Draft

2005 – 2010 Five-Year Review Report
Installation Restoration Program Sites 40 and 70

19 September 2012

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2005 – 2010 Five-Year Review Report
Installation Restoration Program Sites 40 and 70

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EXECUTIVE SUMMARY

The Navy Installation Restoration Program (IRP) requires Five-Year Reviews in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1986, Title 42 *United States Code* Sections (§§) 9602 et seq., and in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 *Code of Federal Regulations* Part 300, et seq., and U.S. Environmental Protection Agency (EPA 2001) *Comprehensive Five-Year Review Guidance* to determine whether remedies implemented at IRP Sites remain protective of human health and the environment. This is the first Five-Year Review for IRP Sites 40 and 70 at Naval Weapons Station (NAVWPNSTA) Seal Beach, Seal Beach, California.

History of Contamination:

At **IRP Site 40**, oil that collected during maintenance operations was formerly discharged through a drainpipe onto a gravel area until the discharge pipe was plugged in 1978. Past industrial activities conducted at a locomotive repair shop resulted in discharge of volatile organic compounds (VOC), primarily from industrial solvents, to soil and groundwater. Results of soil sampling indicated that most of the original release of VOCs has already moved into the groundwater or evaporated into the air, and no cleanup action was necessary for soil at the site. The lateral extent of contaminated groundwater was estimated as a plume 270-ft downgradient by 200-ft wide. The principal contaminant, trichloroethene (TCE), was present from less than 20 ft to 45 ft below grade and did not involve the deep, beneficial use aquifer.

At **IRP Site 70**, some formerly used NASA manufacturing process chemicals, which included industrial solvents (primarily VOCs), lubricating oils, and detergents in the manufacturing process, were released to the environment. This resulted in contamination of the groundwater in the saline aquifer. The primary chemical of concern (COC) was TCE. Other VOCs present were chloroform, dichloroethane (DCA), dichloroethene (DCE), tetrachloroethene (PCE), and vinyl chloride (VC). The VOC-contaminated plume included a source area contaminated with dense non-aqueous phase liquid (DNAPL: TCE and other VOCs) and a larger dissolved phase plume, which extended from around the source area to the leading edge. The extended dissolved-phase plume containing TCE and VOCs comprised an area approximately 4,000-ft downgradient by 1,200-ft wide by 160-ft deep (ECC/Geosyntec 2008b). Both plume areas were shallower than the deep beneficial use aquifer.

Remedial Action Objectives and Remedies:

IRP Site 40:

Because there are no complete exposure pathways to ecological receptors, the remedial action objectives (RAO) focus on mitigating potential human exposures to groundwater:

- Protect existing beneficial uses of the shallow aquifer underlying NAVWPNSTA Seal Beach to the extent practicable while preventing or minimizing VOC migration beyond the current NAVWPNSTA Seal Beach boundaries at concentrations exceeding site remediation goals;
- Protect human health by preventing extraction of VOC-impacted shallow groundwater for domestic use until site remediation goals are achieved; and (added in this report)
- Protect human health by monitoring for vapor intrusion in and around Buildings 239 and 240.

The Record of Decision (ROD) for Site 40 specifies setting the stricter of federal or state Maximum Contaminant Levels (MCL) for each COC as target cleanup goals (TCG).

The remedy approved for IRP Site 40 was enhanced *in situ* bioremediation (EISB) of groundwater, followed by monitored natural attenuation (MNA). The remedy includes land use controls (LUC) to be maintained during treatment and performance monitoring.

IRP Site 70

The following overall RAOs were developed for IRP Site 70 to define the scope of potential groundwater cleanup activities:

- Protect existing beneficial uses of the shallow aquifer underlying NAVWPNSTA Seal Beach to the extent practicable while preventing or minimizing VOC migration beyond the current NAVWPNSTA Seal Beach boundaries at concentrations exceeding site cleanup goals;
- Protect human health by preventing extraction of VOC-impacted shallow groundwater until site cleanup goals are achieved; and (added in this report)
- Protect human health by monitoring for vapor intrusion in buildings and utility corridors.

The ROD for Site 70 specifies setting the stricter of federal or state MCLs for each COC as TCGs.

The Site 70 remedy is based on EISB technology followed by MNA to accelerate natural biodegradation and reduction of VOCs in the plume to their TCGs. The source area was treated via bioaugmentation. Treatment of the extended dissolved-phase plume involved installation of six bioaugmented biobarriers that transect the plume and treat VOCs migrating downgradient.

Technical Assessment:

IRP Site 40

Bioremediation efforts at Site 40 have resulted in PCE concentrations being reduced below TCG at all monitored wells. Only two wells show residual DCE levels above TCG. However, the presence in 12 of 19 wells of VC concentration above TCG means that the dechlorination pathway has not been completed. These results are consistent with transition to MNA phase over most of the plume, and the Navy considers Site 40 to have so transitioned during the first five-year review period.

Although no methane vapor intrusion has been detected in or around Buildings 239 and 240, the presence of methane gas in the vadose zone will require continued surface emissions monitoring along with localized performance monitoring and plume-wide MNA. Low levels of vadose zone VC are considered cause to add surface air sampling and analysis for VC to methane gas measurement.

IRP Site 70

Well installation and bioaugmentation in the source area and six downgradient biobarriers was successfully completed in August of 2010, and sample analysis results indicate that injections have created conditions conducive to reductive dechlorination in all treatment zones. TCE concentrations have greatly decreased in all injection and downgradient performance monitoring wells, and significant production of daughter products has been observed throughout the plume.

However, approximately half of the wells in the monitoring network still show elevated TCE concentrations above TCG. Although some wells exhibit field parameter values that could require further bioaugmentation, favorable conditions for further reductive dechlorination were demonstrated at all biobarriers The 2010 Performance Monitoring Report for Site 70 considered but did not recommend additional substrate injection in 2011 in order to continue the dechlorination process.

Site 70 had not met the criteria for entering MNA phase by the end of the first five-year review period.

Methane was reported in all soil vapor samples. Methane gas was not detected in the ambient air within the breathing zone either inside buildings or in outdoor areas of the locations monitored.

VOCs were not monitored in Site 70 vapor wells, so accumulation of VOCs such as vinyl chloride cannot be ruled out as a source of vapor intrusion. For this reason, VOC monitoring in vapor wells is recommended during the second five-year review period.

Protectiveness Statement:

IRP Site 40

All immediate threats at Site 40 have been addressed. The approved EISB remedy has resulted in TCE concentrations falling below TCG in all wells, and residual COC and daughter-product concentrations are also very low. Only VC is present above its TCG throughout the plume.

Long-term protectiveness of the Site 40 remedy will be verified by a combination of continuing performance monitoring at wells with residual DCE and VC levels above TCGs and MNA at all other monitoring wells. Continued monitoring for methane in surface air emissions and new collection and

analysis of surface air samples for VC can verify that vapor intrusion is not a viable exposure pathway at Site 40. Monitoring and documentation of LUC compliance will provide protection of site receptors until all TCGs are attained in all monitoring wells.

IRP Site 70

All immediate threats at Site 70 have been addressed. The approved EISB remedy has reduced TCE concentrations throughout the plume. Conditions favorable to further reductive dechlorination of COCs in groundwater persist at all biobarrier installations. Exposure pathways that could result in unacceptable risks are being controlled by a combination of remedial action and in-place LUCs and ICs.

Long-term protectiveness of the Site 70 remedy will be maintained by continued performance monitoring, possible additional localized bioaugmentation, and monitoring and documentation of LUC and IC compliance. These actions and subsequent MNA will continue until TCGs are attained for all COCs in all monitored wells.

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LIST OF ACRONYMS

AOCs	areas of concern
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
CE	chlorinated ethene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CKY	CKY Incorporated (contractor)
COC	contaminant of concern
COPC	chemical of potential concern
DCA	dichloroethane
DCE	dichloroethene
Dhc	*Dehalococcoides ethenogenes* spp.
DHG	dissolved hydrocarbon gas
DHS	Department of Health Services
DNAPL	non-aqueous phase liquid
DO	dissolved oxygen
DON	Department of the Navy
DTSC	Department of Toxic Substances Control
EISB	enhanced *in situ* bioremediation
EPA	United States Environmental Protection Agency
ERSE	Extended Removal Site Evaluation
ESQD	explosive safety quantity distance
EVO	emulsified vegetable oil
FS	Feasibility Study
FSB	First Sand Biobarrier
FSI	Focused Site Inspection
HRC®	Hydrogen Release Compound
IC	institutional control
IRP	Installation Restoration Program
KB-1®	dechlorinating microbial culture
LUC	land use control
MCL	Maximum Contaminant Level
MNA	monitored natural attenuation

NASA	National Aeronautics and Space Administration
NAVFAC SW	Naval Facilities Engineering Command Southwest
NAVWPNSTA	Naval Weapons Station
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NWR	National Wildlife Refuge
O&M	operation and maintenance
OCHCA	Orange County Environmental Health
ORP	oxidation-reduction potential
OU	Operable Unit
PA	Preliminary Assessment
PCE	tetrachloroethene
pH	potential hydrogen
RA	Remedial Action
RAB	Restoration Advisory Board
RAO	remedial action objective
RAP	Remedial Action Plan
RAWP	Remedial Action Work Plan
RD	Remedial Design
RFS	Revised Feasibility Study
RI	Remedial Investigation
ROD	Record of Decision
RRSEM	Relative Risk Site Evaluation Model
RSE	Removal Site Evaluation
RT&E	Research, Testing, and Evaluation
RWQCB	Regional Water Quality Control Board
SAB	Source Area Biobarrier
SATG	Source Area Treatment Grid
SHB	Shell Horizon Biobarrier
SI	Site Inspection
SSB	Second Sand Biobarrier
SWRCB	State Water Resources Control Board
TBD	to be determined
TCE	trichloroethene

TCG	target cleanup goal
TOC	total organic carbon
VC	vinyl chloride
VOC	volatile organic compound

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FIRST FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site name: Operable Unit (OU) 4, IRP Site 40 and OU 8, IRP Site 70 at NAVWPNSTA Seal Beach		
US Environmental Protection Agency (EPA) ID: CA0170024491		
Region: 9	**State:** CA	**City/County:** Seal Beach/Orange County

SITE STATUS	
NPL status: None	
Remediation status: On-going	
Multiple OUs? Yes	**Construction completion date:** 9 / 2005 at IRP Site 40 **Construction completion date:** 10 / 2007 at IRP Site 70
Has site been put into reuse? No	

REVIEW STATUS	
Lead agency: Department of the Navy	
Author name: Brenda Reese	
Author title: Remedial Project Manager	**Author affiliation:** NAVFAC SW
Review period:* 2/23/2005 to 10/01/2010	
Date(s) of site inspection: Quarterly	
Type of review: Non-NPL Remedial Action Site	
Review number: ☐ (**first**) 2 (second) 3 (third) Other (specify) _____	
Triggering action: ☐ Actual RA Onsite Construction at OU 4 IRP Site 40 & OU 8 IRP Site 70 Construction Completion Previous Five-Year Review Report Other (specify)	
Triggering action date: 2/23/2005 (start of Remedial Action-Construction)	
Due date *(five years after triggering action date)*: 10/1/2010	

* Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.

NARRATIVE SUMMARY

Issues

IRP Site 40

1. Residual low levels of cis-1,2-DCE and VC remain in excess of their target cleanup goals (TCG), forming dilute plumes in the central and southwest portions of the site. However, concentrations of CEs are low enough to warrant entry to MNA phase over most of the site.
2. Low-level residual DCE/VC at two monitoring wells suggest the possibility of a need for additional localized EISB injections. This will be assessed through future performance monitoring.
3. Methane gas or VC could migrate into Buildings 239 and 240 via vapor intrusion.

IRP Site 70

1. Although EISB has reduced plume extent, TCE and daughter products remain above TCGs in half of the monitoring wells.
2. In some wells, water quality data (TOC, sulfate, methane, ORP, DO) indicate that the EVO may be depleted. However conditions favorable to reductive dechlorination continue at all biobarriers.

IRP Site 70 (continued)

3. Methane and VOCs can accumulate in the subsurface and migrate to the surface.
4. Long-term MNA/LUC costs due to long timeframe expected for MNA to attain RAOs.

Recommendations and Follow-up Actions

IRP Site 40

1. Continue annual groundwater monitoring to assess natural attenuation in wells that have not met TCGs for all COCs over one year of monitoring.
2. Monitor and document LUC compliance until all TCGs have been met in all wells. Document compliance in the NIRIS LUC Tracker and annual performance monitoring reports.
3. Based on monitoring data after this review period, consider possible injection of substrate in wells with persistent high levels of DCE to boost dechlorination rates.
4. Continue performance monitoring/MNA. Continue soil vapor and surface emissions monitoring. Add VC analysis of surface emissions samples.

IRP Site 70

1. Continue performance monitoring to assess natural attenuation in wells that have not met TCGs for all COCs over one year of monitoring.
2. Monitor and document LUC and IC compliance within Site 70 and the LUC buffer zone until all TCGs are met in all wells. Document compliance in the NIRIS LUC Tracker and annual reports.
3. Monitor possible increases in ORP and DO, and changes in concentrations of CEs, Dhc/vcrA, TOC, and VFAs in wells in affected areas.
4. Continue methane monitoring in the vapor points and at the surface. Add VOC analysis of soil vapor samples and add VC analysis of ambient air samples.
5. Synchronize groundwater monitoring, DNAPL gauging, and LUC inspection efforts for maximum cost effectiveness.

Protectiveness Statements

***IRP Site 40* -** All immediate threats at Site 40 have been addressed. The approved EISB remedy has resulted in TCE concentrations falling below TCG in all wells, and residual COC and daughter-product concentrations are also very low. Only VC is present above its TCG throughout the plume.

Long-term protectiveness of the Site 40 remedy will be verified by a combination of continuing performance monitoring at wells with residual DCE and VC levels above TCGs and MNA at all other monitoring wells. Continued monitoring for methane in surface air emissions and new collection and analysis of surface air samples for VC can verify that vapor intrusion is not a viable exposure pathway at Site 40. Monitoring and documentation of LUC compliance will provide protection of site receptors until all TCGs are attained in all monitoring wells.

***IRP Site 70* -** All immediate threats at Site 70 have been addressed. The approved EISB remedy has reduced TCE concentrations throughout the plume. Conditions favorable to further reductive dechlorination of COCs in groundwater persist at all biobarrier installations. Exposure pathways that could result in unacceptable risks are being controlled by a combination of remedial action and in-place LUCs and ICs.

Long-term protectiveness of the Site 70 remedy will be maintained by continued performance monitoring, possible additional localized bioaugmentation, and monitoring and documentation of LUC and IC compliance. These actions and subsequent MNA will continue until TCGs are attained for all COCs in all monitored wells.

I. INTRODUCTION

i. The Purpose of the Review

The Navy Installation Restoration Program (IRP) requires Five-Year Reviews to determine whether remedies implemented at IRP Sites remain protective of human health and the environment. This is the first Five-Year Review for IRP Sites 40 and 70 at Naval Weapons Station (NAVWPNSTA) Seal Beach, Seal Beach, California. The report documents review methods, findings, conclusions recommendations. Recommendations may address issues such as data gaps and opportunities to improve the effectiveness of remedial action (RA) in protecting human health and the environment.

ii. Authority for Conducting the First Five-Year Review

This Five-Year Review report has been prepared in accordance with the U.S. Environmental Protection Agency Comprehensive Five-Year Review Guidance (EPA 2001) and DON Policy for Conducting Five-Year Reviews (DON 2011). The report is prepared pursuant to CERCLA §121 and the NCP. CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The NCP, 40 Code of Federal Regulations §300.430(f)(4)(ii), states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

iii. Who Conducted the First Five-Year Review

The DON is responsible for this first Five-Year Review of the RAs implemented at the IRP Sites 40 and 70 at NAVWPNSTA Seal Beach in Seal Beach, California. The review and report were completed by CKY Inc. (CKY), under Contract Task Order 0004 of Environmental Multiple Award Contract No. N62473-09-D-2626, and under the supervision of Remedial Project Manager Brenda Reese of Naval Facilities Engineering Command Southwest (NAVFAC SW) and NAVWPNSTA Seal Beach IRP Coordinator Pei-Fen Tamashiro.

The review period for this report is from October 2005 through October 2010. Remediation and monitoring effort performed after the review-period is not reported in this document.

iv. Other Review Characteristics

The Review is required due to the fact that hazardous substances, pollutants, or contaminants remain at IRP Sites 40 and 70 above levels that allow for unlimited use and unrestricted exposure.

The triggering action for this review is the initiation of RA (remedial system construction) at IRP Site 40 on February 23, 2005, the earlier of the two IRP Sites.

II. SITE CHRONOLOGY

Table 1: Chronology of Site Events

Event	Date
Initial discovery of problems or contamination:	
IRP Site 40	
• A Stationwide Background Study - Phase I & II was performed, including a preliminary assessment of potential contaminants of concern (COC) at Site 40.	April 1995 / March 1997
IRP Site 70	
• A Preliminary Assessment (PA) resulted in the discovery of contamination, including the presence of TCE and other COCs in groundwater, at specific areas of the site where historical waste disposal and handling activities were conducted (JEG 1995b).	February 1993
Additional studies/investigations:	
IRP Site 40	
• An Extended Removal Site Evaluation (ERSE) served as the Remedial Investigation (RI) for the site. The ERSE confirmed the existence of a VOCs plume. Risk screening for human health and the environment was conducted.	May 1997
• A Site Inspection (SI) Report found two potential COCs, carbon tetrachloride and PCE, had been released to the groundwater at the site and recommended a Focused Site Inspection (FSI) to evaluate the nature and extent of chlorinated hydrocarbons in the groundwater.	March 1998
• The FSI resulted in the discovery and verification of potential impacted areas, and further delineated groundwater contamination.	April 1998
• Screening ecological risk assessment determined that no complete exposure pathway exists between contaminants in groundwater and ecological receptors.	December 1999
IRP Site 70	
• A Removal Site Evaluation (RSE) and Relative Risk Site Evaluation Model (RRSEM) confirmed the presence of contamination in soil and groundwater, and recommended delineation of the groundwater TCE plume and potential source for the COCs (BNI 1996a).	November 1996
• An ERSE defined the nature and extent of impacted groundwater. Groundwater tests further characterized aquifer conditions and provided data to support evaluation of remedial alternatives (BNI 1999b). The Navy determined that the ERSE (BNI 1999a) substantially complied with the requirements of an RI under CERCLA and that it was appropriate to proceed directly to a Feasibility Study (FS) (Geosyntec 2005).	Sept 1999
Remedial Investigation/Feasibility Study complete:	
IRP Site 40	
• A groundwater FS report recommended bench-scale and pilot-scale testing of enhanced in situ bioremediation (EISB) (BNI 2002).	June 2002
IRP Site 70	
• A groundwater FS identified remedial alternatives for groundwater cleanup. A pilot test involving direct injection of chemical reagents to oxidize VOCs demonstrated that VOC concentrations in groundwater were reduced within the pilot test area (BNI 2002).	June 2002
• Based on advancements in bioremediation of DNAPL and dissolved phase VOCs, a Revised FS was developed adopting the EISB remedy for DNAPL and dissolved phase volatile organic compounds (Geosyntec 2005).	August 2005

Table 1: Chronology of Site Events

Event	Date
ROD signature:	
• ***IRP Site 40***: The selected remedial alternative and responses to public comments were documented in the Record of Decision/Remedial Action Plan (ROD/RAP). The Final ROD was signed on June 2, 2004 by the Navy (DON 2004).	June 2004
• ***IRP Site 70***: The ROD/RAP was signed on August 17, 2006 by the Navy (Geosyntec 2006a).	August 2006
Remedial design start:	
• ***IRP Site 40***: A remedial action plan utilizing EISB of groundwater was developed (DON 2004).	May 2004
• ***IRP Site 70***: The selected groundwater remedy used EISB for treatment of the DNAPL and dissolved VOC plume via a series of biobarriers (Geosyntec 2006a)	August 2006
Remedial design finalized:	
• ***IRP Site 40***: The Final remedial design (RD) and Remedial Action Work Plan (RAWP) were developed, detailing EISB, monitored natural attenuation (MNA) and land use controls (LUC) (TtEC 2005). The design included an initial round of bioaugmentation via inoculum injection followed by injections of a 3% sodium lactate solution to provide a carbon substrate for the Dhc organisms to use as electron donors. LUC compliance was to be monitored and documented in annual reports.	February 2005
• ***IRP Site 70***: The Final RAWP for the selected remedy for groundwater employed EISB with injection of emulsified vegetable oil (EVO) and *Dehalococcoides* (Dhc) bacteria in the form of the KB-1® culture for treatment of DNAPL and dissolved VOCs via a series of biobarriers (ECC/Geosyntec 2008a). The RAWP included basewide institutional controls (IC) and LUCs. Compliance monitoring and documentation was to be reported in the site annual reports.	March 2008
Actual remedial action start:	
IRP Site 40	
• Full-scale EISB, including installation of wells, baseline analysis, sodium lactate injection, monthly monitoring, biweekly field testing, and bioaugmentation (TtEC 2011).	February 2005
• Periodic monitoring of groundwater, optimization evaluation, and HRC® injection.	January 2006
• HRC injection Round 1.	April 2007
• HRC injection Round 2.	Oct-Nov 2008
IRP Site 70	
• Implementation of full-scale EISB system began following baseline monitoring.	Nov 2008
• Installation of Source Area Biobarrier (SAB), Second Sand Biobarrier-1 (SSB-1), and Shell Horizon Biobarrier-3 (SHB-3).	2009
• Installation of the First Sand Biobarrier-2 (FSB-2) completed.	Nov 2009
• Installation of the First Sand Biobarrier-1 (FSB-1) completed.	February 2010
• Installation of the Shell Horizon Biobarrier-1 (SHB-1) completed.	April 2010
• Installation of Source Area Treatment Grid (SATG) injection wells.	May 2010
• Installation of the Source Area Treatment Grid (SATG) completed.	August 2010
Note: Installation includes injected EVO and KB-1® culture.	
Federal Facility Agreement Signature:	
NAVWPNSTA Seal Beach entered into Federal Facility Site Remediation Agreement with the RWQCB Santa Ana and DTSC.	Sept 1991

III. BACKGROUND

i. Physical Characteristics

NAVWPNSTA Seal Beach is located about 30 miles south of the Los Angeles urban center. It consists of approximately 5,000 acres of land along the Pacific Coast within the city of Seal Beach in Orange County, California. NAVWPNSTA Seal Beach is bordered on the southwest by Anaheim Bay, on the north by Interstate 405, on the east by Bolsa Chica Street, on the west by Seal Beach Boulevard, and on the southeast by the Orange County flood control channel.

