DRAFT

2013 ANNUAL GROUNDWATER MONITORING REPORT INSTALLATION RESTORATION PROGRAM SITE 40

06 May 2014

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

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Howard Wittenberg, Project Manager

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TABLE OF CONTENTS

SECTION **PAGE**

TABLES

FIGURES

APPENDICES

ACRONYMS

COC	chemical of concern
COD	chemical oxygen demand
DCE	dichloroethene
DO	dissolved oxygen
DON	Department of the Navy
DTSC	Department of Toxic Substances Control
EISB	enhanced in-situ bioremediation
ERSE	extended removal site evaluation
HRC	hydrogen release compound
IRP	Installation Restoration Program
J&E	Johnson and Ettinger
LUC	land use control
MNA	monitored natural attenuation
msl	mean sea level
NAVWPNSTA	Naval Weapons Station
ORP	oxidation reduction potential
PCE	tetrachloroethene
RAP	Remedial Action Plan
ROD	Record of Decision
TCE	trichloroethene
TCG	target cleanup goal
TDS	total dissolved solids
TOC	total organic carbon
VC	vinyl chloride
VOC	volatile organic compound

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1.0 INTRODUCTION

This report provides an overview of site activities conducted in December 2013 associated with enhanced in situ bioremediation (EISB) of groundwater at Installation Restoration Program (IRP) Site 40 at Naval Weapons Station (NAVWPNSTA) Seal Beach, Seal Beach, California. This report includes the presentation and assessment of relevant monitoring data collected during this period. The Site is currently in Monitored Natural Attenuation (MNA) phase and this was the fifth sampling event conducted after the final application of Hydrogen Release Compound (HRC®) in November 2008. A summary of the general status of the project and recommendations based on the conclusions are also provided.

The field activities for this period included groundwater and soil gas monitoring in various wells/locations as well as surface gas emissions monitoring. These activities, along with the dates they were conducted, are listed in Table 1. For this monitoring event (December 2013), chemicals of concern (COCs), including primary COCs tetrachloroethene (PCE) and trichloroethene (TCE), and secondary COCs including cis-1,2-dichloroethene (DCE), and vinyl chloride (VC), were assessed in groundwater samples from monitoring wells MW-40-07, -08, -14, -22, -27, -30, -31 -32, -35, -36, and -37; and injection wells IW-2, -4, -10, and -18. These wells were proposed for annual monitoring based on the Final 2012 Annual Groundwater Monitoring Report, Installation Restoration Program Site 40 (CKY 2013). Most of these wells are key compliance wells located in the central portion of the site where low-level contamination is still being detected.

In addition to routine reporting, Section 4.0 of this report includes a preliminary risk analysis to evaluate the potential for site closure. Recommendations are provided in Section 6.0 for additional site activities to provide data for a risk assessment in support of site closure.

2.0 LAND USE CONTROLS

Land use controls (LUC) and their implementation were inspected and reviewed as part of the Navy's Project Review Process in accordance with Naval Weapons Station Seal Beach Instruction 5090.5B, Environmental Aspects and Requirements Review Procedures for Actions, Projects, Business Practices and Land Use (DON 2012). The land use controls for Site 40 are as follows:

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

- 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 and DTSC.

- The DON, DTSC, 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.

During the 2013 reporting period, no new groundwater wells were installed in IRP Site 40 or the 500-foot buffer zone, and all existing wells and associated piping were in proper working condition and did not

appear to be tampered with or altered. The DON, regulatory agencies, and contractors had full access to the Site to perform monitoring activities as prescribed in the ROD (DON 2004). The LUCs will be inspected and reviewed during the next annual monitoring event and summarized in the 2014 groundwater monitoring report.

3.0 SUMMARY OF DATA

Data from the 2011, 2012, and 2013 sampling events are presented on Figure 1. The analytical data reports from the December 2013 sampling event is included on a CD in Appendix A. Current (December 2013) concentrations and inferred plume delineations for the COCs remaining above target cleanup goals (TCG), cis-1,2-DCE and VC, are presented on Figures 2 and 3, respectively.

