Site Environmental Report for Calendar Year 2001

DOE Operations at The Boeing Company Rocketdyne Propulsion & Power

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RD02-148

Site Environmental Report for Calendar Year 2001 DOE Operations at The Boeing Company Rocketdyne Propulsion & Power

Prepared by the Staff of

The Boeing Company
Rocketdyne Propulsion & Power

September 2002

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RD02-148

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 16, 2002

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Department of Energy
National Nuclear Security Administration
1301 Clay Street
Oakland, California 94612-5208

SEP 2 0 2002

Distribution:

Subject: 2001 Site Environmental Report (SER) for the Energy Technology Engineering Center (ETEC)

The Boeing Company has prepared this 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 2001. SERs 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 2001 environmental monitoring and restoration program at ETEC for DOE. This statement is based on reviews conducted by DOE Oakland Operations Office staff and by the staff of The Boeing Company.

A reader survey form is provided with this report to provide comments. Write directly to the above address. Questions may also be directed to Michael Lopez, U.S. Department of Energy at (510) 637-1633.

Sincerely,

Michael Brown, Acting Director
Oakland Environmental Programs Division

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ACKNOWLEDGMENT

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

- Principal technical contributors are:
  - Radiological Topics: Ning Liu, Ray McGinnis, Richard Harcombe, Phil Rutherford
  - Groundwater: David Chang
  - Surface Water: Bill McIlvaine
  - Waste Management: Ravnesh Amar, Brian Sujata
  - RCRA Facility Investigation: Art Lenox
  - Air: Barbara Ludwig
  - Training: Beverly Hurt
  - Public Outreach: Blythe Jameson
- Editing and review were performed by Phil Rutherford, Sandy Samuels, and Majelle Lee.
- Administrative assistance was provided by Pat Ohara.
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CONTENTS

CONTENTS

TABLES

FIGURES

1. EXECUTIVE SUMMARY

This Annual Site Environmental Report (ASER) for 2001 describes the environmental conditions related to work performed for the Department of Energy (DOE) at Area IV of the Boeing Rocketdyne Santa Susana Field Laboratory (SSFL). In the past, these operations included development, fabrication, and disassembly of nuclear reactors, reactor fuel, and other radioactive materials under the former Atomics International (AI) Division. Other activities included the operation of large-scale liquid metal facilities for testing of liquid metal fast breeder components at the Energy Technology Engineering Center (ETEC), a government-owned, company-operated test facility within Area IV. All nuclear work was terminated in 1988, and subsequently, all radiological work has been directed toward decontamination and decommissioning (D&D) of the previously used nuclear facilities and associated site areas. Closure of the sodium test facilities began in 1996.

Results of the radiological monitoring program for the calendar year of 2001 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 other sites approved by DOE and licensed for radioactive waste. Liquid radioactive wastes are not released into the environment and do not constitute an exposure pathway. No structural debris from buildings, released for unrestricted use, was transferred to municipal landfills or recycled in 2001.

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, which are too small to measure, 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 3.1×10^{-6} 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.

In Area IV, 33 groundwater wells were sampled and analyzed for radiological contaminants during 2001. Only naturally occurring radioactivity was found in groundwater, except for low concentrations of tritium detected in four wells, which are well below the Federal and State drinking water standards.

Currently, there are 47 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 is continued in 2001.

During 2001, 14 Area IV regulatory agency inspections, audits, and visits were conducted. These inspections 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), the US Environment Protection Agency (EPA), the US Department of Energy (DOE), 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 to the responsible oversight regulatory agencies.

This Annual Site Environmental Report was developed as required by DOE Orders 5400.1 and 231.1. In addition, this report communicates to our workers, neighbors, and customers factual information regarding the condition of our environment. To assist us in this effort, a reader response survey form has been included at the end of this report. We would appreciate your comments.

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 2001. Part of the SSFL facility, known as Area IV, had been used for the Department of Energy's (DOE) activities since the 1950s. A broad range of energy-related research and development (R&D) projects, including nuclear technologies, were 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.

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 shows the arrangement of the site. Area IV has an area of about 290 acres.

Since 1956, various R&D projects had been conducted in Area IV, including small test and demonstration 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 2001) 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.

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

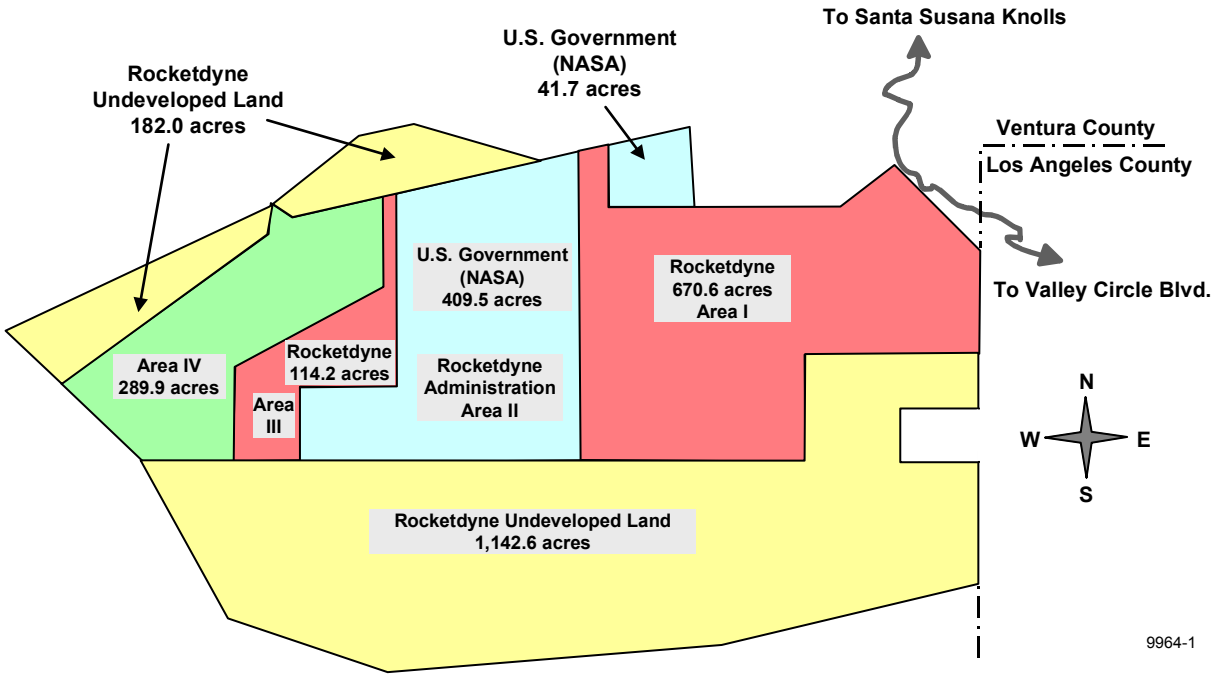

Figure 2-1. Santa Susana Field Laboratory Site Arrangement

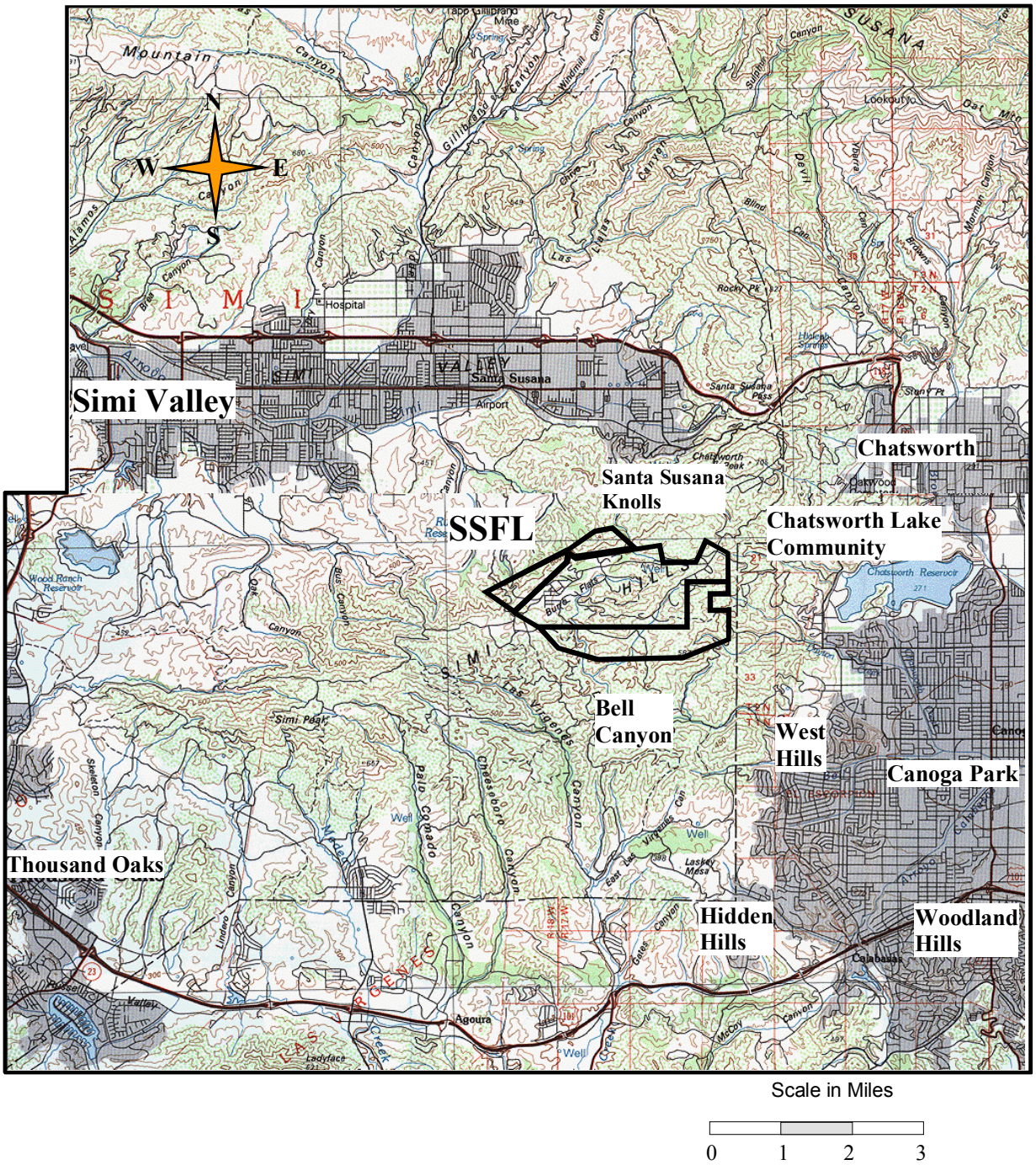

Figure 2-2. Map Showing Location of SSFL

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.

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 SSFL site elevation. 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 or San Fernando Valleys. In the winter season, 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.

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.

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

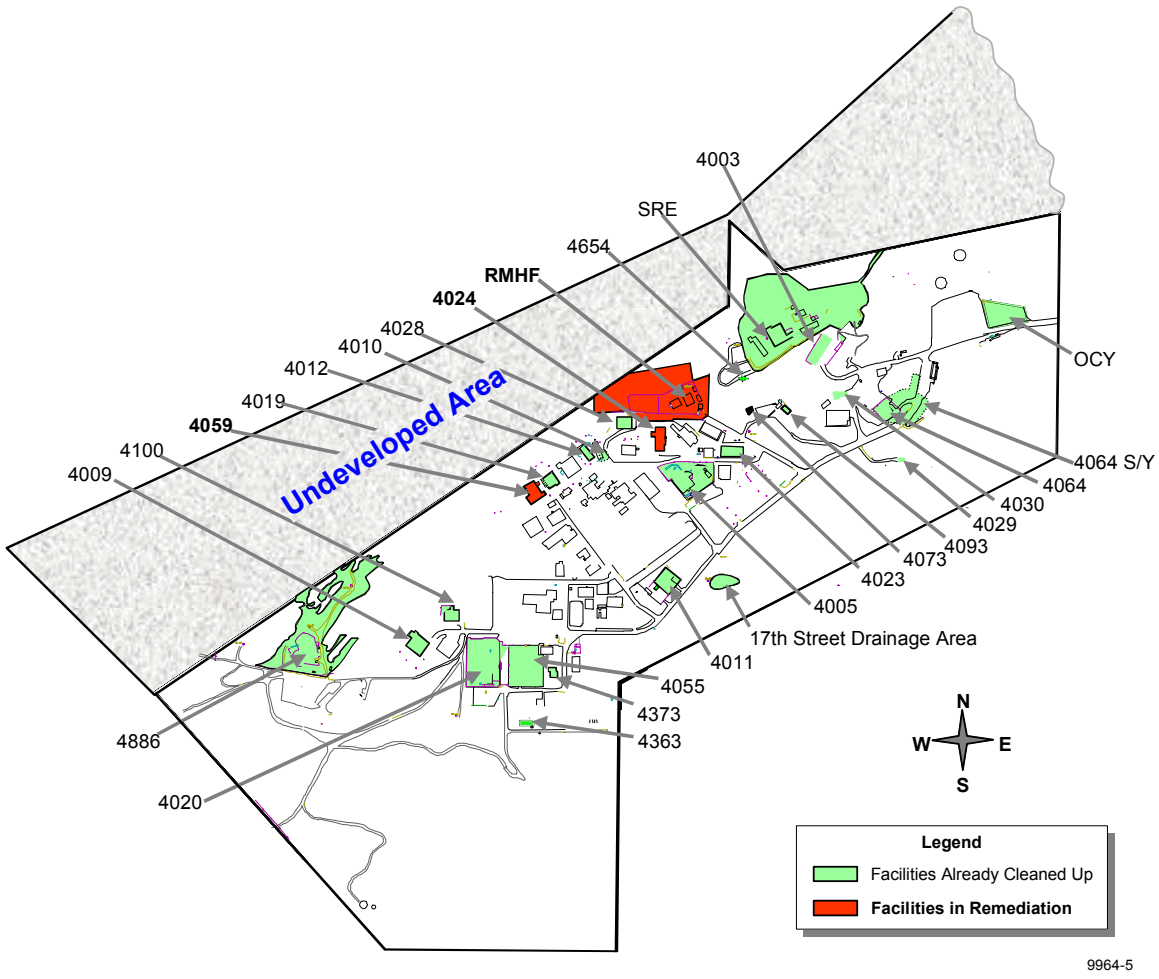

Figure 2-4. Map of Santa Susana Field Laboratory Area IV, Radiological Facilities

2.1 FACILITY DESCRIPTIONS

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

2.1.1 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, 4688, and drainage pond 4614. Operations at RMHF include processing, packaging, and temporary storage of radioactive waste materials, which are then shipped off-site to DOE-approved disposal facilities. Radioactive waste from decontamination operations contains uranium, transuranic 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.

The Part B application submitted in 1999 was reviewed by the Department of Toxic Substances Control (DTSC). A revised permit application was submitted in July 2000 addressing issues raised by DTSC. Separate submittals were also made for the California Environmental Quality Act (CEQA) determination in support of the permit application. Significant issues addressed were the seismic evaluations for the facility and risk assessments for RMHF operations. Engineering calculations of seismic analyses and drawings were submitted to DTSC in 2001. These submittals are currently being reviewed by DTSC.

