FINAL

SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 2
Full-Scale In-Situ Chemical Oxidation Activities at Installation Restoration Site 9 - Intermediate Alameda Point, Alameda, California

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0107

Document Control Number 9177
Revision 0

March 31, 2005

Submitted to:

Base Realignment and Closure
Program Management Office West
1230 Columbia Street, Suite 1100
San Diego, California 92101

Submitted by:

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Concord, California 94520-1120

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Approved by: _____ Date: March 31, 2005
Daniel Shafer
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Approved by: _____ Date: March 31, 2005
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Shaw™ Shaw Environmental, Inc.

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FROM: Bob Hulet for
Dan Shafer
Project Manager

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FINAL WORK PLAN CHEMICAL OXIDATION PILOT TESTING FOR REMOVAL ACTIONS AT INSTALLATION RESTORATION SITES 9, 11/21, AND 16, REVISION 0

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Acronyms and Abbreviations

EPA	U.S. Environmental Protection Agency
ft	feet
bgs	below ground surface
IR	Installation Restoration
ISCO	In-Situ Chemical Oxidation
MCL	maximum contaminant level
PVC	polyvinyl chloride
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
VOC	volatile organic compound

1.0 Introduction

Shaw Environmental, Inc. has prepared this Sampling and Analysis Plan (SAP) Addendum No. 2 in support of the full-scale in-situ chemical oxidation (ISCO) activities to be conducted at Installation Restoration (IR) Site 9 (Intermediate), Alameda Point, Alameda, California. This Work Plan Addendum should be used in conjunction with the *Final Project Plans, Chemical Oxidation Pilot Testing for Removal Actions at Installation Restoration Sites 9, 11/21 and 16, Alameda Point* (IT, 2003), the *Final Work Plan Addendum for In-Situ Chemical Oxidation Pilot Testing at Installation Restoration Site 9 Intermediate, Alameda Point, Alameda, California* (Shaw, 2003a), and the *Final Work Plans, Full-Scale In-Situ Chemical Oxidation Testing at Installation Restoration Sites 9 & 16, Alameda Point, Alameda, California* (Shaw, 2003b).

During the initial ISCO pilot test conducted at IR Site 9 Intermediate in August 2002, surfacing of the oxidant occurred during injection activities. Based on review of the analytical data, it was determined that an insufficient quantity of reagent was introduced into the subsurface to accurately determine an effective radius of influence, and that the test provided insufficient data to be used for design of a full-scale application. Therefore, an additional pilot test was recommended to assess whether the surfacing was specific to the injection well used or if it was site related, and to evaluate the groundwater treatment radial effect and needed reagent quantities. The new pilot test consisted of three injection events (November 2003, January 2004, and April-May 2004).

The results of the new pilot test indicated that reductions in contaminant concentrations could be achieved using the modified Fenton's reagent ISCO process. Shaw recommended, and the Navy agreed, to an expanded pilot test to assess the ability of two different injection methods (direct-push versus injection wells) to successfully deliver the reagent in sufficient volumes without negative effects from surfacing or formation pressures. The expanded ISCO pilot test consisted of 2 injection events (December 2004 and February 2005). The expanded pilot test was conducted northwest of the original IR Site 9 Intermediate pilot test location. Results indicated that the reagent can successfully be injected into the subsurface using temporary injection points (installed with direct-push methods) and that the contaminant concentrations are affected.

The pilot tests (original and expanded) targeted the Upper Intermediate zone between 20 to 30 feet (ft) below ground surface (bgs) and the Lower Intermediate zone between 30 to 40 ft bgs. Based on the results of the expanded pilot test, the Navy has approved the full-scale implementation of the ISCO technology at Site 9 Intermediate using direct-push injection techniques.

This SAP Addendum No. 2 addresses the sampling and analysis associated with full-scale ISCO treatment of Site 9 Intermediate. The project data quality objectives have not changed and are presented in Section 2.0 of Appendix A in the Final Project Plans (IT, 2003). All changes or additions to the existing SAP are addressed in this Addendum.

The work will be conducted under Contract Task Order 0107 of Naval Facilities Engineering Command Engineering Field Activity-West Environmental Remedial Action Contract Number N62474-98-D-2076.

1.1 Purpose and Scope

The purpose of SAP Addendum No. 2 is to summarize the activities to be performed and to define the sampling procedures that will be used during full-scale ISCO application. Field personnel will use this addendum as a reference.

The scope of work for the field activities will consist of the following:

- Monitoring well installation
- Monitoring well development
- Plume delineation and baseline groundwater sampling
- Full-scale ISCO application
- Temporary injection point installation
- Post-oxidant injection test sampling

The previous Work Plans (IT, 2003 and Shaw, 2003b) and the Work Plan Addendum (Shaw, 2003a) provide the detailed procedures for collection, handling, labeling, and shipment of the samples. Included in each of them is a description of analytical methods and quality control samples. The Site Health and Safety Plan are also included as Appendix B.

The following tasks will be conducted:

- Installing 23 new groundwater monitoring wells
- Conducting plume delineation and baseline groundwater sampling
- Conducting three full-scale oxidant injection events by injecting reagents into 2 zones of contamination (the Upper Intermediate zone between 20 to 30 ft bgs and the Lower Intermediate zone between 30 to 40 ft bgs)
- Conducting post-oxidant injection groundwater sampling.

1.2 Objectives

Water matrices will be sampled and analyzed to achieve the project objectives. Analytical data collected under the provisions of SAP Addendum No. 2 will be used for the following purposes:

- Refine and define the extent of the groundwater contaminant plumes
- Evaluate baseline groundwater conditions prior to oxidant injection
- Evaluate the effectiveness of the full-scale oxidation process
- Determine the location and spacing of the temporary injection points prior to each injection event.

2.0 Sampling Strategy

This section discusses the sampling and analysis strategy for groundwater and waste samples required to meet the project data quality objectives.

Procedures for sample collection and handling are discussed in existing project documents (IT, 2003, Shaw, 2003a, and Shaw, 2003b). The Standard Operating Procedures referenced in these sections are part of *IT Standard Quality Procedures and Standard Operating Procedures Manual* (IT, 2000).

