SLAC-404

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ANNUAL ENVIRONMENTAL MONITORING REPORT JANUARY - DECEMBER 1991

ENVIRONMENT, SAFETY, AND HEALTH DIVISION

SLAC-Report-404
MAY 1992

Prepared for the Department of Energy
under contract number DE-AC03-76SF00515

ANNUAL ENVIRONMENTAL MONITORING REPORT
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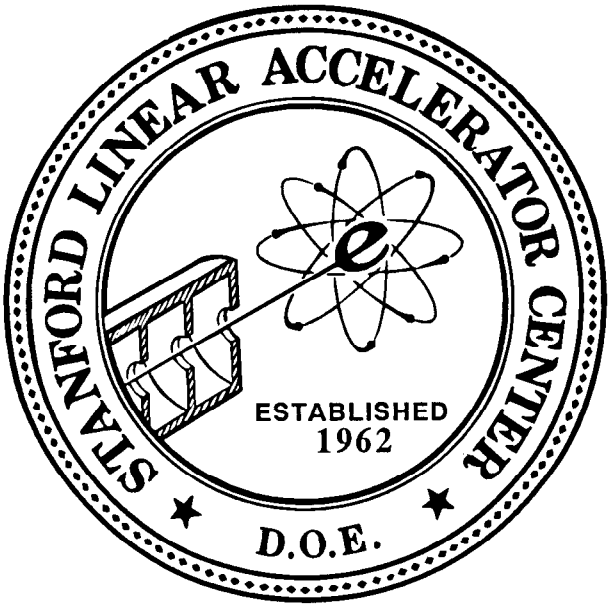
ENVIRONMENT, SAFETY AND HEALTH DIVISION
STANFORD LINEAR ACCELERATOR CENTER
STANFORD UNIVERSITY
STANFORD, CALIFORNIA 94309



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1.0 Executive Summary

This report summarizes the environmental status of the Stanford Linear Accelerator Center (SLAC) for Calendar Year 1991 (CY91). It includes descriptions of SLAC's mission, the status of compliance with applicable environmental regulations, planning and activities to accomplish compliance, and a comprehensive review of environmental surveillance, monitoring, and protection programs.

1.1 Compliance

Throughout its history, SLAC has exhibited a concern for protection of the environment. This has led to a philosophy of respecting environmental protection concerns at all stages of design and operation of the experimental and support facilities. SLAC strives to operate in compliance with Department of Energy (DOE) Orders and other Federal, State, and local environmental laws and regulations. These include the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Clean Air Act (CAA), the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), the Safe Drinking Water Act (SDWA), the Toxic Substances Control Act (TSCA), the National Environmental Policy Act (NEPA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), Executive Order 11988 "Flood Plain Management", and Executive Order 11990 "Protection of Wetlands". Accelerator operations have traditionally caused relatively little radiological impact on the environment. SLAC's radiological and nonradiological effluents and emissions are within applicable standards. Specifically with respect to the CAA, the off-site dose equivalent due to airborne radionuclide emissions and the monitoring thereof are in compliance with 40 CFR 61, Subpart H. SLAC continues to be operated in compliance with these laws and regulations.

1.2 Environmental Program Information Summary

Monitoring and surveillance are critical elements of an effective environmental protection program. SLAC has established and implemented comprehensive environmental monitoring and surveillance programs that ensure compliance with legal and regulatory requirements imposed by Federal, State, and local agencies and that provide for the measurement and

interpretation of the impact of SLAC's operations on the public and the environment. The surveillance and monitoring activities are selected to be responsive to both routine and potential releases of penetrating radiation and liquid or airborne effluents.

1.3 Environmental Radiological Program Information

1.3.1 Airborne Emissions

As a result of operation of the accelerator, some airborne radionuclides are released from the target stations in the experimental areas and the Positron Source used to produce positrons. During CY91, a total of 28.3 Curies (1.05×10^{12} Bq) were conservatively estimated to potentially have been released from the vent stacks or other openings in these areas. Oxygen-15, carbon-11, nitrogen-13, chlorine-38, chlorine-39, and argon-41 have been identified in these airborne emissions resulting in a maximum dose equivalent at the site boundary due to airborne radioactivity in CY91 of 8.59×10^{-2} mrem (8.59×10^{-4} mSv) on the east side of the site.

1.3.2 Penetrating Radiation

Direct sources of ionizing radiation from accelerator operations are due to the operation of fixed target experimental areas. These operations produce ionizing radiation in the form of neutrons. The maximum effective dose equivalent at the SLAC site boundary for CY91 would have been near the northeast corner of the site due to the operations of the End Station A fixed target program, which leads to the production of high energy photons and neutrons. At this point, the site boundary is a significant distance away from the nearest residence. At the location of the nearest residence potentially exposed to radiation from this beamline, the maximum effective dose equivalent was estimated to be less than 2 mrem in CY91. All other SLAC operations delivered less than 1 mrem to various locations. (See Section 4.3 for details.) The measurement equipment which produced the results that form the basis of this assessment of the effective dose equivalent included detectors sensitive to neutron particles as well as high energy photons. Although no neutron or high energy photon fields of environmental significance were identified during CY91 operations, operational experience indicates a potential effective dose equivalent ceiling of 2 mrem at the site boundary.

The maximum site boundary dose rate from the radioactive material stored at the Radioactive Material Storage Yard was less than 1 μrem (1×10^{-2} μSv) for CY91. The maximum site boundary dose rate from the radioactive material stored in Building 660, Interaction Area 6 (IR-6), was also less than 1 μrem (1×10^{-2} μSv) for CY91. These locations are all well within the fence around the controlled area near the accelerator housing. At locations more than a few feet from the stored radioactive material, the observed radiation levels were reduced to the prevalent background for this area, generally on the order of 5 μrem/hour.

The total potential radiation exposure to the general off-site population, some 8,800 persons, from operations during CY91 was conservatively estimated to be less than 18 person-rem (18×10^{-2} person-Sv) which is about 2% of the background dose equivalent (see Table IV-6). This is higher than the estimate of 2.0 person-rem (2.0×10^{-2} person-Sv) for CY90 due to changes in population data from the recently released 1990 census and the analytical model used. Since the exposure to the off-site population is only from penetrating radiation and short-lived airborne radionuclides, the 50 year dose commitment from operations in CY91 will be the same as the effective dose equivalent received for CY91 reported here.

1.3.3 Surface Water Discharges

There was no indication of any release of radioactivity above background concentrations in water released to the storm drain system during CY91. Radioanalysis results of water discharged to the storm drain system are summarized in Appendix E. All applicable data are statistically either within the background radiation levels or the minimum detectable levels of the counting equipment used. A summary of off-site releases of radioactive effluents in CY91 is given in Table I-1.

Table I-1. Summary of Radioactivity Released to the Off-site Environment in CY91

Release Point	Radionuclide	Pathway	Release in Ci	Release in Bq
Target Stations	C-11, N-13, Ar-41, O-15	Air	28.26	1.05×10^{12}
IR-6/ IR-8/ IR-12	H-3, Gross β/γ	Water	None	None

1.3.4 Groundwater

Radioactivation of soil and groundwater can occur in some areas near beam targets and dumps. Samples of groundwater are taken periodically from wells onsite. There have been measurable quantities of tritium found in old well number 24 (referred to as well EXW4 on Figure 5-1), near beam dump east (End Station A area), although these quantities are still within the limits of the Safe Drinking Water Act standard set forth in 40 CFR 141.16 (20,000 pCi/l) in all samples measured to date, except for the sample dated July 19, 1991. See Table I-2. There has been no measurable accelerator produced radioactivity in any of the other SLAC wells.

Table I-2. Well 24 Tritium Analysis History

Date Sampled	Tritium [pCi/liter]
03/21/67	4,000 +/- 2,000
08/29/67	2,000 +/- 5,000
10/23/67	<3,000
12/27/67	<3,000
03/29/68	<3,000
06/25/68	<3,000
08/08/68	16,000 +/- 1,000
10/29/68	<3,000
01/02/69	<3,000
04/22/69	<3,000
06/04/69	<3,000
08/27/69	<3,000
12/02/69	<3,000
04/06/70	<3,000
06/04/70	<3,000
09/17/70	<3,000
01/18/71	<3,000
07/07/71	<3,000
01/04/72	<3,000
07/07/72	6,000 +/- 1,000
02/15/73	5,000 +/- 1,000
07/10/73	6,000 +/- 1,000
06/03/74	4,000 +/- 2,000
07/11/75	5,000 +/- 1,000
02/15/77	15,000 +/- 4,000
08/10/77	16,000 +/- 5,000
07/28/78	12,000 +/- 6,000
04/10/81	<3,000
08/01/84	10,000 +/- 1,000
11/07/84	15,000 +/- 1,000
07/19/91	23,500 +/- 1,000
12/13/91	16,982 +/- 594

1.4 Environmental Nonradiological Program Information

1.4.1 Clean Air Act (CAA)

SLAC has 26 air pollution sources listed and two pending with the Bay Area Air Quality Management District (BAAQMD). SLAC must maintain compliance with the Rules and Regulations established by the BAAQMD to implement the CAA. This includes specific permit conditions placed on individual permitted sources operated at SLAC. In 1991, a Notice-of-Violation (NOV) was issued to SLAC for using paint with volatile organic content exceeding the limits allowed by the BAAQMD.

1.4.2 Clean Water Act (CWA)

SLAC has initiated a characterization program to determine the effects the facility's operations have had on the groundwater. Levels of contaminants above the State of California Drinking Water Standards have been detected. However, due to its high dissolved solids content, the groundwater in the area is not suitable as drinking water. The groundwater in this area is naturally brackish.

Until November 30, 1991, SLAC discharged surface water to San Francisquito Creek under a National Pollutant Discharge Elimination System (NPDES) Permit. The surface water discharges were a combination of cooling tower blowdown water, storm water, and groundwater which infiltrated into underground tunnels at the facility. SLAC obtained a renewed NPDES permit in 1990 which imposed strict heavy metal limitations, e.g., copper, on discharges starting December 1, 1991. Characterization of the discharges indicated that the cooling tower blowdown water was unable to meet the new limits, therefore, it was diverted to the sanitary sewer with permission from the local sanitary sewer district.

1.4.3 Industrial Wastewater

Wastewater discharges from SLAC's plating shop must comply with the Federal Metal Finishing Pretreatment Standards in 40 CFR 433. The total sanitary sewer discharge from the facility also must comply with discharge limits established by the

local municipality. Monitoring of the discharges in CY91 indicated that SLAC continues to operate in compliance with these standards.

1.4.4 Resource Conservation and Recovery Act (RCRA)

SLAC developed waste minimization plans to comply with the DOE as well as California's Hazardous Waste Source Reduction and Management Review Act (Senate Bill—14). Training which meets the requirements of RCRA began in 1991, and that program includes a section on waste minimization and pollution prevention.

1.4.5 Toxic Substances Control Act (TSCA)

As defined by TSCA, SLAC has 13 polychlorinated biphenyl (PCB) transformers and 37 PCB-contaminated transformers. In 1991, a new program for inspecting these transformers was implemented. The new program provides a formal mechanism for inspecting the transformers and for correcting deficiencies in a timely fashion. The Environmental Protection Agency (EPA) conducted a TSCA PCB inspection on June 19, 1991, and some deficiencies were observed, but the EPA has not yet released the report.

1.4.6 Releases to the Environment

On January 31, 1991, SLAC reported to the California Regional Water Quality Control Board (RWQCB) and the San Mateo County Department of Health Services, the detection of metals and/or chlorinated solvents at or above regulatory limits in some of the monitoring wells which had been installed in late 1990.

In the second quarter of CY91, SLAC reported non-radiological off-site PCB soil contamination near the oil-water separator at IR-6. The National Response Center (NRC) was contacted on April 24, 1991 to inform them of the discovery of PCBs in a drainage channel. The reportable quantity (RQ) for PCBs is one (1) pound. Calculations made from soil analytical data indicated that there was a potential for greater than this amount to be present in the ditch.

1.4.7 Environmental Restoration Activities

The last four underground storage tanks at the facility were removed. The tanks had formerly been used for the storage of diesel fuel.

SLAC is in the process of incorporating CERCLA requirements into the environmental restoration program. Many site-wide documents required to comply with CERCLA are under development. A list of known or suspected waste sites has been compiled, and preliminary assessments are being performed in order to prioritize the sites for remedial investigations. This information is also necessary for the site-wide Preliminary Assessment (PA) that SLAC must prepare for the EPA because of being listed on the EPA Hazardous Waste Compliance Docket. A NEPA document has been filed with DOE and a contract has been awarded for remedial investigation.

1.4.8 Other Activities

A Tiger Team Assessment was conducted at SLAC in October 1991. The Tiger Team concluded that neither curtailment nor cessation of any operations at SLAC was warranted as a result of the findings in the assessment, and that operations of the site are not considered to pose a significant risk to the environment.

A Corrective Action Plan was prepared and is being implemented based on the 53 compliance and best management practice findings identified by the Tiger Team.

1.5 Summary

There were no known significant radiological releases to the environment in CY91. New sampling results and calculations in 1991 indicated a potential release greater than the RQ for PCB. The NRC, appropriate agencies and DOE were notified. A NEPA document has been filed with DOE and a contract has been awarded for remedial investigation.

2.0 Introduction

2.1 General

The Stanford Linear Accelerator Center (SLAC) is a national facility operated by Stanford University under contract with the U.S. Department of Energy (DOE). It is located on the San Francisco Peninsula, about halfway between San Francisco and San Jose, California. See Figure 2-1. The site area is in a belt of low rolling foothills, lying between the alluvial plain bordering San Francisco Bay on the east and the Santa Cruz Mountains on the west. The accelerator site varies in elevation from 53 to 114 meters (m) above sea level, whereas the alluvial plain to the east around the Bay lies less than 46 m above sea level; the mountains to the west rise abruptly to over 610 m. See Figure 2-2. The SLAC site occupies 170 hectares of land owned by Stanford University and leased for fifty years in 1962 to the DOE (then AEC) for purposes of research in the basic properties of matter. The lands are part of Stanford's "academic reserve", and are located west of the University and the City of Palo Alto. The site is located in an unincorporated portion of San Mateo County. It is bordered on the north by Sand Hill Road and on the south by the San Francisquito Creek. The accelerator is sited on a roughly 300 meter wide parcel, 3.2 kilometers (km) long, running in an east-west direction. The width of the parcel extends to about 910 m at the target (east) end to allow space for buildings and experimental facilities. See Figure 2-3.

The SLAC staff currently numbers roughly 1,550 employees; there are about 1,200 full-time people, 200 part-time and 150 visiting scientists. Approximately one-quarter of the staff is professional, composed of physicists, engineers, programmers and other scientific-related personnel. The balance of the staff composition is support personnel including technicians, crafts personnel, laboratory assistants, clerical and administrative employees.

2.2 Accelerators in Perspective

Accelerators are simply tools of research enabling physicists to explore and understand the fundamental behavior of the subatomic environment. Some accelerators are linear, as is SLAC's; others are circular in geometry as are cyclotrons, synchrocyclotrons, betatrons and synchrotrons. All conventional accelerators accelerate subatomic particles (electrons, protons, positrons, alpha particles) to a high energy and bombard a target nucleus. Physicists then study the effects of the collisions in an attempt to understand precisely what happens

and thereby understand the nature of the atomic nucleus. Because of the very strong forces which bind the nucleus and its constituents together, physicists need greater and greater energies in order to delve constantly deeper into the structure of the atom. Consequently, accelerators have grown in size and complexity.

One of the important components of the U.S. High Energy Physics Program is the 3.2 km long electron accelerator at SLAC. This machine is now capable of accelerating electrons to 50 billion electron volts (50 GeV), and positrons have achieved very nearly the same energy. These particle beams are utilized by an array of experimental fixed target installations, one colliding beam storage ring and the Stanford Linear Collider (SLC).

The Positron Electron Project (PEP) storage ring is a special extension of the SLAC accelerator and poses no greater environmental problems than does the existing linear accelerator (linac). The center-of-mass energy achieved by colliding beam particles together is vastly more efficient than having a single beam strike a stationary target. In a colliding-beam storage machine, the beam particles are truly "recycled", i.e., the same bunches of beam particles are brought into collision over and over again, rather than striking a target only once. For this reason, colliding-beam devices (in a fundamental way) produce very much less radiation and residual radioactivity than do conventional accelerators.

The PEP facility, completed in 1980, is a large storage ring housed in an underground tunnel at depths varying from 6-30 m, in which beams of electrons and their antimatter equivalent (positrons) circulate in opposite directions at energies up to 15 GeV. The underground ring has a diameter of about 700 m and is located at the eastern extremity of the SLAC site.

When particles of matter and antimatter meet head-on at high velocity, both are completely converted into energy. According to the formulations of Albert Einstein, energy can be transformed into matter and vice versa. In the electron-positron collisions some of the resulting energy is immediately transformed back into matter, producing a variety of particles of immense interest to physicists. Many of the design details of the PEP facility are based on the design and experience of a small existing storage ring at SLAC called the Stanford Positron Electron Asymmetric Ring (SPEAR). The SPEAR facility came into operation and began performing colliding-beam experiments in 1972. The SPEAR machine is about one-eighth the size and capable of about one-quarter the energy of the PEP facility. Although the high energy physics usefulness of SPEAR had been fully exploited in the 1980's, its success has established the feasibility and served as a prototype for PEP.

SPEAR now serves as a strong source of synchrotron light for the Stanford Synchrotron Radiation Laboratory (SSRL) and has its own linac injector and booster ring that operate independently of the 3.2 km SLAC linac. SSRL had been completing operational readiness reviews in CY91 in preparation for fully independent operation.

In addition to the aforementioned facilities, SLAC has built a new machine, the SLC. The SLC project was proposed in 1980 and finished in 1987. Fully operational, SLC provides electron-positron collisions at 100 GeV center-of-mass energy. [1] It is housed in a 3 km underground tunnel having a single interaction region at the eastern end of the site. Associated with SLC is the SLC Large Detector (SLD), a nearly five story high detector assembly located in the SLC Collider Hall. SLD completed commissioning runs in CY91 and has been actively recording events from the Interaction Point (IP) into CY92. This SLC/SLD project has not had any significant additional environmental impact to date.

2.3 Local Climate

The climate in the SLAC area is Mediterranean. Winters are warm and moist, and summers are mostly cool and dry. Long term weather data describing conditions in the area have been assembled from official and unofficial weather records at Palo Alto Fire Station Number 3, 4.8 km to the east. The SLAC site is 60 to 120 m higher than the Palo Alto station and is free of the moderating influence of the city; temperatures therefore average about two degrees lower than those of Palo Alto. Daily mean temperatures are seldom below zero degrees Centigrade or above 30 degrees Centigrade.

Rainfall averages about 560 millimeters (mm) per year. The distribution of precipitation is highly seasonal. About 75% of the precipitation—including most of the major storms—occurs during the four-month period December through March. Most winter storm periods are from two days to as much as a week in duration. The storm centers are usually characterized by relatively heavy rainfall and high winds. The combination of topography and air movement produces short fluctuations in intensity which can be best characterized as a series of storm cells following one another so as to produce heavy precipitation for periods of five to fifteen minutes with lulls in between.

2.4 Site Geology

The SLAC site is underlain by sandstone with some basalt at the far eastern end of SLAC's boundary. In general, the bedrock on which the western half of the accelerator rests is of Eocene age (over 50 million years old), and that under the eastern half is of Miocene age (over ten million years old). On top of this bedrock at various places along the accelerator alignment are found alluvial deposits of sand and gravel, generally of Pleistocene age (one million years old). At the surface is a soil overburden of unconsolidated earth materials averaging from 0.1 to 1.5 m in depth.

2.5 Site Water Usage

Use of water by SLAC is about equally divided between accelerator and equipment cooling, and domestic uses (such as landscape irrigation, sanitary sewer and drinking water). The average water consumption by SLAC is about 2.7×10^5 gallons per day (1.02×10^6 liters per day).

Since half of the water is necessary for machine cooling, the daily consumption of this component varies directly with the accelerator running schedule, and hence also varies directly with electric power demand (the domestic water usage is relatively constant and is insensitive to the accelerator schedule). The relationship between power and water consumption can be appreciated if one considers that 85% of the power used in linac operation is finally dissipated by water evaporation, in the ratio of about 630 kilowatt-hours (kWh) per cubic meter of water. SLAC now employs five cooling water towers comprising a total cooling capacity of 79 mega-watts (MW) to dissipate the heat generated by the linear accelerator and other experimental apparatus.

Power consuming devices are directly cooled by a recycling closed loop system of low conductivity water (LCW). The LCW is piped from the accelerator (or other devices to be cooled) to the cooling towers, where the heat is exchanged from the closed system to the domestic water in the towers. The LCW from the closed system is sampled and analyzed, including for tritium, prior to discharge. A portion of the tower water is ultimately evaporated into the atmosphere. Because of this constant evaporation during operation, the mineral content of the remaining water gradually increases and eventually must be discarded as "blowdown" water.

The SLAC domestic water is furnished via the Menlo Park Municipal Water Department (MPWD) whose source is the City of San Francisco operated Hetch Hetchy aqueduct system from reservoirs in the Sierra Nevada. SLAC and its neighboring Sharon Heights development, including the shopping center, receive water service from a separate independent system (called "Zone 3") within the MPWD. This separate system taps the Hetch Hetchy aqueduct and pumps water up to a 7600 cubic meter reservoir west of Sand Hill Road. The Zone 3 system was constructed in 1962 under special agreements between the City of Menlo Park, the developer of Sharon Heights, Stanford University, and the DOE. The cost of construction—including reservoir, pump station and transmission lines—was shared among the various parties; each party has a vested interest in, and is entitled to, certain capacity rights in accordance with these agreements.

During current operations, roughly 68% of the water consumed by the laboratory is evaporated from the five cooling towers. The remaining 32% is disposed of as follows:

- 8% is cooling tower blowdown water to the sanitary sewers, after December 1, 1991 (prior to that to the storm drains)
- 16% is waste domestic and process water discharged via the sanitary sewers connected to the Menlo Park Sanitary District, and
- 8% is absorbed into the ground from irrigation.

2.6 Land Use

San Mateo County has the ultimate planning responsibility with respect to University lands which are within the county, but not within an incorporated city. The San Mateo County General Plan is the primary land use regulatory tool with respect to such lands. Adherence will be made to all applicable Federal, State and local regulations, including chemical and sanitary discharges which might (directly or indirectly) adversely affect environmental quality.

The Board of Trustees of Stanford University has the responsibility of preserving and protecting Stanford's land endowment for the use of present and future generations of students and faculty. While financial and political influences on land use policy are taken into account, the dominant and prevailing consideration is the appropriateness of those

to encourage land uses consistent with the institutional characteristics and purposes of Stanford, and to discourage those uses or claims which do not relate to or support the mainstream of the University. Certainly SLAC falls into the former category.

The purpose of the Stanford land endowment is to provide adequate land for facilities and space for the instructional and research activities of the University. The use of lands is planned in a manner consistent with the characteristics of Stanford as a residential teaching and research university, and provides flexibility for unanticipated changes in academic needs. Cooperation with adjoining communities is important and the concerns of neighboring jurisdictions are considered in the planning process.

2.7 Demography

The populated area around SLAC is a mix of office, school, university, condominiums, apartments, single family housing, and pasture. SLAC is mainly surrounded by 5 communities: Atherton town, West Menlo Park, Woodside town, Portola Valley town, and Stanford. Population and housing unit data from the recent 1990 census of these five communities are shown in Table II-1.

Table II-1. Demographic Data

GEOGRAPHIC AREA	POPULATION [persons]	POP. DENSITY [per sq mile]	HOUSING [unit]	LAND AREA [sq mile]
Atherton town	7,163	1463.32	2,518	4.895
West Menlo Park	3,959	7086.19	1,701	0.559
Portola Valley town	4,194	458.02	1,675	9.157
Woodside town	5,035	428.88	1,892	11.740
Stanford	18,097	6569.14	4,770	2.755
Total:	38,448	NA	12,556	29.105

A population estimate within 6 km of SLAC was determined as part of the required input to the CAP88-PC computer code. Population data from the 1990 census of San Mateo county and Santa Clara county were used in this study. The area was divided into 7 concentric circles and 16 compass sectors. The population distribution is summarized in Table II-2.

Table II-2. Radial Population Data for CAP88-PC

0.1 km	0.3 km	0.5 km	1.0 km	2.0 km	4.0 km	6.0 km	TOTAL
0	0	1217	2825	14108	31678	42834	92663

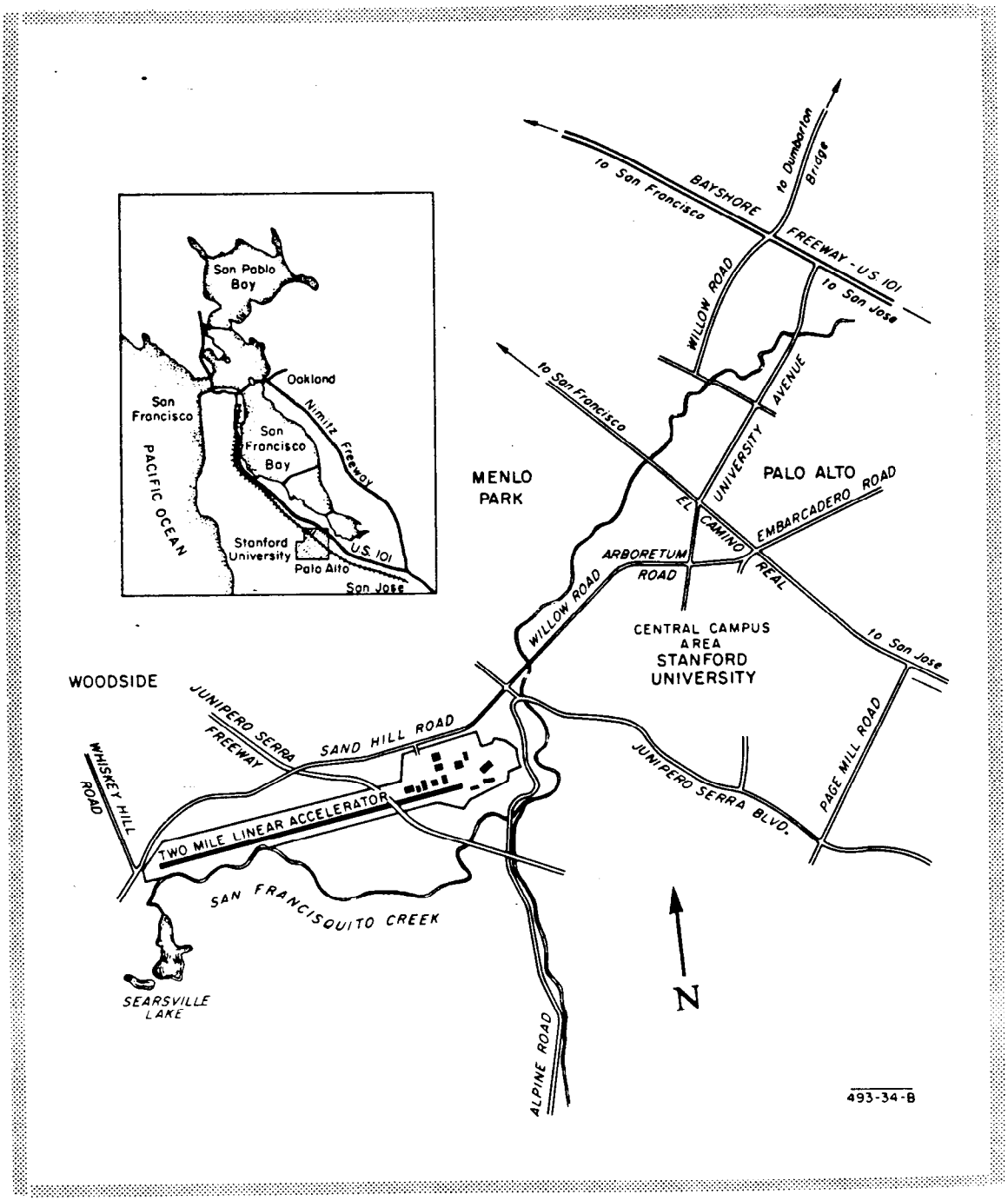

Figure 2-1. SLAC site location.

