsed with a small amount of sample water, which is discarded, before the sample is placed in it. The samples are preserved as specified in 40 CFR Part 136, cooled on ice to 4° C, and transported in ice chests to an appropriate independent laboratory within the holding time specified for each sample analyte.

Sediment samples are collected using clean stainless steel or disposable plastic trowels. Sediment samples analyzed for metals are placed in clean, single-use, plastic whirl packs.

Sediments to be analyzed for organics or inorganics are placed in clean glass jars with Teflon lined lids.

## 4.3 Sample Preservation, Holding Times, Volumes

Analytical methods, detection limits, container type, sample preservation, and maximum holding times are detailed in Table 4.3.1.

Table 4.3.1 Methods, Detection Limits, Container Type, Preservation, and Maximum Holding Times for Major Measurement Parameters.

| PARAMETER | METHOD | D. LIMIT | CONTAINER TYPE | PRESERVATION | MAX HOLDING TIME |
|---|---|---|---|---|---|
| **Metals - Soils** | | uG/G | | | |
| Aluminum | 200.7 ICP | 5 | 4 oz. jar/glass | none | 6 months |
| Arsenic | 200.8 ICP - MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Barium | 200.8 ICP - MS | 5 | 4 oz. jar/glass | none | 6 months |
| Beryllium | 200.7 ICP | 5 | 4 oz. jar/glass | none | 6 months |
| Boron | 200.7 ICP | 2 | 4 oz. jar/glass | none | 6 months |
| Cadmium | 200.8 ICP - MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Calcium | 200.7 ICP | 2 | 4 oz. jar/glass | none | 6 months |
| Chromium | 200.8 ICP - MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Cobalt | 200.8 ICP - MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Copper | 200.8 ICP - MS | 0.5 | 4 oz. jar/glass | none | 6 months |
| Iron | 200.7 ICP | 0.5 | 4 oz. jar/glass | none | 6 months |
| Lead | 200.8 ICP - MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Magnesium | 200.7 ICP | 2 | 4 oz. jar/glass | none | 6 months |
| Manganese | 200.7 ICP | 2.5 | 4 oz. jar/glass | none | 6 months |
| Mercury | 245.1 Cold Vapor | 0.25 | 4 oz. jar/glass | none | 28 days |
| Molybdenum | 200.8 ICP - MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Nickel | 200.7 ICP | 2 | 4 oz. jar/glass | none | 6 months |
| Selenium | 270.2 Furnace AAS | 0.1 | 4 oz. jar/glass | none | 6 months |
| Silicon | 200.7 ICP | 2 | 4 oz. jar/glass | none | 6 months |
| Silver | 200.7 ICP | 2 | 4 oz. jar/glass | none | 6 months |
| Silver | 200.8 ICP-MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Strontium | 200.7 ICP | 2 | 4 oz. jar/glass | none | 6 months |
| Tin | 200.7 ICP | 5 | 4 oz. jar/glass | none | 6 months |
| Uranium | 200.8 ICP - MS | 0.05 | 4 oz. jar/glass | none | 6 months |
| Vanadium | 200.7 ICP | 5 | 4 oz. jar/glass | none | 6 months |
| Zinc | 200.8 ICP - MS | 0.5 | 4 oz. jar/glass | none | 6 months |
| **Metals - Water** | | mG/L | 1 liter plastic | 5 ml HNO3 | |
| Aluminum | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Arsenic | 200.8 ICP - MS | 0.001 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Barium | 200.8 ICP - MS | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Beryllium | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Boron | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Cadmium | 200.8 ICP - MS | 0.001 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Calcium | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Chromium | 200.8 ICP - MS | 0.001 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Cobalt | 200.8 ICP - MS | 0.001 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Copper | 200.8 ICP - MS | 0.01 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Iron | 200.7 ICP | 0.01 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Lead | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Magnesium | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Manganese | 200.7 ICP | 0.05 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Mercury | 245.1 Cold Vapor | 0.0005 | 1 liter plastic | 5 ml HNO3 | 28 days |
| Molybdenum | 200.8 ICP - MS | 0.001 | 1 liter plastic | 5 ml HNO3 | 6 months |

Table 4.3.1 Methods, Detection Limits, Container Type, Preservation, and Maximum Holding Times for Major Measurement Parameters (Continued).

| PARAMETER | METHOD | D. LIMIT | CONTAINER TYPE | PRESERVATION | MAXIMUM HOLDING TIME |
|---|---|---|---|---|---|
| Nickel | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Selenium | 270.2 Furnace AAS | 0.005 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Silicon | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Silver | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Silver | 200.8 ICP-MS | 0.001 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Strontium | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Tin | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Uranium | 200.8 ICP - MS | 0.001 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Vanadium | 200.7 ICP | 0.1 | 1 liter plastic | 5 ml HNO3 | 6 months |
| Zinc | 200.8 ICP - MS | 0.01 | 1 liter plastic | 5 ml HNO3 | 6 months |
| **Organics** | | | | | |
| SDWA VOC-I | EPA-502.2 Screen 774 | | 4 oz. Glass w/ Teflon lined Septa | 4 deg C | 14 days |
| B/N/A Extractable | EPA - 8270 Screen 756 | | 1 L Amber Glass jar | 4 deg C | 7 days to extraction 40 days after extraction |
| **Nutrients** | | | | | |
| Ammonia | EPA 350.1 | | 1 Liter Plastic | 2 ml H2SO4 | 28 days |
| Nitrate & Nitrite | EPA 353.2 | | 1 Liter Plastic | 2 ml H2SO4 | 28 days |
| Total Kjeldahl Nitrogen | EPA 351.2 | | 1 Liter Plastic | 2 ml H2SO4 | 28 days |
| Total Phosphate | EPA 365.4 | | 1 Liter Plastic | 2 ml H2SO4 | 28 days |
| **Anion & Cations** | | | | | |
| Alkalinity | | | 1 Liter plastic | Ice to 4 deg C | 14 days |
| Bicarbonate | EPA 310.1 | | 1 Liter plastic | Ice to 4 deg C | 14 days |
| BOD | EPA 405.1 | | 1 Liter plastic | Ice to 4 deg C | 48 hours |
| COD | HACH | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Calcium | EPA 200.7 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Carbonate | EPA 310.1 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Chloride | EPA 300.0 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Color Test | EPA 110.2 | | 1 Liter plastic | Ice to 4 deg C | N/A |
| Conductivity | EPA 120.1 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Cyanide | EPA 335.2 | | 1 Liter plastic | Ice to 4 deg C | 14 days |
| Fecal Coliform | EPA 922.1 C | | 1 Liter plastic | Ice to 4 deg C | 6 hours |
| Fluoride | EPA 340.2 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Hardness | EPA 200.7 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Magnesium | EPA 200.7 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| PH | EPA 310.1 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| | & 150.1 | | N/A | N/A | Field |
| Potassium | EPA 200.7 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| | & NOVA | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Sodium | EPA 200.7 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| | & NOVA | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Sulfate | EPA 300.0 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| TDS | EPA 160.1 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| TSS | EPA 160.2 | | 1 Liter plastic | Ice to 4 deg C | 28 days |
| Turbidity | EPA 180.1 | | 1 Liter plastic | Ice to 4 deg C | 48 hours |
| **Radiological** | | | | | |
| Gross Alpha | EPA 900.0 | | 1 Liter plastic | 5 ml HNO3 | 6 months |
| Gross Beta | EPA 900.0 | | 1 Liter plastic | 5 ml HNO3 | 6 months |
| Gamma Scan | EPA 901.1 | | 1 Liter plastic | 5 ml HNO3 | 6 months |
| Plutonium 238/239 | EPA 907.0 | | 1 Liter plastic | 5 ml HNO3 | 6 months |
| Tritium | EPA 906.0 | | 1 Liter plastic | 5 ml HNO3 | 6 months |

## 4.4 Benthic Macroinvertebrate Sample Collection Methods

Benthic macroinvertebrate samples are collected qualitatively by the traveling kick-screen-method and quantitatively by using a circular sampler (Jacobi, 1978). Kick samples are collected using a 1 mm mesh "D" net. Riffles, containing gravel or rubble sized rock, generally represent the best habitat available and are the preferred sample sites. Riffles are sampled by agitating approximately one square meter of substrate upstream of the net (Figure 4.4.1). When a stream has no riffle habitat , pools are sampled by sweeping the net through the water and substrate. When sampling pools, all available habitats are sampled (e.g. undercut banks, root wads, aquatic vegetation). Samples are rinsed in the "D" net, dewatered on a no. 35 standard mesh screen and preserved with 70% ethanol. Samples are either sorted in their entirety or sub-sampled according to EPA's Rapid Bioassessment Protocol (Plafkin, et al. 1989).

Sub-sampling consists of evenly distributing the sample upon a screen that has been divided into 30 even sized cells. Cells are selected using a pseudo-random number generator or a roll of a die. All specimens within the selected cells are identified using appropriate taxonomic keys and enumerated (Merritt and Cummins 1984, and Pennak 1989). This process is repeated until at least 100 invertebrates are counted. A larger sub-sample may be used to increase the degree of resolution (e.g., 200, 300), depending upon available resources.

A habitat assessment is performed at each station according to EPA Rapid Bioassessment protocol (Plafkin, et al. 1989). Twelve habitat parameters are assessed and scored. The scores are weighted to emphasize the most biologically significant parameters. All parameters are evaluated for each station studied and scores increase as habitat quality increases. The ratings are totaled and compared to a site-specific control or regional reference station. A reference station is chosen to represent "best attainable" habitat conditions. The ratio between the score for the station and the score for the control or regional reference provides a comparability measure for each station (Plafkin, et al. 1989).

Metrics have been developed which allow the comparison of invertebrate data between the station of interest and a reference or control station. A comparison of habitat quality/availability, invertebrate populations, and water-quality parameters between the specific site and the reference station provides a measure of the biological condition of the site. A site can be evaluated as to whether it is reaching its biological potential or is limited due to degraded habitat, water quality, or both.

# 5.0 QUALITY ASSURANCE / QUALITY CONTROL

The Quality and Control office of the State Laboratory Division (SLD) is responsible for establishing the precision and accuracy of analytical procedures. Data for these quality

control procedures are obtained by analyses of replicate, split, spiked, and blank samples. The following are quality control guidelines used by SLD:

(1) A QC-blank is run at the start of the run and every tenth sample.
(2) A low control is analyzed at the start of the run.
(3) A high control is analyzed at the start of the run.
(4) An external control is analyzed at the start of the run when available.
(5) Every tenth sample is run in duplicate.
(6) Every tenth sample is spiked in duplicate.
(7) A mid-level standard is analyzed every tenth sample.
(8) If the QC is off by as much as + or - 30% on a run, any samples with values > or = to the detection limit are re-analyzed.
(9) If the QC is better than or equal to + or - 20%, the run is accepted as is.

Figure 4.4.1 Benthic Macroinvertebrate Sampling in Los Alamos Canyon

## 5.1 Integrity of Data

Integrity of data is ensured by performing all analyses according to currently approved procedures (Table 4.3.1). Procedures are published in the latest editions of "Standard Methods for the Examination of Water and Wastewater," "Methods for Chemical Analysis of Water and Wastes," and other EPA-approved testing procedures found in the Code of Federal Regulations 40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants under the CWA."

Duplicate samples for chemical and microbiological analyses are collected at the sampling site. The frequency for duplicate sampling is one sample in ten.

All samples are assigned a unique tracking number in the field that is recorded on the sample and the sample-analysis-request form. In addition, this number and all other pertinent information are recorded in the field technician's daily log book. The validity of all environmental measurements is ensured by strict adherence to the procedures given in the Quality Assurance Project Plan for Water Quality Management Programs (Anonymous, 1992).

Quality Assurance/Quality Control (QA/QC) involves equipment calibration, maintenance, and proper methods of sample collection and handling. All field measurement equipment is calibrated daily or before each use as outlined in the operating manual supplied with the equipment. All maintenance and calibration procedures are recorded in an equipment maintenance and calibration log book that is to be kept with each piece of equipment at all times.

## 5.2 Data Analysis

Analytical results are organized into spreadsheets and compared with applicable water quality standards or NPDES permit limits, (whichever is appropriate). Results from sample splits are compared with DOE obtained results to assure consistency in data analysis, evaluate the validity of DOE generated data and to determine if re-sampling is needed.

Three tests were applied to the data groups: Student's Matched Pair t-test, Wilcoxon Matched Pairs Signed-Rank[1] and Pearson's correlation. The Wilcoxon is a non-parametric test analogous to Student's Matched Pair t-test and is based largely on the proportion of positive and negative results when each member of one data group is subtracted from the paired member of the other data group. An equal or approximately equal proportion of pluses and minuses results when there is not a higher or lower trend in one or the other of

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[1]Daniel, W.W., *Applied Non-Parametric Statistics*," PWS-Kent, 2nd edition (1990).

the data groups. The approach employed both parametric and non-parametric evaluations because with small groups of analytical data (which is by nature 'left truncated') it cannot be adequately determined whether or not the data is normally distributed and so it is uncertain whether a parametric test is appropriate.

The Pearson's correlation tests the 'linkage' of the data. For paired data, i.e., data collected at the same location and divided prior to analysis, the data can be said to be 'linked' if when one member of the pair is found to have a high concentration of the target analyte the other is also, or conversely, when one of the pairs is relatively low in concentration, so is the other. When the Pearson's correlation between groups of paired data is not significant then it may be suspected that the data represents the measurement of different chemical species; for example, that the preparation of the sample failed to free some chemically well-defined subspecies of the analyte. In this case the relationship of the concentrations of the analyte between sample pairs may not be consistent and the Pearson's correlation will be low.

# 6.0 LOS ALAMOS NATIONAL LABORATORY

## 6.1 Setting

The following setting description is an excerpt from the NMED report (Stone et al., 1993).

> "LANL is located west of the Rio Grande in Los Alamos County, approximately 40 km (25 mi) northwest of Santa Fe, New Mexico (Figure 6.1.1). Geologically, it sits on the Pajarito Plateau, an area of deeply dissected Quaternary-aged volcanic deposits and Tertiary fill of the Espanola Basin (Figure 6.1.2). The volcanics belong to the Bandelier Tuff, largely rhyolitic ash flows and pumice falls that were derived from the Valles Caldera in the Jemez Mountains to the west (Purtymun, 1984). The basin fill is represented by the Puye Conglomerate (fanglomerate, lake clays, basalt flows, ash, and river gravels) and the Tesuque Formation (mostly poorly consolidated sand and gravel). The average elevation of the plateau is approximately 7,000 feet above sea level."

Perennial, ephemeral, and intermittent streams flowing southeastward have dissected the plateau into a number of finger-like, narrow mesas separated by deep, narrow canyons, lying some 1,450 ft below the plateau (Figure 6.1.3.). From an elevation of approximately 1,890 meters (6,200 ft) at White Rock, the plateau ends in sheer cliffs, dropping to 1,646 meters (5,400 ft) at the Rio Grande (Cross, 1994). The major canyons that cut across the plateau are Guaje, Rendija, Barrancas, Bayo, Pueblo, Los Alamos, Sandia, Mortandad, Pajarito, Water, and Ancho. Springs between 7,900 and 8,900 ft on the flanks of the Sierra de Los Valles supply perennial base flow to the headwaters of Guaje, Los Alamos, Pajarito, and Water canyons (Abeele et al., 1981). Springs between 7,100 and 7,500 ft supply perennial base flow in Pajarito and Cañon de Valle canyons. Perennial flow is maintained in sections of Pueblo, Los Alamos, Sandia, and Mortandad canyons by the release of effluent from industrial-waste treatment plants, sewage plants, and cooling water from the power plant (Purtymun, 1975).

Figure 6.1.1 Regional Location of Los Alamos National Laboratory (LA - 12764 - ENV)

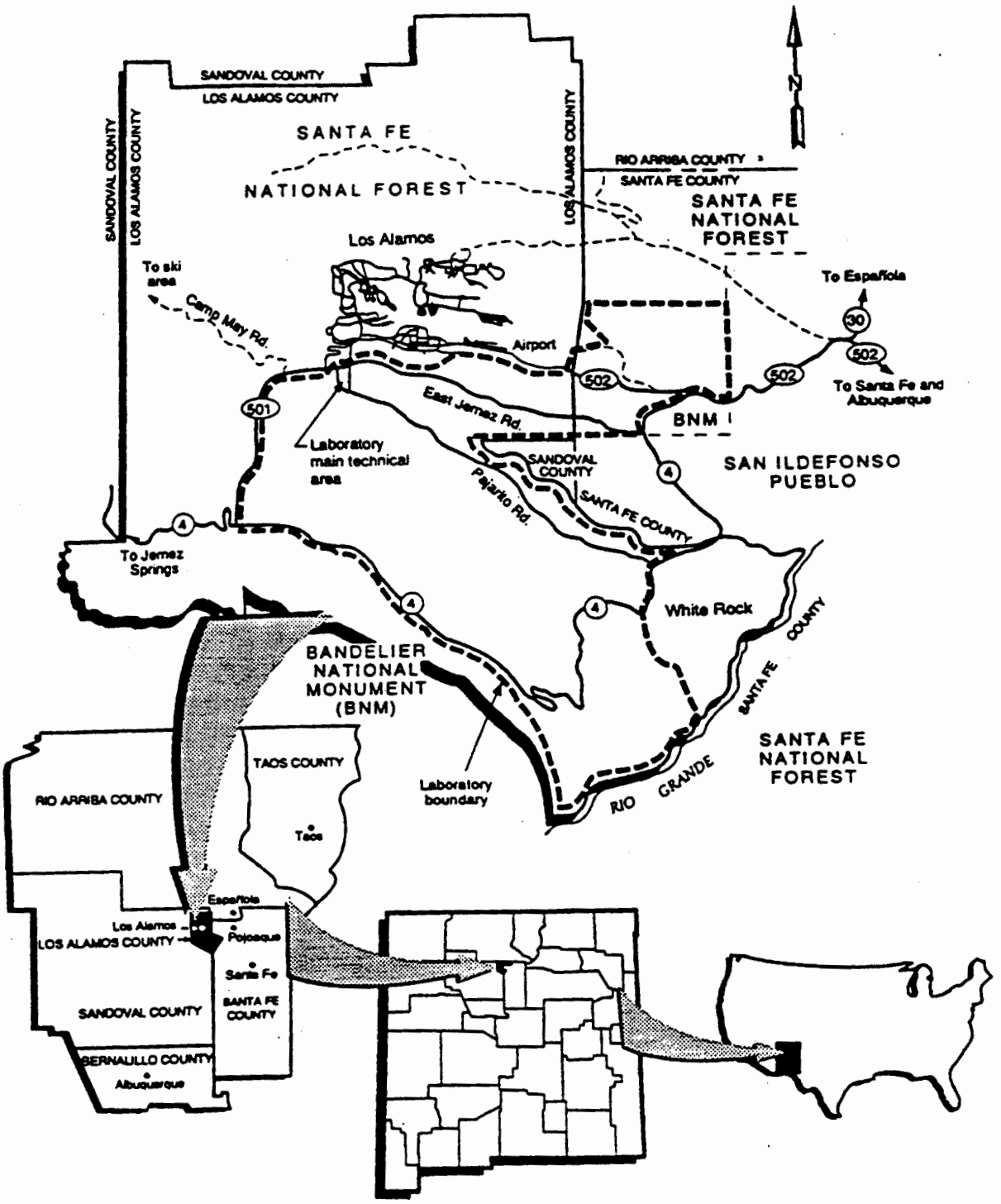


Figure 6.1.2 Generalized Hydrogeologic Model for LANL (from Hoffman and Lyncoln, 1992)

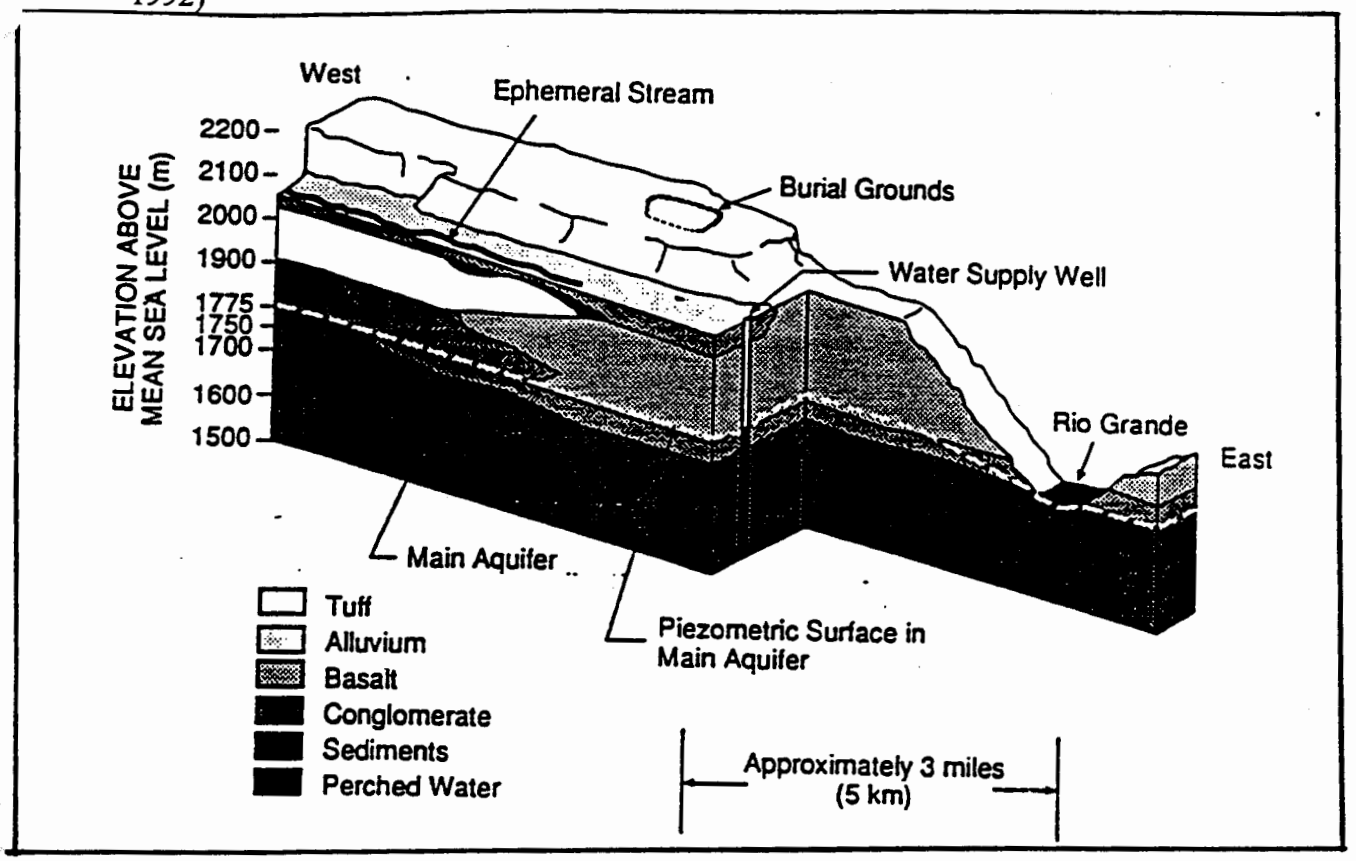
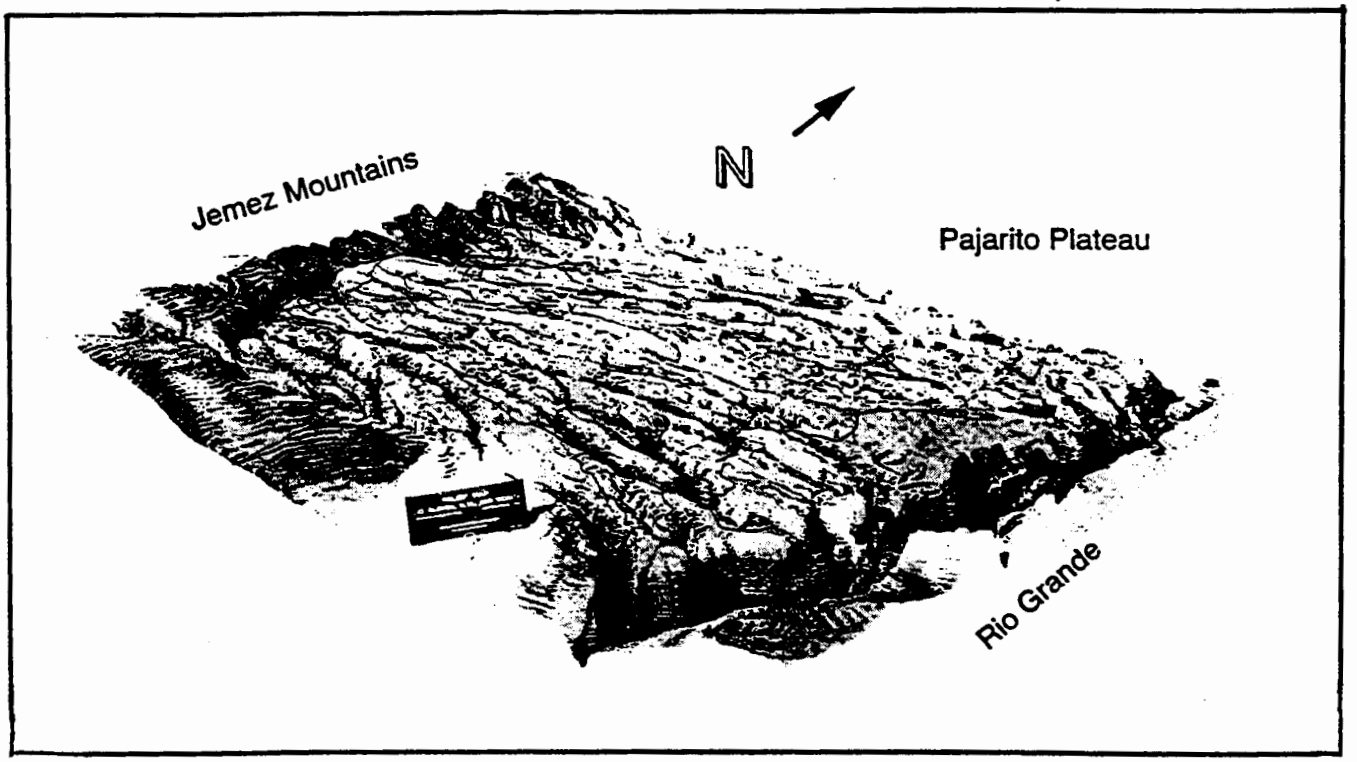



Figure 6.1.3 Topography of the Los Alamos Area. (LA - 12764 - ENV)



## 6.2 Description of Study Areas

The Laboratory discharges treated waste water into these canyons from approximately 128 NPDES discharges. Discharges include treated industrial waste, treated radioactive waste, and treated sanitary sewage. Outfalls and runoff from all sites are possible water sources for wildlife in the area. Throughout the history of the Laboratory, waste has been disposed of in many Solid Waste Management Units (SWMU). SWMUs are located both on the top of the mesa and in watercourses.

## 6.3 Site Selection / Sampling Stations

DOE Oversight Bureau staff members have concentrated their sampling efforts on streams that may have been impacted by discharges due to stormwater runoff and prior spill/discharge histories from Technical Areas (TA), and those streams having SWMUs located in their watershed. LANL has established annual sampling stations both on and off laboratory property.[2] In addition to these previously existing stations, DOE Oversight Bureau has established additional sampling stations for the monitoring of snowmelt runoff, stormwater runoff, and benthic macroinvertebrates. DOE Oversight Bureau personnel accompanied LANL personnel and split samples at established annual sampling stations. Springs and streams discharging into the Rio Grande in White Rock Canyon have been sampled for many years by the LANL staff and have been included in the NMED sampling plan (Figure 6.4.1). Due to budget limitations, DOE Oversight Bureau does not attempt to collect samples at all established stations, but selects some of each type, (springs, stormwater runoff, snowmelt) to sample each year.

