LEHR-38

Final
Community Relations Plan

Laboratory for Energy-Related Health Research
Environmental Restoration
Davis, California

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FINAL COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION
DAVIS, CALIFORNIA
for
OAKLAND OPERATIONS OFFICE
U.S. DEPARTMENT OF ENERGY
AND
THE UNIVERSITY OF CALIFORNIA, DAVIS

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LIST OF ACRONYMS

CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRP	Community Relations Plan
DOE	Department of Energy
CAL/EPA DTSC	California Environmental Protection Agency/Department of Toxic Substances Control
U.S. EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
ITEH	Institute of Toxicology and Environmental Health
LEHR	Laboratory for Energy-Related Health Research
NEPA	National Environmental Policy Act
NPDES	National Pollution Discharge Elimination System
RI	Remedial Investigation
ROD	Record of Decision
SWAT	Solid Waste Assessment Test
TAG	Superfund Technical Assistance Grant
TPHRL	Toxic Pollutant Health Research Laboratory *(at the LEHR facility)*
UC Davis	University of California, Davis
VOC	Volatile Organic Compound

1.0 COMMUNITY RELATIONS PLAN OVERVIEW

This Community Relations Plan (CRP) identifies community issues and concerns regarding the Laboratory for Energy-Related Health Research (LEHR) Superfund site in Davis, California. It also describes the community relations activities to be conducted during the site Remedial Investigation and Feasibility Study (RI/FS). This CRP has been prepared in accordance with the 1992 U.S. Environmental Protection Agency (U.S. EPA) Community Relations in Superfund: A Handbook, (Office of Solid Waste and Emergency Response Directive 9230); the National Contingency Plan; and Section 117 of the Superfund Amendments and Reauthorization Act. It also incorporates recommendations of the U.S. EPA regarding the implementation of effective community relations activities at Department of Energy (DOE) sites and DOE Environmental Guidance for Public Participation in Environmental Restoration Activities. The site was listed on the National Priorities List on May 31, 1994. A general description of the Superfund process is provided in Section 6.0 of this CRP.

The RI/FS activities, including community relations at the LEHR site, are a cooperative effort between the DOE and the University of California, Davis (UC Davis), and are being overseen by U.S. EPA Region IX. The CRP is designed to assist the DOE and UC Davis in communicating information about the cleanup to the public and in monitoring and addressing public concerns. The specific objectives of this CRP are to:

- provide an accurate and timely flow of project information that is easily understood by the layperson;
- implement public outreach activities to help involve and inform stakeholders in project decisions;
- confirm individuals and/or groups who may become interested in the site as work progresses;
- solicit public involvement in decision making;
- aid in the design of a flexible program that addresses public concerns during the various stages of the environmental investigations and cleanup; and
- comply with the legal requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National

Environmental Policy Act (NEPA), and the California Environmental Quality Act (CEQA).

The information in this CRP is based primarily on interviews conducted with members of the community from May 25 through June 24, 1994. Interview participants included area residents and property owners, local officials, civil and government agencies, project personnel, environmental interests, UC Davis employees, and local ministry. The CRP is organized into the following sections:

2.0 Background;
3.0 Community Background;
4.0 Community Relations Highlights;
5.0 Community Relations Activities;
6.0 U.S. EPA's Superfund and National Priorities List Process;
7.0 Community Relations Staffing Roles & Responsibilities and Implementation Plan; and
8.0 References.

Locations and hours of operation for public information centers are included in Appendix A and LEHR public fact sheets are included in Appendix B. A list of contacts and interested parties has been included in Appendix C.

2.0 BACKGROUND

This section presents background information on the LEHR facility and surrounding area in order to establish a basic understanding of past operations and the physical attributes of the site. Section 2.1 gives a description of the structures and location of the LEHR facility. Section 2.2 describes the physical setting at LEHR, and Section 2.3 presents a history of operations. Section 2.4 discusses potential environmental impacts, Section 2.5 presents potential constituents of concern, and Section 2.6 describes LEHR site assessment and cleanup activities. Additional references are cited within each section and presented in Section 8.0.

2.1 BACKGROUND

The LEHR facility is located in the southeast quarter of Section 21, Township 8 North, Range 2 East, Mount Diablo Baseline and Meridian. The site is approximately one and one-half miles south of the main UC Davis campus and the town of Davis, and approximately three-quarters of a mile south of Interstate 80 on County Road 79 (Old Davis Road) in Solano County, California (see Figures 1 and 2).

The site encompasses approximately 15 acres and consists of one- and two-story laboratory and office buildings, and animal-handling facilities in a rural-type setting. Approximately 40 percent (6 acres) of the site is paved with asphalt or concrete, or covered by structures, approximately 30 percent (4.5 acres) of the site is unpaved and kept relatively free of vegetation. Dog pen areas occupy approximately 20 percent (3 acres) of the LEHR facility, and approximately 5 percent (.75 acres) is heavily vegetated with large, deep-rooted vegetation. Major buildings and structures located at LEHR are listed below and shown on Figure 3.

Building Number	Building Name
H-213	Main Office and Laboratory
H-219	Animal Hospital 1
H-218	Animal Hospital 2
H-214	Imhoff
H-217	Pathology Laboratory
H-215	Clinical Medicine
H-216	Feed/Mix Specimen Storage
H-291	Washdown Pad
H-294	Cellular Biology Lab
H-212	Maintenance Shop

Building Number	Building Name
H-290	Receiving and Business
H-300	Storage
H-296	Small Animal Quarters
H-299	Toxic Pollutant Health Research Laboratory
H-289	Cobalt-60 Auxiliary Building
H-229	Cobalt-60 Source
H-292	Geriatrics 1
H-293	Geriatrics 2

The land is owned by the Regents of the University of California and leased to the DOE. All structures at the LEHR facility are owned by the DOE (DOE, 1988).

The site is located in a rural area in the southeast portion of the UC Davis campus, and is bounded by UC Davis research facilities. The southern border of the LEHR facility is the northern levee of the South Fork of Putah Creek. Private land is adjacent to and surrounds UC Davis property to the west, south, and east. Most of the private land is used for agricultural purposes.

2.2 PHYSICAL SETTING

The LEHR facility is located in the southern portion of the Sacramento Valley. The Sacramento Valley extends from the Red Bluff area in the north to the Sacramento-San Joaquin Delta region in the south. The LEHR facility sits in a flat-lying or gently sloping area of former farmland.

The LEHR facility is located in a rural area, with approximately 75 percent of the surrounding land being used for agriculture. Approximately 40 percent of that land is irrigated. Major crops include fruits, nuts, and grains. Additionally, some of the nearby lands are used for cattle grazing (DOE, 1988).

2.2.1 Topography

The regional topography surrounding the LEHR facility is typical of the broad, 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 relatively flat-lying land termed the Putah Plain (Department of Water Resources, 1978). The average elevation at the site is approximately 50 feet above mean sea level. Relief across the site is approximately two feet, with the lowest portion in the area of the Cobalt-60 Field. The land surface slope in the vicinity of the LEHR facility is approximately 0.001 foot/linear foot (5 feet per mile) to the east/northeast toward the Sacramento River. The site is not within the 100-year flood plain as defined in the 1982 Federal Emergency Management Agency (FEMA) Flood Insurance Maps.

Local drainage at the LEHR facility is generally to the south-southwest. Drainage in the south and southwest area is collected in a stormwater drainage system, routed to the LEHR stormwater lift station and subsequently pumped to the west side of Old Davis Road and discharged to Putah Creek.

2.2.2 Geology

The Sacramento Valley is characterized by sedimentary deposits of both marine and continental origin. Deformation of these deposits due to uplift of the surrounding mountains has resulted in a regional dip of the sediments from the sides of the valley toward its axis.

2.3 HISTORY OF OPERATIONS

Full-scale experimental use of radioactive materials, including strontium-90 and radium-226, began at the LEHR facility in 1960. Portions of the LEHR facility site had previously been used as the UC Davis campus landfill. The landfill consisted of two separate disposal units. Disposal in the oldest unit began in the 1940s and ceased in approximately 1958. The area is now covered by the Cobalt-60 Field at the LEHR facility. The next oldest disposal area received wastes from approximately 1958 to 1966. This disposal area is partially covered with the eastern most of two sets of dog pens used for animal research at the LEHR facility. A third landfill disposal unit, located approximately 600 feet east of the LEHR facility, was used from 1963 to 1967. The combined total acreage for the three disposal areas is estimated at approximately six acres (Dames & Moore, 1990).

In the early 1970s, an outdoor Cobalt-60 Field was constructed at the LEHR facility to study the effects of chronic exposure to penetrating gamma ray irradiation on bone marrow cells of beagles. The study was terminated in 1985, and the cobalt-60 source was removed in 1993.

In 1975, a program in basic aerosol science was initiated at the LEHR facility to link the evaluation of airborne materials and the laboratory study of these materials utilizing cellular and animal models. The DOE (1988) reported that research activities in this

program focused on the potential health effects of release to the atmosphere of combustion products from fossil fuel power plants with emphasis on coal flyash.

In 1983, construction of the Toxic Pollutant Health Research Laboratory (TPHRL) was completed at the LEHR facility. This facility supported non-DOE research activities unrelated to LEHR. The facility was designed for the study of highly toxic and carcinogenic agents including both radioactive and chemical materials. Research at the TPHRL included studies of the behavior of plutonium-241 and americium-241 in beagles and monkeys; radioactive and toxic gas-particle mechanistic aerosol studies; monodisperse aerosol inhalation deposition; intratracheal applications of carcinogen-coated particles; and an organic vapor uptake utilizing beagles (DOE, 1988). The plutonium studies at TPHRL ended in 1987.

2.4 POTENTIAL ENVIRONMENTAL IMPACTS

During the 30-year operation of the LEHR facility, a variety of wastes were generated and disposed of on-site. These wastes included radioactive, biologic, chemical, municipal, and laboratory debris. Detailed descriptions of known waste-generating and disposal processes are described in the DOE, Environmental Survey Preliminary Report, dated March 1988. A brief summary of waste-generating processes that may have resulted in potential environmental impacts at the LEHR facility are presented below.

2.4.1 Waste Systems

Radiologic wastes generated from animal experiments using bone-seeking radionuclides were treated using two primary systems. From 1960 to 1987, effluent from strontium-90 experiments was processed through an Imhoff treatment system. From 1982 to 1984, a total of 39.59 μCi of plutonium-241 and 0.136 μCi of americium-241 were processed through the Imhoff Treatment System. The Imhoff Treatment System used a series of settling tanks and cation exchange columns to treat approximately 200 to 500 gallons per day of waste prior to discharge to leach fields (Figure 5). The total throughput of strontium-90 to the Imhoff Treatment System is estimated at 943.2 mCi. After treatment through the Imhoff Treatment System, an estimated 2.55 mCi of strontium-90

was released to the Imhoff Leach Field and subsurface soil. The half-life of strontium-90 is 29 years.

The Imhoff Treatment System utilized the principals of primary sedimentation, aeration, chemical clarification, and filtration prior to passing wastewater through a cation exchange column. The tanks are below-grade and lined with concrete that is sealed with plastic sealant. Total capacity of the tanks is 46,000 gallons. During the years of operation, the tanks filled up with sludge. Sludge was removed by a subcontractor or pumped to a tanker truck. All sludge remaining in the Imhoff Treatment System was removed by the DOE in 1992.

Table 1 summarizes, by year, the volume and strontium-90 level of inflow and effluent from the Imhoff Treatment System discharged to the leach fields, as recorded in DOE files. The table shows the number of batches (approximately 500 gallons each) of effluent treated during each year of system operation, total gallons included in those batches, the resulting clarified waste introduced to the exchange columns, and effluent strontium-90 concentrations.

The second waste treatment system consisted of the radium-226 processing system (Figure 6). This system consisted of septic tanks, dry wells, and a leach trench as shown on Figure 6. The combined capacity of the septic tanks is 14,400 gallons. The septic tanks allowed for the settling of solids, whereas fluids were fed through a distribution box to one of three vertical dry wells. After frequent failures with the original system, a 91-foot-long, 14-foot-deep, and 3-foot-wide cobble-lined seepage trench was added in 1965.

2.4.2 Domestic Septic Tanks

Liquid was disposed of at seven on-site septic tanks (Figure 7) prior to 1971, when the LEHR facility was connected to the currently active UC Davis sewage treatment plant located at the main campus. Septic tanks were reported to have received all liquid wastes from the LEHR facility except for strontium-90 and radium-226 project wastes. However, during backup of the radium-226 system, one septic tank west of AH-2 was reported to have received effluent from AH-2. Prior to connection to the UC Davis Wastewater

Treatment Plant, the septic tanks were reported to have been filled with sand and abandoned in place. Effluent and influent lines were reported to be severed and capped.

2.4.3 Chemical Dispensing Area

The LEHR facility used various bulk chemicals including, but not limited to, acetone, kerosene, toluene, xylene, benzene, formaldehyde, ethyl alcohol, formalin, weed oil (diesel oil), and chlordane. These chemicals were stored and dispensed from two areas, the North Chemical Dispensing Area and the Southwest Chemical Dispensing Area (Figure 7). The chemicals were stored in an open-sided wooden structure in the southwestern portion of the LEHR facility.

2.4.4 Waste Burial

Low-level radioactive solid waste generated by DOE-sponsored research at the LEHR facility was disposed in trenches located primarily in the southwest corner of the site (Figure 7). UC Davis disposed experimental waste in 19 trenches and 49 pits located along the southern boundary and eastern portion of the LEHR facility. The wastes were reportedly disposed in accordance with applicable regulations in place during that time. The UC Davis trenches are reported to have been approximately 2 feet wide and from 33 to 270 feet long, and disposal pits were typically 4 feet by 4 feet. The trenches and pits were reported to be between 8 and 10 feet deep. Potentially radiologic wastes from other UC Davis campus activities were reportedly disposed in these trenches and pits as well. In addition, it was reported by UC Davis personnel that some chemicals and laboratory wastes were disposed in the trenches and pits. Actual conditions or hazardous levels of wastes disposed in trenches and pits are unknown. Some of the waste has been confirmed to be biological (animal carcasses). Total quantities of waste disposed in trenches and pits were estimated at 30,150 cubic feet (Warren, 1985). Waste was reportedly covered with up to four feet of material.

Known radioactive wastes disposed in the disposal pits are summarized in Table 2. This table lists the known trenches and pits that, according to UC Davis and DOE records, reportedly received laboratory wastes. This table also identifies the contents of each pit

and describes the location of each waste burial trench. In many cases, the amount and type of radionuclides in trenches and burial pits are also estimated.

2.4.5 Landfill Units

As discussed previously, prior to construction and during operation of the current LEHR facility, UC Davis disposed sanitary and chemical wastes on and east of the LEHR property in the Old UC Davis Landfill. The landfill consists of three separate landfill units that operated at different times. Two of the landfill units are located at LEHR. A more detailed discussion of the Old UC Davis Landfill is presented in the Solid Waste Assessment Test (SWAT) report prepared for UC Davis (Dames & Moore, 1990).

The oldest of the three inactive disposal units is presently covered by the Cobalt-60 Field. Disposal reportedly began in this unit in the 1940s and ceased in approximately 1958. Based on air photo review, general campus wastes and possibly chemical wastes appear to have been disposed in this landfill unit. Sewage sludge from the adjacent sewage treatment plant was reportedly disposed in the landfill, as well (DOE, 1988).

The second disposal unit was operated from approximately 1958 to 1966, and consisted of east-west oriented disposal pits. This unit is located in the mid-portion of the LEHR facility, and is partially covered with the easternmost of two sets of dog pens. The pits are reported to have averaged 10 feet in depth and are unlined. Types of wastes disposed in this landfill have not been documented, although general refuse, animal parts, ash from the UC Davis incinerator, and some liquid chemicals were reported.

UC Davis operated a third disposal unit from 1963 to 1967. This unit is located east of the LEHR facility and the former UC Davis Sewage Treatment Plant. Wastes were placed in two large, pit-like excavations and covered with a soil cap. This disposal area is outside of the LEHR facility boundaries (Dames & Moore, 1990).

2.4.6 Dog Pen Area

Two outdoor dog pen areas containing approximately 350 separate pens are located at the LEHR facility. The westernmost set of pens originally contained 304 pens. In 1975,

48 pens were removed to allow construction of the Cellular Biology lab (Building H-294; Figure 3). Dogs injected with strontium-90 were housed in Animal Hospital 1 for 540 days during treatment, and an additional 30 days following treatment. The outdoor pens were used to house the dogs after their initial treatments.

Excreta from dogs housed in outdoor pens contained low levels of radiologic constituents. Solids were removed from the pens on a daily basis. Urine would be expected to evaporate rapidly upon contact with pen gravels. An estimated 2 mCi of strontium-90 and 0.5 mCi of radium-226 were potentially excreted in dog urine over the life of the project.

Chlordane was used on dogs kept in outdoor pens from 1960 until the early 1970s to control fleas. Chlordane was sprayed on dogs or dogs were dipped in chlordane, or with chlordane-kerosene, and returned to the dog pen areas. Annual usage of chlordane is estimated between 25 and 50 gallons. Spent chlordane from the dip tanks was recorded to have been disposed in trenches and pits.

2.4.7 Stormwater and Dry Wells

Stormwater runoff, observed to pond at several locations at the LEHR facility, has the potential to come in contact with impacted soils or facilities and to subsequently impact other areas. Potential sources include the Southwest Disposal Area, trenches and burial pits along the southern border of the site, the dog pens, and the former Chemical Dispensing areas.

Stormwater at the LEHR facility was controlled with dry wells. Two dry wells have been reported to have been used. One well is located between the Clinical Pathology Building and the Feed Mix/Specimen Storage Building (Buildings H-215 and H-216, respectively; Figure 3), and the other is by the wash-down pad (Building H-291). Construction of dry wells typically consists of cobble- or gravel-filled open-bottom holes or trenches. Dry wells are typically deep enough to access permeable subsurface materials capable of receiving significant amounts of water.

2.4.8 Wastewater Treatment Plant

The Old UC Davis Sewage Treatment Plant is located adjacent to the eastern boundary of the LEHR facility. The Old UC Davis Sewage Treatment Plant processed campus wastewater until 1949 when a new wastewater treatment plant was constructed on the main UC Davis campus.

Dried sludge and possibly wet sludge from the Old Wastewater Treatment Plant was reported to have been disposed in the Old UC Davis Landfill Unit No. 1 in the area of the current Cobalt-60 Field. Liquid effluent from the Old Wastewater Treatment Plant was reportedly disposed through a gravel drain process located south of the former plant site.

The current wastewater treatment plant is located on the main campus. Effluent from the plant discharges to Putah Creek just west of Old Davis Road. The discharge is permitted under NPDES.

2.5 POTENTIAL CONSTITUENTS OF CONCERN

Potential constituents of concern have been identified from existing analytical data resulting from preliminary investigations at the LEHR site. Tables 3 through 5 list potential constituents of concern detected in soil, surface water, and groundwater during some of the previous investigations. The potential constituents of concern are summarized as radionuclides, organic chemicals, or inorganic chemicals. At the beginning of the RI/FS, the constituents-of-concern list is extensive and includes all potentially present chemicals or radionuclides. This list of constituents will be screened and reduced during the risk assessment portion of the RI/FS, based on frequency of occurrence, carcinogenicity, whether the constituent is an essential nutrient or toxic, or if the constituent is naturally occurring.

2.6 LEHR SITE ASSESSMENT AND CLEANUP ACTIVITIES

A number of groundwater and soils investigations were conducted between 1984 and the present. Soil samples have been collected from most areas of concern, and ongoing groundwater monitoring is being conducted; both of these activities were used to

develop the current RI/FS scope. Results of previous studies indicated the presence of several constituents in soil and groundwater. These constituents included radionuclides, heavy metals, and various organic and inorganic compounds.

To date, carbon-14, tritium, chromium, nitrate, volatile organic compounds (VOCs), and chlorinated pesticides have been found in shallow groundwater (about 45 to 70 feet deep) beneath and adjacent to the site. Concentrations of chromium, nitrate, tritium, and some VOCs have been reported above drinking water standards in some monitoring wells. Tritium has been detected in one deeper test well at 85 feet, but the levels do not exceed drinking water standards. Low levels of nitrate, VOCs, chlordane, radionuclides such as strontium-90, radium-226, tritium, and several trace metals have been detected in soil samples, also.

Further work is needed to evaluate the full extent of groundwater and soil impacts and to assess remedial alternatives. An extensive, site-wide RI/FS Work Plan has been prepared to address areas of soil and groundwater contamination at LEHR, and is being implemented in phases. After receiving agency approval, the RI/FS Work Plan will be placed into the public information centers.

Operable Units — areas of similar waste disposal history or physical characteristics — have been defined for soil and groundwater at LEHR. Soil operable units for the RI/FS are shown in Figure 8. Operable Unit 6 consists of surface water, stormwater, and groundwater.

Described below is a chronology of the main reports and studies that have been completed or are continuing at the LEHR facility. Detailed information about these activities is available in copies of work plans, reports, and news releases located at the LEHR information centers listed in Appendix A. Additional site investigation and cleanup activities will be conducted based on results of the RI.

March 1988	DOE prepared an Environmental Survey Preliminary Report to rank the site for future investigation.
1989 - 1990	The Solid Waste Assessment Test was conducted.

September 1989	Began to test on-site and private wells in the area (ongoing today).
September 1990	The last radioactive animal remains on the site were taken from storage refrigerators, packaged in drums, and sent to the Department of Energy Hanford Site.
February 1991	A CEQA Preliminary Environmental Study for site characterization work at the inactive UC Davis Landfill was conducted.
March 1991	A study of the reconstruction of dose equivalents to the public from the former Cobalt-60 Irradiator facility at LEHR was completed, and a report was prepared.
May 1991	Characterization of on-site buildings began.
September 1991	Additional characterization was completed for the Old UC Davis Landfill site; characterization included a groundwater hydropunch investigation.
Late 1991-Early 1992	Approximately 35,000 gallons of low-level radioactive water and sludge from underground tanks were removed, treated, and shipped to the Department of Energy Hanford Site.
November 1992	Shipment of 18 cans of Sr-90 stock solution to Argonne National Laboratory.
Late 1992	A final report was prepared for liquid and sludge removal at the LEHR facility.
January 1993	The Cobalt-60 Irradiator used for exposing research animals in outdoor pens to radiation was removed. The cobalt-60 source was transferred to private sector for reuse.
February 1993	The Phase II Site Characterization was completed.
September 1993	Three laboratory buildings known as Animal Hospitals 1 & 2, and Specimen Storage Room were decontaminated.
October 1994	A radioactive contaminated tanker which stored low-level radioactive liquids was disposed off-site.
January 1995	A total of 31 drums of mixed waste were shipped to the Department of Energy Hanford Site.

March 1995	Completed demolition of on-site waste treatment building and adjacent laboratory generated low-level waste was shipped to the Department of Energy Hanford Site.
April 1995	Imhoff treatment building demolished and removed.

3.0 COMMUNITY BACKGROUND

3.1 COMMUNITY SETTING

The City of Davis, California is located in Yolo and Solano Counties, approximately 20 miles west of Sacramento and 72 miles northeast of San Francisco. While the LEHR site is located within Davis city limits, the majority of UC Davis is located in Solano County, adjacent to the City of Davis. The current population of Davis is approximately 46,000; however, the city is expected to grow to at least 75,000 residents by the year 2010. According to Davis residents, they consider themselves among the most educated in the United States.

The surrounding community is primarily agricultural. There are four manufacturing plants and several small businesses in the Davis area. UC Davis employs 14,600 people, approximately 50 percent of whom live in Davis, and is considered the town's major employer.

3.2 IDENTIFICATION OF COMMUNITY

For the purposes of this CRP, the term "adjacent residents and property owners" refers to those people who live, work or own property within two miles of the site. Davis residents located outside of those two miles and who are not directly impacted by the LEHR site activities are referred to as the "general community."

3.3 HISTORY OF COMMUNITY INVOLVEMENT

Before 1989, public interest in the LEHR facility was minimal to moderate. Media interest dates back to 1966 and primarily focused on site research. Public interest in cleanup and contamination issues gained some momentum in the late 1980s when UC Davis/DOE news releases presented the findings of groundwater testing at the site. An expanded public information effort relative to the LEHR cleanup process followed these findings. This effort included the distribution of regular fact sheets and press releases. In addition, UC Davis conducted small-group meetings with adjacent residents and property owners to help them understand groundwater contamination.

