Final

Dynamic Site Investigation
Former Operational Areas B, C, F, G, and H
Lockheed Martin Corporation, Beaumont Site 1
Beaumont, California

Prepared for:

LOCKHEED MARTIN

TETRA TECH

348 W. Hospitality Lane, Suite 100
San Bernardino, California 92408
TC# 22288-110302 / October 2009

Responses to DTSC Comments on the Dynamic Site Investigation Report
Lockheed Martin Corporation, Beaumont Site 1, Beaumont, California
Tetra Tech, Inc
Revised September 2009

General Comments		
Comment	**Response**	**Proposed Action**
1. A Recommendations section should be included in this report outlining the next steps at the Site.	A recommendations section will be added to the report to outline the next steps at the Site.	The following recommendations section will be added at the end of the report. Based on the results of this DSI, the characterization of 10 features previously evaluated during recent investigations (Tetra Tech; 2005a, 2005b, and 2009a) is now complete except for the additional evaluation of metals which is being conducted as part of the human health and ecological risk assessment (HHERA). Metals exceeding BTVs that represent a risk to human and/or ecological receptors will be evaluated upon completion of the risk assessment to determine if additional investigation is needed. Results from the previous investigations (Tetra Tech; 2005a, 2005b, and 2009a) indicated that no further investigation was required for the other 42 features identified at the Site. The following is a list of the next steps planned for the Site:

General Comments		
Comment	**Response**	**Proposed Action**
		❑ Prepare a Summary RI Report summarizing all the previous environmental investigations and remedial actions conducted at Site 1 in a single report; ❑ Complete the HHERA; ❑ Prepare a Feasibility Study upon completion of the HHERA; ❑ Prepare a Remedial Action Plan based on the findings of the feasibility study; and ❑ Implement the recommended remedial actions and/or mitigation measures to protect human health and the environment and achieve regulatory closure of the Site.
Specific Comments		
Comment	**Response**	**Proposed Action**
1. Figure 3-5 (cont, from MW-14 to MW-42): This cross-section trace, A-A' should be labeled (even though the ends are outside the boundaries of the figure).		The requested change will be made to Figure 3-5.
2. Section 4.1.9, page 4-14: It should be clarified whether there were dedicated regulators for each Summa canister or if a single regulator was utilized If so, it should be documented how and where it was	A single regulator was utilized which was decontaminated between samples by purging ambient air through the	The text on page 4-14 in Section 4.1.9 will be modified to include the decontamination procedures

General Comments		
Comment	**Response**	**Proposed Action**
decontaminated between samples.	regulator for 3 minutes in accordance with the laboratory's standard operating procedures for soil gas sampling.	for the pressure regulator utilized during soil gas sampling.
3. Figure 5-56: Intersections with C-B' should be identified on cross-sections A-A' and B-B' as C-B', not C-C'.		The requested change will be made to Figure 5-56.
4. Figure 5-70: The subsurface geology on cross-section B-B' should be explained. It appears the silt and clay lenses are truncated by soil borings H49-HSAS6 and H-49-HSA5, respectively		The requested change will be made to Figure 3-5.

Lockheed Martin Corporation, Shared Services
Energy, Environment, Safety and Health
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LOCKHEED MARTIN

July 7, 2009

Mr. Daniel Zogaib
Southern California Cleanup Operations
Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Subject: Submittal of Dynamic Site Investigation Report, Lockheed Martin Corporation, Beaumont Site 1, Beaumont, California

Please find enclosed one (1) copy and two (2) CDs of the *Dynamic Site Investigation Report, Lockheed Martin Corporation, Beaumont Site 1, Beaumont, California* for your approval or comment.

If you have any questions regarding this submittal or the status of site activities, please contact me at 408.756.9595 or denise.kato@lmco.com.

Sincerely,

Denise Kato
Remediation Analyst Senior Staff

Enclosure

Copy with Enc:
Gene Matsushita, LMC (hard copy & electronic copy)
Tom Villeneuve, Tetra Tech, Inc. (hard copy)

TETRA TECH

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October 2009
TC 22288-110302

Prepared for
Lockheed Martin Corporation
Burbank, California

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EXECUTIVE SUMMARY

This Dynamic Site Investigation (DSI) Report has been prepared as part of the remedial investigations for Lockheed Martin Corporation's Beaumont Potrero Creek facility, also known as LMC Beaumont Site 1 and referred to in this report as the Site. The remedial investigations are being conducted under a Consent Order issued in 1989 by the State of California Department of Health Services [currently known as the Department of Toxic Substances Control (DTSC)]. The Order states that all parties should ensure "…that any release or threatened release of hazardous substance to the air, soil, surface water, and groundwater at or from the Site is thoroughly investigated and appropriate remedial actions are taken."

The Site was primarily used for ranching operations prior to the 1950s. Between 1958 and 1974, the Site was primarily used for rocket motor production and testing activities, first by Grand Central Rocket Company, then by Lockheed Propulsion Company. Nine historical operational areas (A through I) have been identified at the Site. Each historical operational area was responsible for various activities associated with rocket motor assembly, testing, and propellant incineration. The Site was also used for the disposal of rocket fuel and industrial solvents.

This DSI report presents the results of investigations performed from August 2008 to June 2009 at the Site. The primary objective of the DSI was to complete the delineation of previously detected contamination at the Site. A secondary objective was to collect additional data that will be used to support the selection of a remedy that is economically feasible and protective of human health and the environment. Following the general guidelines of the United States Environmental Protection Agency's Triad Approach, the DSI utilized a dynamic approach to complete the characterizations in a single mobilization. The data collected and presented within this report successfully identified the extent of contamination within the areas of investigation and will be used to support the evaluation of appropriate mitigation measures/remedial alternatives for the Site, as well as the human health and ecological risk assessments. Key findings and conclusions are briefly summarized below.

UPDATED CONCEPTUAL SITE MODEL

This section presents an updated conceptual site model (CSM) for the Site based on the additional data collected during the DSI.

Geology

Four stratigraphic units that exist beneath the Site were encountered during the DSI: the Quaternary alluvium, the San Timoteo formation, the Mount Eden formation (weathered and unweathered portions), and the Granitic/Metasedimentary basement complex. The depths at which these units were encountered along with the texture and composition were consistent with the previously mapped units.

In the main alluvial valley the relatively flat topography creates a very low energy fluvial environment which is evident by the increase in finer grained sediments, including silts and clays. In general, the sediments become coarser with depth although occasionally fine grained units can still be encountered at the deeper depths. Further down the valley along the sides or tributaries of Potrero Creek, sands dominate the alluvium representing a higher energy depositional environment. Although fine grained units are present along the bluffs above Potrero Creek and near the surrounding Mount Eden foothills, coarse grained units generally dominate the alluvial/colluvial sediments.

The overlying colluvium/alluvium within the side canyons is very similar to the underlying Mount Eden formation. During drilling with the resonant sonic method, the poorly consolidated and friable sandstone is often indistinguishable from the overlying alluvium. As expected, the alluvium overlying the Mount Eden formation within these side canyons is relatively thin ranging from 1 to 20 feet thick.

Hydrogeology

Groundwater occurs in each of the major geologic units beneath the Site; the Quaternary alluvium, Mount Eden formation, the San Timoteo formation, and the Granitic/Metasedimentary basement complex. Shallow groundwater flow at the Site occurs mainly through alluvium and the shallow/weathered portion of the Mount Eden formation. Groundwater observed during this investigation was encountered primarily in the Mount Eden formation within the small box canyons and near the foothills that surround Potrero Creek in the western portion of the Site. Groundwater flow within the small box canyons primarily flows out of the canyons before joining up with the predominant flow direction within the broad alluvial valley (northwest and west) or base-level stream flow within Potrero Creek (west and southwest).

Surface Water

Surface water flow at the Site is ephemeral, flowing briefly only in direct response to precipitation during or immediately after storm events. However, there are small reaches of the stream that remain wet throughout most of the year or flow for short distances before becoming dry again. These flows vary both seasonally and in response to long term precipitation trends at the Site. The areas of intermittent surface flow represent groundwater discharge where the stream is gaining in some reaches while losing in other reaches. The undulating bedrock surface of the Mount Eden formation, some of which appears to be related to faulting, is thought to be the cause of these discontinuous areas of flow along the stream course. Mapping of these discontinuous areas of surface flow within the streambed along with flow measurements and water quality sampling is conducted as part of the routine monitoring program at the Site.

NATURE AND EXTENT OF CONTAMINATION

This section summarizes the overall nature and extent of contamination at the Site based on the results of the DSI, along with all the previous investigations conducted to date.

Chemicals of Potential Concern (COPCs)

The three primary soil COPCs at the Site are perchlorate, trichloroethylene (TCE), and poly-chlorinated biphenyls (PCBs). Perchlorate is the most extensive soil COPC at the Site, while TCE and PCBs are only detected in only a few areas of the Site. Although 1,4-dioxane is also a primary COPC with respect to groundwater, it has not been detected in soil other than a couple of locations outside the Burn Pit Area (BPA), the primary source area, at concentrations near the MDL (0.005-0.031 mg/kg); therefore, 1,4-dioxane is not considered a primary soil COPC for the Site.

The groundwater COPCs identified for the Site based on past site activities and groundwater monitoring results include perchlorate, 1,1-dichloroethene (1,1-DCE), TCE, 1,4-dioxane, 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), cis-1,2-dichloroethene (cis-1,2-DCE), and 1,1,1-trichloroethane (1,1,1-TCA). The primary groundwater COPCs which are detected most frequently and at the highest concentrations are perchlorate, 1,1-DCE, TCE, and 1,4-dioxane.

Nature and Extent of Soil Impacts

Perchlorate is the most extensive contaminant detected in soil at the Site. Perchlorate-impacted soil (above 200 µg/kg) has been identified at 12 features within the Site, with the highest concentrations detected at the Large Motor Washout Area (302,000 µg/kg) and the BPA (171,000 µg/kg). Relatively high concentrations (up to 20,400 µg/kg) have also been detected in the RMPA which is considered a secondary source area for perchlorate in soil in comparison to the BPA. In general, the perchlorate concentrations at the RMPA are an order of magnitude less than the BPA but have a much larger areal extent, possibly due to the transport mechanism resulting from the historical operations (processing and mixing of rocket motor solid propellants and motor washouts) which may have governed the distribution of perchlorate on the surface and eventually into the subsurface.

The only TCE soil source identified at the Site is the BPA, which was remediated through SVE in the mid- to late 1990s, with the system being shut down in 1998 after VOC concentrations had decreased by 99.6%. Elevated concentrations of TCE in soil gas still remain at the BPA and are attributed to off-gassing of affected groundwater beneath this feature and/or possibly residual contamination in the vadose zone. Although TCE impacted groundwater was also detected at Features F-34 and F-39, no soil source was identified at either feature. The soil gas concentrations and trends at these features indicate off-gassing of the TCE-impacted groundwater and therefore soil source areas may no longer be present.

PCBs were detected at four features with very localized shallow impacts at three of the four features (F-35, F-36, and F-40) with concentrations up to 250 µg/kg. At the Sanitary Landfill (Feature H-49), PCBs were detected in several areas with detected concentrations up to 1,400 µg/kg and appear to be fairly localized and limited to shallow soils except on the east side where PCBs were detected at 20 feet bgs in two locations.

Nature and Extent of Groundwater Impacts

In general the Site 1 groundwater plume (perchlorate, 1,4-dioxane, TCE, and 1,1-DCE) has remained relatively stable over time. Slight modifications to the definition of the plume over time are generally the result of newly installed wells better defining the lateral extent of the plume. The overall areal extent of the Site 1 groundwater plume above the maximum contaminant level (MCL) or drinking water notification level (DWNL) is roughly 275 acres.

The highest groundwater COPC concentrations detected at the Site since 2002 are as follows: perchlorate (141,000 µg/L), 1,4-dioxane (3,400 µg/L), 1,1-DCE (14,000 µg/L), TCE (3,500 µg/L), cis-1,2-DCE (990 µg/L) 1,1-DCA (260 µg/L), 1,2-DCA (680 µg/L), and 1,1,1-TCA (23 µg/L). The highest concentrations of the groundwater COPCs have consistently been reported in samples collected from shallow screened wells located in the BPA with concentrations rapidly decreasing outside, and downgradient, of the former BPA. However, secondary perchlorate source areas are also present at the RMPA including the Motor Washout Area (Feature B-9), the Propellant Mixing Station (Feature B-10), the Fuel Slurry Station (Feature B-11), and the Pad with Dry Well (Feature B-14). In addition to the BPA and RMPA, small localized plumes (TCE, 1,4-dioxane, and/or perchlorate) have also been detected at the Large Motor Washout Area (Feature F-33), the Maintenance Shop and Storage Warehouse Area (Feature F-34), and the Test Bays (Feature F-39) located in the western portion of the Site near Potrero Creek.

Nature and Extent of Surface Water Impacts

All groundwater COPCs have been detected in the surface water ponds located near the west end of the alluvial valley which are directly fed by discharging groundwater. COPC concentrations within these surface water ponds, which are not directly connected to the streambed, are consistent with groundwater concentrations detected in nearby monitoring wells. In addition, several groundwater COPCs have been detected in surface water samples collected from within the streambed of Potrero Creek with the highest concentrations generally detected where surface water first daylights within the streambed from discharging groundwater. Concentrations then generally decrease in surface water samples downstream of the first surface water occurrence. As stated above, these areas of intermittent surface flow where the samples are collected represent groundwater discharge where the stream is gaining in some reaches. The highest groundwater COPC concentrations detected in surface samples collected from within the streambed are as follows; perchlorate (8.54 µg/L), 1,4-dioxane (4.2 µg/L), 1,1-DCE (1.2 µg/L), TCE (0.42 µg/L), and cis-1,2-DCE (0.42 µg/L). 1,4-dioxane has been persistent in surface water samples collected within the streambed at the Site and is the only analyte that has been detected within Potrero Creek at the site boundary. Concentrations of 1,4-dioxane detected in surface water in the western portion of the Site at the property boundary have been about 1 µg/L and have never exceeded the DWNL of 3 µg/L.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

3-D	three dimensional
°C	degree Celsius
µg/kg	micrograms per kilogram (parts per billion)
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
%	percent
AETL	American Eagle Testing Laboratories, Inc.
bgs	below ground surface
BMS	Building Management Services
BPA	burn pit area
BTEX	benzene, toluene, ethylbenzene, and total xylenes
BTV	background threshold value
CHHSL	California Human Health Screening Level
CoC	Chain-of-Custody
COPC	chemical of potential concern
CSM	conceptual site model
CY	cubic yards
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene
cis-1,2-DCE	cis-1,2-dichloroethene
DO	dissolved oxygen
DKR	Dulzura kangaroo rat
DPH	California Department of Public Health
DP	direct push
DSI	Dynamic Site Investigation
DWNL	California drinking water notification level
DWP	Dynamic Work Plan

DTSC	Department of Toxic Substances Control
EC	electrical conductivity
EMAX	EMAX Laboratory, Inc.
EPA	United States Environmental Protection Agency
f	The duplicate/replicate sample precision was outside the control limits.
ft/day	feet per day
ft/ft	feet per foot
ft/sec	feet per second
ft^2	square feet
GMP	Groundwater Monitoring Program
gpm	gallons per minute
HASP	Health and Safety Plan
HSA	hollow-stem auger
HSU	hydrostratigraphic unit
IDW	investigation-derived waste
IG	investigation goal
J	The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.
K	hydraulic conductivity
LMC	Lockheed Martin Corporation
LPC	Lockheed Propulsion Company
MCL	Maximum Contaminant Level
MCEA	Massacre Canyon Entrance Area
MDL	method detection limit
MEC	Munitions and Explosives of Concern
MEF	Mount Eden formation
MeV	Million electronic volts
mg/L	milligrams per liter
mg/kg	milligrams /kilogram (parts per million)
ml/min	milliliters per minute

msl	mean sea level
MtBE	methyl-tert butyl ether
mV	millivolt
MVS	Mining Visualization System
na	not analyzed
ND	not detected at or above method detection limit
ng/kg	nanograms per kilogram
NPCA	Northern Potrero Creek Area
NTU	nephelometric turbidity unit
NWS	National Weather Service
O&M	operations and maintenance
OD	outer diameter
ORP	oxidation-reduction potential
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PPE	personal protective equipment
PQL	practical quantitation limit
PRG	EPA Region IX Preliminary Remediation Goal
PTBA	Propellant Test Blowout Area
PVC	polyvinyl chloride
q	The analyte detection was below the practical quantitation limit.
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
Radian	Radian Corporation, Inc.
REC	Recognized Environmental Concern
Report	Dynamic Site Investigation Report
RL	laboratory reporting limit
RMPA	Rocket Motor Production Area
RPD	relative percent difference

SAP	Sampling and Analysis Plan
SIM	selective ion monitoring
SKR	Stephens’ kangaroo Rat
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TAT	turn around time
Tetra Tech	Tetra Tech, Inc.
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCE	trichloroethene
Freon 11	trichlorofluoromethane
Freon 113	1,1,2-trichlorotrifluoroethane
TEF	toxicity equivalent factor
TEQ	Toxicity Equivalency Quotient
TPH	total petroleum hydrocarbons
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,-trichloroethane
USCS	Unified Soil Classification System
VOC	volatile organic compound
WDC	WDC Exploration & Wells, Inc.

1.0 INTRODUCTION

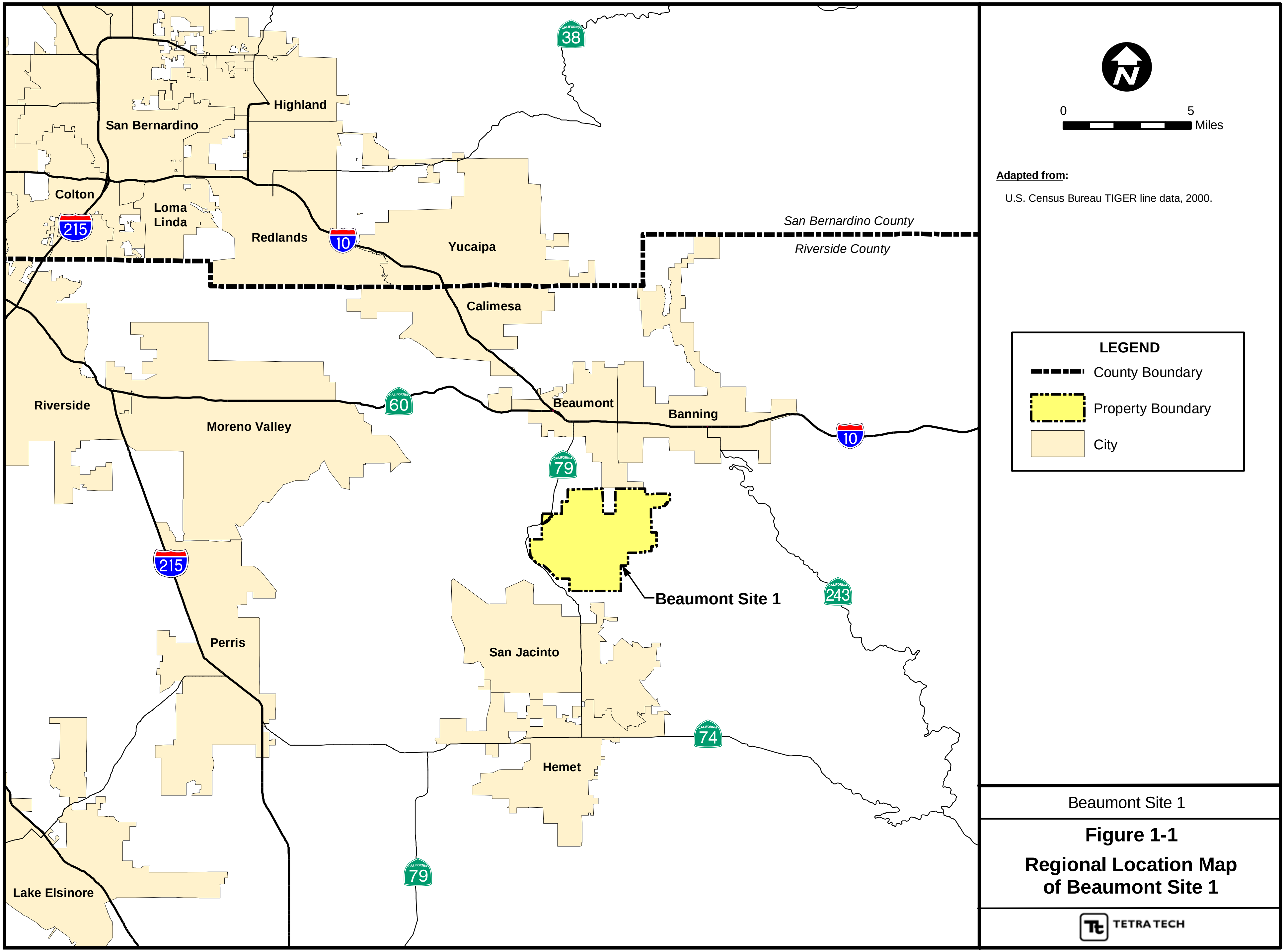
Tetra Tech, Inc. (Tetra Tech) has prepared this *Dynamic Site Investigation Report* (Report) on behalf of Lockheed Martin Corporation (LMC) for Historical Operational Areas B, C, F, G, and H of the Beaumont Potrero Creek facility (LMC Beaumont Site 1), hereafter referred to as the “Site”. The Site is located approximately 85 miles east of Los Angeles in the City of Beaumont, within Riverside County, California, as shown on Figure 1-1. The subsurface investigation was performed in accordance with *Dynamic Site Investigation Work Plan* (Tetra Tech, 2008b), herein referred to as the DWP, and the Consent Order issued to LMC in June 1989 by the California Department of Toxic Substances Control (DTSC). The Consent Order required that LMC investigate and appropriately remediate any releases or threatened releases of hazardous substances to the air, soil, surface water, and groundwater at or from the Site. The State of California owns 8,552 acres of the Site and LMC has retained an easement for the remaining 565 acres referred to as the conservation easement.

The soil and groundwater investigations in Historical Operational Areas B, C, F, G, and H at the Site are follow-up activities to previous investigations conducted in November 2004 (Tetra Tech; 2005a, 2005b) and August 2007 (Tetra Tech, 2009a). Based on the findings of these previous investigations, no further investigation of Historical Operational Areas A, D, E or I was proposed (Tetra Tech, 2009a) and therefore this supplemental investigation only addresses specific features within areas B, C, F, G, and H requiring further assessment. This dynamic site investigation (DSI) utilized surface and subsurface soil sampling, surface water sampling, soil gas probe installation, groundwater sampling, and monitoring well installations in order to better define the affected soil and groundwater associated with these features. Table 1-1 summarizes all of the features at the Site by Operational Area and the status of each investigation. A brief summary of the previous investigations completed where no further investigation was recommended is provided in Appendix A. In addition to the feature-specific characterizations, sitewide background sampling for metals and the installation of an offsite guard well were also conducted as part of this DSI.

The primary purpose of this DSI was to complete the characterization of previously investigated features in order to adequately evaluate appropriate mitigation measures or remedial alternatives for the Site that are protective of human health and the environment.

The objectives of this Report are to:

- Summarize the results of the previous environmental investigations;
- Present the sitewide physical setting;



Beaumont Site 1

Figure 1-1

Regional Location Map of Beaumont Site 1

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Table 1-1 Summary of Features and Investigation Status

Historical Operational Area	Feature Number	Feature Name	No Further Investigation	Further Investigation	Proposed Action
A	1	Avanti Storage Revetments	X		
	2	Test Firing Area	X		
	3	Unknown Structure	X		
	4	Storage Revetments	X		
	5	Gate House Area	X		
	6	Small Storage Tank	X		
	7	55-Gallon Drum	X		
B	8	Blue Motor Burn Pit	X		
	9	Motor Washout Area		X	Further evaluate perchlorate extent in soil
	10	Propellant Mixing Station (Bldg. 315)		X	Further evaluate perchlorate extent in soil and groundwater
	11	Fuel Slurry Station (Bldg. 317)		X	Further evaluate perchlorate extent in soil
	12	Chemical Storage Quonset Hut	X		
	13	Vault - Proposed	X		
	14	Pad with Dry Well		X	Further evaluate perchlorate extent in soil and groundwater
	15	Electrical Enclosure (Bldg. 315A)	X		
	16	Electrical Enclosure	X		
	17	Electrical Enclosure	X		
	18	Cast and Cure Station	X		
	19	Pad on Berm	X		
	20	Pad South of Mix Station Bunker		X	Further evaluate perchlorate extent in soil
	21	55-Gallon Drum	X		
C	22	Burn Pit Area		X	Further evaluate perchlorate extent in soil and VOCs in shallow soil gas
	23	Temporary Storage Area	X		
	24	Beryllium Motor Test Stand	X		
	25	Burn Pit Magazine	X		
D	26	Small Test Area for Incendiary Bombs	X		
	27	Former Class A Storage Area	X		
	28	Former Dissolved TNT Disposal Area	X		
	29	Ballistics Tunnel and Support Facilities	X		
	30	Machine Gun Testing Area	X		
	31	Projectile Landing Zone	X		
	32	Drums	X		
E	NA	Radioactive Waste Burial Site	X		
F	33	Large Motor Washout Area	X		
	34	Maintenance Shop (Bldg. 306) and Storage Warehouse (Bldg. 314)		X	Further evaluate extent of VOCs in soil gas and groundwater
	35	Betatron Building (Bldg. 303)	X		
	36	EBES Testing (Facility 313)	X		
	37	Beryllium Waste Storage Area	X		
	38	Environmental Chambers	X		
	39	Test Bays (Bldgs. 308, 309, and 310)		X	Further evaluate extent of VOCs in soil gas and groundwater
	40	Electrical Enclosure	X		
	41	Temporary Storage of Rocket Motor Segments (Facilities T-3 and T-4)	X		
	42	Storage Bunkers (Bldgs. 311 and 325)	X		
	43	Small Rocket Motor Assembly Building (Bldg. 312)	X		
	44	Electrical Enclosure, Boneyard, Test Motors Conditioning Oven Complex (Bldg. 307)	X		
	45	Testing and Instrumentation / Personnel Bunker (Bldgs. 304 & 305)	X		
G	46	Helicopter Landing Pad and Hanger (Bldg. 302)		X	Further evaluate extent of VOCs in soil gas and groundwater
	47	Asphalt Pads	X		
	48	Gun Mount Test Area	X		
H	49	Sanitary Landfill		X	Further evaluate extent of perchlorate and PCBs in soil. Determine if any potential impacts to groundwater.
I	50	Incendiary Bomb Test Area	X		
	51	Airstrip Area	X		
Totals	52		42	10	

- Describe the field investigation and sampling activities performed for the DSI;
- Analyze and evaluate the soil, soil-gas, groundwater, and geophysical data collected for this DSI along with the previous results for each feature;
- Summarize the results of the background metals sampling;
- Present and summarize the nature, magnitude, and extent of affected soil or groundwater at each feature investigated; and
- Update the current conceptual site model (CSM) based on the findings of this DSI.

This section of the Report provides a brief overview of the document and a summary of historical operations and chemical usage at Historical Operational Areas B, C, F, G, and H. The remainder of this Report is organized as follows.

- Section 2 - Previous Environmental Investigations: This section summarizes the major environmental investigations previously conducted at the Site.
- Section 3 - Physical Setting: This section provides a description of the physical, geologic, and hydrogeologic setting along with the distribution of affected groundwater based on historical information and data collected during previous investigations.
- Section 4 - Field Methodology: This section provides a description of the field activities performed during the installation of soil/groundwater borings, soil vapor probes, and groundwater monitoring wells as part of the DSI. The information presented includes a list of soil, soil gas, and groundwater samples collected and analytical scheme by feature. Any deviations from the DWP are also included in this section.
- Section 5 - Investigation Results and Discussion: This section provides a description of the results of the DSI by individual feature within Historical Operational Areas B, C, F, G, and H. The information presented includes a brief summary of the previous of investigations of each feature assessed, recent investigation results, and a description of the nature, magnitude, and extent of impacts.
- Section 6 - Updated Conceptual Site Model: This section presents an updated CSM for the Site based on the results of the DSI. This updated CSM focuses on the sitewide distribution of soil and groundwater impacts for the purpose of identifying appropriate mitigation measures and remedial alternatives.

- Section 7 - Conclusions and Recommendations: This section summarizes the conclusions drawn from the implementation of this DSI along with recommendations for any follow-on work if needed.
- Section 8 - References: This section provides a list of documents, sources, and publications referenced in this Report.

1.1 SITE BACKGROUND

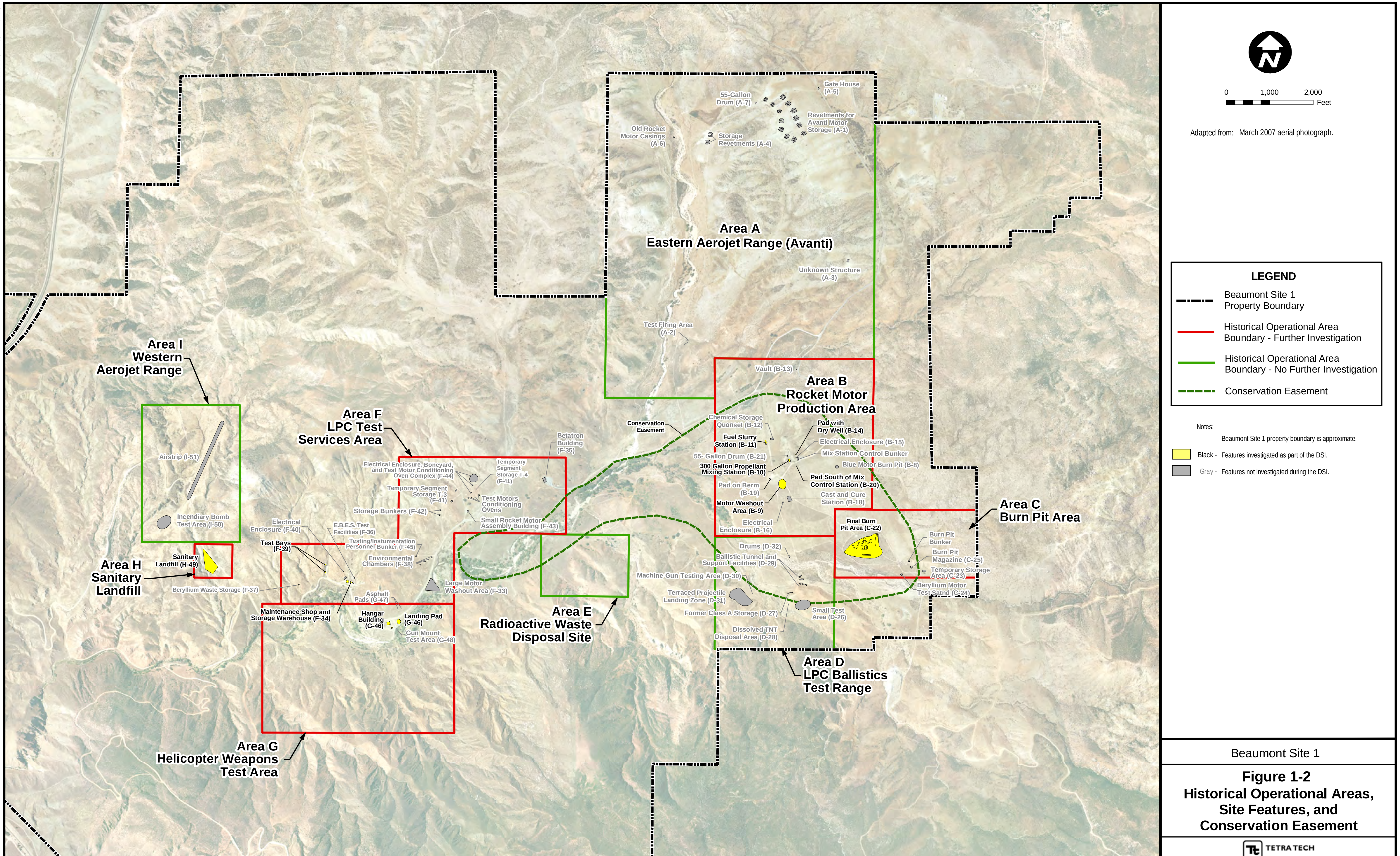
The Site is a 9,117-acre parcel located south of the City of Banning, California (Figure 1-1). The Site was primarily used for ranching prior to 1960. From 1960 to 1974, the Site was used by Lockheed Propulsion Company (LPC) for solid rocket motor and ballistics testing (Tetra Tech, 2003a). Activities at the Site also included burning of process chemicals and waste rocket propellants in an area commonly referred to as the burn pit area (BPA). The company utilized explosives in their work; however, since this work was focused on propulsion systems and weapons delivery systems, most munitions used on site were reportedly practice rounds that did not contain high explosives. In 1970, LMC began offering their test services to outside parties and leased property to Aerojet Corporation and allowed General Dynamics to conduct testing on several occasions.

As a result of the discovery of apparently discarded munitions at the Site in 2005, Tetra Tech was tasked by LMC to provide rapid response to assess and, if necessary, mitigate immediate ordnance-related hazards potentially present on site. Therefore, the munitions and explosives of concern (MEC) investigation and mitigation activities are being conducted on a different track than the remedial investigations. However, a summary of the MEC investigations completed to date have been included in the synopsis of the previous site investigations in Section 2.

Nine former operational areas have been identified at the Site. A Site historical operational areas and features map is presented as Figure 1-2. Each historical operational area was responsible for various activities associated with rocket motor assembly, testing, and propellant incineration. A brief description of the five historical operational areas requiring further assessment follows.

Historical Operational Area B - Rocket Motor Production Area

The Rocket Motor Production Area (RMPA), also known as the Propellant Mixing Area, was used for the processing and mixing of rocket motor solid propellants. The rocket motor production process consisted of: 1) fuel slurry station, 2) mixing station, and 3) cast and curing station.



LEGEND

- Beaumont Site 1 Property Boundary
- Historical Operational Area Boundary - Further Investigation
- Historical Operational Area Boundary - No Further Investigation
- Conservation Easement

Notes:

Beaumont Site 1 property boundary is approximate.

Black - Features investigated as part of the DSI.

Gray - Features not investigated during the DSI.

Beaumont Site 1

Figure 1-2
Historical Operational Areas, Site Features, and Conservation Easement

TETRA TECH

If a defect was found in the solid propellant mix, the rocket motor was scrapped. The solid propellant was removed from the casings by water jetting at the motor washout area located south of the mixing station (Radian, 1986a).

In 1973, an area east of the mixing station, known as the blue motor burn pit, was utilized for the destruction of four motors, which included a motor with Milori Blue, also called Prussian Blue (Radian, 1986a). Prussian Blue is an inert propellant made up of ferric ferrocyanide that was used as a burn rate modifier.

Historical Operational Area C - Burn Pit Area

The BPA consisted of three primary features: 1) chemical storage area, 2) burn pits, and 3) the beryllium test stand. Hazardous waste materials generated at the Site were stored in 55-gallon drums on a concrete pad east of the burn pits at the chemical storage area until enough material was generated for a burning event. The hazardous materials incinerated in the pits included: ammonium perchlorate, wet propellant from motor washout, dry propellant, batches of out-of-specification propellant, various kinds of adhesives, resin curatives such as polybutadiene acrylonitrile/acrylic acid copolymer, burn rate modifiers such as ferrocene, pyrotechnic and ignition components, packaging materials (e.g., metal drums, plastic bags, and paper drums), and solvents (Radian, 1986a).

On the south side of the spur, where the burn pit instrumentation bunker was located, there was a one-time firing of small beryllium research motors (Radian, 1986a).

Historical Operational Area F - LPC Test Services Area

The LPC Test Services Area included the following features: 1) three bays for structural load tests, 2) a 13-foot diameter spherical pressure vessel, 3) six temperature conditioning chambers, 4) five environmental chambers, 5) a 25-million electron volt (MeV) Betatron for emitting X-rays into large structures, 6) personnel and instrumentation protection bunkers, and 7) supporting workshops and storage areas (Radian, 1986a).

If defects were identified during the integrity and environmental testing activities, the rocket motors were taken to a secondary washout area located south of the conditioning chambers adjacent to Potrero Creek (Radian, 1986a).

Rocket motor structural load testing under static and captive firing conditions occurred at the LPC test bays. During several of the initial tests conducted at Bay 309, the readied motor exploded instead of firing (Radian, 1986a).

Historical Operational Area G - Helicopter Weapons Test Area

The helicopter weapons test area was used to develop equipment for handling helicopter weapons systems. The facilities within this area included a hangar (Building 302), a helicopter landing pad, stationary ground-mounted gun platforms, and a mobile target suspended between towers. The primary purpose of this test area was to test both stationary guns and guns mounted on helicopters. Experimentation also was performed on the solid propellant portion of an armor-piercing round. The majority of rounds were fired into the side of the creek wash, about 100 yards to the south of the hanger. A longer impact area labeled with distance markers was located in the canyon to the south of the wash. Reportedly, projectiles were steel only; warheads were not used during tests at this facility (Tetra Tech, 2003a).

Historical Operational Area H - Sanitary Landfill

A permitted sanitary landfill was located along the western side of the Site. The permit for the landfill allowed LPC to dispose of trash such as paper, scrap metal, concrete, and wood generated during routine daily operations. Lockheed policy strictly dictated that hazardous materials were not to be disposed of at this landfill. The trenches were later covered and leveled, with only an occasional tire, metal scrap, or piece of wood remaining on the surface (Tetra Tech, 2003a).

1.2 OBJECTIVES

The objective of the DSI was to complete the assessment of 10 features previously evaluated during the most recent investigation (Tetra Tech, 2008b) in order to support the evaluation of remedial alternatives for the Site. The goal of the investigation was to utilize a dynamic sampling plan to complete the characterizations in a single mobilization following the general guidelines of the United States Environmental Protection Agency's (EPA) Triad Approach. This strategy was utilized to help organize what is already known about each feature for this investigation and help identify information gaps to guide project decisions. For this investigation, the feature-specific CSM was the primary planning tool to help organize what is already known about each feature for this investigation and help identify information gaps to guide project decisions. A summary of the chemicals of potential concern (COPCs) and investigation objectives for each feature is listed in Table 1-2.

1.3 TECHNICAL APPROACH

The investigation encompassed the collection of field and analytical data to fill information gaps at features where affected soil or groundwater was identified during previous investigations but not completely characterized with respect to the magnitude and spatial extent. Additional data were also collected for the human health and ecological risk assessments and to determine sitewide background metals concentrations in soil for the three geologic units (Quaternary alluvium, San Timoteo formation, and Mount Eden formation [MEF]) where previous soil samples had been collected. An offsite guard well was also installed below Gilman Springs Road south of the Site due to recent low-level (0.78 - 0.94 ppb) detections of 1,4-dioxane in the on-site guard well (MW-67). The investigation utilized a combination of hand auger, direct-push (DP), hollow-stem auger (HSA), and resonant sonic soil borings for soil and groundwater sampling and soil gas probe installations. The installation of groundwater monitoring wells was completed using either the HSA or resonant sonic drilling methods based on the subsurface lithology and depth to groundwater.

Groundwater and soil samples collected were submitted to American Environmental Testing Laboratories (AETL) on a rush turn-around time (TAT) basis in lieu of real-time measurement technologies for both perchlorate and VOCs. Soil gas samples were collected by an AETL technician and submitted to AETL for analysis on a standard TAT basis. Samples collected for analysis of metals were submitted to CalScience to meet the method detection limits required by the Quality Assurance Project Plan (QAPP). Depending on the COPCs at each feature, soil, soil gas, and/or groundwater samples were collected to characterize the magnitude and extent of affected soil or groundwater. A summary of the COPCs and investigation objectives for each of the 10 site features that were identified for further investigation and assessed during this investigation are listed in Table 1-2. A map showing the locations of the features is provided in Figure 1-2.

In order to assess the relative magnitude of the COPC concentrations detected at the Site, a table of published regulatory screening levels for the primary soil and groundwater COPCs is presented in Tables 1-3 through 1-5. The regulatory screening levels presented in this table are for comparative purposes only and are not intended to be site-specific cleanup levels in which characterization and remedial actions will be based on. However, while the human health and ecological risk assessments are being conducted these screening levels can be used to provide perspective with regard to the relative risk that each feature represents for the Site.

Table 1-2 Dynamic Site Investigation Objectives

Feature No.	Feature	COPCs	Objectives
B-9	Motor Washout Area	Perchlorate	Delineate extent of perchlorate impacts in shallow soils above highest groundwater level. Delineate extent of perchlorate "hot spots" in deeper soils below highest groundwater level.
B-10	Propellant Mixing Station	Perchlorate	Delineate extent of perchlorate impacts in shallow soils above highest groundwater level. Assess perchlorate impacts to groundwater and determine magnitude and extent of impacts.
B-11	Fuel Slurry Station	Perchlorate	Delineate extent of perchlorate impacts in shallow soils above highest groundwater level.
B-14	Pad with Dry Well	Perchlorate	Delineate extent of perchlorate impacts in shallow soils above highest groundwater level. Delineate extent of perchlorate "hot spots" in deeper soils below highest groundwater level. Assess the magnitude and extent of perchlorate impacts to groundwater.
B-20	Pad South of Mix Station Bunker	Perchlorate	Delineate extent of perchlorate impacts in shallow soils above highest groundwater level.
C-22	Burn Pit Area	Perchlorate, VOCs, and 1,4-Dioxane	Delineate extent of perchlorate impacts in shallow soils above highest groundwater level. Delineate extent of perchlorate "hot spots" in deeper soils below highest groundwater level. Evaluate VOCs in shallow soil gas for human health risk assessment.
F-34	Maintenance Shop and Storage Warehouse Area	VOCs (PCE, TCE, DCE)	Delineate extent of VOC impacts in soil. Assess VOC impacts to groundwater and determine magnitude and extent of impacts.
F-39	Test Bays	VOCs (TCE, PCE)	Delineate extent of VOC impacts in soil. Delineate extent of VOC impacts in groundwater.
G-46	Helicopter Landing Pad and Hangar	VOCs (PCE)	Delineate extent of VOC impacts in soil. Assess VOC impacts to groundwater and determine magnitude and extent of impacts.
H-49	Sanitary Landfill	Perchlorate and PCBs	Delineate extent of perchlorate impacts in soil. Assess perchlorate impacts to groundwater and determine magnitude and extent of impacts. Delineate extent of PCB impacts in soil.

Notes:
COPCs - Chemicals of Potential Concern.
VOCs - Volatile organic compounds.
PCE - Tetrachloroethene.
TCE - Trichloroethene.
PCBs - Polychlorinated biphenyls.

Table 1-3 Human Health and Ecological Screening Levels for Site COPCs - Soil (mg/kg)

Chemical	Lowest Value	RSL (USEPA, 2009) Residential	RSL (USEPA, 2009) Industrial	CHHSL (OEHHA, 2005) Residential	CHHSL (OEHHA, 2005) Industrial	ORNL Soil Benchmarks (Efroymson et al., 1997a,b) Invertebrates	ORNL Soil Benchmarks (Efroymson et al., 1997a,b) Plants	Other
Inorganics								
Perchlorate	1.0	29[*]	380[*]	-	-	-	-	4.0[a], 1.0[b]
VOCs								
1,1,1-Trichloroethane	9,000	9,000	39,000	-	-	-	-	-
1,1,2-Trichloroethane	1.1	1.1	5.5	-	-	-	-	-
1,1-Dichloroethane	3.4	3.4	17	-	-	-	-	-
1,1-Dichloroethene	250	250	1,100	-	-	-	-	-
1,4-Dioxane	18	44	160	18	64	-	-	-
2-Butanone (Methyl ethyl ketone)	28,000	28,000	190,000	-	-	-	-	-
2-Hexanone	-	-	-	-	-	-	-	-
Benzene	1.1	1.1	5.6	-	-	-	-	-
Carbon Disulfide	670	670	3000	-	-	-	-	-
Chloroform	0.3	0.3	1.5	-	-	-	-	-
Chloromethane	120	120	510	-	-	-	-	-
cis-1,2-Dichloroethene	780	780	10,000	-	-	-	-	-
Ethylbenzene	5.7	5.7	29	-	-	-	-	-
m,p-Xylene	4,500	4,500	19,000	-	-	-	-	-
Methylene Chloride	11	11	54	-	-	-	-	-
Methyl-t-Butyl Ether (MTBE)	39	39	190	-	-	-	-	-
o-Xylene	5300	5,300	23,000	-	-	-	-	-
Styrene	300	6,500	38,000	-	-	-	300	-
Tetrachloroethene	0.57	0.57	2.7	-	-	-	-	-
Toluene	200	5,000	46,000	-	-	-	200	-
trans-1,2-Dichloroethene	110	110	500	-	-	-	-	-
Trichloroethene	2.8	2.8	14	-	-	-	-	-
Trichlorofluoromethane	800	800	3,400	-	-	-	-	-
PCBs								
PCBs	0.089	-	-	0.089	0.3	-	40	-
Aroclor 1016	3.9	3.9	21	-	-	-	-	-
Aroclor 1221	0.17	0.17	0.62	-	-	-	-	-
Aroclor 1232	0.17	0.17	0.62	-	-	-	-	-
Aroclor 1242	0.22	0.22	0.74	-	-	-	-	-
Aroclor 1248	0.22	0.22	0.74	-	-	-	-	-
Aroclor 1254	0.22	0.22	0.74	-	-	-	-	-
Aroclor 1260	0.22	0.22	0.74	-	-	-	-	-
Dioxins								
2,3,7,8-TCDD	4.50E-6	4.50E-6	1.80E-5	4.60E-6	1.90E-5	-	-	-

Definitions:
Eco-SSL - Ecological Soil Screening Level
ORNL - Oak Ridge National Laboratory

Notes:
a - Perchlorate screening concentration for plants (U.S. EPA 2002).
b - Perchlorate screening concentration for soil invertebrates (U.S. EPA 2002).
(*) - Cal-modified RSL (DTSC and HERD, 2009).

Sources:

California Environmental Protection Agency (Cal EPA), Office of Environmental Health Hazard Assessment (OEHHA). 2005. Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil. November 2004; January 2005 revision. Available online at: http://calepa.ca.gov/Brownfields/SB32.htm

Efroymson, R.A., M.E. Will, and G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Prepared for the U.S. Department of Energy, Oak Ridge National Laboratory. ES/ER/TM-85/R3.*

Efroymson, R. A., M.E, Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-126/R2.*

U.S. Environmental Protection Agency (U.S. EPA). 2002. *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization. National Center for Environmental Assessment, Office of Research and Development. Washington, DC. NCEA-1-050*

U.S. Environmental Protection Agency (USEPA). 2009. Human Health Regional Screening Levels (RSLs). Available online at: http://epa.gov/region09/superfund/prg/index.html

California Department of Toxic Substances Control (DTSC) and Human and Ecological Risk Division (HERD). 2009. *Human Health Risk Assessment Note 3 - DTSC Recommended Methodology for Use of U.S. EPA Regional Screening Levels (RSLs) in Human Health Risk Assessment Process at Department of Defense Sites and Facilities.* May 6, 2009.

Table 1-4 Human Health Screening Levels for Site COPCs - Soil Gas (μg/m^3)

Constituent	Soil Gas CHHSL (OEHHA, 2005) Residential	Industrial
VOCs		
Carbon Disulfide	-	-
1,1-Dichloroethane	-	-
1,1-Dichloroethene	-	-
cis-1,2-Dichloroethene	15,900	44,400
Tetrachloroethene	180	603
Toluene (Methyl benzene)	135,000	378,000
1,1,1-Trichloroethane	991,000	2,790,000
1,1,2-Trichloroethane	-	-
Trichloroethene	528	1,770
Trichlorofluoromethane	-	-

Definition:

CHHSL - California Human Health Screening Levels [Cal EPA, 2005].

R - Residential screening level.

C/I - Commercial/Industrial screening level.

(-) - Screening level not available.

Source:
California Environmental Protection Agency (Cal EPA), Office of Environmental Health Hazard Assessment (OEHHA). 2005. Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil. November 2004; January 2005 revision. Available online at: http://calepa.ca.gov/Brownfields/SB32.htm

Table 1-5 Human Health and Ecological Screening Levels for Site COPCs - Groundwater (µg/L)

Chemical	Lowest Value	Tap Water RSL (USEPA, 2009)	MCL (CDPH, 2009a)	PHG (CDPH, 2009a)	Notification Level (CDPH, 2009b)	Cal Toxics Rule (USEPA, 2000)	NAWQC (USEPA, 2006)	ORNL Water-Based Benchmark for Plants (Efroymson et al., 1997b)[a]	Other
Inorganics									
Perchlorate	6.0	26	6.0	6.0	-	-	-	-	23[b]
VOCs									
1,1,1-Trichloroethane	200	9,100	200	1,000	-	-	-	100,000	-
1,1,2-Trichloroethane	0.24	0.24	5.0	0.3	-	-	-	-	-
1,1-Dichloroethane	2.4	2.4	5.0	3	-	-	-	-	-
1,1-Dichloroethene	6.0	340	6.0	10	-	-	-	-	-
1,4-Dioxane	3.0	6.1	-	-	3	22,000[c]	22,000[c]	-	-
2-Butanone (Methyl ethyl ketone)	7,100	7,100	-	-	-	-	-	-	-
2-Hexanone	-	-	-	-	-	-	-	-	-
Benzene	0.15	0.41	1.0	0.15		-	-	-	-
Carbon Disulfide	160	1,000	-	-	160	-	-	-	-
Chloromethane	190	190	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	6.0	370	6.0	100	-	-	-	-	-
Ethylbenzene	1.5	1.5	300	300	-	-	-	-	-
m,p-Xylene	1,400	1,400	1750	1,800	-	-	-	100,000	-
Methyl-t-Butyl Ether (MTBE)	12	12	13	13	-	-	-	-	-
o-Xylene	1,000	1,400	1750	1,800	-			1,000	
Styrene	100	1,600	100	-		-	-	10,000	-
Tetrachloroethene	0.06	0.11	5.0	0.06	-	-	-	10,000	-
Toluene	150	2,300	150	150	-	-	-	10,000	-
trans-1,2-Dichloroethene	10	110	10	60	-	-	-	-	-
Trichloroethene	0.8	1.7	5.0	0.8	-	-	-	-	-
Trichlorofluoromethane	150	1,300	150	700	-	-	-	-	-

Definitions:
MCL - Maximum Contaminant Level
NAWQC - National Ambient Water Quality Critieria for Freshwater Aquatic Life
NOAEL - No observed adverse effect level.
ORNL - Oak Ridge National Laboratory
PHG - Public Health Goals
RSL - Regional Screening Level

Notes:
a - May be applied to groundwater screening for phreatophytic plants.
b - Perchlorate NOAEL-based TRV for amphibians (USACHPPM 2007)
c - Midpoint of range of phytotoxically excessive levels in surface soils (Kabata-Pendias and Pendias 1984).

Sources:

California Department of Public Health (CDPH). 2009b. Notification Levels. Available online at: http://www.cdph.ca.gov/certlic/drinkingwater/Pages/NotificationLevels.aspx

California Department of Public Health (CDPH). 2009a. Maximum Contaminant Levels (MCLs) and Public Health Goals (PHGs). Available online at: http://www.cdph.ca.gov/CERTLIC/DRINKINGWATER/Pages/Chemicalcontaminants.aspx

Efroymson, R.A., M.E. Will, and G.W. Suter II, and A.C. Wooten. 1997b. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Prepared for the U.S. Department of Energy, Oak Ridge National Laboratory. ES/ER/TM-85/R3.*

Kabata-Pendias, A., and H. Pendias. 1984. *Trace Elements in Soils and Plants*. CRC Press, Ann Arbor, MI.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2007. Wildlife Toxicity Assessment for Perchlorate. USACHPPM Project Number 87-MA02T6-05D, Aberdeen Proving Ground, Maryland.

U.S. Environmental Protection Agency (USEPA). 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. Federal Register, 40 CFR Part 131. May 18, 2000. Available online at: http://www.epa.gov/waterscience/standards/rules/ctr/

U.S. Environmental Protection Agency (U.S. EPA). 2006. National Recommended Water Quality Criteria-Correction. Office of Water, Office of Science and Technology. Washington, D.C. Available at: http://www.epa.gov/waterscience/criteria/wqcriteria.html

U.S. Environmental Protection Agency (USEPA). 2009. Human Health Regional Screening Levels (RSLs). Available online at: http://epa.gov/region09/superfund/prg/index.html

2.0 PREVIOUS INVESTIGATIONS

The following section provides a brief discussion of previous investigations that have been conducted and a brief regulatory history of the Site.

2.1 INITIAL INVESTIGATIONS

2.1.1 Site History Investigation (1986)

In September 1986, Radian performed a detailed review of the Site history. This investigation described the historical industrial activity at the Site and proposed a method of scientific investigation to allow the nature and extent of environmental impacts to be defined. Much of the Site history was obtained through interviews of employees of LMC, who had formerly conducted work at the Site (Radian, 1986a).

In December 1986, Radian Corporation, Inc. (Radian) released the *Preliminary Remedial Investigation Report* of the Site, which included the sampling of nine groundwater wells in October 1986. Chlorinated hydrocarbons, including 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), 1,1,1-trichloroethane (1,1,1-TCA), and trichloroethene (TCE) had been detected in the groundwater, and comprised the major portion of the analytes found at the Site. It was determined at this time that the affected groundwater extended northwest of the former BPA and former RMPA. The results of this preliminary groundwater study confirmed the conclusions of the Site history investigation that identified these two areas as the primary potential sources of affected groundwater. The report recommended further characterization. During this investigation, a geophysical investigation was conducted to better define the extent of the former BPA trenches (Radian, 1986b).

2.1.2 Source and Hydrogeologic Investigation (1990)

In June 1989, the California Department of Public Health (DPH, formerly California Department of Health Services) issued a Consent Order directing a Remedial Investigation and Feasibility Study of the Site.

Radian conducted a field investigation and produced a report titled *Lockheed Propulsion Company, Beaumont Test Facilities, Source and Hydrogeologic Investigation* in February 1990. This report summarized the field investigation performed in late 1989. Radian conducted a hydrogeologic investigation consisting of a soil vapor investigation and installation of 19 monitoring wells in order to identify the magnitude and extent of surface and subsurface impacts. This analysis indicated that there was a narrow, well-defined groundwater plume of volatile organic compounds (VOCs) limited to the upper alluvial aquifer, originating in the former BPA and former RMPA and extending approximately 2 miles downgradient. Trenching activities in the former BPA were conducted in order to determine the location and alignments of the burn pits, characterize the burn pit waste, and collect samples of waste and surrounding soils for chemical analysis. This investigation resulted in the confirmation of 14 burn pit locations, and chemical analysis indicated that burn pit wastes contain VOCs and semi-volatile organic compounds (SVOCs). Approximately 60 soil vapor samples were collected in and around the former BPA and the former RMPA. Interpretation of soil vapor data indicated that there was a well-defined soil vapor plume originating from the former BPA and the former RMPA, and that the primary source for soil vapor and affected groundwater was derived from the former BPA with the former RMPA as a secondary source of analytes (Radian, 1990).

Surface water was also investigated by Radian, and it was reported that a body of surface water referred to as the "upper pond" had VOC concentrations of 72 micrograms per liter (µg/L). During the same time period, well OW-2, located 500 feet east of the upper pond, had VOC concentrations of 170 µg/L. Also, during the same time period a "lower pond" was sampled and analyzed for VOCs. No VOCs were reported in the samples collected from the lower pond (Radian, 1990).

2.2 REMEDIAL ACTIVITIES

2.2.1 Treatability Study (1991)

Radian submitted a Treatability Study to LMC in February 1992, which presented the test results of the investigation conducted from March to May 1991 at the Site. During this study, the hydrogeologic parameters of the aquifers were investigated, and five pilot-scale treatment technologies were tested to determine their ability to extract and treat the soil vapor and affected groundwater at the Site. It was concluded that the clean-up strategy would comprise a dual phase VOC extraction within the BPA, and included a catalytic oxidation unit with liquid phase granular activated carbon. Within the RMPA a groundwater pump and treat system was constructed, and included two groundwater extraction wells connected to an air stripping column with vapor phase granular activated carbon (Radian, 1992a).

2.2.2 Burn Pit Remediation (1993)

In August 1992, Radian submitted a *Burn Pit Remediation Work Plan* to LMC summarizing the results of the remedial investigations at the Site and describing the remedial action strategy to mitigate and control soil and groundwater impacts at the Site. This document provided an overview of the recommended burn pit removal action, and proposed soil and groundwater extraction and treatment systems (Radian, 1992b).

In June 1993, Radian submitted the *Burn Pit Area Removal Action Report*, which provides details of the removal action performed from November 1992 through February 1993 at the BPA. Using excavation equipment, the soil and waste debris were removed from the burn pits and transported to an appropriate approved off-site disposal facility. During the three-month removal action, 21 burn pits were excavated. Sixteen of these burn pits were known to exist from previous historical reports and previous trenching activities, and five additional burn pits were discovered during these excavation activities. At the completion of excavation and waste disposal activities, the site was restored to its near original condition (Radian, 1993).

2.2.3 Groundwater and Soil Vapor Treatment Systems (1994 - 1998)

In June 1994, LMC and DTSC entered into a Final Operation and Maintenance (O&M) Agreement. This agreement implemented the remediation and O&M Plan, and allowed LMC to operate and maintain the water and soil vapor treatment systems at the Site.

In September 1998, Radian submitted a report titled *Final Lockheed Martin Beaumont Burn Pit Area Remediation System Evaluation* which discussed the feasibility of shutting down the soil vapor extraction (SVE) system located in the former BPA. This report concluded that each of the Regional Water Quality Control Board's performance criteria had been met, and soil vapor concentrations have been reduced by more than 99.6 percent (%), so continued vapor extraction was not considered efficient or necessary (Radian, 1998).

2.2.4 Five Year Review Report (2000)

In March 2000, Earth Tech prepared the *Five Year Review Report*. This report presented an evaluation of analytical and operational data collected during the previous five years of remedial activities at the Site, particularly the former RMPA and the former BPA (Earth Tech, 2000). The report concluded that the SVE system at the former BPA had gone asymptotic and had been effective in remediating VOC-affected soil in the vadose zone; and that concentrations of VOCs in groundwater at the former BPA remained elevated. The groundwater extraction system installed and operated in the former RMPA had been effective in reducing the concentrations of VOCs in the area and appeared to have reduced the migration of VOCs downgradient of the source areas as well (Earth Tech, 2000).

After comments to the *Five Year Review Report* were received from DTSC in July 2001, it was determined that additional analyses needed to be conducted at the Site. LMC reviewed the comments from DTSC, and responded in September 2001. LMC's response included implementation of the Sampling and Analysis Plan (SAP) (Earth Tech, 2002). Among others, one of the main objectives of the 2002 SAP was to evaluate the extent and magnitude of the affected groundwater beneath the Site.

2.3 SUPPLEMENTAL SITE INVESTIGATIONS

2.3.1 Supplemental Site Characterization (2002)

In 2002, soil, soil vapor, and groundwater sampling was performed as proposed in the SAP (Earth Tech, 2002) to further evaluate potential source areas and monitor groundwater (Tetra Tech, 2002). A total of 52 groundwater monitoring wells were sampled and analyzed for VOCs, 1,4-dioxane, perchlorate, and Title 22 metals. Overall, temporal trend analysis indicated decreases in VOC concentrations in areas immediately downgradient of the former BPA and former RMPA. The concentration change was attributed to the remedial actions conducted between 1992 and 1999, as well as plume migration over time (Tetra Tech, 2002). Three surface water samples were collected from three locations believed to be fed by groundwater and analyzed for VOCs, 1,4-dioxane, and perchlorate. Perchlorate, 1,4-dioxane, TCE, and 1,1-DCE were detected at concentrations above the California DPH or federal EPA maximum contaminant levels (MCLs) or California drinking water notification levels (DWNLs) in two of the three surface water locations. Analysis of the data indicated that 1,4-dioxane in groundwater extended beyond the furthest downgradient well sampled during the investigation. A total of 40 soil and soil gas samples were collected and analyzed from 20 locations in the former BPA and former RMPA at depths of 5 and 15 feet below ground surface (bgs). Soil gas samples were also collected from three extraction wells and 10 groundwater monitoring wells. None of the detected soil concentrations were greater then the EPA Region IX Preliminary Remediation Goals (PRGs) for residential soils, and soil gas concentrations had decreased from levels detected in the 1990s (Tetra Tech, 2002).

2.3.2 Soil Investigation (2004)

In 2004, soil characterization was continued over two general areal divisions of the Site: Historical Operational Areas A, B, and C (Tetra Tech, 2005a); and Historical Operational Areas D, E, F, G, H, and I (Tetra Tech, 2005b). In Historical Operational Areas A, B, and C, a total of 293 samples were collected and analyzed from 64 borings at depths ranging from 0.5 to 60 feet bgs (Tetra Tech, 2005a). Soil samples were analyzed for one or more of the following constituents: VOCs, SVOCs, 1,4-dioxane, perchlorate, Title 22 metals, PCBs, total petroleum hydrocarbons (TPH), and explosive residues. PCBs, 1,4-dioxane, and explosive residues were not detected at concentrations above their respective laboratory reporting limits (RLs). Fourteen VOCs were detected in soil at concentrations ranging up to 700 micrograms per kilogram (µg/kg) with ethanol having the highest detected concentration. SVOCs were rarely detected with the highest concentration being an isolated detection of bis-2-ethyl hexyl phthalate in one sample at 4,500 µg/kg. Perchlorate was detected at concentrations up to 171,000 µg/kg. Metals were detected and concentrations of arsenic were reported up to 60.8 milligrams per kilogram (mg/kg). In addition, soil gas concentrations of TCE, PCE, 1,1-DCE, 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113), and 1,1,1-TCA were detected above RLs. In general, limited affected soil was detected in Area A. Perchlorate and VOC affected soil was further delineated in Areas B and C (Tetra Tech, 2005a).

A total of 302 samples were collected and analyzed from 78 borings at depths ranging from 0.5 to 60 feet bgs in Historical Operational Areas D, E, F, G, H, and I (Tetra Tech, 2005b). Soil samples were analyzed for one or more of the following constituents: VOCs, SVOCs, 1,4-dioxane, perchlorate, Title 22 metals, PCBs, TPH, and explosive residues. SVOCs, 1,4-dioxane, and explosive residues were not detected at concentrations above their respective RLs. VOCs were detected at concentrations ranging up to 920 µg/kg with acetone having the highest detected concentration. PCBs were detected at concentrations up to 910 µg/kg. Perchlorate was detected at concentrations up to 57,100 µg/kg. Arsenic was detected at concentrations up to 19 mg/kg. Vanadium was detected at concentrations up to 2.2 mg/kg. In general, limited affected soil was detected in Area D, G, and I. (Tetra Tech, 2005b).

A total of 51 historical features have been identified as potential recognized environmental concerns (RECs) (25 within Historical Operational Areas A, B, and C and 26 within Historical Operational Areas D, F, G, H and I [Tetra Tech, 2003a]). A list of the 51 historical features identified with RECs is presented in Table 1-1 and their locations are shown on Figure 1-2.

No features were identified as potential RECs within Historical Operational Area E. According to the historical report (Radian, 1986a), former employees at the Site reported a one-time burial of low-level radioactive waste. The radioactive waste disposal site was present in Historical Operational Area E when assessed in 1986 and subsequently remediated during 1990. All of the waste reportedly buried at the site was accounted for and removed for analysis. Soil samples collected at the burial site did not indicate measurable concentrations of radioactivity above naturally occurring levels.

Geophysical surveys were performed to assist with the refinement of the CSM in November and December 2005. Downhole seismic velocity surveying was performed at the Site to: (1) aid in differentiating boundaries between unconsolidated alluvium and the weathered and unweathered portions of the Mount Eden formation; and (2) help refine the CSM and aid in future groundwater monitoring well placement. Geophysical reflection surveying was performed at the Site to more accurately locate published alluvium-concealed faults along the southwestern edge of the Site. The following subsections summarize the recent geophysical activities performed at the Site. The surveys and the associated data reduction and interpretation were performed by Terra Physics.

2.3.3 Supplemental Soil Investigation (2007)

In 2007, Tetra Tech conducted a subsurface soil investigation which was a follow-on activity to the site investigation conducted by Tetra Tech in 2004 (Tetra Tech, 2009a). The supplemental investigation was conducted through a combined soil boring and soil gas program. The investigation was conducted in an attempt to delineate chemically impacted soil in Historical Operational Areas A, B, C, D, F, G and H at the Site. During this investigation there were 86 borings installed, 190 soil samples analyzed, 9 groundwater samples collected and analyzed, 54 soil gas probes installed and sampled, and 3 groundwater monitoring wells installed. Tetra Tech delineated the extent of chemically impacted soil at 11 of the 21 features proposed during the 2007 soil investigation. Based on the results of this investigation, no further investigation of Historical Operational Areas A and D was recommended. In addition, no features were identified as potential RECs within Historical Operational Area E. Of the 21 features investigated during this investigation, 10 features were recommended for further evaluation to complete the characterization of the nature, magnitude, and extent of affected soil or groundwater at each feature. Further investigation of these features is needed to determine the mass of affected soil at each location to evaluate long-term threat to groundwater in addition to any human health and ecological risks.

2.3.4 Characterization of Former Sanitary Landfill (2008)

In July 2008, Tetra Tech conducted an investigation to further characterize soil located adjacent to the waste cells that were identified as part of the 2005 geophysical survey of the former Sanitary Landfill (Area H) (Tetra Tech, 2008a). Prior to this investigation, there was limited data to confirm the absence (or presence) of chemicals in soil adjacent to the waste cells. Results of this investigation generally confirmed the locations, depths, and types of wastes present in the landfill as previously reported. In addition to the waste delineation results, this investigation provided a more thorough characterization of the chemical impacts associated with the former landfill activities and wastes still present at the landfill.

A total of 19 trenches were completed and samples were collected immediately below ground surface (0.5 feet bgs) and adjacent to or below the waste layer. A total of 51 samples were collected and tested for perchlorate, PCBs, SVOCs, and metals and three (3) samples were collected from material that appeared burned or contained ash and were tested for dioxins and furans. The sampling results confirmed the presence of perchlorate, PCBs, metals, and dioxins and furans in soil adjacent to the waste cell. Based on the 2004, 2007 and 2008 sampling results, the extent of affected soil is generally limited to the footprints of the waste cells.

2.3.5 Remedial Design Characterization of Former Large Motor Washout Area (F-33) (2008)

The objective of this investigation was to complete the characterization of the lateral and vertical extent of the COPCs at Feature F-33 (Tetra Tech 2009b). The only COPC identified was perchlorate. The investigation goal was to adequately define the lateral and vertical extent of perchlorate impacted soil so that remedial alternatives could be identified for this feature. The investigation was designed to fill data gaps in areas where impacted soil and/or groundwater were identified during the previous investigations.

The depth of vadose zone contaminated soil ranges from ground surface to the groundwater table, which is encountered from 19.5 to 25 feet bgs. The highest detected perchlorate concentration in soil is 302,000 μg/kg at 16 feet bgs located in one location. The bulk of the impacted soil is located along the northeast side of the bluff.

2.4 MUNITIONS AND EXPLOSIVES OF CONCERN INVESTIGATIONS

During the active industrial life of the Site from 1960 until 1974, LMC used the facility for solid propellant mixing, testing, and incineration, as well as ballistics testing. The company utilized explosives in their work; however, since this work was focused on propulsion systems and weapons delivery systems, most munitions used on site were reportedly practice rounds that did not contain high explosives. In 1970, LMC began offering their test services to outside parties. LMC leased property to Aerojet Corporation and allowed General Dynamics to conduct testing on several occasions. There are indications that some of these tests involved live 30mm ammunition, rocket propelled projectiles and explosive shaped charges.

Record rainfall in 2005 caused heavy flows in the ephemeral creeks at the Site. As a result, several creek crossings on site were damaged. During repair of a stream crossing in Operational Area D (the former Lockheed Propulsion Company [LPC] Ballistics Test Range), two small clusters of 20mm link ammunition were found. Personnel from the Riverside County Sheriff's Office responded to the Site and examined the munitions. The officers dispatched were uncertain whether or not the ammunition was live (contained an explosive charge), so it was explosively disposed of on site. As a result of the discovery of these apparently discarded munitions, LMC expressed concern regarding other potential ordnance-related hazards on site.

2.4.1 Summary Report, Munitions and Explosives of Concern (2007)

As a result of the discovery of these apparently discarded munitions, Tetra Tech was tasked by LMC to provide rapid response to assess and, if necessary, mitigate immediate ordnance-related hazards potentially present on site (Tetra Tech, 2007). To facilitate this process, a preliminary list of areas of concern (AOCs) was prepared to focus the assessment in areas most likely to contain MEC hazards. The rapid response and preliminary assessment were designated as the Phase I Munitions and Explosives of Concern (MEC) Evaluation. Based on the results of the Phase I evaluation and a review of historical information available, Tetra Tech was asked to identify areas where follow-on work (more detailed inspection/evaluation) was warranted and to plan and conduct that work.

During the Phase I MEC Evaluation, relevant portions of five operational areas on site (A, B, D, G & I) were swept for surface MEC and related items. In addition, limited shallow subsurface evaluation was conducted in selected areas to evaluate the potential for buried MEC to be present. Areas were selected for evaluation based upon available historical information.

Just over 20 acres of land were evaluated during the Phase I MEC Evaluation. Twenty-five MEC items including 20mm target practice (TP) rounds and primer/igniters were found. In addition, 79 various munitions components were found including 20mm TP projectiles, 30mm TP projectiles, 40mm TP projectiles, primers/igniters and fragmentation (frag) from munitions. This count includes the 11 items initially found by CDFG personnel. The MEC items were all located in Operational Area D, while munitions components were found in areas B, D, G and I. In addition, UXO field personnel identified several areas not designated as test sites where numerous subsurface metallic contacts were present that may be buried MEC or related items.

Supplemental historical information was received during the Phase I MEC Evaluation from a former LMC employee who worked in Operational Area A. The employee indicated that live ordnance was used in this area and housekeeping procedures may not have been as extensive as necessary to ensure removal of all test related MEC and waste.

Following the Phase I MEC Evaluation, all of the data available including historical data, MEC data from Phase I and the new anecdotal information regarding Area A was used to create an initial conceptual site model (CSM) for the Site. The CSM describes the MEC-related operations that are thought to have taken place in each area and the types and general distribution of MEC or related materials expected to be present based on the characteristics of those operations. In addition, the CSM shows the transport mechanisms that may have resulted in re-distribution of MEC over time and the new locations where MEC may now be found. During preparation of the CSM the preliminary list of AOCs was adjusted to reflect the data gathered during Phase I. AOCs were added, removed or modified as appropriate to provide as accurate a depiction of site MEC characteristics as possible at the time.

The initial CSM was used to develop a plan for the Phase II MEC Evaluation. The second phase of evaluation was intended to verify or refute the various assumptions in the CSM and thus provide a more detailed and accurate depiction of the MEC characteristics of the Site. Approximately 82 acres of land were evaluated in seven operational areas during the Phase II MEC Evaluation. Four MEC items were found including three 30mm high explosive (HE) projectiles and one 20mm TP round. In addition, 616 munitions components were found including 20mm TP projectiles, 30mm TP projectiles, 40mm TP projectiles and frag. Table ES-1 summarizes the MEC data for each phase of the evaluation.

Following completion of the Phase II work, the CSM was updated to reflect the most current data available. The updated CSM will serve as the basis for decisions concerning no further action, further characterization or cleanup.

2005a. Summary Report, Munitions and Explosives of Concern (MEC) Evaluation. December 2005.

2.4.2 Supplemental Munitions and Explosives of Concern Evaluation and Removal (Rev 1, 2008)

During the Munitions and Explosives of Concern Evaluation and Removal (SMER), approximately 18 acres of land in Operational Areas A, B, D, and I were evaluated for MEC (Tetra Tech, 2008c). Approximately 66.5 acres of land were cleared of MEC in Operational Area A and, based on the results of the supplemental evaluation phase of the SMER, an additional 14.3 acres of land were cleared of MEC in Area I.

During the evaluation phase of the SMER, two 20mm practice projectiles, three 20mm casings with primers, and one primer assembly for a large caliber munition were found in Area D near Bed Springs Creek. These items were all classified as MEC. No MEC items were found in the other evaluation areas. One hundred fifty-four various munitions components (MC) were found during the evaluation phase of the SMER including intact and partial 27.5mm projectiles and 16mm tungsten penetrators in Area I, intact 30mm projectiles in Area A, and MEC-related scrap and frag in several areas. Eight intact 27.5mm projectiles were found in Area I during the assessment and two intact 30mm projectiles were found in Area A. These projectiles were initially classified as MEC because the interior could not be inspected to ensure that they did not contain explosive filler. Following disposal and inspection of the disposal debris, all of the projectiles were reclassified as MC based on lack of visible filler or residue and/or the type and condition of fragmentation produced by disposal.

During the MEC removal in Area A, 11 MEC items were discovered and removed. All of these items were 30mm projectiles. In addition, 192 MC were discovered and removed including inert 30mm projectiles, an inert 76mm rocket, 16mm penetrators, target debris and frag. The inert 30mm projectiles were initially classified as MEC because the interior could not be inspected. Following disposal and inspection of the disposal debris, the projectiles were reclassified as MC for reasons previously discussed.

Eighty-one MC were discovered and taken out during the removal in Area I. Twenty-one 27.5mm projectiles found during the removal were initially classified as MEC; however, following disposal and inspection of the disposal debris, these items were reclassified as MC for reasons previously discussed. Data collected during the SMER support the conceptual site model (CSM) developed for three of the AOCs included in the evaluation: Area B - Bazooka Impact Area AOC, Area D - End of TPLZ Range Fan AOC, and Area D - Streambed.

No additional MEC evaluation is recommended for these three areas. In addition, the data collected during the Area A - Impact Target Area AOC MEC evaluation and removal and the Area I - Airstrip AOC MEC evaluation and removal indicate that the removal areas were well delineated and MEC associated with past range activities was removed with a high level of confidence. The discovery of potential MEC in Area I resulted in a change of scope and a removal action in that area. The resulting data again supports the determination that the removal area was well delineated and potential MEC were removed with a high level of confidence.

2.4.3 Remedial Action Plan

Following completion of the assessment and removal work in 2007, the DTSC requested that follow-on actions be evaluated in an effort to effectively manage the residual hazard due to MEC that might remain at the Site. Future actions for dealing with potential MEC contamination are being developed as part of a MEC remedial action plan. These actions will consider the planned future use and the type and extent of MEC assessment and removal already completed in each AOC.

2.5 GROUNDWATER MONITORING PROGRAM

Prior to the DSI, 147 piezometers and groundwater monitoring wells were present at the Site and part of the groundwater monitoring program. Water level measurements have been collected at the Site since 1983 (Tetra Tech, 2003b). Monthly water level measurements were collected between 1991 and 1992. Between 1993 and 1994, water level measurements from wells at the Site were collected periodically. During 1995, water level measurements from wells at the Site were collected on a monthly basis. Quarterly water level measurements were collected between 1996 and 1998, and semiannual water level measurements were collected between 1999 and 2002. From 2003 onward, quarterly water level measurements have been collected. Water quality monitoring has been conducted at the Site since 1986. A summary of groundwater investigations, including associated well installation and monitoring activities, is provided in the *Revised Groundwater Sampling and Analysis Plan* (Tetra Tech, 2003b). Baseline groundwater sampling was performed on 111 wells between February 1993 and March 1993. Since 1993 various subsets of the well network have been sampled at a minimum, semiannually.

3.0 PHYSICAL SETTING

Section 3.0 is divided into five subsections: topography, precipitation, surface water, geology, and hydrogeology. The subsections describe the physical setting with all data collected and information available prior to the fall of 2008. While the physical setting is the most accurate representation based on data collected thus far, it should be noted that it will be revised as necessary when additional data or information is acquired.

3.1 TOPOGRAPHY

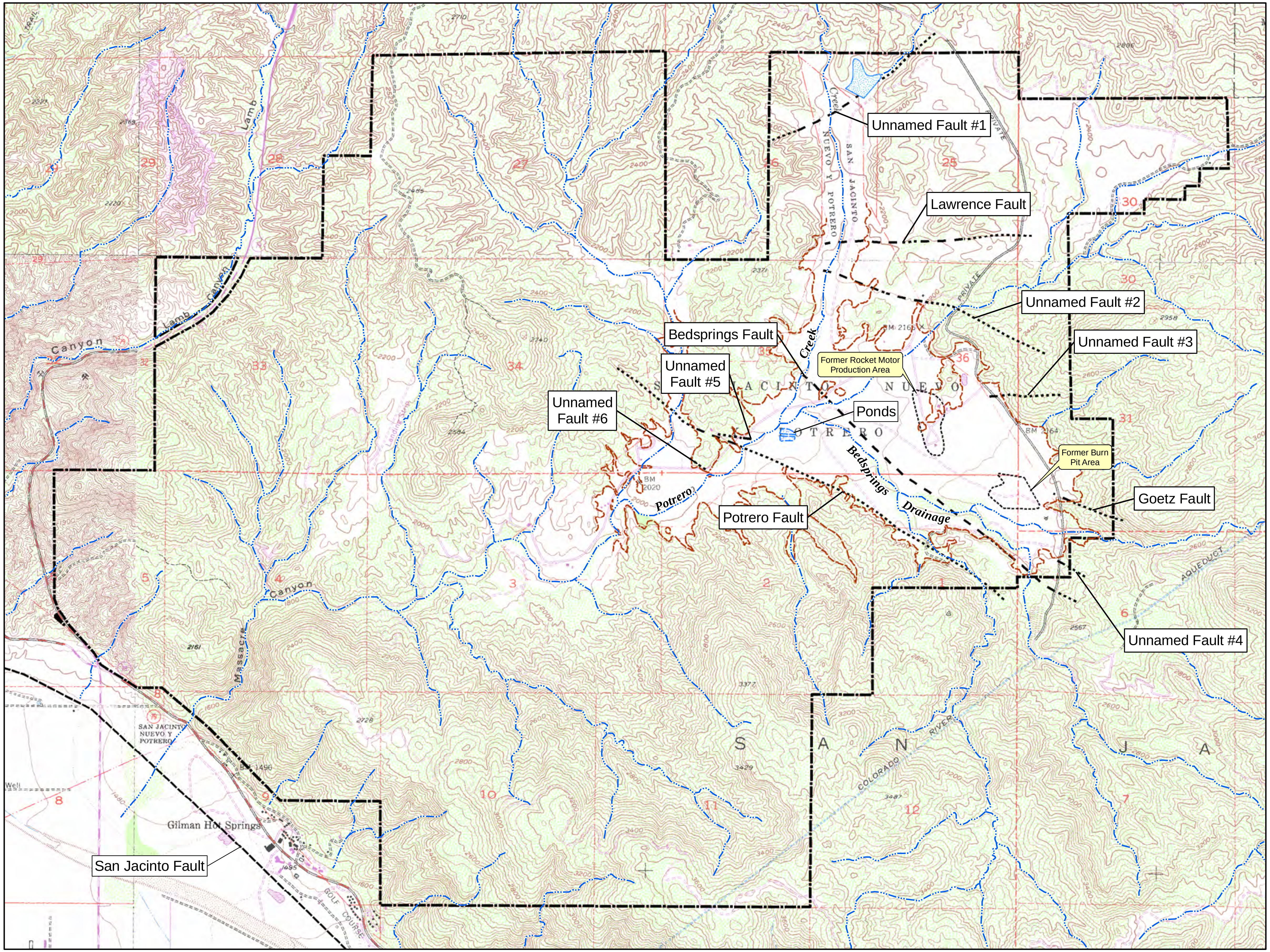
The Site is located south of the city of Beaumont, in a semi-arid region, at the northern end of the Peninsular Ranges Geomorphic Province (Harden, 1998). The Peninsular Ranges Province is dominated by a series of northwest oriented mountain ranges extending from the Baja California Peninsula north to the Transverse Ranges, near the San Jacinto and San Bernardino Mountains. Locally, the Site is located in a small valley (known as San Jacinto Nuevo y Potrero) in the northeastern foothills of the San Jacinto Mountains (Figure 3-1) [Radian, 1990]. The San Jacinto Nuevo y Potrero Valley extends from the San Gorgonio Pass to the San Jacinto Valley and decreases approximately 1,000 feet in elevation from north to south. Southwest of San Jacinto Nuevo y Potrero Valley, the topographic gradient of the valley steepens toward Massacre Canyon and flattens out when it reaches the San Jacinto Valley.

3.2 PRECIPITATION

Southern California has a Mediterranean climate which is characterized by mildly wet winters and warm to hot, dry summers. The Site is located within interior climate zones characterized by continental air mass influencing the climate with little influence from the ocean. The wettest months at the Site are December through March. The Riverside County Flood Control District has two weather stations in the general area of the Site: the Beaumont National Weather Service (NWS) station and the San Jacinto NWS station. Table 3-1 presents a monthly and annual summary of the precipitation data. Figure 3-2 presents the long term average and total annual precipitation for the two weather stations for the period of record. Figure 3-3 presents a detailed figure showing the long term average annual precipitation for the two weather stations for the period of record and the total annual precipitation for each station for the last 10 years.

The long-term average annual precipitation for the period between 1888 and 2008 is 14.28 inches and 10.97 inches for the Beaumont and San Jacinto NWS monitoring stations, respectively. The average annual precipitation between 1888 and 1940 was 18.88 inches and 12.04 inches for the Beaumont and San Jacinto NWS monitoring stations, respectively; the average annual precipitation between 1940 and 1980, X:\GIS\Lockheed 22288-110302\TOPO.mxd

R1W R1E



T3S T4S

T4S T3S

R1W R1E

0 1,250 2,500 Feet

Adapted from:

USGS 7.5' Topographic Quadrangles, El Casco, Lakeview, San Jacinto, and Beaumont.

Faults from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983b.

LEGEND

- Beaumont Site 1 Property Boundary
- Approximate Location of Fault
- Approximate Location of Buried Fault
- Intermittent Creek/Drainage
- Mount Eden/Alluvium Surface Contact

Note: Beaumont Site 1 property boundary is approximate.

Beaumont Site 1

Figure 3-1
Physical Setting

TETRA TECH

Table 3-1 Summary of Precipitation - Beaumont and San Jacinto NWS Monitoring Stations

Beaumont NWS Monitoring Station (for the years 1888 - 2008)														
Precipitation (inches)	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Mean Monthly**	**Annual Total**
Mean	2.86	2.90	2.51	1.03	0.52	0.09	0.09	0.24	0.29	0.61	1.15	2.01	1.19	14.28
Median	1.85	2.28	1.60	0.52	0.10	0.00	0.00	0.00	0.00	0.10	0.76	1.40	1.13	13.60
Maximum	18.80	12.81	11.20	9.10	4.83	1.70	2.10	2.80	4.41	6.82	4.99	14.43	2.90	34.80
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	2.04
2008 year to date	6.06	3.57	0.53	0.05	0.50	0.02	0.00	1.39	0.08	0.05	1.53	2.66	1.37	16.44
San Jacinto NWS Monitoring Station (for the years 1888 - 2008)														
Precipitation (inches)	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Mean Monthly**	**Annual Total**
Mean	2.19	2.11	1.90	0.83	0.36	0.06	0.10	0.20	0.30	0.54	0.93	1.48	0.92	10.97
Median	1.55	1.53	1.40	0.42	0.10	0.00	0.00	0.00	0.00	0.15	0.65	1.07	0.87	10.16
Maximum	13.70	10.30	7.80	6.89	3.40	1.00	1.50	2.32	4.73	5.64	6.47	11.29	2.34	28.03
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008 year to date	4.33	1.58	0.28	0.00	0.74	0.00	0.00	0.02	0.00	0.01	0.65	0.20	0.65	7.81

Notes:

NWS - National Weather Service.

encompassing the period of on-site activities, was 6.53 inches and 8.96 inches for the Beaumont and San Jacinto NWS monitoring stations, respectively.

Since 1980 the average annual precipitation has been above the long-term average (16.30 inches and 12.06 inches for the Beaumont and San Jacinto NWS monitoring stations, respectively) with oscillating periods of drought and heavy precipitation including the highest recorded annual rainfall in 1993 (34.8 inches at the Beaumont NWS monitoring station).

A prolonged period of below average precipitation between 1940 and 1980 would have caused the groundwater elevations on the Site to have been below their present levels during the period of Site activities between 1960 and 1974.

Figure 3-2 Annual Precipitation Since 1888

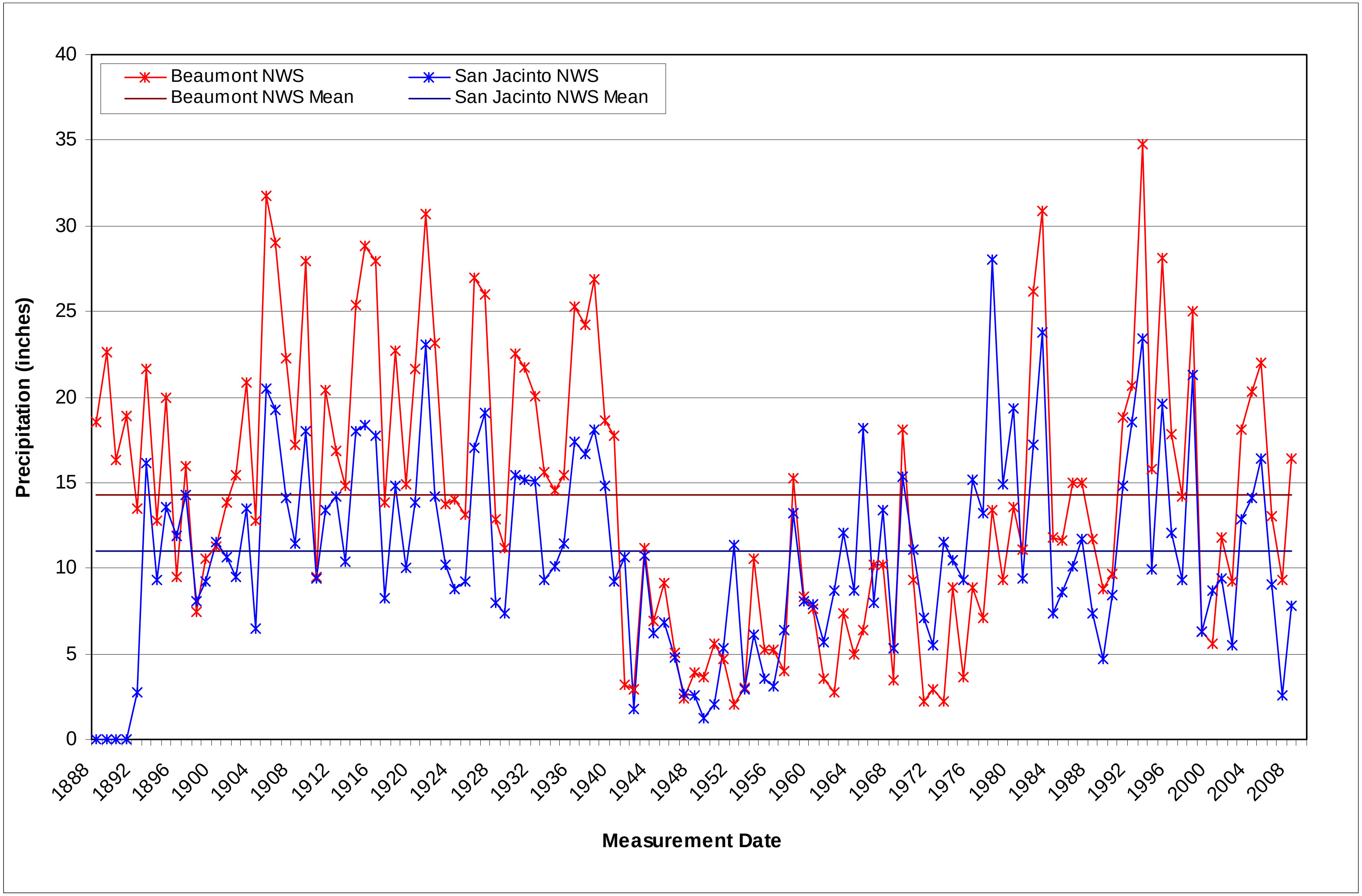
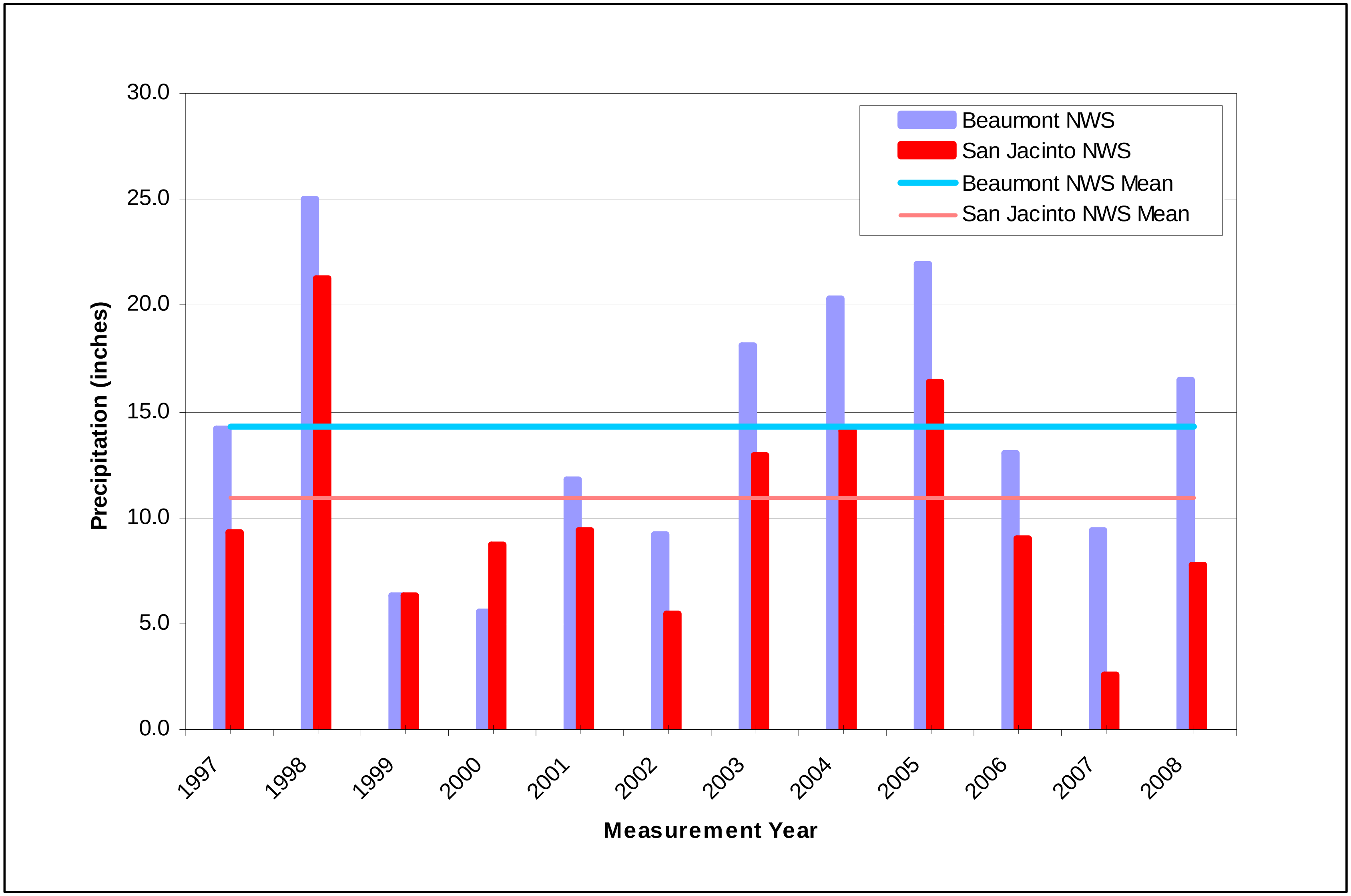


Figure 3-3 Annual Precipitation for the Past Ten Years



3.3 SURFACE WATER

The San Jacinto Nuevo y Potrero Valley watershed is approximately 35 square miles and drains in a southwestern direction (Tetra Tech, 2002). The valley is roughly triangular in shape, and the valley floor covers approximately 800 acres (Figure 3-1). The valley is primarily drained by Potrero Creek, an ephemeral stream which follows the valley from north to south before turning southwest to pass through Massacre Canyon toward its convergence with the San Jacinto River. Potrero Creek is fed by local tributary drainage and stormwater runoff from the city of Beaumont as well as other ephemeral streams in the southern and eastern portions of the Site. The largest of the tributary drainages is Bedsprings Creek, which is located southwest of the former RMPA and former BPA. In general, creeks are dry except during and immediately after periods of rainfall. However, springs and seeps occur in and adjacent to Potrero Creek in the western portion of the Site.

Numerous springs (as many as 50) were located in the valley prior to construction of the San Jacinto tunnel (located approximately 4,000 feet southeast and 500 feet lower in elevation than the former BPA) [Ransome, 1932; Leighton and Associates, 1983]. It was reported that the number of springs in the valley was significantly reduced following completion of the tunnel in the 1930s.

Currently, there are two (2) man-made ponds at the Site (Figure 3-1). The ponds were constructed in an area of shallow groundwater east of the Potrero Fault and appear to be sustained by a localized upward flow of groundwater within the pond excavations (Radian, 1992c; Tetra Tech, 2002).

3.4 GEOLOGY

The following subsections describe the regional and local geology in the area of the Site based on previous investigations and reports.

3.4.1 Regional Geology

Regional geology and stratigraphy in the Site vicinity was mapped by Dibblee (1981) [Figure 3-4], [Diblee, 1983]. Geologic units present in the area, from oldest to youngest, include: the Mesozoic granitic/Paleozoic to middle Mesozoic age metasedimentary (Granitic/Metasedimentary) basement complex rocks; sedimentary deposits of the Pliocene to Pleistocene age Mount Eden formation; overlain by the sedimentary San Timoteo formation; and Quaternary alluvium (Radian, 1990).

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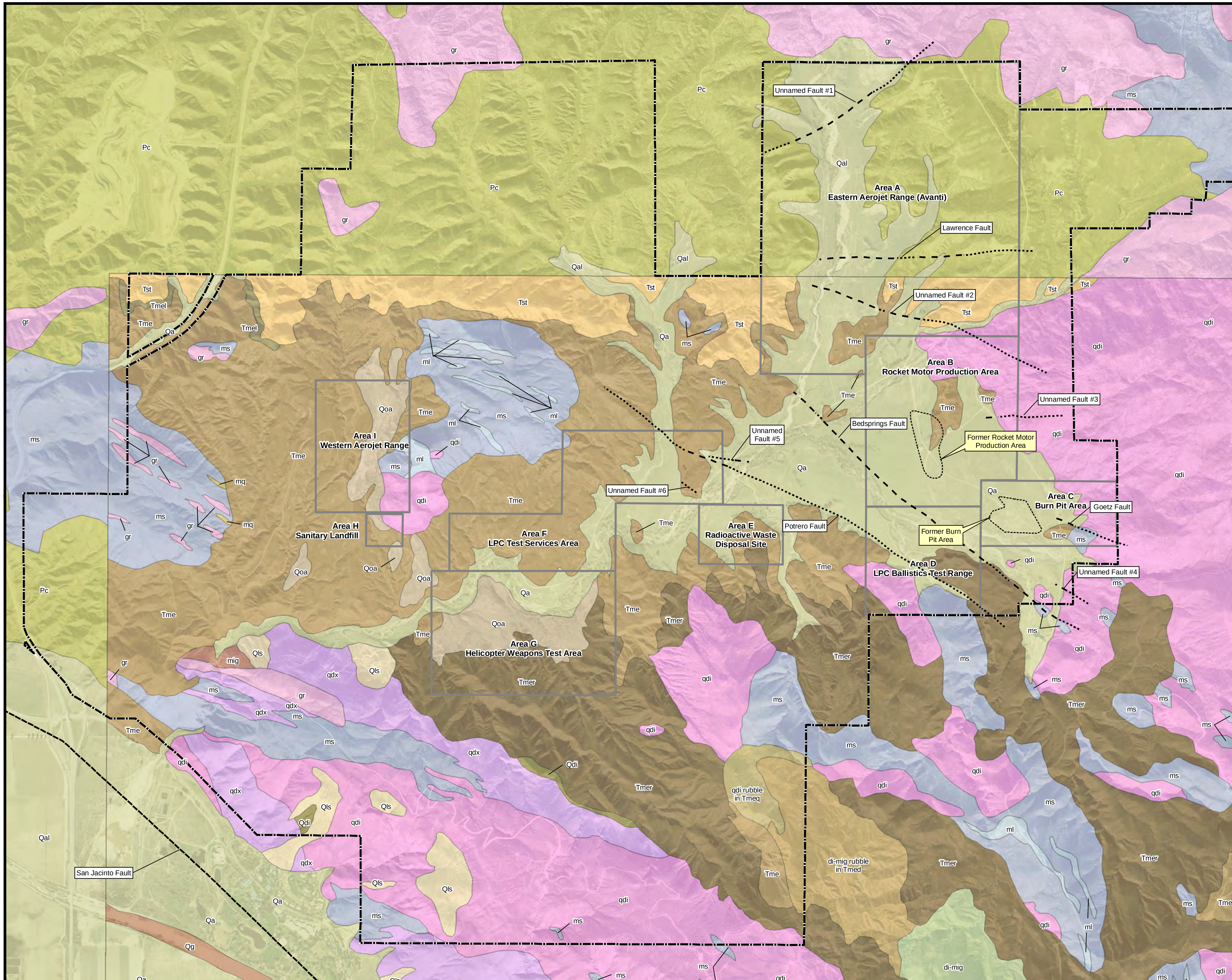

0 1,000 2,000 3,000 Feet

LEGEND

- Beaumont Site 1 Property Boundary
- Approximate Location of Fault
- Approximate Location of Buried Fault
- Historical Operational Unit Boundary

Geology from Dibblee, 2003

SURFICIAL SEDIMENTS

Alluvial sediments, unconsolidated, undissected

Qa — Alluvial sand and clay of valley areas, covered by gray soil, includes stream channel gravel and sand in mountain area

LANDSLIDE DEBRIS

Qls — Landslide of rock rubble

OLDER SURFICIAL SEDIMENTS

Dissected older alluvial deposits, slightly indurated, undeformed, late Pleistocene age

Qoa — Alluvial gravel and sand of low terrace remnants Qog Alluvial gravel and sand of high terrace remnants

SAN TIMOTEO FORMATION

(of Frick, 1921), only lowest part exposed at north border in this quadrangle, weakly lithified; age, Pliocene

Tst — Sandstone, light gray to tan, arkosic, includes thin layers and interbeds of gray cobble - pebbled conglomerate of mostly granitic detritus

MOUNT EDEN FORMATION

(of Fraser, 1931), moderately lithified, derived from basement rocks of San Jacinto Mountains; age upper Miocene

Tme — Sandstone, light orange - red, bedded, arkosic, includes thin layers of reddish claystone and lenses of pebble - cobble conglomerate, gray, of unsorted boulders and cobbles of granitic rocks (qdi), lower part west of Massacre Canyon includes much pebble-cobble conglomerate

Tmer — Conglomerate - fanglomerate, reddish gray-brown of poorly to unsorted sub-granitic (qdi and qdx) detritus in sandy matrix, vaguely bedded

PLUTONIC ROCKS

Medium grained holocrystalline granitic rocks of San Jacinto Mountains, part of Peninsular Range batholith, of Cretaceous age

gr — Granite of Mount Eden (of Morton and Matti, 2001), granite to quartz monzonite, eucocratic, graywhite, hard, massive, of quartz, potassic feldspar and sadie plagioclase feldspar in nearly equal amounts, and less than 5% mica, mostly muscovite; intrusive as large pod into unit xqd at Massacre Canyon and as small pods in ms to northwest

qdi — Quartz diorite, ranges to granodiorite, leucocratic light gray, composed of about 1/3 quartz, 1/2 sadie plagioclase feldspar, less than 1/4 potassic feldspar, and 5-10% biotite, minor hornblende, massive to faintly gneissoid, contains few small dark gray discoid inclusions (xenoliths); most widespread rock of San Jacinto Mountains

qdx — Quartz diorite, gray, massive to gneissoid, composed of about 1/4 quartz, 1/2 sadie plagioclase feldspar, less than 1/4 potassic feldspar, 5-15% biotite and hornblende; contains few to abundant dark gray discoid inclusions (xenoliths) oriented parallel to gneissoid structure of rock; includes migmatized remnants of schist-gneiss (ms) in many places

METASEDIMENTARY ROCKS

Rocks crystallized at depth from deformed sedimentary rocks, mostly argillaceous, of Paleozoic? of Mesozoic? age

ml — Marble, white to light gray, fine-grained crystallized from limestone or dolomite

ms — Schist, dark gray, fine-grained, foliated, of mica (mostly biotite), feldspar and quartz, in some areas in part crystallized to fine grained gneiss

Geology from California Division of Mines and Geology, 1966

Qal — Alluvium

Pc — Undivided Pliocene nonmarine

gr — Mesozoic granitic rocks

ms — Pre-Cretaceous metasedimentary rocks

Note: Beaumont Site 1 property boundary is approximate.

