U.S. DEPARTMENT OF ENERGY

OAKLAND FIELD OFFICE

ANNUAL SITE ENVIRONMENTAL REPORT

for the

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH

University of California, Davis

for Calendar Year 1993

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:** 6/17/94

Dawn Mitchell
LEHR Project

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ACRONYMS AND ABBREVIATIONS

AH-1	Animal Hospital 1
AH-2	Animal Hospital 2
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
Ba-137	Barium 137
BEI	Bechtel Environment Inc.
BHC	Hexachlorocyclohexane
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
Ci	Curie
CLP	Contract Laboratory Program
Co-60	Cobalt 60
CPT	Cone Penetrometer Testing
CrVI	Hexavalent Chromium
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
DDE	Dichloroethane
D&M	Dames & Moore
DTSC	California Department of Toxic Substances Control
DW	Domestic Well
EA	Environmental Assessment
EH-22	Department of Energy Office of Environmental Compliance
EH&S	Environmental Health and Safety Office
EMO	Battelle's Environmental Management Operations
EML	Emission Measurement Laboratory
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
H-3	Tritium
HEPA	High Efficiency Particulate Air Filter

HSU	Hydrostratigraphic Unit
IAW	In Accordance With
IMH	Imhoff Building
ITEH	Institute Toxicology and Environmental Health
IW	Irrigation Well
L	Liter
LEHR	Laboratory for Energy-Related Health Research
LSC	Liquid Scintillation Counter
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Amount
MeV	Megaelectron-volts
mg	milligram
mL	milliliter
mrem	millirem
nCi	Nanocurie
ND	Not Detected
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standard for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NQA	National Quality Assurance
NVLAP	National Volunteer Laboratory Assurance Plan
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
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
RI/FS	Remedial Investigation/Feasibility Study
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
SPCC	Spill Prevention Controls and Countermeasures
Sr-90	Strontium 90

SSDC	System Safety and Development Center
Stor	Storage
STPO	Wastewater (Sewage) Treatment Plan Outfall
SWAT	Solid Waste Assessment Test
Th-228	Thorium 228
Th-232	Thorium 232
TLD	Thermoluminescent Dosimeter
TSCA	Toxic Substances Control Act
UCD	University of California at Davis
uCi	microcurie
ug/l	Micrograms per liter
VOC	Volatile Organic Compound
WEQAP	Work Element Quality Assurance Plan
WSF	Waste Staging Facility (H-292)

1.0 EXECUTIVE SUMMARY

The Laboratory for Energy-Related Health Research (LEHR) was established in 1958 at its present location by the Atomic Energy Commission. For three decades, research continued at LEHR, primarily focusing on the health effects from chronic exposures to the radionuclides strontium 90 and radium 226, using beagles to simulate radiation effects on humans. DOE operations at the LEHR site were discontinued in 1989. Since that time, activities at the site have concentrated on site characterization and decontamination and decommissioning (D&D) of various buildings previously used in the research program.

In May 1994, the U.S. EPA placed the LEHR site on the National Priorities List (NPL). Plans for a site-wide Remedial Investigation/Feasibility Study (RI/FS) incorporating CERCLA guidelines had already been initiated in 1993 by DOE. The RI/FS will provide an extensive environmental evaluation of site soil, groundwater, vegetation, and air. Since data quality objectives required for the RI/FS were more extensive than those required in the Environmental Monitoring and Surveillance Plan for the LEHR site, it was decided to incorporate these environmental monitoring requirements into the RI/FS Plan. Once the RI/FS is completed, the site Environmental Monitoring and Surveillance plan will be revised to include annual monitoring requirements. Work on the RI is scheduled to begin in the summer of 1994.

During 1993, the LEHR site and local environment were monitored for ambient radiation fields as well as for radiological and nonradiological contaminants in the groundwater and surface water. Air effluent monitoring was also performed during decontamination activities for specific site buildings.

1.1 Overview of 1993 Monitoring Results

The majority of environmental monitoring measurements for the LEHR site during 1993 were within previously determined ranges for background levels. Whenever environmental measurements are determined to be above the range for background or within a designated action level for a particular contaminant, the significance of that measurement is evaluated. This evaluation determines whether additional information is needed to verify a trend, establish the cause, or to identify the most appropriate steps for corrective action. Significant aspects of the environmental monitoring data collected for the site are presented in this overview, and further information on each of these subjects is contained in Chapters 5 and 6 of this annual report.

Ambient radiation monitoring was conducted at 35 locations around the LEHR site. This represents an increase of 18 locations from those monitored in 1992. The increase was primarily due to D&D activities that were underway at the site. The only areas that recorded a radiation dose higher than site background were the designated radiological waste storage areas. For complete data summaries of ambient monitoring results, see Tables 5.2A through 5.2D.

The Groundwater and Surface Water Monitoring Program underwent a number of significant improvements during 1993. Extensive groundwater data has been collected for the site since November 1990. However, in 1993, a new Water Monitoring Plan was implemented. Additional parameters were added to assist in evaluation of contaminant fate and transport in the environment, and data quality objectives were elevated to meet the CERCLA requirements for the RI/FS. The higher data quality

objectives included incorporation of EPA Contract Laboratory Program (CLP) Level IV requirements and CLP-equivalent quality control documentation.

Groundwater monitoring data collected during 1992-1993 indicate that three constituents (nitrate, chromium and hexavalent chromium) impact large portions of groundwater beneath the site. Other constituents have been found to impact groundwater beneath only "location specific" portions of the site. Samples from one site well (downgradient from Landfill Disposal Units No. 1 and 2) consistently show elevated levels of volatile organic compounds, 1,1-dichloroethane, 1,1 dichloroethene, 1,2-dichloroethane, and chloroform. Other groundwater constituents, including selenium, nickel, chloroform, carbon-14 and tritium were found at concentrations exceeding upgradient concentrations in one to three wells on a consistent and statistically significant basis.

Impacts to surface water in Putah Creek are more difficult to define due to the need for additional background information and the influence of other nearby sources, such as local agriculture and the UC Davis wastewater treatment plant outfall. However, several parameters that include salts and anthropogenic volatile organic parameters and pesticides have been found in samples from Putah Creek in the vicinity of the site.

Results from the air effluent monitoring of site buildings undergoing D&D action verified that no airborne radiological effluent above background levels had resulted from the activity.

1.2 Assessment of Radiological Impact of LEHR ER Project Operations

The environmental monitoring data collected throughout 1993 for radiological contaminants, 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. Therefore, radiation doses to members of the public in the site vicinity are very limited. Estimated population dose has been calculated with mathematical models which use known transport mechanisms for atmospheric and liquid releases and known major pathways of exposure to man. The EPA-approved CAP88-PC were utilized to develop these estimates.

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/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/year.

There are no active liquid effluent streams which result from current DOE operations at the LEHR site. In 1993, environmental restoration activities within buildings were performed utilizing a number of engineering controls to prevent release of contaminants. Airborne releases were directed through double High Efficiency Particulate Air (HEPA) filters and monitored so that prompt action could be taken if necessary to maintain As Low As Reasonably Achievable (ALARA) guidelines. Calculations were developed prior to the start of such activities in order to estimate potential effective dose equivalent. For the Animal Hospital D&D, the estimated effective dose equivalent was calculated to be less than 0.003 mrem. Air monitoring during the activity determined that only background levels were released.

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. The report provides information about the site and its environmental monitoring operation throughout calendar year 1993. Environmental data for the year are summarized for both radiological and nonradiological monitoring. This report also describes activities conducted during 1993 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 Laboratory for Energy-Related Health Research (LEHR) was established in 1958 at its present location by the Atomic Energy Commission. Research at LEHR originally 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. In 1988, pursuant to a memorandum of agreement between the U.S. Department of Energy (DOE) 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 decontamination and decommissioning (D&D) of the LEHR site is managed by the Oakland Operations Office (OAK) under DOE's Environmental Restoration Program. From October 1989 through February 1990, an interim contract with UC Davis was implemented to succeed the Maintenance and Operations 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).

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, remediation of DOE-contaminated trenches, soil, and underground tanks, community relations, and landlord/general site services. 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,

FIGURE 2.1 General Location Map of the LEHR ER Project Site

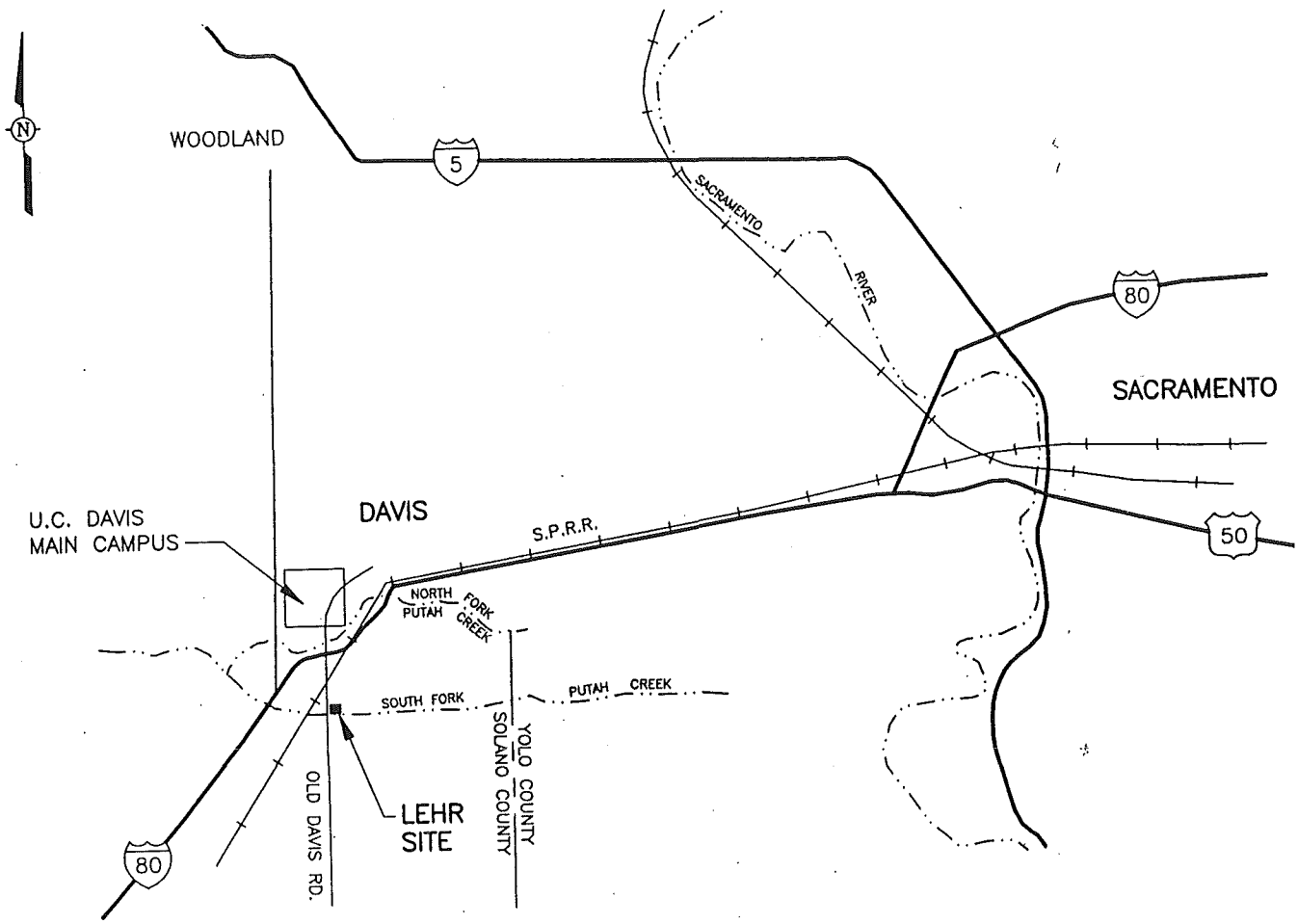

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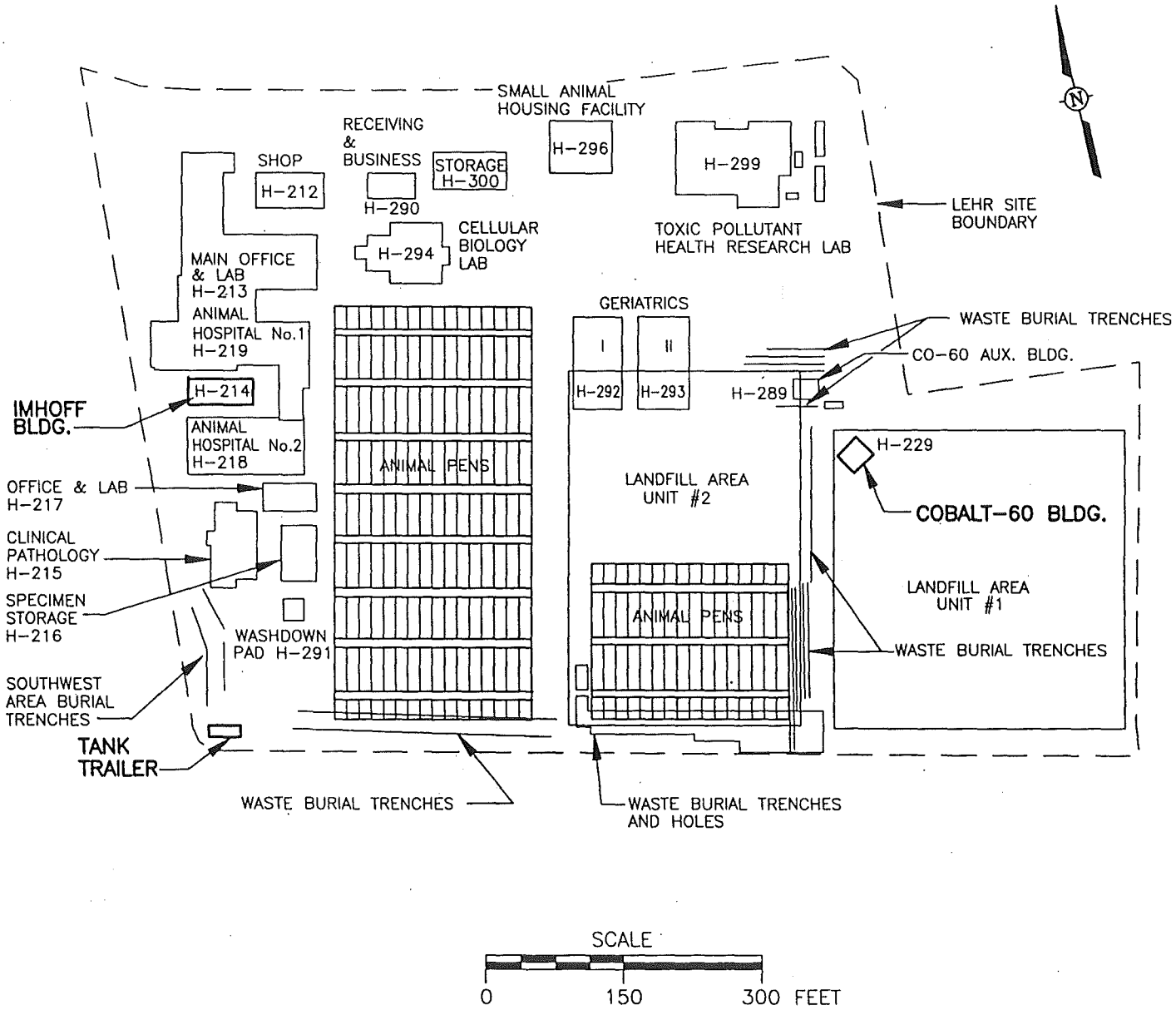
FIGURE 2.2 LEHR ER Project Plot Plan



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 currently 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. In addition, the LEHR site is the location of two inactive campus landfill units and numerous inactive campus low-level radioactive disposal sites (trenches and holes), which were used by UC Davis and DOE to dispose of waste. The cobalt 60 irradiation source has been removed from the site and ongoing remediation involves all of the above areas.

2.4 Population Data

2.4.1 Site Population

During the current D&D remediation, 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 185 university researchers and support staff. These include: 15 faculty, 54 research and technical staff, 14 administrative staff, 45 postgraduate researchers and research assistants, and 62 student assistants. Like most campus researchers, ITEH researchers have varying schedules and are not all present at the LEHR site at the same time.

The LEHR ER Project is managed by PNL, who employs subcontractors responsible for specific aspects of the project. Total LEHR ER Project personnel currently include 10 employees and 4 part-time students. These numbers will increase as on-site work begins on scheduled remediation projects.

