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OAKLAND OPERATIONS OFFICE

ANNUAL SITE ENVIRONMENTAL REPORT

CALENDAR YEAR 1994

for the

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH

UNIVERSITY OF CALIFORNIA, DAVIS

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ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
ADS	Activity Data Sheet
AH-1	Animal Hospital 1
AH-2	Animal Hospital 2
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
BHC	Hexachlorocyclohexane
Bq	becquerel
CAA	Clean Air Act
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CEP	Controls for Environmental Pollution, Inc.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Ci	Curie
CLP	Contract Laboratory Program
Co-60	Cobalt 60
CPT	Cone Penetrometer Testing
CSTP	Conceptual Site Treatment Plan
Cs-137	Cesium 137
CWA	Clean Water Act
DCG	Derived Concentration Guide
D&D	Decontamination and Decommissioning
DHS	California Department of Health Services
DOE	U.S. Department of Energy
DCE	Dichloroethane
D&M	Dames & Moore
DTSC	California Department of Toxic Substances Control
DW	Domestic Well
EA	Environmental Assessment
Ec	Electrical Conductance
EC	Specific Conductance
EH-22	Department of Energy Office of Environmental Compliance
EH&S	Environmental Health and Safety Office
EMO	Battelle's Environmental Management Operations
EPA	U.S. Environmental Protection Agency
EPIP	Environmental Protection Implementation Plan
ER	Environmental Restoration
ESA	Endangered Species Act
FAPAP	Federal Agency Polluction Abatement Plan
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact

g	Gram
Ger	Geriatrics Building
GSA	Gamma Spectral Analysis
H-3	Tritium
HEPA	High Efficiency Particulate Air Filter
HSU	Hydrostratigraphic Unit
ITEH	Institute Toxicology and Environmental Health
L	Liter
LAL	Lockheed Analytical Laboratory
LAS	Lockheed Analytical Services
LEHR	Laboratory for Energy-Related Health Research
LSC	Liquid Scintillation Counter
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Amount
MeV	Megaelectron-volts
mg	milligram
mR	milliroentgen
mrem	millirem
mSv	millisievert
ND	Not Detected
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standard for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NQA	National Quality Assurance
NTU	Nephlometric Turbidity Units
NVLAP	National Volunteer Laboratory Assurance Plan
OAK	Oakland Operations Office
OLC	Organic Low Concentration
OMB	Office of Management and Budget
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Comparability, Completeness
PCB	Polychlorinated Biphenyl
PCD	Putah Creek Downstream
pCi	picocurie
PCU	Putah Creek Upstream
pH	potential of Hydrogen
PNL	Battelle's Pacific Northwest Laboratories
Pu-241	Plutonium 241
QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control
Ra-226	Radium 226

Rad	Radiation Absorbed Dose
RCRA	Resource Conservation and Recovery Act
RDC	Radiation Detection Company
rem	Roentgen Equivalent Man
RESRAD	Residual Radioactive
RI/FS	Remedial Investigation/Feasibility Study
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedures
SOW	Statement of Work
Sr-90	Strontium 90
SSDC	System Safety and Development Center
Stor	Storage
STPO	Wastewater (Sewage) Treatment Plan Outfall
SWAT	Solid Waste Assessment Test
TLD	Thermoluminescent Dosimeter
TSCA	Toxic Substances Control Act
UCD	University of California at Davis
uCi	microcurie
ug/l	micrograms per liter
umhos	units of specific conductance
VOC	Volatile Organic Compound
WSF	Waste Staging Facility (H-29)

1.0 EXECUTIVE SUMMARY

Environmental monitoring and surveillance activities conducted during 1994 at the former Laboratory for Energy-Related Health Research (LEHR) are presented in this Annual Site Environmental Monitoring Report. The U.S. Department of Energy (DOE) projects at the site in 1994 concentrated on site characterization [conducted for the remedial investigation (RI)], source removal, and decontamination and decommissioning (D&D) of site buildings previously used in the research program. In 1989, DOE operations at LEHR were discontinued after completion of three decades of research on health effects of low-level radiation exposure (primarily strontium 90 and radium 226), using beagles to simulate effects on human health.

In May 1994, the U.S. Environmental Protection Agency (EPA) placed the LEHR site on the National Priorities List (NPL). The Final Draft Work Plan for the Remedial Investigation/Feasibility Study (RI/FS) was completed in September 1994. It was prepared in accordance with requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). Since data quality objectives required for the RI/FS are more extensive than those required in the site Environmental Monitoring and Surveillance Plan, it was decided to incorporate the soil, groundwater, biota and air monitoring requirements within the RI/FS. Once the RI/FS is complete, the site Environmental Monitoring and Surveillance Plan will be revised to again include all annual monitoring requirements.

During 1994, environmental monitoring was conducted under the site Environmental Monitoring and Surveillance Plan, the RI/FS Work Plan, and the Decontamination and Decommissioning (D&D) Work Plan. The LEHR site was monitored for ambient radiation fields as well as for radiological and nonradiological contaminants in the groundwater and surface water. Soil borings were taken both on-site and in adjoining areas. Air effluent monitoring was performed during the Imhoff building D&D.

1.1 Progress of the RI/FS

In the fall of 1994, coordination of the Draft RI/FS Work Plan with federal and state agencies responsible for oversight of the LEHR ER Project enabled work to proceed under verbal approval of the plan. Development of a Federal Facilities Agreement (FFA) is currently in progress. Site RI/FS activities are conducted under close coordination between the U.S. EPA, the DOE, the University of California at Davis (UCD), and the state agencies, which include the California EPA, the State Water Resources Control Board (SWRCB), and the Department of Health Services (DHS). In addition, DHS and SWRCB have an Agreement in Principal for oversight of the LEHR environmental data collection.

The RI/FS is planned to have a phased approach. As data is collected, information obtained will affect planning decisions. This promotes the most effective use of resources. Coordination between DOE, UCD, and state and federal oversight agencies is central to this process and will provide advantages for all stakeholders. Key outcomes will include development of information required to support informed risk management decisions that will lead to the most appropriate remedial actions.

1.2 Overview of 1994 Monitoring Results

Ambient radiation monitoring was conducted at 35 locations around the LEHR site. The only areas that recorded a dose higher than site background were the designated radiological waste storage areas; and during the quarter in which the Imhoff demolition was underway, the TLD attached to the containment structure within the Imhoff yard also measured slightly (4 mR) above background.

Groundwater monitoring data collected during 1994 reflect trends similar to previous data. Chromium, nitrate, a few volatile organic chemicals (VOCs), chlorinated pesticides, and low levels of radiological constituents have been found in shallow groundwater (about 45-70 feet deep) under and adjacent to the site. Concentrations of chromium, nitrate, tritium, and VOCs are above drinking water standards in some of the shallow test wells on site. Tritium was detected in one deeper test well at 85 feet, at levels well below the drinking water standard. Carbon 14 was detected in four on-site test wells that are immediately downgradient of trenches previously used to bury radiological waste.

In surface water testing, low levels of radionuclides, metals, and nitrate, and trace amounts of organic chemicals have been detected in samples collected upstream and downstream of LEHR. In 199, only antimony and methylene chloride had results above the drinking water standard. Contamination from LEHR is unlikely since the creek supplies water to, rather than draws from, shallow groundwater.

Nineteen soil borings were completed in the western dog pens. Preliminary results indicated low levels of nitrate, chlordane, several trace metals, and low levels of radionuclides, including radium 226 and strontium 90. The borings also had one detection of acetone and one detection of carbon 14. A background study has been completed to provide comparison data for the on-site samples collected.

Results from the air effluent monitoring of the site building which underwent D&D verified that no airborne radiological effluent above guidelines resulted from the activity.

1.3 Assessment of Radiological Impact of LEHR ER Project Operations

Estimated population dose has been calculated with mathematical models using known transport mechanisms for atmospheric and liquid releases and known major pathways of exposure to man (CAP88-PC). From existing residual contamination with no remediation activities in progress, the maximum credible dose equivalent to a member of the public has been calculated to be less than 0.001 mrem per year. These calculations were based upon the residual radioactive material contamination measured during site characterization activities. Airborne contamination released from site soils (nonpoint sources) in areas which have not yet been remediated is estimated to result in an effective dose equivalent of less than 5 x 10^{-5} mrem per year. Calculations were also performed to estimate the point source effective dose equivalent resulting from site D&D activities involving the Imhoff structure. This was estimated to be no more than 0.055 mrem to the maximally exposed individual located at the UC Davis ITEH facility on the LEHR site. Air monitoring during the activity detected no release, as stated above.

The radiological monitoring data collected throughout 1994, with the exception of carbon 14 and tritium levels in three on-site wells, have primarily indicated results of such low concentrations that they are not

detectable above natural background levels. Perimeter monitoring of ambient radiation found no reading at any location that was above site background levels.

2.0 INTRODUCTION

This Annual Site Environmental Report describes environmental activities for the Department of Energy's Environmental Restoration (ER) Project at the Laboratory for Energy-Related Health Research (LEHR). The report provides information about the site and its environmental monitoring operation throughout calendar year 1994. Environmental data for the year are summarized for both radiological and nonradiological monitoring. This report also describes activities conducted during 1994 in support of the site environmental restoration efforts, and information about the impact of these activities on the public and the environment.

2.1 History

The Atomic Energy Commission (AEC) first sponsored radiological studies on laboratory animals at UC Davis in the early 1950s. Initially situated on the main campus, LEHR was established in 1958 at its present location by the AEC. Research at LEHR through the mid-1980s focused on the health effects from chronic exposures to radionuclides, primarily strontium 90 (Sr-90) and radium 226 (Ra-226), using beagles to simulate radiation effects on humans. Other related research was conducted at the site concurrent with these long term studies. In the early 1970s, a cobalt-60 irradiator facility was constructed on the site to study the effects in beagles of chronic exposure to penetrating radiation.

A campus landfill, used from the 1940s until the mid-1960s, covers about 6 acres of the current LEHR site, extending one acre beyond the east boarder of the site. Also at LEHR are several low-level radioactive waste burial areas. Campus and LEHR research waste were buried there until 1974, in accordance with regulations that were in effect at the time.

In 1988, pursuant to a memorandum of agreement between the U.S. Department of Energy and the University of California, DOE's Office of Energy Research initiated activities to close out the research program at LEHR, with the goal of returning the facilities and site to the University of California, Davis after remediation is complete.

The environmental restoration of the LEHR site is managed by the U.S. Department of Energy Oakland Operations Office (OAK). From October 1989 through February 1990, an interim contract with UC Davis was implemented to succeed the maintenance and operational program and begin site restoration. In March 1990, DOE selected Battelle's Environmental Management Operations (EMO) to provide LEHR ER project management. Battelle has since contracted with various organizations, including UC Davis, to perform specific services required by the project. In 1993, EMO was incorporated into Pacific Northwest Laboratory (PNL).

In May 1994, the U.S. EPA added the LEHR site to the National Priorities List (NPL). A Remedial Investigation/Feasibility Study has been developed to ensure the site remediation is conducted in accordance with regulatory requirements.

2.2 Remediation

Primary remediation objectives include: soil and groundwater characterization, building assessment, D&D activities necessary to remediate site buildings and dog pens, waste management, source removal (radioactive sludge, cobalt 60 sealed source), chemical and radiological risk assessment, and remediation of DOE-contaminated trenches, soil, and underground tanks. Project management, health and safety, and quality assurance are components of all actions undertaken.

2.3 The Site

The LEHR site is located on a 15-acre parcel of land owned by the Regents of the University of California. It is 1.5 miles south of the main UC Davis campus in a rural agricultural area (Figure 2.1). The site is presently occupied by the UC Davis Institute of Toxicology and Environmental Health (ITEH). Research at ITEH is directed towards toxicology, epidemiology, radiation biology, and radiochemistry. Research related to the former LEHR is currently limited to data compilation and preparation of journal articles and scientific papers.

The LEHR site consists of 16 buildings, including a main administration and office building, two animal hospitals, a laboratory and support buildings, cargo container waste storage facilities, and numerous dog pens. A diagram of the current site is shown in Figure 2.2. Authorized historic use of specific facilities and/or areas on the LEHR site has left an environmental impact, which is being investigated and remediated. Former facilities included: radioactive fluid waste treatment systems, indoor/outdoor cobalt 60 beam irradiator, radioactive waste burial ground, the animal hospitals, and outdoor dog pens. Potential environmental impacts from the inactive campus landfill units and numerous inactive campus low-level radioactive disposal sites (trenches and holes), used by UC Davis and DOE to dispose of waste, are being evaluated through the ongoing site characterization.

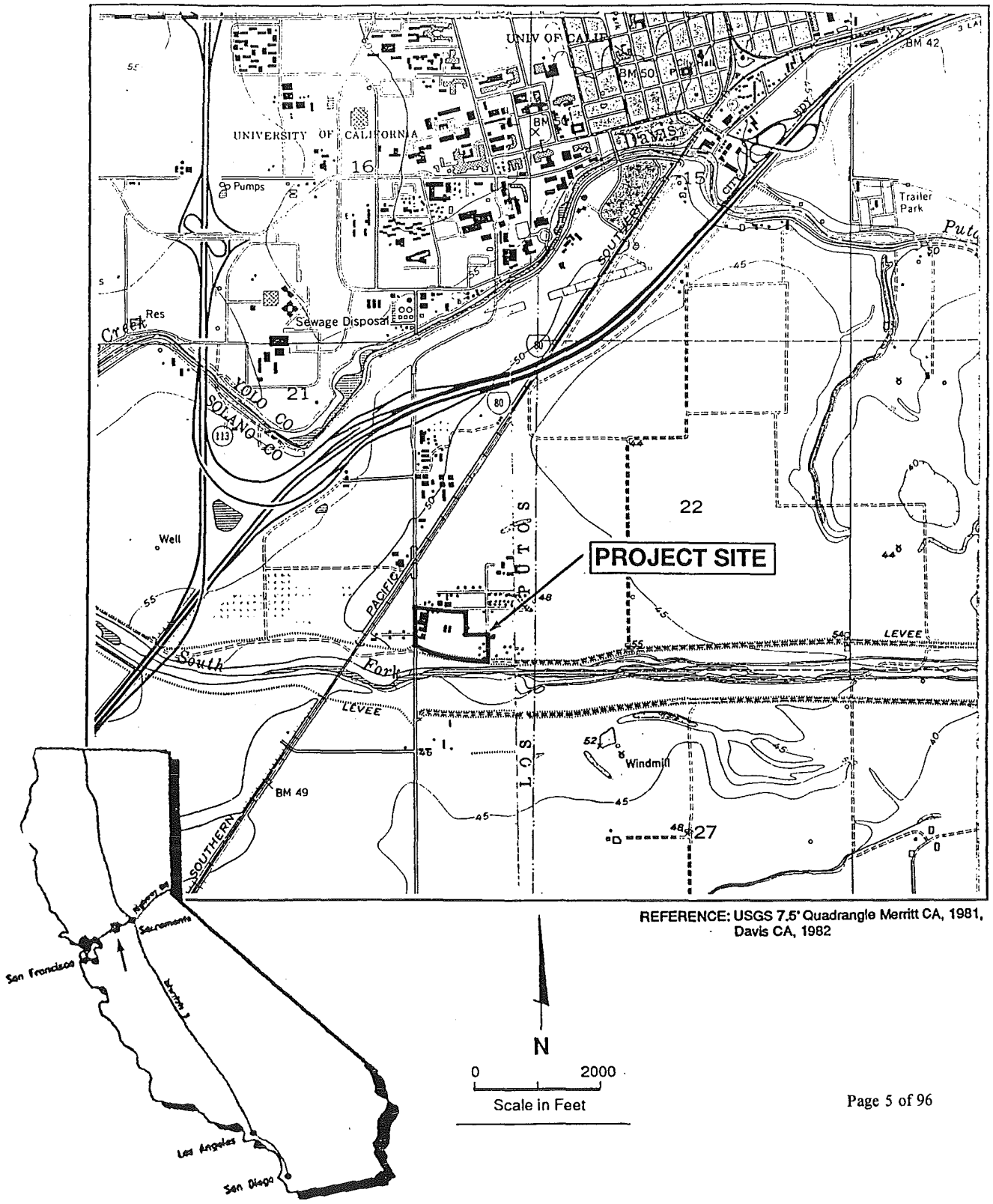
2.4 Population Data

2.4.1 Site Population

During the current remediation activities, the LEHR site is shared by the University and the DOE to support both ongoing research and remediation objectives. UC Davis' Institute of Toxicology and Environmental Health (ITEH) consists of a number of facilities on the LEHR site where health research is conducted. ITEH activities involve approximately 145 university researchers and support staff. These currently include: 15 faculty, 35 research and technical staff, 17 administrative staff, 35 postgraduate researchers and research assistants, and 43 student assistants. Like most campus researchers, ITEH researchers and student assistants have varying schedules and are not all present at the site at the same time.

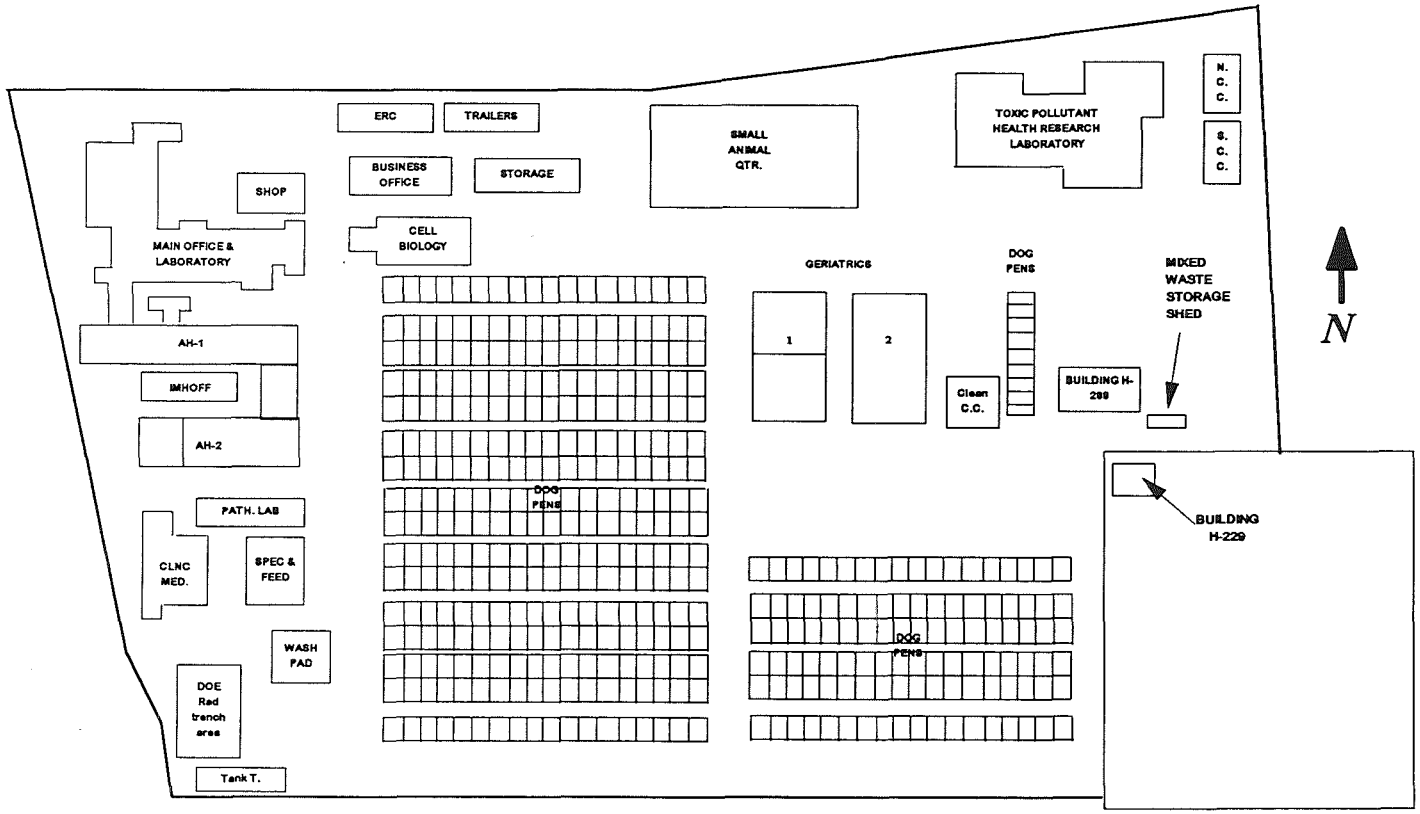
The LEHR ER Project is managed by PNL. PNL employs subcontractors responsible for specific aspects of the project. Total LEHR ER Project on-site personnel currently include 28 employees and 4 part-time students. These numbers will change as on-site work progresses on scheduled remediation projects.

FIGURE 2.1 General Location Map of the LEHR ER Project Site



REFERENCE: USGS 7.5' Quadrangle Merritt CA, 1981, Davis CA, 1982

FIGURE 2.2 LEHR ER Project Plot Plan



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2.4.2 Local Population

UC Davis has a student population of approximately 22,000 and employs approximately 14,000 full-time faculty and staff. The current population of Davis is approximately 51,000 and the current total population of Yolo County is about 120,000. The LEHR site is located in a rural area in northeast Solano County just outside of Davis. The more densely populated and metropolitan Sacramento area is approximately 12 miles east of the LEHR site. The current population of Sacramento County is about 1,130,400, and approximately 385,100 people live in the City of Sacramento.

2.5 Environmental Features

The LEHR site is bordered on the south by a levee located on the north side of the South Fork of Putah Creek. The LEHR site lies outside the 100-year flood plain, which is bounded on the north by the Putah Creek levee.

2.5.1 Land Use

The land within a one-mile radius of the LEHR site is owned both privately and by UC Davis. It is used for animal research, agriculture, and recreation (fishing and swimming). Privately owned lands toward the south and east of the site include permanent residences and are used to produce wheat, tomatoes, corn, barley, and oats. Private property to the south is separated from the site by the south fork of Putah Creek; property to the east is adjacent to non-LEHR, UC Davis-owned research facilities. The property immediately west, north and south (Putah Creek Reserve) of the site is owned by UC Davis and is currently used for various types of animal, agricultural, and health research.

2.5.2 Meteorology

The climate is Mediterranean, with mild winters and long summers. In winter, the average temperature is 46.9 degrees Fahrenheit (°F), and the average daily minimum temperature is 37.6 °F. In summer, the average temperature is 73.0°F and the average daily maximum temperature is 92.3°F. The mean annual precipitation is 17.0 inches, most of which occurs between October and April. The average daily relative humidity is about 80% in the winter, and 40% in the summer and early fall. Local humidity generally increases at night.

The LEHR site is located in the Sacramento Valley Air Basin, which has a very high air pollution potential at times when weather conditions do not favor adequate dispersion. Extensive agricultural, industrial and urban development, combined with topographic and meteorological conditions that often reduce atmospheric dispersion, can allow pollutants to reach relatively high levels at times during the year.

The sun shines approximately 95% of the time in summer and about 45% in winter. The prevailing wind direction is from the south, reflecting frequent incursion of marine air through the Carquinez Strait into the Sacramento Valley. Changes in wind direction are common, with flows from the northwest occurring diurnally. Several times a year, strong winds blow from the north, generally following the passage of Pacific storm systems. When winds are present, 40% of the time speeds are less than 3.7 miles per hour

(mph); 50% of the time they are less than 8.1 mph; and exceed 16.2 mph only 10% of the time for short periods (DOE 1994a).

2.5.3 Topography

The regional topography is typical of the relatively flat Sacramento Valley. The Sacramento River, the primary drainage of the Sacramento Valley, is approximately 12 miles east of the site. The site is situated on flat-lying land termed the Putah Plain. Average site elevation is approximately 50 feet above mean sea level. Relief across the site is about 2 feet, with the lowest portion in the area of the former cobalt 60 irradiation field (DOE 1992b).

2.5.4 Hydrology

The major groundwater sources for public and private water supplies in the Sacramento Valley are the unconsolidated deposits of Pliocene and Pleistocene age, and the older alluvium (Dames & Moore 1993). Groundwater is recharged through leakage from streams and rivers, and direct infiltration from precipitation and irrigation.

The geohydrology of the Sacramento Valley is characterized by both unconfined and confined aquifers in the near flat-lying or gently sloping sedimentary deposits in the upper 3,000 feet of section beneath the valley. No regionally-identified confining units exist in the Sacramento Valley.

Shallow groundwater is first encountered beneath the site at depths ranging from approximately 45 to 70 feet below ground surface (DOE 1992b).

2.5.5 Water Supply and Quality

The regional groundwater is of very good quality, according to state, county and local water agency officials. Poorer water quality occurs in late summer when flows are low. The higher flows during the winter are generally of better quality, but are higher in sediments and turbidity (Dames & Moore 1990, California Department of Water Resources 1978).

Seasonal groundwater levels on the site fluctuate about 30-35 feet between fall and spring months. In the vicinity of the LEHR site, regional groundwater flow is generally east from the Coast Ranges towards the Sacramento River. Across the site itself, shallow groundwater generally flows toward the northeast, but local variations of flow direction can range from north to southeast. For deeper groundwater, the direction of flow also is predominantly toward the northeast across the site; however, the direction of flow is occasionally southeast. No reversals of gradient have been observed over the four years that measurements have been collected (Dames & Moore 1994).

Many domestic and supply wells are located near the LEHR site. Thirty-four groundwater wells are located within approximately one mile of the LEHR site. Although the purpose of some of these wells is not documented, some are used for irrigation and some for domestic purposes (Dames & Moore 1992).

2.5.6 Sanitary Sewer Systems

The LEHR site discharges its sanitary wastewater to the UC Davis Wastewater Treatment Plant. UC Davis operates the plant under the conditions specified in its National Pollutant Discharge Elimination System (NPDES) permit, granted by the EPA in conjunction with the California Central Valley Regional Water Quality Control Board.

2.5.7 Storm Drainage System

Storm water runoff at the LEHR site is controlled through an underground drainage system that feeds into two collection points on the site. According to facility drawings, storm water from the paved area west of the western dog pens is collected in catch-basins and piped to the sanitary sewer. Drainage in the south and southwest area is collected in a storm water drainage system and routed to the LEHR site storm water lift station and subsequently pumped to an outfall along the west side of the Old Davis Road, where it is discharged to Putah Creek. Storm water that falls along the eastern portions of the LEHR site is allowed to percolate into the soil, except for a section of the former cobalt 60 field, where dog pens were once located, that is also connected to the sanitary sewer. Some areas on the site do have drainage problems that allow water to pond during heavy rains.

2.5.8 Biological Resources

Research conducted for an Environmental Assessment (EA) prepared for building D&D activities identified no observation of sensitive, rare, threatened, or endangered plants at the project site. However, a number of sensitive biological resources were identified as having a potential for occurrence in the vicinity of the project site. These species include: Swainson's hawk, the valley oak, the valley elderberry longhorn beetle, the giant garter snake, the Northern harrier, the American white pelican, the great egret, the western snowy plover, and the burrowing owl (see Table 3-1).

2.5.9 Historical and Archeological Resources

An archeological evaluation of the area was conducted during the Phase II Soil and Groundwater Characterization of the LEHR site by the DOE. No evidence of cultural resources, historical or archeological sensitive areas was encountered.

3.0 COMPLIANCE SUMMARY

Environmental regulatory compliance activities conducted during 1994 at the former Laboratory for Energy-Related Health Research (LEHR) are reviewed in this compliance summary. DOE-funded work at the site in 1994 centered on the environmental restoration project. Primary activities involved soil and groundwater characterization accomplished as part of the remedial investigation. decontamination and decommissioning (D&D) also continued throughout the year for remediation of structures used during the 30 years of DOE research at LEHR.

3.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

On May 31, 1994 the U.S. EPA added the former LEHR site to the National Priorities List (NPL). Subsequent to that action, the U.S. EPA and the State of California have coordinated efforts for the regulatory oversight of the LEHR environmental restoration. The State Water Resources Control Board (SWRCB) and the Department of Toxic Substance Control (DTSC) are also centrally involved in CERCLA issues for the site.

The DOE has developed a site-wide Remedial Investigation/Feasibility Study (RI/FS) in coordination with UC Davis, which meets CERCLA requirements. The RI/FS Workplan was submitted to regulatory agencies who continue to review and meet to discuss the approach to be implemented. Continuous interaction with the agencies has enabled the remedial investigation work to proceed under verbal approval of the plan.

RI activities conducted for the LEHR ER Project during 1994 focused primarily on characterization of the site and background studies for soil and water. The RI is designed to ensure that information collected will support informed risk management decisions regarding the most appropriate remedial actions to be implemented for the site. The RI plan includes investigations of groundwater and surface water, soil, sediment, biota, and air quality. The scope of the RI has been staged to sequentially build on existing data until sufficient information has been gathered to complete the Risk Assessment and the Feasibility Study.

3.2 Resource Conservation and Recovery Act (RCRA)

3.2.1 Site Treatment Plan

The Federal Facilities Compliance Act (FFCAct) of 1992 waives sovereign immunity for federal facilities for fines and penalties under the provisions of RCRA's hazardous and solid waste management requirements. It requires that a Site Treatment Plan be prepared for each site within DOE that generates or stores mixed waste. Mixed waste is defined by the FFCAct as any waste that contains both hazardous waste subject to RCRA and a source, special nuclear, or by-product radioactive material subject to the Atomic Energy Act.

