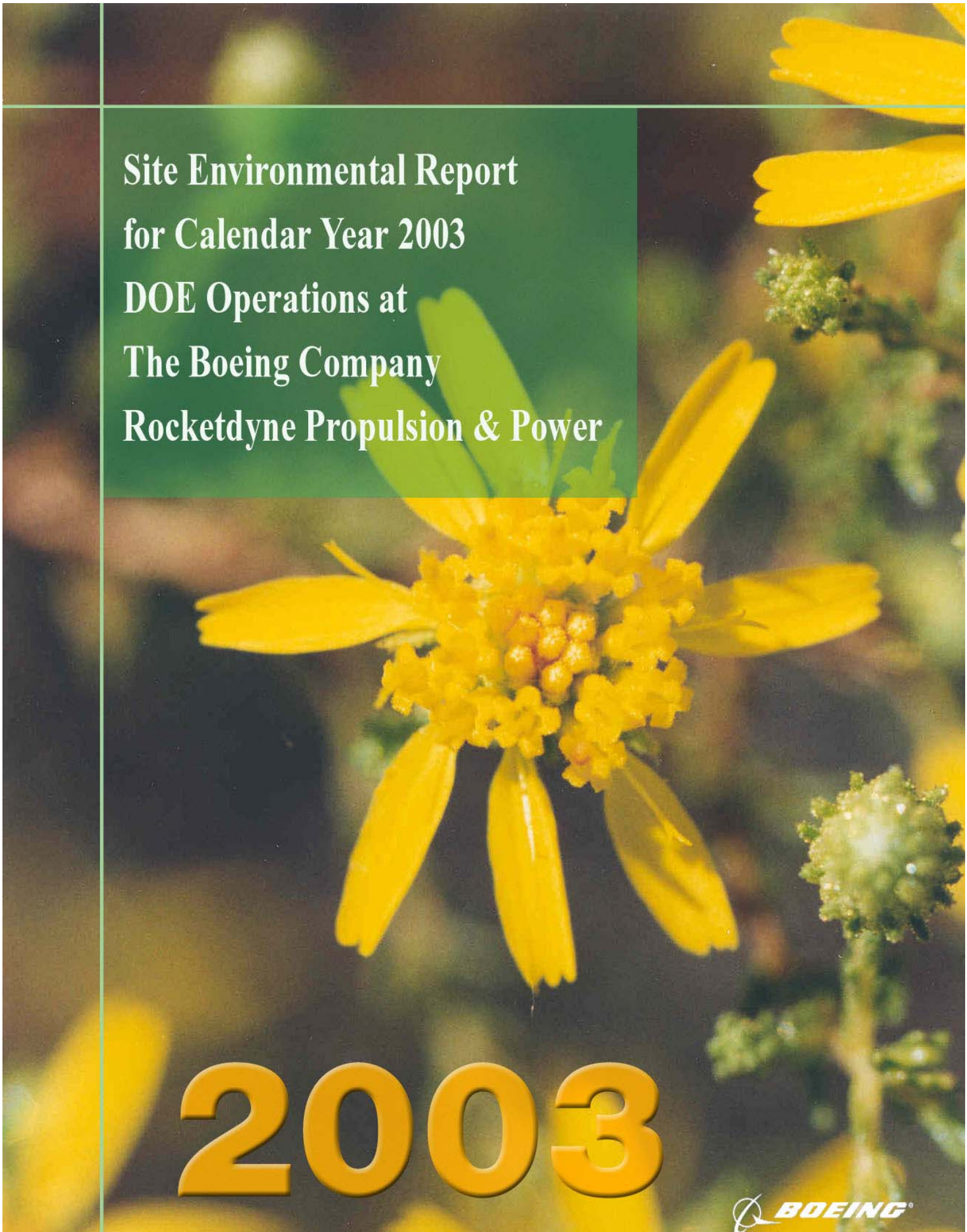

Site Environmental Report for Calendar Year 2003 DOE Operations at The Boeing Company Rocketdyne Propulsion & Power

2003

BOEING®

Site Environmental Report for Calendar Year 2003 DOE Operations at The Boeing Company, Rocketdyne Propulsion & Power

Prepared by the staff of

The Boeing Company,
Rocketdyne Propulsion & Power

September 2004

ESCS 040470

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CERTIFICATE OF ACCURACY

I certify that I have personally examined and am familiar with the information submitted herein and, based on inquiry of those individuals immediately responsible for preparing this report, I believe that the submitted information is true, accurate, and complete.

Majelle E. Lee
Program Manager
DOE Site Closure
The Boeing Company
Rocketdyne Propulsion & Power

September 17, 2004

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Department of Energy
National Nuclear Security Administration
Service Center
P. O. Box 5400
Albuquerque, NM 87185

September 17, 2004

Distribution:

SUBJECT: 2003 Site Environmental Report for the Energy Technology Engineering Center (ETEC)

Dear Sir or Madam:

The Boeing Company has prepared the subject report for the U. S. Department of Energy (DOE). It is a comprehensive summary of the Department's environmental protection activities at ETEC in Canoga Park, California for Calendar Year 2003. Site environmental reports are prepared annually for all DOE sites with significant environmental activities and distributed to external regulatory agencies, interested organizations, and individuals.

To the best of my knowledge this report accurately summarizes the results of the 2003 environmental monitoring and restoration program at ETEC for DOE. This statement is based on reviews conducted by NNSA Service Center staff and by the staff of the Boeing Company.

A reader survey form is provided with this report to provide comments. Write directly to:

U. S. Department of Energy
National Nuclear Security Administration
1301 Clay Street
Post Office Box 54
Oakland, CA 94612

Questions may also be directed to Michael Lopez, U. S. Department of Energy, at (510) 637-1633.

Sincerely,

Laurence B. McEwen
Acting Manager
Oakland Environmental Programs Division

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ACKNOWLEDGMENT

Preparation of this report has been a collaborative effort of many members of Rocketdyne's Safety, Health and Environmental Affairs (SHEA) Department.

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Administrative assistance was provided by Pat Ohara.

The Proposal and Technical Support staff of the Boeing Creative Services group at Rocketdyne provided publication assistance.

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CONTENTS

TABLES

FIGURES

1. EXECUTIVE SUMMARY

This Annual Site Environmental Report (ASER) for 2003 describes the environmental conditions related to work performed for the Department of Energy (DOE) at Area IV of Boeing Rocketdyne's Santa Susana Field Laboratory (SSFL). In the past, the Energy Technology Engineering Center (ETEC), a government-owned, company-operated test facility, was located in Area IV. The operations at ETEC included development, fabrication, and disassembly of nuclear reactors, reactor fuel, and other radioactive materials. Other activities at ETEC involved the operation of large-scale liquid metal facilities that were used for testing liquid metal fast breeder components. All nuclear work was terminated in 1988; all subsequent radiological work has been directed toward decontamination and decommissioning (D&D) of the former nuclear facilities and their associated sites. Closure of the liquid metal test facilities began in 1996.

Results of the radiological monitoring program for the calendar year 2003 continue to indicate that there are no significant releases of radioactive material from Area IV of SSFL. All potential exposure pathways are sampled and/or monitored, including air, soil, surface water, groundwater, direct radiation, transfer of property (land, structures, waste), and recycling.

All radioactive wastes are processed for disposal at DOE disposal sites and/or other licensed sites approved by DOE for radioactive waste disposal. No liquid radioactive wastes were released into the environment in 2003.

Calculated radiation doses to the public due to airborne releases and direct radiation are virtually zero when compared to the applicable regulatory limits as well as the naturally existing background levels. These theoretically calculated doses are too small to measure, and they are calculated to provide upper-limit estimates of possible doses to the public. The radiation dose to a member of the public (maximally exposed individual) due to direct radiation from SSFL is indistinguishable from background, and the maximum dose due to airborne releases from SSFL is estimated to be 1.9×10^{-7} mrem. As a comparison, the annual dose from natural indoor radon activity is about 200 mrem, and the total annual dose from all natural sources is about 300 mrem.

Fifty-eight water samples from 31 groundwater wells in Area IV were sampled and analyzed for radiological contaminants during 2003. Only naturally occurring radioactivity was found in groundwater, except for, in four wells, low concentrations of tritium that are well below the Federal and State drinking water standards.

Currently, there are forty-seven on-site wells in Area IV of SSFL to characterize the hydrogeology and water quality of known groundwater chemical contamination. In addition, there are three interim groundwater remediation systems in Area IV, located at the Former Sodium Disposal Facility (FSDF), the Radioactive Material Handling Facility (RMHF), and Building 4059. Although trichloroethylene (TCE) was detected in these areas, no exposure to the public has occurred because no exposure pathways exist. Remediation of these contaminated areas continued in 2003.

During 2003, four Area IV regulatory agency inspections, audits, and visits were conducted. These inspections and visits were carried out by the California Department of Toxic Substances Control (DTSC), the California Department of Health Services Radiologic Health

Branch (DHS/RHB), Regional Water Quality Control Board (RWQCB), and the Ventura County Air Pollution Control District (VCAPCD).

In summary, this Annual Site Environmental Report provides information to show that there are no indications of any potential impact on public health and safety due to the DOE-sponsored operations conducted at Area IV of SSFL. The report summarizes the environmental and effluent monitoring results for the responsible oversight regulatory agencies. Due to the fact that the site is approaching final closure and radiological related work is winding down, DOE is planning to scale back the radiological monitoring at the site in calendar year 2004.

2. INTRODUCTION

This annual report describes the environmental monitoring program implemented by The Boeing Company, Rocketdyne Propulsion & Power, at its Santa Susana Field Laboratory (SSFL) facility located in Ventura County, California, for calendar year 2003. Part of the SSFL facility, known as Area IV, had been used for Department of Energy's (DOE) activities since the 1950s. A broad range of energy related research and development (R&D) projects, including nuclear technologies projects, was conducted at the site. All the nuclear R&D operations in Area IV ceased in 1988. Current efforts are directed toward decontamination and decommissioning (D&D) of the former nuclear facilities and closure of facilities used for liquid metal research.

2.1 SANTA SUSANA FIELD LABORATORY

The SSFL has been used for various research, development, and test projects funded by several U.S. government agencies, including DOE, Department of Defense (DOD), and National Aeronautics and Space Administration (NASA). The site consists of four administrative areas and undeveloped land. Figure 2-1 illustrates the arrangement of the site. Area IV has an area of approximately 290 acres.

Since 1956, various R&D projects had been conducted in Area IV, including small tests and demonstrations of reactors and critical assemblies, fabrication of reactor fuel elements, and disassembly and declading of used fuel elements. These projects were completed and terminated in the course of the next 30 years. Most of the work is described in detail in the Rocketdyne document, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory—A Factual Perspective* (Oldenkamp, 1991). The only work related to the nuclear operations since 1988 (and during 2003) was the ongoing cleanup and decontamination of the remaining inactive radiological facilities and the off-site disposal of radioactive waste.

The location of the SSFL site in relation to nearby communities is shown in Figure 2-2. Undeveloped land surrounds most of the SSFL site. No significant agricultural land use exists within 30 km (19 miles) of the SSFL site. While the land immediately surrounding Area IV is undeveloped, suburban residential areas are at greater distances. For example, 2.8 km (1.7 miles) northwest of Area IV is the closest residential portion of Simi Valley. The community of Santa Susana Knolls lies 4.8 km (3.0 miles) to the northeast. The Bell Canyon area begins approximately 2.3 km (1.4 miles) to the southeast, and the Brandeis-Bardin Institute is adjacent to the north.

The Los Angeles basin is a semiarid region whose climate is controlled primarily by the semi-permanent Pacific high-pressure cell that extends from Hawaii to the Southern California coast. The seasonal changes in the position of this cell greatly influence the weather conditions in this area. During the summer months, the high-pressure cell is displaced to the north. This results in mostly clear skies with little precipitation. During the winter, the cell moves sufficiently southward to allow some Pacific lows, with their associated frontal systems, to move into the area. This produces light to moderate precipitation with northerly and northwesterly winds.

Subdivisions			
Owner	**Jurisdiction**	**Acres**	**Subtotals**
Boeing, Rocketdyne	Boeing, Rocketdyne -Area IV	289.9	
	Boeing, Rocketdyne	784.8	
	Boeing, Rocketdyne (Undeveloped land)	1,324.6	2,399.3
Government	NASA (former AFP 57)	409.5	
	NASA (former AFP 64)	41.7	451.2
Total Acres			2,850.5

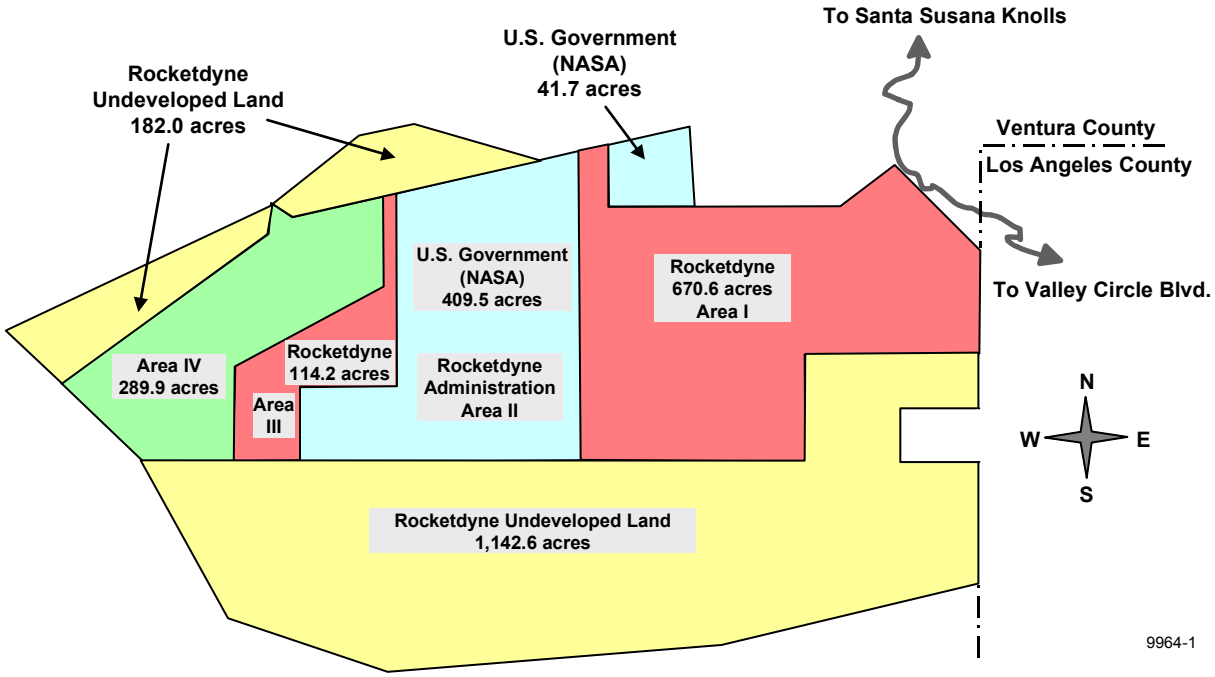

Figure 2-1. Santa Susana Field Laboratory Site Arrangement

During the summer, a shallow inversion layer generally exists in the Los Angeles area. The base and top of this inversion layer usually lie below the elevation of the SSFL site. Thus, any atmospheric release from the SSFL site during the summer would likely result in considerable atmospheric dispersion above the inversion layer prior to any diffusion through the inversion layer into the Simi Valley or San Fernando Valley. In the winter, surface airflow is dominated by frontal activity moving easterly through the area. Storms passing through the area during the winter are generally accompanied by rainfall. Airborne mixing varies depending on the location of the weather front relative to the site. Generally, a light to moderate southwesterly wind precedes these storms, introducing a strong onshore flow of marine air and producing slightly unstable air. Wind speeds increase as the frontal systems approach, enhancing mixing and dispersion. Locally, average wind speeds range from 0 to 4.4 m/s (0 to 9.8 mph), mostly from the north and northwest.

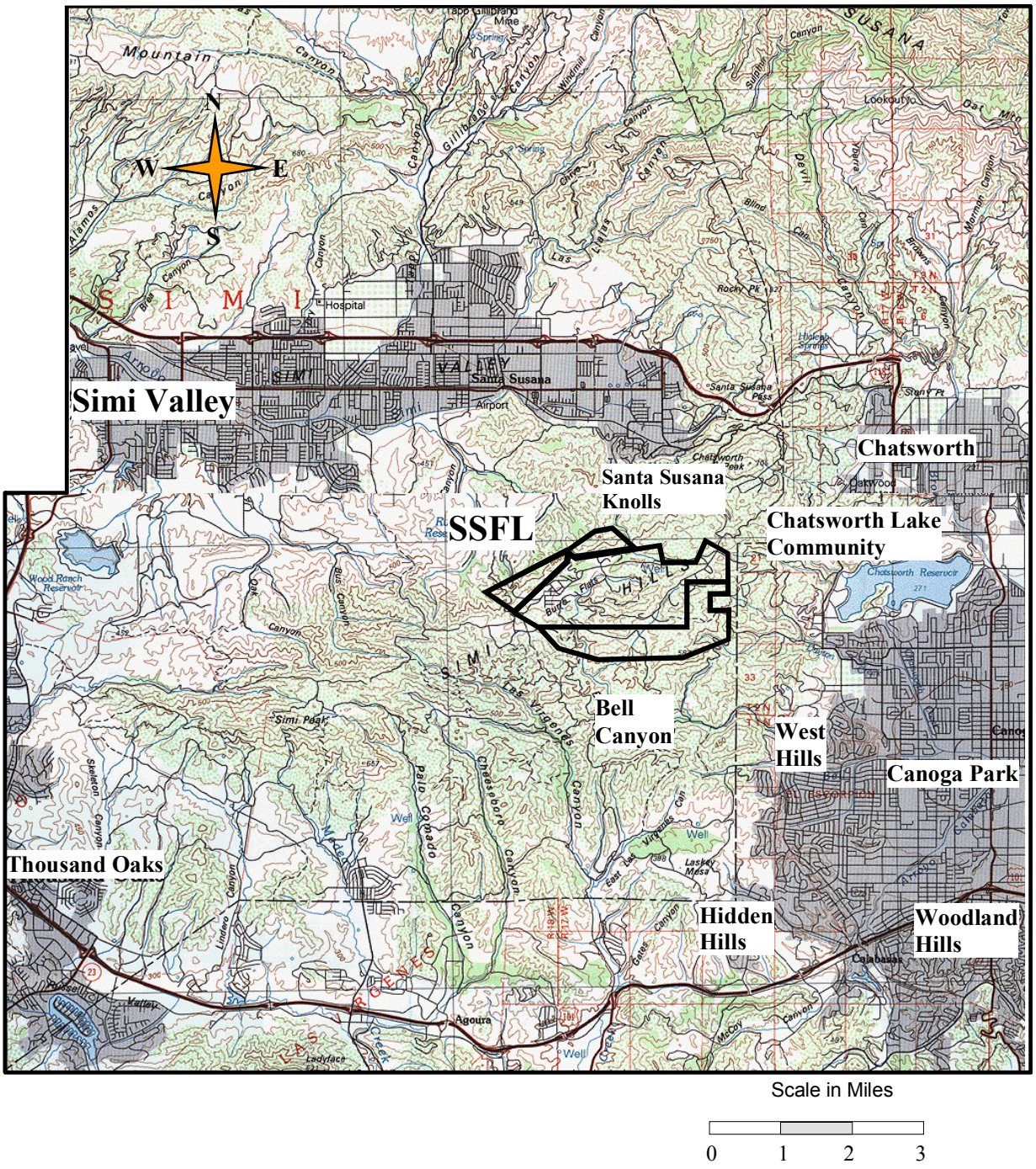

Figure 2-2. SSFL Location

Except for the Pacific Ocean, which is approximately 20 km (12 miles) south, no recreational body of water of noteworthy size is located in the surrounding area. Four major reservoirs providing domestic water to the greater Los Angeles area are located within 50 km (30 miles) of SSFL; the closest one to SSFL (Bard Reservoir, near the west end of Simi Valley) is more than 10 km (6 miles) from Area IV.

The SSFL site occupies 2,850 acres located in the Simi Hills of Ventura County, California, approximately 48 km (30 miles) northwest of downtown Los Angeles. The SSFL is situated on rugged terrain with elevations at the site varying from 500 to 700 m (1,650 to 2,250 ft) above sea level (ASL). Rocketdyne and DOE-operated facilities (Figures 2-3 and 2-4) share the Area IV portion of this site.

In 1998, DOE awarded Rocketdyne a contract for the closure of all DOE facilities in Area IV by 2006. Rocketdyne performs the environmental remediation and restoration activities for the DOE and other closure activities at SSFL.

2.2 FACILITY DESCRIPTIONS

The following facilities in Area IV of SSFL are undergoing cleanup for radiological and chemical, primarily sodium, constituents.