A map depicting sampling locations is shown in Figure 6.2.1. Each station has been assigned a unique map designation. All sample stations in major canyons are designated by incorporating the first two letters of the canyon name and the distance in miles from them to the Rio Grande, as determined from USGS topographic maps (scale 1:24000). For tributaries to major canyons, the station designation is the first two letters of that canyon name and the distance from its junction with the main canyon. For example, station PA 9.0 is located in Pajarito Canyon, 9.0 mi upstream from the Rio Grande, at the confluence of Starmer Gulch and Pajarito Creek. A sample collected in Starmer Gulch, 16 meters above the confluence with Pajarito Creek, would be designated ST 0.01. A sample collected in Pajarito Creek, below the confluence of Starmer Gulch would be designated PA 9.0.

Tables 6.3.1, 6.3.2, 6.3.12, 6.3.13, 6.3.18, 6.4.1 and 6.4.6 provide detailed site locations and descriptions for all sample stations located on Figure 6.2.1.

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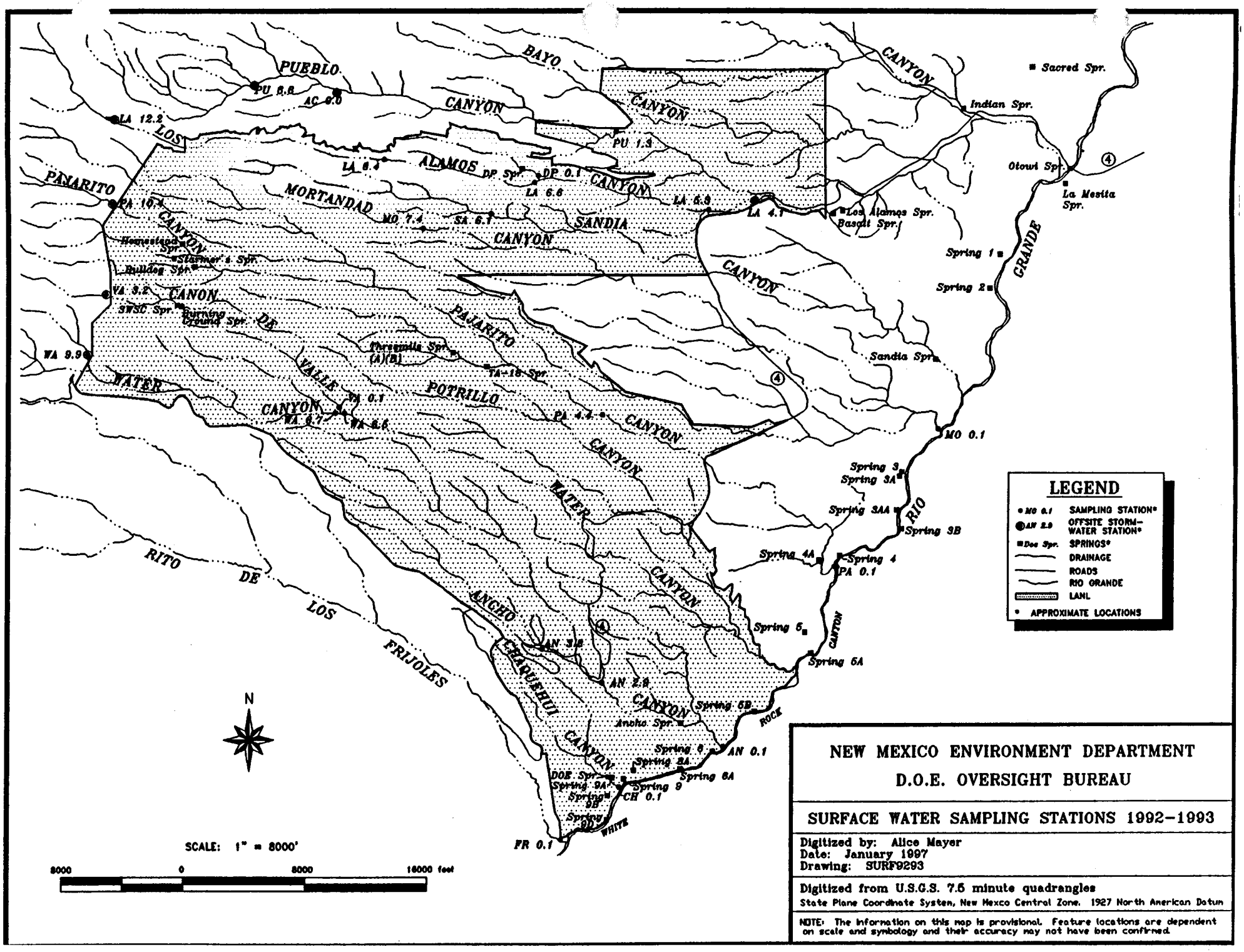
[2] LANL reports data in annual environmental reports.




NEW MEXICO ENVIRONMENT DEPARTMENT

D.O.E. OVERSIGHT BUREAU

SURFACE WATER SAMPLING STATIONS 1992-1993

Digitized by: Alice Mayer
Date: January 1997
Drawing: SURF9293

Digitized from U.S.G.S. 7.5 minute quadrangles
State Plane Coordinate System, New Mexico Central Zone. 1927 North American Datum

NOTE: The information on this map is provisional. Feature locations are dependent on scale and symbology and their accuracy may not have been confirmed.

### 6.3.1 Snowmelt Runoff Sampling - 1992

Snowmelt runoff samples were collected from 10 stations in 1992. Four background locations were established in upper Pajarito, Los Alamos, Water, and Valle canyons, west of Jemez Road, to determine the condition of surface waters prior to entering the Laboratory (Table 6.3.1). Four locations were at sites where snowmelt had flowed on DOE property but did not exit DOE property. Samples were taken upslope from where surface water infiltrated into the alluvium on DOE property. These locations were at Ancho Canyon below the meteorological tower at TA-49, Water Canyon above the confluence with Cañon de Valle, Cañon de Valle above the confluence with Water Canyon, and Sandia Canyon at the turnout below the TA-53 entrance (Table 6.3.2).

Two locations were at sites where snowmelt had flowed across DOE property some distance downstream from the sample site. These locations were at Pajarito Canyon at area G-1 and Los Alamos Canyon below a tributary from TA-53 outfall 09S sanitary lagoon discharge. Both locations were sampled prior to flowing off laboratory property. These samples represent snowmelt leaving DOE property (Table 6.3.2).

From May 5-7, 1992, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.3), total metals (Table 6.3.4), dissolved metals (Table 6.3.5), radiochemistry (Table 6.3.6 & 6.3.7), and volatile organic compounds (Table 6.3.8).

### 6.3.2 Snowmelt Runoff Sampling - 1993

Snowmelt runoff samples were collected from nine stations in 1993, four of which were background locations. The background water samples were collected in Water, Valle, Pajarito and Pueblo canyons (Table 6.3.1). Five additional water samples were collected and split with LANL in Pueblo, Acid, Water, Ancho, and Sandia canyons (Table 6.3.2).

From March 24 to June 28, 1993, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.9), total metals (Table 6.3.10), and dissolved metals (Table 6.3.11).

### 6.3.3 Stormwater Runoff Sampling - 1992

In 1992 the DOE Oversight Bureau was developing a program to monitor stormwater runoff at DOE facilities. DOE Oversight Bureau procured automatic water quality samplers and flow meters during this time. Due to the development of this program, stormwater events were not sampled during 1992.

### 6.3.4 Stormwater Runoff Sampling - 1993

Four stations were sampled during storm events at LANL in 1993. Two stations were sampled in Los Alamos Canyon: Los Alamos Canyon at the Otowi Well # 4 (Table 6.3.12), and Los Alamos Canyon, 500 yds. below State Road 4 (Table 6.3.13 ). Each was sampled once during separate storm events. DP canyon (at the former USGS gaging station) was sampled during six separate storm events and Pajarito canyon (below Area G-1) was sampled during one storm event (Table 6.3.12).

From July 15 to September 10, 1993, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.14), total metals (Table 6.3.15), radiochemistry (Tables 6.3.16 & 6.3.17).

### 6.3.5 Miscellaneous Surface Water Sampling - 1992

Mortandad Canyon was sampled at the USGS gaging station, (GS-1), below TA-50 outfall 051. This sample represents an accumulation of discharges from TA- 50 outfall 051, 03A outfall 160, 04A outfall 127, and 06A outfall 132. Although this was during the snowmelt runoff period, the majority of flow at this sampling site was due to effluent from TA- 50 outfall 051 (Table 6.3.18).

On May 7, 1992, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.19), total metals (Table 6.3.20), dissolved metals (Table 6.3.21), radiochemistry (Tables 6.3.22 & 6.3.23), and volatile organic compounds (Table 6.3.24).

### 6.3.6 Miscellaneous Surface Water Sampling - 1993

On January 30, 1993, a 3 gal/hr leak was detected in the primary coolant loop of the Omega West reactor that contaminated the ground-water under the reactor site. It was unknown how long the reactor coolant had been leaking. Tritium ($H^3$) was detected in the reactor building sump at a level of 109,000 pCi/L on January 30, 1993. This was attributed to ground water infiltration into the reactor building basement. This sump water had been routinely discharged into Los Alamos Canyon (from 1956 - 1993), though it was not an NPDES permitted discharge. This unpermitted point source discharge to a watercourse, Los Alamos Canyon, prompted NMED to sample the sump discharge on February 17, 1993.

Surface water samples were collected on September 3, 1993, at Los Alamos Reservoir spillway and Los Alamos Canyon near Otowi well # 4 to determine conditions above and below ongoing primary reactor coolant loop excavations at Omega West Reactor.

Samples were also collected and split with LANL from Sacred, Indian, La Mesita, and Basalt springs, and Mortandad Canyon at the gaging station from May 12 to July 19, 1993.

The above water samples were tested for the following parameters: water chemistry (Table 6.3.25), total metals (Table 6.3.26), and radiochemistry (Tables 6.3.27 & 6.3.28).

## 6.4 Springs of White Rock Canyon

NMED has collected samples from most of the springs that discharge into White Rock Canyon. Springs 1 and 2 have been sampled at the request of the San Ildefonso Pueblo. Spring 4A (Pajarito Spring) and Ancho Spring supply perennial surface-water flow to the Rio Grande via their respective canyons and are sampled annually. Other springs which discharge to the Rio Grande (after traveling for a short distance above ground) are sampled periodically to verify past and current sampling results documented in LANL's Annual Surveillance Reports (Table 6.4.1).

Samples collected during the September, 1992, and October, 1993, environmental surveillance trips were analyzed for water-chemistry parameters (Table 6.4.2 & 6.4.3). Sediment samples were collected at Spring 5 in 1992 and spring 4A in 1993. (Tables 6.4.4 & 6.4.5).

### 6.4.1 Streams of White Rock Canyon

The Pajarito Plateau, west of the Rio Grande, is drained by numerous canyons, five of which maintain intermittent or perennial flow to the Rio Grande in White Rock Canyon. Sanitary effluent from the county's domestic wastewater treatment plant in White Rock (NPDES permit No. NM0020133) forms a perennial flow (when not diverted for irrigation purposes at the White Rock ball fields) in lower Mortandad Canyon. Base flow in streams in Pajarito and Ancho Canyons is supplied by springs, and maintains perennial flow to the Rio Grande. Base flow in Frijoles Canyon is from a series of headwater springs located about 13 km (8 mi) west of the Rio Grande, which provide perennial flow to the Rio Grande. Flow in Chaquehui Canyon is from springs discharging from the Tesuque Formation. Due to infiltration and evapotranspiration, flow from Chaquehui Canyon does not reach the Rio Grande (Purtymun 1980), except during storm events.

Water, sediments, and stream macroinvertebrates were sampled from five tributaries of the Rio Grande and four stations along the Rio Grande during the annual White Rock Canyon environmental surveillance trips (Figure 6.4.1) (Table 6.4.6).

Water samples collected during September, 1992, and October, 1993, in White Rock

Canyon were analyzed for water-chemistry parameters (Table 6.4.2 & Table 6.4.3). Sediments collected during DOE Oversight Bureau annual White Rock Canyon environmental surveillance trips in 1992 and 1993 were analyzed for total metals (Table 6.4.4 & Table 6.4.5). Stream Macroinvertebrate sampling results are addressed in the following section.

## 6.5 Benthic Macroinvertebrate Sampling - 1992 & 1993

DOE Oversight Bureau staff performed a rapid bioassessment of Frijoles, Ancho, Chaquehui, Pajarito and Mortandad Canyons in 1992 and the resulting previously unpublished report (Hopkins, 1992) is included in Appendix A.

Stream macroinvertebrates were sampled in Frijoles, Ancho, Los Alamos, DP, Sandia, and Pajarito Canyons in 1993 and the samples were analyzed in their entirety. Sample locations are shown in Table 6.5.1. The organisms were identified by Dr. Gerald Z. Jacobi of New Mexico Highlands University. The species list developed from this sampling effort is included in Appendix B.

## 6.6 Applicable Water Quality Standards - LANL

**Unclassified Canyon Watercourses**

The canyon watercourses that receive the laboratory's NPDES permitted discharges and stormwater runoffs are tributaries to the Rio Grande. These watercourses are currently unclassified in the *Water Quality Standards for Interstate and Intrastate Streams in New Mexico* (WQS)[3]. Where no uses are designated through classification by the WQCC, the general standards of the WQS are applicable (WQS §1-102). Further WQS 3-101 lists "Standards Applicable to Attainable or Designated Uses Unless Otherwise Specified in Part 2" (emphasis added). LANL was questioned concerning its possible "attainable" uses when the laboratory's NPDES permit was last reviewed for reissuance by the EPA. A Settlement Agreement was reached between the NMED and the NPDES co-permittees University of California / Department of Energy, and was reviewed and approved by the WQCC[4]. This agreement temporarily resolved the issue until an independent study could be performed to ascertain the existing and attainable uses of the watercourses involved

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[3] As amended by the WQCC October 8, 1991 and effective November 12, 1991. Note the WQS were amended by the WQCC in October 1994 in accordance with triennial review requirements of Section 303 of the federal Clean Water Act. It is NMED SWQB's policy to compare ambient water quality data with the WQS in effect at the time of collection.

[4] April 20, 1993, Settlement Agreement resolving the co-permittee's appeal to the WQCC for review of the NMED's conditional certification of their NPDES permit NM0028355.

and classified standards could be proposed and reviewed by the WQCC. It was agreed that NPDES permit limits would be based upon the livestock and wildlife watering use, as set forth in WQS §3-101 and other applicable sections of the WQS (e.g., §1-102.G - Radioactivity). The WQS §3-101.K numeric standards for water quality necessary to sustain livestock and wildlife watering are listed in (Table 6.6.1):

Table 6.6.1 WQS §3-101.K Livestock and Wildlife Watering Use Standards

| | | | |
|---|---|---|---|
| dissolved aluminum | 5.0 mg/L | dissolved copper | 0.5 mg/L |
| dissolved arsenic | 0.02 mg/L | dissolved lead | 0.1 mg/L |
| dissolved boron | 5.0 mg/L | total mercury | 0.01 mg/L |
| dissolved cadmium | 0.05 mg/L | dissolved selenium | 0.05 mg/L |
| dissolved chromium[5] | 1.0 mg/L | dissolved vanadium | 0.1 mg/L |
| dissolved cobalt | 1.0 mg/L | dissolved zinc | 25.0 mg/L |
| radium-226 + 228 | 30.0 pCi/L | | |

Regarding the radioactivity general standard WQS §1-102.G states:

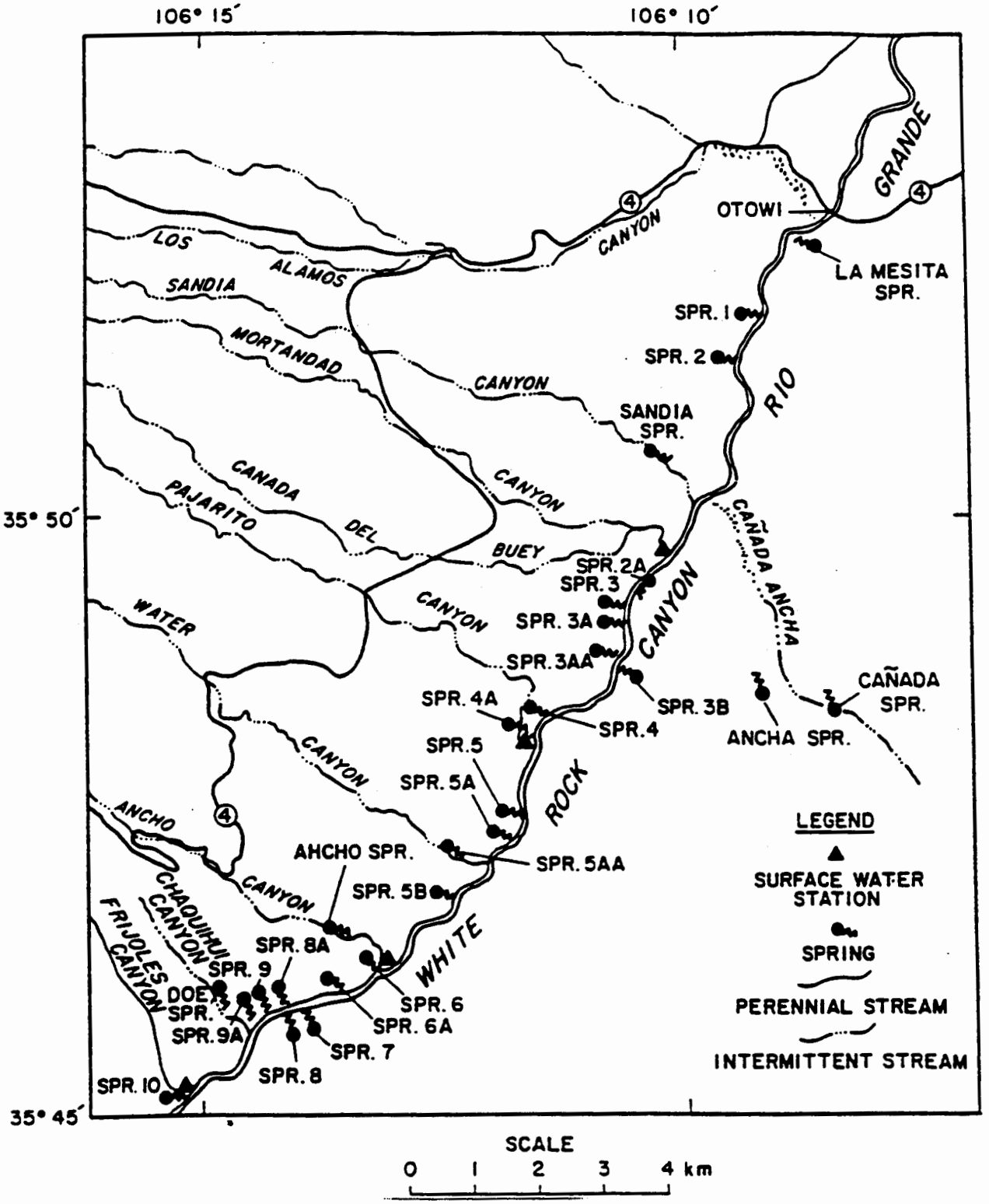
"[t]he radioactivity of surface waters shall be maintained at the lowest practical level and shall in no case exceed the standards set forth in Part 4 of the New Mexico Environmental Improvement Board Radiation Protection Regulations, filed March 10, 1989."

**Classified Watercourses**

The main stem of the Rio Grande from the headwaters of Cochiti Reservoir upstream to Taos Junction Bridge is classified in WQS §2-111 with the following designated uses: irrigation, livestock and wildlife watering, marginal coldwater fishery, secondary contact recreation, and warmwater fishery. Applicable water quality standards for this segment therefore include the narrative standards of the WQS Part I - General Standards, segment specific standards in WQS §2-211, and WQS §3-101 Standards Applicable to Attainable or Designated Uses Unless otherwise Specified in Part 2. Specifically the numeric standards of sections 3-101.D (irrigation), 3-101.F (marginal coldwater fishery), 3-101.J. (all fisheries), and 3-101.K (livestock and wildlife watering) are applicable. The WQS state that for waters with more than a single attainable use (e.g., segment 2-111) "the applicable criteria are those which will protect and sustain the most sensitive use" (§3-101 footnote 1, page 49).

[5] The criteria for chromium shall be applied to an analysis which measures both the trivalent and hexavalent ions.

Figure 6.4.1 Generalized Location of Streams and Springs in White Rock Canyon



## 6.7 Data Interpretation

Split sample data collected by NMED and Santa Fe Engineering (contractor for LANL) was statistically compared using three methods. The objective was to determine whether there was a statistically significant difference which might be attributable to methods of sample collection, methods of sample preservation or differences between analytical laboratories.

**Results of Data Comparison**

The statistical comparisons were made for calcium, magnesium, nitrate/nitrite, bicarbonate and total hardness. Neither parametric nor non-parametric evaluations indicated that there was a statistically significant difference between NMED and Santa Fe Engineering (SFE) data. The Pearson's correlation indicated that the data were significantly linked. NMED concludes that there is no difference between the groups of data which would indicate significant differences in method of sample collection, preservation or analysis. Furthermore, the significant Pearson correlation indicates that the same chemical species were being quantified by the two laboratories.

A comparison of 1993 NMED and LANL analytical results also showed the results are similar, except for one stormwater sampling event ( LA 4.1 - 930803).

On August 3, 1993, the North Community precipitation monitoring site at LANL, recorded 1.12 inches of rainfall. DOE Oversight Bureau personnel were able to position themselves in Los Alamos Canyon, ahead of the first flush of stormwater, at the bridge on State Road 4 (sample station LA 4.1). Samples were collected during the first flush, as it passed onto Bandelier National Monument at Tsankawi Ruins. Replicate samples were collected for submittal to LANL. Samples submitted to SLD for analysis were acidified and stored on ice. DOE Oversight Bureau samples were analyzed for total metals (Table 6.3.15), for gross alpha/beta (Table 6.3.16), and by a gamma scan for activation and fission products (Table 6.3.17).

Upon receiving the radiological results from SLD, DOE Oversight Bureau notified LANL that its analysis showed elevated levels of gross alpha and beta emitters. The results obtained by LANL, though elevated, showed gross alpha and beta levels far below NMED's. LANL re-analyzed its samples, but DOE Oversight Bureau was not able to re-analyze its samples. LANL's results again were far below DOE Oversight Bureau's and nearer to background levels. Appendix C displays the comparisons of NMED and LANL data. DOE Oversight Bureau's total metal results indicated mercury (Hg) present above detection limits (yet below Livestock Watering Standards) while LANL did not detect any mercury.

DOE Oversight Bureau stormwater samples that were submitted for radiological analysis

had nearly 0.2 inch of sediment in the bottom of the sampling container. This accumulation of sediment in the bottom of the Marinelli beaker during counting may have distorted the geometry and affected the quantification of the amount of activity present. It is probable that LANL filtered or decanted the water off the sediments prior to analysis, resulting in significantly lower counts in their gross alpha/beta analysis.

It is probable that concentrated nitric acid was mistakenly added to sample VA 3.2 on 920506 and then tested for nitrate + nitrite resulting in a high (1300 mg/L) analytical result.

It also appears that labels may have been switched on two snowmelt samples collected from Pajarito canyon in May of 1992.

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## 7.0 SANDIA NATIONAL LABORATORIES, NEW MEXICO

### 7.1 Setting

The following setting description is an excerpt from the NMED report (Stone, et al., 1993).

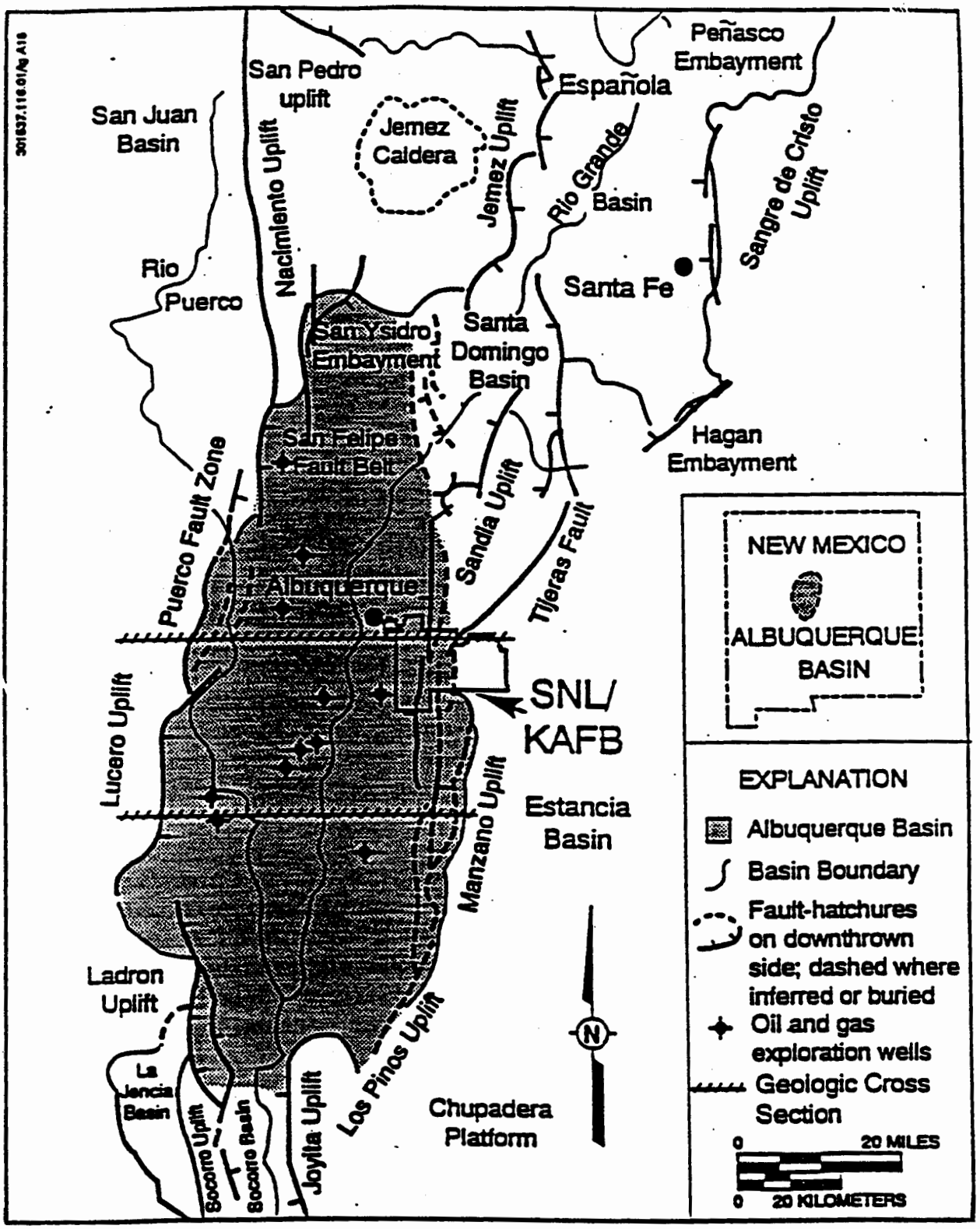
> "SNL/ITRI, NM is located on the Kirtland Air Force Base (KAFB) in the southeastern part of Albuquerque. KAFB is bound roughly by the Manzanito Mountains on the east, the Isleta Pueblo Indian Reservation on the south, Interstate 25 on the west and Central Avenue on the north (Figure 7.1.1). Geologically, the facility straddles the eastern edge of the Albuquerque Basin, one of numerous closed depressions making up the Rio Grande Rift. The Albuquerque Basin is a very complex geologic feature that is just now beginning to be understood through detailed studies like that of Hawley and Haase (1992). In general terms, however, Precambrian metamorphic rocks and Paleozoic sedimentary rocks of the mountains are separated from the thick sequence of mainly unconsolidated Tertiary/Quaternary alluvium in the basin (Santa Fe Group) by the Tijeras Fault Zone. SNL sits on the dissected bajada extending westward from the mountains.
>
> Elevations in the mountains are on the order of 10,000 ft, whereas those along the river are between 4,300 and 5,100 ft. The area is drained by ephemeral streams that flow westerly or southwesterly toward the Rio Grande. Tijeras Arroyo, Arroyo del Coyote and the so-called Travertine Hills Arroyo are the major drainage ways."