Figure 1a (IRP Site 40 Location Map) shows a map of NAVWPNSTA Seal Beach, including IRP Site 40, located in the southwestern portion of the base approximately 0.6 mile west of the Seal Beach National Wildlife Refuge (NWR). A locomotive shop (Building 240) is located on IRP Site 40. Four railroad spurs terminate and provide access for locomotive repair in Building 240. Additional tracks traverse the asphalt-paved area to the south.

Figure 1b (IRP Site 70 Location Map) shows Site 70, also known as the Research, Testing, and Evaluation (RT&E) Area. The site encompasses approximately 40 acres south of Westminster Boulevard and east of Seal Beach Boulevard. Site 70 is comprised of multi-story office and production buildings, asphalt-paved parking areas, an assortment of decommissioned aboveground tanks, a water-storage aboveground tank, attendant above- and below-ground piping-distribution systems, and several concrete-lined sumps.

ii. Land and Resources Use

Land Use

Explosives safety quantity distance (ESQD) arcs that restrict development to specific permitted uses cover approximately 75 percent of the 5,000 acres of NAVWPNSTA Seal Beach. Two agricultural out leases totaling approximately 2,000 acres are used for farming (irrigated and dry land farming) and maintenance. Approximately 100 acres of land is currently being leased for oil production (including Oil Island). In addition to the out leased land, the Seal Beach NWR (a major biological resource), encompasses approximately 911 acres. The areas covered by the ESQD arcs overlap the agricultural out lease areas and portions of the Seal Beach NWR. Other land uses at NAVWPNSTA Seal Beach include residential, ordnance, transfer operations, weapons evaluation, quality assurance, storage (inert and explosive), and administration/community support. Land to the south, southwest, northwest, north, and northeast of NAVWPNSTA Seal Beach is used for residential purposes. Boeing Space and Communications Group is the only major commercial/industrial use bordering the station on the west. The city of Seal Beach Police Department also borders the station on the west. The Orange County Flood Control Channel borders NAVWPNSTA Seal Beach to the south and east. This channel is fenced in and discharges directly to Anaheim Bay. The Sunset Aquatic Park borders the station to the south and is situated on a 63-acre parcel within the corporate boundaries of the city of Seal Beach. The park is a commercial development consisting of 260 boat slips, park facilities, a marine repair yard, a boat launch, the harbor patrol office, and public picnic areas. Future land uses for the adjacent cities include commercial/industrial, limited residential, and open land uses.

NAVWPNSTA Seal Beach is an active, fenced base with restricted and controlled access. These constraints are effective, in-place institutional controls (IC) that ensure the public will not likely be directly exposed to on-station contamination. Land use at the station is expected to remain unchanged in the foreseeable future.

Groundwater Use

Groundwater at NAVWPNSTA Seal Beach is found in four general aquifer zones (JEG 1995):

- a semi-perched, unconfined zone within the upper Recent alluvial deposits;
- a confined fresh groundwater zone contained in lower Recent alluvial deposits;
- Late and Early Pleistocene deposits of the Lakewood and San Pedro formations, respectively, and in some parts, deposits of the Late Pliocene Pico Formation; and

- a confined zone of saline water underlying the freshwater zone.

Shallow (< 75 ft) groundwater underlying NAVWPNSTA Seal Beach (upper Recent Alluvium deposits) is within the Lower Santa Ana River Basin (Orange County management zone) (RWQCB 1995, with Amendment R8-2004-001 2004). Shallow groundwater does not serve as a water source for any of the beneficial uses designated in the Water Quality Control Plan, Santa Ana River Basin (Basin Plan) (RWQCB 1995).

Depth to groundwater during the review period was approximately 13 ft.

The principal groundwater body is a large confined aquifer occupying two zones. The first zone is approximately 75 to 200 ft deep and saline. The second zone is approximately 250 to 1,000 ft deep, is freshwater, and serves as the primary water supply source for neighboring cities. Deep (>250 ft bgs) groundwater in the area of NAVWPNSTA Seal Beach is used as drinking water and irrigation water. Numerous beneficial-use wells are present in and around the station boundaries. To the west of NAVWPNSTA Seal Beach, production water is used to maintain a seawater intrusion barrier as part of the Los Alamitos Barrier Project. Thirty-two municipal wells are located within a 4-mile radius of the station, and 23 domestic, commercial, and community wells have been identified within this region. The groundwater underlying the area is within the Lower Santa Ana River Groundwater Basin (Santa Ana Pressure Subbasin). Beneficial groundwater uses within the Santa Ana Pressure Subbasin include municipal and domestic, agricultural, industrial service, and industrial process supply.

Contaminated groundwater at Sites 40 and 70 lies between 13 ft bgs and 173 ft bgs (Site 70). This vertical plume extent is shallower than the top of the beneficial use zone at 250 ft bgs.

Surface Water Use

Surface water at the station drains through ditches and tidal sloughs in flat-lying clay deposits. Ditch stream flow is intermittent and depends on rainfall and excess irrigation runoff. Ditches at the tidal flat margins also receive saltwater during high tides. Drainage from the station flows predominantly to Anaheim Bay with minor amounts discharged into the Orange County Flood Control Channel. Surface waters from IRP Sites 40 and 70 are not expected to adversely impact local on- or off-station populations. Seawater from Anaheim Bay flushes the salt marsh twice a day, flowing beneath the Pacific Coast Highway and into the tidal flats. Raised roadbeds serve as barriers to control tidal flooding. Because of the presence of sea walls and high street profiles, flooding brought about by a tsunami of the 100-year recurrence interval would affect only a small area along the beach.

iii. History of Contamination

IRP Site 40

A concrete pit within the floor of the locomotive shop Building 240 provides access for repair and maintenance on the underside of the locomotives. This pit also serves as a collection point for oil and solvents spilled during maintenance activities. Oil that collected in the pit was formerly discharged through a drainpipe onto the gravel area outside Building 240 until the pipe was plugged in 1978. Past industrial activities conducted at the locomotive repair shop resulted in discharge of VOC, primarily from industrial solvents, to soil and groundwater. Results of soil sampling indicated that most of the original release of VOCs have already moved into the groundwater or evaporated into the air. Based on the environmental studies and risk screening assessment, the Navy determined that no cleanup action is necessary for soil at the site.

The lateral extent of the contaminated groundwater plume was estimated at 270-ft downgradient by 200-ft wide. Principal contaminants PCE and TCE, as well as DCE and VC, were present from <20 to 45 ft below ground surface (bgs), Negligible levels (1 to 2µg/L) of PCE and TCE were reported below 45 ft in some wells (BNI 1999a, 2002). The presence of DCE indicates that some natural reductive dechlorination was occurring prior to remediation. The VOC contamination is not in a zone of beneficial water use.

IRP Site 70

Site 70 was formerly used by NASA between 1962 and 1973 as its RT&E area, and subsequently by the Department of Energy (DOE) and Garrett Engineering (Allied Signal) for pilot test assembly operations for

a classified uranium enrichment process in portions of Building 112. DOE tests were conducted from 1980 to 1985 and did not include either the manufacture or enrichment of uranium. However, some of the NASA manufacturing process chemicals, including industrial solvents (primarily VOCs), lubricating oils, and detergents in the manufacturing process, were released to the environment. This resulted in contamination of the shallow, saline aquifer. The primary COC was TCE. Other VOCs present were chloroform, dichloroethane (DCA), DCE, PCE, and VC.

The VOC-contaminated plume included the source area within the shallow groundwater zone and the dissolved phase plume, which extended from around the source area to the leading edge. The source area was contaminated with TCE and other VOCs indicative of DNAPL. The extended dissolved-phase plume containing TCE and VOCs comprised an area approximately 4,000-ft downgradient by 1,200-ft wide. Plume depth was indicated as approximately 173 ft. (160 ft below top of water column; depth to groundwater is 13 ft bgs.). No part of this VOC plume is in a beneficial water use zone.

iv. Initial Responses

IRP Site 40

The 1995 SI found that two COCs, carbon tetrachloride and PCE, had been released to the groundwater and recommended an FSI to evaluate the nature and extent of chlorinated hydrocarbons in groundwater (JEG 1995a). The FSI concluded that a plume of chlorinated hydrocarbons containing PCE, TCE, and cis-1,2-DCE was present in groundwater beneath the site (JEG 1998). Because PCE, TCE, and cis-1,2-DCE were reported at levels exceeding state and federal Maximum Contaminant Levels (MCL), further action was recommended. **Figure 2** shows initial plume delineation at IRP Site 40.

An ERSE was conducted in 1998 to supplement data from previous investigations at the site (BNI 1999a). No immediate threat to human health or the environment from groundwater was indicated because groundwater was not used for domestic purposes. However, the ERSE recommended a response action to address groundwater at the site due to the cumulative human health risk determined to exceed the generally acceptable range as defined in the NCP (BNI 1999a). The Navy determined that the screening risk assessment conducted during the ERSE adequately characterized the elevated levels of VOCs in groundwater and identified the need for further action. DTSC and RWQCB Santa Ana Region concurred with these determinations. While this assessment did not consider a surface vapor intrusion pathway, subsequent monitoring during remediation did address both soil vapor and surface air emissions in and around Buildings 239 and 240.

A Final Groundwater Feasibility Study (FS) Report for IRP Sites 40 and 70 issued in June 2002 evaluated five remedial alternatives to address the VOC groundwater plume at Site 40 (BNI 2002). Enhanced *in situ* bioremediation (EISB) using sodium lactate as a carbon source and MNA was ranked highest overall per U.S. EPA selection criteria. On the basis of these results, the Navy decided to perform a pilot test to evaluate the effectiveness of lactate enhancement to promote reductive dechlorination of VOCs at Site 40.

The pilot-scale test was conducted in two phases (BEI 2004). Phase I (conducted from July 2001, to April 2002) involved biostimulation of indigenous bacteria with injected sodium lactate. Reductive dechlorination was confirmed during Phase I, but the reaction process was incomplete. PCE was reduced to DCE, but DCE was not reduced further to VC or ethene. It was reasoned that an appropriate microbial consortium for complete reductive dechlorination was not present at the site. Bacterial characterization tests indicated that the specific bacterial strain known to be capable of complete dechlorination from PCE to ethene was not present at the site.

Phase II involved injection of a bacterial culture that has been shown to completely dechlorinate PCE to ethene in other aquifers. Sodium lactate injections were performed over a 5-month period to provide additional substrate. In the second month, a commercially available bacterial culture capable of carrying out complete reductive dechlorination was added to two bioaugmentation wells. Effects were monitored over an 8-month period via groundwater and soil gas wells. Phase II results indicated that the introduced bacteria were able to complete DCE dechlorination to ethene. Based on the results of the pilot-scale test, the Navy believed that sufficient information was generated to select EISB, followed by MNA, as the preferred remedial alternative for the site.

IRP Site 70

In 1993, Jacobs Engineering Group Inc. conducted a preliminary assessment (PA) of the RT&E Area (JEG 1995b). The PA identified ten areas of concern (AOC) that were recommended for further evaluation to assess the presence or absence of potential COCs: hexavalent chromium, TCE, phenolic compounds, trichlorotrifluorethane, and heavy metals. In 1996, an RSE was conducted to collect information and to evaluate the qualitative presence or absence of potential COCs identified in the RT&E Area (BNI 1996a). The RSE Report recommended that the process piping system and facilities be decommissioned and that soil (hexavalent chromium, VC and heavy metals present) and groundwater be investigated further. The intent was to delineate TCE in groundwater, determine a potential vadose zone source, and evaluate the nature and extent of hexavalent chromium, phenolic compounds, and heavy metals (BNI 1996b). **Figure 3** shows the initial plume delineation at IRP Site 70.

In 1997 and 1998, an ERSE was conducted to supplement data from the RSE at the site (BNI 1999a). Groundwater contamination with VOCs, primarily TCE and associated degradation products, were delineated in two distinct areas: a source area of higher VOC concentrations suspected of containing DNAPL and a hydrogeologically downgradient larger area of lower dissolved-phase VOC concentrations. The ERSE Report concluded that the potential for continual leaching of potential soil COCs to groundwater was low to negligible, and thus recommended no further action for soil at this site. DTSC and RWQCB concurred (BNI 2002). The cancer risk for soil at all four AOCs is estimated to be within the NCP-defined generally acceptable ranges for human health cancer risk.

The ERSE also concluded that the potential for VOCs to have migrated deeper than the depth of the deepest temporary well (191 ft bgs) was low because the concentrations of TCE attenuated so rapidly approaching this depth. The VOC plume was considered to have negligible potential for migration beyond Navy property within the next decades. Analytical results indicated that significant biodegradation of the TCE had occurred in shallow groundwater, and that ambient conditions are conducive to continued degradation.

However, the ERSE concluded that the suspected DNAPL could, unless contained or otherwise treated, continue to be a source of dissolved-phase contamination indefinitely (BNI 1999a). The suspected DNAPL area is estimated to extend from approximately 10 to 50 ft bgs, with a corresponding lateral area of approximately 23,000 sq-ft and a total volume (all media) of approximately 920,000 cu-ft (34,000 cy). The footprint of the suspected DNAPL area corresponds to the 10,000 µg/L iso-contour of TCE from 10 to 35 ft bgs (Geosyntec 2005).

VOCs were considered among the COPCs in the Site 70 Final ROD/RAP Screening Health Risk Assessment (ECC/Geosyntec 2008b.), but exposure to indoor air from soil gas was not considered a significant pathway due to the presence of a surficial clay layer at the site, which, based on soil gas sampling, does not readily release trapped gases to the atmosphere. However, the SAP for Site 70 remediation and monitoring did account for a vapor intrusion pathway (Geosyntec 2006a).

The Final Groundwater Feasibility Study (FS) Report for IRP Sites 40 and 70 (BNI 2002) ranked *in situ* chemical oxidation treatment of the suspected source area -- augmented by a pump and treat component for mass removal of dissolved-phase contamination -- highest overall per U.S. EPA selection criteria. Based on these results, the Navy performed a pilot test to evaluate the effectiveness of this remedy to convert VOCs in the suspected source area to innocuous by-products. The pilot test showed concentrations of VOCs were reduced within the pilot test area after direct injection of chemical reagents into groundwater (BNI 2002).

However, based on advancements in bioremediation of DNAPL and dissolved phase VOCs, a Revised FS rated an alternative remedy, *in situ* bioremediation at the source area and *in situ* biobarriers placed to treat the dissolved plume over a much larger area of groundwater with lower concentrations of contaminants. This alternative was rated highest overall per the five balancing criteria in the Revised FS (Geosyntec 2005).

A microcosm study using the site soil and groundwater was completed to demonstrate complete dechlorination through EISB (Geosyntec 2006b).

v. Basis for Taking Action

IRP Site 40

If not addressed by implementing the RA selected in the ROD (DON 2004), actual or threatened releases of hazardous substances (VOCs) from the contaminated plume at Site 40 might present a current or potential threat to public health and welfare or to the environment. This groundwater contamination appeared to have occurred when chlorinated solvents, used during locomotive maintenance activities, were spilled on the ground surface of the site and migrated through the subsurface soils and into the shallow groundwater beneath the site.

A screening human-health risk assessment was conducted as part of the ERSE to evaluate the potential risk to human health from exposure to contaminants in site soils and groundwater. The fate and transport evaluation determined that the potential for COCs in soil to further leach to groundwater and be transported within the groundwater was negligible. Adverse impacts to ecological receptors were not anticipated due to site development. Accordingly, soil at IRP Site 40 was recommended for no further action.

The human-health risk assessment for groundwater at Site 40 estimated a total cancer risk in excess of the NCP-defined generally acceptable range. Estimates of non-cancer risk indicated a significant potential for systemic toxicity. However, no complete exposure pathway exists between contaminants in groundwater and ecological receptors and reported groundwater contaminants were not evaluated further for ecological risk.

Since the contaminated groundwater at Site 40 posed an unacceptable threat to human health, groundwater was recommended for further action. The likely groundwater-receptor pathways at Site 40 include ingestion, inhalation of particulates and volatiles, and dermal adsorption. Exposure to indoor air from soil gas was not considered a significant pathway due to the presence of a surficial clay layer at the site which, based on soil gas sampling, does not readily release trapped gases to the atmosphere (DON 2004). However, both soil vapor (VOCs) and surface air emissions (methane) have been locally monitored for vapor intrusion potential during remediation.

IRP Site 70

If not addressed by implementing the RA selected in the ROD/RAP (Geosyntec 2006a), actual or threatened releases of hazardous substances (VOCs) from the contaminated plume at Site 70 might present a current or potential threat to public health and welfare or to the environment. VOC contamination in the shallow groundwater underlying Site 70 appeared to have occurred when chlorinated solvents were spilled on the ground surface of the site and migrated through the subsurface soils into the shallow aquifer beneath the site.

A risk assessment was conducted as part of the ERSE to assess the potential cancer and noncancer risks to human health from exposure to contaminants in site soils and groundwater (BNI 1999a). The fate and transport evaluation indicated that the potential for COCs in soil to further leach to groundwater and be transported within groundwater was negligible. The potential for adverse impacts to ecological receptors from soil at Site 70 was also evaluated and found to be negligible. Accordingly, soil at Site 70 is recommended for no further action.

Human-health risk screening for groundwater at Site 70 estimated a total cancer risk in excess of the NCP-defined generally allowable range (BNI 1999a). Estimates of non-cancer risk indicate a significant potential for systemic toxicity. However, no complete exposure pathway existed between contaminants in groundwater and ecological receptors. Thus, contaminants reported in groundwater were not evaluated further for ecological risk.

Since the groundwater at Site 70 posed an unacceptable risk to human health, groundwater was recommended for further action (BNI 2002). The likely pathways at Site 70 include ingestion, inhalation of particulates and volatiles, and dermal adsorption. Exposure to indoor air from soil gas was not considered a significant pathway due to the presence of a surficial clay layer at the site which, based on soil gas sampling, does not readily release trapped gases to the atmosphere (Geosyntec 2006a). However, the Sampling and Analysis Plan (SAP, ECC/Geosyntec 2008a) did recognize a potential vapor intrusion

pathway, and localized monitoring of soil vapor (methane and hydrogen sulfide) and ambient air (methane only) has been performed during remediation.

IV. REMEDIAL ACTIONS

i. Remedy Selection

IRP Site 40

Scope and Role of Actions -- The ROD for IRP Site 40 was signed in June 2004 (DON 2004.

The Navy selected EISB, followed by MNA, as the preferred remedial alternative for the site. In addition to the engineered remedy, the ROD required land-use controls (LUC) to be developed in the remedial design and work plan.

Remedial Action Objectives -- Because there are no complete exposure pathways to ecological receptors, the remedial action objectives (RAOs) focus on mitigating potential human exposures to groundwater (BNI 2002). The RAOs for IRP Site 40 are the following:

- Consistent with U.S. EPA, SWRCB, and RWQCB Santa Ana Region policies and regulations, protect existing beneficial uses of the shallow aquifer underlying NAVWPNSTA Seal Beach to the extent practicable while preventing or minimizing VOC migration beyond the current NAVWPNSTA Seal Beach boundaries at concentrations exceeding site remediation goals; and
- Protect human health by preventing extraction of VOC-impacted shallow groundwater for domestic use until site remediation goals are achieved.
- (Added in this report) Protect human health by monitoring for vapor intrusion in and around Buildings 239 and 240.

The preliminary remediation goals were defined in the FS Report as the lower of either the U.S. EPA or California MCLs for drinking water. Development in the FS of remediation goals for IRP Site 40 groundwater was based on an analysis of Applicable or Relevant and Appropriate Requirements (ARARs). **Table 2** lists target cleanup goals (TCG) for PCE, TCE, DCE, and VC at IRP Site 40.