The Draft Site Treatment Plan (DTSP) was prepared for the LEHR site in August 1994. The DSTP identified preferred site-specific options for storage and/or treatment of mixed waste. It was developed with input from the State of California and was based on currently available information regarding storage and treatment options. The subsequent Proposed Site Treatment Plan (PSTP) was issued in March 1995. It incorporated results of discussions among the State of California and other states, the U.S. EPA, and the DOE. At the time the PTSP was developed, no DOE mixed waste was present at the former LEHR site. The proposed plan describes DOE's process for managing mixed wastes that may be generated in future remedial actions.

3.2.2 Part A Permit

In 1989, UC Davis, as operator, and the DOE, as owner, submitted a Part A permit application to EPA for the storage of mixed waste generated during the DOE-funded research work. Since the original

application was submitted, no formal action, such as notification of interim status, has been taken by the EPA or by the California Department of Toxic Substances Control (DTSC). However, contact with DTSC has indicated that the LEHR site is considered to be under interim status while the application is in process.

Subsequent to filing the Part A Permit application for the storage of RCRA waste on site, the waste identified on the application has been tested, packaged, and shipped off-site for storage. Current decontamination and decommissioning (D&D) and soil and groundwater characterization activities are not expected to encounter or generate any additional mixed waste. If hazardous wastes are discovered, they will be managed in accordance with applicable state and RCRA regulations.

3.3 National Environmental Policy Act (NEPA)

NEPA Categorical Exclusion (CX) for demolition and off-site disposal of the Imhoff building and support facilities was approved by the DOE in January 1994. This categorical exclusion was issued to affirm that D&D work to be accomplished at the site during 1994 satisfied the requirements under DOE NEPA regulations, Subpart D, and SEN-15-90 (National Environmental Policy Act), for exclusion from further NEPA review.

3.4 Clean Air Act (CAA)

The LEHR ER Project Environmental Monitoring and Surveillance Program (DOE 1992b) does not currently require monitoring of airborne effluent streams. The site does not have airborne effluent streams that meet criteria for monitoring requirements. LEHR is subject to the Yolo-Solano Air Pollution Control District (YSACD) rules and regulations. Currently, there are no sources at the former LEHR site that are subject to permits required by the YSAPCD.

An analysis of potential point and diffuse airborne radiological effluent sources on the LEHR site, using the EPA-approved CAP88-PC computer code, indicated that the maximum credible dose equivalent to a member of the public from residual contamination on the site is less than 0.001 mrem. These calculations were based on the residual radioactive material contamination measured during site characterization activities.

As the stages of D&D and remedial action progress on the site, the need for air monitoring is continually evaluated. The potential is recognized for some of the previously fixed contamination within the buildings to become airborne during D&D activities, or for some of the contamination buried in landfills to become exposed during tests and excavation. Prior to the start of each stage of the project, an analysis is performed to determine required controls to reduce potential emissions and to evaluate air monitoring requirements. The monitoring data is collected during the activity to verify that controls are maintained and requirements are met.

3.4.1 National Emission Standards for Hazardous Air Pollutants (NESHAPs)

The LEHR site is in compliance with Subpart H of 40 CFR Part 61 for radionuclide air emissions. During 1994, the only activity on the site that would generate radionuclide emissions was the D&D of the Imhoff Building. A NESHAPs calculation was prepared for this activity, utilizing the EPA computer code CAP88-PC. This calculation conservatively assumed that 10% of the total potential residual radioactivity would be released during the activity through a 95% efficient filter. Results of the modeling determined that potential exposure from the applied conditions would be less than 0.06 mrem per year to the maximally exposed member of the public located on-site at ITEH. This is less than 0.6% of the NESHAPs dose limit of 10 millirem per year estimated dose equivalent standard of 40 CFR 61, Subpart H. However, sufficient preventive measures were taken to prevent release to the external environment.

Confirmatory air sampling conducted during the Imhoff D&D activity verified that no releases of radionuclide air emissions above allowable limits occurred. Measurable releases for the radionuclides of concern (radium 226 and strontium 90) were below 1% of Derived Concentration Guidelines (DCG's) specified in DOE Order 5400.5, "Radiation Protection of the Public and the Environment".

The building demolished in 1994 (Imhoff facility) was under containment and isolated from the external environment through engineering controls. These controls included High Efficiency Particulate Air (HEPA) filters with 99.97% efficiency; sealed plastic linings for inner building surfaces; negative pressurization of work areas for prevention of contaminant release; controlled access to buildings; and exit survey checkpoints. To monitor the effectiveness of the engineering controls, continuous air monitors were employed in the exhaust stacks of areas being decontaminated in order to detect and measure airborne radioactive contamination. Results of this monitoring verified that containment was successful.

3.5 Clean Water Act (CWA)

The site discharges its sanitary waste to the UC Davis Wastewater Treatment Plant. The plant is subject to the conditions set forth in the National Pollutant Discharge Elimination System (NPDES) permit CA0077895 and Waste Discharge Requirements Order No. 92-040, granted by the California Central Valley Regional Water Quality Control Board (RWQCB).

DOE operations at the site include no underground or above ground tanks that are subject to any county, state or federal permit requirements.

During 1993, an evaluation and revision of site water monitoring program resulted in the addition of two monitoring points for the collection of storm water runoff. Monitoring of storm water began during implementation of the RI/FS program in fall 1994. Sections 5.4 and 6.1 describe the constituents detected during this sampling event.

3.6 Safe Drinking Water Act (SDWA)/California Porter-Cologne Water Quality Control Act/California Safe Drinking Water and Toxics Enforcement Act (Proposition 65)

Current DOE activities do not contribute to hazardous discharges. The two facilities at LEHR that historically released liquid effluents to the environment, the Imhoff treatment facility and the radium 226 septic system, have ceased operation and are included in D&D remedial actions.

DOE operations at the LEHR site were discontinued in 1989. Therefore, current water monitoring activities focus primarily on environmental surveillance activities for non-operational facilities as defined in DOE Order 5400.1. Groundwater and surface water monitoring is accomplished under the site Water Monitoring Plan. Quarterly monitoring of groundwater and surface water has been conducted since November 1990. Concerns that groundwater may be affected by previously utilized waste burial sites are being investigated as part of the RI/FS.

DOE and UC Davis are working closely with the U.S. EPA, the California Department of Health Services, and the Regional Water Quality Control Board to determine the extent of contamination and remedial action to be taken. An Agreement in Principal has been established between the Department of Energy and the State of California, which includes independent comparison measurements of radiological conditions in groundwater and surface water at the site.

3.6.1 Surface and Groundwater Quarterly Monitoring

Quarterly monitoring of groundwater is performed using 18 of the 23 monitoring wells located on or near the LEHR site. The remaining 5 wells have been periodically dry due to shallow completion depths. Well level measurements are taken from these wells when they are not dry. Slightly deeper adjacent wells were installed to obtain chemical and radiological data from these locations.

Surface water monitoring is conducted at three sampling locations along the South Fork of Putah Creek: the UC Davis wastewater treatment plant outfall tributary (designated STPO); upstream of the LEHR site (designated PCU); and downstream of the LEHR site (designated PCD).

Primary objectives of the quarterly sampling include the following:

- Provide data to assist in characterizing surface water and groundwater conditions at the LEHR site, as well as to provide information on upgradient background conditions.
- Provide data to support future site activities including, but not limited to, RI/FS, remedial actions, and D&D of the site.

3.7 Toxic Substances Control Act: 40 CFR 763 (TSCA); and Demolition/Renovation Involving Asbestos: NESHAPs Subpart M, 40 CFR 61.14

Asbestos removal was conducted as part of the Imhoff building demolition. During waste packaging activities, the asbestos-containing material was utilized as filler in processing low-level radioactive waste for shipment to the DOE Hanford, Washington disposal site. This process is in accordance with the LEHR Waste Minimization Plan and is acceptable to the Hanford site as well as the State of Washington. A tank trailer that was used to hold low-level radioactive liquid in the past, was also removed and transported to the Hanford site for disposal in October of 1994. All waste regulated by this Act that is processed or stored on site is handled in accordance with TSCA and state requirements.

3.8 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

Herbicides were used on the LEHR site in 1994 by UC Davis Agricultural Services Department personnel to control weeds for fire suppression. Registered pesticides were applied following applicable campus and local regulations.

3.9 Endangered Species Act (ESA)

Current remediation activities do not involve any potential habitat disturbance in the vicinity of the project site. Therefore, there are no biological resources impacted. There have been no reported observations of sensitive, rare, threatened or endangered species on the site. However, a number of sensitive biological resources with a potential for occurrence in the vicinity of the project site (along Putah Creek) have been identified. These resources may need to be considered during future planning if remedial activities are determined to have a potential impact on these species. Table 3.1 presents a list of special status species known to exist at or near Putah Creek.

Since the LEHR site is in an area that contains critical wildlife habitat, activities undertaken during the LEHR environmental restoration will be coordinated with the U.S. Fish and Wildlife Service and the California Department of Fish and Game. A California Environmental Quality Act (CEQA) Preliminary Study for Site Characterization of the UC Davis Landfill was prepared for the University of California, Davis in February, 1990. This study identified the investigation techniques to be used during the characterization of the UC Davis Landfill at the LEHR site and discussed potential environmental impacts from those methods. The study concluded, "Although minor impacts were disclosed in the Environmental Checklist process, all impacts were temporary, consistent with existing land use and less than significant." The investigation techniques defined in the RI Plan for soil characterization are similar to those described in the above mentioned study, and therefore it is expected that associated environmental impacts will be temporary and less than significant.

TABLE 3.1 Special Status Species Near Putah Creek[1]

TAXA		LISTING STATUS[2]		
		Federal	State	Other
Agelaius tricolor	Tricolored blackbird	C-2		SSC
Athene cunicularia	Burrowing owl			SSC
Buteo swainsoni	Swainson's hawk		T	
Casmerodius albus	Great egret		TDH	
Charadruis alexandrinus nivosus	Western snowy plover	C-2		SSC
Circus Cyaneus	Northern harrier			SSC
Desmocerus californicus dimorphus	Valley elderberry longhorn beetle	T		
Grus canadensis tabida	Sandhill Crane		T	
Numenius americanus	Long-billed curlew	C-2		SSC
Pelecanus erythrorhynchos	American white pelican			SSC
Plegadis chihi	White-faced ibis	C-2		SSC
Quercus Lobata	Valley Oak			CNPS
Thamnophis gigas	Giant garter snake	T	T	

1. Source: Dames and Moore, 1994. **2.** Listing Status Codes: **T** Threatened.
CNPS California Native Plant Society, List 4
SSC California Natural Diversity Database (CDFG) Species of Special Concern.
TDH Taxa associated with habitat that is declining in California at an alarming rate.
C-2 Category 2 Candidate for Federal listing.

3.10 National Historic Preservation Act (NHPA)

All areas affected by current remediation activities involve existing building structures located on previously graded and developed land. An archeological evaluation (described in the September 1992 EA) was conducted during the Phase II Soil and Groundwater Characterization of the LEHR site. No evidence of cultural resources, historical or agriculturally sensitive areas was encountered.

3.11 Executive Order 11988, "Floodplain Management" and Executive Order 11990, "Protection of Wetlands"

The LEHR site is not on a floodplain, nor is any portion of it designated as a wetland.

3.12 Current Issues and Actions

Update on Corrective Action Items for DOE EH-24 Environmental Audit

An Environmental Baseline Audit, which evaluated environmental management for the site, was conducted at the site in May 1993 by DOE. The final report was issued in February 1994. The audit identified sixteen compliance and eight best management findings. Key findings involved waste management and formality of operations, although no imminent hazards were found in any areas. DOE project management has validated the corrective action plan that was developed to address the findings and issues identified. At this time, five findings remain open. Corrective actions for the remaining five findings have been 50% to 75% completed. Several of these remaining actions are dependent upon completing remedial investigation activities that are currently scheduled or already in progress.

3.13 Summary of Permits

The following permits are related to operations at LEHR:

1. NPDES Permit #CA0077895 (EPA) and WDR Order No. 92-040 (California RWQCB, Central Valley Region)
   UC Davis permits for discharge of wastewater from the UC Davis Wastewater Treatment Plant to the south fork of Putah Creek.

2. California Radioactive Material License #1334-57
   UC Davis license for authorizing the use and storage of radioactive materials on campus property, including the LEHR site.

3. EPA RCRA Permit #CAD982469702.
   Part A Permit for storage of mixed waste (interim status).

4.0 ENVIRONMENTAL PROGRAM INFORMATION

4.1 Environmental Management Policy

It is the policy of the LEHR ER Project to conduct activities in an environmentally safe and sound manner. The environmental protection program at LEHR shall reflect the policy stated in the DOE and PNL Project 8Management Policy for LEHR (Attachment 1). This program shall ensure the project's operation is in compliance with applicable federal, state, and local regulations in addition to applicable DOE orders and management directives. The policy goals ensure that project management will be proactive in preventing environmental problems.

4.2 Summary of Environmental Protection Program

The environmental protection program at LEHR consists of ongoing programs which include monitoring for compliance and any other relevant environmental protection requirements. Overall program requirements are defined in DOE Order 5400.1, as well as applicable federal, state, and local

environmental regulations. This program shall consist of, but is not limited to, those actions needed for compliance with the following areas:

- Remedial actions involving cleanup of past actions;
- Groundwater, surface water, soil, sediment, air, and biota monitoring defined by the site RI/FS, the Water Monitoring Plan, and the Environmental Monitoring Plan;
- Long-range environmental planning requirements defined through the Environmental Protection Implementation Plan;
- Documentation under the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA);
- Reports to DOE, including the Annual Site Environmental Report, Office of Management and Budget (OMB) Circular A-106, and other reports required by DOE Orders;
- Hazardous waste management, including waste minimization, storage, segregation, characterization, designation, and disposal;
- Hazardous materials inventory and usage and other reports and information as requested or required by regulatory agencies; and
- EPA permit requirements for storage of mixed waste if it is found during remediation.

4.3 Notification of Environmental Occurrences and Reporting

Requirements for notification and reporting of environmental occurrences are defined in DOE Orders and/or in the regulations governing release of hazardous materials. Environmental monitoring personnel have been instructed to notify appropriate management personnel if monitoring data indicates that hazardous material has been released above reportable quantities.

The PNL Project Manager is responsible for reporting environmental occurrences under DOE Orders 5484.1 and 5000.3B. These reports are submitted to DOE for review, analysis, and inclusion within annual summary reports. The reports are transmitted to System Safety and Development Center (SSDC) and Headquarters. Occurrence Reporting and Processing System (ORPS) is utilized in this process. All reports are available for review by any organization, and can be obtained by contacting SSDC, DOE, or the LEHR ER Project site office.

4.4 General Planning and Reporting

- Annual Site Environmental Report
- OMB Circular A-106 [DOE HQ generates this report from the Activity Data Sheet (ADS).]
- Environmental Protection Implementation Plan (EPIP)
- Annual Water Monitoring Report
- Other environmental status reports as required

In addition to this Annual Site Environmental Report, general planning and reporting for the site environmental management program is facilitated through documentation prepared by the DOE prime contractor. This ensures comprehensiveness of the environmental monitoring program at LEHR ER Project.

4.4.1 Office of Management and Budget (OMB) Circular A-106 Pollution Abatement Plan

All federal agencies are required to prepare an annual pollution abatement plan that will provide OMB with information needed to evaluate environmental budget requests. The plan includes estimates of future costs to achieve compliance with environmental requirements. The data for this annual plan is compiled and verified for the LEHR site by the PNL Project Manager. Site information is then incorporated within the ADS process, a computerized budget submittal which is part of the overall DOE budgetary process. The DOE Office of Environmental Compliance (EH-22) utilizes the site information to prepare an agency-wide pollution control plan for EPA assessment.

4.4.2 Environmental Protection Implementation Plan

The LEHR Environmental Protection Implementation Plan (EPIP) sets specific site environmental policies, objectives, and implementation strategies. The EPIP describes an integrated approach to maintaining and ensuring that LEHR and its environs are not adversely impacted by the decontamination and decommissioning and remediation activities performed at the LEHR site.

4.4.3 Annual Water Monitoring Report

The Annual Water Monitoring Report, required by the LEHR site Water Monitoring Plan, provides a summary and analysis of groundwater, surface water, and storm water data collected each year for the site. The objective of this report is to assess the quality of data collected and to quantify the hydrologic and chemical trends observed in order to meet the surveillance and monitoring requirements for the site as expressed in DOE Order 5400.1.

4.5 Environmental Monitoring Programs

LEHR ER Project performs environmental monitoring in accordance with permit and regulatory requirements to establish background information and to monitor operations related to site restoration activities. The PNL Project Manager has responsibility for the oversight of these programs, and assures that plans are reviewed and updated as required by DOE orders.

4.5.1 Environmental Monitoring and Surveillance Plan

The environmental monitoring program for the LEHR ER Project is described in the Environmental Monitoring and Surveillance Plan, developed in accordance with DOE Order 5400.1. The plan provides guidelines for the measurement and documentation of environmental releases (should they occur). Data collected are evaluated to determine the effects of DOE operations at LEHR on the environment, both on-site and off-site. The program supports environmental compliance requirements and promotes goals of the site environmental management policy. Because remedial action at the site is now under the CERCLA requirements, water, soil, and biota are being investigated within the RI/FS.

4.6 Summary of Environmental Monitoring Performed

4.6.1 Effluent Monitoring

There are no liquid or airborne effluent streams currently monitored by the site Environmental Monitoring and Surveillance Program. Active liquid effluent discharges to the environment were curtailed in the 1980s at the end of the LEHR research activities. There are now no active radiological or hazardous liquid effluent discharges to the environment from DOE-sponsored activities at the site. An analysis of potential airborne effluent sources (leach field, chemical dispensing areas, dog pen soils, Imhoff D&D, etc.) determined that current point and diffuse sources at the site would result in an effective dose equivalent of below 0.06 mrem to any member of the public (DOE 1995).

4.6.2 Environmental Surveillance

4.6.2.a Surface and Groundwater Monitoring

The site Water Monitoring Plan (DOE 1994a) has been developed to meet the requirements of DOE's General Environmental Protection Program as defined in DOE Order 5400.1 as well as applicable state and federal regulations. Water monitoring is conducted in conjunction with the site RI/FS as part of the site environmental restoration program.

Monitoring points have been identified in order to evaluate water quality and lateral and vertical extent of impact at the LEHR site. At this point, the program is guided by RI/FS objectives regarding data need for risk analysis and site remediation alternatives. The scope of the program will be modified (as approved by regulatory oversight agencies) when required to meet these objectives as the RI/FS and the environmental restoration activities progress and to obtain temporal and spatial information regarding chemical and radiologic constituents.

4.6.2.b Air Monitoring

Currently, air monitoring is not performed as part of the LEHR ER Project Environmental Monitoring and Surveillance Program. However, a baseline air monitoring investigation is planned as part of the Remedial Investigation. The air monitoring program will include both radiologic and nonradiologic parameters, based on materials previously detected in site soil, groundwater, and surface water. The planned locations

for air monitoring are also based on historical records of site activities, planned investigation activities, and soil and water monitoring data. Wind direction characteristics at the site will be considered in determining the most appropriate air sampling station locations.

During D&D activities, in-stack continuous air sampling was performed in the exhaust stacks of the Imhoff containment structure. The purpose of this sampling was to monitor the effectiveness of engineering controls established to prevent airborne release of previously fixed radiological contamination. Results indicated that containment was successful. Monitoring data verified that releases were near background levels and therefore well below requirements of 40 CFR 61, Subpart H.

4.6.2.c Soil and Biota Monitoring

As planning progressed to develop a site plan for the remedial investigation, it was determined that the soil and vegetation sampling required in the site Environmental Monitoring and Surveillance Plan did not include sufficient sampling locations and did not require data quality levels needed for CERCLA requirements. Therefore, the soil and biota sampling for the site are now conducted within the RI/FS.

Extensive investigations of soil on and around the site were initiated in late 1994, as work began on the RI. One of the first priorities was to establish criteria for the background levels. The background information will provide a comparison necessary to evaluate on-site soil results, and will eventually play an important part in clean-up decisions. Geophysical survey work was begun around the site trenches and landfill in order to develop more specific maps of these areas. Soil borings in dog pens and the north chemical dispensing areas were also conducted.

4.7 Site Environmental Training

Site-specific environmental training has been conducted to instruct D&D workers and other environmental restoration project personnel in methods of pollution prevention, waste minimization, and procedures to ensure environmental controls are adequately maintained during remediation activities. This training is conducted as part of the site orientation training, and also prior to any new activity with the potential of impacting the environment. Daily safety meetings reinforce this training and specify steps needed to assure adequate environmental protection during that day's activities.

Before an employee is allowed to begin hazardous site work, he or she must complete the 40-hour OSHA "Hazardous Waste Operations Training." In addition, prior to working on site, pollution prevention information is provided within the site-specific "Hazard Communication Training." This training assures that the worker is aware of proper handling, usage, and disposal of chemicals used on the job. It also covers spill prevention and control as well as proper storage and chemical disposal methods. To prevent the spread of radioactivity to the environment, workers are trained in radiological control methods, and in the proper use of D&D equipment.

4.8 Waste Minimization

The site Waste Minimization Plan (PNL 1995) reflects the commitment of DOE and the environmental restoration management contractor (PNL) to reduce the quantity and toxicity of waste generated at the site

during restoration activities. The plan is designed to meet requirements of DOE Order 5400.1 and to satisfy the requirements of the Solid Waste Disposal Act, as amended by RCRA, Hazardous and Solid Waste Amendments of 1984, and the Pollution Prevention Act of 1990. It also complies with the intent of NEPA in developing waste management and minimization methodology to reduce the impact of these wastes on natural resources and the environment.

The plan requires that waste assessments be made for all project activities prior to initiation. Economically practicable waste reduction and minimization techniques, including waste abatement, recycling, good housekeeping, and treatment are discussed. Methods to promote awareness and recognition of the waste minimization effort are also included. The plan is designed to eliminate or minimize pollutant releases to all environmental media. The program realized a savings of approximately 1100 cubic feet through volume reduction of hazardous waste that was generated during the animal hospitals D&D activity.

5.0 ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radioactive Effluent

There are no active radioactive effluent discharges from DOE-operated LEHR facilities to the environment. The two facilities at LEHR that historically released liquid effluents to the environment, the Imhoff treatment facility and the radium 226 septic system, have ceased operation and are subject to D&D as part of the LEHR ER Project.

Air sampling was conducted to monitor the effectiveness of engineering controls during demolition of the Imhoff building. Analysis of sample data indicated that effluent from the activity contained no more than background levels of contaminants. All 1994 data reported for in-stack air monitoring were near or below detection limits. To ensure adequate protection of site workers and the public, sample results are compared to the Derived Concentration Guides (DCGs) defined in DOE Order 5400.5 for primary radionuclides previously used in research at the site.

In addition to air effluent monitoring, quarterly sampling of surface water and groundwater was conducted in 1994 to assess potential contamination from previous on-site burial locations. Groundwater and surface water sampling analysis results are summarized in Sections 5.3-5.4. Ambient radiation monitoring was also conducted site-wide in 1994, and results are presented in Section 5.6.

5.1.1 Results of Air Monitoring

Remediation and demolition activities for the Imhoff building were conducted under containment. The containment consisted of a plywood structure constructed over the building and the area which immediately surrounded it. Double plastic sheeting was attached to internal surfaces of the structure. Specific additional containment requirements were followed during removal of asbestos containing materials within the building.

The containment design included negative pressure within the work areas and the use of HEPA filters to filter air released through the ventilation systems. To verify that the containment was effective, continuous air monitors tracked radioactive particulates in the filtered air stream before it was released from the stacks. Temporary ventilation was utilized during the activity. The ventilation system consisted of three 2000 cubic feet per minute portable ventilation units equipped with roughing filters, prefilters and HEPA filters. The ventilation units provided a negative pressure within the containment structure. This prevented release of contaminants at points other than through the filtered and monitored release points that exhausted above the roof line. Isokinetic sampling was performed in each of three release stacks, in accordance with the guidance contained in ANSI N13.1-1969, "Guide to Sampling Airborn Radioactive Materials in Nuclear Facilities."

The sample filters were exchanged on a weekly basis and screened on-site prior to being sent to a NVLAP accredited laboratory. Air sample results were evaluated against the DCG concentrations listed in DOE Order 5400.5 for the isotopic content at LEHR. DCG guidelines were selected for comparison with the sample results based on principal isotopes used in the LEHR research that were processed through the Imhoff building and nearby leach fields and seepage pits. Results of the 1994 stack sampling data collected while D&D was in progress (September through December) are summarized by sample location in Table 5.1. All sample results were significantly less than the DCGs specified in DOE Order 5400.5 "Radiation Protection of the Public and the Environment."

TABLE 5.1 1994 Results for Air Monitoring During Imhoff Demolition

Exhaust #	Number of Samples	Analysis	Results			Comparison with DCG
			Average	Minimum	Maximum	
Hepa #1	14	Gamma Spec	2.93E-15	9.14E-17	7.42E-15	Note (1)
		Ra-226	3.96E-16	1.26E-16	9.91E-16	0.0010
		Sr-90	7.06E-16	9.41E-18	2.05E-15	0.0002
Hepa #2	14	Gamma Spec	4.10E-15	9.41E-17	1.07E-14	Note (1)
		Ra-226	3.54E-16	7.97E-17	9.57E-16	0.0010
		Sr-90	5.23E-16	8.91E-17	9.53E-16	0.0001
Hepa #3	14	Gamma Spec	3.84E-15	1.25E-16	1.37E-14	Note (1)
		Ra-226	5.15E-16	7.91E-17	3.00E-15	0.0030
		Sr-90	7.15E-16	8.50E18	2.1E-15	0.0002

Results are reported in μCi/ml.
Note (1): Sample results less than the Minimum Detectable Activity (MDA) for the analysis.
Analysis protocols/methods: γ Spectroscopy - ASTM D3649-85
Ra-226 - US EPA 903.1, ASTM D3454-79
Sr-90 - US EPA 905.0

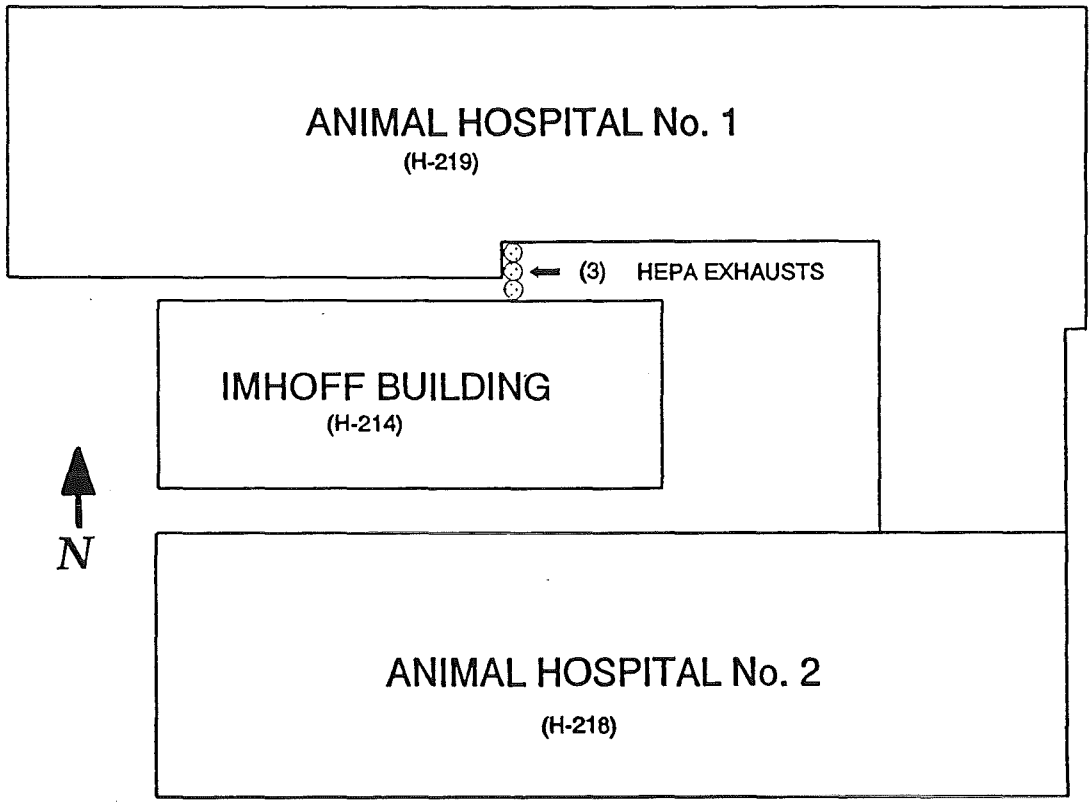
5.2 Groundwater Monitoring-Radiochemical Analyses

5.2.1 Quarterly Sampling of Site Wells

Quarterly groundwater samples were collected in February, May, August, and November 1994 from 18 on-site and off-site monitoring wells. Well locations are shown on Figure 7.1. Results of all analyses are provided in Appendix A. Each quarter, groundwater samples were analyzed for americium-241, carbon-14, plutonium-241, radium-226, strontium-90, tritium, gross alpha and gross beta radioactivity. The analyses for americium-241 and plutonium-241 were added during the summer quarter. Gamma spectral analysis (GSA) was also performed as a screening tool. The GSA included: actinium-228, bismuth-241, cesium-137, cobalt-60, lead-212, lead-214, potassium-40, thallium-208, thorium-234, and uranium-235. It should be noted that the GSA analysis is not as precise as the specific analyses methods completed for the primary radiological constituents of concern. This is reflected in to the high uncertainty values frequently associated with the results.

