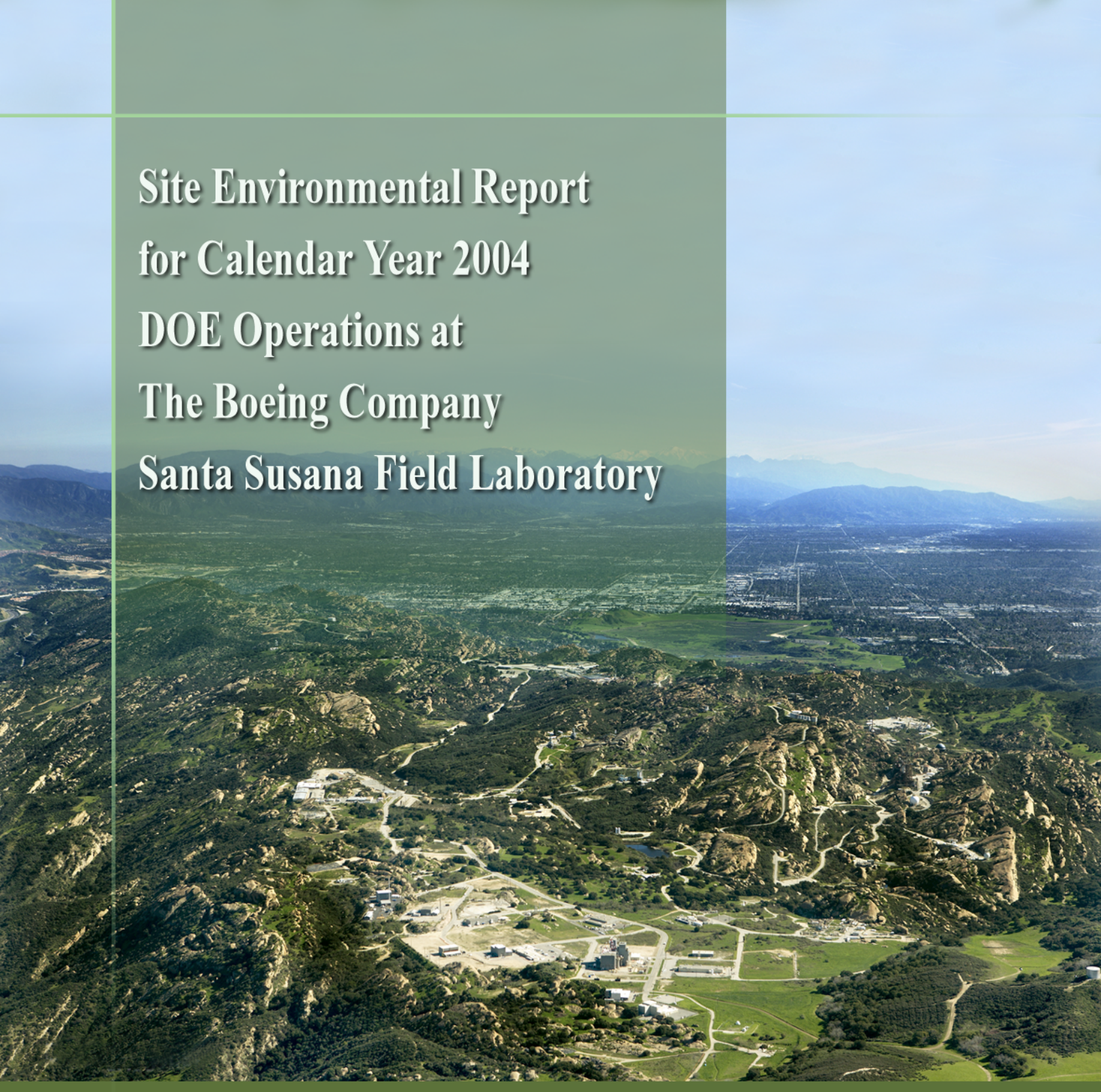
Site Environmental Report for Calendar Year 2004 DOE Operations at The Boeing Company Santa Susana Field Laboratory



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RD05-176

Site Environmental Report for Calendar Year 2004 DOE Operations at The Boeing Company Santa Susana Field Laboratory

Prepared by the Staff of

The Boeing Company,
Santa Susana Field Laboratory

September 2005

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CERTIFICATE OF ACCURACY

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

Majelle E. Lee
Program Manager
DOE Site Closure
The Boeing Company
Santa Susana Field Laboratory

September 20, 2005

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Department of Energy
Washington, DC 20585

SEP 21 2005

Distribution

SUBJECT: 2004 Site Environmental Report for the Energy Technology Engineering Center (ETEC)

Dear Sir or Madam:

The Boeing Company has prepared the subject report for the U.S. Department of Energy (DOE). It is a comprehensive summary of the Department's environmental protection activities at ETEC in Canoga Park, California for Calendar Year 2004. Site Environmental reports are prepared annually for all DOE sites with significant environmental activities and distributed to external regulatory agencies, interested organizations, and individuals.

To the best of my knowledge, this report accurately summarizes the results of the 2004 Environmental Monitoring and Restoration Program at ETEC for DOE. This statement is based on reviews conducted by the Oakland Projects 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:

U.S. Department of Energy
Oakland Projects Office
1301 Clay St.
P.O. Box 54
Oakland, CA 94612

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

Sincerely,

Richard L. Dailey
Federal Projects Director
Oakland Projects Office

Enclosure

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ACKNOWLEDGMENT

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

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- Administrative assistance was provided by Janice Edstrom.
- The staff of the Boeing Creative Services group at provided publication assistance.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. EXECUTIVE SUMMARY

This Annual Site Environmental Report (ASER) for 2004 describes the environmental conditions related to work performed for the Department of Energy (DOE) at Area IV of Boeing's Santa Susana Field Laboratory (SSFL). In the past, the Energy Technology Engineering Center (ETEC), a government-owned, company-operated test facility, was located in Area IV. The operations in Area IV included development, fabrication, and disassembly of nuclear reactors, reactor fuel, and other radioactive materials. Other activities in the area involved the operation of large-scale liquid metal facilities that were used for testing non-nuclear liquid metal fast breeder components. All nuclear work was terminated in 1988; all subsequent radiological work has been directed toward decontamination and decommissioning (D&D) of the former nuclear facilities and their associated sites. Closure of the liquid metal test facilities began in 1996.

Results of the radiological monitoring program for the calendar year 2004 continue to indicate that there are no significant releases of radioactive material from Area IV of SSFL. All potential exposure pathways are sampled and/or monitored, including air, soil, surface water, groundwater, direct radiation, transfer of property (land, structures, waste), and recycling.

All radioactive wastes are processed for disposal at DOE disposal sites and/or other licensed sites approved by DOE for radioactive waste disposal. No liquid radioactive wastes were released into the environment in 2004.

Calculated radiation doses to the public due to airborne releases and direct radiation are virtually zero when compared to the applicable regulatory limits as well as the naturally existing background levels. These theoretically calculated doses are too small to measure, and they are calculated to provide upper-limit estimates of possible doses to the public. The radiation dose to a member of the public (maximally exposed individual) due to direct radiation from SSFL is indistinguishable from background, and the maximum dose due to airborne releases from SSFL is estimated to be 2.5×10^{-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.

Sixty-five water samples from 34 groundwater wells in Area IV were sampled and analyzed for radiological contaminants during 2004. Only naturally occurring radioactivity was found in groundwater, except for tritium reported in several wells. Tritium activity exceeded the Federal and State drinking water standards of 20,000 picocuries per liter (pCi/L) in groundwater samples collected from two of the seven wells that showed detectable tritium activity. Tritium activity ranged up to 86,600 pCi/L in RD-88 and 83,300 pCi/L in RD-90. Further investigation of the source and extent of tritium in groundwater is planned during 2005. The groundwater underneath the SSFL Facility is not used for drinking water purposes.

Currently, there are forty-four 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 trichloroethene (TCE) was detected in these areas, no exposure to the

public has occurred because no exposure pathways exist. Remediation of these contaminated areas continued in 2004.

During 2004, five Area IV regulatory agency inspections, audits, and visits were conducted. These inspections and visits were carried out by the California Department of Toxic Substances Control (DTSC), the California Department of Health Services Radiologic Health Branch (DHS/RHB), Regional Water Quality Control Board (RWQCB), the Ventura County Air Pollution Control District (VCAPCD), and the Ventura County Public Works.

In summary, this Annual Site Environmental Report provides information to show that there are no indications of any potential impact on public health and safety due to the DOE-sponsored operations conducted at Area IV of SSFL. The report summarizes the environmental and effluent monitoring results for the responsible oversight regulatory agencies. Due to the fact that the site is approaching final closure and radiological related work is winding down, DOE is planning to scale back the radiological monitoring at the site in calendar year 2005.

2. INTRODUCTION

This annual report describes the environmental monitoring programs related to the Department of Energy's (DOE) activities at the Santa Susana Field Laboratory (SSFL) facility located in Ventura County, California during 2004. Part of the SSFL facility, known as Area IV, had been used for DOE's activities since the 1950s. A broad range of energy related research and development (R&D) projects, including nuclear technologies projects, was conducted at the site. All the nuclear R&D operations in Area IV ceased in 1988. Current efforts are directed toward decontamination and decommissioning (D&D) of the former nuclear facilities and closure of facilities used for liquid metal research.

As required by DOE Order 231.1 "Environmental and Health Reporting," this report is used internally to DOE as well as externally to the public as a means to communicate the environmental monitoring results and the state of environmental conditions related to DOE activities at SSFL. The report summarizes:

- Environmental management performance for DOE activities (e.g., environmental monitoring of effluents and estimated radiological doses to the public from releases of radioactive materials)
- Environmental occurrences and responses reported during the calendar year
- Compliance with environmental standards and requirements
- Significant programs and efforts related to environmental management.

2.1 SITE LOCATION AND SETTING

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). The location of the SSFL site in relation to nearby communities is shown in Figure 2-1. No significant agricultural land use exists within 30 km (19 miles) of the SSFL site. Undeveloped land surrounds most of the SSFL site.

The site consists of four administrative areas and undeveloped land. Figure 2-2 illustrates the arrangement of the site. Area IV has an area of about 290 acres. Boeing and DOE-operated facilities (Figures 2-3 and 2-4) share the Area IV portion of this site. While the land immediately surrounding Area IV is undeveloped, suburban residential areas are at greater distances. 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. 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.

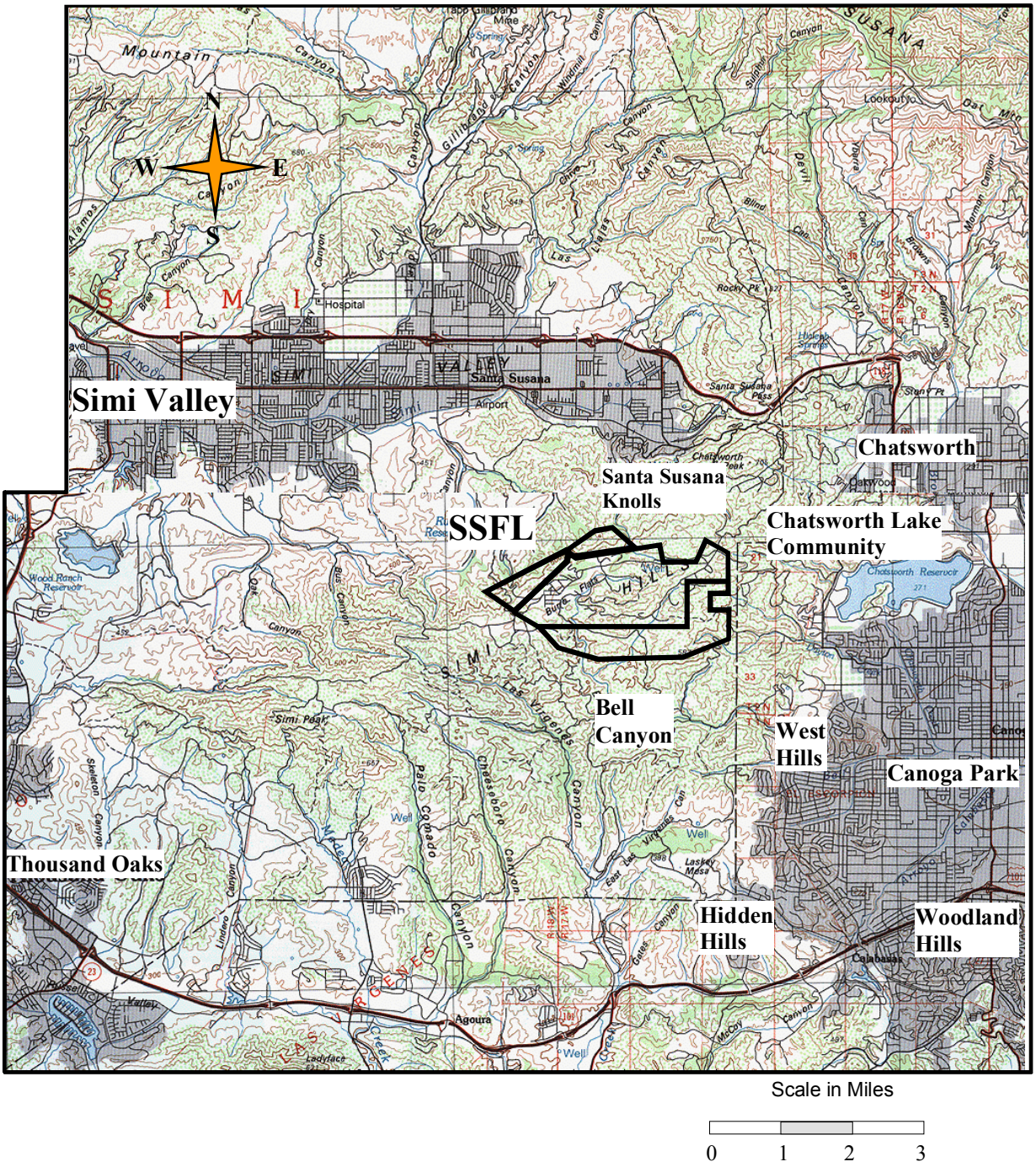

Figure 2-1. Map Showing Location of SSFL

Subdivisions			
Owner	**Jurisdiction**	**Acres**	**Subtotals**
Boeing	Boeing--Area IV	289.9	
	Boeing	784.8	
	Boeing (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

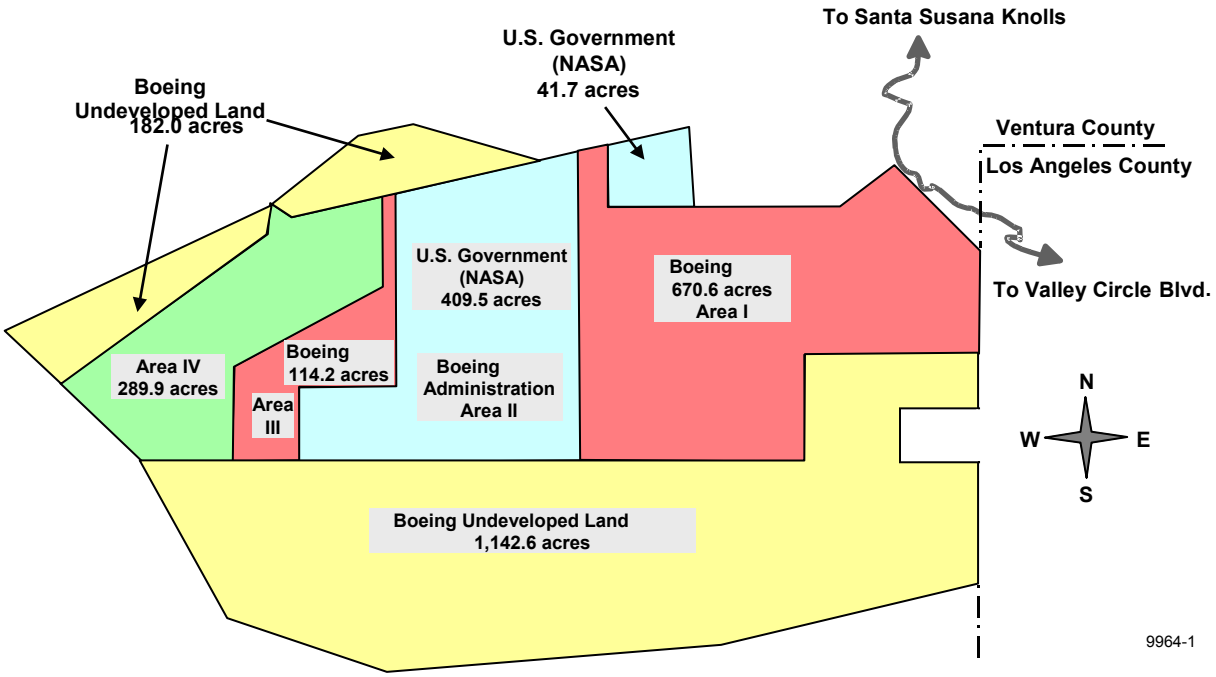

Figure 2-2. Santa Susana Field Laboratory Site Arrangement

2.2 OPERATIONAL HISTORY

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). Since 1956, various R&D projects had been conducted in Area IV, including small tests and demonstrations of reactors and critical assemblies, fabrication of reactor fuel elements, and disassemble 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 document "Nuclear Operations at Rockwell's Santa Susana Field Laboratory - A Factual Perspective" (Oldenkamp, 1991).

All the nuclear R&D operations in Area IV ceased in 1988. The only work related to the nuclear operations since 1988 (and during 2004) was the ongoing cleanup and decontamination of the remaining inactive radiological facilities and the off-site disposal of radioactive waste. In 1998, DOE awarded Boeing a contract for the closure of all DOE facilities in Area IV by 2006. Boeing performs the environmental remediation and restoration activities at SSFL for the DOE.

2.3 FACILITY DESCRIPTIONS

There were 27 radiological facilities that operated in Area IV (See Figure 2-4). As of the end of 2004, twenty of them have been released for unrestricted use, and four have been declared suitable for unrestricted release by DOE. Six radiological facilities have been deemed free of contamination but are yet to be demolished; they are 4009, 4100, 4019, 4055, 4011 and 4029. Building 4059 was demolished in 2004 and is pending release for unrestricted use. Two facilities, Building 4024 and the RMHF are undergoing remediation.