Full-scale implementation of the ISCO activities at Site 9 Intermediate requires that the extent of the contaminant plumes be defined to their respective maximum contaminant levels. In a majority of the interpreted plume areas, limited hydropunch data is available. Therefore, new groundwater monitoring wells will be installed and sampled to supplement and confirm historic groundwater sampling results. The additional data will be used to refine and define the extent of the groundwater contaminant plumes and to determine the location of the full-scale ISCO temporary injection points.

The original technical assumptions for full-scale application at Site 9 Intermediate for injection of the reagents and monitoring of the contaminant plume consisted of the following:

- Installation of 15 groundwater monitoring wells
- Installation of 113 groundwater injection wells
- Only one zone with contamination.

However, as a result of previous activities at the site including; cone penetrometer testing, hydropunch groundwater sampling, and ISCO pilot testing the following decisions were made for full-scale ISCO:

- Injection of the reagent will be made through temporary injection points into two distinct zones of the contaminant plumes.
- The plume consists of the Upper Intermediate zone between 20 to 30 ft bgs and the Lower Intermediate zone between 30 to 40 ft bgs.
- 23 new groundwater monitoring wells will be installed.
- 172 temporary injection points will be used to introduce the reagent into the subsurface. (Based on treating the elevated concentration area. The number of temporary injections points would increase if the treatment area expands to the maximum contaminant level [MCL] boundary).

Table 1, "Summary of Field Sampling and Analysis," presents a summary of sampling and analysis for the project activities.

2.1 Monitoring Well Installation

For full-scale application at Site 9 Intermediate, 23 new groundwater monitoring wells are planned for installation. The proposed locations for the new monitoring wells are shown in Figure 1, "Proposed Groundwater Monitoring Well Locations, IR Site 9 – Intermediate Zone, Upper Intermediate Zone (20-30 ft. bgs)" and Figure 2, "Proposed Groundwater Monitoring Well Locations, IR Site 9 – Intermediate Zone, Lower Intermediate Zone (30-40 ft. bgs)."

Twelve monitoring wells (9IF-MW01U through 9IF-MW12U) will be installed to monitor the Upper Intermediate Zone from approximately 20 to 30 ft bgs. Ten monitoring wells (PIF-MW01L through 9IF-MW10L) will be installed to monitor the Lower Intermediate Zone from approximately 30 to 40 ft bgs. Additionally, 1 monitoring well, 9IF-MW01S, will be installed to monitor the shallow zone from approximately 10 to 20 ft bgs.

The well borings will be a minimum 8-inch inside diameter and will be advanced using a hollow-stem auger rig. The wells will be constructed of new 2-inch inside diameter Schedule 40 polyvinyl chloride (PVC) flush-thread blank casing, with 10 ft of Schedule 40 PVC with 0.020-inch slot. The screen end cap will be threaded to the end of the screen. The bottom auger flight will be plugged with a wooden plug to prevent formation materials from entering the auger flights (this is due to the high potential for flowing sands). Once completion depth is reached, the augers will be flooded with potable water and the wooden plug will be knocked out of the bottom auger flight. The wooden plug will remain in the formation and will not be retrieved. The amount of potable water in the borehole will be measured and recorded.

Sections of solid 2-inch diameter PVC riser will complete the upper portion of the well, and the final section of blank casing (riser) shall be cut with a pipe cutter approximately 6 inches bgs. The top of the casing shall be completed with a 2-inch Schedule 40 PVC slip-by-male pipe thread adapter and 2-inch threaded top cap. The annulus of each well will be filled with #2/12 grade silica sand, which will extend from the bottom of the borehole to approximately 2 ft above the top of the screen. The well pack material will be placed through the augers to the position above the screen. The augers will be slowly removed from the borehole as the sand pack is placed around the screen. The bottom of the augers will never be pulled higher than 1-foot below the top of the sand pack during installation. Frequent measurement of the top of the sand pack will be made to assure that the bottom of the augers is never above the sand pack. Prior to placing the bentonite seal, the sand pack will be carefully surged and then remeasured to assure correct sand pack placement. If necessary, additional sand pack will be added to correctly position the sand pack position/depth.

A bentonite seal consisting of 3/8-inch coated bentonite chips will be placed above the top of the sand pack to 6 ft bgs. The coated bentonite chips will be slowly dropped into the annulus of the borehole. If the bentonite seal is placed above the water table, it will be hydrated with potable water. Once the bentonite seal is placed, it will be allowed to set for a minimum of one hour to allow proper hydration. When the bentonite is set, the remainder of the borehole will be filled to the surface with concrete.

The surface completion for each well will be constructed with a minimum 12-inch diameter steel traffic-rated street box set in the concrete.

2.2 Monitoring Well Development

Following construction, each well will be developed to maximize yield and minimize turbidity of the water. Wells will be developed using a bailer, vented surge block, and submersible pump. Well development will not commence until the concrete seal and street box have been in place and allowed to set-up for at least 48 hours.

2.2.1 Methods and Equipment

Wells will be developed by alternately surging with a vented surge block and pumping with a submersible pump. Care shall be taken so as not to dislodge the bottom end cap during development. One or more development rigs will be required to complete this task within the allotted schedule. Wells will be initially bailed prior to surging to remove debris. Following bailing, the well will be carefully surged for a minimum of 15 minutes. This will be followed by pumping the well with a submersible or peristaltic pump until the water appears to be clear. The process will be repeated as necessary.

The subcontractor will use restraint when developing with a submersible pump so as not to over-pump the well and plug the sand pack. The contractor will also use care when developing with the vented surge block so as not to collapse the well screen or dislodge the end cap. The subcontractor will provide a 500-gallon (minimum), truck-mounted water tank to contain all purge water. All purge water will be transported by the subcontractor from the well site to a central location determined by the Shaw field representative.

2.2.2 Development Criteria

During well development, the Shaw field representative will sample the discharged water for turbidity, pH, temperature, dissolved oxygen, and specific conductance. The subcontractor will provide easy access to the purged water. A water meter will be used to measure flow rate (in gallons per minute) and total gallons removed from the well. Wells will be considered adequately developed when the water produced is sand free and clear/clean; and pH, temperature, dissolved oxygen, turbidity and specific conductance have stabilized to plus or minus 10 percent between two consecutive readings. For deeper wells where potable water was

used to flood the augers, a minimum volume of water must be removed during development equal to the volume of potable water added during well construction.

