SLAC-R-535

Annual Site Environmental Report

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Environment, Safety, and Health Division

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STANFORD LINEAR ACCELERATOR CENTER

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Executive Summary

This report provides information about environmental programs and compliance with environmental regulations in calendar year 1998 (CY98) at the Stanford Linear Accelerator Center (SLAC). The most significant information in this report is summarized in the following sections.

Environmental Compliance

Section 2 contains the complete Environmental Compliance information.

Assessments

In CY98, assessments were performed by a consultant firm, Dames and Moore. For CY98, the Dames and Moore assessment group (comprised of radiological and environmental experts) was on-site for one week. The team found no hazard level 1 findings (the most serious category), three hazard level 2 items, and various items of lower hazard levels.

The three hazard level 2 items (a corroded drum, a drum filled with rainwater, and a 5-gallon container of grease that was corroded and open) were all remedied immediately. The items of lesser hazard level are being tracked to completion using the Corrective Action Management System used by the Program Planning Office.

Program Summary

In CY98, SLAC operated under the Work Smart Standards (WSS) Set, which are incorporated in SLAC's Management and Operating contract. The WSS Set includes all applicable statutory and regulatory requirements for public and worker safety and environmental protection. The WSS Set also includes a number of industry standards that were found to be necessary to control specific hazards present at SLAC.

Releases

During CY98, notification to the Regional Water Quality Control Board was required twice. Each notification was due to large volumes of ultra-pure water being released into a storm-drain. In both cases, the water was completely contained and later pumped out onto softscape. No wastewater discharge permit violations occurred during CY98.

Safety and Environmental Discussion

SLAC held its third annual Safety and Environmental (S&E) Discussion on February 27, 1998. The discussions provided employees the opportunity to raise safety and environmental concerns. Employee issues were entered into a database and tracked. Of the 172 issues raised, three were environmental. As of December 31, 1998, the three environmental concerns from the CY98 S&E Discussions had been addressed.

Environmental Non-Radiological Program

Section 3 contains the complete Environmental Non-Radiological information.

Air Quality

A total of 18 air emission sources were included in the SLAC Permit to Operate from the Bay Area Air Quality Management District (BAAQMD) at year-end. One permit application for the BaBar particle detector was pending at year-end.

BAAQMD conducted an annual inspection of SLAC on April 29, 1998. No instances of non-compliance were noted. Additional permit applications are expected to be filed during CY99, and a baseline air emissions inventory is expected to be initiated.

On March 3, 1998, SLAC filed an initial registration form with the San Mateo County Department of Health Services (the County) for the California Accidental Release Prevention Program (CalARP). The registration was subsequently amended on May 15, 1998. SLAC is expecting that the County will initiate a dialogue in either CY99 or CY00 regarding the CalARP requirements that will be applied to SLAC.

Environmental Restoration

As a part of the SLAC Environmental Restoration Program, the Environmental Protection and Restoration (EPR) Department continued work on site characterization and evaluation of remedial alternatives at four sites with detected volatile organic compounds (VOCS) in groundwater. In addition, EPR continued active participation in various public activities throughout the year.

Hazardous Waste

The San Mateo County Division of Environmental Health conducted a Hazardous Waste Generator Inspection from March through September 1998. Findings of non-compliance were found site wide relating to house keeping, container management, and aisle space in accumulation areas. The findings reflect what is not working at specific line areas. The report states "The regularly generated waste streams are generally in compliance with regulations."

SLAC complied with all waste management requirements for the disposal of hazardous waste in CY98 as required under federal, state, and local regulations. During CY98, all hazardous waste for off-site disposal was successfully shipped from SLAC within 90 days of generation.

Polychlorinated Biphenyls

SLAC has some equipment filled with oil or other dielectric fluids which contain Polychlorinated Biphenyls (PCBs). In CY98, SLAC continued to reduce its inventory of PCBs by replacing or disposing of nearly half of the remaining PCB-containing transformers on site, as well as other PCB-containing equipment. SLAC will continue to remove, or retrofill and reclassify, the remaining 14 PCB-contaminated transformers over the next few years.

Stormwater and Industrial Wastewater

SLAC updated the Stormwater Pollution Prevention Plan in accordance with the new permit, which became effective on July 1, 1997. There were no sanitary sewer permit violations in CY98. Twelve illicit stormwater connections were eliminated in CY98. SLAC completed four erosion control projects in CY98. Monitoring continued for both Stormwater and Industrial Wastewater programs. The results were tabulated in annual or semi-annual reports. All monitoring data indicated continued compliance with corresponding permit conditions.

Environmental Radiological Program

Section 4 contains the complete Environmental Radiological information.

Regulatory Limits

SLAC monitors potential radiological releases to the environment through wastewater, air emissions, and direct radiation from accelerator operations. SLAC did not exceed regulatory limits for radioactivity released to the environment in CY98. In addition, there were no known instances of noncompliance for radionuclide air emissions in CY98. Five new wells were installed for surveillance of potential tritium in groundwater in CY98.

Radioactive Waste

A reorganization of the Environment, Safety, and Health Division shifted the management of radioactive waste from the Waste Management Department to the Operational Health Physics Department. All wastes generated were disposed of or handled according to applicable regulations. SLAC continued to explore options to recycle some mildly activated metals and to improve waste minimization. Projects undertaken included clearing the site of wastes stored from previous years and updating operating procedures and manuals.

Groundwater Monitoring Program

The groundwater monitoring program at SLAC is managed through EPR. Groundwater samples were collected from monitoring wells for surveillance purposes, as well as to investigate the extent of VOCs in groundwater. A total of twelve new wells were installed in CY98 to support the investigative efforts. Five of these wells were for the environmental radiological program, and seven of the wells were for the environmental restoration program.

Section 5 contains more groundwater information.

Additional Information

A reader's survey has been provided at the end of this document. Additional information about SLAC is available at:

`http://www.slac.stanford.edu/`

1 Site Overview

1.1 General

The Stanford Linear Accelerator Center (SLAC) is a national facility operated by Stanford University under contract with the Department of Energy (DOE). SLAC is located on the San Francisco Peninsula, about halfway between San Francisco and San Jose, California (see Figure 1-1).

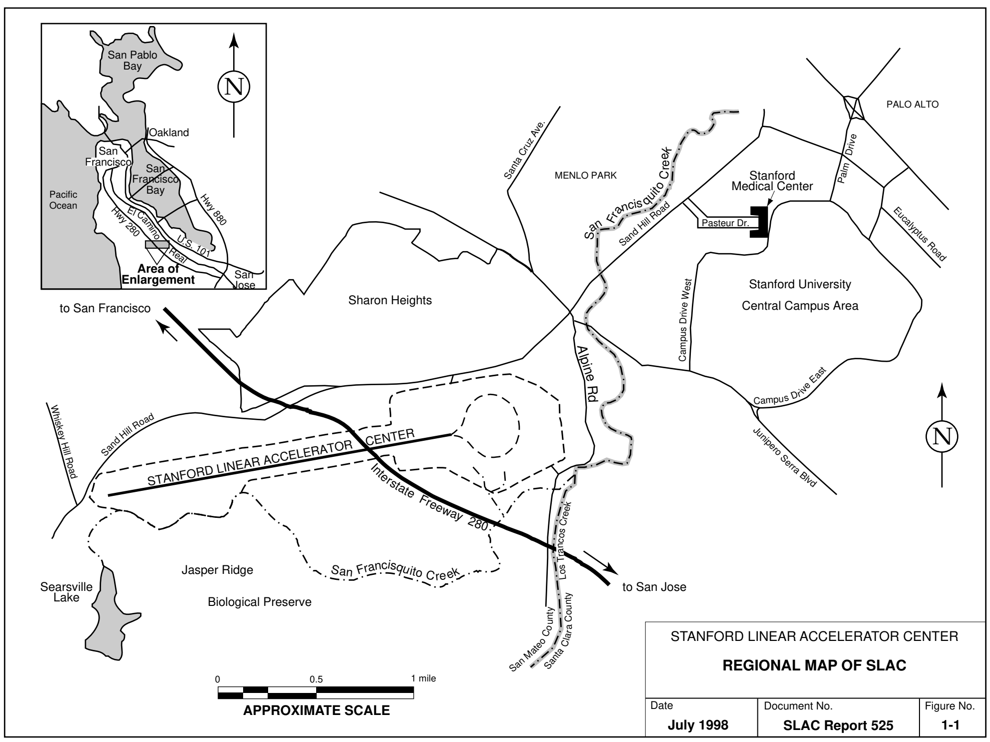

Figure 1-1 SLAC Site Location

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. 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 1-2 on page 2).

The SLAC site occupies 170 hectares of land owned by Stanford University. The property was leased in 1962 for purposes of research in the basic properties of matter. The original lease to the Atomic Energy Commission (AEC), now DOE, was for fifty years. The lease was given for the purpose of researching the basic properties of matter. The land is part of

Stanford's "academic reserve," and is located west of the University and the City of Palo Alto in an unincorporated portion of San Mateo County.

The site is bordered on the north by Sand Hill Road and on the south by San Francisquito Creek. The laboratory is located on a parcel roughly 300 m-wide and 3.2 kilometers (km) long, running in an east-west direction. The parcel widens to about 910 m at the target (east) end to allow space for buildings and experimental facilities.

The SLAC population currently numbers about 1,350 people, of which 150 are Ph.D. physicists. At any given time there are between 900 and 1,000 users, or visiting scientists. Approximately 800 staff members are professional, composed of physicists, engineers, programmers, and other scientific-related personnel. The balance of the staff is composed of support personnel including technicians, crafts personnel, laboratory assistants, and administrative associates.

Figure 1-2 Aerial View of SLAC Site

1.2 Description of Program

The SLAC program centers around experimental and theoretical research in elementary particle physics using accelerated electron beams and a broad program of research in atomic and solid-state physics, chemistry, and biology using synchrotron radiation from accelerated electron beams. There is also an active program in the development of accelerators, detectors, and new sources and instrumentation for synchrotron radiation research. Scientists from all parts of the United States and from throughout the world participate in the experimental programs at SLAC.

The main instrument of research is the 3.2-km linear accelerator (linac) that generates high-intensity beams of electrons and positrons up to 50 GeV, which are among the highest-energy electron and positron beams available in the world. The linac is also used for injecting electrons and positrons into colliding-beam storage rings for particle physics research.

The Positron-Electron Project (PEP) storage ring is about 800 meters in diameter. While the PEP program was completed in 1990, the storage ring has since been upgraded to serve as an Asymmetric *B* Factory (known as PEP-II) that will study the *B* meson. Completed in 1998, PEP-II uses much of the existing PEP equipment and infrastructure and will complete final commissioning with the BaBar detector in 1999.

A smaller storage ring, the Stanford Positron-Electron Asymmetric Ring (SPEAR), contains a seperate, shorter linac and a booster ring for injecting accelerated beams of electrons. SPEAR is fully dedicated to synchrotron radiation research. The synchrotron light generated by the SPEAR storage ring is used by the Stanford Synchrotron Radiation Laboratory (SSRL) to perform experiments. SLAC is also host of the Next Linear Collider (NLC) test facilities, including the Final Focus Test Beam (FFTB), and the Next Linear Collider Test Accelerator (NLCTA).

1.3 Local Climate

The climate in the SLAC area is Mediterranean. Winters are cool and moist, and summers are mostly warm 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 which is 4.8 km east of SLAC. 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 in 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 from December through March. Most winter storm periods are from two days to 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 substantial fluctuations in intensity, which can best be 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.

1.4 Site Geology

The SLAC site is underlain by sandstone with some basalt at the far eastern end of the site boundary. In general, the bedrock on which the western half of the SLAC linac rests is the Whiskey Hill Formation (Eocene age), and the bedrock under the eastern half is the Ladera Formation (Miocene age). On top of this bedrock at various places along the accelerator alignment is the Santa Clara Formation (Pleistocene age), where alluvial deposits of sand and gravel are found. At the surface is a soil overburden of non-consolidated earth material averaging from 0.1 to 1.5 m in depth. A more detailed description of the SLAC geology can be found in the *SLAC Hydrogeologic Review Report* (SLAC-I-750-2A15H-002).

1.5 Site Water Usage

SLAC domestic water is furnished via the Menlo Park Municipal Water Department (MPMWD) whose source is the City of San Francisco-operated Hetch Hetchy aqueduct system from reservoirs in the Sierra Nevada. SLAC and the neighboring Sharon Heights development, including the shopping center, receive water service from an independent system (called Zone 3) within the MPMWD.

This separate system taps the Hetch Hetchy aqueduct and pumps water up to a 7,600-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. Since 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.

Drinking water and process water are 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 protected by backflow prevention devices. The backflow prevention devices are maintained by the Facilities Office. There are no drinking-water wells at SLAC. The nearest drinking-water well to SLAC is 1,500 feet from the SLAC border.

Use of water at 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 for CY98 was 651,800 gallons per day. Since half of the water is necessary for machine cooling, the daily consumption of this component of water usage 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 six cooling-water towers with a total cooling capacity of 79 megawatts (MW) to dissipate the heat generated by the linac and other experimental apparatuses.

Power-consuming devices are cooled directly 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 heat is exchanged from the closed system to the domestic water in the towers.

Prior to discharge, the LCW from the closed system is sampled and analyzed for radioactivity. 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. SLAC discharged a total of 20,206,162 gallons of wastewater to the sanitary sewer system in 1998, an average of 55,359 gallons per day.

1.6 Land Use

San Mateo County has the ultimate planning responsibility with respect to University lands that 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 is made to all applicable federal, state, and local regulations, including chemical and sanitary discharges that might (directly or indirectly) adversely affect environmental quality.

The Board of Trustees of Stanford University is responsible for 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 policies in the furtherance of the University's academic mission. Board policies are designed 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 activities of the University. SLAC falls into the former category.

The purpose of the Stanford land endowment is to provide adequate land for facilities and space for 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.

1.7 Demographics

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

Table 1-1 Demographic Data

Geographic Area	Population (persons)	Pop. Density (per sq mile)	Housing (units)	Land Area (sq mile)
Atherton town	7,163	1,463.32	2,518	4.895
West Menlo Park	3,959	7,086.19	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	6,569.14	4,770	2.755
Total	38,448	NA	12,556	29.105

A population estimate within 80 km of SLAC was determined as part of the required input to the CAP88-PC computer code used to demonstrate compliance with the Clean Air Act (CAA). Population data from the 1990 census of San Mateo County and Santa Clara County were used in this study. The area was divided into 13 concentric circles and 16 compass sectors. The population distribution is summarized in Table 1-2 .

Table 1-2 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	8.0 km	10.0 km	30.0 km	40.0 km	60.0 km	80.0 km	Total
0	0	1,214	2,825	14,106	31,679	42,832	131, 629	114,377	665,574	1,232,353	1,716,571	964,283	4,917,443

2 Environmental Compliance

2.1 General

This section of the *1998 Site Environmental Report* provides an overview of the Environment, Safety, and Health (ES&H) Division's organization and its responsibilities for environmental compliance. The ES&H program is designed to ensure that the Stanford Linear Accelerator Center (SLAC) operates in a safe, environmentally responsible manner, and complies with all the applicable ES&H laws, regulations, and standards. Further information about the ES&H Division is available at:

`http://www.slac.stanford.edu/esh/esh.html`

2.2 Organizational Overview

The ES&H Division consists of five departments, a division office, and a Program Planning Office. Their shared goal is to help ensure that SLAC operates in compliance with federal, state, and local regulations, as well as Department of Energy (DOE) Orders related to environment, safety, and health. The five departments are:

- Environmental Protection and Restoration (EPR)

  The EPR Department oversees the majority of the SLAC environmental programs, including environmental restoration, air quality, storm water and industrial wastewater, polychlorinated biphenyls, groundwater, and National Environmental Policy Act (NEPA) reviews.

- Operational Health Physics (OHP)

  The OHP Department oversees radiological monitoring and dosimetry at SLAC.

- Radiation Physics (RP)

  The RP Department conducts beam checkouts of new experiments to ensure shielding adequacy for the protection of the workers and members of the general public.

- Safety, Health, and Assurance (SHA)

  The SHA Department oversees quality assurance for SLAC's environmental activities.

- Waste Management (WM)

  The WM Department develops and implements waste minimization and pollution prevention plans and coordinates the disposal of regulated waste.

2.3 Compliance Program Summary

2.3.1 WSS Summary

The laws and regulations that specify the environment, safety and health requirements for the laboratory have been identified and are contained in the SLAC Work Smart Standards (WSS) Set. This set of standards was incorporated into the SLAC Management and Operating contract.

The WSS Set requirements are based on potential hazards that have been identified by the people who work at SLAC. It is not necessary for every worker to know the details of these laws and regulations; staff in the ES&H Division are available to assist, upon request. However, it ***is*** necessary that workers know about the hazards associated with their jobs and that managers and supervisors know how to get help with understanding the parts of the SLAC WSS Set that apply to them.

2.3.2 Safety Management System Summary

The DOE requires its contractors, including Stanford University for SLAC, to manage and perform work in accordance with a documented Safety Management System (SMS). This directive comes from DOE P 450.4, *Safety Management System Policy*, which commits the DOE to institutionalizing an integrated SMS throughout the DOE complex. The requirement is implemented through the incorporation of a contract clause from the DOE Acquisition Regulations (DEAR) 970.5204-2, "Integration of Environment Safety, and Health Into Planning and Execution." This clause was incorporated into the contract between DOE and Stanford University for operation of SLAC on February 5, 1998.

The contract between Stanford University and the DOE for the operation of SLAC states, in part:

> The Contractor [SLAC] will perform work safely in a manner that ensures adequate protection for employees, the public, and the environment and shall be accountable for the safe performance of work. The Contractor shall exercise a degree of care commensurate with the work and the associated hazards. The Contractor shall ensure that management of environment, safety, and health (ES&H) functions and activities becomes an integral but visible part of the Contractor's work planning and execution processes.

SLAC's commitment to integrating ES&H considerations into its mission preceded the establishment of the DOE SMS requirements. This is evident in the strong ES&H Program developed by SLAC long before the SMS clause was incorporated into the operating contract.

The *SLAC Safety Management System* document, (SLAC-I-720-0A008-001), describes the SLAC SMS program and how SLAC integrates safety and environmental protection into management and work practices at all levels so that its mission is accomplished while protecting the worker, the public, and the environment.

2.3.3 Environmental Permits and Notifications Summary

The general permits held by SLAC in calendar year 1998 (CY98) are shown in Table 2-1.

Table 2-1 General Permits and Notifications

Quantity	Name
18	Permit-to-Operate permits
3	Wastewater discharge permits
2	Permit-By-Rule (PBR) permits
1	Conditional Authorization permit
1	Industrial Activities Storm Water General permit
1	Hazardous Waste Generator Environmental Protection Agency (EPA) ID No. CA8890016126

The specific permits held by SLAC in CY98 are shown in Table 2-2.