2.4.2 Local Population

UC Davis has a student population of approximately 21,000 and employs approximately 12,000 full-time faculty and staff. The current population of Davis is approximately 44,792 and the current total population of Yolo County is about 150,000. The LEHR site is located in a rural area in northern 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 1,041,219, and approximately 391,122 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 nonLEHR, 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 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 1993)

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 1992)

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 1992). 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.

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

2.5.5 Water Supply and Quality

The regional groundwater is of very good quality, according to state, county and local water agency officials. Stream flow as a result of rainfall runoff and releases from Lake Berryessa is of good quality. 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 Dept. of Water Resources 1978).

Seasonal groundwater levels fluctuate about 30-35 feet between fall and spring months. In general, movement of groundwater is from west to east. However, local variations in the water table surface are present. Local depressions in the water table reflect discharge due to pumping. Since most municipal and industrial water in the area is supplied by groundwater, these depressions are most pronounced near the urban areas, (Dames & Moore 1990, California Dept. of Water Resources 1978).

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

Stormwater runoff at the LEHR site is controlled through an underground drainage system that feeds into two collection points on the site. One system is connected to a stormwater lift station, which pumps excess water directly to the South Fork of Putah Creek upstream of the LEHR site. The other is a combined sanitary/storm system. Some areas on the site do have drainage problems, which 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. It did find, however, that Swainson's hawk (a state-listed threatened species) is present within 1/4 mile of the site. Four other sensitive biological resources were also identified with a potential for occurrence in the vicinity of the project site. These species include: the valley elderberry longhorn beetle, the giant garter snake, the western snowy plover, and the burrowing owl.

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

This summary describes the status of 1993 LEHR ER Project activities with respect to environmental regulatory compliance. Until October 1, 1989, LEHR was an organized research unit at UC Davis. Since the cessation of the DOE-sponsored LEHR research program, all DOE-related work on the site centers on the environmental restoration and cleanup. LEHR ER Project's status with respect to major environmental statutes is summarized as follows:

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

The U.S. EPA has recently placed the LEHR site on the National Priorities List (NPL). The site is not currently under any CERCLA enforcement actions. However, the environmental restoration program for LEHR ER Project continues to include investigations of groundwater and nearby surface water in accordance with CERCLA guidelines. Data obtained for the Phase II site characterization was collected and evaluated according to EPA quality assurance criteria (Level III and below). This data has been used to identify areas requiring further investigation. Beginning with the summer quarter 1993, data quality objectives for collection and analysis of ground and surface water were elevated to EPA Level IV criteria to assure that data quality will meet CERCLA requirements.

More data is needed to adequately assess the site contamination and evaluate/implement remedial actions. Several site areas, such as the waste burial trenches and old campus landfill, must be further investigated. DOE, in coordination with UC Davis, is preparing a site-wide CERCLA RI/FS work plan. Information from the RI/FS will be used to develop plans for soil and groundwater remediation, as necessary.

3.1.1. Phase II Investigation

Results of the Phase II characterization of site soil and water were reported in February 1993. This study examined soil and groundwater on and near the site and surface water from nearby Putah Creek.

Results of soil testing show that low levels of nitrate, a few volatile organic compounds, chlordane, several radionuclides and several trace metals are present in site soils in various locations. Further testing is needed to determine whether the levels exceed those that exist in background locations near the site.

Groundwater and surface water samples were collected and analyzed quarterly during the Phase II investigation. Data obtained during the study indicate that carbon 14, tritium, chromium, nitrate, a few organic chemicals, and some chlorinated pesticides are present in shallow groundwater (about 45-70 feet deep) under and adjacent to the site. Concentrations of some of these constituents are above maximum contaminant levels (MCLs). In surface water samples collected upstream and downstream of the site, small amounts of metals, nitrate, organic chemicals, and radionuclides were detected. Concentrations in surface water samples have rarely exceeded drinking water standards. Additional tests are necessary to determine the significance of these constituents with respect to the LEHR site.

3.2 Resource Conservation and Recovery Act (RCRA)

3.2.1. Conceptual Site Treatment Plan

The Federal Facilities Compliance Act 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 Conceptual Site Treatment Plan (CTSP) be prepared for each site within DOE that generates or stores mixed waste. A CSTP was prepared for the LEHR ER Project site in October 1993. The CSTP presents a preliminary capacity and technology evaluation for the storage and treatment of mixed waste stored at the site.

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 ER Project site is considered to be under interim status while the application is in process.

Current D&D and soil and groundwater characterization activities are not expected to encounter or generate any RCRA 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)

As part of the LEHR ER Project, certain decommissioning, decontamination, and remedial actions require that an appropriate environmental analysis be performed prior to accomplishing those tasks. The activities undertaken in 1993 that required such documentation included the completion of the D&D of Animal Hospital 1, Animal Hospital 2, a specimen storage room, and the cobalt 60 source removal.

An environmental assessment (EA) was prepared and approved by DOE-HQ in 1992. All relevant environmental issues related to the Animal Hospital and specimen storage D&D, and the cobalt 60 source removal were analyzed in the EA. Based on the EA analysis, DOE determined that the proposed action would not constitute a major federal action significantly affecting the quality of human health and the environment within the meaning of NEPA. Therefore, an environmental impact statement was not required. A Finding of No Significant Impact (FONSI) was issued prior to the commencement of the D&D project activities. The NEPA documentation (categorical exclusion-CX) for demolition of Imhoff building was approved by DOE Oakland Operations Manager in January 1994.

3.4 Clean Air Act (CAA)

The LEHR ER Project Environmental Monitoring and Surveillance Program does not currently require monitoring of airborne effluent streams. The site does not have airborne effluent streams which meet criteria for ambient or stack monitoring requirements.

Potential site sources for airborne radiological effluent are evaluated annually utilizing computer models. An analysis of potential point and diffuse airborne 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 potentially hazardous constituents in the landfill to become exposed during tests or remedial actions. 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.

Asbestos removal was conducted as part of the D&D remedial actions. 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 ER Project Waste Minimization Plan and is acceptable to the Hanford site. The site D&D activities involving asbestos removal operations were permitted under state and local permits.

Other potential sources of air releases include emission from LEHR ER Project vehicles and generators used during remediation activities. The wheel-mounted portable diesel generator utilized during 1993 D&D activities was exempt from emissions permitting under Yolo/Solano County requirements. There are no site refueling operations that require emissions release permits.

3.4.1 National Emission Standards for Hazardous Air Pollutants (NESHAPS)

During 1993, the D&D of the Animal Hospitals was the primary site activity with potential for release of airborne contaminants.

A NESHAPS calculation was prepared for this activity, utilizing the EPA computer code CAP88-PC. The evaluation considered the possibility that 10% of the source might be rendered airborne and discharged through building stacks filtered to 95%. This is a conservative estimate, since most of the contamination within the animal hospitals was fixed, and each building exhaust stack had two HEPA filters installed in sequence (each with 99.97% efficiency).

Results of the modeling determined that potential exposure from the applied conditions would be 0.003 mrem per year to the maximally exposed individual. This is 0.03% of the NESHAPS dose limit.

Further measures were also taken during the activity to prevent release to the external environment. Buildings undergoing D&D were under containment and isolated from the external environment through engineering controls. These controls included HEPA filters with 99.97% efficiency; sealed plastic linings for inner building surfaces; 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 indicated that containment was successful. Monitoring data verified that releases were below allowable emission limits and within requirements of 40 CFR 61, Subpart H.

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).

During 1993, an evaluation and revision of site water monitoring program requirements was performed. As a result of this evaluation it was determined that two additional monitoring points will be incorporated to collect stormwater runoff. Monitoring of stormwater will begin in fall of 1994 during the first precipitation event of the rainy season that provides enough runoff for sampling. This will satisfy the monitoring requirements of the State General Stormwater Permit for industrial facilities.

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 nonoperational 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 constituents leaking from previously utilized waste burial areas and leach fields are being investigated as part of the RI/FS.

DOE and UC Davis are working closely with 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 ER Project site. The remaining 5 wells have been periodically dry due to shallow completion depths. Slightly deeper adjacent wells were installed to obtain 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 ER Project site (designated PCU); and downstream of the LEHR ER Project 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 ER Project 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.
- Comply with applicable Federal, state, and local regulations.

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

Herbicides were used on the LEHR site in 1993 by UC Davis Physical Plant/Grounds Crew to control weeds for fire suppression. EPA registered pesticides were applied following applicable campus and local regulations.

3.8 Endangered Species Act (ESA)

Current D&D 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. A number of sensitive biological resources with a potential for occurrence in the vicinity of the project site were described in the September 1992 Environmental Assessment. A Finding of No Significant Impact (FONSI) was issued prior to the start of the D&D actions which were completed on the site in 1993. However, these resources may need to be considered during future remedial action planning. They include Swainson's hawk, the valley elderberry longhorn beetle, the giant garter snake, the western snowy plover, and the burrowing owl.

3.9 National Historic Preservation Act (NHPA)

All areas affected by current D&D 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.

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

The LEHR ER site is not on a floodplain, nor is it designated as a wetland.

3.11 Current Issues and Actions

3.11.1 Compliance Status

National Environmental Policy Act (NEPA)

In January 1994, the DOE Oakland Operations Office determined that the proposed site D&D action, demolition and off-site disposal of the Imhoff building and support facilities, qualified for NEPA Categorical Exclusion (CX) status. It was determined that the D&D operation, scheduled to begin later this spring, would not have a significant impact on the environment. The proposed action meets requirements of DOE NEPA regulations, Subpart D, and SEN-15-90, which define conditions for granting the Categorical Exclusion.

3.11.2 Updates On Other Ongoing Environmental Activities

Groundwater Protection Management Program

The LEHR Environmental Restoration Water Monitoring Plan has been recently finalized. The new monitoring plan complies with the DOE's General Environmental Protection Program as defined in DOE Order 5400.1. Water monitoring for the site is being conducted in coordination with the RI/FS effort and the existing site Environmental Monitoring Plan.

Remedial Investigation/Feasibility Study

A draft work plan has been prepared in accordance with CERCLA to provide guidance for the RI/FS work which will begin on site this summer. The final draft of the work plan was provided for state and federal agency review in April 1994.

Continuation of Site Decontamination and Decommissioning

The next step for D&D of LEHR buildings is also scheduled to begin in summer of 1994. The planned activity includes demolition of the Imhoff building and disassembly of a tank trailer that was formerly used to hold and transport radioactive wastes.

DOE EH-24 Environmental Audit

An Environmental Baseline Audit, which evaluated environmental management for the site, was conducted at LEHR ER Project site in May 1993. The final report was issued in February 1994. Sixteen compliance and eight best management findings were identified. Key findings involved waste management and formality of operations, although no imminent hazards were found in any areas. A corrective action plan has been developed to address the findings and issues identified. Eleven compliance findings have already been resolved and 50% of the remaining findings have been scheduled for resolution. The rest are being prioritized by DOE for future resolution and implementation of corrective action.

3.12 Summary of Permits

The following permits are related to operations at LEHR:

1. NPDES Permit #CA0077895 (EPA) and WDR 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 or storage of radioactive materials on campus property, including the LEHR ER Project site.

3. EPA RCRA Permit #CAD982469702.

   Part A Permit for storage of mixed waste (application in process).

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 Management Policy for LEHR (Attachment 1). This program shall ensure the project's operation in compliance with applicable federal, state, and local regulations in addition to applicable DOE orders and management directives. The policy goals assure that project management will be proactive in preventing environmental problems.

4.2 Summary of Environmental Protection Program

The environmental protection program at LEHR shall consist 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 vegetation monitoring defined by the site RI/FS, 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.

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
- Environmental Protection Implementation Plan (EPIP)
- OMB Circular A-106 [A report which is developed through the DOE Activity Data Sheet (ADS) process.]
- 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 assures comprehensiveness of the environmental monitoring program at LEHR ER Project. Primary documents for the program include the OMB Circular A-106 and the EPIP.

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 to 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.

4.5 Environmental Monitoring Programs

LEHR ER Project performs environmental monitoring in accordance with permit and regulatory requirements for 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) due to site environmental restoration and D&D activities. 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 serves to promote the goals of the site environmental management policy.

4.6 Summary of Environmental Monitoring Performed

4.6.1 Effluent Monitoring

There are no liquid effluent or airborne effluent streams currently monitored by the LEHR ER Project 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 all potential airborne effluent sources determined that current point and diffuse sources at the LEHR site would not result in an effective dose equivalent of greater than 0.001 mrem to any member of the public (DOE 1992).

4.6.2 Environmental Surveillance

4.6.2.a Surface and Groundwater Monitoring:

The site Water Monitoring Plan (Pacific Northwest Laboratory, 1994) 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 will be 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. Water sampling will continue on a quarterly basis for both

groundwater and surface water as required to meet regulations 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 scheduled to begin in 1994. 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 air sampling station locations.

During D&D of the Animal Hospitals, in-stack continuous air sampling was performed in the exhaust stacks of areas being decontaminated. 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 at background levels and therefore well below requirements of 40 CFR 61, Subpart H.

4.6.2.c Soil and Vegetation Monitoring:

During 1993, as planning progressed to develop a site plan for the remedial investigation, it was determined that the soil and vegetation sampling activity planned under the site Environmental Monitoring and Surveillance Plan did not include sufficient sampling locations and did not require data quality levels needed to meet CERCLA requirements. Therefore, the soil and vegetation sampling program for the site will now be included in the RI/FS Work Plan, expected to be finalized in Spring 1994.

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." 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 (Bechtel Environmental 1992) 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 which was generated during the animal hospital D&D activity.

4.9 Summary of Permits

The following permits are related to operations at LEHR:

1. NPDES Permit #CA0077895 (EPA) and WDR 92-040 (California RWQCB, Central Valley Region). Permit expires March 23, 1995.

   UC Davis permits for discharge of wastewater from the UC Davis Wastewater Treatment Plant. For LEHR site, this involves sanitary discharge only.

2 California Radioactive Material License #1334-57 (expires November 1994).

   UC Davis license for authorizing the use and storage of radioactive materials on campus property, including some of the materials left over from DOE research at the LEHR site.

3. EPA RCRA Permit #CAD982469702. (application in process)

   Part A Permit for storage of mixed waste.

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 D&D of the Animal Hospital buildings. Analysis of sample data indicated that effluent from the buildings undergoing D&D contained no more than background levels of contaminants. All 1993 data reported for in-stack air monitoring were below detection limits. To assure 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 radionuclides previously used in site research conducted by DOE.

In addition to air effluent monitoring, quarterly sampling of surface water and groundwater was conducted in 1993 to assess potential contamination from previous on-site burial locations. Groundwater and surface water sampling analysis results are summarized in Sections 5.3 and 5.4. Ambient radiation monitoring was also conducted site-wide in 1993, and results are presented in Section 5.5.

5.1.1 Results of Air Monitoring

Remediation activities within the Animal Hospital buildings were conducted under containment. This included negative pressure within the work areas and the use of HEPA filters in sequence 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.

To determine the optimum sampling velocity for particulate collection, air flow velocities were measured in two-inch increments across each stack, and these readings were averaged to obtain the mean velocity of air within the stack in cubic feet per minute. The air sampler flow rate was set slightly higher than the stack velocity. This was done to assure that particulates would be collected in the filter for measurement in equal or greater numbers than average for the air stream.

Continuous air monitoring was also performed at the Geriatrics I Waste Staging Facility (WSF) in building H-292. This monitoring was performed within the building's work area breathing zone, primarily to assess health and safety requirements for workers entering the building. The data is included in this report to provide verification that potential airborne releases through windows or doors of this facility were below environmental guidelines.