Public interest in the site escalated in August 1989 when the West Davis Community Association, a local environmental interest group, sued UC Davis over its long-range development plan. In the case entitled *West Davis Community Association et. al.* v *Regents of the University of California* (A052284, December 31, 1991), the California State Court of Appeal, First Appellate District, ruled that the Environmental Impact Report (EIR) for the 1989 UC Davis Long Range Development Plan (LRDP) was inadequate because it did not discuss clean-up and future use of the site of the former Laboratory for Energy-Related Health Research (LEHR). In response, UC Davis revised the Environmental Impact Report related to its long-range development plan. This revision included adding information relating to site characterization, history, remediation, future land use and environmental impacts from LEHR to the Environmental Impact Report.

From 1989 to the present, several newspaper articles have been published regarding the LEHR site contamination and the proposed environmental investigation. Many public meetings have been conducted to discuss specific LEHR cleanup activities and to gather community input. One of these public meetings was conducted to present the results of the cobalt-60 dose reconstruction studies performed in March and May of 1991. Thirteen fact sheets have been distributed to describe topics such as the effects of radiation to human health, the LEHR sludge disposal program, LEHR site assessment and cleanup, the RI/FS, decontamination and decommissioning activities, and the cobalt-60 source removal (copies of fact sheets are provided in Appendix B). UC Davis and DOE have also made an effort to keep local elected officials and participating agency representatives apprised of LEHR activities.

3.4 COMMUNITY CONCERNS AND ISSUES

The following section outlines the community issues and concerns that were identified during the initial development of the CRP. This summary is based on discussions with the UC Davis and DOE RI/FS project personnel, comments made by residents at community meetings, and community interviews conducted from May 24 through June 24, 1994.

Public Health and Safety: A few of the interviewed residents whose property is directly adjacent to the site are concerned that they may have been exposed unknowingly by the cobalt-60 radiation source while it was in operation from 1970

to 1987. Most people interviewed are concerned about the long-term health impacts of drinking or bathing in contaminated groundwater. Although some people are being supplied with bottled water as a precautionary measure while the studies are conducted, they are using the groundwater through supply wells to bathe, irrigate crops and vegetable gardens, and as drinking water for their livestock. These individuals fear that what technical experts tell them is safe today may not be considered safe 20 years from now.

Schedule and Timing of Investigation and Remediation: Most area residents and property owners want the contamination cleaned up as quickly as possible. They believe delay in site cleanup could allow the groundwater contamination to spread further.

Impacts of Publicity on Property Values: Some residents and property owners are concerned about what will happen to property values if the site becomes more publicly visible or public perception about the site is magnified (or made to be of more concern than it should be) by local interests. These people seem to understand there is a problem but feel "extreme publicity" could potentially slow down the cleanup process and become a detriment to existing residents and property owners.

Other Financial Considerations/Impacts: Property owners are required to disclose information regarding the site contamination and investigations. Some renters of properties adjacent to LEHR have chosen to move rather than deal with "uncertainties."

Need for Clear and Meaningful Information: Most of the interviewees seem frustrated with the lack of clear and simple information about: (1) the extent of contamination, (2) the schedule for completion of the investigations and cleanup, and (3) potential long-term health effects. As a result, they would like to see:

- more fact sheets for the public;
- timely results on well sampling (with explanation of how to read well sampling results and why readings are not consistent from one report to the next);
- more public meetings (both as small-group workshops with neighbors and as general community meetings so that neighbors can hear each others' concerns);
- access to experts selected by the public, such as doctors, to test analytical results;
- easy access to project reports and technical information;

- media coverage on different points of view;
- articles in the UC Davis newspaper; and
- a telephone information line.

Credibility of UC Davis and the DOE: There is a feeling among some members of the adjacent community and one environmental interest group that UC Davis is very "powerful." Some are concerned about technical information being withheld, while others are concerned about UC Davis/DOE lack of openness with information. A few people feel that the DOE has the stigma of being a "big, bureaucratic, federal agency," while others take comfort in feeling that DOE could potentially clean up the site more quickly because of extensive government financial resources. DOE also seems to be more trusted than UC Davis to convey information to the interested public.

UC Davis and DOE Project Staff Turnover: Some individuals within the adjacent community are frustrated with the frequency of LEHR project personnel turnover. As soon as they (neighbors) establish a relationship with a staff member, there is a change. Some (neighbors, interviewees) feel this is a "step backward" each time it occurs.

4.0 COMMUNITY RELATIONS HIGHLIGHTS

To date, several community relations activities have been conducted for the LEHR site, including 13 fact sheets distributed at key project milestones, 30 press releases, 9 community meetings, workshops or facility tours, and 13 community interviews to help prepare this CRP.

The community relations program for the LEHR site will continue to inform the community about the environmental investigation and cleanup process, and will provide the public opportunities to participate in project decisions. Key goals are to enhance credibility for the process, improve responsiveness, dispel misconceptions and/or misinformation, and to openly share information and to incorporate public input. Consequently, the community relations program for LEHR will be guided by the objectives listed below.

- Use existing mechanisms, such as newsletters and the local media, to inform community residents and interested parties. In addition, make an extra effort to simplify technical information and results into terms the layperson can relate to and understand.

- Provide information to employees of the ITEH at the former LEHR site, via the campus newspaper, news releases, and fact sheets, about site activities so they can relay accurate information to others in the community.

- Provide opportunities for public input through the use of small-group workshops (for adjacent residents and property owners), open houses and public meetings (for the general community), and public comment periods.

- Educate area residents and local officials about the procedures, policies, and requirements of the RI/FS process. Basic information about the Superfund/CERCLA process should be discussed with local officials and community residents early in the process to avoid confusion about the roles and responsibilities of parties involved in the cleanup.

- Provide an open information-sharing process and the opportunity for interested parties to obtain further information. Keep information centers current and accessible to the public. In addition, designate a community liaison(s) for receiving and coordinating responses to public inquiries and requests.

- A community group near the LEHR site has been approved for a Superfund Technical Assistance Grant (TAG). The TAG funds can be used to form a review committee, and for the community to hire an independent technical consultant. The committee and the consultant are then able to review and comment on work being conducted as part of the RI/FS.

5.0 COMMUNITY RELATIONS ACTIVITIES

The general community relations approach to address the preceding objectives is provided below. In some cases, a particular community relations technique may address more than one objective. Focal point community relations activities, such as public workshops and meetings, will be scheduled in conjunction with project milestones. The proposed community relations tasks and project milestones during the RI/FS process are shown in Table 6.

OBJECTIVE 1: Use existing mechanisms to inform community residents and interested parties. Make an extra effort to clarify technical information into non-technical terms.

The community relations program has been designed so that interested and potentially affected individuals are aware of the site and kept informed of the site investigation and remediation activities. To meet this objective, mailing lists have been developed and information about the site will continue to be distributed. The mailing list consists of adjacent residents and property owners, local interest groups, local officials and agency representatives, project personnel, and other interested parties such as UC Davis employees and the media.

Informational materials which will be distributed to individuals on the mailing lists include:

- **Fact sheets:** Fact sheets will be distributed regularly to inform the public about site activities, progress, and pending community relations opportunities. These fact sheets will be mailed to the existing mailing list, posted in common areas at UC Davis, mailed or hand-delivered to the media and local officials, and available as handouts at public workshops and meetings.

- **Press releases:** Press releases will be prepared and distributed to the local media at key project milestones. A list of names and addresses of interested parties and key contacts has been prepared and filed with DOE and UC Davis. These milestones include decontamination and decommissioning activities, completion of the RI, initiation of the RI/FS, and completion of the RI/FS.

- **Public notices or meeting announcements:** Public notices will provide details about the schedule and location of community meetings and public comment periods to be held throughout the RI/FS process. These notices will be distributed to the mailing list, posted in common areas at UC Davis, and mailed or hand-delivered to the media and local officials.

- **Well sampling result letters:** Letters will continue to be mailed to adjacent residents regarding well sampling results. These letters will be reformatted to make the technical results more understandable to non-technical readers.

OBJECTIVE 2: Provide information to ITEH employees about site activities so they can relay accurate information to the community.

It is important that ITEH employees be kept informed of upcoming LEHR site investigations. Employees may be the source of information to the community and should have a general knowledge of the studies and whom to contact for further information. Techniques will include the following:

- **ITEH employee updates:** ITEH employees will receive information on LEHR activities through articles contained in *Dateline*, the campus newspaper, as well as news releases and fact sheets, as developed.

- **Employee bulletin boards:** LEHR public fact sheets, press releases, and public meeting announcements will be posted at UC Davis employee common areas to give employees another way of learning more about the LEHR project activities and schedule.

OBJECTIVE 3: Provide opportunities for public information sharing and input into project decisions.

It will be important for UC Davis/DOE to provide a forum for interaction with the public. Techniques will include the following:

- **Small-group workshops:** Because the adjacent neighbors are highly concerned about the LEHR project, it will be important for UC Davis/DOE to continue to meet with them at key milestones. The goal is to help affected residents understand more about the study and cleanup process, and to demonstrate our willingness to keep them informed as the project evolves.

- **Community meetings, open houses:** General community meetings or open houses will also be conducted at key milestones. This will give the general community and the residents a forum to hear concerns. It will also enable UC Davis/DOE to communicate key project information.

  DOE/UC Davis will assist the agencies in coordinating a public hearing on the Draft RI/FS Report, if requested. This hearing will be conducted during the public comment period and will provide an opportunity for community questions to be answered. A transcript of all comments during the meeting will be prepared.

- **Public comment periods:** Notices will be distributed to the mailing list, and display advertisements will be placed in local newspapers to announce formal comment periods.

- **Responsiveness summary:** This document is required as part of the Record of Decision for the site, and summarizes public concerns and issues raised during the RI/FS process. The summary also will document agency responses to public issues and concerns.

- **Revision of the CRP:** The CRP will be revised when a Record of Decision has been issued for the site or in the event that community concerns and issues change.

- **Observation of field operations:** The public will be invited to observe selected field operations as they are conducted, such as drilling of soil borings, installation or sampling of monitoring wells.

OBJECTIVE 4: Inform area residents and local officials about the procedures, policies, and requirements of the RI/FS process.

The Superfund/CERCLA process will be discussed with local officials and community residents. The roles and responsibilities of parties involved in the cleanup will be explained. Activities will include the following:

- **Fact sheets:** Following completion of the Federal Facilities Agreement, a fact sheet may be distributed to describe the roles and responsibilities of participating agencies and parties involved in the CERCLA process.

- **Small-group workshops and community meetings:** These forums will be used to describe the CERCLA process. Clear and simple presentation

materials will be developed to help people understand the Superfund cleanup process.

OBJECTIVE 5: Provide an open, information-sharing process and the opportunity for interested parties to obtain further information.

The overall objective will be to encourage individuals to seek additional information and express their concerns and interests regarding the LEHR site investigation and cleanup. Techniques will include the following:

- **Information centers at public libraries:** Site background information, documents on the RI/FS activities, and elements of the Administrative Record, such as the regulatory orders and agreements, will be placed at central public information centers. These information centers include the Yolo County Public Library, and the UC Davis Shields Library. A list of current information centers and their hours of operation can be found in Appendix A.

- **Community contact(s):** Representatives from DOE, UC Davis, U.S. EPA, and California Environmental Protection Agency/Department of Toxic Substances Control (Cal/EPA DTSC) will be the community contacts. The names, telephone numbers, and addresses for the representatives are included in Section 7 and in Appendix C. Recipients of fact sheets will be encouraged to direct their comments or inquiries to these contacts.

Information gained from public comments will be used to assess the issues of concern related to the site investigation and remediation process. In addition, a public information line will be maintained to help facilitate responses to public inquiries.

6.0 U.S. EPA's SUPERFUND AND NATIONAL PRIORITIES LIST PROCESS

In 1980, Congress enacted CERCLA (also known as Superfund) to respond to hazardous waste problems that may pose a risk to human health, welfare, and the environment. The Superfund program was established to investigate and clean up abandoned or uncontrolled hazardous waste sites which are ranked by scores determined by the U.S. EPA and then placed on the National Priorities List. The ranking of sites is done according to a Hazard Ranking System. This system is used to assess the relative risk from a release or potential release of hazardous substances to surrounding groundwater, surface water, air, and soil, and the impact that the release would have on public health or the environment.

When LEHR was being investigated by U.S. EPA, four areas were examined: the Strontium-90 Leach Field, the Radium-226 Leach System, disposal trenches, and landfill disposal units (Figure 8). Numbers were assigned to each area, and a composite number was given to the entire LEHR site which is supposed to reflect the potential for contamination. Based primarily on the quantity of wastes processed through the Strontium-90 and Radium-226 systems and the potential for the effluent to impact groundwater, the entire LEHR site was established as a National Priorities List site.

U.S. EPA administers the Superfund program and often works in partnership with state environmental agencies to carry out cleanup efforts. In the case of LEHR, these state agencies include U.S. EPA Region IX, Cal/EPA DTSC, the Regional Water Quality Control Board, and the Department of Health Services Radiologic Health Branch. Below are the 10 phases which comprise the Superfund process:

Site Discovery: The site is initially listed in U.S. EPA's database as a possible source of contamination.

Preliminary Assessment: Existing data and records are reviewed to determine if contamination exists and may potentially affect soil or water.

Site Investigation: Samples are taken and research is conducted to determine if the site has contaminated soil or water.

National Priorities Listing: The site is ranked according to U.S. EPA's HRS and determined eligible for cleanup under the federal Superfund program.

Remedial Investigation: The full extent and sources of contamination are researched and pinpointed during the RI phase. The data developed serves as the basis for a risk assessment. This risk assessment is used to characterize current and potential risks to human health and the environment.

Feasibility Study: Options for cleanup are investigated and identified. The technology and costs of the alternatives are analyzed in detail.

Public Comment Period: Comments related to proposed cleanup alternatives are received at public hearings and in written form in response to RI/FS reports.

Record of Decision (ROD): After careful consideration of all public comments and community concerns, U.S. EPA outlines the selected cleanup option in the Record of Decision.

Remedial Design: This is the engineering phase that follows the Record of Decision during which time the detailed designs, technical drawings, and specifications are developed for the subsequent Remedial Action stage.

Remedial Action: This is the implementation of the Remedial Design. The design is implemented by a qualified contractor according to U.S. EPA-approved plans.

Interim cleanup actions may occur anytime during the initial phases. The public is involved as much as possible throughout the Superfund process.

7.0 COMMUNITY RELATIONS ROLES AND RESPONSIBILITIES AND IMPLEMENTATION PLAN

The roles and responsibilities of involved parties are outlined in Table 7. The primary community contacts for each of the involved agencies are given below.

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U.S. EPA, Region 9
75 Hawthorne Street, (H-1-1)
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(415) 744-2179 or toll free 1-(800) 231-3075

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8.0 REFERENCES

Dames & Moore, 1990. Final SWAT Report, Old UCD Landfill for the University of California, Davis.

Department of Water Resources, 1978. Evaluation of groundwater resources: Sacramento Valley, Bulletin 118-6, 136 pp.

United States Department of Energy, 1988, *Environmental Survey Preliminary Report,* March 1988.

Warren J., 1985. Radioactive Waste Burial at the Laboratory for Energy Related Health Research, University of California, Davis.

TABLES

TABLE 1
WASTEWATER TABULATION
IMHOFF TREATMENT SYSTEM
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

Year	No. of Batches	Total Gallons [c]	Clarified Waste (mCi)[a]	Decontamination Effluent (μCi)[b]
1960-1961	16*	6,300	4	19
1962	17*	8,500	18	5
1963	19*	9,400	15	11
1964	57	250,800	48	20
1965	53	226,800	83	216
1966	57	234,900	138	89
1967	70	280,700	144	389
1968	55	245,100	143	248
1969	30	151,200	25	150
1970	35	178,300	10	91
1971	37	192,400	2	181
1972	37	192,200	5	75
1973	37	192,400	2.64	81
1974	35	182,000	2.46	175
1975	33	171,600	1.43	332
1976	31	161,200	1.06	61
1977	26	130,000	0.991	50
1978	10	52,000	0.472	13
1979	25	135,000	0.659	25
1980	15	78,000	0.275	22
1981	7	36,400	0.165	31
1982	4	20,800	0.110	10
1983	4	20,800	0.078	5.5
1984	N/A	41,600	N/A	31
1985	N/A	54,000	N/A	26
1986	N/A	20,800	N/A	65
1987	N/A	15,600	N/A	139.5
Totals	710	3,288,800	645.340	2,555

Source: DOE, 1988
[a] Entering resin columns.
[b] Discharged to leach field.
[c] Totals using available data.
N/A Data not available.
* Batches approximately 500 gallons each.

TABLE 2
LEHR RADIOACTIVE WASTE BURIAL DATA
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

I. Radioactive Waste Burial Holes

Hole No.	Date	Description and Estimated Radionuclide Quantity
1	Unknown	Radioactive cow buried. Exact location and date not known. Cow buried on a Sunday.
2	1956	Dug in 1956. Exact location not known.
3	5/16/61	Radioactive calves buried 6' -0" deep from Vet. Med., Armstrong Tract. Exact location not known.
4	Unknown	Unknown
5	Unknown	Unknown
6	Unknown	Unknown
7	Unknown	Unknown
8	Unknown	Unknown
9	2/5/63	Not included in original table.
10	4/23/63	Not included in original table.
11	7/9/63	Not included in original table.
12	9/5/63	0.537 nCi ^{14}C
13	9/28/63	.005 mCi ^{59}Fe
14	10/8/63	.03 mCi ^{59}Fe
15	10/18/63	0.102 nCi ^{59}Fe
16	3/3/64	3 nCi ^{45}Ca + 0.05 nCi ^{14}C + 4 nCi ^{32}P
17	6/5/64	2.5 nCi ^{35}S + 4 nCi ^{14}C
18	9/9/64	.4 mCi C14 + .5 mCi ^{35}S + .75 mCi ^{14}C
19	9/20/64	8 mCi ^{45}Ca + .1 mCi ^{3}H
20	12/14/64	.015 mCi ^{85}Sr + .06 mCi ^{137}Cs
21	3/16/64	6 nCi ^{45}Ca + .1 mCi ^{14}C
22	2/1/65	0.5 nCi ^{45}Ca
23	2/12/65	.06 mCi ^{59}Fe
24	4/22/65	0.560 mCi ^{45}Ca, 8 mCi ^{32}P
25	8/17/65	^{14}C-0.2 mCi, ^{3}H-0.1 mCi, ^{35}S-0.01 mCi, ^{59}Fe-0.06 nCi
26	9/8/65	^{3}H-0.005 mCi, ^{35}S-0.05 mCi, ^{65}Zn-0.503 mCi, ^{22}Na-0.02 mCi ^{45}Ca-0.24 mCi, ^{131}I-0.50 mCi, ^{14}C-0.334 mCi, ^{59}Fe-0.99 mCi
27	4/26/66	^{14}C-0.8 mCi
28	10/24/66	^{14}C-0.16 mCi, ^{59}Fe-0.05 mCi, ^{238}U-0.002 mCi, ^{226}Ra-0.018 mCi ^{203}Hg-1.5 mCi
29	2/6/68	^{137}Cs-.05 mCi, ^{14}C-11.174 mCi ^{3}H110.001 mCi, ^{131}I-1.026 mCi
30	6/14/68	^{14}C-32.1992 mCi, ^{60}Co-.23 mCi, unknown .005 mCi
31	7/12/68	^{137}Cs-.15 mCi, ^{3}H-2.21 mCi, ^{60}Co-.003 mCi, ^{14}C 18.276 mCi
32	7/17/69	^{14}C-44.77 mCi

TABLE 2 (CONTINUED)
LEHR RADIOACTIVE WASTE BURIAL DATA
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

Hole No.	Date	Description and Estimated Radionuclide Quantity
33	8/7/69	^{14}C-27.033 mCi
34	9/11/69	^{3}H-55.282 mCi, ^{14}C-32.251 mCi
35	3/19/70	^{3}H-26.388 mCi, ^{14}C-42.699 mCi
36	5/21/70	^{3}H-24.903 mCi, ^{14}C-45.2547 mCi, ^{60}Co-.005 mCi
37	6/25/70	^{3}H-4.4083 mCi, ^{14}C-47.9436 mCi, ^{35}S-.5 mCi
38	4/13/71	^{3}H-19.621 mCi, ^{14}C-33.318 mCi, ^{35}S-0.6 mCi
39	1/4/72	^{3}H-24.451 mCi, ^{14}C32.392 mCi, ^{35}S-6.3 mCi, ^{22}Na -1.051 mCi
40	7/14/72	^{3}H-93.4 mCi, ^{14}C-30 mCi
41	8/22/72	^{3}H-38.85 mCi, ^{14}C-33.1 mCi, ^{125}I-1.5 mCi
42	11/2/72	^{14}C-15.294 mCi, ^{3}H-44.035 mCi, ^{125}I-4.5 mCi
43	2/1/73	^{14}C-35.1 mCi, ^{3}H-26.0 mCi, ^{125}I-5.0 mCi
44	4/12/73	^{14}C-60.1 mCi, ^{3}H-75.0 mCi, ^{125}I-5.0 mCi
45	6/5/73	^{14}C-32.55 mCi, ^{3}H-42.7 mCi, ^{32}P-46.66 mCi
46	10/18/73	^{3}H-51.96 mCi, ^{14}C-45.55 mCi, ^{32}P-67.26 mCi
47	2/20/73	^{14}C-28.63 mCi, H-3 30.17 mCi, ^{32}P-90.31 mCi
48	4/4/74	^{32}P-89.401 mCi, ^{3}H-45.286, ^{14}C-25.53 mCi, ^{125}I-.8768 mCi, ^{45}Ca-.31 mCi, ^{22}Na-.1351 mCi, ^{86}Rb-3.8 mCi, ^{57}Co-.0065 mCi, ^{51}Cr/^{75}Se/^{59}Fe/^{99}Mo/^{198}Au/^{133}Xe/^{111}In/^{203}Hg/^{67}Ga (approximately 1.3 mCi each)
49	7/16/74	^{14}C-24.506 mCi, ^{3}H-83.981 mCi, ^{32}P-79.55 mCi, ^{35}S-11.05 mCi, ^{22}Na-.114 mCi, ^{86}Rb-4.2 mCi, ^{75}Se-.2 mCi, ^{45}Ca-.001 mCi, ^{59}Fe-.1 mCi, ^{36}Cl-.254 mCi

II. Radioactive Waste Burial Trenches

Trench No.	Date	Description
1	Unknown	2'0" wide, 66'0" long, 10'0" from north fence line, and 3'0" from east fence line. Covered June 10, 1957.
2	6/10/57	2'0" wide, 100'0" long, 16'0" from north fence line, and 3'0" from east fence line. Opened on June 10, 1957 and covered on October 27, 1957.
3	10/25/57	Same dimensions as Radioactive Trench #2. Distance from north fence line not known. Opened on October 25, 1957 and covered on May 9, 1958.
4	5/9/58	2'0" wide, 45'0" long, and 30'0" from north fence line. Opened on May 9, 1958 and on November 1958.
5	5/9/58	2'0" wide, 33'0" long, and 63'0" from north fence line. Opened on May 9, 1958 and on November 1958.
6	11/13/58	Opened on November 13, 1958 and covered on May 29, 1959.
7	5/29/59	2'0" wide and 123'0" long. Distance from east fence line not known. Trench dug on May 29, 1959 and covered on April 8, 1960.

TABLE 2 (CONTINUED)
LEHR RADIOACTIVE WASTE BURIAL DATA
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

Trench No.	Date	Description
8	4/8/60	2'0" wide and length to center of rubbish Pit #3. Distance from east fence not known. Opened on April 8, 1960 and covered on September 28, 1960.
9	9/23/60	2'0" wide and to center of rubbish Pit #3. 36'0" from east fence line. Opened on September 23, 1960 and probably closed on November 7, 1960.
10	11/7/60	Exact dimensions and location not known. Opened on November 7, 1960 and closed March 13, 1961.
11	3/13/61	2'0" wide, 180'0" long and 9'0" to center of trench from east fence line. Opened on March 13, 1961. Date closed not known.
12	12/5/58	2'0" wide, 8'0" long, and 55'0" from southwest corner. 9'6" to center of trench from south fence. Charged to University Physician, Job #215160. Opened December 5, 1958. Date closed not known.
13	5/29/59	Continuation of Radioactive Trench #12. Opened on May 29, 1959 and closed on April 8, 1960.
14	4/8/60	2'0" wide. Located between Radioactive Trench #13 and south fence line. Opened on April 8, 1960. Date closed unknown.
15	Unknown	Most likely used between 9/63 and 11/65. Probable contents - radium-226 and strontium-90 from dog fecal waste.
16	Unknown	As #15.
17	Unknown	As #15 and #16

Source: Warren, 1985

NOTE: Radionuclide quantities as recorded in Warren (1985); information not confirmed. Actual volumes of waste not known.