Table 2-2 Specific Permits

Permit From	Permit Type	Permit Number	Expiration Date
West Bay Sanitary District and South Bayside System Authority	Wastewater Discharge	Permit No. WB970401-F	March 31, 2002
	Wastewater Discharge	Permit No. WB970401-P	March 31, 2002
	Wastewater Discharge	Permit No. WB970401-HX	March 31, 2002
Bay Area Air Quality Management District (BAAQMD)	Plant No. 556, 18* listed sources		July 1, 1999
Department of Toxic Substances Control	Tiered Permit Fixed Treatment Units	Unit 1—Building 038, Treatment Facility (PBR)	March 30, 2000
		Unit 2—Building 038, Sludge Dryer (PBR)	March 30, 2000
		Unit 3—Building 460, Treatment Facility (Conditional Authorization)	March 30, 2000
San Francisco Bay Regional Water Quality Control Board (RWQCB)	Industrial Activities Storm Water General Permit	Permit No. CAS000001	July 1, 2002

* As of 12-31-98

2.3.4 Assessments, Inspections, and Quality Assurance Summaries

2.3.4.1 Assessments

Quarterly conduct-of-operations audits of the Environmental Radiological Program were performed by DOE. The California Department of Health Services, Radiation Health Branch conducts an ongoing site boundary radiation monitoring program. There were four thermoluminescent dosimeter change-outs in 1998.

2.3.4.2 Self-Assessment Program

An annual system of site-wide Safety and Environmental (S&E) Discussions is used at SLAC to identify and correct ES&H deficiencies. This program provides the opportunity for all laboratory employees, in small discussion groups, to reflect on the most important ES&H issues and suggest solutions. Divisions may take action on this information directly, or they may develop site-wide corrective action plans. No serious environmental issues were identified in CY98.

In 1998, an environmental specialist was added to the steering committee that supports the process. This addition strengthened the entire S&E program. Plans and materials have been completed this year to provide more detail and direction in the 1999 S&E for environmental concerns.

In 1999, laboratory staff will be provided information (through memos, briefings, internal publications, and a S&E web site) to ensure they are aware of detailed suggestions for environmental issues in their work areas. The 1999 program includes a request for S&E groups to provide at least one environmental issue for resolution in their work area.

2.3.4.3 Inspections

A summary of the enforcement inspections for CY98 is shown in Table 2-3

Table 2-3 Enforcement Inspections

Inspection Date	Inspection Type	Inspection Agency	Findings/Results
April 29, 1998	Annual Air Inspection	BAAQMD	Satisfactory. For details, see Section 3.2.2
March–September, 1998	Hazardous Waste Generator	San Mateo County	Findings on non-compliance. Corrective actions initiated. For details, see Section 3.5.3

2.3.4.4 Quality Assurance

The SLAC site-wide Quality Assurance (QA) Program has been influenced by the requirements of Department of Energy (DOE) Order 5700.6C. The QA Program is described in the *SLAC Institutional Quality Assurance Program Plan* (SLAC-I-770-0A17M-001). This document was approved by the DOE in May 1993. The plan defines the roles, responsibilities, and authorities for implementation of the ten criteria from DOE Order 414.1, which replaced DOE Order 5700.6C in CY98.

The SHA Department is responsible for:

- Auditing the line QA as well as environment, safety, and health (ES&H) programs.
- Maintaining the *SLAC Institutional Quality Assurance Program Plan*.
- Providing direction for implementation of the ten criteria from DOE Order 5700.6C.

Independent Assessment Program

A major multi-year program of ES&H assessments is currently in place at the laboratory. This assessment is conducted twice a year by the consulting firm of Dames and Moore. The assessment personnel are highly qualified ES&H professionals. The Dames and Moore assessment activities covered the following topics in 1998:

- Hazardous Material Management
- Industrial Wastewater Discharge
- Stormwater Management
- Eyewash Station Assessment
- Radiation Protection Program Assessment
- Radioactive Waste Management Program Assessment

Laboratory Testing

Laboratory performance testing is performed as outlined in the latest revision of the *Environmental Laboratory Performance Program* (SLAC-I-770-2A17C-008). This information is used in conjunction with laboratory and field QA and Quality Control (QC) to evaluate specific data packages.

Radioanalysis Laboratory

In CY98, SLAC participated in two external blind sample quality assessment programs:

- DOE Quality Assessment Program (QAP), run by the Environmental Measurements Laboratory (EML).
- Performance Evaluation Studies Program, operated by the EPA Environmental Monitoring Systems Laboratory - Las Vegas (EMSL-LV).

Participation in the QAP program consisted of analyzing water samples provided by EML for gamma emitting radionuclides and reporting the results to EML. There were two QAP evaluations in CY98, one in March and one in September.

The gamma-emitting radionuclides in the QAP samples that are found at SLAC are: Cobalt-60 (^{60}Co), Magnesium-54 (^{54}Mn), and Cesium-137 (^{137}Cs). SLAC's performance in these evaluations was acceptable.

During CY98, SLAC participated in the "Tritium-in-Water Study" run by EMSL-LV. In this quality assessment, the laboratory being assessed analyzes a blind sample of tritiated water provided by EMSL-LV. The results of the analyses are submitted to EMSL-LV for evaluation.

Reports containing data from the participating laboratories and EMSL-LV's evaluation of that data are published approximately six weeks after each study. These "studies" are performed in March and August. The performance of SLAC in these evaluations was acceptable.

The EPA discontinued the Performance Evaluation Studies Program in November of 1998. In CY99, SLAC will participate in an alternative tritium-in-water external quality assessment program.

Environmental Monitoring

Table 2-4 lists the procedures and policies used to support the QA Program for environmental monitoring activities.

Table 2-4 QA Program Documents

Document #	Title
QC-030-004-00-R0	*Radioactive Water Sampling/Analysis Audit Procedure*
SLAC-I-770-0A19C-001	*Oversight Procedure*
SLAC-I-770-2A19C-004	*Non-Radiological Sampling Audit Procedure*
SLAC-I-770-0A16Z-001	*Establishing Data Quality Objectives*

Environmental Restoration Program

The Environmental Restoration Program uses the *Quality Assurance Project Plan* for the *Remedial Investigation and Feasibility Study* for soil and groundwater contamination investigations. This document has most of the components required of *Quality Assurance Project Plans* according to EPA; Comprehensive Environmental Response, Compensation, and Liability Act; and DOE guidance documents. This includes defining required laboratory and field QA/QC procedures and corrective actions, as well as data validation and reporting.

2.3.5 Environmental Incidents/Releases Summary

Table 2-5 summarizes incidents and releases which exceeded regulatory permit limits or local, state, or federal reporting requirements.

Table 2-5 Environmental Incidents/Releases Summary

Date 1998	Material	Amount	Location	Description	Corrective Action Taken/To Be Taken
6/14	LCW	2,500 gallons	IR-6	Failed line connection.	Repaired connection.
12/16	LCW	70,000 gallons	SSRL	Release of water due to spontaneous pipe failure (aging infrastructure).	Reviewed status with operations.

2.3.5.1 Radiological

There were no reportable quantity releases of radioactive material to the environment in CY98.

During CY98, notification to the RWQCB was required for one release of low conductivity water (LCW). The primary concern in the release of LCW was the potential presence of tritium. However, radiological analysis indicated that the levels present in the water released were barely above background levels and two orders of magnitude below drinking water standards.

2.3.5.2 Non-Radiological

No wastewater discharge permit violations occurred during CY98. Four accidental releases entered the storm drain system. The materials released included untreated sewage, hydraulic oil, and two instances of LCW.

All four releases were determined to represent minimal or negligible risk. However, follow-up investigations into the sewage release indicated the need for corrective actions for the site-wide sanitary sewer system to prevent recurrence. These actions are now being developed for timely implementation.

During CY98, notification to the RWQCB was required twice. Both times LCW was released into a storm-drain. In each instance the water was completely contained and later pumped out onto softscape.

2.3.5.3 Program Compliance Summary

Table 2-6 lists the major statutes, executive orders, and main documents that govern the activities at SLAC. It also indicates the location of the data in this document, along with any pertinent comments.

Table 2-6 Compliance Summary

Major Statute/Executive Order	Governing Document	Status	ASER Location	Comments
Superfund Amendments and Reauthorization Act (SARA)/ EPCRA 42 USC, Section11022 (Tier II)	San Mateo County Ordinance California Health and Safety (CHS), Chapter 6.95; Article 80, Uniform Fire Code	Meets Requirements	Section 3.6.1	The Hazardous Materials Business Plan and Hazardous Material Annual Inventory
Executive Order (EO) #12843/ Emergency Planning and Community Right-to-Know Act (EPCRA)	40CFR372	Meets Requirements	Section 3.6.1	Toxic Release Inventory
Resource Conservation and Recovery Act (RCRA) 40CFR261 and following sections.	Title 22 California Code of Regulations	Corrective Actions Initiated	Section 3.5.1	Hazardous Waste Generator requirements
National Environmental Policy Act (NEPA)	NEPA- 42 USC 4321-4347, (40 CFR parts 1500-1508)	Meets Requirements	Section 3.8.1	
Clean Air Act	Clean Air Act -42 USC 7609 (40 CFR Parts 6,51,93	Meets Requirements	Section 3.2.1– Regulatory Framework	SLAC has both a Rad and non-Rad Air quality protection program.
Clean Water Act- Groundwater	Federal Water Pollution Control Act (Clean Water Act) -33 USC 1344 (40 CFR Section 400 et seq.)	Meets Requirements	Section 3.3.1	New wells were installed in CY98 specifically to evaluate for potential contaminants near SLAC facilities.
Clean Water Act- Surface Water	Stormwater Pollution Prevention Plan (SWPPP)	Meets Requirements	Section 3.2.1– Surface Water	SLAC is in process of eliminating identified illicit connections consisting primarily of infiltrated groundwater into below grade structures. This is a multi-year program.
Clean Water Act- Industrial Wastewater	Permit No. WB970401-F Permit No. WB970401-P Permit No. WB970401-HX	Meets Requirements	Section 3.3.4 – Industrial and Sanitary Wastewater	SLAC was in compliance with all specified permit limits.

Table 2-6 Compliance Summary (continued)

Major Statute/Executive Order	Governing Document	Status	ASER Location	Comments
Safe Drinking Water Act (SDWA)		Meets Requirements	Section 3.3.1	Facilities maintain a backflow prevention program to protect all drinking and process water distribution systems.
Toxic Substances Control Act (TSCA)	40CFR761	Meets Requirements	Section 3.7.1	
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	7 USC Section 136, and following sections	Meets Requirements	Section 3.3.6	SLAC uses licensed subcontractors to apply registered use pesticides. Procedures were developed in CY94 that are incorporated into the subcontracts for landscape maintenance and pest control. SLAC personnel apply general use pesticides only.
Endangered Species Act (ESA) 16 USC, 1531 and following sections	Pre-construction notice, US Army Corps of Engineers	Meets Requirements	Section 3.3.5	California red-legged frog designated as threatened by the federal government.
National Historic Preservation Act (NHPA)	NHPA 16 USC 470f	Meets Requirements	Not Applicable	No eligible NHPA sites at SLAC.
Executive Order 11988, Floodplain Management	Executive Order 11988- Floodplain Management (10 CFR Part 1022	Meets Requirements	Section 3.3.7	According to the Federal Emergency Management Agency (FEMA), a one-percent flood event would not reach the SLAC facility, but would be confined to San Francisquito Creek.
Executive Order 11990, Protection of Wetlands	Executive Order 11990- Protection of wetlands	Meets Requirements	Section 3.3.6	
Tank Management Above-ground Petroleum Storage Act	CHS Code, Section 25270	Meets Requirements	Section 3.7.2	

2.4 Training

In CY98, personnel who handle hazardous chemicals and waste received instruction in chemical and waste management, waste minimization, pollution prevention, stormwater protection, on-site transportation of hazardous chemicals and waste, and spill and emergency response. The classroom instruction provided was intended to increase awareness in the aforementioned areas and to ensure environmental compliance.

2.5 Other Major Environmental Issues

Progress continued in CY98 toward completing the corrective actions developed in response to the 1991 Tiger Team assessment. All of the 51 environmental findings have been completed, as have all of the 57 related tasks. Seventeen of the 43 environmental findings have been validated, and 33 of the 53 related tasks have also been validated.

Other external appraisals resulted in the identification of 27 corrective action tasks, of which 24 have been completed. None of these corrective action tasks have been validated. Most of these tasks were primarily concerned with the adequacy of SLAC's documented plans and procedures. No significant threats to the environment were noted.

SLAC's Quality Assurance and Compliance organization completed seven environmental self-assessments. The assessments in 1998 focused on water quality and hazardous waste management practices. No significant problems were identified in these areas. Of the 75 environmental findings made, 68 have been completed.

3

Environmental Non-Radiological Program

3.1 General

This section provides an overview of environmental activities that are performed at the Stanford Linear Accelerator Center (SLAC). Such activities are designed to comply with laws and regulations, to enhance environmental quality, and to improve understanding of the effects of potential environmental pollutants from site operations.

3.2 Air Programs

3.2.1 Regulatory Framework

In the San Francisco Bay Area, most federal and state air regulatory programs are implemented through the rules and regulations of the Bay Area Air Quality Management District (BAAQMD). Included in BAAQMD's roles and responsibilities are implementation of Title V of the Clean Air Act (CAA). The primary mechanisms by which BAAQMD regulates SLAC air emissions include:

- New source permit evaluations.
- Annual information updates for existing permitted sources.
- Annual information updates for emissions of air toxics as identified by the California Air Resources Board in its *Toxic Substances Check List*.
- Annual enforcement inspections.

SLAC is subject to a few other air regulatory programs. These are either implemented by other agencies or have not yet been delegated to BAAQMD. These other programs include the following.

- The National Emission Standards for Halogenated Solvent Cleaning, under *Title 40 Code of Federal Regulations,(*40CFR), Part 63.460 (40CFR63.460), which is administered through the Air Division of Region 9 of the Environmental Protection Agency (EPA)
- The Protection of Stratospheric Ozone requirements (40CFR82), also administered through the Air Division of EPA, Region 9

- The Toxic Chemical Release Reporting: Community Right-to-Know requirements (40CFR312). SLAC provides the appropriate information to meet these program requirements to Department of Energy at Oakland (DOE/OAK), which in turn provides the information from all DOE facilities under its jurisdiction to the EPA
- The California Accidental Release Program (CalARP), which combines the requirements of Section 112(r) of the CAA with California-specific requirements, and is administered through the San Mateo County Department of Health Services (SMC/DHS)

3.2.2 BAAQMD-Implemented Programs

During calendar year 1998 (CY98), SLAC filed two new source applications with BAAQMD. The first was originally filed on June 12, 1998, for an environmental restoration project at the steam cleaning pad. The concern was potential emissions of organic compounds resulting from handling the contaminated soil. BAAQMD's disposition of this permit application was the exemption of the project from air permitting as per BAAQMD Regulation 2-1-128.

The second was originally filed on November 13, for the BaBar particle detector that is part of the new SLAC Asymmetric *B* Factory project. BAAQMD's disposition of this permit application was still pending at year-end.

Following the submittal of its annual information update to BAAQMD in April, the SLAC Permit-to-Operate (PTO) from BAAQMD was renewed for the year from July 2, 1998 to July 1, 1999. A total of 18 sources were included in the PTO, including 11 permitted sources and 7 exempt sources. Information regarding these sources is listed in Table 3-1 on page 3.

At the end of CY98 SLAC had numerous air emissions sources backlogged for permit evaluations. It is anticipated that several new sources will be permitted during calendar year 1999 (CY99).

As part of the annual information update, SLAC informed BAAQMD that toxic substances on the *Toxic Substances Check List*, beyond those substances emitted from SLAC's permitted sources, were “emitted at a rate less than the listed degrees of accuracy based on current process knowledge.” It is anticipated that this information will be revisited during CY99.

BAAQMD's Permit Inspector conducted the SLAC annual enforcement inspection on April 29. No instances of non-compliance were noted, and therefore no notices of violation were received.

3.2.3 EPA-Implemented Programs

SLAC has two vapor degreasers (Sources S-4 and S-54 as shown in Table 3-1 on page 3) that are subject to the National Emission Standards for Hazardous Air Pollutants (NESHAPS). During CY98, SLAC filed the required Initial Notifications for both degreasers with Region 9 of the EPA.

For Source S-4, SLAC initially requested that it be allowed to implement an equivalent method of control to meet the Alternative Standards and Test Methods set forth in 40CFR63.464 and 63.465. Following several months of negotiations with EPA personnel, SLAC rescinded its request for an equivalent method of control and notified EPA that it intended to operate Source S-4 in compliance with all requirements of the Alternative Standards and Test Methods.

Table 3-1 BAAQMD Permitted/Exempt Sources

Source Number	Source Description	Permitted/Exempt	Emitted Chemicals/Materials[a]
S-4	Batch Vapor Degreaser	Permitted	Trichloroethane (TCA)
S-5	Paint Spray Booth	Permitted	Paints, Solvents
S-11	Metal Cutting Operations	Exempt	—
S-17	Metal Grinding Operations	Exempt	—
S-21	Anodizing, Pickling, & Bright Dip Operations	Permitted	Sulfuric Acid
S-26	Batch Solvent Cold Cleaner	Permitted	De-Greeze 500
S-30	Sludge Dryer	Permitted	Copper, Chromium, Particulates, Nickel, NO_x, CO_2, CO
S-34	Batch Solvent Cold Cleaner	Permitted	De-Greeze 500
S-36	Wipe Cleaning Operations	Permitted	Isopropyl Alcohol, Acetone, Methanol, TCA, other solvents
S-37	Batch Solvent Cold Cleaner	Permitted	Isopropyl Alcohol
S-42	Diesel Fuel Storage Tank	Exempt	—
S-43	Diesel Fuel Storage Tank	Exempt	—
S-44	Diesel Fuel Storage Tank	Exempt	—
S-45	Diesel Fuel Storage Tank	Exempt	—
S-49	Cyanide Room Scrubber	Exempt	—
S-52	Horizontal Firetube Boiler	Permitted	NOx, CO_2, CO
S-53	Horizontal Firetube Boiler	Permitted	NOx, CO_2, CO
S-54	Near Zero Emissions (NZE) Closed Loop Vapor Degreaser	Permitted	Perchloroethylene

[a] Emitted chemicals/materials not listed for exempt sources.

All calculations and reports required by the Alternative Standards were prepared and submitted as required by regulation. No exceedances of the Alternative Standard emission limitation for S-4 occurred during CY98 (the limitation for S-4 is 150 kilograms/square meter/month on a 3-month rolling average basis).

For Source S-54, no NESHAPS calculations or reports were prepared during CY98, as it was not in operation during this time period. It is anticipated that Source S-54 will be placed into operation in the second quarter of CY99 and that a similar series of negotiations will be conducted with EPA personnel to arrive at an understanding of the operational requirements necessary to comply with the Alternative Standards.

No releases of stratospheric ozone depleting substances (ODSs) were reported during CY98 that were of sufficient size or quantity to be subject to the release reporting and corrective action requirements in the ODS regulations.

In order to comply with a DOE directive and to improve the status of SLAC's ODS programs, it is anticipated that SLAC's existing ODS inventory will be upgraded during CY99 or CY00.

SLAC is required by Executive Order 12856 to comply with Right-to-Know laws and pollution prevention requirements. One right-to-know regulatory program is incorporated into the SLAC air quality program, the Toxic Chemical Release Reporting: Community Right-to-Know program (more commonly known as the Toxics Release Inventory (TRI) program).

Based on available information such as SLAC Stores distribution records, Purchase Requisitions, and recordkeeping performed by certain chemical users, it did not appear that SLAC "otherwise used" any TRI-listed chemical above its threshold quantity during CY98. However, it did appear that SLAC approached the threshold quantities for at least the following chemicals:

- Nitric Acid
- 1,1,1-trichloroethane (TCA)
- Tetrachloroethylene (also known as perchloroethylene)

SLAC anticipates upgrading the recordkeeping systems used for compliance with TRI reporting requirements in order to improve the degree of certainty that it is under the threshold quantities.

