DRAFT

SITE CLOSURE REPORT
INSTALLATION RESTORATION PROGRAM SITE 40

06 December 2016

Naval Weapons Station Seal Beach
800 Seal Beach Boulevard, Seal Beach
Orange County, California 90740

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ACRONYMS

Cal/EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
COPC	chemical of potential concern
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DHC	*Dehalococcoides* spp.
DO	dissolved oxygen
DON	Department of the Navy
DTSC	Department of Toxic Substances Control
EISB	enhanced in-situ bioremediation
ERSE	extended removal site evaluation
FS	feasibility study
FSI	focused site inspection
HHRA	human health risk assessment
HRC	hydrogen release compound
IAS	initial assessment study
IR	Installation Restoration
IRP	Installation Restoration Program
LUC	land use control
MCL	Maximum Contaminant Level
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per square meter
MNA	monitored natural attenuation
msl	mean sea level
NAVWPNSTA	Naval Weapons Station
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
ORP	oxidation reduction potential
PA	preliminary assessment
PCE	tetrachloroethene
ppm	parts per million
RAO	remedial action objectives
RAP	Remedial Action Plan
RI	remedial investigation
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SI	site inspection
TCE	trichloroethene

TCG	target cleanup goal
VC	vinyl chloride
VOC	volatile organic compound
WBZ	water-bearing zone

1.0 INTRODUCTION

This report summarizes the remediation and monitoring activities performed at Installation Restoration Program (IRP) Site 40 at Naval Weapons Station (NAVWPNSTA) Seal Beach, Seal Beach, California, since the Final Record of Decision/Remedial Action Plan (ROD/RAP) was signed in June 2004 by the Department of the Navy (Navy), the Department of Toxic Substances Control (DTSC), and the Regional Water Quality Control Board (RWQCB) (DON 2004). The information provided in this document supports a closure recommendation for this site. This Site Closure Report is submitted to the California Environmental Protection Agency [Cal/EPA] Department of Toxic Substances Control [DTSC] and the Regional Water Quality Control Board [RWQCB] Santa Ana Region) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The Navy has determined that the existing documentation for IRP Site 40 is adequate for closure and that further remediation or monitoring is not necessary. A summary of the site history, investigation and monitoring results, and current site assessment supporting this conclusion are provided in this document. The evaluation presented in this document considered historical documentation, recent monitoring activities, sampling and analysis, environmental reports, regulatory guidance at the federal and state levels, and Navy policy and guidance. Based on this evaluation, concentrations of chemicals of concern (COCs) have decreased to very low levels across the site, the site environment is favorable for reductive dechlorination to continue, there are no complete exposure pathways to COCs in groundwater at the site, and the COCs in groundwater do not pose an unacceptable risk to potential receptors; therefore, no further action is necessary at this site.

This document is organized into the following sections:

- Section 1 – Introduction: Introduces the purpose and content of the report.
- Section 2 – Site History: Provides a description of the site and its usage.
- Section 3 – Previous Investigations: Describes investigations previously performed at the site.
- Section 4 – Remedial Actions: Describes remedial actions previously performed at the site.
- Section 5 – Results: Presents results of previous sampling activities performed at the site.
- Section 6 – Risk Assessments: Provides results of recent risk assessment performed for the site.
- Section 7 – Conclusions and Recommendation: Presents the ready-for-closure statement.

2.0 SITE HISTORY

NAVWPNSTA Seal Beach is located in Orange County and is bordered by the city of Seal Beach on the north, west, and southwest; the city of Westminster on the northeast; the city of Huntington Beach on the southeast and south; and county land on the south between Edinger and Warner Avenues. The Pacific Ocean borders the station to the south (Figures 1 and 2). NAVWPNSTA Seal Beach provides deployment-ready ordnance to ships and analyzes the performance of weapons. IRP Site 40 is located in the western portion of the station and includes an inactive locomotive repair shop (Building 240) and a partially paved gravel area north of and adjacent to the building.

At IRP Site 40, oil 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 the locomotive repair shop resulted in discharge of volatile organic compounds (VOC), primarily from industrial solvents, to soil and groundwater. Results of soil sampling (JEG 1998) indicated that most of the original release of VOCs had 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

approximately 270-ft by 200-ft. The principal contaminant, tetrachloroethene (PCE), was present from less than 20 ft to 45 ft below grade and did not involve the deep, beneficial use aquifer.

Because there are no complete exposure pathways to ecological receptors, the remedial action objectives (RAO) focused 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
- Protect human health by monitoring for vapor intrusion in and around Buildings 239 and 240.

The Record of Decision (ROD) for Site 40 specified 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 included land use controls (LUC) to be maintained during treatment and performance monitoring.

3.0 PREVIOUS INVESTIGATIONS

The following subsections describe investigations and studies performed at IRP Site 40.

3.1 General Facility Investigations

In 1985, the Navy conducted an initial assessment study (IAS) to investigate potentially contaminated sites at NAVWPNSTA Seal Beach (NEESA 1985). The IAS was conducted under the Navy Assessment and Control of Installation Pollutants Program. Twenty-five potentially impacted sites at NAVWPNSTA Seal Beach (IRP Sites 1 through 25) were identified on the basis of record searches, aerial photographs, field inspections, and facility personnel interviews. The study concluded that 9 of the 25 sites warranted further investigation.

In response to DTSC comments on the IAS Report, Naval Energy and Environmental Support Activity (NEESA) completed a preliminary assessment (PA) as an addendum to the 1985 IAS Report (NEESA 1990). This PA reevaluated the 16 sites recommended for no further action in the IAS Report, recommended all 16 sites for further study, and identified 17 new sites (IRP Sites 35 through 51), including IRP Site 40 at NAVWPNSTA Seal Beach.

3.2 Site Inspections

In 1995, Jacobs Engineering Group Inc. (JEG) conducted a site inspection (SI) of 16 sites, including IRP Site 40 (JEG 1995). The SI found that two chemicals of potential concern (COPCs), carbon tetrachloride and tetrachloroethene (PCE), had been released to the groundwater at this site. The SI Report recommended a focused site inspection (FSI) to evaluate the nature and extent of chlorinated hydrocarbons in the groundwater.

The FSI of IRP Site 40 was conducted in conjunction with further investigations at seven additional sites (JEG 1998). The FSI concluded that a plume of chlorinated hydrocarbons containing PCE, trichloroethene (TCE), and 1,2-dichloroethene (DCE) was present in groundwater beneath IRP Site 40. The study delineated the lateral extent of the plume in the shallow water-bearing zone (WBZ) as approximately 270 by 200 feet. Because PCE, TCE, and 1,2-DCE were detected at levels exceeding state and federal maximum contaminant levels (MCLs), further action was recommended.

3.3 Extended Removal Site Evaluation

In 1998, an Extended Removal Site Evaluation (ERSE) was conducted to supplement data from previous investigations at IRP Sites 40 and 70 (BNI 1999). The ERSE included soil and groundwater sampling. ERSE findings enabled the Navy to support a decision of no further action, removal action, or further evaluation by:

- defining the nature and extent of soil and groundwater contamination,
- refining existing geological and hydrogeological site models,
- evaluating the fate and transport of COPCs from soil to groundwater and within groundwater, and
- evaluating soil and groundwater to assess the potential threat to human health and the environment through screening risk assessments.

Although results of the screening risk assessment indicated that there was no immediate threat to human health or the environment from groundwater (because groundwater is not currently used for domestic purposes), the ERSE Report recommended further action to address groundwater at IRP Site 40 because the cumulative potential human-health risk exceeded the generally acceptable range as defined by the National Contingency Plan (NCP) (BNI 1999). The recommendation for no further action for soil at IRP Site 40 was based on the results of the screening risk assessment (BNI 1999).

The Navy determined that the ERSE for IRP Site 40 substantially complied with the requirements of a remedial investigation (RI) under CERCLA and that it was appropriate to proceed directly to a feasibility study (FS) for groundwater. Although a baseline risk assessment would normally be performed under the NCP, the Navy determined that the screening risk assessment conducted during the ERSE adequately characterized the risk and identified the need for further action to address VOCs in groundwater. DTSC and RWQCB Santa Ana Region concurred with these determinations.

3.4 Groundwater Monitoring Program

In 2000, the final Work Plan for Long-Term Groundwater Monitoring at IRP Sites 40 and 70 was issued (BEI 2000). IRP Site 40 was recommended for inclusion in a 5-year groundwater monitoring program to monitor VOCs, primarily from chlorinated solvents. The final Groundwater Monitoring Work Plan was issued in April 2000, and field activities began that same month. Fifteen wells located in and around the groundwater plume at IRP Site 40 were monitored quarterly for VOCs and semiannually for natural attenuation parameters during the first year of the groundwater monitoring program. On the basis of analytical results from that year, the sampling and water-level measurement frequency was reduced to an annual basis.

3.5 Feasibility Study

In June 2000, the final Groundwater Feasibility Study Report for IRP Sites 40 and 70 was issued. The FS evaluated five remedial alternatives to address the VOC groundwater plume at IRP Site 40 (BNI 2002). Monitored natural attenuation (MNA) and *in situ* treatment with enhanced biodegradation using sodium lactate as a carbon source were ranked highest overall using U.S. Environmental Protection Agency (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 IRP Site 40.