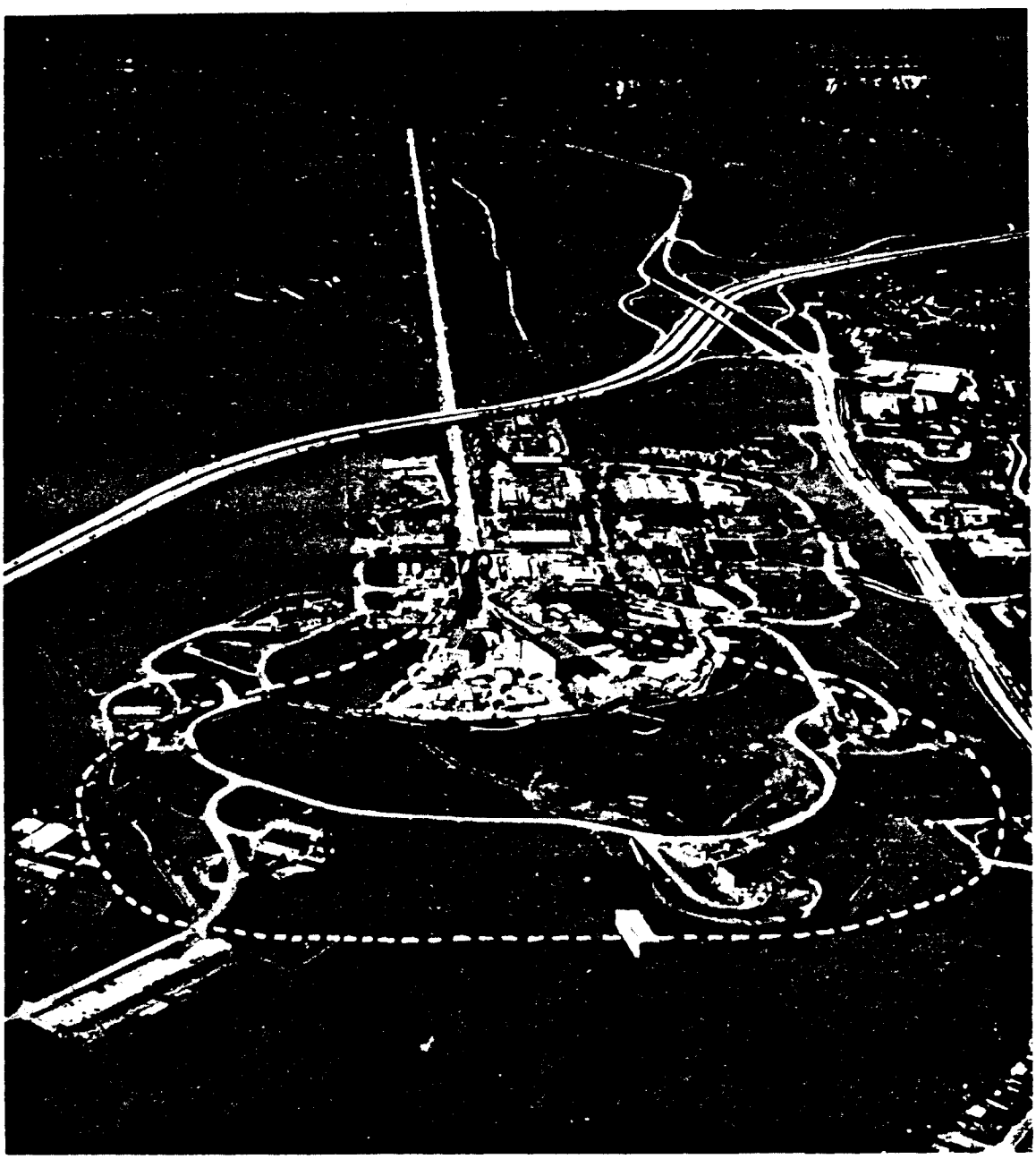

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Figure 2-2. Air view of SLAC site showing the two-mile accelerator, the research facility, and the principal laboratories and shops. Also shown is the SLAC Linear Collider. The PEP Interaction Regions can be seen in the foreground, connected by the circumferential road.

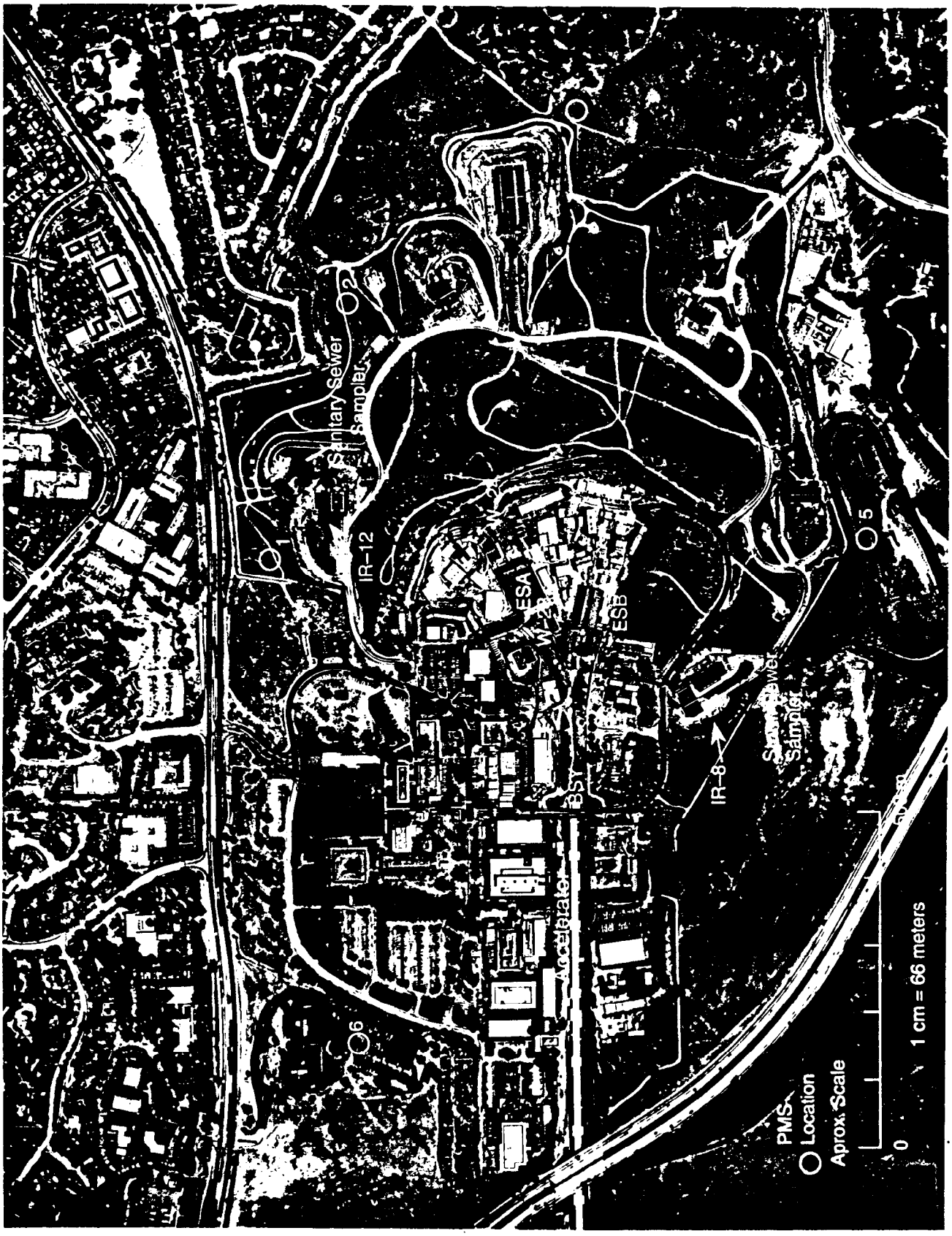

Figure 2-3. SLAC research yard and the surrounding community.

3.0 Compliance Status

This section of the SLAC CY91 Annual Site Environmental Report provides a summary of the site's compliance with environmental laws and regulations. Specific instances of noncompliance are discussed and a description of corrective actions included. More detailed descriptions of environmental programs are presented in the Environmental Program Information Sections (see Sections 4, 5 and 6).

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

In 1991, SLAC began developing a formal environmental restoration program incorporating CERCLA requirements. Sitewide program documents such as a Community Relations Plan (CRP), Program Development Plan, and a Quality Assurance/Quality Control Plan (QA/QC Plan) are being developed. A list of the areas around the site with known or suspected soil contamination was compiled and preliminary assessments (PAs) are being conducted so that a priority for remedial investigations can be established. Also, an Administrative Record is being created to provide the public with access to all documents and information utilized in making decisions throughout the CERCLA process.

SLAC is on the EPA Hazardous Waste Compliance Docket because of soil contamination associated with a former leaking underground tank which was used to store waste organic solvents. All facilities on the Docket are required to submit a sitewide PA to the EPA by July 15, 1993, so that they may score the facilities and determine if they should be on the Superfund National Priority List (NPL).

The Superfund Amendments Reauthorization Act (SARA) Title III report and the State equivalent community Right-to-Know report was submitted March 6, 1992, to the San Mateo County Department of Health Services.

Four underground storage tanks (USTs), formerly used to store diesel fuel, were removed in May of CY91. There are no other underground storage tanks used at the facility.

3.2 Resource Conservation and Recovery Act (RCRA)

SLAC is a Generator of hazardous waste, and is not permitted to treat hazardous waste or store it for longer than 90 days. The San Mateo County Department of Health Services is the agency responsible for inspecting generators of hazardous waste for compliance with Federal, State, and local hazardous waste laws and regulations. SLAC was not inspected by the County in 1991.

In 1991, SLAC developed a waste minimization plan to comply with the hazardous waste minimization and pollution prevention requirements of DOE Order 5400.1. In addition, a waste minimization plan to comply with California's Hazardous Waste Source Reduction and Management Review Act (Senate Bill—14) was completed in September of CY91. All hazardous waste minimization certifications required under RCRA for disposal of hazardous waste were made. The EPA Biennial Report due in 1992, was begun in the third quarter of CY91.

3.3 National Environmental Policy Act (NEPA)

Lack of a formal NEPA Program was one of the findings made by the Tiger Team in their assessment of the facility in October of CY91. SLAC is in the process of formalizing the NEPA process at the laboratory through the development of formal procedures and training of staff.

In CY91, the laboratory submitted a NEPA Environmental Assessment to the DOE for the diversion of cooling tower blowdown water from the storm drain system to the sanitary sewer. In addition, the Laboratory also had several small General Plant Projects (GPP), a site characterization project, and a tank removal project that were classified as Categorical Exclusions (CXs).

3.4 Clean Air Act (CAA)

The BAAQMD implements the Clean Air Act through a set of Rules and Regulations for operations or equipment which may cause air pollution. SLAC had a total of 26 air pollution sources listed with the BAAQMD at the end of CY91. During the year, permit applications were submitted for the operation of two solvent recycling units. Additionally, seven solvent

cleaning operations were closed because they were no longer needed. No permit limitations were exceeded in CY91.

In July of CY91, SLAC was inspected by the BAAQMD. During the inspection, samples of some of the paints used in the permitted paint booth (Source S-5) were collected for analysis by the BAAQMD. Results of the analysis indicated that some of the paint exceeded the allowable limit for volatile organic compounds (VOCs); consequently, a NOV was issued. The noncompliant paint was removed from inventory and other paints used at the site were examined to assure they met the regulations. Findings noted during the inspection conducted in July resulted in a second NOV which was later rescinded. The alleged violation was for disposal of an empty paint can in an uncovered trash container. The BAAQMD further evaluated the situation and determined that it did not constitute a violation of their rules and regulations.

The National Emission Standards for Hazardous Air Pollutants (NESHAPs) program requires that facilities that release radionuclides into the air report those releases to the appropriate regional office of the EPA. In accordance with this requirement, SLAC prepared a report and submitted it to DOE (see Appendix B). SLAC is not a large source of air pollutants and there were no known instances of noncompliant emissions in CY91.

3.5 Clean Water Act (CWA)

3.5.1 Groundwater Monitoring Program

In 1990, SLAC initiated a groundwater monitoring program which included the installation of ten (10) groundwater monitoring wells. The wells were constructed in areas of the facility which historically and/or currently store, handle, or use chemicals which may pose a threat to groundwater quality. Samples collected from the wells were analyzed for a wide range of chemical constituents. Results of the analyses indicated that water in several of the wells contained levels of heavy metals and/or chlorinated solvents at or above the State of California Maximum Contaminant Levels (MCLs) for Drinking Water or EPA National Ambient Water Quality Criteria based on health effects. This information was submitted to the State of California RWQCB and the San Mateo County Department of Health Services on January 31, 1991. The wells were sampled quarterly in CY91, and analyzed for volatile organics and heavy metals. Results of the analyses confirmed findings reported in the 1990

environmental report that water in several of the wells contained elevated levels of heavy metals and/or chlorinated solvents. The main organic contaminants are trichloroethene (TCE), note that trichloroethylene is an alternative spelling of TCE, and its breakdown products. TCE was historically used at the site as a cleaning solvent, and is no longer in use with the exception of very small quantities in research laboratories. The general water quality naturally occurring at SLAC, as measured by total dissolved solids (TDS) values, indicates that the area's groundwater is not suitable for drinking water.

Quarterly monitoring of the wells will continue in CY92. Additionally, a soil-gas survey will be conducted in CY92 to try and determine the horizontal extent of the contamination in those areas with contaminants above regulatory limits. Further groundwater characterization is planned and will be performed in cooperation with and the approval of the County of San Mateo Department of Health Services.

3.5.2 Groundwater Around Former Leaking Underground Storage Tank

The California RWQCB has oversight of a Waste Discharge Order for contaminated groundwater near a former leaking UST which contained organic solvents. Groundwater monitoring wells surrounding the area are sampled and analyzed quarterly. Several of the down-gradient wells contain VOCs in excess of the State of California MCLs for drinking water.

In addition to monitoring of the wells, the RWQCB requested SLAC to monitor a potential groundwater seep to determine if VOCs from the UST are migrating into the subdrain. Chloroform was found only during the first two sampling events conducted March 23 and June 30 of CY90. The concentration found on March 23, 1990 was precisely at the method detection limit (MDL), and the concentration found on June 20, 1990 was roughly three times the MDL. No choloroform was detected in the two subsequent CY90 samples (September 26 and December 11), or in any of the three samples taken in CY91.

Because the reported concentrations of chloroform were at or very slightly above the MDL, and because chloroform was not detected in any of the E-003 samples taken in CY91 (or any of the monitoring well samples from CY91), it is likely that chloroform contamination from an outside source was responsible for March 23 and

June 20 CY90 results. Analysis of samples during the coming year will help determine whether there is chloroform contamination at E-003.

Methylene chloride was found during only one sampling event (June 26, 1991), and the concentration was reported at precisely the MDL; none was detected during the subsequent (and final) quarter of CY91. The analytical method used for the June 26, 1991 sample was EPA 8010/8020, which utilizes a gas chromatograph (GC). The method EPA 8240/8260, an alternative method used for analysis of E-003 samples approximately once per year, utilizes GC with a mass spectrometer (GC-MS), and achieves more conclusive results for extremely volatile compounds such as methylene chloride. Because it was detected only once in seven quarters, and the one time it was detected the concentration was precisely at the 8010/8020 MDL, we believe that there is no methylene chloride contamination at E-003, and that the June 26, 1991 result was laboratory contamination. Analysis of samples during the coming year will help determine whether there is methylene chloride contamination at E-003.

3.5.3 Monitoring Well (Well-24)

Historically, in samples taken in 1968, 1973, 1984 and 1991, tritium at concentrations above minimum detectable levels but below drinking water standards (20,000 pCi/l) have been detected in a groundwater monitoring well and were reported in previous annual reports (also see Table I-2). In samples taken in July and August of CY91 somewhat higher levels were seen (24,000 pCi/l). Possible reasons for tritium being found in this well's water are being investigated and sampling frequency has been increased to quarterly. The most likely cause is activation of groundwater by particles from accelerator beams. No other monitoring wells at SLAC have shown any tritium above minimum detectable levels. There are no drinking water wells at SLAC or in the general vicinity of the facility.

3.5.4 Surface Water

In CY91, SLAC had a NPDES Permit from the California RWQCB, San Francisco Bay Region. The permit regulated surface water discharges from the facility, including blowdown water from five cooling towers. During 1991, analysis of samples collected as required by the permit indicated no permit excursions. A

summary of the compliance status of SLAC's NPDES permit is provided as Table III-1. See Appendix E for results of radioactivity analyses of outfall water.

When the RWQCB renewed the SLAC NPDES permit in 1990, they stipulated that new and more stringent discharge limitations were to become effective on December 1, 1991. Analysis of the blowdown water showed that SLAC would be unable to meet the new limits, e. g., copper, using current operations. After evaluating several options such as ozonation and chemical treatment, the decision was made to divert the discharge from the storm drain system to the sanitary sewer system. A permit for discharging the water to the sewer was obtained from the South Bayside Systems Authority (SBSA), issued jointly with the West Bay Sanitary District (WBSD). On November 30, 1991, SLAC ceased discharging blowdown water to the storm drain, and shortly thereafter began discharging the blowdown water to the sanitary sewer.

Table III-1. NPDES Summary of Compliance Status

SLAC NPDES 1991 #samples / #permit excursions

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sample Location E001												
Setteable Matter	NA1	1/0	NA	NA	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Oil & Grease	NA1	3/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
pH	NA1	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Temperature	NA1	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Phosphate	NA1	3/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
TSS	NA1	3/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
TDS	NA1	3/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
Bioassay	NA1	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Sample Location E002												
Setteable Matter	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Oil & Grease	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
pH	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Temperature	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Phosphate	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TSS	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
TDS	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Bioassay	NA1	NA1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sample Location E003												
Setteable Matter	1/0	1/0	NA	NA	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Oil & Grease	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
pH	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Temperature	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Phosphate	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
TSS	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
TDS	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
Bioassay	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Sample Location E004												
Setteable Matter	NA	1/0	NA	NA	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Oil & Grease	1/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
pH	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Temperature	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR
Phosphate	1/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
TSS	1/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
TDS	1/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	4/0	5/0	4/0	NR
Bioassay	NA	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	NR

3/0 = 3 Samples collected / O permit excursions
NA = Not available
NA1 = Not available due to freeze damaged lines
TSS = Total Suspended Solids
NR = Not required or no blowdown
NF = No Flow
TDS = Total Dissolved Solids

3.5.5 Industrial Wastewater

SLAC has a facility for treating plating shop non-hazardous rinse waters before discharging to a Public Owned Treatment Works (POTW). The SBSA monitors the effluent from the treatment facility for compliance with the metal finishing pretreatment standards under the Clean Water Act and SLAC's industrial wastewater discharge permit limits. No violations of pretreatment standards or permit limits were experienced during 1991.

In 1991, a new discharge permit was obtained for the discharge of cooling tower blowdown water to the sanitary sewer system. The blowdown water had previously been discharged to the storm drain system but discharges had to be discontinued due to more stringent discharge limits being imposed by the RWQCB.

3.6 Safe Drinking Water Act (SDWA)

Drinking water and process water is supplied to SLAC by the City of Menlo Park from the Hetch Hetchy water system. Drinking water and process water are transported throughout the facility by a distribution system which is protected by backflow prevention devices. There are no drinking water wells at SLAC or in the general vicinity of the facility.

3.7 Toxic Substances Control Act (TSCA)

SLAC has equipment which is filled with oil or other dielectric fluids containing PCBs. Handling and disposal of PCBs is regulated by the TSCA. As defined by TSCA, SLAC has 14 PCB transformers (greater than 500 mg/l PCBs) and 34 PCB-contaminated transformers (greater than 50 mg/l but less than 500 mg/l PCBs). On June 19, 1991, SLAC was inspected by EPA for TSCA compliance. Deficiencies relative to routine self-inspections were noted. To date, EPA has not submitted a report of this inspection to SLAC.

In CY91, SLAC implemented a formal program for performing monthly inspections of all PCB and PCB-contaminated transformers. The program has mechanisms in place to provide for the timely correction of deficiencies noted during the inspections.

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

FIFRA regulates pesticide use in the United States. The term "pesticide" refers to insecticides, rodenticides, and herbicides. SLAC uses licensed contractors to apply "registered use" pesticides. SLAC personnel apply "general use" pesticides only.

3.9 Endangered Species Act (ESA)

Six threatened or endangered species (plants and animals) have been recorded for the general area around SLAC. Sensitive species and their presence at SLAC are evaluated when preparing environmental assessments for proposed projects, as required under NEPA.

3.10 National Historic Preservation Act (NHPA)

There are no eligible NHPA sites at SLAC.

3.11 Executive Order 11988, "Floodplain Management"

According to the Federal Emergency Management Agency (FEMA) floodplain maps for the area, a 100 year flood would not reach the SLAC facility, but instead would be confined to the San Francisquito Creek channel south of the facility.

3.12 Executive Order 11990, "Protection of Wetlands"

As part of an environmental assessment conducted in CY91, SLAC had a contractor perform a survey to determine whether any area(s) should be formally designated as wetlands, which are specifically protected under Section 404 of the Clean Water Act. The field survey and evaluation were performed using established Federal Guidance. According to the survey, the drainage system at IR-8 showed characteristics of wetlands, but a definitive evaluation of the vegetation was not possible because of continuing drought conditions and because the study was performed in the fall when reproductive structures were generally absent. The report concluded that the natural hydrology of the area would probably not be capable of supporting the wetlands community because of its periodic drought. The IR-8 drainage channel, which contains the majority of the potential wetlands at and around SLAC, is

approximately 4,000 square feet, less than one-tenth of an acre. By comparison, the Corps of Engineers in practice use ten acres as their functional cutoff for "significant" wetlands.

3.13 Releases to the Environment

3.13.1 Radiological

There were no known releases of airborne or waterborne radioactive material to the environment that exceeded the legal limits during CY91. See Appendix E for waterborne test results.

3.13.2 Non-Radiological

On January 31, 1991, SLAC reported to the California RWQCB, and the San Mateo Department of Health Services, the detection of metals and chlorinated solvents above regulatory limits in several groundwater monitoring wells which were installed in CY90.

On April 24, 1991, SLAC contacted the NRC and other appropriate regulatory agencies to notify them of PCB contamination in the IR-6 drainage ditch. Using assumptions as to the extent of contamination, calculations indicated that greater than the RQ of PCBs were present in the ditch's soil. Characterization of the vertical and horizontal extent of contamination was conducted later in the year. Contamination was detected in soil extending approximately 200 feet beyond SLAC's boundary onto Stanford University owned land leased to another party. Investigations are currently underway to determine whether the source(s) of PCBs have been eliminated.

3.14 Environmental Self Assessment

In preparation for the Tiger Team's visit to SLAC, an environmental Self Assessment was conducted in April 1991 with the assistance of an environmental consulting firm. The self assessment evaluated the status of all major environmental programs at the site.

The major findings of the self assessment were:

- Environmental programs are not adequately planned and implemented.

- There is not adequate training for Hazardous Waste and Materials Coordinators, generators of hazardous waste, and line managers.

- There is a lack of written procedures for carrying out environmental programs, regulations, and DOE Orders.

- Quality assurance has not been adequately incorporated into environmental programs.

3.15 Tiger Team Environmental Assessment

A special assignment team (Tiger Team) visited SLAC during the months of October and November 1991 to provide an independent evaluation of operations and environmental practices at SLAC. The results of these findings were reported in the document: SLAC Corrective Action Plan (SLAC-REPORT-388). Below are the summaries of the Tiger Team's findings and SLAC's proposed corrective action plans that are relevant to the radiological environmental monitoring program.

3.15.1 Radiological Environmental Findings

Three findings were identified by the Tiger Team in this sub-group.

- Finding A/CF-2: *SLAC does not have a documented meteorological monitoring program. Meteorological data currently used by SLAC in the AIRDOS modeling are not representative of local conditions.*

  Response: SLAC will develop a documented meteorological monitoring program to ensure that meteorological data used at the site is representative of local conditions. This program will identify the types of meteorological information required to support all routine and nonroutine environmental protection activities. The meteorological information will include topographical characteristics and distances to critical receptors. Data from offsite sources will be used if the data are well-maintained and the data are readily available and representative of conditions at the site.

