Rcvd. 11/15/10
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November 11, 2010

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Subject: DRAFT REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR SITE 1119 (26 AREA GROUNDWATER), MARINE CORPS BASE CAMP PENDLETON

Dear Ms. Prowell, Mr. Mahmoud, Mr. Hausladen:

Enclosed is the draft Remedial Investigation/Feasibility Study Work Plan for Installation Restoration Site 1119. In accordance with section 7.7 (c) of the Federal Facilities Agreement, this document is subject to a 60-day review period. Therefore comments would be expected by January 10th, 2011. Please call me at (619) 532-1502 if you have any questions.

Sincerely,

For

THERESA MORLEY
By direction

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
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THERESA MORLEY
By direction

Copy to: CG, MCB Camp Pendleton (Attn: ACOS, Environmental Security - Mr. Joe Murtaugh)

DRAFT

WORK PLAN

FOR

SITE 1119 GROUNDWATER INVESTIGATION

MARINE CORPS BASE CAMP PENDLETON, CALIFORNIA

November 11, 2010

Prepared for
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TABLE OF CONTENTS

		Page
1.0	**INTRODUCTION**	**1-1**
1.1	Objectives of Site 1119 Groundwater Investigation	1-2
1.2	Work Plan Organization	1-3
2.0	**SITE 1119 CONCEPTUAL SITE MODEL**	**2-1**
2.1	Contaminant Sources	2-1
2.1.1	Site 3 – 26 Area Pest Control Wash Rack	2-1
2.1.2	Site 10 – 26 Area Sewage Sludge Composting Yard	2-1
2.1.3	Site 24 – 26 Area Morale, Welfare, and Recreation (MWR) Maintenance Facility	2-2
2.1.4	Site 28 – 26 Area Trash Haulers Maintenance Area	2-2
2.1.5	Site 1111 – 26 Area Ash and Debris Disposal Area	2-3
2.1.6	Former UST Site 2653	2-4
2.1.7	Former UST Site 2666	2-5
2.1.8	Former UST Site H49	2-6
2.2	Environmental Setting	2-6
2.2.1	Topography	2-6
2.2.2	Surface Water	2-6
2.2.3	Geology	2-7
2.2.4	Hydrogeology	2-8
2.2.5	Surrounding Land Use	2-8
2.2.6	Ecology	2-9
2.3	Affected Media	2-9
2.3.1	Soil Gas	2-9
2.3.2	Soil	2-9
2.3.3	Groundwater	2-9
2.3.4	Sediment	2-10
2.3.5	Surface Water	2-10
2.4	Contaminant Fate and Transport	2-10
2.5	Existing and Future Land Use Scenarios	2-11
2.6	Exposure Areas	2-11
2.7	Potential Receptors and Exposure Pathways	2-11
2.8	Conceptual Site Model Summary	2-12
3.0	**FIELD PROGRAM DESIGN AND RATIONALE**	**3-1**
3.1	Water Level Measurements	3-2
3.2	Existing Monitoring Well Sampling	3-2
3.3	Passive Diffusion Bag Sampling	3-2
3.4	Well Installation	3-2
4.0	**REFERENCES**	**4-1**

LIST OF TABLES

2-1 Site 1119, Well Construction Details
2-2 Site 1119, Volatile Organic Compounds Detected in Wells 26016 and 26018, 2009
2-3 Site 1119, 1,2,3-TCP Results in Wells 26016 and 26018, 2009
2-4 Site 1119, Geochemical Parameters in Wells 26016 and 26018, 2009

3-1 Site 1119, Proposed Existing Monitoring Well Sampling

LIST OF FIGURES

1-1 Locations of Base Areas and Site 1119
1-2 Site 1119 Location Map

2-1 Site 1119 Site Location Map
2-2 Former IR Sites 3, 10, 24, 28, and 1111 and USTs 2653 and 2666
2-3 Former UST H49
2-4 Site 1119 Geologic Conceptual Site Model
2-5 Site 1119 Potential Exposure Pathways for Human Receptors

3-1 Site 1119 Existing Groundwater Monitoring Well Locations Included in Proposed Sampling
3-2 Site 1119 Existing Groundwater Monitoring Wells Near UST H49 Included in Proposed Sampling
3-3 Site 1119 Proposed Groundwater Monitoring Well Locations

LIST OF APPENDICES

Appendix A Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan)
Appendix B Well Logs for 26016 and 26018

ABBREVIATIONS AND ACRONYMS

µg/kg	microgram per kilogram
µg/L	microgram per liter
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
°C	degree Celsius
CAH	chlorinated aromatic hydrocarbons
Cal/EPA	California Environmental Protection Agency
Camp Pendleton	United States Marine Corps Base, Camp Pendleton
CAP	Corrective Action Plan
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeters per second
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
DCE	dichloroethene
DCP	dichloropropane
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethene
DIPE	di isopropyl ether
DO	dissolved oxygen
DON	U.S. Department of the Navy
DQO	data quality objectives
DTSC	Department of Toxic Substances Control (Cal/EPA)
ETBE	ethyl tertiary butyl ether
°F	degree Fahrenheit
FFA	Federal Facility Agreement
FS	feasibility study
ft/day	feet per day
ft/ft	foot per feet
ft/yr	foot per year
gpd	gallon per day
gpm	gallon per minute
HI	Hazard index
ICLR	incremental lifetime cancer risk
IR	Installation Restoration
MCB	Marine Corps Base
MCL	maximum contaminant level
mg/kg	milligram per kilogram
mg/L	milligram per liter
msl	mean sea level
MTBE	methyl tertiary butyl ether
MWR	Morale, Welfare, and Recreation
NAVFAC SW	Naval Facilities Engineering Command, Southwest

ABBREVIATIONS AND ACRONYMS

NEESA	Naval Energy and Environmental Support Activity
NFA	No Further Action
NTCRA	Non-Time Critical Removal Action
ORP	oxidation/reduction potential
OU	Operable Unit
OWR	Office of Water Resources
PAH	polynuclear/polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PDB	passive diffusion bag
pH	negative $\log_{10}$ of hydrogen ion concentration
PID	photo ionization detector
PRG	preliminary remediation goal
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessments
RG	Remedial Goal
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SAM	Site Assessment and Mitigation
SAP	sampling and analysis plan
SPAWAR	Space and Naval Warfare Command
SVOC	semivolatile organic compounds
SWDIV	Southwest Division Naval Facilities Engineering Command
TAME	tertiary-amyl-ether
TBA	tertiary butyl alcohol
TCA	trichloroethane
TCE	trichloroethene
TCP	trichloropropane
TDS	total dissolved solids
TMB	trimethylbenzene
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
UFP	Unified Federal Policy
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound

1.0 INTRODUCTION

This Work Plan provides a discussion of the technical approach for the groundwater investigation to support a remedial investigation and feasibility study (RI/FS) at Site 1119 at the Marine Corps Base (MCB) Camp Pendleton, California (Figure 1-1). The work plan is designed to evaluate the extent and potential sources of volatile organic compounds (VOCs) detected in Base water supply wells (wells 26016 and 26018). The VOCs that have been detected in the subject wells are trichloroethylene (TCE), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), and trichloropropane (1,2,3-TCP). Site 1119 is defined as the groundwater in the vicinity of Base wells 26016 and 26018, which is present in the alluvial deposits of the Santa Margarita River Valley (Figure 1-2). Groundwater extracted from the alluvial aquifer at the site is used as part of the Base water supply.

Delivery of this document is pursuant to the MCB Camp Pendleton Federal Facility Agreement (FFA) between the United States Environmental Protection Agency (USEPA), the California Environmental Protection Agency, Department of Toxic Substances Control (Cal/EPA DTSC), the San Diego Regional Water Quality Control Board (RWQCB), and the Department of the Navy (DON). The FFA establishes a framework for implementing appropriate environmental response actions at the Base.

A Sampling and Analysis Plan (SAP) accompanies this Work Plan and is included as Appendix A to this document. The SAP was prepared in accordance with the Unified Federal Policy for Quality Assurance Project Plans (UFP-QAPP) guidelines.

Previous environmental investigations conducted in the area include Resource Conservation and Recovery Act (RCRA) Facility Assessments (RFA), underground storage tank (UST) investigations, and Installation Restoration (IR) site investigations. Previous IR site investigations were conducted in the 26 Area at Sites 3, 10, 24, 28, and 1111. Previous UST investigations were conducted in the 26 Area at Sites 2653, 2666, and H49. The chemicals of concern (COCs) at these sites included fuels, fuel related compounds, and waste oils, pesticides, polynuclear/polycyclic aromatic hydrocarbons (PAHs), dioxins, and VOCs. “No further action” status has been achieved at most of these sites and several have undergone corrective or remedial actions.

In well 26016, TCE was reportedly detected above its maximum contaminant level (MCL) of 5 micrograms per liter (µg/L) in 2008 after the well was pumped at high discharge rates during an aquifer pumping test. Base supply well 26016 has not been put into production because of these testing results.

At well 26018, TCE was detected at a maximum concentration of 2.3 µg/L during routine sampling in 2008. Based on data provided by the Base, TCE was not detected in well 26018 until approximately one year after it went into production, and none of the TCE concentrations exceeded the MCL.

In addition, during testing performed in August 2009 by the U.S. Geological Survey (USGS) on behalf of the Naval Facilities Engineering Command (NAVFAC), 1,2,3-TCP, cis1-2 DCE, and TCE were detected in well 26016. The 1,2,3-TCP was detected at 0.0064 µg/L in a depth-specific sample collected at 80 feet below ground surface (bgs), and cis1-2 DCE and TCE were detected in a surface discharge sample at concentrations of 0.45 µg/L and 0.51 µg/L, respectively. The USGS testing at well 26018 also detected carbon disulfide at 0.46 µg/L in a depth-specific sample at 70 feet bgs and cis1-2 DCE and TCE at concentrations of 0.37 J1 µg/L and 2.1 µg/L, respectively, in a surface discharge sample. These wells were pumped by the USGS at lower flow rates

(approximately 80 gallons per minutes [gpm]) than during the pump testing at well 26016 (up to 1800 gpm) and during operation of well 26016.

Review of laboratory data from previous investigations at IR, UST, and RFA sites encompassed by Site 1119 indicate that these sites are not likely to be sources of the TCE or 1,2,3-TCP detected in wells 26016 and 26018. However, at the time that testing was conducted at these sites, the laboratory method for detecting 1,2,3-TCP at a low detection limit was generally not available. There are historically low detections of VOCs at some of the previous IR sites, but the data do not indicate that the concentrations are high enough at these sites to account for the detections present in Base supply wells 26016 and 26018. Recent data from Base supply wells upgradient of 26016 and 26018 indicate no detections of VOCs.

This Work Plan provides the technical design and rationale for investigating potential contaminant sources of VOCs that have migrated to Base supply wells 26016 and 26018. Based on available data, VOCs have only been detected in this drinking water aquifer at relatively low concentrations; that is, a concentrated "source" of VOCs in either soils or groundwater has not been identified to date.

Site 1119 is defined as the groundwater in the vicinity of Base wells 26016 and 26018 (Figure 1-2). The area included in this investigation generally represents the portion of Santa Margarita Valley upstream (or upgradient) of Base supply well 26016 and downstream of Base Office of Water Resources (OWR) monitoring well 5E3, which is adjacent to the river about 1,000 feet south of the Base Hospital. This area is a relatively flat alluvial valley measuring approximately 10,500 feet (2.0 miles) from southwest to northeast (parallel to the long axis) and approximately 4,300 feet (0.81 miles) across the valley.

In the vicinity of Site 1119, there are several areas where industrial and waste handling operations were conducted, and the investigation will be focused on these as potential sources of TCE and 1,2,3-TCP. Some of the previous investigations at former IR, UST, or RFA sites included collection and analysis of groundwater samples from groundwater monitoring wells.

The findings from this investigation will be used in the development of a Remedial Investigation/Feasibility Study (RI/FS).

1.1 Objectives of Site 1119 Groundwater Investigation

The primary objective of this investigation is to identify potential sources of the VOCs detected in wells 26016 and 26018 and to better define their distribution within the alluvial deposits in the vicinity of Site 1119. Secondary objectives of this program include providing the data needed to evaluate remedial alternates to mitigate risks to human or ecological receptors associated with exposure to VOC-contaminated groundwater.

Given the purposes described above, a field sampling approach has been developed using the data quality objectives (DQO) process, as described in the SAP in Appendix A. The SAP provides the criteria and procedures to ensure that sample collection, analysis, and data evaluation meet the project needs with regard to precision, accuracy, representativeness, completeness, and comparability to actual site conditions. The scope of work outlined in this Work Plan includes sampling of existing and planned groundwater monitoring wells in order to meet project objectives. The specific work elements are more fully described in Section 3.0, Field Program Design and Rationale.

1.2 Work Plan Organization

This Work Plan is divided into four sections, including this introductory section, and two appendices. A review of the site history, background information, and site characteristics (conceptual site model) is presented in Section 2. The field program design and rationale are discussed in Section 3. The references cited in this document are listed in Section 4. The Sampling and Analysis Plan is provided in Appendix A. The Wells Logs for 26016 and 26018 are provided in Appendix B.

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2.0 SITE 1119 CONCEPTUAL SITE MODEL

This conceptual site model (CSM) presents the current understanding of conditions at Site 1119. Site 1119 consists of the groundwater in the immediate area of Base wells 26016 and 26018 (Figure 2-1). These wells are located in the portion of the Santa Margarita River Valley extending from northeast of the Air Station to the Base hospital.

2.1 Contaminant Sources

There are several possible sources of past contaminant releases in the vicinity of Site 1119, and there may be sources that have not yet been identified. The past source areas that have been identified and investigated are discussed in the following sections.

2.1.1 Site 3 – 26 Area Pest Control Wash Rack

The former IR Site 3 was identified as the pest control wash rack that was reportedly used for washing pest control vehicles, rinsing application tanks/equipment, mixing pesticides solutions, and disposing of leftover pesticide solutions from the early 1950s to the early 1980s (SWDIV, 1993a). It is shown on Figure 2-2. The wash rack drained to an approximate 10-foot-wide unlined ditch. The ditch cuts into the alluvium of the Santa Margarita Basin and follows a southwesterly course for about 1,000 feet before emptying into the floodplain of the Santa Margarita River (NEESA, 1984).

During the remedial investigation (RI) at the site, soil and sediment samples were obtained for metals, VOCs, semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH) as diesel (TPH-d), TPH as gasoline (TPH-g), pesticides, polychlorinated biphenyls (PCBs), and herbicides. In addition, surface soil sediment samples were analyzed for dioxins and furans (SWDIV, 1993a). The predominant soil contaminants were arsenic, herbicides, and pesticides, including 4,4'-dichlorodiphenyldichloroethane (4,4'-DDD), 4,4'-dichlorodiphenyldichloroethene (4,4'-DDE), 4,4'-dichlorodiphenyltrichloroethene (4,4'-DDT), and chlordane.

Groundwater samples were also analyzed for general inorganic chemistry, and the same analytes as the soil samples, with the exception of dioxins and furans. Groundwater analytical results were below background concentrations and/or MCLs that were available at the time of the study (SWDIV, 1993a).

As a result of the RI/FS, a soil removal action was completed at Site 3 in January 1997 and is documented in the site closure report dated 6 March 1997 (OHM, 1997). The selected alternative included excavation of contaminated soil, stabilization, and disposal at the Box Canyon landfill (Site 7). In addition, the alternative included excavation of dioxin-contaminated soils for disposal at an off-Base facility. No further action was accepted by the FFA team for soil, sediment and groundwater in Operable Unit (OU) 2 Record of Decision (ROD) (SWDIV, 1997a).

During the removal action, a burn layer area adjacent to Subsite 3D was discovered. This area was designated as Site 1111 - 26 Area Burn Layer and is discussed in Section 2.1.5.

2.1.2 Site 10 – 26 Area Sewage Sludge Composting Yard

Former IR Site 10 is located in 26 Area, approximately 600 feet southwest of the intersection of Vandegrift Boulevard and Santa Margarita Road (Figure 2-2). It was used for spreading sewage sludge. The site slopes gently to the southwest, parallel to the

Santa Margarita River, and eventually drains into the river farther downstream. The Santa Margarita River is approximately 2,500 feet west of the site.

Site 10 was initially investigated in 1993 and 1994 during the RI for Group C sites. A Phase 2 RI was conducted at Site 10 in June and July 1996 during the RI for Group D sites (SWDIV, 1997b).

Previous site investigations included surface and subsurface soil sampling and analysis for metals, VOCs, SVOCs, TPH-diesel and TPH-gasoline, pesticides, and PCBs. Groundwater samples were collected for metals, VOCs, SVOCs, TPH-diesel and TPH-gasoline, and general chemistry.

Results of the investigations indicated that none of the organic compounds detected in Site 10 soil exceeded preliminary remediation goals (PRGs). Six detections of diesel in samples from five soil borings exceeded the 100 micrograms per kilogram (µg/kg) screening level; however, no leachable SVOCs were detected, indicating that no toxic constituents of diesel were leachable.

The groundwater investigation included two shallow monitoring wells (groundwater is between 11 to 13 feet bgs) and three rounds of sampling; samples were analyzed for volatile organics (USEPA Method 524.2, CLP-type protocol), SVOCs, metals, TPH-gasoline and -diesel, and general chemistry. Based on the groundwater monitoring well sampling, the cumulative cancer risk from domestic use of groundwater was calculated to be 2.4×10^{-4}, which is primarily attributable to arsenic and beryllium, which were both less than MCLs. Based on analytical results presented in the RI, no VOCs were detected in site groundwater (SWDIV, 1997b). No further action for soil, sediment and groundwater was accepted by the FFA team in the OU 3 ROD (IT, 1999).

2.1.3 Site 24 – 26 Area Morale, Welfare, and Recreation (MWR) Maintenance Facility

Former IR Site 24 was used for vehicle maintenance, painting, and hazardous waste storage since the 1940s; vehicle maintenance was curtailed around 1970.

The soil investigation included eight borings and 11 surface soil and sediment samples; samples were analyzed for VOCs, SVOCs, metals, TPH-gasoline and -diesel, pesticides, PCBs, and chlorinated herbicides. TPH was detected in soil at a maximum concentration of 180 µg/kg. One PCB (Aroclor-1254) was detected at 480 µg/kg in one soil sample; no other compounds were detected in that sample and no PCB compounds were detected in any other samples. Based on site-specific human health and ecological risk assessments (soil results), there was no significant risk with the incremental lifetime cancer risk (ICLR) less than 10^{-6}.

The groundwater investigation included two well clusters and two single wells (six wells total) and three rounds of sampling. No VOCs were detected in site groundwater.

No further action was accepted by the FFA team for soil and groundwater in the OU 1 ROD (SWDIV, 1995a).

2.1.4 Site 28 – 26 Area Trash Haulers Maintenance Area

Former IR Site 28 was used for vehicle maintenance for at least 10 years, during the 1970s and 1980s, but is no longer in operation. Wastes included waste oil, used antifreeze and transmission fluid, diesel, gasoline, and possibly solvents.

The soil investigation included 24 samples from 12 borings; samples were analyzed for VOCs, SVOCs, metals, and TPH-gasoline and -diesel. No organic compounds were

detected in soil that exceeded residential PRGs. Arsenic, beryllium, and chromium were detected at maximum concentrations of 2.2, 2.7, and 28.2 milligrams per kilograms (mg/kg), respectively. Based on the site-specific human health risk assessment for the residential scenario, the ILCR was calculated to be 3 x 10^{-6} and the hazard index (HI) was less than 1.0. The major contributors to the ICLR were beryllium and PAH constituents of diesel. An evaluation of ecological risks from exposure to soil indicated that the metals and PAH concentrations detected would not likely pose a threat to ecological receptors.

The groundwater investigation included installing one well cluster (two wells total) and three rounds of sampling. Samples were analyzed for VOCs, SVOCs, metals, TPH-gasoline and -diesel, and general chemistry. The site-specific human health risk assessment for groundwater resulted in an ILCR of 1x10^{-6} and an HI less than 1.0. The main contributors in groundwater to the ICLR were TCE (at 8 x 10^{-7}) and bis(2-ethylhexyl)phthalate (at 4 x 10^{-7}).

No further action was accepted by the FFA team for soil and groundwater in OU2 ROD (SWDIV, 1997a).

2.1.5 Site 1111 – 26 Area Ash and Debris Disposal Area

Former IR Site 1111 is adjacent to the former Site 3 (Figure 2-2). During remedial activities at Site 3, a subsurface layer of ash and burn material was exposed in the northeastern portion of Subsite 3D (OHM, 1997). Excavation continued to the sensitive habitat boundary and down to groundwater, which is 5 to 6 feet bgs. However, the concentrations of the COCs in remaining waste material exceeded remediation goals. The remaining burn layer was designated as Site 1111 and was included as an IR site in 1997 (USEPA, 1997).

Additional soil and groundwater sampling activities were conducted as part of the OU 4 RI in May and December 1998 (Parsons, 1999). Elevated levels of numerous organic and inorganic contaminants were detected in site soil, primarily between 3 and 5 feet bgs. The highest concentrations were detected within the burn layer. These soil contaminants were determined to pose a potential threat to human health and the environment, and the presence of the burn layer at the water table was found to represent an ongoing threat to groundwater. Various organic and inorganic compounds, including chlorinated solvents, bis(2-ethylhexyl)phthalate, arsenic, and thallium, were detected in groundwater above MCLs and/or tap water PRGs.

Additional RI data was collected between December 2001 and March 2003. VOCs, SVOCs, dioxins/furans, pesticides, and chlorinated herbicides were detected in soil at concentrations above residential soil PRGs. Arsenic, chromium, hexavalent chromium, iron, lead, and mercury were detected above background and residential soil PRGs.

Groundwater contamination was reported to be greatest in the area of soil contamination. Low levels (below MCLs) of SVOCs and pesticides were detected. VOCs detected included 1,2,4- trimethylbenzene (TMB), 1,2-DCA, 2-butanone, acetone, benzene, toluene, ethylbenzene, and total xylenes (BTEX), tetrachloroethene (PCE), TCE, and toluene. Of these, 1,2-DCA, benzene, and PCE were detected above MCLs. Three metals (aluminum, iron, and manganese) were detected above MCLs in groundwater (Parsons, 2004).

Between November 20, 2006 and July 2008, DON implemented a Non-Time Critical Removal Action (NTCRA). The NTCRA consisted of removing materials at the site that contained concentrations of organic and inorganic contaminants above remedial goals

(RGs) for unrestricted land use, transporting the excavated materials to appropriate off-Base disposal facilities, replacing the excavated soil with clean backfill, and approximate restoration of site vegetation. As reported in the Final Site Closure Report, approximately 926 tons of soil and burn ash and 20,000 gallons of impacted groundwater were removed from the excavation and disposed of at an off-Base facility (RBA, 2009). Post removal action groundwater assessment activities were conducted in accordance with the Final Work Plan for Groundwater Assessment (RBA, 2008). Between June 2008 and April 2009, the DON conducted four quarters of groundwater monitoring, and it was concluded that groundwater beneath the site was no longer impacted by the historic release. No further action for groundwater at IR Site 1111 was recommended in the Site Closure Report (RBA, 2009). This site will be included in an upcoming No Further Action ROD.

2.1.6 Former UST Site 2653

Former UST Site 2653 is located in the 26 Area just west of Vandegrift Boulevard and Santa Margarita Road and north of Rattlesnake Canyon Drive as shown on (Figure 2-2). The site consists of Building 2653 and the area that formerly contained UST 2653-1.

On June 20, 1994, one 800-gallon, single-walled, concrete, waste oil UST and associated piping were removed from former UST Site 2653 (Brown and Caldwell, 1996). Following this activity, the excavation was backfilled with the soil that had been removed previously, as well as with clean fill material to fill the volume of the area previously occupied by the UST. As part of the UST removal process, soil samples were analyzed for total recoverable petroleum hydrocarbons (TRPH). TRPH concentrations in the excavation soil samples were reported at 36,000 mg/kg at 4.5 feet bgs and 17,000 mg/kg at 9 feet bgs. The product line pipe soil sample reported a concentration of 29 mg/kg.

Based on the results from the soil samples collected during UST removal activities, the County of San Diego Site Assessment and Mitigation (SAM) Division determined that the site required further action. Subsequently, a site assessment was performed by Brown and Caldwell in September and October 1995. The activities from this site assessment are documented in the *Final Site Assessment Report, Underground Storage Tank Site 2653-1, Marine Corps Base Camp Pendleton, California* (Brown and Caldwell, 1996). Analytical results from the soil samples indicated that soil contamination at former UST Site 2653 extended to a depth of 16 feet bgs and encompassed the area approximately 25 feet in all directions from the former UST cavity.

In April 1997, Battelle conducted additional site assessment activities at former UST Site 2653 to better define the extent of subsurface contamination. These activities are documented in the *Revised Final Corrective Action Plan, UST Remediation Recommendations for Marine Corps Base Camp Pendleton, Oceanside, California* (Battelle, 1997). Results from the analysis confirmed the presence of site hydrocarbon constituents in the vadose zone.

In November 2007, heavily contaminated hydrocarbon-impacted soils at concentrations greater than 1,000 mg/kg had been removed from the site (Battelle, 2009).

Groundwater samples collected from former UST Site 2653 were analyzed for TPH-diesel, TPH-motor oil, and TPH-gasoline and VOCs including BTEX, naphthalene, and methyl-tert butyl ether (MTBE), 1,3,5-TMB and 1,2,4-TMB. Between 1996 and 2004, several active and passive free product removal systems have been employed at the site to extract free product from wells. Since October 2007, less than <0.01 feet of free

product was detected in any groundwater monitoring wells at former UST Site 2653. Sampling results indicate the presence of low level TPH and BTEX compounds in groundwater (Battelle, 2009).

2.1.7 Former UST Site 2666

Former UST Site 2666 is currently a vacant lot that was formerly occupied by the MCB Laundry and Dry Cleaning Facility. Prior to 1995, the site consisted of a 25,000 gallon concrete diesel tank and associated piping and a former concrete sump at Building 2666. The tank was installed in 1943 and was used for heat production fuel.

In 1995, three USTs were removed at Building 2664. Laboratory testing of soil samples collected during the tank removal indicated that hydrocarbons do not appear to extend beyond the tank cavity. The site is currently considered closed.

In February 1995, the 25,000 gallon UST (UST 2666-2) and concrete sump were removed from the site. During the tank removal, distinct discoloration of the soil samples and strong hydrocarbon odors were noted, as well as product seeping from the soil into the excavation. Water was noted in the bottom of the excavation (10 feet below grade). Results from this soil sampling event exhibit TPH-gasoline and TPH-diesel concentrations. Ethylbenzene, toluene, and xylenes also were detected in two water samples that were collected from the bottom of the tank excavation. A site assessment was conducted in 1996, by Brown and Caldwell (Brown and Caldwell, 1997).

In January 2000, an interim remedial action was undertaken at the site including dewatering the former tank excavation, over excavation, and refilling, and compacting with clean soil to eliminate perched water that had ponded in the backfilled excavation. Well RW-1 (previously located in the former tank area) was abandoned at that time. In addition to the excavation activities, a subsurface storm drain adjacent to the former tank excavation was sealed off at both ends to eliminate the potential source of subsurface water flowing into the former UST (backfilled excavation) area. The subsurface storm drain was replaced with an aboveground V-ditch to channel surface runoff.

The *Final Corrective Action Plan (CAP), Underground Storage Tank Site 2666, Marine Corps Base, Camp Pendleton, California*, was submitted to the San Diego RWQCB on October 27, 2000 (IT, 2000). Based on the alternative analysis presented in the *CAP*, the corrective action selected for site remediation was bioventing for soil near the former tank area, biosparging for groundwater on the southeast side of Vandegrift Boulevard, and monitoring natural attenuation for downgradient groundwater on the northwest side of Vandegrift Boulevard. As a part of biosparing/bioventing system operation, groundwater monitoring was conducted by EAR Engineering, Construction & Support Services. Groundwater was analyzed for TPH-diesel and some natural attenuation parameters. Analytical results indicated that groundwater beneath UST Site 2666 has low levels of petroleum hydrocarbons identified as TPH-diesel (EAR, 2008).

Groundwater monitoring for VOCs and SVOCs was conducted between 1998 and 2003. Groundwater monitoring of BTEX continued between 2004 and 2007 during biosparging operations. PCE, 1,1-DCA, 1,2-dichloropropane (1,2-DCP), and cis-1,2-DCA were detected at concentrations that exceeded the California MCLs for drinking water. Due to the presence of CERCLA constituents, former UST Site 2666 was transferred to the IR program in 2007, and the bioventing/biosparging system was shut down. The site is currently being investigated as part of Site 1118. The most recent data collection event was conducted in accordance with the Final Sampling and Analysis Plan dated October 2009 (SES-Tech, 2009).

2.1.8 Former UST Site H49

Former UST Site H49 is associated with the former 1,000-gallon steel UST located approximately 60 feet from the eastern corner of Building H49 (Figure 2-3). The tank was removed in April 1994. In 1995, TPH-diesel and TPH-gasoline were detected in soil samples from one borehole (H49/B1A) (OHM, 1998). The analytical results also indicated that the TPH-diesel migrated downward to approximately 38 feet bgs beneath the former UST, but did not migrate laterally. Groundwater monitoring results showed TPH-gasoline, TPH-diesel, and naphthalene. Neither BTEX nor TRPH were detected at that time. In February 1997, benzene was detected in one HydroPunch® groundwater sample at a level greater than the MCL of 1 µg/L.

Based on the site monitoring results, cleanup goals were detailed in the *Final Remediation Work Plan for Underground Storage Tank Site H49* (Parsons, 2000) and modified for MTBE in groundwater according to the response to RWQCB comments. The bioventing remedial alternative was selected as part of the remedial process, and a bioventing system was installed and operated from 2001 through 2002. Site H49 was closed per RWQCB No Further Action (NFA) letter dated September 2003.

2.2 Environmental Setting

This section includes a description of site topography, geology, hydrogeology, surface water, land use, and ecology. In general, the site consists of groundwater within the alluvial soils of the Santa Margarita River valley in the 26 Area of the Base. Groundwater flows in the same direction as the river, toward the southwest, eventually reaching the ocean. Groundwater tends to flow more readily through the more coarse-grained portions of the alluvial sediments (sands and gravels) than through the less permeable fine-grained sediments (silts and clays). The saturated alluvium of the Santa Margarita River valley serves as the primary aquifer in this portion of the Base. Groundwater flow is minimal in the bedrock underlying and bounding the alluvium. The groundwater table at the site is relatively shallow, and specific depths to groundwater will be better defined during this planned field investigation.

2.2.1 Topography

Site 1119 ground surface is essentially a portion of the Santa Margarita valley floor, and as such is relatively flat, but with localized variations in topography at various drainage swales, channels, graded areas, and depositional terraces. The site is mostly unpaved, but there are many areas of development near the site, including buildings and paved roads. One of the larger man-made features in the vicinity of the site is the Base hospital. Overall ground surface gently slopes toward the southwest. Ground surface elevation at the site ranges from approximately 80 to 90 feet above sea level. The mountains that are southeast and northwest of the site, but that are not classified as part of the site, reach elevations of up to 400 feet above sea level.

2.2.2 Surface Water

Surface water generally flows to the southwest across MCB Camp Pendleton via four principal streams: San Mateo, San Onofre Creek, Los Flores Creek, and the Santa Margarita River (Figure 1-1). The Santa Margarita River watershed is the largest in the vicinity of the Base, covering a total area of approximately 750 square miles, 50 square miles of which are within Base boundaries. Due to low average annual rainfall, surface flow within these streams is ephemeral. The largest surface water body within the Base

boundaries is Lake O'Neill located on the eastern edge of the site, which is used for recreation by Base personnel.

Surface water is present at several locations within the site area, including the percolation ponds, the Santa Margarita River channel, and Lake O'Neill to the east of the site. The area receives rainfall, primarily during the winter months. Most of the site area does not have surface water present; however, the site is within the Santa Margarita River floodplain. As such, there are significant flooding events periodically, during which a large portion of the valley floor may be covered by running water. Heavy rainfall during the 1993, 1997, 1998, and 2010 rainy seasons caused flood level flows in the Santa Margarita River valley.

2.2.3 Geology

Site 1119 is located within the Peninsular Range Geomorphic Province of southern California and lies within the lower Santa Margarita River basin, which extends southward from the confluence of the Santa Margarita River and De Luz Creek. The Lower Santa Margarita River basin has been divided into the following three hydrogeologic subbasins: the Upper Ysidora; the Chappo; and the Lower Ysidora, (Worts and Boss, 1954). Site 1119 lies within the Upper Ysidora subbasin, and the discussion below describes the geology at the site and within the larger Ysidora subbasin.

Geology in the vicinity of Site 1119 consists primarily of Holocene stream-deposited alluvium overlying bedrock. The bedrock is either assigned to the Santiago Formation (eastern side of the subbasin) or the Cretaceous-age basement complex (western side of the subbasin). A concealed fault is located on the western edge of the Upper Ysidora subbasin, where it is in contact with granitic basement and apparently contributing to the alluvium being directly underlain by the granitic basement complex rather than Santiago Formation at this location.

The Holocene alluvium includes active channel and wash deposits that occur in a narrow band along the active river and floodplain-deposited alluvium that occurs throughout the broader valley. The majority of these deposits are unconsolidated sand and gravel deposits with lesser amounts of interbedded clay and silt.

The Santiago Formation underlies the alluvial deposits throughout most of the Lower Santa Margarita River Valley, and generally consists of interbedded sandstone, siltstone, and mudstone. The Eocene-age Santiago Formation unconformably overlies the Cretaceous-age basement complex consisting of granite related to the Peninsular Range batholith. Recent geologic investigators (Camilleri, G.T., et al., 1994) have assigned the uppermost member of rocks previously mapped as the La Jolla Group, which underlie large portions of MCB Pendleton, to the Santiago Formation. The Santiago Formation is exposed in the valley walls adjacent to the site. It is exposed more prominently on the eastern side of the valley within the Upper Yisidora subbasin, with Cretaceous-age granodiorite exposed along the western side of the valley. The formation is described as marine and non-marine, massive, arkosic sandstone, with interbeds of lagoonal mudstone, siltstone, and mostly nonmarine cobble fanglomerate (Kennedy, 2001). The formation is essentially not water bearing (Worts and Boss, 1954).

The Cretaceous to Jurassic-age basement complex consists of rocks of the Southern California batholith and the older, pre-batholitic rocks it has intruded. The northeastern part of the Base is underlain by the western edge of the batholith. Within Camp

Pendleton, the batholith consists predominately of tonalite and granodiorite of Cretaceous age (Worts and Boss, 1954; Kennedy, 2001). The prebatholitic rocks are low grade meta-sedimentary and meta-volcanic rocks of Cretaceous and Jurassic-age that are in part contemporaneous with the intrusive rocks and partly older. The basement rocks are exposed along the western side of the Upper Ysidora subbasin, and they underlie the alluvium deposits in this area.

Based on the data obtained from previous investigations at IR Sites 3 and 1111 (SWDIV, 1993a), soils are generally sandy and gravelly with localized silt and clay lenses, Saturated conditions are present below a depth of approximately 10 feet.

2.2.4 Hydrogeology

The groundwater underlying Site 1119 occurs within the mostly coarse grained Holocene alluvial deposits described in Section 2.2.3. Groundwater is generally unconfined in the Upper Ysidora subbasin, with the water table occurring at approximately 10 feet bgs based on data from nearby sites. Within the Upper Ysidora subbasin, groundwater flows to southwest (down the valley toward the ocean) at an average gradient of approximately 0.002 ft/ft, with flow direction closely following the path of the Santa Margarita River.

However, this investigation will provide more detailed information on depth to groundwater and hydraulic gradient. The site is underlain by saturated alluvium to a depth of roughly 170 feet based on the cross-sections in *Geology and Groundwater Resources of Camp Pendleton, California* (Worts and Boss, 1954). The geology in the vicinity of Site 1119 is shown on Figure 2-4. Well construction details for wells 26016 and 26018 are included on Table 2-1 and well logs are included in Appendix B. The alluvial aquifer is considered the principal water bearing deposit in the Lower Santa Margarita River and the primary water supply for the southwestern portion of the Base. As discussed below, several high yielding supply wells pump groundwater from the alluvial deposits within the Upper Ysidora subbasin.

Within the Upper Ysidora subbasin, primary recharge to the groundwater aquifer includes: 1) seepage from the Santa Margarita River; 2) underflow from areas upstream of the Lower Santa Margarita River valley; and 3) seepage and/or underflow from De Luz Creek. Other groundwater inflows include percolation from precipitation, range front recharge, percolation from minor surface water bodies (drainage channels and streams) and very minor contributions from landscape irrigation (Leadshill-Herkenhoff, 1988; Stetson, 2003). Primary outflows within this subbasin include production well pumping, phreatophyte evapotranspiration along the riparian corridor, and groundwater flow to the Chappo subbasin (Stetson, 2003).

Five on-Base groundwater production wells are located upgradient (2602, 2603, 26071, 26072, and 2673), and two are located downgradient (2393 and 23073) of Site 1119. Locations of these Base water supply wells are shown on Figure 1-2.

2.2.5 Surrounding Land Use

The site area consists of a portion of a large river valley, and land is used for various offices and operational facilities, storage yards, warehouses, infiltration ponds, and the Base hospital and associated buildings. Lake O'Neill is to the east of the site, and the Air Station is to the southwest of the site. Four Base water supply wells are within the same area of the groundwater basin and upgradient of the wells 26016 and 26018. Area. Because the site is essentially the floodplain of the Santa Margarita River, future land

use will likely remain the same. That is, significant development would be limited by the probability of periodic flooding.

2.2.6 Ecology

Most of the site is within the Santa Margarita River floodplain. In general, this area represents a riparian habitat, with the possibility of sensitive species being present at various locations within the site. This riparian habitat is suitable for species such as the least Bell's vireo, southwestern willow flycatcher, and arroyo southwestern toad.

Ecological receptors would not be at risk from contaminated groundwater unless it discharged to surface water, which is not known to occur at the site. The potential risk to ecological receptors from site groundwater will be assessed as part of the RI investigation.

2.3 Affected Media

The potentially affected media at the site include soil gas, soil, groundwater, sediment, and surface water. The following sections describe the review of available information and planned approach for each media.

2.3.1 Soil Gas

Based on initial review of available records, no soil gas data have been obtained in the vicinity of the site, or at the IR or UST sites within the Upper Ysidora subbasin. This is not considered a significant data gap for the purposes of this investigation because the sites in the vicinity of Site 1119 were found not to have significant contamination and were closed as a result of not posing a significant risk to human health or the environment. Consequently, going back to the former IR and UST sites to collect soil gas data would not be cost-effective. In addition, collecting soil gas data at, or in proximity to, Site 1119 is not likely to yield data of value because the contaminants detected in the Base wells were generally at depths below the water table and at relatively low concentrations. As such, contaminants are not likely to have migrated to the vadose zone at detectable concentrations. Upon completion of the planned data collection described herein, this conclusion will be reviewed to see if soil gas data might be helpful in identifying potential sources.

2.3.2 Soil

As noted in Section 2.1, soil contamination has been addressed at several past IR and UST sites. These past releases have been remediated, or were not considered to be significant at the time the sites were addressed. Aside from these known past release points, there are no known additional soil sources in the vicinity of Site 1119 that would be possible sources of the groundwater contaminants found in Base wells 26016 and 26018. Therefore, this investigation is focused on groundwater sampling and characterization. However, soils that are encountered as part of the new well installations described in Section 3.4 will be screened for VOCs in the field using a photo ionization detector (PID).

2.3.3 Groundwater

During sampling performed at well 26016 (following pump testing by CDM in 2008) TCE was detected at 11 µg/kg. In addition, depth-specific sampling was conducted in well 26016 by the USGS in August 2009, and results from the 65-foot deep sample reported TCE at 0.51J µg/kg and *cis*-1,2-DCE at 0.45J µg/kg (Table 2-2). In addition, 1,2,3-TCP was reported in the 80 foot sample at 0.0064 µg/kg, which is above the California

Notification Level (0.005 µg/L) (Table 2-3). In well 26018, TCE has been reported up to 2.3 µg/kg. None of the tests conducted in the other Base wells in the vicinity have reported any VOCs, including TCE, cis-1,2-DCE or 1,2,3-TCP.

Chloride and total dissolved solids (TDS) concentrations in well 26016 and one sulfate sample and the TDS concentrations in well 26018 generally exceed their secondary MCLs (Table 2-4). Secondary MCLs are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color). This is consistent with other wells in the area and the groundwater geochemistry will be compared with groundwater results from this investigation.

2.3.4 Sediment

As noted in Section 2.1, sediment contamination was addressed at several past IR sites where sediment was present. These past releases have been remediated, or were not considered to be significant at the time the sites were investigated. Aside from these known past release points, there are no known additional sediment sources in the vicinity of Site 1119 that would be possible sources of the groundwater contaminants found in Base wells 26016 and 26018. In addition, the COCs in groundwater are present at 65 feet bgs or deeper. Therefore, instead of sampling soils or sediments, groundwater samples will be obtained at locations and depths that will help define the vertical and horizontal distribution of COCs in the aquifer.

2.3.5 Surface Water

Based on the surface water characteristics of the Santa Margarita River in the vicinity of the site, groundwater is not thought to discharge to surface water to a significant extent during most of the year; i.e., the river is a losing stream. Hence, collection of surface water data is not likely to yield information regarding contaminant concentrations in the underlying groundwater. Likewise, if there were past discharges to surface water that contributed to the current groundwater contamination, such discharges would not be currently detectable in surface water. Therefore, surface water sampling is not considered value-added at this time. DON will consider surface water sampling if future data indicate that such sampling may yield useful data for the purposes of this investigation

2.4 Contaminant Fate and Transport

As described in Section 2.3.3, the following contaminants were detected in site groundwater: TCE (up to 11 µg/kg), *cis*-1,2-DCE (0.45J µg/kg), and 1,2,3-TCP (0.0064 µg/kg).

The fate of VOCs in groundwater is determined by physical, chemical, and biological mechanisms, including biodegradation. The presence of detectable concentrations of the degradation (daughter) product *cis*-1,2-DCE is an indication that naturally occurring biologically mediated reductive dechlorination of TCE may be occurring in site groundwater or at a location upgradient from Site 1119. However, this mechanism is likely not significant given the relatively low contaminant concentrations.

As part of this investigation, geochemical parameters of site groundwater and aquifer materials will be obtained in order to better determine potential fate of site contaminants.

Site characterization activities completed to date at former IR and UST sites in the vicinity of Site 1119 have not identified any vadose zone soils that are significantly

impacted by site COCs. Therefore, the source of COCs impacting Site 1119 may be in an area not previously investigated, or may consist of a number of small leaks or spills that occurred over an extended period of time. These past releases would have then migrated vertically to the water table and dissolved into the aqueous phase to form a shallow groundwater plume. The shallow plume or plumes then migrate deeper by following the direction of advective groundwater flow. Plume migration would follow the direction of groundwater flow, which is generally toward the southwest in the site area.

Site COCs, with the exception of 1,2,3-TCP, have relatively high soil sorption coefficient (K_{oc}) and tend to sorb to soils containing significant amounts of organic carbon within the aquifer. Thus, sorption to the soil matrix and resultant retardation are important factors in the fate and transport of these contaminants in the groundwater. If COCs are present in shallow portions of the saturated zone, then there may be volatilization of COCs into the vadose zone and eventual release of this contaminant mass into the atmosphere. Volatilization of shallow volatile COC mass into the atmosphere may be a physical transport process occurring at the site, particularly for compounds with very high vapor pressures and Henry's Law constant. 1,2,3-TCP has a higher water solubility and lower K_{oc} than the other Site 1119 COCs; as a result it does not adsorb well to the soil matrix and is more mobile in the dissolved phase than the other volatile site COCs. 1,2,3-TCP has moderate volatility from the aqueous phase and can be removed from aquatic systems by evaporation or volatilization.

2.5 Existing and Future Land Use Scenarios

Site 1119 is located in a portion of a large river valley. The land in the vicinity of the site is largely undeveloped, but portions are used for various offices and operational facilities, storage yards, warehouses, infiltration ponds, and the Base hospital and associated buildings. Lake O'Neill is northeast of the site, and the Air Station is to the southwest of the site. Several active Base water supply wells are near the site, and the area may be used for future Base water supply wells. Because the site is essentially the floodplain of the Santa Margarita River, future land use will likely remain the same. That is, significant development would be limited by the probability of periodic flooding.

2.6 Exposure Areas

The potential exposure pathways and receptors are described in the following sections in order to provide as complete a conceptual site model (CSM) as possible. The exposure area includes extent of VOC contaminated groundwater in the immediate vicinity of Base wells 26016 and 26018 (Figure 2-1).

2.7 Potential Receptors and Exposure Pathways

Groundwater at Site 1119 is considered to be a source of drinking water (refer to Section 2.3.3). Therefore, potential human receptors include hypothetical residents, industrial workers, and construction workers. The possible pathways for each receptor are as follows:

<u>Resident</u>

- Potable uses of groundwater, including the following:
  - Ingestion of groundwater as a drinking water source
  - Dermal contact with groundwater during showering/bathing

  - Inhalation of volatiles emitted from the potable uses of groundwater (e.g., showering/bathing)
- Inhalation of volatiles emitted from soil gas to indoor air
- Inhalation of volatiles emitted from groundwater to indoor air

Industrial Worker

- Inhalation of volatiles emitted from soil gas to indoor air
- Inhalation of volatiles emitted from groundwater to indoor air

Construction Workers

- Dermal contact with groundwater while working in a trench
- Inhalation of volatiles emitted to trench air from groundwater
- Inhalation of volatiles emitted to outdoor air from groundwater

For a site-related contaminant to pose a potential risk to receptors, there must be a complete exposure pathway from the affected media to the receptor. Potentially complete exposure pathways for the receptors at the site are summarized on Figure 2-5.

Exposure of ecological receptors to groundwater chemicals of potential ecological concern (COPECs) is not considered likely due to the lack of surface discharge of groundwater to surface water (daylighting) in the site area. This would therefore not represent a complete exposure pathway.

Currently, the Base manages drinking water extraction and distribution. Wells with VOC contamination are shut down, thereby eliminating exposure via ingestion. In addition, the risk associated with contact with, or inhalation of, significant contaminant concentrations is considered unlikely given the relatively low concentrations of COCs in groundwater. Potential exposure pathways and possible exposure concentrations will be further evaluated as part of this planned investigation.

2.8 Conceptual Site Model Summary

Testing of Base wells 26016 and 26018 has indicated the presence of TCE in both wells (at maximum detections of 11 µg/L and 2.3 µg/L, respectively). The compound 1,2,3-TCP was detected in Base well 26016 at a concentration of 0.0064 µg/L. Potential receptors at Site 1119 include residents or workers that could be exposed to the groundwater ingestion, dermal contact, or inhalation of vapors. Data gaps indentified in the conceptual site model include:

- Identification of the source of the VOCs at the site.
- Data needed to evaluate potential remedial alternatives for site groundwater.

No sources of VOCs at Site 1119 have been identified to date. A review of data from previous investigations at former IR and UST sites upgradient of Site 1119 was conducted during preparation of this work plan to identify potential sources of VOCs. The historically low detections of VOCs do not indicate that the concentrations are high enough at these sites to account for the detections present in Base supply wells 26016 and 26018. The former IR and UST sites in the vicinity of Site 1119 have been addressed in the past, and have been remediated and/or obtained closure status. The

data obtained from other Base supply wells upgradient of 26016 and 26018 indicate no detections of VOCs to date.

To address these data gaps, groundwater sampling will be conducted in proximity to several of the past sites to ensure that no significant VOCs are currently present that were not identified previously. If VOCs are found, then proposed new groundwater monitoring wells may be sited near those location(s) to delineate the chemicals found in groundwater. If VOCs are not found in the existing groundwater monitoring wells, then the proposed new monitoring wells will be placed to define lateral and vertical contaminant distribution in the Santa Margarita River aquifer upgradient of Site 1119 to evaluate other potential sources where contamination in groundwater may be originating.

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3.0 FIELD PROGRAM DESIGN AND RATIONALE

This section describes the specific steps and technical rationale for the proposed site data collection. The rationale for the proposed steps outlined herein is based on the current understanding of groundwater conditions at the site (Section 2.0). As field activities proceed, site conditions will continue to be evaluated and adjustments to subsequent steps may be proposed if warranted.

The former IR and UST sites discussed in Section 2.1 may or may not be possible sources of the COCs detected in the Base wells 26016 and 26018, because the detections of contamination at the sites are relatively low. The COCs detected in Base wells 26016 and 26018 are discussed in Section 2.3.3. Because the existing data do not provide an understanding of contaminant distribution in the site vicinity, the planned data collection described in this Work Plan is designed to supplement the existing data in order to better determine the distribution of contaminants in the groundwater in the vicinity of the site.