Adapted from:

Geologic Map of the San Jacinto Quadrangle, Thomas W. Dibblee, Jr. 2003

Geologic Map of California - Santa Ana Sheet, California Division of Mines and Geology, 1966.

Faults from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983b.

Beaumont Site 1

Figure 3-4

Regional Geology

TETRA TECH

3.4.2 Local Geology

Findings from geologic studies conducted at the Site are consistent with the regional geologic mapping performed by Dibblee (1981). In general, there are four stratigraphic units that exist beneath the Site which are described below from youngest to oldest: Quaternary alluvium, the San Timoteo formation, the Mount Eden formation (weathered and unweathered portions), and the Granitic/Metasedimentary basement complex. A geologic cross section location map is presented in Figure 3-5 over four pages. Figure 3-6 presents a cross section of the geologic contact of the Mount Eden formation and overlying alluvium, local faulting (Potrero and Bedsprings faults), and the slope of the valley along the longitudinal axis. Figures 3-7 through 3-12 present cross sections of the geologic contact of the Mount Eden formation and the overlying alluvium along lines approximately perpendicular to the longitudinal axis of the valley (as shown in Figure 3-6).

Quaternary Alluvium

Quaternary alluvium was deposited as a result of erosion and subsequent infilling of channels in older underlying rocks, predominantly the Mount Eden formation (Radian, 1992c). The present day surface of the alluvium within the valley slopes gently towards existing stream channels and is then incised about 5 to 15 feet along Bedsprings Creek and its tributaries and up to 30 feet or more in the northern portion of Potrero Creek. The alluvium extends laterally to the edges of valley and up stream channels to the north and a short distance up the stream channels on the south and east sides of the valley. To the southwest, alluvium thins and narrows along Potrero Creek towards the entrance of Massacre Canyon and is not present in lower reaches of the canyon where the stream course is less than 50 feet wide (Radian, 1992c).

At the Site, alluvium is predominantly sand and silty sand with interbedded gravels, sands, silts, and clays, with the predominant lithologies being sand and silty sand (Radian, 1992c). In general, the base of the alluvium is predominately coarser-grained intermixed with silt and/or clay and finer-grained material at shallower depths. In the northern and western portions of the valley, the alluvium is finer-grained where source material is the finer-grained San Timoteo formation (a very fine-grained siltstone to medium-grained silty sand). In the eastern portion of the valley where the source material is the Mount Eden formation or granitic rocks, the alluvium is generally fine-to coarse-grained.

As expected with alluvial deposits, the lithology is laterally heterogeneous and inferred lenses occur which usually cannot be correlated between borings. Coarse-grained materials including pebbles and gravels are present at various depths and tend to be more prominent towards the center of the valley than on the fringes. In the eastern portion of the Site, near the former RMPA and former BPA, fine-grained sediments including silts and sandy silts, ranging in thickness from 10 to 25 feet, were observed in

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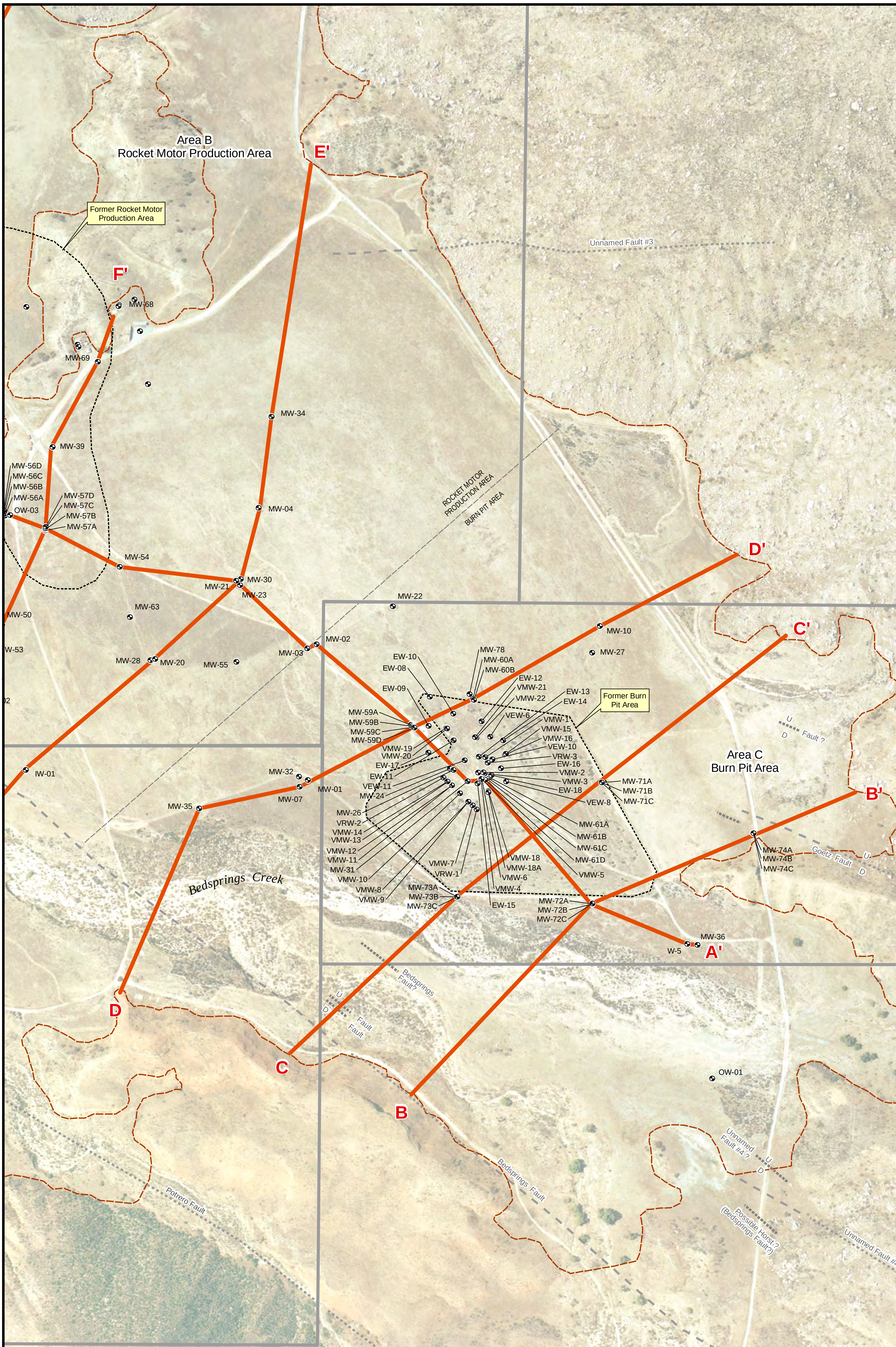

LEGEND

- Well Location
- Cross Section Location
- Historical Operational Unit Boundary
- Approximate Location of Buried Fault
- Approximate Location of Fault
- Mount Eden/Alluvium Surface Contact

N

0 200 400 Feet

Adapted from: March 2007 aerial photograph.

Published fault locations from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983b.

Beaumont Site 1

Figure 3-5
Cross Section Location Map

TETRA TECH

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LEGEND

- Well Location
- Cross Section Location
- Historical Operational Unit Boundary
- Approximate Location of Buried Fault
- Approximate Location of Fault
- Mount Eden/Alluvium Surface Contact

N

0 200 400 Feet

Adapted from: March 2007 aerial photograph.

Published fault locations from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983b.

Beaumont Site 1

Figure 3-5 (cont.)
Cross Section Location Map

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Beaumont Site 1

Figure 3-5 (cont.)
Cross Section Location Map

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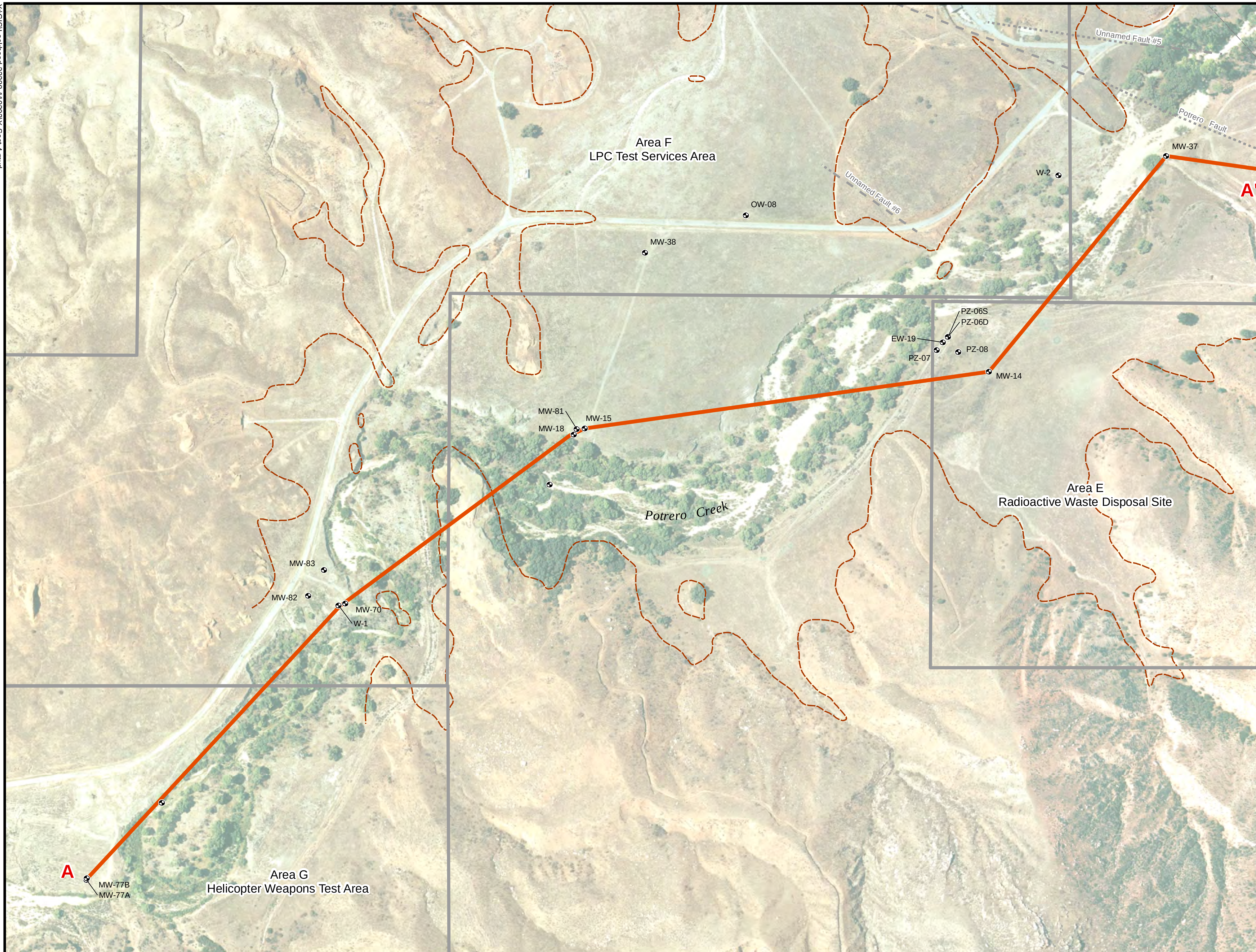

0 200 400 Feet

Adapted from: March 2007 aerial photograph.

Published fault locations from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983b.

LEGEND

- Well Location
- Cross Section Location
- Approximate Location of Fault
- Approximate Location of Buried Fault
- Historical Operational Area Boundary
- Mount Eden/Alluvium Surface Contact

Beaumont Site 1

Figure 3-5 (cont.)
Cross Section Location Map

TETRA TECH

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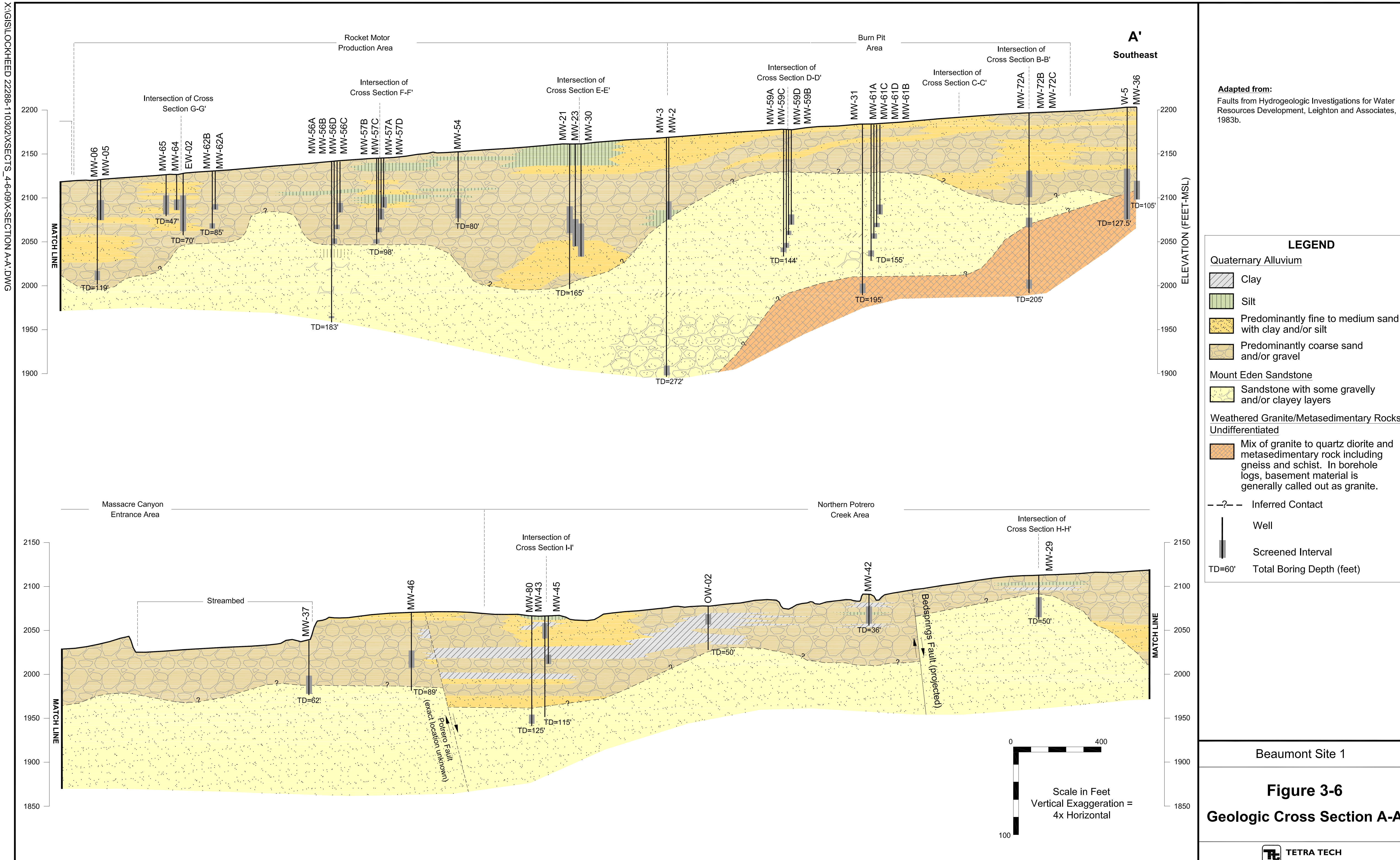
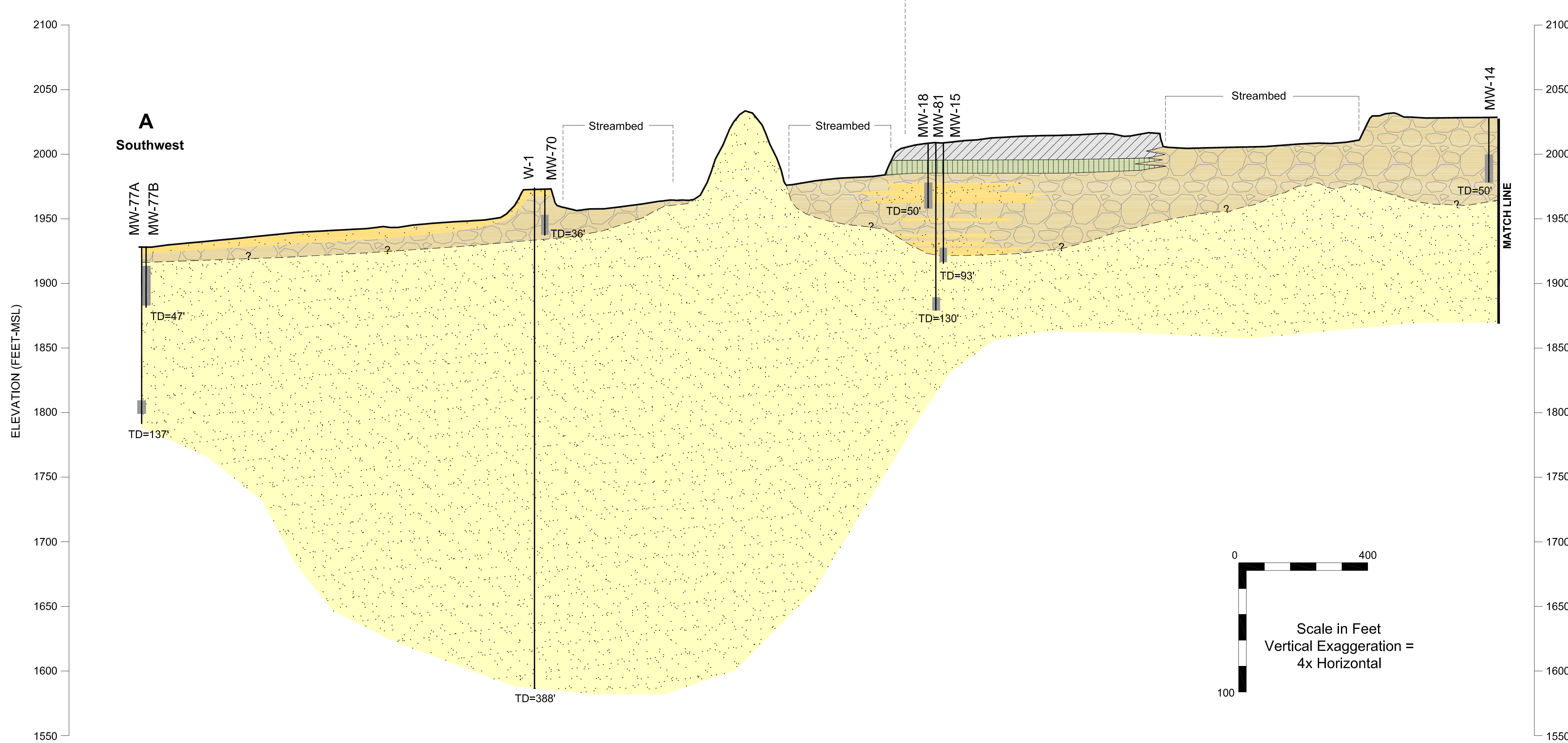


Figure 3-6
Geologic Cross Section A-A'



Adapted from:
Faults from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983b.

LEGEND

Quaternary Alluvium
- Clay
- Silt
- Predominantly fine to medium sand with clay and/or silt
- Predominantly coarse sand and/or gravel

Mount Eden Sandstone
- Sandstone with some gravelly and/or clayey layers

Weathered Granite/Metasedimentary Rocks, Undifferentiated
- Mix of granite to quartz diorite and metasedimentary rock including gneiss and schist. In borehole logs, basement material is generally called out as granite.

- -- ? -- Inferred Contact
- Well
- Screened Interval
- TD=60' Total Boring Depth (feet)

Beaumont Site 1

Figure 3-6 (cont.)
Geologic Cross Section A-A'

TETRA TECH

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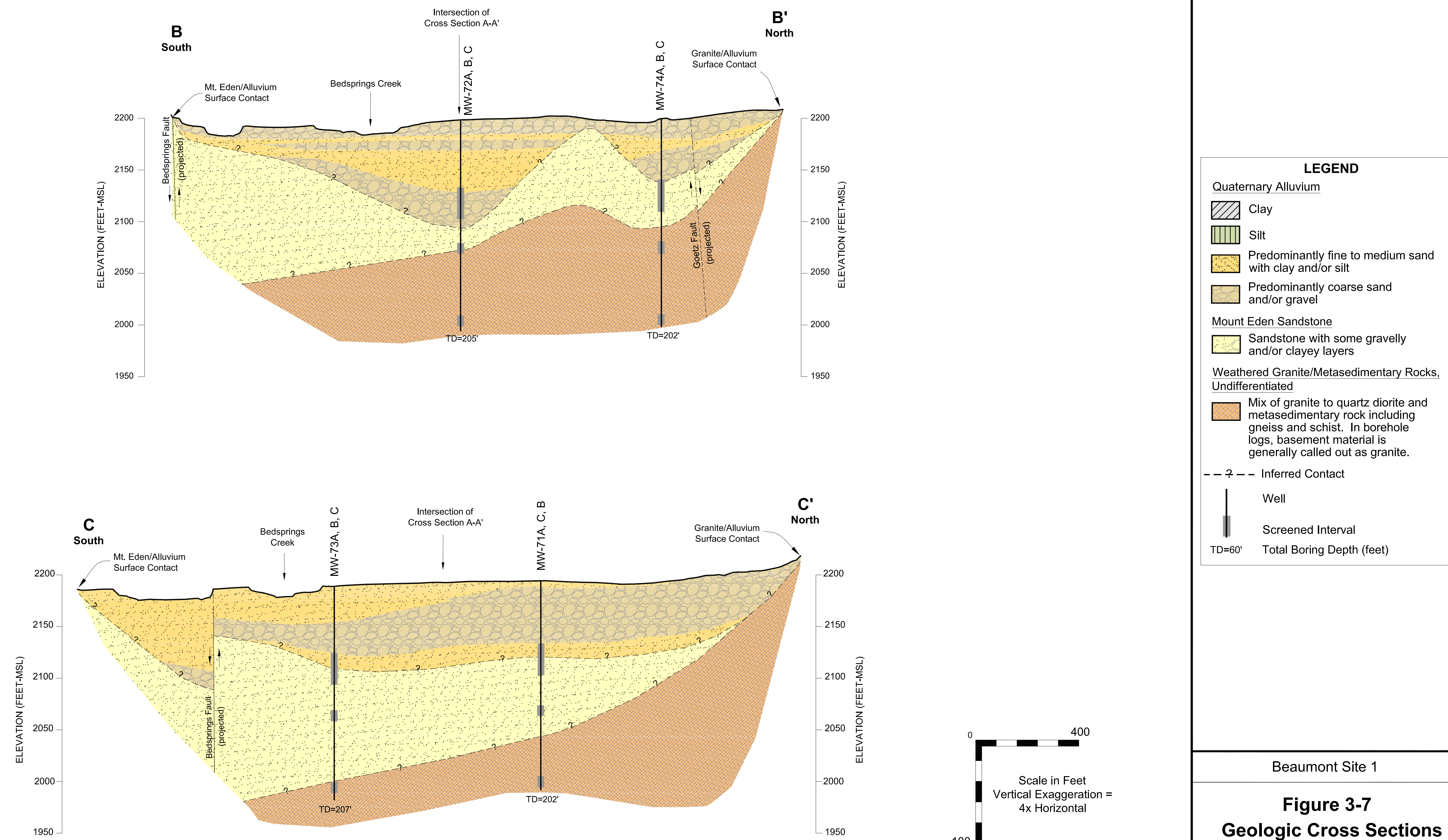
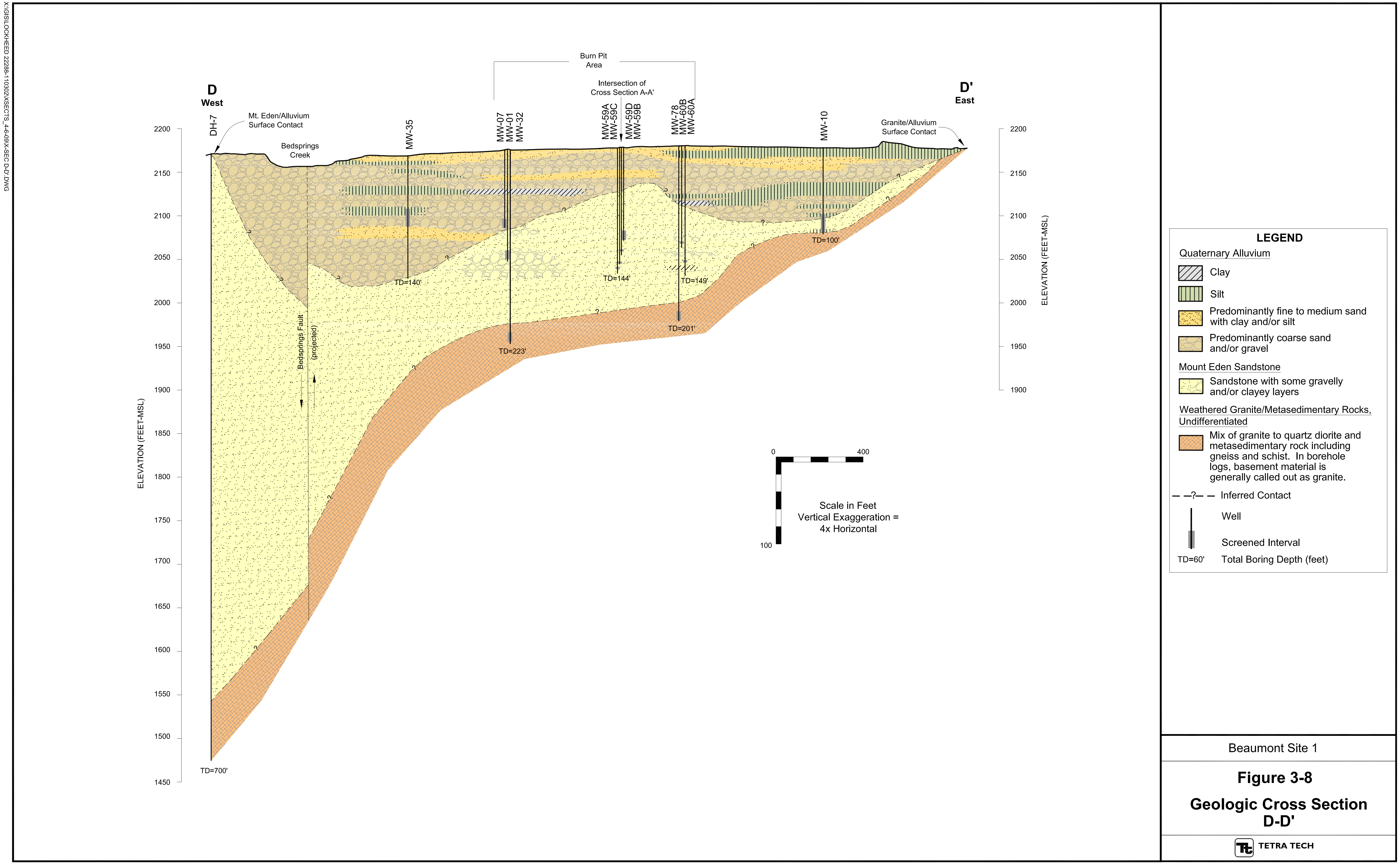
Adapted from:
Faults from Hydrogeologic Investigations
for Water Resources Development,
Leighton and Associates, 1983b.
Faults from Hydrogeologic Investigations



Beaumont Site 1

Figure 3-7
Geologic Cross Sections B-B' and C-C'

TETRA TECH



Beaumont Site 1

Figure 3-8

Geologic Cross Section D-D'

TETRA TECH

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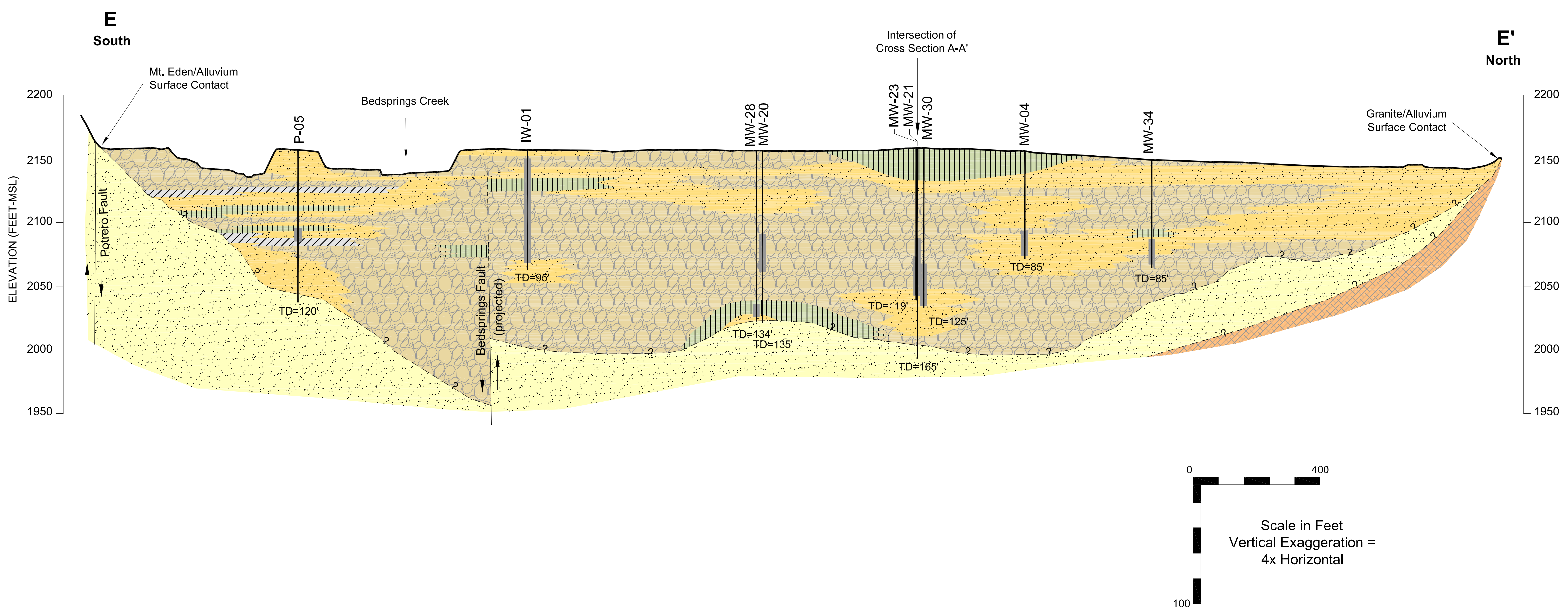


LEGEND

Quaternary Alluvium

- Clay
- Silt
- Predominantly fine to medium sand with clay and/or silt
- Predominantly coarse sand and/or gravel

Mount Eden Sandstone

- Sandstone with some gravelly and/or clayey layers

Weathered Granite/Metasedimentary Rocks, Undifferentiated

- Mix of granite to quartz diorite and metasedimentary rock including gneiss and schist. In borehole logs, basement material is generally called out as granite.

- - ? - - - Inferred Contact

Well

Screened Interval

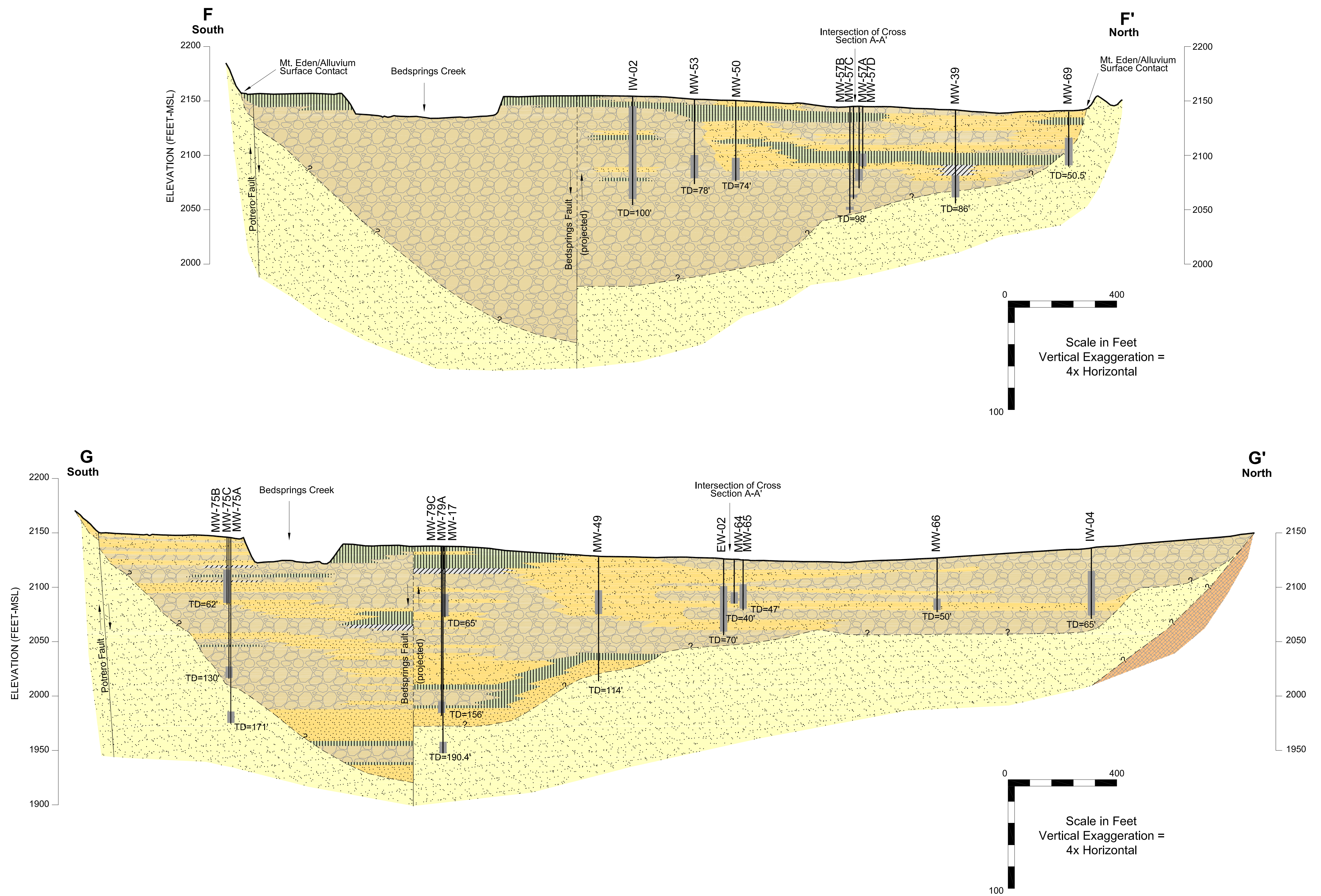
TD=60' Total Boring Depth (feet)

Beaumont Site 1

Figure 3-9

Geologic Cross Section E-E'

TETRA TECH



Adapted from:
Faults from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983b.

LEGEND

Quaternary Alluvium
- Clay
- Silt
- Predominantly fine to medium sand with clay and/or silt
- Predominantly coarse sand and/or gravel

Mount Eden Sandstone
- Sandstone with some gravelly and/or clayey layers

Weathered Granite/Metasedimentary Rocks, Undifferentiated
- Mix of granite to quartz diorite and metasedimentary rock including gneiss and schist. In borehole logs, basement material is generally called out as granite.

- ? Inferred Contact
- Well
- Screened Interval
- TD=60' Total Boring Depth (feet)

Beaumont Site 1

Figure 3-10
Geologic Cross Sections F-F' and G-G'

TETRA TECH

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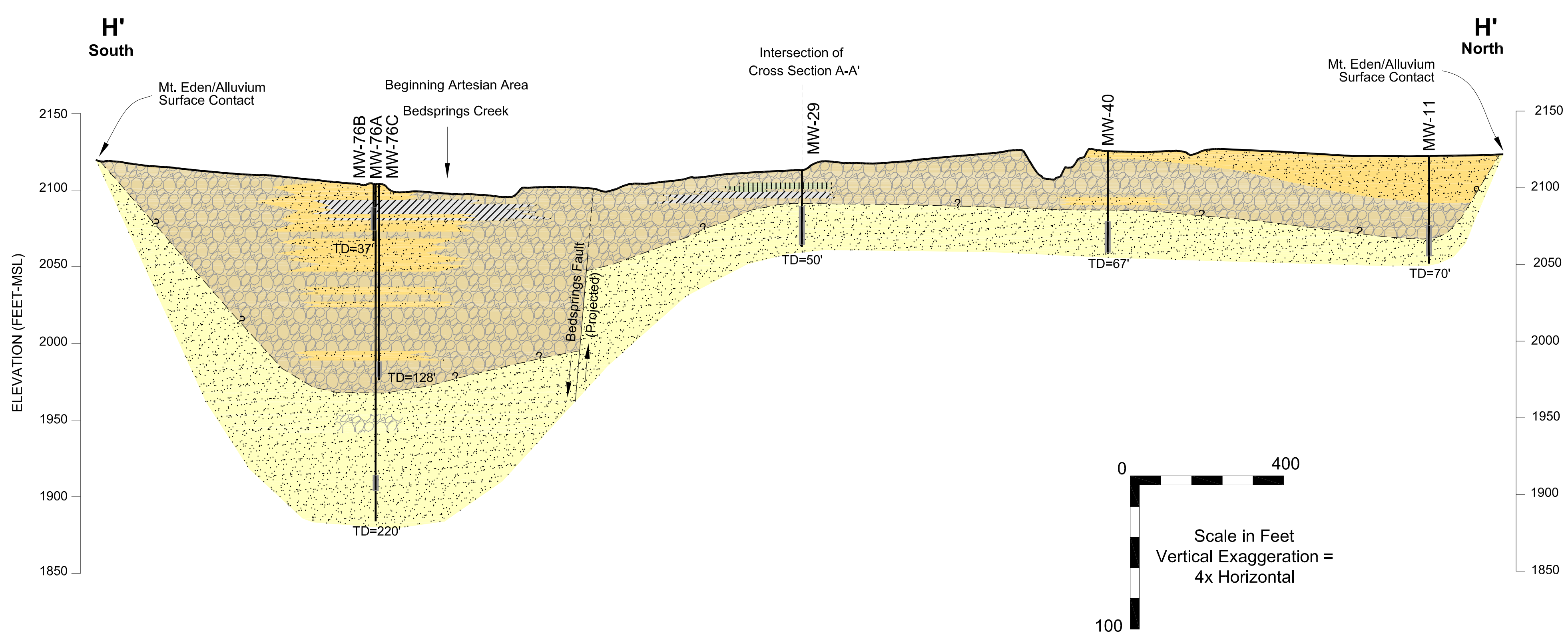

LEGEND

Quaternary Alluvium

- Clay
- Silt
- Predominantly fine to medium sand with clay and/or silt
- Predominantly coarse sand and/or gravel

Mount Eden Sandstone

- Sandstone with some gravelly and/or clayey layers

Weathered Granite/Metasedimentary Rocks, Undifferentiated

- Mix of granite to quartz diorite and metasedimentary rock including gneiss and schist. In borehole logs, basement material is generally called out as granite.

- – ? – – Inferred Contact
- Well
- Screened Interval
- TD=60' Total Boring Depth (feet)

Beaumont Site 1

Figure 3-11
Geologic Cross Section H-H'

TETRA TECH

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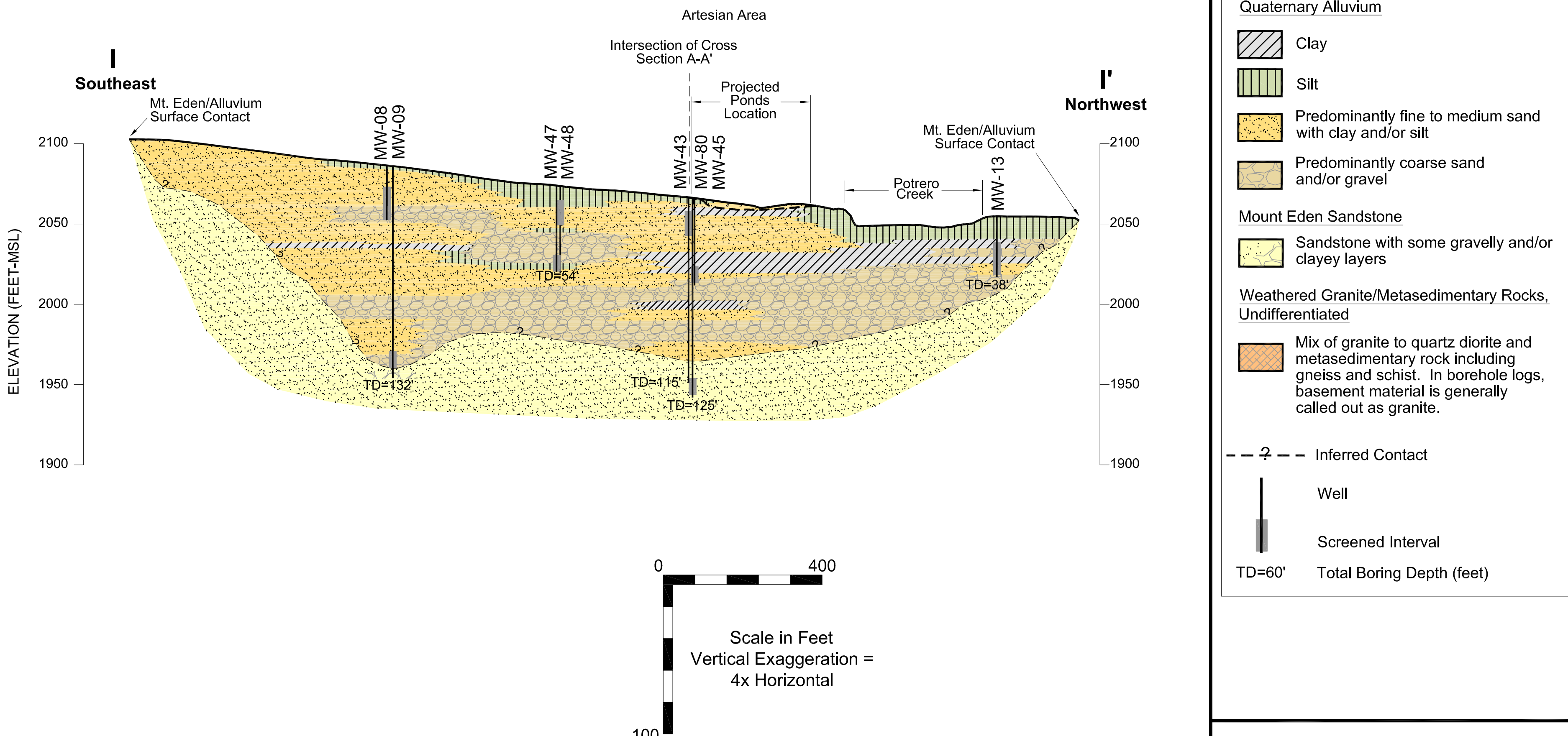

Beaumont Site 1

Figure 3-12

Geologic Cross Section I-I'

TETRA TECH

shallow alluvium. In addition, a 10 to 15-foot clay layer was observed in the central portion of the valley near the convergence of Potrero Creek and Bedsprings Creeks.

San Timoteo formation

The San Timoteo formation (Fraser, 1931), of Upper Pliocene or Pleistocene age (Dibblee, 1981), is primarily composed of poorly indurated, greenish gray interbedded sandstone, siltstone, shale, claystone, and minor conglomerates (Leighton and Associates, 1983). The San Timoteo formation crops out at higher elevations north of the San Jacinto Nuevo Y Potrero Valley. The San Timoteo formation is not present in the main portion of the valley and is, therefore, not significant in the local geologic setting of the Site.

Mount Eden formation

The varying thickness of the Mount Eden formation at the Site is the result of faulting and erosional topography of the pre-Pliocene bedrock surface (Radian, 1992c). Similarly, the irregular Mount Eden formation/alluvium contact is a result of erosional features combined with displacement and/or offset from faulting in the area.

Stratigraphic information for the Mount Eden formation is primarily limited to the former BPA and former RMPA since only a few borings west of the former RMPA (topographically and hydro-geologically downgradient) have penetrated the unit. Where exposed, the Mount Eden formation forms steep-sided ridges around the perimeter of the valley. Where encountered in boreholes, the Mount Eden formation varies from consolidated to loose and is similar to the overlying alluvium. Locally, the Mount Eden formation is primarily fine-to coarse-grained, reddish to reddish gray sandstone with isolated gravelly lenses. Beneath the former BPA and near the former RMPA, similar rounded or flat topped steep sided ridges extend into the valley in the subsurface.

Granitic and Metasedimentary Rocks

The basement complex is composed of metasedimentary and granitic rocks which underlie the entire site. The granitic and metasedimentary rocks are exposed in the hills to the north, south and east and along the eastern side of the San Jacinto Nuevo Y Potrero Valley. Previous studies in the region have reported that the metasedimentary and granitic rocks are fractured and jointed due to faulting in the area.

The metasedimentary rocks primarily consist of foliated, gray, micaceous schists and pink to gray gneiss along with some marble and quartzite (Radian Corporation, 1992c). The metasedimentary rocks are the oldest rock unit at the Site and occur as isolated exposures within the granitic rocks. The metasedimentary rocks are exposed at two small areas long the southeast and northwest edges of the valley. The Mesozoic granitic basement rocks consist primarily of granodiorite and quartz diorite described by Miller (1944) as the San Jacinto Granodiorite. The granitic rocks which are exposed primarily in the eastern and southern portions of the valley originated as intrusions into the older metasedimentary rocks. The granitic rocks are directly overlain by the San Timoteo formation in the northern part of the site and by Quaternary age alluvium in the northeastern portion of the valley. In the southern and western portions of the valley, the granitic basement material is directly overlain by the Mount Eden formation.

Faulting

Based on previous geologic studies, the Site is situated between the San Andreas Fault System (located to the north) and the San Jacinto Fault System (located to the south). Numerous smaller faults, assumed to be associated with movement along these two major fault systems, are found within the Site (Leighton and Associates, 1983). Several faults near the Site have been mapped by Dibblee (1981) and Leighton and Associates (1983). Within the immediate vicinity of the former RMPA and former BPA, three (3) faults have been identified by name (Bedsprings, Goetz, and Potrero) and 6 others have been identified, but as yet remain unnamed (Ransome, 1932; Leighton and Associates, 1983; Tetra Tech, 2003a). Figures 3-5 and 3-6 display the locations of identified faults in the immediate vicinity of the former RMPA and former BPA.

Reportedly, a northwesterly trending graben bounded by the Potrero Fault and Bedsprings Fault (Figure 3-6) is situated southwest of the former RMPA and former BPA (Leighton and Associates, 1983). Although faulting was reported to offset the Mount Eden formation, no conclusive evidence of displacement of recent alluvial material was found. However, alluvial thickness decreases from about 160 feet at the southeast end to about 40 feet at the northwest end of the Potrero Fault.

Seismic reflection surveys completed between 07 December and 14 December 2005 were oriented southwest-northeast and approximately perpendicular to published locations of the Goetz and Bedsprings faults and Unnamed Fault #4 (Figure 3-5) near the former BPA. Along the published location of the Bedsprings Fault reflection analysis showed a 5,650 feet per second (ft/sec) layer at approximately 75 feet bgs which may represent saturated alluvium or weathered bedrock and two faults were interpreted, the shallowest of which comes within 60 feet of the surface. Along the published location of the Goetz Fault reflection analysis showed a 7,900 ft/sec layer at approximately 88 feet bgs that may represent bedrock and two faults were interpreted along this profile, the shallowest of which comes within 70 feet of the surface. Along the published location of Unnamed Fault #4 reflection analysis showed a 11,300 ft/sec layer at approximately 45 feet bgs that likely represents bedrock and two faults were interpreted along this profile, the shallowest of which comes within 20 feet of the surface.

3.5 HYDROGEOLOGY

Several previous reports discuss in detail the occurrence and movement of groundwater at the Site (Leighton and Associates, 1983; Radian, 1990; Radian, 1992c). A summary of general findings from these reports is provided in this subsection along with an update of current conditions based on recent investigations and data collected (Tetra Tech, 2006b).

Groundwater occurs in each of the major geologic units beneath the Site: the Quaternary alluvium, Mount Eden formation, the San Timoteo formation, and the Granitic/Metasedimentary basement complex. Groundwater is present in the alluvium in the majority of the valley except in areas where the underlying Mount Eden formation rises above the surrounding water table. In general, groundwater is present in weathered and unweathered portions of the Mount Eden formation, either where alluvium is not present at the water table or at depth below saturated alluvium.

Reportedly, during the drilling of deep borings into the Granitic/Metasedimentary basement complex, the groundwater encountered occurred only in fractures and joints at great depth (Radian, 1992c). Based on monitoring wells screened in the Granitic/Metasedimentary basement complex rock, the water level ranges from 15 to 75 feet lower than water levels in nearby wells screened within the alluvium and weathered Mount Eden formation. Previous studies indicated that portions of the Mount Eden formation can act as a confining layer separating shallow unconfined groundwater from deep groundwater in the Granitic/Metasedimentary basement complex rocks (Radian, 1992c).

Groundwater Flow

Shallow groundwater flow at the Site occurs mainly through alluvium and the shallow/weathered portion of the Mount Eden formation. As indicated above, alluvium and the shallow/weathered portion of the Mount Eden formation consist of alluvial deposits from former streambeds, floodplains, lakes, and alluvial fans. Although the alluvium and the shallow/weathered portion of the Mount Eden formation are two different geologic units, potentiometric heads, water level responses to seasonal recharge, and water quality data indicate that the two units are in hydraulic communication and may be considered a single hydrostratigraphic unit (HSU). A HSU is a formation, part of a formation, or a group of formations in which there are similar hydrologic characteristics that allow for grouping into aquifers and associated confining layers (Domenico, et. al, 1990).

Generally, groundwater flows northwest from the former BPA, beneath the former RMPA and towards Potrero Creek. Groundwater flow then trends southwest, and generally parallel to the flow direction of Potrero Creek, through the Northern Potrero Creek Area (NPCA) and into the Massacre Canyon Entrance Area (MCEA). However, the groundwater flow direction from the former BPA downgradient through the former RMPA appears to change between periods of low precipitation (dry periods) and periods of high precipitation (wet periods). Groundwater contour maps for a wet period (March 2005) and a dry period (September 2006) are shown in Figures 3-13 and 3-14, respectively. As seen in Figure 3-13, during wet periods, groundwater flow from the former BPA has both westerly and north-northwesterly components. However, during dry periods the groundwater flow direction from the former BPA is more westerly (Figure 3-14). This seasonal change in flow direction likely is caused by increased recharge in the Bedsprings Creek area during wet periods and subsequent decrease in recharge during dry periods.

The saturated zone had been divided into shallow, intermediate and deep intervals, and due to the large elevation change over the Site (400 feet of change between the farthest upgradient (MW-36) and downgradient (MW-67) wells), adjusted for the four (4) general areas of the Site (Tetra Tech, 2004). Since Second Quarter 2004, an additional 18 groundwater monitoring and ten (10) groundwater sampling events have been performed. Summarizing, subsequent groundwater monitoring and sampling results show:

- The highest concentrations of COPC-affected groundwater appears in groundwater samples collected from the former BPA, in the shallow Mount Eden formation;
- Relatively low concentrations of COPCs have been reported in groundwater samples collected from wells screened in the deeper Mount Eden formation, located downgradient and below wells screened in the shallow Mount Eden formation;
- Generally, vertical groundwater gradients appear downward in the former BPA, fluctuate in the former RMPA, and upward in the NPCA and MCEA; and
- Generally, COPC concentrations appear to decrease with depth in the alluvium and the shallow Mount Eden formation.

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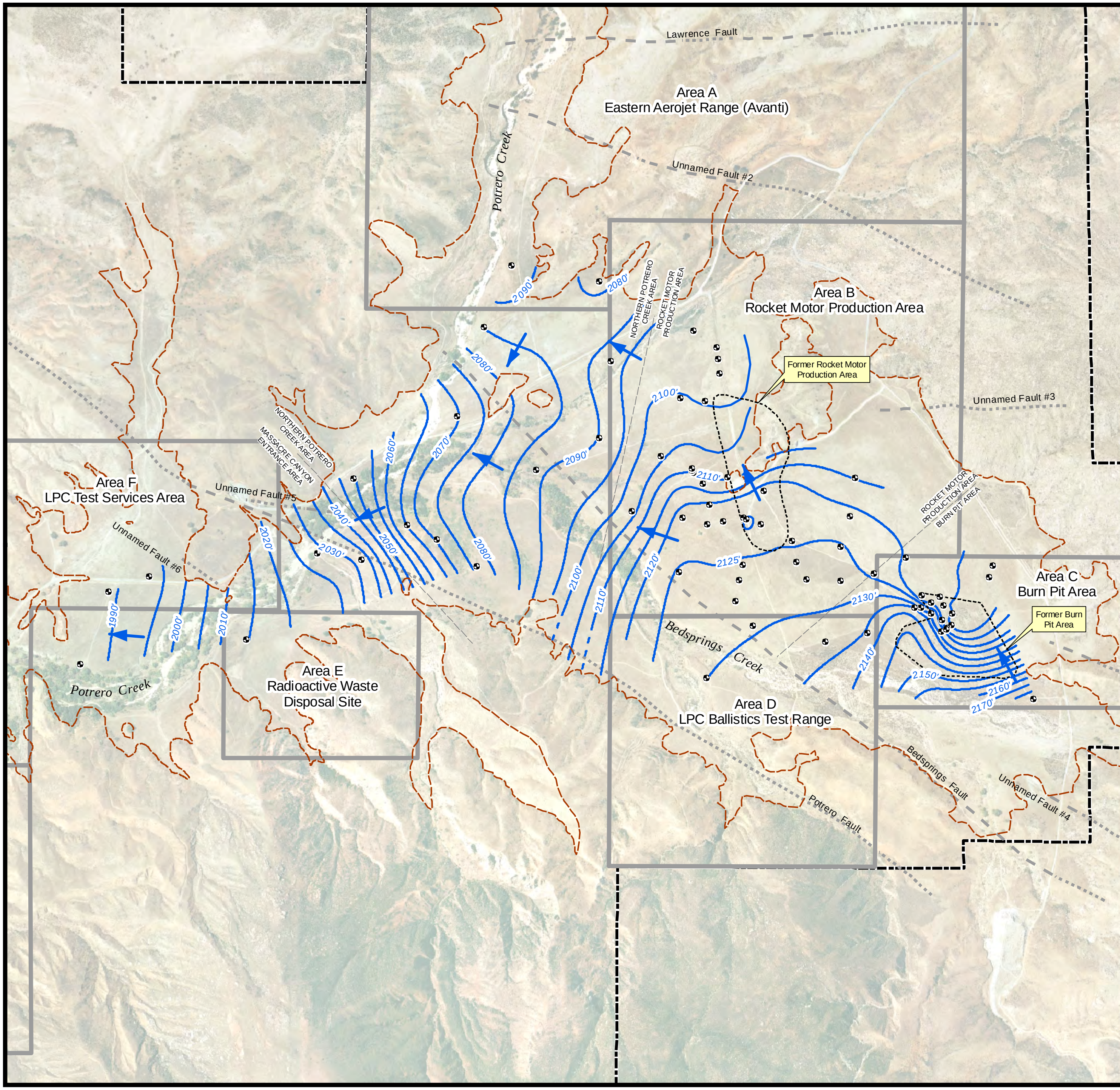

N

0 750 1,500 Feet

Adapted from:
Semiannual Groundwater Monitoring Report, First and Second Quarter 2005. Lockheed Martin Corp., Beaumont Site 1. Tetra Tech, Inc.

LEGEND

- Well Location
- Groundwater Flow Direction
- 2050' Groundwater Elevation Contour (mean sea level, dashed where inferred)
- Historical Operational Area Boundary
- Approximate Location of Fault
- Approximate Location of Buried Fault
- Mount Eden/Alluvium Surface Contact
- Beaumont Site 1 Property Boundary

Beaumont Site 1

Figure 3-13
Wet Period (March 2005) Groundwater Contour for Alluvium and Shallow Mount Eden Formation Wells

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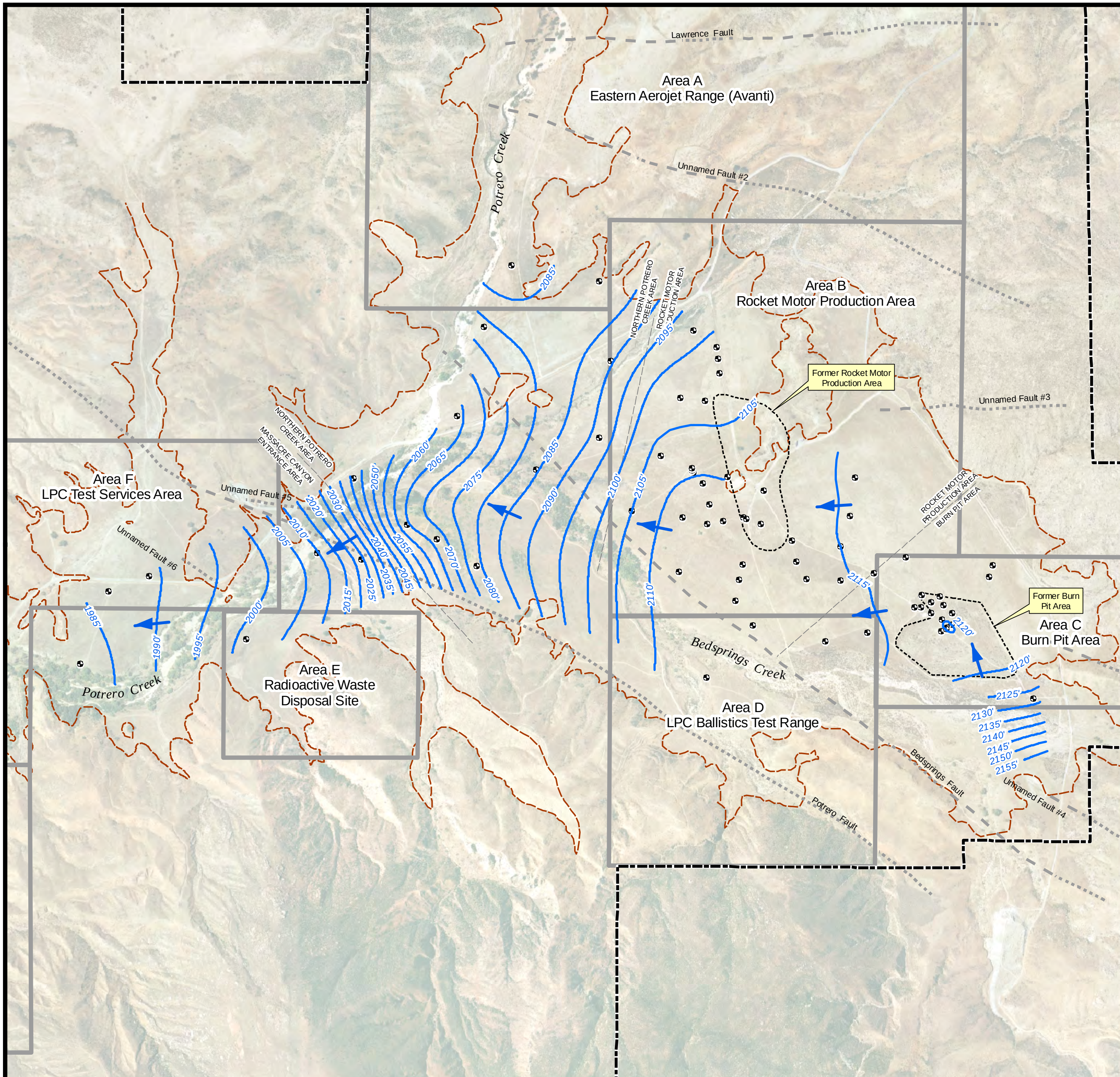


Adapted from:

Semiannual Groundwater Monitoring Report, Third and Fourth Quarter 2006. Lockheed Martin Corp., Beaumont Site 1. Tetra Tech, Inc.

LEGEND

- Well Location
- Groundwater Flow Direction
- 2050' Groundwater Elevation Contour (mean sea level, dashed where inferred)
- Historical Operational Area Boundary
- Approximate Location of Fault
- Approximate Location of Buried Fault
- Mount Eden/Alluvium Surface Contact
- Beaumont Site 1 Property Boundary

Beaumont Site 1

Figure 3-14
Dry Period (September 2006) Groundwater Contour for Alluvium and Shallow Mount Eden Formation Wells

TETRA TECH

Hydraulic Conductivity

Hydraulic conductivity (K) values calculated for selected wells at the Site range from 0.08 to 319 feet per day (ft/day) [Tetra Tech, 2002]. Table 3-2 presents a summary of the K values. The K values for wells screened within the alluvium range from 0.24 to 319 ft/day and the average is 24 ft/day. The K values for wells screened within the Mount Eden formation range from 0.11 to 67.8 ft/day and the average is 7.9 ft/day. The K value for well MW-32 screened in the Granitic/Metasedimentary basement complex rocks is 0.08 ft/day. The average K value for alluvium/shallow Mount Eden formation screened wells is 19 ft/day and the average K value for deeper Mount Eden formation/bedrock screened wells is 1.9 ft/day.

In general, higher K values were obtained from wells screened within the alluvium in the upper (eastern) and lower (western) portions of the valley and K values decrease with depth, with the exception of areas around well groups MW-05/MW-06, MW-15/MW-18 and MW-43/MW-45, which may be a result of coarser grained heterogeneities associated with stream deposits. Beneath the former BPA to the southeast terminus of the former RMPA, the Mount Eden formation has lower K values. Beneath and immediately downgradient of the former RMPA, Mount Eden formation K values increase and then decrease again towards the MCEA.

Table 3-2 Hydraulic Conductivity (K) Values

Well ID	Site Area	Formation Screened	HSU	Hydraulic Conductivity (K) (feet/day)	Well ID	Site Area	Formation Screened	HSU	Hydraulic Conductivity (K) (feet/day)
EW-15	BPA	ME	QA/SMEF	0.38	MW-57B	RMPA	QA	QA/SMEF	< 2.45
MW-01	RMPA	ME	QA/SMEF	0.29	MW-58D	RMPA	QA	QA/SMEF	< 1.97
MW-02	RMPA	QA	QA/SMEF	67.8	MW-59A	BPA	ME	QA/SMEF	< 0.80
MW-03	RMPA	ME	DMEF	< 0.69	MW-59B	BPA	ME	QA/SMEF	< 0.33
MW-04	RMPA	QA	QA/SMEF	< 6.01	MW-60A	BPA	ME	QA/SMEF	< 1.03
MW-05	RMPA	QA	QA/SMEF	< 2.12	MW-60B	BPA	ME	QA/SMEF	< 9.63
MW-06	RMPA	QA/ME	QA/SMEF	< 14.5	MW-62A	RMPA	QA	QA/SMEF	< 5.85
MW-07	BPA	QA	QA/SMEF	45.1	MW-63	RMPA	QA	QA/SMEF	1.32
MW-08	NPCA	QA	QA/SMEF	21.2	MW-64	RMPA	QA	QA/SMEF	2.07
MW-09	NPCA	QA	QA/SMEF	< 2.14	MW-66	RMPA	QA	QA/SMEF	< 1.81
MW-10	RMPA	QA	QA/SMEF	< 19.6	MW-68	RMPA	QA	QA/SMEF	2
MW-11	NPCA	QA	QA/SMEF	< 6.67	MW-69	RMPA	QA	QA/SMEF	0.79
MW-12	NPCA	QA	QA/SMEF	< 4.75	MW-70	NPCA	QA	QA/SMEF	1.3
MW-13	NPCA	QA	QA/SMEF	< 23.6	MW-71A	BPA	Granite/Meta	Granite	< 0.27
MW-14	MCEA	QA	QA/SMEF	46.4	MW-71B	BPA	QA/ME	QA/SMEF	low
MW-15	MCEA	QA	QA/SMEF	103	MW-71C	BPA	ME	QA/SMEF	0.9
MW-17	RMPA	QA	QA/SMEF	< 0.77	MW-72A	BPA	Granite/Meta	Granite	< 1.17
MW-18	MCEA	QA	QA/SMEF	18.5	MW-72B	BPA	ME/Granite	QA/SMEF	1.47
MW-19	NPCA	QA	QA/SMEF	< 0.88	MW-72C	BPA	QA	QA/SMEF	21.67
MW-22	RMPA	QA	QA/SMEF	1.01	MW-73A	BPA	Granite/Meta	QA/SMEF	0.54
MW-26	BPA	ME	QA/SMEF	0.31	MW-73B	BPA	ME	QA/SMEF	low
MW-30	RMPA	QA	QA/SMEF	28.3	MW-73C	BPA	QA/ME	QA/SMEF	< 0.31
MW-31	BPA	Granite/Meta	Granite	0.11	MW-74A	UG	Granite/Meta	Granite	< 0.26
MW-32	RMPA	Granite/Meta	Granite	< 0.08	MW-74B	UG	Granite/Meta	Granite	low
MW-34	RMPA	QA	QA/SMEF	< 6.99	MW-74C	UG	ME	QA/SMEF	low
MW-35	RMPA	QA	Granite	6.8	MW-75A	RMPA	ME	DMEF	< 0.10
MW-36	UG	QA	Granite	1.94	MW-75B	RMPA	QA/ME	QA	1.47
MW-37	MCEA	QA/ME	QA/SMEF	< 0.24	MW-75C	RMPA	QA	QA/SMEF	0.86
MW-38	MCEA	ME	QA/SMEF	< 0.79	MW-76A	NPCA	ME	DMEF	< 0.16
MW-39	RMPA	QA	QA/SMEF	< 2.38	MW-76B	NPCA	QA	QA	0.48
MW-40	NPCA	ME	QA/SMEF	< 7.60	MW-76C	NPCA	QA	QA/SMEF	< 85.15
MW-42	NPCA	QA	QA/SMEF	< 2.31	MW-77A	MCEA	ME	DMEF	< 0.14
MW-43	NPCA	QA	QA/SMEF	< 1.15	MW-77B	MCEA	QA/ME	QA/SMEF	< 0.04
MW-44	NPCA	QA	QA/SMEF	6.17	MW-78	BPA	Granite/Meta	Granite	0.06
MW-46	MCEA	QA	QA/SMEF	< 3.14	MW-79A	RMPA	ME	DMEF	< 1.79
MW-50	RMPA	QA	QA/SMEF	53.7	MW-79C	RMPA	QA	QA	136.99
MW-51	RMPA	QA	QA/SMEF	2.11	MW-80	NPCA	ME	DMEF	0.37
MW-55	RMPA	QA	QA/SMEF	44.4	MW-81	MCEA	ME	DMEF	0.13
MW-56A	RMPA	ME	DMEF	< 11.8	OW-02	NPCA	QA	QA/SMEF	< 0.76
MW-56B	RMPA	QA	QA/SMEF	< 15.3	OW-03	RMPA	QA	QA/SMEF	< 0.66
MW-57A	RMPA	QA	QA/SMEF	45.5	P-05	RMPA	QA	QA/SMEF	< 2

Notes:

HSU - Hydrostratigraphic unit
K - Hydraulic conductivity
BPA - Burn Pit Area
MCEA - Massacre Canyon Entrance Area
NPCA - Northern Potrero Creek Area
RMPA - Rocket Motor Production Area
UG - Up gradient
QA - Quaternary alluvium.
QA/ME - Quaternary alluvium/weathered Mount Eden.
QA/SMEF - Quaternary alluvium / Shallow Mount Eden formation.
ME - Mount Eden formation.
DMEF - Deeper Mount Eden formation.
Granite/Meta - Granite/Metamorphic Basement Material

3.5.1 Distribution of Affected Groundwater

COPCs are routinely re-evaluated during as part of the routine Site Groundwater Monitoring Program (GMP) to determine if the list meets the GMP objectives and regulatory requirements. The purpose for identifying COPCs is to establish a list of analytes that best represent the extent and magnitude of the affected groundwater and to focus more detailed analysis on those analytes. Every analytical method has a standard list of tested target compounds and by reducing the number of target compounds for a given analytical method, the volume of data generated can also be reduced. If sufficient historical analytical data are available, analytes that have not been detected, common laboratory and field contaminants, spurious or randomly detected analytes, and analytes associated with chlorinated potable water, can be removed from the list of target compounds. Primary COPCs are parent products such as TCE and 1,1,1-TCA and are always present with a secondary COPC. Secondary COPCs are breakdown products such as 1,1-DCA and 1,1-DCE and are detected at lower concentrations than their parent products. However, at this site 1,1-DCE, a breakdown product of 1,1,1-TCA, is detected at higher concentrations than 1,1,1-TCA, and is considered the primary COPC, and 1,1,1-TCA is considered a secondary COPC.

Based on Site history and the results of the groundwater monitoring performed at the Site, a list of primary COPCs was identified. Additional chlorinated compounds, which have also been routinely detected in groundwater samples, are considered secondary COPCs. Table 3-3 presents a list of those analytes detected in groundwater at the Site that are considered the primary and secondary COPCs (Tetra Tech, 2006a). The primary COPCs are considered representative of the overall Site; therefore, the following subsections are limited to describing the distribution of primary COPCs affecting groundwater at the Site.

Table 3-3
Groundwater Chemicals of Potential Concern (Tetra Tech, 2006a)

Analyte	Classification
Perchlorate	Primary
1,1-Dichloroethene (1,1-DCE)	Primary
Trichloroethene (TCE)	Primary
1,4-Dioxane	Primary
1,1-Dichloroethane (1,1-DCA)	Secondary
1,2-Dichloroethane (1,2-DCA)	Secondary
Cis-1,2-Dichloroethene (cis-1,2-DCE)	Secondary
1,1,1-Trichloroethane (1,1,1-TCA)	Secondary

In general the Site 1 plume has remained relatively stable over time. Slight modifications to the definition of the plume over time are generally the result of newly installed wells better defining the lateral extent of the plume. The extents of the primary COPCs based on data collected prior to the DSI are described in the following subsections and shown on Figure 3-15.

3.5.2 Perchlorate

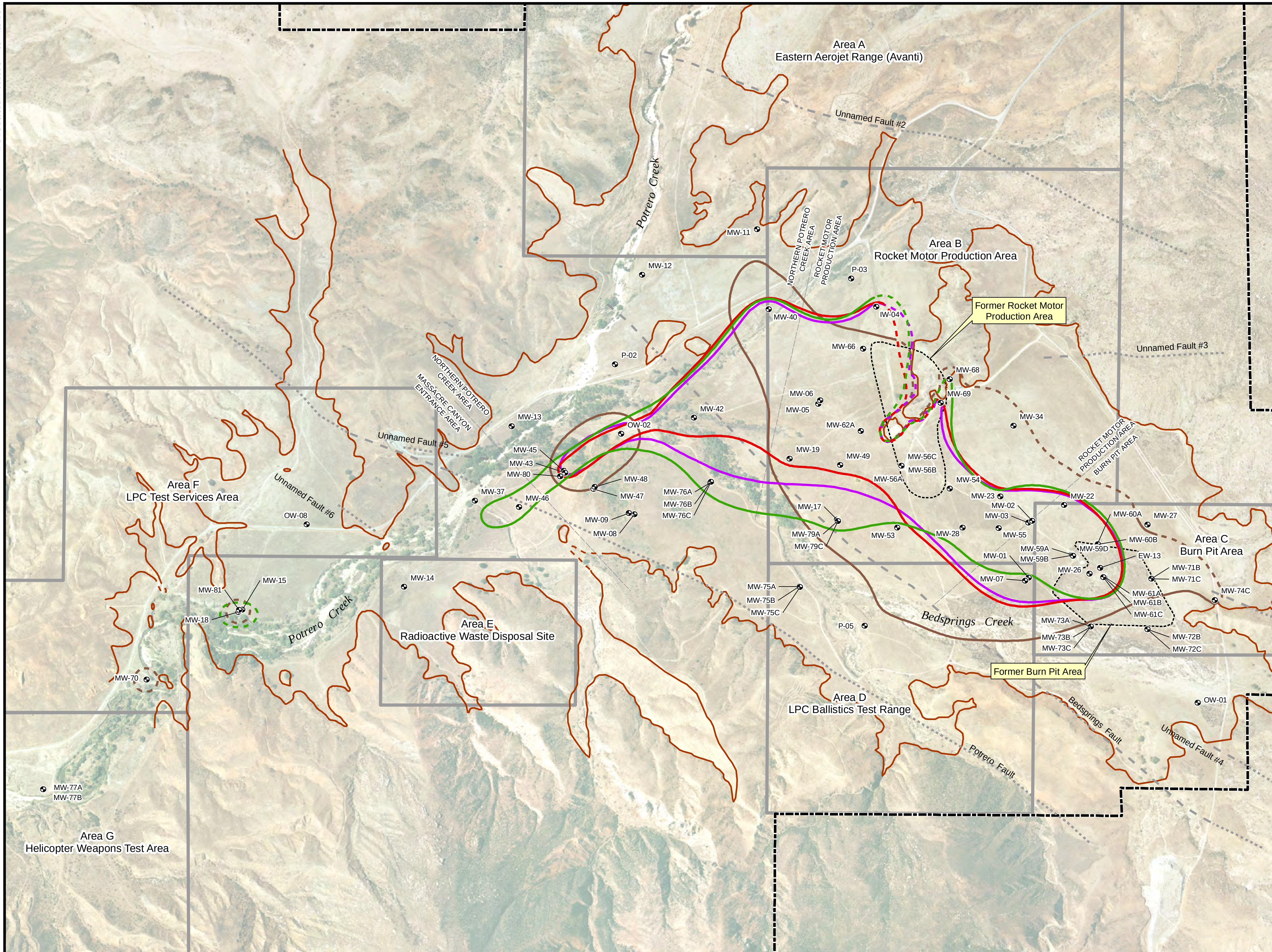
The highest concentrations of perchlorate were reported in groundwater samples collected from shallow screened wells located in the former BPA and concentrations appeared to rapidly decrease outside, and downgradient, of the footprint of the former BPA. Perchlorate was reported in groundwater samples collected from wells screened in the alluvium and shallow Mount Eden formation. The concentrations of perchlorate show a decreasing trend with depth. Low level concentrations of perchlorate have been detected in groundwater samples collected from one deeper Mount Eden formation well in the BPA. The source of perchlorate-affected groundwater appears to primarily be the former BPA; a secondary source may also be the former RMPA.

3.5.3 TCE

The highest concentrations of TCE were reported in groundwater samples collected from shallow screened wells located in the former BPA. Groundwater concentrations rapidly decrease outside, and downgradient, of the footprint of the former BPA. TCE was reported in groundwater samples collected from wells screened in the alluvium, shallow Mount Eden formation and deeper Mount Eden formation. The concentrations of TCE also show a decreasing trend with depth. Low level concentrations of TCE have been detected in groundwater samples collected from all four of the deeper Mount Eden formation wells with the highest concentrations detected in the former BPA. The source of TCE-affected groundwater appears to be the former BPA.

3.5.4 1,4-Dioxane

The highest concentrations of 1,4-dioxane were reported in groundwater samples collected from shallow screened wells located in the former BPA. Groundwater concentrations rapidly decrease outside, and downgradient, of the footprint of the former BPA. 1,4-Dioxane was reported in groundwater samples collected from wells screened in the alluvium, shallow Mount Eden formation and deeper Mount Eden formation. The concentrations of 1,4-dioxane show a decreasing trend with depth. Low level concentrations of 1,4-dioxane have been detected in groundwater samples collected from two of the deep wells with the highest concentrations detected in the RMPA. The source of 1,4-dioxane-affected groundwater appears to be the former BPA.



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Adapted from: March 2007 aerial photograph.
Well locations from Hillwig and Goodrow survey, 2003.

LEGEND

- Groundwater Monitoring Well
- Perchlorate (6.0 µg/L MCL)- Dashed Where Inferred
- 1,1 DCE (6.0 µg/L MCL)- Dashed Where Inferred
- Trichloroethene (5.0 µg/L MCL)- Dashed Where Inferred
- 1,4-Dioxane (3.0 µg/L DWNL)- Dashed Where Inferred
- Historical Operational Area Boundary
- Approximate Location of Fault
- Approximate Location of Buried Fault
- Mount Eden/Alluvium Surface Contact
- Beaumont Site 1 Property Boundary

Notes: Beaumont Site 1 property boundary is approximate.

Contours adapted from *Semiannual Groundwater Monitoring Report First Quarter and Second Quarter 2008, Tetra Tech.*

1,1-DCE - 1,1-Dichloroethene

DWNL - California Department of Health Services drinking water notification level.

MCL - Maximum Contaminant Level.

µg/L - Micrograms per liter.

Beaumont Site 1

Figure 3-15

Primary COPC Extents for Alluvium and Shallow Mount Eden Formation

TETRA TECH

3.5.5 1,1-DCE

The highest concentrations of 1,1-DCE have consistently been reported in groundwater samples collected from shallow screened wells located in the western portion of the former BPA and have also been the highest VOC concentrations reported in groundwater samples collected. Groundwater concentrations rapidly decrease outside, and downgradient, of the footprint of the former BPA. 1,1-DCE was reported in groundwater samples collected from wells screened in the alluvium, shallow Mount Eden formation and deeper Mount Eden formation. The concentrations of 1,1-DCE show a decreasing trend with depth. Low level concentrations of 1,1-DCE have been detected in groundwater samples collected from all four of the deeper Mount Eden formation wells with the highest concentrations detected in the BPA. The source of 1,1-DCE affected groundwater appears to be the former BPA.

4.0 FIELD METHODOLOGY

The DSI activities included a variety of sampling techniques, including: hand auger soil sampling; HSA drilling with soil sampling and groundwater grab sampling; resonant sonic drilling with soil sampling and groundwater grab sampling; soil gas probe installation and sampling; and groundwater monitoring well installation and sampling. Field activities were conducted in accordance with procedures described in the DWP (Tetra Tech, 2008b) and the SAPs (Tetra Tech; 2006b, 2006c) and are briefly described below. Figure 4-1 shows the 10 features where additional characterization was performed during this investigation along with the nine historical operational areas.

4.1 FIELD INVESTIGATION PROGRAM

This section describes the field procedures for installation of the soil borings, soil gas probes, and monitoring wells installed as part of this investigation.

4.1.1 Site Preparation Activities

Pre-drilling activities that were part of this investigation includes: well installation permitting, underground utility clearance, biological monitoring, and health and safety.

Well Installation Permits

Prior to commencing field activities, well permit applications for each groundwater monitoring well were submitted to the Riverside County Department of Environmental Health Services. Copies of the approved permits are provided in Appendix C.

Underground Utility Clearance

Prior to commencement of intrusive activities, drilling locations were marked for subsurface utility clearance. Underground Service Alert was contacted prior to the commencement of drilling activities in order to identify potential underground utility or service lines near the proposed drilling locations. Prior to drilling, the hollow stem auger and resonant sonic borings were hand-augered to 5 feet bgs or refusal to ensure clearance of subsurface utilities or obstructions. No underground utility or service lines were encountered during the drilling activities.

Biological Monitoring

Prior to initiating field sampling activities, biological surveys of proposed soil boring, soil gas probe, and groundwater monitoring well locations were performed by a Section 10A permitted or sub-permitted biologist to evaluate the potential for impacts to sensitive species and habitats (i.e., Stephens' Kangaroo rat [SKR]). As part of the biological survey, the biologist identified and marked potential or suspected

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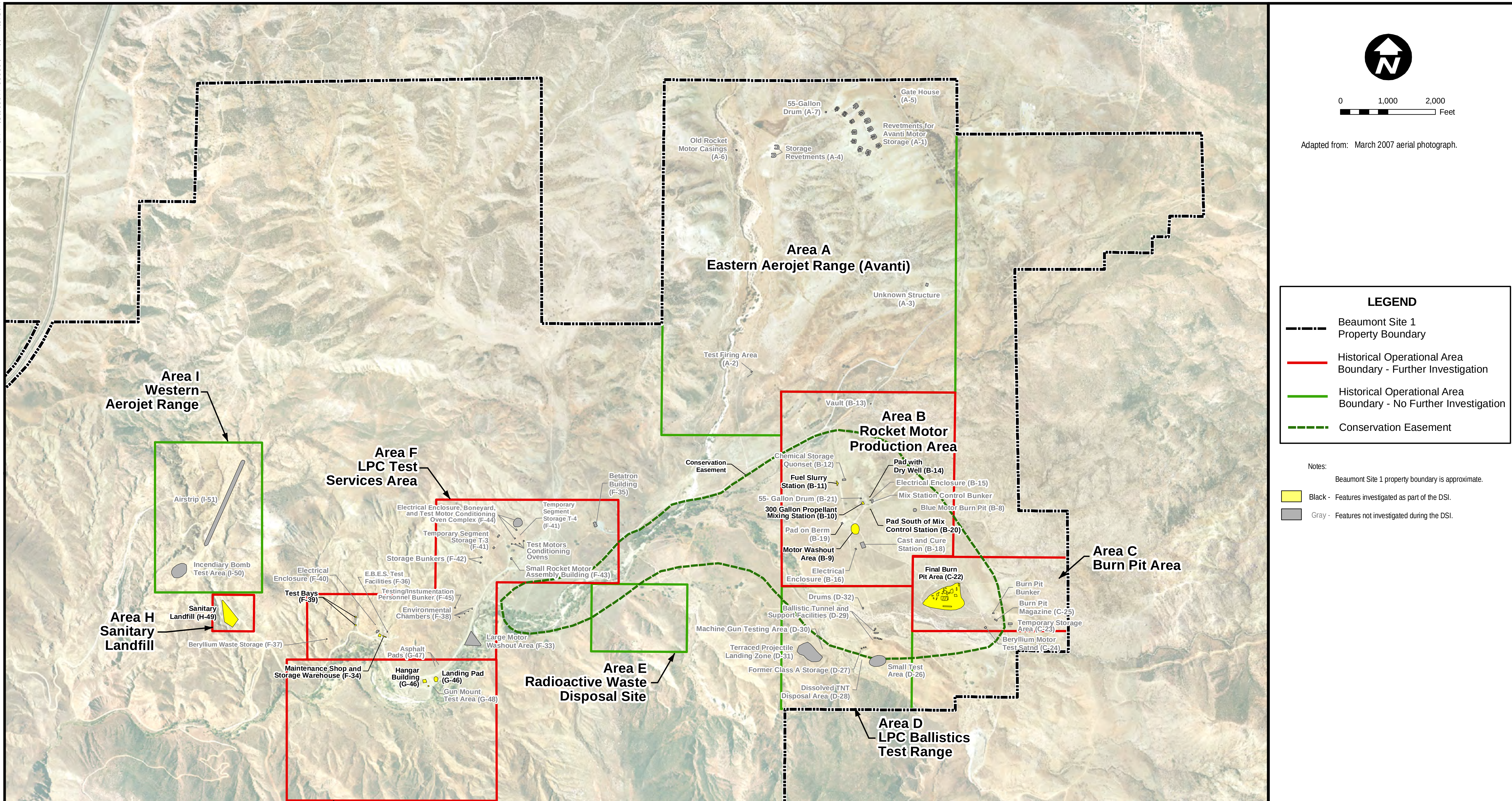

Beaumont Site 1

Figure 4-1
Historical Operational Areas, Site Features, and Conservation Easement

TETRA TECH

SKR burrows that were located within the vicinity of each drilling location to avoid the potential "take" of SKR and sensitive habitat. The biologist also clearly marked the ingress and egress routes at each drilling location in an effort to minimize the overall footprint of the field activities and to prevent potential "take".

Health and Safety

Selection of personal protective equipment (PPE) was made prior to the commencement of field work. Based on previous field activities at the Site and the site-specific Health and Safety Plan (HASP), modified Level D was utilized at the start of field activities. As site conditions and field activities changed, the PPE level was reevaluated. Based on the site conditions and field activities encountered, the PPE level was unchanged throughout the field program.

4.1.2 Seismic Reflection Profiling

A seismic reflection survey was conducted by Terra Physics to characterize geological conditions which may affect ground water flow away from the BPA (Feature C-22). Several near parallel, northwest oriented faults have been mapped across the Site that may influence groundwater flow around the BPA. The survey consisted of three profiles to cross the published fault zones. These profiles were oriented nearly perpendicular to the faults so the clearest image with minimum geometric distortion would be produced.

The seismic survey had two objectives. The first objective was to detect normal faulting, specifically the published faults (Goetz, Dibblee, Unnamed #4, and Bedsprings) that may pass near the BPA. Nearly vertical offsets in subsurface materials caused by normal faulting would probably not be identified in the relatively unconsolidated alluvium because this material is not dense or stiff enough to hold its shape after fault displacement. The most probable way of detecting faulting would be to image bedding (sandstones and siltstones) in the competent Mount Eden formation with the reflection method.

The second objective was to delineate alluvium thickness, topography of the competent Mount Eden formation, and weathering thickness of this bedrock. Since the reflection data recording parameters were designed for deep penetration (300 to 400 feet), it would not clearly image the upper 100 feet of alluvium. Instead, a refraction survey could delineate this objective's features. Stratigraphy could be inferred with the interpreted velocity zones using empirical correlations from previous surveys on site. The results of this survey are located in Appendix B.

4.1.3 Soil Borings

A total of 151 soil borings designated for soil sample collection were drilled and/or hand augered at the Site between 8 September 2008 and 16 December 2008. Of the 151 borings, 7 were completed using resonant sonic for borings greater than 40 feet bgs, 19 were completed using a hand auger for borings less than 5 feet bgs, 51 were completed using DP for borings less than 40 feet, and 74 were completed using HSA for shallow borings. Table 4-1 summarizes the soil borings completed by feature and the boring installation method used. As previously mentioned, all HSA and sonic boreholes were initiated by hand-augering and/or manually digging a pilot borehole to a depth of approximately 5 feet bgs or until refusal occurred, prior to drilling. Drilling activities were completed by a California-licensed drilling contractor WDC Exploration, Inc. (WDC) for HSA and DP drilling activities and Boart Longyear for resonant sonic drilling activities.

Drilling activities commenced where no obstructions were encountered during the hand-augering process. There were no obstructions encountered at any drilling locations. Several borings at the Sanitary Landfill (H-49) were moved slightly for safety reasons due to the slope of the ground surface and close proximity to the drainage channel. Also, there was one location in the Test Bays, Feature F-39 (F39-PSB6), which was shifted after drilling had commenced for safety reasons after the drill rig started to slip towards the wash. The drillers put plywood and Altura Mats (used to protect SKR burrows) under the tires of the rig to regain traction and safely maneuvered the rig into a more suitable position. The boring was relocated approximately five feet east of its original location.

<u>*Lithological Logging*</u>

Core samples from boreholes were logged for lithology using the Unified Soil Classification System (USCS) (United States Bureau of Reclamation, 1986) including mineralogical composition, color, angularity, grain size and distribution, moisture, density, and sorting. Additional information recorded on the boring log also includes drilling subcontractor, geologist, method of drilling, borehole diameter total depth drilled, depth to first encountered groundwater, sample interval, organic vapor analyzer (photo-ionization detector) readings, observed odors and discolorations, location, and coordinates and elevation (if known). Copies of boring logs are provided in Appendix D.

<u>*Borehole Destruction*</u>

When borings were not converted into soil gas probes or groundwater monitoring wells, the boreholes were properly abandoned using the following methodologies. Backfilling of DP borings less than 30 feet bgs was conducted by emplacement of bentonite chips and hydrating in place. Backfilling of all other boreholes was completed by pumping a slurry consisting of Portland Type II/V cement and bentonite grout from the bottom of the borehole using a tremie pipe.

Table 4-1 Dynamic Site Investigation Summary of Soil Borings by Feature

Feature		Soil Borings by Feature	Installation Method			
			HSA	DP	HA	Sonic
B-9	Motor Washout Area	30	11	19	-	-
B-10	Propellant Mixing Station	1	1	-	-	-
B-11	Fuel Slurry Station	18	1	11	6	-
B-14	Pad with Dry Well	4	4	-	-	-
B-20	Pad South of Mix Station Bunker	12	3	9	-	-
C-22	Burn Pit Area	8	8	-	-	-
C-22	Propellant Blowout Test Area	11	-	-	11	-
F-34	Maintenance Shop and Storage Warehouse	7	7	-	-	3
F-39	Test Bays	7	-	-	-	7
G-46	Helicopter Landing Pad and Hangar	9	9	-	-	-
H-49	Sanitary Landfill (PCB Impacts)	5	2	-	3	-
H-49	Sanitary Landfill (Perchlorate Impacts)	5	5	-	-	-
-	Guard Well	-	-	-	-	-
-	Site Background Sampling	34	22	12	-	-
TOTAL		151	73	51	20	10

Notes:
HSA - Hollow-stem auger drilling method.
DP - Direct push drilling method.
HA - Hand auger method.
Sonic - Rotary sonic methodology.

4.1.4 Soil Sampling

Soil samples were collected as part of this investigation to delineate the extent of affected soil in selected Areas B, C, and H. A summary of the environmental sampling conducted for Historical Operational Areas B, C, and H during this investigation is shown in Appendix G. The information is summarized by operational area and feature, and includes the sample locations and dates, analytical methods, and quality assurance/quality control (QA/QC) samples collected for each media.

Soil samples were collected by hand-auger, split-spoon, acetate sleeve, and sonic core barrel methods. When using the hand-auger, soil was placed directly from the hand-auger into designated sample containers. When using split-spoons, soil samples were collected from the relatively undisturbed formation by advancing the split-spoon sampler ahead of the auger bit and placing the recovered soil into designated containers. When using the acetate sleeves, soil samples were collected from the relatively undisturbed formation by advancing the lead end of the rod containing the sleeve to a predetermined depth. The sleeve was removed from the rod and cut open for the sample to be collected and placed into designated containers. The sonic core barrel was advanced ahead of the drive casing and the relatively undisturbed soil was transferred from the core barrel into clean clear plastic bags from which the samples were collected and placed into designated containers. Soil samples were labeled and stored in a chilled cooler, in accordance with the SAP, and delivered to the laboratory via courier under Chain-of-Custody (CoC) protocols. Soil samples were analyzed by AETL, a State of California-certified laboratory located in Burbank, California and/or CalScience, a State of California-certified laboratory located in Torrance, California.

4.1.5 Discrete Groundwater Sampling

Groundwater grab samples were collected from selected features in Areas B, F, G and H. Groundwater grab samples consisted of collecting either first water and/or depth discrete groundwater samples. First water samples were collected where groundwater was encountered, generally less than 30 feet bgs, with enough recharge to enable adequate sample collection. Depth discrete groundwater samples were collected at depths generally greater than 30 feet bgs to evaluate the vertical extent of constituents within the aquifer. The HSA technique was used for selected shallow borings where a first water sample was required. This entailed lowering a disposable bailer into the borehole through the augers and transferring the groundwater from the bailer into the appropriate sample containers. The resonant sonic technique was used for borings where first water and/or depth discrete groundwater samples were required. Based on the continuous core, the geologist determined where moisture was present. The outer casing was advanced to isolate that interval and seal off water-bearing zones at higher elevations. Water from within the drill casing was then purged/evacuated prior to sample collection. When the exposed portion of the borehole yielded water a disposable bailer was lowered into the borehole through the outer casing and the depth discrete sample was transferred from the bailer into the appropriate containers. All samples were placed in a chilled cooler and delivered under CoC via courier to AETL.

4.1.6 Monitoring Well Installation

A total 23 groundwater monitoring wells were installed as part of the investigation using the HSA or resonant sonic method. Table 4-2 summarizes the groundwater monitoring wells installed by feature and the installation method used. A total of 21 groundwater monitoring wells and one (1) temporary well were drilled and installed at the Site between 8 September 2008 and 4 January 4 2009. One (1) groundwater monitoring well, referred to as the “guard well”, was drilled and installed offsite on the Building Management Services Property (BMS) between 29 January and 1 February 2009. Drilling and installation services were performed by WDC and Boart Longyear under the direction of the on-site geologist and supervising Professional Geologist and/or Professional Engineer. A summary of the drilling and well installation activities is presented below.

Of the 23 groundwater monitoring wells, the temporary well was installed using a hand auger, 8 wells were installed using HSA, and 14 wells were installed using resonant sonic. Groundwater monitoring wells were designed and constructed after an evaluation of lithology, groundwater yields, and contaminant concentrations was conducted. The groundwater monitoring wells onsite were constructed with a 2-inch diameter schedule 80 polyvinyl chloride (PVC) casing and a 0.020-inch factory slotted stainless steel screened section. The guard well was constructed using a 4-inch diameter schedule 80 PVC casing and a 0.02-inch factory slotted stainless steel screened section. A summary of monitoring well construction data is presented in Table 4-3 and monitoring well construction logs are included in Appendix D.

Based on previous investigations at the Site and the fine-grained nature of the sediments encountered during drilling, the #2/16 sand adequately provides a zone of higher permeability around the screened section, relative to the surrounding formation material, while still being small enough in size to reduce the amount of suspended fines entering the well. In addition, 0.020-inch perforations were selected for the monitoring wells as this allows for sufficient open area for the screens while the #2/16 sand is used to retain the fine-grained materials.

Once the total depth at each location was reached, the screen and casing were assembled and placed within the borehole. All wells were constructed vertically with the well casing suspended in place during construction. Centralizers were used to keep the wells centered in the borehole. Using a tremie pipe, the annular space around the screen was then backfilled with clean, reagent free #2/16 silica sand to serve as a filter pack, and the well was surged to ensure settling of the filter pack and prevent bridging.

Table 4-2 Dynamic Site Investigation Summary of Groundwater Well Installation by Feature

Feature		Groundwater Wells by Feature	Installation Method		
			HSA	HA	Sonic
B-9	Motor Washout Area	-	-	-	-
B-10	Propellant Mixing Station	3	1	-	2
B-11	Fuel Slurry Station	-	-	-	-
B-14	Pad with Dry Well	3	2	-	1
B-20	Pad South of Mix Station Bunker	1	1	-	-
C-22	Burn Pit Area	-	-	-	-
C-22	Propellant Blowout Test Area	-	-	-	-
F-34	Maintenance Shop and Storage Warehouse	5	2	1	2
F-39	Test Bays	6	1	-	5
G-46	Helicopter Landing Pad and Hangar	-	-	-	-
H-49	Sanitary Landfill (PCB Impacts)	-	-	-	-
H-49	Sanitary Landfill (Perchlorate Impacts)	4	-	-	4
-	Guard Well	1	-	-	1
-	Site Background Sampling	-	-	-	-
TOTAL		23	7	1	15

Notes:
HSA - Hollow-stem auger drilling method.
HA - Hand auger method.
Sonic - Rotary sonic methodology.

Table 4-3 Monitoring Well Construction Data

Boring ID	Well ID	Date Installed	Elevation (TOC, feet)	Depth to TOS (feet)	Depth to BOS (feet)	Screen Length (feet)	Borehole TD (feet)	Borehole Diameter (inches)	Casing Diameter (inches) & Material	Screen Slot Size (inches) & Material	Drilling Method	Filter Pack	Northing Coordinate	Easting Coordinate
H49-PSB1 / MW-84A,B	MW-84A	9/10/2008	2,010.02	85	95	10	95	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256517.74	630158.98
H49-PSB1 / MW-84A,B	MW-84B	11/24/2008	2,011.19	130	140	10	147	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256531.06	6340167.65
H49-SSB1 / MW-96	MW-96	12/3/2008	1,998.63	87	97	10	97.82	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256450.16	6340194.68
H49-SSB2 / MW-97	MW-97	12/9/2008	1,996.47	80	90	10	91	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256464.36	6340092.58
F34-TW1	F34-TW1	10/9/2008	1,894.08	5.4	7.4	2	7.4	4	2 sch 80 PVC	0.020 PVC	Hand Auger	2/12 Sand	2255936.71	6343180.38
F34-PSB5B / MW-87A,B	MW-87A	11/7/2008	1,938.92	90	100	10	101	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256066.27	6343446.58
F34-PSB5B / MW-87A,B	MW-87B	10/24/2008	1,938.82	15	35	20	101	10	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256066.21	6343446.33
F34-SSB10 / MW-84	MW-94	11/17/2008	1936.55	19	39	20	40	8	2 sch 80 PVC	0.020 SS	Auger	2/16 sand	2255902.90	6343431.50
F34-SSB9 / MW-93	MW-93	11/14/2008	1,931.47	25	45	20	50	8	2 sch 80 PVC	0.020 SS	Auger	2/16 sand	2255921.73	6343278.64
F39-PSB2 / MW-85A	MW-85A	10/2/2008	1,929.31	89.6	99.6	10	100.6	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256494.75	6342941.08
F39-PGW2 / MW-85B	MW-85B	12/10/2008	1,928.74	5	25	20	26	8	2 sch 80 PVC	0.020 SS	Auger	2/16 sand	2256494.31	6342934.52
F39-PSB7 / MW-86A	MW-86A	10/28/2008	1,923.21	90	100	10	100	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256229.89	6342904.12
F39-PSB7 / MW-86B	MW-86B	10/28/2008	1,923.21	10	30	20	100	10	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256229.60	6342904.20
F39-SGW9 / MW-92	MW-92	11/12/2008	1919.83	17	37	20	100	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256139.73	6342896.65
F39-SGW8 / MW-95	MW-95	11/13/2008	1920.80	17	37	20	100	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2256148.30	6342971.62
B10-PSB1 / MW-98A	MW-98A	12/21/2008	2,141.68	140	150	10	152	6	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2258941.72	6353555.28
B10-PSB1 / MW-98B	MW-98B	1/4/2009	2,141.73	30	50	20	52	8	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2258932.42	6353559.11
B10-PSB3 / MW-89	MW-89	11/11/2008	2,130.82	20	40	20	41	8	2 sch 80 PVC	0.020 SS	Auger	2/16 sand	2259105.73	6353334.82
B20-PSB6 / MW-90	MW-90	11/12/2008	2,147.71	35	55	20	60	8	2 sch 80 PVC	0.020 SS	Auger	2/16 sand	2258770.88	6353860.67
B14-PSB3 / MW-88	MW-88	11/10/2008	2,141.97	30	50	20	50	8	2 sch 80 PVC	0.020 SS	Auger	2/16 sand	2259000.92	6353826.74
B14-PSB2 / MW-91	MW-91	11/14/2008	2,144.85	30	50	20	51	8	2 sch 80 PVC	0.020 SS	Auger	2/16 sand	2259137.35	6353801.84
B14-PSB1 / MW-99	MW-99	1/4/2009	2,144.63	134.5	144.5	10	145	8	2 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2259108.19	6353733.49
MW-100	MW-100	2/2/2009	1,525.79	145	175	30	175.2	8	4 sch 80 PVC	0.020 SS	Sonic	2/16 sand	2251220.02	6334811.73

Notes:

TOC - Top of casing.
TOS - Top of screen.
BOS - Bottom of screen.
PVC - Polyvinylchloride.
SS - Stainless steel.
TD - Total depth.

At the surface, each well was completed with a steel outer monument casing. Most completions extend approximately 3 feet above grade and contain a locking well cap to provide protection against tampering or unauthorized access. The base of each of these monuments is secured by a 2-foot by 2-foot by 4-inch concrete surface pad. A few of the wells within the road or vehicle pathways were covered with steel flush-mount manhole well boxes so vehicles could drive over them without incident. They stick up approximately 1 to 2 inches above grade and are enveloped by downward sloping concrete to prevent water from pooling on or around them. These are secured with two bolts on either side of the cover to protect against tampering and unauthorized access.

Four concrete-filled steel guard posts were installed around monitoring wells with an above-ground completion near roads or pathways for protection against vehicle collision. The guard posts are 5 feet in length and are installed radially from the wellhead. The posts are recessed approximately 2 to 3 feet bgs and set in concrete. Each well is marked using paint and stencils and secured with a lock keyed for opening with one master key. Groundwater monitoring well construction diagrams are included in Appendix D.

4.1.7 Monitoring Well Development

The groundwater monitoring wells were developed approximately two weeks following well completion. Well development was performed in a step-wise process as described below.

The monitoring wells were developed using a combination of bailing, surging, and pumping. The wells were initially bailed until most of the settleable solids were removed, and the total depth of the well was measured. The wells were then swabbed using a large surge block to flush fine-grained materials from the filter pack. After surging, the fine-grained materials that accumulated inside the well casings were bailed with a suction bailer until nearly all the settleable solids were removed and the bottom of the well probed. After two or more bailing periods, a submersible pump was placed in the well. The submersible pump was used in wells that had an adequate amount of water.

During pumping, water quality parameters consisting of pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity were monitored and recorded on Groundwater Monitoring Well Development Field Data Sheets, which are attached as Appendix E. Water level measurements and pumping rates were also recorded on the forms. Pumping rates were measured using the bucket/stopwatch method. The bucket/stopwatch method consists of pumping the well discharge into a known volume container (usually a calibrated 5-gallon bucket). A stopwatch is started when flow begins entering the container and is stopped when the container is full. This will give the time in minutes and seconds needed to discharge the known volume of water from the well. This number was converted to gallons per minute (gpm) and recorded on the field logging sheets.

This procedure was repeated several times to establish an average pumping rate. The volume pumped during development was calculated based on the average pumping rate and the total time the well was pumped. The water level drawdown was recorded on the logging sheet. Water level drawdown and pumping rates were measured during well development to calculate the specific capacity of the well.