In addition to radiological facilities, two sodium and related liquid metal test facilities were constructed at SSFL 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. The following three radiological facilities and two sodium facilities require remediation of contamination as part of the final closure.

2.3.1 Radiological Facilities

Radioactive Materials Handling Facility (RMHF)

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

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

In 2004, atmospheric effluents were released through a stack as a result of waste handling operations at the RMHF. The effluents were filtered and monitored before release into the atmosphere to ensure compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) requirements. No radioactive liquid effluents were released from the facility.

Preliminary remedial operations of Building 4022 were initiated in 2004.

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

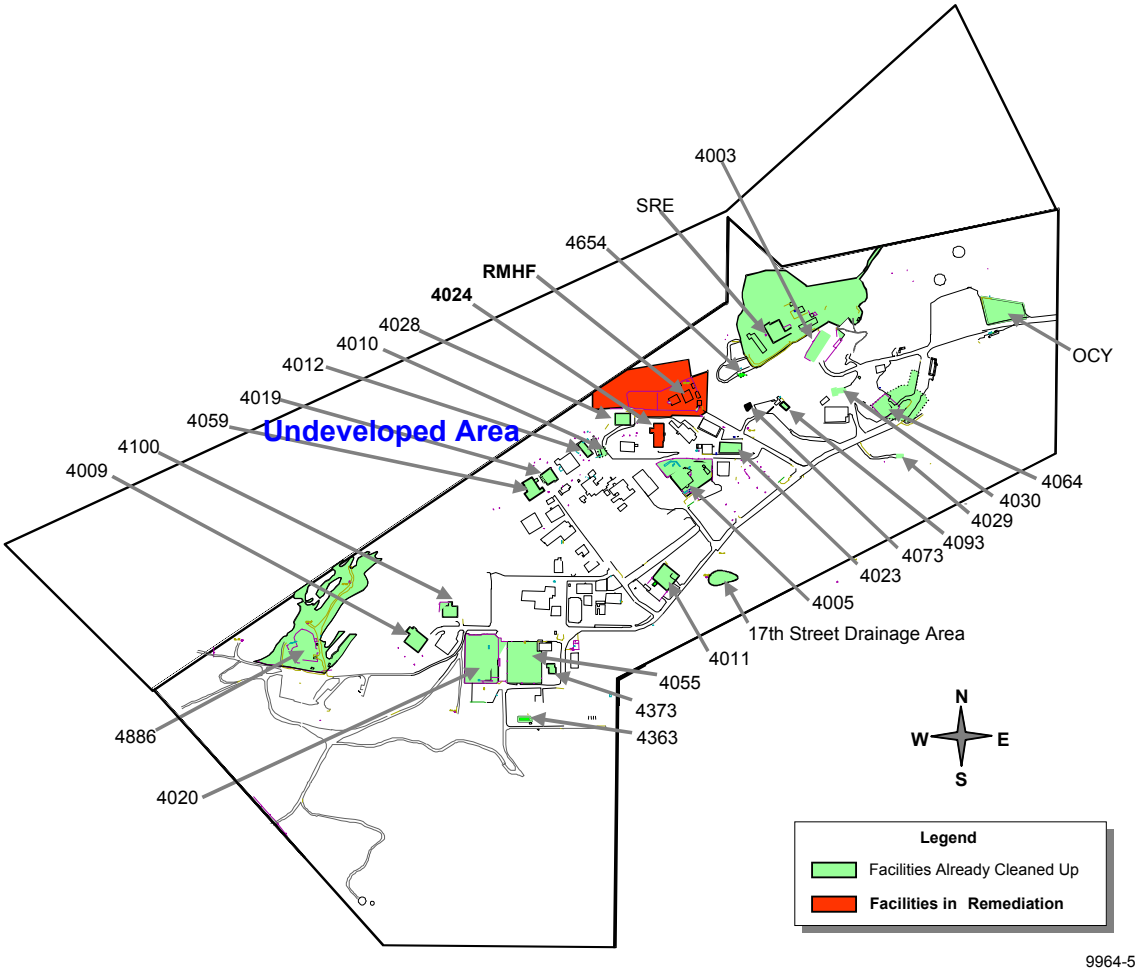

Figure 2-4. Map of Prior and Current Radiological Facilities in Area IV

Building 4059

Operations at Building 4059 during the early 1990s consisted of removal of activated steel and concrete as part of the D&D of the former Systems for Nuclear Auxiliary Power (SNAP) reactor ground test facility. Activation products consist primarily of Fe-55, Eu-152, Co-60, and small amounts of H-3. The demolition of the entire building was completed in 2004, and building debris was shipped to either the Nevada Test Site (radioactive waste) or Kettleman Hills (non-radioactive waste). A MARSSIM survey was completed in the excavation in 2004. The backfilled site is awaiting a final status MARSSIM survey.

Building 4024

Building 4024 houses two shielded vaults in its basement. During the 1960s, this building housed two experimental reactor systems. Following termination of the projects, all equipment and fuel were removed from the facility. The shielding concrete in the vaults currently contains low levels of activation products including cobalt-60 and europium-152/154. This radioactivity is

confined, and the radiation levels inside the vaults are a fraction of a millirem/hour. Preliminary remedial operations were initiated in the building during 2004. The facility is scheduled for final decommissioning and demolition in the 2005-2006 timeframe.

2.3.2 Former Sodium Facilities

Sodium Pump Test Facility (SPTF)

During 2004, a Water Vapor Nitrogen (WVN) process was used to clean sodium contaminated components in the facility. The WVN process safely converts any residual sodium metal into sodium hydroxide and hydrogen gas. The hydrogen gas is safely vented through a scrubber system to the atmosphere. The high quality sodium hydroxide produced is collected and recycled. After being cleaned, the steel components are recycled as well. Large components, such as tanks and large diameter piping systems, are cleaned in place. A special process vessel was constructed to clean smaller components in batches.

A total of 9,670 pounds of sodium metal was converted into sodium hydroxide in 2004. Most of this was from the cleaning of two very large storage tanks, containing 8,000 pounds of residual sodium metal. The rest came from 28 batches of smaller sodium contaminated components that were cleaned in the process vessel. These components contained a total of 1,670 pounds of sodium metal and produced 23,500 pounds of recycleable steel at the end of the process. All of the sodium hydroxide produced in 2004 was recycled. The clean steel will be recycled when the facility is demolished.

Former Sodium Disposal Facility (FSDF)

In 2004, on-going activities at the site included continuing maintenance of the area, rainwater management, and support of closure activities.

2.4 ASER CONTENTS

This ASER provides the following information related to ensuring protection of human health and the environment during implementation of DOE's closure mission at Area IV:

- Section 3 "Compliance Summary", identifies and provides status for applicable permits and other regulatory requirements for DOE's closure mission.
- Section 4 "Environmental Program Information" summarizes the DOE and Boeing programs that are in place to institutionalize the identification, monitoring and response to known or potential releases to the environment that may pose a threat to human health and the environment.
- Section 5 "Environmental Radiological Monitoring" summarizes the data collection activities and associated results for radiological contaminants.
- Section 6 "Environmental Non-Radiological Monitoring" summarizes the data collection activities and associated result for non-radiological contaminants.
- Section 7 "Environmental Monitoring Program Quality Control" summarizes the quality assurance/quality control elements incorporated into the Boeing data analysis program.

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3. COMPLIANCE SUMMARY

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

3.1 COMPLIANCE STATUS

Several agencies performed routine inspections of DOE Environmental Restoration activities during 2004. The inspected activities were found to be compliant with the applicable rules and regulations. A list of inspections, audits, and site visits by the various agencies overseeing the SSFL sites is given in Table 3-1.

Table 3-1. 2004 Agency Inspections/Visits Related to DOE Environmental Remediation

Date (2004)	Agency	Subject Area	Results
January	State of CA, DHS	Environmental TLD exchange	Compliant
January	State of CA, DHS	Radioactive Materials License inspection	Compliant
January	DTSC	Comprehensive Compliance Inspection	Compliant
February	RWQCB	Routine semi-annual inspection	Compliant
February	State of CA, DHS	Split samples of SSFL groundwater	Compliant
March	RWQCB	Storm Water samples at SSFL	Compliant
April	State of CA, DHS	Environmental TLD exchange	Compliant
May	State of CA, DHS	Split samples of SSFL groundwater	Compliant
May	VCAPCD	Annual inspection of Permit to Operate Nos. 00271	Compliant
June	State of CA, DHS	Environmental TLD exchange	Compliant
August	State of CA, DHS	Split samples of SSFL groundwater	Compliant
August	State of CA, DHS	Split samples of SSFL groundwater for newly constructed wells	Compliant
August	County of Ventura Public Works	Grading inspection of Burro Flats, Area IV, Building 203 slope (north) of Area II, Building 359	Compliant
October	State of CA, DHS	Environmental TLD exchange	Compliant
October	State of CA, DHS	Confirmation radiation survey of Phase A, B4059 excavation	Compliant
November	State of CA, DHS	Split samples of SSFL groundwater	Compliant
November	County of Ventura Public Works	Inspect the beginning of the backfilling of B4059 excavation pit per grading permit #9698	Compliant
December	County of Ventura Public Works	Sign off of demo permit for the completion of 4626 concrete slab	Compliant

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, as illustrated in Figure 3-1, are monitored. These include 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 2.5×10^{-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).

3.1.1.2 Groundwater

There are 44 groundwater monitoring wells in and around Area IV. Groundwater is sampled and analyzed periodically for non-naturally occurring radionuclides. In 2004, seven new wells were constructed to investigate tritium in groundwater at the former ETEC site. Relatively high tritium concentrations were observed at RD-87, -88, and -90, which are located down gradient from the former Building 4010 site, a possible source for man-made tritium production. The highest level of tritium observed in these new wells was 86,600 pCi/L. Further wells are planned to help identify the source and extent of tritium migration. None of the groundwater in this area is used for human consumption.

Tritium was also detected in a few existing groundwater monitoring wells in 2004. The positive detections of tritium had maximum concentrations of 259, 1,120, 2,440, and 344 pCi/L at wells RD-25, RD-28, RD-34A, and RD-63, respectively. All these values were in line with historical observations and substantially below the EPA and California drinking water limit of 20,000 pCi/L. No other man-made radionuclides were detected in groundwater. The groundwater underneath the SSFL Facility is not used for drinking water purposes.

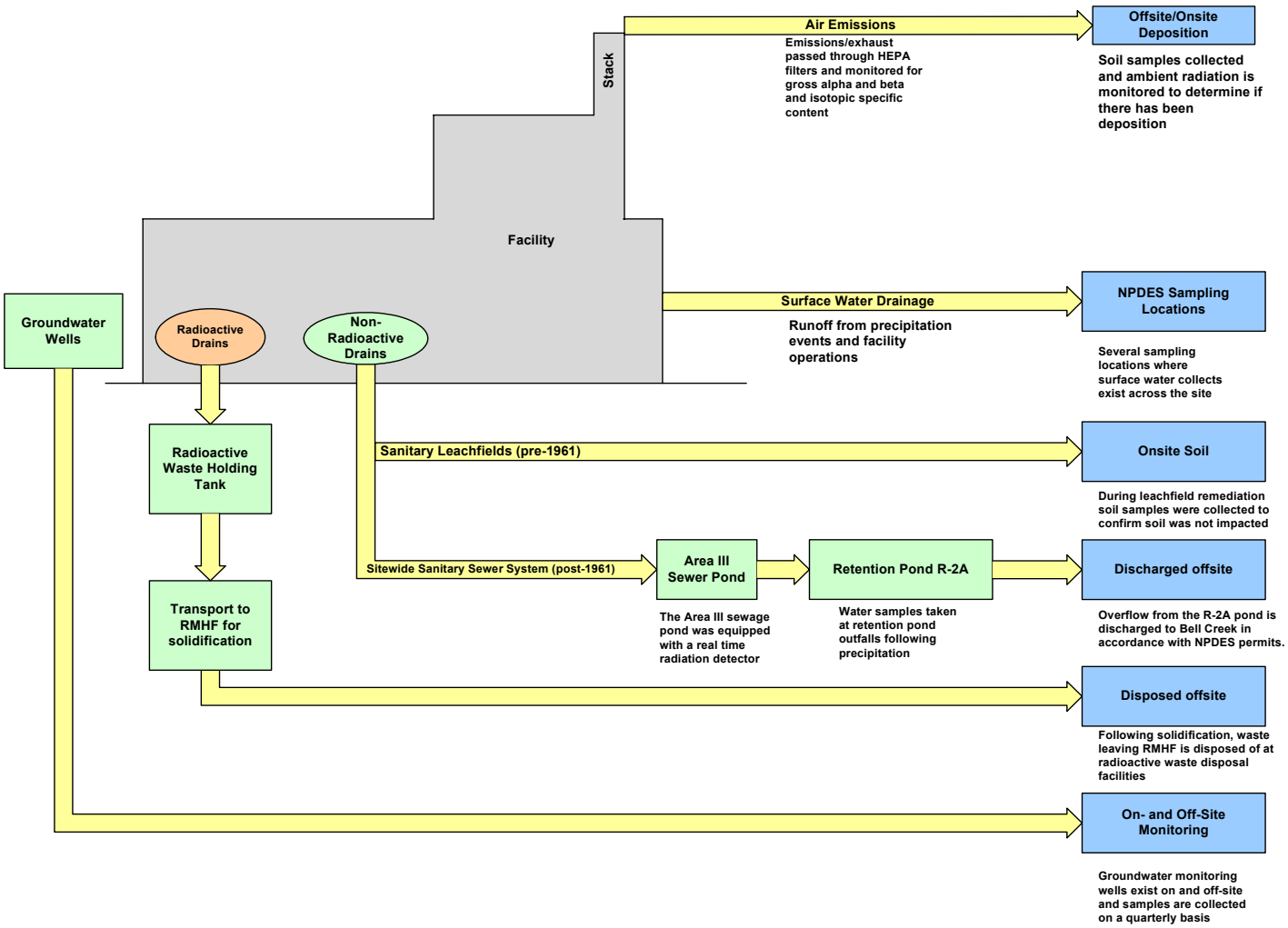

Figure 3-1. Conceptual Model of Potential Pathways

3.1.1.3 Surface Water

Surface water from two National Pollutant Discharge Elimination System (NPDES) permitted discharge points and five storm water only basins are monitored routinely. The NPDES permit allows the discharge of reclaimed waste water, storm water runoff, and industrial waste water from retention ponds into Bell Creek, a tributary to the Los Angeles River. The permit also regulates the discharge of storm water runoff from the northwest slope (Area IV) locations into the Arroyo Simi, a tributary of Calleguas Creek. Discharge along the northwest slope (RMHF: Outfall 003, SRE: Outfall 004, FSDF #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, strontium-90, and total combined radium-226 and radium-228. In 2004, twelve water samples were taken for the NPDES permit compliance, no samples exceeded drinking water supplier limits for radioactivity.

3.1.1.4 Direct Radiation

The external exposure rate at Boeing SSFL'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 19 mrem/year above local background. This is considerably below DOE's 100 mrem/year limit.

3.1.1.5 Protection of Biota

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

The terrestrial biota, i.e., vegetation and small wild animals, are abundant at SSFL. They are 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 2004, the RMHF continued to operate as an Interim Status (Part A) permitted facility. This facility is used primarily for the handling and packaging of radioactive waste. Interim status is required for the storage and treatment of the small quantities of mixed waste (waste containing both hazardous and radioactive constituents) resulting from D&D activities at ETEC. The final disposition of mixed waste is addressed under the DOE and DTSC-approved Site Treatment Plan, which is authorized by the Federal Facilities Compliance Act (FFCA).

3.1.2.1.2 Hazardous Waste Management Facility (HWMF)

The Hazardous Waste Management Facility (HWMF) includes an inactive storage facility (Bldg 4029) and an inactive treatment facility (Bldg 4133) that was utilized for reactive metal waste such as sodium. The facility is no longer in operation and is in the process for final closure.

3.1.2.1.3 Sodium Removal

During 2004, a Water Vapor Nitrogen (WVN) process was used to clean sodium contaminated components in the facility. The WVN process safely converts any residual sodium metal into sodium hydroxide and hydrogen gas. The hydrogen gas is safely vented through a scrubber system to the atmosphere, and the high quality sodium hydroxide produced is collected and recycled. In 2004, a total of 9,670 pounds of sodium metal was converted into sodium hydroxide, and all of the sodium hydroxide produced was recycled. The clean steel components will be recycled when the facility is demolished.

3.1.2.1.4 RCRA Facility Investigation

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

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

The current conditions report and a draft of the RFI Work Plan for the Area IV SWMUs were submitted to the DTSC in October 1993. In November 1996, DTSC approved a revised

work plan addendum. During 2000, an amendment to the 1996 RFI Work Plan was submitted to and approved by DTSC. This amendment added two DOE sites to the RCRA RFI program. Fieldwork in areas of unrestricted use began in November 1996 and is scheduled for completion in 2005.

During 2004, approximately 45 soil matrix samples and 1 surface water sample were collected. No soil vapor or near-surface groundwater samples were collected. The soil matrix samples include five soil leachate samples collected for the purpose of evaluating perchlorate concentrations in soil. Samples collected and analyses performed to date at DOE locations are summarized in Section 6, in Table 6-3. Data review and validation are ongoing and will be completed in 2005.

Preparation of draft RFI site reports was placed on hold in March 2004 due to continuing negotiations with DTSC regarding characterization and risk assessment requirements. It is expected that the additional requirements will be resolved and RFI reporting will resume in 2005. The comprehensive RFI Program Report was completed for DTSC submittal in July 2004.

3.1.2.1.5 Groundwater

Characterization of the groundwater at the site continues. TCE continued to be detected in three areas of Area IV during 2004. 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 4 m^3) of RCRA mixed wastes in accordance with FFCA-mandated Site Treatment Plan (STP) approved in October 1995. All mixed wastes that require extended on-site storage are managed within the framework of the STP. Characterization, treatment, and disposal plans for each of several different waste streams are defined in the STP with enforceable milestones. The current inventory consists only of mixed low-level wastes (MLLW). Management of the mixed wastes has been in full compliance with the STP. Regular updates to reflect changes in inventory or status of mixed wastes and certifications of milestone completion are submitted to DTSC in accordance with the STP.