A phased approach is planned for the investigation of Site 1119. First, samples will be collected and analyzed from existing wells in the area, including 26016 and 26018, then new well locations will be finalized based on that existing data, and, finally, the new wells will be installed and sampled. The following activities will be carried out in the sequence described below:

1. Measure depth to groundwater in all 51 known existing monitoring wells to determine groundwater gradient and condition and suitability of wells for sampling (refer to Section 3.1);
2. Sample groundwater at 16 existing groundwater monitoring wells to determine current contaminant concentrations in site groundwater at available locations that might be helpful in defining contaminant distribution or possible sources (refer to Section 3.2);
3. Sample groundwater at wells 26016 and 26018 using passive diffusion bags (PDBs) to obtain a current vertical profile of chemical concentrations (refer to Section 3.3);
4. Based on the data obtained from sampling existing groundwater wells and 26016 and 26018, determine placement of new wells, either near a known source area if VOCs are found or placed to define lateral and vertical contaminant distribution in the Santa Margarita River aquifer upgradient of Site 1119 (refer to Section 3.4);
5. Install and develop new monitoring wells at eight locations, with up to four nested wells each, and collect geotechnical soil data from the well boreholes (refer to Section 3.4) to fill data gaps that currently exist with the existing network of monitoring wells;
6. Sample groundwater at the new groundwater monitoring wells and submit samples for laboratory analysis to supplement the data from existing monitoring wells for the purpose of defining contaminant distribution (refer to Section 3.4).

Further detail and technical rationale for each of the above activities are presented below.

3.1 Water Level Measurements

Water levels will be measured in all 51 known monitoring wells using the procedures outlined in Worksheet 14 of the SAP (Appendix A). This includes wells at former IR Sites 3, 10, 24, 28, and 1111, and UST Sites 2653 and H49. Wells at UST 2666 are not included because they are being investigated as part of Site 1118. These data will allow mapping of current groundwater gradients. The wells will also be evaluated to determine whether they can be sampled or whether they need to be redeveloped prior to sampling. The data will be tabulated and plotted and will be used to determine if any changes are warranted in the placement of planned groundwater monitoring wells.

Sixteen of the 51 wells are included in the proposed sampling. Based on information gathered during the water level measurements, some wells may require redevelopment prior to sampling. These wells, if any, will be developed in accordance with Worksheet 14 of the SAP (Appendix A).

3.2 Existing Monitoring Well Sampling

Groundwater samples will be collected from 16 of the 51 known wells to evaluate potential source areas. The wells were selected based on past sample data, location compared to the contaminated productions wells, and screened intervals. The rational for each selection are discussed on Table 3-1 and the wells are shown on Figures 3-1 and 3-2.

All groundwater samples will be analyzed for VOCs; methane, ethane, ethene; and general minerals (total hardness, calcium, magnesium, sodium, potassium, total alkalinity, hydroxide, carbonate, bicarbonate, sulfate, chloride, nitrate, nitrite, and fluoride); total organic carbon (TOC); and TDS as detailed in Worksheet 18 of the SAP (Appendix A). In addition, groundwater samples will be analyzed in the field for geochemical parameters (dissolved oxygen [DO], oxidation/reduction potential (ORP), pH, conductivity, temperature, alkalinity, carbon dioxide, hydrogen sulfide, sulfide, and iron (II)).

The sampling of the monitoring wells outlined above will be used to establish current chemicals of potential concern (COPC) concentrations and will be compared to historical results. Based on the results, adjustment of the new well installation locations may be warranted.

3.3 Passive Diffusion Bag Sampling

Groundwater samples will be collected at wells 26016 and 26018 at multiple depths using passive diffusion bags (PDBs) to obtain a vertical profile of chemical distribution. Although these wells have been sampled by both the Base and by the USGS previously, the PDB method will provide more current data. A more current vertical profile will be helpful in identifying stratigraphic layers that may be contributing detectable chemical concentrations to the wells. Existing Base supply wells upgradient of the site are not included in the planned sampling because they are periodically sampled by the Base Office of Water Resources.

3.4 Well Installation

New groundwater monitoring wells are proposed to be installed at key locations upgradient of the contaminated production wells. If VOCs are found at existing

monitoring well locations, then some or all of the proposed new groundwater monitoring wells may be sited near those location(s) to delineate the chemicals found in groundwater, in consultation with the FFA team.

If VOCs are not found in the existing groundwater monitoring wells, then the proposed new monitoring wells shown on Figure 3-3 will be placed to define lateral and vertical contaminant distribution in the Santa Margarita River aquifer upgradient of Site 1119 to evaluate other potential sources where contamination in groundwater may be originating. In this case, new groundwater monitoring wells 1119-MW-1 through 1119-MW-8 (with up to four nested wells at each location) are proposed to be installed to evaluate potential source areas. Maximum total depth of the deepest new monitoring wells will be 100 feet bgs, based on the data reviewed to date. The rationale for the location of each new nested well and some specific targeted depths are discussed below:

1119-MW-1 Proposed location is located near wells 28W-01A/B at Site 28. Existing well 28W-01A is screened from 15 to 22 feet bgs and 28W-01B is screened from 53 to 73 feet. One proposed screened interval of this new well is from 32 to 42 feet bgs, which is in between the existing A and B well screens at Site 28. The well will rest directly on top of the clay layer that occurs from approximately 42 to 52 feet bgs. Other screened intervals, if needed, would be based on the geology encountered during drilling.

1119-MW-2 Proposed location is downgradient of former IR Sites 3, 10, and 28, and former UST Site 2653. The area historically had a number of operations that could have been potentially a source of chlorinated solvents.

The groundwater monitoring well is proposed approximately 450 feet upgradient of 3W-29A/B. The screened intervals for 1119-MW-2A will be selected based on the lithology encountered during drilling and the well screens 3W-29A/B. Well 3W-29A is screened from 4 to 19 feet bgs, and 3W-29B is screened from 60 to 81 feet bgs. Significant clay content was logged between 17 and 65 feet bgs in 3W-29A/B; however, the logging was performed from air rotary cuttings, which provides for much less precise information that logging from core samples collected with the rotosonic rig. Therefore, based on lithologic data, the well(s) will be screened between 17 and 65 feet bgs.

1119-MW-3 Proposed location is downgradient of Site 1111 and was selected using the available information on existing wells at Site 1111. Previous groundwater monitoring results from Site 1111 during 2002 and 2003 indicated PCE at 5.4 µg/L and benzene at 18.1 µg/L, although these compounds were not detected after site cleanup operations. The existing shallow monitoring wells at Site 1111 extend to a maximum depth of 20 feet; therefore this new well(s) would be screened deeper based on the lithologic data.

1119-MW-4 Proposed location is near the southwest side of Vandegrift Boulevard, positioned a few hundred feet south of the mouth of the "Paint Ball Park" canyon to account for the assumed flow direction as groundwater flows down Paint Ball Park canyon and joins the Santa Margarita River Valley. Assuming shallow bedrock is not encountered and there are suitable permeable layers, the well would consist of multiple screened intervals, depending on the lithology encountered.

1119-MW-5 Proposed location is at a point approximately 600 feet upgradient of well 26018. Well 26018 is screened 59 to 79 and 89 to 124 feet bgs. The proposed monitoring well would include up to four screened intervals, each 10 to 15 feet long. The screens would likely be placed in the zone(s) believed to be contributing the most contamination to the supply wells, but would also be placed at shallower depths to provide sampling coverage in the zones not intercepted by the supply well screens.

1119-MW-6 Proposed location is north-northwest of Base supply wells 2602 and 2603. Well 2602 is screened from 60 to 70, 75 to 125, and 135 to 145 feet bgs, and "co-located" former well 2603 is reported screened from 112 to 140 feet bgs. Wells 2602 and 2603 are sampled for TCE and 1,2,3-TCP regularly by the Base, and no detections have been reported to date (1,2,3-TCP analyzed using low level SIM method since 2003). The results for well 2603 are available for the dates between 1999 to 2009, but the results for well 2602 are limited to the dates between 2008 to 2009. The proposed well would target discrete zones shallower than the supply well screens and also in narrower zones within the existing well screens. The proposed monitoring well would consist of up to four screened intervals, each 10 to 15 feet long.

1119-MW-7 Proposed location is west-northwest of 2603 along the east side of the active channel of the Santa Margarita River. This well would ideally be placed closer to Site 1119, but drilling at this location will involve logistical challenges due to sandy conditions and dense brush and may not be feasible. The intent of this well is to monitor for any contaminated groundwater that might be migrating beneath the active river channel. This well also would represent the most northwestern well in a line of four wells (1119-MW-4 through 1119-MW-7) installed across the valley. A secondary intent of these proposed locations is to provide a line of "sentry" monitoring wells across the valley to intercept contamination migrating toward 26016 and 26018 from upgradient locations.

1119-MW-8 Proposed location is near former UST Site 2666 and IR Site 24. There was reportedly a dry cleaning operation near building 2664. The intent of this well is to test groundwater samples for possible detections of VOCs that may not have been detected as part of the prior site investigations. There are existing shallow groundwater wells associated with Site 24 and 2666 and therefore, the new groundwater well will be installed at a deeper interval.

Proposed groundwater monitoring wells will be installed as described in Worksheet 14 of the SAP (Appendix A). The proposed well placement and subsequent monitoring may

be revised based on the groundwater results from the existing monitoring wells as discussed above.

Soil samples from new wells will be collected for geotechnical analysis, and these data will provide added accuracy in soil classification and contribute to fate and transport analysis. Soil samples above the saturated zone will be analyzed for moisture content (ASTM D2216) and bulk density (ASTM D2937). Soil samples within the planned screened interval of each well (saturated zone) will be analyzed for grain size distribution (ASTM D42263), cation exchange capacity (SW9081), and TOC (SW9060 or E415.1).

Groundwater sampling will be conducted at the newly installed wells following procedures detailed in Worksheet 14 of the SAP (Appendix A). Groundwater samples will be analyzed for VOCs, including methyl tertiary butyl ether (MTBE) and ether-based oxygenates (tertiary butyl alcohol [TBA], tertiary-amyl-ether [TAME], di isopropyl ether [DIPE], and ethyl tertiary butyl ether [ETBE]); 1,2,3-TCP, methane, ethane, ethene; general minerals (total hardness, calcium, magnesium, sodium, potassium, total alkalinity, hydroxide, carbonate, bicarbonate, sulfate, chloride, nitrate, and fluoride); TOC; and TDS, as detailed in Worksheet 18 (Appendix A). In addition, groundwater samples will be analyzed in the field for geochemical parameters (DO, ORP, pH, conductivity, temperature, alkalinity, carbon dioxide, and iron (II)).

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TABLES

Table 2-1
Site 1119
Well Construction Details
MCB Camp Pendleton, California

MCB Camp Pendleton Well Identification	Installation Date	Elevation (feet amsl)	Screened Interval (feet bgs)		Total Depth (feet bgs)	TD During Drilling	Screen Type	Screen Diameter (inch)	Pump Rates (GPM)	Comments
26016	21-Jan-09	83	75	125	125	145	SS	16	unknown	never used
26018	26-Jan-98	90	59	79	145	161	SS	16	1000	
			89	124	145					

amsl = above mean sea level
bgs = below ground surface
ss = stainless steel

Table 2-2
Site 1119
Volatile Organic Compounds Detected in Wells 26016 and 26018, 2009
MCB Camp Pendleton, California

Sample ID	Depth	Date Sampled	Units	Carbon Disulfide	*cis* -1,2-Dichloroethene	Di-isopropyl ether	Trichloroethene
		MDL Range	**µg/L**	0.2	0.2	0.2	0.2
		RL Range	**µg/L**	1	1	1-2	1
		MCL (Fed.):	**µg/L**	**NE**	**70**	**NE**	**5**
		MCL (CA):	**µg/L**	**NE**	**6**	**NE**	**5**
26016-A*	65	19-Aug-09	µg/L	< 1	0.45 J1	< 1	0.51 J1
26016-B	80	19-Aug-09	µg/L	< 1	< 1	< 1	< 1
26016-C	95	19-Aug-09	µg/L	< 1	< 1	< 1	< 1
26016-C (D)	95	19-Aug-09	µg/L	< 1	< 1	< 1	< 1
26016-D	105	19-Aug-09	µg/L	< 1	< 1	< 1	< 1
26016-E	120	19-Aug-09	µg/L	< 1	< 1	0.28 J1	< 1
26018-A*	Pump	15-Jul-09	µg/L	< 1	0.37 J1	< 1	2.1
26018-B	70	15-Jul-09	µg/L	0.46 J1	< 1	< 1	< 1
26018-C	82	15-Jul-09	µg/L	< 1	< 1	< 1	< 1
26018-D	95	15-Jul-09	µg/L	< 1	< 1	< 1	< 1
26018-E	105	16-Jul-09	µg/L	< 1	< 1	< 1	< 1
26018-F	110	16-Jul-09	µg/L	< 1	< 1	< 1	< 1

µg/L = micrograms per liter

* = Sample representative of total well water. Sample obtained either from production pumpline or above the screened interval.

<2 = not detected at indicated value

J = Estimated value

J1 = Detected concentration is below the practical quantitation limit (PQL), but above the method detection limit (MDL)

MCL (Fed.) = Federal Maximum Contaminat Level permitted in water which is delivered to any user of the public water system

MCL (CA) = Primary California Maximum Contaminat Level for drinking water (Title 22 CCR)

(D) = Duplicate Sample

NE = Not established

Table 2-3
Site 1119
1,2,3-TCP Results in Wells 26016 and 26018, 2009
MCB Camp Pendleton, California

Sample Location	Depth (ft bgs)	Date Collected	Units	1,2,3-Trichloropropane (2008 - Method 524 Modified) (2009 - Method 8260 SIM)
		MCL (Fed.):	**µg/L**	**NE**
		MCL (CA):	**µg/L**	**0.005[a]**
26016-A*	65	19-Aug-09	µg/L	< 0.005
26016-B	80	19-Aug-09	µg/L	**0.0064**
26016-C	95	19-Aug-09	µg/L	< 0.005
26016-C (D)	95	19-Aug-09	µg/L	< 0.005
26016-D	105	19-Aug-09	µg/L	< 0.005
26016-E	120	19-Aug-09	µg/L	< 0.005
26018-A*	Pump	15-Jul-09	µg/L	< 0.005
26018-B	70	15-Jul-09	µg/L	< 0.005
26018-C	82	15-Jul-09	µg/L	< 0.005
26018-D	95	15-Jul-09	µg/L	< 0.005
26018-E	105	16-Jul-09	µg/L	< 0.005
26018-F	110	16-Jul-09	µg/L	< 0.005

Pump - Production pump sample

0.012 Concentration exceeds California Notification Level

* = Sample representative of total well water. Sample obtained either from production pumpline or above the screened interval.

µg/L = micrograms per liter

<2 = not detected at indicated value

MCL (Fed) = Federal Maximum Contaminant Level permitted in water which is delivered to any user of the public water system

MCL (CA) = Primary California Maximum Contaminant Level for drinking water (Title 22 CCR)

a - notification level = health-based advisory levels established by the California Department of Health Services (DHS) for chemicals in drinking water for which primary MCLs have not been adopted.

Table 2-4
Site 1119
Geochemical Parameters in Wells 26016 and 26018, 2009
MCB Camp Pendleton, California

			Laboratory Data																		
		Method:	RSK-175SOP			SW9056 (2008) E300.0 (2009)					E310.2 (2008) SW2330B (2009)				SW6010B				E160.2 (2008) E160.1 (2009)	E415.1	130.2
Sample Location	Depth (ft bgs)	Sample Date	Methane (mg/L)	Ethane (mg/L)	Ethene (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Sulfate (mg/L)	Total Alkalinity (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hydroxide alkalinity (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	TDS (mg/L)	TOC (mg/L)	Hardness (mg/L)
		PQL:	0.002 - 3	0.002 - 3	0.002 - 3	0.2 - 200	0.1	0.04 - 200	0.1	0.5 - 200	2 - 5	5	5	5	1 - 2	1	1	1	10	1	10
		MDL:	0.022	0.022	0.022	15	0.05	0.0048 - 6	0.05	0.023 - 18	1 - 1.5	1	1	1	0.1 - 1.5	0.1	0.1	0.1	4 - 5	0.76	5
		MCL (Fed.):	**NE**	**NE**	**NE**	**250 [a]**	**4/2 a**	**10**	**NE**	**250 [a]**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**500 [a]**	**NE**	**NE**
		MCL (CA):	**NE**	**NE**	**NE**	**250 [b]**	**2**	**45**	**NE**	**250 [b]**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**500 [b]**	**NE**	**NE**
26016-A*	65	19-Aug-09	0.0092	< 0.002	< 0.002	247	0.442	< 0.1	< 0.1	181	247	247	< 5	< 5	103	36.1	3.24	167	**975**	< 2.59	392
26016-B	80	19-Aug-09	NA	NA	NA	**280**	0.445	< 0.1	< 0.1	189	251	251	< 5	< 5	108	38.4	3.27	181	**1070**	2.76	428
26016-C	95	19-Aug-09	NA	NA	NA	**355**	0.43	0.0537 J1	< 0.1	176	269	269	< 5	< 5	118	40.7	3.52	207	**1180**	< 2.42	476
26016-C (D)	95	19-Aug-09	NA	NA	NA	**357**	0.427	0.0524 J1	< 0.1	177	270	270	< 5	< 5	118	41.7	3.5	207	**1240**	< 2.33	440
26016-D	105	19-Aug-09	NA	NA	NA	**457**	0.412	0.0522 J1	< 0.1	162	293	293	< 5	< 5	134	46.2	3.85	235	**1370**	2.91	548
26016-E	120	19-Aug-09	NA	NA	NA	**582**	0.382	0.0551 J1	< 0.1	152	316	316	< 5	< 5	158	54.8	4.3	269	**1620**	< 2.19	612
26018-A*	Pump	15-Jul-09	0.0068	< 0.002	< 0.002	188	0.361	< 0.1	< 0.1	232	201	201	< 5	< 5	109	42.3	3.22	117	**870**	< 2.78	450
26018-B	70	15-Jul-09	NA	NA	NA	184	0.36	< 0.1	< 0.1	**257**	193	193	< 5	< 5	113	44.8	3.67	110	**865**	< 3.18	500
26018-C	82	15-Jul-09	0.0088	< 0.002	< 0.002	170	0.35	< 0.1	< 0.1	254	175	175	< 5	< 5	108	47.8	4.09	102	**830**	< 2.83	480
26018-D	95	15-Jul-09	NA	NA	NA	163	0.323	< 0.1	< 0.1	248	162	162	< 5	< 5	106	39.1	3.03	98.6	**775**	< 2.21	400
26018-E	105	16-Jul-09	NA	NA	NA	159	0.347	< 0.1	< 0.1	227	172	172	< 5	< 5	104	38.6	3.05	101	**780**	< 2	380
26018-F	110	16-Jul-09	NA	NA	NA	161	0.341	< 0.1	< 0.1	229	174	174	< 5	< 5	102	37.1	2.96	103	**780**	< 1.98	395

°C = degree Celsius
mS/cm = milliSiemens per centimeter
DO = dissolved oxygen
NTU = nephelometric turbidity unit
mg/L = milligrams per liter
ORP = oxidation/reduction potential
TDS = total dissolved solids
TOC = total organic carbon
mV = millivolts
NA = not analyzed
NM = not measured
NE = not established
830 Concentration above MCL
(D) = duplicate sample
<2 = not detected at indicated value
J = estimated value
* = Sample representative of total well water. Sample obtained either from production pumpline or above the screened interval.
MCL (Fed) = Federal Maximum Contaminant Level permitted in water which is delivered to any user of the public water system
a - National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color)
MCL (CA) = Primary California Maximum Contaminat Level for drinking water (Title 22 CCR)
b - Recommended Secondary California Maximum Contaminant Level for drinking water (Title 22 CCR)
MDL = method detection limit, range shown where applicable
PQL = practical quantification limit, range shown where applicable

Table 3-1
Site 1119
Proposed Existing Monitoring Well Sampling
MCB Camp Pendleton, California

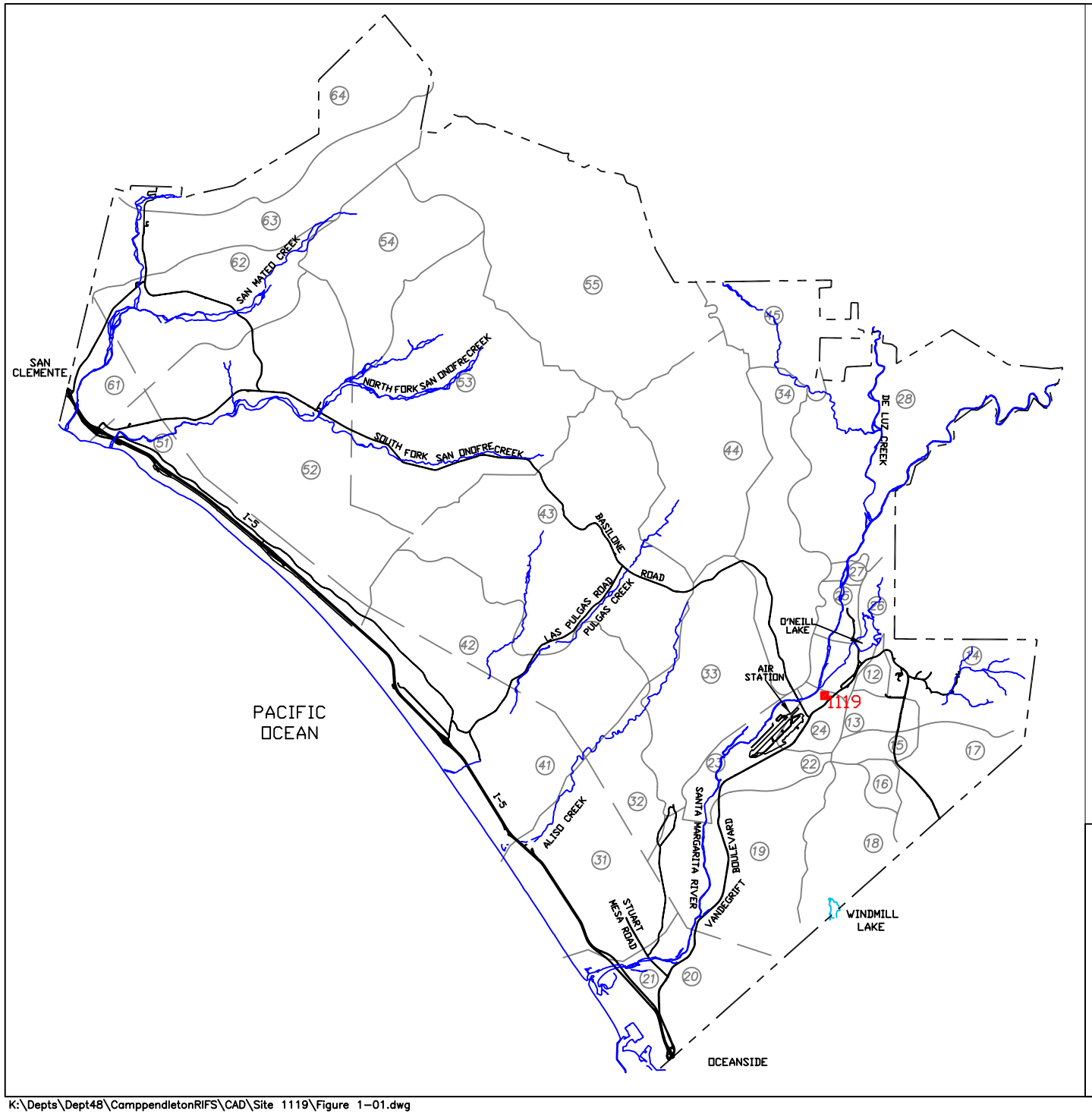
Well Number	Screen (ft bgs)			Total Depth (ft bgs)	Included in Sampling [a]	Not Included in Sampling	Notes
Site 3							
3MW-01	5	to	20	20		X	No COCs previously detected; well could not be found during reconnaissance activities
3MW-02	5	to	20	20		X	No COCs previously detected; well could not be found during reconnaissance activities
3MW-03	4	to	19	19		X	No COCs previously detected; well could not be found during reconnaissance activities
3W-27A	2.5	to	17.5	18.5	X		No COCs previously detected; 1,2,3-TCP not analyzed at low detection limit.
3W-27B	36	to	56	57	X		No COCs previously detected; 1,2,3-TCP not analyzed at low detection limit.
3W-29A	4	to	19	19.5	X		No COCs previously detected; 1,2,3-TCP not analyzed at low detection limit.
3W-29B	60	to	81	81.5	X		No COCs previously detected; 1,2,3-TCP not analyzed at low detection limit.
3W-30A	8	to	27.5	29	X		No COCs previously detected; 1,2,3-TCP not analyzed at low detection limit.
3W-30B	55	to	70	71	X		No COCs previously detected; 1,2,3-TCP not analyzed at low detection limit.
3W-30C	117.5	to	132	133.5	X		No COCs previously detected; 1,2,3-TCP not analyzed at low detection limit.
3W-35A	5	to	20	22	X		VOCs and BTEX previously detected; no 1,2,3-TCP not analyzed at low detection limit.
3W-35B	58.5	to	73.5	74.5	X		VOCs and BTEX previously detected; no 1,2,3-TCP not analyzed at low detection limit.
Site 10							
10W-01	7.5	to	27	29		X	VOCs previously detected below MCLs, but better depths to sample in 3W-30A/B/C
10W-02	7	to	27	29		X	VOCs previously detected below MCLs, but better depths to sample in Site 24 wells
Site 24							
24W-09	4	to	29	39		X	No COCs previously detected; 1,2,3-TCP not analyzed for at low detection limit.
24W-10A	9	to	28.5	30		X	No COCs previously detected; 1,2,3-TCP not analyzed for at low detection limit.
24W-10B	58.5	to	73	79		X	No COCs previously detected; 1,2,3-TCP not analyzed for at low detection limit.
24W-11A	13.5	to	27.5	30	X		VOCs previously detected below MCLs; 1,2,3-TCP not analyzed for at low detection limit. This well is directly downgradient of the site than other wells.
24W-11B	70	to	85	88	X		VOCs previously detected below MCLs; 1,2,3-TCP not analyzed for at low detection limit. This well is directly downgradient of the site than other wells.
24W-12	31	to	51	52		X	No COCs previously detected; 1,2,3-TCP not analyzed for at low detection limit.
Site 28							
28W-01A	7.2	to	22.2	26	X		VOCs previously detected below MCLs; no 1,2,3-TCP not analyzed at low detection limit.
28W-01B	52.8	to	72.8	85	X		VOCs previously detected below MCLs; no 1,2,3-TCP not analyzed at low detection limit.
Site 1111							
1111MW-1	5	to	20	20		X	VOCs previously detected, but better depths to sample in Site 3 wells
1111MW-2	5	to	20	20		X	VOCs previously detected, but better depths to sample in Site 3 wells
1111MW-3	5	to	20	20		X	VOCs previously detected, but better depths to sample in Site 3 wells
1111MW-4	4	to	19	19.5		X	VOCs previously detected, but better depths to sample in Site 3 wells
1111MW-5	4	to	19	19.5		X	VOCs previously detected, but better depths to sample in Site 3 wells
1111MW-6	4	to	19	19.5		X	VOCs previously detected, but better depths to sample in Site 3 wells

Table 3-1
Site 1119
Proposed Existing Monitoring Well Sampling
MCB Camp Pendleton, California

Well Number	Screen (ft bgs)			Total Depth (ft bgs)	Included in Sampling [a]	Not Included in Sampling	Notes
Former UST Site - Site H-49							
H49-MW1	TBD	to	TBD	TBD	X		No VOCs previously detected and 1,2,3-TCP not analyzed for at low detection limit. This well is directly downgradient of the site than other wells.
H49-MW2	TBD	to	TBD	TBD		X	No VOCs in site history, but better depths and locations to sample elsewhere.
H49-MW3	TBD	to	TBD	TBD		X	No VOCs in site history, but better depths and locations to sample elsewhere.
H49-MW4	TBD	to	TBD	TBD		X	No VOCs in site history, but better depths and locations to sample elsewhere.
H49-RW1	TBD	to	TBD	TBD		X	No VOCs in site history, but better depths and locations to sample elsewhere.
Former UST Site - Site 2653							
2653-MW1	7	to	27	28		X	No solvents previously detected; better depths and locations to sample elsewhere.
2653-MW2	7	to	27	28		X	No solvents previously detected; better depths and locations to sample elsewhere.
2653-MW3	7	to	27	28		X	No solvents previously detected; better depths and locations to sample elsewhere.
2653-MW4	7	to	17	17.5		X	No solvents previously detected; better depths and locations to sample elsewhere.
2653-MW5	9	to	19	19		X	No solvents previously detected; better depths and locations to sample elsewhere.
2653-RW1	7	to	27	27		X	No solvents previously detected; better depths and locations to sample elsewhere.
2653-RW1R	7	to	27	28		X	No solvents previously detected; better depths and locations to sample elsewhere.
Observation Wells							
5E3	TBD	to	TBD	TBD	X		No VOCs previously detected and 1,2,3-TCP not analyzed for at low detection limit. This well is directly upgradient of the 26016 and 26018 compared to other wells.
5N1	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
7H3	TBD	to	TBD	TBD		X	No solvents previously detected; better depths and locations to sample elsewhere.
7J1	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
7J4	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
7J8	TBD	to	TBD	TBD	X		No VOCs previously detected and 1,2,3-TCP not analyzed for at low detection limit. This well is directly upgradient of the 26016 and 26018 compared to other wells.
7R7	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
8D4	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
8D5	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
8E4	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
8N4	TBD	to	TBD	TBD		X	No solvents previously detected; better locations to sample elsewhere.
Total Wells					**16**	**35**	

TBD = To be dtermined during this investigation
a Sampling includes analysis of 1,2,3-TCP (8260B SIM); VOCs (including MTBE and ether-based oxygenates) (SW8260B); methane, ethane, ethene (RSK-175SOP); chloride, nitrate, sulfate (SW9056 or E300.0); TOC (SW9060 or E415.1); total dissolved solids (TDS) (E160.2); and alkalinity (E310.2). In addition, groundwater samples will be analyzed in the field for geochemical parameters (dissolved oxygen [DO], oxygen/reduction potential [ORP], pH, conductivity, temperature, carbon dioxide [CO2], iron II, and alkalinity).

FIGURES



LEGEND

- Major Area Boundaries
- Roads And Highways
- Creeks and Streams
- MCB Camp Pendleton Boundary
- (53) Major Area Designation
- 1119 Installation Restoration (IR) Site Location

N

0 15,000 30,000

SCALE IN FEET

SOURCE: IT, INC.

Figure 1-1

Locations of Base Areas and Site 1119

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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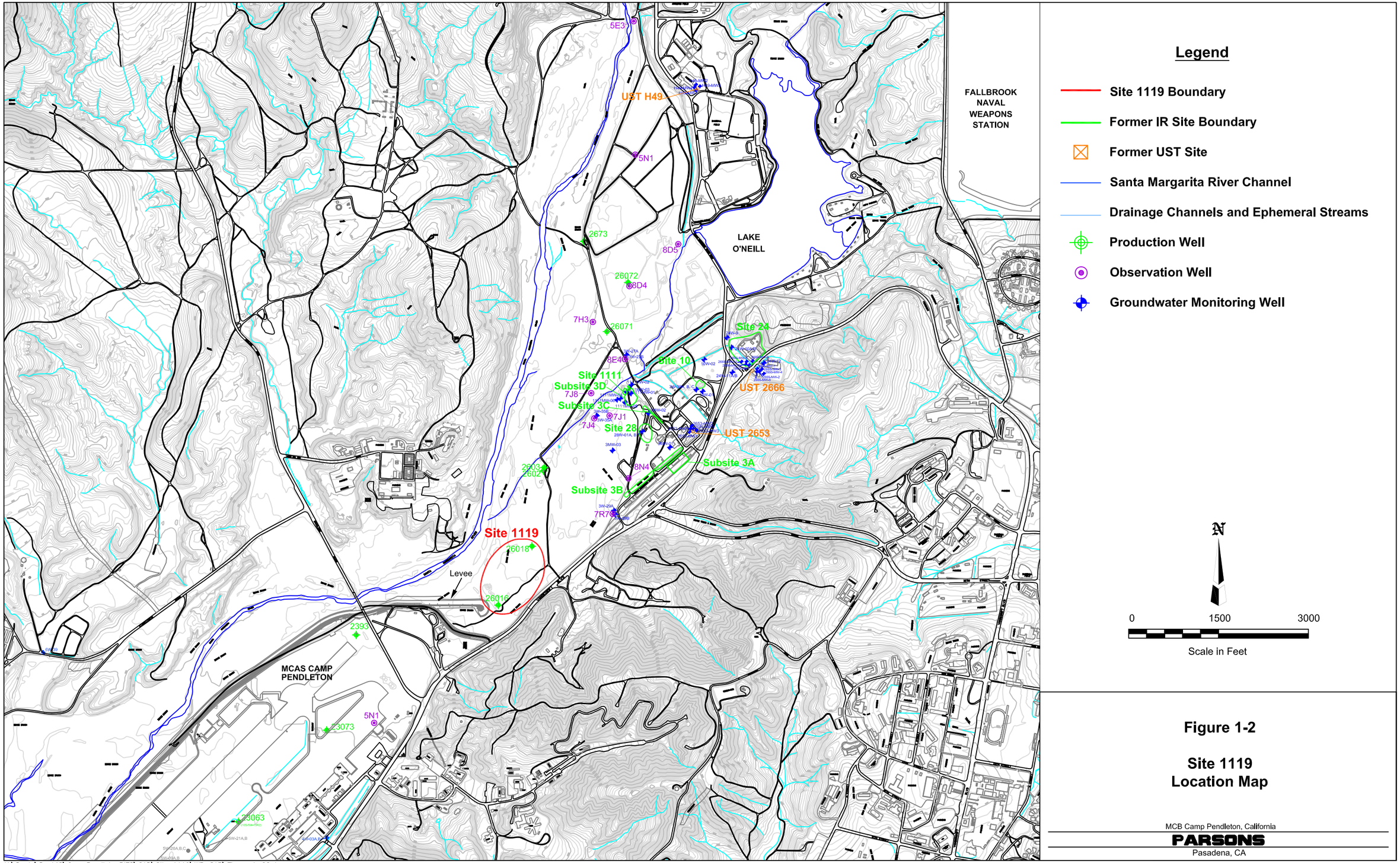

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Figure 1-2

Site 1119
Location Map

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

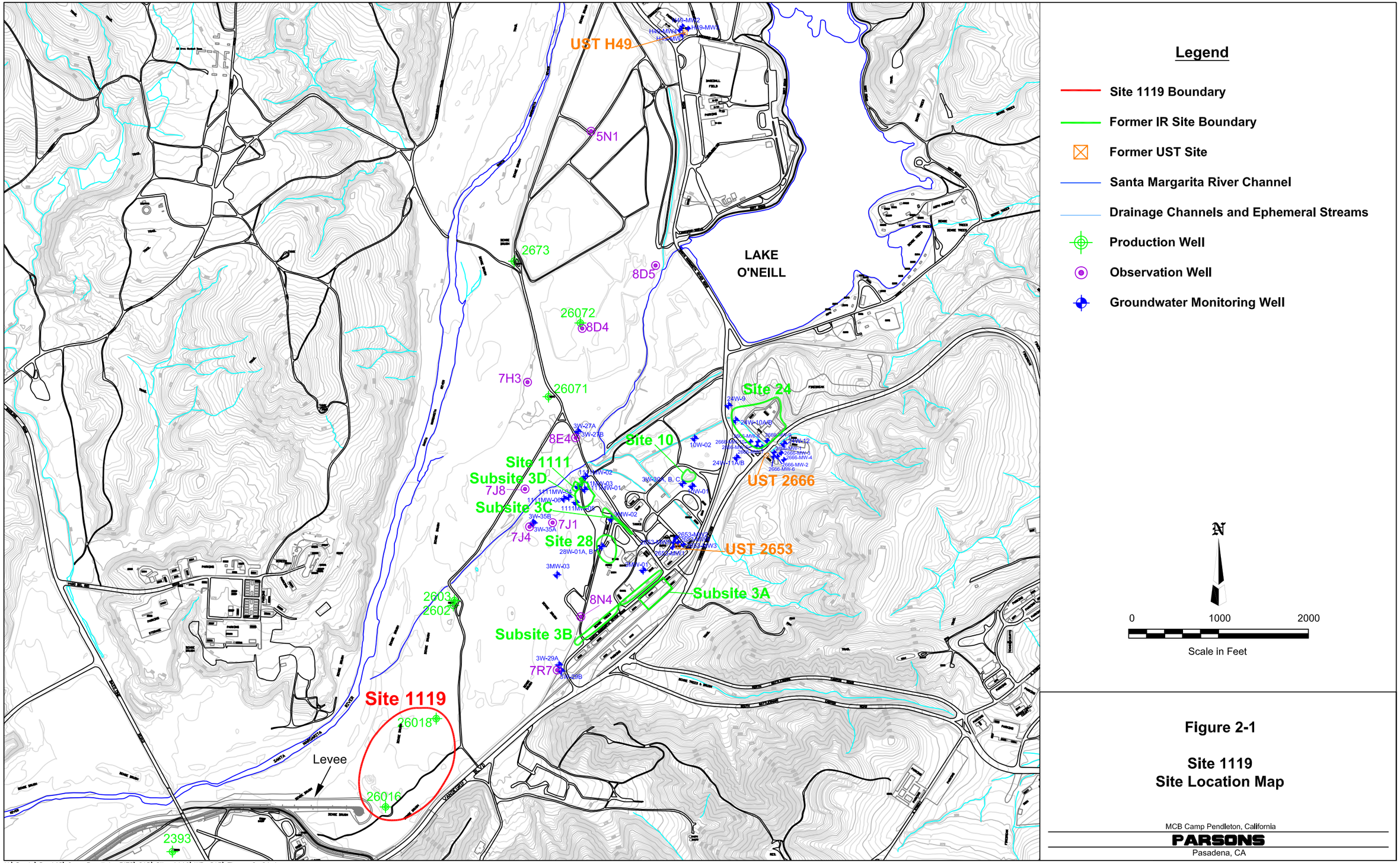
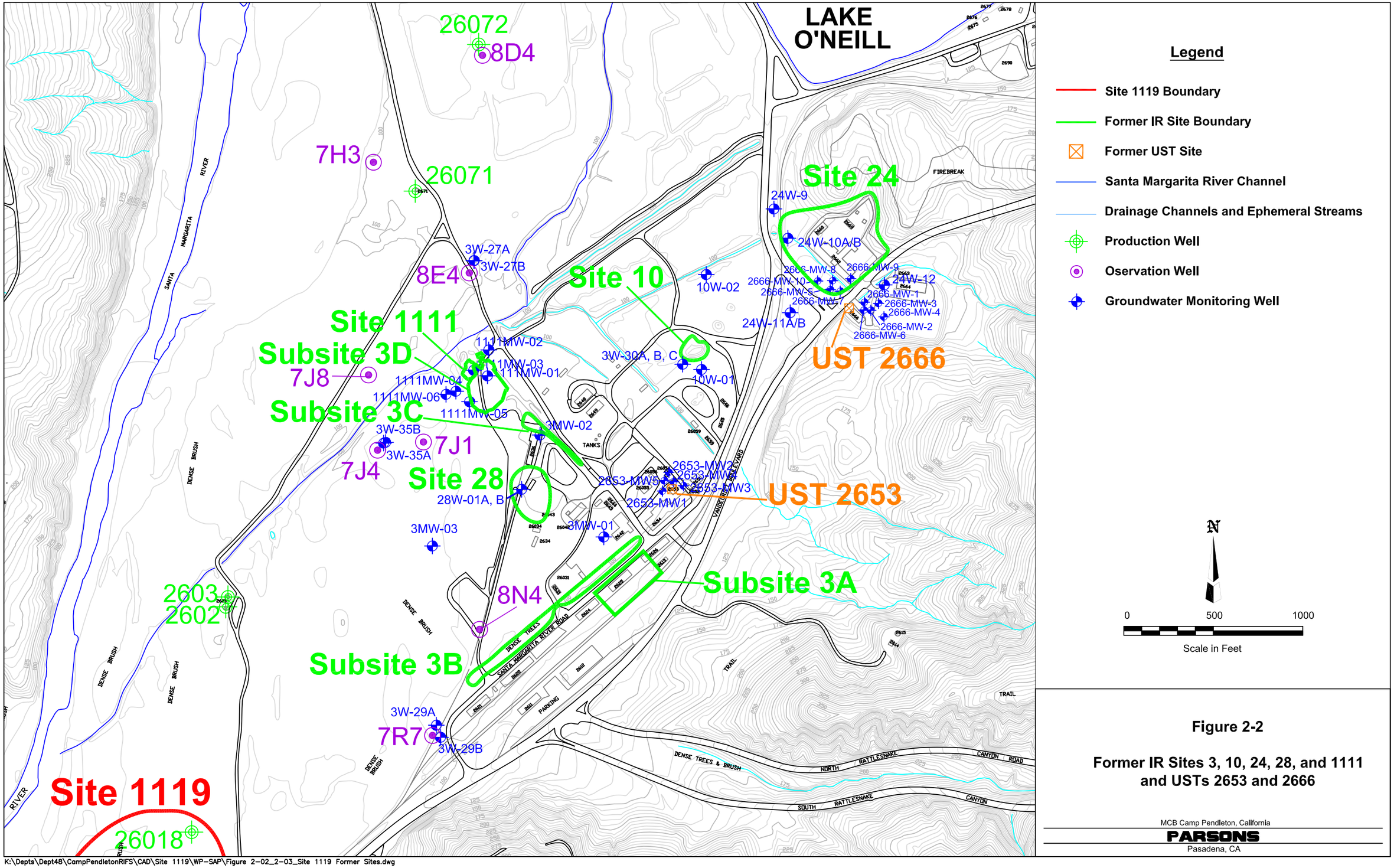


Figure 2-1

Site 1119
Site Location Map

MCB Camp Pendleton, California
PARSONS
Pasadena, CA

K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 2-01.dwg



K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 2-02_2-03_Site 1119 Former Sites.dwg

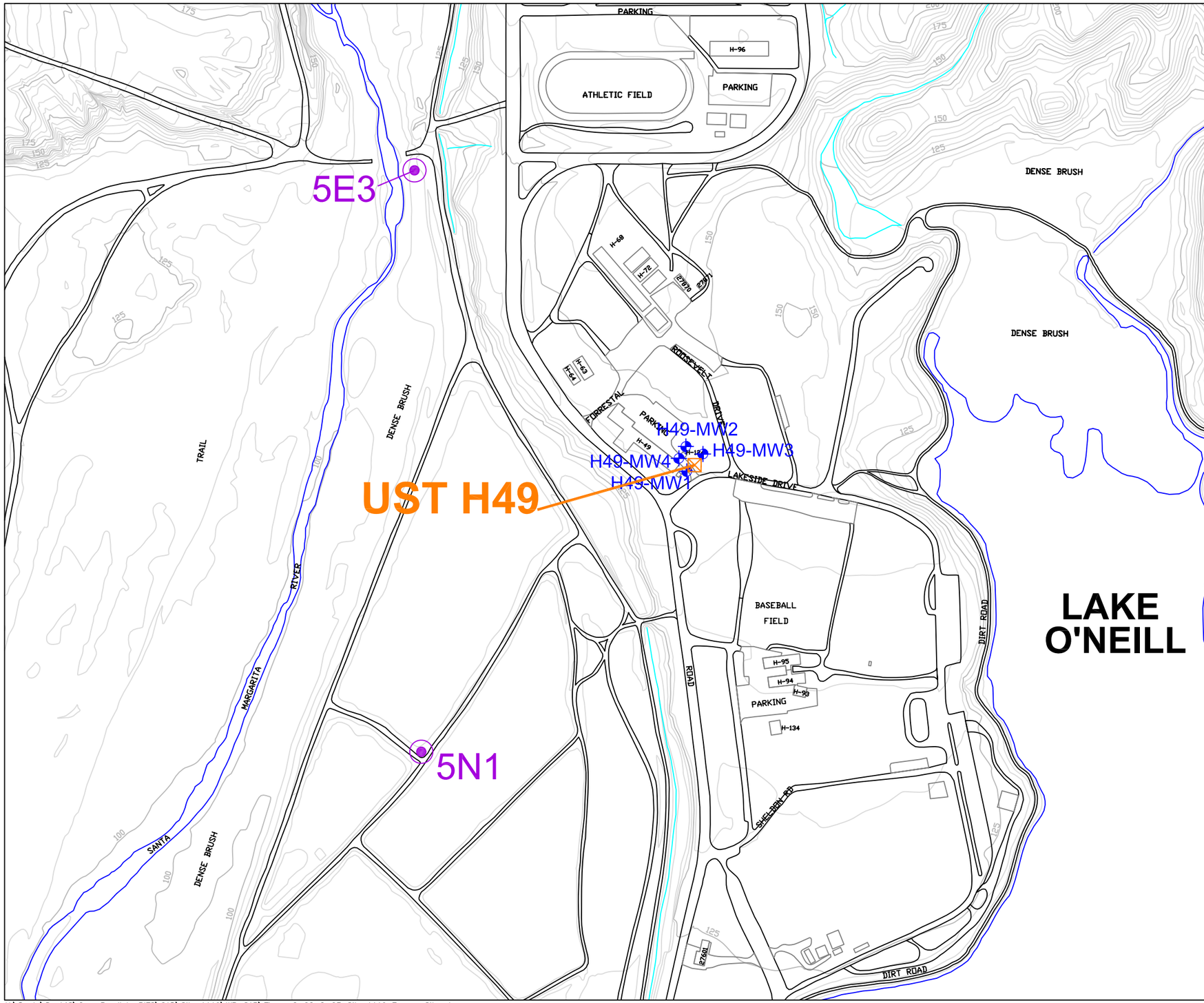
Figure 2-2

Former IR Sites 3, 10, 24, 28, and 1111 and USTs 2653 and 2666

MCB Camp Pendleton, California

PARSONS

Pasadena, CA



Legend

- Site 1119 Boundary
- Former IR Site Boundary
- Former UST Site
- Santa Margarita River Channel
- Drainage Channels and Ephemeral Streams
- Production Well
- Observation Well
- Groundwater Monitoring Well

N

0 400 800

Scale in Feet

Figure 2-3

Former UST H49

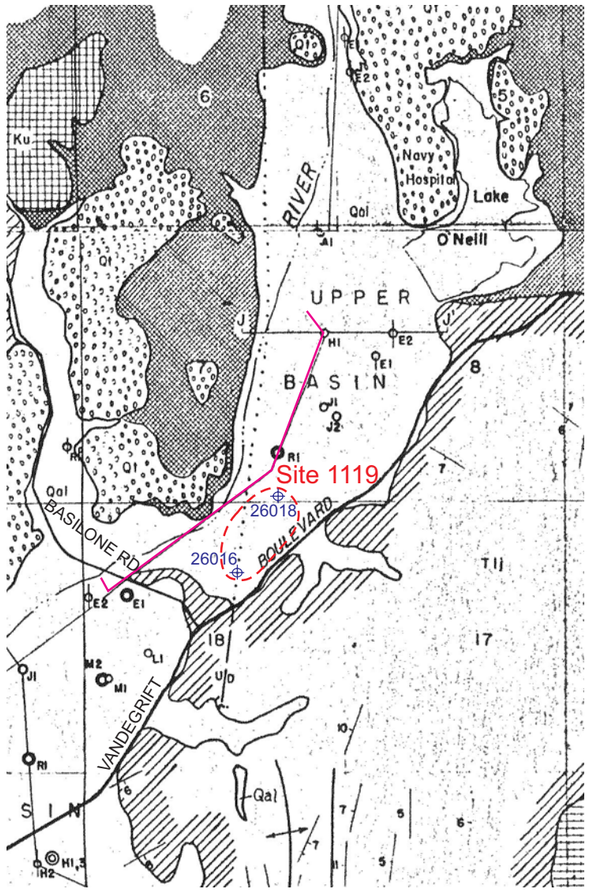
MCB Camp Pendleton, California

PARSONS

Pasadena, CA

K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 2-02_2-03_Site 1119 Former Sites.dwg