### 7.2 Description of Study Area

SNL/ITRI does not operate its own wastewater treatment facility. Most of the wastewater from SNL/ITRI is collected and delivered to the City of Albuquerque's sanitary-wastewater collection system, and is treated by the City's wastewater treatment plant (WWTP). The city discharges treated wastewater to the Rio Grande, pursuant to NPDES permit No. NM0022250.

SNL/ITRI conducts its own wastewater monitoring (Figure 7.2.1), to demonstrate compliance with the effluent limitations specified in the wastewater Discharge Permits (2069A-2, 2069D-3, 2069F-2, 2069G-2, 2069H-2, 2069I, and 2069K) issued to SNL by the city's pretreatment section. ITRI's wastewater Discharge Permit is 2178A. SNL/ITRI's wastewater self-monitoring consists of sample collection at permit-specified frequencies with continuous pH and flow monitoring at the eight stations.

Figure 7.1.1 Location and Geologic Setting of SNL/ITRI (from McCord, et al., 1993).



### Site Selection / Sampling Stations

During 1992 and 1993 the DOE Oversight Bureau was developing and planning a storm water monitoring program to monitor storm-water runoff from DOE facilities. DOE Oversight Bureau procured automatic water quality samplers and flow meters during this time. Thus no stormwater events were sampled during 1992 or 1993.

In 1993 water samples were collected from the sanitary sewer system at two locations WW006 (2069-F) and WW008 (2069-I) (Figure 7.2.1). The samples collected were flow-proportioned, twenty-four-hour composites, which were split with SNL.

The above water samples were tested for the following parameters: water chemistry (Table 7.3.1), total metals (Table 7.3.2), and radiochemistry (Tables 7.3.3).

## 7.4 Applicable Water Quality Standards - SNL/ITRI

**Unclassified Watercourses**

Non-perennial watercourses (e.g., Tijeras Arroyo and its tributaries) are currently not classified in the WQS. Where no uses are designated through classification by the WQCC, the general standards of the WQS are applicable (WQS §1-102). Further WQS 3-101 lists "Standards Applicable to Attainable or Designated Uses Unless Otherwise Specified in Part 2" (emphasis added). The NMED's position, which has been reviewed by the New Mexico Water Quality Control Commission (WQCC), is that where water exists, it will, at a minimum, have an attainable use of livestock and wildlife watering and probably an attainable use of irrigation. The irrigation use is only excluded in cases such as hyper-saline playa lakes and locations where there is no arable land in the vicinity. Since the land in the vicinity is arable, the irrigation use needs to be considered. There are numeric water-quality criteria in the WQS for both these uses (§§3-101. K. and D. respectively).

According to WQS §3-101, for waters with more than a single attainable or designated use the applicable criteria are those which will protect and sustain the most sensitive use. The following standards apply to surface waters and surface-water drainages that may be affected by stormwater runoff, spills, or discharges. The numeric standards for water quality necessary to sustain the livestock and wildlife watering use and the irrigation use are compiled in Table 7.4.1.

Table 7.4.1 §§3-101. K. and D Standards for Livestock, Wildlife, and Irrigation Use

| | | | |
|---|---|---|---|
| dissolved aluminum‡ | 5.0 mg/L | dissolved copper* | 0.20 mg/L |
| dissolved arsenic† | 0.02 mg/L | dissolved lead† | 0.1 mg/L |
| dissolved boron* | 0.75 mg/L | total mercury† | 0.01 mg/L |
| dissolved cadmium* | 0.01 mg/L | dissolved selenium† | 0.05 mg/L |
| dissolved chromium*[6] | 0.1 mg/L | dissolved vanadium‡ | 0.1 mg/L |
| dissolved cobalt* | 0.05 mg/L | dissolved zinc* | 2.0 mg/L |
| radium-226 + 228† | 30.0 pCi/L | | |

‡ = standard is same for both uses.
† = where livestock and wildlife watering is the most sensitive use.
* = where irrigation is the most sensitive use.

**Sanitary Wastewater Discharges**

SNL is authorized to discharge wastewater to the City of Albuquerque sewer system, according to its wastewater discharge permit. The permit sets discharge limits and monitoring requirements on SNL. In addition, SNL is bound by other applicable sections of the WQS (e.g., §1-102.G - Radioactivity).

The radioactivity general standard (WQS §1-102.G) states:

[t]he radioactivity of surface waters shall be maintained at the lowest practical level and shall in no case exceed the standards set forth in Part 4 of the New Mexico Environmental Improvement Board Radiation Protection Regulations, filed March 10, 1989.

Part 4-320 of the New Mexico Environmental Improvement Board Radiation Protection Regulations sets limits on waste disposal by release into sanitary sewerage systems.

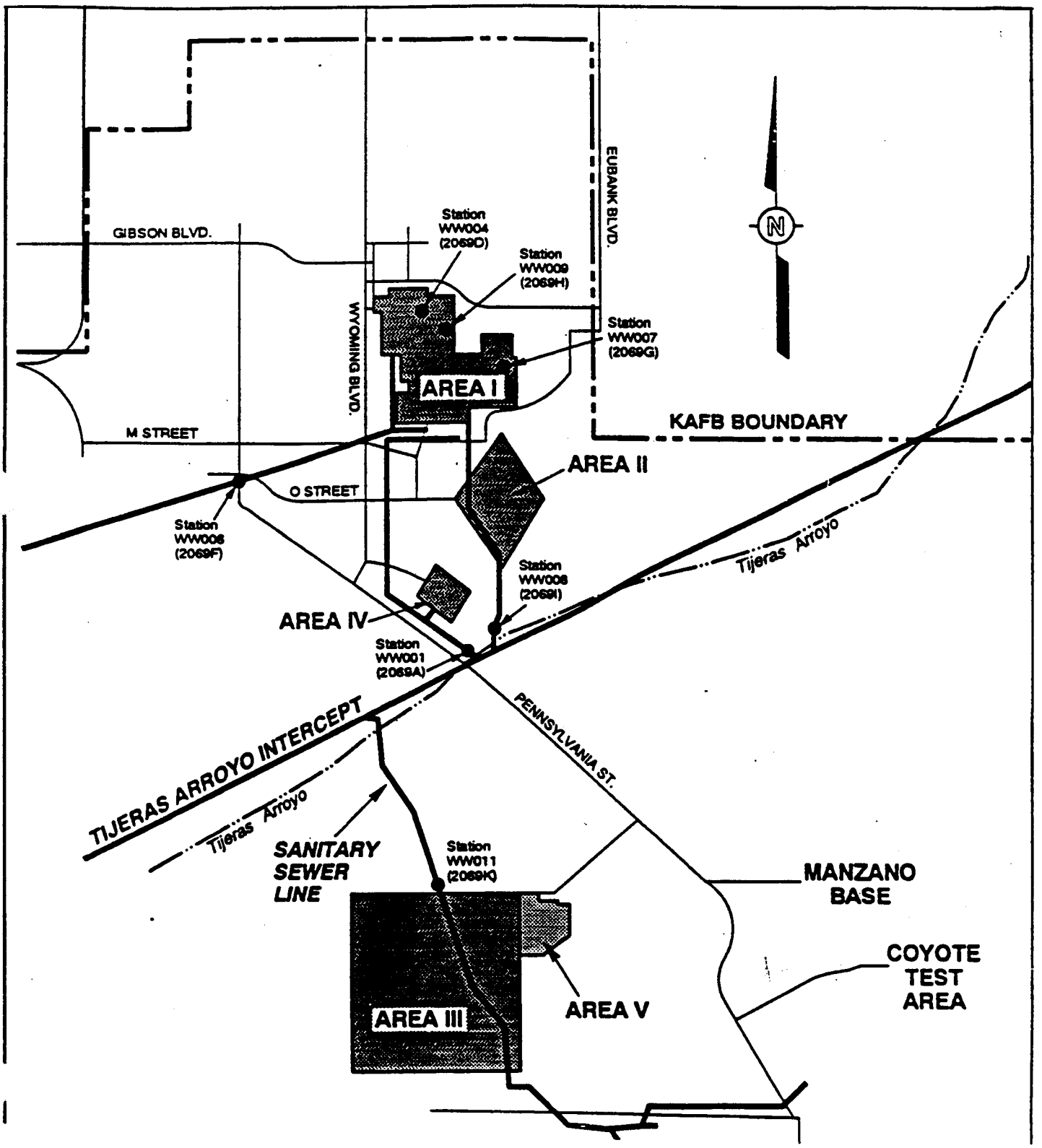
For all water samples use Appendix A, Table 1, Column 2 of the New Mexico Environmental Improvement Board Radiation Protection Regulations, filed March 10, 1989.[7]

---

[6] Water Quality Standards for Interstate and Intrastate Streams in New Mexico, November 12, 1991. The criteria for chromium shall be applied to an analysis which measures both the trivalent and hexavalent ions.

[7] Values in the Radiation Protection Regulation's tables are typically expressed in units of microcuries per milliliter ($\mu$Ci/ml). Results of radiological water quality samples taken as part of this study are typically expressed as picocuries per liter (pCi/L). In order to convert $\mu$Ci/ml to pCi/L, multiply $\mu$Ci/ml by $1 \times 10^9$ and change the denominator to liters.

igure 7.2.1 Location of Wastewater Monitoring Stations at SNL (prepared by IT Corp. and provided by Adrian Jones, SNL).



## 7.5 Data Interpretation

A comparison of the analytical results obtained by NMED and SNL presents no significant differences.

# 8.0 INHALATION TOXICOLOGY RESEARCH INSTITUTE

## 8.1 Setting

The Inhalation Toxicology Research Institute is located on KAFB and its geologic and hydrologic setting is generally the same as given above for SNL (Figure 8.1.1).

## 8.2 Description of Study Area

ITRI no longer operates its own wastewater treatment facility. ITRI was connected into the City of Albuquerque Sanitary Sewer System and stopped using its sewage lagoons on May 21, 1992.

ITRI conducts its own wastewater monitoring to demonstrate compliance with the effluent limitations specified in the Wastewater Discharge Permit 2178A-2, issued to ITRI by the City's pretreatment section. ITRI's wastewater monitoring consists of sample collection at permit-specified frequencies along with continuous pH and flow monitoring.

## 8.3 Site Selection / Sampling Stations

In 1992, DOE Oversight Bureau staff was developing and planning a program to monitor stormwater runoff from DOE facilities. DOE Oversight Bureau procured automatic water quality samplers and flow meters during this time. Stormwater events were not sampled during 1992 or 1993 due to the development of the program and the commitment of resources at other DOE facilities. DOE Oversight Bureau intends to monitor stormwater runoff at ITRI during 1994 and 1995.

## 8.4 Applicable Water-Quality Standards

The same water-quality standards that apply to SNL apply to ITRI.

## 8.5 Data Interpretation

There were no sampling events in 1992 or 1993 at ITRI.

Figure 8.1.1 Location of the ITRI Facility.

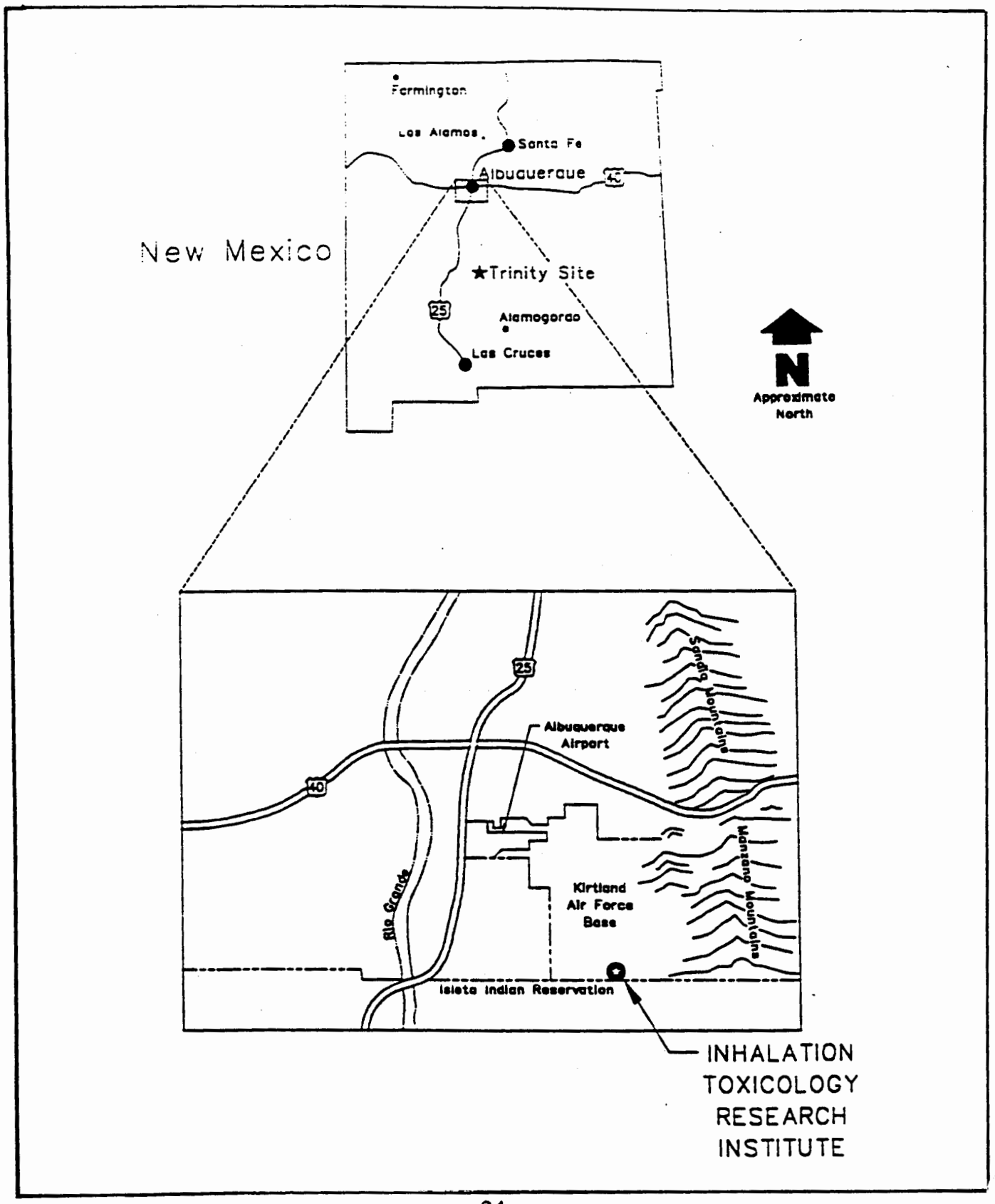
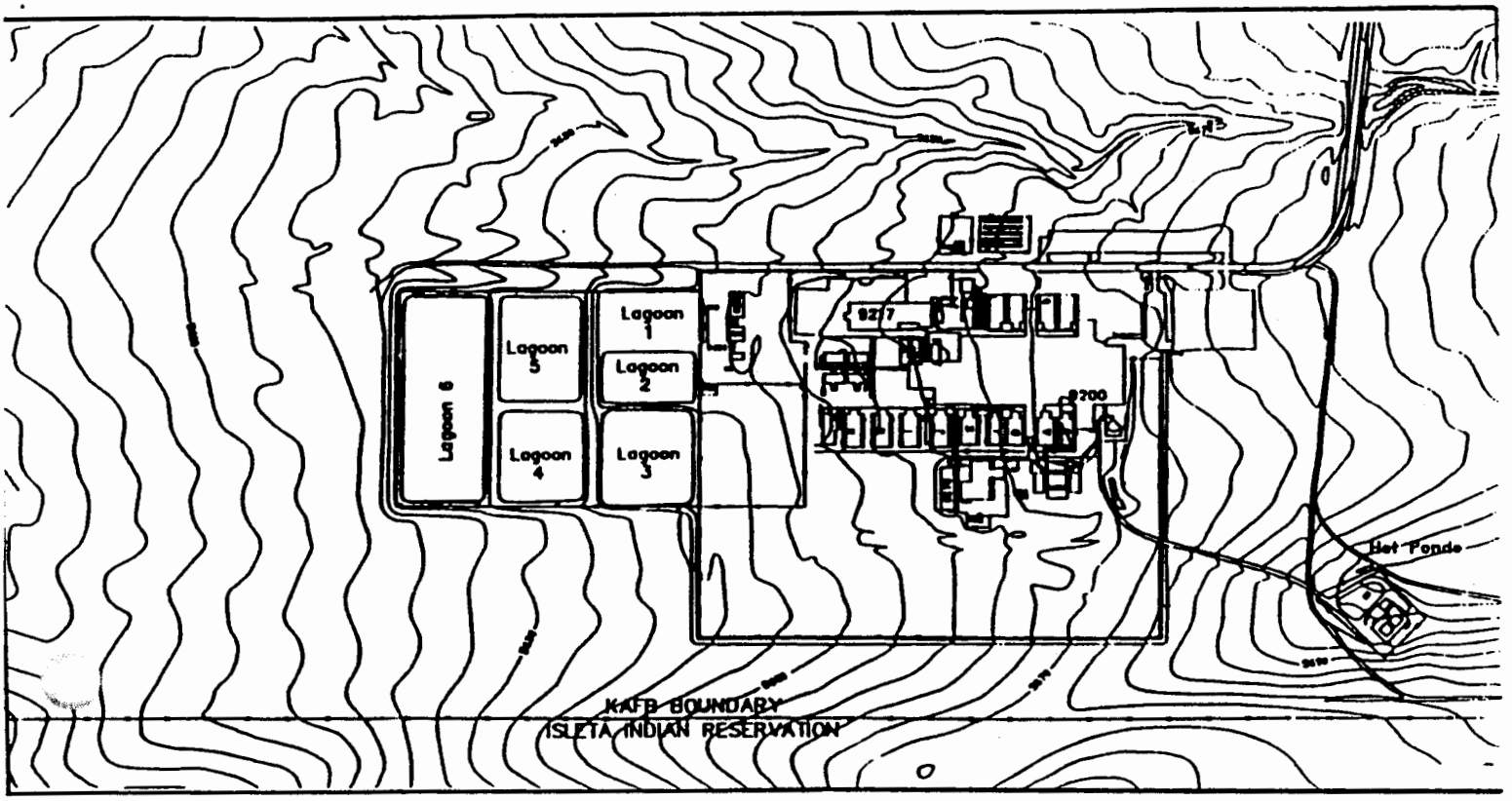


Figure 8.2.1 ITRI site map.




Legend

- 9262 Building
- Roadway
- Chain-link Fence
- Wall
- Topographic Contour (Contour Interval = 2 Feet)

N

0 500
Scale in Feet

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## 9.0 WASTE ISOLATION PILOT PLANT

### 9.1 Setting

The following setting description is an excerpt from Stone, et al., 1993.

> "The Waste Isolation Pilot Plant (WIPP) is located on a karst plain approximately 26 miles east of Carlsbad, New Mexico (Figure 9.1.1). More specifically, it is in the area called "Los Medanos", on the gently sloping terrain rising eastward from the Pecos River to the Southern High Plains (Mercer, 1983). Geologically the site lies in the northern Delaware Basin, a late Paleozoic depression in which a sequence of various kinds of marine deposits accumulated (Figure 9.1.2). Of particular interest for the WIPP site is the Upper Permian or Ochoan Series of rocks. These include, in ascending order, the Castile Formation (anhydrite and halite), the Salado Formation (halite and potash), the Rustler Formation (anhydrite, dolostone, mudstone, halite) and Dewey Lake Red Beds (siltstone, claystone). Overlying the Permian rocks are nonmarine (dune, lake and stream) deposits of Quaternary age. The waste repository is being constructed in the lower halite member of the Salado Formation, at a depth of 2,150 ft below the surface (Chaturvedi and Rehfeldt, 1984).
>
> The region lies within the drainage of the Pecos River. However, owing to the blanket of permeable dune sand and the karst setting, integrated surface drainage features are largely nonexistent. For example, Nash Draw, a southeast-trending solution/collapse depression lying just west of the WIPP site and a major topographic feature of the region, has no external drainage (Mercer, 1983)."

### 9.2 Description of Study Area

The WIPP wastewater treatment system is a lagoon type system with zero discharge. The wastewater gravity flows to a splitter box where it can be directed to either or both of the primary settling basins. From the settling basins the flow goes to another splitter box where it can be directed to either or both of the polishing ponds. After the polishing ponds, chlorine is added by means of commercially available chlorination tablets placed in contact with the flow. After chlorination, the water is discharged to two evaporation basins. A schematic diagram of the wastewater treatment plant is given in Figure 9.2.

### 9.3 Site Selection / Sampling Station

The sanitary lagoons were selected for sampling in order to provide independent

verification of water quality, and determine if the water complies with the Discharge Plan. Samples were also collected to determine background for radiological contaminants.

## 9.4 Applicable Water-Quality Standards

NMWQCC general standards apply to the WIPP site.

## 9.5 Data Interpretation

A comparison of analytical results obtained by NMED and Westinghouse showed no significant differences. While NMED's results indicate that there were measurable levels of Ra-226 present, the values were well below the permit limit.

Figure 9.1.1 Location of Geologic Setting of the WIPP Site (from Chaturvedi and Channell, 1995)

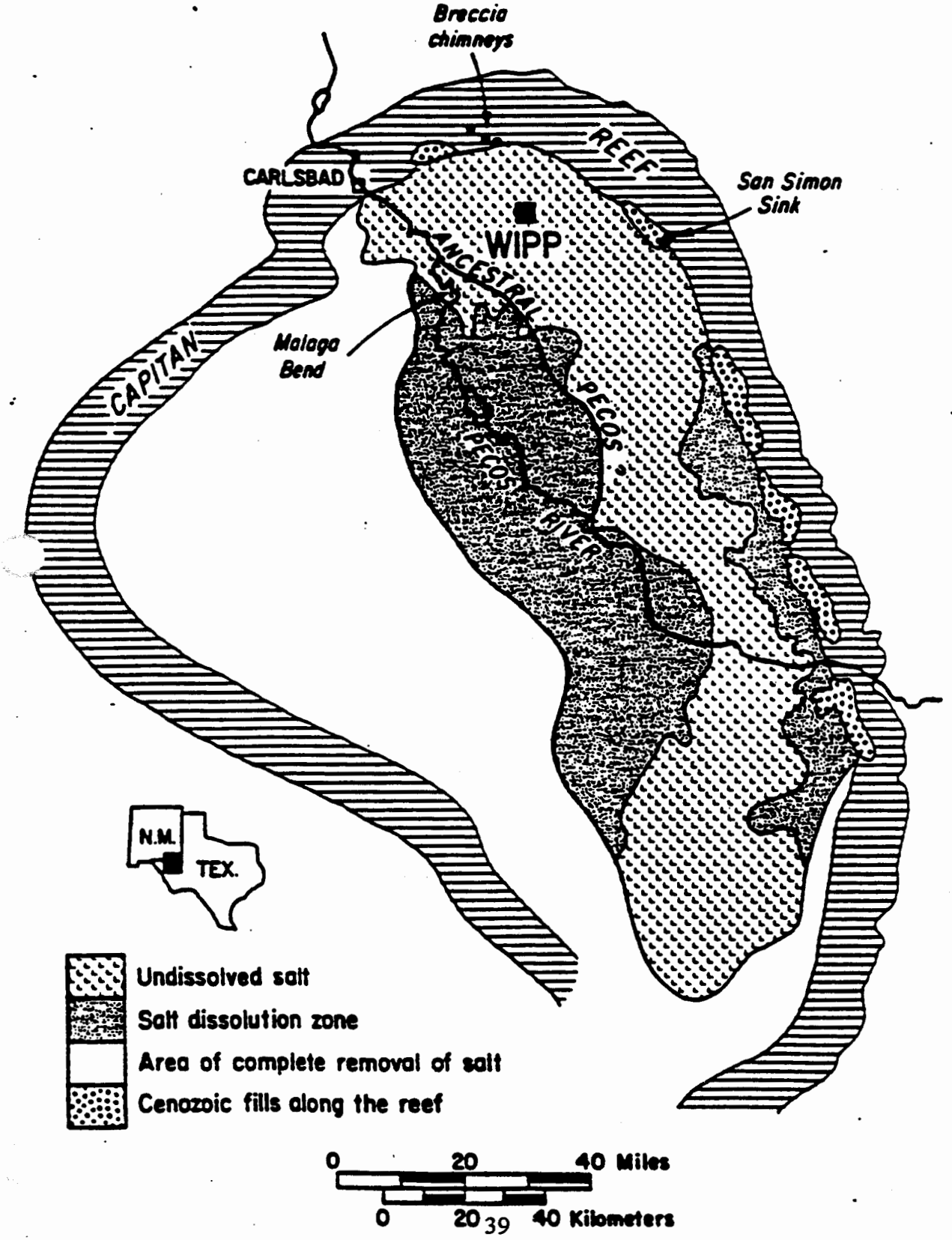


Figure 9.1.2 Generalized Stratiographic Column for the WIPP Site

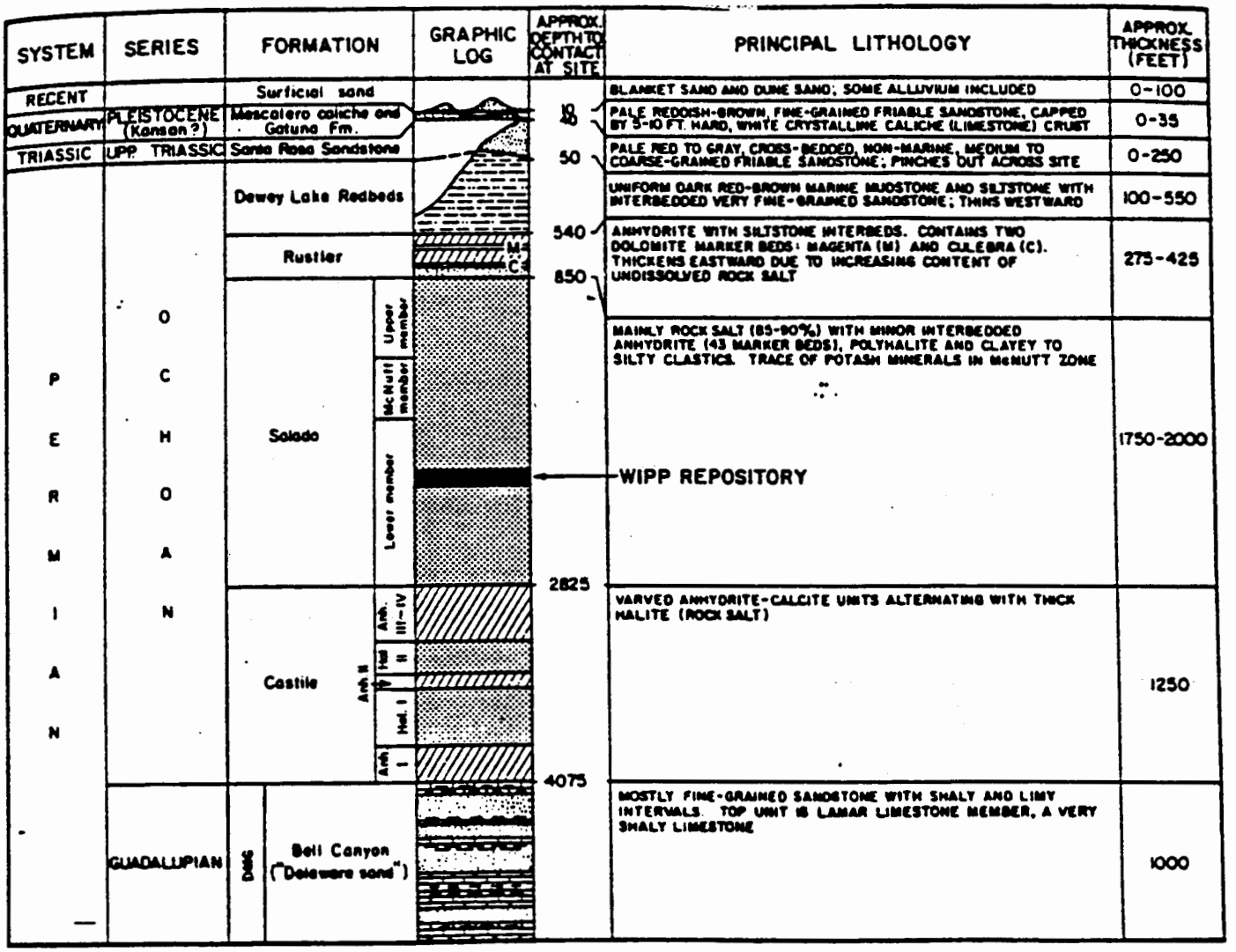
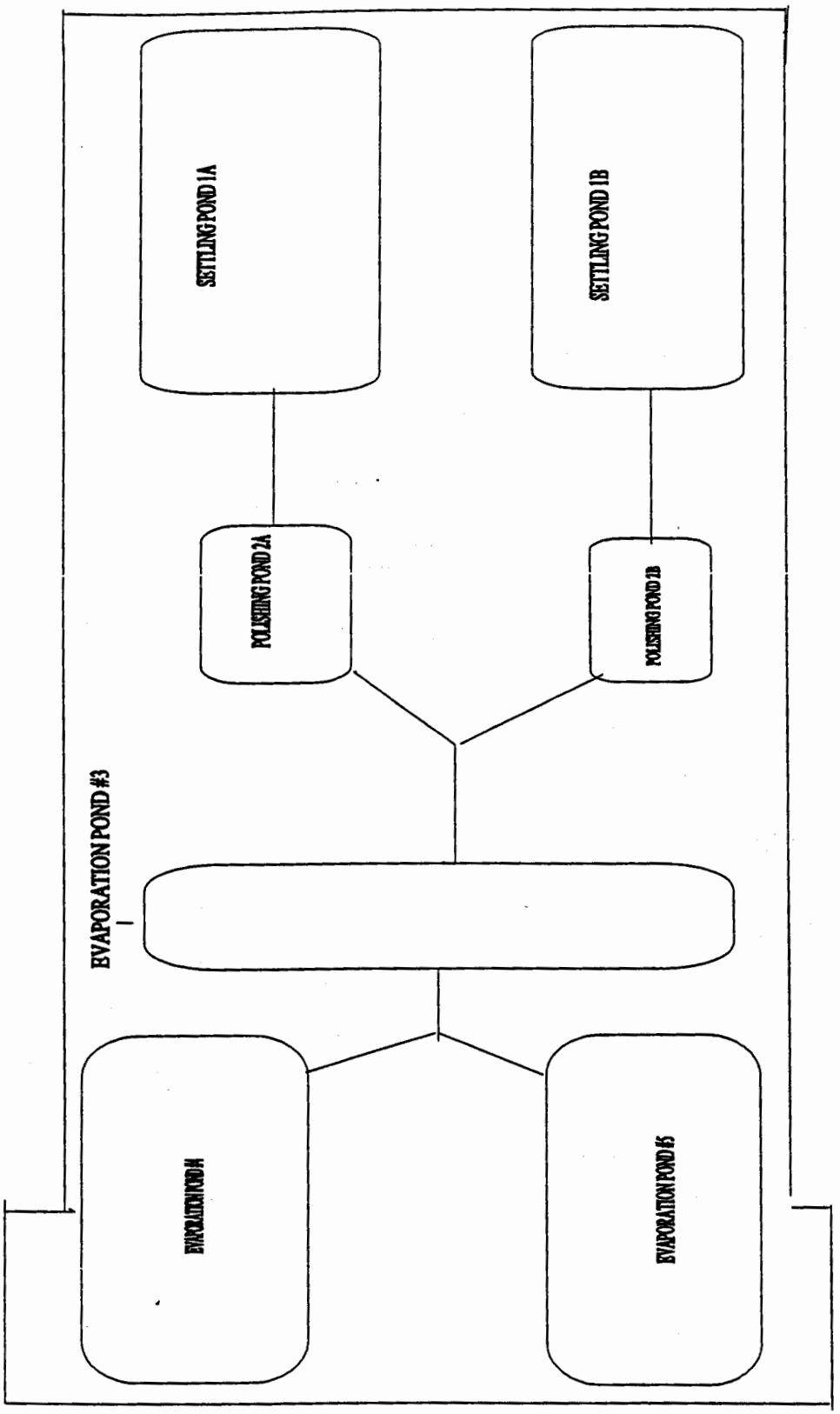


Figure 9.2 WIPP Sewage Facility Layout



ACKOWLEDGEMENTS

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The mention of any manufacturer's name in this report does not constitute an endorsement of any kind by NMED.