- Finding SW/CF-5: *SLAC has never submitted ODIS Reports for effluent and onsite liquid and air radioactive waste discharges as required by DOE 5400.1, Chapter II, Section 5.a.*

  Response: SLAC will identify and record required On-Site Discharge Information System (ODIS) data, such as all emission points, onsite radioactive waste discharge points, and unplanned releases. Emission points will include radioactive gaseous effluents from vents at the LINAC housing, SLC, SPEAR, and PEP. Radioactive waste discharge points will include discharged water from various areas of the LINAC housing, PEP, SPEAR, and SLC.

- Finding SW/CF-6: *SLAC does not have a fully developed program for monitoring and controlling batch discharges of liquid radiological effluents to ensure that all releases meet the requirements of DOE orders.*

  Response: SLAC will revise existing monitoring activities to include a program for monitoring and controlling batch discharges of liquid radiological effluents to ensure that all releases meet the regulatory requirements. The handling of radiological liquids will be evaluated to identify potential environmental problems.

The following is a general summary regarding the Tiger Team's findings for the non-radiological environmental monitoring program.

3.15.2 Non-Radiological Environmental Findings

The objective of the environmental portion of the Tiger Team Assessment was to assess the site's current environmental compliance status with regard to Federal, State, and local regulations; DOE Orders; agreements; and applicable permits. The environmental assessment examined site performance against best management or accepted industry practices, and evaluated the adequacy of DOE and contractor environmental program management and resources in place.

The Environmental Subteam identified 50 nonradiological findings in the assessment of SLAC. Of these findings, 20 percent related to compliance with Federal, State and local requirements and the remainder related to compliance with DOE Orders and best management practices. In response to the Tiger Team Assessment, SLAC is developing a Corrective Action Plan to provide timelines for addressing the findings of the assessment as well as budgetary impact. Also, an institutionalized Self Assessment Program is being developed so that the status of compliance at SLAC can be continuously monitored, issues quickly identified, and corrective action taken.

3.16 Current Issues and Actions for the Period of January 1, 1992-April 15, 1992

3.16.1 Low-Level Radioactive Waste Activities

An audit was conducted by the Westinghouse Hanford Corporation (WHC) at SLAC on April 25 and 26, 1991. As a result of written documentation deficiencies, SLAC was not approved to ship low-level radioactive waste. Steps have been taken to comply with the check list in Appendix C of WHC-EP-0063-3 to correct these deficiencies before a follow-up audit that will be conducted at SLAC in July, 1992.

3.16.2 Clean Water Act (CWA)

3.16.2.1 Industrial Wastewater

On April 15, 1992, SLAC received two new wastewater discharge permits which were issued jointly by the WBSD and the SBSA. One permit is for discharges from the industrial wastewater pretreatment facility which must meet Federal pretreatment standards for metal finishers. The second permit provides for all other discharges at the site, including the cooling tower blowdown water and LCW, and must meet local limits established by the municipalities. The new discharge permits expire April 14, 1993.

On March 31, 1992, SLAC submitted 1991 estimated volume permit information to the WBSD.

3.16.2.2 Surface Water

On March 27, 1992, SLAC submitted a Notice of Intent (NOI) to comply with the State General Permit to discharge storm water associated with industrial activity to the State Water Resources Control Board.

3.16.3 Toxic Substances Control Act (TSCA)

In February of CY92, two PCB transformers and three PCB-contaminated transformers were removed from service and disposed of as hazardous waste. SLAC now has 12 PCB transformers and 31 PCB-contaminated transformers.

3.16.4 Resource, Conservation and Recovery Act (RCRA)

Preparation for the Biennial Report begun in the third quarter of 1991. On April 6, 1992, SLAC submitted the report to EPA Region IX.

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

On March 6, 1992, SLAC submitted the annual SARA Title III report and the State's equivalent Community Right-to-Know report to the San Mateo Department of Health Services.

3.16.6 Releases to the Environment

On February 20, 1992, a mercury spill of an estimated 1.3 pounds occurred inside Building 102. The NRC and other appropriate regulatory agencies were notified of the release. An emergency response contractor was employed to recover the mercury and decontaminate the building.

3.16.7 Tiger Team Assessment

On January 31, 1992, a draft corrective action plan addressing the findings of the Tiger Team Assessment conducted in CY91 was submitted to the DOE.

3.16.8 Agreement in Principle (AIP)

An Agreement in Principle (AIP) was entered into between the DOE and the State of California in CY90. The State's designated lead agency for the AIP is the California Department of Health Services (DHS). The AIP provides technical and financial support to the State for environmental oversight and independent monitoring to ensure compliance with applicable Federal, State, and local laws at SLAC and other

DOE facilities in California. An orientation meeting and tour was conducted at SLAC.

During the first quarter of CY92 representatives from the State AIP have begun working with SLAC. Meetings were held to provide an overview and orientation of general environmental programs as well as monitoring activities and quality assurance. A State representative will be present during the next groundwater sampling event to observe sampling procedures and quality control measures.

3.16.9 Permit-by-Rule (PBR)

On January 30, 1992, SLAC submitted an initial NOI to operate to the California Department of Toxic Substances Control (DTSC). The notification provides information on SLAC's intent to operate fixed hazardous waste treatment units under the new "Permit-by-Rule" (PBR) regulations. PBR allows for treatment of specific hazardous waste streams using proven technologies provided certain requirements are met. Candidate treatment processes allowed by PBR include precipitation of heavy metal bearing caustic solutions and crushing of empty drums which contain residue of hazardous materials.

3.17 Summary of Permits

SLAC has a NPDES permit, two (2) wastewater discharge permits, two (2) interim wastewater discharge permits, 26 air permits, two (2) air permits pending, and two (2) California Extremely Hazardous Waste Disposal Permits. A more detailed description of these permits is provided in Section 5.8.

4.0 Environmental Radiological Program Information

4.1 Airborne Monitoring

Airborne radionuclides are produced in the air volume surrounding major electron beam absorbers such as beam dumps, collimators and targets. The degree of activation is dependent upon the beam power absorbed and the composition of the parent elements. The composition of air is well known, consisting of nitrogen, oxygen, and trace quantities of carbon dioxide and argon. Induced radioactivity produced at high energies is composed of short lived radionuclides, such as oxygen-15 and carbon-11 with half-lives of 2 minutes and 20 minutes, respectively. Nitrogen-13 with a half-life of 10 minutes is also produced, but in much lower concentrations. As a consequence of water cooling and concrete shielding, both containing large quantities of hydrogen, the thermal neutron reaction with stable argon produces argon-41, which has a half-life of 1.8 hours.

We have not detected any other radionuclides including particulates in the airborne effluent exhausted from SLAC.

The accelerator, PEP, SPEAR and experimental areas are designed to transport (not absorb) high energy electrons and positrons. Radioactive gas concentrations are therefore not produced in measurable quantities. The Beam Switch Yard (BSY), Positron Source (PS), and electron/positron (e^-/e^+) beam dumps in the Final Focus System (FFS) represent the only portions of SLAC designed to absorb high energy particles and are the only sources of detectable gaseous radioactive emissions. These areas are not vented continuously. They are vented only for emergencies and at the end of each experimental cycle for brief periods of one hour or less.

The Derived Concentration Guides (DCGs) for airborne radioactivity appear in Ref. 3. They were derived from dose standards which require that no individual in the general population be exposed to greater than 10 mrem in one year.

Airborne radioactivity produced as the result of operations is short lived; i.e., the half-lives range from 2.1 minutes to 1.8 hours and are in gaseous (not particulate) form. The chief radionuclides in SLAC produced airborne radioactivity are listed in Table IV-1.

Table IV-1. Radioactive Gases Released to Atmosphere

Isotope	Half-Life	DCG[μCi/cm^3]
^{15}O	2.1 minutes	1.7×10^{-9} (a)
^{13}N	9.9 minutes	1.7×10^{-9} (a)
^{11}C	20.5 minutes	1.7×10^{-9} (a)
^{41}Ar	1.8 hours	1.7×10^{-9}

(a) Calculated from Ref. 5, assuming total submersion.

Since we do not routinely release airborne radioactivity while the beam is on and require a waiting period before turning on the exhausters, the only radioisotope released is argon-41. By far the greater proportion of exposure an individual may receive under any circumstances from the radionuclides listed in Table IV-1 is from whole-body immersion. Thus for an individual to receive a whole-body dose of 10 mrem annually, it would require continuous exposure to a large cloud with an average concentration equal to 1.7×10^{-9} μCi/cm^3 (Ci/m^3) for an entire year.

The BSY areas are vented by a total of five fans. The discharge point is just slightly above roof elevation. The total exhaust rate for the accelerator is 60 m^3/min, and for the BSY it is 40 m^3/min. Venting of PEP and its IRs is accomplished by a total of 14 exhaust fans which vent just above grade level, with a total exhaust rate of 50 m^3/min. PEP is the only facility that is vented while the beam is on.

Each BSY ventilation fan is provided with a radioactive gas detector. A Geiger-Mueller (GM) detector, power supply, rate meter, input to VAX computer system, and air pump are interlocked with the ventilation fan so that they operate only when the machine is vented. These components are found in every air monitoring station (AMS) at SLAC.

The gas monitors for the BSY collect particulate samples during venting and have revealed negative results. During the CY91 monitoring period particulate radioactivity above background was not detected.

The effluent for the PS and FFS areas are also monitored continuously while the exhausters are running. The same type of air monitoring is used as described above for the BSY.

There were no measurable releases of radioactive gases from the BSY, PS or FFS during 1991. However, NESHAPs requires a compliance report to be submitted regardless of release levels. The results of these calculations appear in Appendix B. They were derived by calculating the saturation activity for oxygen-15, carbon-11, nitrogen-13, and argon-41, and then releasing the radionuclides without applying decay factors. We also conservatively assumed that these releases occurred at the end of each experimental cycle, i.e., whenever the machine was shut down for repair or maintenance, whether or not any venting was done.

The compliance report was generated using the required computer program, EPA, CAP88-PC, Version 1.0. The results (0.0859 mrem) show that the annual effective dose equivalent (EDE) was less than 0.9% of the NESHAP standard (10.0 mrem per year).

4.2 Wastewater Monitoring

Wastewater containing small quantities of radioactivity within regulatory limits is occasionally discharged to the sanitary sewers from the site. The only possible sources of liquid radioactive effluents are from LCW cooling systems in the BSY and certain other areas of the accelerator's housing. See Appendix E for CY91 water analysis data. In the event of leaks from the systems, water is collected in stainless steel lined sumps sized to contain the entire water volume.

The greatest source of induced radioactivity is where the electron/positron beam is absorbed. Since water is composed of hydrogen and oxygen, the only radioisotopes produced are the short lived oxygen-15 and carbon-11, beryllium-7 (half-life of 54 d), and longer lived tritium (half-life of 12.3 y). Oxygen-15 and carbon-11 are too short lived to present an environmental problem in water, and the beryllium-7 is removed by resin beds required to maintain the electrical conductivity of the water at a low level; therefore, tritium is the major radioactive element present in the water that is of environmental importance. See Appendix E for the detailed tritium analysis results of wastewater. Gross beta/gamma analysis results are also shown.

In October 1991, SLAC started to collect all water potentially containing tritium in a 20,000 gallon holding tank at Sector 30 in order to control and keep track of tritium quantities prior

to release to the sanitary sewer. Water in this holding tank is discharged into the sanitary sewer only after analysis has been completed. Records of the wastewater discharged for the fourth quarter of CY91 are given in Table IV-2.

Table IV-2. Wastewater Discharged in Fourth Quarter of CY91

DATE RELEASED	QUANTITY [gal]	TRITIUM [pCi/liter]	TRITIUM [uCi/ml]	TOTAL [mCi]
10/9/91	1,000	<500	<5.00E-7	0.00
10/21/91	2,500	10,700	1.07E-05	0.10
10/31/91	400	<500	<5.00E-7	0.00
11/6/91	2,200	<500	<5.00E-7	0.00
11/13/91	1,500	<500	<5.00E-7	0.00
TOTAL:	7600			0.10

As seen in Table IV-2, the derived concentration of tritium released is less than the Concentration Guides specified by DOE Order 5400.5, "Requirements for Radiation Protection for the Public." SLAC is also bound by the provisions in a contract for service with the WBSD (Permit No. WB860915-FNS) and State regulations (California Codes and Regulations, Title 17, Section 30287) which in turn limit SLAC to a maximum of 1 Ci of total radioactive material discharged to the sanitary sewer per calendar year.

4.3 Peripheral Monitoring Stations

Six Peripheral Monitoring Stations (PMS) designed to provide continuously recorded data from radiation monitors located near SLAC's boundaries have been installed as direct radiation monitors. Their positions are shown in Figure 2-3. During CY91, virtually every station was actively operated for large parts of the year. Among these PMS stations, PMS-1 is located in the most sensitive position. Historically (since 1966), it has measured the highest annual dose and it is the closest location to SLAC's off-site population.

The response of each station is recorded in the VAX history buffer located in the Main Control Center (MCC). Each calendar quarter a plot of the average dose rate for each 24 hour period will be generated together with the maximum dose rates from neutron and high energy photon radiation for that quarter. Each station will record both accelerator and natural background radiation sources. The natural background radiation levels are known

since we have been measuring this source for the past twenty-six years. No significant increases above prevailing background levels for each instrument were identified that were due to radiation. Spikes were observed and were diagnosed as computer/CAMAC signal processing errors in each case.

The measured annual dose to the general population coming from accelerator operations is almost entirely from fast neutrons and is characterized as skyshine from SLAC's research area. During CY91 there were some small neutron peaks recorded by these PMS stations. Estimates of accumulated neutron doses due to these peaks from the PMS-1 station are shown in Table IV-3.

Table IV-3. Direct Reading Neutron Pulse Data from PMS-1[1]

DATE	PEAK [IDAT]	PULSE WIDTH [hr]	DOSE [mrem]
8/27/91	0.14	1	0.0003
	0.25	1	0.0006
	0.1	2	0.0003
	0.1	2	0.0003
	0.13	1	0.0002
	0.15	1	0.0003
9/2/91	0.2	1	0.0005
	0.55	1	0.0016
9/3/91	0.25	2	0.0012
	0.5	2	0.0029
	0.1	4	0.0005
	0.3	2	0.0016
9/13/91	0.08	2	0.0001
	0.12	6	0.0012
10/7/91	0.25	24	0.0148
	0.4	4	0.0044
	0.5	17	0.0242
10/15/91	0.25	3	0.0018
	0.4	3	0.0033
10/17/81	0.25	22	0.0135
10/18/91	0.18	20	0.0078
		TOTAL:	**0.0813**

(1) Only pulses during CY91.

Other PMS stations also responded to these peaks, but at lower levels. A shift in the experimental program to low intensity experiments (including storage ring experiments) is the primary reason for the decrease in AMS and PMS measurements to background levels in recent years.

Radiation information is obtained with a GM tube for the high energy photon component and a polyethylene moderated BF_3 neutron detector for the particle component. The resultant sensitivities are such that a gamma exposure of 1 mR from a ^{60}Co source would be recorded as 10^4 counts per minute on the GM tube channel and a neutron dose equivalent of 1 mrem would be recorded as 10^5 counts per minute on the BF_3 channel. All signals are fed into CAMAC inputs for signal acquisition and buffering by the MCC VAX computer system. All data has been retained in a permanent history record since August 1990.

To improve the continuous tracking of direct reading radiation monitoring equipment, a real time display capability was delivered to the Radiation Physics Department during the first half of CY91. A large scale re-calibration and replacement/repair of active direct reading radiation monitors also has been carried out since the first half of CY91.

Based on a qualitative and quantitative assessment of operating periods for the PMSs during CY91, the work being performed for the experimental program, and the previous and following operating years, it is conservatively estimated the actual exposure at the site boundary would lie between 1 and 2 mrem for CY91. The value 2 mrem was used for summary data as an upper bound estimate for CY91. See Appendix A for the historical analysis model for evaluating PMS data and calculated exposure potentials to members of the off-site population. Tables IV-4 and IV-5 provide measured dose equivalents and the summary effective dose equivalents for CY91.

Table IV-4. 1991 Annual Penetrating Radiation Dose Measured Near SLAC Boundaries

PMS No.	Net Gamma Dose (mrem)	Net Neutron Dose (mrem)
1	< 1	< 1
2	< 1	< 1
3	< 1	< 1
4	< 1	< 1
5	< 1	< 1
6	<1	< 1

Table IV-5. Summary of Annual Effective Dose Equivalents Due to 1991 Laboratory Operations

	Maximum Dose to Laboratory Boundary[a]	Maximum Dose to an Individual[b]	Collective Dose to Population within 1.6 km of Laboratory
Dose	< 2 mrem	< 2 mrem	< 18 person-rem
DOE Radiation Protection Standard	--	100 mrem	--
Percentage of Radiation Protection Standard	--	< 2%	--
Background	100 mrem	100 mrem	880 person-rem
Percentage of Background	< 2%	< 2%	< 2%

[a] Maximum boundary dose is the dose to a hypothetical individual at the Laboratory boundary where the highest dose rate occurs, with no correction for shielding. It assumes that the hypothetical individual is at the Laboratory boundary continuously, 24 hours/day, 365 days/year.

[b] Maximum individual dose is to an individual at or outside the Laboratory where the highest dose rate occurs and where there is a person, but where calculations take into account occupancy (the fraction of time a person is actually at that location).

4.4 Passive Thermoluminescent (TLD) Dosimeter Monitoring Program

To supplement the PMSs for external gamma and neutron dose monitoring, SLAC had initiated an environmental TLD monitoring program near the end of the third quarter of CY91. Radiation Detection Company, a NVLAP certified dosimetry service, was contracted to provide SLAC with quarterly TLD dosimeters. The supplied TLDs consist of two polyethylene capsules, each containing 30 mg of ^{7}LiF powder along with a $CaSO_4$: Dy dosimeter, which are heat sealed in an aluminized paper packet. Reproducibility levels (uncertainty values) of these environmental TLDs are within +/- 2 mR and +/- 10 mR for $CaSO_4$: Dy and ^{7}LiF, respectively.

The environmental measurements using TLDs are summarized in Appendix F. The results show that most of the site boundary locations are either at background levels or within the minimum detectable levels of these environmental TLDs. However, at this point in time, the TLD environmental monitoring program is still considered to be in the evaluation phase until

sufficient data are accumulated to validate the results based on test exposures and TL element variations.

4.5 Radiological Media Sampling Program

Media sampling was limited to water (the major pathway for radionuclide release to the environment) and air (direct reading AMSs for radioactive gases). The low source terms proportionate to DOE's DCGs have identified only these routes as likely pathways for any potential off-site population exposure. Limited soil sampling in past years on site has not revealed detectable levels of man made radionuclides. In future years, a planned characterization of the site through media analysis will be done to establish the naturally occurring radionuclides on site and the background levels seen at different areas as the baseline values for reference. Verification of no significant levels of man made radionuclides by laboratory radioanalytical methods will be done at the same time.

5.0 Environmental Program Information

This section of the Annual Site Environmental Report provides an overview of the site's environmental activities performed in order to comply with laws and regulations, to enhance environmental quality, and/or to improve understanding of the effects of environmental pollutants from site operations. Included is a summary of non-radiological environmental monitoring, environmental permits, and significant environmental activities at the site.

5.1 Clean Air Act (CAA)

Federal air pollution regulations require the states to carry out certain activities and institute specific controls. Because many of the issues of air pollution are regional or local, the states pass portions of their power and authority to local or regional agencies. Each of these agencies is required to adopt and enforce rules and regulations necessary to achieve and maintain both the Federal National Ambient Air Quality Standards and the State Ambient Air Quality Standards. The local agency regulating non-radiological stationary air pollution sources at SLAC is the BAAQMD.

Non-radiological air emissions at SLAC are primarily VOCs from solvent cleaning operations, oxides of nitrogen (NO_x) from industrial boilers, and particulates (PM_{10}*) from metal and wood-working activities in the various shops. SLAC currently has 26 and two pending air pollution sources listed with the BAAQMD. These sources and annual emissions are provided in Table V-1. The breakdown of listed sources is as follows: 24 are permitted sources; four are sources that are exempt from permits but are listed because they have an air pollution abatement device associated with them; and two are new sources for which permit applications have been submitted.

The two new sources that have permits pending are solvent distillation units which will be used to recycle solvent from cleaning operations. Operation of these units will decrease the amount of hazardous waste (HW) generated by the facility. Another significant change to permitted air pollution sources in CY91 was the closure of seven solvent cleaning tanks. Removal of these sources will reduce the emissions from the facility and will more than offset the emissions generated by operation of the new distillation units.

* PM_{10}=Particulate matter less than 10 microns

Table V-1. BAAQMD Permits and Emissions

Annual Average (lbs/day)[a]

S#	Source Description	Particulates	Organics	NO_x	SO_2	CO
1	Boiler	-	-	21	-	5
2	Boiler	-	-	10	-	3
3	Degreaser	-	6	-	-	-
4	Degreaser	-	22	-	-	-
5	Spray-booth	-	2	-	-	-
6	Boiler	-	-	1	-	-
7	Sandblasting booth	<1	-	-	-	-
8	Sandblast room	<1	-	-	-	-
9	Degreaser	-	8	-	-	-
10	Woodworking operations (exempt) [b]	<1	-	-	-	-
11	Metal cutting operations (exempt)	<1	-	-	-	-
13	Metal grinding operations (exempt)	<1	-	-	-	-
14	Sandblast booth	<1	-	-	-	-
16	Sandblast booth	<1	-	-	-	-
17	Metal and epoxy glass grinding (exempt)	<1	-	-	-	-
18	Degreaser	-	5	-	-	-
21	Anodizing, picking and bright dip operations	-	-	-	-	-
22	Degreaser	-	1	-	-	-
26	Cold cleaner	-	0	-	-	-
28	Cold cleaner	-	0	-	-	-
30	Sludge dryer	-	-	0.07	-	-
32	Cold cleaner	-	1	-	-	-
34	Cold cleaner	-	0.002	-	-	-
35	Cold cleaner	-	0.04	-	-	-
36	Wipe cleaning	-	28	-	-	-
37	Cold cleaner	-	5	-	-	-
38	Solvent distillation unit (pending permit)	-	-	-	-	-
39	Solvent distillation unit (pending permit)	-	-	-	-	-

[a] NO_x = Nitrogen oxides; SO_2 = Sulfur dioxide; CO = Carbon monoxide

[b] (exempt) = These sources are exempt from a permit but are listed because they have an air pollution abatement device associated with them.

As required by the BAAQMD, SLAC maintains solvent usage records for permitted solvent sources. Permit conditions may limit the amount of solvent which can be used at an individual source on a daily and/or annual basis. Records for individual sources are compared to permit limits to assure that limits have not been exceeded. No permit limits were exceeded in CY91.

In July CY91, SLAC was inspected by the BAAQMD. During the inspection, samples of some of the paints used in the permitted paint booth (Source S-5) were collected for analysis by the BAAQMD. Results of the analyses indicated that some of the paint exceeded the

allowable limit for VOCs; consequently, a NOV was issued. The non-compliant paint was removed from inventory and other paints used at the site were examined to assure they met the regulations. Findings noted during the inspection conducted in July resulted in a second NOV which was later rescinded. The alleged violation was for disposal of an empty paint can in an uncovered trash container. Upon reevaluating the situation, the BAAQMD determined that it did not constitute a violation of their rules and regulations.

In CY91, SLAC began a site-wide effort to inventory all permitted and non-permitted air pollution sources. Industrial ovens and diesel tanks were the types of sources targeted for the first phase of the project. The survey identified seventy ovens and six diesel tanks. Information on these sources was provided to the BAAQMD which determined that all of the ovens were exempt from permits. Although the diesel tanks are specifically exempt from permits under the BAAQMD's Rules and Regulations, the District requested that SLAC submit completed permit applications for these sources so that they have the information on file. This application information was submitted in CY91. Stand-by generators are the next source type which will be inventoried. As with the diesel storage tanks, stand-by generators are specifically exempted from permits; however, the BAAQMD has requested that the information be submitted so that they can develop an accurate inventory of air pollution sources.

A site survey for hazardous air pollutants and ozone-depleting substances was also conducted in CY91. This information was requested by the DOE so that they may define DOE facility elements which will be affected by the Clean Air Act Amendments of 1990.

5.2 Clean Water Act (CWA)

The ultimate goal of the CWA is the achievement of the "chemical, physical, and biological integrity of the nation's waters." A more immediate goal is to reach a level of water quality which provides for fishable and swimmable waters. In this effort, national water standards have been set for both POTWs and industry. To accomplish the goals of the Act, EPA established mandatory effluent limitation guidelines that must be followed by all dischargers through the NPDES permit program. A set of effluent limitations applies to POTWs, with another set applicable to industrial dischargers. There are also National Pretreatment Standards for industries which discharge wastewater into POTWs.

Discharge of wastewater from SLAC to a POTW is made through the sanitary sewer system while surface runoff is channeled through the storm drain system to San Francisquito Creek.

5.2.1 Surface Water

Until December 1991, SLAC discharged cooling tower blowdown water to surface drainage under a NPDES Permit (Permit CA0028398, Order 90-098) from the California RWQCB, San Francisco Bay Region. The permit specified self monitoring of the discharges and provided specific requirements for sampling frequencies, locations, and analytical parameters. A summary of these monitoring requirements is provided in Table V-2. Sample locations are shown in Figure 5-1. Analytical results for samples collected through December 1991, are provided in Appendix G.

Table V-2. NPDES Sampling Requirements[a]

Sampling Stations	E-001	E-002	E-003	E-004	C-R, C-1[b]	Limit
Flow rate (gal/day)	N/A	N/A	N/A	N/A	M[a]	NONE
Settleable matter (ml/l/hr)	M	M	M	M	N/A	0.1
Oil and grease (mg/l)	W[a]	W	W	W	W	NONE
Total phosphate (mg/l)	W	W	W	W	W	20
Total dissolved solids (mg/l)	W	W	W	W	W	NONE
Total suspended solids (mg/l)	W	W	W	W	W	NONE
pH (units)	M	M	M	M	M	6.5-8.5
Temperature (^{o}C)	M	M	M	M	M	N/A
Toxicity (% survival)	M	M	M	M	N/A	90
All applicable standard observations	M	M	M	M	M	N/A
Cooling water chemicals (type and lbs/mo added)	M	M	M	M	N/A	N/A

(a) Frequency of Sampling: W = once each week
M = once each month

(b) San Francisquito Creek upstream and downstream of discharge points.