Air sample results were evaluated against the DCG concentrations listed in DOE 5400.5 for the isotopic content at LEHR. DCG guidelines were selected for comparison with the sample results

TABLE 5.1: 1993 Results for Air Monitoring During D&D Activity

Codes for buildings sampled:

AH-1: Animal Hospital 1 (H-219)
AH-2: Animal Hospital 2 (H-218)
WSF: Waste Staging Facility (H-292)

Concentrations reported in μCi/mL

MAP CODE[1]	Sample Location (Building/Stack)	Number of Samples	Analysis	Results			
				Average	Minimum	Maximum	
							Comparison with DCG
A.	AH-1/200B STACK	20	Alpha Beta	* *	<1.76E-15 <1.61E-14	<4.77E-15 <2.94E-14	<0.1 <0.1
B.	AH-1/201 STACK	2	Alpha Beta	* *	<2.21E-15 <1.86E-14	<2.37E-15 <2.02E-14	<0.1 <0.1
C.	AH-1/209 STACK	20	Alpha Beta	* *	<2.69E-15 <1.57E-14	<7.11E-15 <4.81E-14	<0.2 <0.1
D.	AH-1/212 STACK	1	Alpha Beta	* *	<3.45E-15 <2.41E-14	<3.45E-15 <2.41E-14	<0.1 <0.1
E.	AH-2/310 STACK	18	Alpha Beta	* *	<1.75E-15 <1.36E-14	<3.82E-14[3] <2.94E-14	<1.0 <0.1
F.	AH-2/East STACK	1	Alpha Beta	* *	<1.73E-15 <1.36E-14	<1.73E-15 <1.36E-14	<0.1 <0.1
G.	AH-2/West STACK	1	Alpha Beta	* *	<1.75E-15 <1.38E-14	<1.75E-15 <1.38E-14	<0.1 <0.1
H.	WSF (H-292)	21	Alpha Beta	5.40E-15 2.86E-14	<2.19E-15 <1.47E-14	1.28E-14 2.99E-14	0.3 <0.1

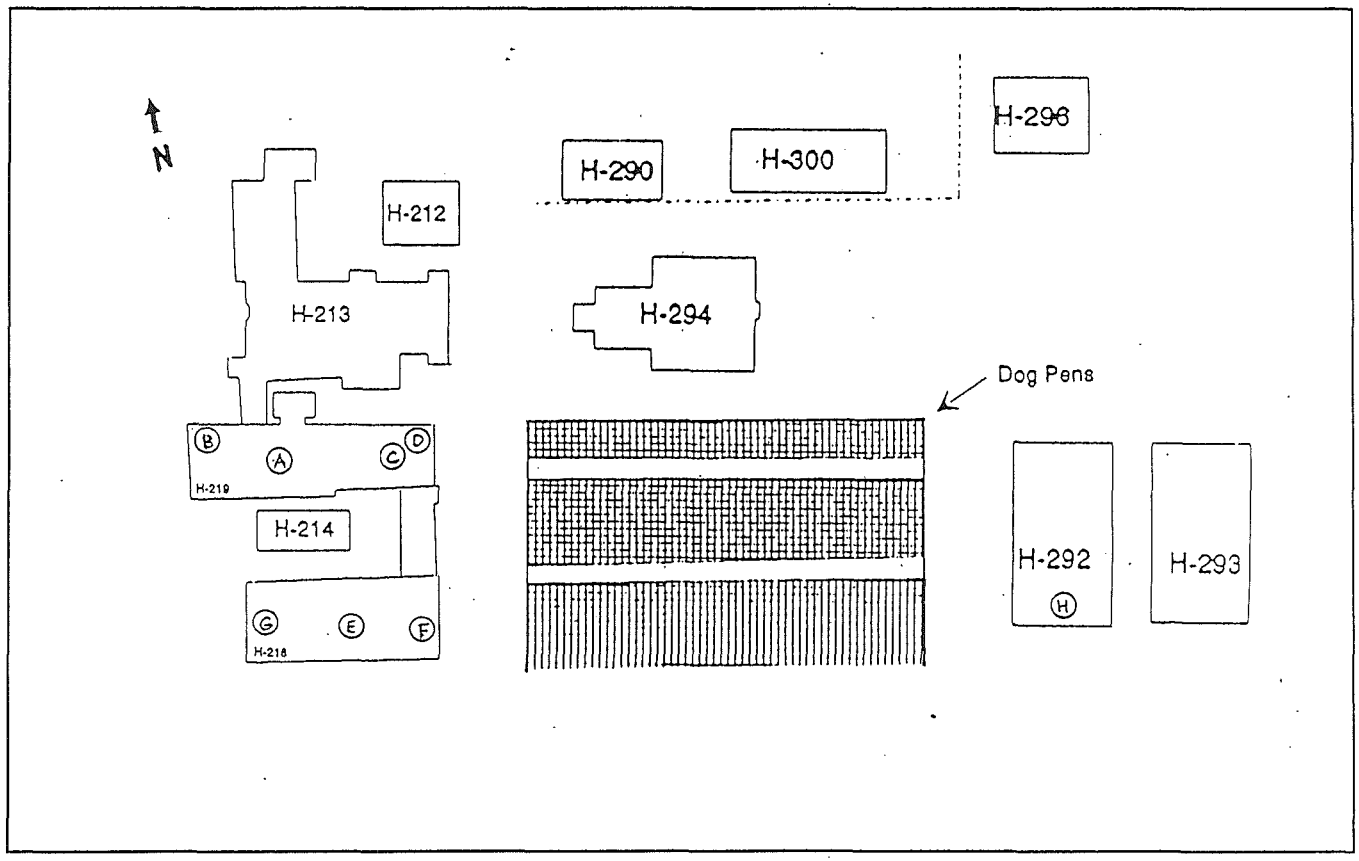
* All results for these locations were below Minimum Detection Amount (MDA)

[1] Refer to Figure 5.1

[2] DCG standards from DOE Order 5400.5 alpha: 4.E-14 (thorium 228)
beta: 1.E-12 (plutonium 241)

[3] High MDA due to low air volume for this sample (<24-hour run)

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



Sample Locations:

A. Building H-219, AH-1/200B STK
B. Building H-219, AH-1/201 STK
C. Building H-219, AH-1/209 STK
D. Builidng H-219, AH-1/212 STK
E. Building H-218, AH-2/310 STK
F. Building H-218, AH-2/East STK
G. Building H-218, AH-2/West STK
H. Building H-292, WSF

by determining which isotopes previously used on site have the most restrictive allowable concentration guidelines. Thorium 228 was selected for the alpha guideline and plutonium 241 was selected for the beta radiation guideline, even though these isotopes were not used extensively in site research. All samples except one were below the DCG criteria. This one sample, from the AH-2 sampling location, was less than the minimum detectable amount (MDA). However, due to the small volume sampled (less than a 24 hour period), the MDA exceeded the DCG. Since that date, all stack samples were collected after a sampling period of one week. Results of the stack sampling data collected while D&D was in progress through August 1993 are summarized by sample location in Table 5.1.

5.2 Groundwater Sampling

5.2.1 Quarterly Sampling of Site Wells

Quarterly groundwater samples were collected in February, May, August, and November 1993 from 18 on- and off-site monitoring wells. Well locations are shown on Figure 5.2F. Each quarter, groundwater samples were analyzed for tritium, carbon 14, strontium 90, gross alpha and beta radioactivity, and gamma emitters (e.g., radium 226, thorium 232, cesium 137). During the fall quarter a specific analysis for radium 226 was added to verify that levels of this constituent, extensively used in site research, were not present above guidelines in site groundwater. No gamma-producing radionuclides were reported for the gamma spectral analysis during any quarter of 1993.

Tables 5.2A through 5.2D provide information on radiological constituents detected in groundwater during 1993. This information is depicted graphically in Figures 5.2A through 5.2E, (except for radium 226, which has results only for the fourth quarter). These graphs provide a comparison between the well with the highest detection for each quarter, the average detection for all wells sampled that quarter, and the primary Maximum Contaminant Limit (MCL). Beginning with the third quarter of 1993, a new contract laboratory (Lockheed Analytical Laboratory) was utilized for sample analysis. At this time additional parameters were added (radium -226 and other non-radiological parameters), and several detection limits were changed. These changes are reflected in the following charts and graphs.

5.3 Surface Water Sampling

Quarterly surface water samples were collected from Putah Creek in February, May, August, and November 1993. Surface water sampling locations are shown on Figure 5.2F. Surface water samples were analyzed for tritium, carbon 14, strontium 90, gross alpha and beta radioactivity, and gamma emitters (e.g., radium 226, thorium 232, cesium 137). A specific analysis for radium 226 was added in the fall quarter, in order to verify that this constituent, extensively used in site research, was not present above drinking water standards (MCLs) in Putah Creek surface water. No gamma-producing radionuclides were reported for the gamma spectral analysis during any quarter of 1993. A summary of radiological constituents detected in the sampling rounds are shown in Table 5.3A and 5.3B.

TABLE 5.2A Summary of Radiological Detections in Groundwater, 1993

Results provided in pCi/L

ANALYSIS	CARBON 14				STRONTIUM 90				TRITIUM			
Sample Date	2/93	5/93	8/93	11/93	2/93	5/93	8/93	11/93	2/93	5/93	8/93	11/93
UCD-01	-	-	46 +/-19	72 +/-28	<0.5	<0.5	-0.64 +/-.55	<0.71 +/-.4	625 +/-535	2211	-20 +/-120	<240 +/-130
UCD-04	<500	<500	57 +/-33	<39 +/-22	0.9 +/-3.0	<0.5	0.39 +/-.56	<0.61 +/-.35	<500	2022 +/-445	40 +/-130	<240 +/-140
UCD-07	-	-	10 +/-27	<40 +/-22	<0.5	<0.5	0.28 +/-.55	<.66 +/-.38	<500	<500	50 +/-130	<240 +/-150
UCD-10	-	-	28 +/-30	<40 +/-22	<0.5	<0.5	<0.86 +/-0.50	<1.1 +/-.62	<500	<500	130 +/-140	<240 +/-130
UCD-11	-	-	195 +/-30	<40 +/-23	<0.5	<0.5	0.16 +/-.58	<0.93 +/-.55	1024 +/-508	<500	20 +/-130	<240 +/-130
UCD-12	-	-	190 +/-46	360 +/-44	<0.5	<0.5	1.94 +/-.59	<0.87 +/-.49	921 +/-528	<500	20 +/-130	<240 +/-130
UCD-12 Duplicate	-	-	-	193 +/-35	-	-	-	2.6 +/-.73	-	-	-	<240 +/-140
UCD-13	1867 +/-357	1930 +/-351	994 +/-63	1559 +/-83	<0.5	<0.5	<1.10 +/-0.62	1.33 +/-.6	20705 +/-761	20917	19620 +/-830	20040 +/-850
UCD-13 Duplicate	-	-	-	1793 +/-89	-	-	-	<.95 +/-.55	-	-	-	20590 +/-860
UCD-14	<500	<500	568 +/-71	864 +/-64	<0.5	<0.5	-0.15 +/-.55	1.68 +/-.64	908 +/-532	5949 +/-869	3810 +/-380	4760 +/-430
UCD-15	<500	<500	9.6 +/-7.7	<39 +/-22	<0.5	<0.5	0.62 +/-.65	1.1 +/-.61	<500	1524 +/-456	80 +/-130	<240 +/-120
UCD-16	-	-	4.6 +/-7	<40 +/-21	<0.5	<0.5	0.5 +/-.76	<0.66 +/-.37	<500	<500	60 +/-130	<250 +/-130

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
* = High statistics due to large amount of solids.
- = Parameter not analyzed or duplicate not taken.

TABLE 5.2A (cont.) Summary of Radiological Detections in Groundwater, 1993

Results provided in pCi/L.

ANALYSIS	CARBON 14				STRONTIUM 90				TRITIUM			
Sample Date	2/93	5/93	8/93	11/93	2/93	5/93	8/93	11/93	2/93	5/93	8/93	11/93
UCD-17	<500	<500	61 +/-34	145 +/-33	<0.5	<0.5	0.6 +/-.64	<0.64 +/-.36	<500	<500	10 +/-120	<240 +/-110
UCD-17 Duplicate	-	-	16 +/-28	-	-	-	0.65 +/-.55	-	-	-	80 +/-130	-
UCD-18	<500	<500	1.5 +/-6.6	<40 +/-22	<0.5	<0.5	-0.08 +/-.67	<0.65 +/-.37	<500	<500	30 +/-120	<240 +/-120
UCD-19	-	-	88 +/-15	<39 +/-22	<0.5	<0.5	0.18 +/-.63	<0.62 +/-.35	1640 +/-520	<500	<220 +/-120	<240 +/-120
UCD-20	-	-	4.6 +/-7	<39 +/-22	1.9 +/-0.8	<0.5	<1.10 +/-.64	<0.69 +/-.39	1550* +/-650	<500	10 +/-120	<240 +/-130
UCD-21	-	-	-1.5 +/-6.1	<40 +/-22	1 +/-.8	<0.5	0.05 +/-.65	<0.68 +/-.39	<500	811 +/-505	120 +/-130	<240 +/-130
UCD-21 Duplicate	-	-	-	-	<0.5	-	-	-	<500	-	-	-
UCD-22	-	-	92 +/-37	<39 +/-21	<0.5	<0.5	0.13 +/-.57	<0.67 +/-.38	<500	<500	130 +/-140	<240 +/-130
UCD-23	-	-	107 +/-16	358 +/-44	1.3 +/-.8	<0.5	-0.21 +/-.77	<0.68 +/-.37	<500	734 +/-477	180 +/-140	<240 +/-130
UCD-24	-	-	0.9 +/-6.5	<39 +/-22	<0.5	<0.5	0.27 +/-.83	<0.65 +/-.37	965 +/-348	<500	150 +/-130	<240 +/-130
UCD-24 Duplicate	-	-	<12 +/-6.4	-	-	-	0.11 +/-.69	-	<500	-	160 +/-140	-
MCL	NA	NA	NA	NA	8	8	8	8	20000	20000	20000	20000

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
* = Verified by reanalysis.
MCL = Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15.
- = Parameter not analyzed or duplicate not taken. NA = No MCL

TABLE 5.2B Summary of Radiological Detections in Groundwater, 1993

Results provided in pCi/L.

ANALYSIS	GROSS ALPHA				GROSS BETA				RADIUM 226
Sample Date	**2/93**	**5/93**	**8/93**	**11/93**	**2/93**	**5/93**	**8/93**	**11/93**	**11/93**
UCD-01	<2	<2	0.2 +/-4.5	<8.8 +/-5.2	9 +/-3	7	5.1 +/-5.5	<7.7 +/-4.4	<0.21 +/-.17
UCD-04	<2	<2	0.3 +/-3.8	<6.3 +/-3.6	<3	7	0.8 +/-4.5	<4.5 +/-2.6	<0.27 +/-.16
UCD-07	3 +/-2*	<2	-0.2 +/-3.2	<5.8 +/-2.6	6 +/-3	<3	-0.3 4.4	<5.6 +/-3.5	0.26 +/-.18
UCD-10	<2	<2	6.3 +/-7.3	<12 +/-6.5	<3	<3	2.6 +/-8.1	<10 +/-5.9	<0.28 +/-.15
UCD-11	4 +/-3*	<2	2.8 +/-4.4	<7.5 +/-5	4 +/-3	<3	3.2 +/-5.3	<7 +/-4.1	<0.2 +/-.11
UCD-12	5 +/-4*	<2	-4.7 +/-6.5	<13 +/-6.2	18 +/-4	<3	4 +/-11	<12 +/-7.3	<0.25 +/-12
UCD-12 Duplicate	-	-	-	<17 +/-9	-	-	-	<13 +/-7.6	<0.35 +/-.21
UCD-13	10 +/-4	4 +/-3*	0.7 +/-.5	<12 +/-5.3	20 +/-4	<3	2.4 +/-7.8	<9.6 +/-5.6	<0.38 +/-.21
UCD-13 Duplicate	-	-	-	<11 +/-5.3	-	-	-	<9.6 +/-5.3	0.67 +/-.27
UCD-14	7 +/-3	<2	2.1 +/-4	<9.3 +/-4.7	22 +/-4	5	2.1 +/-5.3	<7.1 +/-4.1	<0.21 +/-.17
UCD-15	<2	<2	1.5 +/-2.7	<3.9 +/- 2.4	<3	<3	1.7 +/-2.4	<4 +/-2.3	<0.2 +/-.12
UCD-16	<2	<2	-1 +/-1.3	<4.2 +/-2.5	<3	<3	0.9 +/-2.7	<4.5 +/-2.6	<0.19 +/-.11

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
* = High statistics due to large amount of solids.
- = Parameter not analyzed or duplicate not taken.
Radium 226 monitoring began in Fall 1993.

TABLE 5.2B (cont.) Summary of Radiological Detections in Groundwater, 1993

Results provided in pCi/L.