## 10.0 TABLES

### Table 6.3.1 Off-Site Snowmelt Runoff Stations - LANL - 1992 & 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| **1992 Background** | | | |
| Pajarito Canyon 50 yd. above W. Jemez Rd. | 35 52 54.0 | 106 21 09.94 | PA 10.4 |
| Los Alamos Reservoir Spillway Discharge | 35 53 00.1 | 106 21 11.74 | LA 12.2 |
| Water Canyon 100 yd. above W. Jemez Rd. | 35 50 18.4 | 106 22 45.24 | WA 9.9 |
| Valle Canyon above W. Jemez Rd | 35 51 08.8 | 106 21 50.6 4 | VA 3.2 |
| **1993 Background** | | | |
| Pueblo Canyon above Townsite | 35 53 24 | 106 19 33 | PU 6.6 |
| Water Canyon 100 yd. above W. Jemez Rd. | 35 50 18.4 | 106 22 45.24 | WA 9.9 |
| Pajarito Canyon 50 yd. above W. Jemez Rd. | 35 52 54.0 | 106 21 09.94 | PA 10.4 |
| Valle Canyon above W. Jemez Rd. | 35 51 08.8 | 106 21 50.6 4 | VA 3.2 |

### Table 6.3.2 On-Site Snow Melt Stations - LANL - 1992 & 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| **1992 On-site Snowmelt Runoff Stations** | | | |
| Los Alamos Canyon below TA-53 | 35 52 13 | 106 14 18 | LA 5.3 |
| Valle Canyon above Confluence with Water Canyon | 35 49 50.9 | 106 18 15.9 | VA 0.1 |
| Water Canyon above Confluence w/ Canon de Valle | 35 49 50.9 | 106 18 15.9 | WA 6.7 |
| Ancho Canyon below TA-49 @ Met Tower | 35 48 33.3 | 106 17 05.4 | AN 3.8 |
| Pajarito Canyon @ G1 | 35 49 47.5 | 106 14 36.6 | PA 4.4 |
| Sandia Canyon 0.8 mi. E. of LANL TA-53 Entrance | 35 51 59.1 | 106 16 10.1 | SA 6.1 |
| **1993 On-site Snowmelt Runoff Stations** | | | |
| Pueblo 3 | 35 52 44.6 | 106 13 52.2 | PU 1.3 |
| Beta Hole (below confluence of Water & Valle Canyons) | 35 49 50.0 | 106 18 11.0 | WA 6.7 |
| Sandia Canyon 0.8 mi. E. of TA-53 Entrance | 35 51 59.1 | 106 16 10.1 | SA 6.1 |
| Ancho Canyon @ hair pin turn on SR.4 | 35 47 30.3 | 106 15 64.2 | AN 2.9 |
| Acid Canyon Weir | 35 53 26.6 | 106 18 34.5 | AC0.0 |

## Table 6.3.12 On-site Storm Water Sampling Stations - LANL - 1992 & 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| **1992 On-site Stations** | | | |
| None sampled in 1992 | | | |
| **1993 On-site Stations** | | | |
| Los Alamos Reservoir Spillway Discharge (background) | 35 53 00.1 | 106 21 11.74 | LA 12.2 |
| Los Alamos Canyon at Otowi Well No. 4 | 35 52 23 | 106 15 37 | LA 6.6 |
| DP Canyon at 60 deg. V-notch Weir | 35 52 22 | 106 15 35 | DP 0.1 |
| Mortandad Canyon at Gage Station | 35 51 54.8 | 106 17 41.5 | MO 7.4 |
| Pajarito Canyon @ G1 | 35 49 47.5 | 106 14 36.6 4 | PA 4.4 |

## Table 6.3.13 Off-site Stormwater Stations LANL - 1992 - 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| **1993 Off-Site** | | | |
| Los Alamos Canyon (East Side of State Rd. 4) | 35 52 05 | 106 13 37 | LA 4.1 |

## Table 6.3.18 Other Surface Water Sampling Stations - LANL - 1992 & 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| **1992** | | | |
| Mortandad Canyon 300 yds. below LANL TA-50 Outfall 051 (above gage station) | 35 51 54.8 | 106 17 41.54 | MO 7.4 |
| **1993** | | | |
| Mortandad Canyon 300 yds. below LANL TA-50 Outfall 051 (above gage station) | 35 51 54.8 | 106 17 41.54 | MO 7.4 |
| Sacred Spring | 35 53 35.01 | 106 8 57.80 | Sacred Spr. |
| Indian Spring | 35 53 4.39 | 106 9 47.66 | Indian Spr. |
| La Mesita Spring | 35 52 11 | 106 08 37 | La Mesita Spr. |
| Basalt Spring | 35 52 01 | 106 11 44 | Basalt Spr. |
| Los Alamos Reservoir Spillway Discharge | 35 53 00.1 | 106 21 11.74 | LA 12.2 |
| Los Alamos Canyon at Otowi Well No. 4 | 35 52 22 | 106 15 35 | LA 6.6 |
| TA-2 Basement Discharge (Unpermitted Discharge) | 35 53 00.9 | 106 19 11.3 | LA 8.4 |

## Table 6.4.1 Sampling Stations -Springs of White Rock Canyon - 1992 & 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| Spring 1 | 35 51 31.35 | 106 09 23.66 | Spring 1 |
| Spring 2 | 35 51 16.43 | 106 09 31.16 | Spring 2 |
| Sandia Spring | 35 50 28.42 | 106 10 21.38 | Sandia Sir. |
| Spring 2A | 35 49 22.87 | 106 10 27.98 | Spring 2 |
| Spring 3 | 35 49 10.02 | 106 10 42.04 | Spring 3 |
| Spring 3A | 35 49 07.41 | 106 10 41.64 | Spring 3A |
| Spring 3AA | 35 48 45.18 | 106 10 44.44 | Spring 3AA |
| Spring 3B | 35 48 32.95 | 106 10 43.69 | Spring 3B |
| Spring 4 | 35 48 13.93 | 106 11 48.37 | Spring 4 |
| Spring 4A | 35 48 13.68 | 106 11 46.96 | Spring 4A |
| Spring 5 | 35 47 21.05 | 106 11 48.06 | Spring 5 |
| Spring 5A | 35 47 15.75 | 106 11 56.46 | Spring 5A |
| Spring 5AA | 35 47 21.28 | 106 12 47.69 | Spring 5AA |
| Spring 5B | 35 46 37.76 | 106 12 48.92 | Spring 5B |
| Ancho Spring | 35 46 55.58 | 106 13 54.46 | Ancho Spring |
| Spring 6 | 35 46 11.61 | 106 13 15.17 | Spring 6 |
| Spring 6A | 35 45 59.30 | 106 13 43.33 | Spring 6A |
| Spring 7 | 35 45 52.28 | 106 14 01.75 | Spring 7 |
| Spring 8 | 35 45 51.29 | 106 14 09.03 | Spring 8 |
| Spring 8A | 35 45 51.75 | 106 14 16.63 | Spring 8A |
| Spring 8B | 35 45 52.28 | 106 14 23.60 | Spring 8B |
| Spring 9 | 35 45 49.86 | 106 14 21.28 | Spring 9 |
| Spring 9A | 35 45 48.18 | 106 14 29.69 | Spring 9A |
| DOE Spring | 35 45 52.64 | 106 14 34.75 | DOE Spring |
| Spring 10 | 35 44 58.87 | 106 15 26.95 | Spring 10 |

## Table 6.4.6 Sampling Stations and Streams of White Rock Canyon - 1992 & 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| Rio Grande At Otowi Bridge | 35 52 51.5 | 106 08 58.3 | Rio Grande at Otowi Bridge |
| Mortandad Stream above confluence with Rio Grande | 35 49 44.4 | 106 10 19.0 | MO 0.1 |
| Pajarito Stream above confluence with Rio Grande | 35 48 10.9 | 106 11 39.8 | PA 0.1 |
| Ancho Stream above confluence with Rio Grande | 35 46 17.1 | 106 13 11.3 | AN 0.1 |
| Chaquehui above confluence with Rio Grande | 35 45 49.3 | 106 14 32.0 | CH 0.1 |
| Frijoles above confluence with Rio Grande | 35 45 15.5 | 106 15 19.4 | FR 0.1 |
| Cochiti Lake at Bland Canyon | | | Cochiti Lake at Bland Canyon |
| Cochiti Lake at the Tetilla Boat landing | | | Cochiti Lake at Boat landing |
| Cochiti Lake at the Dam Site | 35 37 00.0 | 106 19 00.1 | Cochiti Lake at Dam Site |

## Table 6.5.1 Invertebrate Sampling Stations - LANL - 1992 & 1993

| STATION | LATITUDE | LONGITUDE | MAP DESIGNATION |
|---|---|---|---|
| **Stations Sampled in 1992** | | | |
| Mortandad Stream above confluence with Rio Grande | 35 49 44.4 | 106 10 19.0 | MO 0.1 |
| Pajarito Stream above confluence with Rio Grande | 35 48 10.9 | 106 11 39.8 | PA 0.1 |
| Chaquehui above confluence with Rio Grande | 35 45 49.3 | 106 14 32.0 | CH 0.1 |
| Ancho Stream above confluence with Rio Grande | 35 46 17.1 | 106 13 11.3 | AN 0.1 |
| Frijoles above confluence with Rio Grande | 35 45 15.5 | 106 21 11.7 | FR 0.1 |
| **Stations Sampled in 1993** | | | |
| Los Alamos Canyon below Reservoir Spillway | 35 53 00.1 | 106 21 11.7 | LA 12.2 |
| Los Alamos Canyon below TA 53 | 35 52 13 | 106 14 18 | LA 5.3 |
| Sandia Canyon below TA 53 | 35 51 59 | 106 16 10 | SA 6.1 |
| Ancho Stream above confluence with Rio Grande | 35 46 17.1 | 106 13 11.3 | AN 0.1 |
| Pajarito Stream above confluence with Rio Grande | 35 48 10.9 | 106 11 39.8 | PA 0.1 |
| DP Canyon | 35 52 22 | 106 15 35 | DP 0.1 |
| Frijoles above confluence with Rio Grande | 35 45 15.5 | 1106 21 11.7 | FR 0.1 |

**TABLE 6.3.3 Snowmelt Stations - Water Chemistry - LANL - 1992**

G-1

| WATER CHEMISTRY | SNOWMELT STATIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AN3.8 Dt: 920505 Tm: 0955 | VA0.1 Dt: 920505 Tm: 1215 | WA6.7 Dt: 920505 Tm: 1301 | LA12.2 Dt: 920506 Tm: 0849 | PA10.4 Dt: 920506 Tm: 0953 | VA3.2 Dt: 920506 Tm: 1045 | WA9.9 Dt: 920506 Tm: 1244 | PA4.4 Dt: 920506 Tm: 1420 | SA6.1 Dt: 920507 Tm: 1034 | LA5.3 Dt: 920507 Tm: 1400 |
| Water Temp. (C) | 12.50 | 11.00 | 15.50 | 10.00 | 7.20 | 11.00 | 8.40 | 17.50 | 10.50 | 12.00 |
| Field Conductivity (uhmo) | 140.00 | 90.00 | 90.00 | 50.00 | 35.00 | 8.00 | 95.00 | 220.00 | 310.00 | 125.00 |
| Dissolved Oxygen (mg/L) | 3.00 | 5.80 | 6.00 | 6.40 | 7.20 | 7.20 | 5.60 | 6.50 | 8.15 | 8.20 |
| Field pH (S.U.) | 7.29 | 7.50 | 7.60 | 8.30 | 8.10 | 7.90 | 7.00 | 8.50 | 8.10 | 7.60 |
| Nitrate+Ite (mg/L) | 0.04K | 0.04K | 0.09 | 0.10 | 0.18 | 1300.00 | 0.04K | 0.04K | 4.32 | 0.10 |
| Ammonia (mg/L) | 0.16 | 0.12Q | 0.14Q | 0.10K | 0.10K | 0.10 | 0.14 | 0.10KQ | 0.10 | 0.10 |
| Kjeldahl N (mg/L) | 0.83 | 0.32Q | 0.29Q | 0.22Q | 0.20Q | 0.10KQ | 0.39Q | 0.21Q | 0.71Q | 0.27 |
| Total Phos. (mg/L) | 0.12 | 0.10Q | 0.12Q | 0.09Q | 1.37Q | 0.05Q | 0.10Q | 0.03Q | 1.69Q | 0.12 |
| BOD (mg/L) | 2.00 | 1.00K | 1.00K | 1.00K | 1.00K | 1.00KQ | 1.00K | 1.00K | 1.00K | 1.00K |
| COD (mg/L) | 47.00 | 9.00 | 15.00 | 11.00 | 10.00 | 8.00 | 11.00 | 21.00 | 38.00 | 8.00 |
| Cyanide (mg/L) | 0.02K | 0.02KQ | 0.02K | 0.02K | 0.04K | 0.04KQ | 0.02K | 0.04K | 0.02K | 0.02K |
| Ca (mg/L) | 22.00 | 15.00 | 13.00 | 6.00 | 6.00 | 6.00 | 24.00 | 21.00 | 18.00 | 9.00 |
| Mg (mg/L) | 5.00 | 4.00 | 4.00 | 2.00 | 2.00 | 1.00 | 4.00 | 6.00 | 3.00 | 2.00 |
| K (mg/L) | 6.00 | 3.00 | 4.00 | 2.00 | 2.00 | 2.00 | 4.00 | 4.00 | 9.00 | 3.00 |
| Na (mg/L) | 13.00 | 13.00 | 20.00 | 5.00 | 3.00 | 3.00 | 13.00 | 22.00 | 82.00 | 19.00 |
| Hardness (mg/L) | 76.00 | 54.00 | 49.00 | 23.00 | 23.00 | 19.00 | 76.00 | 77.00 | 57.00 | 31.00 |
| Alkalinity (mg/L) | 89.10Q | 49.10Q | 38.40Q | 21.20Q | 26.10Q | 20.90 | 38.4Q | 78.6Q | 90.20Q | 35.8Q |
| Bicarbonate(mg/L) | 109.00 | 59.80 | 46.90 | 25.80 | 31.90 | 25.50 | 46.90 | 95.90 | 94.60 | 43.70 |
| Carbonate (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 15.20Q | 0.00 |
| Chloride (mg/L) | 5.00KQ | 5.00Q | 24.00Q | 7.80 | 5.00KQ | 5.00KQ | 19.00Q | 30.1Q | 37.70Q | 25.40Q |
| Fluoride (mg/L) | 0.18 | 0.27 | 0.18 | 0.10K | 0.10K | 0.10K | 0.11 | 0.14 | 0.70 | 0.26 |
| Sulfate (mg/L) | 5.00KQ | 6.10Q | 7.60Q | 7.60Q | 7.10Q | 6.20Q | 10.20Q | 8.1Q | 87.40Q | 7.90Q |
| Color Test (units) | 50.00LQ | 50.00L | 50.00L | 30.00Q | 20.00Q | 25.00Q | 50.00LQ | 5.00Q | 25.00Q | 30.00Q |
| Lab Conductivity (uS/cm) | 194.00 | 129.00 | 178.00 | 77.00 | 71.00 | 60.00 | 153.00 | 263.00 | 557.00 | 173.00 |
| Lab pH (S.U.) | 7.74 | 7.63 | 7.28 | 7.28 | 7.42 | 7.35 | 7.78 | 8.07 | 8.72 | 7.53 |
| TDS (mg/L) | 175.00Q | 184.00 | 204.00Q | 68Q | 68Q | 88.00Q | 196.00Q | 152.00Q | 358Q | 156Q |
| TSS (mg/L) | 12.00Q | 8.00 | 4.00Q | 15Q | 35Q | 3.00Q | 8.00Q | 5.00Q | 39Q | 12Q |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.4 Snowmelt Stations - Total Metals - LANL - 1992**

| TOTAL METALS (ug/L) | SNOWMELT STATIONS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AN3.8 Dt: 920505 Tm: 1025 | VA0.1 Dt: 920505 Tm: 1253 | WA6.7 Dt: 920505 Tm: 1316 | LA12.2 Dt: 920506 Tm: 0851 | PA10.4 Dt: 920506 Tm: 0944 | VA3.2 Dt: 920506 Tm: 1043 | WA9.9 Dt: 920506 Tm: 1238 | PA4.4 Dt: 920506 Tm: 1430 | PA4.4 * Dt: 920506 Tm: 1449 | SA6.1 Dt: 920507 Tm: 1051 | LA5.3 Dt: 920507 Tm: 1414 |
| Al | 700 | 6700 | 6500 | 3000 | 2600 | 1500 | 6400 | 100K | 100Q | 1000 | 3000 |
| Ba | 100K | 800 | 110 | 100K | 100K | 100K | 100K | 100K | 100KQ | 100K | 100K |
| Be | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100KQ | 100K | 100K |
| B | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100KQ | 200 | 100K |
| Ca | 21000 | 10000 | 13000 | 64000 | 6300 | 5300 | 11000 | 16000 | 14000Q | 20000 | 10000 |
| Co | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 50KQ | 5K | 5K |
| Cu | 50K | 50K | 50K | 50K | 50K | 50K | 50K | 50K | 100KQ | 50K | 50K |
| Fe | 2500 | 3300 | 2900 | 1100 | 900 | 500 | 2600 | 100 | 100KQ | 700 | 1200 |
| Mg | 5100 | 3400 | 3900 | 2100 | 2400 | 1600 | 4000 | 5000 | 4700Q | 3800 | 2700 |
| Mn | 400 | 50K | 50K | 50K | 50K | 50K | 50K | 50K | 50KQ | 50K | 50K |
| Mo | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100KQ | 200 | 100K |
| Ni | 200 | 200 | 100K | 100 | 100 | 200 | 200 | 100K | 100KQ | 100 | 100K |
| Si | 2900 | 2900 | 3100 | 2600 | 2500 | 2600 | 3300 | 1600 | 1700Q | 3800 | 2700 |
| Ag | 1K | 1K | 1K | 1K | 1K | 1K | 1K | 1K | 100KQ | 1 | 1K |
| Sr | 100 | 100K | 100K | 100K | 100K | 100K | 100K | 100 | 100Q | 100K | 100K |
| Sn | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100KQ | 100K | 100K |
| V | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100KQ | 100K | 100K |
| Zn | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100KQ | 100K | 100K |
| U | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | | 5K | 5K |
| As | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5KQ | 5K | 5K |
| Cd | 1K | 1K | 1K | 1K | 1K | 1K | 1K | 1K | 1KQ | 1K | 1K |
| Cr | 5K | 5K | 5K | 25 | 5K | 5K | 5K | 5K | 5KQ | 15 | 5K |
| Pb | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 6 | 5KQ | 5K | 5K |
| Hg | .5K | .5K | .5K | .5K | .5K | .5K | .5K | .5K | .5KQ | .5K | .5K |
| Se | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | | 5K | 5K |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.5 Snowmelt Stations - Dissolved Metals - LANL - 1992**

| DISSOLVED METALS (ug/L) | SNOWMELT STATIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AN3.8 Dt: 920505 Tm: 1025 | VA0.1 Dt: 920505 Tm: 1253 | WA6.7 Dt: 920505 Tm: 1316 | LA12.2 Dt: 920506 Tm: 0851 | PA10.4 Dt: 920506 Tm: 0944 | VA3.2 Dt: 920506 Tm: 1043 | WA9.9 Dt: 920506 Tm: 1238 | PA4.4 Dt: 920506 Tm: 1430 | SA6.1 Dt: 920507 Tm: 1051 | LA5.3 Dt: 920507 Tm: 1414 |
| Al | 100KQ | 3300Q | 2800Q | 1700Q | 1600Q | 1300Q | 4400Q | 100KQ | 100 | 1000 |
| Ba | 100KQ | 100K | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100Q |
| Be | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100K |
| B | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100K |
| Ca | 20000Q | 10000Q | 11000Q | 6200Q | 6200Q | 5600Q | 10000Q | 21000Q | 19000 | 10000 |
| Co | 5KQ | 10K | 5KQ | 5KQ | 5KQ | 5KQ | 5KQ | 5KQ | 10K | 5KQ |
| Cu | 50KQ | 50K | 50KQ | 50KQ | 50KQ | 50KQ | 50KQ | 50KQ | 50K | 50K |
| Fe | 700Q | 1600Q | 1300Q | 600Q | 500Q | 500Q | 1900Q | 100KQ | 200 | 400 |
| Mg | 4600Q | 3100Q | 3600Q | 2100Q | 2400Q | 1700Q | 4300Q | 5600Q | 3700 | 2700 |
| Mn | 310Q | 50KQ | 50KQ | 50KQ | 50KQ | 50KQ | 50KQ | 50KQ | 50K | 50K |
| Mo | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 200 | 100K |
| Ni | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100K |
| Si | 17000Q | 24000Q | 300Q | 16000Q | 18000Q | 15000Q | 500Q | 12000Q | 40000 | 19000 |
| Ag | 1KQ | 1K | 1KQ | 1KQ | 1KQ | 1KQ | 1K | 1KQ | 1K | 1K |
| Sr | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100K |
| Sn | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100K |
| V | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100K |
| Zn | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100KQ | 100K | 100K |
| U | 5KQ | 5K | 5K | 5KQ | 5KQ | 5K | 5K | 5KQ | 5K | 5K |
| As | 5KQ | 5K | 5KQ | 5KQ | 5KQ | 5KQ | 5KQ | 5KQ | 5K | 5KQ |
| Cd | 1KQ | 1K | 1KQ | 1KQ | 1KQ | 1KQ | 1KQ | 1KQ | 1K | 1KQ |
| Cr | 5KQ | 5K | 5KQ | 15KQ | 7KQ | 18KQ | 5KQ | 5KQ | 8 | 5KQ |
| Pb | 5KQ | 5K | 5KQ | 5KQ | 5KQ | 5KQ | 5KQ | 5KQ | 5K | 5K |
| Hg | .5KQ | .5K | .5K | .5KQ | .5KQ | .5K | .5K | .5KQ | .5K | .5K |
| Se | 5KQ | 5K | 5KQ | 5KQ | 5KQ | 5KQ | 5K | 5KQ | 5K | 5KQ |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.6 Snowmelt Stations - Radiochemistry - LANL - 1992 (Part I)

| ANALYTE (pCi/L) | SNOWMELT STATIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | AN3.8 Dt: 920505 Tm: 0955 | | | VA0.1 Dt: 920505 Tm: 1254 | | | WA6.7 Dt: 920505 Tm: 1328 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 0.30 | 0.30 | 0.40 | 0.70 | 0.20 | 0.40 | 1.20 | 0.40 | 0.60 |
| Gross-alpha w/ U-nat ref | 0.50 | 0.40 | 0.60 | 1.00 | 0.40 | 0.60 | 1.70 | 0.60 | 0.80 |
| Gross-beta w/ Cs-137 ref | 9.70 | 0.80 | 0.70 | 6.00 | 0.60 | 0.60 | 7.20 | 0.70 | 1.00 |
| Gross-beta w/ Sr/Y-90 ref | 9.70 | 0.70 | 0.70 | 6.00 | 0.60 | 0.70 | 7.30 | 0.70 | 1.00 |
| U-238 Alpha Spec. | 0.13 | 0.07 | | 0.22 | 0.07 | | 0.16 | 0.06 | |
| U-234 Alpha Spec. | 0.075 | 0.06 | | 0.11 | 0.05 | | 0.06 | 0.05 | |
| Th-230 Alpha Spec. | -0.003 | 0.04 | | 0.11 | 0.06 | | 0.06 | 0.05 | |
| Th-232 Alpha Spec. | 0.026 | 0.013 | | 0.09 | 0.06 | | 0.1 | 0.06 | |
| Am-241 Alpha Spec. | -0.01 | 0.013 | | 0.06 | 0.025 | | 0.031 | 0.02 | |
| Pu-239 Alpha Spec | -0.005 | 0.006 | | | | | | | |
| Pu-238 Alpha Spec. | -0.027 | 0.015 | | | | | | | |

| ANALYTE (pCi/L) | SNOWMELT STATIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LA12.2 Dt: 920506 Tm: 0902 | | | PA10.4 Dt: 920506 Tm: 1010 | | | VA3.2 Dt: 920506 Tm: 1107 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 0.50 | 0.20 | 0.30 | 0.40 | 0.20 | 0.30 | 0.30 | 0.10 | 0.30 |
| Gross-alpha w/ U-nat ref | 0.60 | 0.20 | 0.40 | 0.60 | 0.20 | 0.30 | 0.40 | 0.20 | 0.30 |
| Gross-beta w/ Cs-137 ref | 3.00 | 0.30 | 0.50 | 3.20 | 0.30 | 0.50 | 2.60 | 0.30 | 0.50 |
| Gross-beta w/ Sr/Y-90 ref | 3.00 | 0.30 | 0.50 | 3.20 | 0.30 | 0.50 | 2.60 | 0.30 | 0.50 |
| U-238 Alpha Spec. | 0.11 | 0.05 | | 0.15 | 0.06 | | 0.11 | 0.06 | |
| U-234 Alpha Spec. | 0.07 | 0.05 | | 0.06 | 0.04 | | 0.04 | 0.04 | |
| Th-230 Alpha Spec. | 0.015 | 0.04 | | 0 | 0.03 | | 0.02 | 0.04 | |
| Th-232 Alpha Spec. | 0.041 | 0.015 | | 0.032 | 0.014 | | 0.029 | 0.013 | |
| Am-241 Alpha Spec. | 0.005 | 0.1 | | -0.004 | 0.007 | | 0.033 | 0.02 | |
| Pu-239 Alpha Spec | 0 | 0.006 | | 0.068 | 0.021 | | 0.012 | 0.011 | |
| Pu-238 Alpha Spec. | -0.019 | 0.013 | | -0.01 | 0.011 | | -0.002 | 0.012 | |

| ANALYTE (pCi/L) | SNOWMELT STATIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | WA9.9 Dt: 920506 Tm: 1306 | | | PA4.4 Dt: 920506 Tm: 1450 | | | PA4.4* Dt: 920506 Tm: 1450 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 1.70 | 0.30 | 0.40 | 0.40 | 0.30 | 0.40 | 0.30 | 0.20 | 0.40 |
| Gross-alpha w/ U-nat ref | 2.40 | 0.50 | 0.60 | 0.60 | 0.40 | 0.60 | 0.40 | 0.30 | 0.60 |
| Gross-beta w/ Cs-137 ref | 6.10 | 0.60 | 0.70 | 4.40 | 0.50 | 0.70 | 4.70 | 0.60 | 0.70 |
| Gross-beta w/ Sr/Y-90 ref | 6.10 | 0.60 | 0.70 | 4.40 | 0.50 | 0.70 | 4.80 | 0.60 | 0.70 |
| U-238 Alpha Spec. | 0.14 | 0.08 | | 0.17 | 0.07 | | 0.15 | 0.06 | |
| U-234 Alpha Spec. | 0.22 | 0.1 | | 0.12 | 0.06 | | 0.1 | 0.05 | |
| Th-230 Alpha Spec. | 0.05 | 0.04 | | -0.03 | 0.04 | | 0 | 0.04 | |
| Th-232 Alpha Spec. | 0.11 | 0.03 | | 0.005 | 0.006 | | 0.017 | 0.015 | |
| Am-241 Alpha Spec. | -0.004 | 0.01 | | 0.002 | 0.007 | | 0.06 | 0.03 | |
| Pu-239 Alpha Spec | 0 | 0.006 | | -0.003 | 0.005 | | 0.06 | 0.04 | |
| Pu-238 Alpha Spec. | -0.019 | 0.013 | | -0.015 | 0.012 | | 0.025 | 0.04 | |