3.2.4 San Mateo County-Implemented Programs

During February, SLAC received a request from the SMC/DHS to submit a CalARP registration form. SLAC submitted one such form on March 3, registering the following regulated substances:

- Nitric Acid
- Sulfuric Acid
- Potassium Cyanide

An amended registration form was submitted on May 15, revising the process quantities reported for nitric acid and potassium cyanide and deleting the registration for sulfuric acid on the basis that SLAC did not use the form of sulfuric acid listed in the CalARP regulations.

SLAC anticipates that it will be revisiting its CalARP registration in CY99 because of new:

- Reported use of CalARP-listed chemicals.
- Information received from the California Office of Emergency Services regarding potential exemptions for the use of nitric acid at SLAC.
- Interpretations of the process quanitity of potassium cyanide used at SLAC.

If SLAC's CalARP registration status is not changed, then SLAC will be subject to the CalARP program regulations based on its use of CalARP Table 3 substances. Under this aspect of the CalARP program, SMC/DHS is required to make a determination regarding whether a Risk Management Plan (RMP) will be required of SLAC.

If SMC/DHS makes such a determination, then SLAC will be required to submit an RMP to SMC/DHS no earlier than 12 months from the date of SMC/DHS's notice to SLAC of such a requirement and no later than 36 months from the date of such notice.

If an RMP is required by SMC/DHS, SLAC will, at minimum, be required to prepare offsite consequence analyses of worst case and alternative release scenarios for its:

- Registered CalARP chemicals.
- Accident histories for the registered chemicals.
- General descriptions of its prevention programs.

3.2.5 Other Programs

BAAQMD staff have repeatedly requested, on an informal basis, that SLAC evaluate its reporting obligations under Title V of the CAA, as implemented through BAAQMD Regulation 2, Rule 6, Permits – Major Facility Review. While SLAC staff firmly believe that SLAC's actual air emissions are significantly below the major facility thresholds, SLAC to-date has not conducted a study of its potential to emit. Therefore, SLAC is considering initiating a baseline air emissions inventory during CY99 to satisfy its obligations under Title V.

3.3 Water Protection Programs

3.3.1 Clean Water Act

The Federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA), was enacted nearly thirty years ago in order to halt the degradation of our nation's waters. Amendments to the CWA in 1972 established the National Pollutant Discharge Elimination System, which regulates discharges of wastewater from point sources such as Publicly Owned Treatment Works and categorically regulated industrial facilities such as electroplating shops. In 1987, the CWA was amended again to include non-point source discharges such as stormwater runoff from industrial, municipal, and construction activities. The CWA is the primary driver behind the SLAC water compliance programs. See Section 5 for information on groundwater.

3.3.2 Surface Water

Federal regulations allow authorized states to issue general permits to regulate industrial stormwater, or non-point source discharges. California is an authorized state, and on November 19, 1991, the State Water Resources Control Board adopted the Industrial Activities Stormwater General Permit (General Permit). SLAC filed a Notice of Intent to comply with the General Permit on March 27, 1992. The General Permit was re-issued, effective July 1, 1997.

The Stormwater Pollution Prevention Plan (SWPPP), which includes the Best Management Practices (BMPs) and the Monitoring Plan, were revised per the new General Permit effective July 1, 1997. The annual stormwater report was submitted to the Regional Water Quality Control Board (RWQCB) on July 1, 1998. The goal of the General Permit is to reduce pollution in the waters of the state by regulating the amounts of pollutants in industrial stormwaters discharged to waters of the state.

During CY98, SLAC made progress in completing the following items:

- Illicit Connections
  - Progress was made on eliminating or redirecting improper drain connections (illicit connections). Twelve illicit connections were eliminated in CY98. Approximately $250,000 was spent toward the elimination of illicit connections.
- Training

  Focused on area specific instruction.
- Erosion Projects

  Completed erosion projects in the following areas:
  - Building 003
  - Sector 6
  - Sector 18
  - Sector 20 (North)
- Coordinated with Facilities Department for
  - Inspection and maintenance of catch basins.
  - Protection of catch basins with straw bales.
- Utilized stormwater autosamplers at IR-6, IR-8, Main Gate, and North Adit.
- Incorporated water and air environmental protection review for subcontractor work on-site.
- Completed SWPPP revision.

The areas that have been identified as needing further improvement include housekeeping and erosion control.

3.3.3 Stormwater Monitoring Program

SLAC's stormwater monitoring program consists of:

1. Two stormwater sampling events per wet season.
2. Monthly visual observations during the wet season.
3. Quarterly visual observations during the dry season.
4. A comprehensive annual site inspection.

During the 1997/1998 wet season (October-May), SLAC analyzed stormwater runoff samples for pH, specific conductance, total petroleum hydrocarbons (TPH) as diesel and motor oil, polychlorinated biphenyls (PCBs), heavy metals, and radioactivity.

There are no enforceable limits, but rather numerical objectives which apply to the data collected for this program based on the RWQCB Basin Plan. The data are used as a general reference for determining whether SLAC appears to be generating stormwater pollutants and whether implementation of BMPs have been effective. Autosamplers were employed for sampling and proved to be a useful asset.

The four sampling locations, as shown in Figure 3-1 on page 8, are identified as:

- Main Gate.
- Northeast Adit.
- IR-6.
- IR-8.

The Main Gate and Northeast Adit watersheds are not, by definition, Industrial Activities areas, unlike the areas discharging at IR-6 and IR-8. IR-6 receives stormwater contributions from the Research Yard, which includes the Stanford Synchrotron Radiation Laboratory (SSRL) and the Positron Electron Project (PEP) ring. IR-8 collects water from the campus, fabrication, and Master Substation areas of the facility. Stormwater results are shown in Table 3-2 on page 9.

The El Nino weather pattern brought unusually heavy rains in the 1997/1998 wet season (over 200% of normal). This excessive rainfall resulted in increased erosion and slumping of hillsides. Heavy flows of rain mobilized sediment and increased groundwater flows. Straw bales were used extensively to minimize sediment transport into catch basins.

As of July 1, 1998, eight of the original seventeen erosion control projects identified were completed, along with two projects identified after the original list was generated. These projects ranged from placing riprap in an unlined channel to cleaning out the storm-drain lines in the Research Yard. The other nine projects are either in progress, awaiting regulatory approval or under the jurisdiction of another entity, such as the California Department of Transportation or the Stanford Management Company.

Natural drainages traverse the SLAC facility at two points along the linac: Sector 14 and Sector 18. Erosion and sediment control projects have been proposed for both drainages. SLAC obtained approval in a timely manner from the Department of Fish and Game (DFG), the Army Corps of Engineers (COE), and the U.S. Fish and Wildlife Service to perform erosion control measures at Sector 18. The RWQCB issued a water-quality certification waiver six months after the revised application was submitted. RWQCB approval for Sector 14 was still pending as of December 31, 1998.

3.3.3.1 Metals

Metals may be both naturally occurring and present due to human activities or industrial processes. The metals may include:

- Zinc
- Copper
- Molybdenum
- Lead

Some metals may be due to vehicle emissions associated with:

- Motor oil.
- Coolant drippings.
- Brake linings.
- Tire fines.

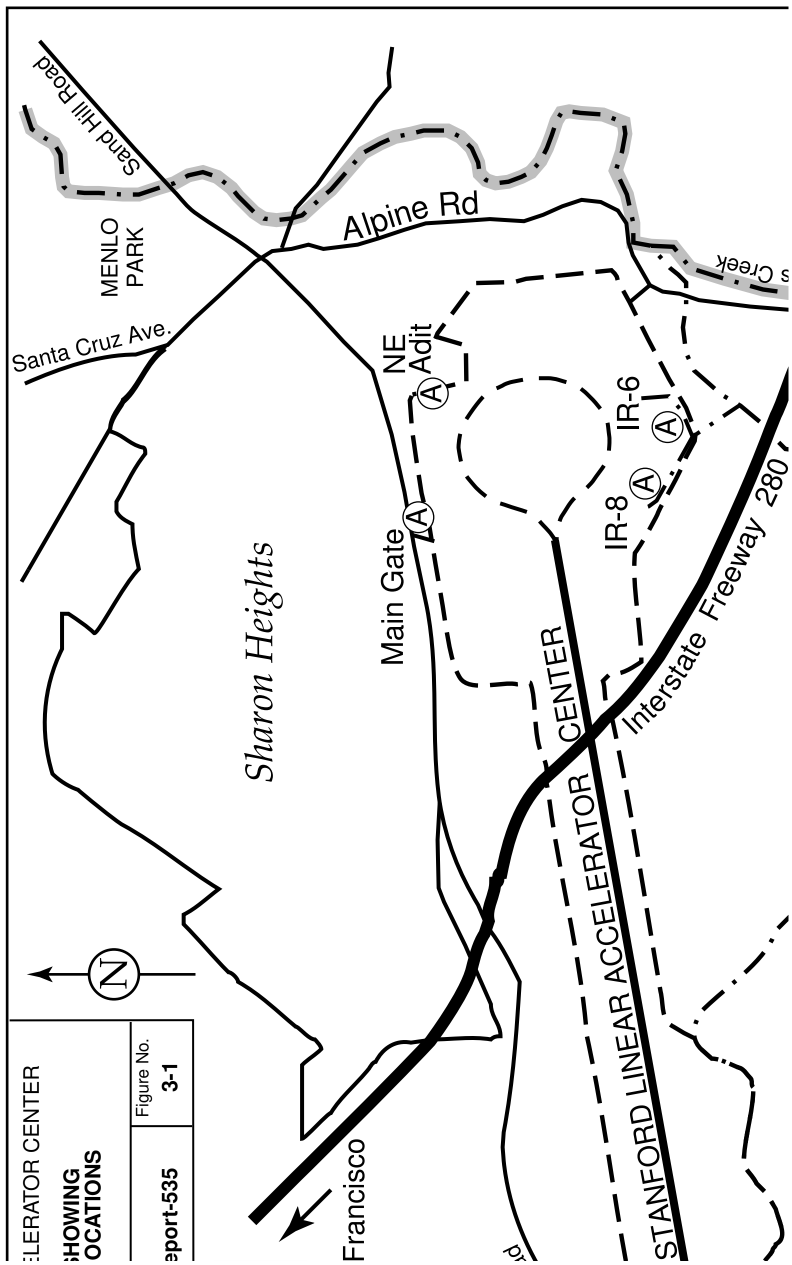

Figure 3-1 SLAC Autosampler Locations

Table 3-2 Stormwater Data for 1997-1998 Storm Season

Date	Main Gate		North Adit		IR-6		IR-8	
	December 9	December 14	November 12	December 9	December 14	December 17	November 12	December 17
Parameter [a]	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event	First Storm Event	Second Storm Event
Metals[b]								
Cadmium	<0.0010 [c]	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.0039	0.0035
Chromium	0.0029	0.0015	0.0086	0.0049	0.0014	0.0029	0.0048	0.0018
Copper	0.016	0.008	0.026	0.022	0.011	0.012	0.032	0.008
Lead	<0.0020	<0.0020	0.010	0.0046	<0.0020	<0.0020	0.0041	<0.0020
Nickel	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silver	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	<0.05	<0.05	0.13	0.064	0.27	<0.050	0.13	<0.050
Non-Metals								
TSS[d]	<5.0	<5.0	91	56	660	1800	7.0	8.8
TPH[e]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
PCBs[f]	NS[g]	NS	NS	NS	0.051[h]	1.1[h]	<0.0035[i]	<0.0035[i]
pH (no units)	7.42	8.27	7.14	8.02	7.72	7.75	6.62	8.23
Specific Conductance (Umhos/cm)[j]	1140	2840	1085	2450	412	500	400	2200

[a] All values in milligrams per liter (mg/l) unless otherwise noted.
[b] Metals results represent total concentrations.
[c] "< "symbol denotes less than a reporting limit.
[d] **TSS** = Total Suspended Solids.
[e] TPH = Total Petroleum Hydrocarbons.
[f] PCBs = Polychlorinated Biphenyls.
[g] NS = Not Sampled for this parameter.
[h] All PCB values above reporting limit represent Aroclor 1254 (only compound detected).
[i] Reporting Limit (RL) of 0.0035 mg/l for PCBs represents sum of individual RLs of 0.005 mg/l for each of 7 Aroclors.
[j] Umhos/cm = micromhos per centimeter.

3.3.3.2 Total Suspended Solids

Significant levels of suspended silt are generated when it rains. Levels of Total Suspended Solids (TSS) continued to vary greatly with each storm event.

TSS appeared elevated at IR-6, which carries significant flow off-site, possibly from erosion in the Research Yard. The storm drain cleanout of August 1997 may have contributed to the higher TSS values for CY98.

3.3.3.3 TPH as Diesel

All of SLAC's regular sampling stations receive run-off from paved areas such as roads and parking lots. However, no TPH was detected in this season's samples, possibly because of the excessive rainfall.

3.3.3.4 PCBs

PCBs were found at IR-6 at levels of 1.10 and 0.054 mg/l for the 1997 sampling events on December 9 and 14, respectively. The source of these PCBs may be residuals contained in fine materials in the storm drain system.

The storm drain lines were cleaned out in August 1997, and no PCBs were detected in November 1997. The 1.1 ppm anomaly was associated with sampling and analytical problems.

During CY98, PCBs continued to be detected in samples from IR-6. The dislodging of residual material by the increased rainfall may have further flushed through the system. This area continues to be monitored. No PCBs were detected in samples taken at IR-8 or the other sampling locations.

3.3.4 Industrial and Sanitary Wastewater

SLAC currently operates under three separate Mandatory Wastewater Discharge Permits. These permits set discharge limits for the sanitary sewer and are in effect from April 1, 1997 until they expire on March 31, 2002.

The SLAC industrial and sanitary wastewaters are treated by the South Bayside System Authority (SBSA) in Redwood City, California before being discharged to San Francisco Bay.

The three SLAC wastewater discharge permits are:

1. WB 970401-F, which regulates SLAC as a whole, including industrial and sanitary wastewaters.
2. WB 970401-P, which regulates operations at the Rinse Water Treatment Plant (RWTP).
3. WB 970401-HX, which regulates operations at the Batch Treatment Plant (BTP).

Permit requirements include:

1. Semi-annual sampling for heavy metals, Total Toxic Organics (TTO), and pH at the RWTP.
2. Semi-annual sampling for cyanide at the Plating Shop cyanide treatment tank.

3. Semi-annual sampling for heavy metals, Total Toxic Organics (TTO), and pH at the BTP.
4. Signs posted throughout the site advising personnel not to discharge non-permitted material to the sanitary sewer and providing emergency response numbers should there be an accidental release.
5. Quarterly sampling for heavy metals and pH at the Sand Hill Road Flow Meter Station.

SLAC discharged a total of 20,206,162 gallons of wastewater to the sanitary sewer system in 1998, an average of 55,359 gallons per day. In CY98, SLAC's Sanitary Wastewater Monitoring Program consisted of the following three permits:

3.3.4.1 Total Facility Discharge Permit

The Total Facility Discharge Permit (Permit No. WB 970401-F) covers SLAC's total[1] contribution to the sanitary sewer, including the combined flow from the RWTP and all other wastewater discharges on-site.

SBSA monitors the discharge quarterly to ensure compliance with the permit. SLAC collects "split" samples with SBSA during these monitoring events and analyzes them to compare results for quality assurance purposes. All analytical results from samples collected in CY98 are presented in Table 3-3 on page 12 and Table 3-4 on page 13.

3.3.4.2 Rinse Water Treatment Plant (Permit No. WB 970401-P)

SLAC conducted metal finishing operations in an on-site electro plating shop during CY98. Rinsewater baths from the plating shop were processed through the RWTP prior to being discharged to the sanitary sewer. The RWTP discharged 2.11 million gallons of effluent to the sanitary sewer in CY98. Effluent from the RWTP consistently met required federal metal finishing pre-treatment standards, which are specified in the permit.

As required by federal standards, the SBSA periodically monitored the metal finishing discharges, as well as the effluent from a cyanide treatment tank in the Plating Shop. SLAC and SBSA split samples from the RWTP and cyanide tank for quality assurance purposes. SBSA and SLAC's analytical results for CY98 are presented in Table 3-5 on page 14.

3.3.4.3 Batch Treatment Plant (Permit No. WB 970401-HX)

The BTP is permitted to treat effluent from the heat-exchanger descaling operation prior to discharge to the sanitary sewer. It accumulates batches of up to 4,000 gallons, which are then treated to remove metals and adjust pH. The BTP was operated once in CY98, discharging approximately 4,000 gallons of effluent to the sanitary sewer in one operation.

[1] A small portion of SLAC's domestic wastewater is carried off-site via the sanitary sewer on the south side of the facility. The amount of wastewater is considered by the sewage authorities to be trivial, and is not routinely monitored.