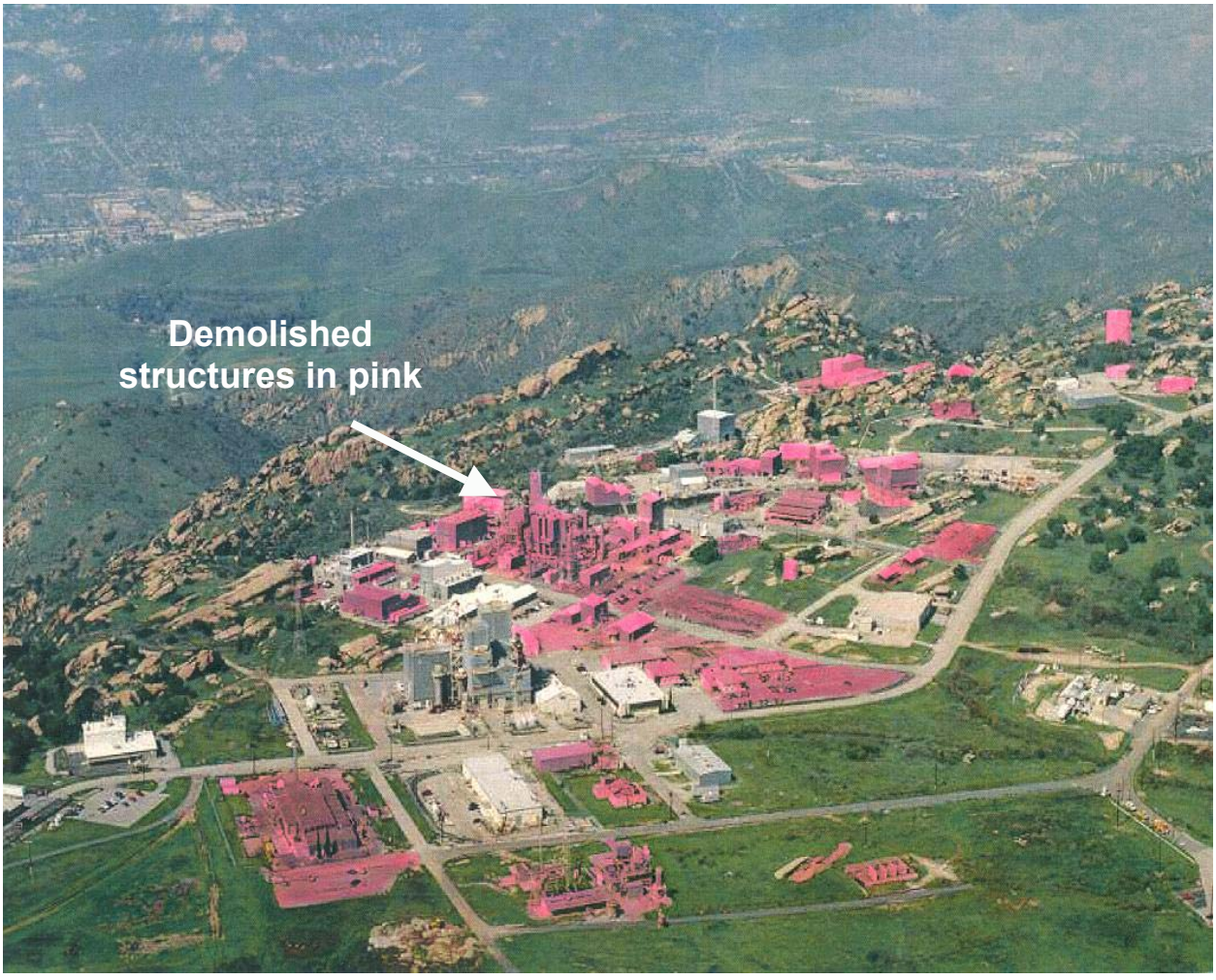

Figure 2-3. Santa Susana Field Laboratory Site, Area IV

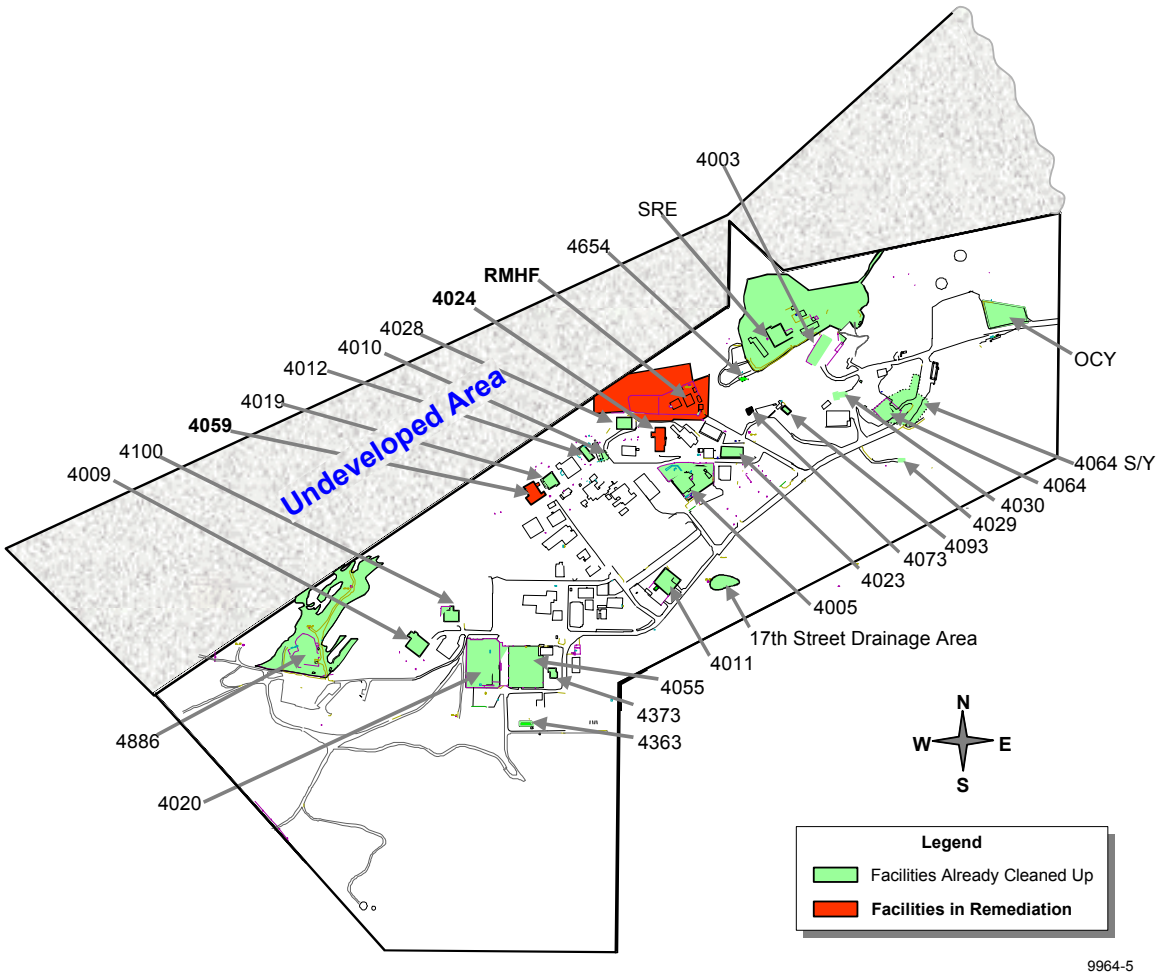

Figure 2-4. Prior and Current Radiological Facilities in Area IV

2.2.1 Radiological Facilities

Figure 2-4 shows a map of the legacy radiological facilities in Area IV. Three of these 28 facilities remain to be remediated.

Radioactive Materials Handling Facility (RMHF)

The RMHF complex consists of Buildings 4021, 4022, 4034, 4044, 4075, 4621, 4658, 4665 and 4688 and drainage pond 4614. Operations at RMHF include processing, packaging, and temporary storage of radioactive waste materials that are shipped off-site to DOE approved disposal facilities. Radioactive waste from decontamination operations includes uranium, transuranic (TRU) elements such as plutonium, mixed fission products such as Cs-137 and Sr-90, and activation products such as Co-60, Eu-152, and tritium.

Repackaging of the TRU waste was completed during 2002. The waste was transferred to DOE's Hanford site for interim storage.

In 2003 atmospheric effluents were released through a stack as a result of waste handling operations at the RMHF. The effluents were filtered and monitored before release into the atmosphere to ensure compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) requirements. No radioactive liquid effluents were released from the facility.

Building 4059

Operations at Building 4059 during the early 1990s consisted of removal of activated steel and concrete as part of the D&D of the former Systems for Nuclear Auxiliary Power (SNAP) reactor ground test facility. Activation products consist primarily of Fe-55, Eu-152, Co-60, and small amounts of H-3. No radiological operations were performed in the building in 2003. Initial demolition of the 4059 support structures was completed in 2003, and building debris were shipped to the Nevada Test Site per DOE instructions. The demolition of the building is scheduled for 2004.

Building 4024

Building 4024 houses two shielded vaults in its basement. During the 1960s, this building housed two experimental reactor systems. Following termination of the projects, all equipment and fuel were removed from the facility. The shielding concrete in the vaults currently contains low levels of activation products including cobalt-60 and europium-152/154. This radioactivity is confined, and the radiation levels inside the vaults are a fraction of a millirem/hour. No radiological operations were performed in the building in 2003. The facility is scheduled for final decommissioning and demolition in the 2004-2006 timeframe.

2.2.2 Former Sodium Facilities

Sodium and related liquid metal test facilities were constructed at ETEC to support development testing of components for liquid metal electrical power production systems. The facilities are no longer needed, and the objective is to remove sodium and other hazardous materials from the former sodium test facilities, dismantle the structural steel, concrete and utilities, and restore the land to previous conditions.

Sodium Pump Test Facility (SPTF)

Testing of the large electromagnetic pump was completed on October 4, 2001. Activities related to pump inspections lasted until mid-November. Following the pump inspections, preparations were begun to offload bulk sodium from the facility feed and drain tanks. In 2002, 316,630 pounds of bulk sodium was shipped offsite as excluded recyclable material. In 2003, an additional 56,000 pounds of bulk sodium was shipped offsite. Water vapor nitrogen (WVN) cleaning of facility piping and components will be carried out in 2004.

Former Sodium Disposal Facility (FSDF)

State of California regulatory approval of the Interim Closure Plan was obtained in 2000. Removal of the remaining chemically contaminated soil, backfilling the site with clean soil, and replacement of the vegetation to blend with the surrounding area were completed in 2000. Approximately 14,000 tons of soil was shipped to an off-site disposal facility between January and March 2001. In 2003, on-going activities at the site included continuing maintenance of the area, rainwater management, and support of closure activities.

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3. COMPLIANCE SUMMARY

This section summarizes Rocketdyne's compliance with federal, state, and local environmental regulations. Two main categories are presented: Section 3.1 discusses compliance status, and Section 3.2 discusses current issues and actions.

3.1 COMPLIANCE STATUS

Several agencies performed routine inspections of DOE Environmental Restoration activities during 2003. The inspected activities were found to be compliant with the applicable rules and regulations. A list of inspections, audits, and site visits by the various agencies overseeing the SSFL sites is given in Table 3-1.

3.1.1 Radiological

The radiological monitoring programs at the SSFL are in compliance with applicable federal, state, and local environmental regulations. The monitoring results indicate that the SSFL does not have any significant radiological impact on the health and safety of the general public. All potential pathways are monitored, including airborne, direct exposure, groundwater, surface water, waste disposal, and recycling.

Table 3-1. 2003 Agency Inspections/Visits Related to DOE Environmental Remediation

Date (2003)	Agency	Subject Area	Results
January	State of CA, DHS Radiologic Health Branch	Radioactive Materials License inspection Environmental TLD exchange	Compliant
February	RWQCB	Sample collection for NPDES permit	Compliant
April	State of CA, DHS Radiologic Health Branch	Environmental TLD exchange	Compliant
May	VCAPCD	Annual inspection of Permit to Operate Nos. 00271	Compliant
June	RWQCB and DTSC	Site tour on the physical layout of the SSFL in support of NPDES permit renewal	Compliant
July	State of CA, DHS Radiologic Health Branch	Environmental TLD exchange	Compliant
September	RWQCB	Routine semi-annual inspection	Compliant
October	State of CA, DHS Radiologic Health Branch	Environmental TLD exchange	Compliant
November	State of CA, DHS	Split samples of SSFL groundwater	Compliant

3.1.1.1 Airborne Activity

Ventilation exhaust effluent from the RMHF is minimized by using high efficiency particulate air (HEPA) filters. These effluents are continuously monitored by sampling the exhaust; their radioactive compositions are determined by radionuclide-specific analyses. The maximum off-site doses at the nearest residence from the effluent source are estimated by using the EPA computer program, CAP88-PC (EPA, 1992).

For the airborne releases from the RMHF exhaust stack, the maximum individual annual exposure was estimated to be 1.9×10^{-7} mrem/yr. This dose is significantly below the limit of 10 mrem/yr and the action level of 1% of the limit (0.1 mrem/yr) as specified in 40 CFR 61, the National Emission Standards for Hazardous Pollutants (NESHAPs), Subpart H (DOE facilities).

3.1.1.2 Groundwater

There are 47 groundwater monitoring wells in and around Area IV. Groundwater is sampled and analyzed periodically for non-naturally occurring radionuclides. During 2003, the only man-made radionuclide detected was tritium in a few groundwater samples. Although the detections were positive, the concentrations of tritium were far below the EPA's drinking water limits. The positive tritium identifications had maximum concentrations of 237, 1,430, 2,420, and 254 pCi/L at wells RD-24, RD-28 (both near Bldg. 4059), RD-34A and RD-34B (both near RMHF), respectively. The EPA's drinking water standard for tritium is 20,000 pCi/L. None of the groundwater in this area is used for human consumption.

During the first quarter of 2004, three new groundwater monitoring wells were installed near the former Building 4010 site, a possible source of man-made tritium. One of the three wells, RD-90, had a tritium concentration of about 80,000 pCi/L, which is 4 times the EPA drinking water standard. Further investigation is planned to determine how tritium was produced and migrated into groundwater. Again, none of the groundwater in this area is used for human consumption.

Extracted groundwater from the French drain at Building 4059 is periodically sampled and analyzed by gamma spectroscopy. The purpose of this analysis is to detect potential leakage of the activation products, namely Co-60 and Eu-152, from the underground reactor vault in Building 4059 to the groundwater. Since the French drain was dry in 2003, no water sample was taken for the year.

3.1.1.3 Surface Water

Surface water from two National Pollutant Discharge Elimination System (NPDES) permitted discharge points and five storm-water-only basins are monitored routinely. The NPDES permit allows the discharge of reclaimed waste water, storm water runoff, and industrial waste water from retention ponds into Bell Creek, a tributary to the Los Angeles River. The permit also regulates the discharge of storm water runoff from the northwest slope (Area IV) locations into the Arroyo Simi, a tributary of Calleguas Creek. Discharge along the northwest slope (RMHF: Outfall 003, SRE: Outfall 004, FSDF No.1: Outfall 005, FSDF No.2: Outfall 006, and T100: Outfall 007) generally occurs only during and immediately after periods of heavy rainfall. The permit applies the numerical limits for radioactivity established for drinking water supplies to drainage through these outfalls.

Excess reclaimed water is discharged occasionally from the R-2A Pond that ultimately releases through Outfall 002. The permit applies the numerical limits for radioactivity in drinking water supplies to drainage through these outfalls. The permit requires radiological measurements of gross alpha, gross beta, tritium, strontium-90, and total combined radium-226 and radium-228. In 2003, thirty-four water samples were taken for the NPDES permit compliance. No samples exceeded drinking water supplier limits for radioactivity.

3.1.1.4 Direct Radiation

The external exposure rate at Rocketdyne's northern property boundary, the closest property boundary to the RMHF, was indistinguishable from natural background. This property line is approximately 300 meters from the RMHF and separated from it by a sandstone ridge that effectively shields the area within the boundary from direct radiation from the RMHF. Dosimeters placed on the RMHF side of this sandstone ridge, approximately 150 meters from the RMHF, read an average of 14 mrem/year above local background. This amount is considerably below DOE's 100 mrem/year limit.

3.1.1.5 Protection of Biota

There is no aquatic system in the Area IV of SSFL. Therefore, the protection of aquatic organisms on-site is not an issue. Since there is no liquid effluent discharge from the site, off-site aquatic systems, if any, are not affected by the DOE operations at SSFL.

The terrestrial biota, i.e., vegetation and small wild animals, are abundant at SSFL. They are potentially subject to exposure to the radioactivity in soil. Preliminary analysis indicates that the radiation in the soil is less than the dose limit recommended by the DOE. Section 5.4 provides detailed information on biota protection.

3.1.2 Chemical

3.1.2.1 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) gives the Environmental Protection Agency (EPA) broad authorities to regulate the handling, treatment, storage, and disposal of hazardous wastes. These authorities have been delegated to the California EPA and DTSC. DOE owns and co-operates two RCRA-permitted treatment, storage, and disposal facilities with ETEC. Permit numbers are listed in Section 3.1.4.

3.1.2.1.1 Radioactive Materials Handling Facility (RMHF)

In 2003, the RMHF continued to operate as an Interim Status (Part A) permitted facility. This facility is used primarily for the handling and packaging of radioactive waste. Interim status is required for the storage and treatment of the small quantities of mixed waste (waste containing both hazardous and radioactive constituents) resulting from D&D activities at ETEC. The final disposition of mixed waste is addressed under the DOE and DTSC-approved Site Treatment Plan, which is authorized by the Federal Facilities Compliance Act (FFCA).

3.1.2.1.2 Hazardous Waste Management Facility (HWMF)

The HWMF includes an inactive storage facility (Bldg 4029) and an inactive treatment facility (Bldg 4133) that was utilized for reactive metal waste such as sodium. In 1998, the facility entered final closure and is no longer operated. A closure plan was submitted to the DTSC in January 1999. The work performed in 2000 included processing of the RCRA Facility Closure Plan and coordination with regulatory agencies. Questions from the regulatory agencies were received and answered in 2000. The DTSC reviewed the response in 2001 and 2002.

3.1.2.1.3 Sodium Removal

Removal of metallic sodium from the SPTF continued in 2003. Removal of sodium is accomplished by bulk transfer and by conversion of metallic sodium into usable sodium hydroxide. The bulk sodium and piping residuals are managed as an "excluded recyclable material" in accordance with applicable regulations. In 2003, 56,000 pounds of bulk sodium was shipped offsite as excluded recyclable material. The WVN cleaning of facility piping and components will be carried out in 2004.

3.1.2.1.4 RCRA Facility Investigation

Under the Hazardous and Solid Waste Amendments of 1984, RCRA facilities can be brought into the corrective action process when an agency is considering any RCRA permit action for the facility. The SSFL was initially made subject to the corrective action process in 1989 by EPA, Region IX. The EPA has completed the Preliminary Assessment Report and the Visual Site Inspection portions of the RCRA Facility Assessment (RFA) process. ETEC is now within the RCRA Facility Investigation (RFI) stage of the RCRA corrective action process.

The DTSC has RCRA authorization and has become the lead agency in implementing the RCRA corrective action process for the SSFL, including ETEC. ETEC has performed soil sampling at various solid waste management units (SWMUs) and areas of concern (AOCs) that were identified in the RFI Work Plan.

The current conditions report and a draft of the RFI Work Plan for the Area IV SWMUs were submitted to the DTSC in October 1993. In November 1996, DTSC approved a revised work plan addendum. During 2000, an amendment to the 1996 RFI Work Plan was submitted to and approved by DTSC. This amendment added two DOE sites to the RCRA RFI program. Fieldwork in areas of unrestricted use began in November 1996 and is scheduled for completion in 2004.

During 2003, approximately 132 soil matrix, 90 soil vapor, 3 surface water, and 21 near-surface groundwater samples were collected. The soil matrix samples include 48 soil leachate samples collected for the purpose of evaluating perchlorate concentrations in soil. Samples collected and analyses performed to date at DOE locations are summarized in Section 6, in Table 6-3. Data review and validation are ongoing and will be completed in 2004.

The draft RFI reports completed in 2002 for the three DOE Area IV RFI sites—the Building 100 Trench (SWMU 7.5), Metals Laboratory Clarifier (Area IV AOC), and Old Conservation Yard (SWMU 7.4) sites—were submitted to DTSC in 2003. In addition, the draft RFI report for the DOE Leach Fields (Area IV AOCs) and a supplemental data report, the draft RFI Area IV Site Reports Data Addendum, were completed and submitted to DTSC in 2003. The RFI report for the Former Sodium Disposal Facility (FSDF) site was completed and will be submitted to DTSC in 2004.

3.1.2.1.5 Groundwater

Characterization of the groundwater at the site continues. TCE continued to be detected in three areas of Area IV during 2003. The high concentrations were detected in three areas inside the northwestern property boundary, as shown in the shaded areas of Figure 6-3. Detailed TCE results are provided in Section 6.3.

3.1.2.2 Federal Facilities Compliance Act

Boeing is managing the DOE's modest inventory (approximately 20 m^3) of RCRA mixed wastes in accordance with the FFCA-mandated Site Treatment Plan (STP) approved in October 1995. All mixed wastes that require extended on-site storage are managed within the framework of the STP. Characterization, treatment, and disposal plans for each of several different waste streams are defined in the STP, along with enforceable milestones. The current inventory consists only of mixed low-level wastes (MLLW). Management of the mixed wastes has been in full compliance with the STP. Regular updates to reflect changes in inventory or status of mixed wastes and certifications of milestone completion are submitted to DTSC in accordance with the STP.

3.1.2.3 National Environmental Policy Act

The National Environmental Policy Act (NEPA) establishes a national policy to ensure that consideration is given to environmental factors in federal planning and decision-making. For those projects or actions expected to either affect the quality of the human environment or create controversy on environmental grounds, DOE requires that appropriate NEPA actions (Categorical Exclusion [CX], Environmental Assessment [EA], Finding of No Significant Impact [FONSI] or Notice of Intent [NOI], draft Environmental Impact Statement [EIS], final EIS, Record of Decision [ROD]) be incorporated into project planning documents. DOE has implemented NEPA as defined in Federal Register Volume 57, Number 80, pages 15122 through 15199, and in accordance with the DOE Order 451.1A.

A Notice of Intent was published in the Federal Register on September 15, 2000 announcing DOE's intention to prepare an Environmental Assessment document. The Environmental Assessment will analyze the potential environmental impacts associated with environmental restoration and waste management activities for closure of the ETEC site. Public meetings to hear issues to be considered in the scope of the EA for the remaining restoration project were held on October 17 and 18, 2000. The draft Environmental Assessment document was released in January 2002. Public meetings were held on January 24, and the public comment

period was extended to April 25, 2002. The DOE issued a Finding of No Significant Impact and the final EA report on March 31, 2003.

3.1.2.4 Clean Air Act

The original 1970 Clean Air Act (CAA) authorized the Federal EPA to establish National Ambient Air Quality Standards (NAAQS) to limit the levels of pollutants in the air. EPA has promulgated NAAQS for six criteria pollutants: sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. All areas of the United States must maintain ambient levels of these pollutants below the ceilings established by the NAAQS; any area that does not meet these standards is considered a "non-attainment" area (NAA). Under this law, states are required to develop state implementation plans (SIPs) that explain how each state will carry out its responsibilities under the CAA. However, the EPA must approve each SIP, and it may enforce the CAA itself if it deems a state's SIP unacceptable. Other requirements include National Emissions Standards for Hazardous Air Pollutants (NESHAPs), New Source Performance Standards (NSPSs), and monitoring programs in an effort to achieve air quality levels beneficial to the public health and environment.

Area IV of the SSFL is regulated by the Ventura County Air Pollution Control District (VCAPCD) and must comply with all applicable rules, regulations, and permit conditions as set forth in Permit to Operate No.00271. In 2003, the VCAPCD performed an inspection on May 22, 2003. No violations or compliance issues were identified.

3.1.2.5 Clean Water Act

The Clean Water Act (CWA) is the primary authority for water pollution control programs, including the NPDES permit program. The NPDES program regulates point source discharges of surface water and the discharge of storm water runoff associated with industrial activities. Basin Plan water quality objectives are applied as effluent standards for off-site discharge of storm and industrial wastewater via the SSFL water reclamation system.

Surface water discharges from SSFL are regulated under the California Water Code (Division 7) as administered by the California Regional Water Quality Control Board (CRWQCB). The existing NPDES Permit (CA0001309) for SSFL was revised and became effective June 29, 1998. The scheduled end date for the current permit was May 10, 2003. However, since the revised permit has not yet been approved by the CRWQCB, SSFL continues to operate under the 1998 Permit. The 1998 NPDES permit incorporated the General Permit (No. CAS000001) for storm water, which includes the requirement for a site-wide Storm Water Pollution Prevention Plan (SWPPP). The SWPPP is periodically revised as needed and includes by reference many existing pollution prevention plans, policies, and procedures implemented at the SSFL site. Several key elements of the plan, including maps, are continually updated. Another key element is the Boeing Canoga Park procedure, *SSFL Storm Water Pollution Prevention Requirements*. The Spill Prevention Control and Countermeasure (SPCC) plan identifies specific procedures for handling oil and hazardous substances in the manner required to prevent uncontrolled discharge into or upon the navigable waters of the State of California or the United States. The U.S. EPA requires the preparation of an SPCC plan by those facilities that, because of their location, could reasonably be

expected to discharge oil in harmful quantities into or upon navigable waters. A revised SPCC plan was submitted as a part of the revised Spill Prevention and Response Plan to the local Administering Agency on November 18, 2003.

3.1.3 Public Participation

During 2003, Boeing Rocketdyne continued its commitment to community involvement by participating in public meetings that brought Rocketdyne environmental remediation staff and technical experts together with 40 to 50 local residents at each meeting. The meetings featured fact sheets, display boards, and exhibits that enhanced public understanding of the technological and scientific mission at SSFL as well as the environmental programs being conducted at the facility. Rocketdyne also continued to support regulatory agency-sponsored meetings. Experts from the company also addressed local Chambers of Commerce on environmental matters and Boeing's role as a responsible corporate neighbor. Public feedback indicated a very positive response to these meetings and the sharing of information.

Between meetings, Rocketdyne continued to periodically update the community through mailings on environmental topics that go to a resident mailing list that has grown to more than 4,300 names. Rocketdyne also continued to regularly responds to phone calls from realtors and home buyers and sellers on the nature and status of environmental activities at the facility.

Rocketdyne continued to support public tours of the facility by conducting tours and briefings at the facility for federal, state, and local representatives and their staffs; this activity is part of a regular outreach program and includes updating elected officials on Rocketdyne's efforts to help these officials be responsive to their constituents in the local community.