In 2004, Boeing completed a major milestone with the shipment of the entire inventory in storage of a RCRA mixed waste stream consisting of evaporator residues. Approximately 11 m^3 of evaporator wastes were shipped to Perma-Fix Environmental Services in Tennessee for treatment to meet Land Disposal Restriction (LDR) standards. After successful treatment, the LDR-compliant Class A portion of treated waste was disposed of at Envirocare of Utah and Class B portion of treated waste at Chem Nuclear Services (Barnwell) in December 2004.

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 17th and 18th, 2000. The draft Environmental Assessment document was released in January 2002. Public meetings were held on January 24th, and the public comment period was extended to April 25th, 2002. The DOE issued a Finding Of No Significant Impact and the final EA report on March 31, 2003.

3.1.2.4 Clean Air Act

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

Area IV of the SSFL is regulated by the Ventura County Air Pollution Control District (VCAPCD) and must comply with all applicable rules, regulations, and permit conditions as set forth in Permit to Operate No.00271. In 2004, the VCAPCD performed an inspection on May 19, 2004. No violations or compliance issues were identified.

3.1.2.5 Clean Water Act

The Clean Water Act (CWA) is the primary authority for water pollution control programs, including the National Pollutant Discharge Elimination System (NPDES) permit program. The

NPDES program regulates point source discharges of surface water and the discharge of storm water runoff associated with industrial activities. Basin Plan water quality objectives are 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 was revised on July 1, 2004 and became effective August 20th 2004. The 2004 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 Boeing 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 November 18, 2003.

3.1.3 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	1/1/05 through 12/31/05
Treatment Storage (EPA)		
CAD000629972 (93-3-TS-002)	Hazardous Waste Management Facility (T133 and T029)	Inactive. Awaiting regulatory approval on modified closure plan.
CA3890090001	Radioactive Materials Handling Facility (RMHF)	Part A interim status Application for Part B submitted May 1999.
NPDES (CRWQCB)		
CA0001309	Santa Susana Field Laboratory	Effective on 8/20/2004
State of California		
Radioactive Materials License (0015-19*)	All Boeing Rocketdyne facilities	Amendment Issued 104 3/2/00 105 1/31/01 106 10/21/03

* DHS changed numbering system; the license stays the same as before.
* Underground Storage Tanks in Area IV are exempt from permitting.

[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 Building 4059

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

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

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

The remaining activated concrete in the basement of 4059 were excavated in Phase II during 2004 and shipped to the Nevada Test Site as radioactive waste. After the excavation was completed, a final status survey was performed in accordance with the MARSSIM protocol. In addition to the survey performed by Boeing, ORISE and DHS also conducted their independent verification survey. The soil sampling results are provided in Section 5.2.4.

The excavation at 4059 has been backfilled with clean soil. Another MARSSIM final status survey is planned for 2005.

3.2.1.2 Building 4024

Concrete core samples were taken from Building 4024 cells in 2003 to determine the remaining residual activation within the shielding concrete. The highest exposure rate at contact in the cells was 100 μr/hr. Activation product levels were relatively low. Cobalt-60 ranged from no detectable activity (NDA) to 9.3 pCi/g, and europium-152 ranged from NDA to 105 pCi/g. No europium-154, tritium, iron-55 or nickel-63 was detected in any of the samples analyzed. This investigation was used to plan the future demolition of 4024. A survey report was developed in 2004 to document these findings.

During 2004, a survey procedure was prepared for releasing the upper portion of the building. The upper portion of the building is free from contamination. Once verified and released by DHS, debris from the upper portion will be disposed at a Class 1 landfill. Survey and release of the upper portion of the building is scheduled for 2005[2].

[2] The survey and release of the upper portion of 4024 has been completed by the time of this publication.

3.2.1.3 RMHF

Operations at RMHF involve radioactive waste packaging, storage, and shipment for disposal. Waste processed during 2004 included radioactive waste from 4059 demolition, the filters and draining system sediments in the RMHF radiological water system, the water in the 8,000-gallon tank, and other LLW generated from the D&D activities at the RMHF.

Decontamination work in Building 4021 and 4022 was continued during 2004. In Building 4021, the steel floor liner was removed from the decontamination room, and the equipment, including an electric fork lift and old drum crusher, was removed, disassembled, and packaged for disposal.

In Building 4022, All vault hardware and storage racks were cleaned with a HEPA vacuum, removed, size reduced and packaged. Two large steel pans were pulled from vault 2 along with a few hundred cubic feet of sand. Vault surfaces were cleaned with HEPA vacuum. Smear surveys on the vault floor and wall were completed.

3.2.2 Environmental Assessment (EA)

The final EA was issued March 31, 2003, and a FONSI (finding of no significant impact) was issued the same day (DOE, 2003b). Based on the analysis in the EA, DOE decided to implement its preferred alternative (remediation of radiological facilities and surrounding soils to 15 mrem/y plus ALARA). DOE has determined that implementation of this alternative will be fully protective of public health and the environment. In 2004, this decision was challenged by the City of Los Angeles, the Natural Resources Defense Council, and Committee to Bridge the Gap.

3.2.3 Historical Site Assessment

A historical site assessment (HSA) has been developed to summarize the operational history of Area IV from a radiological perspective. Based on this history, portions of Area IV have been identified as *radiologically impacted* or *not radiologically impacted*, consistent with applicable California and Federal regulations, and based on guidance from the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).

The DOE and Boeing evaluated 272 numbered structures (collectively referred to as “sites”) and any other areas of radiological contamination that existed in Area IV since its establishment in 1953. This was to ensure all areas where any types of operations were performed in Area IV were evaluated for radiological impact.

To evaluate each site, a site summary was prepared operational records, incident reports, site maps, decommissioning reports and personnel interviews. The site summaries include information about the site’s historical and current use and any information about the management and use of regulated radiological materials at the site.

Based on the information presented in the site summaries, all sites were classified either as radiologically impacted or non-impacted. Sites that had any indication of management or use of regulated radiological material were classified as impacted. All impacted sites were further evaluated to determine if the site had been released for unrestricted use by the appropriate regulatory agency. Sites that had been released went through a decision process to determine if additional soil surveys were necessary.

Impacted sites which have not been released were classified consistent with MARSSIM guidelines based on the degree of radiological impact. The three classifications of radiological impact were defined as:

- Class I sites potentially have or had radioactive contamination above the Derived Concentration Guideline Levels (DCGLs), i.e., release criterion.

- Class II sites potentially have or had radioactive contamination below DCGLs, but above 20% of the DCGLs.

- Class III sites potentially have or had radioactive contamination above background but below 20% of DCGLs.

As Area IV continues to undergo cleanup and remediation, the DOE is using the Area IV HSA to ensure all the sites in Area IV have been reviewed for potential radiological impacts and all impacted areas have been either:

- Surveyed and released and require no further action, or

- Identified as impacted and have not been released.

- These sites require further action, per their MARSSIM classification.

Evaluations performed for the 272 sites in Area IV determined a total of 95 sites were distinguished as impacted or potentially impacted by radiological materials. Of the 95 impacted or potentially impacted sites, 68 have been previously released by the appropriate agency and require no further action, 27 sites require additional actions.

The review of historical activities involving radioactive materials within the Santa Susana Field Laboratory Area IV is documented in the HSA to assist in determining what actions are necessary to allow for the future unrestricted use of the site. This document represents an important step toward ensuring the radiological cleanup of Area IV is completed using the accepted regulatory processes.

The complete HSA document can be found at http://apps.em.doe.gov/etec/hsa.html.

3.2.4 Energy Employees Occupational Compensation Program Act

In July 2001, the Department of Labor (DOL) and DOE initiated a program to compensate DOE contract workers who had become ill because of exposure to radiation, beryllium, or silica as a result of performing work as contractors to the Atomic Energy Commission and/or the Department of Energy. As a past and present DOE contractor, Boeing is cooperating with various agencies of the federal government who are implementing this program. Employment verification and exposure records are being provided to DOE and the Department of Health and Human Services upon request.

As of December 2004, Boeing had provided available exposure records to the National Institute for Occupational Safety and Health (NIOSH) for 101 of 101 claims. As of May 2005, Boeing had provided available exposure records to the National Institute for Occupational Safety and Health (NIOSH) for 103 of 103 claims.

DOE is also requesting exposure information for Part D claims (DAR), which the DOE is passing on to states' Workers' Compensation Boards. As of December 2004, Boeing had provided to DOE available exposure records for 7 of 7 DAR claims. As of May 2005, Boeing had provided to DOE available exposure records for 13 of 13 DAR claims.

3.2.5 Disposal and Recycling of Non-radiological Waste

In 2004, "decommissioned" waste from prior released radiological facilities was sent to the Kettleman Hills Class I hazardous waste disposal facility, in compliance with the Governor's Moratorium of 2002. In 2004, pending completion of the metals recycling Programmatic Environmental Impact Statement (PEIS), no metal from DOE radiological facilities was recycled.

3.2.6 Chatsworth Reservoir

In July 2004, Essentia Management Services performed soil and groundwater sampling for the L.A. Department of Water & Power, in the Chatsworth Dry Reservoir to the east of SFFL. Only background levels of naturally occurring radionuclides (potassium-40, thorium and uranium) were detected. No man-made fission products were detected.

4. ENVIRONMENTAL PROGRAM INFORMATION

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

4.1 ENVIRONMENTAL PROTECTION AND REMEDIATION

Oversight of environmental protection at Boeing 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 Boeing's policy to maintain facilities and conduct operations in accordance with all federal, state, and local requirements and contractual agreements. Boeing employees are responsible for implementing and complying with this policy." Responsibilities for environmental protection at Boeing SSFL fall under four sub-departments: Environmental Protection (EP), Environmental Remediation (ER), Radiation Safety (RS), and DOE Site Restoration. The responsibilities for each are listed below.

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

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

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

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

- Participating in rule and regulation development, including evaluating impacts on Boeing programs; coordinating with other Boeing 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 Boeing operations, including escorting and cooperating with regulatory officials interested in environmental matters and responding to requests for information referred to Communications.

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

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

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

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

- Remediation of historical chemically contaminated Boeing SSFL sites to achieve closure.

- Implementation of groundwater monitoring and treatment.

- Implementation of RCRA soil sampling and cleanup activities.

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

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

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

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

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

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

4.2 ENVIRONMENTAL MONITORING PROGRAM

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

The basic policy for control of radiological and chemical materials requires that adequate containment of such materials be provided through engineering controls, that facility effluent releases be controlled to federal and state standards, and that external radiation levels be reduced to as low as reasonably achievable (ALARA) through rigid operational controls. The

environmental monitoring program provides a measure of the effectiveness of these operational procedures and of the engineering safeguards incorporated into facility designs.

4.2.1 Radiological Monitoring

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

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

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

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

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

- Argonne National Laboratory (ANL)
- California Dept. of Health Services/Environmental Management Branch (DHS/EMB)
- California Department of Health Services/Radiologic Health Branch (DHS/RHB)
- Environmental Protection Agency/Office of Radiation and Indoor Air (EPA/ORIA)
- Essentia Management Services (for L.A. Dept. of Water & Power)
- Groundwater Resources Corporation (GRC), Later Haley & Aldrich.
- Joel Cehn, Consultant to the Brandies-Bardin Institute
- Foster Wheeler Environmental Corp. (for Runkle Ranch)
- Kleinfelder Inc. (for Ahmanson Ranch)

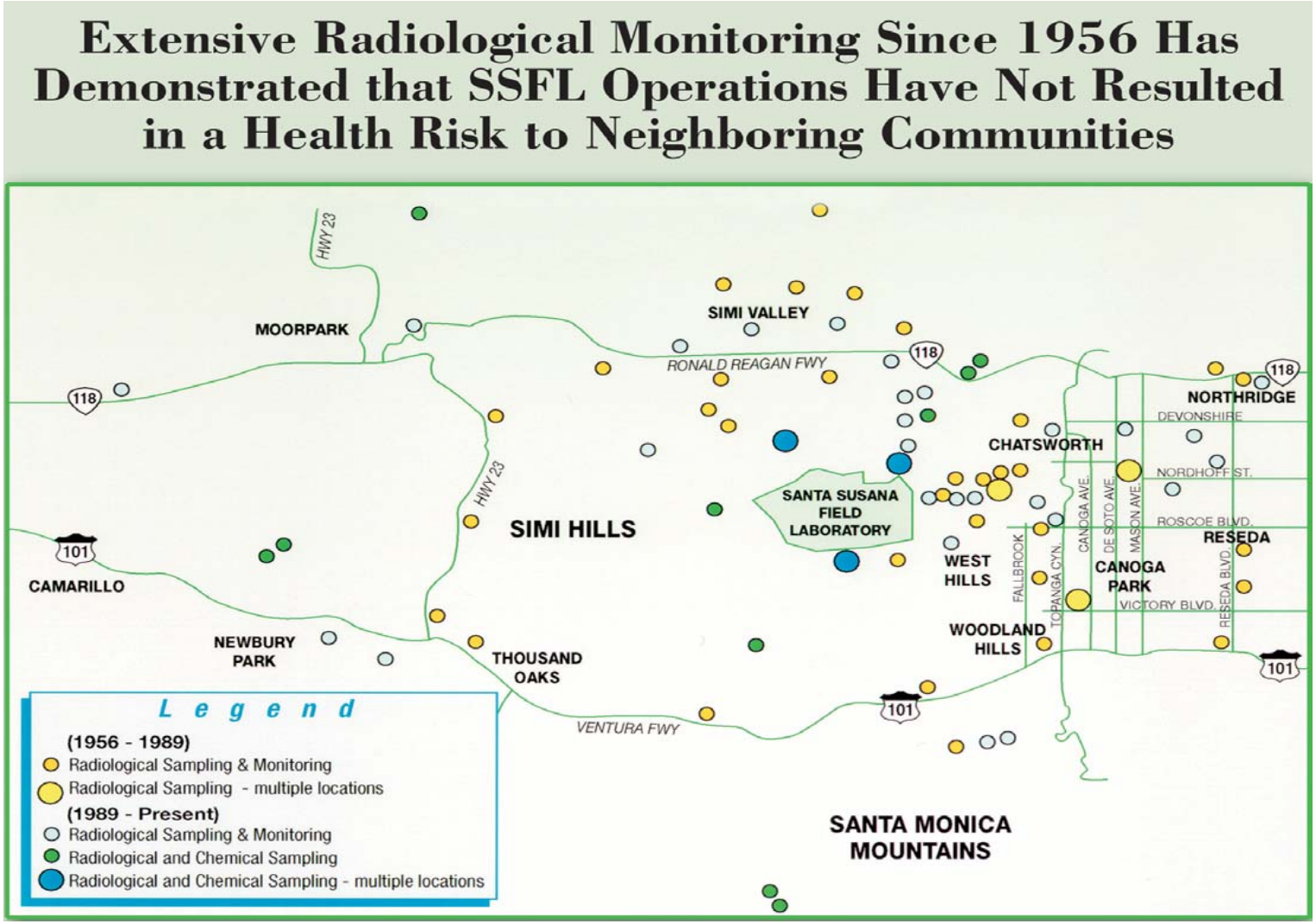

Figure 4-1. Radiological Sampling and Monitoring Locations

- Lawrence Livermore National Laboratory (LLNL)
- McLaren/Hart Environmental Engineering Corporation
- Miller Brooks Environmental Inc. (for Runkle Ranch)
- Oak Ridge Associated Universities (ORAU)
- Oak Ridge Institute of Science and Education (ORISE)
- Ogden Environmental and Energy Services
- QST Environmental Inc. (for Runkle Ranch)
- Regional Water Quality Control Board (RWQCB)
- Rocketdyne Propulsion & Power (or Atomics International)

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

The evidence from thousands of soil, vegetation, water and air samples taken from over 200 off-site locations over the last 49 years by NAA, Rocketdyne, and Boeing and 17 other agencies and organizations demonstrates that no radioactive contamination that could result in excess exposure or risk has been detected in the local community.

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)

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

4.2.2 Nonradiological Monitoring

Extensive monitoring programs for chemical contaminants in air, soil, surface water, and groundwater are in effect to assure that the existing environmental conditions do not pose a threat to the public welfare or the environment. Extensive soil sampling is performed under the Resource Conservation and Recovery Act Facility Investigation and other site-specific remedial programs. Groundwater beneath Area IV is extensively monitored for chemical contaminants. There are 44 DOE-sponsored Chatsworth Formation wells in and around Area IV. In addition, ten DOE-sponsored shallow wells are utilized to monitor near-surface groundwater conditions in Area IV. Groundwater analyses were conducted by Haley & Aldrich using a DTSC-approved sampling and analysis plan and EPA-approved analytical methods and laboratories. Equipment installed in an interim groundwater remediation program in Area IV continued to remove solvents from contaminated groundwater during 2004. Remediated water was returned to the surface water collection ponds.

All surface water discharges are monitored as specified in the National Pollutant Discharge Elimination System (NPDES) permit, which was renewed in August 2004. In addition, all sources of air 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 Boeing'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 Boeing website to promote environmental awareness among all employees.

4.3 INTEGRATED SAFETY MANAGEMENT SYSTEMS (ISMS)

The ETEC *Integrated Safety Management System (ISMS)* description document is the source of Boeing policies and procedures on safety. This document is based on DOE principles and objectives and prescribes a formal, organized process that ensures worker health and safety, and includes a built-in mechanism for self-assessment and continuous improvement. In addition to noting accomplishments and improvements, the Boeing Rocketdyne Annual Safety Report for FY 2003, submitted in 2004, reemphasized the policies and procedures that helped the organization comply with ISMS principles. The Annual Safety Report also contained metrics monitored by Safety Health and Environmental Affairs (SHEA) to assess improvement in the organization's safety practices.

During 2004, Boeing SSFL continued to work toward refining its implementation of ISMS principles. The self-assessment plan incorporates tools such as DOE and Boeing Safety Lessons Learned Reports, DOE ORPS (Occurrence Reporting and Processing System) Reports, and DOE Operating Experience Reports. Safety issues were emphasized with Boeing's subcontractors by having a SHEA representative present the safety requirements and information to each subcontractor in the initial meeting with the subcontractor prior to the start of each job. The ISMS subcontractor audits were performed periodically to ensure that safety requirements were being met while work was in progress.

