The Boeing Company
Santa Susana Field Laboratory
5800 Woolsey Canyon Road
Canoga Park, CA 91304-1148

BOEING

Via Express Courier

December 13, 2007
In reply refer to SHEA-106718

Mr. Norman Riley
SSFL Project Director
California Department of Toxic Substances Control
1001 "I" Street, 25th Floor
P.O. Box 806
Sacramento, CA 95812-0806

RE: Offsite Data Evaluation Report
Santa Susana Field Laboratory, Ventura County, California

Dear Mr. Riley:

Pursuant to Section 3.4.9 of the Consent Order for Corrective Action signed by DTSC, Boeing, NASA, and DOE on August 16, 2007, please find attached the Offsite Data Evaluation Report. Offsite data have been compiled from 18 field sampling and analysis programs. This report summarizes and evaluates the results of offsite media sampling and testing data for chemical and radiological contaminants collected by Boeing, NASA, and DOE within a 15-mile radius around the Santa Susana Field Laboratory over a nearly 60 year time period..

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature:
Name: Thomas D. Gallacher
Title: Director, Santa Susana Field Laboratory, Environment, Health & Safety
Date: 12/12/2007

AJL:bjc
Enclosure

cc: Jim Pappas (w/o enclosures)
Gerard Abrams, DTSC Sacramento (8 hard copies, 12 CDs)
Tom Seckington, DTSC Cypress (2 hard copies, 2 CDs)

cc (con't) Susan Houghton, DTSC Berkeley (1 CD)
William Jeffers, DTSC Glendale (1 hard copy, 1 CD)
Kasia Grisso, CH2M Hill (1 CD)
Allen Elliott, NASA (2 hard copies, 2 CDs)
Thomas Johnson, DOE Canoga Park (1 hard copy, 1 CD)
Patricia Berry, DOE Oakland (1 hard copy, 1 CD)
Robert Marshall, CSUN Oviatt Library (1 hard copy)
Dale Redfield, Simi Valley Library (1 hard copy)
Lynn Light, LA Library (1 hard copy)

OFFSITE DATA EVALUATION REPORT
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

Prepared For:

THE BOEING COMPANY

AND

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AND

THE UNITED STATES DEPARTMENT OF ENERGY

Prepared By:

MWH
618 Michillinda Ave, Suite 200
Arcadia, CA 91007

December 2007

PROFESSIONAL CERTIFICATION
Offsite Data Evaluation Report
Santa Susana Field Laboratory

This report has been prepared by a team of qualified professionals under the supervision of the MWH staff whose seals and signatures appear below. The findings and interpretations of data included herein are based on the available information at the time the report was prepared in accordance with generally accepted professional practices. Contributions are acknowledged from others inside and outside of MWH, including Richard G. Andrachek (Santa Susana Field Laboratory Groundwater Program Director, MWH), Dr. Michael J. Sullivan (Assistant Professor of Environmental and Occupational Health, California State University Northridge), and Mr. Phil Rutherford (Manager of Health, Safety & Radiation Services, The Boeing Company).

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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	asbestos-containing materials
AEC	Atomic Energy Commission
AOC	Area of Concern
ASER	Annual Site Environmental Reports
AST	aboveground storage tank
BaP	benzo(a)pyrene
BBI	Brandeis-Bardin Institute
bgs	below ground surface
Bq/kg	Bacquerel per kilogram
Cal-EPA	California Environmental Protection Agency
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COPC	contaminant of potential concern
DCE	dichloroethene
DHS	California Department of Health Services
DHS-RHB	California Department of Health Services Radiological Health Branch
Dioxins/Furans	(a) - *see table below*
DPH-RHB	California Department of Public Health Radiologic Health Branch
DOE	United States Department of Energy
DTSC	Department of Toxic Substances Control
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ERDA	Energy Research & Development Agency
ETEC	Energy Technology Engineering Center
FAL	field action level
FSDF	Former Sodium Disposal Facility
GPS	global positioning satellite
GRC	Groundwater Resources Consultants, Inc.
GSU	Geological Services Unit

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

GWCC	Groundwater Comparison Concentrations7
H&A	Haley & Aldrich
HEPA	high efficiency particulate air
ICF	ICF Kaiser Engineers
ID	identifier
IM	interim measure
IMIR	Interim Measures Implementation Report
IMWP	Interim Measures Work Plan
ISF	Interim Storage Facility
LADWP	Los Angeles Department of Water and Power
LLNL	Lawrence Livermore National Laboratory
LOX	liquid oxygen
LUFT	Leaking Underground Fuel Tank
MCL	maximum contaminant level
MDC	minimum detectable concentration
mg/kg	milligrams per kilogram
MMH	monomethyl hydrazine
MRCA	Mountains Recreation and Conservation Authority (Sage Ranch)
msl	mean sea level
MWL	meteoric water line
NASA	National Aeronautics and Space Administration
NDMA	n-nitrosodimethylamine
ng/kg	nanograms per kilogram
NMDF	Nuclear Materials Development Facility
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
Ogden	Ogden Environmental and Energy Services Co., Inc.
OMRE	Organic Moderated Reactor Experiment
ORAU	Oak Ridge Associated Universities

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

ORISE	Oak Ridge Institute of Science and Education
OSR	Offsite Data Evaluation Report
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyls
ppb	parts per billion
PRG	USEPA prelminary remediation goal
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
PVC	polyvinyl chloride
QA	quality assurance
RBSL	Risk-based Screening Level
RCRA	Resource Conservation and Recovery Act
R&D	Research & Development
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RHB	Radiologic Health Branch
RL	laboratory reporting limit
RMDF	Radioactive Materials Disposal Facility (also 'RMHF)
RMHF	Radioactive Materials Handling Facility (also RMDF)
RWQCB	Los Angeles Regional Water Quality Control Board
SAIC	Science Applications International Corporation
SMMC	Santa Monica Mountains Conservancy (Sage Ranch)
SNAP	Systems for Nuclear Auxiliary Power
SOP	standard operating procedures
SRAM	Standardized Risk Assessment Methodology
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

TPH	total petroleum hydrocarbon
TCA	trichloroethane
TCE	trichloroethene
TDS	total dissolved solids
TEQ	Toxic Equivalency
UDMH	unsymmetrical dimethyl hydrazine
µg/L	micrograms per liter
µR/H	microRoentgen per hour
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	Volatile Organic Compound

(a) Definition of dioxin/furan congeners

PCDD/PCDDs	Polychlorinated dibenzo-p-dioxins/dibenzofurans
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
1,2,3,7,8-PeCDD	1,2,3,7,8-pentachlorodibenzo-p-dioxin
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-hexachlorodibenzo-p-dioxin
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-hexachlorodibenzo-p-dioxin
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-hexachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin
OCDD	1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin
2,3,7,8-TCDF	2,3,7,8-tetrachlorodibenzofuran
1,2,3,7,8-PeCDF	1,2,3,7,8-pentachlorodibenzofuran
2,3,4,7,8-PeCDF	2,3,4,7,8-pentachlorodibenzofuran
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-hexachlorodibenzofuran
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-hexachlorodibenzofuran
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-hexachlorodibenzofuran
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-hexachlorodibenzofuran
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-heptachlorodibenzofuran
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-heptachlorodibenzofuran
OCDF	1,2,3,4,6,7,8,9-octachlorodibenzofuran
TEQs	Toxic Equivalency Quotients (normalized to 2,3,7,8-TCDD)

EXECUTIVE SUMMARY

Pursuant to Section 3.4.9 of the Consent Order for Corrective Action, Docket No. P3-07-08-003, this report has been prepared on behalf of The Boeing Company (Boeing), the National Aeronautics and Space Administration (NASA), and the United States Department of Energy (DOE) to present and evaluate offsite sampling data collected by Boeing, NASA, or DOE around the Santa Susana Field Laboratory (SSFL).

Specifically, the objectives of this report are to (1) summarize all offsite media sampling and testing data for chemicals and radionuclides conducted by Boeing, NASA, or DOE around the SSFL, and (2) evaluate this data for completeness and make conclusions and recommendations for additional sampling if needed. This report includes:

- Itemized descriptions of all separate offsite sampling programs conducted by Boeing, NASA, or DOE, specifying objectives and summarizing results and conclusions;
- Maps and figures showing sampling locations, results, and media type;
- Data tables of offsite results, including references to original reports;
- Evaluation of sampling results collected by Boeing, NASA, or DOE with conclusions regarding completeness and recommendations for additional sampling where warranted; and,
- A bibliography and electronic copies of all work plans and reports prepared by Boeing, NASA, or DOE for offsite sampling programs.

The offsite data compiled and presented in this report are evaluated for completeness by considering multi-media results and the potential transport of onsite contaminants to offsite locations, and for significance by comparison to residential risk-based or agency-published screening levels. Offsite results were identified as significant if data were above screening levels and likely related to SSFL operations, considering the frequency and level of detection, surrounding sampling results, and relationship to onsite sources. The overall conclusions of this report are:

1. The offsite sampling results are sufficient with no data gaps identified except in areas of ongoing investigation or cleanup. Offsite data will continue to be supplemented with ongoing sampling programs where appropriate. Onsite data gap analysis is continuing and may also result in additional offsite sampling recommendations.
2. The concentrations of chemicals and radionuclides measured in samples collected offsite of the SSFL are not significant in comparison to screening levels except in groundwater north of the main entry gate to the SSFL, and in sediment within the Northern Drainage. These areas are the focus of current and future work, and a remedial cleanup action is currently underway in the Northern Drainage.

Figure ES-1 shows where offsite samples have been collected and indicates the two offsite areas where confirmed contamination above screening levels have been found.

Data included in this report has been collected by Boeing, NASA, or DOE during 18 separate offsite programs conducted within a 15-mile radius of the SSFL over the past nearly 60 years (since 1949). These programs include:

1. Sampling for Annual Site Environmental Reports (1959 – present)
2. Oak Ridge Associated Universities / Oak Ridge Institute of Science and Education Study (1986 and 1997)
3. Offsite Groundwater Sampling Program (1985 - Present)
4. Springs and Seeps Sampling Program (1985 - Present)
5. Brandeis Bardin Institute /Santa Monica Mountains Conservancy Project (1992 - 1994)
6. Chatsworth and West Hills Private Home Sampling (1994)
7. Area IV Radiological Survey (1994-1995)
8. Lawrence Livermore National Laboratory – Rocketdyne Recreation Center Study (1997)
9. Bell Canyon Project (1998)
10. Former Sodium Disposal Facility Offsite Sampling (1995 - 2000)
11. Perchlorate Study (Northern Drainage) (2003)
12. OS-9R Multi-Level Groundwater Monitoring System Program (2003 – 2005)
13. SSFL Soil Background Sampling (1992 - 2005)
14. Post Topanga Fire Background and Surface Water Sampling Program (2005 - 2006)
15. Former SSFL Leased Area Debris Survey (2007)
16. Northern Drainage Clay Target and LOX Debris Sampling Program (2007)
17. AREVA Study (2007)
18. RFI Program (1996 – Present)

Offsite properties and areas sampled include: the American Jewish University Brandeis-Bardin Campus (formerly Brandeis-Bardin Institute), the Mountains Recreation and Conservation Authority Sage Ranch Park, Black Canyon, Woolsey Canyon, West Hills (Rocketdyne Recreational Center), Dayton Canyon, Bell Canyon, and Ahmanson Ranch. Environmental media sampled include: soil vapor, soil and sediment, groundwater, surface water, springs and seeps, bedrock, vegetation, municipal water, and other solids (e.g., concrete, debris). Over 4,000 offsite samples, representing over 110,000 discrete analyses of individual chemicals or radionuclides, were evaluated.

Many regulatory agencies and members of the public have provided oversight, overview, and review of the SSFL offsite programs. A partial list of participating organizations includes:

- United States Environmental Protection Agency (USEPA)
- California Environmental Protection Agency (Cal-EPA), DTSC, Geological Services Unit and Human and Environmental Risk Division
- California Department of Public Health, Radiological Health and Environmental Management Branches
- Cal-EPA, Regional Water Quality Control Board, Los Angeles Region (RWQCB)
- Representatives of Brandeis-Bardin and Simi Valley SSFL Workgroup, and residents from surrounding communities

Offsite data were evaluated to determine the completeness of the dataset and the significance of the measured concentrations. Offsite sampling results were evaluated for spatial and temporal trends in relation to SSFL operational areas or known areas of impacts. Evaluation of potential migration of contaminants from onsite sources was considered for the groundwater, surface water, and air transport pathways. In the comparison of sampling results to screening levels, consideration was given to age and type of detection (e.g., common laboratory contaminants) and temporal consistency of results. Conclusions and recommendations resulting from this evaluation are presented below.

Conclusions for Data Completeness

1. The offsite soil/sediment data are sufficient and no data gaps are identified except in areas of ongoing work in the northeast and in the Northern Drainage.

2. The offsite groundwater data are generally sufficient and additional data are currently being collected with respect to the presence of potential groundwater contaminants in wells surrounding the site, most notably volatile organic compounds (VOCs) in offsite groundwater northeast of the SSFL.

3. The offsite springs and seeps data are generally sufficient and additional data are currently being collected to verify that the low concentrations of VOCs detected in some of the springs southwest of the SSFL are laboratory contaminants and not from site operations. Spring and seep sampling in all areas surrounding the site is ongoing to continue to assess potential groundwater transport of contaminants and to gain insight regarding the groundwater flow system.

4. The offsite surface water data are sufficient and no data gaps have been identified. Evaluation of surface water permit limit exceedances onsite is ongoing to identify potential sources from onsite contamination or naturally occurring conditions.

Conclusions for Data Significance

1. The offsite sample results for VOCs are not significant except for their presence in groundwater and soil vapor in the area northeast of the SSFL. VOCs in this area continue to be evaluated as part of ongoing investigation programs.

2. The offsite sample results for metals and polynuclear aromatic hydrocarbons (PAHs) are not significant except in the Northern Drainage. A DTSC-approved soil and debris removal action is underway in the Northern Drainage on Sage Ranch for construction and clay pigeon target debris areas, and in down-drainage sediments. The construction debris area also contained asbestos-containing materials

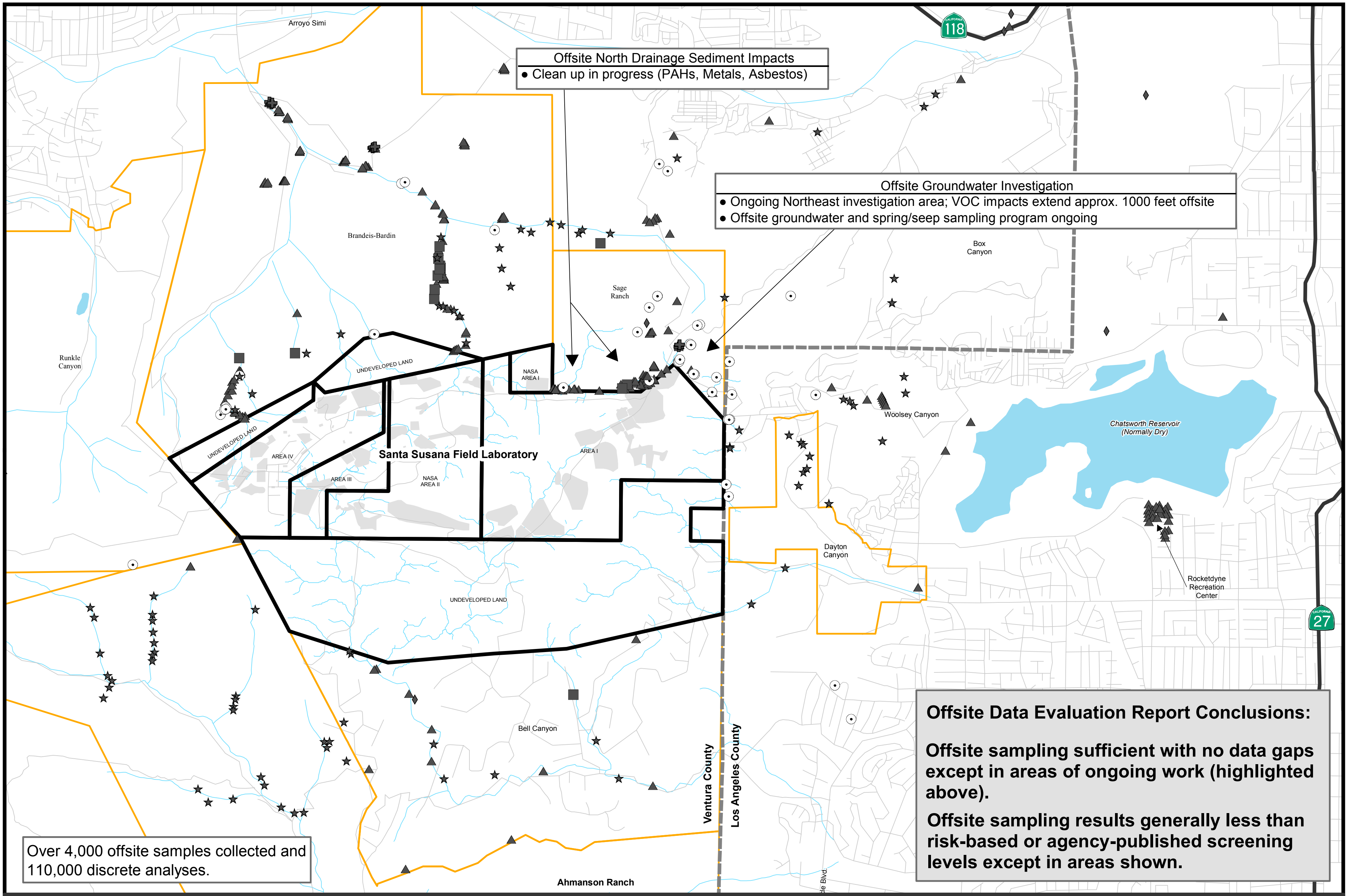
3. The offsite sample results for dioxins, polychlorinated biphenyls (PCBs), perchlorate, total petroleum hydrocarbons (TPH), and radionuclides are not significant.

Recommendations for Additional Sampling

1. Continue ongoing monitoring of offsite groundwater and springs and seeps for VOCs, or as required by work plans until completion of the groundwater investigation program.

2. Complete cleanup actions within the Northern Drainage and evaluate confirmation sampling results to ensure completeness of removal.

3. Continue onsite data gap analysis and sampling, and conduct offsite work as warranted based on results.



Offsite North Drainage Sediment Impacts

- Clean up in progress (PAHs, Metals, Asbestos)

Offsite Groundwater Investigation

- Ongoing Northeast investigation area; VOC impacts extend approx. 1000 feet offsite
- Offsite groundwater and spring/seep sampling program ongoing

Offsite Data Evaluation Report Conclusions:

Offsite sampling sufficient with no data gaps except in areas of ongoing work (highlighted above).

Offsite sampling results generally less than risk-based or agency-published screening levels except in areas shown.

Over 4,000 offsite samples collected and 110,000 discrete analyses.

1 inch equals 4,000 feet

0 2,000 4,000 Feet

▭	**Administrative Area Boundary**
▭	**County Boundary**
🟧	**Properties**
▨	**Investigation Areas**
〰	**Highway**
〰	**Streets**
〰	**Streams**

Sample Locations

♦	**Multimedia**	▲	**Soil/Sediment**
⊙	**Groundwater**	■	**Surface Water**
★	**Spring/Seep**	✚	**Vegetation**

PAHs - Polynuclear Aromatic Hydrocarbons
VOCs - Volatile Organic Compounds

Note: Samples also collected from locations more distant from SSFL not shown on figure. These samples (collected within 15 miles) used as reference or background comparison.

Offsite Data Evaluation Summary Santa Susana Field Laboratory

MWH

Date: Dec 14, 2007

Document: Offsite-Report_Data_Evaluation.mxd

FIGURE ES-1

1.0 INTRODUCTION

The Santa Susana Field Laboratory (SSFL) is a former rocket engine testing and nuclear energy research facility located in the hills west of Los Angeles, California, above the Simi and San Fernando Valleys. The SSFL is jointly owned by The Boeing Company and National Aeronautics Space and Administration (NASA), with several facilities owned by the United States Department of Energy (DOE). The SSFL has been the subject of numerous environmental investigations to determine if chemical or radiological releases have occurred, and the extent and significance of those releases. The majority of chemical characterization has taken place under the Resource Conservation and Recovery Act (RCRA) Corrective Action program, RCRA Facility Investigation (RFI), under the oversight of the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC). Radiological characterization and cleanup has occurred under the oversight of the DOE with regulatory review by the California Department of Health Services Radiological Health Branch (DHS-RHB), now renamed the California Department of Public Health Radiologic Health Branch (DPH-RHB). In addition to onsite investigations, there have been environmental investigations conducted in areas offsite, but adjacent to, the SSFL. The purposes of these investigations have been varied but generally have been designed to answer the question of whether chemicals released at the SSFL are present in these offsite areas. While these investigations have focused on specific offsite areas and the data collected have been sufficient to draw conclusions about those areas, the data obtained from these offsite studies have not been compiled or analyzed as a whole.

This report has been prepared on behalf of Boeing, NASA, and DOE pursuant to Section 3.4.9 of the Consent Order for Corrective Action, Docket No. P3-07-08-003, to present and evaluate offsite chemical and radiological sampling data collected by Boeing, NASA, or DOE around the Santa Susana Field Laboratory.

1.1 OBJECTIVE AND SCOPE OF SSFL OFFSITE DATA EVALUATION REPORT

The objectives of this Offsite Data Evaluation Report (OSR) is to (1) summarize all offsite media sampling and testing data for chemicals and radionuclides conducted by Boeing, NASA, or DOE around the SSFL, and (2) evaluate this data for completeness and make conclusions and recommendations for additional sampling if needed. This report includes:

- Itemized descriptions of all separate offsite sampling programs conducted by Boeing, NASA, or DOE, specifying objectives and summarizing results and conclusions;

- Maps and figures showing sampling locations, results, and media type;
- Data tables of offsite results, including references to original reports;
- Evaluation of sampling results collected by Boeing, NASA, or DOE with conclusions regarding completeness and recommendations for additional sampling where warranted; and,
- A bibliography and electronic copies of all work plans and reports prepared by Boeing, NASA, or DOE for offsite sampling programs.

This report presents and analyzes the results of the chemical and radiological analyses performed on offsite samples. The offsite data are evaluated for completeness considering multi-media results and the potential transport of onsite contaminants offsite, and for significance of detections relative to regulatory based comparison levels. Conclusions and recommendations are made as to the completeness of the sampling, and whether or not additional sampling is necessary.

The data presented in this report consist of the results of offsite sampling conducted by Boeing, NASA or DOE around the SSFL. Offsite data collected by others in areas surrounding the SSFL are not included in this report, although DTSC sample results collected in support of the offsite programs conducted by Boeing, NASA, or DOE are briefly described. Offsite properties where samples have been collected include: the American Jewish University Brandeis-Bardin Campus (formerly the Brandeis-Bardin Institute [BBI]), the Mountains Recreation and Conservation Authority (MCRA) Sage Ranch Park, Black Canyon, Woolsey Canyon, Dayton Canyon, Bell Canyon, West Hills (Rocketdyne Recreational Center), and Ahmanson Ranch (Figure 1-1). Data collected by the Boeing, NASA, or DOE in areas over 15 miles away from the SSFL are not included since these samples are not related to SSFL operations and many were collected as regional reference data for comparison of data collected at or near the SSFL.

This report presents a summary and compilation of previous reports prepared for offsite sampling programs, as well as a compilation of both chemical and radiological analytical results for offsite samples across all sampled media: soil vapor, soil and sediment, groundwater, surface water, springs and seeps, bedrock, vegetation, municipal water, and other solids (e.g., concrete, debris). Air samples have not been collected by Boeing, NASA, or DOE in offsite areas.

1.2 SSFL INFORMATION

The SSFL is located approximately 29 miles northwest of downtown Los Angeles, California in the southeast corner of Ventura County. The SSFL occupies approximately 2,850 acres of hilly terrain with approximately 1,100 feet of topographic relief near the crest of the Simi Hills. Figure 1-1 shows the geographic location, property lines, and surrounding communities of the site. The following sections describe the land use within and surrounding the SSFL, ownership and operational history, and types of chemical use at the site.

1.2.1 History and Land Use

Prior to use as a rocket engine testing facility, the land at the SSFL was used for ranching and grazing. North American Aviation (a predecessor to Boeing) began using (by lease) what is now known as the northeastern portion of Area I during 1947. The majority of the SSFL was acquired as part of the Silvernale property in 1954, and development of the western portion of the SSFL began soon after. Undeveloped land parcels to the south of the SSFL were acquired during 1968 and 1976, and to the north during 1998. No site-related operations were conducted in these areas.

The SSFL is jointly owned by Boeing and NASA and is operated by Boeing. There are DOE-owned facilities on 90 acres of Boeing-owned property in the western SSFL.

The SSFL is divided into four administrative areas (Areas I, II, III, and IV), with undeveloped land areas to both the north and south (Figure 1-1). The areas are owned and operated as follows (Science Applications International Corporation [SAIC] 1994):

Area I - United States Environmental Protection Agency (USEPA) Identification (ID) Number CAD 093365435 consists of 713 acres located in the northeastern portion of the site. Boeing owns 671 acres, and the remaining 42 acres are owned by NASA. Boeing operates the entire Area I, including the NASA portion. The 42-acre NASA property in Area I was formerly owned by the United States Air Force.

Area II - USEPA ID Number CA 1800090010 consists of 410 acres located in the north-central portion of the site. Area II is owned by NASA and operated by Boeing.

Area III - USEPA ID Number CAD 093365435 consists of 114 acres and is owned and operated by Boeing.

Area IV - USEPA ID Numbers CAD 000629972 and CA 3890090001 consist of 290 acres located in the northwest section of the site, which are owned and operated by Boeing. Several remaining buildings in Area IV are owned by the DOE and comprise the Energy Technology Engineering Center (ETEC).

Southern Undeveloped Area - The southern portion of the SSFL is an undeveloped, open space area that consists of approximately 1,200 acres along the southern boundary of the site. This naturally vegetated area is owned by Boeing. Industrial activities have not been conducted in this area.

Northern Undeveloped Area - The northern portion of the SSFL, adjacent to Areas II, III, and IV, is an undeveloped open space area consisting of about 180 acres. This area is naturally vegetated and has not been used for industrial activities. It is owned by Boeing.

The SSFL has been active since 1948. Site activities have included research, development, and testing of rocket engines, water jet pumps, lasers, liquid metal heat exchanger components, nuclear energy, and related technologies. The principal activity has been large rocket engine testing by Boeing and NASA in Areas I, II, and III, and energy technology research by DOE in Area IV. The site is currently inactive with the exception of limited laser research operations and support activities including maintenance, site engineering, environmental, health and safety, and security.

1.2.2 Facility Operations and Chemical / Radiological Use

Operational activities at the SSFL began in 1948 and have primarily included research, development, and testing of liquid-propellant rocket engines and associated components (pumps, valves, etc.) (SAIC 1994). Liquid-propellant rocket engine testing activities have been conducted at six major rocket engine test areas: Bowl, Canyon, Alfa, Bravo, Coca, and Delta. These areas were all in operation in the late 1950s and early 1960s. The Bowl, Canyon, and Delta test areas were phased out of operation in the late 1960s and 1970s. Operations at the Coca test area concluded in May 1988, and operations at the Alfa and Bravo test areas concluded in 2006. Engine testing at these areas primarily used petroleum-based compounds as the “fuel” and liquid oxygen (LOX) as the “oxidizer.” Solvents, primarily trichloroethene (TCE), were used for cleaning engine components. In 1961, TCE recycling systems were installed to capture and reuse the solvent in active testing areas. After 1977, TCE was only used (and reclaimed) at one test stand location (Alfa) (ICF Kaiser Engineers [ICF] 1993a, 1993b, 1993c). TCE use at the SSFL was discontinued in the early

1990s. In addition to the primary facility operation for testing liquid-propelled rocket engines, the SSFL was used for research, development, and testing of water jet pumps and lasers.

From the mid 1950s until the mid 1990s, DOE and its predecessor agencies sponsored nuclear energy research and energy development projects within Area IV of the SSFL. Today, the research center is referred to as the ETEC. The research and energy development activities included nuclear energy operations (design, construction, and operation of nuclear reactors, development, fabrication, disassembly, and examination of nuclear fuel and other radioactive materials), and large-scale liquid sodium metal experiments for testing liquid metal fast breeder reactor components. Nuclear energy operations included 10 nuclear research reactors, 7 critical facilities, the Hot Laboratory, the Nuclear Materials Development Facility (Solid Waste Management Unit [SWMU] 7.2), the Radioactive Materials Handling Facility (RMHF) (SWMU 7.6), and various test and nuclear material storage areas at ETEC. All nuclear research operations ended in 1988. Area IV nuclear energy research and other energy development operations and facility status are summarized in a recent Environmental Assessment Report prepared in anticipation of ETEC closure activities (DOE 2003), in the Area IV Historical Site Assessment (Sapere 2005).

Laboratories, chemical storage areas, equipment assembly, and maintenance facilities have supported operations at the SSFL. Laboratories were used to supply chemicals for testing operations, or to conduct small-scale testing of materials (e.g., metals). Liquid chemicals were historically stored in various types of containers and vessels including drums, aboveground storage tanks (ASTs), and underground storage tanks (USTs). Solid or powdered chemicals used at the SSFL were stored in drums or other containers and often kept in buildings or on above-grade storage pads.

A summary of the primary types of chemicals used for SSFL operations is provided in Table 1-1. Petroleum fuel hydrocarbons and chlorinated solvents have been used at the SSFL in the largest volumes. Petroleum hydrocarbons were used as fuel for many of the liquid-propellant rocket engine tests performed there. Chlorinated solvents, primarily TCE, were used following engine tests to clean elements of the rocket engines (e.g., thrust chambers) and for other equipment degreasing operations at the SSFL. Another solvent used in lesser quantities, 1,1,1-trichloroethane (TCA), likely contained 1,4-dioxane as a stabilizer to increase the longevity and usefulness of the solvent. Based on facility records, 1,4-dioxane was not added to TCE as a stabilizer for rocket engine testing operations at the SSFL because it caused an undesirable residue on engine components that did not meet specifications. Solid propellants, including perchlorate compounds, were used at the SSFL for research and testing operations. Perchlorate was used in relatively small quantities (when compared to liquid propellant quantities) as an oxidizer for the production of turbine spinners and igniters; for research, development, and production of flares; and for small-scale solid-propellant rocket motors research, development, and testing (MWH 2003a). Polychlorinated biphenyls (PCBs) were present in some waste oils, and oils within pre-1980 electrical transformers at various locations within the SSFL.

Other chemicals may have entered the environment as by-products of SSFL operations. The periodic burning of petroleum fuels that accumulated in the ponds may have produced polychlorinated dibenzodioxins and dibenzofurans (collectively referred to in this document as “dioxins”). N-nitrosodimethylamine (NDMA) may have been produced by the environmental breakdown of unsymmetrical dimethyl hydrazine (UDMH). UDMH and monomethyl hydrazine (MMH) were used as fuel in research and development testing of ‘storable propellent’ rocket engines at a few locations within the SSFL. Various metals may have been used in machining operations, or stored or disposed as construction debris.

Chemical and solid wastes created from facility operations have been managed through various methods. Three landfills were used at the SSFL primarily for disposal of nonhazardous, inert construction debris (e.g., concrete, asphalt, rock, soil, etc.). Liquid wastes from engine testing were managed until the 1980s in a series of both flow-through and retention ponds. Ten of these ponds (impoundments) have undergone closure; one was clean-closed, and nine were closed as RCRA-regulated units, managed under the Post-Closure Permit. After closure of these impoundments, wastes were managed for offsite recycling, treatment, or disposal.

1.2.3 SSFL Environmental Programs

The SSFL has several ongoing environmental programs in addition to the RCRA Corrective Action and DOE closure of nuclear testing facilities described briefly above and in more detail in Section 1.4. These include permitting for air emissions and surface water discharges, and various other site investigation and closure activities.

Surface water discharge from the SSFL is regulated under a National Pollutant Discharge Elimination System (NPDES) permit issued by the RWQCB, beginning in 1984. Surface water discharges from the site are regularly monitored at NPDES locations. Air emissions at the SSFL are regulated and permitted by Ventura County Air Pollution Control District (VCAPCD). Emissions of carbon monoxide, nitrogen and sulfur oxides, reactive organic compounds, and particulate matter are managed in accordance with all applicable rules, regulations, and permit conditions. In addition, lead and asbestos abatement work performed at the facility is managed as required by applicable local, state, and federal regulations.

1.3 PHYSICAL SETTING OF THE SSFL AND SURROUNDING AREA

This section presents the topography, climate, and geology of the SSFL. The occurrence of surface water and groundwater at the SSFL is also described.

1.3.1 Topography

The SSFL occupies approximately 2,850 acres of hilly terrain that expresses approximately 1,100 feet of topographic relief near the crest of the Simi Hills. A shaded-relief topographic map depicting site topography is provided as Figure 1-2. The highest surface elevation at the SSFL occurs near the center of the site at an approximate elevation of 2,245 feet above mean sea level (msl). The highest surface elevations at the SSFL occur along two general ridges that trend northeast-southwest, consistent with the geology of the Chatsworth formation that is described in this section.

The lowest elevation within the SSFL occurs at the eastern property boundary in Dayton Canyon and has an elevation of approximately 1,175 feet above msl. The lower elevations at the SSFL occur primarily along the eastern, southern and north-central to northwestern perimeters of the property. A broad, relatively flat area of topography exists within the northwestern portion of the SSFL and is referred to as the Burro Flats area.

Hills surround the SSFL on all sides. To the north, these hills extend to Simi Valley, which is a relatively flat valley that slopes gently toward the southwest. The San Fernando Valley, which slopes gently to the southeast, is beyond the hills to the east of the SSFL. Both of these valleys are approximately 1¼ to 2 miles from the site boundary. The Simi Hills extend to the Santa Susana Mountains northeast of the site, and to the Santa Monica Mountains to the south.

1.3.2 Climate and Precipitation

Climate at the SSFL and surrounding area falls within the Mediterranean sub-classification, and monthly mean temperatures range from 50ºF during winter months to 70ºF during summer months (SAIC 1994). During the summer months (April through October), a landward wind pattern occurs due to proximity of the adjacent ocean; during the winter months this is interrupted by weather fronts (SAIC 1994). Based on wind measurements collected at the SSFL in Area IV from January to December 2001, the prevailing wind pattern is northwest-southeast (Figure 1-3). The pattern is consistent with historical data collected in both the 1960s and 1990s.

Precipitation at the SSFL is normally in the form of rain, although snow has occasionally fallen during winter months. Precipitation at the site has averaged approximately 18 inches per year between 1960 and 2006. The annual precipitation has ranged from a low of 5.7 inches in 2002 to a maximum of 41.2 inches in 1998. Precipitation has been measured at the SSFL daily during rainstorms at two onsite stations. The majority of annual precipitation at the SSFL and surrounding area occurs between the months of November and March, consistent with the regional precipitation pattern of southern California.

1.3.3 Surface Water and Drainages

Figure 1-2 depicts the surface water drainages at and surrounding the SSFL. Most surface water that collects and drains at the SSFL is intermittent and is conveyed offsite via one of four drainages: the Northwestern drainage, the Northern drainage, the Happy Valley drainage, and the Bell Creek drainage. Operational discharges of water, associated with extracted groundwater after treatment to discharge standards, occur only within the central portion of the SSFL in the Bell Creek drainage. As described in Section 1.2.3, surface water discharges from SSFL are monitored as part of the NPDES program. A more detailed view of the SSFL drainages, surface water divides, ponds, and NPDES outfall locations is provided in Figure 1-4.

The majority of the surface water (estimated at greater than 60 percent) from the SSFL runs off the southern property boundary through Bell Canyon and into Bell Creek, which subsequently discharges into the Los Angeles River. NPDES Outfalls 011 and 001, and 018 and 002 (Figure 1-4), monitor surface water discharges from this portion of the site. The eastern portion of the facility drains through Dayton Canyon into Dayton Creek and combines with Bell Creek downstream before joining the Los Angeles River. Surface water discharges from this portion of the site are monitored at NPDES Outfall 008 (Figure 1-4). The northwestern perimeter of the site drains northward into Meier Canyon, which subsequently discharges into Arroyo Simi. Surface water discharges from the northwestern portion of the site are monitored at NPDES Outfalls 003, 004, 005, 006, and 007 (Figure 1-

4). Surface water from the northeastern and north-central portions of the SSFL drain into the Northern Drainage and is monitored at NPDES Outfall 009. The Northern Drainage connects to the Meier Canyon Drainage north of the SSFL on Brandeis-Bardin property. Three other small parcels of the SSFL that have had no operations convey storm water runoff through three other drainages (i.e., Runkle Canyon, Woolsey Canyon, and Eastern drainages) (Figure 1-4).

There are five surface water ponds within the SSFL, as shown on Figure 1-4. The purpose of these ponds was to retain and store water from adjacent or upstream rocket engine testing operations. Two other surface water features are also present onsite: the Sodium Reactor Experiment (SRE) Pond and the Building 56 Excavation. The SRE Pond was associated with the SRE site in Area IV. Surface water exists in the Building 56 excavation, which contains a mixture of surface water and groundwater.

1.3.4 Geology

The SSFL is located in the Transverse Ranges of southern California, a geologic province that is in north-south compression. Geologic structures, such as faults and folds, strike in an approximately east-west direction. The geology in the vicinity of the SSFL is shown on Figure 1-5a, and a simplified stratigraphic column of the Simi Hills is shown on Figure 1-5b.

Quaternary deposits consisting of alluvium and colluvium are locally present within the Simi Hills at the SSFL and in the site vicinity. Where present these deposits are generally thin, typically ranging from 5 to 15 feet thick, and usually occur in topographic lows and along ephemeral drainages. Native soils are generally comprised of weathered bedrock materials. Quaternary alluvium is also present in Simi Valley to the north and in the San Fernando Valley to the east.

Most of the SSFL is underlain by the late Cretaceous Chatsworth formation, a deep-sea turbidite deposit that consists primarily of sandstone interbedded with lesser amounts of shale, siltstone, and conglomerate. The SSFL is located on the south flank of an approximately east-west striking and westward-plunging syncline. Bedding at the SSFL strikes approximately N70°E and dips 25° to 35° to the northwest.

To the north and northwest of the site, the Chatsworth formation is conformably or disconformably overlain by the Paleocene-aged Simi Conglomerate member of the Tertiary Santa Susana formation. In the southwestern part of the SSFL, the Chatsworth formation is faulted against the Santa Susana formation, which is predominantly composed of micaceous claystone and siltstone, with a few minor sandstone beds. To the south and southwest of the SSFL, the Chatsworth formation is unconformably overlain by southward-dipping late Tertiary formations, including the Monterey and Calabasas/Lindero Canyon formations.

Numerous geologic structures are present both at the site and in surrounding areas. These structures include faults with hundreds of feet of inferred displacement, and structures called deformation bands, which in many cases show apparent displacements measured in tenths of an inch. Most of the structures at the SSFL and in the surrounding areas strike in either a northeasterly or approximately east-west direction.

1.3.5 Groundwater

Groundwater occurs at the SSFL in the alluvium, weathered bedrock, and unweathered bedrock (MWH 2004a). First-encountered groundwater typically exists under water table conditions and may be encountered in any of these lithologies. At certain locations within the SSFL, groundwater is vertically continuous (i.e., not separated by a vadose zone) through all lithologies. Perched groundwater also occurs at certain locations within the SSFL. At these locations, a vadose zone within the unweathered Chatsworth formation may locally separate perched groundwater from saturated unweathered Chatsworth formation bedrock.

Groundwater present within the alluvium and weathered bedrock has typically been defined as “shallow groundwater.” Shallow groundwater at the SSFL is oftentimes coincident with topographic lows where surface water drainages are also present. Shallow groundwater is oftentimes encountered within a few feet of the ground surface, depending upon the amount of precipitation received, which is seasonal in nature. The broader groundwater system beneath the SSFL is the Chatsworth formation aquifer. This aquifer extends across most of the SSFL and into the areas where the Chatsworth formation is present. Chatsworth formation groundwater beneath the SSFL is typically encountered at depths ranging from 75 to over 200 feet below ground surface (bgs). However, it can also be encountered occur at depths as shallow as 20 feet bgs.

Groundwater flow directions at the SSFL have varied over time due to withdrawal of the groundwater for use as onsite water supply and as an interim measure. During early facility operations (pre-1964), large volumes of groundwater were extracted to support rocket engine testing. In the mid-1980s, groundwater extraction and treatment were initiated as an interim measure and various levels of groundwater extraction have been maintained since then, although there have been a few periods when little to no pumping has occurred.

1.3.6 Springs and Seeps

During previous field investigations, a total of 100 springs and seeps were identified at the SSFL and in the surrounding area. The seeps, which occur at elevations between 925 and 1,725 feet msl, are found primarily in the Chatsworth formation, though seeps are also present in the Santa Susana formation southwest of the site, in the Calabasas/Lindero Canyon formation near the southeast corner of the site, and in the Simi formation north and southwest of the site. Seep locations are shown on Figure 1-6.

Many of the seeps exhibit active, visible flow, and the vast majority of seeps emerge from rock. Some of the seeps are connected to the bedrock groundwater flow system beneath the site and some are sourced locally. Based on the results of past studies, the discharge rates for the seeps range from 0.03 to 6 liters per minute, although in some seeps the discharge was immeasurable. Seeps exhibit variable flow rates over time, and seeps persist even though the water level in the center of the SSFL has been depressed for decades. Over 70 seeps were identified on the mountain slopes surrounding the SSFL after an extended dry period. Most of the sampled seeps do not show the effects of evaporation.

Some of the seeps have major ion chemistry that does not match the general SSFL groundwater chemistry. In addition, the groundwater chemistry varies among seeps located in different offsite areas (Pierce et. al. 2006).

1.4 SUMMARY OF SSFL INVESTIGATION PROGRAMS

Both chemical and radiological environmental programs are currently being conducted at the SSFL. Onsite environmental investigations for both chemical and radiological constituents have been performed routinely since the mid-1980s, with some radiological investigations occurring as early as the 1950s. Overviews of these programs are described below, followed by a summary of current status.

1.4.1 Chemical Programs

As described in Section 1.2.2, potential chemical impacts resulting from onsite operations are being investigated and will be cleaned up as part of the RCRA Corrective Action Program. The RCRA Corrective Action process includes four phases to achieve site cleanup and closure: the RCRA Facility Assessment (RFA), the RCRA Facility Investigation (RFI), the Corrective Measures Study (CMS), and the Corrective Measures Implementation (CMI). The RFA was completed in 1994 and identified Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) based on units that used, stored, or handled hazardous materials. Investigation of potential chemical releases occurs during the RFI.

The objectives of the RFI are to characterize the nature and extent of chemical contamination in environmental media, evaluate risks to potential receptors, gather data for the Corrective Measures Study (CMS), and identify areas for additional work (DTSC 1995). During the RFI, additional AOCs (beyond those listed in the RFA) have been identified and investigated at the SSFL (MWH 2004a). A total of 135 SWMUs and AOCs have been identified at the SSFL, and those undergoing closure as part of the RFI Program are called "RFI sites" and have been grouped by location for purposes of investigation. The RFI sites identified at the SSFL are shown on Figure 1-7.

Site areas identified in the RFI requiring further assessment and potential cleanup are evaluated in the CMS, and those requiring cleanup are addressed in the CMI. The complete SSFL cleanup plan will be evaluated in an environmental impact report (EIR) prior to implementation. Public review and comment will occur during several steps in this process prior to the selection and implementation of cleanup activities.

1.4.2 Radiological Programs

Various nuclear research and development (R&D) projects have been conducted in Area IV of SSFL, including tests and demonstrations of nuclear reactors and critical assemblies, fabrication of reactor fuel elements, and disassembly and decladding of irradiated nuclear fuel elements. These operations were conducted over a 30-year period beginning in 1956. All nuclear R&D operations in Area IV ceased in 1988, and the only work related to nuclear operations since 1988 has been the ongoing cleanup and decontamination of the remaining inactive radiological facilities and the off-site disposal of radioactive waste.

During the 50+ years that radiological operations (including remediation) have been conducted in Area IV, environmental monitoring has been conducted to characterize environmental media (including soils, vegetation, air, surface water, groundwater, effluent and ambient radiation levels). The DOE is currently conducting an Area IV environmental impact statement (EIS) to identify potential data gaps and alternatives for completion of both chemical and radiological remediation in Area IV. Radiological facilities in the SSFL are located in Area IV which is shown on Figure 1-7.

1.4.3 Current Investigation Status

As of 2004, over 20,000 samples have been collected for chemical and radiological analysis to assess potential soil, sediment, soil vapor, groundwater, surface water, and bedrock impacts (MWH 2004a, DOE 2005). Although most samples have been collected onsite, potential offsite transport of contaminants is considered when evaluating onsite sampling results, and offsite sampling or cleanup actions have been conducted based on those results. For example, RFI sampling has been performed in drainages leading offsite when upstream locations are identified above screening levels. Most notably, this evaluation has resulted in several cleanup actions performed to limit potential offsite contaminant transport, including the FSDF, Happy Valley, and Building 203 interim measures, and most recently, the LOX debris and North Drainage clay pigeon debris cleanup actions. For the radiological program, review of Area IV historical operations (Sapere 2005) resulted in initiation of an extensive tritium groundwater program, including installation of onsite wells and offsite spring/seep sampling.

Thus, there are multiple data gap evaluations in progress at the SSFL (with corrective actions taken as appropriate) and another data gap analysis soon to be implemented as part of the Area IV EIS. The data gap analysis is a robust process, and includes a comprehensive historical records review to identify potential chemical and radiological release areas, and evaluation of current risk assessment data quality standards and potential pathways of contaminant migration.

For the RFI, the SSFL has been divided into eleven Group Reporting Areas that encompass large, interrelated areas of the site. For each Group Reporting Area, historical records and data from all media (soil, soil vapor, surface water, and groundwater) are evaluated to determine characterization completeness. Additional sampling is performed as necessary to fully evaluate the presence, nature, and extent of impacts, and the data are then evaluated for contaminant transport and fate and potential risks to receptors. Data gap analysis and reporting is in progress. As of the date of this report, RFI reports have been prepared and submitted to DTSC for three of the eleven Group Reporting Areas (Groups 4, 6, and 8).

Current environmental radiological assessment activities include ambient airborne radioactivity monitoring, ambient radiation exposure monitoring, and tritium groundwater investigations. Twenty-five of twenty seven radiological facilities have been decommissioned and decontaminated, and have undergone final status surveys. Twenty one of these facilities have been demolished following regulatory release. Following completion of data gap analysis using the Area IV Historical Site Assessment (Sapere 2005), additional sampling of building footprints is ongoing or will be conducted following building demolition. Also, as described above, additional investigations will be conducted as warranted following completion of the data gap analysis to be conducted as part of the Area IV EIS.

1.5 PROPERTIES SURROUNDING SSFL

1.5.1 Overview of Adjacent Properties

The properties surrounding the SSFL are briefly described based on compass directions (north, south, east, west). Surrounding property locations are shown on Figure 1-1.

Northern Adjacent Properties - The adjacent property to the northwest is occupied by the American Jewish University Brandies-Bardin Campus (BBC) which is zoned as rural agricultural and is used for religious, teaching, and camping facilities. The adjacent property to the northeast is occupied by the Mountains Recreation and Conservation Authority (MRCA). The MRCA property is zoned as open space, and currently operates as Sage Ranch Park.

Eastern Adjacent Properties - The adjacent properties situated immediately to the east of the SSFL are zoned light agricultural, with variances that permit higher density use (i.e., mobile home parks). A residential community is present in Woolsey Canyon approximately ¼ mile east of the SSFL boundary. A new residential community has been proposed near Dayton Canyon approximately ½ mile southeast of the SSFL boundary. Dense residential development begins in the San Fernando Valley approximately 2 to 3 miles east of the SSFL.

Southern Adjacent Properties – The adjacent properties situated to the south of the SSFL are used for residential purposes (Bell Canyon).

Western Adjacent Properties - The majority of adjacent properties situated to the west of the SSFL are designated by Ventura County as open space. This land has been and is currently used for cattle grazing. Recently a portion of Runkle Canyon located in this area has been proposed for development.

1.5.2 Specific Property Descriptions

There are nine areas adjacent to or near the SSFL that have been the subject of one or more offsite environmental investigations. Property descriptions for these nine areas are given in more detail in the following sections. These properties have undergone a number of owner and name changes since environmental investigations began around the SSFL. The names by which the properties were known are described below and listed in Table 1-2. To reduce possible confusion by using multiple names for the same property, this report has standardized how a property is referred to in this document. Surrounding property "standardized" names for this document are described below and also provided in Table 1-2. Environmental investigations and findings for these areas are described in Section 2.

1.5.2.1 Brandeis-Bardin

The property adjacent to SSFL located to the northwest is occupied by the American Jewish University BBC, and was formerly known as the Brandeis-Bardin Institute (BBI). For the purposes of this report, this property will be referred to as "Brandeis-Bardin." The Brandeis-Bardin property is approximately 2,500 acres in size and zoned as rural agricultural on Ventura County maps. This designation permits a wide range of agricultural uses, but as noted above, the area is currently used for religious, teaching, and camping facilities. There is also a cemetery located on the property (MWH 2005a).

Brandeis-Bardin and the SSFL share a common property boundary. The northern undeveloped land and the northern portions of SSFL Areas II, III and IV are nearest to the Brandeis-Bardin property. Surface water drainages from the northern portions of the SSFL enter Brandeis-Bardin property. As described in Section 2, several offsite environmental investigations have been performed on Brandeis-Bardin property.

1.5.2.2 Sage Ranch

The property adjacent to SSFL located to the northeast is occupied by the MRCA Sage Ranch Park. This area has been referred to in other reports as Santa Monica Mountains Conservancy (SMMC), or as the Conservancy, or as Sage Ranch. For this report, the northeastern property will be referred to as "Sage Ranch." This area is zoned as open space (MWH 2005a) and currently operates as a Ventura County Park. Sage Ranch Park is a 625-acre parcel that has also been used for growing avocado and oranges. Today the land contains the park site, campgrounds, and a house where the park ranger resides (SMMC 2007a).

Sage Ranch and the SSFL share a common property boundary. The northern portion of SSFL Area I is nearest to the Sage Ranch property. Surface water drainages from the northern portions of SSFL Area I generally follow the boundary between the two properties. As described in Section 2, several offsite environmental investigations have been performed on Sage Ranch.

1.5.2.3 Black Canyon

Black Canyon is not a specific property but a topographic area near (but not adjacent to) the SSFL. This area has not been subject to multiple names, and is referred to in this report as "Black Canyon." Black Canyon contains the Black Canyon Road which connects SSFL to Simi Valley.

Black Canyon does not share a property boundary with the SSFL and does not receive surface water runoff from the SSFL. Therefore, with the possible exception of groundwater, this area is not physically connected by any environmental media with the SSFL. Several groundwater wells have been installed at the top of Black Canyon, adjacent to Sage Ranch and near the SSFL. As described in Section 2, groundwater sampling is the only form of environmental investigation that has been performed in Black Canyon.

1.5.2.4 Woolsey Canyon

Woolsey Canyon is not a specific property but a topographic area adjacent to the eastern boundary of the SSFL. This area has not been subject to multiple names, and is referred to in this report as "Woolsey Canyon." The properties situated in Woolsey Canyon to the east of the SSFL are zoned light agricultural with variances that permit higher density use (e.g., pre-manufactured home parks). There is a residential community in Woolsey Canyon approximately ¼ mile east of the SSFL boundary (MWH 2005a). A portion of Woolsey Canyon was formerly leased to the SSFL along the eastern boundary of the site. This portion of Woolsey Canyon is owned by the MRCA.

Woolsey Canyon and the SSFL share a common property boundary. The easternmost portion of SSFL Area I is nearest to Woolsey Canyon. A single surface water drainage from a small non-operational 12-acre portion of the SSFL Area I enters Woolsey Canyon. As described in Section 2, several offsite environmental investigations have been performed in Woolsey Canyon.

1.5.2.5 Dayton Canyon

Dayton Canyon is not a specific property but a topographic area adjacent to the southeastern boundary of the SSFL. This area has not been subject to multiple names and is referred to in this report as "Dayton Canyon." There are several residents in Dayton Canyon and a large portion of it is owned by Centex Homes, who have proposed a housing development called Sterling Properties surrounded by land designated to be open space. The access road to Dayton Canyon is located near the intersection of Roscoe Boulevard and Valley Circle Boulevard in West Hills.

Dayton Canyon and the SSFL share a common property boundary. The southeastern-most portion of the SSFL southern undeveloped land is adjacent Dayton Canyon. A single surface water drainage, Dayton Creek, begins in an operations portion of the SSFL Area I (Happy Valley) and flows into Dayton Canyon. Several offsite environmental investigations have been performed in Dayton Canyon.

1.5.2.6 Chatsworth Reservoir

The Chatsworth Reservoir is owned by the Los Angeles Department of Water and Power (LADWP). This area has not been subject to multiple names, and is referred to in this report as "Chatsworth Reservoir." It is located approximately 2 miles east of the SSFL (Essentia Management Services 2004). The reservoir was used to hold potable water for Los Angeles. After the 1971 Sylmar earthquake the reservoir was drained and the retaining dam inspected. Based upon the findings of that inspection, the LADWP did not refill the reservoir. The reservoir is currently dry, with the exception of a small area in the northern portion of the reservoir area.

Chatsworth Reservoir does not share a common property boundary with the SSFL. The reservoir is connected to the SSFL via surface water runoff leaving a small 12-acre portion of Area I at the site, traversing through Woolsey Canyon, and then entering the former reservoir. As described in Section 2, offsite environmental investigations have been performed immediately south of the Chatsworth Reservoir area at the West Hills Rocketdyne Recreation Center.

1.5.2.7 Bell Canyon

Bell Canyon is an area located south of the SSFL that contains private residences. This area has not been subject to multiple names, and is referred to in this report as "Bell Canyon." The residents of Bell Canyon and Woolsey Canyon are the nearest residential neighbors to the SSFL. Stormwater runoff from approximately 60 percent of the SSFL flows through Bell Creek in the Bell Canyon area.

Bell Canyon and the SSFL share a common property boundary. Bell Canyon adjoins the southern undeveloped land. As described in Section 2, several offsite environmental investigations have been performed on Bell Canyon property.

1.5.2.8 Ahmanson Ranch

The former Ahmanson Ranch property consisted of approximately 1,900 acres of undeveloped land in Ventura County and was situated south and southwest of the SSFL in the Las Virgenes and East Las Virgenes drainages (Boeing 2004). The Ahmanson Ranch property has been referred to as Ahmanson Ranch Development Project and as the Ahmanson Ranch Open Space Area. It is now known as the Upper Las Virgenes Canyon Open Space Preserve and consists of 2,983 acres of parkland (SMMC 2007b). For this report, this property is referred to as "Ahmanson Ranch."

The Ahmanson Ranch and the SSFL share a common property boundary. The western end of the southern undeveloped land is adjacent to the northeastern portion of Ahmanson Ranch. No surface water from the SSFL flows onto the Ahmanson Ranch property. As described in Section 2, several offsite environmental investigations have been performed on the Ahmanson Ranch.

1.5.2.9 Runkle Canyon

Runkle Canyon is a 1,600-acre proposed residential site located to the northwest of the SSFL (Miller Brooks Environmental [MBE] 2003a, 2003b, 2003c). This area has not been subject to multiple names, and is referred to in this report as "Runkle Canyon."

Runkle Canyon and the SSFL do not share a common property boundary, although it does share a common property boundary with Brandeis-Bardin. A small 11-acre portion of the western portion of the SSFL drains into Runkle Canyon. No environmental investigations have been performed by Boeing, NASA, or DOE on the Runkle Canyon property.

1.6 PARTICIPATING REGULATORY AGENCIES AND PUBLIC ORGANIZATIONS IN OFFSITE SAMPLING PROGRAMS

As indicated in the above descriptions of properties adjacent to the SSFL, numerous environmental investigations have been conducted in offsite areas near the SSFL. Many regulatory agencies and members of the public have served to provide oversight, overview, and review of these programs. Although these agencies and/or organizations are listed specifically within each of the offsite studies described in Section 2 of this report, the following is a list of those participating organizations:

- US Environmental Protection Agency (USEPA)
- US Department of Energy (DOE)
- California Environmental Protection Agency (Cal-EPA), Department of Toxic Substances Control DTSC, Geological Support Unit and Human and Environmental Risk Division
- California Department of Public Health, Radiological Health and Environmental Management Branches
- California Environmental Protection Agency, Regional Water Quality Control Board, Los Angeles Region
- Ventura County Air Pollution Control District
- Representatives of Brandeis-Bardin and the Simi Valley SSFL Workgroup
- California State University, Northridge, Professor of Environmental and Occupational Health
- Various interested members of the public or community residents who have witnessed sampling in offsite areas

1.7 ORGANIZATION OF REPORT

This report contains a total of five sections and is organized as follows:

- Section 1 provides the scope and objective of this report, discusses the facility history and physical setting of SSFL, provides an overview of the properties surrounding SSFL, and identifies the participating regulatory agencies and public organizations in the offsite sampling programs.
- Section 2 provides a summary of each offsite sampling program, including the program area, the program scope and objective, sampling program details, and the program results.
- Section 3 summarizes the findings from all the offsite programs described in Section 2, and presents analysis of the data by pathway, including potential onsite sources impacting offsite sampling conditions, completeness of data and identified data gaps.

- Section 4 summarizes the conclusions from the individual pathway analyses, including a summary of data interpretation and data completeness, and presents recommendations for additional offsite sampling.
- Section 5 lists the references cited in this report.
- Appendices to this report provide a searchable offsite program report document database, an offsite analytical database, a basis for the screening levels employed in the report, and supplementary groundwater information.

2.0 OFFSITE SAMPLING PROGRAMS AND ENVIRONMENTAL MEDIA SAMPLED

The offsite sampling programs conducted by Boeing, NASA, or DOE presented in this report have been compiled from various separate studies that have been conducted to investigate whether chemicals or radionuclides from the SSFL are present in offsite environmental media. Each study addresses either a specific potential source, a specific migration pathway, or a specific radionuclide/chemical group. This section briefly describes the 18 SSFL offsite environmental investigations previously conduced by Boeing, NASA, or DOE, or that are ongoing when this report was prepared. No new studies were performed for the preparation of this document. For more detailed information on the methodology of each of these studies, the reader is referred to Appendix A, which contains electronic versions of each of the reports cited herein. Sampling locations described in these studies and included in the Appendix B database are presented on Figures 2-1 and 2-2.

Each of the following program summaries presents, when available, information about four aspects of the environmental sampling:

- General background;
- Study objective;
- Program area (where sampling was performed);
- Sampling program details; and
- Summary of results.

2.1 ANNUAL SITE ENVIRONMENTAL REPORTS (1959 – PRESENT)

Monitoring both the onsite and offsite environments for potential impacts from past nuclear operations at SSFL has been a primary focus of Boeing and its predecessor organizations on behalf of DOE. Results of these sampling efforts were documented on an annual basis (and on a quarterly or biannual basis in the 1950s and 1960s). These periodic reports were provided principally to the appropriate regulatory agencies in the early years [e.g. Atomic Energy Commission (AEC), Energy Research & Development Agency (ERDA), Nuclear Regulatory Commission (NRC), and Radiologic Health Branch (RHB)]. Later, additional stakeholders (including local libraries, elected officials, local community leaders, and environmental advocates) were added to the distribution list. The titles of these reports have varied over the years and include: “Environmental Monitoring Report”; “Environmental Monitoring and Facility Effluent Report”; “Annual Site Environmental Report”; and “Site

Environmental Report." Today they are collectively referred to as the Annual Site Environmental Reports (ASERs).

In 1956 prior to initial operations, Atomics International, then a Division of North American Aviation, began an ambitious monitoring program to establish baseline conditions and then track potential changes in environmental levels of radioactivity in and around its facilities, including the SSFL. Onsite and offsite environmental monitoring and media sampling have been conducted for more than 50 years throughout the facility's history of nuclear research and later during environmental restoration. In the early years, offsite soil and vegetation sampling was conducted on a monthly basis as far west as the Moorpark freeway (California State Route (SR) 23), as far North as the Simi Valley freeway (SR 118), as far east as Reseda, and as far south as the Ventura freeway (U.S. Interstate (US) 101). Soil/vegetation and water samples were also taken around the Canoga and De Soto facilities, and in and around the Chatsworth Reservoir. This extensive offsite sampling program was terminated in 1989 when all nuclear research and operations (except remediation) came to an end. Onsite radiological sampling of soil, groundwater, air, and surface water was also conducted on a routine basis, in addition to radiological sampling in support of remedial operations.

Prior to 1974, the scope of the ASER reports covered only radiological sampling. Later, following the introduction of NPDES Permit CA 0001309 in December 1974, chemical sampling of surface water was also reported. Today the main focus of these reports remains radiological although summary information is also provided for chemical sampling of soils, groundwater, and surface water.

The regulatory driver for current ASERs is DOE Order 231.1, "Environmental and Health Reporting." DOE Order 231.1 requires the preparation of an annual report to be used to communicate, internally to DOE and externally to the public, the environmental monitoring results and the state of environmental conditions related to DOE activities at the SSFL. The ASER 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; and
- Significant programs and efforts related to environmental management.

2.1.1 Program Area

Offsite sampling of soil and vegetation was conducted in areas up to 1 mile west of the SSFL (to the Moorpark freeway, SR 23), 2 miles north into Simi Valley, 3 miles east into the San Fernando Valley, and 1 mile south toward the Ventura freeway (US 101). In addition to soil and vegetation, water samples were collected around the Canoga and De Soto facilities, around the Chatsworth Reservoir (east of the SSFL in the San Fernando Valley), and from two sampling stations at Bell Creek on a monthly basis beginning in 1966.

2.1.2 Program Scope and Objective

The purposes of the environmental monitoring program were to determine whether Atomics International's operations were contributing to environmental radioactivity and to provide a continuing check on the integrity of engineering safeguards for the containment of radioactivity.

2.1.3 Sampling Program Details

Soil and vegetation sample collection and analysis were initiated at SSFL for the proposed Sodium Reactor Experiment (SRE) and in the Burro Flats section of Area IV in 1957 and reporting began in 1960 (Atomics International 1960). Environmental sampling was conducted monthly in and around the Canoga Avenue Facility from December 1954 through December 1960. When Atomic International's headquarters moved from Canoga Avenue to De Soto Avenue in 1960, soil and vegetation sampling was conducted in and around the De Soto Facility.

Initially, offsite soil and vegetation were sampled and analyzed on a monthly basis at several onsite and offsite locations. Beginning in January 1966, analysis of offsite soil and vegetation samples was performed on a quarterly basis. Routine sampling and analysis of native vegetation was deleted from the environmental program at the end of 1986 after review of the historical offsite soil radioactivity data indicated that Rocketdyne's operations at the SSFL were not contributing measurably to offsite environmental radioactivity (Rockwell 1989).

Between 1957 and 1989, the total number of annual offsite samples varied depending on the operations being conducted during that time at the SSFL. Between 44 and 458 soil samples were collected annually during these years. During this same time period, the total number of annual offsite vegetation and offsite groundwater samples taken ranged from 44 to 459 and 24 to 55, respectively. Soil and vegetation samples were analyzed for gross alpha and gross beta activity and were intended as screening analyses only. In general, isotopic-specific analyses were not performed. Post 1989, subsequent offsite and onsite soil analyses focused on isotope-specific analysis and soil screening by gross alpha and gross beta was terminated.

2.1.4 Program Results

Thousands of samples were collected and analyzed for radioactivity, and the results were reported in the ASERs (Appendix A). Because of the large amount of data, only a brief summary of those data is presented here. Any findings of elevated radionuclide detections are described and further evaluated in Section 3 of this report.

The ASER reports conclude that, throughout the duration of the environmental monitoring program, radioactivity results measured in offsite samples have remained fairly constant. This would indicate that there have been no significant releases of radioactive material from Area IV of the SSFL and therefore, no potential adverse impact on public health and safety due to the DOE-sponsored operations conducted at Area IV of SSFL.

2.2 OAK RIDGE ASSOCIATED UNIVERSITIES (ORAU) STUDY (1986) AND OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION (ORISE) STUDY (1997)

The Oak Ridge Associated Universities (ORAU), whose name was later changed to the Oak Ridge Institute of Science and Education (ORISE), has conducted over 500 independent verification surveys of prior radiological facilities in 42 states since 1980. ORISE has performed almost all the independent radiological verification surveys at Area IV of the SSFL for the DOE. During two of these visits, ORAU performed offsite sampling as part of the L-85 Reactor Facility survey (ORAU 1986) and the Interim Storage Facility (ISF) survey (ORISE 1997).

L-85 Survey

The L-85 Reactor Facility was operated by the Rocketdyne Division of Rockwell International Corporation in Area IV of the SSFL (ORAU 1986). The L-85 Reactor was located in Building 4093. In March 1980, Rockwell International applied for a Nuclear Regulatory Commission (NRC) order authorizing the dismantling of the L-85 Reactor, disposal of the component parts, and termination of the facility license. A decommissioning order from the NRC was issued on February 22, 1983. In March 1986, Rockwell submitted a radiation survey report of the decommissioned facility indicating that the facility satisfied the NRC guidelines for release from licensing restrictions. At the request of the NRC's Region V Office, ORAU conducted a confirmatory survey of the L-85 Reactor Facility from September 30 through October 2, 1986.

ISF – Building 4654 Survey

The Interim Storage Facility (ISF), also referred to as Building 4654 located in Area IV of the SSFL, was constructed in 1958 to support the SRE. The ISF was used to store dummy and irradiated fuel elements, shipping and storage casks, waste generated at the SRE, and items from the Organic Moderated Reactor Experiment (OMRE) and Systems for Nuclear Auxiliary Power (SNAP) facilities (ORISE 1997). During the ISF's use, a number of containers stored there deteriorated and released low-level contamination to adjacent asphalt and concrete surfaces and soil areas. Decommissioning of the ISF began in 1984 and involved the removal of contaminated surfaces, soil, and storage cells. A radiological survey was performed and the area was backfilled and returned to a natural state (Rockwell 1985). Because the historical subsurface soil data were limited, Rocketdyne/Boeing performed further subsurface soil sampling on September 30, 1997 to supplement the original final status survey. The DOE requested that ORISE perform the verification surveys of the ISF. Results are discussed below.

2.2.1 Program Area

L-85 Survey

At the time of the L-85 Reactor Facility survey, four offsite baseline samples were collected at locations along Woolsey Canyon and Valley Circle Boulevard.

ISF – Building 4654 Survey

At the time of the Building 4654 survey, offsite soil samples were collected from six background locations on Woolsey Canyon, Valley Circle Blvd., Black Canyon, and Gaston Road.

2.2.2 Program Scope and Objective

L-85 Survey

The purposes of the radiological survey of the L-85 Reactor Facility were to verify the adequacy and accuracy of Rockwell's final survey and to confirm the radiological condition of the facility relative to the decommissioning guidelines.

ISF – Building 4654 Survey

DOE requested that ORISE perform the verification survey at the ISF to confirm that remedial actions had been effective in meeting established and supplemental guidelines and that the documentation accurately and adequately described the radiological conditions at the site.

2.2.3 Sampling Program Details

L-85 Survey

During the confirmatory radiological survey of the L-85 Reactor Facility, gamma exposure rate measurements and surface soil samples were collected from four offsite locations. Samples were analyzed for gamma-emitting radionuclides using gamma spectroscopy.

ISF – Building 4654 Survey

During the ISF verification survey, six offsite soil samples were collected and analyzed for gamma-emitting radionuclides using gamma spectroscopy.

2.2.4 Program Results

L-85 Survey

Results from offsite samples collected during the L-85 survey showed that radionuclides were all non-detect or typical of background. The exposure rates measured at 1 meter above the ground surface at offsite sample locations ranged from 10 to 13 microRoentgen per hour (μR/H).