Rocketdyne also continued to provide regular updates to the community by being responsive to local media, including the Los Angeles Times, Los Angeles Daily News, and Ventura County Star. This media outreach included holding regular, timely briefings for reporters on special environmental topics.

In addition to these efforts, Rocketdyne partnered with Friends of the Los Angeles River for the Annual Greater Los Angeles River Clean-up. Further, a Boeing Rocketdyne facility in Canoga Park was again made available to the City of Los Angeles, for its regular Household Hazardous Waste Collection events, enabling hundreds of local residents to safely dispose of hazardous materials.

Rocketdyne continued to supply three local repositories with information on environmental remediation projects at the site. They are: Los Angeles Public Library, Platt Branch; Simi Valley Library; and Oviatt Library at Urban Archives Center, California State University, Northridge.

3.1.4 Permits and Licenses (Area IV)

Listed below are the permits and licenses applicable to activities in Area IV[1].

Permit/License	Facility	Valid
Air (VCAPCD)		
Permit 0271	Combined permit renewal	1/1/02 through 12/31/03
Treatment Storage (EPA)		
CAD000629972 (93-3-TS-002)	Hazardous Waste Management Facility (T133 and T029)	Inactive: closure announced
CA3890090001	Radioactive Materials Handling Facility (RMHF)	Part A interim status Application for Part B submitted May 1999.
NPDES (CRWQCB)		
CA0001309	Santa Susana Field Laboratory	6/29/98 through 5/10/03
State of California		
Radioactive Materials License (0015-19*)	All Rocketdyne facilities	Amendment Issued 104 3/2/00 105 1/31/01 106 10/21/03

*DHS changed numbering system; the license stays the same as before.

During 2003, five underground storage tanks (UST) were exempt from permitting in Area IV. A list of these tanks is shown in Table 3-2.

Table 3-2. SSFL Current Underground Storage Tanks

UST	Building Location	Capacity (gallons)	Tank Type	Contents
UT-15	4022	8,000	Stainless Steel Vaulted	RA water[a]
UT-34	4462	36,000	Stainless Steel Vaulted	Sodium[b]
UT-35	4462	34,000	Stainless Steel Vaulted	Sodium[b]

a: Radioactive (RA) water tanks are regulated by U.S. Department of Energy (DOE).
b: Sodium tanks are exempt from UST permitting per Ventura County Environmental Health Division.

3.2 CURRENT ISSUES AND ACTIONS

3.2.1 Progress in Radiological Decommissioning Operations

Currently Rocketdyne is awaiting DOE and DHS action on the release for unrestricted use of Building 4019.

[1]The waste discharge requirements for the sewage treatment plan in Area III that receives the Area IV sewage are included in the NPDES permit.

3.2.1.1 Building 4059

Initial demolition of 4059 support structures was completed in 2003, and building debris were shipped to the Nevada Test Site per DOE instructions.

On December 17, 2003, DOE determined that Phase I of Building 4059 was suitable for unrestricted release and gave approval for demolition of the main structure of 4059 (DOE, 2003). It further gave approval for disposal of the building debris as conventional waste subject to the requirements of Governor Davis' September 2002 moratorium requiring these wastes to be shipped to a Class I hazardous waste landfill.

The main 4059 structure was demolished in March 2004, and building debris was shipped to the Kettleman Hills Hazardous Waste Disposal Site.

The remaining activated concrete in the basement of 4059 will be excavated in Phase II during 2004 as radioactive waste and shipped to the Nevada Test Site. Upon completion of excavation, soil sampling will be performed and verified by ORISE and DHS.

Soil samples were taken in 2003, immediately following removal of the asphalt inside the fence-line of 4059. Results of these soil sample analysis are provided in Section 5.2.4.

3.2.1.2 Building 4024

During 2003 concrete core samples were taken from within the cells of Building 4024 to determine the remaining residual activation within the shielding concrete. The highest exposure rate at contact in the cells was 100 μr/hr. Activation product levels were relatively low. Cobalt-60 ranged from no detectable activity (NDA) to 9.3 pCi/g, and europium-152 ranged from NDA to 105 pCi/g. No europium-154, tritium, iron-55, or nickel-63 was detected in any of the samples analyzed. This investigation was used to plan the future demolition of 4024.

3.2.1.3 RMHF

A vault cleanout was initiated in the third quarter of 2003. Several thousand pounds of sand were removed from vault 2, and several large pieces of hardware were also removed and packaged for disposal as LLW. Radioactive water system cleanout and component removal were also started in 2003. Several large components, including grit blasters and filter units, were reduced in size and packaged for disposal.

The 250-gallon intermediate water storage tank and water filters were removed, reduced in size, and packaged for disposal. All related mixed wastes were packaged. The 3,000-gallon container that previously held Building 4020 drain line residue (TRU) was shipped for disposal.

3.2.2 Environmental Assessment (EA)

The final EA was issued March 31, 2003, and a FONSI (finding of no significant impact) was issued the same day (DOE, 2003c). Based on the analysis in the EA, DOE decided to implement its

preferred alternative (remediation of radiological facilities and surrounding soils to 15 mrem/y plus ALARA). DOE has determined that implementation of this alternative will be fully protective of public health and the environment.

3.2.3 Historical Site Assessment

During 2003, work was initiated on a Historical Site Assessment (HSA) of Area IV of SSFL. This is the first phase of the plan to release the site for unrestricted use.

The purpose of the HSA is to summarize the operational history of Area IV from a radiological standpoint and, based on this history, to identify portions of Area IV as either not radiologically impacted or radiologically impacted.

These classifications are based on guidance from The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). The use of MARSSIM is consistent with California State requirements (State of California Regulations [Title 17, Sections 30253 and 30256(k)(3)]) and the Code of Federal Regulations (10CFR20.1501).

Site Summaries: A detailed investigation and review of SSFL records was performed for all 272 sites (buildings and facilities) in Area IV. A site summary was prepared for each site. Each summary included information on operational history, use of radioactive materials, spills or incidents, remediation and surveys performed, and release status. A more detailed description of the data collected is given below.

Site Identification: Any name used for the site. (Site purpose and association changed over time, resulting in several different names.) Additional support structures used to service the building not warranting an individual site summary (e.g., substations, guard shacks, time clock structures, and construction shacks) are identified here.

Operational Use/History: Information on the date the building was constructed, programs the building supported, the dates these programs were operating, deactivation/decontamination activities, and the demolition date.

Site Description: A description of the site physical characteristics, including any holding tanks or other below-ground structures, leachfield, or air filter structure (stacks, HEPA filtration) associated with the building.

Relevant Site Information: The type of radiological material managed at the site, use authorizations, and any incidents that would have resulted in potential releases to the environment.

Radiological Surveys: Information on radiological surveys performed at the site, including a description of the survey purpose (routine, characterization, final status, verification), the date the survey was conducted, the agency conducting the survey, the survey scope (i.e., interior, exterior), the measured data collected, the acceptable limits of the survey, and the survey results.

Status: Information including the site release date, the identify of the releasing agency (if applicable), and the demolition date or current use.

References: Documents, maps, photographs, personnel interviews, review of Radiation Safety Records Management System, or any other information used to develop the site summary.

Photographs: Photographs of the site that are included in the site summary.

Classification: Based on the information contained in the site summary, each site was evaluated to determine whether it has been radiologically impacted (e.g., by reviewing the history of radiological operations at the site or examining evidence of radiological constituents above background) and classified on the basis of the findings. Sites found to have suffered no radiological impact from site operations were identified as not radiologically impacted. The remaining radiologically impacted sites and any associated areas (e.g., drainage paths, leachfields, etc.) were classified, on the basis of MARSSIM criteria, as follows:

Class I—Sites that potentially have, or ever had, radioactive contamination above the derived concentration guideline levels (DCGLs)

Class II—Sites that potentially have, or ever had, radioactive contamination below DCGLs, but above 20% of the DCGLs.

Class III—Sites that potentially have, or ever had, radioactive contamination above background, but below 20% of the DCGLs.

The DCGLs referenced above are those cleanup standards approved by DOE and DHS in *Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL* (Boeing, 1998).

Review of Soil Sample Data: The second phase of the HSA is currently ongoing. A review of all existing and historical soil sample data for each impacted site is being conducted to determine whether the survey design meets current MARSSIM guidelines. These requirements include requirements concerning footprint coverage, survey unit classification, number of samples taken, and whether or not the soil data satisfies MARSSIM statistical tests. Those sites that have successfully completed the release process will be proposed for no further action.

Future Actions: Based on these assessments, any area of land in Area IV that requires additional soil sampling to satisfy the release process will be identified. Survey plans will be prepared, and surveys will be conducted. The Department of Health Services Radiological Health Branch will be the lead agency responsible for the oversight, verification, and approval of this Area IV site-wide radiological release process.

3.2.4 Worker Health Study

One of Rocketdyne's commitments to its employees following the DOE funded Worker Health Study of 1997-1999 was to perform a follow-on study. This study attempts to answer some of the questions raised by the initial study performed by UCLA.

Rocketdyne and the UAW together selected a Science Committee comprising six nationally renowned experts in the fields of epidemiology, biostatistics, toxicology, and public health. None of the Science Committee was on the Peer Review team that Rocketdyne hired to review the UCLA study. During 2000, this Science Committee issued a Request for Proposal (RFP) and received six bids from academic and professional institutions. The Science Committee selected a team headed by the International Epidemiology Institute. Other team members include the staff from the University of Southern California, Vanderbilt University, Oak Ridge National Laboratory (ORNL), Oak Ridge Associated Universities (ORAU), Lovelace Respiratory Research Institute, and IHI Environmental.

The study, initiated in January 2001, will attempt to answer the basic question of whether Rocketdyne and Atomics International workers have suffered health effects as a result of occupational exposures to radiation and other toxic chemicals. It is anticipated that the study will be completed and released in the fall of 2004.

3.2.5 Energy Employees Occupational Compensation Program Act

In July 2001, the Department of Labor (DOL) and DOE initiated a program to compensate DOE contract workers who had become ill because of exposure to radiation, beryllium, or silica as a result of performing work as contractors to the Atomic Energy Commission and/or the Department of Energy. As a past and present DOE contractor, Rocketdyne is cooperating with various agencies of the federal government who are implementing this program. Employment verification and exposure records are being provided to DOE and the Department of Health and Human Services upon request. As of June 2004, Rocketdyne had provided available exposure records to the National Institute for Occupational Safety and Health (NIOSH) for 101 claims. Of the 101 requests, 72 were DOE radiation workers with dosimetry records, and 29 were not radiation workers.

In March 2004, the DOL requested that Boeing also supply any existing dosimetry records for an additional 34 claims from individuals who had never worked for DOE programs and who had never been exposed to radiation from DOE activities.

DOE is also requesting exposure information for Part D claims, which the DOE is passing on to states' Workers' Compensation Boards. Boeing has to date reviewed four of these claims.

3.2.6 Disposal and Recycling of Non-radiological Waste

In 2003, decommissioned waste from prior released radiological facilities (4059 and 4012) was sent to the Nevada Test Site. In 2003, pending completion of the metals recycling Programmatic Environmental Impact Statement (PEIS), no metals from DOE radiological facilities were recycled.

3.2.7 2003 California Legislation

In 2003, four anti-nuclear bills were introduced in the California Senate.

SB 13 (Romero) was a re-introduction of SB 1970, which was vetoed in 2002. It imposed zero threshold limits on residual radioactivity disposal for landfills.

SB 201 (Romero) transferred the authority for regulation of radioactive materials from the DHS to the DTSC.

SB 208 (Kuehl) imposed a zero risk cleanup goal on the Santa Susana Field Laboratory.

SB 208 (Kuehl) required the disclosure of a theoretical risk measure on all prior radioactively contaminated sites upon transfer of ownership of real property.

Because of the budget crisis, none of the bills made it out of the Senate, and, therefore, they all died in committee.

3.2.8 EPA Hazard Ranking System (HRS) Assessment

In December 2003, EPA issued its Hazard Ranking System Assessment of Area IV of SSFL (EPA, 2003). This process determines whether site hazards qualify the site for placement on the National Priorities List (NPL) or the Superfund list and whether federal response is required.

EPA determined that

"Further remedial site assessment under CERCLA (Superfund) is not required because:

- "• the site does not qualify for further remedial site assessment under CERCLA (No further remedial action planned—NFRAP)."

EPA's rationale for these determinations was that

- "Radionuclides associated with historic Area IV research are not present at concentrations significantly above background in the soils surrounding residential communities."
- "No annual exposures measured are above the Nuclear Regulatory Commission annual dose limit to the general public."
- "The outfalls draining Area IV were in full compliance with the regulations established by the National Pollution Discharge Elimination System (NPDES)."
- "None of the concentrations of tritium [in groundwater] exceed the USEPA maximum contaminant level."

To qualify for listing as a CERCLA (Superfund) site, a site must be assigned, by the HRS, a hazard rank measure of >25. Typical Superfund sites have hazard ranking measures of ~50. Area IV of SSFL was ranked at 1.08.

4. ENVIRONMENTAL PROGRAM INFORMATION

At SSFL, the DOE Site Closure department has programmatic responsibility for the former radiological facilities, former sodium test facilities, and related cleanup operations. DOE Site Closure is responsible for environmental restoration and waste management operations in Area IV, where DOE funded programs conducted energy related research and development. Environmental restoration activities include decontamination and decommissioning (D&D) of radioactively contaminated facilities, building demolition, treatment of sodium, assessment and remediation of soil and groundwater, surveillance and maintenance of work areas, and environmental monitoring. Waste management activities include waste characterization and certification, storage, treatment, and off-site disposal. Waste management activities are performed at the Radioactive Materials Handling Facility (RMHF) for radioactive and mixed waste. The Hazardous Waste Management Facility (HWMF) has been used to handle alkali metal waste, but it is now inactive and undergoing closure.

4.1 ROCKETDYNE ENVIRONMENTAL PROTECTION AND REMEDIATION

Oversight of environmental protection at Rocketdyne is the responsibility of the Safety, Health & Environmental Affairs (SHEA) department, and this department provides support for environmental management and restoration. The stated policy of SHEA is "To support the company's commitment to the well-being of its employees, community, and environment. It is Rocketdyne's policy to maintain facilities and conduct operations in accordance with all federal, state, and local requirements and contractual agreements. Rocketdyne employees are responsible for implementing and complying with this policy." Responsibilities for environmental protection at Rocketdyne fall under four sub-departments: Environmental Protection (EP), Environmental Remediation (ER), Radiation Safety (RS), and DOE Site Restoration. The responsibilities for each are listed below.

Environmental Protection (EP) is responsible for developing and implementing cost-effective and efficient programs designed to ensure achievement of the policy objectives related to environmental protection. The EP responsibilities include:

- Ensuring compliance with applicable federal, state, and local rules and regulations, including maintaining a working knowledge of applicable environmental laws, performing compliance audits, reviewing new and modified facility projects, coordinating solid and hazardous waste disposal, maintaining required records, preparing and submitting required regulatory reports, applying for and maintaining permits, assuring compliance with permit conditions, and performing sampling and analysis.

- Responding to uncontrolled releases and reporting releases as required by law and contractual requirements.

- Suspending operations determined to be in violation of environmental regulations.

- Participating in rule and regulation development, including evaluating impacts on Rocketdyne programs; coordinating with other Rocketdyne functions, as appropriate; and informing management and staff of new or revised requirements.

- Providing a program, in conjunction with Technical Skills and Development, for motivating, informing, and training employees about their duties to comply with environmental regulations and protect the environment.

- Recognizing and responding to the community's concerns regarding the environmental impact of Rocketdyne operations, including escorting and cooperating with regulatory officials interested in environmental matters and responding to requests for information referred to Communications.

- Working with Rocketdyne customers and suppliers to minimize the use of materials and processes that impact the environment while maintaining product quality and competitive pricing.

- Making environmental concerns, including energy and raw material conservation, a priority when evaluating new and existing operations and products or when making decisions regarding land use, process changes, materials purchases, and business acquisitions.

Radiation Safety (RS) is responsible for providing radiological support for the D&D of radiological contamination at all Rocketdyne facilities. The RS responsibilities include:

- Compliance with all federal, state, and local regulations pertaining to occupational and environmental radiation protection.

- Provision of health physics oversight of D&D and radioactive waste management activities.

- Performance of final surveys of D&D'd buildings and facilities to demonstrate acceptability for release for unrestricted use.

- Response to employee and public concerns regarding radiological activities and the impact of these activities on the health and safety of the community.

Environmental Remediation (ER) is responsible for remedial actions to clean up historical chemical contamination at all Rocketdyne facilities. The ER responsibilities include:

- Compliance with all federal, state, and local regulations pertaining to environmental remediation.

- Remediation of historical chemically contaminated Rocketdyne sites to achieve closure.

- Implementation of groundwater monitoring and treatment.

- Implementation of RCRA soil sampling and cleanup activities.

DOE Site Restoration is responsible for performing the "hands on" D&D of former DOE nuclear, liquid metal test, and other (e.g., office and warehouse) facilities in support of the DOE Closure program. DOE Site Restoration responsibilities also include:

- Responsibility for the management and shipment to DOE-approved disposal sites of radioactive waste generated during the D&D operations.

- Operation of the Radioactive Materials Handling Facility (RMHF) under an interim status Part A permitted facility for the management of mixed (radioactive and hazardous) wastes.

- Coordination of activities with specialty contractors used to support D&D activities including asbestos and lead abatement, recycling of sodium from former liquid metal facilities, and demolition of structures following removal of hazardous materials and components.

- Performance of the routine Surveillance and Maintenance (S&M) activities for DOE-owned facilities to ensure that the buildings are properly maintained such that the buildings do not create personnel or environmental safety hazards.

- Responsibility for identifying, removing, staging, and initiating documentation for DOE equipment being divested.

4.2 ENVIRONMENTAL MONITORING PROGRAM

The purpose of the environmental monitoring program is to detect and measure the presence of hazardous and radioactive materials and identify other undesirable impacts on the environment. It includes remediation efforts to correct or improve contaminated conditions at the site and prevent off-site effects. For this purpose, the environment is sampled and monitored, and effluents are analyzed. A goal of this program is to demonstrate compliance with applicable regulations and protection of human health and the environment. Environmental restoration activities at the SSFL include a thorough review of past programs and historical practices to identify, characterize, and correct all areas of potential concern. The key requirements governing the monitoring program are DOE Orders 5400.1 (DOE, 1990) and 5400.5 (DOE, 1993). Additional guidance is drawn from California regulations and licenses, and appropriate standards.

The basic policy for control of radiological and chemical materials requires that adequate containment of such materials be provided through engineering controls, that facility effluent releases be controlled to federal and state standards, and that external radiation levels be reduced to as low as reasonably achievable (ALARA) through rigid operational controls. The environmental monitoring program provides a measure of the effectiveness of these operational procedures and of the engineering safeguards incorporated into facility designs.

4.2.1 Radiological Monitoring

Monitoring the environment for potential impact from our past nuclear operations has been a primary focus of Boeing Rocketdyne and its predecessors.

In the mid 1950s, Atomics International, then a Division of North American Aviation, began initial plans for nuclear research at its facilities in the west San Fernando Valley. In 1956, prior to initial operations, it started a comprehensive monitoring program to sample and monitor environmental levels of radioactivity in and around its facilities.

During the 45-year history of nuclear research and later environmental restoration, on-site and off-site environmental monitoring and media sampling have been extensive. In the early years, soil/vegetation sampling was conducted monthly. Sampling locations extended to the Moorpark freeway to the west, to the Ronald Reagan freeway to the north, to Reseda Avenue to the east, and to the Ventura freeway to the south. Samples were also taken around the Canoga and De Soto facilities as well as around the Chatsworth Reservoir. This extensive off-site sampling program was terminated in 1989 when all nuclear research and operations (except remediation) came to an end.

During the 1990s, extensive media sampling programs were conducted in the surrounding areas, including the Brandies-Bardin Institute and the Santa Monica Mountains Conservancy to the north, the Rocketdyne Recreation Center in West Hills to the south, and various private homes in the Chatsworth and West Hills areas. Samples were also taken from such distant areas as Wildwood Park and Tapia Park. In addition, monitoring of off-site radiation, groundwater, and runoff water from the site were routinely performed during this time.
Figure 4-1 shows sampling and monitoring locations for these two time periods.

In addition to the sampling activities conducted by Rocketdyne, independent sampling was performed by the following other organizations or persons:

- Argonne National Laboratory (ANL)
- California Dept. of Health Services/Environmental Management Branch (DHS/EMB)
- Environmental Protection Agency/Office of Radiation and Indoor Air (EPA/ORIAU)
- California Department of Health Services/Radiologic Health Branch (DHS/RHB)
- Groundwater Resources Corporation (GRC)
- Joel Cehn, Consultant to the Brandies-Bardin Institute
- Lawrence Livermore National Laboratory (LLNL)
- McLaren/Hart Environmental Engineering Corporation
- Oak Ridge Associated Universities (ORAU)
- Oak Ridge Institute of Science and Education (ORISE)
- Ogden Environmental and Energy Services
- Regional Water Quality Control Board (RWQCB)

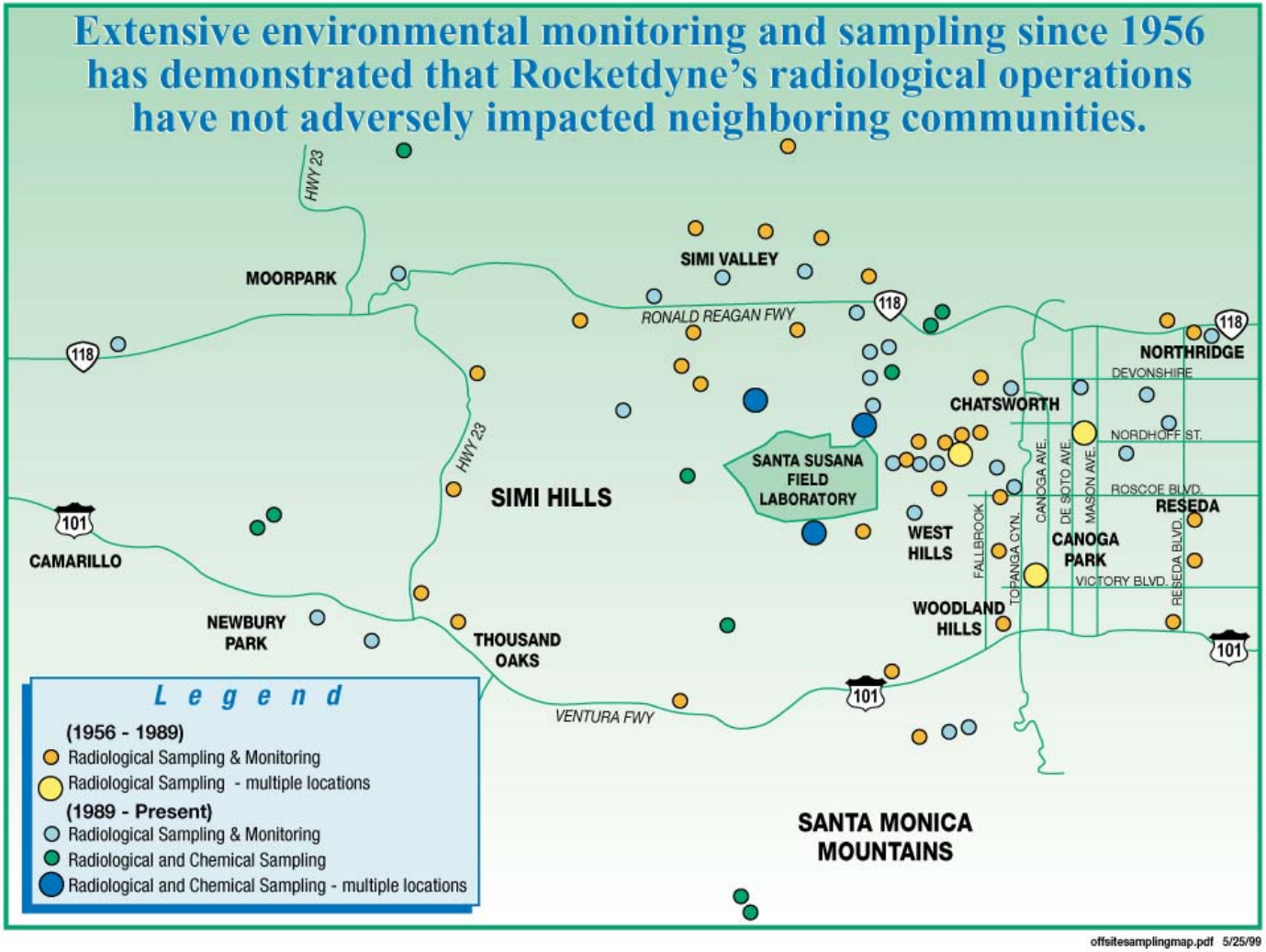


Figure 4-1. Radiological Sampling and Monitoring Locations

Table 4-1 is a matrix of sampled media, organizations, and time periods for all historical off-site radiological monitoring.