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

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/HA) 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/HA) 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) 2004 (Essentia)	1984-Present (GRC/HA) 2004 (Essentia)	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/HA)	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) 1999 (Kleinfelder) 1999 (QST) 1999 (Foster Wheeler) 2003 (Miller Brooks)	1984-Present (GRC/HA) 2003 (DHS-RHB)	1999 (Kleinfelder)	None	1974-Present (Rocketdyne)

4.4 ENVIRONMENTAL TRAINING

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

The Human Resources 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 Boeing SSFL Training and Development department currently maintains a listing of approximately 1,475 courses available to Boeing SSFL personnel. Of these, approximately 270 relate to environment, health, and safety, with approximately 29 relating to environmental protection, 24 to radiation safety and remediation, and 217 to health and safety. Over 50 of these courses are available as computer-based training. 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. Additional off-site courses are also encouraged.

4.5 WASTE MINIMIZATION AND POLLUTION PREVENTION

4.5.1 Program Planning and Development

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

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

- Low-level radioactive waste (LLW), mixed, hazardous, and non-hazardous wastes from D&D operations.

- Oils from ongoing remediation activities.

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

4.5.2 Training and Awareness Programs

The ETEC Waste Minimization and Pollution Prevention Awareness Program includes (1) orientation programs and refreshers, (2) specialized training, and (3) incentive awards and recognition. Employees are reminded about pollution prevention and waste minimization awareness. Posters are placed in work areas to notify employees about environmental issues or practices. Memoranda are circulated about changes in waste management policy, Boeing 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.
- Use of 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 CY04, 2.82 metric tons of white paper and 1.56 metric tons of aluminum cans were recycled.
- Use of a compactor to reduce the volume of soft low-level radioactive waste from approximately 1,600 cubic feet to 600 cubic feet during CY04.
- Approximately 5,600 pounds of sodium was converted into 3,500 gallons of sodium hydroxide solution and recycled.

Approximately 335 metric tons of steel (non-stainless steel), 10.8 metric tons of aluminum, and 3,400 metric tons of concrete/asphalt 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 that accompany the wastes are verified for accuracy and completeness, and filed at the RMHF. Hazardous waste tracking and verification procedures (from generator to final off-site disposal) are followed by the SHEA department. Boeing is responsible for all non-hazardous and sanitary waste operations at the SSFL.

The relevant reports include:

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

4.6 PUBLIC PARTICIPATION

In 2004, the DOE, supported by Boeing and its contractors, initiated a series of quarterly public meetings to inform the public of both current progress in the ETEC closure activities, ongoing environmental monitoring, and historical nuclear operations. These meetings are well attended by the community, agency members, legislative staff, retirees and the media. The format of the meetings comprises three parts: a poster session in which the public can discuss one-on-one with DOE and Boeing staff their questions and concerns; short presentations given by the DOE Project Manager and the Boeing ETEC Closure program Manager; followed by a Q&A session. These meetings have been well received, with the general consensus being that they provide a better forum for information exchange than other public meeting formats. Each meeting has a theme or a main subject. The content of the meetings is summarized below.

- **June 2004:** Groundwater monitoring including new tritium well data. Update on AREA IV cleanup.
- **September 2004:** Sodium Reactor Experiment history, operations, accident recovery and remediation. SRE video. Tritium update and potential sources.
- **December 2004:** SNAP program. History and remediation of the 4059 SNAP facility. Video of SNAP 10A. Tritium well data update.

- **March 2005:** Area IV Historical Site Assessment. Soil analysis results from 4059 MARSSIM survey. Tritium well data update.
- **June 2005:** Hot Lab. History and remediation. Video of EBR II fuel decladding program. Off-site monitoring data. Perchlorate sampling. TCE sampling. Tritium well data update.

In February 2005, DOE launched a new web site devoted to the environmental cleanup associated with the ETEC Closure. The web site is part of an effort to expand DOE's communication with the public. This site is used to disseminate posters, presentations and handouts from the public meetings (see above) and to serve as a focal point for information on DOE activities. It is used to as an on-line source of key documents, including annual environmental monitoring reports, off-site sampling reports, the Environmental Assessment, the Historical Site Assessment, cleanup standards and the EPA Hazard Assessment. Additional material will be added on a continual basis. The web site address is http://apps.em.doe.gov/etec/.

During 2004, Boeing continued its commitment to community involvement by participating in local Homeowner Association meetings that brought Boeing environmental remediation staff and technical experts together with local residents. The meetings featured fact sheets and display boards that enhanced public understanding of the technological and scientific mission at SSFL, as well as the environmental programs being conducted at the facility. Boeing SSFL also continued to support regulatory agency-sponsored meetings. Experts from the company also addressed local Chambers of Commerce and civic groups on environmental matters and Boeing's role as a responsible corporate neighbor. Public feedback indicated a very positive response to these meetings and the sharing of information.

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

Boeing continued to provide regular updates to the community by being responsive to local media, including the Los Angeles Times, Los Angeles Daily News, and Ventura County Star. This media outreach included holding regular, timely briefings for reporters on special environmental topics. Boeing also continued to regularly respond to phone calls from community members on the nature and status of environmental activities at the facility.

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

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

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 northwest, with some seasonal diurnal shifting to the southeast quadrant. Most rainfall runoff at the SSFL site flows through several natural watercourses and drainage channels and is collected in two large-capacity retention ponds. This water may be discharged off-site into Bell Creek to the south, or it may be reused for industrial purposes. The runoff water from Area IV also flows to the northwest, which is monitored through five NPDES sampling locations.

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

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

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

5.1 AIR EFFLUENT MORNITORING

The RMHF and Building 4024 have continuous effluent monitoring capability. In 2004, effluent was only monitored for the RMHF because no radiological work that requires the use of a filtered exhaust system was conducted in Building 4024.

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

Table 5-1. Atmospheric Effluents to Uncontrolled Areas

SSFL/RMHF - 2004	
Effluent volume (m^3)	3.14E+08
Air volume sampled (m^3)	2.63E+04
Annual average concentration in effluent	
Gross alpha (μCi/ml)	8.10E-16
Gross beta (μCi/ml)	7.68E-15
Maximum observed concentration	
Gross alpha (μCi/ml)	3.73E-15
Gross beta (μCi/ml)	8.02E-14
Activity releases (μCi)	
Gross alpha	2.54E-01
Gross beta	2.41E+00

Radionuclide-Specific Data

Radionuclide	Half-Life (yr)	Activity Detected (pCi)	Annual Release (μCi)	Average Exhaust Concentration (μCi/ml)	Average Exhaust Concentration as Percent of DCG	DCG* (μCi/ml)
H-3*	1.23E+01	NA	NA	NA	NA	1E-07
Be-7	1.46E-01	ND				natural*
K-40	1.26E+09	ND				natural
Co-60	5.26E+00	ND				8E-11
Sr-90	2.77E+01	6.35	7.58E-02	2.41E-16	0.0%	9E-12
Cs-137	3.00E+01	104.00	1.24E+00	3.95E-15	0.0%	4E-10
Th-228	1.91E+00	1.82	2.17E-02	6.92E-17	0.2%	4E-14
Th-230	8.00E+04	ND				4E-14
Th-232	1.41E+10	1.72	2.05E-02	6.54E-17	0.9%	7E-15
U-234	2.47E+05	0.92	1.10E-02	3.50E-17	0.0%	9E-14
U-235	7.10E+05	0.18	2.15E-03	6.84E-18	0.0%	1E-13
U-238	4.51E+09	0.66	7.88E-03	2.51E-17	0.0%	1E-13
Pu-238	8.64E+01	ND				3E-14
Pu-239/240	2.44E4/6.58E3	1.01	1.21E-02	3.84E-17	0.2%	2E-14
Pu-241	1.52E+01	ND				1E-12
Am-241	4.33E+02	ND				2E-14

* No H-3 was released from the RMHF stack during 2004.
* Naturally occurring radionuclides are included for information. These activities have not been used in dose estimates.
* Derived Concentration Guide (DCG) for exposure of the public, for the most restrictive form of radionuclide as specified in DOE Order 5400.5 (2/8/90; Change 2: 1/7/93)
* MDA = Minimum Detectable Activity
* ND = Not Detected

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

The total radioactivity, measured as gross alpha and gross beta activity, in the atmospheric effluents flowing to uncontrolled areas from the RMHF is shown in Table 5-1. The total shows that no significant quantities of radioactivity were released in 2004. The gross alpha and gross beta counts were made shortly after the weekly stack samples were collected, a procedure that permitted identification of any unusual release.

The isotopic composition of the radioactivity deposited on the RMHF exhaust air sampling filters, combined for the entire year, is also presented in Table 5-1. Gamma-emitting radionuclides are measured by high-resolution gamma spectrometers, and all others are measured by specific chemical separations followed by alpha or beta counting. Since the water in the 8000-gallon tank is no longer evaporated through the stack, no tritium was released to the atmosphere in 2004. Radionuclides that are found to be less than the detection limits are identified in the table as “not detected” (ND).

Small amounts of Sr-90, Cs-137, Th-228, Th-232, U-234, U-235, U-238, and Pu-239/240 on the filter samples are due to the materials involved in operations at the RMHF. The concentrations in the effluent are compared with appropriate reference values for nonoccupational exposure. The isotopic reference values for DOE facilities are the DCGs specified in DOE Order 5400.5. These values refer to the permissible concentrations allowed by the State of California and the DOE for continuous, nonoccupational exposure (i.e., to general public). The radionuclide concentrations released from the RMHF stack are far below the DCG, as shown in Table 5-1. The fact that dilution and dispersion occur before the material reaches an unrestricted area further reduces the concentration in the public area.

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

The potential downwind radiation exposures due to the atmospheric emissions during 2004 from the RMHF exhaust stack were calculated using the CAP88-PC computer code. Such site-specific input data as wind speed, directional frequency and stability, stack height, and exhaust air velocity were used to perform the dose assessment.

The highest potential radiation exposure doses at the site boundary and the nearest residential area were estimated using the CAP88-PC computer code; the results are presented in Table 5-2. Although the closest SSFL site boundary is about 300 meters NW of the RMHF, due to the weather conditions in 2004, the maximum boundary dose occurred at 436 meters, WNW of the RMHF. Therefore, the boundary dose was calculated at this distance.

The airborne dose calculations were performed to demonstrate compliance with the NESHAPs standard. At the location of the hypothetical Maximally Exposed Individual (MEI), the effective dose equivalent from the DOE facility (RMHF) exhaust during 2004 was 2.5×10^{-6} mrem (2.5×10^{-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 the absence of HEPA filters, estimated doses would be below the level requiring continuous monitoring. However, continuous monitoring is still being performed as a best management practice.

In addition to the point source (i.e., the RMHF stack), there is a potential area source in Area IV, the RMHF Pond (Sump 614). The RMHF Pond had been considered an area source due to the possible resuspension of contaminated sediment in the pond when it is dry. Since the RMHF Pond was covered by water for the entire year, it is not considered an area source for the year 2004.

Table 5-2. Radiation Exposure Dose due to Atmospheric Effluents—2004

Facility	Distance (m) and Direction to		Downwind Exposure Dose (mrem/yr)	
	Boundary	Residence	Boundary	Residence
RMHF	436 WNW	2,867 SSW	6.1×10^{-6}	2.5×10^{-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 that are changed weekly. The samples are counted for gross alpha and beta radiation following a minimum 120-hour decay period to allow the decay of short-lived radon and thoron daughters. The volume of a typical weekly ambient air sample is approximately 50.4 m^3.

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

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

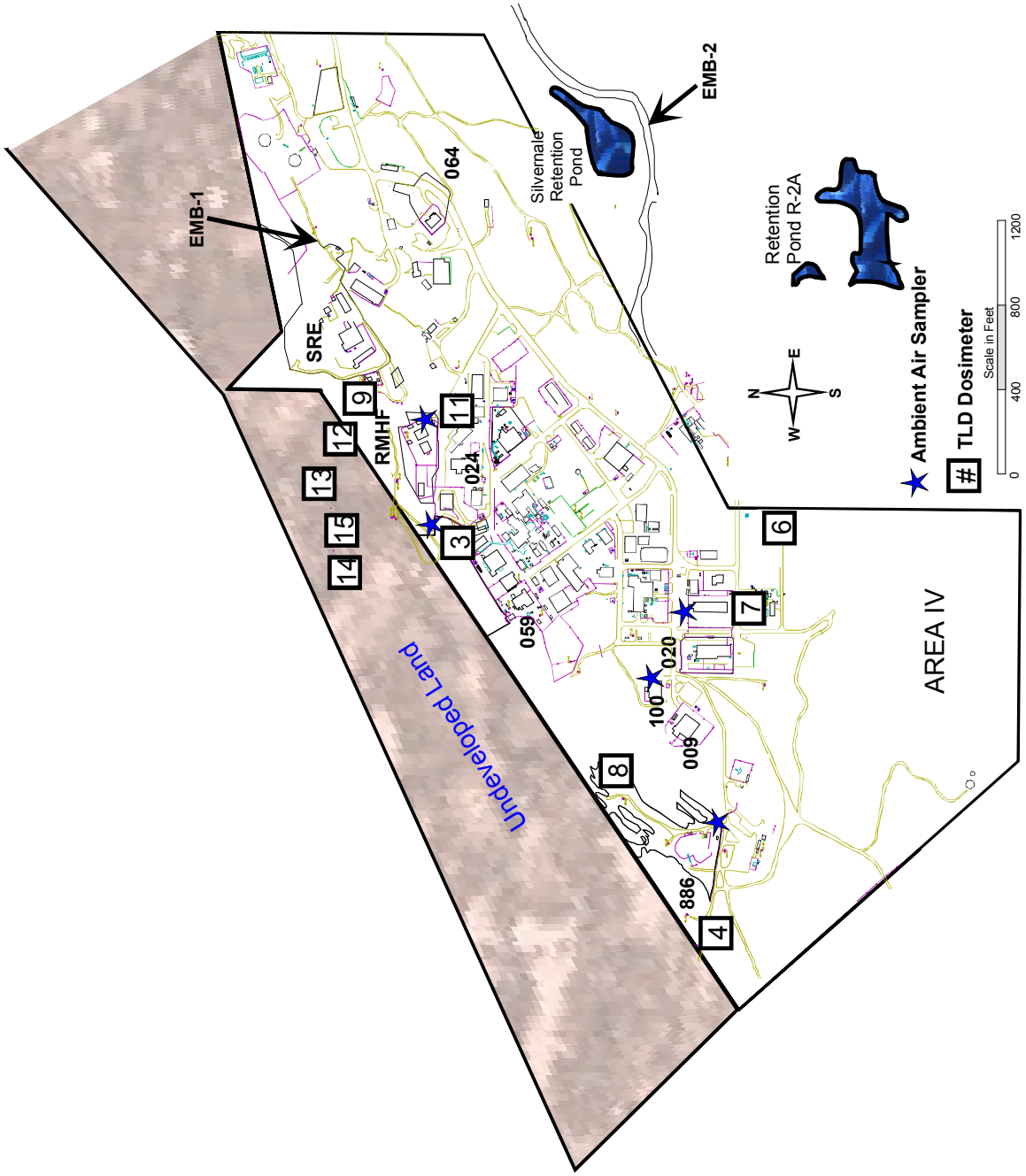

Figure 5-1. Map of Santa Susana Field Laboratory Area IV Sampling Stations

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)	SSFL Site, RMHF northwest property line boundary	(Q)
(or RMHF_Middle)		
EMB-1 (CA)	SSFL Site, SRE area north of 4003	(Q)
EMB-2 (CA)	SSFL Site, south of Silvernale retention pond, off Test Area Road	(Q)
Off-site Ambient Radiation Dosimeter Locations		
OS-1 (CA)	Off-site, Chatsworth	(Q)
BKG-11	Background Location, West Hills	(Q)
BKG-12	Background Location, Somis	(Q)
BKG-13	Background Location, Hollywood	(Q)
BKG-15	Background Location, Calabasas	(Q)
BKG-18	Background Location, Agoura	(Q)
BKG-19	Background Location, Simi Valley	(Q)
BKG-22	Background Location, Saugus	(Q)

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

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

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

Table 5-4. Filtered Exhaust and Ambient Air Radioactivity Concentrations – 2004

	Activity Concentration (microcuries per milliliter, μCi/ml)							
		Exhaust	Ambient					
Radionuclide	Derived Conc. Guide	RMHF Stack (% of DCG)	RMHF	RMHF Pond	T020	T100	T886	Average (% of DCG)
H-3	1E-07	NA	NA	NA	NA	NA	NA	NA
Be-7	natural	ND	ND	ND	ND	ND	ND	NA
K-40	natural	ND	ND	ND	ND	ND	ND	NA
Co-60	8E-11	ND	ND	ND	ND	ND	ND	NA
Sr-90	9E-12	2.4E-16 (0.0%)	ND	ND	7.23E-16	ND	ND	1.45E-16 (0.0%)
Cs-137	4E-10	4.0E-15 (0.0%)	8.75E-15	ND	ND	ND	ND	1.75E-15 (0.0%)
Po-210	natural	ND	2.70E-15	4.53E-15	7.69E-15	4.34E-15	3.27E-15	4.51E-15 (N/A)
Th-228	4E-14	6.9E-17 (0.2%)	3.92E-16	5.14E-16	5.44E-16	4.53E-16	3.96E-16	4.60E-16 (1.1%)
Th-230	4E-14	ND	3.04E-17	1.86E-16	1.29E-16	3.04E-17	1.03E-16	9.59E-17 (0.2%)
Th-232	7E-15	6.5E-17 (0.9%)	4.19E-16	5.52E-16	4.34E-16	3.39E-16	3.35E-16	4.16E-16 (5.9%)
U-234	9E-14	3.5E-17 (0.0%)	4.83E-16	3.50E-16	3.73E-16	3.12E-16	2.78E-16	3.59E-16 (0.4%)
U-235	1E-13	6.8E-18 (0.0%)	2.78E-17	ND	4.19E-17	ND	ND	1.39E-17 (0.0%)
U-238	1E-13	2.5E-17 (0.0%)	4.41E-16	2.47E-16	3.77E-16	2.89E-16	2.63E-16	3.23E-16 (0.3%)
Pu-238	3E-14	ND	ND	ND	ND	ND	ND	NA
Pu-239/240	2E-14	3.8E-17 (0.2%)	ND	ND	7.99E-17	ND	ND	1.60E-17 (0.1%)
Pu-241	1E-12	ND	ND	ND	ND	ND	ND	NA
Am-241	2E-14	ND	ND	ND	ND	ND	ND	NA

NA = Not applicable
ND = Not detected

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. During year 2004, the average gross alpha activities on the environmental air samples are less than that on the background sample.