3.1 Changes from Previous Monitoring Event

The following changes from the previous monitoring event were implemented:

- Monitoring points MW-40-25 and MW-40-34 were not monitored as recommended in the 2012 Site 40 Monitoring Report (CKY 2013)
- Cations, anions, TDS, and TOC were removed from the analyses as recommended in the 2012 Site 40 Monitoring Report (CKY 2013)
- Soil vapor field parameters were not monitored at MW-40-30, MW-40-31, and IW-18 since they have consistently drawn water and there is no probe installed at IW-18.

3.2 COCs in Regularly Monitored Wells

This subsection provides a summary of data collected in December 2013 to assess existing COC concentrations across the Site in relation to their respective target cleanup goal (TCG), followed by key observations regarding COC concentrations in the selected groundwater monitoring wells sampled during the December 2013 event.

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

Evaluation of COC concentrations and plume dynamics included assessment of shallow interval groundwater monitoring wells MW-40-07, -08, -22, -27, -30, -32, -36, and -37; shallow interval injection wells IW-2, -4, -10, and -18; and mid-shallow interval wells MW-40-14, -31, and -35 (refer to Figure 1 for well locations). None of the wells monitored had concentration of PCE or TCE above the TCG. MW-40-08 and MW-40-37 were the only monitoring points that had concentrations of cis-1,2-DCE above the TCG. Eleven of the seventeen monitoring points had concentrations of VC above the TCG.

3.2.1 COC Concentrations

Figure 1 presents COC concentrations of the December 2013 monitoring points. All wells monitored in the December 2013 monitoring event had concentrations of the primary COC concentrations, PCE and TCE, below the TCGs. The key wells sampled have had at least two consecutive sampling events with COC concentrations below the TCGs. The only COCs with concentrations remaining above the TCGs at the site are cis-1,2-DCE and VC.

Figure 2 presents the interpreted plume delineations for cis-1,2-DCE and Figure 3 presents the interpreted plume delineations for VC, based on the December 2013 data. Observations on the fate of COCs in monitoring points above the TCGs are presented below compared to the previous year's results. A concentration followed by the letter "J" indicates that the concentration is an estimated level and a "U" indicates the concentration was not detected above the associated reporting limit.

- Decreases in concentrations of cis-1,2-DCE above the TCG include:

  42 to 25 in MW-40-08

  37 to 33 in MW-40-37

- There were no increases in concentrations of cis-1,2-DCE in monitoring points with results above the TCG

- Decreases in concentrations of VC above the TCG include:

  0.95J to 0.50J in IW-18

  3.6 to 3.5 in MW-40-14

  0.61J to 0.53J in MW-40-27

- Increases in concentrations of VC above the TCG include:

  0.75J to 0.96J in IW-4

  0.90J to 1.6 in IW-10

  0.98J to 7.5 in MW-40-07

  1.4 to 1.7 in MW-40-08

  0.72J to 1.3 in MW-40-22

  0.96J to 3.6 in MW-40-30

  0.55J to 0.88J in MW-40-32

  1.6 to 3.5 in MW-40-36

  3.9 to 4.9 in MW-40-37

The Site has continued a decreasing trend of cis-1,2-DCE in the two monitoring points that have consistently been above the TCG. This represents evidence that reductive dechlorination is still occurring at the Site. Of the monitoring points that had increased concentrations of VC for the 2013 monitoring event, two monitoring points exhibited larger than usual increases than were observed in previous results. MW-40-07 went from 0.98J to 7.5 µg/L and MW-40-30 went from 0.96J to 3.6 µg/L. Results from the other monitoring points are consistent with minor fluctuations observed from previous results. Increases in VC are likely due to continued biodegradation of cis-1,2-DCE. The differences in COC increases and decreases are considered relatively minor and in small pockets of the Site. These flucutations are expected based on the relatively low concentrations as the contaminants are affected more dramatically at low concentrations by their surrounding environment. The increase of VC is a common effect of rebound at chlorinated sites but there is not enough data to determine if a stall is occurring. VC concentrations will be evaluated during subsequent sampling events to determine if further action is required at the Site.

3.3 Plume Interpretations

- Concentrations of PCE and TCE have not exceeded the TCGs (5 µg/L for both COCs) in any wells since the 2010 monitoring event.