The evidence from thousands of soil, vegetation, water and air samples taken from over 200 off-site locations over the last 46 years by Rocketdyne and 12 other agencies and organizations demonstrates that no radioactive contamination that could result in excess exposure or risk has been detected at Rocketdyne's off-site neighborhood.

- The EPA has stated that, "EPA is not aware of any current contamination from the SSFL that poses an unacceptable risk to the community." (EPA, 1999)

- The ATSDR has stated that, "There is currently no indication that off-site residential areas have been adversely impacted by materials from the site." (ATSDR, 1999)

Rocketdyne's ongoing radiological environmental monitoring ensures that activities at the SSFL, including cleanup, do not adversely affect either its employees or its neighbors.

4.2.2 Nonradiological Monitoring

Extensive monitoring programs for chemical contaminants in air, soil, surface water, and groundwater are in effect to assure that the existing environmental conditions do not pose a threat to the public welfare or the environment. Extensive soil sampling is performed under the Resource Conservation and Recovery Act Facility Investigation and other site-specific remedial programs. Groundwater beneath Area IV is extensively monitored for chemical contaminants through sampling at 47 on-site and off-site wells. In addition, 23 shallow wells are utilized to monitor near-surface groundwater conditions. Groundwater analyses were conducted by Haley & Aldrich using a DTSC-approved sampling and analysis plan and EPA-approved analytical methods and laboratories. Equipment installed in an interim groundwater remediation program in Area IV continued to remove solvents from contaminated groundwater during 2003. Remediated water was returned to the surface water collection ponds.

All surface water discharges are monitored as specified in the existing National Pollutant Discharge Elimination System (NPDES) permit. The existing NPDES permit was pending for renewal in 2003. In addition, all sources of emissions are monitored as required by the Ventura County Air Pollution Control District (VCAPCD).

In addition to this environmental monitoring and restoration program, current operational procedures reflect Rocketdyne's commitment to a clean and safe environment. For example, solvents and oils are collected and recycled rather than being discarded. A comprehensive training and employee awareness program is in place. All employees working with hazardous materials are required to attend a course on hazardous materials waste management. Environmental bulletins are printed on the Rocketdyne website to promote environmental awareness among all employees.

Table 4-1. Organizations Conducting Radiological Environmental Sampling

Environmental Sampling for Radiation/Radioactivity Surrounding Santa Susana					
Location	Media Sampled (Date Range and Organization)				
	Soil	Groundwater	Surface water	Airborne Particulates	Radiation Exposure
On-site	1956-Present (Rocketdyne) 1975,81,84 (ANL) 1986-87 (ORAU) 1992-Present (ORISE) 1993 (RWQCB) 1992-Present (DHS-RHB) 1994-95 (DHS-EMB)	1960-86 (Rocketdyne) 1984-Present (GRC) 1998 (EPA-ORIA)	1970-Present (Rocketdyne) 1993-98 (RWQCB)	1956-Present (Rocketdyne)	1971-Present (Rocketdyne) 1975,81,84 (ANL) 1981-Present (DHS-RHB) 1986-87 (ORAU) 1992-Present (ORISE)
North Off-site	1956-89 (Rocketdyne) 1992-94 (McLaren-Hart) 1992-94 (EPA-ORIA) 1992-94 (DHS-EMB) 1991-97 (Cehn) 1995 (Rocketdyne) 1995 (ORISE)	1984-Present (GRC) 1991-96 (Cehn) 1998 (EPA-ORIA)	1992-94 (McLaren-Hart) 1992-94 (EPA-ORIA) 1992-94 (DHS-EMB) 1992-94 (Cehn)	1989 (DHS-RHB & LLNL)	1974-Present (Rocketdyne) 1992-94 (EPA-ORIA) 1995 (ORISE)
East Off-site	1956-89 (Rocketdyne) 1986 (ORAU) 1994 (Rocketdyne) 1995 (ORISE) 1997 (LLNL)	1984-Present (GRC)	1961-71 (Rocketdyne)	1959-Present (Rocketdyne)	1974-Present (Rocketdyne) 1986 (ORAU) 1995 (ORISE)
South Off-site	1956-89 (Rocketdyne) 1992-94 (McLaren-Hart) 1992-94 (EPA-ORIA) 1992-94 (DHS-EMB) 1992-94 (Cehn) 1995 (Rocketdyne) 1998 (Ogden)	1984-Present (GRC)	1966-89 (Rocketdyne)	1989 (DHS-RHB & LLNL)	1974-Present (Rocketdyne)
West Off-site	1956-64 (Rocketdyne) 1992-94 (McLaren-Hart) 1992-94 (EPA-ORIA) 1992-94 (DHS-EMB) 1992-94 (Cehn) 1995 (Rocketdyne)	1984-Present (GRC)	None	None	1974-Present (Rocketdyne)

Sampling Matrix.xls 9/24/99

4.3 INTEGRATED SAFETY MANAGEMENT SYSTEM (ISMS)

The ETEC *Integrated Safety Management System (ISMS)* description document is the source of Boeing Rocketdyne policies and procedures on safety. This document is based on DOE principles and objectives and prescribes a formal, organized process that ensures worker health and safety, and includes a built-in mechanism for self-assessment and continuous improvement. In addition to noting accomplishments and improvements, the Boeing Rocketdyne Annual Safety Report for FY 2002, submitted in 2003, reemphasized the policies and procedures that helped the organization comply with ISMS principles. The Annual Safety Report also contained metrics monitored by Safety Health and Environmental Affairs (SHEA) to assess improvement in the organization's safety practices.

During 2003, Boeing Rocketdyne continued to work toward refining its implementation of ISMS principles. The self-assessment plan incorporates tools such as DOE and Boeing Safety Lessons Learned Reports, DOE ORPS (Occurrence Reporting and Processing System) Reports, and DOE Operating Experience Reports. Safety issues were emphasized with Rocketdyne's subcontractors by having a SHEA representative present the safety requirements and information to each subcontractor in the initial meeting with the subcontractor prior to the start of each job. An ISMS subcontractor audit process was also initiated to ensure that safety requirements were being met while work was in progress.

ISMS training was given to new employees working on the DOE closure programs. Updates on ISMS subjects as well as various safety issues and lessons were presented to the DOE Site Restoration Department personnel at biweekly meetings. The ISMS training class and the biweekly ISMS updates helped assure an in-depth, current understanding of ISMS principles. Feedback from the biweekly meetings and presentation of safety metrics were used to assess the success of ISMS principle implementation.

4.4 ENVIRONMENTAL TRAINING

Rocketdyne conducts training and development programs as an investment in human resources to meet both organizational and individual goals. These programs are designed to improve employee performance, ensure employee proficiency, prevent obsolescence in employee capability, and prepare employees for changing technology requirements and possible advancement.

The People Organization is responsible for the development and administration of formal training and development programs. Process managers are responsible for individual employee development through formal training, work assignments, coaching, counseling, and performance evaluation. Process managers and employees are jointly responsible for defining and implementing individual training development goals and plans, including on-the-job training.

The Rocketdyne Training and Development Department currently maintains a listing of approximately 700 courses available to Rocketdyne personnel. Of these, approximately 115 relate to environment, health, and safety, with approximately 15 relating to environmental protection, 10 to radiation safety and remediation, and 90 to health and safety. Specialized training programs on new technological developments and changes in regulations are provided, as needed, to ensure effective environmental protection and worker health and safety. Also, informal discussions about waste

minimization and management occur at hazardous waste coordinator's meetings. Several courses are available as computer-based training. Additional off-site courses are also encouraged.

4.5 WASTE MINIMIZATION AND POLLUTION PREVENTION

4.5.1 Program Planning and Development

A Waste Minimization and Pollution Prevention Awareness Plan (Atkinson, 1996) developed in accordance with DOE Order 5400.1 (DOE, 1990), is in place and serves as a guidance document for all waste generators at ETEC. The plan emphasizes management's proactive policy of waste minimization and pollution prevention, and outlines goals, processes, and waste minimization techniques to be considered for all waste streams generated at the former ETEC. The plan requires that waste minimization opportunities for all major restoration projects be identified and that all cost-effective waste reduction options be implemented.

Most waste currently generated at the former ETEC results from environmental restoration of surplus facilities and cleanup of sites contaminated on previous programs. The key components of waste generated at ETEC are:

- Low-level waste (LLW), i.e., mixed (hazardous and nonhazardous) radioactive wastes produced by D&D operations.
- Sodium and NaK-contaminated components resulting from closure operations at the former sodium facility.
- Oils deriving from ongoing remediation activities.

Waste minimization is accomplished by evaluating the waste generating processes, identifying waste minimization options, and, finally, conducting technical and economic evaluations to determine the best approach.

4.5.2 Training and Awareness Programs

The ETEC Waste Minimization and Pollution Prevention Awareness Program includes (1) orientation programs and refreshers, (2) specialized training, and (3) incentive awards and recognition. Employees are reminded about pollution prevention and waste minimization awareness. Posters are placed in work areas to notify employees about environmental issues or practices. Memoranda are circulated about changes in waste management policy, Rocketdyne policies or procedures, and technical data relevant to an employee's job assignment. Presentations using visual aids are provided, as needed, to review major changes in environmental issues.

4.5.3 Waste Minimization and Pollution Prevention Activities

The following are some of the significant activities conducted in relation to waste minimization and pollution prevention:

- Oils used in motor vehicles and compressors are shipped to vendors who recycle them.

- Comprehensive segregation and screening procedures are used to minimize generation of mixed waste.
- A chemical/material exchange system linked to the purchasing system prevents the unnecessary purchase of hazardous materials.
- Hazardous waste containers in acceptable condition are reused to the maximum extent possible.
- Empty product drums are returned to the vendor for reuse when practical.
- Approximately 80% of the office paper and aluminum cans are recycled as a result of increased environmental awareness. During CY03, 3.76 metric tons of white paper and 2.08 metric tons of aluminum cans were recycled.
- A compactor is used to reduce the volume of soft LLW. This volume was reduced from approximately 1,800 cubic feet to 700 cubic feet during CY03.
- Size reduction and repackaging of Steel boxes, grit blasters and other components are reduced in size and repackaged. These measures resulted in a waste reduction of approximately 2,050 cubic feet during CY03.
- Bulk sodium is recycled for reuse as excluded recyclable material. In CY03, approximately 56,000 pounds of bulk sodium was recycled.

Roughly 5,910 metric tons of steel (nonstainless steel), 3 metric tons of copper, and 26,760 metric tons of concrete/asphalt resulted from divestment activities at nonradiological facilities.

4.5.4 Tracking and Reporting System

Various categories of materials are tracked from procurement to waste disposal. Radioactive and mixed wastes are characterized sufficiently (for safe storage) by the generator, transferred to the RMHF, and logged and temporarily stored at the RMHF. Documents that accompany the wastes are verified for accuracy and completeness and filed at the RMHF. Hazardous waste tracking and verification procedures (from generator to final off-site disposal) are followed by the SHEA department. Rocketdyne is responsible for nonhazardous and sanitary waste operations at the SSFL.

The relevant reports include:

- EPA's *Biennial Hazardous Waste Report*
- DOE's *Annual Waste Generation and Pollution Prevention Progress Report*
- DOE's *Affirmative Procurement Report*
- *"Source Reduction Evaluation Review* and *Plan" and "Hazardous Waste Management Performance Report,"* both of which are required by the Source Reduction and Hazardous Waste Management Review Act (SB14)

5. ENVIRONMENTAL RADIOLOGICAL MONITORING

The environmental radiological monitoring program at SSFL started before the first radiological facility was established in 1956. The program has continued with modifications to suit the changing operations. The selection of monitoring locations was based on several site-specific criteria such as topography, meteorology, hydrology, and the locations of the nuclear facilities. The prevailing wind direction for the SSFL site is generally from the north and northwest, with some seasonal diurnal shifting to the southeast quadrant. Most rainfall runoff at the SSFL site flows through several natural watercourses and drainage channels and is collected in two large-capacity retention ponds. This water may be discharged off-site into Bell Creek to the south, or it may be reused for industrial purposes. The runoff water from Area IV also flows to the northwest, which is monitored through five NPDES sampling locations.

Ambient and ventilation exhaust air samples are measured for gross alpha and gross beta for screening purposes. These screening measurements can quickly identify any unusual release and provide long-term historical records of radioactivity in the environment. At the end of each year, the air samples for the entire year are combined and analyzed for specific radionuclides. The isotopic analysis results are used for estimating the potential off-site dose from air pathway.

Groundwater and surface water samples are analyzed for gross alpha and gross beta, and the results are compared with the screening limits established by the EPA for suppliers of drinking water. Isotopic uranium and thorium analyses are performed if the gross alpha activity exceeds the drinking water limit. Groundwater samples are also analyzed for gamma emitters and tritium. Surface water samples are analyzed for Sr-90 and tritium.

Direct radiation is monitored by the thermoluminescent dosimeters (TLDs) located on the site boundary and throughout the site. To accurately measure low-level ambient radiation, “sapphire” TLDs, which are very sensitive to low-level radiation, are used. These TLDs are complemented by TLDs installed by the State of California Department of Health Services Radiologic Health Branch for independent surveillance.

5.1 EFFLUENT MORNITORING

The RMHF and Building 4024 have continuous effluent monitoring capability. In 2003, effluent was only monitored for the RMHF because no radiological work that requires the use of a filtered exhaust system was conducted in Building 4024.

At RMHF, continuous workplace ventilation is provided in the decontamination and packaging rooms, where equipment is decontaminated and radioactive waste is repackaged. The ventilation assures protection of the workers from inhalation of airborne radioactive materials and prevents the spread of radioactive contamination into adjacent clean areas. The ventilation exhaust is passed through the HEPA filters before being discharged to the atmosphere. Airborne releases from the RMHF are shown in Table 5-1. No contaminated liquids are discharged to uncontrolled areas. The filtered air generally contains lower levels of naturally occurring radionuclides than does ambient air.

Table 5-1. Atmospheric Effluents to Uncontrolled Areas

SSFL/RMHF - 2003	
Effluent volume (m^3)	3.15E+08
Air volume sampled (m^3)	3.56E+04
Annual average concentration in	
Gross alpha (μCi/cc)	5.19E-17
Gross beta (μCi/cc)	2.19E-15
Maximum observed	
Gross alpha (μCi/cc)	1.27E-15
Gross beta (μCi/cc)	1.32E-14
Activity releases (μCi)	
Gross alpha	1.63E-02
Gross beta	6.89E-01

Radionuclide-Specific Data

Radionuclide	Half-Life (yr)	Activity Detected (pCi)	Annual Release (μCi)	Analysis MDA* (pCi)	Average Exhaust Concentration (μCi/cc)	DCG* (μCi/cc)
H-3*	1.23E+01	ND	ND	350.00*	ND	1E-07
Be-7	1.46E-01	ND	ND	29.90	ND	Natural*
K-40	1.26E+09	ND	ND	21.80	ND	natural
Co-60	5.26E+00	ND	ND	4.79	ND	8E-11
Sr-90	2.77E+01	16.40	1.45E-01	6.31	4.60E-16	9E-12
Cs-137	3.00E+01	46.50	4.11E-01	2.56	1.30E-15	4E-10
Po-210	3.80E-01	ND	ND	0.97	ND	natural
Th-228	1.91E+00	ND	ND	1.34	ND	4E-14
Th-230	8.00E+04	ND	ND	0.87	ND	4E-14
Th-232	1.41E+10	ND	ND	0.67	ND	7E-15
U-234	2.47E+05	0.27	2.42E-03	0.52	7.69E-18	9E-14
U-235	7.10E+05	ND	ND	0.38	ND	1E-13
U-238	4.51E+09	0.14	1.25E-03	0.68	3.96E-18	1E-13
Pu-238	8.64E+01	0.02	1.59E-04	1.59	5.05E-19	3E-14
Pu-239/240	24,390/6,580	0.62	5.50E-03	1.10	1.75E-17	2E-14
Pu-241	1.52E+01	ND	ND	79.10	ND	1E-12
Am-241	4.33E+02	ND	ND	0.60	ND	2E-14

* H-3 concentration is directly measured from evaporated water sample. Its activity and MDA are based on pCi/L.

* Naturally occurring radionuclides are included for information. These activities have not been used in dose estimates.

* Derived Concentration Guide (DCG) for exposure of the public, for the most restrictive form of radionuclide as specified in DOE Order 5400.5 (2/8/90; Change 2: 1/7/93)

* MDA = Minimum Detectable Activity
* ND = Not Detected

The level of radioactivity released to the atmosphere is reduced to the lowest practical value by passing the effluents through certified HEPA filters. The effluents are sampled for particulate radioactive materials in the stack exhaust samplers at the point of release. In addition, the stack monitor installed at the RMHF provides automatic alarm capability in the event of elevated release of particulate activity. The HEPA filters used for filtering atmospheric effluents are at least 99.97% efficient for particles 0.3 μm in diameter.

The total radioactivity, measured as gross alpha and gross beta activity, in the atmospheric effluents flowing to uncontrolled areas from the RMHF is shown in Table 5-1. The total shows that no significant quantities of radioactivity were released in 2003. The gross alpha and gross beta counts were made shortly after the weekly stack samples were collected, a procedure that permitted identification of any unusual release.

The isotopic composition of the radioactivity deposited on the RMHF exhaust air sampling filters, combined for the entire year, is also presented in Table 5-1. Gamma-emitting radionuclides are measured by high-resolution gamma spectrometers; tritium is measured by liquid scintillation counting; and all others are measured by specific chemical separations followed by alpha or beta counting. For each radionuclide, the laboratory calculates the minimum detectable activity (MDA). This is the lowest level of activity that can be identified as "detected" with 95% confidence. Radionuclides that are found to be less than the detection limits are identified in the table as "not detected" (ND).

Small amounts of Sr-90, Cs-137, U-234, U-238, Pu-238, and Pu-239/240 on the filter samples are due to the materials involved in operations at the RMHF. Since the air sampling filter is not capable of catching H-3 in the air, H-3 concentration is directly sampled from the water that is evaporated through the RMHF ventilation stack. In 2003, H-3 was not detected in the water sample.

The concentrations in the effluent are compared with appropriate reference values for nonoccupational exposure. The isotopic reference values for DOE facilities are the DCGs specified in DOE Order 5400.5. These values refer to the permissible concentrations allowed by the State of California and the DOE for continuous, nonoccupational exposure (i.e., to general public). The radionuclide concentrations released from the RMHF stack are far below the DCG, as shown in Table 5-1. The fact that dilution and dispersion occur before the material reaches an unrestricted area further reduces the concentration in the public area.

The U.S. EPA regulates airborne releases of radioactivity from DOE facilities under 40 CFR 61, Subpart H. The isotopic radionuclide concentrations in the exhaust ventilation are used to demonstrate compliance with State DHS/RHB, DOE, and EPA (NESHAPs) standards.

The potential downwind radiation exposures due to the atmospheric emissions during 2003 from the RMHF exhaust stack were calculated using the CAP88-PC computer code. Such site-specific input data as wind speed, directional frequency and stability, stack height, and exhaust air velocity were used to perform the dose assessment.

The highest potential radiation exposure doses at the site boundary and the nearest residential area were estimated using the CAP88-PC computer code; the results are presented in Table 5-2. Although the closest SSFL site boundary is about 300 meters NW of the RMHF, due to the

Table 5-2. Radiation Exposure Dose due to Atmospheric Effluents—2003

Facility	Distance (m) and Direction to		Downwind Exposure Dose (mrem/yr)	
	Boundary	Residence	Boundary	Residence
RMHF	525 NNE	2,867 SSW	3.4×10^{-7}	1.9×10^{-7}

weather conditions in 2003, the maximum boundary dose occurred at 525 meters, NNE of the RMHF. Therefore, the boundary dose was calculated at this distance.

The airborne dose calculations were performed to demonstrate compliance with the NESHAPs standard. At the location of the hypothetical Maximally Exposed Individual (MEI), the effective dose equivalent from the DOE facility (RMHF) exhaust during 2003 was 1.9×10^{-7} mrem (1.9×10^{-9} mSv) per year. The EPA limit for a DOE site is 10 mrem/yr, as specified in 40 CFR 61, Subpart H. Potential releases from the RMHF are so low that, even assuming the absence of HEPA filters, estimated doses would be below the level requiring continuous monitoring. However, continuous monitoring is still being performed as a best management practice.

In addition to the point source (i.e., the RMHF stack), there is a potential area source in Area IV, the RMHF Pond (Sump 614). The RMHF Pond had been considered an area source due to the possible resuspension of contaminated sediment in the pond when it is dry. Since the RMHF Pond was covered by water for the entire year, it is not considered an area source for the year 2003.

5.2 ENVIRONMENTAL SAMPLING

5.2.1 Ambient Air

Ambient air sampling is performed continuously at SSFL with air samplers operating on 7-day sampling cycles. The sampling locations are shown in Figures 5-1 and listed in Table 5-3. Airborne particulate radioactivity is collected on glass fiber (Type A/E) filters that are changed weekly. The samples are counted for gross alpha and beta radiation following a minimum 120-hour decay period to allow the decay of short-lived radon and thoron daughters. The volume of a typical weekly ambient air sample is approximately 50.4 m^3.

Weekly ambient air samples are counted for gross alpha and beta radiation with a low-background, thin-window, gas-flow proportional-counting system. The system is capable of simultaneously counting both alpha and beta radiation. The sample-detector configuration provides a nearly hemispherical (2π) geometry. The thin-window detector is continually purged with argon/methane counting gas. A preset time mode of operation is used for counting all samples.

Counting system efficiencies are determined routinely with Tc-99 and Th-230 standard sources. The activities of the standard sources are traceable to the National Institute of Standards and Technology (NIST).