After water quality parameters stabilized (i.e., pH ± 0.1 units, EC ± 5%, temperature ± 1 degree Celsius [°C], DO ± 0.3 milligrams per liter (mg/L), and turbidity ≤10 nephelometric turbidity units (NTUs) or within 10% of three consecutive measurements), development was considered complete.

Some of the wells went dry during the bailing process and were allowed to recover. The recovery time was noted, and the wells were bailed dry approximately 5 times, after which they were considered developed.

Decontamination procedures were completed after each monitoring well had been developed. Purge equipment, including pumps and discharge lines, were decontaminated by flushing/pumping a phosphate-free detergent (i.e., Liquinox) and water solution and potable water rinse through the components. All measuring equipment, such as water level meters and water quality probes, was thoroughly rinsed with deionized water prior to each use and between wells.

4.1.8 Monitoring Well Sampling

Initial groundwater sampling followed well development and well purging activities by a minimum of 72 hours to allow for the monitoring wells to stabilize after the agitation and aeration caused by development activities. Well purging and sampling activities followed procedures discussed below and described in *RCRA Ground-Water Monitoring: Draft Technical Guidance* (EPA, 1992).

Groundwater samples were collected from monitoring wells by low-flow purging and sampling methods using a submersible purge pump. Field instruments and equipment were properly maintained, calibrated daily, and operated based on the manufacturers' guidelines and recommendations. Copies of the field data sheets are included in Appendix E.

On each day of sampling, an equipment blank was collected prior to sampling if a dedicated pump had not been placed in the well. After decontaminating the pump and discharge line, deionized water was pumped through the system. The equipment blank samples were collected after approximately two hose volumes passed through the lines. During the first round of sampling three of the 23 dedicated pumps for the newly installed wells had come in and were already installed. An equipment blank and decontaminating equipment was not necessary for wells with dedicated pumps as all tubing and other equipment where contamination could be transferred is not shared.

After collection of each equipment blank when necessary, groundwater sampling activities began. Monitoring wells were sampled in order of (suspected) increasing contamination. The submersible purge pump or dedicated pump (where applicable), was placed at the wetted midpoint of the well screen or at depth of maximum draw down. An indication of expected well performance was obtained from the well development field sheets (Appendix E). Purging and sampling activities were performed in a manner that minimized the agitation of sediment in the monitoring well and formation. Pumping began at a rate no greater that 0.5 gpm. After pumping at least one sampling system volume, the first set of water quality readings and water level measurements were taken.

After compiling the initial set of water quality parameters and water level measurements, readings were recorded at three to five minute intervals. Groundwater samples were collected after a minimum of six readings and water quality parameters had stabilized. Stabilization parameters are as follows: pH ± 0.1 units, EC ± 3%, turbidity ≤10 NTUs or within 10%, DO ± 0.3 mg/L, ORP ± 10 millivolts (mV), and water level drawdown ±0.1 feet, for a minimum of three consecutive readings. Attempts were made to minimize the total water level drawdown in the well to less than 0.33 feet. Purging continued until stabilization was achieved and samples were collected.

The groundwater samples collected were those which are collected during the GMP. The samples were placed into appropriate containers prepared for the specified analysis. The feature-specific analytes sampled during the current investigation were sent to AETL with a rush turn-around time. Samples collected as part of the normal GMP which were not analytes specifically sampled at the respective feature during this investigation were sent to EMAX (the lab used during the GMP) with a standard turn-around time. The analytes sampled for were VOCs by EPA Method SW8260B; 1,4-dioxane by EPA Method SW8270 selective ion monitoring (SIM); and perchlorate by EPA Method 314.0. Groundwater samples were collected and delivered under CoC via courier. Sample containers were filled in order of decreasing volatilization as follows:

- VOCs;
- SVOCs; and
- Inorganics (e.g., perchlorate).

Sample containers were labeled, bubble-wrapped, and stored on ice in a thermally insulated shipping container until delivery to the analytical laboratory. Each sample within a shipping container was listed on a CoC form for that container.

Decontamination procedures were completed after each monitoring well had been sampled where applicable. Purge equipment including pumps and discharge lines, were decontaminated by flushing/pumping a phosphate-free detergent (i.e., Liquinox) and water solution, potable water and deionized water through the components. Lifting lines were washed with Liquinox/water or equivalent solution and rinsed with both potable and deionized water. Measuring equipment was thoroughly rinsed with deionized water prior to each use and between sampling points.

4.1.9 Soil Gas Probe Installation and Sampling

A total of 49 soil gas probes were installed in a total of 25 borings during the investigation, under the direction of the on-site geologist and supervising Professional Geologist and/or Professional Engineer.

The soil borings for soil gas probes were installed using HSA drilling or hand auger methods. Table 4-4 summarizes the soil gas borings completed by feature and the boring installation method used. The probes were constructed using 6-inch stainless steel mesh vapor inlets connected to 0.25-inch-outer diameter (OD) Nylaflow® tubing. A sand filter pack, consisting of clean, reagent-free #2/16 sand was placed adjacent to the vapor inlet and extending 1 foot above each vapor inlet (screened interval). Dry granular bentonite was placed 1-foot directly above the sand filter pack. Hydrated bentonite chips were placed atop the granular bentonite. A cement/bentonite grout seal was applied above the shallowest hydrated bentonite chips to ground surface. A flush-mount manhole well box was concreted in at the surface to protect the probes in the event that future soil gas sampling is deemed necessary. A petcock two-way gas-tight valve was installed in the tubing at the surface. Probe installation included combinations of single, dual, and triple probe construction. Figure 4-2 shows a typical soil gas probe construction for a dual probe installation. A summary of soil gas probe construction details is presented in Table 4-5.

Soil gas sampling activities occurred between 02 October 2008 and 02 December 2008. A total of 48 samples were collected using Summa™ or equivalent canisters. The soil gas samples were transported by courier under CoC protocols on each day of sampling to AETL.

During soil gas sampling, a single regulator was utilized, which was decontaminated between samples by purging ambient air through the regulator for three minutes in accordance with the LARWQCB/DTSC's Active Soil Gas Investigation Advisory dated January 28, 2003.

Soil gas samples were collected from the sample probes no less than two to three weeks after installation. Prior to sampling, the initial canister vacuum was measured and recorded. The sample tubing was then attached to the canister manifold and the probe was purged. The purge volume was calculated based on the internal volume of the tubing and the annular space around the probe tip for each probe. The purge and sampling flow rate of 150 to 200 milliliters per minute (ml/min) was attained. Samples were not collected from probes where a no flow condition was experienced. The following information was recorded during soil gas sampling activities: 1) Summa™ Canister Serial No.; 2) well ID and probe depth; 3) status of leak check performed; 4) flow rate; 5) volume purged; and 6) beginning and ending times; and 7) initial and final pressures.

Table 4-4 Dynamic Site Investigation Soil Gas Boring Summary by Feature

Feature		Soil Gas Borings by Feature	Installation Method	
			HSA	HA
B-9	Motor Washout Area	-	-	-
B-10	Propellant Mixing Station	-	-	-
B-11	Fuel Slurry Station	-	-	-
B-14	Pad with Dry Well	-	-	-
B-20	Pad South of Mix Station Bunker	-	-	-
C-22	Burn Pit Area	5	-	5
C-22	Propellant Blowout Test Area	-	-	-
F-34	Maintenance Shop and Storage Warehouse	6	6	-
F-39	Test Bays	5	-	5
G-46	Helicopter Landing Pad and Hangar	9	9	-
H-49	Sanitary Landfill (PCB Impacts)	-	-	-
H-49	Sanitary Landfill (Perchlorate Impacts)	-	-	-
-	Guard Well	-	-	-
-	Site Background Sampling	-	-	-
TOTAL		25	15	10

Notes:
HSA - Hollow-stem auger drilling method.
HA - Hand auger method.

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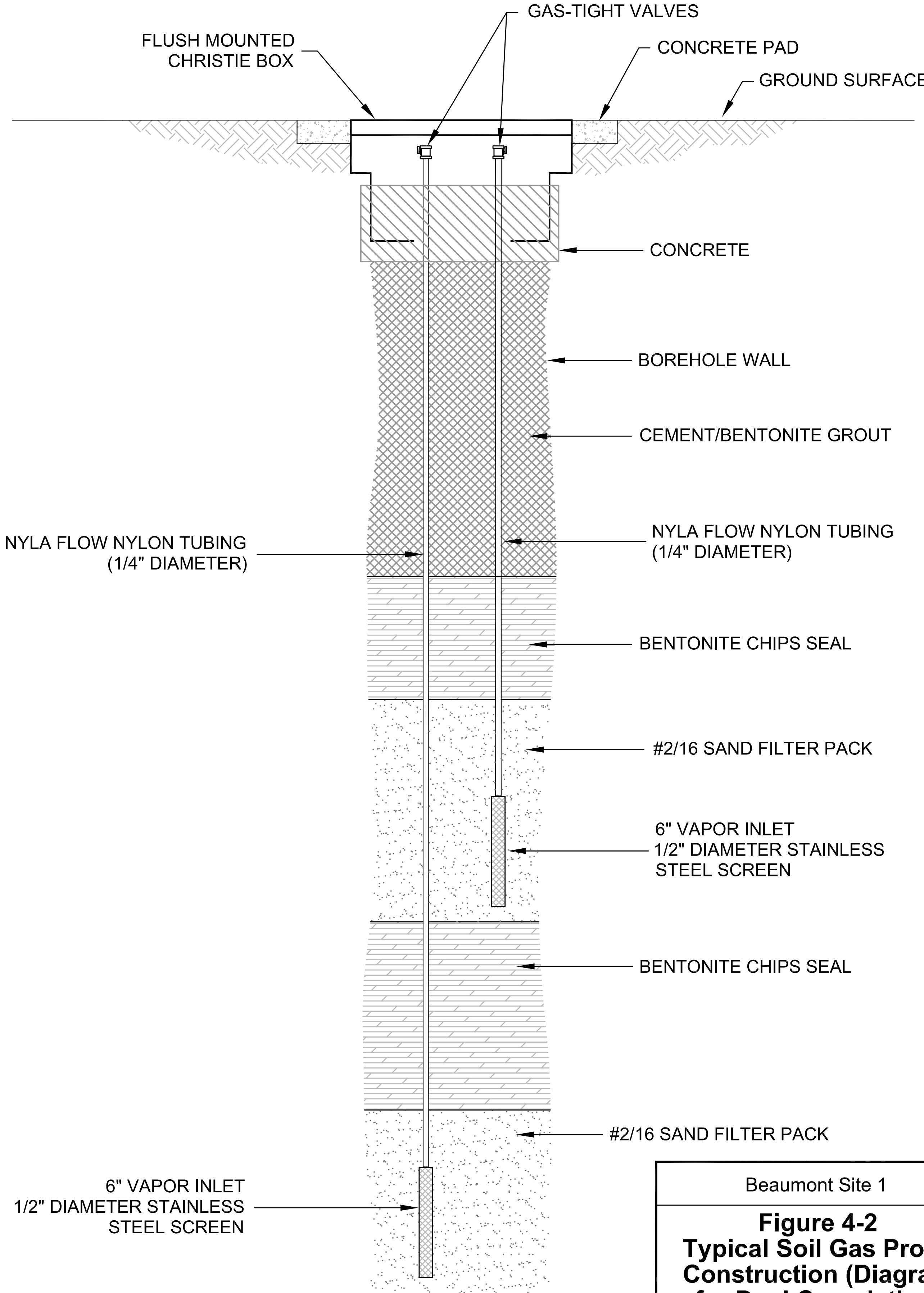

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Beaumont Site 1

Figure 4-2
Typical Soil Gas Probe Construction (Diagram for Dual Completion)

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Table 4-5
Soil Gas Probe Construction Summary

Boring ID	Date Completed	Probe Depth (feet bgs)
F34-PSB1	9/12/2008	5, 13
F34-PSB2	9/12/2008	5, 15
F34-PSB3	9/12/2008	5, 15
F34-PSB4	9/12/2008	5, 15
F34-PSB5	9/12/2008	5, 15
F34-PSB6	9/15/2008	5, 15
G46-PSB1	9/15/2008	5, 10, 20
G46-PSB2	9/16/2008	5, 10, 15
G46-PSB3	9/16/2008	5, 10, 15
G46-PSB4	9/17/2008	5, 10, 15
G46-PSB6	9/17/2008	5, 10, 15
G46-PSB5	9/17/2008	5, 10, 15
G46-PSB7	9/17/2008	5, 10, 15
G46-PSB8	9/17/2008	5, 10, 15
G46-PSB9	9/18/2008	5, 10, 15
C22-PSG1	11/5/2008	5
C22-PSG2	11/5/2008	5
C22-PSG3	11/5/2008	5
C22-PSG4	11/5/2008	5
C22-PSG5	11/4/2008	5
F39-PSB2	11/5/2008	5
F39-PSB3	11/5/2008	5
F39-PSB4	11/5/2008	5
F39-PSB6	11/5/2008	5
F39-PSB7	11/5/2008	5

Note:
bgs - below ground surface

4.1.10 Investigation-Derived Waste

Investigation-derived waste (IDW) generated from the field activities included soil cuttings from drilling, decontamination water, and purge water from well development and sampling activities. Excess soil from sampling activities was temporarily stored on-site in 12, 20-cubic yard roll-off containers prior to disposal, pending characterization. Water generated during drilling activities and subsequent sampling/purging activities was placed in a bin adjacent to a frac tank both of which were on site. The bin was used to allow any suspended solids to settle out of the water. The water was then pumped into the frac tank from the bin to reduce the amount of sediment in the tank in an attempt to minimize disposal costs. All IDW was characterized prior to final transportation and disposal to an approved waste recycling/disposal facility. Copies of the analytical data are provided in Appendix J, and copies of IDW manifests are included in Appendix F.

4.2 HABITAT CONSERVATION

Consistent with the United States Fish and Wildlife Service (USFWS) approved *Low-Effect Habitat Conservation Plan* (Tetra Tech, 2005c) describing "Low Affect" activities for environmental remediation at the Site, prior to initiating groundwater monitoring field activities, a biological survey of the surrounding area of each proposed groundwater monitoring well location was performed by a Section 10A permitted or sub-permitted biologist to evaluate the potential for impacts during field activities to sensitive species/habitats (i.e., SKR).

As part of the biological survey, the biologist identified and marked potential or suspected SKR burrows that were located in the vicinity of proposed well locations to avoid the "take" (i.e., harm, harassment, death, and/or disturbance of habitat) of SKRs. The biologist clearly marked the ingress and egress routes to each proposed well location in an effort to minimize the overall footprint of field activities and impacts to SKR habitat. Further, as specified, surveying the work areas, the biologist remained on-Site during field activities to implement requirements of the "Low Affect" agreement. However, Dulzura kangaroo rat (DKR) and SKR takes did occur during the performance of the drilling activities and corrective actions were implemented in accordance with the permit.

5.0 INVESTIGATION RESULTS AND DISCUSSION

This section presents the results of the DSI conducted at Historical Operational Areas B, C, F, G, and H between September 2008 and March 2009. It includes tabulated data summaries, geologic cross sections, sample location maps, groundwater contours, and contaminant distribution figures including COPC concentration contours, vertical contaminant profiles, and three dimensional (3-D) contaminant visualizations. Figures presenting the contaminant distribution at each feature utilize both recent and historical analytical results when appropriate.

The 3-D contaminant interpolations presented in this section were created with the Mining Visualization System (MVS) software developed by C-Tech (http://www.ctech.com/). MVS is a computer model that produces 3-D visualizations of mining and environmental data utilizing an accurate and geostatistically defensible process called kriging. Kriging has been described as the "best linear unbiased estimator" (Isaaks and Srivastava, 1989) of a spatial variable for a particular site or geographic area. It has also been recognized by the EPA as the best and standard means for interpolation and extrapolation of measured data.

For perchlorate, the concentration contours that best represent the magnitude and extent of impacts in soil were utilized for each feature. It should be noted that in all cases the lowest contouring interval for perchlorate in soil is 200 µg/kg which is well below the investigation goal (IG) of 780 µg/kg. The section is organized by operational area and feature and briefly summarizes the previous investigation results along with the results from the current investigation. Validated analytical results from the DSI as well as the previous supplemental site investigations conducted at the Site since 2002 (Tetra Tech 2002, 2005a, 2005b, 2008a, 2009a) are included in Appendix H. Note that the tabulated data summaries presented herein only show the analytes positively detected. A complete list of analytes tested for is included in the laboratory data packages in Appendix J.

5.1 SITE GEOLOGY

The investigations conducted as part of this DSI were focused on delineating the extent of impacts identified during previous investigations at the individual features and therefore additional information collected with respect to site-wide geology is limited. All four stratigraphic units that exist beneath the Site were encountered during the DSI: the Quaternary alluvium, the San Timoteo formation, the Mount Eden formation (weathered and unweathered portions), and the Granitic/Metasedimentary basement complex. General observations regarding the depths encountered and make-up of the different units observed during the drilling of the borings/wells for this DSI are provided below.

5.1.1 Site Lithology

Quaternary Alluvium

Alluvium was observed at all of the features investigated during the DSI ranging in thickness from less than a foot in some areas where the Mount Eden formation was present just below the surface, to over 40 feet near the RMPA and the Sanitary Landfill. The alluvium observed during the DSI consisted primarily of sand, silt, and a combination thereof, with interbedded clays and a few gravel lenses.

The BPA is within close proximity to the granitic mountains on the eastern portion of the site. Coarse- to medium-grained sands, which have likely eroded from the adjacent mountains, dominate the sediment in the BPA. Moving away from the BPA, toward the RMPA, it appears as though the surface topography in the southeastern portion of the site is relatively flat. Mountains bound the area on all but the west side forming a partial basin. The topography actually slopes very gently northwestward following the orientation of Bedsprings Creek. The minimal change in elevation creates a very low energy fluvial environment. This is evident by the increase in finer grained sediment, including silts and clays, at the RMPA. Fine-grained sand to silty sands dominate the alluvium at the other features (Features F-34, F-39, G-46 and H-49) located further down the valley along the sides or tributaries of Potrero Creek.

San Timoteo formation

The San Timoteo formation was only encountered during this investigation as part of the background metals evaluation where the San Timoteo formation was targeted in order to collect a background data set for metals within this soil type. The San Timoteo formation is present primarily in the northern portions of the Site, including Operational Areas A and I and near the north central boundary. The San Timoteo formation consisted primarily of gray, well-sorted, stiff to very stiff silts, sandy silts, and silty sands.

Mount Eden formation

During the DSI, the Mount Eden formation was encountered at six of the features (B-10, B-14, F-34, F-39, G-46, and H-49). The Mount Eden formation has several members and varies from very well indurated to poorly consolidated and friable. The formation can be red to olive gray and range from mudstone to coarse thick-bedded conglomeritic sandstone. The Mount Eden formation can be seen in exposures throughout the site in its variances. At some features, the formation is very similar to the overlying sediment. Some of the investigative activities disturb the formation rendering it almost indistinguishable from the alluvium.

Granitic/Metasedimentary Basement Complex

The granitic/metasedimentary basement complex underlies the Mount Eden formation. The phaneritic plutonic rock encountered during this investigation had fine to medium grained crystals and was only encountered in one boring at the Sanitary Landfill (H-49).

5.1.2 Seismic Reflection and Profiling

The findings from the seismic reflection survey can be found in the Terra Physics report included in Appendix B. The findings are currently undergoing interpretation and will be discussed in a future document.

5.2 SITE HYDROGEOLOGY

Groundwater was encountered at eight of the features investigated during the DSI: Propellant Mixing Station (B-10), Fuel Slurry Station (B-11), Pad with Dry Well (B-14), Pad south of Mix Station Bunker (B-20), Maintenance Shop and Storage Warehouse (F-34), Test Bays (F-39), Helicopter Landing Pad (G-46), and Sanitary Landfill (H-49). Within these features groundwater was observed within up to three of the four major geologic units present at the Site; the Quaternary alluvium, Mount Eden formation, and the Granitic/Metasedimentary basement complex. Groundwater was not encountered within the San Timoteo formation since only shallow soil borings (<10 feet bgs) for the background metals evaluation were drilled in the northern portion of the Site where the San Timoteo is present. First groundwater was observed as shallow as 5 feet bgs in the drainage below Feature F-39 and as deep as 90 feet bgs at the Sanitary Landfill (H-49). In addition to the on-site investigations, first groundwater was encountered at approximately 130 feet bgs at the offsite well location south of the Site. Groundwater elevations in the newly installed wells for the DSI range from 2,107 feet mean sea level (msl) at the Pad with Dry Well (B-14) in the RMPA to 1,944 feet msl at the Sanitary Landfill (H-49) and 1,416 feet msl at the offsite guard well (MW-100). A tabulated summary of groundwater elevations from February 2009 for the wells installed during the DSI is presented in Table 5-1.

Figure 5-1 shows the site-wide groundwater contours from February 2009 for all new wells installed during the DSI along with the existing wells measured from the routine GMP. Generally, groundwater flowed northwest from the southeastern limits of the valley (near the former BPA) beneath the former RMPA, towards Potrero Creek where groundwater flow then changes direction and begins heading southwest, parallel to the flow of Potrero Creek, into Massacre Canyon. Locally, groundwater flow within the box canyons of the Mount Eden formation (Propellant Mixing Station [B-10], Pad with Dry Well [B-14], and Test Bays [F-39]) flows out of the canyons before converging with groundwater flow within the valley or streambed. As shown in Figure 5-1, the horizontal gradient is lowest between the BPA and

Table 5-1
Groundwater Elevations for Newly Installed Wells - February 2009

Well ID	Date Measured	Measuring Point Elevation (feet msl)	Depth to Water (feet)	Groundwater Elevation (feet msl)
F34-TW1	02/27/09	1894.08	4.71	1889.37
MW-84A	02/26/09	2010.02	62.43	1947.59
MW-84B	02/26/09	2011.19	65.02	1946.17
MW-85A	02/26/09	1929.31	5.55	1923.76
MW-85B	02/26/09	1928.74	1.08	1927.66
MW-86A	02/26/09	1923.21	14.90	1908.31
MW-86B	02/26/09	1923.21	16.50	1906.71
MW-87A	02/26/09	1938.92	21.10	1917.82
MW-87B	02/26/09	1938.82	19.95	1918.87
MW-88	02/26/09	2141.97	35.31	2106.66
MW-89	02/26/09	2130.82	29.97	2100.85
MW-90	02/26/09	2147.71	41.45	2106.26
MW-91	02/26/09	2144.85	37.78	2107.07
MW-92	02/26/09	1919.83	31.40	1888.43
MW-93	02/26/09	1931.47	34.61	1896.86
MW-94	02/26/09	1936.55	21.92	1914.63
MW-95	02/26/09	1920.80	21.17	1899.63
MW-96	02/26/09	1998.63	53.75	1944.88
MW-97	02/26/09	1996.47	48.12	1948.35
MW-98A	02/26/09	2141.68	45.37	2096.31
MW-98B	02/26/09	2141.73	37.50	2104.23
MW-99	02/26/09	2144.63	55.52	2089.11
MW-100	03/02/09	1525.79	108.97	1416.82

Notes:
msl - Mean sea level.
TW - Temporary groundwater monitoring well.

the RMPA with a greatly increased flow through the NPCA and the MCEA. The flattening of the gradient in the BPA and RMPA appears to be attributed to the increased aquifer transmissivity and thickness in these areas.

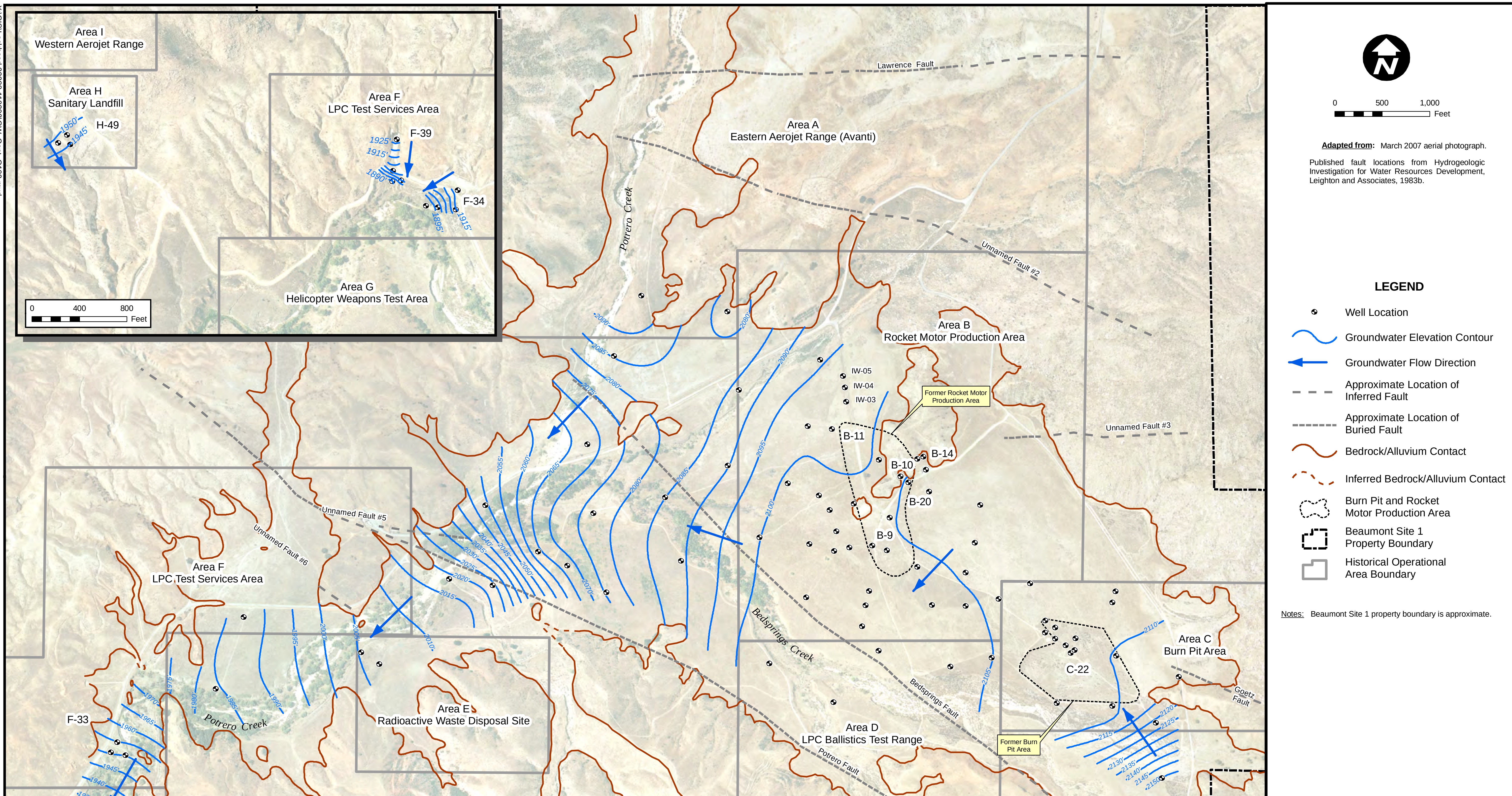

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Figure 5-1
Groundwater Contours for Alluvium and Weathered Mount Eden Formation-February 2009

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5.3 ANALYTICAL RESULTS

This section summarizes the investigation results site-wide and by environmental media for contaminants investigated as part of the DSI and provides a brief overview of previously detected contaminants. A summary of the DSI sampling and analysis program is provided in Table 5-2. The table summarizes the samples collected by media for each of the features investigated.

Table 5-2
Samples Collected by Media and Feature

Feature		Soil Samples	Groundwater Samples	Soil Gas Samples
B-9	Motor Washout Area	150	-	-
B-10	Propellant Mixing Station	16	14	-
B-11	Fuel Slurry Station	75	1	-
B-14	Pad with Dry Well	49	20	-
B-20	Pad South of Mix Station Bunker	67	3	-
C-22	Burn Pit Area	70	1	5
C-22	Propellant Blowout Test Area	21	-	-
F-34	Maintenance Shop and Storage Warehouse	-	27	11
F-39	Test Bays	-	93	5
G-46	Helicopter Landing Pad and Hangar	-	9	27
H-49	Sanitary Landfill (PCB Impacts)	20	-	-
H-49	Sanitary Landfill (Perchlorate Impacts)	115	21	-
-	Guard Well	-	2	-
-	Site Background Sampling	135	-	-
TOTAL		718	191	48

Feature specific result tables and figures are presented in Section 5.4. Tables 1 through 15 located in Appendix H show the validated analytical results for soil, soil gas, groundwater, and surface water in consolidated tabular format for the DSI and previous investigations performed for soil and soil gas. Copies of the original laboratory reports for the DSI are provided in Appendix J.

5.3.1 Data Quality Review

The quality control samples were reviewed in accordance with the Revised Groundwater Sampling and Analysis Plan (Tetra Tech, 2003b). Holding times, field blanks, laboratory control samples, method blanks, duplicate environmental samples, spiked samples, and spike recovery data were also evaluated. The analytical testing and data reporting for the DSI were conducted by EMAX Laboratories Inc., Calsicence Environmental Laboratories Inc., American Environmental Testing Laboratories Inc., and E.S. Babcock and Sons, Inc. These data were reviewed using the National Functional Guidelines for Organic and Inorganic Data Review documents from the EPA (EPA, 1999 and 2004).

Within each environmental sample, the sample specific quality control spike recoveries were examined. These data examinations include comparing statistically calculated control limits to percent recoveries of all spiked analytes and duplicate spiked analytes. Field duplicates were used to monitor unbiased laboratory precision. Relative percent difference (RPD), the measure of duplicate precision, was calculated for results at or above the practical quantitation limit (PQL). Surrogate recoveries were examined for all organic compound analyses and compared to their control limits. Environmental samples were analyzed by the following methods: Method E314.0 and E332.0 for Perchlorate, Method SW7471A for Mercury; Method SW8082 for PCBs; Method TO-15 for Soil Gas; Method SW8270C M for 1,4-Dioxane; Method SW6020 for Metals; and Method SW8260B for VOCs. Unless discussed below, all data results met required criteria, are of known precision and accuracy, did not require any qualification, and may be used as reported.

The RPDs for the quality control samples are as follows: field duplicates range from 0.6 to 1.6% (for methods E314.0 and SW6020) and method blank contamination occurred for approximately 0.1 % of the data for method SW6020. Matrix spike recovery errors range from 0.1 to 1.3% of the total data for SW7471A and SW6020. The acceptance criteria was met (below 40%), and precision was within the control limits for this data set. In conclusion, the analytical results and data collected for this investigation can be used for their intended purpose. All data not qualified are of known precision and accuracy. All “B” qualified results are considered not to have originated from the environmental samples, as cross-contamination is suspected; and all “R” qualified results are qualified as rejected and the presence or absence of the analyte cannot be verified. All data qualified as estimated (flagged with a “J”) are usable as estimated concentrations. Validated analytical results are included in Appendix H.

5.3.2 Soil Results

A total of 590 soil samples were collected and analyzed for one or more of the following constituents:

- Perchlorate (EPA Method 314.0; 563 samples)
- Polychlorinated Biphenyls (EPA Method 8082; 20 samples)
- 1,4-Dioxane (EPA Method 8270M; 7 samples)

Soil samples were submitted to AETL for analysis of the constituents listed above and to determine the moisture content. Of the 590 soil samples collected, 381 samples detected perchlorate above the method detection limit (MDL) at concentrations ranging from 5.23 to 8,500 µg/kg. PCBs and 1,4-dioxane were not detected above the MDL in any of the samples collected (ND). The highest concentrations of perchlorate, PCBs, and 1,4-dioxane detected at the Site to date were reported during previous investigations (Perchlorate: 302,000 µg/kg at the Large Motor Washout Area [F-33]; PCB 1248: 910 µg/kg, PCB 1254: 1400 µg/kg, and PCB 1260 84 µg/kg at the Sanitary Landfill [H-49]; 1,4-dioxane: 4 µg/kg at the Propellant Mixing Station [B-10]) [Tetra Tech, 2009c, Tetra Tech, 2008a, and Tetra Tech, 2002].

Soil samples analyzed for VOCs during the 2004 Soil Investigation (Tetra Tech, 2005a,b) and 2007 Supplemental Soil Investigation (Tetra Tech, 2009a) were re-evaluated to confirm whether the concentrations of chemicals detected in soil have the potential to migrate to groundwater. The Environmental Protection Agency Soil Screening Guidance: User's Guide (EPA, July 1996) was used to determine soil screening levels for chemicals where a MCL or DWNL for groundwater is published. Soil screening levels were established for 1,1-DCE, toluene, TCE and o-xylene, Table H-17 in Appendix H. At the Fuel Slurry Station (Feature B-11), soil samples collected from four borings at 40 feet bgs detected 1,1-DCE (detected in four samples) and TCE (detected in three samples) at concentrations exceeding the soil screening levels. The highest concentrations of 1,1-DCE and TCE were 11 µg/kg and 13 µg/kg, respectively. It should be noted that the soil samples were collected near the water table most likely within the capillary fringe. In 2007, three soil gas borings containing multi-depth soil gas probes down to 20 to 25 feet bgs were installed at Fuel Slurry Station (B-11) to evaluate the presence of VOCs in soil gas at this feature. The soil gas samples confirmed the presence of 1,1-DCE and TCE previously identified in soil samples and showed an increasing concentration with depth down to groundwater. A correlation of the soil gas analytes and concentrations in comparison to the groundwater analytes and concentrations indicates that the soil gas detected represents off-gassing of affected groundwater beneath this feature rather than a shallow VOC soil source. Concentrations of toluene and o-xylene were not detected above the soil screening level. Therefore, the only VOCs detected within soil that exceeded a soil screening level were found near the water table above impacted groundwater and are associated with off-gassing of the site-wide plume.

Table 1 in Appendix H shows the validated analytical results for soil in consolidated tabular format. Soils data by Feature from previous investigations is included in Tables H-6 through H-13 of Appendix H. Summary tables of the validated analytical data, showing only compounds which were detected, are provided by operational area or feature in Section 5.4.

5.3.3 Soil Gas Results

A total of 48 soil gas samples were analyzed for VOCs using EPA Method TO-15. Soil gas samples were submitted to AETL for analysis of VOCs. Of the 48 samples collected, 1,1,1-TCA was detected in 4 samples from 112 to 2,910 micrograms per cubic meter (µg/m^3); 1,1-DCE was detected in 7 samples from 121 to 1,940 µg/m^3; and TCE was detected in 10 samples from 57.0 to 11,500 µg/m^3. Other VOCs were detected in one or more samples including carbon disulfide, 1,1-DCA, cis-1,2-dichloroethene (cis-1,2-DCE), toluene, 1,1,2-trichloroethane (1,1,2-TCA), PCE, and trichlorofluoromethane (Freon-11).

The highest concentrations of 1,1,1-TCA (16,000 µg/m^3 at the Burn Pit Area [C-22]), 1,1-DCE (152,000 µg/m^3 at the Burn Pit Area [C-22], and TCE (47,000 µg/m^3 at the Test Bays [F-39]) detected in soil gas were reported during previous investigations.

Table H-3 in Appendix H shows the validated analytical results for soil gas in consolidated tabular format. Soil gas data from previous investigations is included in Table H-15 of Appendix H. A summary table showing only compounds which were detected in each operational area or feature are provided in Section 5.4 below.

5.3.4 Surface Water Results

A total of 8 surface water samples were collected in order to evaluate 1,4-dioxane concentrations in the area around the Maintenance Shops and Warehouse (F-34). The samples were collected in 8 locations within the streambed and were analyzed for the following constituents:

- Perchlorate (EPA Method 332.0; 8 samples)
- VOCs (EPA Method 8260B; 8 samples)
- 1,4-Dioxane (EPA Method 8270C-SIM; 8 samples)

Surface water samples were submitted to E.S. Babcock & Sons, Inc. for analysis of the constituents listed above. Perchlorate and VOCs were not detected above the MDL in any of the eight samples. 1,4-dioxane was detected in the 8 samples from 1.1 to 4.0 µg/L. The highest concentrations of perchlorate, 1,4-dioxane, 1,1-DCE, and TCE in surface water at the Site were detected during previous surface water sampling events at the ponds located approximately 1.25 miles upgradient of the Maintenance and Storage Warehouse [F-34] [Perchlorate: 180 µg/L at SW-03 (March 2005); 1,4-dioxane: 22 µg/L at SW-02 (March 2005); 1,1-DCE: 19 µg/L at SW-02 (December 2005) ; and TCE 22 µg/L at SW-02 (December 2005)].

Table H-5 in Appendix H shows the validated analytical results for surface water in consolidated tabular format. A summary table showing only compounds which were detected are provided in Section 5.4.3 below.

5.3.5 Groundwater Results

A total of 142 groundwater samples were collected during drilling activities and were analyzed for one or more of the following constituents:

- Perchlorate (EPA Method 314.0; 36 samples)
- VOCs (EPA Method 8260B; 115 samples)
- 1,4-Dioxane (EPA Method 8260B-SIM; 2 samples)

Groundwater grab samples were submitted to AETL for analysis of the constituents listed above.

A total of 49 groundwater samples were collected from new and existing groundwater monitoring wells, and were analyzed for one or more of the following constituents:

- Perchlorate (EPA Method 314.0; 49 samples)
- VOCs (EPA Method 8260B; 48 samples)
- 1,4-Dioxane (EPA Method 8270C-SIM or EPA Method 8260B-SIM; 47 samples)

Groundwater samples were submitted to AETL and EMAX Laboratories for analysis of one or more of the constituents listed above.

Of the 142 groundwater and 49 monitoring well samples collected, perchlorate was detected in 49 samples from 1.21 to 6,600 µg/L; and 1,4-dioxane was detected in 22 samples from 0.63 to 99 µg/L. For VOCs, 1,1-DCE was detected in 26 samples from 0.13 to 27.6 µg/L and TCE was detected in 90 samples from 0.19 to 121 µg/L. Other VOCs detected in groundwater samples include 2-butanone, benzene, carbon disulfide, chloromethane, chloroform, 1,1-dichloroethane, c-1,2-dichloroethene, ethylbenzene, 2-hexanone, methyl-tert-butyl ether (MtBE), styrene, toluene, trichlorofluoromethane, m,p-xylenes and o-xylene. The highest concentrations of 1,1-DCE, 1,4-Dioxane, and TCE were detected in groundwater monitoring wells installed prior to this investigation (Perchlorate: 141,000 µg/L in EW-15 (May 2002); 1,1-DCE: 14,000 µg/L in EW-13 (June 2007); 1,4-Dioxane: 3,400 µg/L in EW-13 (June 2007); and TCE 3,500 in µg/L in MW-26 (June 2008)) [Tetra Tech, 2009b].

Table H-2 in Appendix H shows the validated analytical results for groundwater in consolidated tabular format. Summary tables of the validated analytical data, which include only those compounds which were positively detected in each operational area or feature are provided in Section 5.4.

5.3.6 Background Metals

A total of 135 soil samples were collected during drilling activities and were analyzed for California Title 22 Metals list by ICP/MS EPA Method 6020. Soil samples were submitted to Calscience Environmental Laboratories, Inc. for analysis of metals and moisture content.

These samples were collected and will be used for the background assessment as part of the soil risk assessment to evaluate naturally occurring metals. Table H-4 in Appendix H shows the validated analytical results for soil in consolidated tabular format. Metals data from previous investigations is included in Appendix H.

5.4 SUMMARY BY OPERATIONAL AREA

This section presents the results of the DSI and is organized by operational area and feature and briefly summarizes the previous investigation results along with presenting the results from the current investigation. Figures presenting both the geologic and contaminant data for each feature utilize both recent and historical results when appropriate. For the spatial distribution of soil gas and groundwater, only the most recent results were used given the mobile and dynamic nature of contaminants within these media. Figure 5-2 shows the locations of all the features and operational areas at the Site with the features investigated as part of this DSI in bold with yellow shading.

5.4.1 Historical Operational Area B

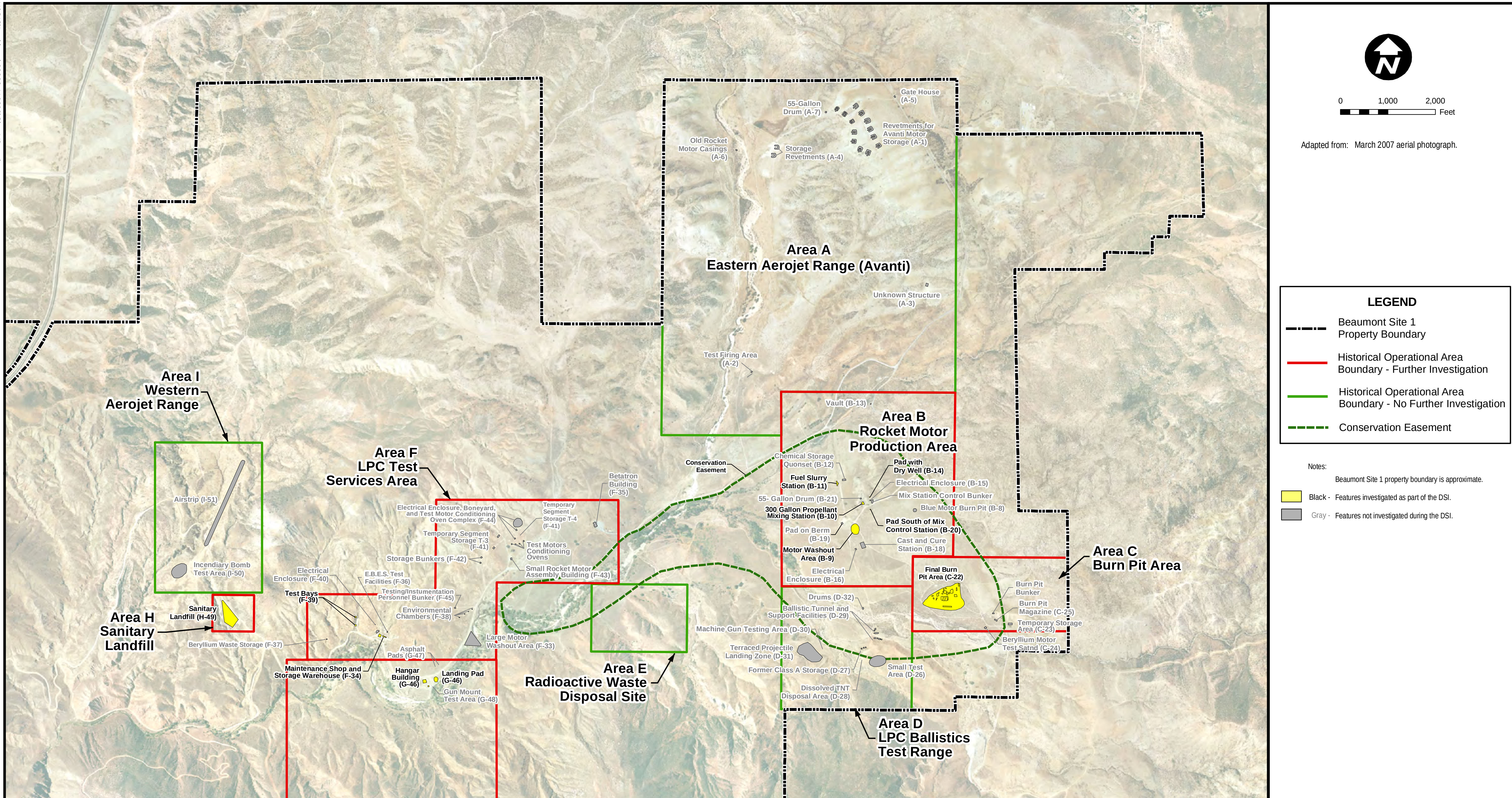
Historical Operational Area B, the RMPA (formerly known as the Propellant Mixing Area), was used for the processing and mixing of rocket motor solid propellants. The rocket motor production process consisted of: 1) fuel slurry station, 2) mixing station, and 3) cast and curing station. The fuel slurry station and mix station were utilized to generate the solid propellants.

5.4.1.1 Feature B-9 - Motor Washout Area

The Motor Washout Area (Feature B-9) is located in the southern portion of Historical Operational Area B, approximately 2,200 feet northwest and downgradient of the Burn Pit Area (Feature C-22) both topographically and with respect to groundwater. The Burn Pit Area is the primary source area for VOC, 1,4-dioxane, and perchlorate groundwater contamination at Beaumont Site 1. Defective solid rocket propellant was washed out of the motor casings with a high-pressure water jet in the Motor Washout Area. The water slurry produced from the washout activities was collected in a lined catch basin and the residual perchlorate solid brought to the Burn Pit Area for incineration (Tetra Tech, 2002).

Previous Results

Fourteen soil borings and two soil gas probes were installed between 15 and 40 feet bgs at the Motor Washout Area (Feature B-9) during previous investigations (Tetra Tech; 2002, 2005a, 2009a). Soil samples were analyzed for VOCs, SVOCs, perchlorate, Title 22 metals, 1,4-dioxane, and TPH. SVOCs, TPH, and 1,4-dioxane were not detected above RLs in any of the samples collected. TCE was detected in four samples at concentrations up to 3 µg/kg and acetone, methylene chloride, and chloroform were detected at concentrations ranging from 1.2 to 64 µg/kg. Perchlorate was detected at concentrations ranging from 26.7 to 5,480 µg/kg. TCE and 1,1-DCE were detected in soil gas at concentrations up to 1,200 µg/m^3 and 900 µg/m^3, respectively. Tables of all the soil and soil gas analytical results from the Motor Washout Area from previous investigations are included in Tables H-7 and H-15 in Appendix H.



Beaumont Site 1

Figure 5-2
Historical Operational Areas, Site Features, and Conservation Easement

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The information collected to date indicates that the area of perchlorate-affected soil appears to be undefined towards the east, west, and north but is defined to the south by samples collected from the Cast and Cure Station (Feature B-18). Additional soil borings were proposed to delineate the perchlorate impacts in the shallow soils to the east, west, and north and the “hot spots” in the deeper soils to the east and northwest (Tetra Tech, 2008b).

In the Motor Washout Area, the alluvium is an average of 90-feet thick beneath this feature with the top of the Mount Eden formation present at a depth of approximately 80 to 100 feet bgs with a south-dipping slope on the north end near the Mount Eden hills outcropping and flattening out in the central and southern portions. Groundwater has fluctuated in the area from less than 3 feet bgs to greater than 51 feet bgs since 1992. Depth to groundwater in the Motor Washout Area in August 2008 prior to commencement of the field activities was approximately 35 feet bgs.

Investigation Activities

Thirteen primary borings and 17 secondary borings were drilled to approximately 20 feet bgs at the Motor Washout Area during this investigation to define the extent of perchlorate in soil using the HSA and DP drilling method (Figure 5-3). Figure 5-3 shows the locations of all borings installed at this feature from the current DSI back to 2002. Five soil samples were collected from each boring at 0.5 feet bgs and every 5 feet thereafter to the total depth of each boring (20 feet bgs). Soil samples were analyzed for perchlorate only.

Geology and Hydrogeology

Soils encountered at the Motor Washout Area were typical of a low energy fluvial depositional environment. Fine- to medium-grained sands, silt and occasional clay lenses were encountered. Silty sand seems to dominate the area but the siliciclastic sediment oscillates between silty sand and sandy silt. The cross section locations and idealized cross sections through this area are presented in Figures 5-3 and 5-4, respectively. As shown in cross sections A-A’, B-B’, and C-C’ in Figure 5-4, the fine-grained silt units are more prevalent in the shallow alluvium east and west of the former Motor Washout Area. Groundwater was not encountered in any of the soil borings installed at the Motor Washout Area during this investigation. The topography in the Motor Washout Area is relatively flat and dipping slightly to the northwest at a gradient of 0.02 feet per foot (ft/ft) with the Mount Eden formation outcropping to the north and northwest near the Pad on Berm (Feature B-19).

Soil Sampling Results and Contaminant Distribution

Perchlorate was detected above the MDL in 134 of the 150 samples collected during this investigation ranging from 5.23 to 2,370 µg/kg with an average concentration of 190 µg/kg (Table 5-3). Figure 5-5

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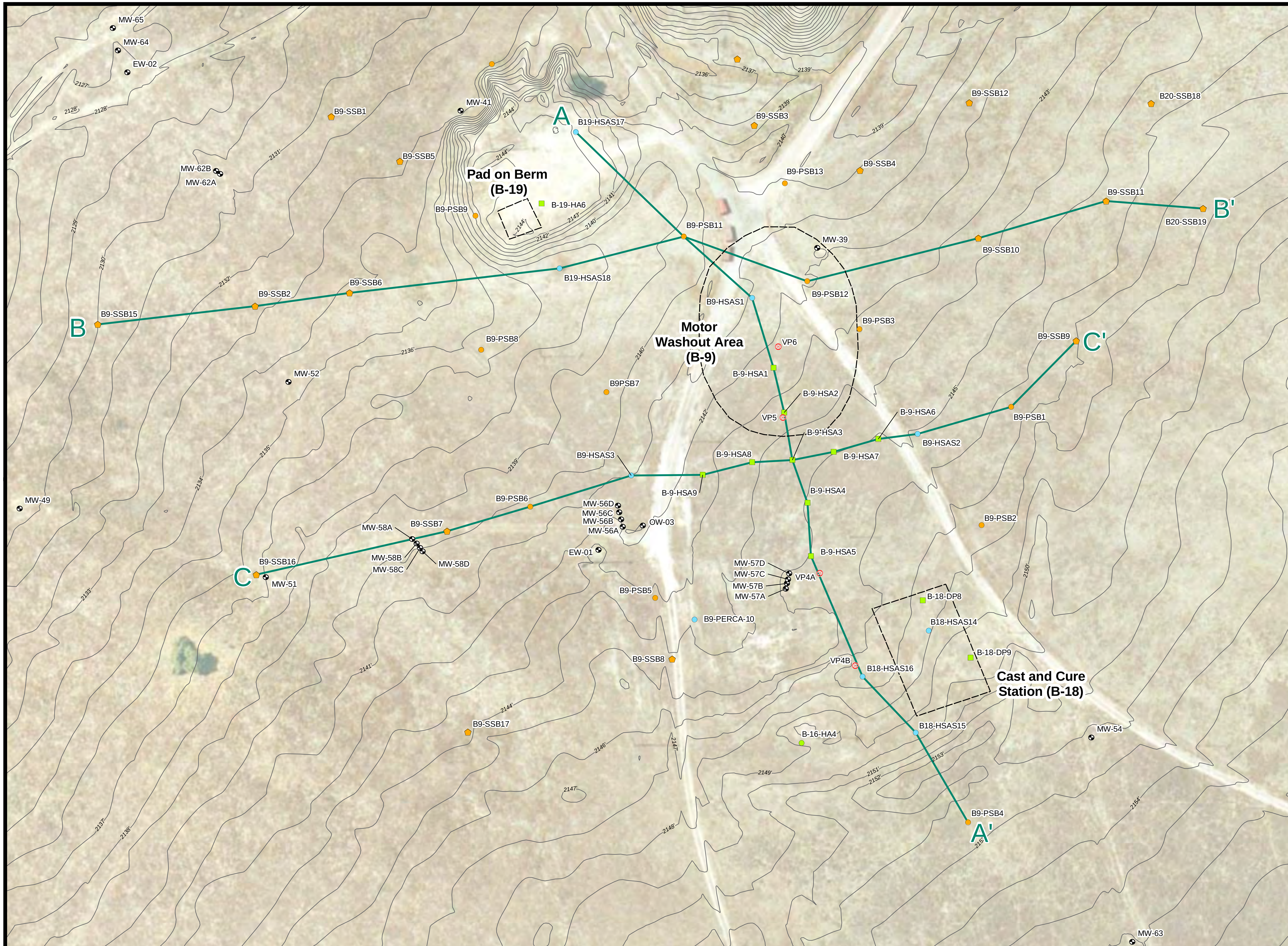

0 50 100 Feet

1 inch = 100 feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Soil Vapor, 2002
- Well Location
- Geologic Cross Section Location Lines
- 2130 Ground Surface Elevation Contour
- Historic Feature Location
- B Geologic Cross Section Line Beginning and End Points

DP Direct Push-Part of the nomenclature for borings installed using a direct push rig during the soil investigation in 2004.

HA Hand Auger-Part of the nomenclature for borings installed using a hand auger during the soil investigation in 2004.

HSA Hollow Stem Auger-Part of the nomenclature for borings installed using a hollow stem auger rig during the soil investigation in 2004.

HSAS Hollow Stem Auger Supplemental-Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB Primary Soil Boring-Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring-Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

VP Vapor Probe-Boring where soil gas probes were installed during supplemental site characterization, 2002.

Note: Ground surface elevation is relative to mean sea level (msl)

- Ground surface elevation derived from survey conducted by Hillwig and Goodrow

Beaumont Site 1

Figure 5-3

Soil Borings and Cross Section Locations Motor Washout Area (Feature B-9)

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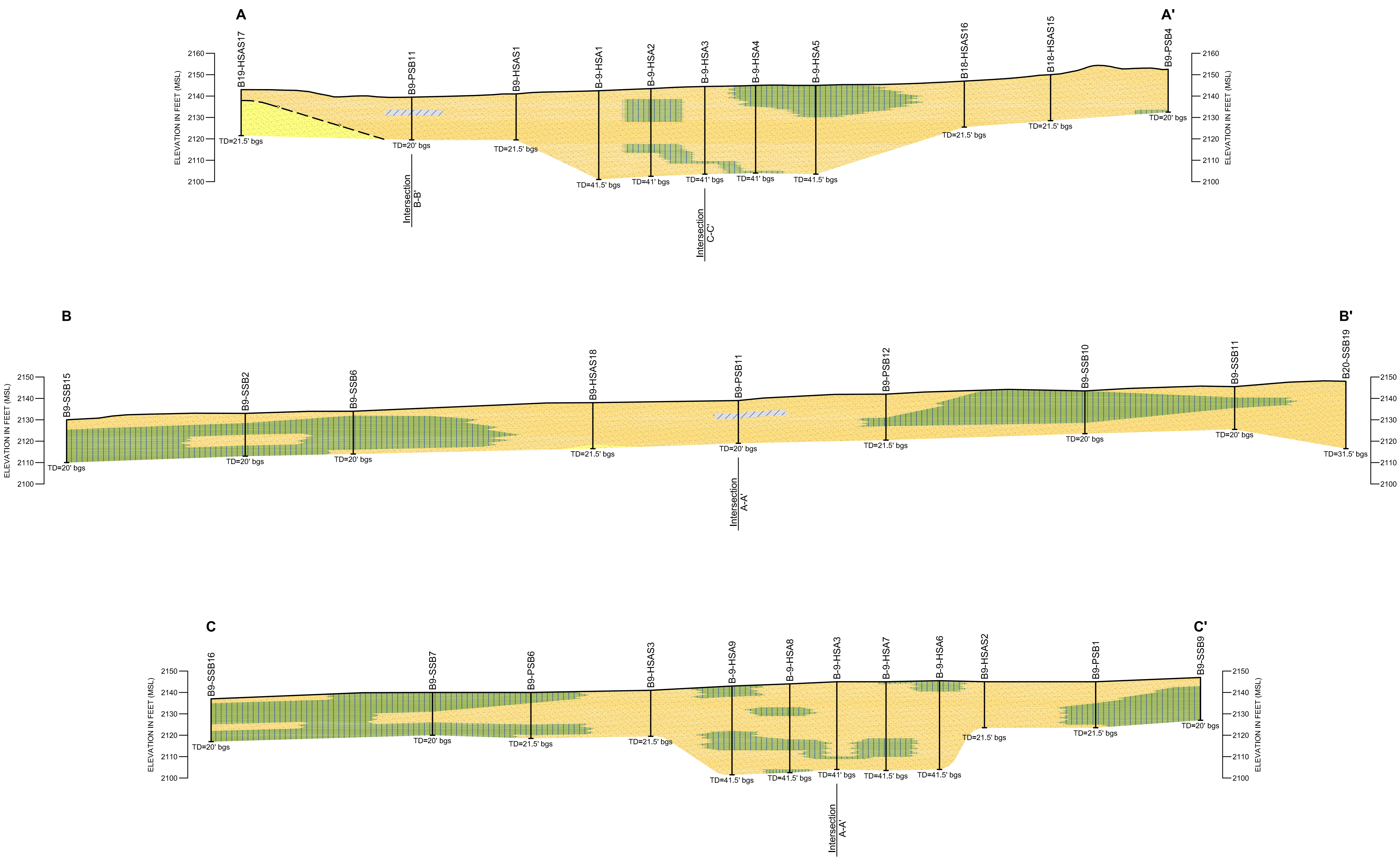

LEGEND

Quaternary Alluvium

- Clay (CL)
- Silt (ML)
- Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

- Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs below ground surface

HSA Hollow Stem Auger - Part of the nomenclature for borings installed with a hollow stem auger rig during the soil investigation in 2004.

HSAS Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MSL Mean sea level

TD=#' Total Boring Depth (feet)

Boring

—?— Inferred contact

Intersection A-A' location where cross sections intersect

0 100 50

Scale in Feet
Vertical Exaggeration = 2x Horizontal

Beaumont Site 1

Figure 5-4
Idealized Geologic Cross Sections A-A', B-B', and C-C'
Motor Washout Area (Feature B-9)

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Table 5-3 Soil Sampling Results for Perchlorate - Motor Washout Area (Feature B-9)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate (µg/kg)
B9-PSB1	B9-PSB1-0.5	0.5	9/23/2008	<5.20
	B9-PSB1-5	5	9/23/2008	**5.94**
	B9-PSB1-10	10	9/23/2008	**112**
	B9-PSB1-15	15	9/23/2008	**165**
	B9-PSB1-20	20	9/23/2008	**75.9**
B9-PSB2	B9-PSB2-0.5	0.5	9/23/2008	<5.15
	B9-PSB2-5	5	9/23/2008	**10.8**
	B9-PSB2-10	10	9/23/2008	<5.18
	B9-PSB2-15	15	9/23/2008	<5.37
	B9-PSB2-20	20	9/23/2008	<5.32
B9-PSB3	B9-PSB3-0.5	0.5	9/23/2008	**7.17**
	B9-PSB3-5	5	9/23/2008	**48.9**
	B9-PSB3-10	10	9/23/2008	**62.3**
	B9-PSB3-15	15	9/23/2008	**110**
	B9-PSB3-20	20	9/23/2008	**83.3**
B9-PSB4	B9-PSB4-0.5	0.5	9/24/2008	<5.09
	B9-PSB4-5	5	9/24/2008	<5.09
	B9-PSB4-10	10	9/24/2008	<5.12
	B9-PSB4-15	15	9/24/2008	<5.11
	B9-PSB4-20	20	9/24/2008	<5.71
B9-PSB5	B9-PSB5-0.5	0.5	9/23/2008	**112**
	B9-PSB5-5	5	9/23/2008	**84.3**
	B9-PSB5-10	10	9/23/2008	**368**
	B9-PSB5-15	15	9/23/2008	**203**
	B9-PSB5-20	20	9/23/2008	**93.6**
B9-PSB6	B9-PSB6-0.5	0.5	9/23/2008	**22.3**
	B9-PSB6-5	5	9/23/2008	**39.5**
	B9-PSB6-10	10	9/23/2008	**958**
	B9-PSB6-15	15	9/23/2008	**52.1**
	B9-PSB6-20	20	9/23/2008	**23.7**
B9-PSB7	B9-PSB7-0.5	0.5	9/23/2008	**60.3**
	B9-PSB7-5	5	9/23/2008	**125**
	B9-PSB7-10	10	9/23/2008	**155**
	B9-PSB7-15	15	9/23/2008	**154**
	B9-PSB7-20	20	9/23/2008	**51.4**
B9-PSB8	B9-PSB8-0.5	0.5	9/23/2008	**68.5**
	B9-PSB8-5	5	9/23/2008	**58.3**
	B9-PSB8-10	10	9/23/2008	**375**
	B9-PSB8-15	15	9/23/2008	**25.8**
	B9-PSB8-20	20	9/23/2008	**129**
B9-PSB9	B9-PSB9-0.5	0.5	9/23/2008	**1,080**
	B9-PSB9-5	5	9/23/2008	**45.4**
	B9-PSB9-10	10	9/23/2008	**260**
	B9-PSB9-15	15	9/23/2008	**111**
	B9-PSB9-20	20	9/23/2008	**131**
B9-PSB10	B9-PSB10-0.5	0.5	9/24/2008	**17.3**
	B9-PSB10-5	5	9/24/2008	**9.11**
	B9-PSB10-10	10	9/24/2008	**428**
	B9-PSB10-15	15	9/24/2008	**358**
	B9-PSB10-20	20	9/24/2008	**218**

Table 5-3 (Cont'd) Soil Sampling Results for Perchlorate - Motor Washout Area (Feature B-9)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate (µg/kg)
B9-PSB11	B9-PSB11-0.5	0.5	9/23/2008	**297**
	B9-PSB11-5	5	9/23/2008	**172**
	B9-PSB11-10	10	9/23/2008	**169**
	B9-PSB11-15	15	9/23/2008	**186**
	B9-PSB11-20	20	9/23/2008	**557**
B9-PSB12	B9-PSB12-0.5	0.5	9/22/2008	<5.28
	B9-PSB12-5	5	9/22/2008	<5.23
	B9-PSB12-10	10	9/22/2008	**2,730**
	B9-PSB12-15	15	9/22/2008	**143**
	B9-PSB12-20	20	9/22/2008	**89.3**
B9-PSB13	B9-PSB13-0.5	0.5	9/22/2008	**13.5**
	B9-PSB13-5	5	9/22/2008	**714**
	B9-PSB13-10	10	9/22/2008	**662**
	B9-PSB13-15	15	9/22/2008	**115**
	B9-PSB13-20	20	9/22/2008	**47.5**
B9-SSB1	B9-SSB1-0.5	0.5	10/2/2008	**24.7**
	B9-SSB1-5	5	10/2/2008	**73.4**
	B9-SSB1-10	10	10/2/2008	**114**
	B9-SSB1-15	15	10/2/2008	**212**
	B9-SSB1-20	20	10/2/2008	**59.6**
B9-SSB2	B9-SSB2-0.5	0.5	10/2/2008	**114**
	B9-SSB2-5	5	10/2/2008	**42.7**
	B9-SSB2-10	10	10/2/2008	**326**
	B9-SSB2-15	15	10/2/2008	**318**
	B9-SSB2-20	20	10/2/2008	**168**
B9-SSB3	B9-SSB3-0.5	0.5	10/2/2008	**15.3**
	B9-SSB3-5	5	10/2/2008	**104**
	B9-SSB3-10	10	10/2/2008	**329**
	B9-SSB3-15	15	10/2/2008	**119**
	B9-SSB3-20	20	10/2/2008	**35.4**
B9-SSB4	B9-SSB4-0.5	0.5	10/2/2008	**6.65**
	B9-SSB4-5	5	10/2/2008	**88.2**
	B9-SSB4-10	10	10/2/2008	**491**
	B9-SSB4-15	15	10/2/2008	**80.4**
	B9-SSB4-20	20	10/2/2008	**215**
B9-SSB5	B9-SSB5-0.5	0.5	10/3/2008	**5.68**
	B9-SSB5-5	5	10/3/2008	**15.3**
	B9-SSB5-10	10	10/3/2008	**75.7**
	B9-SSB5-15	15	10/3/2008	**160**
	B9-SSB5-20	20	10/3/2008	**153**
B9-SSB6	B9-SSB6-0.5	0.5	10/3/2008	**50.3**
	B9-SSB6-5	5	10/3/2008	**245**
	B9-SSB6-10	10	10/3/2008	**449**
	B9-SSB6-15	15	10/3/2008	**169**
	B9-SSB6-20	20	10/3/2008	**62**
B9-SSB7	B9-SSB7-0.5	0.5	10/3/2008	**54.9**
	B9-SSB7-5	5	10/3/2008	**99.9**
	B9-SSB7-10	10	10/3/2008	**595**
	B9-SSB7-15	15	10/3/2008	**96.2**
	B9-SSB7-20	20	10/3/2008	**118**

Table 5-3 (Cont'd) Soil Sampling Results for Perchlorate - Motor Washout Area (Feature B-9)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate (µg/kg)
B9-SSB8	B9-SSB8-0.5	0.5	10/3/2008	**20.8**
	B9-SSB8-5	5	10/3/2008	**7.35**
	B9-SSB8-10	10	10/3/2008	**116**
	B9-SSB8-15	15	10/3/2008	**75.3**
	B9-SSB8-20	20	10/3/2008	**83.9**
B9-SSB9	B9-SSB9-0.5	0.5	10/3/2008	**13.3**
	B9-SSB9-5	5	10/3/2008	**73.6**
	B9-SSB9-10	10	10/3/2008	**103**
	B9-SSB9-15	15	10/3/2008	**33.1**
	B9-SSB9-20	20	10/3/2008	**117**
B9-SSB10	B9-SSB10-0.5	0.5	10/3/2008	**5.23**
	B9-SSB10-5	5	10/3/2008	**57.1**
	B9-SSB10-10	10	10/3/2008	**1,020**
	B9-SSB10-15	15	10/3/2008	**48.6**
	B9-SSB10-20	20	10/3/2008	**89**
B9-SSB11	B9-SSB11-0.5	0.5	10/21/2008	**1,310**
	B9-SSB11-5	5	10/21/2008	**1,550**
	B9-SSB11-10	10	10/21/2008	**882**
	B9-SSB11-15	15	10/21/2008	**104**
	B9-SSB11-20	20	10/21/2008	**88**
B9-SSB12	B9-SSB12-0.5	0.5	10/21/2008	**47**
	B9-SSB12-5	5	10/21/2008	**231**
	B9-SSB12-10	10	10/22/2008	**35.9**
	B9-SSB12-15	15	10/22/2008	**88.4**
	B9-SSB12-20	20	10/22/2008	**121**
B9-SSB13	B9-SSB13-0.5	0.5	10/21/2008	**8.54**
	B9-SSB13-5	5	10/21/2008	**58.6**
	B9-SSB13-10	10	10/21/2008	**53.9**
	B9-SSB13-15	15	10/21/2008	**86.6**
	B9-SSB13-20	20	10/21/2008	**6.39**
B9-SSB14	B9-SSB14-0.5	0.5	10/22/2008	<5.35
	B9-SSB14-5	5	10/22/2008	<6.08
	B9-SSB14-10	10	10/22/2008	<6.13
	B9-SSB14-15	15	10/22/2008	**69.5**
	B9-SSB14-20	20	10/22/2008	**26**
B9-SSB15	B9-SSB15-0.5	0.5	10/22/2008	**56.1**
	B9-SSB15-5	5	10/22/2008	**56.1**
	B9-SSB15-10	10	10/22/2008	**83.7**
	B9-SSB15-15	15	10/22/2008	**320**
	B9-SSB15-20	20	10/22/2008	**216**
B9-SSB16	B9-SSB16-0.5	0.5	10/22/2008	**44.2**
	B9-SSB16-5	5	10/22/2008	**24.3**
	B9-SSB16-10	10	10/22/2008	**36.6**
	B9-SSB16-15	15	10/22/2008	**37.1**
	B9-SSB16-20	20	10/22/2008	**21.4**
B9-SSB17	B9-SSB17-0.5	0.5	10/22/2008	**24.2**
	B9-SSB17-5	5	10/22/2008	<5.47
	B9-SSB17-10	10	10/22/2008	**131**
	B9-SSB17-15	15	10/22/2008	**21.4**
	B9-SSB17-20	20	10/22/2008	**16.2**

Notes:
"Bold" - Indicates concentrations detected above the method detection limit.
bgs - Below ground surface.
ug/kg - Micrograms per kilogram.
PSB - Primary soil boring.
SSB - Secondary soil boring.

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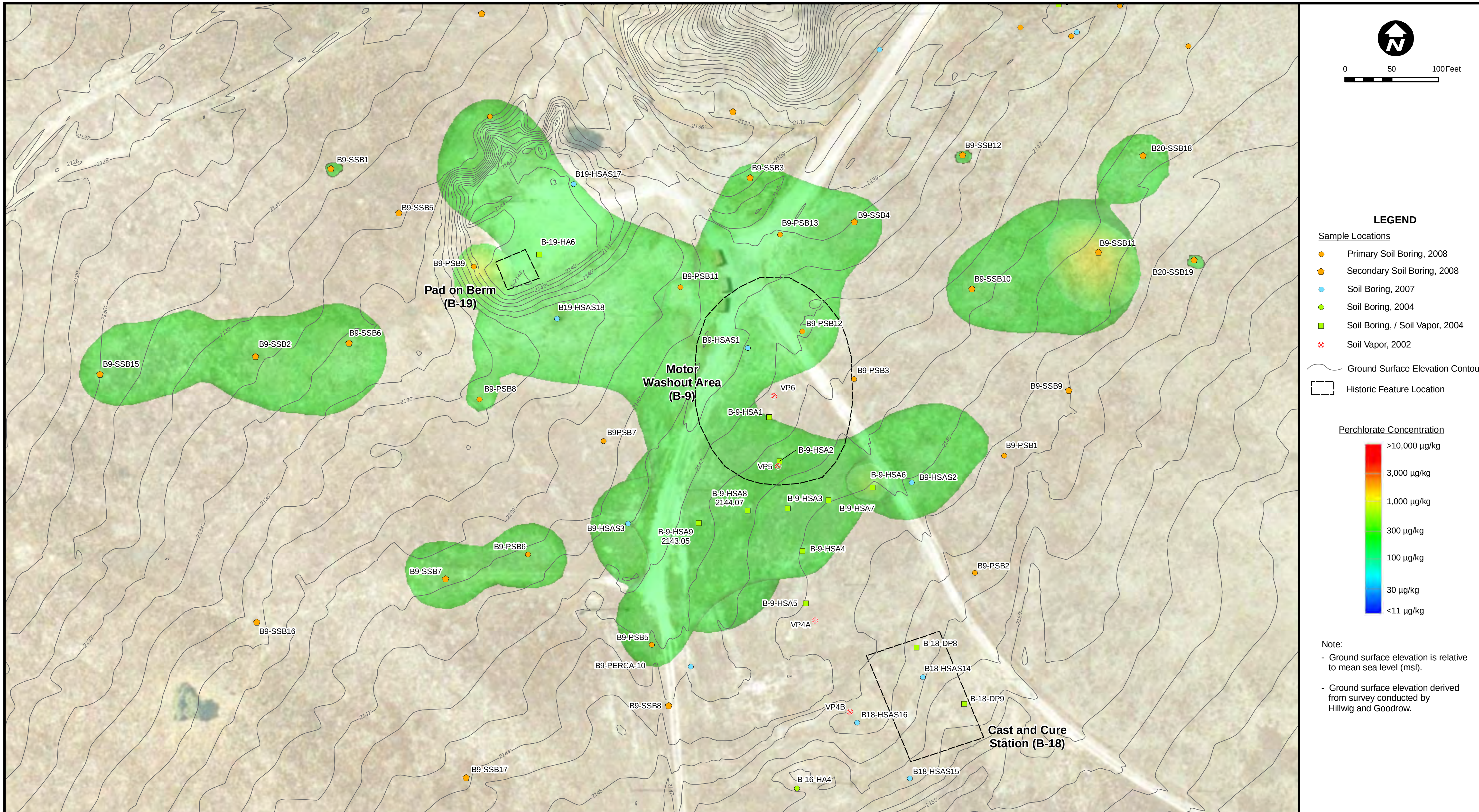

Beaumont Site 1

Figure 5-5
Lateral Extent of Perchlorate in Soil Above 200 µg/kg from 0-40 ft bgs Motor Washout Area (Feature B-9)

TETRA TECH

shows the lateral distribution of perchlorate in soil greater than 200 µg/kg based on the three-dimensional (3-D) modeling of all the available soil sampling results since 2002. As shown in this figure the extent of perchlorate impacts in soil extends out from the former operational area to the east, west and north possibly as a result of the large amounts of water used during the washout activities. The total area of impacted soil above 200 µg/kg is approximately 230,000 square feet (ft^2) or 5.3 acres.

Figure 5-6 shows the perchlorate concentration contours at depths of 0.5, 5, 10, 15, 20, and 30 feet bgs. Results from the Cast and Cure Station (Feature B-18), the Pad on Berm (Feature B-19), and the Pad South of Mix Station (Feature B-20) are shown on the same figure due to their close proximity. The lateral distribution of perchlorate appears to be the most extensive between 10 and 15 feet bgs. Three of the highest detections of perchlorate (5,480, 2,730, and 1,550 µg/kg) were detected at 10 feet bgs. As shown in Figure 5-6, the highest concentrations in the near surface (0.5-foot bgs) samples were detected outside of the Motor Washout Area to the northeast (B9-SSB11) and northwest (B9-PSB9) and could be a result of surface runoff during operations or large storm events. The lateral distribution then begins to increase at 5 feet bgs and is the most wide spread between 10 and 15 feet bgs then decreases between 20 and 30 feet bgs. As mentioned above, the depth to groundwater in August 2008 was 35 feet bgs and has been as shallow as 2 feet bgs in April 1995. The rise and fall of the groundwater at this feature may have played a role in the distribution or re-distribution of the perchlorate impacts in soil.

Figures 5-7 through 5-9 present the 3-D visualizations of the perchlorate-affected soil above 200 µg/kg at the Motor Washout Area with views from the north, east, and west. The figures also show the general boring and sample locations with the relative magnitude of the perchlorate concentrations detected. For boring names and exact concentrations detected, see Figure 5-6.

Based on the 3-D modeling of the perchlorate, the majority of the perchlorate mass is found at depths less than 20 feet bgs except for one area near the south end of the Motor Washout Area where samples from 2004 (B-9-HSA8 and 9) were collected near the capillary fringe and therefore may have been affected by perchlorate-impacted groundwater originating from the BPA (Figure 5-10). Figures 5-10 and 5-11 show the vertical profiles for perchlorate in soil along cross section lines C-C' and B-B' covering the two widest areas of soil impacts while also including three of borings which had the highest perchlorate concentrations detected at this feature (B-9-HSAS2, B9-PSB12, and B9-SSB11). Based on the additional characterization data collected during this investigation, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg.

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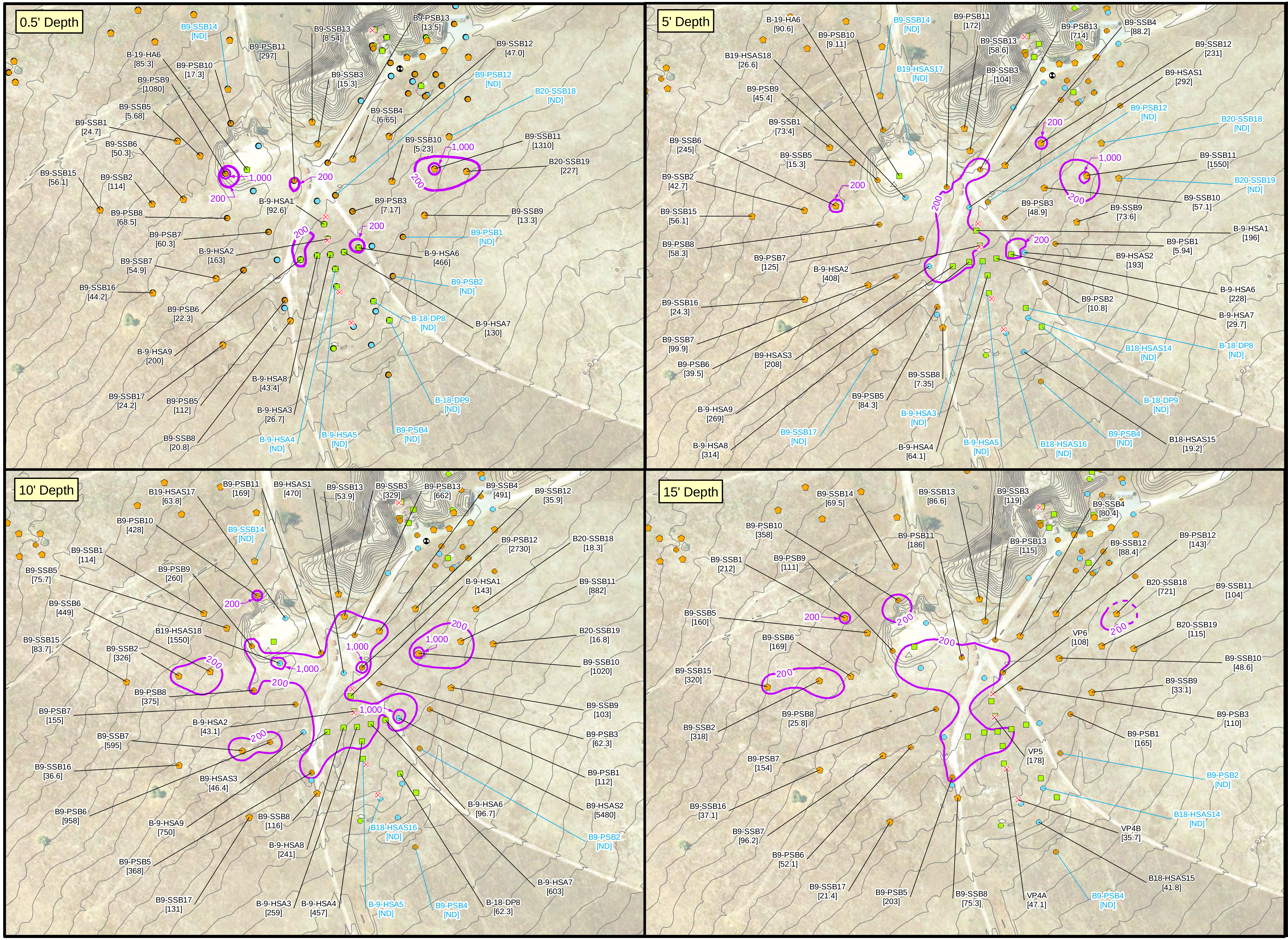


N

0 150 300 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

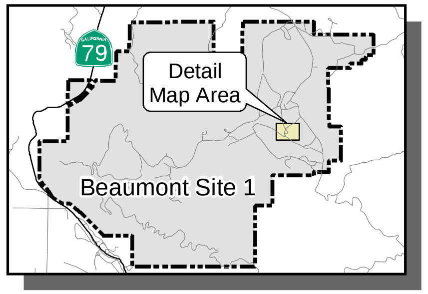
- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Soil Vapor, 2002
- Ground Surface Elevation Contour
- Perchlorate Isoconcentration Contour (dashed where inferred)

Note:

[#] Perchlorate results in µg/kg.

[ND] Non-Detect. (<5.09 - 11 µg/kg)

Boring symbols with no labels indicate sample was not tested at depth interval.



Beaumont Site 1

Figure 5-6

Perchlorate Concentrations in Soil Motor Washout Area (Feature B-9)

TETRA TECH

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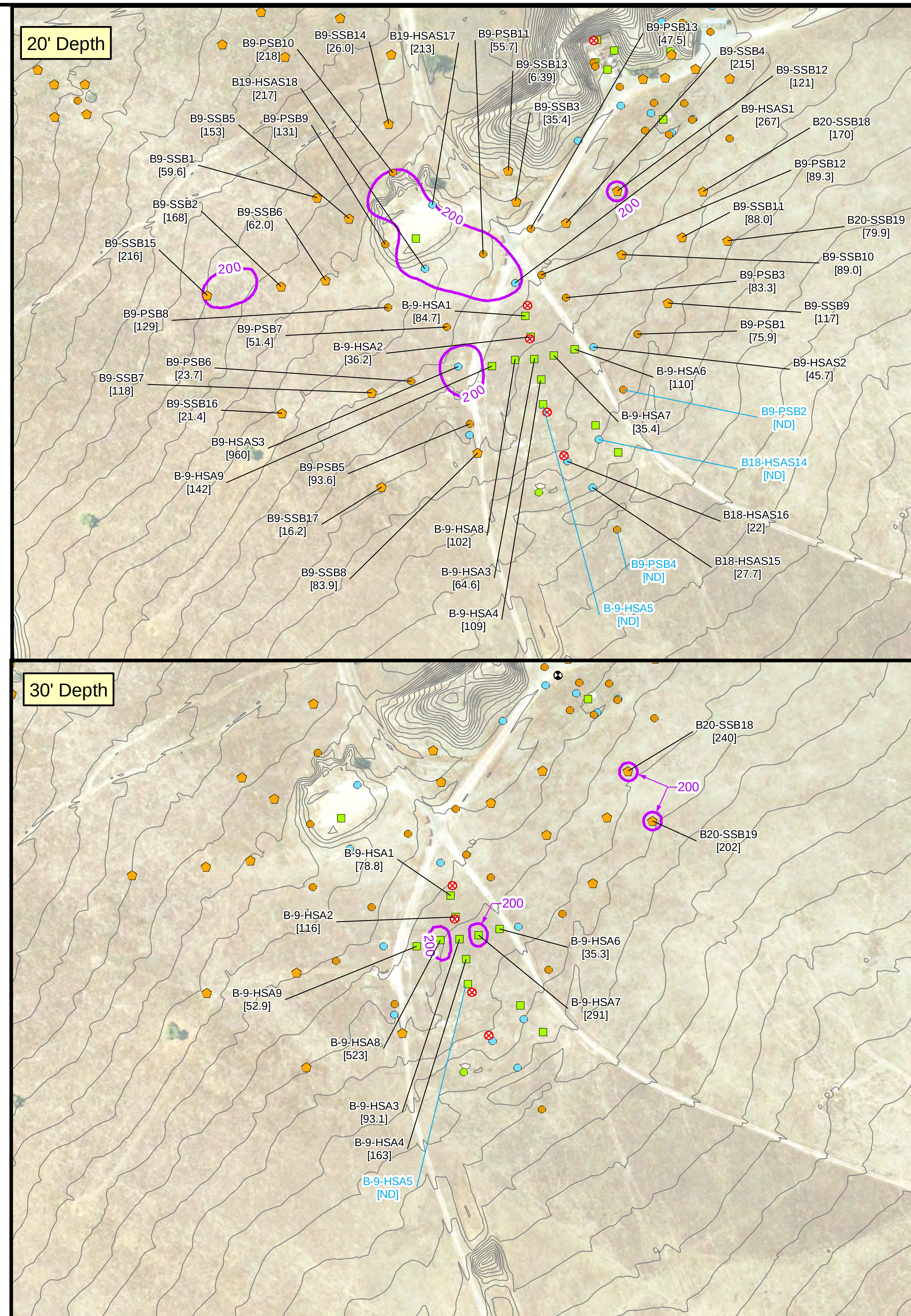


0 150 300
Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

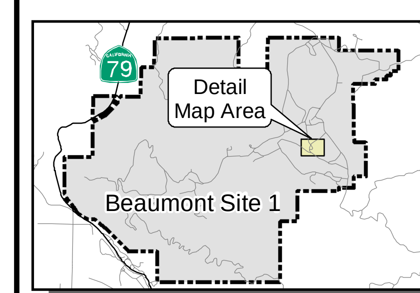
- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Soil Vapor, 2002
- Perchlorate Isoconcentration Contour (dashed where inferred)
- Ground Surface Elevation Contour

Note:

[#] Perchlorate results in µg/kg.

[ND] Non-Detect. (<5.09-11 µg/kg)

Boring symbols with no labels indicate sample was not tested at depth interval.

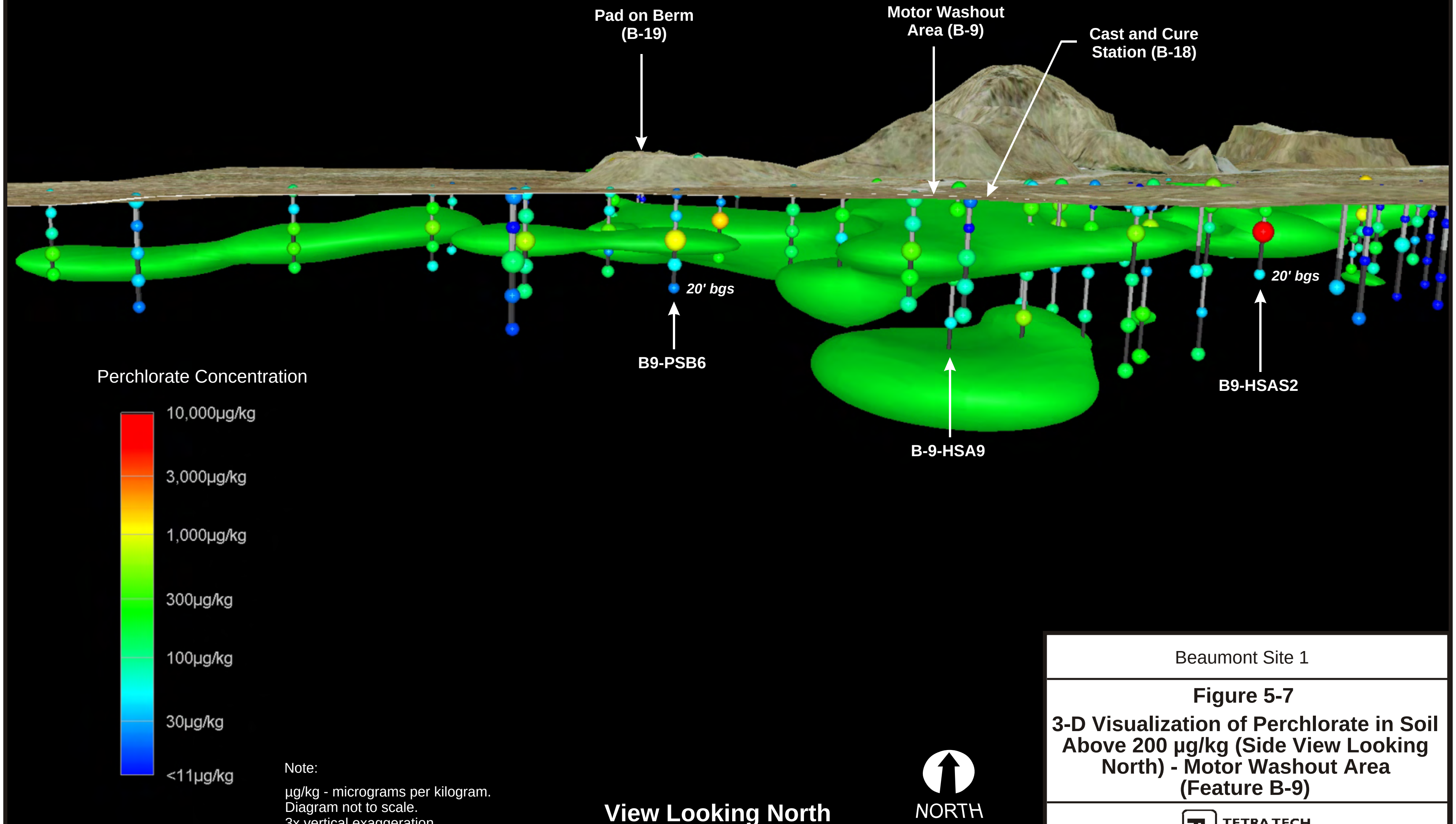


Beaumont Site 1

Figure 5-6 (con't)

Perchlorate Concentrations in Soil Motor Washout Area (Feature B-9)

TETRA TECH



Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
3x vertical exaggeration.

View Looking North

Beaumont Site 1

Figure 5-7

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking North) - Motor Washout Area (Feature B-9)

TETRA TECH

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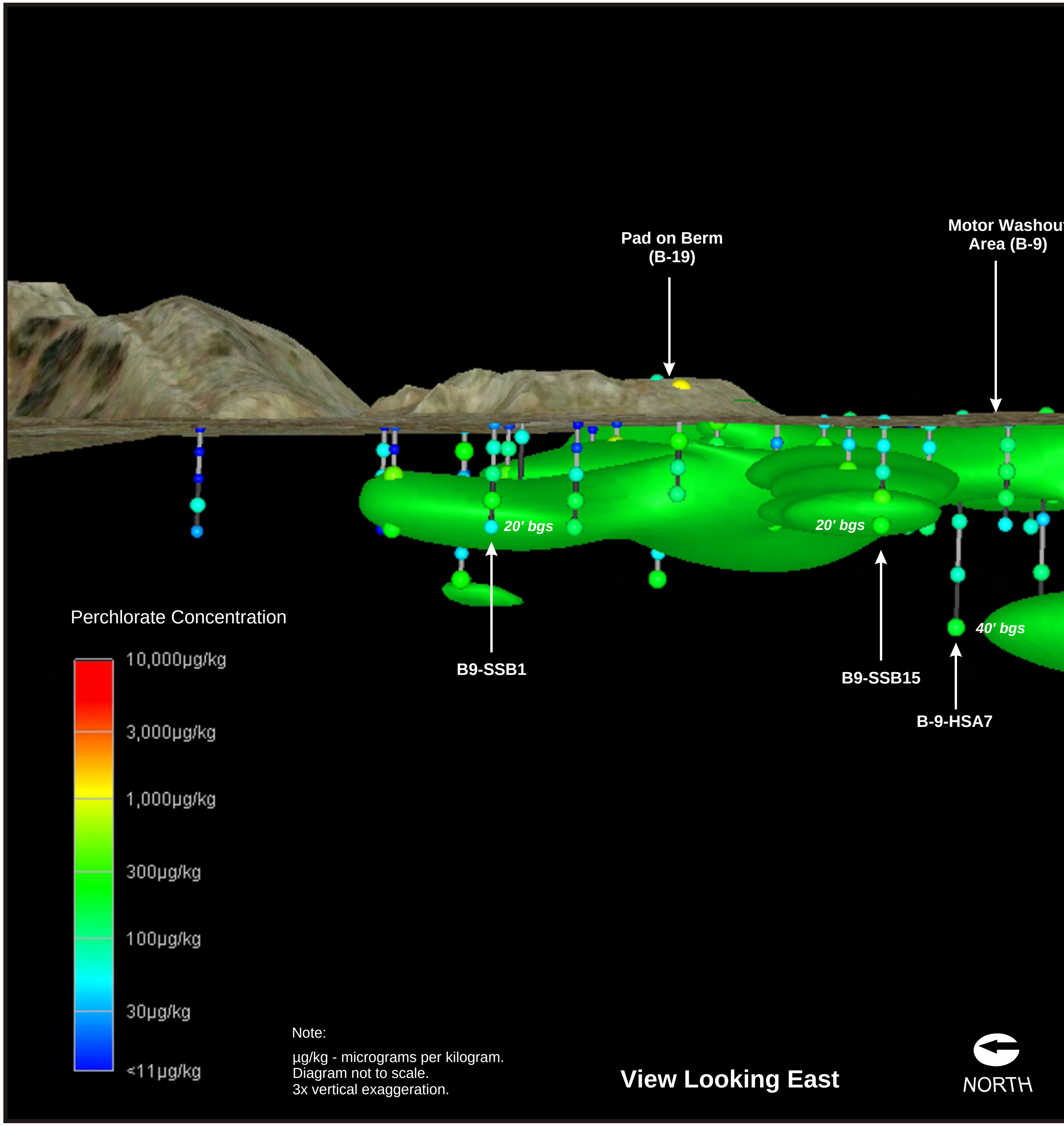

Beaumont Site 1

Figure 5-8

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking East) - Motor Washout Area (Feature B-9)

TETRA TECH

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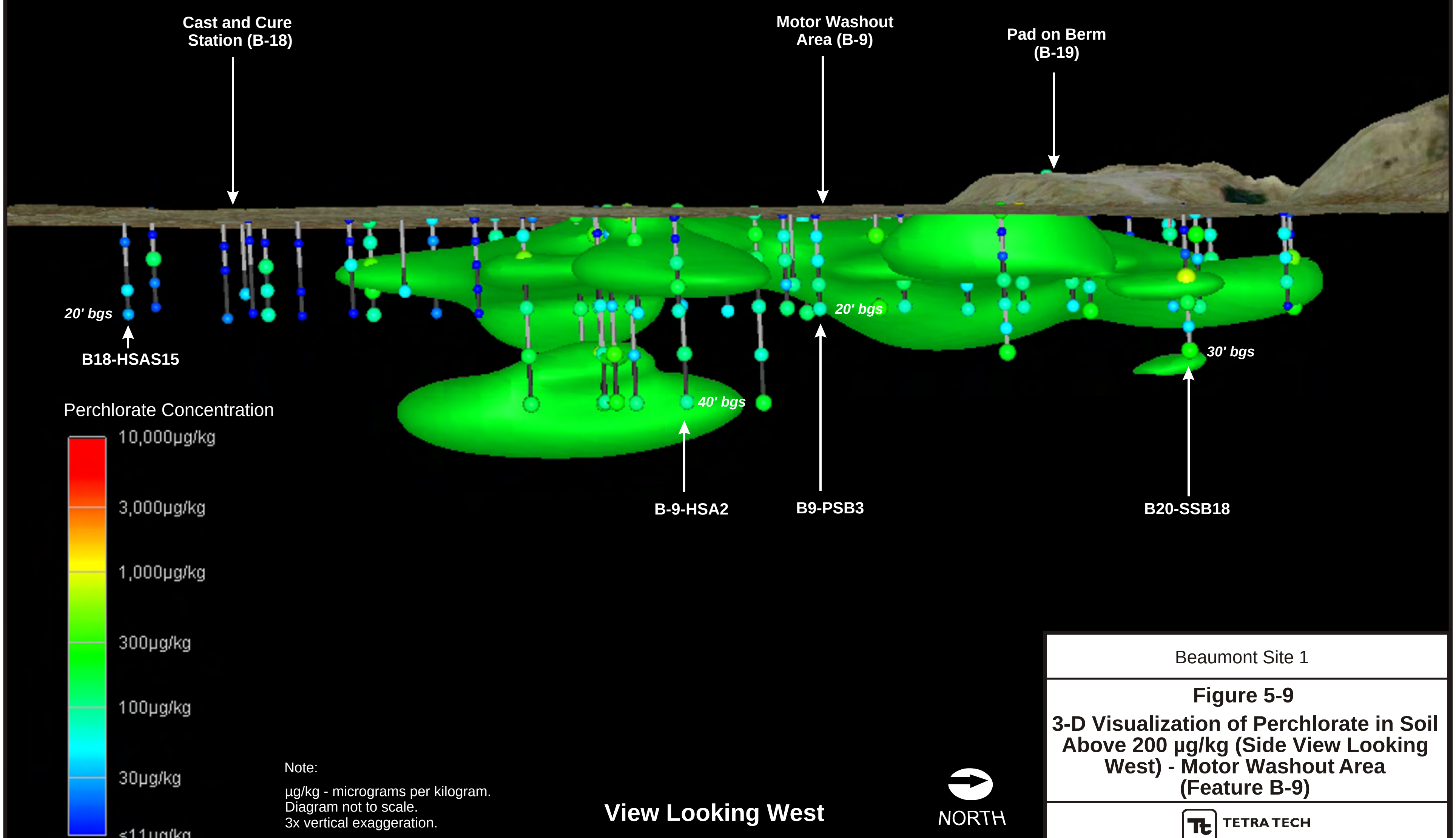


Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
3x vertical exaggeration.

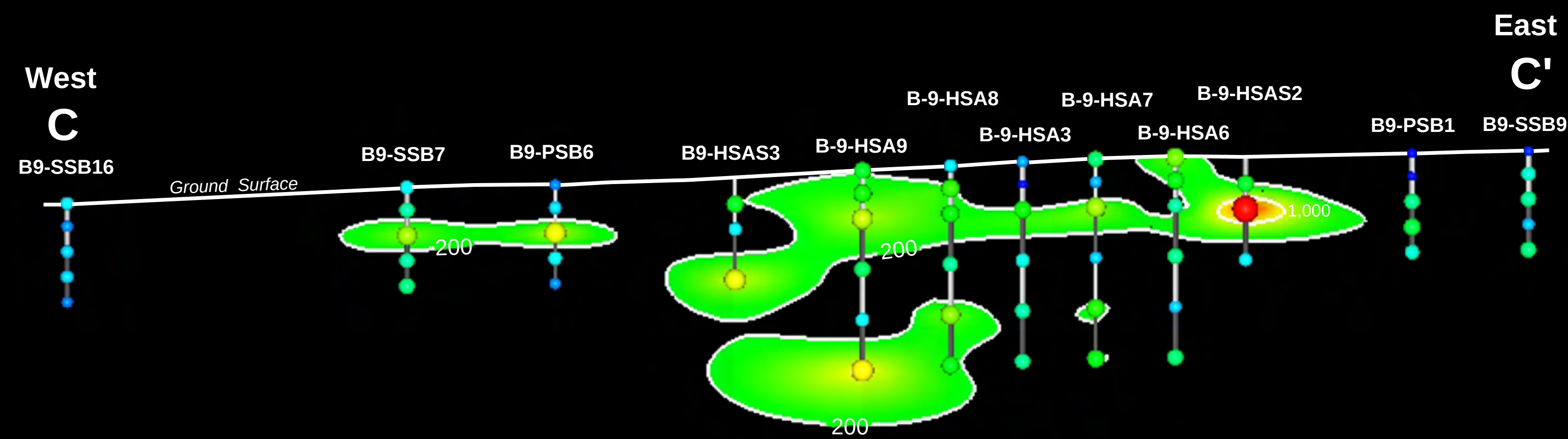
View Looking West

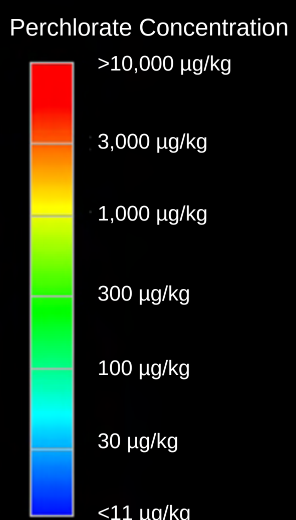
Beaumont Site 1

Figure 5-9

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking West) - Motor Washout Area (Feature B-9)

TETRA TECH





Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
3x vertical exaggeration.

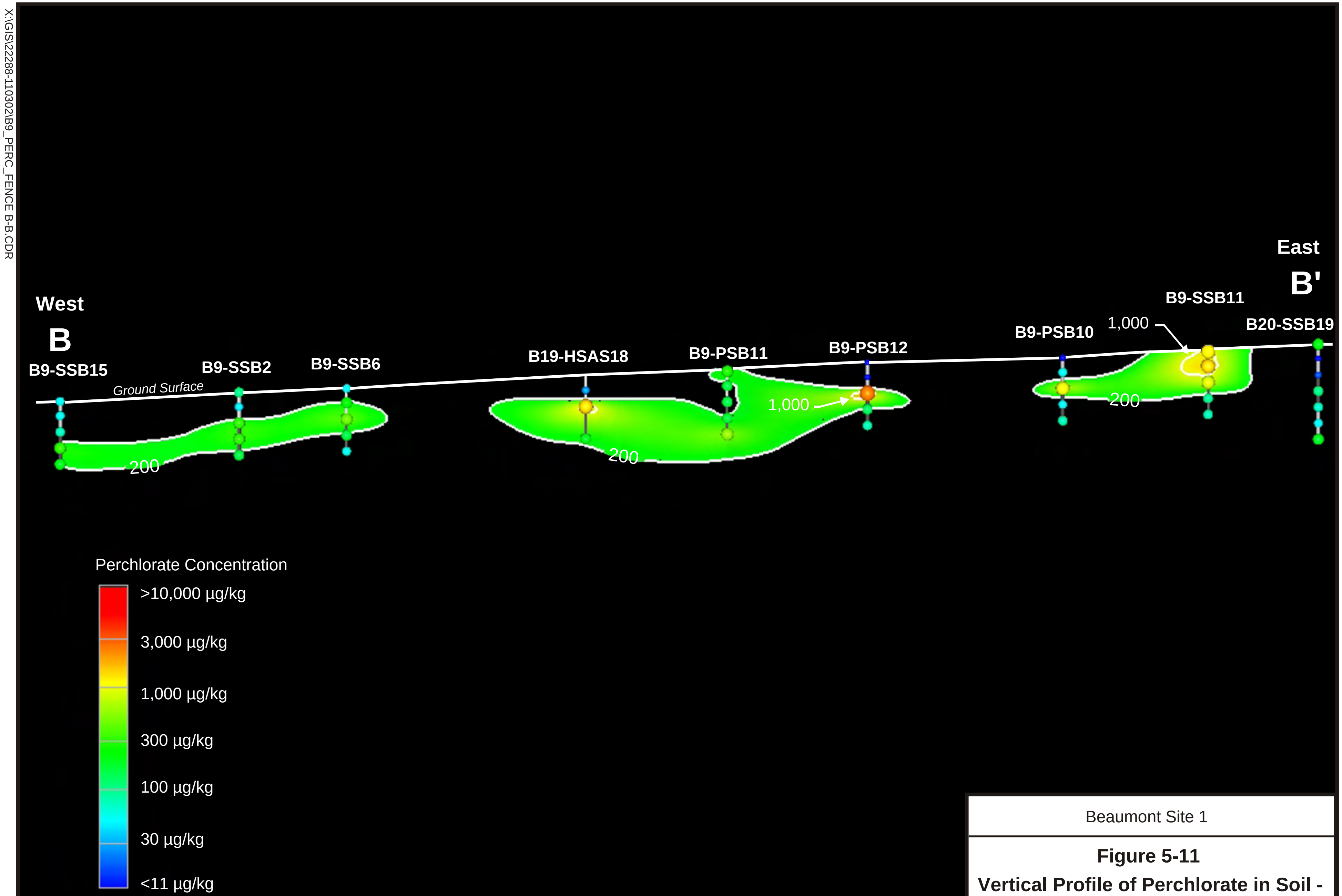
Beaumont Site 1

Figure 5-10

Vertical Profile of Perchlorate in Soil - Cross Section C-C' Motor Washout Area (Feature B-9)

TETRA TECH

X:\GIS\22288-110302\B9_PERC_FENCE C-C.CDR



Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
3x vertical exaggeration.