Table 2. Target Cleanup Goals for IRP Site 40 Groundwater (ug/L)

Chemicals of Concern	Federal Maximum Contaminant Level[a]	California Maximum Contaminant Level[b]	TCG
cis-1,2-Dichloroethene (DCE)[c]	70	6	6
trans-1,2-Dichloroethene (DCE)[c]	100	10	10
Trichloroethene (TCE)	5	5	5
Tetrachloroethene (PCE)	5	5	5
Vinyl chloride (VC)[c]	2	0.5	0.5

Table 2 Notes:
[a] U.S. EPA Safe Drinking Water Act, Title 40 *Code of Federal Regulations* (CFR) § 141
[b] *California Code of Regulations* Title 22, § 64444, Maximum Contaminant Levels (MCLs)
[c] Indicates analytes that have been identified as chemicals of potential concern subsequent to the feasibility study

The primary objective of the RA is to protect human health and the environment. Accordingly, the RAOs and TCGs were developed to provide objectives used to define and evaluate the RA. These TCGs support the RAOs of restoring the shallow aquifer underlying NAVWPNSTA Seal Beach as a potential drinking water supply to the extent practical.

Remedial Actions/Remedies -- The selected remedy for groundwater at IRP Site 40 was EISB in the source area and plume, MNA, and LUCs. EISB included 1) construction, operation, and maintenance of groundwater monitoring wells and injection wells; 2) *biostimulation* by injecting sodium lactate into the PCE source zone to serve as an electron donor for reductive dechlorination of PCE and TCE to DCE (and subsequently to VC and ethane); and 3) *bioaugmentation* using KB-1®, a commercially available CE-respiring bacterial culture (containing Dehalococcoides spp) into the PCE source zone to facilitate complete dechlorination of PCE daughter products. Injection of Hydrogen Release Compound (HRC®) was added during remediation as a result of optimization analysis.

MNA phase was to be entered site-wide when the subsurface benefits of enhanced bioremediation were maximized (estimated to be within 12 to 18 months following start of remediation; DON 2004), Since the groundwater plume is remediated *in situ*, LUCs were established to ensure contaminants do not pose an unacceptable risk to human health and the environment by preventing completion of an exposure pathway, preventing disturbance of or tampering with remedial systems, and maintaining the integrity of the remedial action until cleanup goals are complete. LUCs for the IRP Site 40 groundwater plume that have been implemented included:

- New groundwater extraction, injection, or drinking water wells shall not be installed within the IRP Site 40 groundwater plume or associated buffer zone without prior review and written concurrence from the DON, DTSC, and RWQCB.
- Injection and monitoring wells and associated piping and equipment that are included in the remedial action shall not be altered, disturbed, or removed without the prior review and written concurrence from the DON, DTSC, and RWQCB.

LUC compliance monitoring is required by NAVSTA policy (NAVWPNSTA Seal Beach Station Project Review Process (SPRP)) to be documented in the annual performance monitoring report for the site.

IRP Site 70

Scope and Role of Actions -- The ROD for IRP Site 70 was signed in August 2006 (Geosyntec 2006a). The selected remedy was protective of human health and the environment, compliant with federal and state requirements that were legally applicable or relevant and appropriate to the remedial action, and cost-effective. The remedy used permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfied the statutory preference for remedies employing treatment that reduces toxicity, mobility, or volume as a principal element.

The selected remedy at Site 70 was comprised of *in situ* bioremediation at the source area and *in situ* biobarriers placed to treat the dissolved plume over a much larger area of groundwater with lower concentrations of contaminants (see **Figure 4**).

In addition to the prescribed treatment remedy and applicable base-wide institutional controls (IC), the ROD required LUCs to be developed in the remedial design and work plan. IC/LUC compliance was to be monitored and documented in the annual performance monitoring report for the site, as required by the NAVWPNSTA Seal Beach Station Project Review Process (SPRP).

The effectiveness of the remedial action selected in the ROD/RAP is to be reviewed at 5-year intervals at a minimum to assure that the remedy continues to adequately protect human health and the environment and is achieving cleanup goals. Once cleanup goals have been achieved, the 5-year review will no longer apply to this action because hazardous substances will not remain above health-based levels.

Remedial Action Objectives -- The following overall RAOs were developed for IRP Site 70 to define the scope of potential groundwater cleanup activities:

- Consistent with U.S. EPA, SWRCB, and RWQCB policies and regulations, protect existing beneficial uses of the shallow aquifer underlying NAVWPNSTA Seal Beach to the extent practicable while preventing or minimizing VOC migration beyond the current NAVWPNSTA Seal Beach boundaries at concentrations exceeding site cleanup goals; and
- Protect human health by preventing extraction of VOC-impacted shallow groundwater until site cleanup goals are achieved.
- (Added in this report) Protect human health by monitoring for vapor intrusion in buildings and utility corridors.

Because there are no complete exposure pathways to ecological receptors, the Site 70 RAOs focus on mitigating potential human exposures to the groundwater (BNI 2002; Geosyntec 2005). Chloroform, 1,1-DCE, TCE, and VC were identified as COCs at Site 70 based on their contribution to the screening-level carcinogenic risk and frequency of occurrence at the site. Cleanup goals for IRP Site 70 groundwater

were developed in the FS (BNI 2002) and RFS (Geosyntec 2005), both based on an analysis of ARARs. **Table 3** lists the target cleanup goals for COCs at the site.

Table 3 . Target Cleanup Goals for IRP Site 70 Groundwater (µg/L)

Chemical of Concerns	Federal Maximum Contaminant Level[a]	California Maximum Contaminant Level[b]	TCG
Chloroform	80[c]	80 [d]	80
1,1-Dichloroethane (DCA)[e]	NE	5	5
1,1-Dichloroethene (DCE)	7	6	6
cis-1,2-Dichloroethene (DCE)[e]	70	6	6
trans-1,2-Dichloroethene (DCE)[e]	100	10	10
Tetrachloroethene (PCE)[e]	5	5	5
Trichloroethene (TCE)	5	5	5
Vinyl chloride (VC)	2	0.5	0.5

Table 3 Notes:

[a] U.S. EPA Safe Drinking Water Act, Title 40 *CFR* § 141
[b] California *Code of Regulations* Title 22, § 64439 and § 64444
[c] Changed from 100 to 80 ug/L in 2004
[d] Changed from 100 to 80 ug/L in 2006
[e] chemical not identified as a risk driver during the ERSE (BNI 1999a), but added as a chemical of concern in the ROD because it was reported at the site at concentrations above the maximum contaminant level)
BNI = Bechtel National Inc.
ERSE = extended removal site evaluation
NE = not established
ROD = Record of Decision

These groundwater cleanup goals support the RAO of restoring the shallow aquifer underlying NAVWPNSTA as a potential drinking water supply to the extent practicable. The values listed in Table 3 are federal MCLs promulgated by U.S. EPA and California MCLs established by Department of Health Services (DHS). The TCGs for IRP Site 70 are the more stringent ones of the two sets.

Remedial Actions/Remedies -- The Navy selected EISB via installed biobarriers as the groundwater treatment remedy for both the source area and the dissolved plume. Biobarrier installation involved injection of emulsified vegetable oil (EVO) and *Dehalococcoides* (Dhc) bacteria in the form of the KB-1® culture in order to degrade VOCs to harmless by-products, as specified in the RD. This remedy permanently destroys the COC contaminants and significantly reduces the toxicity, mobility, and volume of hazardous substances in groundwater.

The MNA phase of remediation was designed to replace bioremediation once bioremediation fulfilled its objectives and became ineffective, specifically when TCE concentrations approach the effective limits of bioremediation (estimated to be 200 ppb TCE; Geosyntec 2006a).

The remedy also included ICs and LUCs to a) prevent human use of or exposure to contaminated groundwater and b) protect the integrity of remediation infrastructure, ensuring access for sampling, installing, operating, and maintaining monitoring wells or remediation equipment, and implementation of any remedial measures needed in the future. These controls are required to be in place until residual contamination is reduced below the TCG for each COC.

LUCs for Site 70 remediation are the following:

- New groundwater extraction, injection, or drinking water wells shall not be installed within the IRP Site 70 groundwater plume or associated buffer zone without prior review and written concurrence from the Navy, DTSC, and RWQCB. Well permit applications are reviewed by Orange County Health Care Agency, the Navy, and other appropriate stakeholders (identified by the Navy) prior to granting said permits within the controlled area to determine compliance with applicable sections of the County of orange Ordinance 2607 (OCHCA 2006).

- Injection and monitoring wells and associated piping and equipment that are included in the remedial action shall not be altered, disturbed, or removed without the prior review and written concurrence from the Navy, DTSC, and RWQCB. The RD for Site 70 specified that:
    - Flush-mounted well head vaults shall be closed and bolted shut to restrict access; and
    - Above ground well head vaults shall be locked to restrict access.
- The Navy, DTSC, RWQCB, and their authorized agents, employees, contractors, and subcontractors shall have the right, with the permission of the DON, to:
    - enter the premises to conduct investigations, tests, or surveys and inspect field activities;
    - construct, operate, and maintain the remedial action described in this RD; and
    - undertake any other remedial response or remedial action as required or necessary under the cleanup program.

The LUCs apply to the overlying footprint of the existing areas of contaminations, approximately 50 acres, and two associated buffer zones (250-ft buffer and ½-mile buffer) extending from and encircling the interpreted limits of the VOC plume. This boundary partially extends off-Base and requires coordination with Orange County Environmental Health Department (OCHCA).

IC/LUC compliance monitoring is required by NAVSTA policy (NAVWPNSTA Seal Beach Station Project Review Process (SPRP)) to be documented in the annual performance monitoring report for the site.

ii. Remedy Implementation

IRP Site 40

Remedial Action -- Remediation of groundwater via EISB began in February 2005, following the completion of the ROD (DON 2004) and pilot testing (BEI 2004). The Navy initiated RA for the impacted groundwater at Site 40 to reduce any potential threats to human health and the surrounding environment. RA began with the installation of additional wells for injection, monitoring, and soil gas monitoring. Remediation was conducted in accordance with the selected remedy in the ROD and the approved Work Plan (TtEC 2005), which specified injection of sodium lactate at a concentration of at least 3 percent by volume in water in 19 injection wells for distribution in the aquifer.

The last active remediation procedure (HRC injection round 2) was completed in October-November 2008. HRC injections were designed to compensate for localized lactate substrate depletion.

The vertical extent of contamination was mainly found from <20 to 45 ft bgs. Injection wells were screened from 15 to 35 ft bgs. Monitoring well screen intervals varied, including <20 ft, 15-35 ft, 20-30 ft, and in the range from 40 to 60 ft bgs (limited PCE had been reported below 45 ft bgs; BNI 2002).Following extensive reduction of COC concentrations (see Technical Assessment in Section VII), most areas of Site 40 are considered to have entered MNA phase during the first five-year review period.

Site LUCs were implemented and monitored over the groundwater plume and buffer zone. The Navy considers these LUCs to have been protective of human health and the environment.

Periodic Monitoring -- Injections of sodium lactate and bacterial culture KB-1® conducted as part of the remedial action were followed by performance monitoring, initially on a monthly basis. Monitoring consisted of field testing and collecting samples from various monitoring points for analytical laboratory analysis. Groundwater samples were collected mainly from specified monitoring wells. However, in limited instances, samples were collected from other monitoring points, including hydropunch locations and injection wells, to provide additional data where deemed necessary. Monitoring also included groundwater levels, soil vapor monitoring and surface emissions monitoring (especially in the vicinity of Buildings 239 and 240)

Groundwater monitoring frequencies at several of Site 40 wells where COC analytic results were non-detect (ND) were reduced from quarterly to semiannual with concurrence by the Navy and regulators. Wells that were recommended for reduced monitoring frequency exhibited COC concentrations below TCGs for more than 4 quarters (one year) of monitoring. Several semi-annually monitored wells continued to demonstrate COC concentrations above TCGs. After two years of semiannual monitoring, the frequency for wells that had ND-reported analytic results for two consecutive years was reduced to

annual.

Summary reports of field activities and groundwater monitoring results have been provided to the agencies during the quarterly, semiannual, and annual groundwater monitoring programs regularly, and the regulators have been supportive of the remediation activities and the results achieved to date (TtECI 2011).

Optimization Evaluation -- Overall EISB worked as expected. However, lactate distribution was inconsistent across the plume, and some areas did not receive adequate lactate. To optimize remedy performance, alternative approaches were evaluated for enhancing the EISB system, including augmentation of lactate to the low-lactate areas. This was done by injecting HRC®, concentrated lactate substrate injected into the water bearing formation by means of direct-push drill technology.

HRC® injections were conducted in two rounds, in April 2007 and in October 2008, as a localized optimization effort to establish conditions supportive of reductive dechlorination. Injected HRC® was effectively distributed in plume areas where residual COCs were present.

IRP Site 70

Remedial Action -- Implementation of EISB remediation at Site 70 began in November 2008 after the conclusion of baseline groundwater monitoring of the DNAPL and dissolved-phase chlorinated solvent plumes. Injection of EVO and Dhc bacterial culture in the source area and in the six downgradient biobarriers was conducted sequentially and completed in August of 2010.

Periodic Monitoring – After the conclusion of baseline monitoring, periodic monitoring via groundwater sampling was conducted coincidentally with biobarrier injections in each treatment zone. Monitoring consisted of collection of groundwater samples for analysis of field parameters as well as COCs. Sampling for field parameters (DO, ORP, pH, conductivity, and water temperature) was performed using a Horiba™ Meter to demonstrate conditions necessary for propagation of the KB-1® culture and for the desired dechlorination to occur.

The most recent monitoring episode was completed in Fall 2010 and showed substantial reduction of TCE concentrations in all injection and downgradient performance monitoring wells (see Technical Assessment in Section VII).

Soil vapor monitoring and ambient air monitoring in buildings and utility corridors were also conducted at Site 70.

Performance monitoring reports have been provided to the Navy and regulatory agencies during the remediation (Insight 2011).

Optimization Evaluation -- Prior to performing the initial baseline groundwater monitoring event at the site, existing bladder pumps from wells that were no longer sampled at the site were decontaminated and reused as dedicated pumps in the Site 70 monitoring well network. Reuse of pumps resulted in a cost savings to the government of approximately $10,000.

iii. System Operations/Operation and Maintenance

IRP Site 40

System operations/operations and maintenance (O&M) Requirements -- Implementation of RA at Site 40 did not involve installation of a long-term treatment system requiring O&M. The EISB remediation system employed consisted of *Dosetrons* mounted on portable injection devices with the necessary meters and manually operated valves and plumbing assembled and used for injection of the sodium lactate and water mixture in the wells. Following the initial injections and follow-up injections during 2005 and early 2006, this equipment was no longer needed.

The only long-term O&M at Site 40 involved maintenance of wells caps, vaults, vault covers and seals, and repairs to well-monument aprons. O&M on this infrastructure was done periodically and as needed, and typically required only two field days with two-man technician teams per maintenance or

remediation/monitoring site visit. Well inspections were done during monitoring activities, which were initially quarterly, then semi-annually, and later annually. Incidental maintenance work involved replacement of weathered caution and hazard signs.

Major field activities were performed at Site 40 between October 2005 and May 2010 as part of the EISB remedial action:

- Periodic groundwater monitoring (water level measurement, groundwater sampling and analysis, soil gas sampling and analysis, and surface emissions monitoring). From 2006 on, periodic monitoring was conducted at quarterly or less frequent intervals.
- Optimization evaluation and injection of HRC® was conducted to improve the delivery and distribution of lactate to the specific areas where cleanup was required and lactate distribution had been limited.
- Investigation beneath Building 240 via collection of groundwater samples at various depths from inside the locomotive maintenance shop to assess possible residual or potential source contamination.

Problems in the Implementation **–** Based on monitoring results after the bioaugmentation and lactate injection in 2005 and 2006, it was observed that lactate was not distributed uniformly across the plume. HRC was injected in 2007 and 2008 in areas where lactate was inadequately distributed to provide a carbon substrate to support the growth of Dhc organisms and thus promote reductive dechlorination uniformly throughout the plume.

Original Estimated and Actual Annual O&M Costs – Estimated and actual annual O&M costs at Site 40 are given in **Table 4**.

Table 4: Annual System Operations/O&M Costs, IRP Site 40

Dates		Original Estimated O&M Cost	Actual O&M Costs
From	To		
2005	2010	$1,123,717	$1,116,498

IRP Site 70

System Operation /O&M Requirements -- EISB remediation activities were conducted in accordance with the technical and functional requirements specified in the Site 70 RAWP (ECC/Geosyntec 2008a). The majority of the monitoring and injection wells were installed in 2007 during the RA construction phase of the project (ECC/Geosyntec 2008b). The baseline monitoring event took place in 2008. A subsequent monitoring event in 2009 included analysis of samples collected from only those wells associated with the biobarriers completed at the time sampling was performed (SAB, SSB-1, and SHB-3).

EISB as implemented at Site 70 is a passive remedy that does not require extensive O&M. As in the case of Site 40, the remediation system used for this project consisted of *Dosetrons* mounted on portable injection devices with the necessary meters, and manually operated valves and plumbing assembled and used for injection of the sodium lactate-water mixture. O&M at Site 70 involved semi-annual inspection of the biobarriers and minor maintenance of well heads.

Problems in the Implementation -- There were no important changes to the O&M requirements or maintenance schedule from startup reported through 2009, though several new groundwater wells were added during performance monitoring to better define the extent of the plume (see Insight 2011). There was an issue of pH dropping significantly during the injection activities, which had the potential to impact the Dhc's ability to dechlorinate. However pH gradually returned to baseline conditions and no adverse affects were observed in the sample results. Overall, there have not been any unexpected O&M difficulties since the EISB remedy was initiated at Site 70 in 2008.

Original Estimated and Actual Annual O&M Costs – Estimated and actual annual O&M costs for IRP Site 70 are given in **Table 5**.

Table 5: Annual System Operations/O&M Costs, IRP Site 70

Dates		Original Estimated O&M Cost	Actual O&M Costs
From	**To**		
2008 (actual O&M start)	2010	$2,280,000	$1,509,114

V. PROGRESS SINCE THE LAST REVIEW

This is the first Five-Year Review for both IRP Sites 40 and 70.

VI. FIVE-YEAR REVIEW PROCESS

i. Administrative Components

In November 2011, the review team established the IRP Sites 40 and 70 Five-Year Review schedule whose components were the following:

- Community Involvement;
- Document Review;
- Data Review;
- Site Inspection;
- Local Interviews; and
- Five-year Review Report Development and Review.

ii. Community Notification and Involvement

The NAVWPNSTA Seal Beach Restoration Advisory Board (RAB) meets on a quarterly basis; normally on the second Wednesday of January, April, July and October, at 6:00 PM. Meetings take place at the Seal Beach City Council Chamber, 211 Eighth Street, Seal Beach, CA 90740. Meetings are open to the public and community members are encouraged to attend and participate. Each quarter, one or two active projects are presented by the Navy and its contractors, and open discussions regarding the project progress are held. Updates on IRP Sites 40 and 70 have been the topic of RAB meetings throughout the Remedial Action Construction and Remedial Action Operations phases for both projects. A RAB presentation on the Five-Year Review Report is scheduled for July 11, 2012.

iii. Document and Data Review

Document and literature review consists of researching previous reports that summarized either findings or monitoring data. These include feasibility studies and remedial investigations that lead to the ROD and RAWP. Once RA is completed (during RA in the case of Sites 40 and 70), performance monitoring data from sampling and analysis is compiled in reports. These reports provide a record of remediation progress and document the protectiveness of the remedial design. The documents reviewed for this report are listed in **Section XII**.

iv. Site Inspections

Navy personnel, regulatory agency representatives, and contractor personnel perform quarterly status update meetings and periodic and as-needed site visits to conduct required remediation and O&M field activities.

CKY performed the following inspections in the development of this Five-Year Review Report:

- A site visit to Site 40 on December 19, 2011
- A site visit to Site 70 on December 20, 2011

Inspection reports for these site visits are included in **Attachment 1**.

v. Interviews

Interviews were conducted with IRP Sites 40 and 70 stakeholders to gain a better understanding of how the site operations were being perceived and to document any existing issues with how site remedies were being implemented. Interviews were conducted with the community representative (RAB co-Chair), regulatory agency representatives, and contractor personnel. The following is a list of individuals interviewed and their affiliation.

IRP Site 40

Community co-Chair of RAB	Jackson Jordon
DTSC	Stephen Niou
RWQCB Santa Ana Region	John Broderick
Tetra Tech EC, Inc.	Hamlet Hamparsumian, Project Manager

IRP Site 70

Community co-Chair of RAB	Jackson Jordon
DTSC	Stephen Niou
RWQCB Santa Ana Region	John Broderick
Insight EEC, Inc.	Anthony Ford, Project Manager

Completed interview forms are included in **Attachment 2**.

VII. TECHNICAL ASSESSMENT

The technical assessment follows the three key questions in the U.S. EPA Comprehensive Five-Year Review Guidance (EPA 2001) and is presented by site.