ANALYSIS	GROSS ALPHA				GROSS BETA				RADIUM 226
Sample Date	2/93	5/93	8/93	11/93	2/93	5/93	8/93	11/93	11/93
UCD-17	<2	<2	2.4 +/-2.8	<4.1 +/-2	<3	<3	1.4 +/-2.7	<4.4 +/-2.6	<0.18 +/-.098
UCD-17 Duplicate	-	-	1.2 +/-2.3	-	-	-	0.4 +/-2.6	-	-
UCD-18	<2	<2	2.2 +/-3.8	<5.5 +/-3.3	<3	<3	1.1 +/-3.6	<5.7 +/-3.3	<0.37 +/-.27
UCD-19	4 +/-3*	<2	4 +/-5.3	<10 +/-5.9	<3	<3	-0.4 +/-4.6	<9.3 +/-5.6	<0.24 +/-.14
UCD-20	<2	<2	4.3 +/-4	<5 +/-2.6	5 +/-3	<3	2.3 +/-2.9	<5 +/-2.9	<0.15 +/-.088
UCD-21	<2	3 +/-2*	3.7 +/-4.7	<10 +/-5.7	<3	4 +/-3	3.8 +/-4.7	<8.7 +/-5.2	<0.24 +/-.11
UCD-21 Duplicate	4 +/-3*	-	-	-	4 +/-3	-	-	-	-
UCD-22	<2	3 +/-2*	2.8 +/-4.1	<5.4 +/-2.8	<3	<3	2.1 +/-3.9	<6.6 +/-3.9	-
UCD-23	5 +/-3	<2	3.9 +/-5.1	<6.1 +/-2.8	8 +/-4	<3	4.2 +/-4.8	<6.9 +/-4	<0.22 +/-.081
UCD-24	<2	<2	9.9 +/-6.6	<7.2 +/-3.9	<3	<3	1 +/-5.3	<7.4 +/-4.1	-
UCD-24 Duplicate	<2	-	0.5 +/-3.7	-	<3	-	2.2 +/-4.6	-	-
MCL	15	15	15	15	50	50	50	50	5

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
* = High statistics due to large amount of solids.
- = Parameter not analyzed or duplicate not taken.
MCL = Maximum Contaminant Level (primary), Title 22, Division 4, Chapter 15.
Radium 226 monitoring began in Fall 1993.

FIGURE 5.2A&B 1993 Groundwater Radiological Results (Comparison with MCL)

FIGURE 5.2A

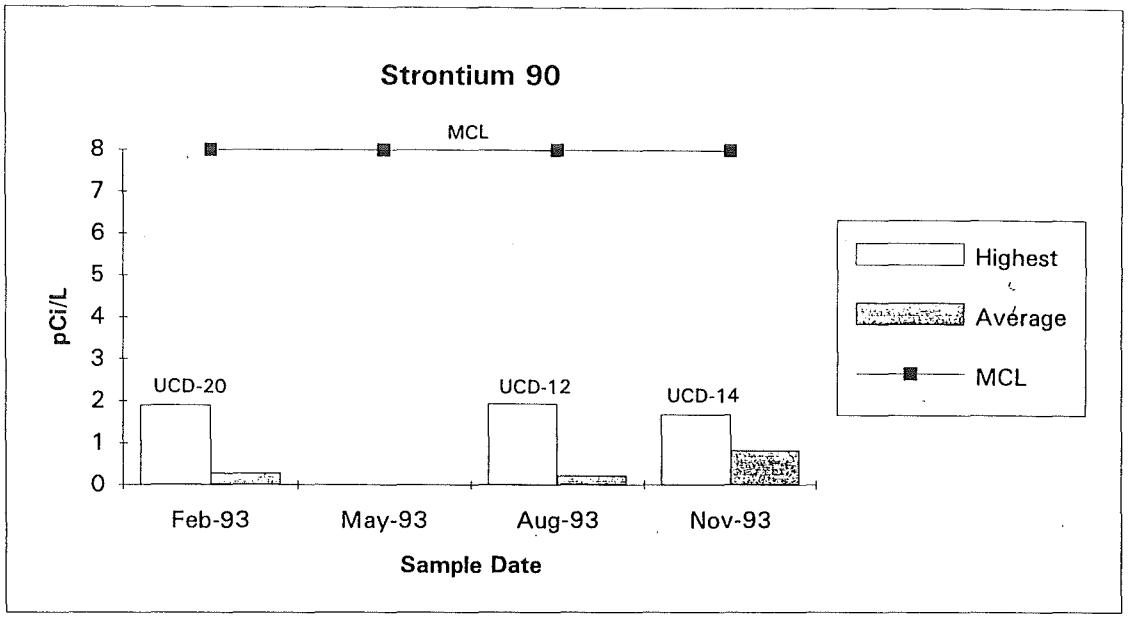


FIGURE 5.2B

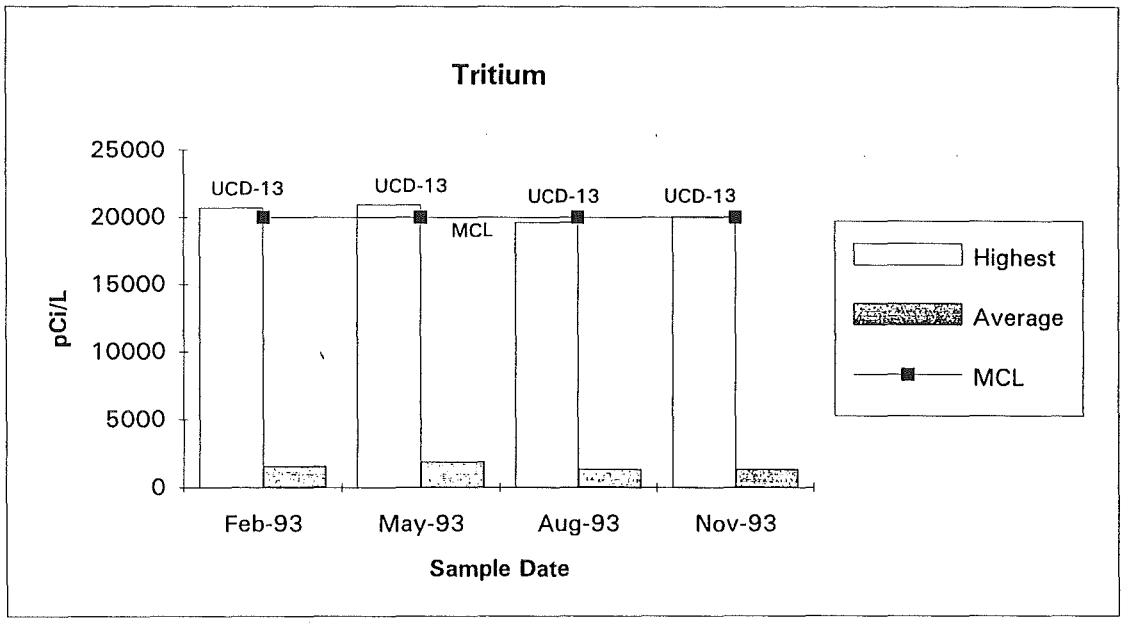


FIGURE 5.2C&D 1993 Groundwater Radiological Results (Comparison with MCL)

FIGURE 5.2C

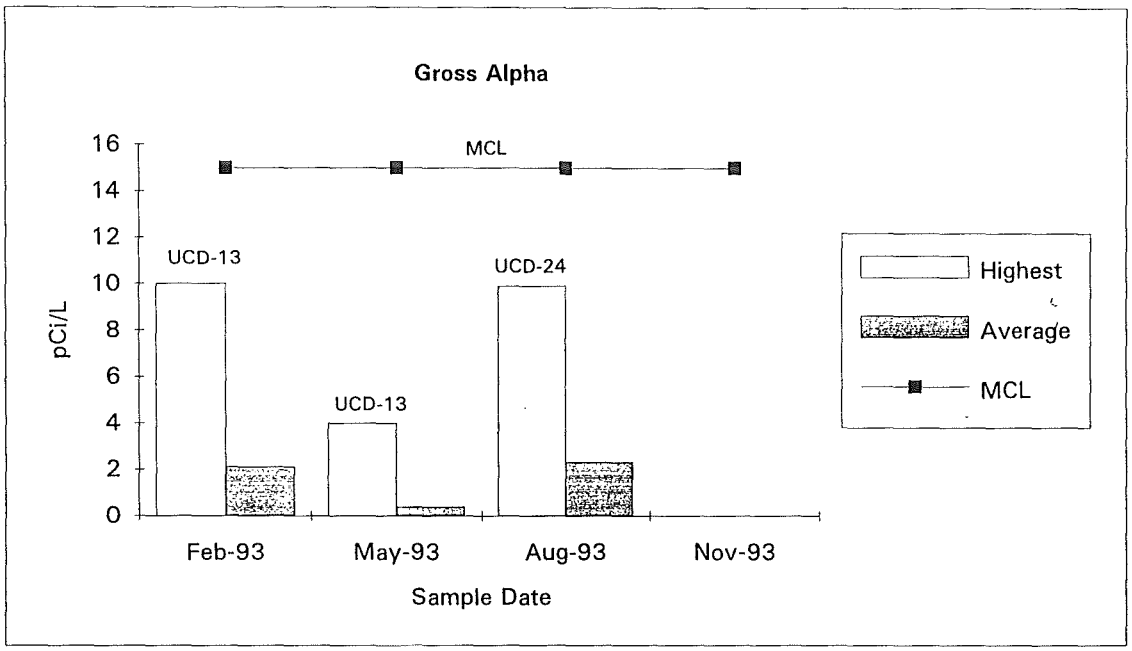
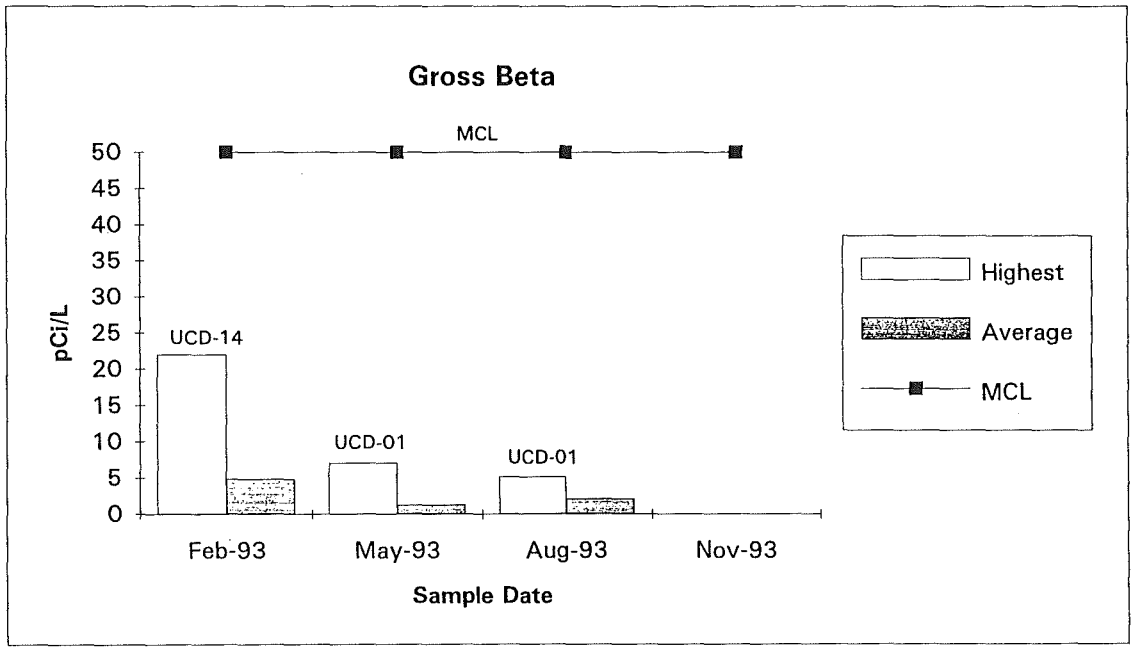


FIGURE 5.2D



Note: All results from November 1993 were below detection limits for gross alpha and gross beta.

FIGURE 5.2E 1993 Groundwater Radiological Results

Figure 5.2E

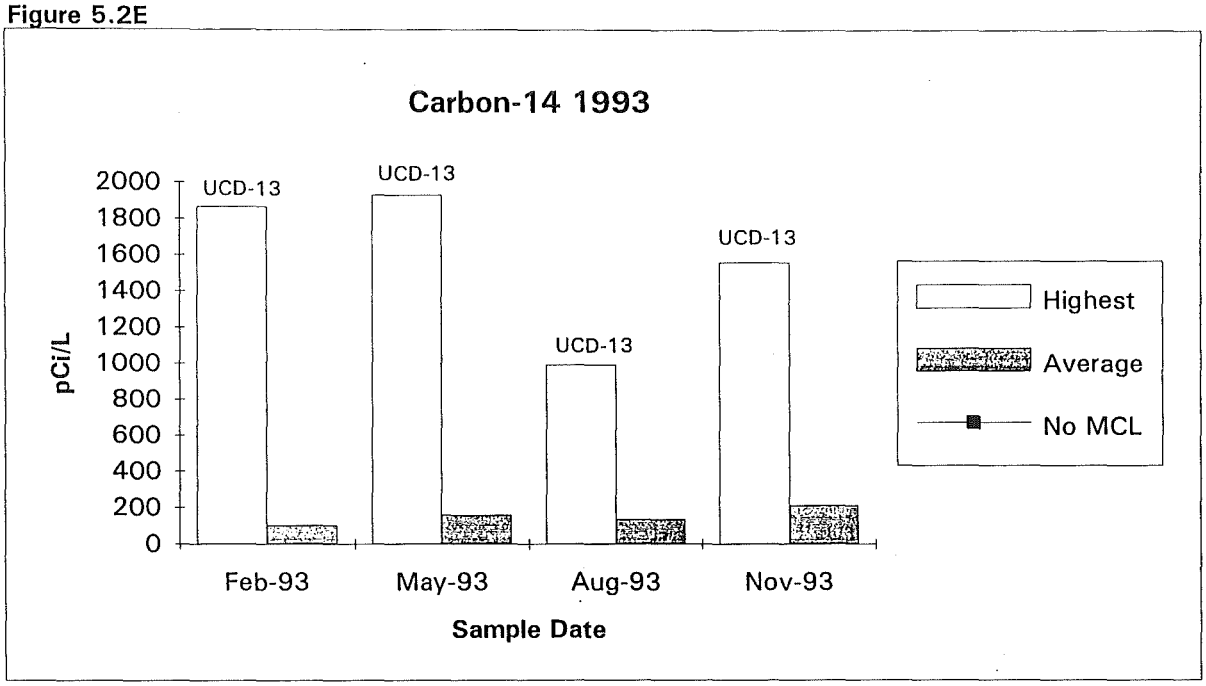
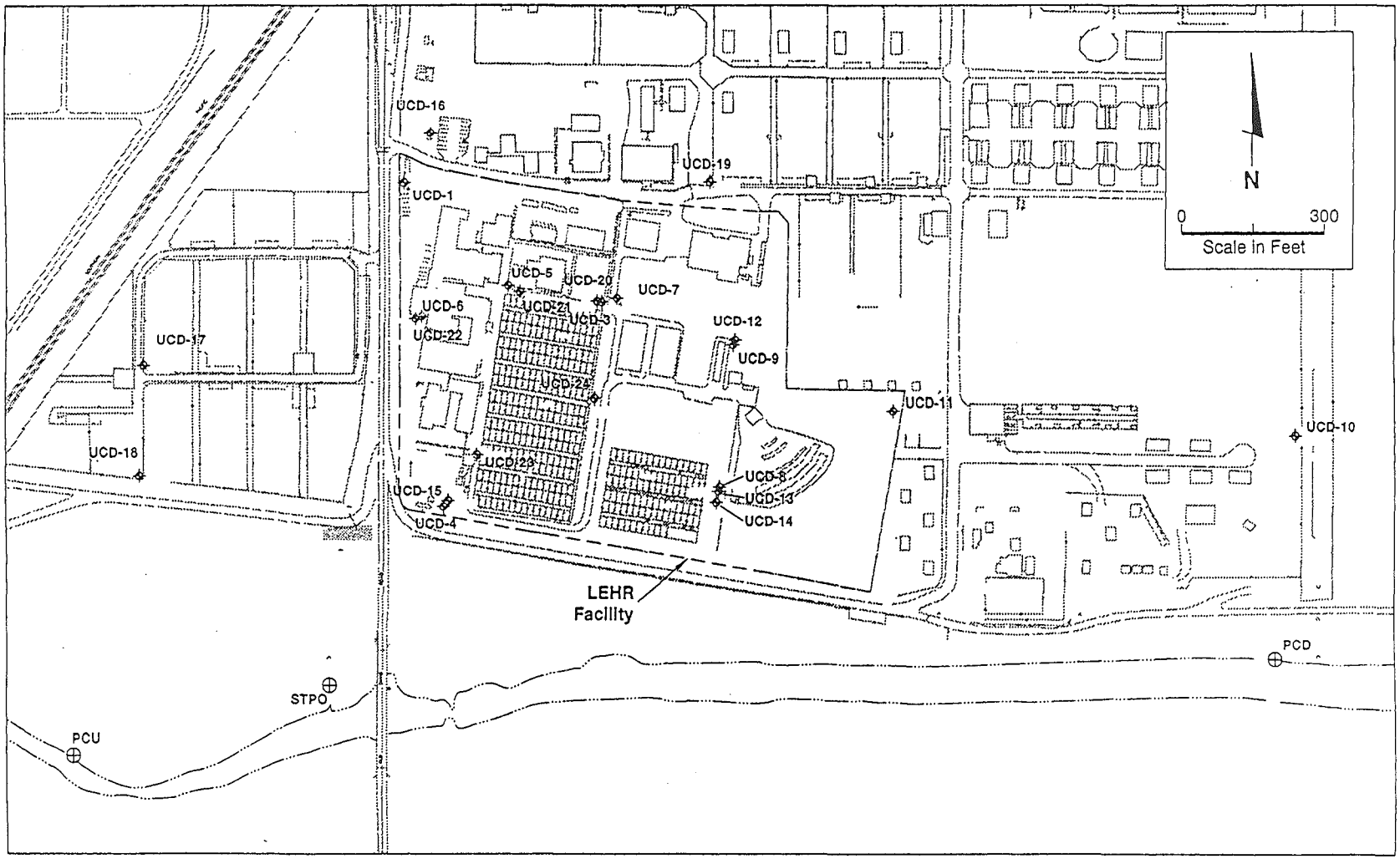


FIGURE 5.3 Groundwater Monitoring Wells and Surface Water Sampling Locations



EXPLANATION

- ⌖ Monitoring Wells
- ⊕ Surface Water Monitoring Point

LOCATION MAP
GROUNDWATER MONITORING WELLS
AND SURFACE WATER MONITORING POINTS

DAMES & MOORE

Source: Pacific Northwest Laboratory. 1994.