Table 3-3 CY98 Flow Meter Station Sampling Data (First Half)

Parameter	DISCHARGE LIMIT[a] (lb/day)	February 25				May 19			
		SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Converted Results [b] (mg/l)	SBSA Converted Results (mg/l)	SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Converted Results (mg/l)	SBSA Converted Results (mg/l)
Metals (mg/l)									
Cadmium	0.036	0.0018	<0.0070[c]	0.0011	0.0042	0.0031	0.0030	0.0020	0.0020
Chromium	0.48	0.0061	0.0500	0.0036	0.0297	0.0071	0.0140	0.0047	0.0092
Copper	0.35	0.0650	0.0700	0.0386	0.0416	0.0960	0.0990	0.0629	0.0649
Lead	0.33	0.0033	<0.0500	0.0020	0.0297	0.0046	0.0065	0.0030	0.0043
Nickel	0.064	0.0140	<0.0300	0.0083	0.0178	0.0130	0.0150	0.0085	0.0098
Silver	0.076	0.0047	0.0110	0.0028	0.0065	0.0023	0.0023	0.0015	0.0015
Zinc	0.7	0.0790	0.0970	0.0469	0.0576	0.1400	0.2000	0.0917	0.1310
Non-Metals									
pH	6.0-12.5[d]	NS[e]	8.40	NA[f]	NA	6.96	8.20	NA	NA
Flow (gpd)	62,175	NS	71,200	NA	NA	NS	78,547	NA	NA

[a] Discharge Limit = SBSA Annual Average Limit (determined by comparison of limit with the average of all samples collected during each one-year term of this permit)
[b] Converted Results in lb/day = (gal/day)(mg/l pollutant)(8.34 lb/gal)($10E^{-6}$ l/mg)
[c] "<"Symbol denotes less than a reporting limit
[d] = Daily Maximum, rather than Annual Average Limit
[e] NS = Not Sampled
[f] NA = Not applicable

Table 3-4 CY98 Flow Meter Station Sampling Data (Second Half)

Parameter	DISCHARGE LIMIT[a] (lb/day)	August 4				November 19			
		SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Converted Results [b] (mg/l)	SBSA Converted Results (mg/l)	SLAC Monitoring Results (mg/l)	SBSA Monitoring Results (mg/l)	SLAC Converted Results (mg/l)	SBSA Converted Results (mg/l)
Metals (mg/l)									
Cadmium	0.036	0.0022	<0.0070[c]	0.0017	0.0054	0.0022	<0.0070	0.0011	0.0033
Chromium	0.48	0.0061	<0.0200	0.0047	0.0155	0.0042	<0.0200	0.0200	0.0955
Copper	0.35	0.0940	0.1100	0.0731	0.0855	0.0960	0.1900	0.0458	0.0907
Lead	0.33	0.0059	<0.0500	0.0046	0.0389	0.0190	<0.0500	0.0091	0.0239
Nickel	0.064	0.0100	<0.0300	0.0078	0.0233	0.0110	<0.0300	0.0053	0.0143
Silver	0.076	0.0014	<0.0030	0.0011	0.0023	0.0017	<0.0030	0.0008	0.0014
Zinc	0.7	0.1000	0.1070	0.0777	0.0832	0.2000	0.2480	0.0955	0.1184
Non-Metals									
pH	6.0-12.5[d]	NS[e]	8.30	NA[f]	NA	7.90	8.40	NA	NA
Flow (gpd)	62,175	NS	93,216	NA	NA	NS	57,253	NA	NA

a Discharge Limit = SBSA Annual Average Limit (determined by comparison of limit with the average of all samples collected during each one-year term of this permit)
b Converted Results in lb/day + (gal/day)(mg/l pollutant)(8.34 lb/gal)(10E^{-6} l/mg)
c "<"Symbol denotes less than a reporting limit
d = Daily Maximum, rather than Annual Average Limit
e NS = Not Sampled
f NA = Not applicable

Table 3-5 CY98 RWTP Sampling Data

Constituent	PERMIT DISCHARGE LIMIT[a]	SAMPLE DATES									
		First Round				Second Round				Third Round	
		January 13		February 24		May 14		July 29		October 29	
		SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA	SLAC	SBSA
Metals (mg/l[b])											
Cadmium	0.69	NS[c]	NS	<0.0010[d]	<0.0070	0.0033	NS	NS	NS	0.0029	NS
Chromium	2.77	NS	NS	0.0076	0.0700	0.0056	NS	NS	NS	0.032	NS
Copper	3.38	NS	NS	0.0950	0.1000	0.0620	NS	NS	NS	0.095	NS
Lead	0.69	NS	NS	<0.0020	<0.0500	<0.0020	NS	NS	NS	0.014	NS
Nickel	3.98	NS	NS	0.0240	0.0300	0.0230	NS	NS	NS	0.033	NS
Silver	0.43	NS	NS	0.0370	0.0500	0.0160	NS	NS	NS	0.014	NS
Zinc	2.61	NS	NS	0.0210	0.0150	0.0100	NS	NS	NS	<0.020	NS
Non-Metals											
Cyanide (mg/l)	1.20	NS	NS	<0.0100	0.0780	<0.0100	NS	NS	NS	0.012	NS
TTO[e]	2.13	0.01412[f]	0.0129	NS	NS	NS	NS	0.0062[g]	NS	0.0331[h]	0.0335
pH	6.0-12.5	NS	NS	8.2	8.5	NS	NS	NS	NS	9.0	NS

[a] Federal Daily Maxima
[b] mg/l = milligrams per liter (= parts per million)
[c] NS = Not Sampled
[d] "<"Symbol denotes a reporting limit
[e] TTO = Total Toxic Organics (analyzed by EPA Method 8240)
[f] = 0.012 mg/l Chloroform + 0.0012 1,1,1-Trichloroethane + 0.00092 Bromodichloromethane
[g] = as Chloroform (only TTO detected)
[h] = 0.019 mg/l Chloroform + 0.013 mg/l Methylene Chloride + 0.00. mg/l 1,1,1-Trichloroethane

3.3.5 Endangered Species Act

Based on information provided by the California Department of Fish and Game and the U. S. Department of Fish and Wildlife, 14 animal species and 13 plant species occurring in San Mateo County are currently listed as endangered, threatened, proposed, or of concern. Of these, three of the animal species may occur on or immediately adjacent to the SLAC leaseholding: the California red-legged frog (*Rana aurora*, subspecies *draytonii*), the San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), and the steelhead trout (*Oncorhynchus mykiss*). All three are aquatic or semi-aquatic species associated with San Francisquito Creek, which is located south of and roughly parallel to the linac. The creek receives run-off from SLAC via three natural drainages, although no part of the creek is on the SLAC leaseholding. SLAC and San Francisquito Creek are shown in Figure 3-2 on page 16.

The red-legged frog, which was granted threatened status at the federal level in August 1997, is common in and around San Francisquito Creek. However, this frog is truly amphibious and can be found as far as one mile from the nearest water body. Accordingly, it may occur at SLAC, and has figured prominently in the permitting process for erosion-control and sediment-control projects in the on-site natural drainages. However, no verified sitings of red-legged frogs have been recorded to date on the SLAC leaseholding. Stanford University's Center for Conservation Biology routinely performs biological surveys on Stanford lands; the first such surveys were done at SLAC in CY98, and a report is expected in early 1999.

Historically, the San Francisco garter snake has occurred on and around the SLAC facility. However, this common name encompasses several subspecies, and the subspecies designated as endangered by the federal government (*T. s. tetrataenia*) intergrades with a similar subspecies (*T. s. infernalis*) in southeastern San Mateo County and northwestern Santa Clara County. In other words, the SLAC facility lies near the northeastern edge of the endangered subspecies' distribution, rather than near its center. This distributional limit, coupled with specific habitat requirements, makes the endangered subspecies unlikely to occur at SLAC.

Steelhead populations are increasing in the creek, due in large part to the efforts of the local watershed consortium established under the Coordinated Resource Management and Planning process, of which Stanford University and SLAC are founding members. However, this species is highly unlikely to occur on the SLAC leaseholding, due to the seasonal water flow patterns, the small sizes of the on-site drainages, and downstream drainage modifications by other Stanford University leaseholders.

3.3.6 Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act regulates pesticide use in the United States. The term “pesticide” refers to insecticides, rodenticides, and herbicides. SLAC uses licensed subcontractors to apply “registered use” pesticides. SLAC personnel apply “general use” pesticides only. In CY98, SLAC used pesticide and herbicide handling and storage procedures that were developed in CY94. These procedures were incorporated into the subcontracts for landscape maintenance and pest control, and have been implemented by the subcontractors.

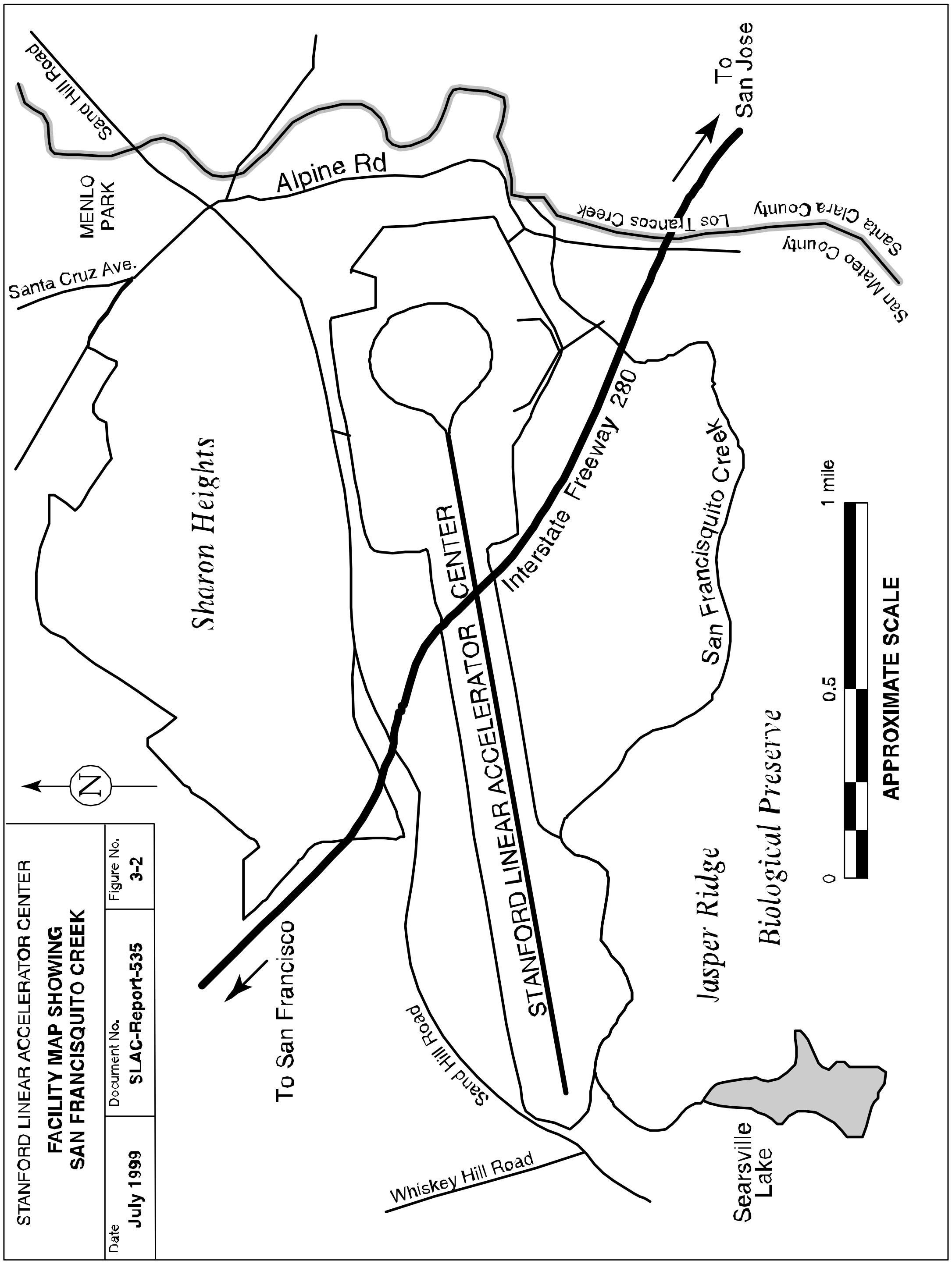

Figure 3-2 Facility Map Showing San Francisquito Creek

3.3.7 Executive Order 11990, Protection of Wetlands

As part of an environmental assessment conducted in CY91, SLAC had a subcontractor perform a survey to determine whether any area(s) within or next to the SLAC facility should be formally designated as wetlands, which are specifically protected under Section 404 of the CWA. The field survey and evaluation were performed using established federal guidance.

According to the survey, the IR-8 drainage ditch showed characteristics of wetlands, but a definitive evaluation was not possible because of continuing drought conditions and because the study was performed in the fall, when reproductive structures on aquatic vegetation are generally absent.

The portion of the IR-8 drainage channel that represents 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, in practice COE uses ten acres as their functional cutoff for “significant” wetlands.

Representatives from the COE, the RWQCB, and the DFG have been on-site to observe erosion-related problems at Sectors 14 and 18. The COE stated that the Sector 18 area appeared to be a wetland, and that the Corps would treat it as such in evaluating the SLAC Pre-Construction Notification, which was submitted and approved in December, 1997. Nevertheless, a follow-up to the 1991 survey would be required for a definitive determination. In the meantime, SLAC has operated proactively under the assumption that wetlands do exist within and adjacent to the facility boundaries.

3.4 Waste Minimization

3.4.1 Site-Wide Program Planning and Development

SLAC has been implementing its waste minimization program on schedule in accordance with established waste minimization plans. The plans address the reduction of specific hazardous waste streams in accordance with regulations and provide strategies to increase employee awareness on waste reduction measures for non-hazardous and low-level radioactive wastes as well as hazardous wastes.

Implementation of waste minimization and pollution prevention is a SLAC line responsibility. Some of the highlights of SLAC implementation of waste minimization and pollution prevention measures are discussed in Section 3.4.2, below.

SLAC has a Waste Minimization and Pollution Prevention Citizens Committee. The committee is composed of a representative from each division, an ES&H Coordinator from the Research Division, and the ES&H Waste Minimization and Pollution Prevention Coordinator. The committee reviews waste streams and identifies pollution prevention opportunities.

3.4.2 Waste Minimization and Pollution Prevention Activities/Implementation

In CY98 SLAC continued to make progress in the implementation of waste reduction measures for non-hazardous (municipal) wastes, hazardous wastes, and low-level radioactive wastes. An overview of the program activities and implemented waste reduction measures are as follows:

3.4.2.1 Pilot Recycling Project

SLAC completed a pilot recycling project to test the feasibility of using new collection containers and collection techniques for recyclable paper, beverage cans and bottles, and corrugated cardboard. Based on the success of the pilot project, SLAC is preparing to use similar collection containers and techniques to implement a site-wide program in CY99. The site-wide program is expected to help increase recycling quantities and to reduce collection costs.

3.4.2.2 Non-hazardous Waste Reduction

The quantities of non-hazardous waste and the materials recycled or diverted from landfills from 1990 to 1998 are summarized in Table 3-6 on page 20. Material recycled or diverted is shown with and without scrap metal recycling to show the contribution of scrap metals. In 1998, SLAC achieved 35 percent diversion without scrap metal and 55 percent diversion with scrap metal.

3.4.2.3 Hazardous Waste

Hazardous waste has been reduced through a combination of techniques, including:

- Reusing chemicals.
- Exchanging chemicals with other users (both on and off-site).
- Returning unused material back to the vendor or manufacturer.
- Converting empty metal containers and drums to scrap metal.
- Treating acid and alkaline wastes in accordance with the California Tiered Permit Program.

Due to the above listed activities, hazardous waste was reduced by more than 16 tons during CY98.

3.4.2.4 Hazardous Waste Reduction

Table 3-7 on page 20 shows the trends in the generation of hazardous waste for three major categories: operational, Toxic Substances Control Act (TSCA), and remediation-related hazardous waste.

Some of the operational hazardous wastes are classified as non-routine due to their one-time or highly infrequent generation. As of CY98, SLAC has reduced its hazardous waste by 54 percent relative to 1993 and by 80 percent relative to 1990.

TSCA wastes result from removal of old electrical equipment PCB-containing equipment) and construction practices (asbestos-containing materials). These wastes result from the phasing out of these materials from use in SLAC operations. Remediation wastes are the result of past practices or accidental spills.

TSCA and remediation wastes are expected to decrease over time due to elimination of the sources of PCB and asbestos wastes and by cleanup of wastes from past practices and spills.

3.4.2.5 Low-Level Radioactive Waste Reduction

Although little of the low-level radioactive materials or waste generated at SLAC are routine, SLAC reduces these materials and waste through measures such as segregation and reuse.

The quantities of low-level radioactive wastes are the accumulation of waste generated over years of operation and various construction and decomissioning activities. Some low-level radioactive waste is generated from maintenance operations. This type of waste generation tends to be sporadic.

3.5 Waste Management

3.5.1 Resource Conservation and Recovery Act

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

Management of hazardous waste at SLAC is performed by the Hazardous Waste Management Group of the WM Department. SLAC is a generator of hazardous waste and is not permitted to treat hazardous waste or store it for longer than 90 days. The SMC/DHS is the agency responsible for inspecting SLAC as a generator of hazardous waste for compliance with federal, state, and local hazardous waste laws and regulations.

The US DOE Oakland Operations Office, (DOE/OAK) coordinates with the State of California EPA Department of Toxic Substances Control on issues pertaining to radioactive and hazardous waste.

SLAC utilizes a self-developed, site-specific computerized hazardous waste tracking system (WTS). Hazardous waste containers are tracked from the time they are issued to the generator to eventual disposal off-site. The WTS includes electronic information fields which generate information for the Biennial, Superfund Amendments and Reauthorization Act (SARA) Title III, and TSCA PCB annual reports.

The majority of hazardous waste generated from operations throughout the site is accumulated in Waste Accumulation Areas (WAAS). Each WAA is managed by a Hazardous Waste and Materials Coordinator, who is provided training and written guidelines on proper management of WAAS. Training includes spill response preparedness, waste minimization, SLAC's waste-tracking system, and required "refresher" generator training.

SLAC has the potential to generate radioactive hazardous waste non-routinely. Waste that has been activated with accelerator-induced radioactivity is considered to be hazardous, but, by regulation, is not defined as mixed. The type of waste generated at SLAC is sometimes referred to as "combined waste" by the state of California, indicating that the waste contains both accelerator-induced radioactivity and a state or federal hazardous component.

Table 3-6 Summary of Non-Hazardous Waste Municipal Waste[a] Disposal & Recycling 1990-1998[b]

Calendar Year	NHW Disposed	Recycled Paper & Corrugated Cardboard	Redeemable Glass, Plastic, & Aluminum Containers	Diverted Garden & Wood Waste	Recycled Construction Materials	Recycled Scrap Metals	Total	Percent Material Recycled (Without Scrap Metal)	Percent Material Recycled (With Scrap Metal)
1990	541	61	2	0	0	113	717	10%	25%
1991	1,014	216	2	0	0	227	1,459	18%	31%
1992	654	233	5	104	0	66	1,062	34%	38%
1993	651	64	5	104	0	830	1,654	21%	61%
1994	800	184	6	87	0	400	1,477	26%	46%
1995	639	69	3	100	1,000	587	2,399	65%	73%
1996	711	95	6	146	0	444	1,403	26%	49%
1997	693	85	6	217	0	374	1,375	31%	50%
1998	635	131	6	198	3	448	1421	35%	55%

[a] Excludes wastewater discharged to the sanitary sewer.
[b] Quantities given are in tons.

Table 3-7 Summary of All Hazardous Waste[a] 1990-1998

Calendar Year	Operational HW (Routine)	Operational HW (Non-Routine)	TSCA Waste	Remediation Waste	Percent Operational HW Reduction (1990 Baseline)
1990	340	—	317	74	0%
1991	411	—	327	679	-21%
1992	160	—	126	17	53%
1993	147	—	227	151	57%
1994	152	—	47	914	55%
1995	118	—	70	1,004	65%
1996	85	—	39	20	75%
1997	63	14	42	550	82%
1998	67	34	52	1085	80%

[a] Quantities given are in tons.

Historically, SLAC has generated small quantities of activated liquids used for experiments and cleaning of accelerator machine parts. Other machine parts and materials used in support of operations have the potential to become activated. These include metal pipe and fittings that contain regulated components at levels above the regulatory threshold, and cooling-line cleaning solutions.

The generation of combined waste at SLAC, as previously noted, occurs on a non-routine basis. SLAC and the DOE are continuing to assess treatment and disposal options for waste streams in this category as well as opportunities for minimizing the generation of this type of waste.

3.5.2 Hazardous Waste Treatment

SLAC currently performs hazardous waste treatment under the State of California Tiered Permit Program (program) using both Permit-by-Rule and Conditional Authorization tier permits. Under this program, SLAC is authorized to treat listed or characteristic hazardous wastes, and currently performs hazardous waste treatment at the BTP and the Rinsewater Treatment Plant (RTP).

Currently, there are two fixed units that have Permit-By-Rule tier permits, and one fixed unit that has a Conditional Authorization permit. Hazardous wastes in these units are the result of waste generated during treatment of:

- Non-hazardous rinse or wastewaters.
- Hazardous wastes specifically authorized by California.

Non-hazardous rinse and wastewaters are treated in these units to ensure the water discharged to the sanitary sewer will meet industrial and sanitary wastewater discharge requirements.

Some wastes (typically acid and alkaline) generated from metal finishing operations are also authorized for treatment. The filtered solids generated in these treatment units are hazardous and are further treated in a sludge dryer to remove water and reduce waste volume.