IRP Site 40

Question A: Is the remedy functioning as intended by the decision documents?	
Element	**Assessment**
Remedial Action Performance	Concentrations of COCs at IRP Site 40 are now very low (see **Figure 5** and Table **6**, below). Only low levels of DCE (2 of 19 wells) and VC (12 of 19 wells) remain in the monitoring well network. Although it is possible that additional remedial action (further injected substrate and/or bacterial culture) could be effective in the areas of MW-40-37 and MW-40-08 (recommendation of the Final Comprehensive Performance Monitoring Report for Site 40, TtEC 2011), these areas will be further monitored periodically to determine whether or not additional injections are warranted. **Figure 6** presents time series concentration data for COCs at selected wells. Based on these results, the Navy considers that most areas of Site 40 had entered MNA phase during the first five-year review period. In all areas of the plume conditions for further reductive dechlorination were favorable at the end of the review period (TtEC 2011. Evidence for this conclusion includes: o Low DO concentrations during monitoring events; o Negative ORP values; o pH readings in the optimal 6 to 8 range (alkalinity is also inferred to be in the desirable range due to the lack of high pH variability during monitoring); and o Dhc microbial counts mostly in the range of 103 to 106 cells/L. Monitoring of natural attenuation will be conducted annually for wells that have not met the ROD-specified criterion of not exceeding a TCG for one year. Other strategically located wells deemed necessary to assess dilute plume dynamics may also be monitored (TtEC 2011). Soil vapor sampling revealed an accumulation of methane in the vadose zone at Site 40. This may be due to a combination of methanogenic processes during EISB and the overlying clay layer and site pavement. Surface air emission monitoring did not produce evidence of methane in or around Buildings 239 and 240 (TtEC 2011).

Table 6. Groundwater Sampling Results at IRP Site 40 for the May 2010 Monitoring Event

COC	Maximum Concentration Detected (µg/L)	Target Cleanup Goal (µg/L)	Number of Wells with Concentration Exceeding TCG[a]
Tetrachloroethene (PCE)	<1	5	0 of 19
Trichloroethene (TCE)	4	5	0 of 19
cis-1,2-Dichloroethene (DCE)	90	6	2 of 19
trans-1,2-Dichloroethene (DCE)	0.44J	10	0 of 19
Vinyl chloride (VC)	37	0.5	12 of 19

Table 6 Notes:

[a] 19 wells were sampled during the May 2010 event, of which 10 were compliance wells and 9 were injection wells converted to monitoring wells.

J estimated concentration

Question A [Cont.]: Is the remedy functioning as intended by the decision documents?	
Element	**Assessment**
System Operations/O&M	The EISB remedy requires only limited O&M, including minor maintenance of well heads and periodic monitoring. From 2006 on, groundwater monitoring (water level measurement, groundwater sampling and analysis, soil gas sampling and analysis, and surface emissions monitoring) was conducted at quarterly or less frequent intervals. The number of well samples and the sampling frequency were reduced with regulatory approval to streamline the program and eliminate collection of data that were not useful. • The first application of HRC® was conducted in April 2007. The potential for CE rebound was identified in the area immediately downgradient of Building 240, and was investigated via collection of groundwater samples at various depths beneath the locomotive maintenance shop to assess possible residual or potential source contamination. COC concentrations were consistent with those reported elsewhere at the site, and thus there was no evidence of a major contaminant source. • A secondary round of HRC® injection was conducted during October and November 2008 to address the area downgradient of Building 240 and other residual contamination where substrate was interpreted to be rate limiting (TtEC 2011).
Cost of Systems Operations/O&M	No cost variances were identified that suggest the remedy is not properly functioning
Opportunity for Optimization	Monitoring data indicated that lactate distribution was inconsistent across the site. Injection of HRC® was performed to improve the delivery and distribution of lactate to the specific areas where MCLs were still exceeded and lactate distribution was limited.
Early Indicators of Potential Remedy Failure	The remedy was functioning as intended. No early indicators of potential remedy failure were noted in the review.
Implementation of ICs and LUCs	NAVWPNSTA Seal Beach is fenced and entry is restricted and vigorously enforced. Site 40 LUCs are to remain in place until TCGs are achieved. During the past 5-year RA period Site 40 LUCs have effectively met their stated objectives of ensuring contaminants do not pose an unacceptable risk to human health and the environment by preventing completion of an exposure pathway, and maintaining the integrity of remediation infrastructure. No LUC violations have been noted during the period. No new production or injection wells were permitted within the Site 40 LUC buffer zone from 2005 through 2010 and there has been no change in groundwater flow direction. This compliance record has not been documented as required, but the remediation contractor will be required to do so during the second five-year review period.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?	
Element	**Assessment**
Changes in Standards and TBC Requirements	All Applicable or Relevant and Appropriate Requirements (ARAR) were considered in the selection of the final remedy specified in the ROD for Site 40 (DON 2004). This included drinking water MCLs for COCs in the contaminated plume. These MCLs were reevaluated as part of this Five-Year Review. No changes applicable to Site 40 were found. The new (Oct 2011) *Vapor Intrusion Mitigation Advisory* updates requirements for work plans, sampling techniques, analytical methods, etc., however, vapor intrusion

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?	
Element	**Assessment**
	risk is already being addressed as part of performance monitoring at the site. All other known standards and TBC requirements applicable to Site 40 are unchanged from the ROD.
Changes in Exposure Pathways and Land Use	No change in land use has occurred at IRP Site 40 since the ROD was prepared in 2004. It is anticipated that NAVWPNSTA Seal Beach will continue to be used for military purposes into the near future. The ERSE did not consider a surface vapor intrusion pathway to exist at Site 40, but subsequent monitoring during remediation has addressed both soil vapor (VOCs) and surface air emissions (methane and H2S) in and around Buildings 239 and 240. This monitoring is expected to continue due to methane gas in the vadose zone in excess of its LEL. The presence of VC in all soil vapor wells (at concentrations from 1,600 µg/m3 (610 ppbv) to 7,000 µg/m3 (2,700 ppbv)) suggests that VC should be considered for surface emissions monitoring of potential vapor intrusion where methane is being monitored. No significant change in receptor populations or new unaddressed exposure pathways have occurred at Site 40.
Changes in Toxicity and Other Contaminant Characteristics	No change in groundwater COC toxicity or other relevant contaminant characteristics has occurred at IRP Site 40 since the ROD was prepared in 2004. A new Reference Concentration for Chronic Inhalation Exposure value for TCE was published in U.S. EPA Integrated Risk Information System (IRIS) after the ROD, but a chronic inhalation pathway does not exist for TCE at Site 40.
Changes in Risk Assessment Methodologies	Risk assessment methods now include evaluation of the vapor intrusion pathway. No other change in risk assessment methodologies that would change the decisions in the ROD has occurred at IRP Site 40 since the ROD was finalized in 2004.
Remedy Byproducts	EISB has degraded and converted PCE to TCE and subsequently to residual byproducts DCE and VC. Residual low levels of cis-1,2-DCE and VC remain in excess of their TCGs, forming a dilute plume in the central and southwest portions of the site.
New Contaminants and Contaminant Sources	No new COCs or COC sources were identified.
Expected Progress Toward Meeting RAOs	RA at Site 40 has proceeded in accordance with CERCLA and NCP protocols under the Navy IRP. The combination of implemented EISB remedy and in place LUCs is consistent with the RAOs intent to protect public health from exposure to COCs at elevated concentrations in the underlying groundwater. As of the May 2010 monitoring event, PCE and TCE (primary COCs) have been degraded below their TCGs in all 19 wells, and only residual low-level cis-1,2-DCE and VC remain in excess of their TCGs. Residual contamination is comprised of a dilute plume in the central and southwest portions of the site. Contaminant concentrations at the plume boundary are stable, and the plume has diminished significantly and does not pose an immediate threat to human or ecological receptors. Groundwater quality data suggest that future long-term impacts to groundwater quality are not likely. MNA will likely be sufficient for residual low-level DCE and VC

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?	
Element	**Assessment**
	to reach TCGs over most of the site. However additional remedial action may be advisable in the areas of MW-40-37 and MW-40-08, as recommended in the Final Comprehensive Performance Monitoring Report (TtEC 2011).

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?	
Element	**Assessment**
Overall	There is no other known information that would call into question the protectiveness of the remedy as prescribed and implemented.

IRP Site 70

Question A: Is the remedy functioning as intended by the decision documents?	
Element	**Assessment**
Remedial Action Performance	Remediation at Site 70 began in 2008. The project has been progressing well (see **Figure 7 and Table 7**, below). Injection of EVO and Dhc bacterial culture in the source area and six downgradient biobarriers was successfully completed in August of 2010, and sample analysis results indicate that injections have created conditions conducive to reductive dechlorination in all treatment zones. TCE concentrations have greatly decreased in all injection and downgradient performance monitoring wells, and significant production of daughter products has been observed throughout the plume. Vertical plume profiles are shown for TCE, DCE and VC along a downgradient transect in **Figures 8, 9 and 10**. However, approximately half of the wells in the monitoring network still show elevated TCE concentrations, indicating that further dechlorination is required to attain TCGs for all COCs. In some wells, water quality data (TOC, sulfate, methane, ORP, DO) indicate that the EVO may be depleted. The 2010 Performance Monitoring Report for Site 70 (Insight 2011) considered but did not recommend additional EVO injection in 2011 in order to continue the dechlorination process. Site 70 had not met the criteria for entering MNA phase by the end of the first five-year review period. However, favorable conditions for further reductive dechlorination were demonstrated at all biobarriers (Insight 2011), including: • DO levels below 1 mg/L; • ORP results in the favorable -300 to -500 mV range; • pH recovery to the ideal range of 6 to 8 for microbial growth; and • Moderate to optimum Dhc microbial counts. Methane was reported in all soil vapor samples, though only three sample locations had concentrations above the LEL or UEL. The highest methane concentrations were from samples in the source area. H2S was reported from a single sample at a concentration below the LEL and the OSHA TWA permissible exposure. Methane gas was not detected in the ambient air within the breathing zone either inside buildings or in outdoor areas of the locations monitored.

Table 7. Groundwater Sampling Results at IRP Site 70 for the Fall 2010 Monitoring Event

COC	Maximum Concentration Detected (µg/L)	Target Cleanup Goal (µg/L)	Number of Wells with Concentration Exceeding TCG[a]
Chloroform	26	80	0 of 73
Tetrachloroethene (PCE)	3.8	5	0 of 73
Trichloroethene (TCE)	4400	5	35 of 73
1,1-Dichloroethene (DCE)	18	6	7 of 73
cis-1,2-Dichloroethene (DCE)	4400	6	19 of 73
trans-1,2-Dichloroethene (DCE)	110	10	13 of 73
1,1-Dichloroethane (DCA)	10	5	5 of 73
Vinyl chloride	3000	0.5	24 of 73

Table 7 Notes:

[a] 73 wells were sampled during the Fall 2010 event, of which 17 were compliance wells.

Question A, Cont.: Is the remedy functioning as intended by the decision documents?	
Element	**Assessment**
System Operations/O&M	The enhanced in-situ bioremediation remedy selected for this site is a passive remedy that does not require extensive O&M. O&M activities include semi-annual inspection of the biobarriers and minor maintenance of the well heads. There have not been any unexpected O&M difficulties since the remedy was implemented.
Cost of Systems Operations/O&M	No cost variances were identified that would suggest the remedy is not properly functioning.
Opportunity for Optimization	Prior to performing the initial baseline groundwater monitoring event at Site 70, existing bladder pumps from wells that were no longer required for monitoring purposes were decontaminated and reused as dedicated pumps in the Site 70 monitoring well network. Reuse of pumps resulted in a cost savings to the government of approximately $10,000.
Early Indicators of Potential Remedy Failure	The remedy is functioning as intended. No early indicators of potential remedy failure were noted in the review.
Implementation of ICs and LUCs	NAVWPNSTA Seal Beach is fenced and entry is restricted and vigorously enforced. Site 70 LUCs and ICs are to remain in place until TCGs are achieved for all COCs. During the past 5-year RA period Site 70 LUCs have effectively met their stated objectives of preventing human use of or exposure to contaminated groundwater; and maintaining the integrity of remediation infrastructure. No LUC violations have been noted during the period. No new production or injection wells were permitted within the Seal Beach Naval Weapons Station buffer zone from 2005 through 2010 (OCHCA) and there has been no change in groundwater flow direction. This compliance record has not been documented as required, but the remediation contractor will be required to do so during the second five-year review period.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?	
Element	**Assessment**
Changes in Standards and TBC Requirements	All Applicable or Relevant and Appropriate Requirements (ARAR) were considered in the selection of the final remedy specified in the ROD for Site 70 (Geosyntec 2006a). This included drinking water MCLs for COCs in the contaminated plume. These MCLs were reevaluated as part of this Five-Year Review. MCLs for all COCs except chloroform were unchanged. The MCLs for chloroform were tightened slightly (from 100 to 80 ug/L) at both the federal and state levels. The federal MCL was changed effective January 1, 2004; the California MCL was updated effective June 17, 2006. Chloroform concentrations are below the current TCG in all 73 Site-70 monitoring wells, and the changed MCL for chloroform is not expected to delay attainment of Site 70 RAOs. The new Vapor Intrusion Mitigation Advisory (Oct 2011) updates requirements for work plans, sampling techniques, analytical methods, etc., however, vapor intrusion risk is already being addressed as part of performance monitoring at the site. All other known standards and TBC requirements applicable to Site 70 are unchanged from the ROD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?	
Element	**Assessment**
Changes in Exposure Pathways and Land Use	No change in land use has occurred at IRP Site 70 since the ROD was prepared in 2006. It is anticipated that NAVWPNSTA Seal Beach will continue to be used for military purposes into the near future. Given the record of soil vapor and air emissions monitoring at Site 70, no significant change in receptor populations or new unaddressed exposure pathways have occurred at the site. However, residual levels of both VC and TCE in groundwater suggest that vadose zone VOC analysis should be added to the current methane and H2S monitoring program. These results should be used to assess whether a vapor intrusion risk exists for VC or any other COC.
Changes in Toxicity and Other Contaminant Characteristics	No change in groundwater COC toxicity or other relevant contaminant characteristics has occurred at IRP Site 70 since the ROD was prepared in 2006. A new Reference Concentration for Chronic Inhalation Exposure value for TCE was published in U.S. EPA Integrated Risk Information System (IRIS), but a chronic inhalation pathway does not exist for TCE at Site 70.
Changes in Risk Assessment Methodologies	Risk assessment methods now include evaluation of the vapor intrusion pathway. No other change in risk assessment methodologies applicable to Site 70 has occurred since the ROD was prepared in 2006.
Remedy Byproducts	As expected EISB has degraded and converted TCE to residual byproducts of DCE and VC, and subsequently to ethene and ethane. In addition, increased concentrations of dissolved hydrocarbon gases, particularly methane and ethane, were evidence in all of the biobarriers (Insight 2011).
New Contaminants and Contaminant Sources	No new COCs have been identified. Groundwater concentrations of original COCs are decreasing under remediation (Insight 2011).
Expected Progress Toward Meeting RAOs	RA at Site 70 has proceeded in accordance with CERCLA and NCP protocols under the Navy IRP. The combination of implemented EISB remedy and in place LUCs and ICs is consistent with the RAOs intent to protect public health from exposure to COCs at elevated concentrations in the underlying groundwater. Injection of EVO and Dhc bacterial culture in the source area and six downgradient biobarriers has created conditions conducive to reductive dechlorination. Fall 2010 monitoring data from the Site 70 2010 Performance Monitoring Report (PMR) indicate that that TCE concentrations have greatly decreased in all injection and downgradient monitoring wells and that TCE daughter products have been observed throughout the plume (Insight 2011). However, approximately half of the monitoring wells show TCE concentrations above the TCG for this COC. The 2010 PMR considered but did not recommend additional injection of substrate or culture during 2011. Accordingly, performance monitoring and site-specific LUCs and ICs were continued in order to maintain progress toward meeting the RAOs.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?	
Element	**Assessment**
Overall	There is no other known information that would call into question the protectiveness of the remedy as prescribed and implemented.

VIII. ISSUES, RECOMMENDATIONS, AND FOLLOW-UP ACTIONS

Several issues were identified during remedial action implementation and the site visits and interviews performed during the Five-Year Review for IRP Sites 40 and 70. These issues are presented together with recommendations and follow up actions in **Table 8**.

Table 8. Five-Year Review Issues, Recommendations and Follow-up Actions

Site	Issue	Recommendations/ Follow-up Actions	Party Responsible	Over-Sight Agency	Affects Protectiveness?	
					Current	Future
IRP Site 40	COC concentrations are less than or close to their TCGs at most monitoring wells. Additional efforts to stimulate reductive dechlorination site-wide would likely have a very limited effect.	Continue annual MNA and groundwater performance monitoring to assess natural attenuation in wells that have not met TCGs for all COCs over one year of monitoring.	DON	DTSC/ RWQCB	N	N
		Monitor and document LUC compliance within established site boundaries until all TCGs are met in all wells.				
	Low-level DCE/VC residual contamination at MW-40-37 and MW-40-08 suggest the possibility of a need for additional EISB injections in these areas of the plume.	Based on performance monitoring data after this review period, consider additional injection of substrate in selected wells to boost dechlorination rates.	DON	DTSC/ RWQCB	N	N
	Methane gas or VC could migrate into buildings via cracks, utility penetration, or other pathways in building floor slabs.	Continue annual monitoring of: 1) soil vapor survey for methane, CO_2, carbon monoxide, oxygen, H_2S, and VOCs at all vapor wells and probes; and 2) surface emissions monitoring for methane and VC (new analyte), in and around Buildings 240 and 239, and inside manholes. Note: Current SAP conforms to the Oct. 2011 Vapor Intrusion Mitigation Advisory.	DON	DTSC/ RWQCB	N	N
	The potential for CE rebound was identified in the area immediately downgradient of Building 240.	Resolved via collection of groundwater samples at various depths from inside the locomotive maintenance shop. COC concentrations were consistent with those reported elsewhere at the site (TtECI 2011).	DON	DTSC	N	N
IRP Site 70	Although EISB has reduced plume extent, TCE and daughter products remain above TCGs in half of the monitoring wells.	Continue current groundwater performance monitoring regimen to assess reductive dechlorination in wells that have not met TCGs for all COCs over one year of monitoring.	DON	DTSC/ RWQCB	N	N
		Monitor and document LUC/IC compliance within established site boundaries until all TCGs are met in all wells.				

Site	Issue	Recommendations/ Follow-up Actions	Party Responsible	Over-Sight Agency	Affects Protectiveness?	
					Current	Future
IRP Site 70	In some wells, water quality data (TOC, sulfate, methane, ORP, DO) indicate that the EVO may be depleted.	The 2010 PMR report (Insight 2011) indicated: "It is not anticipated that additional EVO and/or KB-1 is required during 2011. However, additional assessment will be made at the next annual groundwater monitoring event by reviewing all lines of evidence, including possible increases in ORP and DO, and changes in concentrations of CEs, Dhc/vcrA, TOC, and VFAs."	DON	DTSC/ RWQCB	N	N
	Methane and VOC COCs can accumulate in the subsurface and migrate to the surface.	Modify existing soil vapor monitoring by adding VOC analysis, including VC and TCE. Continue ambient air monitoring for methane.	DON	DTSC	N	N
	Long-term MNA/LUC costs due to long timeframe expected for MNA to attain RAOs.	Synchronize groundwater monitoring, DNAPL gauging, and LUC inspection efforts for maximum cost effectiveness.	DON	DTSC/ RWQCB	N	N

IX. PROTECTIVENESS STATEMENT

IRP Site 40

All immediate threats at Site 40 have been addressed. The approved EISB remedy at IRP Site 40 has been effective at reducing groundwater contamination and is expected to be protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled by a combination of ongoing remedial action, MNA and LUCs. Primary COC (TCE) concentrations are below TCG in all wells, and residual COC and daughter-product concentrations are also very low. Only VC is present above its TCG throughout the plume.

MNA will likely be effective over most of the plume area for attainment of TCGs for residual DCE and VC. However, continued annual performance monitoring must continue to verify this outcome.

Long-term protectiveness of the Site 40 remedy will be verified by a combination of continuing performance monitoring at wells with residual DCE and VC levels above their TCGs and MNA at all other monitoring wells. Ongoing conditions favorable to reductive dechlorination and other natural attenuation processes are considered adequate for full attainment of remaining TCGs. Continued monitoring for methane in surface air emissions and new collection and analysis of surface air samples for VC can verify that vapor intrusion is not a viable exposure pathway at Site 40.

Continued monitoring and future documentation of LUC compliance will provide protection of site receptors until all TCGs are attained in all monitoring wells.

IRP Site 70

All immediate threats at Site 70 have been addressed. The approved EISB remedy at IRP Site 70 has been effective at reducing groundwater contamination and is expected to be protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled by a combination of remedial action and in-place LUCs and ICs. Primary COC (TCE, PCE) concentrations are reduced throughout the plume, and daughter products (DCE, VC) are observed as expected. PCE levels are below TCG in approximately half of the monitored wells. Conditions favorable to further reductive dechlorination of COCs in groundwater persist at all biobarrier installations.

There is a possibility that additional injections of EVO and/or KB-1 culture might be required at individual wells, depending on further performance monitoring for COCs and field parameters such as DO and ORP. However, there is no recommendation to do so as of the end of the first five-year review period.

Long-term protectiveness of the Site 70 remedy will be maintained by continued performance monitoring, possible additional localized bioaugmentation, and monitoring and future documentation of LUC and IC compliance. These actions and subsequent MNA will continue until TCGs are attained for all COCs in all monitored wells.

X. NEXT REVIEW

The next Five-Year Review for IRP Sites 40 and 70 will be triggered by the annual monitoring for Site 40 scheduled to occur in December 2015. Allowing time for report preparation, the second Five-Year Review Report is required in May 2016.

XI REFERENCES

List of Documents and Literature Reviewed

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Insight (Insight) 2011. Final 2010 Performance Monitoring Report, Enhanced *in situ* Bioremediation Installation Restoration Program Site 70 Naval Weapons Station Seal Beach, Seal Beach, California. August.