A detailed description of significant aspects of the groundwater monitoring program for the site is provided in Chapter 7, while quality assurance information for the program is discussed in Chapter 8.

FIGURE 5.1 Map Of Air Sample Locations For D&D Activities



5.2.2 Summary of Radiological Results in Groundwater

In general, the radiological data collected during 1994 revealed patterns similar to previous years' data. Only two constituents, carbon 14 and tritium, indicated clear trends by consistent positive detections in wells immediately downgradient to radiological waste burial trenches. Carbon 14 was found three or more quarters in wells UCD-12, UCD-13, and UCD 14 with results ranging from 200 pCi/L in UCD-12 to 2,000 pCi/L in UCD-13. Tritium was found in wells UCD-13 and UCD-14 during three or more quarters, but only one detection (in UCD-13) was slightly above drinking water standard (MCL). Other detections were more sporadic for the radiological constituents. Gross alpha and gross beta analyses indicated no clear trends, except that all results were well below the MCLs. Positive detections for radium 226 and strontium 90 were sporadic and in very low levels below the MCLs. The analyses for americium 241 and plutonium 241 that were added to the list in the summer quarter indicated no statistically significant results. The GSA data did indicate a number of positive results but there were no significant trends for particular wells. See Appendix A for all results. Additional information will be provided in the Annual Water Monitoring Report for 1994.

5.3 Surface Water Sampling for Radiological Constituents

Quarterly surface water samples were collected from Putah Creek in February, May, August, and November 1994. Surface water sampling locations are shown on Figure 5.2. Surface water samples were analyzed for the same parameters used for the groundwater. A summary of radiological data from the surface water sampling are provided in Appendix B.

5.3.1 Summary of Radiological Results in Surface Water

Positive results for radiological detections in surface water were sporadic (except for gross beta) and all results were well below drinking water standards. Gross beta was detected well below the MCL in most of the samples taken downstream of the LEHR site (PCD). However, it is unlikely that this contamination was from LEHR since the creek supplies water to, rather than draws from, shallow groundwater. Tritium was also detected sporadically in 5 of the 16 samples collected at PCD at levels far below the MCL. For detailed information on surface water radiological results, see Appendix B.

5.4 Storm Water Runoff Monitoring-Radiological Constituents

Two storm water runoff monitoring points have been added to the water monitoring program to evaluate the quality of storm water runoff generated from the LEHR site. In the fall of 1994, storm water runoff monitoring was conducted at the site. Storm water runoff collects at various on-site storm drains and is removed from the site in two locations, as shown on Figure 6.1. One collection area is a lift station located along the west side of the site, which pumps runoff under Old Davis Road where it is routed to Putah Creek. The second area collects storm water from the central portion of the site and routes runoff into a combined storm water/sanitary sewer that directs storm water runoff and sewage wastes from the LEHR, ITEH, and other UC Davis facilities to the UC Davis Wastewater Treatment Plant. Radiological results for storm water monitoring are given in Table 5.4.

TABLE 5.4 Storm Water Radiological Results (Fall 1994)

Parameter	Units	Location Date Sample QA Method	LS-1* (Lift Station)	LS-1* DUPLICATE	SD-1* (West of dog pens)
RADIOCHEMICALS					
Actinium-228 (GSA)	pCi/L	901.1	18±21	0.0±9.2	11±20
Americium-241	pCi/L	LAS108	0.009±0.062	0.022±0.040	0.022±0.046
Bismuth-214 (GSA)	pCi/L	901.1	-1±12	-2.9±6.0	0.00±13
Carbon-14	pCi/L	LSC	-24±64	6±68	-9±66
Cesium-134	pCi/L	901.1	-1.2±3.1	0.4±1.2	-1.7±5.8
Cesium-137 (GSA)	pCi/L	901.1	0.2±5.1	-0.5±1.7	-3.8±5.0
Cobalt-57 (GSA)	pCi/L	901.1	0.9±3.5	-0.2±2.1	0.0±3.5
Cobalt-60 (GSA)	pCi/L	901.1	-0.6±2.8	-0.3±1.5	2.7±3.9
Gross Alpha	pCi/L	9310	0.62±0.70	0.27±0.62	0.20±0.52
Gross Beta	pCi/L	9310	2.1±1.3	2.6±1.3	0.9±1.2
Lead-212 (GSA)	pCi/L	901.1	6.6±9.5	3.4±5.1	6.1±9.5
Lead-214 (GSA)	pCi/L	901.1	7±11	-1.4±5.4	4±11
Plutonium-241	pCi/L	LAS178	-0.4±1.1	-0.6±1.3	-0.7±1.4
Potassium-40 (GSA)	pCi/L	901.1	22±72	-13±29	-8±71
Radium-226	pCi/L	903.1M	0.40±0.32	0.21±0.25	0.30±0.34
Strontium-90	pCi/L	905.0	0.03±0.93	-0.09±0.92	-0.16±0.70
Thallium-208 (GSA)	pCi/L	901.1	1.4±6.8	-0.5±2.9	2.9±6.6
Tritium	pCi/L	906.0	-10±180	-10±180	70±190
Uranium-235 (GSA)	pCi/L	901.1	-15±21	-9.1±8.6	6±27

*See Figure 6.1 for sample codes and map of sample locations

5.5 Soil Investigation

Soil sampling for the remedial investigation began in the fall of 1994. During November and December, six soil borings were taken at near-by off-site locations for the background study. The background investigation was designed to collect information that will enable comparisons with on-site sample results in similar soils at similar depths. Preliminary results of the background study are available at this time. In addition to the background study, nineteen soil borings were also taken on-site, in the western dog pens. Results from these samples are still in the validation process, and are not yet available.

The on-site and off-site soil borings were continuously cored, extending to a depth 40 feet below ground surface. Samples were taken at 0, 5, 20, and 40 feet within each boring. Radionuclides were reported at similar levels in all samples. The preliminary data collected in the background samples is provided in Table 5.5.

TABLE 5.5 Background Soil Study-Preliminary Results

Approximate Ranges of Background Soil Boring Samples in pCi/g:

	0' Depth		5' Depth		20' Depth		40' Depth	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
Gross Alpha	1	12	2	25	3	15	8	14
Gross Beta	8	18	6	18	7	17	7	18
^{14}C	-8	5	-8	8	-8	7	-8	40
^{3}H	-100	75	-120	100	0	200	-100	20
^{60}Co	-0.04	0	-0.03	0.01	-0.05	0	-0.05	0
^{137}Cs	-0.1	0.13	-0.1	0.1	-0.15	0.1	-0.1	0.1
^{226}Ra	0	1	-0.5	1	-0.5	1	0	1
^{90}Sr	-1	0.5	-0.4	0.4	-0.4	0.5	-0.4	0.4

5.6 Ambient Radiation Monitoring

Perimeter fence lines, radioactive waste storage areas, and various work areas around the LEHR ER Project site are monitored by environmental radiation dosimeters. In 1994, there were 35 locations monitored for penetrating radiation through the use of Thermoluminescent dosimeters (TLDs). Additionally, several TLDs are placed to find natural background radiation, and control dosimeters are used to ensure continued accuracy during transport to off-site processing.

Results of the environmental dosimetry readings are provided in Tables 5.6A through 5.6C. Many locations were monitored in 1994 by two dosimeters, one changed monthly and the other changed quarterly. (Therefore, all locations except the first five in Table 5.6A correspond to those listed in Table 5.6B.) Figures 5.6 A-C are maps which show locations for each group of dosimeters.

The radioactive waste storage areas, which are monitored quarterly in Group 63 (see Table 5.6A), had readings slightly above background levels. These areas include Ger I East (this TLD is inside building H-292, where D&D wastes were stored); Mixed Waste (the mixed waste storage facility); and Rad Stor SE (a cargo container used to store radiological waste). After correcting for site background (which was 7 mR), the highest annual result for these storage areas was a total of 18 mR for the year, received at the Ger I East location.

Calculations were performed to determine the maximum potential exposure an individual might receive in the vicinity of this radioactive storage location. The storage building is situated in an area where site employees spend very little time, and visitors rarely go near this area. The maximum estimated potential annual dose for an individual from this source would realistically have been less than 0.26 millirem. This calculation is based on surface contact, assuming an individual would spend as much as 30 minutes each working day leaning against the east wall of the building. At 1 meter, the distance someone would possibly walk by the area, the dose drops to less than 2.6×10^{-3} millirem over the year. Both calculations are based on ANSI N543-1974, which defines an occasional occupancy factor of 1/16 (30 minutes per day). This is much higher than the actual average occupancy for this location, and the area outside the east side of the building is not a sidewalk or passageway.

During the last quarter of 1994, demolition of the Imhoff building contributed a total of 4mR above background to the measurement at the TLD location on the rear wall of the Imhoff containment structure. A second TLD location just a few feet south of the structure measured only 1 mR for the entire year. Personnel working in the area were monitored by personnel dosimetry, with strict entry controls. No doses were recorded for these workers during the year.

TABLE 5.6A 1994 Quarterly Ambient Radiation Monitoring Results, Group 63 Exposure, mR above Radiation Detection Company (RDC) Background

LOCATION	TLD #	1/1/94-3/31/94	4/1/94-6/30/94	7/1/94-9/30/94	10/1/94-12/31/94	ANNUAL TOTAL 1994
South #1	10	1	1	0	2	4
South #2	11	0	2	2	3	7
North #1	7	0	2	0	1	3
East #1	8	0	1	1	2	4
East #2	9	0	1	1	2	4
AH-2	27	0	0	0	1	1
Ger I East	15	5	6	6	8	25
Ger I North	16	0	0	0	0	0
Ger I South	14	0	0	0	0	0
Ger I West	17	0	0	0	1	1
IMH Fence	25	0	0	0	1	1
Mixed Waste	6	0	4	2	4	10
Rad Stor NE	4	0	0	0	0	0
Rad Stor SE	5	3	3	1	1	8
SW Corner	20	0	2	0	2	4
NE Corner	2	0	2	1	2	5
NW Corner	1	0	2	1	2	5
W CO60	12	0	0	0	1	1
NW CO60	13	0	0	0	0	0
W Pen Fence	18	0	0	0	0	0
Boundary	19	0	0	1	1	2
E Imhoff	29	0	2	0	7	9
S Spee Fence	21	0	1	0	1	2
SS Tree	22	0	0	0	0	0
S AH-2	23	0	0	0	0	0
Lift Station	24	0	0	0	0	0
WAH 1	26	0	1	0	0	1
Freezer Fence	31	0	0	0	0	0
Control	38	0	0	3	1	4
Site Background	35	0	2	2	3	7
Bkgd EH&S	36	0	0	0	0	0

All exposure rates are measured in mR above the RDC background, but site background has not been subtracted.

FIGURE 5.6A TLD Locations for Group 63

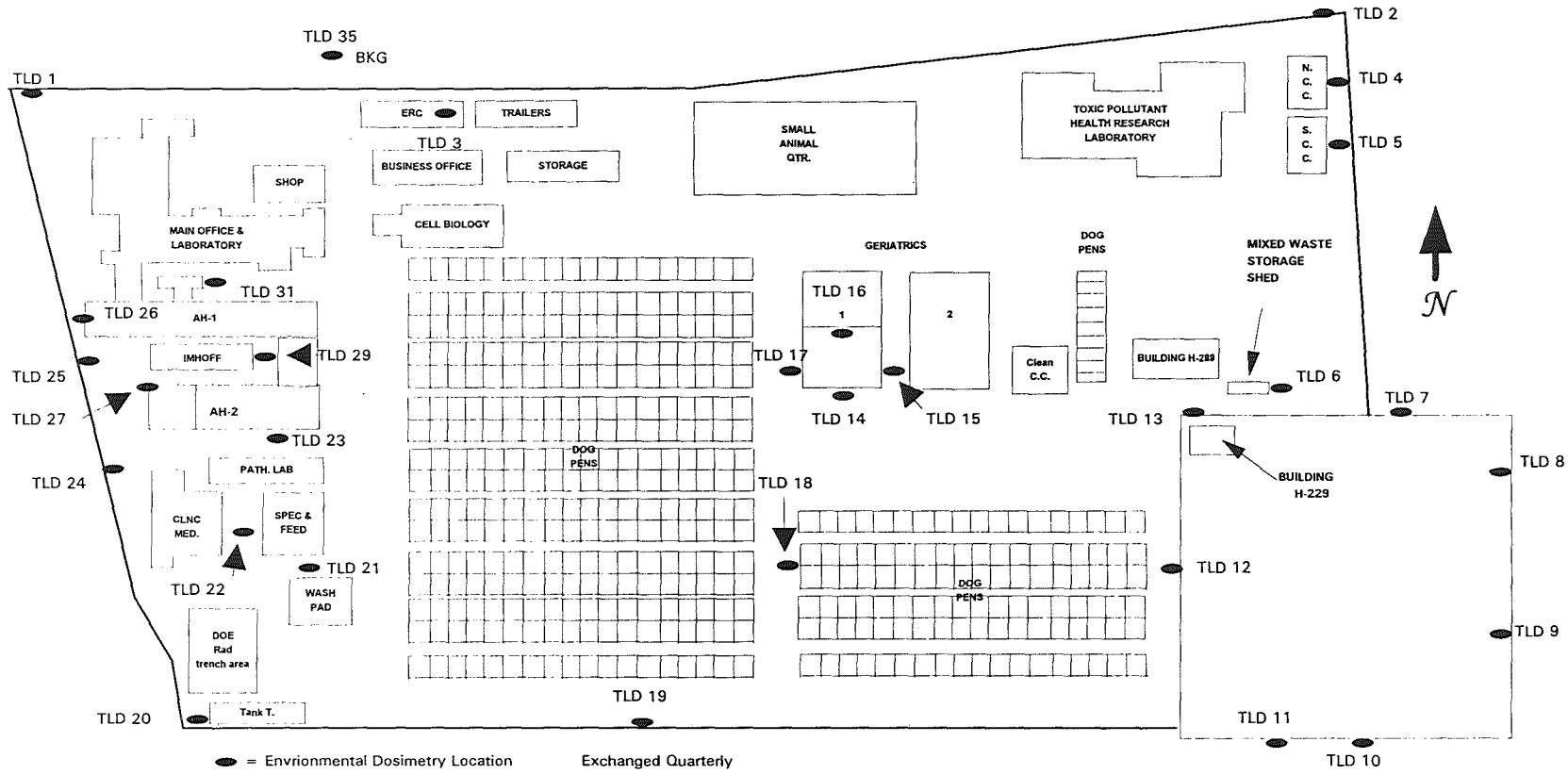


TABLE 5.6B 1994 Monthly Ambient Radiation Monitoring Results, Group 88

LOCATION	TLD #	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
AH-2 North	27	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I E	15	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I N	16	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I S	14	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I W	17	0	0	0	0	0	0	0	0	0	0	0	0	0
Imhoff Fence	25	0	0	0	0	0	0	0	0	0	0	0	0	0
SW Corner	20	0	0	0	0	0	0	0	0	0	0	0	0	0
Control	38	0	0	0	0	0	0	0	0	0	0	0	0	0
Background	35	0	0	0	0	0	0	0	0	0	0	0	0	0
Control LEHR Project/EH&S	37	0	0	0	0	0	0	0	0	0	0	0	0	0

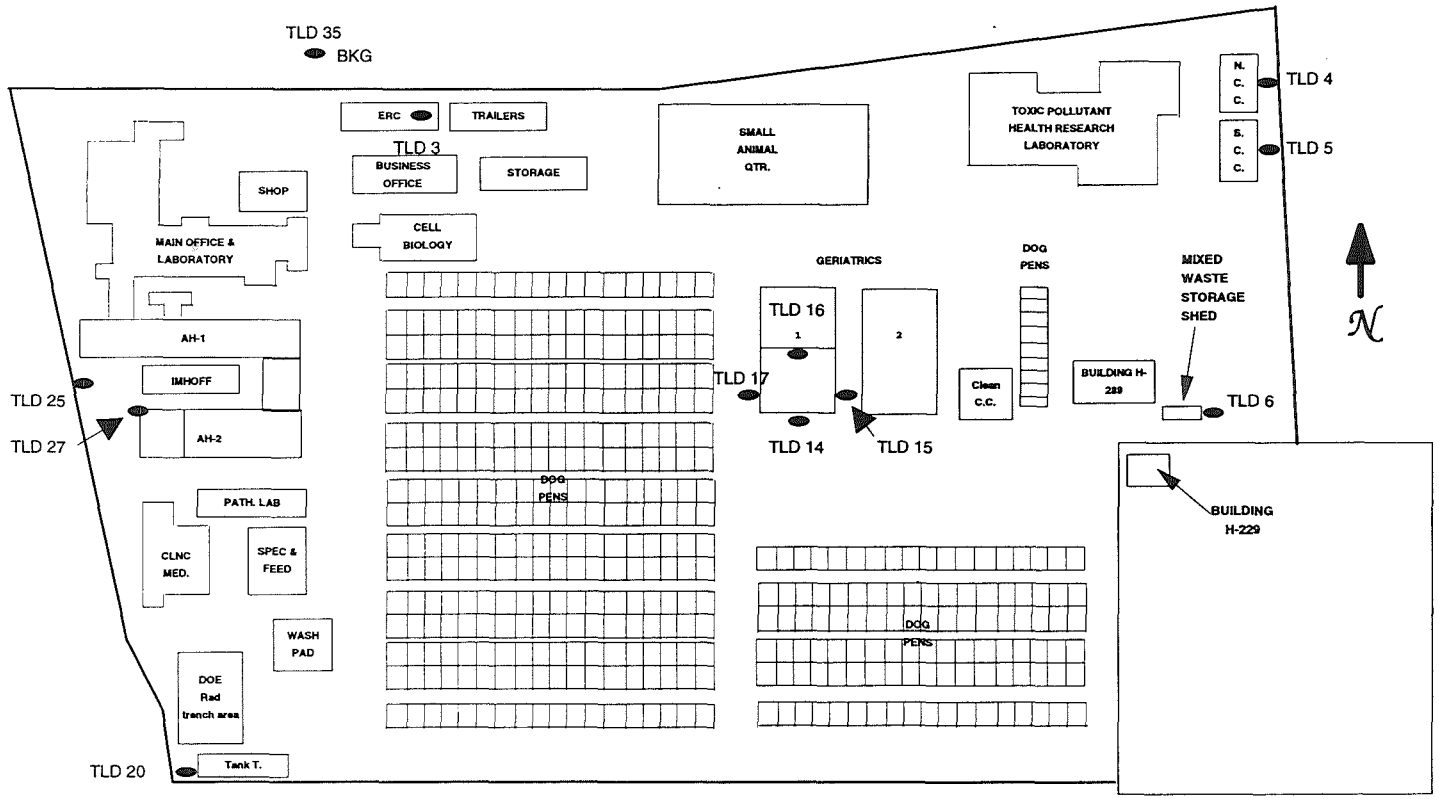
Results reported in mrem

TABLE 5.6C 1994 Monthly Ambient Radiation Monitoring Results, Group 82

LOCATION	TLD #	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bulletin Board	33	0	0	0	0	0	0	0	0	0	0	0	0
Desk	34	0	0	0	0	0	0	0	0	0	0	0	0
Calibrator W.	28	0	0	0	0	0	0	0	0	0	0	0	0
Control LEHR/EH&S	37	0	0	0	0	0	0	0	0	0	0	0	0

Results reported in mrem

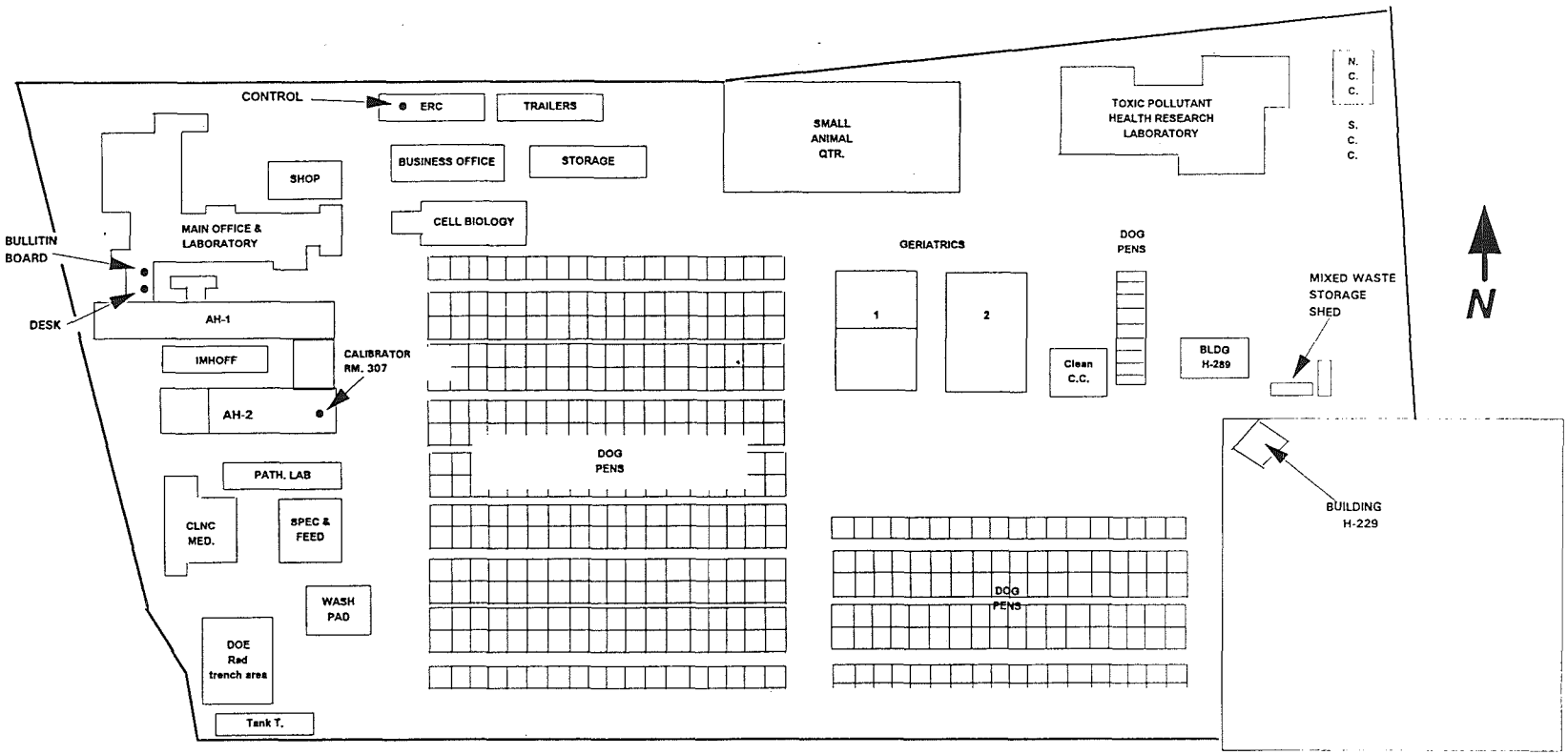
FIGURE 5.6B TLD Locations for Group 88



= Envrionmental Dosimetry Location Exchanged Quarterly

NOT TO SCALE
Rev.4 6/6/95

FIGURE 5.6C TLD Locations for Group 82



NOT TO SCALE
Rev.5 4/95

5.7 NESHAPs Dose Estimation Calculations

Calculations were performed to determine the potential or estimated dose from site sources to members of the public. These calculations were based on both site residual contamination and the remediation activities which were accomplished during the year (point and diffuse sources combined). Contributions to the effective dose equivalent from nonpoint source emissions (surface soils) were insignificant; they are further discussed in section 5.7.2. All estimates of potential dose were well below the NESHAPs limit.

TABLE 5.7 Estimated Annual Maximum Effective Dose Equivalent

Maximum Individual Dose[1]	EPA and DOE Standard	Site Natural Background[2]
5.51 x 10E-2mrem (5.51 x 10E-5 mSv)	10 mrem/year (0.1 mSv/year)	98 mrem (.98 mSv)

[1] = Maximum effective dose equivalent from 1994 NESHAPs report. (Data are calculated, not measured. Therefore, they represent potential or estimated rather than actual doses. Potentially exposed individual is at ITEH, on-site, 150 feet northeast of Imhoff Building.)
[2] = DOE 1992a

The primary activity on the LEHR site to generate radionuclide emissions during 1994 was the demolition of the Imhoff Building, which was conducted within a containment structure. Estimated emissions from this activity are discussed in Section 5.7.1, Point Source Emission.

The site also contains several soil (nonpoint or diffuse source) areas with known or potential radioactive contamination resulting from past activities at the LEHR site. These areas are the strontium 90 leach field, the radium 226 seepage system, the southwest chemical dispensing area, the north chemical dispensing area, dog pen areas, inactive landfill units, storm water runoff system, and radioactive waste burial trenches. Of these nonpoint sources, only four have been determined to have radioactive material contamination in near-surface soils that could potentially lead to airborne radioactive material emissions. Those sources are the radium 226 seepage system, the strontium 90 leach field, the southwest chemical dispensing area, and the dog pen areas. Emission estimates from these sources are discussed in section 5.7.2, Nonpoint Diffuse Source Emission.

5.7.1 Point Source Emission

During 1994, demolition of the Imhoff facility was the primary site activity with potential for release of airborne contaminants. The primary radionuclides present in the building as residual contamination were strontium 90 and radium 226. D&D operations with the potential to release previously fixed contamination included demolition of interior structures, decontamination, and waste processing/packaging. All work was conducted under containment to prevent release to the atmosphere, as described in section 5.1.1

Compliance with the NESHAP requirements for point source emissions is assessed using the EPA computer code, CAP88-PC. Because portions of the LEHR facility have been returned to UC Davis for use in campus research, the distances to structures on-site that contain non-LEHR ER Project staff were used for potential Maximally Exposed Individual locations.

For source data, it was assumed that 10% of the total potential residual contamination was released through a 95% efficient filter. The fact that this was a very conservative estimate was verified by release-stack air monitoring (results in Table 5.1).

The Effective Dose Equivalent for the maximally exposed individual (150 feet north northeast) was estimated to be 5.51×10^{-2} mrem. This is primarily from potential airborne releases of radium 226 and strontium 90.

5.7.2 Nonpoint/Diffuse Source Emission

Calculations of combined dose contributions from the four nonpoint source areas were determined to be less than 5×10^{-5} mrem/year. Previous site characterization studies provided measurements ranging from background to low-levels of residual radioactive material contamination in these areas.

The strontium 90 leach field consisted of two leach fields used to disperse low-level contaminated liquid effluent from an Imhoff treatment process. The soils above the leach fields are partially covered by pavement and the site structures.

The radium 226 seepage system consisted of four septic tanks, three pits and a leach line. The system was used to dispose of the excrement from dogs that were part of the radium 226 injection studies. The radium 226 seepage system lies beneath a paved area.

The southwest chemical dispensing area was used to disburse bulk chemicals. Site characterization has detected near-background concentrations of radioactive materials in the area soil.

The dog pen areas were used to house the dogs that participated in the strontium 90 and radium 226 studies. Radioactive contamination was deposited in the area through urine. Patches of low-level radioactive contamination has been detected in the sub-surface soils of these areas.

The Residual Radioactive (RESRAD) computer code, version 4.6, was used to calculate doses from the nonpoint (diffuse) sources. The radon and groundwater contamination pathways of the RESRAD code were suppressed for computation regarding NESHAP compliance. The results of the assessment are in Table 5.8.

TABLE 5.8 Estimated Dose Equivalent from Site Nonpoint/Diffuse Sources

Nonpoint Source	Dose Equivalent	Percent of NESHAPs
Strontium 90 Leach Field	1.47×10^{-5} mrem/y	>.001
Southwest Chemical Dispensing Area	1.74×10^{-5} mrem/y	>.001
Radium 226 Seepage System	1.29×10^{-6} mrem/y	>.001
Dog Pen Areas	0.00 mrem/y	0.0
Total Combined Contribution	3.3×10^{-5}	>.003

TABLE 5.9 Nonpoint/Diffuse Source Estimated Radiological Releases

Nonpoint Source Radionuclide	Annual Quantity* (Ci)	Annual Quantity* (Bq)
Tritium	6.7×10^{-4}	2.5×10^{7}
Strontuim 90	2.8×10^{-4}	1.0×10^{7}

*Annual quantities are based on 0.001 m erosion of surface soil per year from a contaminated area.

6.0 ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

In addition to quarterly groundwater sampling, the nonradiological Environmental Monitoring Program was expanded in fall 1994 to include storm water monitoring, a number of on-site and off-site soil borings, and Cone Penetrometer Testing (CPT)/Hydropunch samples. This information was collected as part of the Remedial Investigation. The greatest percentage of nonradiological data for 1994, as in previous years, was collected through the surface water and groundwater monitoring program. Quarterly rounds of sampling were conducted for groundwater and surface water on and near the site, employing an extensive list of analytes.

6.1 National Pollutant Discharge Elimination System (NPDES) Data

LEHR discharges its sanitary waste to the UC Davis Wastewater Treatment Plant, which is permitted according to NPDES requirements. Current DOE activities do not contribute to hazardous discharges.