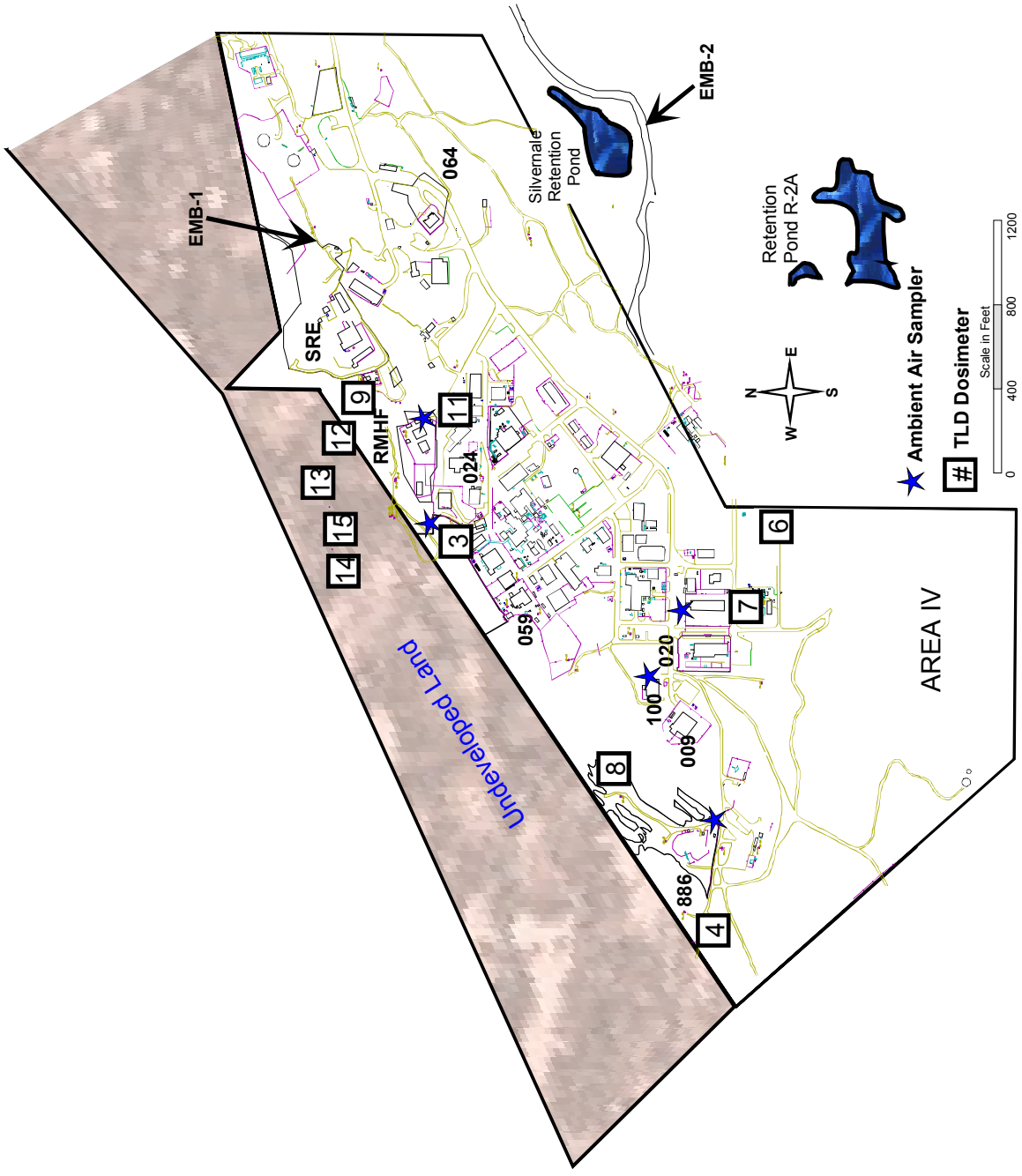


Figure 5-1. Santa Susana Field Laboratory Area IV Sampling Stations

Table 5-3. Sampling Location Description

Station	Location	Sampling Frequency
Ambient Air Sampler Locations		
A-2	SSFL Site, 4020, northeast of site	(W)
A-3	SSFL Site, RMHF Facility, next to 4034	(W)
A-4	SSFL Site, 4886, Former Sodium Disposal Facility	(W)
A-5	SSFL Site, RMHF Pond, north side	(W)
A-6	SSFL Site, 4100, east side	(W)
On-site - SSFL - Ambient Radiation Dosimeter Locations		
SS-3 (CA)	SSFL Site, Electric Substation 719 on boundary fence	(Q)
SS-4 (CA)	SSFL Site, west boundary on H Street	(Q)
SS-6 (CA)	SSFL Site, northeast corner of 4353	(Q)
SS-7 (CA)	SSFL Site, 4363, north side	(Q)
SS-8 (CA)	SSFL Site, Former Sodium Disposal Facility north boundary	(Q)
SS-9 (CA)	SSFL Site, RMHF northeast boundary at 4133	(Q)
SS-11 (CA)	SSFL Site, 4036, east side	(Q)
SS-12 (CA)	SSFL Site, RMHF northwest property line boundary	(Q)
SS-13 (CA)	SSFL Site, RMHF northwest property line boundary	(Q)
SS-14 (CA)	SSFL Site, RMHF northwest property line boundary	(Q)
SS-15 (CA)	SSFL Site, RMHF northwest property line boundary	(Q)
(or RMHF_Middle)		
EMB-1 (CA)	SSFL Site, SRE area north of 4003	(Q)
EMB-2 (CA)	SSFL Site, south of Silvernale retention pond, off Test Area Road	(Q)
Off-site Ambient Radiation Dosimeter Locations		
OS-1 (CA)	Off-site, Chatsworth	(Q)
BKG-11	Background Location, West Hills	(Q)
BKG-12	Background Location, Somis	(Q)
BKG-13	Background Location, Hollywood	(Q)
BKG-15	Background Location, Calabasas	(Q)
BKG-18	Background Location, Agoura	(Q)
BKG-19	Background Location, Simi Valley	(Q)
BKG-22	Background Location, Saugus	(Q)

Codes		Locations	
A	Air Sampler Station	SS	SSFL
W	Weekly Sample	OS	Off-site
Q	Quarterly Sample	BKG	Background
CA	State Confirmatory Location	EMB	Environmental Management Branch

Filter samples for each ambient air sampling location are combined annually and analyzed for isotopic-specific activity. The results of the sample analyses are shown in Table 5-4 with the RMHF stack effluent results for comparison. Like effluent air samples, the ambient air samples have radionuclide concentrations far below the DCG values. The variability in the measurements is primarily due to weather effects, as well as analytical and background variations.

It should be noted that these measurements determine only the long-lived particulate radioactivity in the air and, therefore, do not show radon (Rn-222) and most of its progeny. Polonium-210 is a long-lived progeny and is detected by these analyses. It is assumed to be in equilibrium with its parent, Pb-210, whose relatively long half-life (22.3 years) provides an essentially constant level of Po-210 in the samples.

Because the gross alpha and gross beta activities are counted shortly after collection, some natural Be-7 is detected, which elevates the gross beta activity. Be-7 decays by electron-capture and

Table 5-4. Filtered Exhaust and Ambient Air Radioactivity Concentrations – 2003

	Activity Concentration (microcuries per cubic centimeter, μCi/cc)							
		Exhaust	Ambient					
Radionuclide	Derived Conc. Guide	RMHF Stack	RMHF	RMHF Pond	T020	T100	T886	Average
H-3	1E-07	NA	NA	NA	NA	NA	NA	NA
Be-7	natural							
K-40	natural							
Co-60	8E-11							
Sr-90	9E-12	4.6E-16						
Cs-137	4E-10	1.3E-15						
Po-210	natural		3.50E-15	6.66E-15	4.41E-15	3.35E-15	4.41E-15	4.47E-15
Th-228	4E-14				5.90E-17			5.90E-17
Th-230	4E-14			3.12E-17		1.10E-17		2.11E-17
Th-232	7E-15		2.85E-17			1.83E-17		2.34E-17
U-234	9E-14	7.7E-18	1.03E-17	2.66E-17	1.41E-17	2.13E-17	3.92E-17	2.23E-17
U-235	1E-13			7.61E-18	1.14E-17			9.51E-18
U-238	1E-13	4.0E-18	3.04E-18	1.98E-17	2.63E-17	1.67E-17	4.19E-17	2.15E-17
Pu-238	3E-14	5.1E-19						
Pu-239/240	2E-14	1.7E-17					4.19E-18	4.19E-18
Pu-241	1E-12							
Am-241	2E-14							
Gross Alpha	None	5.2E-17	ND	ND	ND	ND	ND	NA
Gross Beta	None	2.2E-15	5.89E-15	1.78E-14	1.00E-14	7.96E-15	6.31E-15	9.58E-15

NA = Not applicable
ND = Not detected

emits a gamma ray in 10% of the decays; this gamma ray is detected as weak beta activity. The naturally occurring radionuclides, Po-210, Ra-226, Ra-228, are the sources of the gross alpha and gross beta activities detected on the air filter samples. During year 2003, the average gross alpha activities on the environmental air samples are less than that on the background sample.

Guidelines for SSFL site ambient air are based on the reference values in DOE Order 5400.5 (DOE, 1993). The conservative guide value for alpha activity is 2×10^{-14} μCi/mL, and the value for beta activity is 9×10^{-12} μCi/mL. A complete list of the results from the gross alpha and gross beta counting of the ambient air samples is given in Table 5-5.

The isotopic analysis of the environmental air samples indicates that the most significant radionuclide presented in the air is Po-210, which is a naturally occurring radionuclide from the U-238 decay series. Trace amounts of man-made radionuclides were also detected in these samples. Since the quantities are so close to the detection limits, it is possible that these identifications are due to the fluctuation of measurement uncertainties In any event, the reported concentrations are far below the DCGs, as shown in Table 5-4.

Due to the fact that nothing but natural background radioactivity is observed in these ambient air samples, DOE plans to discontinue the ambient air monitoring at nonradiological locations in calendar year 2005. DOE will continue to monitor ambient air at the operating radiological facility and the RMHF and around facilities and sites undergoing remediation.

Table 5-5. Ambient Air Radioactivity Data—2003

Area	Activity	Number of Samples	Gross Radioactivity Concentrations (μCi/mL)		
			Annual Average Value	Maximum Value[a]	Average Percent of Guide[b]
SSFL Area IV	Alpha	51	0[c]	9.83E-15	0.00%
T100	Beta		7.96E-15	7.23E-14	0.09%
SSFL Area IV	Alpha	51	0	1.03E-14	0.00%
Hot Lab	Beta		1.00E-14	6.34E-14	0.11%
SSFL Area IV	Alpha	51	0	7.15E-15	0.00%
RMHF	Beta		5.89E-15	6.34E-14	0.07%
SSFL Area IV	Alpha	51	0	7.87E-15	0.00%
4886	Beta		6.31E-15	5.76E-14	0.07%
SSFL Area IV	Alpha	51	0	1.00E-14	0.00%
RMHF Pond	Beta		1.78E-14	1.08E-13	0.20%

[a]Maximum value observed in a single sample.
[b]Guide SSFL site: 2E-14 μCi/mL alpha, 9E-12 μCi/mL beta, DOE Order 5400.5 (02/08/90).
[c]Values are background subtracted. Zero indicates ≤ background values.

5.2.2 Groundwater

Forty-seven wells in and around Area IV are used to monitor the condition of the groundwater in the unconsolidated surface alluvium and the underlying Chatsworth formation. The locations of these wells are shown in Figure 6-2. The purpose of these wells is to monitor concentrations of chemicals and/or radioactivity released by DOE operations. Water samples from these wells are periodically analyzed for radioactivity. Fifty-eight water samples from 31 of these wells were collected and analyzed in 2003. The summary results are shown in Table 5-6.

The State of California assigns drinking water standards to groundwater as a water-quality goal. Numerical limits for radionuclides not specifically listed by the State were derived from the EPA generic dose limit of 4 mrem/year, as specified in 40 CFR 141. Except for three instances of gross alpha (29.1, 16.1, and 18.5 pCi/L at RS-18, RD-29, and RD-34A, respectively), the monitored groundwater satisfies these goals. The high gross alpha concentrations are due to the presence of higher levels of naturally occurring uranium. Gamma spectrometry analysis did not detect any man-made beta and gamma emitters.

Tritium analyses were performed in 57 water samples from 31 groundwater-monitoring wells (see Figure 6-2). Of the 57 analyses performed, six samples had tritium concentrations higher than the detection limits. The positive tritium identifications had maximum concentrations of 237, 1,430, 2,420, and 254 pCi/L at wells RD-24, RD-28 (both near Bldg 4059), RD-34A and RD-34B (both near RMHF), respectively. In 2002, an offsite well, RD-59A, showed a suspicious false detection of tritium at about 3% of the EPA drinking water supplier standard. Although the tritium level does not pose a significant health risk to the public, this well has been closely monitored since then. During 2003, four consecutive quarterly groundwater samples were taken at this well for tritium analysis, and none of them showed a positive detection. This extensive sampling confirms that there is no detectable tritium in RD-59A. In 2003, the maximum value among all the results, 2,420 pCi/L in

Table 5-6. Radioactivity in Groundwater at SSFL—2003

	Activity (pCi/L)									
	H-3	Cs-137	Th-228	Th-230	Th-232	U-234	U-235	U-238	Gross Alpha	Gross Beta
Water Suppliers MCL[a]	20,000	200	N/A			20 – Total Uranium			15	50
Maximum	2420	ND	0.06	ND	ND	20.30	1.05	19.30	29. 10	17.80
Mean[b]	109	NA	0.03	NA	NA	8.42	0.38	7.79	5.59	8.23
Minimum	ND	ND	ND	ND	ND	1.98	ND	2.02	ND	ND
Number of Analyses[c]	57 (47)	41 (41)	5 (3)	5 (5)	5 (5)	9 (0)	9 (6)	9 (0)	42 (9)	42 (1)

[a]From 40 CFR 141 and EPA limit of 4 mrem/yr (see text). N/A = not applicable

[b]The mean is calculated from all reported values. ND = not detected

[c]Numbers in parentheses represent the number of analyses reported as less than the detectable limit.

well RD-34A, is also far below the EPA and California drinking water limit of 20,000 pCi/L. The occurrence of tritium in groundwater is probably due to unintended production of tritium in soil surrounding various reactors, primarily in Building 4010 and 4059.

Historically, well RD-34A, located on recently acquired land near the RMHF in Area IV, had higher concentrations of tritium than other wells in Area IV. Figure 5-2 shows the historical tritium analysis results for RD-34A. For comparison, the allowable limit in drinking water, 20,000 pCi/L, is used as the full scale on the plot. Since the first detection of about 7,000 pCi/L in 1991, the tritium concentrations in this well have dropped down to the range of 1,000 to 5,000 pCi/L. In 2003, tritium was detected at 2,420 pCi/L at this well.

During the first quarter of 2004, three new groundwater monitoring wells were installed near the former Building 4010 site, a possible source for man-made tritium production. One of the three wells, RD-90, had tritium concentration of about 80,000 pCi/L, which is 4 times of the EPA drinking water standard. Further investigation plan is being developed to fully understand how tritium was produced and migrated in groundwater.

5.2.3 Surface Water and Domestic Water Supply

Most of Area IV slopes toward the southeast, and rainfall runoff is collected by a series of drainage channels and accumulates in the R2A Pond. Water from this pond is eventually released to Bell Creek under the NPDES permit. Some of Area IV slopes to the northwest, and a small amount of rainfall drains toward the northwest ravines, which lead into Meier Canyon. To permit sampling of this runoff, five catch basins were installed in 1989 near the site boundary to accumulate runoff.

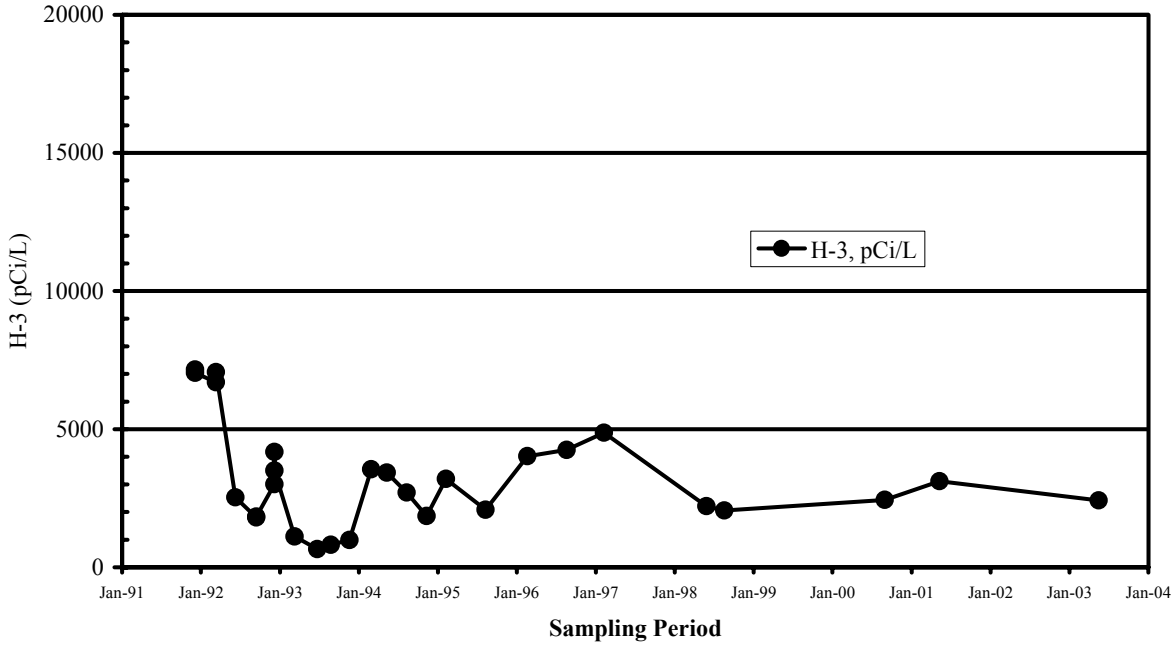


Figure 5-2. Tritium Concentration in Water from Well RD-34A

The average radioactivity concentrations in these catch basin samples are summarized in Tables 5-7 and 5-8. For radioactivity, the maximum contaminant limits (MCL) applicable to suppliers of drinking water (Title 22, Chapter 15, Article 5, Section 64443, of the California Code of Regulations) are imposed on releases from the two southern controlled discharge points (Outfalls 001 and 002) and the five northwest slope runoff channels (Outfalls 003 through 007). There was no indication of any radiological contamination of surface water discharges, and all results were below the drinking water supplier limits established in the NPDES permit.

Domestic water in the areas surrounding the SSFL is supplied by a variety of municipal and regional organizations, including the Los Angeles Department of Water and Power, the Los Angeles County Water District, several Ventura County Waterworks Districts, the Metropolitan Water District, the Burbank Public Service Department, and the Oxnard Public Works Department. Most of the water is imported from distant sources, such as Owens Valley, the Feather River, and the Colorado River. Some water, for Burbank, Oxnard, and Moorpark, comes from local groundwater wells. Water is transported in open aqueducts and/or enclosed pipelines and is stored in open

Table 5-7. NPDES Discharge Radioactivity Data for Northwest Slope Monitoring—2003

Item	Activity (pCi/L)			
	H-3	Sr-90	Gross Alpha	Gross Beta
Water Suppliers MCL	20,000	8	15	50
Maximum	860	ND	4.06	3.54
Mean[a]	258	0.55	1.98	1.73
Minimum	ND	ND	ND	ND
Number of Analyses[b]	26 (21)	26 (26)	26 (15)	26 (10)

[a] Average of all reported values.
[b] Numbers in parentheses represent the number of analyses reported as less than the detectable limit.
ND= Not detected or below detection limit.

Table 5-8. NPDES Discharge Radioactivity Data for Southeast Slope Monitoring—2003

Item	Activity (pCi/L)			
	H-3	Sr-90	Gross Alpha	Gross Beta
Water Suppliers MCL	20,000	8	15	50
Maximum	749	ND	7.40	3.99
Mean[a]	339	0.46	3.61	2.12
Minimum	ND	ND	ND	ND
Number of Analyses[b]	8 (6)	8 (8)	8 (4)	8 (3)

[a] Average of all reported values.
[b] Numbers in parentheses represent the number of analyses reported as less than the detectable limit.
ND= Not detected or below detection limit.

reservoirs and/or underground settling basins. The State of California requires that these suppliers routinely monitor their water for many potentially hazardous materials (and less significant aesthetic quality factors, as well) and report the results of this monitoring to their customers on an annual basis. Tests for radioactivity are performed periodically, but not necessarily done on an annual basis. The latest results reported by local water suppliers at the time of this publication are shown in Table 5-9. It includes the Los Angeles Department of Water and Power, the Los Angeles County Water District, the Burbank Public Service Department, and Simi Valley.

Comparison of the radioactivity in surface water at SSFL (Tables 5-7 and 5-8) with that of the local public supply water (Table 5-9) shows no significant differences in gross alpha or gross beta activities. H-3 and Sr-90 results were not reported by the local public water suppliers.

5.2.4 Soil

The radioactivity in native rock and soil can serve as an indicator of any spread of contamination outside the operating facilities and other known areas of radioactive contamination. Soil radioactivity is due to various naturally occurring radionuclides present in the environment and due to radioactive fallout of dispersed nuclear weapons materials. Naturally occurring radionuclides include K-40 and the uranium and thorium series (including radon and

Table 5-9. Domestic Water Supplies Radioactivity Data

		Gross Alpha	Gross Beta	Ra-226 Ra-228	Uranium
MCL, pCi/L		15	50	5	20
Location		**Average (Range) Activity, pCi/L**			
Los Angeles Department of Water and Power (San Fernando Valley)	Los Angeles Aqueduct Filtration	3.4 (2.0-4.6)	5.1 (2.4-8.6)	<1.0	3.5 (2.2-4.4)
	Encino Reservoir	2.8 (1.5-3.6)	5.5 (4.9-5.8)	<1.0	2.3 (0.2-3.4)
	Combined Wells	3.5 (1.1-5.0)	5.7 (4.1-8.4)	<1.0	3.9 (3.2-4.6)
	Metropolitan Water District Jensen Plant	2.4 (1.5-3.2)	<4	1.0 (<1-2.9)	<2
Los Angeles County Waterworks, District No.40, Region No. 38	Surface Water	1.6 (1.1-2.2)	3.11	NA	NA
	Groundwater	ND	ND	ND	ND
City of Burbank		4.8 (1.5-6.3)	4.7 (ND-6.6)	1.0 (ND-2.9)	7.1 (ND-13.4)
Simi Valley	Metropolitan Jensen (90%)	2.38 (1.5-3.2)	ND (ND-4.44)	1.04 (ND-2.93)	ND (ND-2.12)
	Calleguas (10%)	3.1 (2.4-3.7)	5.5 (5.1-5.9)	ND (ND-0.5)	ND (ND-2.5)

Based on data reported by drinking water suppliers in 2003.
ND = Not detected or above the detection limit set by DHS.

progeny). The radionuclide composition of local area surface soil has been determined to be predominantly K-40, natural thorium, natural uranium, and the decay progeny of these elements. Radioactivity in nuclear weapons test fallout consists primarily of the fission-produced Sr-90, Cs-137, and plutonium isotopes.

Building 4059 Yard

In 2003, initial demolition of 4059 support structures was completed. Fifteen soil samples were taken immediately after the removal of the asphalt inside the 4059 fence-line. In addition to the in-house analysis of gamma-emitting radionuclides, these samples were sent to an independent radiochemical analytical laboratory (Eberline Services in Oak Ridge, TN) for all possible radiological contaminants, including H-3, Fe-55, Ni-63, Sr-90, U-234, U-235, U-238, Th-228, Th-230, Th-232, Pu-238, Pu-239/240, Pu-241, Am-241, and gamma emitters such as Co-60, Cs-137, Eu-152, and Eu-154. Only a trace amount of H-3, Cs-137, and Eu-152 were detected in one soil sample, and the levels were well below the approved soil release criteria. The potassium-40, uranium, and thorium isotopes detected in the soil were naturally occurring. Table 5-10 summarizes the soil sampling results.

Building 4012

After demolition in 2003, a total of 27 soil samples were taken at Building 4012 to support the final status survey of the site. In-house analysis for gamma emitting radionuclides did not detect any man-made gamma emitters in the samples. Among these 27 samples, thirteen were randomly selected and sent to an independent radiochemical analytical lab (Eberline Services in Oak Ridge, TN) for all possible radiological contaminants, including H-3, Fe-55, Ni-59, Ni-63, Sr-90, U-234, U-235, U-238, Th-228, Th-230, Th-232, Pu-238, Pu-239/240, Pu-241, Am-241, and gamma emitters such as Co-60, Cs-137, Eu-152, and Eu-154. No man-made contamination was detected in these samples. The potassium-40, uranium and thorium isotopes detected in the soil were naturally occurring. Table 5-11 summarizes the soil sampling results.