3.5.3 Hazardous Waste Generator Inspection

The San Mateo County Division of Environmental Health conducted a Hazardous Waste Generator Inspection during the period of March through September 1998. Findings of non-compliance were found site wide relating to housekeeping, container management, and aisle space in accumulation areas.

It was noted that similar situations had been documented in previous inspections. The findings reflect what is not working at specific line areas. The report does state that

> "The regularly generated waste streams are generally in compliance with regulations. Those waste that are not regularly generated are more often likely to be out of compliance with the regulations."

3.6 Hazardous Materials Management

The Superfund Amendments and Reauthorization Act (SARA) Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), is primarily directed toward developing an inventory of the information needed to compile the various reports required by EPCRA. These reports also address the implementation requirements for statutes in the State of California (the La Follette and Waters Bills).

In CY98, SLAC submitted a Hazardous Materials Business Plan (HMBP) which details the response in the event of a release of hazardous material. This plan designated an emergency coordinator, described the first response and several levels of escalation, delineated the means by which all mandated notification will be made to the local authority (LA) and local fire department, and described the facility's evaluation, containment, and cleanup capability. The site maps have not changed significantly since the last submittal in 1997.

Under Section 312 of EPCRA, SLAC must provide to the LA and the local fire department, on an annual basis, an annual inventory of hazardous substances that are present in quantities greater than 55 gallons, 500 pounds, or 200 cubic feet. The LA requires a report to be filed for each individual hazardous substance.

Compliance for CY98 was achieved by sending out chemical inventories to the Chemical Inventory Coordinators (CICs). This information was then checked against the chemical inventory database and any discrepancies were checked for verification with the appropriate CIC.

For a discussion of the TRI reporting requirements under Section 313 of the EPCRA, section 3.3.3 on page 6. The SARA Title III report, and the State equivalent, HMBP report, were submitted to SMC/DHS for CY98. See Table 3-8 for report information.

Table 3-8 EPCRA Compliance Information

Article	Title	Report Required	Report Submitted
302-303	Planning Notification	YES	YES
304	EHS Release Notification	YES	YES
311-312	MSDS/Chemical Inventory	YES	YES

3.7 PCB and Tank Management

3.7.1 Toxic Substances Control Act

TSCA regulates equipment that is filled with oil or other dielectric fluids containing PCBs. SLAC has some equipment that falls into this category. PCBs, their use, and their disposal are regulated by TSCA. TSCA regulations include provisions for phasing out PCBs and other chemicals that pose a risk to health or the environment. The EPA is responsible for ensuring that facilities are in compliance with TSCA. The State of California further regulates PCBs as a non-RCRA Hazardous Waste. No EPA inspections regarding TSCA were conducted at SLAC during CY98.

In CY98 SLAC continued to reduce its inventory of PCBs by disposing of several large transformers as well as other PCB-containing equipment. One transformer remains on inventory as a PCB transformer with greater than 500 parts per million (ppm) of PCB. This transformer is pending reclassification to non-PCB status. SLAC registered this transformer with the EPA, per the requirement of the new PCB "mega rule."

SLAC will continue to remove the remaining 14 PCB-contaminated transformers (containing 50 to 500 ppm of PCBs) over the next few years. Other activities and actions completed or initiated at SLAC in CY98 included:

- Prepared 1997 PCB Annual Document Log, per TSCA.
- Completed PCB Transformer Quarterly Inspection Reports, per TSCA.

- Updated the PCB/TSCA transformer and capacitor inventories.
- Completed guidance for management of oil-filled equipment.

3.7.2 Tank Management

SLAC has no remaining underground storage tanks in use. Petroleum storage tanks with capacities over 10,000 gallons are regulated under *Title 40, Code of Federal Regulations*, Part 112 (40CFR112), the "Aboveground Petroleum Storage Act." SLAC currently has one diesel tank subject to this Act.

3.8 Environmental Quality Acts

3.8.1 National Environmental Policy Act

SLAC formalized a National Environmental Policy Act (NEPA) program in CY92. Under this program, proposed project and action descriptions are reviewed to determine if NEPA documentation is required. If so, the proper paperwork is prepared and submitted. The project or action is entered in a database and tracked. The resulting draft NEPA document is reviewed by specified SLAC staff for concurrence, and is forwarded to the DOE Site Office for review and approval.

NEPA provides a three-level mechanism to ensure that all environmental impacts of and alternatives to performing a proposed project are considered before it is carried out. The three types of NEPA documentation, in order of increasing complexity, are Categorical Exclusions (CXs), Environmental Assessments, and Environmental Impact Statements.

The aspects that must be considered when scoping and preparing documentation for a proposed project include archaeological sites, wetlands, floodplains, sensitive species, and critical habitats. If any extraordinary circumstances are identified during project scoping, a range of options for the project must be developed and the impacts of those options evaluated.

In CY98, SLAC submitted 8 CXs for General Plant Projects, Accelerator Improvement Projects, and Capital Equipment Projects, including the Stanford Positron Electron Asymmetric Ring-III at SSRL. All were approved by DOE/OAK.

3.8.2 California Environmental Quality Act

NEPA compliance is considered to be the functional equivalent of the California Environmental Quality Act (CEQA) compliance. In support of this approach, the SMC Planning and Building Division (PBD) sent a letter dated November 4, 1998 to SLAC. The letter stated that PBD had elected not to exercise its CEQA and permitting authority for SLAC projects involving (for example), erosion control.

4 Environmental Radiological Program

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 (^{15}O) and carbon-11 (^{11}C), with half-lives of 2 minutes and 20 minutes, respectively. Nitrogen-13 (^{13}N), 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 (^{41}Ar), which has a half-life of 1.8 hours.

Calendar year (CY98) was an active year at the Stanford Linear Accelerator (SLAC) site. Every major facility at SLAC was powered up at least once during the year. Although each facility was running at dramatically different energies and durations, each had the potential to produce activated airborne radionuclides. Most facilities at SLAC had no uncontrolled venting of the accelerator housing during time of beam acceleration in CY98. There are two facilities at SLAC that are not totally enclosed, so emissions due to diffusion can occur.

For most of the facilities at SLAC, activated air is not released to the environment until the facility is opened for personnel entry. For the purpose of maintaining radiation doses to personnel as low as reasonably achievable, entries are administratively controlled to allow some time for short-half-life radionuclides to decay prior to entry. Cool-down periods are facility- and energy-dependent varying from 30 to 60 minutes in CY98, with the norm being 60 minutes.

Of all the SLAC facilities, only End Station A (ESA) and the *B* Factory, hereinafter referred to as PEP-II, have the potential to allow diffuse emissions of activated airborne products. Diffusion from ESA and PEP-II activities are via Beam Dump East (BDE) and Interaction Region 10 (IR-10), respectively.

The majority of experimental facilities at SLAC are designed to transport the high-energy beams produced by the SLAC linac without high-energy losses, and thus without significant activation of the air within the facility. The accelerator, PEP-II, the Stanford Linear Collider (SLC), the Stanford Synchrotron Radiation Laboratory, and their experimental areas were designed to transport and condition (not absorb) high-energy electrons and positrons. In these structures the concentration of activated gases remaining after the "cool down" period were not measurable.

Those facilities that, by design or operation, involve losing or "dumping" high energy have the potential for producing activated airborne radionuclides. Beam-on time creates both energy loss and activation of the air surrounding the energy-loss area itself. In CY98, the following areas all experienced beam-on time:

- Beam Switchyard (BSY)
- Positron Source (PS)
- BDE at ESA
- Final Focus e^+ and e^- beam dumps at SLC, adjacent to the Stanford Large Detector
- Final Focus Test Beam

Energy-loss and beam-dump areas are sealed from access or venting, unless there is an emergency, during operations, and during beam-off until the required "cool-down" period has passed. The exceptions are BDE and IR-10 as noted earlier. Activation products are very short-lived (half-lives of only 2 minutes to 2 hours, inclusive), with decay during the cool down period resulting in non-measurable concentrations. In order to establish concentrations without measurable quantities, calculations were made using facility specifics. These calculations have been made using extremely conservative (protective of the public) assumptions.

As a government-owned contractor-operated program, SLAC must, at a minimum, meet the requirements set by the Department of Energy (DOE). DOE Order 5400.5, *Requirements for Radiation Protection for the Public*, mandates that no individual in the general population be exposed to greater than 100 mrem (1.0 mSv) in one year from all pathways due to DOE-funded activity. This Order prescribes calculations to be made to ensure that off-site releases to the public are below 100 mrem. The results of these calculations are called Derived Concentration Guides (DCGs).

A number of assumptions must be made in order to make the DCG calculations; SLAC has chosen the most conservative assumptions to err on the side of public safety. As an example of conservatism, SLAC has assumed that a member of the public would be wholly immersed in these activated gases while being off-site. Although it is obvious that this scenario is unrealistic, it allows the calculations to be made without the need to define the real scenario, and provides a wide margin of protection to the public. The DCGs, as calculated for SLAC's potential release of activated radioactive gases (^{15}O, ^{11}C, ^{13}N, and ^{41}Ar) are presented in Table 4-1 on page 3.

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Table 4-1 Radioactive Gases Released to Atmosphere

Radionuclide	Half-Life	DCG μCi/cm^3 [a,b]
^{15}O	2.1 minutes	1.7 x 10^{-9}
^{13}N	9.9 minutes	1.7 x 10^{-9}
^{11}C	20.5 minutes	1.7 x 10^{-9}
^{41}Ar	1.8 hours	1.7 x 10^{-9}

[a] μCi = 3.7 x 10^4 Bq
[b] Calculated from DOE Order 5400.5, assuming total submersion by dividing the averaged DCG by 10. See Appendix A

This same Order requires that DOE-funded activities comply with U.S. Environmental Protection Agency (EPA) requirements. Under EPA National Emission Standards for Hazardous Air Pollutants (NESHAP) *Title 40 Code of Federal Regulations*, Part 61 (40CFR61), SLAC must meet the requirements of this subpart by calculation of potential doses to both the maximally exposed individual and the public as a whole due to the emissions of airborne radionuclides. Continuous monitoring is not required because all of SLAC's emissions points are defined by EPA as "minor sources" of air pollution.

NESHAP emissions were derived using calculations based, again, on conservative assumptions. It was assumed that each time a beam-off situation occurred at any facility that the containment was breached by entry. If there was never a venting or breach, then the activated gases would decay to background and no emissions would result. In 20 hours time after beam-off, all activated gases would be less than 1% of their saturation values.

These emissions were derived by calculating the saturation activity for the radionuclides listed above in Table 4-1, and then hypothetically releasing them instantaneously after the cool-down period. For both the IR-10 and BDE release points (which are not totally contained) a diffusion mechanism was conservatively estimated to determine releases that occurred continuously during beam-on periods.

SLAC demonstrates its fulfillment of NESHAP requirements of off-site dose to the public of less than 10 mrem. Fulfillment of this requirement is evident in the results of running the DOE-approved modeling program CAP88PC[1], Version 1.0 (refer to Table 4-2 on page 4, column 2, and Appendix B of this report).

[1] CAP88PC is a personal computer software system used for calculating both dose and risk from radionuclide emissions to air.

Table 4-2 Summary of Annual Effective Dose Equivalents Due to 1998 Laboratory Operations

	Maximum Dose to General Public[a, b] (direct radiation only)	Maximum Dose to General Public[a, b] (airborne radiation)	Maximum Dose to General Public[a, b] (airborne + direct radiation)	Collective Dose to Population within 80 km of SLAC[b]
Dose	4.6 mrem	0.0004 mrem	4.6 mrem	9.93 person-rem
DOE Radiation Protection Standard	100 mrem	10 mrem	100 mrem	—
Percentage of Radiation Protection Standard	4.6%	<1%	4.6%	—
Background	100 mrem	200 mrem	300 mrem	1.47×10^6 person-rem
Percentage of Background	4.2%	<1%	1.5%	Negligible

[a] This is the dose to the maximally exposed member of the general public. It assumes that the hypothetical individual is at the closest location to the facility continuously, 24 hours/day, 365 days/year.
[b] 100 mrem = 1mSv and 1 person-rem = 0.01 person-Sv.

The results of this modeling show that the maximum off-site dose, with all the conservative assumptions applied, from potential airborne emissions from SLAC is only 4.3×10^{-4} mrem (4.3×10^{-6} mSv) annual effective dose equivalent (EDE). Thus, the public dose due to SLAC research is approximately 25,000 times lower than EPAs level of concern (10 mrem EDE).

4.2 Wastewater Monitoring

During CY98, wastewater containing small quantities of radioactivity within regulatory limits was periodically discharged to the sanitary sewers from the site. The only possible sources of liquid radioactive effluents were from low conductivity water (LCW) cooling systems in the BSY and certain other areas of the accelerator housing. In the event of leaks from these systems, water was collected in stainless-steel lined sumps sized to contain the entire water volume. Along the Klystron Gallery, there are a series of polyethylene tanks which are used to collect LCW from the alcoves of the gallery.

The greatest source of induced radioactivity was where the electron/positron beam was absorbed. The only significant radionuclides produced in water were the short-lived ^{15}O and ^{11}C; beryllium-7 (^{7}Be), with a half-life of 54 days; and longer-lived tritium (^{3}H), with a half-life of 12.3 years. Other radionuclides which could potentially be in the water systems would come from activated corrosion products.

The activated corrosion products were typically gamma emitters. Oxygen-15 and ^{11}C are too short-lived to present an environmental problem in water. Beryllium-7 and the corrosion products were removed from the LCW by the resin beds required to maintain the electrical conductivity of the water at a low-level. Therefore, ^{3}H was the only radioactive element present in the water that was of environmental significance in CY98. Tritium emits a weak beta particle and is detected primarily through liquid scintillation analysis.

As in previous years, SLAC discharged many batches of LCW to the sanitary sewer. All water potentially containing radioactivity was sampled and analyzed. All batches, as well as the cumulative total for the year, had contaminant levels that were within applicable radiological regulatory limits. A summary of radioanalysis records of the wastewater discharged for each quarter of CY98 are given in Table 4-3, below. A total of 1,502,000 gallons of LCW was discharged to the sanitary sewer during CY98. The total amount of ^{3}H discharged was 71.8 millicuries.

Table 4-3 Radioanalysis Results for Wastewater Discharged During CY98

Period Released	Quantity [gal[a]]	Radioactivity [mCi[b]]
First Quarter	487,000	22.8
Second Quarter	408,000	0.9
Third Quarter	340,000	47.5
Fourth Quarter	267,000	0.6
Total:	1,502,000	71.8

[a] 1 gal = 3.8 liter
[b] 1 mCi = 3.7 x 10^{7} Bq

SLAC is also bound by the provisions in a contract for service with the West Bay Sanitary District, Permit No. WB970401-F and State regulations *Title 17; California Code of Regulations*, Section 30287 (17 CCR 30287) which limited SLAC to a maximum of 5,000 mCi (that is, 5 Ci, or 1.85 x 10^{11} Bq) of ^{3}H and 1,000 mCi (1 Ci or 3.7 x 10^{10} Bq) of all other radionuclides to be discharged to the sanitary sewer each calendar year. The concentration of radioactivity released was, in all cases, less than the DCG specified by DOE Order 5400.5. The total ^{3}H activity released in CY98 was less than 5% of the annual limit.

4.3 Stormwater Monitoring

Samples of stormwater, as described in Section 3.3.3, were analyzed for radioactivity. The results of these samples showed no detectable levels of ^{3}H or other radioactivity.

4.4 Groundwater

Tritium analyses were conducted on groundwater from Existing Well 4 (EXW-4), Monitoring Well 30 (MW-30), and all other wells that were sampled. Tritium was detected only in EXW-4 and MW-30. Results for ^{3}H analyses for CY98 groundwater monitoring in well EXW-4 were 4,055 pCi/l, which is less than the California state drinking water maximum concentration level of 20,000 pCi/l. However, groundwater at SLAC is not usable as drinking water due to a very high Total Dissolved Solids content, and is not used for any other purpose.

Tritium concentrations in well EXW-4 have varied (generally between 5,000 and 13,000 pCi/l) since the 1960s. Tritium concentrations in samples from EXW-4 have shown a general decreasing trend since 1991. Well EXW-4 is located in the area of BDE. The most probable source of ^{3}H in the groundwater is low-level activation due to beam particle penetration in the area.

Results for ^{3}H analyses for CY98 groundwater monitoring in MW-30 were 792 pCi/l. Concentrations of ^{3}H in MW-30, measured since the well was installed in CY90, have consistently been below 1,000 pCi/l, and are usually less than the detection limit of 500 pCi/l. Well MW-30 is located next to ESA at the beginning of BDE.

These and other wells will continue to be monitored on a 12 to 18 month schedule in order to define any long-term trends in ^{3}H concentration. All environmental monitoring wells are listed in Table 5-1; the well sampling is described in section 5.1. There were five new groundwater monitoring wells installed to monitor for potential radioactivity during CY98. The new wells are:

- MW-53 near the PS.
- MW-54 near BDE.
- MW 55 near BDE.
- MW-56 near the South Final Focus (SFF) beam dump.
- MW-57 near the North Final Focus (NFF) beam dump.

Soil and water samples taken during well installation yielded results that were less than detectable by the SLAC Radioanalysis Laboratory instrumentation.

4.5 Passive Thermoluminescent Dosimeter Monitoring Program

SLAC has a site boundary environmental Thermoluminescent Dosimeter (TLD) monitoring program. Landauer, a National Voluntary Laboratory Accreditation Program certified dosimetry service, was contracted to provide SLAC with quarterly TLDs. The LDR-X9 aluminum oxide TLD was designed to measure low-level photon radiation with a minimum detection level of 0.02 mrem (0.0002 mSv). The LDR-I9 TLD is used for monitoring neutron radiation with a minimum detection level of 10 mrem (0.1 mSv). Both of these TLD systems were in use throughout CY98.

The environmental measurements using TLDs are summarized in Appendix D. TLD results indicated that the site boundary location with the highest accumulated dose-equivalent in CY98 reported 43.7 mrem (0.437 mSv).

The TLD data for CY98 were used to evaluate the radiation dose from direct radiation to the maximally exposed member of the general public and the collective dose to the general public within 80 km of SLAC. See Table 4-2 on page 4 for a summary of the results and Appendix D for data.

4.6 Radiological Media Sampling Program

Media sampling was limited to industrial wastewater (the major pathway for radionuclide release to the environment) and stormwater. The low source terms proportionate to DOE's DCGs have identified only this route as a likely pathway for any potential off-site population exposure.

Limited soil sampling in past years has not revealed detectable levels of human-made radionuclides. Future monitoring will be part of the radiological Environmental Surveillance Program which is being developed under SLAC's Radiological Environmental Monitoring Plan.

4.7 Low-Level Radioactive Waste Reduction

The quantities of low-level radioactive wastes on site were the accumulation of waste generated over years of SLAC's operation. A significant portion of SLAC's low-level radioactive waste is in the form of scrap metals.

Depending on their condition and the radiological characteristics, some of the metals may be recycled for general public use because radioactive levels are very low and are candidates for regulatory exemption. This waste reduction approach is called Return-on-Investment (ROI). ROI is a DOE-sponsored pollution prevention activity that assists funded sites in removal of their materials or waste that are suspected of being radioactive. ROI activities were moved forward in CY98.