2.3 Plume Delineation and Baseline Groundwater Sampling

Following well development, groundwater samples will be collected from each of the newly installed and developed monitoring wells, and 6 of the existing pilot test monitoring/injection wells (P-9-MWI03, P-9-MWI05, P-9-MWI06, 9EMW01, 9EMW03, and 9EMW04). The existing wells to be sampled are shown on Figures 1 and 2 (three wells screened in the Upper Intermediate Zone and three wells are screened in the Lower Intermediate Zone). The results will be used to refine and define the extent of the groundwater contaminant plumes and to establish baseline conditions. Groundwater samples will be collected using low-flow sampling methods in accordance with the existing SAP (Appendix A) in the Work Plans (IT, 2003 and Shaw, 2003b) and in the Work Plan Addendum (Shaw, 2003a). Samples will be analyzed for the following parameters:

- Volatile organic compounds (VOC) by U.S. Environmental Protection Agency (EPA) Method 8260B
- Dissolved Metals by EPA Method 6010B (aluminum, arsenic, antimony, barium, beryllium, calcium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc)
- Hexavalent Chromium by EPA Method 7196A
- Semivolatile organic compound (SVOC) by EPA Method 8270C

In addition, groundwater samples will also be measured in the field for pH, temperature, specific conductivity, dissolved oxygen, and oxidation-reduction potential using hand-held field instruments, and for ferrous iron and hydrogen peroxide using Hach test kits (or equivalent).

2.4 Full-Scale Application

Even though the area of concern underlies the majority of the parking lot and the storage area associated with Building 166 (Power Engineering main tenant) and the area to the southeast of Building 166 (occupied by Delta Sandblasting) (See Figure 3, "1,1-Dichloroethane Plume Map, IR Site 9 – Intermediate Zone, Upper Intermediate Zone (20-30 ft. bgs)," Figure 4, "1,1-Dichloroethane Plume Map, IR Site 9 – Intermediate Zone, Lower Intermediate Zone (30-40 ft bgs)," Figure 5, "Vinyl Chloride Plume Map, IR Site 9 – Intermediate Zone, Upper Intermediate Zone (20-30 ft. bgs)," and Figure 6, "Vinyl Chloride Plume Map, IR Site 9 – Intermediate Zone, Lower Intermediate Zone (30-40 ft. bgs)." Shaw will start full-scale injections only in the areas of elevated concentrations (Figure 7, "Temporary Injection Point Locations, IR Site 9 – Intermediate Zone, Upper Intermediate Zone [20-30 ft. bgs]" and

Figure 8, "Temporary Injection Point Locations, IR Site 9 – Intermediate Zone, Lower Intermediate Zone [30-40 ft. bgs])." Injections will be conducted by using a direct-push drilling rig to advance temporary injection points into the subsurface to the desired depth, pulling back the drive rods to expose the screen, and injecting the reagent into the targeted interval through the screen. The full-scale application will consist of up to three oxidant injection events (approximately one event per month). The injections will be scheduled one month apart to allow for the collection of post-oxidant injection groundwater samples and to allow for concrete coring for the temporary injection points. The number of temporary injection points (based on treating the elevated concentration area) and quantities of reagent may change during the full scale activities based on the results of each injection event; therefore, the area requiring treatment may change. Additionally the number of temporary injection points would increase if the area of concern expands to encompass the contaminant plumes to the MCL extent. The objective is to treat the areas of concern to the MCL or to a level that is technically and economically practicable.

2.5 Temporary Injection Point Installation

The temporary well points will be placed by a subcontractor using a direct-push rig to push injection screens attached to 1.5-inch diameter rods to the desired depths within the test area at Site 9 Intermediate (see Figures 7 and 8). A specially designed injection screen, 3-ft in length, set inside a retractable rod will be attached to the bottom of the direct-push rods at each temporary well point location. Reagent will be delivered into the subsurface through the screen. The temporary injection well points will be driven to depth. The screened interval is intended for delivery of reagents into the saturated zone, assuming a depth to water of approximately 6 to 10 ft bgs. The depth to water will be measured in several of the monitoring wells at each full-scale test location prior to placement of the temporary well points. The actual depth to water at the time of injection will govern the placement of the injection screen. The entire screen length is intended to be in the saturated zone. There will be approximately 96 temporary injection point locations into the Upper Intermediate Zone (20 to 30 ft bgs) and 76 temporary injection point locations into the Lower Intermediate Zone (30 to 40 ft bgs). Following injection, each temporary injection point will be abandoned by filling with bentonite chips, hydrating the chips, and topping off with concrete.

2.6 Post-Oxidant Injection Test Sampling

Three full-scale oxidant injection events (one event per month) are planned at IR Site 9 Intermediate. The tests will be scheduled one month apart to allow for the collection and analysis of groundwater samples.

Post-injection groundwater samples will be collected one to two weeks following the completion of each oxidant injection event. The post-injection groundwater samples will be collected from

the same wells used for the baseline sampling, which include the 23 new monitoring wells, and 6 existing monitoring/injection wells (from the pilot tests) (P-9-MWI03, P-9-MWI05, P-9-MWI06, 9EMW01, 9EMW03, and 9EMW04). The post oxidant injection samples will be analyzed for the following parameters:

- VOC by EPA Method 8260B
- Dissolved Metals by EPA Method 6010B (aluminum, arsenic, antimony, barium, beryllium, calcium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc)
- Hexavalent chromium by EPA Method 7196A
- SVOC by EPA Method 8270C

In addition, groundwater samples will also be measured in the field for pH, temperature, specific conductivity, dissolved oxygen, and oxidation-reduction potential using hand-held field instruments and for ferrous iron and hydrogen peroxide using Hach test kits (or equivalent).

Post-injection groundwater contaminant concentration levels will be compared to the baseline groundwater results to evaluate changes and to assess the effectiveness of the oxidant injection test. Also this information will be used to determine temporary injection point locations that are used for each subsequent oxidant injection event.

2.7 *Investigation-Derived Waste Streams*

The project investigation-derived waste will be handled according to the requirements described in Appendix A, Section 3.5 of the Final Project Plans (IT, 2003).