KEY:

nCi - picocuries
^{14}C - carbon 14
mCi - milicuries
^{59}Fe - iron 59
^{45}Ca - calcium 45
^{3}H - tritium
^{35}S - sulfur 35
^{137}Cs - cesium 137
^{32}P - phosphate 32
^{65}Zn - zinc 65
^{22}Na - sodium 22
^{131}I - iodine 131
^{238}U - uranium 238
^{226}Ra - radium 226
^{203}Hg - mercury 203
^{60}Co - cobalt 60
^{125}I - iodine 125
^{32}P - phosphate 32
^{86}Rb - rubidium 86
^{57}Co - cobalt 57
^{51}Cr - chromium 51
^{75}Se - selenium 75
^{99}Mo - molybdenum 99
^{198}Au - gold 198
^{133}Xe - xenon 133
^{111}In - indium 111
^{167}Ga - gallium 67
^{36}Cl - chlorine 36

TABLE 3
POTENTIAL CONSTITUENTS OF CONCERN DETECTED IN SOIL
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

Pen Soil Samples

Radionuclides
Cesium-137
Potassium-40
Radium-226
Strontium-90
Thorium-232
Tritium

Organic Chemicals
Chlordane

Inorganic Chemicals
Nitrogen (nitrate)

Soil Boring Samples

Radionuclides
Bismuth-214
Cesium-137
Lead-210
Lead-212
Lead-214
Potassium-40
Radium-226
Strontium-90
Thorium-232
Tritium

Organic Chemicals
Chlordane
Di-N-butylphthalate
Methylene chloride

Inorganic Chemicals
Arsenic
Barium
Beryllium
Cadmium
Chromium (total)
Chromium (hexavalent)
Cobalt
Copper
Lead
Mercury
Molybdenum
Nickel
Nitrogen (nitrate)
Thallium
Vanadium
Zinc

Monitoring Well Soil Samples

Radionuclides
Actinium-228
Cesium-137
Cobalt-60
Lead-212
Lead-214
Manganese-54
Potassium-40
Radium-226
Strontium-90
Thallium-208
Thorium-232
Tritium

Organic Chemicals
Chlordane
Diethyl phthalate
Methylene chloride

Inorganic Chemicals
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium (total)
Chromium (hexavalent)
Cobalt
Copper
Lead
Mercury
Molybdenum
Nickel
Nitrogen (nitrate)
Selenium
Silver
Thallium
Vanadium
Zinc

TABLE 4
POTENTIAL CONSTITUENTS OF CONCERN DETECTED IN SURFACE WATER
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

Radionuclides	Organic Chemicals	Inorganic Chemicals
Strontium-90	2-Chlorophenol	Antimony
Tritium	4,4'-DDD	Barium
	4,4'-DDE	Beryllium
	4,4'-DDT	Cadmium
	Aldrin	Calcium
	Alpha-BHC	Chloride
	Beta-BHC	Chromium (total)
	Bis(2-ethylhexyl)phthalate	Chromium (hexavalent)
	Bis(2-isopropyl)ether	Cobalt
	Bromodichloromethane	Copper
	Chloroform	Lead
	Delta-BHC	Magnesium
	Di-N-butylphthalate	Mercury
	Dibromochloromethane	Molybdenum
	Dieldrin	Nickel
	Endosulfan I	Nitrogen (nitrate)
	Endosulfan II	Phosphate (total)
	Endrin	Potassium
	Gamma-BHC	Selenium
	Heptachlor	Silver
	Methylene chloride	Sodium
	Toluene	Sulfate
		Thallium
		Vanadium
		Zinc

TABLE 5
POTENTIAL CONSTITUENTS OF CONCERN DETECTED IN GROUNDWATER
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

Radionuclides	Organic Chemicals	Inorganic Chemicals
Carbon-14	1,1,1-Trichloroethane	Antimony
Strontium-90	1,1-Dichloroethane	Barium
Tritium	1,1-Dichloroethene	Beryllium
	1,2-Dichloroethane	Cadmium
	4,4'-DDE	Calcium
	Aldrin	Chloride
	Alpha-BHC	Chromium (total)
	Benzyl butyl phthalate	Chromium (hexavalent)
	Beta-BHC	Cobalt
	Bis(2-ethylhexyl)phthalate	Copper
	Bromodichloromethane	Lead
	Chloroform	Magnesium
	Delta-BHC	Mercury
	Di-n-butylphthalate	Molybdenum
	Dieldrin	Nickel
	Endrin	Nitrogen (nitrate)
	Endrin aldehyde	Phosphate (total)
	Gamma-BHC	Potassium
	Heptachlor	Selenium
	Methylene chloride	Silver
	Toluene	Sodium
	Trichloroethene	Sulfate
	Trichlorofluoromethane	Thallium
		Vanadium
		Zinc

Table 6

Community Relations Implementation Plan

Community Relations Activities	Project Milestones				
	D&D Activities	RI Initiated	RI Completed	RI/FS Initiated	RI/FS Completed
Mailing List	— — — — — — — — — Update as Needed — — — — — — — — — —				
Information Centers	— — — — — — — Include Documents as Available — — — — — — —				
Community Contacts	— — — — — — — — Respond to Public Inquiries — — — — — — — —				
Community Meetings	● — — — — ● — — Attend as Requested			● — — — — — ● — —	
Small-Group Workshops	● — — — — ● — — Attend as Requested			● — — — — — ● — —	
Fact Sheets	●		●	●	●
Press Releases	●		●	●	●
Well Sampling Result Letters	— — — — — — — Distribute as Results are Available — — — — — — —				
Campus Newspaper Announcements			●	●	●
Public Comment Period Notices					●
Update Community Relations Plan	— — — — — — — — — Update as Needed — — — — — — — — — —				

Note: community relations activities associated with D&D activities are being conducted separate from the Superfund RI/FS activities.

TABLE 7
STAFFING ROLES & RESPONSIBILITIES
COMMUNITY RELATIONS PLAN
LEHR ENVIRONMENTAL RESTORATION

ACTIVITY	PROCEDURES	PROPOSED STAFFING	RESPONSIBILITY
Maintain Public Information Centers	Information centers will be located at the Yolo County Library, and the UC Davis Shields Library. These files will contain project documents and information related to the LEHR site and will be available for public review. The addresses and hours of operation of the information centers are listed in Appendix A.	DOE/ UC Davis	Initial contact with librarians or reference desk managers. Identify materials to be included in information files. Update as necessary. Prepare and maintain an index of materials sent to the libraries.
Designate Community Contacts	Community contacts will include representatives of the DOE, UC Davis, and EPA.	DOE/ UC Davis/ EPA	Community contacts will respond to and document inquiries from the public and press. Their names, addresses and telephone numbers will be provided in Fact Sheets and listed at the information centers.
Maintain Mailing List	A current project mailing list has been developed; however, names and addresses will be kept confidential. The mailing list includes elected officials, agency and local representatives, residents and other individuals who have expressed interest in the LEHR site. Others will be added to the mailing list throughout the RI/FS.	DOE/ UC Davis	List names, addresses, and telephone numbers of interested individuals, organizations, and agencies. Update lists and prepare mailing labels. Suggest additional names for mailing list.
Prepare ITEH Briefing Materials	At key milestones, updates will be placed into fact sheets, the UC Davis newspaper, and news releases for distribution to ITEH employees.	DOE/ UC Davis	Prepare draft and coordinate placement. Review.
Prepare Fact Sheets	Fact sheets will be developed at key milestones and distributed to the mailing list throughout the LEHR site investigation and cleanup.	DOE/ UC Davis	Suggest topics. Research content. Draft fact sheets. Review and comment on fact sheet content. Organize production. Distribute.

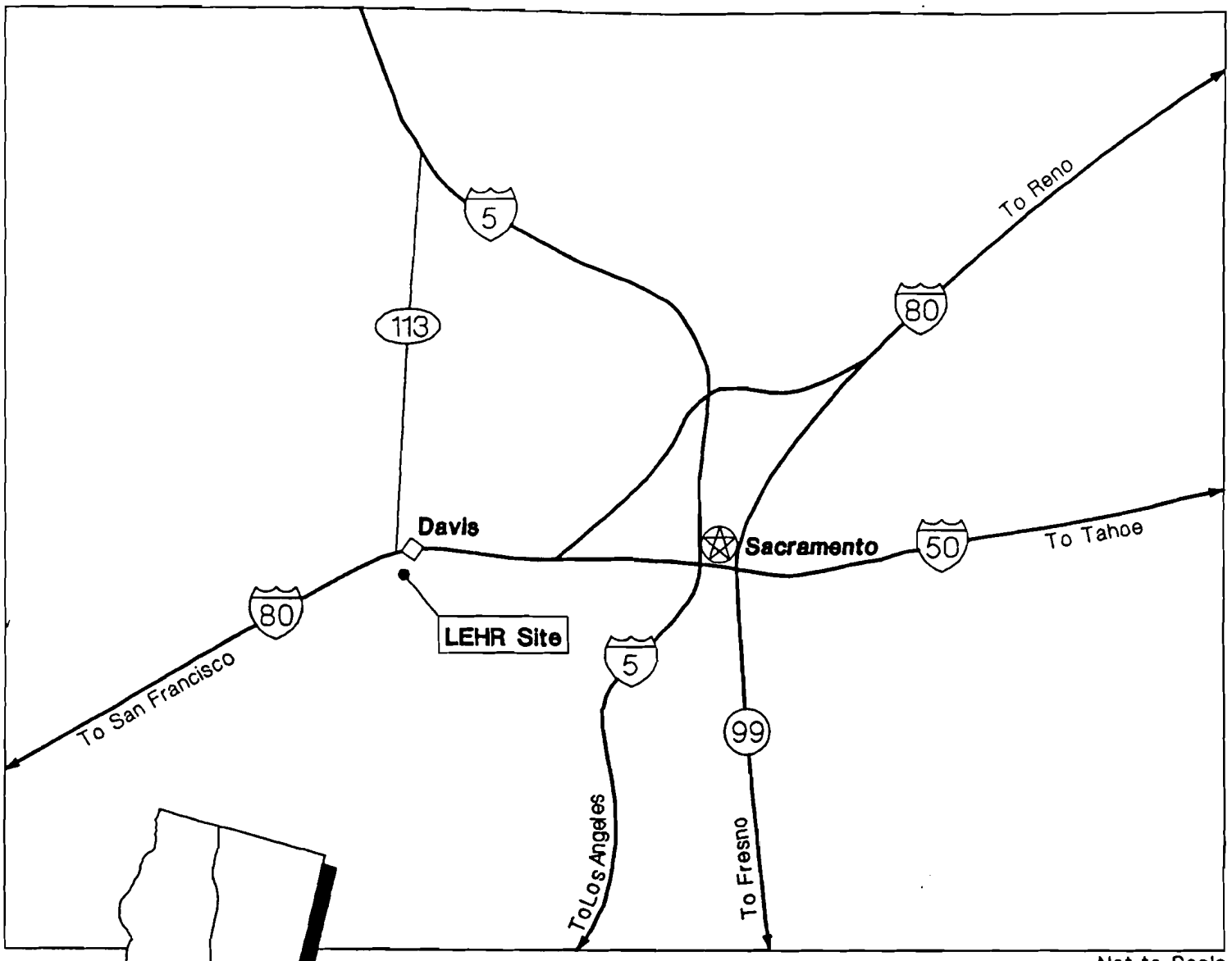
TABLE 7 (CONTINUED)
STAFFING ROLES & RESPONSIBILITIES
COMMUNITY RELATIONS PLAN
LEHR REMEDIAL INVESTIGATION/FEASIBILITY STUDY

ACTIVITY	PROCEDURES	PROPOSED STAFFING	RESPONSIBILITY
Publicize Public Meetings and Public Comment Periods	Display advertisements will be prepared and placed into the Davis newspapers at least two weeks prior to a formal public meeting to announce the meeting and formal 30-day public comment period. Public comment periods are required when the Draft RI/FS Report is released for public review and comment.	DOE/ UC Davis	Prepare draft display advertisement. Review and coordinate placement into local newspaper.
Prepare Press Releases	Press releases will be prepared and distributed to local media at key project milestones and to announce upcoming public meetings.	DOE/ UC Davis	Suggest topics. Research content. Draft press releases. Review and comment on fact sheet content. Organize production. Distribute.
Prepare Well Sampling Result Letters	Prepare well sampling result letters for adjacent neighbors.	DOE/ UC Davis	Prepare draft and coordinate mail-out. Review.
Conduct Public Meetings	Public meetings will be conducted for adjacent neighbors, interested individuals, organizations, and agencies to receive explanation about the site investigation and cleanup program and to hear and address public comments. Public meetings will be held to address the Draft RI/FS Report and the FS alternatives.	DOE/ UC Davis/ EPA	Strategize meeting format and proceedings. Organize public meeting. Secure meeting room location. Draft presentation materials. Review. Attend and participate.
Prepare Public Responsiveness Summary	After each public meeting, a responsiveness summary will be prepared to summarize public questions and concerns and responses to them. These summaries will be available for public review at the information centers.	DOE/ UC Davis/ EPA	Draft preliminary responsiveness summary. Coordinate distribution to information centers. Review.

TABLE 7 (CONTINUED)
STAFFING ROLES & RESPONSIBILITIES
COMMUNITY RELATIONS PLAN
LEHR REMEDIAL INVESTIGATION/FEASIBILITY STUDY

ACTIVITY	PROCEDURES	PROPOSED STAFFING	RESPONSIBILITY
Conduct Small-Group Workshops	Small-group workshops will be conducted with adjacent residents and property owners prior to or following general community public meetings. These meetings will serve as working sessions for those residents and property owners more directly impacted by site activities.	DOE/ UC Davis	Strategize meeting format and proceedings. Organize public meeting. Secure meeting room location. Draft presentation materials. Review. Attend and participate.
Update Community Relations Plan	When significant new information is obtained or project changes occur, the project team will review the CRP to assess the need for revisions	DOE/ UC Davis EPA	Review comments and CRP revisions. Review. Approve.

FIGURES



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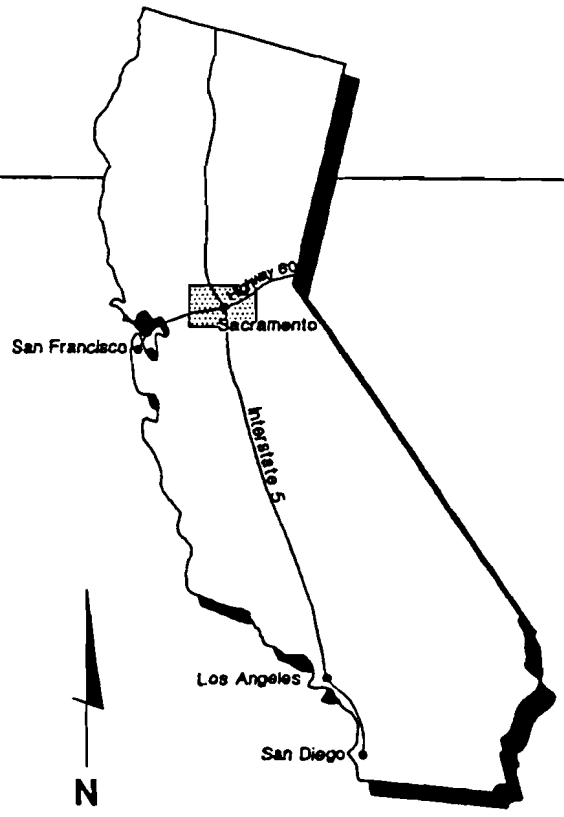
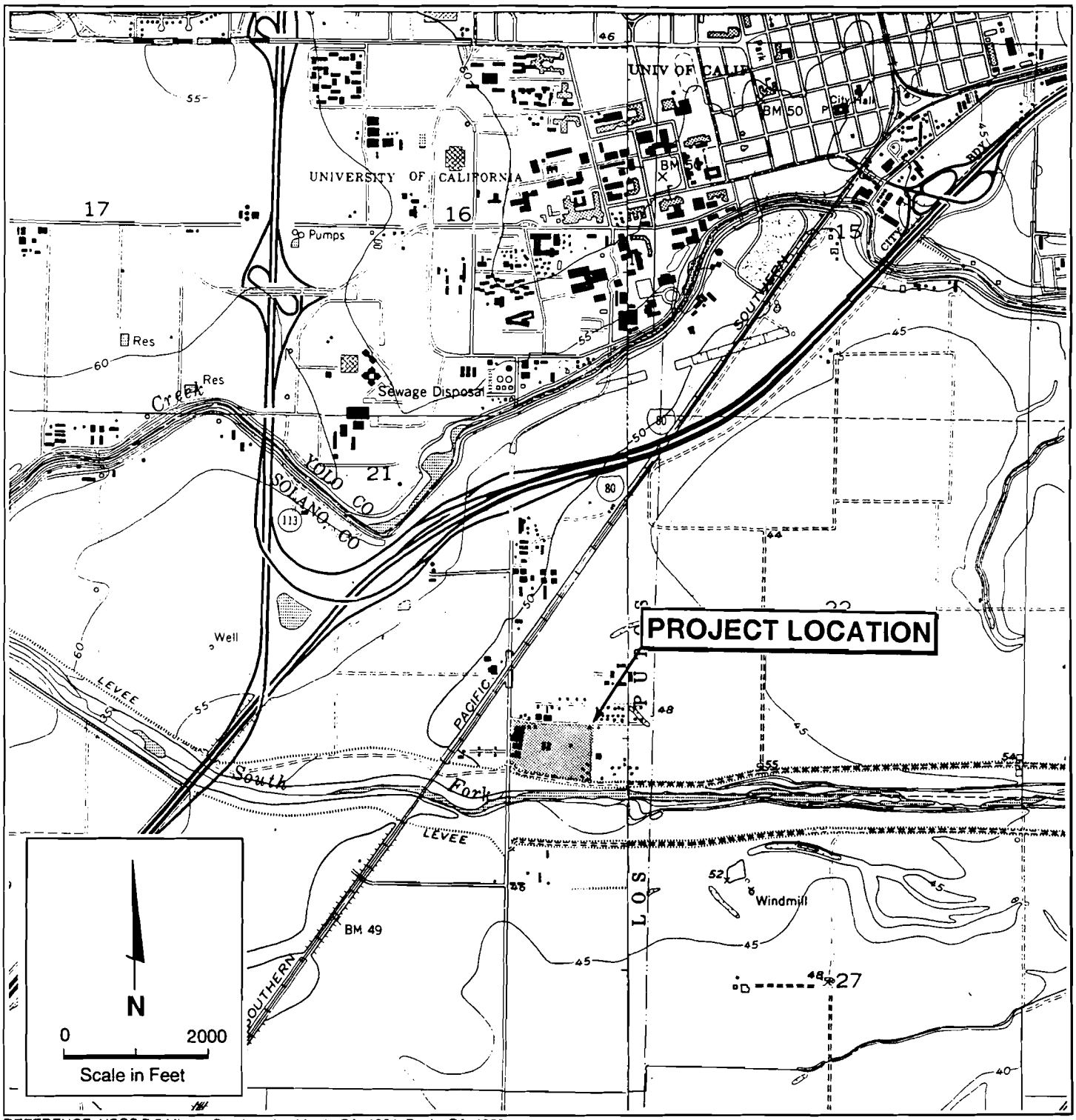


SITE VICINITY MAP
Community Relations Plan
LEHR Environmental Restoration

FIGURE 1



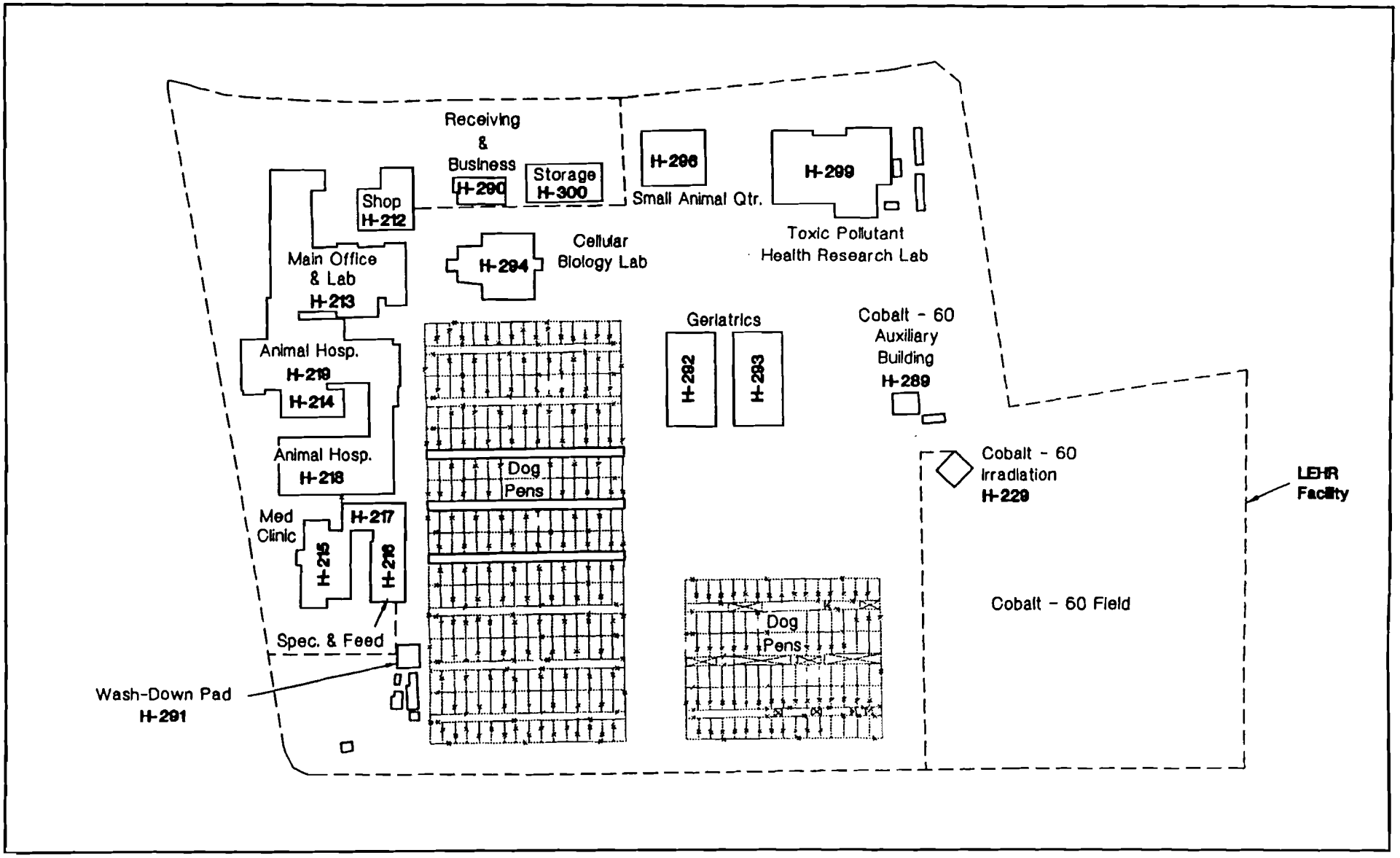
REFERENCE: USGS 7.5 Minute Quadrangle; Merritt CA, 1981, Davis, CA, 1982