Beaumont Site 1

Figure 5-11

Vertical Profile of Perchlorate in Soil - Cross Section B-B' Motor Washout Area (Feature B-9)

TETRA TECH

5.4.1.2 Feature B-10 - Propellant Mixing Station

The Propellant Mixing Station (Building 315) is located in the central portion of Historical Operational Area B. This feature consisted of a 300-gallon mixer. At the mixing station, dry oxidizer, primarily ammonium perchlorate, was blended with the liquid ingredients consisting of butadiene derivatives and a burn rate modifier (primarily ferrocene). Solvents, ammonium perchlorate, ferrocene, and other fuels were reported to have been used at the Propellant Mixing Station. This feature has since been used as the location for the on-site water treatment system for the RMPA during the period from June 1994 to December 2002. The system was shut off in 2002 but the equipment for the system still remains within this canyon.

Due to the close proximity of the Pad with Dry Well (Feature B-14) and Pad South of Mix Station Bunker (Feature B-20) with the Propellant Mixing Station (Feature B-10) and the comingling of perchlorate impacts in soil and groundwater, some of the figures presenting the data and the associated discussion for these three features have been combined.

Previous Results

During previous investigations (Tetra Tech; 2002, 2005a, 2009a), 10 soil borings were installed down to 50 feet bgs. Soil samples were collected and analyzed for VOCs, SVOCs, perchlorate, Title 22 metals, 1,4-dioxane, and TPH. Two soil gas probes were installed between 5 and 20 feet bgs in 6 of the 10 borings installed. Tables of the soil and soil gas analytical results for the Pad South of Mix Station Bunker (Feature B-10) from the previous investigations is included in Tables H-7 and H-15 in Appendix H.

1,4-dioxane was not detected above RLs in any of the soil samples collected. VOCs were not detected above RLs in any of the soil gas samples collected. However, TPH, perchlorate, Title 22 metals, SVOCs, and VOCs (i.e., acetone and toluene) were detected in soil samples from this feature. Diesel range TPH concentrations ranged from 27 to 620 mg/kg and perchlorate concentrations ranged from 29 to 4,610 µg/kg. VOC concentrations detected in soil were 1.1 and 26 µg/kg (acetone and toluene, respectively) and were possibly associated with laboratory cross-contamination. Detected concentrations of SVOCs (polyaromatic hydrocarbons (PAHs), phthalates, and phenols) ranged from 660 to 4,500 µg/kg. SVOCs were detected in only one sample from one boring at 0.5-foot bgs and were not detected in deeper samples or in any adjacent borings. Given the sporadic and random nature of the SVOC detections, they were not identified as COPCs and do not correspond to the soil impacts associated with other compounds within the operational area. In addition, the concentrations detected did not exceed the California Human Health Screening Levels (CHHSL) or the PRGs (also referred to as Regional Screening Levels) used for this investigation (Tetra Tech, 2005a).

One of the soil borings drilled in 2007 located just outside of the box canyon south of the former operations was converted to monitoring well MW-69 (Tetra Tech, 2009a). The perchlorate concentrations in MW-69 have ranged from 2,260 to 2,690 µg/L, 1,4-dioxane has ranged from 6.8 to 11 µg/L, and TCE and 1,1-DCE have been detected at around 12 and 6 µg/L, respectively. Perchlorate concentrations in MW-69 are elevated in comparison to the perchlorate concentrations in nearby monitoring wells to the south (MW-39 and MW-56C) which monitor the groundwater plume (perchlorate, 1,4-dioxane, TCE, and 1,1-DCE) originating at the BPA. However, the levels of 1,4-dioxane, TCE, and 1,1-DCE detected in MW-69, MW-39, and MW-56C are of the same order of magnitude and consistent with the BPA groundwater plume.

Based on the contaminant distribution from previous investigations, the greatest extent of perchlorate in soil is at 10 and 30 feet bgs which coincides with the highest detected concentrations. Additional soil borings, groundwater samples, and groundwater monitoring wells were proposed to delineate perchlorate impacts in soil and groundwater.

The Propellant Mixing Station is located in a very small box canyon approximately 60 feet wide and 120 feet long surrounded by steep hills of the Mount Eden formation from the southwest to the northeast and opens only to the southeast. The alluvium below this feature ranges from a thickness of less than 5 feet to over 20 feet consisting of generally very fine-grained silts and sands with clay interspersed. Depth to groundwater in MW-69 in August 2008 prior to commencement of the field activities was approximately 36 feet bgs.

Investigation Activities

Three primary borings were drilled to 41.5, 46.5 and 152 feet bgs, two utilizing the HSA drilling method and one by the sonic drilling method (Figure 5-12). Soil samples were collected at 0.5-foot and every 5 feet thereafter in two of the borings (B10-PSB1/MW-98A,B and B10-PSB2). No soil samples were collected in the third boring (B10-PSB3/MW-89) since it was installed outside the operational area of the Propellant Mixing Station as a groundwater monitoring well only (Figure 5-12). Soil samples were collected at the surface (0.5 foot bgs) and every 5 feet down to groundwater (30 to 40 feet bgs) in B10-PSB1/MW-98A,B and B10-PSB2 and analyzed for perchlorate only. Groundwater grab samples were collected at first water from all three borings and analyzed for perchlorate. Depth discrete groundwater samples were collected approximately every 20 feet in B10-PSB1/MW-98A,B from 45 to 152 feet bgs. Based on the results of the depth discrete groundwater sampling within the sonic drilled boring (B10-PSB1), one shallow well (B10-PSB1/MW-98B) was installed as a first water well screened from 30 to 50 feet bgs and one deep monitoring well (B-10-PSB1/MW-98A) was installed with a 10-foot

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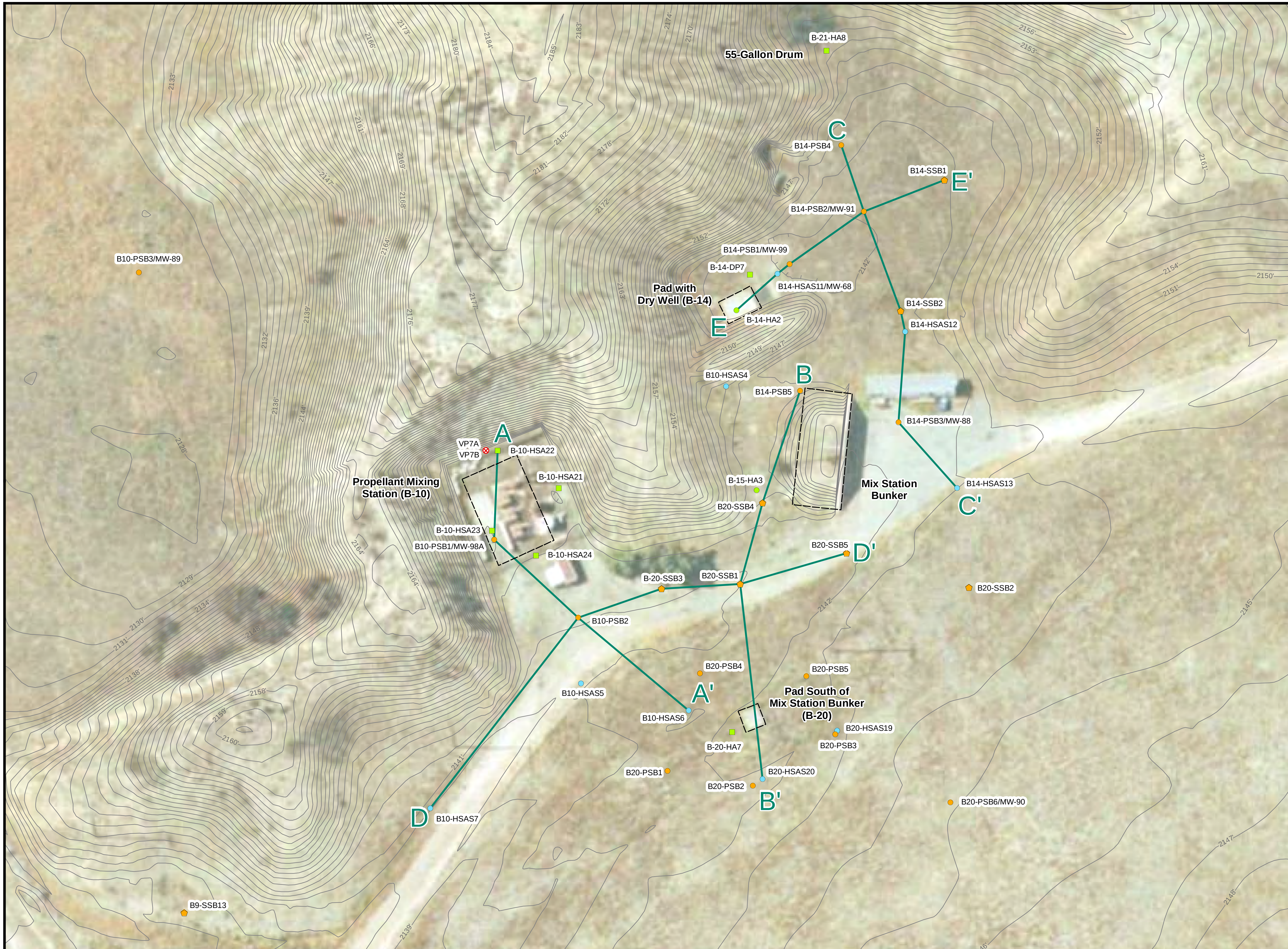


0 30 60 Feet

1 inch = 60 feet

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring, 2004
- Soil Boring, / Soil Vapor, 2004
- Soil Vapor, 2002
- Geologic Cross Section Location
- 2130 Ground Surface Elevation Contour
- Historic Feature Location
- B Geologic Cross Section Line Beginning and End Points

Note: Ground surface elevation is relative to mean sea level (msl)

- Ground surface elevation derived from survey conducted by Hillwig and Goodrow

Beaumont Site 1

Figure 5-12
Soil Borings and Cross Section Locations - Features B10, B14, and B20

TETRA TECH

screened interval from 140 to 150 feet bgs. The wells were constructed as a clustered well pair in separate boreholes. The well construction diagrams are included in Appendix D.

As previously mentioned, one shallow first water monitoring well (B10-PSB3/MW-89) was drilled on the west side of the Mount Eden formation hills, outside the operational area and northwest of Feature B-10, to evaluate the migration pathway of perchlorate impacted groundwater from the Propellant Mixing Station (Feature B-10) and the Pad with Dry Well (Feature B-14) and to determine if the Mount Eden hills form a barrier to groundwater flow. This well was installed as a first water well with a 20-foot screen and a total depth of 40 feet bgs.

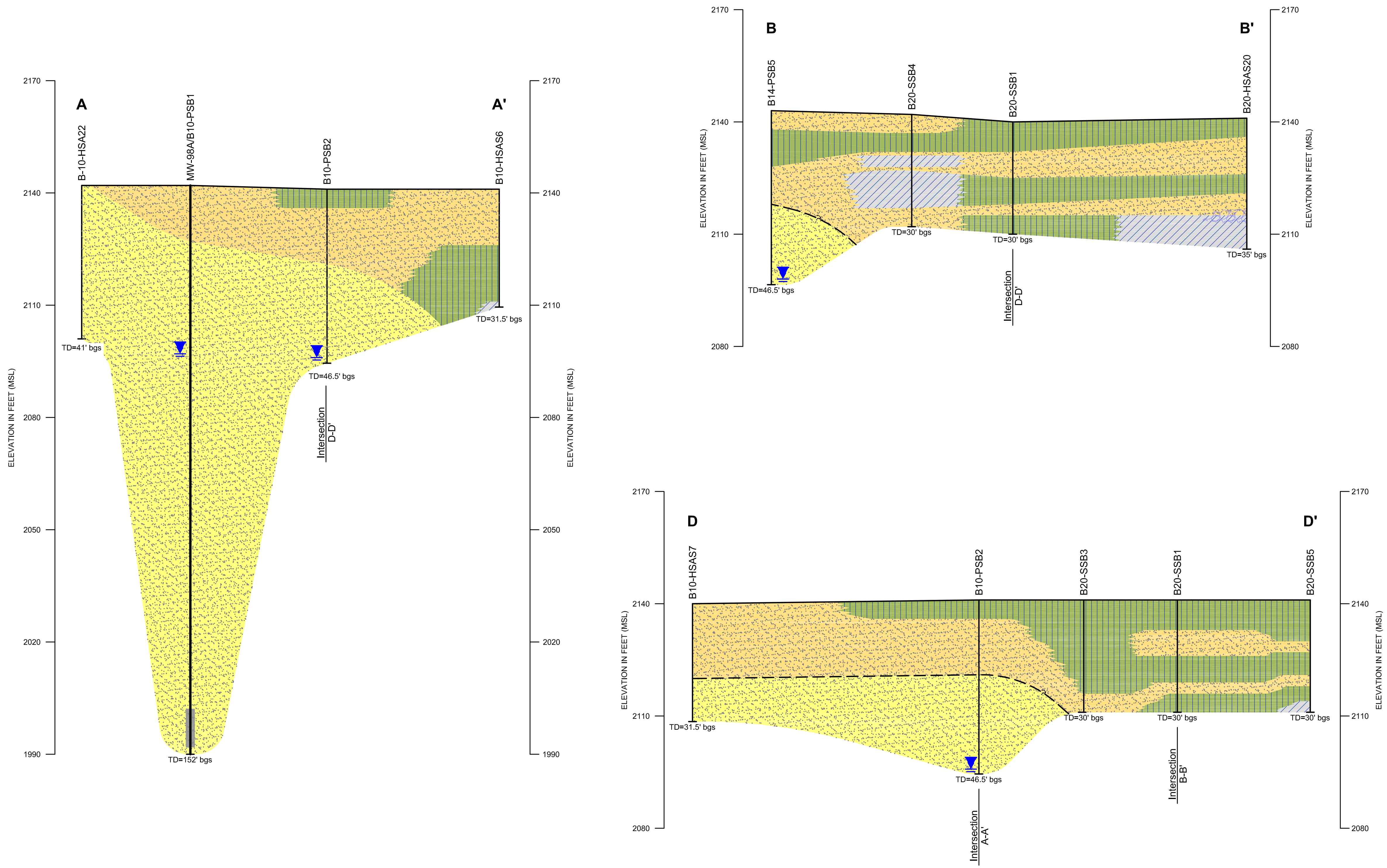
Geology and Hydrogeology

The Mount Eden formation is encountered at the surface in the borings within the canyon near the hillsides. The Mount Eden formation appears to slope away from the canyon walls to the south. In B10-PSB1/MW98A located on the western side of the feature near the Mount Eden foothills, the Mount Eden formation is encountered at 15 feet bgs. The alluvium at this feature consists of the erosional material from the surrounding sandstone hills as well as some influence from the granitic exposures to the east of the site. More specifically, the alluvium is composed of sand, silty sand, sandy silt and occasionally some clay (boring logs are included in Appendix D) as shown in the cross sections for this feature. The cross section location figure and idealized cross sections are presented in Figures 5-12, 5-13, and 5-14.

The hills surrounding the Propellant Mixing Station are composed of the Mount Eden formation which is exposed on the steep sides of the canyon. This sandstone/siltstone formation is thought to be semi-impermeable and a barrier to groundwater flow. Based on the initial groundwater elevation data from these wells and the surrounding wells, it appears that groundwater flows south out of the nearby canyon at the Pad with Dry Well (Feature B-14) and turns to the west flowing past and into the small box canyon at the Propellant Mixing Station (Feature B-10) (Figure 5-15). It should be noted that the groundwater contours presented in this figure represent the first monitoring event for these newly installed wells and therefore additional monitoring is needed to confirm the flow directions and evaluate seasonal trends and any resulting changes in flow direction.

Soil Sampling Results and Contaminant Distribution

Sixteen soil samples were collected from two borings (B10-PSB1/MW-98A,B and B10-PSB2) drilled at the Propellant Mixing Station (B-10) and analyzed for perchlorate. Perchlorate concentrations ranged from 20.7 to 634 µg/kg with an average concentration of 232 µg/kg. A summary of the analytical results are tabulated in Table 5-4 on page 5-36. The highest concentration detected was at 10 feet bgs in the



LEGEND

Quaternary Alluvium

- Clay (CL)
- Silt (ML)
- Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)
- Fine to coarse grained sand with gravel (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)
- Clay with gravel (CL)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

- Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs below ground surface

HSA Hollow Stem Auger - Part of the nomenclature for borings installed using a hollow stem auger rig during the soil investigation in 2004.

HSAS Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MSL Mean sea level

MW Monitoring Well

TD=#' Total Boring Depth (feet)

Well

Screened interval

Boring

First water sample collected during drilling activities, fall to winter 2008

—?— Inferred contact

Intersection A-A' location where cross sections intersect

0 60 30

Scale in Feet
Vertical Exaggeration = 2x Horizontal

Beaumont Site 1

Figure 5-13
Idealized Geologic Cross Sections A-A', B-B', and D-D' Features B-10, B-14, and B-20

TETRA TECH

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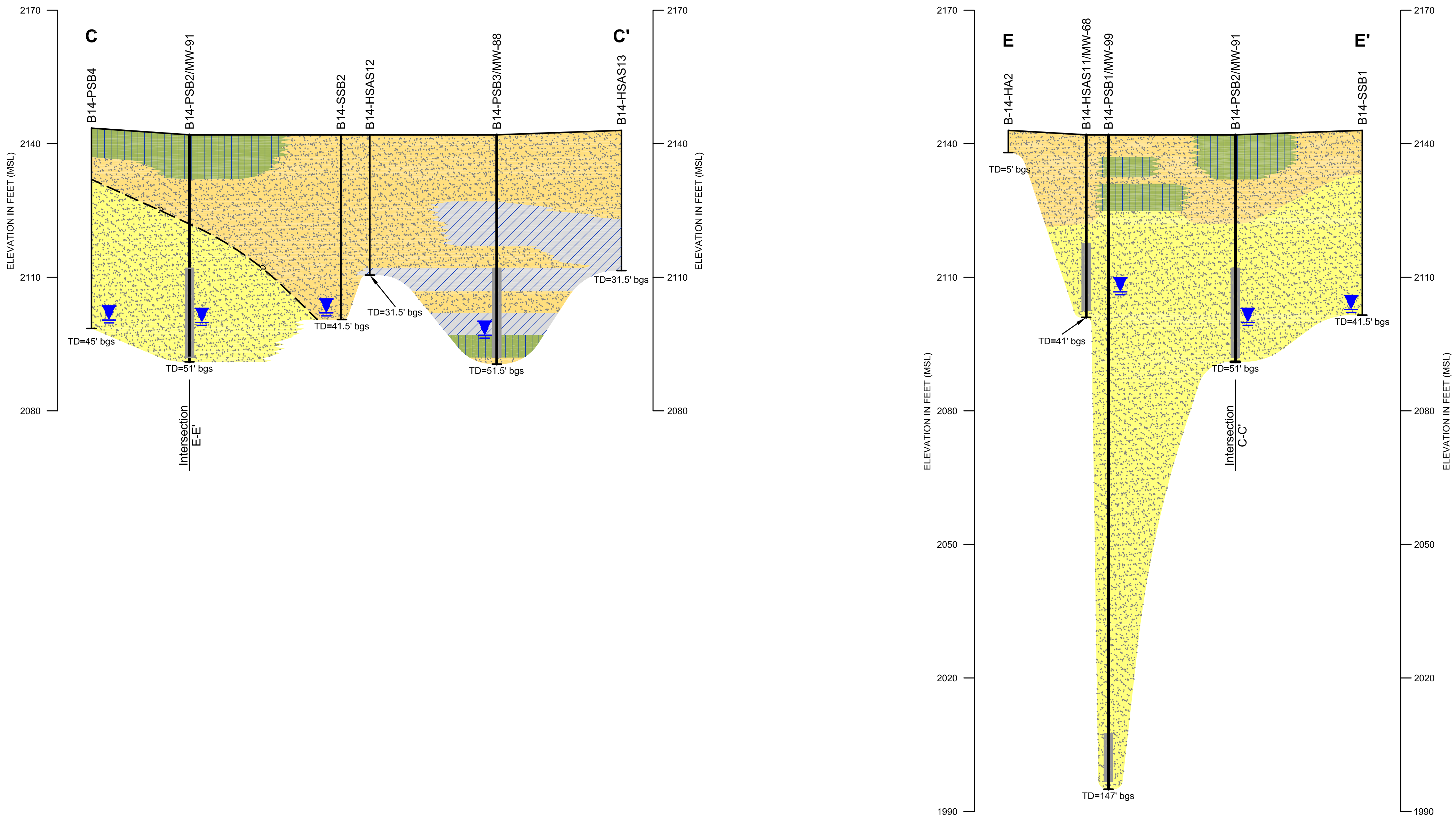

LEGEND

Quaternary Alluvium

- Clay (CL)
- Silt (ML)
- Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

- Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs below ground surface

HA Hand Auger - Part of the nomenclature for borings installed with a hand auger during the soil investigation in 2004.

HSAS Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MSL Mean sea level

MW Monitoring Well

TD=#' Total Boring Depth (feet)

Well

Screened interval

Boring

First water sample collected during drilling activities, fall to winter 2008

—?— Inferred contact

Intersection C-C' location where cross sections intersect

0 60

30

Scale in Feet
Vertical Exaggeration = 2x Horizontal

Beaumont Site 1

Figure 5-14
Idealized Geologic Cross Sections C-C' and E-E'
Features B-10, B-14, and B-20

TETRA TECH

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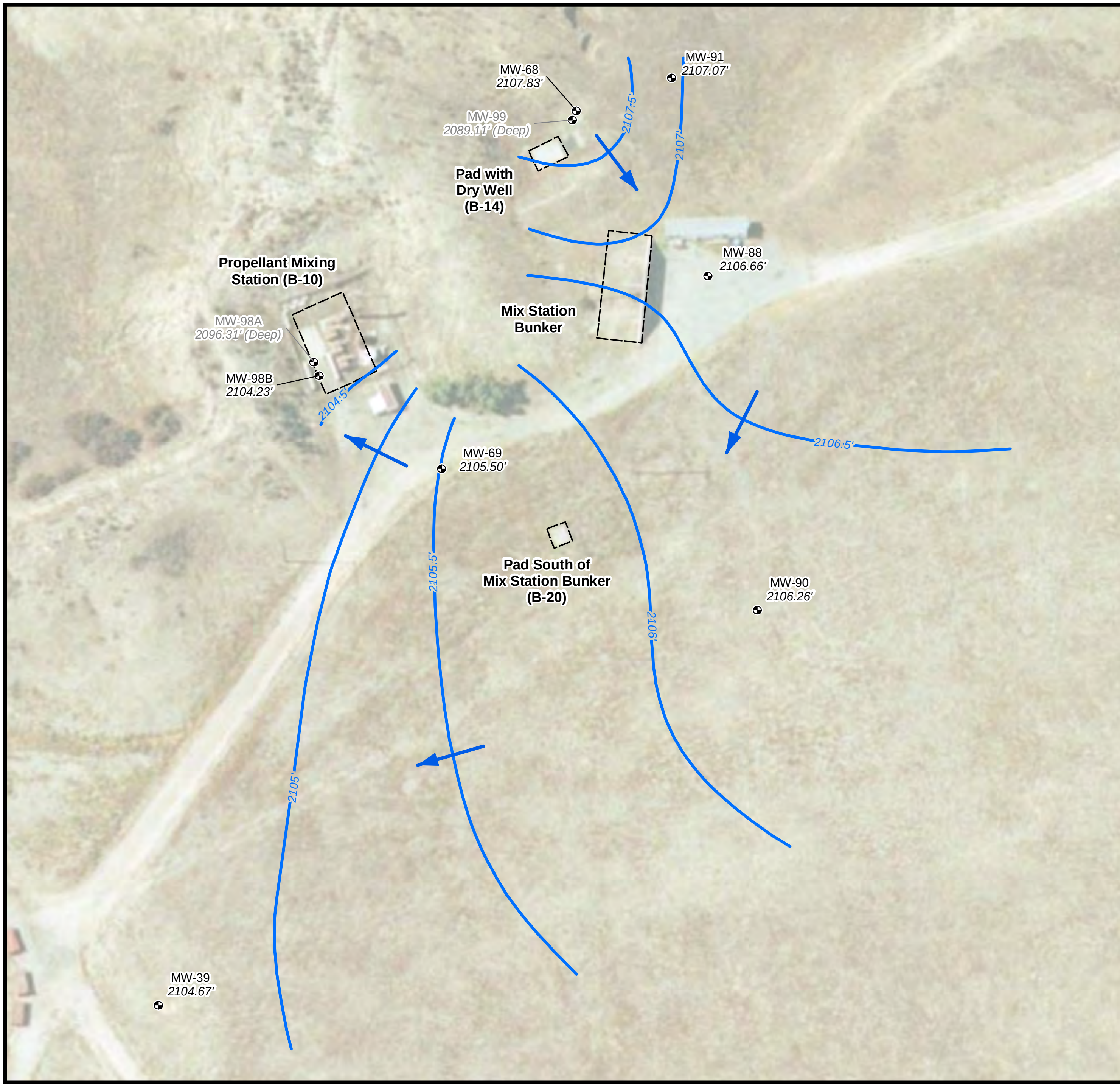


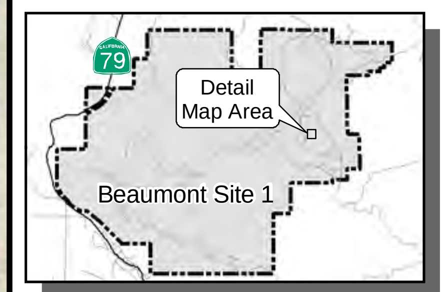
N

0 50 100
Feet

Adapted from: March 2007 aerial photograph.

LEGEND

- Monitoring Well Location
- Groundwater Elevation Contour
- Historic Feature Location
- Groundwater Flow Direction



Beaumont Site 1

Figure 5-15

Groundwater Contours - Feburary 2009 (Features B-10, B-14, and B-20)

TETRA TECH

Table 5-4 Soil and Groundwater Sampling Results - Propellant Mixing Station (Feature B-10)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	1,4-Dioxane	1,1-DCE	1,1-DCA	TCE	Chloro - form
Matrix				***Soil***	***Water***					
Units				µg/kg	µg/L					
MCL				na	6		6	5	5	--
DWNL				na		3				--
B10-PSB1 / MW-98A	B10-PSB1-1.0	1	12/16/2008	**38.6**	-	-	-	-	-	-
	B10-PSB1-5	5	12/16/2008	**63.6**	-	-	-	-	-	-
	B10-PSB1-10	10	12/16/2008	**20.7**	-	-	-	-	-	-
	B10-PSB1-15	15	12/16/2008	**136**	-	-	-	-	-	-
	B10-PSB1-20	20	12/16/2008	**392**	-	-	-	-	-	-
	B10-PSB1-25	25	12/16/2008	**315**	-	-	-	-	-	-
	B10-PSB1-30	30	12/16/2008	**387**	-	-	-	-	-	-
	B10-PSB1-35	35	12/16/2008	**215**	-	-	-	-	-	-
	B10-PSB1-40	40	12/16/2008	**292**	-	-	-	-	-	-
	B10-PGW1-45	45	12/16/08	-	**1,760**	-	**6**	<0.10	**12.4**	**1.04**
	B10-PGW1-67	67	12/17/08	-	**105**	-	<0.10	<0.10	<0.10	<0.10
	B10-PGW1-87	87	12/18/08	-	**142**	-	**9.85**	<0.10	**9.39**	<0.10
	B10-PGW1-102	102	12/18/08	-	**86.5**	-	<0.10	<0.10	**1.76**	<0.10
	B10-PGW1-137	137	12/20/08	-	<0.5	-	<0.10	<0.10	<0.10	<0.10
	B10-PGW1-152	152	12/20/08	-	<0.5	-	<0.10	<0.10	<0.10	<0.10
	MW-98A	140-150	02/11/09	-	<0.5	<0.59	<0.10	<0.10	<0.10	<0.10
	MW-98A	140-150	3/10/2009	-	<0.5	<0.61	<0.10	<0.10	<0.10	<0.10
B10-PSB1 / MW-98B	MW-98B	30-50	2/4/2009	-	**744**	**1.9**	**11.1**	<0.10	**12.9**	<0.10
	MW-98B	30-50	3/10/2009	-	**539**	**1.60**	**4.12**	**0.185**	**8.75**	<0.10
B10-PSB2	B10-PSB2-0.5	0.5	11/6/2008	**93.8**	-	-	-	-	-	-
	B10-PSB2-5	5	11/6/2008	**226**	-	-	-	-	-	-
	B10-PSB2-10	10	11/6/2008	**634**	-	-	-	-	-	-
	B10-PSB2-15	15	11/6/2008	**343**	-	-	-	-	-	-
	B10-PSB2-20	20	11/6/2008	**182**	-	-	-	-	-	-
	B10-PSB2-25	25	11/6/2008	**75.3**	-	-	-	-	-	-
	B10-PSB2-30	30	11/6/2008	**302**	-	-	-	-	-	-
	B10-PGW2-45	45	11/06/08	-	**1,710**	-	-	-	-	-
B10-PSB3	B10-PGW3-30	30	11/11/08	-	**1,930**	-	-	-	-	-
	MW-89	20-40	2/4/2009	-	**2,000**	**4**	**4.4**	<0.2	**7**	**0.72**
	MW-89	20-40	3/9/2009	-	**1,820**	**3**	**4.5**	<0.2	**7**	**0.88**

Notes:

"Bold" - Indicates concentrations detected above the method detection limit.
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
bgs - Below ground surface.
MW - Groundwater monitoring well.
na - Not applicable.
µg/kg - Micrograms per kilogram.
µg/L - Micrograms per liter.
PSB - Primary soil boring.
PGW - Primary groundwater sample.
(-) - Sample not analyzed for analyte.
(--) - MCL or DWNL not available.

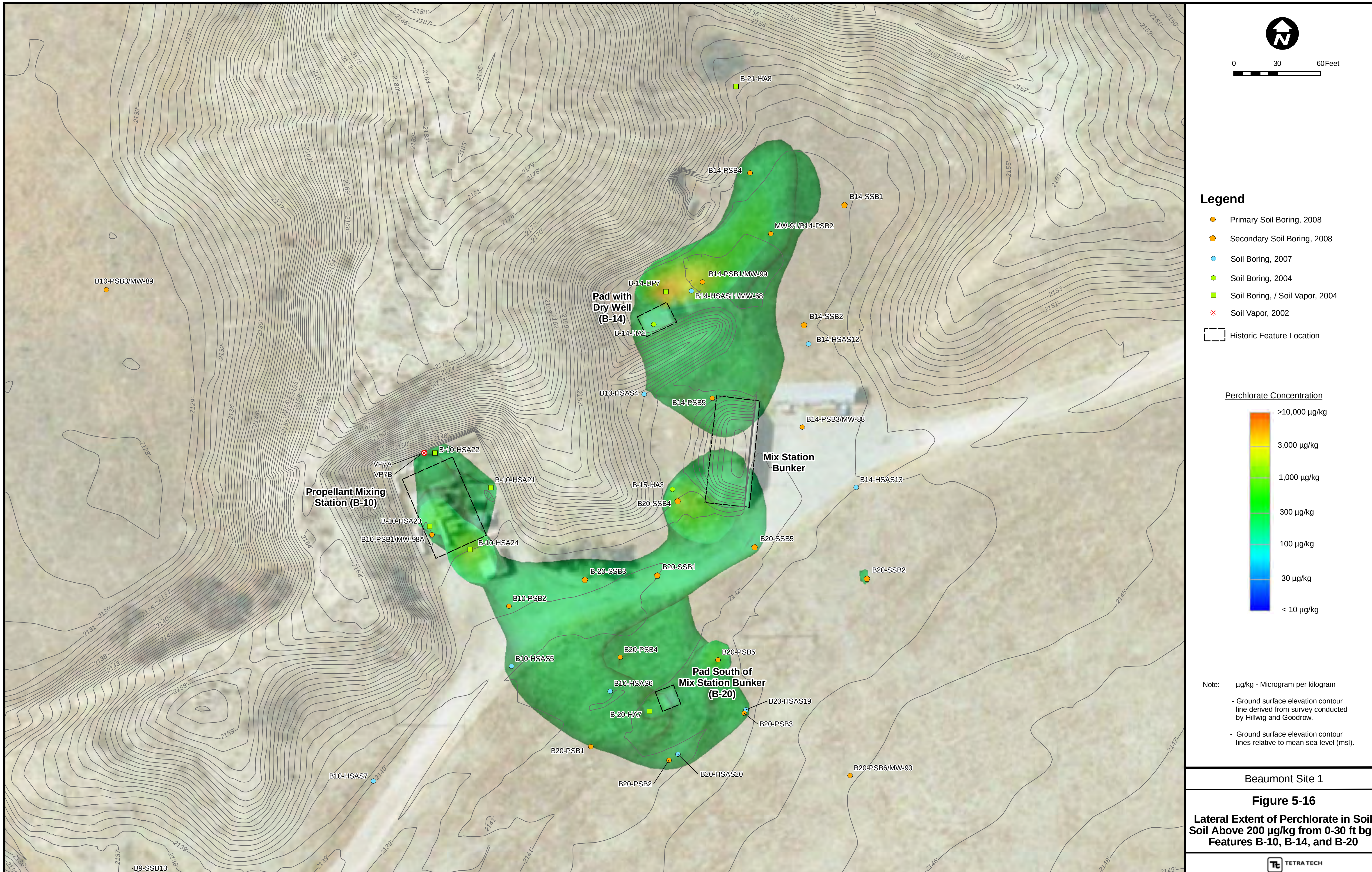
shallow boring, B10-PSB2, installed at the mouth of the box canyon. However, the concentrations of perchlorate in soil detected during this investigation were an order of magnitude less than the previous investigations.

The areal extent of perchlorate in soil above 200 µg/kg, based on the 3-D modeling of all soil sampling results since 2002 for features B-10, B-14, and B-20, is shown in Figure 5-16. As shown in this figure, there appears to be two separate areas of impacted soil: one originating from the Pad with Dry Well (Feature B-14) to the north covering an area of 15,350 ft^2; and the second originating from the Propellant Mixing Station (Feature B-10) commingled with shallow impacts (B20-SSB4) detected behind the Mix Station Bunker covering an area of approximately 27,800 ft^2.

The lateral extent of perchlorate impacts by depth is shown in Figure 5-17. The shallow perchlorate impacts detected in B20-SSB4 at 0.5 foot bgs behind the Mix Station Bunker may have originated from surface water runoff from the Pad with Dry Well where much higher perchlorate concentrations (9,970 to 20,400 µg/kg) were detected. It is possible that if there was a connection between the shallow impact at B20-SSB4 and the Pad with Dry Well that boring B14-PSB5 may not have detected it since it is located off to the side of the topographic low (see 0.5-foot depth in Figure 5-17). Although the perchlorate impacts originating from the Propellant Mixing Station (Feature B-10) extend south into the area of the Pad South of Mix Station Bunker (Feature B-20), the concentration gradient both laterally and vertically suggests perchlorate-impacted surface water from the Propellant Mixing Station (Feature B-10), may have flowed from this feature out the mouth of the canyon and across the road and percolated into the soil near the Pad South of Mix Station Bunker (Feature B-20).

Figures 5-18 through 5-20 present 3-D visualizations of the perchlorate impacts in soil above 200 µg/kg for features B-10, B-14, and B-20 with side views from the northwest and west, and an oblique view from above looking east, respectively. As seen in Figures 5-18 and 5-19, there appear to be four primary areas of perchlorate impacts in the subsurface: one beneath each of the three features (B-10, B-14, and B-20) and the shallow impacts behind the Mix Station Bunker. However, as stated above, the impacted area below Feature B-20 appears to have originated from the Propellant Mixing Station (Feature B-10), the Pad with Dry Well (Feature B-14), or a combination of the two. In comparison to Figures 5-18 and 5-19, Figure 5-20 clearly shows the connection between the high concentrations detected at the Propellant Mixing Station (Feature B-10) and B20-SSB4 and the lower concentrations detected beneath the Pad South of Mixing Station (B-20). Within the canyons themselves it is assumed that the following would drive contaminant migration in the subsurface towards the south out of the canyons: (1) the topography;

X:\GIS\Lockheed 22288-110302\Plume_B-10.mxd

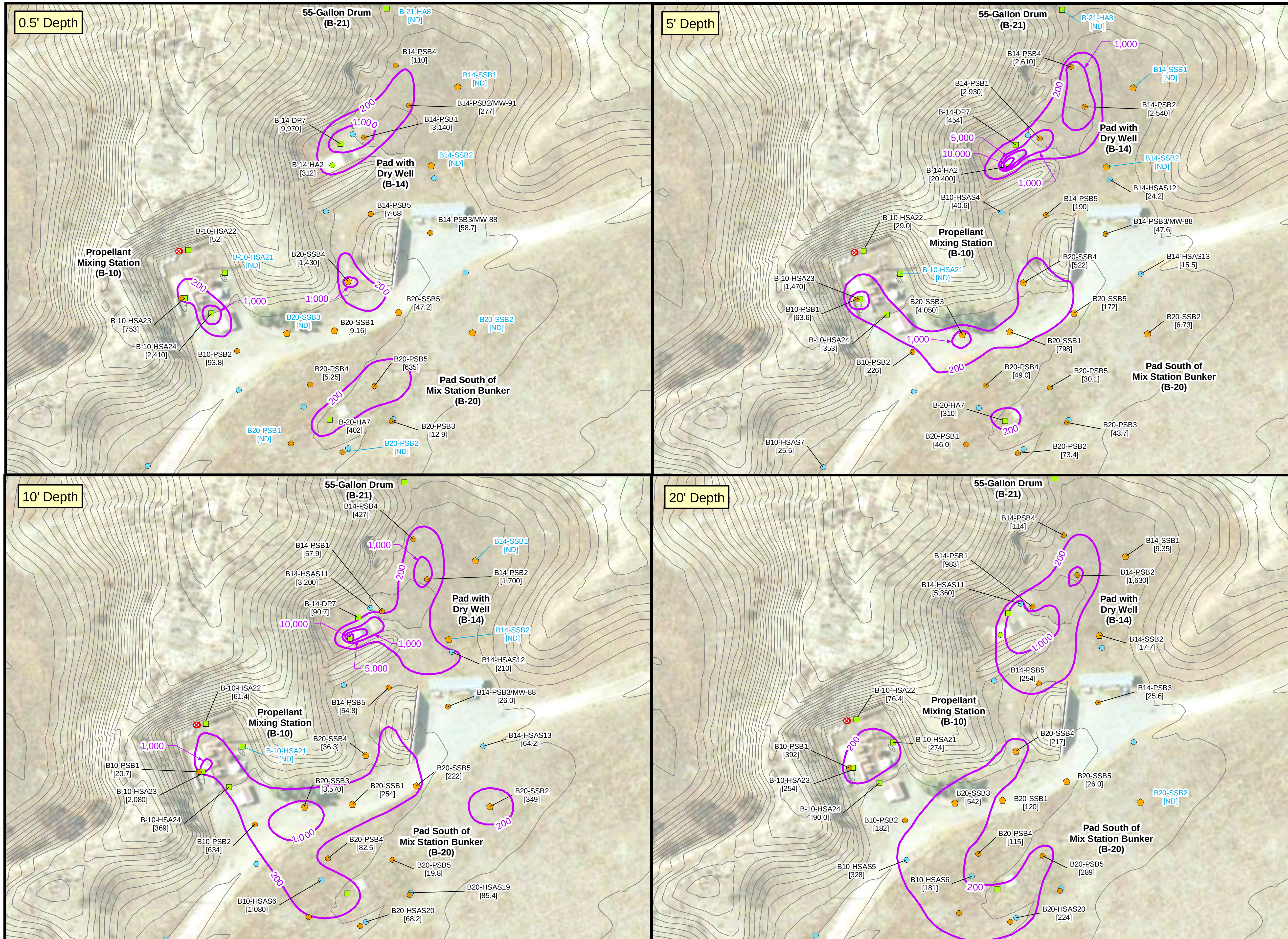


Beaumont Site 1

Figure 5-16

Lateral Extent of Perchlorate in Soil Soil Above 200 µg/kg from 0-30 ft bgs Features B-10, B-14, and B-20

X:\GIS\Lockheed 22288-110302\Isopleths B10_14_20.mxd



0 50 100 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Soil Vapor, 2002
- Perchlorate Isoconcentration Contour (dashed where inferred)
- Ground Surface Elevation Contour

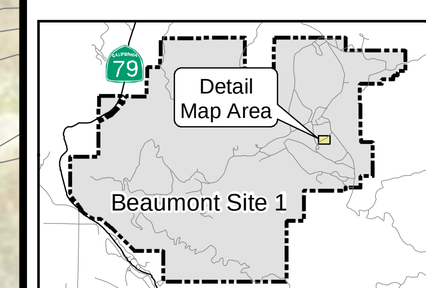
Note:

[#] Perchlorate results in µg/kg.

µg/kg Micrograms per kilogram.

[ND] Non-Detect. (<5.0-6.11 µg/kg)

Boring symbols with no labels indicate sample was not tested at depth interval.



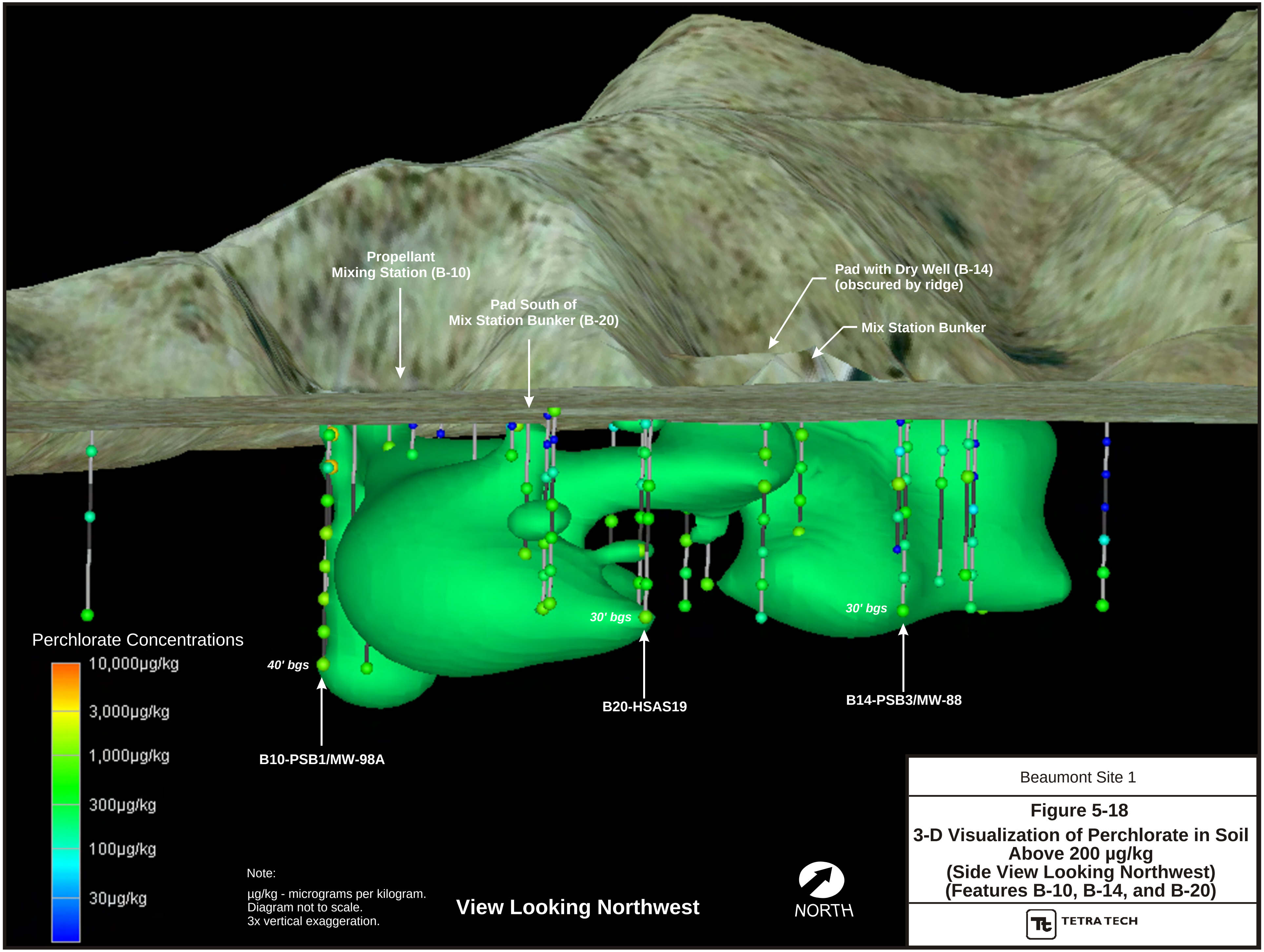
Beaumont Site 1

Figure 5-17

Perchlorate Concentrations in Soil - Features B-10, B-14, and B-20

TETRA TECH

X:\GIS\22288-110302\B10_PERC_SIDE.CDR

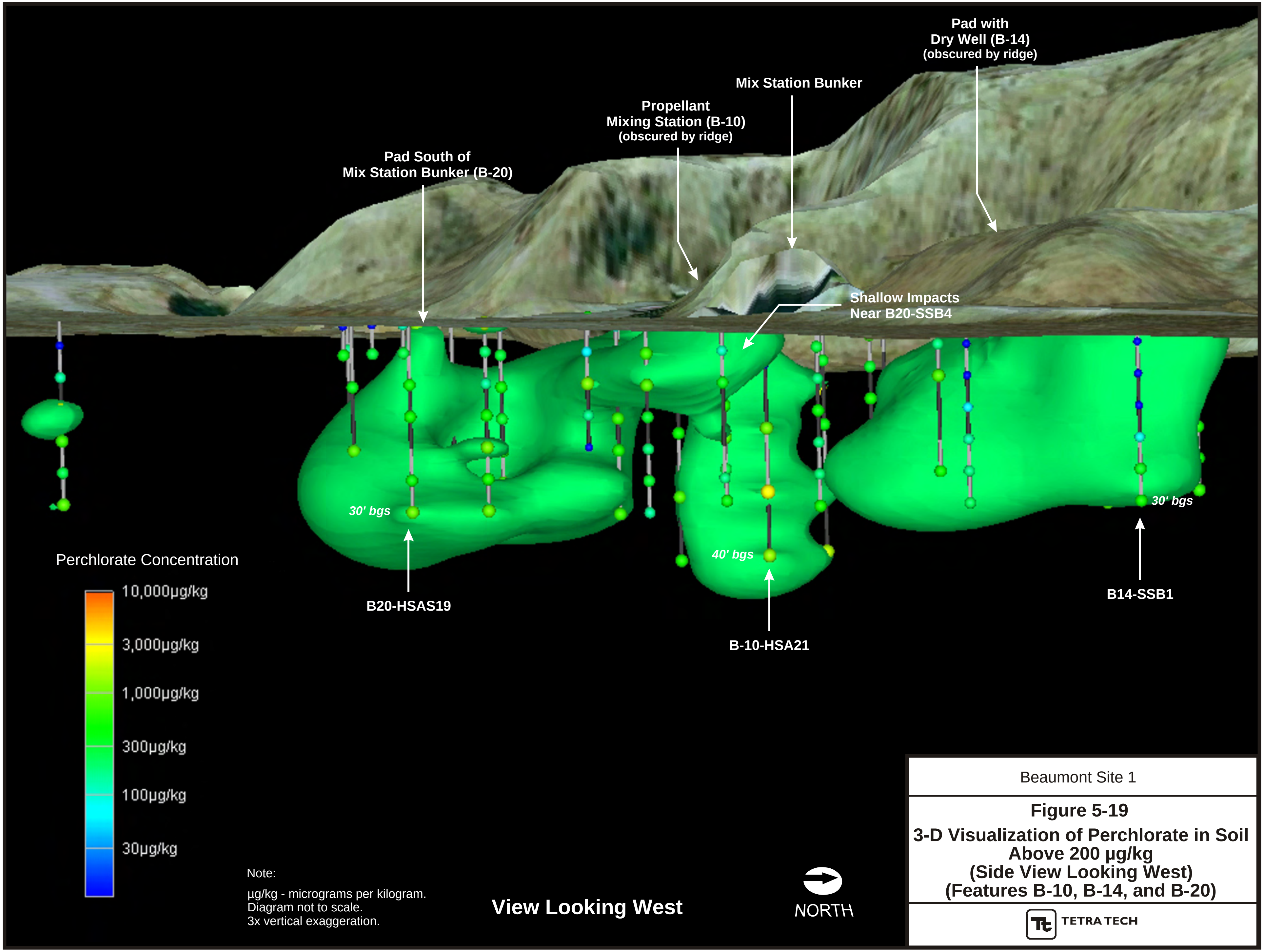


Beaumont Site 1

Figure 5-18
3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking Northwest) (Features B-10, B-14, and B-20)

TETRA TECH

X:\GIS\22288-110302\B10_PERC_SIDE_WEST.CDR



Beaumont Site 1

Figure 5-19

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking West) (Features B-10, B-14, and B-20)

X:\GIS\22288-110302\B10_PERC_TOP_EAST.CDR

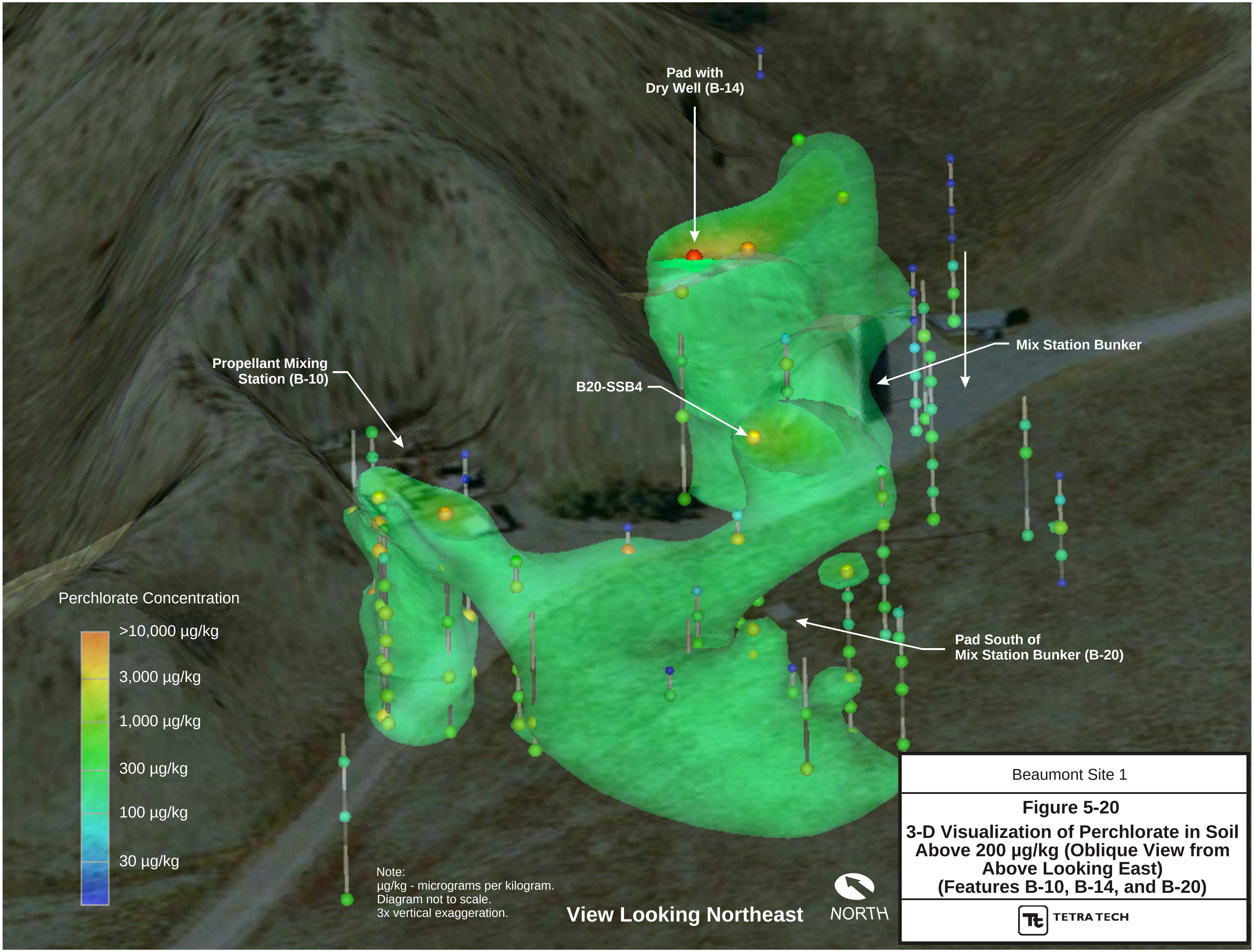


Figure 5-20
3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Oblique View from Above Looking East) (Features B-10, B-14, and B-20)

(2) the significant decrease in permeability of the Mount Eden formation in the surrounding foothills; and (3) the thickening of the higher permeability alluvium moving out of the canyons. Based on the additional borings installed during this investigation along with the topgraphic constraints, the extent of perchlorate in soil at the Propellant Mixing Station (Feature B-10) has been defined to the IG.

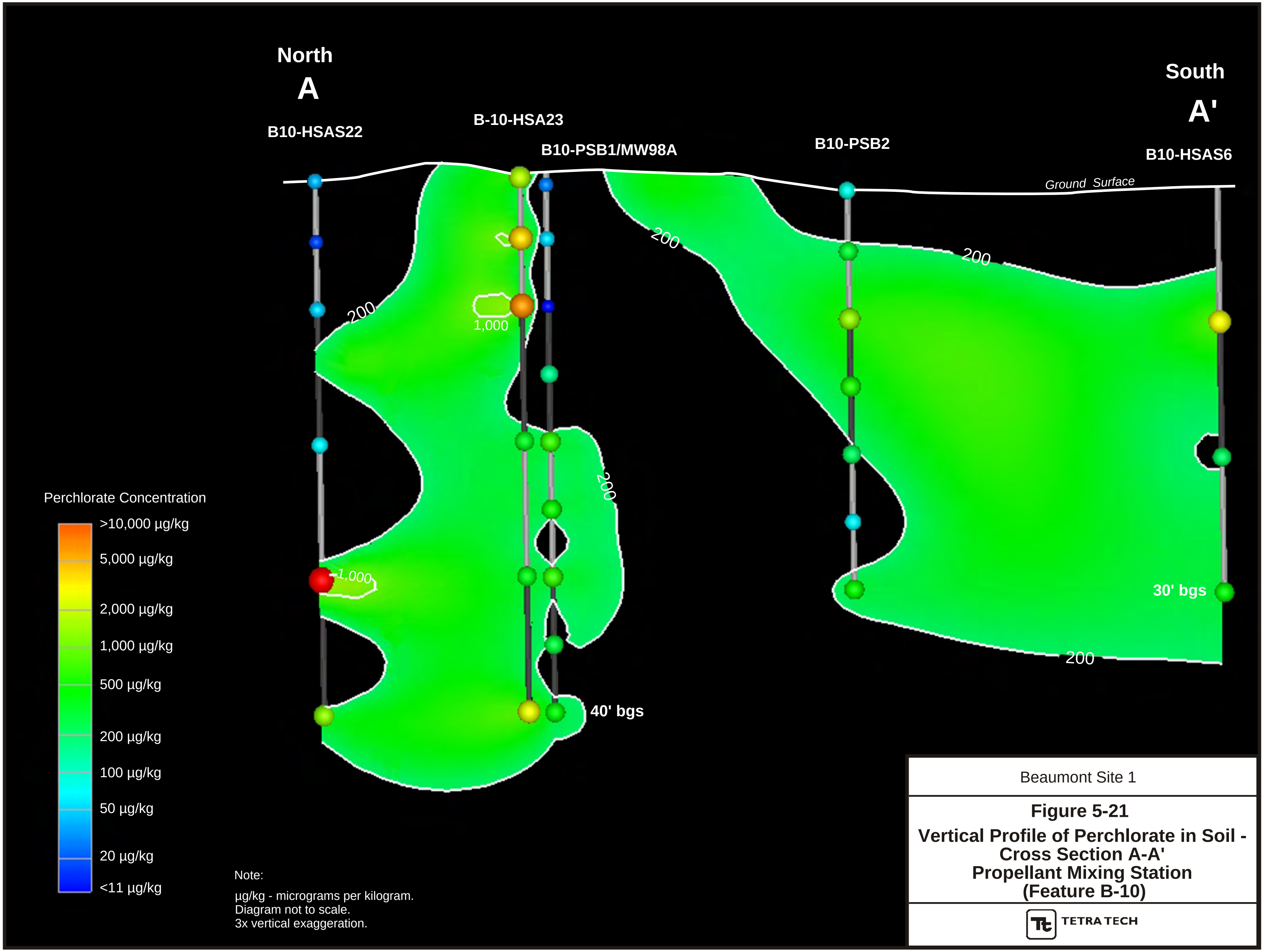
Figure 5-21 shows the vertical profile of perchlorate impacts in soil at Feature B-10 along cross section line A-A’. The highest concentration (4,610 µg/kg) detected at the north end of Feature B-10 at the back of the canyon (B10-HSA22) was found at 30 feet bgs with the perchlorate concentration decreasing to 620 µg/kg at 40 feet bgs. Perchlorate concentrations within other borings in the central portion of the feature (B10-HSA23, B10-HSA24 and B10-PSB2, Figure 5-16) were highest in the shallow samples between 0.5 and 10 feet bgs.

Groundwater Sampling Results and Contaminant Distribution

During drilling activities, perchlorate was detected above the MCL in 6 of the 8 samples collected at concentrations ranging from 86.5 to 1,930 µg/L (Table 5-4). The groundwater grab samples collected at first water ranged from 1,710 to 1,930 µg/L. The depth discrete groundwater results from B10-PSB1/MW-98A indicate that the concentrations decrease with depth, from 1,760 µg/L at first water to below the MDL (0.5 µg/L) at 137 and 152 feet bgs. Based on the results of the vertical characterization of groundwater at PSB1/MW-98A, a shallow well (MW98-B) screened from 30 to 50 feet bgs and a deep well (MW-98A) screened from 140 to 150 feet bgs were installed.

Subsequent to the field investigation, groundwater samples were collected from the three monitoring wells installed at this feature and analyzed for perchlorate, VOCs and 1,4-dioxane. The primary Site groundwater COPCs, perchlorate, 1,4-dioxane, TCE, and 1,1-DCE, were detected in the two shallow monitoring wells (B10-PSB3/MW-89 and B10-PSB1/MW-98B) but were not detected above the MDL in the deep well B10-PSB1/MW-98A. The highest concentrations of perchlorate and 1,1-DCE were detected in MW-89 (1,820 µg/L and 4.5 µg/L), respectively located outside of the operational area of the Propellant Mixing Station (Feature B-10).

Figure 5-22 presents the perchlorate concentration contours for shallow groundwater (first water) near features B-10, B-14, and B-20. Since the highest perchlorate concentrations in groundwater were detected at first water with concentrations decreasing an order of magnitude within the next two samples (20 to 30 feet below) at both Feature B-10 and B-14, perchlorate concentration contours were only prepared for samples collected at first water.



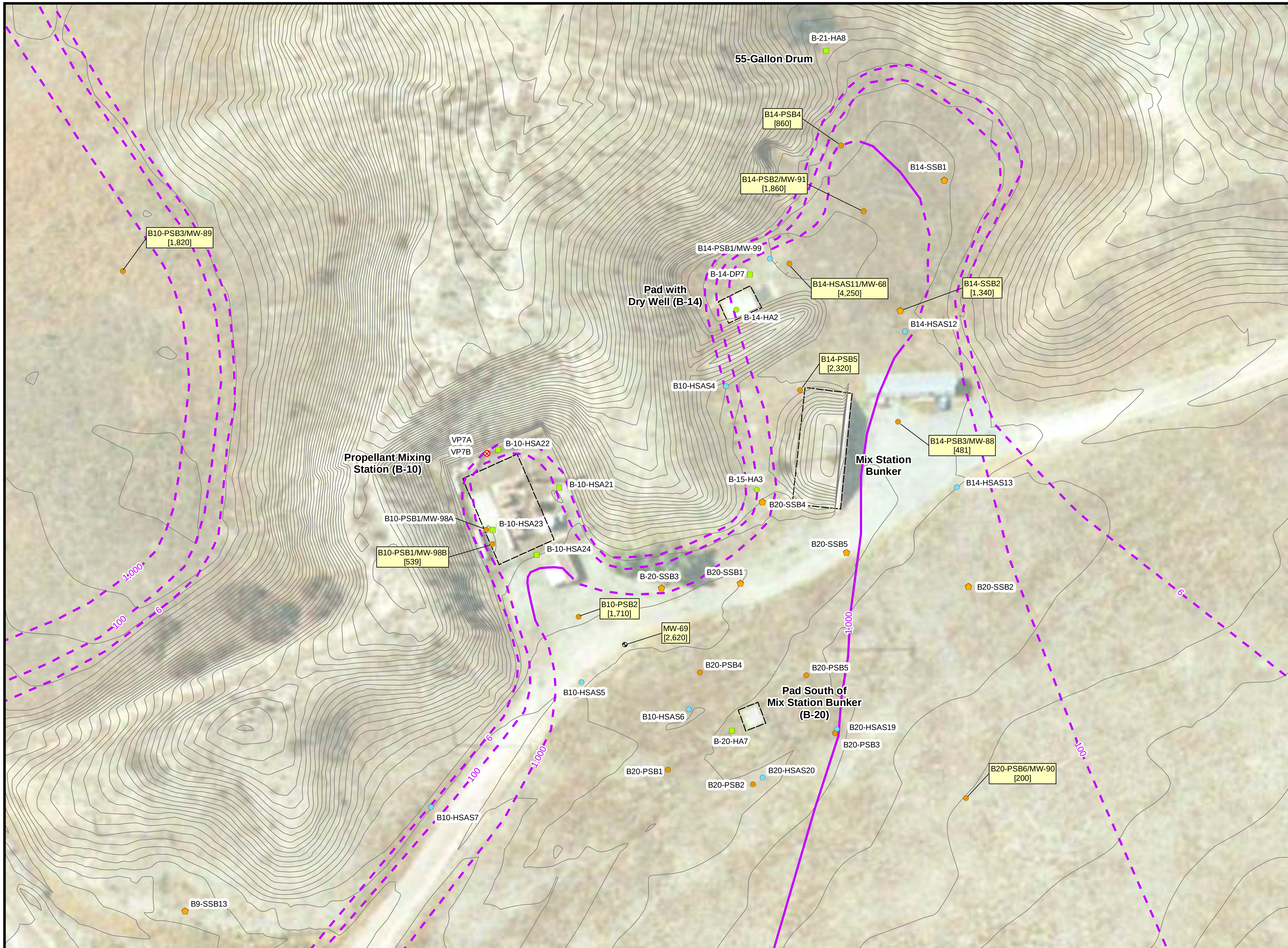
Beaumont Site 1

Figure 5-21
Vertical Profile of Perchlorate in Soil - Cross Section A-A'
Propellant Mixing Station (Feature B-10)

TETRA TECH

X:\GIS\22288-110302\B10_PERC_FENCE.CDR

X:\GIS\Lockheed 22288-110302\Perchlorate B10-B14-B20.mxd



N

0 30 60 Feet

1 inch = 60 feet

Adapted from: March 2007 aerial photograph

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring, 2004
- Soil Boring, / Soil Vapor, 2004
- Soil Vapor, 2002
- Perchlorate Isoconcentration contour (dashed where inferred)
- 2130 Ground Surface Elevation Contour

Note:

- Ground surface elevation is relative to mean sea level (msl).
- Ground surface elevation derived from survey conducted by Hillwig and Goodrow.

MW Monitoring well.

WELL ID [#] Boring/Well where groundwater samples were collected.

[#] Perchlorate concentration in groundwater, µg/L.

Beaumont Site 1

Figure 5-22
Perchlorate Concentrations in Groundwater (First Water)
Features B-10, B-14, and B-20

TETRA TECH

Grab groundwater sample and monitoring well results from this investigation are shown in Table 5-4. Both types of groundwater sampling results were used for Figure 5-22. However, if both types of data were available for the same location, the monitoring well data was used since it is a more representative sample in comparison to the depth discrete groundwater samples collected during drilling. Based on the groundwater results from this investigation, the highest perchlorate concentrations at Feature B-10 were detected out in front of the operational area (MW-69). Based on the perchlorate concentration contours and the groundwater flow directions presented in Figure 5-15, it is possible that the higher perchlorate concentrations detected at the mouth of the canyon near Feature B-10 could have originated from the Pad with Dry Well (Feature B-14). The concentrations of 1,4-dioxane, TCE, and 1,1-DCE at this feature do not appear to be elevated and are consistent with the BPA groundwater plume migrating into this area.

5.4.1.3 Feature B-14 - Pad with Dry Well

The Pad with Dry Well is located in the eastern central portion of Historical Operational Area B. This feature consists of a concrete pad with an adjacent dry well. Use of the pad and dry well is unknown.

As stated at the beginning of Section 5.4.1.2, some of the figures presenting the data and the associated discussion for features B-10, B-14, and B-20 have been combined.

Previous Results

Five soil borings were drilled and sampled between 5 and 31.5 feet bgs at this location during previous investigations (Tetra Tech, 2005a, 2009a). Soil samples collected were analyzed for one or more of the following: VOCs, SVOCs, perchlorate, Title 22 metals, PCBs, and TPH. SVOCs, PCBs, 1,4-dioxane, and TPH were not detected at concentrations above their respective RLs. Perchlorate was detected in soil at concentrations ranging from 15.5 to 20,400 µg/kg. Acetone, a possible laboratory contaminant, was detected in one sample at a concentration of 62 µg/kg. Metals were detected with arsenic at concentrations up to 3.39 mg/kg. A soil gas survey was also performed at this location. VOCs were not detected in any of the soil gas samples collected from this feature. Tables of soil and soil gas analytical results from the previous investigations are included in Tables H-7 and H-15 in Appendix H.

One boring was converted to monitoring well MW-68 and screened from 24.5 to 39.5 feet bgs. Groundwater samples collected from monitoring well MW-68 were analyzed for perchlorate, VOCs, and 1,4-dioxane. Perchlorate and 1,4-dioxane were reported at respective concentrations of 3,270 µg/L and 2.2 µg/L in monitoring well MW-68. Two VOCs, 1,1-DCE and TCE, were detected at concentrations of 1.6 and 2.0 µg/L, respectively. Perchlorate concentrations appear to be elevated in MW-68 and nearby monitoring well MW-69 (Feature B-10) relative to nearby wells located to the south and southwest monitoring the groundwater plume originating from the BPA, indicating that an additional source of perchlorate is present in this area.

TETRA TECH

The highest concentrations of perchlorate at this feature were detected at the Pad with Dry Well. Perchlorate concentrations are confined to the north by the steep hillsides of the Mount Eden formation and concentrations decrease immediately south and southeast of the pad and dry well by two to three orders of magnitude. Concentrations of perchlorate decrease in the deeper soil samples to less than 200 µg/kg in the 25 to 30-foot samples.

The information collected from the previous investigations indicated that further investigation was needed to complete the horizontal and vertical delineation of perchlorate impacts in soil and groundwater at this feature and determine if there is a potential connection between the Propellant Mixing Station (Feature B-10), the Pad with Dry Well (Feature B-14), and the Pad South of Mix Station Bunker (Feature B-20) with respect to perchlorate impacts.

The Pad with Dry Well is located on the western side of a small semi-enclosed basin surrounded by foothills of the Mount Eden formation from the southwest to the northeast and open only to the southeast. The alluvium below this feature ranges from a thickness of less than 8 feet to over 15 feet consisting of generally very fine grained sand with minor amounts of clay. Depth to groundwater in MW-68 in August 2008 prior to commencement of the field activities was approximately 36 feet bgs.

Investigation Activities

Four primary borings (B14-PSB2 thru B14–PSB4) and two secondary borings (B14-SSB1 and SSB2) were drilled to approximately 51 feet bgs and one primary boring (B14-PSB1/MW99) was drilled to 145 feet bgs for vertical characterization of the groundwater (Figure 5-12 on page 5-31). Soil samples were collected at 0.5-foot and every 5 feet down to approximately 30 feet bgs. The soil samples collected were analyzed for perchlorate only. Groundwater grab samples were collected at first water from 7 borings between 35 and 45 feet bgs. Depth discrete groundwater samples were also collected from B14-PSB1/MW99 every 20 feet thereafter to total depth. Two shallow monitoring wells (B-14-PSB2 / MW-91 and B14-PSB2 / MW-88) were installed with 20-foot screened intervals from 30 to 50 feet bgs to monitor the shallow groundwater migrating out from the Pad with Dry Well and box canyon. Based on the results of the depth discrete groundwater sampling within the sonic drilled boring (B14-PSB1), one deep monitoring well (B-14-PSB1 / MW-99) was installed next to the existing shallow well (MW-68) and constructed with a 10-foot screened interval from 134.5 to 144.5 feet bgs. The well construction diagrams are included in Appendix D.

Geology and Hydrogeology

The Pad with Dry Well Feature (B-14) is on the east side of the Mount Eden hill that confines the Propellant Mixing Station Feature (B-10). The pad and dry well are adjacent to a man-made berm which juts out from the Mount Eden hill between the Propellant Mixing Station and the Pad with Dry Well. The area is set in a topographic low with the Mount Eden hills surrounding the area on all but the south side of the feature. The opening of the area is obscured by the east facing bunker (formerly used as the Mix Station Control) and an east/west oriented trailer (used as a temporary field office for previous contract work) set on the south side of the feature. The Mount Eden hill on the west side of the feature is elevated approximately 40 feet above the operational ground surface. The ridge gradually slopes as it continuously wraps around the north and then to the east side of the area to less than 20 feet above the operational ground surface creating a small semi-enclosed basin (Figure 5-12). The Mount Eden formation in this area is the same member as that at the Propellant Mixing Station. The sedimentary formation is friable and has a very similar composition to the overlying alluvium making it difficult to distinguish between the two during drilling.

The Mount Eden formation in this area oscillates between sandstone, siltstone and claystone, and a combination thereof. Based on the boring logs included in Appendix D, the Mount Eden formation slopes to the south and southwest from 10 feet bgs in the northern portion of the feature (B14-PSB4) to deeper than 50 feet bgs out in front of the trailer (B14-PSB3/MW-88) southeast of the feature. The cross section locations and idealized cross sections are on Figures 5-12, 5-13, and 5-14. The alluvium mimics the bedrock and, typical of a low energy fluvial depositional system, is composed of medium to fine grained sand, silt and clay but is predominantly silty sand.

Groundwater was observed during drilling activities between 31 and 45 feet bgs. In February 2009, groundwater elevations were collected for the shallow wells at the feature and ranged from 2107.83 feet above msl in the northern portion of the feature to 2106.66 feet above msl in the southernmost portion of the feature. Groundwater elevations are presented along with the groundwater contours on Figure 5-15. The groundwater at this feature flows southeast toward the Pad South of Mix Station Feature (B-20) then appears to wrap around the Mount Eden hills and flows to the west then northwest toward Bedsprings Creek.

Soil Sampling Results and Contaminant Distribution

Perchlorate was detected above the MDL in 42 of the 49 samples collected during this investigation at concentrations ranging from 6.06 µg/kg to 3,140 µg/kg with an average concentration of 525 µg/kg (Table 5-5). The highest perchlorate concentration in soil detected during this investigation was at B14-PSB1/MW-99 adjacent to the Pad with Dry Well at 0.5-foot bgs (3,140 µg/kg). The concentration detected in this location is consistent with the data from previous investigations based on the depth and magnitude at which perchlorate was detected. The highest concentration of perchlorate at this feature was detected in 2004 at a concentration of 20,400 µg/kg at 5 feet bgs in B-14-HA2 beneath the pad near the dry well (Figure 5-17 on page 5-39).

Table 5-5 Soil and Groundwater Sampling Results - Pad with Dry Well (Feature B-14)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	1,4-Dioxane	1,1-DCE	TCE	Carbon Disulfide	Chloro-methane	Chloro-form
Matrix				*Soil*	*Water*						
Units				µg/kg	µg/L						
MCL				na	6		6	5		--	--
DWNL				na		3			160	--	--
B14-PSB1 / MW-99	B14-PSB1-0.5	0.5	11/17/2008	**3,140**	-	-	-	-	-	-	-
	B14-PSB1-5	5	11/17/2008	**2,930**	-	-	-	-	-	-	-
	B14-PSB1-10	10	11/17/2008	**57.9**	-	-	-	-	-	-	-
	B14-PSB1-15	15	11/17/2008	**224**	-	-	-	-	-	-	-
	B14-PSB1-20	20	11/17/2008	**983**	-	-	-	-	-	-	-
	B14-PSB1-25	25	11/18/2008	**610**	-	-	-	-	-	-	-
	B14-PSB1-30	30	11/18/2008	**132**	-	-	-	-	-	-	-
	B14-PGW1-35	35	11/18/08	-	**6,550**	-	-	-	-	-	-
	B14-PGW1-50	50	11/18/08	-	**1,050**	-	-	-	-	-	-
	B14-PGW1-67	67	11/18/08	-	**722**	-	-	-	-	-	-
	B14-PGW1-85	85	11/18/08	-	**58.3**	-	-	-	-	-	-
	P14-PGW1-100	100	11/19/08	-	**56.1**	-	**1.86**	**1.13**	<0.10	<0.30	<0.10
	P14-PGW1-120	120	11/19/08	-	**192**	-	**4.3**	**5.45**	<0.10	<0.30	<0.10
	B14-PGW1-130	130	11/20/08	-	**2.41**	-	<0.10	<0.10	<0.10	<0.30	<0.10
	B14-PGW1-147	147	11/20/08	-	<0.5	-	<0.10	<0.10	<0.10	<0.30	<0.10
	MW-99	134.5-144.5	02/11/09	-	**37.2**	<0.57	**3.79**	**2.12**	<0.10	<0.30	<0.10
	MW-99	134.5-144.5	3/10/2009	-	**166**	<0.61	**4.14**	**3.19**	<0.10	<0.30	<0.10
B14-PSB2 / MW-91	B14-PSB2-0.5	0.5	11/7/2008	**277**	-	-	-	-	-	-	-
	B14-PSB2-5	5	11/7/2008	**2,540**	-	-	-	-	-	-	-
	B14-PSB2-10	10	11/7/2008	**1,700**	-	-	-	-	-	-	-
	B14-PSB2-15	15	11/7/2008	**1,100**	-	-	-	-	-	-	-
	B14-PSB2-20	20	11/7/2008	**1,630**	-	-	-	-	-	-	-
	B14-PSB2-25	25	11/7/2008	**556**	-	-	-	-	-	-	-
	B14-PSB2-30	30	11/7/2008	**247**	-	-	-	-	-	-	-
	B14-PGW2-42	42	11/07/08	-	**1,580**	-	-	-	-	-	-
	MW-91	30-50	2/5/2009	-	**1,890**	**0.73**	<0.2	<0.2	<0.2	<0.2	<0.2
	MW-91	30-50	3/6/2009	-	**1,860**	**1.5**	**1.8**	**2.2**	**0.21**	**0.33**	**0.25**
B14-PSB3 / MW-88	B14-PSB3-0.5	0.5	11/10/2008	**58.7**	-	-	-	-	-	-	-
	B14-PSB3-5	5	11/10/2008	**47.6**	-	-	-	-	-	-	-
	B14-PSB3-10	10	11/10/2008	**26.0**	-	-	-	-	-	-	-
	B14-PSB3-15	15	11/10/2008	**83.7**	-	-	-	-	-	-	-
	B14-PSB3-20	20	11/10/2008	**25.6**	-	-	-	-	-	-	-
	B14-PSB3-25	25	11/10/2008	**26.5**	-	-	-	-	-	-	-
	B14-PSB3-30	30	11/10/2008	**112**	-	-	-	-	-	-	-
	B14-PGW3-45	45	11/10/08	-	**615**	-	-	-	-	-	-
	MW-88	30-50	2/6/2009	-	**454**	<0.59	<0.2	<0.2	<0.2	<0.2	<0.2
	MW-88	30-50	3/6/2009	-	**481**	<0.62	<0.2	<0.2	<0.2	<0.2	<0.2
B14-PSB4	B14-PSB4-0.5	0.5	11/7/2008	**110**	-	-	-	-	-	-	-
	B14-PSB4-5	5	11/7/2008	**2,610**	-	-	-	-	-	-	-
	B14-PSB4-10	10	11/7/2008	**427**	-	-	-	-	-	-	-
	B14-PSB4-15	15	11/7/2008	**208**	-	-	-	-	-	-	-
	B14-PSB4-20	20	11/7/2008	**114**	-	-	-	-	-	-	-
	B14-PSB4-25	25	11/7/2008	**96**	-	-	-	-	-	-	-
	B14-PSB4-30	30	11/7/2008	**159**	-	-	-	-	-	-	-
	B14-PGW4-43	43	11/07/08	-	**1,080**	-	-	-	-	-	-

Table 5-5 (Cont'd) Soil and Groundwater Sampling Results - Pad with Dry Well (Feature B-14)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	1,4-Dioxane	1,1-DCE	TCE	Carbon Disulfide	Chloro-methane	Chloro-form
Matrix				*Soil*	*Water*						
Units				µg/kg	µg/L						
MCL				na	6		6	5		--	--
DWNL				na		3			160	--	--
B14-PSB5	B14-PSB5-0.5	0.5	11/6/2008	**7.68**	-	-	-	-	-	-	-
	B14-PSB5-5	5	11/6/2008	**190**	-	-	-	-	-	-	-
	B14-PSB5-10	10	11/6/2008	**54.8**	-	-	-	-	-	-	-
	B14-PSB5-15	15	11/6/2008	**107**	-	-	-	-	-	-	-
	B14-PSB5-20	20	11/6/2008	**254**	-	-	-	-	-	-	-
	B14-PSB5-25	25	11/6/2008	**566**	-	-	-	-	-	-	-
	B14-PSB5-30	30	11/6/2008	**386**	-	-	-	-	-	-	-
	B14-PGW5-45	45	11/06/08	-	**2,320**	-	-	-	-	-	-
B14-SSB1	B14-SSB1-0.5	0.5	11/17/2008	<5.0	-	-	-	-	-	-	-
	B14-SSB1-5	5	11/17/2008	<5.0	-	-	-	-	-	-	-
	B14-SSB1-10	10	11/17/2008	<5.0	-	-	-	-	-	-	-
	B14-SSB1-15	15	11/17/2008	<5.0	-	-	-	-	-	-	-
	B14-SSB1-20	20	11/17/2008	**9.35**	-	-	-	-	-	-	-
	B14-SSB1-25	25	11/17/2008	**66.4**	-	-	-	-	-	-	-
	B14-SSB1-30	30	11/17/2008	**107**	-	-	-	-	-	-	-
	B14-PGWB-40	40	11/17/08	-	**548**	-	-	-	-	-	-
B14-SSB2	B14-SSB2-0.5	0.5	11/14/2008	<5.0	-	-	-	-	-	-	-
	B14-SSB2-5	5	11/14/2008	<5.0	-	-	-	-	-	-	-
	B14-SSB2-10	10	11/14/2008	<5.0	-	-	-	-	-	-	-
	B14-SSB2-15	15	11/14/2008	**6.06**	-	-	-	-	-	-	-
	B14-SSB2-20	20	11/14/2008	**17.7**	-	-	-	-	-	-	-
	B14-SSB2-25	25	11/14/2008	**24.6**	-	-	-	-	-	-	-
	B14-SSB2-30	30	11/14/2008	**35.4**	-	-	-	-	-	-	-
	B14-PGWC-40	40	11/17/08	-	**1,340**	-	-	-	-	-	-

Notes:
"Bold" - Indicates concentrations detected above the method detection
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
bgs - Below ground surface.
µg/kg - Micrograms per kilogram.
na - Not applicable.
µg/L - Micrograms per liter.
PSB - Primary soil boring.
SSB - Secondary soil boring.
(-) - Sample not analyzed for analyte.
(--) -MCL or DWNL not available.

As stated in the previous section, the areal extent of perchlorate impacted soil above 200 µg/kg at this feature is 15,350 ft^2 (Figure 5-16 on page 5-38). As shown in Table 5-5 and Figure 5-17 on page 5-39, perchlorate concentrations in soil decrease to concentrations below the IG above 20 feet bgs with the highest concentrations detected shallow at the source area (pad and dry well). The trend of soil perchlorate concentrations with depth in borings B14-SSB1 and B14-SSB2 seems to indicate a relatively thick capillary fringe with possible impacts from perchlorate contaminated groundwater or deeper lateral migration in the subsurface away from the source area (Table 5-5).

As previously mentioned, the shallow perchlorate impacts detected in B20-SSB4 located behind the Mix Station Bunker may have originated from surface water runoff from the Pad with Dry Well or possibly a separate surface release in this area. Based on the perchlorate distribution shown in Figures 5-16, 5-17, and 5-20 on pages 5-38, 5-39, and 5-42, it appears that perchlorate migrated to the northeast into the semi-enclosed basin in addition to the south towards the Mix Station Bunker. This migration pattern is also observed in the perchlorate groundwater concentrations shown in Figure 5-22 on page 5-45.

Figure 5-23 shows the vertical profile of perchlorate in soil along cross section line E-E'. The profile shows the shallow high concentrations detected at the pad and dry well along with the slightly deeper elevated concentrations detected out into the semi-enclosed basin at B14-PSB2/MW-91. As stated in Section 5.4.1.2, it is assumed that the significant decrease in permeability of the Mount Eden formation in the surrounding foothills coupled with the thickening of the higher permeability alluvium moving out of the canyons explains the perchlorate migration pattern observed at this feature.

Groundwater Sampling Results and Contaminant Distribution

During drilling activities, perchlorate was detected above the MDL in 13 of the 14 groundwater samples collected at concentrations ranging from 2.41 to 6,550 µg/L, with an average concentration of 1,240 µg/L (Table 5-5). The depth-discrete groundwater results from B14-PSB1/MW-99 indicate that the concentrations decrease with depth, from 6,550 µg/L at 45 feet bgs to below the MDL (0.5 µg/L) at 147 feet bgs. Subsequent to the field investigation, groundwater samples were collected from the monitoring wells installed during this investigation and analyzed for perchlorate, VOCs, and 1,4-dioxane. The primary Site groundwater COPCs, perchlorate, 1,4-dioxane, TCE, and 1,1-DCE were detected at this feature. Similar to trends observed in the groundwater at Feature B-10, the highest perchlorate concentrations were detected at first water decreasing an order of magnitude within the next two samples and the concentrations of 1,4-dioxane, TCE, and 1,1-DCE at this feature do not appear to be elevated and are consistent with the BPA groundwater plume migrating into this area. The perchlorate concentrations detected at first water are shown in Figure 5-22 on page 5-45.

5.4.1.4 Feature B-20 - Pad South of Mix Station Bunker

The Pad South of Mix Station Bunker (Feature B-20) is located in the central portion of Historical Operational Area B. This concrete pad appears to have been used as a utility pad.

Previous Results

Three borings were drilled and sampled between 5 and 35 feet bgs at this location during previous investigations (Tetra Tech, 2005b, 2009a). Samples were analyzed for one or more of the following: VOCs, SVOCs, perchlorate, 1,4-dioxane, Title 22 metals, and PCBs. SVOCs, 1,4-dioxane, and PCBs were not detected at concentrations above their respective RLs. Perchlorate concentrations ranged from 68.2 to 402 µg/kg. One VOC (acetone) was detected at a concentration of 49 µg/kg in a single sample and may have been associated with laboratory cross-contamination. A table of soil analytical results from the previous investigations is included in Table H-7 in Appendix H.

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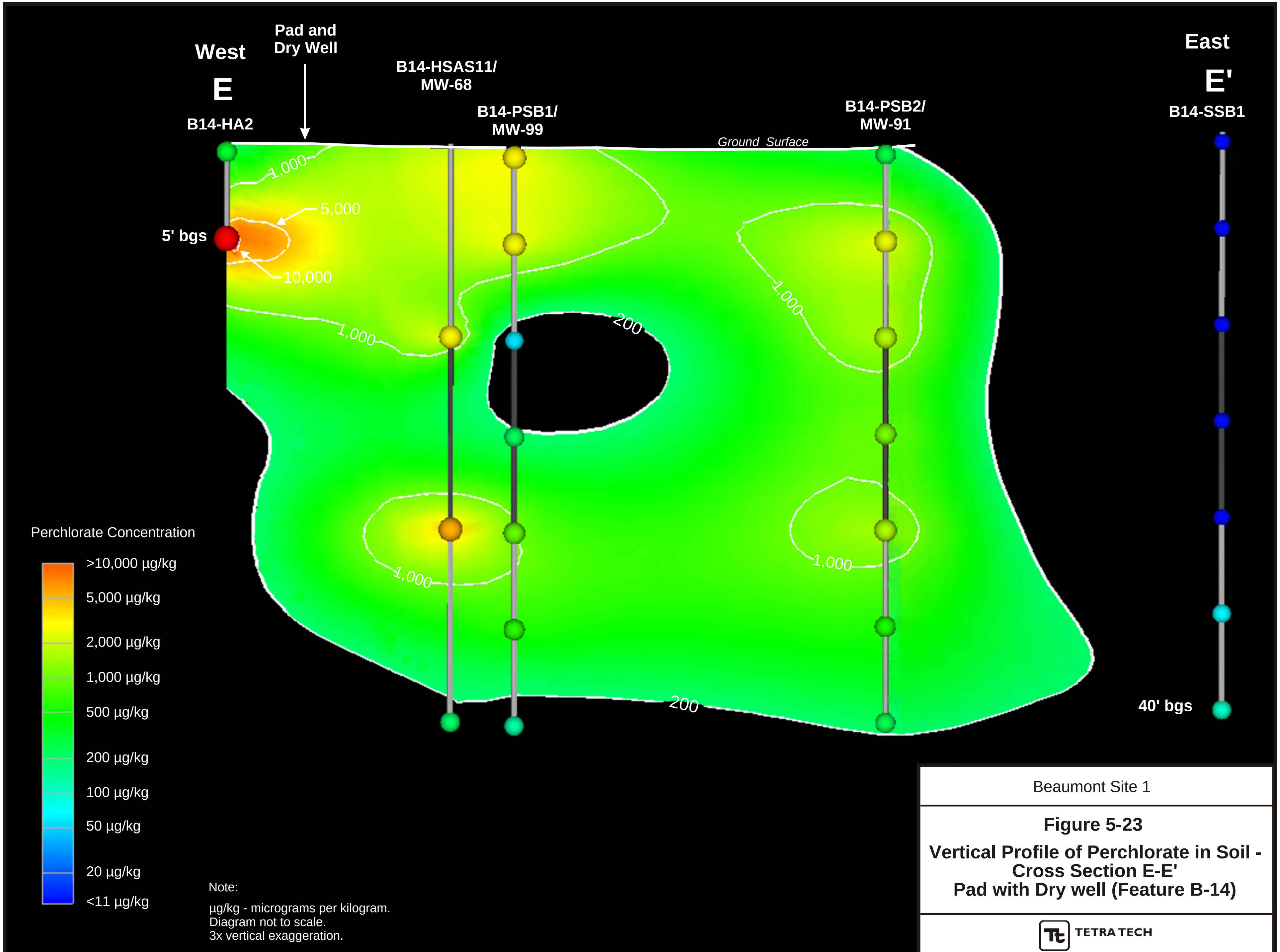

Beaumont Site 1

Figure 5-23

Vertical Profile of Perchlorate in Soil - Cross Section E-E' Pad with Dry well (Feature B-14)

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Perchlorate concentrations are relatively low in comparison to the Propellant Mixing Station (Feature B-10) to the northwest where perchlorate was detected at 4,610 µg/kg and the Pad with Dry Well (Feature B-14) to the north where perchlorate was detected at 20,400 µg/kg.

Based on the contaminant distribution from previous investigations, the greatest extent of perchlorate in soil is at 10 and 30 feet bgs which coincides with the highest detections. The information collected to date indicated that further investigation was needed to complete the characterization of perchlorate in soil, determine a possible connection with either Feature B-10 or B-14, and to delineate downgradient groundwater impacts from both the Propellant Mixing Station and the Pad with Dry Well.

Soils encountered at the Pad South of Mix Station Bunker are generally very fine-grained sands with a clay layer between 25 and 30 feet bgs. Based on the seismic refraction profiles, the alluvium is approximately 25-feet thick below this feature with moderately weathered Mount Eden formation from 25 to 40 feet bgs, and dry, slightly weathered Mount Eden formation below 40 feet.

Investigation Activities

Five (5) primary borings and 7 secondary borings were drilled to approximately 30 feet bgs during this investigation using the HSA and DP method (Figure 5-12 on page 5-31). Soil samples were collected at 0.5-foot and every 5 feet down to 30 feet bgs and analyzed for perchlorate. Groundwater grab samples were collected at first water from one boring (B20-PSB6/MW-90) at 45 feet bgs. One shallow monitoring well (MW-90) was installed with a 20-foot screened interval from 35 to 55 feet bgs to monitor perchlorate impacts migrating from the Propellant Mixing Station (Feature B-10) and the Pad with Dry Well (Feature B-14). The well construction diagram is included in Appendix D.

Geology and Hydrogeology

The Pad South of Mix Station Bunker (Feature B-20) is set in the field southeast of the Propellant Mixing Station (Feature B-10) and southwest of the Pad with Dry Well (Feature B-14). In real space it appears to be relatively flat but Figure 5-12 on page 5-31 shows the one-foot contour elevations which drop slightly to the southwest showing the preferred surface water pathway along the road. The subsurface geology based on the boring logs (Appendix D) is shown on the idealized cross sections (Figure 5-13 on page 5-33). The area is typical of a low energy fluvial depositional environment composed mostly of silty sand to sandy silt with occasional clay layers. Fine grained sediment dominates the area around the Pad South of Mix Station Bunker. The source rocks for most of the recent sediment in this area are likely the Mount Eden hills just north of this feature and the granitic rocks in the foothills to the east. Mount Eden formation was not encountered in any of the borings drilled at this feature during the current investigation.

Water was encountered at 45 feet bgs in the southernmost boring at this feature, B20-PSB6/MW-90 which was converted to monitoring well MW-90. The water in the boring was slightly under pressure as there was more than 30 feet of clay in the boring before water was encountered. Water levels taken in February 2009 show water at approximately 39 feet bgs. The groundwater contours for the area include data collected from the Pad with Dry Well (Feature B-14) and the Propellant Mixing Station (Feature B-10) on Figure 5-15 on page 5-35. The figure shows water moving generally southwest. It moves from the Pad with Dry Well (Feature B-14) through the Pad South of Mix Station Bunker (Feature B-20) possibly up into the Propellant Mixing Station (Feature B-10) and also to the southwest. The subsurface movement appears to generally follow the topographic gradient in this area.

Soil Sampling Results and Contaminant Distribution

Perchlorate was detected above the MDL (5 to 6.11 µg/kg) in 48 of the 53 soil samples collected at concentrations ranging from 5.25 to 4,050 µg/kg, with an average concentration of 367 µg/kg (Table 5-6). Although it appears from the tabular results that high concentrations of perchlorate were detected at the Pad South of Mixing Station (Feature B-20) in comparison to previous investigations, the high concentrations were detected in two borings (B20-SSB3 and B20-SSB4) that are located to the north of this feature and are associated with impacts from the Propellant Mixing Station (Feature B-10) and the Pad with Dry Well (Feature B-14) (Figure 5-16 on page 5-38 and Figure 5-17 on page 5-39). Figure 5-24 shows the vertical profile of perchlorate along cross section line D-D' which follows the road north of Feature B-20 across the entrance to the Propellant Mixing Station (Feature B-10) canyon. The elevated concentrations (4,050 and 3,570 µg/kg) detected at 5 and 10 feet bgs, respectively, most likely represent impacts from Feature B-10 or Feature B-14. As stated in Section 5.4.1.2, the perchlorate distribution at the Propellant Mixing Station (Feature B-10), the Pad with Dry Well (Feature B-14), and the Pad South of Mixing Station (Feature B-20) indicates that the perchlorate impacts at Feature B-20 originated from Features B-10 and B-14. Perchlorate concentrations in the soil borings installed around the pad at Feature B-20 were all less than the IG of 780 µg/kg. Based on the additional borings installed during the DSI, the perchlorate impacts at this feature have been delineated to the IG.

Groundwater Sampling Results and Contaminant Distribution

During drilling activities, perchlorate was detected at a concentration of 288 µg/L in the groundwater grab sample collected at first water (45 feet bgs) in B20-PSB6/MW-90 (Table 5-6). As previously stated, MW-90 was installed at first water to monitor perchlorate impacts migrating from the Propellant Mixing Station (Feature B-10) and the Pad with Dry Well (Feature B-14). Subsequent to the field investigation, additional groundwater samples were collected from MW-90. The primary Site groundwater COPCs,

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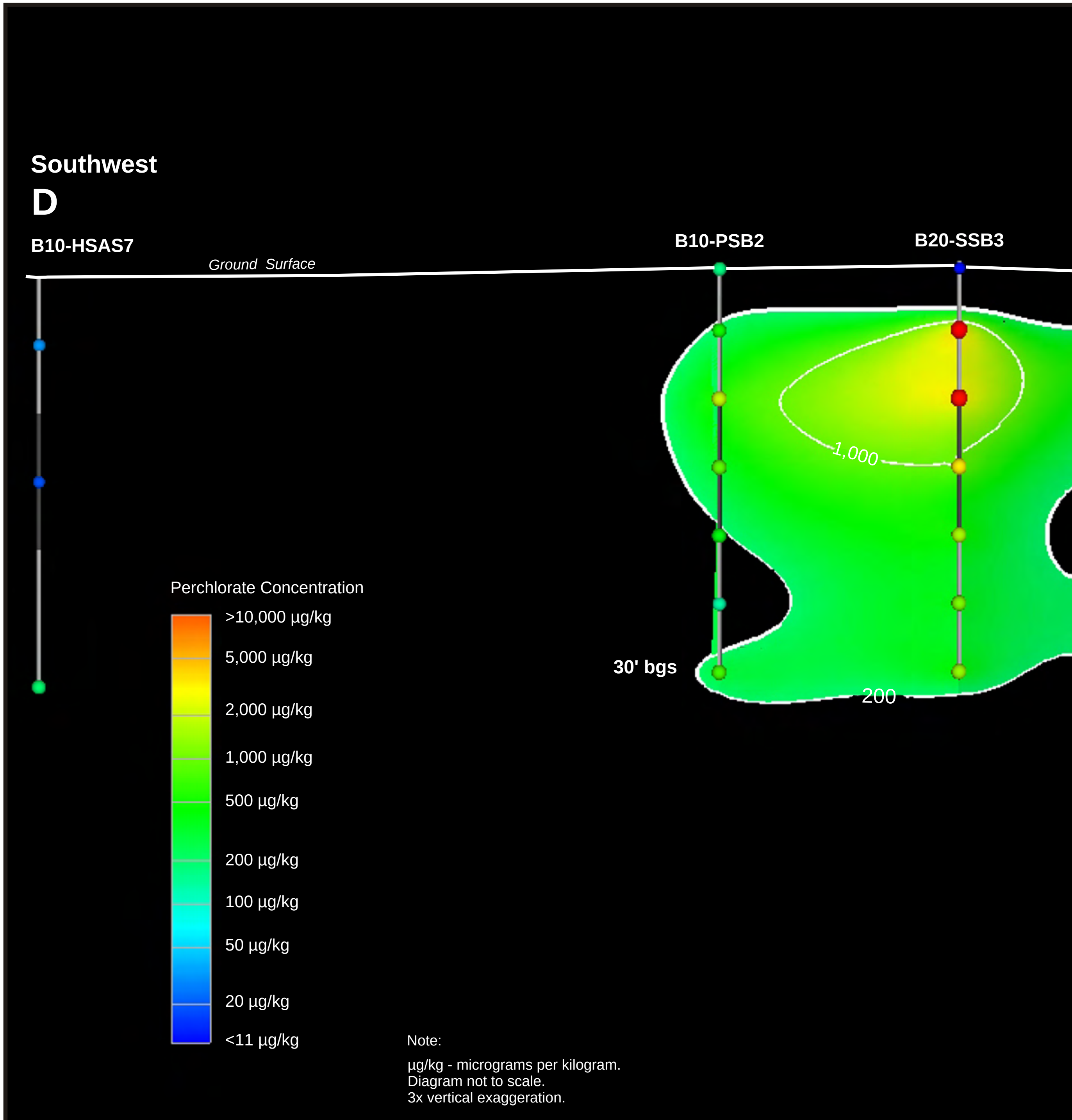

Beaumont Site 1

Figure 5-24

Vertical Profile of Perchlorate in Soil - Cross Section D-D' Pad South of Mix Station Bunker (Feature B-20)

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perchlorate, TCE, and 1,1-DCE, were detected in groundwater samples collected from this well. The concentrations of 1,4-dioxane, TCE, and 1,1-DCE detected in MW-90 are relatively low and consistent with the BPA groundwater plume (Table 5-6). However, the magnitude of perchlorate detected in this well could represent perchlorate migration south from the Pad with Dry Well (Feature B-14), given the concentration gradient or the BPA groundwater plume migrating into this area from the south (Figure 5-22 on page 5-45).

Table 5-6 Soil and Groundwater Sampling Results - Pad South of Mix Station Bunker (Feature B-20)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	1,1-DCE	TCE	Chloro-form
Matrix				***Soil***	***Water***			
Units				µg/kg	µg/L			
MCL				na	6	6	5	--
B20-PSB1	B20-PSB1-0.5	0.5	9/24/2008	<5.11	-	-	-	-
	B20-PSB1-5	5	9/24/2008	**46.0**	-	-	-	-
B20-PSB2	B20-PSB2-0.5	0.5	9/24/2008	<5.10	-	-	-	-
	B20-PSB2-5	5	9/24/2008	**73.4**	-	-	-	-
B20-PSB3	B20-PSB3-0.5	0.5	9/24/2008	**12.9**	-	-	-	-
	B20-PSB3-5	5	9/24/2008	**43.7**	-	-	-	-
B20-PSB4	B20-PSB4-0.5	0.5	9/25/2008	**5.25**	-	-	-	-
	B20-PSB4-5	5	9/25/2008	**49**	-	-	-	-
	B20-PSB4-10	10	9/25/2008	**82.5**	-	-	-	-
	B20-PSB4-15	15	9/25/2008	**56.9**	-	-	-	-
	B20-PSB4-20	20	9/25/2008	**115**	-	-	-	-
	B20-PSB4-25	25	9/25/2008	**193**	-	-	-	-
	B20-PSB4-30	30	9/25/2008	**183**	-	-	-	-
B20-PSB5	B20-PSB5-0.5	0.5	9/25/2008	**635**	-	-	-	-
	B20-PSB5-5	5	9/25/2008	**30.1**	-	-	-	-
	B20-PSB5-10	10	9/25/2008	**19.8**	-	-	-	-
	B20-PSB5-15	15	9/25/2008	**92.9**	-	-	-	-
	B20-PSB5-20	20	9/25/2008	**289**	-	-	-	-
	B20-PSB5-25	25	9/25/2008	**106**	-	-	-	-
	B20-PSB5-30	30	9/25/2008	**251**	-	-	-	-
B20-PSB6 / MW-90	B20-PGW6-45	45	11/12/08	-	**288**	-	-	-
	MW-90	35-55	2/5/2009	-	**200**	**2.4**	**3.1**	**0.24**
	MW-90	35-55	3/6/2009	-	**200**	<0.2	<0.2	<0.2
B20-SSB1	B20-SSB1-0.5	0.5	10/2/2008	**9.16**	-	-	-	-
	B20-SSB1-5	5	10/2/2008	**798**	-	-	-	-
	B20-SSB1-10	10	10/2/2008	**254**	-	-	-	-
	B20-SSB1-15	15	10/2/2008	**166**	-	-	-	-
	B20-SSB1-20	20	10/2/2008	**120**	-	-	-	-
	B20-SSB1-25	25	10/2/2008	**297**	-	-	-	-
	B20-SSB1-30	30	10/2/2008	**178**	-	-	-	-
B20-SSB18	B20-SSB18-0.5	0.5	11/11/2008	<5.0	-	-	-	-
	B20-SSB18-5	5	11/11/2008	<5.0	-	-	-	-
	B20-SSB18-10	10	11/11/2008	**18.3**	-	-	-	-
	B20-SSB18-15	15	11/11/2008	**721**	-	-	-	-
	B20-SSB18-20	20	11/11/2008	**170**	-	-	-	-
	B20-SSB18-25	25	11/11/2008	**40.6**	-	-	-	-
	B20-SSB18-30	30	11/11/2008	**240**	-	-	-	-

Table 5-6 (Cont'd) Soil and Groundwater Sampling Results - Pad South of Mix Station Bunker (Feature B-20)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	1,1-DCE	TCE	Chloro-form
Matrix				***Soil***	***Water***			
Units				µg/kg	µg/L			
MCL				na	6	6	5	--
B20-SSB19	B20-SSB19-0.5	0.5	11/11/2008	**227**	-	-	-	-
	B20-SSB19-5	5	11/11/2008	<5.0	-	-	-	-
	B20-SSB19-10	10	11/11/2008	**16.8**	-	-	-	-
	B20-SSB19-15	15	11/11/2008	**115**	-	-	-	-
	B20-SSB19-20	20	11/11/2008	**79.9**	-	-	-	-
	B20-SSB19-25	25	11/11/2008	**51.9**	-	-	-	-
	B20-SSB19-30	30	11/11/2008	**202**	-	-	-	-
B20-SSB2	B20-SSB2-0.5	0.5	10/2/2008	<5.22	-	-	-	-
	B20-SSB2-5	5	10/2/2008	**6.73**	-	-	-	-
	B20-SSB2-10	10	10/2/2008	**349**	-	-	-	-
	B20-SSB2-15	15	10/2/2008	**22.2**	-	-	-	-
	B20-SSB2-20	20	10/2/2008	<6.11	-	-	-	-
B20-SSB3	B20-SSB3-0.5	0.5	10/21/2008	<5.32	-	-	-	-
	B20-SSB3-5	5	10/21/2008	**4,050**	-	-	-	-
	B20-SSB3-10	10	10/21/2008	**3,570**	-	-	-	-
	B20-SSB3-15	15	10/21/2008	**1,010**	-	-	-	-
	B20-SSB3-20	20	10/21/2008	**542**	-	-	-	-
	B20-SSB3-25	25	10/21/2008	**413**	-	-	-	-
	B20-SSB3-30	30	10/21/2008	**479**	-	-	-	-
B20-SSB4	B20-SSB4-0.5	0.5	10/20/2008	**1,430**	-	-	-	-
	B20-SSB4-5	5	10/20/2008	**522**	-	-	-	-
	B20-SSB4-10	10	10/20/2008	**76.3**	-	-	-	-
	B20-SSB4-15	15	10/20/2008	**110**	-	-	-	-
	B20-SSB4-20	20	10/20/2008	**217**	-	-	-	-
	B20-SSB4-25	25	10/20/2008	**41.8**	-	-	-	-
	B20-SSB4-30	30	10/20/2008	**74.4**	-	-	-	-
B20-SSB5	B20-SSB5-0.5	0.5	10/20/2008	**47.2**	-	-	-	-
	B20-SSB5-5	5	10/20/2008	**172**	-	-	-	-
	B20-SSB5-10	10	10/20/2008	**222**	-	-	-	-
	B20-SSB5-15	15	10/20/2008	**54.3**	-	-	-	-
	B20-SSB5-20	20	10/20/2008	**26**	-	-	-	-
	B20-SSB5-25	25	10/20/2008	**52.9**	-	-	-	-
	B20-SSB5-30	30	10/20/2008	**19.0**	-	-	-	-

Notes:

"Bold" - Indicates concentrations detected above the method detection limit.
bgs - Below ground surface.
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
µg/kg - Micrograms per kilogram.
na - Not applicable.
µg/L - Micrograms per liter.
PSB - Primary soil boring.
SSB - Secondary soil boring.
(-) - Sample not analyzed for analyte.
(--) - MCL or DWNL not available.