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FIGURES

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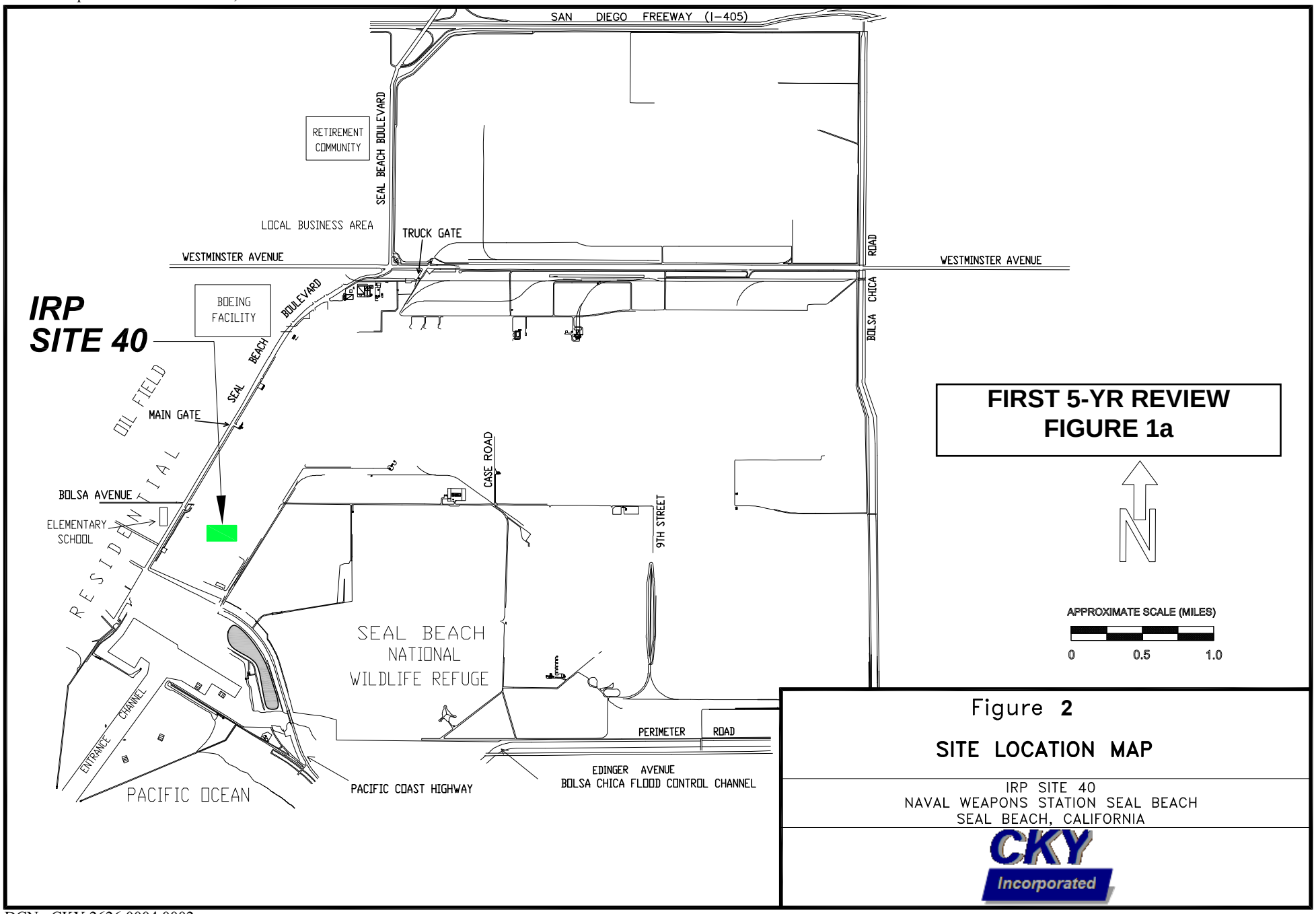
SAN DIEGO FREEWAY (I-405)
RETIREMENT COMMUNITY
SEAL BEACH BOULEVARD
LOCAL BUSINESS AREA
TRUCK GATE
WESTMINSTER AVENUE
WESTMINSTER AVENUE
BOLSA CHICA ROAD
BOEING FACILITY
SEAL BEACH BOULEVARD
IRP SITE 40
OIL FIELD
MAIN GATE
RESIDENTIAL
BOLSA AVENUE
ELEMENTARY SCHOOL
CASE ROAD
9TH STREET
SEAL BEACH NATIONAL WILDLIFE REFUGE
ENTRANCE CHANNEL
PACIFIC OCEAN
PACIFIC COAST HIGHWAY
PERIMETER ROAD
EDINGER AVENUE
BOLSA CHICA FLOOD CONTROL CHANNEL
FIRST 5-YR REVIEW
FIGURE 1a
N
APPROXIMATE SCALE (MILES)
0
0.5
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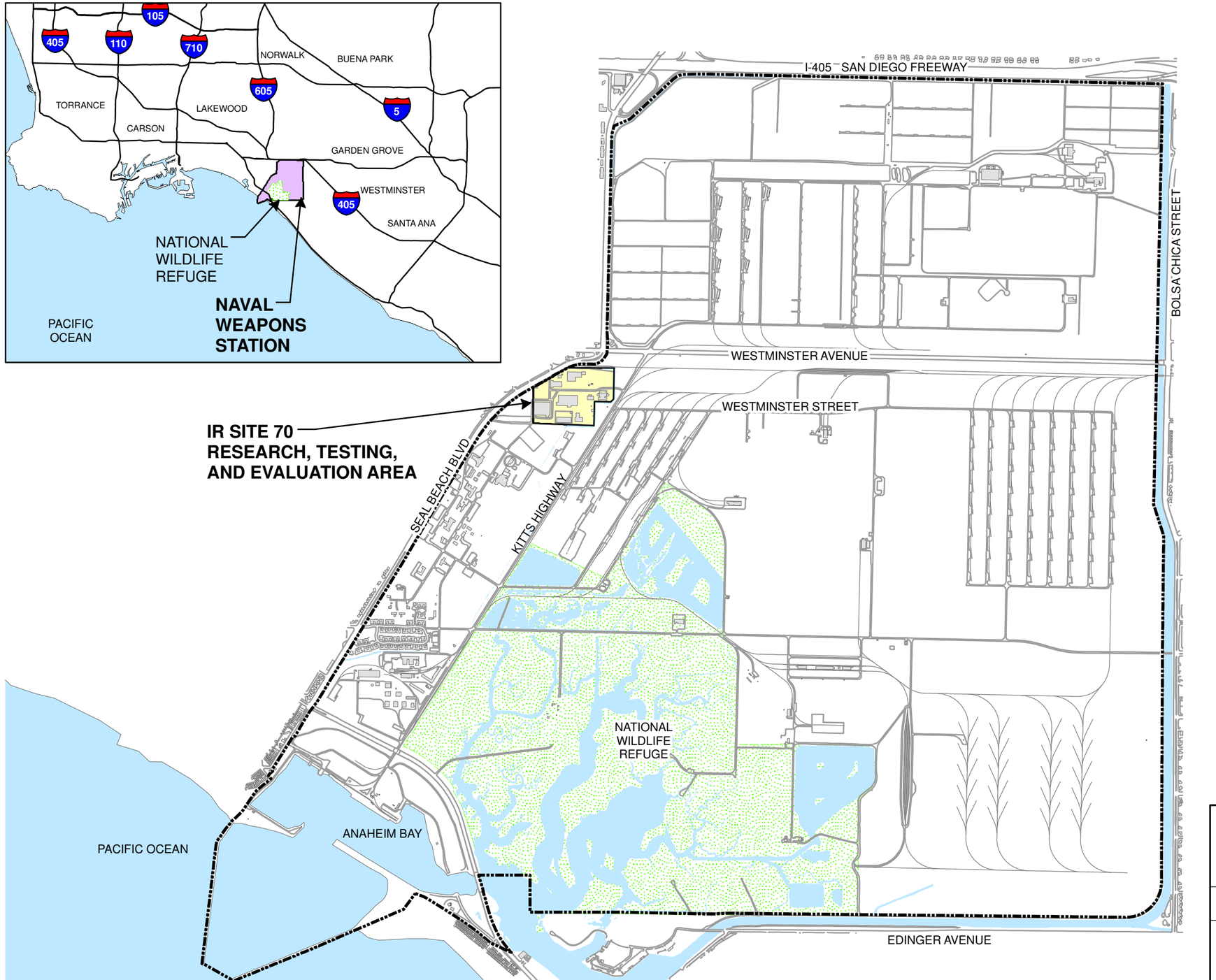
Figure 2
SITE LOCATION MAP
IRP SITE 40
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA
CKY Incorporated



LEGEND

- IR SITE 70 BOUNDARY
- BASE BOUNDARY
- ROAD
- RAILROAD TRACK
- BUILDING

FIRST 5-YR REVIEW
FIGURE 1b

N

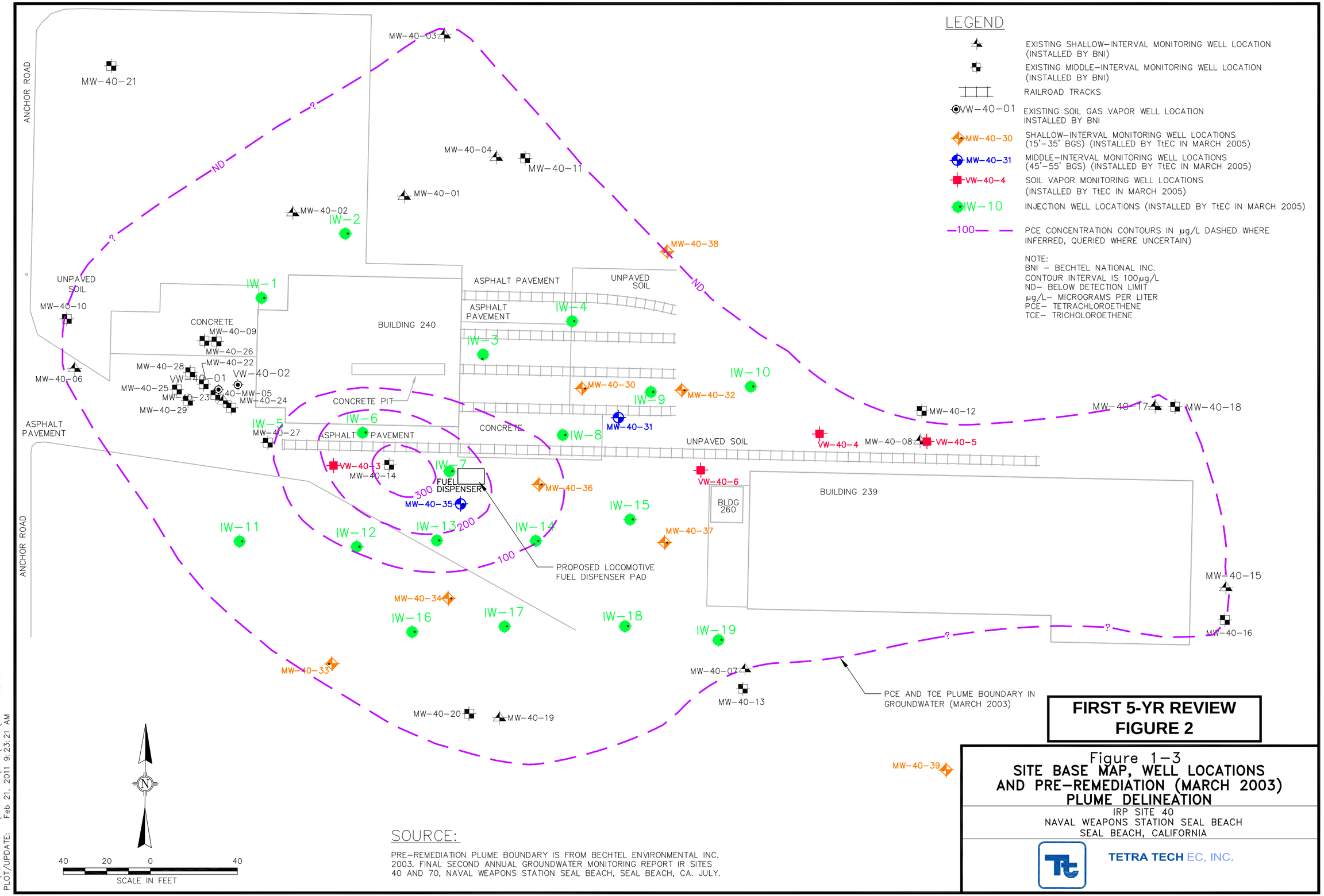
0 1,000 2,000 4,000 Feet

2010 Performance Monitoring Report
Figure 1-1
IR Site 70
Site Location Map

Naval Weapons Station Seal Beach, Seal Beach, California

INSIGHT
Environmental, Engineering and Construction, Inc.

Date:	01/23/2011
File No.	14114vic1.mxd
Project No.:	4-14114
Rev.	A


LEGEND
EXISTING SHALLOW-INTERVAL MONITORING WELL LOCATION (INSTALLED BY BNI)
EXISTING MIDDLE-INTERVAL MONITORING WELL LOCATION (INSTALLED BY BNI)
RAILROAD TRACKS
VW-40-01 EXISTING SOIL GAS VAPOR WELL LOCATION INSTALLED BY BNI
MW-40-30 SHALLOW-INTERVAL MONITORING WELL LOCATIONS (15'-35' BGS) (INSTALLED BY TtEC IN MARCH 2005)
MW-40-31 MIDDLE-INTERVAL MONITORING WELL LOCATIONS (45'-55' BGS) (INSTALLED BY TtEC IN MARCH 2005)
VW-40-4 SOIL VAPOR MONITORING WELL LOCATIONS (INSTALLED BY TtEC IN MARCH 2005)
IW-10 INJECTION WELL LOCATIONS (INSTALLED BY TtEC IN MARCH 2005)
100 PCE CONCENTRATION CONTOURS IN µg/L DASHED WHERE INFERRED, QUERIED WHERE UNCERTAIN)
NOTE:
BNI - BECHTEL NATIONAL INC.
CONTOUR INTERVAL IS 100µg/L
ND- BELOW DETECTION LIMIT
µg/L- MICROGRAMS PER LITER
PCE- TETRACHLOROETHENE
TCE- TRICHOLOROETHENE
ANCHOR ROAD
MW-40-21
MW-40-03
MW-40-04
MW-40-11
MW-40-01
MW-40-02
IW-2
MW-40-38
ND
UNPAVED SOIL
MW-40-10
IW-1
CONCRETE
MW-40-09
MW-40-26
MW-40-22
BUILDING 240
ASPHALT PAVEMENT
IW-4
IW-3
MW-40-06
MW-40-28
VW-40-01
VW-40-02
MW-40-25
MW-40-23
40-MW-05
MW-40-24
MW-40-29
CONCRETE PIT
IW-10
MW-40-30
IW-9
MW-40-32
MW-40-12
MW-40-17
MW-40-18
IW-5
MW-40-27
IW-6
ASPHALT PAVEMENT
CONCRETE
IW-8
MW-40-31
UNPAVED SOIL
VW-40-4
MW-40-08
VW-40-5
VW-40-3
MW-40-14
IW-7
FUEL DISPENSER
300
MW-40-35
MW-40-36
VW-40-6
BLDG 260
BUILDING 239
IW-15
MW-40-37
IW-11
IW-12
IW-13
200
IW-14
100
PROPOSED LOCOMOTIVE FUEL DISPENSER PAD
MW-40-15
MW-40-34
IW-16
IW-17
IW-18
IW-19
MW-40-16
MW-40-33
MW-40-07
MW-40-13
PCE AND TCE PLUME BOUNDARY IN GROUNDWATER (MARCH 2003)
MW-40-20
MW-40-19
MW-40-39
N
40 20 0 40
SCALE IN FEET
SOURCE:
PRE-REMEDIATION PLUME BOUNDARY IS FROM BECHTEL ENVIRONMENTAL INC. 2003. FINAL SECOND ANNUAL GROUNDWATER MONITORING REPORT IR SITES 40 AND 70, NAVAL WEAPONS STATION SEAL BEACH, SEAL BEACH, CA. JULY.
FIRST 5-YR REVIEW
FIGURE 2
Figure 1-3
SITE BASE MAP, WELL LOCATIONS AND PRE-REMEDIATION (MARCH 2003) PLUME DELINEATION
IRP SITE 40
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA
TETRA TECH EC, INC.
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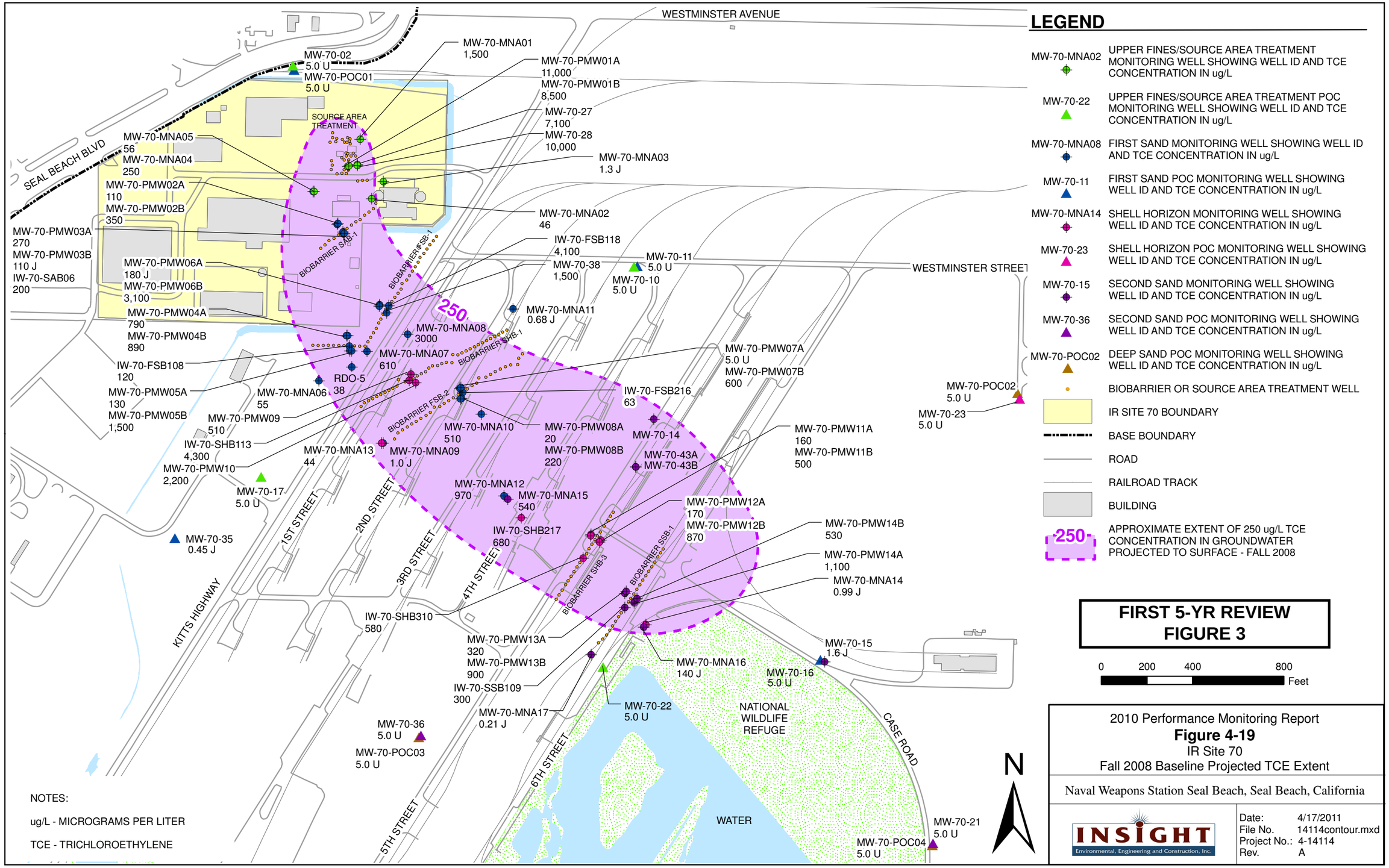
WESTMINSTER AVENUE
WESTMINSTER STREET
SEAL BEACH BLVD
KITTS HIGHWAY
1ST STREET
2ND STREET
3RD STREET
4TH STREET
5TH STREET
6TH STREET
CASE ROAD
SOURCE AREA TREATMENT
BIOBARRIER SAB-1
BIOBARRIER FSB-1
BIOBARRIER STB-1
BIOBARRIER FSB-2
BIOBARRIER SHB-3
BIOBARRIER SSB-1
250
MW-70-02 5.0 U
MW-70-POC01 5.0 U
MW-70-MNA01 1,500
MW-70-PMW01A 11,000
MW-70-PMW01B 8,500
MW-70-27 7,100
MW-70-28 10,000
MW-70-MNA03 1.3 J
MW-70-MNA05 56
MW-70-MNA04 250
MW-70-PMW02A 110
MW-70-PMW02B 350
MW-70-PMW03A 270
MW-70-PMW03B 110 J
IW-70-SAB06 200
MW-70-MNA02 46
IW-70-FSB118 4,100
MW-70-38 1,500
MW-70-11 5.0 U
MW-70-10 5.0 U
MW-70-PMW06A 180 J
MW-70-PMW06B 3,100
MW-70-PMW04A 790
MW-70-PMW04B 890
MW-70-MNA11 0.68 J
MW-70-MNA08 3000
MW-70-MNA07 610
IW-70-FSB108 120
MW-70-PMW05A 130
MW-70-PMW05B 1,500
RDO-5 38
MW-70-MNA06 55
MW-70-PMW09 510
IW-70-SHB113 4,300
MW-70-PMW10 2,200
MW-70-17 5.0 U
MW-70-35 0.45 J
MW-70-PMW07A 5.0 U
MW-70-PMW07B 600
IW-70-FSB216 63
MW-70-MNA10 510
MW-70-PMW08A 20
MW-70-PMW08B 220
MW-70-14
MW-70-43A
MW-70-43B
MW-70-PMW11A 160
MW-70-PMW11B 500
MW-70-MNA13 44
MW-70-MNA09 1.0 J
MW-70-MNA12 970
MW-70-MNA15 540
IW-70-SHB217 680
MW-70-PMW12A 170
MW-70-PMW12B 870
MW-70-PMW14B 530
MW-70-PMW14A 1,100
MW-70-MNA14 0.99 J
IW-70-SHB310 580
MW-70-PMW13A 320
MW-70-PMW13B 900
IW-70-SSB109 300
MW-70-MNA17 0.21 J
MW-70-MNA16 140 J
MW-70-15 1.6 J
MW-70-16 5.0 U
MW-70-22 5.0 U
MW-70-36 5.0 U
MW-70-POC03 5.0 U
MW-70-POC02 5.0 U
MW-70-23 5.0 U
MW-70-21 5.0 U
MW-70-POC04 5.0 U
NATIONAL WILDLIFE REFUGE
WATER
N
LEGEND
MW-70-MNA02 UPPER FINES/SOURCE AREA TREATMENT MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-22 UPPER FINES/SOURCE AREA TREATMENT POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-MNA08 FIRST SAND MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-11 FIRST SAND POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-MNA14 SHELL HORIZON MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-23 SHELL HORIZON POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-15 SECOND SAND MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-36 SECOND SAND POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-POC02 DEEP SAND POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
BIOBARRIER OR SOURCE AREA TREATMENT WELL
IR SITE 70 BOUNDARY
BASE BOUNDARY
ROAD
RAILROAD TRACK
BUILDING
250 APPROXIMATE EXTENT OF 250 ug/L TCE CONCENTRATION IN GROUNDWATER PROJECTED TO SURFACE - FALL 2008
FIRST 5-YR REVIEW
FIGURE 3
0 200 400 800 Feet
NOTES:
ug/L - MICROGRAMS PER LITER
TCE - TRICHLOROETHYLENE
2010 Performance Monitoring Report
Figure 4-19
IR Site 70
Fall 2008 Baseline Projected TCE Extent
Naval Weapons Station Seal Beach, Seal Beach, California
INSIGHT
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Project No.: 4-14114
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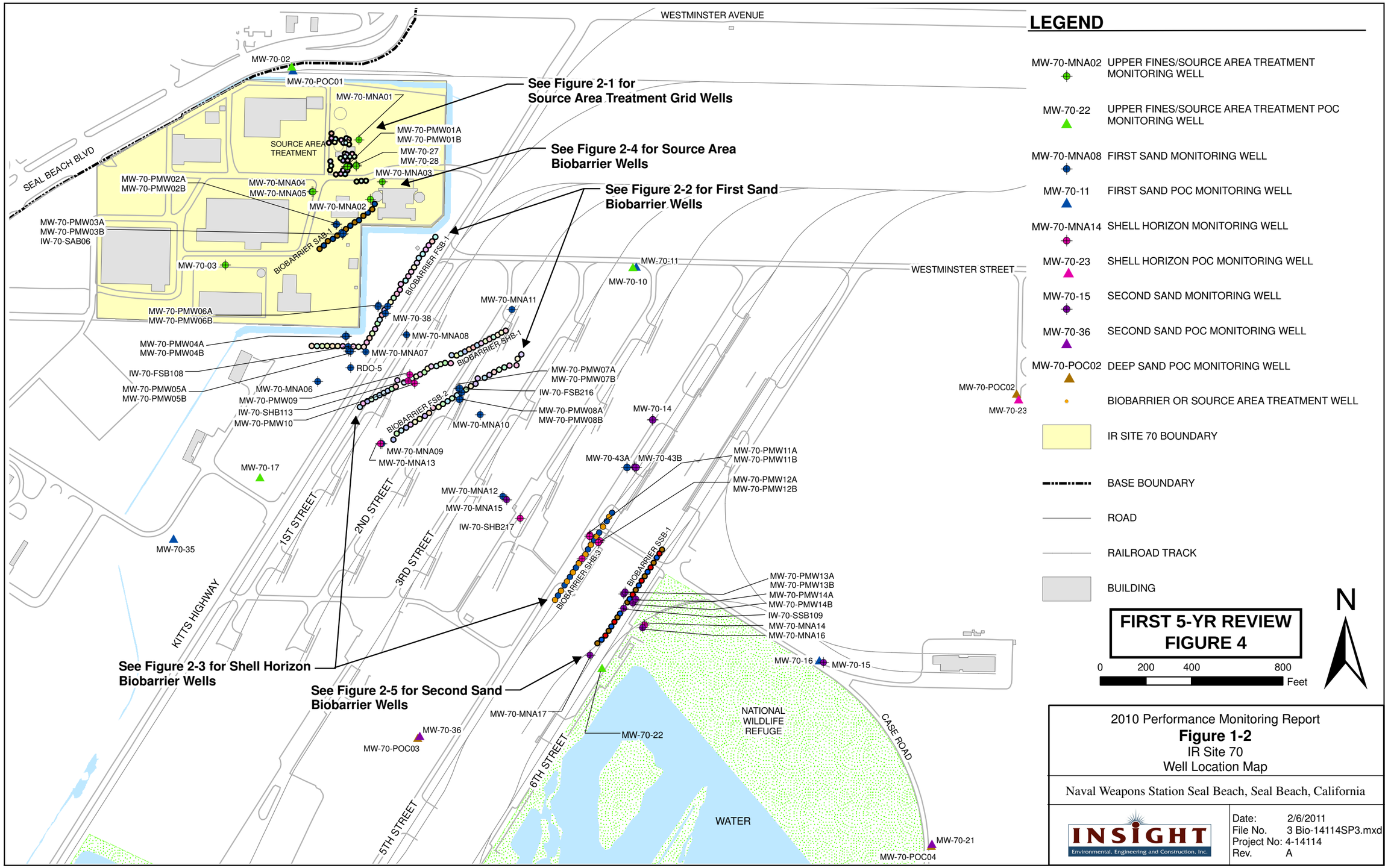