3.0 Analytical Requirements and Quality Control

This section describes analytical methods, container and preservative requirements, and field and laboratory quality control samples.

3.1 Analytical Methods

The following analytical methods will be used to obtain the data for pilot test operations:

- *Test Methods for Evaluating Solid Waste, SW-846* (EPA, 1996) and *Methods for Chemical Analysis of Water and Waste* (EPA, 1983):
  - VOCs by EPA Method 8260B
  - Metals by EPA Method 6010B
  - Hexavalent Chromium by EPA Method 7196A
  - SVOCs by EPA Method 8270C

3.2 Sample Containers, Preservatives, and Holding Times

Sample containers, preservation, and holding time requirements will be according to the EPA methods listed in Table 2, "Sample Containers, Preservatives, and Holding Times." Sample containers for water and soil will be certified pre-cleaned according to EPA protocols.

3.3 Field Quality Control Samples

Field quality control samples will be collected and analyzed during the project to assess the consistency and performance of the sampling program. Field quality control samples for this project will be collected in accordance with Appendix A of the Final Project Plans (IT, 2003), with the following modification to field duplicate collection.

3.4 Field Duplicates

Field duplicate pairs consist of two samples of the same matrix (an original and a duplicate) collected at the same time and location to the extent possible, using the same sampling techniques. The purpose of field duplicate samples is to evaluate the homogeneity of contaminant distribution in the sampled matrix. Field duplicate samples will be collected at a frequency of 10 percent of the total samples, and will be analyzed for VOCs only.

3.4.1 Equipment Rinsate Samples

Equipment rinsate samples are used to evaluate the effectiveness of the decontamination procedure and to identify potential cross-contamination during sampling events. Equipment rinsate samples will be collected for nondisposable sampling equipment. For this project all groundwater samples will be collected using dedicated sample tubing for each well, so

equipment rinse samples are not necessary. However, if non-dedicated sampling equipment is ever used, equipment rinsate samples will be collected once per sampling event to verify that decontamination procedures are effective.

3.4.2 Trip Blanks

Each cooler containing water samples for VOC analysis will contain a trip blank. Trip blanks are 40 milliliter, volatile organic analysis, vials of analyte-free water, which are kept with the field sample containers from the time they leave the laboratory until the time they are returned to the laboratory. The purpose of trip blanks is to determine if samples have been contaminated with VOCs during transportation or sample collection. One trip blank is needed for one day sampling of groundwater samples for VOC analysis. Trip blanks will not be analyzed with wastewater or soil samples.

3.4.3 Temperature Blanks

Each cooler will be shipped with a temperature blank. A temperature blank is a sample container filled with tap water and stored in the cooler during sample collection and transportation. The laboratory will record the temperature of the temperature blank immediately upon receipt of the samples.

3.4.4 Matrix Spike and Matrix Spike Duplicate

The laboratory will analyze a matrix spike/matrix spike duplicate (MS/MSD) for every 20 water samples collected during the field test period. In order for the laboratory to prepare a project-specific MS/MSD, field personnel will collect extra sample volumes for water samples. Field personnel will designate 1 sample per every 20 for MS/MSD analysis on the chain-of-custody form. MS/MSD samples will be submitted for VOC analyses only. Waste samples and in-progress monitoring samples will not be submitted as MS/MSD samples.

4.0 Data Validation

All groundwater monitoring samples collected after the final round of oxidant injection will be validated by an independent third party validation company per the requirements of 3EN2.1 (SWDiv, 2001a). Samples collected for baseline groundwater evaluation, intermediate oxidant injection events and waste characterization will not be validated but will be reviewed by a Shaw Project Chemist. Data will be validated at 90 percent EPA Level III and 10 percent EPA Level IV. The validation will be in accordance with the EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2002), EPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, 1999), and the QC criteria specified in this document. Data will be validated and flagged with the following data qualifiers:

- *J qualifier* denotes the analyte was positively identified, but the associated numerical value is estimated.
- *U qualifier* denotes the analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit.
- *R qualifier* denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

5.0 References

IT Corporation, 2000, *IT Standard Quality Procedures and Standard Operating Procedures Manual*, Revision 2, Concord, California, August.

IT Corporation, 2003, *Final Project Plans, Chemical Oxidation Pilot Testing for Removal Actions at Installation Restoration Sites 9, 11/21 and 16, Alameda Point, Alameda, California*, Concord, California, February 3.

Shaw Environmental, Inc., 2003a, *Final Work Plan Addendum for In-Situ Chemical Oxidation Pilot Testing at Installation Restoration Site 9 Intermediate, Alameda Point, Alameda, California*, Concord, California, October 24.

Shaw Environmental, Inc., 2003b, *Final Work Plan Full-Scale In-Situ Chemical Oxidation Testing at Installation Restoration Sites 9 & 16, Alameda Point, Alameda, California*, Concord, California, December 22.

U.S. Environmental Protection Agency, 1983, *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Washington, D.C.

U.S. Environmental Protection Agency, 1996, *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*, SW-846, Update III, Washington, D.C., September.

U.S. Environmental Protection Agency, 1999, *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, Washington D.C.

U.S. Environmental Protection Agency, 2002, *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, Washington D.C.

U.S. Navy Southwest Division, 2001a, *Environmental Work Instruction 3EN2.1—Chemical Data Validation.*

Figures

DRAWING NUMBER	APPROVED BY		CHECKED BY		DRAWN BY		OFFICE	X-REF	IMAGE
844918-D177	T. Searls	3/31/05	T. Searls	3/31/05	B. JENSEN	3-31-05	CONC	ALA1BASE	---

W. ORISKANY AVENUE

W. TICONDEROGA AVENUE

VIKING STREET

9IHP15
9IHP17
9IHP14
9IHP12
9IF-MW01U
9IF-MW03U
9IHP13
9IF-MW02U
9IHP16
9IHP11
555
9-7
287
9EMW04
9EMW02
9EMW03
9EIW04
9EIW02
9EMW01
9EIW01
9EIW03
9EMW06
9EMW05
351
588
(DEMOLISHED)
P-9-MW109
P-9-MW105
P-9-MW110
S09-DGS-DP02
166
P-9-MW108
P-9-MW102
P-9-MW104
P-9-MW106
410
9-1
9IF-MW011U
P-9-MW107
P-9-MW103
9IF-MW04U
9IF-MW01S
9-3
9IF-MW05U
9IF-MW06U
9-6
9IF-MW012U
9-2
9IF-MW07U
S09-DGS-DP03
9IF-MW10U
72B
9IHP09
9-5
9IF-MW09U
9IF-MW08U
9IHP10
9IHP18
9IHP08
9-4

LEGEND

- PROPOSED FULL-SCALE MONITORING WELL LOCATION
- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. LOWER INTERMEDIATE ZONE IS WITHIN THE LOWER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 20 AND 30 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE
0 40 80 FEET

Shaw™ Shaw Environmental, Inc.