TABLE 5.3A Radiological Constituents Detected in Surface Water, 1993

All units reported as pCi/L

Analyte:	Gross Alpha				Gross Beta				Carbon-14			
Quarter:	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
PCD-01	<2.0	3.0±2.0[1]	<4.0±1.8	<3.3±1.5	<3.0	7.0±5.0	4.3±1.9	5.5±1.9	--	--	7.6±7.4	<40±22
PCD-01 Duplicate	--	<2.0	--	--	--	<3.0	--	--	--	--	--	--
PCU-01	<2.0	4.0±2.0	.80±1.5	<3.1±2.1	5.0±3.0	10.0±7.0	2.7±1.6	<2.7±1.6	--	--	36±11	122±31
PCU-01 Duplicate	--	--	.60±1.3	--	--	--	1.7±1.4	--	--	--	3±6.8	--
STPO	3.0±2.0[1]	3.0[1]	2.3±3.1	<5.7±2.1	9.0±4.0	9.0±7.0	27.3±4.7	41±5.1	--	--	4±7	65±27
STPO (3/4/93)	4.0±3.0[1]	--	--	--	13.0±4.0	--	--	--	--	--	--	--
STPO Duplicate	4.0 ±3.0[1]	--	--	<6.0±2.6	14.0±4.0	--	--	43.5±5.1	--	--	--	<40±24
MCL	15	15	15	15	50	50	50	50	NA	NA	NA	NA

< = Constituent below detection Limit. Detection limits may vary depending on interference by other sample constituents.
[1] = High statistics due to large amount of solids
-- = Parameter not analyzed or duplicate not taken
MCL = Maximum Contaminant Level (primary), Title 22, Division 4, Ch. 15.
NA = No MCL

TABLE 5.3B Radiological Constituents Detected in Surface Water, 1993

All units reported as pCi/L.

Analyte:	Tritum				Strontium-90				Radium-226
Quarter:	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Fall
PCD-01	<500	<500	140±140	<240±120	<0.5	<0.5	0.06±0.67	<0.89±0.51	0.29±0.2
PCD-01 Duplicate	--	891±473	--	--	--	<0.5	--	--	--
PCU-01	<500	<500	120±130	<240±130	<0.5	<0.5	0.6±0.75	<0.79±0.46	<0.28±0.13
PCU-01 Duplicate	--	--	180±140	--	--	--	0.02±0.6	--	--
STPO	<500	<500	300±160	<240±110	1±0.8	<0.5	-0.08±0.67	<1.2±0.67	<0.38±0.18
STPO (3/4/93)	<500	--	--	--	<0.5	--	--	--	--
STPO Duplicate	<500	--	--	<240 ±130	<0.5	--	--	<0.70±..45	<0.29±0.21
MCL	20000	20000	20000	20000	8	8	8	8	5

< = Constituent below detection Limit. Detection limits may vary depending on interference by other sample constituents.
-- = Parameter not analyzed or duplicate not taken
MCL = Macimum Contaminant Level (Primary), Title 22, Division 4, Ch. 15.

5.4 Ambient Radiation Monitoring

Perimeter fenceline dose rates, radioactive waste storage areas, and various work areas around the LEHR ER Project site are monitored by environmental dosimeters. In 1993, there were 27 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 5.4A through 5.4D. Most locations were monitored in 1993 by two dosimeters, one changed monthly and the other changed quarterly. (Therefore, all locations except the first five in Table 5.4A correspond to those listed in Table 5.4B, and the locations in Table 5.4C correspond to those in Table 5.4D.) Figures 5.3 A-C, which follow the tables, are maps which show locations for each group of dosimeters.

The only areas to show above-background levels were the radioactive waste storage areas, which are monitored quarterly in Group 63 (see Table 5.4A). These areas include Ger I East (this TLD is inside building H-292, where D&D wastes were stored prior to shipment); Mixed Waste (the mixed waste storage facility); and Rad Stor SE (a cargo container used to store radiological waste). After correcting for site background, the highest annual result for these storage areas was a total of 30 mR for the year, received at the Rad Stor SE location.

Calculations were performed to determine the maximum potential exposure an individual might receive in the vicinity of this radioactive storage location. The storage container is situated in an area where site employees spend very little time, and visitors rarely go near this part of the site. Averaged over the year, it is estimated that the maximum potential dose for an individual from this source would realistically been less than 3.5×10^{-3} millirem. This calculation is based on surface contact, assuming an individual would spend as much as 30 minutes each day leaning against the building. At 1 meter, the distance someone would possibly walk by the storage container, the dose drops to 3.5×10^{-6} 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.

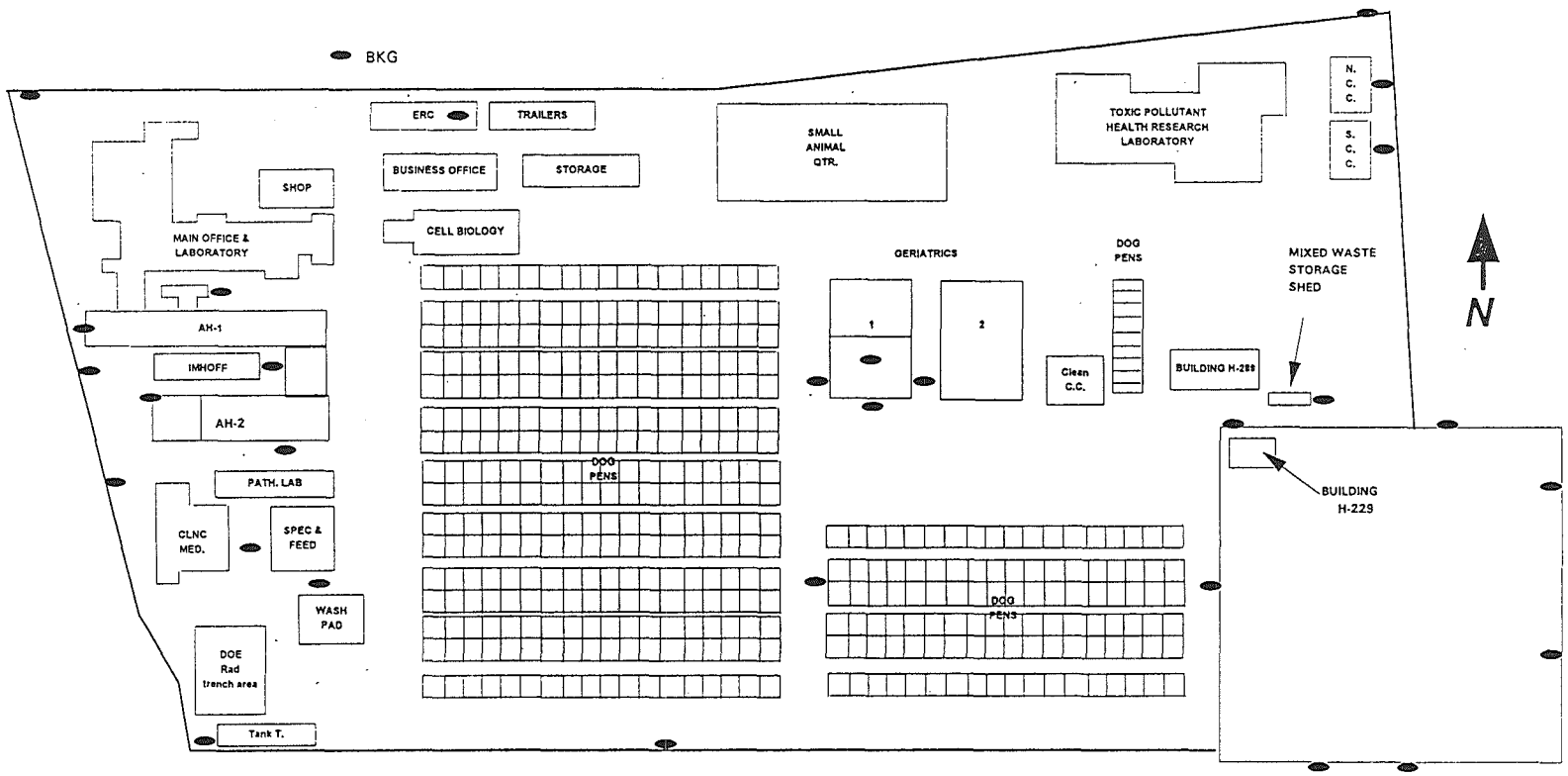
In order to assure fullest implementation of ALARA, an investigation of the storage facility was conducted to determine which items in storage were most likely to be causing the low TLD readings. These items were relocated to another storage location which provided additional shielding. This resulted in a drop of TLD readings during the last quarter.

TABLE 5.4A 1993 Quarterly Ambient Radiation Monitoring Results, Group 63 Exposure, mR above Radiation Detection Company (RDC) background

LOCATION	1/1/93-3/31/93	4/1/93-6/30/93	7/1/93-9/30/93	10/1/93-12/31/93	ANNUAL TOTAL 1993
South #1	0	0	1	2	3
South #2	0	0	0	2	2
North #1	0	0	0	1	1
East #1	0	0	0	2	2
East #2	0	0	2	2	4
AH-2	0	0	0	0	0
Ger I East	0	0	3	5	8
Ger I North	0	0	0	0	0
Ger I South	0	0	0	0	0
Ger I West	0	0	0	0	0
Mixed Waste	13	8	8	0	29
Rad Stor NE	0	0	0	0	0
Rad Stor SE	5	7	14	10	36
SW Corner	0	0	2	2	4
NE Corner	2	0	1	2	5
NW Corner	2	0	1	2	5
W CO60	0	0	0	0	0
NW CO60	0	0	0	1	1
W Pen Fence	0	0	0	0	0
Boundary	2	0	2	2	6
E Imhoff	0	0	1	1	2
S Spee Fence	1	0	0	1	2
SS Tree	0	0	0	0	0
S AH-2	0	0	0	0	0
Lift Station	0	0	0	1	1
WAH 1	1	0	1	1	3
Freezer Fence	0	0	0	0	0
Control	0	0	0	0	0
Background	0	0	3	3	6
Bkgd EH&S	0	0	0	0	0
RDC Bkgd	21	19	19	19	78

All exposure rates are measured in mR above the RDC background.
The RDC background is calibrated to Co-60 with a precision of +/- 2mR or 10%.

FIGURE 5.4A TLD Locations for Group 63



= Envrionmental Dosimetry Location Exchanged Quarterly

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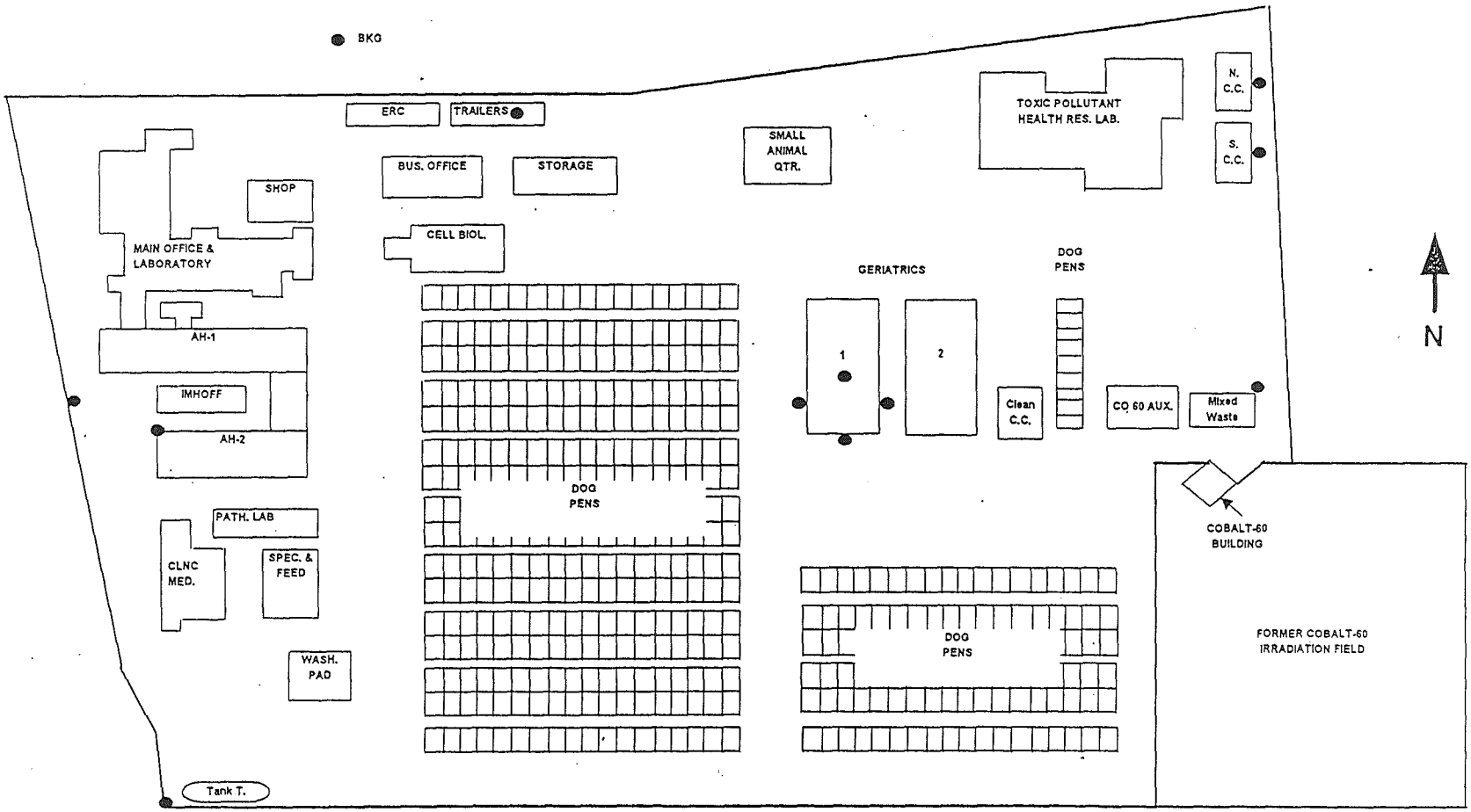
TABLE 5.4B 1993 Monthly Ambient Radiation Monitoring Results, Group 88 (Results in mrem)

LOCATION	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
AH-2 North	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I E	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I N	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I S	0	0	0	0	0	0	0	0	0	0	0	0	0
Geriatrics I W	0	0	0	0	0	0	0	0	0	0	0	0	0
Imhoff Fence	0	0	0	0	0	0	0	0	0	0	0	0	0
SW Corner	0	0	0	0	0	0	0	0	0	0	0	0	0
Control	0	0	0	0	0	0	0	0	0	0	0	0	0
Background	0	0	0	0	0	0	0	0	0	0	0	0	0
Control LEHR Project/EH&S	0	0	0	0	0	0	0	0	0	0	0	0	0

FIGURE 5.3B TLD Locations for Group 88



NOT TO SCALE

● = Environmental Dosimeter Location

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TABLE 5.4C 1993 Quarterly Ambient Radiation Monitoring Results, Group 83 (Results in mrem)