**TABLE 6.3.6** Snowmelt Stations - Radiochemistry - LANL - 1992 (Part I)
(Continued From Previous Page)

| ANALYTE (pCi/L) | SNOWMELT STATIONS | | | | | |
|---|---|---|---|---|---|---|
| | LA5.3 Dt: 920507 Tm: 000 | | | SA6.1 Dt: 920507 Tm: 1052 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 0.60 | 0.30 | 0.40 | 0.60 | 0.40 | 0.90 |
| Gross-alpha w/ U-nat ref | 0.80 | 0.40 | 0.60 | 0.80 | 0.60 | 1.20 |
| Gross-beta w/ Cs-137 ref | 8.00 | 0.70 | 0.70 | 10.70 | 1.10 | 1.50 |
| Gross-beta w/ Sr/Y-90 ref | 8.10 | 0.70 | 0.70 | 10.70 | 1.10 | 1.50 |
| U-238 Alpha Spec. | 0.21 | 0.08 | | 0.14 | 0.06 | |
| U-234 Alpha Spec. | 0.13 | 0.06 | | 0.11 | 0.05 | |
| Th-230 Alpha Spec. | 0.005 | 0.04 | | 0.02 | 0.04 | |
| Th-232 Alpha Spec. | 0.067 | 0.021 | | 0.042 | 0.015 | |
| Am-241 Alpha Spec. | 0.046 | 0.019 | | 0.009 | 0.01 | |
| Pu-239 Alpha Spec | 0.08 | 0.025 | | 0.011 | 0.01 | |
| Pu-238 Alpha Spec. | -0.011 | 0.011 | | -0.01 | 0.013 | |

**TABLE 6.3.7** Snowmelt Stations - Radiochemistry - LANL - 1992 (Part II)

| STATION | DATE | TIME | GAMA SPEC # of PEAKS | NUCLIDE | ENERGY keV | gamma/sec/L | pCi/L |
|---|---|---|---|---|---|---|---|
| AN3.8 | 920505 | 0955 | 0 | | | | |
| VA0.1 | 920505 | 1254 | 0 | | | | |
| WA6.7 | 920505 | 1328 | 0 | | | | |
| LA12.2 | 920506 | 0902 | 0 | | | | |
| PA10.4 | 920506 | 1010 | 1 | K-40 | 1461.58 | 0.22 +- 0.22 | 56. +-55. |
| VA3.2 | 920506 | 1107 | 0 | | | | |
| WA9.9 | 920506 | 1306 | 0 | | | | |
| PA4.4 | 920506 | 1450 | 0 | | | | |
| PA4.4* | 920506 | 1450 | 0 | | | | |
| SA6.1 | 920507 | 1052 | 0 | | | | |
| LA5.3 | 920507 | 000 | 0 | | | | |

* = Replicate

**ABLE 6.3.8** Snowmelt Stations - Volatile Organic Compounds - LANL - 1992

| VOLATILE ORGANIC COMPOUNDS (ug/L) | SNOWMELT STATIONS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AN3.8 920505 0955 | VA0.1 920505 1246 | WA6.7 920505 1323 | LA12.2 920506 0857 | PA10.4 920506 1001 | VA3.2 920506 1058 | WA9.9 920506 1259 | PA4.4 920506 1445 | PA4.4 920506 1452 | SA6.1 920507 1045 | LA5.3 920507 1400 |
| Acetone | U | U | U | U | U | U | U | U | U | U | |
| Benzene | U | U | U | U | U | U | U | U | U | U | |
| Bromobenzene | U | U | U | U | U | U | U | U | U | U | |
| Bromochloromethane (Chlorobromomethane) | U | U | U | U | U | U | U | U | U | U | |
| Bromodichloromethane | U | U | U | U | U | U | U | U | U | U | |
| Bromoform | U | U | U | U | U | U | U | U | U | U | |
| Bromomethane | U | U | U | U | U | U | U | U | U | U | |
| 2-Butanone (MEK) | U | U | U | U | U | U | U | U | U | U | |
| n-Butylbenzene | U | U | U | U | U | U | U | U | U | U | |
| sec-Butylbenzene | U | U | U | U | U | U | U | U | U | U | |
| tert-Butylbenzene | U | U | U | U | U | U | U | U | U | U | |
| tert-Butyl methyl ether (MTBE) | U | U | U | U | U | U | U | U | U | U | |
| Carbon tetrachloride | U | U | U | U | U | U | U | U | U | U | |
| Chlorobenzene | U | U | U | U | U | U | U | U | U | U | |
| Chloroethane | U | U | U | U | U | U | U | U | U | U | |
| Chloroform | U | U | U | U | U | U | U | U | U | U | |
| Chloromethane (Methyl Chloride) | U | U | U | U | U | U | U | U | U | U | |
| 2-Chlorotoluene | U | U | U | U | U | U | U | U | U | U | |
| 4-Chlorotoluene (1-Methyl-4Chlorobenzene) | U | U | U | U | U | U | U | U | U | U | |
| 1,2-Dibromo-3-chloropropane | U | U | U | U | U | U | U | U | U | U | |
| Dibromochloromethane | U | U | U | U | U | U | U | U | U | U | |
| 1,2-Dibromoethane | U | U | U | U | U | U | U | U | U | U | |
| Dibromomethane (Methylene Bromide) | U | U | U | U | U | U | U | U | U | U | |
| 1,2-Dichlorobenzene | U | U | U | U | U | U | U | U | U | U | |
| 1,3-Dichlorobenzene | U | U | U | U | U | U | U | U | U | U | |
| 1,4-Dichlorobenzene | U | U | U | U | U | U | U | U | U | U | |
| Dichlorodifluoromethane | U | U | U | U | U | U | U | U | U | U | |
| 1,1-Dichloroethane | U | U | U | U | U | U | U | U | U | U | |
| 1,2-Dichloroethane | U | U | U | U | U | U | U | U | U | U | |
| 1,1-Dichloroethene | U | U | U | U | U | U | U | U | U | U | |
| cis-1,2-Dichloroethene | U | U | U | U | U | U | U | U | U | U | |
| trans-1,2-Dichloroethene | U | U | U | U | U | U | U | U | U | U | |
| 1,2-Dichloropropane | U | U | U | U | U | U | U | U | U | U | |
| 1,3-Dichloropropane | U | U | U | U | U | U | U | U | U | U | |
| 2,2-Dichloropropane | U | U | U | U | U | U | U | U | U | U | |
| 1,1-Dichloropropene | U | U | U | U | U | U | U | U | U | U | |
| cis-1,3-Dichloropropene | U | U | U | U | U | U | U | U | U | U | |
| trans-1,3-Dichloropropene | U | U | U | U | U | U | U | U | U | U | |
| Ethylbenzene | U | U | U | U | U | U | U | U | U | U | |
| Hexachlorobutadiene | U | U | U | U | U | U | U | U | U | U | |
| Isopropylbenzene | U | U | U | U | U | U | U | U | U | U | |
| (1-Methyl -) 4-Isopropyltoluene | U | U | U | U | U | U | U | U | U | U | |
| Methylene chloride | U | U | U | U | U | U | U | U | U | U | |
| Naphthalene | U | U | U | U | U | U | U | U | U | U | |

Legend:
B = Indicates compound was detected in the Lab Blank as well as in the sample.
J = Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
U = Indicates compound was analyzed for but not detected.

**TABLE 6.3.8** Snowmelt Stations - Volatile Organic Compounds - LANL - 1992
(Continued)

| VOLATILE ORGANIC COMPOUNDS (ug/L) | SNOWMELT STATIONS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AN3.8 920505 0955 | VA0.1 920505 1246 | WA6.7 920505 1323 | LA12.2 920506 0857 | PA10.4 920506 1001 | VA3.2 920506 1058 | WA9.9 920506 1259 | PA4.4 920506 1445 | PA4.4 920506 1452 | SA6.1 920507 1045 | LA5.3 920507 1400 |
| N-Propylbenzene | U | U | U | U | U | U | U | U | U | U | |
| Styrene | U | U | U | U | U | U | U | U | U | U | |
| 1,1,1,2-Tetrachloroethane | U | U | U | U | U | U | U | U | U | U | |
| 1,1,2,2-Tetrachloroethane | U | U | U | U | U | U | U | U | U | U | |
| Tetrachloroethylene | U | U | U | U | U | U | U | U | U | U | |
| Tetrahydrofuran (THF) | U | U | U | U | U | U | U | U | U | U | |
| Toluene | U | U | U | U | U | U | U | U | U | U | |
| 1,2,3-Trichlorobenzene | U | U | U | U | U | U | U | U | U | U | |
| 1,2,4-Trichlorobenzene | U | U | U | U | U | U | U | U | U | U | |
| 1,1,1-Trichloroethane | U | U | U | U | U | U | U | U | U | U | |
| 1,1,2-Trichloroethane | U | U | U | U | U | U | U | U | U | U | |
| Trichloroethylene | U | U | U | U | U | U | U | U | U | U | |
| Trichlorofluoromethane | U | U | U | U | U | U | U | U | U | U | |
| 1,2,3-Trichloropropane | U | U | U | U | U | U | U | U | U | U | |
| 1,2,4-Trimethylbenzene | U | U | U | U | U | U | U | U | U | U | |
| 1,3,5-Trimethylbenzene | U | U | U | U | U | U | U | U | U | U | |
| Vinyl chloride | U | U | U | U | U | U | U | U | U | U | |
| o-Xylene | U | U | U | U | U | U | U | U | U | U | |
| p- & m- Xylene | U | U | U | U | U | U | U | U | U | U | |
| Acenaphthene | U | U | U | U | U | U | U | U | U | U | U |
| Acenaphthylene | U | U | U | U | U | U | U | U | U | U | |
| Anthracene | U | U | U | U | U | U | U | U | U | U | |
| Benzoic acid | U | U | U | U | U | U | U | U | U | U | U |
| Benzo (a) anthracene | U | U | U | U | U | U | U | U | U | U | U |
| Benzo (b) fluoroanthene | U | U | U | U | U | U | U | U | U | U | U |
| Benzo (k) fluoroanthene | U | U | U | U | U | U | U | U | U | U | U |
| Benzo (g,h,i,) perylene | U | U | U | U | U | U | U | U | U | U | U |
| Benzo -a-pyrene | U | U | U | U | U | U | U | U | U | U | U |
| Benzyl alcohol | U | U | U | U | U | U | U | U | U | U | U |
| Bis (2-chloroethoxy) methane | U | U | U | U | U | U | U | U | U | U | U |
| Bis (2-chloroethyl) ether | U | U | U | U | U | U | U | U | U | U | U |
| Bis (2-chloroisopropyl)ether | U | U | U | U | U | U | U | U | U | U | U |
| Bis (2-ethylhexyl) phthalate | 1.00 (J) | U | 10.00 (B) | U | 1.00 (J) | 10.00 | 60.00 | 50.00 | 1.00 (J) | 120.00 | 8.00 (J) |
| 4-Bromophenylphenyl ether | U | U | U | U | U | U | U | U | U | U | U |
| N-Butylbenzyl phthalate | U | U | U | U | U | U | U | U | U | 4.00 (J) | U |
| 4-Chloroaniline (Benzenomine, 4 Chloro) | U | U | U | U | U | U | U | U | U | U | U |
| 2-Chloronaphthalene | U | U | U | U | U | U | U | U | U | U | U |
| 4-Chloro-3-methylphenol (Parachlorometa Cresol) | U | U | U | U | U | U | U | U | U | U | U |
| 2-Chlorophenol | U | U | U | U | U | U | U | U | U | U | U |
| 4-Chlorophenylphenyl ether | U | U | U | U | U | U | U | U | U | U | U |
| Chrysene | U | U | U | U | U | U | U | U | U | U | U |

Legend:
B = Indicates compound was detected in the Lab Blank as well as in the sample.
J = Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
U = Indicates compound was analyzed for but not detected.

**TABLE 6.3.8** Snowmelt Stations - Volatile Organic Compounds - LANL - 1992
(Continued)

| VOLATILE ORGANIC COMPOUNDS (ug/L) | SNOWMELT STATIONS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AN3.8 920505 0955 | VA0.1 920505 1246 | WA6.7 920505 1323 | LA12.2 920506 0857 | PA10.4 920506 1001 | VA3.2 920506 1058 | WA9.9 920506 1259 | PA4.4 920506 1445 | PA4.4 920506 1452 | SA6.1 920507 1045 | LA5.3 920507 1400 |
| Dibenz (a,h) anthracene (1,2,5,6-Dibenzanthracene) | U | U | U | U | U | U | U | U | U | U | U |
| Dibenzofuran | U | U | U | U | U | U | U | U | U | U | U |
| Di-n-butyl phthalate | 1.00 (J) | 2.00 (J,B) | 1.00 (J,B) | U | U | U | U | U | U | U | U |
| 1,2 -Dichlorobenzene | U | U | U | U | U | U | U | U | U | U | U |
| 1,3-Dichlorobenzene | U | U | U | U | U | U | U | U | U | U | U |
| 1,4-Dichlorobenzene | U | U | U | U | U | U | U | U | U | U | U |
| 3,3'-Dichlorobenzidine | U | U | U | U | U | U | U | U | U | U | U |
| 2,4-Dichlorophenol | U | U | U | U | U | U | U | U | U | U | U |
| Diethyl phthalate | U | U | 1.00 (J,B) | U | U | U | U | U | U | U | U |
| 2,4-Dimethylphenol | U | U | U | U | U | U | U | U | U | U | U |
| Dimethyl phthalate | U | U | U | U | U | U | U | U | U | U | U |
| 4,6-Dinitro-2-methylphenol | U | U | U | U | U | U | U | U | U | U | U |
| 2,4-Dinitrophenol | U | U | U | U | U | U | U | U | U | U | U |
| 2,4-Dinitrotoluene | U | U | U | U | U | U | U | U | U | U | U |
| 2,6-Dinitrotoluene | U | U | U | U | U | U | U | U | U | U | U |
| Di-n-octyl phthalate | U | 1.00 (J, B) | U | U | U | U | U | U | U | 60.00 | U |
| Fluoranthene | U | U | U | U | U | U | U | U | U | U | U |
| Fluorene | U | U | U | U | U | U | U | U | U | U | U |
| Hexachlorobenzene | U | U | U | U | U | U | U | U | U | U | U |
| Hexachlorobutadiene | U | U | U | U | U | U | U | U | U | U | U |
| Hexachlorocyclopentadiene | U | U | U | U | U | U | U | U | U | U | U |
| Hexachlorethane | U | U | U | U | U | U | U | U | U | U | U |
| Indeno (1,2,3-cd) pyrene | U | U | U | U | U | U | U | U | U | U | U |
| Isophorone | U | U | U | U | U | U | U | U | U | U | U |
| 2-Methylnaphthalene | U | U | U | U | U | U | U | U | U | U | U |
| 2-Methylphenol (O-Cresol) | U | U | U | U | U | U | U | U | U | U | U |
| 4-Methylphenol (P-Cresol) | U | U | U | U | U | U | U | U | U | U | U |
| Naphthalene | U | U | U | U | U | U | U | U | U | U | U |
| 2-Nitroaniline | U | U | U | U | U | U | U | U | U | U | U |
| 3-Nitroaniline | U | U | U | U | U | U | U | U | U | U | U |
| 4-Nitroaniline | U | U | U | U | U | U | U | U | U | U | U |
| Nitrobenzene | U | U | U | U | U | U | U | U | U | U | U |
| 2-Nitrophenol | U | U | U | U | U | U | U | U | U | U | U |
| 4-Nitrophenol | U | U | U | U | U | U | U | U | U | U | U |
| N-nitrosodiphenylamine | U | U | U | U | U | U | U | U | U | U | U |
| N-nitroso-di-n-propylamine | U | U | U | U | U | U | U | U | U | U | U |
| Pentachlorophenol (PCP) | U | U | U | U | U | U | U | U | U | U | U |
| Phenanthrene | U | U | U | U | U | U | U | U | U | U | U |
| Phenol (C6H5OH) - Single Compound | U | U | U | U | U | U | U | U | U | U | U |
| Pyrene | U | U | U | U | U | U | U | U | U | U | U |
| 1,2,4-Trichlorobenzene | U | U | U | U | U | U | U | U | U | U | U |
| 2,4,5-Trichlorophenol | U | U | U | U | U | U | U | U | U | U | U |
| 2,4,6-Trichlorophenol | U | U | U | U | U | U | U | U | U | U | U |

Legend:
B = Indicates compound was detected in the Lab Blank as well as in the sample.
J = Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
U = Indicates compound was analyzed for but not detected.

**TABLE 6.3.9 Snowmelt Stations - Water Chemistry - LANL -1993**

| WATER CHEMISTRY | SNOWMELT STATIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | PA10.4 930324 1145 | AN2.9 930324 1321 | VA3.2 930430 1103 | PU6.6 930430 1142 | WA9.9 930430 1023 | PU1.3 930618 1156 | AC0.0 930618 1031 | WA6.5 930628 1008 | SA6.1 930614 1029 |
| Water Temp. (C) | | | | | | | | | |
| Field Conductivity (uhmo) | | | | | | | | | |
| Dissolved Oxygen (mg/L) | | | | | | | | | |
| Field pH (S.U.) | | | | | | | | | |
| Total Org. Carbon (mg/L) | | | | | | | | | |
| Nitrate+ite (mg/L) | 0.05 | 0.04K | .04K | .04K | .04K | 5.02 | 1.37 | 0.22 | 1.05 |
| Ammonia (mg/L) | 0.10K | 0.10K | .10K | .10K | .10K | 10.80 | 0.11 | 0.18 | 0.13 |
| Kjeldahl N (mg/L) | 0.38 | 0.68 | 0.27 | 0.87 | 0.40 | 15.60 | 1.21 | 0.96 | 0.80 |
| Total Phos. (mg/L) | 0.07 | 0.11 | .10KQ | .10Q | .10KQ | 5.60 | 0.50 | 0.20 | 2.50 |
| BOD (mg/L) | | | | | | | | | |
| COD (mg/L) | | | 19.00 | 64.00 | 17.00 | | | | |
| Ca (mg/L) | 19.00 | 11.00 | 6.00 | 13.00 | 12.00 | 17.00 | 11.00 | 15.00 | 23.00 |
| Mg (mg/L) | 6.00 | 3.00 | 2.00 | 4.00 | 4.00 | 5.00 | 1.00 | 5.00 | 5.00 |
| K (mg/L) | 4.00 | 5.00 | 2.00 | 3.00 | 4.00 | 15.00 | 5.00 | 2.00 | 11.00 |
| Na (mg/L) | 21.00 | 8.00 | 3.00 | 9.00 | 13.00 | 66.00 | 76.00 | 21.00 | 124.00 |
| Hardness (mg/L) | 72.00 | 40.00 | 23.00 | 49.00 | 46.00 | | | | |
| Alkalinity (mg/L) | 36.90 | 17.10 | 18.00 | 34.40 | 33.90 | | | | |
| Bicarbonate(mg/L) | 45.00 | 23.20 | 22.20 | 41.90 | 41.30 | 112.00 | 68.00 | 69.00 | 177.00 |
| Carbonate (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chloride (mg/L) | 38.80 | 5.00K | 5.00K | 5.00k | 17.30 | 33.70 | 83.00 | 23.00 | 67.00 |
| Fluoride (mg/L) | 0.15 | 0.20 | 0.10K | 0.12 | 0.12 | | | | |
| Sulfate (mg/L) | 11.00 | 10.90 | 5.00K | 11.70 | 8.10 | 26.00 | 12.00 | 8.00 | 104.00 |
| Color Test (units) | 50.00L | 50.00L | 25.00 | 50.00L | 25.00 | | | | |
| Lab Conductivity (uS/cm) | 240.00 | 97.00 | 54.00 | 128.00 | 158.00 | | | | |
| Lab pH (S.U.) | 7.51 | 7.29 | 7.56 | 7.76 | 7.77 | | | | |
| TDS (mg/L) | 198.00 | 256.00 | 77.00 | 274.00 | 182.00 | 388.00 | 272.00 | 210.00 | 520.00 |
| Lab Turbidity (NTU) | 27.00 | 60.00 | | | | | | | |
| TSS (mg/L) | 3.00K | 3.00K | 3.00 | 12.00 | 8.00 | | | | |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.10** Snowmelt Stations - Total Metals - LANL - 1993

| TOTAL METALS (ug/L) | SNOWMELT STATIONS | | |
|---|---|---|---|
| | VA3.2 Dt: 930430 Tm: 1105 | PU6.6 Dt: 930430 Tm: 1145 | WA9.9 Dt: 930430 Tm: 1024 |
| Al | 2500Q | 1200Q | 4800Q |
| Ba | 100KQ | 100KQ | 100KQ |
| Be | 100KQ | 100KQ | 100KQ |
| B | 100KQ | 100KQ | 100KQ |
| Ca | 5000Q | 11000Q | 11000Q |
| Co | 50KQ | 50KQ | 50KQ |
| Cu | 50KQ | 50KQ | 50KQ |
| Fe | 1000Q | 7400Q | 2400Q |
| Mg | 1600Q | 4000Q | 4000Q |
| Mn | 50KQ | 50KQ | 50KQ |
| Mo | 100KQ | 100KQ | 100KQ |
| Ni | 100KQ | 100KQ | 100KQ |
| Si | 1300Q | 1600Q | 200Q |
| Ag | 100KQ | 100KQ | 100KQ |
| Sr | 100KQ | 100Q | 100Q |
| Sn | 100KQ | 100KQ | 100KQ |
| V | 100KQ | 100KQ | 100KQ |
| Zn | 50KQ | 50KQ | 50KQ |
| As | 5KQ | 5KQ | 5KQ |
| Cd | 1KQ | 1KQ | 1KQ |
| Cr | 5KQ | 12Q | 5KQ |
| Pb | 5KQ | 13Q | 5KQ |
| Hg | .5K | .5K | .5K |
| Se | 5KQ | 5KQ | 5KQ |

**TABLE 6.3.11** Snowmelt Stations - Dissolved Metals - LANL - 1993

| DISSOLVED METALS (ug/L) | SNOWMELT STATIONS | | |
|---|---|---|---|
| | VA3.2 Dt: 930430 Tm: 1105 | PU6.6 Dt: 930430 Tm: 1145 | WA9.9 Dt: 930430 Tm: 1024 |
| Al | 1800Q | 5400Q | 3200Q |
| Ba | 100KQ | 100KQ | 100KQ |
| Be | 100KQ | 100KQ | 100KQ |
| B | 100KQ | 100KQ | 100KQ |
| Ca | 4900Q | 11000Q | 10000Q |
| Co | 50KQ | 50KQ | 50KQ |
| Cu | 50KQ | 50KQ | 50KQ |
| Fe | 700Q | 3600Q | 1600Q |
| Mg | 1500Q | 3500Q | 3800Q |
| Mn | 50KQ | 50KQ | 50KQ |
| Mo | 100KQ | 100KQ | 100KQ |
| Ni | 100KQ | 100KQ | 100KQ |
| Si | 1400Q | 500Q | 500Q |
| Ag | 100KQ | 100KQ | 100KQ |
| Sr | 100KQ | 100Q | 100Q |
| Sn | 100KQ | 100KQ | 100KQ |
| V | 100KQ | 100KQ | 100KQ |
| Zn | 50KQ | 60Q | 50KQ |
| As | 5KQ | 5KQ | 5KQ |
| Cd | 1KQ | 1KQ | 1KQ |
| Cr | 5KQ | 5KQ | 5KQ |
| Pb | 5KQ | 7Q | 5KQ |
| Hg | .5K | .5K | .5K |
| Se | 5KQ | 5KQ | 5KQ |