SLAC has found that simple things have had a marked effect on day-to-day production of radioactive waste. Better housekeeping in CY98 of accelerator areas reduced the amount of material (parts, equipment, tools, and supplies) that must be considered potentially activated when removed from high-radiation and beam-loss areas. Here again, a concern for reduction of radioactive waste has led to a more comprehensive approach in both characterization and management of activated material that could become waste. It was found that simple disassembly of parts and equipment, where only certain material was activated, resulted in a significant reduction of waste needing to be managed as being radioactive, a process known as volume reduction.

5 Groundwater Protection and Restoration

The Stanford Linear Accelerator Center (SLAC) performs groundwater protection through monitoring of a network of wells located for environmental surveillance and through investigations of contaminated groundwater plumes to ensure protection of human health and the environment. Documents such as *Remedial Investigation/Feasibility Study (RI/FS) Workplans*, associated *Standard Operating Procedures for Environmental Protection and Restoration*, and a *Quality Assurance Project Plan* support monitoring and investigation activities.

The *Annual Well Inspection and Maintenance Manual* guides inspection of wells to protect the integrity of the monitoring wells. In calendar year 1998 (CY98), groundwater monitoring data were collected on a semi-annual schedule from existing wells and from new wells as they were installed for investigative work. All reports and documents referred to in this section are available at the SLAC library, or can be obtained from the Environmental Protection and Restoration Department at SLAC.

5.1 Groundwater Characterization Monitoring Network

5.1.1 CY98 Summary of Results and Issues

Work continued in CY98 on putting in more wells around the four areas of known contamination to define the lateral and vertical extent of potential contamination. Draft reports of the site characterization and evaluation of remedial alternatives for the Former Solvent Underground Storage Tank (FSUST) area were completed in CY98. These reports, which are described below, were submitted to the California Regional Water Quality Control Board (RWQCB) for review and comment and the results of the investigations were presented to the Coordinated Resource Management and Planning (CRMP) Steering Committee and other interested parties.

Groundwater samples were collected from 46 wells in CY98 and analyzed for a variety of constituents including volatile organic compounds (VOCs). Figure 5-1 on page 2 shows the primary portion of the monitoring network. The groundwater analytical results were generally within each well's historic range of concentrations.

5.1.2 Background

SLAC characterizes groundwater at the site in order to determine and document the effects that the facility operations have had on groundwater quality. The groundwater monitoring network includes 13 wells which provide environmental surveillance of groundwater conditions. They are used to monitor general groundwater quality in the major areas of the facility that historically or presently store, handle, or use chemicals which may pose a threat to groundwater quality. In addition, the groundwater monitoring network at SLAC includes 46 wells that check groundwater at four distinct sites with known groundwater contamination.

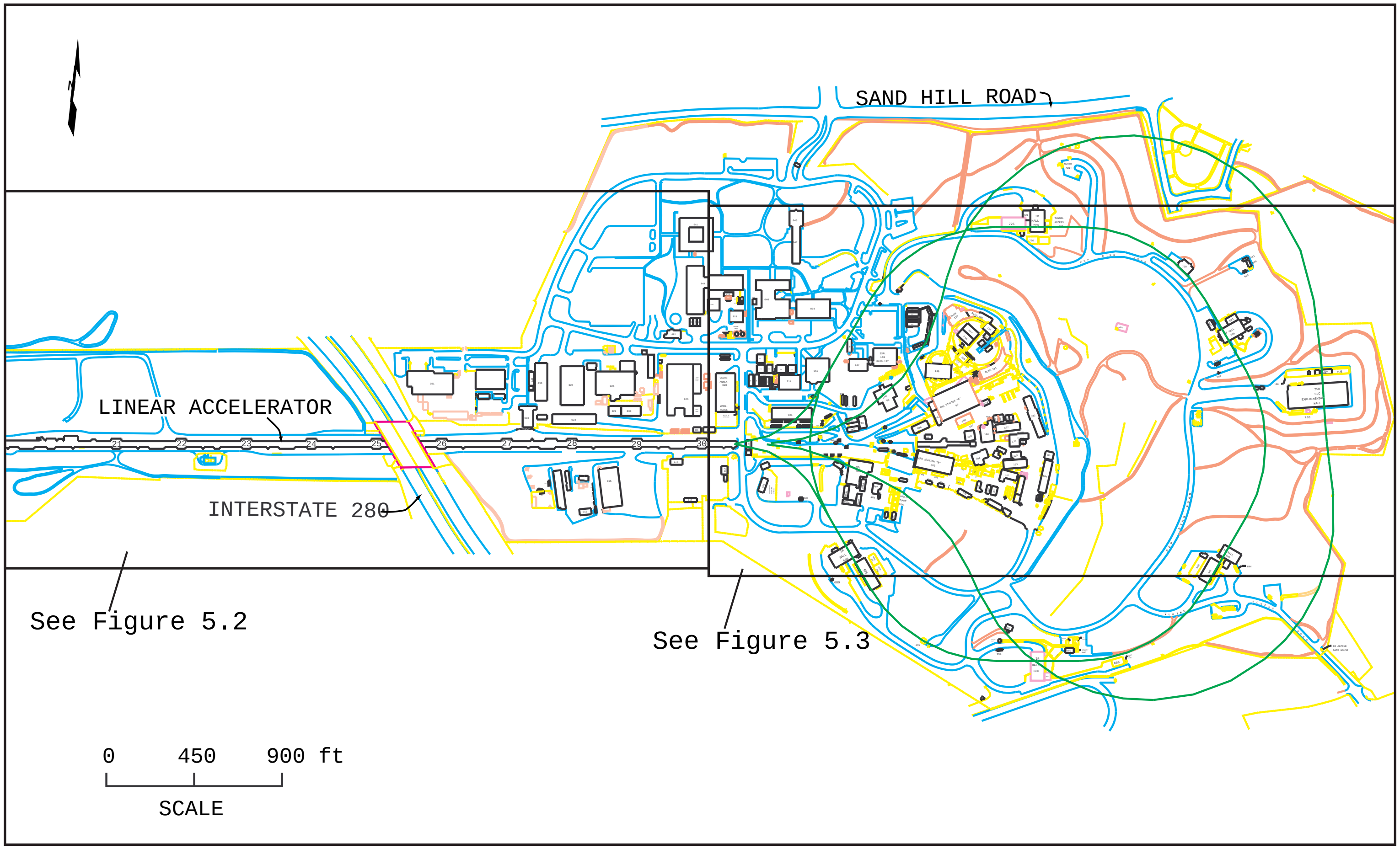

Figure 5-1 Site Map

During ongoing remedial investigations, selected wells at areas with known groundwater contamination are sampled and analyzed on a semi-annual basis. Samples may be analyzed for one or more of the following:

- VOCs
- Total Petroleum Hydrocarbons
- Metals
- Polychlorinated Biphenyls (PCBs)
- Total Dissolved Solids (TDS)
- General minerals
- Tritium

VOCs have been detected at levels of concern at SLAC. The results of semi-annual sampling and analysis of wells are reported to the RWQCB in semi-annual monitoring reports.

Table 5-1 on page 3 summarizes the wells at SLAC by the number of wells, area of the facility, and the purpose of the well. The purpose of the well may be either contaminant plume monitoring or environmental surveillance, including general background monitoring. Eight wells were installed at SLAC in CY98. As noted in Table 6-1, the four areas with groundwater contamination are:

- The Former Hazardous Waste Storage Area (FHWSA).
- FSUST.
- The Test Lab and Central Lab areas.
- The area of the Plating Shop.

Table 5-1 Purpose and Location of Monitoring Wells

	Number of Active Wells	
Area of Site	**Groundwater Contaminated Plume Monitoring**	**Environmental Surveillance**
FSUST[a]	18 wells	
FHWSA[b]	12 wells	
Test Lab/Central Lab	6 wells	
Plating Shop	9 wells	
Research Yard		3 wells
Beam Dump East		3 wells
Master Substation; Lower Salvage Yard		1 well
CHWMA[c]		1 well
End Station B		1 well
Vacuum Assembly Building		1 well
Other (remote area)		4 wells

[a] Former Solvent Underground Storage Tank
[b] Former Hazardous Waste Storage Area
[c] Central Hazardous Waste Management Area

The locations with groundwater contamination are shown in Figure 5-2 on page 5 and in Figure 5-3 on page 6. The main organic contaminant in all of these areas is trichloroethene (TCE) and its breakdown products. TCE was historically used at SLAC as a cleaning solvent. TCE is no longer in general use at SLAC. It is used in very small quantities in a few research laboratories. The four contaminated groundwater sites are discussed in detail in the next section.

5.2 Groundwater Site Descriptions and Results

5.2.1 Former Solvent Underground Storage Tank

5.2.1.1 Background

A groundwater monitoring network is located in proximity to the SLAC Plant Maintenance building in the northwestern portion of the facility (see Figure 5-2 on page 5). This network consists of eighteen wells which are being used to monitor the migration of chemical constituents associated with the FSUST. The tank was used to store organic solvents during the period of 1967 to 1978. A pressure test performed on the FSUST in 1983 indicated a leak. The tank and accessible contaminated soil were removed in December 1983.

The California RWQCB requires that SLAC monitor selected wells at the FSUST site on a semi-annual basis (RWQCB Waste Discharge Order 85-88). Since 1987, the samples have been analyzed for VOCs (EPA Methods 8010/8020) by an analytical laboratory certified by the California Department of Health Services.

5.2.1.2 CY98 Results and Issues

The results of investigations performed at the FSUST were provided in two draft reports, the *Site Characterization for the Former Underground Storage Tank Area*, and the *Evaluation of Remedial Alternatives for the Former Solvent Underground Storage Tank Area*. The *Site Characterization* report described the nature and extent of chemicals in the soil and groundwater at this site and evaluated the risks posed by these chemicals. The evaluation of the risks was used to identify remedial goals. The *Evaluation of Remedial Alternatives* report established remedial action objectives and then evaluated 41 alternatives in order to determine which would meet best the objectives. The reports were submitted to the California RWQCB for review and comments. The final reports are expected to be completed in CY99.

5.2.2 Former Hazardous Waste Storage Area

5.2.2.1 Background

The FHWSA was in use from approximately 1965 to 1982. During closure of the yard, PCBs were found in shallow soils. As a result, several inches of topsoil were removed. Monitoring well 25 (MW-25) was installed in this area in 1990, and VOCs were detected in the groundwater. Three wells were installed in CY98, in addition to the nine wells previously installed at this site. Figure 5-2 on page 5 defines the extent of VOCs in groundwater.

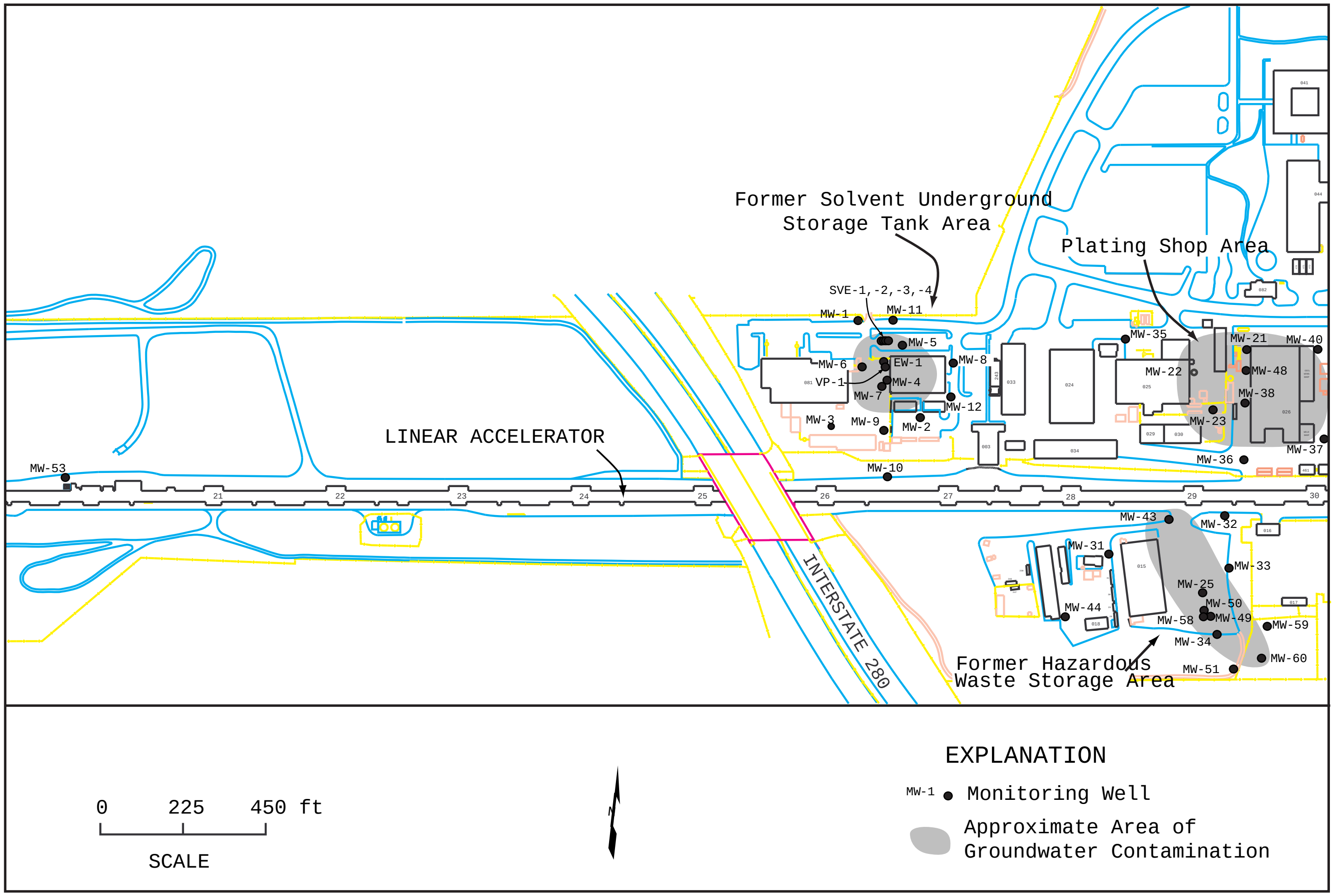

Figure 5-2 Location of Western Groundwater Monitoring Well Network and Areas with Groundwater Contamination

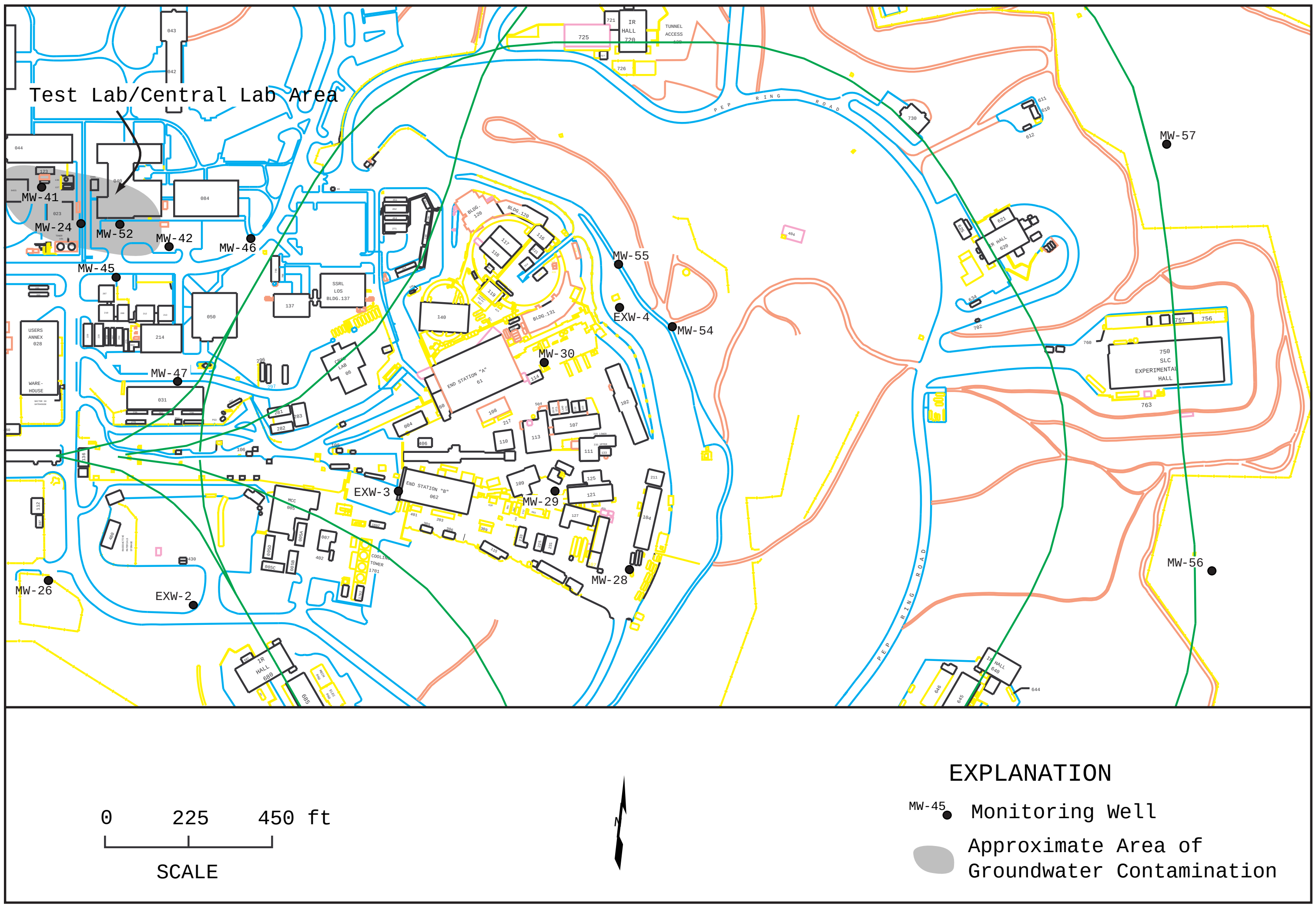

Figure 5-3 Location of Eastern Groundwater Monitoring Well Network and Areas with Groundwater Contamination

5.2.2.2 CY98 Results and Issues

Results of the CY98 drilling and testing program delineated the extent of contamination to the southeast. Based on work performed in CY97, most of the groundwater contamination appears to be confined to the Santa Clara Formation which comprises the upper 20 feet of bedrock. Investigative work will continue in CY99.

5.2.3 Plating Shop

5.2.3.1 Background

In 1990, three monitoring wells, MW-21, MW-22, and MW-23, were installed downgradient of the Plating Shop. Constituents of concern were detected in all of the three wells and an investigation began as described below.

5.2.3.2 CY98 Results and Issues

A concrete steam cleaning pad is located adjacent to the Plating Shop and work performed in CY97 identified the soil beneath it as a potential source of VOCs in the groundwater. Consequently, an Interim Removal Action was performed in CY98, which included removing the pad, and excavating approximately 200 cubic yards of contaminated soil for off-site disposal. A new steam cleaning pad was built to replace it at a location to the south of the original pad. In order to construct it at the new location, MW-22 had to be destroyed. Further investigative work at the Plating Shop is planned for CY99.

5.2.4 Test Lab and Central Lab

5.2.4.1 Background

Monitoring Well 24 was installed between the Test Lab and Central Lab in CY99 at the site of a former leaking diesel pump. Contaminated soil was removed and the well was installed to monitor for the possible presence of diesel fuel, which has never been detected in this well. Chlorinated solvents have been detected, and investigative work is ongoing as described below.