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

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

Due to the fact that nothing but natural background radioactivity is observed in these ambient air samples, DOE plans to discontinue the ambient air monitoring at nonradiological locations in calendar year 2006. DOE will continue to monitor ambient air at the operating radiological facility and the RMHF and around facilities and sites undergoing remediation.

Table 5-5. Ambient Air Radioactivity Data—2004

Area	Activity	Number of Samples	Gross Radioactivity Concentrations (μCi/mL)		
			Annual Average Value	Maximum Value[a]	Average Percent of Guide[b]
SSFL Area IV	Alpha	51	0[c]	7.87E-15	0.00%
T100	Beta		1.30E-14	4.07E-14	0.14%
SSFL Area IV	Alpha	51	0	9.56E-15	0.00%
Hot Lab	Beta		2.89E-14	7.45E-14	0.32%
SSFL Area IV	Alpha	51	0	4.74E-15	0.00%
RMHF	Beta		0	1.72E-14	0.00%
SSFL Area IV	Alpha	51	0	8.31E-15	0.00%
4886	Beta		8.00E-15	4.49E-14	0.09%
SSFL Area IV	Alpha	51	0	1.00E-14	0.00%
RMHF Pond	Beta		1.60E-14	6.47E-14	0.18%

[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-four wells in and around Area IV are used to monitor the condition of the groundwater in the unconsolidated surface alluvium and the underlying Chatsworth formation. The locations of these wells are shown in Figure 6-2. The purpose of these wells is to monitor concentrations of chemicals and/or radioactivity released by DOE operations. Water samples from these wells are periodically analyzed for radioactivity. Sixty-six water samples from 34 of these wells were collected and analyzed in 2004. The summary results are shown in Table 5-6.

Table 5-6. Radioactivity in Groundwater at SSFL—2004

	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	86,600	ND[d]	0.11	0.19	0.01	13.90	0.64	11.20	21.30	16.60
Mean[b]	5845	NA	0.02	0.02	0.00	7.07	0.35	6.69	4.45	7.72
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Number of Analyses[c]	65 (51)	44 (44)	15 (15)	15 (15)	15 (15)	10 (1)	10 (2)	10 (1)	61 (22)	61 (6)

[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.

[d]34 pCi/L of Cs-137 was reported at RD-33B, but later proven to be a false detection.

The State of California assigns drinking water standards to groundwater as a water-quality goal. Numerical limits for radionuclides not specifically listed by the State were derived from the EPA generic dose limit of 4 mrem/year, as specified in 40 CFR 141. Except for one instance of gross alpha (21.3 pCi/L at RD-28), the monitored groundwater satisfies these goals. The high gross alpha concentrations are due to the presence of higher levels of naturally occurring uranium. Except for one false detection, gamma spectrometry analysis did not detect any man-made beta and gamma emitters. In November 2004, 34 pCi/L of Cs-137 was reported at RD-33B. However, the split sample taken by DHS found no Cs-137 in the water. Consequent samples from the same well also indicated no presence of Cs-137.

Tritium analyses were performed in 65 water samples from 34 groundwater-monitoring wells (see Figure 6-2). Seven new wells were constructed in 2004 to investigate tritium in groundwater at the former ETEC site. Relatively high tritium concentrations were observed at RD-87, -88, and -90, which are located down gradient from the former Building 4010 site, a possible source for man-made tritium production. The highest level of tritium observed in these

new wells was 86,600 pCi/L. Investigation is continuing to fully understand the source of the tritium and the extent of migration.

By the time of this publication in 2005, four more new wells were constructed, and water samples were collected for tritium investigation. Figure 5-2 shows the well locations and tritium concentrations in these wells.

From these observations, Building 4028 appears to be discounted as a source. RD-93 at Bldg 4010 has lower than the prior highs of about 80,000 pCi/L in RD-90 and RD-88. Conversely, tritium in RD-95 (several hundred feet west of RD-93) suggests that the tritium plume has spread from Building 4010 both west and north over the past 40 years.

RD-94, which is to the northwest of RD-88 and closer to the northern site boundary, has tritium concentrations less than the drinking water MCL, confirming that the northerly migration has been minimal over the last 40 years.

Besides these new wells, routine groundwater sampling presented similar results as historical data. The positive detections of tritium had maximum concentrations of 259, 1,120, 2,440, and 344 pCi/L at wells RD-25, RD-28, RD-34A, and RD-63, respectively. All these values are substantially below the EPA and California drinking water limit of 20,000 pCi/L. The occurrence of tritium in groundwater is probably due to unintended production of tritium in soil surrounding various reactors, primarily in Building 4010 and 4059.

Historically, well RD-34A, located on recently acquired land near the RMHF in Area IV, had higher concentrations of tritium than other wells in Area IV. Figure 5-3 shows the historical tritium analysis results for RD-34A. For comparison, the allowable limit in drinking water, 20,000 pCi/L, is used as the full scale on the plot. Since the first detection of about 7,000 pCi/L in 1991, the tritium concentrations in this well have dropped down to the range of 1,000 to 5,000 pCi/L. In 2004, tritium was detected at about 2,400 pCi/L at this well.

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). All results were below the drinking water supplier limits established in the NPDES permit.

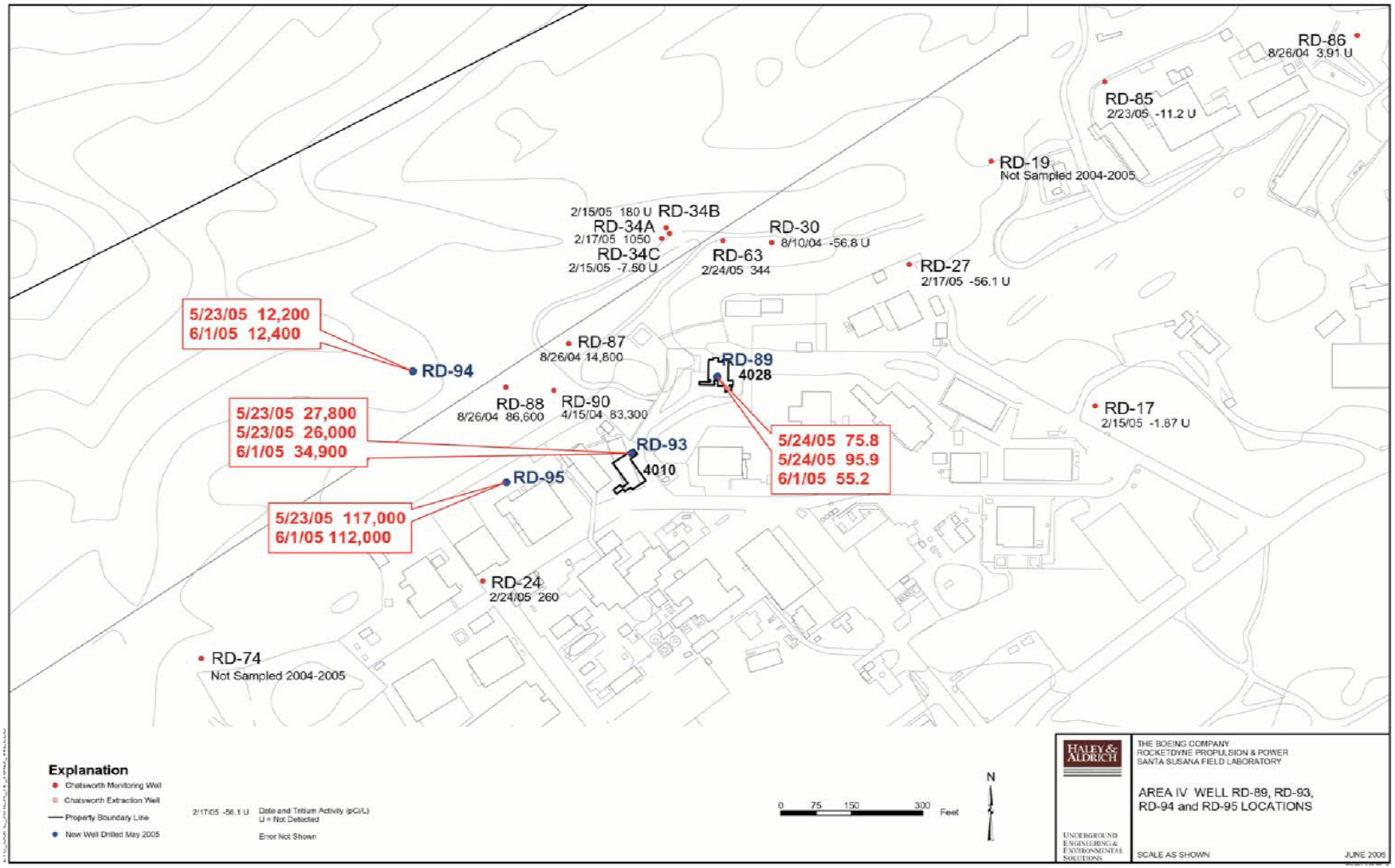

Figure 5-2. New Wells Constructed for Tritium Investigation

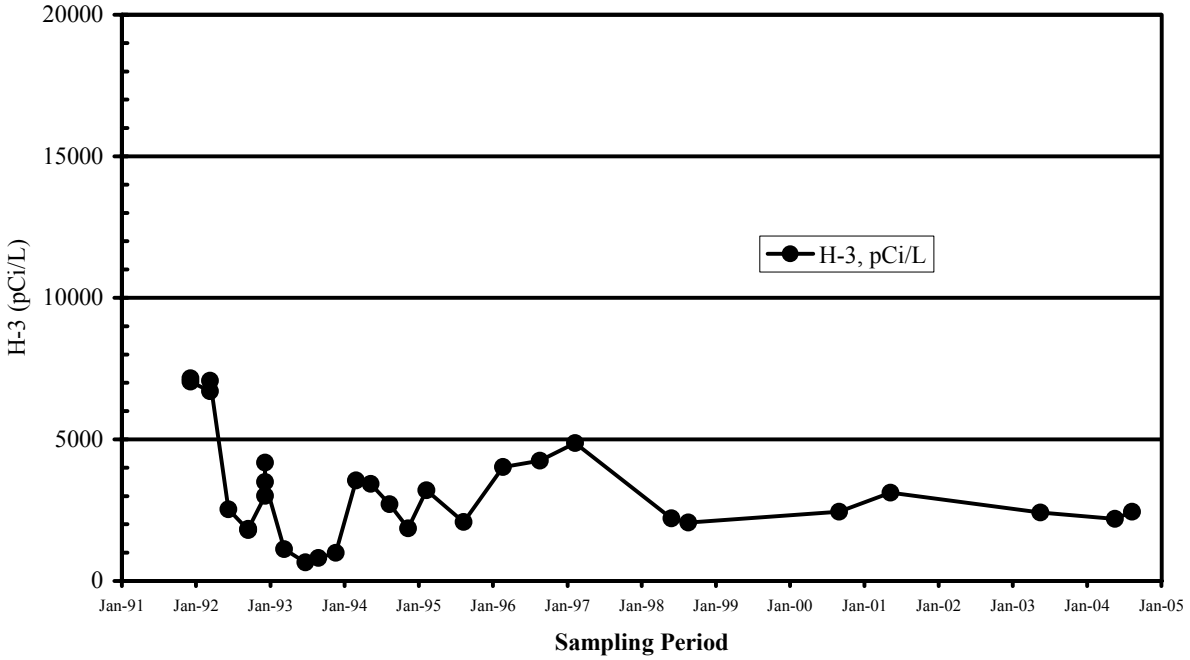

Figure 5-3. Tritium Concentration in Water from Well RD-34A

Table 5-7. NPDES Discharge Radioactivity Data for Northwest Slope Monitoring—2004

	Activity (pCi/L)			
	H-3	**Sr-90**	**Gross Alpha**	**Gross Beta**
Water Suppliers MCL	20,000	8	15	50
Maximum	949.00	1.63	5.37	3.24
Mean[a]	210.50	0.44	2.81	1.09
Minimum	ND	ND	1.25	ND
Number of Analyses[b]	10 (8)	10 (8)	10 (0)	10 (4)

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

Table 5-8. NPDES Discharge Radioactivity Data for Southeast Slope Monitoring—2004

	Activity (pCi/L)			
	H-3	Sr-90	Gross Alpha	Gross Beta
Water Suppliers MCL	20,000	8	15	50
Maximum	ND	ND	3.19	4.50
Mean[a]	NA	NA	2.67	2.34
Minimum	ND	ND	2.15	ND
Number of Analyses[b]	2 (2)	2 (2)	2 (0)	2 (1)

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

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. The latest results reported by local water suppliers at the time of this publication are shown in Table 5-9. It includes the Los Angeles Department of Water and Power, the Los Angeles County Water District, the Burbank Public Service Department, and Simi Valley.

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

Table 5-9. Domestic Water Supplies Radioactivity Data

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

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

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 plutonium isotopes.

Building 4059

The Phase II of 4059 demolition was completed in 2004. After the excavation was completed, a total of 34 soil samples were collected at the excavation site. In addition to the in-house analysis of gamma emitting radionuclides, these samples were sent to an independent radiochemical analytical lab (Severn Trent in St. Louis, MO) for all possible radiological contaminants, including H-3, Fe-55, Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, U-234, U-235, U-238, Th-228, Th-230, Th-232, Pu-238, Pu-239/240, Pu-241, and Am-241. Only a trace amount of H-3, Fe-55, Ni-63, Cs-137, Pu-238, Pu-239/240, and Am-241 were detected in some

samples, and the levels were well below the approved soil release criteria. The uranium and thorium isotopes detected in the soil were naturally occurring. Table 5-10 summarizes these soil sampling results.

Table 5-10. Soil Sampling at Building 4059 Site in 2004

Nuclide	Release Criteria[a]	Minimum	Average	Maximum	Nominal MDA	Number of Samples[d]
	pCi/gram					
H-3	31,900	ND[c]	0.27	5.80	0.41	34 (29)
Fe-55	629,000	ND	10.19	30.00	22.88	34 (33)
Co-60	1.94		ND		0.17	34 (34)
Ni-63	55,300	ND	7.76	48.50	5.84	34 (15)
Sr-90	36.0		ND		0.08	34 (34)
Cs-137	9.20	ND	0.00	0.17	0.09	34 (33)
Eu-152	4.51		ND		0.82	34 (34)
Eu-154	4.11		ND		0.73	34 (34)
Th-228	5.00	0.90	1.05	1.59	0.04	34 (0)
Th-230	NA[b]	0.83	0.82	1.30	0.03	34 (0)
Th-232	5.00	0.86	0.98	1.43	0.02	34 (0)
U-234	30	0.29	0.55	1.07	0.03	34 (0)
U-235	30	ND	0.04	0.10	0.02	34 (9)
U-238	35	0.49	0.52	1.00	0.02	34 (0)
Pu-238	37.2	ND	0.01	0.07	0.03	34 (32)
Pu-239/240	33.9	ND	0.00	0.03	0.01	34 (32)
Pu-241	230		ND		2.77	34 (34)
Am-241	5.44	ND	0.02	0.09	0.05	34 (30)

a. Release criteria are net above natural background. Reported values include natural background.
b. NA = Not applicable.
c. ND = Not detected.
d. Numbers in parentheses represent the number of analyses reported as less than the detectable limit.

In addition, The State of California, Department of Health Services (DHS) and the Oak Ridge Institute for Science and Education (ORISE) performed confirmatory surveys and sampling at the site. The ORISE took a total of 12 soil samples, including two composite samples from the dugout. No man-made radionuclides were detected in their samples. The DHS results are not available at the time of this publication.

Other Soil Samples

During 2004, soil samples were also taken to support various site remediation activities. These included six samples for new groundwater monitoring well drilling, three samples from geological core sampling around 4024, two composite samples from Building 4055 yard, and

one near the 30-gallon tank at 4087 site. None of these samples had any detectable man-made gamma emitting radionuclides.

5.2.5 Vegetation

No vegetation samples were collected in 2004.

5.2.6 Wildlife

No animal samples were collected in 2004.

5.2.7 Ambient Radiation

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

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

The State DHS/RHB provides packages containing calcium sulfate ($CaSO_4$) dosimeters for independent monitoring of radiation levels at SSFL and in the surrounding area. These dosimeters are placed at specific locations along with the Boeing TLDs. The State dosimeters are returned to the Radiologic Health Branch for evaluation. Data obtained in 2004 on these TLDs, which were placed at various Boeing dosimeter locations both on-site and off-site, are shown in Table 5-11.

Table 5-11 shows that individual radiation exposures measured by Boeing and the State DHS are in good agreement. Slight differences are mainly due to the fact that two different types of TLDs were used in the measurement. Radiation doses measured at locations SS-12, -13, -14 and -15, are slightly higher than the rest of the locations on-site. This result is reflective of the normal operations at the RMHF, which involve handling and shipment of radioactive waste.

Table 5-11. 2004 SSFL Ambient Radiation Dosimetry Data

2004		Annual Exposure (mrem)	Average Exposure Rate (μR/h)	
TLD-Locations		By Boeing	Boeing	State DHS
SSFL	SS-3	62.4	7.1	8.7
	SS-4	58.3	6.7	8.3
	SS-6	74.8	8.5	8.9
	SS-7	83.9	9.6	7.6
	SS-8	83.1	9.5	9.9
	SS-9	80.5	9.2	9.3
	SS-11	72.8	8.3	7.6
	SS-12	94.5	10.8	9.4
	SS-13	90.2	10.3	9.9
	SS-14	101.6	11.6	9.4
	SS-15	93.7	10.7	10.8
	EMB-1	84.0	9.6	9.1
	EMB-2	83.1	9.5	9.0
Mean Values		**81.8**	**9.3**	**9.1**
Off-site	OS-1	59.0	6.7	
	BKG-11	54.1	6.2	--
	BKG-12	39.1	4.5	--
	BKG-13	31.0	3.5	--
	BKG-15	57.5	6.6	--
	BKG-18	54.5	6.2	--
	BKG-19	40.5	4.6	--
	BKG-22	28.1	3.2	--
Mean Values		**45.5**	**5.2**	**4.8**

The natural background radiation level as measured by the off-site TLDs ranges from 28 to 59 mrem/yr. At SSFL, the local background ranges from 58 to 84 mrem/yr, based on the data from dosimeters SS-3, -4, -6, -7, -8, -9, and -11 and EMB-1 and -2 as shown in Table 5-11. 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, a condition that results in elevated exposure levels.