ISF – Building 4654 Survey

Results from offsite samples collected during the ISF survey showed that radionuclides were all non-detect or typical of background. Exterior background exposure rates at 1 meter above the surface at offsite sample locations ranged from 12 to 16 μR/H, all within DOE's exposure rate guideline of 20 μR/H. Background concentration ranges for the naturally occurring radionuclides were <0.20 to 1.19 picoCuries per gram (pCi/g) for radium-226, 0.56 to 1.72 pCi/g for thorium-232, <0.13 pCi/g for uranium-235, and <1 to 2.54 pCi/g for uranium-238. Background concentrations of activation and fission products and americium-241 were all less than the respective minimum detectable concentration (MDC) with the exception of cesium-137, which ranged from <0.6 to 0.24 pCi/g.

2.3 OFFSITE GROUNDWATER SAMPLING PROGRAM (1985 – PRESENT)

Following the discovery of chemical contamination in groundwater beneath the SSFL, monitoring of groundwater through an extensive network of groundwater wells both onsite and offsite was initiated. Data from the offsite wells provide an indication of the extent to which chemicals in groundwater may migrate to offsite locations. The groundwater monitoring dataset for onsite and offsite locations includes tens of thousands of sample results and only key offsite results are discussed in the text below.

2.3.1 Program Area

The program area encompasses wells that have been installed around the entire SSFL following agency-approved work plans. Wells installed by others in areas around the SSFL are also sampled by Boeing, NASA, or DOE. The wells farthest from the SSFL are OS-9 and OS-9R, located approximately 4,800 feet north of the SSFL on Brandeis-Bardin property (Figure 1-6).

2.3.2 Program Scope and Objective

Samples from about 400 monitoring points have been included in the SSFL onsite and offsite groundwater sampling program, including piezometers, wells, and springs and seeps. Samples have been collected and analyzed for a variety of parameters since the mid-1980s. Of the monitoring locations, 35 wells and spring/seeps are located offsite. A summary of the number of samples that have been collected and analyzed for various chemical and radiological constituents is presented in quarterly and annual monitoring reports (e.g., H&A 2007a).

The primary purpose of the offsite groundwater sampling program is to monitor for the presence of dissolved-phase chemicals related to site activities, specifically perchlorate and VOCs, with sample collection frequency varying by location. Historically, samples have been collected:

- Quarterly, as part of the Detection Monitoring Program of the Post-Closure Permits;
- Annually to semiannually to monitor whether contaminated groundwater was migrating offsite from the SSFL;
- As part of the Leaking Underground Fuel Tank (LUFT) monitoring program; and
- As part of baseline groundwater characterization for newly constructed wells.

Additionally, samples were analyzed for select VOCs from porewater within the bedrock matrix from two offsite locations near the front entrance gate at the SSFL. This work was performed as specified in the *Northeast Area Chatsworth Formation Work Plan, Phase 2* (MWH 2005c). The two corehole locations are near existing wells RD-39A and RD-39B and are identified as C-16 and C-17. It should be noted that the work plan specified the installation of one corehole at this location, but difficulties encountered during drilling required the installation of two coreholes to meet the project objectives. About 400 rock core samples were collected and analyzed for select VOCs during the installation of these two coreholes.

2.3.3 Sampling Program Details

Groundwater from onsite and offsite monitoring wells is sampled and analyzed as described in the water quality sampling and analysis plans for the SSFL (GRC 1995a and 1995b). Modifications or exceptions to the sampling and analysis protocols are provided in the individual annual groundwater monitoring reports (e.g., H&A 2007a).

2.3.4 Program Results

Pre First Quarter 2005 Offsite Monitoring Well Sampling

An evaluation of offsite groundwater detections was recently prepared by H&A and reported in a document titled *Report on Review of Detected Constituents in Groundwater Collected From Off-site Wells, Springs, and Seeps* (H&A 2007b). In this report, a statistical evaluation was performed on groundwater samples collected up through the first quarter of 2005 to review the historical detections in offsite groundwater monitoring wells. The results of this evaluation are presented below.

Out of 389,439 results for groundwater samples collected as part of SSFL monitoring activities through the first quarter 2005, 65,367 results exist for 47 offsite monitoring locations. Out of the 65,367 offsite results, 4,089 (approximately 6 percent) were "detected" results. Out of the 4,089 detections, 2,967 (approximately 73 percent) were inorganic chemicals, all of which were naturally occurring ions or stable isotopes. The presence of these naturally occurring ions is only potentially significant if they are detected at concentrations above locally established comparison criteria. The stable isotopes deuterium and oxygen-18 accounted for 51 of the offsite detections of inorganic chemicals, and field parameters (pH, turbidity, total solids, total dissolved solids, and electrical conductivity) accounted for 566 of the detections.

A total of 4,089 organic and inorganic chemicals were detected in the offsite groundwater monitoring wells through the first quarter of 2005. The data evaluation process included the review of detected inorganic compounds, semivolatile organic compounds (SVOCs), fuel hydrocarbons, and VOCs. A total of approximately 3,472 results for organic and inorganic constituents were reviewed to evaluate the validity of organic analyte detections and inorganic concentrations in offsite wells, springs, and seeps.

Inorganic constituents are present in natural waters as a result of natural geochemical processes (i.e., dissolution of rock in the presence of water). Historical groundwater monitoring data for inorganic constituents are summarized as follows:

- Inorganic analytes present in an offsite sample collected in 1949 from former water supply well WS-03 included bicarbonate, calcium, carbon dioxide, chlorine, iron oxide, magnesium, silica, sodium, sulfate, total dissolved oxygen, total non-volatile solids, and total solids.
- Groundwater samples were infrequently tested for inorganic constituents (metals and common ions) at some of the offsite wells from 1985 through the first quarter of 2005. Samples were tested for antimony, arsenic, barium, bicarbonate, beryllium, boron, bromide, cadmium, calcium, carbonate, chloride, chromium, cobalt, copper, fluoride, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, nitrate, potassium, selenium, silver, sodium, strontium, sulfate, thallium, vanadium, and zinc.
- As part of the Perchlorate Characterization (MWH 2003a), offsite wells were sampled for perchlorate and inorganic constituents from 2003 through the first quarter of 2005. Detected inorganic compounds included antimony, arsenic, barium, bicarbonate, cadmium, calcium, carbonate, chloride, chromium, cobalt, fluoride, iron, lead,

magnesium, manganese, molybdenum, nickel, nitrate, potassium, sodium, sulfate, thallium, vanadium, and zinc.

SVOCs were sampled at 13 offsite groundwater locations representing 151 individual samples. A total of 58 SVOC detects were reported including benzidine, bis(2-ethylhexyl) phthalate, n-nitrosodimethylamine (NDMA), and volatile alkenes. Phthalate esters [di-n-butyl phthalate and bis(2-ethylhexyl) phthalate] are common laboratory contaminants (USEPA 2001b). SVOC samples were collected infrequently, generally as part of baseline groundwater characterization for newly constructed wells.

Fuel hydrocarbons were sampled at 9 offsite well locations representing 164 individual samples. Fuel hydrocarbons were detected in a total of 42 samples. As part of the LUFT monitoring program, offsite wells RD-32, RD-36A, RD-36B, RD-36C, RD-36D, RD-37, RD-38A, and RD-38B were monitored semiannually for fuel hydrocarbons from 1994 through the first quarter of 2005. Two fuel hydrocarbon samples were also collected from private offsite well OS-24. Fuel hydrocarbons were detected in samples collected from wells RD-32, RD-36A, RD-36B, RD-36C, RD-36C, RD-37, RD-38A, RD-38B, and OS-24.

VOCs were sampled at 45 offsite well locations representing 1,000 individual samples. A total of 1,019 VOC detections were reported. The primary VOC detected in offsite groundwater is TCE.

Samples for testing of stable isotopes oxygen-18 and deuterium were collected from well OS-09 as part of the Perchlorate Characterization, and from wells RD-68A and RD-68B as part of Chatsworth Formation investigations.

Post First Quarter 2005 Offsite Monitoring Well Sampling

During 2005, VOCs were detected in wells located offsite in the northeast, and not detected in any of the other offsite wells sampled, with the exception of TCE concentrations detected in RD-59A and OS-21 (both at estimated concentrations of 0.26 micrograms per liter [µg/L]). The detections were later confirmed by the laboratory and data validation to be carry-over contamination from previously analyzed samples, and the TCE results were therefore considered unrepresentative of RD-59A and OS-21 groundwater (H&A 2006a).

During 2006, 33 of 35 offsite wells were sampled, with a sampling frequency that ranged from quarterly to annually. The focus of the offsite sampling program was to monitor for VOCs and perchlorate. During 2006, VOCs were detected in wells located offsite in the northeast, and were not detected in any of the other offsite wells, with the exception of trace

TCE concentrations detected for the first time in well RD-39B (0.33 µg/L). Results for dissolved trace metals and cyanide in samples collected from wells RD-59A-C during 2006 were consistent with historical results (H&A 2007a).

During the first three quarters of 2007, VOCs and perchlorate were not detected in any of the offsite wells sampled, with the exception of methylene chloride detected in RD-66 at an estimated concentration of 0.3 µg/L (below the maximum contaminant level [MCL] of 5 µg/L), and cis-1,2-dichloroethene (cis-1,2-DCE) detected in RD-68 at an estimated concentration of 0.1 µg/L (below the MCL of 6 µg/L). Both detections occurred in the third quarter, and verification samples will be scheduled for collection and analysis during the fourth quarter of 2007 to determine methylene chloride and cis-1,2-DCE are detectable in RD-66 and RD-68B, respectively (H&A 2007d, 2007e, 2007f).

Rock Porewater Sampling Results, Coreholes C-16 and C-17

Results from the analysis of rock porewater samples from coreholes C-16 and C-17 are included in Appendix B. In corehole C-16, PCE, TCE and Freon-113 were detected in porewater from a single rock core sample from a depth of 163.4 feet (concentrations of 4.36, 4.59 and 8.13 µg/L, respectively). Freon-113 was also detected at a concentration of 3.03 µg/L in porewater from a single rock core sample from a depth of 197.9 feet. None of these values exceed MCLs. No other constituents were detected in any other samples from corehole C-16.

Additionally, in corehole C-17, TCE was detected at concentrations ranging from 8.45 to 132.33 µg/L in porewater from a 13 individual rock core samples between depths of 641.1 and 690.7 feet. No other constituents were detected in any other samples from corehole C-17.

2.4 SPRINGS AND SEEPS SAMPLING PROGRAM (1985 – PRESENT)

Sampling of the SSFL offsite springs and seeps has been performed as part of various environmental programs over the last 22 years. These programs include the RCRA groundwater monitoring program, as well as specific springs and seeps monitoring projects. Since 2000, a concerted effort has been undertaken to identify all springs and seeps in and around the SSFL. The results for all offsite springs and seeps sampling efforts are summarized below.

2.4.1 Program Area

Both the various springs and seeps monitoring projects and the groundwater monitoring program include sampling from onsite and offsite springs and seeps. The offsite sampling program area encompasses springs and seeps identified within approximately 2.5 miles of the SSFL boundary. These springs and seeps have been identified through extensive field observations throughout the areas surrounding the SSFL; therefore, the identified seep locations and their sampling results are considered to represent all areas adjacent to the SSFL. The locations of offsite springs and seeps that have been sampled are shown on Figure 1-6.

2.4.2 Program Scope and Objective

The offsite springs and seeps sampling programs were performed primarily to determine whether there was contamination in the surface water at these locations. Specifically, springs and seeps samples were analyzed to determine whether chemicals found in groundwater at the SSFL were also present in water emerging from the springs and seeps. Spring and seep samples were also analyzed to evaluate the relationships between the springs/seeps and groundwater, and to assess hydrogeologic connections between these two components of the hydrologic system. These data are needed to evaluate the potential transport of contaminants of potential concern (COPCs) in groundwater underlying the SSFL and for use in the Surficial Media Operable Unit risk assessments.

Pre-2003 Sampling

Prior to 2003, identified springs and seeps were sampled and analyzed under the groundwater monitoring program at SSFL. In 1985, Groundwater Resources Consultants, Inc. (GRC) identified and sampled three offsite springs and analyzed for various analytical suites including VOCs, metals, general minerals, and radionuclides/gross alpha-beta. These locations are shown on Figure 1-6 as OS-8, OS-12, and OS-13. At the request of Boeing, GRC continued sampling at these offsite locations on a quarterly basis, although not all analytical suites were tested during each sampling event. Quarterly sampling continued at these springs until a consistent lack of water limited the collection of samples.

2003 Sampling

In 2001 an effort was undertaken to expand the springs and seeps sampling program. In March 2002, a work plan for collecting and analyzing water from springs and seeps within and adjacent to the SSFL was prepared and submitted to the DTSC (MWH 2002). During field investigations conducted by Ogden Environmental and Energy Services Co., Inc (Ogden), MWH, and Haley & Aldrich (H&A), 28 locations where springs or seeps occur within or adjacent to the SSFL property boundary were identified. The springs and seeps work plan proposed collecting samples from 13 of the 28 springs and seeps. Ultimately, samples were collected from only 7 of the 13 proposed locations, because 6 of the locations were either dry, redundant, not safely accessible due to the presence of bees, or on private property where access was denied. Two additional springs/seeps were identified subsequent to the issuance of the work plan, and samples were collected from these two locations. Therefore, samples were collected from a total of 9 locations. These spring and seep sampling locations are also shown on Figure 1-6.

Post-2003 Sampling

Sampling of springs and seeps after 2003 was conducted either as part of the routine groundwater monitoring program or to support onsite characterization activities to further evaluate potential contaminant migration in groundwater. In 2005, two springs and seeps were sampled north of Area IV to support Area IV tritium groundwater studies. Between August 2006 and March 2007, the springs and seeps program was expanded and samples were collected from 45 springs/seeps within and adjoining the SSFL to support the Chatsworth Formation Operable Unit characterization activities. Samples were analyzed for perchlorate and VOCs. Sample locations of the offsite springs and seeps in this 2006/2007 program are also presented on Figure 1-6. Spring and seep sampling is ongoing, with additional samples collected in October and November 2007.

2.4.3 Sampling Program Details

The sampling of offsite springs and seeps has been performed under several separate environmental sampling programs. The sampling methodology used in any program may vary from the others, however, the purpose of the sampling is to collect a valid representative sample of water from that location. The following general descriptions of methodologies are presented based on the work conducted in 2003 (MWH 2003b) to give the reader an understanding of spring and seep sampling techniques.

Techniques Used to Sample Springs and Seeps

Springs and seeps require special care when collecting water samples to be submitted for analysis of VOCs because of the potential mass loss to the atmosphere. First, springs and seeps at or near the SSFL commonly produce little water and hence can require a considerable length of time to collect a representative sample. Second, they often emerge from a relatively large surface area, producing a thin sheet of flowing water. Because of these two characteristics, special sampling techniques were used for low-yield springs or seeps as described below.

Direct Collection: If the flow rate from a spring was sufficiently high, a sample container was directly filled with the water emerging from the ground. If a pool of water was created by the spring/seep, a sample was collected directly from the pool using a plastic syringe or by submersing a plastic sample bottle.

Temporary Sampling Points: Since some springs did not produce sufficient water to collect samples directly as the groundwater emerged at the surface, a temporary sampling point was placed into the soil or weathered bedrock to concentrate flow. If the flow from the spring or seep was diffuse and discharged over a relatively large area, the sampling point was constructed below the discharge area with the highest flow. When these conditions existed, the sampling point was constructed in a joint, bedding plane, or soft soil zone within the spring/seep. In soft soil or very weathered bedrock, the sampling point was constructed by digging a small hole and installing a short length of perforated polyvinyl chloride (PVC) pipe. Water samples were then collected from these sampling points by gravity flow through the PVC pipe.

Dam Construction: Where water flowed out onto the exposed rock surface, a dam was constructed with a silicone-based sealant at the periphery of a seep to allow water to accumulate so samples could be collected. A plastic syringe was used to sample water pooled behind the silicone dam.

Target Analytes and Methods

Laboratory analyses were conducted on the samples collected during this program as specified in the various work plans for the spring and seep sampling events, including the Spring and Seep Work Plan (MWH 2002). In general, these followed the quality assurance criteria specified in the RCRA RFI Quality Assurance Project Plan (Ogden 2000a). Target analytes were grouped into two primary functions. First, samples were analyzed to evaluate whether chemicals used at the SSFL were present in water emerging from the springs and seeps. To this end, samples were analyzed for VOCs, perchlorate, metals, gross alpha, gross beta, and gamma-emitting radionuclides.

The second function of sample analysis was to provide information as to the source of the water collected at the spring or seep (i.e., groundwater or surface water), and/or to evaluate background water quality as it relates to general minerals. The target analytes in this functional group consisted of the following:

- Stable hydrogen (deuterium) and oxygen isotopes (^{2}H and ^{18}O)
- Selected general anions and cations (chloride, sulfate, carbonate, bicarbonate, sodium, potassium, magnesium, calcium), and total dissolved solids (TDS).

2.4.4 Program Results

Results for the offsite springs and seeps sampling programs described above are summarized in the following sections based on information presented in a summary report prepared for data collected during 2003 (MWH 2003b) and a letter report for data collected in 2006 (Boeing 2007b). Detailed offsite springs and seeps analytical data, along with evaluations of the data, are presented as part of the complete database presented in Appendix B.

VOC Results

Prior to 2003, four VOCs were detected in offsite springs and seeps samples: toluene, TCE, Freon 11, and Freon 113. Detections were infrequent and typically not repeated, and possibly related to laboratory contamination (H&A 2007b).

In 2003, four VOCs (acetone, toluene, bromomethane, and methylene chloride) were detected at concentrations up to 21 µg/L in samples collected from 3 of the 9 springs sampled during this program. Except for acetone, which was detected twice, each of the compounds was detected only once. Toluene and bromomethane were detected at concentrations below the laboratory method reporting limits, and the concentrations were reported as estimated by the data validators (i.e., they were reported as trace concentrations). Acetone was detected in one location at a trace concentration. Acetone was also detected in one location where a silicone dam had been constructed to facilitate sampling, and it is believed that the acetone detected in this sample was a result of the silicone caulking material. Methylene chloride, a common laboratory contaminant, was detected in one sample. It was concluded that these detections were not related to onsite groundwater contamination because these VOCs are very infrequently detected in SSFL groundwater, and when detected, are present at low concentrations (MWH 2003b).

In the 2005 samples collected for the Area IV tritium investigation, tritium was not detected. These data have not been published elsewhere, but are included in Appendix B.

In the post-2003 samples collected for the Chatsworth formation groundwater characterization program, VOCs were detected in water samples collected from seven offsite springs. VOC concentrations in these locations appear to be the result of laboratory contamination (Boeing 2007b). Samples from 4 of the 7 springs sampled contained low, estimated concentrations of common laboratory contaminants, acetone and methylene chloride. One sample from a northern location detected benzene at 13 µg/L. DTSC split samples collected at three of these locations did not contain detectable VOCs, including the northern spring with reported benzene. Two spring samples were collected offsite at adjacent to the southern boundary of the SSFL, down-gradient from onsite springs with repeated, high detection of TCE and cis-1,2-DCE (FDP-890). One of the offsite results was non-detect (FDP-735), while the other reported a low estimated detection of cis-1,2-DCE (0.32 µg/L). DTSC split samples were not collected at this location, but earlier data collected from springs in this area during 2003 were non detect. During the 2006 spring sampling event, VOC results reported for chemicals other than TCE were from reprocessed laboratory data since the original analysis was just for TCE. The 2007 spring and seep report concluded that presence of low, estimated VOC concentrations reported for these samples are likely the result of laboratory contamination since previous data was non-detect, several DTSC split samples were non-detect, and potential laboratory instrument carry-over was noted in several samples.

In order to resolve the source and significance of the low-level VOC detections at springs near SSFL, another spring and seep sampling program is currently in progress (Boeing 2007b).

Perchlorate Results

Samples collected during the pre-2003 spring and seep sampling programs were not analyzed for perchlorate. In the 2003 and post-2003 sampling programs, perchlorate was included in the analyte list and was not detected in any of the 45 spring/seep samples collected (MWH

2003b). DTSC collected and analyzed eight split samples and also reported no detectable concentrations.

Radioactivity Results

In the 2003 sampling results, there were no detectable levels of gross alpha radioactivity in any of the samples (MWH 2003b). Gross beta activity levels in spring and seep water samples ranged up to 4.23 ± 1.7 picoCuries per liter (pCi/L). These results are below the drinking water MCL for gross beta activity of 50 pCi/L. It should be noted that the groundwater underlying the SSFL is not a source of drinking water; therefore, the MCLs are not applicable, but are used here solely as a basis for comparison.

No man-made gamma-emitting radionuclides were detected in any of the 2003 spring/seep samples (MWH 2003b). Three naturally occurring gamma-emitting radionuclides were detected in two spring and seep samples:

- Potassium-40 was detected at 234 pCi/L at S-14;
- Bismuth-214 was detected at 17.8 pCi/L; and
- Lead-214 was detected at 29.5 pCi/L at S-29.

Bismuth-214 and lead-214 are part of the uranium-238 decay chain, and uranium-238 is a naturally occurring radionuclide. There are no regulatory action levels associated with the naturally occurring radionuclides of potassium-40, bismuth-214, and lead-214.

In the 2005 sampling results, tritium was not detected. Tritium has not been detected in earlier samples collected north of Area IV at OS-8 as part of routine monitoring.

Stable Hydrogen and Oxygen Isotopes (^{2}H and ^{18}O) Results

In the 2003 spring and seep sampling, deuterium and oxygen isotopes were analyzed to evaluate the relationship between the springs/seeps and groundwater (MWH 2003b). The stable isotope results for samples from eight of the nine springs/seeps were similar to the historical results for groundwater samples collected from wells that monitor Chatsworth formation groundwater. This study concluded that the water flowing from these eight springs/seeps is likely derived from local groundwater. The stable isotope results for the remaining springs/seeps were typical of water that has been subject to evaporation.

General Mineral Results

Offsite spring and seep samples that were collected during all three sampling programs were analyzed for general minerals. The 2003 sampling results, which are representative of the levels that were detected during other historical sampling programs, are discussed briefly below (MWH 2003b).

During the 2003 sampling program, cations that were reported by the laboratory included calcium, magnesium, potassium, and sodium. Anions included bicarbonate, carbonate, chloride, and sulfate. TDS concentrations for all but 1 of the 9 springs/seeps were below 1,000 milligrams per liter (mg/L). One spring/seep had a TDS value of 1,241 mg/L. Chloride concentrations, which are indicators of groundwater flow system activity, ranged from a low of 37.2 mg/L to a high of 78.2 mg/L. These chloride values indicate that the water sampled during this program was groundwater.

Metals Results

Metal analyses were included in limited pre-2003 springs and seeps sampling, but not included in subsequent spring and seep samples since metals in groundwater do not migrate as quickly as VOCs or perchlorate. However, the samples collected by DTSC in 2003 were analyzed for metals and the results were similar to the pre-2003 analytical data. In the samples collected by DTSC, five metals were detected. Barium was detected in all eight samples at concentrations up to 0.144 mg/L. Chromium-III and nickel were detected once in the sample from S-14 at concentrations of 0.014 mg/L and 0.013 mg/L, respectively. Vanadium was detected in three spring/seep samples at concentrations up to 0.029 mg/L, and zinc was detected in four spring/seep samples at concentrations up to 0.085 mg/L. These concentrations were below the established primary and secondary MCLs, or other state regulatory action levels for these metals. Also, these results were similar to or less than the metal concentrations detected in SSFL groundwater monitoring wells (MWH 2003b).

Summary

The following summarizes results from the data collected from these programs:

- The springs and seeps generally result from the discharge of local groundwater for the springs sampled (MWH 2003b).
- Perchlorate was not detected in any of the samples (MWH 2003b, Boeing 2007b).

- VOC detections in offsite spring and seep samples were infrequent and at low concentrations and are considered the result of laboratory contamination (MWH 2003b, Boeing 2007b) Additional sampling is ongoing to verify that low concentrations of VOCs detected offsite, adjacent to the southern SSFL boundary, are not site-related.
- Naturally occurring radionuclides were detected in spring and seep samples, but no man-made gamma-emitting isotopes were detected (MWH 2003b).
- Tritium has not been detected in any of the springs and seeps samples collected north of Area IV (this report).

2.5 BRANDEIS-BARDIN INSTITUTE/SANTA MONICA MOUNTAINS CONSERVANCY PROJECT (1992 - 1994)

Initial assessments of the potential for offsite contamination at properties adjacent to and north of the SSFL were conducted according to the DTSC-approved Work Plan for Multi-Media Sampling (McLaren/Hart 1992) and the Work Plan for Additional Soil and Water Sampling (McLaren/Hart 1993a) on the Brandeis-Bardin and Sage Ranch properties (correct program title indicated above). The investigations were conducted between 1992 and 1994, and included sampling of soil, surface water, groundwater, and agricultural produce at both properties. Reports were produced in 1993 and 1995 (McLaren/Hart 1993b and 1995).

The work plans for this project were reviewed and approved by USEPA, DTSC, DHS-Environmental Management Branch, Brandeis-Bardin, and SSFL Workgroup representatives. Split samples were taken by USEPA, DTSC, DHS and Brandeis-Bardin representatives.

2.5.1 Program Area

Soil and water sampling were conducted on the Brandeis-Bardin property and at the Sage Ranch. Both properties are located adjacent to, and north of, the SSFL. In addition, background samples were collected offsite as part of the sampling program.

Background sample locations from the initial sampling event in 1992 include Santa Susana Park (3 miles north of the SSFL), Bell Canyon, (2.5 miles south of the SSFL), Happy Camp and nearby orchards (12.5 and 11 miles northwest of the SSFL, respectively), the Santa Monica Mountains National Recreation Area (3.5 miles southwest of the SSFL), the Western Location (1 mile west of the SSFL), and Rocky Peak (5 miles northeast of the SSFL). During the follow-up sampling event in 1994, background samples were again collected from the Santa Susana Park and Happy Camp locations. Additionally, background samples were collected from Wildwood Regional Park and Ravine (13 miles west of the SSFL) and Tapia County Park and Ravine (10 miles south of the SSFL).

2.5.2 Program Scope and Objective

The scope of both sampling efforts was focused on offsite areas that could have received contamination from the SSFL as a result of surface water runoff or other transport mechanisms/pathways. The initial study focused on drainages and areas of human activity on the Brandeis-Bardin and Sage Ranch properties. A total of 20 Brandeis-Bardin and 6 Sage Ranch sampling areas were identified, and sampling locations in each area were selected using a random grid approach.

During the first sampling event in 1992, samples of various media were collected where available, including four groundwater samples from two wells, 118 soil and sediment samples, seven surface water samples, and nine fruit samples.

A second phase of sampling was performed in 1994 in order to resolve unanswered questions raised by the initial sampling event. The additional sampling, consisting of 164 soil and sediment samples and two surface water samples, included:

- Additional tritium samples at various locations;
- Mercury in channels downstream of FSDF following removal of mercury-impacted soil;
- Additional plutonium-238 samples in the RD-51 and Building 59 Watersheds;
- Additional strontium-90 and cesium-137 samples in the SRE Watershed;
- Additional tritium, strontium-90, and cesium-137 samples in the Radioactive Materials Disposal Facility (RMDF) Watershed; (Note: RMDF is also known as the Radioactive Materials Handling Facility [RMHF])
- Additional tritium and cesium-137 samples in the Building 59 Watershed;
- Additional tritium, strontium-90, and cesium-137 samples in the drainages between the RMDF/Building 59 and Campsite Area I; and
- Additional background data (five sets of soil samples were collected from each of eight background locations).

2.5.3 Sampling Program Details

During the 1992 study, soil/sediment and surface water samples were collected from nine human activity areas and six ravines/drainages at the Brandeis-Bardin or the Sage Ranch.

All soil/sediment samples were analyzed for VOCs, SVOCs, priority pollutant metals, and naturally occurring and artificial radionuclides as a gamma scan, as well as tritium, isotopic plutonium (i.e., plutonium-238 and plutonium-239), iodine-129, and strontium-90. One surface water sample was collected from a background area and seven surface water samples were collected from the study areas. All surface water samples were analyzed for the same chemicals, and radionuclides cited for soils/sediments as well as for gross alpha and gross beta radioactivity. Groundwater was sampled from two private wells on Sage Ranch property (a minimum of two times each) and analyzed for the same analytes as surface water except for metals. Fifteen fruit samples were collected from background areas. Nine fruit samples were collected from the study areas. All fruit samples were analyzed for the full suite of radionuclides listed in the preceding paragraph.

During the 1994 study, 124 soil and sediment samples were collected from nine human activity areas and six ravines and drainages and analyzed for tritium with additional analyses as defined by the sample area, and seven soil samples collected from the FSDF Watershed were analyzed for mercury. In addition, 40 soil and sediment samples collected from background areas were analyzed for tritium, strontium-90, isotropic plutonium, and gamma emitting radionuclides. Two surface water samples, collected from Campsite Area I and Area II, were analyzed for tritium, gross alpha, and gross beta radiation. Surface water was not observed in the background areas during the 1994 sampling event. VOCs, SVOCs, and other priority pollutant metals were not analyzed for during the 1994 study.

2.5.4 Program Results

Chemical Results. No VOCs or SVOCs associated with activities at the SSFL were detected in any of the 118 soil/sediment samples collected in the study areas during the 1992 study. TCE was detected at 10 μg/L, and 9 μg/L in both groundwater samples collected from an irrigation well (the well by the gate on Sage Ranch, located approximately 800 feet north of the SSFL property line). VOCs and SVOCs were not analyzed for during the 1994 study.

Some organic chemicals that were not associated with activities at the SSFL were reported in the 1992 study. Toluene was detected in two soil samples at the Sage Ranch visitor center parking lot at 0.007 and 0.009 milligrams per kilogram (mg/kg).

Heavy metals in the form of lead and mercury were reported above background at two locations and were associated with activities at SSFL. Lead was detected in all five soil samples collected from the Former Rocketdyne Employee Shooting Range located on Sage

Ranch near the SSFL front gate, at concentrations ranging from 59 to 280 mg/kg. Mercury was detected in 1 of 9 sediment samples collected at the FSDF channel at 0.35 mg/kg. The site containing mercury-bearing sediment was excavated and re-sampled after excavation to confirm the removal of sediment containing mercury. Priority pollutant metals were not analyzed for during the 1994 study.

Radionuclide Results. During the 1992 study, four radionuclides were detected in sediment samples in the watersheds at Brandeis-Bardin which exceeded the 95th percentile of the measured background concentrations (i.e., above measured background) in soil: tritium, strontium-90, cesium-137, and plutonium-238. Two radionuclides were detected above measured background in two surface water samples from the RMDF Watershed: tritium and strontium-90. Radionuclide data from the fruit from the study areas were not above background. No radionuclides were detected above measured background in any of the human activity areas at either Sage Ranch or Brandeis-Bardin. Radionuclides were not detected in groundwater in the two private wells that were sampled.

Sampling results from the 1994 study indicated that, with the exception of the Building 59 and RMDF Watersheds, none of the other sites had radionuclides present at concentrations statistically higher than background values. Tritium was found at concentrations significantly above background values in sediment samples collected from the ravine of the Building 59 Watershed. Cesium-137 and strontium-90 concentrations in samples collected from the Building 59 Watershed and RMDF Watershed, respectively, were statistically different from background levels established for the 1994 study, but were below the literature values for background levels. Plutonium-238 was not detected in any samples collected in RD-51 and Building 59 watersheds. It was concluded that the 1994 study results did not confirm 1992 study results and plutonium-248 was therefore not a concern.

Tritium Results. Tritium analyses conducted on soil moisture during the 1992 study exceeded the 95th percentile of the measured background (552 pCi/L) in 7 of the 118 soil/sediment samples. Tritium concentrations in these sediment samples were: 1,100 ±100 pCi/L, 990 ±150 pCi/L, 1,300 ±300 pCi/L, 1,300 ±200 pCi/L, and 1,500 ±200 pCi/L in the RMDF Watershed and 10,800 ±300 pCi/L and 9,810 ±330 pCi/L in the Building 59 Watershed. Of the seven surface water samples, tritium was detected in one sample from the RMDF Watershed at a concentration of 1,500 ±100 pCi/L (the MCL for tritium in drinking water is 20,000 pCi/L). It was concluded that the tritium was due to offsite migration from the SSFL.

Tritium was not detected in any of the 50 samples collected in the human activity areas during the 1994 study. Tritium samples were collected in four ravine/drainage areas. Tritium was not detected in samples collected from the RD-51 Watershed or Campsite Area 1 Drainage. Concentrations in the RMDF ranged from less than 100 to 230 ±100 pCi/L. Sample results in the RMDF Watershed indicated that concentrations of tritium were not present further down-gradient from the RMDF than previously detected in 1992. Tritium was only detected one order of magnitude above detection limits in the Building 59 Watershed and an up-gradient boring, with concentrations ranging from less than 100 to 5,400 ±200 pCi/L and 7,600 ±300 pCi/L, respectively. Because tritium was not detected in the Campsite Area I Drainage, directly down-gradient of the Building 59 watershed, the impact of tritium to the watershed is limited to the area near the Rocketdyne property boundary. Watershed results were confirmed by split samples analyzed by the USEPA, the DHS, and the Brandeis-Bardin consultant. Tritium was not detected in the surface water samples collected at Campsite Area I and II.

Strontium-90 Results. Of the 118 soil/sediment samples collected during the 1992 study, strontium-90 was detected above the 95th percentile of the measured background [0.07 pCi/g(dry)] in three sediment samples at the RMDF Watershed [0.08 ±0.01 pCi/g(dry), 0.09 ±0.01 pCi/g(dry), and 0.15 ±0.02 pCi/g(dry)] and two sediment samples at the SRE Watershed [0.08 ±0.002 pCi/g(dry) and 0.09 ±0.02 pCi/g(dry)]. Strontium-90 was also detected in two associated surface water samples at the RMDF Watershed at 1.1 ±0.03 pCi/L and 1.8 ±0.05 pCi/L. The MCL for strontium-90 in drinking water is 8.0 pCi/L.

During the 1994 study, strontium-90 analyses were conducted in the SRE and RMDF watersheds and the Building 59/RMDF drainages. Strontium-90 results for the SRE Watershed and Building 59/RMDF Drainage were not identified as statistically different from the background sampling results. Results in the RMDF Watershed were considered statistically different with a mean of 0.103 pCi/g(dry) compared to the mean of 0.052 pCi/g(dry) for background samples. The results in these Watersheds were confirmed by split samples by the USEPA, the DHS, and the Brandeis-Bardin consultant.

Cesium-137 Results. During the 1992 study, cesium-137 was detected in the Brandeis-Bardin watersheds along the SSFL property line at concentrations above the 95th percentile of the measured background 0.21 pCi/g(dry) for cesium-137. Cesium-137 was detected in four of the 118 soil/sediment samples collected in this study at a concentration of 0.34

±0.04 pCi/g(dry) in the RMDF Watershed, 0.24 ±0.06 pCi/g(dry) and 0.30 ±0.05 pCi/g(dry) in the SRE Watershed, and 0.23 ±0.03 pCi/g(dry) in the Building 59 Watershed.

During the 1994 study, cesium-137 analyses were conducted in the RMDF Watershed, SRE Watershed, Building 59 Watershed and Campsite Area I Drainage. Cesium-137 results at the RMDF, SRE, and Campsite Area I watersheds and for borings above the RMDF and Building 59 Watersheds were not identified as statistically different from background sampling results. Results in the Building 59 watershed were considered statistically different from background with a mean of 0.20 pCi/g(dry) compared to the mean of 0.087 pCi/g(dry) for background samples. Because concentrations of cesium-137 in the Campsite Area I Drainage, directly down-gradient of the Building 59 Watershed, were not significantly different than background, the impact in the Building 59 Watershed is limited to the area sampled near the Rocketdyne property boundary.

Plutonium-238 Results. During the 1992 study, plutonium-238 was detected in Brandeis-Bardin watersheds along the SSFL property line at concentrations above the 95th percentile of the measured background [0.10 pCi/g(dry)]. Plutonium-238 was detected in two of the 118 soil/sediment samples at 0.19 ±0.06 pCi/g(dry) and 0.22 ±0.07 pCi/g(dry) in the Building 59 and RD-51 Watersheds, respectively.

During the 1994 study, isotropic plutonium samples were collected in two ravines. Plutonium-238 and 239 results were below detection limits in all samples collected. The plutonium-238 results from the 1992 study were therefore not confirmed, indicating that plutonium-238 is not an issue in these ravines. These results were confirmed by split samples taken by the USEPA, the DHS, and the Brandeis-Bardin consultant.

General Results and Conclusions. Because the data from the ravines, watersheds, and drainage ways collected during the 1992 study were not statistically evaluated, it could not be determined whether the presence of strontium-90, cesium-137 and plutonium-238 in the sediment at concentrations above the 95th percentile of the measured background were due to offsite migration or can be attributed to background. When the t-tests (statistical comparisons of the area samples to background) were run, the concentrations of these radionuclides in the ravines appear similar to background levels, and therefore may be present at naturally occurring levels. The investigation conducted during the 1994 study revealed that, with the exception of Building 59 and RMDF Watersheds, none of the other sites had radionuclides present at concentrations statistically higher than background levels.

USEPA reviewed the Brandeis-Bardin/Sage Ranch sampling results and concluded that, although radionuclide concentrations in the two impacted areas identified by the study (Building 59 and RMDF) were above local background levels, they were below typical levels found throughout the United States. Furthermore, based on EPA calculations, the theoretical cancer probability or risk to camper and camp counselors is less than the EPA threshold for action of one in 1,000,000 (USEPA 1995). The two areas were later purchased by Rockwell International and are now Boeing SSFL property.

2.6 CHATSWORTH AND WEST HILLS PRIVATE HOME REPORTS

During 1994, Rocketdyne received independent requests from two local neighbors to sample their properties in Chatsworth and West Hills. Composite soil samples were taken at both residences and subjected to gamma spectroscopy.

2.6.1 Program Area

On June 5, 1994, a composite soil sample was taken from the backyard of a Chatsworth residence. On June 23, 1994, composite soil samples were taken from the backyard of a West Hills residence. (Note: These locations are not identified on figures in this report in order to protect the residents' privacy but data are included in Appendix B.)

2.6.2 Program Scope and Objective

Samples were taken at the two neighboring Chatsworth and West Hills properties at the requests of the residents.

2.6.3 Sampling Program Details

At the Chatsworth residence, one composite soil sample was taken from the backyard and analyzed for gamma-emitting radionuclides using gamma spectroscopy.

At the West Hills residence, one composite sample was taken from the backyard and analyzed by gamma spectroscopy. In addition, three soil samples were taken in the centers of the north, west, and south walls of the flower bed in the backyard and analyzed for VOCs using USEPA Method 8240.

2.6.4 Program Results

Results from the gamma spectroscopy analysis of the soil sample taken from the Chatsworth residence confirmed that the results were all well within the range found both locally and elsewhere in the U.S. Naturally occurring potassium-40, and uranium and thorium decay products were detected including 0.02 pCi/g of cesium-137, well within the background range of 0 to 0.21 pCi/g. The report to the residents of the Chatsworth home concluded that the results showed no indication of any man-made contamination from SSFL activities.

Results from the gamma spectroscopy report of the composite soil sample taken from the West Hills residence confirmed that the results were all well within the range found both locally and elsewhere in the U.S. Naturally occurring potassium-40 and uranium and thorium decay products were detected. The report to the residents of the West Hills home concluded that the results showed no indication of any man-made contamination from SSFL activities.

Results of the solvent analyses from the three soil samples taken from the flower bed in the backyard of the West Hills residence confirmed that the soil samples did not contain VOCs.

2.7 AREA IV RADIOLOGICAL SURVEY (1994 - 1995)

A radiological characterization study was conducted from March 1994 through September 1995 in Area IV of the Santa Susana Field Laboratory (Rockwell 1996).

2.7.1 Program Area

Offsite areas were sampled to determine the background radioactivity levels for comparison to data collected within Area IV. Offsite background sampling locations selected were those utilized as part of the prior McLaren-Hart offsite multi-media study of the Brandeis-Bardin and the Sage Ranch (McLaren-Hart 1993b). Additional offsite samples were taken in Santa Susana Park, Western Sampling Site, and in Bell Canyon (Figure 1-1) to supplement the background samples taken during the multi-media studies.

2.7.2 Program Scope and Objective

The purpose of the study was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. The study provided a comprehensive investigation of the radiological status of regions in Area IV which had not previously been characterized. It focused on those regions of Area IV which had not previously been surveyed as part of facility specific decommissioning operations.

2.7.3 Sampling Program Details

Most soil analysis at background areas was provided by the 1992 multi-media study. However, additional sampling was needed to analyze for isotopes of thorium and uranium and this was done in the 1994 multi-media study. However, Bell Canyon, Santa Susana Park, and the Western Sampling Site did not undergo thorium and uranium analysis during 1994. Therefore, two additional samples were taken at each of these locations for the Area IV program and analyzed for thorium and uranium.

2.7.4 Program Results

The six background samples taken offsite in Santa Susana Park, Western Sampling Site, and Bell Canyon were analyzed for isotopic thorium (thorium-228, thorium-230 and thorium-232) and isotopic uranium (uranium-234, uranium-235 and uranium-238). The study concluded that sample results were typical of background levels found in other areas.

2.8 LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) – ROCKETDYNE RECREATION CENTER STUDY (1997)

The Lawrence Livermore National Laboratory (LLNL) conducted a study of cesium concentrations in soil at the former Rocketdyne Recreation Center in West Hills, California in 1996 (Hamilton, 1997).

2.8.1 Program Area

The program area comprises 14.2 acres and is located approximately 2.5 miles southeast of SSFL in the San Fernando Valley. No operations were conducted here, other than employee recreation activities and club meetings.

2.8.2 Program Scope and Objective

The sampling strategy was to obtain a sufficient number of soil samples to completely characterize the cesium–137 concentrations around the site.

2.8.3 Sampling Program Details

A sample grid (130 feet x 130 feet) was placed over a site map. A sample was then collected as near as possible to the center point of each grid reference point. This sampling collection technique yielded a total of 15 accessible sampling locations and provided an unbiased approach to sample location selection. An additional seven locations were selectively placed along the boundary of the property. Samples were analyzed for cesium-137.

2.8.4 Program Results

The average cesium-137 soil concentration was of 3.7 +/- 2.2 Bacquerel per kilogram (Bq/kg) (dry weight) (or 0.10 +/- 0.06 pCi/g). The study concluded that the levels of cesium-137 observed in these soil samples are within the range of background cesium-137 concentrations previously reported over a much wider geographical area within southern California and there is no evidence to suggest that soils contain cesium-137 attributable to local sources of contamination.

2.9 BELL CANYON PROJECT (1998)

At the request of a residential neighborhood adjacent to the SSFL, a sampling program similar to that performed on the Brandeis-Bardin (sample drainages and human use areas) was performed in the Bell Canyon area in 1998 (Ogden 1998a and 1998b).

2.9.1 Program Area

The sampling program area encompassed developed and undeveloped portions of Bell Canyon located to the south of SSFL. Sampling locations included undeveloped hillsides, residential yards and drainages. In addition, hillsides and drainages in the southern undeveloped portion of SSFL that lead to Bell Creek were sampled.

The soil and/or sediment samples collected during this investigation can be grouped into four categories based on location:

- Soil and/or sediment samples collected within residential yards (Note: These locations are not identified on figures in this report in order to protect the residents' privacy but data are included in Appendix B.)
- Soil and/or sediment samples collected in or adjacent to Bell Creek within Bell Canyon, including Bell Canyon Park;

- Soil and/or sediment samples collected in the SSFL drainages leading to Bell Creek; and
- Background samples.

2.9.2 Program Scope and Objective

The purpose of this sampling program was to collect and analyze soil and/or sediment samples from various areas of Bell Canyon to evaluate whether contaminants have migrated from the SSFL. The areas evaluated include SSFL drainages, Bell Creek, and the yards of three residents who requested sampling. All samples were collected between 0 and 1 foot bgs).

Additional samples collected during this program were "background" samples. These samples were collected in unused, undeveloped portions of Bell Canyon and in the southern undeveloped portion of the SSFL to provide information about naturally occurring background soil conditions in the area.

2.9.3 Sampling Program Details

Surficial sediments, between ground surface and 1 foot deep, were collected from the finest-grained sediments available at each location. Fine-grain sediments are most likely to contain or adsorb contaminants. Residential sampling locations were selected in conjunction with agency representatives (DTSC, USEPA, and DHS-RHB) and approved by the residents prior to sample collection. Most samples collected along Bell Creek and the SSFL drainages leading to Bell Creek were located along the bank of the drainage. The samples collected in the undeveloped portions of Bell Canyon and the SSFL were selected to provide information regarding naturally occurring background soil conditions.

A total of 23 primary soil and/or sediment samples were collected and analyzed for a comprehensive suite of chemicals and radionuclides using 22 different analytical methods to test for over 200 different compounds. Additional soil and water samples were analyzed for quality assurance (QA) reasons. Samples were collected according to sampling procedures outlined in the SSFL RFI Work Plan (Ogden, 2000a).

2.9.4 Program Results

The following compounds were not detected in any of the soil samples analyzed in this program: petroleum hydrocarbons, hexavalent chromium, perchlorate, formaldehyde, PCBs, ordnance compounds, strontium-90, and plutonium radionuclides.

Only a few organic chemicals were detected in the soil and/or sediment samples and are not considered related to SSFL. Acetone was detected in one sample near the Equestrian Center. A PAH, pyrene, was detected in one background sample. Low concentrations of dioxins consistent with background levels were detected in 17 of the soil samples. Fluoride and chloride were detected at low concentrations in most samples. Nitrate was detected in only four of the samples at low concentrations.

Several metals (barium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc) were detected in most of the samples. Arsenic, beryllium, and cadmium were detected in less than half of the samples. Concentrations of most metals were similar in all the samples except for aluminum, arsenic, barium, chromium, copper, lead, and zinc. These metals generally occur at higher concentrations in soils overlying bedrock composed of shale in the eastern portion of Bell Canyon.

Low concentrations of radionuclides consistent with naturally occurring levels were detected in most of the samples. Five gamma-emitting radionuclides were detected (cesium-137, manganese-54, and the naturally-occurring radionuclides potassium-40, radium-226, and thorium-228).

Cesium-137 levels were within the local background range established by the Brandeis-Bardin/Sage Ranch study (Section 2.5). Manganese-54 was detected in one sample at 0.024 +/- 0.0069 pCi/g, well below the USEPA residential 10^{-6} preliminary remediation goal (PRG) of 0.69 pCi/g. Tritium was originally detected in 11 samples; reanalysis of these samples indicates that only 1 sample had detectable tritium. The maximum tritium detect was 0.3 +/- 0.06 pCi/g, well below the USEPA residential 1×10^{-6} PRG of 2.3 pCi/g. Naturally-occurring thorium and uranium radionuclides were detected at low concentrations in all the samples.

In addition, europium-154 was detected in six samples up to 0.12 pCi/g and cerium-141 detected in one sample at 0.06 pCi/g. However these are judged to be false positives for the following reasons. All europium-154 results are very close to the detection limit and have associated errors almost equal to the measured value.

2.10 FSDF OFFSITE SAMPLING (1995 - 2000)

Offsite drainage sampling was conducted at various times between 1995 and 2000 as a part of an extensive characterization program that resulted in an Interim Measure (IM). In 1995, offsite drainage samples were collected downstream of the FSDF in Brandeis-Bardin by McLaren/Hart (ICF 1997). In 2000, an IM was conducted at the FSDF area and in the drainages. Activities consisted of excavation, transportation, and disposal of soil and sediment from the FSDF and its drainage channels, mapping of the excavation, and verification sampling of the excavated areas. Near the completion of the excavation activities, DTSC requested additional offsite confirmation samples.

The Interim Measures Implementation Report (IMIR) for the FSDF was prepared in 2002 in order to document the implementation and completion of the *Draft Final Interim Measure Workplan for Soil Cleanup, Former Sodium Disposal Facility, Santa Susana Field Laboratory* (IMWP).

2.10.1 Program Area

The offsite portion of sampling during this program included collection of five samples in offsite channels in the 1995 sampling and three samples in offsite channels below in the 2000 sampling. Samples were located approximately 1,500 feet to 3,000 feet downstream of the FSDF, near monitoring well OS-5.

2.10.2 Program Scope and Objective

The drainages downstream of FSDF were sampled in 1995 to assess the potential migration of contaminants from the FSDF in these drainages. The 2000 samples were collected as part of the IMWP. These samples were intended to confirm that no additional chemicals might have migrated further into the drainage during the time between the initial sampling and the interim measure (IT 2002).

2.10.3 Sampling Program Details

Four soil/sediment samples were collected on June 28, 1995 and analyzed for PCBs and dioxins; one duplicate sample was also collected and analyzed for dioxins. Three soil/sediment samples (two samples and a duplicate) were collected on November 9, 2000 and analyzed for PCBs.

2.10.4 Program Results

PCBs were detected up to 56 micrograms per kilogram (µg/kg) and dioxin TEQs were detected up to 1.04 ng/kg in the 1995 sampling. These results were used to characterize the impacts from the FSDF and used in a human health risk assessment to establish cleanup goals for the FSDF IM.

PCBs were detected up to 91 µg/kg in the 2000 sampling taken during the IM. These were below the FSDF IM Cleanup Goal for PCBs and were therefore not removed during the IM.

2.11 PERCHLORATE STUDY (NORTHERN DRAINAGE) (2003)

The Northern Drainage of the SSFL collects storm water runoff from a catchment area of approximately 780 acres, including runoff from nine SSFL RFI sites Because nine SSFL RFI sites lie within the catchment area of this drainage (B-1, Instrument and Equipment Laboratories, Liquid Oxygen Plant, the Area I and Area II Landfills, Area II Incinerator Ash Pile, portions of the Expendable Launch Vehicle site, Building 515 Leach Field, and portions of the Building 359 site), this SSFL drainage was the subject of sediment sampling and analysis in 2003 as part of the Perchlorate Characterization Work Plan implementation.

2.11.1 Program Area

Drainage sediment, surface water, springs/seeps, and selected bedrock/mineral deposits adjacent to springs/seeps were sampled in the Northern Drainage in two sampling events in 2003. The sampling area includes 3 miles of drainage along the SSFL northern property boundary and associated areas adjacent to the drainage.

2.11.2 Program Scope and Objective

The purpose of sampling, as described in the *Northern Drainage Perchlorate Sampling Results Technical Memorandum*, was to test sediments, surface water, or springs/seeps present within the northern drainage to evaluate potential offsite migration of perchlorate from the SSFL. The objective for collection and analysis of the drainage sediment and surface water samples was to evaluate the potential transport of perchlorate by surface water from the SSFL into the Northern Drainage. The objective for collecting and analyzing spring/seep samples was to evaluate the potential groundwater transport pathway from the Building 359 RFI site across geologic features and to confirm that perchlorate releases to groundwater remain local to their respective release location(s).

2.11.3 Sampling Program Details

Seventy-nine (79) locations were tested and 171 samples were collected and analyzed for perchlorate during this program. As described below, some locations/depths were re-sampled during this program, and some samples were analyzed multiple times to achieve lower detection limits or to clarify uncertain results. Only final sample results for each unique location and depth are included in the sample count above. In total, including duplicates and confirmation samples, 140 sediment leachate, 14 surface water, 15 spring/seep, and 2 rock chip samples were collected for this sampling program.

Samples were collected from surficial and deeper sediments within the active channel of the Northern Drainage to evaluate the potential for surface water transport of perchlorate from the SSFL.

In general, the lateral spacing of sediment samples within the drainage increased with distance from the RFI sites, with a maximum lateral distance of 1000 feet as requested by DTSC. At or near RFI sites, the lateral spacing of these samples generally ranged from about 50 to 125 feet. Sediment sample locations near the Area I and Area II landfills were presented in the Area I and Area II Landfills Investigation Work Plan submitted to DTSC in June 2003 (MWH 2003c). A lateral spacing ranging from about 250 feet to 500 feet was used at those sampling locations away from RFI sites but within or immediately adjacent to the SSFL. North of the SSFL (offsite) the lateral spacing of sediment samples increased and ranged from about 500 to 1000 feet (MWH 2003d and 2003e).

Samples were collected at depths between the surface and ½-inch below the surface (designated as sample S01) and at 6 inches above the bedrock (designated as sample S03). At approximately 10 percent of the sample locations, an additional sediment sample was collected between ½ inch and 4 inches below the surface (designated as sample S02). Additional samples of this type were collected in areas with thin sediment deposits that precluded collecting S03 samples (MWH 2003d and 2003e).

Sample locations were added along the drainage if salt deposits were noted. At the two locations within the drainage where thicker sediment deposits were present, over-bank samples and deeper samples were collected at approximately 6-inch depth intervals to just above bedrock.

Aqueous leachates of collected soil/sediment samples were prepared on every other sample or every other in deeper borings. If water was encountered in the bottom of an auger boring, water samples were collected using a disposable bailer or syringe device.

Leachates were prepared by mixing approximately 250 grams of each soil/sediment sample with 250 milliliters of deionized water in laboratory supplied, pre-cleaned containers. The soil-water mixtures were shaken for 2 minutes, allowed to settle for 15 minutes, and shaken again and allowed to settle overnight. The water in the mixture was decanted as the leachate sample and submitted to the laboratory for analysis under appropriate chain-of-custody procedures.

Surface water samples were collected from the Northern Drainage. In saturated portions of the drainage, samples were spaced equidistant with respect to springs/seeps and/or locations where water was encountered in borings. These samples were collected by submerging laboratory obtained sample bottles directly in the surface water stream or pool.

Water samples from springs/seeps located along the Northern Drainage were collected and analyzed for perchlorate to evaluate the potential transport of perchlorate in groundwater. Spring/seep sampling locations targeted were new springs/seeps identified in the Northern Drainage or those previously sampled for perchlorate. Three springs/seeps were located in tributaries leading to the Northern Drainage.

Rock chip samples were collected at spring/seep locations where mineral precipitate deposits were noted adjacent to the spring to verify the presence or absence of perchlorate in spring/seep water (MWH 2003d and 2003e).

2.11.4 Program Results

The results of the Northern Drainage sampling program are that no perchlorate was detected in any offsite samples. Based on these results, it was concluded that sediment and surface water have not transported perchlorate offsite within the Northern Drainage (MWH 2003f).

2.12 OS-9 SAMPLING AND OS-9R MULTI-LEVEL GROUNDWATER MONITORING SYSTEM PROGRAM (2003 – 2005)

A multi-level groundwater monitoring system was installed at a new well OS-9R on the Brandeis-Bardin property in 2004, drilled in proximity to OS-9 (Figure 1-6). Work described in this report was performed in accordance with the *Perchlorate Characterization Work Plan (Rev. 1)* (MWH 2003a) and supplemented by communications between DTSC and Boeing. This work included corehole drilling, geophysical logging, open-corehole groundwater sampling, multi-level groundwater monitoring system installation, multi-level system groundwater monitoring and sampling, and laboratory analysis of groundwater samples (MWH 2005b). The OS-9R sampling program was performed to evaluate reported detections of perchlorate in two groundwater samples collected from well OS-9 by DTSC.

Boeing initiated a comprehensive groundwater sampling program of well OS-9, collecting weekly samples between July 2, 2003 and October 2, 2003, and quarterly through 2004. Similarly, detailed groundwater sampling from new well OS-9R was also implemented following its construction. A complete chronology of these sampling events can be found in the above referenced *Perchlorate Characterization Work Plan (Rev. 1)* (MWH 2003a). This work was performed in order to investigate the potential offsite migration of perchlorate from the SSFL as outlined in a letter from the DTSC dated October 14, 2003 (MWH 2003a).

2.12.1 Program Area

OS-9R is located adjacent to existing offsite well OS-9 (also referred to as Bathtub Well #1) on the Brandeis-Bardin property (Figure 1-6) (MWH 2005b). The well is located approximately 4,600 feet north of the SSFL-Brandeis-Bardin property boundary.

2.12.2 Program Scope and Objective

This program involved the drilling of the OS-9R corehole, installation of the multi-level monitoring system, and groundwater sampling of both OS-9R and OS-9. The primary purpose of the new well was to evaluate whether perchlorate is present in groundwater beneath the Brandeis-Bardin. Various other constituents of concern were also sampled including 1,4-dioxane, VOCs, tritium, and radionuclides.

2.12.3 Sampling Program Details

Open corehole sampling occurred at OS-9R on January 26, 2004. Multi-level sampling occurred on three separate events in June and November of 2004 and in March of 2005.

Open Corehole Sampling

The well was allowed to flow naturally (the well is artesian) prior to sampling. The groundwater samples were collected from the open corehole using a disposable bailer and transferred into the appropriate sample containers. The samples were submitted for analysis of VOCs, perchlorate, general minerals and radioactivity.

Multi-level Sampling

After corehole sampling, a multi-level sampling device was installed in the well. Analyses for VOCs, perchlorate, general minerals and radioactivity were performed on groundwater sampled collected in June 2004.

Additional groundwater samples collected by Boeing representatives during the November 2004 and March 2005 sampling events included perchlorate and general minerals. Split samples were collected by DTSC during the November 2004 sampling event and were analyzed by DTSC for perchlorate and VOCs.

2.12.4 Program Results

VOCs were not detected in the primary sample and field duplicate collected in the OS-9R open borehole. VOCs were detected at concentrations below the laboratory reporting limit in three of the depth-discrete samples collected during the June 2004 OS-9R multi-level sampling event:

- Benzene, Port 2, 0.45J micrograms per liter (µg/L);
- 1,2-dichloroethane, Port 4, 0.57J µg/L; and
- Naphthalene, Port 12, 0.41J µg/L.

VOCs were not detected in any other groundwater sample collected from the OS-9R multi-level system. VOCs were not detected in the split samples collected and analyzed by DTSC and Brandeis-Bardin. 1,4-dioxane was not detected in any groundwater sample.

Perchlorate was not detected in any groundwater sample collected from OS-9R (in the January 2004 open borehole sampling event or in the multilevel sampling events).

Tritium was not detected in any sample collected from the January 2004 OS-9R open borehole event nor the June 2004 multi-level sampling event. No dissolved gross alpha, gross beta and thorium isotopes radioactivity was detected in the samples (MWH 2005b).

This report concluded that these data confirm that contaminants in groundwater beneath the SSFL are not present in the groundwater beneath the Brandeis-Bardin at and near OS-9R (MWH 2005b).

2.13 SSFL SOIL BACKGROUND SAMPLING (1992 - 2005)

Background soil sampling locations for the SSFL were established to provide data representative of ambient or local soil conditions, unaffected by site-related activities.

2.13.1 Program Area

To establish a background data set, sampling locations were selected within and surrounding the SSFL in areas not impacted by site activities. The background locations include all surrounding offsite areas and range in distance up to 3 miles from the SSFL. The background sampling locations were chosen based on extensive review and input by the DTSC, Geological Services Unit (GSU) Branch. An overview of the sampling events during which the data set was assembled is provided herein.

2.13.2 Program Scope and Objective

Background soil sampling was performed during six discrete sampling events from 1992 through 2005. Each of these investigations was conducted in accordance with DTSC-approved work plans and included analytical suites designed for the specific purposes of that sampling program. Background sample locations for each investigation were selected based on DTSC input, and were visited by DTSC personnel. Improvement in laboratory analytical techniques over the course of these investigations resulted in different analytical methods, metals suites, and/or laboratory reporting limits (RLs) for each metal analyzed.

2.13.3 Sampling Program Details

Initial assessments of the potential for offsite contamination at properties adjacent to and north of the SSFL were conducted according to the DTSC-approved Work Plan for Multi-

Media Sampling at the Brandeis-Bardin and Sage Ranch (McLaren/Hart 1992) and the Work Plan for Additional Soil and Water Sampling at the Brandeis-Bardin and Sage Ranch (McLaren/Hart 1993a). The investigations were conducted between 1992 and 1994, and included sampling of soil, surface water, groundwater, and produce at both properties (Figure 2-1). In consultation with the USEPA, personnel from Brandeis-Bardin and Rocketdyne, and the general public, six local background sample locations were selected to provide data on background concentrations of metals and radionuclides (McLaren/Hart 1992). These data were also used for interpretation of sampling results at the two properties. Sample locations were:

- Rocky Peak (Sample Location BG01, approximately 5.1 miles north-northeast of the SSFL);
- Santa Susana Park (Sample Location BG02, approximately 2 miles northeast of the SSFL);
- Bell Canyon (Sample Location BG03, approximately 1 mile south-southeast of the SSFL);
- Western Sampling Site (Sample Location BG04; approximately 0.4 mile west of the SSFL);
- Happy Camp (Sample Location BG05, approximately 12.5 miles northwest of the SSFL); and
- Santa Monica Mountains National Recreation Area (Sample Location BG06, approximately 4.3 miles south-southwest of the SSFL).

At each of these areas, soil samples were collected from three locations within the upper 1 foot of soil and assigned a depth of 0 to 1 foot bgs. Samples were analyzed for 13 priority pollutant metals by USEPA Method 6010/7000 at McLaren/Hart. Sampling results for these events are presented in the Multi-Media Sampling Report for the Brandeis-Bardin and the Sage Ranch and Additional Soil and Water Sampling at the Brandeis-Bardin and the Sage Ranch (McLaren/Hart 1993b and 1995).

FSDF Closure Field Investigation (July 1995)

During 1995, investigation activities for the FSDF (SWMU 7.3) in the SSFL Area IV, 12 background soil sampling locations were selected for comparison with onsite sampling data for metals and dioxins. This sampling event was conducted according to the DTSC-approved Sampling and Analysis Workplan, Former Sodium Disposal Facility (ICF 1995). Soil samples at each location were collected from the surficial soils and analyzed for 17 Title 22 metals by SW846 Method 6010/7000 and dioxins/furans by USEPA Method 8290 (ICF 1997).

Soil metals and dioxins data from 7 of the 12 sampling locations (BKND-1 through BKND-7) were approved by DTSC for use in the background data set for the FSDF Interim Measures (IT 2002; DTSC 2004). Five of the seven selected locations are within undeveloped land in the southern portion of the SSFL; the other two are along the SSFL property boundary adjacent to Area IV, away from any known site activities (Figure 2-1). The five samples that were not selected for the background data set were considered to be too close to SSFL operations.

Additional Sampling for the RFI Standardized Risk Assessment Methodology Work Plan (March 2000)

In 2000, after review of the soil background metals and dioxins data collected during the events described above, DTSC requested additional sampling to improve sample distribution at and surrounding the SSFL and increase the number of samples in the dioxins background data set. Three additional sampling locations were selected, in conjunction with DTSC, within undeveloped land in the northern and southern portions of the SSFL. Sampling was conducted on March 22, 2000 following RFI sampling protocol outlined in the RFI WPA (Ogden 1996) and RFI WPAA (Ogden 2000a). Samples collected at two of these locations (BGSS07 and SGSS01) were analyzed for metals and dioxins using USEPA Methods 6010/7000 and 8290, respectively. The sample collected at location BZSS05 was analyzed only for dioxins by Method 8290. The resulting metals and dioxins background data sets were approved by DTSC (DTSC 2000) as part of the Standardized Risk Assessment Methodology (SRAM) Work Plan in June 2000.

Metals Background Sampling (April 2005)

After discussions with DTSC during late 2004 and early 2005, it was agreed that additional sampling at DTSC-approved background locations was necessary to supplement the existing soil metals background data set. This was accomplished by collecting samples and either completing the metal analyses not previously performed on all samples or adding new analytes not previously included. This sampling event was conducted in April 2005. During this event, sampling and analyses were performed to complete the background dataset for pH and the following metals: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, lithium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, strontium, thallium, vanadium, zinc, and zirconium.

This sampling event was conducted following RFI standard operating procedures (SOPs) (Ogden 1996 and 2000a).

2.13.4 Program Results

The data from the six reports discussed in the previous sections yielded a final background data set consisting of metals, fluoride, and pH data from 41 soil samples collected at 29 agency-approved locations. A total of 27 samples were collected at 21 locations within the SSFL property boundary, and 14 samples were collected from offsite locations. The dioxins soil background data set consists of 17 samples from 16 of the metals sampling locations. Twelve of the locations were onsite, and four of the dioxins sampling locations were offsite.

The SSFL soil background data set meets regulatory criteria established for background data. This includes both the California (DTSC 1997) and Federal (USEPA 2002) criteria. DTSC has reviewed and approved each of the sampling locations. Each location was reviewed to ensure similar geology to the SSFL and evaluated for potential site impacts. This background data set was approved by DTSC for use in the RFI when the SSFL revised SRAM was approved in November 2005 (DTSC 2005).

2.14 POST TOPANGA FIRE BACKGROUND SOIL AND SURFACE WATER SAMPLING PROGRAM (2004 – 2006)

In September 2005, the Topanga Fire burned over 22,000 acres including approximately 2,000 acres of land at the SSFL. The fire burned mostly undeveloped and heavy-brush areas, although one home and a few structures were also destroyed. The fire produced ash and charred materials that deposited fire-related chemicals across the SSFL.

2.14.1 Program Area

Post-fire sampling was performed at agency-approved SSFL background sample locations and distal locations around southern California. Surface or shallow soil samples were collected at six DTSC-approved background locations either within or surrounding the SSFL. Six samples were believed to be sufficient to provide initial data to meet the study objective of providing a qualitative understanding of the potential fire-related soil impacts. The six sample locations of the Post-Topanga Fire Soil and Ash Background Data Set were selected so that they were generally located 360° along the outer boundary of the SSFL. These six locations were selected be representative of ambient site conditions at the SSFL after the Topanga Fire and are based on the following criteria:

- Previous soil samples analyzed for dioxins and metals;
- Received ash fall-out from the fire;
- Represent ambient conditions both within and adjacent to the Topanga Fire burn area; and
- Reflect both upwind and downwind locations from SSFL (i.e., 360° along the outer boundary of the SSFL).

A total of four surface water wet weather samples were collected. Two locations are in the area of the 2005 Burbank (Harvard) Fire (Flow Science 2006).

2.14.2 Program Scope and Objective

The purpose of the Post-Topanga Fire Background Investigation was to provide data to support qualitative evaluations of changes in background concentrations of metals, dioxins, and other chemicals following the Topanga Fire. The scope of the post-Topanga Fire sampling was designed to evaluate potential increases in background concentrations of fire-related chemicals at the SSFL, and included the following:

- The Post-Topanga Fire Soil and Ash Background Data Set
    a. Collection of surficial soil samples from areas that either burned in the fire and/or received ash fall and/or contained fine charred material from the fire; and
    b. Collection of ash from areas near the surficial soil samples that received ash fall from the fire within the burned area;
- The Post-Fire Reference Soil and Ash Data Set
    a. Collection of surficial soil samples from other undeveloped fire burn areas primarily away from the SSFL, including areas burned in the 2005 Topanga and Burbank fires; and
    b. Collection of ash from areas that received ash fall from the fire near the surficial soil sampling locations within burned area.
- Analysis of all samples for fire-related chemicals, including heavy metals and dioxin compounds.
- In addition to soil and ash sampling, surface water runoff samples were collected.

2.14.3 Sampling Program Details

Several evaluations were performed on the collected post-fire data. The comparisons performed included:

- Comparison of metals and dioxin concentrations for co-located samples collected pre- or post-fire. These comparisons provide an indication of the potential for fire-related impacts.
- Comparison of pre-fire metals, dioxin, and PAH maximum concentrations with post-fire maximum concentrations. These comparisons provide an indication of the potential magnitude of the fire-related impacts.
- Comparison of the Post Topanga Fire Background Soil and Ash Data Set to the Post-Fire Reference Soil and Ash Data Set. These comparisons provide an indication of whether post-fire impacts on SSFL are different than at other fires.
- Comparison of metals and dioxin post-fire data to regional pre-fire data. These comparisons also provide an indication of whether post-fire impacts on SSFL are different than at other fires.

All soil samples were collected from 0 to 6 inches bgs. To ensure comparability with the Approved Soil Background Data Set, samples from background locations were collected from the same locations and depths as previous surface samples. For all soil samples, pebbles, visible vegetation, charred twigs, and leaves were carefully removed by scraping them aside with a pre-cleaned trowel, before scooping the sample into a glass jar. The ash samples were collected from accumulations that were generally 2 to 3 inches thick, and typically were located within about 30 feet of the soil background locations. As with the soil samples, a pre-cleaned trowel was used to collect the ash. Every effort was made not to include soil in the ash samples.