6.1.1 Storm Water Runoff Monitoring

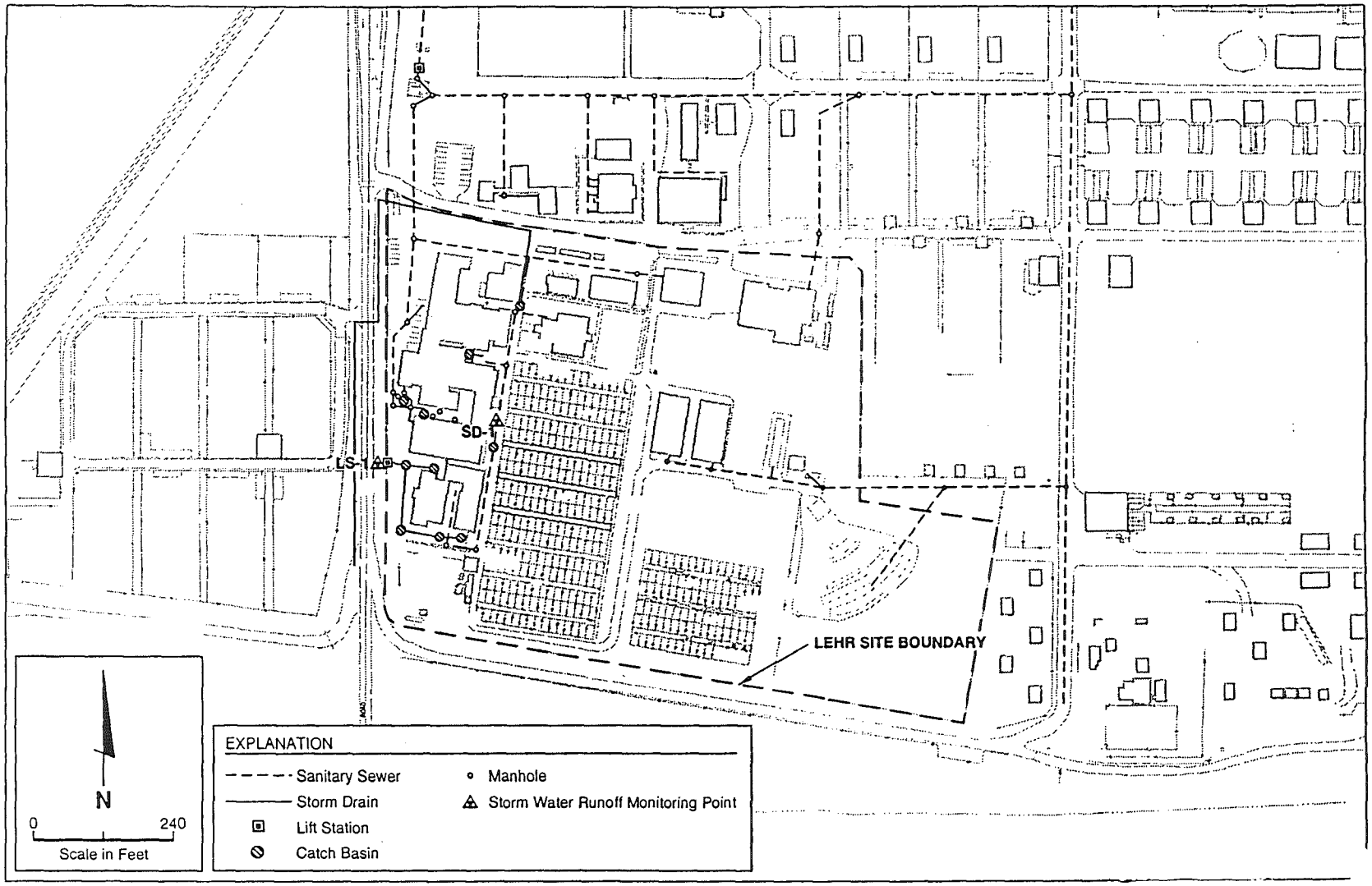
Two storm water runoff monitoring points have been added to the water monitoring program to evaluate the quality of storm water runoff generated from the LEHR site. In the fall of 1994, storm water runoff

monitoring was conducted at the site. Storm water runoff collects at various on-site storm drains and is removed from the site in two locations, as shown on Figure 6.1. One collection area is a lift station located along the west side of the site, which pumps runoff under Old Davis Road where it is routed to Putah Creek. The second area collects storm water from the central portion of the site and routes runoff into a combined storm water/sanitary sewer that directs storm water runoff and sewage wastes from the LEHR, ITEH and other UC Davis facilities to the UC Davis Wastewater Treatment Plant. The list of analytical parameters for storm water monitoring is given in Table 6.1A below. Detected constituents from the November sampling event are provided in Table 6.1B.

TABLE 6.1A Nonradiological Parameters For Storm Water Runoff Monitoring

Field Parameters	Nonradiological Analytes
To be collected during two storm events per year from both locations.	To be collected during two storm events per year from both locations.
pH, Electrical Conductivity, Temperature, Turbidity, Eh, Approximate Flow Rate.	Total Oil and Grease; Volatile Organic Compounds; Semi-Volatile Organic Compounds; Pesticides and PCBs; Antimony, Arsenic, Barium, Beryllium, Cadmium, Cobalt, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, and Zinc; Total Chromium, Hexavalent Chromium; Nitrate, Alkalinity, Cations, Anions, Total Organic Carbon, Total Suspended Solids, Formaldehyde, Chemical Oxygen Demand, Turbidity.

FIGURE 6.1 Storm Water Runoff Water Monitoring Points



REFERENCE: FROM ENVIRONMENTAL SURVEY PRELIMINARY REPORT DOE MARCH 1988

TABLE 6.1B Detected Constituents of Storm Water Runoff Monitoring Event-November 1994

Parameter	Units	Lift Station Sample	Lift Station Duplicate	Catch Basin Sample
Volatiles				
Acetone	ug/L	17 Jc	17 Jc	9 Rc
Metals				
Antimony	ug/L	50.1	51.7	124
Lead	ug/L	14.5	15.2	35.6
Zinc	ug/L	92.6	83.9	96.5
General Chemicals, etc.				
Chloride	mg/L	1.7	1.6	1.1
Sulfate	mg/L	1.2	1.3	<1
Ammonia-Nitrogen	mg/L	0.54	0.68	0.43
Nitrogen, Nitrate (as N)	mg/L	0.29	0.28	0.16
Turbidity	NTU	31	28	9.8
Total Organic Carbon	mg/L	11	11	5.3
Chemical Oxygen Demand	mg/L	26	28	10
Specific Conductance (EC-F)	umhos	56	56	36

Data Qualifier Codes are found in Appendix C.

6.2 Soil Investigations

6.2.1 On-site Soil Borings

Soil sampling for the remedial investigation began in late fall of 1994. Nineteen soil borings were taken in the western dog pens on the LEHR site. The soil borings were continuously cored and extended to a depth of forty feet below ground surface. Samples were taken at 0, 5, 20, and 40 foot depths within each boring. Results from these samples are still in the validation process, and are expected be available in the late spring of 1995.

6.2.2 Off-site Soil Borings-Background Study

During November and December 1994, six soil borings were taken at near-by off-site locations for the Background Study. This investigation was designed to collect information that will enable comparisons with on-site sample results in similar soils at similar depths. These soil borings were also continuously cored; they extended to a depth of forty feet, with samples taken at 0, 5, 20, and 40 feet. Preliminary results for organic, salts, and metals are available at this time and are provided in Tables 6.2A and 6.2B.

Main Observations of Background Study:

- Observed soil types are consistent with those observed on the site.
- Concentrations of salts and general chemical parameters in soils are typical for agriculture land use areas.
- Metal concentrations are consistent with other reported values in California and the western United States.
- Concentrations of general chemical parameters decrease with depth.
- Trace amounts of common agricultural pesticides were reported in surface soils.

TABLE 6.2A Preliminary Results for Background Study-Organics

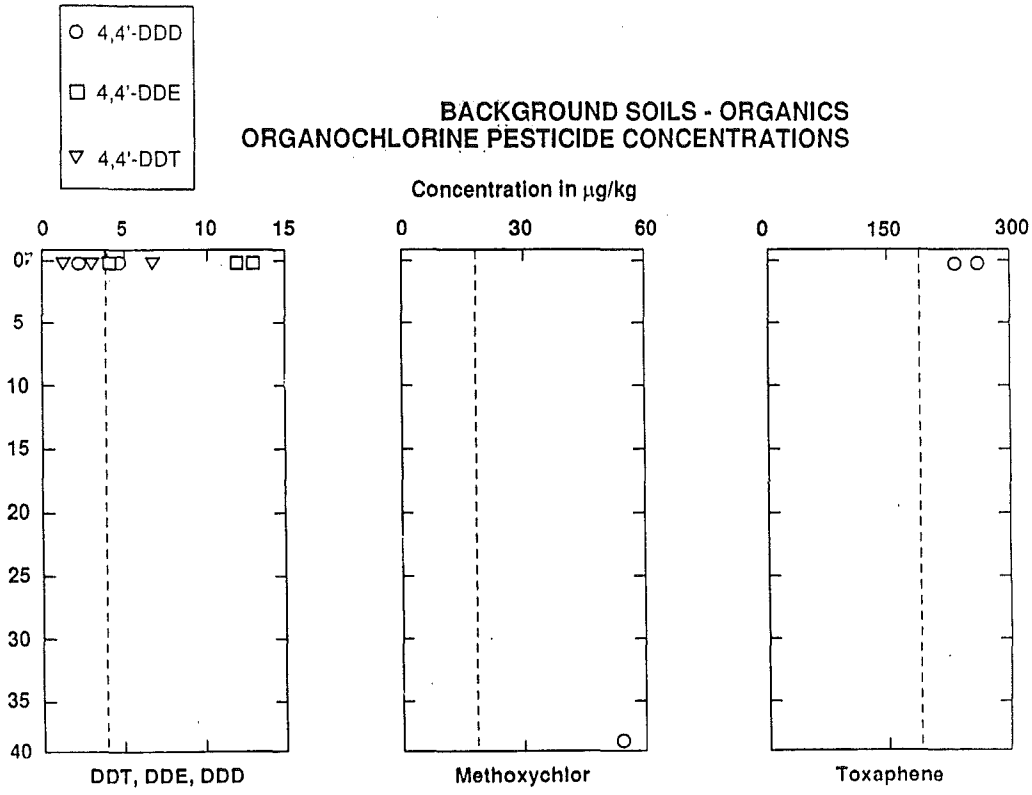
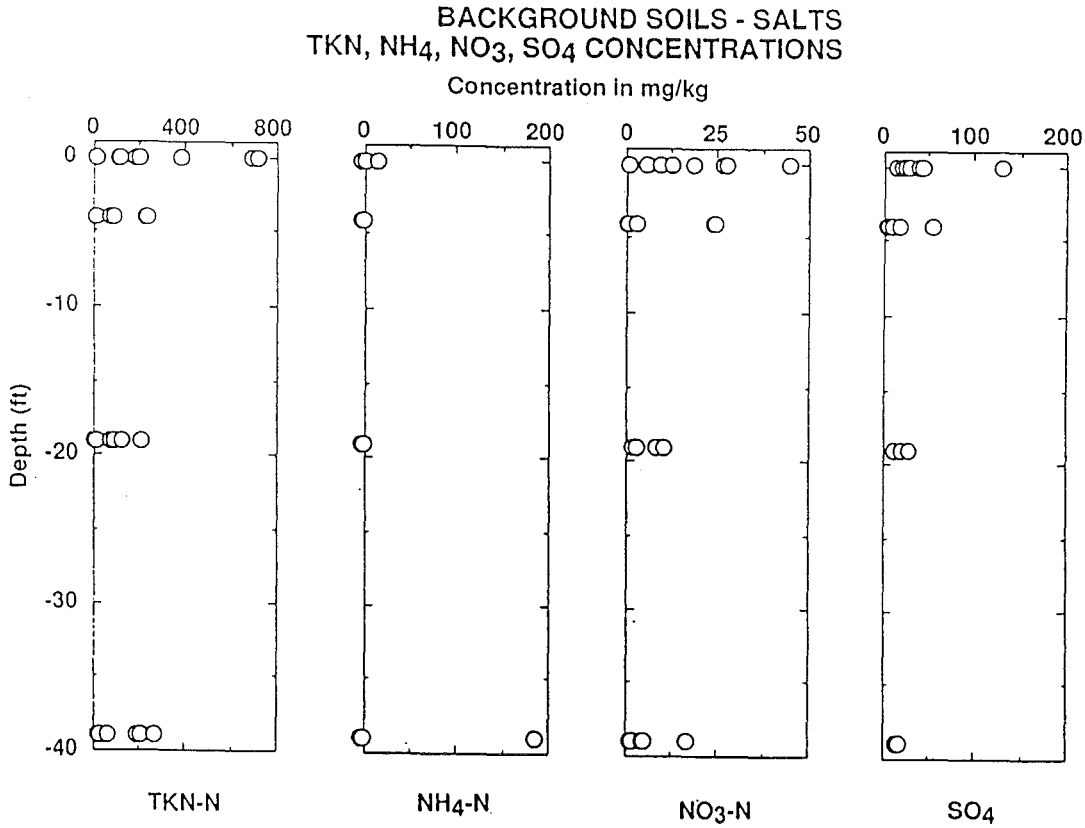
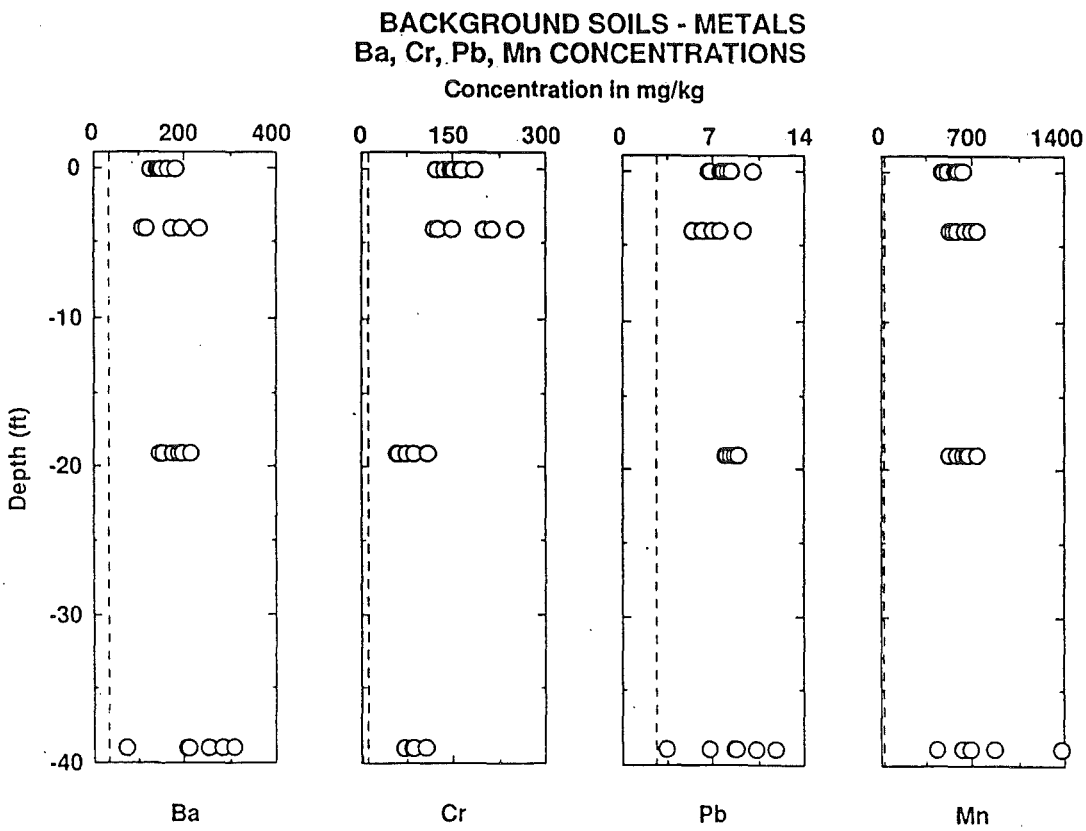


TABLE 6.2B Preliminary Results for Background Study-Salts and Metals





6.3 Groundwater Sampling

The groundwater monitoring program at the LEHR site consists of quarterly sample collection, field measurements, and laboratory analysis of groundwater. The system includes 23 monitoring wells, although samples are normally collected from 18 of the 23 wells. The 5 nonmonitored wells are periodically dry, so deeper wells at these same locations are used for quarterly sample collection. A map of well locations is provided in Figure 7.1. Additional detailed information about site wells is provided in Table 7.1.

6.3.1 CPT/Hydropunch Results

In the fall of 1994, a series of CPT/Hydropunch samples was conducted as a screening investigation to evaluate the lateral extent of impacts in the first and second hydrostratigraphic units (HSUs). The HSUs are subsurface water-bearing units which are relatively continuous and laterally extensive. The two HSUs directly below the site are studied separately because each maintains relatively consistent lithologic and hydraulic properties and because analytes of concern are found in differing concentrations within each HSU. Figures 6.3A-6.3F compare three analytes of concern for the site (chloroform, hexavalent chromium, and nitrates) between the first and second HSU. The information shown includes data collected in the fall of 1994 for both the groundwater sampling and the CPT/Hydropunch results. The data indicate very little or no off-site migration of these analytes.

6.3.2 Groundwater Sampling Results

A listing of analytes and analytical methods for groundwater is provided in Table 6.3A. A summary of preliminary data for constituents detected in the sampling rounds is provided, with comparisons between upgradient wells (Table 6.3B) and downgradient wells (Table 6.3C).

6.4 Surface Water Sampling

The only year-round surface water adjacent to the LEHR site is the South Fork of Putah Creek, although the creek is separated from the site by a levee. Analysis of conditions in Putah Creek indicate that much of the flow through the reach adjacent to the site is derived from the outfall from the UC Davis wastewater treatment plant during late summer and fall when overall flow is reduced. This analysis was based on visual observations, wastewater treatment plant flow data, and the South Fork of Putah Creek stream gauge data. Approximately 2 miles downstream of the site, the South Fork of Putah Creek is dry most of the year. Results of numerical modeling and the groundwater gradient information suggest that the creek acts as a continual recharge source to the local groundwater in the first HSU.

Water from Putah Creek adjacent to the site is sampled quarterly. Surface water monitoring is conducted at three sampling points along Putah Creek: The UC Davis wastewater treatment plant outfall tributary (designated STPO); upstream of the LEHR site (designated PCU); and downstream of the LEHR site (designated PCU). The map in Figure 7.1 identifies surface water sampling locations. A list of analytes and analytical methods is provided in Table 6.3A. A summary of preliminary data for the non-radiological constituents detected in the sampling rounds is found in Table 6.4.

FIGURE 6.3A Fall 1994 CPT/Hydropunch and Groundwater Results: 1st HSU Chloroform

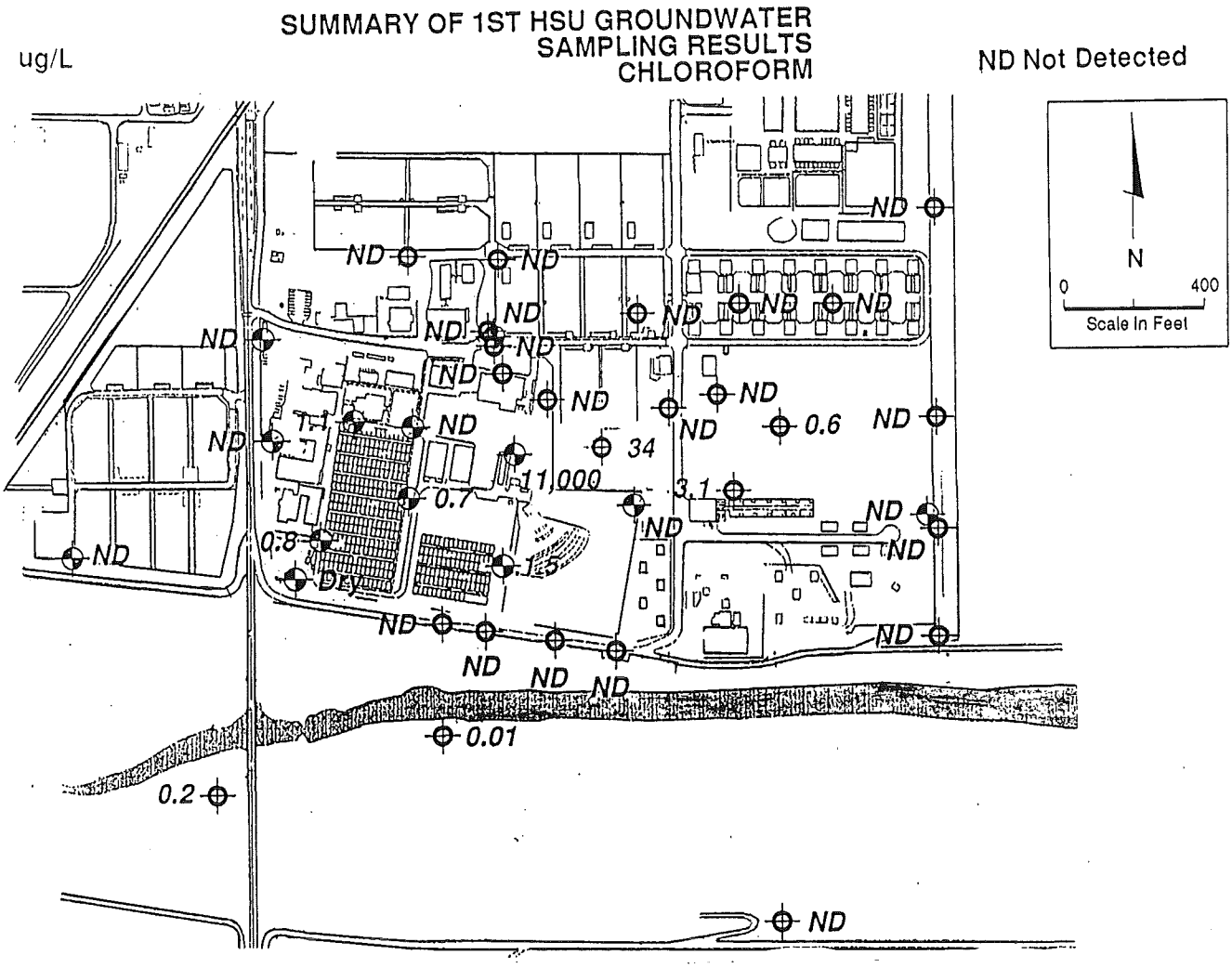


FIGURE 6.3B Fall 1994 CPT/Hydropunch and Groundwater Results: 2nd HSU Chloroform

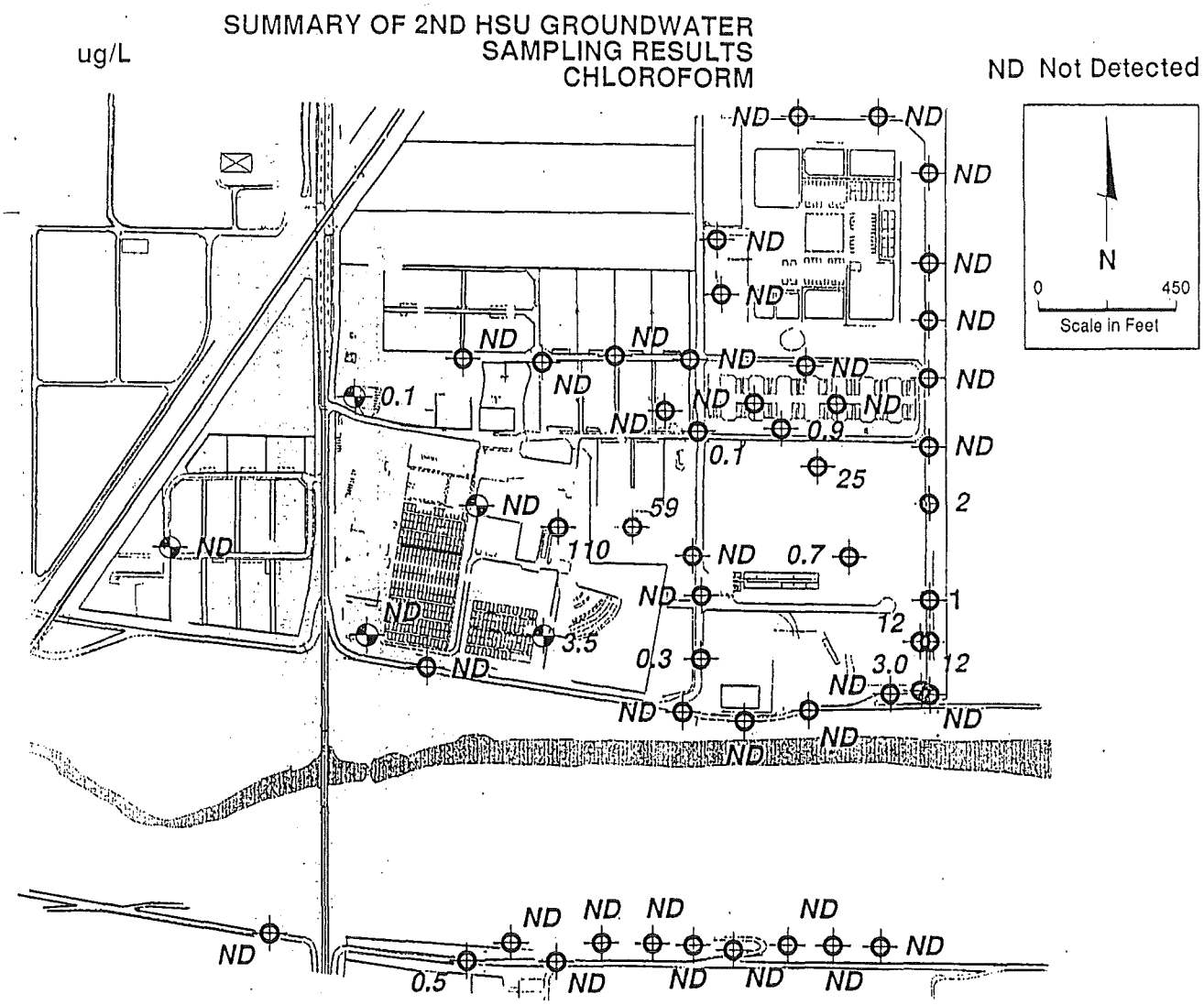


FIGURE 6.3C Fall 1994 CPT/Hydropunch and Groundwater Results: 1st HSU Hexavalent Chromium

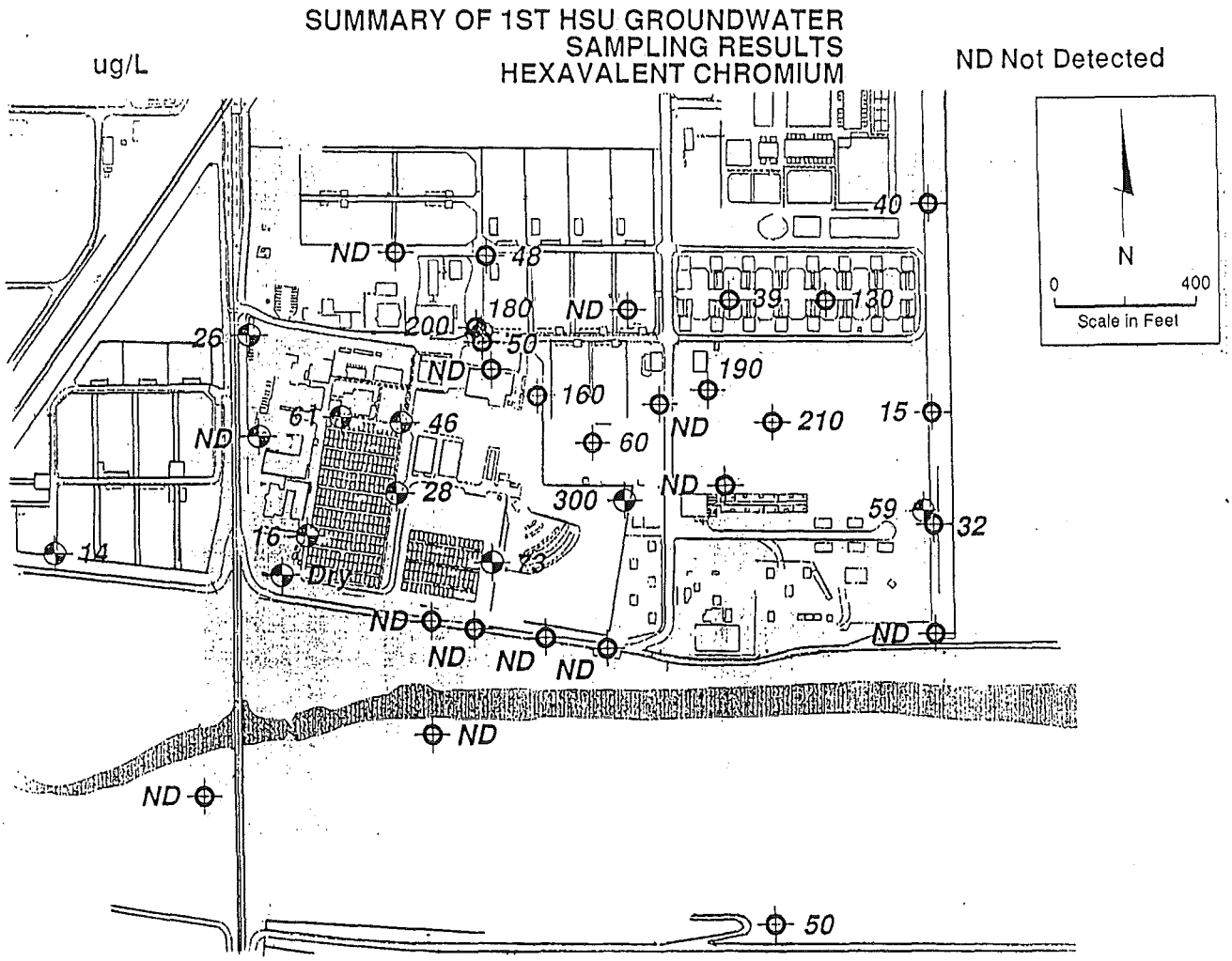


FIGURE 6.3D Fall 1994 CPT/Hydropunch and Groundwater Results: 2nd HSU Hexavalent Chromium