The external exposure rate at Boeing SSFL's northern property boundary, the closest property boundary to the RMHF, should be indistinguishable from natural background. This property line is approximately 300 meters from the RMHF and separated by a sandstone ridge that effectively shields the boundary from direct radiation from the RMHF. Dosimeters placed on the RMHF side of this sandstone ridge (SS-12, -13, –14, and -15), approximately 150 meters from the RMHF, read an average of 19 mrem/year above the local background. This amount is considerably below the 100 mrem/year limit specified in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. The TLD results demonstrate that the potential external exposure at the site boundary is below the DOE's dose limit.

The SSFL local background, calculated as the average of all onsite TLDs (except SS-12, SS-13, SS-14, and SS-15), is 76 mrem/year. This value is 30 mrem/year higher than the background as calculated by the average of all offsite TLDs of 46 mrem/year. This result can be attributed to the contribution of higher elevation and different geology. Offsite TLDs are located in Boeing staff members' backyards, surrounded by natural soil. In contrast, SSFL lies atop the Chatsworth Formation of the San Fernando and Simi valleys. The Chatsworth Formation is composed of arkosic sandstone, rich in feldspar. Arkosic rocks are often high in uranium content. As a result, the Chatsworth Formation rocks produce higher radiation exposure than the soil of the surrounding valleys. To determine this effect, in January 2003 radiation exposure rates were measured with a Ludlum 12S microR meter at Stoney Point, a large rock outcroppings in Chatsworth, about eight miles from SSFL, and at a residence in West Hills (the location of TLD BKG-11). Differences of about 6 μR/h (or about 50 mrem/year) were observed between the two locations, as shown in Table 5-12. Likewise, exposure rates taken at SSFL over rock outcroppings (locations of most of the onsite TLDs) and a soil region also showed a difference of about 6 μR/h (or about 50 mrem/year).

Even single 2- to 3-lb rock samples from both offsite and onsite locations showed increased exposure rate of about 2 μR/h (or about 15 mrem/y), as shown in Table 5-13. In conclusion, the modest increase in exposure observed between offsite valley locations and SSFL locations can easily be attributed to the Chatsworth Formation arkosic sandstone geology.

5.3 ESTIMATION OF RADIATION DOSE

5.3.1 Individual Dose

The total effective dose equivalent (TEDE) to any member of the public from all pathways (combining internal and external dose) shall not exceed 100 mrem/yr (above background) for DOE facilities. Although the four TLD monitoring stations to the north of the RMHF, namely SS-12, -13 –14, and -15, recorded an external dose level at 19 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, 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.

Table 5-12. Exposure Rates Over Different Geology

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

Table 5-13. Radiation Exposure Rates of On-site and Off-site Rock Samples

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

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

Public exposure to radiation and radioactivity is shown in Table 5-14. The table presents the estimated exposures in comparison to the regulatory standards. Dose values in the tables represent both internal and external exposures.

Table 5-14. Public Exposure to Radiation from DOE Operations at SSFL—2004

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	2.5×10^{-6} mrem/yr
	Limit	100 mrem/yr
	("Radiation Protection of the Public and the Environment" DOE Order 5400.5)	
2.	Air pathway (reported in NESHAPs report)	2.5×10^{-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 6.3×10^{-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 Boeing SSFL operations is extremely small. Figure 5-4 shows the population data within 50 miles (80 km) radius from SSFL.

Figures 5-5 and 5-6 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.

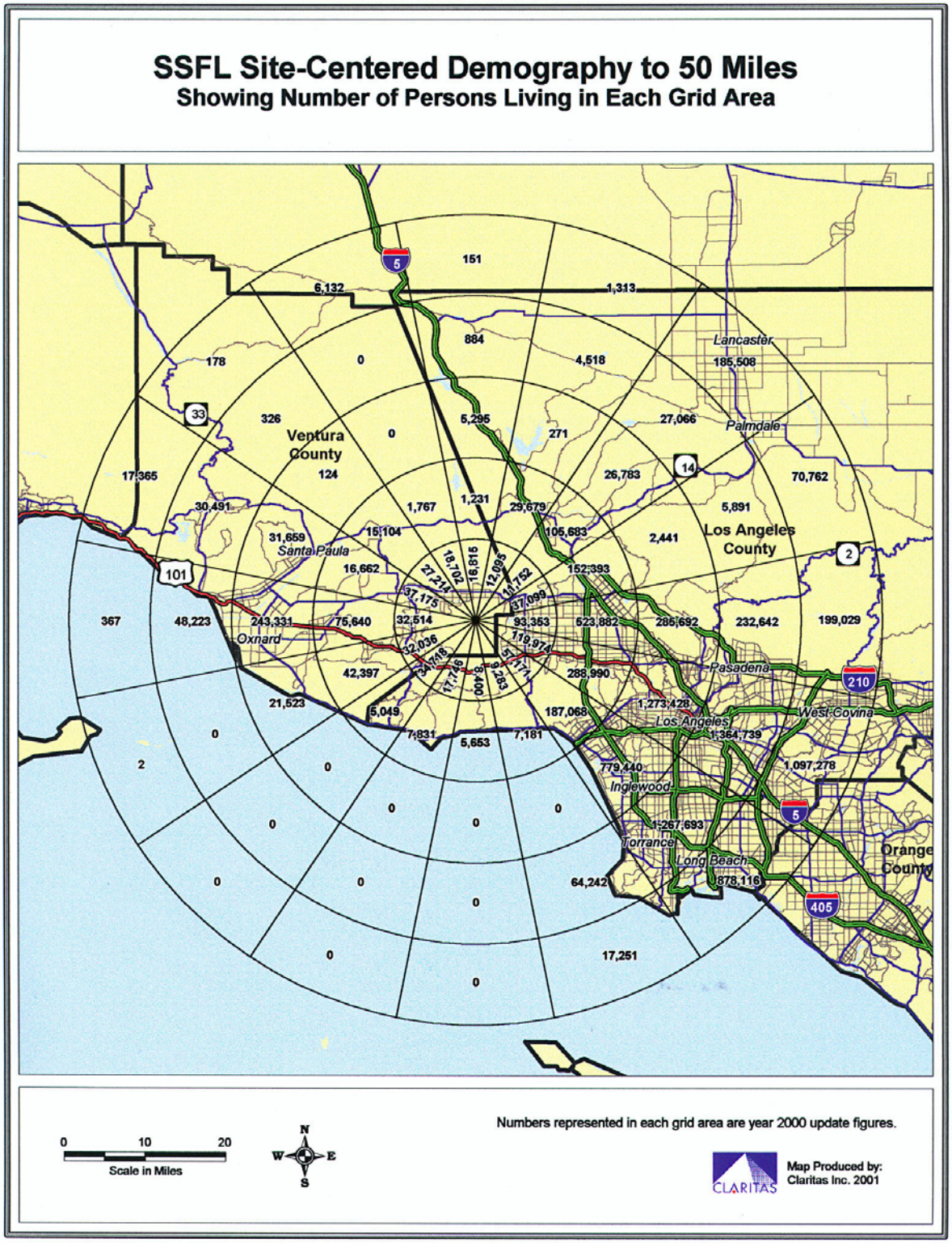

Figure 5-4. Demographic Data within 50 Miles (80 km) of SSFL

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

Figure 5-6. 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 the 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 soil data is used in this preliminary screening process. Average radionuclide concentrations are estimated from thousands of on-site and off-site soil samples collected and analyzed during the past decades. The average values, net above background, are then entered into the RAD-BCG Calculator to compare with the BCGs. Table 5-15, summarizes the comparison results. The total BCG fraction at SSFL, as shown in Table 5-15, is less than one, indicating that the potential exposure is less than the dose limit recommended by the DOE.

Table 5-15. Terrestrial Biota Radiation Exposure as a Fraction of Dose Limit

	Soil		
Nuclide	Limit pCi/g	Average On-site Concentration (net above background), pCi/g	Partial Fraction
Am-241	3.89E+03	5.60E-01	1.44E-04
Ce-144	1.80E+03	1.00E-01	5.57E-05
Cs-135	6.92E+02	2.60E+00	3.76E-03
Cs-137	5.34E+04	7.50E-01	1.41E-05
Co-60	1.13E+01	2.50E-01	2.21E-02
Eu-154	2.08E+01	7.08E+00	3.41E-01
Eu-155	1.52E+03	2.57E+01	1.69E-02
H-3	1.29E+03	4.04E-01	3.13E-04
I-129	1.58E+04	1.10E-01	6.95E-06
I-131	1.74E+05	8.50E+03	4.89E-02
Pu-239	6.11E+03	5.40E-02	8.83E-06
Ra-226	2.25E+01	4.82E+00	2.14E-01
Ra-228	1.51E+03	4.25E+00	2.82E-03
Sb-125	5.13E+03	2.49E+00	4.85E-04
Sr-90	2.77E+03	5.00E-01	1.80E-04
Tc-99	1.58E+03	5.20E+00	3.30E-03
Th-232	4.13E+02	2.10E-01	5.09E-04
U-233	3.89E+03	5.60E-01	1.44E-04
U-234	1.80E+03	1.00E-01	5.57E-05
U-235	6.92E+02	2.60E+00	3.76E-03
U-238	5.34E+04	7.50E-01	1.41E-05
Zn-65	1.13E+01	2.50E-01	2.21E-02
Zr-95	2.08E+01	7.08E+00	3.41E-01
		Sum	6.54E-01

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6. ENVIRONMENTAL NON-RADIOLOGICAL MONITORING

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

The discharge of surface water at SSFL results from storm water runoff or excess treated groundwater. The California Regional Water Quality Control Board regulates discharges through a National Pollutant Discharge Elimination System (NPDES) permit. Most surface water runoff drains to the south and is collected in the water reclamation/pond system. Discharges from this system are subject to effluent limitations and monitoring requirements as specified in the NPDES permit. A small portion of the site within Area IV discharges storm water runoff to five northwest runoff channels where sampling locations (Figure 6-1) have been established and sampling is conducted in accordance with the northwest slope monitoring program. All discharges are regularly monitored for as many as 143 different constituents, including: volatile organics, heavy metals, and applicable radionuclides as well as other parameters necessary to assess water quality. Section 6.1 discusses the monitoring results for the NPDES permit in detail.

The major groundwater contaminants in Area IV are TCE and its degradation products. Three interim groundwater extraction system wells have been installed in Area IV, and evaluation of their performance is in progress. The overall annual groundwater monitoring program at SSFL addresses collection and analysis of groundwater samples and measurement of the water levels for the 266 Boeing SSFL installed wells on-site and off-site and 19 off-site private wells. The locations of these wells within and around DOE areas in Area IV are shown on the map of SSFL in Figure 6-2. Groundwater quality parameters and sampling frequency have been determined on the basis of historical water quality data, location of known or potential sources of groundwater contamination, operational requirements of groundwater extraction and treatment systems, and regulatory direction. The groundwater monitoring program includes the following parameters, all analyzed using the appropriate EPA methods: volatile organic constituents, base/neutral and acid extractable organic compounds, petroleum hydrocarbons, trace metals, and common ion constituents. Radiological analyses are performed on groundwater samples from DOE areas in Area IV and off-site (see section 5.2.2).

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

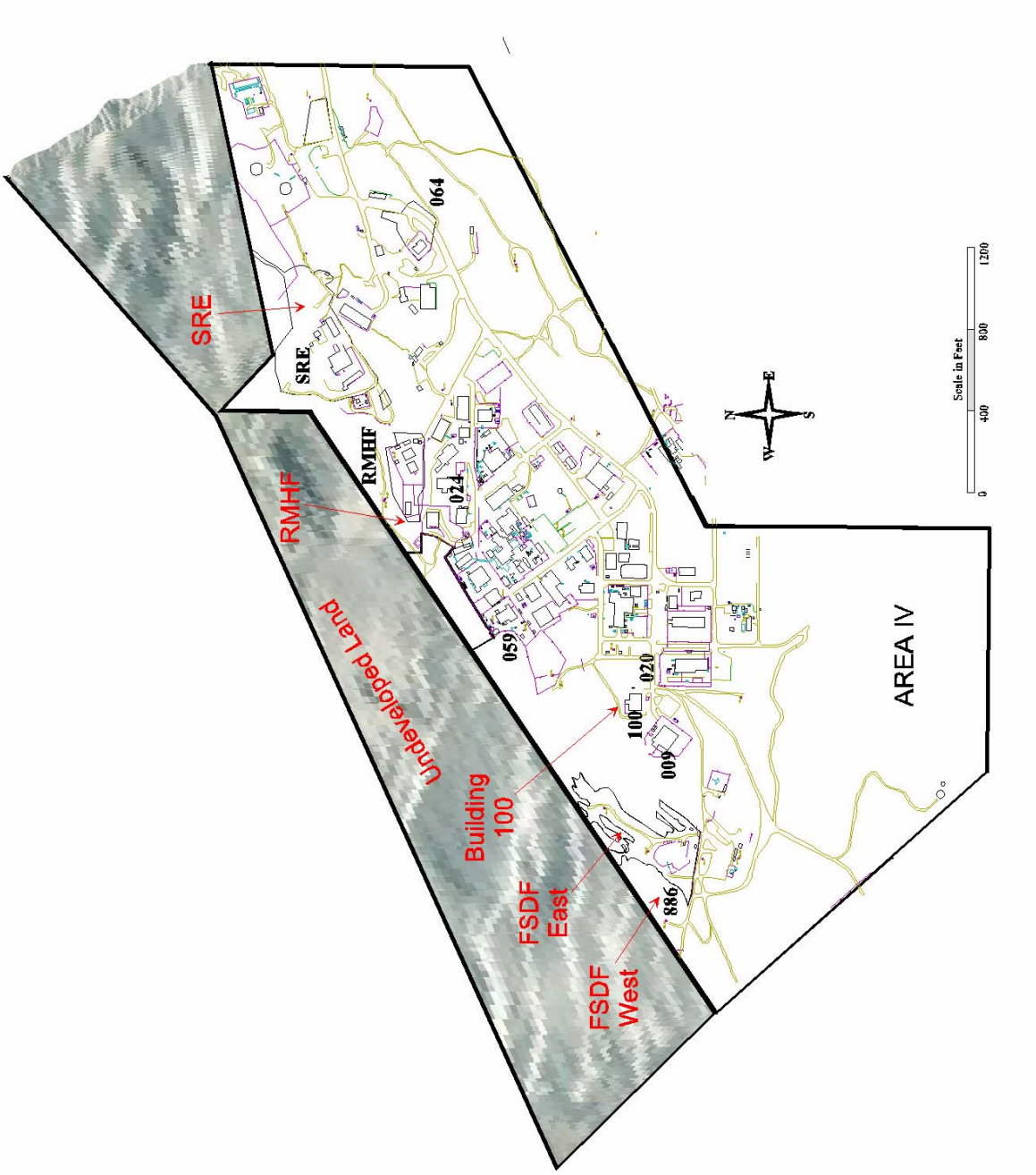


Figure 6-1. Locations of Surface Water Runoff Collectors

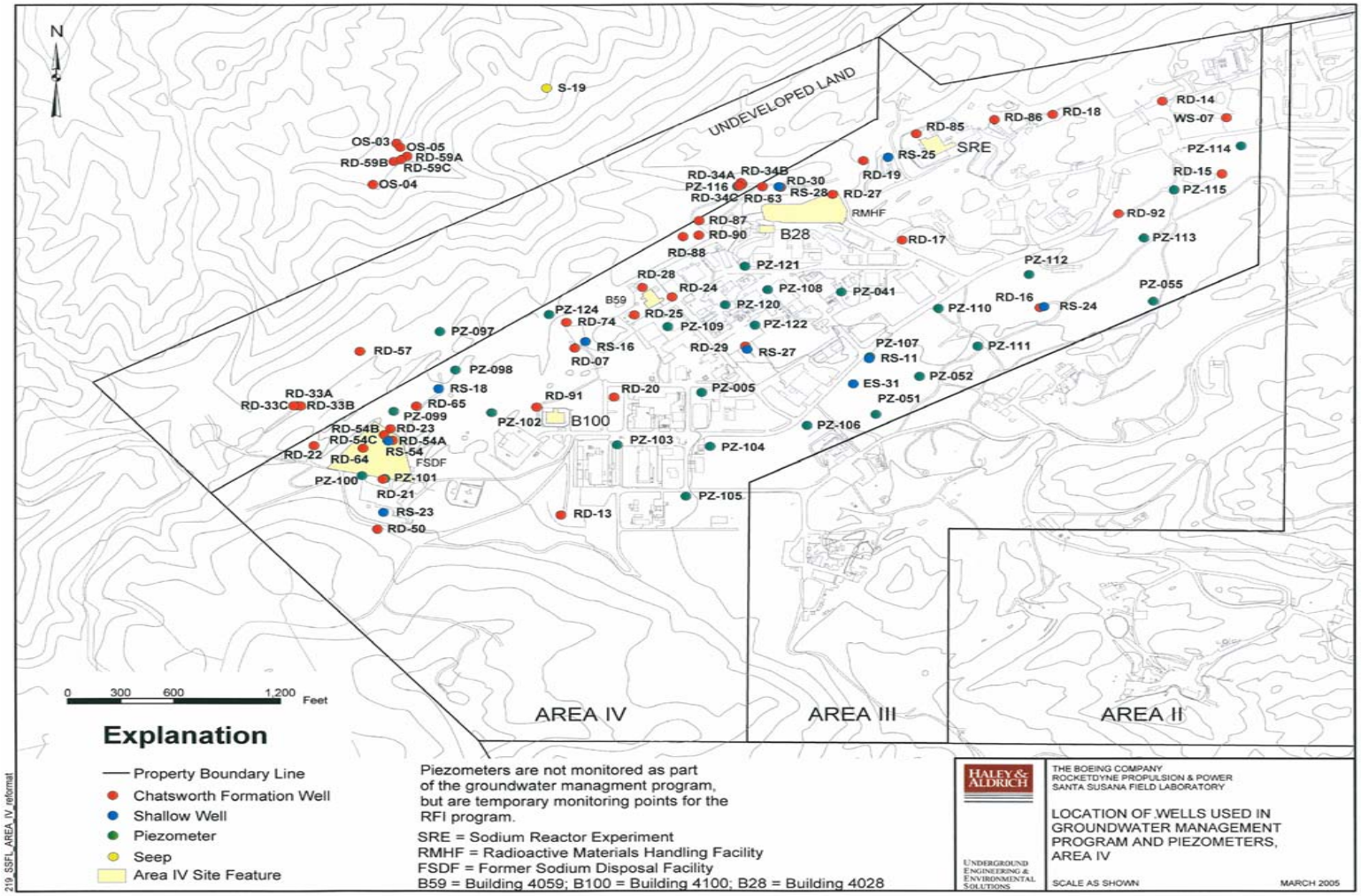


Figure 6-2. Well Locations

6.1 SURFACE WATER

Boeing SSFL 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 July 1, 2004.