SITE LOCATION MAP

Community Relations Plan

LEHR Environmental Restoration

FIGURE 2



EXPLANATION

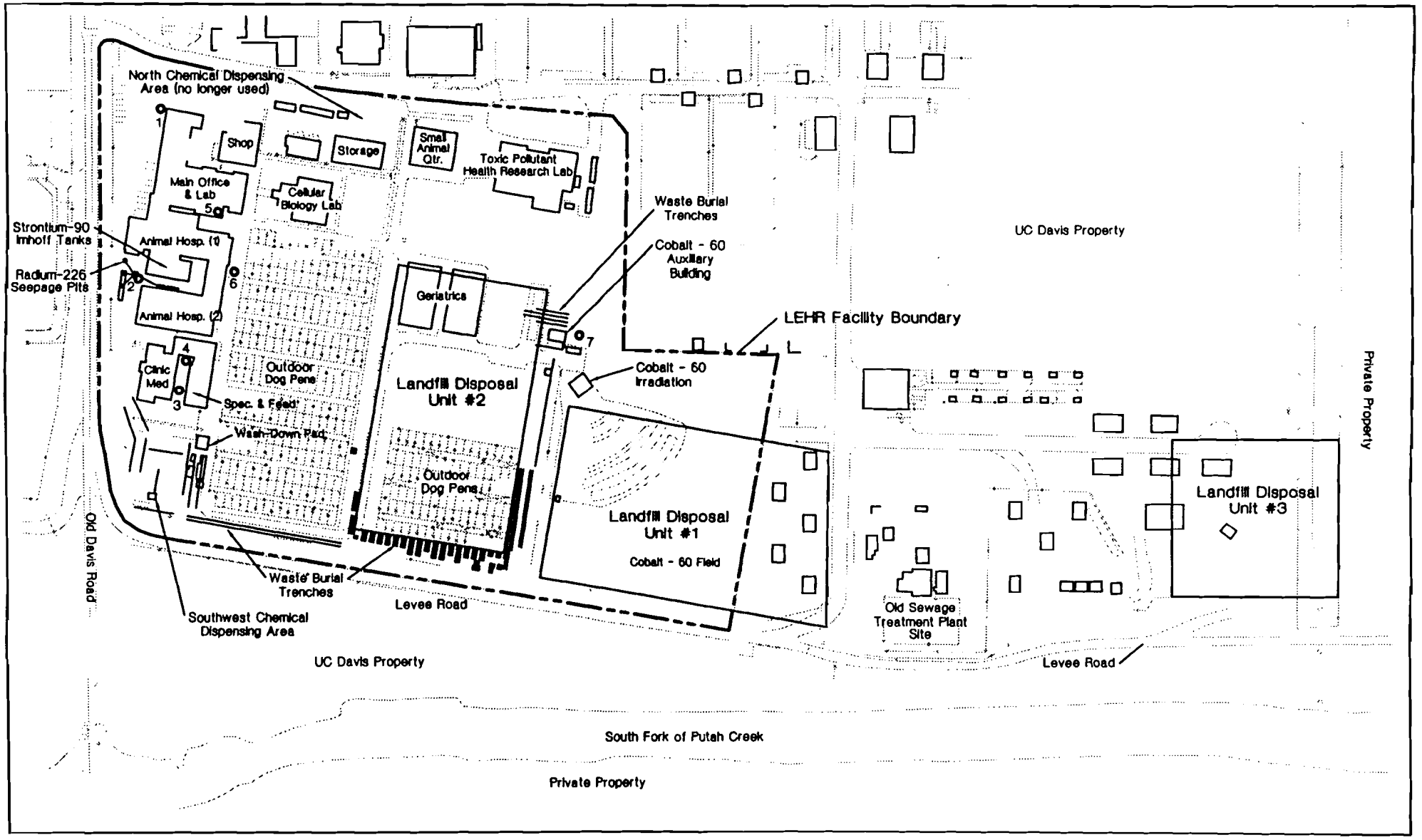
H-291 Building Number

0 150
Scale in Feet

N

SITE STRUCTURES
Community Relations Plan
LEHR Environmental Restoration

FIGURE 3



EXPLANATION

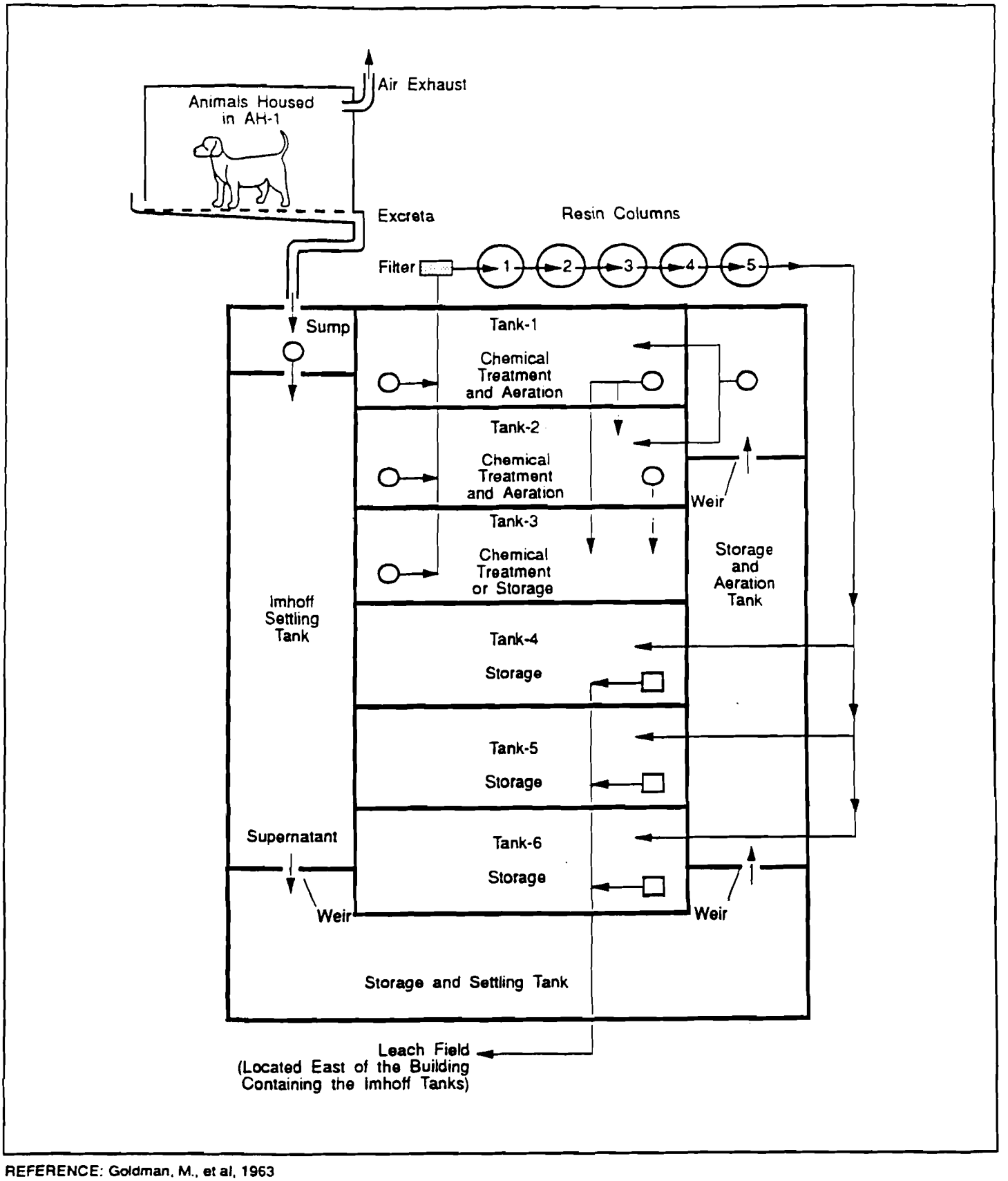
- ■ Radioactive Trenches and Holes
- —— Waste Burial Trenches
- O Domestic Septic Tanks

0 220
Scale in Feet

N

FORMER WASTE DISPOSAL AREAS
Community Relations Plan
LEHR Environmental Restoration

FIGURE 4



REFERENCE: Goldman, M., et al, 1963

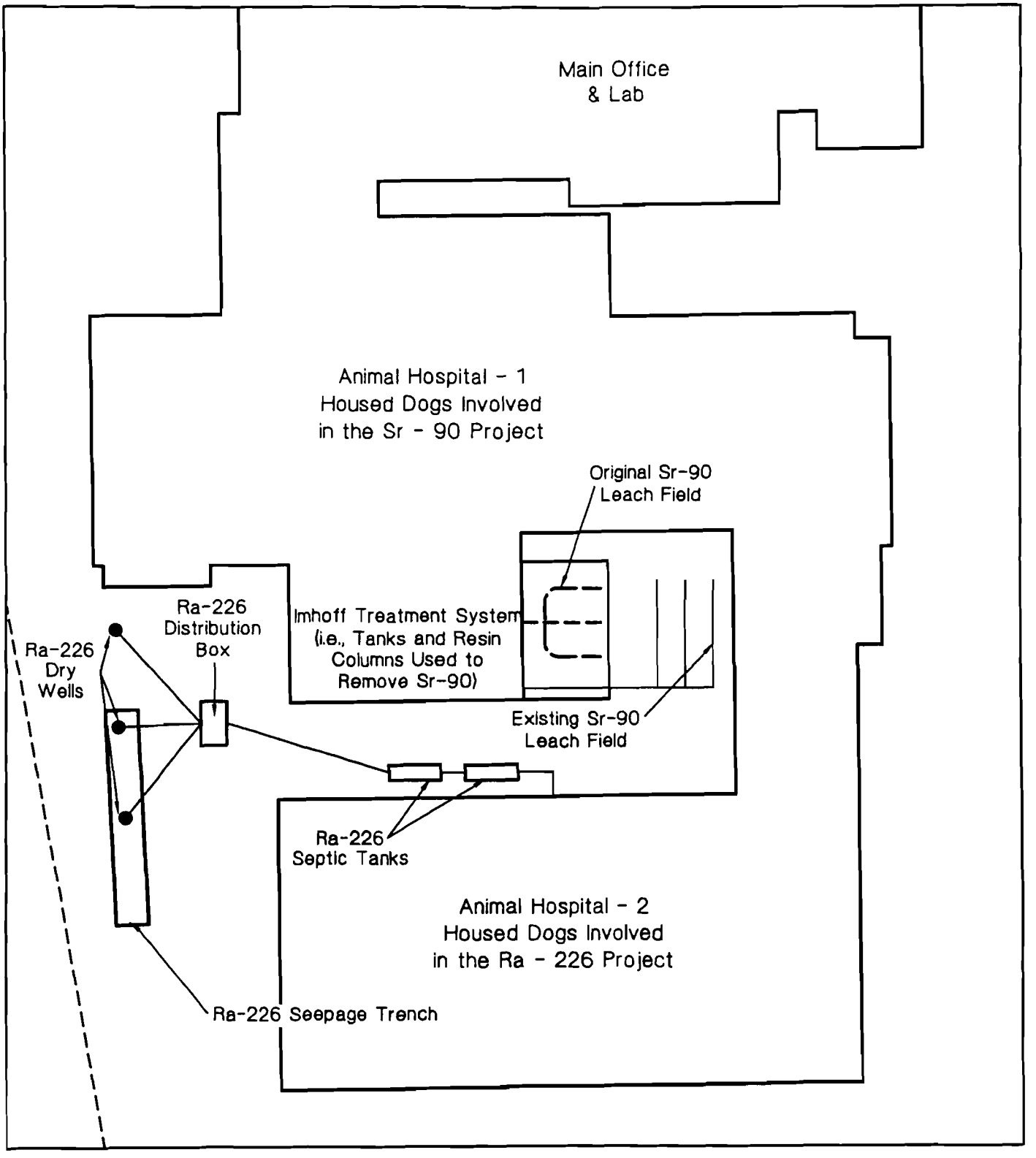
SCHEMATIC REPRESENTATION OF THE IHHOFF TREATMENT SYSTEM

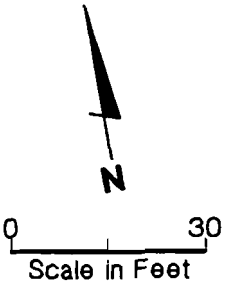
Community Relations Plan
LEHR Environmental Restoration

DAMES & MOORE

10805-454-044 DOE7

FIGURE 5

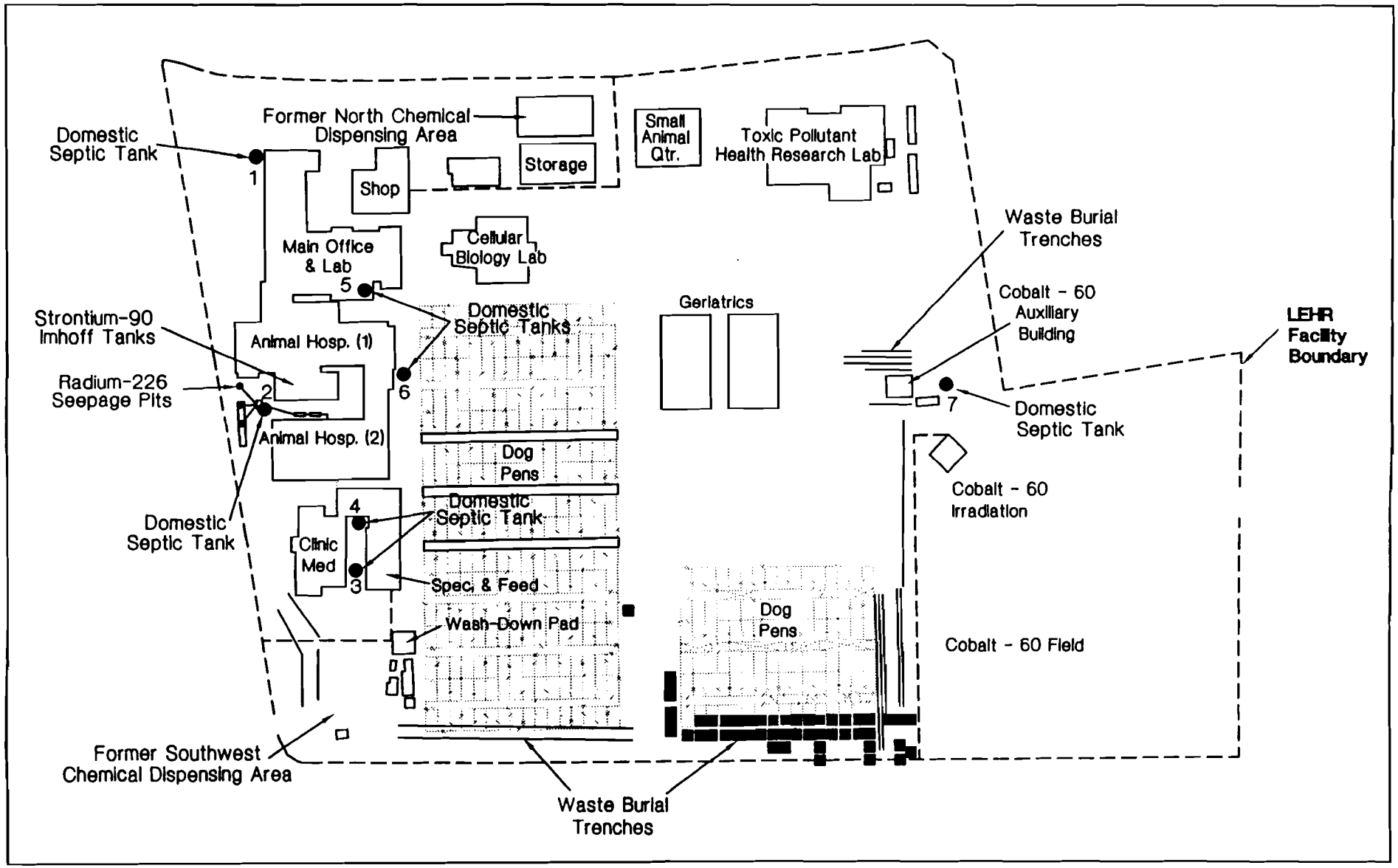




LOCATION OF THE IMHOFF AND THE RADIUM-226 TREATMENT SYSTEMS

Community Relations Plan
LEHR Remedial Investigation/Feasibility Study

FIGURE 6



EXPLANATION

- ■ Radioactive Trenches and Holes
- —— Waste Burial Trenches
- ● Domestic Septic Tanks

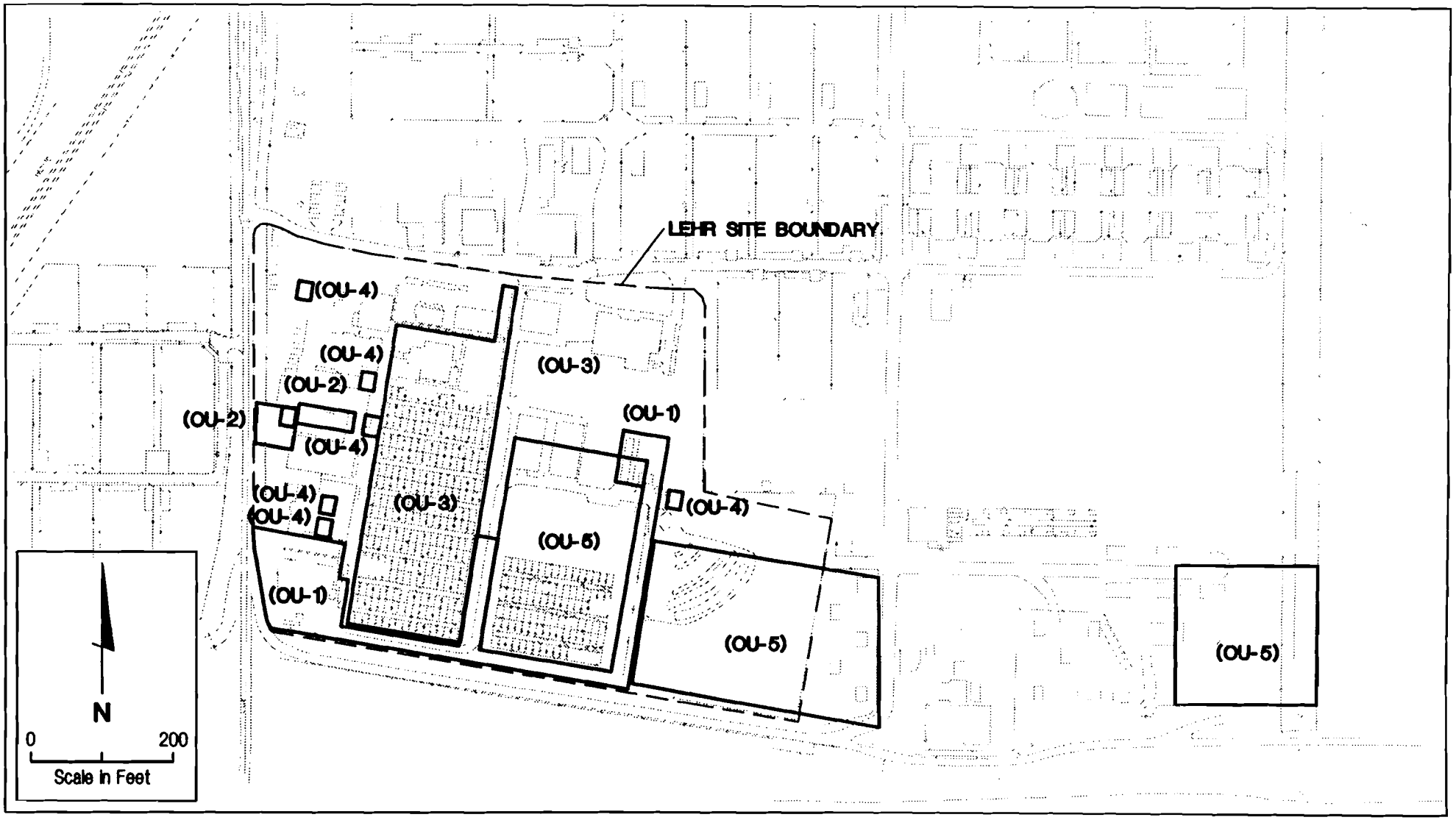
0 150
Scale in Feet

N

LOCATION OF DOMESTIC SEPTIC TANKS

Community Relations Plan
LEHR Environmental Restoration

FIGURE 7



EXPLANATION

OU	Operable Unit	OU-4	Domestic Septic Tanks
OU-1	DOE Disposal Trenches and UC Davis Disposal Trenches	OU-5	Landfill Disposal Units
OU-2	Strontium-90 Leach Field Radium-226 Leach System	OU-6	Groundwater and Surface Water
OU-3	Western Dog Pens and North Chemical Dispensing Area		

SOIL OPERABLE UNIT (OU) INVESTIGATION AREAS

Community Relations Plan
LEHR Environmental Restoration

FIGURE 8

APPENDIX A
SUGGESTED INFORMATION CENTERS

Yolo County Library
Reference Desk
315 E. 14th Street
Davis, CA 95616
(757-5593)

Monday	Noon to 8 P.M.
Tuesday-Thursday	11 A.M. to 8 P.M.
Friday-Saturday	10 A.M. to 5:30 P.M.

Shields Library
Reserve Book Desk
University of California, Davis
Davis, CA 95616
(752-2760)

Monday-Thursday	8 A.M. to 8 P.M.
Friday	8 A.M. to 6 P.M.

APPENDIX B
LEHR FACT SHEETS

Site Assessment and Cleanup at LEHR: An Update

April 1995

OVERVIEW

The former Laboratory for Energy-Related Health Research (LEHR) at UC Davis, where for more than 30 years scientists studied the long-term health effects of exposure to low levels of radiation on laboratory animals, is in the midst of evaluating the environmental impact of chemical and low-level radioactive materials in its facilities and surrounding environment, and treating, containing, or removing these materials. The study was one of several projects the U.S. Department of Energy (DOE) supported for many years at various U.S. research institutions. Also at the site are an inactive campus landfill and several former disposal areas containing low-level radioactive wastes from the campus and the LEHR project.

In May 1994, as a result of groundwater contamination detected during preliminary investigations and the potential threat of contamination to public health and the environment, the U.S. Environmental Protection Agency placed the LEHR site on the National Priorities (Superfund) List.

DOE's assessment and cleanup activities at LEHR are estimated to cost $33 million. Some activities have already been completed, and the cost and plans for future activities will be determined once the assessment is completed, in 1996.

HISTORY AND DESCRIPTION OF LEHR

The Site Located about a mile south of the main UC Davis campus, LEHR occupies 15 acres surrounded by campus research facilities and private land. A levee along Putah Creek borders LEHR to the south. The site, now called the Institute of Toxicology and Environmental Health (ITEH) has outdoor dog kennels and 16 buildings, 11 of which house active research programs and require no treatment or removal of old LEHR research wastes.

UC Davis owns the LEHR land and leases the site to DOE, which built and owns LEHR's facilities. Once treatment or removal of LEHR's research wastes has been completed, UC Davis will assume ownership and operation of the entire facility.

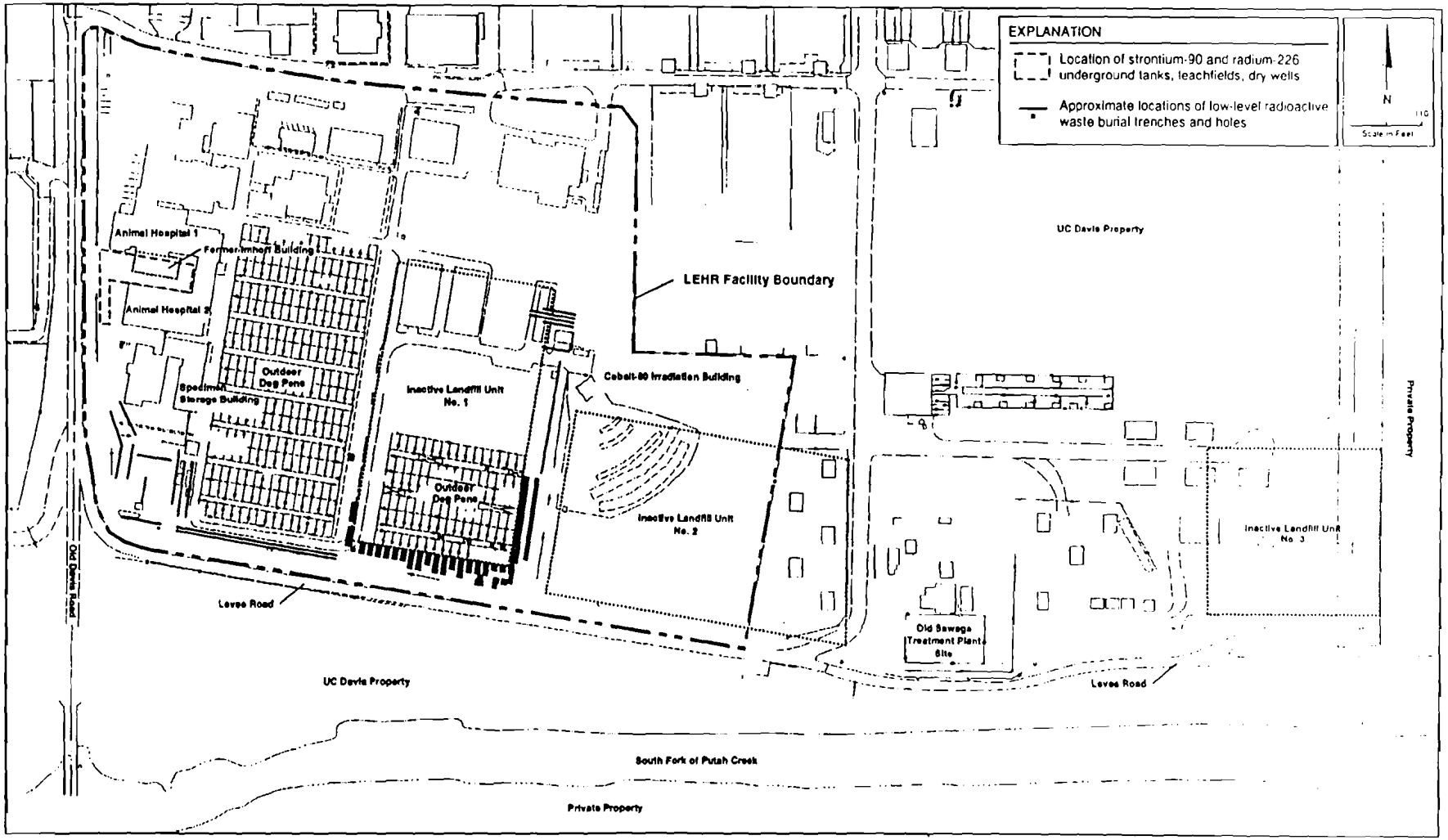
An inactive campus landfill, used from the 1940s until the mid-1960s, covers about 6 acres of the LEHR site, plus another acre approximately 600 feet east of LEHR. Also at LEHR are several low-level radioactive waste burial areas, where the campus and LEHR buried wastes until 1974. The wastes were buried according to regulations that were in effect at the time. Adjacent to LEHR is the old campus sewage treatment plant, which closed in 1949. The site is the subject of a separate study by UC Davis.