5.2.4.2 CY98 Results and Issues

A soil gas survey and soil borings were drilled to delineate the sources of contamination. Results of the investigation indicate three possible source areas including one adjacent to the Test laboratory and two adjacent to the Central Laboratory. Based on the results of the field program, an additional well will be installed at the Test Laboratory in CY99. Results of the investigative work at the Test Lab/Central Lab area will be detailed in the site characterization report for the Test Lab/Central Lab area. This report will be submitted to the RWQCB in late CY99.

5.3 Quality Assurance

As described in the *Quality Assurance Project Plan* and the *Standard Operating Procedures*, SLAC conducts a data validation review for all data collected for RI/FS activities.

5.4 Groundwater Monitoring Program

Major documents to support the investigative work include:

1. *Remedial Investigation/Feasibility Study (RI/FS) Workplans*.
2. *Standard Operating Procedures*.
3. *Quality Assurance Project Plan*.
4. *Annual Well Inspection and Maintenance Manual*.

Note: *The components of the Groundwater Monitoring Program are described in the following subsections.*

5.4.1 Documentation of the Groundwater Regime with Respect to Quantity and Quality

The groundwater regime at the SLAC site and nearby off-site areas has been comprehensively documented in the SLAC *Hydrogeologic Review* completed in CY94. This report compiled data and summarized results of the numerous geologic, hydrogeologic, and hydrogeochemical investigations that have taken place at or near SLAC for various reasons:

- Water resources studies
- Research
- Geotechnical studies (used to site the structures being built at SLAC)
- Environmental and monitoring purposes

The report developed a conceptual model of the groundwater regime at SLAC. Of particular interest to studies of contaminant transport was the fact that the major bedrock unit underlying SLAC conveyed groundwater primarily by fracture flow. Based on numerous tests in exploratory borings and wells, the hydraulic conductivity of this bedrock was much less than the range of hydraulic conductivity generally accepted as representing natural aquifer material.

A *Beneficial Use Assessment*, which included a well survey of the area around SLAC, provided information on possible beneficial uses of groundwater at SLAC, as outlined in the *California Regional Water Quality Control Board Basin Plan*. This report concluded that because groundwater at SLAC has a very high TDS content (as high as 10,000 milligrams per liter) and a very low rate of flow, it is not suitable for most potential beneficial uses. An updated well survey was completed in CY98 as part of the site characterization of the FSUST Area. No new wells were identified in the updates.

5.4.2 Identification and Summary of Potentially Contaminated Areas

The SLAC 1992 report entitled *Identification and Summary of Potentially Contaminated Sites* provides a summary of areas that may be contaminated by hazardous substances. Information for the report was collected from a variety of sources including spill reports, aerial photographs, operations records, reports on previous investigations, and interviews with SLAC personnel throughout the facility.

5.4.3 Strategies for Controlling Sources of Contaminants

Strategies for contaminant source control involve measures to control known soil or groundwater contamination, and procedures to address practices that may contribute to groundwater contamination. In addition, the Stormwater Pollution Prevention Plan and the Spill Prevention, Control, and Countermeasure Plan discuss best management practices for preventing contamination at the SLAC facility. *Environment, Safety, and Health Manual* chapters on Secondary Containment and Oil-filled Equipment Management Programs address practices for preventing contamination from reaching soil or groundwater.

To reduce the threat of groundwater contamination further, SLAC has established Waste Minimization and Pollution Prevention Awareness programs. These programs have promoted source control through the reduction of hazardous material usage and hazardous waste generation. This was accomplished by encouraging environmentally conscious engineering and by increasing employee awareness.

5.4.4 State- and DOE-Required Remedial Action Program

An RI/FS Workplan written following Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance addresses soil and groundwater contamination at SLAC. Associated documents include a *Quality Assurance Project Plan* and associated *Standard Operating Procedures for Environmental Protection and Restoration*. These documents provide overall guidance for the remedial action program.

DOE Order 5400.4 required SLAC to follow CERCLA RI/FS guidance. Although no longer required, SLAC still follows applicable parts of CERCLA technical guidance in developing strategies and preparing documentation. Actual National Priority List (CERCLA) San Francisco Bay sites are under the oversight of the EPA or designated alternative agencies. The RWQCB provides oversight of SLAC.

5.5 Restoration Activities

SLAC first began to develop a comprehensive Environmental Restoration Program (ERP) in CY91. The program delineates how SLAC will address environmental contamination problems from discovery and characterization through remediation and long-term monitoring or maintenance, if required. The restoration approach at SLAC is as follows:

1. Identify sites with actual or potential contamination (involving soil, groundwater, surface water, and/or air).
2. Prioritize contaminated sites based on site complexity, nature of contamination, associated risks, remaining data needs, and projected remedy.
3. Perform investigations and identify remedies protective of human health and the environment, beginning with the highest-priority sites.

SLAC is generally at step 3 above. Investigative work this past year has proceeded for contaminated groundwater sites which are discussed in this section. SLAC personnel continued to be actively involved in various public participation activities throughout CY98. In particular, SLAC participated in the CRMP process, a watershed management group for San Francisquito Creek.

SLAC follows general CERCLA technical guidance in investigating and remediating soil and groundwater contamination. SLAC is not, however, listed in the National Priorities List as a Superfund site and is not required to follow formal CERCLA procedures. The California RWQCB provides oversight and approval of restoration activities at SLAC.

In CY98, SLAC's ERP continued investigation for site characterization and evaluation of remedial alternatives. Four groundwater sites have been identified and are being monitored. One of these sites is monitored on a semi-annual basis under state RWQCB Waste Discharge Order No. 85-88.

Remediation of sites impacted with PCBs continued in CY98 at the Master Substation. A total of 4,366 tons of soil and concrete were excavated and disposed of as part of remedial activities. Work was conducted with oversight from the San Mateo County Department of Health Services.

A community relations plan was completed and distributed to the surrounding community in CY93. SLAC community relations activities currently center on the monthly meetings of the Steering Committee for the CRMP process for the San Francisquito Creek watershed.

5.6 Groundwater Monitoring Program

The restoration program at SLAC manages a groundwater monitoring program that includes planning, integration, and coordination of all supporting activities. Completed documents include:

- *Site Characterization and Evaluation of Remedial Alternative Workplans* and progress reports.
- *Quality Assurance Project Plan* and associated *Standard Operating Procedures*.

SLAC has a groundwater monitoring network comprised of 21 wells. These wells were constructed in areas of the facility that historically and/or currently store, handle, or use chemicals that may pose a threat to groundwater quality. In CY98, samples were collected from monitoring wells on a semi-annual basis and analyzed for a wide range of chemical constituents.

As reported in previous Annual Site Environmental Reports, results of the analyses indicated that water in several of the wells at four sites contained levels of chlorinated solvents at or above the State of California Maximum Contaminant Levels for drinking water. However, relatively high total dissolved solids (TDS) values and low yields indicate that the groundwater at SLAC is not suitable for drinking water. Further definition of the extent of contamination is being performed during the site-wide investigations that began in CY97.

A Model for Potential Dose Assessment

According to Department of Energy (DOE) Orders, an assessment of whole-body dose equivalent (in person-rem) to the general population near SLAC is required where appropriate. For this report, the term dose equivalent simply will be called dose. SLAC's dose to the maximally exposed member of the general public due to accelerator operations was conservatively estimated to be 4.6 mrem (0.046 mSv) in CY98 from penetrating radiation. The 4.6 mrem (0.046 mSv) value is approximately 1.5% of the total natural background dose and is 4.6% of the dose limit for members of the general population, that is, 100 mrem (1 mSv) per year (DOE Order 5400.5).

There are three major pathways leading to human exposure from human-made ionizing radiation:

- Airborne Radioactivity.
- Food Chain Radioactivity.
- 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 sources of this exposure are from neutrons resulting from the absorption of high-energy electrons, from photons from klystron operations, and/or from the experimental areas where energetic particles are created, some of which may 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 radiological environment be known, that is, background radiation. This is true because the instruments used respond to natural radiation sources as well as human-made sources, and the portion due to natural radiation must be subtracted from the total measurement. The population exposure assessments appearing in this report are in all cases overstatements, due to the conservative modeling assumptions used compared to the likely actual impact; hence, the resulting values are representative of an upper limit of the possible range.

While the annual radiation 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 Environmental Protection Agency (EPA) report, the average dose from cosmic, terrestrial, and internal radiation (not including radon) in California is 125 mrem (1.25 mSv). For purposes of comparison, we have rounded this number down to 100 mrem (1 mSv).

Another quantity of interest is the population dose in units of person-rem (person-cSv). 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 (1 mSv), then the population dose is 0.1 x 1,000 or 100 person-rem (1 person-Sievert) from natural background radiation. The annual variation of exposure to natural background radiation may be ± 20%, largely caused by differences in naturally occurring uranium, thorium, and potassium present in the ground and in building material where people live and work.

Most of the high energy accelerator laboratories have made measurements to determine the characteristic attenuation of radiation fields from their facilities. These measurements are unique to each facility because of design differences, types of machines, and surrounding topography. We have chosen a conservative formula for calculating the dose at distances other than the point of measurement. Lindenbaum gave a method for evaluating skyshine which was later verified by Ladu using Monte Carlo techniques. Lindenbaum approximated the falloff by $(e^{-R/\lambda})(R^{-1})$ where R is distance in meters from the source and $\lambda = 250$ m. This equation fits the SLAC data fairly well for neutron doses and is the one used to predict skyshine doses beyond our measuring stations (see Figure A-1). It is likely that the methods used and reported in this document could overestimate the true population dose by at least an additional factor of two. This model is used for photon skyshine as well as a conservative model for neutron.

In CY98, the doses to the public were dominated by photon radiation from either the klystrons or the accelerator with neutron doses being insignificant. The model used for evaluating the dose to the general public was as follows:

A. Maximally Exposed Member of the General Public:
   1. Determined the closest locations of the general public to the facility.
   2. Evaluated the thermoluminescent dosimeter (TLD) data closest to these locations.
   3. Determined the source of the radiation as seen by the TLD station.
   4. Extrapolated the photon dose from the source to the general public using a conservative line source geometry (1/R relationship), if the source was klystron radiation. In locations where the line source geometry may not have been accurate, it was conservative.
   5. Extrapolated the neutron dose or photon dose from accelerator radiation using the Lindenbaum approximation.
   6. Evaluated TLD data to determine the highest dose locations.
   7. Determined the location of the general public closest to these TLD locations.
   8. Extrapolated the photon dose from the source to the general public using a conservative line source geometry (1/R relationship), if the source was klystron radiation. In locations where the line source geometry may not have been accurate, it was conservative.
   9. Extrapolated the neutron dose or photon dose from accelerator radiation using the Lindenbaum approximation.
   10. Reported the highest dose to any member of the general public as the maximally exposed individual.

B. Collective Dose to the General Public:
   1. Established a population grid out to 80 km from the facility.
   2. Determined the highest site boundary TLD dose.

3. Applied this dose conservatively to the whole facility.
4. Applied this dose to the population grid using a line source geometry (1/R relationship) out to 500 meters of the facility and a point source geometry (1/R^2 relationship) from 501 meters to 80,000 meters.
5. Extrapolated the neutron dose using the Lindenbaum approximation.
6. Summed all the population doses from the grid.

The population demographics in the vicinity of SLAC, that is, within an 80 km radius, include a mixture of commercial and residential dwellings. Based on the data from the 1990 census, the population estimate in this area is about 4,917,443 residents. Based on the TLD results, the maximum dose at the SLAC site boundary was about 44 mrem in CY98. Using this maximum dose value, it was estimated that the collective dose to the population within 80 km of SLAC was about 9.93 person-rem (0.0993 person-Sv).

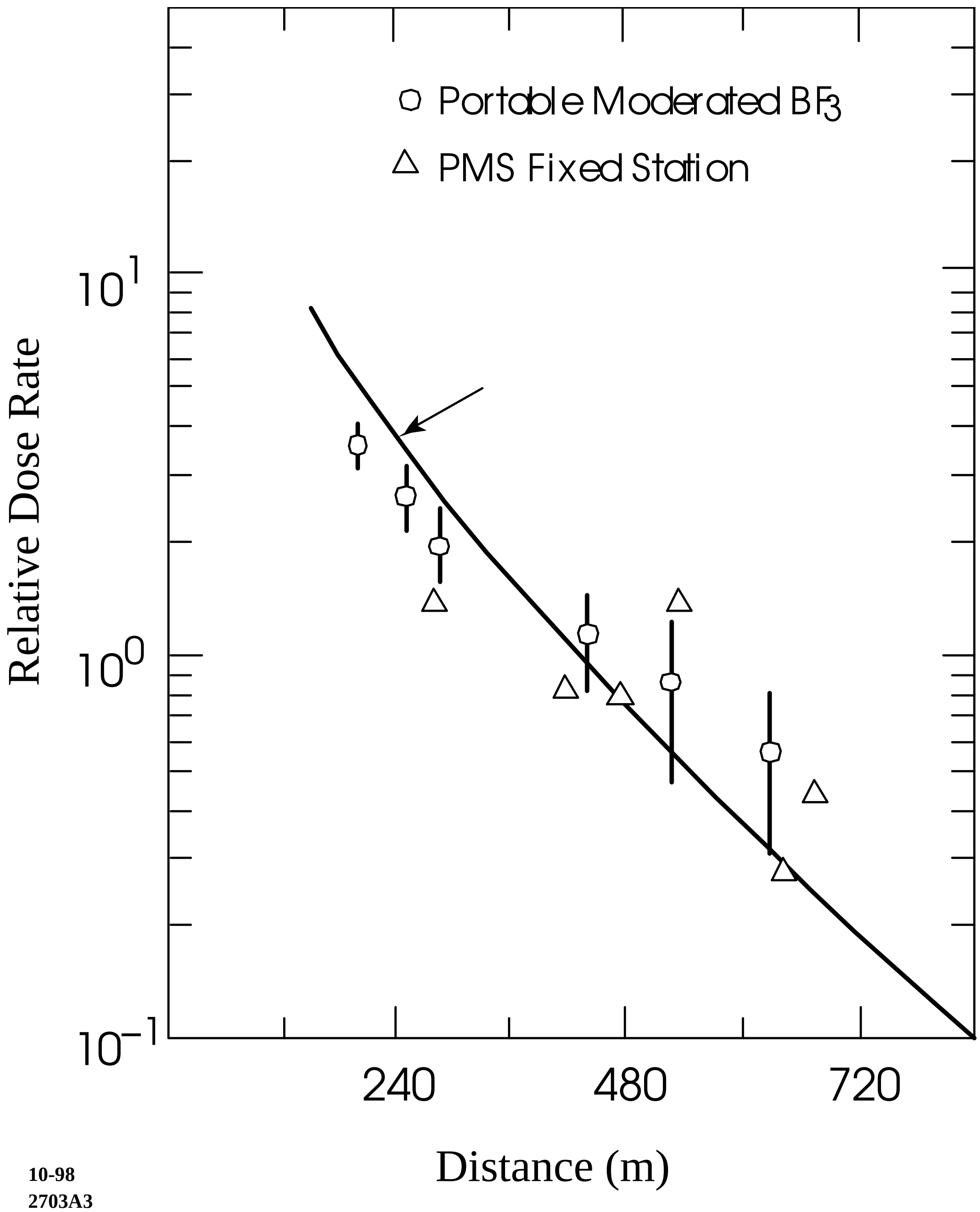

Figure A-1 Neutron Measurements Made Along a Line Between End Station A and the Site Boundary.

Note: *The relative dose rate is normalized with respect to beam power.*

B NESHAPs Report

Original report published in June 1999.
Table and section formats reflect those of the original.

1.1 Facility Information

Stanford Linear Accelerator Center (SLAC) was in full compliance in calendar year 1998 (CY98) with the requirements set forth in 40 CFR Part 61 Subpart H.

1.1 Site Description

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. 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 (175 to 375 feet) above sea level, whereas the alluvial plain to the east around the Bay lies less than 46 meters (150 feet) above sea level. The mountains to the west rise abruptly to 610 meters (2,000 feet). The SLAC site occupies 170 hectares (420 acres) 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 1,400 employees, temporary staff, and visiting scientists. The climate in the SLAC area is Mediterranean. Winters are cool, with intermittent rains, and summers are mostly warm 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 1990 census for these five communities are shown in Table 1 below:

Table 1: Table 1 Demographic Data

Geographic Area	**Population** [persons]	**Pop. Density** [persons/sq.mile]	**Housing** [units]	**Land Area** [sq. mile]
Atherton town	7,163	1,463.32	2,518	4.895
West Menlo Park	3,959	7,086.19	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	6,569.14	4,770	2.755
Total:	38,448	NA	12,556	29.106

C Calibration and Quality Assurance Procedures

The recording of natural background radiation provides continuous verification that the monitoring equipment at SLAC is connected and functioning properly. Also, backgrounds collected during accelerator downtimes and any interrupted operations provide additional information for establishing the calibration baseline.

C.1 Direct Radiation Monitoring Equipment

A regular calibration procedure was performed on the Peripheral Monitoring Stations in CY98. Radiation sources were placed at a measured distance from the detector to produce a known dose equivalent rate, for example, 1 mrem/h (0.01 mSv/h).

The equipment is kept in normal operation during these checks. The data printout is marked so that the calibration data is not confused with actual measurements of machine-produced radiation. This procedure will be carried out at least once each year, and following any equipment repair or maintenance actions.

An appropriate response to natural background radiation provides evidence that the instruments are operating properly. An improved calibration program is under development.

C.2 Liquid Radiological Effluents

Water samples are analyzed in-house with a liquid scintillation counter and a hyper-pure germanium detector as necessary. Both pieces of equipment are calibrated with appropriate National Institute of Standards and Technology traceable sources.

D Environmental TLD Measurements for CY98

This appendix contains data on environmental thermoluminescent dosimeter (TLD) measurements for CY98, including:

- Summary of net photon and neutron doses for CY98.
- Environmental TLD Monitoring Stations (Table D-1).