DEPARTMENT OF THE NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 1
PROPOSED GROUNDWATER MONITORING WELL LOCATIONS
IR SITE 9 – INTERMEDIATE ZONE
UPPER INTERMEDIATE ZONE (20-30 FT. BGS)

ALAMEDA POINT ALAMEDA, CALIFORNIA

DRAWING NUMBER	844918-D178		
APPROVED BY	T. Searls	3-31-05	
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OFFICE	CONC		
X-REF	ALA1BASE		
IMAGE	---		

W. ORISKANY AVENUE

9IHP15

9IHP17

9IHP14

9IHP12

9IHP13

9IHP16

9IHP11

555

9-7

9IF-MW01L

9IF-MW02L

287

9EMW04

9EMW02

9EIW02

9EMW03

9EIW04

9EMW01

9EIW01

9EIW03

9EMW06

9EMW05

351

588

(DEMOLISHED)

P-9-MW09

P-9-MW05

P-9-MW10

S09-DGS-DP02

166

P-9-MW08

P-9-MW02

9-1

P-9-MW04

P-9-MW06

410

9IF-MW03L

9IF-MW10L

P-9-MW07

P-9-MW03

9-3

9IF-MW04L

9IF-MW09L

9-6

9IF-MW06L

9-2

S09-DGS-DP03

72B

9IF-MW08L

9IHP09

9-5

9IF-MW05L

STREET

VIKING

9IF-MW07L

9-4

W. TICONDEROGA AVENUE

9IHP18

9IHP10

9IHP08

LEGEND

- PROPOSED FULL-SCALE MONITORING WELL LOCATION
- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. LOWER INTERMEDIATE ZONE IS WITHIN THE LOWER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 30 AND 40 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE 0 40 80 FEET

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NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 2
PROPOSED GROUNDWATER MONITORING WELL LOCATIONS
IR SITE 9 – INTERMEDIATE ZONE
LOWER INTERMEDIATE ZONE (30-40 FT. BGS)

ALAMEDA POINT ALAMEDA, CALIFORNIA

DRAWING NUMBER	844918-D183		
APPROVED BY	T. Searls	3/31/05	
CHECKED BY	T. Searls	3/31/05	
DRAWN BY	B. JENSEN	3-17-05	
OFFICE	CONC		
X-REF	ALA1BASE		
IMAGE	---		

W. ORISKANY AVENUE

9IHP15

9IHP17

9IHP14

9IHP12

9IHP13

9IHP16

9IHP11

555

9-7

287

9EMW04

9EMW02

9EMW01

9EIW02

9EIW01

9EMW03

9EIW04

9EIW03

9EMW06

9EMW05

351

588

(DEMOLISHED)

P-9-MW109

S09-DGS-DP02

P-9-MW108

P-9-MW106

P-9-MW103

166

410

9-1

5

100

50

5

9-3

9-6

9-2

S09-DGS-DP03

72B

9IHP09

9-5

VIKING STREET

9-4

W. TICONDEROGA AVENUE

9IHP18

9IHP10

9IHP08

5

LEGEND

- PROPOSED FULL-SCALE MONITORING WELL LOCATION
- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. UPPER INTERMEDIATE ZONE IS WITHIN THE UPPER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 20 AND 30 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE

0 40 80 FEET

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SAN DIEGO, CALIFORNIA

FIGURE 3

1,1-DICHLOROETHANE PLUME MAP
IR SITE 9 – INTERMEDIATE ZONE
UPPER INTERMEDIATE ZONE (20-30 FT. BGS)

ALAMEDA POINT ALAMEDA, CALIFORNIA

DRAWING NUMBER	844918-D184		
APPROVED BY	T. Searls	3/31/05	
CHECKED BY	T. Searls	3/31/05	
DRAWN BY	B. JENSEN	3-17-05	
OFFICE	CONC		
X-REF	ALAIBASE		
IMAGE	---		

W. ORISKANY AVENUE

W. TICONDEROGA AVENUE

VIKING STREET

9IHP15
9IHP17
9IHP14
9IHP12
9IHP13
9IHP16
9IHP11
9IHP09
9IHP10
9IHP18
9IHP08

555
287
351
588
(DEMOLISHED)
166
72B
410

9-7
9-6
9-5
9-4
9-3
9-2
9-1

9EMW02
9EMW01
9EIW02
9EIW01
9EMW04
9EMW03
9EIW04
9EIW03
9EMW06
9EMW05

P-9-MW09
S09-DGS-DP02
P-9-MW08
P-9-MW06
P-9-MW03
S09-DGS-DP03

5
50
500

LEGEND

- PROPOSED FULL-SCALE MONITORING WELL LOCATION
- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. LOWER INTERMEDIATE ZONE IS WITHIN THE LOWER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 30 AND 40 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE
0 40 80 FEET