The permit allows the discharge of reclaimed wastewater, storm water runoff, and industrial waste water from retention ponds into Bell Creek, a tributary of the Los Angeles River. Storm water from the southeastern portion of Area I is permitted to discharge to Dayton Creek and from the Northeastern locations of Area II into the Arroyo Simi, a tributary of Calleguas Creek. 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 is temporarily stored in three inactive Sewage Treatment Plants and then trucked offsite for treatment and disposal. Permit conditions are in place for the operation of the three treatment plants if needed. Area IV sewage is piped directly to the Area III Sewage Treatment Plant (STP III).

Of the two retention ponds at SSFL that discharge via the NPDES permit, only one, the R-2A Pond, receives influent from Area IV. Influent to the pond may include tertiary treated domestic sewage, cooling water from various testing operations, treated ground water and storm water runoff. When there is discharge from either the Perimeter or R-2 ponds 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 watershed (Outfalls 005 and 006), and the Building T100 watershed (Outfall 007). Runoff monitoring is currently conducted as set forth by the NPDES permit referenced above. Furthermore, all surface water program activities for the SSFL, including Area IV, have been addressed and incorporated into the current NPDES permit. A Storm Water Pollution Prevention Plan was prepared in accordance with the current federal and state regulations.

The permit imposes contaminant limits for radioactivity similar to those for drinking water 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 week needs to be obtained from each of the outfalls. During dry weather, samples must be collected whenever there is discharge from Outfall 002 or 018. The minimum sampling frequency during dry weather is once per month.

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

Monitoring methods and results have been reviewed for permit compliance for all outfalls that had flow during 2004. The previous NPDES permit's requirements, which were effective from July 1998, were used during the 1st and 2nd Quarter of 2004 and through August 19, 2004. The current NPDES permit requirements took effect commencing on August 20, 2004. Therefore, this report, as necessary, discusses and refers to two sets of permit requirements and permit limits. Discharges related to the DOE operations at SSFL were in compliance with the permit limits with the following exceptions.

Stormwater Outfall 002

Outfall 002 had three exceedences during the 2004 monitoring period; one was for TCDD, and two were for mercury. On December 28, 2004, TCDD was detected at a concentration of 3.7 x 10^{-8} µg/L compared to the permit limit of 2.8 x 10^{-8} µg/L. On December 28 and 31, 2004, mercury was detected at 0.21 and 0.32 µg/L, compared to the permit limit of 0.10 µg/L (for compliance determination, the laboratory reporting limit for mercury of 0.20 µg/L is used). Sources and corrective actions for TCDD and mercury are discussed later in this section.

Stormwater Outfall 003

Outfall 003 had three exceedences during the 2004 monitoring period; one was for pH, and two were for TCDD. The permitted pH range for Outfall 003 in October was 6.5 to 8.5. On October 17, 2004, pH was measured at 9.13. This elevated pH value was likely the result of construction activities, which included the installation of a mortar and concrete surface-water sampling station. The alkalinity of the newly installed mortar and concrete sampling station likely resulted in a slightly increased pH value. Surface water samples collected from this outfall later in the quarter were within the permitted range.

On October 17 and December 5, 2004, TCDD was detected at concentrations of 8.5 x 10^{-6} µg/L and 4.5 x 10^{-8} µg/L compared to the permit limit of 2.8 x 10^{-8} µg/L, respectively. Sources and corrective actions for TCDD are discussed later in this section.

Stormwater Outfall 004

Outfall 004 had two exceedences during the 2004 monitoring period; one was for TCDD, and one was for copper. On October 17, 2004, TCDD was detected at a concentration of 7.08 x 10^{-5} µg/L compared to the permit limit of 2.8 x 10^{-8} µg/L. Sources and corrective actions for TCDD are discussed later in this section.

On October 17, 2004, copper was detected at a concentration of 15 µg/L, slightly exceeding the permit limit of 14 µg/L. Three subsequent samples collected from Outfall 004 during the quarter were in compliance. Based on the extensive history of compliance with copper discharge limits at Outfall 004 both prior to and after this non-compliant event, this copper result was not truly representative of the general discharge water quality at this location. In addition, it should be noted that this concentration of copper was a result of the new requirement to analyze for total recoverable metals instead of dissolved metals and is within the naturally occurring variability and concentrations similar to this may be detected in the future. Additional BMP's are being implemented in an attempt to further reduce the level of all constituents at this outfall.

Stormwater Outfall 005

Outfall 005 had two exceedences during the 2004 monitoring period; one was for TCDD, and one was for mercury. On October 17, 2004, TCDD was detected at a concentration of 3.32 x 10^{-6} µg/L compared to the permit limit of 2.8 x 10^{-8} µg/L. On December 27, 2004, mercury was detected at 0.20 µg/L, compared to the permit limit of 0.10 µg/L (for compliance determination, the reporting limit for mercury of 0.20 µg/L is used). Sources and corrective actions for TCDD and mercury are discussed later in this section.

Stormwater Outfall 006

Outfall 006 had four exceedences during the 2004 monitoring period, one for TCDD, one for mercury, and two for pH. On October 17, 2004, TCDD was detected at a concentration of 1.92 x 10^{-4} µg/L compared to the permit limit of 2.8 x 10^{-8} µg/L. On December 27, 2004, mercury was detected at 0.22 µg/L, compared to the permit limit of 0.10 µg/L (for compliance determination, the laboratory reporting limit for mercury of 0.20 µg/L is used). On October 27 and December 27, 2004, pH was measured at 6.29 and 9.7, respectively. The October 27 result was most likely the result of the low ambient pH of the rain water itself. Samples of ambient rain have been found to have a pH level as low as 4.9. The December 27 result was directly attributable to recent construction activity to install a stainless steel sample box where mortar was used to secure the device. The alkalinity of the mortar used to install the new sampling station likely resulted in the increased pH value. Four consecutive daily samples collected on December 28 through December 31 from Outfall 006 were within the permitted range for pH.

Potential Sources of TCDD and Mercury

The presence of TCDD in surface water at NPDES Outfalls was due to both the naturally occurring TCDD in soil and ash from non-facility-related fires such as brush fires that routinely occur throughout the hills of Southern California. Facility operations are likely not the sources of

the TCDD. Continued monitoring of surface water will provide a more thorough dataset for further evaluation of the occurrence of TCDD.

The six TCDD exceedences reported during the 4th Quarter 2004 have been compared to the Federal and California Maximum Contaminant Levels (MCLs) for drinking water (drinking water standard). The drinking water MCL is 3.0×10^{-8} mg/L (3.0×10^{-5} µg/L) and is established for 2,3,7,8-TCDD. This concentration represents the safe level of 2,3,7,8-TCDD or TCDD TEQs that can be present in drinking water. The single congener 2,3,7,8-TCDD was not detected in any of the surface water samples collected during the 4th Quarter. Two of the TCDD TEQ results, 1.92×10^{-4} and 7.08×10^{-5} µg/L, were greater than this level and represent one-time occurrences. All of the remaining four reported TCDD TEQ values above the permit limit are approximately 10 to 1,000 times lower than the drinking water standard.

The presence of mercury in surface water at the NPDES outfalls is most likely due to the presence of naturally occurring mercury in soil. Onsite mercury sources have been identified, investigated, and mitigated, and no new sources of mercury are known or have been identified. The recent fires are a newer contributing source of mercury to the levels at the site.

The California drinking water standard for mercury is 2.0 µg/L, which indicates the safe level of mercury in drinking water. The detected values of mercury at the outfalls and dates listed above were 0.21, 0.32, 0.20 and 0.22 µg/L, respectively. These reported values were approximately 6 to 10 times less than the drinking water standard. Although this surface water was not directly consumed, the concentrations of mercury detected in the surface water samples did not pose a health risk to the surrounding communities.

Corrective Actions

The BMPs for minimizing the potential impact of chemicals or pollutants on surface water have been implemented at SSFL in accordance with the facility and project-specific Storm Water Pollution Prevention Plans (SWPPPs) and the Best Management Practices Plans (BMPPs). The BMPs consists of chemical use reduction or elimination, spill prevention, installation of berms or other containment structures, installation of sediment basins, continuous training on appropriate materials handling and storage and spill response, and remediation of known areas of chemicals and pollutants. Specific BMPs related to DOE operations at SSFL in 2004 included:

- All Outfalls: installed telemetry systems to provide improved flow monitoring capability.
- Outfall 003: installed a stainless steel sample box and vermiculite and activated carbon filters to control sediment.
- Outfall 004: cleared trees and brushes, repaired and/or replaced plastic sheeting/tarp, sand bags, and silt fencing, and installed additional silt fencing, vermiculite and activated carbon filters.
- Outfall 005 - replaced plastic sheeting/tarp and sand bags, added vermiculite, and activated carbon filters.

- Outfall 006 - installed a stainless steel sample box, replaced plastic sheeting/tarp, sand bags, silt fencing, and installed additional silt fencing and added vermiculite and activated carbon filters.
- Outfall 007 - installed a stainless steel sample box and replaced silt fencing.

In addition, other sediment control structures may be placed at Outfalls 003, 004, 005, and 006 to further minimize sediment transport and remove potential pollutants from surface water.

Based on the results of the 2004 surface water sampling, the implemented Best Management Practices (BMPs) are providing controls to minimize the migration of pollutants in surface water. Continued evaluation, implementation, and improvement of the BMPs will be performed. To address the specific exceedences during 2004, the following corrective actions will be implemented:

TCDD concentrations will continue to be monitored in accordance with the NPDES permit. Based on the comparison to MCLs, the concentration of TCDD detected in surface water does not pose a health risk. However, further evaluation of the impacts of the Piru and other Southern California fires and the relationship between TCDD concentrations and TSS and settleable solids in surface water will be performed. Evaluation of BMPs and their implementation, including sediment control measures, will be conducted and implemented as necessary and appropriate.

Mercury concentrations will continue to be monitored in accordance with the NPDES permit. Based on the comparison to MCLs, the concentration of mercury detected in surface water does not pose a health risk. However, further evaluation of the relationship between mercury concentrations and TSS and settleable solids in surface water will be performed. Evaluation of BMPs and their implementation, including sediment control measures, will be conducted and implemented as necessary and appropriate.

Copper concentrations will continue to be monitored in accordance with the NPDES permit. A specific corrective action has not been identified for the one-time exceedence at Outfall 004. However, BMPs will be reviewed, evaluated, and implemented as necessary.

The range of pH values will continue to be monitored in accordance with the NPDES permit. Additional ambient rainfall samples will be collected and analyzed to further evaluate the potential affect of rainwater on pH of surface water samples. As a corrective action for the pH exceedences at Outfalls 003 and 006, outfalls involving the use of concrete or mortar type products will be rinsed after the material is cured. The rinsing water will be collected and disposed properly. In addition, every attempt will be made to control the algae growth, which is associated with the elevated pH levels in the ponds.

6.2 AIR

The SSFL is regulated by the VCAPCD and must comply with all applicable rules, regulations, and permit conditions set forth in Permit to Operate No.00271. Permit to Operate No.00271 covers Area IV of the SSFL, which is inspected each year by the air district. On May 19, 2004, the VCAPCD performed its annual inspection. No issues or violations were identified.

Likewise, air emissions allocated to this operating permit have continued to remain under applicable thresholds and, as a result, the area is considered a non-Title-V, non-Aerospace NESHAP, and non-SARA 313 stationary source.

6.3 GROUNDWATER

A groundwater monitoring program has been in place at the SSFL site since 1984. Currently, the monitoring system includes 266 Boeing SSFL installed on-site and off-site wells and 19 private off-site wells. Routine quarterly chemical and radiological monitoring of the wells is conducted according to the monitoring plan submitted to the lead agency for the groundwater program. Quarterly reports are submitted to the regulatory agencies at the end of the first three quarters. An annual report is submitted to the lead agencies after the monitoring for the fourth quarter is completed. A summary of groundwater monitoring activities and sampling results for Area IV during 2004 is presented in Tables 6-1 and 6-2.

Table 6-1. Purposes of Groundwater Monitoring at Area IV in 2004

Item	Remediation	Waste Management	Environmental Surveillance	Other Drivers
Number of active wells monitored	0	0	54	0
Number of samples taken	0	0	140	0
Number of analyses performed	0	0	4819	0
% of analyses that are nondetects	0	0	76	0

Table 6-2. Ranges of Results of Groundwater Monitoring in 2004

Analytes	Ranges of Results for Positive Detections
Metals (µg/l)	<0.048 to 1700
Trichloroethene (TCE) (µg/l)	<0.61 to 110
cis-1,2-Dichloroethene (cis-1,2-DCE) (µg/l)	<1.6 to 430
Tetratchloroethene (PCE) (µg/l)	<0.48 to 0.67

Groundwater occurs at SSFL in the alluvium, weathered bedrock, and unweathered bedrock. First-encountered groundwater is indicated to exist under water table conditions and may be encountered in any of these media. For the purposes of this report, near-surface groundwater is defined as groundwater that is present in the alluvium and weathered bedrock, and groundwater that occurs in the unweathered bedrock is referred to as Chatsworth Formation groundwater. The alluvium is indicated to generally consist of unconsolidated sand, silt, and clay materials. Water levels in the alluvium respond to recharge resulting from precipitation and runoff and may vary considerably between wet and dry periods. Within Area IV, there are 10 DOE-sponsored near-surface groundwater wells (Figure 6-2). The Chatsworth Formation is predominantly composed of weakly to well-cemented sandstone with interbeds of siltstone and claystone. Several hydraulically significant features such as fault zones and shale bedas are present at SSFL and may act as impediments to groundwater flow across them. There are 44 DOE-sponsored Chatsworth Formation wells in and around Area IV (Figure 6-2).

The solvents found in Area IV groundwater include trichloroethene (TCE) and its family of degradation products. The results of the 2004 analyses of the Area IV wells were documented in the 2004 Annual Groundwater Monitoring Report (HA, 2005). Boeing initiated a voluntary site-wide program to assess the occurrence and distribution of perchlorate in 1997. This assessment identified a limited area of groundwater in the vicinity of the FSDF that has been impacted by perchlorate.

Six distinct areas of TCE-impacted groundwater have been delineated in the northwest part of Area IV. These areas include the drainage below RMHF, the vicinity of former Building 4059, the FSDF area, the former Building 28 area, the Building 100 area, and the Sodium Reactor Experiment (SRE) area (Figure 6-3). These areas are roughly defined by the locations of monitor wells where results of laboratory analyses of water samples indicate concentrations of TCE equal to or above the MCL of 5 µg/l. In 2004, TCE was detected below the MCL in well RD-13, located in the central part of Area IV near Burro Flats. This occurrence was determined to be the result of improperly decontaminated sampling equipment temporarily installed during the fourth quarter of 2000.

The TCE occurrence associated with the RMHF canyon (the northern occurrence) has historically been detected in shallow wells and Chatsworth Formation wells. Shallow well RS-28 was dry during 2004, but has historically contained TCE concentrations up to 87 µg/l. Chatsworth Formation well RD-30 contained 4.9 to 5.4 µg/l of TCE in 2004. RD-63, an extraction well installed in 1994 in the Chatsworth Formation for the pilot extraction test in the area, contained 3.4 to 4.3 µg/L TCE in 2004.

Near former Building 4059, Chatsworth Formation well RD-07 contained TCE concentrations ranging from 1.5 to 17 µg/l in 2004, . The RD-07 samples were collected from a discrete interval groundwater monitoring system installed in April 2002. Since its construction in 1986, RD-07 generally contained TCE concentrations in the 12 to 81 µg/l range with a maximum TCE concentration of 130 µg/l. Well RD-25, located southwest of former Building 4059, continued to contain low concentrations of tetrachloroethene (PCE). In 2004, the well contained 0.48 µg/l PCE, compared to 6.2 to 27 µg/l PCE in 2003. TCE was not detected in RD-25 during 2004. Well RD-24, located southeast of former Building 4059, contained TCE at an estimated concentration of 0.34 µg/l. Previously, TCE concentrations in RD-24 groundwater ranged from 0.18 to 1.5 µg.

TCE was detected in groundwater samples collected in 2004 from wells located near the FSDF area (Figure 6-3). In Chatsworth Formation wells, the maximum TCE concentration for samples collected during 2004 was 110 µg/l in RD-21. Historic RD-21 TCE concentrations have ranged from 59 µg/l to 680 µg/l. In addition to the RD-21 concentration, TCE concentrations exceeding the MCL of 5 µg/l were reported in 2004 from RD-23 (66 µg/l), RD-64 (71 µg/l), and RD-65 (27 µg/l). Historic maximum TCE concentrations for these wells are: RD-23, 610 µg/l; RD-64, 680 µg/l; and RD-65, 960 µg/l. Shallow wells in the FSDF area were not sampled during 2004. To accommodate the FSDF-area pumping test, sampling was postponed until the fourth quarter 2004. During the fourth quarter, well RS-18 could not be sampled because a pressure transducer was installed in the well. Samples could not be collected from shallow well RS-54

because electrical power that had been diverted during the pumping test had not been re-instated to this well.

TCE was reported in three Chatsworth Formation wells constructed in 2004. Well RD-86, located northeast of the SRE area, contained 10 µg/l TCE. Well RD-87, locate west of the former Building 28 location, contained 0.55 µg/l TCE. Well RD-91, located northwest of Building 100, contained 81 to 130 µg/l.