The Research Through the support of DOE's predecessor, the U.S. Atomic Energy Commission, LEHR (also known in the earlier years as the Radiobiology Laboratory) began in 1951 as a research project investigating the biological effects of X-rays. A few years later, the Atomic Energy Commission contracted with LEHR for what became a 33-year study that investigated the health effects of internal exposure to low levels of strontium 90 and radium 226. In a separate but related project, research animals were exposed to cobalt 60 radiation. Research involving the use of small amounts of plutonium 241, thorium 228, and other radioisotopes was also performed.

Research at LEHR has focused on:

- understanding better the effects of exposure to low-level radiation on the skeleton and its blood-forming constituents;
- investigating the behavior of certain bone-seeking radioactive materials;
- studying the beagle as an experimental animal model;
- exploring how low-level radiation triggers and affects the formation of tumors and development of leukemia; and,
- developing effective ways to use results gathered from animal studies to assess risks to humans.

In all, 1063 beagles were used in the strontium and radium study. Selected because of their relatively long life spans and



LEHR Site and Old UC Davis Landfill

Decontamination and Decommissioning of LEHR Imhoff Building

April 1995

OVERVIEW

As part of its continuing effort to clean up a former research facility located at UC Davis, the U.S. Department of Energy (DOE) has completed the decontamination and decommissioning (D&D) of a special treatment facility ("Imhoff Building") that was used to process liquid radioactive waste at the former Laboratory for Energy-Related Health Research (LEHR), where for more than 30 years scientists studied the long-term health effects of exposure to radiation on laboratory animals.

From 1961 to 1987, laboratory animals (primarily beagles) housed in Animal Hospital 1 (AH-1) were fed strontium 90 to study the long-term effects of exposure to this radionuclide, a component of radioactive fallout. Excreta from the animals and wash water from the animal cages in AH-1 were discharged to the Imhoff Building through a special drainage system that was separate from the domestic sanitary sewage system at LEHR. The wastewater was processed through a series of underground holding and settling tanks and ion-exchange columns to remove the strontium 90. The treated effluent was then discharged to a leachfield under and adjacent to the building.

During the research project, water and sludge from the tanks were removed periodically and disposed off-site. In 1991-92, the remaining sludge was removed, solidified, and transported to a DOE-licensed disposal site in Hanford, Washington. After evaluating potential D&D options, DOE determined that demolition of the Imhoff Building was the best alternative because of its age and condition. In addition, more extensive soil testing under and around the underground tanks is planned. Access to these areas was very limited, and removal of the building will enable personnel collecting soil data to do so more safely and efficiently.

LOCATION

Approximately one mile south of the main UC Davis campus on Old Davis Road, the LEHR site covers 15 acres and is surrounded by scattered campus research facilities and private farms. The Imhoff Building is located on the west side of LEHR between Animal Hospitals 1 and 2.

IMHOFF BUILDING D&D PROCESS

Prior to finalizing the plans for the Imhoff D&D, DOE performed an assessment pursuant to the National Environmental Policy Act (NEPA) to evaluate potential impacts to the public and the environment from the planned D&D activity. From the assessment, DOE determined that the Imhoff D&D was eligible for a NEPA Categorical Exclusion because the process would not have a significant impact on public health or the environment.

DOE contracted Battelle Pacific Northwest Laboratory (PNL) to manage the site cleanup, which includes the Imhoff D&D. IT Corporation, based in Martinez, California, was selected by PNL to perform the actual D&D work. All activities were performed according to a work plan that was reviewed by DOE and UC Davis.

The first step in the process was the construction of a containment structure to enclose the entire building and surrounding area to assure that any radioactive or chemical contamination would be successfully contained during the operation. Access to the containment structure was limited to personnel directly involved in the actual work. Removal of all building contents and demolition of the building itself was performed inside the containment structure. All wastes from the project were packaged onsite and shipped to the DOE Hanford waste site in Richland, Washington, according to applicable federal and state regulations.

To isolate and prevent contaminants from being released to the environment, engineering controls, such as High-Efficiency Particulate Air (HEPA) filters were also used. Throughout the operation, extensive monitoring both inside and outside the containment structure was performed to verify that no radiation exposure to workers, the public, or the environment occurred. To further ensure the safety of workers, personnel were required to wear radiation detection badges and appropriate protective clothing during the activities.

Demolition of the building began in November 1994 and was completed in March 1995. Afterwards, the ground surface, tank covers, and air were checked to ensure there was no radioactivity above naturally occurring levels, and the containment structure was removed. The empty underground tanks that were under the building and surrounding soils will be further evaluated and remediated as necessary as part of other site cleanup activities.

To get additional information, please

CALL:

LEHR Information Line	(916) 752-8351
Jim Littlejohn, DOE	(510) 637-1526
Julie McNeal, UC Davis	(916) 752-3575

or

WRITE:

LEHR Cleanup Project
Mail Stop ITEH
Old Davis Road
Davis, CA 95616

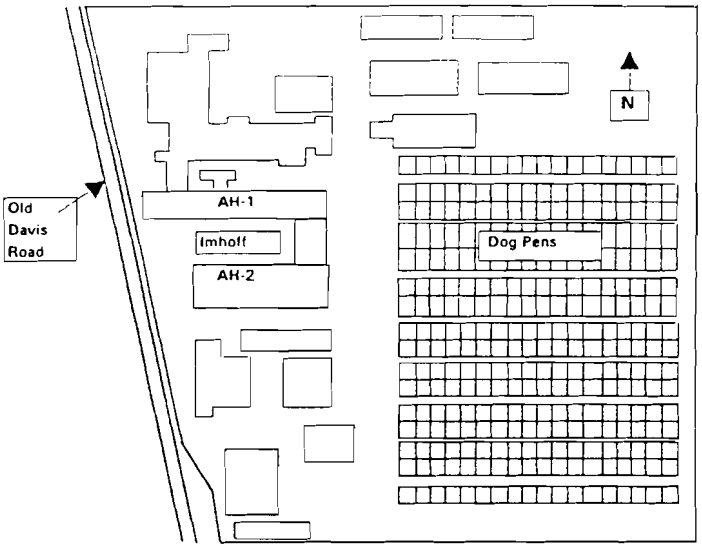
or

DOCUMENTS RELATING TO THE LEHR CLEANUP PROJECT ARE AVAILABLE FOR REVIEW AT:

UC Davis Sheilds Library, Reserve Desk
University of California
Davis, California 95616
(916) 752-1203

Davis Public Library, Reference Desk
315 East 14th Street
Davis, California 95616
(916) 756-2332

LEHR SITE (Western Section)



SUPERFUND ABBREVIATIONS and GLOSSARY

Abbreviation

AOC — Administrative Order on Consent

A legal agreement between EPA and PRPs whereby PRPs agree to perform or pay the cost of a site cleanup. The agreement describes the actions to be taken at a site and may be subject to a public comment period. Unlike a consent decree (CD), an AOC does not have to be approved by a judge.

Administrative Record

A file that is maintained and contains all information used by the lead agency to make its decision and selection of a response action under CERCLA. This file is available for public review and is established at or near the site, usually at one of the information repositories. Also, a duplicate file is held in a central location, such as a regional or state office.

ARARs — Applicable or Relevant and Appropriate Requirements

Federal, state, and local cleanup standards, control standards, and other substantive requirements, criteria, or limitations pertaining to the proposed remeidal action.

CD — Consent Decree

A legal document, approved and issued by a judge, that formalizes an agreement reached between EPA and PRPs where PRPs will perform all or part of a Superfund site cleanup. The CD describes actions that PRPs are required to perform and is subject to a public comment period.

CERCLA — Comprehensive Environmental Response, Compensation, and Liability Act

A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The Acts created a special tax that goes into a trust fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites.

CLP — Contract Laboratory Program

Laboratories under contract to EPA that analyze soil, water, and waste samples taken from areas at or near Superfund sites.

CRP — Community Relations Plan

Formal plan for community relations activities at a Superfund site.

FFA Federal Facility Agreement

A legal agreement between various agencies such as EPA, California Department of Toxic Substances Control, and the DOE to undertake cleanups under CERCLA.

HRS Hazard Ranking System

A scoring system used to evaluate potential relative risks to public health and the environment from releases or threatened releases of hazardous substances. EPA uses the HRS to calculate a site score, from 0 to 100, based on the actual or potential release of hazardous substances from a site through air, soil, surface water, or groundwater. This score is the primary factor used to decide if a hazardous waste site should be placed on the NPL. Sites scoring 28.5 or higher are candidates for the NPL.

Information Repository

A file containing current information, technical reports, and reference documents regarding a Superfund site. The information repository is usually located in a public building that is convenient for local residents, such as a public school, city hall, or library.

Interim Action

A remedial action taken prior to the final cleanup action at a site. It is usually consistent with the final action.

NCP National Oil and Hazardous Substances Contingency Plan

The federal regulation that guides the Superfund program.

NPL National Priorities List

EPA's list of hazardous waste sites identified for possible long-term remedial response. EPA is required to update the NPL at least once a year.

OU Operable Unit

These are study areas at a Superfund site that can be categorized by media (groundwater, soil, or surface water), by geological similarities, or similar use or contents (for example, a landfill or underground tanks).

PRP Potentially Responsible Party

Individual(s) or company(ies), such as owners, operators, transporters, or generators, potentially responsible for, or contributing to, the contamination problems at a Superfund site. Whenever possible, EPA requires PRPs, through administrative and legal actions, to clean up hazardous waste sites they have contaminated.

PA Preliminary Assessment

The process of collecting and reviewing available information about a known or suspected hazardous waste site or release. EPA uses this information to determine if the site requires further study.

QA/QC Quality Assurance/Quality Control

A system of procedures, checks, audits, and corrective actions used to ensure that field work and laboratory analysis during the investigation and cleanup of Superfund sites meet established standards.

ROD Record of Decision

A public document that explains which cleanup alternative(w) will be used at NPL sites. The ROD is based on information and technical analysis generated during the RI/FS and consideration of public comments and community concerns.

RA Remedial Action

The actual construction or implementation phase that follows the remedial design of the selected cleanup alternative at a site on the NPL.

RD Remedial Design

An engineering phase that follows the ROD when technical drawings and specifications are developed for the subsequent remedial action at a site on the NPL.

RI/FS Remedial Investigation/Feasibility Study

Investigative and analytical studies usually performed at the same time in an interactive, iterative process. They are intended to gather data necessary to determine the type and extent of contamination; establish criteria for cleaning up the site; identify and screen cleanup alternatives for remedial action; and analyze in detail the technology and costs of the alternatives.

Remedial Response

A long-term action that stops or substantially reduces a release or threatened release of hazardous substances that is serious, but does not pose an immediate threat to public health and/or the environment.

Removal Action

An immediate action taken over the short-term (6 to 18 months) to address a release or threatened release of hazardous substances.

RCRA Resource Conservation and Recovery Act of 1976

A federal law that established a regulatory system to track hazardous substances from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous substances. RCRA is designed to prevent new, uncontrolled hazardous waste sites.

Risk Assessment

Characterization of the potential adverse health effects to human health and the environment as a result of contaminants present at a Superfund site.

RPM Remedial Project Manager

The EPA or agency official responsible for overseeing remedial response activities.

SI Site Inspection

A technical phase that follows a PA designed to collect more extensive information about a hazardous waste site. The information is used to score the site according to the HRS to determine whether a response action is needed.

Superfund

The common name used for the CERCLA, sometimes referred to as the trust fund.

SARA Superfund Amendments and Reauthorization Act

Modifications to CERCLA enacted in 1986.

TSDF Treatment, Storage, and Disposal Facility

Any building, structure, or installation where a hazardous substance has been treated, stored, or disposed. TSD facilities are regulated by EPA and states under the RCRA.

g \wp\at\acronym doc

The Remedial Process

Remedial Investigation (RI)

An assessment of the nature and extent of contamination and the associated health and environmental risks

Feasibility Study (FS)

Development and analysis of the range of cleanup alternatives for the site, according to the nine evaluation criteria; usually undertaken concurrently with the RI

↓

Selection of Remedy

Selection of the remedial alternative for the site. This step includes:

Proposed Plan

Identifies a preferred remedial alternative for a Superfund site and explains why it is the preferred alternative, and allows for public comment

Record of Decision (ROD)

The official report documenting the background information on the site and describing the chosen remedy and why it was selected

↓

Remedial Design (RD)

Preparation of technical plans and specifications for implementing the chosen remedial alternative

↓

Remedial Action (RA)

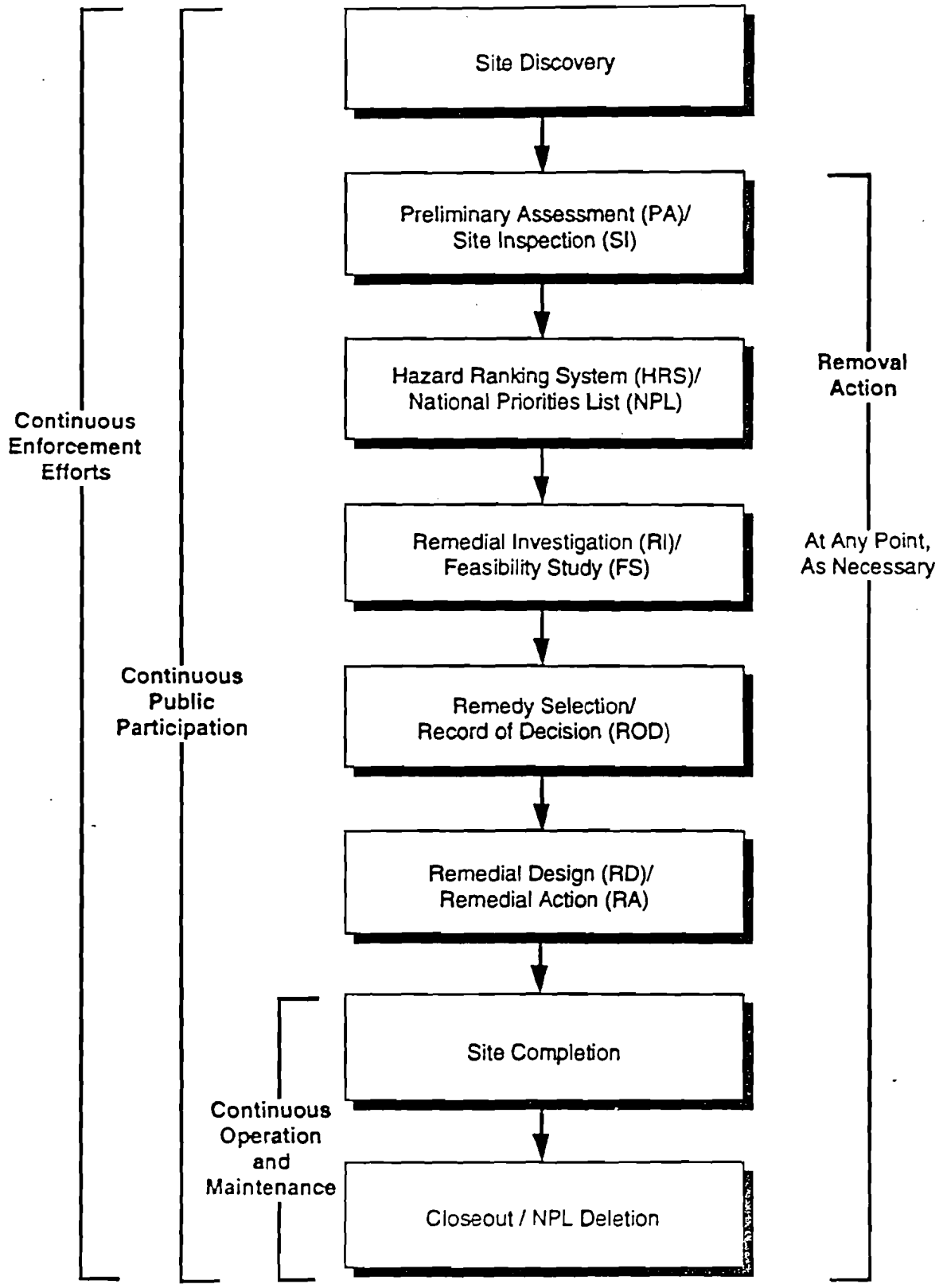
Construction or other work necessary to implement the remedial alternative

↓

Operation & Maintenance (O&M)

Activities conducted at a site after a response action occurs to ensure that the cleanup methods are working properly and to ensure site remedy continues to be effective

The Superfund Process



RADIATION AND HUMAN HEALTH

Radiation is part of our everyday lives. Humankind has been exposed to naturally occurring radioactive materials and direct ionizing radiation from both terrestrial and cosmic sources since the beginning of life on the earth.

We are all exposed to radiation from the sun and in the atmosphere: naturally occurring radioactive materials are present in the earth, the houses we live in, and in the foods we eat. Radioactive gases are mixed in the air we breathe. Radon, a radioactive gas emitted from uranium in the earth, accounts for more radiation exposure than all other sources combined. Even our own bodies contain naturally occurring elements that are radioactive. Bones contain radioactive potassium, and radioactive carbon is found naturally in body tissues.

The average per capita effective ionizing radiation dose in the United States (from all sources exclusive of smoking) is about 360 millirem per year. Approximately 80% of this exposure, about 300 millirem, is from naturally occurring (or "background") sources. The average U.S. per capita dose from cosmic radiation is 27 millirem per year or about 7% of natural background. This inescapable radiation exposure is called "natural background," and it varies from place to place. For example, exposure to cosmic radiation increases with altitude as there is less atmosphere to absorb the radiation, so populations at higher elevations receive higher cosmic doses. People living at Lake Tahoe receive about 50 millirem more exposure per year than people living in the Sacramento Valley.

In addition to natural background radiation, there are human-made sources of radiation. Medical techniques used in the diagnosis and treatment of injury and disease account for 15% of the average American's annual radiation exposure. Another 3% comes from various consumer products such as televisions, household smoke detectors, and luminous watch dials. Less than 1% comes from the nuclear power industry or weapons testing.

What Is Radiation and How Is It Measured?

The word *radiation* is a general term and includes light, radio waves, and electric fields. There are two types of radiation, nonionizing and ionizing. Light, radio waves, and electric fields are examples of nonionizing radiations whose energies are lower than ionizing radiation. They do not affect matter in the same way. In contrast, ionizing radiation changes the physical state of atoms it strikes, causing them to become electrically charged or "ionized."

All matter is made up of atoms. The basic parts of atoms are neutrons, protons, and electrons. Neutrons and protons form the nucleus of the atom and electrons surround (orbit) the nucleus. An atom of a particular element has a unique number of protons in its nucleus. Certain combinations of protons and neutrons are stable (not radioactive). When an atom has an unstable combination of neutrons and protons, the atom will decay (emit radiation). These unstable atoms are called radioisotopes or radionuclides. As the atom decays, the amount of radiation decreases. The length of time it takes for half of the radioactivity in a source to decay is called the half-life.

Main Types of Ionizing Radiation

Alpha (α) radiation consists of heavy, positively charged particles emitted by atoms of heavy elements such as uranium and radium and some human-made sources. Alpha radiation is completely absorbed by the outer dead layer of skin and is therefore not a hazard outside the body. Alpha particles can effectively be stopped by an inert material such as paper. However, if alpha particles enter the body by inhalation or with food or water, they can directly expose internal tissues and can be a hazard. Radium 226, thorium 228, and uranium 232 are examples of alpha-emitting radioisotopes.

Beta (β) radiation (positively or negatively charged electrons) is emitted from the nucleus during radioactive decay. Beta particles are more penetrating than alpha particles and can sometimes penetrate the skin. But like alpha particles, they are generally more hazardous when inhaled or ingested. In air, beta particles may be stopped by plastic or wood. Carbon 14 and tritium, which are examples of radioisotopes that emit beta particles, are naturally produced in the environment. Other beta-emitting radioisotopes include plutonium 241 and strontium 90.

Gamma (γ) rays and X-rays are forms of electromagnetic radiation because they have both electric and magnetic properties. Gamma rays, or photons, come from the nucleus when materials decay. Cobalt 60 emits gamma radiation. X-rays are a result of electron removal or rearrangement in atoms. Gamma and X-ray radiations are used frequently in medicine because they can easily penetrate the human body. Gamma rays and X-rays are stopped by lead or concrete.

Neutrons are heavy, uncharged particles that cause the atoms that they strike to become ionized. Neutrons (n) are absorbed by hydrogen-rich materials such as wax, water, or plastic.

Radiation Measurements

Radioactivity is measured in the number of disintegrations (nuclear transformations or decays) a radioactive material undergoes in a certain period of time. The Curie (abbreviated Ci) is a measurement of the number of radioactive decays occurring in a source. There are 37 billion disintegrations per second (dps) in a 1-Curie source. Because the Curie is a large amount of radioactivity, fractions of Curies are often used as units of measure. These units include the picocurie (pCi), which is one trillionth of a Curie; microcurie (μCi), which is one millionth of a Curie; and millicurie (mCi), which is one thousandth of a Curie. A picocurie yields about two radioactive disintegrations per minute. When measured in solids (such as soil or sludge) or liquids (such as water), the amount of radioactivity is usually expressed in fractions of a Curie per unit of metric weight. For example, radioactive thorium occurs naturally in all of the soil and rock on earth at about 1 picocurie per gram (abbreviated 1 pCi/g).

Environmental Sampling Laboratory Analyses

In environmental sampling, laboratory methods for analyzing radioactivity in a sample include screening analyses and radioisotope-specific analyses. Various kinds of analytical equipment designed to measure the amount of radioactivity are used.

Gross alpha and gross beta analyses are types of screening methods. A gross alpha analysis provides a general measurement of the total alpha-emitting radioisotopes in a sample, but it does not specify which radionuclide is responsible for the radioactivity. Naturally occurring uranium is most often the alpha emitter causing alpha activity in water or soil samples. Gross beta analysis is similar to gross alpha analysis. It includes all sources of beta radiation, and some gamma radiation may also be detected since it is a component in some radioisotopic decays. As with gross alpha analysis, this method provides a means to determine whether further radioisotope-specific analysis is needed.

Radioisotope-specific analyses are usually more complicated. Typically, in order to isolate a specific radionuclide, additional steps are needed. These include the use of physical methods such as evaporation or distillation, or the addition of certain chemicals to remove the radioisotopes prior to analysis with specialized radioactivity counting equipment.

Measuring the amount of radioactivity in water or soil is not as precise as measuring the amount of other constituents such as chemicals or nonradioactive elements. Since measurements of radioactive decay present some variability, statistical methods are an important part in the analysis and reporting of the amount of radioactivity present. As a result, radiological results are reported with a small uncertainty value, which is usually

symbolized as "+/-" on analytical reports. The reported measurement (for example, 5 +/-2 pCi/L) represents an estimate with a high degree of certainty that the amount of radioactivity is somewhere between the resulting values obtained when adding or subtracting the uncertainty. In this example, the amount would be somewhere between 3 and 7. Additionally, a reported detection also takes into account calculations that are necessary to convert radioactive disintegrations (dps) to a concentration in water (pCi/L) or soil (pCi/g).

From Radiation Exposure to Dose

Damage from radiation depends on several factors such as whether the exposure was from internal or external sources, the length of time of exposure, properties of the chemical element itself, the distance from the source, the radioisotopes half life, and the type and amount of radiation. The dose of radiation is the quantity of radiation received over a certain period of time. The unit for measuring absorbed energy as radiation exposure to the human body is the rem (**R**oentgen **E**quivalent **M**an).

Any radioisotope can enter the body by inhalation, ingestion, or absorption through an open wound. In the case of an internal exposure, any kind of ionizing radiation can directly harm living cells. External radiation exposures come from a source outside the body, such as when a medical X-ray is taken. In order to cause any biological effect, the radiation must have enough energy to penetrate the body. Three factors affect the dose that the individual will receive: the amount of time the individual was exposed; the distance from the source of radiation; and the amount of shielding between the individual and the source of radiation.