From Worts and Boss, 1954, Plate 1 - Geologic Map



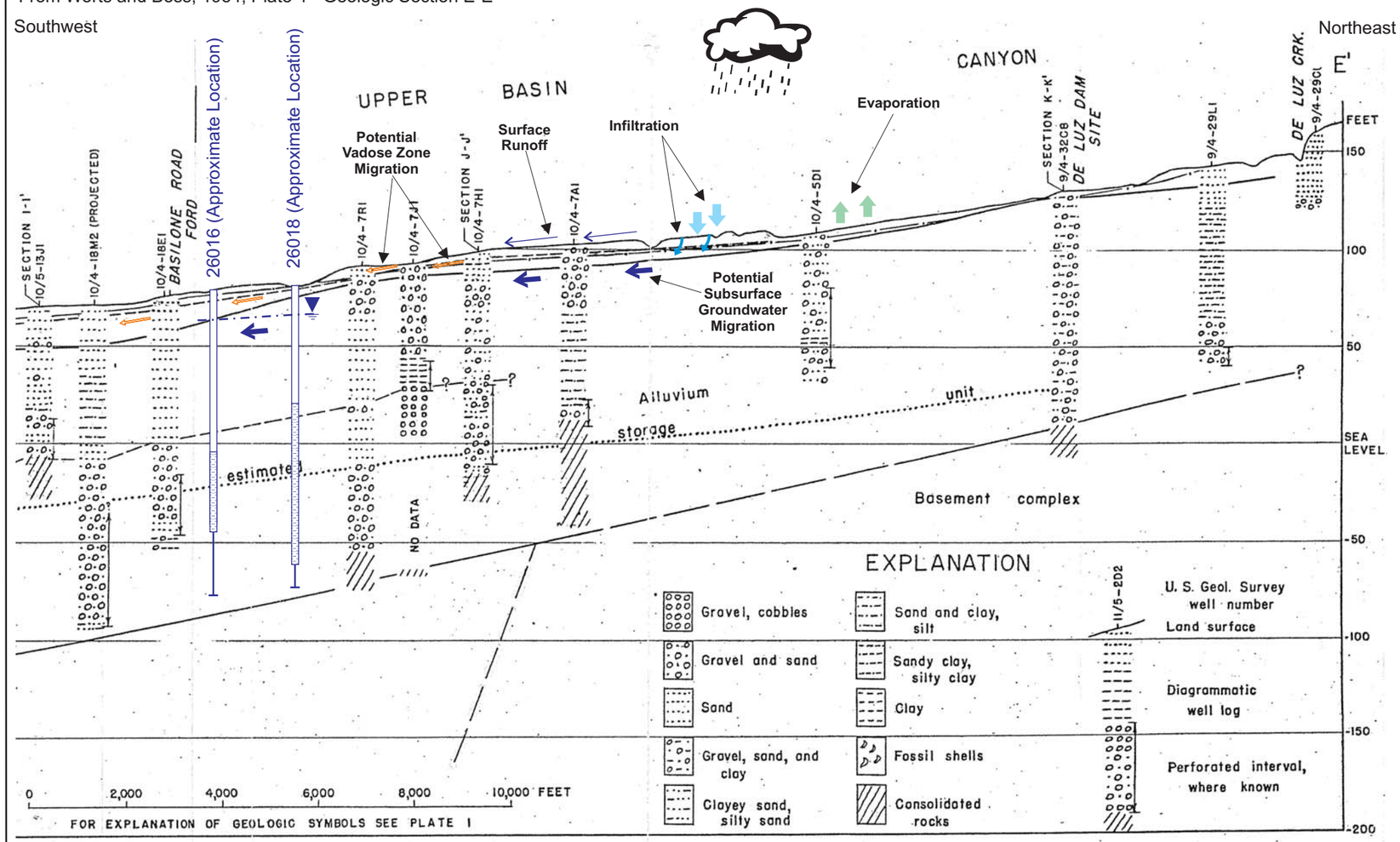
Approximate Horizontal Scale
1 inch = ½ mile

Site 1119

Line of Section Shown on CSM

N

From Worts and Boss, 1954, Plate 4 - Geologic Section E-E'



LOOKING NORTHWEST

Precipitation
Surface Runoff
Infiltration
Evaporation
Vadose Zone Migration
Subsurface Water Flow
Groundwater Level
Well Casing
Well Screen
Total Depth of Boring

Approximate Horizontal Scale
1 inch = ½ mile

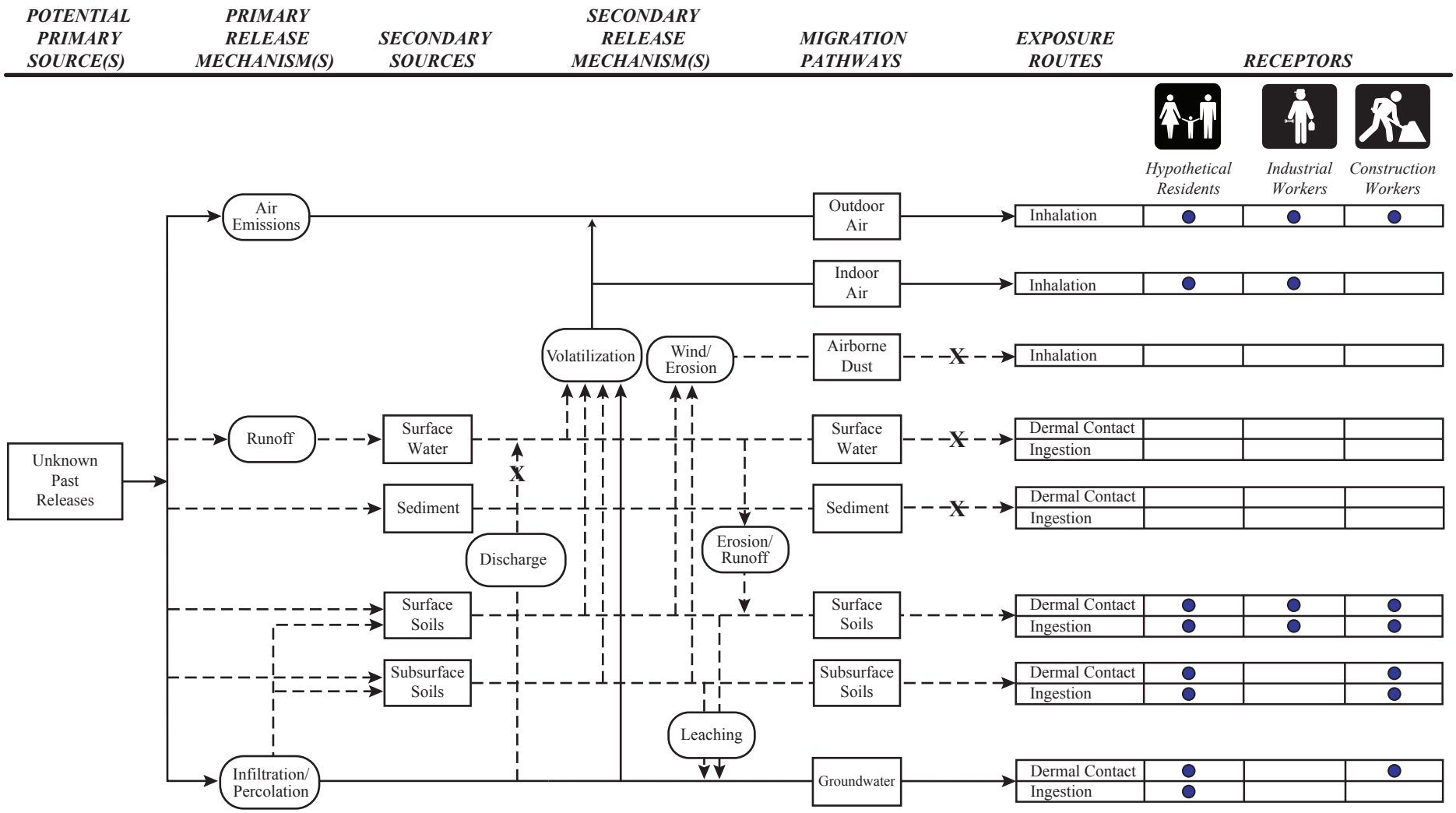
Approximate Vertical Scale
1 inch = 66 feet

Approximate Vertical Exaggeration 40:1

Figure 2-4

Site 1119
Geologic Conceptual Site Model

MCB Camp Pendleton, CA
PARSONS
Pasadena, CA



Legend

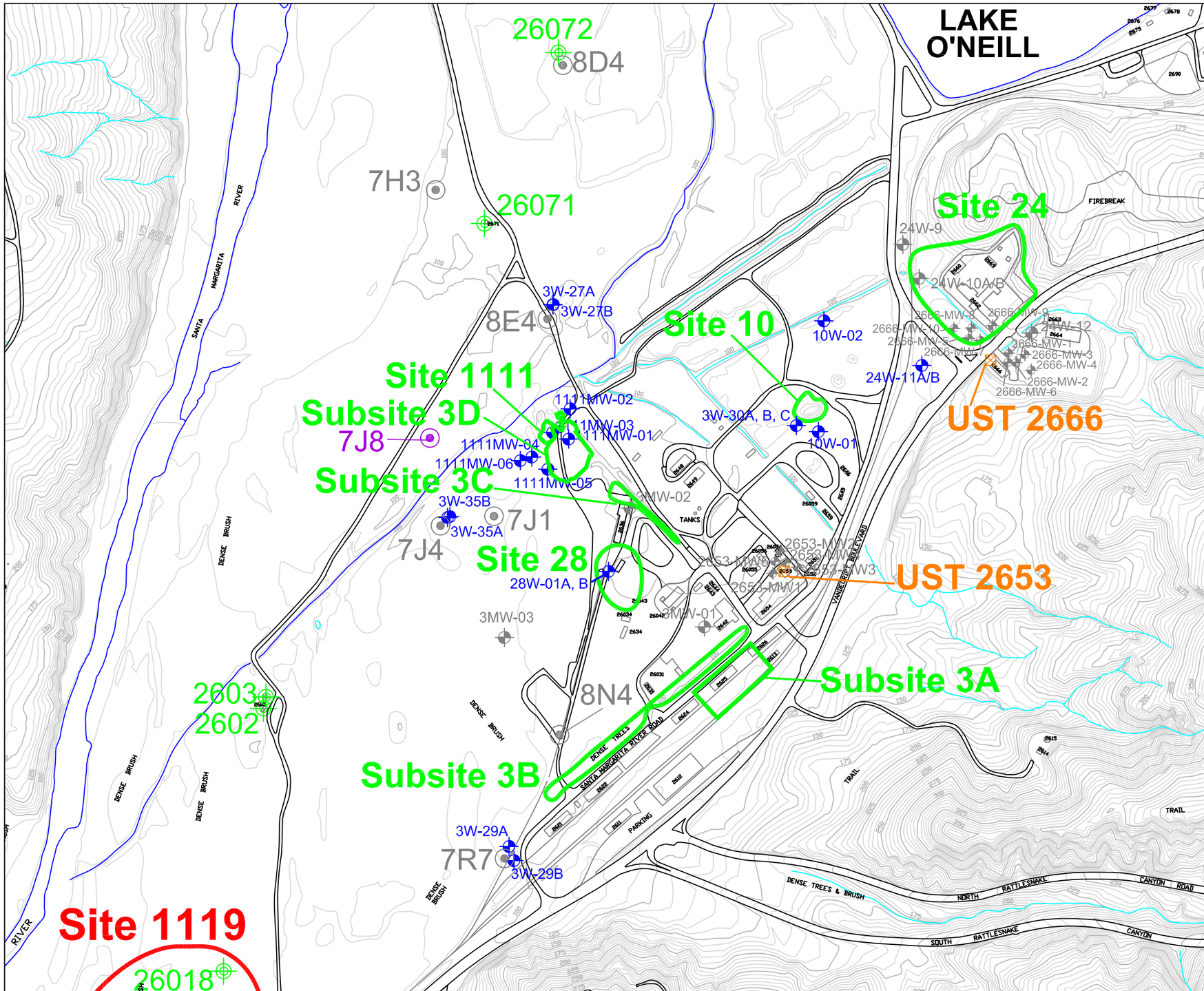
- Potentially complete exposure pathway
- Potentially incomplete exposure pathway
- Incomplete exposure pathway
- Potentially complete exposure route

Figure 2-5
Site 1119
Potential Exposure Pathways for Human Receptors

MCB Camp Pendleton, California

PARSONS

Pasadena, CA



Legend

- Site 1119 Boundary
- Former IR Site Boundary
- Former UST Site
- Santa Margarita River Channel
- Drainage Channels and Ephemeral Streams
- Production Well
- Observation Well Included in Sampling
- Observation Well Not Included in Sampling
- Groundwater Monitoring Well Included in Sampling
- Groundwater Monitoring Well Not Included in Sampling

N

0 500 1000

Scale in Feet

Figure 3-1

Site 1119
Existing Groundwater Monitoring Well Locations Included in Proposed Sampling

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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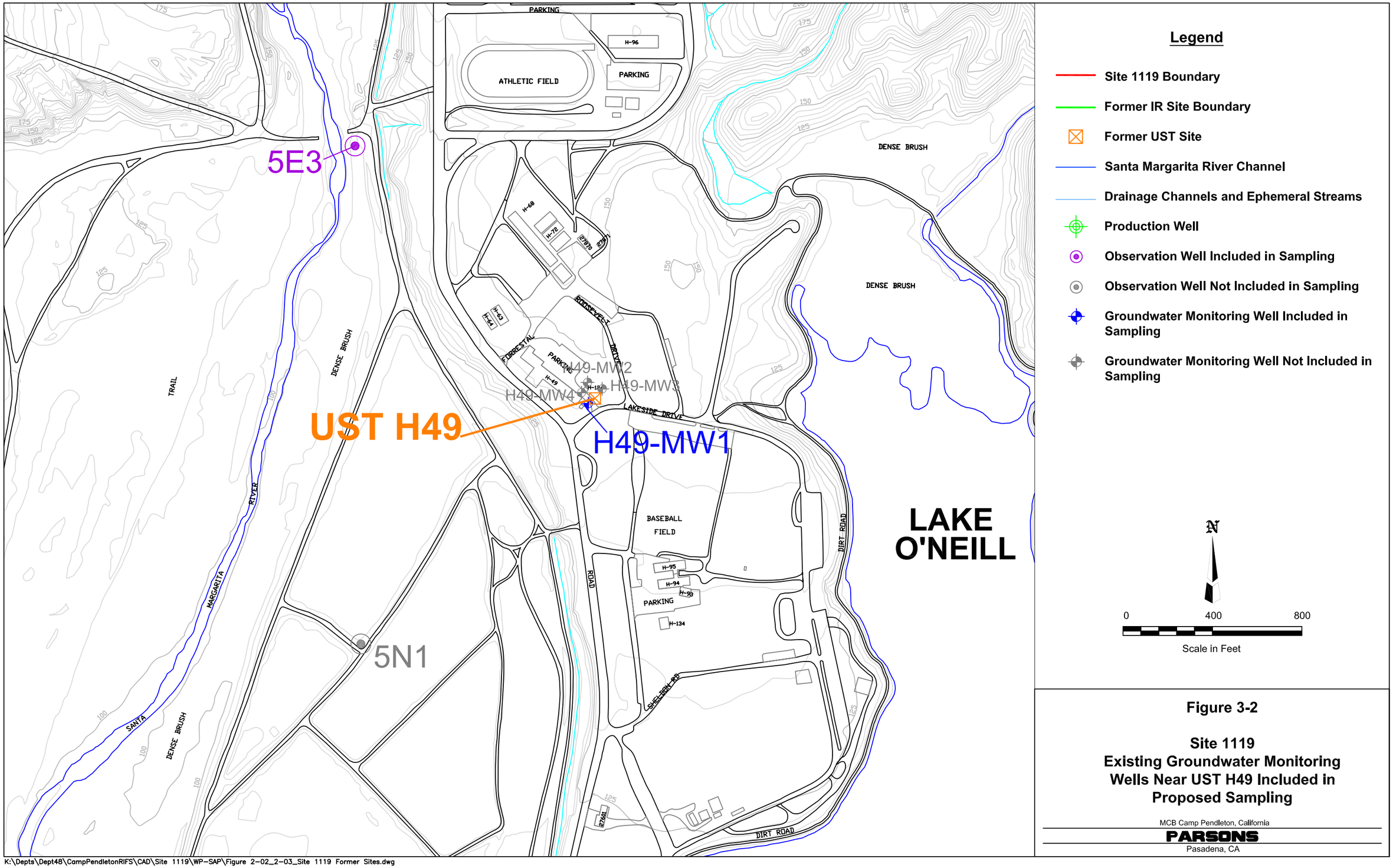

Figure 3-2

Site 1119
Existing Groundwater Monitoring Wells Near UST H49 Included in Proposed Sampling

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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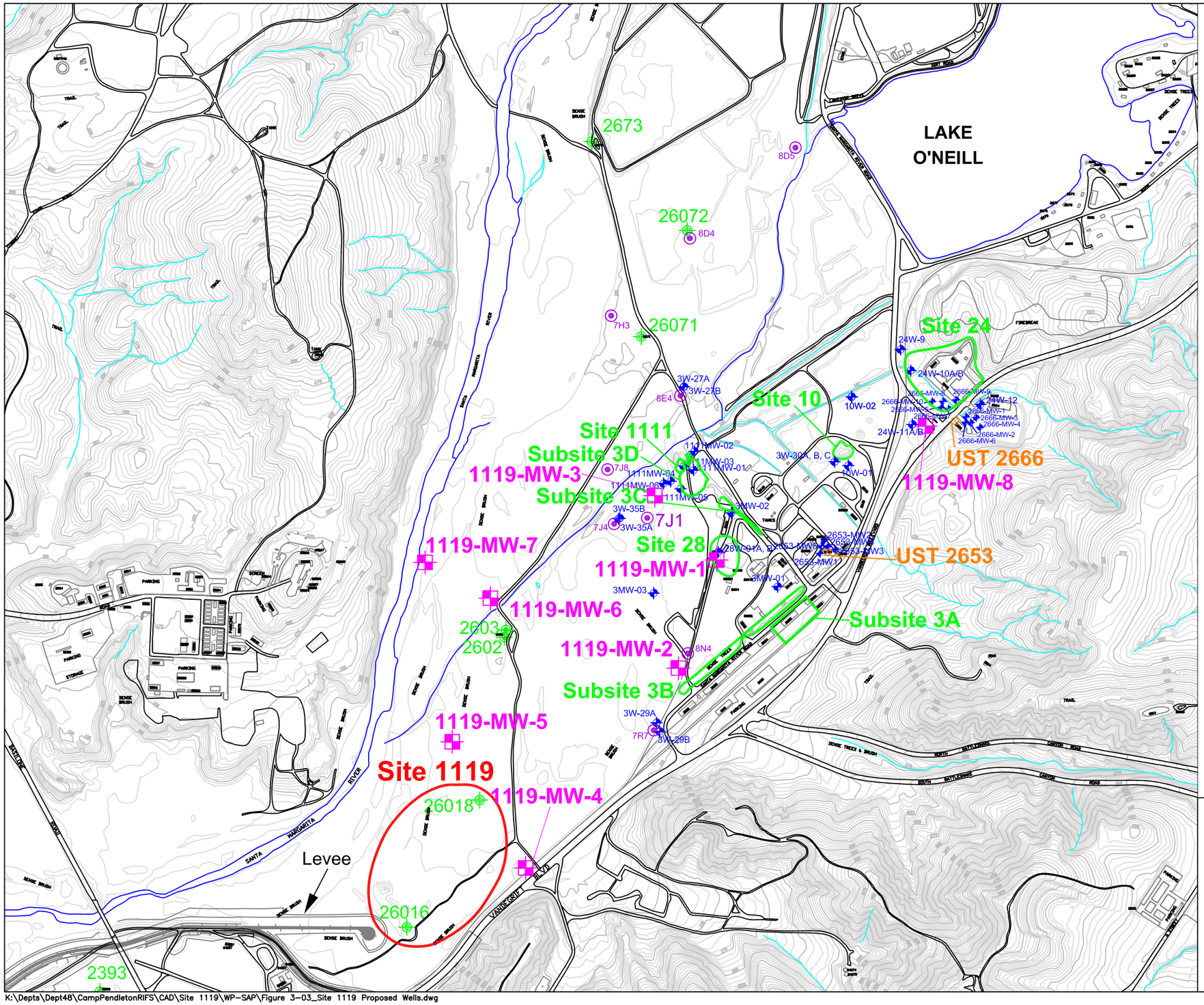

Figure 3-3

Site 1119
Proposed Groundwater Monitoring Well Locations

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 3-03_Site 1119 Proposed Wells.dwg

APPENDIX A
SAMPLING AND ANALYSIS PLAN (FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN)

SAP Worksheet #1 -- Title and Approval Page

DRAFT
SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
for Site 1119 Groundwater
Marine Corps Base Camp Pendleton, California

November 10, 2010

Prepared for:
NAVAL FACILITIES ENGINEERING COMMAND – SOUTHWEST DIVISION
1220 Pacific Highway, San Diego, CA 92132-5190

Prepared by:
PARSONS
100 W. Walnut St., Pasadena, California 91124
(626) 440-4000

Prepared under:
Contract Number: N62473-09-D-1212
Delivery Order Number: 0014
Document Control Number: SDV-1212-0014-0011

Reviewed By: Steve T. Griswold
Steve Griswold PG
Parsons Project Manager
Date: 11-10-10

Reviewed By: Cindy Zicker
Cindy Zicker
Parsons Quality Assurance Manager
Date: 11-10-10

Approved By: Joseph Michalowski for
Nars Ancog
NAVFAC Quality Assurance Officer
Date: 11-10-2010

EXECUTIVE SUMMARY

This Sampling and Analyses Plan (SAP) provides a discussion of the technical approach for a groundwater investigation at Site 1119 at the Marine Corps Base (MCB) Camp Pendleton, California. The investigation is designed to evaluate the extent and potential sources of volatile organic compounds (VOCs) detected in Base water supply wells (wells 26016 and 26018) in the 26 Area (Figure 1). Former Installation Restoration (IR) sites that may be contributing to water quality in the 26 Area include former Sites 3, 10, 24, 28, and 1111 and former UST Sites 2653, 2666, and H49. Site 1119 was added to the IR program because of trichloroethene (TCE) detected at a concentration of 11 µg/L during installation of new Base water supply well 26016 (CDM, 2009).

Because TCE was detected when these Base water supply wells were being installed, the U.S. Geological Survey (USGS) conducted hydrogeological and analytical testing at 26016 and 26018. Well 26016 contained concentrations of TCE (0.51 µg/L J1) and cis-1,2-dichloroethene (DCE) (0.45 µg/L J1). Well 26018 contained concentrations of cis-1,2-DCE (0.37 µg/L J1) and 1,2,3-trichloropropane (TCP) (0.0064 µg/L). The USGS investigation and these detections are discussed in more detail in the Work Plan. The purpose of the field investigation at Site 1119 is to identify potential sources of the VOCs, including 1,2,3-TCP, detected in the new Base production wells (26016 and 26018).

SAP Worksheets

#1 -- Title and Approval Page 1
#2 -- SAP Identifying Information 10
#3 -- Distribution List 13
#4 -- Project Personnel Sign-Off Sheet 15
#5 -- Project Organizational Chart 16
#6 -- Communication Pathways 17
#7 -- Personnel Responsibilities and Qualifications Table 19
#8 -- Special Personnel Training Requirements Table 21
#9 -- Project Scoping Session Participants Sheet 22
#10 -- Problem Definition 24
#11 -- Project Quality Objectives/Systematic Planning Process Statements 26
#12 -- Measurement Performance Criteria Table in Groundwater Samples 31
#13 -- Secondary Data Criteria and Limitations Table 32
#14 -- Summary of Project Tasks 34
#15 -- Reference Limits and Evaluation Table 46
#16 -- Project Schedule 52
#17 -- Sampling Design and Rationale 53
#18 -- Sampling Locations and Methods/SOP Requirements Table 54
#19 -- Analytical SOP Requirements Table 57
#20 -- Field Quality Control Sample Summary Table 58
#21 -- Project Sampling SOP References Table 60
#22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table 61
#23 -- Analytical SOP References Table 62
#24 -- Analytical Instrument Calibration Table 63
#25 -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 67
#26 -- Sample Handling System 69
#27 -- Sample Custody Requirements Table 70
#28 -- QC Samples Table 73
#29 -- Project Documents and Records Table 91
#30 -- Analytical Services Table 92
#31 -- Planned Project Assessments Table 93
#32 -- Assessment Findings and Corrective Action Responses 94
#33 -- QA Management Reports Table 95
#34 -- Verification (Step I) Process Table 96
#35 -- Validation (Steps IIa and IIb) Process Table 97
#36 -- Analytical Data Validation (Steps IIa and IIb) Summary Table 99
#37 -- Usability Assessment 101

List of Figures

1 Site 1119 Site Location Map
2 Site 1119 Geologic Conceptual Site Model
3 Site 1119 Potential Exposure Pathways for Human Receptors
4 Site 1119 Existing Groundwater Monitoring Well Locations Included in Proposed Sampling
5 Site 1119 Existing Groundwater Monitoring Wells Near UST H49 Included in Proposed Sampling
6 Site 1119 Proposed Groundwater Monitoring Well Locations

List of Attachments

1 Examples of Chain-of-Custody Forms and Labels

2 Laboratory Control Sample (LCS) Control Limits for Volatile Organic Compounds

3 Laboratory Standard Operating Procedures

Laboratory to be determined (TBD)

Procurement of the analytical laboratory is not complete at this time. Specific information regarding company names, key personnel, and contact numbers will be provided when the SAP is finalized and before field implementation.

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ABBREVIATIONS AND ACRONYMS

µg/L	micrograms per liter
µg/kg	micrograms per kilogram
AFCEE	Air Force Center for Environmental Excellence
ASTM	American Society for Standards and Materials
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
C	Celsius
Cal/EPA	California Environmental Protection Agency
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	chain-of-custody
COPC	chemical of potential concern
CO_2	carbon dioxide
CPR	cardiopulmonary resuscitation
DCC	daily calibration check
DCE	dichloroethene
DEH	Department of Environmental Health
DI	deionized
DIPE	diisopropyl ether
DO	dissolved oxygen
DoD	Department of Defense
DON	Department of the Navy
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
DTSC	Department of Toxic Substances
ETBE	ethyl tertiary butyl ether
EWI	Environmental Work Instruction
FFA	Federal Facility Agreement
GC	gas chromatograph
GC/MS	gas chromatograph/mass spectrometer
GPS	Global Positioning System
GW	groundwater
HAZWOPER	hazardous waste operations and emergency response
HCl	hydrochloric acid
HDPE	high density polyethylene

L/min	liters per minute
ICAL	Initial calibration
ICV	Initial calibration verification
IDW	investigation-derived waste
LCS	laboratory control sample
LDC	Laboratory Data Consultants
MCB	Marine Corps Base
MCL	maximum contaminant level
MDL	method detection limit
MEK	methyl ethyl ketone
MIBK	methyl isobutyl ether
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
MTBE	methyl tert-butyl ether
mV	millivolts
NAVFAC	Naval Facilities Engineering Command, Southwest
NE	not established
NEDD	Navy Electronic Data Deliverable
NIRIS	Naval Installation Restoration Information Solution
NTU	nephelometric turbidity units
ORP	oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PC	percent complete
PDB	passive diffusion bag
PG	Professional Geologist
PID	photo-ionization detector
PM	Project Manager
POC	point-of-contact
PPE	personnel protection equipment
PT	proficiency testing (previously known as performance evaluation (PE) sample)
PVC	polyvinyl chloride
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
%R	percent recovery
RL	reporting limit
RPD	relative percent difference

RPM	Remedial Project Manager
RSD	relative standard deviation
RSL	regional screening level
RWQCB	Regional Water Quality Control Board
RT	retention time
SAM	Site Assessment and Mitigation
SAP	Sampling and Analysis Plan
SD	standard deviation
SOP	Standard Operating Procedure
SPAWAR	Space and Naval Warfare Command
SVOC	semivolatile organic compound
SW	Southwest
TAME	tertiary amyl methyl ether
TBA	tertiary butyl alcohol
TCE	trichloroethene
TCP	trichloropropane
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSA	technical systems audit
UFP	Uniform Federal Policy
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	Unites States Geological Survey
UST	underground storage tank
VOA	volatile organic analytes
VOC	volatile organic compound

SAP Worksheet #2 -- SAP Identifying Information

Site Name/Number: MCB Camp Pendleton, Site 1119
Operable Unit: Not assigned to an Operable Unit
Contractor Name: Parsons
Contract Number: N62473-09-D-1212, DO 0014
Contract Title: Small Disabled Veteran (SDV) Joint Venture Contract
Work Assignment Number (optional): Delivery Order 0014

1. This SAP was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (USEPA 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (USEPA 2002)*

2. Identify regulatory program:
This project is part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program.

3. This SAP is a project-specific SAP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Federal Facility Agreement (FFA) Meeting	May 20, 2010

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
None	

6. List organizational partners (stakeholders) and connection with lead organization: The stakeholders are the U. S. Environmental Protection Agency, Region 9 (USEPA), California Department of Toxic Substances (DTSC) and San Diego Regional Water Quality Control Board (RWQCB).

7. Lead organization
The Department of the Navy (DON) is the lead organization for this project.

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

No specialized training is required for this project.

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	
2	Table of Contents SAP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
Project Organization		
5	Project Organizational Chart	
6	Communication Pathways	
7	Personnel Responsibilities and Qualifications Table	
8	Special Personnel Training Requirements Table	No specialized training is required for this project.
Project Planning/ Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	
11	Site-Specific Project Quality Objectives	
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	
14	Summary of Project Tasks	
15	Reference Limits and Evaluation Table	
16	Project Schedule/Timeline Table	
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	
18	Sampling Locations and Methods/ Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	
19	Analytical Methods/SOP Requirements Table	
20	Field Quality Control Sample Summary Table	
21	Project Sampling SOP References Table Sampling SOPs	This project does not use sampling SOPs. Sampling procedures are identified in Worksheet #14.
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	
Analytical Tasks		
23	Analytical SOPs Analytical SOP References Table	
24	Analytical Instrument Calibration Table	
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	
Quality Control Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	
Data Management Tasks		
29	Project Documents and Records Table	
30	Analytical Services Table Analytical and Data Management SOPs	
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	
32	Assessment Findings and Corrective Action Responses Table	
33	QA Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	
35	Validation (Steps IIa and IIb) Process Table	
36	Validation (Steps IIa and IIb) Summary Table	
37	Usability Assessment	

SAP Worksheet #3 -- Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Theresa Morley	Remedial Project Manager	Naval Facilities Engineering Command, (NAVFAC) Southwest	(619) 532-1502	theresa.morley@navy.mil NAVFAC SW 1220 Pacific Highway San Diego, CA 92132-5190
Nars Ancog	Quality Assurance Officer	NAVFAC Southwest	(619) 532-3046	narciso.ancog@navy.mil NAVFAC SW 1220 Pacific Highway San Diego, CA 92132-5190
Tracy Sahagun	Assistant Chief of Staff	MCB Camp Pendleton Environmental Security	(760) 725-9752	tracy.sahagun@usmc.mil AC/S Environmental Security Box 55508, Bldg. 22165 Camp Pendleton, CA 92055-5008
Joseph M. Murtaugh	Installation Restoration Manager	MCB Camp Pendleton Environmental Security	(760) 725-9744	joseph.murtaugh@usmc.mil AC/S Environmental Security Box 55508, Bldg. 22165 Camp Pendleton, CA 92055-5008
Martin Hausladen	Project Manager	USEPA	(415) 972-3007	hausladen.martin@epa.gov U.S. EPA Federal Facilities Branch 75 Hawthorne Street San Francisco, CA 94105
Tayseer Mahmoud	Project Manager	DTSC	(714) 484-5419	tmahmoud@dtsc.ca.gov DTSC 5796 Corporate Ave. Cypress, CA 90630
Cheryl Prowell	Water Resource Control Engineer	RWQCB	(858) 467-2745	cprowell@waterboards.ca.gov San Diego RWQCB 9174 Sky Park Court, Suite 100 San Diego, CA 92123-4353

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Steve Griswold, PG	Project Manager	Parsons	(626) 440-6076	steve.griswold@parsons.com Parsons 100 West Walnut Street Pasadena, CA 91124
Cindy Zicker	Quality Assurance Manager	Parsons	(626) 440-6156	cindy.zicker@parsons.com Parsons 100 West Walnut Street Pasadena, CA 91124
Josh Sacker, PG	On-Site Health and Safety Officer	Parsons	(626) 440-6191	josh.sacker@parsons.com Parsons 100 West Walnut Street Pasadena, CA 91124
TBD	Project Manager	Analytical Laboratory Contractor[1]	TBD	TBD
Rich Amano	Principal Chemist	Laboratory Data Consultants (LDC)	(760) 634-0437	rich.amano@ldc.com LDC 7750 El Camino Real, Suite 2C Carlsbad, CA 92009

TBD – to be determined

1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding the analytical laboratory will be provided when the SAP is finalized and before field implementation.

SAP Worksheet #4 -- Project Personnel Sign-Off Sheet

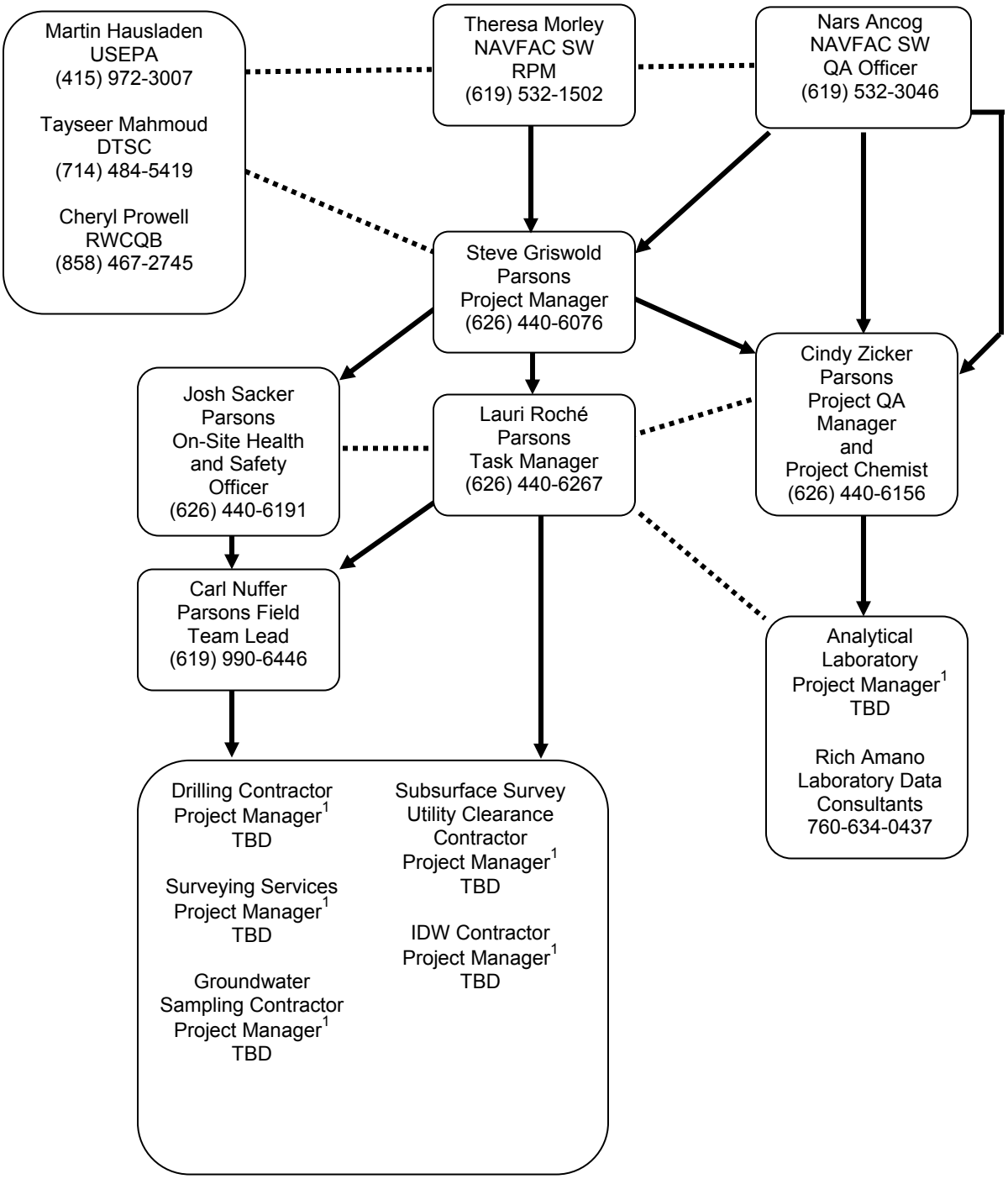
The Task Manager will personally provide a copy of the SAP to listed personnel and provide a master of this worksheet for signature. In addition, the Task Manager will be responsible for establishing the central files for the project and personally ensuring the signed worksheet is in the filing system.

Name	Organization/Title/Role	Telephone Number (optional)	Signature/email receipt	SAP Section Reviewed	Date SAP Read
Carl Nuffer, PG	Parsons/Field Team Leader	(619) 990-6446			
Lauri Roché	Parsons/Task Manager	(626) 440-6267			
Katia Kiseleva	Parsons/Geologist	(626) 440-2042			
TBD	Drilling Company Contractor[1]	TBD			
TBD	Laboratory/Project Manager[1]	TBD			
LDC Inc.	Rich Amano/Principal Chemist	(760) 634-0437			

TBD – to be determined

1 - Procurement of these services is not complete at this time. Company names, key personnel, and contact numbers will be provided when the SAP is finalized and before field implementation.

SAP Worksheet #5 -- Project Organizational Chart



1 – Procurement of these services is not complete at this time. Company names, key personnel, and contact numbers will be provided when the SAP is finalized and before field implementation.

TBD = to be determined

SAP Worksheet #6 -- Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Approvals	Navy Remedial Project Manager (RPM) Navy Quality Assurance Officer (QAO) Parsons Project Manager	Theresa Morley Nars Ancog Steve Griswold	(619)532-1502 (619) 532-3046 (626) 440-6076	Parsons Project Manager will be called for issues requiring approval request. Navy Personnel will be notified if any major problems or work delay occur.
Field Corrective Actions	Parsons Project Manager Health and Safety Officer Field Team Leader	Steve Griswold Josh Sacker Carl Nuffer	(626) 440-6076 (626) 440-6191 (619) 990-6446	Parsons Project Manager will be called once field problem has been identified and resolution/ corrective action will be decided.
Laboratory Corrective Actions[1]	Parsons Quality Assurance (QA) Officer Analytical Laboratory PM[1]	Cindy Zicker TBD	(626) 440-6156 TBD	Parsons QA Officer will be called once QA/quality control (QC) problem has been identified and resolution/ corrective action will be decided.
Stop Work Issues	Parsons Project Manager Parsons Health & Safety Officer Parsons Field Team Leader NAVFAC SW QAO	Steve Griswold Josh Sacker Carl Nuffer Nars Ancog	(626) 440-6267 (626) 440-6191 (619) 990-6446 (619) 532-3046	Project Manager, Health and Safety Officer, or Field Team Leader will be notified immediately.
Modifications to Sampling and Analysis Plan	Navy RPM Parsons Project Manager NAVFAC SW QAO	Theresa Morley Steve Griswold Nars Ancog	(619) 532-1502 (626) 440-6267 (619) 532-3046	Field Team Leader will call Parsons PM immediately once problem is identified. Parsons PM will immediately discuss resolution with Navy RPM and project will move forward with approved modifications. NAVFAC SW QAO approval must be secured as needed.

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Sampling and Analysis Plan Amendment	USEPA DTSC RWQCB Navy RPM Parsons PM Navy QAO	Martin Hausladen Tayseer Mahmoud Cheryl Prowell Theresa Morley Steve Griswold Nars Ancog	(415) 972-3007 (714) 484-5419 (858) 467-2745 (619) 532-1502 (626) 440-6076 (619) 532-3046	Regulatory Agencies will contact Navy RPM with direction to amend SAP. Navy RPM will contact Parsons PM with direction to amend SAP. Navy QAO approval needed.

TBD = to be determined

1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding the analytical laboratory will be provided when the SAP is finalized and before field implementation.

SAP Worksheet #7 -- Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Theresa Morley	Remedial Project Manager	NAVFAC SW	Responsible for project execution. Responsible for ensuring compliance with the Federal Facility Agreement (FFA) and adhering to the FFA schedule. The RPM is the Navy's primary point of contact (POC) and interacts with the regulatory agencies.
Nars Ancog	Quality Assurance Officer	NAVFAC SW	Responsible for governmental oversight of the QA Program. Provides quality-related directives through Contracting Officer's Technical Representative. Provides technical and administrative oversight of surveillance audit activities. Acts as POC for all matters concerning QA and the Navy's Laboratory QA Program. Coordinates training on matters pertaining to generation and maintenance of quality of data. Suspends project execution if QA requirements are not adequately followed.
Steve Griswold, PG	Project Manager	Parsons	Exercises project control over all project activities including field investigation and report writing. Responsible for planning and staffing to meet project requirements, assuring adequate planning for and execution of the Health and Safety Plan, implementing the SAP, ensuring project chemical data quality and data management, executing delivery order requirements, and coordinating with NAVFAC SW, MCB Camp Pendleton, and regulatory agencies.
Lauri Roché	Task Manager	Parsons	Exercises project oversight of the investigation activities and reports to the PM. Oversees the day-to-day progress of the investigation, including manpower, scheduling, and compliance with the SAP. Responsible for budget, schedule, and quality of technical memoranda, data packages, and reports.
Cindy Zicker	Quality Assurance Officer	Parsons	Responsible for ensuring sufficient QA procedures are developed for the project, that adequate quality controls are imposed to achieve the required level of quality control, that audits are conducted to verify the level of quality, and that these procedures and controls are implemented properly. Coordinates directly with the task manager and reports to the PM.
Josh Sacker, PG	Health and Safety Officer	Parsons	Responsible for approval and implementation of the project Health and Safety Plan.

Name	Title/Role	Organizational Affiliation	Responsibilities
Carl Nuffer, PG	Field Team Manager	Parsons	Responsible to the task manager for the conduct of site investigation activities and the coordination and scheduling of subcontract support. Supervise the field support facility team. Correct non-conformances identified in field methods. Implement field health and safety protocols and interact in field procedure training for all newly assigned field personnel. Ensure compliance with the SAP in handling and recording field samples.
TBD	Laboratory Project Manager[1]	TBD	Responsible for implementation of the SAP (for analytical control) and the laboratory subcontract. Ensures project-required QA/QC procedures for laboratory activities are adhered to for the project-specified level of data quality. The primary POC between the subcontract laboratory and the Parsons QA Officer.
Rich Amano	Principal Chemist	LDC	Ensures project-required QA/QC procedures for laboratory analyses are adhered to and determines data quality following SAP guidance and assigns data flags, as appropriate. Ensures adequate documentation provided by the laboratory to evaluate data quality.

TBD = to be determined

1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding the analytical laboratory will be provided when the SAP is finalized and before field implementation.

SAP Worksheet #8 -- Special Personnel Training Requirements Table

NO SPECIALIZED TRAINING IS REQUIRED FOR THIS PROJECT. However, personnel who work at a hazardous-waste site are required to meet the health and safety training requirements of Title 29 Code of Federal Regulations (29 CFR) Part 1910.120(e). All field staff and subcontractors must have successfully completed an initial Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) course, an annual 8-hour refresher course, and submit to annual medical clearance. Field staff must have current cardiopulmonary resuscitation (CPR)-First Aid certification. HAZWOPER Supervisor training is required for Parsons employees supervising field staff and subcontractors supervising their own field crews. Daily site-specific safety training will be conducted when field staff and subcontractors are engaged in field activities at the site.

SAP Worksheet #9 -- Project Scoping Session Participants Sheet

Project Name: MCB Camp Pendleton Site 1119 Projected Date(s) of Sampling: April 2011 Project Manager: Steve Griswold, PG	Site Name: Site 1119 Groundwater Site Location: MCB Camp Pendleton

Date of Session: May 20, 2010
Scoping Session Purpose: 100th FFA Meeting, discussed several sites including Site 1119

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Theresa Morley	Project Manager	NAVFAC SW	(619) 532-1502	theresa.morley@navy.mil	RPM
Geoff Buckner	Geologist	NAVFAC SW	(619) 532-3579	geoff.buckner@navy.mil	Geologist
Tracy Sahagun	Assistant Chief of Staff	MCB Camp Pendleton Environmental Security	(760) 725-9752	tracy.sahagunl@usmc.mil	Assistant Chief of Staff
Joseph Murtaugh	Installation Restoration Manager	MCB Camp Pendleton Environmental Security	(760) 725-9744	joseph.murtaugh@usmc.mil	Installation Restoration Manager
Steve Griswold, PG	Project Manager	Parsons	(626) 440-6076	Steve.Griswold@parsons.com	PM
Martin Hausladen	Project Manager	USEPA	(415) 972-3007	hausladen.martin@epa.gov	USEPA Representative
Tayseer Mahmoud	Project Manager	DTSC	(714) 484-5419	tmahmoud@dtsc.ca.gov	DTSC Representative
Kimberly Day	Project Manager	DTSC	(916) 255-6685	kday@dtsc.ca.gov	DTSC Representative
Cheryl Prowell	Water Resource Control Engineer	RWQCB	(858) 467-2745	cprowell@waterboards.ca.gov	RWQCB Representative

Project Name: MCB Camp Pendleton Site 1119 Projected Date(s) of Sampling: April 2011 Project Manager: Steve Griswold, PG	Site Name: Site 1119 Groundwater Site Location: MCB Camp Pendleton

Date of Session: May 20, 2010
Scoping Session Purpose: 100th FFA Meeting, discussed several sites including Site 1119

Bill Mabey	Hydrogeologist	TechLaw Inc.	(415) 281-8730 Ext. 24	bmabey@techlawinc.com	Hydrogeologist
Josh Sacker, PG	Project Geologist	Parsons	(626) 440-6191	josh.sacker@parsons.com	On-Site Health and Safety Officer/Project Geologist
Dan Griffiths	Project Geologist	Parsons	(303) 764-1940	daniel.r.griffiths@parsons.com	Project Geologist

Comments/Decisions:

A discussion of Site 1119 and the results at wells 26016 and 26018 was conducted at this meeting. The team discussed the need to sample selected wells at Former IR sites and to evaluate other areas that may be sources of contamination. The next step on the project will be preparation of a groundwater work plan.

Action Items: None

Consensus Decisions: The next step on the project would be preparation of a groundwater work plan.

SAP Worksheet #10 -- Problem Definition

The purpose of this worksheet is to define the problem(s) to be addressed by the project, as defined in "Step 1" in the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006).

Step 1 – State the Problem

Describing the problem. Several VOC compounds, including TCE and 1,2,3-TCP, have been detected in water supply wells (26016 and 26018) in the upper Santa Margarita River Basin above their respective maximum contaminant levels (MCLs) or the notification levels. Therefore, groundwater in the vicinity of these wells was designated as IR Site 1119. The source(s) of TCE and 1,2,3-TCP in groundwater is not known, so it was determined that investigation was required to evaluate potential sources and to determine possible remedial actions.

Therefore the following specific problem statements pertain to the investigation of Site 1119 groundwater:

- Limited data are available for VOCs including low level 1,2,3-TCP near the Base production wells in the upper Santa Margarita River Basin; therefore, more data are required to identify areas of higher VOC concentrations in groundwater and determine the possible source area(s).
- Once a suspected source is identified, site-specific data regarding the release mechanism are needed for potential remedy evaluation.
- Collecting more data on general geochemistry of groundwater and hydrogeologic regimes of the river basin are needed to understand mechanisms of contaminant transport at the site and to determine possible remedial actions.

Establishing the planning team. The planning team includes Naval Facilities Engineering Command, Southwest (NAVFAC SW), the USEPA, the California Environmental Protection Agency (Cal/EPA) DTSC, and the San Diego RWQCB.

Describing the conceptual model of the potential hazard. The exact origin of chlorinated VOCs in groundwater at Site 1119 has not been ascertained. However, there are several former IR and UST sites upgradient of the contaminated wells with existing groundwater monitoring wells that may be used to help narrow down the search for source(s) (Figure 1).

Shallow subsurface geology in the vicinity of Site 1119 consists primarily of Holocene stream-deposited alluvium overlying bedrock either assigned to the Santiago Formation (eastern side of the subbasin) or the Cretaceous-age basement complex (western side of the subbasin). The Santiago Formation broadly consists of inter-bedded sandstone, siltstone, and mudstone. The Santiago Formation unconformably overlies the Cretaceous-age basement complex consisting of granite related to the Peninsular Range batholith (Worts and Boss, 1954).

The Upper Alluvium consists of unconsolidated sand and silt with lesser amounts of clay and gravel. The underlying Lower Alluvium generally consists of more sand and gravel, and less fine grained sediments. A conceptual site model is shown on Figure 2 and will be refined with specific site information as part of this investigation.