Detectable perchlorate concentrations have been observed in FSDF-area wells. Historic perchlorate concentrations in RS-54 groundwater ranged from not detected above a 4 µg/L detection limit to 15 µg/L. Historic samples collected from RD-21 have contained perchlorate at concentrations ranging from 3.7 to 9 µg/L. No FSDF-area wells were sampled for perchlorate in 2004.

Interim groundwater extraction systems are in place in the FSDF, RMHF, and former Building 4059 areas of degraded groundwater discussed above. A pilot extraction test initiated in 1994 at RMHF included installation of an extraction well and treatment of the extracted groundwater in a granular activated carbon (GAC) absorption treatment unit. Extraction and treatment of contaminated groundwater continued on an interim basis at RMHF in 2004. Groundwater extraction is also conducted in three wells (RD 24, RD-25, and RD-28) in the former 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 impacted groundwater continued on an interim basis at Building 4059 in 2004. Wells RD-25 and RD-28 were abandoned in April 2004 in conjunction with the demolition of Building 4059. The extraction activity at the FSDF was initiated in 1995. The groundwater extraction system at FSDF included extraction of impacted groundwater from wells RD-21 and RS-54 and treatment of the extracted groundwater in a GAC adsorption treatment unit. The FSDF system also uses ion exchange resin in series to treat perchlorate-impacted groundwater prior to discharge. Groundwater was not extracted from FSDF interim extraction well RS-54 during 2004 in order to accommodate the FSDF-area pumping test. To date, approximately 123,000 gallons, 3.5 million gallons, and 3.8 million gallons of groundwater have been extracted and treated from the FSDF, RMHF, and Building 4059 areas, respectively.

In addition to groundwater monitoring activities, additional characterization efforts have been conducted in the FSDF area of Area IV. During 2004, discrete interval groundwater monitoring systems installed in ten FSDF-area wells were sampled for VOCs, perchlorate, and radiochemicals. The data loggers monitored discrete-interval water level fluctuations, produced discrete-interval hydraulic head readings within the Chatsworth Formation groundwater system, and allowed the collection of discrete fracture connectivity testing data. Single-transducer data loggers installed in seven FSDF-area groundwater wells collected continuous water level data that supplemented discrete interval monitoring data and provided groundwater drawdown and recovery data during the FSDF-area pumping test.

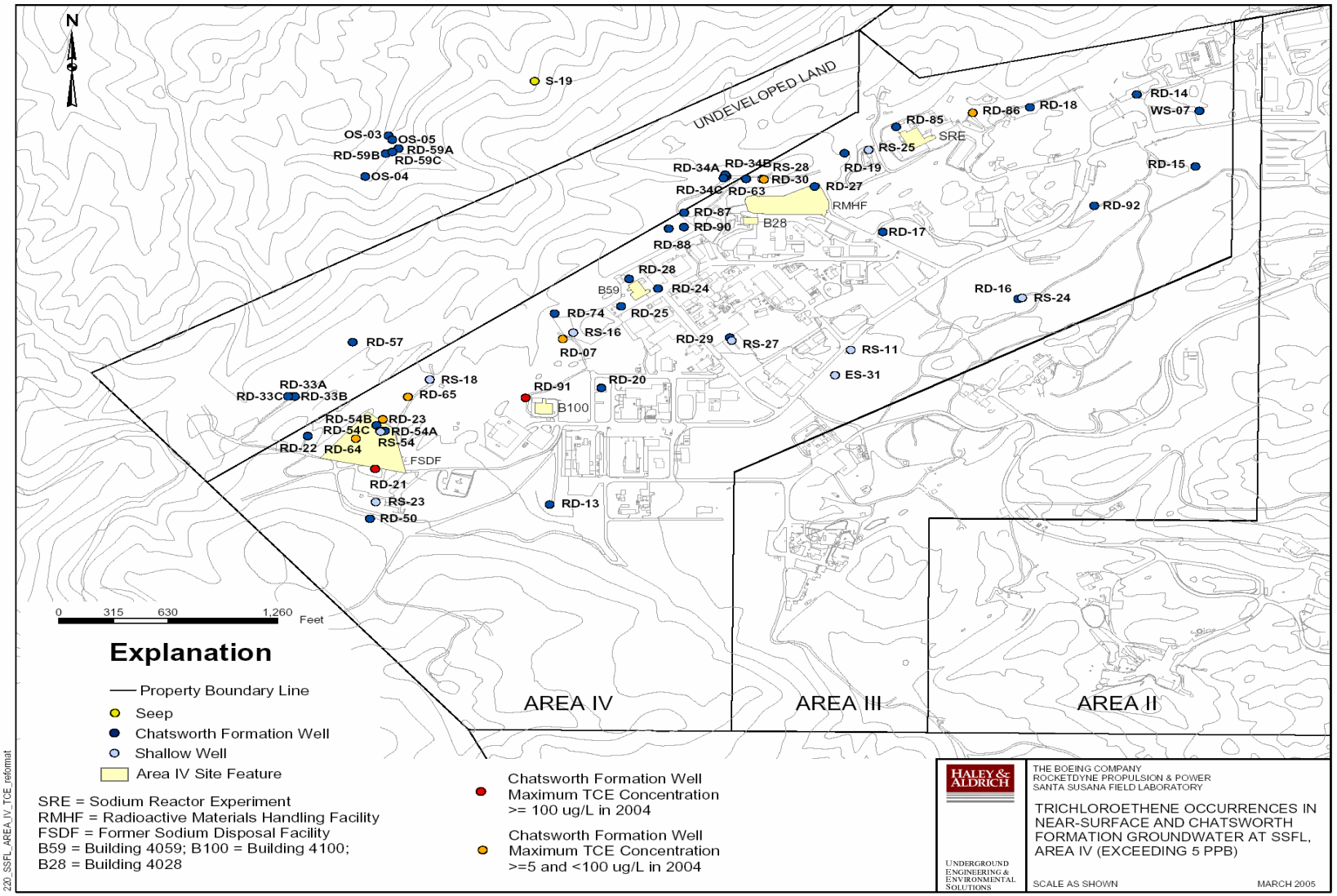


Figure 6-3. TCE Occurrences in Groundwater at SSFL, Area IV (exceeding 5 ppb)

6.4 SOIL

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

The RFI Program started at the SSFL site in 1996 and is presently ongoing. RFI fieldwork is scheduled to be completed in 2005. Field methodologies for the soil investigation include soil matrix sampling, soil vapor sampling, surface water sampling, and trenching. DTSC was onsite during much of the fieldwork to observe sampling protocols and select sampling locations and depths. Field action levels (FALs) were developed prior to sampling in conjunction with DTSC risk assessors for use as soil screening values during the field program. They were calculated to be chemical concentrations in soil that would not pose a threat to human health or groundwater quality.

Limited RFI fieldwork was completed in 2004 at the Building 4059 / Former SNAP Reactor Facility (Area IV AOC) excavation, and at DOE ground-mounted transformer locations. During 2004, approximately 45 soil matrix samples and 1 surface water sample were collected. No soil vapor or 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 2005.

Table 6-3. Sampling for RCRA Facility Investigation

Date	Soil matrix*		Soil Vapor		Surface Water		Groundwater		Spring/Seep	
	Sample	Analysis	Sample	Analysis	Sample	Analysis	Sample	Analysis	Sample	Analysis
1/1/04 to 12/31/04	45	66	0	0	1	7	0	0	0	0
Total to date	404	1,365	145	145	6	15	49	157	3	18

*Soil matrix totals include 5 soil leachate samples and 5 analyses to evaluate perchlorate concentrations in soil.

Key activities completed in the year 2004 included:

The comprehensive RFI Program Report was completed for DTSC submittal in July 2004. Per DTSC requirements, the report describes all elements of the RFI, including project objectives and scope of work, and provides laboratory information for samples collected through December 31, 2003.

Preparation of draft RFI site reports continued until March 2004, when activities were put on hold pending resolution of characterization and risk assessment requirements with DTSC.

Preliminary draft reports were prepared for the Former Sodium Disposal Facility (FSDF) (SWMU 7.3), the Building 56 Landfill (SWMU 7.1), and the Hazardous Materials Storage Area (HMSA) (Area IV AOC) RFI sites.

- A series of meetings were held and interim deliverables prepared to define agency requirements for a revised Standardized Risk Assessment Methodology Work Plan (SRAM). Revision of this document is in progress (SRAM Revision 2), and has been focused on soil and groundwater background data, new toxicological parameters, and inclusion of the vapor migration pathway from deep groundwater and bedrock.

- Soil sampling near DOE ground-mounted transformer locations in Area IV was completed in August 2004 (with the exception of those near Building 4059 [Area IV AOC] due to excavation activities).

- Soil sampling was conducted with DTSC at the Building 4059 / Former SNAP Reactor Facility (Area IV AOC) excavation. Except for metals (most at or near background levels), chemicals were not detected in the samples collected.

As described above, continuing DTSC negotiations regarding characterization and risk assessment requirements have resulted in a delay of the preparation and submittal of RFI site reports and risk assessments. Work planned for 2005 includes finalization and submittal of the SRAM Work Plan Revision 2 based upon negotiations with DTSC, followed by preparation and submittal RFI reports for DTSC review and approval. In addition, the Building 020 and the remainder of the Building 4059 site investigation fieldwork is scheduled to be implemented.

7. ENVIRONMENTAL MONITORING PROGRAM QUALITY CONTROL

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

- Reagent Quality—Certified grade counting gas is used.
- Laboratory Ventilation—Room air supply is controlled to minimize temperature variance and dust incursion.
- Laboratory Contamination—Periodic laboratory contamination surveys for fixed and removable surface contaminations are performed. Areas are cleaned routinely and decontaminated when necessary.
- Control Charts—Background and reference source control charts for counting equipment are maintained to evaluate stability and response characteristics.
- Laboratory Intercomparisons—Boeing SSFL participates in the DOE RESL-MAPEP.
- Calibration Standards—Counting standard radioactivity values are traceable to NIST primary standards.
- Co-location of State DHS thermoluminescent dosimeters.

7.1 PROCEDURES

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

7.2 RECORDS

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

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

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

7.3 QUALITY ASSURANCE

Boeing SSFL participated in the DOE Quality Assessment Program (QAP) for radiological analyses. This program was operated by the DOE's Environmental Measurements Laboratory (EML) in New York. In 2004 the DOE terminated the QAP program.

Boeing SSFL currently participates in the DOE Mixed Analyte Performance Evaluation Program (MAPEP). This program is operated by the DOE's Radiological and Environmental Sciences Laboratory (RESL). During 2004, one set of samples were distributed. The samples were: air filter (MAPEP-04-RdF12), water (MAPEP-04-W12), and soil (MAPEP-04-MaS12).

Acceptance criteria was developed by reviewing precision and accuracy data compiled from other performance evaluation programs, analytical methods literatures, the MAPEP pilot studies, and what is considered reasonable, acceptable, and achievable for routine analyses among the more experienced laboratories. The acceptance criteria are designed to be pragmatic in approach and may be changed as warranted.

For each reported radiological and inorganic analyte, the laboratory result and the RESL reference value will be used to calculate a relative bias:

$$\%\,\text{BIAS} = \frac{(100)(\text{Labortory Result} - \text{RESL Reference Value})}{\text{RESL Reference Value}}$$

For each reported organic analyte, the laboratory result, the mean of all reported results and the standard deviation of all results (less outliers) will be used to calculate a Z-score:

$$\text{Z - Score} = \frac{(100)(\text{Laboratory Result - Mean of All Data})}{\text{Standard Deviation of All Data}}$$

The relative bias will place the laboratory result in one of three categories:
1) ACCEPTABLE..... BIAS <= 20%
2) ACCEPTABLE WITH WARNING…. 20% < BIAS <= 30%
3) NOT ACCEPTABLE..... BIAS > 30%

The Z-Score will place the laboratory result in one of three categories:
1) ACCEPTABLE..... Z-Score <= 2.0
2) ACCEPTABLE WITH WARNING…. 2.0 < Z-Score <= 3.0
3) NOT ACCEPTABLE..... Z-Score > 3.0

The reported uncertainty is not currently used as part of the acceptance criteria, but it will be used to flag a potential area of concern. Activity levels and other analyte concentrations for MAPEP samples are typically sufficient to permit analyses with uncertainties of 10% or less, but it is unreasonable to expect the uncertainty for a single analysis of a routine sample to be much lower than the 10% value.

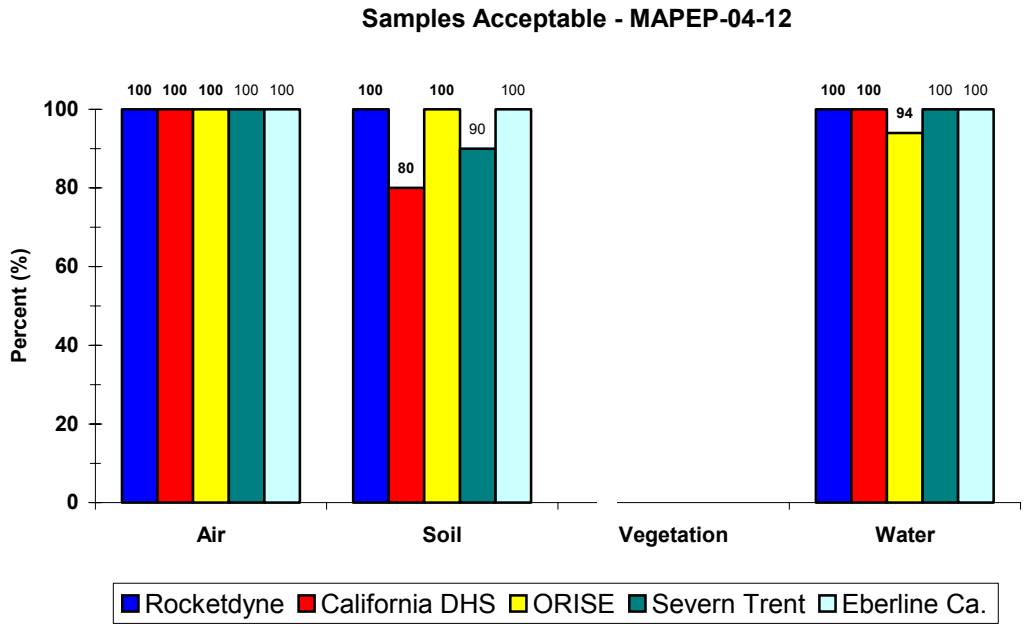
Variations in counting efficiencies, chemical yields, analytical methods, sample size, count times, difficult analyses, etc., will likely cause some uncertainties to exceed the 10% value. A meaningful routine analysis, however, will not over inflate the uncertainty estimate. The MAPEP will provide some feedback to the participants regarding the uncertainties reported with their results. Reported uncertainties that appear unreasonably low or suspiciously high will be flagged. Participants with flagged uncertainties, particularly if they are numerous, should review their methods and ensure that the uncertainties are appropriate.

Boeing SSFL and DOE use contract laboratories for environmental sample analyses. The MAPEP results of Boeing SSFL, California DHS Sanitation and Radiation Laboratory, Oak Ridge Institute for Science and Education (ORISE), the contract laboratories, are shown in Figure 7-1 for MAPEP-04. These comparisons involve sample types, geometries, and analyses that are not part of the routine procedures at the Boeing SSFL laboratory.

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

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

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



Note: The vegetation sample was not a part of the MAPEP-04 sample set.

Figure 7-1. Mixed Analyte Performance Evaluation Program for 2004

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APPENDIX A
ACRONYMS

AI	Atomics International
ALARA	As Low As Reasonably Achievable
ASER	Annual Site Environmental Report
ANL	Argonne National Laboratory
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
D&D	Decontamination and Decommissioning
DCG	Derived Concentration Guide
DHS/RHB	Department of Health Services/Radiologic Health Branch
DOD	Department of Defense
DOE	Department of Energy
DTSC	Cal-EPA Department of Toxic Substances Control
EA	Environmental Assessment
EEOICPA	Energy Employees Occupational Illness Compensation Program Act
EML	Environmental Measurements Laboratory
EP	Environmental Protection
EPA	Environmental Protection Agency
ER	Environmental Remediation
ETEC	Energy Technology Engineering Center
FFCA	Federal Facilities Compliance Act
FONSI	Finding of No Significant Impact
FSDF	Former Sodium Disposal Facility
GRC	Groundwater Resources Consultants, Inc. (Tucson, AZ)
HEPA	High-Efficiency Particulate Air
HPGe	High-Purity Germanium (Detector)
HWMF	Hazardous Waste Management Facility

ISMS	Integrated Safety Management System
LLNL	Lawrence Livermore National Laboratory
LLW	Low Level Waste
MAPEP	Mixed Analyte Performance Evaluation Program
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCA	Multichannel Analyzer
MCL	Maximum Contamination Level
MDA	Minimum Detectable Activity
MEI	Maximally Exposed Individual
MLLW	Mixed Low-level Waste
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
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
ORPS	Occurrence Reporting and Processing System
PCB	Polychlorinated Piphenyl
PCE	Perchloroethene
PEIS	Programmatic Environmental Impact Statement
QA	Quality Assurance
QAP	Quality Assessment Program
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RESL	Radiological and Environmental Sciences Laboratory
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RFP	Request for Proposal
RMHF	Radioactive Materials Handling Facility
ROD	Record of Decision
RS	Radiation Safety
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SHEA	Safety, Health & Environmental Affairs
SIPs	State Implementation Plans

S&M	Surveillance and Maintenance
SNAP	Systems for Nuclear Auxiliary Power
SPCC	Spill Prevention Control and Countermeasure
SPTF	Sodium Pump Test Facility
SRAM	Standardized Risk Assessment Methodology
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
SWPPP	Storm Water Pollution Prevention Plan
STP	Sewage Treatment Plant or Site Treatment Plan
SWMU	Solid Waste Management Unit
TCE	Trichloroethylene
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
TRU	Transuranic
UST	Underground Storage Tank
VCAPCD	Ventura County Air Pollution Control District
WVN	Water Vapor Nitrogen

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Site Environmental Report Reader Survey--2004

To Our Readers:

The Annual Site Environmental Report publishes the results of environmental monitoring in support of DOE-sponsored programs at Boeing'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 Boeing'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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