All soil and ash samples collected during the post-Topanga Fire sampling event were analyzed for fire-related chemicals (metals, dioxins, and PAHs). Soil and ash samples were also analyzed for the following fire-retardant related chemicals: cyanide, sulfate, surfactants, and ammonia. Sulfate, surfactants, and ammonia were chosen for analysis due to their common occurrence in fire fighting foams compiled by the United States Forest Service on its website. Cyanide was chosen for analysis due to the potential of free cyanide to be formed when water makes contact with fire-retardant Fire-Troll 931R.

2.14.4 Program Results

The following describes the findings of this sampling program:

- Concentrations of several fire-related chemicals in soil and ash in the Post-Topanga Fire Soil and Ash Background Data Set were greater than their collocated soil samples in the Approved Soil Background Data Set.
- Some chemicals are higher in post-fire soil samples than background soil including some metals, dioxin congeners and PAHs.
- Some chemicals are higher in post-fire ash samples than background soil including some metals, dioxin congeners and PAHs.
- Post-fire concentrations of metals and dioxins are not limited to the SSFL area but occur in distal areas affected by other Southern California fires.

Based on these findings, the following conclusions and recommendations are made:

- Regional brush fires are a source of heavy metals, dioxins, and other fire-related chemicals in soil (Aronsson and Ekelund 2004; Clement and Tashiro 1991; Nestrick and Lamparski 1983);
- The Topanga Fire has increased the concentration of metals, dioxins, and PAHs in soil at and near the SSFL;
- The Post-Topanga Fire Soil and Ash Background Data Set can be used in the SSFL RCRA Program in a manner consistent with DTSC-approved work plans and agency guidance to make decisions for site characterization, risk assessment, and cleanup.

2.15 FORMER SSFL LEASED AREA DEBRIS SURVEY (2007)

A debris survey was conducted in July 2007 within the two former SSFL leased areas that are now part of the MCRA; one is located north on Sage Ranch and the other is located to the northeast also on property owned by the MRCA. They were leased from a private party (Mr. Dundas, c/o Mr. Sage) between 1947 and approximately 1970 by North American Aviation and Rocketdyne, predecessor companies of Boeing.

2.15.1 Program Area

The former leased areas are located to the north and east of Area I of the SSFL and total approximately 75 acres in size. Of these, approximately 55 acres were surveyed; the remaining 20 acres were inaccessible due to heavy vegetation and/or steep bedrock cliffs.

2.15.2 Program Scope and Objective

The purpose surveys were to identify potential debris areas in the former leased areas and to conduct sampling to determine if there was soil or sediment contamination as a result of the presence of debris within the survey locations. This program focused on small debris accumulations or containers identified within the former leased areas. A historical photograph identified the east debris area as a former drum storage area. It should be noted that significant additional sampling was already in progress at construction debris noted within the Northern Drainage near the former Liquid Oxygen (LOX) Plant RFI Site, and for clay pigeon target debris near the former Rocketdyne employee shooting range on Sage Ranch. Offsite work for the LOX debris and clay pigeon target debris areas are described in Section 2.16 below.

2.15.3 Sampling Program Details

Soil and sediment samples were collected according to standard RFI sampling practices described in the SSFL RFI Program Report (MWH 2004a). Five soil samples were collected and analyzed for SVOCs, TPH, metals, and VOCs.

2.15.4 Program Results

One soil sample was collected at the turnout south of Woolsey Canyon Road (east debris area) and analyzed for metals, TPH, VOCs, and SVOCs. Eight polynuclear hydrocarbons (PAHs) were detected at 0.75 feet bgs. Benzo(b)fluoranthene was detected up to 50.1 µg/kg; diesel range TPH was detected up to 9.55 mg/kg; and 1,1-dichloroethene was detected at an estimated value of 1.42 µg/kg. No metals were detected above background. These data were reported to DTSC as part in conjunction with other Northern Drainage samples described in the next section.

2.16 NORTHERN DRAINAGE CLAY TARGET & LOX DEBRIS SAMPLING PROGRAM (2007)

The Northern Drainage program area includes the former Rocketdyne employee shooting range located on Sage Ranch property, immediately north of SSFL, the offsite portion of the Northern Drainage east of the former LOX Plant RFI Site, and the portion of the Northern Drainage that extends onto BBI property. This offsite program is in progress, and includes additional sampling and mapping to support cleanup actions to remove a debris area near the LOX Plant and to remove clay target debris associated with the former shooting range.

Cleanup at the LOX debris area began in November 2007. Completion of clay pigeon target debris will continue into 2008. For the purpose of this OSR, samples collected prior to September 30 are described and presented.

2.16.1 Program Area

The program area includes the former employee-owned shooting range located on the Sage Ranch, immediately north of SSFL, the offsite portion of the Northern Drainage east of the former Liquid Oxygen (LOX) Plant, and the portion of the Northern Drainage that extends onto Brandeis-Bardin.

The Northern Drainage roughly bisects the former shooting range area, extending east to west. Beyond the former shooting range to the west, the Northern Drainage traverses the property line between SSFL to the south and Sage Ranch to the north. The Northern Drainage extends approximately 8,000 linear feet (1.5 miles) from the east end of the former shooting range to Outfall No. 009, and leaves SSFL property entering Brandeis-Bardin approximately 500 feet north of Outfall No. 009.

2.16.2 Program Scope and Objective

Cleanup plans have been prepared to remove construction debris, including some asbestos containing material (ACM), offsite on Sage Ranch near for the former LOX Plant RFI Site (Zenco 2007), and clay target debris near the offsite former employee shooting range on Sage Ranch and in down-gradient drainage areas (H&A 2007c). The extent of planned removals have been based on an ongoing sampling program performed in late June through August 2007 to further delineate the extent of these debris areas and remnants of clay target debris within the drainage sediments. The clay target debris is the most likely source of PAHs detected in soil at the former shooting range and in the drainage (H&A 2007c). Sampling was also conducted to assess residual lead shot present in the target area and asbestos in the vicinity of a debris area east of the former LOX Plant. As described in the clay target debris work plan, Boeing has conducted periodic cleanup actions to remove residual lead shot in this area since 1992 (H&A 2007c).

2.16.3 Sampling Program Details

Soil samples were collected from the clay target shooting range, offsite debris areas, and from the portion of the Northern Drainage that extends on to Brandeis-Bardin property. Samples were collected from the banks and sediments of the drainage from depths ranging from 0 to 5.5 feet bgs. During the clay target debris characterization activities, possible ACM was encountered in an offsite portion of the North Drainage located east of the former LOX Plant. The analytical suite for selected soil samples included PAHs, metals, TPH, PCBs, and VOCs, as well as asbestos for select soil samples collected from the LOX debris area. Samples taken from the LOX debris area were also analyzed for gamma-emitting radionuclides, strontium-90, and tritium during the removal work.

2.16.4 Program Results

Based on the results of the characterization activities, the approximate extent of clay target debris in the former shooting range and Northern Drainage was established. Soil samples with detectable PAH concentrations occur throughout the length of the drainage, with concentrations generally decreasing in the down-gradient portions.

In the area of the former shooting range, the maximum benzo(a)pyrene (BaP) toxic equivalency (TEQ) was 900 mg/kg. In the offsite area east of the former LOX Plant, the maximum BaP TEQ concentration was 0.69 mg/kg. In the portion of the Northern Drainage on the Brandeis-Bardin property, the maximum BaP TEQ was 0.56 mg/kg. Lead concentrations in samples from the former shooting range area ranged up to 319 mg/kg and decreased rapidly to background concentrations down drainage. A cleanup action to remove clay target debris and residual lead shot in the former shooting range and drainage area is being conducted during 2007/2008.

Analytical data from soil samples collected from June through August 2007 were used to delineate ACM in the LOX debris area. Asbestos was found at a maximum of 80 percent in a single sample. A cleanup action to remove ACM from the LOX debris area began in November 2007 and is expected to be completed before year end.

2.17 AREVA STUDY (2007)

As part of the radiological characterization survey for the Building 4024 decommissioning project, AREVA Inc. took eighteen offsite soil samples. The report for this survey is not yet finalized at the time this OSR was prepared, but work plans and data, and study findings are described here for completeness.

2.17.1 Program Area

The extent of the offsite sampling conducted as part of the AREVA survey includes Woolsey Canyon, Black Canyon, and the Santa Susana Pass Road.

2.17.2 Program Scope and Objective

Offsite samples were taken to provide background levels for the Building 4024 decommissioning project.

2.17.3 Sampling Program Details

A total of 18 offsite soil samples were collected: six samples were taken along the lower portion of Woolsey Canyon (WC1 through WC6), six samples were taken along Black Canyon Road (BC1 through BC6), and six samples were taken along the Santa Susana Pass Road (SSP1 through SSP6). Samples were analyzed via gamma spectroscopy for gamma-emitting radionuclides (cesium-137, cobalt-60, cesium-134, europium-152, europium-154, potassium-40, manganese-54, sodium-22), tritium, strontium-90, americium-241, iron-55, nickel-59, nickel-63, isotopic plutonium, isotopic, thorium and isotopic uranium.

2.17.4 Program Results

Sample results for the following radionuclides were found to be non-detect: americium-241, cesium-134, iron-55, tritium, manganese-54, sodium-22, nickel-63, nickel-59, plutonium-238, plutonium-239/240, plutonium-241, strontium-90, europium-152, europium-154, and thorium-228.

The following radionuclides were detected in the samples, with detected concentrations within background levels and less than USEPA residential 10^{-6} PRGs: cesium-137, potassium-40, thorium-232, uranium-234, uranium-235, and uranium-238.

Radiological analysis of the soil samples taken confirmed that the results were either non-detect or well within background levels, and that the results showed no indication of any man-made contamination from SSFL activities at the locations sampled.

2.18 RFI PROGRAM (1996 – PRESENT)

As described in Section 1.4, the RFI Program is an ongoing effort to complete a comprehensive, integrated assessment of chemicals present onsite for the entire SSFL. The purposes of the RFI are to characterize the nature and extent of chemicals in environmental media; evaluate risks to potential receptors; gather data to support the next phase of the RCRA Corrective Action Program, the CMS; and identify areas for further work.

The RFI is included in the OSR as an offsite program since evaluation of onsite conditions sometimes leads to offsite sampling. The RFI Program does not specifically address offsite characterization; however, offsite sampling is performed if necessary to evaluate potential historical releases to offsite areas, characterize the nature and extent of onsite impacts, or assess transport or fate of contaminant migration pathways. For example, onsite sampling programs have extended into offsite areas to assess potential contaminant migration in drainages leading from the site. In some cases, these investigations have sometimes resulted in cleanup actions when potential offsite contaminant transport was indicated in surficial media (e.g., FSDF, Happy Valley, and Building 203 interim measures, and the currently in progress cleanup action in the Northern Drainage). As another example, comprehensive and detailed groundwater investigations are being conducted for the RFI in the northeast, a location where offsite groundwater impacts were identified in the 1990s.

Offsite data collected as part of the RFI site assessments are included and evaluated as part of this OSR and are provided in Appendix A.

3.0 OFFSITE DATA EVALUATION

The previous sections of this report describe the scope and findings of the various environmental programs that have been conducted offsite of the SSFL. In this section, the data collected during these programs are collectively evaluated by analyzing the data for spatial trends and patterns in relationship to onsite sources and potential migration transport pathways and by comparing results to risk-based or agency published screening levels. These evaluations were made in order to draw conclusions about the completeness of the offsite data and the significance of the measured concentrations.

The following sections first describe the purpose and methodology of offsite data evaluation and then present the results of the evaluation by analytical group. Overall evaluation of migration of contaminants by transport pathways is presented at the end of this section.

3.1 PURPOSE OF THE DATA EVALUATION

Data evaluation was performed to determine the completeness of the offsite data and the significance of the measured concentrations. In order to accomplish these objectives, several questions were asked of the entire offsite dataset. These questions include:

- What is the magnitude of offsite results compared to risk-based or agency-published screening levels?
- Are there sufficient offsite data to evaluate pathways of transport and migration with respect to potential onsite sources?
- Are there patterns or trends in the offsite results that would suggest an onsite source?
- Are there onsite data to indicate whether onsite sources have migrated offsite?
- Are there data gaps in the offsite data, and do these data gaps prohibit drawing conclusions about potential migration?

3.2 METHODOLOGY

The methodology and approach followed to answer the above questions are described in the six steps outlined below.

Step 1. Environmental characterization data were compiled from all programs conducted by Boeing, NASA, or DOE that collected and analyzed environmental samples from locations outside of the SSFL property boundary. Data from samples collected within approximately 15 miles of the SSFL were input into an analytical database for tabulation and further evaluation. All sampled media were included and categorized as: soil (including sediment and leachates), soil vapor, surface water, spring/seep, groundwater, solid (including debris, scrap metal, etc.), bedrock, vegetation, and municipal water. The analytical data tables are provided in Appendix B. Sampling locations are shown on Figures 2-1 and 2-2 differentiated by media type. Some offsite data were collected to provide naturally-occurring background concentrations. These results were used to compare concentrations from samples located nearer the SSFL that were collected from other programs or to assess other sources of contaminants. These background samples include various media results from the more distant locations (generally between 5 and 15 miles from SSFL) or municipal water supply data. Since these background samples were collected for interpretation of data presented in this report, these results are included in the database.

Step 2. Detected sampling results for analyzed media are presented on figures in Appendix B. Figures have been prepared by analytical group (e.g., VOCs, metals, SVOCs, etc). Analytical results that were reported as non-detect are shown on the maps only if that analyte was detected in collocated samples at that location. Because metals, dioxins, and some radionuclides are naturally occurring, detected concentrations for these constituents are presented if encountered at concentrations above background levels. SSFL-specific background levels that have been approved by DTSC (chemical data) or used by Boeing in prior published surveys provided to DHS-RHB (radiological data) have been used to screen the data and for graphical presentation of the results. Unlike soil and sediment, water samples may be analyzed on numerous occasions thus producing results that are temporal in nature. Because of the large number of water samples in the database, the results posted on figures and maps represent the most recent data collected for that analytical group at that sampling location. Again, similar to soil and sediment, metals results from groundwater and spring/seep samples have been compared to SSFL-specific Groundwater Comparison Concentrations (GWCC) approved by DTSC. However, all offsite data compiled for this report are included in the database in Appendix B and have been evaluated for completeness and significance as described below. Where notable, historical detections are described in this section of the report and noted on Figures 3-1 to 3-7.

Step 3. Data included in the comprehensive offsite database were compared to risk-based or agency-published screening levels. Screening levels used and information regarding the basis of the screening levels selected for this evaluation are presented in Appendix C.

Screening levels for offsite soil, sediment, soil vapor, and bedrock samples were based on SSFL Risk-Based Screening Levels (RBSLs) that have been developed for the hypothetical future resident (i.e., residential land use) using a DTSC-approved risk assessment methodology. Only perchlorate had a screening level that was based on previous cleanups instead of its RBSL. These surficial media RBSLs are used for onsite RFI data evaluation and are based on residential land use. Screening levels for radionuclides in soil were calculated using the USEPA PRG on a 1 x 10^{-6} excess risk level over background for residential land use (USEPA 2002b). Screening levels for groundwater, springs and seeps, and surface water were all compared to regulatory agency levels for drinking water (i.e., USEPA and California MCLs, DHS notification levels, etc.). Ecological-based screening criteria were considered but not used for this evaluation. This is because the offsite data includes both residential developments and undeveloped land, and consistent ecological criteria can not be applied to all offsite areas since they are not applicable to residential developed areas. In addition, for the majority of chemicals evaluated, the human health/residential-based RBSLs are more protective (i.e., lower concentration) than the ecological-based RBSLs.

Step 4. Tabulated data summaries were prepared that include all sampling results and indicate the number of detections, range of detected concentrations, range of detection limits, and number of samples exceeding screening values (Tables 3-1 through 3-8). These data tables are presented for each environmental media sampled and represent the entire dataset presented in Appendix B, including samples collected at offsite locations designated as background or reference locations.

S*tep 5.* Summary figures were prepared to aid in the evaluation of the spatial data distribution compared to screening levels (Figures 3-1 through 3-13). Additional information regarding preparation of these evaluation materials is provided below.

- The figures provide a summary overview of media and locations sampled in offsite areas and are presented by analytical group. The data presented on these figures are limited to areas within about 5 miles of the SSFL since the more distant data were used for comparison of results nearer to or on the facility (i.e., the distant samples are offsite program reference or background samples).
- Data results are color-coded to indicate the magnitude of the results compared to screening levels (Appendix C). For most chemicals the colors are selected at each location by comparing each detected result at that location to its screening level. When there are multiple analytes in an analytical group, the highest ratio of all analytes at that sample location is presented on the figure.

- For naturally occurring chemicals such as metals, dioxins, and certain radionuclides, all results were first compared to background before comparison to screening levels. The figures present sample results as color-coded dots to represent non-detect or as factors of the ratios that are either below (i.e., less than 1) or above the screening levels.
- Similar to the individual result figures in Appendix B, only the most recent aqueous sample results are compared to screening levels. Historical data are described if notably or repeatedly different from the most current data.

Step 6. Offsite sampling results were evaluated to determine whether the data suggest a spatial trend or are indicative of a specific migration/transport pathway from an onsite source area(s). This approach included the following steps (described in additional detail in Section 3.4):

- Data were evaluated for patterns and trends both within individual media (i.e., a comparison of all spring/seep data offsite) and between media (e.g., groundwater in relationship to nearby soil data, or springs/seeps in relationship to groundwater).
- The evaluation was performed on an analytical group basis since similar uses and physical and chemical properties of the chemicals or radionuclides within a group would be expected to lead to similar environmental transport and fate (e.g., adsorptive properties of metals are generally higher than those of solvents).
- The transport and fate evaluation via the groundwater, surface water, and air pathways were performed in light of the site conceptual model for that environmental media at SSFL. For example:
  - SSFL operational areas or known areas of soil impacts were considered as potential onsite sources. These potential source areas are identified on the summary figures presented in this section. Evaluation of contaminant migration from these sources to offsite areas was considered for each analytical group as described above via groundwater, surface water, and air pathways. In addition, the extent of onsite chemical use and contamination was considered in this analysis.
  - When the evaluation suggested a trend from an onsite source, the offsite data were further evaluated to determine if there are trends suggestive of migration and if additional data are needed to further define the presence of the offsite contamination. The data from specific offsite environmental media were evaluated in the transport and fate evaluation.
  - Sampling results were evaluated for consistency in concentration, type of contaminant detected, and spatial distribution. This was particularly true for evaluating groundwater results since many samples from many locations were available. Notable infrequent occurrences of historical or recent sampling results above screening levels are described if considered potentially related to site operations or sources areas onsite. Otherwise, the results were considered as outliers (i.e. false positives) to the dataset. Evaluation of offsite groundwater data

considered findings presented in the report entitled *Review of Detected Constituents in Groundwater Collected from Off-Site Wells, Springs, and Seeps* (H&A 2007b), and provided in Appendix A.

- The offsite dataset contains results that require additional consideration. For example, many low concentrations of typical laboratory or field contaminants are reported in the older data. This older data sometimes contain detection limits above typical current methods. Laboratory analytical methods and procedures have improved through time, generally resulting in a higher confidence that more recent results are more representative, although false positives still occur.
  - Common laboratory contaminants detected environmental sampling results include methylene chloride, acetone, methyl ethyl ketone, solvent preservatives like hexane, certain freons, phthalates, and others (USEPA 1999). Additional chemicals may result from contamination from equipment used for sampling such as toluene, benzene, carbon disulfide, and others (H&A 2007b). While these detections were considered for offsite data analysis, they did not drive data gap recommendations since they were typically found at concentrations less than screening levels and patterns in their occurrence and concentration relative to SSFL operations and onsite results were not observed. As described in Section 2.3, evaluation of infrequent detections in offsite groundwater has been performed (H&A 2007b), and is considered in evaluation of groundwater data presented in this OSR.
  - Elevated detection limits in the older data were evaluated in light of the entire dataset. Consideration was given to the relationship of the older non-detect to nearby more recent results, their location in relationship to potential onsite sources, and ongoing offsite studies.
- As necessary, the summary tables by media, and the detailed maps and database (Appendix B) were used to further evaluate specific chemicals and sample locations to determine trends and to evaluate migration/transport pathways from SSFL source areas.

3.3 DATA EVALUATION SUMMARY

The following sections present the data evaluation results. Figures 3-1 to 3-13, present the comparison of measured concentrations to screening values and/or background, as appropriate. Tables 3-1 to 3-8 present sampling results by analyte for each environmental media sampled. Appendix B presents figures and tables with individual sample results.

3.3.1 Chemical Data

3.3.1.1 VOCs

The evaluation of the offsite VOC data shows that, with the exception of two areas in the northeast as described below, there are no consistent offsite VOC detections above screening levels in soil/sediment, groundwater, surface water, or springs/seeps that are related to SSFL operations (Figure 3-1). Most offsite soil and sediment sampling results are non-detect, and where detected, mostly consist of typical laboratory contaminants (methylene chloride, acetone, etc.). However, offsite sampling results have confirmed the presence of significant VOCs above screening levels in groundwater and soil vapor in two locations beyond the north and northeast property boundary. There are sufficient offsite sampling data to assess potential offsite migration of onsite VOCs above screening values. In addition, there is an ongoing program to evaluate VOCs in springs and seeps surrounding the SSFL. The following provide additional information regarding VOCs present in offsite areas:

- In the northeastern offsite area, there is a consistent pattern of VOCs in groundwater and soil vapor at concentrations exceeding screening levels and in soil and sediment at concentrations less than screening levels. Detected VOCs primarily include TCE and its daughter products. These VOCs are not present in either surface water or springs/seeps in this area although a single occurrence of benzene has been reported in a spring further to the northeast. Benzene was not detected in a DTSC split sample from this location. This area is part of an ongoing, offsite groundwater evaluation near the northeastern RFI sites.
- Several benzene detections above screening levels have occurred in offsite wells located in the northeast (RD-66, RD-71, RD-38B, and OS-24) following discrete-interval monitoring equipment installation. These detections are considered the result of discrete-interval monitoring equipment since benzene had not been detected previously from these wells and studies have shown this equipment can cause this type of contamination (H&A 2007b).
- Benzene was detected at 5.6 µg/L, above its screening level, in a groundwater sample from well OS-17 in 2004. This detection occurred after well repair and is considered related to that maintenance activity (H&A 2007b). Benzene was not detected in 60 other samples collected prior to or following this single occurrence.
- Other groundwater results above screening levels in offsite wells are infrequent and sporadic and are generally low concentrations possibly related to laboratory contamination or other indeterminate sources (see H&S, 2007b). These areas are considered adequately assessed based on additional data from the wells and other surrounding well data.
- Adjacent to the LOX debris area, a single VOC (tetrachloroethene [PCE]) was detected above its screening level in one soil vapor sample. The PCE detection (at

1.2 µg/L) was just above the laboratory reporting limit and not confirmed by soil results from nearby sampling locations. The soils in this area are undergoing excavation as part of a DTSC-approved cleanup action being conducted by Boeing and NASA during November/December 2007. Following removal, additional sampling will be conducted to confirm that the removal action was complete.

- Spring/seep data around the SSFL is mostly non-detect for VOCs, although detections of common laboratory contaminants occur. A trace concentration of cis-1,2-DCE (at 0.32 µg/L, less than its screening level of 6 µg/L) was detected south of onsite springs near Bell Creek with repeated detections of TCE and cis-1,2-DCE. This detection along with others reported during this program are considered the likely result of laboratory contamination since other reported VOC detections from this program were not confirmed by DTSC split data, and earlier samples in the area were non-detect. As described in Section 2.4 and noted above, springs and seeps sampling in this area and surrounding the SSFL is ongoing.
- Offsite surface water sampling results are non-detect for VOCs and surface water results for onsite NPDES sampling locations have not exceeded permit limits and are all below screening levels used in this report.
- DTSC split sample results were evaluated and these sample results are generally consistent with the results from samples collected by Boeing, NASA, or DOE, and provide independent confirmatory data that also support the conclusions presented above.

The potential for onsite VOC source migration via groundwater, surface water or air transport pathways has been evaluated. As part of this evaluation, consideration was given to the location of historical chemical use within the SSFL, release mechanisms for the type of chemical being considered, and the onsite RFI characterization findings. At SSFL, VOCs are associated primarily with the use of solvents (primarily TCE) at rocket engine test stands, component test areas, laboratories, and disposal areas. This evaluation has confirmed previous findings that VOC-impacted groundwater and soil vapor occur in the northeast beyond the SSFL property boundary, and that a low concentration of PCE was detected adjacent to the LOX Plant debris area along the Northern Drainage (which is currently undergoing excavation).

The northeastern onsite and offsite area of the SSFL is the location of a focused, detailed study of potential groundwater transport of contaminants. Surface water and air transport of VOC impacts in soil are considered not significant since these chemicals quickly volatilize within moving water or disperse in air. Ambient air sampling has been done near the SSFL property boundary northwest of the former LOX Plant RFI Site which has an area with high soil VOC concentrations. VOCs were not detected in the ambient air samples collected

(MWH, 2007a). Also, VOCs have not been detected above permit limits in surface water samples collected at NPDES outfalls onsite.

In summary, based on the evaluation of available data, there are no offsite VOC data gaps except those already being addressed in ongoing RFI programs for the northeast or as part of the spring/seep sampling program. Offsite data collected during these programs should continue to be evaluated for significance and patterns when available.

3.3.1.2 SVOCs

The evaluation of the offsite SVOC data shows that, with the exception of two areas in the northeast as described below, there are no offsite SVOC detections above screening levels in soil/sediment, groundwater, surface water, or springs/seeps related to SSFL operations (Figure 3-2). There are sufficient offsite sampling data to assess potential offsite migration of onsite SVOCs above screening values. The following provide additional information regarding SVOCs present in offsite areas:

- In the Northern Drainage of the SSFL, SVOCs are detected at concentrations exceeding screening levels associated with clay pigeon target debris from a former Rocketdyne employee shooting range located offsite adjacent to the northeast property boundary on Sage Ranch. SVOCs (PAHs) are contained in coal pitch used as a binding agent for the clay targets. Most SVOC detections above screening levels in the Northern Drainage occur near the former shooting range (source area) with concentrations decreasing downstream north of the SSFL property boundary. These SVOCs have been sufficiently characterized both onsite and offsite in drainages to the north (H&A 2007c), and are being removed by excavation as part of a DTSC-approved cleanup action being conducted by Boeing during 2007/2008. Following removal, additional sampling will be conducted to confirm that the removal action was complete.
- Detections of NDMA near or above its screening level have occurred in three wells located in the northeastern and eastern offsite areas. Two samples from groundwater well (OS-24), located northeast of the SSFL property boundary, contained concentrations of NDMA up to 0.011 µg/L, just slightly above its screening level of 0.010 µg/L. This well also contains concentrations of TCE and its daughter products above their respective screening values. Detections of NDMA below the screening level also occur in two other discrete-interval monitoring wells offsite (RD-66 and OS-28). These detections may be related to site activities or it may be related to non-SSFL sources such as materials used to construct the discrete-interval monitoring system in this well or potential discharge of stored municipal water (Calleguas) from an aboveground storage tank.
- Offsite spring/seep and surface water samples have all been non-detect for SVOCs.

- DTSC split sample results were evaluated and are consistent with the results from samples collected by Boeing, NASA, or DOE, and provide independent confirmatory data that also support the conclusions presented above.

The potential for onsite SVOC source migration via groundwater, surface water or air transport pathways has been evaluated. As part of this evaluation, consideration was given to the location of historical chemical use within the SSFL, release mechanisms for the type of chemical being considered, and onsite RFI characterization findings. At SSFL, SVOCs are generally associated with waste oils or likely generated by burning of organic materials, including petroleum fuels, paper, or other waste products. NDMA formation is generally associated with degradation of unsymmetrical dimethyl hydrazine rocket fuel, however, NDMA is also present in some plastic materials. This data evaluation has confirmed previous findings that identified a SVOC-impacted area occurs in the Northern Drainage (H&A 2007c), resulting from sediment transport via the surface water pathway as described above. Confirmation soil samples will be collected following completion of excavation activities, and surface water runoff will be monitored. Migration of NDMA via the groundwater pathway is under further evaluation, but the presence of this chemical in groundwater offsite may have resulted from other anthropogenic sources not related to SSFL operations.

There are no identified offsite SVOC data gaps based on the evaluation of available data.

3.3.1.3 TPH

The evaluation of the offsite TPH data shows that, with the exception of an area in the northeast as described below, there are no offsite TPH detections above screening levels in soil/sediment or groundwater that are related to SSFL operations (Figure 3-3). There are sufficient offsite sampling data to assess potential offsite migration of onsite TPH above screening values. The following provide additional information regarding TPH present in offsite areas:

- In the Northern Drainage of the SSFL, there are TPH concentrations exceeding screening levels associated with clay pigeon target debris from a former Rocketdyne employee shooting range located offsite on Sage Ranch adjacent to the northeast property boundary. This location is coincident with the SVOC impacts described above. Like SVOCs, TPH is contained in coal pitch used as a binding agent for the clay targets. TPH detections above screening levels in the Northern Drainage occur near the former shooting range (source area), with very few detected concentrations in soil and sediment downstream (generally less than 100 mg/kg). The TPH detections have been sufficiently characterized both onsite and offsite in drainages to the north (MWH 2007d; H&A 2007c), and will be removed as part of a DTSC-approved cleanup action being conducted during 2007/2008. Following removal, additional sampling will be conducted to confirm that the removal action was complete.

- Groundwater samples from three monitoring wells located adjacent to the northeastern boundary of the SSFL (wells RD-36B, RD-37, and RD-38A) have had detections of gasoline-range TPH above the screening level, ranging up to 170 μg/L. The potential source of the TPH detection may be related to the adjacent B-1 RFI Site within the facility boundary where underground tanks stored petroleum fuels, although data usability for some results is indeterminate (H&A 2007b). The TPH detections are collocated with VOC impacts in these wells as described above. This area is part of an ongoing, offsite evaluation of groundwater near the northeastern SSFL property boundary.
- Near the LOX debris area, two gasoline-range TPH detections were estimated to be present above its screening level in soil samples collected adjacent to a debris area. TPH detections (at 2.1J and 2.3J mg/kg) were estimated near the laboratory reporting limit and not confirmed by other TPH or VOC soil sample results nearby. The soils in this area are undergoing removal as part of a DTSC-approved cleanup that began in November 2007. Following removal, additional sampling will be conducted to confirm that the removal action was complete.

The potential for onsite TPH source migration via groundwater, surface water or air transport pathways has been evaluated. As part of this evaluation, consideration was given to the location of historical chemical use onsite, release mechanisms for the type of chemical being considered, and the onsite RFI characterization findings. At SSFL, TPH is associated with the use and storage of petroleum fuels at rocket engine test stands, component test areas, jet engine test areas, and disposal areas. This evaluation has identified that a TPH-impacted area occurs in the Northern Drainage collocated with the SVOC impacts described in Section 3.3.2, adjacent to the former Rocketdyne employee shooting range. Transport of TPH contained in the clay pigeon target debris has occurred to offsite areas, but downstream detections for TPH in the Northern Drainage are generally low. Migration of gasoline-range TPH via the groundwater pathway is under further evaluation as part of the northeast onsite and offsite groundwater program.

There are no identified offsite TPH data gaps based on the evaluation of available data. Although no spring/seep and surface water samples have been collected offsite of the SSFL and analyzed for TPH, this is not considered a data gap based on evaluation of onsite data and contaminant transport characteristics. Surface water data is not required offsite since onsite surface water data do not indicate significant transport of this contaminant (two separate one-time NPDES exceedances of oil and grease [TPH components] since 1998), and onsite drainage sediment results above TPH screening levels is characterized by downstream data. The lack of TPH data at offsite springs and seeps is not considered a data gap since these locations are analyzed for VOCs, and the volatile components of TPH (benzene, toluene, ethylbenzene and xylenes) have not been encountered.

3.3.1.4 PCBs

The evaluation of the offsite PCBs data shows that there are no offsite PCB detections above screening levels in soil/sediment (Figure 3-4). The majority of the samples have been non-detect for PCBs, and where detected in a few samples, the PCB concentrations are below screening levels. There are sufficient offsite sampling data to assess potential offsite migration of onsite PCBs above screening values. The following provide additional information regarding PCBs present in offsite areas:

- In the offsite drainage located north of the FSDF area, PCBs have been detected below screening levels in a few sediment samples. Concentrations ranged up to 91 μg/kg, compared to the screening level of 350 μg/kg. These PCBs are likely associated with former disposal operations at the FSDF. PCBs onsite and in down-gradient channels present at concentrations above DTSC-approved cleanup values were removed from the FSDF and down-gradient channels during 2000 (IT 2002). PCBs have been sufficiently characterized both onsite and offsite in drainages to the north.
- PCBs have been detected at concentrations less than screening levels in a few samples collected in the Northern Drainage. Most detected concentrations are less than 100 μg/kg, although one estimated result near the Instrument and Equipment Laboratories RFI Site ranges up to 230 μg/kg. These detections are considered sufficiently characterized by the presence of multiple samples up and downstream that are non-detect.

The potential for onsite PCB source migration via sediment, groundwater, surface water or air transport pathways has been evaluated. As part of this evaluation, consideration was given to location of historical chemical use onsite, release mechanisms for the type of chemical being considered, and the onsite RFI characterization database. At SSFL, PCBs are associated with some transformers, waste oils, and at a few Area IV radiological facilities. This evaluation has confirmed previous findings that low concentrations of PCBs present to the north of the FSDF area likely result from sediment transport via the surface water pathway (IT 2002; MWH 2007c).

There are no identified offsite PCBs data gaps based on the evaluation of available data. Although springs/seeps and offsite groundwater monitoring wells have not been analyzed for

PCBs, this is not considered a data gap since there are no onsite detections of PCBs in groundwater. Surface water data is not required offsite since onsite surface water data do not indicate significant transport of this contaminant (no exceedances of PCBs since 1992), and onsite drainage sediment results above PCB screening levels are infrequent and limited by downstream onsite data.

3.3.1.5 Dioxins

The evaluation of the offsite dioxin data shows that there are no offsite dioxins above the screening levels in soil/sediment, that are related to SSFL operations (Figure 3-6) (for the purpose of this report, the term "dioxins" refers to a suite of chlorinated dioxin and furan congeners that are provided in the acronym list). There are sufficient offsite sampling data to assess potential offsite migration of onsite dioxins above screening values. The following provide additional information regarding dioxins present in offsite areas:

- In the offsite drainage located north of the former FSDF area, dioxins have been detected below screening levels, but above background, in a few sediment samples (TEQs range up to 1.04 nanograms per kilogram [ng/kg] compared to a background of 0.87 ng/kg). These detections of dioxins may be associated with former burning operations at the FSDF, or may result from the accumulation of naturally-occurring dioxin in fine-grained sediments and ash within the drainage. Dioxins onsite and in down-gradient channels present at concentrations above DTSC-approved cleanup values were removed during the FSDF IM conducted in 2000 (IT 2002). Dioxins have been sufficiently characterized both onsite and offsite in drainages to the north.

- At the offsite soil background location on Sage Ranch, dioxins were detected above background in a sample collected following the Topanga Fire.

- DTSC split sample results were evaluated and are consistent with the results from samples collected by Boeing, NASA, or DOE and provide independent confirmatory data that also support the conclusions presented above.

The potential for onsite dioxin source migration via groundwater, surface water, or air transport pathways has been evaluated. As part of this evaluation, consideration was given to the location of historical chemical uses within the SSFL, release mechanisms for the type of chemical being considered, and the onsite RFI characterization findings. At SSFL, dioxins are associated with the burning of organic materials and ash from brush fires (Flow Science 2006). This evaluation has confirmed previous findings that low concentrations of dioxins present to the north of the FSDF area may result from sediment transport via the surface water pathway (IT 2002; MWH 2007c).

The migration of dioxins via the surface water pathway has been the subject of evaluation due to repeated dioxin exceedances of the NPDES permit limits at several storm water monitoring locations (Boeing 2006 and 2007a). Onsite investigations are continuing to assess these occurrences. The presence of dioxins in both background soils and fire-related materials is well documented in the scientific literature (USEPA 2000 and 2001, Aronsson and Ekelund 2004, Clement and Tashiro 1991), as well as in previously completed onsite and offsite studies (Flow Science 2006). These reports suggest that the levels of dioxins measured in surface water samples at the SSFL may result primarily from wildfire combustion processes, regional atmospheric deposition, and other offsite sources. Soil, ash, and surface water samples have been collected from offsite locations for comparison of results local to the SSFL as presented in this report.

There are no identified offsite dioxin data gaps based on the evaluation of available data. Onsite evaluations to identify potential sources for NPDES exceedances are ongoing as part of the RFI and NPDES programs, and evaluation of potential air transport of dioxins included as part of the RFI program. Neither groundwater samples nor spring/seep samples have been collected for dioxins from offsite locations since dioxin compounds dioxins are strongly adsorbed to particulate matter do not readily transport in the dissolved phase. The few onsite dioxin detections in groundwater occur at very low concentrations and are believed the result of particulate matter from the surrounding bedrock in the groundwater sample. Based on groundwater transport evaluations, these will remain localized and not migrate offsite due to strong attenuation by adsorption.

3.3.1.6 Metals

The evaluation of the offsite metals data shows that, with the exception of two areas in the Northern Drainage, there are no offsite metals at concentrations above screening levels in soil/sediment, groundwater, surface water, or springs/seeps that are related to SSFL operations. There are sufficient offsite sampling data to assess potential offsite migration of onsite metals above screening values. The following provide additional information regarding metals present in offsite areas:

- In the Northern Drainage of the SSFL, there are metals at concentrations above screening levels associated with residual lead shot at and near the former Rocketdyne employee shooting range offsite (primarily lead) and associated with insulation materials at the debris area near the former LOX Plant (primarily antimony). These metals have been sufficiently characterized both onsite and offsite in drainages, with most detections further down-drainage onsite and offsite at or near background levels

(H&A 2007c; MWH 2007d). Metals in these soils/sediments are being removed as part of a DTSC-approved cleanup action being conducted by Boeing and NASA during 2007/2008. Following removal, additional sampling for these metals will be conducted to confirm that the removal action is complete.

- There are some offsite metals sampling results that exceed SSFL background and screening levels that most likely result from naturally occurring concentrations in bedrock. The metals considered in this category during data evaluation are cadmium and arsenic at two locations offsite.
    - The first occurrence is located in the drainage downstream of the former FSDF north of Area IV. Concentrations of arsenic range up to 34.9 mg/kg, and are limited in extent near a shale bedrock outcrop. Over 100 samples upstream of this location are within the SSFL background level for arsenic, and the concentrations drop to below background within about 200 feet downstream of this shale unit. Other detections of arsenic above the screening level also occur offsite but these detections are very close to the background level (16 mg/kg compared to 15 mg/kg), and are considered within the natural variation of background.
    - The second occurrence of this condition is located south of Bell Canyon, where cadmium concentrations range up to 7.3 mg/kg, and are considered to be related to specific characteristics of the Monterey formation shale (Ogden 1998b). In more distant samples from the SSFL, cadmium occurs up to 3.9 mg/kg at a 1992/1994 Brandeis-Bardin/Sage Ranch study soil background location in Tapia Canyon. This sampling result is also believed to be on a Monterey formation shale.
- Other metals detected above background but less than screening levels in offsite areas around SSFL include generally infrequent (typically in less than 5 samples) occurrences of several metals including barium, lead, mercury, vanadium, and zinc among others. The most notable occurrence, however, is selenium concentrations detected in several samples (240) collected in the 1992 Brandeis-Bardin program. Concentrations of selenium in these samples ranged up to 8.1 mg/kg, much less than the screening level of 380 mg/kg. These detections mostly occurred in the Northern Drainage area near OS-9. Most offsite recent samples analyzed for selenium have had results less than background, with only 3 detections greater than background noted. Only one of these occurs in the North Drainage.
- Offsite groundwater and spring/seep samples show only sporadic detections of metals above screening levels. Detected metals above screening levels include manganese, iron, and lead at groundwater wells, and boron at spring/seep locations.
    - Of these metals, only iron and manganese have been repeatedly detected above the screening level at a given well location and are most likely related to variability in the bedrock since these metals are either a major earth element (iron) or commonly occurs on fracture and joint coatings (manganese). The only other metal detected above screening levels is lead at RD-36D, RD-43A, and RD-66. These detections ranged up to 0.05 mg/L at RD-43A above the screening level of 0.015 μg/L. These occur offsite in an area of ongoing groundwater characterization.

  - Boron was detected above the screening level twice at one spring location (OS-12) in 1985 and 1987. Subsequent samples have not been collected at this location.
  - Due to the lack of trends and their distance from onsite SSFL sources, these groundwater or spring/seep detections above screening are not considered likely to be related to onsite operations. Although there are a few onsite metals detections in groundwater that may be associated with releases onsite, these groundwater concentrations will remain localized and not migrate offsite due to strong attenuation by sorption and matrix diffusion. There is ongoing analysis of onsite metals in groundwater as part of the RFI groundwater characterization program, and work is continuing in the northeast.
- Metals in offsite surface water samples were detected at concentrations below screening levels except for those collected as part of an offsite sampling program conducted to collect regional fire-related data for comparison to onsite data collected following the Topanga Fire (Flow Science 2006).
- DTSC split sample results were evaluated and are generally consistent with the results from samples collected by Boeing, NASA, or DOE and provide independent confirmatory data that also support the conclusions presented above. The few exceptions to this statement include: (1) a lead detection above its the screening level in a single DTSC split sample collected in Bell Canyon near a model railroad in a residential yard when the SSFL sample was less than background, and (2) cadmium was not detected in the offsite DTSC samples from the Monterey formation.

The potential for onsite metals source migration via groundwater, surface water, or air transport pathways has been evaluated. As part of this evaluation, consideration was given to the location of historical chemical uses within the SSFL, release mechanisms for the type of chemical being considered, and the onsite RFI characterization findings. At SSFL, metals are associated with debris areas, burn or incineration facilities, laboratories or chemical process areas, and rocket engine testing locations. This evaluation has confirmed previous findings that identified two metals-impacted areas occur in the Northern Drainage near the former Rocketdyne employee shooting range and LOX debris area (H&A 2007c, MWH 2007d), with limited or no surface water transport of metal contamination offsite via the surface water pathway as described above.

The migration of metals via the surface water pathway has been the subject of evaluation due to exceedances of the NPDES permit limits at storm water monitoring locations for some metals (Boeing 2006 and 2007a). Most notable of the NPDES exceedances are mercury and iron since they were repeated in different storm events. Onsite investigations are ongoing to continue to assess these occurrences, and corrective actions taken to control erosion of contaminated soils (excavation/removal or covering with a plastic tarp) and to remove metals from storm water. The presence of metals in both background soils and fire-related materials is well documented in scientific literature (Kearney 1996, Hunter et al. 2005, USEPA 2000, USEPA 2001a), as well as in previously completed on- and offsite studies (Flow Science 2006). Concentrations in NPDES storm water samples collected at the SSFL are similar to and often lower than concentrations in storm water runoff from other open space and natural areas (Flow Science 2006). Soil, ash, and surface water samples have been collected from offsite locations for comparison of results local to the SSFL as presented in this report.

There are no identified offsite metals data gaps based on the evaluation of available data. Onsite evaluations to identify potential sources for NPDES metals exceedances are ongoing as part of the RFI and NPDES programs, and evaluation of potential air transport of metals is included as part of the RFI program.

3.3.1.7 Perchlorate

The evaluation of the offsite perchlorate data shows that there are no offsite perchlorate detections in soil/sediment, groundwater, surface water, or springs/seeps. There are sufficient offsite sampling data to assess potential offsite migration of onsite perchlorate above screening values. The following provide additional information regarding perchlorate sampling results in offsite areas:

- Extensive offsite sampling for perchlorate in environmental media has been completed (>850 analyses) and results are non-detect with only three exceptions. Offsite areas are considered adequately assessed since these are unconfirmed, non-repeatable occurrences. These sporadic detections include:
    - A single estimated detection of perchlorate at 0.81 µg/L during 2005 at well RD-71, located in the northeast. A subsequent sample collected at this location was non-detect.
    - A single detection of perchlorate at 5 µg/L during 1998 at well RD-59A located north of FSDF. Over 25 subsequent samples at this well have been non-detect. A soil cleanup action was performed at this site in 2000. Downgradient onsite drainage samples for perchlorate were predominantly non-detect with only three low detections at less than 6 µg/L (MWH, 2007c).
    - A single reported detection of perchlorate at well OS-15. Upon review of this data, the result was determined to be invalid (H&A 2007b).
- Perchlorate was also reportedly detected by DTSC in two groundwater samples collected from OS-9 in May and June 2003 (the June sample was split to a confirmatory laboratory which did not detect perchlorate). As described in Section 2.12, subsequent collection of hundreds of samples from OS-9 plus the installation

and sampling of an adjacent well (OS-9R) has not resulted in any perchlorate detections in this offsite area.

- With the exception of the OS-9 data described above, DTSC split sample results were evaluated and are consistent with the results from samples collected by Boeing, NASA or DOE and provide independent confirmatory data that also support the conclusions presented above.

The potential for onsite perchlorate source migration via groundwater, surface water, or air transport pathways has been evaluated. As part of this evaluation, consideration was given to the location of historical chemical use within the SSFL, release mechanisms for the type of chemical being considered, and the onsite RFI characterization findings. At SSFL, perchlorate is associated with solid propellant manufacture and use (i.e., ignitors, turbine spinners, and small munitions), and the production of flares. This evaluation has not identified offsite data that indicates that offsite transport of perchlorate has occurred.

There are no identified offsite perchlorate data gaps based on the evaluation of available data.

3.3.1.8 Other Chemicals

The offsite environmental characterization programs have included analyses for other chemicals that would not be included in the above chemical groups. Many of these chemicals are general minerals (e.g. bicarbonate, calcium, sulfate) that are naturally occurring and can be used as an indication of groundwater source and flow paths. These chemicals are not considered site-related and have not been evaluated similarly to the chemicals described above. These data are used to gain insight into the groundwater flow system and are being further evaluated in ongoing studies at the SSFL. However, there are five other chemicals related to SSFL operations that are potentially related to site operations. These include energetic compounds, fluoride, cyanide, formaldehyde, and asbestos. Findings for these chemicals are presented below.

The evaluation of the offsite data shows that there are no offsite detections of energetic compounds, fluoride, cyanide, nitrate (as NO_3) or formaldehyde in soil/sediment above screening levels. Detections of fluoride in groundwater have occurred above screening levels infrequently. Cyanide was only detected in samples collected in offsite fire locations. ACM has been found offsite in one area and is being removed as part of a ongoing cleanup action (Zenco, 2007). There are sufficient offsite sampling data to assess potential offsite migration of these “other” chemicals above screening values from onsite. The following provide additional information regarding other chemicals present in offsite areas:

- There are no detections of these "other" chemicals above screening values in offsite soil/sediment data with the exception of ACM in a debris area adjacent to the LOX site, which is being removed during a DTSC-approved cleanup action in November/December 2007. Down-drainage samples for ACM have been non-detect, indicating limited transport from the source area. These "other" chemicals have been sufficiently characterized in offsite soil/sediment since onsite sources are small and limited by nearby sampling results.
- Fluoride has been detected above its screening level infrequently in one offsite groundwater well (OS-2), and in five springs and seeps. At well OS-2, located north of FSDF, fluoride was detected in three samples collected in the mid-1980s. Although subsequent samples have not been collected at this well, nearby wells OS-3 and the RD-59 well cluster have not had detections of fluoride above the screening level. Thus, this offsite area is considered adequately assessed. The spring/seep detections of fluoride occur at locations east of the site coincident with the Woolsey and Box Canyon faults and may be indicated of local geochemical changes associated with faulting. At one of these springs (FDP-871), chloride and bromide also occur above screening levels. Other springs in the northeast do not contain fluoride, chloride, or bromide above screening levels. As noted above, additional spring and seep sampling and data review are ongoing.
- Formaldehyde was detected above its screening level in a single groundwater sample from RD-43C (located in the northeast) just above its screening value. Other samples from this well and nearby wells RD-43B and -43A have not detected formaldehyde at concentrations above the screening level, so this area is considered adequately assessed.
- Nitrate/nitrite (as N) was detected offsite above its screening level in surface water samples collected offsite for post-Topanga Fire assessment. Nitrite (as N) was also reportedly detected above its screening level in one discrete-interval sample collected from OS-9R and in one sample from one spring (FDP-728). Nitrite (as N) was not above its screening level in other interval samples from OS-9R, or in other nearby spring/seep or groundwater samples.
- Sulfate has been frequently detected above its screening level in offsite groundwater, springs/seep, and surface water samples collected around the SSFL. These detections, ranging from 260 µg/L to 2,200 µg/L, occur in the north, east, and south and are considered a result of different groundwater chemistry resulting from reactions between the bedrock and groundwater. The elevated concentrations found in the undeveloped land and other offsite locations in the southwest are the result of pyrite oxidation based on the analysis of sulfur isotopes. In this area of the SSFL, surface water detections of sulfate also occur above NPDES limits and result from the discharge of groundwater containing higher concentrations of sulfate associated with pyrite oxidation.

The potential for onsite 'other' chemical source migration via groundwater, surface water, or air transport pathways has been evaluated. As part of this evaluation, consideration was given to location of historical chemical use onsite, release mechanisms for the type of chemical being considered, and the onsite RFI characterization findings. At SSFL, fluoride, formaldehyde, and energetic compounds are only present in limited onsite areas due to their association with special rocket engine testing and laser programs, storage and use of ‘storable’ rocket fuels (e.g., hydrazines), and energetic chemical research programs, respectively. Nitrates or sulfates were not used at the SSFL in large quantities, although nitrates likely resulted from onsite treatment of sanitary sewage. ACM were used onsite as insulation materials.

There are no identified offsite “other” chemical data gaps based on the evaluation of available data.

3.3.2 Radionuclide Data

The major potential onsite sources of radionuclide contamination are the research and experimental reactors and other nuclear operations facilities that were part of the energy research programs conducted in Area IV of the SSFL. The various SSFL offsite environmental programs that have sampled and analyzed for radionuclides have generally been conducted to determine if there have been any onsite radionuclide releases that have resulted in offsite contamination. Some sampling has also been conducted to establish background ranges for some radionuclides. As described in Section 2, early sampling for gross alpha and gross beta was also performed around two other facilities on Canoga and De Soto Avenues.

The sampling results and offsite evaluation findings for all radionuclides are presented together in this section. It focuses on five specific radionuclides which have been used in this evaluation as indicators of potential migration from onsite sources to offsite locations. These five radionuclide types are cesium-137, strontium-90, tritium, plutonium- 238, and plutonium-239/240 (combined), and potassium-40. Sampling results for these radionuclides are presented in Figures 3-8 through 3-13. Offsite data for other radionuclides are described below if they were collocated or provide additional information about these indicator radionuclides, and data are provided in Tables 3-1 through 3-8 and in Appendix B.

Potassium-40 results are presented in the tables and figures. However, it should be noted that it is the most prevalent of all naturally occurring radionuclides and is found in soil, rock, food, and consequently in our own bodies. Potassium-40 is not generally considered a product of nuclear operations, it is not nuclear fuel or a fission product, and is not generally considered a neutron activation product. However, since some reactors at SSFL used a sodium-potassium alloy (NaK) as a coolant, this radionuclide has been included in sample analysis in onsite and offsite locations. There are no regulatory levels for total potassium in soil. In evaluation of this data, consideration was given to the prevalence of potassium-40 in the environment, magnitude of results above screening levels, and consistency with other radionuclide results.

The evaluation of the offsite radionuclide data shows that, with one exception in the drainage north of FSDF, there are no offsite radionuclide detections above screening levels in soil/sediment, groundwater, surface water or springs/seeps that are considered to be associated with SSFL operations. The majority of the samples are either non-detect, less than background, or similar to but slightly above background levels. Although there is an onsite tritium-impacted groundwater plume within the SSFL property boundary, radionuclide contamination above screening levels has not been detected in offsite groundwater, spring/seeps, or surface water. There are sufficient offsite sampling data to assess potential offsite migration of onsite radionuclides above screening values. The following provide additional supporting descriptions.

<u>Groundwater</u>

- Only two of the radionuclides listed above has been detected in samples from offsite monitoring wells. Several detects of tritium up to 968 pCi/L at well RD-59A located north of FSDF have occurred, all well below the screening level. Tritium has not been detected in 11 samples collected since 2002. Onsite and offsite evaluations of tritium in Area IV groundwater are ongoing. Potassium 40 was also detected at RD059A in one sample at 16.54 pCi/L, but was not detected in subsequent samples.

<u>Springs/Seeps</u>

- The five radionuclides listed above have not been detected in offsite spring/seeps.

<u>Surface Water</u>

- The five radionuclides were not detected in offsite surface water samples except for tritium in one 1992 sample collected during the Brandeis-Bardin study. Tritium was detected at 300 pCi/L, well below the screening level of 20,000 pCi/L. Onsite radionuclide surface water sampling at NPDES monitoring points for these radionuclides have detected strontium-90 and radium-226/228 above permit limits one time each.
    - Strontium-90 was detected above the permit limit in one location in 2005 (Outfall 003, RMHF). Repeated, subsequent surface water samples at this location did not contain strontium-90 exceeding NPDES limits (Boeing 2007c).
    - Radium-226/228 was detected above the permit limit at Outfall 002 in September 2007 in a sample that contained a high concentration of suspended sediment due to a small landslide near the sampling point.

Soil

- In the offsite drainage north of the former FSDF area, three of the five radionuclides have been detected in soil above screening levels, and one has been detected above background. Detections above screening levels include a single occurrence of cesium-137 at 0.38 pCi/g (compared to 0.273 pCi/g); during the 1992/1994 Brandeis-Bardin/Sage Ranch Multi-Media sampling program; two occurrences of potassium-40 at 25.3 pCi/g and 26.1 pCi/L (compared to 25 pCi/g); and five occurrences of radium-226 (up to 2.04 pCi/g, compared to 1.69 pCi/g). The detection above background was one strontium-90 occurrence at 0.18 pCi/g during the Brandeis-Bardin/Sage Ranch project (compared to a background of 0.13 pCi/g but less than the screening level of 0.36 pCi/g). It is also worth noting that more distinct offsite background comparison samples collected during this program contained radium-226 at similar or higher levels (BG02 at 2.35 pCi/g). Because the detections north of FSDF are very close to screening levels and/or background, and because there are multiple adjacent samples (both up and down drainage) that do not have detects above background, these detections are likely due to analytical and background variability. The Brandeis-Bardin/Sage Ranch sampling program utilized non-parametric statistical tests to compare the aggregate of samples in individual sampling locations to the aggregate of samples in background areas and did not identify the strontium-90 in the FSDF drainage as being distinguishable from background (McLaren/Hart 1993b).
- Cesium-137 has also been detected above screening levels in soil samples at one location on Sage Ranch during the 1992/1994 Brandeis-Bardin/Sage Ranch Multi-Media sampling program. Detections at this location range up to 0.42 pCi/g. Sampling locations north and in drainages below this occurrence are less than the screening level with most samples non-detect. The Brandeis-Bardin/Sage Ranch sampling program utilized non-parametric statistical tests to compare the aggregate of samples in individual sampling locations to the aggregate of samples in background areas and did not identify the cesium-137 at Sage Ranch as being distinguishable from background (McLaren/Hart 1995). Also, in one background location on Sage Ranch, potassium-40 was detected at 25.2 pCi/g, just above its screening level of 25.11 pCi/g.
- There are 5 offsite sampling locations with detections of plutonium-238 during the 1992 Brandeis-Bardin/Sage Ranch Multi-Media sampling program (background is assumed to be non-detect since a level has not been established). Offsite detections range up to 0.12 pCi/g (at BB-14), much less than the screening level of 2.97 pCi/g, and are also present south of the SSFL in background locations selected for the 1992/1994 sampling program (BG03 and BG06), a location in the Northern Drainage, and on a ridge on Sage Ranch Park. The locations of these samples coupled with the lack of plutonium-138 detections in sediment downstream of these locations suggest that these may result from laboratory error or international weapons test fallout, and are not related to the SSFL. Furthermore the 1994 re-sampling of those locations on Brandeis-Bardin property with 1992 plutonium-238 detects did not identify any plutonium-238 above detection limits, and therefore the existence of plutonium-238 was not confirmed.

- Plutonium-239 has been detected offsite in one distant sample (8 miles south) at 0.006 pCi/g (BG12). This result is slightly above laboratory reporting limits, and much less than its screening level of 2.59 pCi/g.
- Tritium in offsite soil/sediment samples generally has been within background range. Two types of tritium data have been collected: tritium reported in "wet units" of pCi/L soil moisture and tritium reported in "dry units" of pCi/g soil. Sample locations for both result types are shown on Figure 3-10. Since local background is reported in dry units, dry units are shown where both result types are available. As shown on Figure 3-10, dry units results show that soil/sediment tritium is within background range. One location, a Bell Canyon residence contained soil tritium at 0.35 pCi/g in a duplicate sample, slightly above the background of 0.3 pCi/g, but well below the screening level of 2.58 pCi/g. The primary sample at this location contained 0.15 pCi/g tritium, below background. Wet unit samples (locations only shown on Figure 3-10) were evaluated (McLaren Hart 1995) by comparing results with data from selected "background" locations. Based on this comparison, data were considered representative of background levels.
- There is no pattern to the detection of other radionuclides in SSFL offsite areas. Gross alpha and gross beta have been measured in groundwater, surface water, spring/seeps, vegetation, and soil/sediment. These historical measurements (1957-1989) were conducted for screening purposes and are not isotope-specific.
- Four other radionuclide detections above their screening levels occur offsite. These include detections of thorium-228, uranium-238, and radium-226 slightly above their respective screening levels at locations selected as background for offsite studies (BG-01, BG02, BG05, BG14, and ORISE-1). The detections at these locations are slightly above background and indicate that the local radionuclide background data used as screening for this OSR may not include a full range of background concentrations. Radium-226, thorium-238 and uranium-238 are naturally occurring radionuclides found in soil and bedrock. Europium-154 has also been detected in five samples at Bell canyon above the screening level however these have been judged to be false positive for reasons explained in Section 2.9.4. Overall, the sporadic detections of these other radionuclides do not indicate a pattern of release from sources at the SSFL.
- USEPA or DHS-RHB split sample results were evaluated and are generally consistent with the results from samples collected by Boeing, NASA or DOE and provide independent confirmatory data that also support the conclusions. The USEPA was closely involved in the 1992/994 BBI/SMMC multi-media sampling program in terms of approving work plans, taking split samples and reviewing the final report, EPA issued an EPA Update newsletter following completion of the program in which it concluded, "*[The Study] confirmed the presence of radionuclides in two areas near SSFL on Brandeis-Bardin property. Specifically, Rocketdyne found tritium, a radioactive form of hydrogen, and cesium in one area and strontium in another, however EPA has determined that the radionuclides do not pose a threat to human health and the environment.*" The areas of land referred to by USEPA were later purchased by Rockwell International and are therefore now

> Boeing property. USEPA's concluding statement is also pertinent to the sampling results for the balance of both the Brandeis-Bardin and Sage Ranch land. USEPA split sample results in Bell Canyon were generally similar to SSFL data, however several USEPA samples contained radium-226 (up to 3.61 pCi/g), slightly above the screening level of 1.69 pCi/g.

The potential for onsite radionuclide source migration via groundwater, surface water, or air transport pathways has been evaluated. As part of this evaluation, consideration was given to the location of historical radionuclide production onsite, release mechanisms for the type of radionuclide being considered, and the radionuclide characterization findings. At the SSFL, radionuclides are associated with energy-related programs in Area IV. This evaluation has not identified any offsite sample results suggesting significant migration offsite from onsite operations. Detections north of FSDF may represent transport of low levels of contaminants from Area IV, but this area is sufficiently well characterized by up and down-drainage sample results.

There are no identified offsite radionuclide data gaps based on the evaluation of available data. Onsite evaluation of tritium in groundwater is continuing.

3.4 TRANSPORT AND FATE ANALYSIS

The evaluation of potential chemical and radionuclide impacts from the SSFL to offsite locations must consider the body of available data, source locations at the SSFL, transport pathways, physical properties of the materials that can be transported, and the properties of the environmental media through which they are transported. This section presents a summary of the transport and fate evaluations that were performed for the groundwater, surface water, and air transport pathways as part of the analysis of the offsite data.

3.4.1 Groundwater

As described in Section 2.19, onsite evaluation of groundwater conditions to identify potential source areas and transport of contaminants has been ongoing since the mid-1980s. Various previously published documents provide information on contaminant source locations at the SSFL. These documents include:

- Near-Surface Groundwater Characterization Report (MWH 2003g)
- RFI Program Report (MWH 2004a)
- Report of Results, Phase I of Northeast Investigation Area Groundwater Characterization (MWH, 2004b)

- Group 6 RFI Report (MWH 2006)
- Group 4 RFI Report (MWH 2007b)
- Group 8 RFI Report (MWH 2007c)
- Source Zone Characterization at the Santa Susana Field Laboratory: Rock Core VOC Results for Core Holes C1 through C7 (Hurley et al. 2007a)
- Rock Core VOC Results for Corehole C8: Source Zone Characterization at the Santa Susana Field Laboratory Addendum Report No. 1 (Hurley et al. 2007b)
- Rock Core VOC Results for Corehole C9 (RD-84): Source Zone Characterization at the Santa Susana Field Laboratory Addendum Report No. 3 (Hurley et al. 2007c)
- Annual Groundwater Monitoring Reports (e.g., H&A 2007a)

Information included in these reports indicates that sources for impacted groundwater are proximal to the facility boundary at a number of locations within the SSFL. These locations are also shown on Figures 3-1 through 3-13. The current understanding of contaminant transport in the groundwater system underlying the SSFL was recently described in detail in a report titled "*Overview of the Site Conceptual Model for the Migration and Fate of Contaminants in Groundwater at the Santa Susana Field Laboratory* (Cherry et al. 2007). This document describes the processes affecting the transport and retardation of contaminants dissolved in groundwater beneath the SSFL (primarily TCE), and indicates that contaminants will remain close to where they entered the subsurface due to various attenuation processes such as molecular diffusion, adsorption, degradation and decay.

Extensive data are available to assess the groundwater transport pathway to offsite locations. These data include decades of water quality sampling results from both on and offsite sampling locations, and many other data as described in the *Site Conceptual Model Update*. The chemicals that are of the most interest in groundwater migration are those with high aqueous solubility, low viscosity, and specific gravity greater than 1.0 (i.e., primarily TCE and other chlorinated solvents). Perchlorate is another chemical with high solubility (essentially 100 percent). Because of extensive historical solvent use at the SSFL, TCE and other chlorinated VOCs are the chemicals considered most likely to be transported the greatest distances in groundwater based on the hydrogeologic conditions beneath the SSFL. Other chemicals having larger molecular structure, low aqueous solubility (e.g., dioxins, PCBs, and metals) and stronger adherence to particles, are not expected to migrate in groundwater. Of the radionuclides, tritium (in the form of tritiated water) is the isotope most likely to be transported the furthest since tritiated water has the same physical properties as water.

The presence of chemicals and radionuclides in groundwater onsite at the SSFL represent potential sources of these contaminants to migrate to offsite locations. Onsite groundwater impacts are predominantly TCE and associated breakdown products, although localized areas of perchlorate and tritium impacts occur as shown in Figure 3-14. Although other chemicals also occur in some of these impact areas, they are collocated with the chlorinated VOCs. Since the presence of these contaminants in groundwater is measured in decades, and therefore likely representative of steady-state conditions, the current characterization of groundwater (i.e., the onsite and offsite concentrations) provides the basis for evaluation of the potential for offsite migration of onsite groundwater impacts.

Offsite groundwater transport evaluation findings include:

1. VOC transport via the groundwater pathway has occurred to the offsite area northeast of the SSFL based on the available data. The lateral extent of impacted groundwater reaches a distance of approximately 1,000 feet beyond the property boundary (Figure 3-14) (MWH 2004b). Several VOCs measured in this area can be traced to onsite sources. The data suggest that as the groundwater flows through bedrock there is a significant attenuation of concentrations due to the strong influence of bedrock matrix diffusion (Cherry, et al., 2007). These aspects of groundwater contaminant transport suggest that offsite concentrations will not increase, but rather will decrease over time. There are other chemicals that have been detected above regulatory action levels in one offsite well (e.g., NDMA) and one spring/seep (benzene) in the northeastern offsite area. These chemicals do not present the same pattern of characterization findings as the TCE-related compounds, and therefore their presence is considered not likely due to an onsite source, although continued investigation of offsite groundwater in this area is ongoing.
2. VOC transport via the groundwater pathway to springs/seeps has occurred onsite at locations in the southwest, but potential offsite transport is still under evaluation. The majority of the springs/seeps samples around the SSFL do not have measurable levels of contaminants (a finding that the supports the bedrock attenuation model of contaminant transport). The southwestern portion of the SSFL, however, where there are VOCs in groundwater, is the focus of ongoing investigation. Near this location are several onsite springs/seeps that have repeatable, measurable VOC concentrations, but down-gradient measurements are estimated and suspect, since they are not present in earlier samples collected from the same location. Groundwater wells between the location of repeated spring/seep detections and the property boundary are also non-detect for VOCs. An ongoing investigation is studying the relationship between these springs/seeps and groundwater in this portion of the SSFL.
3. VOCs in groundwater have the ability to migrate in the vapor phase to the ground surface. This migration has been described, modeled, and measured in a vapor migration validation report (MWH 2007a). VOCs measured in soil vapor in areas above groundwater contamination may be an indication that vapor-phase migration is occurring, or may result from other surficial sources. The offsite soil vapor VOC

concentrations above screening levels in the northeast are believed to be predominantly (if not entirely) from onsite soil sources located at the B-1 RFI Site. As described above, this area is being further investigated as part of the RFI, which will include additional analysis regarding this potential pathway.

4. Perchlorate transport via the groundwater pathway has not occurred offsite based on available data. Perchlorate occurs in groundwater onsite in several localized impact areas (Figure 3-15), but these extents are defined by existing groundwater well data. Extensive investigation has been performed both on- and offsite to evaluate potential perchlorate transport via groundwater offsite. In summary:
   - Over 300 groundwater monitoring points have been sampled, with all locations non-detect for perchlorate except in known onsite use or disposal areas;
   - Over 250 groundwater samples collected offsite by Boeing, regulatory agencies, and Brandeis-Bardin representatives were all non-detect for perchlorate from OS-9R, a new well installed at the location where DTSC reported perchlorate detections at OS-9;
   - Over 75 spring/seep samples collected on- and offsite, with all confirmed results non-detect.
5. Significant tritium transport via the groundwater pathway has not occurred to offsite locations based on available data, including the sporadic, mostly low groundwater detects (well below the screening level) offsite of Area IV. The presence of tritium has been defined through the installation and sampling of nine groundwater monitoring wells. While there is no conclusive evidence that tritium from Area IV has migrated offsite (and is, therefore, not the focus of this evaluation), characterization of this onsite groundwater impact is ongoing.

In summary, analysis of available data including the offsite sampling results presented in this report indicates that contaminants in groundwater have only migrated offsite in the northeast portion of the SSFL which is an area of extensive, ongoing investigations. Continued evaluation of potential offsite transport of VOCs to the southwest is ongoing, as is investigation of tritium groundwater impacts. The other offsite sampling results indicate that the groundwater flow system has not transported contaminants from beneath the SSFL to offsite locations. Monitoring will continue in the future to allow continued assessment of contaminant transport from sources present from within the SSFL to offsite locations via groundwater flow.