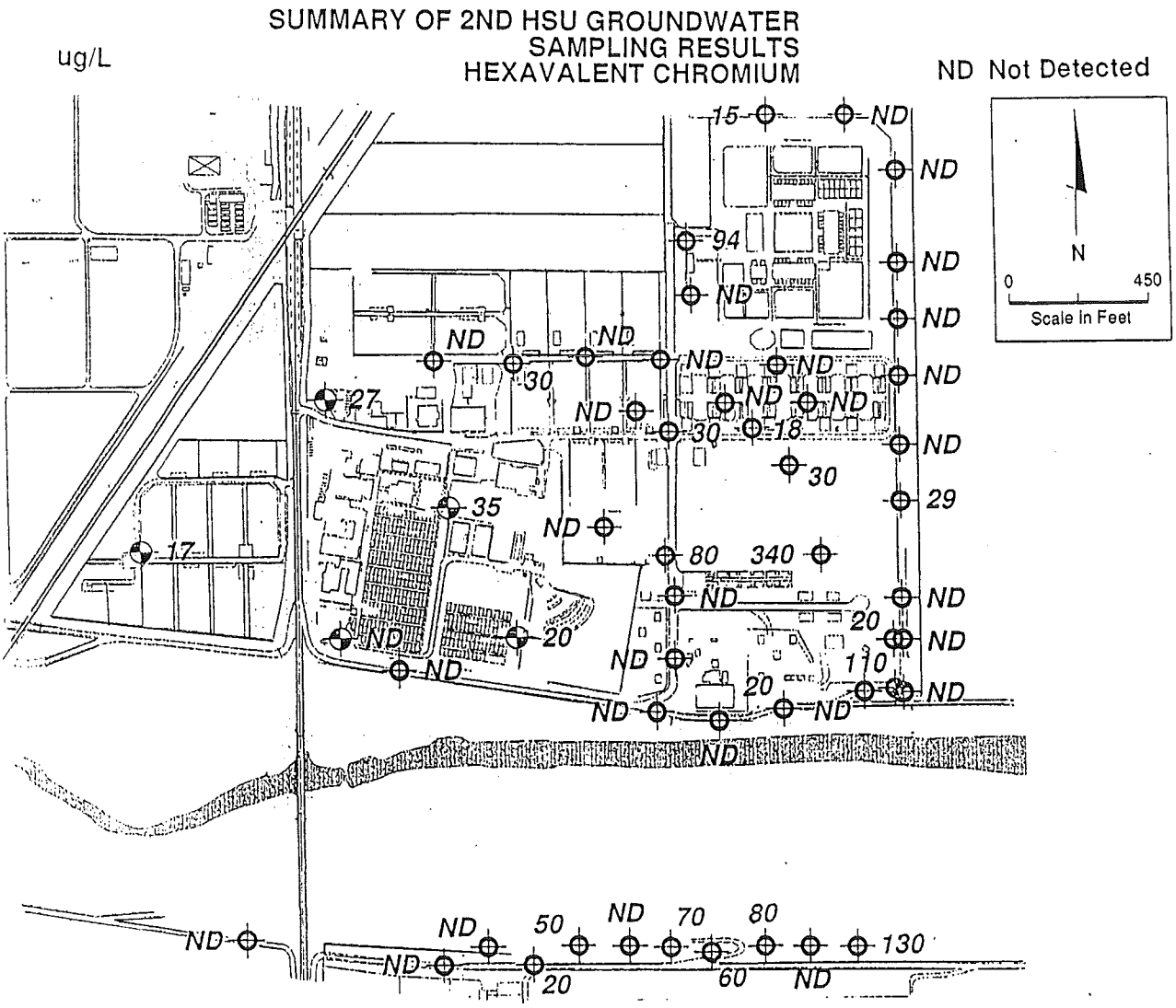


FIGURE 6.3E Fall 1994 CPT/Hydropunch and Groundwater Results: 1st HSU Nitrate

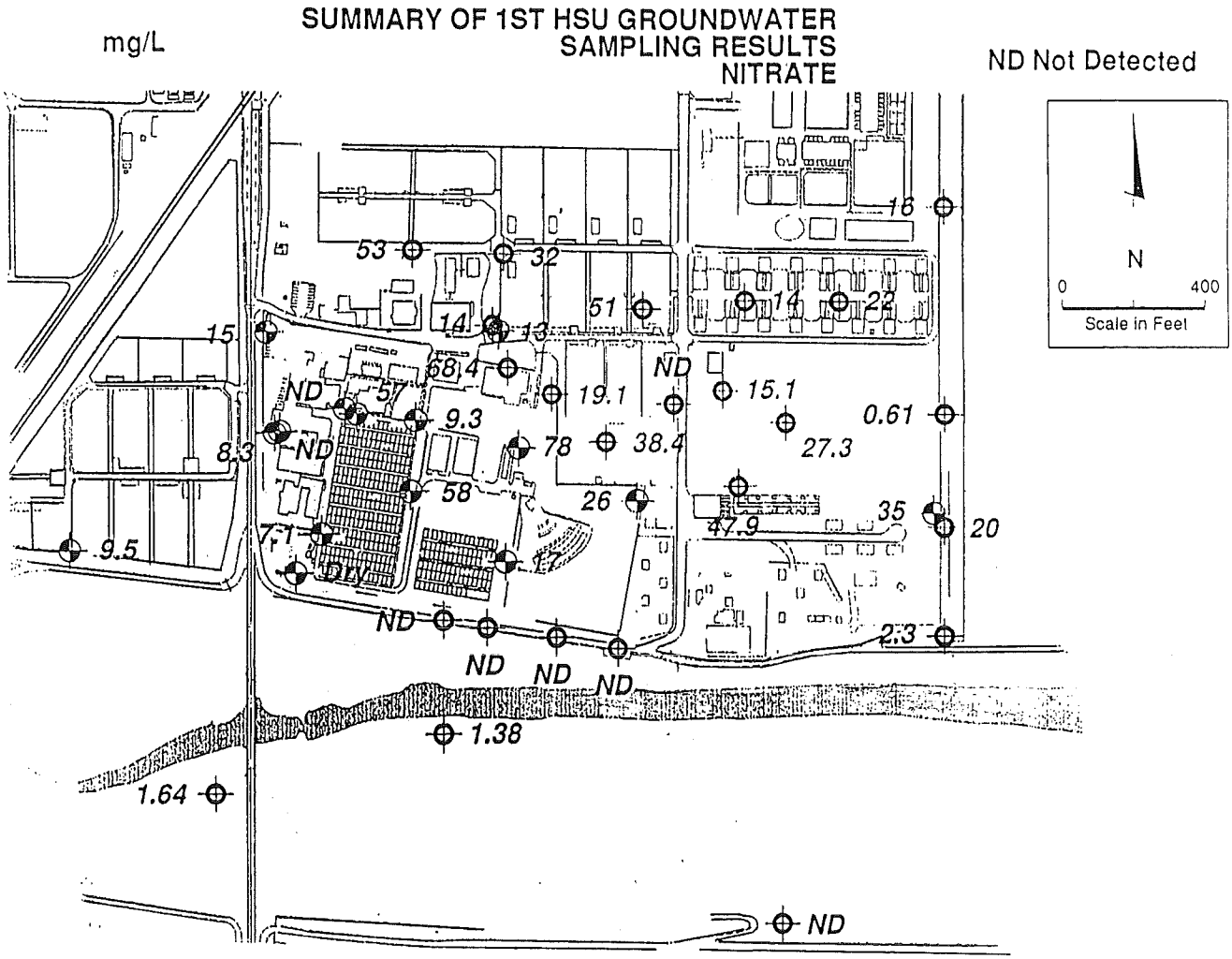


FIGURE 6.3F Fall 1994 CPT/Hydropunch and Groundwater Results: 2nd HSU Nitrate

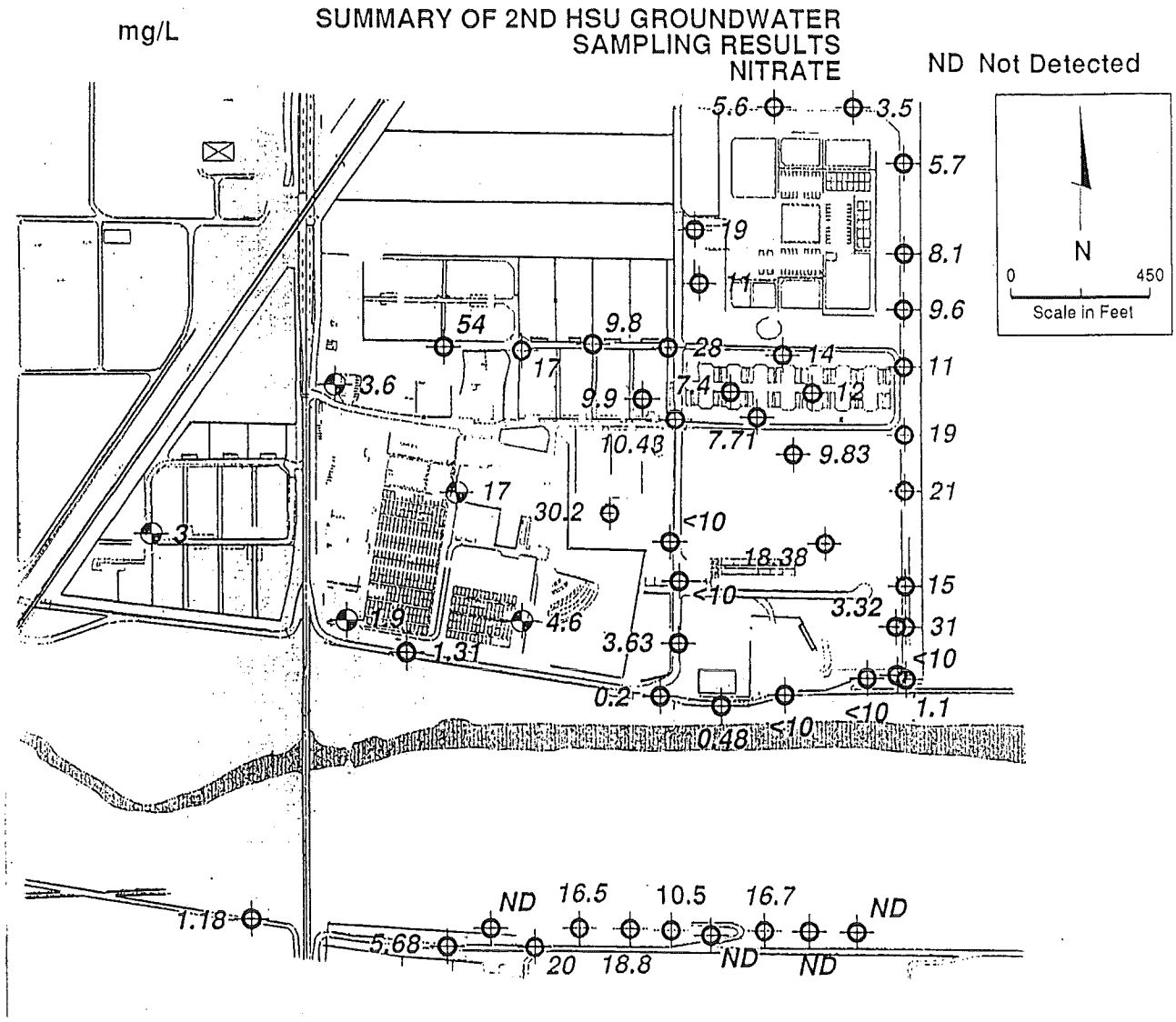


TABLE 6.3A Analyses Requested for 1994 LEHR ER Project Water Monitoring Program

ANALYTE	METHOD	ANALYTE	METHOD
GENERAL PARAMETERS		**RADIOLOGICS**	
pH	SOP[a]	Americium 241	LAS 108
Ec		Carbon 14	LSC C-01[b]
Temperature		Gamma Spectral Analysis	LAL-91-SOP-0063
Turbidity		Gross Alpha	EPA 9310
		Gross Beta	EPA 9310
GENERAL CHEMICAL		Plutonium 241	LAS178
Alkalinity	EPA 301.1	Radium	903.1M
Sodium	EPA 6010	Strontium 90	EPA 905.0[c]
Calcium		Tritium	EPA 906.0
Potassium			
Magnesium		**ORGANICS**	
Nitrate (as Nitrogen)	EPA 300.0	Volatile Organic Compounds	
Sulphate		Semivolatile Organic Compounds	
Chloride		Organochlorine Pesticides	
Phosphorous, all forms	EPA 365.2	Formaldehyde	
Total Kjedahl Nitrogen	EPA 351.2		
Total Dissolved Solids	EPA 160.1		
Total Organic Carbon	EPA 415.2		
Ammonia	EPA 350.1		
Turbidity	EPA 180.1		
METALS			
Total Chromium	CLP SOW ILC		
Hexavalent Chromium			
Antimony			
Arsenic			
Barium			
Beryllium			
Cadmium			
Cobalt			
Copper			
Iron			
Lead			
Mercury			
Molybdenum			
Nickel			
Selenium			
Silver			
Thallium			
Vanadium			
Zinc			

(a) Dames & Moore
(b) Method Reference
(c) Modified procedure specified in laboratory SOP
Reference: Pacific Northwest Laboratory, 1994

TABLE 6.3B Summary of Principal Nonradiological Detected Constituents in Upgradient Groundwater Monitoring Wells, 1994

			Upgradient Wells					
	Parameter	MCL	Number of Results	Number of Detections	Number > MCL	Maximum Value	Date of Maximum	Location of Maximum
Volatile Organics (ug/L)	Acetone		9	0	-	-	-	-
	Bromodichloromethane	100	9	0	0	-	-	-
	Chloroform	100	9	0	0	-	-	-
	1,1-Dichloroethane	5	9	0	0	-	-	-
	1,2-Dichloroethane	0.5	9	0	0	-	-	-
	1,1-Dichloroethene	6	9	0	0	-	-	-
	1,1,2-Trichloroethane	5	9	0	0	-	-	-
Semivolatile Organics (ug/L)	Bis(2-Ethylhexyl)phthalate	4	9	0	0	-	-	-
Pesticides & PCBs (ug/L)	Alpha-Chlordane		9	0	-	-	-	-
	Gamma-Chlordane		9	0	-	-	-	-
	Dieldrin		9	0	-	-	-	-
	Endrin	0.2	9	0	0	-	-	-
Metals (ug/L)	Arsenic	50	9	5	0	3.1	12/1/94	UCD1-017
	Barium	1000	9	9	0	168	5/26/94	UCD1-018
	Beryllium	4	9	0	0	-	-	-
	Chromium	50	9	9	0	17.1	12/1/94	UCD2-017
	Chromium, Hexavalent (+6)		9	7	-	27	8/25/94	UCD2-017
	Manganese		4	0	-	-	-	-
	Mercury	2	9	0	0	-	-	-
	Nickel	100	9	4	0	96	8/25/94	UCD1-018
	Selenium	10	9	3	0	4.6	5/26/94	UCD1-018
	Vanadium		9	1	-	10.6	2/24/94	UCD1-018
	Zinc		9	1	-	21.3	2/28/94	UCD2-017
Cations and Anions (mg/L)	Calcium (mg/L)		9	9	-	41.2	2/24/94	UCD1-018
	Iron (mg/L)		9	2	-	0.502	2/24/94	UCD1-018
	Mangesium (mg/L)		9	9	-	105	5/26/94	UCD1-018
	Potassium (mg/L)		9	1	-	2.2	2/24/94	UCD1-018
	Chloride (mg/L)		9	9	-	41.5	2/24/94	UCD1-018
	Sodium (mg/L)		9	9	-	41.4	5/26/94	UCD1-018
	Sufate (mg/L)	400#	9	9	0	38	5/26/94	UCD1-018
	Ammonia-Nitrogen (mg/L)	45	9	1	0	0.081	12/1/94	UCD2-017
	Nitrogen, Nitrate (as N) (mg/L)	10#	9	9	0	20	5/26/94	UCD1-018
	Total Kjeldahl Nitrogen (mg/L)		9	1	-	0.86	12/1/94	UCD2-017
General Chemical Parameters	Alkalinity Total (as CaCo3) (mg/L)		9	9	-	470	5/26/94	UCD1-018
	Total Dissolved Solids (mg/L)		9	9	-	650	5/26/94	UCD1-018
	Turbidity (NTU)		9	9	-	29	8/25/94	UCD1-018
	Turbidity-F (NTU)		9	9	-	11.14	2/24/94	UCD1-018
	Total Organic Carbon (mg/L)		9	5	-	6.3	12/1/94	UCD2-017
	Chemical Oxygen Demand (mg/L)		3	1	-	16	12/1/94	UCD2-017
	Specific Conductance (EC)-F (umhos)		9	9	-	1012	5/26/94	UCD1-018
	EH-F (mvolt)		8	8	-	237	8/25/94	UCD1-018
	pH-F (STD)		9	9	-	7.89	5/23/94	UCD2-017
	Temperature-F (deg C)		9	9	-	19.2	8/25/94	UCD2-017
	Formaledhyde (mg/L)		9	1	-	1.2	8/25/94	UCD1-018

MCL = Maximum Contamination Level (primary), Title 22, Division 4, Chapter 15.
C = California State Action Level, Department of Health Services.
* = Proposed MCL.
# = US EPA MCL
- = Not Applicable or Not Analyzed For

UCD1-0XX = First HSU Well.
UCD2-0XX = Second HSU Well.

TABLE 6.3C Summary of Principal Nonradiological Detected Constituents in Downgradient Groundwater Monitoring Wells, 1994

			Downgradient Wells					
	Parameter	MCL	Number of Results	Number of Detections	Number > MCL	Maximum Value	Date of Maximum	Location of Maximum
Volatile Organics (ug/L)	Acetone		65	1	-	6.4	8/25/94	UCD1-010
	Bromodichloromethane	100	65	3	0	2.6	5/17/94	UCD1-012
	Chloroform	100	65	16	3	11000	12/1/94	UCD1-012
	1,1-Dichloroethane	5	65	3	3	15	12/1/94	UCD1-012
	1,2-Dichloroethane	0.5	65	3	3	8.8	5/17/94	UCD1-012
	1,1-Dichloroethene	6	65	3	3	33	12/1/94	UCD1-012
	1,1,2-Trichloroethane	5	65	1	0	2.7	12/1/94	UCD1-012
Semivolatile Organics	Bis(2-Ethylhexyl)phthalate	4	67	1	1	32	11/28/94	UCD1-020
Pesticides & PCBs (ug/L)	Alpha-Chlordane		65	1	-	0.011	5/17/94	UCD1-013
	Gamma-Chlordane		65	1	-	0.012	5/17/94	UCD1-013
	Dieldrin		65	4	-	0.094	11/30/94	UCD1-013
	Endrin	0.2	65	2	0	0.035	11/30/94	UCD1-013
(ug/L)	Arsenic	50	65	35	0	3.8	11/28/94	UCD1-019
	Barium	1000	65	65	0	388	5/17/94	UCD1-012
	Beryllium	4	65	1	0	1.4	2/22/94	UCD1-001
	Chromium	50	65	60	23	298	5/18/94	UCD1-011
	Chromium, Hexavalent (+6)		65	56	-	310	2/23/94	UCD1-011
	Manganese		31	1	-	12.4	5/19/94	UCD1-023
	Mercury	2	65	2	0	1.0	11/29/94	UCD1-022
	Nickel	100	65	6	1	117	5/19/94	UCD1-023
	Selenium	10	65	24	12	25.1	5/18/94	UCD1-010
	Vanadium		65	17	-	12.6	3/2/94	UCD1-024
	Zinc		65	3	-	26.2	5/26/94	UCD1-021
Cations and Anions (mg/L)	Calcium (mg/L)		65	65	-	85.7	12/1/94	UCD1-012
	Iron (mg/L)		65	18	-	0.921	2/23/94	UCD1-013
	Mangesium (mg/L)		65	65	-	269	12/1/94	UCD1-012
	Potassium (mg/L)		65	10	-	4.54	2/23/94	UCD1-012
	Chloride (mg/L)		65	65	-	350	12/1/94	UCD1-012
	Sodium (mg/L)		65	65	-	175	5/18/94	UCD1-010
	Sufate (mg/L)	400#	65	65	0	340	11/22/94	UCD1-010
	Ammonia-Nitrogen (mg/L)	45	65	10	0	0.44	8/31/94	UCD1-024
	Nitrogen, Nitrate (as N) (mg/L)	10#	65	65	36	78	12/1/94	UCD1-012
	Total Kjeldahl Nitrogen (mg/L)		65	1	-	2.2	11/22/94	UCD1-010
General Chemical Parameters	Alkalinity Total (as CaCo3) (mg/L)		65	65	-	870	11/30/94	UCD1-013
	Total Dissolved Solids (mg/L)		75	75	-	1700	12/1/94	UCD1-012
	Turbidity (NTU)		65	65	-	2800	5/18/94	UCD1-001
	Turbidity-F (NTU)		57	57	-	53.2	5/18/94	UCD1-001
	Total Organic Carbon (mg/L)		65	36	-	4.8	12/1/94	UCD1-012
	Chemical Oxygen Demand (mg/L)		16	5	-	11	11/28/94	UCD1-019
	Specific Conductance (EC)-F (umhos)		57	57	-	2560	12/1/94	UCD1-012
	EH-F (mvolt)		56	56	-	251	8/30/94	UCD1-020
	pH-F (STD)		57	57	-	7.59	8/30/94	UCD1-020
	Temperature-F (deg C)		57	57	-	21.3	8/30/94	UCD1-020
	Formaledhyde (mg/L)		65	3	-	3.5	8/31/94	UCD1-021

MCL = Maximum Contamination Level (primary), Title 22, Division 4, Chapter 15.
C = California State Action Level, Department of Health Services.
* = Proposed MCL.
# = US EPA MCL
- = Not Applicable or Not Analyzed For
UCD1-0XX = First HSU Well.
UCD2-0XX = Second HSU Well.

TABLE 6.4 Summary of Principal Nonradiological Detected Constituents in Surface Water, 1994

	Parameter	MCL	Number of Results	Number of Detections	Number > MCL	Maximum Value	Date of Maximum	Location of Maximum
Volatile Organics	Acetone		16	2	-	18	2/24/94	PCD
	Bromodichloromethane	100	16	5	0	1.6	5/25/94	PCD
(ug/L)	Chloroform	100	16	11	0	8.4	5/25/94	PCD
	Methylene Chloride	5	16	6	5	13	8/29/94	STPO
	Toluene	1000#	16	1	0	1.7	8/29/94	PCD
Pesticides & PCBs	Beta-BHC	0.3C	16	1	0	0.042	5/25/94	STPO
(ug/L)	Gamma-BHC	0.2	16	8	0	0.066	8/29/94	STPO
	Alpha-Chlordane		16	2	-	0.017	2/24/94	STPO
Metals	Antimony	6	16	4	2	9.1	2/24/94	PCD
(ug/L)	Arsenic	50	16	9	0	6.5	8/29/94	PCU
	Barium	1000	16	16	0	147	2/24/94	STPO
	Chromium	50	16	1	0	21.6	2/24/94	STPO
	Copper	1300#	16	1	0	10.1	5/25/94	STPO
	Manganese		8	1	-	21.8	8/29/94	STPO
	Molybdenum		16	9	-	56.1	2/24/94	STPO
	Selenium	10	16	2	0	4.3	5/25/94	STPO
	Vanadium		16	5	-	13.4	8/29/94	PCU
	Zinc		16	5	-	41.0	11/30/94	STPO
Cations and Anions	Calcium (mg/L)		16	16	-	24.9	11/30/94	PCD
(mg/L)	Iron (mg/L)		16	4	-	0.506	2/24/94	STPO
	Mangesium (mg/L)		16	16	-	38.6	5/25/94	PCU
	Potassium (mg/L)		16	13	-	14.3	2/24/94	STPO
	Chloride (mg/L)		16	16	-	160	11/30/94	STPO
	Sodium (mg/L)		16	16	-	164	11/30/94	STPO
	Sufate (mg/L)	400#	16	16	0	93	8/29/94	PCU
	Phosphate, Total (as P) (mg/L)		16	1	-	2.9	5/25/94	STPO
	Ammonia-Nitrogen (mg/L)	45	16	15	0	5.8	11/30/94	STPO
	Nitrogen, Nitrate (as N) (mg/L)	10#	16	14	0	8.5	2/24/94	STPO
	Total Kjeldahl Nitrogen (mg/L)		16	12	-	6.7	5/25/94	STPO
General Chemical Parameters	Alkalinity Total (as CaCo3) (mg/L)		16	16	-	230	8/29/94	PCU
	Total Dissolved Solids (mg/L)		16	16	-	600	2/24/94	STPO
	Turbidity (NTU)		16	16	-	130	2/24/94	PCU
	Turbidity-F (NTU)		14	14	-	200	2/24/94	PCD
	Total Organic Carbon (mg/L)		16	16	-	9.4	2/24/94	PCU
	Chemical Oxygen Demand (mg/L)		4	4	-	25	11/30/94	STPO
	Specific Conductance (EC)-F (umhos)		15	15	-	1001	11/30/94	STPO
	EH-F (mvolt)		14	14	-	192	8/29/94	STPO
	pH-F (STD)		15	15	-	8.4	5/25/94	PCU

MCL = Maximum Contamination Level (primary), Title 22, Division 4, Chapter 15.
C = California State Action Level, Department of Health Services.
* = Proposed MCL.
# = US EPA MCL
- = Not Applicable or Not Analyzed For

7.0 GROUNDWATER PROTECTION PROGRAM

Groundwater monitoring has been conducted quarterly for the LEHR ER Project site since November 1990. The quarterly monitoring program began as a component of the Phase II Site Characterization (Dames & Moore 1993). In 1993, the program evolved to include the development of a site Water Monitoring Plan, designed to meet the requirements of DOE's General Environmental Protection Program as presented in DOE Order 5400.1.

Water monitoring is conducted in conjunction with the RI/FS as part of the DOE-sponsored environmental restoration program underway at the LEHR ER site. Since LEHR has not been an operational site since 1989, the current water monitoring program focuses primarily on environmental surveillance activities for nonoperational facilities.

The objectives of the groundwater monitoring program are to characterize baseline groundwater conditions at the site, to further evaluate impacts of previous LEHR facility operations on groundwater in the area, to provide data to support future site activities (RI/FS, site remedial actions, and D&D), and to comply with applicable federal, state and local regulations.

7.1 Summary of Hydrogeologic Conditions

The hydrogeology of the Sacramento Valley is comprised of both unconfined and confined aquifers in the near flat or gently sloping sedimentary deposits in the upper 3,000 feet beneath the valley. No regionally identified confining units are known to exist in the Sacramento Valley. Groundwater is recharged through leakage from streams and rivers, as well as from direct precipitation and irrigation (DOE 1992b).

Groundwater is encountered beneath the LEHR site at depths ranging seasonally from about 45 to 70 feet below ground surface. The water levels are usually at their highest in early spring and at their lowest in summer. Based on analysis of subsurface stratigraphy, the uppermost aquifer has been separated (for investigation purposes) into 2 HSUs. A hydraulic connection does exist between these two layers, as evidenced by comparison of hydrographs. Water levels in both HSUs show the characteristic rise during fall and winter, and the same decline during spring and summer. However, the two HSUs are distinctly different water-bearing zones, with different characteristics. Deeper HSUs have not been investigated below the LEHR ER site, yet they are known to exist on a regional basis (DOE 1994b).

The direction of groundwater flow in the first HSU is generally toward the northeast, although local temporary changes in flow direction and gradient occasionally occur. Local groundwater gradients across the site in the first HSU vary from approximately 0.0001 to 0.0015 ft/ft. The average flow velocity is estimated to be 1.6 ft/yr. (DOE 1994b). Figure 7.2 provides a contour map of groundwater elevations in the first HSU during summer of 1994.

In the second HSU, groundwater flow is predominantly toward the east/northeast. Both the direction of flow and the lateral gradient are more consistent than in the first HSU. According to the recent study, Ground-Water Flow Velocity and Flow Direction Calculations for the Second HSU-LEHR Site, the second HSU's lateral gradient ranges from approximately 0.009 ft/ft in winter to approximately 0.0017 in

summer. Based on average flow velocities determined for the two measurement periods, groundwater is estimated to travel annually at a rate between approximately 600 ft/yr and 1170 ft/yr (PNL 1995d). Refer to Figure 7.3 for a contour map of groundwater elevations in the second HSU during summer of 1994.