**TABLE 6.3.14** Stormwater Stations - Water Chemistry - LANL - 1993

| | STORMWATER STATIONS | |
|---|---|---|
| WATER CHEMISTRY | PA4.4<br>Dt: 930910<br>Tm: 1335 | LA6.6<br>Dt: 930830<br>Tm: 0900 |
| Ca (mg/L) | 22.00 | 15.00 |
| Mg (mg/L) | 6.00 | 2.00 |
| K (mg/L) | 5.00 | 4.00 |
| Na (mg/L) | 22.00 | 8.00 |
| Hardness (mg/L) | 80.00 | 46.00 |
| Alkalinity (mg/L) | 81.00 | 40.00 |
| Bicarbonate(mg/L) | 99.00 | 50.00 |
| Carbonate (mg/L) | 0.00 | 0.00 |
| Chloride (mg/L) | 29.00 | 6.00 |
| Fluoride (mg/L) | 0.18 | 0.10K |
| Sulfate (mg/L) | 6.00 | 5.00 |
| Color Test (units) | 20.00 | 50.00L |
| Lab Conductivity (uS/cm) | 278.00 | 127.00 |
| Lab pH (S.U.) | 8.13 | 7.47 |
| TDS (mg/L) | 186.00 | 134.00 |
| Lab Turbidity (NTU) | 4.10 | |
| TSS (mg/L) | 3.00K | 840.00 |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.15 Stormwater Stations - Total Metals - LANL - 1993**

| TOTAL METALS (ug/L) | STORMWATER STATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DP0.1 Dt: 930715 Tm: 1531 | LA4.1 Dt: 930803 Tm: 1740 | DP0.1 Dt: 930806 Tm: 1824 | DP0.1 Dt: 930806 Tm: 1840 | DP0.1 Dt: 930807 Tm: 2114 | DP0.1 Dt: 930807 Tm: 2115 | DP0.1 Dt: 930813 Tm: 1830 | DP0.1 Dt: 930813 Tm: 2230 | DP0.1 Dt: 930813 Tm: 2250 | DP0.1 Dt: 930813 Tm: 2300 | LA6.6 Dt: 930830 Tm: 0900 | PA4.4 Dt: 930910 Tm: 1335 |
| Al | 84000 | 300000 | 17000 | 9600 | 3200 | 85000 | 9100 | 4700 | 6600 | 7000 | 69000 | 300 |
| Ba | 900 | 2800 | 300 | 100 | 100K | 2100 | 100K | 100K | 100K | 100K | 600 | 100K |
| Be | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K |
| B | 100K | 100 | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K |
| Ca | 43000 | 84000 | 22000 | 20000 | 17000 | 69000 | 12000 | 11000 | 11000 | 12000 | 27000 | 23000 |
| Co | 50K | 90 | 50K | 50K | 50K | 100 | 50K | 50K | 50K | 50K | 50K | 50K |
| Cu | 110Q | 320 | 50K | 50K | 50K | 120 | 50K | 50K | 50K | 50K | 70 | 50K |
| Fe | 82000 | 273000 | 15000 | 6900 | 2100 | 110000 | 6300 | 2900 | 4400 | 4600 | 59000 | 200 |
| Mg | 14000 | 4600 | 3900 | 2700 | 1800 | 20000 | 2000 | 1400 | 1600 | 1700 | 11000 | 100K |
| Mn | 3300 | 9180 | 890 | 230 | 50K | 15000 | 170 | 50K | 100 | 140 | 1700 | 6100 |
| Mo | 100K | 100K | 100K | 100K | 100K | 1000K | 100K | 100K | 100K | 100K | 100K | 100K |
| Ni | 100K | 200 | 100K | 100K | 100K | 100 | 100K | 100K | 100K | 100K | 100K | 100K |
| Si | 1100 | 2500 | 900 | 700 | 1000 | 600 | 800 | 900 | 700 | 1200 | 1700 | 400 |
| Ag | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K |
| Sr | 300 | 700 | 100 | 100 | 100K | 500 | 100K | 100K | 100K | 100K | 200 | 200 |
| Sn | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K | 100K |
| V | 100 | 300 | 100K | 100 | 100K | 200 | 100K | 100K | 100K | 100K | 100K | 100K |
| Zn | 940 | 260 | 200 | 70 | 50K | 1700 | 60 | 50K | 50K | 60K | 380 | 50K |
| As | 9 | 13 | 5K | 5K | 5K | 8 | 5K | 5K | 5K | 5K | 7 | 5K |
| Cd | 4Q | 1K | 1K | 1K | 1K | 8 | 1K | 1K | 1K | 1K | 1 | 1K |
| Cr | 68 | 330 | 5K | 7 | 5K | 130 | 16 | 6 | 8 | 9 | 63 | 5K |
| Pb | 400Q | 1080 | 86 | 30 | 8 | 1500 | 25 | 11 | 17 | 19 | 190 | 5K |
| Hg | .5KQ | 2.80 | .5K | .5K | .5K | .5K | .5K | .5K | .5K | .5K | 1 | .5K |
| Se | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K | 5K |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.16** Stormwater Stations - Radiochemistry - LANL - 1993 (Part I)

| ANALYTE (pCi/L) | STORMWATER STATIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DP0.1 Dt: 930714 Tm: 1921 | | | DP0.1 Dt: 930720 Tm: 1531 | | | LA4.1 Dt: 930803 Tm: 1740 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 350.00 | 60.00 | 18.00 | 150.00 | 30.00 | 9.00 | 1000.00 | 150.00 | 50.00 |
| Gross-alpha w/ U-nat ref | 430.00 | 60.00 | 23.00 | 180.00 | 25.00 | 10.00 | 1480.00 | 150.00 | 80.00 |
| Gross-beta w/ Cs-137 ref | 760.00 | 60.00 | 33.00 | 390.00 | 35.00 | 15.00 | 1680.00 | 120.00 | 90.00 |
| Gross-beta w/ Sr/Y-90 ref | 750.00 | 50.00 | 32.00 | 390.00 | 35.00 | 15.00 | 1590.00 | 100.00 | 80.00 |

| ANALYTE (pCi/L) | STORMWATER STATIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DP0.1 Dt: 930806 Tm: 1824 | | | DP0.1 Dt: 930807 Tm: 2115 | | | DP0.1 Dt: 930813 Tm: 1830 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 5.60 | 2.30 | 3.60 | 0.00 | 1.50 | 2.50 | 7.20 | 1.60 | 0.90 |
| Gross-alpha w/ U-nat ref | 5.60 | 2.20 | 3.60 | 0.00 | 1.50 | 2.50 | 8.70 | 1.70 | 1.10 |
| Gross-beta w/ Cs-137 ref | 119.00 | 9.00 | 6.40 | 92.00 | 6.00 | 5.00 | 82.00 | 6.00 | 1.60 |
| Gross-beta w/ Sr/Y-90 ref | 116.00 | 8.00 | 6.30 | 92.00 | 6.00 | 5.00 | 82.00 | 5.00 | 1.60 |

| ANALYTE (pCi/L) | STORMWATER STATIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DP0.1 Dt: 930813 Tm: 2230 | | | DP0.1 Dt: 930813 Tm: 2250 | | | DP0.1 Dt: 930813 Tm: 2300 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 4.70 | 1.00 | 0.90 | 5.00 | 1.20 | 0.90 | 9.70 | 1.80 | 1.00 |
| Gross-alpha w/ U-nat ref | 5.60 | 1.00 | 1.10 | 5.90 | 1.20 | 1.10 | 12.90 | 1.80 | 1.40 |
| Gross-beta w/ Cs-137 ref | 81.00 | 6.00 | 1.60 | 74.00 | 5.00 | 1.60 | 84.00 | 6.00 | 1.60 |
| Gross-beta w/ Sr/Y-90 ref | 81.00 | 5.00 | 1.60 | 74.00 | 4.00 | 1.60 | 82.00 | 5.00 | 1.60 |

| ANALYTE (pCi/L) | STORMWATER STATIONS | | | | | |
|---|---|---|---|---|---|---|
| | LA6.6 Dt: 930830 Tm: 0900 | | | PA4.4 Dt: 930910 Tm: 1335 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 32.00 | 6.00 | 1.30 | 0.30 | 0.70 | 1.60 |
| Gross-alpha w/ U-nat ref | 54.00 | 7.00 | 2.20 | 0.30 | 0.70 | 1.60 |
| Gross-beta w/ Cs-137 ref | 48.00 | 4.00 | 2.40 | 6.30 | 1.80 | 3.40 |
| Gross-beta w/ Sr/Y-90 ref | 44.00 | 3.00 | 2.20 | 6.60 | 1.90 | 3.50 |

**TABLE 6.3.17 Stormwater Stations - Radiochemistry - LANL - 1993**

| STORM WATER STATIONS | DATE | TIME | GAMA SPEC # of PEAKS | NUCLIDE | ENERGY keV | QUANTIFICATION | COMMENTS |
|---|---|---|---|---|---|---|---|
| DP0.1 | 930714 | 1921 | 3 | Cs-137 | 661.9 | 170. +- 15 pCi/L | Confirmed |
| | | | | K-40 | 1461.3 | 360. +- 150 pCi/L | Very Weak |
| | | | | Pb-212 | 238.9 | Not quantified 0.2 gps +- 60% | Very Weak |
| DP0.1 | 930720 | 1531 | 2 | Cs-137 | 661.6 | 7. +- 5. pCi/L | Very Weak |
| | | | | Cs-137 | 1460.7 | 21. +- 4. pCi/L | |
| LA4.1 | 930803 | 1740 | 9 | Pb-212 | 239.1 | Not quantified; 1.5 gps +- 10% | |
| | | | | Pb-214 | 295.9 | Not quantified; 0.6 gps +- 20% | |
| | | | | Pb-214 | 352.5 | Not quantified; 1.3 gps +- 10% | |
| | | | | Be-7 | 478.4 | 230. +- 40. pCi/L | Atms Prd. |
| | | | | Tl-208 | 584.2 | Not quantified; 1.3 gps +- 15% | |
| | | | | Bi-214 | 610 | Not quantified; 0.9 gps +- 20% | |
| | | | | Cs-137 | 662.5 | 140. +- 10. pCi/L | |
| | | | | Ac-228 | 969.6 | Not quantified; 1.1 gps +- 20% | |
| | | | | K-40 | 1462.1 | 760. +- 80. pCi/L | |
| DP0.1 | 930806 | 1824 | 0 | | | | |
| DP0.1 | 930807 | 2115 | 0 | | | | |
| DP0.1 | 930813 | 1830 | 0 | | | | |
| DP0.1 | 930813 | 2230 | 0 | | | | |
| DP0.1 | 930813 | 2250 | 0 | | | | |
| DP0.1 | 930813 | 2300 | 1 | Cs-137 | 661.6 | 7. +- 5. pCi/L | Very Weak |
| LA6.6 | 930830 | 0900 | 1 | Cs-137 | 661.6 | 21. +- 4. pCi/L | |
| PA4.4 | 930910 | 1335 | 0 | | | | |

**TABLE 6.3.19** Surface Water Stations - Water Chemistry - LANL - 1992

| WATER CHEMISTRY | SURFACE WATER STATION<br>MO7.4<br>Dt: 920507<br>Tm: 0916 |
|---|---|
| Water Temp. (C) | |
| Field Conductivity (uhmo) | |
| Dissolved Oxygen (mg/L) | |
| Field pH (S.U.) | |
| Nitrate+ite (mg/L) | 144.00 |
| Ammonia (mg/L) | 1.10 |
| Kjeldahl N (mg/L) | 0.00Q |
| Total Phos. (mg/L) | 0.13Q |
| BOD (mg/L) | 1.00K |
| COD (mg/L) | 15.00 |
| Cyanide (mg/L) | 0.03 |
| Ca (mg/L) | 79.00 |
| Mg (mg/L) | 3.00 |
| K (mg/L) | 45.00 |
| Na (mg/L) | 209.00 |
| Hardness (mg/L) | 210.00 |
| Alkalinity (mg/L) | 292.00Q |
| Bicarbonate(mg/L) | 357.00 |
| Carbonate (mg/L) | 0.00 |
| Chloride (mg/L) | 67.10Q |
| Fluoride (mg/L) | 1.44 |
| Sulfate (mg/L) | 51.20Q |
| Color Test (units) | 5.00Q |
| Lab Conductivity (uS/cm) | 1680.00 |
| Lab pH (S.U.) | 7.72 |
| TDS (mg/L) | 986.00Q |
| TSS (mg/L) | 26.00Q |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.20**
**Surface Water Station -**
**Total Metals - LANL - 1992**

| TOTAL METALS (ug/L) | SURFACE WATER STATION MO7.4 Dt: 920507 Tm: 0917 |
|---|---|
| Al | 200 |
| Ba | 100K |
| Be | 100K |
| B | 300 |
| Ca | 160000 |
| Co | 5K |
| Cu | 50K |
| Fe | 100 |
| Mg | 3500 |
| Mn | 50K |
| Mo | 300 |
| Ni | 100K |
| Si | 14000 |
| Ag | 1K |
| Sr | 200 |
| Sn | 100K |
| V | 100K |
| Zn | 100K |
| U | 5K |
| As | 5K |
| Cd | 1K |
| Cr | 5K |
| Pb | 5K |
| Hg | .1K |
| Se | 5K |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.21**
**Surface Water Station -**
**Dissolved Metals - LANL - 1992**

| DISSOLVED METALS (ug/L) | SURFACE WATER STATION MO7.4 Dt: 920507 Tm: 0917 |
|---|---|
| Al | 100KQ |
| Ba | 200Q |
| Be | 100KQ |
| B | 300Q |
| Ca | 160000Q |
| Co | 5KQ |
| Cu | 50KQ |
| Fe | 100KQ |
| Mg | 3800Q |
| Mn | 50KQ |
| Mo | 300Q |
| Ni | 100KQ |
| Si | 14000Q |
| Ag | 1KQ |
| Sr | 200Q |
| Sn | 100KQ |
| V | 100KQ |
| Zn | 100KQ |
| U | 5K |
| As | 5KQ |
| Cd | 1KQ |
| Cr | 5KQ |
| Pb | 5KQ |
| Hg | .5K |
| Se | 5KQ |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.22** Surface Water Station - Radiochemistry - LANL - 1992 (Part I)

| ANALYTE (pCi/L) | SURFACE WATER STATION MO7.4 Dt: 920507 Tm: 0933 | | |
|---|---|---|---|
| | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 9.20 | 2.10 | 2.00 |
| Gross-alpha w/ U-nat ref | 15.00 | 4.00 | 3.30 |
| Gross-beta w/ Cs-137 ref | 1210.00 | 70.00 | 3.00 |
| Gross-beta w/ Sr/Y-90 ref | 1190.00 | 60.00 | 3.00 |
| U-238 Alpha Spec. | 0.77 | 0.19 | |
| U-234 Alpha Spec. | 2.2 | 0.5 | |
| Th-230 Alpha Spec. | -0.01 | 0.04 | |
| Th-232 Alpha Spec. | 0.01 | 0.008 | |
| Am-241 Alpha Spec. | 2.6 | 0.7 | |
| Pu-239 Alpha Spec | 2.3 | 0.6 | |
| Pu-238 Alpha Spec. | 0.6 | 0.15 | |

**TABLE 6.3.23** Surface Water Station - Radiochemistry - LANL - 1992 ( Part II)

| STATION | DATE | TIME | GAMA SPEC # of PEAKS | NUCLIDE | ENERGY keV | gamma/sec/L | pCi/L |
|---|---|---|---|---|---|---|---|
| MO7.4 | 920507 | 933 | 3 | Cs-137 | 662.24 | 5.0 +- 0.2 | 159. +- 7. |
| | | | | Se-75 | 136.38 | 0.95 +- 0.10 | 46. +- 5. |
| | | | | Se-74 | 264.88 | 1.04 +- 0.11 | 48. +- 6. |

**TABLE 6.3.24** Surface Water Station - Volatile Organic Compounds - LANL - 1992

| SURFACE WATER STATION<br>MO7.4<br>Dt: 920507<br>Tm: 0926 | | | | | |
|---|---|---|---|---|---|
| VOLATILE ORGANIC COMPOUNDS | (ug/L) | CONT'D<br>VOLATILE ORGANIC COMPOUNDS | CONT'D<br>(ug/L) | CONT'D<br>VOLATILE ORGANIC COMPOUNDS | CONT'D<br>(ug/L) |
| Acetone | U | Naphthalene | U | Dibenzofuran | U |
| Benzene | U | N-Propylbenzene | U | Di-n-butyl phthalate | U |
| Bromobenzene | U | Styrene | U | 1,2 -Dichlorobenzene | U |
| Bromochloromethane (Chlorobromomethane) | U | 1,1,1,2-Tetrachloroethane | U | 1,3-Dichlorobenzene | U |
| Bromodichloromethane | U | 1,1,2,2-Tetrachloroethane | U | 1,4-Dichlorobenzene | U |
| Bromoform | U | Tetrachloroethylene | U | 3,3'-Dichlorobenzidine | U |
| Bromomethane | U | Tetrahydrofuran (THF) | U | 2,4-Dichlorophenol | U |
| 2-Butanone (MEK) | U | Toluene | U | Diethyl phthalate | U |
| n-Butylbenzene | U | 1,2,3-Trichlorobenzene | U | 2,4-Dimethylphenol | U |
| sec-Butylbenzene | U | 1,2,4-Trichlorobenzene | U | Dimethyl phthalate | U |
| tert-Butylbenzene | U | 1,1,1-Trichloroethane | U | 4,6-Dinitro-2-methylphenol | U |
| tert-Butyl methyl ether (MTBE) | U | 1,1,2-Trichloroethane | U | 2,4-Dinitrophenol | U |
| Carbon tetrachloride | U | Trichloroethylene | U | 2,4-Dinitrotoluene | U |
| Chlorobenzene | U | Trichlorofluoromethane | U | 2,6-Dinitrotoluene | U |
| Chloroethane | U | 1,2,3-Trichloropropane | U | Di-n-octyl phthalate | U |
| Chloroform | U | 1,2,4-Trimethylbenzene | U | Fluoranthene | U |
| Chloromethane (Methyl Chloride) | U | 1,3,5-Trimethylbenzene | U | Fluorene | U |
| 2-Chlorotoluene | U | Vinyl chloride | U | Hexachlorobenzene | U |
| 4-Chlorotoluene (1-Methyl-4Chlorobenzene) | U | o-Xylene | U | Hexachlorobutadiene | U |
| 1,2-Dibromo-3-chloropropane | U | p- & m- Xylene | U | Hexachlorocyclopentadiene | U |
| Dibromochloromethane | U | Acenaphthene | U | Hexachlorethane | U |
| 1,2-Dibromoethane | U | Acenaphthylene | U | Indeno (1,2,3-cd) pyrene | U |
| Dibromomethane (Methylene Bromide) | U | Anthracene | U | Isophorone | U |
| 1,2-Dichlorobenzene | U | Benzoic acid | U | 2-Methylnaphthalene | U |
| 1,3-Dichlorobenzene | U | Benzo (a) anthracene | U | 2-Methylphenol (O-Cresol) | U |
| 1,4-Dichlorobenzene | U | Benzo (b) fluoroanthene | U | 4-Methylphenol (P-Cresol) | U |
| Dichlorodifluoromethane | U | Benzo (k) fluoroanthene | U | Naphthalene | U |
| 1,1-Dichloroethane | U | Benzo (g,h,i,) perylene | U | 2-Nitroaniline | U |
| 1,2-Dichloroethane | U | Benzo -a-pyrene | U | 3-Nitroaniline | U |
| 1,1-Dichloroethene | U | Benzyl alcohol | U | 4-Nitroaniline | U |
| cis-1,2-Dichloroethene | U | Bis (2-chloroethoxy) methane | U | Nitrobenzene | U |
| trans-1,2-Dichloroethene | U | Bis (2-chloroethyl) ether | U | 2-Nitrophenol | U |
| 1,2-Dichloropropane | U | Bis (2-chloroisopropyl)ether | U | 4-Nitrophenol | U |
| 1,3-Dichloropropane | U | Bis (2-ethylhexyl) phthalate | 4.00 (J) | N-nitrosodiphenylamine | U |
| 2,2-Dichloropropane | U | 4-Bromophenylphenyl ether | U | N-nitroso-di-n-propylamine | U |
| 1,1-Dichloropropene | U | N-Butylbenzyl phthalate | 1.00 (J) | Pentachlorophenol (PCP) | U |
| cis-1,3-Dichloropropene | U | 4-Chloroaniline (Benzenomine, 4 Chloro) | U | Phenanthrene | U |
| trans-1,3-Dichloropropene | U | 2-Chloronaphthalene | U | Phenol (C6H5OH) - Single Compound | U |
| Ethylbenzene | U | 4-Chloro-3-methylphenol (Parachlorometa Cresol) | U | Pyrene | U |
| Hexachlorobutadiene | U | 2-Chlorophenol | U | 1,2,4-Trichlorobenzene | U |
| Isopropylbenzene | U | 4-Chlorophenylphenyl ether | U | 2,4,5-Trichlorophenol | U |
| (1-Methyl -) 4-Isopropyltoluene | U | Chrysene | U | 2,4,6-Trichlorophenol | U |
| Methylene chloride | U | Dibenz (a,h) anthracene (1,2,5,6-Dibenzanthracene) | U | | |

Legend:
' = Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
J = Indicates compound was analyzed for but not detected.

**TABLE 6.3.25 Surface Water Stations - Water Chemistry - LANL - 1993**

| WATER CHEMISTRY | SURFACE WATER STATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | LA8.4 Dt: 930217 Tm: 1305 | Sacred Spring Dt: 930512 Tm: 0325 | Indian Spring Dt: 930512 Tm: 1235 | La Mesita Spring Dt: 930615 Tm: 0948 | Basalt Spring Dt: 930615 Tm: 1149 | MO7.4 Dt: 930719 Tm: 1036 | LA12.2 Dt: 930903 Tm: 1015 | LA6.6 Dt: 930903 Tm: 1100 |
| Water Temp. (C) | | | | | | | | |
| Field Conductivity (uhmo) | | | | | | | | |
| Dissolved Oxygen (mg/L) | | | | | | | | |
| Field pH (S.U.) | | | | | | | | |
| Total Org. Carbon (mg/L) | 5.00K | | | | | | | |
| Nitrate+ite (mg/L) | | 0.14 | 0.81 | 3.04 | 1.36 | .04K | | |
| Ammonia (mg/L) | | 0.12 | 0.10K | 0.10K | 0.10K | 0.01K | | |
| Kjeldahl N (mg/L) | | 1.20 | 0.16 | 0.10K | 0.30 | 0.27 | | |
| Total Phos. (mg/L) | | 0.10K | 0.10K | 0.10K | 1.80 | 0.10KQ | | |
| BOD (mg/L) | 1.00K | | | | | | | |
| COD (mg/L) | 5.00K | | | | | | | |
| Ca (mg/L) | 49.00 | 23.00 | 36.00 | 35.00 | 32.00 | 35.00 | 8.00 | 14.00 |
| Mg (mg/L) | 10.00 | 1.00K | 3.00 | 1.00K | 8.00 | 3.00 | 3.00 | 3.00 |
| K (mg/L) | 21.00 | 4.00 | 3.00 | 4.00 | 6.00 | 9.00 | 3.00 | 4.00 |
| Na (mg/L) | 109.00 | 24.00 | 26.00 | 29.00 | 37.00 | 73.00 | 6.00 | 28.00 |
| Hardness (mg/L) | 164.00 | 57.00 | 102.00 | | | | 32.00 | 47.00 |
| Alkalinity (mg/L) | 38.10 | 98.80 | 102.00 | | | | 31.00 | 52.00 |
| Bicarbonate(mg/L) | 46.50 | 121.00 | 125.00 | 147.00 | 127.00 | 140.00 | 38.00 | 63.00 |
| Carbonate (mg/L) | 0.00 | 0.00 | 0.00 | 2.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chloride (mg/L) | 244.00 | 5.00K | 32.10 | 7.00 | 27.00 | 9.00 | 6.00 | 34.00 |
| Fluoride (mg/L) | 0.13 | | | | | 10.00 | 0.10K | 0.19 |
| Sulfate (mg/L) | 14.30 | 6.90 | 7.30 | 14.00 | 22.00 | | 5.00K | 7.00 |
| Color Test (units) | 5.00 | | | | | | 50.00L | 25.00 |
| Lab Conductivity (uS/cm) | 901.00 | | | | | | 98.00 | 239.00 |
| Lab pH (S.U.) | 7.51 | | | | | | 7.66 | 8.10 |
| TDS (mg/L) | 596.00 | 172.00 | 222.00 | 194.00 | 280.00 | 370.00 | 114.00 | 184.00 |
| Lab Turbidity (NTU) | 0.06 | | | | | | | |
| TSS (mg/L) | 3.00K | | | | | | 14.00 | 9.00 |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.

**TABLE 6.3.26** Surface Water Stations - Total Metals - LANL - 1993

| TOTAL METALS (ug/L) | SURFACE | | WATER | STATIONS |
|---|---|---|---|---|
| | LA8.4<br>Dt: 930217<br>Tm: 1257 | MO7.4<br>Dt: 930719<br>Tm: 1034 | LA12.2<br>Dt: 930903<br>Tm: 1015 | LA6.6<br>Dt: 930903<br>Tm: 1100 |
| Al | 100KQ | 600Q | 3200 | 2500 |
| Ba | 100Q | 100KQ | 100K | 100K |
| Be | 100KQ | 100KQ | 100K | 100K |
| B | 100KQ | 100KQ | 100K | 100K |
| Ca | 51000Q | 2900Q | 8100 | 14000 |
| Co | 50KQ | 5KQ | 50K | 50K |
| Cu | 100KQ | 5KQ | 50K | 50K |
| Fe | 100KQ | 500Q | 1200 | 1300 |
| Mg | 11000Q | 2200Q | 2800 | 3400 |
| Mn | 50KQ | 50KQ | 50K | 50K |
| Mo | 100KQ | 100Q | 100K | 100K |
| Ni | 100KQ | 100KQ | 100K | 100K |
| Si | 16000Q | 700Q | 1300 | 800 |
| Ag | 100KQ | 10KQ | 100K | 100K |
| Sr | 360Q | 100KQ | 100K | 100K |
| Sn | 100KQ | 100KQ | 100K | 100K |
| V | 100KQ | 100KQ | 100K | 100K |
| Zn | 100KQ | 100KQ | 50K | 50K |
| U | | 5KQ | | |
| As | 1K | 5KQ | 5K | 5K |
| Cd | 1K | 1KQ | 1K | 1K |
| Cr | 1K | 5KQ | 5K | 8 |
| Pb | 1K | 5KQ | 5K | 5K |
| Hg | .5K | .5KQ | .5K | .5K |
| Se | 5K | 5KQ | 5K | 5K |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.3.27 Surface Water Stations - Radiochemistry - LANL - 1993 (Part I)**

| ANALYTE (pCi/L) | SURFACE WATER STATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LA12.2 Dt: 930903 Tm: 1015 | | | LA6.6 Dt: 930903 Tm: 1100 | | | LA8.4 Dt: 930217 Tm: 1308 | | | MO7.4 Dt: 930719 Tm: 1030 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 0.10 | 0.70 | 1.50 | 1.00 | 0.90 | 1.50 | 0.40 | 0.40 | 0.80 | 3.20 | 0.80 | 1.00 |
| Gross-alpha w/ U-nat ref | 0.10 | 0.60 | 1.40 | 1.00 | 0.90 | 1.50 | 0.70 | 0.60 | 1.30 | 4.30 | 1.00 | 1.30 |
| Gross-beta w/ Cs-137 ref | 7.30 | 2.20 | 3.30 | 7.40 | 2.20 | 3.30 | 7.00 | 0.90 | 1.30 | 135.00 | 9.00 | 1.70 |
| Gross-beta w/ Sr/Y-90 ref | 7.70 | 2.30 | 3.50 | 7.70 | 2.30 | 3.50 | 6.40 | 0.80 | 1.20 | 131.00 | 7.00 | 1.60 |
| U-238 Alpha Spec. | | | | | | | 1.26 | 0.21 | | | | |
| U-234 Alpha Spec. | | | | | | | 0.54 | 0.10 | | | | |
| Th-230 Alpha Spec. | | | | | | | 0.04 | 0.04 | | | | |
| Th-232 Alpha Spec. | | | | | | | 0.00 | 0.03 | | | | |
| Ra-226 Non-SWDA | | | | | | | 0.09 | 0.02 | 0.02 | | | |
| Ra-228 Total | | | | | | | 0.70 | 0.90 | | | | |

**TABLE 6.3.28 Surface Water Stations - Radiochemistry - LANL - 1993 (Part II)**

| STATION | DATE | TIME | GAMA SPEC # of PEAKS | NUCLIDE | ENERGY keV | QUANTIFICATION |
|---|---|---|---|---|---|---|
| MO7.4 | 930719 | 1030 | 7 | Rb-83 | 520.3 | 190. +- 30. pCi/L |
| | | | | Rb-83 | 529.5 | 190. +- 30. pCi/L |
| | | | | Rb-83 | 552.5 | 190. +- 30. pCi/L |
| | | | | Se-75 | 264.6 | 19. +- 5. pCi/L |
| | | | | Se-75 | 136 | 19. +- 5. pCi/L |
| | | | | Cs-137 | 661.6 | 25. +- 6. pCi/L |
| | | | | Ann-Rad | 511 | |
| LA12.2 | 930903 | 1015 | 0 | | | |
| LA6.6 | 930903 | 1100 | 0 | | | |
| LA8.4 | 930217 | 1308 | 4 | Pb-214* | 295 | Not quantified; 1.0 gps +- 9% |
| | | | | Pb-214* | 351 | Not quantified; 2.0 gps +- 6% |
| | | | | Bi-214* | 609 | Not quantified; 2.3 gps +- 8% |
| | | | | Bi-214* | 1121 | Not quantified; 0.96 gps +- 16% |