The groundwater underlying Site 1119 occurs within the mostly coarse grained Holocene alluvial deposits, as described in the Work Plan. Groundwater is generally unconfined in the Upper Ysidora subbasin, with the water table at approximately 10 feet bgs based on data from nearby sites. Within the Upper Ysidora subbasin, groundwater flows to southwest (down the

valley toward the ocean) at an average gradient of approximately 0.002 ft/ft, with flow direction closely following the path of the Santa Margarita River. The water table and hydraulic gradient will be accurately mapped as part of this investigation.

Site 1119 is located in the Santa Margarita River basin, a watershed occupying approximately 50 square miles on Base and about 700 square miles off the Base (SWDIV, 1993). The groundwater in the Santa Margarita River basin is classified as beneficial use. Four Base water supply wells are within the same area of the groundwater basin and upgradient of wells 26016 and 26018. Because of the low annual rainfall, surface flow is ephemeral and occurs primarily in the Santa Margarita River and several drainage ditches near the site.

The highest detected TCE concentration was measured at 11 µg/L during pump testing at production well 26016 (CDM, 2009). This concentration exceeds the MCL for TCE of 5 µg/L.

The areas of the site near the Santa Margarita River and the Base Production wells are heavily vegetated and undeveloped. Areas of the site near former IR or UST sites are developed and include industrial buildings, an air station complex, and warehouses. Given the site's military use, it is highly unlikely that the area would be redeveloped for residential use. However, consistent with the Base's desire to avoid formal land use restrictions and monitoring requirements, a hypothetical future resident will be one receptor of interest for future decision making. Exposure pathways and receptors are shown on Figure 3.

Identifying available resources, constraints, and deadlines. The planning team determined that the analytical laboratory that will be contracted will need to meet all of the project action limits specified in this document. There are also practical constraints to conducting field work at the site, including entry into a restricted area. The site is located at the military base with restricted access controlled by Base personnel, so close coordination will be required to ensure that field data collection can be conducted without interfering with Base operations. With regard to resources, company staff is available to conduct the planned work, and the staff has the required training.

SAP Worksheet #11 -- Project Quality Objectives/Systematic Planning Process Statements

The purpose of this worksheet is to define project quality objectives and the planning process, as defined in "Steps 2 through 7" in the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006).

Step 2 – Identify the Goal of the Study

The following decision questions have been developed to address the investigation objectives outlined in Step 1 – Problem Statement (Worksheet #10):

- What depth(s) of the screened intervals is contributing to VOC concentrations detected in groundwater samples collected from wells 26016 and 26018?
- Is one of the upgradient former IR or UST sites a source of VOCs?
- Is there an upgradient source of VOCs, other than former IR or UST sites, impacting wells 26016 or 26018?
- Should remediation be focused on addressing source areas of contamination, or on treatment of water at the Base water supply wells 26016 and 26018?

The next step (Step 3 of this Worksheet) will discuss data needed to answer the study questions listed above, and the decision rules outlined in Step 5 will guide how the data will be used to address these questions.

Step 3 – Identify Information Inputs

- **Identify the type of information that is needed to resolve the decision statement.**

  Groundwater Data: Wells at former IR Sites 3, 10, 24, 28, and 1111 and former UST Sites 2653, 2666, and H49 will be inspected, and water levels and total depth measured to determine groundwater gradient and condition and suitability of wells for sampling and also to determine if wells need to be re-developed prior to use.

  Groundwater samples will be collected at the following 16 existing wells: 3W-27A, 3W-27B, 3W-29A, 3W-29B, 3W-30A, 3W-30B, 3W-30C, 3W-35A, 3W-35B, 24W-11A, 24W-11B, 28W-01A, 28W-01B, H49-MW1, OWR-5E3, and OWR-7J8 (Figures 4 and 5). These wells were selected based on past sample data, location compared to contaminated wells 26016 and 26018, and screened intervals, as discussed in more detail in the Work Plan. Groundwater samples from some of these wells were never analyzed for VOCs, and none of these wells were analyzed for 1,2,3-TCP at the lower detection limits developed in 2003.

  Groundwater samples will be collected at wells 26016 and 26018 at multiple depths using passive diffusion bags (PDBs) to obtain a vertical profile of chemical distribution. Although these wells have been sampled by both the Base and by the USGS previously, the PDB method will provide more current data. A more current vertical profile will be helpful in identifying stratigraphic layers that may be contributing detectable chemical concentrations to the wells. Existing Base supply wells upgradient of the site are not included in the planned sampling because they are periodically sampled by the Base Office of Water Resources.

  Up to eight groundwater monitoring wells (1119-MW-1 through 1119-MW-8) with up to four nested wells at each location are proposed to be installed to evaluate potential source areas (Figure 6). As discussed in more detail in the Work Plan and under Step 5, locations for these wells will be finalized based on the results of the groundwater samples collected

at the existing wells and in consultation of the FFA team. Maximum total depth of the new monitoring wells will be 100 feet bgs, based on the data reviewed to date, and screened intervals will be determined based on geology observed during drilling. Groundwater samples will be collected at the newly installed wells.

All groundwater samples will be analyzed for VOCs; 1,2,3-TCP; methane, ethane, ethene; general minerals; total organic carbon (TOC); and total dissolved solids (TDS). In addition, groundwater samples will be analyzed in the field for geochemical parameters (dissolved oxygen [DO], oxidation/reduction potential [ORP], pH, conductivity, temperature, alkalinity, carbon dioxide (CO_2), and iron (II)). The non-VOC analyses will be collected to establish baseline groundwater geochemical conditions.

Geotechnical/Geophysical Data: Geotechnical soil analysis data and geophysical borehole data will be collected from the eight new well locations at the site. Samples will be analyzed for bulk density, moisture content, grain size distribution, TOC, and cation exchange capacity. These data will be used to improve the understanding of the hydrogeologic framework of the site, including the depth, thickness, and extent of low permeability layer(s) within the shallow and deep groundwater, and to assess pathways for potential contaminant migration.

- **Identify the source of information:** Laboratory analytical reports from the collected soil and groundwater samples.
- **Identify how the action level will be determined:** The action levels listed on Worksheet #15 have been derived using USEPA guidance, and DTSC guidance has also been taken into consideration (DTSC 2009). The DTSC guidance recommends the use of the USEPA Regional Screening Levels (RSLs) for the majority of chemicals. For those chemicals that DTSC guidance (2009) does not recommend the use of the RSLs, the alternative value recommended by DTSC (2009) has been used for this worksheet. Action levels in groundwater samples have been derived from the drinking water maximum contaminant level (MCLs). If a particular contaminant does not have an MCL, DTSC guidance (2009) has been followed to derive an appropriate action level.
- **Identify the appropriate sampling and analytical method:** VOCs in groundwater samples will be analyzed using Method SW8260B and 1,2,3-TCP will be analyzed using Method SW8260B SIM. Groundwater samples for methane, ethane, and ethene; general minerals, TOC; and TDS will be analyzed using EPA Methods RSK175 SOP, E300.0, SM4500F-C, SM5310B, 6010B, SM2320B, SM2340C, and SM2540C, respectively. In addition, geotechnical analysis of soil samples for bulk density, moisture content, grain size distribution, cation exchange capacity, and TOC will be performed in accordance to American Society for Standards and Materials (ASTM) Methods D2937, D2216, D422/D4464M, EPA Method SW 9081, and Walkley-Black.

Step 4 – Define the Boundaries of the Study

- **Specify the target population:** The target population will consist of all soil and groundwater samples collected at the selected locations. The sample volume will be determined by the analytical laboratory requirements.
- **Specify the spatial and temporal boundaries and other practical constraints:** The study boundaries at Site 1119 are dependent on the project stage and sampling matrix and are discussed below.
  - Groundwater Sampling: The spatial study boundaries for the groundwater sampling are defined by the area that encompasses newly constructed monitoring wells (1119-MW-1 through 1119-MW-8 with up to four nested wells at each location)) and 16 existing wells

being sampled as part of this investigation (3W-27A, 3W-27B, 3W-29A, 3W-29B, 3W-30A, 3W-30B, 3W-30C, 3W-35A, 3W-35B, 24W-11A, 24W-11B, 28W-01A, 28W-01B, H49-MW1, OWR-5E3, OWR-7J8) and southwest to Base Production Wells 26016 and 26018. The vertical boundary is defined by the well construction specifications, in particular depth of the screen intervals.

The *temporal constraint* for conducting the proposed groundwater sampling is that groundwater analysis of samples collected from the existing wells must be conducted prior to installation of new wells, since that data are necessary to finalize well locations and sampling depths.

- **Specify the scale of interference for decision making:** Individual groundwater sample analytical results are the smallest units used for decision making during this project. Collectively, those data with concentrations below project criteria (Worksheet #15) will define areas that do not require action while data above project criteria indicate areas that will require remediation.

Step 5 – Develop the Analytical Approach

Soil and groundwater action limits for chemicals of concern at the site are identified on Worksheet #15. The decision rules have been developed to address the investigation objectives outlined in Step 2 for the planned activities at Site 1119.

- **IF** groundwater sample results at specific depth(s) sampled in wells 26016 or 26018 show that VOCs are present at concentrations that exceed action levels (Worksheet #15), **THEN** it will be concluded that this depth(s) should be screened in the construction of new wells.
- **IF** groundwater sample results at specific depths sampled in wells 26016 or 26018 show that VOCs are not present at concentrations that exceed action levels (Worksheet #15), **THEN** it will be concluded that the previous VOCs above action levels were the result of pumping during well testing, and previous data will be used to determine depths where well screens in new wells should be placed.
- **IF** groundwater sample results at an existing well at the former IR or UST site show that VOCs are present at concentrations that exceed action levels (Worksheet #15), **THEN** it will be concluded that the former site is a potential source of contamination, plume maps will be adjusted to include this point, and the locations of new wells or their screened intervals may be modified in consultation with the FFA Team to better evaluate the extent of contamination.
- **IF** groundwater sample results at an existing well at the former IR or UST site show that VOCs are not present at concentrations that exceed action levels (Worksheet #15), **THEN** it will be concluded that the former site is not a potential source of contamination and no further action at that location will be necessary.
- **IF** sample results from a new well show that VOCs are present at concentrations that exceed action levels (Worksheet #15), **THEN** it will be concluded that contamination is present at that location and plume maps will be adjusted to include this point.
- **IF** sample results from a new well show that VOCs are not present at concentrations that exceed action levels (Worksheet #15), **THEN** it will be concluded that groundwater contamination is not present at that location, and the plume maps will not include this point and no further action at that location will be necessary.
- **IF** sample results from existing and/or new wells show that VOCs are present at concentrations that exceed action levels (Worksheet #15), **THEN** remediation

strategies developed in the feasibility study will focus on addressing the identified source areas of contamination.

- **IF** sample results from existing and/or new wells show that VOCs are not present at concentrations that exceed action levels (Worksheet #15), **THEN** remediation strategies developed in the feasibility study will focus on treatment of water at the points of discharge (i.e. Base water supply wells 26016 and 26018).

Step 6 – Specify Performance or Acceptance Criteria

The nature of field investigations lends itself to uncertainties, and because data are being collected on a judgmental basis, limits on decision errors cannot be quantified. However, potential errors that may be encountered in the field can be mitigated through the use of established sampling procedures.

One type of decision error, referred to as a false negative error, may arise if sampling or analyses fail to detect contamination that is present at levels of concern. This type of error would result in incorrectly concluding that soil and/or groundwater contamination does not exist at levels in excess of those that are protective of direct contact and groundwater (i.e., soil screening criteria). This type of error will be minimized by optimizing the sampling design such that samples are collected in the area(s) where contamination is most likely to exist. Additionally, data from each well will be compared to data from nearby (i.e., surrounding) wells to check the results for consistency. Also, analytical detection limits will be used that are below the project action levels specified in Worksheet #15.

Incorrectly concluding that contamination is present at levels above the project action level when in fact it is not is another type of potential decision error. This type of error may result if analytical results of soil/groundwater samples overestimate actual contaminant concentrations, if samples are cross-contaminated, or if contaminants are misidentified. To minimize the potential for this type of error, appropriate sampling and analytical methods (including thorough decontamination procedures, sampling cleanest well first, etc.) will be employed and all laboratory data will undergo third-party validation to identify any problems that could lead to this type of decision error.

Another type of decision error involves concluding that groundwater contaminants are undergoing remediation when in fact they are not. This type of decision error can be mitigated by using multiple lines of evidence to decide whether or not the remediation is occurring. The USEPA and Air Force Center for Environmental Excellence (AFCEE) protocols that will be employed to evaluate the occurrence of intrinsic remediation already do this; therefore, the probability of this type of error will be minimized by adhering to these established protocols.

The converse of the above decision error is another potential error; however, the probability of this type of error can also be controlled using the same multiple lines of evidence approach to evaluating the effectiveness of the remediation program.

Step 7 – Develop the Detailed Plan for Obtaining Data

The purpose of this final step is to define the sampling and analysis program for data collection based on the knowledge gained in the previous six project quality objective steps.

The investigation design and implementation at Site 1119 uses a judgment-based approach that relies on information gathered during the project and previous investigations to guide further data collection. Each step of data collection will be optimized based on interpretation of results from the previous step.

Wells at former IR Sites 3, 10, 24, 28, and 1111 and former UST Sites 2653, 2666, and H49 will be inspected and water levels and total depth measured to determine groundwater gradient and

condition and suitability of wells for sampling and also to determine if wells need to be re-developed prior to use.

Existing wells will be sampled to determine current contaminant concentrations in site groundwater at available locations that might be helpful in defining contaminant distribution or possible sources (Figures 4 and 5).

New monitoring wells will be placed based on the results of the known site hydrogeology, known chemical of potential concern (COPC) detections, and geotechnical subsurface data obtained during monitoring well installations. The proposed well locations are shown in Figure 6. Final well locations may be modified by the field team, in consultation with the Federal Facility Agreement (FFA) team, based on analysis and interpretation of the data gathered during the field work.

The groundwater sampling design for the selected locations is shown on Figures 4, 5, and 6 and described in Worksheet #17. The rationale for including particular monitoring wells is also discussed in Worksheet #17. All soil and groundwater samples will be analyzed by the certified fixed laboratory. The analytical program is summarized in Worksheet # 18.

SAP Worksheet #12 -- Measurement Performance Criteria Table in Groundwater Samples

Measurement Performance Criteria Table – Field QC Samples (Groundwater)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicates	VOCs; 1,2,3-TCP; Methane, Ethane, Ethene; Chloride, Fluoride, Nitrate, Nitrite, Sulfate; Calcium, Manganese, Potassium, Sodium; TOC; TDS; Alkalinity	One field duplicate pair per ten field samples	Precision-Overall	RPD≤35% when target compound detected for both field duplicate samples; for results ≤5xQL the range between results must be ≤2xQL	S&A
Trip Blanks	VOCs;1,2,3-TCP; Methane, Ethane, Ethene	One trip blank for each cooler containing VOC and/or dissolved gas samples	Accuracy/Bias Contamination	Temperature must be with 4±2°C; No target compounds ≥ QL	S&A
Temperature Blanks	VOCs;1,2,3-TCP; Methane, Ethane, Ethene; Alkalinity	One temperature blank for each cooler shipped to the lab	Accuracy/Bias Contamination	Temperature must be with 4±2°C	S
Source Blank	VOCs;1,2,3-TCP; Methane, Ethane, Ethene; Chloride, Fluoride, Nitrate, Nitrite, Sulfate; Calcium, Manganese, Potassium, Sodium; TOC	One source blank per sampling event	Accuracy/Bias Contamination	No target compounds ≥ QL	S&A
Equipment Rinsate Blank	VOCs;1,2,3-TCP; Methane, Ethane, Ethene; Chloride, Fluoride, Nitrate, Nitrite, Sulfate; Calcium, Manganese, Potassium, Sodium; TOC	One equipment rinsate blank per sampling event for each type of sampling equipment used	Accuracy/Bias Contamination	No target compounds ≥ QL	S&A

SAP Worksheet #13 -- Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
Soil and Groundwater Data	Parsons, "*Draft Final Operable Unit 5 Remedial Investigation Report for Sites 1A-1, 6A, 21, 1111, and 12 Area*", July 21, 2004.	Parsons: VOC, semivolatile organic compounds (SVOCs), Dissolved Gasses, Metals, Pesticides, Dioxins/Furans, and geochemical parameters groundwater data Collection date: December 1998 through March 2003	Historical Groundwater from Site 1111	None
Soil and Groundwater Data	SWDIV, 1993. *Draft Final RI Report for Group A Sites, Remedial Investigation/Feasibility Study*, Marine Corps Base Camp Pendleton, California, prepared by Jacobs Engineering Group Inc.	SWDIV: VOC, SVOC, metals, geochemical parameters, and groundwater data; well construction details and boring logs Collection date: July 1992 to March 1993	Historical Groundwater from Sites 3 and 24	None
Soil and Groundwater Data	SWDIV, 1996. *Draft Final RI Report for Group C Sites, Remedial Investigation/Feasibility Study*, Marine Corps Base Camp Pendleton, California, prepared by Jacobs Engineering Group Inc., 23 September.	SWDIV: VOC, SVOC, metals, geochemical parameters, and groundwater data; well construction details and boring logs Collection date: December 2001 to March 2003	Historical Groundwater from Site 28	None
Soil and Groundwater Data	SWDIV, 1997. *Draft Final RI Report for Group D Sites, Remedial Investigation/Feasibility Study*, Marine Corps Base Camp Pendleton, California, prepared by Jacobs Engineering Group Inc., 14 February.	SWDIV: VOC, SVOC, metals, geochemical parameters, and groundwater data; well construction details and boring logs Collection date: late 1993 to 1994	Historical Groundwater from Site 10	None

Secondary Data	**Data Source** (originating organization, report title and date)	**Data Generator(s)** (originating organization, data types, data generation / collection dates)	**How Data Will Be Used**	**Limitations on Data Use**
Well Construction Details	CDM, 2009. *Well 26016 Final Casing Design*, Camp Pendleton Water and Wastewater System, Design, Build, Operate and Maintain, Contract N68711-04-D-5110-0018, DO 0018 (Area 26 wells).	CDM: borehole log, well construction diagram, geophysical logs; Collection date: January 2009	Site characterization	None
Groundwater Data	Battelle, 2009. Semiannual Groundwater Monitoring Report for Former UST Site 2653, MCB Camp Pendleton, California.	Battelle: groundwater elevations, well construction details, analytical data Collection date: April and May 2009	Site characterization	None
Groundwater Data	EAR, 2008. *Final Annual Groundwater Monitoring Report – 2007*, Underground storage tank Site 2666, MCB Camp Pendleton, California.	EAR: well construction details, analytical data, historic site information Collection date: 2007	Site characterization	None

SAP Worksheet #14 -- Summary of Project Tasks

This section presents the proposed data collection methods and procedures to be followed during field activities at Site 1119 as described in Worksheet #17.

14.1 Fieldwork Tasks

14.1.1 Permitting and Underground Clearance

This task includes preparing permits and conducting a geophysical clearance survey to clear well locations that may be in proximity to utilities. Underground utility clearance will be completed for each well location. The entire area within a 10-foot radius of each proposed well location will be cleared.

14.1.2 Well Drilling and Installation

All monitoring wells will be drilled and installed using a hollow-stem auger drill rig. During drilling, detailed continuous logging will be conducted from ground surface to the total depth of the borehole, which will extend up to 100 feet bgs. Boreholes will be described using the Unified Soil Classification System (USCS). Soil borings will be screened with a photoionization detector (PID). PID readings will be recorded on borehole logs.

Groundwater monitoring wells will be constructed of 4-inch diameter, flush-jointed and threaded, Schedule 40 polyvinyl chloride (PVC) casing and screen. The screen size will range between 0.01 and 0.02-inch and the well screened intervals will range from 30 to 100 feet. The exact slot size and screened interval depths will be determined based on lithologic and hydrogeologic characteristics of the site. If the borehole is deeper than the bottom of the screen, the borehole will be backfilled to within 1 foot of the screen interval with bentonite pellets. After the screen and casing is placed inside the borehole, a 1-foot layer of filter pack sand will be placed in the well annulus on top of the bentonite pellets. The filter pack will be selected based on silt and clay content present and will extend from the bottom of the boring to at least 2 feet above the screen. Bentonite-cement grout will be used to fill the annulus above the sand pack. Newly installed monitoring wells will be installed in accordance with the State of California Well Standards (Bulletins 74-81 and 74-90) and the County of San Diego Site Assessment and Mitigation (SAM) Manual.

14.1.3 Soil Sampling

Soil samples will be collected during drilling of the new wells. Each soil sample will be described using the USCS and noted whether or not there is visual evidence of suspected contamination. Worksheet #18.1 provides a list of the proposed soil samples that will be collected at the site. Soil samples collected from 1119-MW-1 through 1119-MW-8 will be chosen from within the vadose zone or within the screened interval, as described on Worksheet #18.1. Soil samples will be analyzed for geochemical parameters, including TOC.

For soil analyses, if the soil sample is not collected with an acetate, brass, or stainless-steel sleeve, the sample will be transferred from the sampler into 8-ounce wide-mouth glass jars using a trowel, sealed, and chilled to 4 ± 2 °C immediately upon collection. Soil samples collected in an acetate, brass, or stainless-steel sleeve will be covered with a Teflon square and capped, then chilled to 4 ± 2 °C.

14.1.4 Well Development

All newly installed substrate injection and groundwater monitoring wells will be developed prior to substrate injection and groundwater sampling. Wells will be developed by surging and

removing a minimum of three casing volumes of groundwater using a Grundfos® pump (or similar) and disposable high density polyethylene (HDPE) tubing. As the well casing volumes are removed, geochemical parameters DO, temperature, pH, ORP, electrical conductivity, and turbidity will be monitored with a field instrument. The geochemical parameters will be allowed to stabilize in accordance with USEPA well development criteria.

14.1.5 Water-Level Measurements

Groundwater monitoring wells will be measured for depth to water from top of casing and total well depth (only for wells that are designated for sampling during this investigation). An electronic sounder, accurate to the nearest ±0.01 feet, will be used to measure depth to water in each well. When using an electronic sounder, the probe will be lowered down the casing to the top of the water column, and the graduated markings on the probe wire or tape will be used to measure the depth to water from the surveyed point on the rim of the well casing. Total well depth will be sounded from the surveyed top of casing (north side) by lowering the weighted probe to the bottom of the well and recording the depth to the nearest 0.1 foot. The weighted probe will sink into silt, if present, at the bottom of well screen.

Water-level sounding equipment will be decontaminated before and after use in each well. Water levels will be measured in wells that have the least amount of known contamination first. Wells with known or suspected contamination will be measured last.

14.1.6 Purging Procedures

All of the wells designated for sampling will be purged prior to sampling. When a submersible pump is used for purging, clean flexible Teflon-lined tubes will be used for groundwater extraction. The tubes used for each well will either be dedicated or decontaminated before use in each well. Submersible pumps will be decontaminated before use in each well as described in Section 14.1.14. Pumps will be placed 2 to 3 feet from the bottom of the well to permit reasonable draw-down, while preventing cascading conditions. If low-flow procedures are unable to meet the requirements, then the conventional purging method will be used.

14.1.6.1 Low-Flow Purging

Low-flow procedures will be used for groundwater purging and sampling following procedures of the USEPA and San Diego County (USEPA, 1996; DEH, 2009). Low-flow/low-volume sampling can control sample turbidity and minimize sample chemistry alteration by pumping at very low flow rates from the well screen zone, avoiding disturbance to the water column in the well and minimizing stress on the surrounding formation. By pumping water only from the screen zone and not drawing water that may be present above the screen, the volume of water purged to achieve stable water chemistry can be reduced significantly. Samples obtained in this manner will better reflect the groundwater chemistry at ambient flow conditions and the true mobile load of any contaminants present. The procedures are as follows:

- A bladder pump with disposal bladders will be slowly lowered into the well to a point in the middle of the screened interval. Caution will be employed in order to avoid contact with the bottom of the well as this may cause unnecessary agitation of silt. In general, a portable pump shall be installed approximately 2 hours prior to start-up to allow settling of solids and re-establishment of horizontal flow through the screen zone; however, this time will vary based on formation materials and well construction. The position of the pump intake will not be altered once purging begins.
- The hosing from the pump will be connected to the flow-through cell/YSI 6820 meter (or equivalent). The display on the YSI 6820 screen should include pH, specific conductivity, temperature, turbidity, DO, and ORP.

- During purging and sampling, the target equilibrium pumping rate should be 0.1 to 0.5 liters per minute (L/min), or lowest flow rate possible (< 1.0 L/min maximum), and surging should be avoided. If the initial turbidity reading is high (>50 nephelometric turbidity units [NTUs]) and the second reading is not significantly lower, the pump rate should be lowered until turbidity decreases. If high turbidity rates persist after pumping rates are reduced, turn the pump off to allow turbidity to settle, and restart the purging process.
- The water level will be periodically checked to monitor drawdown during purging. The allowable static water level drawdown shall not generally exceed 25 percent of the distance between the top of the saturated well screen (or the air-water interface in an unconfined aquifer) and the pump intake, because there is a danger that recharging water will cascade into the well, causing excessive turbulence, which can compromise the quality of the sample (ASTM D: 6771, 2002). If drawdown exceeds these criteria using the lowest pumping rates, then it will be noted in the field records and also in the data report.
- Field parameters shall be recorded every 3 to 5 minutes, depending on flow rate.
- Purging will continue until all field parameters have stabilized for three consecutive readings. Stabilization is achieved after all indicator parameters have stabilized within the predetermined ranges presented below for each water chemistry parameter for three successive readings (DEH, 2004).

Stability Criteria for Low-Flow Purging	
Constituent	**Criteria**
Temperature	± 3% (min. of ± 0.2 °C)
pH	± 0.2 units
Specific conductance	± 3% to 5%
Oxidation/reduction potential (ORP)	± 20 mV
Dissolved oxygen:	± 0.2 mg/L
Turbidity	±10%

- If water level parameter criteria are not met after 4 hours of purging, the sample will be collected and the lack of stabilization recorded. If a monitoring well is pumped dry before water stabilization criteria have been achieved, the sample shall be collected after the water has recovered to 80 percent of its original level.

14.1.6.2 Conventional Purging

Once the well casing volume has been calculated, a minimum of three casing volumes of water will be purged using a submersible pump, or bailer, depending on the diameter and configuration of the well. Water will be collected into a measured bucket to record the purge volume. Casing volumes will be calculated based on total well depth, standing water level, and casing diameter. One casing volume will be calculated as:

$$V = \pi r^2 hc$$

where:

V = Volume to be purged for one casing volume in gallons
r = Radius of casing in feet
h = Static water column in the well in feet
c = Volumetric conversion from cubic feet to gallons (7.48 gallons/ft^3)

It is most important to obtain a representative sample from the well. Stable water quality parameter measurements (temperature, pH and electrical conductivity) indicate that a

representative sampling is obtainable. Water quality is considered stable if, for three consecutive readings:

- temperature changes by no more than ±1°C;
- pH varies by no more than 0.2 pH units; and
- electrical conductivity readings are within 10% of each other.

The water in which measurements were taken will not be used to fill sample bottles. If the well casing volume is known, measurements will be taken before the start of purging, in the middle of purging and at the end of purging each casing volume. If a well dewaters during purging and three casing volumes are not purged, that well will be allowed to recharge up 80% of the static water column. The well will be sampled once the well has recovered to 80% of the static water column, or two hours have passed.

14.1.7 PDB Sampling

An EQUILIBRATOR™ brand passive diffusion bag (PDB) sampler manufactured by EON Products, Inc. or similar device will be used for no-purge, diffusion sampling for volatile organic compounds (VOCs). The PDB is 18 inches in length, 1.5 inches in diameter, and consists of a semi-permeable low-density polyethylene (LDPE) membrane housed in a protective mesh. The membrane will be filled with deionized water prior to deployment within the screened interval of the monitoring well. VOCs in the groundwater diffuse into the sampler until the concentration gradient equilibrates between the water in the formation and the sampler. Once the sampler is retrieved after a minimum deployment of two weeks, the contents are transferred into volatile organic analysis (VOA) vials for VOC analysis.

14.1.7.1 Tether Preparation

Standard nylon bailer rope will be used as a tether line which will be permanently connected to a stainless steel ring on the underside of a specialized well cap. The other end of the tether will be connected to a snap connector that will allow quick connection and disconnection to the PDB.

The length of the tether will be calculated such that the midpoint of the PDB is positioned three feet above the bottom of the well screen. The tether length will be calculated using a water level indicator and the following procedure:

1. The bottom of the monitoring well will be sounded, and the depth from the top of casing will be recorded;
2. Six inches will be subtracted from this number to account for the end cap with the resulting number being equivalent to the depth of the bottom of the screen;
3. Three feet will then be subtracted from this number to determine the depth corresponding to three feet above the bottom of the well screen;
4. Nine inches will then be subtracted to account for half the length of the PDB; and
5. Finally, the length of any additional hardware used to assemble the tethers (e.g. snap connectors) will be factored into the tether length calculation.

14.1.7.2 PDB Deployment

A new PDB will be removed from the manufacturer's packaging, and the end cap will be removed in order to fill the PDB membrane with 350 mL of deionized water. The membrane will then be sealed by re-inserting the end cap. A source blank of deionized water will be submitted for laboratory analysis to ensure that it is contaminant free. A stainless steel weight holder will be slipped over the top of the PDB's protective mesh and secured with cable ties and a

stainless steel weight will be hung from the end to ensure that the PDB remains vertical and does not float upwards in the water column. The PDB will be deployed for a minimum of two weeks, but is designed to remain in a monitoring well for extended periods of time.

14.1.8 Well Sampling Procedures

Prior to sampling each well, the water level in the well will be measured as described in Section 14.1.5. Then the well will be purged as described in Section 14.1.6 or a PDB or similar device will be used at locations where no purging will be conducted as described in Section 14.1.7. Samples will be collected from wells using low flow purging using the outlet hose of the flow-through cell. If aquifer yield does not allow for low-flow and conventional purging was used, then a bailer may be necessary for sampling. Where PDBs are used, the membrane will be punctured with a small “straw,” and sample vials will be filled via the straw.

The water will be carefully poured down the inner walls of the sample bottles to minimize aeration of the sample. The sample will be collected directly into the appropriate sample containers. When filling containers, care will be taken not to touch the tubing or bailer to the sample container.

Vials for VOC analysis will be filled first to minimize the effect of aeration on the water sample. Water samples will be collected in 40 milliliters (mL) glass vials. 1:1 hydrochloric acid (HCl) will be added to the vial prior to sample collection. The vials will be filled directly from the low flow cell under laminar flow with minimal agitation of the water sample and transferred directly into the appropriate sample containers with preservative, if required. The vial will be inverted and checked for air bubbles to ensure zero headspace. Groundwater samples for VOCs will be chilled and processed for shipment to the laboratory. The samples will be chilled to 4 ± 2°C immediately upon collection. Three vials of each water sample are required for analysis.

Water samples collected for methane, ethane, and ethene analysis will be collected like the VOCs; however, there is no preservative added to the 40 mL glass vials. The samples will be chilled to 4 ± 2°C immediately upon collection. Three vials of each water sample are required for analysis.

All other water samples will then be collected into appropriate bottles with preservative, where appropriate, as described in Worksheet #19. The samples will be chilled to 4 ± 2°C immediately upon collection.

14.1.9 On-Site Groundwater Parameter Measurement Procedures

Geochemical parameters specific for evaluating naturally occurring contaminant attenuation mechanisms will be measured in the field. Field procedures are described in the following subsections. Actual field test procedures for Fe(III), alkalinity, carbon dioxide, hydrogen sulfide, and sulfide tests are included in the portable Hach® and CHEMetrics® test kits.

Duplicate measurements of parameters measured by field instruments will be made for 10 percent of the field measurements. The results will be recorded in the field notebook. If duplicate field measurements differ by more than 25 percent, they will be considered suspect and the instruments will be recalibrated and the suspect measurements will be repeated.

- **pH, Temperature, and Conductivity:** Because the pH, temperature, and conductivity of a groundwater sample can change significantly within a short time following sample acquisition, these parameters will be measured in the field in unfiltered, unpreserved, "fresh" water. The measurements will be made in a flow-through cell or a clean glass container separate from those intended for laboratory analysis, and the measured values will be recorded in the groundwater sampling record.

- **Dissolved Oxygen (DO) Measurements:** DO measurements will be made using a direct-reading meter with an oxygen sensor in a flow through cell during purging and immediately before groundwater sample acquisition. Groundwater wells will be purged until DO measurements levels have stabilized. For each DO measurement, the lowest stable DO reading will be recorded.
- **Oxidation/Reduction Potential (ORP):** The ORP of groundwater is an indication of the relative tendency of a solution to accept or transfer electrons. ORP reactions in groundwater are usually biologically mediated; therefore, the ORP of a groundwater system depends on and influences rates of biodegradation. ORPs can be used to provide real-time data on the location of the contaminant plume, especially in areas undergoing anaerobic biodegradation. The ORP of a groundwater sample can change significantly within a short time following sample acquisition and exposure to atmospheric oxygen. As a result, ORP measurements will be made using a direct-reading meter in a flow-through cell during purging and immediately before groundwater sample acquisition.
- **Iron (II) Measurements:** Iron is an important trace nutrient for bacterial growth, and different states of iron can affect the ORP of the groundwater and act as an electron acceptor for biological metabolism under anaerobic conditions. Iron (II) concentrations will be measured in the field via colorimetric analysis with a Hach® DR/700 Portable Colorimeter after appropriate sample preparation. Hach® Method 8146 (or similar) for ferrous iron (0 to 3.0 mg/L Fe^{2+}) will be used to prepare and quantify the samples. Distilled water will be used as a blank to calibrate the machine at the beginning of each day. An untreated groundwater sample from the same well will be used as the blank for each ferrous iron analysis.
- **Alkalinity:** Alkalinity concentrations will be measured in the field via titrametric analysis with a Hach® kit.
- **Carbon Dioxide Measurements:** CO_2 concentrations will be measured in the field using a CHEMetrics® portable titration kit. The method uses a sodium hydroxide titrant with a pH indicator.
- **Hydrogen Sulfide:** H_2S concentrations will be measured in the field using a portable Hach® field test kit. This is a colorimetric test that uses Alka-Seltzer® to effervesce H_2S from the water sample onto test paper. The test paper changes color and is compared to a chart to determine H_2S concentration.
- **Sulfide:** Sulfide concentrations will be measured in the field using a CHEMetrics® colorimetric test kit. Total acid soluble sulfides in the sample react to produce methylene blue. The resultant blue color of the sample is directly proportionate to sulfide concentration.

14.1.10 Site Surveying

Following soil sampling and well drilling, horizontal and vertical geographic positions will be established for all sampling locations. Surveying will be conducted by a professional surveyor. Control monuments for horizontal and vertical geographic positions will be used to tie into the existing base coordinate system at MCB Camp Pendleton. Horizontal datum will be referenced to North American Datum of 1983 [NAD83], Zone 6 and vertical datum will be referenced to National Geographic Vertical Datum of 1988 (NGVD88) elevations. The vertical accuracy for the sampling locations will be ±0.01 feet. The degree of horizontal accuracy required for the site is ±0.1 feet.

14.1.11 Equipment Decontamination Tasks

Decontamination of all sampling and drilling equipment must be conducted consistently to assure the quality of samples collected. All equipment that comes into contact with potentially contaminated soil and groundwater will be decontaminated. Disposable equipment intended for one-time use will not be decontaminated, but will be packaged for appropriate disposal. Decontamination will occur prior to and after use of each piece of equipment. The decontamination zone will be located upwind of field activities to prevent wind-borne site related contamination from impacting clean equipment. All sampling devices used, including trowels and auger, will be steam-cleaned or decontaminated according to USEPA Region 9 recommended procedures.

The following sequence will be used to clean equipment and sampling devices prior to and between each use:

1. Rinse with potable water.
2. Wash with Liquinox™ detergent and tap water and clean with a stiff-bristle brush.
3. Rinse with deionized (DI) water.
4. Place the sampling equipment on a clean surface and air-dry.

Submersible pumps will be set into separate buckets containing the above rinses and allowed to run for 5 minutes in each bucket.

Equipment will be decontaminated in a designated area on pallets or plastic sheeting, and clean bulky equipment will be stored on plastic sheeting in uncontaminated areas. Cleaned, small equipment will be stored in plastic bags. Materials to be stored more than a few hours will also be covered.

14.1.12 Investigation-Derived Waste (IDW) Tasks

In the process of collecting environmental samples at MCB Camp Pendleton, the site team will generate different types of potentially contaminated IDW that include the following:

- Used personnel protection equipment (PPE),
- Disposable sampling equipment,
- Decontamination fluids,
- Soil cuttings from soil borings, and
- Purged groundwater.

IDW will be managed and disposed of in accordance with current Federal, State, and local requirements. IDW will be labeled and stored in accordance with the County of San Diego, SAM Manual (DEH, 2004). Disposal of wastes will be based on analytical results of the item in question. All waste will be transported to a suitable and authorized disposal facility.

Soil cuttings generated during the subsurface sampling will be stored in 55-gallon drums on site. Profiling of soil cuttings will be done to ensure appropriate disposal. Purged groundwater and decontamination water will be stored in 55-gallon drums or a Baker tank as site conditions warrant.

Used PPE and disposable equipment will be double bagged and stored on site until analytical results are available. If the waste is determined to be non-hazardous, then the materials will be placed in a municipal refuse dumpster on site. If these wastes are considered hazardous based on the soil or groundwater results, then the material will be transported to a suitable and

authorized disposal facility. Any PPE and disposable equipment that is to be disposed of that can be reused will be rendered inoperable before disposal in the refuse dumpster.

14.2 Field Records

14.2.1 Field Logbooks

Field activities will be documented in field notebooks. The information contained in the field notebook will provide sufficient data and observations to enable personnel to reconstruct events that occur during the project and serve as a record of the activities conducted at the site. Field logbooks will be permanently bound with consecutively pre-numbered pages. If corrections are required, entries will be deleted by drawing a single line through them with a signature. If correct information cannot be included on the same page, then a reference to the page with the correct information will be added. At a minimum, the following information will be recorded for all site activities:

- Sample location and description
- Sampler's name(s)
- Date and time of sample collection
- Designation of sample as composite or grab
- Type of sample (soil, sediment or water)
- Type of sampling equipment used
- Field instrument readings
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors, etc.)
- Preliminary sample descriptions (e.g., for soils: "silty sand, very wet"; for water: "clear water with no noticeable odors, colors, etc.)
- Sample preservation
- Sample identification numbers and explanatory code, chain-of-custody form numbers
- Shipping arrangements
- Name(s) of recipient laboratory(ies).

In addition to the sampling information, the following specific information may also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities
- Time of arrival/entry on site and time of site departure
- Other personnel on site
- Deviations from sampling plans, site safety plans, and SAP procedures
- Changes in personnel and responsibilities with reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used and equipment model and serial number.

14.2.2 Photographs

Photographs will be taken during field activities. For each photograph taken, the following information will be written in logbook or recorded in a separate field photography log:

- Direction in which the photograph was taken
- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of the person taking the photograph.

14.3 Data Management Tasks

14.3.1 Data Reporting

The deliverables required for this project are in both hard-copy and electronic format. These formats are described below.

Hardcopy Data Deliverables: Hard-copy reporting of analytical results is defined in Worksheet #29 and will include two different analytical reporting levels. A summary data format for definitive data results equivalent to the Level III format is defined as all items listed with an * in Worksheet #29. Data deliverables of this level will constitute 80 percent of all data deliverables. The additional data deliverables will be the equivalent to the Level IV format and are defined as all requirements listed in Worksheet #29. Both deliverable levels will be reported using contract laboratory program (CLP) forms when applicable forms are available for the method. The original chain-of-custody form will accompany the laboratory report submittal and will become a permanent part of the project records. The laboratory will be required to provide two copies of each hard-copy data reporting package. The laboratory will be expected to provide full data packages to Parsons in 30 calendar days from the time of receipt.

The laboratory will maintain all relevant raw data and documentation, including but not limited to logbooks, data sheets, electronic files, and final reports, for a minimum of 7 years. Parsons will be notified 30 days prior to disposal of any relevant laboratory records.

Parsons will retain copies of all chain-of-custody forms until receipt of the laboratory report. Laboratory reports will be filed in chronological order. A second copy of the report will be sent for third-party data validation.

Electronic Data Deliverables: To facilitate data handling and management, laboratory data will be entered into Parsons' database. Field information (e.g., sample identification number, date sampled, time sampled, and matrix) will be entered into Parsons' database from the chain-of-custody forms. Laboratory electronic deliverables will be in the format specified in NAVFAC SW Environmental Work Instruction (EWI) #6 (issued April 19, 2005). Upon receipt, the data will be loaded into Parsons' database and reviewed for errors. If any errors are identified, the file will be manually edited or regenerated by the laboratory. All data will be delivered from the laboratory in the Navy Electronic Data Deliverable (NEDD) format. Data will be uploaded into the Naval Installation Restoration Information Solution (NIRIS) database. All electronic data files will be generated from the same data source as the hardcopy report to minimize errors in the electronic deliverable.

14.3.2 Data Review, Validation, and Verification

To ensure field decisions are made based on real-time data of known quality, measurements will be reviewed daily. A summary of all data generated using field methods will be provided to the project manager or his designee at the beginning of each workday following the date of sample data acquisition. These data will be forwarded to Parsons QA manager periodically for

a more thorough review of QC results and identify any issues adversely affecting data quality. Any problems encountered during real-time measurements will be documented by the field team and discussed with Parsons QA manager to ensure appropriate corrective action.

The following sections discuss overall verification and validation process implemented for data generated during this field investigation. Verification involved evaluation of data with respect to Standard Operating Procedure (SOP) protocols and project requirements. Validation involves evaluation of the technical usability of generated data.

Raw data collected in the field and used in project reports will be verified and included in the final report. Data verification and validation procedures employed during this project will ensure data collected meet project data quality objectives (DQOs) and assure a reasonable basis for decision making.

14.3.2.1 Field and Laboratory Data Verification

Project personnel will verify field data collected during this investigation by reviewing accuracy, precision, and completeness as summarized in Worksheet #34. Errors or inconsistencies will be resolved immediately by clarifying identified issues with appropriate field team members. Field team members will be responsible for following sampling and documentation procedures described in this SAP. Discrepancies and incomplete information identified during the review of data will be addressed as uncertainty associated with the decision-making process. The following verification criteria must be clearly documented to assure field activity and laboratory data are sufficient and may serve as a legal record.

Laboratory data generated during this investigation will be subject to two types of review. A supervisory-level chemist other than the original data processor will verify analyte identification, quantitation, transcription, and QC data. Each page of checked data will be signed and dated by the verifier. The laboratory PM will work with the laboratory QA/QC manager to review all results, investigate QC trends and outliers, data anomalies, and noncompliance issues.

Samples associated with out-of-control QC data will be identified in the data package case narrative, and an assessment of the utility of such analytical results will be made. The laboratory project manager will review each data deliverable package and must ensure that:

- All samples and analyses specified in the chain-of-custody have been processed;
- Complete records exist for each analysis and the associated QC samples; and
- Procedures specified in this SAP have been implemented.

14.3.2.2 Data Validation

Data validation will be performed only on analytical data generated by the fixed laboratory. Following data verification, data validation for fixed laboratory data collected during this investigation will be performed in accordance with NAVFAC SW.

In accordance with NAVFAC SW policy, an independent validator with experience performing data validation for Navy projects will perform the validation. With the exception of waste characterization samples and geotechnical parameters, data will be validated at 80 percent USEPA Level III and 20 percent USEPA Level IV. Data validation will be performed in accordance with Navy protocol and the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2008), USEPA Contract Laboratory Program National Functional Guidelines for Superfund Inorganic Methods Data Review (USEPA, 2010), and QC criteria specified in this document. Validation of data generated from previous investigations will generally conform to Level III guidelines except that evaluation of QC sample results will be limited to the information provided in the available laboratory reports.

For Level III data validation, the data values for routine and QC samples are generally assumed to be reported correctly by the laboratory. Data quality will be assessed by comparing the QC parameters to the appropriate criteria as specified in this SAP. If calculations for quantitation are verified, it is done on a limited basis and may required raw data in addition to the standard forms. The Level III validation process includes an evaluation of summary information including:

- Analytical results;
- Holding times;
- Field duplicates;
- Laboratory blanks;
- Surrogate spikes;
- Laboratory duplicates (if applicable);
- matrix spikes/matrix spike duplicates (MS/MSDs);
- laboratory control samples (LCSs);
- Initial and continuing calibrations;
- Instrument performance criteria;
- Second-column confirmations;
- Chain-of-custody forms;
- Case narratives; and
- Sample temperatures during shipping and storage.

Level IV follows the USEPA protocols and criteria established in the functional guidelines for evaluating organic and inorganic analyses (USEPA, 2008 and 2010). These guidelines apply to full validation data packages that include the raw data (e.g., spectra and chromatograms) and backup documentation of calibration standards, analysis run logs, dilution factors, batch QC data, samples preparation logs, and other types of information. This additional information is used for checking calculations for quantified analytical data in the full data validation process. Calculations are checked for laboratory QC samples (e.g., LCS and MS/MSD data) and routine field samples (including field duplicates). To assure that detection limit and data values are appropriate, and evaluation is made of instrument performance, method of calibration, and the original data for calibration standards. A Level IV validation includes a Level III validation plus a review of analytical raw data and calculation checks. Data qualifiers are applied to analytical results during the data validation process, based on adherence to method protocols and QA/QC limits.

Analytical data may be qualified based on data validation reviews. Qualifiers will be consistent with the applicable USEPA functional guidelines and will be used to provide data users with an estimate of the level of uncertainty associated with the result “flagged”.

Data validation results will be evaluated with respect to the attached qualifiers to determine data usability issues, if any. The following qualifiers may be assigned during the validation process.

- J – estimated concentration
- R – rejected value (unusable)
- U – not detected (e.g., not present based on blank contamination)
- UJ – sample detection limited is estimated.

Where the validation qualifiers impact the overall data interpretation and project recommendations, the report will discuss the issue and the necessary corrective action.

14.4 Data Management

Verified and validated analytical data and global positioning system (GPS) survey measurements will be uploaded into the NIRIS database. Analytical data will also be uploaded in a Parsons MicroSoft® Access-based database and used to generate data tables.

14.5 Field Audits

The field team leader may conduct an audit during the field sampling event to ensure field team members are following proper sample collection procedure (see Worksheet #17) and keeping proper records in the field sampling notebook and on chain-of-custody forms.

SAP Worksheet #15.1 -- Reference Limits and Evaluation Tables for Soil

Matrix: Soil

Analytical Group: General Minerals and Soil Geochemistry

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory-specific[1]	
					QLs (mg/kg)	MDLs (mg/kg)
TOC (Walkley-Black)[2]	-28	NE	NE	1	TBD	TBD

NE = Not established. There is no regulatory limit for these parameters in soil. This parameter is being used to evaluate geochemical conditions.

TBD = to be determined

1 - Procurement of the analytical laboratory is not complete at this time. Specific information regarding QLs and MDLs will be provided when the SAP is finalized and before field implementation.

2 - In the absence of CAS numbers for certain reported parameters, the NEDD ANALYTE_ID is supplied for these parameters in the CAS Number field of this table.