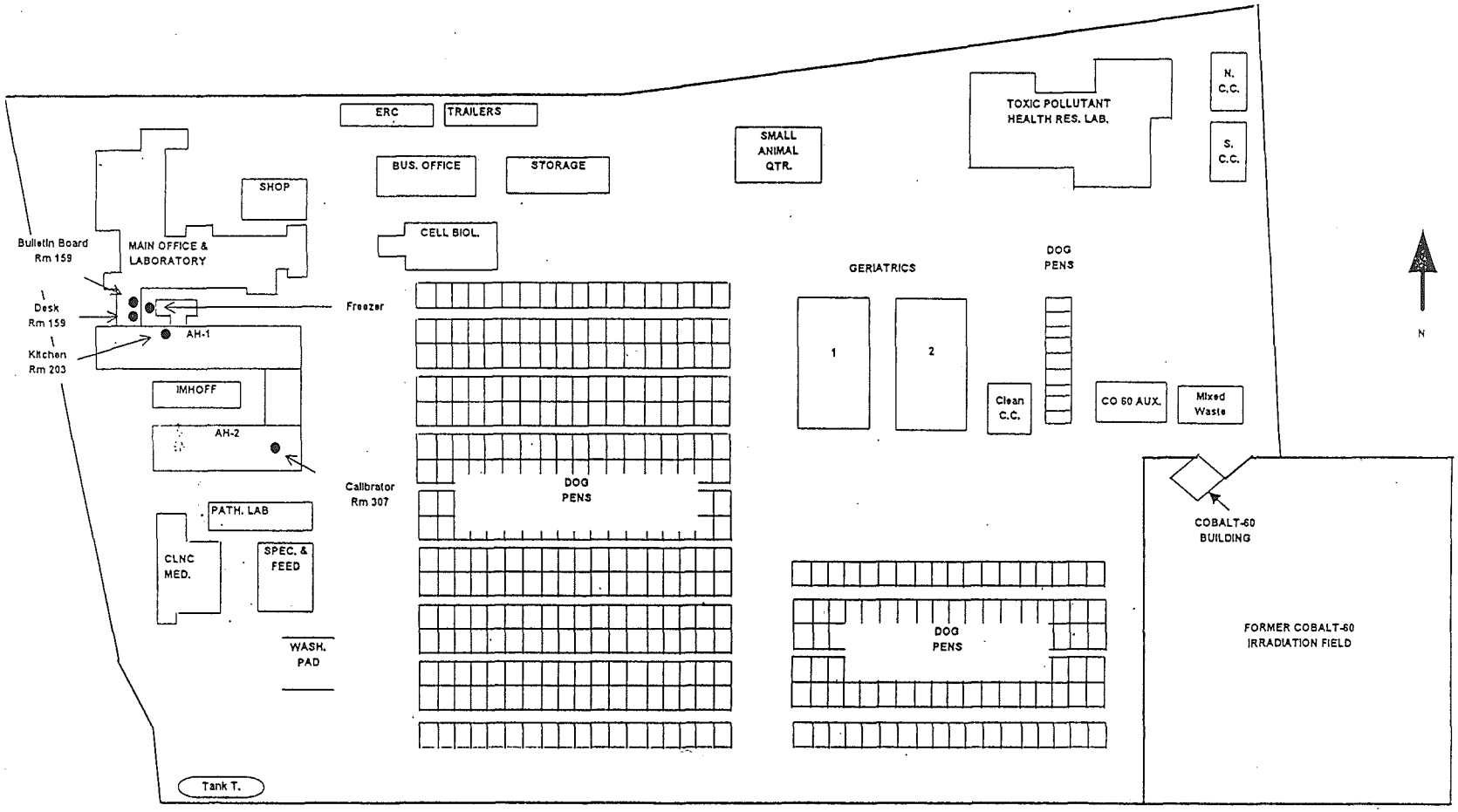
LOCATION	1/1/93-3/31/93	4/1/93-6/30/93	7/1/93-9/30/93	10/1/93-12/31/93
Bulletin Board	0	0	*	*
Desk	0	0	*	*
Calibrator W.	0	0	*	*

TABLE 5.4D 1993 Monthly Ambient Radiation Monitoring Results, Group 82 (Results in mrem)

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

* These locations no longer monitored by Group 83, still monitored monthly under Group 82.

FIGURE 5.4C TLD Locations for Groups 82 and 83



NOT TO SCALE

● = Environmental Dosimeter Location -Groups 82 and 83

Two Sets: one exchanged monthly and the other exchanged quarterly.

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5.5 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/or the remediation activities which were accomplished during the year. All estimates of potential dose were well below the NESHAPS limit.

TABLE 5.5 Estimated Annual Maximum Effective Dose Equivalent

Maximum Individual Dose[1]	Collective Population Dose[1]	EPA and DOE Standard	Site Natural Background[2]
3.19 x 10-3mrem (3.19 x 10-5 mSv)	6.77 x 10-3 person-rem (6.77 x 10-5 person-Sv)	100 mrem/year (1 mSv/year)	98 mrem (.98 mSv)

[1] = Maximum effective dose equivalent and collective population dose from 1992 NESHAPS report. (Data are calculated, not measured. Therefore, they represent potential or estimated rather than actual doses.)
[2] = DOE 1992.

The only activity on the LEHR site to generate radionuclide emissions during 1993 was the D&D of Animal Hospitals 1 & 2. Estimated emissions from this activity are discussed in Section 5.6.1, Point Source Emission.

The site also contains several soil (nonpoint 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, stormwater 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 5.6.2, Nonpoint Source Emission.

5.5.1 Point Source Emission:

In 1993, D&D operations were completed in Animal Hospital 1 (AH-1) and Animal Hospital 2 (AH-2). The primary radionuclides present in the buildings 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, abrasive decontamination, limited excavation of soils beneath the facilities, and waste processing/packaging.

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 nonLEHR 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 (see Section 5.1).

The Effective Dose Equivalent for the maximally exposed individual (75 meters north northeast) was estimated to be 3.19×10^{-3} mrem. This is primarily from potential airborne releases of radium 226 and strontium 90, as shown in Table 5.8.

5.5.2 Nonpoint 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 site structures.

The radium 226 Seepage System consisted of two 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 are 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 by way of urine. Patches of low-level radioactive contamination has been detected in the sub-surface soils of these areas.

The (RESRAD) Residual Radioactive computer code, Version 4.6 was used to calculate doses from the nonpoint sources. The results of this dose assessment are defined in Table 5.6.

TABLE 5.6 Estimated Dose Equivalent from Site Nonpoint Sources

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

TABLE 5.7 Nonpoint Source Estimated Radiological Releases

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

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

TABLE 5.8 Potential Radiological Releases From Animal Hospital D&D Activities

RADIONUCLIDE	STACK 1 AH-1, RM 209	STACK 2 AH-1, RM 200	STACK 3 AH-2, RM 310	TOTAL Ci/YEAR
Sr-90	2.7E-05	2.7E-05	2.5E-07	5.4E-05
Ra-226			4.8E-06	4.8E-06
Th-228	7.9E-08	7.9E-08		1.6E-07
H-3	2.7E-07	2.2E-07		5.4E-07
C-14	2.7E-07	2.7E-07		5.4E-07
Pu-241	2.7E-11	2.7E-11		5.4E-11

Note: Source terms for each stack are given in Ci. Only three stacks were considered in this calculation because 3 of the 5 stacks in AH-1 have been closed off, and their blowers were de-energized during Decontamination and Decommissioning operations. The source term for AH-1 was equally divided between stacks 1 and 2.

6.0 ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

Environmental monitoring for nonradiological information in 1993 consisted of surface water and groundwater monitoring. Quarterly rounds of sampling were conducted for groundwater and surface water on and near the site. Neighbors' wells were also monitored for nonradiological information three times during the year. The neighbors' wells are monitored by UC Davis and are not included in the Environmental Monitoring and Surveillance Plan for the site.

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 on site do not contribute to hazardous discharges.

6.2 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 5.2. Additional detailed information about site wells is provided in Table 7.1.

During 1993, the monitoring program underwent a number of changes, which began with the third quarter collection. These changes reflected both the implementation of the site Water Monitoring Plan, and an increase in the level of data quality objectives required for the RI/FS. Also beginning the third quarter, the laboratory where samples were sent for analysis was changed from Controls for Environmental Pollution to Lockheed Analytical Laboratories. The new laboratory was required to provide U.S. EPA Contract Laboratory Program (CLP) and CLP-equivalent quality control documentation. A listing of analytes and analytical methods is provided in Table 6.1 for the first two quarters of 1993 and in Table 6.2 for the last two quarters. A summary of constituents detected in the sampling rounds is shown in Table 6.3.

6.3 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 LEHR 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 hydrostratigraphic unit (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 5.2 identifies surface water sampling locations. A list of analytes and analytical methods is provided in Table 6.1 for the first two quarters of 1993 and in Table 6.2 for the last two quarters. A summary of the constituents detected in the sampling rounds is found in Table 6.4.

Table 6.1 Analyses Requested for LEHR ER Project Water Monitoring Program Winter and Spring Quarters of 1993

Analyte	Analytical Method	Analyte	Analytical Method
Silver	EPA 6010	Alkalinity	EPA 2320
Gross Alpha	EPA 900.0	Arsenic	EPA 7060
Barium	EPA 6010	Gross Beta	EPA 900.0
Beryllium	EPA 200.7	Calcium	EPA 6010
Cadmium	EPA 7131	Chloride	EPA 10-117-07-1-B
COD	EPA 5220	Cobalt	EPA 6010
Hexavalent Chromium	EPA 10-124-13-1-A	Chromium	EPA 6010
Copper	EPA 6010	Formaldehyde	NIOSH-3500
Gamma	D-04 HASL-300	Mercury	EPA 245.1
Potassium	EPA 7610	Magnesium	EPA 7450
Molybdenum	EPA 6010	Sodium	EPA 7770
Nickel	EPA 6010	Nitrate	EPA 10-107-04-1-13
Lead	EPA 7421	Phosphate	EPA 10-115-01-1-A
Antimony	EPA 7041	Selenium	EPA 7740
Sulfate	EPA 300.0	Strontium 90	Radioassay Procedures for Environmental Samples
TDS	EPA 160.1	Thallium	EPA 7841
Turbidity	EPA 214-A	Vanadium	EPA 6010
Volatile Organics	EPA 624	Pesticides	EPA 608
Semi-Volatile Organics	EPA 625	Tritium	Radioassay Procedures for Environmental Samples

Note: This is Analyte List 1 from the Phase II Site Characterization Work Plan, Dames and Moore 1990.

Table 6.2 Analyses Requested for LEHR ER Project Water Monitoring Program Summer and Fall Quarters of 1993

ANALYTE	METHOD	ANALYTE	METHOD
GENERAL PARAMETERS		RADIOLOGICS	
pH	SOP (Dames & Moore)	Gross Alpha	EPA 9310
Ec		Gross Beta	EPA 9310
Temperature		Tritium	EPA 906.0
Turbidity		Carbon 14	LSC C-01[a]
GENERAL CHEMICAL		Strontium 90	EPA 905.0(m)[b]
Alkalinity	EPA 301.1	Gamma Spectral Analysis	
Sodium	EPA 6010	METALS	
Potassium		Total Chromium	CLP SOW ILC 2.0
Calcium		Hexavalent Chromium	
Magnesium		Antimony	
Chloride	EPA 300.0	Arsenic	
Sulfate		Barium	
Phosphorous, all forms	EPA 365.2	Beryllium	
Nitrate (as Nitrogen)	EPA 300.0	Cadmium	
Total Kjedahl Nitrogen	EPA 351.2	Cobalt	
Total Dissolved Solids	EPA 160.1	Copper	
Total Organic Carbon	EPA 415.2	Iron	
Ammonia	EPA 350.1	Lead	
Turbidity	EPA 180.1	Mercury	
ORGANICS		Molybdenum	
Volatile Organic Compounds	CLP SOW OLC 02.0	Nickel	
Semivolatile Organic Compounds	CLP OLM 01.8	Selenium	
Organochlorine Pesticides	CLP SOW 2.0	Silver	
Formaldehyde	Modified NIOSH 3500	Thallium	
		Vanadium	
		Zinc	

(a) Method Reference
(b) Modified procedure specified in laboratory SOP
Note: Reference from Pacific Northwest Laboratory 1993c.

Table 6.3 Summary of Nonradiological Detections in Groundwater (1992-1993)

	PARAMETER	Upgradient Wells				Downgradient Wells			
		Number of Samples & Duplicates	Number of Detections	Maximum Value Detected	Location of Maximum Detection	Number of Samples & Duplicates	Number of Detections	Maximum Value Detected	Location of Maximum Detection
General Chemical Parameters	ALKALINITY TOTAL(AS CACO3) (mg/liter)	18	18	465	UCD-18	136	136	890	UCD-13
	CHEMICAL OXYGEN DEMAND (ug/liter)	13	7	51,900	UCD-18	101	47	65,000	UCD-04
	EC-F (umhos/cm)	18	18	1,205	UCD-18	128	128	4,640	UCD-12
	EH-F (mvolts)	2	2	118	UCD-18	16	16	127	UCD-15
	FORMALDEHYDE (ug/ml)	18	3	500	UCD-18	136	34	500	UCD-13
	TEMPERATURE (degree C)	18	18	19.6	UCD-17	128	128	24.9	UCD-23
	TOTAL DISSOLVED SOLIDS mg/liter)	18	18	887	UCD-18	136	136	2,451	UCD-12
	TOTAL ORGANIC CARBON (mg/liter)	5	3	1.3	UCD-17	35	28	5.8	UCD-10
	TURBIDITY (NTU)	18	18	28.5	UCD-18	136	133	949	UCD-01
	TURBIDITY-F (NTU)	17	17	26.3	UCD-18	126	118	200	UCD-01
	pH-F	18	18	8.06	UCD-17	128	128	8.26	UCD-15
Metals (µg/liter)	ANTIMONY (TOTAL)	18	0	-	-	136	6	10	UCD-21
	ARSENIC (TOTAL)	18	2	10	UCD-17	136	18	10	UCD-21
	BARIUM (TOTAL)	18	18	170	UCD-18	136	134	430	UCD-12
	BERYLLIUM (TOTAL)	18	1	1.5	UCD-18	136	3	3	UCD-22
	CADMIUM (TOTAL)	18	0	-	-	136	1	2	UCD-21
	CHROMIUM (TOTAL)	18	16	50	UCD-18	136	131	450	UCD-11
	CHROMIUM, HEXAVALENT (+6)	18	12	40	UCD-18	136	123	350	UCD-11
	COBALT (TOTAL)	13	1	30	UCD-17	101	2	30	UCD-23
	COPPER (TOTAL)	18	0	-	-	136	10	30	UCD-23
	LEAD (TOTAL)	18	2	8.8	UCD-17	136	22	63	UCD-07
	MERCURY (TOTAL)	18	1	0.4	UCD-17	136	8	2.2	UCD-21
	MOLYBDENUM (TOTAL)	18	5	30	UCD-17	136	27	70	UCD-23
	NICKEL (TOTAL)	18	8	80	UCD-18	136	60	390	UCD-23
	SELENIUM (TOTAL)	18	0	-	-	136	29	26	UCD-10
	SILVER (TOTAL)	18	1	30	UCD-17	136	13	30	UCD-12
	THALLIUM (TOTAL)	18	0	-	-	136	11	130	UCD-12
	VANADIUM (TOTAL)	18	10	30	UCD-17	136	72	40	UCD-04
	ZINC (TOTAL)	18	9	30	UCD-18	136	73	60	UCD-24
Anions and Cations (mg/liter)	AMMONIA-NITROGEN	5	1	51	UCD-17	136	0	-	-
	CALCIUM (TOTAL)	18	18	41	UCD-18	136	136	77	UCD-12
	CHLORIDE	18	18	42	UCD-18	136	136	370	UCD-12
	IRON	5	4	0.2	UCD-18	35	34	0.3	UCD-13
	MAGNESIUM (TOTAL)	18	18	111	UCD-18	136	136	333	UCD-12
	NITROGEN, NITRATE (AS N)	18	18	20	UCD-18	136	136	65	UCD-12
	PHOSPHATE, TOTAL (AS P)	18	10	1.0	UCD-17	136	89	1.0	UCD-12
	POTASSIUM (TOTAL)	18	18	1.3	UCD-18	136	131	44	UCD-16
	SODIUM (TOTAL)	18	18	43	UCD-18	136	136	190	UCD-10
	SULFATE	18	18	44	UCD-18	136	136	897	UCD-10
Volatile Organics (µg/liter)	1,1-DICHLOROETHANE	18	0	-	-	136	8	24	UCD-12
	1,1-DICHLOROETHENE	18	0	-	-	136	8	44	UCD-12
	1,2-DICHLOROETHANE	18	0	-	-	136	8	15	UCD-12
	ACETONE	18	0	-	-	35	1	25	UCD-01
	BROMODICHLOROMETHANE	18	0	-	-	136	3	5	UCD-01
	CARBON TETRACHLORIDE	18	0	-	-	136	1	5	UCD-01
	CHLOROFORM	18	0	-	-	136	30	16,000	UCD-12
	METHYLENE CHLORIDE	18	0	-	-	136	9	10	UCD-01
	TOLUENE	18	0	-	-	136	1	13	UCD-15
	TRICHLOROETHENE	18	0	-	-	136	1	5	UCD-01
Semivolatile Organics (µg/liter)	BIS(2-ETHYLHEXYL)PHTHALATE	18	5	10.1	UCD-18	134	38	37	UCD-24
	DI-N-BUTYLPHTHALATE	18	0	-	-	134	5	14.4	UCD-23
Pesticides and PCBs (ug/liter)	4,4'-DDD	18	0	-	-	133	1	0.11	UCD-12
	4,4'-DDT	18	0	-	-	133	1	0.11	UCD-12
	ALPHA-BHC	18	0	-	-	133	2	0.057	UCD-01
	BETA-BHC	18	0	-	-	133	1	0.057	UCD-01
	DIELDRIN	18	0	-	-	133	8	0.11	UCD-12
	ENDOSULFAN I	18	0	-	-	133	1	0.057	UCD-01
	ENDRIN	18	0	-	-	133	6	0.11	UCD-12
	GAMMA-BHC	18	0	-	-	133	4	0.057	UCD-01
	HEPTACHLOR	18	0	-	-	133	2	0.057	UCD-01