- Concentrations of cis-1,2-DCE exceed the TCG (6 µg/L) in only two of the seventeen monitoring points (MW-40-08 and MW-40-37). The concentrations in these wells are approximately five times the TCG. Both wells have shown a continual decrease in concentration from previous monitoring events.
- Low concentrations of VC, generally in the 0.5 to 2.0 µg/L range, form a residual plume across the Site. Higher concentrations exists slightly downgradient from the source but has not migrated significantly. Five wells (MW-40-07, -14, -30, -36, and -37) had concentrations over 2 µg/L.

An increase in VC concentration across the Site were 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.

3.4 Field Parameters

Field parameters were measured during this monitoring event including DO, ORP, and pH, which are included in Table 3. Monitoring of these parameters provide additional indication of the potential for further reductive dechlorination.

Key observations regarding field parameter data are as follows:

- Based on the December 2013 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 2013 event were negative for all monitoring points, ranging from -113.6 millivolts (mV) to -176.8 mV. These values reflect conditions favorable for reductive dechlorination, however, above the optimum value of -240 mV.
- The pH readings ranged from 6.3 to 7.0 pH units. These values are only slightly out of the optimum range of 6.5 to 8.5.

The December 2013 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.

3.5 Soil Gas Data

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 from December 18–19, 2013. Methane gas was present at concentrations from 0.0 to 71.5 percent (%) in air. The highest methane concentration was in the soil gas probe in injection well IW-7. The average methane concentration was 26% in air, which is lower than the average of 36% recorded in 2012. Hydrogen sulfide was reported in 10 of 14 probes with concentrations ranging from 0 to 40 parts per million (ppm). The highest hydrogen sulfide concentration was in monitoring well MW-40-37, which is one of the monitoring points with the highest levels of COCs in groundwater. Table 4 summarizes the soil gas field parameter data.

In addition, soil gas samples were collected in 6-liter SUMMA™ canisters from four vapor monitoring wells (VW-40-02, -03, -04, and -06) and soil gas monitoring probes that are installed in groundwater monitoring wells MW-40-32 and -37 and injection wells IW-1 and -3. Table 5 lists the analytical results for the soil gas analyses.

Although certain COCs such as PCE and TCE are well below the target cleanup goals in groundwater, they

are still present in the vadose zone in soil gas. PCE was reported in the soil gas samples ranging from 1.9J to 278 $\mu g/m^3$ and TCE was reported ranging from 3.2 to 1,074 $\mu g/m^3$. The maximum reported concentration in 2012 was 454 and 3,866 $\mu g/m^3$ for PCE and TCE, respectively. These results are roughly half year over year and are expected to decrease as COCs in groundwater decrease.

Concentrations of cis-1,2-DCE were reported in all sampled wells at concentrations ranging from non-detect in the soil gas probe installed in injection well VW-40-04 to 3,686 $\mu g/m^3$ in soil gas monitoring well VW-40-02. The average cis-1,2-DCE concentration was 900 $\mu g/m^3$ compared to 1,320 $\mu g/m^3$ in 2012. The average concentration is lower year over year reflecting the continuing reductive dechlorination.

VC was reported at concentrations from non-detect in the vapor monitoring well VW-40-04 to 4,344 $\mu g/m^3$ in vapor monitoring well VW-40-02. The average VC concentration was 1,265 $\mu g/m^3$ compared to 1,525 $\mu g/m^3$ in 2012. The average concentration is similar likely due to continued reduction of cis-1,2-DCE concentrations.

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 well VW-40-04 and MW-40-32 to 51.3% by volume in the soil gas monitoring well VW-40-03. In comparison 2012 results, methane gas concentrations are similar but trending lower. Soil gas is expected to be present as a result of volatilization and bio-fermentation.

Methane gas and volatile organic compound (VOC) surface emissions monitoring was performed on December 20, 2013. During this monitoring event, neither methane gas nor VOC emissions were detected within Buildings 239 or 240, or in the surrounding areas.

In addition to routine monitoring of soil gas data, a preliminary risk analysis has been performed of the December 2013 data to evaluate the potential for site closure. Section 4.0 includes the results of the preliminary risk analysis.