SAP Worksheet #15.2 -- Reference Limits and Evaluation Tables for Groundwater

Matrix: Groundwater
Analytical Group: Volatile Organic Compounds (8260B)

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-specific[2]	
					QLs (µg/L)	MDLs (µg/L)
1,1,1,2-Tetrachloroethane	811-97-2	0.52	DTSC	0.5	TBD	TBD
1,1,1-Trichloroethane	71-55-6	200	MCL (Fed)	5	TBD	TBD
1,1,2,2-Tetrachloroethane	79-34-5	1	MCL (CA)	0.5	TBD	TBD
1,1,2-Trichloroethane	79-00-5	5	MCL (CA)	1	TBD	TBD
1,1-Dichloroethane	75-34-3	2.4	RSL	1	TBD	TBD
1,1-Dichloroethene	75-35-4	6	MCL (CA)	1	TBD	TBD
1,1-Dichloropropene	563-58-6	NE	NE	1	TBD	TBD
1,2,3-Trichlorobenzene	87-61-6	NE	NE	1	TBD	TBD
1,2,4-Trichlorobenzene	120-82-1	5	MCL (CA)	1	TBD	TBD
1,2,4-Trimethylbenzene	95-63-6	15	RSL	1	TBD	TBD
1,2-Dibromo-3-chloropropane	96-12-8	0.2	MCL (CA)	0.2	TBD	TBD
1,2-Dibromoethane	106-93-4	0.05	MCL (CA)	0.005	TBD	TBD
1,2-Dichlorobenzene	95-50-1	600	MCL (CA)	5	TBD	TBD
1,2-Dichloroethane	107-06-2	0.5	MCL (CA)	0.5	TBD	TBD
1,2-Dichloropropane	78-87-5	5	MCL (CA)	1	TBD	TBD
1,2,3-Trichloropropane[3]	96-18-4	0.005	CA Notification Level	0.5	TBD	TBD
1,3,5-Trimethylbenzene	108-67-8	330	CA Notification Level	5	TBD	TBD
1,3-Dichlorobenzene	541-73-1	180	DTSC	5	TBD	TBD
1,3-Dichloropropane	142-28-9	730	RSL	5	TBD	TBD
1,4-Dichlorobenzene	106-46-7	5	MCL (CA)	1	TBD	TBD
2,2-Dichloropropane	594-20-7	NE	NE	5	TBD	TBD
2-Butanone (MEK)	78-93-3	7,100	RSL	20	TBD	TBD
2-Chlorotoluene	95-49-8	120	DTSC	5	TBD	TBD
2-Hexanone	591-78-6	NE	NE	10	TBD	TBD
4-Chlorotoluene	106-43-4	140	CA Notification Level	5	TBD	TBD
4-Methyl-2-Pentanone (MIBK)	108-10-1	120	CA Notification Level	10	TBD	TBD
Acetone	67-64-1	22,000	RSL	20	TBD	TBD
Benzene	71-43-2	1	MCL (CA)	0.5	TBD	TBD
Bromobenzene	108-86-1	20	RSL	1	TBD	TBD

Matrix: Groundwater
Analytical Group: Volatile Organic Compounds (8260B)

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-specific[2]	
					QLs (µg/L)	MDLs (µg/L)
Bromochloromethane	74-97-5	NE	NE	0.5	TBD	TBD
Bromodichloromethane	75-27-4	120	DTSC	0.5	TBD	TBD
Bromoform	75-25-2	8.5	RSL	0.5	TBD	TBD
Bromomethane	74-83-9	8.7	RSL	0.5	TBD	TBD
Carbon Disulfide	75-15-0	1,000	RSL	0.5	TBD	TBD
Carbon tetrachloride	56-23-5	0.5	MCL (CA)	0.4	TBD	TBD
Chlorobenzene	108-90-7	70	MCL (CA)	0.5	TBD	TBD
TBD Chloroethane	75-00-3	21,000	RSL	0.5	TBD	TBD
Chloroform	67-66-3	0.19	RSL	0.19	TBD	TBD
Chloromethane	74-87-3	1.8	RSL	0.5	TBD	TBD
cis-1,2-Dichloroethene	156-59-2	6	MCL (CA)	0.5	TBD	TBD
cis-1,3-Dichloropropene	10061-01-5	0.43	RSL	0.2	TBD	TBD
Dibromochloromethane	124-48-1	0.8	RSL	0.5	TBD	TBD
Dibromomethane	74-95-3	61	DTSC	1	TBD	TBD
Dichlorodifluoromethane	75-71-8	390	RSL	5	TBD	TBD
Di-isopropyl ether (DIPE)	108-20-3	830	RSL	5	TBD	TBD
Ethyl tert-butyl ether (ETBE)	637-92-3	NE	NE	5	TBD	TBD
Ethylbenzene	100-41-4	300	MCL (CA)	5	TBD	TBD
Hexachlorobutadiene	87-68-3	0.86	RSL	0.5	TBD	TBD
Isopropylbenzene	98-82-8	680	RSL	5	TBD	TBD
m/p-Xylene	1330-20-7	200	MCL (CA)	5	TBD	TBD
Methyl tert-butyl ether (MTBE)	1634-04-4	12	DTSC	1	TBD	TBD
Methylene chloride	75-09-2	4.8	RSL	2	TBD	TBD
Naphthalene	91-20-3	0.14	RSL	0.14	TBD	TBD
n-Butylbenzene	104-51-8	240	DTSC	5	TBD	TBD
n-Propylbenzene	103-65-1	240	DTSC	5	TBD	TBD
o-Xylene	95-47-6	1,400	RSL	10	TBD	TBD
p-Isopropyltoluene	99-87-6	NE	NE	5	TBD	TBD
sec-Butylbenzene	135-98-8	240	DTSC	5	TBD	TBD
Styrene	100-42-5	100	MCL (Fed)[2]	5	TBD	TBD
Tertiary amyl methyl ether (TAME)	994-05-8	NE	NE	5	TBD	TBD
tert-Butylbenzene	98-06-6	240	DTSC	5	TBD	TBD

Matrix: Groundwater
Analytical Group: Volatile Organic Compounds (8260B)

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-specific[2]	
					QLs (µg/L)	MDLs (µg/L)
Tertiary butyl alcohol (TBA)	75-65-0	12	CA Notification Level	10	TBD	TBD
Tetrachloroethene	127-18-4	5	MCL (CA)	1	TBD	TBD
Toluene	108-88-3	150	MCL (CA)	1	TBD	TBD
trans-1,2-Dichloroethene	156-60-5	10	MCL (CA)	1	TBD	TBD
trans-1,3-Dichloropropene	10061-02-6	0.5	MCL (CA)	0.4	TBD	TBD
Trichloroethene	79-01-6	5	MCL (CA)	1	TBD	TBD
Trichlorofluoromethane	75-69-4	150	MCL (CA)	10	TBD	TBD
Vinyl Acetate	108-05-4	410	RSL	10	TBD	TBD
Vinyl Chloride	75-01-4	0.5	MCL (CA)	0.4	TBD	TBD

TBD = to be determined

RSL = Tap Water Regional Screening Levels for Chemical Contaminants at Superfund Sites, May 20, 2008.

MCL (Fed) = Federal Maximum Contaminant Level permitted in water which is delivered to any user of the public water system.

MCL (CA) = Primary California MCL for drinking water (Title 22 CCR).

CA Notification Level = health-based advisory levels established by the California Department of Public Health (CDPH) for chemicals in drinking water for which primary MCLs have not been adopted.

DTSC = Human and Ecological Risk Division (HERD) RSL recommendations (May 6, 2009).

NE = Not established

1 - Project action levels have been derived as described on Worksheet #11.

2 - Procurement of the analytical laboratory is not complete at this time. Specific information regarding QLs and MDLs will be provided when the SAP is finalized and before field implementation.

3 - Project action limits for 1,2,3-trichloropropane are lower than technically achievable; therefore, a separate method will be used to achieve these limits.

Matrix: Groundwater
Analytical Group: 1,2,3-Trichloropropane (8260B SIM)

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-specific[2]	
					QLs (µg/L)	MDLs (µg/L)
1,2,3-Trichloropropane[3]	96-18-4	0.005	CA Notification Level	0.001	TBD	TBD

TBD = to be determined

CA Notification Level = health-based advisory levels established by the California Department of Public Health (CDPH) for chemicals in drinking water for which primary MCLs have not been adopted.

1 - Project action levels have been derived as described on Worksheet #11.

2 - Procurement of the analytical laboratory is not complete at this time. Specific information regarding QLs and MDLs will be provided when the SAP is finalized and before field implementation.

Matrix: Groundwater
Analytical Group: Methane, Ethane, Ethene (RSK-175SOP)

Analyte	CAS Number	Project Action Limit (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-specific[1]	
					QLs (µg/L)	MDLs (µg/L)
Methane	74-82-8	NE	NE	1	TBD	TBD
Ethane	74-84-0	NE	NE	1	TBD	TBD
Ethene	74-85-1	NE	NE	1	TBD	TBD

NE = Not established. There is no regulatory limit for these parameters in groundwater. These parameters are being used to evaluate changes in groundwater geochemistry by in-situ biological activity

TBD = to be determined

1 - Procurement of the analytical laboratory is not complete at this time. Specific information regarding QLs and MDLs will be provided when the SAP is finalized and before field implementation.

Matrix: Groundwater

Analytical Group: General Minerals and Groundwater Geochemistry

Analyte	CAS Number	Project Action Limit (mg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/L)	Laboratory-specific[1]	
					QLs (mg/L)	MDLs (mg/L)
Total Hardness (SM 2340C)[2]	-8	NE	NE	1	TBD	TBD
Calcium (SW6010B)	7440-70-2	NE	NE	1	TBD	TBD
Magnesium (SW6010B)	7439-95-4	NE	NE	1	TBD	TBD
Sodium (SW6010B)	7440-23-5	NE	NE	1	TBD	TBD
Potassium (SW6010B)	7440-09-7	NE	NE	1	TBD	TBD
Total Alkalinity (SM2320B)[2]	-17	NE	NE	2	TBD	TBD
Hydroxide (SM 2320B)	14280-30-9	NE	NE	1	TBD	TBD
Carbonate (SM2320B)	3812-32-6	NE	NE	1	TBD	TBD
Bicarbonate (SM2320B)	71-52-3	NE	NE	1	TBD	TBD
Sulfate (E300.0)	14808-79-8	250	MCL (CA) Secondary	1	TBD	TBD
Chloride (E300.0)	16887-00-6	250	MCL (CA) Secondary	1	TBD	TBD
Nitrate (E300.0)	7697-37-2	10	MCL	1	TBD	TBD
Nitrite (E300.0)	14797-65-0	1	MCL	0.5	TBD	TBD
Fluoride (SM4500F-C)	16984-48-8	4	MCL	1	TBD	TBD
TDS (SM2540C)[2]	-10	500	MCL (CA) Secondary	10	TBD	TBD
TOC (SM5310B)	-28	NE	NE	1	TBD	TBD

1 - Procurement of the analytical laboratory is not complete at this time. Specific information regarding QLs and MDLs will be provided when the SAP is finalized and before field implementation.

2 In the absence of CAS numbers for certain reported parameters, the NEDD ANALYTE_ID is supplied for these parameters in the CAS Number field of this table.

TBD = to be determined

MCL (Fed) = Federal Maximum Contaminant Level permitted in water which is delivered to any user of the public water system.

MCL (CA) Secondary = Secondary California MCL for drinking water (Title 22 CCR).

NE = Not established. There is no regulatory limit for these parameters in groundwater. These parameters are being used to evaluate changes in groundwater geochemistry by in-situ biological activity

SAP Worksheet #16 -- Project Schedule

Site 1119 Schedule

Task	Start	Finish
Site 1119 Sampling and Analysis Plan		
Issue Draft Document to FFA Team		November 4, 2010
FFA Team Review	November 10, 2010	January 10, 2011
Prepare Responses to Comments and Draft Final	January 10, 2011	March 16, 2011
Issue Final Document to FFA Team		March 16, 2011
Site 1119 Field Work		
Field Investigation	March 17, 2011	July 29, 2011
Complete Lab Analyses		August 30, 2011
Complete Data Validation		September 30, 2011

SAP Worksheet #17 -- Sampling Design and Rationale

Field sampling will include sampling 16 existing monitoring wells, and installing and sampling new wells at eight locations (with up to four nested wells at each location). Sampling locations have been selected on a judgmental basis because of the amount of secondary data available for the site (Worksheet #13). Soil and groundwater samples will be analyzed as detailed on Worksheet #15. Sampling rationale for each location is provided in the Work Plan and summarized below.

Wells at former IR Sites 3, 10, 24, 28, and 1111 and former UST Sites 2653, 2666, and H49 will be inspected and water levels and total depth measured to determine groundwater gradient and condition and suitability of wells for sampling.

Groundwater sampling will be conducted at 16 of the 51 existing monitoring wells (Figures 4 and 5). The rationale for the selection of each well to be sampled is discussed in the work plan and is designed to evaluate former IR or UST sites as potential sources of VOCs in Base production wells. The wells were selected based on their locations and screened interval depths and previous sampling results. Based on the well inspection and depth measurements, some of the existing monitoring wells may need to be re-developed prior to use. If any of the preferred wells defined in the Work Plan cannot be redeveloped or no longer exist, then substitute wells will be chosen in consultation with the FFA team. Existing wells will be sampled as discussed in Worksheet #14.

Groundwater samples will be collected at wells 26016 and 26018 at multiple depths using PDBs to obtain a vertical profile of chemical distribution. Although these wells have been sampled by both the Base and by the USGS previously, the PDB method will provide both current data. A more current vertical profile will be helpful in identifying stratigraphic layers that may be contributing detectable chemical concentrations to the wells.

Following the sampling of the existing wells, the data will be reviewed and final locations of the new wells may be modified, in consultation with the FFA team.

Up to 32 new groundwater monitoring wells (locations 1119-MW-1 through 1119-MW-8, with up to four nested wells at each location) are proposed to be installed in areas downgradient of other potential sources or along major groundwater pathways upgradient from the contaminated wells (Figure 6). New wells will be installed and sampled as discussed in Worksheet #14.

The primary objective of the proposed investigation is to determine where the contamination in Base production wells may have originated.

SAP Worksheet #18.1 -- Soil Sampling Locations and Methods/SOP Requirements Table

Sampling Location / ID Number	Matrix	Depth[1] (ft)	Analytical Group	Number of Samples	Sampling SOP Reference[2]
1119-MW-1 through 1119-MW-8	Soil	10 (in vadose zone above groundwater)	Moisture Content, Bulk Density	8	Worksheet 14, 14.1.2
1119-MW-1 through 1119-MW-8	Soil	25 to 40, 45 to 60, 65 to 80, 85 to 100, (in saturated zone within planned screen interval for each well)	TOC, Grain Size Distribution, Cation Exchange Capacity	32	Worksheet 14, 14.1.2

1 Depth of the soil samples will be determined in the field based on field observation and the geology at each location such that samples are collected within the vadose zone or within the screened interval, as described above.
2 Sample collection and decontamination procedures are described in Worksheet #14.

SAP Worksheet #18.2 -- Groundwater Sampling Locations and Methods/SOP Requirements Table

Sampling Location / ID Number	Matrix	Depth (ft)[1]	Analytical Group	Number of Samples[2]	Sampling SOP Reference[3]
Existing Well Samples[4]					
3W-27A	Groundwater	15	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals[5]; TOC; and TDS	1	Worksheet 14, 14.1.7
3W-27B	Groundwater	45	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
3W-29A	Groundwater	15	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
3W-29B	Groundwater	70	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
3W-30A	Groundwater	20	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
3W-30B	Groundwater	65	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
3W-30C	Groundwater	125	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
3W-35A	Groundwater	15	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	2 (including 1 duplicate)	Worksheet 14, 14.1.7
3W-35B	Groundwater	65	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
24W-11A	Groundwater	20	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7

Sampling Location / ID Number	Matrix	Depth (ft)[1]	Analytical Group	Number of Samples[2]	Sampling SOP Reference[3]
24W-11B	Groundwater	80	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
28W-01A	Groundwater	20	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
28W-01B	Groundwater	65	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
H49-MW1	Groundwater	15	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
OWR-5E3	Groundwater	65	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	2 (including 1 duplicate)	Worksheet 14, 14.1.7
OWR-7J8	Groundwater	65	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	1	Worksheet 14, 14.1.7
26016	Groundwater	80, 85, 90, 95, 100, 105, 110, 115, 120, 125	VOCs and 1,2,3-TCP	11 (including 1 duplicate)	Worksheet 14, 14.1.7
26018	Groundwater	64, 69, 74, 79, 94, 99, 104, 109, 114, 119, 124	VOCs and 1,2,3-TCP	12 (including 1 duplicate)	Worksheet 14, 14.1.7
New Well Samples[5]					
1119-MW-1 through 1119-MW-8	Groundwater	30, 50, 70, 90	VOCs; 1,2,3-TCP, methane, ethane, ethane; general minerals; TOC; and TDS	36 (up to 4 samples per location at different depths, plus 4 duplicates)	Worksheet 14, 14.1.7

1 Depth based on previous sampling, actual depth will be recorded at time of sampling.
2 Duplicates will be collected at a frequency of 10 percent.
3 Sample collection and decontamination procedures are described in Worksheet #14.
4 It is anticipated that 4 nested wells will be installed at each location at different depths; final screen intervals and sample depths will be determined based on the geology at each location.
5 General minerals include: total hardness, total alkalinity, hydroxide, carbonate, bicarbonate, sulfate, chloride, nitrate, nitrite, calcium, magnesium, potassium, sodium, and fluoride.

SAP Worksheet #19 -- Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers[2] (number, size, and type)	Sample volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[3] (preparation / analysis)
Soil	Total Organic Carbon	Walkley-Black / TBD	T, G - Teflon®-lined cap	8 ounces	$4^o \pm 2^oC$	28 days
Soil	Bulk Density	ASTM D2937 / TBD	P, T	All geotech analyses can be combined in one 2" x 6" sleeve	$4^o \pm 2^oC$	Not Applicable
Soil	Grain Size Distribution	ASTM D422 / TBD	P, T		$4^o \pm 2^oC$	Not Applicable
Soil	Moisture Content	ASTM D2216/ TBD	P, T		$4^o \pm 2^oC$	Not Applicable
Soil	Cation Exchange Capacity	SW9081 / TBD	G	4 ounces	None	6 months
Water	Volatile Organic Compounds	SW8260B / TBD	G, Teflon®-lined septum	3 x 40 ml	$4^o \pm 2^oC$, HCl to pH < 2	14 days; 7 days if unpreserved by acid
Water	1,2,3-Trichloropropane	SW8260B SIM / TBD	G, Teflon®-lined septum	3 x 40 ml	$4^o \pm 2^oC$, HCl to pH < 2	14 days; 7 days if unpreserved by acid
Water	Methane, Ethane, Ethene	RSK-175SOP / TBD	G, Teflon®-lined septum	3 x 40 ml	$4^o \pm 2^oC$	7 days
Water	Calcium, Magnesium, Sodium, and Potassium	SW6010B / TBD	P, G	500 ml	HNO_3 to pH <2	180 days
Water	Chloride, Nitrate, Nitrite, Sulfate, Fluoride	E300.0 / and SM4500F-C/ TBD	P, G	100 ml	$4^o \pm 2^oC$	28 days for Cl^-, and SO_4^{-2}; 48 hours for NO_3^-
Water	Total Hardness	SM 2340C / TBD	P, G	100 ml	$4^o \pm 2^oC$	14 days
Water	Total Alkalinity, Hydroxide, Carbonate, Bicarbonate	SM 2320B / TBD	P, G	500 ml	$4^o \pm 2^oC$	14 days
Water	Total Organic Carbon	SM5310B / TBD	G - Teflon®- lined cap	500 ml	H_2SO_4 to pH <2, $4^o \pm 2^oC$	28 days
Water	Total Dissolved Solids	SM2540C / TBD	P, G	500 ml	$4^o \pm 2^oC$	7 days

TBD = to be determined

1 Procurement of these services is not complete at this time. Specific information regarding SOP references will be provided when the SAP is finalized and before field implementation.

2 Polyethylene (P); glass (G); brass or stainless steel sleeves in the sample barrel (T).

3 Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

SAP Worksheet #20 -- Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equip. Blanks	No. of VOA Trip Blanks	No. of PT Samples	Total No. of Samples to Lab[1]
Soil	Bulk Density	8	0	0	0	0	0	0	8
Soil	Moisture Content	8	0	0	0	0	0	0	8
Soil	Grain Size Distribution	32	0	0	0	0	0	0	32
Soil	Cation Exchange Capacity	32	0	0	0	0	0	0	32
Soil	TOC	32	0	0	0	0	0	0	32
Water	VOCs	69 (16 from existing wells, 21 from wells 26016 and 26018, and 32 new wells)	8 (2 during sampling of existing wells, 2 from wells 26016 and 26018, and 4 during sampling of newly installed wells)	4 (1 during sampling of existing wells, 1 from wells 26016 and 26018, and 2 during sampling of newly installed wells)	3 (1 during sampling of existing wells, 1 from wells 26016 and 26018, and 1 during sampling of newly installed wells)	2 (1 during sampling of existing wells and 1 during sampling of newly installed wells)	14 (4 during sampling of existing wells, 2 from wells 26016 and 26018, and 8 during sampling of newly installed wells)	0	96
Water	1,2,3-TCP	69	8	4	3	2	14	0	96
Water	Methane, Ethane, Ethene	48 (16 from existing wells and 32 new wells)	6 (2 during sampling of existing wells and 4 during sampling of newly installed wells)	3 (1 during sampling of existing wells and 2 during sampling of newly installed wells)	2 (1 during sampling of existing wells and 1 during sampling of newly installed wells)	2	0	0	58
Water	Calcium, Magnesium, Sodium, and Potassium	48	6	3	2	2	0	0	58
Water	Chloride, Sulfate, Nitrate, Nitrite, Fluoride	48	6	3	2	2	0	0	58

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equip. Blanks	No. of VOA Trip Blanks	No. of PT Samples	Total No. of Samples to Lab[1]
Water	Total Hardness	48	6	3	2	2	0	0	58
Water	Total Alkalinity, Hydroxide, Carbonate, Bicarbonate	48	6	3	2	2	0	0	58
Water	TOC	48	6	3	2	2	0	0	58
Water	TDS	48	6	3	0	0	0	0	54

VOA = volatile organic analytes

PT = proficiency testing

1 MS/MSD sample counts are not included in the “Total No. of Samples Sent to Lab” since these are additional sample bottles only, the primary sample of the MS/MSD is accounted for in the “No. of Sampling Locations.”

SAP Worksheet #21 -- Project Sampling SOP References Table

This project does not use sampling SOPs. Sampling procedures are identified in Worksheet #14.

SAP Worksheet #22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Comments
Photo-Ionization Detector (PID)	Calibration	Daily prior to commencing work and as needed	± 15%	If the PID does not start up, check out, or calibrate properly, the instrument should not be used and should be returned to the manufacturer or similar facility repair or re-calibration.	Field Supervisor	Manufacturer's Equipment User's Manual	None
Water Quality Checker (YSI 6820 meter, or equivalent)	Calibration	Daily prior to commencing work and as needed	± 0.5%	**High DO Charge** message: Remove DO probe and resurface according to instruction manual. Activate resurfaced DO charge parameter and confirm value is within acceptable range. Allow sensor to pulse in Run mode for at least 5 minutes (DO charge may drop in value if sensor is still functional). If DO charge is not lowered, contact YSI Technical Support for additional help. **Out of Range** message: Insure that standard have not been contaminated and DO sensor is in air (DO%Cal) or in a solution of known DO concentration. Confirm the correct value has been entered for calibration solution. If message continues, contact YSI Technical Support. **Bad Input** message: Return to desired parameter in the Calibrate menu and repeat calibration entry, being certain to enter only numbers.	Field Supervisor	YSI 6820 Manual, or equivalent	None
Water Sampling Equipment	Decontamination	Before each use at a sampling location	n/a	n/a	Field Supervisor	Worksheet #14, Section 14.1.14	None
Drilling Rig/Equipment	Decontamination	Before each use at a sampling location	n/a	n/a	Field Supervisor	Worksheet #14, Section 14.1.14	None

SAP Worksheet #23 -- Analytical SOP References Table

Analytical SOP references are to be determined upon selecting the analytical laboratory. This table will be completed prior to finalizing the SAP[1].

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
TBD	TBD	TBD	TBD	TBD	TBD	TBD
TBD	TBD	TBD	TBD	TBD	TBD	TBD

TBD = to be determined

1 Procurement of these services is not complete at this time. Specific information regarding SOP references will be provided when the SAP is finalized and before field implementation. Analytical laboratory SOPs will be provided in CD format as an attachment to the Final SAP. Any proprietary SOPs will be submitted in a legally acceptable manner.

SAP Worksheet #24 -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Gas Chromatograph/ Mass Spectrometer (GC/MS)	Minimum 5-point Initial calibration for all analytes (ICAL)	Initially, after the BFB Tune Check, and as needed thereafter	SPCCs average RF ±0.050 and %RSD for CCCs <30% and one option below 1) linear- mean RSD for all analytes ≤15% 2) linear-least squares regression r≥0.995, when RSD >15%	Locate the source of the problem. If expected RFs are not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem, then repeat initial calibration.	Analyst	TBD
GC/MS	Second Source Standard - Initial calibration verification (ICV)	After every ICAL	All analytes within ±25% of expected value	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	TBD
GC/MS	Continuing Calibration Verification (CCV)	After the BFB Tune Check and prior to sample or QC analysis - Every 12 hours thereafter	SPCCs average RF >0.050; and CCCs <20% difference (when using RFs) or drift (when using least squares regression or non-linear calibration)	Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	TBD

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Gas Chromatograph (GC)	3 to 5-point Initial calibration for all analytes (ICAL)	Initially, as needed thereafter	1) RSD ≤ 20% for all analytes 2) Linear – least squares regression r> 0.995	Locate the source of the problem. If expected RSD is not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial calibration.	Analyst	TBD
GC	Continuing Calibration Verification (CCV)	Every 24 hours	All analytes within ±15% of expected value	Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persists perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	TBD
ICP	Initial calibration for all analytes (ICAL). Minimum of one high standard and a calibration blank.	Daily initial calibration prior to sample analysis	No acceptance criteria unless more than one standard is used, in which case r ≥ 0.995	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persists perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	TBD
ICP	Second source calibration verification (ICV)	Once after each initial calibration, prior to sample analysis	Value of second source for all analyte(s) within ± 10% of expected value (initial source) RSD of replicate integrations <5%	If RSDs <5%, prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If RSD >5%, perform instrument maintenance to correct the problem and repeat ICAL.	Analyst	TBD

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
ICP	Continuing calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	Within ± 10% of expected value RSD of replicate integrations <5%	If RSDs <5%, prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If RSD >5%, perform instrument maintenance to correct the problem. Recalibrate and reanalyze all samples since last successful CCV.	Analyst	TBD
Spectrometer TOC Analyzer	ICAL	Daily	Correlation coefficient (r^2) ≥0.995	Locate the source of the problem. If outliers exist, prepare fresh calibration standards and repeat ICAL. If problem persists, perform photometric linearity check. If maximum absorbance is non-compliant, replace the spectrometer lamp and repeat ICAL.	Analyst	TBD
Spectrometer	ICV	After ICAL	All anlaytes within ± 10% of expected value	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persists perform instrument maintenance to correct the problem and repeat ICAL.	Analyst	TBD
Spectrometer	CCV	Daily before sample analysis, at the end of the analysis sequence	All analytes within ±10% of expected value	Repeat calibration and reanalyze all samples since last successful calibration.	Analyst	TBD
Titration	Standard check	Daily before sample analysis	All analytes within ±10% of expected value	Discard the standard and use a new standard lot.	Analyst	TBD

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Gravimetric	Analytical Balance Calibration Check	Daily before sample analysis	±0.1% of certified weight value.	Clean the balance, center the level indicator and repeat calibration check.	Analyst	TBD
Conductivity Meter	Cell calibration	Daily before sample analysis	3 consecutive readings must be constant.	Check power source, otherwise replace conductivity meter.	Analyst	TBD

TBD = to be determined

1 Procurement of these services is not complete at this time. Specific information regarding SOP references will be provided when the SAP is finalized and before field implementation

RSD = relative standard deviation

SAP Worksheet #25 -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity[1]	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference[3]
GC/MS GC ICP IC	Parameter Setup	Physical check	Check that the autosampler is functioning as expected. Check that temperature program is set at the most recently determined optimum condition.	Initially; prior to each use	Autosampler must move to the expected position when activated. Refer to instrument optimize temperature program setup.	Reset autosampler, if problem persists perform autosampler troubleshooting prior to instrument use. Reset to optimized temperature setup (e.g., if temperature program is optimized at the following conditions: Initial Temp=40°C, hold for 1 min, Ramp=6 ^{o}C, Final Temp=200°C, Injection port=160 ^{o}C, Interface= 250°C, then the instrument setting must be on that condition when checked.)	Analyst	TBD
GC/MS	Tune Check	Instrument Performance	Conformance to instrument tuning	Initially; prior to DCC	Compliance to ion abundance criteria as specified by the method.	Repeat tune check to rule out standard degradation or inaccurate injection. If problem persists perform re-tune of instrument and repeat tune check.	Analyst	TBD

Instrument/ Equipment	Maintenance Activity[1]	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference[3]
ICP	ICSA/ICSAB	Instrument Performance	Conformance to interference check	Prior to sample analysis	Within ± 20% of expected value	Terminate analysis, re-analyze ICS to rule out standard degradation or inaccurate injection. If problem persists, perform instrument maintenance, repeat calibrations and re-analyze all associated samples.	Analyst	TBD
ICP	ICB/CCB	Instrument Performance	Instrument contamination check	After every calibration verification	No analytes detected ≥ 3xIDL	Determine possible source of contamination and apply appropriate measures to correct the problem. Reanalyze.	Analyst	TBD
Spectrometer, Gravimetric, Conductivity Meter	ICB/CCB	Instrument performance	Instrument contamination check	After every calibration verification	No analytes detected > 3xIDL	Determine possible source of contamination and apply appropriate measure to correct the problem. Reanalyze calibration blank and all associated samples.	Analyst	TBD

TBD = to be determined

RSD = relative standard deviation

1 Record all maintenance activities in an instrument maintenance log book.

2 Name or title of responsible person may be used.

3 Procurement of these services is not complete at this time. Specific information regarding SOP references will be provided when the SAP is finalized and before field implementation

SAP Worksheet #26 -- Sample Handling System

Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Field Team/Parsons
Sample Packaging (Personnel/Organization): Field Team/Parsons
Coordination of Shipment (Personnel/Organization): Field Team/Parsons
Type of Shipment/Carrier: Courier/Analytical Laboratories[1] TBD
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodian/ Analytical Laboratories[1] TBD
Sample Custody and Storage (Personnel/Organization): Sample Custodian/ Analytical Laboratories[1] TBD
Sample Preparation (Personnel/Organization): Analyst/ Analytical Laboratories[1] TBD
Sample Determinative Analysis (Personnel/Organization): Analyst/ Analytical Laboratories[1] TBD
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Sample Custodian/ Analytical Laboratories[1] TBD
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Analyst/ Analytical Laboratories[1] TBD
Biological Sample Storage (No. of days from sample collection): Not applicable
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodian/ Analytical Laboratories[1] TBD
Number of Days from Analysis: 90 days

1 – Procurement of analytical laboratory is not complete at this time. Laboratory-specific information will be provided when the SAP is finalized and before field implementation.

TBD = to be determined

SAP Worksheet #27 -- Sample Custody Requirements Table

All sampling protocols will be performed per this SAP and the County of San Diego Department of Environmental Health (DEH) Site Assessment and Mitigation (SAM) Manual (DEH, 2004). Examples of chain-of-custody forms and labels are included in Attachment 1.

27.1 Sample Handling

The laboratory will provide sample containers, chain-of-custody forms, and coolers to the project site. New, properly cleaned sample containers must be used so that no target compound contamination occurs from contact with the sample container. The laboratory will provide documentation attesting to the cleanliness of the containers following their cleaning procedures. A certificate of cleanliness will be provided for any commercially purchased sample containers. Worksheet #19 lists the types of sample containers, sample volumes, methods of preservation, and holding times for each parameter. Field team members will ship samples directly to the laboratory at the end of each sampling day, which will enable the laboratory to analyze the samples within the specified holding times.

27.2 Sample Number

The sample numbering system will be used to uniquely identify each soil or groundwater sample collected during field investigations, including all field QC samples. For soil samples, primary field samples will be given sequential sample numbers that consist of the well identification number hyphenated with the soil boring location number followed by the sample collection depth, e.g. 1119-MW-1-35 would be the sample collected from well boring 1119-MW-1 at 35 feet below ground surface (bgs). Field duplicates for soil will not be analyzed due to the soil heterogeneity. For groundwater samples, primary field samples will be given sample numbers that consist of well identification number hyphenated with the month and year during which this sample was collected. For example, 1119-MW-1-0511 would be the sample collected from well 1119-MW-1 in May 2011. For groundwater samples from nested wells, each well at a location will be designated A, B, C, or D based on descending depth. For example, 1119-MW-2A-0511 would be the sample collected from well 1119-MW-2A in May 2011. Field duplicates of groundwater will be sent "blind" to the laboratory and will be uniquely identified by site identification number hyphenated with the number 99 followed by an alphabetic character hyphenated with the month and year during which this sample was collected, e.g. 1119-MW-99A-0511 will be the first field duplicate collected from Site 1119 in May 2011. The association of field duplicates with primary field samples will be documented in the field log book. Equipment rinsates will be labeled with site number hyphenated with blank type and a two-digit number corresponding to the number of each type of blank collected, for example 1119-EB02-0511 would indicate the second equipment blank collected from Site 1119 in May 2011. The numbering system will be a tracking mechanism to allow retrieval of information about a particular location and to ensure that each sample is uniquely numbered. A listing of sample numbers will be maintained by the field team leader.

27.3 Sample Custody

Sample custody begins in the field at the time of collection and continues throughout the laboratory analytical process, as follows:

- Immediately after sample collection, sample labels will be filled out and affixed to each sample container. Examples of chain-of-custody forms and labels are included in Attachment 1. Each sample will be placed in a re-sealable plastic bag to keep the sample container and label dry.

- The cooler will be filled with the jars or bottles. Sufficient packing material will be used to prevent sample containers from making contact during shipment. Enough wet ice will be added to maintain sample temperatures at 4 ± 2 °C. Ice will be double bagged in re-sealable plastic bags to avoid contact with samples.
- The chain-of-custody form will be completed and signed by the field crew and courier (if other than the sampler) for the samples transported to the laboratory. The chain-of-custody form will be placed inside a watertight re-sealable plastic bag, and then be taped to the inside of the sample cooler lid or handed directly to the laboratory courier.
- Unless the cooler is hand delivered to a laboratory courier, the cooler will be closed and taped shut with strapping tape (filament-type) around both ends. The cooler drain will be taped shut both inside and outside the cooler.
- If the samples are to be delivered to the laboratory using a commercial shipment courier service, custody seals will be used on each ice chest to provide tampering detection. Two signed custody seals will be placed on the cooler, one on front and one on the side. Wide clear tape will be placed over the seals to help reduce accidental breakage.
- Samples accumulated before transfer to the laboratory will be stored in an ice-filled chest and properly protected from breakage.

27.3.1 Sample Chain-of-Custody

Chain-of-custody forms will be prepared at the time of sample collection and will accompany the samples through the laboratory sample processing. Chain-of-custody forms will be completed for each cooler in a shipment of samples to track the samples and provide a written record of all persons handling the samples. The following information for each sample will be documented on the chain-of-custody form:

- Unique sample identification;
- Date and time of sample collection;
- Source of sample (including name, location, and sample type);
- Designation of matrix spike/matrix spike duplicate (MS/MSD);
- Preservative used (ice);
- Analyses required;
- Name(s) of collector(s);
- Custody transfer signatures, and dates and times of sample transfer from the field to transports (or courier) and to the laboratory; and
- Bill of lading or transported tracking number (if applicable).

Shipments either will be picked up by laboratory courier or sent by common carrier for overnight delivery, and a bill of lading will be prepared. The shipping bill number will be recorded on the chain-of-custody form. Bills of lading will be retained as part of the permanent documentation.

27.3.2 Labeling, Packaging, and Shipment

All samples collected will be labeled in a unique, clear, and precise way for proper identification in the field and for tracking in the laboratory. Sample labels will be affixed to each container to identify the sample number, collector's name, date and time of collection, location of sampling point, and analyses requested. The integrity of the sample label will be maintained by affixing clear packing tape over the sample label and completely around the sample container

overlapping the tape onto itself. All glass sample containers will be wrapped in bubble wrap and sealed in heavy-duty re-sealable plastic bags prior to packing in the sample shipment container in an effort to minimize sample container breakage during sample shipment. All project samples will be placed in a strong-outside shipping container. Sufficient ice sealed in doubled re-sealable plastic bags will be added to maintain sample temperatures at 4 ± 2°C. The chain-of-custody form will be completed and signed by the sampler and courier for samples transported to the laboratory. The chain-of-custody form will be placed inside a watertight re-sealable plastic bag and affixed with packing tape to the inside of the sample shipment container (cooler) lid.

27.3.3 Laboratory Custody Procedures

To facilitate the documentation of sample custody, the laboratory will track the progress of sample preparation, analysis, and report preparation. Samples received by the laboratory will be checked carefully for label identification, chain-of-custody forms, and any discrepancies. The laboratory will also note physical damage, incomplete sample labels, incomplete paperwork, discrepancies between sample labels and paperwork, broken or leaking containers, and inappropriate caps or bottles. On the day of receipt of samples from the field, the laboratory will send signed facsimile copies of all chain-of-custody forms and sample log-in receipt forms to the project chemist. All discrepancies and/or potential problems (e.g., lack of sample volume) will be discussed immediately with the project chemist.

The laboratory sample custodian will provide a report to the project chemist of any problems observed with any of the samples received. This report will also document the condition of samples, sample numbers received, corresponding laboratory numbers, and the estimated date for completion of analyses. Written permission must be received from the project chemist before sending any samples originally scheduled to be analyzed at their facility to another laboratory. Analyses will not be performed on samples whose integrity has been compromised or is suspect.

Samples will be logged into the laboratory information management system, which includes a tracking system for extraction and analysis dates. The laboratory will assign a unique work number to each sample for identification and tracking purposes. Samples will be stored in a secured area at a temperature of approximately 4 ± 2°C or cooler (as applicable) until analyses commence. The tracking system should also identify storage cooler numbers (if applicable) where samples are stored while on laboratory premises. Samples will be logged when they are removed from and returned to storage. Samples must be stored in coolers separate from those used to store analytical standards, reagents, and/or QC samples. Disposal of sample containers and remaining sample material will be the responsibility of the laboratory.

SAP Worksheet #28.1 -- Laboratory QC Samples Table

This worksheet identifies all laboratory QC samples anticipated to be completed for this investigation. A separate table is provided for each analytical method, matrix, and analytical group. Laboratory QC samples are analyzed as part of standard laboratory practice. The laboratory monitors the precision and accuracy of the results of its analytical procedures through analysis of QC samples. Laboratory QC samples will be collected in accordance to SOP III-C Laboratory QC Samples.

At a minimum, one laboratory QC sample is required per 14 days or one per 20 samples (including blanks and duplicates), whichever is greater. If the sample event lasts longer than 14 days or involves collection of more than 20 samples per matrix, additional QC samples will be designated. If method/SOP QC acceptance limits exceed the measurement performance criteria identified in the tables below, the data may be qualified in the data validation process and be unusable for making project decisions if rejected. QC acceptance criteria for VOCs as specified by the Department of Defense (DoD) are included in Attachment 2 and laboratory SOPs are included in Attachment 3.

Matrix	Soil
Analytical Group	TOC
Analytical Method / SOP Reference	Walkley-Black / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
LCS/LCSD	1 per analytical batch	80–120% RPD ≤ 20%	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed. If outside control limits (CL) but within marginal excess (ME), no action –	Lead Chemist	Accuracy/ Precision	QC acceptance based on laboratory in-house limits

Matrix	Soil
Analytical Group	TOC
Analytical Method / SOP Reference	Walkley-Black / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
			discuss in narrative			
MS/MSD	1 pair per analytical batch	75–125% RPD ≤ 25%	None – Flag Data	Lead Chemist	Accuracy/ Precision	For matrix evaluation use QC acceptance criteria for LCS
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤35% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards.

SAP Worksheet #28.2 -- Laboratory QC Samples Table

Matrix	Soil
Analytical Group	% Moisture / Solids
Analytical Method / SOP Reference	ASTM D2216/ TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
Sample Duplicate	1 per 20 samples	0-20% RPD	None	Lead Chemist	Precision	QC acceptance criteria based on laboratory in-house limits

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.3 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	VOCs
Analytical Method / SOP Reference	EPA 8260B / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥1/2 QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥1/2 QL
LCS	1 per analytical batch	Use QC acceptance criteria specified by DoD (see Attachment 2)	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed. If outside CL but within ME, no action – discuss in narrative	Lead Chemist	Accuracy, Precision	QC acceptance criteria for LCS specified by DoD
Surrogate	All environmental and laboratory samples	1,2-Dichloroethane-d4 (70-120%) 4-Bromofluorobenzene (75-120%) Dibromofluoromethane (85-115) Toluene-d8 (85-120%)	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy/Bias	QC acceptance criteria for surrogates specified by DoD
Internal Standard	All environmental and laboratory samples	-50% - +100%	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	QC acceptance criteria for internal standards specified by DoD

Matrix	Groundwater
Analytical Group	VOCs
Analytical Method / SOP Reference	EPA 8260B / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	1 pair per analytical batch	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS (see Attachment 2).	None – Flag data	Lead Chemist	Accuracy, Precision	For matrix evaluation, use QC acceptance criteria for LCS specified by DoD
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL
Equipment Rinsate	1 per sampling event for each type of sampling equipment used.	Per project requirements (see Measurement Performance Criteria)	The source of contamination must be identified and removed, if applicable.	Project Team/ Field Personnel	Accuracy/Bias (Contamination)	Target compounds ≤ RL
Trip Blank	1 per cooler containing VOC samples per each day of sampling	Per project requirements (see Measurement Performance Criteria)	Discuss in case narrative.	Project QA Manager (Parsons)/ Data Validator	Accuracy/Bias (Contamination)	Target compounds ≤ RL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.4 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	1,2,3-TCP
Analytical Method / SOP Reference	EPA 8260B SIM/ TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥1/2 QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥1/2 QL
LCS	1 per analytical batch	Use QC acceptance criteria specified by DoD (see Attachment 2)	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed. If outside CL but within ME, no action – discuss in narrative	Lead Chemist	Accuracy, Precision	QC acceptance criteria for LCS specified by DoD
Surrogate	All environmental and laboratory samples	80-120%	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy/Bias	QC acceptance based on laboratory in-house limits
Internal Standard	All environmental and laboratory samples	-50% - +100%	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	QC acceptance criteria of internal standard specified by DoD

Matrix	Groundwater
Analytical Group	1,2,3-TCP
Analytical Method / SOP Reference	EPA 8260B SIM/ TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	1 pair per analytical batch	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS (see Attachment 2).	None – Flag data	Lead Chemist	Accuracy, Precision	For matrix evaluation, use QC acceptance criteria for LCS specified by DoD.
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL
Equipment Rinsate	1 per sampling event for each type of sampling equipment used.	Per project requirements (see Measurement Performance Criteria)	The source of contamination must be identified and removed, if applicable.	Project Team/ Field Personnel	Accuracy/Bias (Contamination)	Target compounds ≤ RL
Trip Blank	1 per cooler containing VOC samples per each day of sampling	Per project requirements (see Measurement Performance Criteria)	Discuss in case narrative.	Project QA Manager (Parsons)/ Data Validator	Accuracy/Bias (Contamination)	Target compounds ≤ RL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.5 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	Methane, Ethane, Ethene
Analytical Method / SOP Reference	RSK175-SOP/ TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, re-extract and reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
LCS	1 per analytical batch	80-120%	If sufficient sample volume is available, re-extract and reanalyze affected samples. If volume is not sufficient, reanalyze extracts and qualify data as needed. If outside CL but within ME, no action – discuss in narrative	Lead Chemist	Accuracy/ Precision	QC acceptance based on laboratory in-house limits
MS/MSD	1 pair per analytical batch	60-140% RPD≤20%	None	Lead Chemist	Precision	QC acceptance criteria based on in-house limits

Matrix	Groundwater
Analytical Group	Methane, Ethane, Ethene
Analytical Method / SOP Reference	RSK175-SOP/ TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL
Equipment Rinsate	1 per sampling event for each type of sampling equipment used.	Per project requirements (see Measurement Performance Criteria)	The source of contamination must be identified and removed, if applicable.	Project Team/ Field Personnel	Accuracy/Bias (Contamination)	Target compounds ≤ RL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.6 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	TOC
Analytical Method / SOP Reference	SM5310B / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
LCS	1 per analytical batch	80-120%	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed. If outside CL but within ME, no action – discuss in narrative	Lead Chemist	Accuracy/Precision	% Recovery / % RPD
MS/MSD	1 pair per analytical batch	75-125% RPD≤20%	None – Flag Data	Lead Chemist	Accuracy/Precision	QC acceptance criteria based on laboratory in-house limits

Matrix	Groundwater
Analytical Group	TOC
Analytical Method / SOP Reference	SM5310B / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL
Equipment Rinsate	1 per sampling event for each type of sampling equipment used.	Per project requirements (see Measurement Performance Criteria)	The source of contamination must be identified and removed, if applicable.	Project Team/ Field Personnel	Accuracy/Bias (Contamination)	Target compounds ≤ RL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.7 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	Total Hardness
Analytical Method / SOP Reference	SM2340C/ TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
Sample Duplicate	1 per analytical batch	RPD≤20%	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Precision	QC acceptance criteria for duplicate based on laboratory in-house limits
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.8 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	Chloride, Nitrate, Nitrite, Sulfate, Fluoride
Analytical Method / SOP Reference	EPA 300.0 and SM4500F-C / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	Reanalyze with all associated samples	Lead Chemist	Accuracy	No detects ≥ ½ QL
LCS	1 per analytical batch	80-120%	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed. If outside CL but within ME, no action – discuss in narrative	Lead Chemist	Accuracy / Precision	QC acceptance criteria for LCS specified by DoD
MS/MSD	1 pair per analytical batch	80-120% RPD≤15%	None – Flag Data	Lead Chemist	Accuracy / Precision	QC acceptance limits for MS/MSD specified by DoD
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL

Matrix	Groundwater
Analytical Group	Chloride, Nitrate, Nitrite, Sulfate, Fluoride
Analytical Method / SOP Reference	EPA 300.0 and SM4500F-C / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Equipment Rinsate	1 per sampling event for each type of sampling equipment used.	Per project requirements (see Measurement Performance Criteria)	The source of contamination must be identified and removed, if applicable.	Project Team/ Field Personnel	Accuracy/Bias (Contamination)	Target compounds ≤ RL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.9 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	Calcium, Magnesium, Sodium, and Potassium
Analytical Method / SOP Reference	EPA 6010B / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, re-extract and reanalyze affected samples. If volume is not sufficient, reanalyze extracts. Qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
ICB	After each ICAL	No detects ≥ ½ QL	Reanalyze with all associated samples	Lead Chemist	Accuracy	No detects ≥ ½ QL
CCB	1/10 samples	No detects ≥ ½ QL	Reanalyze with all associated samples	Lead Chemist	Accuracy	No detects ≥ ½ QL
Lab Duplicate (if analyzed)	1 per analytical batch	≤20% RPD	None	Lead Chemist	Precision	QC acceptance criteria specified by DoD
LCS	1 per analytical batch	80-120%	If sufficient sample volume is available, re-extract and reanalyze affected samples. If volume is not sufficient, reanalyze extracts. Qualify data as needed. If outside CL but within ME, no action - discuss in narrative	Lead Chemist	Accuracy, Precision	QC acceptance criteria for LCS specified by DoD
Post-digestion Spike	1/batch	75%-125%	None	Lead Chemist	Accuracy	QC acceptance criteria for post-digestion spike specified by DoD

Matrix	Groundwater
Analytical Group	Calcium, Magnesium, Sodium, and Potassium
Analytical Method / SOP Reference	EPA 6010B / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Serial Dilution	1/batch	±10% for analytes with concentration >50x LOQ	None	Lead Chemist	Accuracy	QC acceptance criteria specified by DoD
MS/MSD	1 pair per analytical batch	80%-120% –<20%	None – Flag data	Lead Chemist	Accuracy, Precision	QC acceptance criteria specified by DoD
ICSA/AB	Beginning Daily	ICS-A: Absolute value of all detected non-spiked analytes < LOD ICS-AB: Within ±20% of true value	Terminate analysis, correct problem, recalibrate instrument, check calibration, and re-run all samples analyzed since last compliant ICS.	Lead Chemist	Accuracy	QC acceptance criteria specified by Dod
Equipment Rinsate	1 per sampling event for each type of sampling equipment used.	No detects ≥ ½ QL	The source of contamination must be identified and removed.	Project Team/ Field Personnel	Accuracy/Bias (Contamination)	No detects ≥ ½ QL RL
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤35% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.10 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	Total Alkalinity, Hydroxide, Carbonate, Bicarbonate
Analytical Method / SOP Reference	SM2320B/ TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
Sample Duplicate	1 per analytical batch	RPD≤20%	None	Lead Chemist	Precision	QC acceptance criteria based on laboratory in-house limits
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #28.11 -- Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	TDS
Analytical Method / SOP Reference	SM2540 C / TBD[1]

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch[2]	No detects ≥ ½ QL	If sufficient sample volume is available, reanalyze affected samples. If volume is not sufficient, qualify data as needed.	Lead Chemist	Accuracy	No detects ≥ ½ QL
Sample Duplicate	1 per analytical batch	RPD≤5%	None	Lead Chemist	Precision	QC criteria based on laboratory in-house limits
Field Duplicate	1 per 10 field samples	Per project requirements (see Measurement Performance Criteria)	If outside acceptance criteria, flag data appropriately and discuss in DQA.	Project QA Manager (Parsons)/ Data Validator	Precision	RPD≤30% when target compound detected in both field duplicate samples; for results ≤5xRL the range between results must be ≤2xRL

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before final implementation.
2 – Analytical batch is a group of 20 or fewer project samples which are processed together using the same method, same lot of reagents, and at the same time or in continuous sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards

SAP Worksheet #29 -- Project Documents and Records Table

Document	Where Maintained
Field notes/logbook	Parsons Project file
Chain-of-custody forms	Parsons Project file
Hard copy of Analytical Data (including raw data)	Parsons Project file and NAVFAC SW Administrative Record
Audit/assessment checklists/reports	Parsons Project file and laboratory (TBD[1])
Corrective action forms/reports	Parsons Project file and laboratory (TBD[1])
Laboratory equipment calibration logs	Laboratory (TBD[1])
Sample preparation logs	Laboratory (TBD[1])
Run logs	Laboratory (TBD[1])
Sample disposal records	Laboratory (TBD[1])
Validated data	Parsons Project file and NAVFAC SW Administrative Record

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. The name of the laboratory will be provided when the SAP is finalized and before final implementation.