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5.4.1.5 Feature B-11 - Fuel Slurry Station

The Fuel Slurry Station (Building 317) is located in the western central portion of Historical Operational Area B. It was used primarily to weigh and premix liquid fuel prior to propellant mixing activities. Perchlorate and solvents (primarily butadiene) were used at this feature.

Previous Results

Nine soil borings were drilled with two to three soil gas probes installed in each boring during previous investigations (Tetra Tech; 2002, 2005b, 2009a). The soil gas probes were installed between 5 and 30 feet bgs during these previous investigations. Soil samples collected from the borings were analyzed for VOCs, SVOCs, 1,4-dioxane, and perchlorate. 1,4-Dioxane was not detected at concentrations above its RL in any of the samples collected. Perchlorate was detected at concentrations ranging from 29.2 to 725 µg/kg. VOCs including 1,1-DCA, 1,1,1-TCA, acetone, benzene, and toluene were detected in soil at concentrations ranging from 0.93 to 50 µg/kg.

Several VOCs were detected in soil gas at the Fuel Slurry Station (Feature B-11) with concentrations increasing with depth with the highest concentrations detected near the water table. The groundwater COPCs, TCE and 1,1-DCE, were detected at concentrations up to 4,150 and 5,270 µg/m^3, respectively. TCE was detected at concentrations ranging from 223 to 4,150 µg/m^3, and was the only analyte detected above California Human Health Screening Levels (CHHSLs). Tables of the soil and soil gas analytical results from the 2004 and 2007 investigations are included in Tables H-7 and H-15 in Appendix H.

One groundwater grab sample was collected and analyzed for perchlorate and VOCs. Perchlorate was detected in the grab sample at a concentration of 1,980 µg/L. TCE and 1,1-DCE were also detected in the grab sample at concentrations of 110 and 31 µg/L, respectively. Low-level detections (<3 µg/L) of chloroform, 1,1-DCA, 1,2-DCA, cis-1,2-DCE, 1,1,1-TCA, 1,1,2-TCA, and PCE were also detected in the grab sample. The concentrations reported for perchlorate, 1,1-DCE and TCE, are similar to groundwater sampling results obtained from nearby wells monitoring the groundwater plume originating at the BPA.

Based on the contaminant distribution from previous investigations, the greatest extent of perchlorate in soil is at 20 and 30 feet bgs which coincides with the highest detected concentrations. The information collected to date indicated that further investigation was needed to complete the characterization of perchlorate in soil since the higher concentrations of perchlorate appear to be focused immediately under the Fuel Slurry Station (Feature B-11) and to the south but are undefined.

At the Fuel Slurry Station (Feature B-11), the alluvium is at least 40-feet thick based on the deepest boring. However, the thickness of the alluvium is unknown since the Mount Eden formation was not encountered in any borings installed at this feature. Groundwater was encountered at approximately 27 to

30 feet bgs during the 2007 investigation. Groundwater has fluctuated in the area from less than 13 feet bgs to greater than 38 feet bgs since 1992.

Investigation Activities

Four primary and 8 secondary borings were drilled between 20 and 25 feet bgs using the HSA and DP method (Figure 5-25). Five additional secondary borings were hand augered to 5 feet bgs. An attempt was made to drill two of the secondary borings to 30 feet bgs with additional samples collected at 25 and 30 feet bgs. The sediment was too moist to collect samples any deeper than 25 feet bgs with any certainty that the soil samples were not compromised by the possible presence of groundwater. Soil samples were collected at the surface (~0.5-foot bgs), 5 feet bgs and every 5 feet thereafter and analyzed for perchlorate.

A deviation from the Work Plan at this feature included the evaluation of a potential perchlorate smear zone in the RMPA due to the large groundwater fluctuations of perchlorate impacted groundwater. In order to evaluate this, two locations were selected next to existing groundwater monitoring wells where the groundwater elevations and perchlorate concentrations had been monitored over time. One location was selected downgradient of the BPA, which will be discussed with the BPA (Feature C-22) results in Section 5.4.2.1, and the second location was selected near MW-05 located approximately 900 feet southwest of the Fuel Slurry Station (Feature B-11). Soil samples were collected from a single boring near MW-05 from 0.5-foot bgs and every 5 feet down to the water table (~ 20 feet bgs). Soil samples were analyzed for perchlorate, with only the first three samples (0.5, 5, and 10 feet bgs) analyzed for 1,4-dioxane. In addition to the soil samples, a first water sample was collected and analyzed for perchlorate and 1,4-dioxane. Due to the shallow perchlorate detections at this location (BG-SBA), five step out borings (BG-SBA1, 2, 3, 4, and 7) were also installed at this location (Figure 5-27).

Geology

The Fuel Slurry Station (Feature B-11) is located approximately 1,200 feet north-northwest of the Motor Washout Area (Feature B-9). Topographically the two areas appear to be very similar. This is demonstrated in the subsurface soils as well. Sediment encountered at the Fuel Slurry Station was typical of a low energy fluvial depositional environment. Fine- to medium-grained sands, silt and occasional clay lenses were encountered. Silty sand seems to dominate the area but the siliciclastic sediment oscillates between silty sand and sandy silt. The cross section locations and idealized cross sections through this area are presented in Figures 5-25 and 5-26, respectively. The Mount Eden formation was not encountered in any of the borings installed at the Fuel Slurry Station. In November 2008, the groundwater level recorded in a nearby well (MW-66) was approximately 31 feet bgs. Although some of the soil samples were moist near the bottom of the boring, groundwater was not encountered in any of the soil borings installed at the Fuel Slurry Station area during this investigation.

0 30 60Feet

1 inch = 60 feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, / Soil Vapor, 2007
- Soil Boring, / Soil Vapor, 2004
- Soil Vapor, 2002
- Well Location
- Geologic Cross Section Location
- 2130 Ground Surface Elevation Contour
- Historic Feature Location
- B Geologic Cross Section Line Beginning and End Points

Note: Ground surface elevation is relative to mean sea level (msl)

- Ground surface elevation derived from survey conducted by Hillwig and Goodrow

Beaumont Site 1

Figure 5-25
Soil Borings and Cross Section Locations - Fuel Slurry Station (Fetaure B-11)

TETRA TECH

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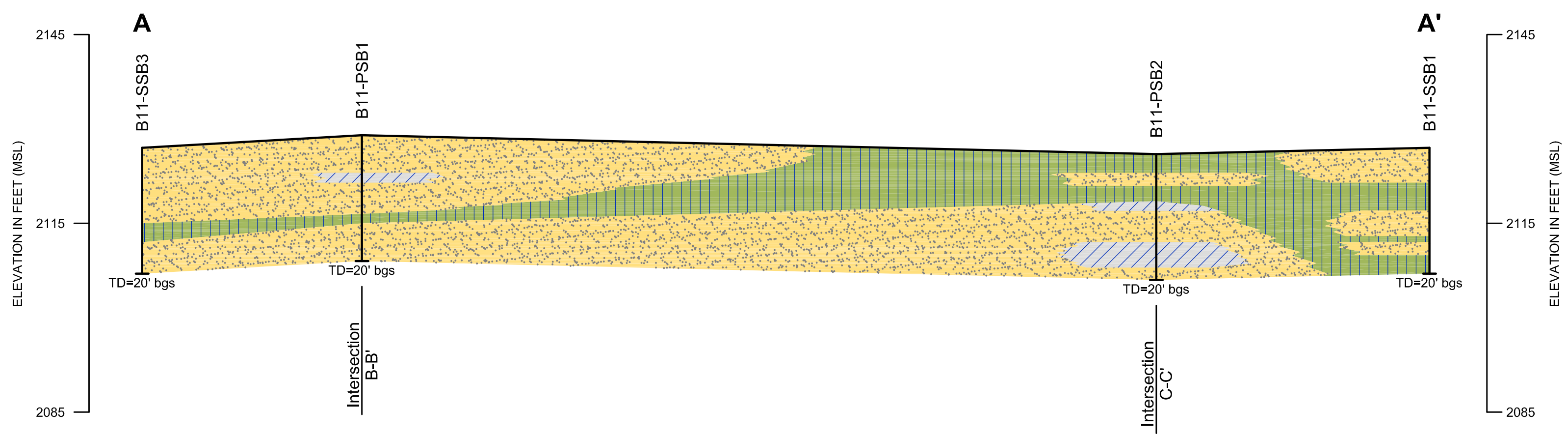
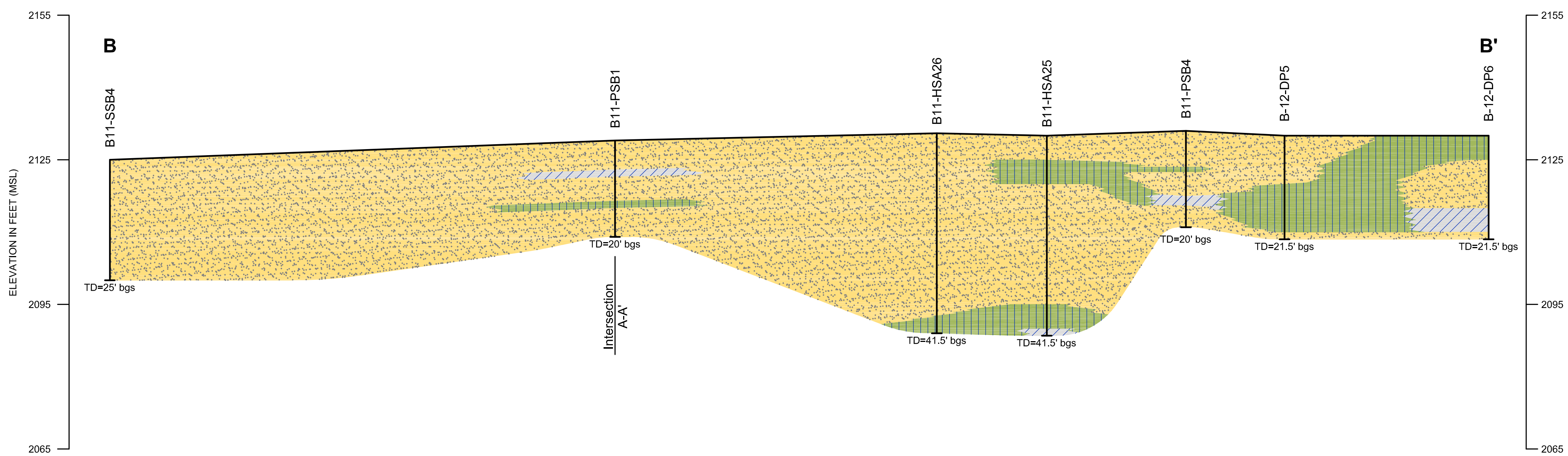
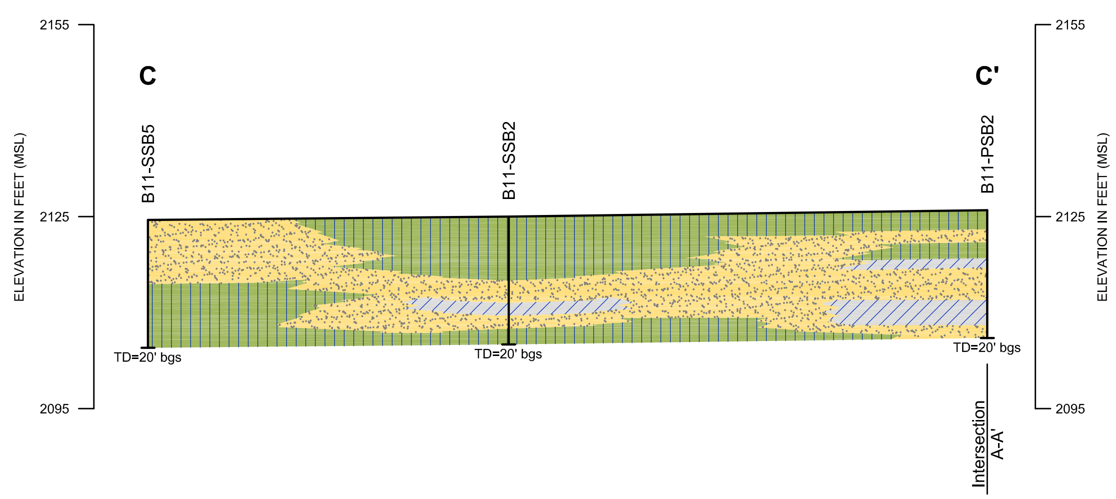
X:\GIS\LOCKHEED 22288-0306\CAD\B11 XSEC AA_BB_CC.DWG







LEGEND

Quaternary Alluvium

- Clay (CL)
- Silt (ML)
- Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

- bgs — below ground surface
- DP — Direct Push - Part of the nomenclature for borings installed using a direct push rig during the soil investigation in 2004.
- HSA — Hollow Stem Auger - Part of the nomenclature for borings installed using a hollow stem auger rig during the soil investigation in 2004.
- PSB — Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.
- SSB — Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.
- MSL — Mean sea level
- TD=#' — Total Boring Depth (feet)
- Boring
- Intersection A-A' — location where cross sections intersect

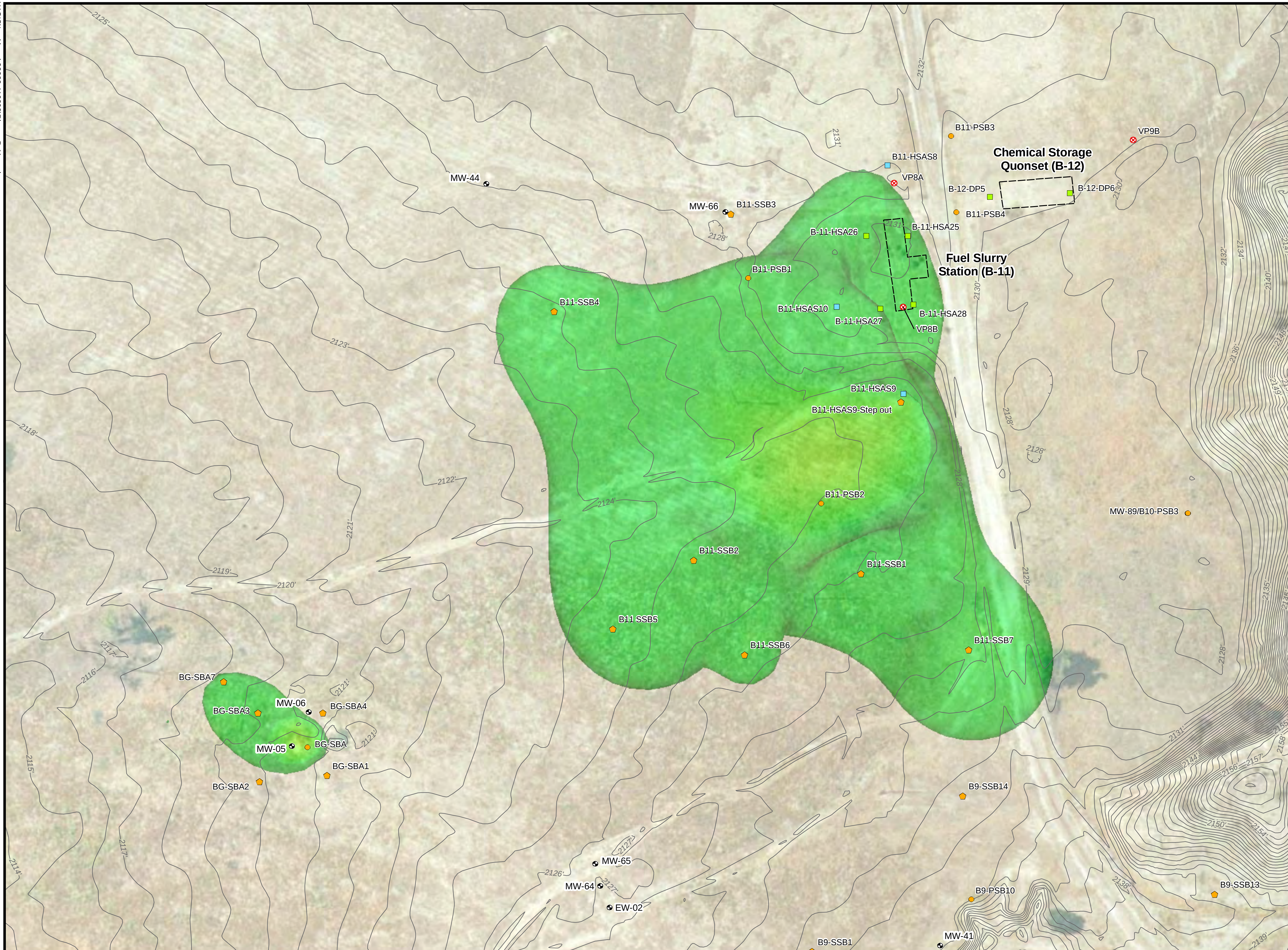
0 60 30

Scale in Feet
Vertical Exaggeration = 2x Horizontal

Beaumont Site 1

Figure 5-26
Idealized Geologic Cross Sections A-A', B-B', and C-C'
Fuel Slurry Station (Feature B11)

TETRA TECH



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0 50 100 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring / Soil Vapor, 2007
- Soil Boring / Soil Vapor, 2004
- Soil Vapor, 2002
- Well Location
- Ground Surface Elevation Contour
- Historic Feature Location

Perchlorate Concentration

- >10,000 µg/kg
- 3,000 µg/kg
- 1,000 µg/kg
- 300 µg/kg
- 100 µg/kg
- 30 µg/kg
- <11 µg/kg

Note:

µg/kg - Micrograms per kilogram.

Ground surface elevation contour lines derived from survey conducted by Hillwig and Goodrow.

Ground surface elevation contour lines relative to mean sea level (msl).

Beaumont Site 1

Figure 5-27
Lateral Extent of Perchlorate in Soil Above 200 µg/kg from 0-40 ft bgs Fuel Slurry Station (Feature B-11)

TETRA TECH

Soil Sampling Results

During the drilling activities, perchlorate was detected above the MDL (5 to 6 µg/kg) in 64 of the 75 samples collected ranging from 9.22 to 8,500 µg/kg with an average concentration of 431 µg/kg (Table 5-7). Figures 5-27 on page 5-62 presents the areal distribution of perchlorate in soil greater than 200 µg/kg based on the 3-D modeling of all soil sampling results available since 2004. As shown in this figure, the extent of perchlorate impacts in soil extends out from the former operational area to the south and west with the highest concentration detected approximately 300 feet south at B11-PSB2. The total area of impacted soil above 200 µg/kg is approximately 232,400 ft^2 or 5.3 acres.

Figure 5-28 shows the perchlorate concentration contours at depths of 0.5, 5, 10-15, 20, and 25 feet bgs. Results from the Chemical Storage and Quonset Building (Feature B-12) were included to assist in the definition of perchlorate impacts due to their close proximity. The lateral distribution of perchlorate above 200 µg/kg appears to be the most extensive between 20 and 25 feet bgs. However, two of the highest detections of perchlorate (8,500 and 1,850 µg/kg) were detected at 5 feet bgs. As shown in Figure 5-28, the highest concentrations in the near surface (0.5-foot bgs) samples were detected outside of the Fuel Slurry Station (Feature B-11) to the southwest (BG-SBA) and could be a result of surface runoff. The lateral distribution then begins to increase at 5 feet bgs and is the most wide spread between 20 and 25 feet bgs. The depth to groundwater in August 2008 in a nearby well (MW-66) was 32 feet bgs and has been as shallow as l2 feet bgs April 1995. The rise and fall of the groundwater at this feature may have played a role in the distribution or re-distribution of the perchlorate impacts in soil.

Figures 5-29 through 31 present 3-D visualizations of the perchlorate-affected soil above 200 µg/kg at the Fuel Slurry Station (Feature B-11)with views from the north, east, and west. The figures also show the general boring and sample locations with the relative magnitude of the perchlorate concentrations detected. For boring names and exact concentrations detected, refer to Figure 5-28. Based on the 3-D modeling of the perchlorate, the majority of the perchlorate mass appears to have migrated south and west away from the Fuel Slurry Station. In addition, the shallow impacts detected at BG-SBA is defined in all directions and does not appear to be connected to the Fuel Slurry Station based on the data collected (Figures 5-27, 5-28, and 5-29). However, it is assumed based on topography that the shallow perchlorate impacts detected at this location would have originated either from the Fuel Slurry Station to the northeast or the Motor Washout Area (Feature B-9) to the southeast. Figure 5-32 shows the vertical profile for perchlorate in soil along cross section line A-A’ through the area in which the highest concentration was detected. Based on the additional characterization data collected during this investigation, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg.

Table 5-7 Soil and Groundwater Sampling Results - Fuel Slurry Station (Feature B-11)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	Perchlorate	1,4-Dioxane
Matrix				***Soil***		***Water***	
Units				mg/kg	µg/kg	µg/L	
MCL				na	na	6	
DWNL				na	na		3
B11-HSAS9 - step out	B11-HSAS9-0.5	0.5	12/12/2008	-	**550**	-	-
	B11-HSAS9-5	5	12/12/2008	-	**150**	-	-
	B11-HSAS9-10	10	12/12/2008	-	**604**	-	-
B11-PSB1	B11-PSB1-0.5	0.5	9/24/2008	-	**9.22**	-	-
	B11-PSB1-5	5	9/24/2008	-	**101**	-	-
	B11-PSB1-10	10	9/24/2008	-	**546**	-	-
	B11-PSB1-15	15	9/24/2008	-	**941**	-	-
	B11-PSB1-20	20	9/24/2008	-	**363**	-	-
B11-PSB2	B11-PSB2-0.5	0.5	9/24/2008	-	**350**	-	-
	B11-PSB2-5	5	9/24/2008	-	**8,500**	-	-
	B11-PSB2-10	10	9/24/2008	-	**290**	-	-
	B11-PSB2-15	15	9/24/2008	-	**709**	-	-
	B11-PSB2-20	20	9/24/2008	-	**433**	-	-
B11-PSB3	B11-PSB3-0.5	0.5	9/24/2008	-	<5.04	-	-
	B11-PSB3-5	5	9/24/2008	-	<5.28	-	-
	B11-PSB3-10	10	9/24/2008	-	<5.15	-	-
	B11-PSB3-15	15	9/24/2008	-	<5.62	-	-
	B11-PSB3-20	20	9/24/2008	-	<5.36	-	-
B11-PSB4	B11-PSB4-0.5	0.5	9/24/2008	-	<5.87	-	-
	B11-PSB4-5	5	9/24/2008	-	<5.15	-	-
	B11-PSB4-10	10	9/24/2008	-	<5.19	-	-
	B11-PSB4-15	15	9/24/2008	-	<5.61	-	-
	B11-PSB4-20	20	9/24/2008	-	<5.45	-	-
B11-SSB1	B11-SSB1-0.5	0.5	10/2/2008	-	**52.6**	-	-
	B11-SSB1-5	5	10/2/2008	-	**31.8**	-	-
	B11-SSB1-10	10	10/2/2008	-	**95.9**	-	-
	B11-SSB1-15	15	10/2/2008	-	**45.3**	-	-
	B11-SSB1-20	20	10/2/2008	-	**325**	-	-
B11-SSB2	B11-SSB2-0.5	0.5	10/2/2008	-	**51.2**	-	-
	B11-SSB2-5	5	10/2/2008	-	**165**	-	-
	B11-SSB2-10	10	10/2/2008	-	**46.5**	-	-
	B11-SSB2-15	15	10/2/2008	-	**1,850**	-	-
	B11-SSB2-20	20	10/2/2008	-	**570**	-	-
B11-SSB3	B11-SSB3-0.5	0.5	10/3/2008	-	**31.8**	-	-
	B11-SSB3-5	5	10/3/2008	-	**47**	-	-
	B11-SSB3-10	10	10/3/2008	-	**10.0**	-	-
	B11-SSB3-15	15	10/3/2008	-	**9.91**	-	-
	B11-SSB3-20	20	10/3/2008	-	**24.4**	-	-
B11-SSB4	B11-SSB4-0.5	0.5	10/20/2008	-	**61.9**	-	-
	B11-SSB4-5	5	10/20/2008	-	**419**	-	-
	B11-SSB4-10	10	10/20/2008	-	**781**	-	-
	B11-SSB4-15	15	10/20/2008	-	**347**	-	-
	B11-SSB4-20	20	10/20/2008	-	**62.9**	-	-

Table 5-7 (Cont'd) Soil and Groundwater Sampling Results - Fuel Slurry Station (Feature B-11)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	Perchlorate	1,4-Dioxane
Matrix				***Soil***		***Water***	
Units				mg/kg	µg/kg	µg/L	
MCL				na	na	6	
DWNL				na	na		3
B11-SSB5	B11-SSB5-0.5	0.5	10/20/2008	-	**33.8**	-	-
	B11-SSB5-5	5	10/20/2008	-	**48.1**	-	-
	B11-SSB5-10	10	10/20/2008	-	**50.3**	-	-
	B11-SSB5-15	15	10/20/2008	-	**519**	-	-
	B11-SSB5-20	20	10/20/2008	-	**409**	-	-
B11-SSB6	B11-SSB6-0.5	0.5	10/20/2008	-	**59.3**	-	-
	B11-SSB6-5	5	10/20/2008	-	**106**	-	-
	B11-SSB6-10	10	10/20/2008	-	**361**	-	-
	B11-SSB6-15	15	10/20/2008	-	**248**	-	-
	B11-SSB6-20	20	10/20/2008	-	**138**	-	-
	B11-SSB6-25	25	10/20/2008	-	**163**	-	-
B11-SSB7	B11-SSB7-0.5	0.5	10/20/2008	-	**85.9**	-	-
	B11-SSB7-5	5	10/20/2008	-	**91.3**	-	-
	B11-SSB7-10	10	10/20/2008	-	**251**	-	-
	B11-SSB7-15	15	10/20/2008	-	**600**	-	-
	B11-SSB7-20	20	10/20/2008	-	**318**	-	-
	B11-SSB7-25	25	10/20/2008	-	**279**	-	-
BG-SBA	BG-SBA-0.5	0.5	12/11/2008	<0.010	**1,110**	-	-
	BG-SBA-5	5	12/11/2008	<0.010	**1,830**	-	-
	BG-SBA-10	10	12/11/2008	<0.010	**64.1**	-	-
	BG-SBA-15	15	12/11/2008	-	**333**	-	-
	BG-SBA-20	20	12/11/2008	-	<5.0	-	-
	BG-SBA-25	25	12/11/2008	-	**740**	-	-
	BG-GWA-20	20	12/11/2008	-	-	**1,560**	**88**
BG-SBA1	BG-SBA1-0.5'	0.5	12/19/2008	-	**12.4**	-	-
	BG-SBA1-5.0'	5	12/19/2008	-	**27.1**	-	-
BG-SBA2	BG-SBA2-0.5'	0.5	12/19/2008	-	**47.3**	-	-
	BG-SBA2-5.0'	5	12/19/2008	-	**135**	-	-
BG-SBA3	BG-SBA3-0.5'	0.5	12/19/2008	-	**84.5**	-	-
	BG-SBA3-5.0'	5	12/19/2008	-	**513**	-	-
BG-SBA4	BG-SBA4-0.5'	0.5	12/19/2008	-	**82.3**	-	-
	BG-SBA4-5.0'	5	12/19/2008	-	**70**	-	-
BG-SBA7	BG-SBA7-5.0'	5	12/19/2008	-	**217**	-	-

Notes:
"Bold" - Indicates concentrations detected above the method detection limit.
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
bgs - Below ground surface.
mg/kg - Milligrams per kilogram.
HSAS - Sample collected using the auger drilling method.
na - Not applicable.
µg/kg - Micrograms per kilogram.
µg/L - Micrograms per liter.
PSB - Primary soil boring.
SSB or SB - Secondary soil boring.
GW - Groundwater sample.
(-) - Sample not analyzed for analyte.
(--) - MCL or DWNL not available.

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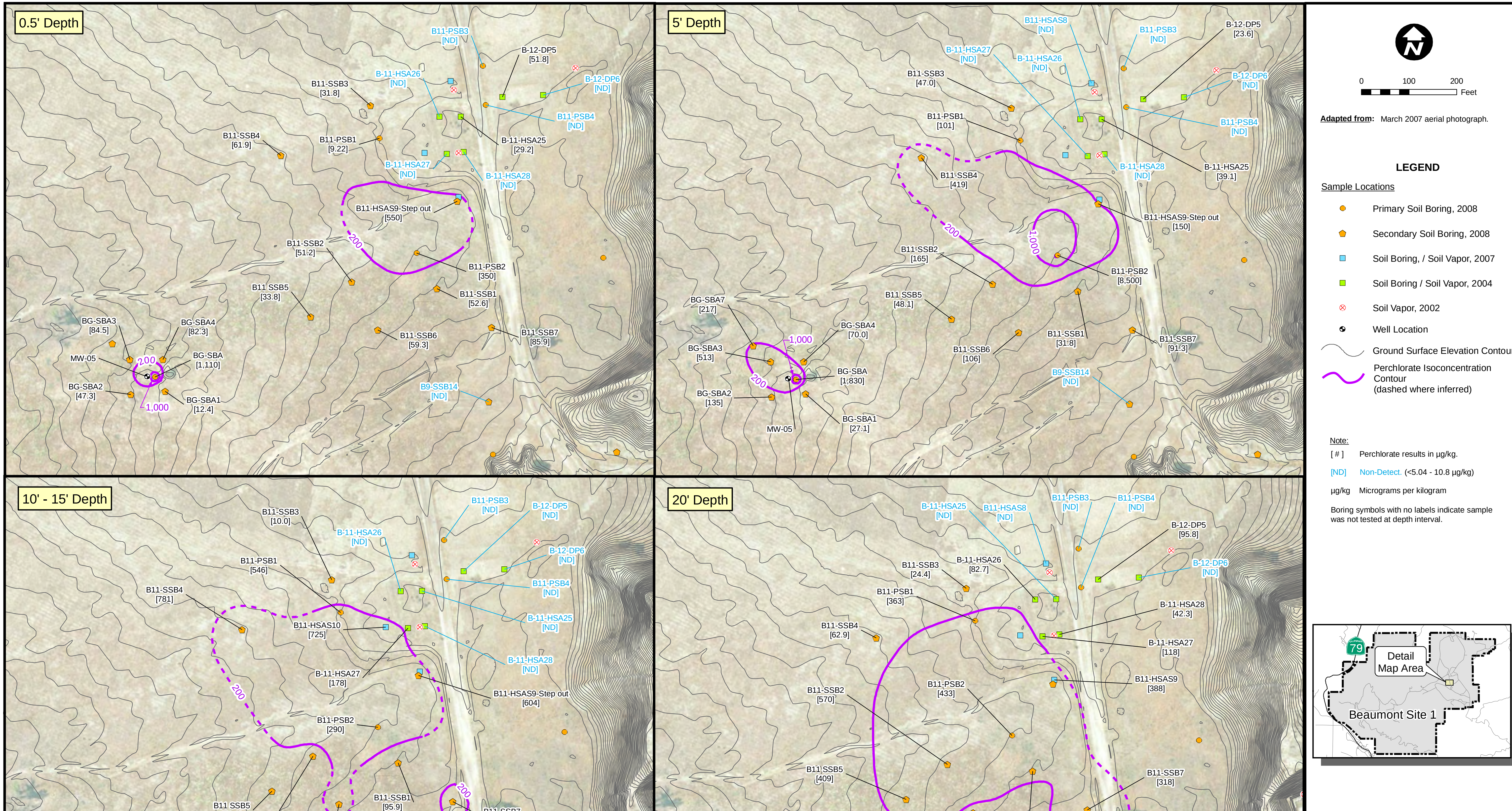

Beaumont Site 1

Figure 5-28
Perchlorate Concentrations in Soil - Fuel Slurry Station (Feature B-11)

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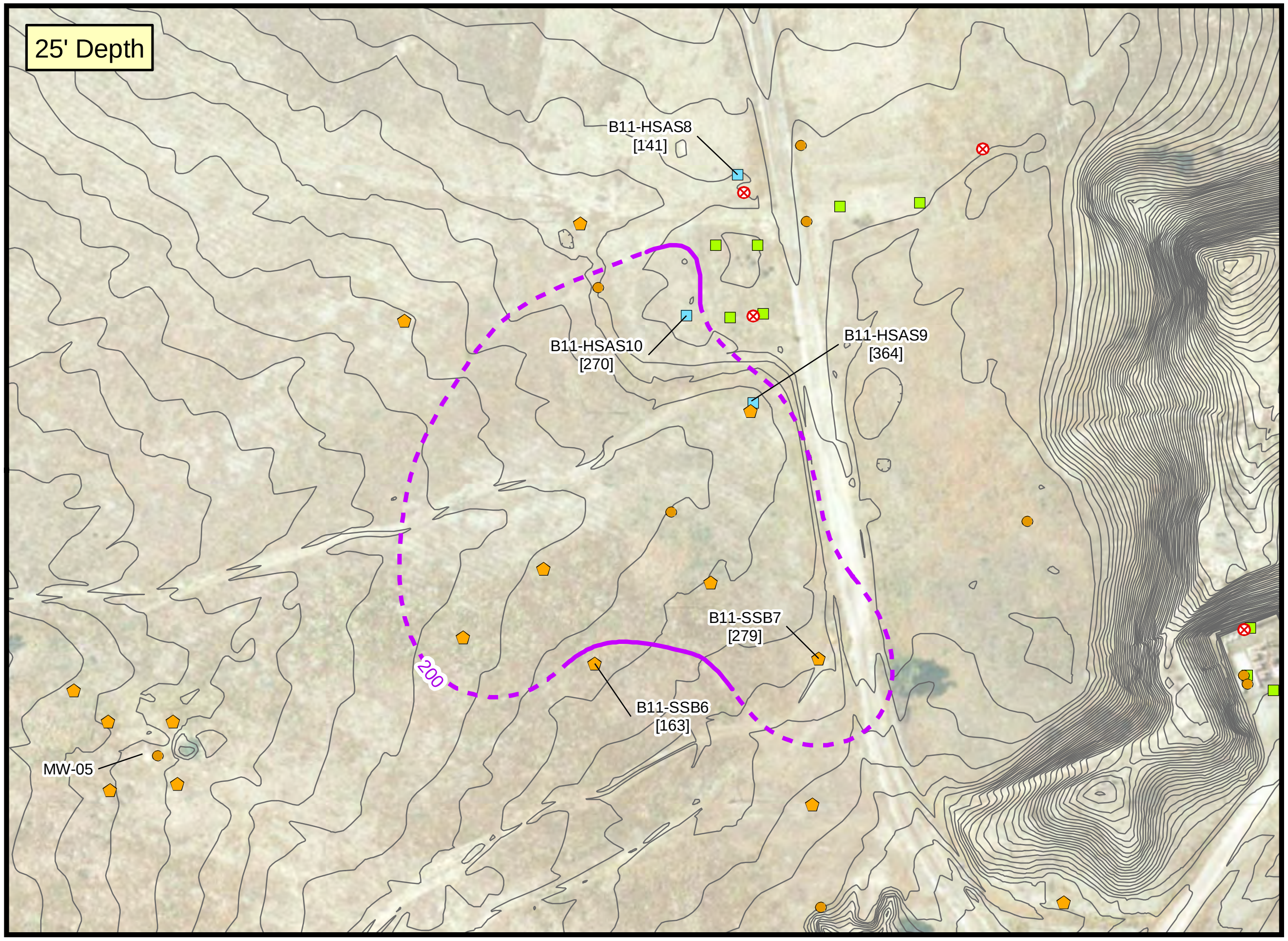


0 100 200 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

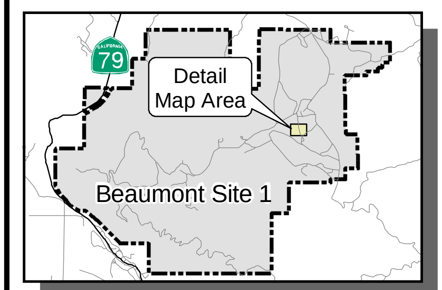
- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring/Soil Vapor, 2007
- Soil Boring/Soil Vapor, 2004
- Soil Vapor, 2002
- Well Location
- Gound Surface Elavation Contour
- Perchlorate Isoconcentration Contour (dashed where inferred)

Note:

[#] Perchlorate results in µg/kg.

µg/kg Micrograms per kilogram

Boring symbols with no labels indicate sample was not tested at depth interval.



Beaumont Site 1

Figure 5-28 (con't)

Perchlorate Concentrations in Soil - Fuel Slurry Station (Feature B-11)

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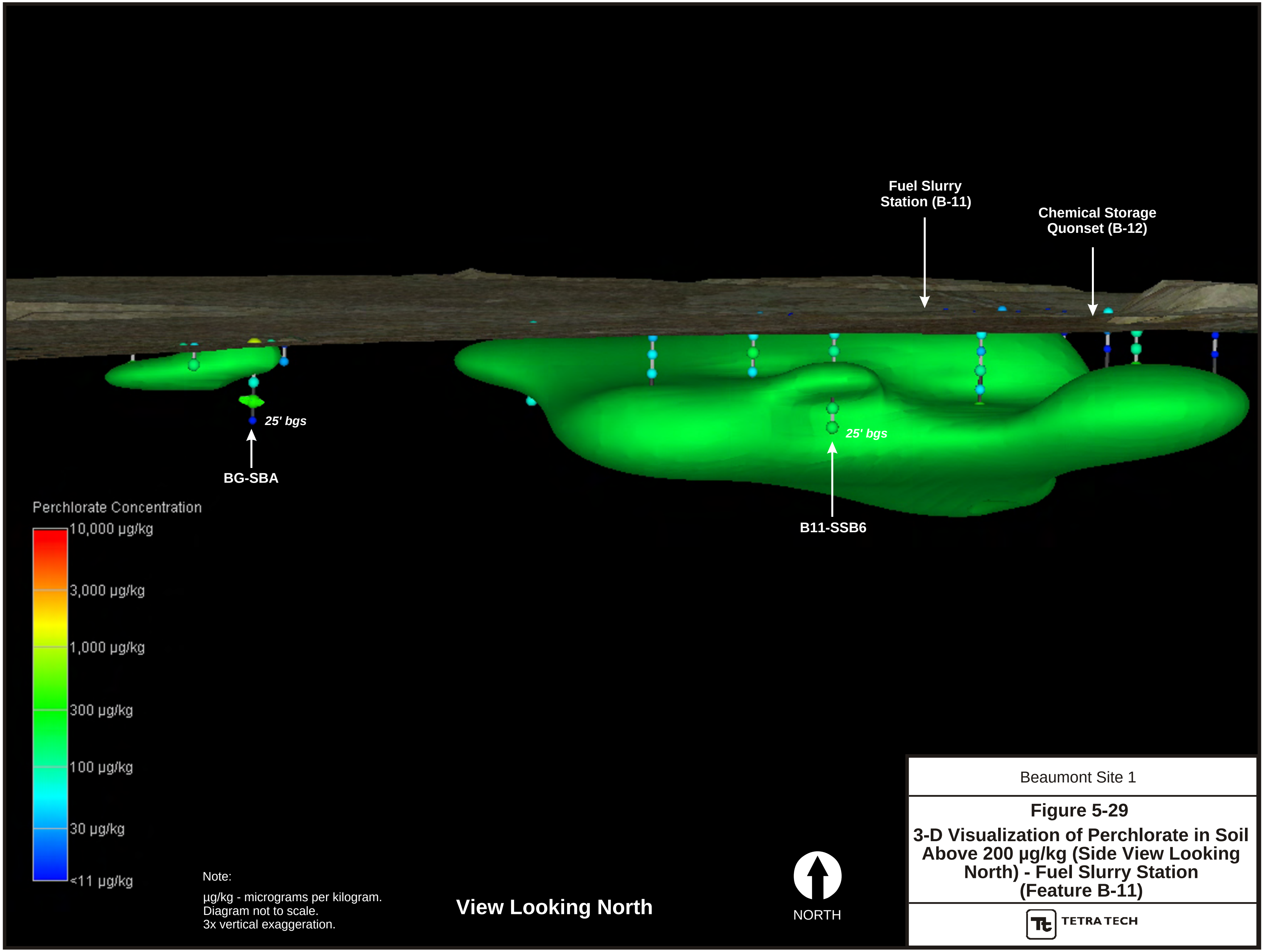

Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
3x vertical exaggeration.

Beaumont Site 1

Figure 5-29

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking North) - Fuel Slurry Station (Feature B-11)

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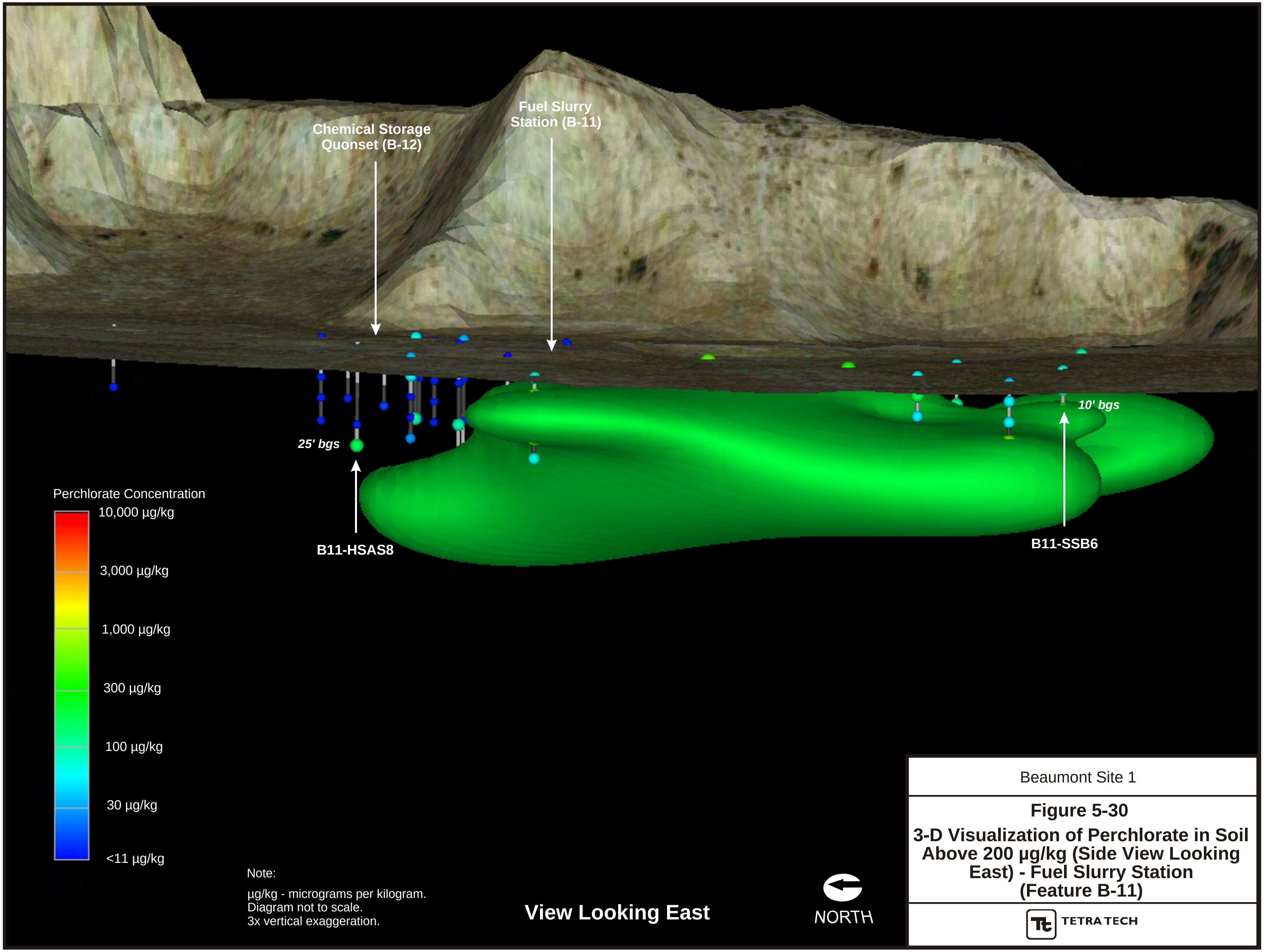

Beaumont Site 1

Figure 5-30

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking East) - Fuel Slurry Station (Feature B-11)

TETRA TECH

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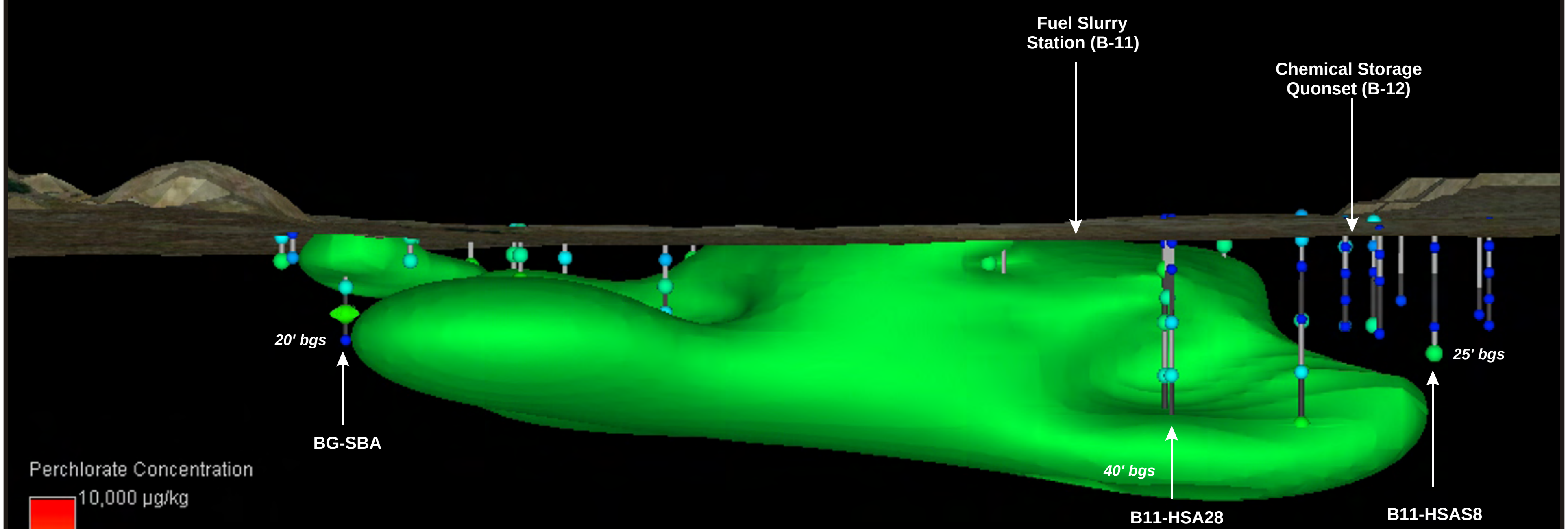

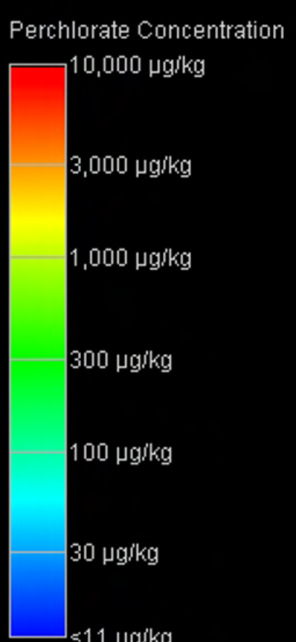

Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
3x vertical exaggeration.

View Looking West

NORTH

Beaumont Site 1

Figure 5-31

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking West) - Fuel Slurry Station (Feature B-11)

TETRA TECH

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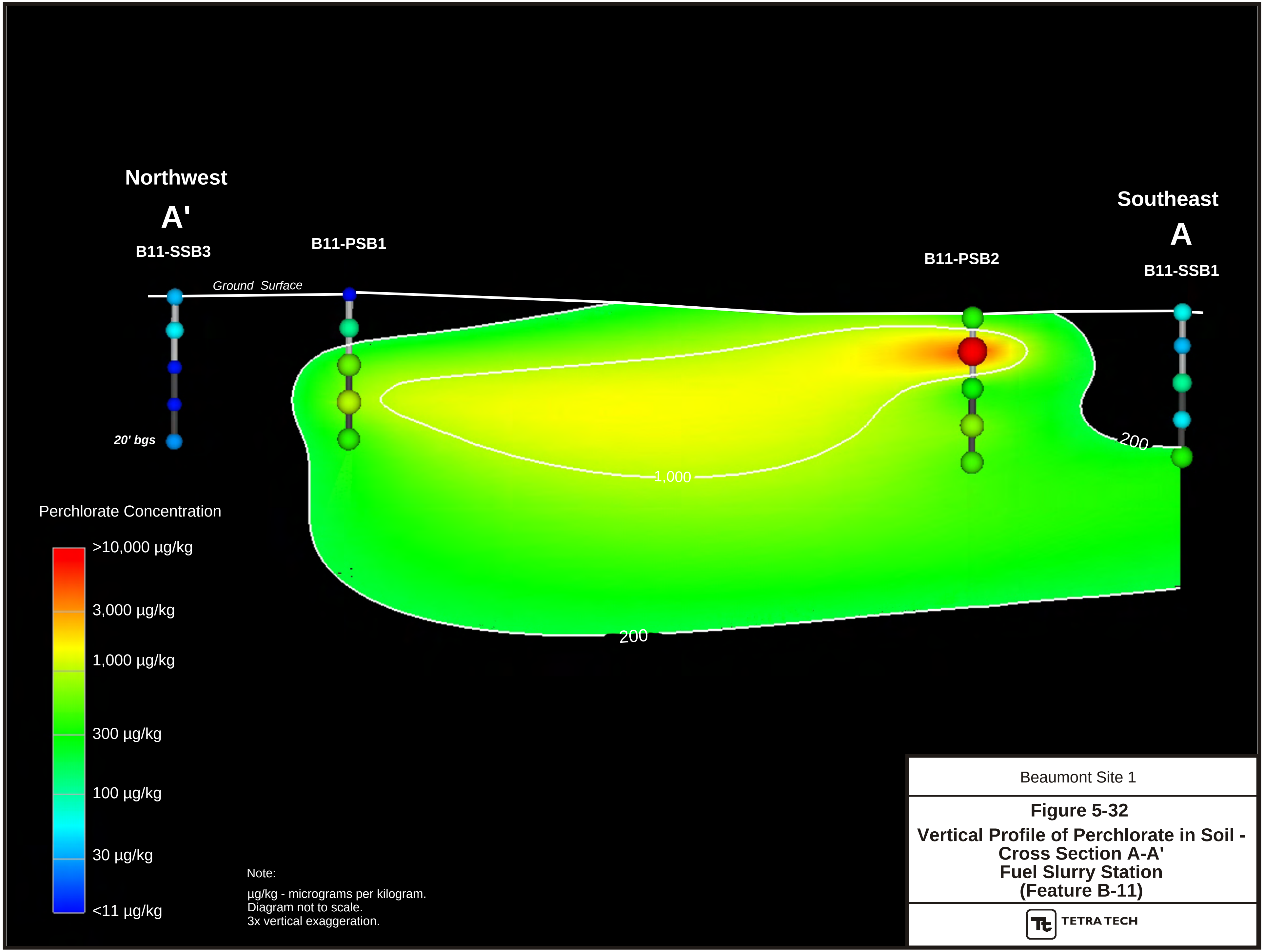


Beaumont Site 1

Figure 5-32
Vertical Profile of Perchlorate in Soil - Cross Section A-A'
Fuel Slurry Station
(Feature B-11)

TETRA TECH

Although the results of the samples from BG-SBA showed shallow perchlorate impacts most likely from an upgradient operational area, the results of the deeper samples seem to indicate that a perchlorate smear zone is not present (Table 5-7). Groundwater in the nearby well MW-05 fluctuated from 30 feet bgs in 1991 to within one foot of the ground surface in 1995 with detected perchlorate concentrations ranging from 4,230 µg/L in May 2002 to 436 µg/L in June 2008. The perchlorate concentrations in soil from 10 to 20 feet bgs in BG-SBA did not exceed 333 µg/kg in comparison to the 1,560 µg/L detected in groundwater from the grab sample collected at 20 feet bgs. The sample collected from within the capillary fringe at a depth of 20 feet bgs just above the water table was non-detect for perchlorate and the soil sample below the water table at 25 feet bgs had 740 µg/kg since it contained impacted groundwater. 1,4-dioxane was not detected above the MDL in the 0.5, 5, and 10 feet bgs samples but was present in the groundwater at 88 µg/L in the grab sample collected at a depth of 25 feet bgs. The results of this field test do not appear to support that a perchlorate smear zone is present at this location.

5.4.2 Historical Operational Area C

Historical Operational Area C, the BPA, consisted of three primary features: 1) temporary chemical storage area, 2) burn pits, and 3) the beryllium test stand. Hazardous waste materials were stored in 55-gallon drums on a concrete pad east of the burn pits at the chemical storage area until enough material was generated for a burning event. The hazardous materials burned in the pits included: ammonium perchlorate, wet propellant from motor washout, dry propellant, batches of out-of specification propellant, various kinds of adhesives, resin curatives, burn rate modifiers, ignition components and packaging materials (Radian, 1986a).

During burn pit procedures, the hazardous materials were placed in the center of the burn pits, saturated with fuel and ignited. After burning activities, if the trench was suitable for reuse, it was left open for additional burns; otherwise, the trench was filled and covered with soil (Radian, 1986a).

On the south side of the spur, where the burn pit instrumentation bunker was located, there was a one-time firing of small beryllium research motors (Radian, 1986a).

5.4.2.1 Feature C-22 - Burn Pit Area

The BPA is located in the southeastern portion of the Site in Historical Operational Area C. Waste material from Beaumont Site 1 and the Redlands Site was placed in trenches, incinerated, and buried in the BPA. Materials burned in the trenches included: ammonium perchlorate, diesel fuel, wet propellant, dry propellant, out-of-specification propellant, adhesives, resin, metal drums, plastic bags, paper, and solvents.

Previous Results

In 1992, a remedial action program within the BPA was performed and 21 former burn pits were excavated (Radian, 1993). Approximately 18.6 tons of specific wastes were excavated from the trenches. Overall, 48,600 cubic yards of soil were removed and later backfilled into the excavation trenches. Confirmation soil samples were collected from below the excavated materials at four of the burn pits and analyzed for Title 22 metals, VOCs, and SVOCs; however, none of the confirmation soil samples were analyzed for perchlorate or 1,4-dioxane.

A total of 31 soil and soil gas borings were drilled during previous investigations (Tetra Tech; 2002, 2005b, 2009a) at depths ranging from 5 to 60 feet bgs with soil gas probes installed between 10 and 50 feet bgs. Groundwater was not encountered in any of the borings installed during these previous soil investigations. The soil samples collected were analyzed for VOCs, SVOCs, 1,4-dioxane, perchlorate, Title 22 metals, and TPH. SVOCs, TPH, and 1,4-dioxane were not detected at concentrations above their respective RLs. Perchlorate was detected at concentrations ranging from 22.6 to 171,000 μg/kg. VOCs, including acetone, benzene, chloroethane, and toluene, were detected at concentrations ranging from 1.1 to 40 μg/kg. VOCs, including but not limited to TCE, PCE, 1,1-DCE, 1,1,1-TCA, and Freon-113, were detected in the soil gas. Tables of the soil and soil gas analytical results from the 2002, 2004, and 2007 investigations are included in Tables H-8 and H-15 in Appendix H.

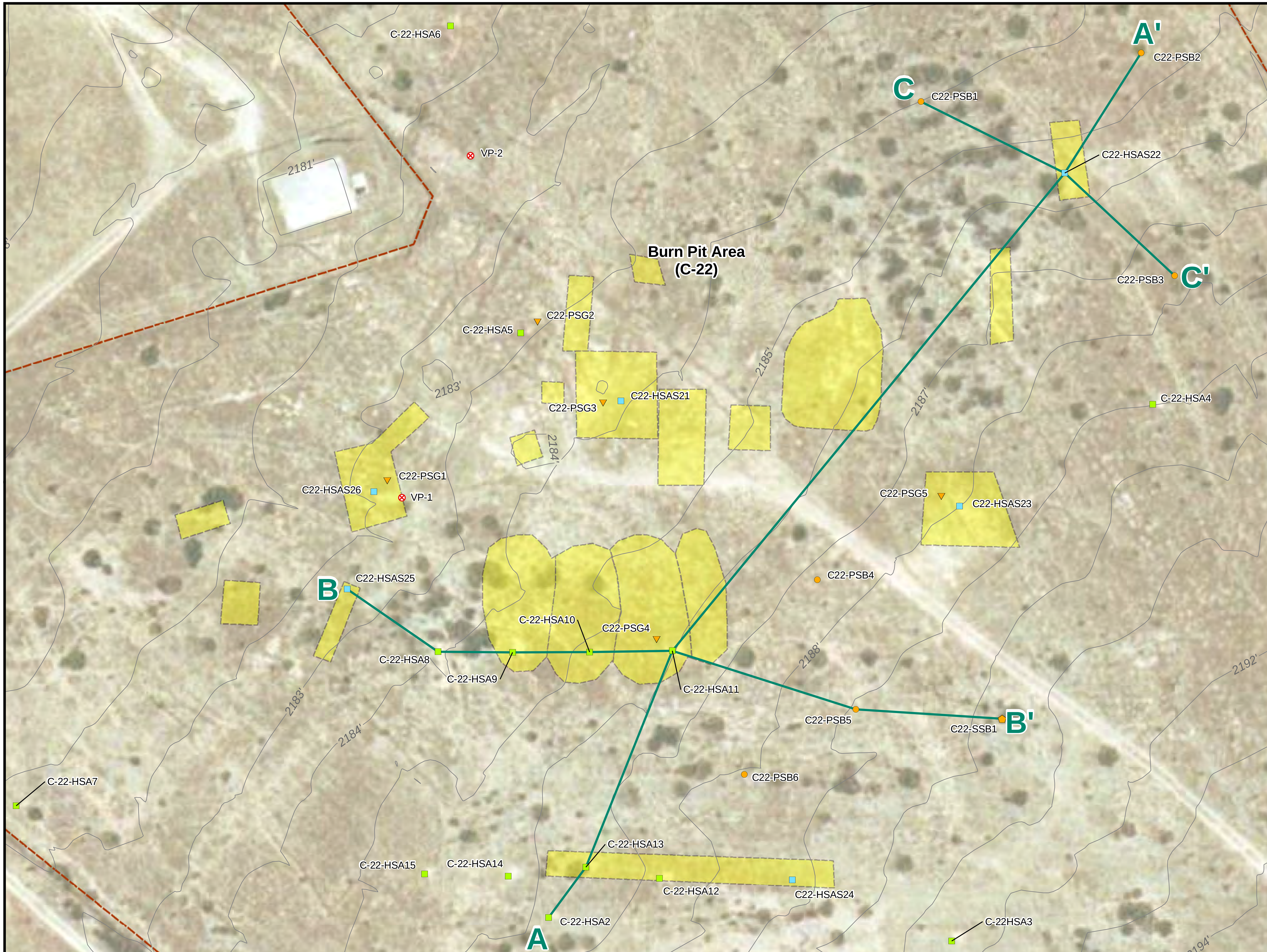
The highest VOC concentrations in soil gas were detected near the center of the former BPA and the concentrations drop off towards the outer portion. Based on the analytes and concentrations of VOCs in soil gas in comparison to groundwater sample results from wells within the BPA, it is likely that the analytes detected in soil gas are a result of off-gassing of affected groundwater beneath this feature or possibly some residual soil contamination in the vadose zone. Based on this information, an evaluation of the soil gas in the shallow portion (5 feet bgs) of the vadose zone was needed to evaluate human health risks in the area exhibiting the highest VOC concentrations.

Based on the results of previous soil investigations, the greatest extent of perchlorate in soil is between 20 and 30 feet bgs. The information collected to date indicated that further investigation was needed to complete the characterization of perchlorate in soil in the eastern and northeastern portion of the BPA in addition to the Propellant Test Blowout Area (PTBA) located east of the former burn pits where reportedly blowout testing of a perchlorate-based propellant was conducted.

Soils at the BPA are generally sand to silty sand with minor clay or gravel content. The alluvium ranges in thickness from about 50 to 75 feet at this feature and is underlain by weathered Mount Eden formation. Groundwater is present primarily in the weathered Mount Eden formation at a depth of approximately 70 to 75 feet bgs in August 2008. The BPA is located at the southeastern limits of the valley near the foothills of the San Jacinto Mountains and therefore receives significant mountain front recharge after storm events. Water levels at the BPA have risen as much as 50 to 65 feet in early spring after a wet winter. Several nearly parallel northwest striking, steeply dipping, normal faults with a northeast hanging wall have been mapped to the east (Goetz fault), southeast (unnamed fault), and southwest (Bedsprings fault) of the BPA.

Investigation Activities

Six primary borings and one secondary boring were drilled to depths of approximately 40 feet bgs using the HSA method at the BPA (Figure 5-33). Soil gas probes were installed in five hand augered borings to 5 feet bgs. Eleven primary borings were hand augered in the PTBA to a total depth of 5 feet bgs (Figure 5-34). Soil samples were collected at the surface (~0.5-foot bgs), 5 feet bgs and every 5 feet to a total depth and analyzed for perchlorate. Soil gas samples were analyzed for VOCs.



0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Vapor, 2008
- Soil Boring, / Soil Vapor, 2007
- Soil Boring, / Soil Vapor, 2004
- Soil Vapor, 2002
- Geologic Cross Section Location
- 2130 Ground Surface Elevation Contour
- Former Burn Pit Location
- Burn Pit Boundary
- B Geologic Cross Section Line Beginning and End Points

HSA	Hollow Stem Auger - Part of the nomenclature for borings installed with a hollow stem auger rig during the soil investigation in 2004.
HSAS	Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed with a hollow stem auger rig during the supplemental soil investigation in 2007.
PSB	Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.
PSG	Primary Soil Gas- Part of the nomenclature for primary borings where soil gas probes were installed during the Dynamic Site Investigation, 2008.
SSB	Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.
VP	Vapor Probe, 2002

Note: - Ground surface elevation is relative to mean sea level (msl)

- Ground surface elevation derived from survey conducted by Hillwig and Goodrow

Beaumont Site 1

Figure 5-33

Soil Borings and Cross Section Locations Burn Pit Area (Feature C-22)

TETRA TECH

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X:\GIS\Lockheed 22288-110302\C22_Blowout Area.mxd

0 100 200 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Vapor, 2008
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2007
- Soil Boring/Soil Vapor, 2004
- Soil Boring, 2004
- Soil Vapor, 2002
- Well Location
- Ground Surface Elevation Contour

Note:

[ND] Non-Detect (<5.02 - 11.6 µg/kg)

Boring symbols with no labels indicate sample was not tested at depth interval.

Beaumont Site 1

Figure 5-34
Perchlorate Concentrations in Soil - Propellant Test Blowout Area, BPA (Feature C-22)

TETRA TECH

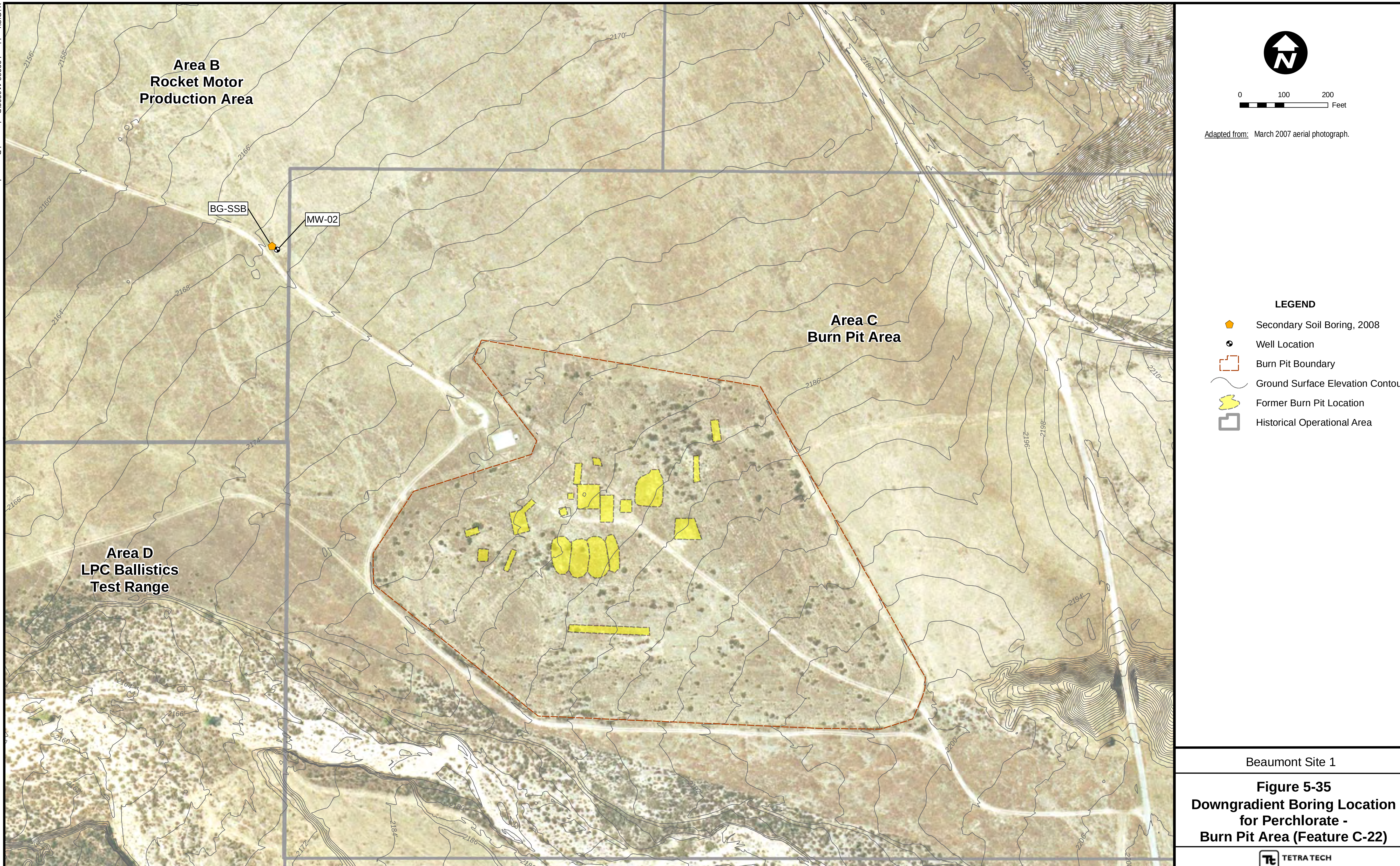
As previously stated in Section 5.4.1.5, a deviation from the Work Plan at this feature included the evaluation of a potential perchlorate smear zone downgradient of the BPA due to the large groundwater fluctuations of perchlorate impacted groundwater. Soil samples were collected from a single boring near MW-02 from 5 feet bgs and every 5 feet down to the water table (65 feet bgs) (Figure 5-35). Soil samples were analyzed for perchlorate with only samples from 5, 10, 30, and 50 feet bgs also analyzed for 1,4-dioxane. In addition to the soil samples, a first water sample was collected and analyzed for perchlorate and 1,4-dioxane.

Geology

Alluvial soils encountered at the BPA (Feature C-22) were predominantly fine- to coarse-grained sand and silty sand, some silt and clay layers and minor gravel content (boring logs are included in Appendix D). Cross section locations and idealized geologic cross sections through this feature are shown in Figures 5-33 and 5-36. The alluvial provenance is the granitic/metasedimentary mountains approximately 1,500 feet to the east of the BPA. The Mount Eden formation was only encountered in one of the soil borings (C22-PSB5), at a depth of 40 feet bgs. Groundwater was not encountered in any of the soil borings during this investigation.

Soil Sampling Results and Contaminant Distribution

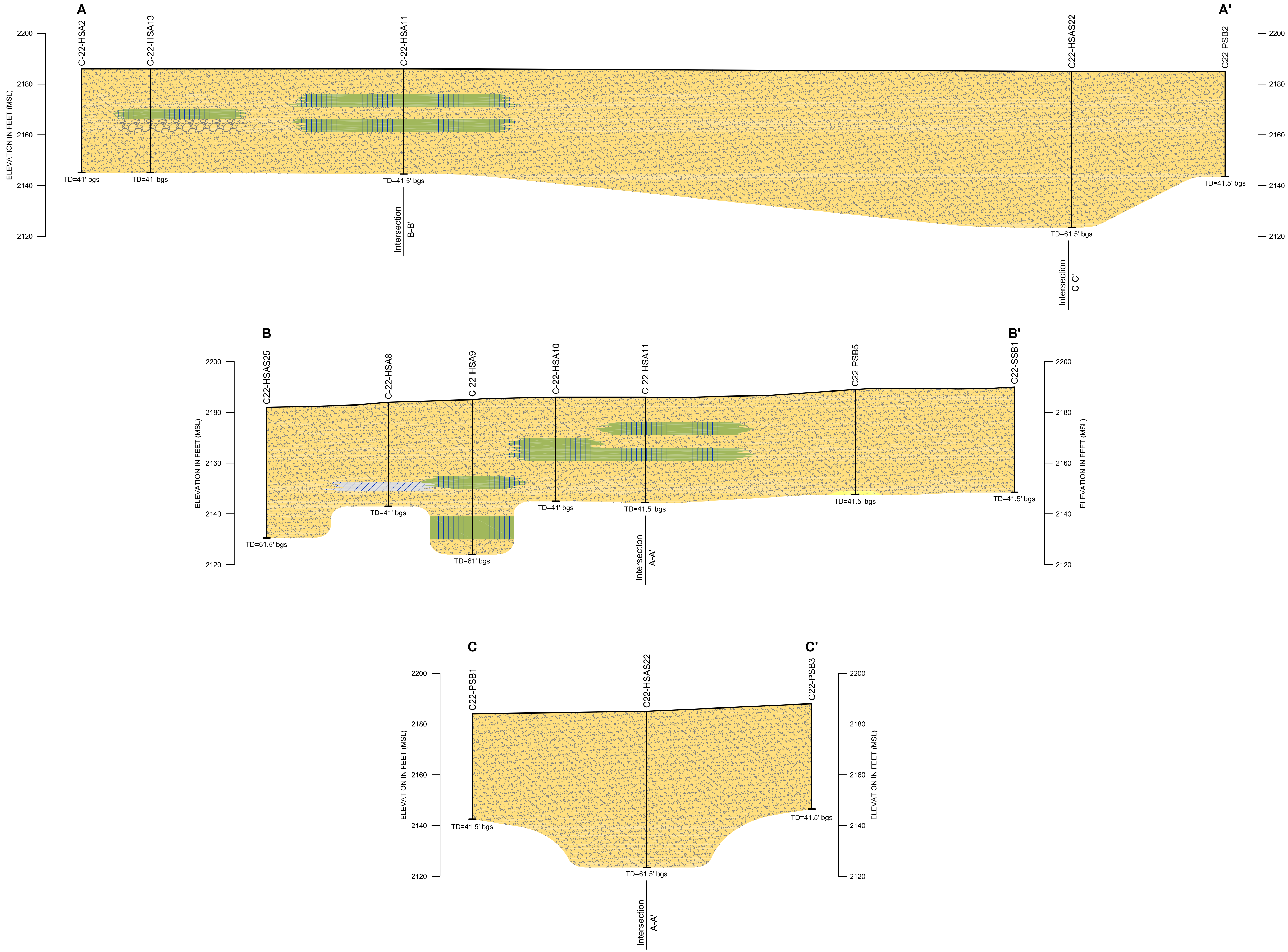
During the current investigation of the BPA, perchlorate was detected above the MDL (5.0 to µg/kg) in 29 of the 70 samples collected ranging from 5.46 to 1,260 µg/kg with an average concentration of 226 µg/kg (Table 5-8). Perchlorate was not detected above the MDL in the 21 samples collected in the PTBA at the surface and at 5 feet bgs (Figure 5-34). Figures 5-37 presents the areal distribution of perchlorate in soil at the BPA greater than 200 µg/kg based on the 3-D modeling of all available soil sampling results since 2002. A compilation of the soil analytical results from the DSI and previous investigations was used to generate this figure. As shown in this figure, the extent of perchlorate impacts is limited to the former operational area and is centralized within the BPA. The total area of impacted soil above 200 µg/kg is approximately 134,300 ft^2 or 3 acres. Figure 5-38 shows the perchlorate concentration contours at depths of 0.5, 10-15, 20, 25 to 30, and 35 to 40 feet bgs. The lateral distribution of perchlorate in soil appears to be the most extensive between 10 and 30 feet bgs.



Beaumont Site 1

Figure 5-35
Downgradient Boring Location for Perchlorate - Burn Pit Area (Feature C-22)

TETRA TECH



LEGEND

Quaternary Alluvium

Clay (CL)

Silt (ML)

Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

Fine to coarse grained sand with gravel (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs below ground surface

HSA Hollow Stem Auger - Part of the nomenclature for borings installed with a hollow stem auger rig during the soil investigation in 2004.

HSAS Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MSL Mean sea level

TD=#' Total Boring Depth (feet)

Boring

Intersection A-A' location where cross sections intersect

0 60

40

Scale in Feet
Vertical Exaggeration = 1.5x Horizontal

Beaumont Site 1

Figure 5-36
Idealized Geologic Cross Sections A-A', B-B', and C-C' Burn Pit Area (Feature C-22)

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Table 5-8 Soil and Groundwater Sampling Results - Burn Pit Area (Feature C-22)

Boring ID	Sample Name	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	Perchlorate	1,4-Dioxane
Matrix				***Soil***		***Water***	
Units				mg/kg	µg/kg	µg/L	
MCL				na	na	6	
DWNL				na	na		3
	C22-PSB1-0.5	0.5	11/3/2008	-	<5.09	-	-
	C22-PSB1-5	5	11/3/2008	-	<5.08	-	-
	C22-PSB1-10	10	11/3/2008	-	<5.16	-	-
	C22-PSB1-15	15	11/3/2008	-	<5.07	-	-
C22-PSB1	C22-PSB1-20	20	11/3/2008	-	<5.07	-	-
	C22-PSB1-25	25	11/3/2008	-	<5.22	-	-
	C22-PSB1-30	30	11/3/2008	-	<5.44	-	-
	C22-PSB1-35	35	11/3/2008	-	<5.15	-	-
	C22-PSB1-40	40	11/3/2008	-	**58.8**	-	-
	C22-PSB2-0.5	0.5	11/3/2008	-	<5.09	-	-
	C22-PSB2-5	5	11/3/2008	-	<5.12	-	-
	C22-PSB2-10	10	11/3/2008	-	<5.38	-	-
	C22-PSB2-15	15	11/3/2008	-	<5.42	-	-
C22-PSB2	C22-PSB2-20	20	11/3/2008	-	<5.42	-	-
	C22-PSB2-25	25	11/3/2008	-	<5.16	-	-
	C22-PSB2-30	30	11/3/2008	-	<5.44	-	-
	C22-PSB2-35	35	11/3/2008	-	<5.29	-	-
	C22-PSB2-40	40	11/3/2008	-	<5.22	-	-
	C22-PSB3-0.5	0.5	11/4/2008	-	<5.04	-	-
	C22-PSB3-5	5	11/4/2008	-	<5.21	-	-
	C22-PSB3-10	10	11/4/2008	-	<5.20	-	-
	C22-PSB3-15	15	11/4/2008	-	<5.31	-	-
C22-PSB3	C22-PSB3-20	20	11/4/2008	-	<5.30	-	-
	C22-PSB3-25	25	11/4/2008	-	<5.39	-	-
	C22-PSB3-30	30	11/4/2008	-	<5.39	-	-
	C22-PSB3-35	35	11/4/2008	-	<5.21	-	-
	C22-PSB3-40	40	11/4/2008	-	<5.27	-	-
	C22-PSB4-0.5	0.5	9/19/2008	-	**43.6**	-	-
	C22-PSB4-5	5	9/19/2008	-	**80.6**	-	-
	C22-PSB4-10	10	9/19/2008	-	**103**	-	-
	C22-PSB4-15	15	9/19/2008	-	**97.2**	-	-
C22-PSB4	C22-PSB4-20	20	9/19/2008	-	**169**	-	-
	C22-PSB4-25	25	9/19/2008	-	**498**	-	-
	C22-PSB4-30	30	9/19/2008	-	**514**	-	-
	C22-PSB4-35	35	9/19/2008	-	**99.4**	-	-
	C22-PSB4-40	40	9/19/2008	-	**271**	-	-
	C22-PSB5-0.5	0.5	9/22/2008	-	**1,200**	-	-
	C22-PSB5-5	5	9/22/2008	-	**487**	-	-
	C22-PSB5-10	10	9/22/2008	-	**1,260**	-	-
	C22-PSB5-15	15	9/22/2008	-	**163**	-	-
C22-PSB5	C22-PSB5-20	20	9/22/2008	-	**6.40**	-	-
	C22-PSB5-25	25	9/22/2008	-	**107**	-	-
	C22-PSB5-30	30	9/22/2008	-	**13.1**	-	-
	C22-PSB5-35	35	9/22/2008	-	**5.46**	-	-
	C22-PSB5-40	40	9/22/2008	-	**36**	-	-

Table 5-8 (Cont'd) Sampling Results for Perchlorate - Burn Pit Area (Feature C-22)

Boring ID	Sample Name	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	Perchlorate	1,4-Dioxane
Matrix				***Soil***		***Water***	
Units				mg/kg	μg/kg	μg/L	
MCL				na	na	6	
DWNL				na	na		3
C22-PSB6	C22-PSB6-0.5	0.5	9/22/2008	-	**105**	-	-
	C22-PSB6-5	5	9/22/2008	-	**349**	-	-
	C22-PSB6-10	10	9/22/2008	-	**7.36**	-	-
	C22-PSB6-15	15	9/22/2008	-	**26.3**	-	-
	C22-PSB6-20	20	9/22/2008	-	**68.7**	-	-
	C22-PSB6-25	25	9/22/2008	-	**72.1**	-	-
	C22-PSB6-30	30	9/22/2008	-	**173**	-	-
	C22-PSB6-35	35	9/22/2008	-	**225**	-	-
	C22-PSB6-40	40	9/22/2008	-	**246**	-	-
C22-SSB1	C22-SSB1-0.5	0.5	11/4/2008	-	<5.04	-	-
	C22-SSB1-5	5	11/4/2008	-	<5.12	-	-
	C22-SSB1-10	10	11/4/2008	-	<5.77	-	-
	C22-SSB1-15	15	11/4/2008	-	<5.19	-	-
	C22-SSB1-20	20	11/4/2008	-	<5.24	-	-
	C22-SSB1-25	25	11/4/2008	-	<5.17	-	-
	C22-SSB1-30	30	11/4/2008	-	<5.21	-	-
	C22-SSB1-35	35	11/4/2008	-	<5.19	-	-
	C22-SSB1-40	40	11/4/2008	-	<5.47	-	-
BG-SBB	BG-SBB-5	5	12/11/2008	<0.010	<5.0	-	-
	BG-SBB-10	10	12/11/2008	<0.010	<5.0	-	-
	BG-SBB-20	20	12/11/2008	-	<5.0	-	-
	BG-SBB-30	30	12/11/2008	<0.010	<5.0	-	-
	BG-SBB-40	40	12/11/2008	-	<5.0	-	-
	BG-SBB-50	50	12/11/2008	<0.010	<5.0	-	-
	BG-SBB-60	60	12/11/2008	-	**57**	-	-
	BG-GWB-65	65	12/12/08	-	-	**999**	**99.3**

Notes:

"Bold" - Indicates concentrations detected above the method detection limit.
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
bgs - Below ground surface.
mg/kg - Milligrams per kilogram.
na - Not applicable.
μg/kg - Micrograms per kilogram.
μg/L - Micrograms per liter.
(-) - Sample not analyzed for analyte.
PSB - Primary soil boring.
SSB or SB - Secondary soil boring.

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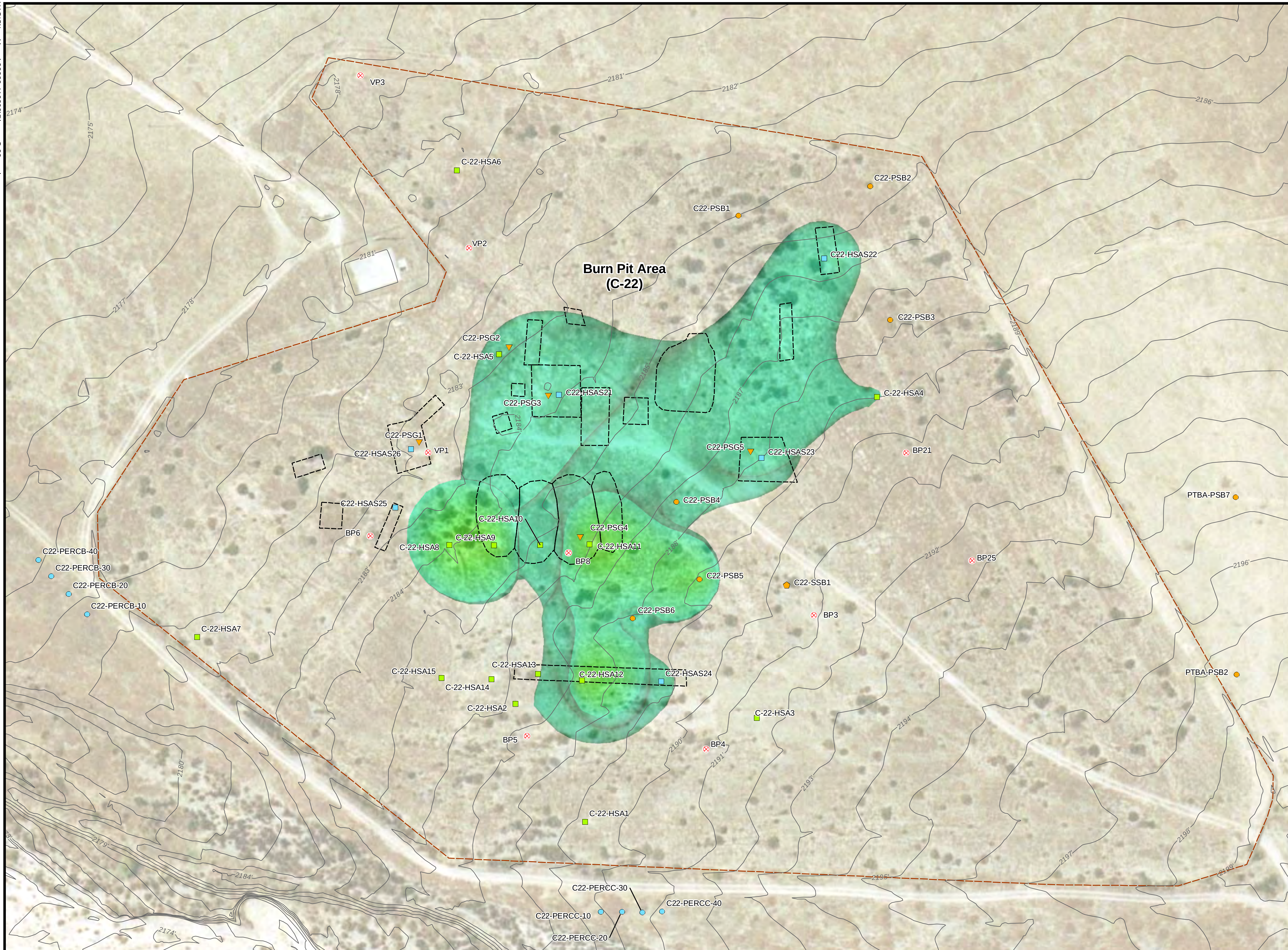

N

0 50 100 Feet

LEGEND

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Vapor, 2008
- Soil Boring, 2007
- Soil Boring / Soil Vapor, 2007
- Soil Boring / Soil Vapor, 2004
- Soil Vapor, 2002
- Ground Surface Elevation Contour
- Former Burn Pit Location
- Burn Pit Boundary

Perchlorate Concentration

- >100,000 µg/kg
- 30,000 µg/kg
- 10,000 µg/kg
- 3,000 µg/kg
- 1,000 µg/kg
- 300 µg/kg
- 100 µg/kg
- 30 µg/kg
- <10 µg/kg

Note:

µg/kg - Micrograms per kilogram.

Ground surface elevation contour lines derived from survey conducted by Hillwig and Goodrow.

Ground surface elevation contour lines relative to mean sea level (msl).

Beaumont Site 1

Figure 5-37

Lateral Extent of Perchlorate in Soil Above 200 µg/kg from 0-60 ft bgs Burn Pit Area (Feature C-22)

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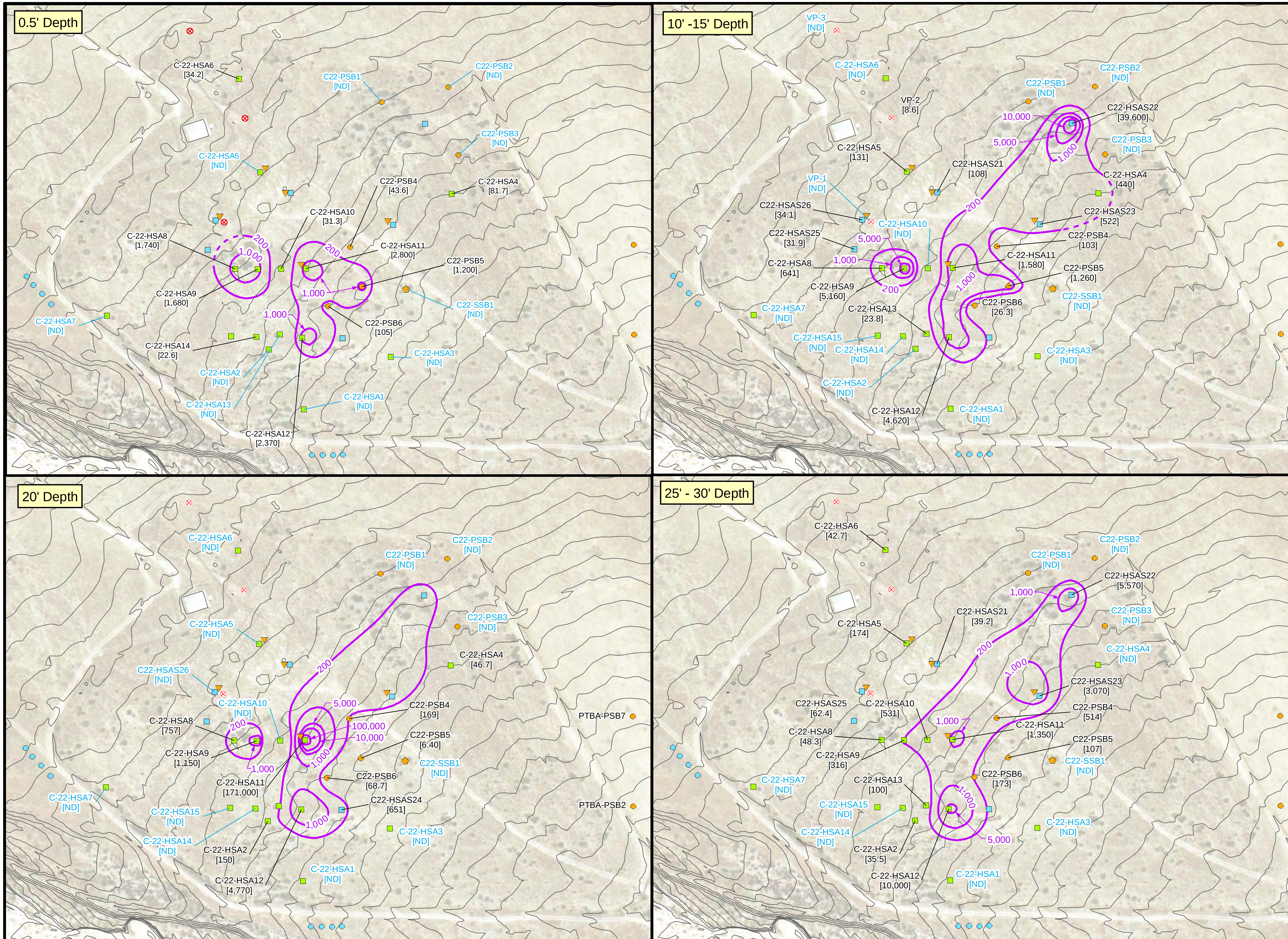


N

0 100 200 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Vapor, 2008
- Soil Boring, 2007
- Soil Boring, / Soil Vapor, 2007
- Soil Boring, / Soil Vapor, 2004
- Soil Vapor, 2002
- Ground Surface Elevation Contour
- Perchlorate Isoconcentration Contour (dashed where inferred)

Note:

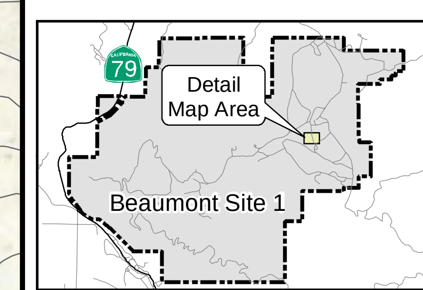
[#] Perchlorate results in µg/kg.

[ND] Non-Detect. (<5.02 - 11.6 µg/kg)

Boring symbols with no labels indicate sample was not tested at depth interval.

Ground surface elevation contour lines derived from survey conducted by Hillwig and Goodrow.

Ground surface elevation contour lines relative to mean sea level (msl).



Beaumont Site 1

Figure 5-38
Perchlorate Concentrations in Soil - Burn Pit Area (Feature C-22)

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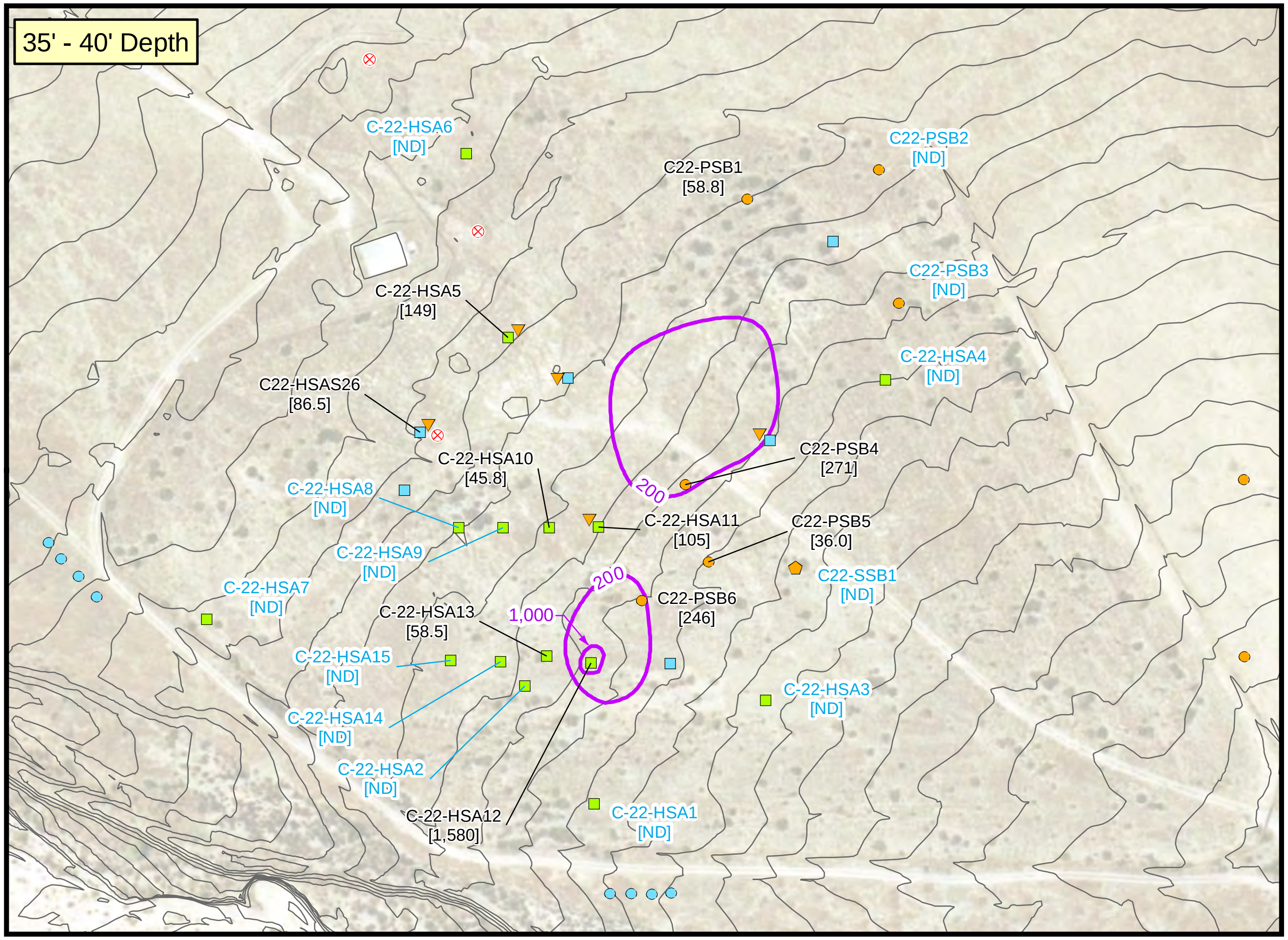


N

0 100 200 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Vapor, 2008
- Soil Boring, 2007
- Soil Boring, / Soil Vapor, 2007
- Soil Boring, / Soil Vapor, 2004
- Soil Vapor, 2002
- Perchlorate Isoconcentration Contour
- Ground Surface Elevation Contour

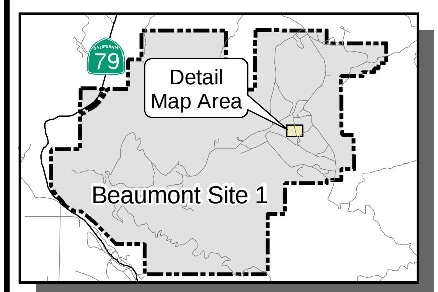
Note:

[#] Perchlorate results in µg/kg.

[ND] Non-Detect. (<5.02 - 11.6 µg/kg)

Boring symbols with no labels indicate sample was not tested at depth interval.

Topographic contours generated by Hillwig and Goodrow.



Beaumont Site 1

Figure 5-38 (cont.)

Perchlorate Concentrations in Soil - Burn Pit Area Feature C-22

TETRA TECH

Two of the highest concentrations of perchlorate (1,200 and 1,260 µg/kg) detected during this investigation were at 0.5 and 10 feet bgs in boring C22-PSB5 located in the central portion of the feature. This boring was installed just east of C-22-HSA11 where the highest concentration of perchlorate (171,000 µg/kg) ever detected at the BPA was reported at a depth of 20 feet bgs. As shown in Figure 5-38, the lateral distribution begins to increase at 10 to 15 feet bgs and is the most widespread between 10 and 30 feet bgs and decreases at 40 feet bgs. Figures 5-39 through 5-41 present the 3-D visualizations of the perchlorate affected soil above 200 µg/kg at the BPA with views from the north, west, and east. The figures also show the general boring and sample locations with the relative magnitude of the perchlorate concentrations detected. For boring names and exact concentrations detected, see Figure 5-38. Based on the 3-D modeling of the perchlorate, the majority of the perchlorate mass is found at depths less than 30 feet bgs in the central and southwestern portion of the feature. Figures 5-42 and 5-43 show the vertical profiles for perchlorate in soil along cross section line A-A' and B-B' covering the area in which the highest concentration (C-22-HSA11) was detected. Figure 5-42 also shows the high concentration detected at C22-HSA22 located in the northeastern portion of the feature which required additional delineation during this investigation. Based on the additional characterization data collected during this investigation, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg.

Soil Gas Sampling Results

Several VOCs were detected in soil gas at a depth of 5 feet bgs at the BPA during this investigation (Table 5-9). The purpose for the installation of the 5-foot soil gas probes was to support the risk assessments being conducted at the Site. The groundwater COPCs, PCE, TCE and 1,1-DCE, were detected in soil gas samples collected at 5 feet bgs. The soil gas probes were installed next to existing soil gas locations where deeper samples were collected showing the highest VOC concentrations at the BPA (Figure 5-33). PCE (1 sample), TCE (4 samples) and 1,1-DCE (4 samples) were detected up to 332 µg/m^3, 1,530 µg/m^3, and 1,940 µg/m^3, respectively. Other VOCs detected in soil gas include 1,1,1-TCA and 1,1,2-TCA. One sample from boring C22-PSG3 exceeded the residential and commercial/industrial CHHSLs for TCE and the residential CHHSL for PCE (Figure 5-33). Boring C22-PSG3 was installed adjacent to C22-HSA21 which exhibited the highest concentration of VOCs in the shallow vadose zone (10 feet bgs) during previous investigations. Based on the vertical concentration profile coupled with the analytes detected and magnitude of VOCs in soil gas and groundwater, it is likely that the VOCs detected in soil gas are attributed to the off-gassing of affected groundwater beneath this feature and/or possibly residual contamination in the vadose zone. As stated above, the intent of the soil gas survey was to collect data to further evaluate the human health risks in the shallow vadose zone.