7.2 Uses of Groundwater in Vicinity

Local groundwater is utilized for both drinking and agricultural purposes. The major groundwater sources for both public and private water supplies in the Sacramento Valley are the unconsolidated deposits of Pliocene and Pleistocene age, and the older alluvium. (DOE 1994b) The first HSU is shallow groundwater and is not used for drinking or irrigating purposes. In the general area near the site, a number of domestic and irrigation wells draw from the second HSU.

7.3 Potential Sources of Groundwater Pollution

Studies of potential sources of groundwater pollution have not determined the extent of the environmental impact of site sources, although additional data is being collected and analyzed. A number of locations on site are considered "waste management areas," where a variety of potential wastes were handled and/or buried during former site operations. Impact from these areas has been evaluated during previous investigations or will be evaluated during the RI/FS. Most impacts to groundwater that have been identified are localized on the site near waste burial locations and are within the first HSU, which is not used for drinking water. The primary waste management areas include: the Imhoff treatment system, the radium 226 treatment system, domestic septic tanks (reported to have received project effluent), chemical dispensing areas, waste burial trenches, landfill units, dog pen areas, and dry wells for storm water (storm water may have carried wastes from other management areas).

7.4 LEHR ER Project Site Groundwater Monitoring Wells

A total of 24 groundwater monitoring wells were installed during previous site investigations. A map of groundwater sampling locations is provided in Figure 7.1. During the Phase I investigation, nine wells (UCD-1 through UCD-9) were installed. A short time later, during the SWAT investigation of the Old UC Davis Landfill at the LEHR ER Project site, five groundwater monitoring wells (UCD-10 through UCD-14) were installed. The last ten monitoring wells (UCD-15 through UCD-24) were added during the Phase II Site Characterization. Nineteen wells were installed in the first HSU and five wells were installed in the second HSU. Monitoring well UCD-2 was abandoned by DOE in 1990 because it was installed through the UC Davis Landfill Disposal Unit No. 2. A map of site monitoring well locations is found in Figure 7.1, and additional information on site monitoring wells is provided in Table 7.1. Additional wells are planned for installation during 1995 as part of the RI/FS.

7.4.1 CPT/Hydropunch Investigation

In fall of 1994, a screening level CPT/Hydropunch investigation was begun downgradient of the LEHR site to evaluate the lateral extent of impacts in the first and second HSUs. In addition to providing information on impacts regarding site constituents of concern, the information obtained from Hydropunch samples will be used to determine the best locations to install additional perimeter monitoring wells. Results of this investigation will be available in late spring of 1995.

After assessment of the second HSU CPT/Hydropunch, geophysical survey and groundwater monitoring data, the need for wells in the deeper third HSU will be determined. The final scoping of groundwater invest-igation will be completed by the site team and regulatory agencies, as agreed upon prior to the field work.

7.5 Overview of LEHR ER Project Groundwater Monitoring Program

The groundwater monitoring program consists of quarterly samples collected from 18 of 23 site monitoring wells (the remaining 5 wells are periodically dry). Groundwater monitoring consists of water-level measurements, field measurements and the collection of groundwater samples. After purging is complete, groundwater samples are collected directly from the sampling pumps into sample containers supplied by the laboratory. During sampling, a number of field measurements are taken. These include, pH, electrical conductivity, temperature, turbidity, etc. Samples are collected each quarter and analyzed for the chemical and radiologic parameters presented in Table 6.3A

7.5.1 Program Changes Implemented in 1994

During 1994, two additional radiological constituents were added to the water monitoring program. These were specific analyses for americium 241 and plutonium 241 added in the summer quarter. In addition, analytes measured within the gamma spectral analysis were reported separately beginning with the first quarter of the year. Two storm water runoff monitoring points were added to the monitoring program to evaluate the quality of storm water runoff generated from the site. Additional monitoring points for groundwater are planned for the future, with monitoring wells to be installed to the south, and possibly north and east of the site during 1995. The list of analytical parameters and analysis methods is given in Table 7.2, with rational defined for each parameter.

7.6 Summary of Trends in Analytical Results 1990-1994

Volatiles/Semivolatiles

Results reported from groundwater monitoring have indicated the presence of some volatile and semi-volatile compounds. Chloroform has been detected at low levels in 5 site wells and at consistently higher levels in UCD-12. The parameters 1,1-dichloroethene, 1,1-dichloroethane, and 1,2-dichloroethane are also consistently reported in groundwater samples, taken from UCD-12, which is downgradient from Landfill Disposal Units No. 1 and 2. One semivolatile phthalate compound [bis(2-ethylhexyl)phthalate] has been

sporadically reported. However, this compound was also found in laboratory blanks and is a common field and laboratory artifact.

Pesticides

A few organochlorine pesticides have occasionally been found in site wells, but have also been reported in low concentrations in upgradient wells, and in surface water.

Metals

A number of metals have been regularly reported in groundwater samples, both upgradient and downgradient of the site. These metals include antimony, barium, total chromium, hexavalent chromium, vanadium and zinc. With the exception of hexavalent chromium and total chromium, the metals are reported in groundwater samples from site wells on a random basis. The results for hexavalent chromium and total chromium generally show higher levels in several site wells than are found in upgradient wells. Additional evaluation of potential sources is being studied in the RI/FS. Figures 6.3C and 6.3D give information on recently collected data for chromium.

Nitrate

Nitrate is present in groundwater throughout the site. However, it was determined through statistical analysis that only 5 of 16 downgradient wells actually contained nitrate in levels significantly higher than that detected in the upgradient wells. The background studies have found elevated levels throughout the local region (see Table 7.3).

Radiochemicals

Statistical evaluations of measurements for gross alpha, gross beta, and gamma radioactivity suggest that groundwater samples collected at the LEHR site do not have elevated alpha, beta, or gamma activity with regard to upgradient conditions. Measurements for strontium 90 show sporadic and generally low activity levels. Consistent measurements of tritium activity (below or near MCL levels) have been reported in groundwater samples collected from site wells UCD-13 and UCD-14. Since the analysis for carbon 14 was added in 1991, consistent measurements of carbon 14 activity have also been reported in UCD-13 and UCD-14.

FIGURE 7.1 Location Map of Groundwater Monitoring Wells and Surface Water Monitoring Points

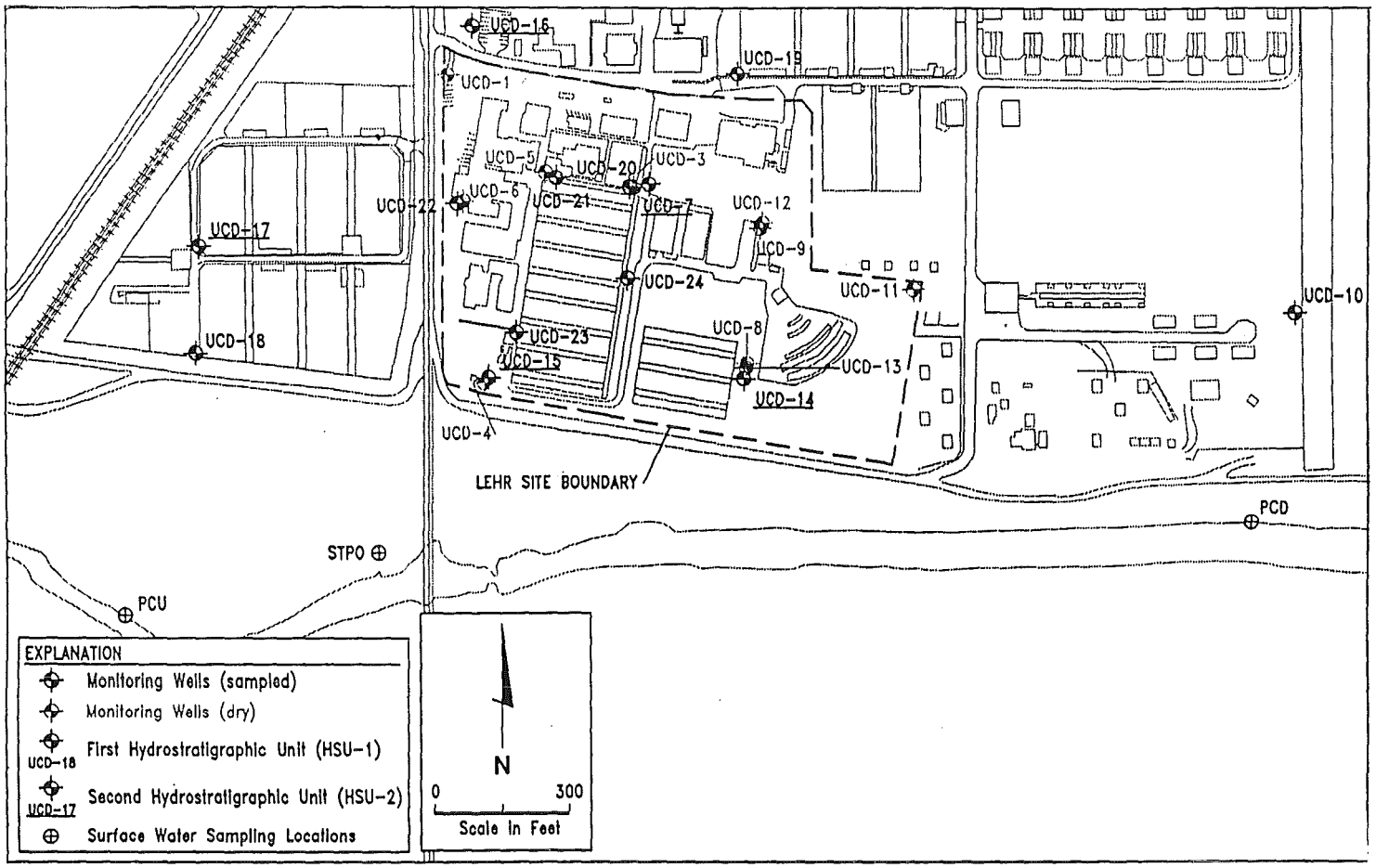


TABLE 7.1 Summary of Monitoring Wells at the LEHR ER Project Site

Well Name	Total Depth (feet bgs)	Screened Interval (feet bgs)	HSU[1]	Well Location[2]	Date Completed
UCD - 1	56.5	46.5 - 56.5	First	Northwest corner of site	10/09/87
UCD - 3	49.0	39 - 49	First	Northeast corner of west dog pen area	10/23/87
UCD - 4	57.2	45 - 55	First	Southwest corner of site	10/14/87
UCD - 5	48.0	38 - 48	First	East of Main Admin. Building	10/22/87
UCD - 6	50.0	40 - 50	First	Southwest corner of AH-1	10/21/87
UCD - 7	90.0	80 - 90	Second	Northeast corner of west dog pen area	11/05/87
UCD - 8	53.5	43.5 - 53.5	First	West of midsection of Cobalt-60 field, and adjacent to low-level radioactive waste trenches	11/03/87
UCD - 9	50.0	40 - 50	First	Northeast of Landfill Disposal Unit 2	11/04/87
UCD - 10	70.0	54 - 69	First	Landfill Disposal Unit 3	10/11/89
UCD - 11	66.5	50 - 65	First	Northeast corner of Cobalt-60 field, and Landfill Disposal Unit 1	10/17/89
UCD - 12	65.0	49.5 - 64.5	First	Northeast of Landfill Disposal Unit 2	10/19/89
UCD - 13	65.0	50 - 65	First	West of midsection of Cobalt-60 field, and adjacent to low-level radioactive waste trenches	10/26/89
UCD - 14	85.0	75 - 85	Second	West of midsection of Cobalt-60 field, and adjacent to low-level radioactive waste trenches	11/15/89
UCD - 15	120.5	91 - 116	Second	Southwest corner of site	03/28/90

TABLE 7.1 Continued (Summary of Monitoring Wells)

Well Name	Total Depth (feet bgs)	Screened Interval (feet bgs)	HSU[1]	Well Location[2]	Date Completed
UCD - 16	122.0	92 - 117	Second	50 feet north of site boundary, north of Main Admin. Bldg.	04/04/90
UCD - 17*	143.0	88 - 113	Second	700 feet west of west site boundary	04/10/90
UCD - 18*	70.0	54 - 69	First	700 feet west of southwest site boundary	10/04/90
UCD - 19	74.5	71.5 - 56.5	First	50 feet north of site boundary, north of TPHRL	10/01/90
UCD - 20	73.0	57 - 72	First	Northeast corner of west dog pen area	10/09/90
UCD - 21	73.0	57 - 72	First	Northwest corner of west dog pan area	10/11/90
UCD - 22	73.0	57 - 72	First	Southwest corner of AH-1	10/25/90
UCD - 23	73.0	56.5 - 71.5	First	Southeast of Specimen Storage Building	10/17/90
UCD - 24	73.0	57 - 72	First	East of west dog pen area, and west of Landfill Disposal Unit 2	10/22/90

(1) HSU = Hydrostratigraphic Unit.

(2) See Figure 7.1

* Upgradient monitoring well.

NOTE: UCD-2 was abandoned by UC Davis in 1990 because it was installed through the UC Davis Landfill Disposal Unit No. 2.

FIGURE 7.2 First HSU Groundwater Elevation Contours, Summer 1994

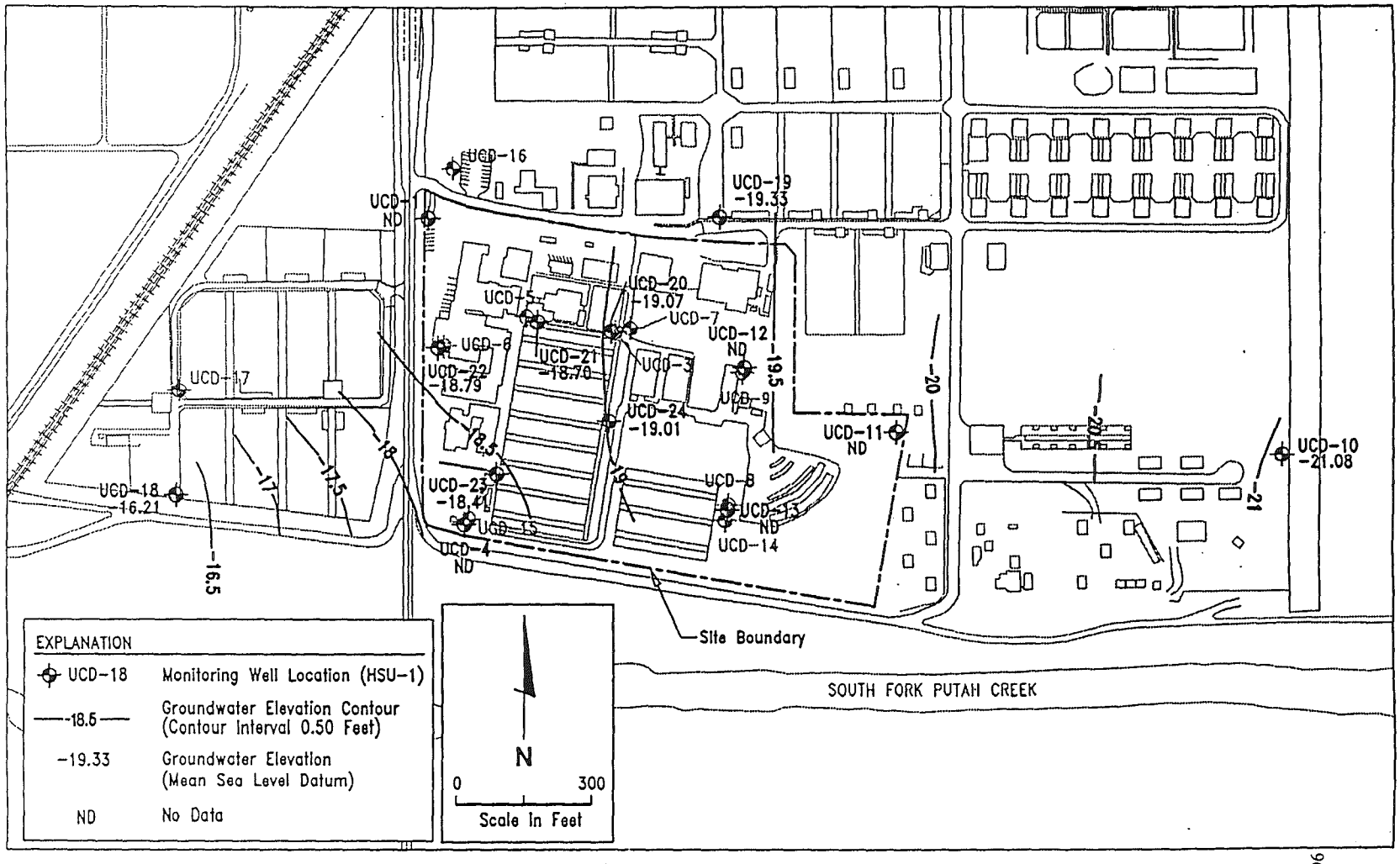


FIGURE 7.3 Second HSU Groundwater Elevation Contours, Summer 1994

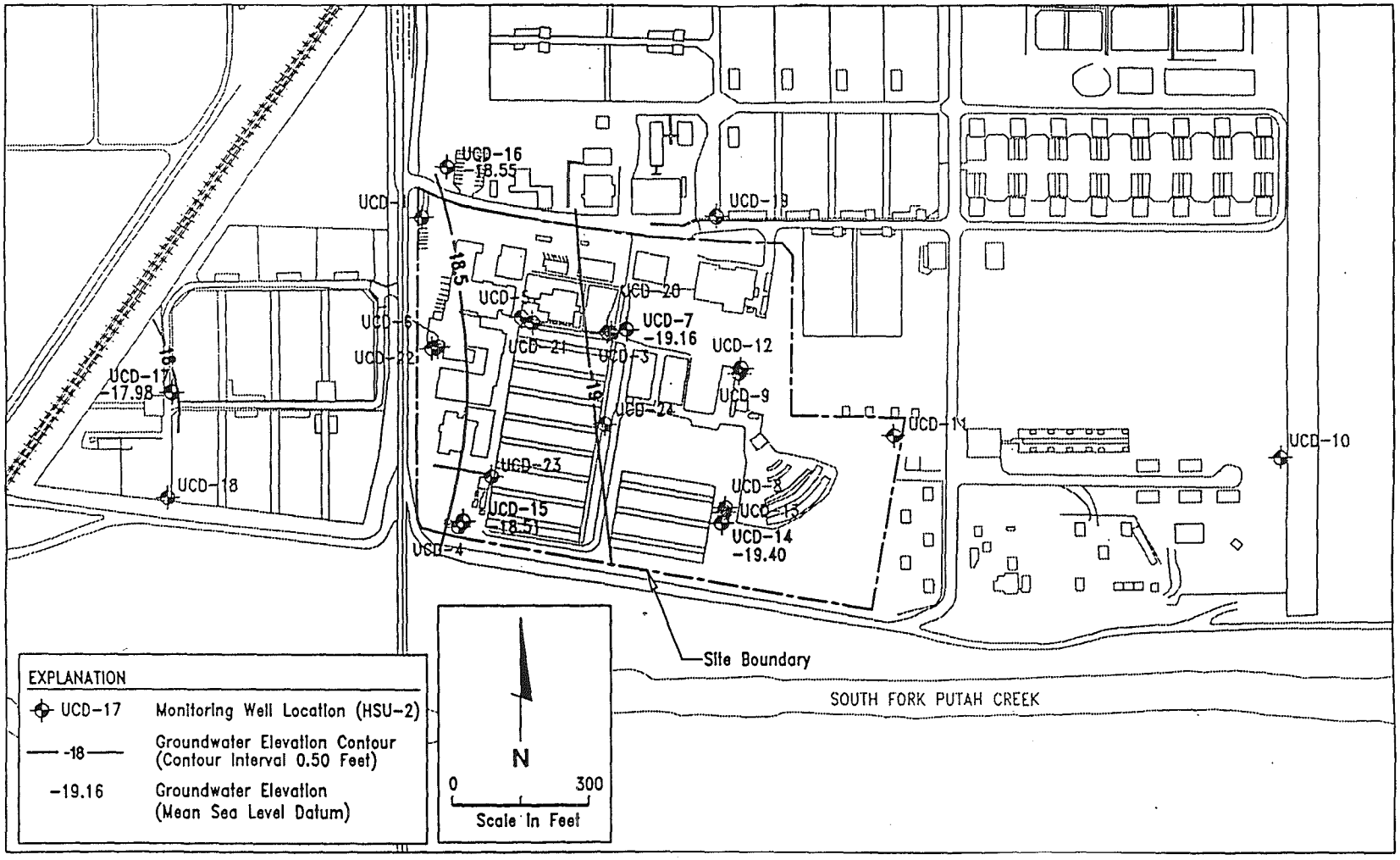


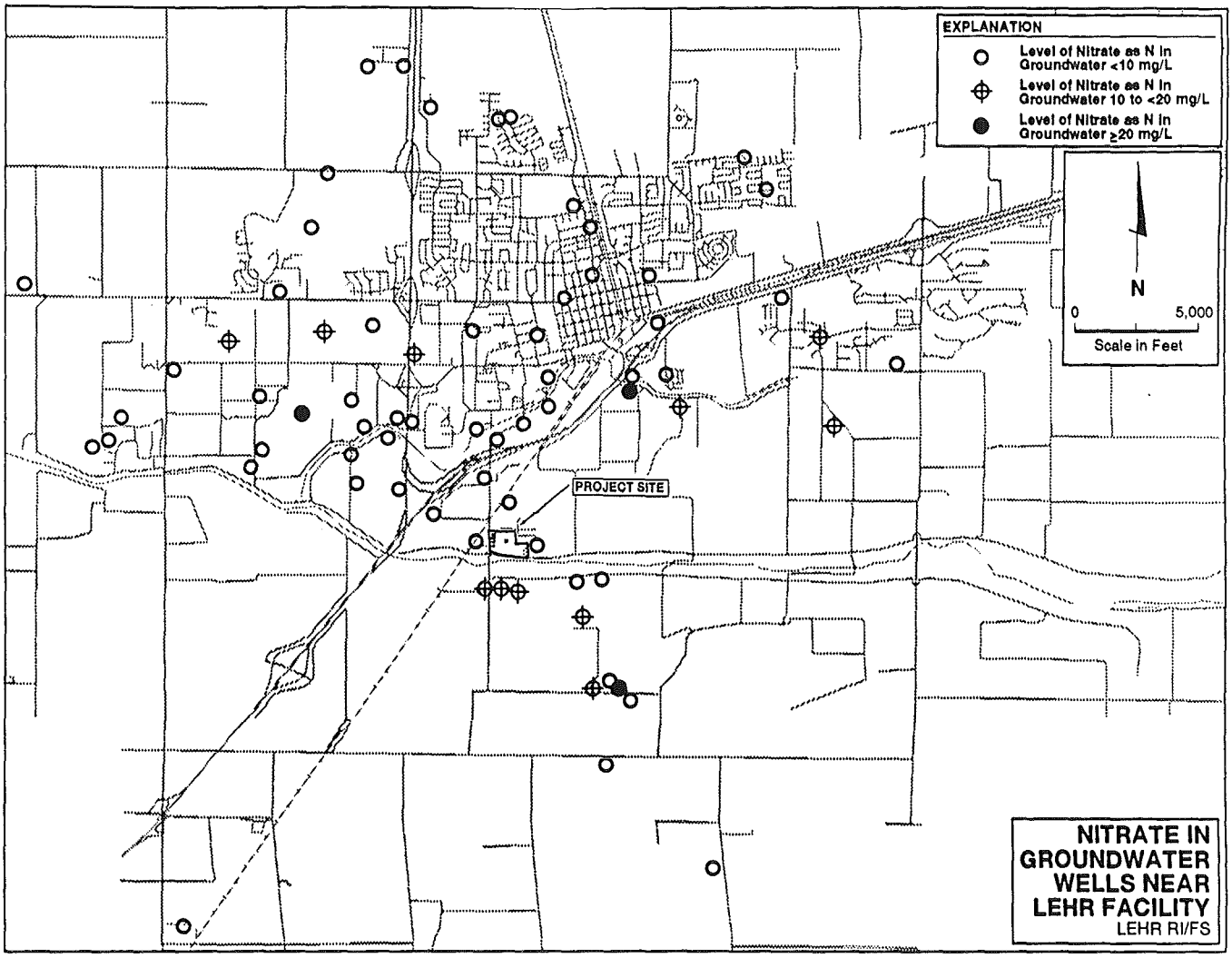
TABLE 7.2 Analytical Parameters Requested for LEHR ER Project Water Monitoring

Constituent	Rationale[a]	Constituent	Rationale[a]	Constituent	Rationale[a]
Gross Alpha	6,7,8,9	Metals	3,4,5,7,8,9,10	TOC	6,8,9,10
Gross Beta	6,7,8,9	Hexavalent Chromium	2,4,7,8,9	pH	6,7,8,9,10
Gamma Spec	3,4,5,6,7,8,9	Pesticides	1,3,4,5,7,8,9	Electrical Conductivity	6,8,9,10
Strontium-90	1,3,4,5,7,8,9	Formaldehyde	1,3,4,7,8	Eh	6,8,9,10
Radium-226	1,4,5,7,8,9	VOCs	1,2,4,5,7,8	Turbidity	6,8,9,10
Carbon-14	1,2,4,7,8,9	Semi VOCs	1,3,4,5,7,8	TDS	6,7,8,9,10
Tritium	1,2,4,5,7,8,9	Nitrate	2,4,5,6,7,8,9,11	Chemical Oxygen Demand	6,8,9,10
Cesium-137	1,3,4,7,8,9	Alkalinity	6,7,8,9,10	Total Suspended Solids	6,8,10
Sodium-22	1,4,7,8,9	TKN	4,6,7,8,9,10,11	Total Oil & Grease	1,6,8
Uranium-238	1,4,7,8,9	Ammonia	4,6,7,8,9,10,11	Dissolved oxygen	6,8,9,10
Cobalt-60	1,4,7,8,9	Anions	2,4,6,7,8,9,10	Biological Oxygen Demand	6,8,9,10
Chlorine-36	1,4,7,8,9	Cations	2,4,6,7,8,9,10	Bacteriological Count	6,8,9,10
Plutonium-241	1,4,9	Americium-241	1,4,9		

[a] **Rationale Key:**

1 Known constituent used or disposed on site.
2 Suspected site constituent based on consistent detections in groundwater.
3 Suspected site constituent based on sporadic detections in groundwater.
4 Suspected site constituent based on previous disposal practices.
5 Suspected site constituent based on detections in previous soil investigations.
6 Indicator parameter for other constituent.
7 Data needed for Risk Assessment.
8 Data useful for FS.
9 Data needed to establish background versus on-site concentration.
10 Influences mobility of other constituents.
11 May contribute to nitrate loading.

TABLE 7.3 Nitrate-Nitrogen in Vicinity of LEHR Site



8.0 QUALITY ASSURANCE

Quality assurance (QA) is a key element of the environmental protection program for the LEHR site. Within the planning for each phase of the LEHR ER Project (site characterization, investigation, D&D actions, etc.), separate and specific quality assurance plans are prepared. The purpose of each Quality Assurance Project Plan (QAPjP) is to identify the specifications and methods employed to establish technical accuracy and precision, validity of measurements and statistics, and to provide a sound basis for management decisions that will be based on environmental information collected for the site. Each quality assurance plan for the LEHR ER Project is prepared in accordance with EPA QAMS-005/80 and NQA-1 specifications. The plans also incorporate the guidance of DOE Order 5700.6C and the General Environmental Protection Program as defined in DOE Order 5400.1, to ensure that DOE quality and environmental goals are met.

Environmental samples are collected, analyzed and reviewed according to the approved quality assurance plans. To ensure quality assurance, quality control (QC) is built into all aspects of environmental sampling. Included in each QAPjP are sections identifying quality control sample collection requirements and specific quality assurance objectives for the measurement data. Quality control samples are run with each sample batch at the laboratory to validate the method of analysis and the proficiency of the technician. Because holding times are an important factor in the sample quality, these are controlled within acceptable limits. To ensure the comparability of analytical data, all samples are analyzed by EPA-approved methods when available. When analysis results are received, they are reviewed by the contractor according to the defined data quality objectives and data review procedures.

8.1 Field Quality Assurance

Quality assurance for field sampling is checked by the use of field replicates, decontamination rinsates, trip blanks and field blanks. Replicates are collected to check for consistency in the sampling process. For each round of sampling, replicate samples are collected from a selected sample point at the same time as the original sample. The replicate sample is labeled with a fictitious sample number and serves as a check on the precision of the sampling and analytical procedures. Decontamination rinsates are analyzed whenever the potential exists for cross-contamination from sampling equipment. Trip blanks are sent with each shipment of samples requiring analysis for volatiles. Field blanks are collected to check for contamination during the sampling process. Calibration records for each field instrument are maintained in the contractor QA files.