SAP Worksheet #30 -- Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization[1] (name and address, contact person and telephone number)	Backup Laboratory / Organization[1] (name and address, contact person and telephone number)
Soil	TOC, Bulk Density, Grain Size Distribution, Moisture Content, Cation Exchange Capacity	1119-MW-1 through 1119-MW-8	Walkley-Black, ASTM D2937, ASTM D422/D4464M, ASTM D2216, SW9081	30 days	TBD	TBD
Groundwater	VOCs, 1,2,3-TCP, Methane, Ethane, Ethene, Chloride, Nitrate, Nitrite, Sulfate, Fluoride TOC, TDS, Alkalinity, Calcium, Magnesium, Potassium, Sodium, Hardness	3W-27A, 3W-27B, 3W-29A, 3W-29B, 3W-30A, 3W-30B, 3W-30C, 3W-35A, 3W-35B, 24W-11A, 24W-11B, 28W-01A, 28W-01B, H49-MW1, OWR-5E3, OWR-7J8, and 1119-MW-1 through 1119-MW-8	SW8260B, SW8260B SIM, RSK175-SOP, E300.0, SM4500F-C SM5310B, SM2540C, SM2320B,6010B, SM2340C	30 days	TBD	TBD

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before field implementation

SAP Worksheet #31 -- Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Readiness review meeting	Initial meeting held with field team prior to implementation of fieldwork	I	Parsons	Project Manager/ Parsons	Field Team/ Parsons	Field Team/ Parsons	Project Manager/ Parsons
System Audit	Initial audit performed after implementation of measurement systems	I	Parsons	Project Manager/ Parsons	Field Team/ Parsons	Field Team/ Parsons	Project Manager/ Parsons
Field Audit	As needed	I	Parsons	Field Team Leader	Field Team/ Parsons	Field Team Leader/ Parsons	Project Manager/Field Team Leader/ Parsons

SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Field Sampling TSA	Memo	Steve Griswold, Project Manager, Parsons	48 Hours after audit	Letter	Project File, Parsons	5 Days after receiving notification
Data Review TSA	Memo	Rich Amano, Principle Chemist, LDC	48 Hours after receiving report	Letter	Cindy Zicker, Quality Assurance Manager, Parsons	5 Days after receiving notification

SAP Worksheet #33 -- QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Field Sampling TSA Report	One (at start-up of sampling)	March 30, 2011	Quality Assurance Manager, Parsons	Project Manager, Parsons
Data Review Report	One (after all data generated and reviewed)	October 31, 2011	Quality Assurance Manager, Parsons	Project Manager, Parsons
Final Project Report	One (after QA Management Reports completed)	April 30, 2012	Project Manager, Parsons	RPM, NAVFAC & Project Manager, RWQCB

SAP Worksheet #34 -- Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain of Custody Forms	Chain-of-custody forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody should be initialed by the reviewer, a copy of the chain-of-custody retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Internal	Field Sampling Personnel (Parsons)
Sample Receipt	Sample receipts will be sent to the project chemist from the laboratory upon their completion and verified against the chain of custody and the SAP. If corrective actions are required, a copy of the documented corrective action taken will be attached to the chain of custody in the project file.	Internal	Project Chemist (Parsons)
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the project manager will be notified to ensure action is taken.	Internal	Project Manager (Parsons) Project Quality Assurance Manager (Parsons)
Field Notes/Logbook	Field notes will be reviewed internally and placed in the project file. A copy of the field notes will be attached to the final report.	Internal	Field Sampling Personnel (Parsons) Project Quality Assurance Manager (Parsons)
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be verified externally according to the data validation procedures specified in SAP worksheet #36.	Internal/ External	Laboratory TBD[1] LDC

TBD = to be determined
1 - Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before field implementation

SAP Worksheet #35 -- Validation (Steps IIa and IIb) Process Table

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Data Deliverables	Ensure all required deliverables are provided and requested analyses are reported.	Project Quality Assurance Manager (Parsons)
IIa	Analytes	Ensure that all required analytes are reported for requested analyses and that requested methods were used of analysis.	Project Quality Assurance Manager (Parsons)
IIa	Chains-of-custody	Examine traceability of data from sampled collection to reporting of data. Compare chains-of-custody records against contract, method, or procedural requirements.	Project Quality Assurance Manager (Parsons)
IIa	Holding Times	Confirm holding times were met. Document deviations and confirm appropriate notifications were made and that approval to proceed was received prior to analysis.	Project Quality Assurance Manager (Parsons)
IIa	Sample Handling	Ensure proper sample handling, receipt, and storage procedures were followed, and any deviations were documented.	Project Quality Assurance Manager (Parsons)
IIa	Sampling Methods and Procedures	Establish required sampling methods were used and any deviations were noted. Ensure sampling procedures and field measurements met performance criteria and any deviations were documented.	Field Team Leader (Parsons)
IIa	Field Transcription	Compare transcription accuracy of sampling data from field notebook to reports.	Field Team Leader (Parsons)
IIa	Analytical Methods and Procedures	Confirm required analytical methods were used and that deviations were noted. Ensure QC samples met performance criteria and any deviations are documented.	Project Quality Assurance Manager (Parsons)
IIa	Data Qualifiers	Confirm laboratory data qualifiers were defined and applied as specified in methods, procedures, and/or contracts.	Project Quality Assurance Manager (Parsons)
IIa	Laboratory Transcription	Authenticate accuracy of transcription of analytical data (Level IV data packages only).	Chemist, LDC
IIa	Standards	Ensure traceability of standards meet contract, method, or procedural requirements.	Chemist, LDC
IIa	Communication	Establish required communication procedures were followed by field or laboratory personnel.	Project Manager (Parsons)

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Audits	Review field and laboratory audit reports and accreditation and certification records for the laboratory's performance.	Project Quality Assurance Manager (Parsons)
IIb	Deviations	Determine impact(s) of any deviations from sampling or analytical methods and SOPs. Consider the effectiveness and appropriateness of any corrective action.	Project Quality Assurance Manager (Parsons)
IIb	Sampling Plan	Determine whether the sampling plan was executed as specified (i.e., the number, location, and type of field samples were collected and analyzed as specified).	Project Manager (Parsons)
IIb	Sampling Procedures	Evaluate whether sampling procedures were followed with respect to equipment and proper sampling support (e.g., techniques, equipment, decontamination, volume, temperature, preservatives, etc.).	Project Manager (Parsons)
IIb	Co-located Field Duplicates	Compare results of co-located field duplicates with criteria established in the SAP).	Project Quality Assurance Manager (Parsons)
IIb	Project Quantitation Limits	Determine whether quantitation limits were achieved.	Project Quality Assurance Manager (Parsons)
IIb	Performance Criteria	Evaluate QC data against project-specific performance criteria in the SAP.	Project Quality Assurance Manager (Parsons)
IIb	Step IIb Validation Report	Summarize outcome of comparison of data to method performance criteria in SAP. Include qualified data and explanation of all data qualifiers.	Project Quality Assurance Manager (Parsons)

[1] IIa=compliance with methods, procedures, and contracts
IIb=comparison with measurement performance criteria in the SAP

SAP Worksheet #36 -- Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator[1] (title and organizational affiliation)
IIa	Soil	TOC	Walkley-Black, SOPs	Chemist, TBD Project Manager, LDC
IIa	Soil	% Moisture	ASTM D2216, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	VOCs	SW-846 Method 8260B, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	1,2,3-TCP	Method 8260B SIM, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	Methane, Ethane, Ethene	RSK-SOP 175, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	TOC	SM5310B, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	Total Hardness	SM 2340C, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	Sulfate, Chloride, Nitrate, Nitrite, Fluoride	E300.0 or SM4500F-C, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	Calcium, Magnesium, Sodium, and Potassium	SW6010B, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	Total Alkalinity, Hydroxide, Carbonate, Bicarbonate	SM 2320B, SOPs	Chemist, TBD Project Manager, LDC
IIa	Groundwater	TDS	SM 2540C, SOPs	Chemist, TBD Project Manager, LDC

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator[1] (title and organizational affiliation)
IIb	Soil	TOC	Worksheet #28.1	Project Manager, LDC
IIb	Soil	% Moisture	Worksheet #28.2	Project Manager, LDC
IIb	Groundwater	VOCs	Worksheet #28.3	Project Manager, LDC
IIb	Groundwater	1,2,3-Trichloropropane	Worksheet #28.4	Project Manager, LDC
IIb	Groundwater	Methane, Ethane, Ethene	Worksheet #28.5	Project Manager, LDC
IIb	Groundwater	TOC	Worksheet #28.6	Project Manager, LDC
IIb	Groundwater	Total Hardness	Worksheet #28.7	Project Manager, LDC
IIb	Groundwater	Sulfate, Chloride, Nitrate, Nitrite, Fluoride	Worksheet #28.8	Project Manager, LDC
IIb	Groundwater	Calcium, Magnesium, Sodium, and Potassium	Worksheet #28.9	Project Manager, LDC
IIb	Groundwater	Total Alkalinity, Hydroxide, Carbonate, Bicarbonate	Worksheet #28.10	Project Manager, LDC
IIb	Groundwater	TDS	Worksheet #28.11	Project Manager, LDC

TBD = to be determined

1 Procurement of analytical laboratory is not complete at this time. Specific information regarding laboratory SOPs will be provided when the SAP is finalized and before field implementation.

SAP Worksheet #37 -- Usability Assessment

37.1 Analytical Data Quality Assessment Criteria

Data quality assessment (DQA) criteria will be used to evaluate the quality of the field sampling efforts, field screening results, and fixed-base laboratory results for compliance with project data quality objectives (DQOs). The DQA criteria will be evaluated in terms of analytical precision, accuracy, representativeness, completeness, and comparability (PARCC).

37.1.1 Precision

Precision is the measure of variability among individual sample measurements under prescribed conditions. The relative percent difference (RPD) between primary and field duplicate samples, laboratory sample duplicate (SD) pairs, and matrix spike/matrix spike duplicate (MS/MSD) sample results demonstrate the precision of the sample matrix. When the laboratory control sample (LCS) results meet the accuracy criteria (DoD, 2006), results are also believed to be precise, and represent the precision of the laboratory, independent from sample matrix. This is based on the LCS being within control limits in comparison to LCS results from previous analytical batches of similar methods and matrices. Precision will be expressed in terms of RPD between the values resulting from primary and duplicate sample analyses. RPD is calculated as follows:

$$RPD = [|(x1 - x2)|/X][100]$$

where:

x1	=	analyte concentration in the primary sample,
x2	=	analyte concentration in the duplicate sample, and
x	=	average analyte concentration of the primary and the duplicate sample.

Acceptable levels of precision will vary according to the sample matrix, the specific analytical method, and the analytical concentration relative to the method detection limit (MDL). For field duplicate samples, the target RPDs are $\leq$ 35 percent. If the concentration of either duplicate is less than five times the reporting limit (RL), a control limit of $\pm$ 2xRL will be compared against the range of the duplicate pair. Precision criteria for the laboratory QC samples are listed in Worksheets 28.1 through 28.11. An RPD within the control limit indicates satisfactory precision in a measurement system.

37.1.2 Accuracy

Accuracy is a measure of the closeness of a reported concentration to the true value. Accuracy is expressed as a bias (high or low) and is determined by calculating percent recovery (%R) from MS/MSDs, LCSs, and surrogate spikes (where applicable). MS/MSD and surrogate spike recoveries indicate accuracy relevant to a unique sample matrix. LCS recoveries indicate accuracy relevant to an analytical batch lot, and are strictly a measure of accuracy conditions in preparation and analysis independent of samples and matrices. The %R of an analyte, and the resulting degree of accuracy expected for the analysis of spiked samples for QC, are dependent upon the sample matrix, method of analysis, dilution (if required) and the compound or element being measured.

Accuracy expressed as %R is calculated as follows:

$$\%R = [(A-B)/C] \times 100$$

where:

A	=	spiked sample concentration,

B = measured sample concentration (without spike), and
C = concentration of spike added.

Accuracy criteria for the laboratory are defined by control limits listed in Worksheets 28.1 through 28.11.

37.1.3 Completeness

Completeness is defined as the percentage of laboratory measurements judged to be valid on a method-by-method basis. In addition to valid results (data not rejected), broken and/or spilled samples, and any other problems that may compromise sample representativeness are included in the assessment of completeness. Valid data are defined as all data and/or qualified data considered to meet the DQOs for this project. Data completeness is expressed as percent complete (PC) and should be ≥ 90 percent. The goal for meeting analytical holding times is 100 percent. At the end of each sampling event, the completeness of the data will be assessed. If any data omissions are apparent, the parameter in question will be resampled and/or reanalyzed, if feasible. Laboratory results will be monitored as they become available to assess laboratory performance and its effect on data completeness requirements.

PC is calculated as follows:

$$PC = \frac{N_A}{N_I} X100$$

Where:
N_A = Actual number of valid analytical results obtained, and
N_I = Theoretical number of results obtainable under ideal conditions.

37.1.4 Comparability

Comparability expresses the confidence with which data from one sample, sampling round, site, laboratory, or project can be compared to those from another. Comparability during sampling is dependent upon sampling program design and time periods. Comparability during analysis is dependent upon analytical methods, detection limits, laboratories, units of measure, and sample preparation procedures.

Comparability is determined on a qualitative rather than quantitative basis. For this project, comparability of all data collected will be ensured by adherence to standard sample collection procedures, standard field measurement procedures, and standard reporting methods, including consistent units. For example, concentrations will be reported in a manner consistent with general industry practice (e.g., soil data will be reported on a dry-weight basis).

In addition, to support the comparability of fixed-base laboratory analytical results with those obtained from previous or future testing, all samples will be analyzed by USEPA-approved methods, where available. The USEPA-recommended maximum permissible sample holding times (Worksheet #19) for organic and inorganic parameters will not be exceeded.

All analytical standards will be traceable to standard reference materials. Instrument calibrations will be performed in accordance with USEPA method specifications, and will be checked at the frequency specified for the methods. The results of these analyses can then be compared to analyses by other laboratories and/or to analyses for other sites addressed by this investigation.

37.1.5 Representativeness

Representativeness expresses the extent to which collected data define site contamination. Where appropriate, sample results will be statistically characterized to determine the degree to which the data accurately and precisely represent a characteristic of a population, parameter

variation at a sampling point, a process, or an environmental condition. Sample collection, handling, preservation, and analytical procedures are designed to obtain the most representative sample possible. Representative samples will be achieved by the following:

- Collection of samples from locations fully representing site conditions;
- Use of appropriate sample preservation techniques;
- Use of appropriate sampling procedures, including proper equipment and equipment decontamination;
- Use of appropriate analytical methods for the required parameters and RLs; and
- Analysis of samples within the required holding times.

Sample representativeness is also affected by the portion of each sample chosen for analysis. The laboratory will adequately homogenize all samples prior to taking aliquots for analysis to ensure that the reported results are representative of the sample received. Because many homogenization techniques may cause loss of contaminants through volatilization, homogenization for all VOC method analyses will not be performed.

37.1.6 Sensitivity

The concentration of any one target compound that can be detected and/or quantified is a measure of sensitivity for that compound. Sensitivity is instrument-, compound-, method-, and matrix-specific. The subcontract laboratory will flag (as an estimate, “J” flag) and report target compounds detected below the reporting limit down to the MDL in an effort to meet regional screening levels (RSLs).

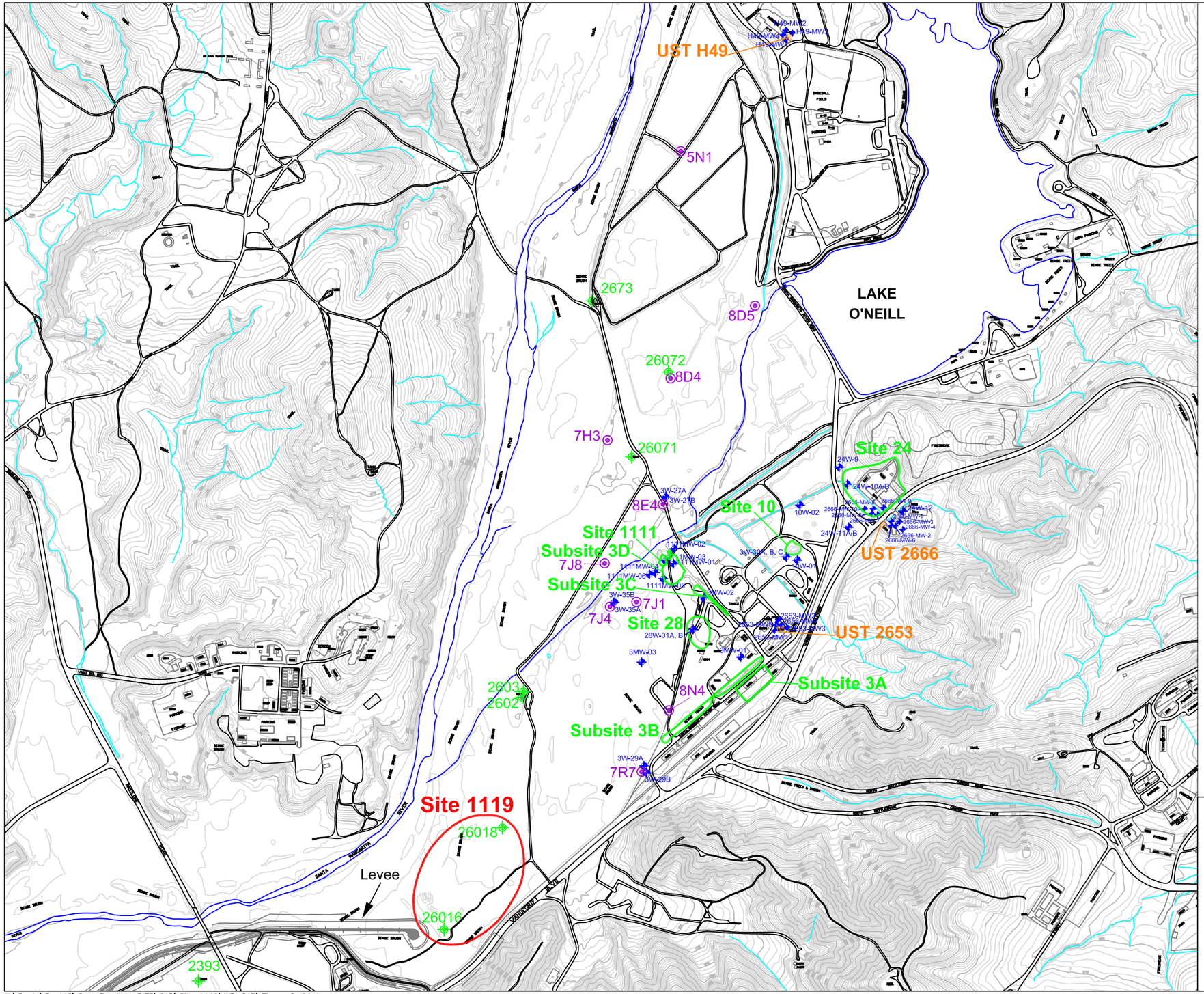
Raw data collected in the field will be verified and included in the final report. Data verification and validation procedures employed during this project will ensure data collected meet project DQOs and assure a reasonable basis for decision making.

37.2 Assessment of Usability

Parsons will assess data usability based on validation results to determine the project precision, accuracy, representativeness, completeness, and comparability. Any limitations on data use will be expressed quantitatively to the extent practicable. The outcome of this data review will be a data set appropriate to support project-specific requirements. A DQA will be written, summarizing the findings of the validation review, and providing an assessment of overall data quality and usability.

List of Figures

1 Site 1119 Site Location Map
2 Site 1119 Geologic Conceptual Site Model
3 Site 1119 Potential Exposure Pathways for Human Receptors
4 Site 1119 Existing Groundwater Monitoring Well Locations Included in Proposed Sampling
5 Site 1119 Existing Groundwater Monitoring Wells Near UST H49 Included in Proposed Sampling
6 Site 1119 Proposed Groundwater Monitoring Well Locations



Legend

- Site 1119 Boundary
- Former IR Site Boundary
- Former UST Site
- Santa Margarita River Channel
- Drainage Channels and Ephemeral Streams
- Production Well
- Observation Well
- Groundwater Monitoring Well

N

0 1000 2000

Scale in Feet

Figure 1

Site 1119
Site Location Map

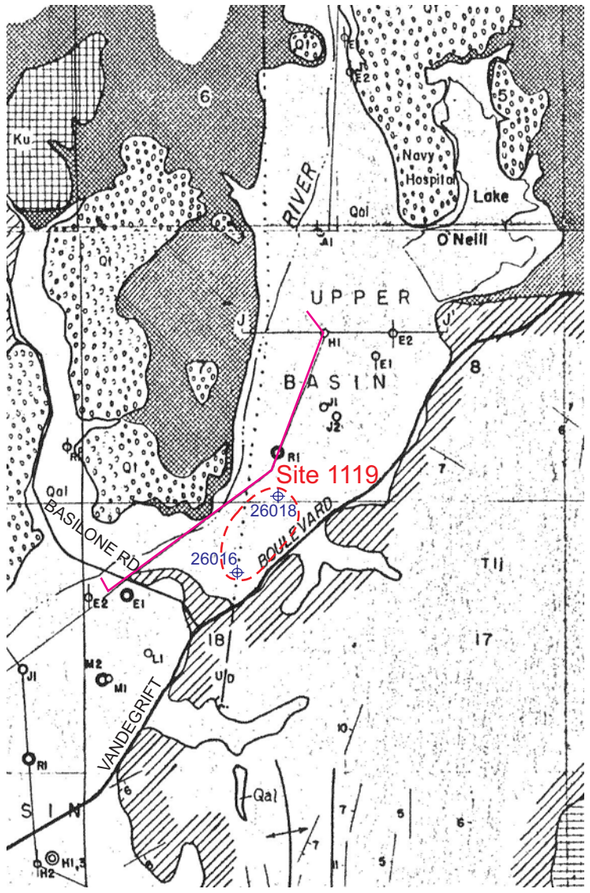
MCB Camp Pendleton, California

PARSONS

Pasadena, CA

K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 2-01.dwg

From Worts and Boss, 1954, Plate 1 - Geologic Map



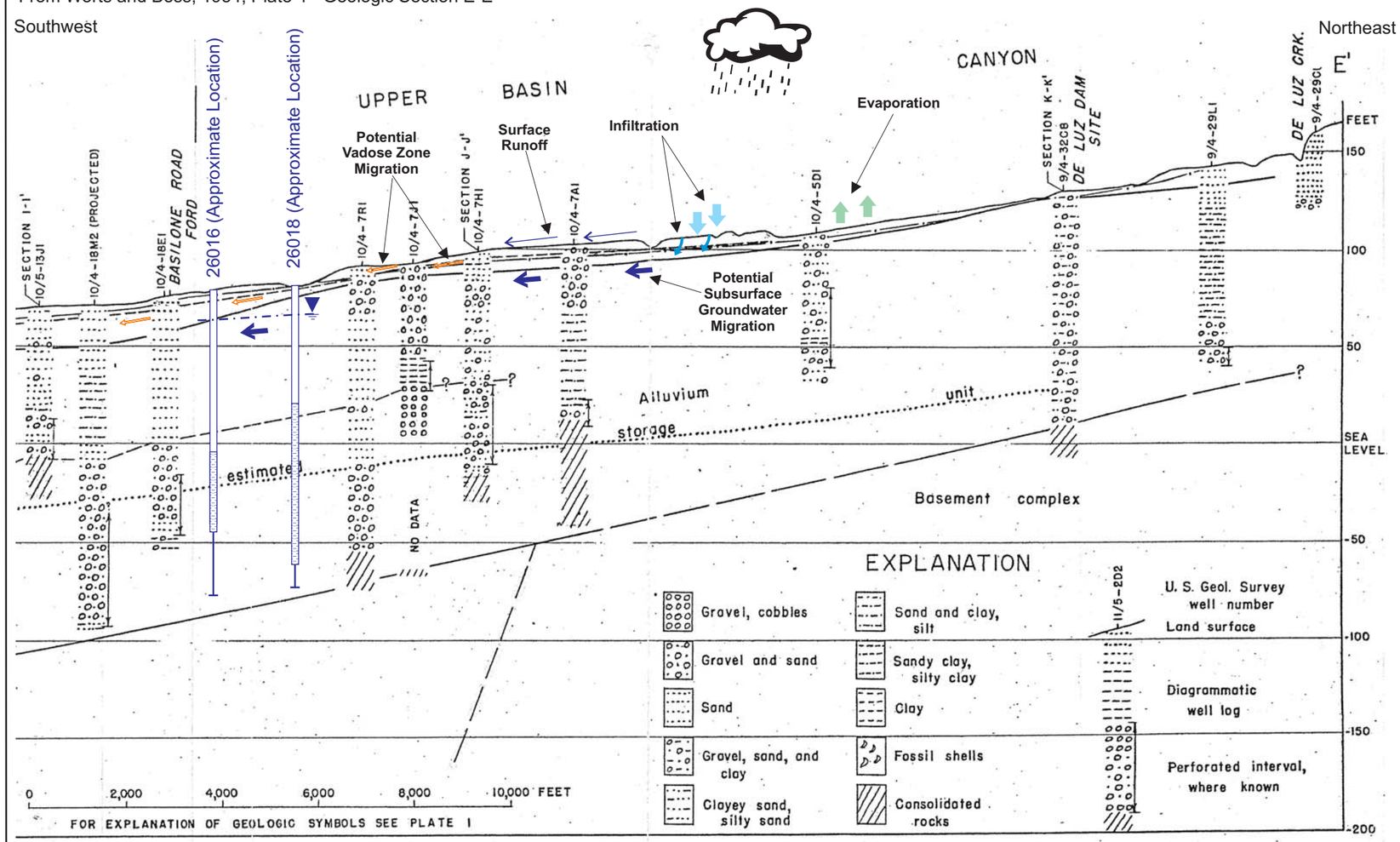
Approximate Horizontal Scale
1 inch = ½ mile

Site 1119

Line of Section Shown on CSM

N

From Worts and Boss, 1954, Plate 4 - Geologic Section E-E'



LOOKING NORTHWEST

Precipitation

Surface Runoff

Infiltration

Evaporation

Vadose Zone Migration

Subsurface Water Flow

Groundwater Level

Well Casing

Well Screen

Total Depth of Boring

Approximate Horizontal Scale
1 inch = ½ mile

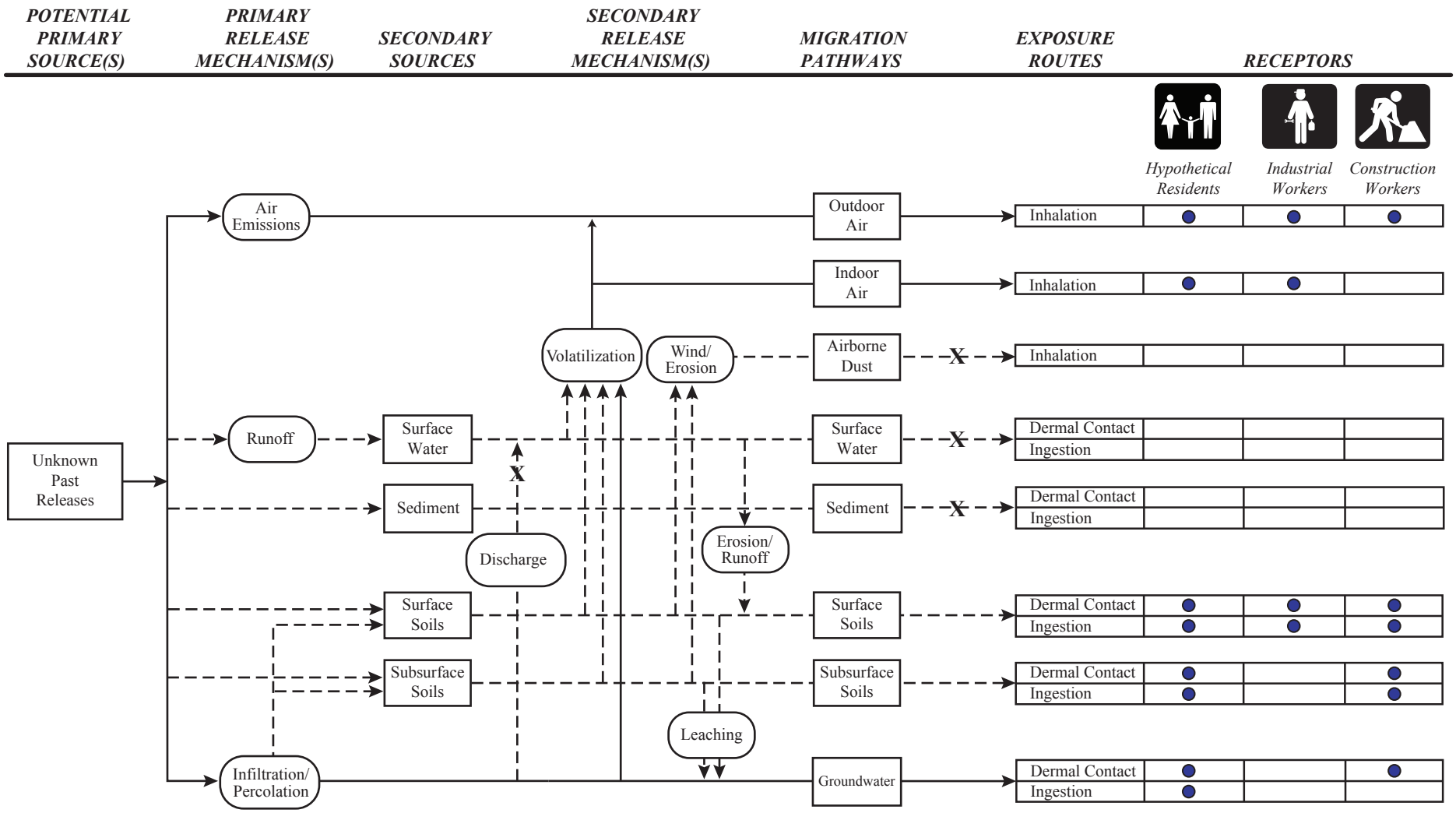
Approximate Vertical Scale
1 inch = 66 feet

Approximate Vertical Exaggeration 40:1

Figure 2

Site 1119
Geologic Conceptual Site Model

MCB Camp Pendleton, CA
PARSONS
Pasadena, CA



Legend

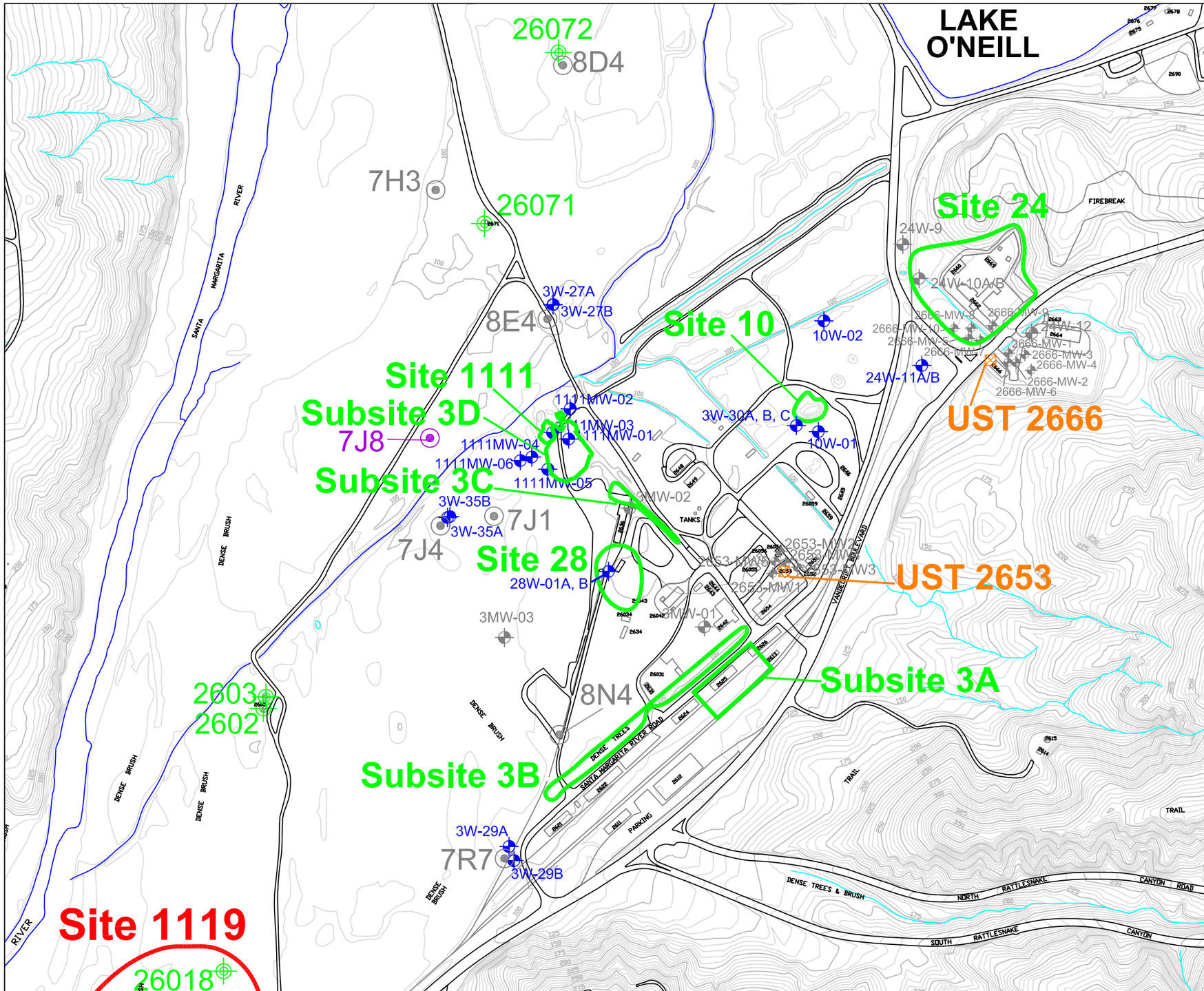
- Potentially complete exposure pathway
- Potentially incomplete exposure pathway
- Incomplete exposure pathway
- Potentially complete exposure route

Figure 3
Site 1119
Potential Exposure Pathways for Human Receptors

MCB Camp Pendleton, California

PARSONS

Pasadena, CA



Legend

- Site 1119 Boundary
- Former IR Site Boundary
- Former UST Site
- Santa Margarita River Channel
- Drainage Channels and Ephemeral Streams
- Production Well
- Observation Well Included in Sampling
- Observation Well Not Included in Sampling
- Groundwater Monitoring Well Included in Sampling
- Groundwater Monitoring Well Not Included in Sampling

N

0 500 1000

Scale in Feet

Figure 4

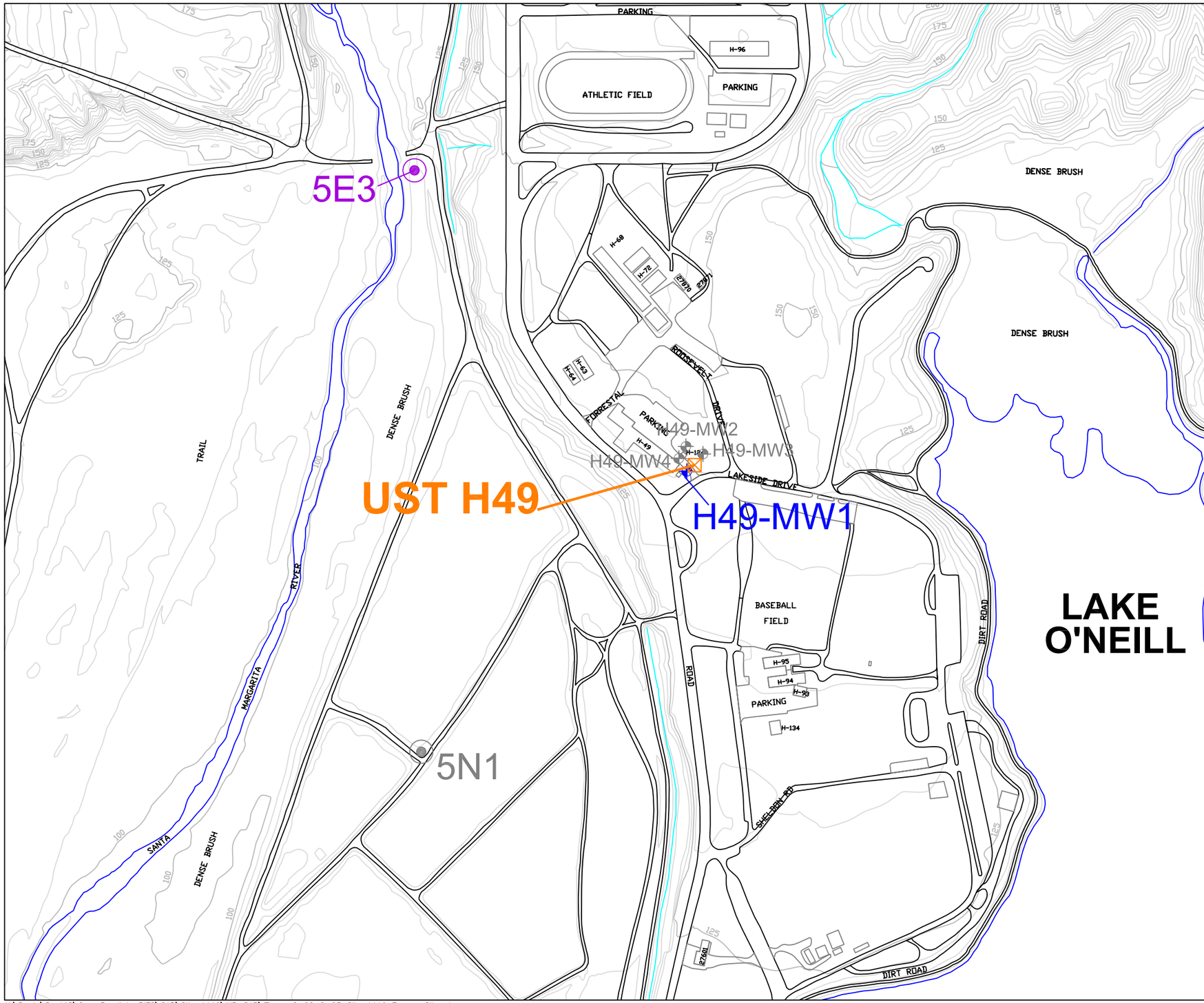
Site 1119
Existing Groundwater Monitoring Well Locations Included in Proposed Sampling

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 2-02_2-03_Site 1119 Former Sites.dwg



Legend

- Site 1119 Boundary
- Former IR Site Boundary
- Former UST Site
- Santa Margarita River Channel
- Drainage Channels and Ephemeral Streams
- Production Well
- Observation Well Included in Sampling
- Observation Well Not Included in Sampling
- Groundwater Monitoring Well Included in Sampling
- Groundwater Monitoring Well Not Included in Sampling

N

0 400 800

Scale in Feet

Figure 5

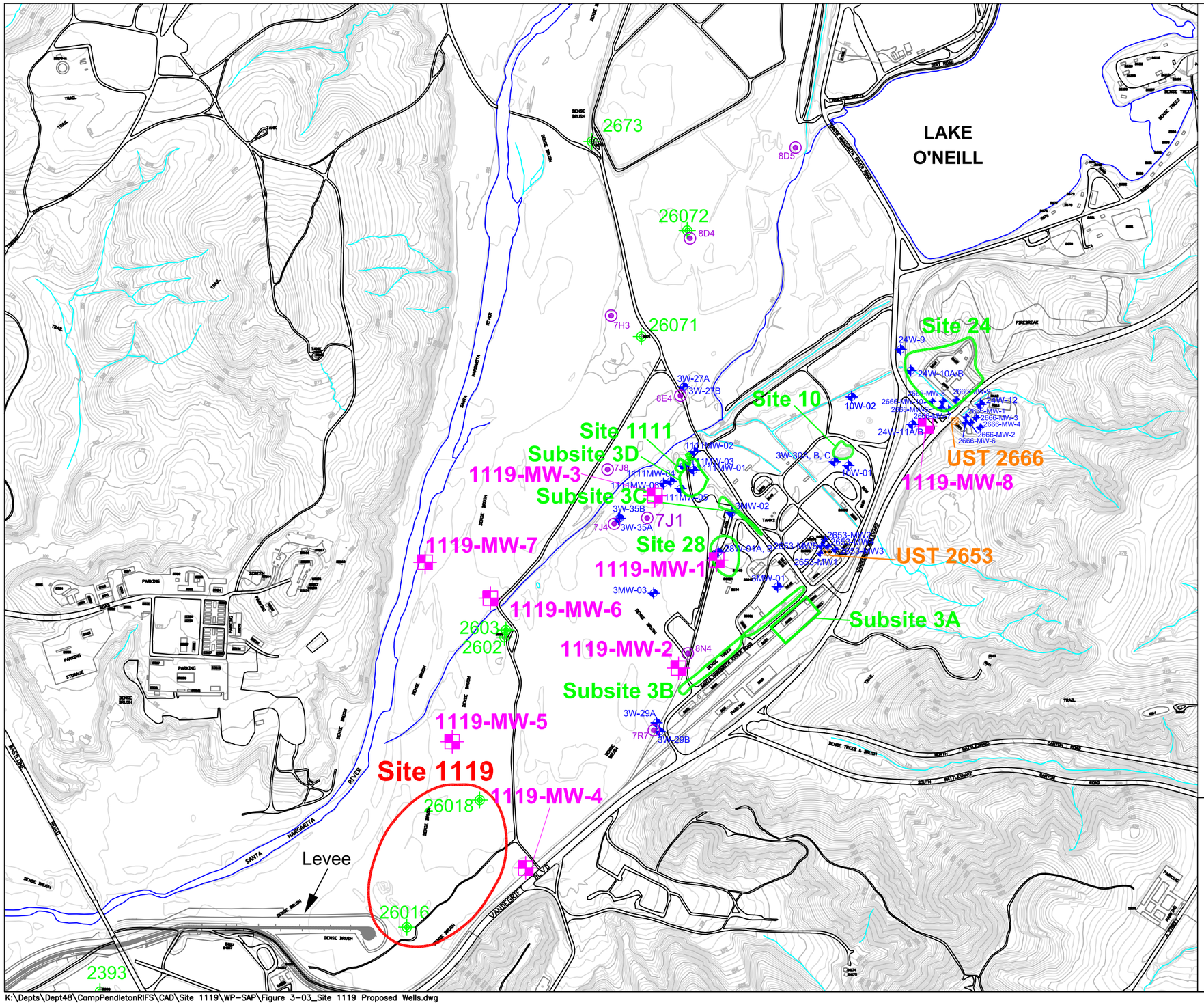
Site 1119
Existing Groundwater Monitoring Wells Near UST H49 Included in Proposed Sampling

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 2-02_2-03_Site 1119 Former Sites.dwg



Legend

- Site 1119 Boundary
- Former IR Site Boundary
- Former UST Site
- Santa Margarita River Channel
- Drainage Channels and Ephemeral Streams
- Production Well
- Observation Well
- Groundwater Monitoring Well
- Proposed Groundwater Monitoring Well

N

0 800 1600

Scale in Feet

Figure 6

Site 1119
Proposed Groundwater Monitoring Well Locations

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

K:\Depts\Dept48\CampPendletonRIFS\CAD\Site 1119\WP-SAP\Figure 3-03_Site 1119 Proposed Wells.dwg

ATTACHMENT 1
EXAMPLES OF CHAIN OF CUSTODY FORMS AND LABELS

Procurement of the analytical laboratory is not complete at this time. An example laboratory chain of custody form will be provided when the SAP is finalized and before field implementation.

Example Labels

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _2223-TB01-1008_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _____ Sampler: _____
Date: _____ Time: _____

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _____ Sampler: _____
Date: _____ Time: _____

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
1,2,3-TCP SW8260B SIM
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
Methane, Ethane, Ethene RSKSOP-175
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
Total Organic Carbon (TOC) E415.1
Preservative: HCL

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
1,2,3-TCP SW8260B SIM
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
Methane, Ethane, Ethene RSKSOP-175
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
Total Organic Carbon (TOC) E415.1
Preservative: HCL

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _2223-TB01-1008_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _____ Sampler: _____
Date: _____ Time: _____

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _____ Sampler: _____
Date: _____ Time: _____

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
1,2,3-TCP SW8260B SIM
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
Methane, Ethane, Ethene RSKSOP-175
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
Hardness, Calcium, Magnesium, Sodium, and Potassium
E130.2, SW6010B Preservative: HNO3

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
1,2,3-TCP SW8260B SIM
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
Methane, Ethane, Ethene RSKSOP-175
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
Hardness, Calcium, Magnesium, Sodium, and Potassium
E130.2, SW6010B Preservative: HNO3

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _____ Sampler: _____
Date: _____ Time: _____

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _____ Sampler: _____
Date: _____ Time: _____

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
1,2,3-TCP SW8260B SIM
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
Methane, Ethane, Ethene RSKSOP-175
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27A-0411_ Sampler: _____
Date: _____ Time: _____
Alkalinity, Hydroxide, Carbonate, Bicarbonate; Chloride, Nitrate, Nitrite, Sulfate, Fluoride, TDS
SM2320B, E300.0, E340.2, E160.1

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
VOCs SW8260B
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
1,2,3-TCP SW8260B SIM
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
Methane, Ethane, Ethene RSKSOP-175
Preservative: HCl

Parsons **MCB Camp Pendleton Site 1119 - 747324**

Sample: _3W-27B-0411_ Sampler: _____
Date: _____ Time: _____
Alkalinity, Hydroxide, Carbonate, Bicarbonate; Chloride, Nitrate, Nitrite, Sulfate, Fluoride, TDS
SM2320B, E300.0, E340.2, E160.1

ATTACHMENT 2
LCS CONTROL LIMITS FOR VOLATILE ORGANIC COMPOUNDS
(WORKSHEETS 28.3 AND 28.4)

LCS Control Limits for Volatile Organic Compounds (Method SW8260B)

Analyte	Soil		Groundwater	
	Lower Control Limit (%)	Upper Control Limit (%)	Lower Control Limit (%)	Upper Control Limit (%)
1,1,1,2-Tetrachloroethane	75	125	80	130
1,1,1-Trichloroethane	70	135	65	130
1,1,2,2-Tetrachloroethane	55	130	65	130
1,1,2-Trichloroethane	60	125	75	125
1,1-Dichloroethane	75	125	70	135
1,1-Dichloroethene	65	135	70	130
1,1-Dichloropropene	70	135	75	130
1,2,3-Trichlorobenzene	60	135	55	140
1,2,3-Trichloropropane	65	130	75	125
1,2,4-Trichlorobenzene	65	130	65	135
1,2,4-Trimethylbenzene	65	135	75	130
1,2-Dibromo-3-chloropropane	40	135	50	130
1,2-Dibromoethane	70	125	80	120
1,2-Dichlorobenzene	75	120	70	120
1,2-Dichloroethane	70	135	70	130
1,2-Dichloropropane	70	120	75	125
1,3,5-Trimethylbenzene	65	135	75	130
1,3-Dichlorobenzene	70	125	75	125
1,3-Dichloropropane	75	125	75	125
1,4-Dichlorobenzene	70	125	75	125
2,2-Dichloropropane	65	135	70	130
2-Butanone	30	160	30	150
2-Chlorotoluene	70	130	75	125
2-Hexanone	45	145	55	130
4-Chlorotoluene	75	125	75	130
4-Methyl-2-pentanone	45	145	60	135
Acetone	20	160	40	140
Benzene	75	125	80	120
Bromobenzene	65	120	75	125
Bromochloromethane	70	125	65	130
Bromodichloromethane	70	130	75	120
Bromoform	55	135	70	130
Bromomethane	30	160	30	145
Carbon Disulfide	45	160	35	160
Carbon tetrachloride	65	135	65	140
Chlorobenzene	75	125	80	120
Chlorodibromomethane	65	130	60	135
Chloroethane	40	155	60	135
Chloroform	70	125	65	135
Chloromethane	50	130	40	125
cis-1,2-Dichloroethene	65	125	70	125

Analyte	Soil		Groundwater	
	Lower Control Limit (%)	Upper Control Limit (%)	Lower Control Limit (%)	Upper Control Limit (%)
cis-1,3-Dichloropropene	70	125	70	130
Dibromomethane	75	130	75	125
Dichlorodifluoromethane	35	135	30	155
Ethylbenzene	75	125	75	125
Hexachlorobutadiene	55	140	50	140
Isopropylbenzene	75	130	75	125
m,p-Xylene	80	125	75	130
Methylene chloride	55	140	55	140
Naphthalene	40	125	55	140
n-Butylbenzene	65	140	70	135
n-Propylbenzene	65	135	70	130
o-Xylene	75	125	80	120
p-Isopropyltoluene	75	135	75	130
sec-Butylbenzene	65	130	70	125
Styrene	75	125	65	135
tert-Butylbenzene	65	130	70	130
Tetrachloroethene	65	140	45	150
Toluene	70	125	75	120
trans-1,2-Dichloroethene	65	135	60	140
trans-1,3-Dichloropropene	65	125	55	140
Trichloroethene	75	125	70	125
Trichlorofluoromethane	25	185	60	145
Vinyl Chloride	60	125	50	145

ATTACHMENT 3
LABORATORY STANDARD OPERATING PROCEDURES

Procurement of the analytical laboratory is not complete at this time. Laboratory standard operating procedures will be provided when the SAP is finalized and before field implementation.