3.6 Pilot-Test Program

An *in situ* lactate enhanced bioremediation pilot test began in June 2001 at IRP Site 40 (BEI 2002). Approximately 55,000 gallons of 3 percent sodium lactate was injected into contaminated groundwater through an injection well to enhance anaerobic biodegradation between 31 July 2001 and 20 March 2002. Groundwater conditions were monitored before, during, and after the pilot-test study.

Results of the pilot-scale test indicated that conditions for reductive dechlorination were achieved through the injection of sodium lactate. PCE and TCE were reduced to DCE; however, DCE was not reduced further to vinyl chloride or ethene. Because the dechlorination process was incomplete, the pilot-test report recommended that technology refinements such as bioaugmentation and cometabolic oxidation be evaluated during the remedial design phase if this alternative is selected for implementation (BEI 2002).

4.0 REMEDIAL ACTIONS

4.1 Initial Implementation of EISB

The selected remedy defined in the ROD for IRP Site 40 (DON 2004) was enhanced in situ bioremediation (EISB), monitored natural attenuation (MNA), and land-use controls (LUCs). The First Annual Semiannual Performance Monitoring Report (TtEC 2006) covered the first 6 months of implementation of the EISB portion of the remedy, describing the installation and operation of a remediation system and the associated performance monitoring for groundwater contaminated with chlorinated VOCs (CVOCs). Sodium lactate was injected into groundwater to generate conditions favorable for reductive dechlorination and to stimulate growth of indigenous microorganisms capable of degrading PCE and TCE to DCE, and groundwater was bioaugmented with a commercially available dechlorinating microbial culture containing *Dehalococcoides* spp. (DHC) to complete reductive dechlorination of DCE to innocuous end products.

Eighteen injection wells, eight groundwater monitoring wells, and four vapor monitoring wells were installed in the area of contamination. Between March and October 2005, two rounds of injection of 3 percent sodium lactate solution were completed with a total injection volume for Round 1 of 472,000 gallons and 217,000 gallons for Round 2. In September 2005, bioaugmentation was performed by injecting 12.5 to 21 liters of KB-1 culture of DHC in each of the 10 selected injection wells.

4.2 Optimization Remedial Actions

The Comprehensive Performance Monitoring Report (October 2005 through May 2010) (TtEC 2011) summarized the remedial actions performed at IRP Site 40 since the initial implementation of EISB. Because data from process monitoring indicated that lactate migration had been inconsistent across the site and some areas did not receive adequate lactate, alternative approaches were considered for enhancing the EISB system. Injection of Hydrogen Release Compound (HRC®) was selected to improve the delivery and distribution of lactate to the specific areas where cleanup is required and lactate migration has been limited. Two rounds of application of HRC were conducted, Round 1 in April 2007 and Round 2 during October and November 2008. A total of 18,300 pounds of HRC was injected into the groundwater in Round 1 to address areas where the lactate distribution under the initial treatment scenario was not effective. Approximately 25,000 pounds of HRC were injected at 186 locations in the subsurface of the site (22 locations within Building 240 and 164 locations outside the building) to address residual contamination.

4.3 Monitored Natural Attenuation

From 2006 through 2014, periodic 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 sampling frequency were reduced with regulatory approval to streamline the program and eliminate collection of data that were not useful).

Field parameters that were measured during these monitoring events included DO, ORP, and pH. Monitoring of these parameters provided additional indication of the potential for further reductive dechlorination.

Additionally, in 2015, ambient air samples were collected to evaluate air quality in and around Site 40 and to provide data for a risk assessment in support of site closure (CKY 2016). Section 6 of this Site Closure

Report summarizes the risk assessments performed for this site.

4.4 Land Use Controls

Land use controls (LUC) that were implemented for Site 40 are the following:

- No new groundwater extraction, injection, or drinking water wells shall be installed within the IRP Site 40 groundwater plume or associated buffer zone without prior review and written concurrence from the DON [Department of the Navy], DTSC [Department of Toxic Substances Control] and the RWQCB [Regional Water Quality Control Board].

- 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.

- The DON, DTSC, RWQCB, and their authorized agents, employees, contractors, and subcontractors will have the right to:
    - enter the premises to conduct investigations, tests, or surveys;
    - inspect field activities;
    - construct, operate, and maintain the remedial action described in this ROD/RAP [Record of Decision/Remedial Action Plan]; and
    - undertake any other remedial response or remedial action as required or necessary under the cleanup program.

No new groundwater wells have been installed in IRP Site 40 or the 500-foot buffer zone since the execution of the ROD in September 2005, and all existing wells and associated piping were in proper working condition at the most recent inspection in December 2014 and did not appear to be tampered with or altered. The DON, regulatory agencies, and contractors have full access to the Site to perform monitoring activities as prescribed in the ROD (DON 2004).

5.0 RESULTS

5.1 Groundwater

Concentrations of COCs from groundwater sampling for key monitoring wells from 2005 through 2014 are summarized in Table 1. December 2014 concentrations and inferred plume delineations for the COCs remaining above target cleanup goals (TCG), TCE and cis-1,2-DCE, and vinyl chloride (VC), are presented on Figures 3 and 4, respectively.

The following are the TCGs for the COCs at Site 40:

Chemicals of Concern	TCG (μg/L)
Tetrachloroethene	5
Trichloroethene	5
cis-1,2-Dichloroethene	6
Vinyl chloride	0.5

Key observations regarding COC concentrations in the selected groundwater monitoring wells sampled during the December 2014 event (CKY 2016) are as follows:

- Concentrations of PCE have not exceeded the TCGs (5 µg/L) in any wells since the 2010 monitoring event.
- Concentrations of TCE have exceeded the TCGs (5 µg/L) once and in only one well (MW-40-14) since the 2010 monitoring event.
- Concentrations of cis-1,2-DCE exceed the TCG (6 µg/L) in four of the seventeen monitoring points (MW-40-08, MW-40-14, MW-40-36, and MW-40-37). The concentrations in these wells are approximately from two to five times the TCG.
- Low concentrations of VC, generally in the 0.5 to 2.0 µg/L range, form a residual plume across the Site. Higher concentrations exist slightly downgradient from the source but have not migrated significantly. Four wells (MW-40-14, -30, -36, and -37) had concentrations over 2 µg/L.

A decrease in VC concentrations across the Site was noted during this event. Most COC concentrations are consistent with previous monitoring results and are attributed to the reductive dechlorination occurring at the Site. The plume is not migrating and there is evidence to suggest that dechlorination will continue, however, at a slower rate than previously observed.

5.2 Soil Gas

Concentrations of COCs from soil gas sampling for key monitoring wells from 2005 through 2014 are summarized in Table 2.

In 2014, PCE was present in the soil gas samples ranging from <10.3 to 9003 µg/m^3 and TCE concentrations ranged from 7.1 to 658 µg/m^3. The maximum reported concentrations in 2013 were 278 and 1074 µg/m^3 for PCE and TCE, respectively, and in 2012, 454 and 3,866 µg/m^3, respectively. There was a significant increase in PCE in 2014 in one sampling location (IW-1) that is not consistent with previous monitoring periods. However, the presence of Site COCs in soil gas can be affected by many different site conditions, and the main concern is soil vapor effects on human and ecological receptors.

Concentrations of cis-1,2-DCE were reported in all sampled wells in 2014 at concentrations ranging from 5.7 µg/m^3 in the soil gas probe installed in vapor monitoring well VW-40-04 to 971 µg/m^3 in vapor monitoring well VW-40-03. The average cis-1,2-DCE concentration in 2014 was 229 µg/m^{3}compared to 900 µg/m^3 in 2013 and 1,320 µg/m^3 in 2012. The average concentration is lower year over year reflecting the continuing reductive dechlorination.

VC was reported in 2014 at concentrations from 1.1 µg/m^3 in the vapor monitoring well VW-40-04 to 3,391 µg/m^3 in vapor monitoring well VW-40-03. The average VC concentration was 845 µg/m^3 in 2014 compared to 1,265 µg/m^3 in 2013 and 1,525 µg/m^3 in 2012. The average concentration is lower likely due to continued reduction of Site COC concentrations.

In addition to the soil gas samples collected from vapor monitoring wells and soil gas monitoring probes, soil gas field parameters were measured at IW-1, -3, -7, -10, MW-40-32, -34, -35, -36, -37, and VW-40-01,-02, -03, -04, and -06. In December 2014, methane gas was present at concentrations from 0.0 to 58.6 percent (%) in air. The highest methane concentration was in the soil gas probe in injection well IW-7. The average methane concentration was 15% in air, which is lower than the average of 26% recorded in 2013 and the 36% recorded in 2012. Hydrogen sulfide was reported in 6 of 14 probes with concentrations ranging from 0 to 29 parts per million (ppm). The highest hydrogen sulfide concentration was in vapor monitoring well VW-40-03.

Methane gas concentrations in samples collected in SUMMA™ canisters from the soil gas monitoring probes and vapor monitoring wells ranged from below the detection limit in soil gas monitoring wells VW-

40-04, IW-01, and MW-40-32 to 40.6% by volume in the soil gas monitoring well VW-40-03. In comparison to 2013 results, methane gas concentrations are similar but trending lower. Methane gas is expected to be present as a result of volatilization and bio-fermentation, referred to as methanogenesis.