- Not applicable

Table 6.4 Summary of Nonradiological Detections in Surface Water (1992-1993)

PARAMETER		SURFACE WATER			
		Number of Samples & Duplicates	Number of Detections	Maximum Value Detected	Location of Maximum Detection
General Chemical Parameters	ALKALINITY TOTAL(AS CACO3) (mg/liter)	33	33	228	PCU
	CHEMICAL OXYGEN DEMAND (ug/liter)	25	19	55,800	STPO
	EC-F (umhos/cm)	29	29	1,402	STPO
	EH-F (mvolts)	3	3	52	STPO
	FORMALDEHYDE (ug/ml)	33	7	500	STPO
	TEMPERATURE (degree C)	29	29	28.8	STPO
	TOTAL DISSOLVED SOLIDS mg/liter)	33	33	625	STPO
	TOTAL ORGANIC CARBON (mg/liter)	8	8	11	PCU
	TURBIDITY (NTU)	33	33	128	PCU
	TURBIDITY-F (NTU)	26	19	200	PCU
	pH-F	25	25	8.89	PCU
Metals	ANTIMONY (TOTAL)	33	8	10	STPO
(ug/liter)	ARSENIC (TOTAL)	33	5	10	STPO
	BARIUM (TOTAL)	33	31	90	PCU
	BERYLLIUM (TOTAL)	33	3	1	STPO
	CADMIUM (TOTAL)	33	4	500	STPO
	CHROMIUM (TOTAL)	33	11	80	PCD
	CHROMIUM, HEXAVALENT (+6)	33	11	45	STPO
	COBALT (TOTAL)	25	1	30	STPO
	COPPER (TOTAL)	33	3	40	PCU
	LEAD (TOTAL)	33	5	11.2	STPO
	MERCURY (TOTAL)	33	5	0.9	PCU
	MOLYBDENUM (TOTAL)	33	9	110	STPO
	NICKEL (TOTAL)	33	5	310	PCD
	THALLIUM (TOTAL)	33	2	60	STPO
	VANADIUM (TOTAL)	33	3	30	STPO
	ZINC (TOTAL)	33	23	60	STPO
Anions and Cations	AMMONIA-NITROGEN	8	7	8.3	STPO
(µg/liter)	CALCIUM (TOTAL)	33	33	26.9	PCU
	CHLORIDE	33	33	181	STPO
	IRON	8	2	0.1	STPO
	MAGNESIUM (TOTAL)	33	33	36.1	PCU
	NITROGEN, NITRATE (AS N)	33	31	11.1	STPO
	PHOSPHATE, TOTAL (AS P)	33	23	10.0	STPO
	POTASSIUM (TOTAL)	33	33	56.9	STPO
	SODIUM (TOTAL)	33	33	164	STPO
	SULFATE	33	33	130	STPO
	TOTAL KJELDAHL NITROGEN	8	5	9.2	STPO
Volatile Organics	ACETONE	8	3	36	STPO
(µg/liter)	BROMODICHLOROMETHANE	33	5	13	STPO
	CHLOROFORM	33	20	33	STPO
	DIBROMOCHLOROMETHANE	33	3	4.8	STPO
	METHYLENE CHLORIDE	33	11	8.2	STPO
Semivolatile Organics	2-CHLOROPHENOL	33	1	10	PCU
(µg/liter)	BIS(2-ETHYLHEXYL)PHTHALATE	33	18	13.3	STPO
	BIS(2-ISOPROPYL)ETHER	21	2	5.7	STPO
	DI-N-BUTYLPHTHALATE	33	3	10	PCU
Pesticides and PCBs	4,4'-DDD	33	7	0.1	STPO
(µg/liter)	4,4'-DDE	33	3	0.1	STPO
	ALDRIN	33	4	0.051	PCD
	ALPHA-BHC	33	15	0.055	PCU
	BETA-BHC	33	2	0.051	PCD
	DELTA-BHC	33	7	0.35	STPO
	DIELDRIN	33	3	0.1	STPO
	ENDOSULFAN I	33	3	0.055	STPO
	ENDOSULFAN II	33	1	0.1	STPO
	ENDRIN	33	1	0.1	STPO
	ENDRIN ALDEHYDE	33	1	0.1	STPO
	GAMMA-BHC	33	6	0.052	STPO
	HEPTACHLOR	33	2	0.051	PCD

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 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 1992).

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 late 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. (Pacific Northwest Laboratory 1994)

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. (Pacific Northwest Laboratory 1994) Figure 7.2 provides a contour map of groundwater elevations in the first HSU during summer of 1993.

In the second HSU, groundwater flow is also predominantly toward the northeast. Both the direction of flow and the lateral gradient are more consistent than in the first HSU. The second HSU's lateral gradient is approximately 0.0015 ft/ft, and the average flow velocity is estimated to be 71 ft/yr. (Pacific Northwest Laboratory 1994) Refer to Figure 7.3 for a contour map of groundwater elevations in the second HSU during summer of 1993.

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. (Dames & Moore 1993)

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. 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).

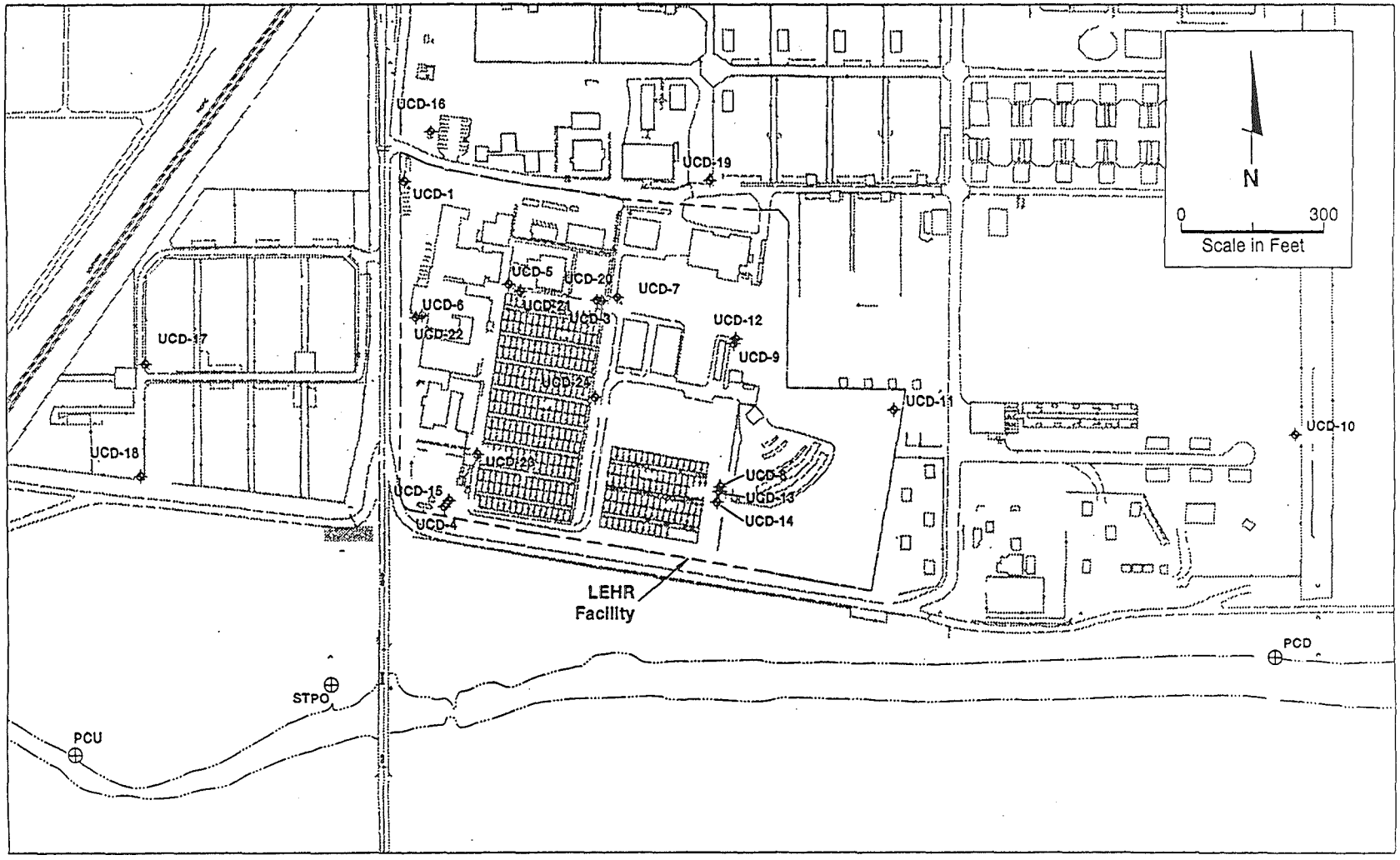
7.4 LEHR ER Project Site Groundwater Monitoring Wells

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.

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). During sampling, a number of field measurements are taken and then samples are sent off to a contracted laboratory, where the analyses for the remaining parameters are performed. Groundwater monitoring during 1993 was performed in accordance with procedures developed during the Phase II Site Characterization Plan (Dames & Moore 1990) and EPA procedures described in "Test Methods for Evaluating Solid Wastes" (EPA 1986). The list of parameters and analysis methods utilized during the first two sampling quarters is found in Table 7.2.

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



EXPLANATION

- Monitoring Wells
- Surface Water Monitoring Point

LOCATION MAP
GROUNDWATER MONITORING WELLS
AND SURFACE WATER MONITORING POINTS

DAMES & MOORE

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

Source: Pacific Northwest Laboratory. 1994.

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.

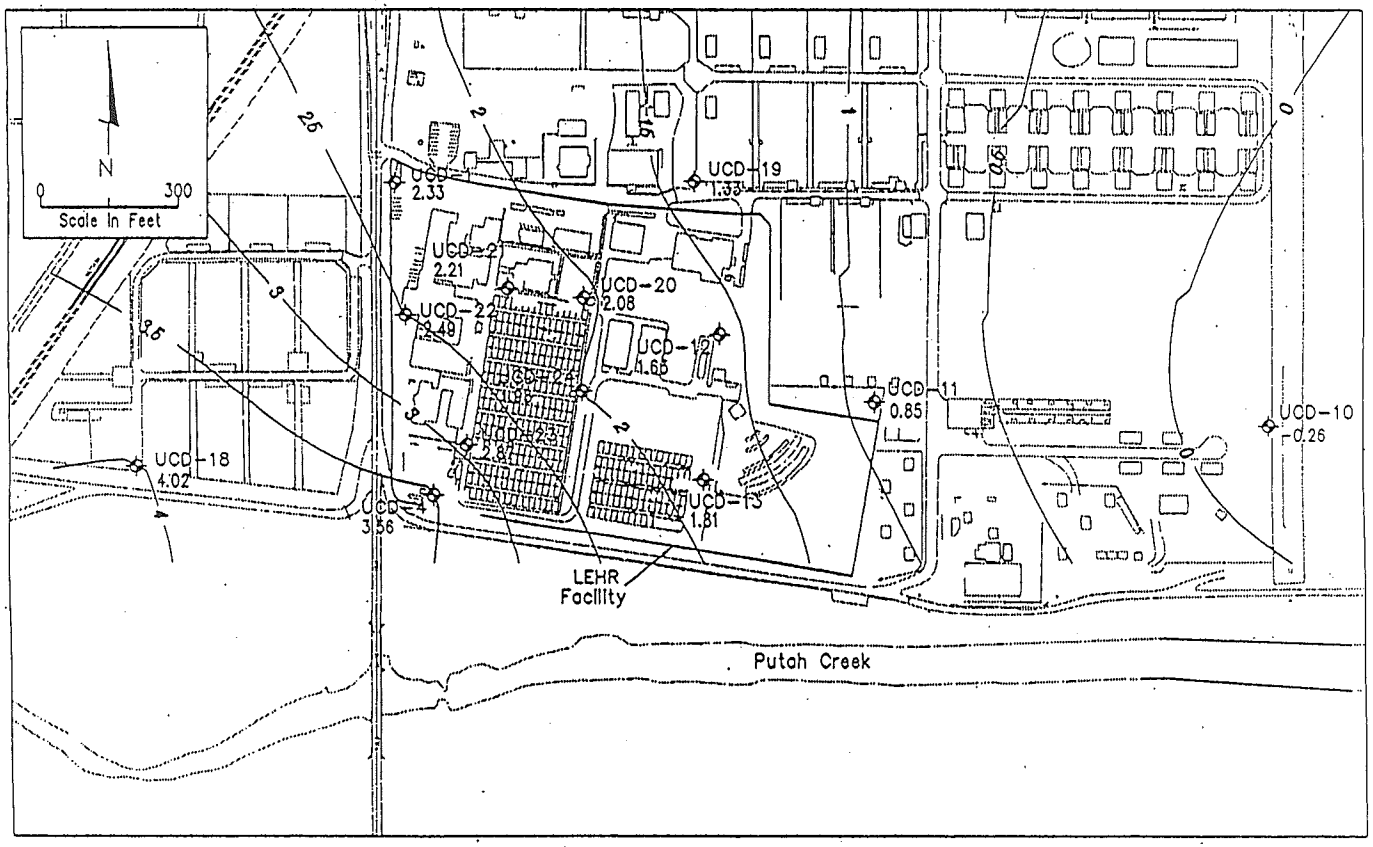
(2) See Figure 7.1

* 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.

Source: Pacific Northwest Laboratory. 1994.