When the RWQCB renewed the SLAC NPDES permit in CY90, they stipulated that new and more stringent discharge limitations were to become effective on December 1, 1991. Analysis of the blowdown water showed that SLAC would be unable to

meet the new limits (copper) using current operations. After evaluating several options such as ozonation and chemical treatment, the decision was made to divert the discharge from the storm drain system to the sanitary sewer system. A permit for discharging this water to the sewer was obtained from the SBSA, issued jointly with the WBSD. On November 30, 1991, SLAC ceased discharging blowdown water to the storm drain, and shortly thereafter began discharging the blowdown water to the sanitary sewer.

5.2.2 Industrial Wastewater

Due to the types of processes at the site which generate industrial wastewater, SLAC must comply with the EPA effluent guidelines and standards for metal finishing. SLAC has a facility for pre-treating non-hazardous plating shop rinse waters before discharge to the sanitary sewer. The SBSA monitors the effluent from the treatment facility for compliance with the Federal Metal Finishing Pretreatment Standards. SBSA also monitors the site's total sanitary sewer discharge for compliance with SLAC's permit limits established by the WBSD. The standards and sampling frequencies for metal finishing pretreatment (Wastewater Discharge Permit No. WB860915-PTE) and SLAC's total sanitary sewer discharge limits (Wastewater Discharge Permit No. WB860915-FNS) are presented in Tables V-3 and V-4. Results of analyses on samples collected by the SBSA in 1991 are provided in Table V-5 and Table V-6. Sample locations are shown in Figure 5-2.

In CY91, a new discharge permit was obtained for the discharge of cooling tower blowdown water into the sanitary sewer system. The blowdown water was previously discharged to the storm drain system but that method had to be discontinued due to the more stringent discharge limits being imposed.

Table V-3. Standards for Treatment Facility

Wastewater Discharge Permit No. WB860915-PTE
Monitoring Location: Pretreatment effluent outfall uncombined with other waste streams

Constituent	Allowable Maximum	Monitoring Frequency	Sample Type
Oil and grease	100 mg/l[a]		
pH (minimum-maximum)	6.0-12.5[b]	Continuous	Grab or composite
Temperature	150° F		
Arsenic	0.1 mg/l		
Cadmium	0.62 mg/l	Quarterly[c]	Composite
Chromium (total)	2.77 mg/l	Quarterly[c]	Composite
Copper	3.38 mg/l	Quarterly[c]	Composite
Lead	0.69 mg/l	Quarterly[c]	Composite
Nickel	3.38 mg/l	Quarterly[c]	Composite
Silver	0.43 mg/l		
Zinc	2.61 mg/l	Quarterly[c]	Composite
Cyanide (total)	1.20 mg/l[d]	Quarterly[c]	Grab
Phenols	1.0 mg/l		
Toxic organics	2.13 mg/l[e]	Semiannual[c]	Grab

(a) Oil and grease of mineral or petroleum origin.
(b) pH of pretreatment effluent continuously monitored by industrial discharger.
(c) Sampling and analysis by SBSA.
(d) Cyanide samples will be collected at the plating shop pretreatment tank uncombined with other waste streams.
(e) Compliance with toxic organics limit will be based on all compounds detected by EPA Analytical Methods 601 and 602.

Table V-4. Sanitary Sewer Standards[a]

Wastewater Discharge Permit No. WB860915-FNS
Monitoring Location: Flowmeter station adjacent to Sand Hill Road

Constituent	Allowable Maximum	Monitoring Frequency	Sample Type
Daily Flow	64,375 gal		
Oil and grease	100 mg/l[b]		
pH (Minimum-Maximum)	6.0-12.5		Grab or composite
Temperature	150° F		
Arsenic	0.1 mg/l		
Cadmium	0.2 mg/l	Quarterly[c]	Composite
Chromium (total)	0.5 mg/l	Quarterly[c]	Composite
Copper	2.0 mg/l	Quarterly[c]	Composite
Lead	1.0 mg/l	Quarterly[c]	Composite
Mercury	0.01 mg/l		
Nickel	1.0 mg/l	Quarterly[c]	Composite
Silver	4.0 mg/l		
Zinc	3.0 mg/l	Quarterly[c]	Composite
Cyanide (total)	1.0 mg/l		
Phenols	1.0 mg/l		

(a) See Appendix E for radiological standards.
(b) Oil and grease of mineral or petroleum origin.
(c) Sampling and analysis by SBSA.

Table V-5. Analytical Results of Sanitary Sewer Discharges
Plating Shop

	1/14	1/15	1/28	4/16	4/17	5/22	8/8	8/9	10/23	10/24	11/26	Limit
Cyanide (mg/l)	0.09	na	0.09	na	<0.01	na	na	<0.010	na	<0.010	na	1.0
pH (pH units)	na	8.8	na	8.3	na	na	8.6	na	9.8	na	na	6.0-12.5
Cadmium (mg/l)	na	<0.005	na	<0.005	na	na	0.005	na	<0.005	na	na	0.69
Chromium (mg/l)	na	0.005	na	<0.05	na	na	<0.050	na	<0.050	na	na	2.77
Copper (mg/l)	na	0.220	na	0.02	na	na	0.050	na	<0.020	na	na	3.38
Lead (mg/l)	na	<0.050	na	<0.05	na	na	0.130	na	0.060	na	na	0.69
Nickel (mg/l)	na	0.190	na	<0.04	na	na	0.040	na	0.04	na	na	3.98
Silver (mg/l)	na	0.110	na	<0.01	na	na	0.020	na	0.01	na	na	4.00
Zinc (mg/l)	na	0.052	na	0.62	na	na	0.024	na	0.02	na	na	2.61
Toxic Organics (mg/l)	na	na	na	na	na	0.0709	na	na	na	na	0.0014	2.13

na = Not analyzed for that parameter

Note: Samples were collected by the South Bayside System Authority (SBSA)

Table V-6. Analytical Results of Sanitary Sewer Discharges
Sand Hill Road Flow Station

	1/15	8/8	10/23	Limit
pH (pH units)	8.0	7.7	8.7	6 to 12.5
Cadmium (mg/l)	0.007	<0.005	0.005	0.2
Chromium (mg/l)	<0.05	<0.005	<0.05	0.5
Copper (mg/l)	0.23	0.28	0.24	2.0
Lead (mg/l)	<0.05	0.08	0.05	1.0
Nickel (mg/l)	0.080	<0.040	0.05	1.0
Silver (mg/l)	0.16	<0.040	0.01	4.0
Zinc (mg/l)	0.300	0.338	0.323	3.0
B.O.D. (mg/l)	na	290	240	NE
T.S.S. (mg/l)	240	410	380	NE
T.O.C. (mg/l)	96	160	87	NE

na = Not analyzed for that parameter
B.O.D. = Biological Oxygen Demand
T.S.S. = Total Suspended Solids
T.O.C. = Toxic Organic Carbon
NE = None Established

Note: Samples were collected by the South Bayside System Authority (SBSA).

5.3 Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) of 1976 provides "cradle to grave" authority to control hazardous wastes from their generation to their ultimate disposal. This is accomplished through a system of transportation manifests, record-keeping, permitting, monitoring, and reporting.

SLAC is a Generator of hazardous waste, and is not permitted to treat hazardous waste or store it for longer than 90 days. Some hazardous wastes disposed off-site require "Extremely Hazardous Waste Disposal Permits (EH) applications. These applications were submitted to the State for those hazardous waste materials. The EH permits for CY91 are listed in section 5.8. The San Mateo County Department of Health Services is the agency responsible for inspecting generators of hazardous waste for compliance with Federal, State, and local hazardous waste laws and regulations. SLAC was not inspected by the County in CY91.

A computerized hazardous waste drum tracking system has been initiated. Hazardous waste drums are tracked from the time of being issued to the generator to eventual disposal offsite.

5.3.1 Waste Minimization

In CY91, SLAC developed a waste minimization plan to comply with the hazardous waste minimization and pollution prevention requirements of DOE. In addition, a waste minimization plan to comply with California's Hazardous Waste Source Reduction and Management Review Act (Senate Bill—14) was completed in September CY91.

A Waste Minimization and Pollution Prevention Policy Statement was developed and signed by SLAC management in March 1991. An ongoing training program meeting the requirements of RCRA was started in July to help increase employee awareness of the significance of the Waste Minimization and Pollution Prevention Program. Articles on waste minimization and pollution prevention are being published in the facility newsletter, the Interaction Point, to further promote employee awareness.

Implementation of waste minimization in CY91 included performing a preliminary waste assessment of waste reduction options for the Plating Shop and implementation of a pilot program to test the feasibility of using recharged laser printer toner cartridges. Assessments related to decreasing the generation of waste oils and cleaning solutions are scheduled for CY92.

A bimonthly meeting on waste minimization and pollution prevention has been established with representatives from DOE and Waste Minimization Coordinators from other area DOE facilities. The meetings have provided a communications medium for expediting technology transfer and serving as a means of maintaining contact with other DOE laboratories.

SLAC completed its 1991 Biennial Waste Report for EPA to address HW generation and minimization activities for CY90 and CY91. Data review and evaluation activities were performed during two periods: (a) the second quarter of 1991 (for 1990 data) and (b) the first quarter of 1992 (for 1991 data). The report was submitted to EPA Region IX in an interim format on April 6, 1992. The finalized hard copy paper format was sent to EPA on May 4, 1992, and the finalized electronic reporting version was sent directly to EPA's contractor, Westat, on May 7, 1992.

An initial notification was sent to California's Department of Toxic Substance Control (DTSC) that SLAC would be planning or intending to treat HW generated from its metal finishing operations. The notification, however, was not required until 60 days before SLAC is ready to start treating HW. SLAC is currently preparing a schedule and division of work for permit preparation and will prepare to notify the DTSC when SLAC has a firmer schedule for permit completion.

5.4 Toxic Substances Control Act (TSCA)

SLAC has equipment filled with oil or other dielectric fluids containing PCBs. PCBs, their use and disposal, are regulated by the Toxic Substances Control Act (TSCA) of 1976. TSCA provides for regulation of raw materials as well as the control or banning of already existing chemicals that pose a risk to health or the environment.

At the end of CY91, SLAC had 14 PCB transformers (greater than 500 mg/l PCBs) and 34 PCB-contaminated transformers (greater than 50 mg/l but less than 500 mg/l PCBs). Many of the PCB transformers are scheduled for removal over the next few years. Plans to retrofit PCB-contaminated transformers are being developed as well.

In CY91, SLAC implemented a program for performing monthly inspections of all PCB and PCB-contaminated transformers. The program has mechanisms in place to provide for the timely correction of deficiencies noted during the inspections.

5.5 The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) "Superfund"

5.5.1 Environmental Restoration

One of the main goals of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980—commonly known as Superfund—is to provide a system for identifying and cleaning up chemical and hazardous substance releases. It is the policy of the DOE to respond to hazardous substance releases in accordance with the provisions of CERCLA, as amended, as well as the National Contingency Plan (NCP).

In CY91, SLAC began developing a formal environmental restoration program incorporating CERCLA requirements. An overview of the Superfund process is

provided as Figure 5-3. Sitewide program documents such as a Community Relations Plan (CRP), Program Development Plan, and a Quality Assurance/Quality Control Plan (QA/QC Plan) are being developed. A list of the areas around the site with known or suspected soil contamination was compiled and preliminary assessments (PAs) are being conducted so that a priority for remedial investigations can be established. Additionally, an Administrative Record is being created to provide the public with access to all documents and information utilized in making decisions throughout the CERCLA process.

In 1986, SLAC was placed on the EPA Hazardous Waste Compliance Docket because of the release of solvents from an UST (the tank was removed in 1983). All facilities on the Docket are required to submit a sitewide PA to the EPA by July 15, 1993. The PAs will be used by the EPA to score each facility using the Hazardous Ranking System (HRS) for determining sites which should be on the National Priority List for Superfund sites.

SLAC has already began work on a sitewide PA. Elements to be included in the PA include:

- Net impact of all SLAC activities on the surrounding environment.
- Identification of all potential hazardous waste sites that may require further attention and possible remediation.
- Provide a baseline for all subsequent changes in site structures and operations.

On April 24, 1991, SLAC reported to the NRC the discovery of greater than a RQ of PCBs (RQ for PCBs is one (1) pound) in an area of the facility referred to as the IR-6 drainage ditch. Sampling and analysis of soil samples collected from this area showed approximately 200 feet of storm drain that contained levels of PCBs as high as 590 mg/kg. The State of California Action Level for PCBs is 5 mg/kg. A section of the contaminated ditch extended beyond SLAC's site boundary to an area that is owned by Stanford and leased to another party. A fence was constructed around the perimeter of the contaminated area and a remedial investigation was performed to define the vertical and horizontal extent of contamination.

Other remedial activities in CY91 include:

- Four PCB transformers were removed from the 5.8 mega-watt (MW) power supply in the Research Yard. Analysis of soil samples collected from below the transformers indicated PCB contamination in excess of the State of California action level of 5 mg/kg. Contaminated soil was removed and disposed of as hazardous waste. Confirmation soil samples were collected and analyzed to assure that clean-up levels had been met.

- Mitigation of diesel contaminated soil near Cooling Tower 101 has been completed. The contamination resulted from a spill (approximately 25 gallons) which occurred during filling operations of an above-ground diesel tank. Fuel was delivered to the above-ground tank at a rate that created a siphon effect in an abandoned transfer line which was used to transfer fuel from four USTs to the above-ground tank. When the siphon was created, the diesel fuel flowed through the transfer line and out an uncapped valve, contaminating the soil in the vicinity of the four USTs. To prevent a similar occurrence in the future, the transfer line was terminated. The spill contaminated the backfill material surrounding the four USTs. To mitigate the contamination, the four tanks and contaminated soil were removed. Confirmation soil samples were analyzed to confirm clean-up levels had been met. This project was performed with direct oversite by the San Mateo Department of Health Services. This project constituted closure of the last USTs at the facility.

- Remediation of a soil contamination site north of Building 26 has been completed. Mitigation involved the excavation of soil from under the former location of a large vacuum pump that had leaked non-PCB oil during its service life. Analysis of confirmation samples collected from the excavation confirmed clean-up levels had been met.

- SLAC's general environmental contractor collected samples throughout the facility to determine: (1) background levels of PCBs, metals, and petroleum hydrocarbons in asphalt and soil, and (2) any indication of bioaccumulation of PCBs or metals in marshland vegetation. These

samples will be of great value in interpreting data collected elsewhere at SLAC.

5.5.2 The Superfund Amendments and Reauthorization Act (SARA)

The Superfund Amendments and Reauthorization Act of 1986 (SARA), includes a free-standing title known as the Emergency Planning and Community Right-to-Know Act, otherwise known as Title III. It is intended to encourage and support emergency planning efforts at the State and local levels. Annually, SLAC submits applicable information required by SARA Title III as well as the State's equivalent to the San Mateo County Department of Health Services.

5.6 National Environmental Policy Act (NEPA)

NEPA serves to provide a mechanism to assure that all environmental impacts and options to a project are considered before it is carried out. The following are some of the areas which must be addressed when preparing documentation for a proposed project: archeological sites, wetlands, floodplains, and sensitive habitats. Options for the proposed project and the impacts of those options must be evaluated.

Lack of a formal NEPA Program was one of the findings made by the Tiger Team in their assessment of the facility in 1991. SLAC is in the process of formalizing the NEPA process at the Laboratory through the development of formal procedures and training of staff.

In CY91, SLAC submitted a NEPA Environmental Assessment to DOE for the discharge of cooling tower blowdown water to the sanitary sewer. Also, SLAC received CX determinations for several small GPPs, a site characterization, and an UST removal project.

5.7 Tiger Team Assessment

The DOE has made a firm commitment to strengthen environment, safety, and health (ES&H) programs and waste management operations at DOE facilities. Part of this commitment has been the establishment of Tiger Team Assessments which are conducted to evaluate the status of compliance in the areas of environment, safety, and health. The Tiger Team Assessments provide the Secretary of Energy with information on the following:

- current ES&H status and the vulnerabilities associated with that compliance status.

- root causes for noncompliance.

- adequacy of DOE and SLAC management programs.

- response actions to address identified problem areas.

- effectiveness of self-assessment.

In preparation for the Tiger Team's visit to SLAC, an environmental self assessment was conducted in April 1991 with the assistance of an environmental consulting firm. The self assessment evaluated the status of all major environmental programs at the site.

The major findings of the assessment were:

- Environmental programs are not adequately planned and implemented.

- There is not adequate training for Hazardous Waste and Material Coordinators.

- There is a lack of written procedures for carrying out environmental programs, regulations, and DOE orders.

- Quality assurance has not been adequately incorporated into environmental programs.

A Tiger Team Assessment was conducted at SLAC from October 7 through November 5, 1991. The objective of the environmental portion of the Tiger Team Assessment was to assess the site's current environmental compliance status with regard to Federal, State, and local regulations; DOE Orders; agreements; and applicable permits. The environmental assessment examined site performance against best or accepted industry practices, and evaluated the adequacy of DOE and contractor environmental program management and resources. The Environmental Subteam identified fifty-three findings in the assessment of SLAC (this included radiological as well as nonradiological findings). Of these findings, 20 percent related to compliance with Federal, State and local requirements and the remainder related to compliance with DOE Orders and best management practices.

In response to the Tiger Team Assessment, SLAC is developing a Corrective Action Plan which provides timelines for correcting the findings of the assessment as well as budgetary impacts. Additionally, an Institutional Self Assessment Program is being developed so that the status of compliance at SLAC can be continuously monitored, issues quickly identified, and corrective action taken.

5.8 Permits

SLAC has been issued the following permits:

- California Regional Water Quality Control Board
  San Francisco Bay Region
  NPDES Permit CA0028398, Order 90-098
  Expiration date: July 18, 1995

  Waste Discharge Order 85-88 (for groundwater contamination around former leaking underground storage tank)

- West Bay Sanitary District and South Bayside System Authority
  Wastewater Discharge Permit No. WB860915-PTE
  Wastewater Discharge Permit No. WB860915-FNS
  Expiration date: June 14, 1991 (renewal application has been submitted)
  Interim permits to discharge cooling water blowdown water and LCW (will be incorporated into 1992 permit)

- Bay Area Air Quality Management District (BAAQMD)
  Plant No. 556, 26 permits (two pending)

- Environmental Protection Agency
  Hazardous Waste Generator EPA ID No. CA8890016126

- California Extremely Hazardous Waste Disposal Permits
  EH-2-13587
  EH-2-14012

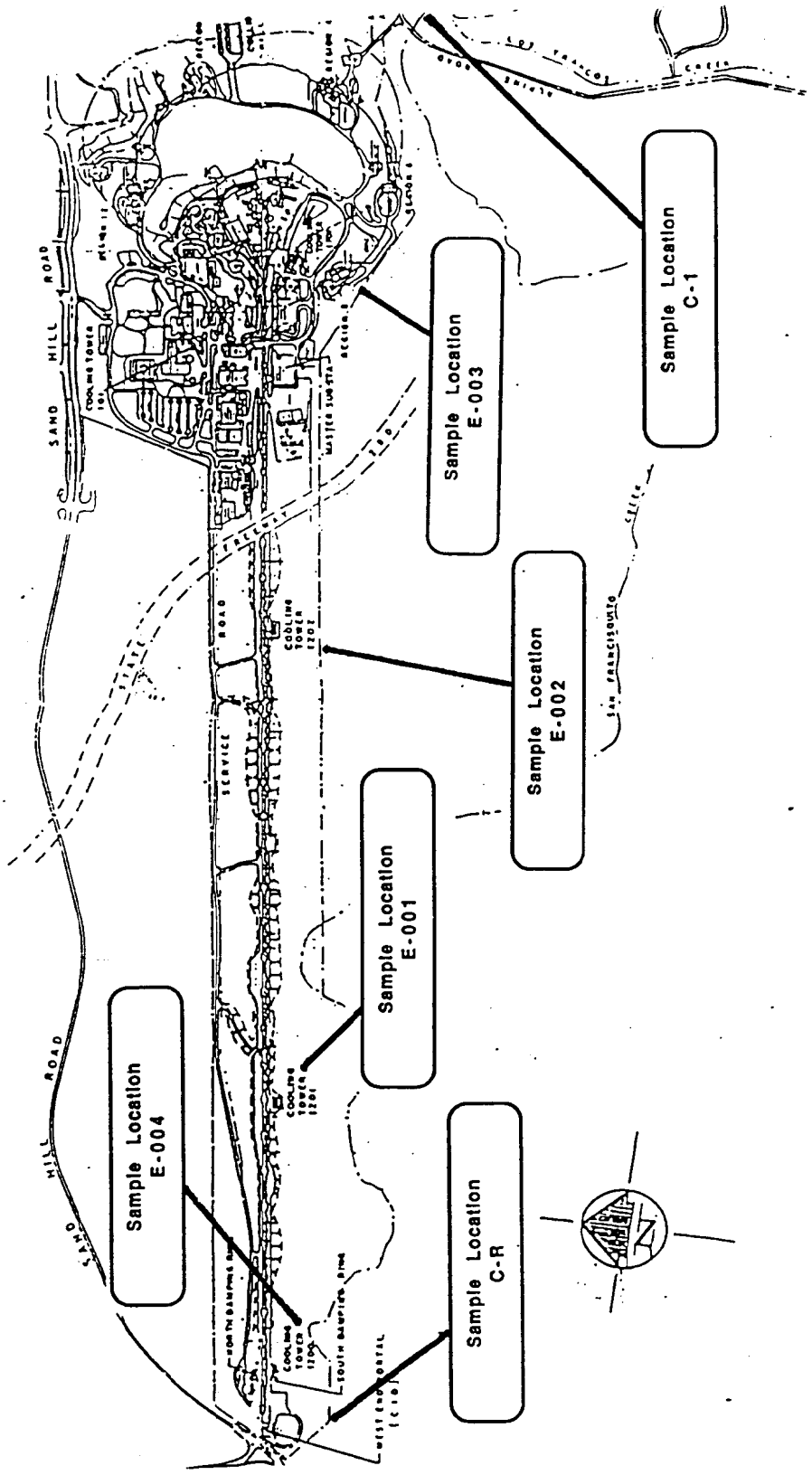

Figure 5-1. NPDES Sampling Locations

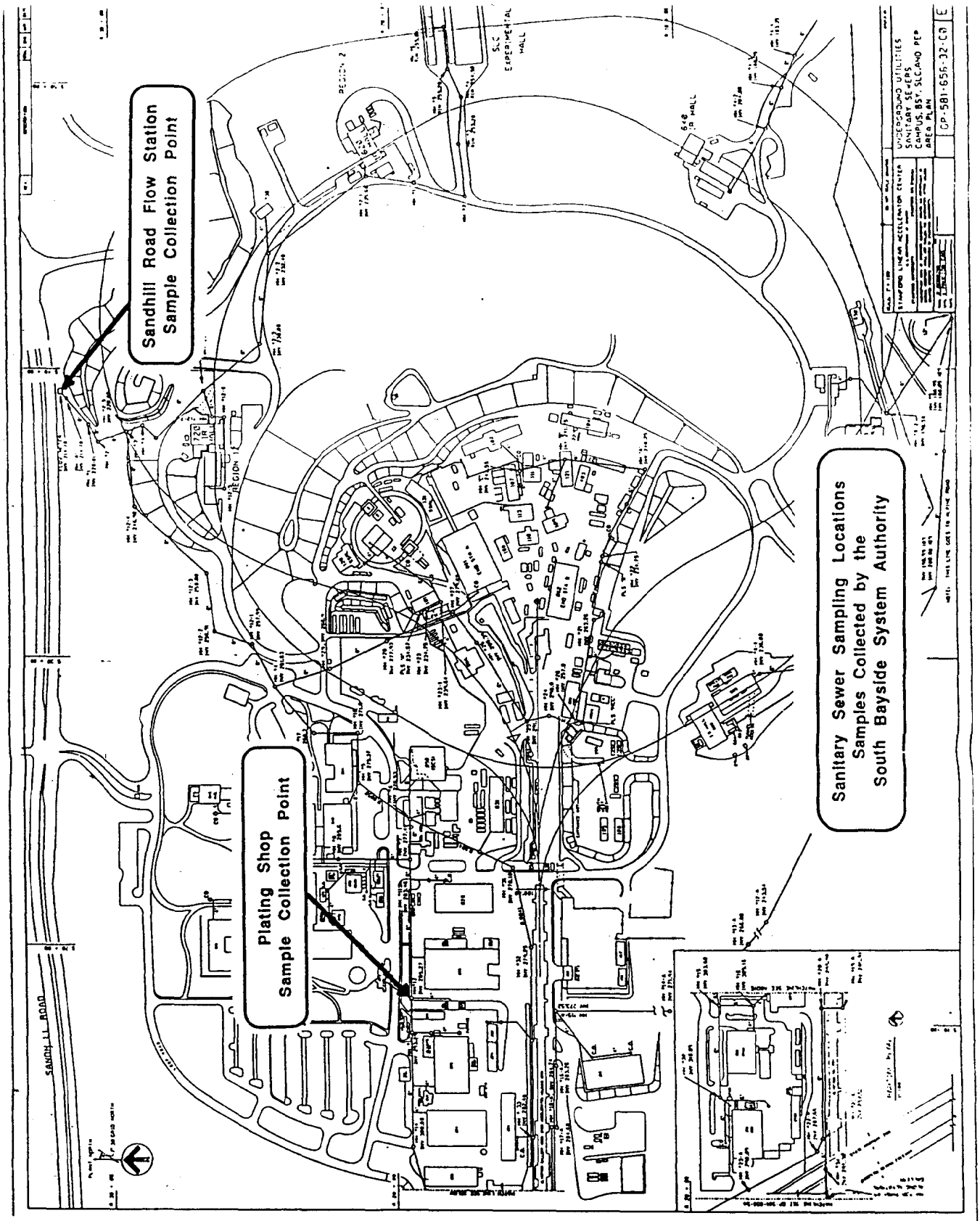

Figure 5-2. Sanitary sewer sampling locations (samples collected by the SBSA).