3.6 Groundwater Level Measurements

Groundwater level measurements were collected on December 18, 2013. Groundwater elevations within the Site ranged from 1.56 feet above mean sea level (msl) in MW-40-08 to 2.24 feet above msl in IW-2. In general, water level measurements collected in December 2013 were similar in comparison with the elevations measured during the previous monitoring event in 2012. Minor fluctuations are likely due to seasonal/annual variation in precipitation. Groundwater elevation trends since the start of the project (March 2005) are similar but show an overall slight decline in groundwater level at the site. Groundwater levels ranged from approximately 1.5 to 2.5 feet above msl in 2005. Differences in groundwater elevation are not significant enough to have an impact on achieving the remedial goals of this project.

4.0 Risk Analysis

A screening-level human health risk assessment 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 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 in the ROD/Remedial Action Plan (DON 2004). Based on this information, the preliminary risk evaluation focused on potential groundwater exposure pathways.

At sites where VOCs are present in groundwater, risk assessments generally consider the following potential exposure pathways:

- Inhalation of VOCs that may intrude to indoor air 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.

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 and has shown almost no plume migration. Therefore, this potential exposure pathway is not complete.

This preliminary risk evaluation focuses on the inhalation of VOCs that may intrude to indoor air from the subsurface. Because soil vapor data are available and better represent to potential for vapor intrusion than groundwater data, the preliminary risk evaluation was conducted using available soil vapor data.

4.1 Preliminary Screening Evaluation

The preliminary risk evaluation generally followed procedures outlined in DTSC–Cal/EPA's 2011 Vapor Intrusion Guidance Document (VI Guidance, DTSC – Cal/EPA 2011). The first step was to conduct a preliminary screening evaluation, which consists of using available soil vapor data and default attenuation factors to estimate indoor air VOC concentrations. These estimated indoor air concentrations were then compared to residential and industrial air screening levels from DTSC's Human Health Risk Assessment Note Number 3 (DTSC, 2013).

Attenuation factors represent the ratio of indoor air concentrations and soil vapor concentration, as noted below:

$$\propto = \frac{Cindoor}{Csoil\ vapor}$$

Default attenuation factors are available for existing and future residential and commercial buildings. The attenuation factors were used, along with soil vapor data, to estimate potential indoor air concentrations under three exposure scenarios: existing industrial, future residential and future industrial/commercial.

4.2 Preliminary Screening Evaluation Results

Air and Vapor Concentrations in µg/m³	DTSC Air Screening Levels		Maximum Soil Vapor Concentration (2013)	Estimated Indoor Air Concentrations		
	Residential	Industrial		Existing Industrial (AF = 0.001)	Future Residential (AF = 0.001)	Future Industrial (AF = 0.0005)
PCE	0.41	2.1	278 (VW-40-04)	0.28	0.28	0.14
TCE	0.43	3.0	1,074 (VW-40-03)	1.1	1.1	0.54
cis-1,2-DCE	7.3	31	3,686 (VW-40-02)	3.7	3.7	1.8
Vinyl chloride	0.031	0.16	4,344 (VW-40-02)	4.3	4.3	2.2

Note: Estimated indoor air concentrations values in red are greater than applicable DTSC air screening levels (residential or industrial).

The table above shows the DTSC air screening levels, maximum soil vapor concentrations, estimated indoor air concentrations for PCE, TCE, cis-1,2-DCE, and vinyl chloride, and whether the estimated indoor air concentrations are greater than the residential or industrial air screening levels.

The table shows the estimated TCE indoor air concentration in future residential homes is greater than the DTSC residential air screening level and that the estimated vinyl chloride indoor air concentrations are greater than DTSC air screening levels under each of the three scenarios evaluated. Because the estimated indoor air concentrations for TCE and vinyl chloride are greater than DTSC air screening levels, a more focused site-specific screening evaluation was required. Note that, because the DTSC air screening levels for TCE and vinyl chloride are based on a carcinogenic risk of 1×10^{-6}, estimated indoor air concentrations greater than the DTSC levels correspond to excess carcinogenic risks of greater than 1×10^{-6}. The excess carcinogenic risk estimates for vinyl chloride at future residential buildings are greater than 1×10^{-4} because the estimated indoor air concentrations are greater than 100 times the DTSC air screening level.