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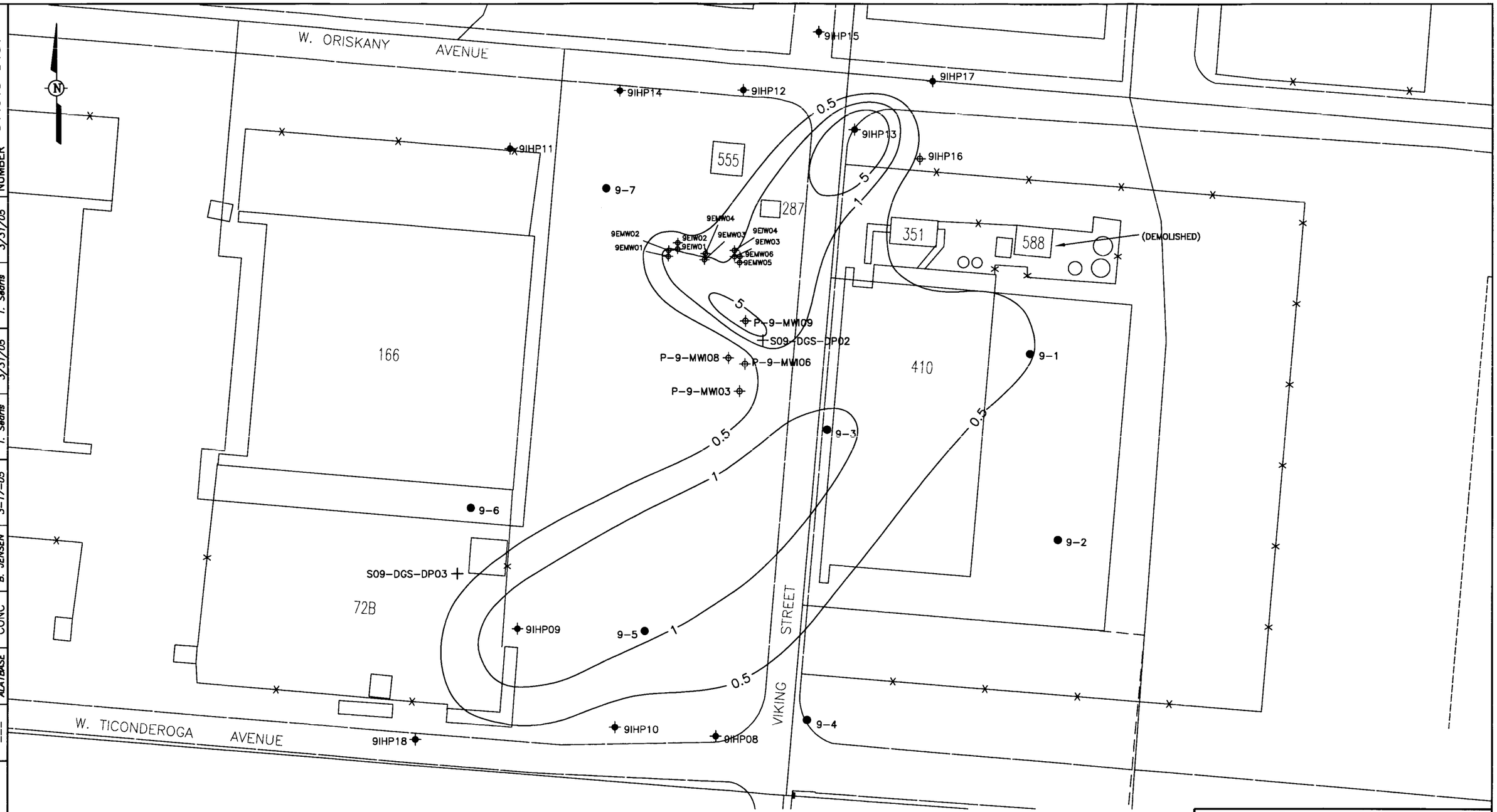
SAN DIEGO, CALIFORNIA

FIGURE 4

1,1-DICHLOROETHANE PLUME MAP
IR SITE 9 – INTERMEDIATE ZONE
LOWER INTERMEDIATE ZONE (30-40 FT. BGS)

ALAMEDA POINT ALAMEDA, CALIFORNIA

DRAWING NUMBER	844918-D181		
APPROVED BY	T. Searls	3/31/05	
CHECKED BY	T. Searls	3/31/05	
DRAWN BY	B. JENSEN	3-17-05	
OFFICE	CONC		
X-REF	ALAIBASE		
IMAGE	---		



LEGEND

- PROPOSED FULL-SCALE MONITORING WELL LOCATION
- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. UPPER INTERMEDIATE ZONE IS WITHIN THE UPPER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 20 AND 30 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE
0 40 80 FEET

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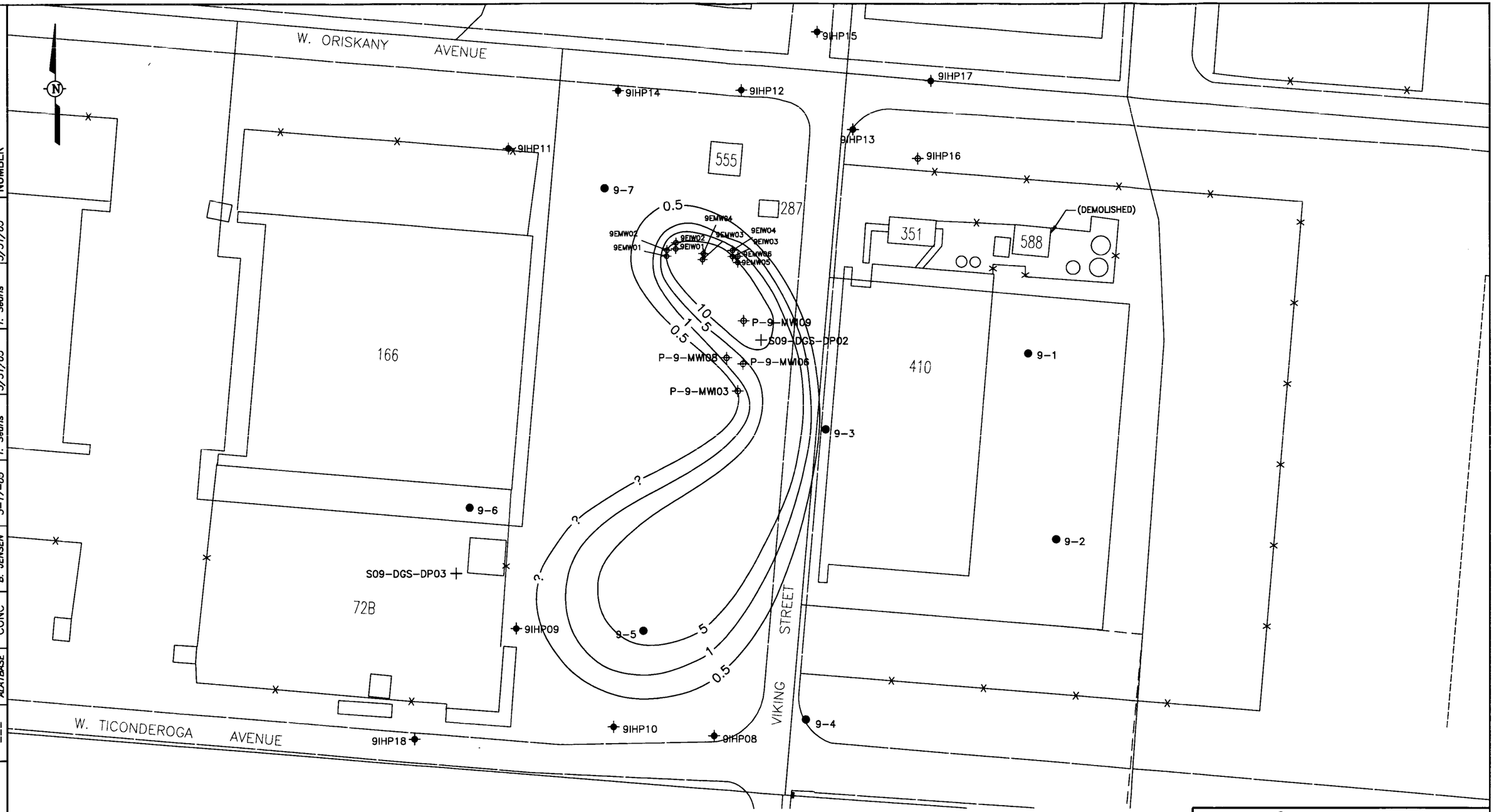
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 5