Repackaging and characterization of the transuranic (TRU) waste were continued during 2001. Meanwhile, the site is also closely working with DOE and the TRU community to find a path forward for offsite disposition of the TRU waste.

During 2001, atmospheric effluents were released through a stack as a result of the 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.

Groundwater was pumped and treated throughout 2001 as part of the interim groundwater remediation program. The groundwater from well RD-63 is impacted with a trace concentration of trichloroethylene (TCE) and groundwater pumped from the well is treated at the RMHF Area Interim Extraction and Treatment System (ETS).

Building 4059

During the early 1990s, operations at Building 4059 consisted of removal of activated steel and concrete as part of the D&D of this 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 work requiring ventilation was performed in the building in 2001, and, therefore, no effluent monitoring was performed. A groundwater treatment system was installed at Building 4059 in February 1998, and groundwater from Wells RD-24, 25, and 28 impacted with a trace quantity of TCE was processed with the system. Building 4059 will be demolished following completion of DOE's Environmental Assessment (EA).

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 was removed from the facility. The shielding concrete in the vaults currently contains low levels of activation products including Co-60 and Eu-152/154. This radioactivity is confined and the radiation levels inside the vaults are a fraction of a millirem/hour. The facility is scheduled for final decommissioning and demolition in the 2004-2006 time frame.

2.1.2 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.

Buildings 4355/4356 (SCTI)

The Sodium Components Test Installation (SCTI) includes Buildings 4355, 4356, 4357, 4358, 4359, 4360, 4361, and 4392. The complex consists of two adjoining steel and concrete test stands. Two steam generator test articles contain residual amounts of sodium in the complex. Removal of sodium containing piping and components was completed in 2000. The steam generators were cleaned in situ using a Wet-Vapor-Nitrogen (WVN) process. In 2001, the WVN cleaning of sodium piping and components was completed.

Sodium Pump Test Facility (SPTF)

The Large Epectro-Magnetic Pump test 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. Shipment of bulk sodium will start in 2002.

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 was completed in 2000. Approximately 14,000 tons of soil was shipped to an off-site disposal facility between January and March 2001. Ongoing activities include continuing maintenance of the area, rainwater management, and support of closure activities.

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

Table 3-1 gives a list of inspections, audits, and site visits by the various agencies overseeing the SSFL.sites Following a compliance inspection of the Radioactive Materials Handling Facility (RMHF) in March 2001, the Department of Toxic Substances Control (DTSC) issued an inspection report noting three violations. One violation (a missing signature on an inspection form) was minor in nature and corrected immediately. The DTSC withdrew one of the remaining two violations (maintaining an inaccurate operating record) after receiving additional information. Corrective actions were immediately implemented to address the last remaining violation (failure to inspect all required items). This violation resulted from an inspection form not being clear enough. The inspection form was immediately modified to make it clearer. Based on the corrective actions and additional information provided subsequent to the Notice of Violation (NOV), the DTSC determined that no further action was required and compliance would be verified during the next inspection. No fines were issued as a result of this inspection. In November 2001, the DTSC performed another compliance inspection of the RMHF. No violations were cited as a result of this inspection.

3.1.1 Radiological

The radiological monitoring programs at the SSFL comply with the applicable federal, state, and local environmental regulations. The monitoring results indicate that the SSFL does not pose 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.

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 3.1×10^{-6} 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).

Table 3-1. 2001 Agency Inspections/Visits Related to DOE Environmental Remediation

Date (2001)	Agency	Subject Area	Results
January	State of CA, DHS Radiologic Health Branch	Environmental TLD exchange	Compliant
March	DTSC	Compliance evaluation and inspection	NOV
March	DOE	Review the Fire Protection Program for the ETEC Closure Contract	Compliant
April	VCAPCD	Perform static and dynamic pressure testing of gasoline tank in Area II, Permit to Operate (Permit 5228)	Compliant
April	State of CA, Radiologic Health Branch	Environmental TLD exchange	Compliant
June	EPA Region IX	Site tour and briefing in preparation for EPA's development of an Area IV survey scoping document	Compliant
June	VCAPCD	Annual inspection of Permit to Operate (Permit 0271 and 5228)	Compliant
July	State of CA, Radiologic Health Branch	Environmental TLD exchange	Compliant
July	State of CA, DHS Radiologic Health Branch	Inspect the region of SRE planned for Hg soil removal	Compliant
July	State of CA, DHS Radiologic Health Branch	Sample soil at SRE in vicinity of proposed Hg excavation. Perform GPS radiation data logging of vicinity	Compliant
October	EPA Region IX and Tetra Tech	Perform validation surveys of Buildings 4011, 4019, 4055, and 4100	Compliant
October	State of CA, DHS Radiologic Health Branch	Environmental TLD exchange	Compliant
October	RWQCB	Inspection of Storm Water Prevention Plan implementation at Former Sodium Disposal Facility and Soil Borrow Area.	Compliant
November	DTSC	Compliance evaluation and inspection	Compliant

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 2001, 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 493, 1100, 3120, and 968 pCi/L at wells RD-24, RD-28, RD-34A, and RD-59A, 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.

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 any 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 2001, no water sample was taken for the year.

3.1.1.3 Surface Water

Surface water from two National Pollutant Discharge Elimination System (NPDES) discharge points and five storm water basins are monitored routinely. The permit allows the discharge of reclaimed wastewater, storm water runoff, and industrial waste water from retention ponds into Bell Creek, a tributary to the Los Angeles River. The permit also allows for 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 #1: Outfall 005, FSDF #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, Sr-90, and total combined Ra-226 and Ra-228. In 2001, 51 water samples were taken for 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 by a sandstone ridge, effectively shielding the boundary from any 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 is considerably below DOE's 100 mrem/year limit.

3.1.1.5 Protection of Biota

No aquatic system is 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 system, if any, is not affected by the DOE operations at SSFL.

The terrestrial biota, i.e., vegetation and small wild animals, are abundant at SSFL. They are subject to potential exposure to the radioactivity in soil. Preliminary analysis indicates that the potential radiation exposure 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 2001, 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).

In July 1998, the California EPA and DTSC requested the completion of the RCRA permitting process for RMHF. Completion of the RCRA permitting involves the creation of an Operations Plan document, public comment and agency approval, and the issuance of a Part B permit by the DTSC. A draft Operations Plan was submitted to DTSC in May 1999. In February 2000, the DTSC issued a Notice of Deficiency (NOD) for the Operation Plan. A response to the NOD was provided to the DTSC in May 2000. The DTSC reviewed the response in 2001.

3.1.2.1.2 Hazardous Waste Management Facility (HWMF)

The Hazardous Waste Management Facility (HWMF) includes an inactive storage facility (Bldg 4029) and an inactive treatment facility (Bldg 4133), which was used 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.

3.1.2.1.3 Sodium Removal

Removal of metallic sodium from the closed facilities continued in 2001. 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 2001, approximately 500 pounds of surplus sodium were removed from Area IV using the Water Vapor Nitrogen process. At the completion of testing activities at the Sodium Pump Test Facility at the end of 2001, approximately 54,000 gallons of sodium were declared “excluded recyclable material.” Most of the SPTF sodium will be removed in 2002.

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 performed 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 State of California 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), which 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 2002.

Fieldwork in 2001 included the completed installation of 23 shallow groundwater wells in Area IV. Sampling of the shallow wells is expected to take place during the rainy season of 2002. Environmental sampling was also conducted at three locations where septic tanks and leach fields were removed. Soil vapor sampling was conducted at two locations.

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 2001. The high concentrations were detected in three areas inside the northwestern property boundary, as shown in the shaded areas in 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 17 m^3) of RCRA mixed wastes at ETEC in accordance with FFCA-mandated Site Treatment Plan (STP) approved in October 1995. The inventory includes both mixed low-level wastes (MLLW) and mixed Transuranic wastes (MTRU). All mixed wastes that require on-site storage beyond the regulatory (i.e., per RCRA) allowed time limits 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 with enforceable milestones. These include characterization, reporting, study of treatment options, shipping schedules, and actual removal. During CY2001 treatment of mercury sediment (volume ~ 1 liter) mixed waste stream was accomplished. Overall volume of mixed waste inventories in storage remained about the same due to generation of a small volume of evaporator sludge. Management of the mixed waste 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]) have been 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 is expected to either issue a Finding of No Significant Impact or commit to further study of the issue using an Environmental Impact Statement in 2002.

3.1.2.4 Clean Air Act

The Clean Air Act (CAA) resulted in federal regulations that set air quality standards and required state implementation plans (SIPs), 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 welfare. The SSFL is regulated by the Ventura County Air Pollution Control District (VCAPCD) and must comply with VCAPCD Rules and Regulations. The EPA can enforce VCAPCD Rules and also regulates pollutants such as Ozone Depleting Substances (ODS) under 40 CFR 82. VCAPCD Rules and Regulations incorporate, by reference, NESHAPs regulations as codified under the CAA.

3.1.2.5 Clean Water Act

The Clean Water Act (CWA) is the primary authority for water pollution control programs, including the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES program regulates point source discharges of surface water to drainage channels (i.e., to locations other than sewage systems), and the discharge of storm water runoff associated with industrial activities. Basin Plan water quality objectives are one aspect 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, which was revised and became effective June 29, 1998, is expected to remain in force through May 10, 2003. The revised 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 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 Rocketdyne procedure "SSFL Storm Water Pollution Prevention Requirements." The Spill Prevention Control and Countermeasure (SPCC) plan serves to identify specific procedures for handling oil and hazardous substances 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 March 20, 2000.

Sewage from Area IV (including DOE facilities) is either treated at the Area III Sewage Treatment Plant (STP), which discharges to the R2A Pond, or shipped off-site for proper disposal. Most surface runoff from Area IV also drains to R2A Pond. The monitored northwest slope of Area IV drains through five small catch basins. During periods of rainfall, and when there is adequate runoff for sampling, grab samples of surface water runoff are collected at the outfalls. Samples are collected no more than twice a month (biweekly) per outfall during the rainy season. In the dry season, if discharges occur, samples are collected monthly. A notice of violation (NOV) and requirement to submit information was received from the California Regional Water Quality Control Board on June 27, 2001. The NOV refers to issues of non-compliance from January 1, 2000 through March 2001. Rocketdyne has responded as required and corrective actions have been implemented. A discussion of non-compliance and corrective actions for 2001 may be found in Section 6.1 of this report.

3.1.3 Public Participation

During 2001, Rocketdyne has continued and expanded its commitment to community involvement by hosting three homeowners association and community meetings and one bus tour at the Santa Susana Field Laboratory (SSFL). These activities provided a two-way exchange of information for more than 200 community members. Rocketdyne staff members and technical experts were on hand with display boards and exhibits to enhance understanding of the technological and scientific mission at SSFL as well as all environmental programs at the facility. Surveys indicated a very positive response to these meetings and the sharing of information. Rocketdyne also supported eight regulatory agency-sponsored meetings as well as three meetings with local elected officials. During 2001, Rocketdyne also received approximately 12 visits from news media including the Los Angeles Times, Ventura County Star, and Daily News.

Rocketdyne supported the Department of Toxic Substances Control review of past and future public outreach activities documented in the Public Participation Plan by distributing a survey to the local community. In all, nearly 98,000 surveys were distributed to community members living within a five-mile radius of the SSFL.

In addition to these efforts, Rocketdyne partnered with Friends of the Los Angeles River for the 12th Annual Great Los Angeles River Clean-up and the City of Los Angeles for the Countywide Household Hazardous Waste Collection Program – "Hazmobile" event.

In support of Rocketdyne's Educational Outreach program, the SSFL Council hosts several teacher and student tours each year at the field lab. The tours provide an opportunity for the teachers and students to see the historical site and talk to scientists and engineers involved in SSFL programs.

Rocketdyne continues to supply three local repositories with information on environmental remediation projects at the site. In addition, Rocketdyne catalogues and inventories the documents at two of these repositories.

Rocketdyne maintains a community mailing list of more than 2,700 people and distributed information to these community members as part of our ongoing community outreach activities and on behalf of the regulatory agencies.

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	1/1/01 through 12/31/02
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
* DHS changed numbering system; the license stays the same as before.		

During 2001, five underground storage tanks (UST) were exempt from permitting in Area IV. Table 3-2 shows a list of these tanks.

Table 3-2. SSFL Current Underground Storage Tanks

UST	Building Location	Capacity (gallons)	Tank Type	Contents
UT-7	4022	3,000	Stainless Steel Vaulted	RA water[a]
UT-15	4022	8,000	Stainless Steel Vaulted	RA water[a]
UT-16	4021	200	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.

[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 CURRENT ISSUES AND ACTIONS

3.2.1 Progress in Radiological Decommissioning Operations

3.2.1.1 2001 Status of Building Release

In 2001, neither DOE nor the State Department of Health Services Radiologic Health Branch (DHS/RHB) released any buildings for unrestricted use.

Currently Rocketdyne is awaiting DOE and DHS action on the release for unrestricted use for Buildings 4020, 4019, 4059 (Phase I), 4064 Side Yard, and 4654. Rocketdyne is awaiting DHS action on the release for unrestricted use of the 17th Drainage Area.

3.2.1.2 2001 Status of Radiological Release Surveys

3.2.1.2.1 Building 4059 (SNAP Test Facility)

No fieldwork occurred in 2001 relative to 4059 (Phase I) demolition pending finalization of the Environmental Assessment. A work plan was prepared to document the planned demolition of Phases I and II of B/4059.

3.2.1.2.2 Building Surveys by EPA

Since January 2000, EPA has been permitted to survey prior released radiological facilities. Surveys are being performed to give additional assurance to the public that prior surveys and release processes have been conducted in compliance with federal and state regulations and have met federal and state cleanup standards. So far, EPA surveys have apparently confirmed results of prior surveys, though DOE and Boeing have yet to receive any EPA survey reports. So far they have performed surveys at eight facilities.

In October 2001, EPA and its contractor, Tetra-Tech, performed additional radiation surveys of one DOE building (B/4019 – Flight System Critical Assembly) and three Boeing buildings (B/4011 – Radiation Instrument Calibration Laboratory, B/4055 – Nuclear Materials Development Facility, and B/4100 – Fast Critical Experiment Laboratory).

B/4019 has been remediated and verification surveys performed by Oak Ridge Institute for Science and Education (ORISE) and DHS. It is pending release by DOE. B/4011 has been released for unrestricted use by DHS. Both B/4055 and B/4100 have been released for unrestricted use by the Nuclear Regulatory Commission (NRC).

During 2001, Boeing provided additional (and in some cases redundant) information to EPA and its contractor Tetra Tech related to Buildings 4059 (Rutherford, 2001a; Rutherford, 2001b), and 4009, 4011, 4019, 4055 and 4100 (Rutherford, 2001c).

3.2.2 Agency for Toxic Substances and Disease Registry (ATSDR)

In 1999, the Agency for Toxic Substances and Disease Registry (ATSDR) conducted an environmental review of the SSFL and surrounding community to determine the potential for significant off-site impacts. Their report, released on November 15, 1999, may be found on the web at http://www.atsdr.cdc.gov/HAC/PHA/santa/san_toc.html. The report's findings were that the surrounding community has not been exposed to chemicals or radionuclides from SSFL.