3.4.2 Surface Water

Transport and fate via surface water at SSFL was evaluated in light of the understanding of the physical characteristics of the surface water system. As described in Section 1.3.3, perennial surface water bodies at the SSFL are limited to five ponds. Historically, testing operations used high quantities of pumped groundwater (until about 1964) or imported municipal water as a non-contact coolant which was captured in four of these ponds (R-1, Perimeter, Silvernale, and R-2) for re-use onsite (Montgomery Watson, 2000). Numerous onsite drainage channels connect the rocket engine testing areas to these ponds, and drainages leading from the R-2 and Perimeter Ponds discharge surface water to the Bell Canyon drainage to the south. On- and offsite drainages are shown in Figure 1-4. Currently, most surface water at the SSFL occurs as the result of storm water runoff and monitored as part of the NPDES program. Onsite evaluation of surface water conditions for the RFI has been limited to existing perennial ponds, but assessment of potential contaminant source areas includes evaluation of NPDES surface water sampling results, which have been routinely collected since 1984. Various previously published documents provide information on surface water assessment and potential contaminant source locations at the SSFL. These documents include:

- RFI Program Report (MWH 2004a)
- North Drainage Perchlorate Sampling Results Technical Memorandum (MWH 2003f)
- SSFL NPDES Annual Reports (e.g., Boeing 2007a)
- Potential Background Constituent Levels in Storm Water at Boeing's Santa Susana field Laboratory (Flow Science 2006)

Information included in these reports indicates that although surface water concentrations above screening levels have not been detected in the ponds, sediments within the ponds contain chemical concentrations above screening levels (MWH 2004a). As reported in NPDES monitoring reports, concentrations above NPDES permit levels have been detected in storm water discharges at the outfalls. (It is worth noting that NPDES permit levels are based on receiving water quality standards, not onsite SSFL receptors.) Potential sources for the surface water permit exceedances are still under evaluation (Boeing 2007a), and for naturally occurring constituents, may result from contribution of naturally occurring sources such as fire ash or background soil concentrations (Flow Science 2006). As described in this report and in Section 3.3, several metals and dioxins occur in fire ash and may occur in onsite storm water samples as a result from naturally occurring, background soil concentrations and/or the onsite Topanga Fire in 2005 or the nearby Piru Fire in 2003. Onsite NPDES sampling results for several metals and dioxins following these fires were similar to stormwater data collected in other burn areas in southern California (Flow Science 2006).

Onsite surficial soil sources for surface water transport have been and continue to be investigated as part of the RFI (MWH 2004a, 2004b, 2006, 2007b, and 2007c). When soil sources have been identified as potentially contributing to surface water permit exceedances, actions have been taken to remove or control that discharge. Over the last several years, five interim actions have been taken as a result of this evaluation, including the FSDF IM in 2000, the Happy Valley IM in 2003, the Building 203 IM in 2004, and covering impacted soil areas with plastic tarp at SRE and the Area IV pistol target range in 2004 (MWH, 2004a). Although not driven by surface water permit exceedances, the 2007/2008 cleanup in the Northern Drainage (ongoing) will remove clay pigeon target debris that has migrated via the surface water pathway. In addition, erosion control measures were installed throughout the SSFL at potential surficial soil impact areas following the Topanga Fire as erosion control actions (Boeing 2006 and 2007a). Finally, as surficial soil impact areas warranting further evaluation are identified during the RFI, erosion control measures are recommended and installed (MWH 2006, 2007b, and 2007c).

Surface water transport to offsite areas was evaluated based on type of constituent since the type of transport is different depending on solubility of the chemical or radionuclide. Constituents with a high aqueous solubility dissolve in surface water, with possible discharge offsite in the dissolved phase. Constituents with low aqueous solubility are bound to particulate matter (e.g., soil or sediment particles), with possible transport by entrained soil/sediment in the surface water flow. Transport of particulate-bound constituents is traced by sediments deposited in on- and offsite drainages and ponds. Transport of more soluble constituents may also be traced by deposition in channels, although it is highly constituent-dependent. For the evaluation of transport and fate in surface water, the focus was on concentrations of particulate-bound constituents in channel sediment, although some dissolved constituents (e.g., perchlorate) were also considered. The presence and patterns of potential contaminants in sediment with increasing distance from the SSFL provides understanding regarding the offsite presence and migration of potential contaminants in surface water.

For the evaluation of the transport and fate of constituents in surface water, onsite surface water ponds and locations of surficial sediment/soil impacts were considered as primary sources. For transport by dissolved phase, perchlorate impact areas were considered as primary sources (solvents volatilize in surface water transport and are rarely detected). For transport by adsorbed phase, soil impact areas of PCBs, PAHs, metals, dioxins, and radionuclides that have impacted onsite channels or ponds were considered as primary sources.

Datasets available to assess surface water transport pathways to offsite locations include RFI pond surface water data, NPDES monitoring data, and on- and offsite drainage channel sediment data. Contaminant transport for this pathway included dissolved constituents (e.g., perchlorate) and persistent chemicals that are particulate-bound (e.g., metals, dioxins, and radionuclides). The dissolved surface water transport evaluation focused on perchlorate since VOCs would volatilize in surface water transport. For perchlorate, residual deposition is likely since it is a salt which remains in surficial drainage deposits when sediments dry (MWH, 2003f). For persistent chemicals, such as metals, dioxins, and most radionuclides, drainage sediments serve as an effective tracer for contaminant transport.

Offsite surface water transport evaluation findings include:

1. Interim actions have been taken onsite and offsite to address potential offsite transport of contamination from onsite sources (FSDF, Happy Valley, Building 203, SRE, Northern Drainage). Evaluation of onsite NPDES permit levels and installation of additional erosion control measures implementation is continuing.
2. Offsite soil/sediment drainage data are generally non-detect or below background levels except within the Northern Drainage which is the location of a current removal action. Notably, perchlorate has not been detected in offsite soil/sediments in samples collected by Boeing, NASA, and DOE. Detections of perchlorate offsite by DTSC in offsite sediments in Dayton Canyon have been non-detect or low (< 2 ppb).
3. Where offsite soil/sediment detections occur (above background for naturally-occurring chemicals), such as PCBs or select radionuclides north of FSDF, results are either below screening levels and/or surrounded by other samples less than screening levels. It is noteworthy that results to the south of the SSFL in the Bell Canyon drainage area, which receives over 60 percent of the SSFL storm water discharge, does not show any detected chemicals or radionuclides (above background levels for naturally-occurring constituents) in the drainage sediments.

In summary, analysis of available data including the RFI surface water pond data, NPDES surface water monitoring data, and the offsite drainage channel sediment data presented in this report, show that there are limited locations where contamination has migrated offsite in surface water. Potential onsite impacts from known soil sources either have been removed, are scheduled for removal, or are considered stable and not migrating. Evaluation of NPDES surface water data in relationship to potential onsite soil sources continues, and additional actions will be taken if operational soil sources are identified. In addition, extensive best management practices are being installed onsite to reduce erosion and discharge of suspended sediment at NPDES outfalls.

3.4.3 Air

The evaluation of air dispersion as a pathway for the potential migration of chemicals and radionuclides from SSFL to offsite areas has been completed in a manner similar to the groundwater and surface water/sediment evaluations described above. While the entire offsite dataset has been evaluated by analytical group, there has been a specific focus on those chemicals and radionuclides that have the greatest potential for airborne release, transport, and deposition in offsite areas. Although offsite sampling programs have predominantly focused on collecting and evaluating groundwater and drainage sediment data, there is sufficient onsite and offsite data to evaluate the air dispersion pathway to offsite areas.

The potential for chemical and radionuclide migration from onsite sources to offsite locations is based upon their physical state when released (i.e., gases versus particulates), the dominant wind directions and the environmental persistence. If offsite migration has occurred and chemicals/radionuclides persist in the environment, a pattern should be reflected in offsite soil. For the evaluation of the transport and fate of constituents in air, onsite sources including rocket engine test stands, open burning areas, radiological operations or release areas, and locations of impacted soil were considered as potential sources. An evaluation of offsite data for such potential patterns is presented below.

Evaluation of the potential for contaminant migration via the air migration pathway has been addressed in various onsite RFI studies and investigations, and is considered in RFI risk assessments for both vapor migration and fugitive dust. Onsite evaluations have included:

- Vapor Validation and Soil Source Evaluation (MWH 2007a);
- RFI Group 6, 4, and 8 Reports (MWH 2006, 2007b, and 2007c);
- Area I Burn Pit RFI Work Plan (H&A 2006b);
- Rocket engine exhaust source testing data (ABB 1992);
- Soil Background Report (MWH 2005a); and
- Area IV Radiological Survey (Rockwell 1996).

The overall potential for offsite contamination migration from onsite sources rests largely on whether onsite releases were gaseous or solid/particulate. These two release types are discussed below and depicted on Figure 3-16.

3.4.3.1 Gaseous Releases

Gaseous releases from onsite operations, such as VOC volatilization during rocket engine cleaning and gaseous radionuclide releases from nuclear research areas, would disperse and rapidly dilute as the airborne plume moved downwind and offsite. Gaseous releases can only disperse in the air and are not deposited in offsite soil or water.

Gaseous releases may also result onsite from existing VOC soil impacts. To assess this type of potential migration of VOC vapors, ambient air samples have been collected at the SSFL property boundary near the LOX RFI Site, where soil vapor TCE occurs at the highest concentrations in uncovered soils at the SSFL. VOCs were not detected in ambient air samples collected near the property boundary (Figure 3-16) (MWH 2007a). Therefore, migration of VOCs from contaminated soil is not considered a significant pathway to offsite areas.

3.4.3.2 Particulate Releases

In contrast to gaseous compounds, airborne particulate emissions of persistent chemicals (e.g., metals, dioxins, or radionuclides) are well suited to evaluate potential offsite migration via air transport. Potential onsite sources of particulate chemical air emissions include rocket engine testing, open burning operations, and dust from contaminated surficial soil. The most significant potential onsite chemical sources areas include emissions from testing at the six large rocket engine test stand areas (Bowl, Canyon, Alfa, Bravo, Coca and Delta), open burning operations at the Area I Burn Pit, the FSDF, the Coca-Delta Fuel Farm, and skim ponds located at large test stands. For radiological operations, potential significant sources include high efficiency particulate air (HEPA) filtered radiological stack effluent. These are described further below.

The material burned or combusted in the largest quantity at the SSFL was kerosene-based rocket fuel. In 1990, source testing of rocket engine exhaust was performed at SSFL (ABB 1992). Test results indicate metals were present in rocket engine exhaust; most prevalent were trace concentrations of beryllium, cadmium, chromium, lead, manganese, nickel, and zinc. These metals were also presumably present in SSFL rocket engine test emissions from 1950 to 2006 since a similar kerosene-based fuel was used in earlier tests. Therefore, these metals provide indicators for potential migration of particulate emissions at the SSFL.

In addition to the metals listed above, dioxins are potentially formed during the uncontrolled burning of kerosene-based fuels. The controlled (i.e., stoichiometrically-balanced) combustion of fuel during rocket engine testing was not likely a significant dioxin source. The open burning of fuels, conducted at the Coca Delta Fuel Farm, the Area I Burn Pit, and the FSDF, are the more likely onsite dioxin source. These source assumptions are consistent with onsite RFI data where dioxins are associated with open burning of fuels. Therefore, dioxins provide another indicator for potential migration of particulate air emissions at the SSFL.

For radionuclides, particulate airborne emissions of long-lived isotopes such as plutonium-238, cesium-137 and strontium-90 that are also associated with nuclear research would provide indicators for potential air-borne particulate migration. However, major radiological facilities in Area IV utilized negative pressure containment systems. In order to eliminate airborne releases from contaminated rooms, radiological facility buildings were maintained at a slightly negative pressure, so that any air leakage was inward rather than outward. Inflowing air was drawn initially through non-contaminated rooms, then through radiation-controlled areas, then through rooms with a potential for contamination, and finally through rooms with actual radiological contamination. Finally, this air was then drawn through HEPA filters. The exit air was monitored for radiation, and sampled on a continual basis. Air samples were analyzed for radionuclides. Ambient air sampling stations throughout Area IV were also sampled for particulate airborne radionuclides on a continual basis. Both effluent and ambient airborne concentrations are reported in the ASERs (Appendix A).

For the offsite air dispersion evaluation, likely particulate migration routes have been inferred from the general wind direction patterns which are predominantly to the northwest and southeast (Figure 1-3). Any persistent chemical associated with rocket engine testing (e.g., metals) or burning operation air emissions (e.g., dioxins), and deposited in offsite locations would result in an offsite data pattern dependant upon the release location(s), wind direction, and other physical parameters (e.g. particle size, atmospheric conditions, etc.). The same is true of radionuclides. Higher concentrations would be expected oriented in a northwest-southeast direction if significant air transport occurred.

Offsite air transport evaluation findings include:

1. Onsite chemical data indicate that releases from open burn or incineration areas are largely contained in soils near the immediate source areas (i.e., within several hundred feet, close to their release point). These chemicals do not generally migrate far from source areas after deposition in soil, and any migration is predominantly

controlled by surface water transport. Examples near onsite sources, shown on Figure 3-15, indicate that metals and dioxins results do not exhibit concentration distributions the might suggest air dispersion (H&A 2006b, MWH 2007c). For instance, targeted sampling for an indicator metal (silver) at an Area IV incinerator did not indicate elevated concentrations consistent with air dispersion of ash (MWH 2006). As described above, this pathway is part of ongoing RFI data gap analysis, and additional sampling is planned (e.g., Area I Burn Pit [H&A 2006b]).

2. Onsite metals data distributions across the entire SSFL do not suggest a significant air deposition pattern from rocket engine test emissions. Metals data were evaluated site-wide for the indicator metals from engine testing listed above (beryllium, cadmium, chromium, lead, manganese, nickel and zinc). This analysis indicates that although concentrations above screening levels occur, there is no pattern to suggest air dispersion source. Elevated metals concentrations are predominantly localized near other potential sources (e.g., debris areas, processing areas, etc.), and the lateral extent is defined by surrounding data. Elevated concentrations of the engine test indicator metals were not observed in the direction of the prevailing winds across the SSFL or near the engine test stands. Overall, onsite metals sampling shows relatively few samples contain metals above background (about 10 percent of total surficial soil samples), and even fewer samples (less than 2 percent) contain metals more than 10 times background levels.
3. Offsite metals, dioxins, and radionuclides, especially in offsite areas to the northwest and southeast (consistent with prevalent wind patterns), do not exhibit any patterns consistent with airborne dispersion and deposition in adjacent offsite areas. Figures 3-1 through 3-13 provide a summary of these findings for individual analytical groups. Although most offsite sediment/soil data are collected in the drainages surrounding the SSFL, these channels serve as receiving or collection features from adjacent hillslope soils. If significant air contaminant transport had occurred from the SSFL to surrounding area, elevated concentrations of constituents would have been detected in these drainages also.
4. Spatial and depth relationships evaluated in the soil background dataset (MWH, 2005a) do not suggest significant airborne migration of site chemicals (Figure 3-15). This dataset includes samples collected from around the SSFL, near operational areas, within undeveloped SSFL land and on neighboring properties. No patterns were observed in the spatial distribution of metals or dioxins in these samples, indicating that the air migration pathway is not significant. Furthermore, three locations both northwest and southeast of major test stands (Coca and Delta) and the Area I Burn Pit were evaluated for potential airborne migration and no pattern in the data were observed to suggest air dispersion impacts (e.g., surficial results similar to deep, and no spatial pattern in relationship to test stand locations). Finally, overall SSFL background sampling results were well within the range of published state and regional background levels (MWH 2005a).
5. Extensive radiological facility decommissioning and decontamination (D&D), including soil remediation and post-remedial soil sampling, has been conducted in Area IV. These data indicate that, when significant soil contamination existed, it was generally in close proximity to radiological facilities and was due to waste treatment

operations (e.g., FSDF), or known incidents of spills or leaks from drums, containers, tanks, or piping systems (e.g., storage yards at Building 4064 and Old Conservation Yard). Although radionuclides were detected slightly above background in some soil samples taken during the Area IV Radiological Survey in 1995, these data indicate that the balance of Area IV (areas not in close proximity to radiological facilities) are also within overall USEPA residential risk range.

6. Temporal variations in particulate airborne radionuclide levels at Area IV have been compared by Boeing to other historical data taken by the California Department of Public Health at other locations in California from the mid 1950s to 1999.. The time variation of Area IV and California data is closely matched and can be correlated to historical events such as the initiation and termination of above ground nuclear weapons testing in Nevada and the Pacific by the U.S. in the 1950s and 1960s, the later above ground nuclear testing by the Chinese and the 1987 Chernobyl accident. During the period of these events in other parts of the world, airborne activity rose significantly in both California and Area IV. In contrast there is no observed increase in ambient airborne radioactivity in Area IV during or immediately after the 1959 SRE accident or during other periods of nuclear testing at SSFL. Therefore, air radiologic monitoring data at SSFL are consistent with other onsite/offsite data since ambient radiologic levels are controlled by large-scale atmospheric trends.

In summary, analysis of available information including onsite and offsite soil chemical and radionuclide data, wind direction, and site characteristics indicate that airborne migration of site contaminants is limited to areas near the onsite sources. Ambient air monitoring near the property boundary indicate no vapor transport to offsite areas from an exposed soil source. RFI soil and sediment sampling data indicate that chemicals migrate only short distances, controlled primarily by the surface water pathway (see Section 3.4.2), and do not indicate extensive migration by air dispersion (open air burning impacts measured within hundreds of feet). Therefore, air transport of chemical or radiological contaminants from onsite sources to offsite locations is not considered significant.

4.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The SSFL has been the subject of numerous environmental investigations to determine whether releases have occurred and the extent and significance of those releases. Many of these investigations have included or focused on areas offsite but adjacent to the SSFL. The purpose of these offsite investigations has varied, but each has generally been designed to evaluate whether chemicals or radionuclides used at the SSFL are present in offsite areas. As of the date of this report, Boeing, NASA, and/or DOE have collected over 4,000 samples from offsite locations representing more than 110,000 discrete chemical and radiological analyses. Data included in this report has been collected by Boeing, NASA, or DOE during 18 separate offsite programs conducted within a 15-mile radius of the SSFL over the past nearly 60 years (since 1949). These programs, described in Section 2, include:

1. Sampling for Annual Site Environmental Reports (1959 – Present)
2. Oak Ridge Associated Universities / Oak Ridge Institute of Science and Education Study (1986 and 1997)
3. Offsite Groundwater Sampling Program (1985 - Present)
4. Springs and Seeps Sampling Program (1985 - Present)
5. Brandeis Bardin Institute /Santa Monica Mountains Conservancy Project (1992 - 1994)
6. Chatsworth and West Hills Private Home Sampling (1994)
7. Area IV Radiological Survey (1994-1995)
8. Lawrence Livermore National Laboratory – Rocketdyne Recreation Center Study (1997)
9. Bell Canyon Project (1998)
10. Former Sodium Disposal Facility Offsite Sampling (1995 - 2000)
11. Perchlorate Study (Northern Drainage) (2003)
12. OS-9R Multi-Level Groundwater Monitoring System Program (2003 – 2005)
13. SSFL Soil Background Sampling (1992 - 2005)
14. Post Topanga Fire Background and Surface Water Sampling Program (2005 - 2006)
15. Former SSFL Leased Area Debris Survey (2007)
16. Northern Drainage Clay Target and LOX Debris Sampling Program (2007)
17. AREVA Study (2007)
18. RFI Program (1996 – Present)

This Offsite Data Evaluation Report represents the first comprehensive compilation of the offsite data collected by Boeing, NASA, or DOE from the various SSFL environmental investigation programs. While these data have been evaluated in many previous reports, this report has the advantage of the review of the entire chemical and radionuclide dataset from all offsite environmental matrices. The offsite data presented in this report was also evaluated using data from two other sources: offsite data collected by regulatory agencies that have responsibility for overseeing the SSFL environmental programs, and onsite data collected by Boeing, NASA, or DOE during comprehensive investigations programs that have occurred at the SSFL routinely since the mid-1980s for chemical assessments, and as far back as the 1950s for radiological assessments. Onsite investigation programs consider potential offsite transport of onsite contaminants, which have resulted in both offsite sampling programs and in some cases to cleanup actions. There are multiple data gap evaluations in progress at SSFL including a comprehensive historical records review to identify potential chemical and radiological release areas, and evaluation of current risk assessment data quality standards and potential pathways of contaminant migration. While the initial focus of the investigations are at and near onsite operational areas, environmental sampling has been and will be performed in all areas as warranted, including the collection of offsite data as needed.

This section presents an overall summary of the evaluation of the SSFL offsite dataset. Offsite data findings and evaluation details are included in Section 3 of this report.

4.1 SUMMARY

Offsite data around the SSFL have been evaluated for characterization completeness including the consideration of potential transport of onsite contaminants offsite. The offsite data have also been evaluated for significance of detected concentrations relative to residential human health risk-based and regulatory-published comparison levels. A summary of these findings are presented below and shown on Figure 4-1.

4.1.1 Summary of Data Completeness

Evaluation of data completeness addresses whether there are sufficient offsite data to understand whether a chemical or radionuclide is present, and if present, to assess its extent in environmental matrices and if its presence can be associated with an onsite source. The completeness evaluation results for chemicals and radionuclides can be divided into three categories:

- No Data Gaps. The data are sufficiently complete;
- Ongoing Data Collection. The data are generally complete and there are ongoing offsite environmental investigations to further supplement the data; or,
- Data Gaps Identified. The data are insufficient and further sampling and analysis is not currently planned.

The following summary presents completeness evaluation findings by environmental matrix for chemicals and radionuclides compiled and presented as part of this report:

1. The offsite soil/sediment data are sufficient and no data gaps are identified except in areas of ongoing work in the northeast and in the Northern Drainage.
2. The offsite groundwater data are generally sufficient and additional data are currently being collected with respect to the presence of potential groundwater contaminants in wells surrounding the site, most notably VOCs in offsite groundwater northeast of the SSFL.
3. The offsite springs and seeps data are generally sufficient and additional data are currently being collected to verify that the low concentrations of VOCs detected in some of the springs around the SSFL are laboratory contaminants and not from site operations. Spring and seep sampling in all areas surrounding the site is ongoing to continue to assess potential groundwater transport of contaminants and to gain insight regarding the groundwater flow system.
4. The offsite surface water data are sufficient and no data gaps have been identified. Evaluation of onsite surface water permit limit exceedances is ongoing to identify potential sources from either onsite contamination or naturally occurring conditions.

4.1.2 Summary of Data Significance

The chemical and radiological data were evaluated for significance based on comparisons to residential risk-based or agency-published screening levels. Chemical screening levels for offsite soil, sediment, soil vapor, and bedrock sample concentrations were compared to SSFL RBSLs that have been developed for residential land use according to a DTSC-approved risk assessment methodology (MWH 2005a). Screening levels for radionuclides in soil were developed using the USEPA PRG based on 10^{-6} excess risk level over background for residential land use (USEPA 2002b). Screening levels for groundwater, spring and seep water, and surface water were all compared to regulatory agency action levels for drinking water concentrations. Each result in the offsite dataset was compared to the media-specific screening level. In evaluation of the offsite data for this report, over 110,000 discrete sample result comparisons were made.

The significance evaluation results for chemicals and radionuclides can be divided into two categories:

- Not Significant. Data in this category is typified by one of the following conditions: (a) Concentrations are all below screening levels; (b) Concentrations above screening levels are not repeatable, persistent, and/or limited by surrounding data with results less than screening levels. Sufficient data are present to evaluate offsite conditions and potential transport from SSFL. In the latter case (b), concentrations may or may not be related to SSFL operations.
- Significant. Offsite concentrations are above screening levels and likely related to SSFL operations. These locations should be the focus of additional characterization (i.e., sampling and analysis).

The following summary presents significance evaluation findings by environmental matrix for chemicals and radionuclides compiled and presented as part of this report:

1. The offsite sample results for VOCs are not significant except for the presence of VOCs in groundwater and soil vapor in the area northeast of the SSFL. VOCs in this area continue to be evaluated as part of ongoing investigation programs.
2. The offsite sample results for metals and PAHs are not significant except in the Northern Drainage. A DTSC-approved soil and debris removal action is underway in the Northern Drainage on Sage Ranch for construction and clay pigeon target debris areas, and in down-drainage sediments (Zenco 2007, H&A 2007c). The construction debris area also contained asbestos-containing materials.
3. The offsite sample results for dioxins, PCBs, perchlorate, TPH, and radionuclides are not significant.

4.2 OVERALL CONCLUSIONS

Based on the summary presented above and the detailed evaluation and findings presented in Section 3, the overall conclusions are:

1. The offsite sampling results are sufficient with no data gaps identified except in areas of ongoing investigation or cleanup. Offsite data will continue to be supplemented with ongoing sampling programs where appropriate. Onsite data gap analysis is continuing and may also result in additional offsite sampling recommendations.
2. The concentrations of chemicals and radionuclides measured in samples collected offsite of the SSFL are not significant in comparison to screening levels except in groundwater north of the main entry gate to the SSFL, and in sediment within the Northern Drainage. These areas are the focus of current and future work, and a remedial cleanup action is currently underway in the Northern Drainage.

4.3 RECOMMENDATIONS FOR ADDITIONAL SAMPLING

Based on the summary presented above and the detailed evaluation and findings presented in Section 3, the overall recommendations are:

1. Continue ongoing monitoring of offsite groundwater and springs and seeps for VOCs, or as required by work plans until completion of the groundwater investigation program.
2. Complete cleanup actions within the Northern Drainage and evaluate confirmation sampling results to ensure completeness of removal.
3. Continue onsite data gap analysis and sampling, and conduct offsite work as warranted based on results.

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TABLES

Table 1-1
Chemical and Radionuclide Use and Wastes Generated at the SSFL
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Chemical or Waste Category	Use	Types of Chemicals Used / Stored / Produced
Petroleum Test Fuels	Large engine and component systems testing	RP-1 (kerosene-based), JP-4 (jet fuel),
Storable Test Fuels	Small engine and component testing	monomethyl hydrazine (MMH), unsymmetrical dimethyl hydrazine (UDMH), hydrazine derivatives, N-nitrosodimethylamine
Oxidizers	Engine and component system testing	Nitrogen tetraoxide (NTO), inhibited red fuming nitric acid (IRFNA), liquid oxygen (LOX), and fluorine compounds
Solvents	Cleaning	Trichloroethene (TCE), tetrachloroethene (PCE), 1,1,1-trichloroethane (TCA), 1,1-dichloroethane (DCA), chlorofluorocarbons (Freon compounds), 1,4-dioxane
Caustic and Acidic Solutions	Laboratory testing	Potassium hydroxide, sodium hydroxide, hydrochloric and other acids
Scrap Metals	Construction	Copper, lead, zinc, etc.
Polychlorinated Biphenyls	Pre-1980 transformers, waste oils	Primarily Aroclor 1254 / 1260 mixtures
Petroleum Fuel and Solvent Burn Products	Generated through burning practices	Polyaromatic hydrocarbons (PAHs) and dioxins/furans
Solid Propellants and Energetic Compounds	Igniters and energetic testing	Perchlorate, beryllium, gycildyl azide polymer (GAP), RDX, HMX, and C-4
Vehicle Fuels	Transportation	Petroleum hydrocarbons (gasoline-range)
Waste Oil	Maintenance operations, lubricating oils	Petroleum hydrocarbons (oil-range)
Construction Debris	Construction	Concrete, asphalt, wood, scrap metal, and asbestos
"Green Liquor" Wastewater	Coal gasification processes	Water containing organic and sulfur compounds, and ash (generated from coal gasification operations)
Incinerator Ash	Refuse burning (paper, wood, etc.)	PAHs and dioxins
Photographic Waste	Photo and X-Ray development	Silver
Nuclear Energy Research Wastes	Area IV nuclear energy, research and testing	Sodium potassium (NaK), Nuclear fission waste products (b)
Pyrophoric material	Ignition source	Triethyl aluminum/triethyl boron (TEA/TEB)
Biocides	Control algal growth in ponds (a)	Sodium hypochlorite (a)

(a) Biocides are not currently used in cooling waters or water treatment systems at the SSFL; sodium hypochlorite, an oxidizer, was used at sewage treatment plants as a disinfectant.

(b) Nuclear fission waste products: americium-241, cobalt-60, cesium-134, cesium-137, europium-152, europium-154, iron-55, tritium, potassium-40, manganese-54, sodium-22, nickel-59, nickel-63, plutonium-238, plutonium-239, plutonium-240, plutonium-241, plutonium-242, radium-226, strontium-90, thorium-228, thorium-232, uranium-234, uranium-235, uranium-238

Sources: SAIC 1994; ICF 1993; Ogden 1996.
See Acronym List for definitions of acronyms.

Table 1-2
SSFL Surrounding Properties
Page 1 of 1

Property Name[(a)]	Other Property Names[(b)]
Brandeis-Bardin	American Jewish University - Brandeis-Bardin Campus Brandeis-Bardin Institute
Sage Ranch	Mountains Recreation and Conservation Authority (MRCA) Santa Monica Mountains Conservancy (SMMC) Sage Ranch Park The Conservancy
Black Canyon	None
Woolsey Canyon	None
Dayton Canyon	None
Chatsworth Reservoir	None
Bell Canyon	None
Ahmanson Ranch	Ahmanson Ranch Development Project Ahmanson Ranch Open Space Area Upper Las Virgenes Canyon Open Space Preserve
Runkle Canyon	None

(a) Property name used in this report.
(b) Property names usd in other reports.

Table 3-1
Offsite Soil Sampling Summary
Santa Susana Field Laboratory
Page 1 of 7

			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
VOC															
	1,1,1,2-Tetrachloroethane	ug/kg	0.25	NA(3)	37	0				NA(3)	37	0.979	32	37	NA(3)
	1,1,1-Trichloroethane	ug/kg	490	NA(3)	158	0				NA(3)	158	0.979	8	0	NA(3)
	1,1,2,2-Tetrachloroethane	ug/kg	1.4	NA(3)	158	0				NA(3)	158	0.979	8	146	NA(3)
	1,1,2-Trichloro-1,2,2-trifluoroethane	ug/kg	16000	NA(3)	40	0				NA(3)	40	3.8	32	0	NA(3)
	1,1,2-Trichloroethane	ug/kg	1.2	NA(3)	158	0				NA(3)	158	0.979	8	153	NA(3)
	1,1-Dichloroethane	ug/kg	1.6	NA(3)	158	0				NA(3)	158	0.979	8	145	NA(3)
	1,1-Dichloroethene	ug/kg	23	NA(3)	158	5	0.324	1.42	0	NA(3)	153	0.979	8	0	NA(3)
	1,1-Dichloropropene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	2.3	NA(4)	NA(3)
	1,2,3-Trichlorobenzene	ug/kg	120	NA(3)	16	0				NA(3)	16	0.979	5.8	0	NA(3)
	1,2,3-Trichloropropane	ug/kg	0.051	NA(3)	16	0				NA(3)	16	0.979	12	16	NA(3)
	1,2,4-Trichlorobenzene	ug/kg	120	NA(3)	16	0				NA(3)	16	0.979	5.8	0	NA(3)
	1,2,4-Trimethylbenzene	ug/kg	35	NA(3)	37	0				NA(3)	37	0.979	32	0	NA(3)
	1,2-Dibromo-3-chloropropane	ug/kg	29	NA(3)	37	0				NA(3)	37	0.979	32	2	NA(3)
	1,2-Dibromoethane	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	2.3	NA(4)	NA(3)
	1,2-Dichlorobenzene	ug/kg	1800	NA(3)	158	0				NA(3)	158	0.979	16	0	NA(3)
	1,2-Dichloroethane	ug/kg	0.5	NA(3)	158	0				NA(3)	158	0.979	8	158	NA(3)
	1,2-Dichloroethenes	ug/kg	14	NA(3)	2	0				NA(3)	2	10	11	0	NA(3)
	1,2-Dichloropropane	ug/kg	NA(4)	NA(3)	156	0			NA(4)	NA(3)	156	0.979	8	NA(4)	NA(3)
	1,3,5-Trimethylbenzene	ug/kg	35	NA(3)	37	0				NA(3)	37	0.979	32	0	NA(3)
	1,3-Dichlorobenzene	ug/kg	1700	NA(3)	158	0				NA(3)	158	0.979	16	0	NA(3)
	1,3-Dichloropropane	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	2.3	NA(4)	NA(3)
	1,4-Dichlorobenzene	ug/kg	10	NA(3)	158	6	0.266	0.676	0	NA(3)	152	0.979	16	18	NA(3)
	2-Chloro-1,1,1-trifluoroethane	ug/kg	NA(4)	NA(3)	19	0			NA(4)	NA(3)	19	21	32	NA(4)	NA(3)
	2-Chloroethylvinyl ether	ug/kg	0.0096	NA(3)	155	0				NA(3)	155	3.8	80	155	NA(3)
	2-Hexanone	ug/kg	NA(4)	NA(3)	137	0			NA(4)	NA(3)	137	4.9	25	NA(4)	NA(3)
	Acetone	ug/kg	51000	NA(3)	158	15	5	470	0	NA(3)	143	6.48	77	0	NA(3)
	Benzene	ug/kg	0.13	NA(3)	158	0				NA(3)	158	0.979	8	158	NA(3)
	Bromobenzene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	5.8	NA(4)	NA(3)
	Bromochloromethane	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	5.8	NA(4)	NA(3)
	Bromodichloromethane	ug/kg	0.31	NA(3)	158	0				NA(3)	158	0.979	8	158	NA(3)
	Bromoform	ug/kg	NA(4)	NA(3)	158	0			NA(4)	NA(3)	158	0.979	8	NA(4)	NA(3)
	Bromomethane	ug/kg	NA(4)	NA(3)	158	0			NA(4)	NA(3)	158	0.979	16	NA(4)	NA(3)
	Carbon Disulfide	ug/kg	68	NA(3)	121	0				NA(3)	121	5	5	0	NA(3)
	Carbon Tetrachloride	ug/kg	0.042	NA(3)	158	0				NA(3)	158	0.979	8	158	NA(3)
	Chlorobenzene	ug/kg	97	NA(3)	158	0				NA(3)	158	0.979	8	0	NA(3)
	Chloroethane	ug/kg	NA(4)	NA(3)	158	0			NA(4)	NA(3)	158	0.979	16	NA(4)	NA(3)
	Chloroform	ug/kg	0.77	NA(3)	158	0				NA(3)	158	0.979	8	158	NA(3)
	Chloromethane	ug/kg	NA(4)	NA(3)	158	0			NA(4)	NA(3)	158	0.979	16	NA(4)	NA(3)
	Chlorotrifluoroethylene	ug/kg	NA(4)	NA(3)	21	0			NA(4)	NA(3)	21	5	32	NA(4)	NA(3)
	cis-1,2-Dichloroethene	ug/kg	14	NA(3)	158	0				NA(3)	158	0.979	8	0	NA(3)
	cis-1,3-Dichloropropene	ug/kg	NA(4)	NA(3)	156	0			NA(4)	NA(3)	156	0.979	8	NA(4)	NA(3)
	Cumene	ug/kg	380	NA(3)	16	0				NA(3)	16	0.979	2.3	0	NA(3)
	Dibromochloromethane	ug/kg	94000	NA(3)	137	0				NA(3)	137	0.979	5	0	NA(3)
	Dibromomethane	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	2.3	NA(4)	NA(3)
	Dichlorodifluoromethane	ug/kg	15	NA(3)	40	0				NA(3)	40	0.979	16	1	NA(3)
	Ethylbenzene	ug/kg	1200	NA(3)	158	1	1	1	0	NA(3)	157	0.979	8	0	NA(3)
	Hexachlorobutadiene	ug/kg	9200	NA(3)	16	0				NA(3)	16	0.979	5.8	0	NA(3)
	Methyl ethyl ketone	ug/kg	62000	NA(3)	158	4	2.3	11	0	NA(3)	154	4.9	80	0	NA(3)
	Methyl isobutyl ketone (MIBK)	ug/kg	20000	NA(3)	137	0				NA(3)	137	3.8	25	0	NA(3)
	Methyl tert-butyl ether	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	5.8	NA(4)	NA(3)
	Methylene chloride	ug/kg	4	NA(3)	158	2	2.86	3.71	0	NA(3)	156	4.9	32	156	NA(3)
	m-Xylene & p-Xylene	ug/kg	150	NA(3)	155	5	0.383	2	0	NA(3)	150	1.5	11	0	NA(3)

Table 3-1
Offsite Soil Sampling Summary
Santa Susana Field Laboratory
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			Screening Levels (SLs) (1)		Total Number Samples Analyzed	Detect Data Summary					Non-Detect Data Summary				
	Constituent	Units	Residential SL	Background (2)		Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
	Naphthalene	ug/kg	6000	NA(3)	16	0				NA(3)	16	0.979	5.8	0	NA(3)
	n-Butylbenzene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	5.8	NA(4)	NA(3)
	n-Propylbenzene	ug/kg	200	NA(3)	16	0				NA(3)	16	0.979	2.3	0	NA(3)
	o-Chlorotoluene	ug/kg	1222000	NA(3)	16	0				NA(3)	16	0.979	5.8	0	NA(3)
	o-Xylene	ug/kg	190	NA(3)	155	1	1	1	0	NA(3)	154	0.979	8	0	NA(3)
	p-Chlorotoluene	ug/kg	1222000	NA(3)	16	0				NA(3)	16	0.979	5.8	0	NA(3)
	p-Cymene	ug/kg	NA(4)	NA(3)	16	2	0.414	0.461	NA(4)	NA(3)	14	0.979	2.3	NA(4)	NA(3)
	sec-Butylbenzene	ug/kg	77000	NA(3)	16	0				NA(3)	16	0.979	5.8	0	NA(3)
	sec-Dichloropropane	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	2.3	NA(4)	NA(3)
	Styrene	ug/kg	7200	NA(3)	137	0				NA(3)	137	0.979	5	0	NA(3)
	tert-Butylbenzene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.979	5.8	NA(4)	NA(3)
	Tetrachloroethene	ug/kg	0.43	NA(3)	158	0				NA(3)	158	0.979	8	158	NA(3)
	Toluene	ug/kg	300	NA(3)	158	18	0.534	9	0	NA(3)	140	0.979	8	0	NA(3)
	trans-1,2-Dichloroethene	ug/kg	16	NA(3)	158	0				NA(3)	158	0.979	8	0	NA(3)
	trans-1,3-Dichloropropene	ug/kg	NA(4)	NA(3)	158	0			NA(4)	NA(3)	158	0.979	8	NA(4)	NA(3)
	Trichloroethene	ug/kg	2.2	NA(3)	158	0				NA(3)	158	0.979	8	143	NA(3)
	Trichlorofluoromethane	ug/kg	110	NA(3)	158	0				NA(3)	158	0.979	10	0	NA(3)
	Vinyl chloride	ug/kg	0.0096	NA(3)	158	0				NA(3)	158	0.979	16	158	NA(3)
	Xylenes, Total	ug/kg	150	NA(3)	5	0				NA(3)	5	5	16	0	NA(3)
SVOC															
	1,2,4-Trichlorobenzene	ug/kg	120	NA(3)	136	0				NA(3)	136	320	670	136	NA(3)
	1,2-Dichlorobenzene	ug/kg	1800	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	1,3-Dichlorobenzene	ug/kg	1700	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	1,4-Dichlorobenzene	ug/kg	10	NA(3)	135	0				NA(3)	135	320	670	135	NA(3)
	1-Methyl naphthalene	ug/kg	230000	NA(3)	58	8	6.8	170	0	NA(3)	50	15	1700	0	NA(3)
	2,4,5-Trichlorophenol	ug/kg	5700000	NA(3)	136	0				NA(3)	136	320	860	0	NA(3)
	2,4,6-Trichlorophenol	ug/kg	10000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	2,4-Dichlorophenol	ug/kg	170000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	2,4-Dimethylphenol	ug/kg	1100000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	2,4-Dinitrophenol	ug/kg	110000	NA(3)	136	0				NA(3)	136	320	3300	0	NA(3)
	2,4-Dinitrotoluene	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	2,6-Dinitrotoluene	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	2-Chloronaphthalene	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	2-Chlorophenol	ug/kg	290000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	2-Methylnaphthalene	ug/kg	230000	NA(3)	200	13	3.74	3400	0	NA(3)	187	4	1690	0	NA(3)
	2-Nitroaniline	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	3300	NA(4)	NA(3)
	2-Nitrophenol	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	3,3'-Dichlorobenzidine	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	1300	NA(4)	NA(3)
	3-Nitroaniline	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	3300	NA(4)	NA(3)
	4,4'-DDD	ug/kg	NA(4)	NA(3)	119	5	46	110	NA(4)	NA(3)	114	330	670	NA(4)	NA(3)
	4,4'-DDE	ug/kg	NA(4)	NA(3)	119	5	190	360	NA(4)	NA(3)	114	330	670	NA(4)	NA(3)
	4,4'-DDT	ug/kg	NA(4)	NA(3)	119	2	46	76	NA(4)	NA(3)	117	330	670	NA(4)	NA(3)
	4,6-Dinitro-o-cresol	ug/kg	5700	NA(3)	136	0				NA(3)	136	320	3300	0	NA(3)
	4-Bromophenyl phenyl ether	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	4-Chlorophenylphenyl ether	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	4-Nitrophenol	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	3300	NA(4)	NA(3)
	Acenaphthene	ug/kg	3400000	NA(3)	200	19	2.7	2700	0	NA(3)	181	4	670	0	NA(3)
	Acenaphthylene	ug/kg	1700000	NA(3)	200	3	7.3	2000	0	NA(3)	197	4	1900	0	NA(3)
	Aldrin	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	alpha-BHC	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Anthracene	ug/kg	17000000	NA(3)	200	22	3.5	9360	0	NA(3)	178	4	1900	0	NA(3)
	Benzo(a)anthracene	ug/kg	600	NA(3)	199	39	3	57500	5	NA(3)	160	15.7	1900	5	NA(3)
	Benzo(a)pyrene	ug/kg	60	NA(3)	199	38	4	86700	23	NA(3)	161	15.7	1900	120	NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
	Benzo(b)fluoranthene	ug/kg	600	NA(3)	199	38	7	86500	7	NA(3)	161	15.7	1900	5	NA(3)
	Benzo(ghi)perylene	ug/kg	NA(4)	NA(3)	199	35	3	50200	NA(4)	NA(3)	164	16.7	1900	NA(4)	NA(3)
	Benzo(k)fluoranthene	ug/kg	600	NA(3)	199	19	6	43300	4	NA(3)	180	4	1900	6	NA(3)
	Benzoic acid	ug/kg	230000000	NA(3)	136	1	140	140	0	NA(3)	135	320	3300	0	NA(3)
	Benzyl alcohol	ug/kg	17000000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	beta-BHC	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	bis(2-Chloroethoxy)methane	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	bis(2-Chloroethyl) ether	ug/kg	290	NA(3)	136	0				NA(3)	136	320	670	136	NA(3)
	bis(2-Chloroisopropyl) ether	ug/kg	2300000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	bis(2-Ethylhexyl) phthalate	ug/kg	250000	NA(3)	193	31	6.1	8500	0	NA(3)	162	12.7	1900	0	NA(3)
	Butyl benzyl phthalate	ug/kg	11000000	NA(3)	175	4	5.7	102	0	NA(3)	171	15.6	1700	0	NA(3)
	Carbazole	ug/kg	36000	NA(3)	17	0				NA(3)	17	320	480	0	NA(3)
	Chrysene	ug/kg	6000	NA(3)	199	41	6	67500	2	NA(3)	158	15.7	1900	0	NA(3)
	delta-BHC	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Dibenzo(a,h)anthracene	ug/kg	170	NA(3)	200	15	4	10900	4	NA(3)	185	4	1900	121	NA(3)
	Dibenzofuran	ug/kg	110000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	Dieldrin	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Diethyl phthalate	ug/kg	46000000	NA(3)	193	5	3.7	5.56	0	NA(3)	188	7	1900	0	NA(3)
	Dimethyl phthalate	ug/kg	570000000	NA(3)	175	1	5.13	5.13	0	NA(3)	174	15	1700	0	NA(3)
	Di-n-butyl phthalate	ug/kg	5700000	NA(3)	193	17	5.13	83.3	0	NA(3)	176	15.6	1900	0	NA(3)
	Di-n-octyl phthalate	ug/kg	2300000	NA(3)	175	5	6.28	43.8	0	NA(3)	170	15	1700	0	NA(3)
	Endosulfan sulfate	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Endrin	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Fluoranthene	ug/kg	2300000	NA(3)	199	46	6.42	55300	0	NA(3)	153	7	670	0	NA(3)
	Fluorene	ug/kg	2300000	NA(3)	200	12	0.91	840	0	NA(3)	188	7	1700	0	NA(3)
	gamma-BHC	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Heptachlor	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Heptachlor epoxide	ug/kg	NA(4)	NA(3)	119	0			NA(4)	NA(3)	119	330	670	NA(4)	NA(3)
	Hexachlorobenzene	ug/kg	400	NA(3)	136	0				NA(3)	136	210	670	4	NA(3)
	Hexachlorobutadiene	ug/kg	9200	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	Hexachlorocyclopentadiene	ug/kg	340000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	Hexachloroethane	ug/kg	18000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	Indeno(1,2,3-cd)pyrene	ug/kg	600	NA(3)	199	34	2	45700	6	NA(3)	165	16.7	1900	5	NA(3)
	Isophorone	ug/kg	750000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	m+p Cresol	ug/kg	290000	NA(3)	16	0				NA(3)	16	320	480	0	NA(3)
	Naphthalene	ug/kg	6000	NA(3)	198	13	1.1	1400	0	NA(3)	185	7	1700	0	NA(3)
	Nitrobenzene	ug/kg	29000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	n-Nitrosodimethylamine	ug/kg	45	NA(3)	71	0				NA(3)	71	2	1700	4	NA(3)
	n-Nitrosodi-n-propylamine	ug/kg	100	NA(3)	136	0				NA(3)	136	320	670	136	NA(3)
	n-Nitrosodiphenylamine	ug/kg	80000	NA(3)	136	0				NA(3)	136	32	670	0	NA(3)
	o-Cresol	ug/kg	2867000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	p-Chloroaniline	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	p-Chloro-m-cresol	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	670	NA(4)	NA(3)
	p-Cresol	ug/kg	290000	NA(3)	120	1	670	670	0	NA(3)	119	330	670	0	NA(3)
	Pentachlorophenol	ug/kg	8800	NA(3)	136	0				NA(3)	136	320	3300	0	NA(3)
	Phenanthrene	ug/kg	1700000	NA(3)	200	37	5.19	15900	0	NA(3)	163	5	670	0	NA(3)
	Phenol	ug/kg	18000000	NA(3)	136	0				NA(3)	136	320	670	0	NA(3)
	p-Nitroaniline	ug/kg	NA(4)	NA(3)	136	0			NA(4)	NA(3)	136	320	3300	NA(4)	NA(3)
	Pyrene	ug/kg	1700000	NA(3)	199	48	6.36	76800	0	NA(3)	151	7	670	0	NA(3)
TPH															
	Diesel Range Organics (C14-C20)	mg/kg	1400	NA(3)	20	2	7.9	9.1	0	NA(3)	18	4	16	0	NA(3)
	Diesel Range Organics (C15-C20)	mg/kg	1400	NA(3)	27	6	4.9	62	0	NA(3)	21	3.38	136	0	NA(3)
	Gasoline Range Organics (C8-C11)	mg/kg	1.1	NA(3)	46	3	2.1	5.1	3	NA(3)	43	3.38	136	43	NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
	Kerosene Range Organics (C11-C14)	mg/kg	1400	NA(3)	20	0				NA(3)	20	4	35	0	NA(3)
	Kerosene Range Organics (C12-C14)	mg/kg	1400	NA(3)	26	1	4.8	4.8	0	NA(3)	25	3.38	136	0	NA(3)
	Lubricant Oil Range Organics (C20-C30)	mg/kg	1400	NA(3)	20	4	4.4	390	0	NA(3)	16	11	16	0	NA(3)
	Lubricant Oil Range Organics (C21-C30)	mg/kg	1400	NA(3)	27	22	1.89	961	0	NA(3)	5	3.59	6.2	0	NA(3)
Perchlorate															
	Perchlorate	ug/L	6 (5)	NA(3)	65	0				NA(3)	65	2	30	4	NA(3)
	Perchlorate (Soil Leachate)	ug/kg	6 (5)	NA(3)	16	0				NA(3)	16	43	260	16	NA(3)
Dioxins															
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	ng/kg	690	2.5	31	7	0.47	3.73	0	1	24	0.0986	31	0	18
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ng/kg	690	13	31	15	0.355	23	0	2	16	4.2	31	0	2
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ng/kg	690	0.19	31	6	0.18	0.92	0	5	25	0.0614	31	0	20
	1,2,3,4,7,8-Hexachlorodibenzofuran	ng/kg	69	0.73	31	9	0.079	0.64	0	0	22	0.0492	31	0	18
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ng/kg	69	0.34	31	8	0.23	0.607	0	2	23	0.0826	31	0	18
	1,2,3,6,7,8-Hexachlorodibenzofuran	ng/kg	69	0.3	31	9	0.0668	0.382	0	2	22	0.051	31	0	19
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	ng/kg	69	0.95	31	12	0.145	2.2	0	4	19	0.259	31	0	18
	1,2,3,7,8,9-Hexachlorodibenzofuran	ng/kg	69	0.43	31	5	0.12	0.38	0	0	26	0.0433	31	0	18
	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ng/kg	69	1.1	31	10	0.148	1.2	0	1	21	0.155	31	0	18
	1,2,3,7,8-Pentachlorodibenzofuran	ng/kg	230	0.59	31	7	0.12	0.4	0	0	24	0.0942	31	0	18
	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ng/kg	6.9	0.18	31	6	0.14	0.334	0	2	25	0.0699	31	8	21
	2,3,4,6,7,8-Hexachlorodibenzofuran	ng/kg	69	0.45	31	7	0.22	0.54	0	2	24	0.0516	31	0	19
	2,3,4,7,8-Pentachlorodibenzofuran	ng/kg	23	0.64	31	9	0.13	0.73	0	1	22	0.083	31	1	18
	2,3,7,8-TCDD	ng/kg	6.9	0.5	31	5	0.08	0.18	0	0	26	0.0609	6.1	0	19
	2,3,7,8-Tetrachlorodibenzofuran	ng/kg	69	1.8	31	11	0.151	1.1	0	0	20	0.0791	6.1	0	8
	Heptachlorodibenzofurans	ng/kg	NA(4)	NA(3)	31	10	0.174	9.09	NA(4)	NA(3)	21	0.124	31	NA(4)	NA(3)
	Heptachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	31	15	0.76	46.5	NA(4)	NA(3)	16	4.9	55	NA(4)	NA(3)
	Hexachlorodibenzofurans	ng/kg	NA(4)	NA(3)	31	12	0.123	6.19	NA(4)	NA(3)	19	4.2	31	NA(4)	NA(3)
	Hexachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	31	12	0.602	12.7	NA(4)	NA(3)	19	0.257	31	NA(4)	NA(3)
	Octachlorodibenzofuran	ng/kg	23000	8.1	31	9	0.331	8.37	0	1	22	0.358	61	0	18
	Octachlorodibenzo-p-dioxin	ng/kg	23000	140	31	26	2.4	340	0	3	5	10	31	0	0
	Pentachlorodibenzofurans	ng/kg	NA(4)	NA(3)	31	10	0.0916	5.08	NA(4)	NA(3)	21	0.136	31	NA(4)	NA(3)
	Pentachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	31	6	0.15	3.21	NA(4)	NA(3)	25	0.0869	31	NA(4)	NA(3)
	TCDD TEQ (ND=0) 2005 WHO	ng/kg	6.9	0.87	31	31	0	1.246741	0	4	0				
	Tetrachlorodibenzofurans	ng/kg	NA(4)	NA(3)	31	13	0.26	7.1	NA(4)	NA(3)	18	0.0791	44.1	NA(4)	NA(3)
	Tetrachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	31	8	0.08	1.19	NA(4)	NA(3)	23	0.0609	6.1	NA(4)	NA(3)
Energetics															
	1,3-Dinitrobenzene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	2,4,6-Trinitrotoluene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	2,4-Dinitrotoluene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	2,6-Dinitrotoluene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.26	0.26	NA(4)	NA(3)
	2-Amino-4,6-Dinitrotoluene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	2-Nitrotoluene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	3-Nitrotoluene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	4-Am-2,6-DNT	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	4-Nitrotoluene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	HMX	ug/kg	3100000	NA(3)	16	0			NA	NA(3)	16	2.2	2.2	0	NA(3)
	Nitrobenzene	ug/kg	29000	NA(3)	16	0			NA	NA(3)	16	0.26	0.26	0	NA(3)
	RDX	ug/kg	6900	NA(3)	16	0			NA	NA(3)	16	1	1	0	NA(3)
	sym-Trinitrobenzene	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.25	0.25	NA(4)	NA(3)
	Tetryl	ug/kg	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.65	0.65	NA(4)	NA(3)
PCBs															
	Aroclor 1016	ug/kg	3900	NA(3)	35	0				NA(3)	35	3.38	190	0	NA(3)
	Aroclor 1221	ug/kg	350	NA(3)	35	0				NA(3)	35	3.38	190	0	NA(3)
	Aroclor 1232	ug/kg	350	NA(3)	35	0				NA(3)	35	3.38	190	0	NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
	Aroclor 1242	ug/kg	350	NA(3)	35	0				NA(3)	35	3.38	190	0	NA(3)
	Aroclor 1248	ug/kg	350	NA(3)	35	0				NA(3)	35	3.38	190	0	NA(3)
	Aroclor 1254	ug/kg	350	NA(3)	39	9	22	230	0	NA(3)	30	3.38	190	0	NA(3)
	Aroclor 1260	ug/kg	350	NA(3)	35	3	28.9	84	0	NA(3)	32	3.38	190	0	NA(3)
Metals															
	Aluminum	mg/kg	75000	20000	72	72	2510	30400	0	2	0				
	Antimony	mg/kg	30	8.7	177	19	0.031	2.2	0	0	158	0.095	16	0	16
	Antimony	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.05	0.05	NA(4)	NA(3)
	Arsenic	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.01	0.01	NA(4)	NA(3)
	Arsenic	mg/kg	0.095	15	191	168	1	34.9	168	6	23	0.5	7	23	0
	Barium	mg/kg	15000	140	77	77	22	790	0	5	0				
	Beryllium	mg/kg	150	1.1	185	170	0.15	3.6	0	5	15	0.11	0.8	0	0
	Beryllium	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.005	0.005	NA(4)	NA(3)
	Boron	mg/kg	15000	9.7	79	40	1.1	118	0	6	39	0.97	16	0	16
	Cadmium	mg/kg	2.6	1	185	60	0.055	7.3	6	10	125	0.02	2	0	1
	Cadmium	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.01	0.01	NA(4)	NA(3)
	Calcium	mg/kg	NA(4)	NA(3)	3	3	1000	143000	NA(4)	NA(3)	0			NA(4)	NA(3)
	Chromium	mg/kg	3400	36.8	185	185	6	96	0	3	0				
	Chromium	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.01	0.01	NA(4)	NA(3)
	Cobalt	mg/kg	1500	21	77	75	2.3	21	0	0	2	2	2	0	0
	Copper	mg/kg	3000	29	185	185	3	72	0	9	0				
	Copper	mg/L	NA(4)	NA(3)	1	1	0.17	0.17	NA(4)	NA(3)	0			NA(4)	NA(3)
	Hexavalent Chromium	mg/kg	110	NA(3)	16	0				NA(3)	16	0.2	0.6	0	NA(3)
	Iron	mg/kg	NA(4)	28000	23	23	5750	28000	NA(4)	0	0			NA(4)	
	Lead	mg/kg	150	34	185	178	5	319	6	20	7	6	6	0	0
	Lead	mg/L	NA(4)	NA(3)	2	1	1.2	1.2	NA(4)	NA(3)	1	0.003	0.003	NA(4)	NA(3)
	Lithium	mg/kg	1522	37	15	15	12	37	0	0	0				
	Magnesium	mg/kg	NA(4)	NA(3)	3	3	1280	48400	NA(4)	NA(3)	0			NA(4)	NA(3)
	Manganese	mg/kg	1800	495	23	23	153	2700	1	3	0				
	Mercury	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.0005	0.0005	NA(4)	NA(3)
	Mercury	mg/kg	23	0.09	190	47	0.0084	1.7	0	3	143	0.003	0.3	0	130
	Molybdenum	mg/kg	380	5.3	74	45	0.13	4.4	0	0	29	0.26	16	0	16
	Nickel	mg/kg	1500	29	185	180	4.2	82	0	8	5	6	7	0	0
	Nickel	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.02	0.02	NA(4)	NA(3)
	Potassium	mg/kg	NA(4)	6400	18	18	850	6400	NA(4)	0	0			NA(4)	
	Selenium	mg/kg	380	0.655	188	74	0.23	8.1	0	50	114	0.2	8	0	24
	Selenium	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.005	0.005	NA(4)	NA(3)
	Silver	mg/kg	380	0.79	185	39	0.029	4.1	0	8	146	0.02	2	0	134
	Silver	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.01	0.01	NA(4)	NA(3)
	Sodium	mg/kg	NA(4)	110	18	17	53	1900	NA(4)	3	1	75	75	NA(4)	0
	Thallium	mg/kg	6.1	0.46	199	46	0.13	4.5	0	5	153	0.1	8	2	142
	Thallium	mg/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.01	0.01	NA(4)	NA(3)
	Vanadium	mg/kg	76	62	77	77	10.3	68	0	1	0				
	Zinc	mg/kg	23000	110	185	185	23	284	0	7	0				
	Zinc	mg/L	NA(4)	NA(3)	1	1	0.12	0.12	NA(4)	NA(3)	0			NA(4)	NA(3)
	Zirconium	mg/kg	NA(4)	8.6	15	15	1.2	8.6	NA(4)	0	0			NA(4)	
Inorganics															
	Ammonia-N	mg/kg	NA(4)	NA(3)	6	5	2.1	30	NA(4)	NA(3)	1	6.8	6.8	NA(4)	NA(3)
	Bromide	mg/kg	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	0.5	0.5	NA(4)	NA(3)
	Chloride	mg/kg	NA(4)	NA(3)	19	13	1.74	70	NA(4)	NA(3)	6	11	13	NA(4)	NA(3)
	Cyanides	mg/kg	1500	NA(3)	6	6	0.64	6.7	0	NA(3)	0				NA(3)
	Fluoride	mg/kg	4600	6.7	31	24	0.49	13	0	2	7	1	3.3	0	0
	Nitrate-N	mg/kg	120000	NA(3)	19	5	2.37	37	0	NA(3)	14	11	16	0	NA(3)

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Offsite Soil Sampling Summary
Santa Susana Field Laboratory
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
	Nitrite-N	mg/kg	NA(4)	NA(3)	19	0			NA(4)	NA(3)	19	1	16	NA(4)	NA(3)
	Phosphate	mg/kg	NA(4)	NA(3)	3	2	2.36	2.9	NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Sulfate	mg/kg	NA(4)	NA(3)	9	9	2.33	17000	NA(4)	NA(3)	0			NA(4)	NA(3)
	Sulfide	mg/kg	NA(4)	NA(3)	1	1	110	110	NA(4)	NA(3)	0			NA(4)	NA(3)
Asbestos															
	Actinolite	%	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Amosite	%	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Anthophyllite	%	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Chrysotile	%	NA(4)	NA(3)	1	1	1	1	NA(4)	NA(3)	0			NA(4)	NA(3)
	Crocidolite	%	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Tremolite	%	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
Other Chemicals															
	Moisture	%	NA(4)	NA(3)	163	148	0.425	42	NA(4)	NA(3)	15	5.05	34.78	NA(4)	NA(3)
	pH	pH Units	NA(4)	NA(3)	43	43	5.9	8.42	NA(4)	NA(3)	0			NA(4)	NA(3)
	Total Solids	%	NA(4)	NA(3)	54	54	34	99.7	NA(4)	NA(3)	0			NA(4)	NA(3)
	Formaldehyde	mg/kg	12000	NA(3)	16	0				NA(3)	16	3	4	0	NA(3)
	Surfactants	mg/kg	NA(4)	NA(3)	6	3	0.48	3.6	NA(4)	NA(3)	3	1	5.1	NA(4)	NA(3)
	Total Organic Carbon	mg/kg	NA(4)	NA(3)	1	1	17300	17300	NA(4)	NA(3)	0			NA(4)	NA(3)
Radionuclides															
	Actinium-228	pCi/g	NA(4)	NA(3)	2	2	0.5789	0.8694	NA(4)	NA(3)	0			NA(4)	NA(3)
	Americium-241	pCi/g	1.87	NA(3)	40	0				NA(3)	40	0.045	0.2	0	NA(3)
	Antimony-124	pCi/g	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	0.1	0.1	NA(4)	NA(3)
	Barium-140	pCi/g	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.12	0.32	NA(4)	NA(3)
	Beryllium-7	pCi/g	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.12	0.32	NA(4)	NA(3)
	Bismuth-214	pCi/g	NA(4)	NA(3)	2	2	0.7074	1.864	NA(4)	NA(3)	0			NA(4)	NA(3)
	Cerium-141	pCi/g	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.028	0.069	NA(4)	NA(3)
	Cerium-144	pCi/g	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.073	0.17	NA(4)	NA(3)
	Cerium-242	pCi/g	NA(4)	NA(3)	18	0			NA(4)	NA(3)	18	0.038	0.072	NA(4)	NA(3)
	Cerium-243/244	pCi/g	NA(4)	NA(3)	18	0			NA(4)	NA(3)	18	0.026	0.046	NA(4)	NA(3)
	Cesium-134	pCi/g	0.157	NA(3)	34	0				NA(3)	34	0.0064	0.075	0	NA(3)
	Cesium-137	pCi/g	0.2727	0.213	256	175	0.016	0.456	7	14	81	0.013	0.1	0	0
	Chromium-51	pCi/g	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	0.1	1.1	NA(4)	NA(3)
	Cobalt-57	pCi/g	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	0.1	0.1	NA(4)	NA(3)
	Cobalt-58	pCi/g	NA(4)	NA(3)	22	0			NA(4)	NA(3)	22	0.015	0.2	NA(4)	NA(3)
	Cobalt-60	pCi/g	0.0361	NA(3)	44	0				NA(3)	44	0.0085	0.2	12	NA(3)
	Europium-152	pCi/g	0.0416	NA(3)	45	0				NA(3)	45	0.024	0.3	32	NA(3)
	Europium-154	pCi/g	0.0499	NA(3)	38	6	0.038	0.12	5	NA(3)	32	0.034	0.11	27	NA(3)
	Europium-155	pCi/g	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.049	0.13	NA(4)	NA(3)
	Gross alpha	pCi/g	NA(4)	NA(3)	26	12	0.285	13.5	NA(4)	NA(3)	14	0.45	46	NA(4)	NA(3)
	Gross beta	pCi/g	NA(4)	NA(3)	26	12	23	30.6	NA(4)	NA(3)	14	23	31.2	NA(4)	NA(3)
	Iodine-129	pCi/g	NA(4)	NA(3)	117	0			NA(4)	NA(3)	117	0.1	0.4	NA(4)	NA(3)
	Iron-55	pCi/g	2690	NA(3)	18	0				NA(3)	18	4.4	8.5	0	NA(3)
	Iron-59	pCi/g	NA(4)	NA(3)	22	0			NA(4)	NA(3)	22	0.043	0.3	NA(4)	NA(3)
	Lead-210	pCi/g	NA(4)	NA(3)	2	2	0.9854	2.579	NA(4)	NA(3)	0			NA(4)	NA(3)
	Lead-212	pCi/g	NA(4)	NA(3)	2	2	0.6652	1.009	NA(4)	NA(3)	0			NA(4)	NA(3)
	Lead-214	pCi/g	NA(4)	NA(3)	2	2	0.7981	2.047	NA(4)	NA(3)	0			NA(4)	NA(3)
	Manganese-54	pCi/g	0.692	NA(3)	40	0				NA(3)	40	0.014	0.1	0	NA(3)
	Nickel-59	pCi/g	208	NA(3)	18	0				NA(3)	18	630	1600	18	NA(3)
	Nickel-63	pCi/g	94.8	NA(3)	18	0				NA(3)	18	1.3	5.6	0	NA(3)
	Plutonium-238	pCi/g	2.97	NA(3)	207	21	0	0.13	0	NA(3)	186	0.006	0.2	0	NA(3)
	Plutonium-239	pCi/g	2.59	NA(3)	175	1	0.006	0.006	0	NA(3)	174	0.0002	0.09	0	NA(3)
	Plutonium-239/240	pCi/g	2.6	NA(3)	47	14	0	0.0071	0	NA(3)	33	0.02	0.092	0	NA(3)

Table 3-1
Offsite Soil Sampling Summary
Santa Susana Field Laboratory
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
	Plutonium-241	pCi/g	406	NA(3)	18	0				NA(3)	18	1.8	4.8	0	NA(3)
	Potassium-40	pCi/g	25.108	25	89	89	1.62	26.1	3	3	0				
	Radium-223	pCi/g	NA(4)	NA(3)	1	1	0.1762	0.1762	NA(4)	NA(3)	0			NA(4)	NA(3)
	Radium-224	pCi/g	NA(4)	NA(3)	2	2	0.9103	0.9903	NA(4)	NA(3)	0			NA(4)	NA(3)
	Radium-226	pCi/g	1.693	1.5	56	55	0.5	2.74	17	21	1	0.2	0.2	0	0
	Ruthenium-103	pCi/g	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.015	0.045	NA(4)	NA(3)
	Ruthenium-106	pCi/g	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.1	1.3	NA(4)	NA(3)
	Sodium-22	pCi/g	0.0865	NA(3)	18	0				NA(3)	18	0.012	0.037	0	NA(3)
	Strontium-90	pCi/g	0.361	0.13	204	114	0.01	0.18	0	4	90	0.01	0.18	0	12
	Thallium-208	pCi/g	NA(4)	NA(3)	2	2	0.1823	0.2728	NA(4)	NA(3)	0			NA(4)	NA(3)
	Thorium-227	pCi/g	NA(4)	NA(3)	1	1	0.204	0.204	NA(4)	NA(3)	0			NA(4)	NA(3)
	Thorium-228	pCi/g	1.754	1.6	90	68	0.058	2.08	1	1	22	0.03	0.93	0	0
	Thorium-230	pCi/g	NA(4)	NA(3)	76	69	0.022	4.2	NA(4)	NA(3)	7	0.061	0.09	NA(4)	NA(3)
	Thorium-232	pCi/g	4.6	1.5	79	75	0.023	1.7	0	2	4	0.03	0.038	0	0
	Thorium-234	pCi/g	NA(4)	NA(3)	2	2	1.395	3.048	NA(4)	NA(3)	0			NA(4)	NA(3)
	Tritium	pCi/g	2.58	0.3	119	39	0.013	0.3	0	0	80	0.008	1.7	0	18
	Tritium	pCi/L	20000	NA(3)	234	53	120	2392	0	NA(3)	181	100	1000	0	NA(3)
	Uranium-233	pCi/g	NA(4)	NA(3)	16	16	0.41	1	NA(4)	NA(3)	0			NA(4)	NA(3)
	Uranium-233/234	pCi/g	5.91	1.9	20	20	0.41	1.9	0	1	0				
	Uranium-233/240	pCi/g	NA(4)	NA(3)	1	1	0.57	0.57	NA(4)	NA(3)	0			NA(4)	NA(3)
	Uranium-234	pCi/g	5.91	1.9	54	51	0.027	0.81	0	0	3	0.02	0.02	0	0
	Uranium-235	pCi/g	0.295	0.1	87	43	0.0074	0.1509	0	1	44	0.005	0.3	2	4
	Uranium-238	pCi/g	2.442	1.7	85	79	0.022	2.5	1	2	6	0.7	2.2	0	1
	Zinc-65	pCi/g	NA(4)	NA(3)	22	0			NA(4)	NA(3)	22	0.039	0.3	NA(4)	NA(3)

Notes:

(1) Chemical risk-based screening levels (SLs) for human health receptors are provided as reference points for comparison. Chemical SL based on residential receptor for a risk level of 1 x 10^{6} cancer risk or noncancer Hazard Index. Radionuclide SLs based on sum of residential EPA Residential 10^{6} PRG value and maximum background levels. Additional information provided in Appendix C.

(2) Reference: Soil Background Report (MWH 2005a) for metals and inorganic constituents; Bell Canyon (Ogden, 1998), Area IV Characterization (Rockwell, 1996) and Brandeis Barden Institute (McLaren/Hart, 1995) reports for radionuclides (see Appendix C).