5.3 Indoor and Ambient Air

Methane gas and volatile organic compound (VOC) surface emissions monitoring was performed on December 30, 2014. During this monitoring event, neither methane gas nor VOC emissions were detected within Buildings 239 or 240, or in the surrounding areas.

5.3.1 February and April 2015 Indoor and Ambient Air Results

PCE was detected in indoor air samples collected at Buildings 239 and 240 at concentrations greater than DTSC residential and/or industrial air screening levels (DTSC 2015) in February 2015 (CKY 2016). However, the indoor air PCE concentrations ranging from 0.71 to 3.1 $\mu g/m^3$ are equal to or less than the outdoor air PCE concentrations, which ranged from 1.6 to 34 $\mu g/m^3$. TCE concentrations in the indoor air samples, which are equal to or less than TCE concentrations in the ambient air samples, did not exceed DTSC residential and industrial air screening levels. Vinyl chloride and TCE were also detected from ambient air at concentrations greater than DTSC residential and/or industrial air screening levels.

Due to the elevated ambient air concentrations detected in the air samples collected in February 2015, another set of ambient air samples were collected in April 2015 to confirm the February 2015 results. The four COCs were either not detected or were detected at concentrations less than DTSC residential and industrial air screening levels.

The similarity between the indoor and ambient air PCE and TCE concentrations in February 2015 and the lack of PCE detections in April 2015 indicate that the PCE and TCE indoor air detections in February 2015 may be associated with an outdoor source, and are not associated with vapor intrusion from subsurface contamination. In subsequent discussions with building occupants, it was discovered that the February ambient sample location (S40AA-4) was in an area where cleaning solvents are routinely used during the course of normal business operations. The sample location was moved out of the area for the April 2015 sampling event, approximately 20 feet to the east.

5.3.2 July 2015 Indoor and Ambient Air Results

PCE, TCE, cis-1,2-DCE and vinyl chloride concentrations in the indoor air samples collected at Buildings 239 and 240 in July 2015 did not exceed DTSC's residential and industrial air screening levels (CKY 2016).

Vinyl chloride was detected at one ambient air sample location at a concentration greater than the DTSC residential air screening level. However, the results for the four COCs are qualified due to potential laboratory contamination. Vinyl chloride was not detected in ambient air samples at concentrations greater than the DTSC industrial air screening level. PCE was detected in ambient air samples at concentrations greater than DTSC residential and industrial air screening levels.

The lack of indoor air COC detections at concentrations greater than DTSC residential and industrial air screening levels and higher PCE detections from ambient air are consistent with an outdoor source, not vapor intrusion from subsurface contamination.

5.4 Field Parameters

Key observations regarding field parameter data collected in 2014 (CKY 2016) are as follows:

- Based on the December 2014 readings, DO concentrations in the monitoring wells remained at or less than 0.9 mg/L (given limitations associated with this measurement, this essentially represents not detected).

- ORP values measured during the December 2014 event were negative for all monitoring points, ranging from -87.1 millivolts (mV) to -149.0 mV. These values reflect conditions favorable for reductive dechlorination, however, above the optimum value of -240 mV.
- The pH readings ranged from 6.27 to 6.96 pH units. These values are only slightly out of the optimum range of 6.5 to 8.5.

The December 2014 field parameter data indicate the presence of sufficient parameters supportive of continued reductive dechlorination. While reductive dechlorination will continue to occur at the Site, the rates will decrease as concentrations of COCs decrease. Field parameter data is useful as an indicator of site conditions; however, it should not be the only consideration to determine expected future results.

On December 29, 2014, groundwater elevations within the Site ranged from 1.82 feet above mean sea level (msl) in MW-40-08 to 2.55 feet above msl in IW-2 (CKY 2016). In general, water level measurements collected in December 2014 were similar to the elevations measured during the previous monitoring event in 2013. Minor fluctuations are likely due to seasonal/annual variation in weather. Differences in groundwater elevation are not significant enough to have an impact on achieving the remedial goals of this project.

6.0 RISK ASSESSMENTS

A risk assessment was completed to determine if potential risks at IRP Site 40 are acceptable for site closure.

6.1 1998 Screening Level Risk Assessments

A screening-level human health risk assessment (HHRA) and an ecological risk assessment were conducted in 1998 at IRP Site 40 during the Extended Removal Site Evaluation (ERSE; BNI 1999). The ERSE report recommended further action to address volatile organic compounds (VOCs) in groundwater (based on the use of groundwater as tap water) and no further action for soil. DTSC and RWQCB Santa Ana Region concurred with these recommendations (2004 ROD/Remedial Action Plan).

6.2 2014 Preliminary Risk Evaluation

Based on the 1998 screening level risk assessments, a preliminary risk evaluation was performed in 2014 initially considering on the following potential groundwater exposure pathways (CKY 2014):

- Inhalation of VOCs that may intrude into buildings from the subsurface,
- Inhalation of VOCs from groundwater being used as tap water for showering and general household use, and
- Ingestion of groundwater used as tap water.

Groundwater at IRP Site 40 is not currently being used as tap water and will not be used as tap water in the future due to salt water intrusion and because the shallow aquifer is not capable of producing sufficient groundwater for use as tap water. Therefore, the two tap water-related exposure pathways are not complete.

In addition to these three potential human health exposure pathways, another potential groundwater exposure pathway is the migration of VOCs in groundwater to the Seal Beach National Wildlife Refuge; approximately 500 feet southeast of Building 239. However, based on groundwater monitoring results conducted since 2005, it does not appear that the VOC groundwater contamination extends southeast of Building 239. Therefore, the migration of VOCs to the wildlife refuge is not a complete exposure pathway.

Because the other potential exposure pathways discussed above are not complete at IRP Site 40, the preliminary risk evaluation was conducted focusing on the inhalation of VOCs that may intrude into buildings from the subsurface. Groundwater and soil vapor VOC data are available at IRP Site 40; soil vapor data better represent the potential for vapor intrusion into buildings than groundwater data and were used in

the 2014 preliminary risk evaluation. The preliminary risk evaluation was limited to the two primary groundwater COCs (PCE and TCE) and the two secondary COCs (cis-1,2-DCE and VC), and was conducted using 2012 and 2013 soil vapor data.

The preliminary risk evaluation generally followed procedures outlined in DTSC–Cal/EPA's 2011 Vapor Intrusion Guidance Document (VI Guidance, DTSC – Cal/EPA 2011) and resulted in the following conclusions:

- **Future Buildings.** The preliminary screening evaluation showed potential risks from vapor intrusion for future residential and industrial buildings within the excess carcinogenic risk range of 1×10^{-6} to 1×10^{-4} (NCP, 40 CFR 300.430). Risks less than 1×10^{-6} are allowable, while risks greater than 1×10^{-4} may require additional evaluation or remedial action. However, due to a change in the vinyl chloride DTSC residential air screening level (from 0.031 µg/m^3 to 0.0095 µg/m^3 [DTSC 2015]), the potential future residential risk associated with vinyl chloride is greater than 1×10^{-4}. These conclusions, which were based on 2012 and 2013 soil vapor data, would not change using 2014 soil vapor data. Based on this, vapor mitigation (e.g., constructive vapor barriers) may be required for future buildings at IRP Site 40.
- **Existing Buildings**. Excess carcinogenic risks for the existing buildings (based on industrial use) are within the carcinogenic risk range of 1×10^{-6} to 1×10^{-4}. These conclusions, which were based on 2012 and 2013 soil vapor data, would not change using 2014 soil vapor data. Based on these results, it was recommended to collect two rounds of indoor air samples within Buildings 239 and 240 and ambient (outdoor) air samples outside of the VOC groundwater plume so that potential risks can be calculated using actual, instead of estimated, indoor air concentrations.

6.3 2015 Risk assessment

Indoor and ambient air samples were collected in February and July 2015 so that potential risks could be calculated using actual, instead of estimated, indoor air concentrations.

Indoor and outdoor air samples were collected concurrently using 6-liter stainless steel Summa canisters over an 8-hour period, which represents a typical work day. Air sampling was conducted using vacuum gauges and 8-hour flow controllers. The indoor air canisters were placed so that the samples were collected in the breathing zone, approximately 3- to 5-feet aboveground. The outdoor air canisters were located approximately 6-feet aboveground. The canisters were filled until the vacuum equivalent of approximately 5-inches of mercury remained in the Summa canister.

Summary of results for each COC:

- Vinyl Chloride and cis-1,2-DCE are the primary groundwater COCs at IRP Site 40. Neither COC was detected in indoor air at concentrations greater than DTSC residential or industrial air screening levels.
- TCE has been detected in groundwater infrequently in the vicinity of buildings 239 and 240. The preliminary screening evaluation using existing soil vapor data indicated a potential for indoor air concentrations greater than the DTSC residential air screening level for TCE. However, TCE was not detected in indoor air at concentrations greater than DTSC residential or industrial air screening levels for TCE.
- PCE was generally not detected in groundwater in the vicinity of Buildings 239 and 240 and the preliminary risk evaluation using existing soil vapor data predicted PCE indoor air concentrations less than DTSC residential and industrial air screening levels for PCE. However, this prediction would have been different if the 2014 soil vapor data were used in the preliminary risk evaluation. During the February 2015 sampling event, PCE was detected in indoor air at concentrations greater than DTSC residential and industrial air screening level for PCE. However, these concentrations

appear to be associated with ambient air as the indoor and ambient air PCE air concentrations are similar. During the July 2015 sampling event, PCE was detected in indoor air at concentrations less than the DTSC air screening levels and less than the PCE concentrations detected in ambient air.