APPENDIX B
WELL LOGS FOR 26016 AND 26018

WELL LOG 26016

Camp Pendleton
Water and Wastewater System
Design, Build, Operate and Maintain
Contract N68711-04-D-5110-0018
DO 0018 (Area26Wells)

Well 26016 Final Casing Design

Submitting to: Meryll Gonzalez, CIV NAVFAC SW

Submitted by: John M. Price, P.E.

Submittal Date: January 28, 2009

Prepared by: Mike Hoffman, C.H.G.
Suzanne Rowe, C.H.G.
Nate Lazewski, P.E.

Reviewed by: Jack Taylor, P.E. Mike Smith

Distributed to:

NAVFAC, Southwest (San Diego)	Meryll Gonzalez	Electronic Copy
NAVFAC, Southwest (MCBCP)	Simon Kroon	Electronic Copy
	Robert Anigbogu	Electronic Copy
Activity Public Works Officer (PWO)	Khoa Pham	Electronic Copy

DCN: 01844

Approved for Construction

SOUTHWESTNAVFACENGCOM 4355/2 (10-89)

TRANSMITTAL AND APPROVAL

See instructions on reverse
No carbon paper is required to complete this form
No transmittal letter is required

DCN: 01844

DQC/CQC CLAUSE [X] IS APPLICABLE [ ] IS NOT APPLICABLE

REFERENCES TO USE WHEN DQC/CQC CLAUSE IS APPLICABLE

PART 1 - FOR CONTRACTOR USE

REFERENCES TO USE WHEN COC CLAUSE IS NOT APPLICABLE

(A) ROICC/REICC

FROM (CONTRACTOR): CDM Constructors Inc.

TO (A): NAVFAC SWDIV CENTRAL IPT

(A) DESIGNER

CONTRACT NO: N68711 04-D-5110-0018 (A26Wells)

CONTRACT TITLE: Camp Pendleton Water and Wastewater System DBOM

(B) (Check one)
[ ] RECORD
[x] APPROVAL

(B) APPROVAL

THE FOLLOWING ITEM IS SUBMITTED FOR (B) PER SPECIFICATION SECTION NUMBER

Well 26016 Final Casing Design
(Spec Section 02521)

CERTIFICATION (THIS FORM SHALL NOT BE USED TO FORWARD PROPOSED SUBSTITUTIONS)

IT IS HEREBY CERTIFIED THAT THE [ ] EQUIPMENT [ ] MATERIAL SHOWN AND MARKED IN THIS SUBMITTAL IS THAT PROPOSED TO BE INCORPORATED INTO CONTRACT N68711 -04-D-5110-0018 (A26Wells) IS IN COMPLIANCE WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS, AND CAN BE INSTALLED IN THE ALLOCATED SPACES.

28/JAN/09

(C) AUTHORIZED CONTRACTOR QUALITY CONTROL REPRESENTATIVE

CERTIFIED BY (C): Nate Lazewski P.E. and/or Jack Taylor, P.E.

DATE: 28-Jan-09

(C) PERSON DESIGNATED BY CONTRACTOR AS HAVING AUTHORITY TO SIGN CERTIFICATION

PART II - FOR DESIGNER USE

FROM (DESIGNER):

TO (ROICC/REICC):

(D) CURSORY REVIEW REQUIRED ON RECORD COPIES-REPLY TO ROICC ONLY IF APPROPRIATE. DETAILED REVIEW REQUIRED ON SUBMITTALS FOR GOVERNMENT APPROVAL

(D) DETAILED REVIEW REQUIRED. STAMP AND MARK EACH COPY AS APPROPRIATE

THIS SUBMITTAL HAS BEEN REVIEWED (D). THE FOLLOWING RECOMMENDATION IS MADE:

N/A

STAMP AND MARK EACH COPY AS APPROPRIATE

SIGNATURE:

DATE:

PART III - FOR ROICC/REICC USE

FROM (ROICC/REICC): NAVFAC SWDIV CENTRAL IPT

TO (E): CDM Constructors Inc.

(E) DESIGNER (COPY TO OICC)

(E) CONTRACTOR (COPY TO OICC)

ENCLOSURES ARE RETURNED WITH THE FOLLOWING COMMENTS:

Approved

SIGNATURE:

DATE: 28 JAN 09

C:\Documents and Settings\lazewskink\My Documents\Camp Pendleton\DO 018 (26 Area Wells)\Design\26016 Casing\090128_A26Wells_2601_Well Ca6sign Design_T&A.xls

Camp Pendleton
Well 26016
Casing Schedule

Interval (ft)	Length (ft)	Casing Diameter (in)	Wall Thickness (in)	Casing
0 - 53	53	30 OD	5/16	MS Conductor Casing
0 - 73	73	16 ID	5/16	Cu Bearing Blank
73 - 75	2	16 ID	--	Mechanical Coupler
75 - 125	50	16 ID	--	304 SS 0.060-inch Wire Wrap
125 - 145	20	16 ID	1/4	304 SS Blank with endcap

Borehole	**Interval**	**Borehole Diameter**
	0 - 53	38-inch
	53 - 155	26-inch

Tubing	**Interval**	**Type**
	0 - 70	2-inch diameter, Schedule 40, mild steel sounding tube (located to south)
	0 - 55	3-inch diameter, Schedule 40, mild steel gravel tube (located to east)

Annular Material	**Interval**	**Type**
	0 - 45	10.5-sack sand/cement slurry
	45 - 155	8 x 16 Colorado Silica Gravel Pack

Gravel Pack Gradation 8 x 16

Sieve Size	Percent Retained
8	6-15
10	30 - 36
12	75 - 78
14	85-98
16	96-99

BOREHOLE LOG

BOREHOLE 2a016

PROJECT Camp Pendleton

PAGE 1 OF ___

COORDS.	DRILLER Cord - Barney's Well - BWP	START DATE 1/21/09
		FINISH DATE
GROUND ELEV.		GEOPHYSICAL LOG YES ☒ NO ☐
TOTAL DEPTH	RIG	☒ RESISTIVITY
BOREHOLE DIAMETER(S) 0-50 - 38";	BIT(S)	☒ SELF POTENTIAL
		☒ NATURAL GAMMA
LOGGED BY Mike Hoffman	FLUID	☒ CALIPER
	SURFACE CASING	☐ OTHER

DEPTH	LITHOLOGY DESCRIPTION	COMMENTS
0-7	SAND: 100% sand, pg, f-m, a-sa; tr gravel wg, f-c, sa-sr, 3" max Ø; tr silt, moist	
7-17	SAND: 100% sand, pg, f-m, mostly med, a-sa, wet.	Water @ 7' bgs
17-19	SAND: 100% sand, same as above	
19-20	SILT 100% silt, soft, nonplastic, wet	
20'-30'	SAND: Same as above	
30'-35'	SAND: Same as above	
35'-40'	SILT: 100% clay, soft	
40'-45'	SILTY SAND: 85% sand, pg, f-m; a-sa, 15% silt.	
45'-53'	SILT: same as above w/ tr mica	

BOREHOLE LOG

BOREHOLE 26016

PROJECT C.P. well replacement

PAGE ___ OF ___

DEPTH	LITHOLOGY DESCRIPTION	COMMENTS
53'-62'	SAND: dk gray (5Y 4/1); 100% sand, pg m-f trace coarse, sa-sr; trace silt,	trace mica
62'-72'	SAND: dk gray (5Y 4/1); 95% sand, pg f, sr; 5% silt	trace mica
72'-76'	SAND: dk gray (5Y 4/1); same as above	trace mica
76'-80	SAND: gray (5Y 5/1); pg m-f trace coarse, sa-r,	trace mica Gravel sound thru spliter
80'-90'	SAND: gray (5Y 6/1); wg f-c, sa-sr;	trace mica Gravel sound thru spliter
90'-100'	SAND; gray (2.5Y 5/1); pg, m-c trace fine, sr; trace gravel max Ø 1/4", sa.	trace mica Hit something hard at 95'
100'-110'	SAND: gray (2.5Y 5/1); same as above	trace mica
110'-120'	SAND: gray (2.5Y 5/1); same as above	trace mica
120'-126'	SAND: olive brown (2.5Y 4/3); wg f-c, sa-sr; trace gravel, pg, sa max Ø = 1/2"	hard spot at 123' 1x6" cobble trace mica
126'-130'	SANDY SILT: lt olive brown (2.5Y 5/3); 60% silt soft, non-plastic; 40% sand, wg, f-c, sa.	
130'-140'	CLAY: lt olive brown (2.5Y 5/4); 100% clay, soft, non-plastic.	
140'-150	CLAY: lt olive brown (2.5Y 5/4) same as above	
150-157	CLAY: same as above	

CAMP DRESSER & McKEE INC.

X=72-76

WELL NO. 26016

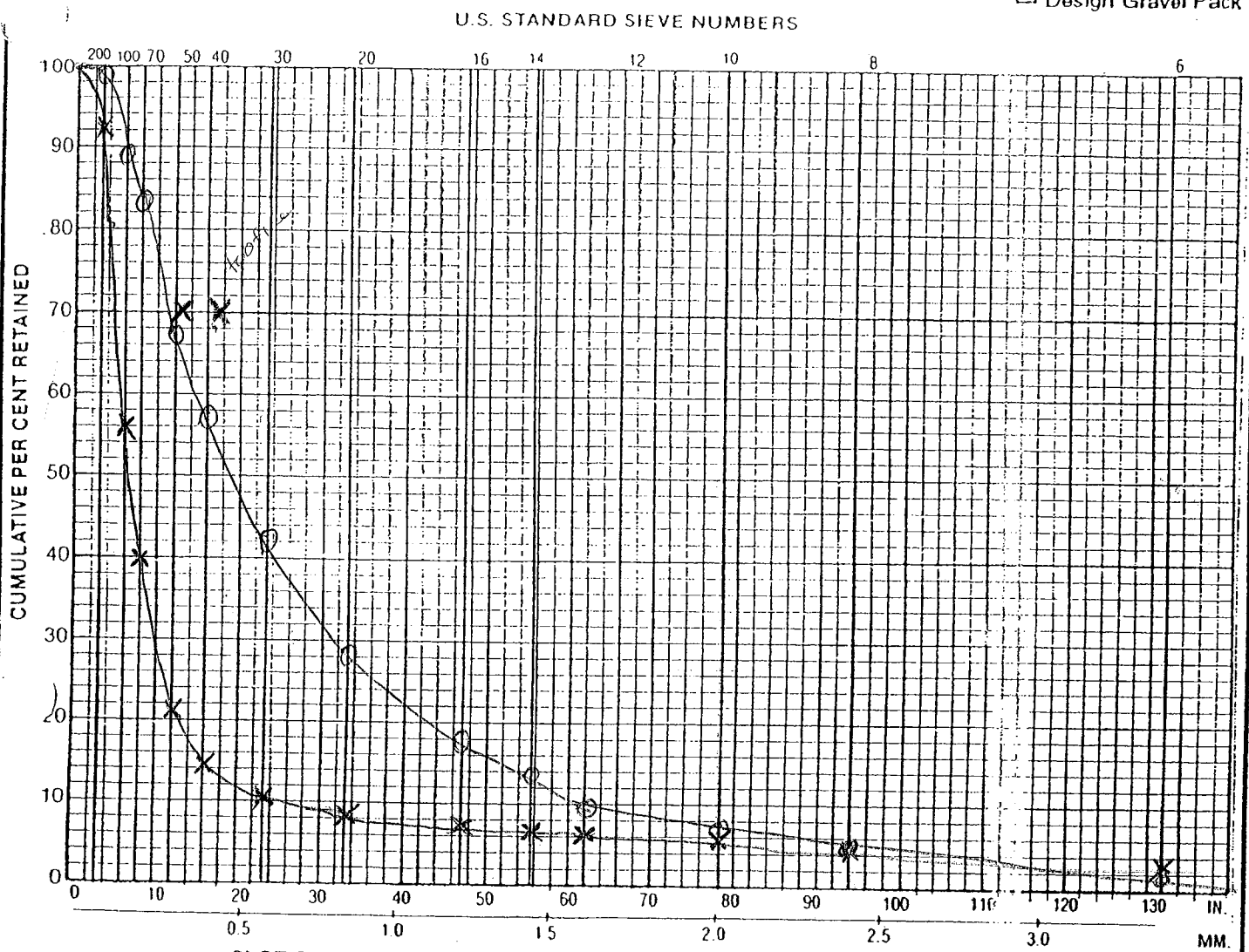
LOCATION C.P.

DATE 1/27/09

BY Andy Gruenzel & Mike Hoffman

INTERVALS O=76-80

SAMPLE TYPE: ☒ Formation ☐ Gravel Pack QA/QC ☐ Design Gravel Pack



U.S. Sieve No.	Slot Opening IN.	Slot Opening MM	x Interval Cum. Weight (g)	x Interval Cum. % Retained	o Interval Cum. Weight (g)	o Interval Cum. % Retained
6	0.132	3.36	6.6	2.7	6.3	1.7
8	0.094	2.38	9.8	4.1	17.4	4.8
10	0.079	2.00	13.0	5.4	25.0	6.9
12	0.066	1.68	14.3	6.6	34.3	9.5
14	0.055	1.40	15.9	6.6	49.1	13.6
16	0.047	1.19	17.3	7.2	64.5	17.9
20	0.033	0.84	19.9	8.2	100.4	27.7
30	0.023	0.60	24.8	10.4	152.7	42.2
40	0.016	0.42	34.6	14.5	206.0	56.9
50	0.012	0.30	49.7	20.8	244.1	67.4
70	0.008	0.21	94.6	39.5	299.1	82.6
100	0.006	0.15	133.7	55.8	321.4	88.6
0	0.003	0.08	221.2	92.4	357.0	98.6
N			239.4	100	362.1	100

x INTERVAL: 72-76 wet 392.2g

DRY START WEIGHT (g): 263.4

DRY WEIGHT AFTER WET SIEVE WITH NO. 200 SIEVE (g): 239.4

o INTERVAL: 76-80

DRY START WEIGHT (g): 363.8

DRY WEIGHT AFTER WET SIEVE WITH NO. 200 SIEVE (g): 362.1

COMMENTS:

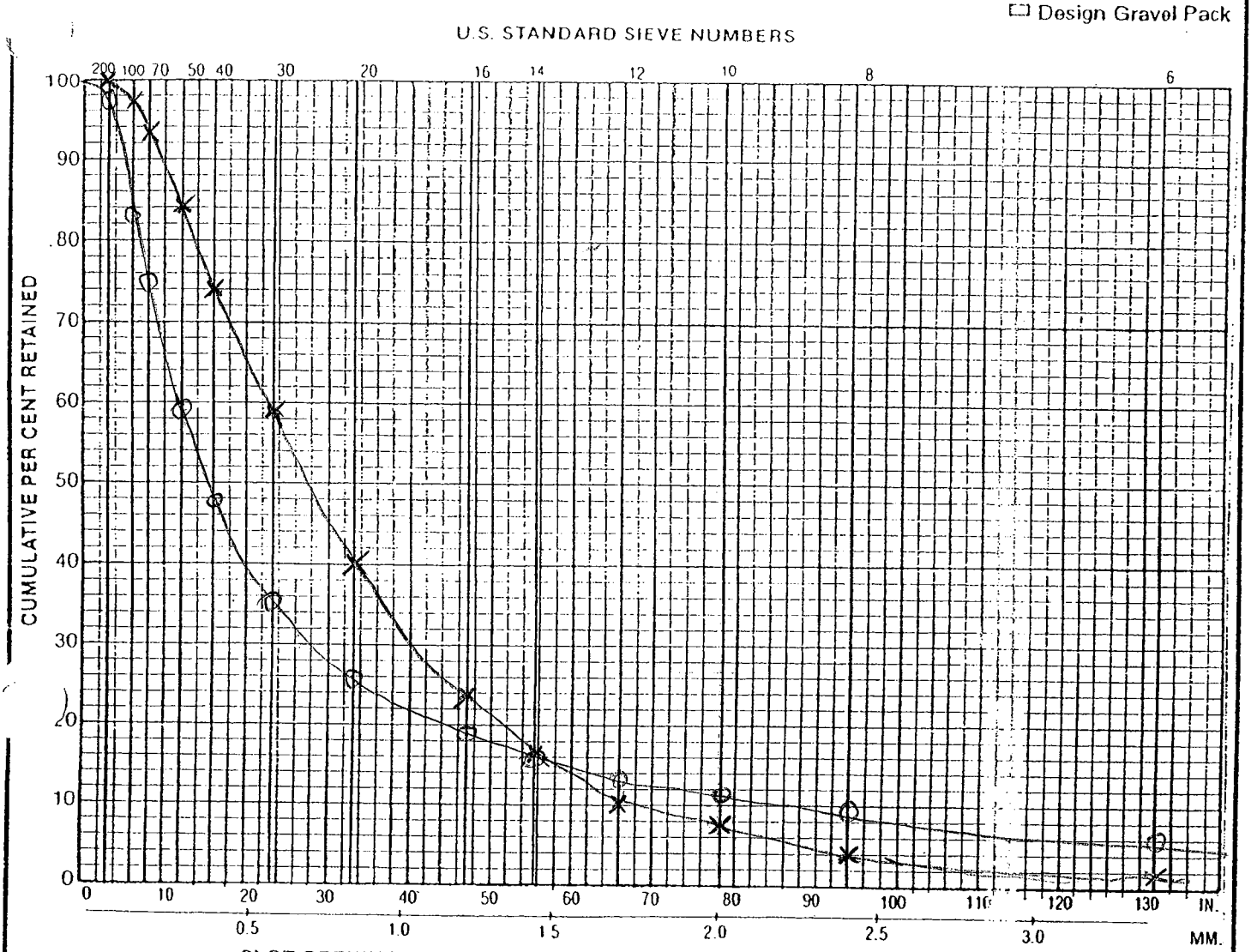
CDM
environmental engineers, scientists, planners, & management consultants

SIEVE ANALYSIS PLOT

X = 90-100

WELL NO. 26016 DATE MH INTERVALS O = 126-130

LOCATION CP, Area 26 BY 1/28/09 SAMPLE TYPE: ☒ Formation ☐ Gravel Pack QA/QC ☐ Design Gravel Pack



U.S. Sieve No.	Slot Opening IN.	Slot Opening MM	x Interval Cum. Weight (g)	x Interval Cum. % Retained	o Interval Cum. Weight (g)	o Interval Cum. % Retained
6	0.132	3.36	4.6	1.6	14.4	5.9
8	0.094	2.38	11.6	4.1	22.8	9.4
10	0.079	2.00	19.5	6.8	27.3	11.2
12	0.066	1.68	28.9	10.1	31.6	13.0
14	0.055	1.40	46.4	16.2	38.7	15.9
16	0.047	1.19	67.2	23.5	46.2	19.0
20	0.033	0.84	114.5	40.0	63.1	25.9
30	0.023	0.60	169.5	59.2	86.3	35.5
40	0.016	0.42	211.6	74.0	115.5	47.4
50	0.012	0.30	241.1	84.3	144.1	59.2
70	0.008	0.21	267.0	93.3	182.3	74.9
100	0.006	0.15	277.8	97.1	202.5	83.2
200	0.003	0.08	285.5	99.8	237.0	97.4
PAN			286.1	100	243.3	100

x INTERVAL: 90-100

DRY START WEIGHT (g): 288.1

DRY WEIGHT AFTER WET SIEVE WITH NO. 200 SIEVE (g): 286.1

o INTERVAL: 126-130

DRY START WEIGHT (g): 274.5

DRY WEIGHT AFTER WET SIEVE WITH NO. 200 SIEVE (g): 243.3

COMMENTS:

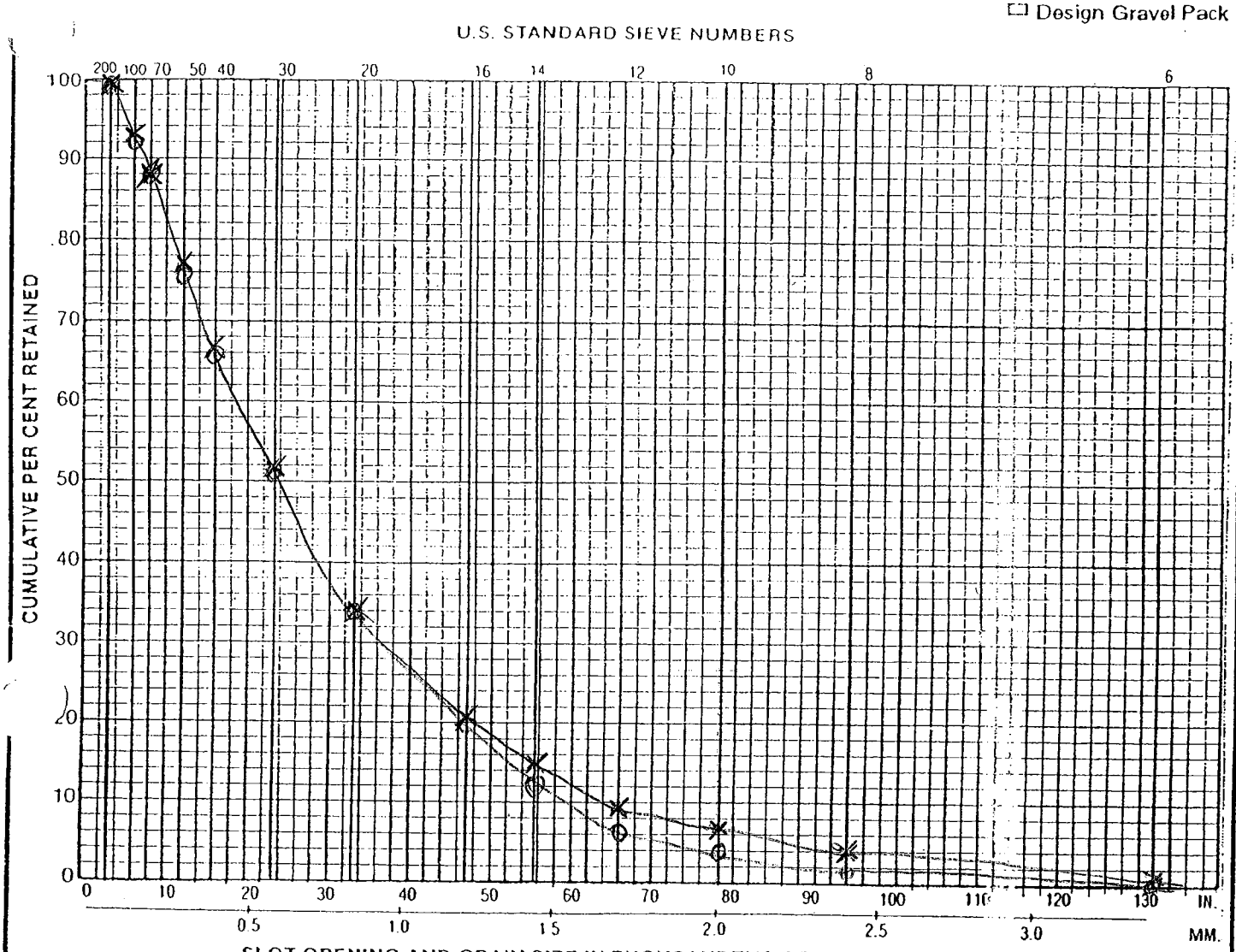
CDM
environmental engineers, scientists, planners, & management consultants

SIEVE ANALYSIS PLOT

Y: 110-120

WELL NO. 26016 DATE 1/28/09 INTERVALS O: 120-126

LOCATION CR, Area 26 BY MH SAMPLE TYPE: ☒ Formation ☐ Gravel Pack QA/QC ☐ Design Gravel Pack



U.S. Sieve No.	Slot Opening IN.	Slot Opening MM	x Interval Cum. Weight (g)	x Interval Cum. % Retained	o Interval Cum. Weight (g)	o Interval Cum. % Retained
6	0.132	3.36	3.0	0.9	1.4	0.3
8	0.094	2.38	12.4	4.0	6.0	1.6
10	0.079	2.00	20.8	6.4	14.4	3.6
12	0.066	1.68	29.3	9.4	24.6	6.4
14	0.055	1.40	45.9	14.7	48.0	12.5
16	0.047	1.19	64.6	20.6	75.3	19.6
20	0.033	0.84	106.3	34.0	130.7	34.0
30	0.023	0.60	161.5	51.6	196.8	51.3
40	0.016	0.42	207.9	66.4	251.4	65.5
50	0.012	0.30	240.3	76.7	289.4	75.4
70	0.008	0.21	275.8	88.1	338.3	88.1
100	0.006	0.15	290.8	92.9	353.2	92.0
0	0.003	0.08	311.6	99.5	380.2	99.0
N			313.1	100	383.9	100

x INTERVAL: 110-120

DRY START WEIGHT (g): 326.1

DRY WEIGHT AFTER WET SIEVE WITH NO. 200 SIEVE (g): 313.1

o INTERVAL: 120-126

DRY START WEIGHT (g): 386.5

DRY WEIGHT AFTER WET SIEVE WITH NO. 200 SIEVE (g): 383.9

COMMENTS:

CDM
environmental engineers, scientists, planners, & management consultants

SIEVE ANALYSIS PLOT

welenco

5201 Woodmere Drive, Bakersfield, CA 93313– www.welenco.com–(800) 445-9914
California Contractor's License No. 722373

X-Y 4-ARM CALIPER LOG

FILING NO.

COMPANY Bakersfield Well and Pump

WELL No. 26016

FIELD Camp Pendleton

STATE California COUNTY San Diego

LOCATION:
Vandegrift Road

OTHER SERVICES:
Elog
Deviation
Guard

JOB NO.
10865

SEC: 18 TWP: 10S RGE: 4W LAT.: 33° 18' 41.5" LONG.: 117° 20' 14.9" MERIDIAN: San Bernardino

Permanent Datum: Ground Level, Elev. 83 Ft. Elev.: K.B. ____ Ft.
Log Measured From: Ground Level, 0 Ft. Above Perm. Datum D.F. ____ Ft.
Drilling Measured From: Ground Level G.L. 83 Ft.

Date	Jan. 28, 2009			
Type Of Log	X-Y Caliper			
Run	One			
Depth-Driller	157 Ft	Ft	Ft	Ft
Depth-Logger	155 Ft	Ft	Ft	Ft
Top Logged Interval	0 Ft	Ft	Ft	Ft
Btm. Logged Interval	153 Ft	Ft	Ft	Ft
Type Fluid In Hole	Polybore			
Fluid Level	Full Ft	Ft	Ft	Ft
Max Temp	N/A °F	°F	°F	°F
Operating Rig Time	.75 Hr	Hr	Hr	Hr
Van No. / Location	LV-1 / Bfld			
Recorded By	Dan Ihde			
Witnessed By	Mike Hoffman			

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	TYPE	FROM	TO
1	17.5 In	53 Ft	155 Ft	30 In	Steel	0 Ft	53 Ft
2	In	Ft	Ft	In		Ft	Ft
3	In	Ft	Ft	In		Ft	Ft

Miscellaneous Information

Remarks:
A recreational GPS accurate to +/- 45 feet set for Datum NAD27 was used to calculate Latitude, Longitude & Elevation values. The Section, Township, and Range then determined using the TRS program (TRS accuracy is not guaranteed). The TRS program converts Latitude and Longitude to Section, Township, and Range. The NOTICE at the bottom of this heading also applies.

Drilled by: Bakersfield Well and Pump

Perforated Intervals:

Line Speed:

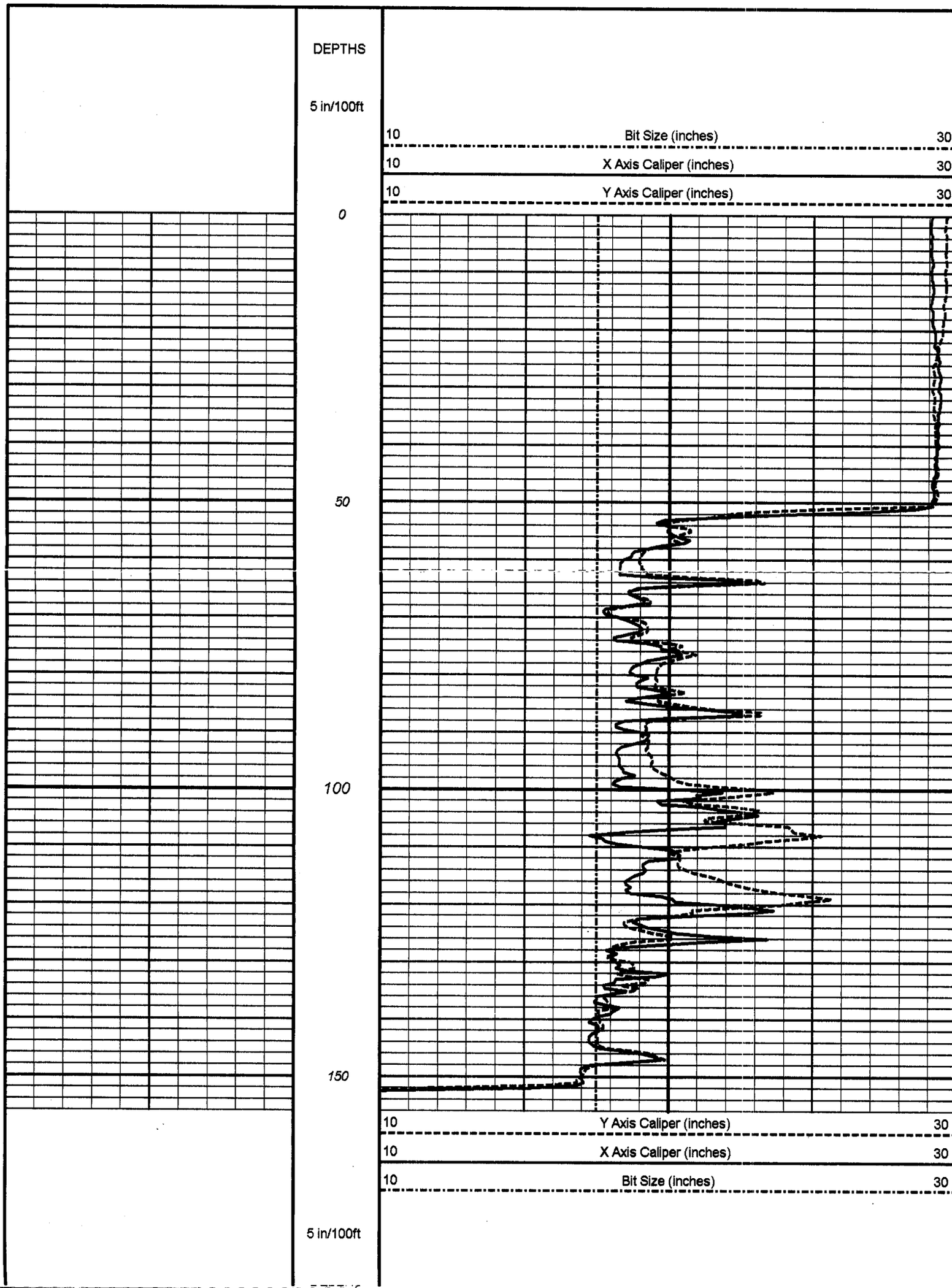
Borehole/Annular Volume Calculations:

Other Information:

NOTICE: All interpretations are opinions based on inferences from electrical and other measurements and we do not guarantee the accuracy or correctness of any verbal or written interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule. *welenco, inc. January 28, 2009*

GEOPHYSICAL WELL LOGS

Bakersfield Well and Pump No. 26016 Jan 28, 2009 C:\.....10865Cali.LOG



welenco

5201 Woodmere Drive, Bakersfield, CA 93313-- www.welenco.com--(800) 445-9914
California Contractor's License No. 722373

ELECTRIC - GUARD - GAMMA RAY - LOG

FILING NO.

COMPANY Bakersfield Well and Pump

WELL No. 26016

FIELD Camp Pendleton

STATE California COUNTY San Diego

LOCATION:
Vandegrift Road

OTHER SERVICES:
X-Y Caliper
Deviation

JOB NO.
10865

SEC: 18 TWP: 10S RGE: 4W LAT.: 33° 18' 41.5" LONG.: 117° 20' 14.9" MERIDIAN: San Bernardino

Permanent Datum: Ground Level, Elev. 83 Ft. Elev.: K.B. ____ Ft.
Log Measured From: Ground Level, 0 Ft. Above Perm. Datum D.F. ____ Ft.
Drilling Measured From: Ground Level G.L. 83 Ft.

Run	Elog	Guard		
Date	Jan. 28, 2009	Jan. 28, 2009		
Depth-Driller	157 Ft	157 Ft	Ft	Ft
Depth-Logger	155 Ft	155 Ft	Ft	Ft
Top Logged Interval	0 Ft	0 Ft	Ft	Ft
Btm. Logged Interval	154 Ft	152 Ft	Ft	Ft
Casing-Driller	30 In @ 53 Ft	In @ Ft	In @ Ft	In @ Ft
Casing-Logger	30 In @ 53 Ft	In @ Ft	In @ Ft	In @ Ft
Bit Size	17.5 In	17.5 In	In	In
Time On Bottom	2:00 AM	2:30 AM		
Type Fluid In Hole	Polybore			
Density / Viscosity				
pH / Fluid Loss	ml	ml	ml	ml
Source of Sample	Tank			
Rm @ Measured Temp.	4.5 @ 75 °F	@ °F	@ °F	@ °F
Rmf @ Measured Temp.	4.1 @ 75 °F	@ °F	@ °F	@ °F
Rmc @ Measured Temp.	@ °F	@ °F	@ °F	@ °F
Source Rmf / Rmc	meas			
Rm @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circulation	1 Hr	2 Hr	Hr	Hr
Max. Rec. Temp.	N/A °F	°F	°F	°F
Van No. / Location	LV-1 / Bfld			
Recorded By	Dan Ihde			
Witnessed By	Mike Hoffman	Mike Hoffman		

Miscellaneous Information

A recreational GPS accurate to +/- 45 feet set for Datum NAD27 was used to calculate Latitude, Longitude & Elevation values. The Section, Township, and Range then determined using the TRS program (TRS accuracy is not guaranteed). The TRS program converts Latitude and Longitude to Section, Township, and Range. The NOTICE at the bottom of this heading also applies.

Drilled by: Bakersfield Well and Pump

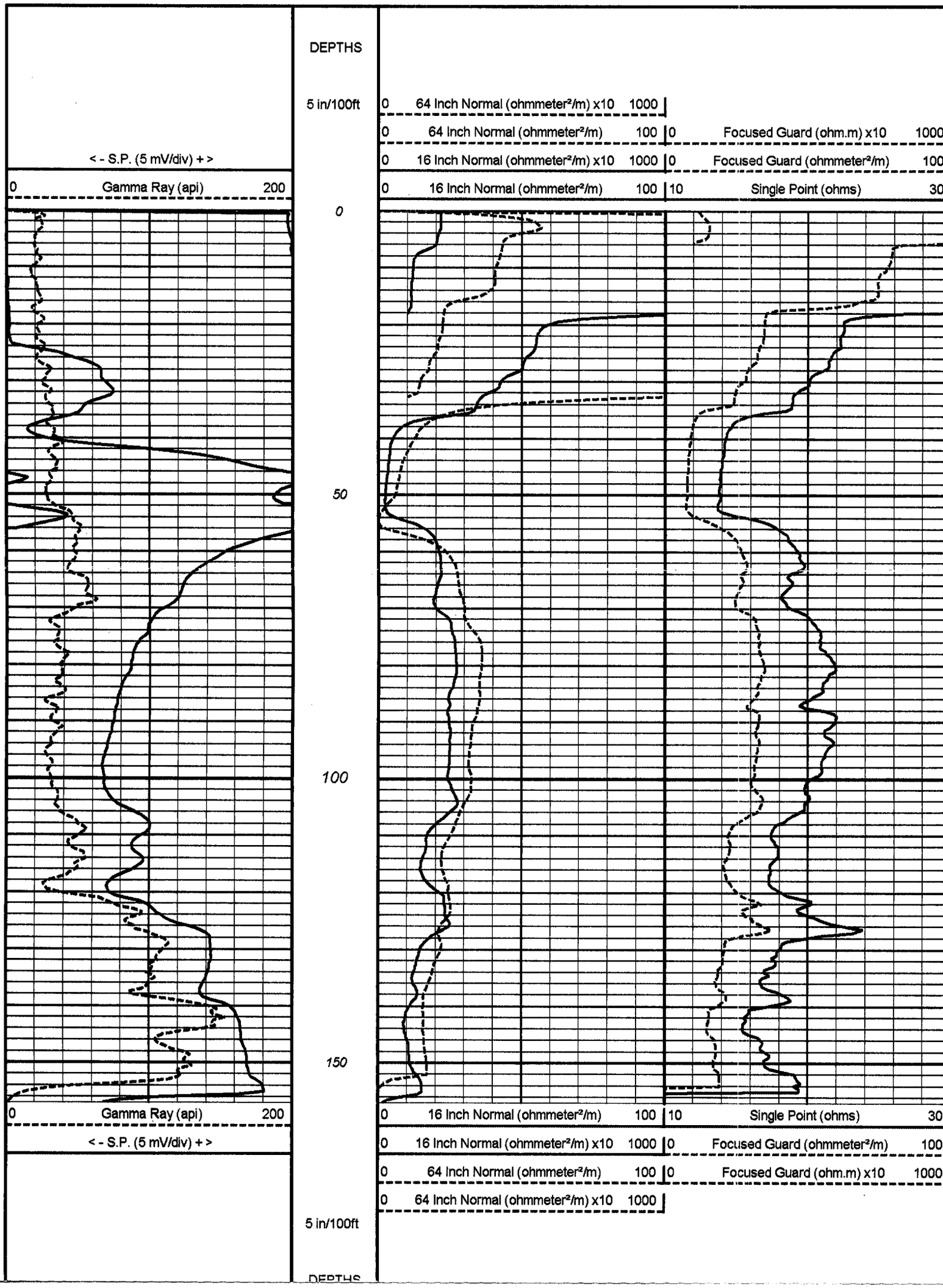
NOTICE

All interpretations are opinions based on inferences from electrical and other measurements and we do not guarantee the accuracy or correctness of any verbal or written interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

welenco, inc. January 28, 2009

GEOPHYSICAL WELL LOGS

Bakersfield Well and Pump No. 26016 Jan 28, 2009 C:\.....10865Elog.LOG



DRIFT-PAC

Wellbore Drift Survey

Bakersfield Well & Pump

No. 26016

Date of Survey: January 28, 2009

True Vertical Depth At Total Depth: 154.86 Feet
Drift Distance At Total Depth: 0.2 Feet
Drift Bearing At Total Depth: 197.1 Degrees
Type Survey Tool: Compass
Job Ticket Number: 10865
Calculation Method: Balanced Tangential Method

DRIFT-PAC AND WELLBORE DRIFT SURVEY REPRESENTATION

This Wellbore Drift Survey represents our best efforts to provide a correct interpretation. Nevertheless, since all interpretations are opinions based on inferences from electrical or other types of measurements, we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by Customer resulting from any interpretation made by this document. Welenco does not warrant or guarantee the accuracy of the Data, specifically including (but without limitation) the accuracy of data transmitted by electronic process, and Welenco will not be responsible for accidental or intentional interception of such data by third parties. Welenco employees are not empowered to change or otherwise modify the attached interpretation. Furthermore, Welenco does not warrant or guarantee the accuracy of the programming techiques employed to produce this document. By accepting this document, the Customer agrees to the foregoing and to the General Terms and Conditions of Welenco, Inc.

welenco

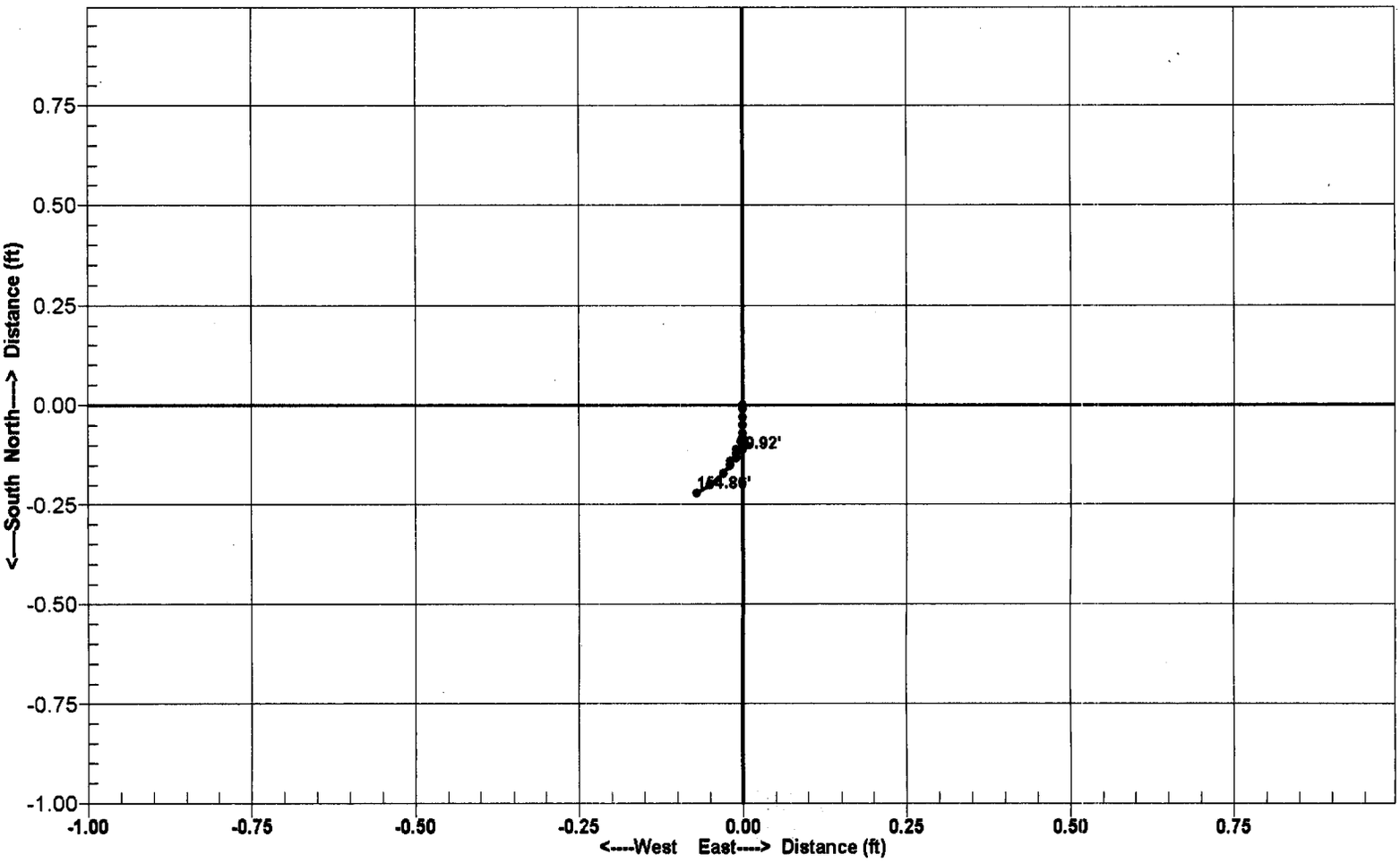
(800) 445-9914

DRIFT-PAC SPREADSHEET - Balanced Tangential Calculation Method

Measured Depth, Feet	Inclination, Degrees	Azimuth, Degrees	Course Dev., Feet	TVD, Feet	Total Latitude, Feet	Total Departure, Feet	Drift Bearing, Degrees	Drift Distance, Feet
0	.05	174	.00	.00	0.00	0.00	0.00	0.00
10	.08	183	.01	10.00	-0.01	0.00	179.50	0.01
20	.12	179	.02	19.99	-0.03	0.00	180.40	0.03
30	.13	185	.02	29.98	-0.05	0.00	180.90	0.05
40	.08	181	.02	39.97	-0.07	0.00	181.80	0.07
50	.06	180	.01	49.96	-0.08	0.00	181.50	0.08
60	.05	162	.01	59.95	-0.09	0.00	180.40	0.09
70	.04	181	.01	69.94	-0.10	0.00	179.80	0.10
80	.07	203	.01	79.93	-0.11	0.00	181.30	0.11
90	.03	211	.01	89.92	-0.11	-0.01	182.90	0.11
100	.07	209	.01	99.92	-0.12	-0.01	184.80	0.12
110	.05	195	.01	109.91	-0.13	-0.01	186.10	0.13
120	.06	187	.01	119.90	-0.14	-0.02	186.40	0.14
130	.10	208	.01	129.89	-0.15	-0.02	187.70	0.16
140	.15	213	.02	139.88	-0.17	-0.03	190.60	0.18
150	.25	219	.03	149.87	-0.20	-0.05	194.70	0.21
155	.25	221	.02	154.86	-0.22	-0.07	197.10	0.23