(3) Not applicable – Background values only established for naturally-occurring constituents.

(4) RBSL not available for this constituent.

(5) Perchlorate screening level based on recent SSFL interim measure goals, not health-based.

(6) Additional soil/sediment sample data collected and analyzed for gross alpha/gross beta and results averaged. These data are not displayed on this table (see Appendix B).

Acronyms:

DL – Detection Limit
SL – Screening Level
NA – Not Applicable
ND – Non-Detect
NR – Not Reported
SVOC – Semivolatile Organic Compounds
PCB – Polychlorinated Biphenyls
TPH – Total Petroleum Hydrocarbons
VOC – Volatile Organic Compounds

Table 3-2
Offsite Soil Vapor Sampling Summary
Santa Susana Field Laboratory
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			Screening Levels (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res RBSL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
VOC															
	1,1,1,2-Tetrachloroethane	ug/L	0.048	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)
	1,1,1-Trichloroethane	ug/L	640	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	1,1,2,2-Tetrachloroethane	ug/L	0.048	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)
	1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	8800	NA(3)	14	0				NA(3)	14	5	5	0	NA(3)
	1,1,2-Trichloroethane	ug/L	0.17	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)
	1,1-Dichloroethane	ug/L	1.7	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	1,1-Dichloroethene	ug/L	58	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	1,2-Dichloroethane	ug/L	0.13	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)
	Benzene	ug/L	0.095	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)
	Carbon Tetrachloride	ug/L	0.063	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)
	Chloroethane	ug/L	NA(4)	NA(3)	14	0			NA(4)	NA(3)	14	1	1	NA(4)	NA(3)
	Chloroform	ug/L	0.5	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)
	cis-1,2-Dichloroethene	ug/L	10	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	Dichlorodifluoromethane	ug/L	58	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	Ethylbenzene	ug/L	290	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	Methylene chloride	ug/L	2.7	NA(3)	14	0				NA(3)	14	20	20	14	NA(3)
	m-Xylene & p-Xylene	ug/L	29	NA(3)	14	0				NA(3)	14	2	2	0	NA(3)
	o-Xylene	ug/L	29	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	Tetrachloroethene	ug/L	0.45	NA(3)	14	2	1.2	4.1	2	NA(3)	12	1	1	12	NA(3)
	Toluene	ug/L	110	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	trans-1,2-Dichloroethene	ug/L	20	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	Trichloroethene	ug/L	1.4	NA(3)	14	4	1.6	7.3	4	NA(3)	10	1	1	0	NA(3)
	Trichlorofluoromethane	ug/L	200	NA(3)	14	0				NA(3)	14	1	1	0	NA(3)
	Vinyl chloride	ug/L	0.035	NA(3)	14	0				NA(3)	14	1	1	14	NA(3)

Notes:

(1) Chemical risk-based screening levels (SLs) for human health receptors are provided as reference points for comparison. Chemical SL based on residential receptor for a risk level of 1 x 10^{-6} cancer risk or noncancer Hazard Index. Radionuclide SLs based on sum of residential EPA Residential 10^{-6} PRG value and maximum background levels. Additional information provided in Appendix C.

(2) Reference: Soil Background Report (MWH 2005a) for metals and inorganic constituents; Bell Canyon (Ogden, 1998), Area IV Characterization (Rockwell, 1996) and Brandeis Barden Institute (McLaren/Hart, 1995) reports for radionuclides (see Appendix C).

(3) Not applicable – Background values only established for naturally-occurring constituents.

(4) RBSL not available for this constituent.

Acronyms:

DL – Detection Limit
SL – Screening Level
NA – Not Applicable
ND – Non-Detect
NR – Not Reported
VOC – Volatile Organic Compounds

Table 3-3
Offsite Surface Water Sampling Summary
Santa Susana Field Laboratory
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
VOC															
	1,1,1-Trichloroethane	ug/L	200	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	1,1,2,2-Tetrachloroethane	ug/L	1	NA(3)	3	0				NA(3)	3	5	5	3	NA(3)
	1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	1200	NA(3)	1	0				NA(3)	1	5	5	0	NA(3)
	1,1,2-Trichloroethane	ug/L	5	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	1,1-Dichloroethane	ug/L	5	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	1,1-Dichloroethene	ug/L	6	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	1,2-Dichlorobenzene	ug/L	600	NA(3)	3	0				NA(3)	3	5	5	0	NA(3)
	1,2-Dichloroethane	ug/L	0.5	NA(3)	4	0				NA(3)	4	5	5	4	NA(3)
	1,2-Dichloroethenes	ug/L	6	NA(3)	1	0				NA(3)	1	5	5	0	NA(3)
	1,2-Dichloropropane	ug/L	5	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	1,3-Dichlorobenzene	ug/L	600	NA(3)	3	0				NA(3)	3	5	5	0	NA(3)
	1,4-Dichlorobenzene	ug/L	5	NA(3)	3	0				NA(3)	3	5	5	0	NA(3)
	2-Chloroethylvinyl ether	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	2-Hexanone	ug/L	250	NA(3)	4	0				NA(3)	4	10	25	0	NA(3)
	Acetone	ug/L	20000	NA(3)	4	0				NA(3)	4	10	25	0	NA(3)
	Benzene	ug/L	1	NA(3)	4	0				NA(3)	4	5	5	4	NA(3)
	Bromodichloromethane	ug/L	80	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Bromoform	ug/L	80	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Bromomethane	ug/L	NA(4)	NA(3)	4	0			NA(4)	NA(3)	4	10	10	NA(4)	NA(3)
	Carbon Disulfide	ug/L	160	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Carbon Tetrachloride	ug/L	0.5	NA(3)	4	0				NA(3)	4	5	5	4	NA(3)
	Chlorobenzene	ug/L	70	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Chloroethane	ug/L	16	NA(3)	4	0				NA(3)	4	10	10	0	NA(3)
	Chloroform	ug/L	80	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Chloromethane	ug/L	3	NA(3)	4	0				NA(3)	4	10	10	4	NA(3)
	cis-1,2-Dichloroethene	ug/L	6	NA(3)	3	0				NA(3)	3	5	5	0	NA(3)
	cis-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	4	0			NA(4)	NA(3)	4	5	5	NA(4)	NA(3)
	Dibromochloromethane	ug/L	80	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Ethylbenzene	ug/L	300	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Methyl ethyl ketone	ug/L	8400	NA(3)	4	0				NA(3)	4	10	25	0	NA(3)
	Methyl isobutyl ketone (MIBK)	ug/L	120	NA(3)	4	0				NA(3)	4	10	25	0	NA(3)
	Methylene chloride	ug/L	5	NA(3)	4	1	1	1	0	NA(3)	3	5	5	0	NA(3)
	m-Xylene & p-Xylene	ug/L	1750	NA(3)	3	0				NA(3)	3	5	5	0	NA(3)
	o-Xylene	ug/L	1750	NA(3)	3	0				NA(3)	3	5	5	0	NA(3)
	Styrene	ug/L	100	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Tetrachloroethene	ug/L	5	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Toluene	ug/L	150	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	trans-1,2-Dichloroethene	ug/L	10	NA(3)	3	0				NA(3)	3	5	5	0	NA(3)
	trans-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	4	0			NA(4)	NA(3)	4	5	5	NA(4)	NA(3)
	Trichloroethene	ug/L	5	NA(3)	4	0				NA(3)	4	5	5	0	NA(3)
	Trichlorofluoromethane	ug/L	150	NA(3)	3	0				NA(3)	3	10	10	0	NA(3)
	Vinyl acetate	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Vinyl chloride	ug/L	0.5	NA(3)	4	0				NA(3)	4	10	10	4	NA(3)
	Xylenes, Total	ug/L	1750	NA(3)	1	0				NA(3)	1	5	5	0	NA(3)
SVOC															
	1,2,4-Trichlorobenzene	ug/L	5	NA(3)	12	0				NA(3)	12	0.96	10	1	NA(3)
	1,2-Dichlorobenzene	ug/L	600	NA(3)	12	0				NA(3)	12	0.48	10	0	NA(3)
	1,2-Diphenylhydrazine	ug/L	NA(4)	NA(3)	11	0			NA(4)	NA(3)	11	0.96	5	NA(4)	NA(3)
	1,3-Dichlorobenzene	ug/L	600	NA(3)	12	0				NA(3)	12	0.48	10	0	NA(3)
	1,4-Dichlorobenzene	ug/L	5	NA(3)	12	1	0.1	0.1	0	NA(3)	11	0.48	10	1	NA(3)
	2,4,5-Trichlorophenol	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	1.9	10	NA(4)	NA(3)
	2,4,6-Trichlorophenol	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.96	10	NA(4)	NA(3)
	2,4-Dichlorophenol	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	1.9	10	NA(4)	NA(3)
	2,4-Dimethylphenol	ug/L	100	NA(3)	12	1	1.1	1.1	0	NA(3)	11	1.9	10	0	NA(3)

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Analyte Group	Constituent	Units	Screening Levels (SLs) (1)		Total Number Samples Analyzed	Detect Data Summary					Non-Detect Data Summary				
			Groundwater SL	Groundwater Comparison Concentration (2)		Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	2,4-Dinitrophenol	ug/L	NA(4)	NA(3)	12	1	2.8	2.8	NA(4)	NA(3)	11	4.8	50	NA(4)	NA(3)
	2,4-Dinitrotoluene	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	25	NA(4)	NA(3)
	2,6-Dinitrotoluene	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	25	NA(4)	NA(3)
	2-Chloronaphthalene	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.48	10	NA(4)	NA(3)
	2-Chlorophenol	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.96	10	NA(4)	NA(3)
	2-Methylnaphthalene	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.96	10	NA(4)	NA(3)
	2-Nitroaniline	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	50	NA(4)	NA(3)
	2-Nitrophenol	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	1.9	10	NA(4)	NA(3)
	3,3'-Dichlorobenzidine	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	25	NA(4)	NA(3)
	3-Nitroaniline	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	50	NA(4)	NA(3)
	4,4'-DDD	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	4,4'-DDE	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	4,4'-DDT	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	4,6-Dinitro-o-cresol	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	50	NA(4)	NA(3)
	4-Bromophenyl phenyl ether	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.96	10	NA(4)	NA(3)
	4-Chlorophenylphenyl ether	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.48	10	NA(4)	NA(3)
	4-Nitrophenol	ug/L	NA(4)	NA(3)	12	1	0.76	0.76	NA(4)	NA(3)	11	4.8	50	NA(4)	NA(3)
	Acenaphthene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	10	NA(4)	NA(3)
	Acenaphthylene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	10	NA(4)	NA(3)
	Aldrin	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	alpha-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Aniline	ug/L	NA(4)	NA(3)	11	0			NA(4)	NA(3)	11	9.6	50	NA(4)	NA(3)
	Anthracene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	10	NA(4)	NA(3)
	Benzidine	ug/L	NA(4)	NA(3)	8	0			NA(4)	NA(3)	8	4.8	5	NA(4)	NA(3)
	Benzo(a)anthracene	ug/L	NA(4)	NA(3)	15	3	0.31	0.33	NA(4)	NA(3)	12	4.8	25	NA(4)	NA(3)
	Benzo(a)pyrene	ug/L	0.2	NA(3)	15	0				NA(3)	15	1.9	20	15	NA(3)
	Benzo(b)fluoranthene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	1.9	20	NA(4)	NA(3)
	Benzo(ghi)perylene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	4.8	50	NA(4)	NA(3)
	Benzo(k)fluoranthene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	20	NA(4)	NA(3)
	Benzoic acid	ug/L	NA(4)	NA(3)	12	7	4.9	85	NA(4)	NA(3)	5	19	50	NA(4)	NA(3)
	Benzyl alcohol	ug/L	NA(4)	NA(3)	12	4	0.24	27	NA(4)	NA(3)	8	4.8	25	NA(4)	NA(3)
	beta-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	bis(2-Chloroethoxy)methane	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.48	10	NA(4)	NA(3)
	bis(2-Chloroethyl) ether	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.48	10	NA(4)	NA(3)
	bis(2-Chloroisopropyl) ether	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.48	10	NA(4)	NA(3)
	bis(2-Ethylhexyl) phthalate	ug/L	4	NA(3)	12	0				NA(3)	12	4.8	25	12	NA(3)
	Butyl benzyl phthalate	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	25	NA(4)	NA(3)
	Chrysene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	20	NA(4)	NA(3)
	delta-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Dibenzo(a,h)anthracene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	50	NA(4)	NA(3)
	Dibenzofuran	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.48	10	NA(4)	NA(3)
	Dieldrin	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Diethyl phthalate	ug/L	NA(4)	NA(3)	12	1	5.9	5.9	NA(4)	NA(3)	11	0.96	10	NA(4)	NA(3)
	Dimethyl phthalate	ug/L	NA(4)	NA(3)	12	2	0.35	0.4	NA(4)	NA(3)	10	0.48	10	NA(4)	NA(3)
	Di-n-butyl phthalate	ug/L	2700	NA(3)	12	1	0.48	0.48	0	NA(3)	11	1.9	10	0	NA(3)
	Di-n-octyl phthalate	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	4.8	25	NA(4)	NA(3)
	Endosulfan sulfate	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Endrin	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Fluoranthene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	10	NA(4)	NA(3)
	Fluorene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	10	NA(4)	NA(3)
	gamma-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Heptachlor	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Heptachlor epoxide	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Hexachlorobenzene	ug/L	1	NA(3)	12	0				NA(3)	12	0.96	10	3	NA(3)
	Hexachlorobutadiene	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	1.9	10	NA(4)	NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	**Constituent**	**Units**	**Groundwater SL**	**Groundwater Comparison Concentration (2)**	**Total Number Samples Analyzed**	**Total Samples with Detections**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Number Detected Concentration > GW_SL**	**Number Detected Concentration > GWCC**	**Total Samples ND**	**Minimum DL**	**Maximum DL**	**Number DLs > GW_SL**	**Number DLs > GWCC**
	Hexachlorocyclopentadiene	ug/L	50	NA(3)	12	0				NA(3)	12	4.8	25	0	NA(3)
	Hexachloroethane	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	2.9	15	NA(4)	NA(3)
	Indeno(1,2,3-cd)pyrene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	1.9	50	NA(4)	NA(3)
	Isophorone	ug/L	NA(4)	NA(3)	12	5	0.13	0.9	NA(4)	NA(3)	7	0.96	10	NA(4)	NA(3)
	Naphthalene	ug/L	17	NA(3)	15	0				NA(3)	15	0.96	10	0	NA(3)
	Nitrobenzene	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.96	10	NA(4)	NA(3)
	n-Nitrosodimethylamine	ug/L	0.01	NA(3)	11	0				NA(3)	11	1.9	10	11	NA(3)
	n-Nitrosodi-n-propylamine	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	1.9	10	NA(4)	NA(3)
	n-Nitrosodiphenylamine	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	0.96	10	NA(4)	NA(3)
	o-Cresol	ug/L	NA(4)	NA(3)	12	2	2.1	2.6	NA(4)	NA(3)	10	1.9	10	NA(4)	NA(3)
	p-Chloroaniline	ug/L	NA(4)	NA(3)	12	0			NA(4)	NA(3)	12	1.9	10	NA(4)	NA(3)
	p-Chloro-m-cresol	ug/L	120	NA(3)	12	0				NA(3)	12	1.9	10	0	NA(3)
	p-Cresol	ug/L	NA(4)	NA(3)	12	5	0.24	5.5	NA(4)	NA(3)	7	4.8	10	NA(4)	NA(3)
	Pentachlorophenol	ug/L	1	NA(3)	12	0				NA(3)	12	1.9	50	12	NA(3)
	Phenanthrene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	10	NA(4)	NA(3)
	Phenol	ug/L	4200	NA(3)	12	3	4	14	0	NA(3)	9	0.96	10	0	NA(3)
	p-Nitroaniline	ug/L	NA(4)	NA(3)	12	1	1.7	1.7	NA(4)	NA(3)	11	4.8	50	NA(4)	NA(3)
	Pyrene	ug/L	NA(4)	NA(3)	15	0			NA(4)	NA(3)	15	0.48	10	NA(4)	NA(3)
Perchlorate															
	Perchlorate	ug/L	6 (5)	NA(3)	15	0				NA(3)	15	1	4	0	NA(3)
Dioxins															
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	7	0.00392	0.032	NA(4)	NA(3)	9	0.000615	0.05	NA(4)	NA(3)
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ng/L	NA(4)	NA(3)	16	8	0.00576	0.3	NA(4)	NA(3)	8	0.000996	0.00401	NA(4)	NA(3)
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.000519	0.05	NA(4)	NA(3)
	1,2,3,4,7,8-Hexachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	1	0.005	0.005	NA(4)	NA(3)	15	0.000263	0.05	NA(4)	NA(3)
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ng/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.00102	0.05	NA(4)	NA(3)
	1,2,3,6,7,8-Hexachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	1	0.00577	0.00577	NA(4)	NA(3)	15	0.000258	0.05	NA(4)	NA(3)
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	ng/L	NA(4)	NA(3)	16	4	0.0023	0.0185	NA(4)	NA(3)	12	0.00109	0.05	NA(4)	NA(3)
	1,2,3,7,8,9-Hexachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	1	0.0028	0.0028	NA(4)	NA(3)	15	0.000436	0.05	NA(4)	NA(3)
	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ng/L	NA(4)	NA(3)	16	2	0.0243	0.0265	NA(4)	NA(3)	14	0.00103	0.05	NA(4)	NA(3)
	1,2,3,7,8-Pentachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.000824	0.05	NA(4)	NA(3)
	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ng/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.00059	0.05	NA(4)	NA(3)
	2,3,4,6,7,8-Hexachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.000299	0.05	NA(4)	NA(3)
	2,3,4,7,8-Pentachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	1	0.0025	0.0025	NA(4)	NA(3)	15	0.000742	0.05	NA(4)	NA(3)
	2,3,7,8-TCDD	ng/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.000608	0.01	NA(4)	NA(3)
	2,3,7,8-Tetrachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	1	0.00418	0.00418	NA(4)	NA(3)	15	0.00055	0.01	NA(4)	NA(3)
	Heptachlorodibenzofurans	ng/L	NA(4)	NA(3)	16	7	0.00392	0.0472	NA(4)	NA(3)	9	0.0006	0.05	NA(4)	NA(3)
	Heptachlorodibenzo-p-dioxins	ng/L	NA(4)	NA(3)	16	10	0.00153	0.45	NA(4)	NA(3)	6	0.000996	0.00293	NA(4)	NA(3)
	Hexachlorodibenzofurans	ng/L	NA(4)	NA(3)	16	8	0.00165	0.031	NA(4)	NA(3)	8	0.000307	0.00522	NA(4)	NA(3)
	Hexachlorodibenzo-p-dioxins	ng/L	NA(4)	NA(3)	16	7	0.0023	0.0588	NA(4)	NA(3)	9	0.00105	0.05	NA(4)	NA(3)
	Octachlorodibenzofuran	ng/L	NA(4)	NA(3)	16	8	0.00525	0.181	NA(4)	NA(3)	8	0.00205	0.1	NA(4)	NA(3)
	Octachlorodibenzo-p-dioxin	ng/L	NA(4)	NA(3)	16	12	0.00356	2	NA(4)	NA(3)	4	0.0031	0.0297	NA(4)	NA(3)
	Pentachlorodibenzofurans	ng/L	NA(4)	NA(3)	16	5	0.00158	0.0191	NA(4)	NA(3)	11	0.000782	0.05	NA(4)	NA(3)
	Pentachlorodibenzo-p-dioxins	ng/L	NA(4)	NA(3)	16	1	0.00245	0.00245	NA(4)	NA(3)	15	0.00059	0.05	NA(4)	NA(3)
	TCDD TEQ (ND=0) 2005 WHO	ng/L	NA(4)	NA(3)	16	16	0	0.00558171	NA(4)	NA(3)	0			NA(4)	NA(3)
	Tetrachlorodibenzofurans	ng/L	NA(4)	NA(3)	16	3	0.0109	0.0186	NA(4)	NA(3)	13	0.00055	0.01	NA(4)	NA(3)
	Tetrachlorodibenzo-p-dioxins	ng/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	0.000608	0.01	NA(4)	NA(3)
Metals															
	Aluminum	mg/L	1	NA(3)	1	0				NA(3)	1	0.04	0.04	0	NA(3)
	Antimony	mg/L	0.006	0.0025	37	18	0.000062	0.0009	0	0	19	0.00018	0.05	4	7
	Arsenic	mg/L	0.05	0.0077	37	22	0.0039	0.045	0	14	15	0.002	0.011	0	5
	Barium	mg/L	1	0.15	34	34	0.012	2	2	12	0				
	Beryllium	mg/L	0.004	0.00014	37	11	0.0011	0.013	4	11	26	0.001	0.005	3	26
	Boron	mg/L	1	0.34	33	25	0.016	0.2	0	0	8	0.037	0.13	0	0

Table 3-3
Offsite Surface Water Sampling Summary
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	Cadmium	mg/L	0.005	0.0002	37	23	0.000048	0.012	2	15	14	0.000076	0.01	3	11
	Calcium	mg/L	NA(4)	NA(3)	1	1	13.6	13.6	NA(4)	NA(3)	0			NA(4)	NA(3)
	Chromium	mg/L	0.05	0.014	37	18	0.004	0.43	9	11	19	0.0012	0.013	0	0
	Cobalt	mg/L	NA(4)	0.0019	34	21	0.0022	0.12	NA(4)	21	13	0.01	0.02	NA(4)	13
	Copper	mg/L	1.3	0.0047	37	31	0.0028	0.092	0	29	6	0.005	0.02	0	6
	Iron	mg/L	0.3	4.1	34	33	0.051	300	29	18	1	0.04	0.04	0	0
	Lead	mg/L	0.015	0.011	37	31	0.00017	0.11	10	12	6	0.00026	0.003	0	0
	Magnesium	mg/L	NA(4)	NA(3)	1	1	4.47	4.47	NA(4)	NA(3)	0			NA(4)	NA(3)
	Manganese	mg/L	0.05	0.15	34	34	0.008	6.4	31	24	0				
	Mercury	mg/L	0.002	0.000063	37	9	0.000058	0.00036	0	7	28	0.0002	0.0005	0	28
	Nickel	mg/L	0.1	0.017	37	24	0.002	0.29	6	11	13	0.01	0.027	0	7
	Potassium	mg/L	NA(4)	NA(3)	1	1	1.27	1.27	NA(4)	NA(3)	0			NA(4)	NA(3)
	Selenium	mg/L	0.05	0.0016	37	24	0.00043	0.19	1	10	13	0.002	0.005	0	13
	Silver	mg/L	0.1	0.00017	37	11	0.00004	0.00097	0	6	26	0.001	0.01	0	26
	Sodium	mg/L	NA(4)	NA(3)	1	1	9.74	9.74	NA(4)	NA(3)	0			NA(4)	NA(3)
	Thallium	mg/L	0.002	0.00013	37	11	0.00015	0.002	0	11	26	0.00012	0.01	3	24
	Vanadium	mg/L	0.05	0.0026	34	26	0.0036	0.65	10	26	8	0.01	0.01	0	8
	Zinc	mg/L	5	6.3	37	22	0.015	0.93	0	0	15	0.016	0.02	0	0
Inorganics															
	Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	7	7	46	380	NA(4)	NA(3)	0			NA(4)	NA(3)
	Ammonia-N	mg/L	1.5	NA(3)	15	8	0.56	1.1	0	NA(3)	7	0.5	0.5	0	NA(3)
	Bicarbonate Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	7	7	46	380	NA(4)	NA(3)	0			NA(4)	NA(3)
	Carbonate Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	7	1	4	4	NA(4)	NA(3)	6	2	2	NA(4)	NA(3)
	Chloride	mg/L	250	NA(3)	7	7	6.4	120	0	NA(3)	0				NA(3)
	Cyanides	mg/L	0.15	NA(3)	11	10	0.0023	0.0064	0	NA(3)	1	0.005	0.005	0	NA(3)
	Nitrate/Nitrite as N	mg/L	1	NA(3)	28	25	0.11	5.7	14	NA(3)	3	0.15	0.75	0	NA(3)
	Sulfate	mg/L	250	NA(3)	7	7	6.7	290	1	NA(3)	0				NA(3)
Other Chemical															
	pH	pH Units	NA(4)	NA(3)	30	30	6.88	8.34	NA(4)	NA(3)	0			NA(4)	NA(3)
	pH (Field)	pH Units	NA(4)	NA(3)	2	2	7.1	7.11	NA(4)	NA(3)	0			NA(4)	NA(3)
	Temperature	F	NA(4)	NA(3)	2	2	62.1	62.4	NA(4)	NA(3)	0			NA(4)	NA(3)
	Total Dissolved Solids	mg/L	NA(4)	NA(3)	4	4	550	900	NA(4)	NA(3)	0			NA(4)	NA(3)
	Total Settleable Solids	ml/l/hr	NA(4)	NA(3)	5	4	2	10	NA(4)	NA(3)	1	0.1	0.1	NA(4)	NA(3)
	Total Suspended Solids	mg/L	NA(4)	NA(3)	33	29	11	9200	NA(4)	NA(3)	4	10	10	NA(4)	NA(3)
	Surfactants	mg/L	NA(4)	NA(3)	11	9	0.05	0.24	NA(4)	NA(3)	2	0.2	1	NA(4)	NA(3)
Radionuclides															
	Cesium-137	pCi/L	200	NA(3)	4	0				NA(3)	4	4	5	0	NA(3)
	Gross alpha	pCi/L	15	NA(3)	30	15	0.019	0.75	0	NA(3)	15	0.14	28.7	2	NA(3)
	Gross beta	pCi/L	50	NA(3)	30	14	1.25	15	0	NA(3)	16	2.6	8.2	0	NA(3)
	Iodine-129	pCi/L	NA(4)	NA(3)	4	0			NA(4)	NA(3)	4	0.7	1.1	NA(4)	NA(3)
	Plutonium-238	pCi/L	15	NA(3)	4	0				NA(3)	4	0.2	0.2	0	NA(3)
	Plutonium-239	pCi/L	15	NA(3)	4	0				NA(3)	4	0.07	0.2	0	NA(3)
	Strontium-90	pCi/L	8	NA(3)	4	0				NA(3)	4	0.4	0.5	0	NA(3)
	Tritium	pCi/L	20000	NA(3)	5	1	300	300	0	NA(3)	4	100	200	0	NA(3)
Other Radionuclides															
	Deuterium	per mil	NA(4)	NA(3)	6	6	-44.84	-13.79	NA(4)	NA(3)	0			NA(4)	NA(3)
	Oxygen-18	per mil	NA(4)	NA(3)	6	6	-6.81	1.07	NA(4)	NA(3)	0			NA(4)	NA(3)

Notes:

(1) Screening levels (SLs) for water media based on regulatory agency standards (EPA and State Drinking Water MCLs for radionuclides). Additional information provided in Appendix C.
(2) Reference: Groundwater Comparison Concentration Report (MWH 2005a) for metals and inorganic constituents (see Appendix C).
(3) Not applicable – Background values only established for naturally-occurring constituents.
(4) RBSL not available for this constituent.
(5) Perchlorate screening level based on recent SSFL interim measure goals, not health-based.
(6) Additional surface water sample data collected and analyzed for gross alpha/gross beta and results averaged. These data not included in this table (see Appendix B).

Table 3-4
Offsite Spring and Seep Sampling Summary
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	**Constituent**	**Units**	**Groundwater SL**	**Groundwater Comparison Concentration (2)**	**Total Number Samples Analyzed**	**Total Samples with Detections**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Number Detected Concentration > GW_SL**	**Number Detected Concentration > GWCC**	**Total Samples ND**	**Minimum DL**	**Maximum DL**	**Number DLs > GW_SL**	**Number DLs > GWCC**
VOC															
	1,1,1,2-Tetrachloroethane	ug/L	NA(4)	NA(3)	9	0			NA(4)	NA(3)	9	0.5	5	NA(4)	NA(3)
	1,1,1-Trichloroethane	ug/L	200	NA(3)	131	0				NA(3)	131	0.13	5	0	NA(3)
	1,1,2,2-Tetrachloroethane	ug/L	1	NA(3)	131	0				NA(3)	131	0.099	7	11	NA(3)
	1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	1200	NA(3)	42	2	0.69	3.7	0	NA(3)	40	0.2	5	0	NA(3)
	1,1,2-Trichloroethane	ug/L	5	NA(3)	131	0				NA(3)	131	0.2	5	0	NA(3)
	1,1-Dichloroethane	ug/L	5	NA(3)	131	0				NA(3)	131	0.1	5	0	NA(3)
	1,1-Dichloroethene	ug/L	6	NA(3)	131	0				NA(3)	131	0.1	5	0	NA(3)
	1,1-Dichloropropene	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.5	0.5	NA(4)	NA(3)
	1,2,3-Trichlorobenzene	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.5	0.5	NA(4)	NA(3)
	1,2,3-Trichloropropane	ug/L	0.005	NA(3)	2	0				NA(3)	2	0.5	0.5	2	NA(3)
	1,2,4-Trichlorobenzene	ug/L	5	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	1,2,4-Trimethylbenzene	ug/L	330	NA(3)	9	0				NA(3)	9	0.5	5	0	NA(3)
	1,2-Dibromo-3-chloropropane	ug/L	0.2	NA(3)	9	0				NA(3)	9	5	10	9	NA(3)
	1,2-Dibromoethane	ug/L	0.05	NA(3)	2	0				NA(3)	2	0.5	0.5	2	NA(3)
	1,2-Dichlorobenzene	ug/L	600	NA(3)	100	0				NA(3)	100	0.1	5	0	NA(3)
	1,2-Dichloroethane	ug/L	0.5	NA(3)	131	0				NA(3)	131	0.16	5	72	NA(3)
	1,2-Dichloroethenes	ug/L	6	NA(3)	1	0				NA(3)	1	10	10	1	NA(3)
	1,2-Dichloropropane	ug/L	5	NA(3)	125	0				NA(3)	125	0.14	6	2	NA(3)
	1,3,5-Trimethylbenzene	ug/L	330	NA(3)	9	0				NA(3)	9	0.5	5	0	NA(3)
	1,3-Dichlorobenzene	ug/L	600	NA(3)	100	0				NA(3)	100	0.1	5	0	NA(3)
	1,3-Dichloropropane	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.5	0.5	NA(4)	NA(3)
	1,3-Dichloropropene	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	1,4-Dichlorobenzene	ug/L	5	NA(3)	100	0				NA(3)	100	0.11	5	0	NA(3)
	1,4-Dioxane	ug/L	3	NA(3)	4	0				NA(3)	4	20	500	4	NA(3)
	2-Chloroethylvinyl ether	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	0.2	10	NA(4)	NA(3)
	2-Hexanone	ug/L	250	NA(3)	82	0				NA(3)	82	0.6	100	0	NA(3)
	Acetone	ug/L	20000	NA(3)	89	8	1.38	21	0	NA(3)	81	1	100	0	NA(3)
	Acrolein	ug/L	NA(4)	NA(3)	19	0			NA(4)	NA(3)	19	0.9	70	NA(4)	NA(3)
	Acrylonitrile	ug/L	NA(4)	NA(3)	19	0			NA(4)	NA(3)	19	0.7	50	NA(4)	NA(3)
	Benzene	ug/L	1	NA(3)	122	1	13	13	1	NA(3)	121	0.1	5	9	NA(3)
	Bromobenzene	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	1	1	NA(4)	NA(3)
	Bromochloromethane	ug/L	34000	NA(3)	2	0				NA(3)	2	1	1	0	NA(3)
	Bromodichloromethane	ug/L	80	NA(3)	131	0				NA(3)	131	0.074	50	0	NA(3)
	Bromoform	ug/L	80	NA(3)	131	0				NA(3)	131	0.1	5	0	NA(3)
	Bromomethane	ug/L	NA(4)	NA(3)	131	1	1	1	NA(4)	NA(3)	130	0.1	10	NA(4)	NA(3)
	Carbon Disulfide	ug/L	160	NA(3)	82	2	5	5	0	NA(3)	80	0.3	10	0	NA(3)
	Carbon Tetrachloride	ug/L	0.5	NA(3)	131	0				NA(3)	131	0.15	5	75	NA(3)
	Chlorobenzene	ug/L	70	NA(3)	131	1	58	58	0	NA(3)	130	0.085	6	0	NA(3)
	Chloroethane	ug/L	16	NA(3)	131	0				NA(3)	131	0.1	10	0	NA(3)
	Chloroform	ug/L	80	NA(3)	131	0				NA(3)	131	0.1	5	0	NA(3)
	Chloromethane	ug/L	3	NA(3)	131	0				NA(3)	131	0.14	10	34	NA(3)
	Chlorotrifluoroethylene	ug/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	5	5	NA(4)	NA(3)
	cis-1,2-Dichloroethene	ug/L	6	NA(3)	82	2	0.32	0.41	0	NA(3)	80	0.14	5	0	NA(3)
	cis-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	124	0			NA(4)	NA(3)	124	0.1	5	NA(4)	NA(3)
	Cumene	ug/L	770	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	Dibromochloromethane	ug/L	80	NA(3)	124	0				NA(3)	124	0.18	3	0	NA(3)
	Dibromomethane	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.5	0.5	NA(4)	NA(3)
	Dichlorobenzenes	ug/L	NA(4)	NA(3)	16	0			NA(4)	NA(3)	16	5	50	NA(4)	NA(3)
	Dichlorodifluoromethane	ug/L	1000	NA(3)	18	0				NA(3)	18	0.5	5	0	NA(3)
	Diisopropyl ether	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	5	5	NA(4)	NA(3)
	Ethyl acetate	ug/L	2600	NA(3)	1	1	20	20	0	NA(3)	0				NA(3)
	Ethylbenzene	ug/L	300	NA(3)	123	0				NA(3)	123	0.1	7	0	NA(3)

Table 3-4
Offsite Spring and Seep Sampling Summary
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	Hexachlorobutadiene	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.5	0.5	NA(4)	NA(3)
	Methyl ethyl ketone	ug/L	8400	NA(3)	76	0				NA(3)	76	1	100	0	NA(3)
	Methyl isobutyl ketone (MIBK)	ug/L	120	NA(3)	82	0				NA(3)	82	0.9	100	0	NA(3)
	Methyl tert-butyl ether	ug/L	13	NA(3)	2	0				NA(3)	2	1	1	0	NA(3)
	Methylene chloride	ug/L	5	NA(3)	131	4	1.4	6	2	NA(3)	127	0.22	50	12	NA(3)
	m-Xylene	ug/L	1750	NA(3)	9	0				NA(3)	9	1	2	0	NA(3)
	m-Xylene & p-Xylene	ug/L	1750	NA(3)	58	0				NA(3)	58	0.3	10	0	NA(3)
	Naphthalene	ug/L	17	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	n-Butylbenzene	ug/L	260	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	n-Propylbenzene	ug/L	260	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	o + p Xylene	ug/L	1750	NA(3)	9	0				NA(3)	9	1	2	0	NA(3)
	o-Chlorotoluene	ug/L	140	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	o-Xylene	ug/L	1750	NA(3)	58	0				NA(3)	58	0.1	5	0	NA(3)
	p-Chlorotoluene	ug/L	140	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	p-Cymene	ug/L	770	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	sec-Butylbenzene	ug/L	260	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	sec-Dichloropropane	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.5	0.5	NA(4)	NA(3)
	Styrene	ug/L	100	NA(3)	39	0				NA(3)	39	0.2	10	0	NA(3)
	tert-Amyl methyl ether	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	5	5	NA(4)	NA(3)
	tert-Butyl alcohol	ug/L	12	NA(3)	2	0				NA(3)	2	10	10	0	NA(3)
	tert-Butyl ethyl ether	ug/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	5	5	NA(4)	NA(3)
	tert-Butylbenzene	ug/L	260	NA(3)	2	0				NA(3)	2	0.5	0.5	0	NA(3)
	Tetrachloroethene	ug/L	5	NA(3)	130	0				NA(3)	130	0.086	5	0	NA(3)
	Toluene	ug/L	150	NA(3)	123	7	1	11	0	NA(3)	116	0.093	6	0	NA(3)
	trans-1,2-Dichloroethene	ug/L	10	NA(3)	131	0				NA(3)	131	0.1	5	0	NA(3)
	trans-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	128	0			NA(4)	NA(3)	128	0.1	5	NA(4)	NA(3)
	Trichloroethene	ug/L	5	NA(3)	130	2	0.66	1	0	NA(3)	128	0.12	11	1	NA(3)
	Trichlorofluoromethane	ug/L	150	NA(3)	87	2	11	11	0	NA(3)	85	0.099	5	0	NA(3)
	Vinyl acetate	ug/L	NA(4)	NA(3)	30	0			NA(4)	NA(3)	30	0.9	100	NA(4)	NA(3)
	Vinyl chloride	ug/L	0.5	NA(3)	130	0				NA(3)	130	0.1	5	71	NA(3)
	Xylenes, Total	ug/L	1750	NA(3)	40	0				NA(3)	40	1	15	0	NA(3)
SVOC															
	1,1,1-Trichloroethane	ug/L	200	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	1,1,2,2-Tetrachloroethane	ug/L	1	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	1,1,2-Trichloroethane	ug/L	5	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	1,1-Dichloroethane	ug/L	5	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	1,1-Dichloroethene	ug/L	6	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	1,2,4-Trichlorobenzene	ug/L	5	NA(3)	3	0				NA(3)	3	10	10	3	NA(3)
	1,2-Dichlorobenzene	ug/L	600	NA(3)	4	0				NA(3)	4	3	10	0	NA(3)
	1,2-Dichloroethane	ug/L	0.5	NA(3)	1	0				NA(3)	1	1	1	1	NA(3)
	1,2-Dichloropropane	ug/L	5	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	1,2-Diphenylhydrazine	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	1,3-Dichlorobenzene	ug/L	600	NA(3)	4	0				NA(3)	4	2	10	0	NA(3)
	1,4-Dichlorobenzene	ug/L	5	NA(3)	4	0				NA(3)	4	3	10	3	NA(3)
	2,4,6-Trichlorophenol	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	2,4-Dichlorophenol	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	2,4-Dimethylphenol	ug/L	100	NA(3)	3	0				NA(3)	3	10	10	0	NA(3)
	2,4-Dinitrophenol	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	25	25	NA(4)	NA(3)
	2,4-Dinitrotoluene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	2,6-Dinitrotoluene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	2-Chloroethylvinyl ether	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	2-Chloronaphthalene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	2-Chlorophenol	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	2-Nitrophenol	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	3,3'-Dichlorobenzidine	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	4,6-Dinitro-o-cresol	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	50	50	NA(4)	NA(3)
	4-Bromophenyl phenyl ether	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	4-Chlorophenylphenyl ether	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	4-Nitrophenol	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	25	25	NA(4)	NA(3)
	Acenaphthene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Acenaphthylene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Anthracene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Benzene	ug/L	1	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Benzidine	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	40	40	NA(4)	NA(3)
	Benzo(a)anthracene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Benzo(a)pyrene	ug/L	0.2	NA(3)	3	0				NA(3)	3	10	10	3	NA(3)
	Benzo(b)fluoranthene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Benzo(ghi)perylene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Benzo(k)fluoranthene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	bis(2-Chloroethoxy)methane	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	bis(2-Chloroethyl) ether	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	bis(2-Chloroisopropyl) ether	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	bis(2-Ethylhexyl) phthalate	ug/L	4	NA(3)	3	0				NA(3)	3	10	10	3	NA(3)
	Bromodichloromethane	ug/L	80	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Bromoform	ug/L	80	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Bromomethane	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Butyl benzyl phthalate	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Carbon Tetrachloride	ug/L	0.5	NA(3)	1	0				NA(3)	1	1	1	1	NA(3)
	Chlorobenzene	ug/L	70	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Chloroethane	ug/L	16	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Chloroform	ug/L	80	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Chloromethane	ug/L	3	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Chrysene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	cis-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Dibenzo(a,h)anthracene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Dibromochloromethane	ug/L	80	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Diethyl phthalate	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Dimethyl phthalate	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	25	25	NA(4)	NA(3)
	Di-n-butyl phthalate	ug/L	2700	NA(3)	3	0				NA(3)	3	50	50	0	NA(3)
	Di-n-octyl phthalate	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Ethylbenzene	ug/L	300	NA(3)	1	0				NA(3)	1	2	2	0	NA(3)
	Fluoranthene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Fluorene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Hexachlorobenzene	ug/L	1	NA(3)	3	0				NA(3)	3	10	10	3	NA(3)
	Hexachlorobutadiene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Hexachlorocyclopentadiene	ug/L	50	NA(3)	3	0				NA(3)	3	10	10	0	NA(3)
	Hexachloroethane	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Indeno(1,2,3-cd)pyrene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Isophorone	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Methylene chloride	ug/L	5	NA(3)	1	0				NA(3)	1	2	2	0	NA(3)
	Naphthalene	ug/L	17	NA(3)	3	0				NA(3)	3	10	10	0	NA(3)
	Nitrobenzene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	n-Nitrosodimethylamine	ug/L	0.01	NA(3)	3	0				NA(3)	3	80	80	3	NA(3)
	n-Nitrosodi-n-propylamine	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	40	40	NA(4)	NA(3)
	n-Nitrosodiphenylamine	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	p-Chloro-m-cresol	ug/L	120	NA(3)	3	0				NA(3)	3	10	10	0	NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	Pentachlorophenol	ug/L	1	NA(3)	3	0				NA(3)	3	10	10	3	NA(3)
	Phenanthrene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Phenol	ug/L	4200	NA(3)	3	0				NA(3)	3	10	10	0	NA(3)
	Pyrene	ug/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	10	10	NA(4)	NA(3)
	Tetrachloroethene	ug/L	5	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Toluene	ug/L	150	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	trans-1,2-Dichloroethene	ug/L	10	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	trans-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	Trichloroethene	ug/L	5	NA(3)	1	0				NA(3)	1	1	1	0	NA(3)
	Vinyl chloride	ug/L	0.5	NA(3)	1	0				NA(3)	1	1	1	1	NA(3)
Perchlorate															
	Perchlorate	ug/L	6 (5)	NA(3)	70	0				NA(3)	70	0.35	4	0	NA(3)
Metals															
	Antimony, Dissolved	mg/L	0.006	0.0025	3	0					3	1	1	3	3
	Arsenic, Dissolved	mg/L	0.05	0.0077	3	0					3	0.01	0.01	0	3
	Barium, Dissolved	mg/L	1	0.15	3	0					3	0.5	0.5	0	3
	Beryllium, Dissolved	mg/L	0.004	0.00014	3	0					3	0.05	0.05	3	3
	Boron, Dissolved	mg/L	1	0.34	6	4	0.15	2.2	2	2	2	0.1	0.1	0	0
	Cadmium, Dissolved	mg/L	0.005	0.0002	3	0					3	0.005	0.005	0	3
	Calcium	mg/L	NA(4)	NA(3)	59	59	2.3	390	NA(4)	NA(3)	0			NA(4)	NA(3)
	Calcium, Dissolved	mg/L	NA(4)	NA(3)	10	10	62	340	NA(4)	NA(3)	0			NA(4)	NA(3)
	Chromium, Dissolved	mg/L	0.05	0.014	3	0					3	0.01	0.01	0	0
	Copper, Dissolved	mg/L	1.3	0.0047	3	0					3	0.01	0.01	0	3
	Iron	mg/L	0.3	4.1	3	0					3	0.05	0.05	0	0
	Iron, Dissolved	mg/L	0.3	4.1	1	1	0.0088	0.0088	0	0	0				
	Lead, Dissolved	mg/L	0.015	0.011	3	0					3	0.01	0.01	0	0
	Magnesium	mg/L	NA(4)	77	59	59	2.1	250	NA(4)	19	0			NA(4)	
	Magnesium, Dissolved	mg/L	NA(4)	77	10	10	23	270	NA(4)	2	0			NA(4)	
	Manganese, Dissolved	mg/L	0.05	0.15	3	0					3	0.01	0.01	0	0
	Mercury, Dissolved	mg/L	0.002	0.000063	3	0					3	0.0002	0.0002	0	3
	Molybdenum, Dissolved	mg/L	0.04	0.0022	3	0					3	0.1	0.1	3	3
	Nickel, Dissolved	mg/L	0.1	0.017	3	0					3	0.05	0.05	0	3
	Potassium	mg/L	NA(4)	9.6	59	55	0.5	23	NA(4)	8	4	5	5	NA(4)	0
	Potassium, Dissolved	mg/L	NA(4)	9.6	10	10	2.6	5.1	NA(4)	0	0			NA(4)	
	Selenium, Dissolved	mg/L	0.05	0.0016	3	0					3	0.005	0.005	0	3
	Silica, Dissolved	mg/L	NA(4)	NA(3)	6	6	21	34	NA(4)	NA(3)	0			NA(4)	NA(3)
	Silver, Dissolved	mg/L	0.1	0.00017	3	0					3	0.01	0.01	0	3
	Sodium	mg/L	NA(4)	190	59	59	34	430	NA(4)	11	0			NA(4)	
	Sodium, Dissolved	mg/L	NA(4)	190	10	10	58	427	NA(4)	2	0			NA(4)	
	Strontium, Dissolved	mg/L	4	0.8	3	3	0.3	2.8	0	1	0				
	Thallium, Dissolved	mg/L	0.002	0.00013	3	0					3	0.5	0.5	3	3
	Zinc, Dissolved	mg/L	5	6.3	3	0					3	0.01	0.01	0	0
Inorganics															
	Alkalinity	mg/L	NA(4)	NA(3)	8	8	250	301	NA(4)	NA(3)	0			NA(4)	NA(3)
	Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	8	8	130	1400	NA(4)	NA(3)	0			NA(4)	NA(3)
	Bicarbonate	mg/L	NA(4)	NA(3)	17	17	250	576	NA(4)	NA(3)	0			NA(4)	NA(3)
	Bicarbonate Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	62	62	84	1400	NA(4)	NA(3)	0			NA(4)	NA(3)
	Bromide	mg/L	2.3	NA(3)	53	34	0.17	8.6	1	NA(3)	19	0.16	0.8	0	NA(3)
	Carbonate	mg/L	NA(4)	NA(3)	17	6	0	0	NA(4)	NA(3)	11	1	2	NA(4)	NA(3)
	Carbonate Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	62	9	4	24	NA(4)	NA(3)	53	2	2	NA(4)	NA(3)
	Chloride	mg/L	250	NA(3)	79	78	5.3	430	2	NA(3)	1	44	44	0	NA(3)
	Cyanides	mg/L	0.15	NA(3)	3	0				NA(3)	3	0.02	0.02	0	NA(3)
	Fluoride	mg/L	2	0.8	59	59	0.19	6.4	5	18	0				

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	Nitrate-N	mg/L	45	NA(3)	53	11	0.078	0.94	0	NA(3)	42	0.072	0.16	0	NA(3)
	Nitrate-NO3	mg/L	45	NA(3)	9	3	0.4	2.6	0	NA(3)	6	0.32	0.4	0	NA(3)
	Nitrite-N	mg/L	1	NA(3)	52	3	0.15	1.6	1	NA(3)	49	0.045	0.29	0	NA(3)
	Sulfate	mg/L	250	NA(3)	79	79	0.56	2200	30	NA(3)	0				NA(3)
Other Chemical Analyses															
	Cation/Anion Balance (%)	%	NA(4)	NA(3)	3	3	0.1	0.3	NA(4)	NA(3)	0			NA(4)	NA(3)
	pH	pH Units	NA(4)	NA(3)	4	4	7.26	8.03	NA(4)	NA(3)	0			NA(4)	NA(3)
	Specific conductivity	umhos/c	NA(4)	NA(3)	6	6	750	2000	NA(4)	NA(3)	0			NA(4)	NA(3)
	Total Dissolved Solids	mg/L	NA(4)	NA(3)	33	33	481	3490	NA(4)	NA(3)	0			NA(4)	NA(3)
Radionuclides															
	Actinium-228	pCi/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	31.5	73.1	NA(4)	NA(3)
	Actinium-228, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	150	150	NA(4)	NA(3)
	Bismuth-212	pCi/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	52.3	114	NA(4)	NA(3)
	Bismuth-214	pCi/L	NA(4)	NA(3)	6	1	17.8	17.8	NA(4)	NA(3)	5	13.7	30.2	NA(4)	NA(3)
	Bismuth-214, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	83	83	NA(4)	NA(3)
	Cesium-134	pCi/L	80	NA(3)	7	0				NA(3)	7	3.93	16.8	0	NA(3)
	Cesium-134, Dissolved	pCi/L	80	NA(3)	1	0				NA(3)	1	24	24	0	NA(3)
	Cesium-137	pCi/L	200	NA(3)	7	0				NA(3)	7	2.12	15	0	NA(3)
	Cesium-137, Dissolved	pCi/L	200	NA(3)	2	0				NA(3)	2	0	29	0	NA(3)
	Cobalt-57	pCi/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	4.68	10.2	NA(4)	NA(3)
	Cobalt-57, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	18	18	NA(4)	NA(3)
	Cobalt-60	pCi/L	100	NA(3)	6	0				NA(3)	6	7.22	17.4	0	NA(3)
	Cobalt-60, Dissolved	pCi/L	100	NA(3)	1	0				NA(3)	1	28	28	0	NA(3)
	Gross alpha	pCi/L	15	NA(3)	16	2	48	74.9	2	NA(3)	14	-1	7	0	NA(3)
	Gross alpha, Decanted	pCi/L	15	NA(3)	2	2	1.2	2.6	0	NA(3)	0				NA(3)
	Gross alpha, Dissolved	pCi/L	15	NA(3)	4	0				NA(3)	4	-1	6.9	0	NA(3)
	Gross beta	pCi/L	50	NA(3)	16	9	1.6	129.5	2	NA(3)	7	1.66	5.51	0	NA(3)
	Gross beta, Decanted	pCi/L	50	NA(3)	2	2	4.5	12.4	0	NA(3)	0				NA(3)
	Gross beta, Dissolved	pCi/L	50	NA(3)	4	1	10	10	0	NA(3)	3	-1	7.6	0	NA(3)
	Lead-210	pCi/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	807	2130	NA(4)	NA(3)
	Lead-212	pCi/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	11.2	20.6	NA(4)	NA(3)
	Lead-212, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	59	59	NA(4)	NA(3)
	Lead-214	pCi/L	NA(4)	NA(3)	6	1	29.5	29.5	NA(4)	NA(3)	5	12.6	30	NA(4)	NA(3)
	Lead-214, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	75	75	NA(4)	NA(3)
	Potassium-40	pCi/L	NA(4)	NA(3)	6	1	234	234	NA(4)	NA(3)	5	195	295	NA(4)	NA(3)
	Potassium-40, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	480	480	NA(4)	NA(3)
	Radium-226	pCi/L	5	NA(3)	6	0				NA(3)	6	98.7	209	6	NA(3)
	Radium-226, Dissolved	pCi/L	5	NA(3)	1	0				NA(3)	1	580	580	1	NA(3)
	Strontium-90, Dissolved	pCi/L	8	NA(3)	1	0				NA(3)	1	1.1	1.1	0	NA(3)
	Thallium-208	pCi/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	11	16.9	NA(4)	NA(3)
	Thallium-208, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	42	42	NA(4)	NA(3)
	Thorium-234	pCi/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	192	363	NA(4)	NA(3)
	Thorium-234, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	690	690	NA(4)	NA(3)
	Tritium	pCi/L	20000	NA(3)	7	0				NA(3)	7	140	1000	0	NA(3)
	Uranium-235	pCi/L	20	NA(3)	6	0				NA(3)	6	37.5	81.6	6	NA(3)
	Uranium-235, Dissolved	pCi/L	20	NA(3)	1	0				NA(3)	1	150	150	1	NA(3)
Other Radionuclides															
	Deuterium	per mil	NA(4)	NA(3)	18	18	-52.08	-17.88	NA(4)	NA(3)	0			NA(4)	NA(3)
	Oxygen-18	per mil	NA(4)	NA(3)	18	18	-7.85	-1.3	NA(4)	NA(3)	0			NA(4)	NA(3)

Notes:

Table 3-4
Offsite Spring and Seep Sampling Summary
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Analyte Group	Constituent	Units	Screening Levels (SLs) (1)		Total Number Samples Analyzed	Detect Data Summary					Non-Detect Data Summary				
			Groundwater SL	Groundwater Comparison Concentration (2)		Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC

(1) Screening levels (SLs) for water media based on regulatory agency standards (EPA and State drinking water MCLs for radionuclides) Additional information provided in Appendix C.
(2) Reference: Groundwater Comparison Concentration Report (MWH 2005a) for metals and inorganic constituents (see Appendix C).
(3) Not applicable – Background values only established for naturally-occurring constituents.
(4) RBSL not available for this constituent.
(5) Perchlorate screening level based on recent SSFL interim measure goals, not health-based.

Acronyms:

DL – Detection Limit
GW_SL – Groundwater Screening Level
GWCC – Groundwater Comparison Concentration
NA – Not Applicable
ND – Non-Detect
NR – Not Reported
SVOC – Semivolatile Organic Compounds

Table 3-5
Offsite Groundwater Sampling Summary
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
VOC															
	1,1,1,2-Tetrachloroethane	ug/L	NA(4)	NA(3)	48	0			NA(4)	NA(3)	48	0.1	5	NA(4)	NA(3)
	1,1,1-Trichloroethane	ug/L	200	NA(3)	1638	14	0.17	3.3	0	NA(3)	1624	0.088	10	0	NA(3)
	1,1,2,2-Tetrachloroethane	ug/L	1	NA(3)	1638	0				NA(3)	1638	0.099	10	61	NA(3)
	1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	1200	NA(3)	1075	21	0.31	5	0	NA(3)	1054	0.2	10	0	NA(3)
	1,1,2-Trichloroethane	ug/L	5	NA(3)	1638	0				NA(3)	1638	0.1	10	2	NA(3)
	1,1-Dichloroethane	ug/L	5	NA(3)	1638	71	0.3	8.9	11	NA(3)	1567	0.1	10	1	NA(3)
	1,1-Dichloroethene	ug/L	6	NA(3)	1637	83	0.35	30	27	NA(3)	1554	0.1	10	2	NA(3)
	1,1-Dichloropropene	ug/L	NA(4)	NA(3)	40	0			NA(4)	NA(3)	40	0.1	2	NA(4)	NA(3)
	1,2,3-Trichlorobenzene	ug/L	NA(4)	NA(3)	40	0			NA(4)	NA(3)	40	0.1	5	NA(4)	NA(3)
	1,2,3-Trichloropropane	ug/L	0.005	NA(3)	50	0				NA(3)	50	0.001	10	44	NA(3)
	1,2,4-Trichlorobenzene	ug/L	5	NA(3)	40	0				NA(3)	40	0.2	5	0	NA(3)
	1,2,4-Trimethylbenzene	ug/L	330	NA(3)	40	0				NA(3)	40	0.2	2	0	NA(3)
	1,2-Dibromo-3-chloropropane	ug/L	0.2	NA(3)	38	0				NA(3)	38	0.2	5	37	NA(3)
	1,2-Dibromoethane	ug/L	0.05	NA(3)	40	0				NA(3)	40	0.16	2	40	NA(3)
	1,2-Dichlorobenzene	ug/L	600	NA(3)	1384	3	0.11	0.53	0	NA(3)	1381	0.0005	10	0	NA(3)
	1,2-Dichloroethane	ug/L	0.5	NA(3)	1637	5	0.28	0.6	2	NA(3)	1632	0.1	10	421	NA(3)
	1,2-Dichloroethenes	ug/L	6	NA(3)	1	0				NA(3)	1	5	5	0	NA(3)
	1,2-Dichloropropane	ug/L	5	NA(3)	1636	2	0.37	2	0	NA(3)	1634	0.1	10	15	NA(3)
	1,3,5-Trimethylbenzene	ug/L	330	NA(3)	38	0				NA(3)	38	0.12	2	0	NA(3)
	1,3-Dichlorobenzene	ug/L	600	NA(3)	1394	1	0.64	0.64	0	NA(3)	1393	0.0005	10	0	NA(3)
	1,3-Dichloropropane	ug/L	NA(4)	NA(3)	40	0			NA(4)	NA(3)	40	0.15	2	NA(4)	NA(3)
	1,3-Dichloropropene	ug/L	NA(4)	NA(3)	6	0			NA(4)	NA(3)	6	0.5	1	NA(4)	NA(3)
	1,4-Dichlorobenzene	ug/L	5	NA(3)	1395	3	0.11	0.64	0	NA(3)	1392	0.0005	10	2	NA(3)
	1,4-Dioxane	ug/L	3	NA(3)	367	5	0.44	2	0	NA(3)	362	0.07	5000	336	NA(3)
	1-Chlorohexane	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.3	0.3	NA(4)	NA(3)
	2-Chloroethylvinyl ether	ug/L	NA(4)	NA(3)	869	0			NA(4)	NA(3)	869	0.1	10	NA(4)	NA(3)
	2-Hexanone	ug/L	250	NA(3)	1225	3	3.8	4.4	0	NA(3)	1222	0.0005	50	0	NA(3)
	Acetone	ug/L	20000	NA(3)	1275	89	0.85	92	0	NA(3)	1186	0.2	200	0	NA(3)
	Acetonitrile	ug/L	NA(4)	NA(3)	19	0			NA(4)	NA(3)	19	0.7	500	NA(4)	NA(3)
	Acrolein	ug/L	NA(4)	NA(3)	470	0			NA(4)	NA(3)	470	0.9	500	NA(4)	NA(3)
	Acrylonitrile	ug/L	NA(4)	NA(3)	470	0			NA(4)	NA(3)	470	0.7	500	NA(4)	NA(3)
	Allyl chloride	ug/L	8.9	NA(3)	1	0				NA(3)	1	0.4	0.4	0	NA(3)
	Benzene	ug/L	1	NA(3)	1537	69	0.1	6.2	33	NA(3)	1468	0.1	10	49	NA(3)
	Benzyl chloride	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	5	5	NA(4)	NA(3)
	Bromobenzene	ug/L	NA(4)	NA(3)	40	0			NA(4)	NA(3)	40	0.11	5	NA(4)	NA(3)
	Bromochloromethane	ug/L	34000	NA(3)	40	0				NA(3)	40	0.2	5	0	NA(3)
	Bromodichloromethane	ug/L	80	NA(3)	1638	5	0.4	29	0	NA(3)	1633	0.074	50	0	NA(3)
	Bromoform	ug/L	80	NA(3)	1638	2	5.5	5.7	0	NA(3)	1636	0.1	10	0	NA(3)
	Bromomethane	ug/L	NA(4)	NA(3)	1638	0			NA(4)	NA(3)	1638	0.08	10	NA(4)	NA(3)
	Carbon Disulfide	ug/L	160	NA(3)	1229	39	0.1	11	0	NA(3)	1190	0.0005	20	0	NA(3)
	Carbon Tetrachloride	ug/L	0.5	NA(3)	1638	2	1	4.5	2	NA(3)	1636	0.1	10	435	NA(3)
	Chlorobenzene	ug/L	70	NA(3)	1664	20	0.12	2.2	0	NA(3)	1644	0.085	10	0	NA(3)
	Chloroethane	ug/L	16	NA(3)	1638	2	0.62	4.4	0	NA(3)	1636	0.1	10	0	NA(3)
	Chloroform	ug/L	80	NA(3)	1638	13	0.13	24	0	NA(3)	1625	0.095	10	0	NA(3)
	Chloromethane	ug/L	3	NA(3)	1638	18	0.15	19	1	NA(3)	1620	0.1	10	191	NA(3)
	cis-1,2-Dichloroethene	ug/L	6	NA(3)	1458	125	0.1	110	68	NA(3)	1333	0.1	10	2	NA(3)
	cis-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	1633	1	0.21	0.21	NA(4)	NA(3)	1632	0.1	10	NA(4)	NA(3)
	cis-1,4-Dichloro-2-butene	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1.1	1.1	NA(4)	NA(3)
	Cumene	ug/L	770	NA(3)	40	0				NA(3)	40	0.11	2	0	NA(3)
	Dibromochloromethane	ug/L	80	NA(3)	1638	3	2	26	0	NA(3)	1635	0.1	10	0	NA(3)
	Dibromomethane	ug/L	NA(4)	NA(3)	40	0			NA(4)	NA(3)	40	0.1	2	NA(4)	NA(3)
	Dichlorobenzenes	ug/L	NA(4)	NA(3)	81	0			NA(4)	NA(3)	81	5	5	NA(4)	NA(3)
	Dichlorodifluoroethane	ug/L	NA(4)	NA(3)	8	0			NA(4)	NA(3)	8	0.2	0.2	NA(4)	NA(3)
	Dichlorodifluoromethane	ug/L	1000	NA(3)	143	1	2.5	2.5	0	NA(3)	142	0.2	5	0	NA(3)
	Ethyl acetate	ug/L	2600	NA(3)	2	2	10	20	0	NA(3)	0				NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	**Constituent**	**Units**	**Groundwater SL**	**Groundwater Comparison Concentration (2)**	**Total Number Samples Analyzed**	**Total Samples with Detections**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Number Detected Concentration > GW_SL**	**Number Detected Concentration > GWCC**	**Total Samples ND**	**Minimum DL**	**Maximum DL**	**Number DLs > GW_SL**	**Number DLs > GWCC**
	Ethyl cyanide	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	100	100	NA(4)	NA(3)
	Ethyl methacrylate	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1.8	1.8	NA(4)	NA(3)
	Ethylbenzene	ug/L	300	NA(3)	1538	11	0.19	7.2	0	NA(3)	1527	0.099	10	0	NA(3)
	Gasoline Range Organics	ug/L	5	NA(3)	7	6	14	1100	6	NA(3)	1	10	10	1	NA(3)
	Hexachlorobutadiene	ug/L	NA(4)	NA(3)	40	0			NA(4)	NA(3)	40	0.35	5	NA(4)	NA(3)
	Iodomethane	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	0.5	0.6	NA(4)	NA(3)
	Methacrylonitrile	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1.4	1.4	NA(4)	NA(3)
	Methyl ethyl ketone	ug/L	8400	NA(3)	1249	7	2.7	34	0	NA(3)	1242	0.0005	50	0	NA(3)
	Methyl isobutyl ketone (MIBK)	ug/L	120	NA(3)	1230	0				NA(3)	1230	0.0005	50	0	NA(3)
	Methyl tert-butyl ether	ug/L	13	NA(3)	6	0				NA(3)	6	1.1	5	0	NA(3)
	Methylene chloride	ug/L	5	NA(3)	1638	55	0.22	12	5	NA(3)	1583	0.1	20	34	NA(3)
	m-Xylene	ug/L	1750	NA(3)	29	0				NA(3)	29	1	2	0	NA(3)
	m-Xylene & p-Xylene	ug/L	1750	NA(3)	1015	7	0.2	30	0	NA(3)	1008	0.0005	10	0	NA(3)
	Naphthalene	ug/L	17	NA(3)	40	1	0.41	0.41	0	NA(3)	39	0.2	5	0	NA(3)
	n-Butylbenzene	ug/L	260	NA(3)	40	0				NA(3)	40	0.1	5	0	NA(3)
	n-Propylbenzene	ug/L	260	NA(3)	38	0				NA(3)	38	0.14	2	0	NA(3)
	o + p Xylene	ug/L	1750	NA(3)	29	0				NA(3)	29	1	2	0	NA(3)
	o-Chlorotoluene	ug/L	140	NA(3)	40	0				NA(3)	40	0.1	5	0	NA(3)
	o-Xylene	ug/L	1750	NA(3)	1015	1	12	12	0	NA(3)	1014	0.0005	10	0	NA(3)
	p-Chlorotoluene	ug/L	140	NA(3)	38	0				NA(3)	38	0.093	5	0	NA(3)
	p-Cymene	ug/L	770	NA(3)	40	0				NA(3)	40	0.14	2	0	NA(3)
	Pentachloroethane	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	0.6	0.6	NA(4)	NA(3)
	sec-Butylbenzene	ug/L	260	NA(3)	40	0				NA(3)	40	0.1	5	0	NA(3)
	sec-Dichloropropane	ug/L	NA(4)	NA(3)	40	0			NA(4)	NA(3)	40	0.1	2	NA(4)	NA(3)
	Styrene	ug/L	100	NA(3)	670	0				NA(3)	670	0.0005	10	0	NA(3)
	tert-Butylbenzene	ug/L	260	NA(3)	40	0				NA(3)	40	0.13	5	0	NA(3)
	Tetrachloroethene	ug/L	5	NA(3)	1635	65	0.18	13	11	NA(3)	1570	0.086	10	2	NA(3)
	Toluene	ug/L	150	NA(3)	1537	67	0.11	34	0	NA(3)	1470	0.093	10	0	NA(3)
	trans-1,2-Dichloroethene	ug/L	10	NA(3)	1637	27	0.2	40	8	NA(3)	1610	0.1	10	0	NA(3)
	trans-1,3-Dichloropropene	ug/L	NA(4)	NA(3)	1619	0			NA(4)	NA(3)	1619	0.1	10	NA(4)	NA(3)
	trans-1,4-Dichloro-2-butene	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	1.5	1.5	NA(4)	NA(3)
	Trichloroethene	ug/L	5	NA(3)	1631	262	0.1	900	160	NA(3)	1369	0.1	250	2	NA(3)
	Trichlorofluoromethane	ug/L	150	NA(3)	1306	6	0.5	12	0	NA(3)	1300	0.0005	10	0	NA(3)
	Vinyl acetate	ug/L	NA(4)	NA(3)	559	0			NA(4)	NA(3)	559	0.0005	100	NA(4)	NA(3)
	Vinyl chloride	ug/L	0.5	NA(3)	1635	7	0.35	1	4	NA(3)	1628	0.1	10	418	NA(3)
	Xylenes, Total	ug/L	1750	NA(3)	297	7	0.43	10	0	NA(3)	290	0.4	30	0	NA(3)
SVOC															
	1,2,4-Trichlorobenzene	ug/L	5	NA(3)	66	0				NA(3)	66	2	30	22	NA(3)
	1,2-Dichlorobenzene	ug/L	600	NA(3)	66	0				NA(3)	66	2	30	0	NA(3)
	1,2-Diphenylhydrazine	ug/L	NA(4)	NA(3)	55	0			NA(4)	NA(3)	55	1	30	NA(4)	NA(3)
	1,3-Dichlorobenzene	ug/L	600	NA(3)	66	0				NA(3)	66	2	30	0	NA(3)
	1,3-Dinitrobenzene	ug/L	NA(4)	NA(3)	23	0			NA(4)	NA(3)	23	1.9	8.4	NA(4)	NA(3)
	1,4-Dichlorobenzene	ug/L	5	NA(3)	66	0				NA(3)	66	2	30	22	NA(3)
	1,4-Dioxane	ug/L	3	NA(3)	2	0				NA(3)	2	5	5	2	NA(3)
	2,4,5-Trichlorophenol	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	10	NA(4)	NA(3)
	2,4,6-Trichlorophenol	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	2,4-Dichlorophenol	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1.9	30	NA(4)	NA(3)
	2,4-Dimethylphenol	ug/L	100	NA(3)	66	0				NA(3)	66	2	30	0	NA(3)
	2,4-Dinitrophenol	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	50	NA(4)	NA(3)
	2,4-Dinitrotoluene	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1	30	NA(4)	NA(3)
	2,6-Dinitrotoluene	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	2-Chloronaphthalene	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	2-Chlorophenol	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	2-Methylnaphthalene	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	10	NA(4)	NA(3)
	2-Nitroaniline	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	50	NA(4)	NA(3)
	2-Nitrophenol	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)