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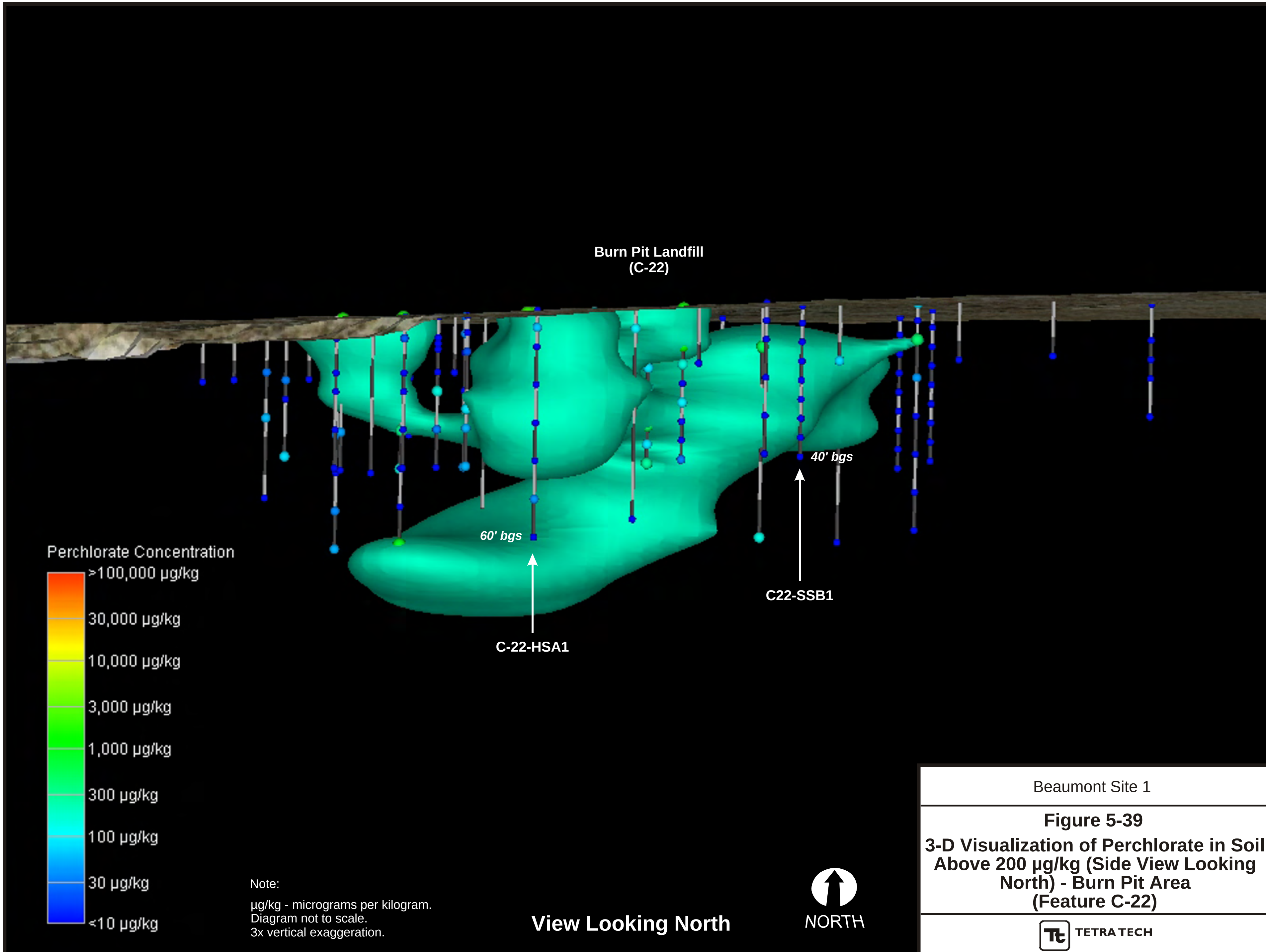

Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
3x vertical exaggeration.

Beaumont Site 1

Figure 5-39

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking North) - Burn Pit Area (Feature C-22)

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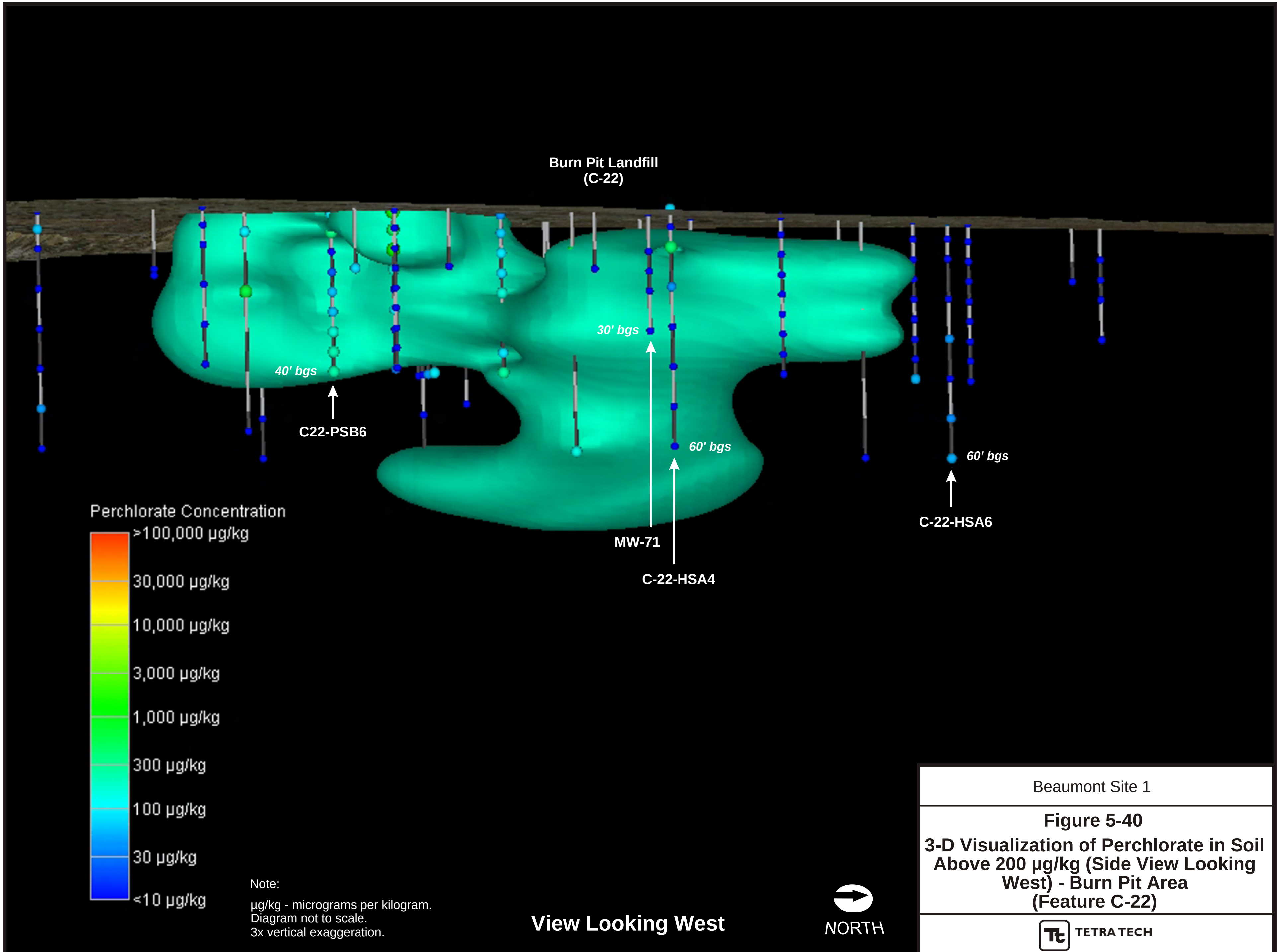

Beaumont Site 1

Figure 5-40

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking West) - Burn Pit Area (Feature C-22)

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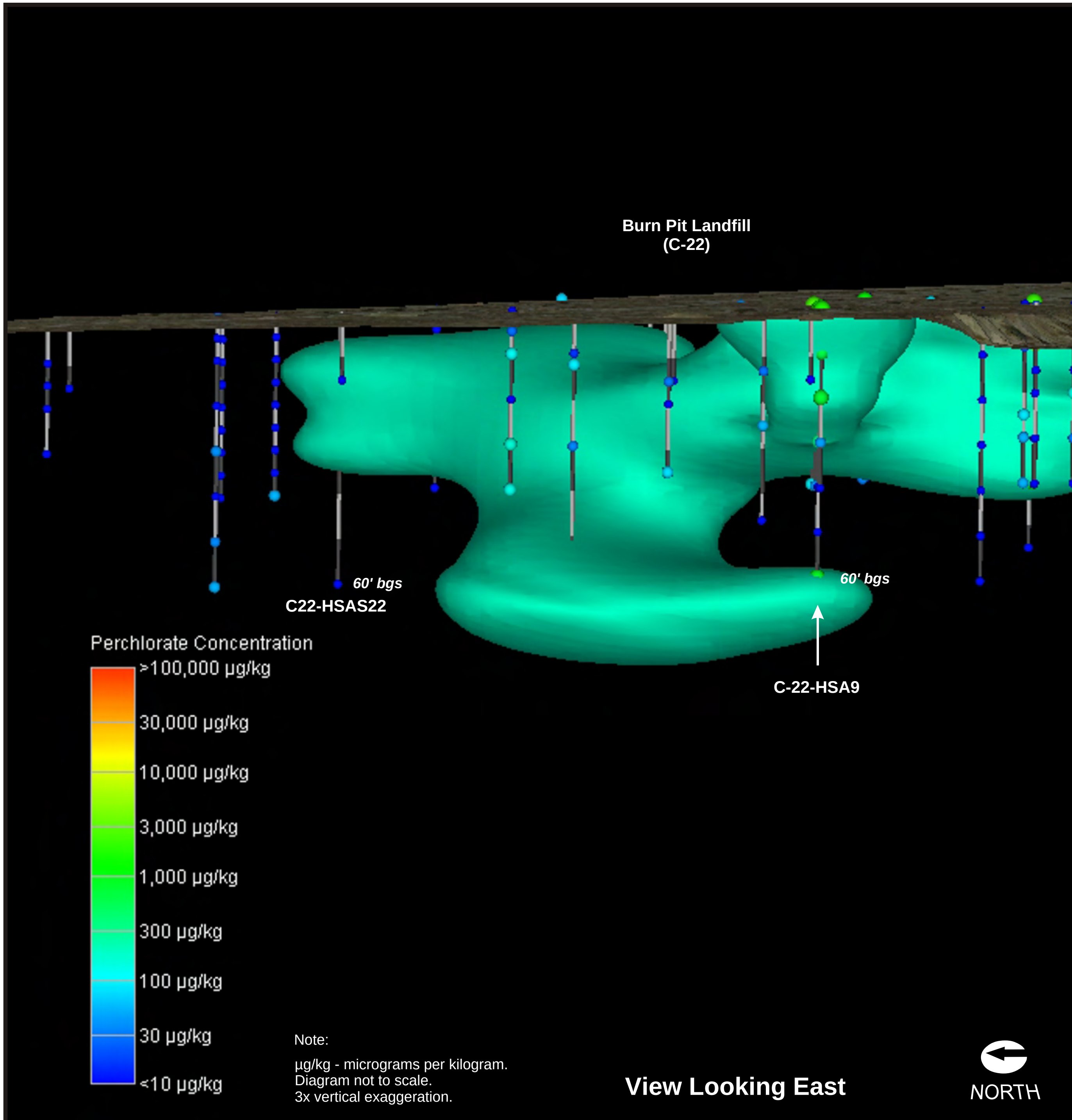
X:\GIS\22288-110302\C22_PERC_SIDE_EAST.CDR



Beaumont Site 1

Figure 5-41

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking East) - Burn Pit Area (Feature C-22)

TETRA TECH

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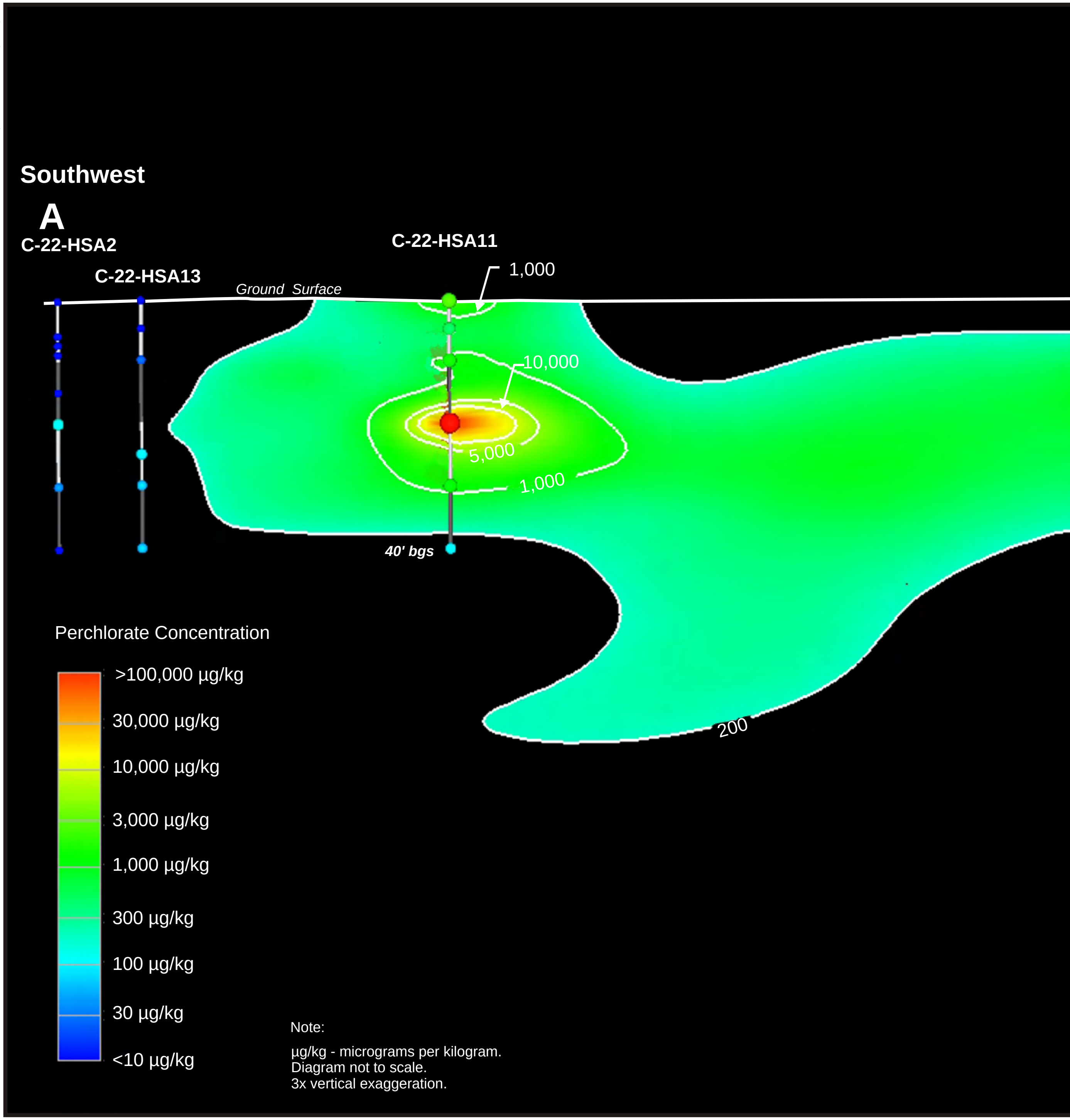
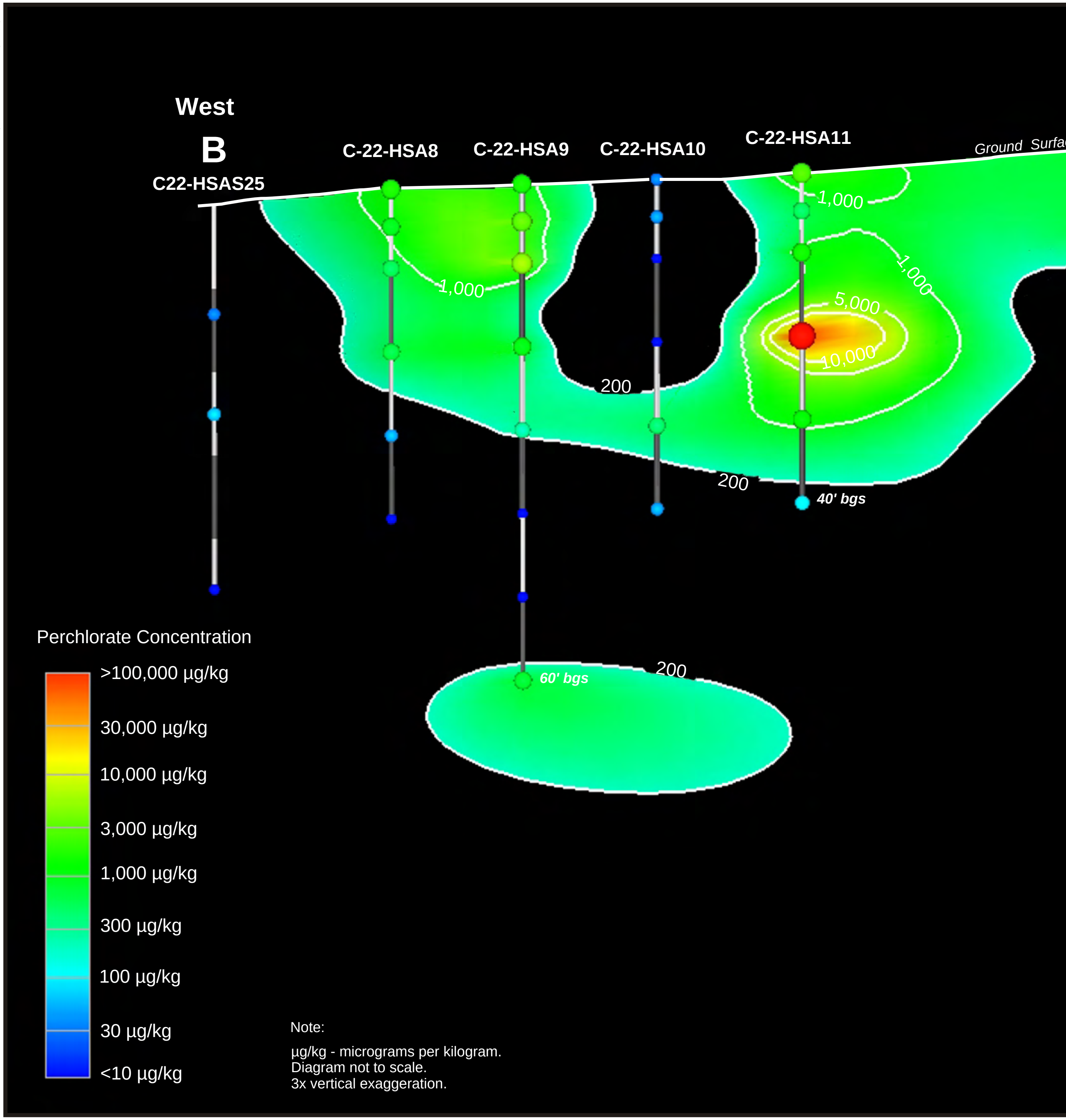


Beaumont Site 1

Figure 5-42

Vertical Profile of Perchlorate in Soil - Cross Section A-A' Burn Pit Area (Feature C-22)

TETRA TECH



Beaumont Site 1

Figure 5-43

Vertical Profile of Perchlorate in Soil - Cross Section B-B' Burn Pit Area (Feature C-22)

TETRA TECH

Table 5-9 Soil Gas Sampling Results - Burn Pit Area (Feature C-22)

Boring ID	Sample Name	Depth (feet bgs)	Sample Date	1,1-DCE	1,1,1-TCA	1,1,2-TCA	TCE	PCE
Matrix				***Soil Gas***				
Units				μg/m³				
CHHSL - Res				--	991,000	--	528	180
CHHSL - C/I				--	2,790,000	--	1,770	603
C22-PSG1	C22-SVP1-5	5	12/2/2008	**1,360**	**132**	<58	**453**	<72
C22-PSG2	C22-SVP2-5	5	12/2/2008	**1,100**	**640**	<58	**458**	<72
C22-PSG3	C22-SVP3-5	5	12/2/2008	**1,940**	**2,910**	**160**	**1,530**	**332**
C22-PSG4	C22-SVP4-5	5	12/2/2008	**431**	**112**	<58	**492**	<72
C22-PSG5	C22-SVP5-5	5	12/2/2008	<42	<58	<58	<57	<72

Notes:

CHHSL - California Human Health Screening Level.
Res - Residenital CHHSL for vapor intrusion, January 2005.
C/I - Commercial/Industrial CHHSL for vapor intrusion, January 2005.
$\mu g/m^3$ - Micrograms per cubic meter.
bgs - Below ground surface.
PSG - Primary soil gas.
SVP - Soil Vapor Probe.
(--) - CHHSL not available.

5.4.3 Historical Operational Area F

Historical Operational Area F, the LPC Test Services Area, included the following features: 1) three bays for structural load tests, 2) a 13-foot diameter spherical pressure vessel, 3) six temperature conditioning chambers, 4) five environmental chambers, 5) a 25 MeV Betatron for emitting X-rays into large structures, 6) personnel and instrumentation protection bunkers, 7) supporting workshops and storage areas, and 8) a large motor washout area.

5.4.3.1 Feature F-34 - Maintenance Shop and Storage Warehouse Area

The Maintenance Shop (Bldg. 306) and Storage Warehouse (Bldg. 314) Area is located in the southwestern portion of Historical Operational Area F. The shops were used for general equipment/material storage and possible instrument repair and maintenance. Oils, fuels, solvents, and paints were reported to have been used in this area. (Tetra Tech; 2003a, 2005b).

Previous Results

Seven soil borings and four soil gas probes (1-single and 3-multi-depth) were installed between 21.5 and 41.5 feet bgs at the Maintenance Shop and Storage Warehouse Area (Feature F-34) during previous investigations (Tetra Tech, 2005b, 2009a). Soil samples were analyzed for VOCs, 1,4-dioxane, TPH, and Title 22 metals. VOCs and 1,4-dioxane were not detected at concentrations above their respective RLs. Low levels of benzene, toluene, ethylbenzene, and total xylenes (BTEX), PCE, TCE, and 1,1-DCE were detected in the soil gas samples collected. The highest concentrations of COPCs previously detected are as follows: TCE was detected at 15 feet bgs (18.1 µg/m3), PCE at 25 feet bgs (17.2 µg/m^3), 1,1-DCE at 10 feet bgs (2,900 µg/m^3), BTEX at 15 feet bgs (513 µg/m^3). Two of the soil gas probes could not be sampled due to no-flow conditions because of saturated soils. All analytes and concentrations detected in soil gas were below their respective residential and commercial CHSSLs. Tables of the soil and soil gas analytical results from the previous investigations are included in Tables H-10 and H-15 in Appendix H. Based on the results of the previous investigations, further investigation of the soil and groundwater was needed to delineate the impacts of VOCs in soil gas and groundwater as well as evaluate potential off-gassing from groundwater.

Soils at the Maintenance Shop (Bldg. 306) and Storage Warehouse (Bldg. 314) Area are generally very fine- to coarse-grained sand. The alluvium ranges in thickness from 0 to 10 feet at this feature and when present is underlain by weathered Mount Eden formation. Groundwater was encountered in the Mount Eden formation in one boring at approximately 30 feet bgs during the 2007 investigation. However, no groundwater samples were collected at this feature so impacts to groundwater were unknown.

Investigation Activities

Six (6) primary and 4 secondary shallow borings were drilled between 13 and 27 feet bgs, one secondary boring was hand augered to 7.4 feet bgs, and one primary boring was drilled to 100 feet bgs using HSA or Sonic method (Figure 5-44). Dual-completion soil gas probes were installed in six of the borings (F34-PSB1/PSG1 through F34-PSB6/PSG6) at approximately 5 and 15 feet bgs. Groundwater grab samples were collected at first water from the 12 shallow borings installed to depths between 3 and 27 feet bgs and analyzed for VOCs only. The investigative approach used at this feature involved the collection of depth-discrete groundwater samples for vertical characterization of groundwater from the boring with the highest concentration of TCE detected at first water. Depth-discrete groundwater samples were collected from boring F34-PSB5B/MW-87A,B every 20 feet from 39 to 100 feet bgs and analyzed for VOCs. Soil gas samples were collected from 11 of the 12 probes installed and analyzed for VOCs. One of the soil gas probes (F34-PSB6/PSG6 at 15 feet bgs) could not be sampled due to no-flow conditions because of saturated soils.

Based on the depth-discrete groundwater samples collected within the sonic drilled boring (F34-PSB5B), one shallow monitoring well (F34-PSB5B/MW-87B) was installed at first water and screened from 15 to 35 feet bgs, and one deep monitoring well (F34-PSB5B/MW-87A) was installed with a 10-foot screened interval from 90-100 feet bgs. Two additional shallow first water monitoring wells (F34-SSB9/MW-93 and F34-SSB10/MW-94) were installed with 20-foot screens with total depths of 45 and 39 feet bgs, respectively. A temporary monitoring well (F34-TW1) was also installed southwest within the drainage and downgradient of this feature (screened from 2.5 to 4.5 feet bgs). The shallow monitoring wells were installed to the south and southwest downgradient of this feature to define the lateral extent of impacted groundwater. The well construction diagrams are included in Appendix D. Subsequent to the field investigation and well development, groundwater samples were collected and analyzed for perchlorate, VOCs, and 1,4-dioxane in February and March 2009. Due to the detections of 1,4-dioxane and perchlorate at this feature and the continual detections of 1,4-dioxane in Potrero Creek, surface water samples were collected in March 2009 from 8 locations along the streambed to evaluate the surface water impacts upgradient and downgradient of Feature F-34. The surface sampling was conducted to evaluate if the 1,4-dioxane from Feature F-34 was contributing additional mass to the already impacted surface water within Potrero Creek. The surface water samples were analyzed for perchlorate, VOCs, and 1,4-dioxane.

Geology and Hydrogeology

Operations at the Maintenance Shop and Storage Warehouse (Feature F-34) were conducted in an area that is oriented approximately northwest and elevated about 7 to 10 feet above one of the main site access roads (Figure 5-44). The hills surrounding the area on the northwest and northeast are composed of very

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0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Primary Soil Boring Soil Vapor, 2008
- Soil Boring/Soil Vapor, 2007
- Soil Boring/Soil Vapor, 2004
- Well Location
- Geologic Cross Section Location
- 2130 Ground Surface Elevation Contour
- B Geologic Cross Section Line Beginning and End Points

HSA Hollow Stem Auger - Part of the nomenclature for borings installed with a hollow stem auger rig during the soil investigation in 2004.

HSAS Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed with a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

PSG Primary Soil Gas- Part of the nomenclature for primary borings where soil gas probes were installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MW Monitoring Well

TW Temporary Well

Note:
- Ground surface elevation is relative to mean sea level (msl)
- Ground surface elevation from Riverside County Flood Control.

Beaumont Site 1

Figure 5-44
Soil Borings and Cross Section Locations Maintenance Shop and Storage Warehouse (Feature F-34)

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well indurated Mount Eden sandstone. The area includes several concrete pads where the former shops and warehouse existed and appears to have been cut back into the formation on the north side with a short (approximately 2 feet) retaining wall holding back the erosional material. There are a couple of small tributaries coming from the north; one appears to flow through the feature on the west side while the other has been directed around the feature with a culvert on its eastern boundary diverting water beneath the existing roads. The boring closest to the retaining wall (F34-PSB1/PSG1) encounters Mount Eden formation at the surface. The other boring close to the retaining wall (F34-PSB4/PSG4) is also adjacent to the former warehouse and appears to be placed in the former flow path of the westernmost tributary prior to operational activities. That boring (F34-PSB4/PSG4), does not encounter Mount Eden formation until approximately 20 feet bgs. The Mount Eden sandstone is encountered gradually deeper (between 3 and 20 feet bgs) in the other borings moving further away from the retaining wall and closer to the streambed of Potrero Creek. The cross section locations and idealized cross sections through this area are presented in Figures 5-44 and 5-45.

The alluvium at the Maintenance Shop and Storage Warehouse is predominantly sand with some silty sand. The alluvium appears to be very different from the surrounding source rocks as noted in the boring logs (Appendix D) as being possible fill material to level out the area before the asphalt and concrete foundations were laid down.

Within the operational area (borings F34-PSB1/PSG1 - F34-PSB5/PSG5), groundwater was encountered between 16 and 31.5 feet bgs. Groundwater was encountered at depths ranging from 21 to 35 feet bgs in the area located 7 to 10 feet lower in elevation of the operational area near the road and downgradient of the feature. Based on the groundwater level data collected during February 2009, the groundwater elevations show the groundwater flow direction is towards the west and slightly southwest into Potrero Creek (Figure 5-46).

Groundwater Sampling Results and Contaminant Distribution

During drilling activities, TCE was detected above the MDL (0.10 µg/L) in 12 of the 17 samples ranging from 0.645 to 120 µg/L (Table 5-10). Other VOCs detected in the grab samples include 1,1-DCE, 1,1-DCA, BTEX, chloroform and MtBE. Depth discrete groundwater samples collected from boring F34-PSB5B/MW-87A,B indicate that the TCE concentrations generally decrease with depth, from 120 µg/L at first water (26 feet bgs) to below 0.10 µg/L at 90 and 100 feet bgs. The highest concentrations of TCE and 1,1-DCE at the feature were detected in the first water sample (26 feet bgs) from F34-PSB5B/MW-87A. The concentrations of TCE (9 samples) and 1,1-DCE (5 samples) exceeded their respective MCLs in the groundwater grab samples collected. Figure 5-47 shows the areal extent of TCE

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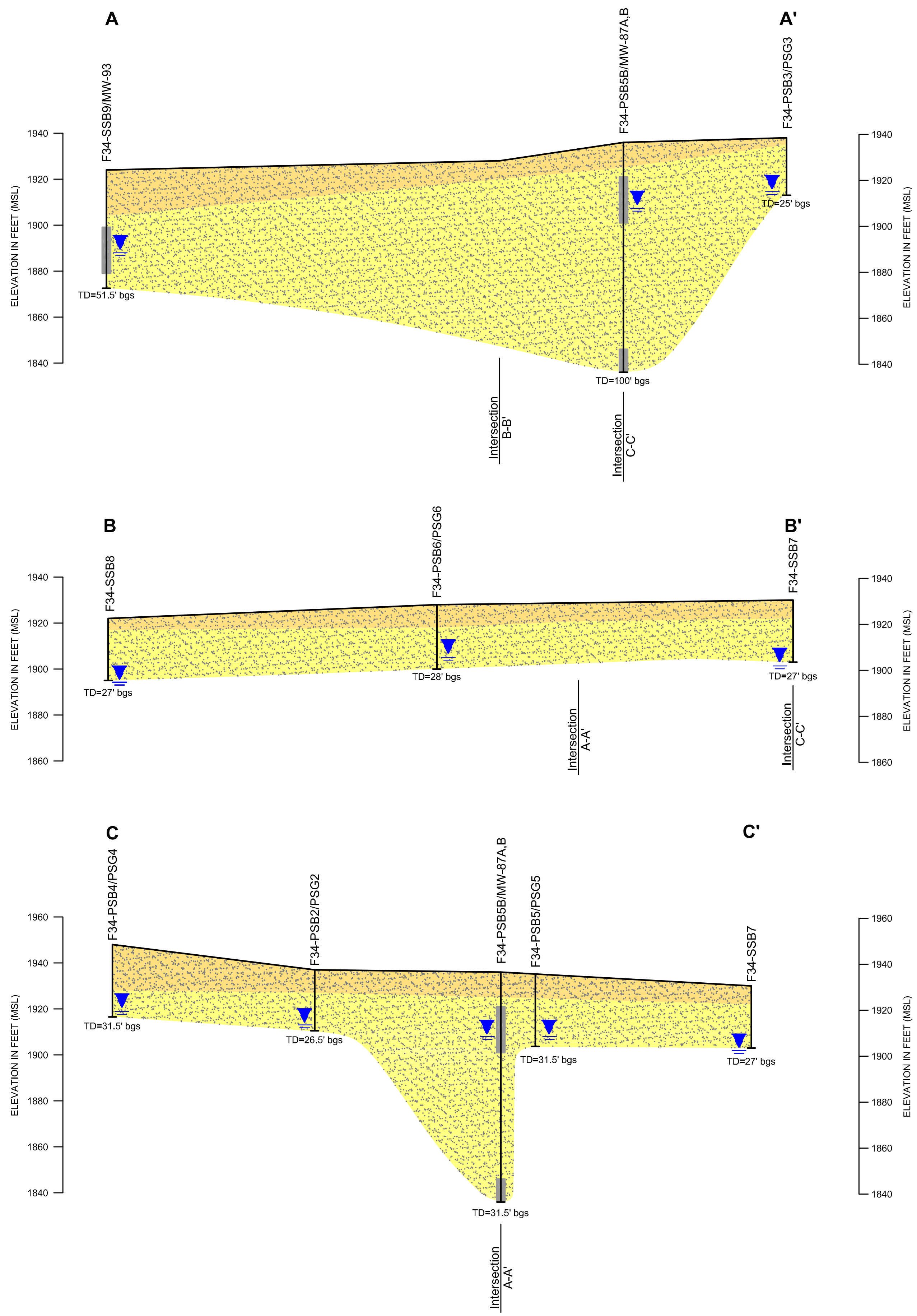

LEGEND

Quaternary Alluvium

Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs below ground surface

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

PSG Primary Soil Gas - Part of the nomenclature for initial primary borings where soil gas probes were installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MSL Mean sea level

MW Monitoring Well

TD=#' Total Boring Depth (feet)

Well

Screened interval

Boring

First water sample collected during drilling activities, fall to winter 2008

Intersection A-A' location where cross sections intersect

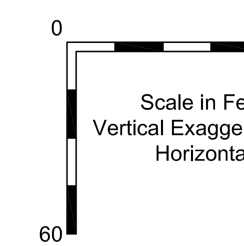

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Figure 5-45
Idealized Geologic Cross Sections A-A', B-B', and C-C'
Maintenance Shop and Storage Warehouse (Feature F-34)

TETRA TECH

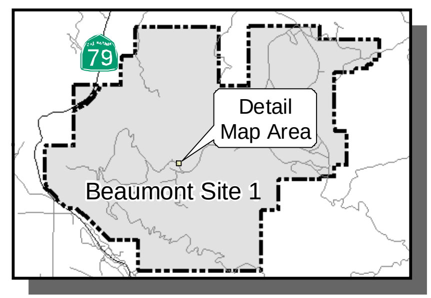
0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

- Monitoring Well Location
- Groundwater Elevation Contour (relative to mean sea level)
- Groundwater Flow Direction

Note: Groundwater elevation is relative to mean sea level (msl).



Beaumont Site 1

Figure 5-46
Groundwater Contours - February 2009
Maintenance Shops and Warehouse (Feature F-34)

TETRA TECH

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Table 5-10 Groundwater Sampling Results - Maintenance Shop and Storage Warehouse Area (Feature F-34)

Boring ID	Sample Name	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	Benzene	Chloro-form	1,1-DCA	1,1-DCE	Ethyl - benzene	MTBE	Toluene	TCE	m,p-Xylenes	o-Xylene
Matrix				***Water***											
Units				µg/L											
MCL					6	1	--	5	6	300	13	150	5	1,750	1,750
DWNL				3			--								
F34-PSB1 /	F34-PGW1-19	19	9/15/2008	-	-	0	0	<0.10	**19**	<0.10	<0.10	0	**24.9**	<0.20	<0.10
F34-PSB2 /	F34-PGW2-23	23	09/15/08	-	-	**0.170**	**0.160**	**0.700**	**8.1**	<0.10	<0.10	**0.300**	**30.7**	<0.20	<0.10
F34-PSB3 /	F34-PGW3-22	22	09/12/08	-	-	**0.220**	<0.10	<0.10	**2.6**	<0.10	**0.40**	**0.41**	**6.42**	**0.20**	<0.10
F34-PSB4 /	F34-PGW4-27	27	09/12/08	-	-	**0.170**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.26**	<0.10	<0.20	<0.10
F34-PSB5B / MW-87A	F34-PGW5-26	26	09/15/08	-	-	<0.10	**0.250**	**0.210**	**23.1**	**0.430**	**0.290**	**0.860**	**120**	**0.500**	**0.900**
	MW-87B	15-35	2/2/2009	**73**	**79.7**	<0.10	<0.10	<0.10	**27.6**	<0.10	<0.10	<0.10	**87**	<0.20	<0.10
	MW-87B	15-35	3/4/2009	**63**	**35.2**	<0.10	<0.10	<0.10	**10.2**	<0.10	<0.10	<0.10	**60**	<0.20	<0.10
F34-PSB5B / MW-87A	F34-PGW5-39	39	10/22/08	-	-	<0.10	<0.10	<0.10	**2.65**	<0.10	<0.10	<0.10	**9.35**	<0.20	<0.10
	F34-PGW5-50	50	10/23/08	-	-	<0.10	<0.10	<0.10	**7.45**	<0.10	<0.10	<0.10	**27.3**	<0.20	<0.10
	F34-PGW5-60	60	10/23/08	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**7.3**	<0.20	<0.10
	F34-PGW5-70	70	10/23/08	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**2.29**	<0.20	<0.10
	F34-PGW5-80	80	10/23/08	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.790**	<0.20	<0.10
	F34-PGW5-90	90	10/23/08	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.20	<0.10
	F34-PGW5-100	100	10/23/08	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.20	<0.10
	MW-87A	90-100	2/2/2009	**3**	<0.5	<0.10	<0.10	<0.10	**0.590**	<0.10	<0.10	<0.10	**0.540**	<0.20	<0.10
	MW-87A	90-100	3/4/2009	**4**	<0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.570**	<0.20	<0.10
F34-PSB6 /	F34-PGW6-21	21	09/16/08	-	-	**0.23**	<0.10	**0.41**	**7.6**	<0.10	<0.10	**0.32**	**21.3**	**0.20**	**0.10**
F34-SSB7	F34-SGW7-27	27	10/22/08	-	-	<0.10	<0.10	**0.280**	<0.10	<0.10	<0.10	<0.10	**5.85**	<0.20	<0.10
F34-SSB8	F34-SGW8-27	27	10/23/08	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.20	<0.10
F34-SSB9 / MW-93	MW-93	25-45	02/05/09	**7**	**1.48**	<0.10	<0.10	<0.10	**0.41**	<0.10	<0.10	<0.10	**1.46**	<0.20	<0.10
	MW-93	25-45	3/9/2009	**6.9**	**3.03**	<0.10	<0.10	<0.10	**0.130**	<0.10	<0.10	<0.10	**1.67**	<0.20	<0.10
F34-SSB10 / MW-94	F34-PGW10-25	25	11/17/08	-	<0.5	-	-	-	-	-	-	-	-	-	-
	MW-94	19-39	2/2/2009	**1.6**	**4.04**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**1.25**	<0.20	<0.10
	MW-94	19-39	3/9/2009	**3.2**	<1	<0.10	<0.10	**0.290**	**0.140**	<0.10	<0.10	<0.10	**1.74**	<0.20	<0.10
F34-TW1	F34-TW1	2.5-4.5	10/22/08	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.645**	<0.20	<0.10
	F34-TW1	2.5-4.5	02/11/09	**2.1**	<0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.350**	<0.20	<0.10
	F34-TW1	2.5-4.5	3/3/2009	**5.4**	<0.5	<0.10	<0.10	<0.10	**0.260**	<0.10	<0.10	<0.10	**0.940**	<0.20	<0.10

Notes:

"Bold" - Indicates concentrations detected above the method detection limit.
bgs - Below ground surface.
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
µg/L - Micrograms per liter.

PSB - Primary soil boring.
SSB - Secondary soil boring.
TW - Temporary groundwater monitoring well.
MW - Groundwater monitoring well.
(-) - Sample not analyzed for analyte.

PGW - Primary groundwater sample.
SGW - Secondary groundwater sample.
(--) - MCL or DWNL not available.

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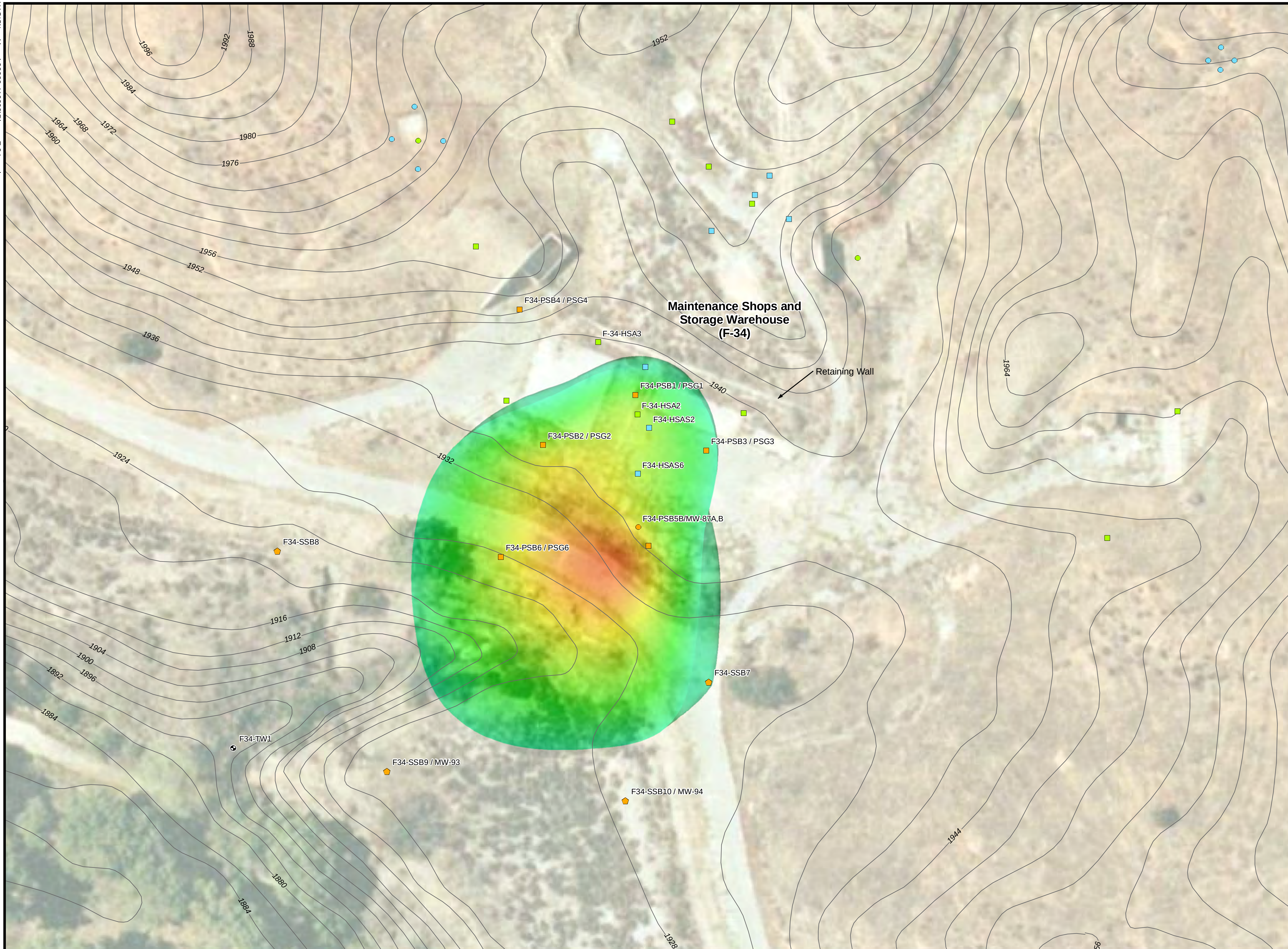

0 30 60 Feet

LEGEND

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring, / Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring, / Soil Vapor, 2004
- Well, 2008
- Ground Surface Elevation Contour

Trichloroethene (TCE) Concentration

>100 µg/L
30 µg/L
10 µg/L
3 µg/L
<1 µg/L

Note:

Borings with no sample name indicates no sample was collected at the depth interval.

Ground surface elevation from Riverside County Flood Control.

Ground surface elevation relative to mean sea level (msl).

Beaumont Site 1

Figure 5-47
Lateral Extent of TCE in Groundwater Above 5 µg/L from 3.59 - 100 ft bgs Maintenance Shop and Storage Warehouse (Feature F-34)

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in groundwater above 5 µg/L based on the 3-D modeling of groundwater data collected during this investigation. TCE impacts in groundwater extend out from the former operational area towards the southwest generally following the topographic gradient covering an area of approximately 40,825 ft^2. Figure 5-48 presents the TCE concentration contours for samples collected at first water during the DSI showing the highest concentrations detected at F34-PSB5B/MW-87A,B decreasing an order of magnitude a 100 feet downgradient of this location/well. Further downgradient (about 200 feet from F34-PSB5B/MW-87A,B), the concentrations decrease to below the MCL (5 µg/L) at F34-SSB9/MW-93. Based on the additional characterization data collected during this investigation, the extent of TCE has been defined to the MCL.

Figures 5-49 and 5-50 present 3-D visualizations of the TCE-affected groundwater above 5 µg/L at this feature with views looking north and west. As shown in these figures along with the vertical profile (Figure 5-51), the vertical extent of TCE impacts is defined by samples collected from F34-PSB5B/MW-87A with concentrations decreasing below the MCL (5 µg/L) by a depth of 70 feet bgs. Figure 5-51 shows the vertical profile for TCE in groundwater along cross section lines A-A' covering the longest areal extent of the TCE plume from the feature outward to the drainage leading into Potrero Creek. The figure includes boring F34-PSB5B/MW-87B which had the highest primary COPCs detected at this feature and was selected to characterize the vertical extent of impacts within groundwater.

Subsequent to the field investigation, groundwater samples were collected from the five on-site monitoring wells and analyzed for perchlorate, VOCs and 1,4-dioxane. Recent groundwater sample results (March 2009) detected the following primary Site groundwater COPCs: 1,4-dioxane in all five wells (range: 3.2 µg/L to 63 µg/L); perchlorate in two wells (F34-SSB9/MW-93 at 3.03 µg/L and F34-PSB5B/MW-87B at 35.2 µg/L); TCE in all five wells (0.57 µg/L to 60 µg/L); and 1,1-DCE in four of the wells (0.13 µg/L to 10.2 µg/L). Figures 5-52 and 5-53 show the 1,4-dioxane and perchlorate concentration contours based on the monitoring well results from March 2009. The footprints of the 1,4-dioxane and perchlorate plumes are consistent with the TCE plume shown in Figure 5-48. BTEX and MTBE previously detected in the groundwater grab samples were not detected in any of the monitoring wells installed and sampled in February and March 2009. The BTEX and MTBE detections may represent field cross contamination originating from the drilling rig, gas powered portable pumps, or support vehicles. The highest concentration of COPCs were identified in F34-PSB5B/MW-87B. The concentrations of TCE (1 sample), perchlorate (1 sample) and 1,1-DCE (1 sample) exceeded their respective MCLs and 1,4-dioxane (five samples) exceeded the DWNL.

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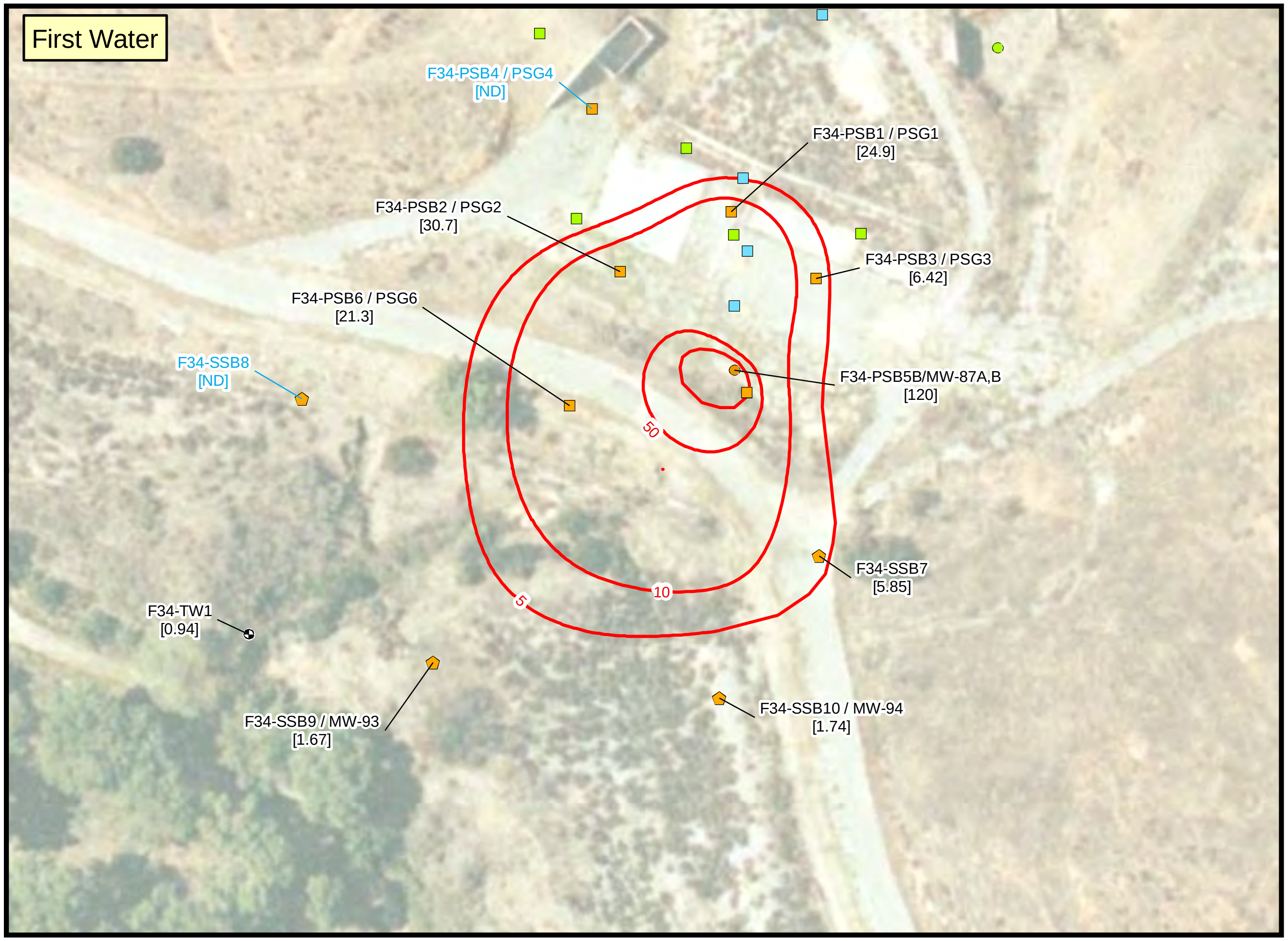


0 50 100
Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Secondary Soil Boring, 2008
- Soil Boring/Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Well Location

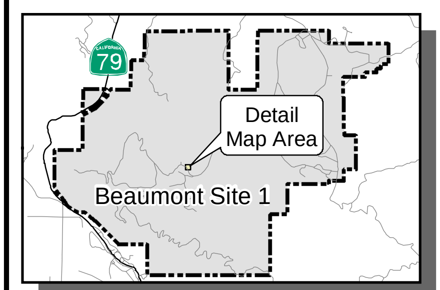
TCE Trichloroethene

TCE Isoconcentration Contours in Groundwater

Note:

[#] TCE results in µg/L.

[ND] Non-Detect. (<0.10 µg/kg)



Beaumont Site 1

Figure 5-48
TCE Concentrations in Groundwater - Maintenance Shop and Storage Warehouse (Feature F-34)

TETRA TECH

X:\GIS\22288-110302\F34_TCE_SIDE.CDR

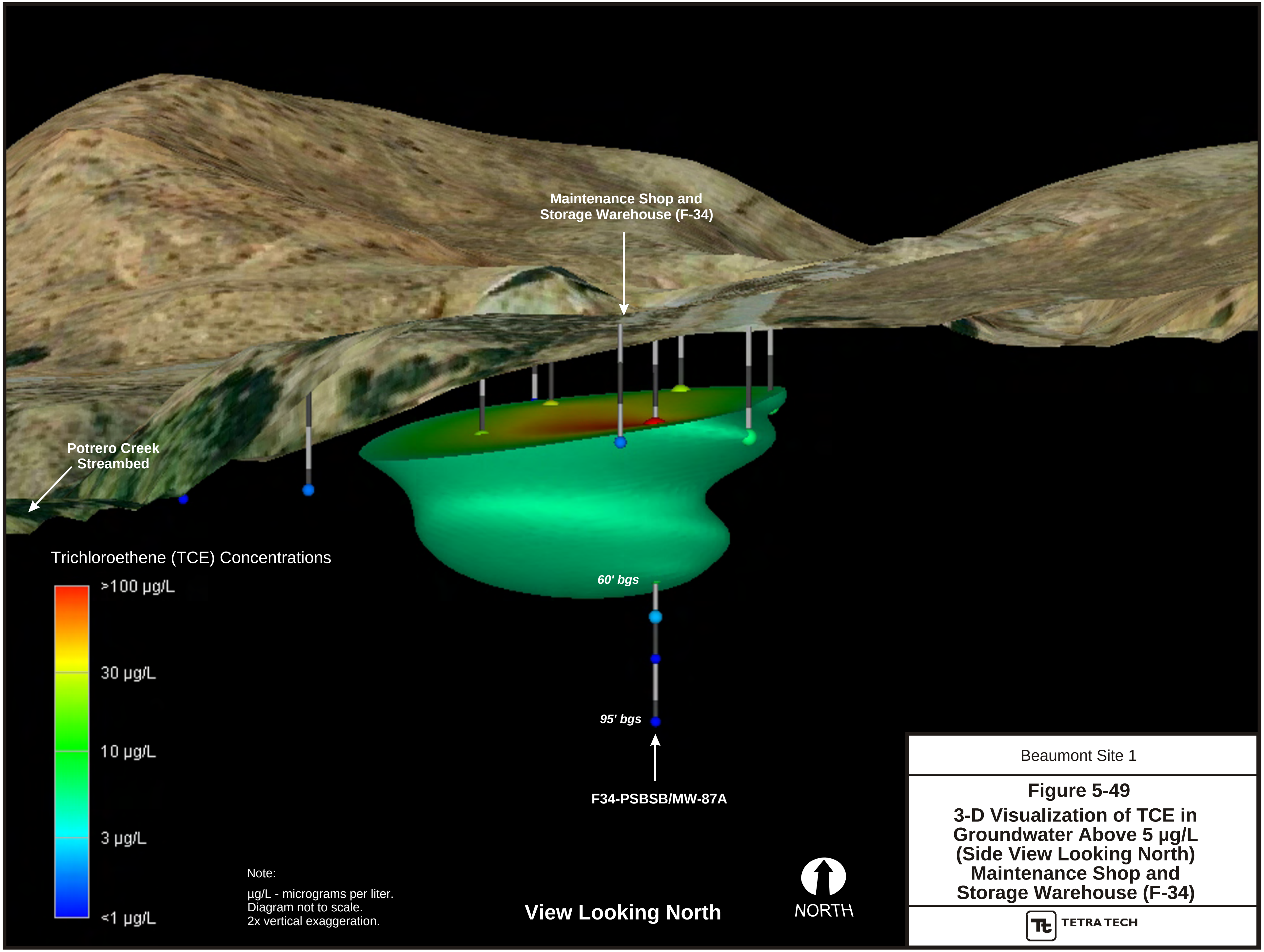
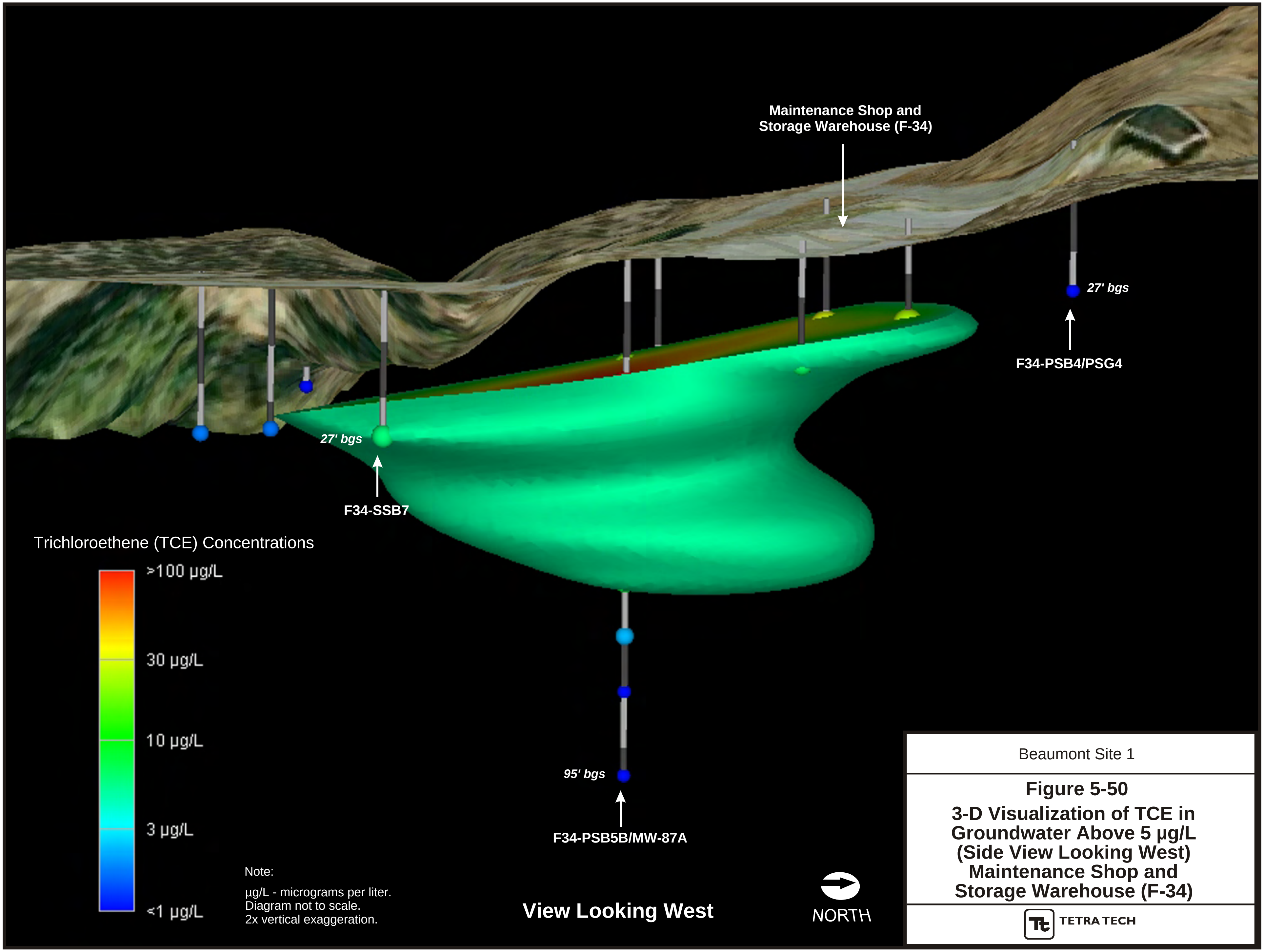


Figure 5-49
3-D Visualization of TCE in Groundwater Above 5 µg/L (Side View Looking North) Maintenance Shop and Storage Warehouse (F-34)



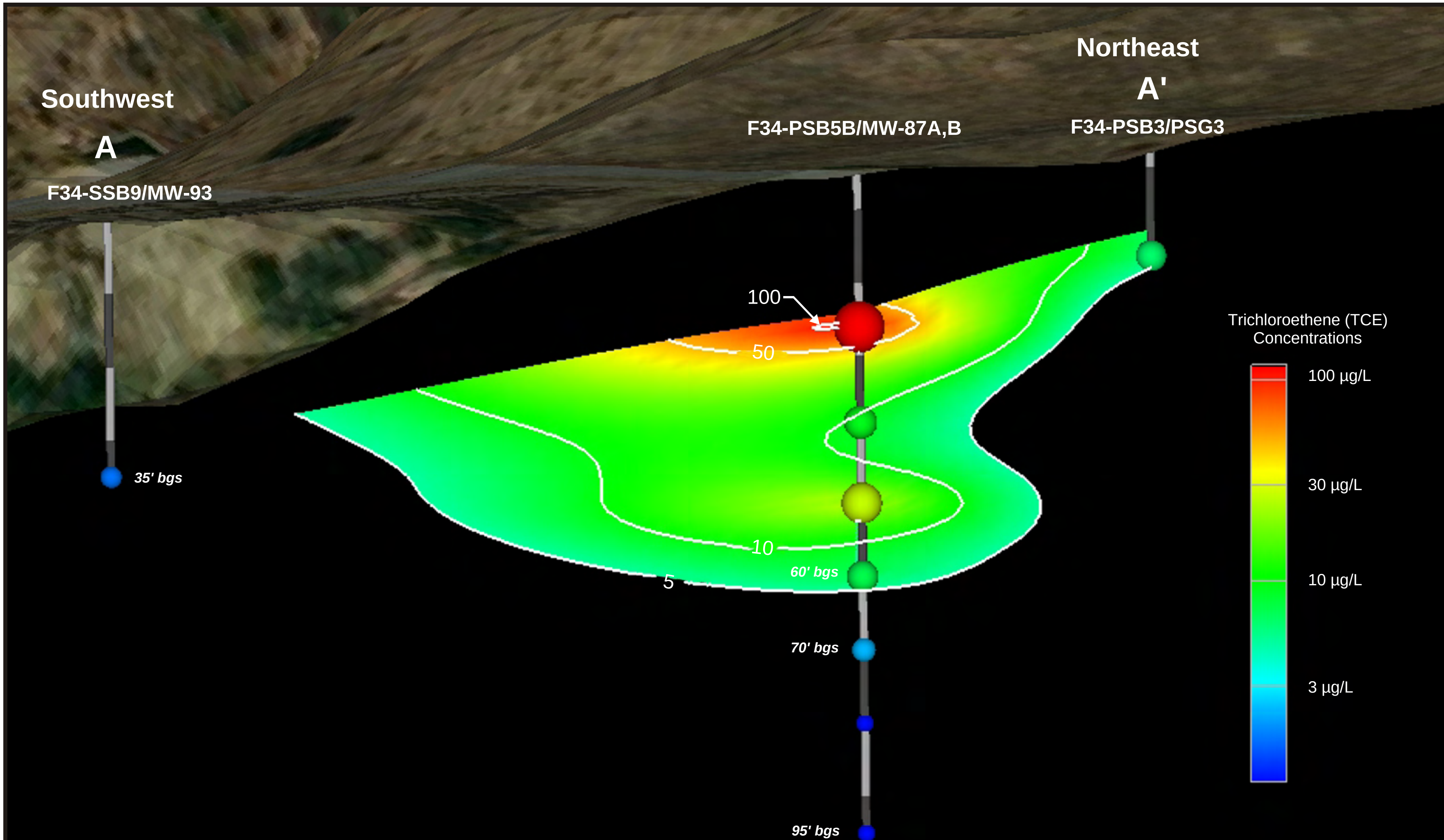
Beaumont Site 1

Figure 5-50

3-D Visualization of TCE in Groundwater Above 5 µg/L (Side View Looking West) Maintenance Shop and Storage Warehouse (F-34)

TETRA TECH

X:\GIS\22288-110302\F34_TCE_SIDE_WEST.CDR



Note:

µg/L - micrograms per Liter.
Diagram not to scale.
2x vertical exaggeration.

Beaumont Site 1

Figure 5-51
Vertical Profile of TCE in Groundwater Cross Section A-A' Maintenance Shop and Storage Warehouse (F-34)

TETRA TECH

X:\GIS\Lockheed 22288-110302\DIOX_GW_ F34.mxd

0 30 60 Feet

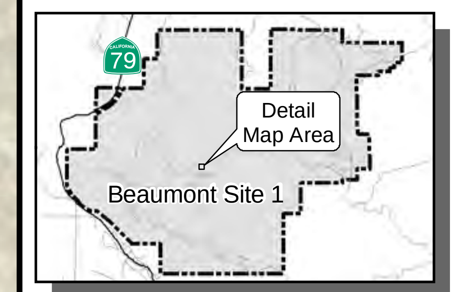
Adapted from: March 2007 aerial photograph.

LEGEND

Monitoring Well Location

1,4-Dioxane Isoconcentration Contour (dashed where inferred)

[#] 1,4-Dioxane Results in µg/L

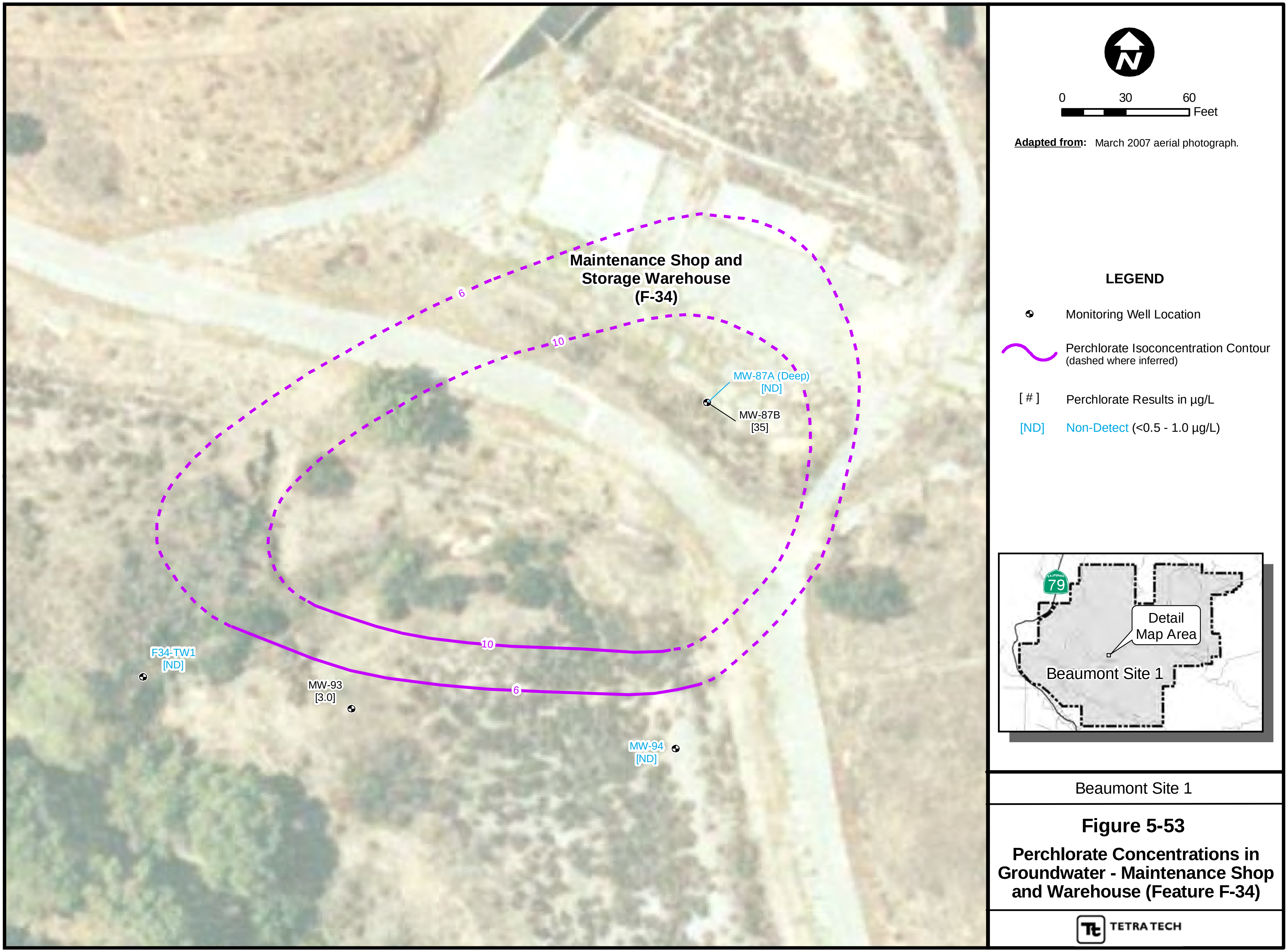


Beaumont Site 1

Figure 5-52

1,4-Dioxane Concentrations in Groundwater - Maintenance Shop and Warehouse (Feature F-34)

TETRA TECH



Beaumont Site 1

Figure 5-53

Perchlorate Concentrations in Groundwater - Maintenance Shop and Warehouse (Feature F-34)

TETRA TECH

Surface Water

Surface water flow at the Site is ephemeral, flowing briefly only in direct response to precipitation during or immediately after storm events. However, there are small reaches of the stream that remain wet throughout most of the year or flow for short distances before becoming dry again. These flows vary both seasonally and in response to long term precipitation trends at the Site. The areas of intermittent surface flow represent groundwater discharge where the stream is gaining in some reaches while losing in other reaches. The undulating bedrock surface of the Mount Eden formation, some of which appears to be related to faulting, is thought to be the cause of these discontinuous areas of flow along the stream course. Mapping of these discontinuous areas of surface flow within the streambed along with flow measurements and water quality sampling is conducted as part of the routine monitoring program at the Site.

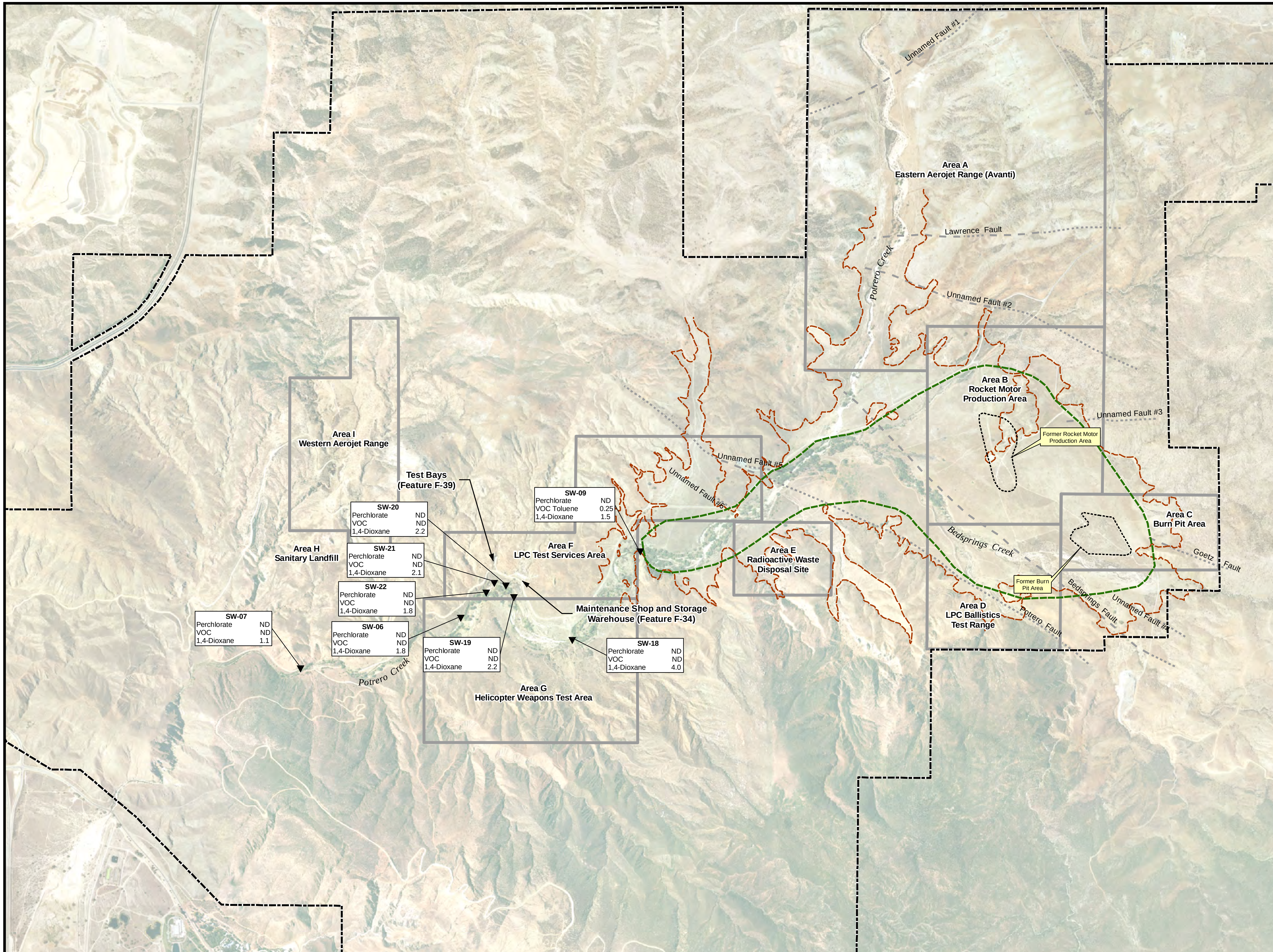
As stated previously, surface water samples were collected from eight locations along the stream bed above and below Features F-34 and F-39: SW-06, SW-07, SW-09, and SW-18, through SW-22 (Figure 5-54). The sample results indicate that perchlorate was not detected above the MDL (Table 5-11). One VOC (toluene) was detected in location SW-09 (0.25 µg/L) and 1,4-dioxane was detected in 8 locations ranging from 1.1 to 4 µg/L. The highest concentration of 1,4-dioxane was detected at SW-18 which is located upgradient of Feature F-34.

Table 5-11 Surface Water Sampling Results - Maintenance Shop and Storage Warehouse Area (Feature F-34)

Sample Name	Sample Date	1,4-Dioxane
Matrix		***Water***
Units		µg/L
DWNL		3
SW-06	3/5/2009	1.8
SW-07	3/5/2009	1.1
SW-09	3/5/2009	1.5
SW-18	3/5/2009	4
SW-19	3/5/2009	2.2
SW-20	3/5/2009	2.2
SW-21	3/5/2009	2.1
SW-22	3/5/2009	1.8

Notes:
"Bold" - Indicates concentrations detected above the method detection limit.
bgs - Below ground surface.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
µg/L - Micrograms per liter.
SW - Surface water.

The concentrations of 1,4-dioxane decrease from 2.2 to 1.1 µg/L in samples collected downgradient of SW-18. Based on the results from this non-routine surface water sampling event, the results indicate that the 1,4-dioxane impacts to groundwater at Feature F-34 are not adversely affecting the surface water in Potrero Creek.



X:\GIS\Lockheed 22288-11030\Surface COPC.mxd

0 1,000 2,000 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

- ▼ Surface Water Sample
- Conservation Easement Boundary
- Approximate Location of Fault
- Approximate Location of Buried Fault
- Beaumont Site 1 Property Boundary
- Historical Operational Area Boundary
- Mount Eden/Alluvium Surface Contact

Notes: Beaumont Site 1 property boundary is approximate.

Beaumont Site 1

Figure 5-54

Surface Water Sampling Results (µg/L) - March 2009 Features F-34 & F-39

TETRA TECH

Soil Gas Sampling Results and Contaminant Distribution

Several VOCs were detected in soil gas at the Maintenance Shop and Storage Warehouse Area during this investigation (Table 5-12). Groundwater COPCs, TCE and 1,1-DCE, were detected at concentrations up to 104 µg/m^3 (13 feet bgs) and 183 µg/m^3 (15 feet bgs), respectively. Other VOCs detected in soil gas include carbon disulfide and toluene. The highest concentrations of TCE and 1,1-DCE were detected in the deeper probes near the groundwater and in the areas where the highest groundwater concentrations were detected. The concentrations of VOCs detected in soil gas do not exceed the residential or commercial/industrial CHHSLs for vapor intrusion. Based on the vertical concentration profile coupled with the analytes detected and magnitude of VOCs in soil and groundwater, , it is likely that the analytes detected in soil gas are a result of off-gassing of affected groundwater beneath this feature rather than a shallow soil source.

Table 5-12
Soil Gas Sampling Results - Maintenance Shop and Storage Warehouse Area (Feature F-34)

Boring ID	Sample Name	Depth (feet bgs)	Sample Date	Carbon Disulfide	1,1-DCE	Toluene	TCE
Matrix				***Soil Gas***			
Units				µg/m^3			
CHHSL - Res				--	--	135,000	528
CHHSL - C/I				--	--	378,000	1,770
F34-PSB1 / PSG1	F34-SVP1.5	1.5	10/1/2008	<33	<42	<40	<57
	F34-SVP1-13	13	10/02/08	<33	**121**	**42.7**	**104**
F34-PSB2 / PSG2	F34-SVP2.5	2.5	10/1/2008	<33	<42	<40	<57
	F34-SVP2-15	15	10/2/2008	**78.1**	**183**	<40	**66.7**
F34-PSB3 / PSG3	F34-SVP3.5	3.5	10/1/2008	<33	<42	<40	<57
	F34-SVP3-15	15	10/2/2008	<33	<42	<40	<57
F34-PSB4 / PSG4	F34-SVP4-5	5	10/2/2008	<33	<42	<40	<57
	F34-SVP4-15	15	10/2/2008	<33	<42	<40	<57
F34-PSB5 / PSG5	F34-SVP5.5	6	10/1/2008	<33	<42	<40	<57
	F34-SVP5-15	15	10/2/2008	**71.1**	**168**	**44**	**57**
F34-PSB6 / PSG6	F34-SVP6-5	5	10/2/2008	<33	<42	<40	<57
	F34-SVP6-15	15	10/2/2008	NS	NS	NS	NS

Notes:

CHHSL - California Human Health Screening Level.
Res - Residenital CHHSL for vapor intrusion, January 2005.
C/I - Commercial/Industrial CHHSL for vapor intrusion, January 2005.
µg/m3 - Micrograms per cubic meter.
NS - Not samples due to no flow conditions.
bgs - Below ground surface.
PSB - Primary soil boring.
PSG - Primary soil gas boring.
SVP - Soil Vapor Probe.
(--) - CHHSL not available.

5.4.3.2 Feature F-39 - Test Bays (Buildings 308, 309, & 310)

The Test Bays (Buildings 308, 309, & 310) are located in the south western portion of Historical Operational Area F. These structures were used for the firing of large and small rocket motors. Solvents may have been utilized to clean equipment or walls at this feature.

Previous Results

A total of 12 soil borings were drilled during previous investigations (Tetra Tech, 2005b, 2009a) at depths ranging from 12 to 36.5 feet bgs. Soil gas probes were installed in six borings at 10 feet bgs and dual-completion probes were installed in four borings at depths of 10 and 20 feet bgs. Soil samples were analyzed for VOCs, SVOCs, TPH, and 1,4-dioxane. 1,4-dioxane was not detected at concentrations above the RL. The previous report for the 2004 investigation (Tetra Tech, 2005b) indicated that perchlorate was analyzed for in soil but not detected. However, review of the analytical results, database, and lab data packages showed that the soil samples were not analyzed for perchlorate. One SVOC (bis[2-ethylhexyl]phthalate) was detected at concentrations ranging from 0.57 to 1.6 mg/kg. Diesel range TPH was detected at concentrations ranging from 1.2 to 270 mg/kg. Acetone, benzene, ethylbenzene, toluene, and TCE were detected at concentrations ranging from 1.5 to 38 µg/kg.

Soil gas samples could not be collected from four probes since groundwater eventually came into the borings at depths less than 20 feet bgs. VOCs were detected at concentrations above RLs in soil gas samples collected from two soil borings. The primary COPCs detected in soil gas include TCE, PCE, 1,1-DCE, and BTEX. The highest concentration of TCE was detected at 10 feet bgs (47,000 µg/m^3). Acetone, benzene, and TCE were the only VOCs detected in groundwater at the Test Bays. TCE was detected above the MCL (5 µg/L) at concentrations ranging from 1.4 to 64 µg/L. A table of the soil and soil gas analytical results from the 2004 and 2007 investigations is included in Tables H-10 and H-15 in Appendix H.

Based on the TCE results from the groundwater samples, it is possible that the TCE in soil gas could be from off-gassing of the groundwater. However, given the limited soil gas and groundwater data available for this feature, additional information was needed to evaluate and delineate VOC impacts in soil and groundwater.

Soils at the Test Bays (Feature F-39) are generally fine- to very coarse-grained sand with minor amounts of gravel. The alluvium ranges in thickness from 0 to 10 feet at this feature and when present is underlain by weathered Mount Eden formation. Although groundwater was not observed during drilling until depths between 24 and 31 feet bgs during the 2007 investigation, groundwater was observed later in the

20-foot soil gas probes and was estimated to be about 15 feet bgs. However, no groundwater monitoring wells were installed at this feature.

Investigation Activities

Seven (7) primary and two secondary borings were drilled to approximately 100 feet bgs using the sonic method. One secondary boring was also installed with the sonic drilling method to a depth of 50 feet bgs. Additionally, one shallow monitoring well was installed to 25 feet bgs and two borings were drilled to 5 feet bgs for the installation of soil gas probes with the HSA drilling method (Figure 5-55). Soil gas probes were installed in five borings (F39-PSG2, F39-PSB3/PSG3, F39-PSB4/PSG4, F39-PSB6/PSG6 and F39-PSG7) down to 5 feet bgs. Groundwater grab samples were collected at first water from 11 borings between 10 and 30 feet bgs and analyzed for VOCs only. Depth-discrete groundwater samples were collected approximately every 10 feet after first water between 20 and 100 feet bgs and analyzed for VOCs. Soil gas samples were collected from the five probes installed and analyzed for VOCs.

Based on the depth discrete groundwater samples collected, the following monitoring wells were installed at the Test Bays (Feature F-39) for long term monitoring:

- one dual completion clustered well pair was installed (F39-PSB2/MW-85A,B) next to the large vertical test bay and screened from 5 to 25 feet bgs and 89.5 to 99.5 feet bgs;
- one dual-completion nested well was constructed at F39-PSB7/ MW-86A,B at the mouth of the canyon and screened from 15-35 feet bgs and 90 to 100 feet bgs; and
- two single completion wells (F39-PSB9/MW-92 and F39-PSB8/MW-95) were installed on the bluff south of the Test Bays and screened from 17 to 37 feet bgs.

Based on the results of boring F39-PSB7/MW-86A,B installed near the mouth of the canyon, F39-SSB10 was installed on the edge of bluff to the southwest, and F39-SGW9/MW-92 and F39-SGW8/MW-95 were installed to the south/southeast of the Test Bays to evaluate and monitor the migration of impacted groundwater from this feature. The well construction diagrams are included in Appendix D. Subsequent to the field investigation and well development, groundwater samples were collected and analyzed for perchlorate, VOCs, and 1,4-dioxane in February and March 2009.

X:\GIS\Lockheed 22288-0306\Site 1 Samp_Pts_Zoom-Area Figure3-1.mxd

LEGEND

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Secondary Soil Boring, 2008
- Soil Vapor, 2008
- Soil Boring, / Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring, / Soil Vapor, 2004
- Geologic Cross Section Location
- B Geologic Cross Section Line Beginning and End Points

0 30 60 Feet

1 inch = 60 feet

Beaumont Site 1

Figure 5-55
Soil Borings and Cross Section Locations - Test Bays (Feature F39)

TETRA TECH

Geology and Hydrogeology

Before the Test Bays (Feature F-39) were built, the area appears to have been the mouth of a tributary which still feeds Potrero Creek. The Test Bays are cut into the large, very well indurated Mount Eden formation outcrop on the northwest side of the feature. The outcrop currently stands more than 50 feet above the ground surface of the former operational area. Another foothill composed of Mount Eden formation confines the area on the east just beyond the wash which parallels the feature. A culvert on the southwest side of the feature directs water under the road near the mouth of the canyon toward Potrero Creek.

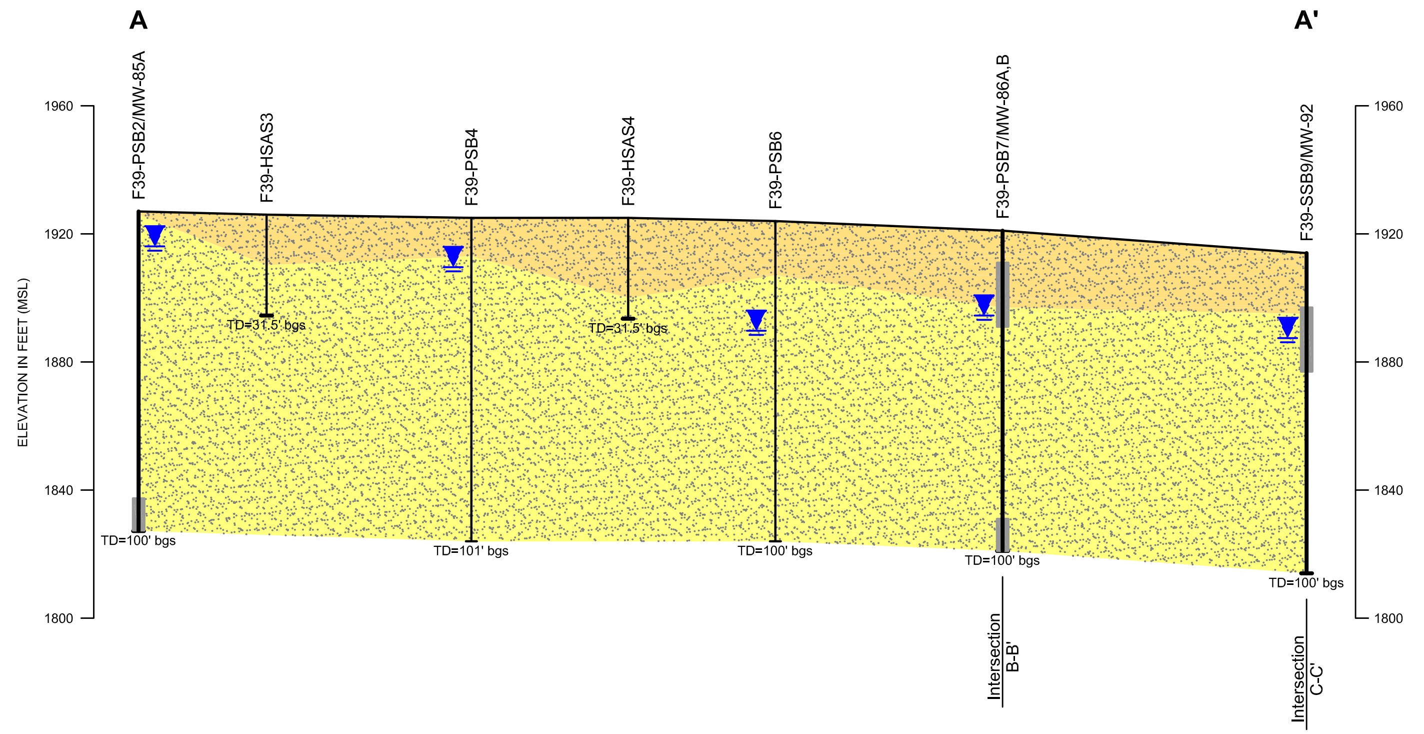
Based on the boring logs included in Appendix D, the material overlying the Mount Eden formation ranges from sand to silty sand and could be fill material. The Mount Eden formation undulates and gradually drops in elevation about 30 feet moving from north to south on cross section line A to A' (Figure 5-55) as shown in the idealized cross sections on Figure 5-56. The slight dip at F39-HSAS4 may represent the original flow path of the wash where it originally fed Potrero Creek.

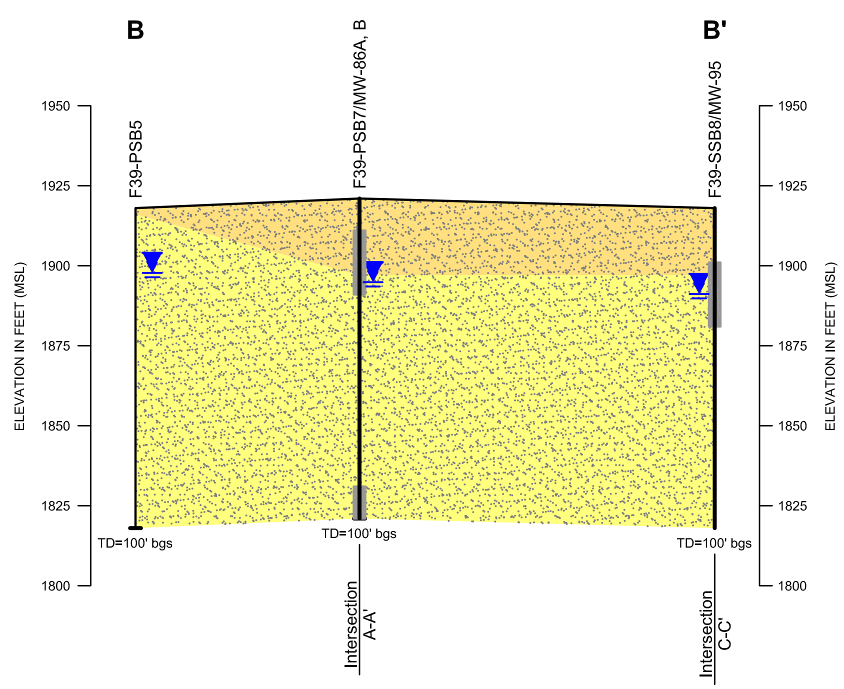
The groundwater elevation in the shallow wells as measured in February 2009 ranges from 1927.66 feet above msl in MW-85B at the north end of the feature dropping to 1888.43 in MW-92 on the bluff south of the canyon. As shown in the groundwater contour map (Figure 5-57), the groundwater flows south out of the canyon and upon crossing the road turns slightly in a southwestern direction toward, and in the same general direction as Potrero Creek.

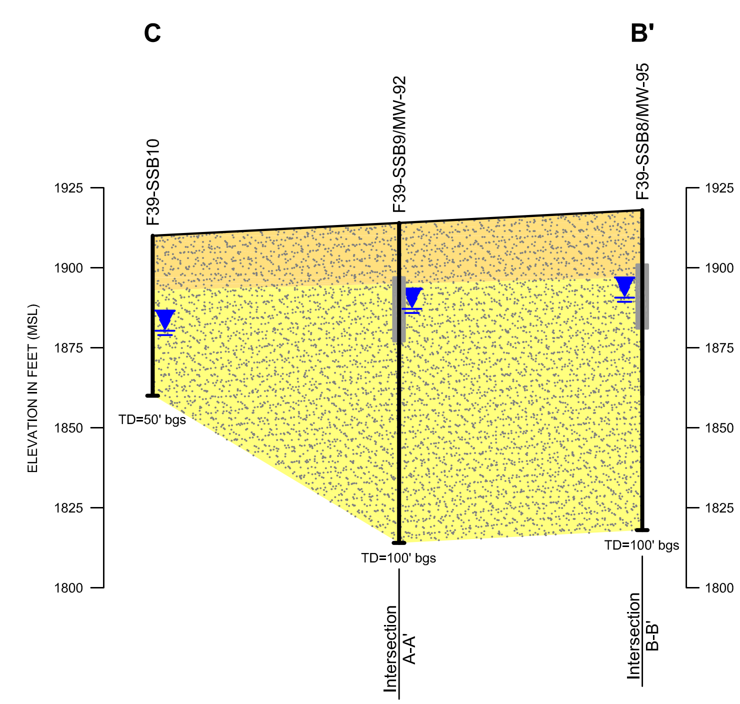
Groundwater Sampling Results and Contaminant Distribution

During drilling activities, TCE was detected above the MDL (0.10 µg/L) in 48 of the 81 samples collected ranging from 0.19 to 99.5 µg/L (Table 5-13). Figure 5-58 shows the areal distribution of TCE in groundwater greater than 5 µg/L based on the 3-D modeling of data collected during this investigation. The extent of TCE impacts in groundwater extends out from the former operational area towards the Potrero Creek drainage and covers an area of approximately 22,530 ft^2.

X:\GIS\LOCKHEED 22288-0306\CAD\F39 XSEC AA_BB_CC.DWG







LEGEND

Quaternary Alluvium

Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs below ground surface

HSAS Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

SSB Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MSL Mean sea level

MW Monitoring Well

TD=#' Total Boring Depth (feet)

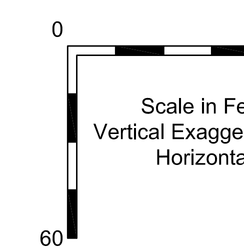
Well

Screened interval

Boring

First water sample collected during drilling activities, fall to winter 2008

Intersection A-A' location where cross sections intersect



Beaumont Site 1

Figure 5-56
Idealized Geologic Cross Sections A-A', B-B', and C-B'
Test Bays (Feature F-39)

TETRA TECH

0 30 60 Feet

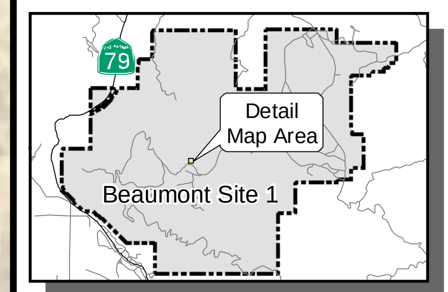
Adapted from: March 2007 aerial photograph.

LEGEND

Monitoring Well Location

Groundwater Elevation Contour
(relative to mean sea level)

Groundwater Flow Direction



Beaumont Site 1

Figure 5-57

Groundwater Contours - February 2009 Test Bays (Feature F-39)

TETRA TECH

X:\GIS\Lockheed 22288-110302GW_Contours F39.mxd

Table 5-13 Groundwater Sampling Results - Test Bays (Feature F-39)

Boring ID	Sample Location	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	2-Butanone	Benzene	1,1-DCA	cis-1,2-DCE	Ethyl-benzene	2-Hexanone	Styrene	Toluene	TCE	m,p-Xylenes	o-Xylene
Matrix				***Water***												
Units				µg/L												
MCL					6	--	1	5	6	300	--	100	150	5	1,750	1,750
DWNL				3		--					--					
F39-PSB1	F39-PGW1-23.5	23.5	09/18/08	-	-	**3.06**	**1.43**	<0.10	<0.10	**0.160**	**2.55**	<0.10	**0.870**	**0.370**	**0.200**	**0.170**
	F39-PGW1-32	32	09/19/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**0.440**	<0.20	<0.10
	F39-PGW1-42	42	09/19/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**0.240**	<0.20	<0.10
	F39-PGW1-52	52	09/19/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW1-62	62	09/19/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW1-72	72	09/19/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW1-82	82	09/22/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW1-92	92	09/22/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW1-100	100	09/22/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
F39-PSB2 / MW-85A	F39-PGW2-10	10	09/23/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**12.7**	<0.20	<0.10
	F39-PGW2-20	20	09/23/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**4.2**	<0.20	<0.10
	F39-PGW2-30	30	09/23/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**1.51**	<0.20	<0.10
	F39-PGW2-40	40	09/23/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**8.55**	<0.20	<0.10
	F39-PGW2-50	50	09/23/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**2.79**	<0.20	<0.10
	F39-PGW2-60	60	09/23/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW2-70	70	09/24/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**7.05**	<0.20	<0.10
	F39-PGW2-77	77	09/25/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**0.590**	<0.20	<0.10
	F39-PGW2-91	91	09/26/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**2.21**	<0.20	<0.10
	F39-PGW2-100	100	09/29/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**1.33**	<0.20	<0.10
	MW-85A	89.6-99.6	2/2/2009	<0.59	<0.5	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	MW-85A	89.6-99.6	3/2/2009	**0.63**	<1	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
MW-85B	F39-PGW2B-15	15	12/10/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**7.07**	<0.20	<0.10
	MW-85B	5-25	2/4/2009	<0.61	<0.5	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**97.5**	<0.20	<0.10
	MW-85B	5-25	3/2/2009	**1.5**	<2.5	<1.0	<0.10	**0.275**	**0.135**	<0.10	<0.50	<0.10	<0.10	**121**	<0.20	<0.10
F39-PSB3 / PSG3	F39-PGW3-18	18	09/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**17.7**	<0.20	<0.10
	F39-PGW3-28	28	09/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**2.29**	<0.20	<0.10
	F39-PGW3-38	38	09/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**1.0**	<0.20	<0.10
	F39-PGW3-48	48	09/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**1.0**	<0.20	<0.10
	F39-PGW3-58	58	10/01/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW3-68	68	10/01/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW3-78	78	10/01/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW3-88	88	10/01/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW3-100	100	10/01/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
F39-PSB4/ PSG4	F39-PGW4-15	15	10/07/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**19.2**	<0.20	<0.10
	F39-PGW4-27	27	10/08/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**8.53**	<0.20	<0.10
	F39-PGW4-38	38	10/08/08	-	-	<1.0	**0.285**	<0.10	<0.10	<0.10	<0.50	<0.10	**0.225**	**8.9**	<0.20	<0.10
	F39-PGW4-48	48	10/08/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**5.3**	<0.20	<0.10
	F39-PGW4-63	63	10/08/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**0.750**	<0.20	<0.10
	F39-PGW4-73	73	10/08/08	-	-	<1.0	**0.120**	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW4-83	83	10/09/08	-	-	<1.0	**0.370**	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW4-93	93	10/09/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW4-101	101	10/09/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10

Table 5-13 (Cont'd) Groundwater Sampling Results - Test Bays (Feature F-39)

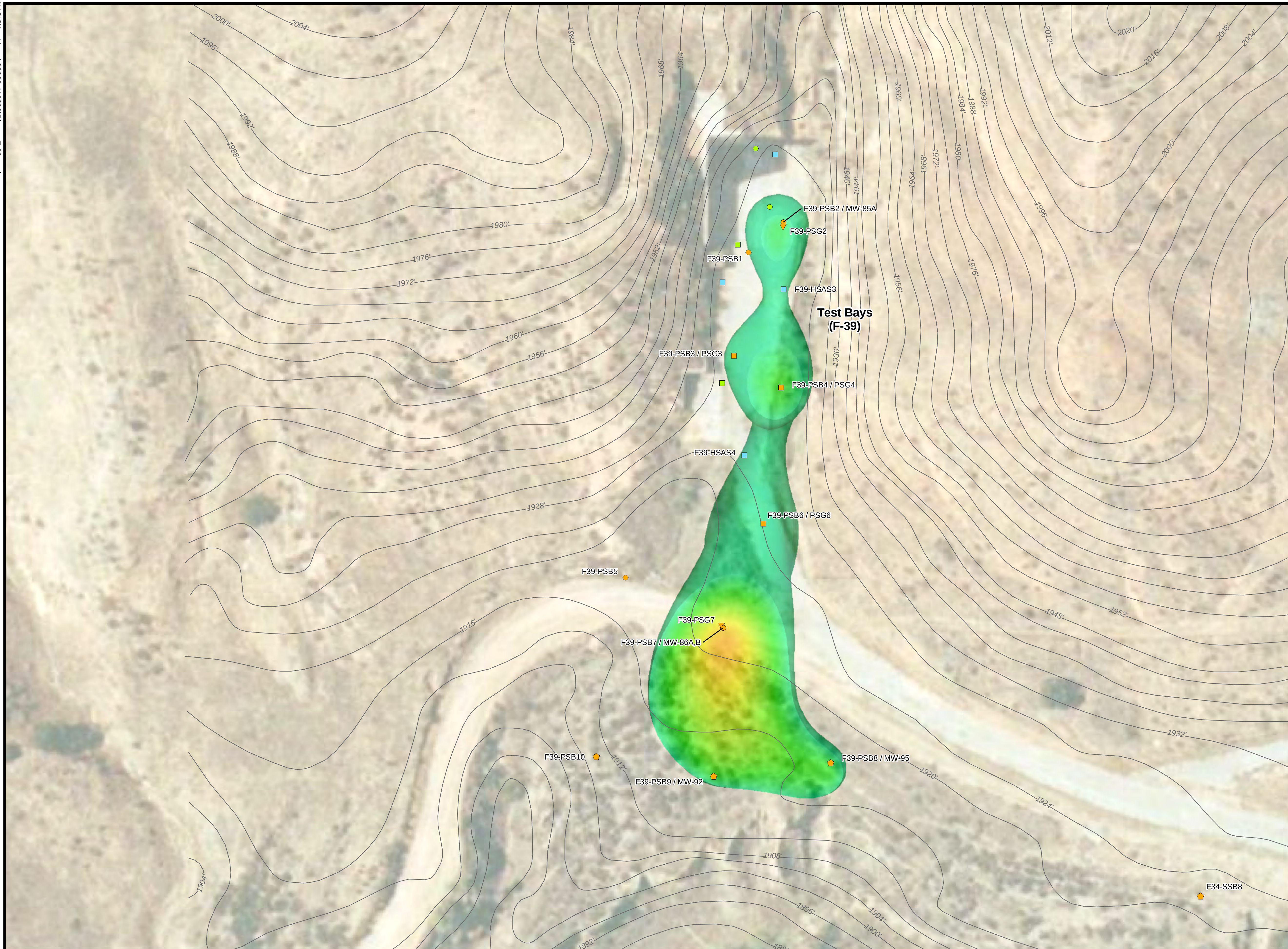
Boring ID	Sample Location	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	2-Butanone	Benzene	1,1-DCA	cis-1,2-DCE	Ethyl-benzene	2-Hexanone	Styrene	Toluene	TCE	m,p-Xylenes	o-Xylene
Matrix				***Water***												
Units				µg/L												
MCL					6	--	1	5	6	300	--	100	150	5	1,750	1,750
DWNL				3		--					--					
F39-PSB5	F39-PGW5-20	20	10/17/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW5-30	30	10/17/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW5-40	40	10/17/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW5-50	50	10/17/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW5-60	60	10/20/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW5-70	70	10/20/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW5-80	80	10/20/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-PGW5-90	90	10/20/08	-	-	<1.0	**0.62**	<0.10	<0.10	<0.10	<0.50	<0.10	**0.33**	<0.10	<0.20	<0.10
	F39-PGW5-100	100	10/20/08	-	-	<1.0	**24**	<0.10	<0.10	<0.10	<0.50	<0.10	**9.03**	<0.10	**1.08**	**0.75**
F39-PSB6 / PSG6	F39-PGW6-24	24	10/07/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**12.2**	<0.20	<0.10
	F39-PGW6-35	35	10/10/08	-	-	<1.0	<0.10	<0.10	<0.10	**0.130**	<0.50	<0.10	<0.10	**40**	**0.310**	<0.10
	F39-PGW6-45	45	10/10/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**46.9**	<0.20	<0.10
	F39-PGW6-55	55	10/13/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**99.5**	<0.20	<0.10
	F39-PGW6-67	67	10/13/08	-	-	<1.0	**0.140**	<0.10	<0.10	<0.10	<0.50	<0.10	**0.140**	**10.4**	<0.20	<0.10
	F39-PGW6-77	77	10/14/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**3.19**	<0.20	<0.10
	F39-PGW6-87	87	10/14/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**3.71**	<0.20	<0.10
	F39-PGW6-100	100	10/14/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**1.25**	<0.20	<0.10
F39-PSB7 / MW-86A	F39-PGW7-27	27	10/09/08	-	-	<1.0	<0.10	<0.10	**0.540**	<0.10	<0.50	<0.10	<0.10	**91.5**	<0.20	<0.10
	F39-PGW7-37	37	10/15/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**8.06**	<0.20	<0.10
	F39-PGW7-57	57	10/16/08	-	-	<1.0	**1.34**	<0.10	<0.10	**0.18**	<0.50	<0.10	**0.91**	**6.08**	<0.20	**0.14**
	F39-PGW7-70	70	10/16/08	-	-	<1.0	**0.53**	<0.10	<0.10	**0.15**	<0.50	<0.10	**0.52**	**21.5**	<0.20	**0.13**
	F39-PGW7-80	80	10/16/08	-	-	<1.0	**0.95**	<0.10	<0.10	**0.12**	<0.50	<0.10	**0.43**	**5.89**	<0.20	<0.10
	F39-PGW7-90	90	10/16/08	-	-	<1.0	**0.66**	<0.10	<0.10	**0.12**	<0.50	<0.10	**0.46**	**3.02**	<0.20	<0.10
	F39-PGW7-100	100	10/16/08	-	-	<1.0	**4.69**	<0.10	<0.10	**0.38**	<0.50	**0.47**	**2.31**	**0.70**	**0.43**	**0.39**
	MW-86A	90-100	2/3/2009	<0.56	<0.5	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	MW-86A	90-100	3/4/2009	**4.5**	<0.5	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
F39-PSB7 / MW-86B	MW-86B	10-30	2/3/2009	<0.58	<0.5	<1.0	<0.10	<0.10	**0.660**	<0.10	<0.50	<0.10	<0.10	**90**	<0.20	<0.10
	MW-86B	10-30	3/4/2009	**13**	<0.5	<1.0	<0.10	<0.10	**1.05**	<0.10	<0.50	<0.10	<0.10	**100**	<0.20	<0.10
F39-SSB8 / MW-95	F39-SGW8-27	27	10/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**9.95**	<0.20	<0.10
	F39-SGW8-37	37	11/03/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**15.4**	<0.20	<0.10
	F39-SGW8-50	50	11/04/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**3.88**	<0.20	<0.10
	F39-SGW8-63	63	11/04/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**2.57**	<0.20	<0.10
	F39-SGW8-73	73	11/04/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**1.44**	<0.20	<0.10
	F39-SGW8-79	79	11/04/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**0.560**	<0.20	<0.10
	F39-SGW8-90	90	11/05/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-SGW8-100	100	11/05/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	MW-95	17-37	2/3/2009	<0.59	<0.5	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**15.5**	<0.20	<0.10
	MW-95	17-37	3/9/2009	<0.64	<0.5	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**18**	<0.20	<0.10

Table 5-13 (Cont'd) Groundwater Sampling Results - Test Bays (Feature F-39)

Boring ID	Sample Location	Depth (feet bgs)	Sample Date	1,4-Dioxane	Perchlorate	2-Butanone	Benzene	1,1-DCA	cis-1,2-DCE	Ethyl-benzene	2-Hexanone	Styrene	Toluene	TCE	m,p-Xylenes	o-Xylene
Matrix				***Water***												
Units				µg/L												
MCL					6	--	1	5	6	300	--	100	150	5	1,750	1,750
DWNL				3		--					--					
F39-SSB9 / MW-92	F39-SGW9-27	27	10/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**4.05**	<0.20	<0.10
	F39-SGW9-37	37	10/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**8.65**	<0.20	<0.10
	F39-SGW9-47	47	10/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-SGW9-57	57	10/30/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-SGW9-67	67	10/31/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**0.19**	<0.20	<0.10
	F39-SGW9-77	77	10/31/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-SGW9-87	87	10/31/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-SGW9-100	100	10/31/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	MW-92	17-37	2/4/2009	<0.6	**24.9**	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**19.4**	<0.20	<0.10
	MW-92	17-37	3/9/2009	<0.62	**24.5**	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**18.3**	<0.20	<0.10
F39-SSB10	F39-SSB10-30	30	11/11/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	**0.57**	<0.20	<0.10
	F39-SSB10-40	40	11/11/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10
	F39-SGW10-50	50	11/12/08	-	-	<1.0	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10	<0.10	<0.10	<0.20	<0.10

Notes:

"Bold" - Indicates concentrations detected above the method detection limit.
bgs - Below ground surface.
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
µg/L - Micrograms per liter.
PSB - Primary soil boring.
PGW - Primary groundwater sample.
SGW - Secondary groundwater sample.
MW - Groundwater monitoring well.
(-) - Sample not analyzed for analyte.
(--) - MCL or DWNL not available.