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

National Oil and Hazardous Substances Pollution Contingency Plan (NCP)
Procedural Flowchart

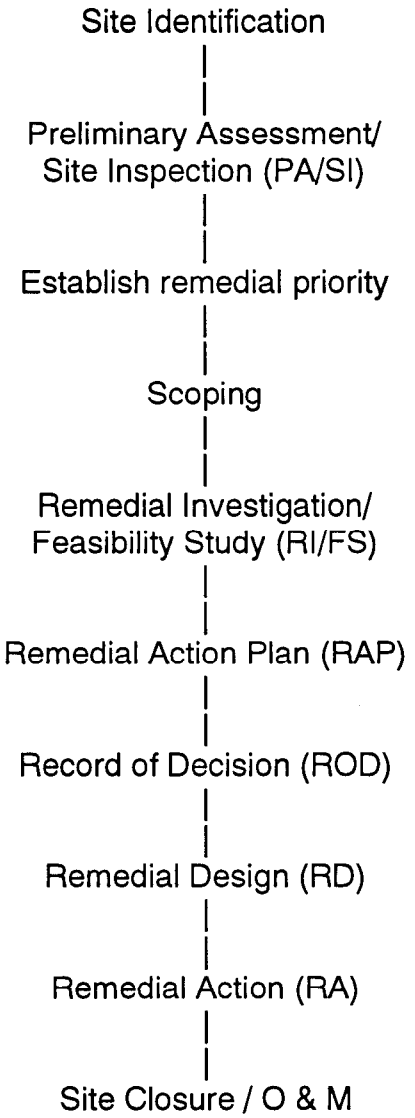

Figure 5-3. Overview of CERCLA Process.

6.0 Groundwater Protection

This section of the SLAC CY91 Annual Site Environmental Report provides information and data from groundwater monitoring activities at the site. There are two distinct groundwater monitoring networks at the facility. Each network as well as other information related to groundwater protection is described below.

6.1 Groundwater Characterization Monitoring Network

DOE Order 5400.1 requires that facilities characterize their groundwater to determine and document the effects they have had on groundwater quality. Three wells constructed at SLAC during initial construction are still in place. SLAC began a characterization program in 1990 by installing ten new groundwater monitoring wells (MW-21 through MW-30) in the major areas of the facility that historically and/or presently store, handle, or use chemicals which may pose a threat to groundwater quality. Locations of the ten new wells in addition to the three old wells are shown in Figure 6-1.

The ten groundwater monitoring wells were installed in late 1990. Samples collected from the wells were analyzed for a wide range of potential chemical constituents and general groundwater quality parameters including heavy metals, volatile and semi-volatile organics, PCBs, total petroleum hydrocarbons as diesel (TPH), cyanide, and TDS. General groundwater quality, as measured by TDS values, ranged from 1,100 ppm (parts per million) to 11,000 ppm, and can be characterized as "brackish". Water containing more than 2,000-3,000 ppm TDS is generally too salty to drink. No PCBs, TPH, or cyanide were detected in any of the wells. Nickel, selenium, thallium, and chlorinated solvents were detected in several of the wells at or above the State of California MCLs for drinking water or EPA National Ambient Water Quality Criteria based on health effects. This information was submitted to the California RWQCB and the San Mateo County Department of Health Services on January 31, 1991.

In CY91, the wells were placed on a quarterly sampling schedule. Samples collected were analyzed for volatile organics (EPA Methods 8010/8020) and metals based on the results of the CY90 samples. Results of analyses performed since installation of the wells are provided in Appendix G. Review of the data confirms the findings reported in the CY90 environmental report that water in several of the wells contain elevated levels of heavy

metals and/or chlorinated solvents. The main organic contaminants are TCE and its breakdown products. TCE was historically used at the site as a cleaning solvent, and is no longer in use with the exception of very small quantities in research laboratories.

In order to better define the impact SLAC has had on groundwater quality, additional work is scheduled for CY92. The monitoring wells will continue to be sampled and analyzed for volatile organics and metals on a quarterly basis. Samples will also be analyzed for radioactivity: tritium, and gross beta/gamma. Additionally, a soil-gas survey will be conducted to estimate the horizontal extent of contamination in those areas where contaminants in the water were detected above regulatory limits. Further, a Beneficial Use Report (BUR) for groundwater at SLAC will be prepared and a Fate/Transport study will be done to determine factors affecting attenuation, transport, and the eventual fate of contaminants detected in site groundwater. Additional groundwater characterization to comply with DOE Order 5400.1 will be performed in the future.

6.2 Groundwater Monitoring Network Around Former Solvent Storage Tank

A groundwater monitoring network consisting of eight shallow wells is located in the vicinity of SLAC's Plant Maintenance building in the northwestern portion of the facility (see Figure 6-2). The wells (MW-1 through MW-7 and EW-1) are being used to monitor the migration of chemical constituents associated with a former UST which contained organic solvents during the period of 1967 to 1978. A pressure test performed on the UST in 1983 indicated a leak. The tank was removed in December, 1983.

The California RWQCB requires that SLAC monitor the wells at the former UST site on a quarterly basis (RWQCB Waste Discharge Order 85-88). Samples are collected from the wells by an outside contractor using sampling methods described in EPA SW-846. The samples are analyzed for volatile organics (EPA Methods 8010/8020) by an analytical laboratory certified by the California Department of Health Services. A summary of the organic chemical analyses since installation of the wells is presented in Appendix G.

As indicated in the October 1991 Quarterly Monitoring Report prepared by Earth Sciences Associates, groundwater current and general flows are to the north-northwest vicinity of the former solvent tank. Water levels in this area however, have fluctuated through time and these fluctuations are not uniform throughout the monitoring field. Earth Science Associates

concluded that groundwater flow direction and gradient vary over time, but generally have flowed to the north-northwest.

In addition to monitoring of the wells, the RWQCB requested SLAC to monitor a potential groundwater seep to determine if VOCs from the UST are migrating into the subdrain. The sampling point selected by the RWQCB is referred to as point E-003 and is shown in Figure 5-1. The RWQCB requested that point E-003 be sampled on a quarterly basis, analyzed for VOCs (EPA methods 8010/8020) and metals, and that annually, preferably in the winter, the analysis shall use EPA Method 8240 in lieu of 8010/8020. Though two VOCs (chloroform and methylene chloride) were detected at the surface seep (E-003), their concentrations were extremely low, and neither compound was found in samples collected during subsequent quarterly events. Both of these compounds are common laboratory contaminants.

Results of point E-003 heavy metal analyses, listing only those detected, are presented in Table VI-1. The RWQCB will be evaluating the need to continue monitoring point E-003 in CY92.

Table VI-1. Sampling Point E-003: Results of Heavy and VOCs Metal Analyses

Metals
Results in parts per million (ppm)

	3/23/90	6/20/90	9/26/90	12/11/90	3/25/91	6/26/91	10/3/91
Arsensic	<0.001	<0.01	<0.005	<0.005	<0.005	<0.005	0.013
Antimony	0.3	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	NA	NA	0.04	0.04	0.0566	0.0391	0.036
Copper	0.03	0.05	0.06	0.05	<0.01	0.0398	0.094
Lead	<0.01	<0.01	0.002	0.009	0.007	0.001	0.0032
Nicke	0.01	NA	0.05	<0.02	<0.02	<0.02	<0.02
Zinc	0.05	0.09	0.11	0.21	0.187	0.019	0.043

NA = Not analyzed for that parameter.

Volatile Organics
(Results in parts per million (ppm)

	3/23/90	6/20/90	9/26/90	12/11/90	3/25/91	6/26/91	10/3/91
Chloroform	0.0005*	0.0015	<0.0005	<0.002	<0.0005	<0.0005	<0.0005
Methylene Chloride	<0.0005	<0.0005	<0.0005	<0.002	<0.0005	<0.0005*	<0.0005

*Reported at method detection limit

The following are a list of MCLs as indicated in 40 CFR Part 141—National Primary Drinking Water Regulations, Subpart B, Section 141.11. MCLs for inorganic compounds:

Contaminant	Level (mg/l)
Arsenic	0.05
Antimony	NE
Barium	1
Copper	NE
Lead	0.05
Nickel	NE
Zinc	NE

NE = None Established

6.3 Groundwater Protection Management Program

SLAC is in the process of revising the Groundwater Protection Management Program required by DOE Order 5400.1. The program will address the following:

- Documentation of the groundwater regime with respect to quantity and quality;
- Design and implementation of a groundwater monitoring program to support resource management and comply with applicable environmental laws and regulations;
- A management program for groundwater protection and remediation, including specific SDWA, RCRA and CERCLA actions;
- A summary and identification of areas that may be contaminated with hazardous substances;
- Strategies for controlling sources of these contaminants;
- A remedial action program that is part of the site CERCLA program required by DOE Order 5400.4;
- and quality assurance.

6.4 Monitoring Well (Well-24)

Tritium at concentrations as high as 23,500 pCi/l have been detected in water from groundwater monitoring well Well-24 (referred to as EXW4 in Figure 6-1). The drinking water standards for tritium are 20,000 pCi/l. Possible reasons for tritium being found in this well's water are being investigated. The most likely cause is activation of groundwater by particles from accelerator beams. No other monitoring wells at SLAC have shown any tritium above minimum detectable levels. There are no drinking water wells at SLAC or in the general vicinity of the facility. Groundwater samples will be collected and analyzed quarterly during CY92. See Table I-2.

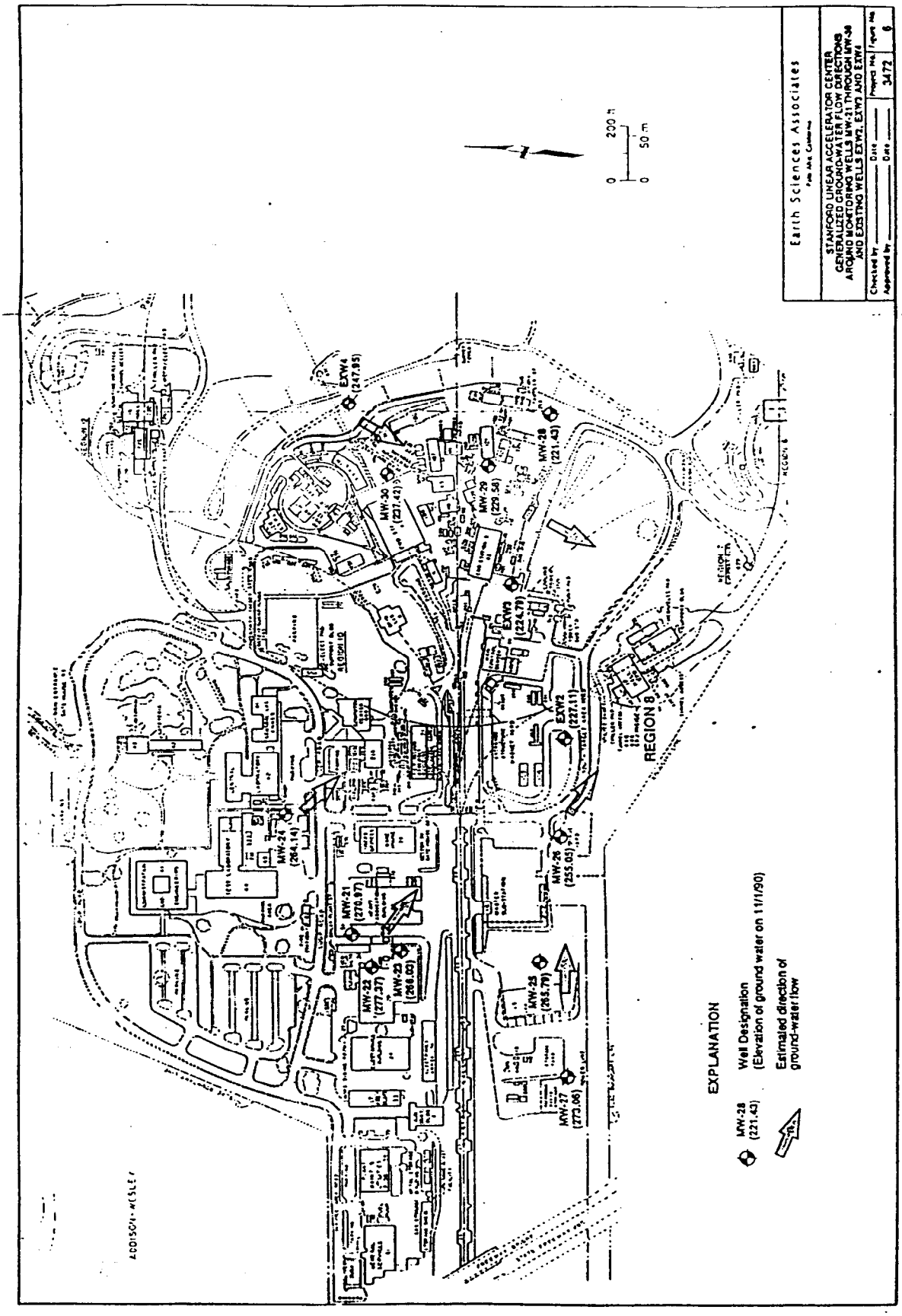

Figure 6-1. Location of ten groundwater monitoring wells installed in 1990.

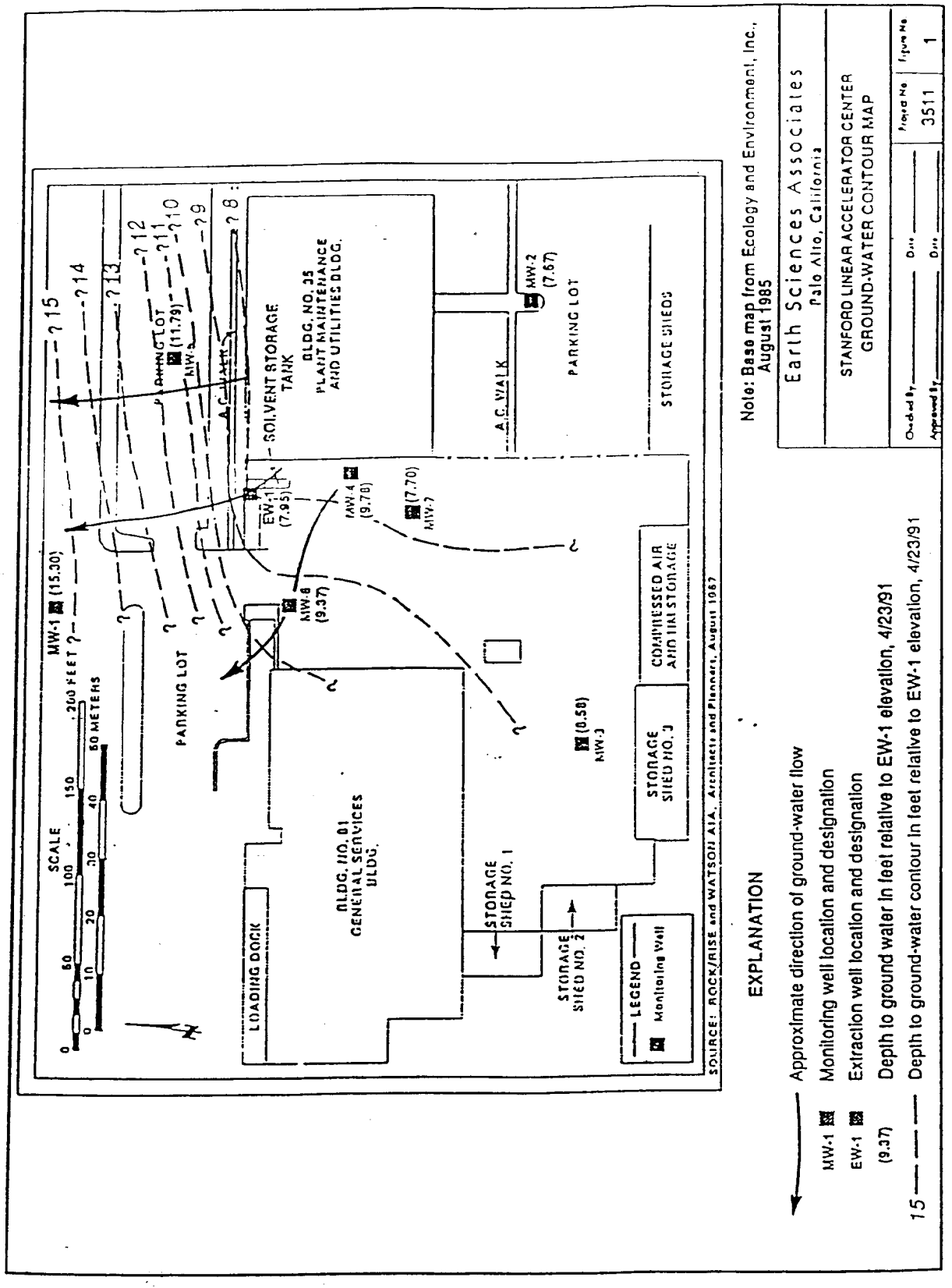

Figure 6-2. Location of groundwater monitoring wells surrounding a former solvent storage tank.

7.0 Quality Assurance

In December of 1990, the Quality Assurance and Compliance (QA&C) Department was formed within the Environment, Safety and Health Division to implement a site-wide Quality Assurance program. This organization has been hiring staff over the course of CY91, and at the end of the year had a total of four full-time employees.

Analytical laboratories that provide analytical services, and contractors that supply sampling are subject to audit by the QA&C. The *Quality Assurance and Compliance Analytical Laboratory Audit Procedure* QC-030-003-00-R0, is the document that describes the auditing process. Four environmentally related audits were conducted in CY91 by QA&C. Two of these audits involved environmental laboratories. The audits included but were not limited to verification of: DHS certification; chain of custody practices; proper holding times; approved methods for implementation; adequate data review; data approval; internal quality assurance checks; calibrations; and general implementation of the QA program. EPA Inter-laboratory cross check information was reviewed in detail during the audits. When out of tolerance performance data was observed, the auditor verified a corrective action had been taken, and took steps to ensure that the excursion did not represent an adverse trend that was evident in prior performance tests. Findings that result from internal and external audits are tracked to closure on a data base by the QA&C organization. Eight of the nine findings developed during the laboratory audits were corrected at the end of CY91. The QA&C program is an on-going effort, and will include other areas of environmental activity such as contractor sampling and internal laboratory operations in future audits.

SLAC performs in-house measurements of tritium in water to support the environmental program. A procedure has been implemented to split these samples between the internal analysis group and a recognized external laboratory. Preliminary data from this program indicates an average difference of only 3.9% between laboratories, a value which is considered acceptable.

Comparisons of split samples for chemical analysis are provided in the groundwater section of this report. Some differences were observed between split samples. Fortunately these differences were not large enough to cause conflicting conclusions regarding whether the samples were above or below the drinking water MCL's, or the lowest regulatory standard or requirement.

The SLAC Quality Assurance Program is described in the *SLAC Institutional Quality Assurance Manual* QC-031-110-03-R0. This manual is currently being updated to incorporate the changes required by the new Department of Energy order on Quality Assurance, DOE 5700.6C, and the Draft R&D Implementing Guidance that is designed to be used in conjunction with the new order.

8.0 References

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6. J. A. Murray, L. M. Vaughn and R. W. McMullen, *Atmospheric Transport and Diffusion Characteristics for Selected Daytime Meteorological Regimes at* SLAC, Memorandum Report No. 326-1, Metronics Aerosol Laboratory, Palo Alto, California, 21 December 1967.

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8. S. J. Lindenbaum, *Shielding of High Energy Accelerators,* Proc. Int. Confon High Energy Accelerators, Brookhaven, 1961.

9. M. Ladu *et al., A Contribution to the Skyshine Study,* Nucl. Inst. and Methods 62, 51 (1968).

9.0 External Distribution

U.S. Department of Energy
San Francisco Operations Office
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Oakridge National Laboratory
Technical Information Center
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U.S. Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, California 94105
Attn: Regional Administrator

State of California
Department of Health Services
Radiological Health Branch
1232 Q Street
Sacramento, California 95804
Attn: Jack L. Brown

Bay Area Air Quality Management District
939 Ellis Street
San Francisco, California 94109
Attn: J. Slamovich

California Regional Water Quality Control Board
San Francisco Bay Region
1111 Jackson Street
Oakland, California 94612
Attn: S. Ritchie

Office of Environmental Health
San Mateo Department of Health Services
County Office Building
590 Hamilton St.
Redwood City, CA 94063
Attn: W. Lent

Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720
Attn: Gary Schliemer

Rocky Flats
U.S. Department of Energy
Rocky Flats Office
P.O. Box 928
Golden, Colorado 80401
Attn: Nancy Daugherty

San Francisco Regional Water Quality Control Board
2101 Webster Street, Suite 500
Oakland, California 94805
Attn: Elizabeth Adams

State Water Resources Control Board
Division of Clean Water Programs
P.O. Box 944212
Sacramento, California 94244-2120
Attn: Leslie S. Laudon

10.0 Acronym List

A

AIP	Agreement in Principle
AMS	Air Monitoring Station

B

BAAQMD	Bay Area Air Quality Management District
BSY	Beam Switch Yard
BUR	Beneficial Use Report

C

CAA	Clean Air Act
CCR	California Code of Regulations
CERCLA	Comprehensive, Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRP	Community Relations Plan
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year

D

DCG	Derived Concentration Guide
DHS	Department of Health Services
DOE	Department of Energy
DTSC	Department of Toxic Substance Control

E

EDE	Effective Dose Equivalent
EH	Extremely Hazardous
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ES&H	Environment, Safety, and Health

F

FEMA	Federal Emergency Management Agency
FFS	Final Focus System
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act

G

GC	Gas Chromatograph
GM	Geiger-Mueller Tube
GPP	General Plant Project

H

HRS	Hazardous Ranking System
HW	Hazardous Waste

I

IP	Interaction Point
IR	Interaction Area

K

kWh	Kilowatt-hour

L

LCW	Low Conductivity Water
LINAC	Linear Accelerator

M

MCC	Main Control Center
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MPWD	Menlo Park Municipal Water Department
MW	Megawatt

N

NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NOV	Notice-of-Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NRC	National Response Center
NVLAP	National Voluntary Laboratory Accreditation Program

O

ODIS	On-Site Discharge Information System

P

PA	Preliminary Assessment
PBR	Permit-by-Rule
PCB	Polychlorinated Biphenyl
PEP	Positron Electron Project
PMS	Peripheral Monitoring Stations
POTW	Public Owned Treatment Works
PS	Positron Source

Q

QA	Quality Assurance
QA&C	Quality Assurance and Compliance
QC	Quality Control

R

RCRA	Resource Conservation and Recovery Act
RQ	Reportable Quantity
RWQCB	Regional Water Quality Control Board

S

SARA	Superfund Amendments Reauthorization Act
SBSA	South Bayside Systems Authority
SDWA	Safe Drinking Water Act
SLAC	Stanford Linear Accelerator Center
SLC	Stanford Linear Collider
SLD	SLC Large Detector
SPEAR	Stanford Positron Electron Asymmetric Ring
SSRL	Stanford Synchrotron Radiation Laboratory

T

TCE	Trichloroethene, alternative spelling trichloroethylene
TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimeter
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act

U

UST	Underground Storage Tank

V

VOC	Volatile Organic Compound

W

WBSD	West Bay Sanitary District
WHC	Westinghouse Hanford Corporation

Appendix A

Model For Potential Dose Assessment

According to Department of Energy orders, an assessment of whole-body person-rem dose to the general population near SLAC is required where appropriate. Our site boundary dose due to accelerator operation has generally been less than 10 mrem per year from penetrating radiation. We have estimated the population size to include individual annual doses down to 1 mrem, which corresponds to a distance of approximately 1.6 km from a central point representative of the source of neutrons. The 1 mrem value is approximately 1% of the total natural background dose and is 1% of the technical standards for the general population (DOE Order 5480.11).

There are three major pathways leading to human exposure from ionizing radiation: (1) airborne, (2) food chain and (3) direct exposure to penetrating radiation. Of these three major pathways, only direct exposure to penetrating radiation is of any measurable significance from SLAC operations. The source of this exposure is from neutrons resulting from the absorption of high-energy electrons and photons in the experimental areas creating energetic particles, some of which escape from the heavily shielded enclosures.

In order to make an accurate and realistic assessment of radiation exposure to the public at low doses, it is necessary that exposure from the natural radiation environment be known. This is true because the instruments used respond to natural radiation sources as well as man-made sources, and the portion due to natural radiation must be subtracted from the total measurement. The population exposure assessments appearing in this document are in all cases overstatements of the true impact; hence, the resulting values are representative of an upper limit of the possible range.

While the annual neutron dose from accelerator operations at the site boundary has generally been measurable, it has always amounted to less than 10% of the total annual individual dose from natural background radiation. According to an EPA report, the average dose from cosmic, terrestrial and internal radiation in California is 125 mrem. For purposes of comparison, we have rounded this number to 100 mrem.[7]

Another quantity of interest is the population dose in units of person-rem. This is simply the product of average individual dose and the total population exposed. For example, if 1,000

people are exposed to an average annual background dose of 0.1 rem (100 mrem), then the population dose is 0.1 x 1000 or 100 person-rem from natural background radiation. The annual variation of exposure to natural background radiation may vary by $\pm$ 20%, largely caused by the differences in naturally occurring uranium, thorium, and potassium present in the ground and in building materials where people live and work.

Two major problems associated with this dose assessment affect overall accuracy of the measurement. First, the conversion of neutron flux to dose requires that the spectrum of neutrons at the measurement point be known, because the quality factor (QF) is a function of neutron energy. Because of the very low neutron fluence at the SLAC boundary and beyond, it is impossible to measure the energy spectrum; therefore, we have selected a QF of ten as a conservative choice. We feel that this choice leads to an overestimate of the neutron dose-equivalent by a factor of approximately two. Until a useful experiment can be performed with neutron yields of sufficient intensity, the quality factor cannot be determined with any better precision.

A second problem is the behavior of neutrons at large distances. Most of the high energy accelerator laboratories have made measurements. They are unique to each facility because of design differences, type of machine, and surrounding topography. Here again we have chosen a conservative formula for calculating the dose at distances other than the point of measurement. Lindenbaum[8] gave a method for evaluating skyshine neutrons which was later verified by Ladu, et al.[9] using Monte Carlo techniques. Lindenbaum approximated the falloff by $(e^{-} R/\lambda)/R$ where R is distance in meters from the source and λ = 250 m. This equation fits the SLAC data fairly well, and is the one used to predict doses beyond our measuring station (see Figure A-1). We feel that the methods used and reported in this document may overestimate the true population dose by at least an additional factor of two.