The longer a person is exposed to a source of radiation, the higher the radiation dose. The relationship between distance and exposure is not as simple because the intensity of radiation falls off very quickly. This is referred to as the inverse square law. For example, if a source produces a dose rate to an individual of 1 rem per hour at a distance of 1 foot, then at twice the distance (2 feet), the dose rate will be one-fourth of 1 rem per hour or 0.25 rem per hour. Likewise, at 3 feet, the rate will be one-ninth of 0.11 rem per hour.

Radiation Dose Perspective

1 millirem	One one-thousandth of a rem (written as 0.001 rem or abbreviated mrem)
2.5 millirem	cosmic radiation dose to a person on a one-way flight from New York to Los Angeles
10 millirem	one chest X-ray using modern equipment

25 millirem	yearly exposure limit set by the U.S. Environmental Protection Agency for people who live near nuclear power plants
60-80 millirem	average yearly radiation dose from cosmic radiation to people who live in the Rocky Mountain States
83 millirem	estimate of the largest dose any off-site person could have received from the Three Mile Island accident
100 millirem	yearly limit from all sources of human-made radiation (non-radiation worker) set by the Nuclear Regulatory Commission (NRC) and DOE
160 millirem	yearly dose to the average flight crew members from cosmic radiation
300 millirem	average yearly dose to people in the U.S. (background radiation)
5 rem	yearly limit for radiation workers set by the NRC (external and internal)
25 rem	U.S. EPA guideline for voluntary maximum radiation dose to emergency workers for nonlifesaving work during a reactor emergency (assumed to be a once-in-a-lifetime event)
75 rem	U.S. EPA guideline for maximum radiation dose to emergency workers volunteering for lifesaving work

Can Radiation by Harmful?

There are no known health effects associated with the exposure of people to ionizing radiation at levels equal to or below the levels of normal natural background exposures. States and cities in the U.S. with higher natural background have been found to have lower cancer rates than states or cities with lower background.

An average of 1,800 people in every 10,000 die from cancer each year. If all 10,000 people received 1 rem each as a single exposure, we would expect 1 additional person to die of cancer. However, it is not possible to tell which of the 1,801 fatal cancers was caused by the radiation.

FOR MORE INFORMATION,

published references include:

Bushberg, Jerrold T. (1994). *The Essential Physics of Medical Imaging.*

Cember, Herman (1992). *Introduction to Health Physics.*

Committee on the Biological Effects of Ionizing Radiation (1990). *Health Effects of Exposure to Low Levels of Ionizing Radiation,* BEIR V.

Eisenbud, Merril (1987). *Environmental Radioactivity.*

National Council on Radiation Protection (1987). *Exposure of the Population of the United States and Canada from Natural Background Radiation*, NCRP Report No. 94.

U.S. Environmental Protection Agency, Office of Radiation Programs (1993). *Environmental Radiation Data*, Report No. 67, 402-R-93-019.

or write or call:

Radiation Safety Officer
Office of Environmental Health and Safety
University of California, Davis
Davis, CA 95616

916-752-1493

LEHR Remedial Investigation/Feasibility Study (RI/FS)

WHAT:

Work is currently in progress at the former Laboratory for Energy-Related Health Research (LEHR) site at UC Davis to determine the environmental impacts from U.S. Department of Energy-sponsored research activities at LEHR. For over 30 years, scientists studied the long-term health effects of radiation on laboratory animals at the site. Also located at LEHR are low-level radioactive waste burial areas and an inactive campus landfill, which UC Davis has also been investigating for environmental contamination. These investigations have shown that some low-level radioactive materials and chemicals are present in shallow groundwater under and adjacent to LEHR and in soils at the site.

Throughout the investigations, DOE and UC Davis have coordinated their activities and worked closely with various state agencies. In May 1994, the federal Environmental Protection Agency (EPA), which has also been reviewing the results of the investigations since 1989, placed LEHR on the National Priorities List (Superfund) because of contaminants detected in groundwater and the potential threat of the contaminants to public health and the environment.

To follow up on the initial findings, and in anticipation of being placed on the Superfund list, DOE and UC Davis had previously determined that additional information was needed to further identify in greater detail possible sources of contamination and evaluate cleanup options. This assessment, called a "Remedial Investigation/Feasibility Study," is required by the EPA for sites placed on the Superfund list.

LOCATION:

LEHR is located about one mile south of the main UC Davis campus, on the east side of Old Davis Road, just north of the South Fork of Putah Creek. A levee separates the southern boundary of the site from Putah Creek. Occupying approximately 15 acres, LEHR is surrounded by various campus research facilities. A few residences and private farms are located to the south of LEHR on the south side of the creek.

RI/FS PROCESS:

A remedial investigation/feasibility study (RI/FS) is a two-part formal process for performing site assessment and cleanup activities according to strict EPA requirements. These requirements are set forth in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The RI examines the nature and extent of contamination at the site, and the FS identifies and evaluates alternatives for cleanup.

The key steps in the RI/FS process are shown below. Phrases in italics are the official names of these steps.

- Identify the areas of investigation
- Collect environmental data from these areas (*remedial investigation*)
- Analyze the data to determine what effects there might be from residual contamination to human health or the environment (*risk assessment*)
- Determine, evaluate, and test possible cleanup options based on results of the risk assessment (*feasibility study*)
- Reach agreement with regulatory agencies regarding cleanup methods and cleanup levels (*record of decision*)
- Design the actual cleanup systems (*remedial design*)
- Implement the cleanup plan (*remedial action*)

RI/FS at LEHR:

The first RI/FS activity, which is planned to begin in Fall 1994, is performing the remedial investigation (RI). At LEHR, the RI has been divided into a number of tasks designed to evaluate the impacts of past site activities on soil, water, vegetation/wildlife, and air. These tasks have been described in detail in a draft work plan that has been submitted to various regulatory agencies for review. The work plan also includes information on the measures that will be taken to ensure worker and public health and safety during the actual field work. Copies of the final work plan will be available for public review at Shields Library at UC Davis and the Davis Public Library.

During the RI, soil samples will be collected and analyzed from these areas:

- DOE low-level radioactive waste trenches
- radium-226 treatment system
- strontium-90 treatment system ("Imhoff")
- old domestic septic tanks
- former outdoor chemical dispensing areas
- outdoor dog pens
- UC Davis low-level radioactive waste trenches
- inactive UC Davis landfill

Various methods will be used to collect samples from these different areas. A soil gas survey will be performed and other special instruments will be used to delineate areas requiring further investigation. Soil samples will then be collected from these areas by boring holes with a drilling rig or excavating small sections with a backhoe. The samples will be analyzed for metals, organic and inorganic chemicals, pesticides, and radioactivity.

Groundwater under and adjacent to the site will continue to be tested using existing monitoring wells. In addition, cone penetrometer and hydropunch testing, which allows water samples to be collected from a predetermined depth without the need for drilling a monitoring well, will also be performed. The hydropunch information is highly useful for determining the best location to install new monitoring wells. As with the soil samples, water will be tested for metals, organic and inorganic chemicals, pesticides, and radioactivity. Other tests will be performed on groundwater to determine physical characteristics such as flow rate. Additionally, stormwater from the site and water from the South Fork of Putah Creek will be tested for the same constituents as groundwater.

Vegetation and wildlife at and near the site will also be evaluated as necessary to characterize potential impacts to the local ecology. In addition, air sampling, designed to monitor worker and public health during the RI, will also be performed.

Throughout the RI, sample collection and analyses will be performed according to strict EPA quality assurance requirements and applicable federal and state health and safety and environmental regulations.

During the RI, the data will be constantly evaluated to determine if more information is needed to perform the risk assessment or develop the feasibility study. Should significant changes be needed regarding the kind of information collected or the way it is collected, these changes will be discussed with the appropriate agencies, and the work plan will be modified as necessary.

NEPA/CEQA:

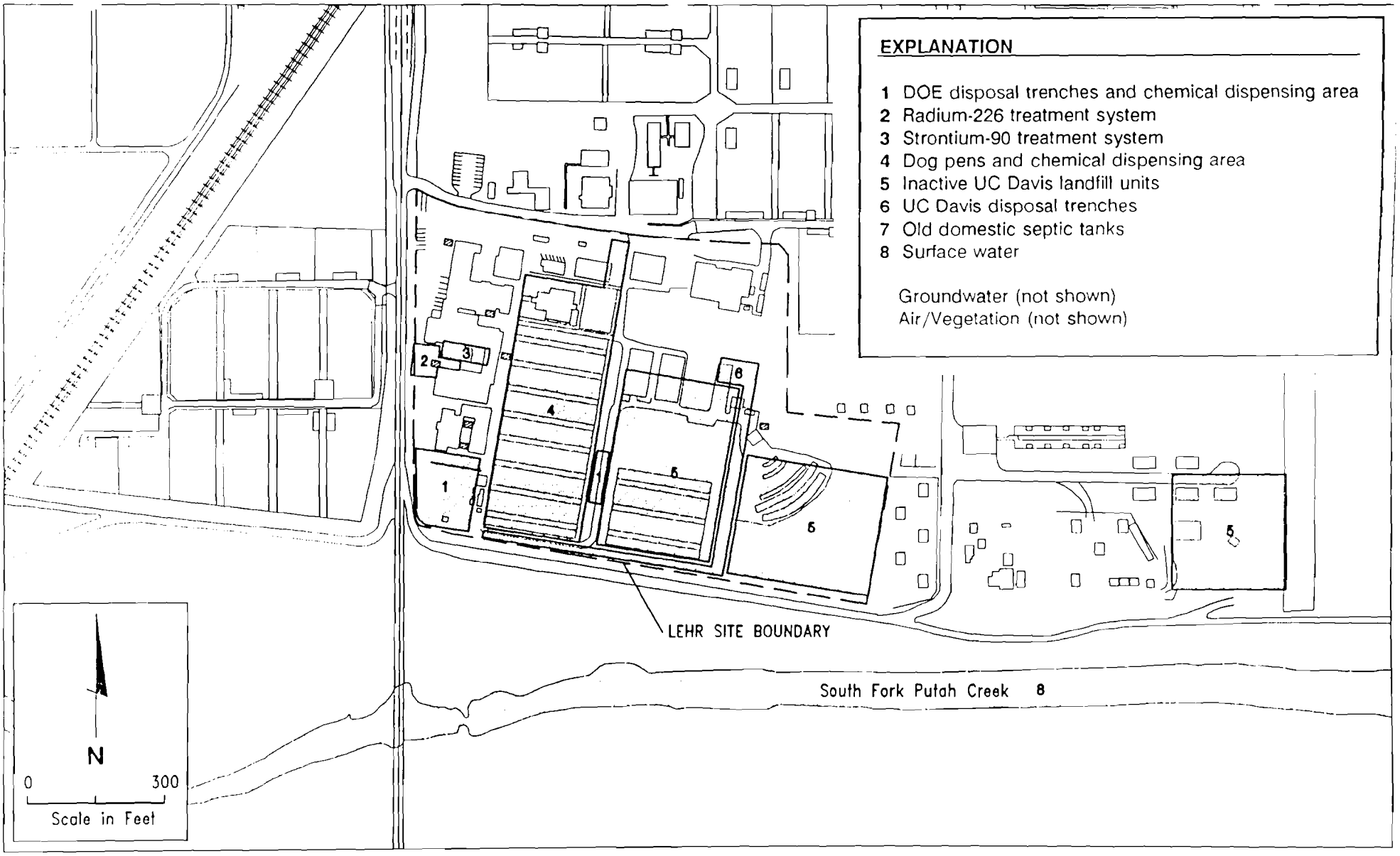
Environmental review and disclosure laws apply to DOE and UC Davis RI/FS activities. Both DOE and UC Davis have prepared appropriate documents intended to satisfy National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) requirements. Additional documentation will be prepared as needed for cleanup activities.

COMMUNITY INVOLVEMENT:

Community involvement and participation in the RI/FS is a vital part of the process and is also mandated by EPA. DOE and UC Davis will continue to hold public meetings and provide informational materials. In addition, a revised Community Relations Plan, updated to reflect specific EPA Superfund requirements, is also being prepared.

SCHEDULE:

Pending availability of funds, the RI/FS is anticipated to be completed in less than 3 years. A detailed schedule will be negotiated between DOE, UC Davis, and regulatory agencies as part of a formal agreement between these entities.



LEHR RI/FS
AREAS OF INVESTIGATION

WHERE DO I GET MORE INFORMATION?

To get additional information, please:

CALL:

LEHR	Larry McEwen
Information Line	DOE Project Manager
(916) 752-8351	(510) 637-1641

OR

WRITE:

LEHR Cleanup Project
Old Davis Road
Mail Stop: ITEH
Davis, CA 95616

COPIES OF INFORMATION RELATING TO THE LEHR CLEANUP PROJECT ARE AVAILABLE FOR REVIEW AT:

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(916) 752-1203

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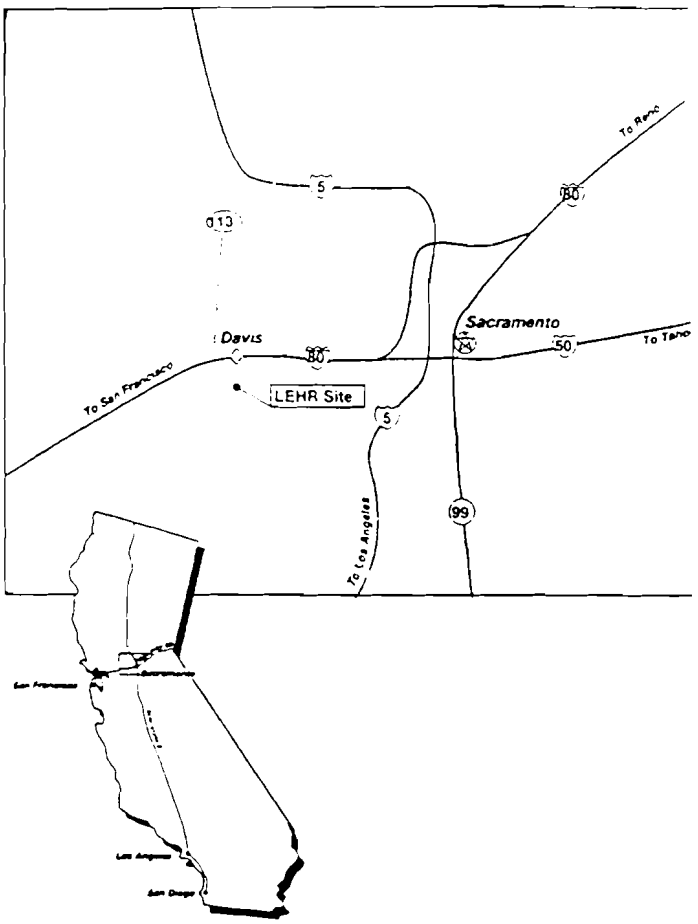

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Decontamination and Decommissioning of LEHR Imhoff Building To Begin

OVERVIEW

As part of its continuing effort to clean up a former research facility located at UC Davis, the U.S. Department of Energy (DOE) has finalized plans and will soon begin the decontamination and decommissioning (D&D) of a special treatment facility ("Imhoff Building") that was used to process radioactive waste at the Laboratory for Energy-Related Health Research (LEHR), where for more than 30 years scientists studied the long-term health effects of radiation on laboratory animals.

From 1961 to 1987, laboratory animals (primarily beagles) housed in Animal Hospital 1 (AH-1) were fed strontium 90 to study the long-term effects of exposure to this radionuclide, a component of radioactive fallout. Excreta from the animals and wash water from the animal cages in AH-1 were discharged to the Imhoff Building through a special drainage system that was separate from the domestic sanitary sewage system at LEHR. The wastewater was processed through a series of underground holding and settling tanks and ion-exchange columns to remove the strontium 90. The treated effluent was then discharged to a leachfield.

During the project, water and sludge from the tanks were removed periodically and disposed off-site. In 1991-92 the remaining sludge was removed, solidified, and transported to a DOE-licensed disposal site in Hanford, Washington. With the removal of the sludge, the Imhoff Building itself, ventilation, plumbing, and ion-exchange treatment equipment are now ready for D&D. After evaluating potential D&D options, DOE has determined that demolition of the Imhoff Building is the best alternative because of its age and condition. In addition, more extensive soil testing under and around the underground tanks is planned. Access to these areas is very limited, and removal of the building will enable personnel collecting soil data to do so more safely and efficiently.

LOCATION

Located approximately one mile south of the main UC Davis campus on Old Davis Road, the LEHR site covers 15 acres and is surrounded by scattered campus research facilities and private farms. The Imhoff Building is located on the west side of LEHR between Animal Hospitals 1 and 2.

IMHOFF BUILDING D&D PROCESS

Prior to finalizing the plans for the Imhoff D&D, DOE performed an assessment pursuant to the National Environmental Policy Act (NEPA) to evaluate potential impacts to the public and the environment from the planned D&D activities. From the assessment, DOE determined that the Imhoff D&D was eligible for a NEPA Categorical Exclusion.

DOE has contracted Battelle Pacific Northwest Laboratories (PNL) to manage the site cleanup and oversee the Imhoff D&D. IT Corporation, based in Martinez, California, has been selected by PNL to perform the actual D&D work. All activities will be performed according to a work plan that has been reviewed and approved by DOE and UC Davis.

The first step in the process will be the construction of a containment structure to enclose the entire building and surrounding area to assure that any radioactive or chemical contamination is successfully contained during the operation. Access to the containment structure will be limited to personnel directly involved in the actual work. Removal of all building contents and demolition of the building itself will be performed in the containment structure. All wastes from the project will be packaged on-site and shipped to the DOE Hanford waste site in Richland, Washington, according to applicable federal and state regulations.

To isolate and prevent contaminants from being released to the environment, engineering controls, such as High-Efficiency Particulate Air (HEPA) filters will be used. Throughout the operation, extensive monitoring both inside and outside the containment structure will also be performed to verify that no radiation exposure to workers, the public, or the environment occurs. To further ensure the safety of workers, personnel will be required to wear radiation detection badges and appropriate protective clothing during the activity.

Demolition of the building is expected to take approximately 6 months. Afterwards, the area will be checked to ensure there is no radioactivity above naturally occurring levels, and the containment structure will be removed. The empty underground tanks and surrounding soils will then be further evaluated and remediated as necessary as part of other site cleanup activities.

WHERE DO I GET MORE INFORMATION?

To get additional information, please:

CALL:

LEHR	Larry McEwen
Information Line	DOE Project Manager
(916) 752-8351	(510) 637-1641

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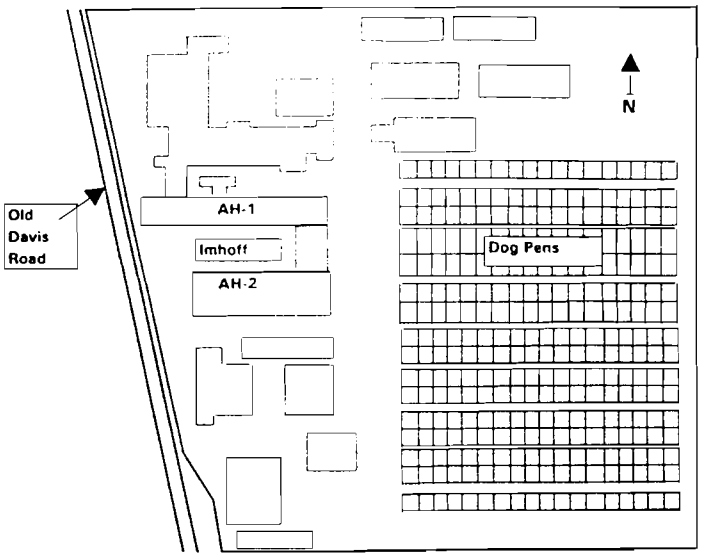
LEHR SITE (Western Section)



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Decontamination and Decommissioning of LEHR Animal Hospitals

OVERVIEW

In October 1995, the U.S. Department of Energy completed the Decontamination and Decommissioning (D&D) of two Animal Hospital buildings (AH-1 and AH-2) at the former Laboratory for Energy-related Health Research (LEHR) site on the UC Davis campus. Research was conducted in the Animal Hospitals from 1958 through 1989, focusing on the long-term health effects of low-level radiation exposure in beagles. The AH-1 and AH-2 D&D effort was a major component of the LEHR Environmental Restoration Project, which continues at the site. Throughout the D&D, project goals have focused on restoring the buildings to a condition that will permit transfer of ownership to UC Davis. A final verification that AH-1 and AH-2 are free of contamination will be performed by an independent contractor. This will allow release of the buildings to UC Davis for unrestricted use.

LOCATION

Located approximately one mile south of the main UC Davis campus on Old Davis Road, the former LEHR site occupies 15 acres surrounded by scattered campus research facilities and private farms. AH-1 and AH-2 are near the western site boundary (see map on back).

PROCESS

The focus of the Animal Hospital D&D was the elimination of any remnants of low-level radiation from the buildings. This involved removal of animal cages, plumbing and heating systems, ventilation and air-conditioning (HVAC), building fixtures, and walk-in freezers. Materials containing asbestos in floor coverings and insulation were also removed as needed to provide access to the ventilation systems and to the drainage systems (including pipes below the floor surface).

SAFETY AND ENVIRONMENTAL PROTECTION

Prior to the start of this activity, an Environmental Assessment was prepared and approved in 1992. Potential impacts to the public and the environment were evaluated, and a "Finding of No Significant Impact" (FONSI) was issued. Federal and state safety guidelines were clearly followed during the building restoration. High standards of safety and worker protection resulted in an excellent safety record.

Care was taken to assure that contamination within the buildings was successfully contained during the removal operations. The buildings were isolated from the external environment with engineering controls, such as High Efficiency Particulate Air (HEPA) filters, sealed plastic tentings both for inner building surfaces and for specific work areas, negative pressurization of work areas, controlled access to buildings, and exit survey checkpoints. To assess the effectiveness of controls, routine breathing zone air sampling and ventilation stack sampling were conducted throughout D&D work.

HAZARDOUS WASTE MINIMIZATION

Hazardous waste minimization during the AH-1 and AH-2 D&D was considered a success in both cost reduction and preservation of valuable landfill space. A significant decrease in volume of hazardous waste was achieved with implementation of an effective waste minimization program. Materials, including fixtures and cage rubble, were surveyed for contamination after removal. This facilitated segregation of clean vs. contaminated waste and permitted recycling of uncontaminated materials. In addition, a shredder and compactor were used to reduce the volume of hazardous waste by nearly 50%. These efforts resulted in a project savings of $870,000 in waste disposal costs.

WHERE DO I GET MORE INFORMATION?

[illegible]

CALL:

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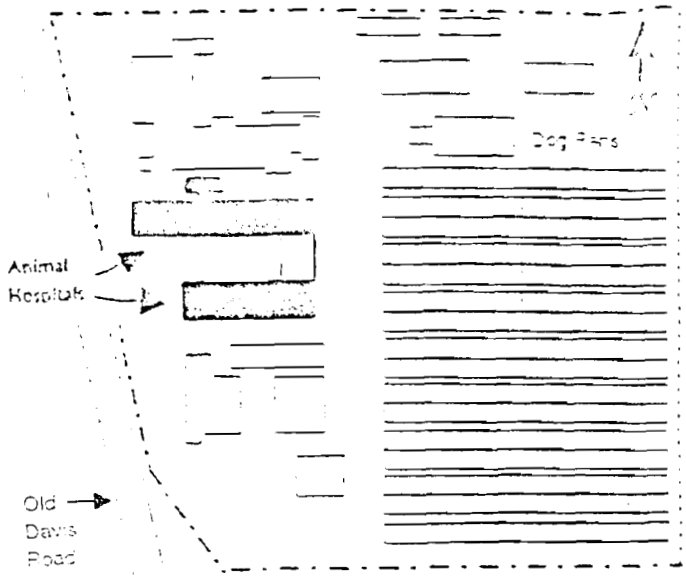

The LEHR Site is approximately one mile south of the main UC Davis campus.

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Cobalt 60 Source Removal

OVERVIEW:

A radioactive Cobalt 60 (CO-60) source, used for irradiation studies at the former *Laboratory for Energy-Related Health Research* (LEHR), will be removed and transported to a licensed nuclear facility in Pleasanton, California in January 1993. Removal of the source, which will take approximately 1 week, is part of on-going environmental assessment and cleanup activities at the LEHR site conducted by the *US Department of Energy* (DOE) and UC Davis. Battelle's *Environmental Management Operations* (Battelle EMO) has been contracted by the DOE to manage the site restoration.