In 2000, ATSDR contracted with ERG, a consulting firm located in Massachusetts, who in turn, hired several professors from University of California at Los Angeles (UCLA) to perform additional evaluation. The UCLA team includes Dr. Yorem Cohen (environmental fate of chemicals), Dr. Hal Morgenstern (cancer registry of surrounding community), and Dr. Deborah Glik (community education/outreach). The UCLA work began in 2000 and was planned to be completed in approximately 3 years. During 2001, the UCLA team collected and reviewed information on SSFL operations and constructed a web site for community information. The website can be found at: http://www.ph.ucla.edu/erg/intro.html.

3.2.3 Metal Recycling

In July 2000, Secretary Richardson imposed a suspension on recycling of metal from DOE radiological facilities. This was principally in response to concerns over recycling of nickel from gaseous diffusion plants, however the suspension applied to all metals from existing DOE radiological facilities. The suspension does not apply to metals that are still left in buildings after they have been released.

In October 2001, DOE conducted two public meetings in the Southern California area on the Programmatic Environmental Impact Statement on the Disposition of Scrap Metals. Subsequently, Boeing transmitted a data package to Kenneth G. Picha Jr., Office of Technical Program Integration (EM-22), Metals Disposition PEIS (Rutherford, 2001d). The enclosed material provided information for several facilities that have gone through the formal "release for unrestricted use" process. Subsequent dose and risk assessments were performed using post-remedial survey data and a variety of programs such as RESRAD-Build and RESRAD-Recycle. Results demonstrate that released facilities, whether they be occupied, demolished and disposed of to landfills, or recycled, pose trivially insignificant doses to the public. Theoretical risks are well below the lower end of the CERCLA risk range of one in a million, assuming the linear-no-threshold model is valid at these low dose rates.

The suspension remains in effect pending completion of the PEIS.

3.2.4 Environmental Assessment

In January 2002, DOE released a draft of its "Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center." (DOE, 2002)

Prior radiological D&D activities at ETEC have undergone NEPA review on a facility-by-facility basis resulting in CXs (categorical exclusions). In September 2000, DOE initiated an environmental assessment (EA) to investigate the site-wide, and community-wide impact of remaining radiological and sodium facility D&D and land remediation. Chemical cleanup of land

and groundwater is excluded from the DOE EA since that is being addressed by an ongoing RCRA program and associated EIR under CEQA.

This EA assesses the impacts of three radiological cleanup goals.

- **Alternative 1.** D&D and demolish radiological and sodium facilities. Remediate land (soil) using an existing approved dose limit of 15 mrem/year plus ALARA. This is DOE's preferred option
- **Alternative 2.** D&D and demolish radiological and sodium facilities. Remediate land (soil) to a theoretical lifetime risk goal of 10^{-6} (one-in-a-million)
- **Alternative 3.** No Action. No further remediation. Close site and maintain restricted access

DOE conducted two public meetings in January 2002 and solicited public and agency comments. The comment period ended April 25, 2002. The EA is accessible online at http://www.oak.doe.gov/etec_ea.html.

Table 3-3 provides the key impacts of the EA. Conclusions of the EA can be summarized as follows.

- Alternative 1 is consistent with NRC, EPA, DOE, and DHS regulations and policy.
- EPA states that 15 mrem/year is consistent with the CERCLA risk range of 10^{-6} to 10^{-4} (OSWER 9200.4-18, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.")
- There are no public health benefits to using Alternative 2.
- There are no on-site or off-site cancer fatalities due to residual contamination from Alternative 1 or 2.
- There is a detriment due to increased traffic fatalities and the disruption to local residents due to 58,000 truck shipments for Alternative 2.
- Post-remedial soil sampling demonstrates that past implementation of Alternative 1 has achieved site risk levels in the lower end of the CERCLA risk range of 10^{-6} to 10^{-4}.
- Alternative 1 is the preferred alternative.

Table 3-3. Comparison of EA Alternative Impacts

Impact	Units	Alternative 1	Alternative 2	Alternative 3
Annual dose limit	mrem/year	15 plus ALARA	~ 0.05	No Action
U.S. background radiation	mrem/year	~ 300	~ 300	~ 300
Post-remedial theoretical latent cancer fatality risk to on-site residents*	probability of fatal cancer	~ 3×10^{-4} *	1×10^{-6}	1.7×10^{-3} ****
U.S. fatal cancer rate **	probability of fatal cancer	0.23	0.23	0.23
Total cancer risk to on-site residents	probability of fatal cancer	0.2303	0.230001	0.2317 ****
Theoretical radiation induced cancer fatalities in on-site residents ***	latent cancer fatalities	0	0	1 ****
Expected cancer fatalities in on-site residents from natural causes **	cancer fatalities	58	58	58
Total cancer fatalities in on-site residents	cancer fatalities	58	58	59 ****
Theoretical radiation induced cancer fatalities in off-site population	latent cancer fatalities	0	0	0
Volume of waste	cubic meters	32,800	432,000	0
No. of truck shipments	truck shipments	2,500	58,000	0
Expected deaths due to traffic accidents	fatalities	0	1 to 2	0

* Conservatively ignores ALARA for Alternative 1

** Based on U.S. natural cancer mortality rate of ~23% (National Center for Health Statistics)

*** Conservatively assumes 500 residents and 40 year on-site residence time following completion of remediation. Includes contribution from U.S. cancer mortality rate of ~ 23% (National Center for Health Statistics)

**** Conservatively based on assuming maximum measured cesium-137 activity at RMHF exists in all Area IV soil. Based on more actual site wide average cesium-137 levels, the current risk levels are ~ 2×10^{-6}, and expected radiation cancer fatalities in on-site residents would be zero.

3.2.5 Former Sodium Disposal Facility (FSDF) Soil

In May 1998, following numerous radiological soil sample surveys by Rocketdyne and DHS, the DHS released the FSDF for (radiologically) unrestricted use (DHS, 1998). In May 2000, the DTSC and DHS gave approval for approximately 13,000 cubic yards of FSDF soil with trace levels of PCBs, dioxins, and mercury to be shipped to a Class I hazardous waste facility. Concerns were expressed that this soil was radioactive waste and should be sent to a licensed low-level radioactive waste facility. DTSC and DHS reviewed the record, and in December 2000 reaffirmed their decision stating that,

> "The soil from the Former Sodium Disposal Facility currently stored on site was released by DHS with no radiological restrictions. DHS has carefully reconsidered the issues presented and has concluded, with confidence, that the soils at issue do not present a radiological health hazard. DHS and DTSC concur that the soils at issue may legally and safely be disposed of at a permitted Class I hazardous waste facility."

Between January and March 2001, all FSDF soil was shipped to the Buttonwillow Class I hazardous waste disposal site in California's Central Valley.

3.2.6 Worker Health Study

One of Rocketdyne's commitments to its employees following the DOE-funded Worker Health Study was to perform a follow-on study. This study attempts to answer some 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 were on the Peer Review team that Rocketdyne had 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. The project will take 3 to 4 years to complete and is being funded entirely by Rocketdyne.

3.2.7 Energy Employees Occupational Illness Compensation Program Act (EEOICPA)

In July 2001, the 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 co-operating 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 on request.

3.2.8 EPA Survey of Area IV

In June 2001, a team from EPA visited SSFL to commence their initial planning for a radiological survey of Area IV. Subsequently, a Scoping Document was prepared and released in September 2001 (EPA, 2001) to describe the scope of the proposed survey. Comments were solicited from the public and other agencies.

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 is currently inactive and undergoing closure.

4.1 ROCKETDYNE ENVIRONMENTAL PROTECTION AND REMEDIATION

Oversight of the 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 subdepartments: 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 and assuring compliance with permit conditions, 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 regulatory 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, 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 and liquid metal test facilities in support of the DOE Closure program. DOE Site Restoration responsibilities also include:

- Responsibility for managing and shipping radioactive waste, generated during the D&D operations, to DOE-approved disposal sites.
- Operation of the Radioactive Materials Handling Facility (RMHF) under an interim status Part A permitted facility for managing 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 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 on a monthly basis. Sampling locations extended to the Moorpark freeway to the west, the Ronald Reagan freeway to the north, Reseda Avenue to the east, the Ventura freeway to the south. Samples were also taken around the Canoga and De Soto facilities, as well as around the Chatsworth Resevoir. 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 distant areas such 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 has been performed by 12 other organizations. These are:

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

Table 4-1 shows 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 demonstrate that no radioactive contamination that could result in excess exposure or risk has been detected at our 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)

Our ongoing radiological environmental monitoring ensures that activities at the SSFL, including cleanup, do not adversely affect either our employees or our neighbors.

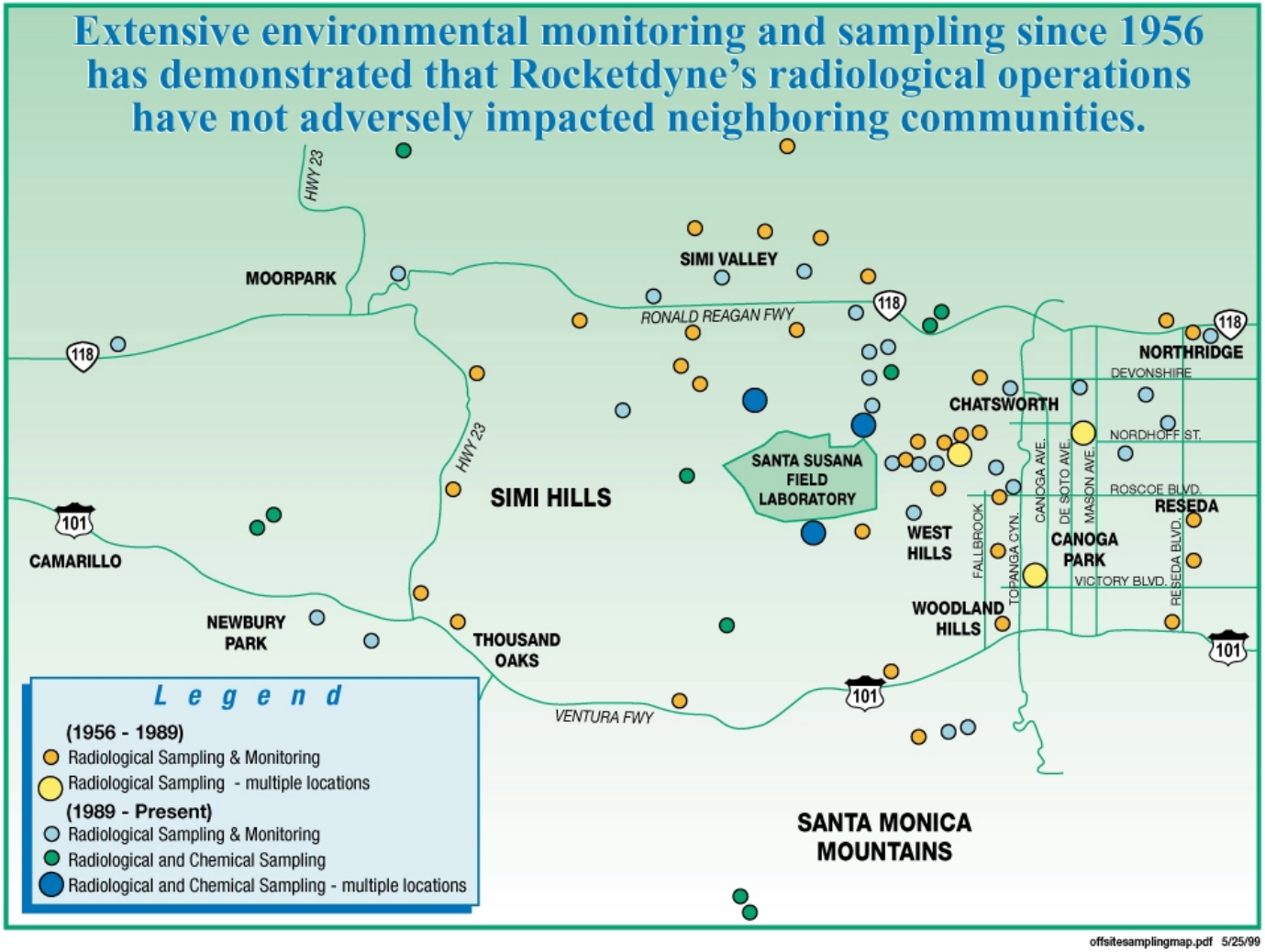

Figure 4-1. Radiological Sampling and Monitoring Locations

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

4.2.2 Non-Radiological Monitoring

Extensive monitoring programs for chemical contaminants in air, soil, surface water, and groundwater are in effect to ensure that the existing environmental conditions do not pose a threat to the public welfare or the environment. Soils contaminated by petroleum products are remediated whenever underground fuel tanks are removed. 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. Groundwater analyses were conducted by Haley & Aldrich (formerly Groundwater Resources Consultants, Inc.) using a DTSC-approved sampling and analysis plan and EPA-approved analytical methods. Equipment installed in an interim groundwater remediation program in Area IV continuously removed solvents from contaminated groundwater during 2001. 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 NPDES permit was renewed in 1998. 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 internal Rocketdyne website to promote environmental awareness among all employees.

4.3 INTEGRATED SAFETY MANAGEMENT SYSTEMS (ISMS)

The ETEC Integrated Safety Management System (ISMS) description is a recap of the Boeing Rocketdyne policies and procedures on safety. It follows the DOE principle and objective to format a formal and organized process to ensure worker's health and safety. It also has a built-in mechanism for self-assessment and continuous improvement. The Annual Safety Report for FY 2000, submitted in 2001, reemphasized the Boeing Rocketdyne policies and procedures that aided in complying with ISMS principles, as well as noting accomplishments and improvements. The Annual Safety Report also contained some metrics monitored by Safety Health and Environmental Affairs (SHEA) to assess improvement in our safety practices.

During 2001, Boeing continued to work with the DOE in refining the implementation of ISMS principles. A Self-Assessment plan was developed, which used 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 our subcontractors by having a SHEA representative to present the Safety requirements and information to the subcontractor in the initial subcontractor meeting before starting any work. An ISMS subcontractor audit process was also established to ensure that the Safety requirements are being met while work is 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 are presented to the DOE Site Restoration project personnel bi-weekly. The ISMS training class and the bi-weekly ISMS updates assure that there is an in-depth current understanding of the ISMS principles. Feedback in the bi-weekly meetings and presentation of Safety metrics 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 aimed toward improving employee performance, assuring employee proficiency, preventing obsolescence in employee capability, and preparing employees for changing technology requirements and for 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 for Rocketdyne personnel. Of these, approximately 102 relate to environment, health, and safety, with approximately 10 relating to environmental protection, 10 to radiation safety and remediation, and 82 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 all cost-effective waste reduction options be implemented.

The majority of waste currently generated at the former ETEC results from environmental restoration of surplus facilities and clean up of contaminated sites from previous programs. The key hazardous components of waste generated at ETEC are:

- Low-level radioactive waste (LLW), mixed, hazardous, and non-hazardous wastes from D&D operations.
- Sodium and NaK-contaminated components from closure operations at the former sodium facilities.
- Oils from ongoing remediation activities.

In general, the measures used to promote waste minimization at ETEC are:

- Using comprehensive segregation and screening procedures to minimize mixed wastes by separating LLW and hazardous wastes.
- Removing bulk sodium from facility drain tanks for recycling/reuse.
- Converting residual sodium in piping and components to high-grade sodium hydroxide for commercial use.
- Reusing containers of radioactive LLW for storage.
- Linking a chemical/material exchange system with the purchasing system to reduce purchases of hazardous materials.
- Reducing non-hazardous waste disposal through process changes and recycling.
- Using/operating improved air filtration technology in decontamination of a facility to minimize generation of filter media wastes.