2010 Performance Monitoring Report

Figure 1-2

IR Site 70

Well Location Map

Naval Weapons Station Seal Beach, Seal Beach, California

INSIGHT Environmental, Engineering and Construction, Inc.

Date: 2/6/2011
File No. 3 Bio-14114SP3.mxd
Project No: 4-14114
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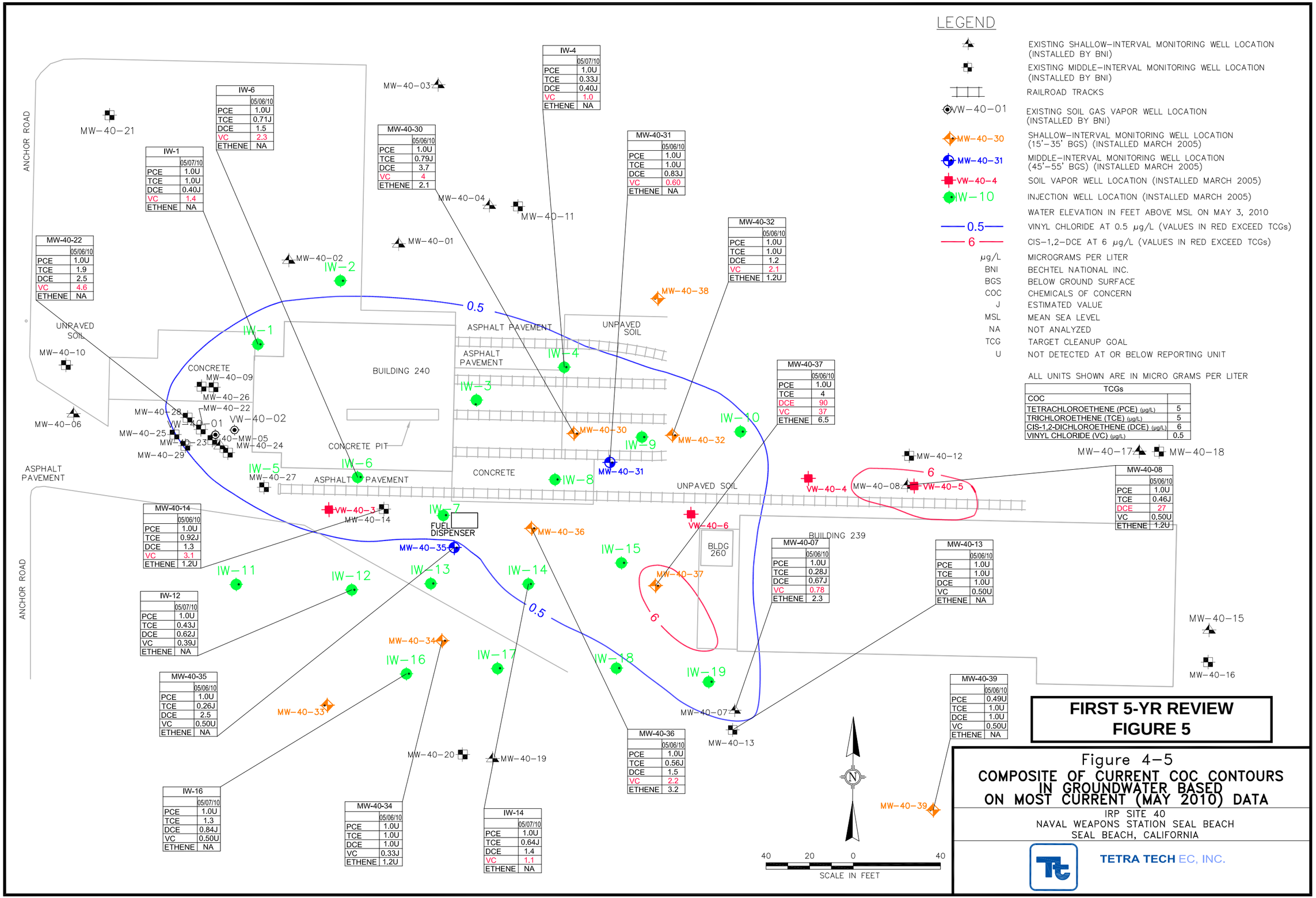

FIRST 5-YR REVIEW
FIGURE 5

Figure 4-5
COMPOSITE OF CURRENT COC CONTOURS IN GROUNDWATER BASED ON MOST CURRENT (MAY 2010) DATA

IRP SITE 40
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

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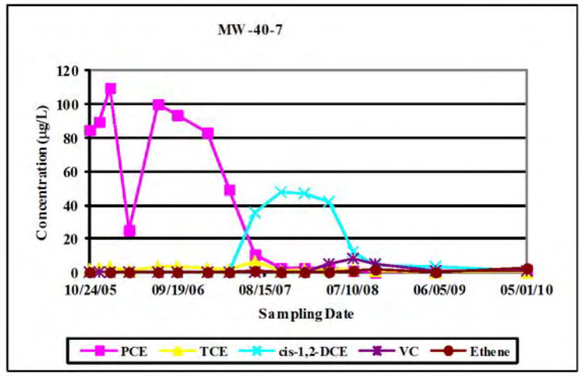

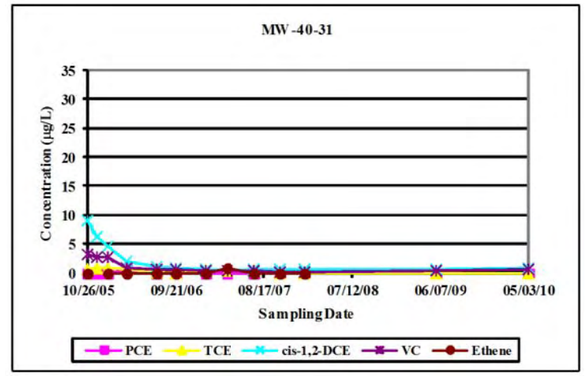

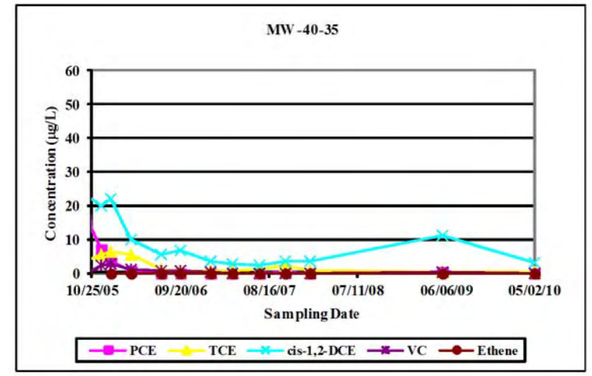

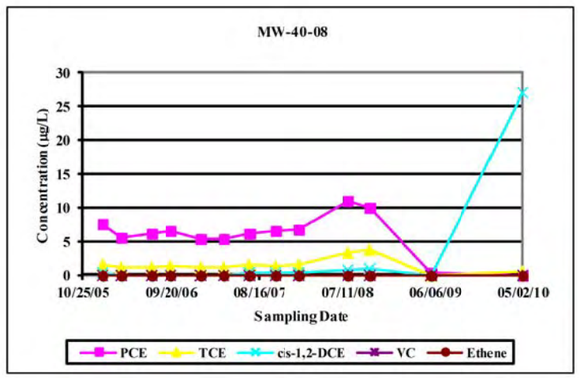

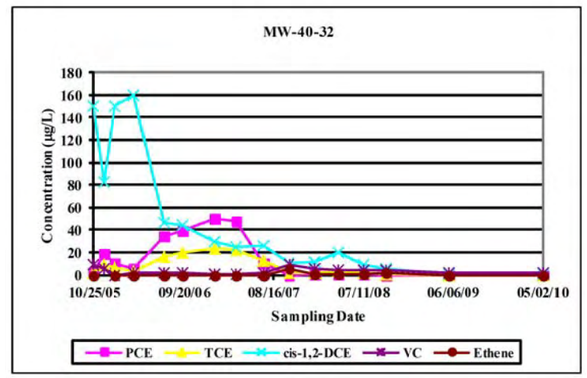

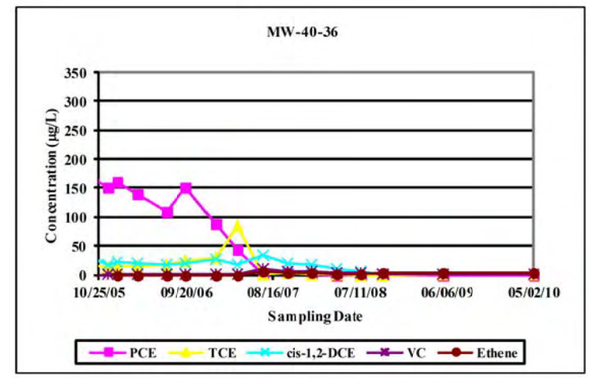

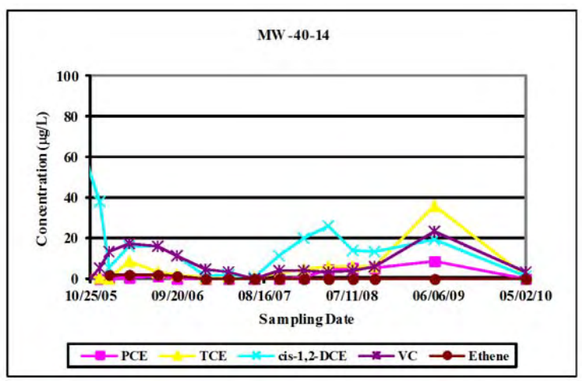

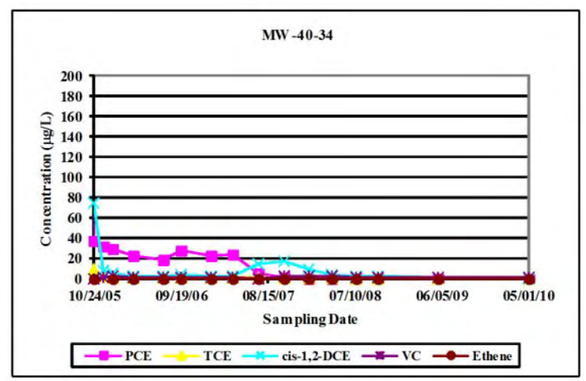

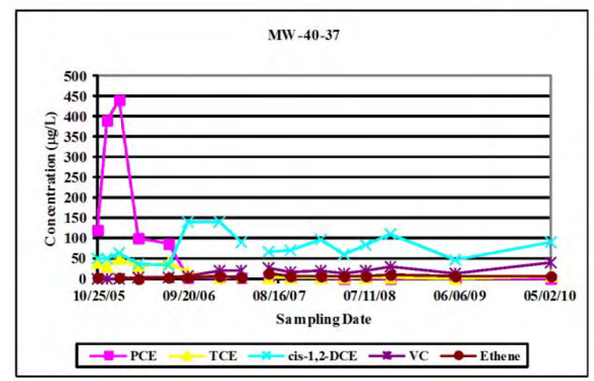

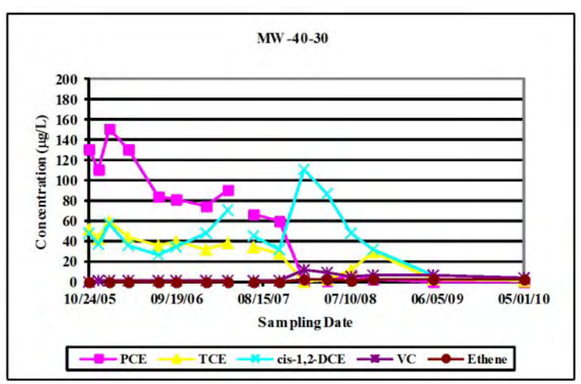

NOTES:

PCE – TETRACHLOROETHENE
TCE – TRICHLOROETHENE
DCE – DICHLOROETHENE
VC – VINYL CHLORIDE
µg/L – MICROGRAMS PER LITER
COC – CHEMICAL OF CONCERN