4.3 Site Specific Screening Evaluation

The site-specific screening evaluation consisted of using available site-specific data and information and U.S. Environmental Protection Agency's Johnson and Ettinger (J&E) model spreadsheet for soil vapor to calculate a site-specific and building-specific attenuation factor, which is then used to estimate indoor air concentrations for Buildings 239 and 240. EPA's advanced soil vapor Excel spreadsheet (SG-ADV-Feb04.xls) was used to model vapor intrusion into Buildings 239 and 240. DTSC-Cal/EPA's VI guidance recommends the use of DTSC-modified J&E model spreadsheets for the site-specific screening evaluation. However, these screening-level spreadsheets were not used because they do not allow for the use of site-specific building dimensions and for multiple soil types. The following DTSC-recommended parameter values were used in the EPA advanced spreadsheet: Average Soil Temperature (24 degrees Celsius) and Crack-to-Total Area Ratio (0.005).

Building-specific attenuation factors were calculated using the following site- and building-specific information:

- **Soil vapor sampling depth below grade** – the soil vapor wells are generally screened from 3.5 to 10-feet below ground surface (bgs). The building-specific attenuation factors were modeled using sample depths of 3.5 and 10 feet.
- **Soil type** – soil types for buildings 239 (sand, silty clay, and sand) and 240 (sand, silt, and sandy clay) are from Tetra Tech EC, Inc. boring logs for MW-37 (Building 239) and VW-03 (Building 240).
- **Building dimensions** – building dimensions for Building 239 were estimated at 75- by 200-feet with a ceiling height of 10-feet. Building dimensions for Building 240 were estimated at 70- by 85-feet with a ceiling height of 10-feet.

4.4 Site-Specific Screening Evaluation Results – Vinyl Chloride

Air and Vapor Concentrations in µg/m³	Maximum Soil Vapor Concentration	Soil Vapor Sample Depth (feet)	Building-Specific Attenuation Factor	Estimated Indoor Air Concentration	DTSC Air Screening Level – Vinyl Chloride	Estimated Excess Carcinogenic Risk
Building 239 (2013 results)	639 (MW-40-37)	3.5	0.0005	0.30	0.16	1.9×10^{-6}
		10	0.0002	0.15	0.16	9.7×10^{-7}
Building 239 (2012 results)	1,203 (MW-40-37)	3.5	0.0005	0.57	0.16	3.5×10^{-6}
		10	0.0002	0.29	0.16	1.8×10^{-6}
Building 240 (2013 results)	4,344 (VW-40-02)	3.5	0.0004	1.8	0.16	1.1×10^{-5}
		10	0.0001	0.52	0.16	3.3×10^{-6}
Building 240 (2012 results)	4,608 (VW-40-02)	3.5	0.0004	1.9	0.16	1.2×10^{-5}
		10	0.0001	0.55	0.16	3.5×10^{-6}

Note: Estimated excess carcinogenic risk calculated by dividing estimated indoor air concentration by the DTSC air screening level, then multiplying by 1×10^{-6}.

The site-specific screening evaluation results show that the building-specific attenuation factors are equal to or lower than the lowest default attenuation factor used in the preliminary screening evaluation. These results also show that the estimated indoor air concentrations result in estimated excess carcinogenic risks from 1.9×10^{-6} to 1.2×10^{-5}. These risk estimates are 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. Risks within the risk range are typically evaluated on a site-specific basis.

4.5 Risk Analysis Conclusions

Risk Summary. The preliminary risk evaluation presented above shows estimated excess carcinogenic risks associated with the vapor intrusion pathway at IRP Site 40 are within the excess carcinogenic risk range of 1×10^{-6} to 1×10^{-4}, with the exception of vinyl chloride at future residential buildings. The estimated excess cancer risk for future residential buildings due to vinyl chloride is 1.4×10^{-4} and is based on the maximum detected vinyl chloride concentration of 4,344 $\mu g/m^3$ (December 2013, VW-02).

Indoor Air Quality Uncertainty. The soil vapor concentrations used to estimate indoor air concentrations at Building 239 likely overestimate soil vapor concentrations beneath this building because the monitoring locations used (MW-40-37) are located near the west end of the building at the downgradient end of the vinyl chloride groundwater plume. Soil vapor concentrations beneath Building 239 are expected to be lower than those detected at MW-40-37.