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 significant activities related to waste minimization and pollution prevention:

- Oils used in motor vehicles and compressors are shipped to vendors who recycle them.
- Using comprehensive segregation and screening procedures to minimize generation of mixed waste.
- A chemical/material exchange system is currently linked to the purchasing system and prevents the unnecessary purchase of hazardous materials.
- Hazardous waste containers in acceptable condition are reused to the maximum extent possible.
- Empty product drums 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 CY01, 2.7 metric tons of white paper and 1.5 metric tons of aluminum cans were recycled.
- Using a compactor to reduce the volume of soft low-level radioactive waste from approximately 1200 cubic feet to 240 cubic feet during CY01.
- Size reduction and repackaging of a portable HEPA unit, a glove box, a ladder, and other items achieved a waste reduction of over 300 cubic feet during CY01.
- Approximately 507 pounds of residual sodium in tanks and piping systems were converted into commercial-grade sodium hydroxide using a water vapor nitrogen (WVN) process. This resulted in avoiding generation of approximately 2,000 gallons of hazardous waste during 2001.
- Approximately 31.3 metric tons of clean recyclable stainless steel and 5.5 metric tons of carbon steel resulted from divestment activities at non-radiological facilities.

4.5.4 Tracking and Reporting System

Various categories of materials from procurement to waste disposal are tracked. 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 accompanying 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 all non-hazardous and sanitary waste operations at the SSFL.

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. For groundwater, samples are also analyzed for gamma emitters and tritium. For surface water, Sr-90 and tritium analyses are also performed.

Direct radiation is monitored by the thermoluminescent dosimeters (TLDs) located on 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, Buildings 4024 and 4059 have continuous effluent monitoring capability. In 2001, effluent was only monitored for the RMHF because no radiological work requiring the use of a filtered exhaust system was conducted in Buildings 4024 or 4059.

At RMHF, continuous workplace ventilation is provided in the decontamination and packaging rooms, where equipment is decontaminated and radioactive waste is repackaged. The ventilation ensusres 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 – 2001						
Effluent volume (m^3)	2.38E+08					
Air volume sampled (m^3)	2.63E+04					
Annual average concentration in effluent						
Gross alpha (μCi/cc)	1.70E-16					
Gross beta (μCi/cc)	5.29E-15					
Maximum observed concentration						
Gross alpha (μCi/cc)	3.15E-15					
Gross beta (μCi/cc)	8.86E-14					
Activity releases (μCi)						
Gross alpha	4.04E-02					
Gross beta	1.26E+00					
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*		412.94*	ND	1E-07
Be-7	1.46E-01	ND		99.53	ND	natural*
K-40	1.26E+09	ND		22.57	ND	natural
Co-60	5.26E+00	75.71	6.85E-01	11.64	2.88E-15	8E-11
Sr-90	2.77E+01	15.51	1.40E-01	7.83	5.90E-16	9E-12
Cs-137	3.00E+01	274.20	2.48E+00	10.99	1.04E-14	4E-10
Po-210	3.80E-01	4.23	3.83E-02	2.40	1.61E-16	natural
Th-228	1.91E+00	ND		1.86	ND	4E-14
Th-230	8.00E+04	ND		1.65	ND	4E-14
Th-232	1.41E+10	ND		2.36	ND	7E-15
U-234	2.47E+05	1.06	9.59E-03	0.72	4.03E-17	9E-14
U-235	7.10E+05	ND		1.34	ND	1E-13
U-238	4.51E+09	ND		0.93	ND	1E-13
Pu-238	8.64E+01	ND		1.74	ND	3E-14
Pu-239/240	24,390/6,580	ND		1.30	ND	2E-14
Pu-241	1.52E+01	ND		12.06	ND	1E-12
Am-241	4.33E+02	ND		1.62	ND	2E-14

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

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

* 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
* NA = Not Applicable

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.

Table 5-1 shows the total radioactivity, measured as gross alpha and gross beta activity, in atmospheric effluents to uncontrolled areas from the RMHF. The total shows that no significant quantities of radioactivity were released in 2001. The gross alpha and gross beta counts were done shortly after the weekly stack samples were collected, which 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 activity that would be identified as "detected" with 95% confidence. Radionuclides reported as less than the detection limits are shown as "not detected" (ND).

The Po-210 collected on the filters is a naturally occurring radionuclide from the U-238 decay chain in the environment. Small amounts of Co-60, Sr-90, Cs-137, and U-234 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 evaporated through the RMHF ventilation stack. In 2001, no H-3 was detected in the water sample.

The concentrations in the effluent are compared with appropriate reference values for non-occupational 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, non-occupational exposure (i.e., to the general public). The radionuclide concentrations released from the RMHF stack are far below the DCG, as shown in Table 5-2. Furthermore, dilution and dispersion occur before the material reaches an unrestricted area, which further reduce 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 2001 from the RMHF exhaust stack are calculated using the CAP88-PC computer code. Site-specific input data such as wind speed, directional frequency and stability (developed by the NRC and Argonne National Laboratory), and 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, and the results are presented in Table 5-2. Although the new SSFL site boundary is 300 meters from the RMHF, the maximum dose occurs at a distance of 325 meters. 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 2001 was 3.1×10^{-6} mrem (3.1×10^{-8} 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 absence of the 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), two potential area sources are in Area IV: the RMHF Pond (Sump 614) and the RMHF North Slope. The RMHF Pond had been considered an area source because of 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 except for one day, it is not considered an area source for the year 2001. Similarly, the RMHF North Slope is now fully covered by native vegetation, and it is unlikely that wind borne resuspension of contaminated soil could occur.

Table 5-2. Radiation Exposure Dose due to Atmospheric Effluents—2001

Facility	Distance (m) and Direction to		Downwind Exposure Dose (mrem/yr)	
	Boundary	Residence	Boundary	Residence
RMHF	325 NW	2,867 NW	3.1×10^{-5}	3.1×10^{-6}

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 Figure 5-1 and listed in Table 5-3. Airborne particulate radioactivity is collected on glass fiber (Type A/E) filters, which 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.

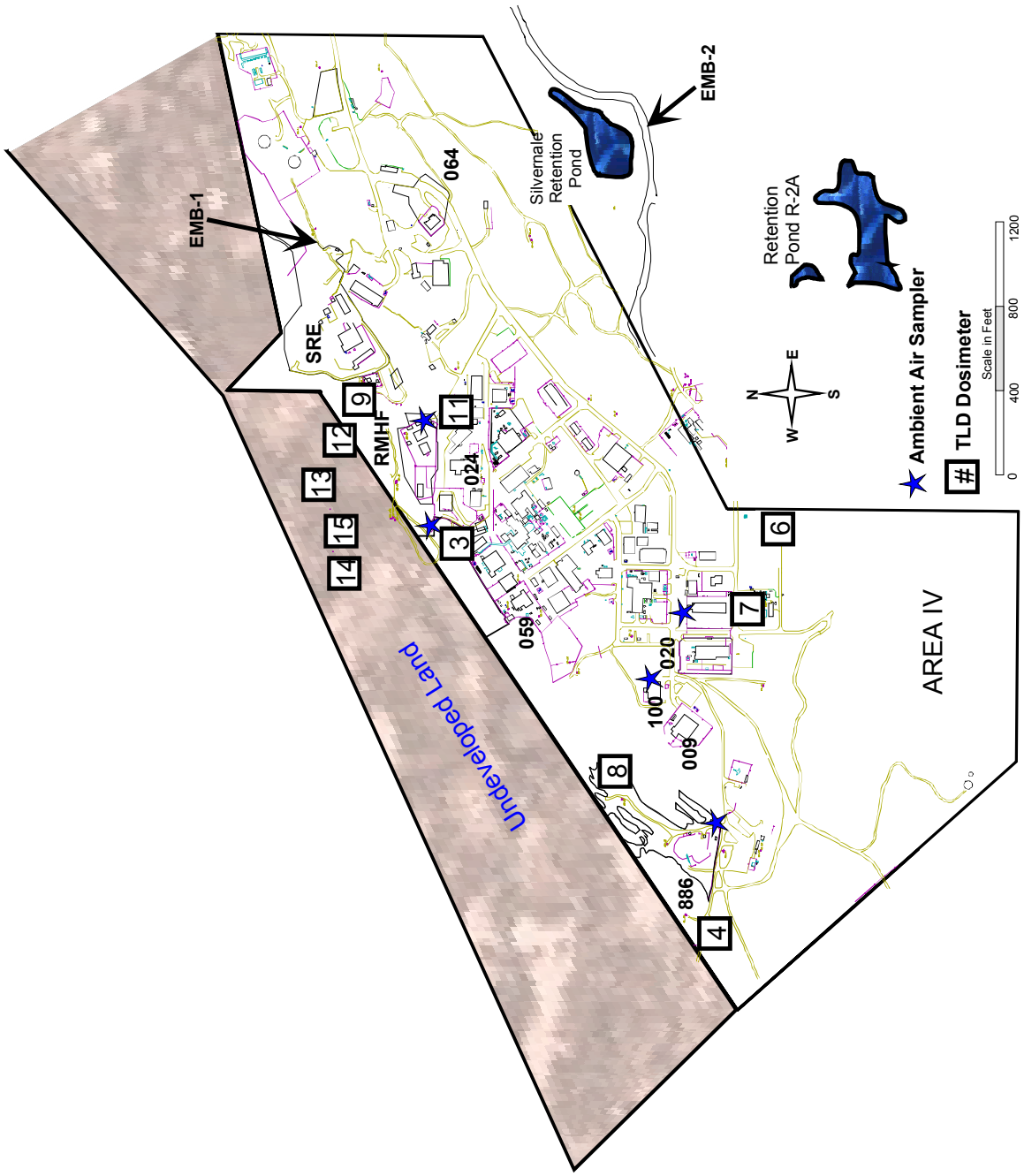

Figure 5-1. Map of Santa Susana Field Laboratory Area IV Sampling Stations

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) (or RMHF_Middle)	SSFL Site, RMHF northwest property line boundary	(Q)
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, Simi Valley (west)	(Q)
BKG-18	Background Location, Calabasas	(Q)
BKG-19	Background Location, Burbank	(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

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).

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.

Table 5-4. Filtered Exhaust and Ambient Air Radioactivity Concentrations—2001

Radionuclide	Activity Concentration (microcuries per cubic centimeter, µCi/cc)							
	Derived Conc. Guide	Exhaust	Ambient					
		RMHF Stack	RMHF	RMHF Pond	T020	T100	T886	Average
H-3	1E-07	ND	NA	NA	NA	NA	NA	NA
Be-7	natural							
K-40	natural							
Co-60	8E-11	2.9E-15						
Sr-90	9E-12	5.9E-16				3.5E-15		3.5E-15
Cs-137	4E-10	1.0E-14						
Po-210	natural	1.6E-16	9.2E-16	5.6E-15	7.8E-15	6.0E-15	4.1E-15	4.9E-15
Th-228	4E-14		3.0E-15					3.0E-15
Th-230	4E-14		3.7E-16					3.7E-16
Th-232	7E-15							
U-234	9E-14	4.0E-17	8.3E-16		6.7E-16			7.5E-16
U-235	1E-13							
U-238	1E-13							
Pu-238	3E-14				9.5E-16	2.6E-16		6.1E-16
Pu-239/240	2E-14			8.2E-16		3.4E-16		5.8E-16
Pu-241	1E-12							
Am-241	2E-14		1.0E-15	2.3E-15		3.1E-16		1.2E-15
Gross Alpha	None	1.7E-16	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Gross Beta	None	5.3E-15	5.4E-15	1.2E-14	1.3E-14	6.4E-15	4.7E-15	8.5E-15

Note 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 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. For year 2001, the average gross alpha activities on the environmental air samples are reported as zero, because, on average, the detected gross alpha activities on field samples are less than the background.

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. Table 5-5 shows a complete list of the results from the gross alpha and gross beta counting of the ambient air samples.

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.

Table 5-5. Ambient Air Radioactivity Data—2001

Area	Activity	Number of Samples	Gross Radioactivity Concentrations (μCi/mL)		
			Annual Average Value	Maximum Value[a] and Date Observed	Average Percent of Guide[b]
SSFL Area IV T100	Alpha Beta	51	0[c] 6.36E-15	4.74E-15 (11/13) 3.71E-14 (9/25)	0.00% 0.07%
SSFL Area IV Hot Lab	Alpha Beta	51	0 1.34E-14	3.31E-15 (11/13) 5.09E-14 (3/6)	0.00% 0.15%
SSFL Area IV RMHF	Alpha Beta	51	0 5.42E-15	4.74E-15 (11/13) 4.60E-14 (1/3)	0.00% 0.06%
SSFL Area IV 4886	Alpha Beta	51	0 4.73E-15	2.41E-15 (11/13) 2.32E-14 (11/20)	0.00% 0.05%
SSFL Area IV RMHF Pond	Alpha Beta	51	0 1.24E-14	1.16E-15 (7/31) 4.42E-14 (10/23)	0.00% 0.14%

[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. Figure 6-2 shows the locations of these wells. 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. Forty-six water samples from 33 of these wells were collected and analyzed in 2001, and the summary results are shown in Table 5-6.

The State of California assigns the 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 four instances of gross alpha (21.5, 24.5, 59.4, and 20.1 pCi/L at RD-21, RD-28, RS-54, and RD-54, 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.

Laboratory analyses were performed for tritium in 46 water samples from 33 groundwater-monitoring wells (see Figure 6-2). Of the 46 analyses performed, five samples from four wells had tritium concentrations higher than the detection limits. The positive tritium identifications had maximum concentrations of 493, 1100, 3120, and 968 pCi/L at wells RD-24, RD-28, RD-34A, and RD-59A, respectively. The maximum value among all the results, 3120 pCi/L in well RD-34A, is far below the EPA and California drinking water limit of 20,000 pCi/L.

Table 5-6. Radioactivity in Groundwater at SSFL—2001

	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	3120	ND	0.36	0.44	0.55	20.59	0.72	14.80	59.44	15.90
Mean[b]	153	ND	0.09	0.0.9	0.10	7.92	0.35	6.89	7.97	6.83
Minimum	-111	ND	0.00	-0.03	0.00	2.21	0.12	1.67	0.72	2.07
Number of Analyses[c]	46 (41)	37 (37)	6 (5)	6 (5)	6 (5)	10 (0)	10 (0)	10 (0)	38 (9)	38 (2)

[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.

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 7000 pCi/L in 1991, the tritium concentrations in this well have dropped down to the range of 1000 to 5000 pCi/L. In 2001, RD-34A had a tritium concentration of 3120 ± 200 pCi/L (5/9/01).

RD-24, near Building 4059, showed 245 ± 110 pCi/L (2/6/01) and 493 ± 113 pCi/L (10/25/01). One off-site well, RD59A, showed the presence of tritium at 968 ± 115 pCi/L, which is about 5% of the EPA drinking water supplier standard. The occurrence of tritium in groundwater is probably due to unintended production of tritium in soil surrounding various reactors, primarily in Buildings 4010 and 4059. Low-level tritium in groundwater could also be naturally occurring.