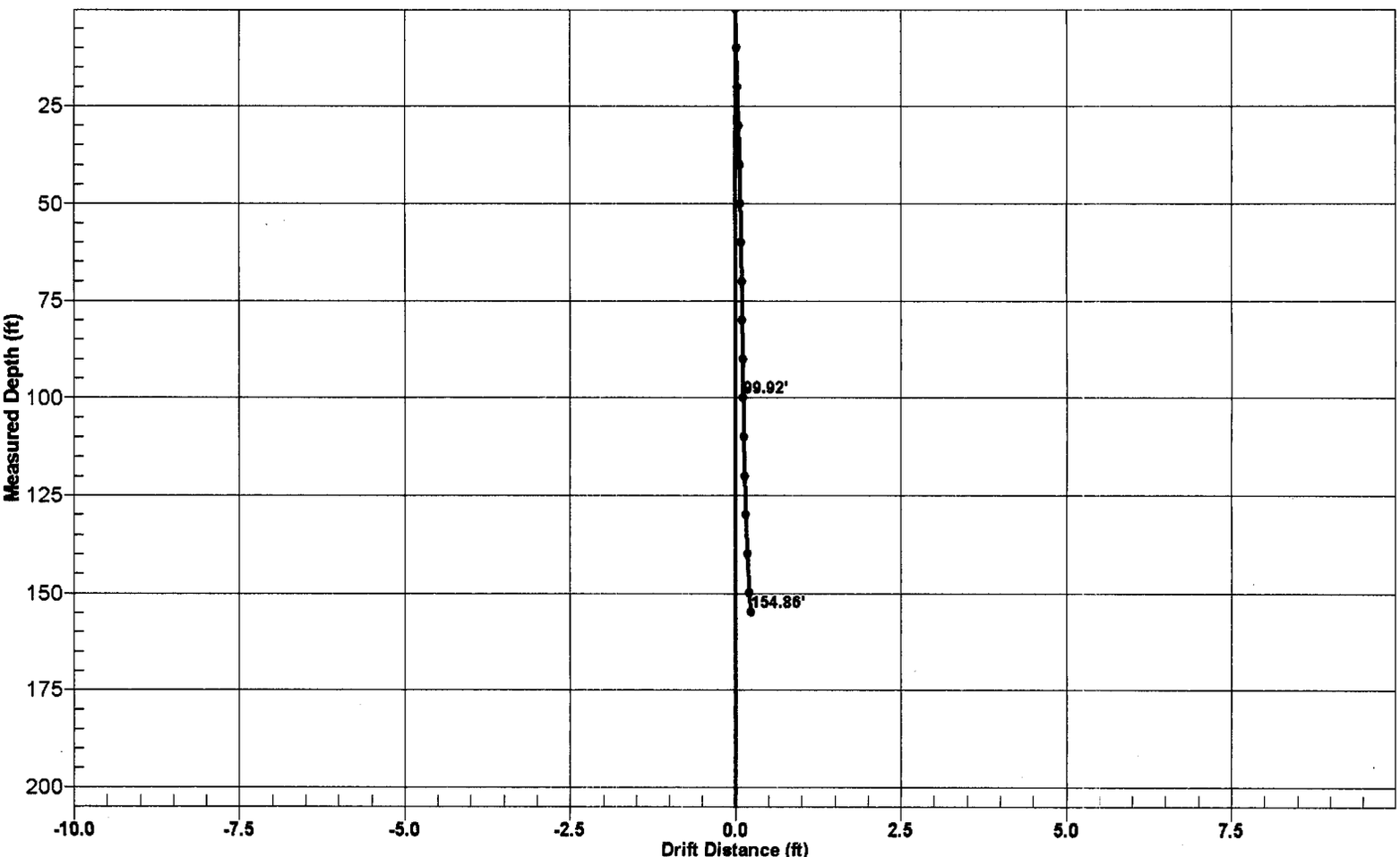
PLAN VIEW

Drift Distance = 0.23 Feet Drift Bearing = 197.1 Degrees True Vertical Depth = 154.86 Feet



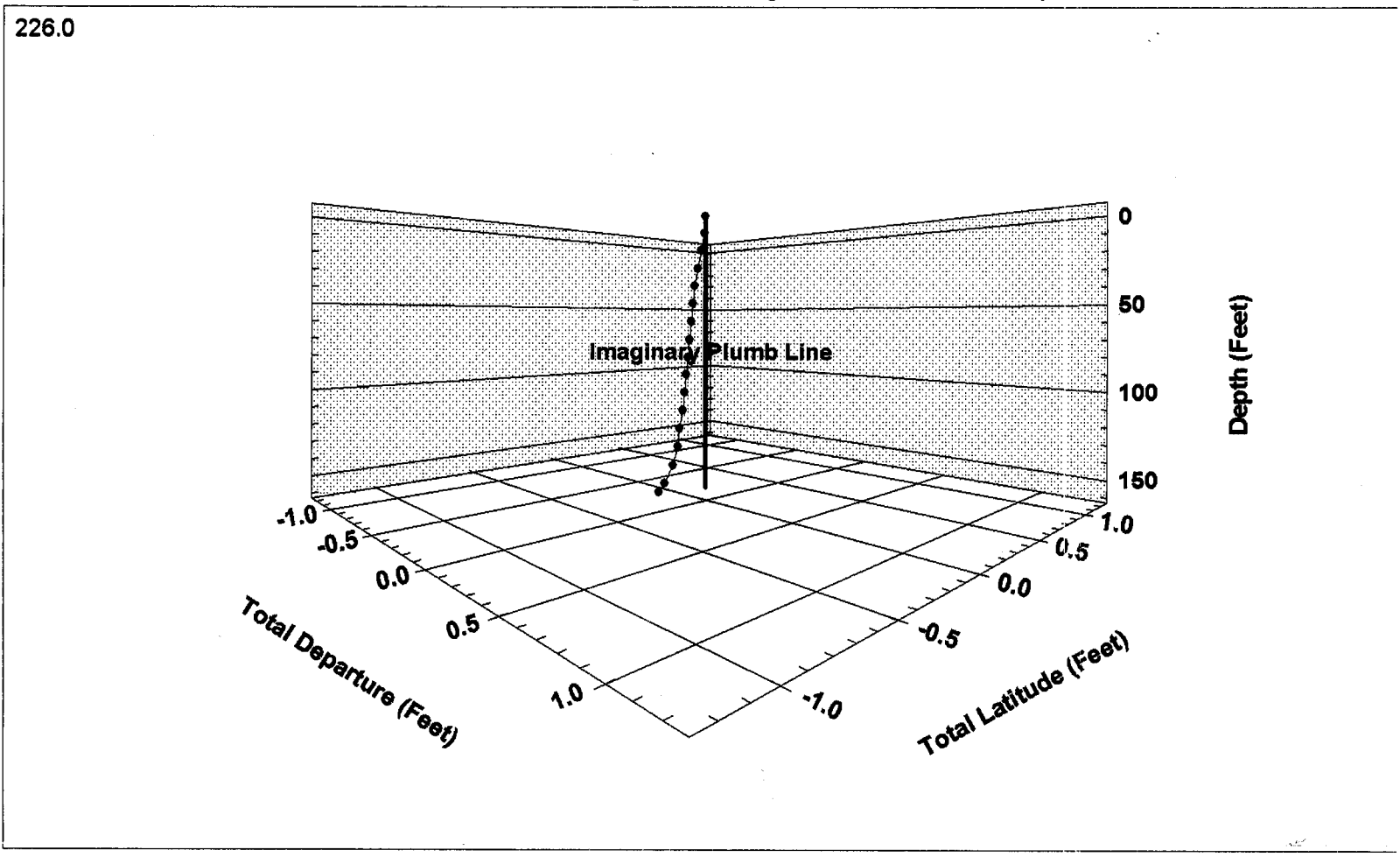
PLANE OF DRIFT VIEW

Drift Distance = 0.23 Feet Drift Bearing = 197.1 Degrees True Vertical Depth = 154.86 Feet



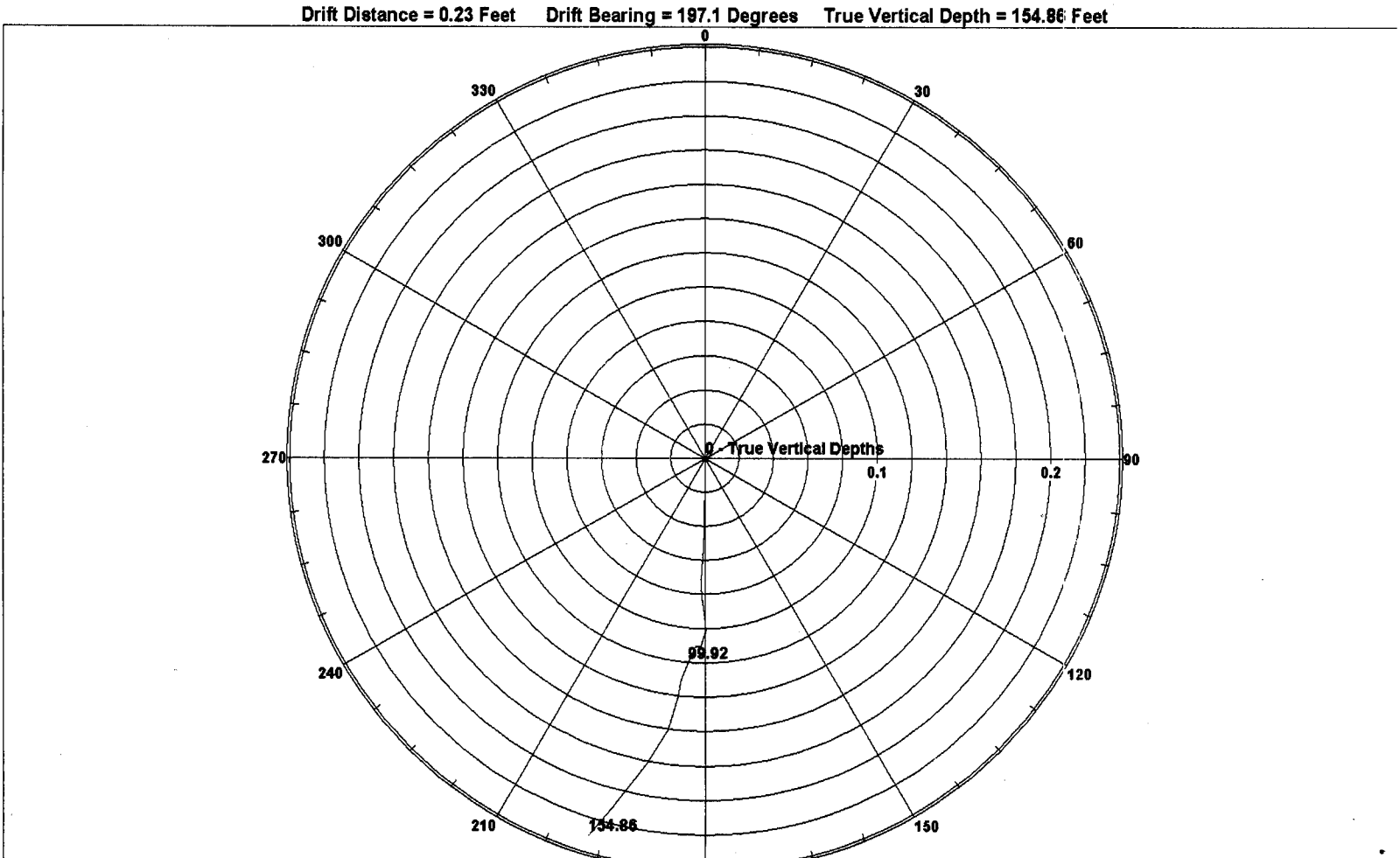
DRIFT-PAC 3-D PROJECTION VIEW

Drift Distance = 0.23 Feet Drift Bearing = 197.1 Degrees True Vertical Depth = 154.86 Feet



POLAR VIEW

Drift Distance = 0.23 Feet Drift Bearing = 197.1 Degrees True Vertical Depth = 154.86 Feet



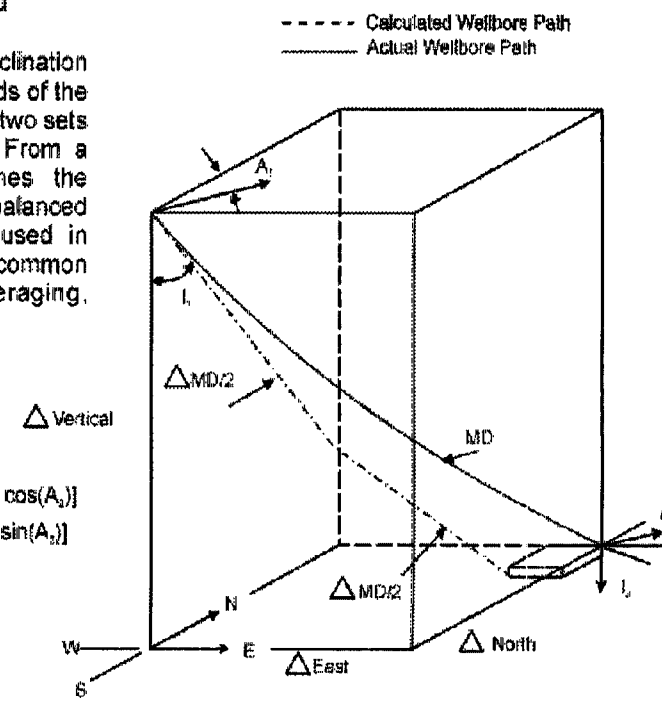
Balanced Tangential Method

The Balanced Tangential Method uses the inclination and direction angles at the upper and lower ends of the course length in a manner so as to balance the two sets of measured angles over a course length. From a theoretical standpoint, this method combines the trigonometric functions to provide the average balanced inclination and direction angles, which are used in standard computational procedures. Other common names for this method are Vector Averaging, Acceleration, and Trapezoidal.

Δ North = [ΔMD/2] x [sin(I_1) x cos(A_1) + sin(I_2) x cos(A_2)]

Δ East = [ΔMD/2] x [sin(I_1) x sin(A_1) + sin(I_2) x sin(A_2)]

Δ Vertical = [ΔMD/2] x [cos(I_1) + cos(I_2)]



Camp Pendleton

Water and Wastewater System
Design, Build, Operate and Maintain
Contract N68711-04-D-5110-0018

DO 0018 (Area 26 Wells)

Well 26016 Final Design Meeting

Date: January 28, 2009
Time: 0900 hrs.
Location: Camp Pendleton- Field Offices

Meeting Minutes

Purpose: This meeting was held to provide.

1. List of Attendees:

Meryll Gonzalez	NAVFAC
Simon Kroon	ROICC
Louis Carnevale	ROICC
Suzanne Rowe	CDM
Nate Lazewski	CDM

2. Wells:

- Suzanne presented the well design and provided an overview of the well design process.
- Well will have 50-ft of screen from 75-ft to 125-ft below grade. This is 20-ft more than CDM had previously estimated based upon the exploratory boring.
- Borehole was drilled to 157-ft. Clay encountered at 130-ft.
- The soil samples were inspected by all
- Gravel Pack will be 8 x 16 silica and 0.060-inch wire wrap screen
- CDM requested an additional sieve on the proposed gravel pack from BWP prior to finalizing design.

3. Action Items:

CDM to submit formal/final package.

4. Decisions:

The Government Approved/Accepted the well design

Camp Pendleton
Water and Wastewater System
Design, Build, Operate and Maintain
Contract N68711-04-D-5110-0017
DO 0018 (Area 26 Wells)

Sign-In Sheet

Date: 28-Dec-09
Time: 0900-1000
Location: CDM
Meeting: Meeting to Discuss Well 26016 Well Casing Design

List of Attendees:

Initials:	Name:	Representing:	Phone:	E-mail:
	Khalique Khan	ES, MCBCP	760-725-9753	khalique.khan@usmc.mil
	Linda Teason	ES, MCBCP	760-725-9741	linda.teason@usmc.mil
	Luis Ledesma	ES, MCBCP	760-725-0141	Luis.ledesma@usmc.mil
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	Melvin Kutaka	FMD, MCBCP	760-725-4503	melvin.kutaka@usmc.mil
	Steve Pearce	FMD, MCBCP		
	Terry Cummings	FMD, MCBCP		
	John Rockwell	FMD, QASP	760-622-6526	john.rockwell@usmc.mil
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	Khoa Pham	PW, MCBCP	760-725-6083	khoa.x.pham@usmc.mil
	Marc Lumabas	PW, MCBCP	760-725-5507	marc.lumabas@usmc.mil
	Ron Couchot	PW, MCBCP	760-725-6061	ronald.couchot@usmc.mil
	Lou Chiong	NAVFAC SW	619-532-2092	luis.n.chiong@navy.mil
MGG	Meryll Gonzalez	NAVFAC SW	619-532-1503	meryll.gonzalez@navy.mil
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	Al Simpson	ROICC	760-725-8213	alfred.simpson@navy.mil
	Bob Anigbogu	ROICC	760-763-2065	robert.anigbogu@navy.mil
	David Boone	ROICC		David.c.boone@navy.mil
	David Noya	ROICC	760-725-8193	david.noya@navy.mil
	Denise Winters	ROICC	760-725-0790	Denise.winters@navy.mil
	Gary Watanabe	ROICC	760-763-2081	gary.watanabe@navy.mil
	Leilani Murray	ROICC	760-725-8692	leilani.murray@navy.mil
	Michele Hovis	ROICC	760-725-3489	Michele.hovis@navy.mil
	Michelle Yarmer	ROICC	760-725-0789	Michelle.yarmer@navy.mil
	Mike Stover	ROICC	760-725-3399	michael.a.stover@navy.mil
	Mike White	ROICC	760-725-8967	michael.i.white@navy.mil

List of Attendees:

Initials:	Name:	Representing:	Phone:	E-mail:
SK	Simon Kroon	ROICC	760-725-8220	simon.kroon@navy.mil
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	Sungalu Lavulavu	ROICC	760-447-6768	sungalu.lavulavu.ctr@navy.mil
	Barbara Melcher	CDM	760-438-7755	MelcherBA@cdm.com
	Bill O'Neil	CDM	760-438-7755	oneilwk@cdm.com
	Charlie Allaben	CDM	602-281-7886	AllabenCC@cdm.com
	Dan Hutton	CDM	760-947-4898	huttondl@cdm.com
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	Vianey Contreras	CDM Field Trailer		
	Mark Andrews	CDM Field Trailer	760-543-0129	Andrewsmr@cdm.com
NL	Nate Lazewski	CDM Field Trailer	760-543-0129	lazewskink@cdm.com
	Peter Huhn	CDM Field Trailer	760-543-0108	HuhnPC@cdm.com
	Randy Redmann	CDM Field Trailer	760-543-0129	redmannrh@cdm.com
	Louis Carnevale	ROICC	760-725-0789	louis.carnevale@navy.mil

WELL LOG 26018

WELL DATA SHEET (Page 1 of 3)

Complete as much information as possible. Leave blank if information is not available, use N.A. if not applicable.		
** Indicates items required for Source Water Assessment*		
*** Indicates additional items required for assessments and Ground Water Rule*		
	(separate multiple entries in field with semi-colon)	Actual, Estimated or Default?
DATA SHEET GENERAL INFORMATION		
System Name	Camp Pendleton South System	*from DHS database*
System Number	3710702	*from DHS database*
Source of Information *(well log, DHS/County files, system, etc)*	files,driller's logs,water permits	
Organization Collecting Information *(DHS, County, System, other)*	DHS	
Date Information Collected/Updated	17-Jan-07	
WELL IDENTIFICATION		
* Well Number or Name	Well 26018	*from DHS database*
* DHS Source Identification Number (**FRDS ID No.**)		
DWR Well Log on File? ("YES" or "NO")	Yes	
State Well Number (from DWR)	3710702-033	
Well Status (Active, Standby, Inactive)	Awaiting P/O	*from DHS database*
WELL LOCATION		
Latitude	33.31393965	*from DHS database*
Longitude	-177.3360962	*from DHS database*
Ground Surface Elevation (ft above Mean Sea Level)	90	
Street Address	26018 Vandergrift Rd.	
Nearest Cross Street	Basilone Rd.	
City	Camp Pendleton	
County	San Diego	
* Neighborhood/Surrounding Area *(see Note 1)*	Rural	
Site plan on file? ("YES" or "NO")	Yes	
DWR Ground Water Basin	Santa Margarita	*to come from DWR*
DWR Ground Water Sub-basin		*to come from DWR*
SANITARY CONDITIONS		
** Distance to closest Sewer Line, Sewage Disposal, Septic Tank (ft)	>1,000	
Distance to Active Wells (ft)	~1,320	
Distance to Abandoned Wells (ft)	n/a	
Distance to Surface Water (ft)	~1,000	
** Size of controlled area around well (square feet)	10,000	
* Type of access control to well site *(fencing, building, etc)*	Raised Building and Fence	
* Surface Seal? (Concrete slab)("YES", "NO" or "UNKNOWN")	NA	
* Dimensions of concrete slab: Length(ft)/ Width(ft)/ Thick(in)	NA	
* Within 100 year flood plain? ("YES", "NO" or "UNKNOWN")	UNKNOWN	
* Drainage away from well? ("YES" or "NO")	Yes	
ENCLOSURE/HOUSING		
Enclosure Type *(building, vault, none, etc.)*	raised building	
Floor material	steel	
Located in Pit? ("YES" or "NO")	No	
Pit depth (feet) (if applicable)	NA	
WELL CONSTRUCTION		
Date drilled	Dec-06	
Drilling Method	Reverse Circulation	
Depth of Bore Hole (feet below ground surface)	154	
Casing Beginning Depth/Ending Depth(ft below surface); 2nd Casing Beginning Depth/Ending Depth; 3rd Casing, etc.	0-50; 58-145	
Casing Diameter (inches); 2nd Casing Diameter; 3rd Casing, etc.	30, 16	
Casing Material; 2nd Casing Material; 3rd Casing, etc.	Stainless Steel	
	(separate multiple entries in field with semi-colon)	Actual, Estimated or Default?
WELL CONSTRUCTION (continued)		
Conductor casing used? ("YES", "NO" or "UNKNOWN") *(See Note 2)*	Yes	
Conductor casing removed? ("YES", "NO" or "UNKNOWN")	No	
* Depth to highest perforations/screens (ft below surface) (or "UNKNOWN")	59	
Screened Interval Beginning Depth/Ending Depth (ft below surface); 2nd Screened Interval Beg. Depth/Ending Depth; 3rd Screened Interval, etc.	59-79 89-124	
* Total length of screened interval (ft) *(default = 10% pump capacity in gpm)* (or "UNKNOWN")	55	
* Annular Seal?("YES", "NO" or "UNKNOWN") *(See Note 3)*	YES	
* Depth of Annular Seal (ft)	50	
Material of Annular Seal *(cement grout, bentonite, etc.)*	cement grout	
Gravel pack, Depth to top (ft below ground surface)	40	
Total length of gravel pack (ft)	121	

WELL DATA SHEET (Page 2 of 3)

Complete as much information as possible. Leave blank if information is not available, use N.A. if not applicable.		
** Indicates items required for Source Water Assessment*		
*** Indicates additional items required for assessments and Ground Water Rule*		
AQUIFER		
* Aquifer Materials *(list all that apply: sand, silt, clay, gravel, rock, fractured rock)*	sand, gravel, cobbles and boulders	
* Effective porosity (decimal percent) *(default = 0.2)* (or "UNKNOWN")	0.2	
* Confining layer (Impervious Strata) above aquifer? ("YES", "NO" or "UNKNOWN")	Yes	
Thickness of confining layer, if known (ft)	16	
Depth to confining layer, if known (ft below ground)	45	
* Static water level (ft below ground surface)	8.43	
Static water level measurement: Date/Method	1/16/2007	
Pumping water level (ft below ground surface)	24.59	
Pumping water level measurement: Date/Method	1/17/07 nonequilibrium analytical	
WELL PRODUCTION		
Well Yield (gpm)	1,000	
Well Yield Based On (i.e., pump test, etc.)	Pump Test	
Date measured	1/17/2007	
Is the well metered? ("YES" or "NO")	Yes	
Production (gallons per year)		
Frequency of Use (hours/year)		
Typical pumping duration (hours/day)		
PUMP		
Make	American-Marsh	
Type	Vertical Turbine	
Size (hp)	100	
* Capacity (gpm)	1050	
Depth to suction intake (ft below ground surface)	92	
Lubrication Type	water	
Type of Power: *(i.e., electric, diesel, etc.)*	electric	
Auxiliary power available? ("YES" or "NO")	no	
Operation controlled by: *(i.e., level in tank, pressure, etc.)*	tank level	
Pump to Waste capability? ("YES" or "NO")	Yes	
Discharges to: *(i.e., distribution system, storage, etc.)*	system	
NOTES		
1. Neighborhood/Surrounding Area (list all that apply): A= Agricultural, Ru = Rural, Re = Residential, Co = Commercial, I = Industrial, Mu = Municipal, P = Pristine, O = Other		
2. Conductor Casing - Oversized casing used to stabilize bore hole during well construction. Should be removed during installation of annular seal.		
3. Annular Seal - Seal of grout in the space between the well casing and the wall of the drilled hole. Sometimes called "sanitary seal".		
Please Note:		
The information on this Well Data Sheet is considered confidential. To allow the information to be included		
in the permit report, or made available subject to a public information act request, the waiver clause below has		
to to be signed and dated by the owner (public water system). In lieu of this signature, the WDS has to be		
retained in a confidential file, or the information shown in the shaded rows has to be "blacked out."		
I/We, *(Name)*_____, ***certify that I/Weam/are the present owners of the well described on this well data sheet. I/We have reviewed the information presented on this well data sheet and I/We take no exception to having the information inlcuded in the Department of Health Services' Engineering Report. I/We understand that by including the well data sheet in the Engineering Report, it will be part of a public document that can be reviewed and copied subject to a Public Information Act request.***		
_____ _____		
(Signature) (Date)		

Owner's Well No. 26018

Date Work Began 9-15-06, Ended 1-15-07

Local Permit Agency san diego co. env health

Permit No. 18058 Permit Date 8-31-06

Refer to Instruction Pamphlet

No. 1086863

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD reverse rotary FLUID polybore

DEPTH FROM SURFACE Ft	to Ft.	DESCRIPTION Describe material, grain size, color, etc.
0	15	Sand
15	25	Silty Sand
25	30	Sand
30	40	Silty Sand
40	45	Silt
45	50	Sand With Silt
50	60	Sandy Silt
60	125	Sand
125	135	Silty Sand
135	145	Sand with Silt

TOTAL DEPTH OF BORING 165 (Feet)

TOTAL DEPTH OF COMPLETED WELL 145 (Feet)

WELL OWNER

Name US NAvy- Camp Pendleton

Mailing Address Box 55229

Camp Pendleton (CITY) Ca. (STATE) 92005 (ZIP)

WELL LOCATION

Address Building 26018

City Camp Pendleton

County San Diego

APN Book 101 Page 520 Parcel 14

Township 10s Range 4w Section 14

Lat 33 (DEG.) 18 (MIN.) 50.4 (SEC) N Long 117 (DEG) 20 (MIN) 6.9 (SEC) W

LOCATION SKETCH

NORTH

WEST

EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY X

___ Domestic ___ Public

___ Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 11 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 11 (Ft.) & DATE MEASURED 1-12-07

ESTIMATED YIELD * 1000 (GPM) & TEST TYPE const rate

TEST LENGTH 12 (Hrs.) TOTAL DRAWDOWN 16 (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	50	36			x		mid steel	30	5/16	
0	58	26	x				copbear	16	5/16	
58	60	26	x				mechcoup	16		
60	80	26		x			304s.s	16	1/4	.055
80	90	26	x				304s.s	16	1/4	
90	125	26		x			304s.s	16	1/4	.055

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	40	x			10.5 asch
					sandslurr
40	155			x	8x16
					silica
					gravel

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Bakersfield Well & Pump Co. (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 7212 Fruitvale Ave (CITY) Bakersfield (STATE) Ca. (ZIP) 93308

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 7-12-07

C-57 LICENSE NUMBER 440537

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 7884

Refer to Instruction Pamphlet

No. 1086864

Owner's Well No. 26018

Date Work Began 9-15-06 Ended 1-15-07

Local Permit Agency San Diego Co. Env Health

Permit No. 18058 Permit Date 8-31-06

STATE WELL NO/STATION NO

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD reverse rotary FLUID polybore

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*

TOTAL DEPTH OF BORING 165 (Feet)

TOTAL DEPTH OF COMPLETED WELL 145 (Feet)

WELL OWNER

Name US Navy- Camp Pendleton

Mailing Address Box 55229

Camp Pendleton (CITY) Ca. (STATE) 92005 (ZIP)

WELL LOCATION

Address Building 26018

City Camp Pendleton

County San Diego

APN Book 101 Page 520 Parcel 14

Township 10s Range 4w Section 7

Lat 33 (DEG) 18 (MIN) 50.4 (SEC) Long 117 (DEG) 20 (MIN) 6.9 (SEC) W

LOCATION SKETCH

NORTH

WEST EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY (*Describe Procedures and Materials Under "GEOLOGIC LOG"*)

USES (✓)

WATER SUPPLY

___ Domestic X Public

___ Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 11 (Ft) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 11 (Ft.) & DATE MEASURED 1-12-07

ESTIMATED YIELD 1000 (GPM) & TEST TYPE const rate.

TEST LENGTH 12 (Hrs) TOTAL DRAWDOWN 16 (Ft)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft to Ft	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
125 145	26	x				304s.s	16	1/4	endcap
0 56		x				midsteel	2	sch40	sound
0 50		x				midsteel	3	sch40	gravwel

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

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ADDRESS 7212 Fruitvale Ave (CITY) Bakersfield (STATE) Ca. (ZIP) 93308

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DATE SIGNED 7-12-07 C-57 LICENSE NUMBER 440537

DWR 188 REV. 03-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 7083

CDM
18581 Teller Avenue, Suite 200
Irvine, CA 92612
(949) 752-5452
(949) 752-1307 (FAX)

BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER	4000-44415-002.CNS.CNSRW	**BORING/WELL NUMBER**	26018
PROJECT NAME	Camp Pendleton	**DATE DRILLED**	12/13/06 - 12/22/06
LOCATION	Area 26	**CASING TYPE/DIAMETER**	5/16" Cu Bearing MS & 1/4" 304 SS/16" ID
DRILLING METHOD	Reverse Circulation	**SCREEN TYPE/SLOT**	16" ID 304 SS Wire Wrap / 0.055-inch
SAMPLING METHOD	Grab	**GRAVEL PACK TYPE**	8x16 Colorado Silica
GROUND SURFACE ELEVATION (FT MSL)	91.00	**GROUT TYPE/QUANTITY**	10.5-sack sand/cement slurry
TOP OF CASING ELEVATION (FT MSL)	99.5	**STATIC WATER LEVEL (FT BELOW TOC)**	8.40
LOGGED BY	Andy Greazel	**GROUND WATER ELEVATION (FT MSL)**	91.10
REMARKS			

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
								SAND: brown (10YR 4/3); 100% sand, poorly graded, fine to medium, angular to subangular; moist.	
					5	SP		SAND: brown (10YR 4/3); 100% sand, poorly graded, medium to coarse, angular to subangular.	
					10			SAND: dark grayish brown (2.5Y 4/2); 100% sand, poorly graded, fine to medium, angular to subangular.	
					15			SILTY SAND: very dark gray (5Y 3/1); 80% sand, poorly graded, fine to medium, angular to subangular; 20% silt.	15.0
					20	SM			
					25	SP		SAND: very dark gray (5Y 3/1); 80% sand, poorly graded, medium to coarse, angular to subangular.	25.0
					30	SM		SILTY SAND: very dark gray (5Y 3/1); 80% sand, poorly graded, fine to medium, angular to subangular; 20% silt.	30.0
					35				35.0

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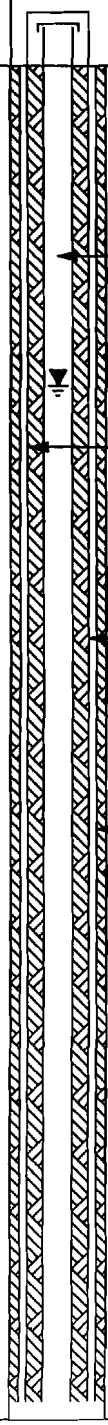
WELL DIAGRAM



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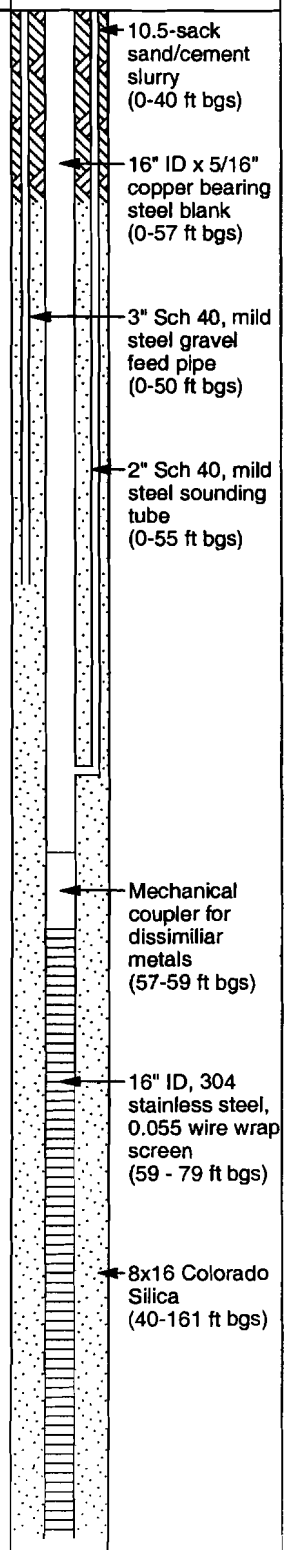
BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER 4000-44415-002.CNS.CNSRW **BORING/WELL NUMBER** 26018
PROJECT NAME Camp Pendleton **DATE DRILLED** 12/13/06 - 12/22/06

Continued from Previous Page

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						SM		SILTY SAND: very dark gray (5Y 3/1); 80% sand, poorly graded, fine to medium, angular to subangular; 20% silt.	
					40	SW		SAND: very dark gray (5Y 3/1); 100% sand, well graded, fine to coarse, subangular.	40.0
					45	ML		SILT: very dark gray (5Y 3/1); 100% silt, nonplastic, soft.	45.0
					50	SP SM		SAND WITH SILT: dark olive gray (5Y 3/2); 90% sand, poorly graded, fine, trace medium, subangular; 10% silt; trace mica.	50.0
					55	ML		SANDY SILT: very dark gray (5Y 3/1); 70% silt, nonplastic, soft; 30% sand, poorly graded, fine, subangular; trace mica.	55.0
					60	SP		SAND: very dark gray (5Y 3/1); 95% sand, poorly graded, fine to medium, trace coarse, subangular to subrounded; 5% silt; trace mica.	61.0
					65				
					70			SAND: very dark gray (5Y 3/1); 95% sand, poorly graded, fine, trace medium, subangular; 5% silt; trace mica. Gravel can be heard in discharge pipe.	
					75				75.0



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BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER 4000-44415-002.CNS.CNSRW **BORING/WELL NUMBER** 26018
PROJECT NAME Camp Pendleton **DATE DRILLED** 12/13/06 - 12/22/06

Continued from Previous Page

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
								SAND: very dark gray (5Y 3/1); 95% sand, poorly graded, fine, trace medium, subangular; 5% silt; trace mica. Gravel can be heard in discharge pipe.		16" ID, 304 stainless steel, 0.055 wire wrap screen (59 - 79 ft bgs)
					80			SAND: dark gray (5Y 4/1); 100% sand, poorly graded, fine to medium, trace coarse, subangular, trace mica. Gravel can be heard in discharge pipe.		16" ID x 1/4", 304 stainless steel blank (79-89 ft bgs)
					85					
					90			SAND: dark gray (5Y 4/1); 100% sand, poorly graded, fine to medium, subangular; trace mica. Gravel can be heard in discharge pipe.		
					95	SP				8x16 Colorado Silica (40-161 ft bgs)
					100			SAND: same as above.		
					105					16" ID, 304 stainless steel, 0.055 wire wrap screen (89-124 ft bgs)
					110			SAND: dark gray (5Y 4/1); 100% sand, poorly graded, fine to medium, trace coarse, subangular to subrounded. Gravel can be heard in discharge pipe.		
					115				115.0	

Continued Next Page

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(949) 752-1307 (FAX)

BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER 4000-44415-002.CNS.CNSRW **BORING/WELL NUMBER** 26018
PROJECT NAME Camp Pendleton **DATE DRILLED** 12/13/06 - 12/22/06

Continued from Previous Page

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
						SP			117.0	16" ID, 304 stainless steel, 0.055 wire wrap screen (89-124 ft bgs)
					120	SW		SAND: dark gray (5Y 4/1); 100% sand, well graded, fine to coarse, subangular. Gravel can be heard in discharge pipe.	124.0	
					125	SM		SILTY SAND: very dark gray (5Y 3/1); 60% sand, poorly graded, fine, trace medium, subangular; 40% silt, nonplastic soft.		8x16 Colorado Silica (40-161 ft bgs)
					130				134.0	
					135	SP SM		SAND WITH SILT: very dark gray (5Y 3/1); 90% sand, poorly graded, fine, subangular; 10% silt.		16" ID x 1/4", 304 stainless steel blank with welded endcap (124-145 ft bgs)
					140			SAND WITH SILT: same as above.		
					145				148.0	
					150	CL		CLAY: very dark gray (5Y 3/1); 95% clay, nonplastic, soft; 5% sand.	154.0	Bottom of 17.5" diameter pilot hole
					155			Total depth of pilot hole is 154 feet bgs.		

Continued Next Page

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PROJECT NUMBER 4000-44415-002.CNS.CNSRW **BORING/WELL NUMBER** 26018
PROJECT NAME Camp Pendleton **DATE DRILLED** 12/13/06 - 12/22/06

Continued from Previous Page

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
								Based on observations of the geologist and the driller, it is CDM's conclusion that the cuttings collected from the pilot hole are not representative of the actual lithology . This discrepancy is likely due to a malfunction of the collection system. Also, the cuttings are not consistent with the cuttings collected from Observation Well 26018 (located 21 feet away) and Well 2602 (located 1,000 feet away).		8x16 Colorado Silica (40-161 ft bgs)
					160					Sluff (161-162 ft bgs)
					165					
					170					
					175					
					180					
					185					
					190					
					195					

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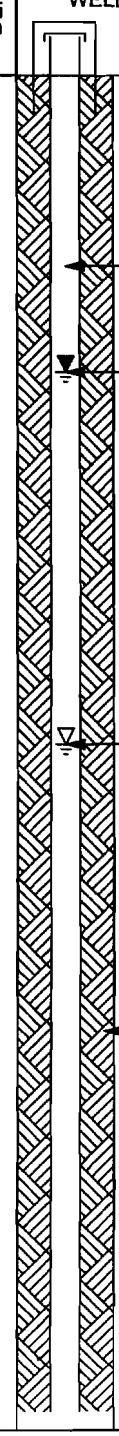
BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER	4000-44415-002.CNS.CNSRW	**BORING/WELL NUMBER**	OW 26018
PROJECT NAME	Camp Pendleton	**DATE DRILLED**	10/18/06 - 10/19/06
LOCATION	Area 26	**CASING TYPE/DIAMETER**	Schedule 80 PVC/4-inch ID
DRILLING METHOD	Sonic	**SCREEN TYPE/SLOT**	4" ID Sch 80 PVC Mill Slot/0.040-inch
SAMPLING METHOD	Continuous Core Barrel	**GRAVEL PACK TYPE**	No.3 Sand / 22 ft^3
GROUND SURFACE ELEVATION (FT MSL)	91.00	**GROUT TYPE/QUANTITY**	Portland cement w/ bentonite grout / 11.5 ft^3
TOP OF CASING ELEVATION (FT MSL)	92.87	**STATIC WATER LEVEL (FT BELOW TOC)**	7.77
LOGGED BY	Kelly Rowe & Andy Greazel	**GROUND WATER ELEVATION (FT MSL)**	85.10
REMARKS			

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
						ML		SANDY SILT: brown (10YR 4/3); 65% silt, nonplastic, soft; 25% sand, poorly graded, fine, subrounded; 10% sand stone, weakly cemented, fine grained; dry.	2.0
						SP		SAND: brown (10YR 4/3); 100% sand, poorly graded, fine to medium, some coarse, subangular to subrounded; trace silt; moist.	5.0
					5	SC		CLAYEY SAND: brown (10YR 4/3); 65% sand, poorly graded, fine to medium, subrounded; 30% clay, 5% silt, plastic, soft to hard; moist.	7.0
						SP SM		SAND WITH SILT: brown (10YR 4/3); 90% sand, poorly graded, fine to medium, some coarse, subangular to subrounded; 10% silt; trace gravel, poorly graded, fine, 1/4-inch maximum diameter; moist.	10.0
					10	SP		SAND: dark grayish brown (2.5Y 4/2); 100% sand, poorly graded, fine to coarse, mostly medium, subangular to subrounded; moist.	
					15	SP		SAND: very dark gray (5Y 3/1); 100% sand, poorly graded, medium to coarse, some fine, subangular to subrounded; wet.	
					20				24.0
					25	SP SC		SAND WITH CLAY AND GRAVEL: very dark gray (5Y 3/1); 65% sand, poorly graded, medium to coarse, some fine, subangular; 25% gravel, well graded, fine to coarse, 2-inch maximum diameter; 10% clay; wet.	25.0
						SW		SAND: very dark gray (5Y 3/1); 100% sand, well graded, fine to coarse, subangular; wet.	29.0
					30	SP		SAND: very dark gray (5Y 3/1); 95% sand, poorly graded, fine to medium, mostly fine, subangular; 5% silt; trace clay and mica; wet.	
					35				35.0

Continued Next Page

WELL DIAGRAM



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PROJECT NUMBER 4000-44415-002.CNS.CNSRW **BORING/WELL NUMBER** OW 26018
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Continued from Previous Page

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
						SC		CLAYEY SAND: very dark gray (5Y 3/1); 65% sand, poorly graded, fine, subangular; 35% clay, plastic, soft; trace mica; wet.		Portland cement with bentonite grout (0-43 ft bgs)
					40				41.0	
						SW		SAND: very dark gray (5Y 3/1); 100% sand, well graded, fine to coarse, subangular to subrounded; trace clay; wet.		
					45				45.0	Bentonite Chips (43-48 ft bgs)
						SC		CLAYEY SAND: very dark gray (5Y 3/1); 85% sand, poorly graded, fine, trace coarse subangular to subrounded; 15% clay, nonplastic, soft; trace mica; wet.		
					50				50.0	4" ID, Sch 80 PVC casing (0-58 ft bgs)
						ML		SILT WITH SAND: dark olive gray (5Y 3/2); 80% silt; 20% sand, poorly graded, fine, subangular to subrounded; wet.		
					55				55.0	
								SAND: very dark gray (5Y 3/1); 100% sand, well graded, fine to coarse, subangular to subrounded; wet.		
					60			SAND: same as above.		No.3 Lapis Lustre sand (48-135 ft bgs)
					65	SW		SAND: same as above.		
					70			SAND: same as above.		4" ID, Sch 80 PVC, continuous slot screen (0.040") (58-118 ft bgs)
					75				75.0	

Continued Next Page

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Continued from Previous Page

PID (ppm)	BLOW COUNTS	RECOVERY (inches)	SAMPLE ID.	EXTENT	DEPTH (ft. bgs)	U.S.C.S.	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
								SAND WITH GRAVEL: very dark gray (5Y 3/1); 85% sand, well graded, fine to coarse, subangular to subrounded; 15% gravel, well graded, fine to coarse, 2-inch maximum diameter, round; wet.		
					80	SW		SAND WITH GRAVEL: same as above with 4-inch diameter cobbles; wet.		4" ID, Sch 80 PVC, continuous slot screen (0.040") (58-118 ft bgs)
					85			SAND: dark gray (5Y 4/1); 100% sand, well graded, fine to coarse, subangular to subrounded; wet.	85.0	
					90	SW		SAND: same as above.		No.3 Lapis Lustre sand (48-135 ft bgs)
					95			SAND WITH GRAVEL: dark gray (5Y 4/1); 85% sand, well graded, fine to coarse, subangular to subrounded; 15% gravel, well graded, fine to coarse, 2-inch maximum diameter, round; wet.	95.0	
					100	SW		SAND WITH GRAVEL: same as above with 4-inch diameter cobbles; wet.		
					105			SAND WITH SILT: dark gray (5Y 4/1); 100% sand, well graded, fine to coarse, subangular to subrounded; 15% silt.	105.0	
					110	SW SM				
					115				115.0	

Continued Next Page

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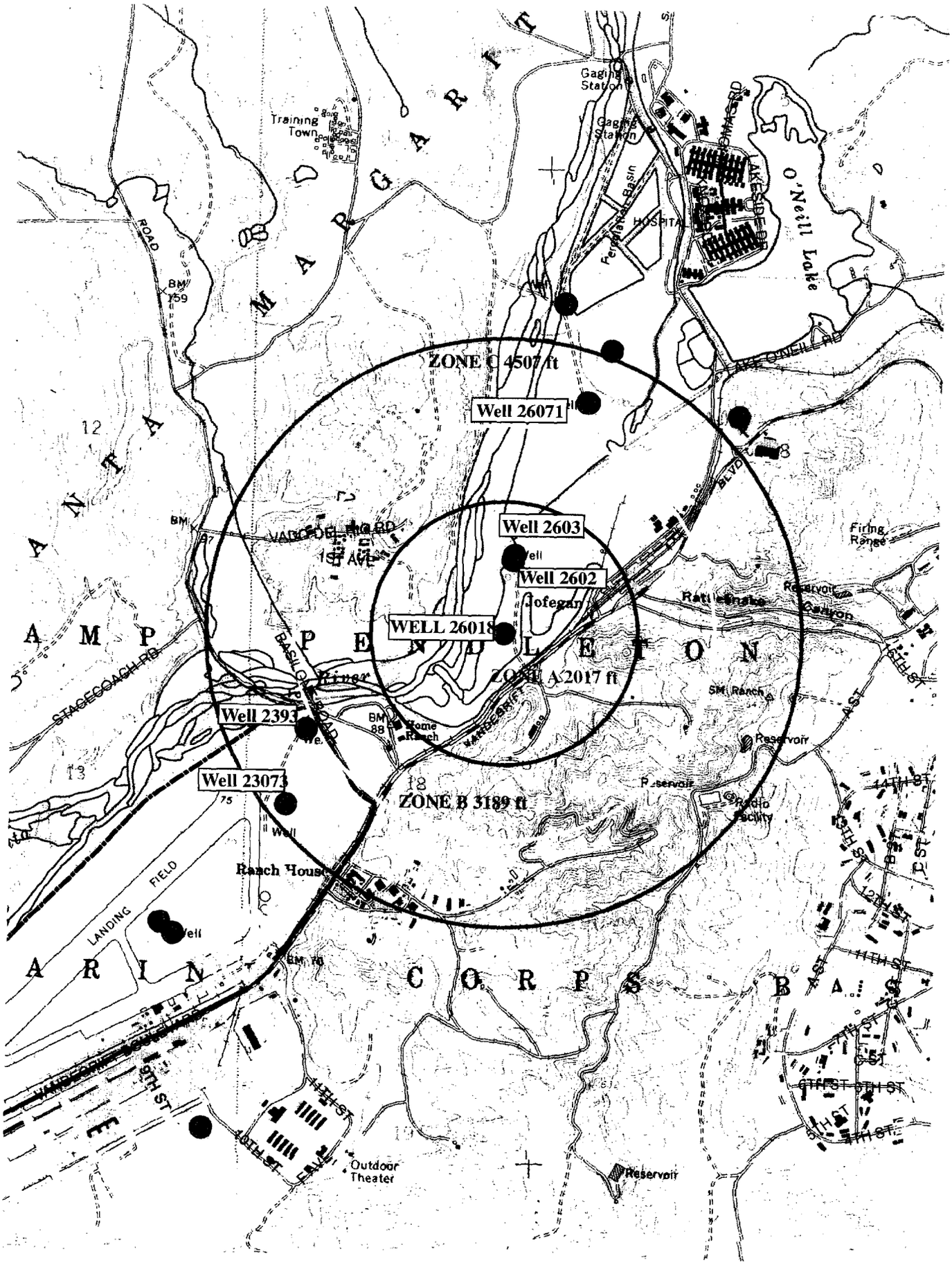
						SW		SAND WITH GRAVEL: dark gray (5Y 4/1); 85% sand, well graded, fine to coarse, subangular to subrounded; 15% gravel, well graded, fine to coarse, 2-inch maximum diameter, round; wet.	120.0	4" ID, Sch 80 PVC, continuous slot screen (0.040") (58-118 ft bgs)
					120	CH		CLAY AND SAND: dark gray (5Y 4/1); clay, plastic interbedded with sand, poorly graded, coarse; wet.	125.0	4" ID, Sch 80 PVC casing with endcap (0-58 ft bgs)
					125	ML		SILT: very dark gray (5Y 3/1); 100% silt, nonplastic, hard, wet.	135.0	No.3 Lapis Lustre sand (48-135 ft bgs)
					130			SILT: same as above with clay.		
					135	SP		SAND WITH GRAVEL: very dark gray (5Y 3/1); 85% sand, poorly graded, coarse, angular to subangular; 15% gravel, poorly graded, coarse, decomposed granite; some clay; wet.	145.0	Caved in material (135-152 ft bgs)
					140			SAND WITH GRAVEL: same as above.		
					145	CL		CLAY AND GRAVEL: with decomposed granite.	152.0	
					150			Total depth of borehole is 152 feet bgs.		
					155					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Well 26071
Well 2603
Well 2602
WELL 26018
ZONE A 2017 ft
Well 2393
Well 23073
ZONE B 3189 ft
Training Town
Gaging Station
Gaging Station
Ferguson Basin
HOSPITAL
LAKESIDE RD
O'Neill Lake
O'NEILL RD
VANDERBILT RD
1ST AVE
BASILONE RD
STAGECOACH RD
Rattlesnake Canyon
Firing Range
Reservoir
SM Ranch
Home Ranch
Reservoir
Reservoir
Radio Facility
Ranch House
LANDING FIELD
Outdoor Theater
Reservoir
14TH ST
11TH ST
6TH ST
5TH ST
4TH ST
3RD ST
2ND ST
1ST ST
ANTA MARGARITA
AMP PENDLETON
ARINE CORPS BASE