Figure 7.2 First HSU Groundwater Elevation Contours, Summer 1993



EXPLANATION

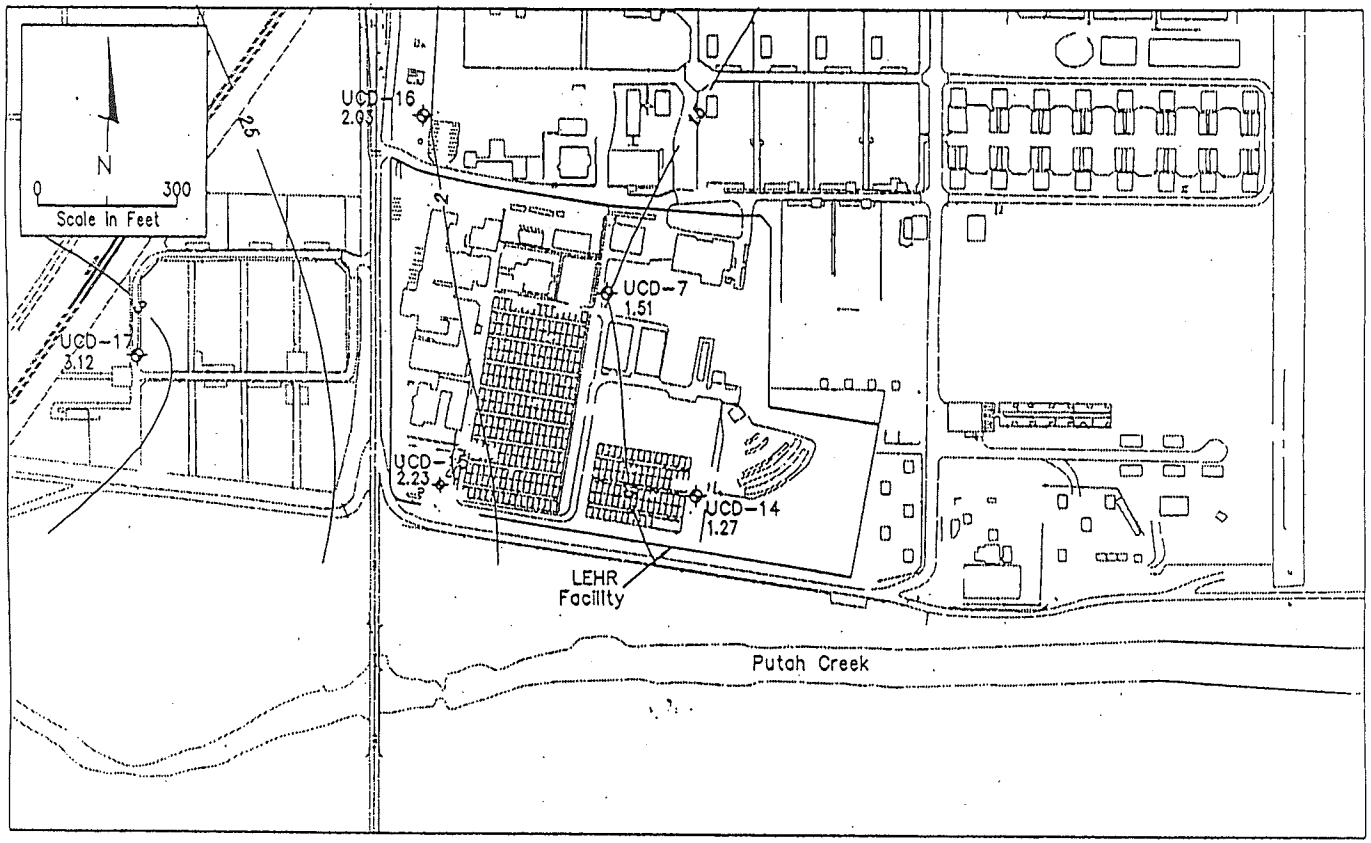
Monitoring Wells

—1— Groundwater Contours

FIRST HSU GROUNDWATER
ELEVATION CONTOURS
SEPTEMBER 2, 1993

Source: Pacific Northwest Laboratory. 1994.

Figure 7.3 Second HSU Groundwater Elevation Contours, Summer 1993



EXPLANATION

Monitoring Wells

Groundwater Contours

SECOND HSU GROUNDWATER
ELEVATION CONTOURS
SEPTEMBER 2, 1993

Source: Pacific Northwest Laboratory. 1994.

7.5.1 Program Changes Implemented in 1993

The third quarter of 1993 brought a number of changes in the program. These changes included addition of several new monitoring parameters (total organic carbon, total Kjeldahl nitrogen, ammonia, and reduction/oxidation), increased data quality objectives, and a new contracted analysis laboratory. The additional parameters will supply information useful to evaluate contaminant fate and transport, as well as potential remedial alternatives. The higher data quality objectives included incorporation of EPA Contract Laboratory Program (CLP) requirements and CLP-equivalent quality control documentation. These changes were implemented in order to meet monitoring and data objectives for the site RI/FS program. Additional monitoring points are planned for the future, as well. The list of analytical parameters and analysis methods is given in Table 7.3, with rational defined for each parameter in Table 7.4.

7.6 Summary of Trends in Analytical Results 1990-1993

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. It 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 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 (See Table 6.3 and Figure 7.4). Additional evaluation of potential sources will be addressed in the RI/FS.

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. For summary information, see Table 6.3 and figure 7.5.

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.

Table 7.2 Analytical Parameters Requested for LEHR ER Project Water Monitoring Program, Winter and Spring Quarters, 1993

Analyte	Analytical Method	Analyte	Analytical Method
Silver	EPA 6010	Alkalinity	EPA 2320
Gross Alpha	EPA 900.0	Arsenic	EPA 7060
Barium	EPA 6010	Gross Beta	EPA 900.0
Beryllium	EPA 200.7	Calcium	EPA 6010
Cadmium	EPA 7131	Chloride	EPA 10-117-07-1-B
COD	EPA 5220	Cobalt	EPA 6010
Hexavalent Chromium	EPA 10-124-13-1-A	Chromium	EPA 6010
Copper	EPA 6010	Formaldehyde	NIOSH-3500
Gamma	D-04 HASL-300	Mercury	EPA 245.1
Potassium	EPA 7610	Magnesium	EPA 7450
Molybdenum	EPA 6010	Sodium	EPA 7770
Nickel	EPA 6010	Nitrate	EPA 10-107-04-1-13
Lead	EPA 7421	Phosphate	EPA 10-115-01-1-A
Antimony	EPA 7041	Selenium	EPA 7740
Sulfate	EPA 300.0	Strontium 90	Radioassay Procedures for Environmental Samples
TDS	EPA 160.1	Thallium	EPA 7841
Turbidity	EPA 214-A	Vanadium	EPA 6010
Volatile Organics	EPA 624	Pesticides	EPA 608
Semi-Volatile Organics	EPA 625	Tritium	Radioassay Procedures for Environmental Samples

Note: This is Analyte List 1 from the Phase II Site Characterization Work Plan, Dames & Moore 1990.

Table 7.3 Analytical Parameters Requested for LEHR ER Project Water Monitoring Program, Summer Quarter, 1993

ANALYTE	METHOD
GENERAL PARAMETERS	
pH	SOP (Dames & Moore)
Ec	
Temperature	
Turbidity	
GENERAL CHEMICAL	
Alkalinity	EPA 301.1
Sodium	EPA 6010
Potassium	
Calcium	
Magnesium	
Chloride	EPA 300.0
Sulfate	
Phosphorous, all forms	EPA 365.2
Nitrate (as Nitrogen)	EPA 300.0
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
ORGANICS	
Volatile Organic Compounds	CLP SOW OLC 02.0
Semivolatile Organic Compounds	CLP OLM 01.8
Organochlorine Pesticides	CLP SOW 2.0
Formaldehyde	Modified NIOSH 3500

ANALYTE	METHOD
RADIOLOGICS	
Gross Alpha	EPA 9310
Gross Beta	EPA 9310
Tritium	EPA 906.0
Carbon 14	LSC C-01[a]
Strontium 90	EPA 905.0(m)[b]
Gamma Spectral Analysis	
METALS	
Total Chromium	CLP SOW ILC 2.0
Hexavalent Chromium	
Antimony	
Arsenic	
Barium	
Beryllium	
Cadmium	
Cobalt	
Copper	
Iron	
Lead	
Mercury	
Molybdenum	
Nickel	
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	

(a) Method Reference
(b) Modified procedure specified in laboratory SOP
Note: Reference from PNL 1993c

Table 7.4 Rationale for Water Sample Analyses

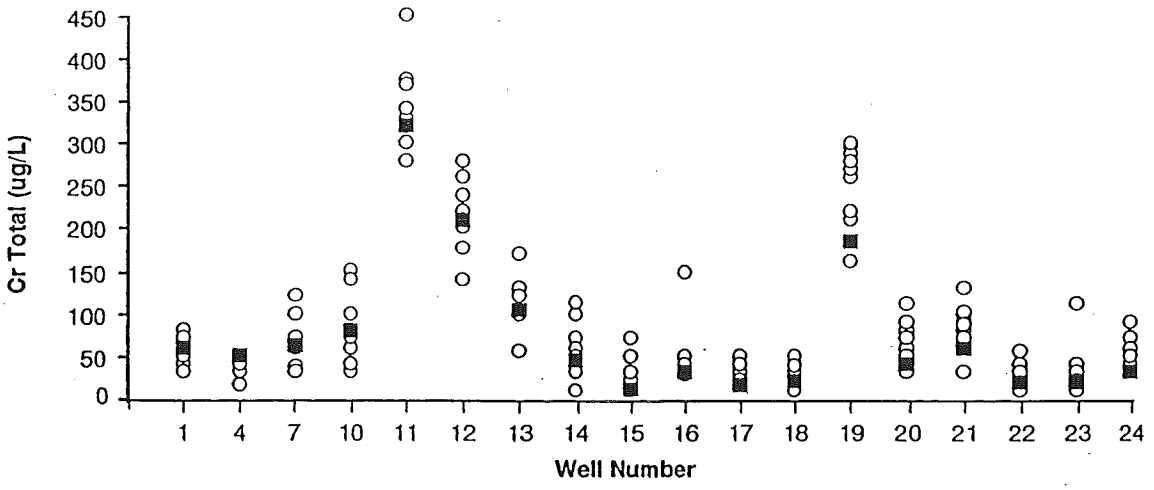
Constituent	Rationale*	Constituent	Rationale*	Constituent	Rationale*
Gross Alpha	6, 7, 8, 9	Metals	3, 4, 5, 7, 8, 9, 10	TOC	6, 8, 9, 10
Gross Beta	6, 7, 8, 9	Hexavalent Chromium	2, 4, 7, 8, 9	pH	6, 7, 8, 9, 10
Gamma Spec	3, 4, 5, 6, 7, 8, 9	Pesticides	1, 3, 4, 5, 7, 8, 9	Electrical Conductivity	6, 8, 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		
Cesium-137	1, 3, 4, 7, 8, 9	Alkalinity	6, 7, 8, 9, 10		
Sodium-22	1, 4, 7, 8, 9	TKN	4, 6, 7, 8, 9, 10, 11		
Uranium-238	1, 4, 7, 8, 9	Ammonia	4, 6, 7, 8, 9, 10, 11		
Cobalt-60	1, 4, 7, 8, 9	Anions	2, 4, 6, 7, 8, 9, 10		
Chlorine-36	1, 4, 7, 8, 9	Cations	2, 4, 6, 7, 8, 9, 10		

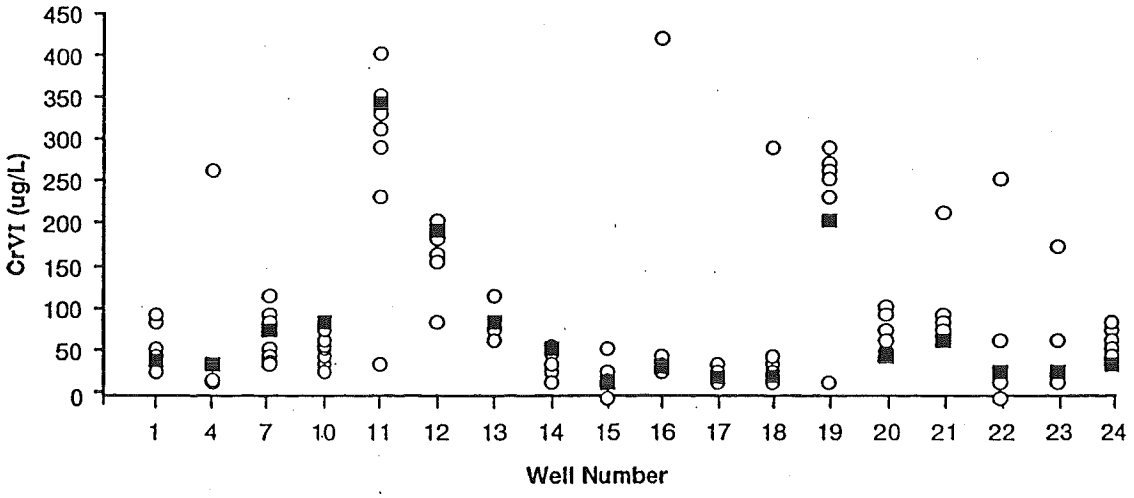
* **Rationale:**

1 Known constituent used or disposed on site.
2 Suspected site constituent based upon consistent detections in groundwater.
3 Suspected site constituent based upon sporadic detections in groundwater.
4 Suspected site constituent based upon previous disposal practices.
5 Suspected site constituent based upon detections in previous soil investigations.
6 Indicator parameter for other constituent.
7 Data needed for RI.
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.

Reference: Pacific Northwest Laboratory. 1994.

Figure 7.4 Total Chromium and Hexavalent Chromium by Well Quarterly Monitoring Results November 1990 - September 1993





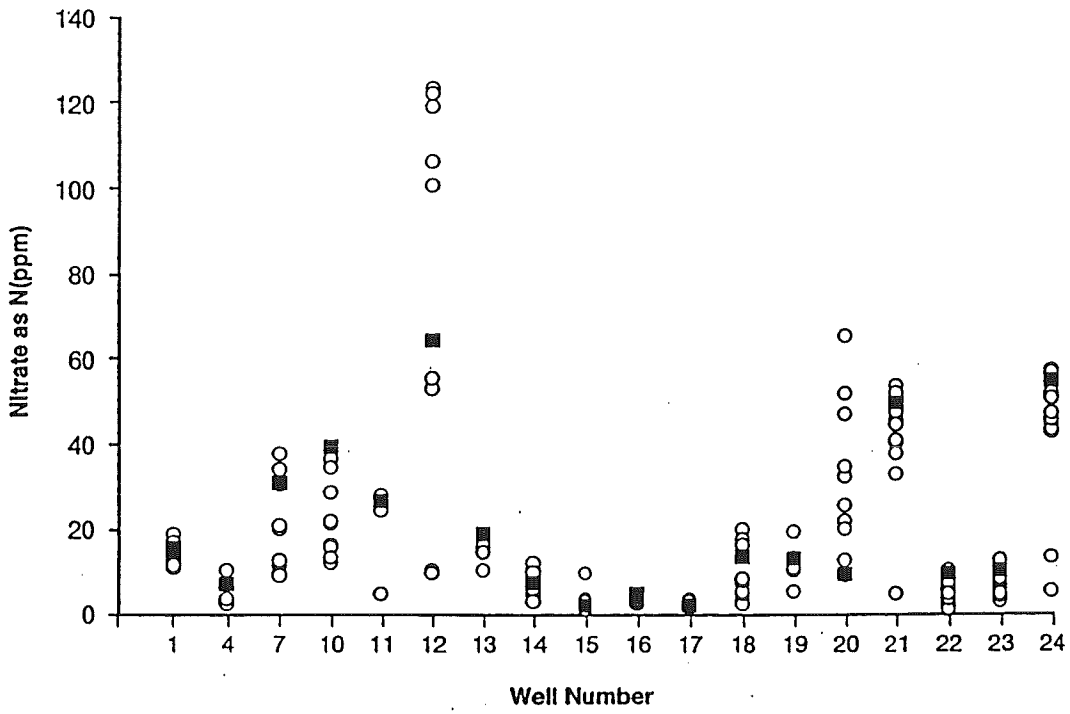
EXPLANATION

■ Summer Quarter 1993 Data

○ Data From All Previous Quarterly Rounds

Reference: Pacific Northwest Laboratory. 1994.

Figure 7.5 Nitrate as N by Well
Quarterly Monitoring Results, Nov. 90 - Sept. 93



EXPLANATION

■ Summer Quarter 1993 Data

○ Data From All Previous Quarterly Rounds

Reference: Pacific Northwest Laboratory. 1994.

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 according to the defined data quality objectives and data review procedures.

8.1 Field Quality Assurance

Quality assurance of 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 used on this project are maintained and a copy is kept in the project 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.

In addition, 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 1993, a Quality Assurance Program Audit was performed at Lockheed Analytical Laboratories by Dames and Moore. The scope of the audit involved contractual quality-related requirements pertaining to services required for support of the LEHR ER Project. The audit determined that the laboratory QA program met project requirements for EPA CLP quality assurance standards.

8.3 Summary of Quality Control Data Validation

There were no significant problems identified in the quality control data collected for 1993 site environmental programs. The water monitoring program, which comprises the majority of measurements obtained, reported that more than ninety-six percent of the sample data collected were valid, satisfying the data quality objectives for this program.

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 duplicates 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.

Department of Energy
San Francisco Field Office
1333 Broadway
Oakland, California 94612

JUN 28 1994

LEHR
RECEIVED
JUL 0 5 1994

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

Subject: Approval of the 1993 Site Environmental Report for the Laboratory for Energy-Related Health Research

Dear Dr. Attiga:

This is to notify you that the 1993 Site Environmental Report (SER) for the Laboratory for Energy-Related Health Research (LEHR) is approved for public release. My approval for release is based on OAK's 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) ten copies of the final report. Should your staff have any questions, please have them contact Steve Black of ESS at (510) 637-1595.

Sincerely,

Terry A. Vaeth
Acting Manager