LOCATION:

Located approximately one mile south of the main UC Davis campus on Old Davis Road, the former LEHR site covers 15 acres and is surrounded by scattered campus research facilities and private farms. The pencil-sized CO-60 source is housed in a building located on the southeast corner of the site. (See map on reverse.)

CO-60 HISTORY:

The CO-60 irradiator facility was an indoor-outdoor facility designed to study the effects of low-level whole-body radiation exposure to research animals. The study was one of several studies conducted at the LEHR site to examine the effects of continuous CO-60 radiation exposure on beagles. The study ran from 1970 to 1987, with the last outdoor exposure experiment completed in October, 1985. The irradiator continued to be operated exclusively for indoor irradiation experiments until 1987. In 1988 the CO-60 irradiator was formally put into safe storage.

REMOVAL PROCESS:

During late January, the CO-60 source, along with its support structure (a weather-tight housing structure bolted to the roof of the CO-60 irradiator building) will be removed, packaged and transported to a nuclear facility in Pleasanton, California. EMO's contractor, *Bechtel Environmental, Inc.* of Oakridge Tennessee, will effect the actual removal, packaging and transport of the source.

Beginning the last week in January, Bechtel will remove the irradiator from the roof of the CO-60 irradiator building and package it for shipment to *General Electric Vallecitos Nuclear Center*, where removal of the actual source and packaging for final disposition will take place. Bechtel will use a licensed transportation company and shielded cask to transport the irradiator to the facility, where the source will be removed from its shielded housing. The tasks involved in removal of the source from the LEHR site are expected to require a few days.

SAFETY ISSUES:

The operations which will take place at the LEHR site -- *removal* and *packaging* of the CO-60 sealed source -- pose virtually no public threat. The cask used for the operation is specially designed to contain and shield radiation such as that emitted by the CO-60 source, and all work will follow applicable State and Federal guidelines. In addition, an *Emergency Response Plan* has been written, environmental monitoring will be performed, and work zone access will be limited to personnel directly involved in the actual work. To adequately ensure the safety of those workers involved in the actual task, special steps will be taken, and personnel will be required to wear radiation detection badges and appropriate protective clothing. Throughout the operation, extensive monitoring will be performed to ensure that no unnecessary radiation exposure occurs.

WHERE DO I GET MORE INFORMATION?

[illegible]

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Information Line	Local Project Manager
[illegible]	[illegible]

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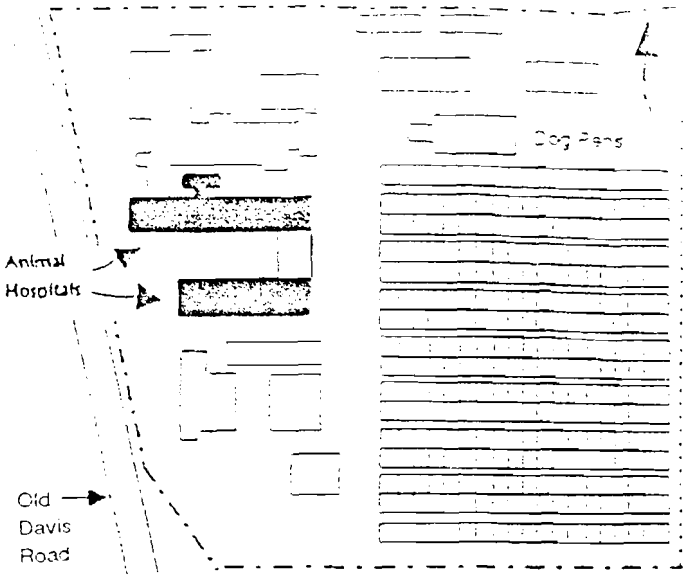


The LEHR Site is approximately one mile south of the main UC Davis campus

LEHR Cleanup Project
Old Davis Road
Mail Stop: ITEH
Davis, California 95616

Phase II Site Characterization Results
Laboratory for Energy-Related Health Research

WHAT:

As part of its effort to assess the extent of environmental contamination from a former research project located at UC Davis, the U.S. Department of Energy (DOE) has been testing soil and water under and adjacent to the Laboratory for Energy-Related Health Research (LEHR) facility for possible chemical and radioactive contamination. DOE began the soil, groundwater, and surface water investigation ("Phase II site characterization") in January 1990 to follow up on the results of a study that began in 1987. Details of the Phase II study, which was completed in November 1991, have been compiled into a comprehensive report, *Phase II Site Characterization Report: LEHR Environmental Restoration*, soon to be issued by DOE.

DOE and UC Davis have been working closely with the California Department of Health Services and the Regional Water Quality Control Board on the investigation.

LOCATION:

LEHR is located about one mile south of the main UC Davis campus, on the east side of Old Davis Road, just north of the South Fork of Putah Creek. A levee separates the southern boundary of the site from Putah Creek. Occupying approximately 15 acres, LEHR is surrounded by various campus research facilities. A few residences and private farms are located to the south of LEHR on the south side of the creek.

PHASE II SITE CHARACTERIZATION PROCESS:

The Phase II study was designed to investigate specific areas at LEHR. These areas included outdoor dog pens, areas adjacent to former special waste treatment facilities (strontium-90 leachfield and radium-226 seepage pits), and former outdoor chemical storage/dispensing areas. Over 200 soil samples were collected from these areas as well as from off-site UC Davis property to provide a means of comparison.

To evaluate potential environmental impacts on water, DOE tested groundwater under the site and surface water from the South Fork of Putah Creek. During the Phase II investigation, DOE installed 10 monitoring wells in order to collect groundwater samples. Seven of the wells are approximately 70 feet deep ("shallow wells"), and three are approximately 120 feet deep ("deep wells"). Installation of these new wells increased the monitoring network at LEHR to 23 wells. Groundwater samples were collected and analyzed on a quarterly basis. DOE also collected water from the South Fork of Putah Creek upstream and downstream from the LEHR site on a quarterly basis as part of the Phase II study. Additional hydrologic testing was conducted to learn more about groundwater flow under and near the site. Soil and water samples were tested for organic and inorganic chemicals, metals, pesticides, and radioactivity by certified laboratories according to U.S. Environmental Protection Agency or other approved procedures.

An inactive campus landfill and low-level radioactive waste burial trenches are also present at the site. Although the waste burial areas were not specifically included in the Phase II study, DOE and UC Davis have been investigating them. Further studies are planned for these areas.

RESULTS OF THE PHASE II STUDY:

Hydrogeology

Subsurface materials LEHR consist of layers of sediments. The upper zone consists of about 80 feet of clay and fine sands. Underlying this is a sand and gravel zone, which ranges from 80 to 140 feet deep. Additional clay and sand/gravel units are known to exist below these two zones, but they have not yet been thoroughly investigated as part of the LEHR cleanup project. The groundwater level beneath the site varies from 40 to 65 feet deep, depending on the season. Groundwater flows predominantly toward the

northeast at the LEHR site. Prior to this study, it was thought that the clay and sand/gravel zones were not connected hydrologically, but the results of the Phase II investigation indicate that they are. Data from the Phase II study also indicated that the South Fork of Putah Creek, which flows eastward, recharges the water table under the LEHR site. This means that groundwater from the LEHR site does not flow into Putah Creek, but away from it.

Soil

Metals were detected in soils across the site. In general, the amounts measured were similar to what is found naturally in the soil in the Davis area. No significant levels of organic chemicals were detected in soil samples. Elevated levels of chlordane, which was used to treat the dogs for fleas, were found in some soils in the outdoor dog pen areas. Low levels of nitrate were detected in on-site soil samples, but were similar to off-site samples. Low levels of tritium, strontium 90, and radium 226 were detected in some soil samples collected from the areas investigated. Further work is planned to determine how these levels compare to levels in off-site soils.

Groundwater

Several organic chemicals have been detected in groundwater at the LEHR site. High levels of chloroform have been detected consistently in an on-site shallow well adjacent to one of UC Davis' inactive campus landfill units. Other organic compounds such as 1,1-dichloroethane, 1,2-dichloroethane, and 1,1-dichloroethylene have also been detected consistently in the same well but at much lower concentrations. Concentrations of these four organic chemicals exceeded drinking water standards. Other organic compounds have been detected sporadically at very low levels in other wells at the site. The levels of these compounds have not exceeded drinking water standards.

In general, the concentrations of metals detected in the on-site shallow and deep monitoring wells are similar to those found in off-site wells. Concentrations of antimony and thallium exceeded drinking water standards a few times. Hexavalent chromium (a form of chromium) was detected consistently in most sampling rounds in several shallow wells. In many of these wells, the level of hexavalent chromium exceeded the drinking water standard for total chromium. Since chromium and other metals occur naturally in soil, further studies are planned to determine whether the metals in groundwater at LEHR are naturally occurring, are the result of geochemical processes in the soil, or are the result of past activities at the site.

Small amounts of various chlorinated pesticides such as aldrin, dieldrin, heptachlor, and others were detected sporadically in some wells. Chlordane was not detected in any of the samples. The presence of pesticides in groundwater in the Davis area is not unusual, and additional data will be needed to determine whether LEHR is the only source of these compounds.

Nitrate was detected in several monitoring wells at the site. In many cases, the concentrations were above the drinking water standard. Other possible sources of nitrate, such as wastewater effluent and regional agricultural practices, must be further evaluated to determine whether LEHR is the only source of the nitrate in groundwater.

Tritium was detected consistently at levels above the drinking water standard in an on-site shallow well next to former radioactive waste burial trenches. Lesser amounts (below the drinking water standard) of tritium and carbon 14 were detected in an adjacent 85-foot well. Trace amounts of tritium were detected sporadically in other shallow wells. Small amounts of strontium 90 were detected sporadically, but the levels did not exceed the drinking water standard. Radium 226 was not detected in any groundwater samples.

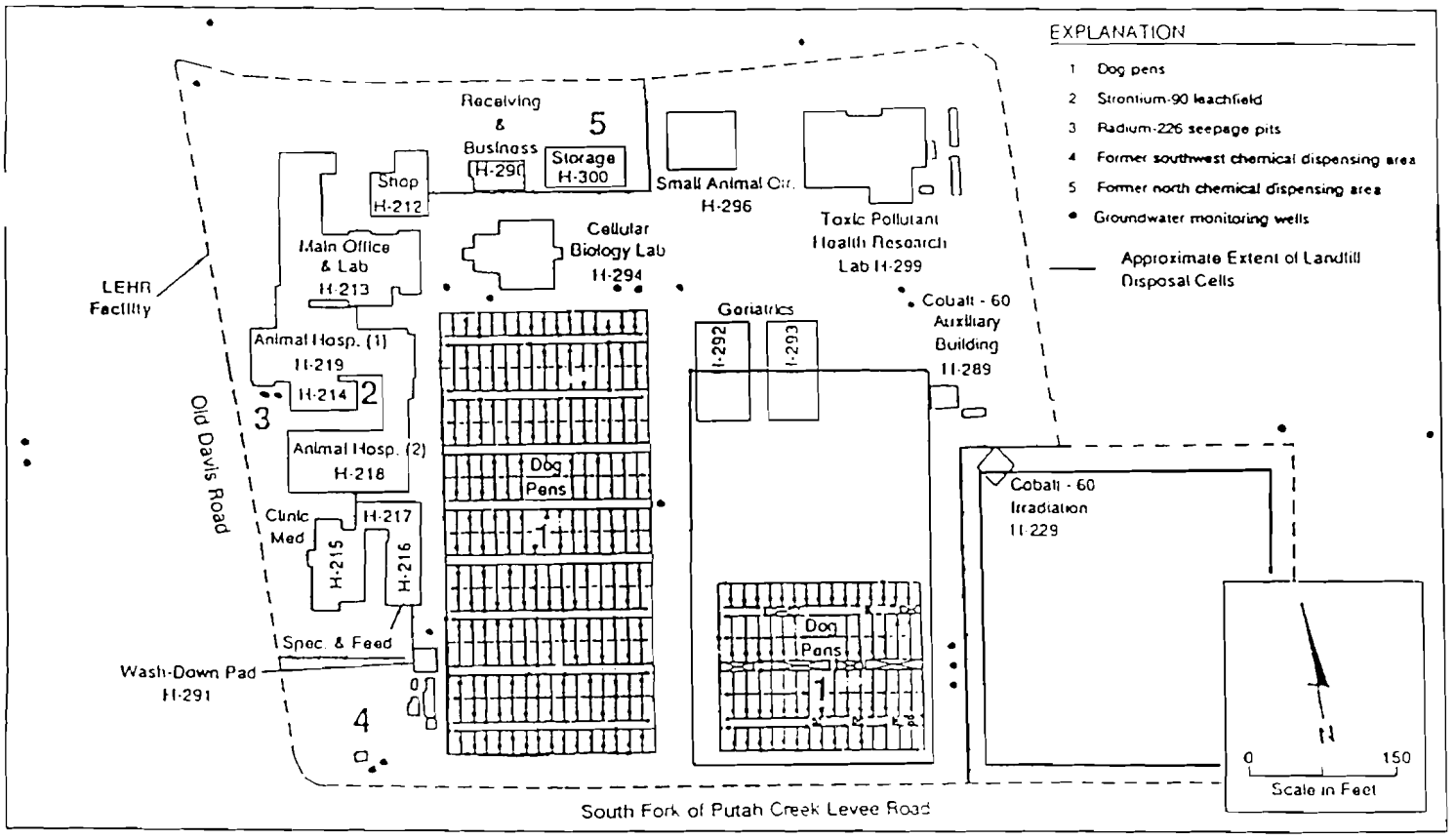
Surface Water (South Fork of Putah Creek)

Some organic chemicals and pesticides were detected in surface water samples collected both upstream and downstream of LEHR. Small amounts of metals such as antimony, barium, hexavalent chromium, lead, thallium, and zinc were detected in upstream and downstream samples. Nitrate was detected consistently in upstream and downstream samples. In a few cases, levels of some of these compounds exceeded drinking water standards. Since the South Fork of Putah Creek receives water from many upstream sources, additional tests will be necessary to determine what effect, if any, the LEHR site has had on the chemical quality of the creek and the significance of those chemicals whose levels exceeded drinking water standards. Tritium, carbon 14, and strontium 90 were detected sporadically in surface water samples. None of the levels exceeded drinking water standards.

FUTURE PLANS:

As noted, more data is needed to adequately evaluate some of the findings of the Phase II study. In addition, other areas, such as the trenches and landfill, must be further investigated. To complete the soil and groundwater investigation, DOE and UC Davis are preparing a site-wide plan, called a "Remedial Investigation/Feasibility Study" (RI/FS). Information from the RI/FS will be used to develop the plans to clean up the soil and groundwater as necessary.

February 1993



LEHR PHASE II SITE CHARACTERIZATION
AREAS OF INVESTIGATION

FOR MORE INFORMATION:

Call: LEHR Information Line
(916) 752-8351

or

Larry McEwen, DOE
(510) 637-1641

or

Julie McNeal, UC Davis
(916) 752-5536

Write: LEHR Cleanup Project
ITEH
UC Davis
Old Davis Road
Davis, CA 95616

COPIES OF DOCUMENTS RELATING TO THE LEHR CLEANUP PROJECT ARE AVAILABLE FOR REVIEW AT:

Shields Library
Reserve Desk
UC Davis
Davis, CA 95616
(916) 752-1203

Davis Public Library
Reference Desk
315 East 14th Street
Davis, CA 95616
(916) 757-5591

LEHR Cleanup Project
UC Davis
ITEH
Old Davis Road
Davis, CA 95616

LEHR SLUDGE DISPOSAL TO BEGIN
An Update

WHAT:

Approximately 34,000 gallons of low-level radioactive sludge and water which has been pumped from underground storage tanks, treated and packaged, is being shipped from the former Laboratory for Energy-Related Health Research (LEHR) site to a disposal site in Hanford, Washington. Disposal of this material, which will take place in two stages, is part of ongoing environmental assessment and cleanup activities at the former LEHR site, and is being undertaken by the U.S. Department of Energy and UC Davis.

LOCATION:

Located roughly a mile south of the main UC Davis campus on Old Davis Road, the former LEHR site occupies 15 acres surrounded by scattered campus research facilities and private farms. The sludge and water scheduled for disposal comes from 12 underground concrete tanks along the western section of the site (see map on back).

SLUDGE HISTORY:

The sludge and water were the remaining byproducts from two specially designed waste-processing systems built at LEHR. These systems handled the low-level radioactive waste of research animals used to study the health effects of exposure to low-level radiation. Certain animals involved in the study, mostly beagles, were fed or injected with varying doses of strontium-90 and radium-226. Using the special systems, the wastes were collected and processed to remove the majority of radioactive contamination. Throughout the years of active DOE research at the site (the waste systems were last used in 1986), sludge was periodically removed from the tanks and shipped to a licensed low-level radioactive waste site. This disposal operation will complete the disposal of the sludge accumulated during the last few years of the study.

PROCESS:

Since September 1991, a contractor hired by the U.S. Department of Energy (Chem-Nuclear Environmental Services, Inc., based in South Carolina) has been preparing the sludge for disposal. After removal from the underground storage tanks, the sludge and water is mixed with non-hazardous fly ash and magnesium oxide, and solidified in 55-gallon drums. The solidified material in the drums, which contain about 200 millicuries total, are stored in a secured building on the LEHR site. A total of 480 drums are ready for shipment and will be transported during the weeks of January 27 and February 5 to the DOE low-level radioactive waste disposal site in Hanford, Washington. An additional 300 drums and two 200-cubic-foot steel cylindrical containers will be scheduled for shipment in mid-February. All packaging and transportation will adhere to U.S. Department of Transportation regulations. The emptied underground tanks at the LEHR site will be decontaminated at a later stage in the project.

TRANSPORTATION:

A licensed and experienced transportation contractor, Tri-State Motor Transit of Missouri, has been contracted to handle the transport of the drums. The planned schedule specifies that one truck per day for eight days will leave the LEHR work site. Each truck will hold 60 drums. Shipments will leave the site each afternoon. The trip to Hanford will take 2 days. All required transport permits have been obtained. The route the trucks will take is Route 113 to Interstate 5, the primary transportation route through California. During the second transport phase, the remaining 200 drums and two steel containers will be removed from LEHR and transported to the DOE Hanford site for disposal. All sludge processing work, transportation, and equipment removal is expected to be complete by mid-March.

1/16/92

WHERE DO I GET MORE INFORMATION?

For additional information, please:

CALL:

LEHR	Larry McEwen Salem Attiga
Information Line	DOE Project Manager
(916) 752-8381	(916) 752-8450

OR

WRITE:

LEHR Cleanup Project
Old Davis Road
Mail Stop: ITEH
Davis, CA 95616

COPIES OF INFORMATION RELATING TO THE LEHR CLEANUP PROJECT ARE AVAILABLE FOR REVIEW AT:

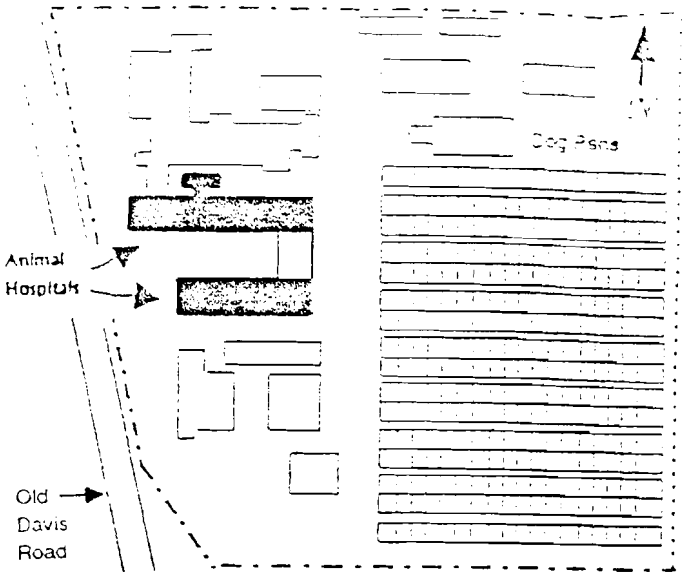
UC Davis Shields Library, Reserve Desk
University of California
Davis, CA 95616
(916) 752-1203

OR

Davis Public Library, Reference Desk
315 East 14th Street
Davis, CA 95616
(916) 756-2332

LEHR Cleanup Project
Old Davis Road
Mail Stop: ITEH
Davis, California 95616

LEHR SITE (Western Section)



The LEHR Site is approximately one mile south of the main UC Davis campus.

LEHR SLUDGE DISPOSAL
An Overview

WHAT:

Approximately 34,000 gallons of low-level radioactive sludge and water will be pumped from underground storage tanks, treated, packaged and removed from the former Laboratory for Energy-Related Health Research (LEHR) site beginning in early September. Treatment and disposal of this material - expected to take about three months and cost an estimated $1.2 million - is part of ongoing environmental assessment and cleanup activities at the former LEHR site undertaken by the U.S. Department of Energy and UC Davis.

LOCATION:

Located roughly a mile south of the main UC Davis campus on Old Davis Road, the former LEHR site occupies 15 acres surrounded by scattered campus research facilities and private farms. The sludge and water that will be treated and removed are held in 12 underground concrete tanks along the western section of the site (see map on back).

SLUDGE HISTORY:

The sludge and water are the remaining byproducts of two specially designed waste-processing systems built at LEHR to handle the low-level radioactive waste of research animals used to study the health effects of exposure to low-level radiation. Certain animals involved in the study, mostly beagles, were fed or injected with varying doses of strontium 90 and radium 226. Using the special systems, the wastes were collected and processed to remove the majority of radioactive contamination. Throughout the years of active research at the site (the waste systems were last used in 1986), sludge was removed from the tanks when necessary and shipped to a licensed low-level radioactive waste site. This disposal operation will clear the tanks of what remains.

PROCESS:

During the first week in September, a contractor hired by the U.S. Department of Energy (Chem-Nuclear Environmental Services, Inc., based in South Carolina) will mark off sections of the site and set up operations. The sludge and water have already been evaluated and tested to determine the best method for handling and treating the materials. Since the sludge varies in consistency and volume from tank to tank, the sludge will be processed in batches. This processing involves pumping a certain amount of the material into a mixing tank, adding lime and cement to solidify the sludge, pumping this mixture into 55 gallon drums, "curing" the contents, sealing the drums and storing them temporarily in an empty, secured building in the center of the former LEHR site. Approximately 800 drums will be filled and then shipped within a few months to a DOE low-level radioactive waste disposal site in Hanford, Washington. The emptied tanks on the site will be decontaminated if necessary at a later stage in the project.

SAFETY ISSUES:

The process being used involves state-of-the-art technology, and it follows state and federal safety guidelines. To adequately ensure the protection of people and the environment during this operation, special steps will be taken. Only people directly involved with the operation will be allowed in the work areas and these people will be required to wear radiation detection badges and appropriate protective clothing. In addition, work areas will be covered with plastic sheeting and surrounded by berms. Throughout the operation, extensive monitoring and air sampling will be performed to guard against contamination. The concentration of radioactivity in the sludge and water is very low; about 200 milliCuries of strontium 90 and about .003 milliCuries of radium 226.

WHERE DO I GET MORE INFORMATION?

To get additional information, please:

CALL:

LEHR
Information Line
(916) 752-8351

Larry McEwen/Salem Attiga
DOE Project Manager
(916) 752-5459

OR

WRITE:

LEHR Cleanup Project
Old Davis Road
Mail Stop: ITEH
Davis, CA 95616

COPIES OF INFORMATION RELATING TO THE LEHR CLEANUP PROJECT ARE AVAILABLE FOR REVIEW AT:

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Davis, CA 95616
(916) 752-1203

OR

Davis Public Library, Reference Desk
315 East 14th Street
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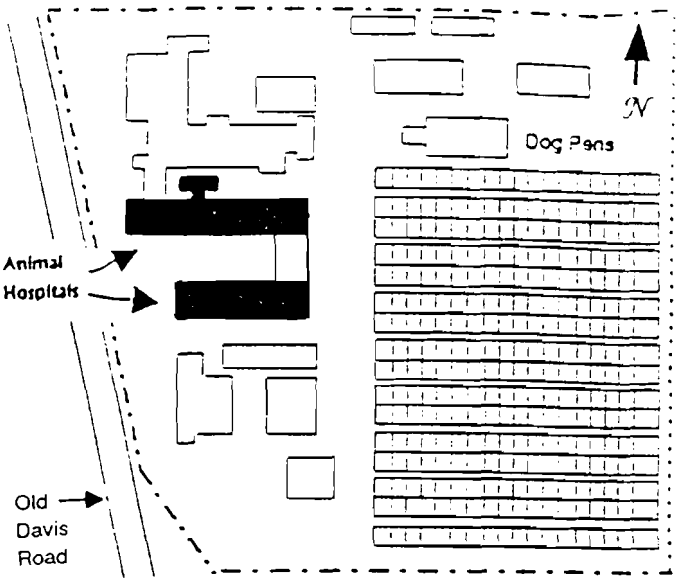
(916) 756-2332

LEHR SITE (Western Section)



The LEHR Site is approximately one mile south of the main UC Davis campus.