VINYL CHLORIDE PLUME MAP
IR SITE 9 – INTERMEDIATE ZONE
UPPER INTERMEDIATE ZONE (20-30 FT. BGS)
ALAMEDA POINT ALAMEDA, CALIFORNIA

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	OFFICE	X-REF	IMAGE
844918-D182	T. Searls 3/31/05	T. Searls 3/31/05	B. JENSEN 3-17-05	CONC	ALA1BASE	---



LEGEND

- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. LOWER INTERMEDIATE ZONE IS WITHIN THE LOWER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 30 AND 40 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE
0 40 80 FEET

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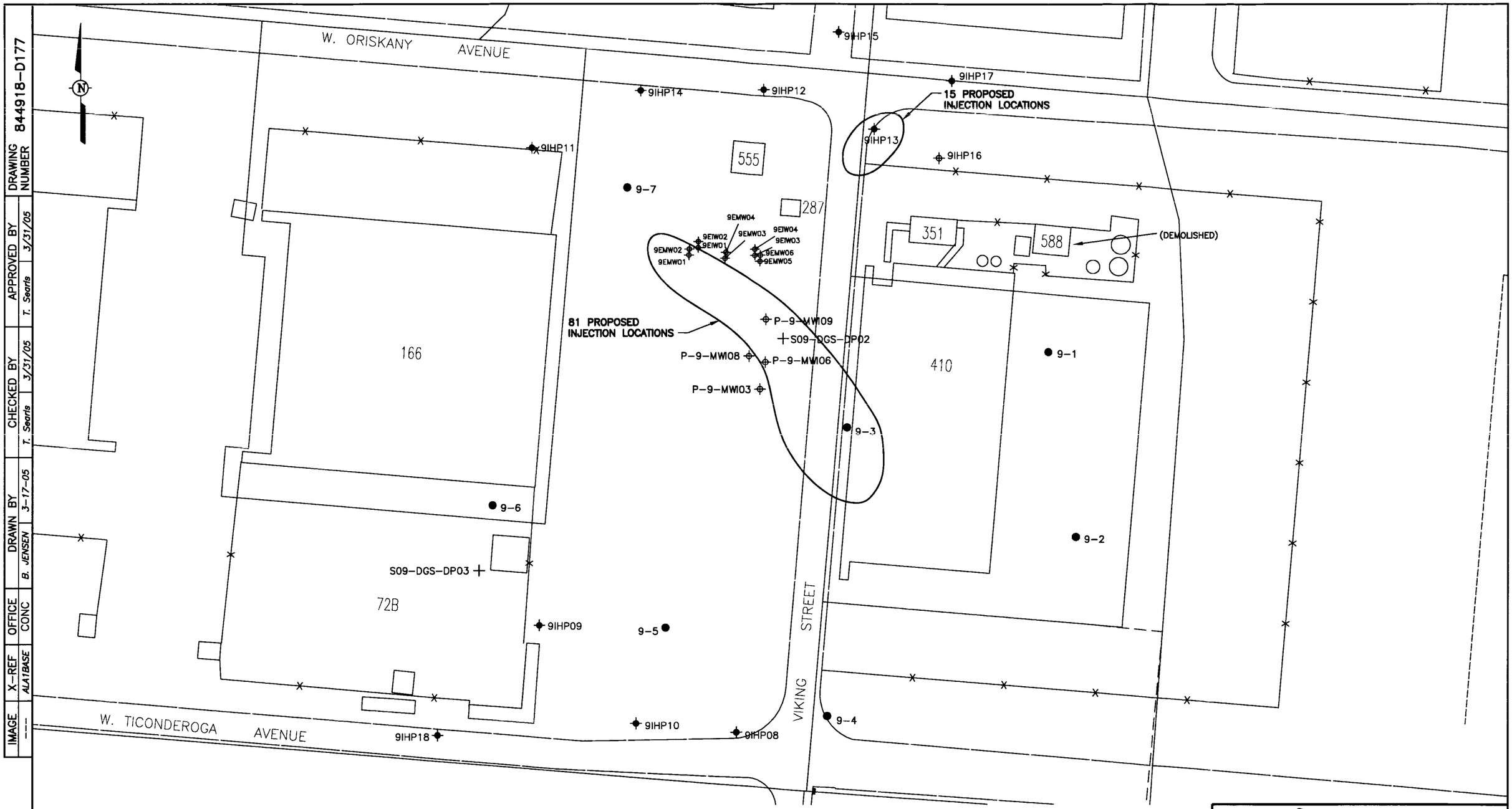
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 6