FIRST 5-YR REVIEW
FIGURE 6

Figure 4–3
COC TRENDS (MASS BASIS) IN GROUNDWATER FOR KEY MONITORING WELLS

IRP SITE 40
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

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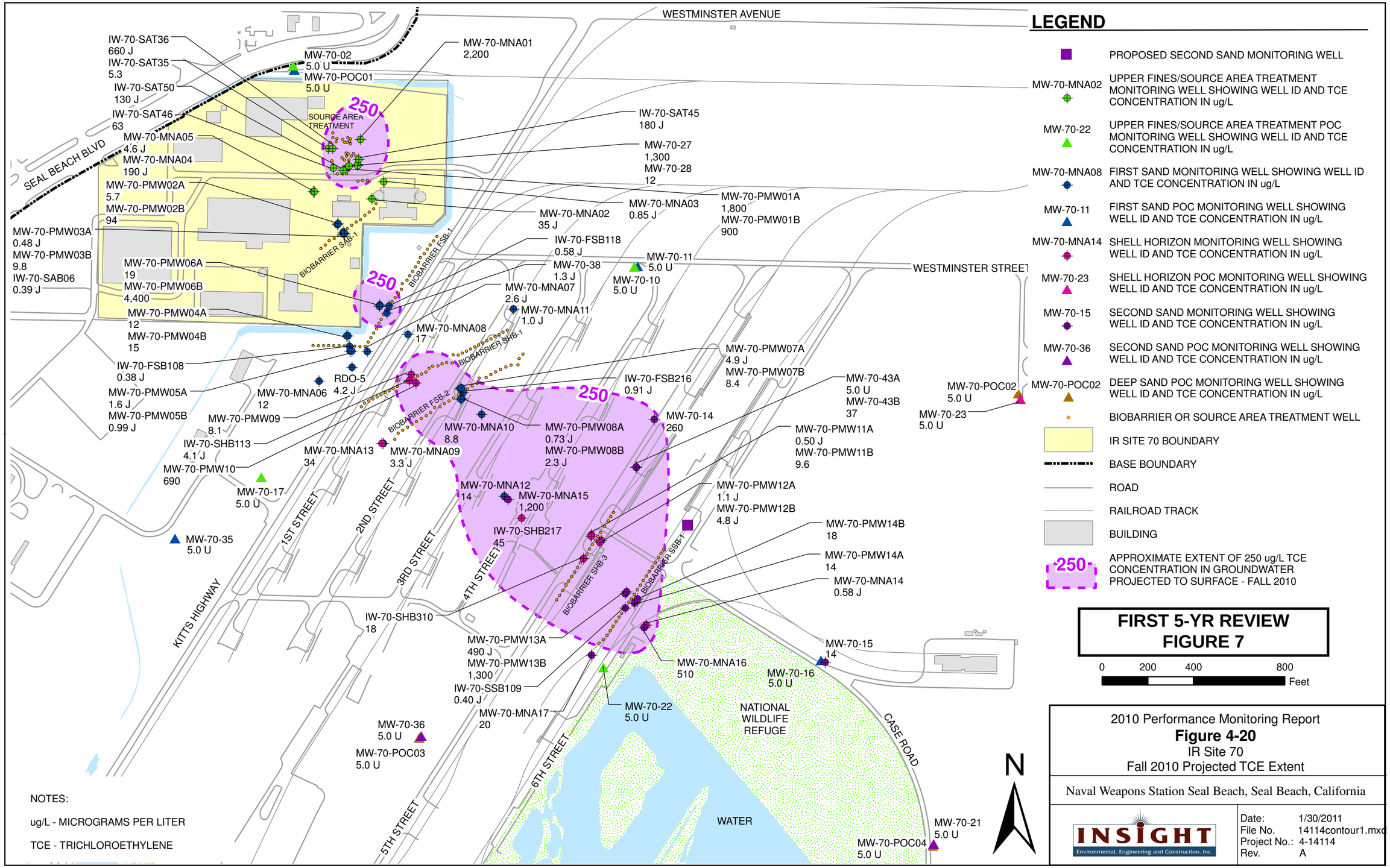
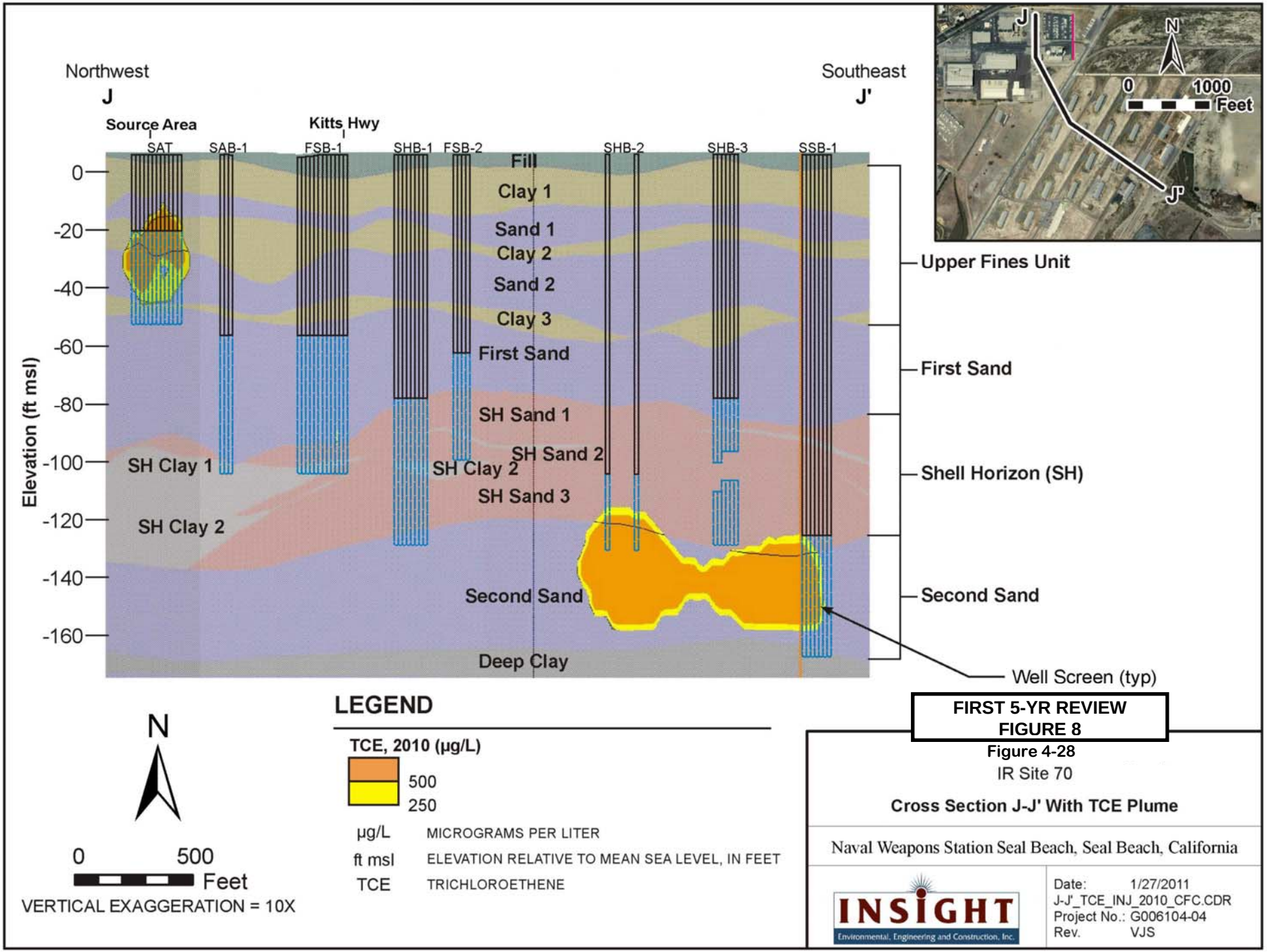

WESTMINSTER AVENUE
WESTMINSTER STREET
SEAL BEACH BLVD
KITTS HIGHWAY
1ST STREET
2ND STREET
3RD STREET
4TH STREET
5TH STREET
6TH STREET
CASE ROAD
SOURCE AREA TREATMENT
BIOBARRIER SAB-1
BIOBARRIER FSB-1
BIOBARRIER SHB-1
BIOBARRIER FSB-2
BIOBARRIER SHB-3
BIOBARRIER SSB-1
250
IW-70-SAT36 660 J
IW-70-SAT35 5.3
IW-70-SAT50 130 J
IW-70-SAT46 63
MW-70-02 5.0 U
MW-70-POC01 5.0 U
MW-70-MNA01 2,200
MW-70-MNA05 4.6 J
MW-70-MNA04 190 J
MW-70-PMW02A 5.7
MW-70-PMW02B 94
MW-70-PMW03A 0.48 J
MW-70-PMW03B 9.8
IW-70-SAB06 0.39 J
IW-70-SAT45 180 J
MW-70-27 1,300
MW-70-28 12
MW-70-MNA03 0.85 J
MW-70-PMW01A 1,800
MW-70-PMW01B 900
MW-70-MNA02 35 J
IW-70-FSB118 0.58 J
MW-70-38 1.3 J
MW-70-11 5.0 U
MW-70-10 5.0 U
MW-70-MNA07 2.6 J
MW-70-MNA11 1.0 J
MW-70-PMW06A 19
MW-70-PMW06B 4,400
MW-70-PMW04A 12
MW-70-PMW04B 15
MW-70-MNA08 17
IW-70-FSB108 0.38 J
MW-70-PMW05A 1.6 J
MW-70-PMW05B 0.99 J
RDO-5 4.2 J
MW-70-MNA06 12
MW-70-PMW09 8.1
IW-70-SHB113 4.1 J
MW-70-PMW10 690
MW-70-17 5.0 U
MW-70-35 5.0 U
MW-70-MNA13 34
MW-70-MNA09 3.3 J
MW-70-PMW07A 4.9 J
MW-70-PMW07B 8.4
IW-70-FSB216 0.91 J
MW-70-43A 5.0 U
MW-70-43B 37
MW-70-POC02 5.0 U
MW-70-23 5.0 U
MW-70-MNA10 8.8
MW-70-PMW08A 0.73 J
MW-70-PMW08B 2.3 J
MW-70-14 260
MW-70-PMW11A 0.50 J
MW-70-PMW11B 9.6
MW-70-MNA12 14
MW-70-MNA15 1,200
IW-70-SHB217 45
MW-70-PMW12A 1.1 J
MW-70-PMW12B 4.8 J
MW-70-PMW14B 18
MW-70-PMW14A 14
MW-70-MNA14 0.58 J
IW-70-SHB310 18
MW-70-PMW13A 490 J
MW-70-PMW13B 1,300
IW-70-SSB109 0.40 J
MW-70-MNA17 20
MW-70-MNA16 510
MW-70-15 14
MW-70-16 5.0 U
MW-70-22 5.0 U
MW-70-36 5.0 U
MW-70-POC03 5.0 U
NATIONAL WILDLIFE REFUGE
WATER
MW-70-21 5.0 U
MW-70-POC04 5.0 U
N
LEGEND
PROPOSED SECOND SAND MONITORING WELL
MW-70-MNA02 UPPER FINES/SOURCE AREA TREATMENT MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-22 UPPER FINES/SOURCE AREA TREATMENT POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-MNA08 FIRST SAND MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-11 FIRST SAND POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-MNA14 SHELL HORIZON MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-23 SHELL HORIZON POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-15 SECOND SAND MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-36 SECOND SAND POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
MW-70-POC02 DEEP SAND POC MONITORING WELL SHOWING WELL ID AND TCE CONCENTRATION IN ug/L
BIOBARRIER OR SOURCE AREA TREATMENT WELL
IR SITE 70 BOUNDARY
BASE BOUNDARY
ROAD
RAILROAD TRACK
BUILDING
250 APPROXIMATE EXTENT OF 250 ug/L TCE CONCENTRATION IN GROUNDWATER PROJECTED TO SURFACE - FALL 2010
FIRST 5-YR REVIEW
FIGURE 7
0 200 400 800 Feet
NOTES:
ug/L - MICROGRAMS PER LITER
TCE - TRICHLOROETHYLENE
2010 Performance Monitoring Report
Figure 4-20
IR Site 70
Fall 2010 Projected TCE Extent
Naval Weapons Station Seal Beach, Seal Beach, California
INSIGHT
Environmental, Engineering and Construction, Inc.
Date: 1/30/2011
File No. 14114contour1.mxd
Project No.: 4-14114
Rev. A

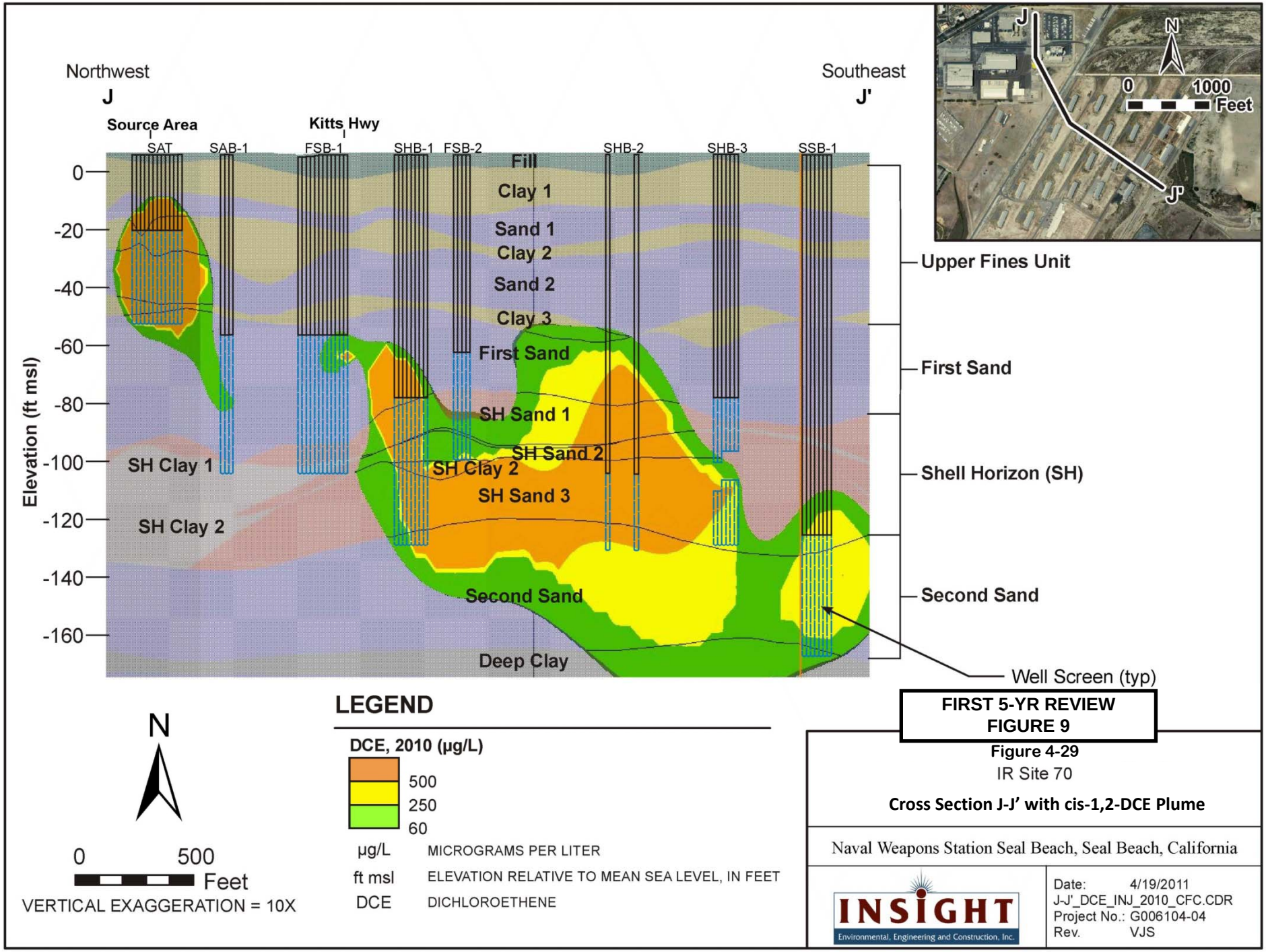


FIRST 5-YR REVIEW
FIGURE 8

Figure 4-28
IR Site 70

Cross Section J-J' With TCE Plume

Naval Weapons Station Seal Beach, Seal Beach, California



FIRST 5-YR REVIEW
FIGURE 9

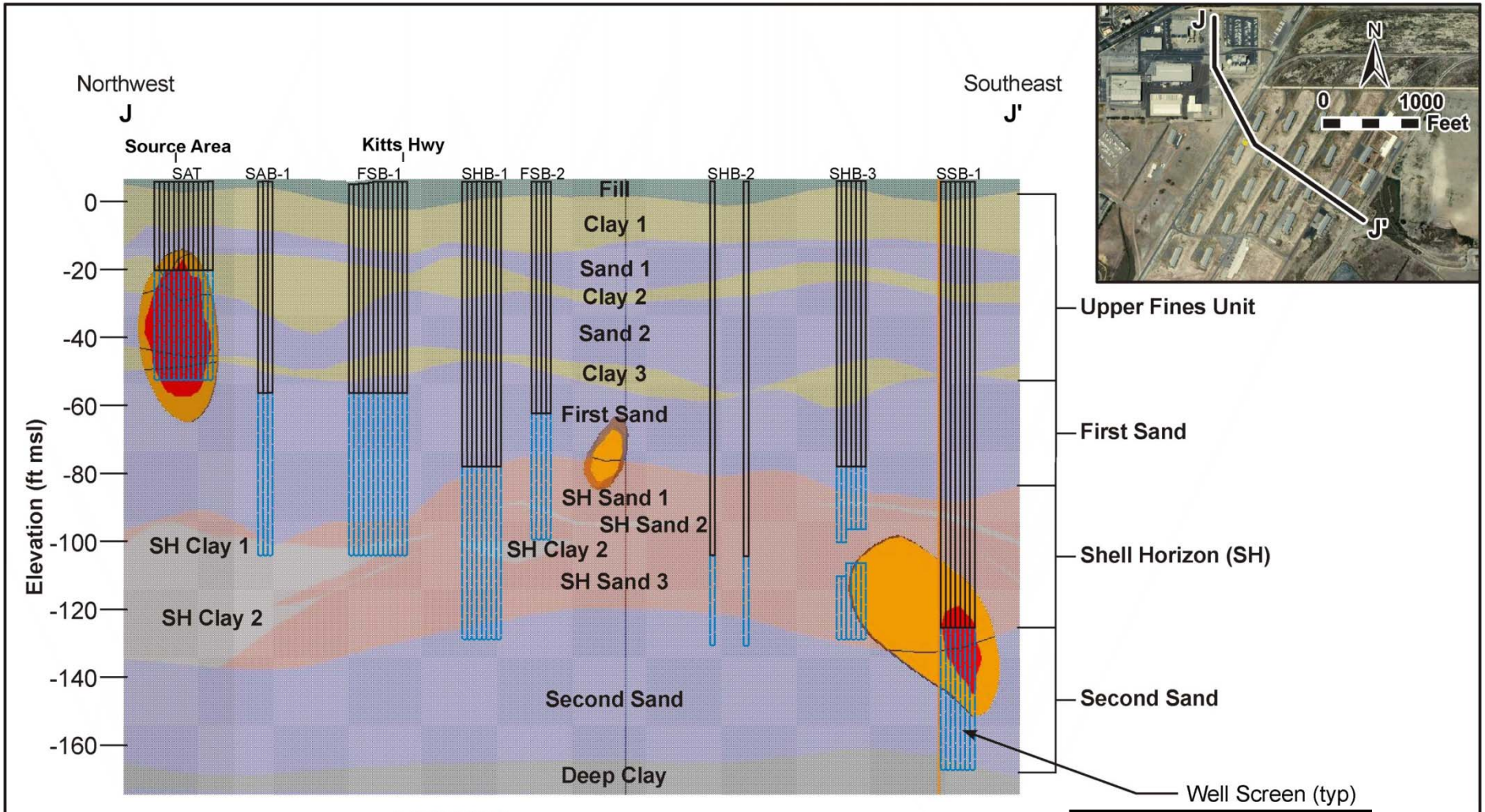
Figure 4-29
IR Site 70

Cross Section J-J' with cis-1,2-DCE Plume

Naval Weapons Station Seal Beach, Seal Beach, California

INSIGHT
Environmental, Engineering and Construction, Inc.

Date: 4/19/2011
J-J'_DCE_INJ_2010_CFC.CDR
Project No.: G006104-04
Rev. VJS



LEGEND

VC, 2010 (µg/L)

250

50

µg/L MICROGRAMS PER LITER

ft msl ELEVATION RELATIVE TO MEAN SEA LEVEL, IN FEET

VC VINYL CHLORIDE

N

0 500 Feet

VERTICAL EXAGGERATION = 10X

FIRST 5-YR REVIEW
FIGURE 10

Figure 4-30
IR Site 70

Cross Section J-J' With VC Plume

Naval Weapons Station Seal Beach, Seal Beach, California

INSIGHT
Environmental, Engineering and Construction, Inc.

Date: 4/19/2011
J-J'_VC_INJ_2010_CFC.CDR
Project No.: G006104-04
Rev. VJS

Attachment-1 Site Inspection Reports

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: IRP Site 40	**Date of inspection: 12/19/2011**
Location and Region: Seal Beach, CA	**EPA ID: N/A**
Agency, office, or company leading the five-year review: U.S. Navy	**Weather/temperature: Overcast, high 60's, low 70's**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Monitored natural attenuation
- ☒ Access controls
- ☒ Land use controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: Enhanced In-Situ Bioremediation

Attachments: ☐ Inspection team roster attached ☐ Site map attached

Inspection Team Members:

Howard Wittenberg (CKY)

II. INTERVIEWS
(Please see paragraph v of Section VI of the Five-Year Review Report for information on interviews)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☐ O&M manual ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ As-built drawings ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

4. **Permits and Service Agreements**
   - ☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Other permits_____ ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

5.	**Gas Generation Records** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A
6.	**Settlement Monument Records** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A
7.	**Groundwater Monitoring Records** Remarks_____	☒ Readily available	☒ Up to date	☐ N/A
8.	**Leachate Extraction Records** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A
	Remarks_____			
10.	**Daily Access/Security Logs** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A

	IV. O&M COSTS	
1.	**O&M Organization** ☐ State in-house ☐ PRP in-house ☐ Federal Facility in-house ☒ Other: Contractor for U.S. Navy	☐ Contractor for State ☐ Contractor for PRP ☐ Contractor for Federal Facility
2.	**O&M Cost Records** ☐ Readily available ☐ Up to date ☒ N/A ☐ Funding mechanism/agreement in place Original O&M cost estimate: $1,123,717 ☐ Breakdown attached (See paragraph iii of Section IV for O&M information)	
3.	**Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: N/A	
	V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. Fencing		
1.	**Fencing** Remarks: No damage to fence noted. Fence appears to be in excellent condition.	
B. Other Access Restrictions		
1.	**Signs and other security measures** Remarks: Signs for base access clearly visible.	