8.2 Laboratory Quality Assurance

Contracted laboratories providing analytical services for the LEHR ER Project activities are evaluated by UC Davis, Dames and Moore, and/or PNL to assure compliance with the QA program requirements. Laboratory quality assurance is analyzed externally by the submission of split samples, spiked samples, and blanks to the laboratories performing analysis for environmental samples. Laboratories must submit their analytical procedure for review if it differs from standard procedures (such as EPA or NRC). Each contracted laboratory is required to have acceptable accreditation through participation in DOE Emission Measurement Laboratory (EML) Interlaboratory Comparison Program, the National Volunteer Laboratory Assurance Plan (NVLAP), or similar approved programs. For nonradiological analyses, laboratories

participate in the EPA's Interlaboratory Comparison Program. LEHR RI analytical laboratory comparison results from the EML Interlaboratory Comparison Program are available for review at the site.

8.3 Quality Assurance Program Audits

Contracted laboratories that perform environmental analyses for the project are subject to periodic audits of their QA program to assure compliance with project standards. In December 1994, Battelle PNL performed an audit of their subcontractor, Dames & Moore, who performs environmental monitoring under the RI/FS program. The audit was designed to verify compliance with the approved quality assurance program and field procedures. A total of five findings were identified. A corrective action plan has been developed which addresses resolution of all findings.

In November of 1994, Dames & Moore performed an audit of the laboratory which analyzes the environmental samples collected for the LEHR RI/FS program. This laboratory is Lockheed Analytical Services (LAS) in Las Vegas, Nevada. One finding and several observations were identified during the audit. The finding and observations were resolved to the satisfaction of auditors while the team was at the laboratory. The audit found that the LAS QA Program met all contractual QA-related requirements described in the following documents: the Laboratory Services Agreement (which details methods and technical requirements), the Master Agreement between Dames & Moore and Battelle, the Final Draft RI/FS Work Plan, and the laboratory's internal QA Program.

8.4 Summary of Quality Control Data Validation

There were no significant problems identified in the quality control data collected for 1994 site environmental programs. Each element of the environmental monitoring program for the site employs the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters for evaluation of quality control data. The Table 8.1 summarizes the program components that are used to monitor and evaluate the quality of environmental data.

TABLE 8.1 Components of QC Program in Support of Data Quality Objectives

Data Quality Objective	QC Component	Evaluation Criteria
Precision	•Field duplicate •Matrix spike •Matrix spike duplicate	Relative percent difference
Accuracy	•Matrix spike •Matrix spike duplicate •Surrogate spikes	Percent recovery
Representativeness	•Trip blanks •Field duplicated •Method blanks	Qualitative degree of confidence
Completeness	•Holding time •Valid data points	Percent valid data
Comparability	•Analytical methods •Field duplicates	Qualitative degree of confidence

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ATTACHMENT 1: PROJECT MANAGEMENT POLICY

The Environmental Protection Program at LEHR reflects DOE and the DOE prime contractor, PNL, policy and practice to conduct LEHR ER operations in a safe and environmentally sound manner.

The environmental protection program is developed to ensure that:

1) ER project activities are conducted in a safe and environmentally sound manner.

2) The ER project complies with applicable Federal, state and local regulations, and

3) The ER project staff are proactive in preventing environmental problems.

4) Generation of waste is minimized.

In addition, this program ensures that ER operations are proactive in preventing environmental problems. This policy is achieved through awareness, education, and commitment on the part of all ER project staff.

APPENDIX A

Radiological Results for Groundwater

Annual, 1994

TABLE A-1

ANALYSIS	ACTINIUM - 228 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	-11.1±4.8	8.0±19.0	*	0.4±8.8
UCD-04	0.2±8.9	-24.7±7.8	*	*
UCD-07	1.5±3.9	9.0±18.0	-29.0±16.0	-11.0±11.0
UCD-10	5.9±9.6	-5.0±18.0	0.0±88.0	-2.1±8.8
UCD-11	3.0±4.0	-1.0±19.0	*	-11.0±13.0
UCD-11-Duplicate	-	0.0±19.0	-	-
UCD-12	-4.0±3.0	-1.0±18.0	*	-17.0±8.0
UCD-13	8.8±9.1	-14.1±8.7	*	5.0±15.0
UCD-13-Duplicate	-	-	-	-2.00±15.00
UCD-14	9.0±9.0	-6.0±14.0	-13.0±9.0	4.0±15.0
UCD-14-Duplicate	-	-	-2.0±20.0	-
UCD-15	-16.8±5.7	0.7±7.8	0.0±130.0	1.0±20.0
UCD-15-Duplicate	-6.9±5.3	-	-	-
UCD-16	3.9±9.4	-2.4±7.9	-10.8±8.9	9.0±15.0
UCD-16-Duplicate	-	-2.3±7.7	-3.0±9.4	-
UCD-17	19.8±9.4	2.9±7.8	-16.0±92.0	2.0±15.0
UCD-17-Duplicate	-	-	-	-2.0±15.0
UCD-18	2.1±3.9	4.0±18.0	10.0±17.0	-9.0±14.0
UCD-19	-7.5±5.2	-2.0±7.9	-5.2±8.8	6.0±15.0
UCD-20	-8.7±4.7	-2.0±14.0	-2.0±21.0	0.0±15.0
UCD-21	7.5±9.7	0.6±9.6	-13.3±7.4	-2.0±14.0
UCD-22	0.6±3.8	0.0±20.0	17.0±20.0	-2.0±15.0
UCD-22-Duplicate	4.6±8.6	-	-	-
UCD-23	0.0±3.7	-15.0±12.0	-4.0±13.0	1.0±15.0
UCD-23-Duplicate	2.7±3.6	-	-	-
UCD-24	2.9±3.9	-4.0±19.0	10.0±21.0	-14.5±7.0

All Units reported as pCi/Liter No MCL
* =Monitoring well dry
- =Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-2

ANALYSIS	AMERICIUM - 241			
	Winter	Spring	Summer	Fall
UCD-01	-	-	*	0.005±0.068
UCD-04	-	-	*	*
UCD-07	-	-	-0.010±0.010 UJl	0.008±0.036
UCD-10	-	-	0.03±0.05 UJl	0.063±0.041
UCD-11	-	-	*	0.008±0.036
UCD-11-Duplicate	-	-	-	-
UCD-12	-	-	*	0.035±0.035
UCD-13	-	-	*	-0.015±0.030
UCD-13-Duplicate	-	-	-	0.016±0.061
UCD-14	-	-	-0.0091±0.0 UJl	-0.004±0.040
UCD-14-Duplicate	-	-	0.0025±0.01 UJl	-
UCD-15	-	-	0.0023 ±0.010 UJl	-0.004±0.030
UCD-15-Duplicate	-	-	-	-
UCD-16	-	-	0.010±0.010 UJl	-0.006±0.050
UCD-16-Duplicate	-	-	0.00±0.33 UJl	-
UCD-17	-	-	0.00±0.01 UJl	0.00±0.039
UCD-17-Duplicate	-	-	-	0.000±0.026
UCD-18	-	-	-	-0.006±0.010
UCD-19	-	-	0.010±0.02 0UJl	0.002±0.046
UCD-20	-	-	0.020±0.030 UJl	0.025±0.055
UCD-21	-	-	0.040±0.150 UJlY	-0.014±0.030
UCD-22	-	-	0.014±0.020 UJl	-0.030±0.090
UCD-23	-	-	-0.003±0.01 UJl	0.004±0.022
UCD-24	-	-	0.006±0.017 UJl	-0.002±0.040

All Units reported as pCi/Liter — No MCL
* = Monitoring well dry
\- = Duplicate not taken
+/- = Sigma Range
Description Data Qualifiers: Refer to Appendix C

TABLE A-3

ANALYSIS	BISMUTH-212 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	15±30	20±46	*	2.70±20.27
UCD-04	46±28	11±40	*	*
UCD-07	1±15	-19±16	-5.47±62.47	-42.38±28.10
UCD-10	-12±31	-15±17	20.88±170.76	-4.38±17.80
UCD-11	2±16	-17±44	*	9.33±42.87
UCD-11-Duplicate	-	5±43	-	-
UCD-12	18±17	-17±19	*	-6.44±31.77
UCD-13	-16±17	-6±38	*	-13.66±32.50
UCD-13-Duplicate	-16±28	-	-	-17.50±12.86
UCD-14	-7±30	-13±41	16.81±47.37	-16.39±8.05
UCD-14-Duplicate	22±23	-	18.52±44.51	-
UCD-15	-1±31	8±15	100.82±296.38	29.13±48.08
UCD-15-Duplicate	43±41	-	-	-
UCD-16	-14±17	13±15	-15.57±17.73	7.12±31.13
UCD-16-Duplicate	-	-1.33±16.00	5.31±19.69	-
UCD-17	12±32	5±15	48.24±180.93	0.44±36.69
UCD-17-Duplicate	-	-	-	-4.86±32.50
UCD-18	16±15	-11±29	-4.45±38.51	-24.12±8.12
UCD-19	12.00±24.00	-14.10±7.00	11.87±17.56	-5.71±33.57
UCD-20	26.00±27.00	-4.58±45.00	17.50±49.07	-3.88±31.31
UCD-21	29±28	24±40	-18.13±17.17	7.47±30.02
UCD-21-Duplicate	29±28	-	-	-
UCD-22	2±14	-20±20	23.82±44.33	-0.78±32.65
UCD-22-Duplicate	-21±18	-	-	-
UCD-23	6±15	-8±39	2.70±17.96	-25.96±9.82
UCD-23-Duplicate	12±15	-	-	-
UCD-24	0±15	7±41	-2.62±48.86	3.92±32.69

All Units reported as pCi/Liter No MCL
* =Monitoring well dry
-- = Duplicate not taken
+/- = Sigma Ranget
For Description of Data Qualifiers Refer to Appendix C

TABLE A-4

ANALYSIS	BISMUTH 214 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	-5.8±4.8	18.0±12.0	*	9.1±6.3
UCD-04	0.0±5.4	-3.0±11.0	*	*
UCD-07	6.6±2.7	-2.6±7.7	-3.0±16.0	21±14
UCD-10	5.6±5.5	-1.5±9.7	7.0±53.0	8.7±6.7
UCD-11	6.4±2.7	8.0±12.0	*	14.0±14.0
UCD-11-Duplicate	-	21.0±12.0	-	-
UCD-12	38.8±3.9	14.0±11.0	*	12.0±10.0
UCD-13	45.0±7.4	10.0±12.0	*	-0.4±8.9
UCD-13-Duplicate	19.2±6.4	-	-	11.1±9.7
UCD-14	5.5±5.7	3.0±11.0	19.0±13.0	-2.5±8.5
UCD-14-Duplicate	11.8±6.1	-	39.0±16.0	-
UCD-15	-3.6±4.6	12.6±5.8	-12.0±79.0	3.0±13.0
UCD-15-Duplicate	8.7±5.5	-	-	-
UCD-16	7.0±5.7	8.2±5.5	23.0±15.0	-6.4±8.9
UCD-16-Duplicate	-	6.7±5.4	0.2±5.9	-
UCD-17	2.8±5.2	6.8±5.7	41.0±56.0	19.0±11.0
UCD-17-Duplicate	-	-	-	3.9±9.0
UCD-18	33.2±3.8	35.0±14.0	8.0±11.0	-2.7±9.0
UCD-19	20±6	7.8±5.6	3.2±5.9	-4.5±8.9
UCD-20	22.8±6.2	18.0±12.0	6.0±12.0	-5.3±9.3
UCD-21	16.6±6.1	38.0±14.0	2.0±12.0	-9.0±5.8
UCD-21-Duplicate	17.8±6.3	-	-	-
UCD-22	24.1±3.3	2.0±11.0	-15.0±12.0	-11.8±6.5
UCD-22 -Duplicate	25.9±6.3	-	-	-
UCD-23	21.7±3.2	-2.7±9.8	3.0±5.6	15±11
UCD-23-Duplicate	30±3.4	-	-	-
UCD-24	30.4±3.5	9.0±11.0	4.0±12.0	-5.7±8.8

All Units reported as pCi/Liter — No MCL
* = Monitoring well dry
\- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-5

ANALYSIS	CARBON - 14			
	Winter	Spring	Summer	Fall
UCD-01	-31±59	21±62	*	15±97
UCD-04	-17±61	35±63 UJd	*	-
UCD-07	-56±56	-1±59	64±54	25±98
UCD-10	20±65	64±66	45±53	20±98
UCD-11	-17±61	-19±57	*	-4±95
UCD-11-Duplicate	-	-1±59	-	-
UCD-12	179±80	278±86UJdl	*	270±120
UCD-13	2150±180	1380.00±140 Jd	*	1970±220
UCD-13-Duplicate	2000±180	-	-	1980±220
UCD-14	810±120	790±110 Jd	641±43	80±100
UCD-14-Duplicate	810±120	-	491±38	-
UCD-15	-20±60	3±60	-8±68	6±96
UCD-15-Duplicate	16±64	-	-	-
UCD-16	-45±57	-44±54	-28±65	60±100
UCD-16-Duplicate	-	-30±56	16±71	-
UCD-17	2±63	-5±59	40±52	70±100
UCD-17-Duplicate	-	-	-	90±100
UCD-18	-20±60	-44±46	25±51	50±100
UCD-19	2±63	17±61	-8±68	10±97
UCD-20	16±64	3±60	-3±68	50±100
UCD-21	5±63	0±51	-3±68	-19±94
UCD-21 Duplicate	16±64	-	-	-
UCD-22	-12±61	6±60	-52±61	-14±94
UCD-22 Duplicate	5±63	-	-	-
UCD-23	197±82	137±73	50±75	130±110
UCD-23 Duplicate	168±69	-	-	-
UCD-24	27±66	-16±57	25±72	10±97

All Units reported as pCi/Liter No MCL
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-6

ANALYSIS	CESIUM - 137 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	-0.7±5.4	-1.6±5.2	*	-1.1±1.4
UCD-04	-1.6±5.1	-1.6±5.2	*	*
UCD-07	0.1±1.9	-1.5±4.6	-2.5±8.1	0.8±4.4
UCD-10	3.1±5.2	-1.7±5.1	-6.00±19.0	0.9±1.6
UCD-11	0.1±1.8	3.5±5.4	*	-2.0±4.4
UCD-11-Duplicate	-	3.6±5.6	-	-
UCD-12	1.4±1.9	-1.9±5.0	*	-1.3±4.0
UCD-13	1.2±4.9	-4.1±1.8	*	-1.1±3.9
UCD-13-Duplicate	39±5.4	-	-	-1.3±4.0
UCD-14	0.7±5.3	-2.6±5.0	-0.5±5.6	-0.7±3.9
UCD-14-Duplicate	-1.4±4.6	-	4.1±6.8	-
UCD-15	1.1±4.7	-0.8±1.8	-7.0±35.0	2.2±3.7
UCD-15-Duplicate	-1.0±4.7	-	-	-
UCD-16	-1.1±5.1	0.6±1.9	-1.1±6.1	-0.9±2.0
UCD-16-Duplicate	-	-0.70±1.80	-1.65±0.97	-
UCD-17	0.6±5.0	0.6±1.9	-4.0±22.0	1.9±2.2
UCD-15-Duplicate	-	-	-	0.0±2.2
UCD-18	0.4±1.9	7.5±5.7	2.7±5.4	-0.4±3.9
UCD-19	1.0±5.2	1.0±1.8	-0.7±2.2	-0.1±2.1
UCD-20	-1.9±4.9	0.0±4.9	-2.8±2.7	0.2±2.1
UCD-21	0.6±5.1	1.6±5.6	-1.3±6.3	-1.1±3.9
UCD-21 Duplicate	-0.4±5.1	-	-	-
UCD-22	-0.60±1.70	-0.80±5.10	0.50±5.80	-1.86±0.61
UCD-22-Duplicate	0.8±5.0	-	-	-
UCD-23	0.0±1.7	-2.5±5.1	-0.6±2.1	1.0±2.2
UCD-23 Duplicate	0.6±1.8	-	-	-
UCD-24	-0.3±1.8	0.7±5.3	4.4±6.1	0.6±2.3

All Units reported as pCi/Liter — No MCL
* = Monitoring well dry
\- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-7

ANALYSIS	COBALT - 60 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	1.70±1.80	-1.40±3.10	*	-1.16±0.79
UCD-04	0.90±1.80	1.30±3.60	*	*
UCD-07	1.02±0.62	-1.50±3.40	4.80±4.60	-1.60±3.0
UCD-10	-3.24±0.67	-0.10±3.40	3.00±13.00	-0.99±0.83
UCD-11	0.95±0.65	0.00±3.30	*	0.30±2.60
UCD-11-Duplicate	-	0.90±3.20	-	-
UCD-12	0.45±0.63	1.10±3.50	*	-1.70±1.30
UCD-13	0.80±1.80	-0.30±3.50	*	0.40±2.40
UCD-13-Duplicate	-1±1.5	-	-	-0.20±1.50
UCD-14	0.60±1.70	1.10±3.50	-2.50±2.10	-2.00±1.10
UCD-14-Duplicate	-3.07±0.72	-	-0.80±2.60	-
UCD-15	1.20±1.80	0.70±1.20	-15.00±12.00	-2.70±3.00
UCD-15-Duplicate	0.40±1.60	-	-	-
UCD-16	0.00±1.70	0.20±1.20	1.30±3.60	-1.80±1.20
UCD-16-Duplicate	-	0.00±1.20	0.40±1.40	-
UCD-17	0.40±1.70	0.10±1.20	0.00±14.00	-0.20±2.70
UCD-17-Duplicate	-	-	-	0.80±2.40
UCD-18	0.37±0.60	0.40±3.50	-0.90±1.40	0.60±2.30
UCD-19	0.80±1.70	-0.20±1.20	-0.30±1.30	-1.20±1.20
UCD-20	1.70±1.80	-0.40±3.60	1.80±3.20	3.10±2.30
UCD-21	-1.40±1.70	2.00±3.50	-2.10±2.60	-2.10±1.20
UCD-21 Duplicate	-0.4±1.7	-	-	-
UCD-22	-0.23±0.55	-2.10±1.90	0.90±4.50	-0.40±2.30
UCD-22-Duplicate	1.00±1.70	-	-	-
UCD-23	0.23±0.53	1.90±3.70	0.00±2.20	-1.40±1.30
UCD-23 Duplicate	0.31±0.53	-	-	-
UCD-24	0.57±0.61	-1.40±3.10	2.10±3.70	-0.80±1.30

All Units reported as pCi/Liter No MCL
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-8

ANALYSIS	GROSS ALPHA			
MCL:15pCi/L	Winter	Spring	Summer	Fall
UCD-01	-0.1±5.3	-3.0±3.3	*	0.2±3.9 C
UCD-04	-0.8±3.3	1.3±4.1	*	*
UCD-07	1.60±3.30	1.4±4.3	1.3±3.1	2.3±3.3 C
UCD-10	8.4±9.3	4.4±7.8	-0.3±4.9 C	6.5±8.2 JmC
UCD-11	0.4±4.1	1.8±3.9	*	4.0±4.5 Jm C
UCD-11-Duplicate	-	3.0±5.6	-	-
UCD-12	12.0±11.0	-1.4±5.6	*	10.0±10.0 C
UCD-13	6.2±8.4	1.6±6.4	*	-0.6±6.1 C
UCD-13-Duplicate	0.9±6.4	-	-	2.6±5.4 C
UCD-14	2.6±5.7	1.1±5.7	0.0±3.9 C	0.5±2.9 C
UCD -14-Duplicate	7.7±7.3	-	2.4±5.3 C	-
UCD-15	-1.0±1.6	1.5±2.5	0.4±2.1 C	4.4±3.3 C
UCD-15-Duplicate	1.7±2.6	-	-	-
UCD-16	0.0±2.1	1.9±2.9	0.5±2.5 C	-2.1±2.6C
UCD-16-Duplicate	-	0.5±2.7	1.4±2.6 C	-
UCD-17	1.2±2.2	2.2±3.0	1.2±2.6	1.3±2.4 C
UCD-17-Duplicate	-	-	-	0.4±2.30 C
UCD-18	0.0±3.2	2.3±3.8	0.1±3.2	2.2±3.3 JmC
UCD-19	3.2±5.9	-0.3±5.7	4.5±5.5 C	7.1±6.3 C
UCD-20	3.2±3.5	1.1±3.2	2.2±2.9 C	0.1±2.4 C
UCD-21	0.5±5.0	3.0±5.4	0.1±4.9 C	5.5±6.2
UCD-21 Duplicate	15±8.7	-	-	-
UCD-22	3.8±4.8	1.0±3.8	-2.1±2.2 C	-0.5±2.7 C
UCD-22-Duplicate	0.0±2.8	-	-	-
UCD-23	1.5±4.6	1.3±4.2	1.8±3.2 C	1.8±4.2 C
UCD-23 Duplicate	3.9±5.3	-	-	-
UCD-24	0.9±5.1	5.1±6.3	3.4±5.4 C	1.4±4.3 C

All Units reported as pCi/Liter MCL = 15 pCi/L
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C
MCL =Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15

TABLE A-9

ANALYSIS	GROSS BETA			
MCL:50pCi/L	Winter	Spring	Summer	Fall
UCD-01	-2.1±5.9	-1.8±5.5	*	-2.3±5.9 BC
UCD-04	23.4±5.9	3.6±4.8	*	*
UCD-07	3.7±4.3	1.3±4.0	2.6±3.3 C	0.3±2.8 C
UCD-10	1.3±7.6	6.7±8.4	3.2±7.9 C	3.1±6.4 C
UCD-11	1.2±5.2	-0.1±5.6	*	1.8±3.2 C
UCD-11-Duplicate	-	1.4±5.6	-	-
UCD-12	5.0±10.0	-1.0±10.0	*	2.0±10.0 BC
UCD-13	1.8±7.7	3.6±8.2	*	1.5±6.8 BC
UCD-13-Duplicate	-0.4±7.7	-	-	1.8±6.4 BC
UCD-14	0.9±6.0	2.2±6.2	2.3±3.9 C	0.8±3.1 B
UCD -14-Duplicate	0.3±6.1	-	-0.80±5.1 C	-
UCD-15	1.4±2.3	0.6±3.2	0.6±2.1	0.2±3.1 BC
UCD-15-Duplicate	-0.5±2.1	-	-	-
UCD-16	-0.8±2.2	1.0±3.2	1.4±2.3	2.0±10.0 BC
UCD-16-Duplicate	-	2.5±3.7	1.6±2.6 C	-
UCD-17	0.3±2.1	-0.2±3.1	1.7±2.3	-0.9±2.60 BC
UCD-17-Duplicate	-	-	-	0.5±3.1 BC
UCD-18	1.6±4.2	0.90±3.8	2.2±3.2 C	0.0±3.3 BC
UCD-19	-0.7±5.2	5.5±6.8	3.7±4.0 C	1.8±5.0 BC
UCD-20	3.9±2.8	5.5±3.6	2.7±2.2	0.8±3.0 BC
UCD-21	-0.7±4.8	1.90±6.0	2.9±4.6 C	-0.8±5.8 BC
UCD-21 Duplicate	1.9±5.1	-	-	-
UCD-22	1.70±3.2	-0.80±4.0	5.40±3.7 C	-0.20±3.9 BC
UCD-22-Duplicate	1.7±3.3	-	-	-
UCD-23	1.7±3.7	-1.1±4.5	11.6±4.2 C	0.9±3.8 BC
UCD-23 Duplicate	-1.3±3.4	-	-	-
UCD-24	2.30±4.60	1.40±6.50	2.40±4.40 C	0.30±6.20 BC

All Units reported as pCi/Liter MCL = 50 pCi/L
* =Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C
MCL =Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15

TABLE A-10

ANALYSIS	LEAD-210 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	0.4±3.0	70.0±110.0	*	-83.81±293.30
UCD-04	1.4±2.9	-30.0±110.0	*	*
UCD-07	-1.0±1.4	-60.0±110.0	26.53±144.89	-45.48±105.21
UCD-10	-0.7±2.9	-12.0±97.0	1487.46±6582.82	-73.93±121.52
UCD-11	-0.2±1.4	19.0±109.0	*	5.68±108.21
UCD-11-Duplicate	-	-30.0±110.0	-	-
UCD-12	-1.3±1.5	10.0±100.0	*	-0.35±75.09
UCD-13	-1.4±3.1	-20.0±100.0	*	-21.27±69.66
UCD-13-Duplicate	-1.7±2.9	-	-	-23.15±73.30
UCD-14	0.0±3.0	30.0±110.0	-23.39±105.07	10.67±71.61
UCD-14-Duplicate	1.3±2.9	-	26.52±109.00	-
UCD-15	-3.3±2.9	-210.0±300.0	-562.27±1391.08	18.61±111.82
UCD-15 Duplicate	0.2±2.9	-	-	-
UCD-16	-0.5±3.0	-80.0±310.0	-27.87±109.17	-13.29±73.81
UCD-16-Duplicate	-	-169.0±300.0	-6.49±265.24	-
UCD-17	1.7±3.0	-270.0±310.0	-1919.46±6839.03	-34.00±78.63
UCD-17-Duplicate	-	-	-	-16.93±74.81
UCD-18	-0.4±1.5	0.0±110.0	-27.92±89.16	-13.50±70.22
UCD-19	-1.7±2.8	-180.0±310.0	-80.44±270.21	-5.10±73.77
UCD-20	-0.5±2.9	28.0±109.0	40.06±101.33	18.57±75.83
UCD-21	-0.4±3.0	20.0±100.0	75.70±109.68	3.76±72.18
UCD-21 Duplicate	1.4±3	-	-	-
UCD-22	-0.9±1.4	-20.0±100.0	-33.53±109.11	-48.72±72.85
UCD-22-Duplicate	3.5±3.0	-	-	-
UCD-23	-1.7±1.4	-100.0±100.0	194.23±281.24	-1.80±77.49
UCD-23 Duplicate	-0.1±1.4	-	-	-
UCD-24	-0.3±1.5	0.0±110.0	-14.92±103.98	0.36±74.19

All Units reported as pCi/Liter — No MCL

* = Monitoring well dry

\- = Duplicate not taken

+/- = Sigma Range

For Description of Data Qualifiers: Refer to Appendix C

TABLE A-11

ANALYSIS	LEAD-212 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	1.8±8.8	8.7±9.3	*	0.7±5.2
UCD-04	7.7±9.0	5.7±8.5	*	*
UCD-07	1.9±4.8	6.7±8.7	-7.0±13.0	-0.6±9.9
UCD-10	-0.4±8.6	7.0±9.1	-2.0±44.0	2.1±5.7
UCD-11	0.7±4.8	-0.5±8.7	*	8.0±10.0
UCD-11-Duplicate	-	4.7±9.2	-	-
UCD-12	5.8±5.3	5.1±9.0	*	-1.7±7.1
UCD-13	2.3±9.3	1.8±9.0	*	11.4±7.1
UCD-13-Duplicate	23±9.1	-	-	0.2±6.9
UCD-14	7.1±8.9	-5.4±8.4	5.0±10.0	-2.3±6.7
UCD-14-Duplicate	-1.9±8.8	-	8.0±11.0	-
UCD-15	3.7±8.6	3.2±4.8	-69.0±58.0	-3.4±9.9
UCD-15-Duplicate	3.9±8.6	-	-	-
UCD-16	-1.0±8.7	1.5±4.8	4.0±10.0	4.7±7.0
UCD-16-Duplicate	-	1.7±4.7	-0.8±5.3	-
UCD-17	2.8±8.7	2.3±5.1	-28.0±46.0	0.0±7.4
UCD-17-Duplicate	-	-	-	1.4±6.9
UCD-18	5.1±5.2	7.6±9.2	-1.2±8.3	-0.6±6.8
UCD-19	-3.4±8.3	-1.5±4.70	0.0±5.6	1.6±6.7
UCD-20	2.9±8.6	8.4±9.0	3.0±10.0	4.2±7.1
UCD-21	1.3±9.2	7.0±9.6	-1.0±10.0	-2.3±6.5
UCD-21-Duplicate	-8.1±8.2	-	-	-
UCD-22	-0.3±4.7	2.5±8.5	7.0±10.0	-2.3±7.1
UCD-22-Duplicate	-5.8±8.3	-	-	-
UCD-23	-2.1±4.5	-0.6±8.5	-0.4±5.6	1.3±7.2
UCD-23-Duplicate	1±4.6	-	-	-
UCD-24	1.6±4.8	3.2±8.5	9.0±10.0	2.7±6.8

All Units reported as pCi/Liter No MCL
* =Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-12

ANALYSIS	LEAD-214 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	5.5±4.7	13.4±9.8	*	1.1±5.8
UCD-04	-4.9±3.3	1.4±9.1	*	*
UCD-07	4.1±2.4	-5.1±7.1	-10.9±4.2	7.0±12.0
UCD-10	5.8±4.7	-4.5±6.1	0.0±45.0	7.6±6.1
UCD-11	4.1±2.4	-2.0±6.4	*	16.0±12.0
UCD-11-Duplicate	-	5.2±9.9	-	-
UCD-12	24.4±3.1	5.2±9.9	*	4.2±8.1
UCD-13	34.7±5.8	3.1±9.5	*	3.2±7.5
UCD-13-Duplicate	13.8±5.2	-	-	8.5±8.1
UCD-14	13.1±5.2	0.2±8.9	0.0±11.0	-0.8±7.5
UCD-14-Duplicate	12.1±5.1	-	35.0±14.0	-
UCD-15	14.1±5.2	10.7±5.2	-18.0±64.0	-5.0±12.0
UCD-15-Duplicate	5.7±4.7	-	-	-
UCD-16	8.1±5.1	9.8±5.1	14.0±12.0	-7.5±7.7
UCD-16-Duplicate	-	6.0±4.8	2.2±5.5	-
UCD-17	12.3±5.0	6.4±5.0	0.0±47.0	2.7±8.6
UCD-17-Duplicate	-	-	-	-2.3±7.8
UCD-18	31.3±3.3	14.0±10.0	1.2±9.5	-2.8±7.4
UCD-19	13.3±5.0	5.0±4.8	-0.1±5.3	-19.7±4.2
UCD-20	32.2±5.6	9.6±9.8	4.0±11.0	-4.1±7.8
UCD-21	30.2±5.5	12.0±10.0	3.0±11.0	-3.1±7.5
UCD-21-Duplicate	23.3±5.4	-	-	-
UCD-22	27.5±3.0	5.3±9.6	4.0±11.0	1.9±7.9
UCD-22-Duplicate	17.5±5.0	-	-	-
UCD-23	26.1±3.0	0.0±9.7	0.2±5.7	6.0±8.4
UCD-23-Duplicate	31.2±3.1	-	-	-
UCD-24	33.9±3.2	3.6±9.5	1.0±11.0	-4.4±7.7