Based on the indoor and ambient air data collected in February, April, and July 2015, there is no indication of vapor intrusion occurring at Buildings 239 and 240. Indoor air detections of TCE and PCE appear to be associated with ambient air as the indoor air TCE and PCE concentrations are consistent with the TCE and PCE ambient air concentrations. Therefore, because the vapor intrusion pathway is not complete, COCs in groundwater at IRP Site 40 do not pose an unacceptable risk to potential receptors.

7.0 CONCLUSIONS AND RECOMMENDATION

While the contaminant plume boundaries have shifted slightly (as expected due to dechlorination activity), significant reductions in total chloroethene concentrations have been observed in all monitoring wells over the life of the project. Trichloroethene had a slight increase in concentrations during the December 2014 monitoring event. However, the single exceedance was at a concentration of 5.5 µg/L, only slightly above the TCG of 5.0 µg/L.

Field parameter data suggest an environment favorable for reductive dechlorination to continue. However, COC concentrations have decreased to very low levels across the site, which would limit the rate of dechlorination.

The risk assessment concluded that there are no complete exposure pathways to COCs in groundwater at IRP Site 40 and that the COCs in groundwater do not pose an unacceptable risk to potential receptors.

The data presented in the 2014 Annual IRP Site 40 Groundwater Monitoring Report (CKY 2016) and summarized in this Site Closure Report support a request for No Further Action at this Site based on the following main conclusions:

- While COC concentrations in groundwater remain above the TCGs in some monitoring points at the Site, it is highly unlikely that there will be any contact between potential receptors and the groundwater.
- Given the Site's proximity to the ocean and brackish groundwater, the groundwater offers no beneficial use for consumption.
- The plume has not shown evidence of migration and the site conditions remain favorable to continued dechlorination.
- The anticipated use of the Site is projected to remain industrial under the Navy's control.
- As outlined in Section 6.0, the vapor intrusion pathway does not appear to be complete and COCs in groundwater at IRP Site 40 do not pose an unacceptable risk to potential receptors.

Based on the above, it is recommended that a determination of No Further Action be made for IRP Site 40. With the residual contamination in the groundwater and the soil gas, the site will remain as an industrial site. For any intrusive work in the area of the site, the Navy will exercise precautionary measures to ensure the health and safety of workers. The Navy will also consider the site condition prior to any additional development of the area.

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TABLES

Table 1. SUMMARY OF LABORATORY ANALYTICAL RESULTS
FOR COCs IN GROUNDWATER SAMPLES FROM KEY MONITORING WELLS
OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/L)	trichloroethene (µg/L)	cis-1,2-dichloroethene (µg/L)	vinyl chloride (µg/L)
MW-40-07	10/25/2005	**85**	2	0.28 J	0.5 U
	11/28/2005	**90**	2.4	0.34 J	0.5 U
	1/9/2006	**110**	3.7 J	0.41 J	0.5 U
	3/23/2006	**25**	0.85 J	1 U	0.5 U
	7/11/2006	**100**	3.2	0.31	0.5
	9/21/2006	**94**	3.1	0.43 J	0.5 U
	1/9/2007	**83**	2.7	0.34 J	0.5 U
	4/4/2007	**49**	1.8	1 U	0.5 U
	5/16/2007	NA	NA	NA	NA
	6/14/2007	NA	NA	NA	NA
	7/10/2007	**11**	**6.7**	**36**	0.5 U
	10/16/2007	3	1.4	**48**	0.5 U
	1/15/2008	2.8	1.7	**47**	0.5 U
	4/14/2008	2.6	1.7	**42**	**5.4**
	7/16/2008	1.3	1.8	**12**	**8.3**
	10/6/2008	1 U	1.1	3.9	**4.7**
	5/21/2009	1 U	0.51 J	3.2	**1.2**
	5/6/2010	1 U	0.28 J	0.67 J	**0.78**
	Dec. 2011	0.5 UJ	0.5 U	0.50 U	**0.5**
	Dec. 2012	0.50 U	0.46 J	0.89 J	**0.98 J**
	Dec. 2013	0.50 U	1.9	2.8	**7.5**
	Dec. 2014	0.50 U	0.44 J	1.5	**1.3**
MW-40-08	1/6/2006	**7.5**	1.5	0.24 J	0.5 U
	3/22/2006	**5.5**	1.1	1 U	0.5 U
	7/13/2006	**6.2**	1.2	1	0.5
	9/21/2006	**6.6**	1.4	1 U	0.5 U
	1/11/2007	**5.4**	1.1	1 U	0.5 U
	4/4/2007	**5.3**	1.1	1 U	0.5 U
	7/12/2007	**6.1**	1.5	0.23 J	0.5 U
	10/16/2007	**6.5**	1.4	0.29 J	0.5 U
	1/16/2008	**6.8**	1.5	0.33 J	0.5 U
	7/15/2008	**11**	3.3	0.69 J	0.5 U
	10/7/2008	**10**	3.7	0.83 J	0.5 U
	5/22/2009	0.29 J	1 U	1 U	0.5 U
	5/6/2010	1 U	0.46 J	**27**	0.5 U
	9/30/2010	1 U	1 U	**38**	0.5 U
	Dec. 2011	0.5 UJ	0.5 U	**56**	0.44 J
	Dec. 2012	0.50 U	0.50 U	**42**	**1.4**
	Dec. 2013	0.50 U	0.50 U	**25**	**1.7**
	Dec. 2014	0.50 U	0.50 U	**15**	**1.0**

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FOR COCs IN GROUNDWATER SAMPLES FROM KEY MONITORING WELLS
OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/L)	trichloroethene (µg/L)	cis-1,2-dichloroethene (µg/L)	vinyl chloride (µg/L)
MW-40-14	10/24/2005	1.1	1	**66**	0.5 U
	11/28/2005	1 U	0.37 J	**38**	**5**
	1/4/2006	1 U	1 U	5.2	**13**
	3/21/2006	0.55 J	**8.1**	**16**	**17**
	7/11/2006	1	3.3	**16**	**16**
	9/19/2006	1 U	1.8	**11**	**11**
	1/9/2007	1 U	0.61 J	1.2	**4.6**
	4/3/2007	1 U	1.1	1.5	**2.8**
	7/10/2007	1 U	0.58 J	0.51 J	0.5 U
	10/15/2007	1 U	2.4	**11**	**3.8**
	1/15/2008	0.65 J	4.2	**20**	**4**
	4/14/2008	4.6	**6**	**26**	**2.8**
	7/15/2008	**5.2**	**5.8**	**14**	**3.6**
	10/7/2008	4.8	**5.9**	**13**	**6**
	5/22/2009	**8.7**	**36**	**19**	**23**
	5/6/2010	1 U	0.92 J	1.3	**3.1**
	Dec. 2011	0.5 UJ	1.9	3.7	**5.3**
	Dec. 2012	0.50 U	1.5	2.7	**3.6**
	Dec. 2013	0.50 U	1.2	3.0	**3.5**
	Dec. 2014	0.50 U	**5.5**	**11**	**3.2**
MW-40-30	10/24/2005	**130**	**44**	**44**	**0.85**
	11/30/2005	**110**	**42**	**37**	**0.83**
	1/9/2006	**150**	**60**	**57**	**1.2**
	3/22/2006	**130**	**43**	**36**	0.48 J
	7/12/2006	**83**	**35**	**26**	0.46
	9/20/2006	**81**	**40**	**34**	**0.65**
	1/10/2007	**74**	**31**	**48**	0.39 J
	4/4/2007	**91**	**38**	**70**	0.42 J
	5/16/2007	NA	NA	NA	NA
	6/14/2007	NA	NA	NA	NA
	7/11/2007	**66**	**34**	**45**	0.38 J
	10/16/2007	**60**	**28**	**32**	**1.2**
	1/16/2008	0.36 J	1 U	**110**	**11**
	4/14/2008	0.84 J	2.2	**86**	**8.3**
	7/16/2008	**5.6**	**12**	**47**	**4.2**
	10/6/2008	2.6	**29**	**31**	**5.4**
	5/21/2009	1 U	2	5.7	**6.3**
	5/6/2010	1 U	0.79 J	3.7	**4**
	Dec. 2011	0.5 UJ	0.5 U	0.95	**1.2**
	Dec. 2012	0.50 U	0.50 U	1.2	**0.96 J**
	Dec. 2013	0.50 U	0.50 U	3.4	**3.6**
	Dec. 2014	0.50 U	0.50 U	3.7	**2.3**