RMHF South Fence

Historically, small amounts of Cs-137 have been detected in soils outside of the RMHF south fence. In 2003, an extensive characterization was performed on the contaminated area. More than 40 soil samples were taken and analyzed for man-made gamma emitters. Cs-137 was detected in most of the samples. The Cs-137 concentration was averaged at 27 pCi/g, ranging from nondetectable to 124 pCi/g in a few isolated spots. After the area was identified, contaminated soils were excavated and shipped to a waste site for disposal.

After the removal of contaminated soil, six more soil samples were taken from the area, and the average Cs-137 concentration was lowered to 3.75 pCi/g, ranging from 1.65 to 7.08 pCi/g. These results were below the approved soil release criterion for Cs-137, which is 9.2 pCi/g. Since RMHF is an operating radiological facility, final cleanup and survey will be performed after RMHF closure.

Table 5-10. Soil Sampling at Building 4059 in 2003

Radionuclide	Release Criterion[a]	Minimum	Average	Maximum	Nominal MDA	Number Positive Detection
	pCi/gram					
H-3	31,900	ND[c]	ND	11.8	5.95	1
K-40	27.6	ND	26.54	33.10	0.99	14
Fe-55	629,000		ND		1.42	0
Co-60	1.94		ND		0.16	0
Ni-63	55,300		ND		3.95	0
Sr-90	36.0		ND		0.58	0
Cs-137	9.20	ND	ND	0.44	0.14	1
Eu-152	4.51	ND	ND	0.84	0.35	1
Eu-154	4.11		ND		0.74	0
Th-228	5.00	0.90	1.20	1.74	0.11	15
Th-230	NA[b]	0.83	1.19	2.39	0.15	15
Th-232	5.00	0.86	1.13	1.58	0.08	15
U-234	30	ND	0.78	1.04	0.15	14
U-235	30		ND		0.08	0
U-238	35	0.49	0.77	1.04	0.09	15
Pu-238	37.2		ND		0.11	0
Pu-	33.9		ND		0.08	0
Pu-241	230		ND		4.49	0
Am-241	5.44		ND		0.08	0

a. K-40, uranium and thorium isotopes are naturally occurring. Their release criteria are net above natural background. Reported values include natural background.
b. NA = Not applicable.
c. ND = Not detected.

Area IV Survey Grids S19 and T19

In 2003, further investigation was conducted on the grids S19 and T19 where Cs-137 was identified during 2002 survey. Twenty-four soil samples were taken in the area and analyzed for man-made gamma emitters. Cs-137 concentrations ranged from below detection limit to 15.1 pCi/g. Once the "hot spots" were pin pointed, the contaminated soils were excavated and removed. A post-remedial sample was collected, and no man-made gamma emitters were detected in the sample. Detailed information about this remediation project is documented in a Boeing Internal Letter (McGinnis, 2003).

Table 5-11. Soil Sampling at Building 4012 in 2003

Radionuclide	Release Criterion[a]	Minimum	Average	Maximum	Nominal MDA	Number Positive Detection
	pCi/gram					
H-3	31,900		ND[c]		3.78	0
K-40	27.6	ND	20.90	30.50	0.65	11
Fe-55	629,000		ND		1.87	0
Co-60	1.94		ND		0.11	0
Ni-59	151,000		ND		28.74	0
Ni-63	55,300		ND		4.94	0
Sr-90	36.0		ND		5.35	0
Cs-137	9.20		ND		0.09	0
Eu-152	4.51		ND		0.24	0
Eu-154	4.11		ND		4.52	0
Th-228	5.00	1.05	1.40	1.72	0.10	13
Th-230	NA[b]	1.20	1.47	1.84	0.09	13
Th-232	5.00	1.39	1.49	1.71	0.14	13
U-234	30	0.69	0.91	1.10	0.08	13
U-235	30	ND	0.07	0.12	0.08	5
U-238	35	0.46	0.87	1.08	0.08	13
Pu-238	37.2		ND		0.15	0
Pu-239/240	33.9		ND		0.12	0
Pu-241	230		ND		5.54	0
Am-241	5.44		ND		0.09	0

a. K-40, uranium and thorium isotopes are naturally occurring. Their release criteria are net of natural background. Reported values include natural background.
b. NA = Not applicable.
c. ND = Not detected.

Other Soil Samples

During 2003, soil samples were also taken to support various site remediation activities. These included six samples for the groundwater monitoring well drilling at SCTI, five samples for Building 4373 leach field excavation, one for the removal of the power pack sewer line, and one for the parking lot near Building 4038. None of these samples had any detectable man-made gamma emitting radionuclides.

5.2.5 Vegetation

No vegetation samples were collected in 2003.

5.2.6 Wildlife

No animal samples were collected in 2003.

5.2.7 Ambient Radiation

During the later years of the nuclear programs at Atomics International and Rocketdyne, from 1974 through 1989, the ambient radiation monitoring program used complicated bulb-type dosimeters (CaF_2:Mn). This usage was justified by the amount of nuclear materials handled in the operations at SSFL and De Soto, and by the low levels of radiation in the environment. At the termination of all nuclear work in 1989, such a program was no longer needed, and efforts were directed toward simplifying the program. This simplification was initially accomplished by using the same dosimeters (LiF) that were well established in use for monitoring personnel engaged in radiation work. While these dosimeters are well suited to measuring exposures in the range of interest for compliance with occupational radiation regulations (doses "above background"), they are somewhat insensitive for environmental measurements, since they have a resolution, in terms of dose increments, of only 10 mrem per quarter. Using these dosimeters, Rocketdyne demonstrated that environmental exposures did not reach regulatory limits, but obtained only limited information on the actual exposure rates present around the facilities and in the neighboring environment.

In addition to the LiF TLDs discussed above, Rocketdyne began deploying, in the last quarter of 1995, environmental TLDs that use an aluminum oxide ("sapphire") chip. These TLDs are capable of determining doses in increments of 0.1 mrem (compared to 10 mrem for the LiF-based badges previously used). In addition, the aluminum oxide badge reporting is much more detailed, providing both gross and corrected readings for the locations. Proper use of the control badges supplied with these dosimeters allows elimination of the natural and transportation exposure that occurs before, during, and after the deployment of the environmental dosimeters to measure the ambient radiation. This usage permits accurate determination of the net exposure received while the environmental TLDs are in the field, exposed to the ambient radiation. In various intercomparisons, aluminum-oxide-based dosimeters have been shown to be among the most accurate dosimeters available in measuring environmental exposure rates.

The State DHS/RHB provides packages containing calcium sulfate ($CaSO_4$) dosimeters for independent monitoring of radiation levels at SSFL and in the surrounding area. These dosimeters are placed at specific locations along with the Rocketdyne TLDs. The State dosimeters are returned to the Radiologic Health Branch for evaluation. Data obtained in 2003 on these TLDs, which were placed at various Rocketdyne dosimeter locations both on-site and off-site, are shown in Table 5-12.

Table 5-12 shows that individual radiation exposures measured by Rocketdyne and the State DHS are in good agreement. Slight differences are mainly due to the fact that two different types of TLDs were used in the measurement. Radiation doses measured at locations SS-12, -13, -14 and -15, are slightly higher than the rest of the locations on-site. This result is reflective of the normal operations at the RMHF, which involve handling and shipment of radioactive waste.

Table 5-12. 2003 SSFL Ambient Radiation Dosimetry Data

2003		Annual Exposure (mrem) by Rocketdyne	Average Exposure Rate (µR/h)	
TLD-Locations			Rocketdyne	State DHS
SSFL	SS-3	76.9	8.8	8.4
	SS-4	82.0	9.4	10.0
	SS-6	91.3	10.4	10.2
	SS-7	93.0	10.6	10.4
	SS-8	94.1	10.7	10.2
	SS-9	92.2	10.5	9.4
	SS-11	90.6	10.3	9.5
	SS-12	104.5	11.9	12.4
	SS-13	98.5	11.2	12.0
	SS-14	106.5	12.2	10.2
	SS-15	107.6	12.3	13.1
	EMB-1	97.0	11.1	10.6
	EMB-2	92.5	10.6	10.5
Mean Values		**94.4**	**10.8**	**10.5**
Off-site	OS-1	69.3	7.9	6.6
	BKG-11	57.5	6.6	--
	BKG-12	44.8	5.1	--
	BKG-13	39.3	4.5	--
	BKG-15	64.2	7.3	--
	BKG-18	59.5	6.8	--
	BKG-19	43.8	5.0	--
	BKG-22	32.2	3.7	--
Mean Values		**51.3**	**6.1**	**6.6**

The natural background radiation level as measured by the off-site TLDs ranges from 32 to 69 mrem/yr. At SSFL, the local background ranges from 77 to 97 mrem/yr, based on the data from dosimeters SS-3, -4, -6, -7, -8, -9, and -11 and EMB-1 and -2 as shown in Table 5-12. The variability observed in these values can be attributed to differences in elevation and geologic conditions at the various sites. The altitude range for the dosimeter locations is from approximately 260 m (850 ft) ASL at the off-site locations to a maximum of approximately 580 m (1,900 ft) ASL at SSFL. Many of the SSFL TLD locations are also affected by proximity to sandstone rock outcroppings, a condition that results in elevated exposure levels.

The external exposure rate at Rocketdyne's northern property boundary, the closest property boundary to the RMHF, should be indistinguishable from natural background. This property line is approximately 300 meters from the RMHF and separated by a sandstone ridge that effectively shields the boundary from direct radiation from the RMHF. Dosimeters placed on the RMHF side of this sandstone ridge (SS-12, -13, –14, and -15), approximately 150 meters from the RMHF, read an average of 14 mrem/year above the local background. This amount is

considerably below the 100 mrem/year limit specified in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. The TLD results demonstrate that the potential external exposure at the site boundary is below the DOE's dose limit.

The SSFL local background, calculated as the average of all onsite TLDs (except SS-12, SS-13, SS-14, and SS-15), is 90 mrem/year. This value is 39 mrem/year higher than the background as calculated by the average of all offsite TLDs of 51 mrem/year. This result can be attributed to the contribution of higher elevation and different geology. Offsite TLDs are located in Rocketdyne staff members' backyards, surrounded by natural soil. In contrast, SSFL lies atop the Chatsworth Formation of the San Fernando and Simi valleys. The Chatsworth Formation is composed of arkosic sandstone, rich in feldspar. Arkosic rocks are often high in uranium content. As a result, the Chatsworth Formation rocks produce higher radiation exposure than the soil of the surrounding valleys. To determine this effect, in January 2003 radiation exposure rates were measured with a Ludlum 12S microR meter at Stoney Point, a large rock outcroppings in Chatsworth, about eight miles from SSFL, and at a residence in West Hills (the location of TLD BKG-11). Differences of about 6 μR/h (or about 50 mrem/year) were observed between the two locations, as shown in Table 5-13. Likewise, exposure rates taken at SSFL over rock outcroppings (locations of most of the onsite TLDs) and a soil region also showed a difference of about 6 μR/h (or about 50 mrem/year).

Even single 2- to 3-lb rock samples from both offsite and onsite locations showed increased exposure rate of about 2 μR/h (or about 15 mrem/y), as shown in Table 5-14. In conclusion, the modest increase in exposure observed between offsite valley locations and SSFL locations can easily be attributed to the Chatsworth Formation arkosic sandstone geology.

5.3 ESTIMATION OF RADIATION DOSE

5.3.1 Individual Dose

The total effective dose equivalent (TEDE) to any member of the public from all pathways (combining internal and external dose) shall not exceed 100 mrem/yr (above background) for DOE facilities. Although the four TLD monitoring stations to the north of the RMHF, namely SS-12, -13 –14, and -15, recorded an external dose level at 14 mrem above the local background, the actual dose at the property boundary is likely to be indistinguishable from the natural background. This is because the high rocky terrain between the actual property line and the TLD monitoring stations acts as an effective shield and makes the exposure from direct radiation at the property line indistinguishable from background. Exposure from direct radiation at the nearest residence would also be indistinguishable from background for the same reason.

Table 5-13. Exposure Rates Over Different Geology

Location	Exposure Rate, μR/h
SSFL sandstone rocks	17 to 22
Stoney Point	18 to 22
SSFL soil	~14
West Hills home soil (TLD BKG-11 location)	~14

Table 5-14. Radiation Exposure Rates of On-site and Off-site Rock Samples

Count	1 minute Cumulative Gross Counts Using Ludlum 2221 Scaler			
	Background in 4038	SSFL Rock Sample (Large)	SSFL Rock Sample (Small)	Stoney Point Rock Sample
1	2097	2462	2560	2530
2	2033	2435	2349	2360
3	2031	2432	2392	2414
4	2049	2421	2397	2425
5	2076	2447	2450	2388
6	2019	2511	2513	2437
7	2020	2459	2401	2387
8	2139	2455	2392	2400
9	2090	2465	2248	2520
10	2113	2598	2389	2442
Average	2067	2469	2409	2430
Std. Dev.	42	52	86	56
Exposure rate in microR/hr*	9.6	11.5	11.2	11.3
Exposure rate in milliR/yr	84	101	98	99

*Using conversion factor of 215 cpm/(microR/hr)

Estimates of the internal dose from airborne releases assume a constant unsheltered exposure throughout the year and, therefore, considerably overestimate the actual annual doses near the site. Estimated internal radiation doses due to atmospheric emission of radioactive materials from SSFL nuclear facilities are calculated using the EPA program, CAP88-PC; are many orders of magnitude below the radiation standards; and are far below doses from internal exposure resulting from natural radioactivity in air. For DOE operations, the air pathway standard is 10 mrem/yr (CEDE), as established by EPA.

Public exposure to radiation and radioactivity is shown in Table 5-15. The table presents the estimated exposures in comparison to the regulatory standards. Dose values in the tables represent both internal and external exposures.

5.3.2 Population Dose

The general population dose (person-rem) estimates were calculated using CAP88-PC code. This code uses release rate, wind speed, wind direction and frequency, stability fractions, and stack height parameters as input data. Population dose is estimated to be 4.9×10^{-5} person-rem for the SSFL site. As a comparison, an average person in the US receives approximately 300 mrem/yr

Table 5-15. Public Exposure to Radiation from DOE Operations at SSFL—2003

1.	All pathways	
	a. Maximum estimated external dose to an individual from direct radiation	0 mrem/yr
	b. Maximum estimated internal dose to an individual	1.9×10^{-7} mrem/yr
	Limit	100 mrem/yr
	("Radiation Protection of the Public and the Environment" DOE Order 5400.5)	
2.	Air pathway (reported in NESHAPs report)	1.9×10^{-7} mrem/yr
	Limit (40 CFR 61, Subpart H)	10 mrem/yr

from natural background radiation, and the total population dose within 80 km radius is estimated to be 3×10^6 person-rem. In spite of the large number of people in the surrounding population, the population dose estimated for Rocketdyne operations is extremely small. Figure 5-3 shows the population data within 50 miles (80 km) radius from SSFL.

Figures 5-4 and 5-5 show more detailed local population distribution estimated from the demographic survey. Claritas Inc, a leading demographic survey company, developed the demographic data around SSFL in 2000 based on the census data and modified by direct observations of nearby residential areas around the SSFL site.

5.4 PROTECTION OF BIOTA

Since 1990, DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, has required that populations of aquatic organisms be protected using a dose limit of 1 rad/day. In 2003, DOE Order 450.1 requires that data obtained from environmental monitoring program be sufficient to allow for biota dose evaluation. While there is no formal DOE dose limit for terrestrial biota, DOE strongly recommends that its site activities meet the internationally recommended dose limits for terrestrial biota, which are:

- the absorbed dose to aquatic animals will not exceed 1 rad/day (10 mGy/day) from exposure to radiation or radioactive material,
- the absorbed dose to terrestrial plants will not exceed 1 rad/day (10 mGy/day) from exposure to radiation or radioactive material, and
- the absorbed dose to terrestrial animals will not exceed 0.1 rad/day (1 mGy/day) from exposure to radiation or radioactive material.

There is no aquatic system in the Area IV of SSFL. Therefore, the protection of aquatic organisms on-site is not an issue. Since there is no liquid effluents discharge from the site, as demonstrated in Section 5.2.3, off-site aquatic systems, if any, are not affected by the DOE operations at SSFL.

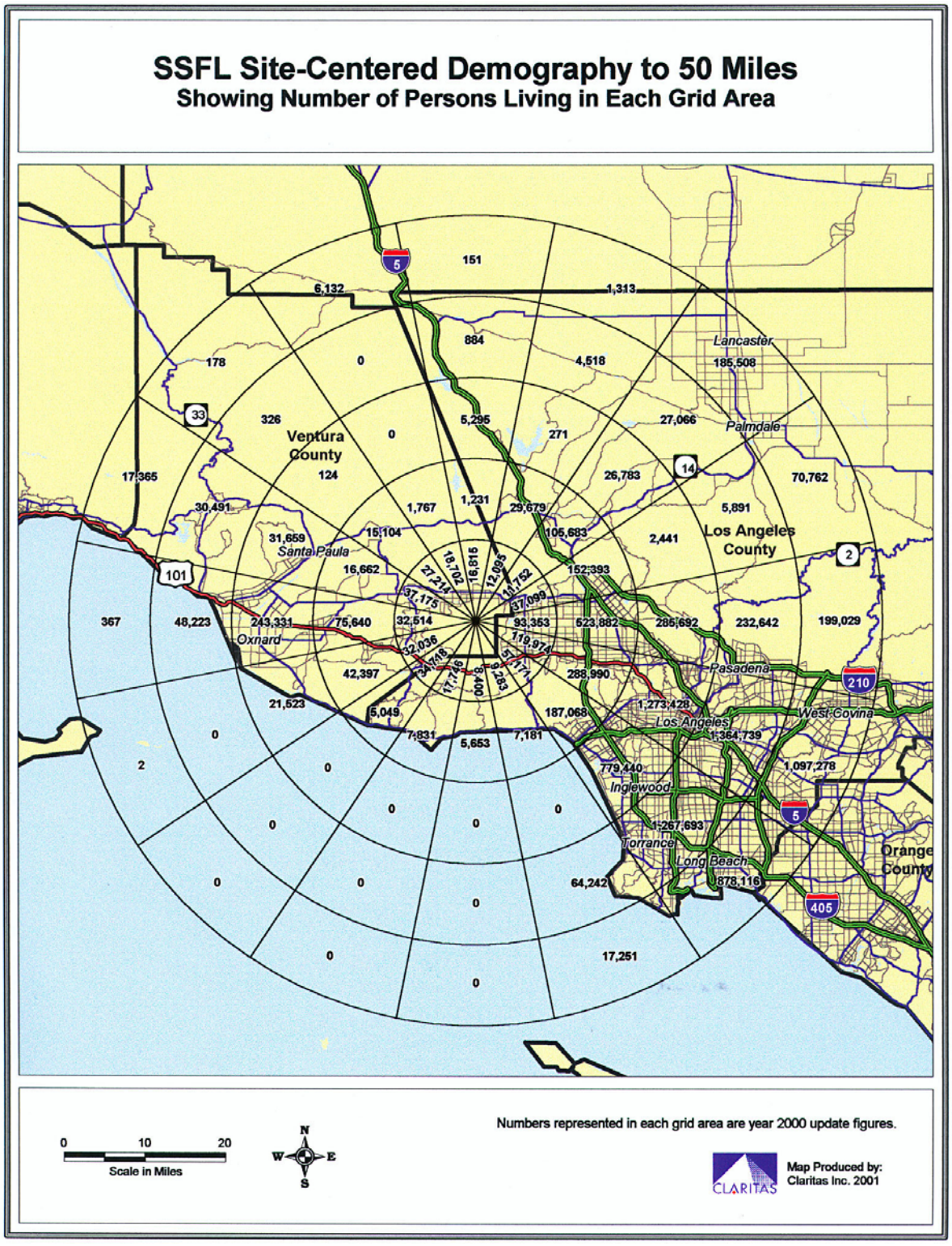


Figure 5-3. Demographic Data Within 50 miles (80 km) of SSFL

Figure 5-4. Number of Persons Living Within 5 miles (8 km) of SSFL Site

Figure 5-5. Number of Persons Living Within 10 miles (16 km) of SSFL Site

The terrestrial biota, i.e., vegetation and small wild animals, are abundant at SSFL. They are subject to exposure to the radioactivity in soil. The DOE Technical Standard, *A Graded Approach for Evaluating Doses to Aquatic and Terrestrial Biota* (DOE, 2002), provides a methodology for demonstrating compliance with the requirement for protection of biota. RESRAD-BIOTA, a computer program developed by DOE, implements the graded approach for biota dose evaluation. There are three levels of dose evaluations in RESRAD-BIOTA. The first level is a conservative screening tool for compliance demonstration. Once the screening test in Level 1 is passed, no further action is necessary.

In the Level 1 dose evaluation, measured radionuclide concentrations in environmental media are compared with the biota concentration guides (BCGs). Each radionuclide-specific BCG represents the limiting concentration in environmental media that would not cause the biota dose limits to be exceeded.

Soil concentrations in Area IV are used for the Level 1 dose evaluation. During the past decades, thousands of soil samples were collected and analyzed, and the maximum values, as recommended for the Level 1 dose evaluation, were entered into the RESRAD-BIOTA to compare against the BCGs. Table 5-16, summarizes the comparison results. The total BCG fraction at SSFL, as shown in Table 5-16, is less than 1, indicating that the potential exposure is less than the dose limit recommended by the DOE.

Table 5-16. Terrestrial Biota Radiation Exposure as a Fraction of Dose Limit

Nuclide	Soil		
	BCG Limit pCi/g	Maximum Concentration pCi/g	Partial Fraction
Am-241	3.89E+03	5.60E-01	1.44E-04
Co-58	1.80E+03	1.00E-01	5.57E-05
Co-60	6.92E+02	2.60E+00	3.76E-03
Cr-51	5.34E+04	7.50E-01	1.41E-05
Cs-134	1.13E+01	2.50E-01	2.21E-02
Cs-137	2.08E+01	7.08E+00	3.41E-01
Eu-152	1.52E+03	2.57E+01	1.69E-02
Eu-154	1.29E+03	4.04E-01	3.13E-04
Eu-155	1.58E+04	1.10E-01	6.95E-06
H-3	1.74E+05	8.50E+03	4.89E-02
Pu-239	6.11E+03	5.40E-02	8.83E-06
Sr-90	2.25E+01	4.82E+00	2.14E-01
Th-232	1.51E+03	4.25E+00	2.82E-03
U-234	5.13E+03	2.49E+00	4.85E-04
U-235	2.77E+03	5.00E-01	1.80E-04
U-238	1.58E+03	5.20E+00	3.30E-03
Zn-65	4.13E+02	2.10E-01	5.09E-04
		Sum	6.54E-01

6. ENVIRONMENTAL NON-RADIOLOGICAL MONITORING

Rocketdyne maintains a comprehensive environmental program to ensure compliance with all applicable regulations, to prevent adverse environmental impact, and to restore the quality of the environment from past operations.

The discharge of surface water at SSFL results from storm water runoff or excess treated groundwater. The California Regional Water Quality Control Board regulates discharges through a National Pollutant Discharge Elimination System (NPDES) permit. Most surface water runoff drains to the south and is collected in the water reclamation/pond system. Discharges from this system are subject to effluent limitations and monitoring requirements as specified in the NPDES permit. A small portion of the site within Area IV discharges storm water runoff to five northwest runoff channels where sampling locations (Figure 6-1) have been established and sampling is conducted in accordance with the northwest slope monitoring program. All discharges are regularly monitored for as many as 143 different constituents, including: volatile organics, heavy metals, and applicable radionuclides as well as other parameters necessary to assess water quality.