The population activity close to SLAC, i.e., within 1.6 km radius, is a mixture of commerce and residential dwellings. This area is partially covered by West Menlo Park town, Atherton town, and the Stanford unincorporated community. Based on the population data from the 1990 census, the population estimate in this area is about 8800 residents. Previous estimates have resulted in a much smaller number (by a factor of 8) which is due to the fact that a larger impacted area and higher population density data were used. In addition a different analytical model and approach were also used for CY91. The same exposure assumptions were used for the CY90 report using a ceiling estimate of 2 mrem to the site boundary. The 17.6 person-rem collective dose was estimated from this value.

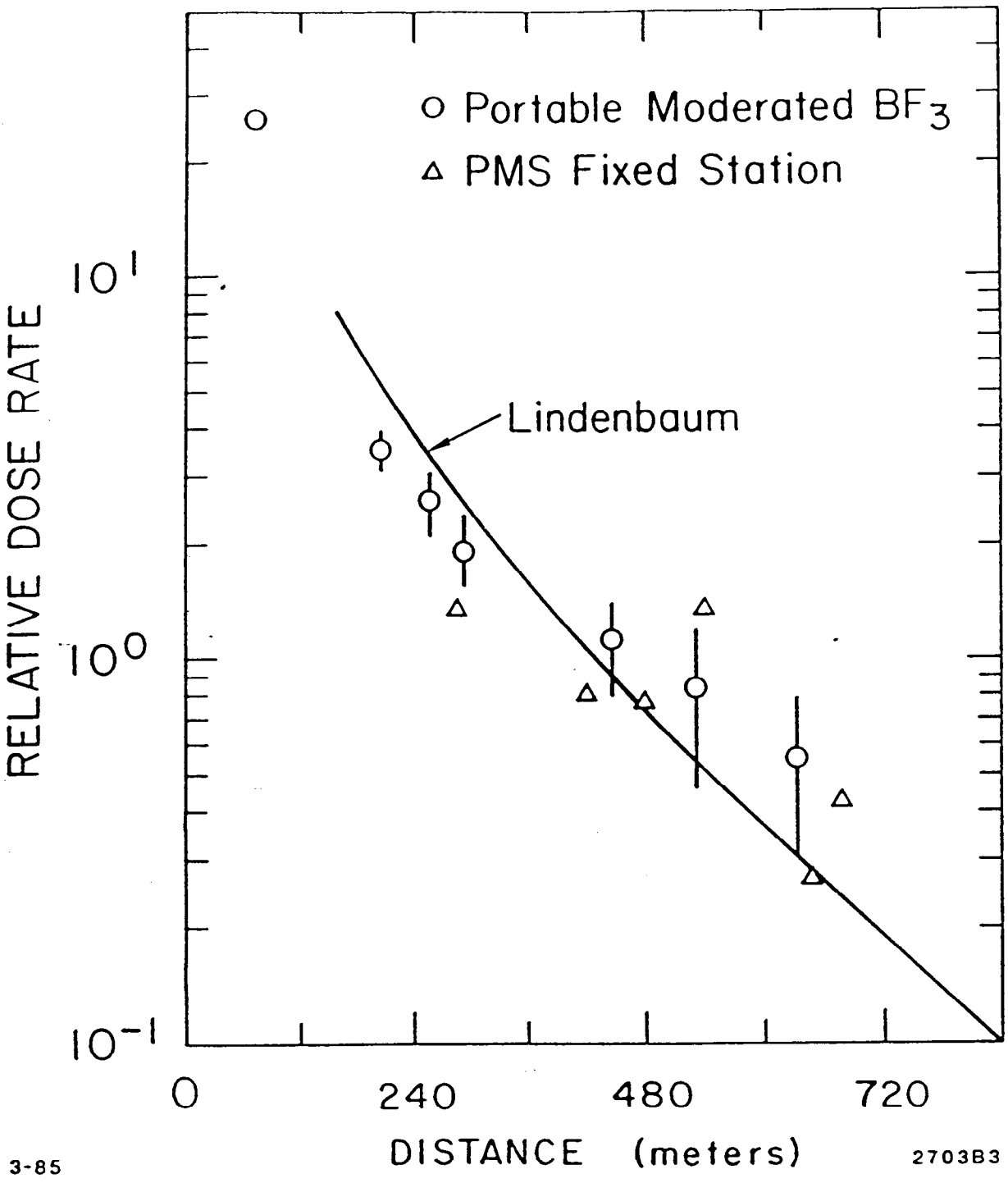

Figure A-1. Measurements made along a line between End Station A and the site boundary.

U.S. Department of Energy
Radionuclide Air Emissions Annual Report
(under Subpart H of 40 CFR 61)
Calendar Year 1991

Site Name: **Stanford Linear Accelerator Center (SLAC)**

Field Office Information

Office:	Department of Energy SF		
Address:	1333 Broadway Oakland, CA 94612		
Contact:	John Muhlestein	Phone:	(415) 926-3208

Site Information

Operator:	Stanford University		
Address:	P.O. Box 4349 Stanford, CA 94309		
Contact:	Gary Warren	Phone:	(415) 926-3614

Section I. Facility Information

Stanford Linear Accelerator Center is fully in compliance with the required 40 CFR Part 61 Subpart H for CY91.

Site Description

The Stanford Linear Accelerator Center (SLAC) is a national facility operated by Stanford University under contract with the U.S. Department of Energy. It is located on the San Francisco peninsula, about halfway between San Francisco and San Jose, California. The site area is a belt of low, rolling foothills, lying between the alluvial plain bordering the San Francisco Bay on the east and the Santa Cruz Mountains on the west.

The whole accelerator site varies in elevation from 53 to 114 meters above sea level, whereas the alluvial plain to the east around the Bay lies less than 46 meters above sea level. The mountains to the west rise abruptly to 610 meters. The SLAC site occupies 170 hectares of land. The site is located in an unincorporated portion of San Mateo County. It is bordered on the north by Sand Hill Road and on the south by San Francisquito Creek.

The SLAC staff is roughly 1550 employees, temporary staff and visiting scientists. The climate in the SLAC area is Mediterranean. Winters are warm (sometimes it rains) and summers are mostly cool and dry.

The populated area around SLAC is a mix of office, school, university, condominiums, apartments, single family housing, and pasture. SLAC is mainly surrounded by 5 communities: Atherton town, West Menlo Park, Woodside town, Portola Valley town, and Stanford. Population distribution and housing data from the recent 1990 census for these five communities are shown below:

Table 1. Demographic Data

GEOGRAPHIC AREA	POPULATION [persons]	POP. DENSITY [per/sq mile]	HOUSING [unit]	LAND AREA [sq mile]
Atherton town	7,163	1463.32	2,518	4.895
West Menlo Park	3,959	7086.19	1,701	0.559
Portola Valley town	4,194	458.02	1,675	9.157
Woodside town	5,035	428.88	1,892	11.740
Stanford	18,097	6569.14	4,770	2.755
Total:	38,448	NA	12,556	29.105

SLAC is a component of the U.S. high energy physics program. The laboratory uses a 3.2 km long electron accelerator to produce and accelerate both electrons and positrons for basic particle physics research.

The facilities at SLAC are used to support research in accelerator technology, maintenance of the accelerator, design and construction of new detector systems.

Source Description

Radioactive materials are inevitably produced by the operation of the accelerator. During the acceleration process some electrons strike accelerator components and induce radioactivity in the material. In addition, some high energy particles interact with air molecules producing relatively short-lived isotopes such as ^{15}O, ^{13}N, ^{11}C, ^{38}Cl, ^{39}Cl, and ^{41}Ar. These radioactive gases are normally produced in areas where the beam strikes beam line components (beam loss). There are six potential beam loss areas currently identified at SLAC: Accelerator Housing, Positron Source, SLC Beam Dump, Beam Switchyard, SLC Damping Rings, and SSRL Booster Injector. The saturation radioactivity produced in these areas has been studied by Jenkins, et al. (CN-227). The saturation activity is defined to be the equilibrium radioactivity level inside these areas when the accelerator is running. Potential release points from these areas are either from the access openings (i.e. entrance doors, manways) or from the forced air ventilation ducts. All the access openings are closed and administratively secured during the beam

operation. Detail descriptions of these areas and their associated radionuclide concentrations are discussed below.

- Accelerator Housing: The accelerator is housed in a 3.2 km long housing. The housing is located 25 feet below ground. Access to the housing is through 30 inch diameter shafts every 330 feet. These shafts (release points) are also used as intake and exhaust shafts for the accelerator housing. Before machine operation, the housing is searched and locked. There is a cover across each manway shaft which is interlocked with the accelerator. The cover must be in place for machine operation; consequently, the housing cannot be vented when the accelerator is in operation. Thus, there is no release from these points when the machine is on. After the machine is off, the housing can be vented.

  The radioactive gas concentration is very low in the accelerator housing because there is very little beam loss, as determined by the level of activation in the accelerator structure. It is assumed that the saturation activities in this area are similar to those in one of the SLC Beam Dump areas.

Table 2. Accelerator Housing Activity

Isotope	Saturation Activity [Ci/Release]	Number of Releases per Year	Total Activity Released [Ci/yr]	Percent of Contribution
O-15	1.0E-01	9	9.0E-01	63%
N-13	2.0E-02	9	1.8E-01	13%
C-11	3.0E-02	9	2.7E-01	19%
Cl-38	4.0E-03	9	3.6E-02	3%
Cl-39	3.0E-03	9	2.7E-02	2%
Ar-41	1.5E-03	9	1.4E-02	1%
TOTAL:	1.6E-01	NA	1.4E+00	100%

After the electron beam leaves the accelerator, it is guided to an area where it may interact with a stationary target or be directed to collide with a beam of positrons. The distance from this facility to the nearest off-site residence is about 400 meters.

- Positron Source: The positron source is located in an area separated from the accelerator housing by a thick concrete shield. The beam is deflected out of the accelerator into the positron target. The electron beam produces electron/positron pairs in the target. The positrons are separated and transported back to the beginning of the accelerator. Jenkins, et al (CN 226), have reviewed the air activation associated with the operation of the positron target. The saturation activities of potential radioactive gases in this area are listed below:

Table 3. Positron Source Activity

Isotope	Saturation Activity [Ci/Release]	Number of Releases per Year	Total Activity Released [Ci/yr]	Percent of Contribution
O-15	1.4E+00	9	1.3E+01	68%
N-13	3.0E-01	9	2.7E+00	15%
C-11	3.0E-01	9	2.7E+00	15%
Cl-38	5.0E-03	9	4.5E-02	0%
Cl-39	3.0E-02	9	2.7E-01	1%
Ar-41	2.0E-02	9	1.8E-01	1%
TOTAL:	2.1E+00	NA	1.8E+01	100%

The positron source has a separate exhaust fan (release point). The positron source is not vented during machine operation. There is a long pause period between beam off and ventilation (several hours to several days). The distance to the nearest occupied areas off site is about 400 m.

- Beam Dumps: Over the past few years, SLAC has commissioned and operated a machine called the SLAC Linear Collider (SLC). The SLC is the upgraded linear accelerator which produces 50 GeV positrons and electrons. These beams are deflected into transport systems which guide them to an interaction point. The electrons and positrons remaining in the beam after the collision are deflected into beam dumps.

  There are two beam dumps located in shielded rooms in the SLC arcs. The saturation activities for both of these beam dumps are listed below:

Table 4. Beam Dumps Activity

Isotope	Saturation Activity [Ci/Release]	Number of Releases per Year	Total Activity Released [Ci/yr]	Percent of Contribution
O-15	2.0E-01	9	1.8E+00	63%
N-13	4.0E-02	9	3.6E-01	13%
C-11	6.0E-02	9	5.4E-01	19%
Cl-38	8.0E-03	9	7.2E-02	3%
Cl-39	6.0E-03	9	5.4E-02	2%
Ar-41	3.0E-03	9	2.7E-02	1%
TOTAL:	3.2E-01	NA	2.9E+00	100%

The SLC arcs and dump areas are not vented (release point) during beam operation. The distance from the north arc SLC vent to the nearest off-site residence is 300 m.

- Beam Switchyard: There are four vents (release point) on the beam switchyard. The vents on the beam switchyard and Beam Dump East have covers. The covers are closed during beam operation. If we use the saturation activity produced in the Accelerator Housing as the release from these four vents, this will give a conservative estimate of the effective dose equivalent possible for people off site. The distance from this facility to the nearest off-site residence is about 400 meters.

Table 5. Beam Switchyard Activity

Isotope	Saturation Activity [Ci/Release]	Number of Releases per Year	Total Activity Released [Ci/yr]	Percent of Contribution
O-15	1.0E-01	32	3.2E+00	63%
N-13	2.0E-02	32	6.4E-01	13%
C-11	3.0E-02	32	9.6E-01	19%
Cl-38	4.0E-03	32	1.3E-01	3%
Cl-39	3.0E-03	32	9.6E-02	2%
Ar-41	1.5E-03	32	4.8E-02	1%
TOTAL:	1.6E-01	NA	5.1E+00	100%

- Damping Rings: There are two damping rings associated with the SLC. The rings are located on the north and south sides of the accelerator at the end of Sector 1. The distance from these two rings to the nearest off-site residence is about 400 meters. Each ring has a forced air ventilation system (release point). No ventilation is carried out during the beam operation. The saturation activity produced in each ring has been calculated by Jenkins, (CN 51). The isotopes produced and the saturation activity are listed in the following table:

Table 6. Damping Rings Activity

Isotope	Saturation Activity [Ci/Release]	Number of Releases per Year	Total Activity Released [Ci/yr]	Percent of Contribution
O-15	1.8E-02	18	3.2E-01	81%
N-13	3.2E-03	18	5.8E-02	14%
C-11	6.0E-04	18	1.1E-02	3%
Cl-38	1.3E-06	18	2.3E-05	0%
Cl-39	8.0E-05	18	1.4E-03	0%
Ar-41	2.2E-04	18	3.9E-03	1%
TOTAL:	2.2E-02	NA	4.0E+01	100%

- SSRL Booster Injector: The Stanford Synchrotron Radiation Laboratory has a 3 GeV booster that produces very low concentrations of radioactive gases. The isotopes and saturation activities are listed in the following table.

Table 7. SSRL/Booster Injector Activity

Isotope	Saturation Activity [Ci/Release]	Number of Releases per Year	Total Activity Released [Ci/yr]	Percent of Contribution
O-15	3.7E-04	9	3.3E-03	31%
N-13	7.0E-04	9	6.3E-03	58%
C-11	8.0E-05	9	7.2E-04	7%
Cl-38	1.6E-06	9	1.4E-05	0%
Cl-39	4.0E-05	9	3.6E-04	3%
Ar-41	1.2E-05	9	1.0E-04	1%
TOTAL:	1.2E-03	NA	1.1E-02	100%

The booster ring does not have forced air ventilation, thus the entrance door is the only potential release point. The distance from this facility to the nearest off-site residence is about 400 meters.

A radioactive gas monitor is provided at each vent from the BSY, positron source and SLC vent. The monitors consist of a detector unit at the vent and the pulse processing equipment located in the Main Control Room.

The detector unit is a GM tube mounted inside a nine liter air volume container. Gas from the vent is pulsed through the monitor air volume while the exhaust fan at the vent

is on. When the exhaust fan is turned off the pump pulling gas through the air volume is turned off.

The GM tube is 11 inches long x 5/8 inch diameter. The wall is 50 milligrams per square centimeter. The GM tube inside the nine liter volume was calibrated using ^{85}Kr gas. The sensitivity of the equipment is 2×10^{-8} μCi/cc per count per minute.

The isotopes being monitored are beta emitters. The maximum energy of the spectrum is as follows:

Table 8. Beta Endpoint Energies

Isotope	half-life [Minute]	Beta Energy [Mev]
0-15	2.03	1.74
N-13	9.96	1.20
C-11	20.30	0.97
Cl-38	37.00	4.80
Cl-39	55.00	1.91
Ar-41	109.20	1.79
Kr-85	3.38E+08	0.70

Since ^{85}Kr has the lowest energy, the detector will be more sensitive to the other isotopes. The net result is that by calibrating to ^{85}Kr, SLAC is reporting a higher concentration than is actually present.

The pulses from the detector are stored in history buffers which are read out by the VAX computer. The data is analyzed to determine a concentration and total activity for each vent.

As mentioned above, none of the identified areas are vented or accessed during the beam operation; therefore potential releases occur only after the shutdown of the beam. The time between turning the beam off and venting (or making entry) is normally over an hour, which is long enough for the dominant radioisotope O^{15} to decay through several half-lives. For the purpose of calculating the source terms, it is conservatively assumed that all of these facilities will be vented or accessed right after the shutdown of machine

for emergency repairs or routine maintenance. In addition, since all the emission points at SLAC have similar types of source terms and physical characteristics, they will be grouped together as one release point with a stack height of 1.0 meter and 0.0 meter in diameter. The distance from this single release point to the nearest off-site residence is taken to be 300 meters.

The activity used for assessing compliance is listed in the following tables: The activity was calculated using internal reports and memoranda to file.

Table 9. Summary Activity by Location

Isotope	Accelerator Housing [Ci]	Positron Source [Ci]	SLC Beam Dump [Ci]	Beam Switchyard [Ci]	SLC Damping Rings [Ci]	SSRL Booster [Ci]	All Site Total [Ci]	Percent of Contribution
O-15	9.0E-01	1.3E+01	1.8E+00	3.2E+00	3.2E-01	3.3E-03	**18.83**	67%
N-13	1.8E-01	2.7E+00	3.6E-01	6.4E-01	5.8E-02	6.3E-03	**3.94**	14%
C-11	2.7E-01	2.7E+00	5.4E-01	9.6E-01	1.1E-02	7.2E-04	**4.48**	16%
Cl-38	3.6E-02	4.5E-02	7.2E-02	1.3E-01	2.3E-05	1.4E-05	**0.28**	1%
Cl-39	2.7E-02	2.7E-01	5.4E-02	9.6E-02	1.4E-03	3.6E-04	**0.45**	2%
Ar-41	1.4E-02	1.8E-01	2.7E-02	4.8E-02	3.9E-03	1.0E-04	**0.27**	1%
TOTAL [Ci]:	**1.43**	**18.50**	**2.85**	**5.07**	**0.40**	**0.01**	**28.26**	100%
Percent of Contribution	5%	65%	10%	18%	1%	0%	100%	

Section II. Air Emissions Data

Grouped Source	Type Control Efficiency	Distance to Receptor
Positron Source	Not vented during beam operation	400 m
Damping Ring	Not vented during beam operation	400 m
SLC Beam Dump	Not vented during beam operation	300 m
Acc. Housing	Not vented during beam operation	400 m
Beam Switchyard	Not vented during beam operation	400 m
SSRL Booster	Not vented during beam operation	400 m

Table 10. Total Radioactive Gases Released in 1991

Isotope	All Site Total [Ci]	Percent of Contribution
O-15	18.827	67%
N-13	3.944	14%
C-11	4.482	16%
Cl-38	0.281	1%
Cl-39	0.449	2%
Ar-41	0.273	1%
TOTAL [Ci]:	**28.225**	100%

Section III. Dose Assessments

Description of Dose Model

The EPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC version 1.0, was used to calculate the average radiation dose to an individual within each population segment. Collective population dose is calculated as the average radiation dose to an individual in a specified area, multiplied by the number of individuals in that area.

As discussed above, the 1991 radioactivity air emissions used as input to the CAP88-PC were conservatively derived and are shown in Table 10 in Section II. The "number of releases/year" was overly estimated for many systems and, in many cases, was not representative of the true release. This parameter was purely based on the number of times that the machine was shut down for repair or maintenance in 1991, and was independent of whether or not venting was carried out.

An estimate of the population residing within 6 km of SLAC was made using 1990 census data for San Mateo and Santa Clara counties. An area defined by a circle of 6 km radius around the center of SLAC (Sector 30) was further divided into 16 equal sectors, with segments formed by the intersection of the sectors and a total of 7 radial distances of 0.1, 0.3, 0.5, 1.0, 2.0, 4.0, and 6.0 km. For information an additional 6 radial distances extending beyond the 6 km boundary to 80 km were also specified in the CAP88-PC input, but without population data supplied. The population within each segment was derived by multiplying the segment area by the population density of the appropriate city/cities. Unpopulated areas, i.e., mountains and grazing fields, were also taken into account in this population study.

Since SLAC does not have a qualified weather station, meteorological input data for 1991 was based on the data provided for San Francisco Airport. Study of different meteorological data from different cities within the Bay Areas (Berkeley, Oakland, Livermore) has shown that San Francisco Airport meteorological data would yield a conservative dose assessment value using CAP-88 model.

Summary of Input Parameters

- SOURCE TERMS:

Table 11. Total Activity for CAP88-PC

Isotope	All Site Total [Ci]	Percent of Contribution
0-15	18.827	68%
N-13	3.944	14%
C-11	4.482	16%
Ar-41	0.273	1%
TOTAL [Ci]:	**27.525**	100%

- POPULATION DATA:

Table 12. Radial Population Data for CAP88-PC

Direction	0.1 km	0.3 km	0.5 km	1.0 km	2.0 km	4.0 km	6.0 km	TOTAL
N	0	0	125	403	1100	1331	4103	7063
NNW	0	0	126	403	1292	1696	4956	8474
NW	0	0	127	403	1292	1231	1803	4856
WNW	0	0	127	403	1289	910	650	3380
W	0	0	125	379	149	793	650	2096
WSW	0	0	12	0	0	715	520	1247
SW	0	0	12	0	0	242	668	922
SSW	0	0	12	0	0	417	690	1119
S	0	0	12	0	1195	1529	913	3650
SSE	0	0	12	0	1195	1529	3579	6315
SE	0	0	12	0	896	1195	2020	4125
ESE	0	0	12	0	896	598	4855	6362
E	0	0	125	0	1195	5976	4855	12151
ENE	0	0	125	40	1322	5976	5174	12637
NE	0	0	125	391	869	4944	3773	10101
NNE	0	0	125	403	1416	2597	3623	8165
TOTAL:	0	0	1217	2825	14108	31678	42834	92663

- SEE ATTACHMENTS FOR OTHER INPUT PARAMETERS

Compliance Assessment

This assessment of the potential activity released is based on calculations of the activity produced and the immediate release of all of the activity at one time. This is a very conservative approach since ^{15}O dominates the dose calculation. ^{15}O has a two (2) minute half-life and the time between turning the beam off and venting is long (probably in excess of an hour, which is 30 half-lives). This compliance assessment uses the computer code CAP-88 PC Version 1.0 to calculate the dose.

Effective Dose Equivalent: 8.59E-2 (mrem)

Location of Maximally Exposed Individual: 400 meters East Southeast

Additional Information:

SLAC did not have any new/completed construction projects nor modifications during CY91.

A special assignment team (Tiger Team) visited SLAC during the months of October and November 1991 to provide an independent evaluation of operations and environmental practices at SLAC. The results of these findings were reported in the document: SLAC Corrective Action Plan (SLAC-REPORT-388). Below are the summary of the Tiger Team's findings and SLAC's proposed corrective action plans that are relevant to the NESHAP compliance issue.

Finding A/CF-2: *SLAC does not have a documented meteorological monitoring program. Meteorological data currently used by SLAC in the AIRDOS modeling are not representative of local conditions.*

Response: SLAC will develop a documented meteorological monitoring program to ensure that meteorological data used at the site is representative of local conditions. This program will identify the types of meteorological information required to support all routine and nonroutine environmental protection activities. The meteorological information will include topographical characteristics and distances to critical receptors. Data from offsite sources will be used if the data are well-maintained and the data are readily available and representative of conditions at the site.

Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See 18 U.S.C. 1001).

Section IV. Supplemental Information

- During CY91, the collective effective dose equivalent for population within 6 km from SLAC's site boundary was estimated to be 6.95e-02 person-rem.

- There were no unplanned releases of radionuclides to the atmosphere during CY91.

- The reported source terms in the NESHAP report for CY91 include both monitored and unmonitored sources that are currently identified at SLAC.

- There were no known diffuse emissions at SLAC.