Table 1. SUMMARY OF LABORATORY ANALYTICAL RESULTS
FOR COCs IN GROUNDWATER SAMPLES FROM KEY MONITORING WELLS
OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/L)	trichloroethene (µg/L)	cis-1,2-dichloroethene (µg/L)	vinyl chloride (µg/L)
MW-40-31	10/26/2005	1 U	0.61 J	**9 J**	3.2 J
	11/30/2005	1 U	0.93 J	**6.2**	2.8
	1/9/2006	1 U	0.84 J	4.5	2.6
	3/22/2006	0.59 J	0.55 J	1.9	0.83
	7/12/2006	1 U	0.23 J	0.96 J	0.7
	9/20/2006	1 U	1 U	0.88 J	0.49 J
	1/10/2007	1 U	0.37 J	0.61 J	0.37 J
	4/4/2007	1 U	0.29 J	0.45 J	0.39 J
	7/11/2007	1 U	0.3 J	0.67 J	0.25 J
	10/16/2007	1 U	1 U	0.47 J	0.23 J
	1/16/2008	1 U	1 U	0.58 J	0.2 J
	5/21/2009	1 U	1 U	0.53 J	0.26 J
	5/6/2010	1 U	1 U	0.83 J	0.6
	Dec. 2011	0.5 UJ	0.5 U	0.5 U	0.5 U
	Dec. 2012	0.50 U	0.50 U	0.50 U	0.50 U
	Dec. 2013	0.50 U	0.50 U	0.50 U	0.50 U
	Dec. 2014	0.50 U	0.50 U	0.50 U	0.50 U
MW-40-32	10/25/2005	1.3	1.4	**150**	**8.5**
	11/30/2005	**19**	**9.6**	**82**	**5.7**
	1/9/2006	**10**	**6.1 J**	**150**	0.5 U
	3/22/2006	**5.1**	2.6	**160**	**1.8**
	7/12/2006	**34**	**16**	**46**	**1.7**
	9/20/2006	**39**	**20**	**44**	**1.8**
	1/10/2007	**50**	**23**	**30**	**1.2**
	4/4/2007	**47**	**22**	**25**	**0.97**
	5/16/2007	NA	NA	NA	NA
	6/14/2007	NA	NA	NA	NA
	7/11/2007	10	**13**	**26**	**1.6**
	10/16/2007	1 U	1.4	**10**	**9.5**
	1/16/2008	0.74 J	1.3	**12**	**5.6**
	4/14/2008	0.6 J	3.1	**20**	**4.8**
	7/16/2008	0.22 J	1.3	**8.6**	**3.8**
	10/6/2008	1 U	0.62 J	5.1	**4.2**
	5/22/2009	1 U	1 U	0.64 J	**1.3**
	5/6/2010	1 U	1 U	1.2	**2.1**
	Dec. 2011	0.5 UJ	0.5 U	0.72	**0.80**
	Dec. 2012	0.50 U	0.50 U	0.98 J	**0.55 J**
	Dec. 2013	0.50 U	0.50 U	0.94 J	**0.88 J**
	Dec. 2014	0.50 U	0.50 U	1.2	**0.54 J**

Table 1. SUMMARY OF LABORATORY ANALYTICAL RESULTS
FOR COCs IN GROUNDWATER SAMPLES FROM KEY MONITORING WELLS
OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/L)	trichloroethene (µg/L)	cis-1,2-dichloroethene (µg/L)	vinyl chloride (µg/L)
MW-40-34	10/24/2005	**33**	**6.5**	**74**	**0.79**
	11/28/2005	**31**	2.1	**7.5**	**1.1**
	1/5/2006	**29**	1.3	4.7	**1.6**
	3/22/2006	**22**	0.64 J	2.1	**0.59**
	7/12/2006	**18**	0.89	2.3	**0.54**
	9/20/2006	**28**	1.2	2.8	**0.67**
	1/10/2007	**22**	1	1.8	**0.53**
	4/3/2007	**24**	1.2	1.9	**0.66**
	5/16/2007	NA	NA	NA	NA
	6/14/2007	NA	NA	NA	NA
	7/11/2007	4.5	1.3	**14**	0.5 U
	10/15/2007	0.31 J	1.2	**17**	**2.2**
	1/16/2008	1 U	0.65 J	**8.5**	**2.6**
	4/14/2008	1 U	0.25 J	3	**1.7**
	7/16/2008	1 U	1 U	1.6	**1.3**
	10/6/2008	1 U	1 U	1.6	**1.1**
	5/21/2009	1 U	1 U	0.44 J	0.35 J
	5/6/2010	1 U	1 U	1 U	0.33 J
	Dec. 2011	0.5 UJ	0.5 U	0.5 U	0.38 J
	Dec. 2012	0.50 U	0.50 U	0.50 U	0.50 U
MW-40-35	10/25/2005	**13**	4.4	**22**	**0.65**
	11/30/2005	**7**	**5.6**	**20**	**2.1**
	1/5/2006	3.5	**6.4**	**22**	**2.6**
	3/22/2006	0.48 J	**5.6**	**9.7**	**1.1**
	7/12/2006	1 U	1.2	5.5	**0.73**
	9/20/2006	1 U	0.67 J	**6.6**	**0.58**
	1/10/2007	1 U	0.64 J	3.5	0.25 J
	4/3/2007	1 U	0.66 J	2.6	0.5 U
	7/11/2007	1 U	0.95 J	2.1	0.5 U
	10/15/2007	0.29 J	2.2	3.5	0.5 U
	1/16/2008	1 U	0.55 J	3.6	0.5 U
	5/22/2009	0.26 J	0.27 J	**11**	0.22 J
	5/6/2010	1 U	0.26 J	3	0.5 U
	Dec. 2011	0.5 UJ	0.5 U	3.4	**0.55**
	Dec. 2012	0.50 U	0.50 U	1.3	0.50 U
	Dec. 2013	0.50 U	0.50 U	0.99 J	0.34 J
	Dec. 2014	0.50 U	0.50 U	0.58 J	0.50 U

Table 1. SUMMARY OF LABORATORY ANALYTICAL RESULTS
FOR COCs IN GROUNDWATER SAMPLES FROM KEY MONITORING WELLS
OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/L)	trichloroethene (µg/L)	cis-1,2-dichloroethene (µg/L)	vinyl chloride (µg/L)
MW-40-36	10/24/2005	**160**	**14**	**20**	0.5 U
	11/30/2005	**390**	**29**	**48**	0.5 U
	1/5/2006	**160**	**16**	**22**	**0.6**
	3/22/2006	**140**	**15**	**20**	0.41 J
	7/12/2006	**110**	**18**	**18**	0.42
	9/20/2006	**150**	**24**	**20**	**0.6**
	1/10/2007	**87**	**30**	**26**	**0.95**
	4/3/2007	**43**	**85**	**17**	**0.65**
	5/16/2007	NA	NA	NA	NA
	6/14/2007	NA	NA	NA	NA
	7/11/2007	1	2	**35**	**9.6**
	10/15/2007	2.6	4.6	**19**	**6.4**
	1/16/2008	1.1	2.1	**17**	**6.5**
	4/14/2008	1 U	0.68 J	**11**	**4.6**
	7/16/2008	1 U	1 U	4.8	**3.5**
	10/6/2008	1 U	1 U	1.6	**2.3**
	5/22/2009	1 U	0.42 J	1.5	**1.9**
	5/6/2010	1 U	0.56 J	1.5	**2.2**
	Dec. 2011	0.5 UJ	0.41 J	1.4	**1.2**
	Dec. 2012	0.50 U	0.80 J	2.8	**1.6**
	Dec. 2013	0.50 U	1.2	6.0	**3.5**
	Dec. 2014	0.50 U	2.4	**10**	**4.6**

Table 1. SUMMARY OF LABORATORY ANALYTICAL RESULTS
FOR COCs IN GROUNDWATER SAMPLES FROM KEY MONITORING WELLS
OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/L)	trichloroethene (µg/L)	cis-1,2-dichloroethene (µg/L)	vinyl chloride (µg/L)
MW-40-37	10/25/2005	**380**	**38**	**58**	0.5 U
	11/30/2005	**150**	**13**	**17**	0.23 J
	1/9/2006	**440**	**48 J**	**63**	0.5 U
	3/23/2006	**100**	**28**	**35**	**1.2**
	7/12/2006	**84**	**39**	**33**	**3.2**
	9/20/2006	1.3	**16**	**140**	**4.5**
	1/10/2007	2.1	0.94 J	**140**	**18**
	4/4/2007	1.1	4.9	**89**	**18**
	5/16/2007	NA	NA	NA	NA
	6/14/2007	NA	NA	NA	NA
	7/11/2007	0.31 J	0.36 J	**64**	**24**
	10/1/2007	1.6	3	**69**	**16**
	1/16/2008	0.36 J	1.3	**94**	**18**
	4/14/2008	1 U	1.3	**58**	**12**
	7/1/2008	0.48 J	1.5	**82**	**18**
	10/1/2008	1 U	1.7	**110**	**27**
	5/21/2009	1 U	1 U	**46**	**13**
	5/6/2010	1 U	4	**90**	**37**
	Dec. 2011	0.5 UJ	2.5	**61**	**8.7**
	Dec. 2012	0.50 U	0.81 J	**37**	**3.9**
	Dec. 2013	0.50 U	0.48 J	**33**	**4.9**
	Dec. 2014	0.50 U	0.50 U	**33**	**4.8**

Notes:

J – estimated value

U – not detected above the associated reporting limit

UJ – not detected above the associated estimated reporting limit

Abbreviations and Acronyms:

µg/L – micrograms per liter

COCs - chemicals of concern

PCE – tetrachloroethene

TCE – trichloroethene

DCE – dichloroethene

VC – vinyl chloride

Table 2. SUMMARY OF LABORATORY ANALYTICAL RESULTS FOR COCs IN SOIL GAS SAMPLES COLLECTED FROM KEY WELLS OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/m^3)	trichloroethene (µg/m^3)	cis-1,2-dichloroethene (µg/m^3)	vinyl chloride (µg/m^3)
IW-1	10/11/05	7,900	5,500	26,000	3,700
	10/31/05	3,700	3,600	17,100	2,600
	11/29/05	4,000	2,800	22,300	4,900
	01/18/06	1,100	2,200	10,000	2,300
	03/16/06	680	2,000	5,100	1,600
	07/19/06	500 U	850	8,300	5,400
	09/14/06	270 U	780	10,200	7,800
	01/08/07	1800 U	450 U	11,500	6,700
	04/05/07	1800 U	350 U	16,100	6,900
	07/09/07	3600 U	680 U	14,800	10,300
	10/11/07	180 U	360 J	9,700	8,100
	10/11/07	180 U	370 J	12,200	9,300
	01/22/08	26 U	50 J	1,400	1,700
	04/10/08	360 U	290 U	5,500	5,300
	07/15/08	360 U	480 J	9,900	7,500
	07/15/08	360 U	480 J	10,500	8,000
	10/02/08	140 U	930	15,400	12,000
	10/02/08	140 U	820	14,500	11,500
	05/28/09	140 U	180 J	2,600	1,100
	05/04/10	360 U	330	2,600	3,900
	Dec 2011	18	190	2,100	3,100
	Dec 2012	32	540	1,300	2,400
	Dec 2013	24	490	990	1,300
	Dec 2014	9000	470	23	9.4
IW-3	10/11/05	17,500	6,500	1,300	5,000
	10/31/05	22,100	6,800	2,300	16,400
	11/29/05	22,000	6,400	5,500	40,500
	01/18/06	19,400	9,300	2,300	27,400
	03/16/06	880	1,400	3,200	8,400
	07/19/06	10,200	5,400	3,400	21,000
	09/14/06	9,000	4,200	3,000	21,500
	01/08/07	7,400	1,300 J	1,300	15,200
	04/05/07	2,300	2,400	3,000	16,100
	07/09/07	3,600	4,000	4,600	16,200
	10/11/07	3,900	680	690	18,400
	01/22/08	280 J	570	1,100	3,500
	04/10/08	430 J	810 J	960 J	6,200
	07/15/08	2,500	1,700	210 U	130 U
	10/02/08	420 J	340 J	670	14,000
	Dec 2011	7.5	16	25	1,000
	Dec 2012	2.7 U	3.9 J	9.1	610
	Dec 2013	1.9 J	5.4	8.7	430
	Dec 2014	10 U	7.1	8.4	440

Table 2. SUMMARY OF LABORATORY ANALYTICAL RESULTS FOR COCs IN SOIL GAS SAMPLES COLLECTED FROM KEY WELLS OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/m^3)	trichloroethene (µg/m^3)	cis-1,2-dichloroethene (µg/m^3)	vinyl chloride (µg/m^3)
IW-7	10/11/05	4,600	480 U	74,900	19,600
	10/31/05	5,900	400	46,700	9,500
	11/29/05	6,400	480 U	51,800	28,900
	01/18/06	5,600	970	10,400	25,700
	03/16/06	1,000	100	920	7,600
	07/19/06	2,100	850	820	14,500
	09/14/06	3,300	800	900	15,500
	01/08/07	8,300	1,600	1,500	12,200
	04/05/07	1,900	2,000	2,300	10,000
	07/09/07	550 J	1,400 U	1,100 U	670 U
	10/11/07	2,900	4,400	1,200	15,300
	01/22/08	420	1,200	470	3,100
	04/10/08	1,100 J	4,000	1,100	7,000
	07/15/08	2,100	5,600	890	9,100
	10/02/08	6,400	5,400	720	14,600
	05/28/09	140 J	1,400	810	940
	05/04/10	260 J	260 J	210 U	7,000
MW-40-34	10/11/05	16,800	910	1,100	330
	10/31/05	21,200	1,300	1,800	470
	11/29/05	41,200	850	580	1,100
	01/18/06	55,800	920	310	690
	03/16/06	2,600	100	22 U	150
	07/19/06	81,900	3,100	360 U	810
	09/14/06	60,200	3,100	900	900
	01/08/07	30,500	2,900	1,000	1,100
	04/05/07	47,400	3,100	760	1,200
	07/09/07	32,900	4,000	1,300	730
	10/11/07	21,400	1,600	1,400	480 J
	01/22/08	2,700	590	320	380
	04/10/08	16,500	1,700	1,200	670
	07/15/08	17,600	3,600	3,400	940
	10/02/08	7,000	1,800	3,300	3,000
MW-40-37	05/28/09	140 U	1,100	600	1,700
	Dec 2011	12	71	1400	980
	Dec 2012	8.1 J	120	320	1,200
	Dec 2013	32	110	480	640
	Dec 2014	69	88	350	440

Table 2. SUMMARY OF LABORATORY ANALYTICAL RESULTS FOR COCs IN SOIL GAS SAMPLES COLLECTED FROM KEY WELLS OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/m^3)	trichloroethene (µg/m^3)	cis-1,2-dichloroethene (µg/m^3)	vinyl chloride (µg/m^3)
VW-40-01	10/11/05	5,400	3,800	21,100	8,800
	10/31/05	4,200	3,900	15,000	7,200
	11/29/05	7,500	5,000	20,000	9,400
	01/18/06	2,600	4,100	8,900	6,300
	03/16/06	96	330	740	430
	07/19/06	1,500	8,800	11,800	7,500
	09/14/06	1,000	7,500	11,100	7,600
	01/08/07	1,800 U	1,100 J	6,400	6,400
	04/05/07	1,800 U	4,600	9,700	7,100
	07/09/07	1,800 U	4,200	5,500	6,000
	10/11/07	180 U	2,900	3,400	3,600
	01/22/08	26 U	310	840	1,300
	04/10/08	360 U	2,400	3,900	3,800
	07/15/08	360 U	2,400	2,800	3,200
	10/02/08	180 J	2,200	2,500	4,400
VW-40-02	10/11/05	6,800	5,700	12,000	6,800
	10/31/05	5,700	4,900	7,900	4,800
	11/29/05	8,400	5,900	10,400	5,800
	01/18/06	7,300	5,000	5,700	4,100
	03/16/06	500	460	1,400	860
	07/19/06	13,500	10,400	6,600	5,100
	09/14/06	1,700	1,600	17,800	5,900
	01/08/07	460 J	1,800	11,300	5,200
	04/05/07	440 J	2,800	16,500	5,700
	07/09/07	3,600 U	1,200 J	5,400	6,600
	10/11/07	180 U	1,800	9,300	5,800
	01/22/08	26 U	210 J	1,100	1,300
	04/10/08	360 U	290 U	5,700	4,100
	07/15/08	360 U	2,100	1,700	1,900
	10/02/08	140 U	480 J	4,500	4,500
	Dec 2011	100	360	7,200	4,600
	Dec 2012	160	3900	4,000	4,600
	Dec 2013	14	65	3,700	4,300
	Dec 2014	140	540	310	2,100

Table 2. SUMMARY OF LABORATORY ANALYTICAL RESULTS FOR COCs IN SOIL GAS SAMPLES COLLECTED FROM KEY WELLS OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/m^3)	trichloroethene (µg/m^3)	cis-1,2-dichloroethene (µg/m^3)	vinyl chloride (µg/m^3)
VW-40-03	10/11/05	61,900	6,400	11,100	7,300
	10/31/05	58,000	6,300	8,800	5,900
	11/29/05	75,100	7,900	12,000	7,000
	01/18/06	60,500	4,500	5,500	2,800
	03/16/06	28,900	2,300	4,600	1,300
	07/19/06	69,000	6,400	7,000	1,800
	09/14/06	57,500	6,000	7,500	1,700
	01/08/07	37,400	4,500	5,800	2,000
	04/05/07	49,500	4,400	6,200	2,000
	07/09/07	21,400	7,800	3,300	2,400
	10/11/07	8,600	16,300	4,800	1,900
	01/22/08	840	2,300	810	550
	04/10/08	6,700	22,100	3,300	1,700
	07/15/08	3,900	23,300	3,600	1,400
	10/02/08	2,800	25,400	4,400	1,900
	05/28/09	1,400 U	8,700	7,800	3,400
	05/04/10	180 J	9,300	9,000	3,200
	Dec 2011	67	3,600	5,200	1,900
	Dec 2012	53	2,600	4,800	2,800
	Dec 2013	20	1,100	1,900	3,100
	Dec 2014	4200	660	970	3,400
VW-40-04	10/11/05	6,600	380	850	220 U
	10/31/05	4,100	230	360	220 U
	11/29/05	4,800	420	540	220 U
	01/08/07	7,900	1,200 J	230 J	670 U
	07/09/07	5,900	2,800	2,500	16,500
	10/11/07	2,100	190 J	190 J	67 U
	01/22/08	540	130 J	47 J	350
	04/10/08	1,600 J	930 J	210 U	1,600
	07/15/08	3,900	290 J	210 U	130 U
	10/02/08	2,000	110 U	84 U	54 U
	Dec 2011	290	25	33	2.8
	Dec 2012	450	4.1	0.79 U	1.3 U
	Dec 2013	280	3.2	0.8 U	1.3 U
	Dec 2014	690	20	5.7	1.1