An extensive site-wide (SSFL) groundwater remediation system enables the removal of solvent contamination from approximately 10 million gallons of groundwater per month. The major groundwater contaminants in Area IV are TCE and its degradation products. Three interim groundwater extraction system wells have been installed in Area IV, and evaluation of their performance is in progress. The overall annual groundwater monitoring program at SSFL addresses collection and analysis of groundwater samples and measurement of the water levels for the 247 Rocketdyne installed wells on-site and off-site and 16 off-site private wells. The locations of these wells within and around DOE areas in Area IV are shown on the map of SSFL in Figure 6-2. Groundwater quality parameters and sampling frequency have been determined on the basis of historical water quality data, location of known or potential sources of groundwater contamination, operational requirements of groundwater extraction and treatment systems, and regulatory direction. The groundwater monitoring program includes the following parameters, all analyzed using the appropriate EPA methods: volatile organic constituents, base/neutral and acid extractable organic compounds, petroleum hydrocarbons, trace metals, and common ion constituents. Radiological analyses are performed on groundwater samples from DOE areas in Area IV and off-site (see section 5.2.2).

Petroleum hydrocarbon contaminated soils resulting from underground storage tanks (USTs) have been remediated as tanks are removed. Most of the storage tanks have been removed. The few remaining USTs contain either sodium or radioactive water and are located within concrete vaults and equipped with automatic leak detection systems. As stated previously, these tanks are exempt from the UST regulations.

6.1 SURFACE WATER

Boeing Canoga Park has filed a Report of Waste Discharge with the California Regional Water Quality Control Board and has been granted a discharge permit pursuant to the National Pollutant Discharge Elimination System and Section 402 of the federal Water Pollution Control Act. The

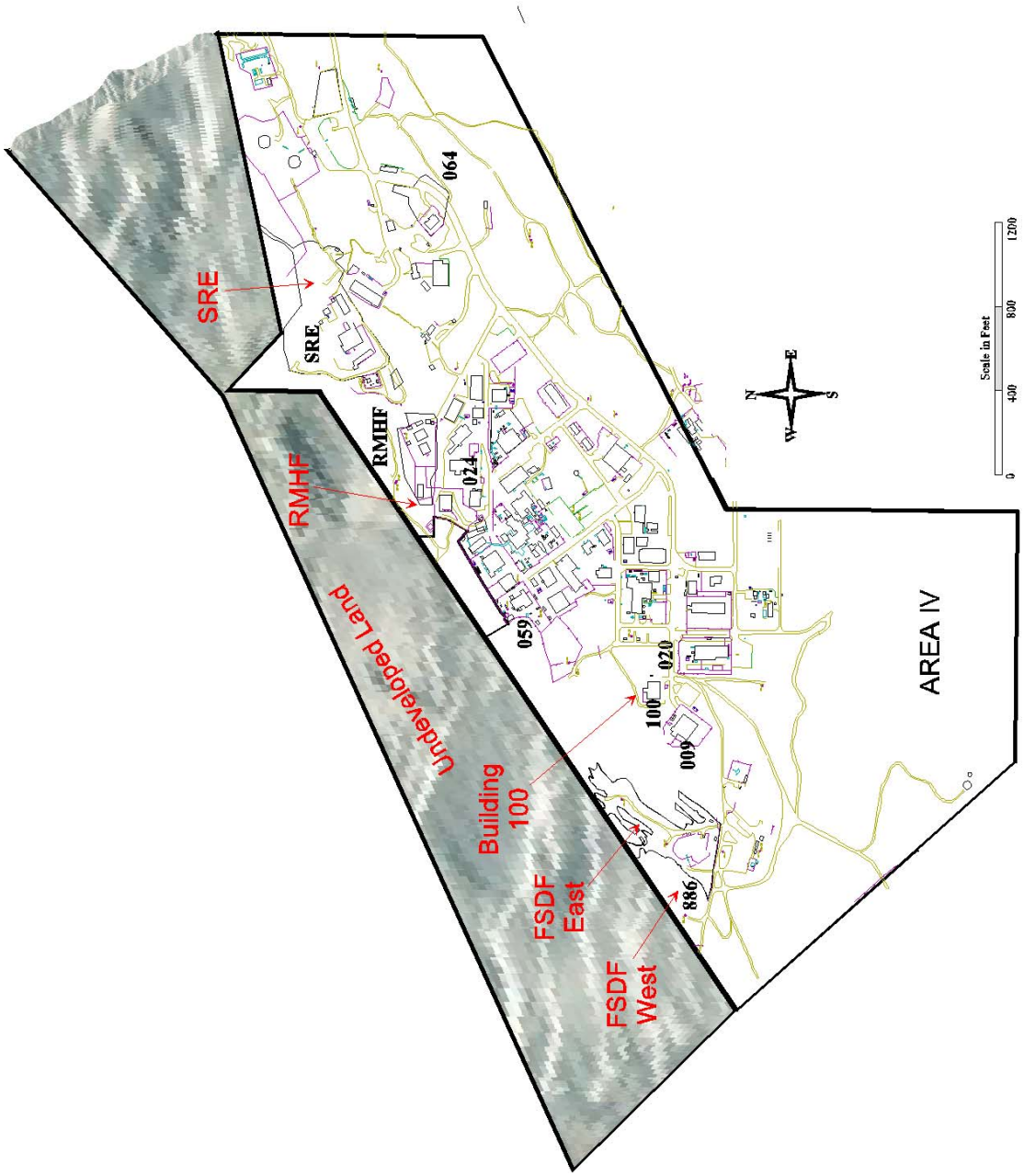


Figure 6-1. Locations of Surface Water Runoff Collectors

permit to discharge, NPDES No. CA0001309, initially became effective September 27, 1976, and was most recently renewed on June 29, 1998. The current permit although scheduled to expire on May 10, 2003, continues to be in effect until the revised Permit is approved by the CRWQCB.

The permit allows the discharge of reclaimed wastewater, storm water runoff, and industrial waste water from retention ponds into Bell Creek, a tributary of the Los Angeles River. The permit also allows for the discharge of storm water runoff from the northwest slope (Area IV) locations into

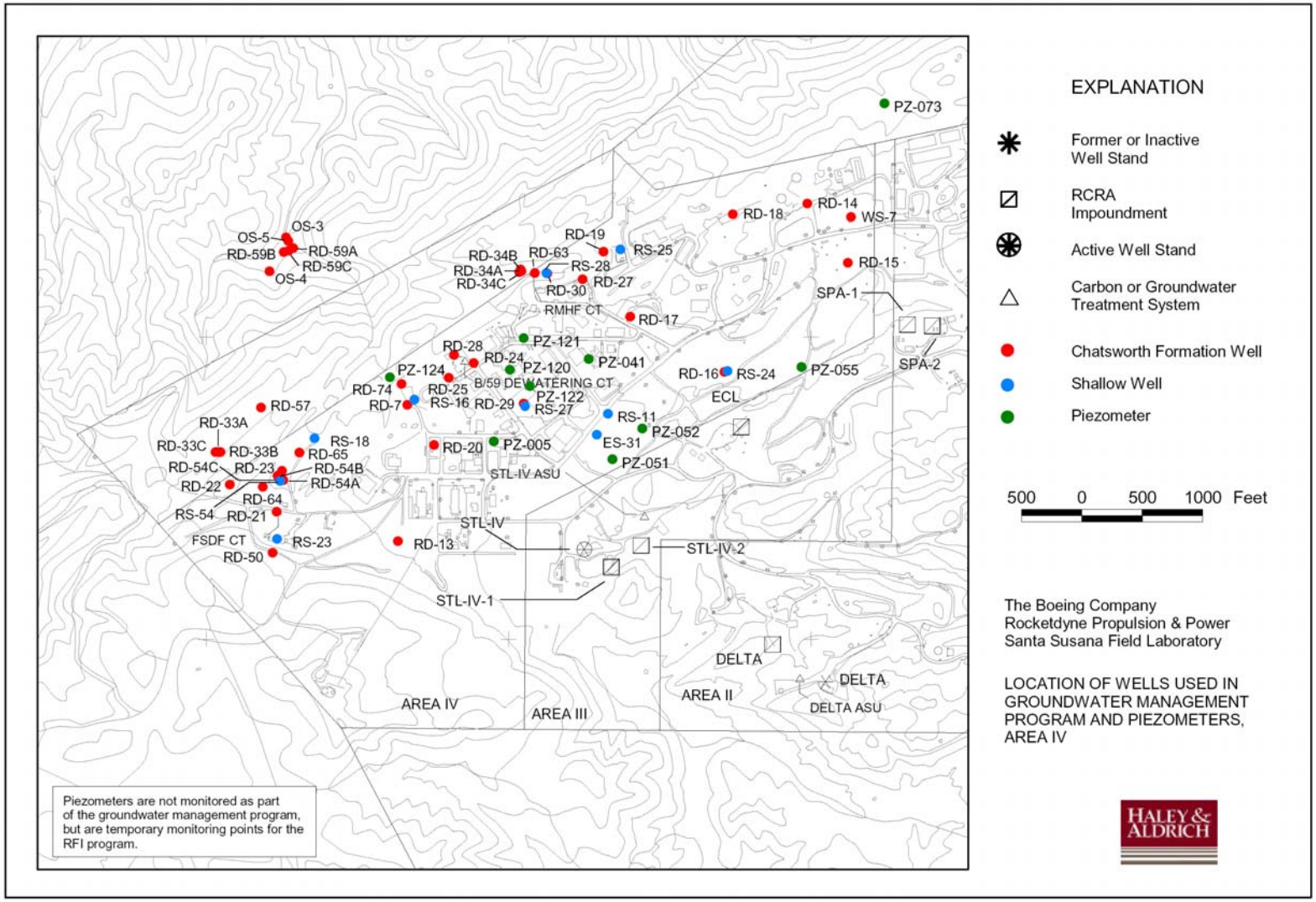


Figure 6-2. Well Locations

the Arroyo Simi, a tributary of Calleguas Creek. Discharge along the northwest slope (RMHF: Outfall 003, SRE: Outfall 004, FSDF 1: Outfall 005, FSDF 2: Outfall 006, and T100: Outfall 007) generally occurs only during and immediately after heavy rainfall. The permit applies the numerical limits for radioactivity established for drinking water supplies to drainage through these outfalls. Excess reclaimed water is discharged occasionally from the R-2A Pond that ultimately releases through Outfall 002.

There is no sanitary sewer connection to a publicly owned treatment works from SSFL. Domestic sewage is trucked offsite for treatment and disposal. Permit conditions are imposed on the operation of the two treatment plants. Area IV sewage is piped directly to the Area III Sewage Treatment Plant (STP III).

Of the two retention ponds at SSFL that discharge via the NPDES permit, only one, the R-2A Pond, receives influent from Area IV. Influent to the pond may include tertiary treated domestic sewage, cooling water from various testing operations, treated ground water, and storm water runoff. If any discharge from the ponds reaches the sampling location at Outfall 002, grab samples are collected and sent to a California State certified testing laboratory for analysis. Analyses include analyses of such chemical constituents as heavy metals, volatile organics, base/neutral and acid extractables, general chemistry, and specified radionuclides. Toxicity testing is also conducted in the form of acute and chronic toxicity bioassays.

In November 1989, a storm water runoff-monitoring program was developed and implemented in Area IV for runoff from the northwest portion of the site. The five monitoring locations selected include the Radioactive Materials Handling Facility watershed (Outfall 003), Sodium Reactor Experiment watershed (Outfall 004), the Former Sodium Disposal Facility watershed (Outfalls 005 and 006), and the Building T100 watershed (Outfall 007). Runoff monitoring is currently conducted as set forth by the NPDES permit referenced above. Furthermore, all surface water program activities for the SSFL, including Area IV, have been addressed and incorporated into the current NPDES permit. A Storm Water Pollution Prevention Plan was prepared in accordance with the current federal and state regulations.

The permit imposes contaminant limits for radioactivity similar to those for drinking water and goes beyond the requirements of the drinking water regulations by requiring more frequent sampling and analysis. During wet weather flow (when rainfall is greater than 0.1 inch), no more than 1 sample per 2 weeks needs to be obtained from each of the outfalls. During dry weather, samples must be collected whenever there is discharge from Outfall 002. The minimum sampling frequency during dry weather is once per month.

There was no discharge from the domestic sewage treatment plants, since the waste water previously treated by the STPs is captured and trucked off site for proper disposal, as summarized in the monthly DMR reports to the RWQCB. Boeing does not anticipate future use of either STP.

Monitoring methods and results for the seven outfalls that had flow during 2003were reviewed for permit compliance. Discharges were found to be compliant with permit limits with the exception of one event each at Outfalls 001 and 002 and two events at Outfall 005 as described below.

Stormwater Outfall 001

Iron was reported at a daily maximum of 0.67 mg/l at Outfall 001 for the February 12, 2003 sampling event. The daily maximum limit for iron is 0.3 mg/l. Since the iron result was inconsistent with historical data, Boeing requested that the laboratory prepare and analyze another aliquot from the Outfall 001 sample container. The analytical result for this aliquot was 0.21 mg/l of iron. Iron concentrations in subsequent Outfall 001 samples collected March 16 and May 3, 2003, were 0.21 and 0.18 mg/l, respectively, and below the daily maximum permit limit of 0.3 mg/l. The resample and subsequent sample results are consistent with historical data.

Detergent (surfactant) was reported at 2.0 mg/l at Outfall 001 for the May 3, 2003 sampling event. The maximum daily permit limit for detergent is 0.5 mg/l. Since the detergent result was inconsistent with historical data, Boeing requested that the laboratory prepare and analyze another aliquot from the Outfall 001 sample container. The analytical result for this aliquot was <0.1 mg/l (nondetectable). Detergent concentrations in previous Outfall 001 samples collected February 12 and March 16, 2003, were also <0.1 mg/l (nondetectable) and well below the daily maximum permit limit. The resample and subsequent sample results are consistent with historical data. In addition, a corrective action letter from the laboratory indicated that the original sample was analyzed using an inappropriate method.

Given the extensive history of compliance with iron and detergent discharge limits at Outfall 001 both prior to and after the February 12 and May 3, 2003 events, respectively, it is Boeing's position that the February 12, 2003, and May 3, 2003, iron and detergent results for Outfall 001 are not truly representative of the discharge water quality at this location and that, therefore, no additional corrective action is required. According to footnotes 7 and 8 on page 14 of the February 27, 2004, revision of the tentative permit renewal, the CRWQCB concurs in this conclusion.

Stormwater Outfall 002

Outfall 002 had one maximum daily permit limit exceedence during 2003. The iron concentration at Outfall 002 for the February 12, 2003, sample event was 0.7 mg/l compared to the daily maximum permit limit of 0.3 mg/l. Since the iron result was inconsistent with historical data, Boeing requested that the laboratory prepare and analyze another aliquot from the Outfall 002 sample container. The analytical result for this aliquot was 0.07 mg/l of iron. Iron concentrations in subsequent samples from the 2003 monitoring period ranged from <0.01 (nondetectable) to 0.08 mg/l, well below the permit limit and consistent with historical data.

It is important to note that the CRWQCB collected a sample at Outfall 002 on February 13, 2003. Boeing obtained and analyzed a split of the CRWQCB sample. The iron concentration reported for the split of the RWQCB sample was 0.068 mg/l.

Given the extensive history of compliance with iron discharge limits at Outfall 002 both prior to and after the February 12, 2003, event, it is Boeing's position that the February 12, 2003, iron result for Outfall 002 is not truly representative of the discharge water quality at this location and that, therefore, no corrective action is required. According to footnote 7 on page 14 of the February 27, 2004, revision of the tentative permit renewal, the CRWQCB concurs in this conclusion.

Stormwater Outfall 005

Outfall 005 had two exceedences during the 2003 monitoring period. The pH at Outfall 005 for the March 15, 2003 sampling event was 5.3, compared to a permit limit ranging from 6 to 9. The copper concentration at Outfall 005 for the November 1, 2003, was 12.0 µg/l compared to a monthly average permit limit of 11.0 µg/l.

The pH of the Outfall 005 March 15, 2003, sample was reported at 5.3, below the permitted range of 6 to 9. Since this pH value was inconsistent with historical data, Boeing requested that the laboratory re-evaluate the sample. The re-evaluated pH value was 6.4. The pH values for other samples collected during the 2003 monitoring period ranged from 6.6 to 7.4. The re-analyzed sample and subsequent sample results are consistent with historical data.

The copper concentration for the November 1, 2003 Outfall 005 sample event was 12 µg/l, i.e., below the daily maximum of 17 µg/l but above the monthly average of 11 µg/l. Since this copper result was inconsistent with historical data, Boeing requested that the laboratory prepare and analyze another aliquot from the Outfall 005 sample container. An analysis of this sample showed it to have a copper concentration of 9.0 µg/l. Because November had only one sampling event, Boeing was unable to obtain additional data points to better reflect a monthly average. As a result, this one sample constituted the monthly average and, hence, a reported violation. Yet, in reviewing historical data from past rain events and those subsequent to this reporting month, all results demonstrated compliance with the monthly average, with results ranging from <2.0 µg/l (nondetectable) to 2.2 µg/l. Since no industrial operations in the area use copper in their processes and the background levels of copper in the SSFL soil range from 4.5 to 72 mg/kg, any copper detected at this location would have to be from natural sources.

Given the extensive history of compliance with pH and copper discharge limits at Outfall 005 both prior to and after the March 15, 2003, and November 1, 2003, events, it is Boeing's position that the March 15, 2003, pH result and November 1, 2003, copper result for Outfall 005 samples are not truly representative of the typical discharge water quality at this location.

6.2 AIR

The SSFL is regulated by the VCAPCD and must comply with all applicable rules, regulations, and permit conditions set forth in Permit to Operate No.00271. Permit to Operate No.00271 covers Area IV of the SSFL, which is inspected each year by the air district. On May 22, 2003, the VCAPCD performed its annual inspection. No issues or violations were identified. Likewise, air emissions allocated to this operating permit have continued to remain under applicable thresholds and, as a result, the area is considered a non-Title-V, non-Aerospace NESHAP, and non-SARA 313 stationary source.

6.3 GROUNDWATER

A groundwater monitoring program has been in place at the SSFL site since 1984. Currently, the monitoring system includes 247 Rocketdyne installed on-site and off-site wells and 18 private off-site wells. Routine quarterly chemical and radiological monitoring of the wells is conducted

according to the monitoring plan submitted to the lead agency for the groundwater program. Quarterly reports are submitted to the regulatory agencies at the end of the first three quarters. An annual report is submitted to the lead agencies after the monitoring for the fourth quarter is completed. A summary of groundwater monitoring activities and sampling results for Area IV during 2003 is presented in Tables 6-1 and 6-2.

Groundwater occurs at SSFL in the alluvium, weathered bedrock, and unweathered bedrock. First-encountered groundwater exists under water table conditions and may be encountered in any of these media. For the purposes of this report, near-surface groundwater is defined as groundwater that is present in the alluvium and weathered bedrock, and groundwater that occurs below the weathered bedrock is referred to as Chatsworth Formation groundwater. The alluvium is composed of a heterogeneous mixture of gravel, sand, silt, and clay. Water levels in the alluvium respond to recharge resulting from precipitation and runoff and may vary considerably between wet and dry periods. Within Area IV, there are 10 DOE-sponsored near-surface groundwater wells (Figure 6-2). The Chatsworth Formation is composed of consolidated, massively bedded sandstone with inter-embedded layers of siltstone and claystone. Several structural features and fine-grained shale units are apparent at the site, including the Shear Zone trending to the northeast in Area I and several shale units located throughout the facility. These major features appear to compartmentalize groundwater flow within delineated units, making the determination of groundwater flow rates and direction difficult to infer from water level contours. There are 37 DOE-sponsored Chatsworth Formation wells in and around Area IV (Figure 6-2).

Table 6-1. Purposes of Groundwater Monitoring at Area IV in 2003

Item	Remediation	Waste Management	Environmental Surveillance	Other Drivers
Number of active wells monitored	0	0	47	0
Number of samples taken	0	0	91	0
Number of analyses performed	0	0	4488	0
% of analyses that are nondetects	0	0	87.6	0

Table 6-2. Ranges of Results of Groundwater Monitoring in 2003

Analytes	Ranges of Results for Positive Detections
Heavy Metals (mg/L)	<0.00003 to 4.4
Trichloroethene (TCE) (µg/l)	<0.26 to 130
cis-1,2-Dichloroethene (cis-1,2-DCE) (µg/l)	<0.32 to 190
Tetrachloroethene (PCE) (µg/l)	<0.32 to 27
Perchlorate (µg/l)	<0.8 to 2.1

The solvents found in Area IV groundwater include trichloroethene (TCE) and its family of degradation products. The results of the 2003 analyses of the Area IV wells were documented in the 2003 Annual Groundwater Monitoring Report (HA, 2004). Boeing initiated a voluntary site-wide program to assess the occurrence and distribution of perchlorate in 1997. This assessment identified a limited area of groundwater in the vicinity of the FSDF that has been impacted by perchlorate.

Three distinct areas of TCE-impacted groundwater have been delineated in the northwest part of Area IV. These areas include the drainage below RMHF, the Building 59 area, and the FSDF area (Figure 6-3). These areas are roughly defined by the locations of monitor wells where results of laboratory analyses of water samples indicate concentrations of TCE equal to or above the MCL of 5 µg/l. The central occurrence, near well RD-7, may also extend laterally; however, no data are available because the area is located in inaccessible terrain. In 2003, TCE was detected below the MCL in well RD-13, located in the central part of Area IV near Burro Flats. This occurrence was determined to be the result of improperly decontaminated sampling equipment.

The TCE occurrence associated with the RMHF canyon (the northern occurrence) has historically been detected in shallow wells and Chatsworth Formation wells. Shallow well RS-28 was dry during 2003 but has, historically, contained TCE concentrations up to 87 µg/l. Chatsworth Formation well RD-30 contained 7.1 to 8.2 µg/l of TCE in 2003. RD-63, an extraction well installed in 1994 in the Chatsworth Formation for the pilot extraction test in the area, contained 3.3 to 6.6 µg/l TCE in 2003.

Within the central contaminated area (Figure 6-3), southwest of Building 59, Chatsworth Formation well RD-7 contained TCE concentrations ranging from 1.6 to 8.4 µg/l in 2003, compared to 11 to 77 µg/l in 2002. The low TCE concentrations (1.6 to 11 µg/l) reported for RD-7 samples were collected from a discrete interval groundwater monitoring system installed in RD-7 in April 2002. The samples were collected at depth intervals of 90-100 feet and 290-300 feet. Since its construction in 1986, RD-7 generally contained TCE concentrations in the 12 to 81 µg/l range with a maximum TCE concentration of 130 µg/l. Well RD-25, located southwest of Building 59, continued to contain low concentrations of tetrachloroethene (PCE). In 2003, the well contained 6.2 to 27 µg/l PCE, compared 5.7 to 12 µg/l PCE in 2002. TCE was also detected in samples from RD-25 in 2003, but concentrations were below the MCL of 5 µg/l.

TCE was detected in groundwater samples collected in 2003 from wells located near the FSDF area (Figure 6-3). Through 2002, historic samples collected from shallow wells contained TCE at concentration ranges of 19 to 3,200 µg/l in RS-18 and 180 to 4,500 µg/l in RS-54. The power supply was diverted from RS-54 to support FSDF characterization efforts and, consequently, RS-54 was not sampled in 2003. During 2003, well RS-18 contained 17 µg/l TCE. In Chatsworth Formation wells, TCE concentrations ranged from not-detected up to 130 µg/l in RD-64 in samples collected during 2003. Historic TCE concentrations have ranged from not detected above the 1 µg/l detection limit to 680 µg/l in samples from RD-64. Lower TCE concentrations exceeding the MCL of 5 µg/l were reported in 2003 samples collected from wells RD-21 (59 to 84 µg/l), RD-23 (37 to 48 µg/l), RD-54A (5.1 to 7.3 µg/l), and RD-65 (11 µg/l). Historic maximum TCE concentrations for these wells are: RD-21, 610 µg/l; RD-23, 610 µg/l; RD-54A, 580 µg/l; and RD-65, 960 µg/l.