ATTACHMENTS

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Population Assessment
Apr 14, 1991 0:31 am

Facility: STANFORD LINEAR ACCELERATOR
Address: P.O. BOX 4349
MAIL STOP #84
City: STANFORD
State: CA Zip: 94309

Effective Dose Equivalent
(mrem/year)

8.59E-02

At This Location: 400 Meters East Southeast

Source Category: RADIOACTIVE GASES
Source Type: Stack
Emission Year: 1991

Comments: This report is prepared to comply with NESHAP

Dataset Name: SLAC91
Dataset Date: Apr 14, 1991 0:25 am
Wind File: WNDFILES\SFO.WND
Population File: POPFILES\SLAC.POP

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 400 Meters East Southeast
Lifetime Fatal Cancer Risk: 2.08E-06

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	9.92E-02	7.99E-02
BREAST	9.21E-02	7.41E-02
R MAR	7.56E-02	6.10E-02
LUNGS	8.68E-02	7.19E-02
THYROID	9.22E-02	7.44E-02
ENDOST	8.64E-02	6.95E-02
RMNDR	7.47E-02	6.05E-02
EFFEC	8.59E-02	6.95E-02

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Risk Range	Number of People	Number of People In This Risk Range Or Higher	Deaths/Year In This Risk Range	Deaths/Year In This Risk Range Or Higher
1.0E+00 TO 1.0E-01	0	0	0.00E+00	0.00E+00
1.0E-01 TO 1.0E-02	0	0	0.00E+00	0.00E+00
1.0E-02 TO 1.0E-03	0	0	0.00E+00	0.00E+00
1.0E-03 TO 1.0E-04	0	0	0.00E+00	0.00E+00
1.0E-04 TO 1.0E-05	0	0	0.00E+00	0.00E+00
1.0E-05 TO 1.0E-06	262	262	4.84E-06	4.84E-06
LESS THAN 1.0E-06	92394	92656	1.91E-05	2.39E-05

RADIONUCLIDE EMISSIONS DURING THE YEAR 1991

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
AR-41	*	0.00	2.7E-01	2.7E-01
C-11	D	1.00	4.5E+00	4.5E+00
N-13	D	1.00	3.9E+00	3.9E+00
O-15	D	1.00	1.9E+01	1.9E+01

SITE INFORMATION

Temperature:	10 degrees C
Precipitation:	100 cm/y
Mixing Height:	1000 m

SOURCE INFORMATION

Source Number: 1

Stack Height (m): 1.00
Diameter (m): 0.00

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.076	0.000	0.008
Fraction From Assessment Area:	0.924	1.000	0.992
Fraction Imported:	0.000	0.000	0.000

Beef Cattle Density: 8.81E-02
Milk Cattle Density: 2.85E-02
Land Fraction Cultivated for Vegetable Crops: 1.18E-02

POPULATION DATA

Direction	Distance (m) 50	200	400	750	1500	3000	5000
N	0	0	125	403	1100	1331	4103
NNW	0	0	126	403	1292	1696	4956
NW	0	0	127	403	1292	1231	1803
WNW	0	0	127	403	1289	910	650
W	0	0	125	379	149	793	650
WSW	0	0	12	0	0	715	520
SW	0	0	12	0	0	242	668
SSW	0	0	12	0	0	417	690
S	0	0	12	0	1195	1529	913
SSE	0	0	12	0	1195	1529	3579
SE	0	0	12	0	896	1195	2020
ESE	0	0	12	0	896	598	4855
E	0	0	125	0	1195	5976	4855
ENE	0	0	125	40	1322	5976	5174
NE	0	0	125	391	869	4944	3773
NNE	0	0	125	403	1416	2597	3623

Direction	Distance (m) 8000	20000	35000	45000	55000	70000
N	0	0	0	0	0	0
NNW	0	0	0	0	0	0
NW	0	0	0	0	0	0
WNW	0	0	0	0	0	0
W	0	0	0	0	0	0
WSW	0	0	0	0	0	0
SW	0	0	0	0	0	0
SSW	0	0	0	0	0	0
S	0	0	0	0	0	0
SSE	0	0	0	0	0	0
SE	0	0	0	0	0	0
ESE	0	0	0	0	0	0
E	0	0	0	0	0	0
ENE	0	0	0	0	0	0
NE	0	0	0	0	0	0
NNE	0	0	0	0	0	0

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Population Assessment
Apr 14, 1991 0:31 am

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MAIL STOP #84
City: STANFORD
State: CA Zip: 94309

Source Category: RADIOACTIVE GASES
Source Type: Stack
Emission Year: 1991

Comments: This report is prepared to comply with NESHAP

Dataset Name: SLAC91
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Wind File: WNDFILES\SFO.WND
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LUNGS	8.68E-02	7.19E-02
THYROID	9.22E-02	7.44E-02
ENDOST	8.64E-02	6.95E-02
RMNDR	7.47E-02	6.05E-02
EFFEC	8.59E-02	6.95E-02

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)	Collective Population (person-rem/y)
INGESTION	0.00E+00	0.00E+00
INHALATION	1.98E-03	1.94E-03
AIR IMMERSION	8.27E-02	6.62E-02
GROUND SURFACE	1.19E-03	1.36E-03
INTERNAL	1.98E-03	1.94E-03
EXTERNAL	8.39E-02	6.76E-02
TOTAL	8.59E-02	6.95E-02

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclides	Selected Individual (mrem/y)	Collective Population (person-rem/y)
AR-41	2.09E-03	4.19E-03
C-11	2.30E-02	2.77E-02
N-13	1.75E-02	1.70E-02
O-15	4.32E-02	2.07E-02
TOTAL	8.59E-02	6.95E-02

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
LEUKEMIA	2.39E-07	2.73E-06
BONE	1.53E-08	1.74E-07
THYROID	4.19E-08	4.78E-07
BREAST	3.61E-07	4.10E-06
LUNG	4.25E-07	5.01E-06
STOMACH	2.32E-07	2.69E-06
BOWEL	1.10E-07	1.25E-06
LIVER	2.42E-07	2.76E-06
PANCREAS	1.46E-07	1.67E-06
URINARY	9.04E-08	1.03E-06
OTHER	1.79E-07	2.04E-06
TOTAL	2.08E-06	2.39E-05

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
INGESTION	0.00E+00	0.00E+00
INHALATION	7.76E-08	1.11E-06
AIR IMMERSION	1.98E-06	2.24E-05
GROUND SURFACE	2.83E-08	4.60E-07
INTERNAL	7.76E-08	1.11E-06
EXTERNAL	2.00E-06	2.28E-05
TOTAL	2.08E-06	2.39E-05

PATHWAY GENETIC RISK SUMMARY
(Collective Population)

Pathway	Genetic Risk (person-rem/y)
INGESTION	0.00E+00
INHALATION	1.14E-04
AIR IMMERSION	6.52E-02
GROUND SURFACE	1.34E-03
INTERNAL	1.14E-04
EXTERNAL	6.66E-02
TOTAL	6.67E-02

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
AR-41	5.07E-08	1.43E-06
C-11	5.70E-07	9.69E-06
N-13	4.26E-07	5.83E-06
O-15	1.03E-06	6.99E-06
TOTAL	2.08E-06	2.39E-05

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	4.3E-02	8.9E-03	1.5E-03	2.4E-04	6.6E-05
NNW	0.0E+00	0.0E+00	2.2E-02	4.6E-03	7.7E-04	1.2E-04	3.5E-05
NW	0.0E+00	0.0E+00	2.1E-02	4.5E-03	7.7E-04	1.3E-04	3.6E-05
WNW	0.0E+00	0.0E+00	1.4E-02	3.0E-03	5.3E-04	9.0E-05	2.6E-05
W	0.0E+00	0.0E+00	1.0E-02	2.2E-03	3.7E-04	6.1E-05	1.7E-05
WSW	0.0E+00	0.0E+00	9.1E-03	0.0E+00	0.0E+00	5.4E-05	1.5E-05
SW	0.0E+00	0.0E+00	8.4E-03	0.0E+00	0.0E+00	4.8E-05	1.3E-05
SSW	0.0E+00	0.0E+00	7.2E-03	0.0E+00	0.0E+00	4.4E-05	1.2E-05
S	0.0E+00	0.0E+00	1.3E-02	0.0E+00	5.0E-04	8.4E-05	2.4E-05
SSE	0.0E+00	0.0E+00	6.3E-03	0.0E+00	2.3E-04	3.7E-05	1.0E-05
SE	0.0E+00	0.0E+00	2.3E-02	0.0E+00	9.0E-04	1.6E-04	4.6E-05
ESE	0.0E+00	0.0E+00	8.6E-02	0.0E+00	3.8E-03	7.0E-04	2.1E-04
E	0.0E+00	0.0E+00	6.1E-02	0.0E+00	2.8E-03	5.0E-04	1.5E-04
ENE	0.0E+00	0.0E+00	2.6E-02	5.6E-03	9.7E-04	1.6E-04	4.7E-05
NE	0.0E+00	0.0E+00	1.9E-02	4.0E-03	6.8E-04	1.1E-04	3.2E-05
NNE	0.0E+00	0.0E+00	2.0E-02	4.2E-03	7.2E-04	1.2E-04	3.4E-05

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

COLLECTIVE EFFECTIVE DOSE EQUIVALENT (person rem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	5.4E-03	3.6E-03	1.6E-03	3.2E-04	2.7E-04
NNW	0.0E+00	0.0E+00	2.8E-03	1.8E-03	9.9E-04	2.1E-04	1.7E-04
NW	0.0E+00	0.0E+00	2.7E-03	1.8E-03	1.0E-03	1.6E-04	6.6E-05
WNW	0.0E+00	0.0E+00	1.8E-03	1.2E-03	6.8E-04	8.2E-05	1.7E-05
W	0.0E+00	0.0E+00	1.3E-03	8.2E-04	5.5E-05	4.9E-05	1.1E-05
WSW	0.0E+00	0.0E+00	1.1E-04	0.0E+00	0.0E+00	3.9E-05	7.7E-06
SW	0.0E+00	0.0E+00	1.0E-04	0.0E+00	0.0E+00	1.2E-05	8.7E-06
SSW	0.0E+00	0.0E+00	8.7E-05	0.0E+00	0.0E+00	1.9E-05	8.5E-06
S	0.0E+00	0.0E+00	1.6E-04	0.0E+00	6.0E-04	1.3E-04	2.2E-05
SSE	0.0E+00	0.0E+00	7.5E-05	0.0E+00	2.7E-04	5.7E-05	3.8E-05
SE	0.0E+00	0.0E+00	2.7E-04	0.0E+00	8.1E-04	1.9E-04	9.3E-05
ESE	0.0E+00	0.0E+00	1.0E-03	0.0E+00	3.4E-03	4.2E-04	1.0E-03
E	0.0E+00	0.0E+00	7.7E-03	0.0E+00	3.3E-03	3.0E-03	7.5E-04
ENE	0.0E+00	0.0E+00	3.3E-03	2.2E-04	1.3E-03	9.6E-04	2.4E-04
NE	0.0E+00	0.0E+00	2.4E-03	1.6E-03	5.9E-04	5.5E-04	1.2E-04
NNE	0.0E+00	0.0E+00	2.5E-03	1.7E-03	1.0E-03	3.1E-04	1.2E-04

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

AVERAGE COLLECTIVE GENETIC DOSE EQUIVALENT
(person rem)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	1.6E-01	1.0E-01	4.7E-02	9.1E-03	7.8E-03
NNW	0.0E+00	0.0E+00	8.1E-02	5.3E-02	2.8E-02	6.0E-03	4.9E-03
NW	0.0E+00	0.0E+00	7.8E-02	5.2E-02	2.9E-02	4.5E-03	1.9E-03
WNW	0.0E+00	0.0E+00	5.2E-02	3.5E-02	2.0E-02	2.3E-03	4.8E-04
W	0.0E+00	0.0E+00	3.7E-02	2.3E-02	1.6E-03	1.4E-03	3.1E-04
WSW	0.0E+00	0.0E+00	3.2E-03	0.0E+00	0.0E+00	1.1E-03	2.2E-04
SW	0.0E+00	0.0E+00	2.9E-03	0.0E+00	0.0E+00	3.4E-04	2.5E-04
SSW	0.0E+00	0.0E+00	2.5E-03	0.0E+00	0.0E+00	5.3E-04	2.4E-04
S	0.0E+00	0.0E+00	4.5E-03	0.0E+00	1.7E-02	3.7E-03	6.3E-04
SSE	0.0E+00	0.0E+00	2.2E-03	0.0E+00	7.7E-03	1.6E-03	1.1E-03
SE	0.0E+00	0.0E+00	7.8E-03	0.0E+00	2.3E-02	5.3E-03	2.7E-03
ESE	0.0E+00	0.0E+00	3.0E-02	0.0E+00	9.8E-02	1.2E-02	3.0E-02
E	0.0E+00	0.0E+00	2.2E-01	0.0E+00	9.5E-02	8.6E-02	2.1E-02
ENE	0.0E+00	0.0E+00	9.5E-02	6.4E-03	3.7E-02	2.8E-02	7.0E-03
NE	0.0E+00	0.0E+00	7.0E-02	4.5E-02	1.7E-02	1.6E-02	3.4E-03
NNE	0.0E+00	0.0E+00	7.2E-02	4.9E-02	2.9E-02	8.8E-03	3.5E-03

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	1.1E-06	2.2E-07	3.6E-08	5.8E-09	1.6E-09
NNW	0.0E+00	0.0E+00	5.4E-07	1.1E-07	1.9E-08	3.0E-09	8.5E-10
NW	0.0E+00	0.0E+00	5.2E-07	1.1E-07	1.9E-08	3.1E-09	8.9E-10
WNW	0.0E+00	0.0E+00	3.4E-07	7.4E-08	1.3E-08	2.2E-09	6.3E-10
W	0.0E+00	0.0E+00	2.5E-07	5.2E-08	9.1E-09	1.5E-09	4.1E-10
WSW	0.0E+00	0.0E+00	2.2E-07	0.0E+00	0.0E+00	1.3E-09	3.6E-10
SW	0.0E+00	0.0E+00	2.0E-07	0.0E+00	0.0E+00	1.2E-09	3.2E-10
SSW	0.0E+00	0.0E+00	1.8E-07	0.0E+00	0.0E+00	1.1E-09	3.0E-10
S	0.0E+00	0.0E+00	3.2E-07	0.0E+00	1.2E-08	2.0E-09	5.9E-10
SSE	0.0E+00	0.0E+00	1.5E-07	0.0E+00	5.5E-09	9.1E-10	2.6E-10
SE	0.0E+00	0.0E+00	5.5E-07	0.0E+00	2.2E-08	3.8E-09	1.1E-09
ESE	0.0E+00	0.0E+00	2.1E-06	0.0E+00	9.2E-08	1.7E-08	5.2E-09
E	0.0E+00	0.0E+00	1.5E-06	0.0E+00	6.7E-08	1.2E-08	3.8E-09
ENE	0.0E+00	0.0E+00	6.4E-07	1.4E-07	2.4E-08	3.9E-09	1.1E-09
NE	0.0E+00	0.0E+00	4.7E-07	9.8E-08	1.7E-08	2.7E-09	7.7E-10
NNE	0.0E+00	0.0E+00	4.9E-07	1.0E-07	1.8E-08	2.9E-09	8.3E-10

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

COLLECTIVE FATAL CANCER RATE (deaths/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	50	200	400	750	1500	3000	5000
N	0.0E+00	0.0E+00	1.9E-06	1.2E-06	5.7E-07	1.1E-07	9.4E-08
NNW	0.0E+00	0.0E+00	9.6E-07	6.3E-07	3.4E-07	7.3E-08	6.0E-08
NW	0.0E+00	0.0E+00	9.3E-07	6.2E-07	3.4E-07	5.4E-08	2.3E-08
WNW	0.0E+00	0.0E+00	6.2E-07	4.2E-07	2.4E-07	2.8E-08	5.8E-09
W	0.0E+00	0.0E+00	4.4E-07	2.8E-07	1.9E-08	1.7E-08	3.8E-09
WSW	0.0E+00	0.0E+00	3.8E-08	0.0E+00	0.0E+00	1.3E-08	2.7E-09
SW	0.0E+00	0.0E+00	3.5E-08	0.0E+00	0.0E+00	4.1E-09	3.0E-09
SSW	0.0E+00	0.0E+00	3.0E-08	0.0E+00	0.0E+00	6.4E-09	2.9E-09
S	0.0E+00	0.0E+00	5.4E-08	0.0E+00	2.1E-07	4.4E-08	7.6E-09
SSE	0.0E+00	0.0E+00	2.6E-08	0.0E+00	9.3E-08	2.0E-08	1.3E-08
SE	0.0E+00	0.0E+00	9.3E-08	0.0E+00	2.8E-07	6.4E-08	3.2E-08
ESE	0.0E+00	0.0E+00	3.5E-07	0.0E+00	1.2E-06	1.4E-07	3.6E-07
E	0.0E+00	0.0E+00	2.6E-06	0.0E+00	1.1E-06	1.0E-06	2.6E-07
ENE	0.0E+00	0.0E+00	1.1E-06	7.7E-08	4.4E-07	3.3E-07	8.4E-08
NE	0.0E+00	0.0E+00	8.3E-07	5.4E-07	2.0E-07	1.9E-07	4.1E-08
NNE	0.0E+00	0.0E+00	8.6E-07	5.8E-07	3.5E-07	1.1E-07	4.2E-08

	Distance (m)					
Direction	8000	20000	35000	45000	55000	70000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
W	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SSE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ESE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Population Assessment
Apr 14, 1991 0:31 am

Facility: STANFORD LINEAR ACCELERATOR
Address: P.O. BOX 4349
MAIL STOP #84
City: STANFORD
State: CA Zip: 94309

Source Category: RADIOACTIVE GASES
Source Type: Stack
Emission Year: 1991

Comments: This report is prepared to comply with NESHAP

Dataset Name: SLAC91
Dataset Date: Apr 14, 1991 0:25 am
Wind File: WNDFILES\SFO.WND
Population File: POPFILES\SLAC.POP

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class							
Dir	A	B	C	D	E	F	G	Wind Frequency
N	0.000	1.018	1.537	3.480	2.760	1.462	0.772	0.065
NNW	0.000	1.211	1.661	3.082	2.740	1.552	0.772	0.035
NW	0.000	0.973	1.784	3.481	2.931	1.531	0.772	0.041
WNW	1.304	1.259	2.375	2.546	2.860	1.498	0.772	0.032
W	1.304	1.452	1.978	2.054	2.925	1.138	0.772	0.027
WSW	0.000	1.739	2.249	2.320	3.545	1.597	0.772	0.031
SW	0.772	1.825	2.289	2.225	3.201	1.323	0.772	0.029
SSW	1.304	2.016	2.505	2.625	2.914	1.358	0.772	0.024
S	1.304	2.003	2.642	3.449	3.363	1.498	0.772	0.031
SSE	0.000	1.758	3.492	2.535	3.462	1.845	0.772	0.012
SE	0.970	1.621	4.654	5.002	3.817	1.865	0.772	0.066
ESE	0.000	1.329	5.056	5.870	4.095	2.061	0.772	0.276
E	0.000	2.216	4.811	5.822	3.912	1.916	0.772	0.213
ENE	0.000	1.546	4.780	4.203	3.525	1.647	0.772	0.054
NE	0.000	1.146	2.398	3.207	2.881	1.828	0.772	0.031
NNE	0.000	1.215	4.600	3.401	2.932	1.705	0.772	0.033

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.000	1.451	2.921	5.564	2.870	1.987	0.772
NNW	0.000	1.790	2.389	4.416	2.839	2.065	0.772
NW	0.000	1.408	2.680	4.860	3.108	2.047	0.772
WNW	1.822	2.022	3.167	3.762	3.012	2.019	0.772
W	1.822	2.146	2.747	3.144	3.099	1.599	0.772
WSW	0.000	2.404	2.759	3.414	3.773	2.101	0.772
SW	0.772	2.506	2.980	3.594	3.431	1.843	0.772
SSW	1.822	2.731	3.171	3.889	3.085	1.882	0.772
S	1.822	2.738	3.738	5.914	3.600	2.019	0.772
SSE	0.000	2.334	4.451	5.292	3.696	2.268	0.772
SE	1.297	2.731	5.986	6.565	3.999	2.280	0.772
ESE	0.000	2.233	6.470	6.971	4.198	2.381	0.772
E	0.000	3.028	6.520	6.904	4.070	2.308	0.772
ENE	0.000	2.758	5.576	5.264	3.754	2.139	0.772
NE	0.000	1.612	4.411	4.807	3.041	2.258	0.772
NNE	0.000	2.172	5.587	5.165	3.109	2.180	0.772

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.0000	0.0283	0.0451	0.5093	0.1027	0.1914	0.1231
NNW	0.0000	0.0344	0.0471	0.5116	0.1179	0.1882	0.1007
NW	0.0000	0.0245	0.0784	0.5889	0.0964	0.1340	0.0779
WNW	0.0037	0.0487	0.1597	0.5842	0.0788	0.0828	0.0422
W	0.0045	0.1573	0.2419	0.4529	0.0611	0.0552	0.0272
WSW	0.0000	0.3795	0.2293	0.2684	0.0537	0.0485	0.0205
SW	0.0042	0.4360	0.2218	0.2274	0.0451	0.0437	0.0218
SSW	0.0049	0.3246	0.2657	0.2743	0.0589	0.0544	0.0172
S	0.0039	0.1204	0.2018	0.4448	0.0781	0.0963	0.0547
SSE	0.0000	0.1400	0.2132	0.3105	0.1327	0.1191	0.0845
SE	0.0037	0.0277	0.2743	0.4434	0.1356	0.0722	0.0431
ESE	0.0000	0.0067	0.1061	0.5709	0.2022	0.0990	0.0152
E	0.0000	0.0041	0.0670	0.7438	0.1033	0.0592	0.0226
ENE	0.0000	0.0161	0.0525	0.6101	0.1258	0.1156	0.0798
NE	0.0000	0.0048	0.0696	0.5386	0.1010	0.1783	0.1077
NNE	0.0000	0.0136	0.0607	0.5300	0.0972	0.2034	0.0951
TOT	0.0008	0.0535	0.1168	0.5574	0.1273	0.1004	0.0438

ADDITIONAL WEATHER INFORMATION

Average Air Temperature:	10.0 degrees C
	283.2 K
Precipitation:	100.0 cm/y
Lid Height:	1000 meters
Surface Roughness Length:	0.010 meters
Height Of Wind Measurements:	10.0 meters
Average Wind Speed:	4.847 m/s

Vertical Temperature Gradients:

STABILITY E	0.073 k/m
STABILITY F	0.109 k/m
STABILITY G	0.146 k/m

NOTE: Reproducibility levels for CaSO4-TLD and LiF-TLD are +/- 2 mR and +/- 10 mR, respectively
Minimum Detectable Levels for CaSO4-TLD and LiF-TLD are 2 mR and 10 mR respectively

		FOURTH QUARTER OF CY91				*THIRD QUARTER OF CY 91*			
DOSIMETER ID	LOCATION	CaSO4 GROSS [mR]	CaSO4 NET [mR]	LIF GROSS [mR]	LIF NET [mR]	CaSO4 GROSS [mR]	CaSO4 NET [mR]	LIF GROSS [mR]	LIF NET [mR]
9901	SB AT REGION 6	20	4	45	5	31	2	50	5
9902	SB AT INJECTOR	20	4	45	5	31	2	50	5
9903	COMPUTER CENTER SE	19	3	40	BKG	30	1	50	5
9904	SB AT REGION 4	20	4	40	BKG	30	1	50	5
9905	SB AT NORTH DAMPING RING	25	9	45	5	38	9	55	10
9906	I-280 OVERPASS ACC. SOUTH	23	7	45	5	36	7	55	10
9907-GAMMA	GAMMA CALIBRATION	20	4	45	5	57	28	70	25
9908		18	2	40	BKG	32	3	45	BKG
9909	ALPINE GATEHOUSE	16	BKG	40	BKG	25	BKG	45	BKG
9910	METEOROLOGICAL TOWER	26	10	50	10	28	BKG	50	5
9911	SB AT SLD	19	3	45	5	29	BKG	50	5
9912	SB AT REGION 12	21	5	50	10	31	2	50	5
9913	SB AT REGION 2	17	1	45	5	29	BKG	45	BKG
9914	SLAC ENTRANCE GATEHOUSE	18	2	45	5	27	BKG	50	5
9915	SLAC CAFETERIA	18	2	40	BKG	29	BKG	50	5
9916	SB AT REGION 8	20	4	45	5	30	1	50	5
9917	SB AT ADDISON WESLEY BLD.	21	5	45	5	33	4	50	5
9918	SB AT POSITRON VAULT	25	9	50	10	35	6	50	5
9919-CONTROL	TRANSPORT CONTROL	16	BKG	40	BKG	29	BKG	45	BKG
9920	SB AT SECTOR 20 SOUTH	24	8	50	10	35	6	50	5
9921	SB AT SOUTH DAMPING RING	25	9	50	10	38	9	55	10
9922	O-280 OVERPASS ACC. NORTH	20	4	45	5	32	3	50	5
9923-NEU&GAM	GAMMA/NEUTRON CALIBRATION	31	15	55	15	140	111	165	120
9924	OHP DEPT HEAD OFFICE	17	1	40	BKG	30	1	45	BKG
9925	OHP DEPT OFF. (NO HOLDER)	17	1	40	BKG		BKG		BKG

See Section 4.4 for explanation of passive TLD radiation monitoring system

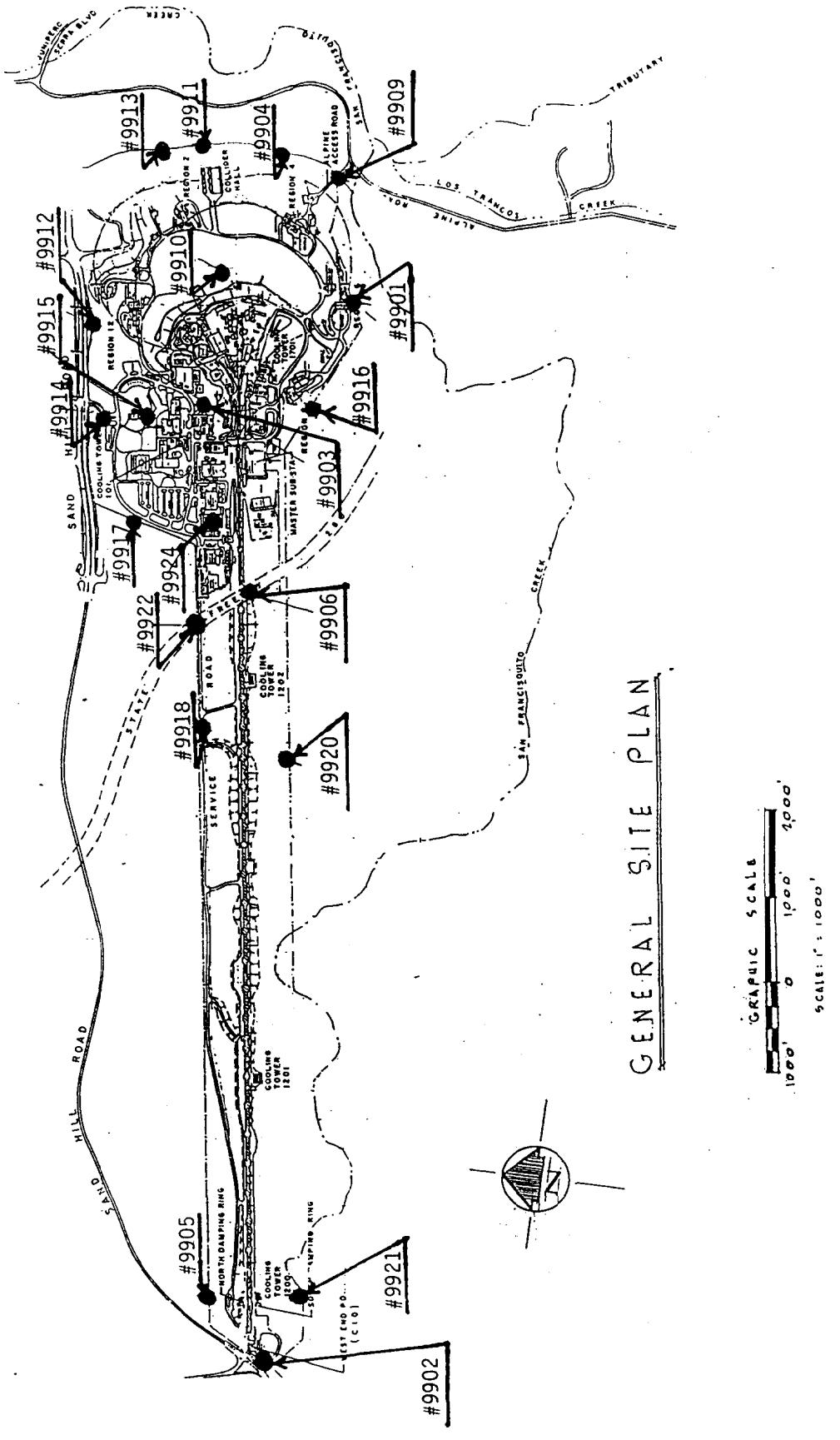

Figure F-1. Environmental TLD Monitoring Stations

Appendix G

Summary of organic chemical analyses for groundwater monitoring network.