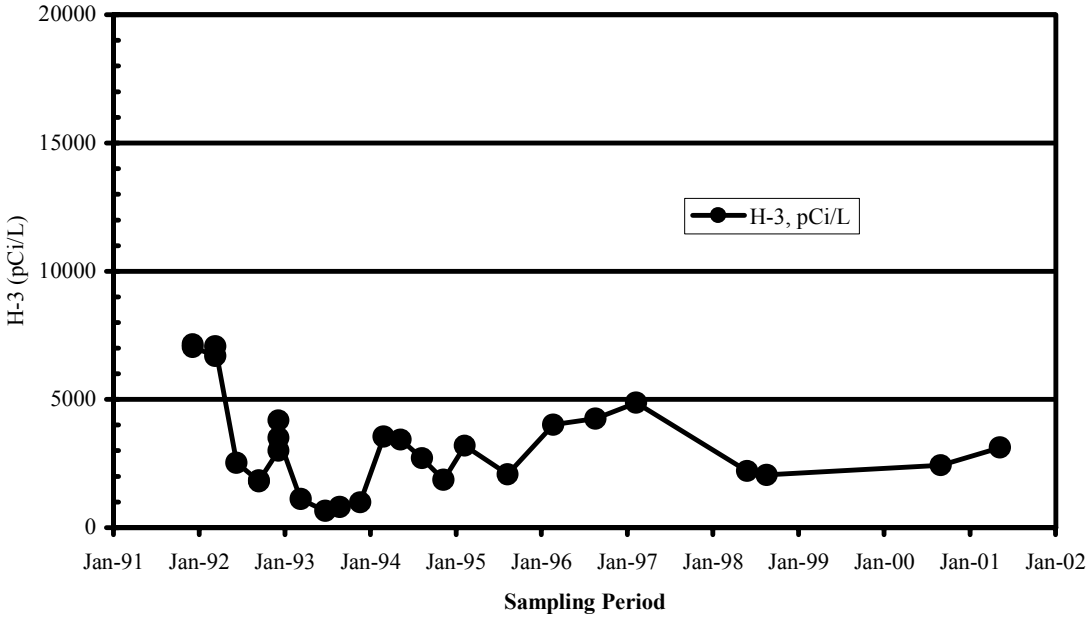

Figure 5-2. Tritium Concentration in Water from Well RD-34A

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.

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 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. Table 5-9 shows the latest results reported by local water suppliers at the time of this publication. 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 between the radioactivity in surface water at SSFL (Tables 5-7 and 5-8) and 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.

Table 5-7. NPDES Discharge Radioactivity Data for Northwest Slope Monitoring—2001

	Activity (pCi/L)			
	H-3	**Sr-90**	**Gross Alpha**	**Gross Beta**
Water Suppliers MCL	20,000	8	15	50
Maximum	680	2.43	5.30	18.88
Mean[a]	133	0.82	2.06	4.58
Minimum	0.00	0.00	0.20	0.53
Number of Analyses[b]	38 (22)	38 (18)	38 (2)	38 (3)

[a]Average of all reported values.
[b]Numbers in parentheses represent the number of analyses reported as less than the detectable limit.

Table 5-8. NPDES Discharge Radioactivity Data for Southeast Slope Monitoring—2001

	Activity (pCi/L)			
	H-3	Sr-90	Gross Alpha	Gross Beta
Water Suppliers MCL	20,000	8	15	50
Maximum	1516	2.46	5.13	3.72
Mean[a]	276	0.78	3.00	2.23
Minimum	0.00	0.00	0.45	0.00
Number of Analyses[b]	13 (6)	13 (8)	13 (0)	13 (1)

[a]Average of all reported values.
[b]Numbers in parentheses represent the number of analyses reported as less than the detectable limit.

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)

a. ND = Not detected or above the detection limit set by DHS.
b. NA = Nor available.

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 progeny). The radionuclide composition of local area surface soil has been determined to be predominantly K-40, natural thorium, natural uranium, and their decay progeny. Radioactivity in nuclear weapons test fallout consists primarily of the fission-produced Sr-90, Cs-137, and Pu-239.

Septic Tanks and Leach Fields

In 2001, most of the soil sampling was conducted to support the site remediation activities. During the year, five septic tanks and leach fields, which are located at Buildings 4005, 4011, 4100, 4373, and 4535, were excavated. Soil samples were taken at various stages of the excavation to ensure that no radiological contamination was present. A total of 49 soil samples were taken from these sites and analyzed using the HPGe MCA system for gamma emitters. Table 5-10 summarizes the gamma spectrometry analysis results for these soil samples. The majority of the samples had no man-made gamma-emitting radionuclides. A few samples indicated positive detection of Cs-137 and Eu-152, with the maximum observed concentrations of 0.06 and 2.84 pCi/g, respectively. These concentrations are well below the site-wide release limit of 9.2 pCi/gram for Cs-137 and 4.5 pCi/g for Eu-152.

Sodium Reactor Experiment (SRE)

The State of California, Department of Health Services (DHS) conducted soil sampling in and around the area of the SRE site where mercury contaminated soil has been proposed for excavation. Eight soil samples were collected at the SRE site. Our split samples indicated no positive detections on Cs-137, except for one sample, which had a Cs-137 concentration of 0.25 pCi/g.

As part of this investigation, Rocketdyne also took soil samples from the two shallow trenches where elevated radiation levels were observed. Two isolated hot spots were identified, one in the west trench and the other in the north trench. Soil samples from the west trench had an average Cs-137 concentration of 3.78 pCi/g, ranging from not detected to 6.30 pCi/g. These soil samples indicated that the area of contamination was small and localized. The contaminated soil was excavated and managed as LLRW per ALARA policy. After the cleanup, five additional soil samples were taken from the "hot spot," and the average Cs-137 concentration was 0.30, ranging from 0.10 to 0.50 pCi/g.

Similarly, the contamination found in the north trench was also a small isolated area. Ten soil samples were taken, and the average Cs-137 concentration was 6.08, ranging from 0.30 to 30.30 pCi/g. After the contaminated soil was excavated per ALARA policy, the average Cs-137 in soil became 0.30, ranging from not detected to 1.20 pCi/g.

Table 5-10. Soil Radioactivity Data—2001

Sample Location		Man-made Gamma Emitters (pCi/g)	
		Cs-137	**Eu-152**
4005	Maximum	ND[a]	2.84
	Mean	ND	0.39
	Minimum	ND	ND
	Number of Analyses[b]	27 (27)	27 (19)
4011	Maximum	ND	ND
	Mean	ND	ND
	Minimum	ND	ND
	Number of Analyses[b]	4 (4)	4 (4)
4100	Maximum	ND	ND
	Mean	ND	ND
	Minimum	ND	ND
	Number of Analyses[b]	8 (8)	8 (8)
4373	Maximum	0.062	ND
	Mean	0.031	ND
	Minimum	ND	ND
	Number of Analyses[b]	2 (1)	2 (2)
4535	Maximum	ND	ND
	Mean	ND	ND
	Minimum	ND	ND
	Number of Analyses[b]	8 (8)	8 (8)

[a]ND = Not detected
[b]Numbers in parentheses represent the number of analyses reported as less than the detectable limit

Miscellaneous

In 2001, a few soil samples were also taken at the new groundwater well drilling locations, PT-05, PT-055 and PT-106. Cs-137 was found at PT-05 and PT-055, with soil concentrations of 3.12 and 0.17 pCi/g, respectively. No Cs-137 was found at PT-106.

In addition, three soil samples were taken in the drainage channel located in the Area IV survey grid T29. No man-made radionuclides were found in these samples.

5.2.5 Vegetation

Historically, Rocketdyne and its predecessor, Atomics International, had sampled vegetation both on-site and off-site in the surrounding local community during the operational period from 1956 to 1989. In addition, Rocketdyne has sampled vegetation periodically since 1989. No evidence of any radioactive contamination in vegetation has ever been found.

In 2000, another set of vegetation samples were collected and analyzed to address the concern about potential brush fires in and around SSFL. Detailed information on this study can be found in the 2000 ASER report. The study, once again, confirms the results from the previous vegetation sampling conducted by Rocketdyne and Atomics International.

No vegetation samples were collected in 2001.

5.2.6 Wildlife

No animal samples were collected in 2001.

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 rather complicated bulb-type dosimeters (CaF_2:Mn). This 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 was done initially by using the same dosimeters (LiF) that were well established in use for personnel monitoring 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 the resolution in terms of dose uses increments of 10 mrem per quarter. Using these dosimeters demonstrated that environmental exposures did not reach regulatory limits, but provided 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 the elimination of natural and transportation exposure that occurs before, during, and after the deployment of the environmental dosimeters to measure the ambient radiation. This 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 for these TLDs, which were placed at various Rocketdyne dosimeter locations both on-site and off-site, are also shown in Table 5-11 for 2001.

Table 5-11 shows that individual radiation exposures measured by Rocketdyne and the State DHS agreed to within 1 μr/hr. 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 is reflective of the normal operations at the RMHF, which involve handling and shipment of radioactive waste.

Table 5-11. 2001 SSFL Ambient Radiation Dosimetry Data

2000		Annual Exposure (mrem) By Rocketdyne	Average Exposure Rate (μR/h)	
TLD-Locations			Rocketdyne	State DHS
SSFL	SS-3	69.9	8.0	8.2
	SS-4	76.6	8.7	9.1
	SS-6	74.0	8.4	8.9
	SS-7	83.5	9.5	9.2
	SS-8	80.2	9.2	9.5
	SS-9	79.2	9.0	9.1
	SS-11	84.7	9.7	9.2
	SS-12	92.9	10.6	10.3
	SS-13	98.9	11.3	10.4
	SS-14	81.9	9.3	8.9
	SS-15	98.6	11.3	11.1
	EMB-1	88.7	10.1	9.5
	EMB-2	76.4	8.7	9.8
Mean Values		**83.3**	**9.5**	**9.5**
Off-site	OS-1	60.4	6.9	7.3
	BKG-11	57.3	6.5	--
	BKG-12	34.0	3.9	--
	BKG-13	29.0	3.3	--
	BKG-15	54.5	6.2	--
	BKG-18	64.0	7.3	--
	BKG-19	48.8	5.6	--
	BKG-22	20.0	2.3	--
Mean Values		**50.1**	**5.7**	**7.3**

The natural background radiation level as measured by the off-site TLDs ranges from 20 to 64 mrem/yr. At SSFL, the local background ranges from 70 to 89 mrem/yr, based on the data from dosimeters SS-3, -4, -6, -7, -8, -9, -11, and EMB-1 and EMB-2 as shown in Table 5-11. 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 which results in elevated exposure levels.

The external exposure rate at Rocketdyne's northern property boundary, the closest property boundary to the RMHF, would be indistinguishable from natural background. This property line is approximately 300 meters from the RMHF and separated by a sandstone ridge, effectively shielding the boundary from any 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 is considerably below DOE's 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.

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.

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, and 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 5-12. The table presents the estimated exposures in comparison to the regulatory standards. Dose values in the table represent both internal and external exposures.

Table 5-12. Public Exposure to Radiation from DOE Operations at SSFL—2001

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	3.1×10^{-6} mrem/yr
	Limit ("Radiation Protection of the Public and the Environment" DOE Order 5400.5)	100 mrem/yr
2.	Air pathway (reported in NESHAPs report)	3.1×10^{-6} mrem/yr
	Limit (40 CFR 61, Subpart H)	10 mrem/yr

5.3.2 Population Dose

The general population (person-rem) dose 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 7.5×10^{-4} person-rem for the SSFL site. As a comparison, an average individual in the US receives approximately 300 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.