* Daughters of naturally occuring RA-226

**TABLE 6.4.2 Raft Trip Stations - Springs and Streams of White Rock Canyon - Water Chemistry - LANL - 1992**

| | RAFT TRIP STATIONS (Springs & Streams) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WATER CHEMISTRY | Rio Grande Otowi Bridge 920908 1025 | Spring 1 920908 1216 | Spring 2 920908 1220 | Sandia Spring 920908 1445 | MO 0.1 920908 1615 | Spring 3A 920908 1655 | Spring 4 920909 845 | Spring 4A 920909 930 | Spring 5 920909 1159 | Ancho Spring 920909 1505 | AN 0.1 920909 | Spring 6A 920909 1703 | DOE Spring 920910 1015 | Spring 9 920910 800 | FR0.1 920910 1205 |
| Water Temp. (C) | 17.50 | 19.00 | 23.00 | 19.70 | 18.00 | 18.00 | 16.50 | 18.00 | 18.90 | 21.00 | 18.00 | 21.60 | | | 19.80 |
| Field Conductivity (uhmo) | | | 253.00 | 255.00 | 410.00 | 160.00 | 175.00 | 115.00 | 159.00 | 130.00 | 147.00 | 110.00 | | | 100.00 |
| Dissolved Oxygen (mg/L) | 222.00 | | | 6.70 | | | 6.40 | | 11.90 | | | 7.00 | | | 7.40 |
| Field pH (S.U.) | 7.65 | 6.96 | 8.40 | 6.98 | 7.90 | 6.90 | 7.15 | 7.67 | 8.73 | 7.30 | 8.74 | 7.47 | | | 8.50 |
| Total Org. Carbon (mg/L) | 5.00 | 2.00 | 4.00 | 2.00 | 16.00 | 2.00 | 2.00 | 1.00K | 2.00 | 3.00 | | 1.00K | 2.00 | 3.00 | 3.00 |
| Nitrate+Ite (mg/L) | .04K | 0.44 | 0.04K | 0.12 | 8.15 | 0.84 | 1.35 | 0.96 | 0.23 | 0.49 | | 0.44 | 0.10 | 0.23 | 0.04K |
| Ammonia (mg/L) | 0.23 | 0.10K | 0.20 | 0.10K | 0.36 | 0.10K | 0.10K | 0.10K | 0.11 | 0.30 | | 0.10K | 0.16 | 0.14 | 0.14 |
| Kjeldahl N (mg/L) | 0.40 | 0.10K | 0.55 | 0.18 | 2.43 | 0.10K | 0.10K | 0.11 | 0.13 | 0.40 | | 0.10K | 0.28 | 0.16 | 0.18 |
| Total Phos. (mg/L) | 0.29 | 0.01 | 0.06 | 0.11 | 3.89 | 0.02 | 0.02 | 0.02 | 0.02 | 0.10 | | 0.03 | 0.02 | 0.05 | 0.06 |
| Ca (mg/L) | 43.00 | 17.00 | 17.00 | 43.00 | 29.00 | 22.00 | 24.00 | 21.00 | 19.00 | 13.00 | | 10.00 | 12.00 | 21.00 | 10.00 |
| Mg (mg/L) | 7.00 | 1.00 | 1.00k | 3.00 | 8.00 | 2.00 | 4.00 | 4.00 | 5.00 | 3.00 | | 3.00 | 3.00 | 5.00 | 3.00 |
| K (mg/L) | 3.00 | 2.00 | 2.00 | 3.00 | 16.00 | 3.00 | 4.00 | 3.00 | 2.00 | 4.00 | | 4.00 | 2.00 | 2.00 | 2.00 |
| Na (mg/L) | 16.00 | 28.00 | 42.00 | 14.00 | 67.00 | 11.00 | 12.00 | 10.00 | 9.00 | 9.00 | | 8.00 | 10.00 | 12.00 | 8.00 |
| Hardness (mg/L) | 136.00 | 47.00 | 42.00 | 120.00 | 103.00 | 61.00 | 76.00 | 69.00 | 68.00 | 45.00 | | 37.00 | 42.00 | 73.00 | 37.00 |
| Alkalinity (mg/L) | 105.00 | 98.60 | 143.00 | 141.00 | 154.00 | 80.40 | 81.20 | 78.00 | 79.80 | 59.40 | | 53.30 | 60.30 | 98.90 | 51.80 |
| Bicarbonate(mg/L) | 128.00 | 118.00 | 172.00 | 173.00 | 185.00 | 96.50 | 97.40 | 94.20 | 97.30 | 71.50 | | 63.90 | 72.40 | 119.00 | 62.20 |
| Carbonate (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 |
| Chloride (mg/L) | 5.00K | 5.00K | 5.00k | 5.00K | 49.50 | 5.00K | 5.80 | 5.00K | 5.00K | 5.00K | | 5.00K | 5.00K | 5.00K | 5.00K |
| Fluoride (mg/L) | 0.32 | 0.52 | 1.17 | 0.54 | 0.37 | 0.40 | 0.48 | 0.44 | 0.43 | 0.31 | | 0.29 | 0.47 | 0.51 | 0.14 |
| Sulfate (mg/L) | 90.60 | 17.20 | 8.10 | 5.00K | 33.30 | 5.00K | 8.60 | 5.00K | 5.00K | 5.00K | | 5.00K | 5.00K | 5.00K | 5.00K |
| Color Test (units) | 15.00Q | 5.00K | 5.00Q | 5.00K | 40.00Q | 5.00 | 5.00K | 5.00K | 5.00K | 5.00K | | 5.00K | 5.00K | 10.00 | 10.00 |
| Lab Conductivity (uS/cm) | 343.00 | 221.00 | 304.00 | 281.00 | 623.00 | 191.00 | 216.00 | 193.00 | 187.00 | 132.00 | | 124.00 | 132.00 | 204.00 | 124.00 |
| Lab pH (S.U.) | 8.06 | 8.14 | 8.30 | 8.29 | 7.96 | 8.22 | 8.09 | 8.19 | 8.25 | 7.78 | | 8.05 | 8.12 | 7.92 | 8.06 |
| TDS (mg/L) | 228.00 | 106.00 | 206.00 | 202.00 | 476.00 | 154.00 | 174.00 | 174.00 | 170.00 | 153.00 | | 144.00 | 144.00 | 192.00 | 130.00 |
| Lab Turbidity (NTU) | | | | | | | | | | | | 4.00 | 6.00 | 5.00 | 7.00 |
| TSS (mg/L) | 50.00 | 8.00 | 13.00 | 21.00 | 15.00 | 3K | 3.00 | 3.00K | 4.00 | 34.00 | | | | | |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.4.3** Raft Trip Stations - Springs and Streams of White Rock Canyon - Water Chemistry - LANL - 1993

| | RAFT TRIP STATIONS (Springs & Streams) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WATER CHEMISTRY | Spring 1 931012 1200 | Spring 2 931012 1245 | Sandia Spring 931012 1400 | MO0.1 931012 1540 | Spring 3 931012 1600 | Spring 4 931012 1815 | PA0.1 931013 0745 | Spring 4A 931013 0900 | Spring 5 931013 1130 | AN0.1 931013 1400 | Ancho Spring 931013 1452 | Spring 8A 931014 0800 | DOE Spring 931014 0915 | FR0.1 931014 1200 |
| Water Temp. (C) | 15.60 | 15.60 | 16.20 | | 18.80 | | 21.00 | 21.00 | 14.00 | 20.40 | 19.00 | 11.00 | 11.40 | 15.40 |
| Field Conductivity (uhmo) | 256.00 | | 317.00 | | 195.00 | | 80.30 | 80.30 | 166.00 | 125.00 | 115.00 | 90.00 | 130.00 | 93.00 |
| Field pH (S.U.) | 8.16 | | 6.71 | | 8.17 | | 8.38 | 8.38 | 7.93 | 8.41 | 7.18 | 7.03 | 8.29 | 6.72 |
| Nitrate+ite (mg/L) | 1.00 | 0.10K | 0.10K | 9.50 | 0.90 | 0.30 | 0.90 | 1.00 | 0.40 | 0.10K | 0.20 | 0.30 | 0.10K | 0.10K |
| Ammonia (mg/L) | 0.10K | 0.10 | 0.10K | 0.40 | 0.10K | 0.20 | 0.10K | 0.10K | 0.70 | 0.10K | 0.10K | 0.10K | 0.10K | 0.10K |
| Kjeldahl N (mg/L) | 9.00 | 6.50 | 0.10K | 3.30 | 0.10 | 1.90 | 0.10K | 0.10K | 0.70 | 0.10 | 0.10K | 0.10K | 0.20 | 0.20 |
| Total Phos. (mg/L) | 2.50 | 1.60 | 0.09K | 7.10 | 0.09K | 0.30 | 0.09K | 0.09K | 0.09K | .09K | 0.09K | 0.09K | 0.09K | 0.09K |
| Ca (mg/L) | 21.00 | 27.00 | 51.00 | 23.40 | 25.00 | 32.00 | 23.00 | 19.00 | 18.00 | 13.00 | 14.00 | 12.00 | 13.00 | 11.00 |
| Mg (mg/L) | 1.00 | 1.00 | 4.00 | 6.00 | 2.00 | 6.00 | 5.00 | 4.00 | 5.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| K (mg/L) | 3.00 | 3.00 | 4.00 | 14.00 | 4.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 2.00 | 3.00 |
| Na (mg/L) | 32.00 | 60.00 | 17.00 | 77.00 | 15.00 | 17.00 | 14.00 | 12.00 | 13.00 | 11.00 | 10.00 | 12.00 | 12.00 | 10.00 |
| Hardness (mg/L) | 57.00 | 72.00 | 144.00 | 82.00 | 11.00 | 105.00 | 78.00 | 64.00 | 66.00 | 45.00 | 47.00 | 42.00 | 45.00 | 40.00 |
| Alkalinity (mg/L) | 107.00 | 176.00 | 153.00 | 108.00 | 81.00 | 94.00 | 83.00 | 76.00 | 78.00 | 65.00 | 58.00 | 60.00 | 59.00 | 51.00 |
| Bicarbonate(mg/L) | 130.00 | 214.00 | 187.00 | 132.00 | 98.00 | 114.00 | 10.00 | 93.00 | 95.00 | 79.00 | 71.00 | 73.00 | 72.00 | 63.00 |
| Carbonate (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00K | 0.00 | 0.00 | 0.00 | 0.00 |
| Chloride (mg/L) | 5.00 | 5.00 | 5.00 | 46.00 | 5.00 | 9.00 | 6.00 | 6.00 | 6.00 | 5.00K | 5.00K | 5.00K | 5.00K | 5.00 |
| Fluoride (mg/L) | 0.53 | 1.16 | 0.53 | 0.98 | 0.42 | 0.46 | 0.43 | 0.43 | 0.39 | 0.36 | 0.34 | 0.36 | 0.45 | 0.17 |
| Sulfate (mg/L) | 7.00 | 9.00 | 5.00 | 29.00 | 6.00 | 10.00 | 8.00 | 7.00 | 6.00 | 5.00K | 5.00K | 5.00K | 5.00K | 5.00K |
| Color Test (units) | 50.00L | 50.00L | 10.00 | 25.00 | 5.00 | 50.00L | 0.00 | 5.00 | 15.00 | 5.00 | 5.00 | 15.00 | 5.00 | 10.00 |
| Lab Conductivity (uS/cm) | 238.00 | 362.00 | 308.00 | 553.00Q | 192.00 | 232.00 | 199.00 | 187.00 | 180.00 | 142.00 | 134.00 | 134.00 | 134.00 | 116.00 |
| Lab pH (S.U.) | 7.79 | 7.95 | 8.25 | 7.60 | 8.16 | 8.17 | 8.13 | 8.04 | 7.98 | 8.54 | 7.87 | 8.06 | 7.94 | 7.98 |
| TDS (mg/L) | 188.00 | 292.00 | 224.00 | 420.00 | 168.00 | 170.00 | 178.00 | 184.00 | 192.00 | 168.00 | 170.00 | 158.00 | 160.00 | 162.00 |
| TSS (mg/L) | 335.00 | 790.00 | 15.00 | 54.00 | 7.00 | 295.00 | 4.00 | 8.00 | 51.00 | 5.00 | 4.00 | 5.00 | 10.00 | 4.00 |

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

**TABLE 6.4.4** Sediment Stations - Raft Trip - LANL - 1992

| SEDIMENT (mg/kg) | SEDIMENT STATIONS (1992 Raft Trip) | | | | |
|---|---|---|---|---|---|
| | Spring 5 Date: 920909 Time: 1230 | Rio Grande @ Otowi Bridge Date: 920908 Time: 0950 | PA 0.1 Date: 920909 Time: 0000 | Cochiti Lake Sed. @ Bland Canyon Date: 921007 Time: 0945 | Cochiti Lake Sed. @ Dam Date: 921007 Time: 1015 |
| Al | 13850 | 4498Q | 9750Q | 26862Q | 56904Q |
| Ba | 416 | 111Q | 200Q | 448Q | 335Q |
| Be | 6.93K | 0.12Q | 6.25KQ | 13.4KQ | 16.8KQ |
| B | 6.93K | 0.12Q | 6.25KQ | 1.03Q | 7.11Q |
| Ca | 23546 | 13840Q | 20000Q | 31103Q | 3561Q |
| Co | 5.5 | 2.88Q | 5.00Q | 10Q | 15.9Q |
| Cu | 11.1 | 5.5Q | 8.75Q | 21Q | 39.7Q |
| Fe | 13850 | 7151Q | 12500Q | 20621Q | 41213Q |
| Mg | 6233 | 1961Q | 4000Q | 10552Q | 15858Q |
| Mn | 388 | 150Q | 238Q | 621Q | 1213Q |
| Mo | 6.93K | 5.77KQ | 6.25KQ | 13.8KQ | 16.75KQ |
| Ni | 12.5 | 5.77KQ | 8.75Q | 21Q | 33.1Q |
| Si | 471 | 415Q | 575Q | 1448Q | 1757Q |
| Ag | 6.93K | 5.77KQ | 6.25KQ | 13.8KQ | 16.75KQ |
| Sr | 194 | 40.4Q | 87.5Q | 238Q | 167.7Q |
| Sn | 6.93K | 5.77K | 6.25KQ | 7.59Q | 13.0Q |
| V | 22.2 | 13.8Q | 25Q | 32Q | 66.9Q |
| Zn | 34.6 | 16.2Q | 30Q | 59Q | 121Q |
| As | 1.9 | 0.93Q | 2.03Q | 4.1Q | 5.86Q |
| Cd | 0.18 | 0.08Q | 0.14Q | 0.34Q | 0.54Q |
| Cr | 23 | 9.19Q | 16.3Q | 40.3Q | 45.5Q |
| Pb | 11.1 | 3.46Q | 5.75Q | 17.7Q | 36.1Q |
| Hg | 0.35K | 0.29K | 0.31K | 0.86K | 1.05K |
| Se | 0.35K | 0.29KQ | 0.31KQ | 0.86K | 1.05KQ |

**TABLE 6.4.5** Sediment Stations - Raft Trip - LANL - 1993

| SEDIMENT (mg/kg) | SEDIMENT STATIONS (1993 Raft Trip) | | |
|---|---|---|---|
| | Spring 4A Date: 931013 Time: 0900 | AN0.1 Date: 931013 Time: 1400 | Ancho Spring Date: 931013 Time: 1455 |
| Al | 2955 | 1187 | 1620 |
| Ba | 41.6 | 10.88 | 18.87 |
| Be | 5.6K | 5.49K | 5.55K |
| B | 5.6K | 5.49K | 5.55K |
| Ca | 2719 | 307.7 | 665.93 |
| Co | 2.8 | 0.56 | 1.11 |
| Cu | 5.1 | 2.75K | 2.89 |
| Fe | 8315 | 3340.66 | 3140.9 |
| Mg | 1629 | 329.67 | 621.5 |
| Mn | 93.26 | 105.49 | 66.59 |
| Mo | 5.6K | 5.49K | 5.55K |
| Ni | 5.6K | 5.49K | 5.55K |
| Si | 168.5 | | 155.38 |
| Ag | 5.6K | 5.49K | 5.55K |
| Sr | 12.4 | 5.49K | 5.77 |
| Sn | 5.6K | 5.49K | 5.55K |
| V | 16.9 | 5.49K | 5.55K |
| Zn | 16.9 | 10.77 | 10.99 |
| As | 0.28K | 0.27K | 0.28K |
| Cd | 0.06K | 0.05K | 0.06K |
| Cr | 15.7 | 0.75 | 1.44 |
| Pb | 5.4 | 2.09 | 1.44 |
| Hg | .25K | 0.27k | 0.28K |
| Se | 0.25K | 0.27K | 0.28K |

**TABLE 7.3.1** Waste Water Stations - Water Chemistry - SNL - 1993

| WATER CHEMISTRY | WASTE WATER STATIONS | |
|---|---|---|
| | WW006<br>Dt: 931206<br>Tm: 0930 | WW008<br>Dt: 931206<br>Tm: 0945 |
| Water Temp. (C) | | |
| Field Conductivity (uhmo) | | |
| Dissolved Oxygen (mg/L) | | |
| Field pH (S.U.) | | |
| Total Org. Carbon (mg/L) | | |
| Nitrate+ite (mg/L) | 0.10K | 0.60 |
| Ammonia (mg/L) | 18.50 | 4.60 |
| Kjeldahl N (mg/L) | 26.80 | 7.90 |
| Total Phos. (mg/L) | 5.40 | 0.80 |
| Ca (mg/L) | 36.00 | 44.00 |
| Mg (mg/L) | 6.00 | 8.00 |
| K (mg/L) | 19.00 | 7.00 |
| Na (mg/L) | 157.00 | 59.00 |
| Hardness (mg/L) | 115.00 | 142.00 |
| Alkalinity (mg/L) | 239.00 | 154.00 |
| Bicarbonate(mg/L) | 290.00 | 188.00 |
| Carbonate (mg/L) | 0.00 | 0.00 |
| Chloride (mg/L) | 155.00Q | 35.00 |
| Fluoride (mg/L) | 0.62Q | 1.45 |
| Sulfate (mg/L) | 72.00Q | 107.00 |
| Color Test (units) | 50.00L | 30.00 |
| Lab Conductivity (uS/cm) | 1075.00 | 566.00 |
| Lab pH (S.U.) | 7.80 | 7.54 |
| TDS (mg/L) | 640.00 | 394.00 |
| Lab Turbidity (NTU) | | |
| TSS (mg/L) | 106.00 | 36.00 |

**TABLE 7.3.2** Waste Water Stations - Total Metals - SNL - 1993

| TOTAL METALS (ug/L) | WASTE WATER STATIONS | |
|---|---|---|
| | WW006<br>Dt: 931207<br>Tm: 0930 | WW008<br>Dt: 931207<br>Tm: 0945 |
| Al | 1000 | 100K |
| Ba | 100 | 100 |
| Be | 100K | 100K |
| B | 200 | 100K |
| Ca | 46000 | 51000 |
| Co | 50K | 50K |
| Cu | 130 | 50K |
| Fe | 2000 | 100 |
| Mg | 64000 | 7600 |
| Mn | 50K | 50K |
| Mo | 100K | 100K |
| Ni | 100K | 100K |
| Si | NA | NA |
| Ag | 100K | 100K |
| Sr | 300 | 400 |
| Sn | 100K | 100K |
| V | 100K | 100K |
| Zn | 110 | 50K |
| As | 7 | 5K |
| Cd | 1K | 1K |
| Cr | 16 | 5K |
| Pb | 9 | 5K |
| Hg | .5K | .5K |
| Se | 5K | 5K |

**TABLE 7.3.3** Waste Water Stations - Radiochemistry - SNL - 1993

| ANALYTE (pCi/L) | WASTE WATER STATIONS | | | | | |
|---|---|---|---|---|---|---|
| | WW006 Dt: 931207 Tm: 0930 | | | WW008 Dt: 931207 Tm: 0945 | | |
| | Value | Sigma | D. Limit | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 5.80 | 2.5 | 3.5 | 2.7 | 0.8 | 1.1 |
| Gross-alpha w/ U-nat ref | 6.00 | 2.5 | 3.6 | 3.2 | 1 | 1.3 |
| Gross-beta w/ Cs-137 ref | 14.60 | 4.4 | 8 | 7.3 | 1.4 | 2.2 |
| Gross-beta w/ Sr/Y-90 ref | 14.60 | 4.3 | 8 | 7 | 1.3 | 2.1 |

**TABLE 9.5.1** Waste Water Effluent Pond - Water Chemistry - WIPP - 1993

| WATER CHEMISTRY | WW STATION<br>SW Evap. Pond<br>LWDF<br>Dt: 930830<br>Tm: 0838 |
|---|---|
| Ca (mg/L) | 510.00 |
| Mg (mg/L) | 290.00 |
| K (mg/L) | 200.00 |
| Na (mg/L) | 990.00 |
| Hardness (mg/L) | 2470.00 |
| Alkalinity (mg/L) | 189.00 |
| Bicarbonate(mg/L) | 231.00 |
| Carbonate (mg/L) | 0.00 |
| Chloride (mg/L) | 1400.00 |
| Fluoride (mg/L) | 1.48 |
| Sulfate (mg/L) | 425.00 |
| Color Test (units) | 50.00L |
| Lab Conductivity (uS/cm) | 5842.00 |
| Lab pH (S.U.) | 7.25 |
| TDS (mg/L) | 4000.00 |
| TSS (mg/L) | 290.00 |

**TABLE 9.5.2** Waste Water Effluent Pond - Radiochemistry - WIPP - 1993

| ANALYTE (pCi/L) | WW STATION<br>SW Evap. Pond,<br>LWDF<br>Dt: 930930<br>Tm: 0835 | | |
|---|---|---|---|
| | Value | Sigma | D. Limit |
| Gross-alpha w/ Am-241 ref | 13.00 | 5.00 | 7.00 |
| Gross-alpha w/ U-nat ref | 22.00 | 8.00 | 12.00 |
| Gross-beta w/ Cs-137 ref | 206.00 | 18.00 | 13.00 |
| Gross-beta w/ Sr/Y-90 ref | 189.00 | 14.00 | 12.00 |
| Ra-226 Total | 0.81 | 0.20 | 0.13 |
| Ra-228 Total | -0.60 | 2.50 | |

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# APPENDIX A

## Rapid Bioassessment of Five Rio Grande Tributaries in White Rock Canyon, New Mexico

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# Rapid Bioassessment of Five Rio Grande Tributaries in White Rock Canyon, New Mexico.

September 8 - 11, 1992

J. S. Hopkins

During the week of September 7-11, 1992, five tributary streams to the Rio Grande (Mortandad Canyon, Pajarito Canyon, Ancho Canyon, Chaquehui Canyon and Frijoles Canyon) (Fig. 1) were sampled using EPA's Rapid Bioassessment Protocols level II (RBA II). This methodology involves the comparison of the biological community with an evaluation of the available habitat to determine not only the quality of the benthic community but also the degree to which the habitat is utilized. This effort was undertaken to test the usefulness of the RBA II protocols on small, warmwater systems and to provide biological information to augment ongoing chemical and radiological surveys in this area.

The segment of the Rio Grande that receives the five systems in question is bisected by the flood-stage level of Cochiti Reservoir and so the tributary streams have been divided into two groups on the basis of habitat evaluations. Mortandad and Pajarito Canyons join the Rio Grande above the level flooded by Cochiti Reservoir and so scored much higher on the habitat assessment than did Ancho, Chaquehui or Frijoles Canyons (Table 1). Because of these habitat differences and the disparate scores they generated, Mortandad Canyon is compared to Pajarito Canyon and Frijoles Canyon serves as a reference for Ancho and Chaquehui Canyons.

Floodplain and riparian vegetative communities above the Cochiti flood pool are typical of Southern Rocky Mountain Ecoregion floodplains with Oneseed Juniper (*Juniperus monosperma*) dominating the uplands and Coyote Willow (*Salix exigua*) and Fremont Cottonwood (*Populus fremontii*) occupying the riparian areas with an often dense mix of other phreatophytic deciduous shrubs. Ancho, Chaquehui and Frijoles Canyons, which have been flooded periodically by Cochiti Reservoir, now pass through a very different type of landscape. Large woody plants such as Juniper and Cottonwood have been drowned to a height of forty to fifty feet above the current level of the Rio Grande and the floodplain has been buried to an often considerable depth by sediments deposited during high water events. While Ancho and Frijoles Canyons have cut down to the approximate levels of their original channels, Chaquehui Canyon no longer supports surface

flow to the Rio Grande, if it ever did. The floodplain vegetation in this area is dominated by the skeletons of drowned juniper and a thin ground cover of *Kochia scoparia*. Living woody vegetation at the time of sampling was largely limited to isolated clumps of Current bushes (*Ribes* sp.) and Coyote Willow in the riparian area. Herbaceous vegetation in this area is limited to a usually sparse growth of forbes and grasses. The net effect of this recently flooded environment is increased sediment input to the streams in question as well as an increase in insolation and water temperature. Evidence of utilization of floodplain and riparian areas by cattle was found in all five canyons.At the time of this survey those areas of Frijoles and Chaquehui Canyons that supported forage were being grazed by a herd of at least ten, apparently stray, cattle. Because the only remaining forage in these canyons was located in wet riparian areas, grazing and loafing activities were concentrated along the streams.

Samples were collected using a 1 mm mesh 'D' net. Where flow permitted, riffles were sampled by agitating the substrate upstream of the net.Where flow was insufficient for this method, pools were sampled by sweeping the net through the water and substrate. All available habitats were sampled.Samples were rinsed in the 'D' net, dewatered on a no. 35 standard mesh screen and preserved with 70% ethanol. After further washing to remove preservative and residual turbidity, samples were floated in a gridded white enamel pan. Grid cells were selected using a pseudo-random number generator and sorted until approximately 100 organisms were sub-sampled. With the exception of Nematoda and Ostracoda, specimens were identified to the level of Family and enumerated. Only seven of the eight metrics normally used in RBA II could be utilized for the Ancho/Chaquehui/Frijoles group. As no scraper insects were found the scraper/filtering collector ratio could not be run. In addition to the eight metrics listed for RBA II, Percent Model Affinity, Shannon-Wiener Diversity and Winget and Mangum's CTQa were calculated (Table 2). A rough estimate of relative standing crop was developed by calculating the mean number of organisms per cell in the sorting tray. These data were not incorporated in the RBA II process. Rather, they were calculated for comparison to the RBA II results and as 'tie-breakers' should the assessment of any station not fall within clearly defined assessment limits.

Results of the RBA process show all stations to be 'Moderately Impaired' relative to their respective reference stations (Fig. 3). It should be noted that Pajarito Canyon, the reference station for Mortandad Canyon, is also 'Moderately Impaired' relative to the biological community at Frijoles Canyon. With the exception of a result of 'Partially Supporting' for Mortandad Canyon, habitat evaluations for all stations yielded results of at least marginally 'Supporting'. In that Pajarito Canyon scored 166 on the habitat assessment, 195% of Frijoles score of 85, it is possible that some as yet unidentified water quality effect is influencing community structure there. Frijoles Canyon produced the greatest number of high water quality dependent macroinvertebrates and was therefore used as the local reference for Ancho and Chaquehui Canyons. However, diversity at this station was low and community composition skewed due to the apparent absence of numerous taxa found at similar stations (Table 2). Whether or not this imbalance is related to the contamination of the Rito de los Frijoles by DDT and associated breakdown products as documented by the National Park Service and NMEID in 1988 and 1989 (M.R. Fletcher, N.P.S., Pers. Comm.) or is an artifact generated by the small number of cells sub-sampled during the sorting process (3) is not clear at this time. Note that the two stations with the lowest relative standing crop, Mortandad and Chaquehui, both produced greater numbers

of taxa than their respective reference stations. Thus there is a direct correlation between the number of cells counted and the number of taxa found. This is an artifact that is amplified by differences between stations and further work on sub-sampling techniques is clearly required.