MONITORING WELL EW-1

Date Sampled	7/8/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	01/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91
Type of analysis	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/601	601/601
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
Bromoform	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
Bromomethane	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry
Carbon Tetrachloride	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
Chlorobenzene	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
Chloroethane	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry
2-Chloroethylvinyl ether	<1500	<25	<200	<20	<50	na	na	na	<25	dry	na	na	dry	dry	<250	<100	dry
Chloroform	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
Chloromethane	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry
Dibromochloromethane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
1,2-Dichlorobenzene	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry
1,3-Dichlorobenzene	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry
1,4-Dichlorobenzene	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry
Dichlorodifluoromethane	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry
1,1-Dichloroethane	7000	2800	1500	1800	2100	780	970	1400	2300	dry	900	1000	dry	dry	820	790	dry
1,2-Dichloroethane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
1,1-Dichloroethene	<1500	150	<100	90	70	76	93	82	180	dry	200	210	dry	dry	240	94	dry
cis-1,2-Dichloroethene	<1500	50	<200	200	210	5.4	11	53	25	dry	180	<25	dry	dry	<25	<10	dry
trans-1,2-Dichloroethene	<1500	<50	<200	<50	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
1,2-Dichloropropane	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
cis-1,3-Dichloropropene	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	na	dry	dry	na	<10	dry
trans-1,3-Dichloropropene	<1500	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<50	dry	dry	<25	<10	dry
Methylene Chloride	160000	1400	<200	30	<50	89	<5	<5	43	dry	230**	<25	dry	dry	30	<10	dry
1,1,2,2-Tetrachloroethane	<1500	<50	<200	<50	<50	<5	<5	<5	<25	dry	<13	<100	dry	dry	<25	<10	dry
Tetrachloroethene	<1500	82	<200	60	50	30	33	38	39	dry	170	<25	dry	dry	<25	20	dry
1,1,1-Trichloroethane	1000	4800	3500	2700	1700	1500	1900	1700	1900	dry	310	1300	dry	dry	1100	1100	dry
1,1,2-Trichloroethane	<1500	<25	<200	<20	<50	<5	5.3	8	<25,	dry	<25	<50	dry	dry	<25	<10	dry
Trichloroethene	1700	700	420	420	300	260	250	350	350	dry	240	240	dry	dry	210	240	dry
Trichlorofluoromethane	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<25	<50	dry	dry	<25	<10	dry
1,1,2-Trichlorotrifluoroethane	<1500	<25	<200	<20	<50	na	na	na	<25	dry	<13	<25	dry	dry	<25	<10	dry
Vinyl Chloride	<1500	<25	<200	<20	<50	<10	<10	<10	<25	dry	<13	<25	dry	dry	<25	<10	dry
Benzene	<150	<25	<200	<20	<50	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
Toluene	2500	760	<200	110	590	<5	<5	<5	32	dry	<25	<50	dry	dry	<25	<10	dry
Ethylbenzene	850	69	<200	35	110	<5	<5	<5	<25	dry	<13	<25	dry	dry	<25	<10	dry
Total xylenes	3800	310	<700	160	440	<5	<5	41	<70	dry	<38	<75	dry	dry	<25	<10	dry

MONITORING WELL MW-2

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	2/25/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91
Type of analyses	601/602	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	4.3	<0.5	<0.5	18	<0.5	<0.5	<0.5	7.1	<5	<5	<0.5	<0.5	0**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.9
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	<1.5	<1.5	<1.5	<2.0	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5

MONITORING WELL MW-3

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/28/91
Type of ananlyes	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	1.9	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	2.4	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	2.4	<0.5	<0.5	<0.5	<0.5	0.6	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	10	<0.5	<0.5	<0.5	<0.5	0.8	<5	<5	<5	<0.5	1.6	<1	<1	<1	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	1.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	8.9	<1.5	<1.5	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5

MONITORING WELL MW-4

Date Sampled	7/8/87	8/20/87	11/20/87	1/15/88	2/25/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91
Type of analyses	601/602	601/602	601/602	601/602	601/601	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	<0.5	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	21.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	55.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	0.6	<1	<1	<1	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	4.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	27.0	<1.5	<1.5	<2.0	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5
Bis(2-ethylhexyl)phthalate	na	na	na	na	na	na	na	25	30	68	na	na	na	na	na	na	na	na	na

MONITORING WELL MW-5

Date Sampled	7/6/87	9/14/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	1/24/91	4/23/91	7/18/91	10/23/91
Type of ananlyse	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	duplicate	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	0.9	7.0	1	2	2	2	7	8.0	13
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<5	<5	<5	0.7	1.4	8	4	4	3	3	11	8.0	14
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	1	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	6	1	1	<0.5	<0.5	3	3.0	6.3
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	8.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	7.4	0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	5.8	<1.5	<1.5	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5	<0.5

MONITORING WELL MW-6

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	5/10/88	7/19/90	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91
Type of ananlyse	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	0.5	<0.5	<0.5	<0.5	0.6	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	1	1.3
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	0.5	<0.2	<0.2	<0.2	1.0	0.3	<5	<5	<5	1.6	1.4	6	3	3	3	8	12	11
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	18	<0.5	<0.5	<0.5	<0.5	<0.5	120	<5	<5	<0.5	<0.5	9**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	23.0	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1	<1	<1	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	18.0	<1.5	<1.5	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5

MONITORING WELL MW-7

Date Sampled	7/8/87	9/14/87	11/20/87	1/15/88	5/10/88	8/7/88	7/19/89	1/30/89	4/21/89	7/17/89	10/30/89	1/30/90	4/30/90	7/11/90	10/18/90	1/24/91	4/23/91	7/18/91	10/23/91
Type of ananlyse	601/602	601/602	601/602	601/602	601/602	601/602	601/602	624/625	624/625	624/625	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602	601/602
COMPOUNDS*	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	na	na	na	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	1.8	0.8	0.5	0.8	0.8	0.6	0.5	<5	<5	<5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	1	4	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	8.1	1.9	2.2	4.7	3.6	2.2	1.6	<5	6.9	<5	0.5	5.2	7	3	2	2	6	21	1.8
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	3.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	na	na	na	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	6**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	31	0.9
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Trichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<1	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	na	na	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	na	<0.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	1.9	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<1.0	<1	<1	<1	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	1.8	<1.5	<1.5	<2.0	<2.0	<2.0	<2.0	<5	<5	<5	<2.0	<2.0	<2.0	<2	<2	<0.5	<0.5	<0.5	<0.5

MONITORING WELL MW-21

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	Split of 1/22/92	Drinking Water MCL
Trichloroethene (TCE)	90	84	59	75	120	130	180	5
1,1-Dichloroethene (DCE)	<6.5	1	<3	<1.0	<2.5	<2.5	<2.5	6
1,1,1-Trichloroethane (TCA)	<4.3	2	<3	<1.0	<2.5	<2.5	<2.5	200
Chloroform	<4.5	2	<3	<1.0	<2.5	<2.5	<2.5	100
cis-1,2-Dichloroethene	na	<0.5	<3	<1.0	2.5	<2.5	<2.5	0.2
Metals (µg/l)								**Lowest Regulatory Standard or Requirement**
Antimony	50	<50	142	<50	<50	<50	<50	146 a
Arsenic	<0.010	<5.0	64.3	<5.0	<5.0	8.5	8.0	50 b
Barium	30	23.3	1270	16.2	20	350	230	1000 b
Beryllium	<0.002	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.006	<5.0	6.9	<5.0	<5.0	<5.0	<5.0	10 b
Chromium	<0.010	<10	796	<10	<10	150	78	50 b
Cobalt	<0.016	<10	72.4	<10	<10	17	15	none
Copper	<0.005	<10	49.2	<10	15	12	15	1000 c
Lead	<0.045	<1.0	28.8	2.3	<1.0	8.6	5.3	50 b
Mercury	na	<0.2	1.4	<0.2	<0.2	<0.2	<0.2	2 b
Molybdenum	<0.020	<10	72.2	36.7	22	35	27	none
Nickel	<0.021	30.9	1120	31.4	22	250	180	13.4 a
Selenuim	<0.005	88.2	104	54.6	47	51	48	10 b
Silver	<0.005	<10	<10	<10	<10	<10	<10	100 c
Thallium	<0.051	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.011	<10	300	<10	<10	62	47	none
Zinc	<0.006	<10	387	<10	12	110	95	5000 c
Total Dissolved Solids (mg/l)	9,900	na	na	na	na	6,700	6,200	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
▒▒▒ = indicates detectable quantity

MONITORING WELL MW-22

Organics (µg/l) **	10/16/90	1/24/91	Split of 1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	Drinking Water MCL
Trichloroethene (TCE)	830	760	850	730	850	810	930	5
1,1-Dichloroethene (DCE)	1000	180	150	<50	240	<10	240	6
Freon* 113	na	600	500	1200	1300	1200	1000	1200(proposed)
cis-1,2-Dichloroethene	na	<25	<25	<50	<13	200	<10	0.2
Metals (µg/l)								**Lowest Regulatory Standard or Requirement**
Antimony	<0.06	<50	<50	71.5	<50	<50	<50	146 a
Arsenic	<0.005	<5.0	<5.0	44.9	<5.0	<5.0	6.6	50 b
Barium	30	24.0	23.1	1230	23.6	24	1400	1000 b
Beryllium	<0.01	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.005	<5.0	<5.0	<5.0	<5.0	<5.0	6.1	10 b
Chromium	<0.01	<10	<10	683	<10	<10	750	50 b
Chromium Hex	na	11.0	11.0	na	na	na	na	50 b
Cobalt	<0.01	<10	<10	84.4	<10	<10	77	none
Copper	<0.01	<10	<10	49.1	<10	<10	66	1000 c
Lead	<0.1	<1.0	<1.0	30.8	<1.0	1.4	17	50 b
Mercury	na	<0.2	<0.2	1.1	<0.2	<0.2	0.26	2 b
Molybdenum	20	<10	<10	55.2	16.3	<20	55	none
Nickel	<0.02	<20	24.4	973	<20	<20	1100	13.4 a
Selenium	29	16.1	18.2	38.6	45.8	36	37	10 b
Silver	<0.01	<10	<10	<10	<10	<10	<10	100 c
Thallium	0.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.01	<10	<10	252	<10	<10	270	none
Zinc	<0.01	<10	<10	370	12.7	14	440	5000 c
Total Dissolved Solids (mg/l)	5,300	na	na	na	na	na	5,100	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= indicates detectable quantity

MONITORING WELL MW-23

Organics (µg/l) **	10/16/90	1/24/91	4/24/91	Split of 4/24/91	7/19/91	10/24/91	1/22/92	Drinking Water MCL
1,1-Dichloroethene (DCE)	<5	6	10	12	7	4.4	6.1	6
1,1,1-Trichloroethane (TCA)	7	5	10	11	8	2.4	4.9	200
1,1-Dichloroethane (DCA)	<5	3	6	7	5	2.5	4.3	5(proposed)
Freon* 113	1200	<0.5	<0.5	<0.5	<0.5	0.90	<0.50	1200(proposed)
trans-1,2-Dichloroethene	5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.50	0.2
Metals (µg/l)								**Lowest Regulatory Standard or Requirement**
Antimony	<0.06	<50	127	118	58.2	<50	<50	146 a
Arsenic	<0.005	<5.0	49.5	37.4	<5.0	<5.0	22	50 b
Barium	30	11.0	2350	1720	18.0	18	1100	1000 b
Beryllium	<0.01	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.005	<5.0	8.0	6.6	<5.0	<5.0	<5.0	10 b
Chromium	<0.01	<10	979	718	<10	<10	410	50 b
Cobalt	<0.01	<10	93.6	69.1	<10	<10	38	none
Copper	<0.01	<10	111	78.5	<10	11	51	1000 c
Lead	<0.1	<1.0	47.5	33.3	<1.0	1.5	17	50 b
Mercury	na	<0.2	7.5	4.7	<0.2	<0.20	2.8	2 b
Molybdenum	30	<10	70.1	56.4	35.7	21	42	none
Nickel	100	76.6	1250	899	106	57	610	13.4 a
Selenium	15	14.6	8.5	10.6	16.3	24	15	10 b
Silver	<0.01	<10	<10	<10	<10	<10	<10	100 c
Thallium	900	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.01	<10	392	300	<10	<10	180	none
Zinc	<0.01	<10	560	384	14.9	23	280	5000 c
Total Dissolved Solids (mg/l)	9,700	na	na	na	na	na	8,600	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= Indicates detectable quantity

MONITORING WELL MW-24

	Monitoring Well MW-24						
Organics (µg/l) **	**11/1/90**	**1/24/91**	**4/24/91**	**7/19/91**	**10/24/91**	**1/22/92**	**Drinking Water MCL**
Trichloroethene (TCE)	<3.5	4	2	3	3.8	2.0	5
1,1-Dichloroethene (DCE)	<6.5	<0.5	<0.5	<0.5	0.50	<0.50	6
1,1,1-Trichloroethane (TCA)	<4.3	2	<0.5	<0.5	<0.50	0.50	200
1,1-Dichloroethane (DCA)	<4.4	<0.5	<0.5	<0.5	0.50	<0.50	5(proposed)
Freon* 113	na	<0.5	<0.5	<0.5	1.0	<0.50	1200(proposed)
cis-1,2-Dichloroethene	na	8	1	2	4.9	1.6	0.2
trans-1,2-Dichloroethene	<3.7	1	<0.5	<0.5	<0.50	<0.50	0.2
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.50	<0.50	100
Metals (µg/l)							**Lowest Regulatory Standard or Requirement**
Antimony	80	<50	<50	<50	<50	84	146 a
Arsenic	<0.005	<5.0	18.3	<5.0	<5.0	22	50 b
Barium	20	13.9	821	12.8	14	1400	1000 b
Beryllium	<0.01	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.005	<5.0	<5.0	<5.0	<5.0	6.2	10 b
Chromium	<0.01	<10	335	<10	<10	1300	50 b
Cobalt	<0.01	<10	31.6	<10	<10	120	none
Copper	<0.01	<10	26.1	<10	<10	210	1000 c
Lead	<0.1	<1.0	14.1	<1.0	<1.0	31	50 b
Mercury	<0.0002	<0.2	1.1	<0.2	<0.20	3.2	2 b
Molybdenum	40	<10	54.8	45.7	28	100	none
Nickel	110	61.5	468	86.7	76	2000	13.4 a
Selenuim	12	17.00	23.9	21.7	17	11	10 b
Silver	<0.01	<10	<10	<10	<10	<10	100 c
Thallium	210	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.01	<10	140	<10	<10	450	none
Zinc	20	<10	157	<10	12	750	5000 c
Total Dissolved Solids (mg/l)	11,000	na	na	na	na	5,100	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
▒▒▒ = Indicates detectable quantity

MONITORING WELL MW-25

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	Split of 7/19/91	10/24/91	1/22/92	Drinking Water MCL
Trichloroethene (TCE)	<3.5	<0.5	<0.5	1	0.8	1.4	0.60	5
1,1-Dichloroethene (DCE)	11	34	17	25	26	40	25	6
1,1-Dichloroethane (DCA)	11	33	31	55	53	68	46	5(proposed)
Methylene Chloride	<10	<0.5	<0.5	0.5	<0.5	<1.0	<0.50	none
cis-1,2-Dichloroethene	na	2	2	8	8	10	4.6	0.2
Trichlorofluoromethane	na	<0.5	<0.5	<0.5	2	<1.0	2.6	100
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.5	<1.0	<0.50	100
1,2-Dichloroethane	<3.9	<0.5	<0.5	0.5	0.5	<1.0	<0.50	0.2
Metals (µg/l)								**Lowest Regulatory Standard or Requirement**
Antimony	44	<50	<50	<50	<50	<50	<50	146 a
Arsenic	<0.010	<5.0	8.9	<5.0	<5.0	<5.0	11	50 b
Barium	35	23.3	1130	20.5	22.1	23	1900	1000 b
Beryllium	<0.002	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.006	<5.0	<5.0	<5.0	<5.0	<5.0	23	10 b
Chromium	<0.010	<10	151	<10	<10	<10	270	50 b
Cobalt	<0.016	<10	17.7	<10	<10	<10	37	none
Copper	<0.005	<10	<10	11.7	<10	<10	75	1000 c
Lead	<0.045	<1.0	11.9	1.9	<1.0	<1.0	9.2	50 b
Mercury	na	<0.2	0.49	<0.2	<0.2	<0.20	0.93	2 b
Molybdenum	<0.020	11.9	23.9	27.6	30.7	<20	28	none
Nickel	33	24.2	204	23.2	28.0	<20	400	13.4 a
Selenuim	15	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Silver	<0.005	<10	<10	<10	<10	<10	<10	100 c
Thallium	<0.051	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.011	<10	84.2	<10	<10	<10	110	none
Zinc	<0.006	<10	85.6	16.2	<10	15	220	5000 c
Total Dissolved Solids (mg/l)	3,900	na	na	na	na	na	3,300	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= indicates detectable quantity

MONITORING WELL MW-26

Organics (µg/l) **	11/1/90	1/24/91	4/24/91	7/19/91	10/24/91	Split of 10/24/91	1/22/92	Drinking Water MCL
Trichloroethene (TCE)	<3.5	<0.5	1	<0.5	<0.50	<0.50	<0.50	5
1,1,1-Trichloroethane (TCA)	<4.3	1	<0.5	<0.5	<0.50	<0.50	<0.50	200
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.50	<0.50	<0.50	100
Metals (µg/l)								**Lowest Regulatory Standard or Requirement**
Antimony	<0.06	<50	<50	<50	<50	<50	<50	146 a
Arsenic	<0.005	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	50 b
Barium	30	19.6	169	17.5	18	18	440	1000 b
Beryllium	<0.01	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.005	<5.0	<5.0	5.5	<5.0	<5.0	<5.0	10 b
Chromium	<0.01	<10	28.4	<10	<10	<10	78	50 b
Cobalt	<0.01	<10	<10	<10	<10	<10	<10	none
Copper	<0.01	<10	<10	<10	<10	<10	16	1000 c
Lead	<0.1	<1.0	3.3	<1.0	<1.0	1.1	3.3	50 b
Mercury	<0.0002	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	2 b
Molybdenum	<0.02	<10	13.5	18.2	<20	<20	<20	none
Nickel	30	<20	42.2	<20	<20	<20	100	13.4 a
Selenuim	10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Silver	<0.01	<10	<10	<10	<10	<10	<10	100 c
Thallium	<0.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.01	<10	16.2	<10	<10	<10	38	none
Zinc	<0.01	<10	16.0	<10	19	11	67	5000 c
Total Dissolved Solids (mg/l)	3,400	na	na	na	na	na	9,000	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= Indicates detectable quantity

MONITORING WELL MW-27

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	Drinking Water MCL
Trichloroethene (TCE)	<3.5	<0.5	<0.5	<0.5	<0.50	1.3	5
1,1,1-Trichloroethane (TCA)	<4.3	1	<0.5	<0.5	<0.50	<0.50	200
Freon* 113	na	<0.5	<0.5	<0.5	0.80	<0.50	1200(proposed)
Benzoic Acid	12	na	na	na	na	na	none
Metals (µg/l)							**Lowest Regulatory Standard or Requirement**
Antimony	<0.037	<50	<50	<50	<50	<50	146 a
Arsenic	<0.010	<5.0	6.7	<5.0	<5.0	5.5	50 b
Barium	100	81.7	656	80.0	76	600	1000 b
Beryllium	<0.002	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.005	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Chromium	36	<10	197	<10	<10	150	50 b
Cobalt	<0.016	<10	29.7	<10	<10	33	none
Copper	<0.005	<10	58.4	<10	<10	73	1000 c
Lead	<0.045	1.4	16.6	2.0	1.4	15	50 b
Mercury	na	<0.2	<0.2	<0.2	<0.20	<0.20	2 b
Molybdenum	<0.020	<10	14.8	12.8	<20	<20	none
Nickel	<0.021	<20	295	<20	<20	300	13.4 a
Selenium	<0.005	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Silver	<0.005	<10	<10	<10	<10	<10	100 c
Thallium	<0.051	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.011	<10	146	<10	<10	120	none
Zinc	12	<10	138	<10	10	150	5000 c
Total Dissolved Solids (mg/l)	1,000	na	na	na	na	2,100	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= indicates detectable quantity

MONITORING WELL MW-28

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	Drinking Water MCL
1,1-Dichloroethane (DCA)	<4.4	<0.5	1	<0.5	<0.50	0.90	5(proposed)
Metals (µg/l)							**Lowest Regulatory Standard or Requirement**
Antimony	<0.037	<5.0	<50	<50	<50	<50	146 a
Arsenic	<0.010	<5.0	11.4	<5.0	18	<5.0	50 b
Barium	22	14.7	128	12.1	14	39	1000 b
Beryllium	<0.002	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.005	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Chromium	<0.010	<10	413	<10	<10	99	50 b
Cobalt	<0.016	<10	27.5	<10	<10	<10	none
Copper	<0.005	<10	<10	10.9	<10	<10	1000 c
Lead	<0.045	<1.0	8.4	<1.0	1.1	<2.0	50 b
Mercury	na	<0.2	0.49	<0.2	<0.20	<0.20	2 b
Molybdenum	<0.020	<10	21.6	<10	<20	<20	none
Nickel	<0.021	49.9	444	20.7	<20	130	13.4 a
Selenuim	<0.005	5.0	<5.0	<5.0	<5.0	<5.0	10 b
Silver	<0.005	<10	<10	<10	<10	<10	100 c
Thallium	<0.051	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.011	<10	103	<10	<10	30	none
Zinc	<0.006	<10	91.2	<10	11	44	5000 c
Total Dissolved Solids (mg/l)	6,500	na	na	na	na	6,600	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= Indicates detectable quantity

MONITORING WELL MW-29

Organics (µg/l) **	11/21/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	Drinking Water MCL
Trichloroethene (TCE)	<0.3	<0.5	<0.5	<0.5	<0.50	0.80	5
1,1,1-Trichloroethane (TCA)	<0.5	1	1	1	0.50	1.2	200
1,1-Dichloroethane (DCA)	1.3	1	1	<0.5	1.4	1.2	5(proposed)
Freon* 113	na	<0.5	<0.5	<0.5	0.50	<0.50	1200(proposed)
Methylene Chloride	2.6	<0.5	<0.5	<0.5	<0.50	<0.50	none
Dichlorodifluoromethane	na	<0.5	1	<0.5	<0.50	<0.50	100
Metals (µg/l)	**10/25/90**						**Lowest Regulatory Standard or Requirement**
Antimony	<0.037	<50	<50	<50	<50	<50	146 a
Arsenic	3	<5.0	9.1	<5.0	<5.0	7.6	50 b
Barium	15	13.2	56.8	13.0	12	29	1000 b
Beryllium	<0.002	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.006	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Chromium	<0.010	<10	180	<10	<10	58	50 b
Cobalt	<0.016	<10	14.7	<10	<10	<10	none
Copper	<0.005	<10	<10	31.7	<10	<10	1000 c
Lead	<0.045	<1.0	12.3	<1.0	1.0	<2.0	50 b
Mercury	na	<0.2	<0.2	<0.2	<0.20	<0.20	2 b
Molybdenum	<0.020	<10	10.3	15.7	<20	<20	none
Nickel	<0.021	<20	237	42.2	<20	92	13.4 a
Selenuim	<0.005	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Silver	<0.005	<10	<10	<10	<10	<10	100 c
Thallium	<0.051	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.011	<10	56.5	<10	<10	22	none
Zinc	<0.006	<10	63.5	<10	10	34	5000 c
Total Dissolved Solids (mg/l)	1,100	na	na	na	na	1,100	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= Indicates detectable quantity

MONITORING WELL MW-30

Organics (µg/l) **	10/25/90	1/24/91	4/24/91	7/19/91	10/24/91	1/22/92	Drinking Water MCL
1,1,1-Trichloroethane (TCA)	<4.3	1	<0.5	<0.5	<0.50	<0.50	200
Freon* 113	na	3	5	9	6.9	10	1200(proposed)
Ethane	8	na	na	na	na	na	none
Trichlorofluoromethane	na	<0.5	<0.5	4	4.6	9.2	100
Metals (µg/l)							**Lowest Regulatory Standard or Requirement**
Antimony	<0.037	<50	<50	<50	<50	<50	146 a
Arsenic	<0.010	5.2	14.5	<5.0	<5.0	<5.0	50 b
Barium	33	25.3	2750	19.8	20	500	1000 b
Beryllium	<0.002	<5.0	<5.0	<5.0	<5.0	<5.0	none
Cadmium	<0.006	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Chromium	<0.010	<10	540	<10	<10	110	50 b
Cobalt	<0.016	<10	43.6	<10	<10	<10	none
Copper	<0.005	<10	<10	<10	<10	<10	1000 c
Lead	<0.045	<1.0	19.5	2.8	<1.0	3.7	50 b
Mercury	na	<0.2	<0.2	<0.2	<0.20	<0.20	2 b
Molybdenum	<0.020	<10	12.9	10.4	<20	<20	none
Nickel	<0.021	<20	715	<20	<20	160	13.4 a
Selenuim	<0.005	<5.0	<5.0	<5.0	<5.0	<5.0	10 b
Silver	<0.005	<10	<10	<10	<10	<10	100 c
Thallium	<0.051	<5.0	<5.0	<5.0	<5.0	<5.0	13 a
Vanadium	<0.011	<10	179	<10	<10	44	none
Zinc	<0.006	<10	174	<10	<10	54	5000 c
Total Dissolved Solids (mg/l)	1,100	na	na	na	na	690	not applicable

**For clarity, only compounds with detected values shown for organics
na = not analyzed for that paramater
MCL = Maximum Contaminant Level
* 1,1,2-Trichloro-1,2,2-trifluoroethane
a = National Ambiant Water Quality Standard
b = Primary Maximus Contaminant Level (MCL)
c = Secondary Maximum Contaminant Level (MCL)
= indicates detectable quantity