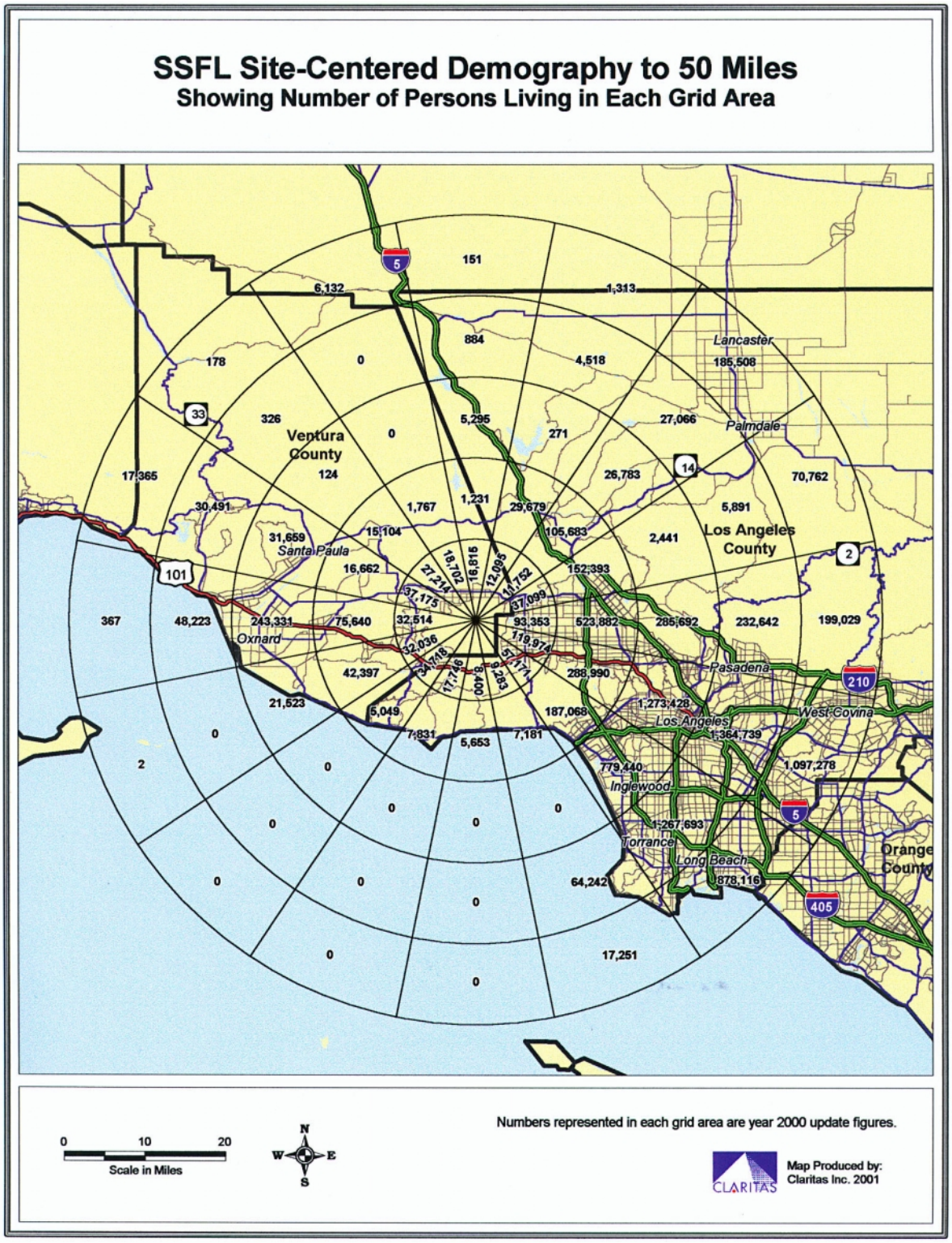

Figure 5-3. Demographic Data within 50 Miles (80 km) of SSFL

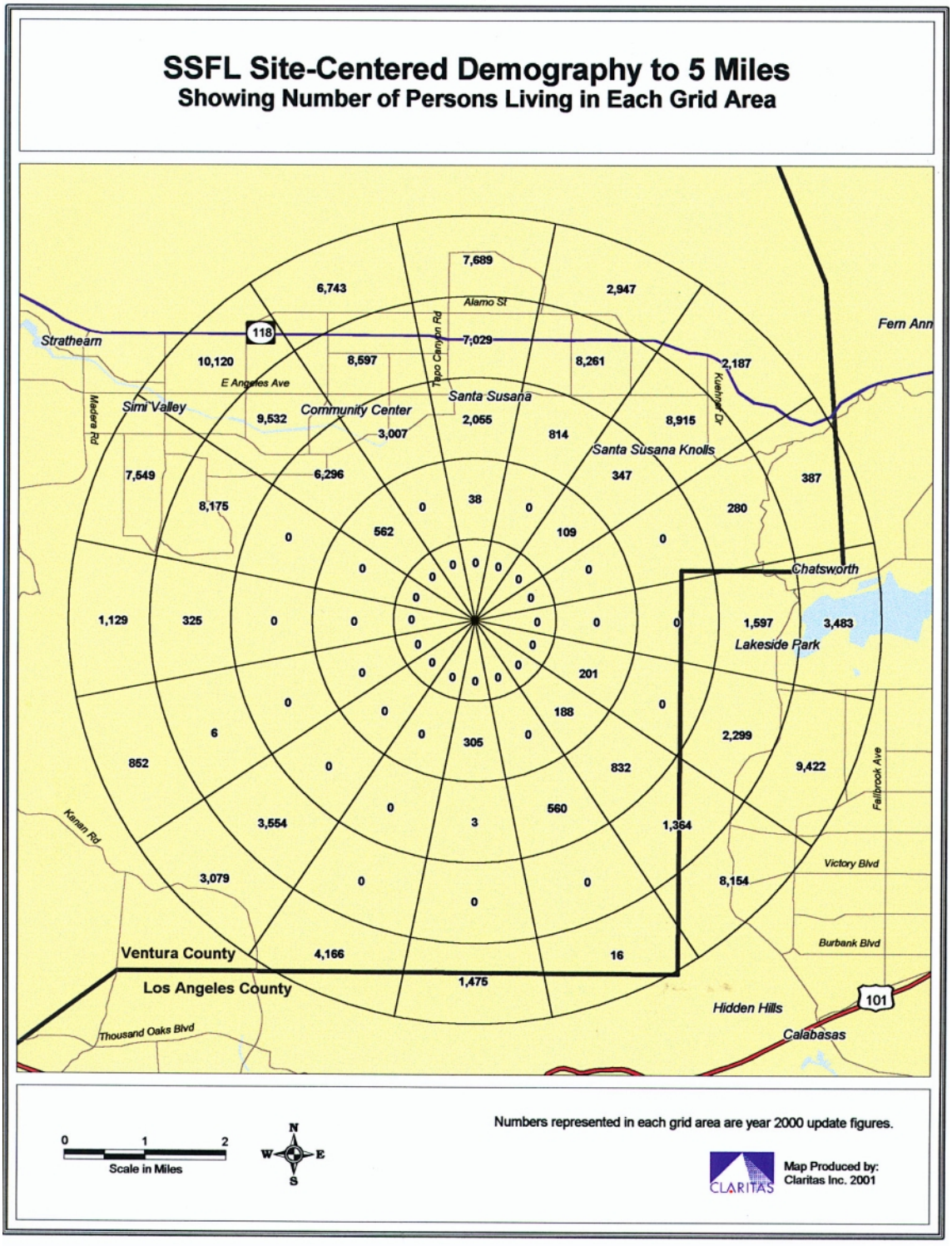

Figure 5-4. Number of Persons Living within 5 Miles (8 km) from SSFL Site

Figure 5-5. Number of Persons Living within 10 Miles (16 km) from 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. 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 Area IV of SSFL. Therefore, the protection of aquatic organisms on-site is not an issue. Since there's 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.

The terrestrial biota, i.e., vegetation and small wild animals, are abundant at SSFL. They are subject to potential exposure to the radioactivity in soil. The interim DOE Technical Standard, "A Graded Approach for Evaluating Doses to Aquatic and Terrestrial Biota" [DOE, 2000], provides a methodology for demonstrating compliance with the requirement for protection of biota. RAD-BCG Calculator, a spreadsheet program developed by DOE's Biota Dose Assessment Committee, is a conservative screening tool for compliance demonstration. Once the screen test is passed, no further action is necessary.

In the screening phase, 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, which would not cause the biota dose limits to be exceeded.

Historical on-site soil data is used in this preliminary screening process. Average radionuclide concentrations are estimated from hundreds of on-site and off-site soil samples collected and analyzed during the past decade. The average values, net of background, are then entered into the RAD-BCG Calculator to compare with the BCGs. Table 5-13, summarizes the comparison results. The total BCG fraction at SSFL, as shown in Table 5-13, is less than one, indicating that the potential exposure is less than the dose limit recommended by the DOE.

This screening analysis is based on the partially available on-site and off-site soil data. More recent soil data are being compiled so that they can be incorporated into the compliance demonstration. As these data become available, the screening results of the biota protection will be updated.

Table 5-13. Terrestrial Biota Radiation Exposure as a Fraction of Dose Limit

Nuclide	Soil			Sum of Fraction
	Limit pCi/g	Average On-site Concentration (net of background), pCi/g	Partial Fraction	
Am-241	3.88E+03			
Ce-144	1.44E+03			
Cs-135	2.62E+02			
Cs-137	2.08E+01	0.02	9.6E-04	9.64E-04
Co-60	7.02E+02	0.05	7.1E-05	7.13E-05
Eu-154	1.27E+03			
Eu-155	1.58E+04	0.06	3.8E-06	3.79E-06
H-3	6.47E+04			
I-129	5.67E+03			
I-131	8.55E+02			
Pu-239	6.11E+03			
Ra-226	2.52E+00			
Ra-228	2.15E+00	0.31	1.4E-01	1.44E-01
Sb-125	3.40E+03			
Sr-90	2.25E+01			
Tc-99	4.47E+03			
Th-232	1.51E+03	0.34	2.3E-04	2.26E-04
U-233	4.82E+03	0.06	1.2E-05	1.24E-05
U-234	5.13E+03	0.37	7.2E-05	7.21E-05
U-235	2.83E+03			
U-238	1.58E+03	0.19	1.2E-04	1.20E-04
Zn-65	4.13E+02			
Zr-95	1.17E+03			
			Sum	1.46E-01

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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. The majority of 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, and other parameters necessary to assess water quality.

An extensive site-wide (SSFL) groundwater remediation program has the capacity for removing solvent contamination from approximately 10 million gallons of groundwater per month at SSFL. The major groundwater contaminant in Area IV is 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 based on 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, and 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 (UST) have been remediated as tanks are removed. The majority 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.

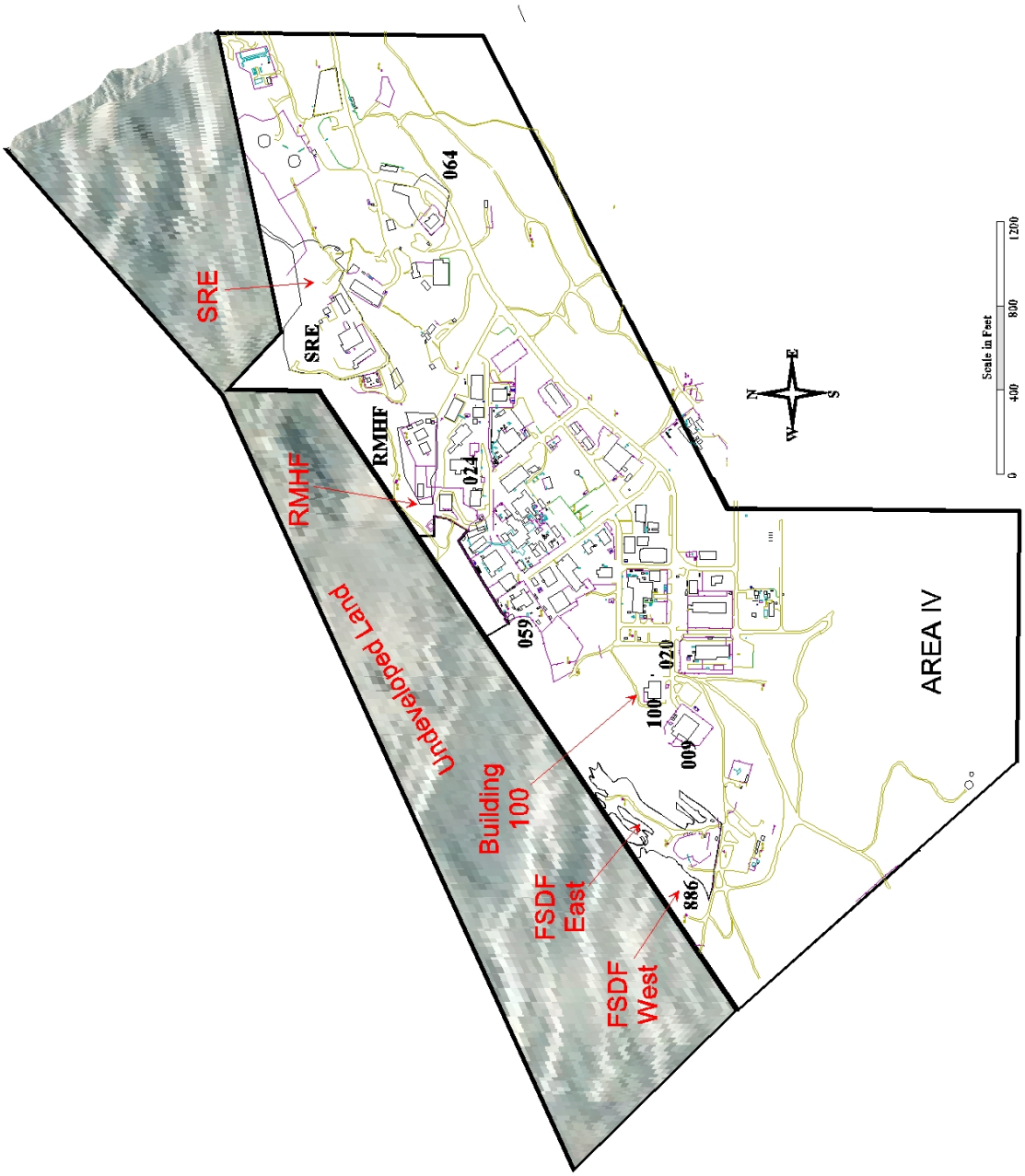

Figure 6-1. Locations of Surface Water Runoff Collectors

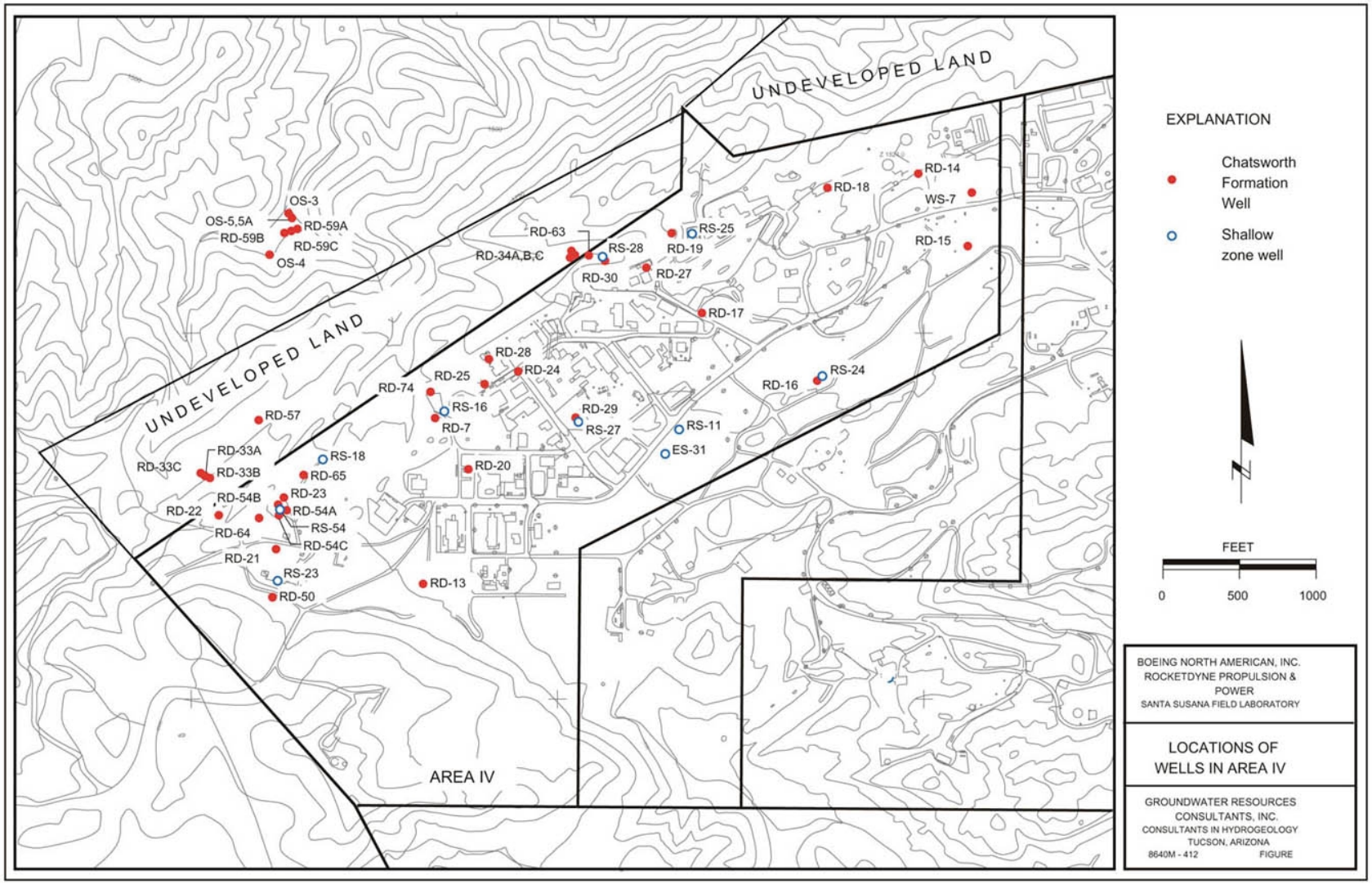

Figure 6-2. Location of Wells Used in Groundwater Management Program

6.1 SURFACE WATER

Rocketdyne 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 permit to discharge, NPDES No. CA0001309, initially became effective September 27, 1976, and was most recently renewed on June 29, 1998. The current permit is in effect through May 10, 2003.

The permit allows the discharge of reclaimed wastewater, storm water runoff, and industrial waste water from retention ponds into Bell Creek, a tributary to the Los Angeles River. The permit also allows for 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 #1: Outfall 005, FSDF #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.