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Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Secondary Soil Boring, 2008
- Soil Vapor, 2008
- Soil Boring, / Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring, / Soil Vapor, 2004
- Ground Surface Elevation Contour

Trichloroethene (TCE) Concentration

- >100 µg/L
- 30 µg/L
- 10 µg/L
- 3 µg/L
- <1 µg/L

Note:

µg/L - Micrograms per liter.

Ground surface elevation contour lines relative to mean sea level (msl).

Beaumont Site 1

Figure 5-58
Lateral Extent of TCE in Groundwater Above 5 µg/L from 10 - 100 ft bgs - Test Bays (Feature F-39)

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Figure 5-59 presents the TCE concentration contours at various depths from first water to approximately 90 feet bgs. This figure shows that the areal extent of TCE is confined to the boundaries of the test bay canyon with the greatest extent primarily limited to first water. The contours show that the lateral extent of TCE decreases with depth. Based on the data collected beyond 20 feet bgs, the contamination appears centralized towards the mouth of the canyon.

Other VOCs detected in the grab samples were BTEX, 2-butanone, cis-1,2-DCE, 2-hexanone, and styrene (Table 5-13). The concentrations of TCE detected at first water ranged from 0.37 to 91.5 µg/L. The highest concentration of TCE detected in first water during drilling was at F39-PSB7/MW-86A (27 feet bgs) near the mouth of the canyon. However, subsequent sampling of the site monitoring wells has shown that the highest concentration of TCE detected (120 µg/L) is actually at the north end of the feature near the large motor test stand in F39-PSB2/MW-85B. The TCE concentrations in 7 of the 11 grab samples (64%) collected at first water exceeded the MCL (5 µg/L).

The concentrations of TCE detected in the depth-discrete samples collected below the water table ranged from 0.19 to 99.5 µg/L. The highest concentration of TCE detected at depth was at F39-PSB6 (55 feet bgs). Depth discrete groundwater samples collected from 10 borings indicate that the concentrations generally decrease with depth except at F39-PSB6 where the highest concentration was observed approximately 30 feet below the water table. However, concentrations begin to decrease in this boring below 55 feet bgs to levels below the MCL at 77 feet bgs. The concentration of TCE detected in 15 of the 70 (21%) of the depth-discrete groundwater grab samples exceeded the MCL.

Subsequent to the field investigation, groundwater samples were collected from the 6 site monitoring wells and analyzed for perchlorate, VOCs and 1,4-dioxane. Recent groundwater sample results (March 2009) detected the following primary COPCs: 1,4-dioxane in four wells ranging from 0.63 to 13 µg/L, perchlorate in one well at a concentration of 24.5 µg/L (F39-PSB7/MW-86B), and TCE in three wells ranging from 18 to 121 µg/L. Figures 5-60 and 5-61 show the 1,4-dioxane and perchlorate concentration contours based on the monitoring well results from March 2009. The footprint of the 1,4-dioxane plume above 3 µg/L covers an area of approximately 20,330 ft^2 and is consistent with the TCE plume (Figure 5-59) except that only low concentrations were detected at the north end of the feature which differs from the TCE plume. Showing a different trend, perchlorate was only detected in one well on the bluff south of

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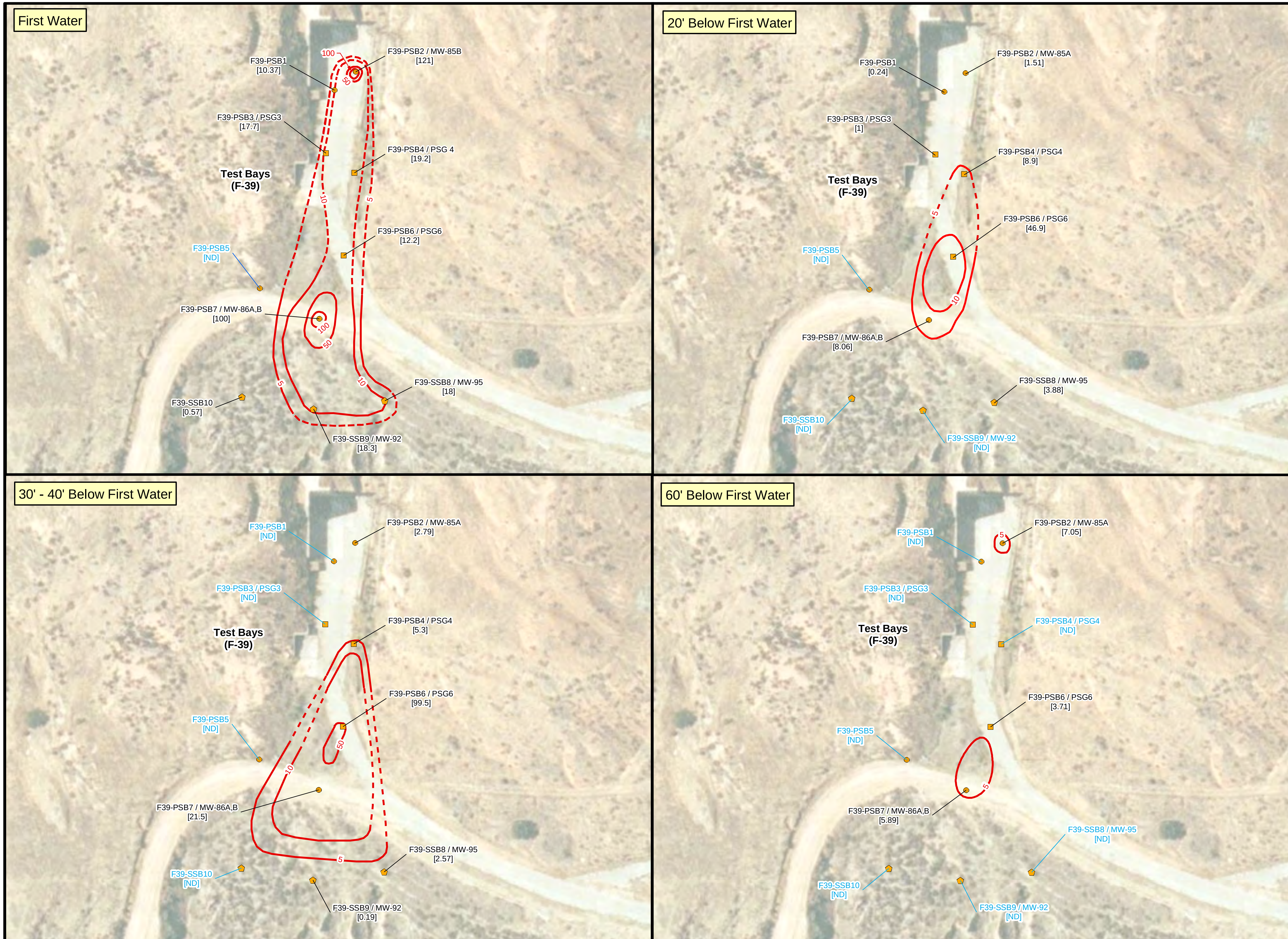


0 50 100
Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Secondary Soil Boring
- TCE Concentration in Groundwater (dashed where inferred)

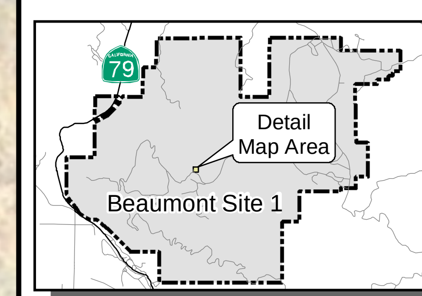
Note:

[#] - TCE results in µg/L.

[ND] - Non-Detect. (<0.1 µg/L)

µg/L - Micrograms per liter

TCE - Trichloroethene



Beaumont Site 1

Figure 5-59

TCE Concentrations in Groundwater - Test Bays (Feature F-39)

TETRA TECH

0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

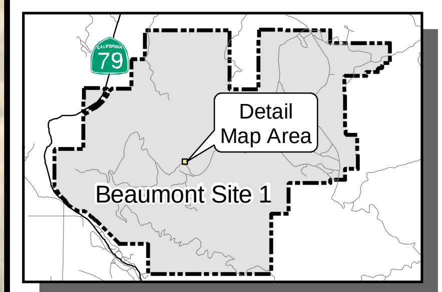
Monitoring Well Location

1,4-Dioxane Isoconcentration Contour (dashed where inferred)

[#] - 1,4-Dioxane Results in µg/L.

µg/L - Micrograms per liter.

[ND] - Non-Detect (<0.6 µg/L)



Beaumont Site 1

Figure 5-60

1,4-Dioxane Concentrations in Groundwater - Test Bays (Feature F-39)

TETRA TECH

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X:\GIS\Lockheed 22288-110302\Perc_GW_F39.mxd

0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

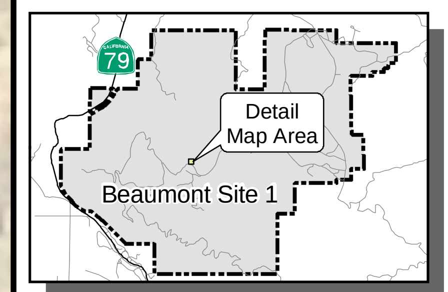
Monitoring Well Location

Perchlorate Isoconcentration Contour (dashed where inferred)

[#] - Perchlorate Results in µg/L

µg/L - Micrograms per liter.

ND - Non-Detect (<0.5 - 2.5 µg/L)



Beaumont Site 1

Figure 5-61

Perchlorate Concentrations in Groundwater - Test Bays (Feature F-39)

TETRA TECH

the feature and was not detected within the test bay canyon and therefore represent an area of only 10,850 ft^2 (Figure 5-61). The highest concentrations of TCE, 1,4-dioxane and perchlorate were detected in the shallow wells at this feature. The concentrations of TCE (4 samples) and perchlorate (1 sample) exceeded their respective MCLs and 1,4-dioxane (2 samples) exceeded the DWNL.

Figures 5-62 and 5-63 present 3-D visualizations of the TCE-affected groundwater above 5 µg/L at this feature with views looking west and north. As shown in Figure 5-62, the TCE impacts are primarily limited to first water near the north end of the feature but begin to migrate vertically along with the horizontal migration as you move south towards the mouth of the canyon. As mentioned above, the elevated TCE concentrations detected at a depth of 55 feet bgs in boring F39-PSB6 (99.5 µg/L) and 70 feet in F39-PSB7/MW-86A,B (21.5 µg/L) expand the vertical extent of TCE impacts near the mouth of the canyon. However, the plume appears fairly narrow coming out of the canyon as defined by the deep borings (F39-PSB5, F39-PSB9/MW-92, and F39-PSB8/MW-95) where TCE was not detected above the MCL below 37 feet bgs as shown in Figure 5-63. Figure 5-64 shows the vertical profile for TCE in groundwater along the cross section line A-A' covering the greatest lateral extent of the contaminant plume that extends from the Test Bays (Feature F-39) to the bluff above Potrero Creek. The figure also includes borings F39-PSB4/PSG4, F39-PSB2/MW-85A, F39-PSB7/MW-86A/B and F39-SGW9/MW-92 some of which exhibit the highest concentrations of TCE identified in groundwater detected at this feature.

As discussed above in Section 5.4.3.1, due to the detections of 1,4-dioxane and perchlorate at the Maintenance Shop and Storage Warehouse (Feature F-34) and the Test Bays (Feature F-39), surface water samples were collected from eight locations along the stream bed upgradient and downgradient of these features (Figure 5-54). One VOC (toluene) was detected upstream of features F-34 and F-39 at concentrations below the MCL. Perchlorate was not detected above the MDL in any of the samples collected and 1,4-dioxane was detected in 8 locations ranging from 1.1 to 4 µg/L. The highest concentration of 1,4-dioxane was detected upstream of features F-34 and F-39 at SW-18. The concentrations of 1,4-dioxane decrease from 2.2 to 1.1 µg/L in samples collected downgradient of SW-18. Based on this non-routine surface water sampling event, the results indicate that the impacts to groundwater at Feature F-39 are not negatively impacting the surface water in Potrero Creek.

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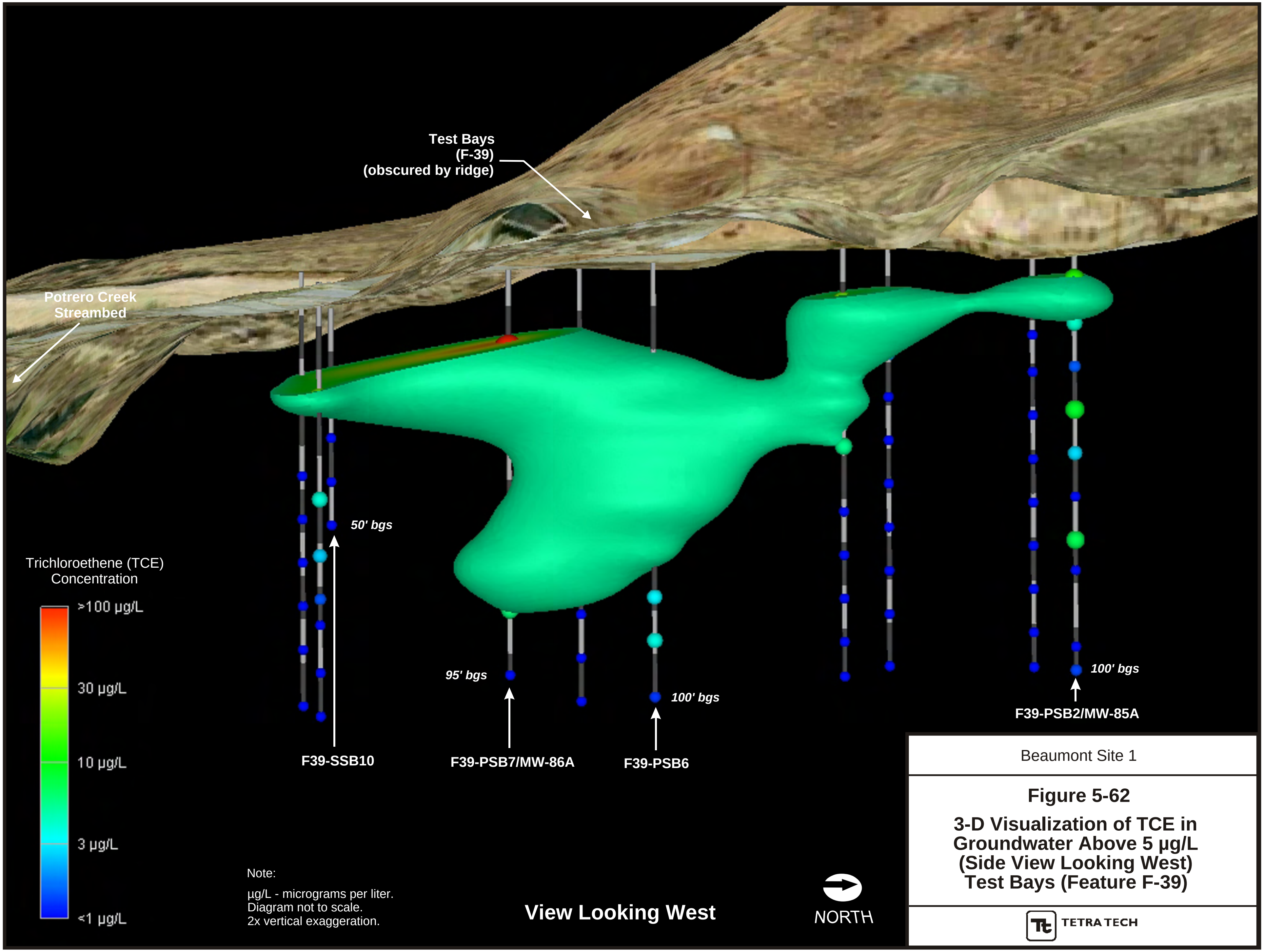

Beaumont Site 1

Figure 5-62

3-D Visualization of TCE in Groundwater Above 5 µg/L (Side View Looking West) Test Bays (Feature F-39)

TETRA TECH

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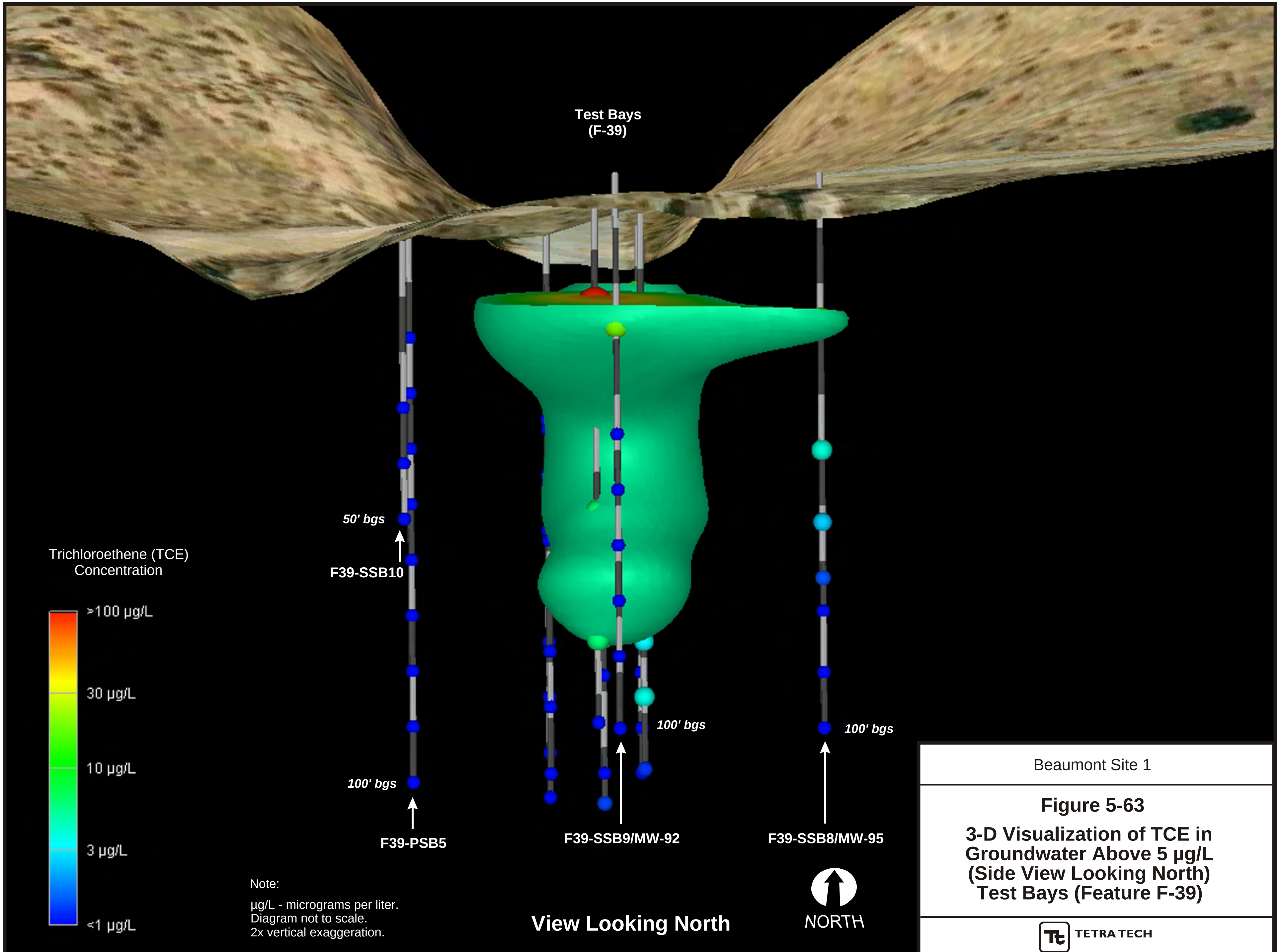
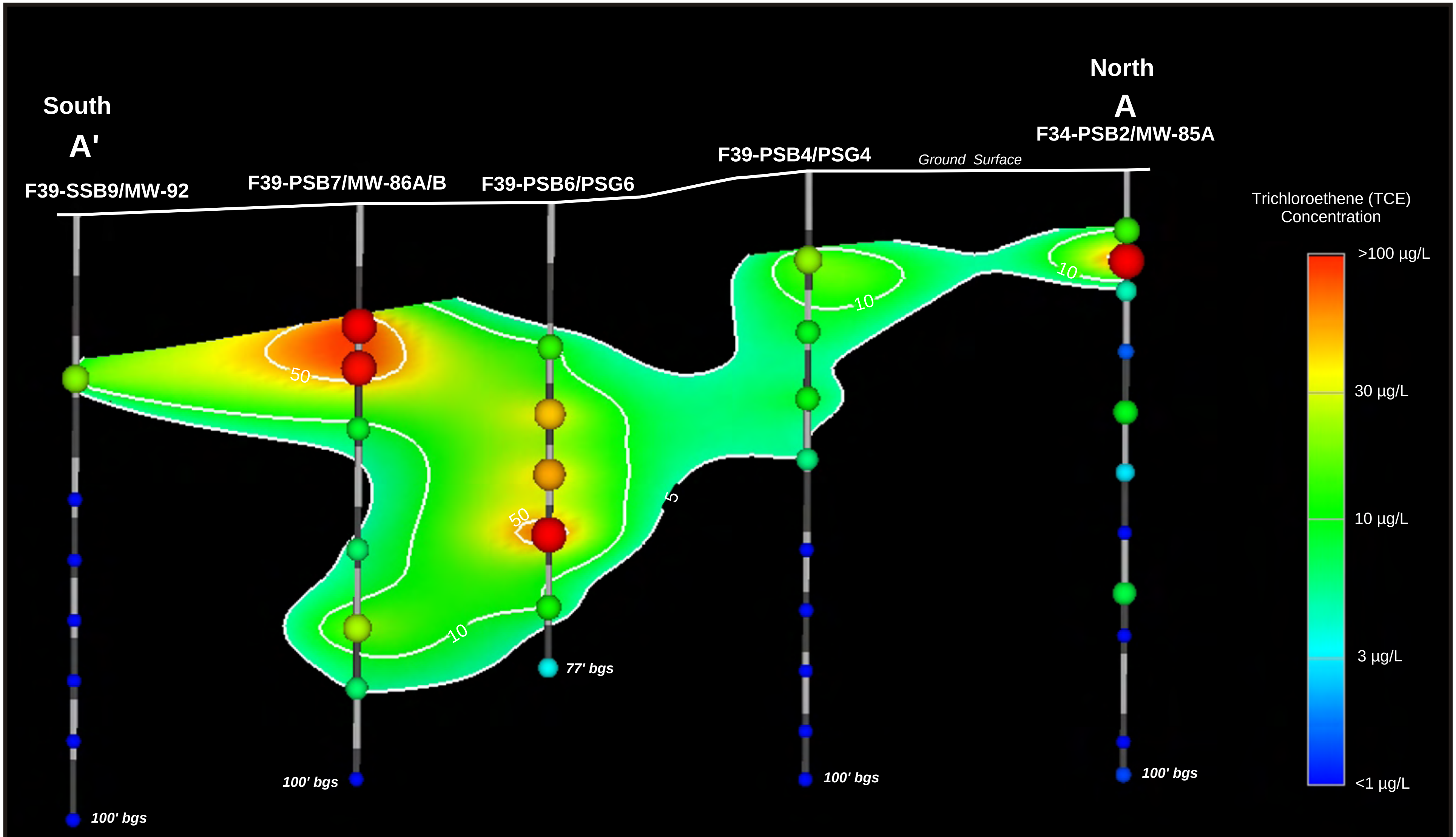


Beaumont Site 1

Figure 5-63

3-D Visualization of TCE in Groundwater Above 5 µg/L (Side View Looking North) Test Bays (Feature F-39)

TETRA TECH



Note:

µg/L - micrograms per Liter.
Diagram not to scale.
2x vertical exaggeration.

Beaumont Site 1

Figure 5-64

Vertical Profile of TCE in Groundwater Cross Section A-A' Test Bays (Feature F-39)

TETRA TECH

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Soil Gas Sampling Results and Contaminant Distribution

Several VOCs were detected in soil gas at the Test Bays (Feature F-39) during this investigation (Table 5-14). The groundwater COPCs, TCE and 1,1-DCE, were detected in soil gas samples collected at 5 feet bgs. TCE was detected in 3 samples collected up to 11,500 µg/m^3 and 1,1-DCE was detected in one sample at 212 µg/m^3. Other VOCs detected in soil gas include carbon disulfide, cis-1,2-DCE and trichlorofluoromethane (Freon 11). Two samples (F39-PSB3/PSG3 at 3,260 µg/m^3 and F39-PSG2 at 11,500 µg/m^3) were detected above the residential and/or commercial/industrial CHHSLs for vapor intrusion (Figure 5-65). The concentrations detected in soil gas have decreased since the 2004 investigation where the highest concentration detected was 47,000 µg/m^3. A table of the soil gas analytical results from the 2004 and 2007 investigations is included in Table H-15 in Appendix H. The magnitude and locations in which TCE was detected is consistent with previous data in that the contaminant distribution is limited to the Test Bays. The areal extent of TCE in the vadose zone is superimposed within the TCE groundwater plume and is defined to the north, east and west topographically and to the south based on samples collected from both the 2008 and 2004 investigations. Based on the analytes and the magnitude of VOCs detected in soil gas and groundwater, it is likely that the VOCs detected in soil gas are attributed to the off-gassing of affected groundwater beneath this feature rather than a shallow soil source.

Table 5-14
Soil Gas Sampling Results - Test Bays (Feature F-39)

Boring ID	Sample Name	Depth (ft bgs)	Sample Date	Carbon Disulfide	1,1-DCE	c-1,2-DCE	TCE	Trichloro-fluoromethane (Freon-11)
Matrix				***Soil Gas***				
Units				µg/m^3				
CHHSL - Res				--	--	15,900	528	--
CHHSL - Ind				--	--	44,400	1,770	--
F39-PSB3/PSG3	F39-SVP3-5	5	12/2/2008	<33	<43	<42	**3,260**	**272**
F39-PSB4/PSG4	F39-SVP4-5	5	12/2/2008	<33	<43	<42	**61.1**	**89.8**
F39-PSB6/PSG6	F39-SVP6-5	5	12/2/2008	<33	<43	<42	<57	**173**
F39-PSG2	F39-SVP2-5	5	12/2/2008	**286**	**212**	**60.3**	**11,500**	**38,200**
F39-PSG7	F39-SVP7-5	5	12/2/2008	<33	<43	<42	<57	**60.1**

Notes:
CHHSL - California Human Health Screening Level.
Res - Residenital CHHSL for vapor intrusion, January 2005.
C/I - Commercial/Industrial CHHSL for vapor intrusion, January 2005.
bgs - Below ground surface.
µg/m3 - Micrograms per cubic meter.
PSB - Primary soil boring.
PSG - Primary soil gas boring.
SVP - Soil vapor probe.
(--) - CHHSL not available.

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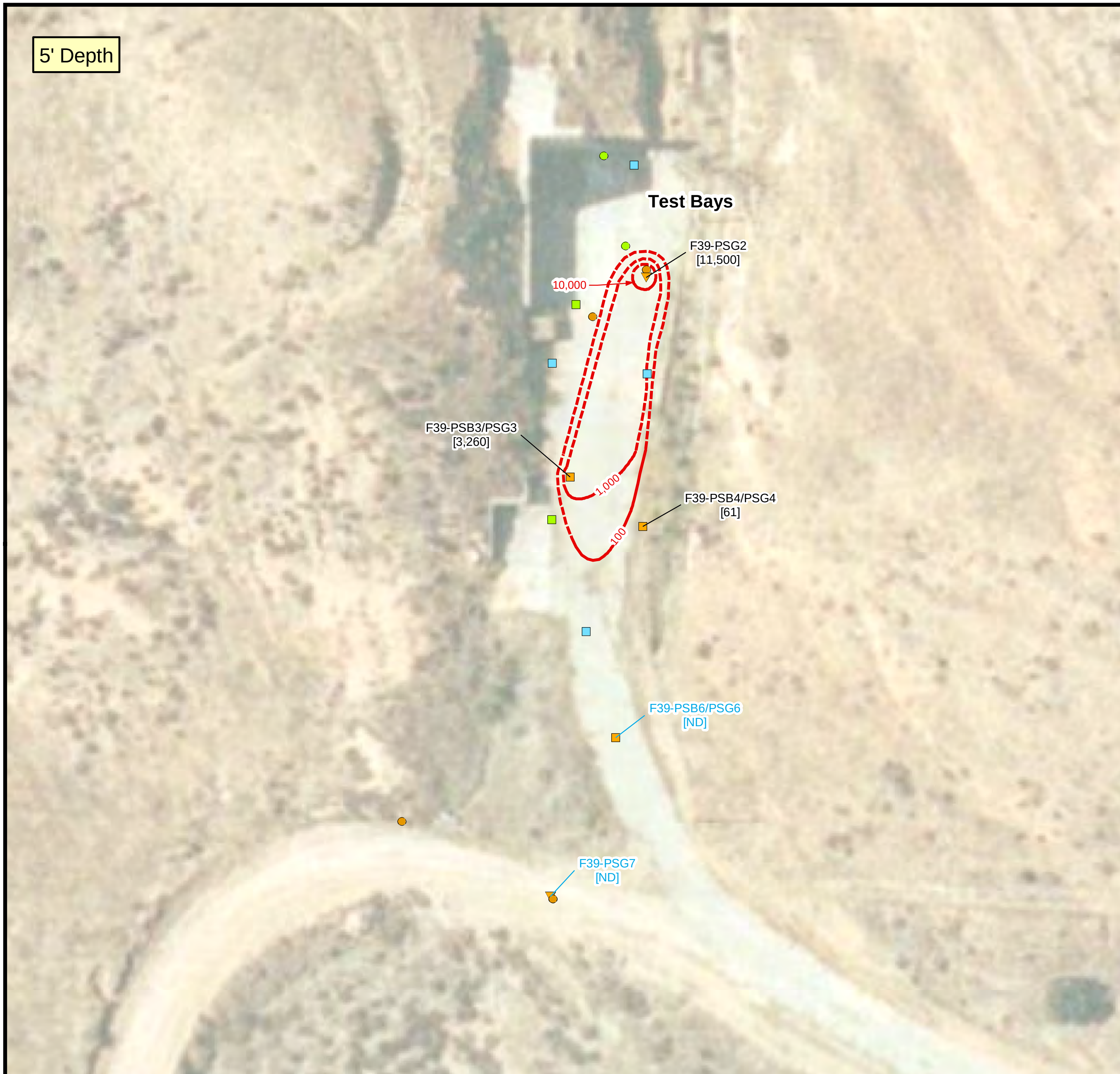


0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

- Primary Soil Boring, 2008
- Primary Soil Boring/Soil Vapor, 2008
- Soil Vapor, 2008
- Soil Boring/Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Soil Gas TCE (dashed where inferred)

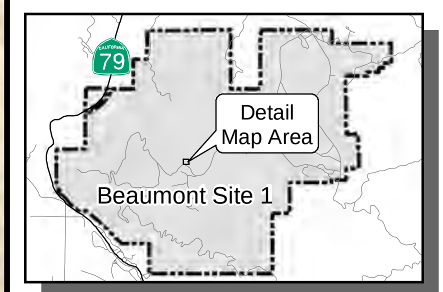
Note:

µg/m^3 - Micrograms per cubic meter.

[#] - Results in µg/m^3.

[ND] - Non-Detect (<57 µg/m^3)

TCE - Trichloroethene



Beaumont Site 1

Figure 5-65

TCE Concentrations in Soil Gas - Test Bays (Feature F-39)

TETRA TECH

5.4.4 Historical Operational Area G

Historical Operational Area G, the helicopter weapons test area, was used to develop equipment for handling helicopter weapons systems. The facilities within this area included a hangar (Building 302), helicopter landing pad, stationary ground mounted gun platforms, and a mobile target suspended between towers. The primary project at this test area was testing of both stationary guns and guns mounted on helicopters. Experimentation also was performed on the solid propellant portion of an armor-piercing round. The majority of rounds were fired into the side of the creek wash, about 100 yards to the south of the hangar. A longer impact area labeled with distance markers was located in the canyon to the south of the wash. Projectiles were steel only; warheads were not used during tests at this facility (Tetra Tech, 2003a).

5.4.4.1 Feature G-46 - Helicopter Landing Pad and Hangar (Bldg. 302)

The Helicopter Landing Pad and Hangar (Building 302) are located in the north-central portion of the Site in Historical Operational Area G. It is unknown whether helicopters were fueled and/or serviced in this area.

Previous Results

Four soil borings were drilled during previous investigations (Tetra Tech, 2005b and 2009a) to depths between 5 and 30 feet bgs with soil gas probes installed at 10 and 20 feet bgs. Soil samples were analyzed for VOCs and TPH. VOCs (acetone, benzene, and toluene) were detected at concentrations ranging from 1.0 to 27 µg/kg but were qualified due to method blank contamination. Soil gas sampling conducted in 2007 reported PCE in all 4 samples collected with concentrations ranging from 179 to 226 $\mu g/m^3$. The VOC concentrations detected were similar at both locations and depth intervals. TPH was detected at concentrations ranging from 34 to 160 mg/kg. Groundwater was not encountered in any of the borings installed during these previous investigations. Based on the information collected to date, further investigation of the soil and groundwater at this feature was needed to evaluate VOC impacts (primarily PCE and BTEX) in soil and potential impacts to groundwater. Table of the soil and soil gas analytical results from the 2004 and 2007 investigations are included in Tables H-11 and H-15 in Appendix H.

Soils at the Helicopter Landing Pad and Hangar (Feature G-46) are generally very fine-grain silts with minor sand content. The alluvium ranges in thickness from 17 to 20 feet at this feature and is underlain by weathered Mount Eden formation. Groundwater was not encountered in any of the previous borings which were installed to a total depth of 30 feet bgs.

Investigation Activities

Nine primary soil borings were drilled to depths ranging from 26.5 feet to 36.5 feet bgs using the HSA method. Soil gas probes were installed in each of the nine soil borings, at depths of 5, 10, and 20 feet bgs with variances occurring when groundwater was encountered at or above 20 feet bgs. No secondary borings were installed since sample concentrations from the primary borings did not exceed IGs. Groundwater grab samples were collected from all 9 borings at depths between 21 and 31 feet bgs and analyzed for VOCs only. Soil gas samples were collected from the 27 probes installed and analyzed for VOCs.

Geology and Hydrogeology

The main site access road follows the meander in the creek near the Helicopter Landing Pad and Hanger. The former operational area is just south of and level with the main road and on a bluff north of Potrero creek in an area with little elevation change. Soils encountered at the Helicopter Landing Pad and Hangar were typically silt to sandy silt with minor fine to coarse grained sand. The Mount Eden formation was encountered at depths ranging from 16.5 feet to 25 feet bgs. A cross section location figure and two idealized geologic cross sections through this feature are shown in Figures 5-65 and 5-66, respectively. Groundwater was encountered in the borings at depths ranging from 21 to 31 feet bgs and was deeper to the south toward Potrero Creek.

Soil Gas Sampling Results and Contaminant Distribution

Carbon disulfide was detected above the MDL in 7 of the 27 samples in 5 borings at depths of 10 and 15 feet bgs (Table 5-15). No other VOCs including PCE or BTEX were detected in soil gas at the Helicopter Landing Pad and Hangar during this investigation. Figure 5-67 shows the locations of the PCE detections from 2007 along with the soil gas sampling results from this investigation. As shown in the figure, PCE was not detected in any of the soil gas probes surrounding the locations where it was previously detected. The detections of carbon disulfide may be naturally occurring since it can be a bi-product of anaerobic biodegradation in marshland areas with high biological activity. Carbon disulfide evaporates rapidly when released to the environment, does not stay dissolved in water very long, and it also moves quickly through soils. Based on the operations at this feature and its location near the riparian zone of Potrero Creek, the carbon disulfide is assumed to be naturally occurring.

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N

0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring/ Soil Vapor, 2008
- Soil Boring/Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Historic Feature Location
- Geologic Cross Section Location
- **B** Geologic Cross Section Line Beginning and End Points

HA — Hand Auger - Part of the nomenclature for borings installed with a hand auger during the soil investigation in 2004.

HSA — Hollow Stem Auger - Part of the nomenclature for borings installed with a hollow stem auger rig during the soil investigation in 2004.

HSAS — Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed with a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB — Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

PSG — Primary Soil Gas- Part of the nomenclature for primary borings where soil gas probes were installed during the Dynamic Site Investigation, 2008.

Beaumont Site 1

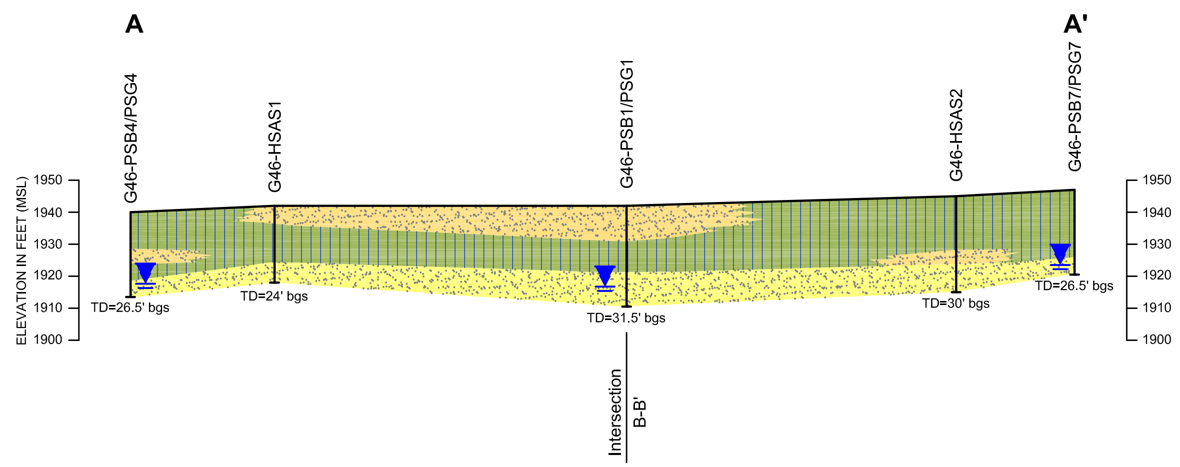
Figure 5-66
Soil Borings and Cross Section Locations - Helicopter Landing Pad and Hangar (Feature G-46)

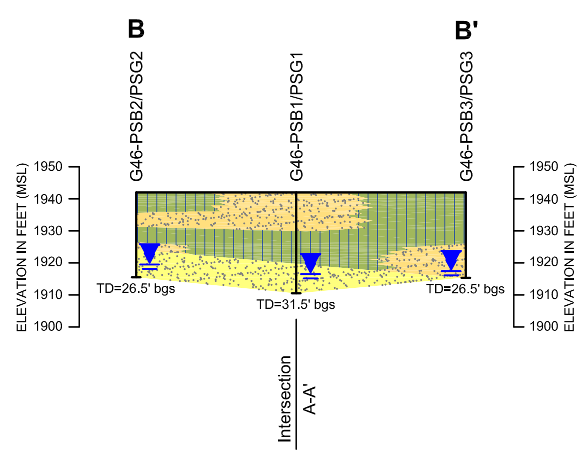
TETRA TECH

Table 5-15
Soil Gas Sampling Results - Helicopter Landing Pad and Hangar (Feature G-46)

Boring ID	Sample Name	Depth (feet bgs)	Sample Date	Carbon Disulfide
Matrix				***Soil Gas***
Units				μg/m^3
CHHSL - Res				--
CHHSL - Ind				--
G46-PSB1 / PSG1	G46-SVP1-5	5	10/6/2008	<33
	G46-SVP1-10	10	10/6/2008	<33
	G46-SVP1-20	20	10/7/2008	<33
G46-PSB2 / PSG2	G46-SVP2-5	5	10/6/2008	<33
	G46-SVP2-10	10	10/6/2008	<33
	G46-SVP2-15	15	10/7/2008	<33
G46-PSB3 / PSG3	G46-SVP3-5	5	10/6/2008	<33
	G46-SVP3-10	10	10/6/2008	<33
	G46-SVP3-18	18	10/7/2008	<33
G46-PSB4 / PSG4	G46-SVP4-5	5	10/6/2008	<33
	G46-SVP4-10	10	10/7/2008	<33
	G46-SVP4-15	15	10/8/2008	**42.9**
G46-PSB5 / PSG5	G46-SVP5-5	5	10/7/2008	<33
	G46-SVP5-10	10	10/8/2008	**34.0**
	G46-SVP5-15	15	10/8/2008	<33
G46-PSB6 / PSG6	G46-SVP6-5	5	10/7/2008	<33
	G46-SVP6-10	10	10/8/2008	**110**
	G46-SVP6-15	15	10/8/2008	**45.3**
G46-PSB7 / PSG7	G46-SVP7-5	5	10/7/2008	<33
	G46-SVP7-10	10	10/8/2008	**39.9**
	G46-SVP7-15	15	10/8/2008	**39.0**
G46-PSB8 / PSG8	G46-SVP8-5	5	10/7/2008	<33
	G46-SVP8-10	10	10/8/2008	**52.9**
	G46-SVP8-15	15	10/8/2008	<33
G46-PSB9 / PSG9	G46-SVP9-5	5	10/8/2008	<33
	G46-SVP9-10	10	10/8/2008	<33
	G46-SVP9-15	15	10/8/2008	<33

Notes:
"Bold" - Indicates concentrations detected above the method detection limit.
Res - Residenital CHHSL for vapor intrusion, January 2005.
C/I - Commercial/Industrial CHHSL for vapor intrusion, January 2005.
μg/m^3 - Micrograms per cubic meter.
bgs - Below ground surface.
PSB - Primary soil boring.
SVP - Soil vapor probe.
(--) - CHHSL not available.





LEGEND

Quaternary Alluvium

Silt (ML)

Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs below ground surface

PSB Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

PSG Primary Soil Gas - Part of the nomenclature for primary borings where soil gas probes were installed during the Dynamic Site Investigation, 2008.

HSAS Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.

MSL Mean sea level

TD=#' Total Boring Depth (feet)

Boring

First water sample collected during drilling activities, fall to winter 2008

Intersection A-A' Location where cross sections intersect

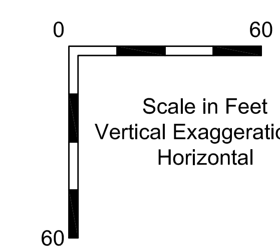


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Figure 5-67
Idealized Geologic Cross Sections A-A' and B-B' - Helicopter Landing Pad and Hangar (Feature G-46)

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Groundwater Sampling Results and Contaminant Distribution

During drilling activities, VOCs including benzene (4 samples), MTBE (1 sample), toluene (4 samples), and xylenes (1 sample) were detected above the MDL groundwater grab samples from 4 of the 9 borings with concentration ranging from 0.10 to 0.45 µg/L (Table 5-16), see Figure 5-68. PCE was not detected in any of the groundwater samples collected and the concentrations of VOCs that were detected did not exceed their respective MCLs. The low-level detections of the fuel-related compounds may be associated with potential field contamination or the former operational uses of the Helicopter Landing Pad and Hangar. Based on the soil gas and groundwater grab sample results, no further characterization of the Helicopter Landing Pad and Hangar area is needed.

Table 5-16
Groundwater Sampling Results - Helicopter Landing Pad and Hangar (Feature G-46)

Boring ID	Sample Location	Depth (feet bgs)	Sample Date	Benzene	MTBE	Toluene	m,p-Xylenes	o-Xylene
Matrix				***Water***				
Units				µg/L				
MCL				1	13	150	1,750	1,750
G46-PSB1 / PSG1	G46-PGW1-24	24	09/16/08	<0.10	<0.10	<0.10	<0.20	<0.10
G46-PSB2 / PSG2	G46-PGW2-22	22	09/17/08	<0.10	<0.10	<0.10	<0.20	<0.10
G46-PSB3 / PSG3	G46-PGW3-24	24	09/17/08	**0.110**	<0.10	**0.230**	<0.20	<0.10
G46-PSB4 / PSG4	G46-PGW4-22	22	09/17/08	**0.180**	<0.10	**0.220**	<0.20	<0.10
G46-PSB5 / PSG5	G46-PGW5-31	31	09/17/08	<0.10	<0.10	<0.10	<0.20	<0.10
G46-PSB6 / PSG6	G46-PGW6-21	21	09/17/08	**0.450**	**0.150**	**0.430**	**0.310**	**0.160**
G46-PSB7 / PSG7	G46-PGW7-23	23	09/18/08	**0.100**	<0.10	**0.250**	<0.20	<0.10
G46-PSB8 / PSG8	G46-PGW8-22	22	09/18/08	<0.10	<0.10	<0.10	<0.20	<0.10
G46-PSB9 / PSG9	G46-PGW9-23	23	09/22/08	<0.10	<0.10	<0.10	<0.20	<0.10

Notes:
"Bold" - Indicates concentrations detected above the method detection limit.
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
µg/L - Micrograms per liter.
(-) - Sample not analyzed for analyte.
PSB - Primary soil boring.
SVP - Soil vapor probe.

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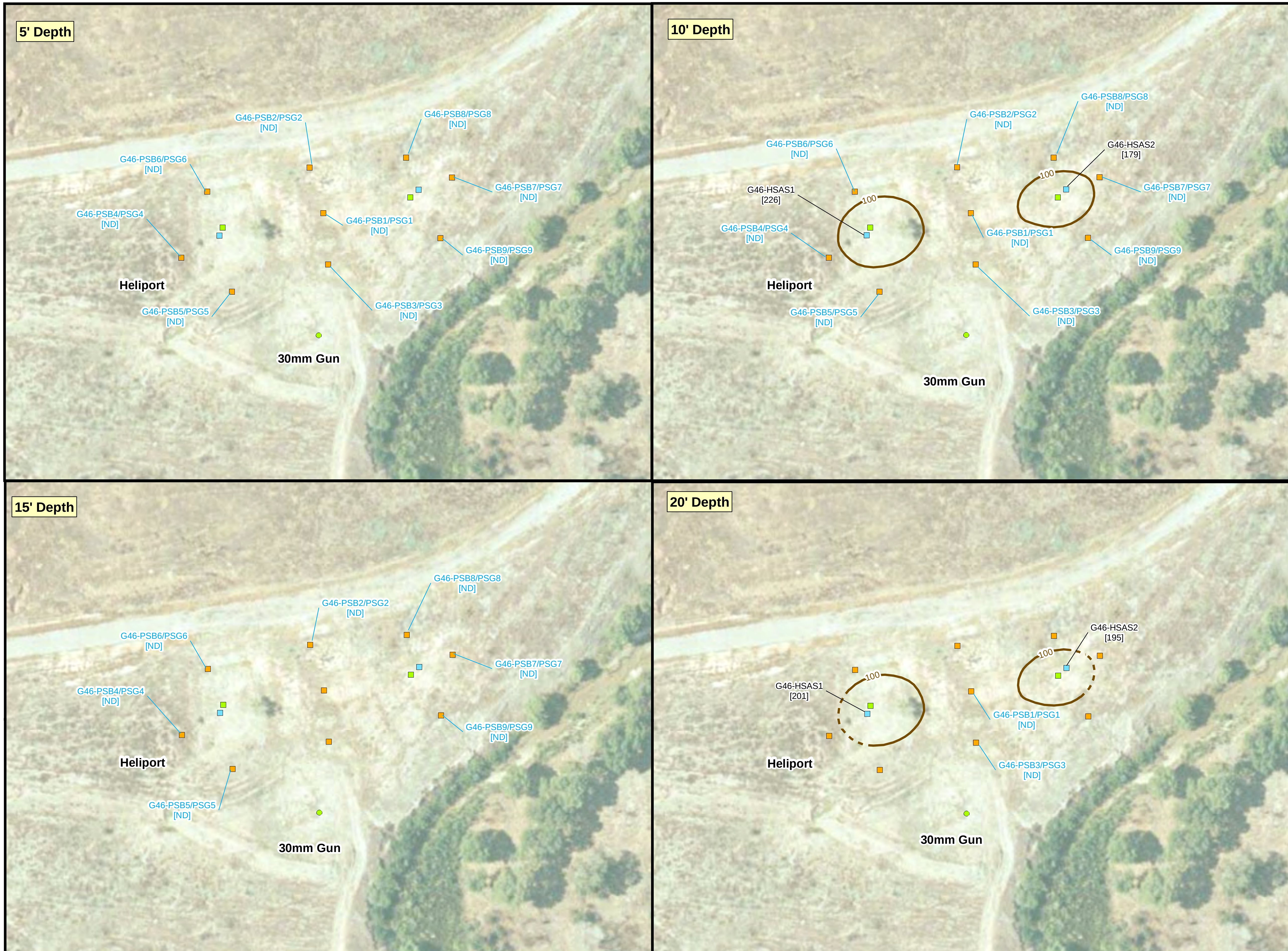


N

0 50 100 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring/Soil Vapor, 2008
- Soil Boring/Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004

PCE Tetrachloroethene

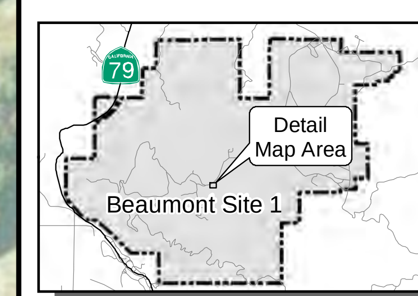
PCE Isoconcentration Contour (dashed where inferred)

Note:

Boring symbols with no labels indicate sample was not tested at depth interval.

[#] - PCE results in µg/m³

[ND] - Non-Detect (<72 µg/m³)



Beaumont Site 1

Figure 5-68
PCE Concentrations in Soil Gas - Helicopter Landing Pad and Hangar (Feature G-46)

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5.4.5 Historical Operational Area H

Historical Operational Area H, a permitted sanitary landfill, was located along the western side of the Site. The permit for the landfill allowed LPC to dispose of trash such as paper, scrap metal, concrete, and wood generated during routine daily operations. Lockheed policy strictly dictated that hazardous materials were not to be disposed of at this landfill. The trenches were later covered and leveled, with only an occasional tire, metal scrap, or piece of wood remaining on the surface.

5.4.5.1 Feature H-49 - Sanitary Landfill

The Sanitary Landfill (Feature H-49) is positioned on the eastern flank of a ravine that drains into Potrero Creek near the entrance to Massacre Canyon and is located approximately 2,000 feet upslope of the streambed. The surface of the landfill slopes gently (5 to 20%) away from the road located on the eastern side of the landfill and then falls sharply away into a deep ravine. The relatively flat portion of the area was used as the sanitary landfill during the period the LMC facility was in operation. The Sanitary Landfill covers an irregular area approximately 3.0 acres in size. Based on previous investigations, the waste cells occupy approximately 16.6% or a 0.5 acre of the total landfill area with the maximum depth of waste ranging between 4 and 10 feet bgs. Anecdotal information collected from a former LPC employee during the 2005 Munitions and Explosives of Concern (MEC) evaluation indicates that small amounts of 30 and 40 millimeter practice ammunition were occasionally disposed of in the Sanitary Landfill (Tetra Tech, 2005b).

Previous Results

Eighteen (18) borings were drilled to depths between 21.5 and 71.5 feet bgs, 19 test pits were investigated down to approximately 12 feet bgs, and 5 soil gas probes were installed between 10 and 19 feet bgs during previous investigations (Tetra Tech, 2005b, 2008a, 2009a). Soil samples were analyzed for one or more of the following: VOCs, TPH, SVOCs, perchlorate, 1,4-dioxane, PAHs, dioxins/furans, PCBs, and Title 22 metals. SVOCs, 1,4-dioxane, and PAHs were not detected above their respective RLs. Diesel range TPH was detected at concentrations ranging from 6.8 to 10 mg/kg. Perchlorate was detected at concentrations ranging from 31.5 to 67,300 µg/kg. The highest concentration of perchlorate was detected near a small drainage channel at 0.5-foot bgs that runs through the Site. VOCs (acetone, benzene, p-isopropyltoluene, and toluene) were detected at concentrations ranging from 0.97 to 72 µg/kg. Detected concentrations of acetone, benzene, and toluene were qualified due to method blank contamination. No VOCs were detected in soil gas in the five probes sampled in 2004. One PCB, Aroclor-1248, was detected at concentrations of 86, 210, and 910 µg/kg in the northeast portion of the Sanitary Landfill; and two PCBs, Aroclor-1254 and 1260, were detected adjacent to the T-depression (Aroclor 1254: 76, 78, and 1400 µg/kg; Aroclor 1260: 31, 44, and 84 µg/kg) where waste is buried.

Detected dioxin/furan concentrations were converted to their 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) Toxicity Equivalency Quotient (TEQ) using toxicity equivalent factors (TEFs). TEQ values ranged from 0.000092 to 13.53 nanograms per kilogram (ng/kg). Tables with the soil and soil gas analytical results from the previous investigations in 2004, 2007, and 2008 are included in Tables H-12, H-15 H-16a and H-16b in Appendix H.

The information collected to date indicated that further investigation was needed to complete the characterization of perchlorate and PCB impacts in soil and evaluate potential perchlorate impacts to groundwater.

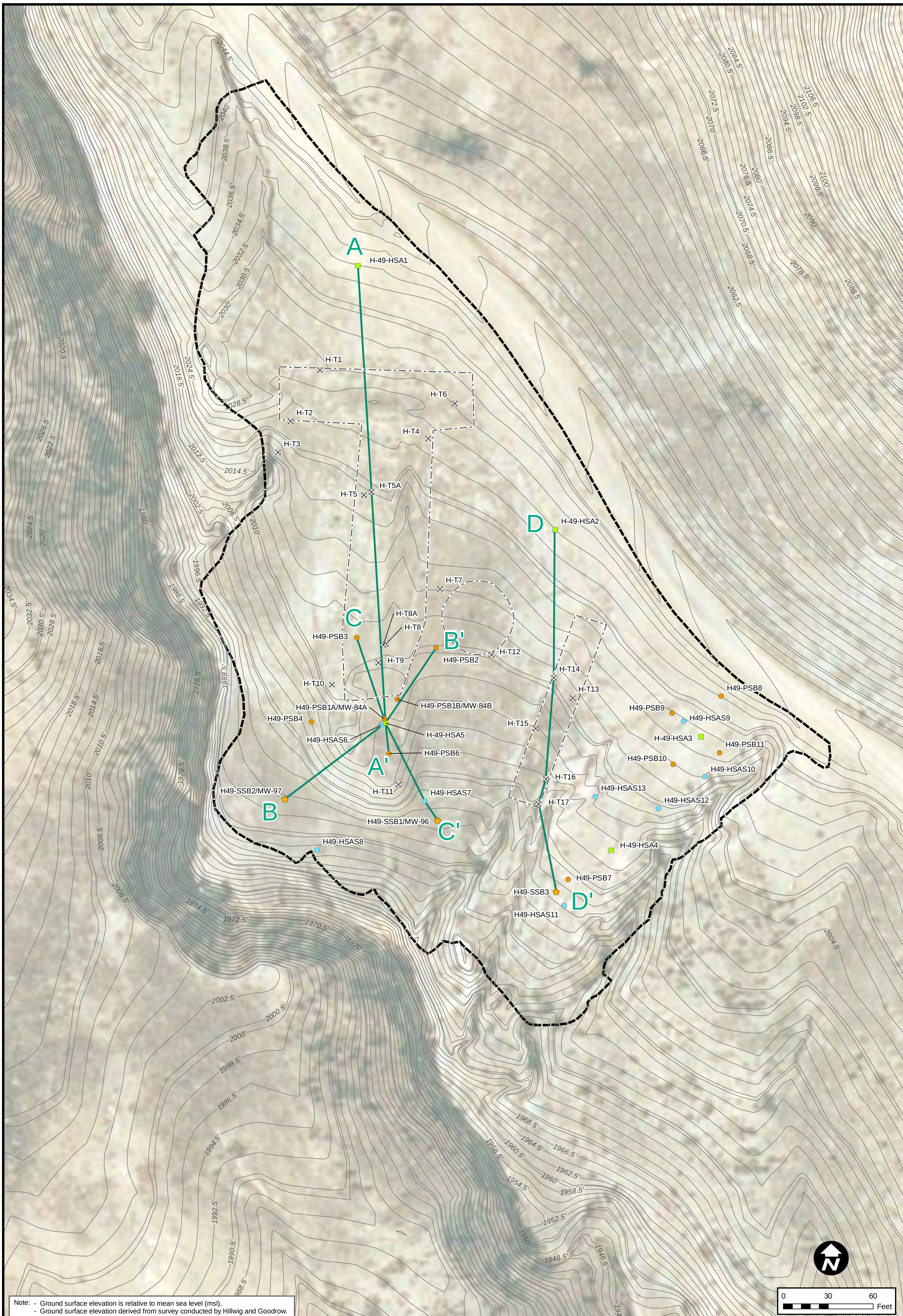
Investigation Activities

Two (2) primary borings (H49-PSB7 and 8) were drilled using HSA to approximately 30 feet bgs and three (3) primary borings (H49-PSB9, 10, and 11) were hand augered to 5 feet bgs to delineate the extent of PCBs in the northeast corner of the landfill (Figure 5-69). Soil samples were collected at the surface (0.5 foot bgs), and every 5 feet thereafter to the total depth of each boring. Soil samples from these borings were analyzed for PCBs only.

Five primary borings (H49-PSB1A/MW-84A, H49-PSB2, 3, 4 and 6) and three secondary borings H49-SSB1, 2, and 3) were drilled using the sonic drilling method to depths between 78 and 106 feet bgs (Figure 5-69). One primary boring (H49-PSB1B/MW-84B) was drilled to 147 feet bgs to delineate the vertical extent of perchlorate impacts in groundwater. Soil samples were collected at the surface (0.5 foot bgs), and approximately every 5 feet down to 40 feet bgs and every 10 feet thereafter in 8 of the 9 borings (H49-PSB1/MW-84A, H49-PSB2 through H49-PSB4, H49-PSB6, H49-SSB1/MW-96, H49-SSB2/MW-97 and H49-SSB3) and analyzed for perchlorate. No soil samples were collected from H49-PSB1B/MW-84B since this boring was installed as a groundwater boring to vertically delineate perchlorate impacts detected at first water in H49-PSB1A/MW-84A.

Groundwater grab samples were collected at first water between 91 and 103 feet bgs in 5 primary borings (H49-PSB1A/MW-84A, H49-PSB1B/MW-84B, H49-PSB3, H49-PSB4 and H49-PSB6) and three secondary borings (H49-SSB1/MW-96, H49-SSB2/MW-97 and H49-SSB3). Two depth discrete groundwater samples were collected from one primary boring (H49-PSB1B/MW-84B) (adjacent to H49-PSB1/MW-84A where the highest concentrations in soil and first water were detected) at 130 and 140 feet bgs to delineate the vertical extent of perchlorate impacts to groundwater.

X:\GIS\Lockheed 22288-110302\Site 1 Samp_Pts_Zoom-Area Figure2-3.mxd



LEGEND

Sample Locations

- × Investigative Trench, 2008
- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2004

Geologic Cross Section Location Line

Boundary of Area with Metallics (from Tt geophysical survey)

Ground Surface Elevation Contour

Landfill Extent

HSA- Hollow Stem Auger - Part of the nomenclature for borings installed with a hollow stem auger rig during the soil investigation in 2004.

HSAS- Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed with a hollow stem auger rig during the supplemental soil investigation in 2007.

PSB- Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.

SSB- Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.

MW- Monitoring Well

Adapted from: March 2007 aerial photograph.

Beaumont Site 1

Figure 5-69

Soil Borings and Cross Section Locations - Sanitary Landfill (Feature H-49)

TETRA TECH

All groundwater samples were analyzed for perchlorate only. The well construction diagrams are included in Appendix D. Three shallow first water monitoring wells (H49-PSB1A/MW-84A, H49-SSB1/MW-96 and H49-SSB2/MW-97) were installed with 10-foot screen intervals with total depths of 95, 97 and 90 feet bgs, respectively. Groundwater at this feature is confined and therefore only 10-foot screens were installed to target the water bearing unit. Based on the depth discrete groundwater sampling, one deep monitoring well (H49-PSB1B/MW-84B) was installed with a 10-foot screen interval from 130 to 140 feet bgs. Subsequent to the field investigation and well development, groundwater samples were collected and analyzed for perchlorate, VOCs, and 1,4-dioxane in February and March 2009.

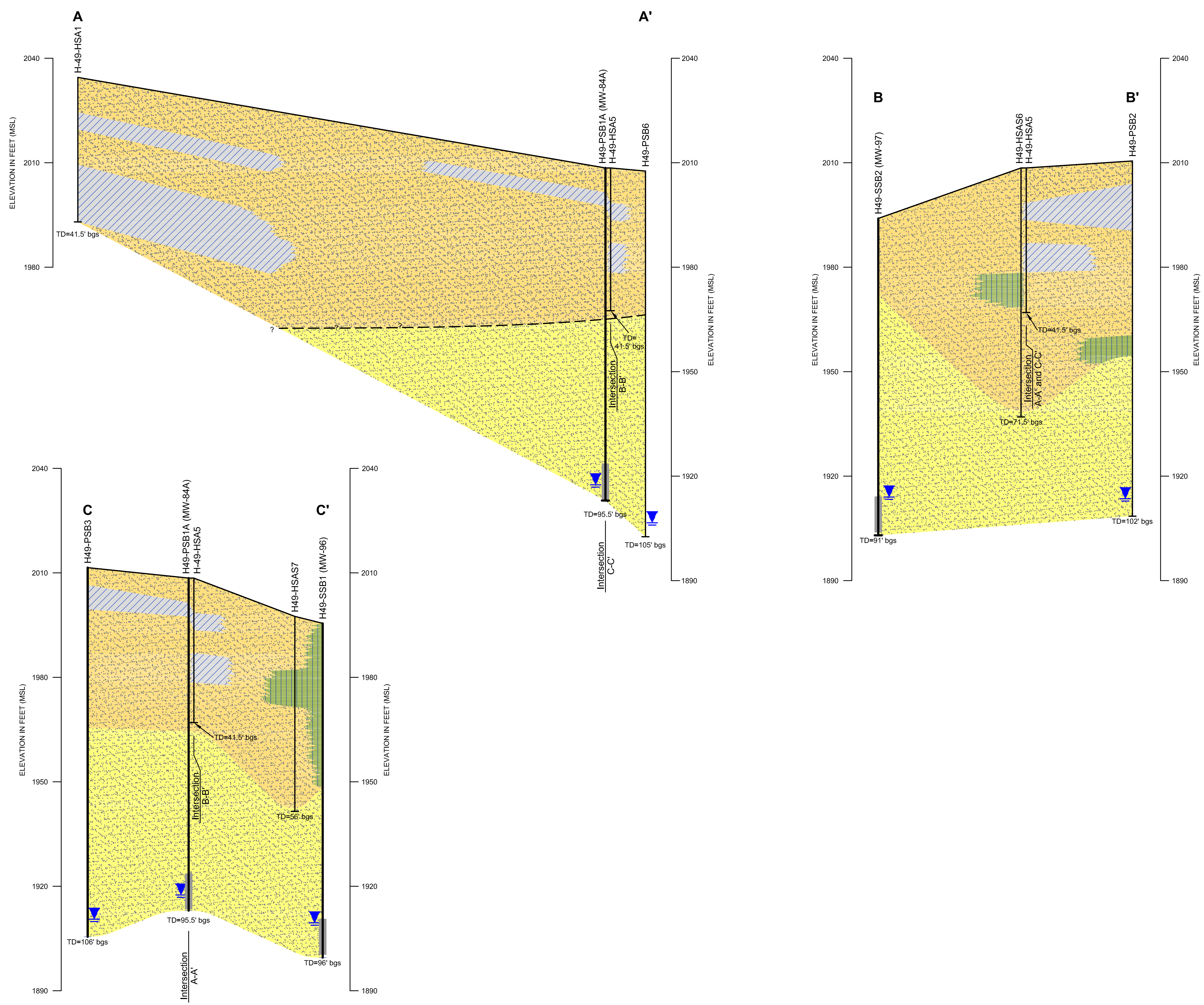
Geology and Hydrogeology

The Sanitary Landfill (Feature H-49) is bound on the north and east by a quartz diorite mountain. On the landfill's west side, oriented approximately 20 degrees west of north, is the ravine which has incised the very well indurated Mount Eden sandstone. The Mount Eden formation exposed by the ravine and contains thick sandstone beds with occasional conglomerate lenses (1 to 2 feet thick). The Mount Eden was encountered in 10 of the borings installed during the DSI and depth to Mount Eden formation ranges from 14 to 56 feet bgs. As seen in the cross sections on Figure 5-70, the surface of the Mount Eden formation appears to undulate beneath the alluvium. The alluvium at the Sanitary Landfill is predominantly silty sand with some transitions to sandy silt and a few layers of clay. Interbedded layers of very fine sand, silts, and clays were observed, with discrepancies between nearby borings occurring due to slight differences in the percentages of the fine-grained sediments present.

Depth to water, where encountered, ranges from about 74 to 100 feet bgs. Figure 5-71 shows the groundwater elevation contours generated from the newly installed wells during groundwater sampling event in February 2009. As shown in the figure, groundwater at this feature is at its highest elevation in MW-97 (the westernmost well) at 1948.35 feet above msl and the lowest groundwater elevation is at 1944.88 feet above msl at MW-96 (the southernmost well). The groundwater flows parallel with the ravine in a southeastern direction toward Potrero Creek.

Soil Sampling Results and Contaminant Distribution

As stated previously, PCBs were detected in the northeast portion of the Sanitary Landfill (Feature H-49) and adjacent to the T-depression where waste is buried (Figure 5-72). Figure 5-71 shows the PCB concentrations detected at 0.5, 2.5, 5, and 20 feet bgs which represent the depths where PCBs were detected. PCBs were not detected above the MDL in the 20 samples collected during this investigation in the northeast corner of the Sanitary Landfill. The PCBs detected during the previous investigations are localized and generally do not extend beyond a depth of 5 feet bgs except for two locations where they were detected at 20 feet bgs (Figure 5-71).



LEGEND

Quaternary Alluvium

- Clay (CL)
- Silt (ML)
- Fine to coarse grained sand (SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, SM, SC)

(Above symbols and abbreviations taken from the Unified Soil Classification System)

Mount Eden formation

- Fine to coarse grained sandstone with some gravelly lenses and may include siltstone and/or claystone intervals

bgs	below ground surface
HSA	Hollow Stem Auger - Part of the nomenclature for borings installed using a hollow stem auger rig during the soil investigation in 2004.
HSAS	Hollow Stem Auger Supplemental - Part of the nomenclature for borings installed using a hollow stem auger rig during the supplemental soil investigation in 2007.
PSB	Primary Soil Boring - Part of the nomenclature for initial primary borings installed during the Dynamic Site Investigation, 2008.
SSB	Secondary Soil Boring - Part of the nomenclature for secondary step-out borings installed during the Dynamic Site Investigation, 2008.
MSL	Mean sea level
MW	Monitoring Well
TD=#'	Total Boring Depth (feet)
	Well
	Screened interval
	Boring
	First water sample collected during drilling activities, fall to winter 2008
—?—	Inferred contact
Intersection A-A'	location where cross sections intersect

0 60

Scale in Feet
Vertical Exaggeration = 2x Horizontal

30

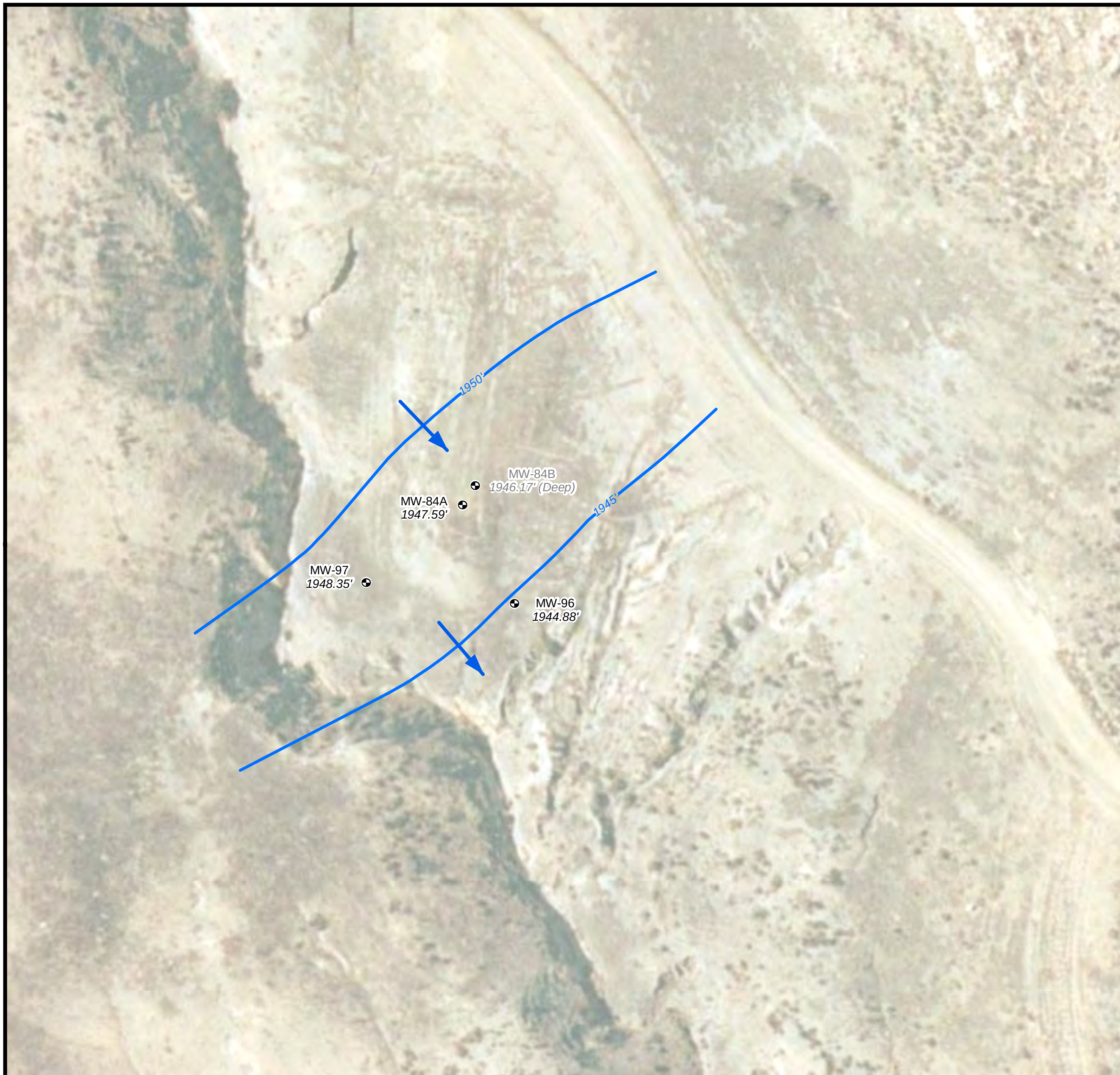
Beaumont Site 1

Figure 5-70
Idealized Geologic Cross Sections A-A', B-B', and C-C'
Sanitary Landfill (Feature H-49)

TETRA TECH

X:\GIS\LOCKHEED 22288-0306\CAD\H49 XSEC AA_BB_CC.DWG

X:\GIS\Lockheed 22288-110302\GW_Contours H49.mxd



0 30 60
Feet

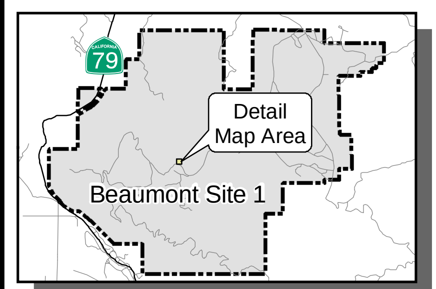
Adapted from: March 2007 aerial photograph.

LEGEND

Monitoring Well Location

Groundwater Elevation Contour
(relative to mean sea level)

Groundwater Flow Direction

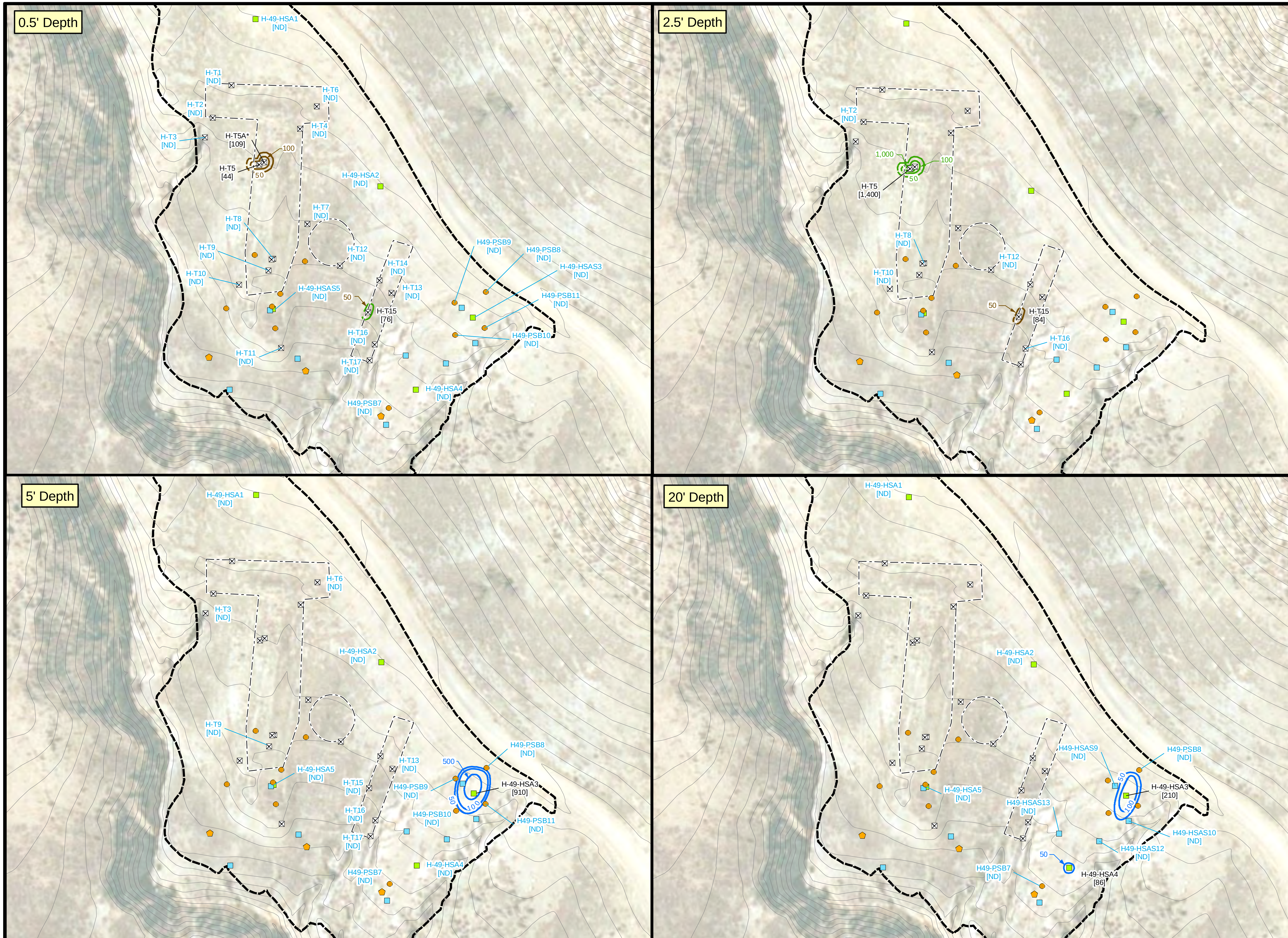


Beaumont Site 1

Figure 5-71

**Groundwater Contours-
February 2009
Sanitary Landfill (Feature H-49)**

TETRA TECH



0 50 100 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Investigative Trench, 2008
- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2004
- Boundary of Area with Metallics (from Tt geophysical survey)
- PCB Isoconcentration Contour - (PCB-1248)
- PCB Isoconcentration Contour - (PCB-1254)
- PCB Isoconcentration Contour - (PCB-1260)
- Ground Surface Elevation Contour
- Landfill Extent

Note:

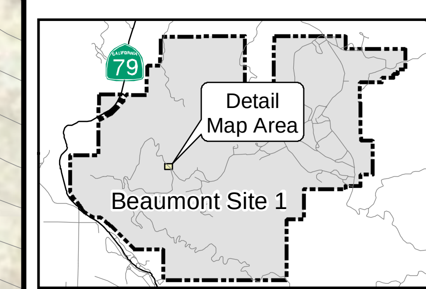
[#] - PCB results in µg/kg.

[ND] - Non-Detect. (<5.0 - 30.8 µg/kg)

* - Summation of PCB 1254 and 1260.

µg/kg - Micrograms per kilogram.

Boring symbols with no labels indicate sample was not tested at depth interval.



Beaumont Site 1

Figure 5-72
PCB Concentrations in Soil - Sanitary Landfill (Feature H-49)

TETRA TECH

Perchlorate was detected above the MDL in 38 of the 115 soil samples collected during this investigation ranging from 5.92 to 1,430 µg/kg with an average concentration of 137 µg/kg (Table 5-17). Figure 5-73 shows the lateral distribution of perchlorate in soil greater than 200 µg/kg based on the 3-D modeling of all the available soil sampling results since 2004. A compilation of the soil analytical results from the DSI and previous investigations (2004, 2007, and 2008) were used to generate this figure. The areal extent of impacted soil above 200 µg/kg is approximately 12,120 ft^2 or 0.28 acres and is comprised of soils from the drainage channel (9,220 ft^2) and the southern portion of the T-depression (2,900 ft^2). As shown in this figure, the highest concentrations were detected in shallow soils (H-T14) in the impacted area near the drainage channel during the 2008 investigation. Figure 5-74 shows the perchlorate concentration contours at depths of 0.5, 5, 10, 20, 30, and 40 feet bgs. The highest concentration (1,430 µg/kg) detected during this investigation was in boring H49-PSB1A/MW-84A at the southern end of the T-depression at a depth of 40 feet bgs. The extent of perchlorate detected in this location is consistent with data from previous investigations with respect to depth and magnitude. The lateral distribution of perchlorate appears to be the most extensive between 0.5 and 10 feet bgs in the drainage channel and between 10 and 40 feet bgs in the southern portion of the T-depression.

Figures 5-75 and 5-76 present the 3-D visualizations of the perchlorate-affected soil above 200 µg/kg at the Sanitary Landfill (Feature H-49) with views from the north and northeast. The figures show the general boring and sample locations with the relative magnitude of the perchlorate concentrations detected in soil. For boring names and exact concentrations detected, refer to Figure 5-74. Based on the 3-D modeling of perchlorate, the majority of the perchlorate does not extend beyond 40 feet bgs. The contaminant distribution of perchlorate is generally limited laterally to the area containing metallics (as defined by a geophysical survey) based on the samples collected from borings downgradient and adjacent to the drainage channel and T-depression (Figures 5-75 and 5-76).

Figures 5-77 and 5-78 show the vertical profiles for perchlorate in soil along cross section lines C-C' and D-D' depicting the vertical extent of impacts with the two impacted areas, the southern portion of the T-depression and the drainage channel, respectively. As shown in Figure 5-77 and 5-73, the perchlorate concentrations are defined both laterally and vertically in this area decreasing to below 100 µg/kg at 55 feet bgs. Figure 5-78 shows the highest concentration of perchlorate (67,300 µg/kg at H-T14) detected in a trench sample at 0.5 feet bgs which decreases an order of magnitude to 5,240 µg/kg at 5 feet bgs. The surrounding subsurface soil borings indicate that the lateral extent of perchlorate at depth around the drainage channel is not extensive. Based on the additional characterization data collected during this investigation, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg.

Table 5-17 Soil and Groundwater Sampling Results - Sanitary Landfill (Feature H-49)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	Carbon Disulfide	Chloro - methane	Chloro - form
Matrix				***Soil***	***Water***			
Units				µg/kg	µg/L			
MCL				na	6		--	--
DWNL				na		160	--	--
H49-PSB1 / MW-84A	H49-PSB1-0.5	0.5	9/8/2008	**14.50**	-	-	-	-
	H49-PSB1-5	5	9/8/2008	**7.83**	-	-	-	-
	H49-PSB1-9	9	9/8/2008	**107**	-	-	-	-
	H49-PSB1-15	15	9/8/2008	**101**	-	-	-	-
	H49-PSB1-20	20	9/8/2008	**153**	-	-	-	-
	H49-PSB1-25	25	9/8/2008	**334**	-	-	-	-
	H49-PSB1-30	30	9/8/2008	**586**	-	-	-	-
	H49-PSB1-35	35	9/8/2008	**574**	-	-	-	-
	H49-PSB1-40	40	9/8/2008	**1,430**	-	-	-	-
	H49-PSB1-45	45	9/8/2008	**288**	-	-	-	-
	H49-PSB1-50	50	9/8/2008	**146**	-	-	-	-
	H49-PSB1-55	55	9/8/2008	**11.6**	-	-	-	-
	H49-PSB-1-60	60	9/9/2008	<5.24	-	-	-	-
	H49-PSB-1-70	70	9/9/2008	**11.5**	-	-	-	-
	H49-PSB-1-80	80	9/9/2008	<5.24	-	-	-	-
	H49-PSB-1-90	90	9/9/2008	<5.20	-	-	-	-
	H49-PGW1-91	91	9/9/2008	-	**158**	-	-	-
	MW-84B	85-95	12/03/08	-	**21.3**	-	-	-
	MW-84B	85-95	12/08/08	-	<0.5	-	-	-
	MW-84B	85-95	2/4/2009	-	**5.19**	**0.38**	<0.2	<0.2
	MW-84B	85-95	3/5/2009	-	<0.5	**1.6**	<0.2	<0.2
H49-PSB1B / MW-84B	H49-PGW1D-92	92	11/20/08	-	<0.5	-	-	-
	H49-PGW1A-130	130	11/24/08	-	<0.5	-	-	-
	H49-PGW1A-140	140	11/24/08	-	<0.5	-	-	-
	MW-84B	130-140	12/03/08	-	<0.5	-	-	-
	MW-84B	130-140	2/11/2009	-	<0.5	**3.7**	<0.2	**0.37**
	MW-84B	130-140	3/5/2009	-	<0.5	**3.8**	<0.2	**0.22**
H49-PSB2	H49-PSB2-0.5	0.5	9/10/2008	<5.22	-	-	-	-
	H49-PSB2-5.0	5	9/10/2008	<5.68	-	-	-	-
	H49-PSB2-10.0	10	9/10/2008	<5.97	-	-	-	-
	H49-PSB2-15.0	15	9/10/2008	**23.3**	-	-	-	-
	H49-PSB2-20.0	20	9/10/2008	**93.2**	-	-	-	-
	H49-PSB2-25.0	25	9/10/2008	<5.27	-	-	-	-
	H49-PSB2-30.0	30	9/10/2008	<5.39	-	-	-	-
	H49-PSB2-35.0	35	9/10/2008	<6.06	-	-	-	-
	H49-PSB2-40	40	9/11/2008	<5.47	-	-	-	-
	H49-PSB2-50	50	9/11/2008	<5.24	-	-	-	-
	H49-PSB2-60	60	9/11/2008	<5.21	-	-	-	-
	H49-PSB2-70	70	9/11/2008	<5.25	-	-	-	-
	H49-PSB2-80	80	9/11/2008	<5.22	-	-	-	-
	H49-PSB2-90	90	9/11/2008	<5.24	-	-	-	-
	H49-PSB2-100	100	9/11/2008	<5.22	-	-	-	-

Table 5-17 (Cont'd) Soil and Groundwater Sampling Results - Sanitary Landfill (Feature H-49)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	Carbon Disulfide	Chloro - methane	Chloro - form
Matrix				***Soil***	***Water***			
Units				µg/kg	µg/L			
MCL				na	6		--	--
DWNL				na		160	--	--
H49-PSB3	H49-PSB3-0.5	0.5	9/12/2008	**6.52**	-	-	-	-
	H49-PSB3-5.0	5	9/12/2008	<5.42	-	-	-	-
	H49-PSB3-10.0	10	9/12/2008	**49.2**	-	-	-	-
	H49-PSB3-15.0	15	9/12/2008	**65.3**	-	-	-	-
	H49-PSB3-18.0	18	9/12/2008	**144**	-	-	-	-
	H49-PSB3-20.0	20	9/12/2008	**37.9**	-	-	-	-
	H49-PSB3-25.0	25	9/12/2008	<5.59	-	-	-	-
	H49-PSB3-30.0	30	9/12/2008	<5.42	-	-	-	-
	H49-PSB3-35.0	35	9/12/2008	<5.26	-	-	-	-
	H49-PSB3-40.0	40	9/12/2008	**27.9**	-	-	-	-
	H49-PSB3-50	50	9/15/2008	**44.4**	-	-	-	-
	H49-PSB3-60	60	9/15/2008	**29.6**	-	-	-	-
	H49-PSB3-70	70	9/15/2008	**29.6**	-	-	-	-
	H49-PSB3-80	80	9/15/2008	<5.23	-	-	-	-
	H49-PSB3-90	90	9/15/2008	<5.20	-	-	-	-
	H49-PSB3-100	100	9/15/2008	<5.17	-	-	-	-
	H49-PSB3-106	106	9/16/2008	<5.26	-	-	-	-
	H49-PGW3-103	103	09/16/08	-	**3.34**	-	-	-
H49-PSB4	H49-PSB4-0.5	0.5	12/10/2008	<5.0	-	-	-	-
	H49-PSB4-5	5	12/10/2008	<5.0	-	-	-	-
	H49-PSB4-10	10	12/10/2008	<5.0	-	-	-	-
	H49-PSB4-15	15	12/10/2008	<5.0	-	-	-	-
	H49-PSB4-25	25	12/10/2008	<5.0	-	-	-	-
	H49-PSB4-30	30	12/11/2008	**37.9**	-	-	-	-
	H49-PSB4-35	35	12/11/2008	**74.3**	-	-	-	-
	H49-PSB4-40	40	12/11/2008	**57.9**	-	-	-	-
	H49-PSB4-45	45	12/11/2008	**54.1**	-	-	-	-
	H49-PSB4-50	50	12/11/2008	<5.0	-	-	-	-
	H49-PSB4-60	60	12/11/2008	<5.0	-	-	-	-
	H49-PSB4-70	70	12/11/2008	<5.0	-	-	-	-
	H49-PGW4-78	78	12/11/08	-	**122**	-	-	-
H49-PSB6	H49-PSB6-0.5	0.5	9/16/2008	**11.4**	-	-	-	-
	H49-PSB6-5.0	5	9/16/2008	<5.37	-	-	-	-
	H49-PSB6-10	10	9/16/2008	**30.7**	-	-	-	-
	H49-PSB6-15	15	9/16/2008	**30.1**	-	-	-	-
	H49-PSB6-20	20	9/16/2008	**80.8**	-	-	-	-
	H49-PSB6-25	25	9/16/2008	**337**	-	-	-	-
	H49-PSB6-30	30	9/16/2008	**127**	-	-	-	-
	H49-PSB6-35	35	9/16/2008	**5.92**	-	-	-	-
	H49-PSB6-40	40	9/16/2008	**25.6**	-	-	-	-
	H49-PSB6-50	50	9/17/2008	<5.24	-	-	-	-
	H49-PSB6-60	60	9/17/2008	<5.30	-	-	-	-
	H49-PSB6-70	70	9/17/2008	<5.26	-	-	-	-
	H49-PSB6-80	80	9/17/2008	<5.26	-	-	-	-
	H49-PSB6-90	90	9/17/2008	<5.27	-	-	-	-
	H49-PSB6-100	100	9/17/2008	<5.25	-	-	-	-
	H49-PGW6-101	101	09/17/08	-	**1.21**	-	-	-

Table 5-17 (Cont'd) Soil and Groundwater Sampling Results - Sanitary Landfill (Feature H-49)

Boring ID	Sample ID	Depth (feet bgs)	Sample Date	Perchlorate	Perchlorate	Carbon Disulfide	Chloro - methane	Chloro - form
Matrix				***Soil***	***Water***			
Units				µg/kg	µg/L			
MCL				na	6		--	--
DWNL				na		160	--	--
H49-SSB1 / MW-96	H49-SSB-1-0.5	0.5	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-5	5	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-10	10	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-15	15	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-20	20	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-25	25	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-30	30	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-35	35	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-40	40	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-50	50	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-60	60	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-70	70	12/2/2008	<5.0	-	-	-	-
	H49-SSB-1-80	80	12/2/2008	<5.0	-	-	-	-
	H49-SGW1-86	86	12/03/08	-	<0.5	-	-	-
	MW-96	85-95	02/04/09	-	<0.5	<0.2	<0.2	**0.77**
	MW-96	85-95	3/5/2009	-	<0.5	**2.0**	**0.65**	**0.63**
H49-SSB2 / MW-97	H49-SSB2-0.5	0.5	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-5	5	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-10	10	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-15	15	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-20	20	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-25	25	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-30	30	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-35	35	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-40	40	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-45	45	12/8/2008	<5.0	-	-	-	-
	H49-SSB2-50	50	12/8/2008	**7.34**	-	-	-	-
	H49-SSB2-55	55	12/8/2008	**6.76**	-	-	-	-
	H49-SSB2-65	65	12/9/2008	<5.0	-	-	-	-
	H49-SSB2-75	75	12/9/2008	<5.0	-	-	-	-
	H49-SGW2-80	80	12/09/08	-	**26.8**	-	-	-
	MW-97	80-90	2/4/2009	-	<0.5	<0.2	<0.2	**0.72**
	MW-97	80-90	3/5/2009	-	<0.5	**3.9**	**0.48**	**0.61**
H49-SSB3	H49-SSB3-0.5	0.5	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-5.0	5	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-10	10	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-15	15	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-20	20	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-25	25	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-30	30	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-35	35	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-40	40	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-50	50	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-60	60	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-70	70	12/13/2008	<5.0	-	-	-	-
	H49-SSB3-80	80	12/13/2008	<5.0	-	-	-	-
	H49-SGW3-83	83	12/14/08	-	<0.5	-	-	-

Notes:

"Bold" - Indicates concentrations detected above the method detection limit.
bgs - below ground surface
MCL - Maximum Contaminant Level, CDPH October 10, 2008.
DWNL - Drinking Water Notification Level, CDPH December 14, 2007.
µg/L - Micrograms per liter.
µg/kg - Micrograms per kilogram.
PSB - Primary soil boring.
SSB - Secondary soil boring.
MW - Groundwater monitoring well.
(-) - Sample not analyzed for analyte.
(--) - MCL or DWNL not available.
na - Not applicable.

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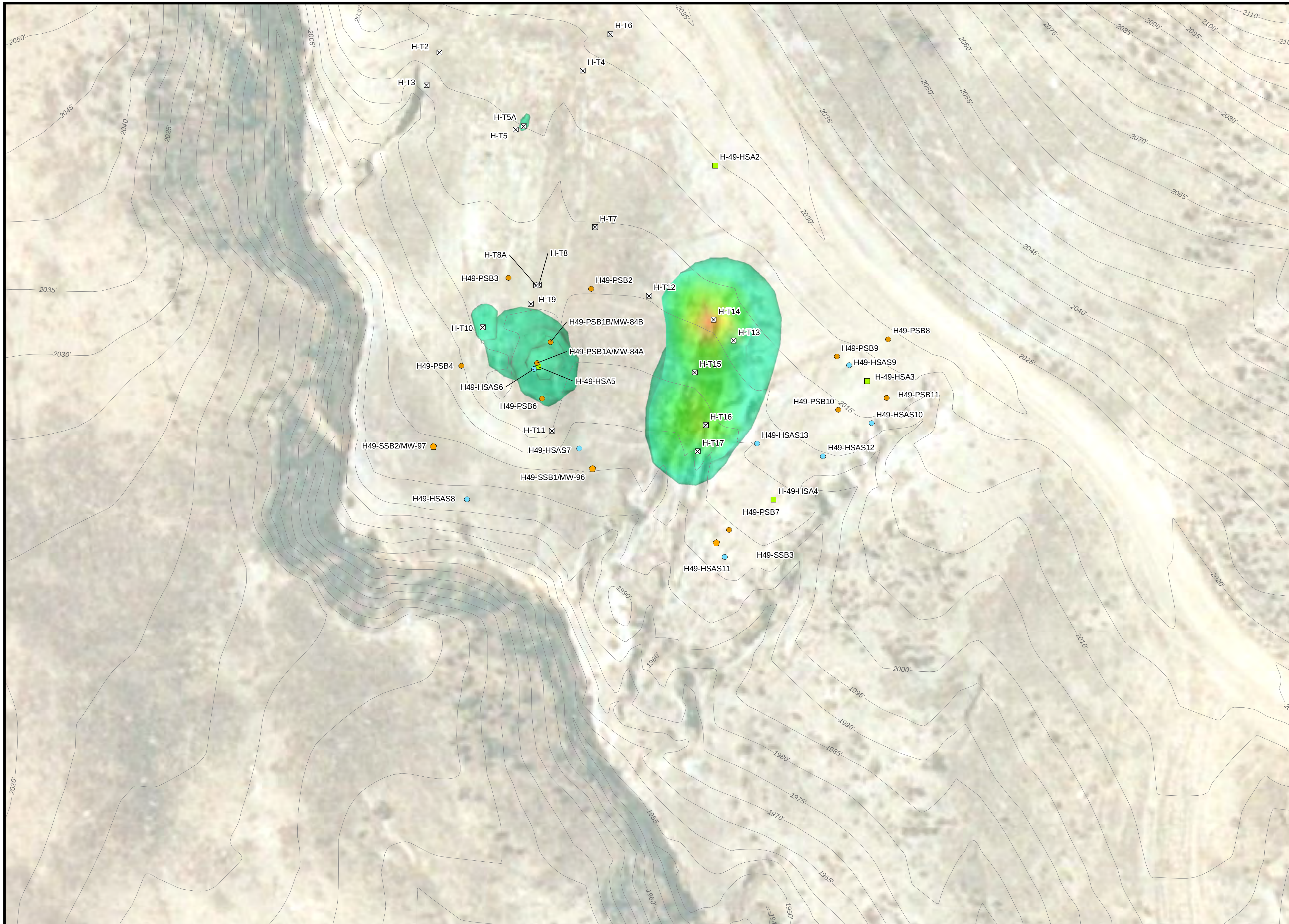

0 30 60 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Trench, 2008
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2004
- Ground Surface Elevation Contour

Perchlorate Concentration

>60,000 µg/kg
30,000 µg/kg
10,000 µg/kg
3,000 µg/kg
1,000 µg/kg
300 µg/kg
100 µg/kg
30 µg/kg
<14 µg/kg

Note:

µg/kg - Micrograms per kilogram.

- Ground surface elevation contour lines from survey conducted by Hillwig and Goodrow.
- Ground surface elevation contour lines relative to mean sea level (msl).