Table 2. SUMMARY OF LABORATORY ANALYTICAL RESULTS FOR COCs IN SOIL GAS SAMPLES COLLECTED FROM KEY WELLS OCTOBER 2005 THROUGH DECEMBER 2014

Location	Date	tetrachloroethene (µg/m^3)	trichloroethene (µg/m^3)	cis-1,2-dichloroethene (µg/m^3)	vinyl chloride (µg/m^3)
VW-40-05	10/11/05	5,300	230	730	220 U
	10/31/05	4,100	220	410	220 U
	11/29/05	4,800	360	520	220 U
VW-40-06	10/11/05	44,700	5,900	4,000	1,700
	10/31/05	51,000	8,700	2,900	1,800
	11/29/05	65,200	11,400	5,700	2,400
	01/18/06	56,600	8,000	3,100	1,500
	03/16/06	7,600	1,600	600	380
	07/19/06	57,000	10,300	2,500	1,700
	09/14/06	40,100	9,300	3,200	1,700
	01/08/07	22,700	8,500	2,600 J	2,500
	04/05/07	26,500	4,000	1,000	670 U
	07/09/07	12,700	12,100	3,100	1,400
	10/11/07	5,900	1,800	10,100	4,400
	01/22/08	620	240 J	1,100	2,600
	04/10/08	2,000	960 J	3,300	8,600
	07/15/08	2,000	1,200	2,100	7,200
	10/02/08	1,900	1,400	2,600	5,700
	05/28/09	360 U	1,200 J	990 J	6,700
	05/28/09	360 U	830 J	590 J	260 J
	05/04/10	190 J	640	370	1,600
	Dec 2011	34	300	170	470
	Dec 2012	16	150	150	490
	Dec 2013	16	120	87	360
	Dec 2014	1300	180	150	390

Abbreviations and Acronyms:

µg/m^3 – micrograms per cubic meter
DCE – dichloroethene
J – estimated value
PCE – tetrachloroethene
TCE – trichloroethene
U – analyte is not detected at or below the listed reporting limit
VC – vinyl chloride