There is no sanitary sewer connection to a publicly owned treatment works from SSFL. Domestic sewage may be treated, disinfected, and discharged to the retention ponds or trucked off-site for treatment and disposal. Permit conditions are placed 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 receives influent from Area IV, and is referred to as R-2A Pond. 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 chemical constituents such 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 (Outfalls 005 and 006), and behind T100 (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 standards 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 one sample per 2 weeks needs to be obtained from each of the outfalls. During dry

weather, whenever there is discharge from Outfalls 001 and 002, the minimum sampling frequency is once per month.

There was discharge from the permitted storm water outfalls at SSFL during the months of January, February, March, April, November, and December 2001.

There was discharge from the domestic sewage treatment plants (STP–1 and –3) for a portion of the year, with use of STP-1 and STP-3 terminating in December and October, respectively. Waste water previously treated by the STPs are captured and hauled off-site for proper disposal, as summarized in the monthly Discharge Monitoring Report (DMR) reports to the RWQCB. Boeing does not anticipate future use of either of the STPs.

Monitoring methods and results have been reviewed for permit compliance for all seven outfalls and the two STPs. A summary of noncompliance events identified through this review are identified in Sections 6.1.1 through 6.1.6, including a description of corrective actions implemented where appropriate.

6.1.1 Outfall 002 (R-2A Pond Discharge)

Outfall 002 had three incidents of noncompliance during 2001. Two of the incidents were the result of detection limits exceeding permit limits and one was a daily maximum exceedance as follows.

10-Jan Cyanide detection limit of 7.1 µg/L exceeded permitted monthly average limit of 5.2µ g/L.

Review of prior sampling events and communications with the laboratory performing the cyanide analysis revealed that Boeing had specified a detection limit of 5.2 µg/L or lower. The lab had been complying with this request until their 2000 annual method detection limit (MDL) study, after which they raised the cyanide limit from 5.0 g/µl to 7.1 µg/L without notifying Boeing. The lab ran their next annual MDL study on January 22, 2001, which reduced the MDL from 7.1 µg/L to 3.7 µg/L, which was compliant with the permit limit.

Corrective measures have been implemented to prevent the laboratory from raising MDLs during their annual studies to levels exceeding SSFL NPDES permit requirements. The corrective measures include (1) contacting the lab to determine the date of their annual MDL studies (to occur in 2002 within the next few months) so Boeing's consulting project chemist can stay involved in the process to ensure MDLs do not exceed permit limits, and (2) review of preliminary laboratory reports within 24 hours of receipt to identify potential issues such as elevated MDLs – in which case samples can be rerun at lower limits within holding times. [Note that the second corrective measure described has been in place since November 2001.]

26-Jan Lead detection limit of 3.9 µg/L exceeded permitted monthly average limit of 2.5 µg/L.

The method used by the lab for lead analyses before November 2001 (EPA 200.7) was not capable of meeting the lead permit limit of 2.5 µg/L. As a result, the lab would perform a concentrated extraction on the samples to lower the detection limit. For an undocumented reason, the lab failed to perform the necessary concentrated extraction for the January 26, 2001 sampling event resulting in elevated lead MDLs in all samples from this sampling event.

Beginning November 2001, the analysis method for lead was changed to EPA 200.8 improving the achievable detection limits for all metals of concern. The current MDL for lead by this analysis method is 1.0 µg/L, meeting the lead permit limit of 2.5 µg/L. No further corrective measures are necessary since the current methodology does not require special sample extraction measures to be performed by the lab.

08-Feb Thallium detection of 4.1 µg/L exceeded permitted daily maximum limit of 2 µg/L.

Thallium had never been detected at the location before the February 8, 2001 event. For this reason, a false positive laboratory result was suspected and follow-up sampling was performed in accordance with the permit to demonstrate compliance. This follow-up sampling and subsequent sampling events did not detected thallium, indicating that the February 8, 2001 detection was a false positive.

6.1.2 Stormwater Outfall 003 (RMHF)

One noncompliance incident was associated with Outfall 003. The lead detection limit for the January 26, 2001 sampling event was 3.9 µg/L, which is greater than the permit monthly average limit of 2.5 µg/L. This lead detection limit issue and corrective measures are the same as discussed previously for Stormwater Outfall 002.

6.1.3 Stormwater Outfall 004 (SRE)

Outfall 004 had two incidents of noncompliance during 2001. One incident was the result of a detection limit exceeding a permit limit and one was a monthly average exceedance as follows.

26-Jan Lead detection limit of 3.9 µg/L exceeded permitted monthly average limit of 2.5 µg/L. This lead detection limit issue and corrective measures are the same as discussed previously for Stormwater Outfall 002.

05-Mar The monthly average of 1.9 µg/L for total recoverable mercury exceeded the permitted monthly average limit of 0.2 µg/L.

As described in prior DMR reports, mercury has been detected in soil samples at the facility and the area around Outfall 004 (i.e., the SRE area) and is being investigated through the RCRA corrective action program under oversight of the Department of Toxic Substances Control. While measures are evaluated for the soils in the SRE area, Boeing has enhanced sediment reduction systems as an interim control. The sediment reduction measures implemented in 2001 included expanded sediment traps and tarping of the area around Outfall 004. These measures appear to have been successful as mercury concentrations were in compliance with permit limits subsequent to the March 5, 2001 event.

6.1.4 Stormwater Outfall 005 (FSDF 1)

Outfall 005 had three incidents of noncompliance during 2001. One incident was the result of a detection limit exceeding a permit limit and two were daily maximum exceedances as follows:

26-Jan — Lead detection limit of 3.9 µg/L exceeded permitted monthly average limit of 2.5 µg/L. This lead detection limit issue and corrective measures are the same as discussed previously for Stormwater Outfall 002.

27-Feb — Nitrite and nitrate (as nitrogen) detection of 14 mg/L exceeded permitted daily maximum limit of 8 mg/L. (See discussion following March 7 result.)

07-Mar — Nitrite and nitrate (as nitrogen) detection of 8.4 mg/L exceeded permitted daily maximum limit of 8 mg/L.

The nitrite and nitrate (as nitrogen) exceedances were believed to be associated with a re-vegetation project performed up-drainage of the Outfall 005 location. The re-vegetation project involved application of a seed mixture that may have included fertilizer–a possible nitrogen source material. Follow-up sampling performed in accordance with the permit indicated that the nitrogen source had stabilized after the March 7, 2001 storm event and nitrogen levels returned to previous ranges in compliance with permit limits.

6.1.5 Stormwater Outfall 006 (FSDF 2)

Outfall 006 had two incidents of noncompliance during 2001. One incident was the result of a detection limit exceeding a permit limit and one was a daily maximum exceedance as follows.

26-Jan — Lead detection limit of 3.9 µg/L exceeded permitted monthly limit of 2.5 µg/L. This lead detection limit issue and corrective measures are the same as discussed previously for Stormwater Outfall 002.

07-Apr — Fluoride detection of 2.6 mg/L exceeded permitted daily maximum limit of 1.6 mg/L.

The fluoride detection was believed to be a possible false positive due to the absence of prior detections and follow-up sampling was implemented in accordance with the permit. The absence of detectable fluoride concentrations in samples collected before and after the April 7, 2001 event and the absence of an on-site fluoride source indicates that this was a false positive.

6.1.6 Stormwater Outfall 007 (Building 4100)

One noncompliance incident was associated with Outfall 007. The lead detection limit for the January 26, 2001 sampling event was 3.9 µg/L, which is greater than the permit monthly average limit of 2.5 µg/L. This lead detection limit issue and corrective measures are the same as discussed previously for Stormwater Outfall 002.

6.2 AIR

Air pollutant discharge limitations are imposed by VCAPCD (Ventura County Air Pollution Control District) Rules and Regulations and Permit to Operate (P/O) No. 0271 for this area. P/O No. 0271 is kept current and renewed each year by VCAPCD.

At present, the Sodium Treatment Facility (Bldg 4133) and the 33,000-gallon ethanol storage tank located at the SPTF are the only permitted stationary sources in Area IV. However, both items will be removed from P/O No. 271 this year. A majority of the stationary sources included in P/O No. 0271 were deleted over the past few years due to their inactive or demolished state.

Lastly, because the air emissions allocated to this operating permit have continued to remain under applicable thresholds, the area is considered a non-Title V, non-Aerospace NESHAP and non-SARA313 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 16 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. Tables 6-1 and 6-2 present a summary of groundwater monitoring activities and sampling results for Area IV during 2001.

Table 6-1. Purposes of Groundwater Monitoring in 2001

	Remediation	Waste Management	Environmental Surveillance	Other Drivers
Number of Active Wells Monitored	0	0	47	0
Number of Samples Taken	0	0	312	0
Number of Analyses Performed	0	0	5761	0
% of Analyses that are non-detects	0	0	90.9	0

Table 6-2. Ranges of Results of Groundwater Monitoring in 2001

Analytes	Ranges of Results for Positive Detections
Tritium (pCu/L)	<MDA to 3129±200
Heavy Metals (mg/L)	<0.00005 to 4.5
TCE (µg/L)	<0.14 to 1,300
cis-1,2-DCE (µg/L)	<0.14 to 16
PCE (µg/L)	<0.16 to 12
Perchlorate (µg/L)	<0.43 to 11

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, shallow groundwater is defined as groundwater present in the alluvium and weathered bedrock, and groundwater occurring 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 shallow groundwater wells (Figure 6-2). The Chatsworth Formation is composed of consolidated, massively bedded sandstone with interbedded 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 several groundwater 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).

The solvents found in Area IV groundwater include trichloroethylene (TCE) and its family of degradation products. The 2001 analytical results of the Area IV wells have been documented in the 2001 Annual Groundwater Monitoring Report (HA, 2002). Boeing initiated a voluntary site-wide program to assess the occurrence and distribution of sodium perchlorate in 1997. This

assessment program 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 area southwest of Building 4059, 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 Maximum Contaminant Level (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. TCE was detected in well RD-13, located in the central part of Area IV near Burro Flats in 2001. This occurrence was determined to be the results of improperly decontaminated sampling equipment.

The TCE occurrence associated with the RMHF canyon (the northern occurrence) has been detected in shallow groundwater wells and in Chatsworth formation wells. Shallow groundwater well RS-28, which contained TCE concentrations up to 87 µg/L historically, contained TCE concentrations of 29 µg/L in 2001. The Chatsworth formation well RD-30 contained 8.7 to 22 µg/L of TCE in 2001. RD-63, an extraction well installed in 1994 in the Chatsworth formation for the pilot extraction test in the area, detected 6.5 to 7.5 µg/L TCE in 2001.

Within the central contaminated area (Figure 6-3), southwest of Building 4059, Chatsworth formation well RD-7 contained TCE concentration from 72 to 76 µg/L in 2001, compared to 64 to 81 µg/L in 2000. Since its construction in 1986, RD-7 generally contained TCE concentrations in the 16 to 56 µg/L range with a maximum TCE concentration of 130 µg/L. Well RD-25, located southwest of Building 4059 continued to contain low concentrations of tetrachloroethylene (PCE). In 2001, the well contained 4.2 to 12 µg/L PCE, compared to 5.9 to 6.9 µg/L PCE in 2000. TCE was also detected in samples from RD-25 in 2001, but were below the State action level of 5 µg/L.

Groundwater samples from two shallow groundwater wells (RS-18 and RS-54) located near the FSDF (Figure 6-3) contained elevated TCE concentrations. TCE concentrations in well RS-54 ranged from 180 to 4,500 µg/L between 1993 and 1999. In 2001, the TCE concentration was 1,300 µg/L. Well RS-18, often dry since its construction in 1985, recorded TCE at 19 to 3,200 µg/L during the period from 1993 to 1999. Well RS-18 contained 110 µg/L TCE in 2001. Perchlorate was detected in shallow well ES-11, located in the south central portion of Area IV, at a concentration of 11 µg/L. Perchlorate was also detected in shallow well RS-54, located in the area of FSDF at a concentration of 5.5 µg/L, but the sample data did not meet project QA/QC criteria. Perchlorate was detected in shallow well RS-54 at a concentration of 6 µg/L in 2000. RD-21 and RD-23, two Chatsworth formation wells installed in 1989 at the FSDF contained TCE ranging up to 2,900 µg/L. In 2001, TCE in these wells ranged from 320 to 770 µg/L. Well RD-33A, a Chatsworth formation (shallowest of a three-well cluster constructed in 1991) contained 9.2 to 14 µg/L TCE in 2001, compared to 2.4 to 9.8 µg/L in the period from 1993 to 1999. Well RD-65, a Chatsworth formation well, located northeast of the FSDF contained from 360 to 740 µg/L TCE in 2001. TCE in this well has contained up to 960 µg/L historically. Due to the excavation activities at FSDF, groundwater samples could not be collected from some FSDF

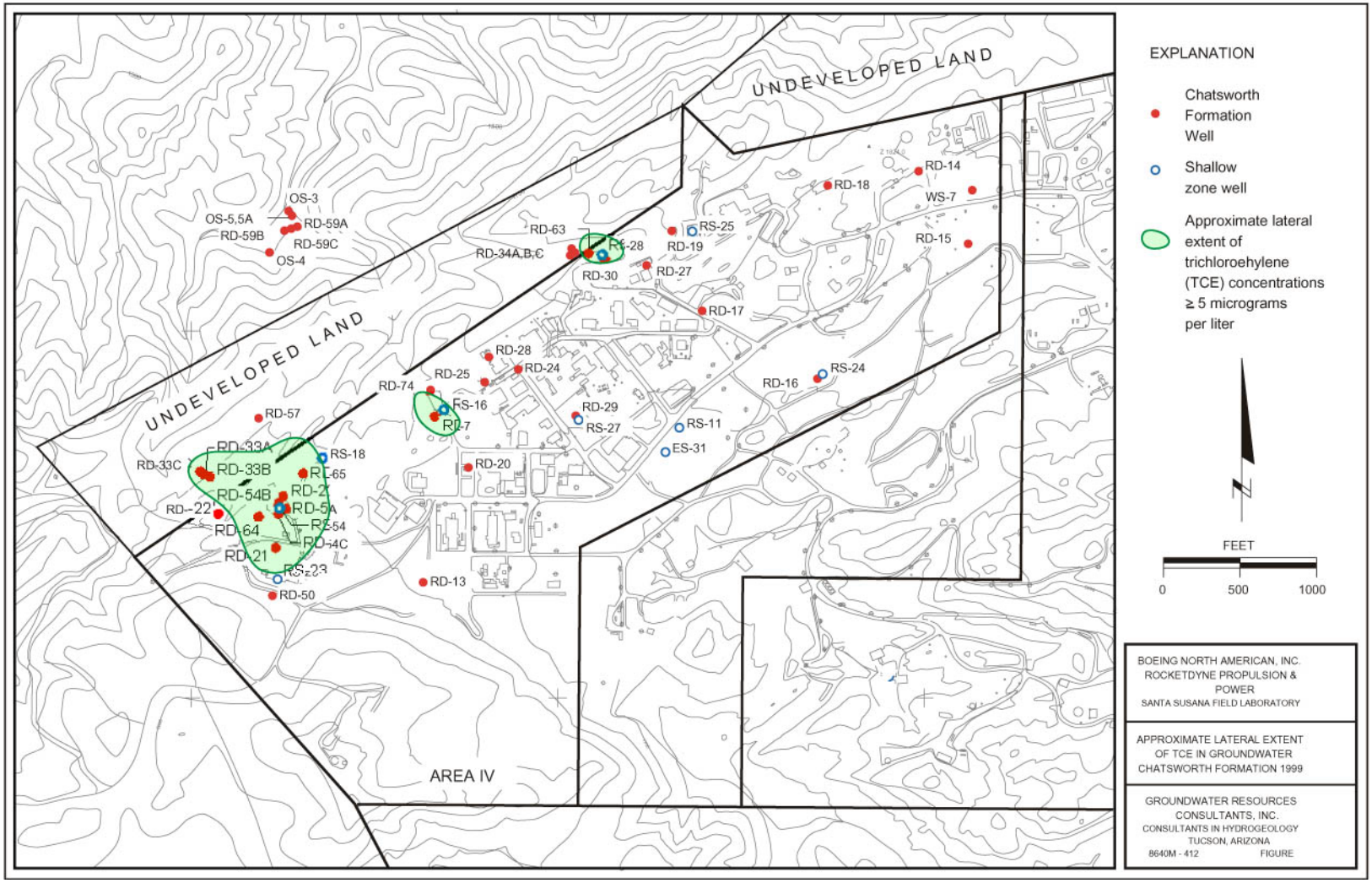

Figure 6-3. TCE Occurrences in Groundwater at SSFL, Area IV (exceeding 5 ppb)

wells during the early part of 2001. Perchlorate was detected in well RD-21 at a concentration of 3.7 µg/L, but the sample data did not meet project QA/QC criteria. Perchlorate was detected in well RD-21 at concentrations ranging from 5 to 7.2 µg/L in 2000.