The greatest indication of water quality impairment found in these five streams is the generally high value developed by the Family Level Biotic Index (Hilsenhoff, 1988), which indicates communities tolerant to depressed dissolved oxygen levels. This condition is interpreted as an indication of organic nutrient loading.High nutrient loads are to be expected in Mortandad Canyon since flow is maintained in that system by effluent from the White Rock Waste Water Treatment Plant. Sources of nutrient enrichment in Pajarito, Ancho and Chaquehui Canyons are not readily apparent but sediment loading, groundwater inputs and cattle dung should be considered as well as non-contaminant related effects such as elevated water temperatures and site selection artifacts. One aspect of the benthic community in Mortandad Canyon, the near total lack of any filtering-collectors (Fig. 2), raises the possibility that toxic materials are being sorbed to suspended particulate material in that system. The filtering-collector trophic group strains fine particulates from the water column as a food source and can be eliminated if the fines are contaminated with toxic materials.

Flooding by Cochiti Reservoir has had a profound effect on habitat at the three lower stations. The combination of sandy soils and the removal of the sheltering effect of the Juniper forest has made the establishment of good ground cover difficult. Surface soils are, consequently, subject to erosion and stream banks remain unstable over much of the area. Above the Cochiti flood pool, Mortandad Canyon appears to be suffering the effects of a general destabilization of its channel. Ground cover has been disturbed over much of the valley floor and there is evidence of sediment deposition in the stream bed.

The Percent Model Affinity metric (PMA), as developed by Novak and Bode for use in New York State was run along side the RBA protocols for comparison. This metric, which requires identification of macroinvertebrates only to the level of Order, has been shown to correlate well with other metrics, notably Hilsenhoff's FBI. Results of this metric here parallel the results of the RBA II process closely and may offer an economical and truly rapid bio-assessment technique.

A number of concrete recommendations may be made on the basis of this survey. Nutrient analyses should be run on all five systems on an "above and below" basis ie, samples should be drawn as high as is practicable in the watershed as well as down on the Rio Grande floodplain. Additionally, all five systems, and especially the Rito de los Frijoles, should be sampled for DDT and associated decomposition products. The removal of cattle from federal land in White Rock Canyon would remove a major impediment to the re-establishment of riparian vegetation along tributary streams and the eventual stabilization of their banks. Damage to vegetative cover in some areas of Chaquehui and Frijoles Canyons caused by grazing and loafing activities was significant. It is apparent that sub-sampling methods for the RBA protocols need improvement over the method used here. One methodology that appears promising is to sort some percentage of cells in the tray. While there are drawbacks with this method as well, eg. some impacted stations may yield very low numbers, the bias engendered by unequal sampling effort would be minimized.

It is desirable but probably not practical at this time to conduct RBA II surveys on all five systems on an above and below basis to aid in separating watershed effects from base water quality effects. A program of this nature would be an invaluable aid in assessing the progress of any remediation efforts that might be undertaken on these streams.

igure 1.

Whiterock Tributaries Abundances.
% Taxon Contribution.

OTOWI

DIRECTION of FLOW

N

BUCKMAN

CANYON

ROCK

WHITE

TO COCHITI RES.

Pajarito Canyon

Mortandad Canyon

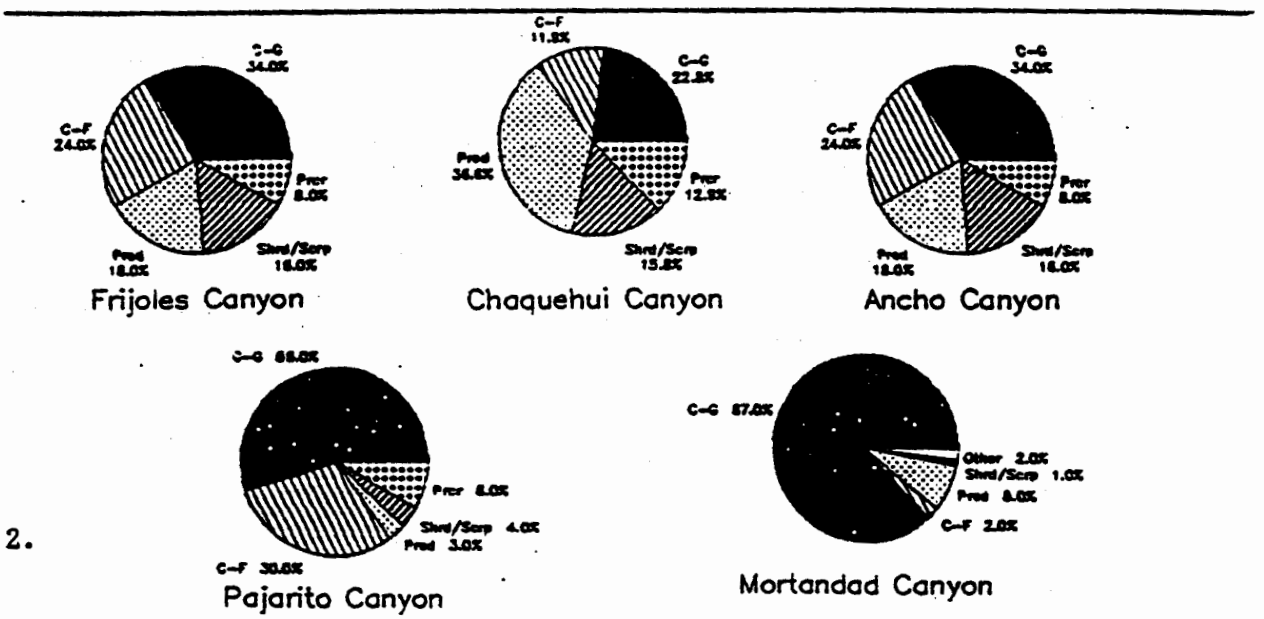
Chaquehui Canyon

Ancho Canyon

Frijoles Canyon

Colorado
New Mexico
Arizona
Study Area
Texas
Mexico

Vicinity Map

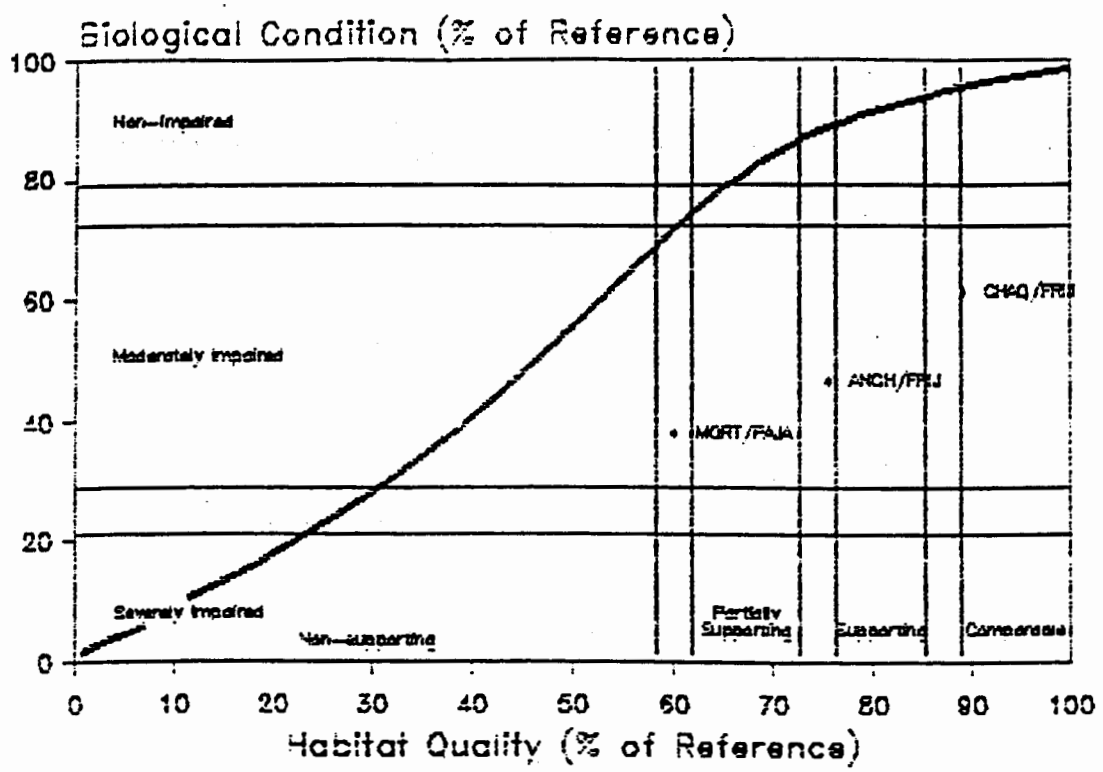



F ıre 2.

Whiterock Tributaries % Trophic Groups:
Percent of population by trophic group.

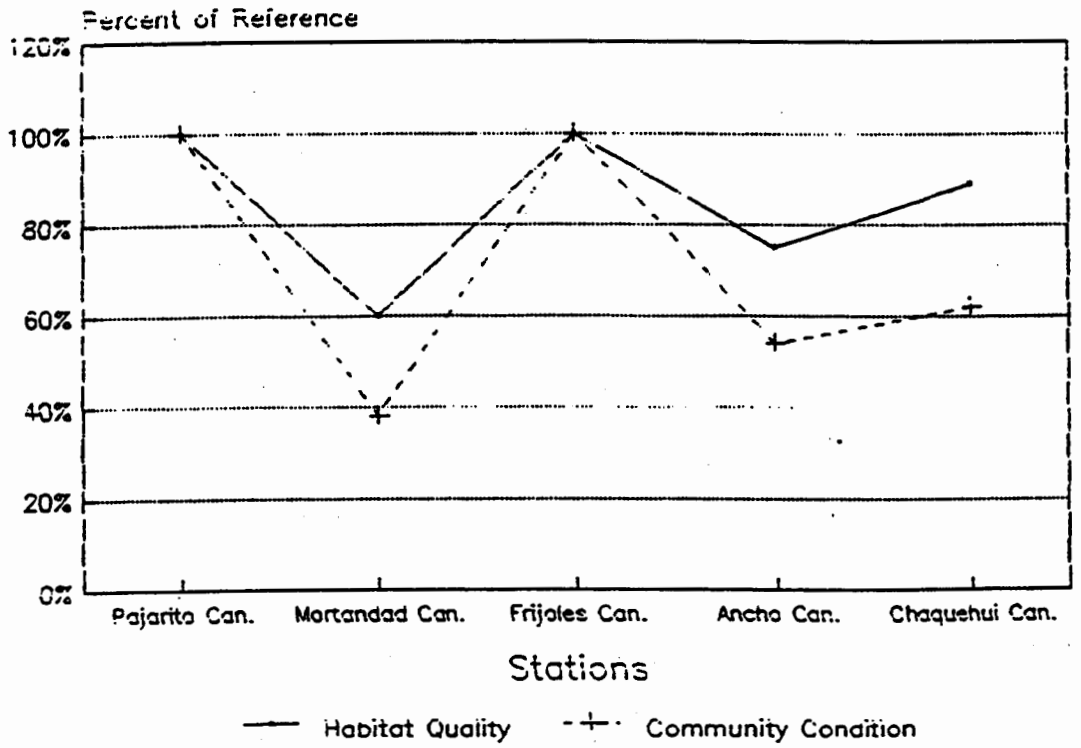
C-G = gatherer, C-F = filterer, Pred = predator, Shrd/Scrp = shredder/scraper, Prcr = piercer, Other = nematodes

Figure 3. Bioassessment Summary: RBA II
Biological Condition vs Habitat Quality




Reference stations assumed to be 100%.

White Rock Canyon Stations:
Habitat Quality vs Biological Condition




values given are percent of reference.

Table 1. RAPID BIOASSESSMENT (PROTOCOL II) OF LOWER WHITE ROCK CANYON STATIONS, SEPTEMBER 8 - 11, 1992

| METRIC | Station 2 Pajarito Canyon (Reference) | Station 1 Mortandad Canyon |
|---|---|---|
| **Calculated Value** | | |
| Number of Taxa | 9 | 11 |
| Biotic Index | | |
| FBI | 6.56 | 7.82 |
| Shredders/Total | 0.11 | 0.09 |
| EPT/(Chironomids + EPT) | 0.80 | 0 |
| % Dominant Taxa | 47 | 69 |
| EPT Index | 4 | 0 |
| Community Loss | - | 0.64 |
| Scrapers/(Scrapers + Collector-Filterers) | 0.25 | 0 |
| **Percent of Reference** | | |
| Number of Taxa | 100% | 122% |
| Biotic Index | | |
| FBI | 100 | 84 |
| Shredders/Total | 100 | 82 |
| EPT/(Chironomids + EPT) | 100 | 0 |
| % Dominant Taxa | 100 | 146 |
| EPT Index | 100 | 0 |
| Community Loss | - | 0.64 |
| Scrapers/(Scrapers + Collector-Filterers) | 100 | 0 |
| **Score** | | |
| Number of Taxa | 6 | 6 |
| Biotic Index | | |
| FBI | 6 | 3 |
| Shredders/Total | 6 | 6 |
| EPT/(Chironomids + EPT) | 6 | 0 |
| % Dominant Taxa | 6 | 0 |
| EPT Index | 6 | 0 |
| Community Loss | 6 | 3 |
| Scrapers/(Scrapers + Collector-Filterers) | 6 | 0 |
| **Total** | 48 | 18 |
| **Biological Condition** | 100% reference | 38% Moderately Impared |
| **Habitat Condition** | 166 | 100 Partially Supporting 60 % of Reference |

**Table 1. (cont) RAPID BIOASSESSMENT (PROTOCOL II) OF LOWER WHITE ROCK CANYON STATIONS**

| METRIC | Station 5 Frijoles Canyon (Reference) | Station 4 Chaquehui Canyon | Station 3 Ancho Canyon |
|---|---|---|---|
| | STATIONS | | |
| **Calculated Value** | | | |
| Number of Taxa | 11 | 16 | 9 |
| Biotic Index | | | |
| FBI | 4.12 | 6.97 | 6.26 |
| Shredders/Total | 0.20 | 0.06 | 0.00 |
| EPT/(Chironomids + EPT) | 0.89 | 0.67 | 1.00 |
| % Dominant Taxa | 30 | 16 | 34 |
| EPT Index | 8 | 2 | 2 |
| Community Loss | ref. | 0.58 | 1.00 |
| **Percent of Reference** | | | |
| Number of Taxa | 100 | 145 | 82 |
| Biotic Index | | | |
| FBI | 100 | 59 | 66 |
| Shredders/Total | 100 | 30 | 0 |
| EPT/(Chironomids + EPT) | 100 | 75 | 112 |
| % Dominant Taxa | 30 | 16 | 34 |
| EPT Index | 100 | 25 | 25 |
| Community Loss | ref | 0.58 | 1.00 |
| **Score** | | | |
| Number of Taxa | 6 | 6 | 6 |
| Biotic Index | | | |
| FBI | 6 | 3 | 3 |
| Shredders/Total | 6 | 3 | 0 |
| EPT/(Chironomids + EPT) | 6 | 3 | 6 |
| % Dominant Taxa | 3 | 6 | 3 |
| EPT Index | 6 | 0 | 0 |
| Community Loss | 6 | 3 | 3 |
| **Total** | 39 | 24 | 21 |
| **Biological Condition** | 100% Reference | 62% Moderately Impared | 54% Moderately Impared |
| **Habitat Condition** | 85 Reference | 76 89% Comparable | 64 75% Supporting |

Table 2. TAXONOMIC LISTS FOR PAJARITO AND MORTADAD CANYONS, SEPTEMBER 8 - 11, 1992.

| TAXON | Station 2 Pajarito Canyon (Reference) | Station 1 Mortandad Canyon |
|---|---|---|
| Lumbricidae | - | 69 |
| Nematoda | - | 2 |
| Ostracoda | - | 1 |
| Naucoridae | - | 1 |
| Ochteridae | - | 1 |
| Ceratopogonidae | 1 | 2 |
| Chironomidae | 48 | 18 |
| Culicidae | - | 1 |
| Dolichopodidae | 2 | - |
| Simuliidae | 27 | - |
| Tabanidae | - | 2 |
| Tipulidae | - | 1 |
| Pyralidae | 4 | - |
| Baetidae | 8 | - |
| Hydropsychidae | 3 | - |
| Philopotamidae | 1 | - |
| Hydroptilidae | 8 | - |
| Libellulidae | 2 | - |
| TOTAL | 102 | 100 |

| NON-RBA METRICS | Station 2 Pajarito Canyon (Reference) VALUE | Station 1 Mortandad Canyon |
|---|---|---|
| Shannon-Weiner Diversity | 2.64 | 1.60 |
| Hmax | 3.17 | 3.46 |
| E | 0 .68 | 0.46 |
| BCI/CTQa | 102 | 107 |
| No. cells picked | 5 | 12 |
| $\bar{X}$ no. per cell | 20 | 8 |
| Percent Model Affinity (PMA) | Ref. | 31 |
| PMA/Frijoles as reference | 40 | 24 |

Table 2 (cont). TAXONOMIC LISTS FOR FRIJOLES, CHAQUEHUI AND ANCHO CANYONS,SEPTEMBER 8 - 11, 1992.

| TAXON | Station 5 Frijoles Canyon (Reference) | Station 4 Chaquehui Canyon | Station 3 Ancho Canyon |
|---|---|---|---|
| Lumbricidae | 3 | 12 | - |
| Naididae | - | 2 | - |
| Nematoda | - | - | - |
| Ostracoda | - | 5 | 20 |
| Physidae | - | 13 | 16 |
| Notonectidae | - | 3 | - |
| Corixidae | - | 1 | 1 |
| Gerridae | - | 7 | - |
| Ceratopogonidae | - | 3 | - |
| Chironomidae | 24 | 7 | - |
| Ephydridae | - | 1 | - |
| Simuliidae | - | - | 4 |
| Tipulidae | - | 4 | - |
| Elmidae | 30 | - | - |
| Dytiscidae | - | 2 | 5 |
| Perlidae | 3 | - | - |
| Pteronarcidae | 2 | - | - |
| Nemouridae | 2 | - | - |
| Perlodidae | 3 | - | - |
| Baetidae | 22 | 9 | 34 |
| Tricorythidae | 3 | - | 8 |
| Hydroptilidae | 1 | 13 | - |
| Brachycentridae | 7 | - | - |
| Coenagrionidae | - | 5 | 9 |
| Libellulidae | - | 17 | - |
| TOTAL | 100 | 104 | 100 |

| NON-RBA METRICS VALUE | Station 5 Frijoles Canyon | Station 4 Chaquehui Canyon | Station 3 Ancho Canyon |
|---|---|---|---|
| S/W Diversity | 2.66 | 3.61 | 2.64 |
| Hmax | 3.46 | 4.00 | 3.17 |
| E | 0.77 | 0 .90 | 0.83 |
| BCI/CTQa | 88 | 95 | 93 |
| No. cells picked | 3 | 10 | 3 |
| $\bar{X}$ no. per cell | 33 | 10 | 33 |
| % Model Affinity (PMA) | Ref | 27 | 30 |
| PMA/Pajarito as ref. | 40 | 58 | 41 |

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# APPENDIX B

## 1993 Invertebrate Taxa List

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1993 Invertebrate Taxa List

| STATION | LA 5.3 | AN 0.1 | SA 6.1 | DP 0.1 | PA 0.1 | FR 0.1 | LA 12.2 |
|---|---|---|---|---|---|---|---|
| DATE | 21-Jun-93 | 13-Oct-93 | 21-Jun-93 | 21-Jun-93 | 13-Oct-93 | 14-Oct-93 | 21-Jun-93 |
| TAXA | | | | | | | |
| PLECOPTERA - stoneflies | | | | | | | |
| *Malenka sp.* | 57 | | | | | | 466 |
| *Suwallia sp.* | 3 | | | | | | |
| *Zapada cinctipes* | | | | | | 4 | 12 |
| Capniidae | | | | | | 1 | |
| *Pteronarcella badia* | | | | | | 4 | |
| *Isoperla sp.* | | | | | | 4 | 2 |
| *Hesperoperla pacifica* | | | | | | 8 | |
| | | | | | | | |
| EPHEMEROPTERA - mayflies | | | | | | | |
| Siphlonuridae | | 1 | | | | | |
| *Siphlonurus occidentalis* | 2 | | | | | | |
| *Baetis tricaudatus* | 102 | 120 | 660 | 6 | 6 | 10 | 65 |
| *Nixe simplicoides* | 3 | | | | | | 108 |
| *Tricorythodes sp.* | | 5 | | | | 2 | |
| *Paraleptophlebia sp.* | | | | | | 1 | 9 |
| *Ephemerella inermis* | | | | | | 7 | |
| *Ameletus sp.* | | | | | | | 2 |
| *Epeorus sp.* | | | | | | | 72 |
| | | | | | | | |
| TRICHOPTERA - caddisflies | | | | | | | |
| *Chimarra sp.* | | 102 | | | 7 | | |
| *Hydropsyche oslari* | | 4 | | | | 7 | |
| *Hydroptila sp* | | 5 | | | 4 | | |
| *Stactobiella sp.* | | 3 | | | 1 | | |
| *Hesperophylax sp.* | | | 10 | | | | 3 |
| *Hydropsyche occidentalis* | | | | | 118 | | |
| *Cheumatopsyche sp.* | | | | | 5 | | |
| *Leucotrichia sp.* | | | | | 157 | | |
| *Alisotrichia sp.* | | | | | 36 | | |
| *Brachycentrus americanus* | | | | | | 34 | |
| *Limnephilus sp.* | | | | | | | 1 |
| *Lepidostoma sp.* | | | | | | | 2 |
| *Wormaldia sp.* | | | | | 7 | | |
| | | | | | | | |
| DIPTERA - true flies | | | | | | | |
| *Dicranota sp.* | 2 | | 2 | | | | 2 |
| Simulidae | | | | 1 | | | |
| *Simulium sp.* | 362 | 339 | 1 | | 32 | 23 | 14 |
| *Pagastia sp.* | 10 | | | | | | |
| *Brillia sp.* | 1 | | 1 | | | | 6 |
| *Eukieffefiella sp.* | 7 | 10 | | | | | 2 |
| *Parametriocnemus sp.* | 4 | | | | | | |
| *Tvetenia sp.* | 8 | | 1 | | | 1 | 1 |
| *Chilifera sp.* | 1 | | | | | | |
| *Limnophora sp.* | 5 | 3 | 1 | 1 | | | |
| *Thienimeniella sp.* | | 1 | | | | | |

1993 Invertebrate Taxa List

| STATION | LA 5.3 | AN 0.1 | SA 6.1 | DP 0.1 | PA 0.1 | FR 0.1 | LA 12.2 |
|---|---|---|---|---|---|---|---|
| DATE | 21-Jun-93 | 13-Oct-93 | 21-Jun-93 | 21-Jun-93 | 13-Oct-93 | 14-Oct-93 | 21-Jun-93 |
| TAXA | | | | | | | |
| DIPTERA - true flies cont. | | | | | | | |
| *Thienemannimyia sp.* | | 2 | 3 | | | | |
| *Cricotopus sp.* | | 14 | | | 11 | 7 | |
| *Rheotanytarsus sp.* | | 3 | | | 1 | 1 | |
| *Polypedilum sp.* | | 6 | | | | 2 | |
| *Pseudochironomus sp.* | | 1 | | | | | |
| *Micropsectra sp.* | | 1 | | | | | |
| Stratiomyidae | | 1 | | | | 8 | |
| *Tipula sp.* | | | | 1 | | | |
| *Culiseta sp.* | | | | 64 | | | |
| *Microtendipes sp.* | | | | 3 | | | |
| *Corynoneura sp.* | | | | | 2 | | |
| *Dixa sp.* | | | | | | 3 | 3 |
| *Prosimulium sp.* | | | | | | | 5 |
| | | | | | | | |
| ODONATA - damsel/dragonflies | | | | | | | |
| Libellulidae | | 11 | | | 10 | 1 | |
| *Hetaerina sp.* | | 5 | | | 2 | | |
| *Argia sp.* | | 5 | | | 4 | | |
| | | | | | | | |
| HEMIPTERA - true bugs | | | | | | | |
| *Gerris sp.* | 1 | | | 1 | | 1 | |
| *Ambrysus mormon* | | 3 | | | 1 | | |
| Veliidae | | 20 | | | 1 | | |
| *Sigara sp.* | | | | | | 1 | |
| | | | | | | | |
| COLEOPTERA - beetles | | | | | | | |
| *Agabus sp.* | 36 | 17 | 24 | 12 | | | 8 |
| *Deronectes sp.* | 2 | | | | | | |
| *Optioservus sp.* | | | 3 | 5 | 2 | 1071 | 3 |
| *Zaitzevia parvula* | | | | 1 | | 2 | 11 |
| Curculionidae | | | | 1 | | | |
| *Helichus sp.* | | | | | 1 | 2 | 1 |
| *Heterelmis sp.* | | | | | 18 | | |
| *Microcylloepus sp.* | | | | | 6 | | |
| | | | | | | | |
| LEPIDOPTERA - moths | | | | | | | |
| *Paragyractis kearfottalis* | | | | | 24 | 3 | |
| | | | | | | | |
| AMPHIPODA - scuds | | | | | | | |
| *Hyalella azteca* | | | | | 5 | | |
| ANNELIDA - segmented worms | | | | | | | |
| Lumbricidae | 1 | | 42 | | | 4 | 2 |
| MOLLUSCA - snails/clams | | | | | | | |
| *Phusella sp.* | | 25 | | | | | |
| | | | | | | | |
| Totals | 607 | 707 | 748 | 96 | 461 | 1212 | 800 |
| Total Taxa | 18 | 25 | 11 | 11 | 24 | 26 | 23 |

# APPENDIX C

## Comparison of NMED & LANL data on (LA 4.1; 930803)

# Comparison of NMED & LANL data on (LA 4.1; 930803)

| | NMED - DOE Oversight Program | LANL EM - 8 |
|---|---|---|
| TOTAL | LA 4.1 | LA 4.1; Sample Num. 93.15751 |
| METALS | 930803 | 930803 |
| TIME: | 1740 | 1740 |
| (ug/L) | | |
| Al | 300000 | 23,000 |
| Ba | 2800 | 1,400 |
| Be | 100K | 13 |
| B | 100 | 10K |
| Ca | 84000 | NA |
| Co | 90 | 45 |
| Cu | 320 | 90 |
| Fe | 273000 | NA |
| Mg | 4600 | NA |
| Mn | 9180 | NA |
| Mo | 100K | NA |
| Ni | 200 | 50 |
| Si | 2500 | NA |
| Ag | 100K | 10K |
| Sr | 700 | NA |
| Sn | 100K | NA |
| U | NA | 4 |
| V | 300 | 65 |
| Zn | 260 | 1,300 |
| As | 13 | 5.7 |
| Cd | 1K | 6 |
| Cr | 330 | 22 |
| Pb | 1080 | 400 |
| Hg | 2.80 | 0.2K |
| Se | 5K | 2K |

Legend: K= Actual value is known to be less than value given.

| | NMED - DOE Oversight | | | | LANL EM-8 | | |
|---|---|---|---|---|---|---|---|
| | LA 4.1 | | | | LA 4.1 | | |
| DATE: | 930803 | | | | 930803 | | |
| TIME: | 1740 | | | | 1740 | | |
| | | | | | Sampling Num. 93.15751 | | |
| ANALYTE | | | | | ANALYTE | | |
| | (pCi/L) | Value | Sigma | | (pCi/L) | Value | Sigma |
| Gross-alpha w/ Am-241 ref | | 1000.00 | 150.00 | 50.00 | Gross-alpha w/ Am-241 ref | 22.00 | 5.00 |
| Gross-alpha w/ U-nat ref | | 1480.00 | 150.00 | 80.00 | H-3 | 600.00 | 300.00 |
| Gross-beta w/ Cs-137 ref | | 1680.00 | 120.00 | 90.00 | | | |
| Gross-beta w/ Sr/Y-90 ref | | 1590.00 | 100.00 | 80.00 | Gross-beta w/ Sr/Y-90 ref | 93.00 | 9.00 |