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Analyte Group	Constituent	Units	Screening Levels (SLs) (1)		Total Number Samples Analyzed	Detect Data Summary					Non-Detect Data Summary				
			Groundwater SL	Groundwater Comparison Concentration (2)		Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	3,3'-Dichlorobenzidine	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1	100	NA(4)	NA(3)
	3-Nitroaniline	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	50	NA(4)	NA(3)
	4,4'-DDD	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	4,4'-DDE	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	4,4'-DDT	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	4,6-Dinitro-o-cresol	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1	50	NA(4)	NA(3)
	4-Bromophenyl phenyl ether	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	4-Chlorophenylphenyl ether	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1	30	NA(4)	NA(3)
	4-Nitrophenol	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	0.7	50	NA(4)	NA(3)
	Acenaphthene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	1	30	NA(4)	NA(3)
	Acenaphthylene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	1	30	NA(4)	NA(3)
	Aldrin	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Alkene	ug/L	NA(4)	NA(3)	1	1	20	20	NA(4)	NA(3)	0			NA(4)	NA(3)
	alpha-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Aniline	ug/L	NA(4)	NA(3)	4	0			NA(4)	NA(3)	4	5	5	NA(4)	NA(3)
	Anthracene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	1	30	NA(4)	NA(3)
	Benzidine	ug/L	NA(4)	NA(3)	63	0			NA(4)	NA(3)	63	5.2	500	NA(4)	NA(3)
	Benzo(a)anthracene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	1	30	NA(4)	NA(3)
	Benzo(a)pyrene	ug/L	0.2	NA(3)	69	0				NA(3)	69	0.9	30	69	NA(3)
	Benzo(b)fluoranthene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	2	30	NA(4)	NA(3)
	Benzo(ghi)perylene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	1	50	NA(4)	NA(3)
	Benzo(k)fluoranthene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	0.9	30	NA(4)	NA(3)
	Benzoic acid	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	50	50	NA(4)	NA(3)
	Benzyl alcohol	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	10	10	NA(4)	NA(3)
	beta-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	bis(2-Chloroethoxy)methane	ug/L	NA(4)	NA(3)	60	0			NA(4)	NA(3)	60	2	30	NA(4)	NA(3)
	bis(2-Chloroethyl) ether	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	bis(2-Chloroisopropyl) ether	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	bis(2-Ethylhexyl) phthalate	ug/L	4	NA(3)	66	7	3.4	400	5	NA(3)	59	2	10	48	NA(3)
	Butyl benzyl phthalate	ug/L	NA(4)	NA(3)	57	0			NA(4)	NA(3)	57	3	30	NA(4)	NA(3)
	Chrysene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	0.8	30	NA(4)	NA(3)
	delta-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Dibenzo(a,h)anthracene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	1	50	NA(4)	NA(3)
	Dibenzofuran	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	10	NA(4)	NA(3)
	Dieldrin	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Diethyl phthalate	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	Dimethyl phthalate	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1	30	NA(4)	NA(3)
	Di-n-butyl phthalate	ug/L	2700	NA(3)	66	2	8.8	37	0	NA(3)	64	1	50	0	NA(3)
	Di-n-octyl phthalate	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	Endosulfan sulfate	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Endrin	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Fluoranthene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	2	30	NA(4)	NA(3)
	Fluorene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	2	30	NA(4)	NA(3)
	gamma-BHC	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Heptachlor	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Heptachlor epoxide	ug/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	10	10	NA(4)	NA(3)
	Hexachlorobenzene	ug/L	1	NA(3)	66	0				NA(3)	66	1	30	57	NA(3)
	Hexachlorobutadiene	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	Hexachlorocyclopentadiene	ug/L	50	NA(3)	58	0				NA(3)	58	2	30	0	NA(3)
	Hexachloroethane	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	Indeno(1,2,3-cd)pyrene	ug/L	NA(4)	NA(3)	63	0			NA(4)	NA(3)	63	0.9	50	NA(4)	NA(3)
	Isophorone	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	30	NA(4)	NA(3)
	Naphthalene	ug/L	17	NA(3)	69	0				NA(3)	69	1.8	30	1	NA(3)
	Nitrobenzene	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1	30	NA(4)	NA(3)
	n-Nitrosodimethylamine	ug/L	0.01	NA(3)	117	19	0.0001	0.011	2	NA(3)	98	0.0005	80	65	NA(3)
	n-Nitrosodi-n-propylamine	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	2	40	NA(4)	NA(3)

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	n-Nitrosodiphenylamine	ug/L	NA(4)	NA(3)	66	0			NA(4)	NA(3)	66	1	30	NA(4)	NA(3)
	o-Cresol	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	10	NA(4)	NA(3)
	p-Chloroaniline	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	10	NA(4)	NA(3)
	p-Chloro-m-cresol	ug/L	120	NA(3)	66	0				NA(3)	66	2	30	0	NA(3)
	p-Cresol	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	10	10	NA(4)	NA(3)
	Pentachlorophenol	ug/L	1	NA(3)	66	0				NA(3)	66	2	50	66	NA(3)
	Phenanthrene	ug/L	NA(4)	NA(3)	69	0			NA(4)	NA(3)	69	1	30	NA(4)	NA(3)
	Phenol	ug/L	4200	NA(3)	66	0				NA(3)	66	0.9	30	0	NA(3)
	p-Nitroaniline	ug/L	NA(4)	NA(3)	5	0			NA(4)	NA(3)	5	5	50	NA(4)	NA(3)
	Pyrene	ug/L	NA(4)	NA(3)	61	0			NA(4)	NA(3)	61	2	30	NA(4)	NA(3)
	Pyridine	ug/L	NA(4)	NA(3)	4	0			NA(4)	NA(3)	4	10	10	NA(4)	NA(3)
TPH															
	Diesel Range Organics (C13-C22)	mg/L	0.1	NA(3)	4	0				NA(3)	4	0.2	0.5	4	NA(3)
	Gasoline Range Organics	mg/L	0.005	NA(3)	58	15	0.0079	0.28	15	NA(3)	43	0.007	0.3	43	NA(3)
	Gasoline Range Organics (C4-C12)	mg/L	0.005	NA(3)	4	0				NA(3)	4	0.2	0.5	4	NA(3)
	Gasoline Range Organics (C6-C12)	mg/L	0.005	NA(3)	129	33	0.0099	0.18	33	NA(3)	96	0.007	0.088	96	NA(3)
	Lubricant Oil Range Organics (C23-C32)	mg/L	0.1	NA(3)	4	0				NA(3)	4	0.2	0.5	4	NA(3)
	Total Petroleum Hydrocarbons	mg/L	0.1	NA(3)	4	0				NA(3)	4	0.2	0.5	4	NA(3)
	Total Volatile Hydrocarbons	mg/L	0.005	NA(3)	5	0				NA(3)	5	0.1	0.1	5	NA(3)
Other Organic Data															
	Dissolved Organic Carbon	mg/L	NA(4)	NA(3)	8	4	1.2	3.6	NA(4)	NA(3)	4	0.42	0.42	NA(4)	NA(3)
	Ethane	mg/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.002	0.002	NA(4)	NA(3)
	Ethylene	mg/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.003	0.003	NA(4)	NA(3)
	Formaldehyde	mg/L	0.1	NA(3)	21	3	0.01	0.02	0	NA(3)	18	0.01	0.13	1	NA(3)
	Methane	mg/L	NA(4)	NA(3)	2	1	0.867	0.867	NA(4)	NA(3)	1	0.001	0.001	NA(4)	NA(3)
	Total Organic Carbon	mg/L	NA(4)	NA(3)	2	2	35	110	NA(4)	NA(3)	0			NA(4)	NA(3)
Perchlorate															
	Perchlorate	ug/L	6 (5)	NA(3)	709	2	0.81	5	0	NA(3)	707	0.033	8	1	NA(3)
Metals															
	Antimony, Dissolved	mg/L	0.006	0.0025	63	12	0.000066	0.0041	0	1	51	0.000032	1	24	27
	Arsenic, Dissolved	mg/L	0.05	0.0077	100	10	0.00012	0.0071	0	0	90	0.0001	0.01	0	14
	Barium, Dissolved	mg/L	1	0.15	100	86	0.015	0.18	0	5	14	0.1	0.5	0	11
	Beryllium, Dissolved	mg/L	0.004	0.00014	71	1	0.0006	0.0006	0	1	70	0.000037	0.05	14	37
	Boron, Dissolved	mg/L	1	0.34	19	10	0.1	0.27	0	0	9	0.1	0.1	0	0
	Cadmium, Dissolved	mg/L	0.005	0.0002	100	3	0.000027	0.0017	0	1	97	0.000015	0.005	0	60
	Calcium	mg/L	NA(4)	NA(3)	118	118	2.4	130	NA(4)	NA(3)	0			NA(4)	NA(3)
	Calcium, Dissolved	mg/L	NA(4)	NA(3)	283	283	2.4	240	NA(4)	NA(3)	0			NA(4)	NA(3)
	Chromium, Dissolved	mg/L	0.05	0.014	100	14	0.00037	0.014	0	0	86	0.00014	0.01	0	0
	Cobalt, Dissolved	mg/L	NA(4)	0.0019	30	20	0.000056	0.00055	NA(4)	0	10	0.000053	0.00015	NA(4)	0
	Copper, Dissolved	mg/L	1.3	0.0047	68	27	0.00058	0.013	0	2	41	0.00044	0.02	0	33
	Iron	mg/L	0.3	4.1	80	52	0.01	3.6	11	0	28	0.0088	0.083	0	0
	Iron, Dissolved	mg/L	0.3	4.1	104	57	0.0098	2.2	10	0	47	0.0088	0.02	0	0
	Lead, Dissolved	mg/L	0.015	0.011	101	49	0.00016	0.05	3	7	52	0.000098	0.05	10	10
	Magnesium	mg/L	NA(4)	77	118	118	0.89	33.6	NA(4)	0	0			NA(4)	
	Magnesium, Dissolved	mg/L	NA(4)	77	283	283	1.4	100	NA(4)	4	0			NA(4)	
	Manganese, Dissolved	mg/L	0.05	0.15	75	62	0.01	0.39	15	7	13	0.01	0.01	0	0
	Mercury, Dissolved	mg/L	0.002	0.000063	100	1	0.0002	0.0002	0	1	99	0.00005	0.0005	0	75
	Molybdenum, Dissolved	mg/L	0.04	0.0022	63	32	0.0011	0.0028	0	3	31	0.0015	0.1	14	27
	Nickel, Dissolved	mg/L	0.1	0.017	63	19	0.00016	0.0043	0	0	44	0.0001	0.05	0	24
	Potassium	mg/L	NA(4)	9.6	117	113	0.63	2	NA(4)	0	4	0.77	1.1	NA(4)	0
	Potassium, Dissolved	mg/L	NA(4)	9.6	283	277	0.45	7.1	NA(4)	0	6	1	1.5	NA(4)	0
	Selenium, Dissolved	mg/L	0.05	0.0016	100	14	0.00027	0.0014	0	0	86	0.0003	0.005	0	64
	Silica, Dissolved	mg/L	NA(4)	NA(3)	20	20	5.6	32	NA(4)	NA(3)	0			NA(4)	NA(3)
	Silver, Dissolved	mg/L	0.1	0.00017	100	1	0.00009	0.00009	0	0	99	0.000025	0.01	0	67
	Sodium	mg/L	NA(4)	190	118	118	33.6	210	NA(4)	27	0			NA(4)	
	Sodium, Dissolved	mg/L	NA(4)	190	283	283	17	250	NA(4)	32	0			NA(4)	

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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Groundwater SL	Groundwater Comparison Concentration (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	Strontium, Dissolved	mg/L	4	0.8	14	14	0.2	0.78	0	0	0				
	Thallium, Dissolved	mg/L	0.002	0.00013	63	6	0.00006	0.00027	0	3	57	0.000044	0.5	24	44
	Zinc, Dissolved	mg/L	5	6.3	68	47	0.0022	1.5	0	0	21	0.0028	0.045	0	0
Inorganics															
	Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	119	119	230	310	NA(4)	NA(3)	0			NA(4)	NA(3)
	Ammonia-N	mg/L	1.5	NA(3)	23	3	0.0001	0.027	0	NA(3)	20	0.00004	0.11	0	NA(3)
	Bicarbonate	mg/L	NA(4)	NA(3)	232	232	39	510	NA(4)	NA(3)	0			NA(4)	NA(3)
	Bicarbonate Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	54	54	92	360	NA(4)	NA(3)	0			NA(4)	NA(3)
	Bromide	mg/L	2.3	NA(3)	119	9	0.17	1	0	NA(3)	110	0.25	0.5	0	NA(3)
	Carbonate	mg/L	NA(4)	NA(3)	231	60	0	14	NA(4)	NA(3)	171	1.2	6	NA(4)	NA(3)
	Carbonate Alkalinity as CaCO3	mg/L	NA(4)	NA(3)	54	23	2.4	160	NA(4)	NA(3)	31	1	5	NA(4)	NA(3)
	Chloride	mg/L	250	NA(3)	402	402	5.9	250	0	NA(3)	0				NA(3)
	Chlorine	mg/L	NA(4)	NA(3)	1	1	44	44	NA(4)	NA(3)	0			NA(4)	NA(3)
	Cyanides	mg/L	0.15	NA(3)	26	1	0.014	0.014	0	NA(3)	25	0.01	0.05	0	NA(3)
	Fluoride	mg/L	2	0.8	177	128	0.07	5.4	3	9	49	0.1	0.55	0	0
	Iron Oxide	mg/L	NA(4)	NA(3)	1	1	0.4	0.4	NA(4)	NA(3)	0			NA(4)	NA(3)
	Nitrate-N	mg/L	45	NA(3)	123	7	0.075	0.39	0	NA(3)	116	0.072	0.15	0	NA(3)
	Nitrate-NO3	mg/L	45	NA(3)	301	59	0.04	22	0	NA(3)	242	0.1	0.5	0	NA(3)
	Nitrite-N	mg/L	1	NA(3)	119	1	1.5	1.5	1	NA(3)	118	0.011	0.15	0	NA(3)
	Phosphate	mg/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.1	0.1	NA(4)	NA(3)
	Sulfate	mg/L	250	NA(3)	403	402	0.22	780	17	NA(3)	1	0.25	0.25	0	NA(3)
	Sulfide, Dissolved	mg/L	NA(4)	NA(3)	2	0			NA(4)	NA(3)	2	0.029	0.029	NA(4)	NA(3)
	Total Kjeldahl nitrogen	mg/L	NA(4)	NA(3)	2	2	0.28	0.84	NA(4)	NA(3)	0			NA(4)	NA(3)
Other Chemical Analyses															
	Carbon Dioxide	mg/L	NA(4)	NA(3)	1	1	44	44	NA(4)	NA(3)	0			NA(4)	NA(3)
	Cation/Anion Balance (%)	%	NA(4)	NA(3)	21	21	0.19	9.87	NA(4)	NA(3)	0			NA(4)	NA(3)
	Dissolved oxygen	mg/L	NA(4)	NA(3)	3	2	0.4	1.6	NA(4)	NA(3)	1	1	1	NA(4)	NA(3)
	pH	pH Units	NA(4)	NA(3)	244	244	6.29	9.4	NA(4)	NA(3)	0			NA(4)	NA(3)
	Redox Potential	mV	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	380	380	NA(4)	NA(3)
	Specific conductivity	umhos/cm	NA(4)	NA(3)	250	250	90	2000	NA(4)	NA(3)	0			NA(4)	NA(3)
	Total Dissolved Solids	mg/L	NA(4)	NA(3)	284	284	140	1640	NA(4)	NA(3)	0			NA(4)	NA(3)
	Total Non-Volatile Solids	mg/L	NA(4)	NA(3)	1	1	585.3	585.3	NA(4)	NA(3)	0			NA(4)	NA(3)
	Turbidity	NTU	NA(4)	NA(3)	1	1	10	10	NA(4)	NA(3)	0			NA(4)	NA(3)
Radionuclides															
	Actinium-228, Dissolved	pCi/L	NA(4)	NA(3)	59	0			NA(4)	NA(3)	59	5	220	NA(4)	NA(3)
	Beryllium-7, Dissolved	pCi/L	NA(4)	NA(3)	1	0			NA(4)	NA(3)	1	12.4	12.4	NA(4)	NA(3)
	Bismuth-212, Dissolved	pCi/L	NA(4)	NA(3)	29	0			NA(4)	NA(3)	29	5	254	NA(4)	NA(3)
	Bismuth-214, Dissolved	pCi/L	NA(4)	NA(3)	59	23	15.4	303	NA(4)	NA(3)	36	2.6	120	NA(4)	NA(3)
	Cesium-134, Dissolved	pCi/L	80	NA(3)	71	0				NA(3)	71	1.02	49	0	NA(3)
	Cesium-137	pCi/L	200	NA(3)	7	0				NA(3)	7	-3.32	5	0	NA(3)
	Cesium-137, Dissolved	pCi/L	200	NA(3)	121	0				NA(3)	121	-1.12	50	0	NA(3)
	Cobalt-57, Dissolved	pCi/L	NA(4)	NA(3)	75	0			NA(4)	NA(3)	75	0.49	26	NA(4)	NA(3)
	Cobalt-60, Dissolved	pCi/L	100	NA(3)	76	0				NA(3)	76	0.805	53	0	NA(3)
	Europium-152, Dissolved	pCi/L	200	NA(3)	17	0				NA(3)	17	2.06	7.38	0	NA(3)
	Europium-154, Dissolved	pCi/L	60	NA(3)	17	0				NA(3)	17	2.24	8.03	0	NA(3)
	Gross alpha	pCi/L	15	NA(3)	46	16	2.57	18.5	1	NA(3)	30	-1	35	5	NA(3)
	Gross alpha, Decanted	pCi/L	15	NA(3)	10	9	1.6	11.6	0	NA(3)	1	-1	-1	0	NA(3)
	Gross alpha, Dissolved	pCi/L	15	NA(3)	153	36	1.02	15	0	NA(3)	117	-1	20	1	NA(3)
	Gross beta	pCi/L	50	NA(3)	46	24	1.55	17.1	0	NA(3)	22	-1	12	0	NA(3)
	Gross beta, Decanted	pCi/L	50	NA(3)	10	10	4.2	40.1	0	NA(3)	0				NA(3)
	Gross beta, Dissolved	pCi/L	50	NA(3)	153	97	2.2	21.2	0	NA(3)	56	-1	35	0	NA(3)
	Iodine-129	pCi/L	NA(4)	NA(3)	4	0			NA(4)	NA(3)	4	0.7	1.1	NA(4)	NA(3)
	Lead-210, Dissolved	pCi/L	NA(4)	NA(3)	29	0			NA(4)	NA(3)	29	5	1540	NA(4)	NA(3)
	Lead-212, Dissolved	pCi/L	NA(4)	NA(3)	59	2	36	42	NA(4)	NA(3)	57	2.18	84	NA(4)	NA(3)
	Lead-214, Dissolved	pCi/L	NA(4)	NA(3)	59	22	11.7	362	NA(4)	NA(3)	37	2.75	100	NA(4)	NA(3)
	Manganese-54, Dissolved	pCi/L	300	NA(3)	17	0				NA(3)	17	0.787	2.48	0	NA(3)

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Analyte Group	Constituent	Units	Screening Levels (SLs) (1)		Total Number Samples Analyzed	Detect Data Summary					Non-Detect Data Summary				
			Groundwater SL	Groundwater Comparison Concentration (2)		Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > GW_SL	Number Detected Concentration > GWCC	Total Samples ND	Minimum DL	Maximum DL	Number DLs > GW_SL	Number DLs > GWCC
	Plutonium-238	pCi/L	15	NA(3)	4	0				NA(3)	4	0.1	0.2	0	NA(3)
	Plutonium-239	pCi/L	15	NA(3)	4	0				NA(3)	4	0.04	0.09	0	NA(3)
	Polonium-210	pCi/L	NA(4)	NA(3)	1	1	0.0357	0.0357	NA(4)	NA(3)	0			NA(4)	NA(3)
	Polonium-210, Dissolved	pCi/L	NA(4)	NA(3)	1	1	0.0265	0.0265	NA(4)	NA(3)	0			NA(4)	NA(3)
	Potassium-40, Dissolved	pCi/L	NA(4)	NA(3)	76	1	16.54	16.54	NA(4)	NA(3)	75	5	690	NA(4)	NA(3)
	Radium-226	pCi/L	5	NA(3)	3	3	0.778	1.07	0	NA(3)	0				NA(3)
	Radium-226, Dissolved	pCi/L	5	NA(3)	64	8	0.532	1.09	0	NA(3)	56	0.349	930	39	NA(3)
	Radium-228	pCi/L	5	NA(3)	3	3	1.46	1.94	0	NA(3)	0				NA(3)
	Radium-228, Dissolved	pCi/L	5	NA(3)	22	17	0.479	1.95	0	NA(3)	5	0.372	0.545	0	NA(3)
	Sodium-22, Dissolved	pCi/L	400	NA(3)	17	0				NA(3)	17	0.776	2.73	0	NA(3)
	Strontium-90	pCi/L	8	NA(3)	4	0				NA(3)	4	0.3	0.4	0	NA(3)
	Strontium-90, Dissolved	pCi/L	8	NA(3)	8	0				NA(3)	8	1	1.3	0	NA(3)
	Thallium-208, Dissolved	pCi/L	NA(4)	NA(3)	52	1	11.7	11.7	NA(4)	NA(3)	51	5	66	NA(4)	NA(3)
	Thorium-228	pCi/L	NA(4)	NA(3)	3	2	0.0456	0.109	NA(4)	NA(3)	1	0.0355	0.0355	NA(4)	NA(3)
	Thorium-228, Dissolved	pCi/L	NA(4)	NA(3)	4	1	0.149	0.149	NA(4)	NA(3)	3	0.029	0.0352	NA(4)	NA(3)
	Thorium-230	pCi/L	NA(4)	NA(3)	3	0			NA(4)	NA(3)	3	0.0035	0.00618	NA(4)	NA(3)
	Thorium-230, Dissolved	pCi/L	NA(4)	NA(3)	4	1	0.0795	0.0795	NA(4)	NA(3)	3	0.00739	0.103	NA(4)	NA(3)
	Thorium-232	pCi/L	NA(4)	NA(3)	3	1	0.0889	0.0889	NA(4)	NA(3)	2	0.00525	0.00539	NA(4)	NA(3)
	Thorium-232, Dissolved	pCi/L	NA(4)	NA(3)	4	1	0.0659	0.0659	NA(4)	NA(3)	3	0.00554	0.037	NA(4)	NA(3)
	Thorium-234, Dissolved	pCi/L	NA(4)	NA(3)	59	0			NA(4)	NA(3)	59	5	920	NA(4)	NA(3)
	Tritium	pCi/L	20000	NA(3)	208	6	29.4	968	0	NA(3)	202	-227	1000	0	NA(3)
	Uranium-233/234, Dissolved	pCi/L	20	NA(3)	3	3	1.54	2.48	0	NA(3)	0				NA(3)
	Uranium-235, Dissolved	pCi/L	20	NA(3)	63	4	0.0306	0.084	0	NA(3)	59	1.2	200	51	NA(3)
	Uranium-238	pCi/L	20	NA(3)	1	1	1.07	1.07	0	NA(3)	0				NA(3)
	Uranium-238, Dissolved	pCi/L	20	NA(3)	4	4	1.06	2.03	0	NA(3)	0				NA(3)
Other Radionuclides															
	Deuterium	per mil	NA(4)	NA(3)	24	24	-55.3	-45.4	NA(4)	NA(3)	0			NA(4)	NA(3)
	Oxygen-18	per mil	NA(4)	NA(3)	23	23	-7.59	-6.94	NA(4)	NA(3)	0			NA(4)	NA(3)

Notes:

(1) Screening levels (SLs) for water media based on regulatory agency standards (EPA and State Drinking Water MCLs for radionuclides). Additional information provided in Appendix C.
(2) Reference: Groundwater Comparison Concentration Report (MWH 2005a) for metals and inorganic constituents (see Appendix C).
(3) Not applicable – Background values only established for naturally-occurring constituents.
(4) RBSL not available for this constituent.
(5) Perchlorate screening level based on recent SSFL interim measure goals, not health-based.

Acronyms:

DL – Detection Limit
GW_SL – Groundwater Screening Level
GWCC – Groundwater Comparison Concentration
NA – Not Applicable
ND – Non-Detect
NR – Not Reported
SVOC – Semivolatile Organic Compounds
TPH – Total Petroleum Hydrocarbons
VOC – Volatile Organic Compounds

Table 3-6
Offsite Solid (Debris) Sampling Summary
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			Screening Levels (SL) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	**Constituent**	**Units**	**Residential SL**	**Background (2)**	**Total Number Samples Analyzed**	**Total Samples with Detections**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Number Detected Concentration > Res RBSL**	**Number Detected Concentration > Background**	**Total Samples ND**	**Minimum DL**	**Maximum DL**	**Number DLs > Res SL**	**Number DLs > Background**
SVOC															
	1-Methyl naphthalene	ug/kg	230000	NA(3)	7	4	12	22	0	NA(3)	3	33.5	4000	0	NA(3)
	2-Methylnaphthalene	ug/kg	230000	NA(3)	7	4	17	33	0	NA(3)	3	33.5	4000	0	NA(3)
	Acenaphthene	ug/kg	3400000	NA(3)	7	3	110	58300	0	NA(3)	4	20	33.5	0	NA(3)
	Acenaphthylene	ug/kg	1700000	NA(3)	7	0				NA(3)	7	20	4000	0	NA(3)
	Anthracene	ug/kg	17000000	NA(3)	7	2	19600	20800	0	NA(3)	5	20	33.5	0	NA(3)
	Benzo(a)anthracene	ug/kg	600	NA(3)	6	1	259000	259000	1	NA(3)	5	20	33.5	0	NA(3)
	Benzo(a)pyrene	ug/kg	60	NA(3)	6	1	466000	466000	1	NA(3)	5	20	33.5	0	NA(3)
	Benzo(b)fluoranthene	ug/kg	600	NA(3)	5	0				NA(3)	5	20	33.5	0	NA(3)
	Benzo(ghi)perylene	ug/kg	NA(4)	NA(3)	6	1	167000	167000	NA(4)	NA(3)	5	20	33.5	NA(4)	NA(3)
	Benzo(k)fluoranthene	ug/kg	600	NA(3)	6	1	243000	243000	1	NA(3)	5	20	33.5	0	NA(3)
	bis(2-Ethylhexyl) phthalate	ug/kg	250000	NA(3)	3	0				NA(3)	3	33.5	4000	0	NA(3)
	Butyl benzyl phthalate	ug/kg	11000000	NA(3)	3	0				NA(3)	3	33.5	4000	0	NA(3)
	Chrysene	ug/kg	6000	NA(3)	6	5	8.2	316000	1	NA(3)	1	33.5	33.5	0	NA(3)
	Dibenzo(a,h)anthracene	ug/kg	170	NA(3)	7	0				NA(3)	7	20	4000	2	NA(3)
	Diethyl phthalate	ug/kg	46000000	NA(3)	3	0				NA(3)	3	33.5	4000	0	NA(3)
	Dimethyl phthalate	ug/kg	570000000	NA(3)	3	0				NA(3)	3	33.5	4000	0	NA(3)
	Di-n-butyl phthalate	ug/kg	5700000	NA(3)	3	0				NA(3)	3	33.5	4000	0	NA(3)
	Di-n-octyl phthalate	ug/kg	2300000	NA(3)	3	0				NA(3)	3	33.5	4000	0	NA(3)
	Fluoranthene	ug/kg	2300000	NA(3)	6	4	12	227000	0	NA(3)	2	20	33.5	0	NA(3)
	Fluorene	ug/kg	2300000	NA(3)	7	1	1210	1210	0	NA(3)	6	20	4000	0	NA(3)
	Indeno(1,2,3-cd)pyrene	ug/kg	600	NA(3)	6	1	190000	190000	1	NA(3)	5	20	33.5	0	NA(3)
	Naphthalene	ug/kg	6000	NA(3)	7	4	130	580	0	NA(3)	3	33.5	4000	0	NA(3)
	n-Nitrosodimethylamine	ug/kg	45	NA(3)	3	0				NA(3)	3	33.5	4000	2	NA(3)
	Phenanthrene	ug/kg	1700000	NA(3)	7	6	33	54800	0	NA(3)	1	33.5	33.5	0	NA(3)
	Pyrene	ug/kg	1700000	NA(3)	6	4	11	325000	0	NA(3)	2	20	33.5	0	NA(3)
Dioxins															
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	ng/kg	690	NA(3)	4	1	0.485	0.485	0	NA(3)	3	0.0913	0.15	0	NA(3)
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ng/kg	690	NA(3)	4	4	0.581	5.87	0	NA(3)	0				NA(3)
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ng/kg	690	NA(3)	4	0				NA(3)	4	0.109	0.218	0	NA(3)
	1,2,3,4,7,8-Hexachlorodibenzofuran	ng/kg	69	NA(3)	4	2	0.11	0.268	0	NA(3)	2	0.0687	0.088	0	NA(3)
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ng/kg	69	NA(3)	4	0				NA(3)	4	0.242	0.596	0	NA(3)
	1,2,3,6,7,8-Hexachlorodibenzofuran	ng/kg	69	NA(3)	4	1	0.184	0.184	0	NA(3)	3	0.0654	0.0836	0	NA(3)
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	ng/kg	69	NA(3)	4	0				NA(3)	4	0.263	0.613	0	NA(3)
	1,2,3,7,8,9-Hexachlorodibenzofuran	ng/kg	69	NA(3)	4	0				NA(3)	4	0.101	0.148	0	NA(3)
	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ng/kg	69	NA(3)	4	1	0.562	0.562	0	NA(3)	3	0.254	0.422	0	NA(3)
	1,2,3,7,8-Pentachlorodibenzofuran	ng/kg	230	NA(3)	4	0				NA(3)	4	0.159	0.295	0	NA(3)
	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ng/kg	6.9	NA(3)	4	1	0.288	0.288	0	NA(3)	3	0.11	0.207	0	NA(3)
	2,3,4,6,7,8-Hexachlorodibenzofuran	ng/kg	69	NA(3)	4	0				NA(3)	4	0.0698	0.109	0	NA(3)
	2,3,4,7,8-Pentachlorodibenzofuran	ng/kg	23	NA(3)	4	1	0.286	0.286	0	NA(3)	3	0.139	0.212	0	NA(3)
	2,3,7,8-TCDD	ng/kg	6.9	NA(3)	4	0				NA(3)	4	0.141	0.249	0	NA(3)
	2,3,7,8-Tetrachlorodibenzofuran	ng/kg	69	NA(3)	4	1	0.212	0.212	0	NA(3)	3	0.112	0.199	0	NA(3)
	Heptachlorodibenzofurans	ng/kg	NA(4)	NA(3)	4	1	1.03	1.03	NA(4)	NA(3)	3	0.0994	0.16	NA(4)	NA(3)
	Heptachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	4	4	0.581	16	NA(4)	NA(3)	0			NA(4)	NA(3)
	Hexachlorodibenzofurans	ng/kg	NA(4)	NA(3)	4	2	0.11	1.36	NA(4)	NA(3)	2	0.0755	0.0999	NA(4)	NA(3)
	Hexachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	4	3	0.319	7.42	NA(4)	NA(3)	1	0.421	0.421	NA(4)	NA(3)
	Octachlorodibenzofuran	ng/kg	23000	NA(3)	4	0				NA(3)	4	0.441	0.661	0	NA(3)
	Octachlorodibenzo-p-dioxin	ng/kg	23000	NA(3)	4	4	2.33	23.8	0	NA(3)	0				NA(3)
	Pentachlorodibenzofurans	ng/kg	NA(4)	NA(3)	4	1	1.46	1.46	NA(4)	NA(3)	3	0.148	0.221	NA(4)	NA(3)
	Pentachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	4	1	3.55	3.55	NA(4)	NA(3)	3	0.121	0.207	NA(4)	NA(3)
	TCDD TEQ (ND=0) 2005 WHO	ng/kg	6.9	NA(3)	4	4	0.009029	0.56709	0	NA(3)	0				NA(3)
	Tetrachlorodibenzofurans	ng/kg	NA(4)	NA(3)	4	1	2.16	2.16	NA(4)	NA(3)	3	0.112	0.199	NA(4)	NA(3)
	Tetrachlorodibenzo-p-dioxins	ng/kg	NA(4)	NA(3)	4	1	0.179	0.179	NA(4)	NA(3)	3	0.187	0.249	NA(4)	NA(3)

Table 3-6
Offsite Solid (Debris) Sampling Summary
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Analyte Group	Constituent	Units	Screening Levels (SL) (1)		Total Number Samples Analyzed	Detect Data Summary					Non-Detect Data Summary				
			Residential SL	Background (2)		Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res RBSL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
Metals															
	Aluminum	mg/kg	75000	20000	5	5	1200	12000	0	0	0				
	Antimony	mg/kg	30	8.7	7	5	0.12	465	1	1	2	0.386	0.395	0	0
	Antimony	mg/L	NA(4)	NA(3)	1	1	63	63	NA(4)	NA(3)	0			NA(4)	NA(3)
	Arsenic	mg/kg	0.095	15	8	8	1.3	10	8	0	0				
	Barium	mg/kg	15000	140	8	8	0.64	630	0	4	0				
	Beryllium	mg/kg	150	1.1	8	5	0.088	1.1	0	0	3	0.0193	0.8	0	0
	Boron	mg/kg	15000	9.7	8	8	2.9	330	0	6	0				
	Cadmium	mg/kg	2.6	1	8	6	0.31	1.5	0	2	2	0.0193	0.0981	0	0
	Chromium	mg/kg	3400	36.8	8	6	3.3	35	0	0	2	0.193	0.981	0	0
	Cobalt	mg/kg	1500	21	8	7	0.046	12	0	0	1	0.0981	0.0981	0	0
	Copper	mg/kg	3000	29	8	7	0.23	84	0	3	1	0.28	0.28	0	0
	Iron	mg/kg	NA(4)	28000	4	4	11000	33000	NA(4)	1	0			NA(4)	
	Lead	mg/kg	150	34	8	8	0.36	64	0	3	0				
	Lead	mg/L	NA(4)	NA(3)	2	1	3.4	3.4	NA(4)	NA(3)	1	0.18	0.18	NA(4)	NA(3)
	Lithium	mg/kg	1522	37	1	1	16	16	0	0	0				
	Manganese	mg/kg	1800	495	4	4	270	1400	0	3	0				
	Mercury	mg/kg	23	0.09	8	3	0.0031	0.058	0	0	5	0.00139	0.0031	0	0
	Molybdenum	mg/kg	380	5.3	5	2	0.24	1	0	0	3	0.0965	0.478	0	0
	Nickel	mg/kg	1500	29	8	7	0.3	37	0	2	1	0.49	0.49	0	0
	Potassium	mg/kg	NA(4)	6400	1	1	9400	9400	NA(4)	1	0			NA(4)	
	Selenium	mg/kg	380	0.655	8	2	0.82	3.8	0	2	6	0.483	2.45	0	3
	Silver	mg/kg	380	0.79	8	3	0.11	0.22	0	0	5	0.0386	0.81	0	1
	Sodium	mg/kg	NA(4)	110	1	1	430	430	NA(4)	1	0			NA(4)	
	Thallium	mg/kg	6.1	0.46	8	4	0.17	3.2	0	1	4	0.0386	0.392	0	0
	Vanadium	mg/kg	76	62	8	6	4.1	71	0	1	2	0.386	1.96	0	0
	Zinc	mg/kg	23000	110	8	8	1.1	350	0	3	0				
	Zirconium	mg/kg	NA(4)	8.6	1	1	2.8	2.8	NA(4)	0	0			NA(4)	
Asbestos															
	Amosite	%	NA(4)	NA(3)	1	1	7	7	NA(4)	NA(3)	0			NA(4)	NA(3)
	Asbestos	%	NA(4)	NA(3)	18	0			NA(4)	NA(3)	18	0.1	1	NA(4)	NA(3)
	Cellulose	%	NA(4)	NA(3)	4	4	1	1	NA(4)	NA(3)	0			NA(4)	NA(3)
	Chrysotile	%	NA(4)	NA(3)	4	4	2	80	NA(4)	NA(3)	0			NA(4)	NA(3)
	Crocidolite	%	NA(4)	NA(3)	1	1	5	5	NA(4)	NA(3)	0			NA(4)	NA(3)
	Fibrous Glass	%	NA(4)	NA(3)	16	16	10	98	NA(4)	NA(3)	0			NA(4)	NA(3)
	Non-fibrous	%	NA(4)	NA(3)	19	19	1	100	NA(4)	NA(3)	0			NA(4)	NA(3)
Inorganics															
	Ammonia-N	mg/kg	NA(4)	NA(3)	4	3	8.7	23	NA(4)	NA(3)	1	6	6	NA(4)	NA(3)
	Cyanides	mg/kg	1500	NA(3)	4	4	2.4	4.9	0	NA(3)	0				NA(3)
	Sulfate	mg/kg	NA(4)	NA(3)	4	4	1100	6200	NA(4)	NA(3)	0			NA(4)	NA(3)
Other Chemicals															
	Moisture	%	NA(4)	NA(3)	4	4	0.09	0.644	NA(4)	NA(3)	0			NA(4)	NA(3)
	Total Solids	%	NA(4)	NA(3)	4	4	97	100	NA(4)	NA(3)	0			NA(4)	NA(3)
	Surfactants	mg/kg	NA(4)	NA(3)	4	4	1.7	1400	NA(4)	NA(3)	0			NA(4)	NA(3)

Notes:

(1) Chemical risk-based screening levels (SLs) for human health receptors are provided as reference points for comparison. Chemical SL based on residential receptor for a risk level of 1 x 10^{6} cancer risk or noncancer Hazard Index. Radionuclide SLs based on sum of residential EPA Residential 10^{6} PRG value and maximum background levels. Additional information provided in Appendix C.

(2) Reference: Soil Background Report (MWH 2005a) for metals and inorganic constituents; Bell Canyon (Ogden, 1998), Area IV Characterization (Rockwell, 1996) and Brandeis Barden Institute (McLaren/Hart, 1995) reports for radionuclides (see Appendix C).

(3) Not applicable – Background values only established for naturally-occurring constituents.

(4) RBSL not available for this constituent.

(5) Solid materials include construction or other debris.

Table 3-6
Offsite Solid (Debris) Sampling Summary
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			Screening Levels (SL) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Residential SL	Background (2)	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res RBSL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background

Acronyms:

DL – Detection Limit
SL – Screening Level
NA – Not Applicable
ND – Non-Detect
NR – Not Reported
SVOC – Semivolatile Organic Compounds

Table 3-7
Offsite Bedrock Sampling Summary
Santa Susana Field Laboratory
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	**Constituent**	**Units**	**Residential SL**	**Background (2)**	**Total Number Samples Analyzed**	**Total Samples with Detections**	**Minimum Detected Concentration**	**Maximum Detected Concentration**	**Number Detected Concentration > Res RBSL**	**Number Detected Concentration > Background**	**Total Samples ND**	**Minimum DL**	**Maximum DL**	**Number DLs > Res RBSL**	**Number DLs > Background**
Perchlorate															
	Perchlorate (Soil Leachate)	ug/L	6 (5)	NA(3)	1	0				NA(3)	1	4	4	0	NA(3)
	Perchlorate	ug/kg	6 (5)	NA(3)	1	0				NA(3)	1	41	41	1	NA(3)
Other Chemicals															
	Total Solids	%	NA(4)	NA(3)	1	1	99	99	NA(4)	NA(3)	0			NA(4)	NA(3)

Notes:

(1) Chemical risk-based screening levels (SLs) for human health receptors are provided as reference points for comparison. Chemical SL based on residential receptor for a risk level of 1 x 10^{6} cancer risk or noncancer Hazard Index. Radionuclide SLs based on sum of residential EPA Residential 10^{6} PRG value and maximum background levels. Additional information provided in Appendix C.

(2) Reference: Soil Background Report (MWH 2005a) for metals and inorganic constituents; Bell Canyon (Ogden, 1998), Area IV Characterization (Rockwell, 1996) and Brandeis Barden Institute (McLaren/Hart, 1995) reports for radionuclides (see Appendix C).

(3) Not applicable – Background values only established for naturally-occurring constituents.

(4) RBSL not available for this constituent.

(5) Perchlorate screening level based on recent SSFL interim measure goals, not health-based.

(6) Bedrock core sample data from locations C-16 and C-17 not included in this table (see Appendix B).

Acronyms:

DL – Detection Limit
SL – Screening Level
NA – Not Applicable
ND – Non-Detect

Table 3-8
Offsite Vegetation Sampling Summary
Santa Susana Field Laboratory
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			Screening Levels (SLs) (1)			Detect Data Summary					Non-Detect Data Summary				
Analyte Group	Constituent	Units	Residential SL	Background	Total Number Samples Analyzed	Total Samples with Detections	Minimum Detected Concentration	Maximum Detected Concentration	Number Detected Concentration > Res SL	Number Detected Concentration > Background	Total Samples ND	Minimum DL	Maximum DL	Number DLs > Res SL	Number DLs > Background
Radionuclides															
	Cesium-137	pCi/g	NA(4)	NA(3)	30	0			NA(4)	NA(3)	30	0.003	0.008	NA(4)	NA(3)
	Gross alpha	pCi/g	NA(4)	NA(3)	25	11	0.15	1.13	NA(4)	NA(3)	14	0.25	5.67	NA(4)	NA(3)
	Gross beta	pCi/g	NA(4)	NA(3)	25	11	96	240	NA(4)	NA(3)	14	175.6	280.7	NA(4)	NA(3)
	Iodine-129	pCi/g	NA(4)	NA(3)	30	0			NA(4)	NA(3)	30	0.01	0.04	NA(4)	NA(3)
	Plutonium-238	pCi/g	NA(4)	NA(3)	30	0			NA(4)	NA(3)	30	0.00009	0.002	NA(4)	NA(3)
	Plutonium-239	pCi/g	NA(4)	NA(3)	29	0			NA(4)	NA(3)	29	0	0.002	NA(4)	NA(3)
	Strontium-90	pCi/g	NA(4)	NA(3)	30	13	0.0016	0.021	NA(4)	NA(3)	17	0.002	0.1	NA(4)	NA(3)
	Tritium	pCi/L	NA(4)	NA(3)	30	2	160	180	NA(4)	NA(3)	28	100	200	NA(4)	NA(3)

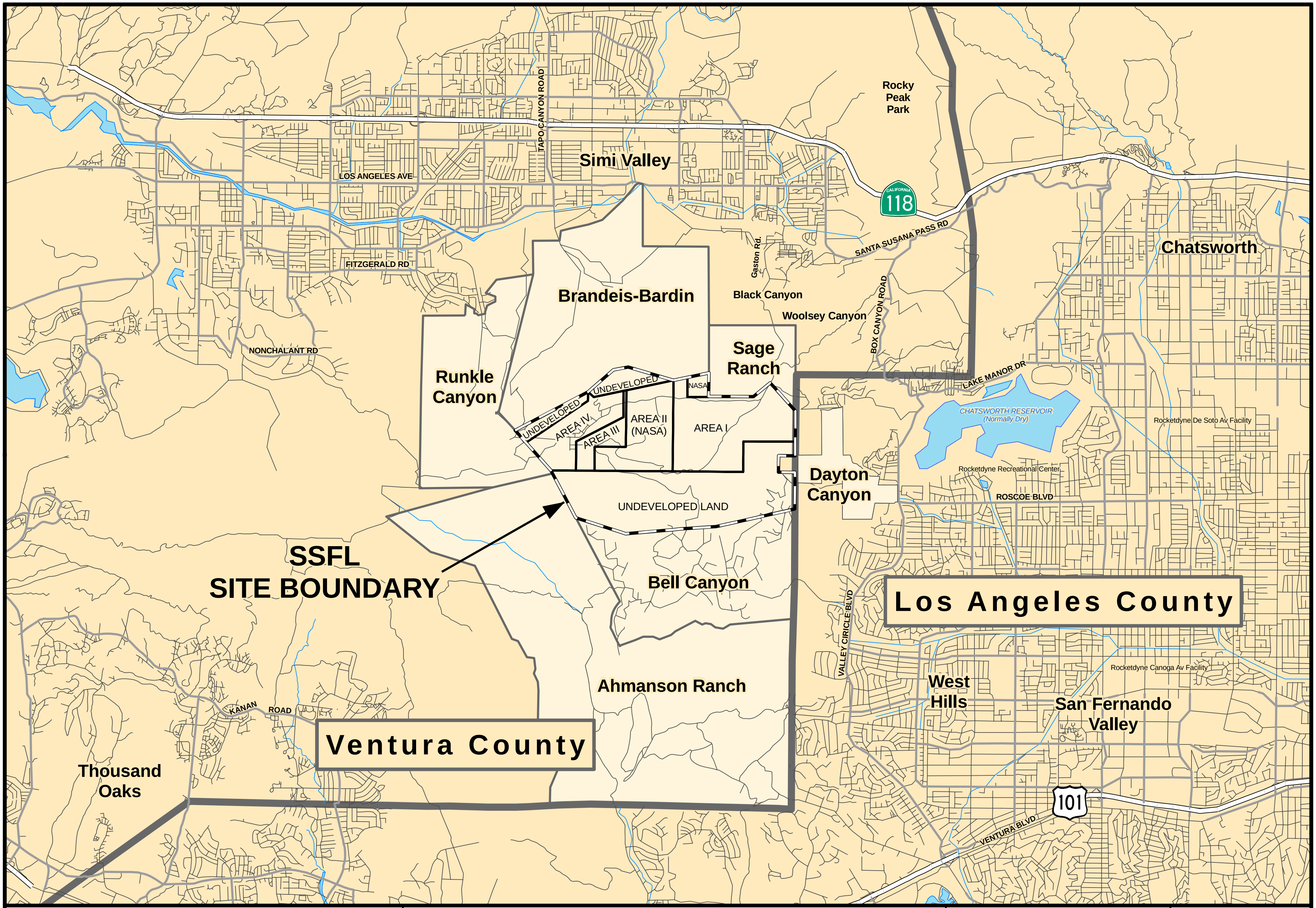
Notes:

(1) Screening or background levels not established for vegetation.
(2) Additional vegetation sample data colleced and analyzed for gross alpha/gross beta and results averaged. These data not displayed on this table (see Appendix B).

Acronyms:

DL – Detection Limit
SL – Screening Level
NA – Not Applicable
ND – Non-Detect
NR – Not Reported

FIGURES



1 inch equals 1.5 miles

0 1.5 3 Miles

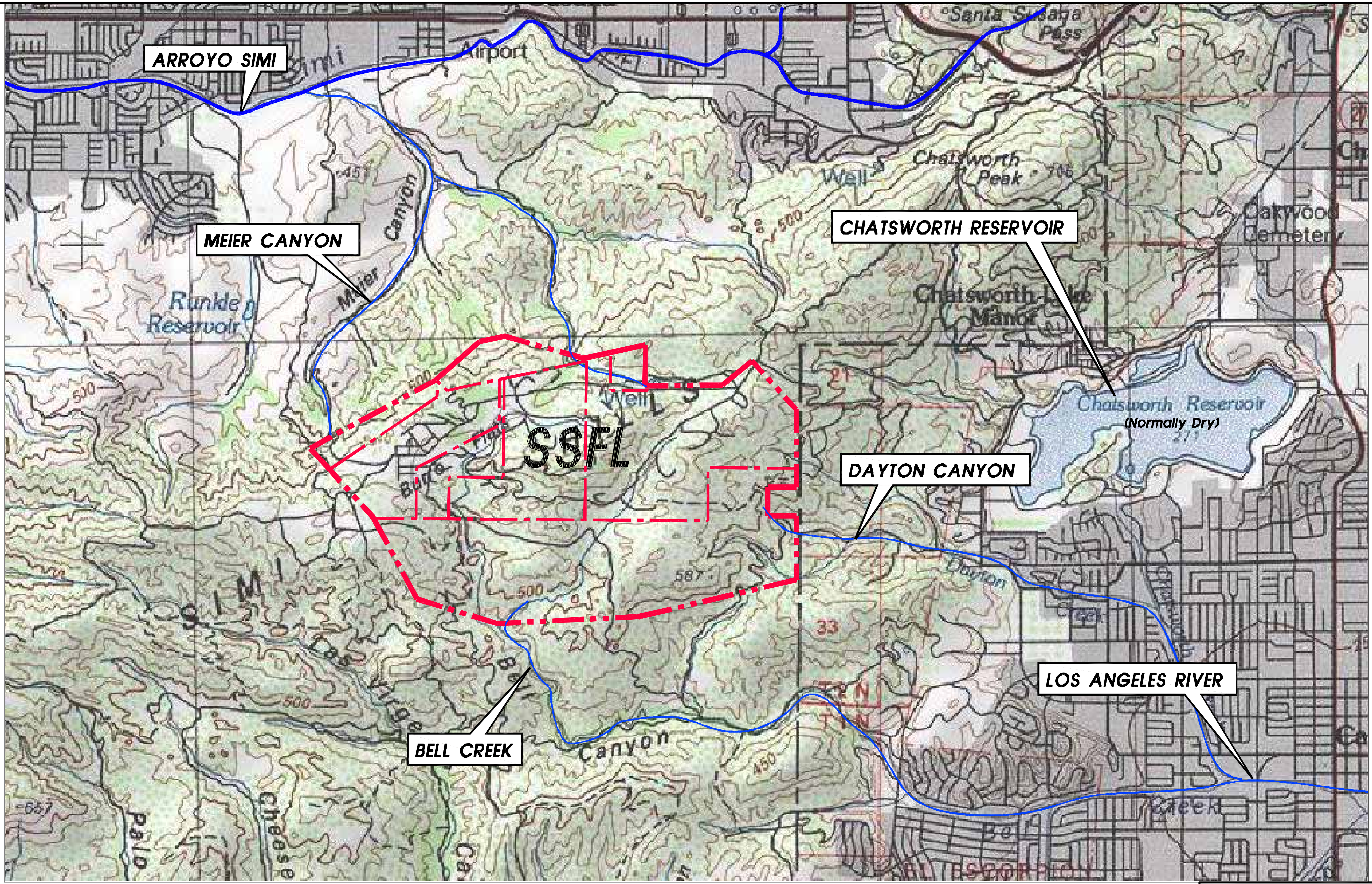
SANTA SUSANA FIELD LABORATORY

Document: Offsite-Report-Regional_Map.mxd

Date: Dec 10, 2007

Regional Map

FIGURE 1-1



JOB No. — — FILE No. CAD MLUEBKE\BOEING\SANTA SUSANA\OFFSITE REPORT 11 07\DRAINAGES 11 07

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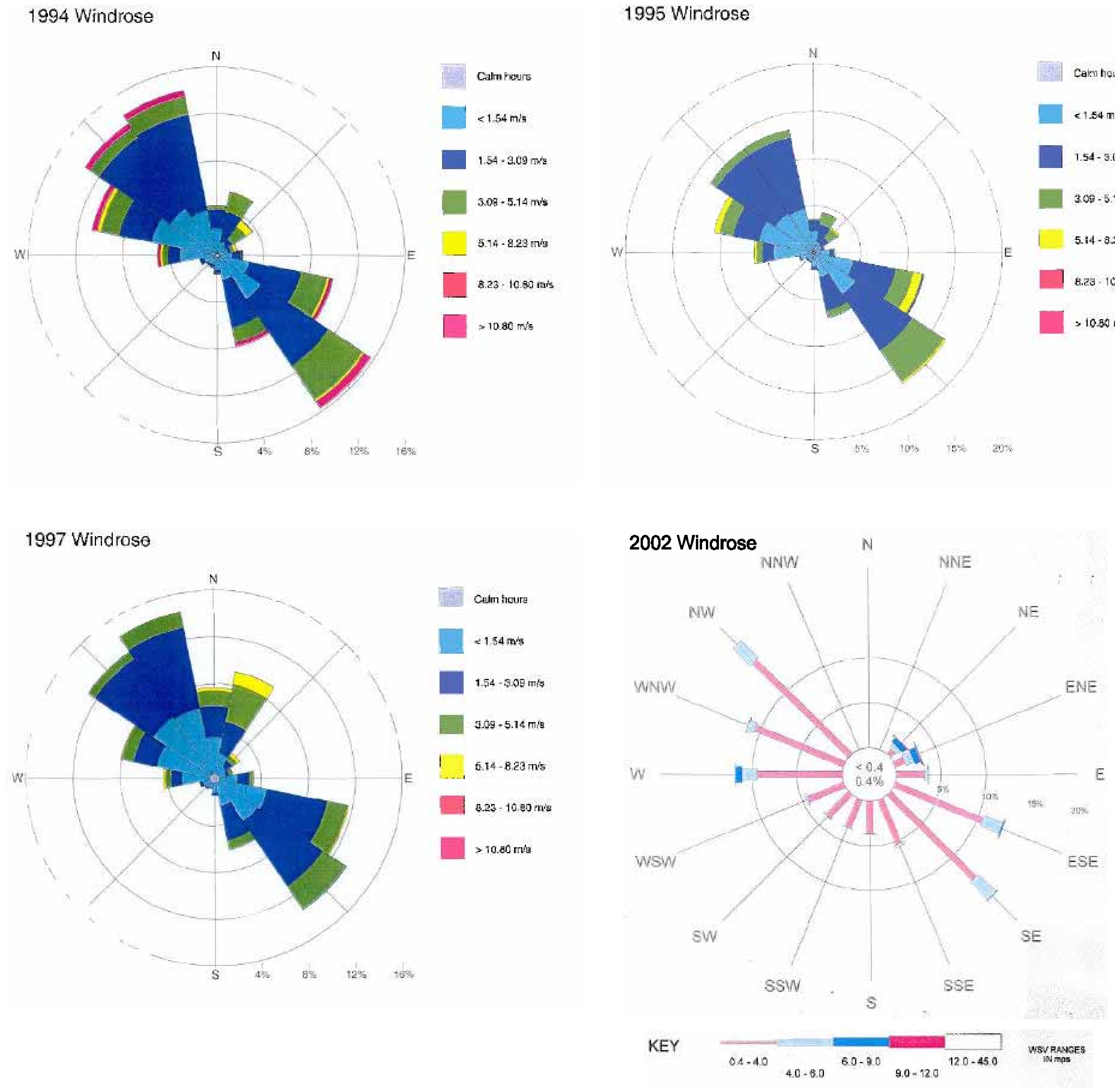
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
DECEMBER 2007

DRAINAGES IN THE VICINITY OF SSFL

FIGURE 1–2



1994 Windrose

1995 Windrose

1996 Windrose

1997 Windrose

2002 Windrose

Source: SSFL windrose data from the Area IV meteorological station

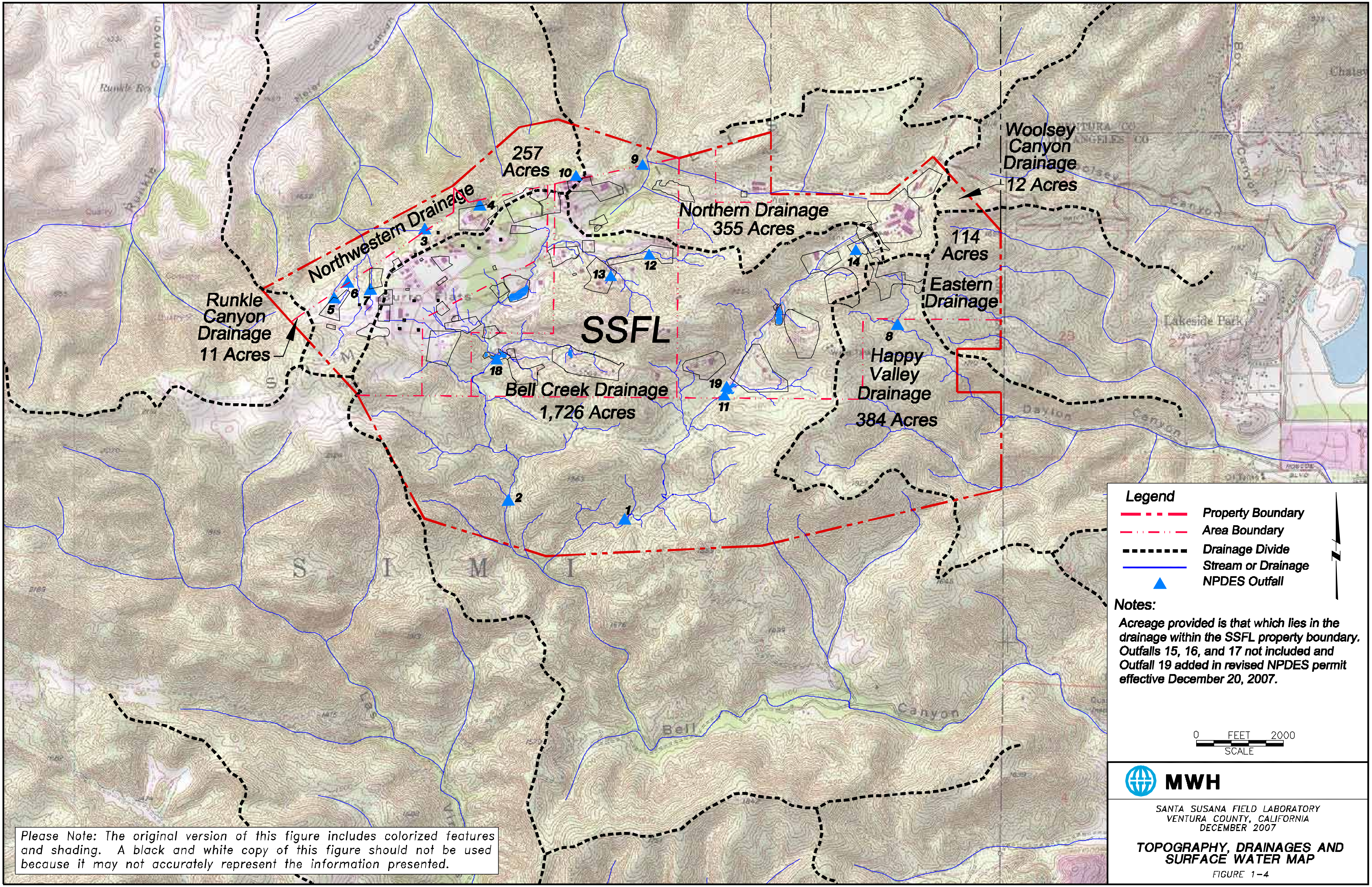
JOB No. ___ FILE No. ___ INDSVR\INDUSTRIAL\CAD_MLUEBKE\BOEING\SANTA_SUSANA\OFFSITE_REPORT\WINDROSES_12_07

MWH

SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
DECEMBER 2007

SANTA SUSANA FIELD LABORATORY WIND ROSES

FIGURE 1-3



Legend

— · —	Property Boundary
- · -	Area Boundary
▪▪▪▪▪	Drainage Divide
——	Stream or Drainage
▲	NPDES Outfall

Notes:

Acreage provided is that which lies in the drainage within the SSFL property boundary. Outfalls 15, 16, and 17 not included and Outfall 19 added in revised NPDES permit effective December 20, 2007.

0 FEET 2000
SCALE

MWH

SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
DECEMBER 2007

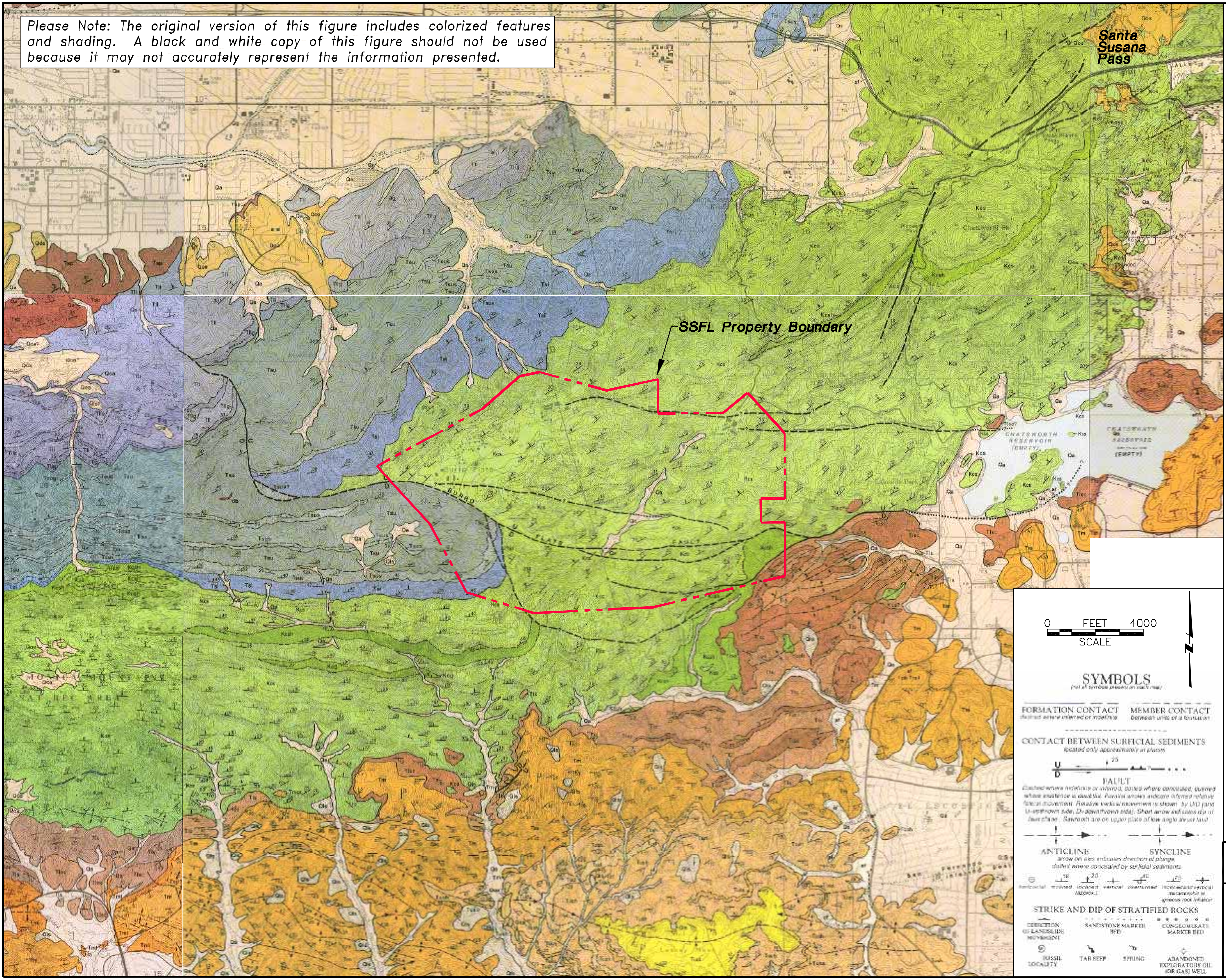
TOPOGRAPHY, DRAINAGES AND SURFACE WATER MAP

FIGURE 1–4

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of this figure should not be used because it may not accurately represent the information presented.

JOB No. ___ FILE No. ___ INDSVR\INDUSTRIAL\CAD MLUEBKE\BOEING\SANTA SUSANA\OFFSITE REPORT\DRAINAGES AND DIVIDES 11 14 07

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of this figure should not be used because it may not accurately represent the information presented.



Legend

af
Qa

SURFICIAL SEDIMENTS

af *artificial cut and fill*

Qa *alluvium: gravel, sand and clay of valley areas, includes gravel and sand of stream channels, gravel and sand of alluvial fans, and slope wash; undissected to slightly dissected*

Qoa
Qos

OLDER SURFICIAL SEDIMENTS

dissected, weakly consolidated alluvial deposits

Qos *older sandy alluvium, including slope wash, derived from Chatsworth Formation (Kcs)*

Qoa *older alluvium composed largely of angular pebble-size fragments of Miocene shale and some of sandstone*

Tm
Tmss
Tmcg

MONTEREY FORMATION

(lower part of Modelo Formation of Hoots 1931; Soper 1938; Durrell 1954; A.E.G. maps 1982; Modelo Formation of Yerkes and Campbell 1979; Weber 1984; Modelo-Monterey and lower Monterey Formation of Truex and Hall 1969; Truex 1976; equivalent to Monterey Formation of Dibblee 1989, in Ventura basin)

marine biogenic and clastic;

middle and late Miocene age (late Luisian(?) and Mohnian Stages)

Tm *gray-brown, white weathering siliceous shale, thin bedded, moderately hard with platy fracture; includes soft tissue diatomaceous shale, hard, brittle cherty shale, and few layers of hard, yellow-weathering calcareous concretions or lenses*

Tmss *light gray to tan, semi-friable bedded sandstone*

Tmcg *gray cobble conglomerate of mostly granitic detritus in sandstone matrix*

Tlsc
Tls

DETRITAL SEDIMENTS OF LINDERO CANYON

(included in Topanga Formation of Weber 1984; unconformable on Chatsworth Formation; best exposed in Lindero Canyon, Thousand Oaks quadrangle; may be equivalent to upper Topanga Formation of Durrell 1954, or Calabasas Formation of Yerkes and Campbell 1989)

marine transgressive clastic; middle Miocene age (Luisian(?) Stage)

Tls *light gray to nearly white massive sandstone, semi-friable, locally conglomeratic*

Tlsc *light gray calcareous sandstone, massive to crudely bedded, with calcite veins; includes gray conglomerate composed of cobbles of metavolcanic, granitic and quartzitic rocks and of sandstone derived from Chatsworth Formation; sparsely fossiliferous*

Tsp

SESPE FORMATION

nonmarine; primarily Oligocene age

not exposed in quadrangle, but present in subsurface (see cross section) in southern part of area and exposed just south of this quadrangle

Tll
Tllg

LLAJAS FORMATION

(of Cushman and McMasters 1936; Stipp 1943; Squires and Filewicz 1983)

marine clastic; middle Eocene age (Domengine and Capay molluscan Stages)

Tll *gray micaceous claystone and siltstone, crumbly with ellipsoidal fracture where weathered*

Tllg *gray to brown cobble conglomerate of granitic, metavolcanic and quartzitic detritus in sandstone matrix; includes some brown sandstone strata*

Tsu
Tsus
Tsuv
Tsl

SANTA SUSANA FORMATION

(of Cushman and McMasters 1936; Stipp 1943; Squires and Filewicz 1983)

marine and nonmarine(?) clastic; lower Eocene and Paleocene ages (Meganos and Martinez molluscan Stages)

Tsu *gray micaceous claystone and siltstone, few minor thin sandstone beds*

Tsus *tan coherent fine grained sandstone; locally contains thin shell-beds and calcareous concretions*

Tsuv *Las Virgenes Sandstone Member: tan semi-friable bedded sandstone, locally pebbly*

Tsl *Simi Conglomerate Member: gray to brown cobble conglomerate with smooth cobbles of quartzite, metavolcanic and granitic rocks in sandstone matrix that locally includes thin lenses of red clay; marine or nonmarine(?)*

Kcg
Kcs
Kcsh

CHATSWORTH FORMATION

(of Colburn et al. 1981; Weber 1984; "Chico" Formation of Sage 1971)

marine clastic; late Cretaceous age (Maastrichtian and Campanian Stages)

Kcs *light gray to light brown sandstone, hard, cemented, arkosic, micaceous, mostly medium grained, in thick strata separated by thin partings of siltstone*

Kcg *gray conglomerate of cobbles of metavolcanic and granitic detritus in hard sandstone matrix*

Kcsh *gray clay shale, crumbly with ellipsoidal fracture where weathered; includes some thin sandstone strata in western area*

FROM DIBBLEE, 1992 and 1992a

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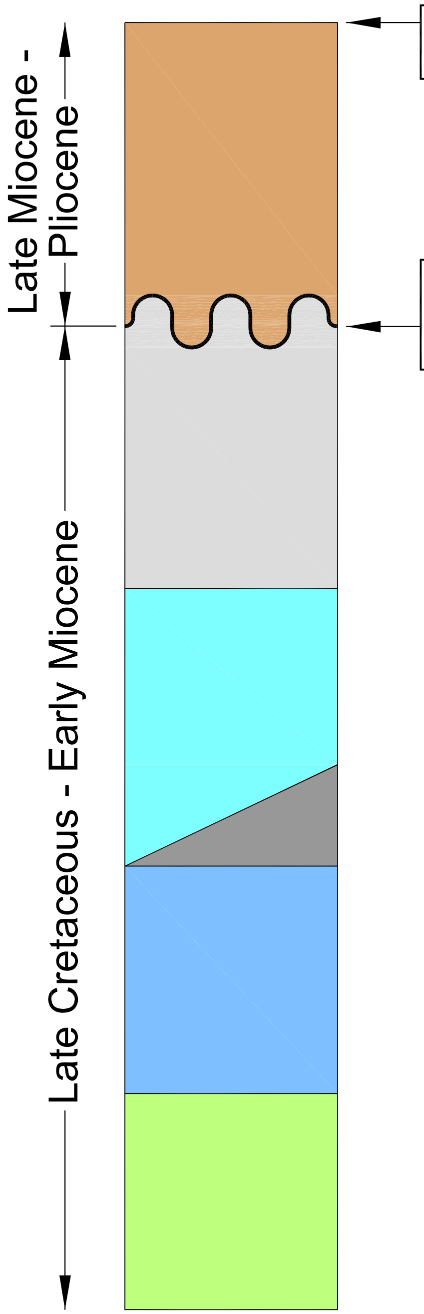
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
DECEMBER 2007

REGIONAL GEOLOGIC MAP

FIGURE 1-5a

JOB No. __ FILE No. __ INDSVR\INDUSTRIAL\CAD MLUEBKE\BOEING\SANTA SUSANA\OFFSITE REPORT 11 07\REG GEO 12 06



Major Deformation Creates the Transverse Ranges

Calabasas/Lindero Canyon Formation
Late Miocene (?) Marine Clayey Silty Sandstone,
Silty Shale and Coarse Conglomerate

Major Unconformity - Late Miocene Folding and Faulting of the Chatsworth Formation, Probable Intrusion of Diabase Dikes and Development of Joint System

Llajas Formation - Early to Middle Eocene Marine Mudstone, Siltstone, and Sandstone with a Basal Conglomerate

Santa Susana Formation - Late Pliocene and Early Eocene Marine Mudstone, Shale, Sandstone, and Conglomerate

Las Virgenes Formation - Paleocene Marine and Non-Marine Sandstone, Mudstone, and Very Rare Conglomerate

Simi Formation - Paloecene Marine and Non-Marine Shale, Siltstone, Sandstone, and Conglomerate

Chatsworth Formation - Late Cretaceous Marine Turbidite Sandstone and Shale

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SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
DECEMBER 2007

STRATIGRAPHY AND STRUCTURAL EVENTS OF THE SIMI HILLS

FIGURE 1-5b

FILE: CADMLUEBKE\BOEING SANTA SUSANA\OFFSITE REPORT\STRAT COLUMN 11 15 07

JOB No.