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. Results indicated that groundwater extraction in the test well at RMHF was effective in creating a capture zone for degraded groundwater. Extraction and treatment of contaminated groundwater continued on an interim basis at RMHF in 2001. Groundwater extraction is also conducted in three wells (RD-24, RD-25, and RD-28) in the Building 4059 area. The Building 4059 interim groundwater extraction and treatment program was initiated in 1995. This extraction is primarily to dewater the building basement. Extraction and treatment of contaminated groundwater continued on an interim basis at Building 4059 in 2001. The extraction activity at the FSDF was initiated in 1995. The groundwater extraction system at FSDF included extraction of impacted groundwater from wells RD-21and RS-54 and treatment of the extracted groundwater in a GAC adsorption treatment unit. No groundwater was extracted from the FSDF interim extraction wells in 2001. To date, approximately 118,000 gallons, 3.0 million gallons, and 2.6 million gallons of groundwater have been extracted and treated from the FSDF, RMHF, and Building 4059 areas, respectively.

6.4 RCRA FACILITY INVESTIGATION

The RCRA Facility Investigation (RFI) Program started at the SSFL site in 1996 and is presently ongoing. RFI fieldwork is scheduled to be completed in 2002. Individual draft RFI site reports and the overall draft RFI program report will be prepared and submitted in 2002 and 2003.

The primary objectives of the RFI at the SSFL are to (1) investigate the nature and extent of chemicals in soil and the potential threat to near-surface groundwater quality for each SWMU and AOC identified for potential RFI Corrective Action, and (2) to evaluate the potential risk to human health and the environment presented by each SWMU and AOC'to assess whether remediation is required. The resulting data will then be evaluated following DTSC-approved risk assessment methodologies to evaluate whether remediation, additional assessment, or no further action is necessary to bring each site to closure.

Field methodologies for the soil investigation include soil matrix sampling, soil vapor sampling, surface water sampling, and trenching. DTSC was on-site during much of the fieldwork to observe sampling protocols and select sampling locations and depths. Field action levels (FALs) were developed before 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.

An investigation work plan for the near-surface groundwater was approved by DTSC in October 2000. DTSC was on-site to select locations for the new Area IV wells. One well was installed in November 2000; however, due to fiscal reasons, the near-surface groundwater field program was halted in fall 2000. The field program resumed in fall 2001. These piezometers

have been required by DTSC as temporary monitoring points for the RFI to evaluate contaminant extent and migration in the near-surface groundwater. As such, their locations are not shown on Figure 6-2.

Some key activities in the year 2001, include:

- Completion of the soil sampling for all the DOE RFI sites except Building 4020 and the Building 4056 Landfill. These two sites are planned for investigation during 2002.
- Installation of 20 DOE near-surface piezometers in Area IV. Sampling these piezometers is planned for spring 2002. Three additional near-surface wells will be installed near the Building 4056 Landfill site after that soil investigation is completed in 2002.
- A Standardized Risk Assessment Methodology (SRAM) Addendum was prepared to describe additional risk assessment procedures requested by DTSC. This was submitted to DTSC in October 2001, and will be completed in 2002.

During 2001, approximately 17 soil matrix, 8 soil vapor, and 3 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 2002.

Table 6-3. Sampling for RCRA Facility Investigation

RFI Sampling Period	Soil Matrix Samples	Soil Matrix Analyses	Soil Vapor Samples	Soil Vapor Analyses	Surface Water Samples	Surface Water Analyses	Ground – water Samples	Ground – water Analyses
11/16/00-12/31/01	17	76	8	8	0	0	3	6
Total to date	210	716	30	30	2	2	3	6

RFI soil analytical results for samples collected between 1999 and 2001 have not been published or validated at the time of publication for the 2001 ASER. RFI data collected before 1999, however, has been published and validated. A summary of soil sample results from the Building 4056 Landfill (SWMU 7.1) and the Old Conservation Yard (SWMU 7.4) that exceed FALs can be found in the 2000 ASER. Near-surface groundwater samples collected during May 2001 from the DOE piezometer installed in the Burro Flats area contained 7 µg/L TCE.

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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 measurements (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 15th to 85th percentile) was established as Acceptable and the next 10% on both sides of the 70%—the 5th to 15th and 85th to 95th percentiles—as Acceptable with Warning. Results outside this 90% band were considered Not Acceptable. During 2001, two sets of samples were distributed: QAP-54 and QAP-55 (DOE, 2001a; DOE, 2001b).

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-54 and QAP-55. Although these comparisons involve sample types, geometries, and analyses that are not part of the routine procedures at the Rocketdyne laboratory, the results indicate the quality level that the Rocketdyne laboratory maintains.

Davi Laboratories, Environmental Associates (Pinole, CA) does not participate in the DOE QAP program, however, in 2000, they participated in another inter-laboratory comparison blind test controlled by Environmental Resource Associates. All of their analysis results were 100% acceptable.

All quantitative environmental air samples for the site are analyzed by outside laboratories. For this report, air and effluent filter samples were analyzed by Eberline Services (Richmond, CA), and surface water and groundwater samples were analyzed by Davi Laboratory (Pinole, CA) and Eberline Services (Richmond, CA).

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 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.

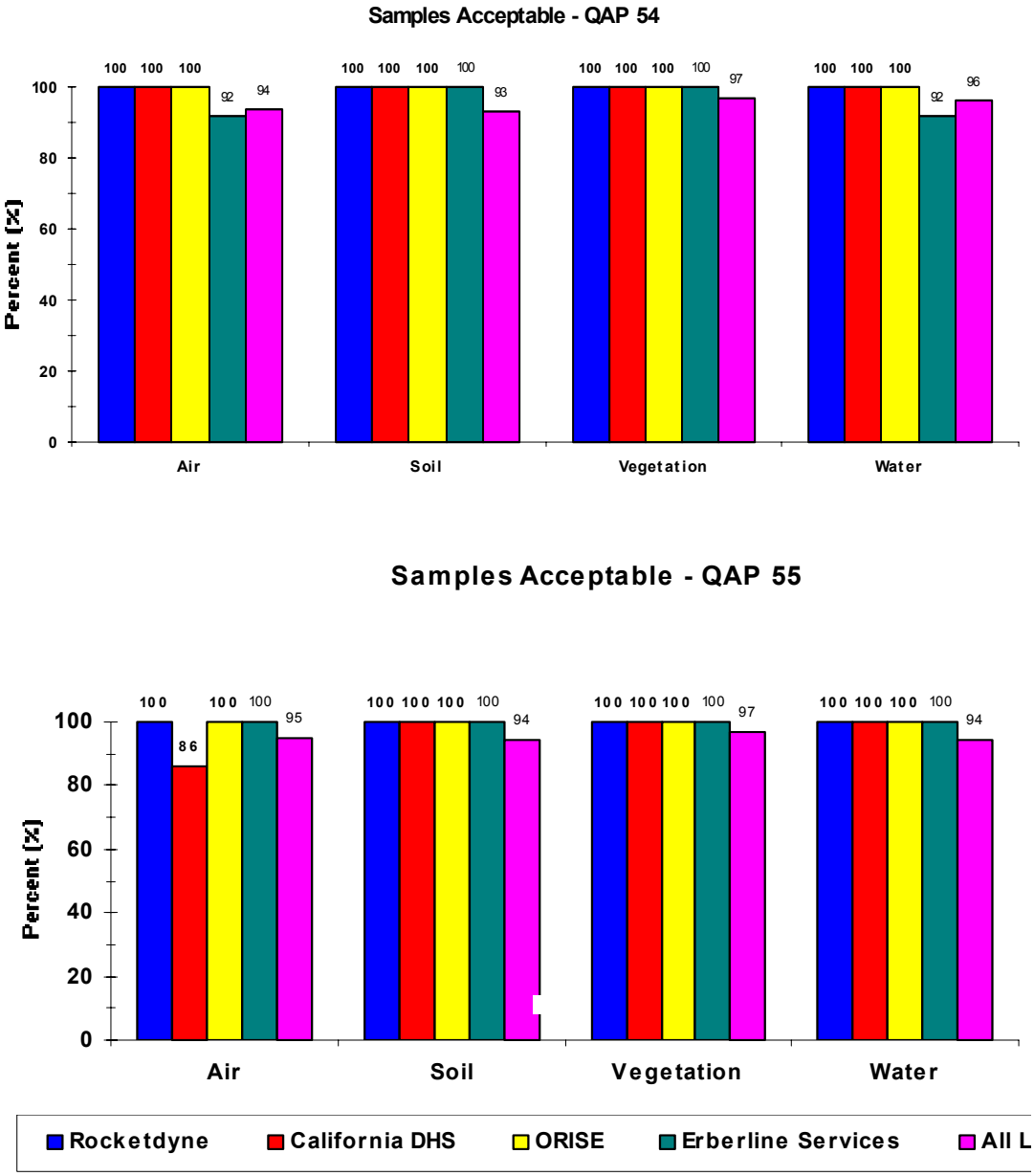

Figure 7-1. Quality Assessment Program Results for QAP-54 and QAP-55

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APPENDIX A
ACRONYMS

AI	Atomics International
ALARA	As Low As Reasonably Achievable
ANL	Argonne National Laboratory
AOC	Areas of Concern
APF	Air Force Plant
ASER	Annual Site Environmental Report
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/EMB	California Department of Health Services/Environmental Management Branch
DHS/RHB	Department of Health Services/Radiologic Health Branch
DMR	Discharge Monitoring Report
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
EPA/ORIA	US Environmental Protection Agency/Office of Radiation and Indoor Air
ER	Environmental Remediation
ETEC	Energy Technology Engineering Center
ETS	Extraction and Treatment Center
FAL	Field Action Level

FFCA	Federal Facilities Compliance Act
FONSI	Finding of No Significant Impact
FSDF	Former Sodium Disposal Facility
GAC	Granular Activated Carbon
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
LiF	Lithium Fluoride
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
MDL	Method Detection Limit
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
ORNL	Oak Ridge National Laboratory
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
S&M	Surveillance and Maintenance
SARA	Superfund Amendments and Reauthorization Act
SCTI	Sodium Component Test Installation
SHEA	Safety, Health & Environmental Affairs
SIPs	State Implementation Plans
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
STP	Sewage Treatment Plant or Site Treatment Plan
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
TCE	Trichloroethylene
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
TRU	Transuranic
TSA	Technical Support and Administration
UAW	United Auto Workers
UCLA	University of California at Los Angeles
UST	Underground Storage Tank
VCAPCD	Ventura County Air Pollution Control District
WVN	Water Vapor Nitrogen

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Office of Scientific and
Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Mary Gross
U.S. Department of Energy
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Oakland, CA 94612

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U.S. Department of Energy
Oakland Operations Office
1301 Clay Street, Suite 700-N
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Environmental Measurements Lab
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U.S. Department of Energy, EH-412
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Steve Baker
County of Ventura
Fire Protection District
Hazardous Materials Section
165 Durley Ave.
Camarillo, CA 93010

County of Ventura
Resource Management Agency
Ventura, CA 93009
Ventura County Board of Supervisors
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Ventura, CA 93009

John Beach
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, CA 94105

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U.S. Environmental Protection Agency
Region 9
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San Francisco, CA 94105

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Region 9
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Gregg Dempsey
Center for Environmental Restoration,
Monitoring and Emergency Response
U.S. Environmental Protection Agency
944 E. Harmon Street
Post Office Box 98517
Las Vegas, NV 89193

Ed Bailey
California State Department of Health
Services
Radiologic Health Branch
601 North 7th Street
Sacramento, CA 94234-7320

Robert Greger
California State Department of Health Services
Radiologic Health Branch
601 North 7th Street
Sacramento, CA 94234-7320

Paul Baldenweg
California State Department of Health Services
Radiological Health Branch
10605 Balboa Blvd., # 315
Granada Hills, CA 91344

Paula Batarse
California Environmental Protection Agency
Department of Toxic Substances Control
Region 1
Facility Permitting Branch
10151 Croydon Way, Suite 3
Sacramento, CA 95827-2106

Peter Raftery
California Regional Water Quality Control Board
Los Angeles Region
320 West 4th St, Suite 200
Los Angeles, CA 90013

Los Angeles County Health Department
Occupational Health and Radiation Management
Los Angeles, CA 90007

U.S. Nuclear Regulatory Commission
Office for Analysis and Evaluation of Operational Data
Washington, DC 20555

Richard Turtil
Low Level Waste & Decommissioning
Division of Waste Management
Office of Nuclear Material Safety & Safeguards
U.S. Nuclear Regulatory Commission
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Paul Fox
American Nuclear Insurers
Town Center, Suite 3005
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300 E. Esplanade Drive, No. 1800
Oxnard, CA 93030-1262

Dan Hirsch
Committee to Bridge the Gap
1637 Butler Street
Los Angeles. CA 90027

Sheldon Plotkin
3318 Culbert Avenue
Los Angeles, CA 90066

Barbara Johnson
6714 Clear Spring Road
Simi Valley, CA 93063

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18350 Los Alimos Street
Northridge, CA 91326

Mountains Recreation & Conservation Authority
Attn: Rorie Skei
5750 Ramirez Canyon Road
Malibu, CA 90265
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Brandeis-Bardin Institute
1101 Pepper Tree Lane
Simi Valley, CA 93064

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United States Senate
Hart Senate Office Building, Suite 112
Washington, DC 20510

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Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

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State Capital, Room 4032
Sacramento, CA 95814

Wayne Nastri
Regional Administrator
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Fransisco, CA 94105-3901

Jeff Scott
Director, Waste Management Division
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Fransisco, CA 94105-3901

Burt Cooper
Chief, Energy Section
Federal Facilities Assessment Branch
Agency for Toxic Substances and Disease Registry
Executive Park, Building 33
1600 Clifton Road NE, E-56
Atlanta, GA 30333

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Site Environmental Report Reader Survey--2001

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.

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