LEHR Cleanup Project
Old Davis Road
Mail Stop: ITEH
Davis, California 95616

COBALT 60 DOSE RECONSTRUCTION STUDY

An Overview

WHY?

The purpose of the study was to evaluate potential radiation doses to UC Davis employees, students and volunteers who worked in the vicinity of the former Laboratory for Energy-Related Health Research (LEHR) during the period of outdoor operation of the Cobalt 60 (Co-60) irradiator. The Co-60 irradiator was used from 1970 to 1985 for outdoor irradiation studies and for indoor irradiation studies until 1987.

WHAT?

The Co-60 irradiator facility, located at LEHR south of the University of California, Davis (UC Davis) campus, was an indoor-outdoor gamma irradiation facility designed to study the effects of low level continuous whole body radiation exposure to research animals. The LEHR site was operated for the U.S. Department of Energy (DOE) by UC Davis from 1970 to 1987 to study the effects of continuous Cobalt 60 radiation exposure on beagles. The last outdoor radiation exposure experiment at the Co-60 Irradiator Facility was completed in October 1985. At that time the Co-60 irradiator ceased outdoor radiation experimentation. The irradiator continued operation exclusively for indoor radiation experiments until 1987. In 1988 the Cobalt 60 irradiator was formally put in safe storage.

Though direct exposure to the outdoor portion of the irradiator beam was controlled to within a fenced area, environmental monitoring data show that low-level indirect radiation was present outside the fence perimeter. This indirect radiation was due to the photons (radiation) emitted from the irradiator undergoing multiple scattering in the air and on the ground.

HOW?

Determination of the potential radiation dose was performed by sophisticated computer modeling programs using:

Radiation monitoring data taken from various locations at LEHR and nearby environs from 1970 to 1985 (the period of outdoor radiation use) to determine radiation exposure rates;

Data from the actual irradiator use logs to determine the periods of time the radiation was exposed to the outdoors;

Construction and operating specifications of the irradiator and Co-60 sealed source to determine the radiation characteristics; and

Estimates of time individuals worked/lived in nearby locations to determine the maximum and average annual residence time (occupancy) for those areas.

RESULTS:

PART I, RECONSTRUCTION OF DOSE TO THE NEIGHBORING GENERAL PUBLIC (March 1991)

This study showed that potential dose to the public from the Co-60 irradiator was well below all regulatory limits.

For an individual living in the closest residence 24 hrs/day, 365 days/yr the maximum annual dose, in addition to natural background, was 1.6 mrem.*

For an individual present (fishing) at South Fork of Putah Creek for 5 hrs/wk, 52 wks/yr, the maximum annual dose, in addition to natural background, was 11 mrem.

PART II, RECONSTRUCTION OF DOSE TO UCD EMPLOYEES, STUDENTS AND VOLUNTEERS (May 1991)

This study showed that the potential dose to UC Davis staff, students, and volunteers who worked in the vicinity of LEHR was below the regulatory limits in place during the period of the irradiator's outdoor operation.

Natural Background Radiation:

For an individual living in the Central Valley continuously for one year, the natural background ranges from 110-150 mrem, excluding radon. If contributions from radon in air are included, the total natural background radiation dose is approximately 310 mrem. All subsequent data and limits mentioned below are in excess of natural radiation background.

The largest potential annual radiation dose was 360 mrem for a few individuals residing in a trailer at the Raptor Center 24 hours per day for approximately 1 year.

The study also calculated annual radiation doses to employees and volunteers at other locations near LEHR. The study calculated the annual radiation dose to Raptor Center staff as 200 mrem for 30 hours per week and Raptor Center volunteers as 94 mrem for 14 hours per week. For the Animal Resources Services area, known as the Goat Facility since 1981, the annual radiation dose was 220 mrem for 50 hours per week. The annual radiation dose was calculated as 190 mrem for isolation building areas for 7 hours per week. The annual radiation dose calculated for LEHR site buildings, Equine Research facility and Comparative Oncology area ranged from 13 to 34 mrem based on 50 hours per week, 50 weeks per year.

*A MILLIREM (mrem) IS A UNIT OF RADIATION DOSE.

RELATIONSHIP TO RISK:

In 1990, The National Academy of Science issued a report (BEIR V) on radiation risk. The report noted that the primary effect from low level radiation exposure is cancer and determined that for every 100,000 people exposed to 1000 mrem for one year an additional 81 people may get cancer.

The American Cancer Society estimates that the lifetime chance of cancer from all causes is 18,000 out of 100,000 people. Using the BEIR V risk estimate, below are calculated the excess lifetime cancer risk for each year of exposure for the locations noted.

Location	Lifetime Excess Cancer Risk per Year of Exposure
Trailer Occupants	29 in 100,000
Raptor Center Staff	16 in 100,000
Raptor Center Volunteers	8 in 100,000
Goat Facility Area	18 in 100,000
Isolation Building	15 in 100,000
LEHR Site, Equine Research Facility, Comparative Oncology Area	1 to 3 in 100,000

REGULATORY LIMITS:

The current annual California State Regulatory limit for members of the general public is 500 mrem. The current annual DOE limit to the general public is 100 mrem. During the time of outdoor irradiator operation (1970-1985), the annual regulatory limit (California State and DOE) to the general public was 500 mrem.

WHERE DO I GET MORE INFORMATION?

To get additional information or to request copies of the reports, please:

CALL:
Cobalt 60 Information Line
(916) 752-8351

or

WRITE:
Cobalt 60 Study
Environmental Health & Safety
TB-30, UC Davis
Davis, CA 95616

COPIES OF THE COBALT 60 DOSE RECONSTRUCTION REPORT WILL BE AVAILABLE FOR REVIEW AT:

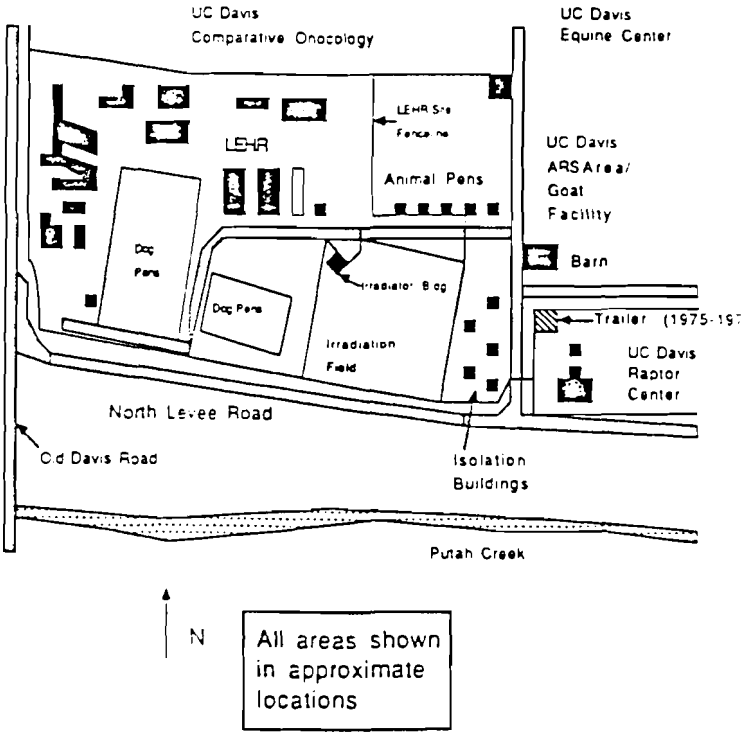
UC Davis Shields Library, Reserve Desk
University of California
Davis, CA 95616
(916) 752-1203
or

Davis Public Library, Reference Desk
315 East 14th St.
Davis, CA 95616
M 1-9 pm
T,W 10 am-9 pm
Th,F 10 am-6 pm
Sat 10 am-5 pm
(916) 756-2332

PRESENT STATUS AND FUTURE PLANS:

The Co-60 irradiator has been shut down for outdoor irradiation research since 1985 and indoor irradiation since 1987. The irradiator is no longer used for research and will be disposed of as radioactive waste.

MAP OF THE LEHR STUDY AREA



The LEHR Site is located approximately one mile south of the main UC Davis Campus.

Date: May 22, 1991 cobalt60.br

UNIVERSITY OF CALIFORNIA AT DAVIS
DEPARTMENT OF ENERGY

COBALT 60 DOSE RECONSTRUCTION STUDY

An Overview March 1991

WHY?

The purpose of the study is to evaluate potential radiation doses to the general public and UC Davis employees, students, and volunteers from the operation of the Cobalt 60 irradiator during the years 1970-1985 of operation.

WHAT?

The Co-60 irradiator facility, located at the former Laboratory for Energy-Related Health Research (LEHR) near the University of California, Davis (UC Davis) campus, was an indoor-outdoor gamma irradiation facility designed to study the effects of low level continuous whole body exposure to mammals. The LEHR site was operated for the U.S. Department of Energy (DOE) by UC Davis. From 1970 to 1985 outdoor radiation exposure experiments were conducted at the facility to study the effects of continuous radiation exposure on beagles. The final outdoor radiation exposure experiment at the Co-60 Irradiator Facility was conducted in October 1985, after ·ch the source was shut down.

Although direct exposure to the outdoor portion of the irradiator beam was controlled to within a fenced area, environmental monitoring data show that low-level indirect radiation exposure rates were present outside the fence perimeter. This indirect radiation was due to the photons (radiation) emitted from the irradiator undergoing multiple scattering in the air and on the ground.

HOW?

Determination of the potential radiation dose is performed by sophisticated computer modeling programs using:

> Radiation monitoring data taken at LEHR and nearby environs from 1970 to 1985 at various locations;
>
> Data from the actual irradiator use logs to determine the periods of time the radiation source was exposed to the outdoors;
>
> Construction and operating specifications of the irradiator and Co-60 sealed source to determine the radiation field characteristics; and
>
> Estimates of time individuals worked/lived in nearby locations to determine the maximum and average annual residence time (occupancy) for those areas.

AVAILABLE RESULTS:

PART I, RECONSTRUCTION OF DOSE TO THE NEIGHBORING GENERAL PUBLIC

This study, now completed, showed that potential dose to the public from the Co-60 irradiator was well below all regulatory limits.

For an individual living in the Central Valley continuously for one year, the natural background ranges from 110-150 mrem*, excluding radon. If contributions from radon in air are included, the total natural background radiation dose is approximately 310 millirem.

*A millirem (mrem) is a unit of radiation dose.

For an individual living in the closest residence 24 hrs/day, 365 days/yr the maximum annual dose, in addition to natural background, is 1.6 mrem.

For an individual present (fishing) at South Fork of Putah Creek for 5 hrs/wk, 52 wks/yr, the maximum annual dose, in addition to natural background, is 11 mrem.

The current annual DOE regulatory limits to the general public, in excess of natural background, is 100 mrem. During the time of irradiator operation (1970-1985) the annual regulatory limit to the general public, in excess of natural background radiation was 500 mrem.

Status of the Report and Future Plans for the Irradiator

PART II, RECONSTRUCTION OF DOSE TO UCD EMPLOYEES, STUDENTS AND VOLUNTEERS

This study evaluates the potential radiation dose to UC Davis employees, students, and volunteers working near the LEHR facility. The results of this study will be available in late **May, 1991.**

The Co-60 irradiator has been shut down for outdoor irradiation research since 1985. The irradiator is no longer used for research and will be transferred or disposed of as radioactive waste.

WHERE DO I GET MORE INFORMATION?

To get additional information, please:

CALL:
Cobalt 60 Information Line
(916) 752-8351

or

WRITE:
Cobalt 60 Study
Environmental Health & Safety
TB-30, UC Davis
Davis, CA 95616

COPIES OF THE COBALT 60 DOSE RECONSTRUCTION REPORT WILL BE AVAILABLE FOR REVIEW AT:

UC Davis Shields Library, Reserve Desk
University of California
Davis, CA 95616
(916) 752-1203

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Davis, CA 95616

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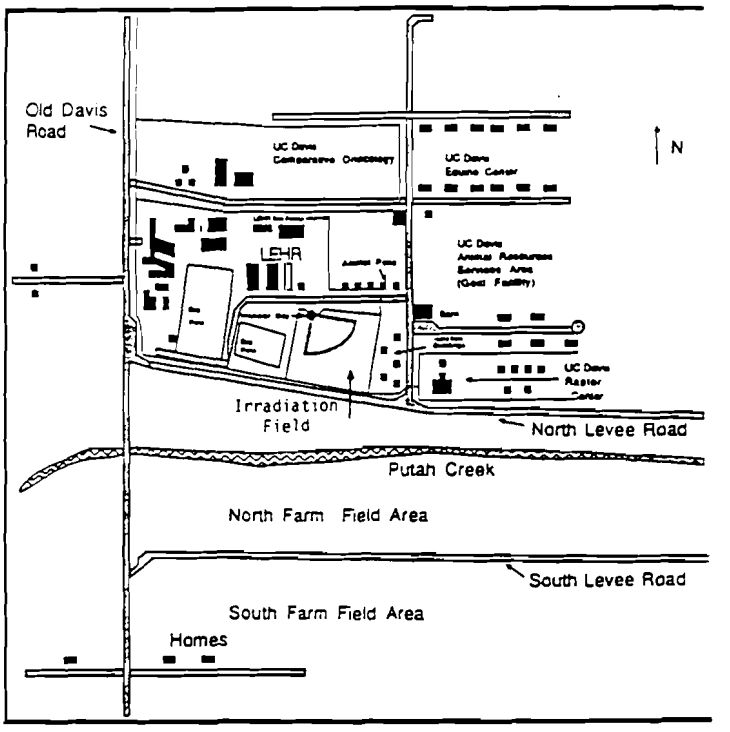
T,W	10 am-9 pm
Th,F	10 am-6 pm
Sat	10 am-5 pm

(916) 756-2332

Date: 3/26/91 co60hand.out

LEHR Site
Areas included in the cobalt-60 outdoor radiation exposure study



The LEHR site is located approximately one mile south of the main UC Davis campus.

Cobalt 60 Study
Environmental Health and Safety
TB-30
University of California
Davis, California 95616

February 25, 1991

FACT SHEET ON THE LEHR COBALT 60 (Co-60) IRRADIATOR DOSE RECONSTRUCTION STUDY

I. Purpose of the Study

The Co-60 irradiator was used from the early 1970's to 1985 to perform outdoor, low-level radiation experiments. The purpose of the dose reconstruction study was to evaluate potential radiation exposures from the operation of the irradiator.

II. Findings of the Study

- For an individual living in the farmhouse 24 hrs/day, 365 days/yr the maximum annual dose, in addition to natural background, is 1.6 mrem.
- For an individual staying (fishing) at South Fork of Putah Creek for 5 hrs/wk for 52 weeks/yr, the maximum annual dose, in addition to natural background, is 11 mrem.
- For an individual living in the Central Valley continuously for one year, the natural background ranges from 100-150 mrem, excluding radon.
- This study showed that potential dose to the public from the C0-60 irradiator was well within the DOE off-site dose limits.

III. The Determination of the Dose Involved Using:

- Radiation monitoring data taken during the experimental period to determine radiation levels at various locations;
- Data from actual irradiator use logs to determine the periods of time the radiation source was exposed to the outdoors;
- Construction and operating specifications of the irradiator and Co-60 sealed source to determine the radiation field characteristics; and
- Estimates of times individuals worked/lived in certain locations to determine average annual residence time (occupancy) for those areas.

With this information, a sophisticated computer modeling program calculated the radiation dose to individuals working/living in specific locations indicated below.

Location	Distance From Source	Residence Time or Occupancy (If less time, then the dose would be less)	Annual Radiation Dose
Farmhouses (Residences)	1900 ft. SSW	24 hr/day; 365 days/yr	1.6 mrem/yr
S. Private Farm Fields (South of the southern levee of Putah Creek)	1300 ft. S	10 hr/week	1.9 mrem/yr
N. Private Farm Field (North of the southern levee of Putah Creek)	1000 ft. S	10 hr/week	6 mrem/yr
South Fork of Putah Creek	770 ft. S	5 hr/week	11 mrem/yr

(over)

IV. Background Radiation and Relationship to Standards

The following activities or sources contribute to a radiation dose:

Activity/Source	Dose
• Natural background radiation - Central Valley	100-150 mrem/yr (excluding radon)
• Natural background radiation - Colorado	165 - 250 mrem/yr (excluding radon)
• One round trip transcontinental airline flight	4-5 mrem/round trip flight
• One chest x-ray	10 mrem/exam
• Current allowable DOE radiation standards for the General Public	100 mrem/yr (in excess of Natural Background)

V. Relationship to Risk

The chances of excess cancer mortality above the natural cancer rate were calculated from the radiation doses determined by the computer modeling program.

Location	Lifetime Excess Cancer Risk per year of exposure
Farmhouses	1 in 1,000,000
S. Private Farm Fields	2 in 1,000,000
N. Private Farm Fields	5 in 1,000,000
South Fork of Putah Creek	10 in 1,000,000

For comparison, the risk of cancer per year in the general population is 3,000 in 1,000,000.

VI. Current Status and Future Plans

The CO-60 irradiator has been shut down for outdoor irradiation research since 1985. The irradiator is no longer used for research and will be transferred or disposed of as radioactive waste.

VII. Written Report

Final written report will be available by the end of March.

VIII. Persons to Contact for Questions

CALL:
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RADIATION AND HUMAN HEALTH

Where is it?

Radiation is part of our every day lives. We are all exposed to radiation from the sun and in the atmosphere; naturally occurring radioactive materials are present in the earth, the house we live in, and the foods we consume. Radioactive gases are mixed in the air we breathe; and even our own bodies contain naturally occurring elements which are radioactive. This inescapable radiation exposure is called "natural background", and it varies from place to place.

We create and use sources of radiation for medical uses in the diagnosis and treatment of injury and disease.

What is it?

The word radiation is very general and includes light, radio waves, and electric fields. These are examples of non-ionizing radiations, whose energies are lower than the nuclear radiation we are discussing here. They do not affect matter in the same way.

Ionizing radiation changes the physical state of atoms which it strikes, causing them to become electrically charged or "ionized".

All matter is made up of atoms. The basic parts of atoms are neutrons, protons, and electrons. Neutrons and protons form the nucleus of the atom and electrons surround (orbit) the nucleus.

An atom of a particular element has a unique number of protons in its nucleus.

Certain combinations of protons and neutrons are stable (not radioactive). When an atom has an unstable combination of neutrons and protons, the atom will decay (emit radiation). These unstable atoms are called "radioisotopes".

Main Types of Ionizing Radiations:

Alpha radiation consists of heavy positively charged particles emitted by atoms of heavy elements such as uranium and radium (naturally occurring) and some human-made elements. Alpha radiation is completely absorbed by the outer dead layer of skin and is therefore not a hazard outside the body. If it is taken into the body by inhalation or with food or water, it can expose internal tissues directly and can be a hazard.

Beta Radiation (positively or negatively charged electrons) is emitted from the nucleus during decay. These are more penetrating than alphas and can sometimes penetrate the skin, but like alphas, they are generally more hazardous when inhaled or ingested.

In air, betas may be stopped by plastic or wood. ^{14}Carbon is naturally produced in the atmosphere.

Gamma and X-rays are electromagnetic radiations because they have both electric and magnetic properties. Gamma rays or photons come from the nucleus when materials decay and x-rays are a result of electron removal or rearrangement in atoms. These radiations are used frequently in medicine because they can easily penetrate the human body.

Neutrons are heavy, uncharged particles which cause ionizations indirectly in the atoms which they strike.

From Radiation Exposure to Dose

The damage from radiation depends on several factors we will discuss, such as whether the exposure was from internal or external sources. The unit for measuring absorbed energy as radiation exposure considering all factors, is the Rem (Roentgen Equivalent Man).

External Exposure

External radiation exposures come from a source outside of the body. To do harm, the radiation must have enough energy to penetrate the body and if it does, three factors affect the radiation dose that the individual will receive:

1. The amount of time the individual was exposed;
2. The distance from the source of radiation;
3. The amount of shielding between the individual and the source of radiation.

The longer an individual is exposed to a source of radiation, the higher the radiation dose will be. The relationship between distance and exposure is not so simple because the intensity of radiation falls off very quickly. Say a source produces a dose rate of 1 Rem per hour at a distance of 1 foot. At twice the distance (2 feet), the dose rate will be one-fourth of 1 Rem or .25 Rem. At three feet, the rate will be one-ninth or .11 Rem.

Internal Exposure

Any radioisotope may enter the body by inhalation, ingestion, or through an open wound. If that happens, any kind of radiation can directly harm living cells. The damage the radiation produces depends on the following factors:

1. The amount deposited into the body;
2. The type of radiation emitted;
3. The kind of element;
4. The half-life of the isotope (how fast it decays away);
5. The length of time in the body.

Can it be Harmful?

An average of 1,800 people in every 10,000 die from one or another form of cancer. If all 10,000 people received 1 rem (dose equivalent - effective energy deposited) each, we would expect 1 additional person to die of cancer and we would not be able to tell which of the 1,801 fatal cancers was caused by the radiation.

Genetic disorders in offspring are estimated as follows: Assume a 1 rem dose to the sperm of one million fathers or the eggs of one million mothers. This dose may produce between 5 and 75 serious genetic illnesses per 1 million live births. Add this to the 90,000 genetic illnesses expected among any 1 million live births. Thus, the one rem dose plus the normal incidence rate would result in 90,005 genetic illnesses for each one million live births.

Radiation Dose Perspective

1 millirem dose:	One one-thousandth of a rem.
2.5 millirem dose:	Cosmic radiation dose to a person on a one-way flight from New York to Los Angeles.
10 millirem dose:	One chest x-ray using modern equipment.
25 millirem dose:	Yearly exposure limit set by the EPA for people who live near nuclear power plants.
31 millirem dose:	Average yearly radiation dose from cosmic radiation to people in the U.S.
60 - 80 millirem dose:	Average yearly radiation dose from cosmic radiation to people who live in the Rocky Mountain States.
83 millirem dose:	The estimate of the largest dose any off-site person could have received from the Three Mile Island accident.
160 millirem dose:	Yearly dose to the average flight crew member from cosmic radiation.
300 millirem dose:	Average yearly dose to people in the U.S. (background radiation).
500 millirem dose:	Yearly limit from all sources of man-made radiation (non-radiation worker).
5 rem dose:	Yearly limit for radiation workers set by the NRC.
25 rem dose:	EPA guideline for voluntary maximum radiation dose to emergency workers for non-lifesaving work during a reactor emergency. Assumed to be a once-in-a-lifetime event.
75 rem dose:	EPA guideline for maximum radiation dose to emergency workers volunteering for lifesaving work.

Radiation Dose Effects - Low Exposure

The effects of radiation are either "prompt" or "delayed". Prompt effects occur within the first several weeks after exposure and delayed effects occur over many years. Prompt effects include hair loss, severe loss of appetite, bleeding, increased risk of infections, and death. The delayed effects are cancer in exposed individuals and genetic illness in their descendants.

People differ in their response to high exposures of radiation. For small exposures, we know much less about long-term effects like genetic changes, so we estimate these effects based on what is known about exposure.

Radiation Dose Effect - High Exposure

This information comes from cases of high exposures delivered quickly over the whole body.

50 - 200 rem: At the lower end of this range, the radiation sickness symptoms of nausea and vomiting are delayed as much as a few weeks. If they occur, they are mild and last a short time.

There is some reduction of the white blood cells which can cause some increased risk from infections.

As the dose increases, the symptoms are more severe and appear sooner. At the upper end, hair loss and severe diarrhea are likely as well. The reduction in the white blood count is worse. The threat of infection is greater. Fewer red blood cells form, resulting in anemia. Without medical care a small percentage of those exposed at the upper end of this range may die.

200 - 500 rem: As the dose increases, all symptoms appear sooner and are more severe. The number of white blood cells is greatly reduced. The bone marrow loses its ability to make new blood cells. Without medical treatment, about half of the people exposed to 400 rem will die within several weeks. Death is from a combination of dehydration, infection, and severe anemia. Proper medical care can reduce the death rate.

500 - 600 rem: In this range, the symptoms begin within the first day and are extreme. Above the upper end of the dose range, damage to the lining of the intestines causes greatly increased risk of infection, diarrhea, and dehydration. All white blood cells are killed. Even with major medical care, most people exposed to this dose would die within 30 days.

APPENDIX C
LIST OF CONTACTS AND INTERESTED PARTIES

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