All Units reported as pCi/Liter No MCL
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-13

ANALYSIS	PLUTONIUM - 241			
	Winter	Spring	Summer	Fall
UCD-01	-	-	*	-1.0±1.3
UCD-04	-	-	*	*
UCD-07	-	-	0.3±5.7 UJm	-0.7±1.1
UCD-10	-	-	-0.3±3.1 UJm	0.0±8.0
UCD-11	-	-	*	-0.5±1.0
UCD-11-Duplicate	-	-	-	-
UCD-12	-	-	*	-0.3±4.2
UCD-13	-	-	*	-0.3±3.1
UCD-13-Duplicate	-	-	-	0.4±3.8
UCD-14	-	-	0.4±3.8 UJm	-0.6±1.8
UCD-14-Duplicate	-	-	-0.4±3.1 UJm	-
UCD-15	-	-	-0.8±2.1 UJm	-0.3±4.2
UCD-16	-	-	-1.6±2.2 UJm	-0.5±2.7
UCD-16-Duplicate	-	-	0.0±26.0 UJm	-
UCD-17	-	-	0.6±3.2 UJm	0.0±76.0
UCD-17-Duplicate	-	-	-	0.0±10.0
UCD-18	-	-	-2.4±2.5 UJm	0.0±16.0
UCD-19	-	-	-0.6±2.4 UJm	0.0±10.0
UCD-20	-	-	-1.0±2.4 UJm	0.3±4.1
UCD-21	-	-	-1.5±5.2 UJm	-0.6±1.6
UCD-22	-	-	0.3±5.3 UJm	-0.4±2.4
UCD-23	-	-	-0.6±2.4 UJm	-0.1±8.5
UCD-24	-	-	-1.1±2.7 UJm	1.±2.3

All Units reported as pCi/Liter
* =Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-14

ANALYSIS	POTASSIUM - 40 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	-15±55	6±62	*	-3±28
UCD-04	-41±64	9±60	*	*
UCD-07	6±27	-2±55	64±74	-11±66
UCD-10	-15±56	22±62	-20±310	14±36
UCD-11	-7±28	2±57	*	3±74
UCD-11-Duplicate	-	4±56	-	-
UCD-12	2±29	4±55	*	-20±49
UCD-13	-11±63	11±59	*	-3±45
UCD-13-Duplicate	-8±56	-	-	-24±44
UCD-14	-4±62	-9±63	44±72	-12±47
UCD-14-Duplicate	7±58	-	73±63	-
UCD-15	-30±50	0±28	-50±420	1±59
UCD-15-Duplicate	10±53	-	-	-
UCD-16	21±63	-14±28	40±63	-3±47
UCD-16-Duplicate	-	-4±27	13±34	-
UCD-17	0±61	-18±26	160±350	3±54
UCD-17-Duplicate	-	-	-	-8±49
UCD-18	-8±27	15±56	37±52	-23±48
UCD-19	10±59	-8±28	6±31	32±49
UCD-20	-53±27	-5±61	59±57	0±46
UCD-21	7±57	-14±61	24±69	-16±46
UCD-21-Duplicate	0±52	-	-	-
UCD-22	5±27	29±57	35±76	0±48
UCD-22-Duplicate	-11±53	-	-	-
UCD-23	-1±27	26±65	3±32	6±53
UCD-23-Duplicate	-11±24	-	-	-
UCD-24	22±28	-45±18	24±47	14±47

All Units reported as pCi/Liter No MCL
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-15

ANALYSIS	RADIUM - 226			
MCL:5pCi/L	Winter	Spring	Summer	Fall
UCD-01	0.00±0.13	0.00±0.16	*	0.25±0.38
UCD-04	-0.02±0.10	0.56±0.29	*	*
UCD-07	0.060±0.099	0.110±0.110	0.270±0.230	0.190±0.330
UCD-10	0.00±0.11	0.00±0.14	0.03±0.13	0.31±0.32
UCD-11	0.09±0.11	0.33±0.19	*	0.15±0.17
UCD-11-Duplicate	-	0.06±0.17	-	-
UCD-12	0.07±0.08	0.31±0.24	*	0.16±0.34
UCD-13	0.002±0.059	0.100±0.170	*	0.340±0.420
UCD-13-Duplicate	0.09±0.10	-	-	0.06±0.37
UCD-14	0.10±0.10	0.00±0.15	0.09±0.16	2.14±0.72
UCD-14-Duplicate	0.124±0.092	-	0.070±0.120	-
UCD-15	0.113±0.090	0.110±0.130	0.160±0.120	0.520±0.400
UCD-15-Duplicate	0.00±0.10	-	-	-
UCD-16	0.13±0.12	0.00±0.13	0.06±0.14	0.19±0.45
UCD-16-Duplicate	-	0.07±0.15	0.02±0.08	-
UCD-17	0.066±0.065	0.050±0.140	0.120±0.170	0.120±0.300
UCD-17-Duplicate	-	-	-	0.37±0.34
UCD-18	0.050±0.072	0.110±0.180	0.160±0.160	-0.060±0.290
UCD-19	0.07±0.10	0.00±0.14	0.03±0.07	0.22±0.34
UCD-20	-0.02±0.099	0.00±0.13	0.00±0.09	0.31±0.27
UCD-21	0.05±0.12	0.11±0.13	0.00±0.07	0.00±0.22
UCD-21-Duplicate	0.10±0.12	-	-	-
UCD-22	0.07±0.12	0.10±0.12	0.11±0.11	0.73±0.45
UCD-22-Duplicate	0.00±0.079	-	-	-
UCD-23	0.04±0.069	0.22±0.16	0.08±0.11	0.29±0.33
UCD-23-Duplicate	0.000±0.078	-	-	-
UCD-24	0.00±0.10	0.24±0.17	0.11±0.13	0.25±0.30

All Units reported as pCi/Liter MCL = 5 pCi/L
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C
MCL=Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15

TABLE A-16

ANALYSIS	STRONTIUM - 90			
MCL:8pCi/L	Winter	Spring	Summer	Fall
UCD-01	0.20±0.56 U p	1.01±0.81	*	0.29±0.51
UCD-04	0.44±0.61 U p	-0.08±0.56	*	*
UCD-07	0.36±0.62 U p	0.59±0.66	0.57±0.66	0.23±0.45
UCD-10	0.59±0.65 U p	0.45±0.54	-0.27±0.62	0.24±0.43
UCD-11	0.54±0.74 U p	0.66±0.48	*	0.19±0.44
UCD-11-Duplicate	-	0.29±0.48	-	-
UCD-12	-0.07±0.91 UJl	0.39±0.59	*	-0.05±0.49
UCD-13	-0.50±1.1 UJl	0.67±0.62	*	-0.05±0.46
UCD-13-Duplicate	-1.3±1.3	-	-	0.32±0.50
UCD-14	0.04±0.74 U p	0.12±0.68	0.00±0.64	0.79±0.57
UCD-14-Duplicate	0.06±0.69	-	0.25±0.56	-
UCD-15	0.12±0.44	0.07±0.44	0.81±0.89 Je	-0.37±0.48
UCD-15-Duplicate	-0.07±0.45	-	-	-
UCD-16	0.27±0.45	0.55±0.48	-0.24±0.91 UJe	0.28±0.51
UCD-16-Duplicate	-	0.27±0.54	0.88±0.91 Je	-
UCD-17	0.25±0.45	0.72±0.48	0.02±0.59	0.03±0.51
UCD-17-Duplicate	-	-	-	0.31±0.53
UCD-18	-0.28±0.63	0.62±0.52	0.55±0.61	0.69±0.46
UCD-19	-0.13±0.50	1.50±0.70 Uz	-1.43±0.84 UJe	0.57±0.47
UCD-20	0.23±0.56	1.38±0.57 Uz	-0.20±0.95 UJe	0.23±0.48
UCD-21	0.00±0.52	0.33±0.57	-0.56±0.86 UJe	0.05±0.47
UCD-21-Duplicate	-0.03±0.49	-	-	-
UCD-22	-0.36±0.46	0.62±0.50	0.61±0.86 Je	0.17±0.43
UCD-22-Duplicate	-0.03±0.46	-	-	-
UCD-23	0.19±0.48	0.34±0.50	0.28±0.89 Je	0.23±0.47
UCD-23-Duplicate	-0.42±0.45	-	-	-
UCD-24	0.24±0.43	0.31±0.52	-0.85±0.79 UJe	0.40±0.46

All Units reported as pCi/Liter MCL = 8 pCi/L
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C
MCL =Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15

TABLE A-17

ANALYSIS	THALLIUM - 208 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	-3.1±6.7	-1.4±7.3	*	1.8±3.2
UCD-04	-2.8±6.5	-0.3±6.7	*	*
UCD-07	1.9±3.1	-5.7±6.4	13.0±11.0	-6.7±3.3
UCD-10	-2.5±6.6	-2.3±6.6	18.0±31.0	-1.0±3.1
UCD-11	2.0±3.0	0.5±6.8	*	0.0±6.4
UCD-11-Duplicate	-	6.7±7.2	-	-
UCD-12	2.2±3.2	7.2±7.1	*	1.2±5.0
UCD-13	2.8±6.9	4.7±6.9	*	2.5±4.8
UCD-13-Duplicate	-0.4±6.2	-	-	-0.5±5.1
UCD-14	-1.4±6.8	1.2±6.7	7.4±7.8	0.0±4.6
UCD-14-Duplicate	-4±6.7	-	9.9±8.0	-
UCD-15	1.9±6.7	1.6±2.9	16.0±45.0	5.2±7.9
UCD-15-Duplicate	1.1±6.4	-	-	-
UCD-16	4.2±6.5	-0.5±3.0	-4.0±7.7	-0.2±4.9
UCD-16-Duplicate	-	0.9±2.9	0.0±3.1	-
UCD-17	-4.0±6.8	1.1±2.8	-16.0±32.0	-1.7±4.9
UCD-17-Duplicate	-	-	-	-0.4±4.9
UCD-18	0.6±3.1	4.4±6.7	3.1±6.2	-2.3±4.7
UCD-19	-3.2±6.5	2.3±3.0	0.5±3.2	-3.5±4.7
UCD-20	-2.0±6.3	-3.1±7.0	4.5±7.4	-1.1±5.0
UCD-21	-0.2±6.6	3.5±6.7	-2.6±7.4	-0.7±4.6
UCD-21-Duplicate	-3.1±6.4	-	-	-
UCD-22	0.3±2.8	0.7±6.5	0.6±6.8	0.9±5.1
UCD-22-Duplicate	1.1±6.3	-	-	-
UCD-23	0.1±2.6	-1.8±6.2	0.9±3.1	-1.8±4.9
UCD-23-Duplicate	3.2±2.9	-	-	-
UCD-24	2.9±3.0	3.6±7.0	3.9±7.9	-0.3±4.7

All Units reported as pCi/Liter No MCL
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

TABLE A-18

ANALYSIS	THORIUM - 234 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	-10.0±28.0	39.0±56.0	*	-15.71±44.92
UCD-04	0.0±28.0	40.0±56.0	*	*
UCD-07	14.0±18.0	-8.0±56.0	46.0±84.0	-17.6±102
UCD-10	8.0±28.0	0.0±54.0	0.0±270.0	2.74±43.7
UCD-11	-12.0±19.0	18.0±55.0	*	19.6±68.2
UCD-11-Duplicate	-	-3.0±55.0	-	-
UCD-12	-18.0±19.0	-21.0±55.0	*	-7.92±47.19
UCD-13	22.0±28.0	-10.0±55.0	*	-7.48±45.15
UCD-13-Duplicate	-7±28	-	-	-3.79±46.60
UCD-14	0.0±28.0	46.0±56.0	41.0±62.0	-8.62±44.68
UCD-14-Duplicate	-6±28	-	-22.0±64.0	-
UCD-15	47.0±28.0	36.0±37.0	-140.0±340.0	-9.60±65.53
UCD-15-Duplicate	22.0±27.0	-	-	-
UCD-16	-31.0±27.0	-3.0±37.0	-45.0±65.0	7.62±46.26
UCD-16-Duplicate	-	23.0±37.0	0.0±43.0	-
UCD-17	20.0±29.0	11.0±36.0	-180.0±290.0	-7.52±47.68
UCD-17-Duplicate	-	-	-	10.67±44.91
UCD-18	-2.0±19.0	19.0±55.0	5.0±54.0	7.48±44.7
UCD-19	8.0±27.0	14.0±36.0	29.0±43.0	29.45±46.14
UCD-20	44.0±27.0	43.0±56.0	9.0±63.0	-9.89±45.36
UCD-21	-52.0±28.0	-8.0±55.0	21.0±64.0	10.19±44.35
UCD-21-Duplicate	28±28	-	-	-
UCD-22	14.0±18.0	-28.0±54.0	-33.0±64.0	-3.64±47.17
UCD-22-Duplicate	19.0±27.0	-	-	-
UCD-23	-20.0±18.0	-18.0±55.0	6.0±43.0	19.21±47.63
UCD-23-Duplicate	4±18	-	-	-
UCD-24	-47.0±19.0	32.0±56.0	20.0±64.0	-9.80±45.88

All Units reported as pCi/Liter — No MCL

* = Monitoring well dry

\- = Duplicate not taken

+/- = Sigma Range

For Description of Data Qualifiers: Refer to Appendix C

TABLE A-19

ANALYSIS	TRITIUM			
MCL:20,000pCi/L	Winter	Spring	Summer	Fall
UCD-01	-60±120	-70±120	*	20±200
UCD-04	10±140U p	70±140	*	*
UCD-07	30±140U p	-60.00±120	20.00±140	50.00±190
UCD-10	0±140	-70±120	-40±130	140±200
UCD-11	-100±120	-60±12	*	-40±18
UCD-11-Duplicate	-	-90±110	-	-
UCD-12	50±150U p	0±130	*	-20±190
UCD-13	21490±990	19250±910	*	16900±1100
UCD-13-Duplicate	20820±980	-	-	16600.00±1100.00
UCD-14	5440±520	8320±600	2500±360	10±210
UCD-14-Duplicate	5280±500	-	2550±370	-
UCD-15	10±130	40±130	-30±140	0±190
UCD-15-Duplicate	70±140	-	-	-
UCD-16	-30±120	80±140	-40±130	110±210
UCD-16-Duplicate	-	-40±120	-70±130	-
UCD-17	-50±120	-150±99	0.00±130	200±220
UCD-17-Duplicate	-	-	-	-90±180
UCD-18	-20±130	-90±120	10±130	100±190
UCD-19	-120±110	0±130	-40±130	-20±180
UCD-20	50±130	0±120	-70±130	80.00±190
UCD-21	90±140	-20±130	-50±130	10±180
UCD-21-Duplcate	-80±120	-	-	-
UCD-22	-20±120	-50±120	30±150	-100±180
UCD-22-Duplicate	-30±120	-	-	-
UCD-23	-60±120	-20±130	-50±130	0±190
UCD-23-Duplicate	-30±120	-	-	-
UCD-24	-20±120	-100±110	10±140	-180±170

All Units reported as pCi/Liter MCL = 20,000 pCi/L
* = Monitoring well dry
- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C
MCL =Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15

TABLE A-20

ANALYSIS	URANIUM - 235 (GSA)			
	Winter	Spring	Summer	Fall
UCD-01	-5.0±12.0	13.0±24.0	*	-3.0±14.0
UCD-04	-17.4±9.2	3.0±23.0	*	*
UCD-07	-4.5±3.1	2.0±22.0	-2.0±34.0	-3.0±27.0
UCD-10	-2.0±11.0	-12.0±17.0	90.0±120.0	11.0±15.0
UCD-11	3.3±6.2	-16.0±17.0	*	4.0±28.0
UCD-11-Duplicate	-	6.0±23.0	-	-
UCD-12	-8.5±3.4	10.0±23.0	*	-16.0±19.0
UCD-13	2.0±12.0	3.0±23.0	*	-7.0±18.0
UCD-13-Duplicate	13±12	-	-	-27.0±11.0
UCD-14	-10.0±12.0	-23.0±18.0	3.0±26.0	-6.0±18.0
UCD-14-Duplicate	3±12	-	12.0±29.0	-
UCD-15	-9.0±11.0	-1.0±14.0	110.0±150.0	-10.0±28.0
UCD-15-Duplicate	-2.0±11.0	-	-	-
UCD-16	-3.0±12.0	-7.0±14.0	-8.0±27.0	0.0±18.0
UCD-16-Duplicate	-	-12.9±6.7	3.0±15.0	-
UCD-17	6.0±11.0	-13.8±6.6	-24.0±95.0	4.0±20.0
UCD-17-Duplicate	-	-	-	0.0±18.0
UCD-18	2.2±6.4	0.0±19.0	-6.0±23.0	-5.0±18.0
UCD-19	10.0±11.0	9.0±13.0	0.0±12.0	3.0±18.0
UCD-20	5.0±11.0	-2.0±23.0	-1.0±21.0	-4.0±18.0
UCD-21	2.0±12.0	-14.3±7.2	2.0±27.0	-20.0±11.0
UCD-21-Duplicate	-5±11	-	-	-
UCD-22	5.5±6.2	4.0±23.0	17.0±27.0	-6.0±19.0
UCD-22-Duplicate	-8.0±12.0	-	-	-
UCD-23	3.1±5.9	-8.0±23.0	0.0±15.0	3.0±19.0
UCD-23-Duplicate	-4.2±3.2	-	-	-
UCD-24	8.3±6.3	-3.0±24.0	0.0±26.0	4.0±18.0

All Units reported as pCi/Liter — No MCL
* = Monitoring well dry
\- = Duplicate not taken
+/- = Sigma Range
For Description of Data Qualifiers: Refer to Appendix C

APPENDIX B

Radiological Results for Surface Water

Annual, 1994

Analyte:	Actinium-228 (GSA)				Americium-241				Bismuth-212 (GSA)			
Quarter	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD	4.6±8.6	8.0±19.0	4.0±22.0	12.0±22.0	-	-	0.02±0.02UJI	0.017±0.027	-16.00±17.00	3.0±26.0	-	-
PCU-D	-	-	10.0±23.0	-	-	-	0.02±0.02UJI	-	-	-	-	-
PCU	-1.2±4	17.8±7.0	5.0±9.1	11.0±21.0	-	-	0.04±0.05UJIY	0.034±0.052	14.00±16.00	-12.4±6.1	-	-
PCU-D	-	-7.1±7.4	-	-	-	-	-	-	-	3.96±15.00	-	-
STPO	-4.0±3.9	-2.2±7.7	-4.0±17.0	1.7±8.3	-	-	0.00±0.01UJI	0.016±0.062	5.00±16.00	2.00±15.00	-	-
STPO-D	7.4±9.6	-	-	1.8±9.1	-	-	-	0.000±0.130	5.00±38.00	-	-	-
MCL	-	-	-	-	-	-	-	-	-	-	-	-

Analyte	Bismuth-214 (GSA)				Carbon-14				Cesium-137 (GSA)			
Quarter	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD	25.4±6.2	13.0±12.0	9.0±12.0	15.0±14.0	-9±62	68±56	60±76	-21±94	1.5±5.5	2.2±5.1	-0.1±6.1	-2.0±3.2
PCD-D	-	-	5.0±13.0	-	-	-	16±71	-	-	-	-2.0±6.3	-
PCU	5.0±2.9	20.0±5.5	3.2±5.6	4.0±13.0	-24±60	-39±47	-18±66	18±98	1.3±1.7	2.7±1.9	0.9±2.0	2.3±6.6
PCU-D	-	2.50±5.20	-	-	-	6±60	-	-	-	0.0±1.8	-	-
STPO	0.8±2.6	-0.6±5.1	-3.0±13.0	0.2±5.6	23±65	21±53	-18±66	50±100	1.2±1.9	-0.5±1.9	-0.2±5.8	-0.9±1.7
STPO-D	17.2±6.1	-	-	5.2±6.0	-20±60	-	-	8±97	2.6±5.1	-	-	1.1±1.7
MCL	-	-	-	-	-	-	-	-	-	-	-	-

All Units reported as pCi/Liter.Description Data Qualifiers: Refer to Appendix C
-=Parameter not analyzed D=Duplicate
+/-=Sigma RangeMCL=Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15

Analyte	Cobalt-60 (GSA)				Gross Alpha				Gross Beta			
Quarter	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD	-1.30±1.60	-0.40±3.20	2.50±3.90	-4.40±2.20	-0.2±1.1	0.1±2.3	1.4±2.1	0.5±1.8 C	3.3±1.7	8.8±2.5 Uz	22.0±3.0	3.9±2.1 B
PCD-D	-	-	-1.40±3.90	-	-	-	-0.9±2.1	-	-	-	30.1±6.0	-
PCU	0.26±0.58	1.09±0.93	0.10±1.30	1.70±3.90	0.8±1.1	0.2±1.3	1.266±2.5	0.6±1.2 C	0.9±1.4	1.7±1.4	13.8±3.2	1.9±1.7 B
PCU-D	-	-0.20±1.20	-	-	-	0.0±1.5	-	-	-	2.1±2.1	-	-
STPO	0.53±0.60	-0.70±1.10	0.90±4.20	-1.24±0.82	1.7±3.8	1.1± 2.4	0.3±1.7	13.9±5.5 C	0.9±3.5	11.9±2.9 Uz	14.50±2.70	17.1±4.3 C
STPO-D	-1.10±1.80	-	-	-0.85±0.69	1.4±2.6	-	-	2.2±3.2 C	17.2±4.5	-	-	17.6±4.3 C
MCL	-	-	-	-	15	15	15	15	50	50	50	50

Analyte	Lead-210 (GSA)				Lead-212 (GSA)				Lead-214 (GSA)			
Quarter	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD	2.2±3.0	-10.0±110.0	-	-	4.2±9.1	-1.5±9.2	6.0±11.0	6.0±11.0	17.5±5.3	3.7±9.4	-4.6±8.3	7.0±11.0
PCD-D	-	-	-	-	-	-	-3.2±9.9	-	-	-	-2.0±11.0	-
PCU	-0.2±1.4	160.0±250.0	-	-	5.7±4.9	9.2±4.7	-2.6±5.2	3.0±10.0	8.7±2.5	15.0±4.9	-1.1±5.3	5.0±11.0
PCU-D	-	-240.0±301.0	-	-	-	4.6±4.9	-	-	-	2.9±4.5	-	-
STPO	-0.6±1.5	80.0±310.0	-	-	4.4±5.1	-0.5±4.6	-4.0±10.0	1.5±5.3	0.7±2.4	0.2±4.6	0.0±11.0	2.1±5.4
STPO-D	-0.9±3.0	-	-	-	3.4±8.7	-	-	4.8±5.3	12.9±4.9	-	-	1.7±5.5
MCL	-	-	-	-	-	-	-	-	-	-	-	-

All Units reported as pCi/Liter.Description Data Qualifiers: Refer to Appendix C
-=Parameter not analyzedD=Duplicate
+/-=Sigma RangeMCL=Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15.

Analyte	Plutonium-241				Potassium-40 (GSA)				Radium-226			
Quarter	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD	-	-	-1.20±2.90 UJm	0.3±4.5	-26±55	-4±61	25±51	-12±69	0.020±0.120	0.000±0.160	0.050±0.100	0.36±0.30
PCD-D	-	-	-0.30±3.10 UJm	-	-	-	8±75	-	-	-	0.160±0.130	-
PCU	-	-	2.70±3.00 UJm Y	0.0±16.0	6±28	49±26	6±33	15±72	-.020±0.082	0.000±0.150	0.030±0.100	0.00±0.28
PCU-D	-	-	-	-	-	-2±28	-	-	-	0.000±0.170	-	-
STPO	-	-	-2.10±2.20 UJm	-0.3±3.1	24±29	-4±28	-24±67	3±32	0.020±0.110	0.070±0.100	0.030±0.080	0.26±0.24
STPO-D	-	-	-	0.5±3.4	14±69	-	-	1±33	0.000±0.046	-	-	0.36±0.26
MCL	-	-	-	-	-	-	-	-	5	5	5	5

Analyte	Strontium-90				Thallium-208 (GSA)				Thorium-234 (GSA)			
Quarter	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD	0.20±0.69	0.25±0.59	2.10±1.10 Je	0.04±0.45	1.1±7.2	3.0±6.7	5.2±7.2	-1.2.0±6.9	2.0±2.7	7.0±5.5	16.0±63.0	-
PCD-D	-	-	0.70±1.00 UJe	-	-	-	3.0±7.7	-	-	-	33.0±65.0	-
PCU	0.07±0.66	-0.03±0.59	-0.49±0.95 UJe	-0.24±0.39	2.7±3.0	6.3±2.7	-0.8±3.2	5.4±6.8	14.0±19.0	-133.0±40.0	0.0±42.0	-
PCU-D	-	0.25±0.404	-	-	-	0.3±2.9	-	-	-	28.0±37.0	-	-
STPO	0.16±0.68	0.18±0.94	1.00±1.00 Je	-0.59±0.54	1.5±3.1	-0.6±2.8	4.5±8.4	1.1±3.0	3.0±18.0	-2.0±37.0	28.0±66.0	-
STPO-D	0.06±0.67	-	-	-0.06±0.5	1.9±6.7	-	-	2.9±3.4	-2.0±28.0	-	-	-
MCL	8	8	8	8	-	-	-	-	-	-	-	-

All Units reported as pCi/Liter. Description Data Qualifiers: Refer to Appendix C
-=Parameter not analyzed D=Duplicate
+/-=Sigma RangeMCL=Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15.

Analyte	Tritium				Uranium (GSA)			
Quarter	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD	30±140	2030±320	570±210	20±200	9.0±11.0	2.0±23.0	0.0±26.0	-2.0±26.0
PCD- D	-	-	620±220	-	-	-	-6.0±21.0	-
PCU	0±140	-100±110	120±160	-30±190	-3.2±6.0	-11.0±11.0	-20.0±12.0	-18.0±21.0
PCU- D	-	0±130	-	-	-	5.0±13.0	-	-
STPO	0±140	320±170	10±140	480±250	-3.1±6.3	-15.6±6.3	4.0±27.0	3.0±15.0
STPO- D	0±130	-	-	80±200	-11.0±12.0	-	-	-6.0±13.0
MCL	20000	20000	20000	20000	-	-	-	-

All Units reported as pCi/Liter.
-=Parameter not analyzed
+/-=Sigma Range
D=Duplicate
MCL=Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15.
Description Data Qualifiers: Refer to Appendix C

APPENDIX C

Data Qualifier Definitions

Annual, 1994

DATA VALIDATION QUALIFIERS

The following definitions provide brief explanation of the qualifiers assigned in the data review process. Validation reason codes for GC/MS Organics, GC organic, and Metals are recorded by the data reviewers and retained in review support documentation for the data review process.

Flag Data Qualifier Definition

B- Any constituent that was also detected in the associated blank whose concentration was greater than the reporting detection limit (RDL) and /or minimum detectable activity (MDA).
C- Presence of high TDS in sample required reduction of sample size which increased the MDA.
J- The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N- The analysis indicated the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
U- The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ-The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R- The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
Y- Chemical yield exceeded acceptance limits.
c- Calibration failure; poor or unstable response.
d- Matrix spike/matrix spike duplicate imprecision or matrix duplicate imprecision.
e- Laboratory duplicate control sample imprecision.
j- Poor mass spectrographic performance.
l- Laboratory control sample recovery failure.
m-Matrix spike/matrix spike duplicate recovery failure.
z- Method blank contamination.

Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

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Dr. Salem Attiga
Laboratory for Energy-Related
Health Research
University of California
Old Davis Road
Davis, California 95616-8615

Subject: Approval of the 1994 Site Environmental Report (SER) for the Laboratory for Energy-Related Health Research (LEHR)

Dear Dr. Attiga:

This is to notify you that the 1994 SER for LEHR is approved for public release. My approval for release is based on Oakland Operations Office review of the SER and LEHR's certification of the validity and accuracy of the monitoring data in the report.

Please provide the Environment and Safety Support Division (ESS) with eight copies of the final report. Should your staff have any questions, please have them contact Steve Black of ESS at (510) 637-1595.

Sincerely,

James T. Davis
Assistant Manager
for Environmental
Management and Support

Certification of Accuracy for:

Annual Site Environmental Report for LEHR, 1993

I certify that the information submitted herein is true, accurate, and complete, based on my familiarity with the information and my inquiry of those individuals immediately responsible for obtaining the information.

Signature: _____ **Date:** 7/18/95

Salem Attiga
Senior Project Manager