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs are properly implemented ☒ Yes ☐ No ☐ N/A
Site conditions imply ICs are being fully enforced ☒ Yes ☐ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) : Base patrol
Frequency: Routine, Ongoing
Responsible party/agency: Navy

Reporting is up-to-date ☐ Yes ☐ No ☒ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions:

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒ N/A
Remarks

3. **Land use changes off site** ☒ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks

B. Other Site Conditions

Remarks

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

(This is not a landfill site)

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** ☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks_____
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks_____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks_____
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A	
1.	**Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks_____
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks_____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks_____

C. Treatment System	☒ Applicable ☐ N/A
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☒ Bioremediation ☐ Air stripping ☐ Carbon adsorbers ☐ Filters_____ ☐ Additive (*e.g.*, chelation agent, flocculent)_____ ☐ Others_____ ☐ Good condition ☐ Needs Maintenance ☐ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date ☐ Equipment properly identified ☐ Quantity of groundwater treated annually_____ ☐ Quantity of surface water treated annually_____ Remarks: Bioremediation has little to no equipment (limited O&M requirements)
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☒ N/A ☐ Good condition ☐ Needs Maintenance Remarks_____
3.	**Tanks, Vaults, Storage Vessels** ☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks_____
4.	**Discharge Structure and Appurtenances** ☒ N/A ☐ Good condition ☐ Needs Maintenance Remarks_____
5.	**Treatment Building(s)** ☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks_____
6.	**Monitoring Wells** (pump and treatment remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☒ N/A Remarks_____
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

D. Monitored Natural Attenuation			
1. **Monitoring Wells** (natural attenuation remedy)			
☒ Properly secured/locked	☒ Functioning	☒ Routinely sampled	☒ Good condition
☒ All required wells located	☐ Needs Maintenance		☐ N/A
Remarks_____			

X. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy is designed to contain a chlorinated solvent contaminant plume. The remedy including land use controls is effectively meeting the RAO's for the site.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Bioremediation requires little O&M. The site requires routine monitoring and reporting and is meeting the RAO's.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

None

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Monitor data results and discontinue sampling efforts at wells that have at least two sampling events with concentrations below TCGs.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: IRP Site 70	**Date of inspection: 12/20/2011**
Location and Region: Seal Beach, CA	**EPA ID: N/A**
Agency, office, or company leading the five-year review: U.S. Navy	**Weather/temperature: Overcast, high 60's, low 70's**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Monitored natural attenuation
- ☒ Access controls
- ☒ Land use controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: Enhanced In-Situ Bioremediation

Attachments: ☐ Inspection team roster attached ☐ Site map attached

Inspection Team Members:

Howard Wittenberg (CKY)

II. INTERVIEWS
(Please see paragraph v of Section VI of the Five-Year Review Report for information on interviews)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☐ O&M manual ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ As-built drawings ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

4. **Permits and Service Agreements**
   - ☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A
   - ☐ Other permits_____ ☐ Readily available ☐ Up to date ☒ N/A

   Remarks_____

5.	**Gas Generation Records** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A
6.	**Settlement Monument Records** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A
7.	**Groundwater Monitoring Records** Remarks_____	☒ Readily available	☒ Up to date	☐ N/A
8.	**Leachate Extraction Records** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A
	Remarks_____			
10.	**Daily Access/Security Logs** Remarks_____	☐ Readily available	☐ Up to date	☒ N/A

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☒ Other: Contractor for U.S. Navy

2. **O&M Cost Records**

☐ Readily available ☐ Up to date ☒ N/A
☐ Funding mechanism/agreement in place
Original O&M cost estimate: $2,280,000 ☐ Breakdown attached

(See paragraph iii of Section IV for O&M information)

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: N/A

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing**

Remarks: No damage to fence noted. Fence appears to be in excellent condition.

B. Other Access Restrictions

1. **Signs and other security measures**

Remarks: Signs for base access clearly visible.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs are properly implemented	☒ Yes	☐ No	☐ N/A
Site conditions imply ICs are being fully enforced	☒ Yes	☐ No	☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) : Base patrol
Frequency: Routine, Ongoing
Responsible party/agency: Navy

Reporting is up-to-date	☐ Yes	☐ No	☒ N/A
Reports are verified by the lead agency	☐ Yes	☐ No	☒ N/A
Specific requirements in deed or decision documents have been met	☐ Yes	☐ No	☒ N/A
Violations have been reported	☐ Yes	☐ No	☒ N/A

Other problems or suggestions:

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒ N/A
Remarks

3. **Land use changes off site** ☒ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks

B. Other Site Conditions

Remarks

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

(This is not a landfill site)

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** ☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks_____
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks_____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks_____
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A	
1.	**Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks_____
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks_____
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks_____

C. Treatment System	☒ Applicable ☐ N/A
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☒ Bioremediation ☐ Air stripping ☐ Carbon adsorbers ☐ Filters_____ ☐ Additive (*e.g.*, chelation agent, flocculent)_____ ☐ Others_____ ☐ Good condition ☐ Needs Maintenance ☐ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date ☐ Equipment properly identified ☐ Quantity of groundwater treated annually_____ ☐ Quantity of surface water treated annually_____ Remarks: Bioremediation has little to no equipment (limited O&M requirements)
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☒ N/A ☐ Good condition ☐ Needs Maintenance Remarks_____
3.	**Tanks, Vaults, Storage Vessels** ☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks_____
4.	**Discharge Structure and Appurtenances** ☒ N/A ☐ Good condition ☐ Needs Maintenance Remarks_____
5.	**Treatment Building(s)** ☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks_____
6.	**Monitoring Wells** (pump and treatment remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☒ N/A Remarks_____
D. Monitoring Data	
3.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
4.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

D. Monitored Natural Attenuation			
1. **Monitoring Wells** (natural attenuation remedy)			
☒ Properly secured/locked	☒ Functioning	☒ Routinely sampled	☒ Good condition
☒ All required wells located	☐ Needs Maintenance		☐ N/A
Remarks_____			

X. OTHER REMEDIES

If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy is designed to contain a chlorinated solvent contaminant plume. The remedy including land use controls is effectively meeting the RAO's for the site.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Bioremediation requires little O&M. The site requires routine monitoring and reporting and is meeting the RAO's.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

None

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Synchronize efforts for routine monitoring to maximize cost efficiency.

Attachment-2 Completed Interview Forms

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INTERVIEW RECORD

Site Name: Naval Weapons Station Seal Beach, IRP Sites 40 and 70	**EPA ID No.:**	
Subject:5-Year Review Information Survey	**Time:**	**Date: 3/16/2012**
Type: ☐ Telephone ☐ Visit ☒ Other **Location of Visit:**	☐ Incoming ☐ Outgoing	

Contact Made By:

Name: Howard Wittenberg **howard@ckyinc.com**	**Title: Project Manager**	**Organization: CKY Inc.**

Individual Contacted:

Name: Jack Jordan	**Title: RAB Community Co-Chair**	**Organization: RAB**

Telephone No: (562) 430-3288 **Fax No:** **E-Mail Address: jjordan1@earthlink.net**	**Street Address:** **City, State, Zip:**

Summary Of Interview

1. This interview pertains to the following sites: (please check)

IRP Site 40 ☒

IRP Site 70 ☒

2. What is your overall impression of the project? (general sentiment)

IRP Site 40: Seems to be moving along.

IRP Site 70: No problems.

3. What effects have site operations had on the surrounding community?

IRP Site 40: No idea.

IRP Site 70: None that I know of.

4. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

IRP Site 40: No.

IRP Site 70: No.

5. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details

IRP Site 40: No

IRP Site 70: No.

6. Do you feel well informed about the site's activities and progress?

IRP Site 40: Yes.

IRP Site 70: Yes.

7. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

IRP Site 40: No.

IRP Site 70: No.

INTERVIEW RECORD

Site Name: Naval Weapons Station Seal Beach, IRP Sites 40 and 70	**EPA ID No.:**	
Subject:5-Year Review Information Survey	**Time:**	**Date: 1/11/2012**
Type: ☐ Telephone ☒ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing	

Contact Made By:

Name: Howard Wittenberg **howard@ckyinc.com**	**Title: Project Manager**	**Organization: CKY Inc.**

Individual Contacted:

Name: Stephen Niou	**Title:**	**Organization: DTSC**
Telephone No: **Fax No:** **E-Mail Address:**	**Street Address:** **City, State, Zip:**	

Summary Of Interview

1. This interview pertains to the following sites: (please check)

IRP Site 40 ☒

IRP Site 70 ☒

2. What is your overall impression of the project? (general sentiment)

IRP Site 40: Overall the project is going good especially since there is no beneficial use of groundwater nearby.

IRP Site 70: Overall the project seems to be going good.

3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

IRP Site 40: Visits have been made but not routine. Visited the site at least 6 times to inspect such things as injection activities, sampling activities, and general site inspection activities.

IRP Site 70: Visits have been made but not routine. Visited the site to inspect injection activities, groundwater sampling, and system startup activities.

4. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

IRP Site 40: No complaints or violations.

IRP Site 70: No complaints or violations.

5. Do you feel well informed about the site's activities and progress?

IRP Site 40: Yes.

IRP Site 70: Yes.

6.	***Do you have any comments, suggestions, or recommendations regarding the site's management or operation?***
IRP Site 40: Not at this time. IRP Site 70: Not at this time.	

INTERVIEW RECORD

Site Name: Naval Weapons Station Seal Beach, IRP Sites 40 and 70	**EPA ID No.:**	
Subject:5-Year Review Information Survey	**Time:**	**Date: 1/5/2012**
Type: ☒ Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ☐ Outgoing	

Contact Made By:

Name: Howard Wittenberg **howard@ckyinc.com**	**Title: Project Manager**	**Organization: CKY Inc.**

Individual Contacted:

Name: John Broderick	**Title:**	**Organization: RWQCB Santa Ana**

Telephone No: **Fax No:** **E-Mail Address:**	**Street Address:** **City, State, Zip:**

Summary Of Interview

1. This interview pertains to the following sites: (please check)

IRP Site 40 ☒

IRP Site 70 ☒

2. What is your overall impression of the project? (general sentiment)

IRP Site 40: RA is pretty close to completion.

IRP Site 70: Remedy is in place and seems to be working and just a matter of monitoring it properly.

3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

IRP Site 40: Yes we have done inspections but have not been routine. Wanted to see status of physical site.

IRP Site 70: Yes we have done inspections but have not been routine. Made site visits to view drilling activities, well installation activities, view physical location of wells after and during installation. Also viewed sampling activities and adding of EVO and inoculant.

4. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

IRP Site 40: No.

IRP Site 70: No.

5. Do you feel well informed about the site's activities and progress?

IRP Site 40: We routinely submit our concerns to the Navy and our concerns are addressed.

IRP Site 70: We routinely submit our concerns to the Navy and our concerns are addressed.

6.	***Do you have any comments, suggestions, or recommendations regarding the site's management or operation?***
IRP Site 40: No. IRP Site 70: No.	

INTERVIEW RECORD

Site Name: Naval Weapons Station Seal Beach, IRP Sites 40 and 70	**EPA ID No.:**	
Subject:5-Year Review Information Survey	**Time:**	**Date: 3/6/2012**
Type: ☐ Telephone ☐ Visit ☒ Other **Location of Visit:**	☐ Incoming ☐ Outgoing	

Contact Made By:

Name: Howard Wittenberg **howard@ckyinc.com**	**Title: Project Manager**	**Organization: CKY Inc.**

Individual Contacted:

Name: Hamlet Hamparsumian	**Title: IRP Site 40 Project Manager**	**Organization: Tetra Tech**

Telephone No: **Fax No:** **E-Mail Address:**	**Street Address:** **City, State, Zip:**

Summary Of Interview

1. This interview pertains to the following sites: (please check)

IRP Site 40 ☒

IRP Site 70 ☐

2. What is your overall impression of the project? (general sentiment)

The enhanced in situ bioremediation (EISB) of groundwater contaminated with chlorinated ethenes (CEs), including tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE), and vinyl chloride (VC) at Installation Restoration Program (IRP) Site 40, began in March 2005, following the completion of the Record of Decision and the pilot test conducted by Bechtel. The Navy initiated the remedial action for the impacted groundwater at IRP Site 40 to reduce any potential threats to human health and the surrounding environment. The remedial action also involves performance monitoring, monitored natural attenuation (MNA), and land-use controls (LUCs). In general, following the initial treatment and two subsequent optimizations that were conducted in 2007 and 2008, and monitoring activities, the results show significant improvement and reduction in contaminant concentrations in groundwater, and as were anticipated. With the reduction of contaminant concentrations the risk to the humans and the environment form exposure to the chemicals of concern have been significantly reduced. The project has been conducted with no disturbance or impact to the on-going activities and the public within and outside the project area. No accidents and or incidents had occurred during the remediation activities and post-remediation monitoring period. Furthermore the agencies have been updated on regular and consistent basis regarding the field activities. Summary reports of the field activities and groundwater monitoring results have been provided to the agencies during the quarterly, semiannual, and annual groundwater monitoring programs regularly and the regulators have been supportive of the remediation activities and the results achieved to date.

3. Is the remedy functioning as expected? How well is the remedy performing?

The remediation was conducted in accordance with the selected remedy in the ROD and the approved Work Plan which involved injection of sodium lactate at a concentration of at least 3 percent by volume in water in 19 injection wells for distribution in the aquifer. In addition, the remedial design was developed based on the results of the pilot test and parameters developed during the pilot test which were effective in reducing the contaminant concentrations within the study area.

The injections conducted as part of the remedial action were followed by rigorous performance monitoring. Following the sodium lactate injection it became apparent that reductive dechlorination of PCE and TCE to DCE continued to occur to varying degrees and bio-augmentation with KB-1 was conducted to further breakdown the DCE to VC and non-harmful by-products. In general, the results were as expected and as was demonstrated during the pilot test.

4. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

The primary objective of the remedial action is to protect human health and the environment. Accordingly, remedial action objectives (RAOs) and target cleanup goals (TCGs) were developed to provide objectives used to define and evaluate the remedial action. The TCGs developed for the IRP Site 40 remediation are based on federal maximum contaminant levels (MCLs) developed for TCE, PCE, DCE and VC. These TCGs support the RAO of restoring the shallow aquifer underlying NAVWPNSTA Seal Beach as a potential drinking water supply to the extent practical.

A human-health risk screening for IRP Site 40 groundwater was conducted as part of the remedial investigation (RI) which estimated a total cancer risk of 4.1×10^{-3} and a hazard index of 85, resulting primarily from PCE and TCE. Approximately 88 percent of the total cancer risk was determined to be from PCE, and 85 percent of the total hazard index was determined to be from PCE and TCE.

Prior to the remediation the maximum concentrations of the primary chemicals of concern (COCs) PCE and TCE were reported at 300 and 48 micrograms per liter. Since the start of the remediation and based on the most recent analytical results (May 2010 annual monitoring data), concentrations of PCE and TCE in all wells have been reported below the detection limit. Therefore, the risk form these primary contaminants have significantly been reduced. Based on these results, and even though there are residual concentration of breakdown by-products such as DCE and VC, it is believed that the remedy has been effective in reducing the COC concentrations and the overall risk associate with exposure to these chemicals.

In general, significant reductions in total COC concentrations have been observed in all monitoring wells over the life of the project.

5. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

The implementation of the remedial action at IRP Site 40 did not involve installation of a long-term treatment system and apparatus requiring on-going operations and maintenance (O&M) activities. The remediation system used for this project consisted of dosetrons mounted on portable devises with the necessary meters, and manually operated valves and plumbing that where assembled and used for injection of the sodium lactate and water mixture in the wells. Following the initial injections and the follow-up periodic injections during 2005 and early 2006, these apparatus were no longer needed and at the end of the project were discarded. The only O&M involved at this project was maintenance of the wells caps, vaults, vault covers and seals, and repairs to well monument aprons. These were only done periodically and on as needed basis and involved only couple of people in the field for couple of days only. The inspections of the wells are done during the monitoring activities, which were initially quarterly, then semi-annually and later reduced to annually. Other maintenance work involved replacing the caution and hazard signs at the site, which were weathered during the course of several years, and since they were installed at the site.

6. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

During the course of the project there has been reduction to the groundwater monitoring frequencies of several of the wells at the site. The reductions were due to not-detected concentration of COCs in samples collected from those wells. The wells that were recommended for reduced monitoring frequency had demonstrated COC concentrations of below the TCGs for more than 4 quarters of monitoring. The monitoring frequency for these wells was reduced to semiannually. Several of the wells that were being monitored on semi-annual basis continued demonstrating COC concentrations and after two years of semiannual monitoring the wells that had reported non-detect concentrations for the COCs for two consecutive years were reverted to annual monitoring. Periodic status reports were prepared during the implementation, monitoring, and optimization phases, which documented details and critical aspects of ongoing site activities. The monitoring results and a summary of the monitoring activities along with any recommendations for reduction in monitoring frequencies were discussed and reported in the status reports and provided to the regulators for review. Any changes to monitoring frequencies and changes to the network of monitoring wells were implemented following agencies' concurrence. The changes to monitoring frequency or network of wells did not have any effect on the protectiveness of effectiveness of the remedy.

7. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details.

The groundwater remedy implemented at IRP Site 40 did not involve any traditional O&M generally associated with a fixed-base treatment system. Therefore, there are no O&M costs associated with the remedy.

8. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

Over the course of the process monitoring, it was observed that lactate distribution was adequate in some areas of the site, and the EISB process performed as expected at those locations. However, data indicated that lactate migration has been inconsistent across the site, and some areas did not receive adequate lactate. As a result, to optimize the remedy performance, alternative approaches were evaluated for enhancing the EISB system, including improving the delivery and distribution of lactate to the specific areas where lactate migration was limited. This involved injecting HRC, which is a similar type substrate. HRC, however is a concentrated form of lactate and is injected in the water bearing formation by means of direct push technology. HRC injections were conducted in two rounds in April 2007 and in October 2008, as part of optimization efforts in reestablishing conditions supportive of reductive dechlorination in critical areas. In general, the HRC was effectively distributed within areas where residual COCs were present. Following the optimization efforts, the residual concentrations of the COCs within the site decreased significantly. Overall, the final round of HRC injection was considered successful, and in reducing residual COC concentrations and maximizing the extent of the EISB treatment. The implementation of optimization reduced the cost for prolonged quarterly monitoring and reliance on monitored natural attenuation alone, for reduction in COC concentrations.

9. Do you have any comments, suggestions, or recommendations regarding the project?

Based on the recent monitoring results it is evident that substantial reductions in COCs have been achieved, PCE and TCE concentrations are below their TCGs, and in most cases DCE and VC concentrations are below the TCG. Current microbiological and geochemical data suggest an environment favorable for reductive dechlorination to continue. The Navy will continue annual sampling and determine whether there is any evidence of rebounds in COCs concentrations. However, rebound in COCs concentration is not anticipated and it is expected that the residual concentrations of the DCE and VC will decrease due to natural attenuation processes, and given the low COC concentrations remaining, it is unlikely that further addition of substrate would be beneficial.

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INTERVIEW RECORD

Site Name: Naval Weapons Station Seal Beach, IRP Sites 40 and 70	**EPA ID No.:**	
Subject:5-Year Review Information Survey	**Time:**	**Date: 2/13/2012**
Type: ☐ Telephone ☐ Visit ☒ Other **Location of Visit:**	☐ Incoming ☐ Outgoing	

Contact Made By:

Name: Howard Wittenberg **howard@ckyinc.com**	**Title: Project Manager**	**Organization: CKY Inc.**

Individual Contacted:

Name: Anthony Ford	**Title: IRP Site 70 Project Manager**	**Organization: Insight**

Telephone No: **Fax No:** **E-Mail Address:**	**Street Address:** **City, State, Zip:**

Summary Of Interview

1. This interview pertains to the following sites: (please check)

IRP Site 40 ☐

IRP Site 70 ☒

2. What is your overall impression of the project? (general sentiment)

The project is progressing well. Injection of emulsified vegetable oil (EVO) and Dehalococcoides (Dhc) bacterial culture in the source area and six downgradient biobarriers was successfully completed in August of 2010, and laboratory results indicate that reductive dechlorination is occurring in each of the treatment zones.

3. Is the remedy functioning as expected? How well is the remedy performing?

Yes, the remedy is functioning as expected. In general, emulsified vegetable oil (EVO) injections have created conditions conducive to reductive dechlorination in all the biobarriers and bioaugmentation appears to have been successful for establishing dechlorination populations in the treatment areas.

4. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

The monitoring data shows that trichloroethene (TCE) concentrations have greatly decreased in all injection and downgradient performance monitoring wells and a significant production of daughter products, including ethene, has been observed throughout the plume. However, total organic carbon (TOC), sulfate, methane, oxygen reduction potential (ORP), and dissolved oxygen (DO) data collected in 2011 indicate that the amendment (EVO) may be depleted and additional EVO, and possible bioaugmentation, may be needed in the near future.

5. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

No, there is not a continuous on-site O&M presence. The enhanced in-situ bioremediation remedy selected for this site is a passive remedy that does not require extensive O&M. O&M activities include semi-annual inspection of the biobarriers and minor maintenance of the well heads. Two performance/plume groundwater monitoring was also performed during 2011.

6. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

There have not been any significant changes to the O&M requirements or maintenance schedule since startup. Several wells have been added to the groundwater sampling program to better define the extent of the plume and one injection well in the First Sand Biobarrier 1 was replaced due to damage observed during injection.

7. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details.

No, there have not been any unexpected O&M difficulties since the remedy was implemented.

8. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

Prior to performing the initial baseline groundwater monitoring event at the site, existing bladder pumps from wells that were no longer sampled at the site were decontaminated and reused as dedicated pumps in the IRP Site 70 monitoring network. The reuse of the pumps resulted in a cost savings to the government of approximately $10K.

9. Do you have any comments, suggestions, or recommendations regarding the project?

The remedy for IRP Site 70 is functioning as expected. The following recommendations are provided:

Additional EVO injection should be performed in order to continue the dechlorination process at IR Site 70

Injection approach and scope should be optimized based on areas where active treatment is required (e.g. injection into every well may not be required)

Continued Semi-Annual Groundwater monitoring is recommended