Beaumont Site 1

Figure 5-73
Lateral Extent of Perchlorate in Soil Above 200 µg/kg from 0-70 ft bgs Sanitary Landfill (Feature H-49)

TETRA TECH

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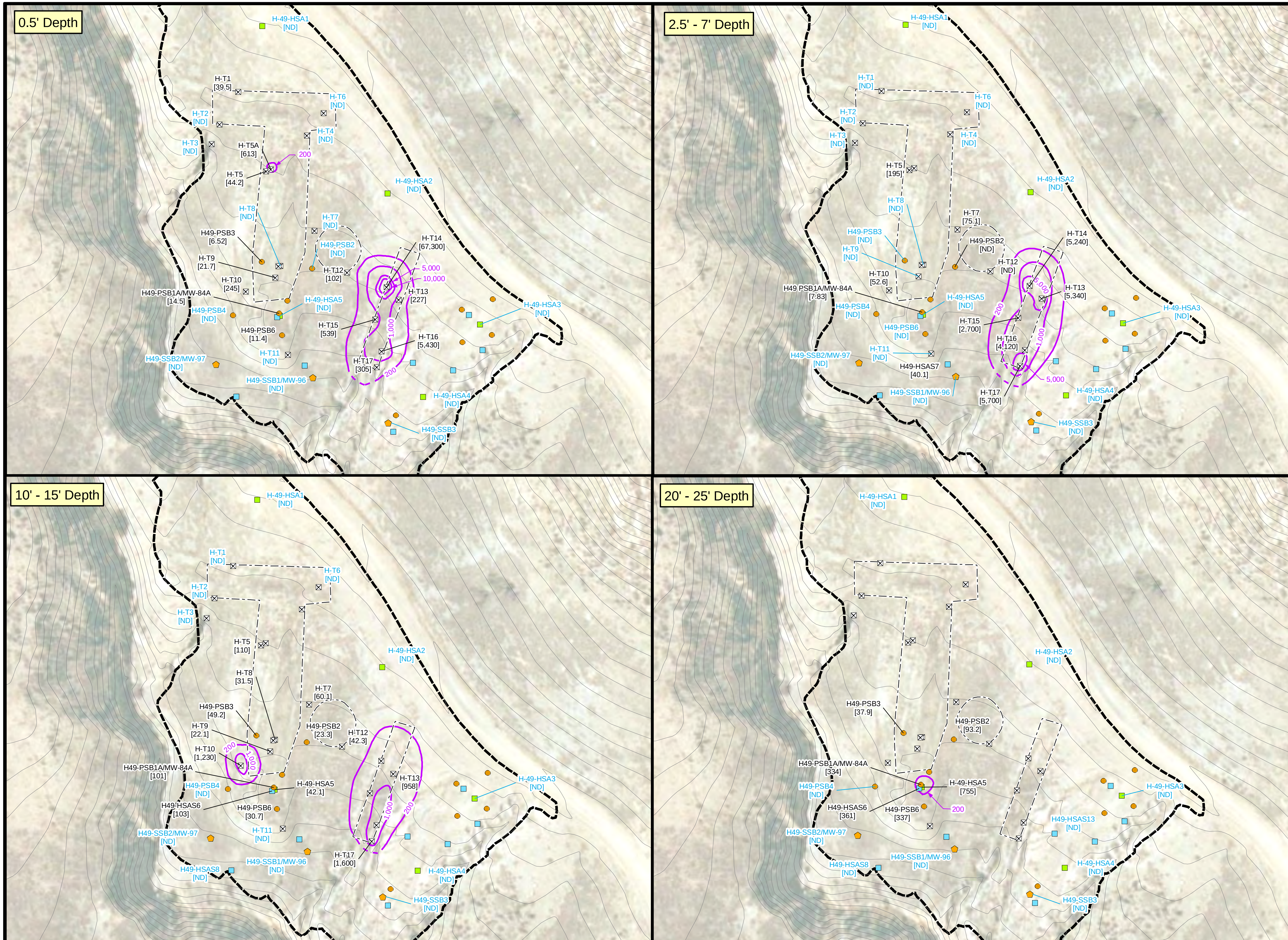


0 50 100 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Trench, 2008
- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2004
- Boundary of Area with Metallics (from Tt geophysical survey)

H49_Perc_0_5ft

- Ground Surface Elevation Contour
- Landfill Extent

Note:

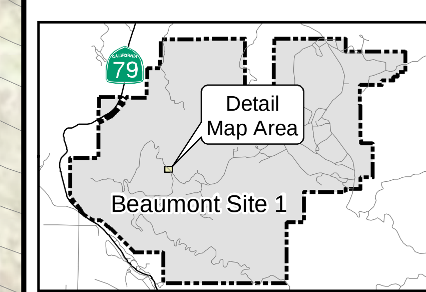
[#] Perchlorate results in µg/kg.

[ND] Non-Detect (<5.0 - 14.6 µg.kg)

µg/kg Micrograms per kilogram.

Boring symbols with no labels indicate sample was not tested at depth interval.

Ground surface elevation contours relative to mean sea level (msl).



Beaumont Site 1

Figure 5-74
Perchlorate Concentrations in Soil - Sanitary Landfill (Feature H-49)

TETRA TECH

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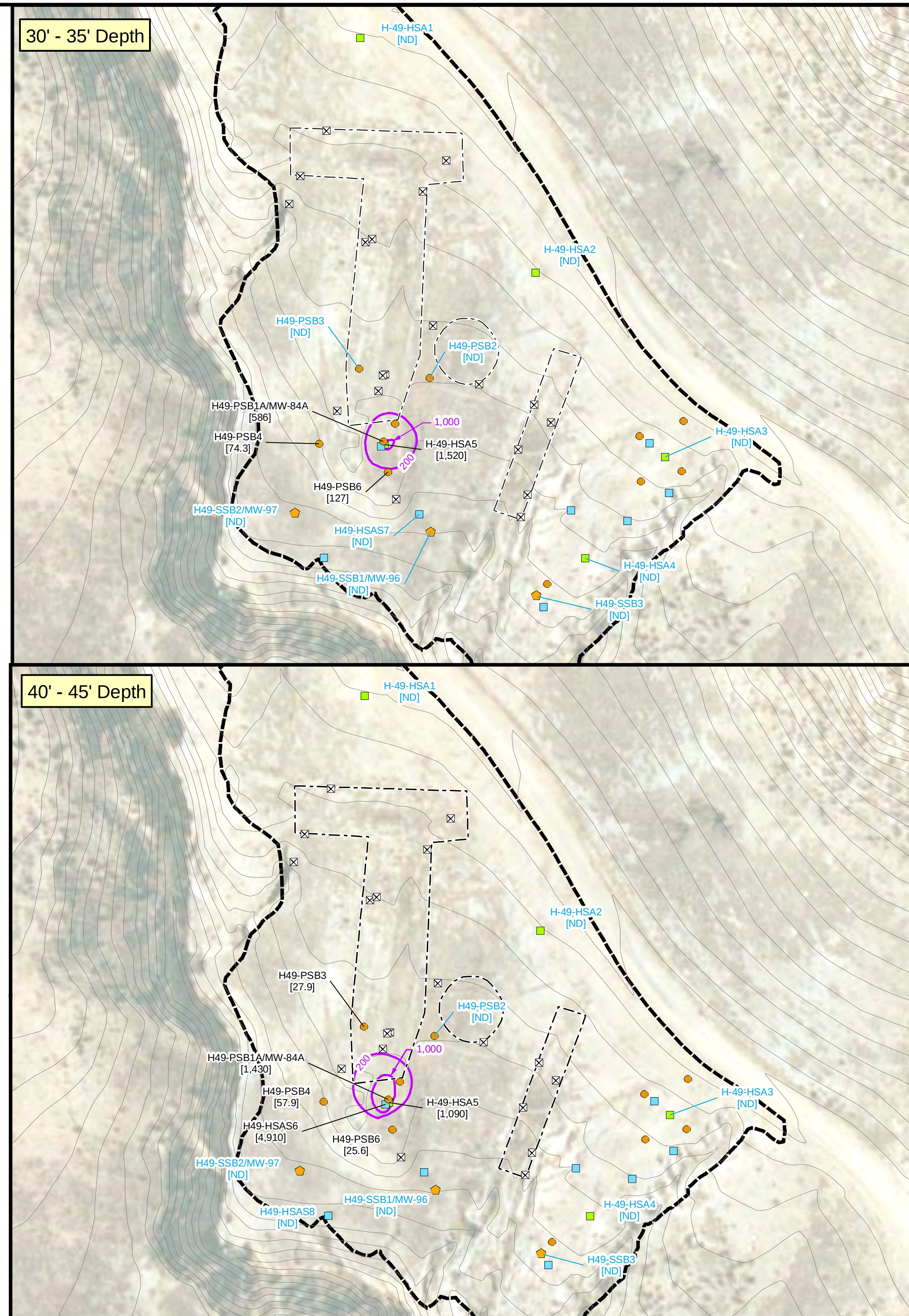


N

0 50 100 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Trench, 2008
- Primary Soil Boring, 2008
- Secondary Soil Boring, 2008
- Soil Boring, 2007
- Soil Boring/Soil Vapor, 2004
- Boundary of Area with Metallics (from Tt geophysical survey)
- Perchlorate Isoconcentration Contour (dashed where inferred)
- Ground Surface Elevation Contour
- Landfill Extent

Note:

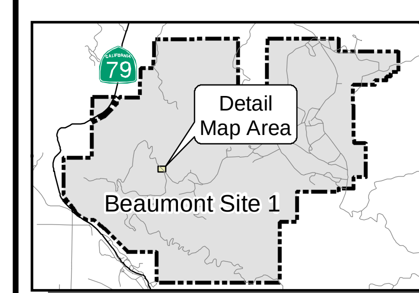
[#] Perchlorate results in µg/kg.

[ND] Non-Detect (<5.0 - 14.6 µg/kg)

µg/kg Micrograms per kilogram.

Boring symbols with no labels indicate sample was not tested at depth interval.

Ground surface elevation contour lines from survey conducted by Hillwig and Goodrow.

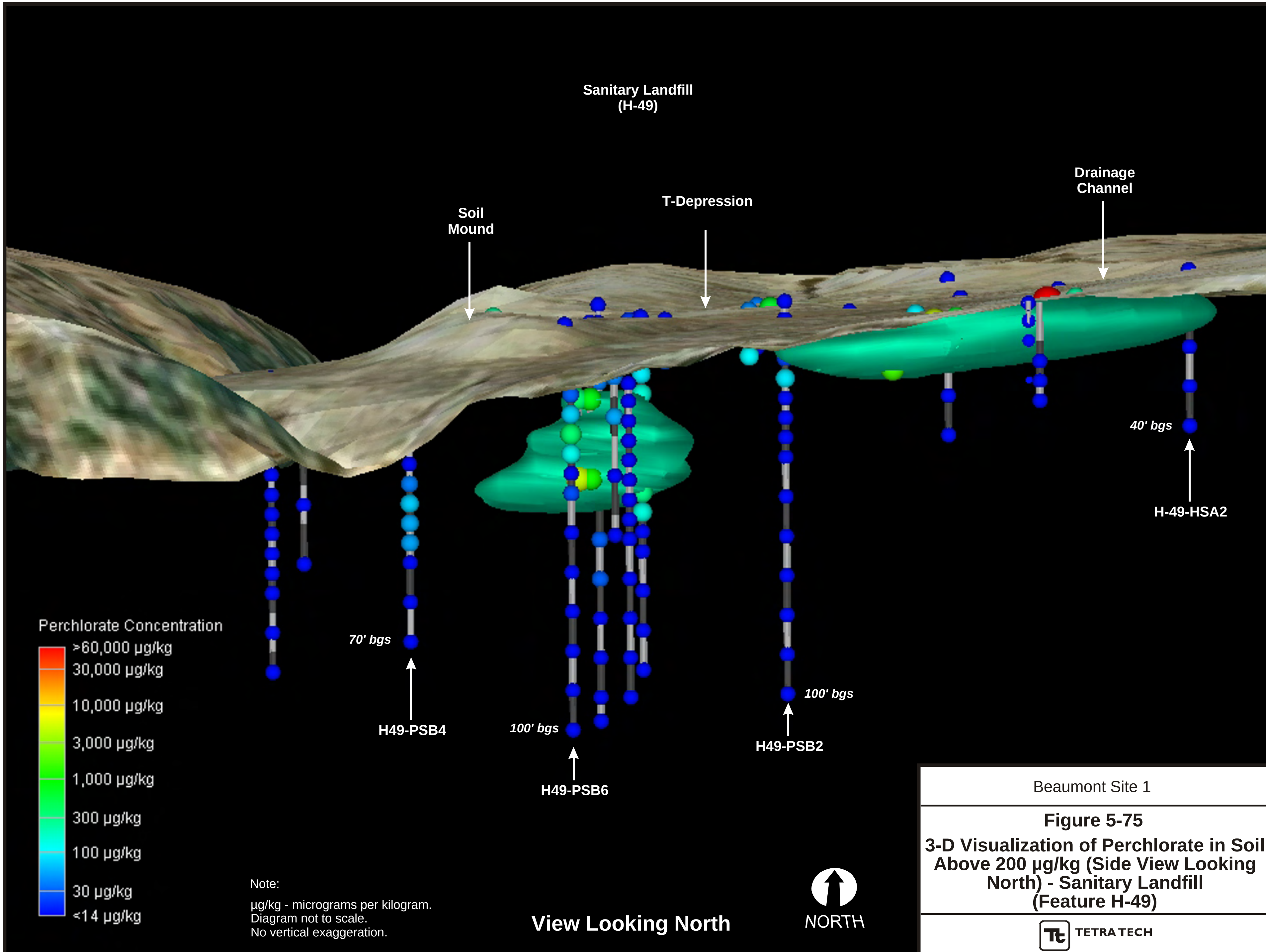


Beaumont Site 1

Figure 5-74 (cont.)

Perchlorate Concentrations in Soil - Sanitary Landfill (Feature H-49)

TETRA TECH



Note:

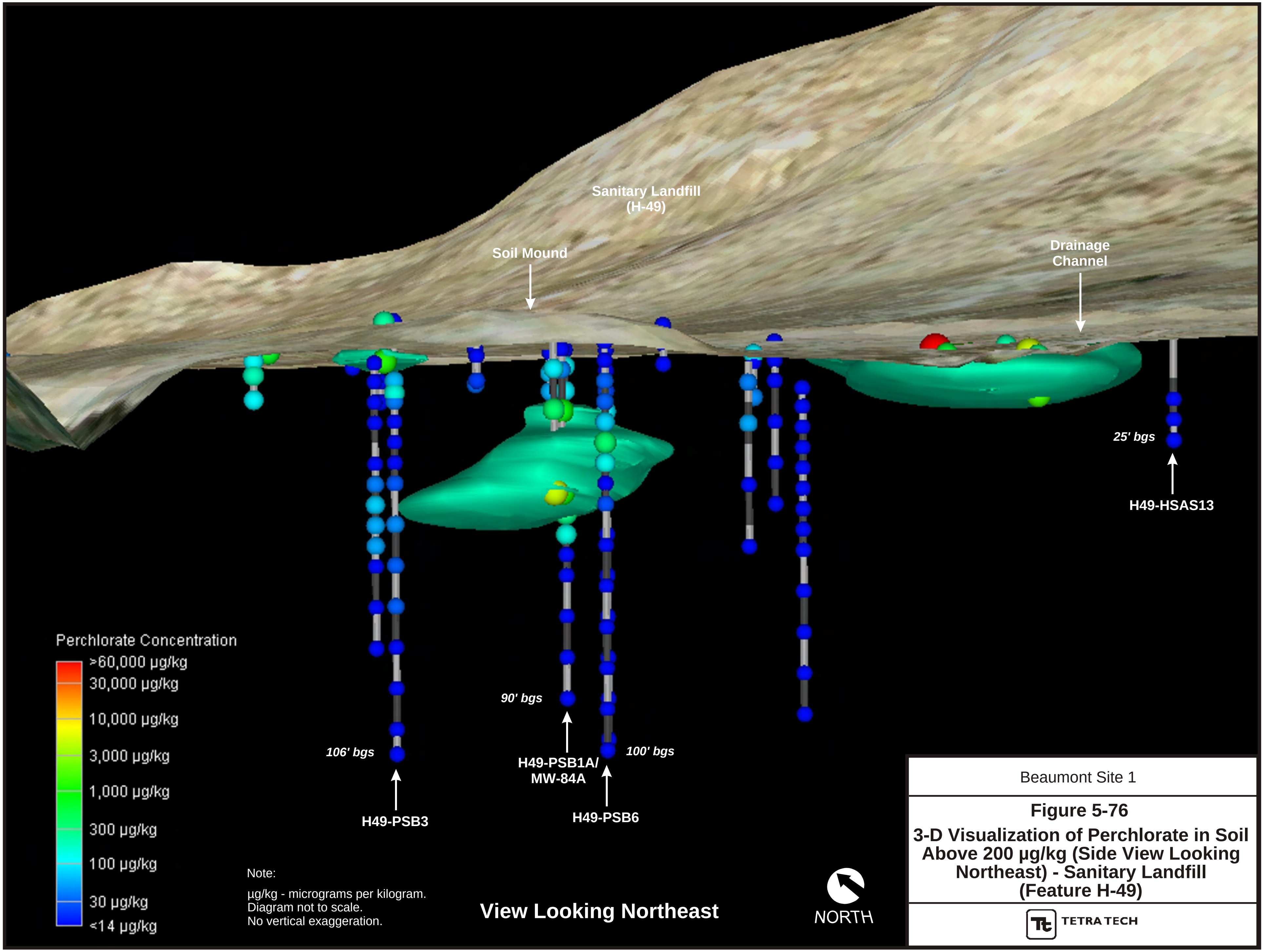
µg/kg - micrograms per kilogram.
Diagram not to scale.
No vertical exaggeration.

Beaumont Site 1

Figure 5-75

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking North) - Sanitary Landfill (Feature H-49)

TETRA TECH



Beaumont Site 1

Figure 5-76

3-D Visualization of Perchlorate in Soil Above 200 µg/kg (Side View Looking Northeast) - Sanitary Landfill (Feature H-49)

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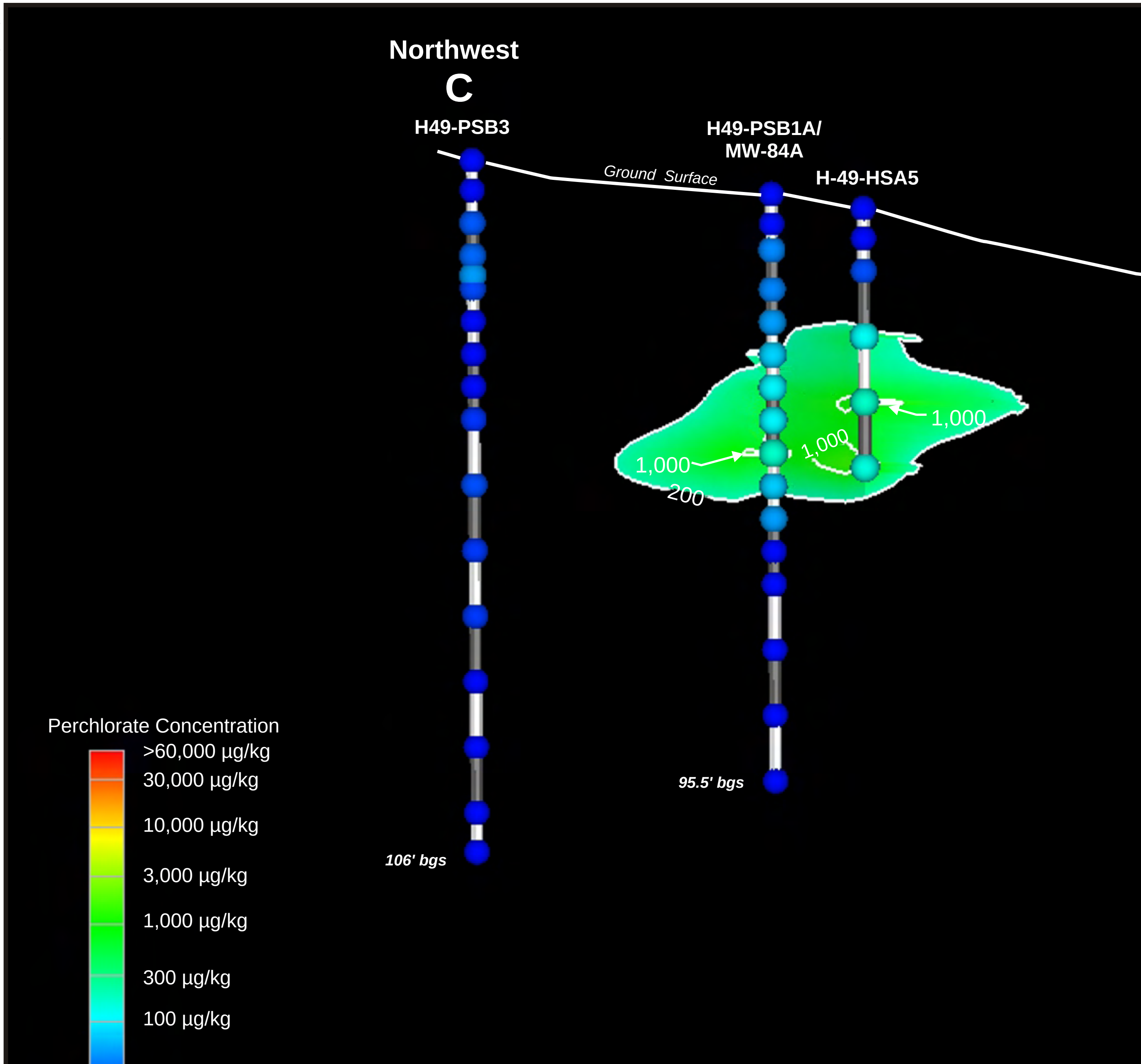

Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
No vertical exaggeration.

Beaumont Site 1

Figure 5-77

Vertical Profile of Perchlorate in Soil - Cross Section C-C' Sanitary Landfill (Feature H-49)

TETRA TECH

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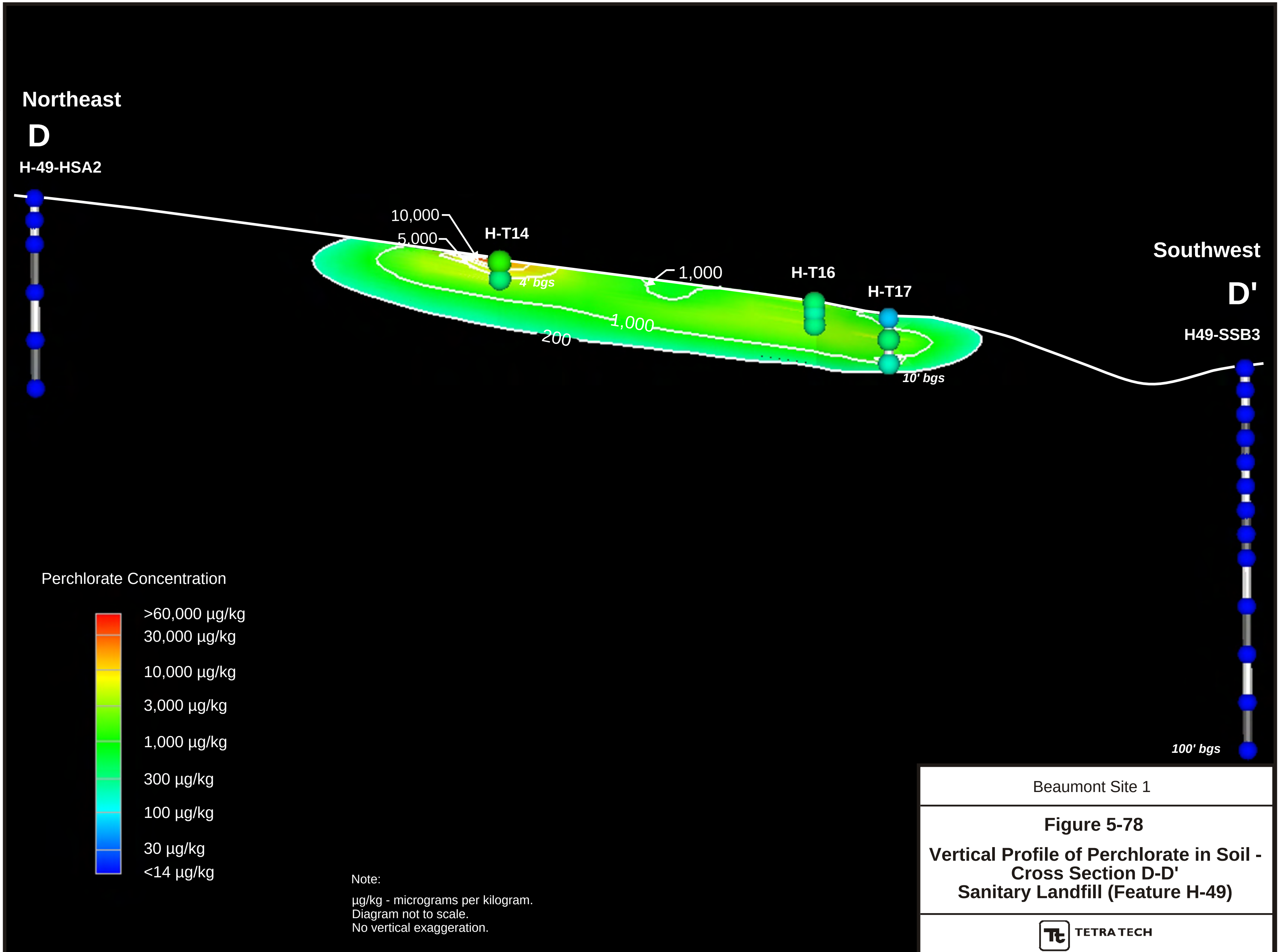

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Note:

µg/kg - micrograms per kilogram.
Diagram not to scale.
No vertical exaggeration.

Beaumont Site 1

Figure 5-78

Vertical Profile of Perchlorate in Soil - Cross Section D-D' Sanitary Landfill (Feature H-49)

TETRA TECH

Groundwater Sampling Results and Contaminant Distribution

During drilling activities, perchlorate was detected above the MDL in 5 of the 10 groundwater grab samples ranging from 1.21 to 158 µg/L with an average concentration of 62.3 µg/L (Table 5-17). Three grab samples exceeded the MCL at H49-PSB1A/MW-84A (158 µg/L at 91 feet bgs), H49-PSB4 (122 µg/L at 78 feet bgs) and H49-SSB2/MW-97 (26.8 µg/L at 80 feet bgs). Figure 5-73 shows the locations of these borings/wells with respect to the soil impacts. However, since perchlorate was not detected above the MCL (6 µg/L) in any of the monitoring wells, a separate figure for groundwater results was not prepared. Subsequent to the field investigation, groundwater samples were collected from the four monitoring wells and analyzed for perchlorate, VOCs and 1,4-dioxane. Perchlorate concentrations in H49-PSB1/MW-84A decreased from 5.19 µg/L in February 2009 to below the MDL (0.5 µg/L) in March 2009. Perchlorate was not detected in the two other shallow wells (H49-SSB1/MW-96 and H49-SSB2/MW-97) and the deep well (H49-PSB1B/MW-84B) during either sampling event. Low levels of VOCs including carbon disulfide, chloromethane and chloroform were detected above the MDL. 1,4-dioxane was not detected above the MDL in any of the wells during the first two sampling events. Based on the results of the groundwater investigation at the Sanitary Landfill (Feature H-49) as part of the DSI, perchlorate impacts to groundwater have been defined and are below the MCL.

5.5 GUARD WELL INSTALLATION

1,4-dioxane was detected at 0.94 and 0.78 µg/L in the existing site guard well (MW-67) during previous routine monitoring events (June and November 2007, respectively). Monitoring well MW-67 is located within the streambed of Potrero Creek near the entrance to Massacre Canyon below the Sanitary Landfill (Feature H-49). Based on these results, it appears that MW-67 is impacted at least seasonally and therefore an additional guard well was installed downgradient of the Site property boundary. The monitoring well was installed on the property located to the south of the Site, herein referred to as the "Building Management Services (BMS) Property", Assessors Parcel No. 430-070-005. The BMS Property is located at 19625 Gilman Springs Road, CA 92583 (Figure 5-79). The well installation was conducted in accordance with the DTSC approved DWP and the conditions stipulated in the Access Agreement between the BMS Property and LMC dated 27 January 2009.

The investigation included the installation and sampling of one offsite groundwater monitoring well to confirm the absence (or presence) of chemicals in the shallow aquifer that may be attributed to the former practices at Beaumont Site 1. Field activities associated with the installation of one groundwater monitoring well (MW-100), commenced on January 29, 2009 and were completed on February 3, 2009.

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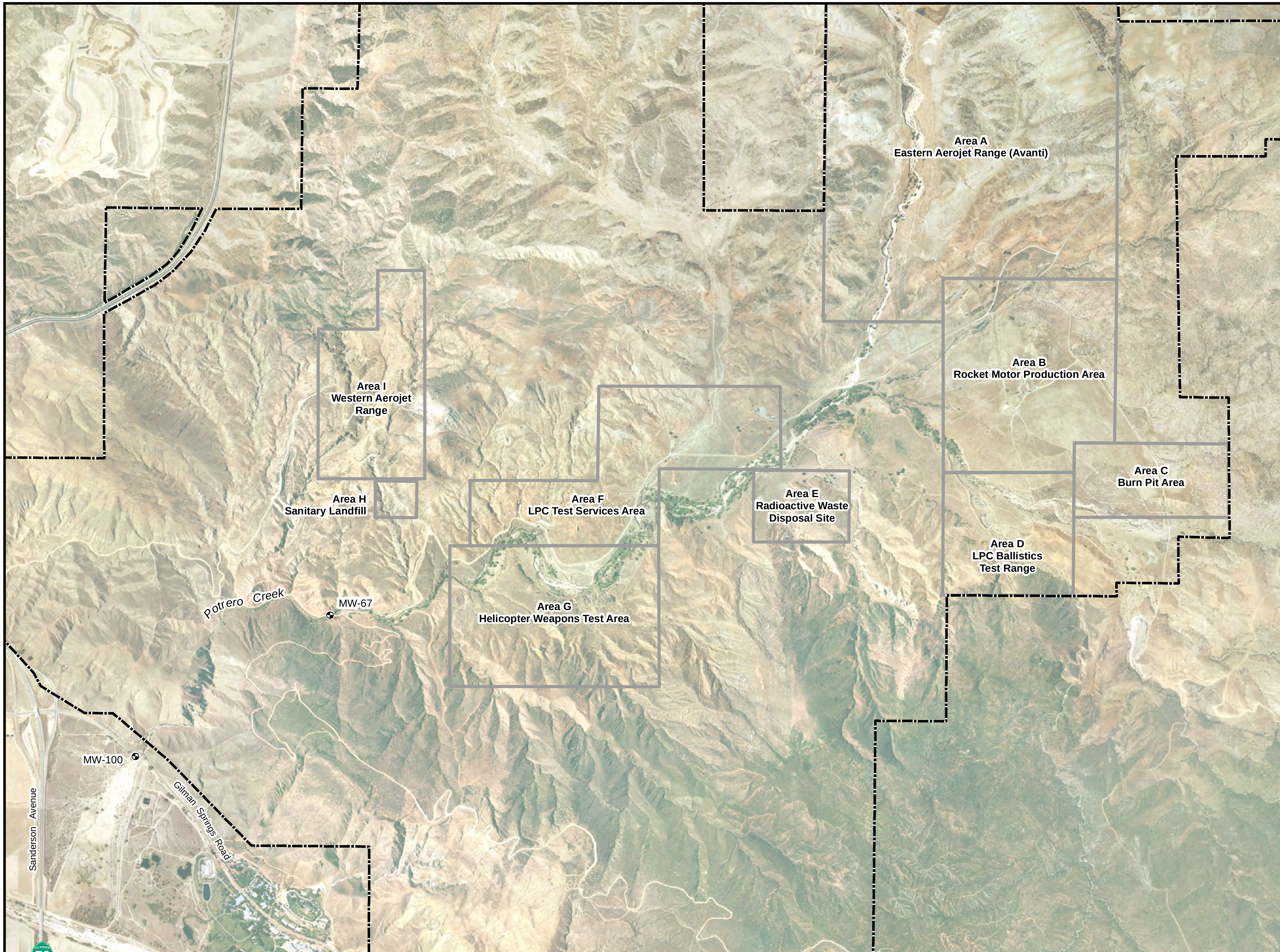


0 1,000 2,000
Feet

Adapted from: March 2007 aerial photograph.

LEGEND

- Monitoring Well
- Beaumont Site 1 Property Boundary

Beaumont Site 1

Figure 5-79
Offsite Guard Well Location (MW-100)

TETRA TECH

These activities included biological surveying, drilling using the resonant sonic method, well installation and well development activities. The field preparation procedures, IDW handling, monitoring well installation, development and sampling activities were performed following the general procedures discussed in Section 4.0. The monitoring well was installed approximately 100 feet south of Gilman Springs Road and approximately 100 feet west of Potrero Creek on the BMS Property (Figure 5-79). The boring was advanced using the resonant sonic methodology to a total depth of 190 feet bgs and the soil lithology recorded. The boring log is included in Appendix D. All IDW generated as part of the field activities was removed and properly disposed of at a licensed offsite disposal facility.

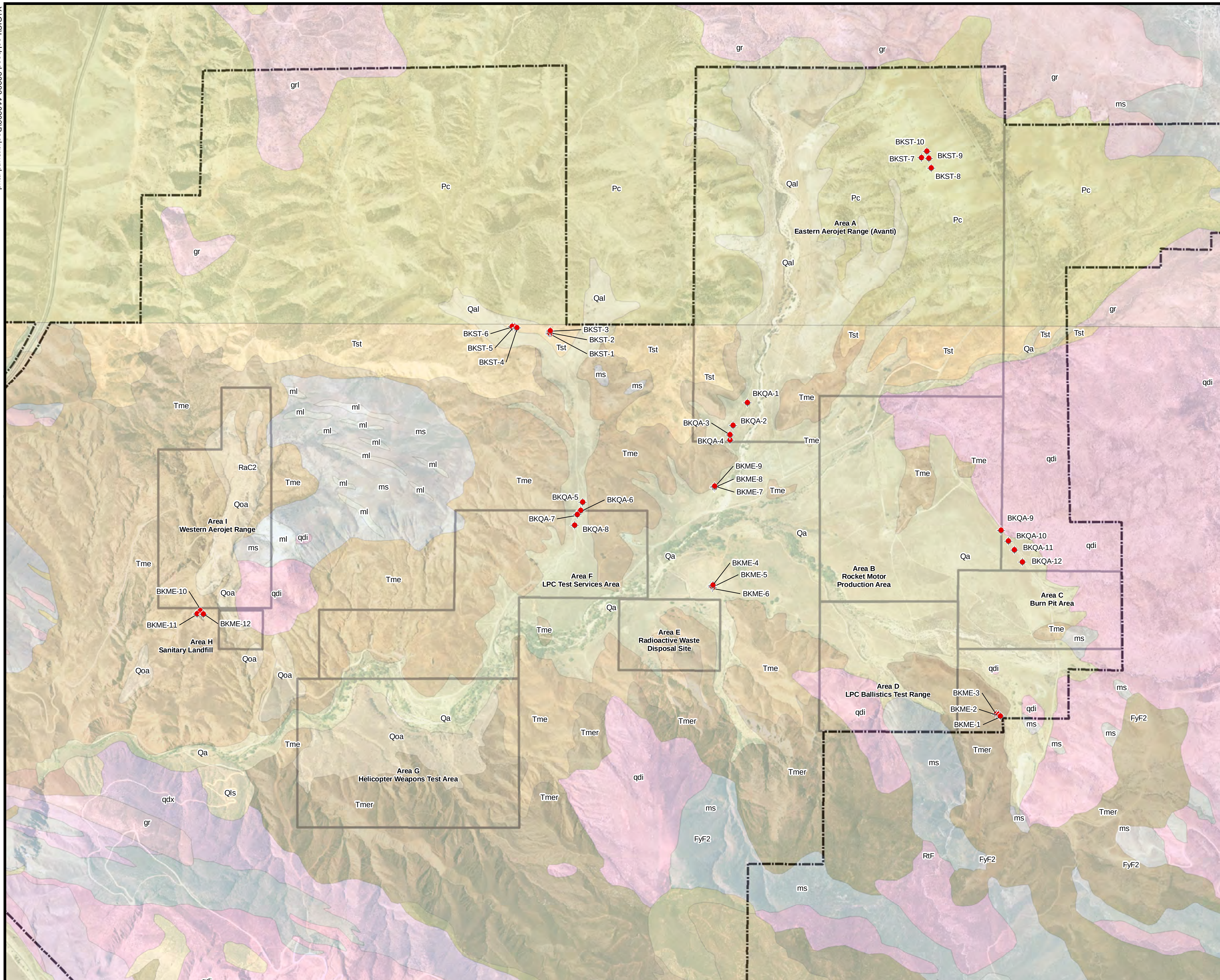
Groundwater monitoring well, MW-100, was installed at first water with a 30-foot screen interval extending from 145.2 to 175.2 feet bgs within a zone of decomposed schist. The well was constructed using 4-inch diameter schedule 80 PVC casing and a stainless steel screen with a corresponding slot size of 0.02-inches. A monitoring well construction diagram is provided Appendix D. Due to the low yield of the well, pumping during development was not possible. Well development data sheets are included in Appendix E.

Groundwater samples were collected and analyzed for VOCs, 1,4-dioxane, and perchlorate. No analytes were reported above their respective detection limit in the groundwater sample collected from MW-100. The laboratory analytical data is provided in Appendix J.

5.6 BACKGROUND METALS EVALUATION

Background soil samples were collected in various geographical areas around the Site that were outside of the areas of impact from former on-site operations. Sampling locations were evaluated for the entire Site in areas which were upgradient topographically or outside the areas where former site activities were conducted within the Historical Operational Areas. In accordance with the DWP (Tetra Tech 2008b), samples were collected in the three soil types that have been sampled as part of the previous soil investigations: (1) the Mount Eden formation, (2) Quaternary alluvium, and (3) the San Timoteo formation, see Figure 5-80. The soil types where each of the samples were collected was confirmed as part of the sampling activities.

A total of 34 borings were completed, 22 borings were completed using HSA and 12 were completed using the DP method. At each background sampling location, samples were collected at 0 to 0.5, 5, and 10 feet bgs. An additional 0 to 0.5 foot sample was collected approximately 50 feet from each sampling location to increase the number of samples for the near surface data set due to the potential for high variability in these samples. A total of 151 samples (including duplicates) were collected and analyzed for California Title 22 metals and moisture content. Of the 151 samples collected, 54 samples were collected



X:\GIS\Lockheed 22288-110302\Background.mxd

0 1,000 2,000 Feet

Background Soil Sampling Location

Beaumont Site 1 Property Boundary

Historical Operational Unit Boundary

Geology from Dibblee, 2003

SURFICIAL SEDIMENTS

Alluvial sediments, unconsolidated, undissected

Qa — Alluvial sand and clay of valley areas, covered by gray soil, includes stream channel gravel and sand in mountain area

LANDSLIDE DEBRIS

Qls — Landslide of rock rubble

OLDER SURFICIAL SEDIMENTS

Dissected older alluvial deposits, slightly indurated, undeformed, late Pleistocene age

Qoa — Alluvial gravel and sand of low terrace remnants Qog Alluvial gravel and sand of high terrace remnants

SAN TIMOTEO FORMATION

(of Frick, 1921), only lowest part exposed at north border in this quadrangle, weakly lithified; age, Pliocene

Tst — Sandstone, light gray to tan, arkosic, includes thin layers and interbeds of gray cobble - pebbled conglomerate of mostly granitic detritus

MOUNT EDEN FORMATION

(of Fraser, 1931), moderately lithified, derived from basement rocks of San Jacinto Mountains; age upper Miocene

Tme — Sandstone, light orange - red, bedded, arkosic, includes thin layers of reddish claystone and lenses of pebble - cobble conglomerate, gray, of unsorted boulders and cobbles of granitic rocks (qdi), lower part west of Massacre Canyon includes much pebble-cobble conglomerate

Tmer — Conglomerate - fanglomerate, reddish gray-brown of poorly to unsorted sub-granitic (qdi and qdx) detritus in sandy matrix, vaguely bedded

PLUTONIC ROCKS

Medium grained holocrystalline granitic rocks of San Jacinto Mountains, part of Peninsular Range batholith, of Cretaceous age

gr — Granite of Mount Eden (of Morton and Matti, 2001, granite to quartz monzonite, eucocratic, graywhite, hard, massive, of quartz, potassic feldspar and sadie plagioclase feldspar in nearly equal amounts, and less than 5% mica, mostly muscovite; intrusive as large pod into unit xqd at Massacre Canyon and as small pods in ms to northwest

qdi — Quartz diorite, ranges to granodiorite, leucocratic light gray, composed of about 1/3 quartz, 1/2 sadie plagioclase feldspar, less than 1/4 potassic feldspar, and 5-10% biotite, minor hornblende, massive to faintly gneissoid, contains few small dark gray discoid inclusions (xenoliths); most widespread rock of San Jacinto Mountains

qdx — Quartz diorite, gray, massive to gneissoid, composed of about 1/4 quartz, 1/2 sadie plagioclase feldspar, less than 1/4 potassic feldspar, 5-15% biotite and hornblende; contains few to abundant dark gray discoid inclusions (xenoliths) oriented parallel to gneissoid structure of rock; includes migmatized remnants of schist-gneiss (ms) in many places

METASEDIMENTARY ROCKS

Rocks crystallized at depth from deformed sedimentary rocks, mostly argillaceous, of Paleozoic? of Mesozoic? age

ml — Marble, white to light gray, fine-grained crystallized from limestone or dolomite

ms — Schist, dark gray, fine-grained, foliated, of mica (mostly biotite), feldspar and quartz, in some areas in part crystallized to fine grained gneiss

Geology from California Division of Mines and Geology, 1966

Qal — Alluvium

Pc — Undivided Pliocene nonmarine

gr — Mesozoic granitic rocks

ms — Pre-Cretaceous metasedimentary rocks

Note:
Beaumont Site 1 property boundary is approximate.

Adapted from:

Geologic Map of the San Jacinto Quadrangle, Thomas W. Dibblee, Jr. 2003

Geologic Map of California - Santa Ana Sheet, California Division of Mines and Geology, 1966.

Faults from Hydrogeologic Investigations for Water Resources Development, Leighton and Associates, 1983.

Beaumont Site 1

Figure 5-80

Background Soil Sampling Locations

TETRA TECH

from 12 locations in the Mount Eden formation, 53 samples were collected from 12 locations in the Quaternary alluvium, and 44 samples were collected from 10 locations in the San Timoteo formation. As stated in Section 5.3.6., soil samples were analyzed using EPA Method 6020 except for mercury that was analyzed using EPA Method 7471.

Background comparisons were conducted to identify metals potentially elevated above background in soil in the seven operational areas of the Site. The analytical data from soil samples collected during the 2002, 2004, and 2007 site investigations were used for comparison purposes. Metals were identified as potentially elevated above background if they were found to be statistically elevated over background, if they were detected in Site soils but not in background, or if the Site dataset contained a concentration that exceeded the background threshold values (BTV). All of these determinations are presented in detail in Appendix I and summarized in Table I-17. Metals potentially elevated above background are also described by soil type and depth of detection. Background comparisons indicate that the following metals statistically differed from background in one or more of the Operational Areas (A, B, C, D, F and/or G): arsenic, beryllium, total chromium, cobalt, copper, lead, mercury, molybdenum, nickel, silver and vanadium. One metal (selenium) was detected on-site in Operational Areas A, B, C and F but not in the background sample dataset. Other metals with concentrations that exceeded the BTVs will be further evaluated in the human health and ecological risk assessment. The background comparisons including the statistical test results and interpretation are included in Appendix I.

6.0 UPDATED CONCEPTUAL SITE MODEL

This section presents an updated conceptual site model (CSM) for the Site based on the additional data collected during the DSI. The purpose of this CSM is to provide a representation of the current status of the environmental setting based on all available data. The CSM provides a tool for site managers and regulators to evaluate the nature, extent, and magnitude of contamination at the Site along with the physical setting and historical operations that influence the fate and transport of contaminants within the environment. The CSM will be used to evaluate potential risks to human health and the environment and determine appropriate mitigation measures and remedial alternatives that are both technically and economically feasible.

6.1 GEOLOGY AND HYDROGEOLOGY

Observations made during the DSI with respect to the geologic and hydrogeologic setting along with general updates to the physical setting at the Site are described below.

<u>Geology</u>

All four stratigraphic units that exist beneath the Site were encountered during the DSI: the Quaternary alluvium, the San Timoteo formation, the Mount Eden formation (weathered and unweathered portions), and the Granitic/Metasedimentary basement complex. The depths at which these units were encountered along with the texture and composition were consistent with the previously mapped units.

In the main alluvial valley near the area of the RMPA (Features B-9, B-11, and B-20), the relatively flat topography creates a very low energy fluvial environment which is evident by the increase in finer grained sediments, including silts and clays. These fine-grained units present in the shallow alluvium were more clearly distinguishable upon completion of the additional borings in this area and the associated geologic cross sections. In general, the sediments become coarser with depth although occasionally fine grained units can still be encountered at depth. Further down the valley along the sides or tributaries of Potrero Creek (Features F-34, F-39, G-46 and H-49), sands dominate the alluvium representing a higher energy depositional environment. Although fine grained units are present along the bluffs above Potrero Creek and near the surrounding Mount Eden foothills, coarse grained units generally dominate the alluvial/colluvial sediments.

The Mount Eden formation observed at the RMPA is very similar to the overlying alluvium within the small box canyons at Features B-10 and B-14. During drilling with the resonant sonic method, the poorly consolidated and friable sandstone is often indistinguishable from the overlying alluvium. In addition, the more typical red Mount Eden sandstone in this area is not present and only the grey to olive-grey sandstone is observed. As expected, the alluvium overlying the Mount Eden formation within these canyons was relatively thin ranging from 1 to 20 feet thick.

Hydrogeology

Groundwater occurs in each of the major geologic units beneath the Site; the Quaternary alluvium, Mount Eden formation, the San Timoteo formation, and the Granitic/Metasedimentary basement complex. Shallow groundwater flow at the Site occurs mainly through alluvium and the shallow/weathered portion of the Mount Eden formation. Groundwater observed during this investigation was encountered primarily in the Mount Eden formation within the small box canyons and near the foothills that surround Potrero Creek in the western portion of the Site. Groundwater flow within the small box canyons primarily flows out of the canyons before joining up with the predominant flow direction within the broad alluvial valley (northwest and west) or stream flow within Potrero Creek (west and southwest). Figure 5-1 in Section 5.2 shows the sitewide groundwater flow directions in February 2009 with the addition of the new monitoring wells installed as part of this DSI. As previously mentioned in Section 5.4.1.2, groundwater in the RMPA area appears to flow out of the small box canyon (Feature B-14) before joining up with the southwesterly flow near Feature B-20 which eventually wraps around the end of the Mount Eden formation outcrop and flows north to northeast back into the upper alluvial valley near injection wells IW-3 through 5 (Figure 5-1). Hydraulic conductivities within the Mount Eden formation are very low but could not be accurately quantified during this investigation due to the inability to sustain a constant flow rate during pumping for well development.

Surface Water

Surface water flow at the Site is ephemeral, flowing briefly only in direct response to precipitation during or immediately after storm events. However, there are small reaches of the stream that remain wet throughout most of the year or flow for short distances before becoming dry again. These flows vary both seasonally and in response to long term precipitation trends at the Site. The areas of intermittent surface flow represent groundwater discharge where the stream is gaining in some reaches while losing in other reaches. The undulating bedrock surface of the Mount Eden formation, some of which appears to be related to faulting, is thought to be the cause of these discontinuous areas of flow along the stream course. Mapping of these discontinuous areas of surface flow within the streambed along with flow measurements and water quality sampling is conducted as part of the routine monitoring program at the Site.

6.2 SUMMARY OF SOIL SOURCE AREAS AND IMPACTS

Additional information collected as part of the DSI with respect to the nature, magnitude, and extent of affected soil at the 10 features is described in detail in Section 5.0 which incorporates all existing soil sampling data collected since 2002. Therefore, the individual discussions in Section 5.0 for each feature represent the most current and detailed discussion regarding the distribution of affected soil and groundwater at each feature. However, an overall sitewide description of the soil source areas and extent of impacts is provided in this section for the three primary soil COPCs at the Site (perchlorate, TCE, and PCBs). Although 1,4-dioxane is also a primary site COPC with respect to groundwater, it has not been detected in soil other than a couple of locations outside the BPA at concentrations near the MDL (0.005-0.031 mg/kg) and therefore is not considered a primary soil COPC for the Site.

6.2.1 Perchlorate

The highest concentrations of perchlorate in soil have been detected at the BPA (Feature C-22 at 171,000 µg/kg), the primary source area located in the southeastern portion of the Site in Operational Area C, and the Large Motor Washout Area (Feature F-33 at 302,000 µg/kg) located in the western portion of the Site in Operational Area F. Relatively high concentrations (up to 20,400 µg/kg) have also been detected in the RMPA which is considered a secondary source area for perchlorate in soil in comparison to the BPA. In general, the perchlorate concentrations at the RMPA are an order of magnitude less than the BPA but have a much larger areal extent, possibly due to the transport mechanism resulting from the historical operations (processing and mixing of rocket motor solid propellants and motor washouts) which may have governed the distribution of perchlorate on the surface and eventually into the subsurface. In addition, the operations at the RMPA used the largest quantities of perchlorate at the Site since it is here where the processing and mixing of rocket motor solid propellants was conducted. Also, motor washout areas traditionally use significant amounts of water as part of their operation. This coupled with the high solubility of perchlorate could explain the wide distribution of low-level perchlorate in this area.

Figure 6-1 shows the sitewide distribution of perchlorate in soil and groundwater. As shown in this figure, the high soil concentration areas (Features C-22, B-10, B-14, and B-11) also have a shadow of perchlorate impacts in groundwater above 1,000 µg/L immediately below or downgradient of the soil source areas. This trend observed in the eastern portion of the Site is not present in the western portion at Feature F-33, Feature F-34, Feature F-39, and Feature H-49 (Figure 6-1, page 6-4). At Feature F-33, only low concentrations (<10 µg/L) are detected in groundwater below the soil source area that has the highest reported perchlorate soil concentrations at the Site. Groundwater monitoring data indicates that in addition to other natural attenuation processes, the anaerobic conditions in this riparian area are biodegrading the perchlorate that has migrated into groundwater. Further south at Features F-34 and F-39, perchlorate has been detected at relatively low concentrations (<50 µg/L) in groundwater but has not been detected within the surface water downgradient of these features. At the Sanitary Landfill (Feature H-49), perchlorate has been detected up to 67,300 µg/kg in shallow soils (0.5-foot bgs) and up to 5,000 µg/kg at 40 feet bgs. However, groundwater samples collected at a depth of approximately 90 feet bgs reported only low-level detections during the initial sampling event in February 2009. Perchlorate was not detected above the MDL in any of the wells during the subsequent sampling in March 2009. Table 6-1 lists summary information for the perchlorate soil source areas by feature with the maximum concentrations and depth detected and estimated area of affected soil above 200 µg/kg.

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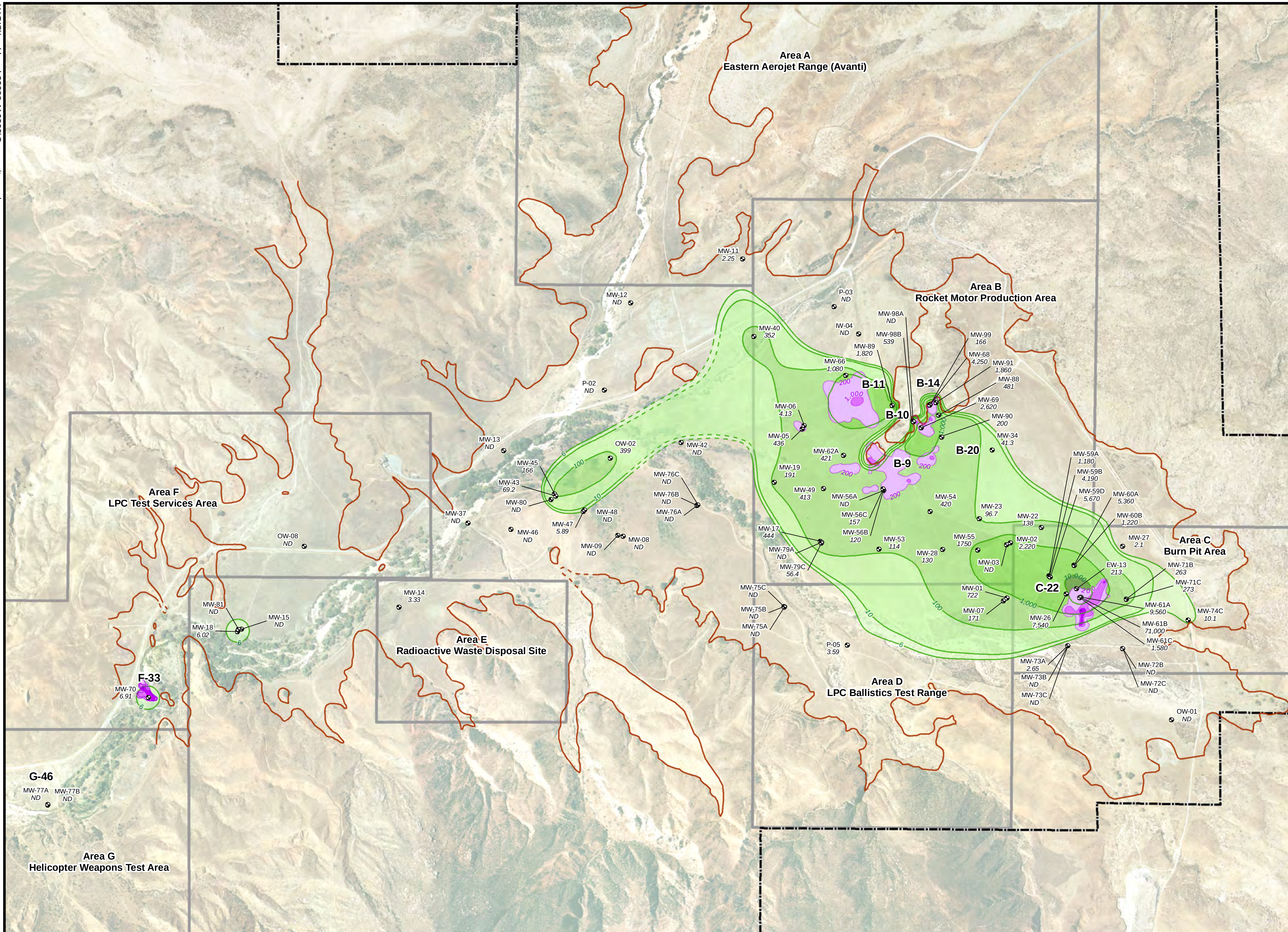

0 500 1,000 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

- Well Location
- Alluvium / Bedrock contact (dashed where inferred)

Perchlorate Concentration in Soil
- >200 µg/kg
- >1,000 µg/kg
- >10,000 µg/kg
- >100,000 µg/kg

Perchlorate Concentration in Groundwater
- >6 µg/L
- >10 µg/L
- >100 µg/L
- >1,000 µg/L
- >10,000 µg/L

- Beaumont Site 1 Property Boundary
- Historical Operational Area Boundary

Beaumont Site 1

Figure 6-1

Perchlorate Soil Source Areas and Groundwater Impacts

TETRA TECH

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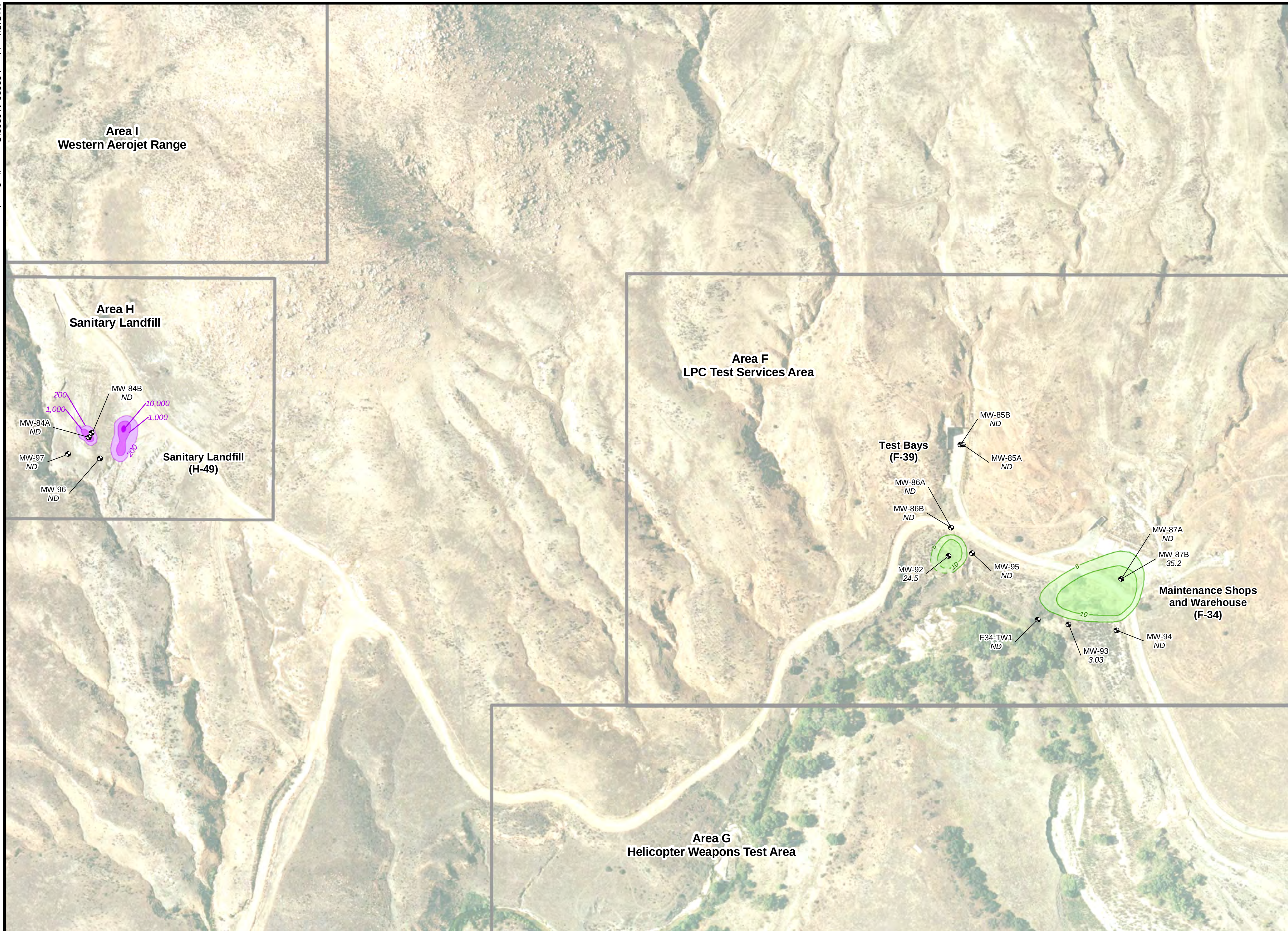


0 150 300
Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Well Location

Alluvium / Bedrock contact
(dashed where inferred)

Perchlorate Concentration in Soil

- >200 µg/kg
- >1,000 µg/kg
- >10,000 µg/kg
- >100,000 µg/kg

Perchlorate Concentration in Groundwater

- >6 µg/L
- >10 µg/L
- >100 µg/L
- >1,000 µg/L
- >10,000 µg/L

Beaumont Site 1 Property Boundary

Historical Operational Area Boundary

Beaumont Site 1

Figure 6-1 (cont.)

Perchlorate Source Areas and Groundwater Impacts

TETRA TECH

Table 6-1
Summary of Perchlorate Soil Source Areas

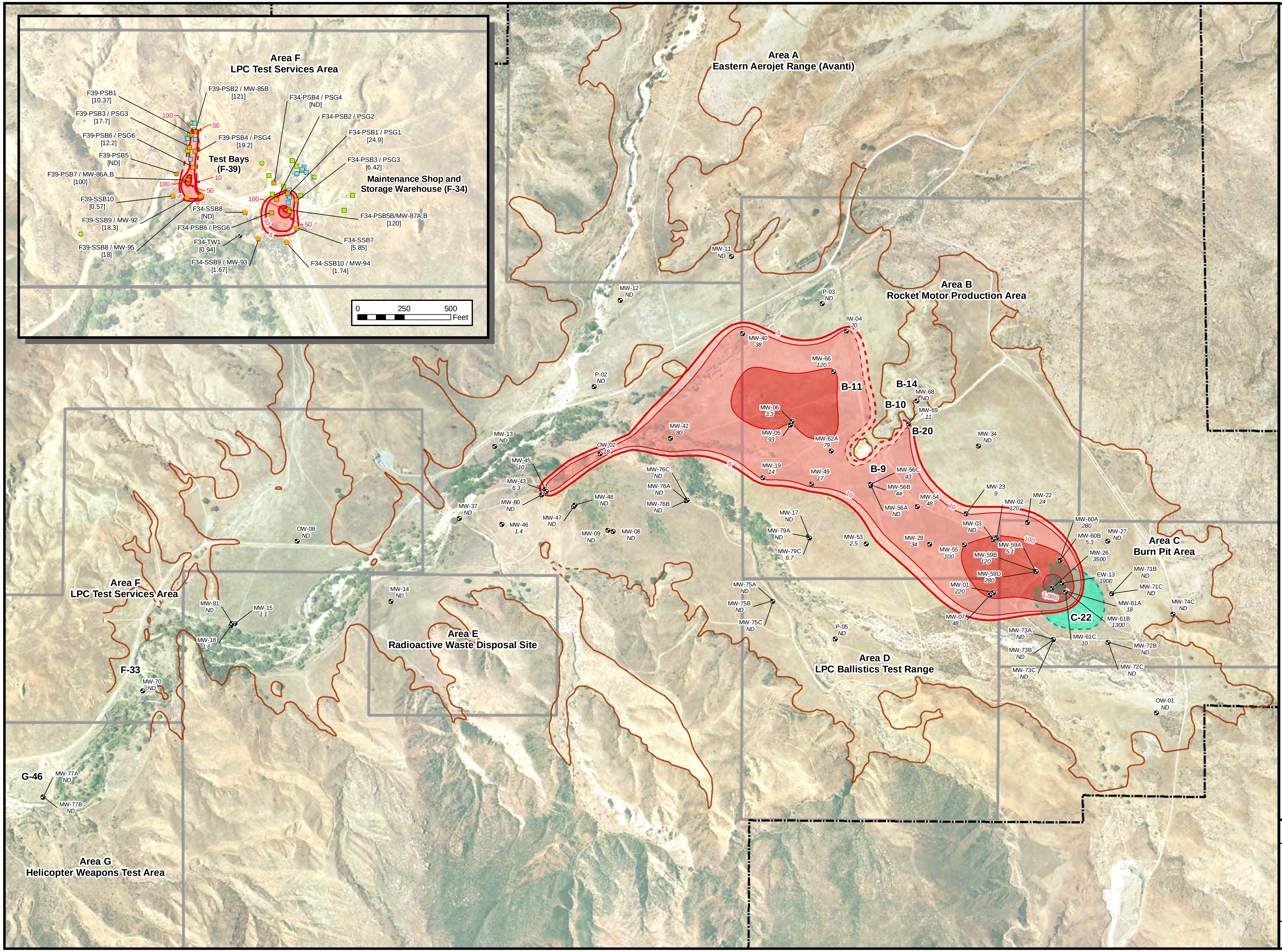
Feature	Description	COPC	Media	Maximum Soil Concentration Detected (µg/kg)	Depth of Maximum Concentration (ft bgs)	Estimated Area of Perchlorate in Soil Above 200 µg/kg (ft^2)
B-9, B-19	Motor Washout Area & Pad on Berm	Perchlorate	Soil	5,480	10	230,000
B-10, B-20	Propellant Mixing Station, Pad South of Mix Station Bunker	Perchlorate	Soil	4,610	0.5	27,800
B-11	Fuel Slurry Station	Perchlorate	Soil	8,500	10	232,400
B-14	Pad with Dry Well	Perchlorate	Soil	20,400	5	15,350
C-22	Burn Pit Area	Perchlorate	Soil	171,000	20	134,300
C-23	Temporary Storage Area	Perchlorate	Soil	505	20	1,900
F-33	Large Motor Washout Area	Perchlorate	Soil	302,000	20	22,080
H-49	Sanitary Landfill	Perchlorate	Soil	67,300	0.5	12,120

Notes:
µg/kg - micrograms per kilogram
ft bgs - feet below ground surface
ft^2 - square feet

Two borings were installed during this investigation to evaluate a previous theory regarding the potential for a perchlorate smear zone downgradient of the BPA resulting from the significant groundwater fluctuations observed at the Site. The results of this test indicate that a perchlorate smear does not seem to be present at the Site and that the large groundwater fluctuations of perchlorate impacted water do not appear to leave residual perchlorate within the soil or pore water once the groundwater elevations drop again. However, the rise and fall of the groundwater at the RMPA may still have played a role in the distribution or re-distribution of perchlorate impacts in soil in this area.

6.2.2 Trichloroethene (TCE)

The only TCE soil source identified at the Site is the BPA which was remediated through SVE in the mid to late 1990s with the system being shutdown in 1998 after VOC concentrations had decreased by 99.6%. Elevated concentrations of TCE in soil gas still remain at the BPA which is attributed to off-gassing of affected groundwater beneath this feature and/or possibly residual contamination in the vadose zone. Although TCE impacted groundwater was also detected at Features F-34 and F-39, no soil source was identified at either feature. The soil gas concentrations and trends at these features indicate off-gassing of the TCE-impacted groundwater and therefore soil source areas may no longer be present. Figure 6-2 shows the TCE soil source at the BPA along with extent of TCE impacts in groundwater. Table 6-2 lists summary information for the TCE soil source area at the BPA with the maximum concentration and depth detected along with the estimated area of VOCs detected in soil gas.



X:\GIS\Lockheed 22288-110302\Composite_TCE.mxd

0 500 1,000
Feet

Adapted from: March 2007 aerial photograph.

LEGEND

Sample Locations

- Primary Soil Boring, 2008
- Secondary Soil Boring
- Primary Soil Boring/Soil Vapor, 2008
- Soil Vapor, 2002
- Soil Boring/Soil Vapor, 2007
- Soil Boring, 2004
- Soil Boring/Soil Vapor, 2004
- Well

Trichloroethene (TCE) in Soil

- VOC Soil Source Area

Trichloroethene (TCE) Concentration in Groundwater

- >5 µg/L
- >10 µg/L
- >50 µg/L
- >100 µg/L
- >1,000 µg/L

- Alluvium / Bedrock contact
- Beaumont Site 1 Property Boundary
- Historical Operational Area Boundary

Note:

[#] - TCE results in µg/L.

µg/L - Micrograms per liter.

[ND] - Non-Detect.

Boring symbols with no labels indicate sample was not tested at depth interval.

Beaumont Site 1

Figure 6-2

TCE Soil Source Area and Groundwater Impacts

TETRA TECH

6.2.3 Polychlorinated Biphenyls (PCBs)

PCBs were detected at four features with very localized shallow impacts at three of the four features (F-35, F-36, and F-40). At the Sanitary Landfill (Feature H-49), PCBs were detected in several areas and appear to be fairly localized and limited to shallow soils except on the east side where PCBs were detected at 20 feet bgs in two locations. Table 6-3 lists summary information for the PCB-impacted areas with the maximum concentration and depth detected along with estimated area of affected soil. Given the very small areal extents of the PCB affected areas, a sitewide figure showing the impacts is not feasible. Maps showing the PCB impacts at Features F-35, F-36, and F-40 are included in the *Supplemental Soil Investigation Report, Historical Operational Areas A, B, C, D, F, G, and H* (Tetra Tech, 2009a). The distribution of PCB impacts at the Sanitary Landfill (Feature H-49) is shown in Figure 5-71 in Section 5.4.5.1.

Table 6-2
Summary of VOC Soil Source Area

Feature	Description	COPC	Media	Maximum Soil Gas Concentration Detected (μg/m^3)	Depth of Maximum Concentration (ft bgs)	Estimated Area of VOCs in Soil Gas (ft^2)
C-22	Burn Pit Area	TCE	Soil Gas	11,000	40	218,414

Notes:
μg/kg - micrograms per kilogram
ft bgs - feet below ground surface
ft^2 - square feet

Table 6-3
Summary of PCB Soil Source Areas

Feature	Description	COPC	Media	Maximum Soil Concentration Detected (μg/kg)	Depth of Maximum Concentration (ft bgs)	Estimated Area of Affected Soil (ft^2)
F-35	Betatron Building	Aroclor-1260	Soil	72	0.5	118
F-36	EBES Testing Area	Aroclor-1254	Soil	130	10	536
F-40	Electrical Enclosure	Aroclor-1248	Soil	250	0.5	481
H-49	Sanitary Landfill	Aroclor-1260	Soil	109	0.5	465
		Aroclor-1254		1,400	2.5	
H-49	Sanitary Landfill	Aroclor-1248	Soil	910	5	1,726

Notes:
μg/kg - micrograms per kilogram
ft bgs - feet below ground surface
ft^2 - square feet

6.3 SUMMARY OF GROUNDWATER SOURCE AREAS AND IMPACTS

As previously stated in Section 3.5.1, the identification of groundwater COPCs is an ongoing process that is conducted routinely to determine if the list of previously identified COPCs still meets the objectives of the site characterization, groundwater monitoring program, and remediation goals.

Based on the results of this investigation, there are no changes to the list of primary and secondary groundwater COPCs identified in Section 3.5.1. The previously indentified primary COPCs are still considered representative of the overall Site including the features investigated as part of this investigation. Updates to the extent of the primary COPCs in groundwater based on the results of this investigation are described below.

6.3.1 Perchlorate

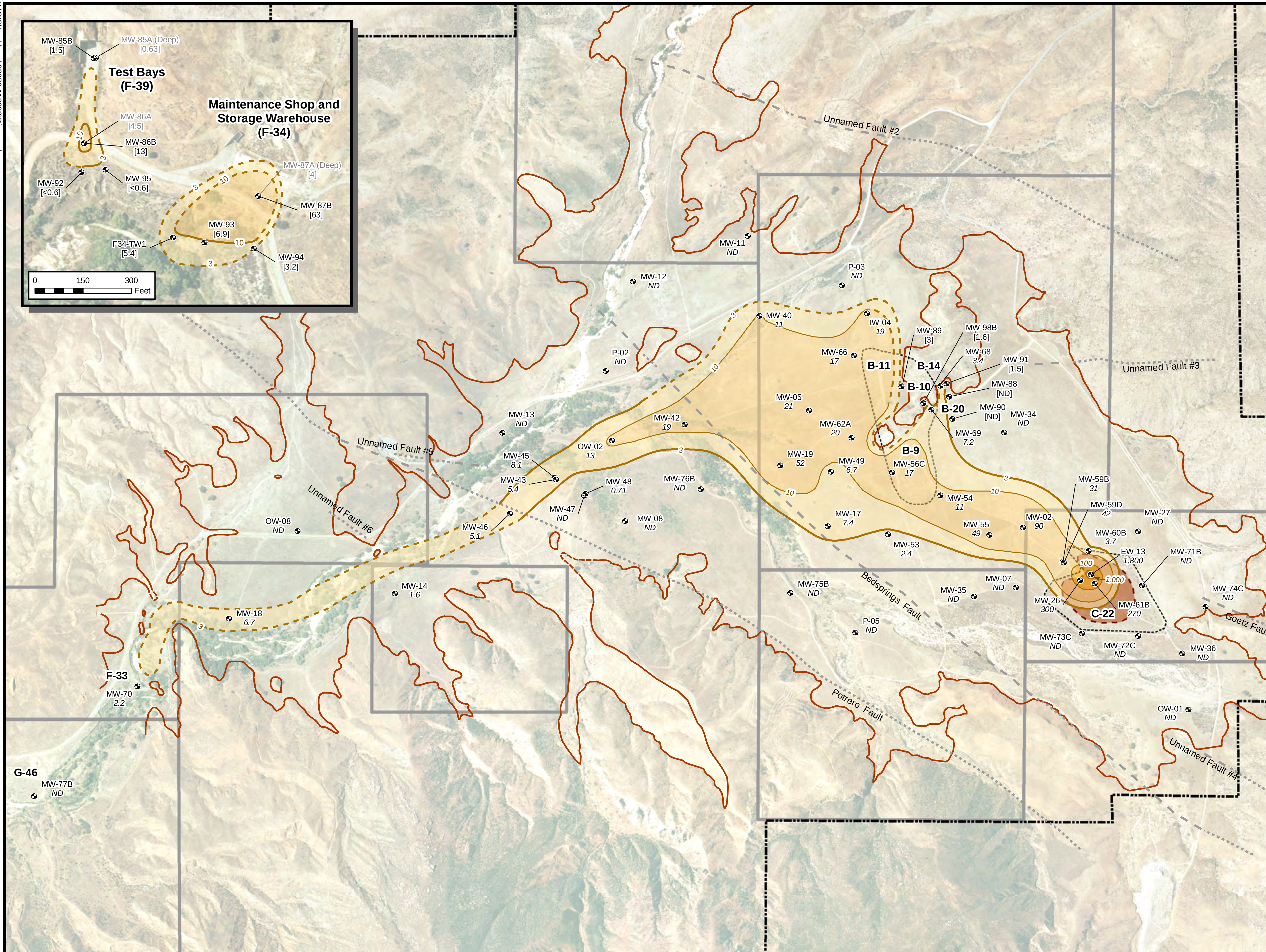
The highest concentrations of perchlorate have consistently been reported in groundwater samples collected from shallow screened wells located in the BPA (Feature C-22) and concentrations appear to rapidly decrease outside, and downgradient, of the former BPA (Figure 6-1). However, secondary perchlorate source areas are also present at the RMPA including the Motor Washout Area (Feature B-9), the Propellant Mixing Station (Feature B-10), the Fuel Slurry Station (Feature B-11), and the Pad with Dry Well (Feature B-14). Perchlorate was detected in groundwater samples collected from wells within the RMPA source areas ranging from 2,620 to 4,250 µg/L. These perchlorate concentrations are elevated in comparison to concentrations in nearby wells that represent migration of perchlorate from the BPA plume (TCE, 1,1-DCE, 1,4-dioxane, perchlorate). Based on the presence of low concentrations of TCE, 1,1-DCE, and 1,4-dioxane in the RMPA, it is thought that the BPA plume migrates into this area after significant storm events when the groundwater flow directions change from northwest to northeast within the main alluvial valley. The vertical extent of perchlorate in groundwater at the RMPA has been characterized with perchlorate concentrations decreasing rapidly with depth. Low concentrations of perchlorate have also been detected at the Large Motor Washout Area (Feature F-33), the Maintenance Shop and Storage Warehouse Area (Feature F-34), and the Test Bays (Feature F-39). The highest concentrations of perchlorate have been detected in the alluvium and the shallow weathered Mount Eden formation. However, low concentrations of perchlorate have also been detected in groundwater within the deeper Mount Eden formation and the granitic/metasedimentary basement complex at the BPA. The primary source of perchlorate-affected groundwater appears to be the BPA with secondary sources located within the former RMPA and at Features F-33, F-34, and F-39 in Historical Operational Area F.

6.3.2 Trichloroethene (TCE)

The highest concentrations of TCE have consistently been reported in groundwater samples collected from shallow screened wells located in the former BPA (Feature C-22). Similar to perchlorate, groundwater concentrations appear to rapidly decrease outside, and downgradient, of the former BPA (Figure 6-2). No sources of TCE have been identified in the RMPA or elsewhere in the main alluvial valley. However, further to the west outside of the main valley, two other TCE sources in groundwater have been identified at the Site, the Maintenance Shop and Storage Warehouse Area (Feature F-34) and the Test Bays (Feature F-39) located in the western portion of Operational Area F. Relatively small localized TCE groundwater plumes are present at Features F-34 and F-39 with maximum TCE concentrations around 100 μg/L and decreasing with depth. The vertical extent of TCE in groundwater at these features has been characterized and monitoring wells have been installed to monitor the plumes over time. The former BPA is the primary source of TCE-affected groundwater at the Site. Features F-34 and F-39 represent secondary sources that are fairly localized based on the topographical setting and low permeability/hydraulic conductivity of the aquifer within the sandstone of the Mount Eden formation.

6.3.3 1,4-Dioxane

Although 1,4-dioxane represents one of the primary COPCs in groundwater at the Site, 1,4-dioxane has not been detected in soil at the BPA (Feature C-22) which is thought to be the primary source for 1,4-dioxane at the Site. 1,4-Dioxane was a common stabilizer in 1,1,1-TCA and to a lesser degree in TCE and therefore is usually associated with a 1,1,1-TCA or TCE spill or source area such as the BPA. The highest concentration of 1,4-dioxane detected in soil at the Site was only 4 μg/kg and was detected at Feature B-11 located approximately 3,000 feet downgradient of the BPA. The highest concentrations of 1,4-dioxane in groundwater have consistently been reported in samples collected from shallow screened wells located in the BPA, the primary source of 1,4-dioxane at the Site. However, 1,4-dioxane has not been detected in any soil samples collected from the BPA. Groundwater concentrations rapidly decrease outside, and downgradient of the BPA (Figure 6-3). Two other sources of 1,4-dioxane in groundwater have been identified at the Site, the Maintenance Shop and Storage Warehouse Area (Feature F-34) and the Test Bays (Feature F-39) located in the western portion of Operational Area F. Relatively small localized 1,4-dioxane groundwater plumes are present at Features F-34 and F-39 with maximum concentrations around 75 and 13 μg/L, respectively. However, similar to the BPA, 1,4-dioxane was not detected in soil samples collected from either feature. The BPA is the primary source of 1,4-dioxane-affected groundwater at the Site with Features F-34 and F-39 representing secondary sources that are fairly localized based on the topographical setting and low permeability/hydraulic conductivity of the aquifer within the sandstone of the Mount Eden formation.



0 500 1,000 Feet

Adapted from: March 2007 aerial photograph.

LEGEND

MW-01 Well ID
600 1,4-Dioxane Concentration

1,4-Dioxane in Soil

1,4-Dioxane Soil Source Area

1,4-Dioxane Concentration in Groundwater

- >3
- >10
- >100
- >1,000

Mt. Eden/Alluvium Surface Contact (dashed where inferred)

Beaumont Site 1 Property Boundary

Notes: Beaumont Site 1 property boundary is approximate.
contour interval 3, 10, 100, 1,000.

Beaumont Site 1

Figure 6-3

1,4-Dioxane Source Area and Groundwater Impacts

TETRA TECH

1,4-dioxane has been persistent in surface water at the Site and is the only analyte that has been detected within Potrero Creek at the Site boundary. The concentrations of 1,4-dioxane detected in surface water in the western portion of the Site near the property boundary have been around 1 µg/L and have never exceeded the DWNL of 3 µg/L. Based on the results from the non-routine surface water sampling event conducted as part of the DSI, the 1,4-dioxane groundwater impacts at Features F-34 and F-39 are not adversely affecting the surface water in Potrero Creek near and downgradient of these features.

7.0 CONCLUSIONS

During this Dynamic Site Investigation, 10 features were investigated within five historical operational areas (B, C, F, G, and H). The primary objective of the investigation was to obtain additional data in features previously investigated to further characterize the soil, soil gas and/or groundwater at each of features and complete the delineation of previously detected impacts. A secondary objective was to collect a background data set for metals for the three geologic units present within the Site where previous soil samples were collected. In addition, a new guard well was installed offsite due to the recent detections of 1,4-dioxane (below the DWNL) in the on-site guard well. The analytical data collected during the 2002, 2004, 2007, and 2008 site investigations was compiled for soil and soil gas where applicable to: (1) summarize all the previous results within one report and (2) model the extent of impacts utilizing all available data. The data for the 10 features recently investigated were used to evaluate the contaminant distribution in soil, soil gas, and groundwater, simulate 3-D visualizations of impacted soil and groundwater, produce vertical profiles through the areas with the highest concentrations and/or largest impacts, and determine the overall extent of contamination at each feature. The information collected to date and presented within this report will be used to support the human health and ecological risk assessments as well as the evaluation of appropriate mitigation measures/remedial alternatives for the Site. A summary of conclusions is presented below by operational area and feature.

7.1 HISTORICAL OPERATIONAL AREA B INVESTIGATION CONCLUSIONS

Historical Operational Area B, the RMPA, was used for the processing and mixing of rocket motor solid propellants. Five features (B-9, B-10, B-11, B-14, and B-20) were investigated during this DSI. It should be noted that Operational Area B is located downgradient from Historical Operational Area C (the Burn Pit Area) and is located within the sitewide groundwater plumes (perchlorate, TCE, 1,1-DCE, and 1,4-dioxane) known to have originated from the BPA. Although secondary sources for perchlorate exist in Operational Area B, the highest concentrations of perchlorate detected in the groundwater have been at the primary source area (the BPA) located upgradient of Operational Area B, the RMPA. This coupled with the significant seasonal fluctuations and the resulting shallow groundwater elevations in this area, complicates discussions about the distribution of soil and groundwater impacts in Operational Area B.

7.1.1 Feature B-9 - Motor Washout Area

The objective of the investigation in the Motor Washout Area was to delineate the perchlorate impacts in shallow soils to the east, west, and north and the “hot spots” in the deeper soils located east and northwest of this feature. During the investigation, the concentrations of perchlorate detected in soil ranged from 5.23 to 2,730 µg/kg, with the highest concentration detected at 10 feet bgs. The highest concentration detected in previous investigations was 5,480 µg/kg at 10 feet bgs. The depth to groundwater in August 2008 was 35 feet bgs and has been as shallow as 2 feet bgs in April 1995. The rise and fall of the groundwater at this feature may have played a role in the distribution or re-distribution of the perchlorate impacts in soil. The highest concentrations in the near surface samples were detected outside of the Motor Washout Area to the northeast which may be attributed to surface runoff during operations or large storm events. The lateral distribution increases at 5 feet bgs and is the most wide spread between 10 and 15 feet bgs then decreases between 20 and 30 feet bgs. The majority of the perchlorate mass is found at depths less than 20 feet bgs except for one area near the south end of the Motor Washout Area where samples from 2004 were collected near the capillary fringe and therefore may have been affected by perchlorate-impacted groundwater originating from the BPA.

The areal extent of impacted soil above 200 µg/kg is approximately 230,000 ft^2 or 5.3 acres. Based on the additional characterization, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg. No further investigation is proposed for the Motor Washout Area (Feature B-9).

7.1.2 Features B-10, B-14 and B-20 - Rocket Motor Production Area

Feature B-10-Propellant Mixing Station

The objective of the investigation of the Propellant Mixing Station (Feature B-10) was to delineate the shallow perchlorate impacts in soil and groundwater. During the investigation, the concentrations of perchlorate detected in soil ranged from 20.7 to 634 µg/kg, with the highest concentration detected at 10 feet bgs. The highest concentration detected in previous investigations was 4,610 µg/kg at 30 feet bgs. Within the canyons themselves it is assumed that (1) the topography, (2) the significant decrease in permeability of the Mount Eden formation in the surrounding foothills, and (3) the thickening of the higher permeability alluvium moving out of the canyons, would drive contaminant migration in the subsurface towards the south out of the canyons. Based on the additional characterization along with the topographic constraints, the extent of perchlorate in soil at the Propellant Mixing Station (Feature B-10) has been defined to the IG of 780 µg/kg.

Depth to groundwater in MW-69 in August 2008, prior to commencement of the field activities, was approximately 36 feet bgs. The perchlorate concentrations in MW-69 have ranged from 2,260 to 2,690 µg/L, 1,4-dioxane has ranged from 6.8 to 11 µg/L, and TCE and 1,1-DCE have been detected at around 12 and 6 µg/L, respectively. During the investigation, groundwater was encountered from between 30 and 45 feet bgs. Groundwater grab samples collected at first water ranged from 1,710 to 1,930 µg/L. Based on the groundwater results from this investigation, the highest perchlorate concentrations at the Propellant Mixing Station (Feature B-10) were detected out in front of the former operational area (MW-69). Based on the contaminant distribution and the groundwater flow directions, it is possible that the higher perchlorate concentrations detected at the mouth of the canyon near the Propellant Mixing Station (Feature B-10) could have originated from the Pad with Dry Well (Feature B-14). The concentrations of 1,4-dioxane, TCE, and 1,1-DCE at this feature do not appear to be elevated with respect to wells south of this feature and are consistent with the BPA groundwater plume (TCE, 1,1-DCE, 1,4-dioxane, perchlorate) migrating into this area. Based on the findings from the DSI, no further investigation is proposed for the Propellant Mixing Station (Feature B-10).

Feature B-14-Pad With Dry Well

The objective of the investigation of the Pad with Dry Well was to complete the horizontal and vertical delineation of perchlorate impacts in soil and groundwater at this feature and determine if there is a connection between the Propellant Mixing Station (Feature B-10), the Pad with Dry Well (Feature B-14), and the Pad South of the Mix Station Bunker (Feature B-20) with respect to perchlorate impacts. The concentrations of perchlorate detected in soil ranged from 6.06 to 3,140 µg/kg, with the highest concentration detected at 0.5-foot bgs. The highest concentration detected in previous investigations was 20,400 µg/kg at 5 feet bgs. The perchlorate concentrations in soil decrease to concentrations below the IG above 20 feet bgs with the highest concentrations detected in shallow soils at the source area (pad and dry well).

Groundwater was observed during drilling activities between 31 and 45 feet bgs. The groundwater grab samples collected at first water ranged from 2.41 to 6,550 µg/L. The depth discrete groundwater results from B14-PSB1/MW-99 indicate that the concentrations decrease with depth, from 6,550 µg/L at 45 feet bgs to below the MDL (0.5 µg/L) at 147 feet bgs. The primary Site groundwater COPCs, perchlorate, 1,4-dioxane, TCE, and 1,1-DCE were detected at this feature. Similar to trends observed in the groundwater at Feature B-10, the highest perchlorate concentrations were detected at first water but decrease by an order of magnitude with depth. The concentrations of 1,4-dioxane, TCE, and 1,1-DCE at this feature do not appear to be elevated in comparison to wells south of the feature and are consistent with the BPA groundwater plume migrating into this area. Based on the findings from the DSI, no further investigation is proposed for the Pad with Dry Well (Feature B-14).

Feature B-20- Pad South of Mix Station Bunker

The objective of the investigation of the Pad South of Mix Station Bunker was to delineate the shallow perchlorate impacts in soil and determine a possible connection with either Feature B-10 or B-14, and to delineate downgradient groundwater impacts from both the Propellant Mixing Station and the Pad with Dry Well. During the investigation, the concentrations of perchlorate detected in soil ranged from 5.25 to 4,050 µg/kg with the highest concentration detected at 5 feet bgs. The highest concentration detected in previous investigations was 402 µg/kg at 0.5-foot bgs. The elevated concentrations detected at 5 and 10 feet bgs, respectively, most likely represents impacts from Feature B-10 or Feature B-14. Based on the additional characterization, the perchlorate impacts at this feature appear to have originated from either Feature B-10 or Feature B-14 and have been delineated to the IG of 780 µg/kg.

Water was encountered at 45 feet bgs in the southernmost boring at this feature, B20-PSB6/MW-90 which was converted to monitoring well MW-90. The concentrations of 1,4-dioxane, TCE, and 1,1-DCE detected in MW-90 are relatively low and consistent with the BPA groundwater plume. Of the four primary COPC's detected in this well, only perchlorate exceeded the MCL. Based on the groundwater flow directions, the analytes, and the concentrations detected, it appears that the groundwater impacts most likely originated from both the Pad with Dry Well (Feature B-14) and the BPA groundwater plume. Based on the findings from this DSI, no further investigation is proposed for Pad South of Mix Station Bunker (Feature B-20).

Features B-10, B-14, B-20 - Rocket Motor Production Area

The shallow perchlorate impacts detected at Feature B-20 at 0.5 feet bgs behind the Mix Station Bunker may have originated from surface water runoff from the Pad with Dry Well (Feature B-14) where much higher perchlorate concentrations (9,970 to 20,400 µg/kg) were detected. Although the perchlorate impacts originating from the Propellant Mixing Station (Feature B-10) extend south into the area of the Pad South of Mix Station Bunker (Feature B-20), the concentration gradient suggests that the Pad South of the Mix Station Bunker (Feature B-20) is not a source of perchlorate contamination.

There appears to be two separate areas of impacted soil (note: the areal extents are based on impacted soil above 200 µg/kg): one originating from the Pad with Dry Well (Feature B-14) to the north covering an area of 15,350 ft^2; and the second originating from the Propellant Mixing Station (Feature B-10) commingled with shallow impacts detected behind the Mix Station Bunker covering an area of approximately 27,800 ft^2. Based on the additional characterization, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg and no further investigation is proposed for Features B-10, B-14, and B-20.

The initial groundwater elevation data from these wells and the surrounding wells suggest that groundwater flows south out of the nearby canyon at the Pad with Dry Well (Feature B-14) and turns to the west flowing past and into the small box canyon at the Propellant Mixing Station (Feature B-10). Based on the perchlorate concentrations and groundwater flow directions, it is possible that the higher perchlorate concentrations detected at the mouth of the canyon near Feature B-10 could have originated from the Pad with Dry Well (Feature B-14). The groundwater impacts in this area have been characterized and therefore no further groundwater investigation is proposed for this area.

7.1.3 Feature B-11 - Fuel Slurry Station

The objective of the investigation at the Fuel Slurry Station was to complete the characterization of perchlorate in soil since the higher concentrations of perchlorate appeared to be focused immediately under the Fuel Slurry Station (Feature B-11) and to the south but were undefined. During the investigation, the concentrations of perchlorate detected in soil ranged from 9.22 to 8,500 µg/kg, with the highest concentration detected at 5 feet bgs. The highest concentration detected in previous investigations was 725 µg/kg at 20 feet bgs. The extent of perchlorate impacts in soil extends out from the former operational area to the south and west with the highest concentration detected approximately 300 feet south of this feature. The lateral distribution of perchlorate above 200 µg/kg appears to be the most extensive between 20 and 25 feet bgs. However, two of the highest detections of perchlorate were detected at 5 feet bgs. The highest concentrations in the near surface samples were detected outside of the Fuel Slurry Station to the southwest and could be a result of surface runoff.

The areal extent of impacted soil above 200 µg/kg is approximately 232,400 ft^2 or 5.3 acres. Based on the additional characterization data collected during this investigation, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg and therefore no further investigation is proposed for the Fuel Slurry Station (Feature B-11).

7.2 HISTORICAL OPERATIONAL AREA C INVESTIGATION CONCLUSIONS

Operational Area C, the BPA, consisted of three primary features: 1) temporary chemical storage area, 2) burn pits, and 3) the beryllium test stand. Feature C-22, the former burn pits, was investigated during this investigation along with the area east of the former burn pits and referred to as the Propellant Test Blow Out Area. This area had reportedly been used for blow out testing of a perchlorate based propellant. A summary of the investigations and conclusions is provided below.

7.2.1 Feature C-22 - Burn Pit Area

The objective of the investigation at the BPA was to complete the characterization of perchlorate in soil in the eastern and northeastern portion of the BPA. During the investigation, the concentrations of perchlorate detected in soil ranged from 5.46 to 1,260 µg/kg, with the highest concentration detected at 10 feet bgs. The highest concentration detected in previous investigations was 171,000 µg/kg at 20 feet bgs, located near the center of the BPA. The extent of perchlorate impacts is limited to the former operational area, is centralized within the BPA, and appears to be the most extensive between 10 and 30 feet bgs. The areal extent of impacted soil above 200 µg/kg is approximately 134,300 ft^2 or 3 acres. Based on the additional characterization, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg and therefore no further investigation at the BPA is proposed.

Soil gas results for the shallow vadose zone at the BPA indicate that the VOCs detected in soil gas may be attributed to the off-gassing of affected groundwater and/or residual contamination in the vadose zone based on the analytes detected, vertical trends, and magnitude of the VOCs in soil gas and groundwater. The additional soil gas results from 5 feet bgs collected during this investigation will be used to support the human health and ecological risk assessments. No further investigation is proposed for the BPA (Feature C-22).

7.2.2 Propellant Test Blow Out Area

The objective of the investigation at the Propellant Blow Out Test Area was to confirm the absence (or presence) of perchlorate in shallow soils (< 5 feet bgs) as a result of the historical testing conducted in this area. Perchlorate was not detected in soil above the MDL at any sample locations within the estimated 2.75 acre area. No further investigation is proposed for the Propellant Blow Out Test Area.

7.3 HISTORICAL OPERATIONAL AREA F INVESTIGATION CONCLUSIONS

Operational Area F, the LPC Test Services Area, included the following features: 1) three test bays for rocket motor testing and later structural load tests, 2) a 13-foot diameter spherical pressure vessel, 3) six temperature conditioning chambers, 4) five environmental chambers, 5) a 25 MeV Betatron for emitting X-rays into large structures, 6) personnel and instrumentation protection bunkers, 7) supporting work shops and storage areas, and 8) a large motor washout area. A summary of the investigations and conclusions for the Maintenance Shop and Storage Warehouse (Feature F-34) and Test Bays (Feature F-39) is provided below.

7.3.1 Feature F-34 - Maintenance Shop and Storage Warehouse Area

The objective of the investigation of the Maintenance Shop and Storage Warehouse Area was to delineate the impacts of VOCs in soil gas and groundwater as well as evaluate potential off-gassing from groundwater. Groundwater was observed during drilling activities between 16 and 31 feet bgs within the feature. The concentrations of TCE detected in groundwater ranged from 0.645 to 120 µg/L, with the highest concentration detected at first water. Groundwater samples from monitoring wells at this feature detected the following primary Site groundwater COPCs: 1,4-dioxane, perchlorate, TCE, and 1,1-DCE. The highest concentration of COPCs was identified within the feature’s footprint. TCE impacts in groundwater extend out from the former operational area towards the southwest generally following the topographic gradient covering an area of approximately 40,825 ft^2. TCE concentrations at first water show the highest concentrations at F34-PSB5B/MW-87A,B below the feature decreasing an order of magnitude a 100 feet downgradient of this location/well. Further downgradient (about 200 feet from F34-PSB5B/MW-87A,B), the concentrations decrease to below the MCL (5 µg/L) at F34-SSB9/MW-93. Surface water samples collected along the stream bed upgradient and downgradient of this feature indicate that the concentrations of COPCs at this feature are not adversely impacting the surface water in Potrero.

Soil gas results for the shallow vadose zone indicate that the VOCs detected in soil gas are attributed to the off-gassing of affected groundwater beneath the feature based on the analytes detected and magnitude of VOCs in soil gas and groundwater. Based on the additional characterization, the extent of TCE in soil gas and groundwater has been defined; therefore, no further investigation at the Maintenance Shop and Storage Warehouse Area (Feature F-34) is proposed.

7.3.2 Feature F-39 - Test Bays (Buildings. 308, 309, and 310)

The objective of the investigation at the Test Bays was to evaluate and delineate VOC impacts in soil and groundwater and to evaluate potential off-gassing of groundwater. Groundwater was observed during drilling activities between 10 and 30 feet bgs within the feature. The concentrations of TCE detected in groundwater ranged from 0.19 to 99.5 µg/L, with the highest concentrations generally detected at first water except at one location where the highest concentration was detected at 55 feet bgs (approximately 30 feet below first water). Groundwater samples from monitoring wells detected the following primary Site groundwater COPCs: 1,4-dioxane, perchlorate, and TCE. The extent of TCE impacts in groundwater extends out from the former operational area towards the Potrero Creek drainage and covers an area of approximately 22,530 ft^2. The footprint of the 1,4-dioxane plume above 3 µg/L covers an area of approximately 20,330 ft^2 and is consistent with the TCE plume except that only low concentrations were detected at the north end of the feature which differs from the TCE plume. Showing a different trend, perchlorate was only detected in one well on the bluff south of the feature and was not detected within the test bay canyon and therefore represent an area of only 10,850 ft^2. Although soil samples were not analyzed for perchlorate at this feature, the relatively low perchlorate impacts to groundwater indicates that a significant source of perchlorate is not likely present. As stated above, surface water samples collected along the stream bed upgradient and downgradient of this feature and Feature F-34 indicate that the COPCs detected at this feature are not adversely impacting the surface water in Potrero Creek.

Soil gas results for the shallow vadose zone at the Test Bays indicate that the VOCs detected in soil gas is attributed to off-gassing of affected groundwater beneath the feature based on the analytes detected and the magnitude of VOCs present in soil gas and groundwater. No further investigation is proposed for Feature F-39.

7.4 HISTORICAL OPERATIONAL AREA G INVESTIGATION CONCLUSIONS

Operational Area G, the helicopter weapons test area, was used to develop equipment for handling helicopter weapons systems. The facilities within this area included a hangar (Building 302), helicopter landing pad, stationary ground mounted gun platforms, and a mobile target suspended between towers. Only one feature (G-46) was investigated in Operational Area G during this investigation. A summary of the investigation and conclusions for Feature G-46 is provided below.

7.4.1 Feature G-46 - Helicopter Landing Pad and Hangar (Building 302)

The objective of the investigation at the Helicopter Landing Pad and Hangar (Bldg. 302) was to further investigate the soil and groundwater at this feature to evaluate VOC impacts (primarily PCE and BTEX) in soil and potential impacts to groundwater. PCE was not detected in any of the groundwater samples or soil gas samples collected during this investigation. The low level detections of the fuel-related compounds in groundwater may be associated with potential field contamination or the former operational uses of the Helicopter Landing Pad and Hangar. No further investigation is proposed for Feature G-46.

7.5 HISTORICAL OPERATIONAL AREA H INVESTIGATION CONCLUSIONS

Operational Area H, a permitted sanitary landfill, was located along the western side of the Site. The permit for the landfill allowed LPC to dispose of trash such as paper, scrap metal, concrete, and wood generated during routine daily operations. Operational Area H consists of only one feature (H-49) which was investigated during this investigation. A summary of the investigation and conclusions for Feature H-49 is provided below.

7.5.1 Feature H-49 - Sanitary Landfill

The objective of the investigation of the Sanitary Landfill was to complete the characterization of perchlorate and PCB impacts in soil and evaluate potential perchlorate impacts to groundwater.

No PCBs were detected during the investigation in the northeast corner of the Sanitary Landfill. The PCBs detected during the previous investigations are localized and generally do not extend beyond a depth of 5 feet bgs except for two locations where they were detected at 20 feet bgs.

The concentrations of perchlorate detected in soil during this investigation ranged from 5.92 to 1,430 µg/kg, with the highest concentration detected at 40 feet bgs. The highest concentration detected in previous investigations was 67,300 µg/kg at 0.5-foot bgs. The lateral distribution of perchlorate appears to be the most extensive between 0.5 and 10 feet bgs near the drainage channel area and between 10 and 40 feet bgs in the southern portion of the T-depression. The extent is generally limited laterally to the area containing metallics (as defined by a geophysical survey) based on characterization of soils adjacent to the drainage channel and T-depression. The lateral extent of perchlorate at depth around the drainage channel is not extensive. In the southern portion of the T-depression, the perchlorate concentrations are defined both laterally and vertically in this area decreasing to below 100 µg/kg at 55 feet bgs.

The areal extent of impacted soil above 200 µg/kg is approximately 12,120 ft^2 or 0.28 acres and is comprised of soils from the drainage channel (9,220 ft^2) and the southern portion of the T-depression (2,900 ft^2). Based on the additional characterization data collected during this investigation, the extent of perchlorate in soil has been defined to the IG of 780 µg/kg.

Groundwater was observed during drilling activities between 74 to 100 feet bgs. The concentrations of perchlorate detected in groundwater samples during drilling ranged from 1.21 to 158 µg/L, with the highest concentration detected at first water. There were no detections of groundwater COPCs based on recent samples collected from the on-site monitoring wells. The perchlorate impacts to groundwater have been defined and are below the MCL. No further investigation is proposed for Feature H-49.

7.6 GUARD WELL INSTALLATION

The investigation included the installation and sampling of one groundwater monitoring well to confirm the absence (or presence) of chemicals in the shallow aquifer that may be attributed to the former practices at the Site. The monitoring well was installed on the BMS property located to the south of the Site approximately 100 feet south of Gilman Springs Road and approximately 100 feet west of Potrero Creek.

Groundwater monitoring well MW-100 was installed at first water with a 30-foot screen interval extending from 145.2 to 175.2 feet bgs within a zone of decomposed schist. Groundwater samples were collected and analyzed for VOCs, 1,4-dioxane, and perchlorate. No analytes were reported above their respective detection limit in the groundwater sample collected from MW-100.

7.7 BACKGROUND METALS EVALUATION

Background comparisons were conducted to identify metals potentially elevated above background in soil in the seven operational areas of the Site. Background comparisons indicate that the following metals statistically differed from background in one or more of the Operational Areas (A, B, C, D, F and/or G): arsenic, beryllium, total chromium, cobalt, copper, lead, mercury, molybdenum, nickel, silver and vanadium. One metal (selenium) was detected on-site in Operational Areas A, B, C and F but not in the background sample dataset. Other metals with concentrations that exceeded the BTVs will be further evaluated in the human health and ecological risk assessment.

8.0 RECOMMENDATIONS

Based on the results of this DSI, the characterization of 10 features previously evaluated during recent investigations (Tetra Tech; 2005a, 2005b, and 2009a) is now complete except for the additional evaluation of metals which is being conducted as part of the human health and ecological risk assessment (HHERA). Metals exceeding BTVs that represent a risk to human and/or ecological receptors will be evaluated upon completion of the risk assessment to determine if additional investigation is needed. Results from the previous investigations (Tetra Tech; 2005a, 2005b, and 2009a) indicated that no further investigation was required for the other 42 features identified at the Site. The following is a list of the next steps planned for the Site:

- Prepare a Summary RI Report summarizing all the previous environmental investigations and remedial actions conducted at Site 1 in a single report;
- Complete the HHERA;
- Prepare a Feasibility Study upon completion of the HHERA;
- Prepare a Remedial Action Plan based on the findings of the feasibility study; and
- Implement the recommended remedial actions and mitigation measures to protect human health and the environment and achieve regulatory closure of the Site.

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