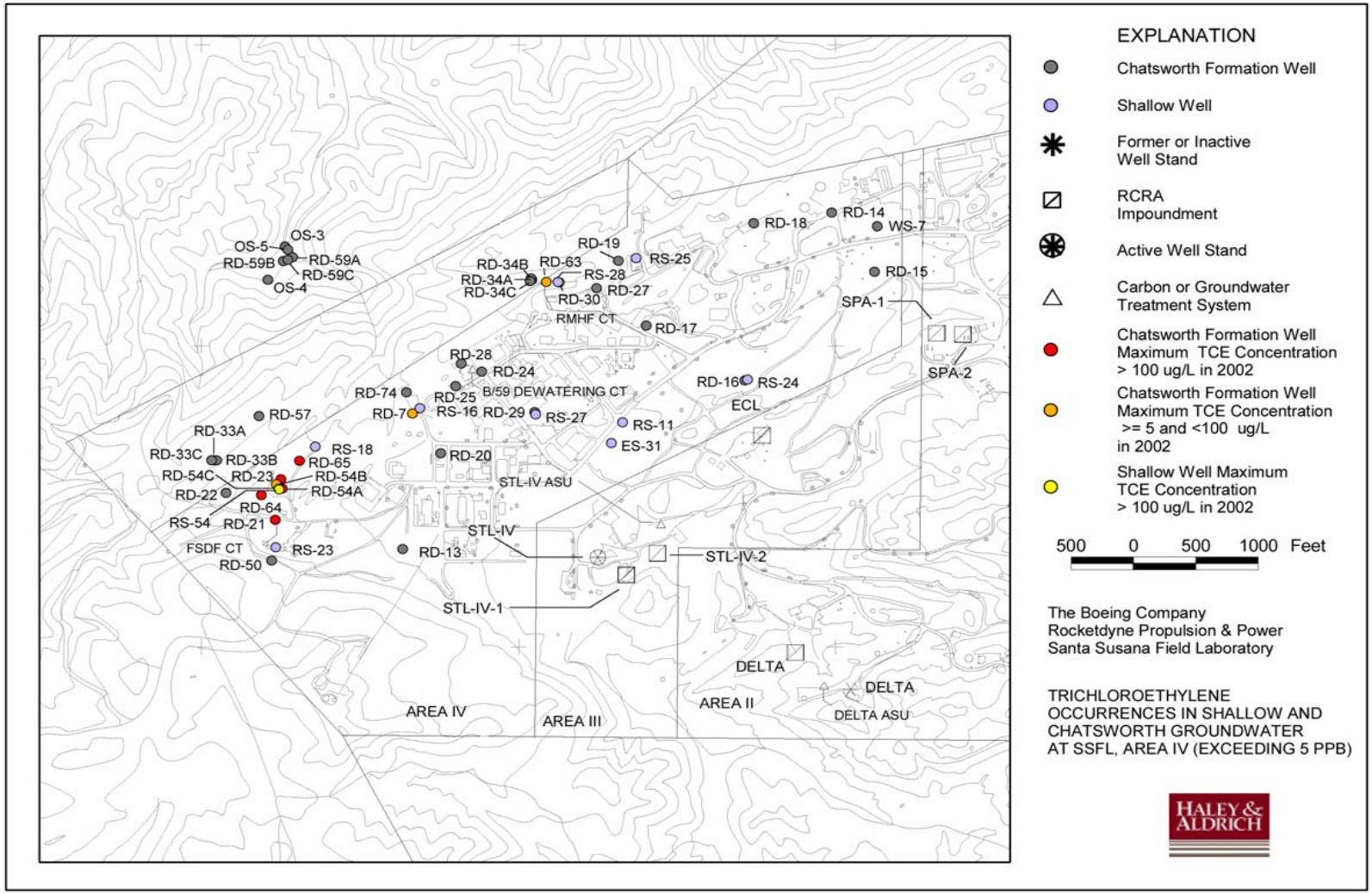


Figure 6-3. TCE Occurrences in Groundwater at SSFL, Area IV (exceeding 5 ppb)

Detectable perchlorate concentrations have been observed in FSDF-area wells. Historic perchlorate concentrations in RS-54 groundwater ranged from not detected above a 4 µg/L detection limit to 15 µg/L. Historic samples collected from RD-21 have contained perchlorate at concentrations ranging from 3.7 to 9 µg/L. RS-18 was the only FSDF-area well sampled for perchlorate in 2003, and perchlorate was not detected.

Interim groundwater extraction systems are in place in each of the three areas of degraded groundwater discussed above. A pilot extraction test initiated in 1994 at RMHF included installation of an extraction well and treatment of the extracted groundwater in a granular activated carbon (GAC) absorption treatment unit. Extraction and treatment of contaminated groundwater continued on an interim basis at RMHF in 2003. Groundwater extraction is also conducted in three wells (RD 24, RD-25, and RD-28) in the Building 59 area. The Building 59 interim groundwater extraction and treatment program was initiated in 1995. This extraction is primarily to dewater the building basement. Extraction and treatment of impacted groundwater continued on an interim basis at Building 59 in 2003. The extraction activity at the FSDF was initiated in 1995. The groundwater extraction system at FSDF included extraction of impacted groundwater from wells RD-21 and RS-54 and treatment of the extracted groundwater in a GAC adsorption treatment unit. The FSDF system also uses ion exchange resin in series to treat perchlorate-impacted groundwater prior to discharge. Groundwater was extracted only from FSDF interim extraction well RS-54 during 2003. To date, approximately 123,000 gallons, 3.4 million gallons, and 3.4 million gallons of groundwater have been extracted and treated from the FSDF, RMHF, and Building 59 areas, respectively.

In addition to groundwater monitoring activities, additional characterization efforts have been conducted in the FSDF area of Area IV. During 2003, discrete interval groundwater monitoring systems were installed in six groundwater wells, bringing the total number of discrete-interval groundwater monitoring systems installed in FSDF-area wells to 10. Individual system ports were sampled for VOCs and perchlorate and outfitted with continuous data logging monitoring systems. The data loggers monitored discrete-interval water level fluctuations, produced discrete-interval hydraulic head readings within the Chatsworth Formation groundwater system, and allowed the collection of discrete fracture connectivity testing data. Testing was also performed on individual system ports to determine discrete interval hydraulic conductivity values for the Chatsworth Formation. Single-transducer data loggers were also installed in seven FSDF-area groundwater wells. Continuous water level monitoring at these wells supplemented discrete interval monitoring data and will provide groundwater drawdown data during the upcoming FSDF-area pumping test.

6.4 RCRA FACILITY INVESTIGATION

The primary objectives of the RCRA Facility Investigation (RFI) at the SSFL are (1) to investigate the nature and extent of chemicals in soil and the potential threat to groundwater quality for each of the SWMUs and AOCs identified for potential RFI Corrective Action, and (2) to evaluate the potential risk to human health and the environment presented by these SWMUs and AOCs to assess whether remediation is required. The data from the investigation will be evaluated following DTSC-approved risk assessment methodologies to determine whether remediation, additional assessment, or no further action is necessary to bring each site to closure.

The RFI Program started at the SSFL site in 1996 and is presently ongoing. RFI fieldwork is scheduled to be completed in 2004. Field methodologies for the soil investigation include soil matrix sampling, soil vapor sampling, surface water sampling, and trenching. DTSC was onsite during much of the fieldwork to observe sampling protocols and select sampling locations and depths. Field action levels (FALs) were developed prior to sampling in conjunction with DTSC risk assessors for use as soil screening values during the field program. They were calculated to be chemical concentrations in soil that would not pose a threat to human health or groundwater quality.

During 2003, approximately 132 soil matrix, 90 soil vapor, 3 surface water, and 21 near-surface groundwater samples were collected. Samples collected and analyses performed to date at DOE locations are summarized in Table 6-3. Data review and validation is ongoing and will be completed in 2004.

RFI soil analytical results and risk assessment findings for samples collected between 1999 and 2003 have been published for the four report sites listed above: Building 100 Trench (SWMU 7.5), Metals Laboratory Clarifier (Area IV AOC), Old Conservation Yard (SWMU 7.4), and DOE Leach Fields (Area IV AOCs) RFI sites. Findings and recommendations regarding these sites include the following:

- A small, localized area of lead-impacted soil exists at the Building 100 Trench site; cleanup of this area will be evaluated during the Corrective Measures Study (CMS).
- Three areas at the Old Conservation Yard site contain impacted soils (including polychlorinated biphenyls, polycyclic aromatic hydrocarbons, dioxins/furans, and metals); cleanup of these areas will be evaluated during the CMS. Based on DTSC comments on the draft report, limited additional sampling will be required at this site prior to (or coincident with) the CMS.
- Evaluation of potential impacts to burrowing animals due to VOCs in soil vapor is needed for ecological receptors at the Metals Laboratory Clarifier site; this evaluation will be conducted at representative locations at the SSFL, and the findings will be applied to the Metals Laboratory Clarifier site.
- No further action for soil at the DOE leach field sites is recommended.
- Evaluation in the CMS is recommended for the following DOE RFI sites due to VOC impacts in near-surface groundwater: Metals Clarifier (Building 065), and the Building 353, Building 363, Building 373, and Building 383 Leach Field sites. Although recommended for CMS inclusion, it is anticipated that an administrative control will be proposed rather than treatment.

Table 6-3. Sampling for RCRA Facility Investigation

Date	Soil matrix*		Soil Vapor		Surface Water		Groundwater		Spring/Seep	
	Sample	Analysis	Sample	Analysis	Sample	Analysis	Sample	Analysis	Sample	Analysis
1/1/03 to 12/31/03	132	508	90	90	3	6	21	63	0	0
Total to date	359	1,299	145	145	5	8	49	157	3	18

*Soil matrix totals include 48 soil leachate samples and 50 analyses to evaluate perchlorate concentrations in soil.

Key activities completed in the year 2003 included:

- Submittal of four draft RFI reports for DOE Area IV sites: the Building 100 Trench (SWMU 7.5), Metals Laboratory Clarifier (Area IV AOC), Old Conservation Yard (SWMU 7.4), and DOE Leach Fields (Area IV AOCs) RFI sites.

- Completion of the draft RFI report for the FSDF RFI site (SWMU 7.3). This report will be submitted to DTSC in 2004.

- Submittal of the Spring and Seep Sampling and Analysis Report. Based on the findings, no further evaluation appears warranted, since no chemicals of potential concern or man-made radionuclides were detected that were not either naturally occurring or likely caused by laboratory contamination.

- Implementation of the Building 56 Landfill investigation following DTSC approval of a revised work plan. This investigation indicated that although surficial debris and asbestos were found in the landfill, the majority of the landfill materials are composed of soil and rock.

- Completion of the near-surface groundwater program and submittal of a comprehensive Near-Surface Groundwater Investigation Report to DTSC. Field work this period included installing three shallow piezometers near the Hazardous Materials Storage Area (HMSA, Building 457) site and one piezometer at the Building 56 Landfill (SWMU 7.1) site and sampling of 12 DOE near-surface piezometers located in Area IV. The piezometers were installed to evaluate the extent of VOC impacts identified during 2002 (HMSA and south of Building 059). Groundwater samples in the new piezometers had lower VOC concentrations than in the original wells.

- A Standardized Risk Assessment Methodology (SRAM) Work Plan, Revision 1 was prepared and submitted to DTSC. Based on DTSC comments, this document is being revised and will be resubmitted during 2004.

Individual draft RFI site reports are being prepared for those sites at which characterization has been completed. As described above, draft RFI reports for five Area IV sites were completed, and four were submitted to DTSC. Since field work has been completed, two other reports for DOE RFI sites in Area IV (Building 056 Landfill and HMSA) will be prepared and submitted to DTSC during 2004. Reports for the two remaining DOE RFI sites in Area IV (Building 020 and Building 059) will be prepared once the investigation of these sites has been completed in 2004. Finally, the overall draft RFI program report providing all laboratory data and a description of the field methods will be prepared and submitted during 2004.

7. ENVIRONMENTAL MONITORING PROGRAM QUALITY CONTROL

This section describes the quality assurance (QA) elements incorporated into the Rocketdyne radiological analysis program. The following elements of quality control are used for the Rocketdyne program:

1) Reagent Quality—Certified grade counting gas is used.

2) Laboratory Ventilation—Room air supply is controlled to minimize temperature variance and dust incursion.

3) Laboratory Contamination—Periodic laboratory contamination surveys for fixed and removable surface contamination are performed. Areas are cleaned routinely and decontaminated when necessary.

4) Control Charts—Background and reference source control charts for counting equipment are maintained to evaluate stability and response characteristics.

5) Laboratory Intercomparisons—Rocketdyne participates in the DOE EML-QAP.

6) Calibration Standards—Counting standard radioactivity values are traceable to NIST primary standards.

7) Co-location of State DHS thermoluminescent dosimeters.

7.1 PROCEDURES

Procedures followed include those for selection, collection, packaging, shipping, and handling of samples for off-site analysis; sample preparation and analysis; the use of radioactive reference standards; calibration methods, and instrument QA; and data evaluation and reporting.

7.2 RECORDS

Records generally cover the following processes: field sample collection and laboratory identification coding; sample preparation method; radioactivity measurement (counting) of samples, instrument backgrounds, and analytical blanks; and data reduction and verification.

Quality control records for laboratory counting systems include the results of measurements of radioactive check sources, calibration sources, backgrounds, and blanks as well as a complete record of all maintenance and service.

Records relating to overall laboratory performance include the results of analysis of inter-laboratory cross-check samples and other quality control analyses; use of standard (radioactive) reference sources; and calibration of analytical balances.

7.3 QUALITY ASSURANCE

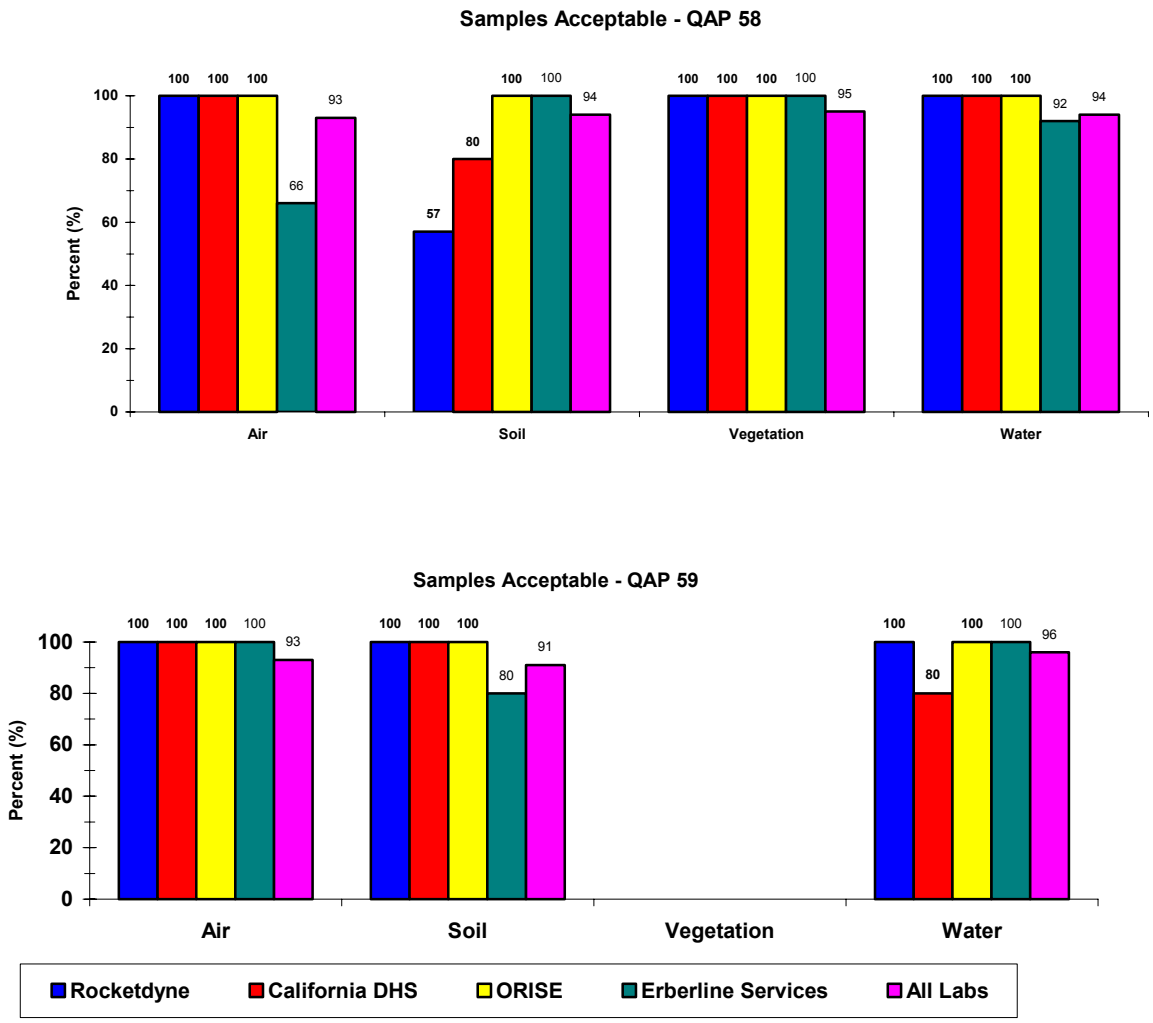
Rocketdyne participates in the DOE Quality Assessment Program (QAP) for radiological analyses. This program is operated by the DOE's Environmental Measurements Laboratory (EML) in New York. Individual data values reported by participating laboratories were compared to the EML reference values, and the comparison results were grouped into percentiles. The middle 70% of all historical reported values (from the 15^{th} to 85^{th} percentile) was established as Acceptable, and the next 10% on both sides of the 70%—the 5^{th} to 15^{th} and 85^{th} to 95^{th} percentiles—was established as Acceptable with Warning. Results outside this 90% band were considered Not Acceptable. During 2003, two sets of samples were distributed: QAP-58 and QAP-59 (DOE, 2003a; DOE, 2003b).

Rocketdyne and DOE use contract laboratories for environmental sample analyses. The QAP results of Rocketdyne, California DHS Sanitation and Radiation Laboratory, Oak Ridge Institute for Science and Education (ORISE), the contract laboratories, and the average for all laboratories that participated in the QAP program are shown in Figure 7-1 for QAP-58 and QAP-59. These comparisons involve sample types, geometries, and analyses that are not part of the routine procedures at the Rocketdyne laboratory. It should be noted that the QAP-58 soil sample result from Rocketdyne is only about 50% of the standard. A thorough review of the raw data and the reported data indicates a typographic error was made when the Rocketdyne sample results were entered into the EML database. Therefore, the comparison on the soil sample is invalid. The results for air, water, and vegetation indicate the Rocketdyne gamma spectrometry system is up to the standard.

All quantitative environmental air samples for the site are analyzed by outside laboratories. For this report, air and effluent filter samples were analyzed by Severn Trent Laboratories, and surface water and groundwater samples were analyzed by Eberline Services.

In addition to the QAP comparison, representatives from SHEA's Technical Support and Administration (TSA), Radiation Safety, and Quality Assurance periodically conduct on-site audits at these contract laboratories to ensure the quality of the sample analysis.

For chemical analysis, most of the environmental samples are analyzed by certified contract laboratories. However, a limited number of analyses are also conducted at the SSFL Analytical Laboratory, which is a State of California Certified environmental laboratory. The in-house laboratory is also monitored for quality and compliance by the TSA team.



Note: DOE/EML has not posted a final report for QAP59. The" ALL Labs" data is estimated. Also, the vegetation sample was not a part of the QAP59 sample set.

Figure 7-1. Quality Assessment Program Results for QAP-58 and QAP-59

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ACRONYMS

AI	Atomics International
ALARA	As Low As Reasonably Achievable
APF	Air Force Plant
ASER	Annual Site Environmental Report
ANL	Argonne National Laboratory
AOC	Areas of Concern
ASL	Above Sea Level
ATSDR	Agency for Toxic Substances and Disease Registry
BCG	Biota Concentration Guides
CAA	Clean Air Act
CAL/OSHA	California Occupational Safety and Health Administration
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRWQCB	California Regional Water Quality Control Board
CWA	Clean Water Act
CX	Categorical Exclusion
D&D	Decontamination and Decommissioning
DCG	Derived Concentration Guide
DHS/RHB	Department of Health Services/Radiologic Health Branch
DOD	Department of Defense
DOE	Department of Energy
DTSC	Cal-EPA Department of Toxic Substances Control
EA	Environmental Assessment
EEOICPA	Energy Employees Occupational Illness Compensation Program Act
EIS	Environmental Impact Statement
EML	Environmental Measurements Laboratory
EP	Environmental Protection
EPA	Environmental Protection Agency
ER	Environmental Remediation
ETEC	Energy Technology Engineering Center
ETS	Extraction and Treatment Center
FFCA	Federal Facilities Compliance Act
FONSI	Finding of No Significant Impact
FSDF	Former Sodium Disposal Facility
GRC	Groundwater Resources Consultants, Inc. (Tucson, AZ)

HEPA	High-Efficiency Particulate Air
HPGe	High-Purity Germanium (Detector)
HWMF	Hazardous Waste Management Facility
ISMS	Integrated Safety Management System
LLNL	Lawrence Livermore National Laboratory
LLW	Low Level Waste
LMDL	Liquid Metal Development Laboratory
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCA	Multichannel Analyzer
MCL	Maximum Contamination Level
MDA	Minimum Detectable Activity
MEI	Maximally Exposed Individual
MLLW	Mixed Low-level Waste
MTRU	Mixed Transuranic Waste
NASA	National Aeronautics and Space Administration
ND	Not Detected
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NOD	Notice of Deficiency
NOI	Notice of Intent
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NSPS	New Source Performance Standards
ODS	Ozone Depleting Substance
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
ORPS	Occurrence Reporting and Processing System
PCB	Polychlorinated Piphenyl
PCE	Perchloroethene
PEIS	Programmatic Environmental Impact Statement
QA	Quality Assurance
QAP	Quality Assessment Program
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation

RFP	Request for Proposal
RMHF	Radioactive Materials Handling Facility
ROD	Record of Decision
RS	Radiation Safety
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SCTI	Sodium Component Test Installation
SHEA	Safety, Health & Environmental Affairs
SIPs	State Implementation Plans
S&M	Surveillance and Maintenance
SNAP	Systems for Nuclear Auxiliary Power
SPCC	Spill Prevention Control and Countermeasure
SPTF	Sodium Pump Test Facility
SRAM	Standardized Risk Assessment Methodology
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
SWPPP	Storm Water Pollution Prevention Plan
STP	Sewage Treatment Plant or Site Treatment Plan
SWMU	Solid Waste Management Unit
TCE	Trichloroethylene
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
TRU	Transuranic
UST	Underground Storage Tank
VCAPCD	Ventura County Air Pollution Control District
WVN	Water Vapor Nitrogen

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Site Environmental Report Reader Survey--2003

To Our Readers:

The Annual Site Environmental Report publishes the results of environmental monitoring in support of DOE-sponsored programs at Rocketdyne's Santa Susana Field Laboratory, and documents our compliance with federal, state, and local environmental regulations. In providing this information, our goal is to give our readership—regulators, scientists, and the public—a clear understanding of our environmental activities, the methods we use, how we can be sure our results are accurate, the status of our programs, and significant issues affecting our programs.

It is important that the information we provide is easily understood, of interest, and communicates Rocketdyne's efforts 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 and will help us to improve our communications.

1. Is the writing ❑ too concise? ❑ too wordy? ❑ uneven? ❑ just right?
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