Legend

SSFL Property Boundary

S28
FDP 445 ● Spring or Seep Location

Note:
Locations marked "Domestic Water Supply" (FDP 446 and FDP 759) represent domestic supply tank and sprinkler runoff sample locations, respectively.

FILE No. CAD MLUEBKE\BOEING\SANTA SUSANA\OFFSITE REPORT\SPRING SEEP LOCATIONS 11 14 07

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of this figure should not be used because it may not accurately represent the information presented.

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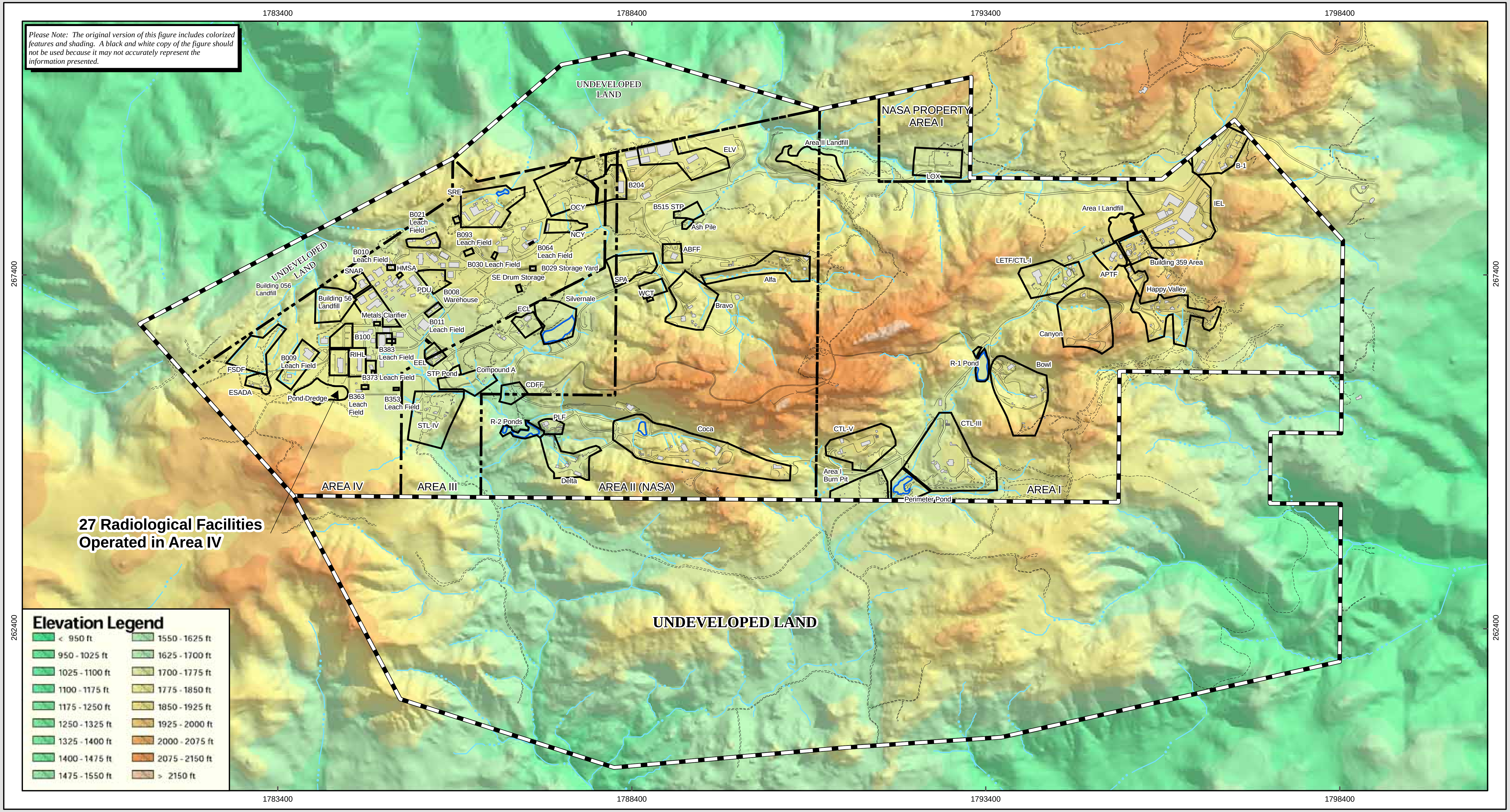
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
DECEMBER 2007

SPRING AND SEEP LOCATION MAP

FIGURE 1-6



Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

N

0 1,300
FEET

MAP COORDINATES IN
STATEPLANE, NAD 27, ZONE V

RFI SITES (Chemical Investigation Area)

AREA I
- SWMU 4.1 - B-1 Area
- SWMU 4.2 - Area I Landfill
- SWMUs 4.3, 4.4 and AOC - Instrument and Equipment Laboratories (IEL)
- SWMU 4.5, 4.6 - LOX Plant Former Sump/Clarifier and Drum Disposal Area
- SWMU 4.7 - Component Test Laboratory III (CTL-III) Area
- SWMU 4.8 - Area I Burn Pit
- SWMU 4.9, AOC - Advanced Propulstion Test Facility (APTF) Area
- SWMU 4.12 - Laser Engineering Test Facility (LETF)/Component Test Lab I (CTL-I) Area
- SWMU 4.14 - Canyon Area
- SWMU 4.15 and AOC - Bowl Area and Building 901 Leachfield
- SWMU 4.16 - Area I Reservoir (R-1 Pond)
- SWMU 4.17 - Perimeter Pond
- AOC - Building 359 Sump
- AOC - Happy Valley Area

AREA II
- SWMU 5.1 - Area II Landfill
- SWMU 5.2 - ELV Final Assembly, Building 206
- SWMU 5.5 and AOC - Building 204 Area
- SWMU 5.6 - Former Incinerator Ash Pile
- SWMU 5.7 - Hazardous Waste Storage Area Waste Coolant Tank (WCT)
- SWMU 5.9, 5.10, 5.11 - Alfa Area
- SWMU 5.12, 5.13, 5.14, 5.15 - Alfa/Bravo Skim Pond and Bravo Area
- SWMU 5.18, 5.19 - Coca Area
- SWMU 5.20, 5.21, 5.22 - Propellant Load Facility (PLF)
- SWMU 5.23 - Delta Area
- SWMU 5.26 - R-2A and R-2B Ponds
- AOC - Building 515 Sewage Treatment Plant
- AOC - Storable Propellant Area (SPA)
- AOC - Alfa/Bravo Fuel Farm
- AOC - Coca/Delta Fuel Farm
- AOC - Building 224 Leach Field

AREA III
- SWMUs 6.1, 6.3, AOC - Engineering Chemistry Laboratory (ECL) Area
- SWMU 6.4 Compound A Facility
- SWMU 6.5 Systems Test Laboratory IV (STL-IV) Area
- SWMU 6.8 - Silvernale Reservoir
- SWMU 6.9 - Environmental Effects Laboratory (EEL)
- AOC - Sewage Treatment Plant (STP) Pond Area

AREA IV
- SWMU 7.1 - Building 56 Landfill
- SWMU 7.3 - Former Sodium Disposal Facility (FSDF)
- SWMU 7.4 - Old Conservation Yard (OCY)
- SWMU 7.5 - Building 100 Trench
- SWMU 7.6 - Radioactive Materials Handling Facility (RMHF)

AREA IV (cont)
- SWMU 7.7 - Rockwell International Hot Laboratory (RIHL)
- SWMU 7.8 - New Conservation Yard (NCY)
- SWMU 7.9 - ESADA Chemical Storage Area
- SWMU 7.10 - Former Coal Gasification PDU
- AOC - Former Hazardous Materials Storage Area (HMSA)
- AOC - Chemistry Laboratory Metals Clarifier
- AOC - Pond Dredge Area
- AOC - Sodium Reactor Experiment (SRE) Area
- AOC - SE Drum Storage Yard
- AOC - SNAP Facility
- AOC - Boeing Area IV Leach Fields
- AOC - DOE Area IV Leach Fields

Legend

▭	SSFL Property Boundary	▭	Pond
▭	Administrative Boundary	⁄	Drainage
▭	RFI Site Boundary	⁄	Dirt Road
▭	Building	⁄	Road

Chemical and Radiological Facilities Location Map

SANTA SUSANA FIELD LABORATORY

Date: Dec 08, 2007

Document: Offsite-Report-RFI_Location.mxd

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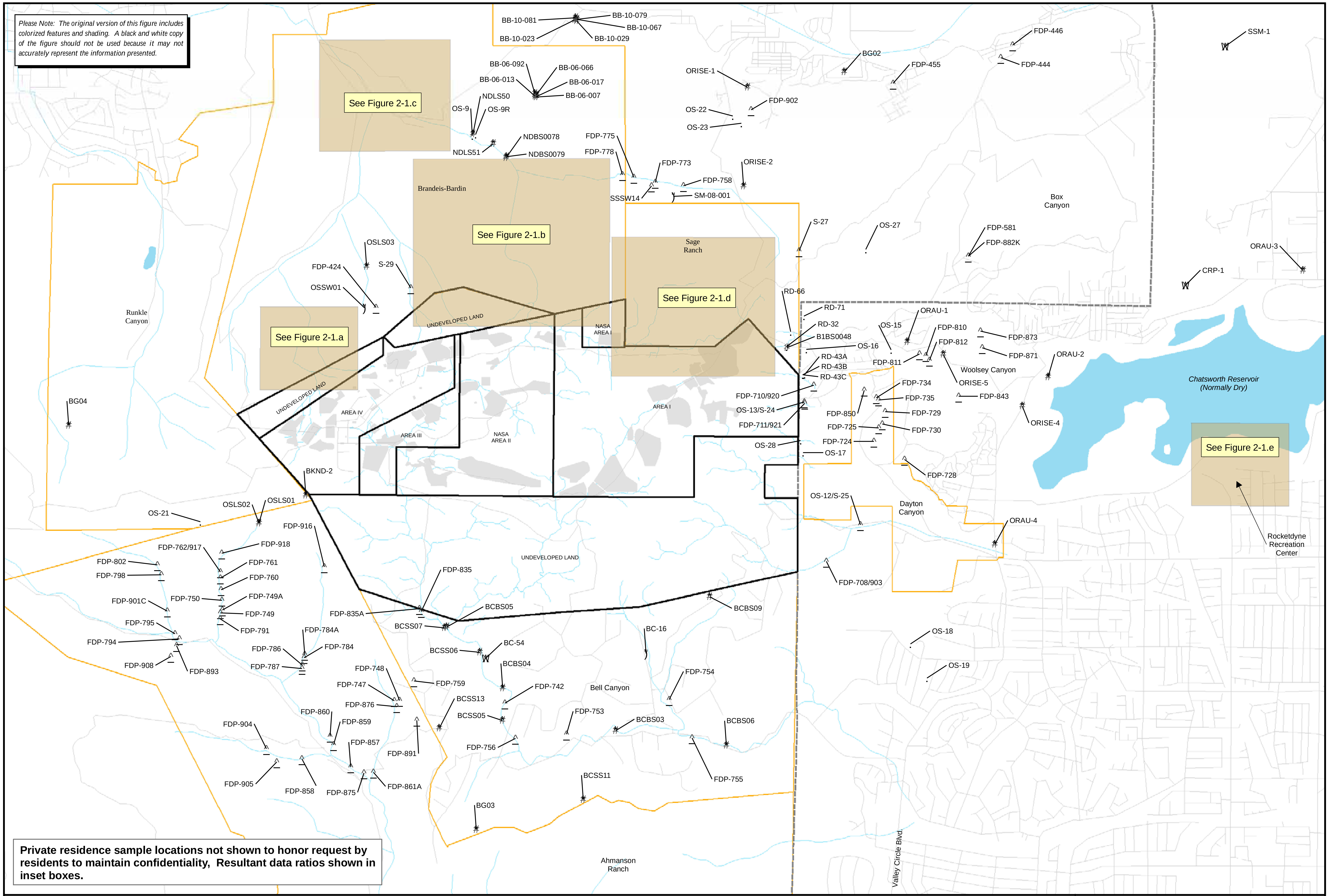
FIGURE 1-7

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.



Private residence sample locations not shown to honor request by residents to maintain confidentiality, Resultant data ratios shown in inset boxes.

1 inch equals 2,000 feet

0 2,000 4,000 Feet

- Administrative Area Boundary
- County Boundary
- RFI Boundary
- Properties
- Highway
- Streets
- Streams

Sample Locations

₩	Multimedia	⾣	Soil/Sediment
.	Groundwater	)	Surface Water
^	Spring/Seep	₲	Vegetation

Extent of Inset Figures ▨

Offsite Sampling Near Santa Susana Field Laboratory

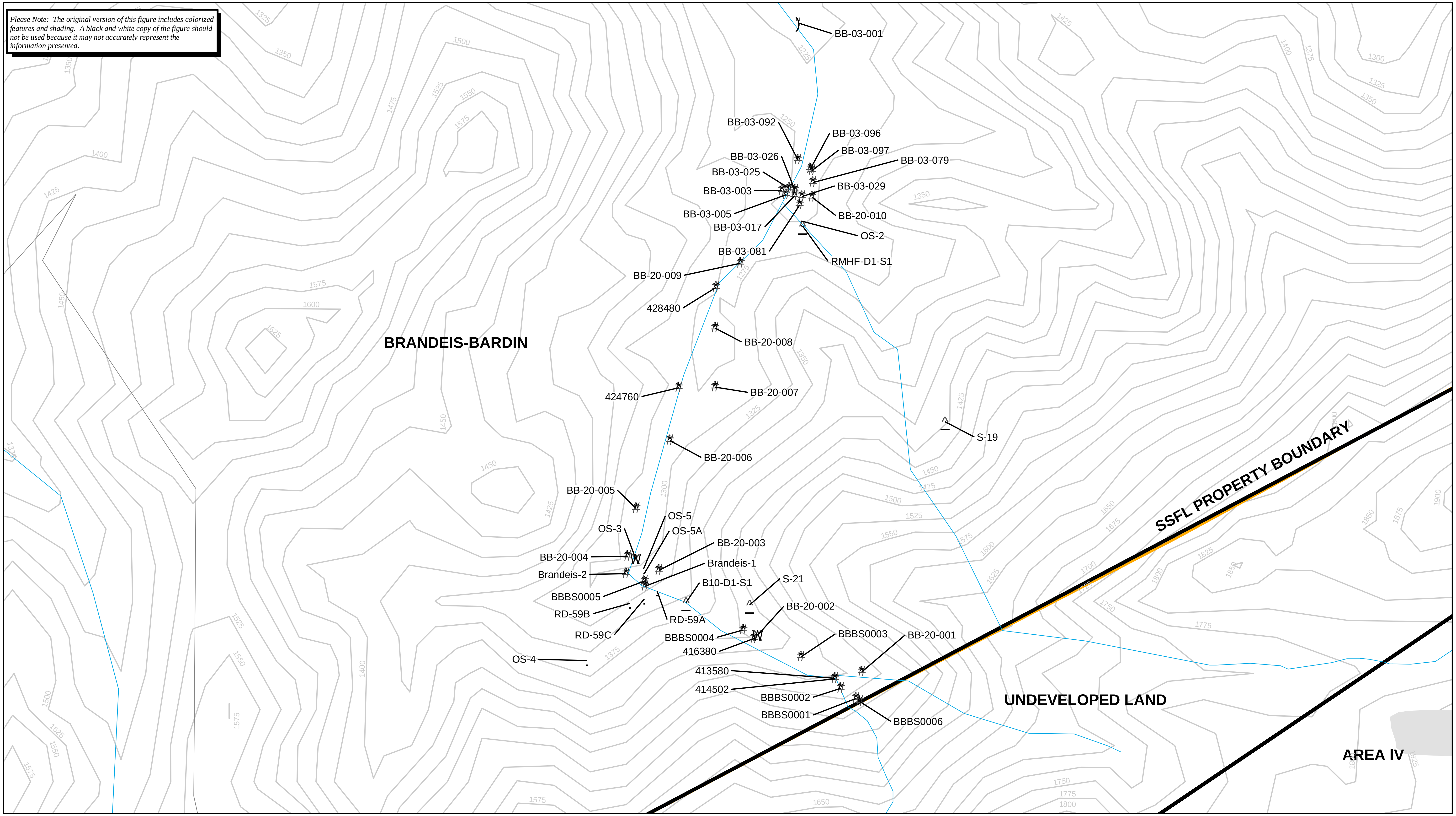
MWH

Date: Dec 13, 2007

Document: Offsite-Report-Sampling_Around_SSFL.mxd

FIGURE 2-1

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.



1 inch equals 250 feet

0 250 500 Feet

Sample Locations

- Multimedia
- Groundwater
- Spring/Seep
- Soil/Sediment
- Surface Water
- Vegetation

SANTA SUSANA FIELD LABORATORY

- Administrative Area Boundary
- County Boundary
- RFI Sites
- Surrounding Property
- Highway
- Streets
- Streams
- Contour

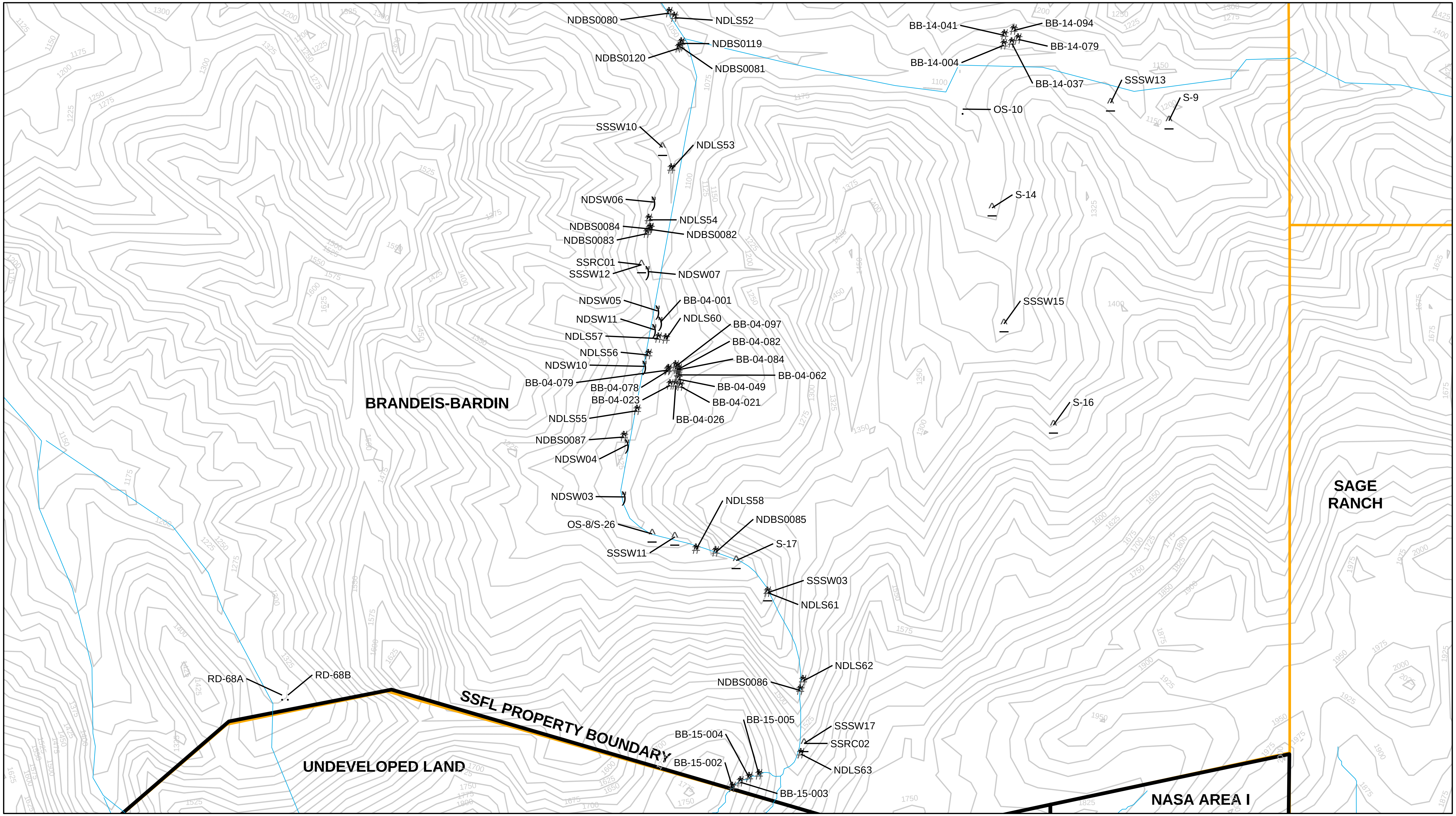
Offsite Sampling Near Santa Susana Field Laboratory - North of FSDF

Date: Dec 13, 2007

Document: Offsite-Report_Samples_a_11x17.mxd

MWH

FIGURE
2-1.A



1 inch equals 500 feet

Feet
0 500 1,000

Sample Locations

- Multimedia
- Soil/Sediment
- Groundwater
- Surface Water
- Spring/Seep

SANTA SUSANA FIELD LABORATORY

- Administrative Area Boundary
- County Boundary
- RFI Sites
- Surrounding Property
- Highway
- Streets
- Streams
- Contour

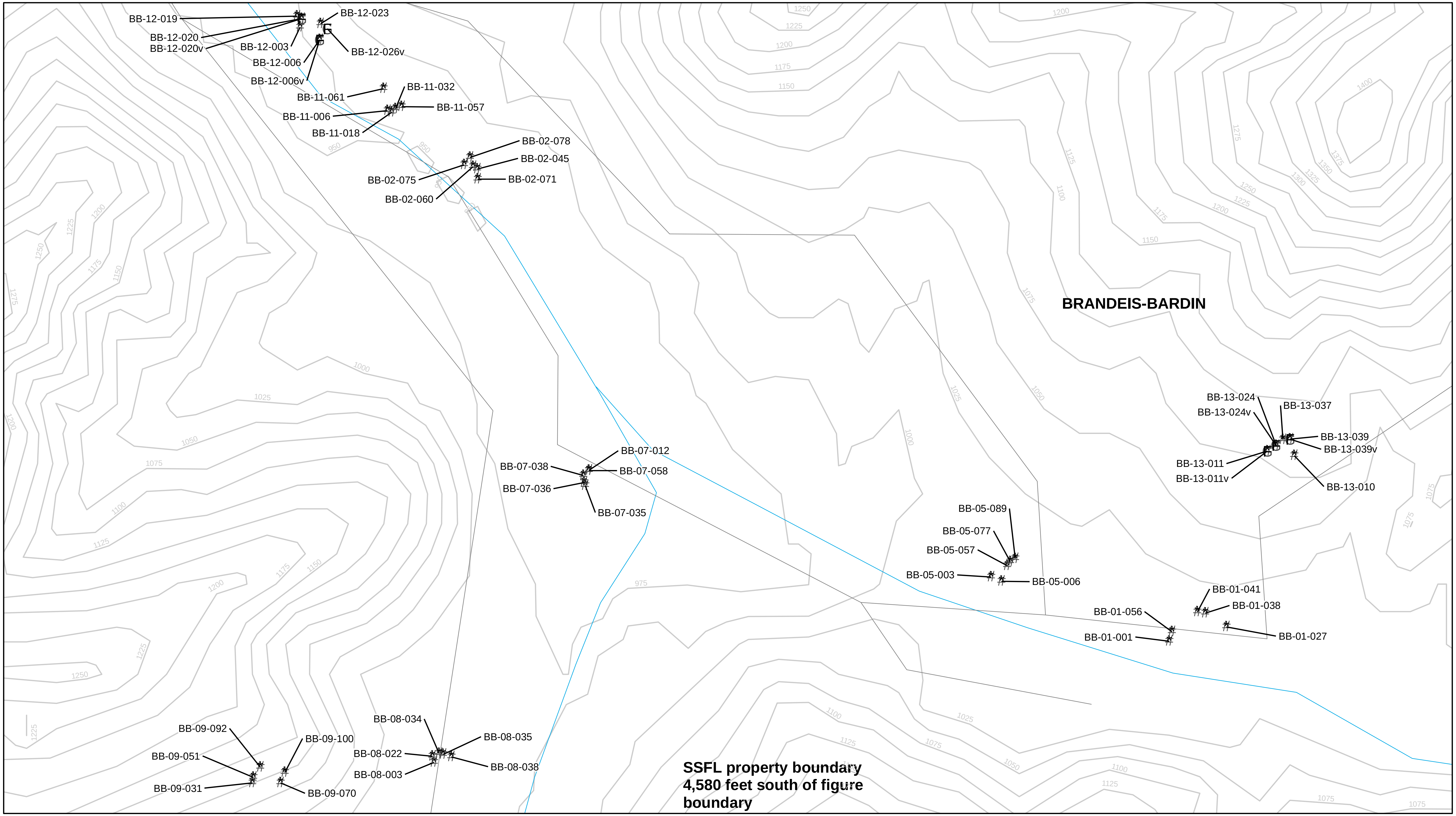
Offsite Sampling Near Santa Susana Field Laboratory - Brandeis Bardin South

Date: Dec 13, 2007

Document: Offsite-Report_Samples_b_11x17.mxd

MWH

FIGURE
2-1.B



1 inch equals 300 feet

Feet
0 300 600

Sample Locations

W	Multimedia	#	Soil/Sediment
.	Groundwater	)	Surface Water
^	Spring/Seep	G	Vegetation

SANTA SUSANA FIELD LABORATORY

- Administrative Area Boundary
- County Boundary
- RFI Sites
- Surrounding Property
- Highway
- Streets
- Streams
- Contour

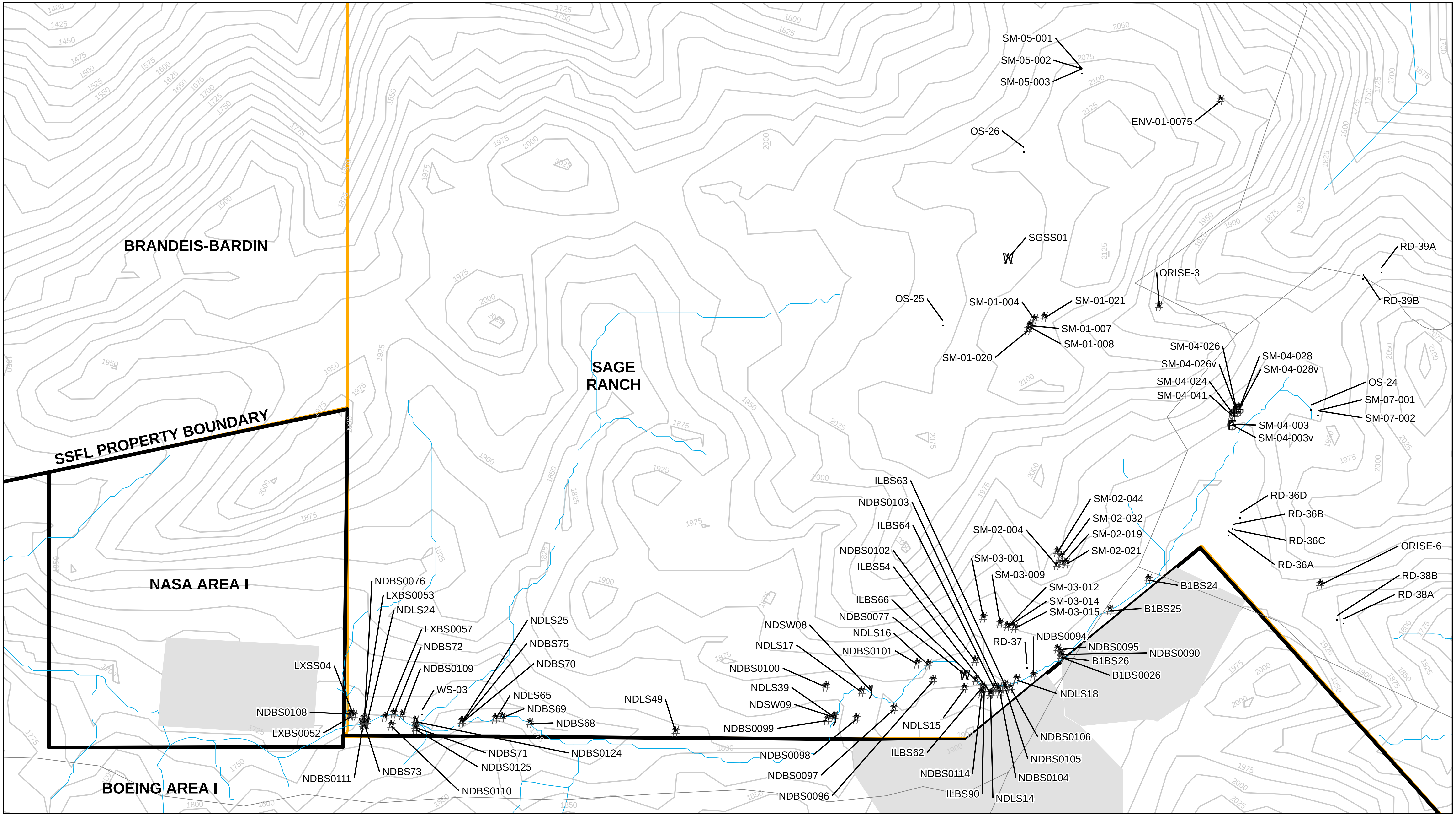
Offsite Sampling Near Santa Susana Field Laboratory - Brandeis Bardin North

Date: Dec 13, 2007

Document: Offsite-Report_Samples_c_11x17.mxd

MWH

FIGURE 2-1.C



1 inch equals 400 feet

Feet
0 400 800

Sample Locations

Multimedia
Soil/Sediment
Groundwater
Surface Water
Spring/Seep
Vegetation

SANTA SUSANA FIELD LABORATORY

Administrative Area Boundary
County Boundary
RFI Sites
Surrounding Property
Highway
Streets
Streams
Contour

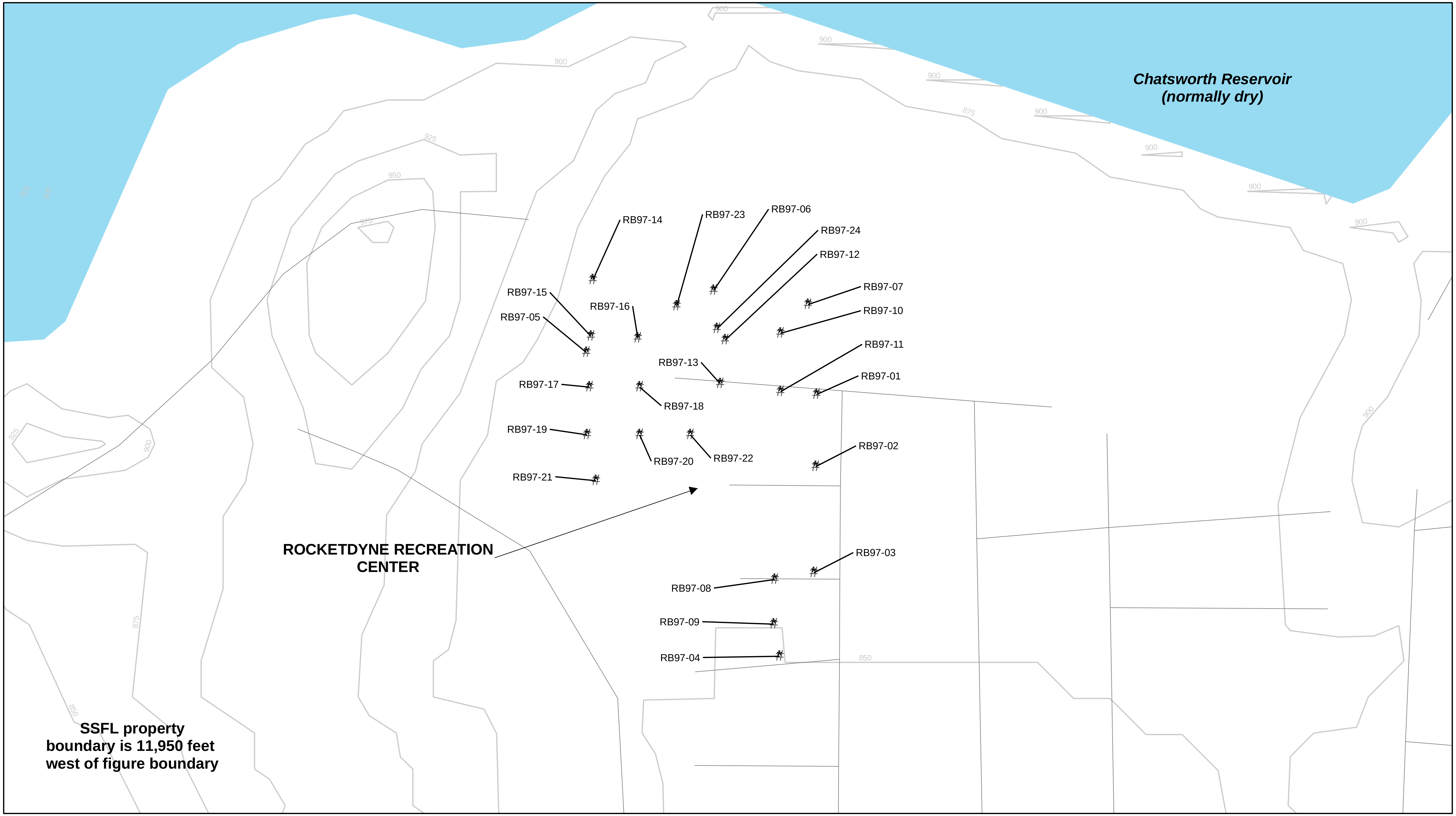
Offsite Sampling Near Santa Susana Field Laboratory - Sage Ranch

Date: Dec 13, 2007

Document: Offsite-Report_Samples_d_11x17.mxd

MWH

FIGURE
2-1.D



1 inch equals 250 feet

0 250 500 Feet

Sample Locations

- Multimedia
- Groundwater
- Spring/Seep
- Soil/Sediment
- Surface Water
- Vegetation

SANTA SUSANA FIELD LABORATORY

- **Administrative Area Boundary**
- **County Boundary**
- **RFI Sites**
- **Surrounding Property**
- **Highway**
- **Streets**
- **Streams**
- **Contour**

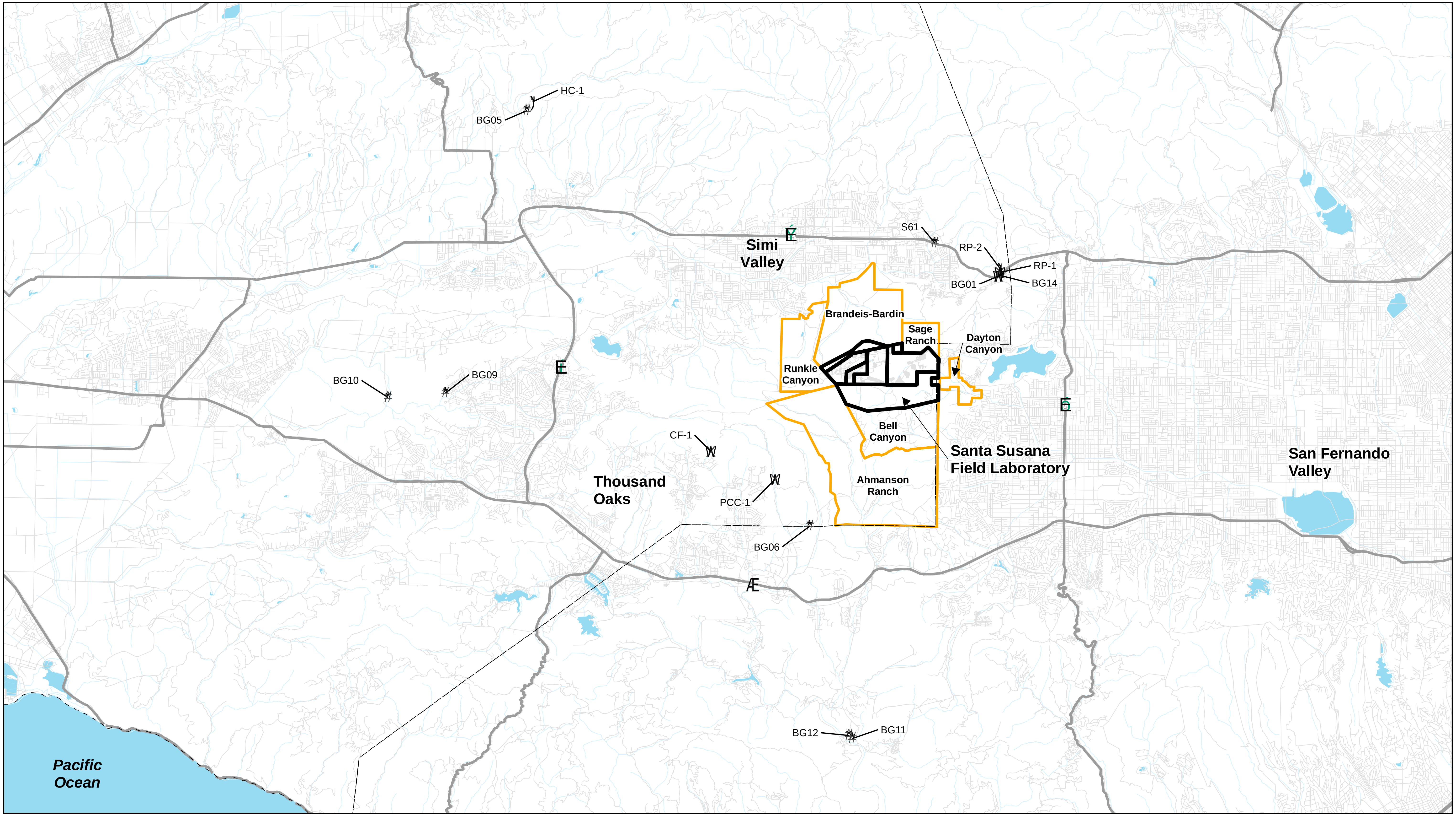
Offsite Sampling Near Santa Susana Field Laboratory- Rocketdyne Recreation Center

Date: Dec 13, 2007

Document: Offsite-Report_Samples_e_11x17.mxd

MWH

FIGURE 2-1.E



1 inch equals 2.5 miles

0 2.5 5 Miles

Sample Locations

	Multimedia		Soil/Sediment
	Groundwater		Surface Water
	Spring/Seep		Vegetation

SANTA SUSANA FIELD LABORATORY

	Administrative Area Boundary		Highway
	County Boundary		Streets
	RFI Sites		Streams
	Surrounding Property		

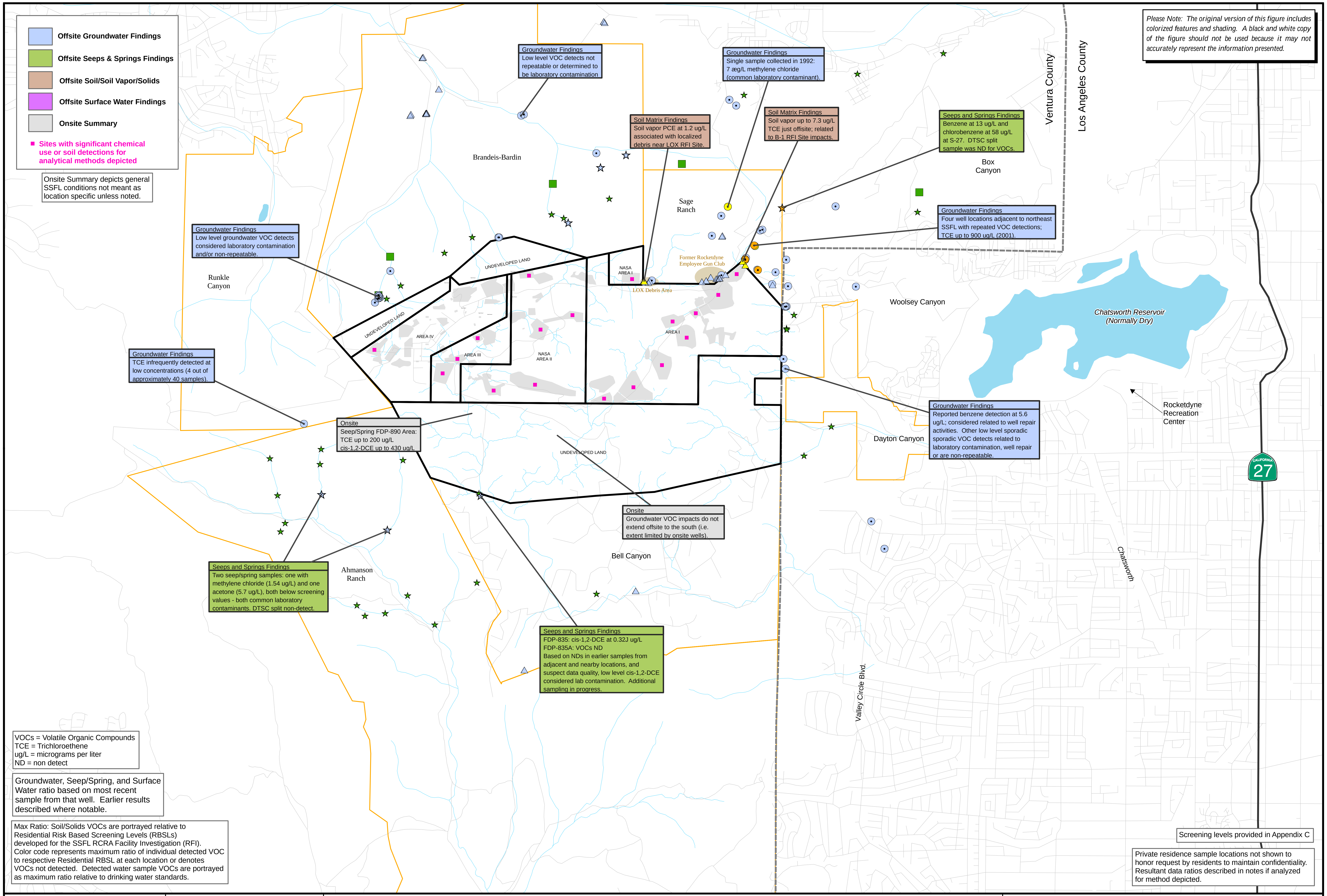
Offsite Sampling Distant From Santa Susana Field Laboratory

Date: Dec 13, 2007

Document: Offsite-Report_Samples_f_11x17.mxd

MWH

FIGURE 2-2



🟦 **Offsite Groundwater Findings**
🟩 **Offsite Seeps & Springs Findings**
🟫 **Offsite Soil/Soil Vapor/Solids**
🟪 **Offsite Surface Water Findings**
⬜ **Onsite Summary**
■ **Sites with significant chemical use or soil detections for analytical methods depicted**

Onsite Summary depicts general SSFL conditions not meant as location specific unless noted.

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Groundwater Findings
Low level VOC detects not repeatable or determined to be laboratory contamination

Soil Matrix Findings
Soil vapor PCE at 1.2 ug/L associated with localized debris near LOX RFI Site.

Groundwater Findings
Single sample collected in 1992: 7 æg/L methylene chloride (common laboratory contaminant).

Soil Matrix Findings
Soil vapor up to 7.3 ug/L TCE just offsite; related to B-1 RFI Site impacts.

Seeps and Springs Findings
Benzene at 13 ug/L and chlorobenzene at 58 ug/L at S-27. DTSC split sample was ND for VOCs.

Groundwater Findings
Four well locations adjacent to northeast SSFL with repeated VOC detections; TCE up to 900 ug/L (2001).

Groundwater Findings
Low level groundwater VOC detects considered laboratory contamination and/or non-repeatable.

Groundwater Findings
TCE infrequently detected at low concentrations (4 out of approximately 40 samples).

Onsite
Seep/Spring FDP-890 Area:
TCE up to 200 ug/L
cis-1,2-DCE up to 430 ug/L

Groundwater Findings
Reported benzene detection at 5.6 ug/L; considered related to well repair activities. Other low level sporadic sporadic VOC detects related to laboratory contamination, well repair or are non-repeatable.

Onsite
Groundwater VOC impacts do not extend offsite to the south (i.e. extent limited by onsite wells).

Seeps and Springs Findings
Two seep/spring samples: one with methylene chloride (1.54 ug/L) and one acetone (5.7 ug/L), both below screening values - both common laboratory contaminants. DTSC split non-detect.

Seeps and Springs Findings
FDP-835: cis-1,2-DCE at 0.32J ug/L
FDP-835A: VOCs ND
Based on NDs in earlier samples from adjacent and nearby locations, and suspect data quality, low level cis-1,2-DCE considered lab contamination. Additional sampling in progress.

VOCs = Volatile Organic Compounds
TCE = Trichloroethene
ug/L = micrograms per liter
ND = non detect

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Max Ratio: Soil/Solids VOCs are portrayed relative to Residential Risk Based Screening Levels (RBSLs) developed for the SSFL RCRA Facility Investigation (RFI). Color code represents maximum ratio of individual detected VOC to respective Residential RBSL at each location or denotes VOCs not detected. Detected water sample VOCs are portrayed as maximum ratio relative to drinking water standards.

Screening levels provided in Appendix C

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend
Administrative Area Boundary
County Boundary
RFI Boundary
Properties
Highway
Streets
Drainages

Offsite Soil Matrix/Solids (e.g. Debris) /Soil Vapor Max Ratio
△ < Res RBSL
△ < 10 x Res RBSL
▲ **Offsite Soil Matrix/Solids/Soil Vapor Non-Detect**

Offsite Groundwater Max Ratio
⊙ < Drinking Water Standards
⊙ < 10 x Drinking Water Standards
⊙ < 100 x Drinking Water Standards
● **Offsite Groundwater Non-Detect**

Offsite Surface Water Max Ratio
🟦 < Drinking Water Standards
🟨 < 10 x Drinking Water Standards
🟧 < 100 x Drinking Water Standards
🟩 **Offsite Surface Water Non-Detect**

Offsite Seeps/Springs Max Ratio
☆ < Drinking Water Standards
☆ < 10 x Drinking Water Standards
☆ < 15 x Drinking Water Standards
★ **Offsite Seeps/Springs Non-Detect**

VOC Summary for All Media Areas Offsite of SSFL

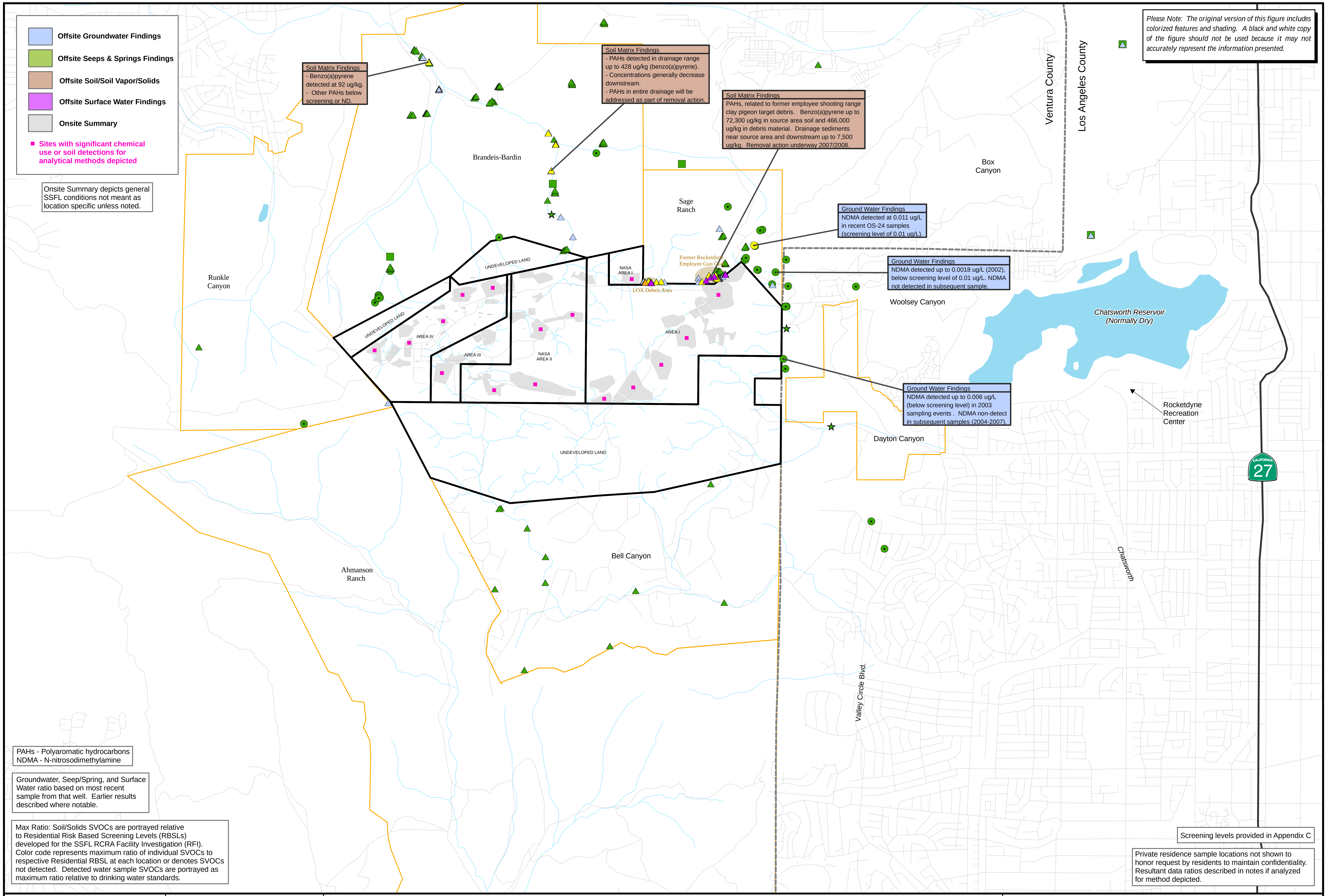
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 14, 2007

Document: Offsite-Report-VOC_Summary.mxd

FIGURE 3-1



- 🟦 Offsite Groundwater Findings
- 🟩 Offsite Seeps & Springs Findings
- 🟫 Offsite Soil/Soil Vapor/Solids
- 🟪 Offsite Surface Water Findings
- ⬜ Onsite Summary
- ■ Sites with significant chemical use or soil detections for analytical methods depicted

Onsite Summary depicts general SSFL conditions not meant as location specific unless noted.

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Soil Matrix Findings
- Benzo(a)pyrene detected at 92 ug/kg.
- Other PAHs below screening or ND.

Soil Matrix Findings
- PAHs detected in drainage range up to 428 ug/kg (benzo(a)pyrene).
- Concentrations generally decrease downstream.
- PAHs in entire drainage will be addressed as part of removal action.

Soil Matrix Findings
PAHs, related to former employee shooting range clay pigeon target debris. Benzo(a)pyrene up to 72,300 ug/kg in source area soil and 466,000 ug/kg in debris material. Drainage sediments near source area and downstream up to 7,500 ug/kg. Removal action underway 2007/2008.

Ground Water Findings
NDMA detected at 0.011 ug/L in recent OS-24 samples (screening level of 0.01 ug/L).

Ground Water Findings
NDMA detected up to 0.0018 ug/L (2002), below screening level of 0.01 ug/L. NDMA not detected in subsequent sample.

Ground Water Findings
NDMA detected up to 0.006 ug/L (below screening level) in 2003 sampling events . NDMA non-detect in subsequent samples (2004-2007).

PAHs - Polyaromatic hydrocarbons
NDMA - N-nitrosodimethylamine

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Max Ratio: Soil/Solids SVOCs are portrayed relative to Residential Risk Based Screening Levels (RBSLs) developed for the SSFL RCRA Facility Investigation (RFI). Color code represents maximum ratio of individual SVOCs to respective Residential RBSL at each location or denotes SVOCs not detected. Detected water sample SVOCs are portrayed as maximum ratio relative to drinking water standards.

Screening levels provided in Appendix C

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend
- ☐ Administrative Area Boundary
- ⬚ County Boundary
- ▨ RFI Boundary
- ☐ Properties
- Highway
- Streets
- Drainages

Offsite Soil Matrix/Solids (e.g. Debris) Max Ratio
- △ < Res RBSL
- △ < 10 x Res RBSL
- △ < 100 x Res RBSL
- △ > 100 x Res RBSL
- ▲ Offsite Soil Matrix/Solids Non-Detect

Offsite Groundwater Max Ratio
- ⊙ < 10 x Drinking Water Standards
- ⊙ Offsite Groundwater Non-Detect

Offsite Surface Water Max Ratio
- ■ Offsite Surface Water Non-Detect

Offsite Seeps/Springs Max Ratio
- ★ Offsite Seeps/Springs Non-Detect

SVOC Summary for All Media Areas Offsite of SSFL

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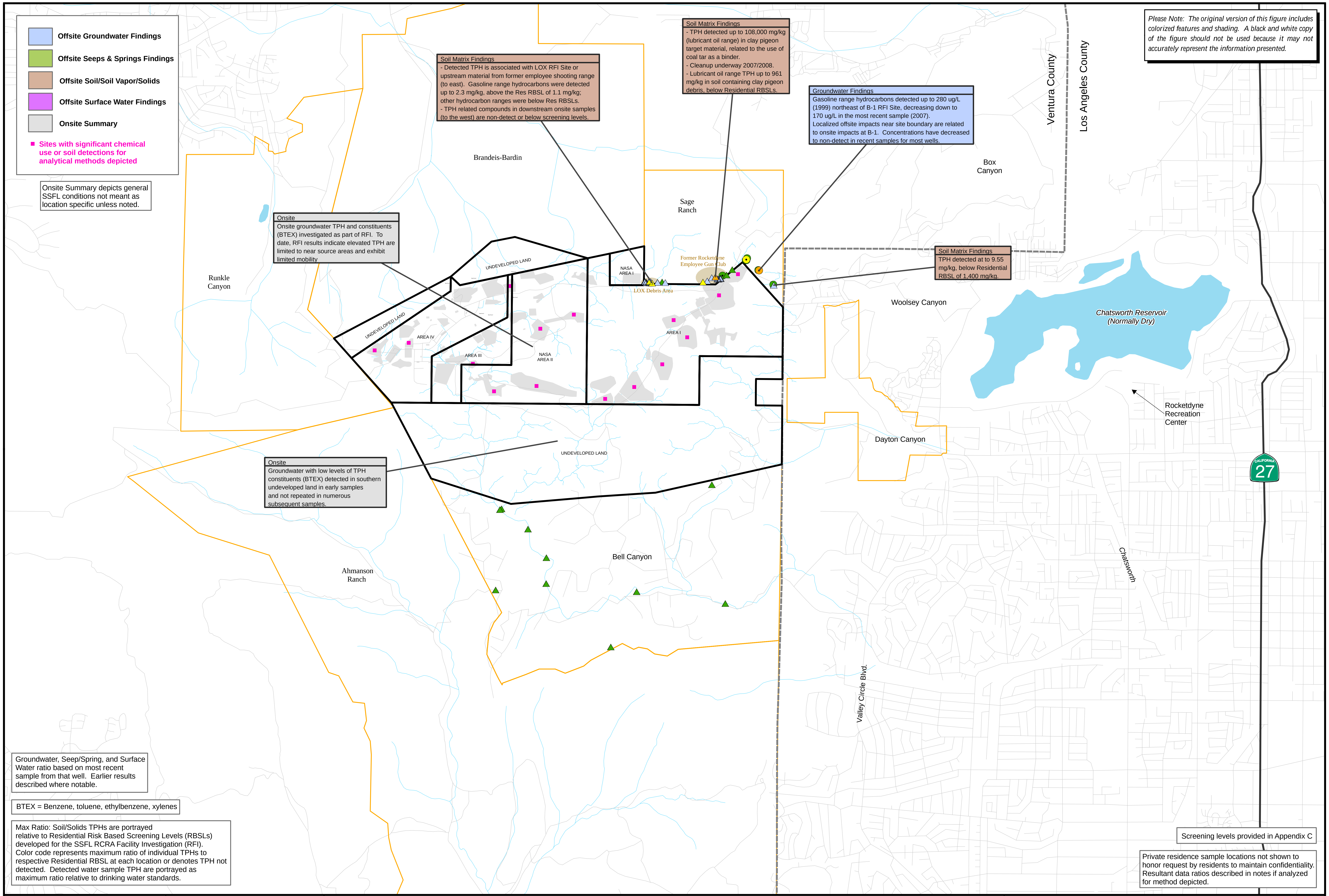
MWH

Date: Dec 14, 2007

Document: Offsite-Report-SVOC_Summary.mxd

FIGURE 3-2



🟦 Offsite Groundwater Findings

🟩 Offsite Seeps & Springs Findings

🟫 Offsite Soil/Soil Vapor/Solids

🟪 Offsite Surface Water Findings

⬜ Onsite Summary

■ Sites with significant chemical use or soil detections for analytical methods depicted

Onsite Summary depicts general SSFL conditions not meant as location specific unless noted.

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Soil Matrix Findings

- Detected TPH is associated with LOX RFI Site or upstream material from former employee shooting range (to east). Gasoline range hydrocarbons were detected up to 2.3 mg/kg, above the Res RBSL of 1.1 mg/kg; other hydrocarbon ranges were below Res RBSLs.
- TPH related compounds in downstream onsite samples (to the west) are non-detect or below screening levels.

Soil Matrix Findings

- TPH detected up to 108,000 mg/kg (lubricant oil range) in clay pigeon target material, related to the use of coal tar as a binder.
- Cleanup underway 2007/2008.
- Lubricant oil range TPH up to 961 mg/kg in soil containing clay pigeon debris, below Residential RBSLs.

Groundwater Findings

Gasoline range hydrocarbons detected up to 280 ug/L (1999) northeast of B-1 RFI Site, decreasing down to 170 ug/L in the most recent sample (2007). Localized offsite impacts near site boundary are related to onsite impacts at B-1. Concentrations have decreased to non-detect in recent samples for most wells.

Onsite

Onsite groundwater TPH and constituents (BTEX) investigated as part of RFI. To date, RFI results indicate elevated TPH are limited to near source areas and exhibit limited mobility

Soil Matrix Findings

TPH detected at to 9.55 mg/kg, below Residential RBSL of 1,400 mg/kg.

Onsite

Groundwater with low levels of TPH constituents (BTEX) detected in southern undeveloped land in early samples and not repeated in numerous subsequent samples.

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

BTEX = Benzene, toluene, ethylbenzene, xylenes

Max Ratio: Soil/Solids TPHs are portrayed relative to Residential Risk Based Screening Levels (RBSLs) developed for the SSFL RCRA Facility Investigation (RFI). Color code represents maximum ratio of individual TPHs to respective Residential RBSL at each location or denotes TPH not detected. Detected water sample TPH are portrayed as maximum ratio relative to drinking water standards.

Screening levels provided in Appendix C

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

N

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend

- Administrative Area Boundary
- County Boundary
- RFI Boundary
- Properties
- Highway
- Streets
- Drainages

Offsite Soil Matrix Max Ratio

- △ < Res RBSL
- △ < 10 x RES RBSL
- △ < 100 x Res RBSL
- ▲ Offsite Soil Matrix/Solids/Soil Vapor Non-Detect

Offsite Groundwater Max Ratio

- ● < 10 x Drinking Water Standards
- ● > 10 x Drinking Water Standards
- ● Offsite Groundwater Non-Detect

TPH Summary for All Media Areas Offsite of SSFL

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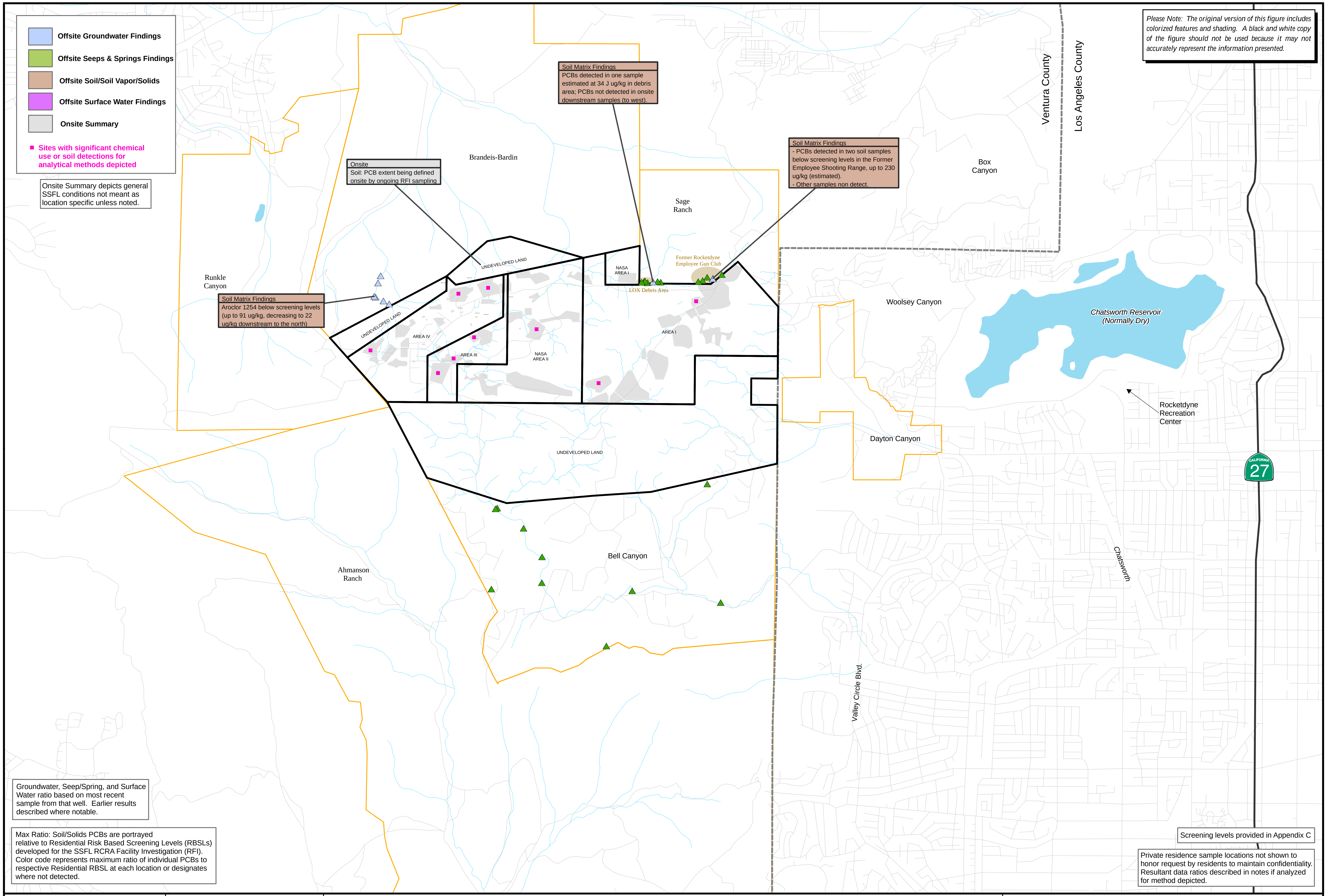
Date: Dec 14, 2007

Document: Offsite-Report-TPH_Summary.mxd

FIGURE 3-3



🟦 Offsite Groundwater Findings

🟩 Offsite Seeps & Springs Findings

🟫 Offsite Soil/Soil Vapor/Solids

🟪 Offsite Surface Water Findings

⬜ Onsite Summary

■ Sites with significant chemical use or soil detections for analytical methods depicted

Onsite Summary depicts general SSFL conditions not meant as location specific unless noted.

Please Note: *The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.*

Soil Matrix Findings
PCBs detected in one sample estimated at 34 J ug/kg in debris area; PCBs not detected in onsite downstream samples (to west).

Soil Matrix Findings
- PCBs detected in two soil samples below screening levels in the Former Employee Shooting Range, up to 230 ug/kg (estimated).
- Other samples non detect.

Onsite
Soil: PCB extent being defined onsite by ongoing RFI sampling

Soil Matrix Findings
Aroclor 1254 below screening levels (up to 91 ug/kg, decreasing to 22 ug/kg downstream to the north)

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Max Ratio: Soil/Solids PCBs are portrayed relative to Residential Risk Based Screening Levels (RBSLs) developed for the SSFL RCRA Facility Investigation (RFI). Color code represents maximum ratio of individual PCBs to respective Residential RBSL at each location or designates where not detected.