Notes:

TLD Type	Nominal Minimum Detectable Levels	Type of Radiation Detected
Al_2O_3:C (LDR-X9 Landauer Company)	0.02 mrem	Gamma
NeutrakER (LDR-I9 Landauer Company)	10 mrem	Neutron

D-1 Net Annual Doses for CY98

TLD Location	TLD #	Net Photon Dose (mrem)			Net Neutron Dose (mrem)
Transport Control	—	NA			M[a]
Deployment Control	—	NA			M[a]
SB at Region 6	1	3.9	+/-	5.8	M[a]
SB at Injector	2	4.5	+/-	6.2	M[a]
Computer Center SE Corner	3	1.2	+/-	6.6	M[a]
SB at Region 4	4	3.2	+/-	6.8	M[a]
SB at North Damping Ring	5	22.6	+/-	9.4	M[a]
I-280 Overpass South	6	11.0	+/-	5.9	M[a]
SB at Sector 10 south	7	9.2	+/-	7.8	M[a]
SB across from B of A	8	9.2	+/-	6.5	M[a]
Alpine Gatehouse	9	5.7	+/-	6.1	M[a]
Meteorological Tower	10	1.4	+/-	5.7	M[a]
SB at SLD	11	6.2	+/-	6.1	M[a]
SB at Region 12	12	2.8	+/-	7.1	M[a]
SB at Region 2	13	-2.9	+/-	5.7	M[a]
SLAC Entrance Gatehouse	14	6.1	+/-	6.5	M[a]
SLAC Cafeteria	15	3.9	+/-	5.7	M[a]
SB at Region 8	16	0.7	+/-	5.9	M[a]
SB at Addison Wesley Building	17	7.3	+/-	6.4	M[a]
SB at Positron Vault	18	5.9	+/-	7.4	M[a]
Control	19	17.2	+/-	7.2	M[a]
SB at Sector 20 south	20	15.1	+/-	6.9	M[a]
SB at South Damping Ring	21	5.3	+/-	6.3	M[a]
I-280 Overpass North	22	15.9	+/-	7.1	M[a]
SB at Sector 21 south	23	14.6	+/-	7.6	M[a]
SB at building 81	24	0.5	+/-	6.5	M[a]
RAMSY	25	-7.2	+/-	6.3	M[a]
PMS 1	26	14.2	+/-	6.3	M[a]
PMS 2	27	5.7	+/-	6.0	M[a]
PMS 3	28	13.7	+/-	7.2	M[a]
PMS 4	29	6.4	+/-	5.9	M[a]
PMS 5	30	7.3	+/-	6.4	M[a]
PMS 6	31	16.7	+/-	6.0	M[a]
PMS 7	32	8.1	+/-	6.2	M[a]
SB at Sector 24 north	33	-2.1	+/-	7.7	M[a]
SB at Sector 17 north	34	9.7	+/-	6.3	M[a]
SB at Sector 5 north	35	43.7	+/-	8.4	M[a]

[a] Below the minimum detection limit.

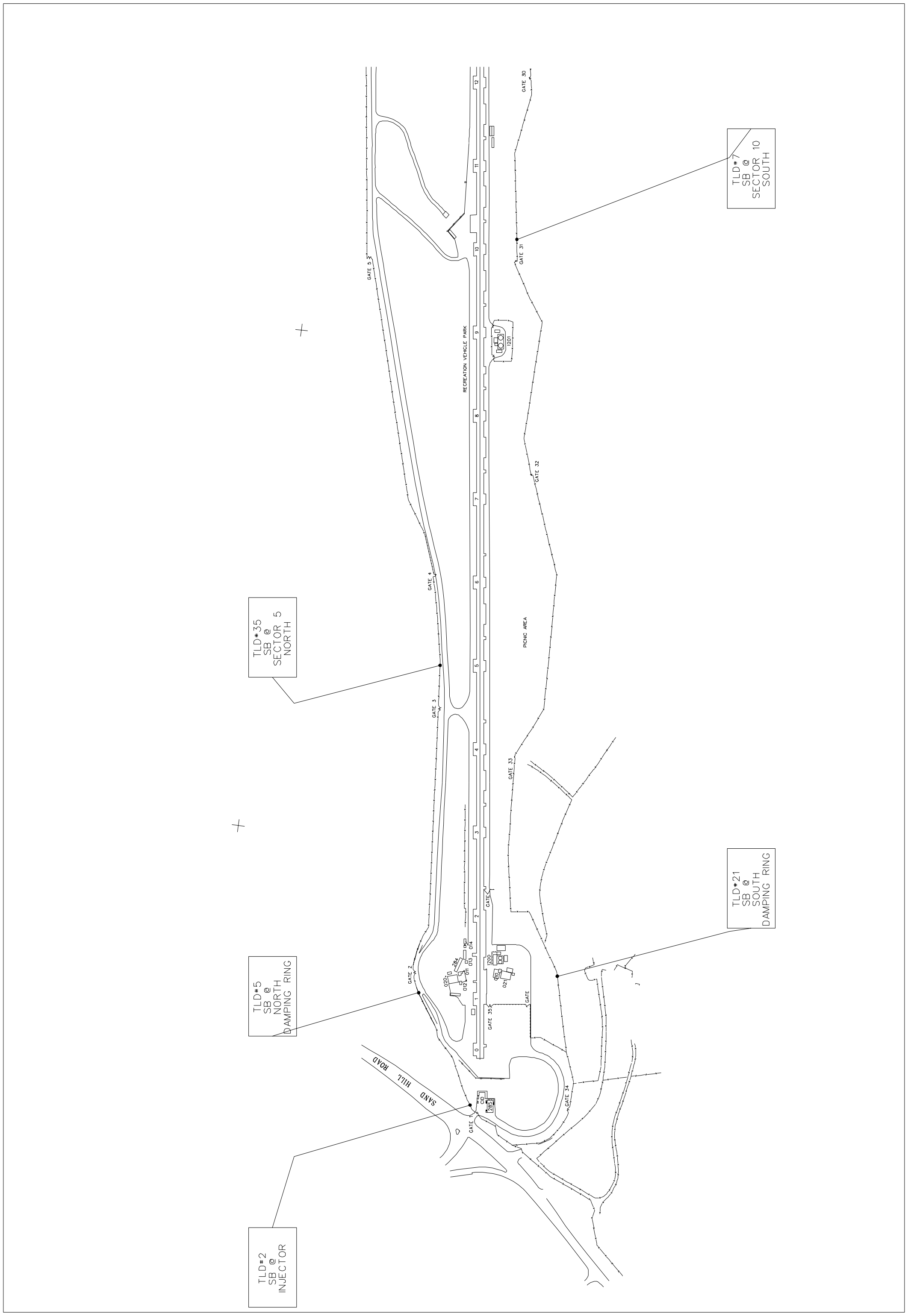

Figure D-1 Environmental TLD Monitoring Stations, Sectors 0 through 12

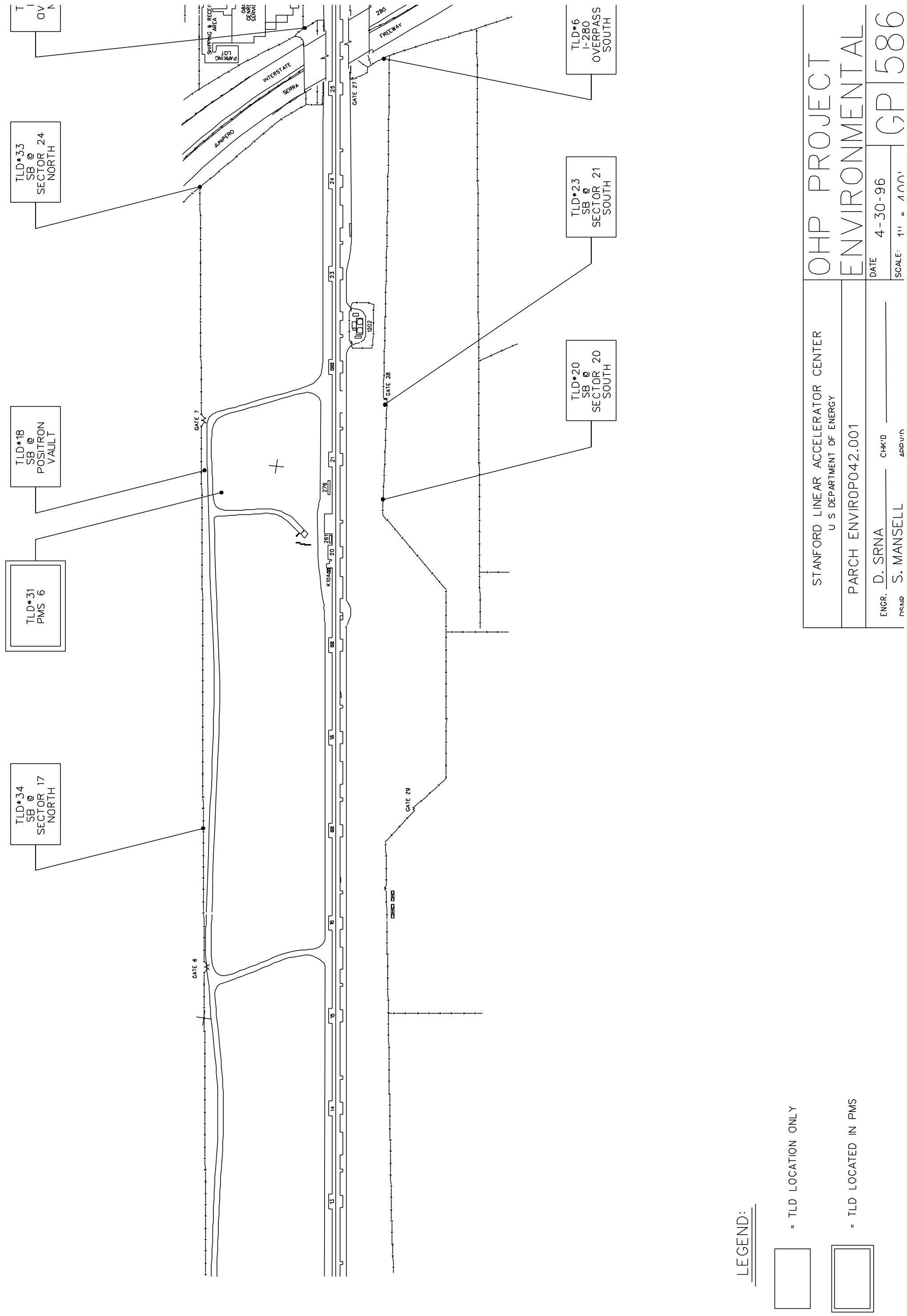

Figure D-2 Environmental TLD Monitoring Stations, Sectors 12 through 27

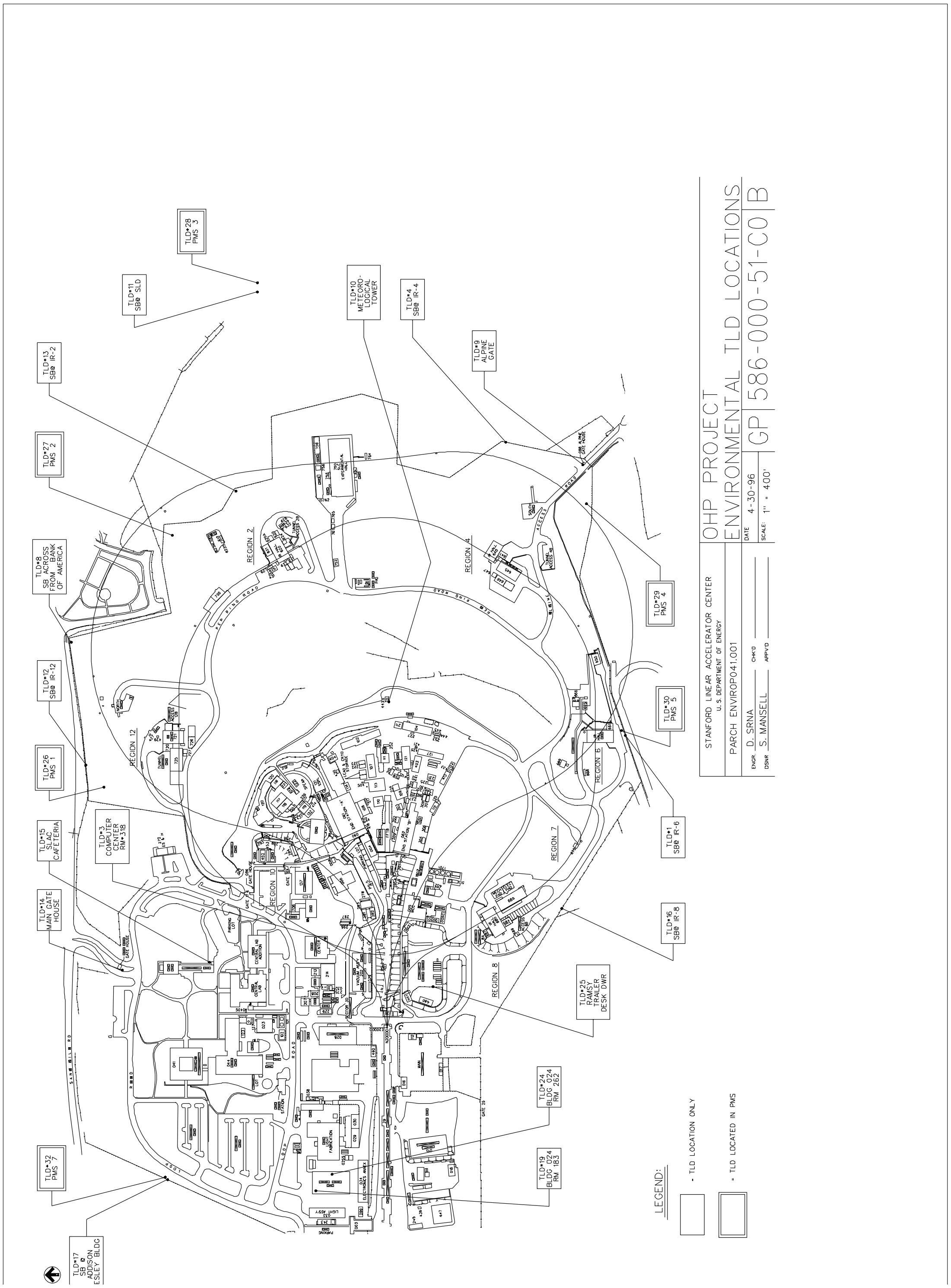

Figure D-3 Environmental TLD Monitoring Stations, Sector 27 through SLC

E Acronym List

A

ALARA As Low As Reasonably Achievable

B

BAAQMD Bay Area Air Quality Management District
BDE Beam Dump East
BMP Best Management Practice
BPO Basin Plan Objective
BSY Beam Switchyard
BTP Batch Treatment Plant

C

CAA Clean Air Act
CalARP California Accidental Release Prevention Program
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CEQA California Environmental Quality Act
CHWMA Central Hazardous Waste Management Area
COE Army Corp of Engineers
CPM Counts Per Minute
CRMP Comprehensive Resource Management and Planning
CWA Clean Water Act
CX Categorical Exclusion
CY Calendar Year

D

DCE Dichloroethene
DCG Derived Concentration Guide
DEAR DOE Acquisition Regulations
DFG Department of Fish and Game
DOE Department of Energy
DOE/OAK DOE Oakland Operations Office

E

EA Environmental Assessment
EC Electrical Conductivity
EDE Effective Dose Equivalent

EEECA	Engineering Evaluation and Cost Analysis
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EML	Environmental Measurements Laboratory
EMSL-LV	Environmental Monitoring Systems Laboratory- Las Vegas
EPR	Environmental Protection and Restoration
ERP	Environmental Restoration Program
ES&H	Environment, Safety, and Health
ESA_2	End Station A
ESA_1	Endangered Species Act
ESHCC	Environment, Safety, and Health Coordinating Council

F

FEMA	Federal Emergency Management Agency
FFS	Final Focus System
FFTB	Final Focus Test Beam
FHWSA	Former Hazardous Waste Storage Area
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FMS	Flow Meter Station
FSUST	Former Solvent Underground Storage Tank
FUST	Former Underground Storage Tank

G

GPMP	Groundwater Protection Management Program
GPP	General Plant Project

H

HMBP	Hazardous Materials Business Plan
HPGe	Hyper-pure Germanium
HWMC	Hazardous Waste and Material Coordinator
HWMG	Hazardous Waste Management Group

I

IR	Interaction Region
IRA	Interim Removal Action

K

kWh	kilowatt-hour

L

LA	Local Authority
LCW	Low Conductivity Water
linac	Linear Accelerator
LSC	Liquid Scintillation Counter

M

MCC	Main Control Center
MCL	Maximum Concentration Level
MEI	Maximally Exposed Individual
MFD	Mechanical Fabrication Department
MPMWD	Menlo Park Municipal Water Department
MW	mega-watt

N

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NLC	Next Linear Collider
NLCTA	Next Linear Collider Test Accelerator
NOI	Notice of Intent
NO_X	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NVLAP	National Voluntary Laboratory Accreditation Program

O

ODS	Ozone-Depleting Substance
OHP	Operational Health Physics

P

PCB	Polychlorinated Biphenyl
pCi/l	Pico-curies per Liter
PED	Plant Engineering Department
PEL	Physical Electronics Laboratory
PEP	Positron-Electron Project
PEP-II	Asymmetric *B* Factory
PMS	Peripheral Monitoring Station
ppb	parts per billion
ppm	parts per million
POTW	Publicly Owned Treatment Works
PPO	Program Planning Office
PS	Positron Source

Q

QA	Quality Assurance
QAP	Quality Assessment Program
QC	Quality Control

R

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RMP	Risk Management Plan
ROI	Return-on-Investment
RP	Radiation Physics
RQ	Reportable Quantity
RWQCB	Regional Water Quality Control Board
RWTP	Rinse Water Treatment Plant

S

S&E	Safety and Environmental
SARA	Superfund Amendments and Reauthorization Act
SBSA	South Bayside System Authority
SDWA	Safe Drinking Water Act
SER	Site Environmental Report
SHA	Safety, Health, and Assurance
SLAC	Stanford Linear Accelerator Center
SLC	Stanford Linear Collider
SLD	SLAC Large Detector
SMC/DHS	San Mateo County Department of Health Services
SMS	Safety Management System
SPCC	Spill Prevention, Control, and Countermeasure Plan
SPEAR	Stanford Positron-Electron Asymmetric Ring
SSRL	Stanford Synchrotron Radiation Laboratory
Sv	Sievert
SWPPP	Storm Water Pollution Prevention Plan

T

TCA	Trichloroethane
TCE	Trichloroethene
TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimeter
TPH	Total Petroleum Hydrocarbons
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TSS	Total Suspended Solids
TTO	Total Toxic Organics

U

USEPA US Environmental Protection Agency

V

VOC Volatile Organic Compound

W

WAA Waste Accumulation Area
WBSD West Bay Sanitary District
WSS Work Smart Standards
WM Waste Management
WTS Waste Tracking System

F ASER Distribution List

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Annual Site Environmental Report
Reader Survey

To Our Readers:

Each annual Site Environmental Report publishes the results of environmental monitoring at SLAC and documents our compliance with federal, state, and local environmental regulations. In providing this information, our goal is to give our readership—whether they be regulators, scientists, or the public—a clear accounting of the range of environmental activities we undertake, the methods we employ, the degree of accuracy of our results, the status of our program, and significant issues affecting programs.

It is important that the information we provide is easily understood, of interest, and communicates SLAC's effort to protect human health and minimize our impact on the environment. We would like to know from you whether we are successful in achieving these goals. Your comments are appreciated.

1. Is the writing ☐ too concise? ☐ too verbose? ☐ uneven? ☐ just right?
2. Is the technical content ☐ too high? ☐ too low? ☐ uneven? ☐ just right?

		YES	NO
3.	Is the report comprehensive?	☐	☐
4.	Do the illustrations help you understand the text better?	☐	☐
	Are the figures understandable?	☐	☐
	Are there enough figures?	☐	☐
	Are there too few figures?	☐	☐
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5.	Are the data tables of interest?	☐	☐
	Would you prefer short summaries of data trends instead of data tables?	☐	☐
6.	Is the background information sufficient?	☐	☐
7.	Are the methodologies described reasonably understandable?	☐	☐
8.	Is the acronym list useful?	☐	☐
9.	Are the appendices useful?	☐	☐

Other comments:

This survey may be folded and stapled and returned to SLAC. Laboratory staff may send their survey forms through laboratory mail to Gene Holden, Mailstop 84.

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