VINYL CHLORIDE PLUME MAP
IR SITE 9 – INTERMEDIATE ZONE
LOWER INTERMEDIATE ZONE (30-40 FT. BGS)
ALAMEDA POINT ALAMEDA, CALIFORNIA

DRAWING NUMBER	APPROVED BY		CHECKED BY		DRAWN BY		OFFICE	X-REF	IMAGE
844918-D177	T. Searls	3/31/05	T. Searls	3/31/05	B. JENSEN	3-17-05	CONC	ALA1BASE	---



LEGEND

- PROPOSED FULL-SCALE MONITORING WELL LOCATION
- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. LOWER INTERMEDIATE ZONE IS WITHIN THE LOWER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 20 AND 30 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE
0 40 80 FEET

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SAN DIEGO, CALIFORNIA

FIGURE 7

TEMPORARY INJECTION POINT LOCATIONS
IR SITE 9 – INTERMEDIATE ZONE
UPPER INTERMEDIATE ZONE (20-30 FT. BGS)
ALAMEDA POINT ALAMEDA, CALIFORNIA

DRAWING NUMBER	844918-D180		
APPROVED BY	T. Searls	3/31/05	
CHECKED BY	T. Searls	3/31/05	
DRAWN BY	B. JENSEN	3-17-05	
OFFICE	CONC		
X-REF	ALA1BASE		
IMAGE	---		

W. ORISKANY AVENUE

9IHP15

9IHP17

9IHP14

9IHP12

53 PROPOSED INJECTION LOCATIONS

9IHP13

9IHP16

9IHP11

555

9-7

287

(DEMOLISHED)

351

588

9EIW02
9EIW01
9EIW04
9EMW02
9EMW01
9EMW04
9EMW03
9EMW06
9EMW05
9EIW03

P-9-MW109

P-9-MW108

S09-DGS-DP02

P-9-MW106

P-9-MW103

166

410

9-1

9-3

9-6

23 PROPOSED INJECTION LOCATIONS

9-2

S09-DGS-DP03

72B

9IHP09

9-5

VIKING STREET

9-4

W. TICONDEROGA AVENUE

9IHP18

9IHP10

9IHP08

LEGEND

- CTO107 HYDROPUNCH LOCATION
- TtEMI HYDROPUNCH LOCATION
- PILOT TEST MONITORING OR INJECTION WELL LOCATION
- CTO59 PLUME DELINEATION LOCATION
- CERCLA BOUNDARY

NOTES:

1. LOWER INTERMEDIATE ZONE IS WITHIN THE LOWER PORTION OF THE UPPER SANDY ZONE OF THE MERRITT SAND, GENERALLY AT DEPTHS BETWEEN 30 AND 40 FEET BELOW GROUND SURFACE.
2. TtEMI HYDROPUNCH DATA SOURCE: DATA SUMMARY REPORT – SUPPLEMENTAL REMEDIAL INVESTIGATION DATA GAP SAMPLING OU-1 & OU-2. ORIGINAL DOCUMENT: TtEMI, JULY 2002.

SCALE
0 40 80 FEET

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NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 8

TEMPORARY INJECTION POINT LOCATIONS
IR SITE 9 – INTERMEDIATE ZONE
LOWER INTERMEDIATE ZONE (30-40 FT. BGS)
ALAMEDA POINT ALAMEDA, CALIFORNIA

Tables

Table 1
Summary of Field Sampling and Analysis

Location	Number of Field Samples	Number of QC Samples	Analysis	Description
Baseline Groundwater Sampling				
Groundwater Plume Delineation	29	Trip blanks 3 Field duplicates (VOCs analysis only and collect only if enough water is available) 1 MS/MSD pair per 20 samples collected (collect only if enough water is available)	VOC (EPA 8260B) SVOC (EPA 8270C) Hexavalent Chromium (EPA 7196A) Dissolved Metals (EPA 6010B) ORP, pH, temperature, dissolved oxygen, and specific conductivity (field measurement) Ferrous iron (field measurement – Hach Kit) Hydrogen Peroxide (field measurement - Hach Field kit)	23 new monitoring wells, and 6 existing monitoring/injection wells (from pilot test)
Post Oxidant Injection Groundwater Sampling				
Post Oxidant Injection Groundwater Monitoring	29 (3 events)	Trip blanks 3 Field duplicates (VOCs analysis only and collect only if enough water is available) 1 MS/MSD pair per 20 samples collected (collect only if enough water is available)	VOC (EPA 8260B) SVOC (EPA 8270C) Hexavalent Chromium (EPA 7196A) Dissolved Metals (EPA 6010B) ORP, pH, temperature, dissolved oxygen, and specific conductivity (field measurement) Ferrous iron (field measurement – Hach Kit) Hydrogen Peroxide (field measurement - Hach Field kit)	Collect groundwater samples 1 to 2 weeks after each of three oxidant injection events Samples will be collected from: 23 new monitoring wells, and 6 existing monitoring/injection wells (from pilot test)

EPA denotes U.S. Environmental Protection Agency
ORP denotes oxidation-reduction potential
SVOC denotes semivolatile organic compound
VOC denotes volatile organic compound

Table 2
Sample Containers, Preservatives, and Holding Times

Analytes	Method	Container[a]	Preservative	Holding Time
		Water		
VOCs	EPA 8260B	Three 40-mL vials, Teflon™-lined septum	HCl to pH <2 Cool at 4±2°C	14 days
Dissolved Metals	EPA 6010B	500 mL HDPE	HNO_3 to pH <2	180 days for all metals
Hexavalent Chromium	EPA 7196A	250 mL HDPE	Cool at 4±2°C	24 hours
SVOC	EPA 8270C	Two 1-Liter Amber glass jars, Teflon™-lined septum	Cool at 4±2°C	7 days to extraction 40 days for analysis

°C denotes degrees Celsius
EPA denotes U.S. Environmental Protection Agency
HCl denotes hydrochloric acid
HDPE denotes high-density polyethylene
HNO_3 denotes nitric acid
mL denotes milliliter(s)
SVOC denotes semivolatile organic compound
VOC denotes volatile organic compound