Screening levels provided in Appendix C

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

N

1 inch equals 2,500 feet

0 2,000 4,000 Feet

Base Map Legend

▢ **Administrative Area Boundary**	**Highway**
⬚ **County Boundary**	**Streets**
⬜ **RFI Boundary**	**Drainages**
▢ **Properties**	

Offsite Soil Matrix/Solids (e.g. Debris) Max Ratio

△ < Res RBSL

▲ Offsite Soil Matrix/Solids Non-Detect

PCB Summary for All Media Areas Offsite of SSFL

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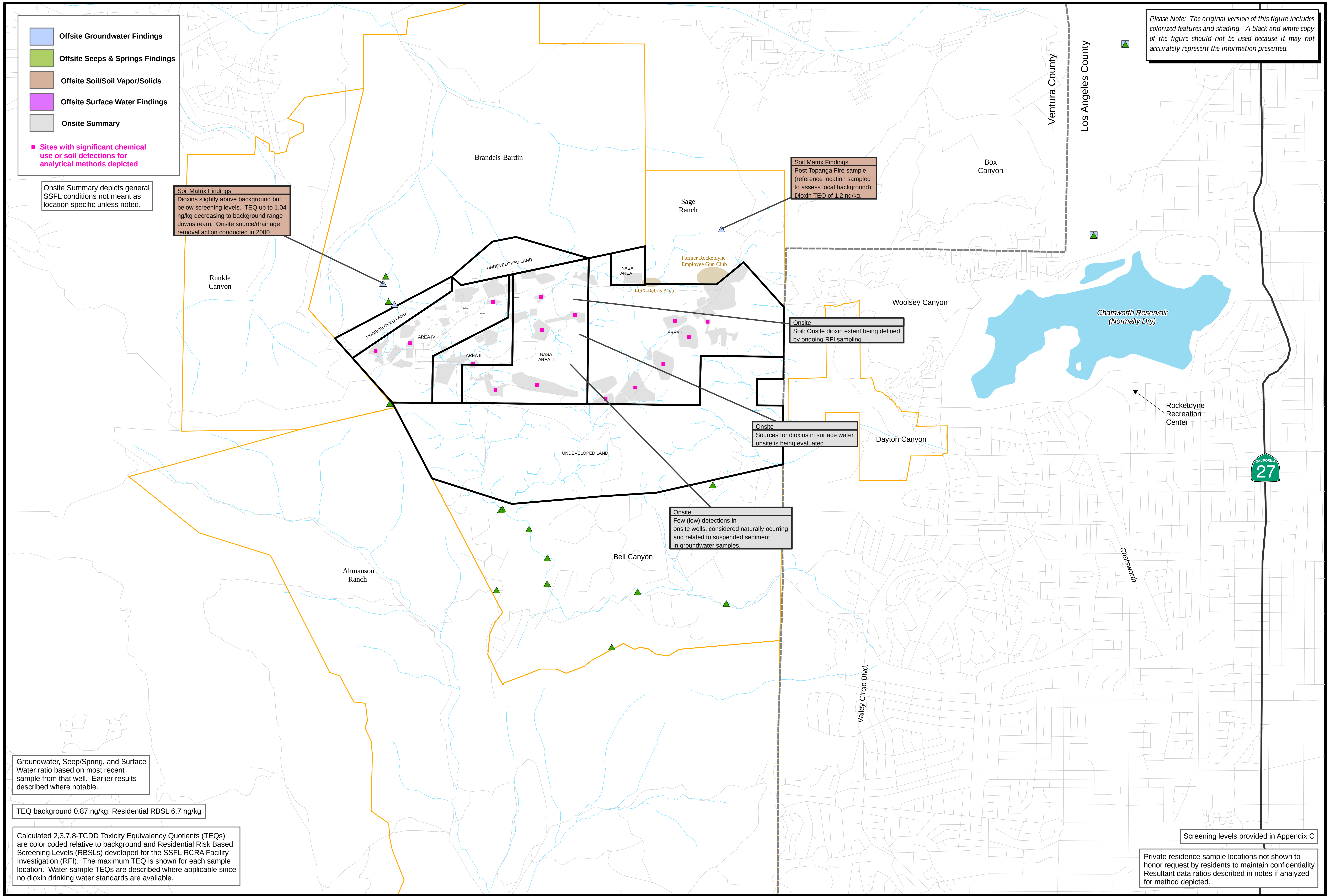
Date: Dec 14, 2007

Document: Offsite-Report-PCB_Summary_x.mxd

FIGURE 3-4



🟦 Offsite Groundwater Findings
🟩 Offsite Seeps & Springs Findings
🟫 Offsite Soil/Soil Vapor/Solids
🟪 Offsite Surface Water Findings
⬜ Onsite Summary

■ Sites with significant chemical use or soil detections for analytical methods depicted

Onsite Summary depicts general SSFL conditions not meant as location specific unless noted.

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Soil Matrix Findings
Dioxins slightly above background but below screening levels. TEQ up to 1.04 ng/kg decreasing to background range downstream. Onsite source/drainage removal action conducted in 2000.

Soil Matrix Findings
Post Topanga Fire sample (reference location sampled to assess local background): Dioxin TEQ of 1.2 ng/kg.

Onsite
Soil: Onsite dioxin extent being defined by ongoing RFI sampling.

Onsite
Sources for dioxins in surface water onsite is being evaluated.

Onsite
Few (low) detections in onsite wells, considered naturally ocurring and related to suspended sediment in groundwater samples.

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

TEQ background 0.87 ng/kg; Residential RBSL 6.7 ng/kg

Calculated 2,3,7,8-TCDD Toxicity Equivalency Quotients (TEQs) are color coded relative to background and Residential Risk Based Screening Levels (RBSLs) developed for the SSFL RCRA Facility Investigation (RFI). The maximum TEQ is shown for each sample location. Water sample TEQs are described where applicable since no dioxin drinking water standards are available.

Screening levels provided in Appendix C

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

N

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend
- **Administrative Area Boundary**
- **County Boundary**
- **RFI Boundary**
- **Properties**
- **Highway**
- **Streets**
- **Drainages**

Max Ratio

Offsite Soil Matrix Max Ratio
▲ < Background
△ < Res RBSL

Offsite Surface Water Max Ratio
🟦 TEQ up to 0.0013 ng/L (No Drinking Water Standard)

Dioxin Summary for All Media Areas Offsite of SSFL

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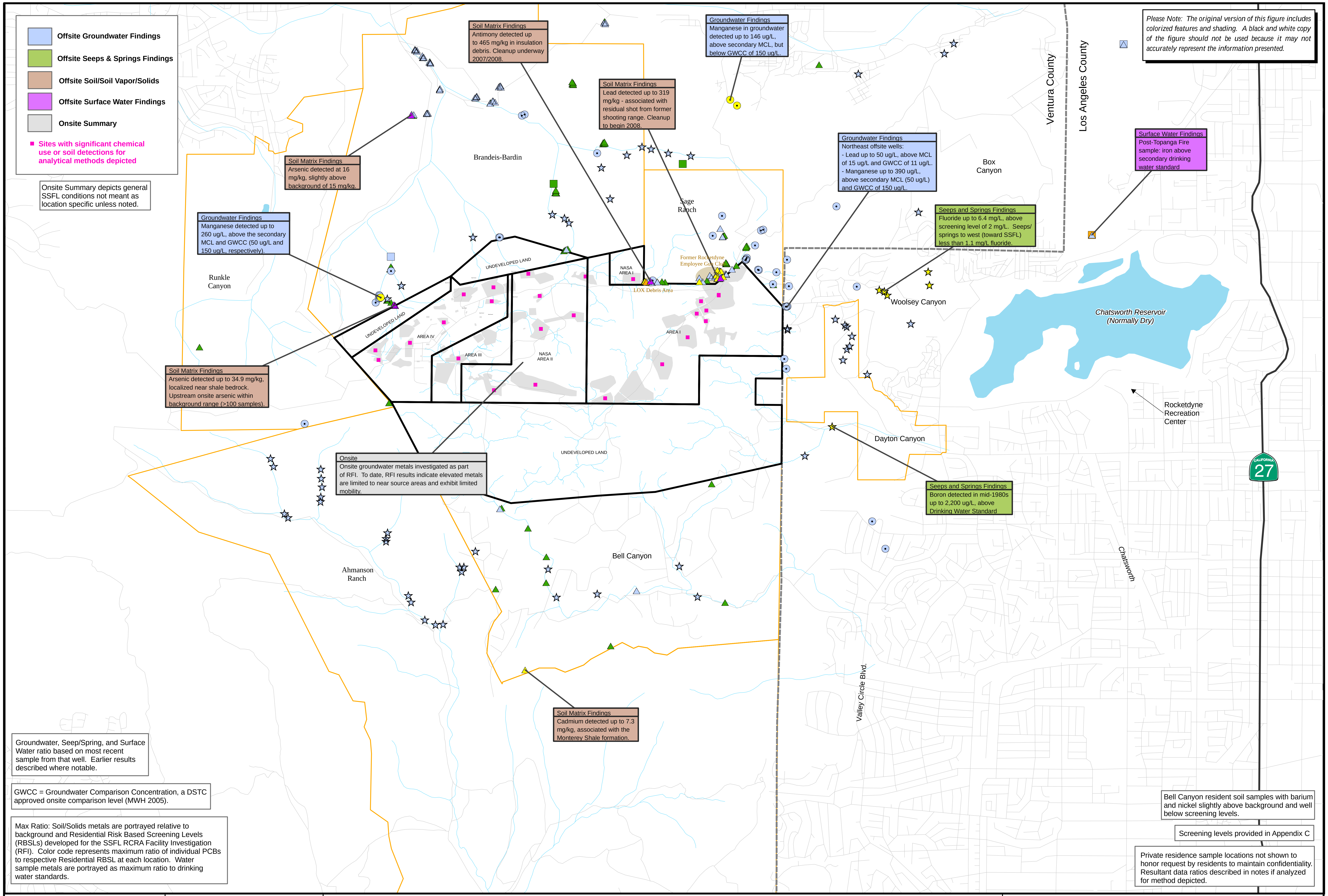
MWH

Date: Dec 14, 2007

Document: Offsite-Report-Dioxin_Summary.mxd

FIGURE
3-5



Offsite Groundwater Findings
Offsite Seeps & Springs Findings
Offsite Soil/Soil Vapor/Solids
Offsite Surface Water Findings
Onsite Summary

- Sites with significant chemical use or soil detections for analytical methods depicted

Onsite Summary depicts general SSFL conditions not meant as location specific unless noted.

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Soil Matrix Findings
Antimony detected up to 465 mg/kg in insulation debris. Cleanup underway 2007/2008.

Soil Matrix Findings
Lead detected up to 319 mg/kg - associated with residual shot from former shooting range. Cleanup to begin 2008.

Groundwater Findings
Manganese in groundwater detected up to 146 ug/L, above secondary MCL, but below GWCC of 150 ug/L.

Soil Matrix Findings
Arsenic detected at 16 mg/kg, slightly above background of 15 mg/kg.

Groundwater Findings
Northeast offsite wells:
- Lead up to 50 ug/L, above MCL of 15 ug/L and GWCC of 11 ug/L.
- Manganese up to 390 ug/L, above secondary MCL (50 ug/L) and GWCC of 150 ug/L.

Surface Water Findings
Post-Topanga Fire sample: iron above secondary drinking water standard

Groundwater Findings
Manganese detected up to 260 ug/L, above the secondary MCL and GWCC (50 ug/L and 150 ug/L, respectively).

Seeps and Springs Findings
Fluoride up to 6.4 mg/L, above screening level of 2 mg/L. Seeps/springs to west (toward SSFL) less than 1.1 mg/L fluoride.

Soil Matrix Findings
Arsenic detected up to 34.9 mg/kg, localized near shale bedrock. Upstream onsite arsenic within background range (>100 samples).

Onsite
Onsite groundwater metals investigated as part of RFI. To date, RFI results indicate elevated metals are limited to near source areas and exhibit limited mobility.

Seeps and Springs Findings
Boron detected in mid-1980s up to 2,200 ug/L, above Drinking Water Standard

Soil Matrix Findings
Cadmium detected up to 7.3 mg/kg, associated with the Monterey Shale formation.

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

GWCC = Groundwater Comparison Concentration, a DSTC approved onsite comparison level (MWH 2005).

Max Ratio: Soil/Solids metals are portrayed relative to background and Residential Risk Based Screening Levels (RBSLs) developed for the SSFL RCRA Facility Investigation (RFI). Color code represents maximum ratio of individual PCBs to respective Residential RBSL at each location. Water sample metals are portrayed as maximum ratio to drinking water standards.

Bell Canyon resident soil samples with barium and nickel slightly above background and well below screening levels.

Screening levels provided in Appendix C

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend
Administrative Area Boundary
County Boundary
RFI Boundary
Properties
Highway
Streets
Drainages

Offsite Soil Matrix/Solids (e.g. Debris) Max Ratio
- △ < Res RBSL
- ▲ < 10 x Res RBSL
- ▲ < 100 x Res RBSL
- ▲ > 100 x Res RBSL
- ▲ Offsite Soil Matrix/Solids Non-Detect or < Background

Offsite Groundwater Max Ratio
- ⊙ < Drinking Water Standards
- ⊙ < 10 x Drinking Water Standards

Offsite Surface Water Max Ratio
- ☐ < Drinking Water Standards
- ■ < 10 x Drinking Water Standards
- ■ < 100 x Drinking Water Standards
- ■ Offsite Surface Water Non-Detect

Offsite Seeps/Springs Max Ratio
- ☆ < Drinking Water Standards
- ★ < 10 x Drinking Water Standards

Metals Summary for All Media Areas Offsite of SSFL

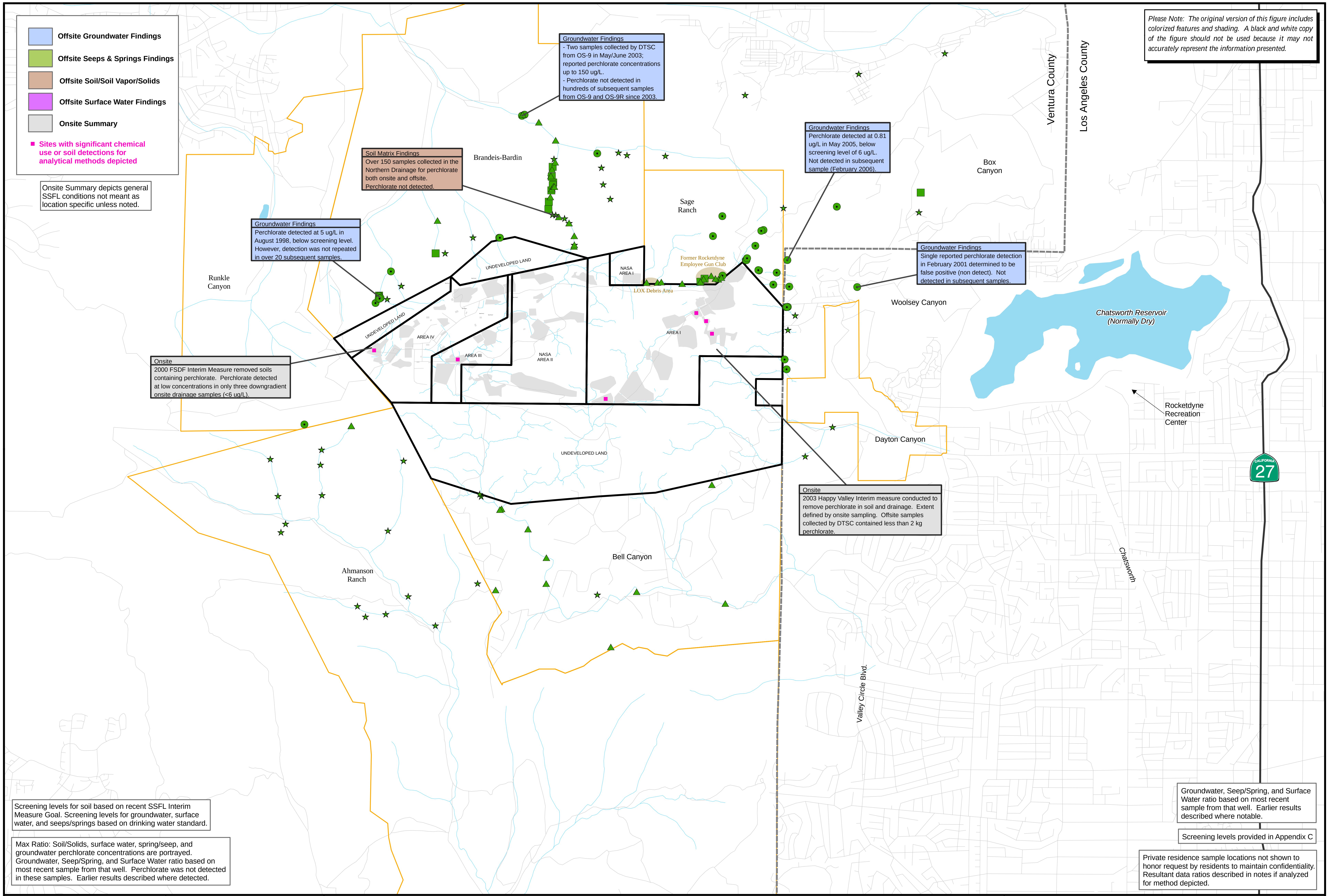
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 14, 2007

Document: Offsite-Report-Metals_Summary.mxd

FIGURE 3-6



- 🟦 **Offsite Groundwater Findings**
- 🟩 **Offsite Seeps & Springs Findings**
- 🟫 **Offsite Soil/Soil Vapor/Solids**
- 🟪 **Offsite Surface Water Findings**
- ⬜ **Onsite Summary**
- ■ **Sites with significant chemical use or soil detections for analytical methods depicted**

Onsite Summary depicts general SSFL conditions not meant as location specific unless noted.

Groundwater Findings
- Two samples collected by DTSC from OS-9 in May/June 2003; reported perchlorate concentrations up to 150 ug/L.
- Perchlorate not detected in hundreds of subsequent samples from OS-9 and OS-9R since 2003.

Soil Matrix Findings
Over 150 samples collected in the Northern Drainage for perchlorate both onsite and offsite. Perchlorate not detected.

Groundwater Findings
Perchlorate detected at 5 ug/L in August 1998, below screening level. However, detection was not repeated in over 20 subsequent samples.

Onsite
2000 FSDF Interim Measure removed soils containing perchlorate. Perchlorate detected at low concentrations in only three downgradient onsite drainage samples (<6 ug/L).

Groundwater Findings
Perchlorate detected at 0.81 ug/L in May 2005, below screening level of 6 ug/L. Not detected in subsequent sample (February 2006).

Groundwater Findings
Single reported perchlorate detection in February 2001 determined to be false positive (non detect). Not detected in subsequent samples.

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Onsite
2003 Happy Valley Interim measure conducted to remove perchlorate in soil and drainage. Extent defined by onsite sampling. Offsite samples collected by DTSC contained less than 2 kg perchlorate.

Screening levels for soil based on recent SSFL Interim Measure Goal. Screening levels for groundwater, surface water, and seeps/springs based on drinking water standard.

Max Ratio: Soil/Solids, surface water, spring/seep, and groundwater perchlorate concentrations are portrayed. Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Perchlorate was not detected in these samples. Earlier results described where detected.

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Screening levels provided in Appendix C

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend
- ▭ **Administrative Area Boundary**
- ▭ **County Boundary**
- ▨ **RFI Boundary**
- ▭ **Properties**
- **Highway**
- **Streets**
- **Drainages**

Offsite Soil Matrix/Solids (e.g. Debris) Max Ratio
▲ **Offsite Soil Matrix/Solids Non-Detect**

Offsite Groundwater Max Ratio
⊙ Offsite Groundwater Non-Detect

Offsite Surface Water Max Ratio
■ **Offsite Surface Water Non-Detect**

Offsite Seeps/Springs Max Ratio
★ **Offsite Seeps/Springs Non-Detect**

Perchlorate Summary for All Media Areas Offsite of SSFL

SANTA SUSANA FIELD LABORATORY

MWH

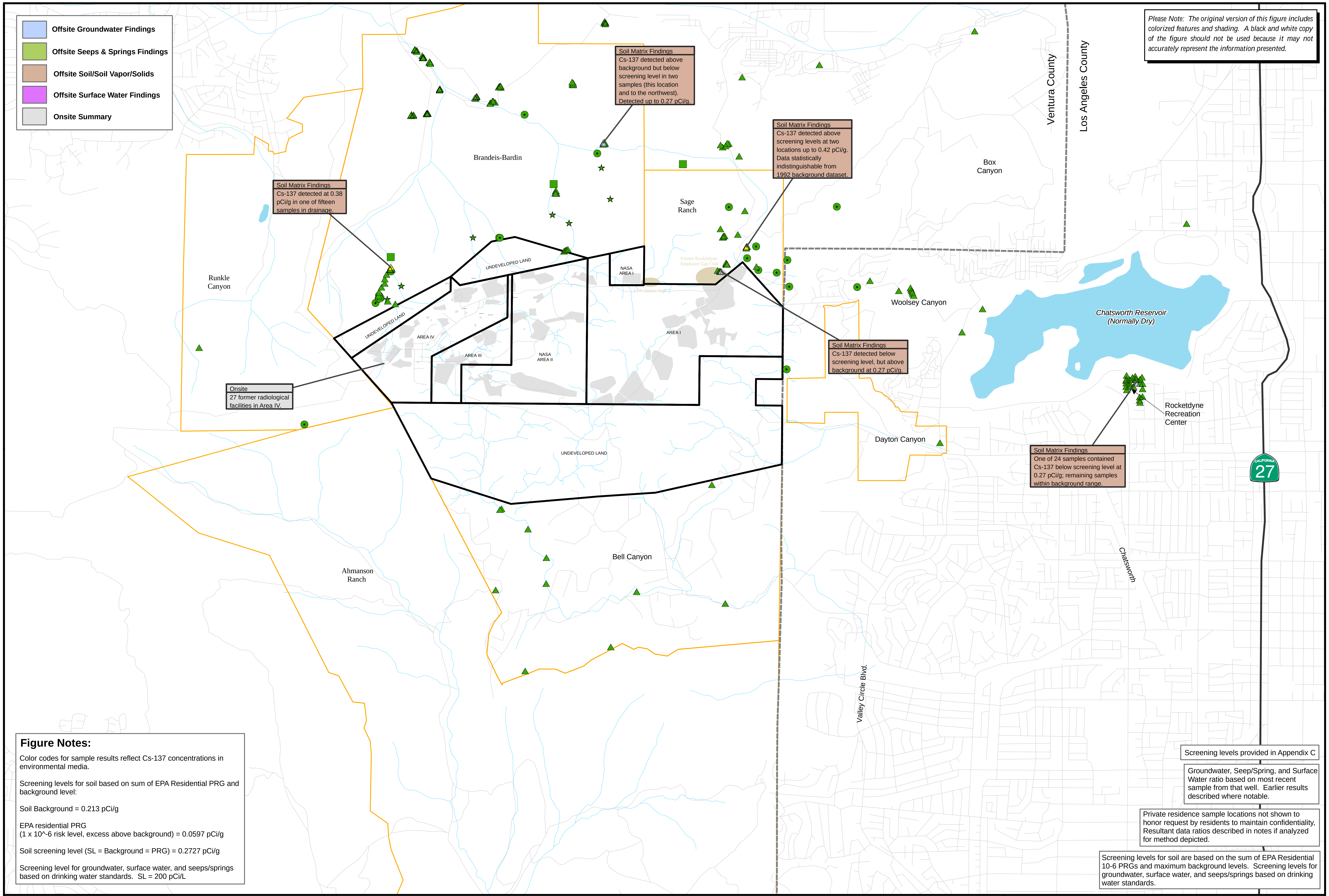
Date: Dec 14, 2007

Document: Offsite-Report-Perchlorate_Summary.mxd

FIGURE
3-7

- 🟦 Offsite Groundwater Findings
- 🟩 Offsite Seeps & Springs Findings
- 🟫 Offsite Soil/Soil Vapor/Solids
- 🟪 Offsite Surface Water Findings
- ⬜ Onsite Summary

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.



Soil Matrix Findings
Cs-137 detected above background but below screening level in two samples (this location and to the northwest). Detected up to 0.27 pCi/g.

Soil Matrix Findings
Cs-137 detected above screening levels at two locations up to 0.42 pCi/g. Data statistically indistinguishable from 1992 background dataset.

Soil Matrix Findings
Cs-137 detected at 0.38 pCi/g in one of fifteen samples in drainage.

Soil Matrix Findings
Cs-137 detected below screening level, but above background at 0.27 pCi/g.

Onsite
27 former radiological facilities in Area IV.

Soil Matrix Findings
One of 24 samples contained Cs-137 below screening level at 0.27 pCi/g; remaining samples within background range.

Screening levels provided in Appendix C

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

Screening levels for soil are based on the sum of EPA Residential 10-6 PRGs and maximum background levels. Screening levels for groundwater, surface water, and seeps/springs based on drinking water standards.

Figure Notes:

Color codes for sample results reflect Cs-137 concentrations in environmental media.

Screening levels for soil based on sum of EPA Residential PRG and background level:

Soil Background = 0.213 pCi/g

EPA residential PRG
(1 x 10^-6 risk level, excess above background) = 0.0597 pCi/g

Soil screening level (SL = Background = PRG) = 0.2727 pCi/g

Screening level for groundwater, surface water, and seeps/springs based on drinking water standards. SL = 200 pCi/L

N

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend

- **Administrative Area Boundary**
- **County Boundary**
- **RFI Boundary**
- **Properties**
- **Highway**
- **Streets**
- **Drainages**

Offsite Soil Matrix/Solids (e.g. Debris) Results

- ▲ < Background
- ▲ < Screening Level
- ▲ > Screening Level
- ▲ **Offsite Soil Matrix/Solids Non-Detect**

Offsite Groundwater Max Result

- ● **Offsite Groundwater Non-Detect**

Offsite Surface Water Max Results

- ■ **Offsite Surface Water Non-Detect**

Offsite Seeps/Springs Max Results

- ★ **Offsite Seeps/Springs Non-Detect**

Cesium-137 Summary for All Media Areas Offsite of SSFL

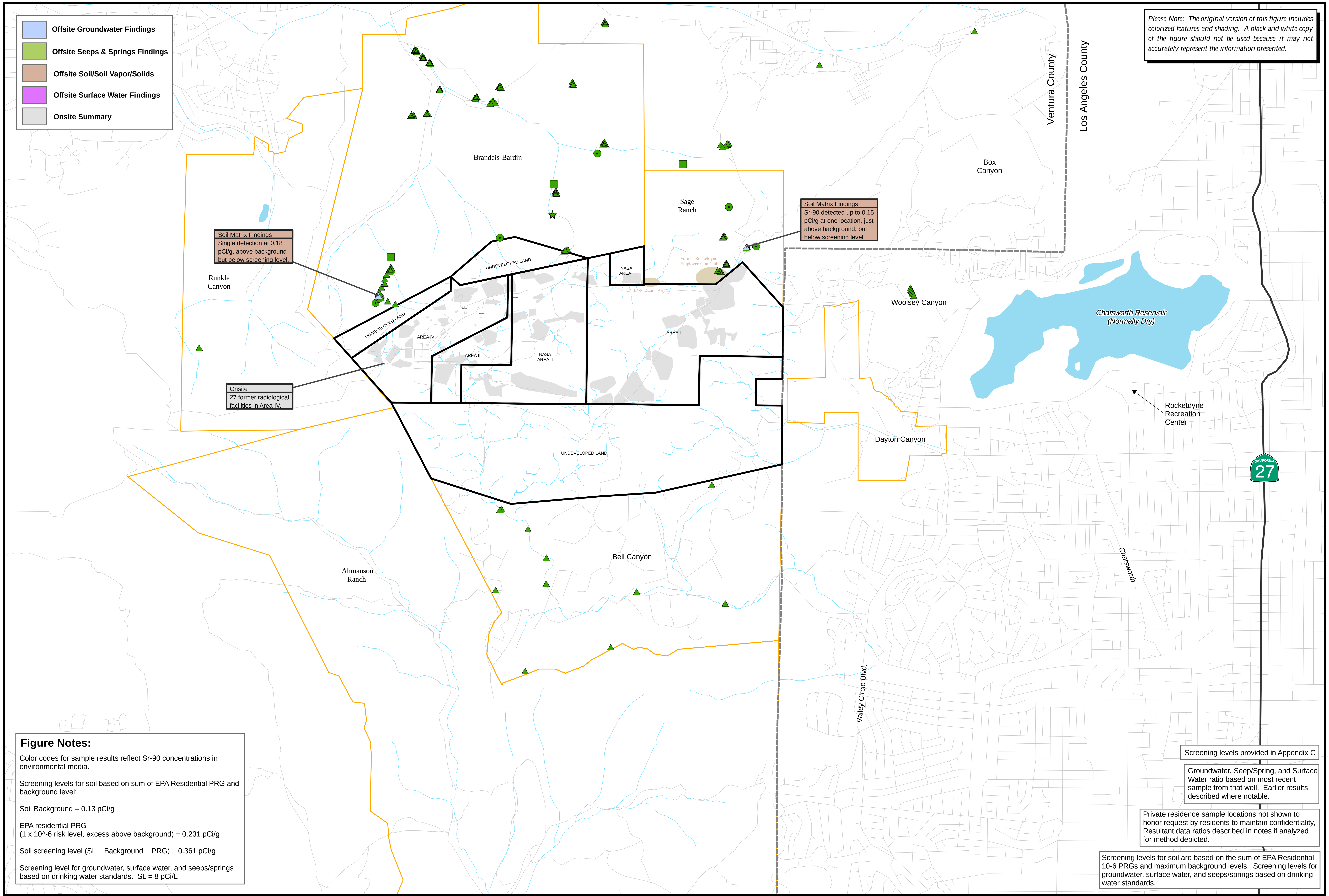
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 13, 2007

Document: Offsite-Report-Cesium_Summary.mxd

FIGURE 3-8



Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Soil Matrix Findings
Single detection at 0.18 pCi/g, above background but below screening level.

Soil Matrix Findings
Sr-90 detected up to 0.15 pCi/g at one location, just above background, but below screening level.

Onsite
27 former radiological facilities in Area IV.

Figure Notes:

Color codes for sample results reflect Sr-90 concentrations in environmental media.

Screening levels for soil based on sum of EPA Residential PRG and background level:

Soil Background = 0.13 pCi/g

EPA residential PRG
(1 x 10^-6 risk level, excess above background) = 0.231 pCi/g

Soil screening level (SL = Background = PRG) = 0.361 pCi/g

Screening level for groundwater, surface water, and seeps/springs based on drinking water standards. SL = 8 pCi/L

Screening levels provided in Appendix C

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Private residence sample locations not shown to honor request by residents to maintain confidentiality, Resultant data ratios described in notes if analyzed for method depicted.

Screening levels for soil are based on the sum of EPA Residential 10-6 PRGs and maximum background levels. Screening levels for groundwater, surface water, and seeps/springs based on drinking water standards.

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend

- Administrative Area Boundary
- County Boundary
- RFI Boundary
- Properties
- Highway
- Streets
- Drainages

Offsite Soil Matrix/Solids (e.g. Debris) Results

RBSLratio_SOLIDS_Strontium.MAX_SR_90

- ▲ < Screening Level
- △ < Background
- ▲ Offsite Soil Matrix/Solids Non-Detect

Offsite Groundwater Results

- ⊙ Offsite Groundwater Non-Detect

Offsite Surface Water Results

- ■ Offsite Surface Water Non-Detect

Offsite Seeps/Springs Results

- ★ Offsite Seeps/Springs Non-Detect

Strontium - 90 Summary for All Media
Areas Offsite of SSFL

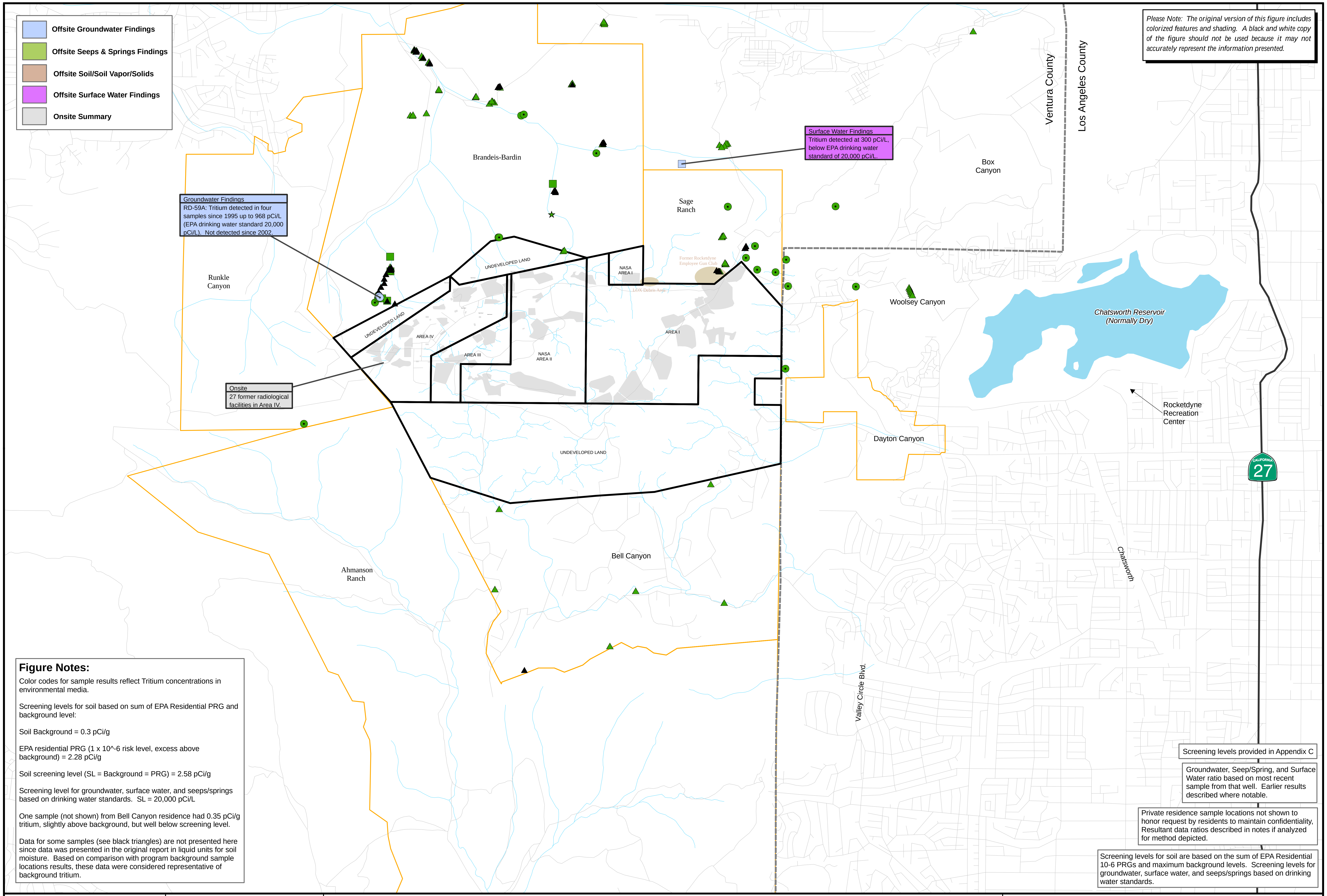
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 13, 2007

Document: Offsite-Report-Strontium_Summary.mxd

FIGURE
3-9



🟦 **Offsite Groundwater Findings**

🟩 **Offsite Seeps & Springs Findings**

🟫 **Offsite Soil/Soil Vapor/Solids**

🟪 **Offsite Surface Water Findings**

⬜ **Onsite Summary**

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Surface Water Findings
Tritium detected at 300 pCi/L, below EPA drinking water standard of 20,000 pCi/L.

Groundwater Findings
RD-59A: Tritium detected in four samples since 1995 up to 968 pCi/L (EPA drinking water standard 20,000 pCi/L). Not detected since 2002.

Onsite
27 former radiological facilities in Area IV.

Figure Notes:

Color codes for sample results reflect Tritium concentrations in environmental media.

Screening levels for soil based on sum of EPA Residential PRG and background level:

Soil Background = 0.3 pCi/g

EPA residential PRG (1 x 10^-6 risk level, excess above background) = 2.28 pCi/g

Soil screening level (SL = Background = PRG) = 2.58 pCi/g

Screening level for groundwater, surface water, and seeps/springs based on drinking water standards. SL = 20,000 pCi/L

One sample (not shown) from Bell Canyon residence had 0.35 pCi/g tritium, slightly above background, but well below screening level.

Data for some samples (see black triangles) are not presented here since data was presented in the original report in liquid units for soil moisture. Based on comparison with program background sample locations not shown to, these data were considered representative of background tritium.

Screening levels provided in Appendix C

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

Screening levels for soil are based on the sum of EPA Residential 10-6 PRGs and maximum background levels. Screening levels for groundwater, surface water, and seeps/springs based on drinking water standards.

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend

- **Administrative Area Boundary**
- **County Boundary**
- **RFI Boundary**
- **Properties**
- **Highway**
- **Streets**
- **Drainages**

Offsite Soil Matrix/Solids (e.g. Debris) /Soil Vapor Results

- ▲ Brandeis-Bardin Institute and Santa Monica Mountains Conservancy Samples
- ▲ **Offsite Soil Matrix/Solids Non-Detect or < Background**

Offsite Groundwater Results

- ⊙ < Drinking Water Standards
- ⊙ **Offsite Groundwater Non-Detect**

Offsite Surface Water Results

- ■ **< Drinking Water Standards**
- ■ **Offsite Surface Water Non-Detect**

Offsite Seeps/Springs Results

- ★ **Offsite Seeps/Springs Non-Detect**

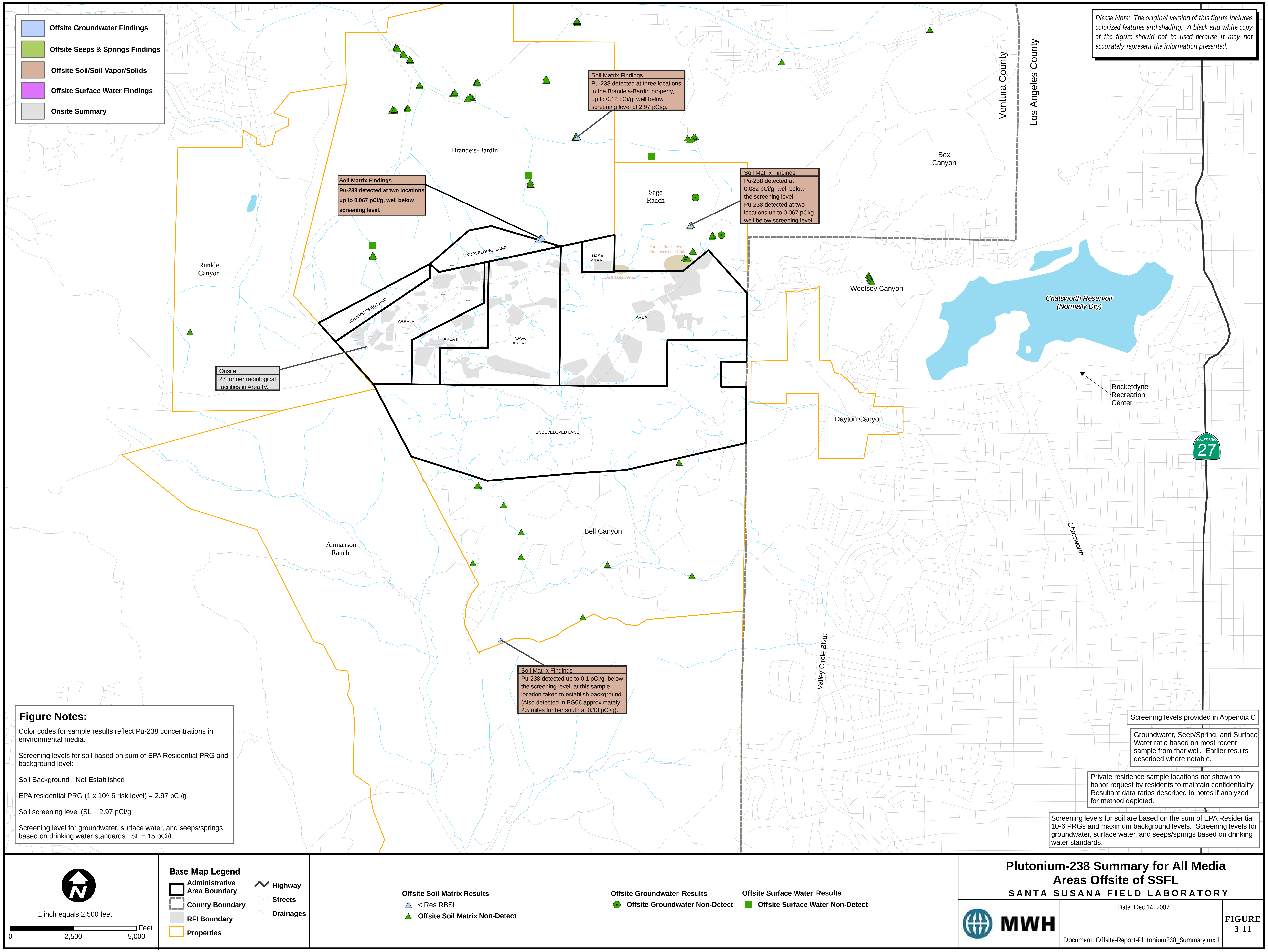
Tritium Summary for All Media
Areas Offsite of SSFL
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 13, 2007

Document: Offsite-Report-Tritium_Summary.mxd

FIGURE
3-10



Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Soil Matrix Findings
Pu-238 detected at three locations in the Brandeis-Bardin property, up to 0.12 pCi/g, well below screening level of 2.97 pCi/g.

Soil Matrix Findings
Pu-238 detected at two locations up to 0.067 pCi/g, well below screening level.

Soil Matrix Findings
Pu-238 detected at 0.082 pCi/g, well below the screening level.
Pu-238 detected at two locations up to 0.067 pCi/g, well below screening level.

Onsite
27 former radiological facilities in Area IV.

Soil Matrix Findings
Pu-238 detected up to 0.1 pCi/g, below the screening level, at this sample location taken to establish background. (Also detected in BG06 approximately 2.5 miles further south at 0.13 pCi/g).

Figure Notes:

Color codes for sample results reflect Pu-238 concentrations in environmental media.

Screening levels for soil based on sum of EPA Residential PRG and background level:

Soil Background - Not Established

EPA residential PRG (1 x 10^-6 risk level) = 2.97 pCi/g

Soil screening level (SL = 2.97 pCi/g

Screening level for groundwater, surface water, and seeps/springs based on drinking water standards. SL = 15 pCi/L

Screening levels provided in Appendix C

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Private residence sample locations not shown to honor request by residents to maintain confidentiality, Resultant data ratios described in notes if analyzed for method depicted.

Screening levels for soil are based on the sum of EPA Residential 10-6 PRGs and maximum background levels. Screening levels for groundwater, surface water, and seeps/springs based on drinking water standards.

Plutonium-238 Summary for All Media Areas Offsite of SSFL

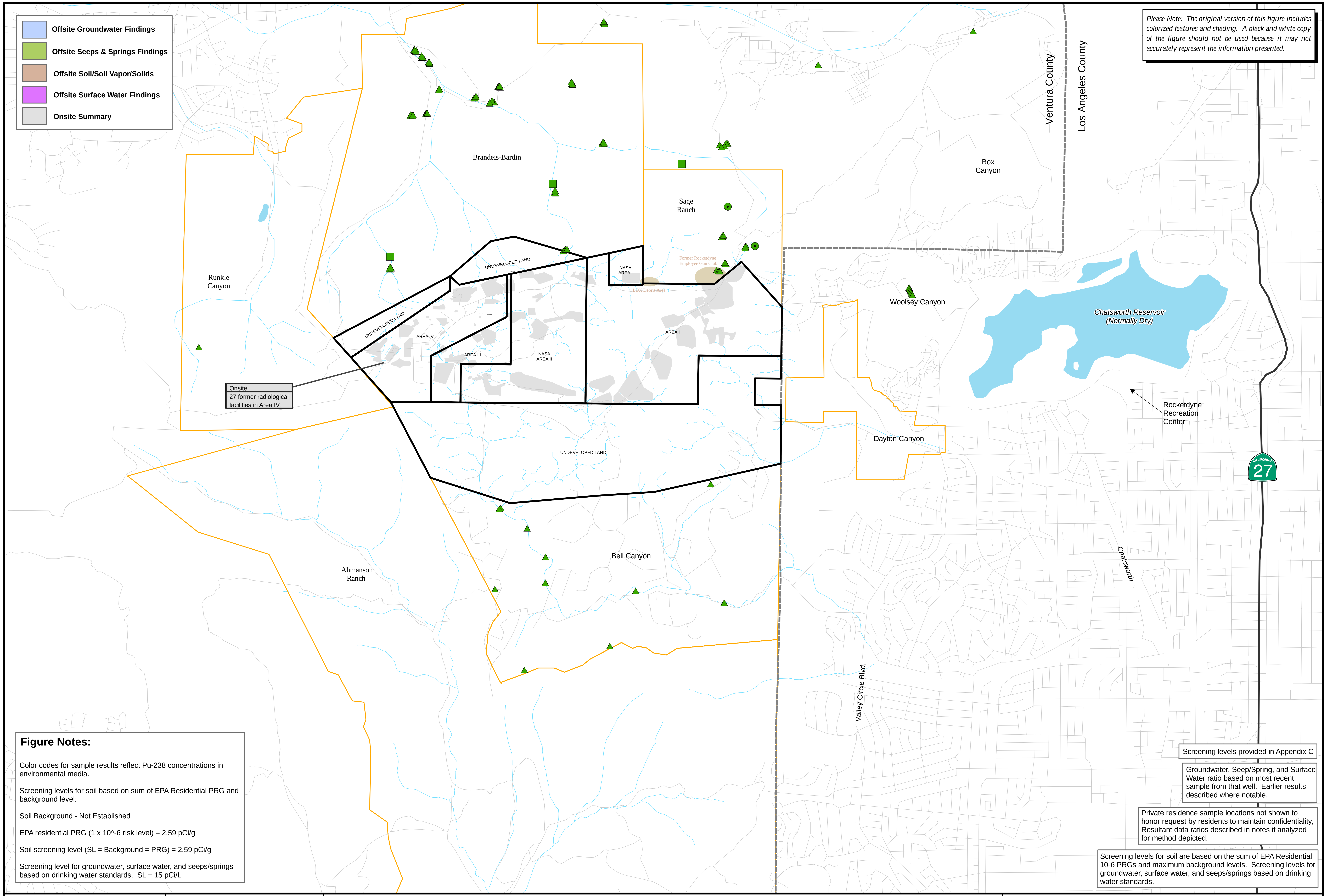
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 14, 2007

FIGURE
3-11

Document: Offsite-Report-Plutonium238_Summary.mxd



Onsite
27 former radiological facilities in Area IV.

- 🟦 Offsite Groundwater Findings
- 🟩 Offsite Seeps & Springs Findings
- 🟫 Offsite Soil/Soil Vapor/Solids
- 🟪 Offsite Surface Water Findings
- ⬜ Onsite Summary

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Figure Notes:

Color codes for sample results reflect Pu-238 concentrations in environmental media.

Screening levels for soil based on sum of EPA Residential PRG and background level:

Soil Background - Not Established

EPA residential PRG (1 x 10^-6 risk level) = 2.59 pCi/g

Soil screening level (SL = Background = PRG) = 2.59 pCi/g

Screening level for groundwater, surface water, and seeps/springs based on drinking water standards. SL = 15 pCi/L

Screening levels provided in Appendix C

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

Screening levels for soil are based on the sum of EPA Residential 10-6 PRGs and maximum background levels. Screening levels for groundwater, surface water, and seeps/springs based on drinking water standards.

N

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend

- Administrative Area Boundary
- County Boundary
- RFI Boundary
- Properties
- Highway
- Streets
- Drainages

Offsite Soil Matrix Results

▲ **Offsite Soil Matrix/Solids Non-Detect**

Offsite Groundwater Results

⊙ **Offsite Groundwater Non-Detect**

Offsite Surface Water Results

■ **Offsite Surface Water Non-Detect**

Plutonium - 239/240 Summary for All Media Areas Offsite of SSFL

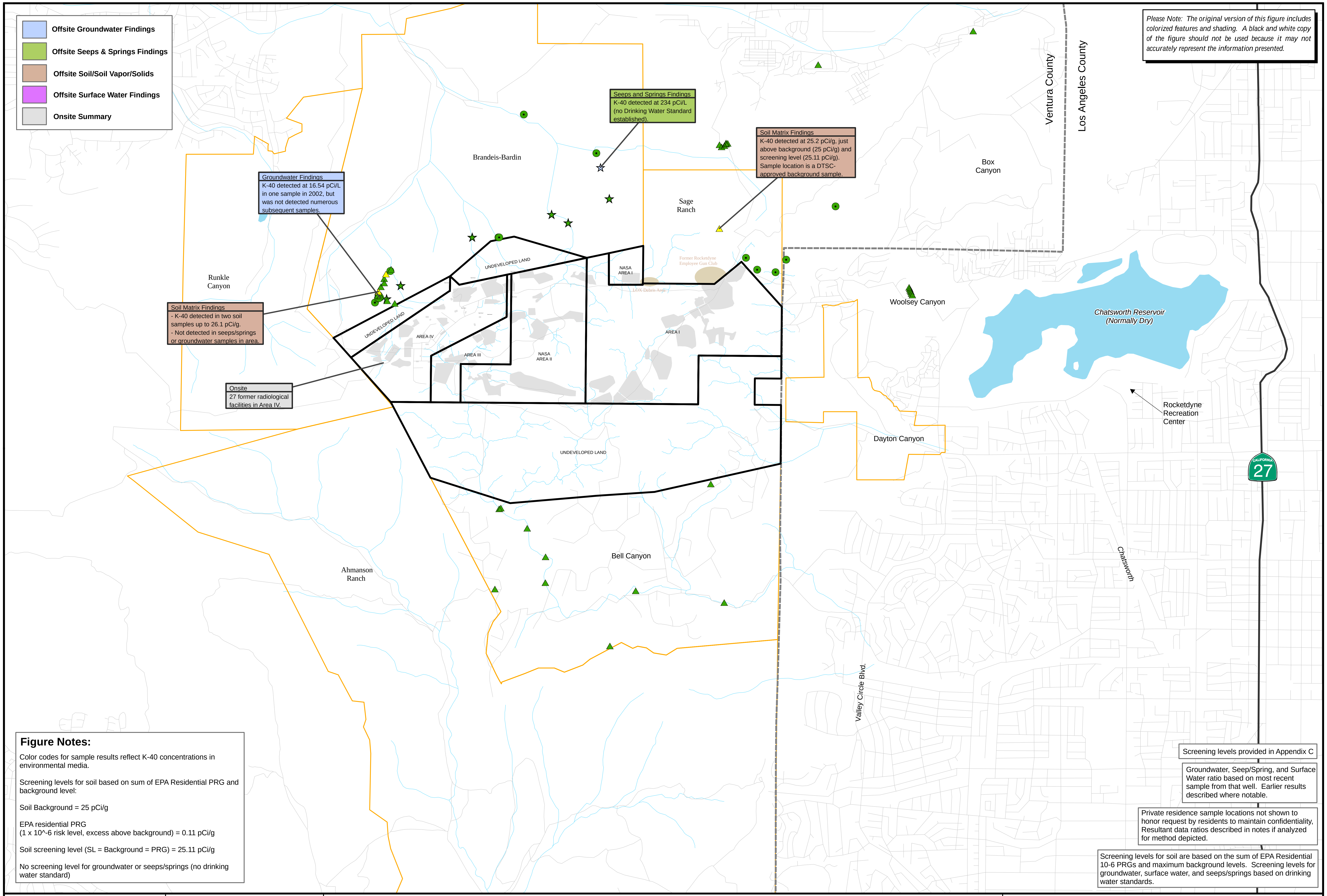
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 13, 2007

Document: Offsite-Report-Plutonium239_Summary.mxd

FIGURE 3-12



🟦 Offsite Groundwater Findings
🟩 Offsite Seeps & Springs Findings
🟫 Offsite Soil/Soil Vapor/Solids
🟪 Offsite Surface Water Findings
⬜ Onsite Summary

Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

Seeps and Springs Findings
K-40 detected at 234 pCi/L (no Drinking Water Standard established).

Soil Matrix Findings
K-40 detected at 25.2 pCi/g, just above background (25 pCi/g) and screening level (25.11 pCi/g). Sample location is a DTSC-approved background sample.

Groundwater Findings
K-40 detected at 16.54 pCi/L in one sample in 2002, but was not detected numerous subsequent samples.

Soil Matrix Findings
- K-40 detected in two soil samples up to 26.1 pCi/g.
- Not detected in seeps/springs or groundwater samples in area.

Onsite
27 former radiological facilities in Area IV.

Figure Notes:

Color codes for sample results reflect K-40 concentrations in environmental media.

Screening levels for soil based on sum of EPA Residential PRG and background level:

Soil Background = 25 pCi/g

EPA residential PRG
(1 x 10^-6 risk level, excess above background) = 0.11 pCi/g

Soil screening level (SL = Background = PRG) = 25.11 pCi/g

No screening level for groundwater or seeps/springs (no drinking water standard)

Screening levels provided in Appendix C

Groundwater, Seep/Spring, and Surface Water ratio based on most recent sample from that well. Earlier results described where notable.

Private residence sample locations not shown to honor request by residents to maintain confidentiality. Resultant data ratios described in notes if analyzed for method depicted.

Screening levels for soil are based on the sum of EPA Residential 10-6 PRGs and maximum background levels. Screening levels for groundwater, surface water, and seeps/springs based on drinking water standards.

N

1 inch equals 2,500 feet

0 2,500 5,000 Feet

Base Map Legend

Administrative Area Boundary
County Boundary
RFI Boundary
Properties
Highway
Streets
Drainages

Offsite Soil Matrix Results
▲ Non-Detect or < Background
△ < Screening Level
△ > Screening Level

Offsite Groundwater Results
● **Offsite Groundwater Non-Detect**

Offsite Seeps/Springs Results
☆ Detected up to 234 pCi/L (No Drinking Water Standard)
★ **Offsite Seeps/Springs Non-Detect**

Potassium - 40 Summary for All Media
Areas Offsite of SSFL

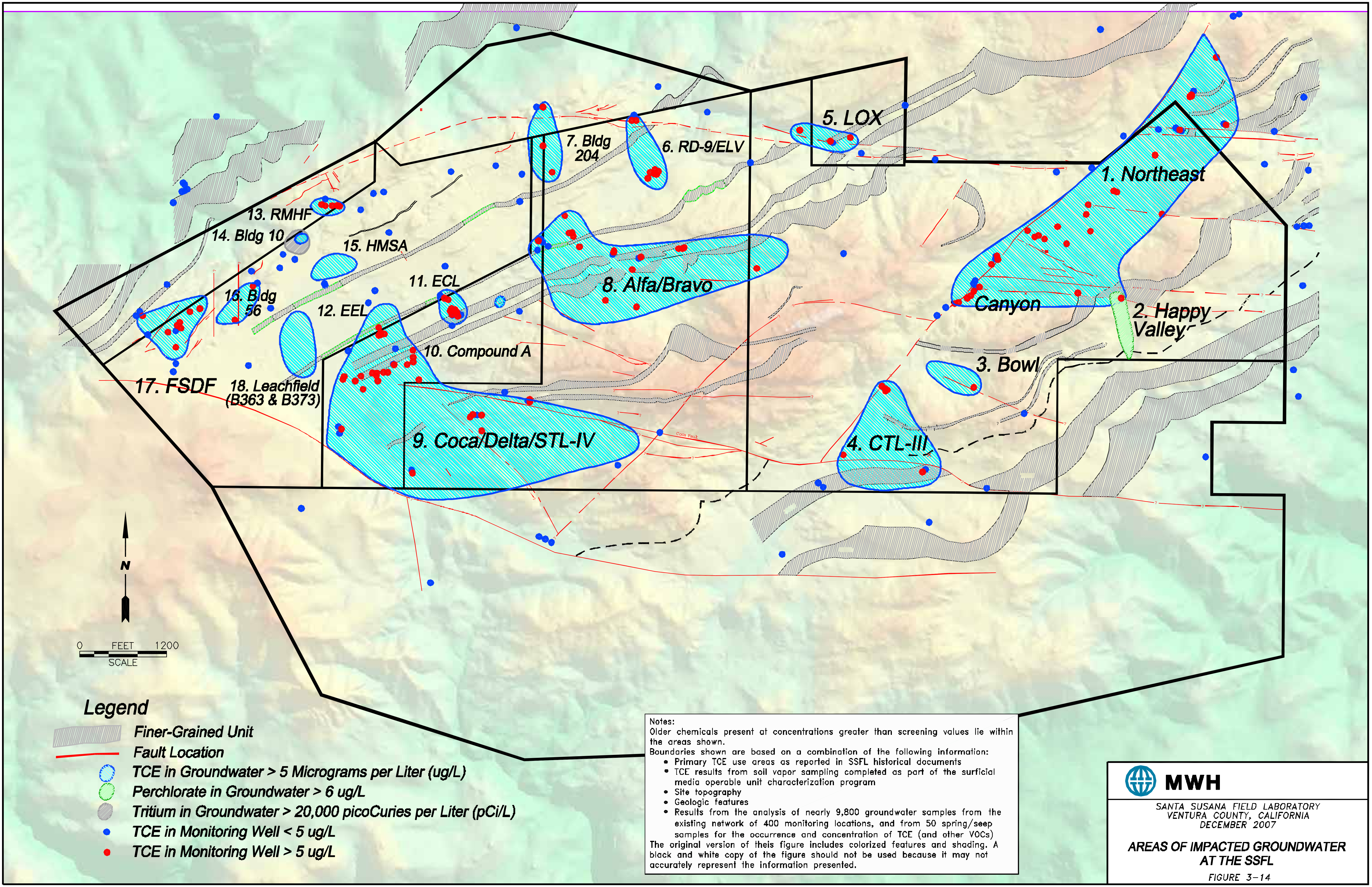
SANTA SUSANA FIELD LABORATORY

MWH

Date: Dec 13, 2007

Document: Offsite-Report-Potassium_Summary.mxd

FIGURE
3-13



Notes:
Older chemicals present at concentrations greater than screening values lie within the areas shown.
Boundaries shown are based on a combination of the following information:
- Primary TCE use areas as reported in SSFL historical documents
- TCE results from soil vapor sampling completed as part of the surficial media operable unit characterization program
- Site topography
- Geologic features
- Results from the analysis of nearly 9,800 groundwater samples from the existing network of 400 monitoring locations, and from 50 spring/seep samples for the occurrence and concentration of TCE (and other VOCs)

The original version of theis figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

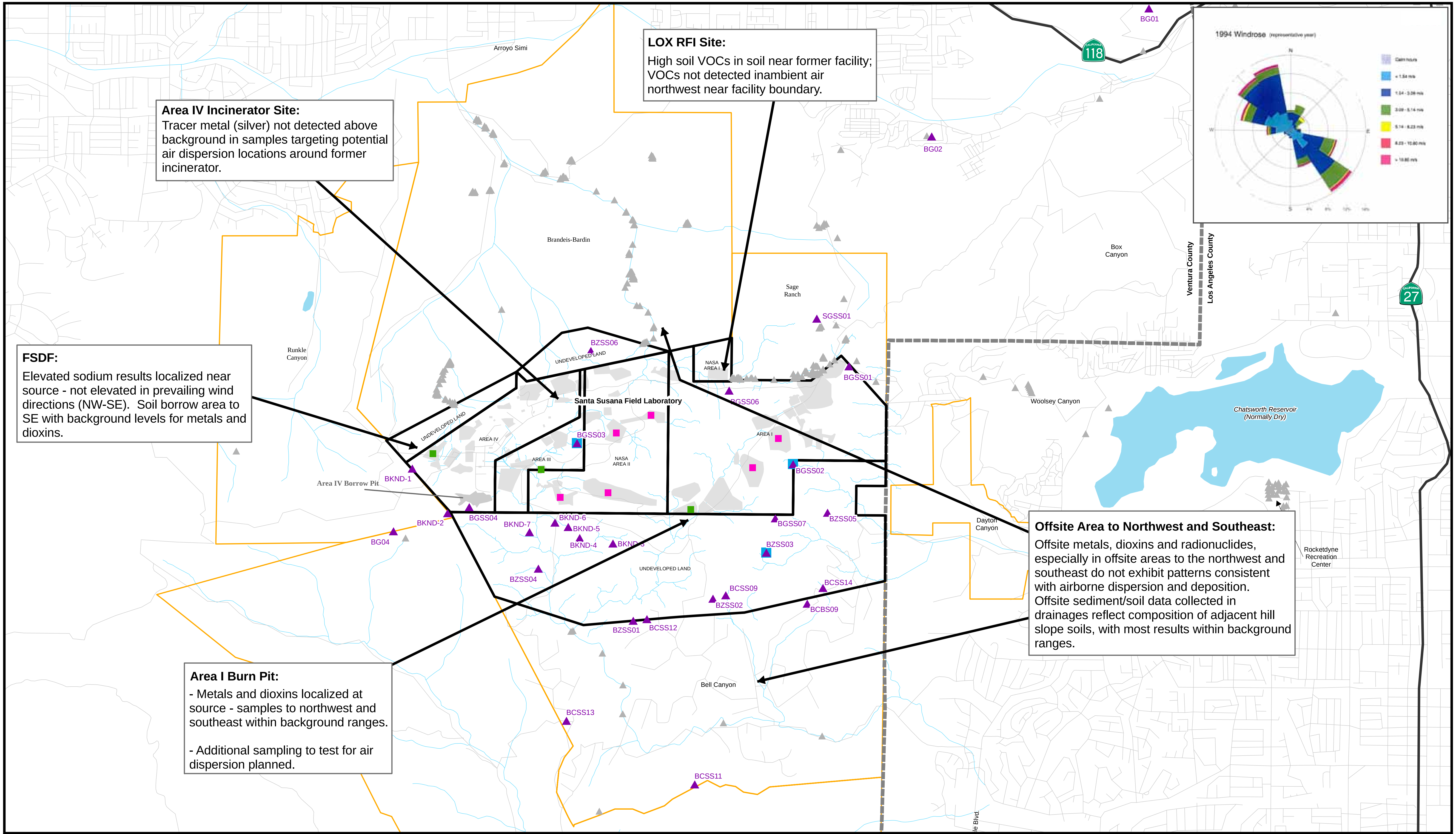
MWH

SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA
DECEMBER 2007

AREAS OF IMPACTED GROUNDWATER
AT THE SSFL

FIGURE 3-14

JOB No. __ FILE No. __ INDSVR\INDUSTRIAL\CAD MLUEBKE\BOEING\SANTA SUSANA\SITE WIDE WORKPLAN\AREAS OF IMPACTED GW 9 07



Area IV Incinerator Site:
Tracer metal (silver) not detected above background in samples targeting potential air dispersion locations around former incinerator.

LOX RFI Site:
High soil VOCs in soil near former facility; VOCs not detected inambient air northwest near facility boundary.

FSDF:
Elevated sodium results localized near source - not elevated in prevailing wind directions (NW-SE). Soil borrow area to SE with background levels for metals and dioxins.

Offsite Area to Northwest and Southeast:
Offsite metals, dioxins and radionuclides, especially in offsite areas to the northwest and southeast do not exhibit patterns consistent with airborne dispersion and deposition. Offsite sediment/soil data collected in drainages reflect composition of adjacent hill slope soils, with most results within background ranges.

Area I Burn Pit:
- Metals and dioxins localized at source - samples to northwest and southeast within background ranges.

- Additional sampling to test for air dispersion planned.

1 inch equals 3,000 feet

0 3,000 6,000 Feet

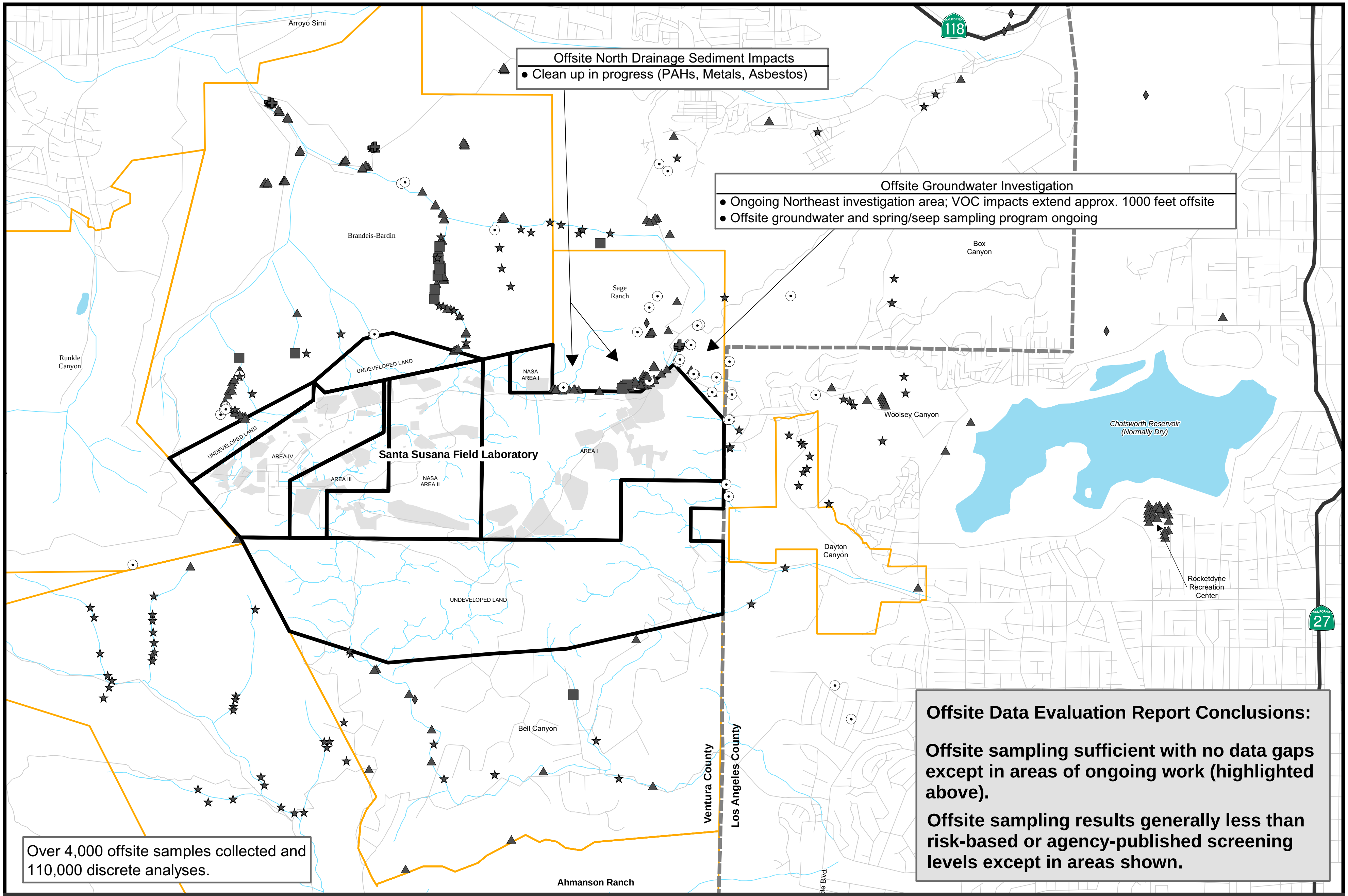
- ▭ Administrative Area Boundary
- ▭ County Boundary
- ▭ Properties
- ▨ RFI Site Boundary
- Highway
- Streets
- Streams
- ▲ Soil/Sediment location
- 🟩 Open burn site
- 🟥 Rocket engine test stand
- ▲ DTSC approved background locations:
  Distribution of metals and dioxins does not indicate impacts in prevailing wind direction. Metals are within published ranges for California soils (MWH 2005a).
- ▲ Vertically discrete samples:
  Locations with vertically discrete samples do not show no pattern of higher concentrations at shallow depths, with exception of lead (common component of atmospheric deposition in urban areas). Lateral distribution data from all background samples show no pattern for air dispersion (MWH 2005a).

Air Dispersion Evaluation Summary

MWH

Date: Dec 14, 2007
Document: Offsite-Report-Air_Dispersion.mxd

Figure 3-15



Offsite North Drainage Sediment Impacts
- Clean up in progress (PAHs, Metals, Asbestos)

Offsite Groundwater Investigation
- Ongoing Northeast investigation area; VOC impacts extend approx. 1000 feet offsite
- Offsite groundwater and spring/seep sampling program ongoing

Offsite Data Evaluation Report Conclusions:

Offsite sampling sufficient with no data gaps except in areas of ongoing work (highlighted above).

Offsite sampling results generally less than risk-based or agency-published screening levels except in areas shown.

Over 4,000 offsite samples collected and 110,000 discrete analyses.

1 inch equals 4,000 feet

0 2,000 4,000 Feet

Administrative Area Boundary

County Boundary

Properties

Investigation Areas

Highway

Streets

Streams

Sample Locations

◆	**Multimedia**	▲	**Soil/Sediment**
⊙	**Groundwater**	■	**Surface Water**
★	**Spring/Seep**	✚	**Vegetation**

PAHs - Polynuclear Aromatic Hydrocarbons
VOCs - Volatile Organic Compounds

Note: Samples also collected from locations more distant from SSFL not shown on figure. These samples (collected within 15 miles) used as reference or background comparison.

Offsite Data Evaluation Summary
Santa Susana Field Laboratory

MWH

Date: Dec 14, 2007

Document: Offsite-Report_Data_Evaluation.mxd

FIGURE 4-1