FIGURES

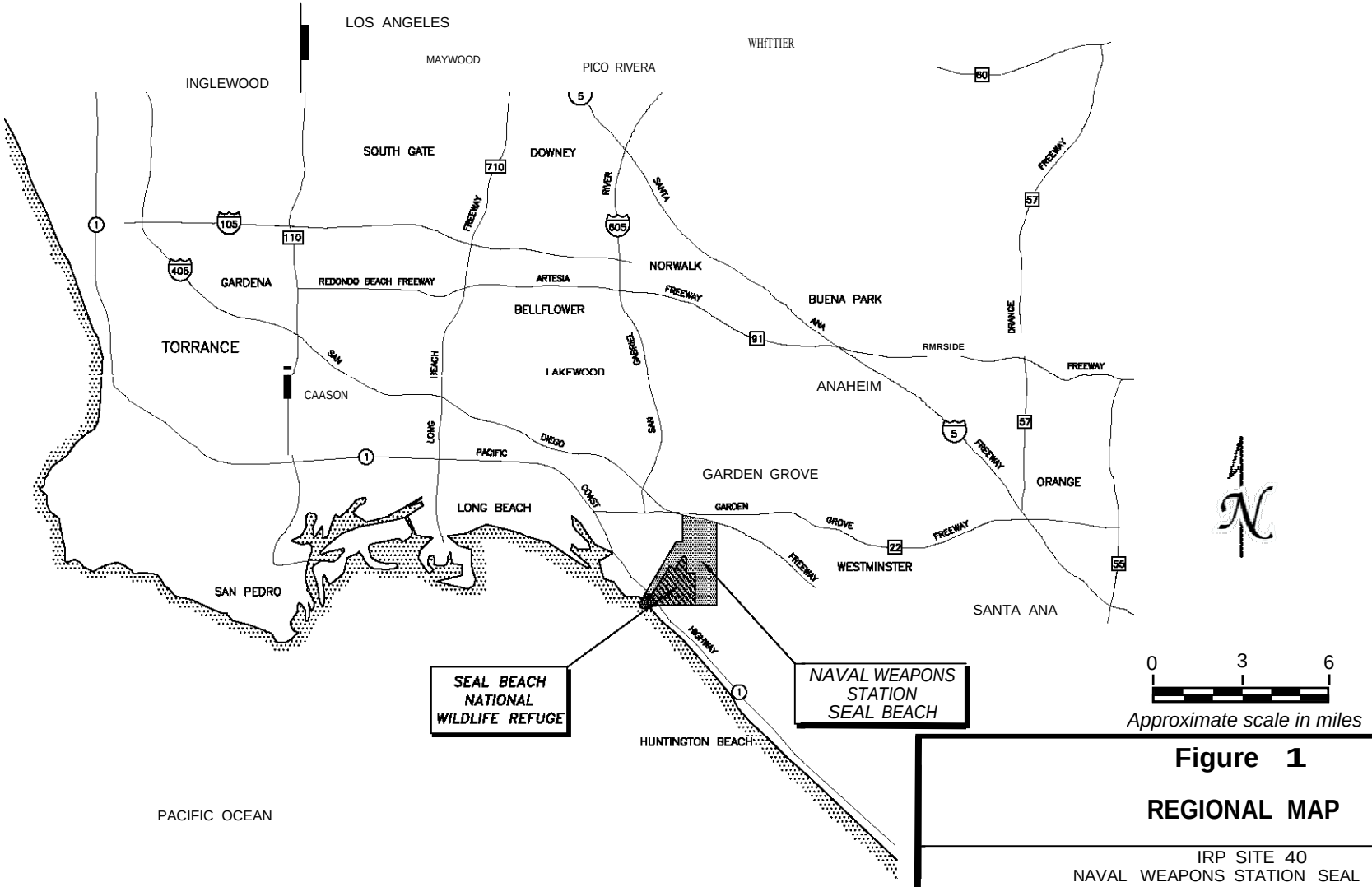

Figure 1

REGIONAL MAP

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

SOURCE: CH2M HILL 2002, TtEC 2011

CKY Incorporated
Civil Engineering - Environmental Remediation

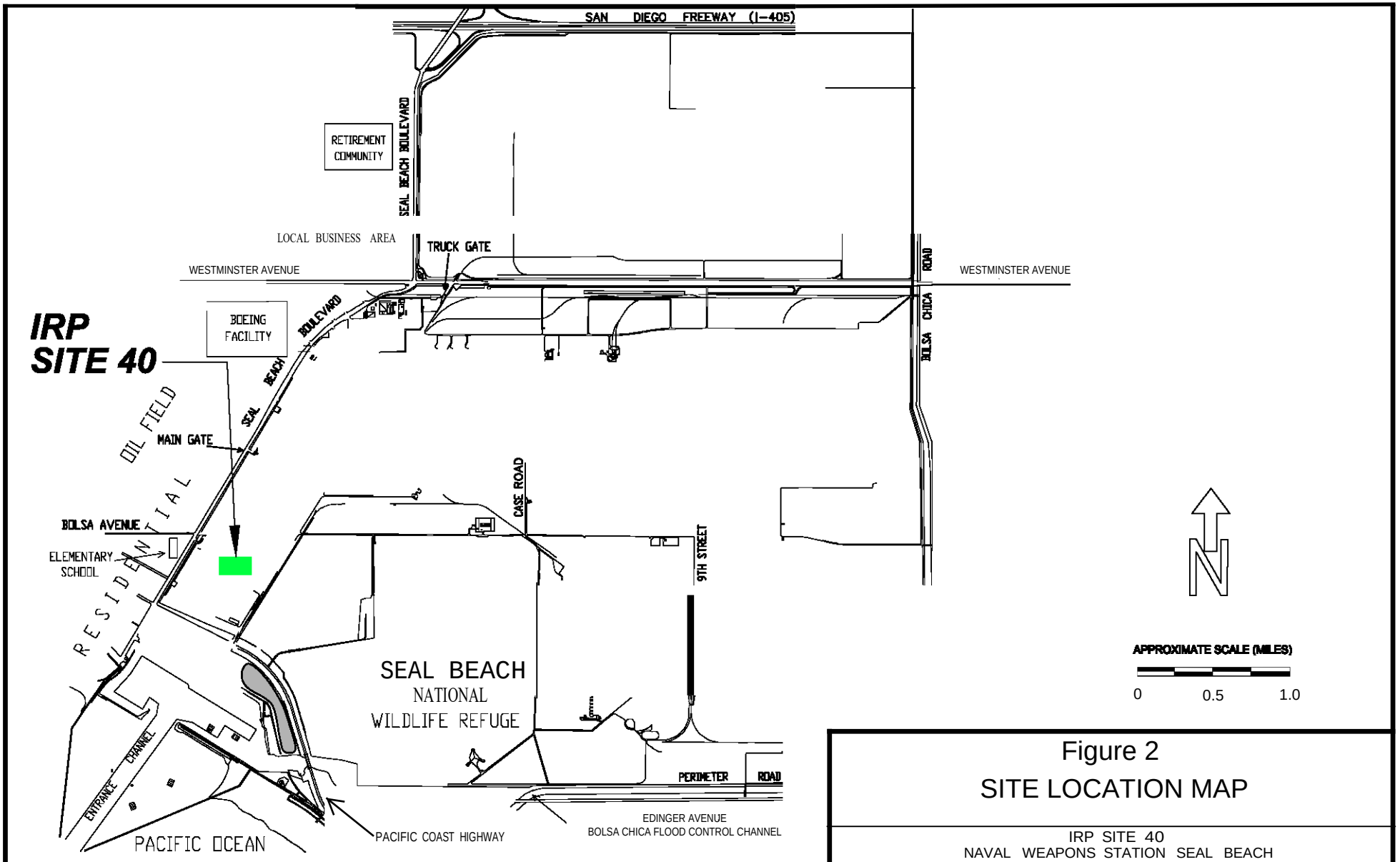

Figure 2

SITE LOCATION MAP

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

CKY Incorporated
Civil Engineering · Environmental Remediation

SOURCE: TtEC 2011

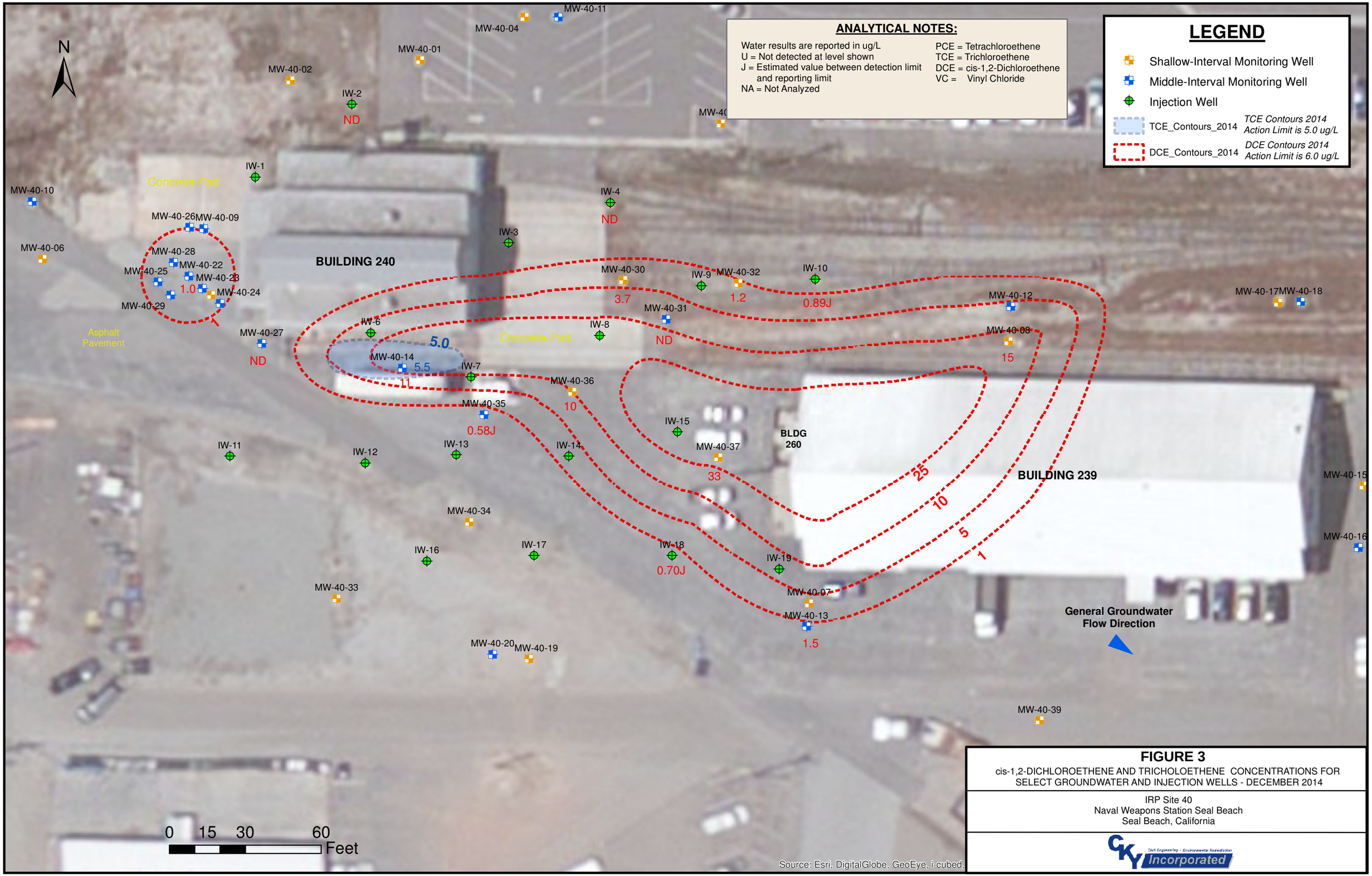

FIGURE 3

cis-1,2-DICHLOROETHENE AND TRICHOLOETHENE CONCENTRATIONS FOR SELECT GROUNDWATER AND INJECTION WELLS - DECEMBER 2014

IRP Site 40
Naval Weapons Station Seal Beach
Seal Beach, California

CKY Incorporated

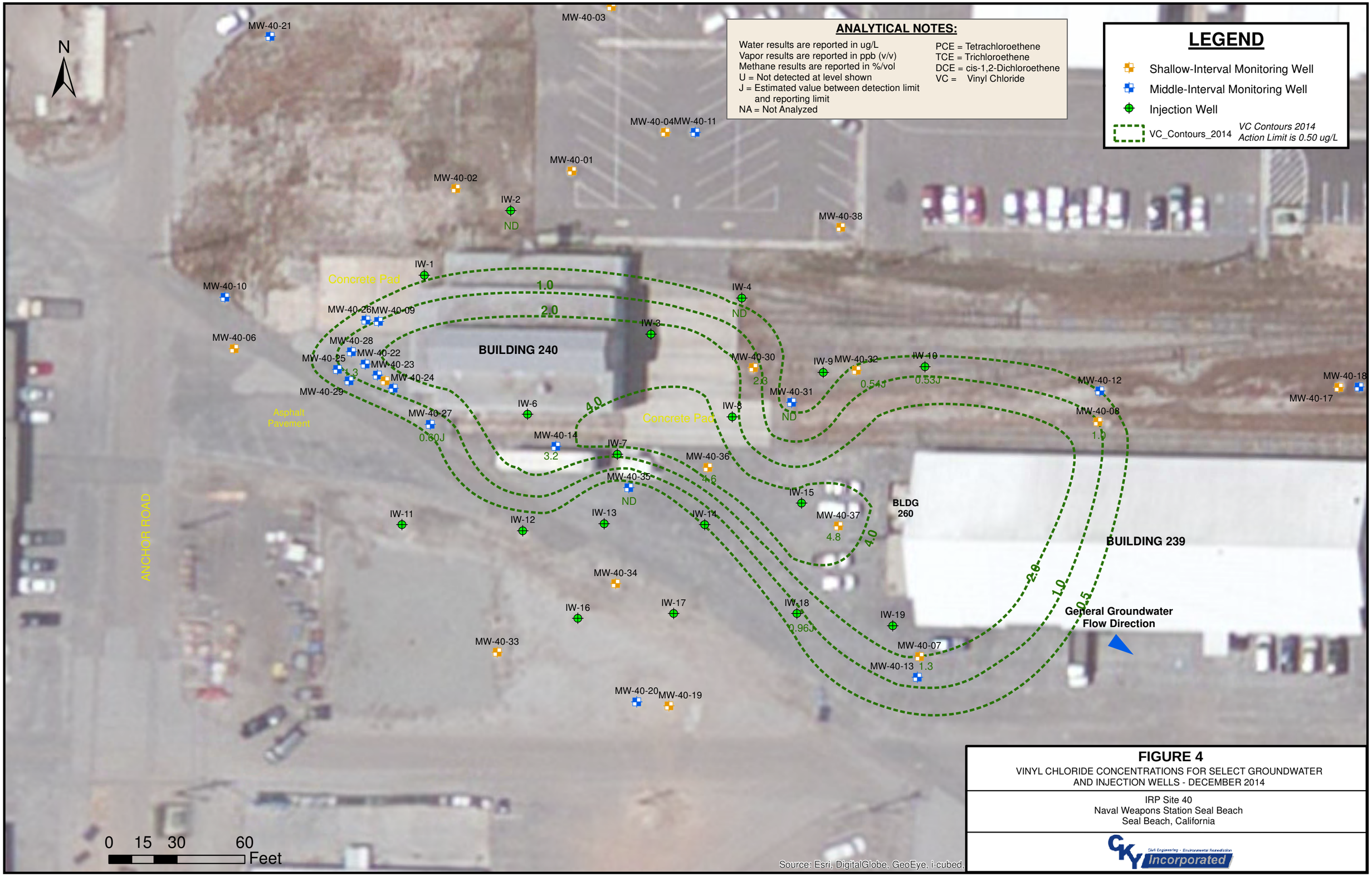

FIGURE 4

VINYL CHLORIDE CONCENTRATIONS FOR SELECT GROUNDWATER AND INJECTION WELLS - DECEMBER 2014

IRP Site 40
Naval Weapons Station Seal Beach
Seal Beach, California

CKY Incorporated
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