Future Buildings. The preliminary screening evaluation showed potentially unacceptable risks from vapor intrusion for future residential and industrial buildings. Based on this, vapor mitigation (e.g., constructive vapor barriers) may be required for future buildings at IRP Site 40.

Existing Buildings. The excess carcinogenic risks for the existing buildings are within the carcinogenic risk range of 1×10^{-6} to 1×10^{-4}. However, indoor air samples within Buildings 239 and 240 should be collected so that risk estimates can be calculated using actual, instead of estimated, indoor air concentrations.

5.0 CONCLUSIONS

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. Vinyl chloride has had a minor spike in concentrations during the December 2013 monitoring event, however, additional data acquired during routine monitoring is required to determine if this is a temporary spike indicative of rebound or a more significant stalling event.

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 Site is suitable for closure from a risk standpoint as it pertains to groundwater contamination as the COC concentrations across the Site have been consistently low and there are no complete exposure pathways to groundwater. However, additional data is likely required to support site closure in regards to soil vapor intrusion.

6.0 RECOMMENDATIONS

Collection of additional soil vapor data is recommended to support a risk assessment for the potential of site closure. In order to obtain more representative data reflecting actual conditions at Buildings 239 and 240, indoor and subsurface air samples should be collected. DTSC-Cal/EPA (2011) recommends a minimum of two sampling events (late summer/early autumn and late winter/early spring). Collecting 2 indoor and 2 subsurface air samples from Building 239, 2 indoor and 2 subsurface air samples from Building 240, and 3

outdoor air samples; 1 upwind, 1 near the two buildings, and 1 downwind. These 11 samples should provide the necessary information to facilitate preparation of a risk assessment that is more representative of expected exposure threats than the data set that currently exists. The samples will be collected and analyzed in accordance with the existing Sampling and Analysis Plan for the Site for PCE, TCE, cis-1,2-DCE and vinyl chloride. Temporary soil gas probes will be installed as detailed in Section 6.1. With concurrence from the regulatory agencies, the samples will be collected in June and September of 2014. Results will be presented in a site closure request, if warranted, with the risk assessment report.

6.1 Soil Gas Probe Installation

Two temporary soil gas probes will be installed inside Building 239 and two probes inside Building 240 at locations indicated on Figure 4. Temporary probes will be installed by drilling through the building foundation with a rotary hammer drill equipped with a 1 – 1½ -inch drill bit followed by driving a 1-inch rod down to a depth of 3-4 feet to create that annular space needed for the sampling probe. The sample probe will be constructed with ¼-inch outside diameter (1/8-inch inside diameter) Nylaflow tubing with a screen tip emplaced midway into a 12-inch layer sand pack (#2/12 sand). The sand layer will be overlain by a 12-inch layer of fine dry granular bentonite to fill the borehole annular space around the probe tubing. Hydrated granular bentonite will be used to fill the remaining borehole annular space to the ground surface. After the probes are installed, subsurface conditions will be allowed to equilibrate for at least 30 minutes before soil gas samples are collected. Figure 5 illustrates the typical probe installation and sampling train methodology for temporary soil gas probes. At the completion of the September sampling event, the probes will be removed and the temporary wells restored to pre-existing conditions.

7.0 REFERENCES

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TABLES

TABLE 1

SUMMARY OF MONITORING ACTIVITIES CONDUCTED

Date	Event	Wells Sampled[a]	Analytes/Parameters	Notes
12/18	Groundwater level measurement	MW-40-07, 08, -14, -22, -27, -30, -31, -32, -35, 36, and -37, and IW-2, -4, -10, and -18.	Not applicable	Groundwater level measurements
12/20	Surface emissions monitoring	Not applicable	Methane gas and VOC concentrations	Inside Building 240 and western portion of Building 239, and areas between the buildings in the Site 40 vicinity
12/18 and 12/19	Groundwater sampling	MW-40-07, 08, -14, -22, -27, -30, -31, -32, -35, 36, and -37, and IW-2, -4, -10, and -18.	VOCs and field parameters	Laboratory and field parameters
12/18 and 12/19	Soil vapor/gas probe monitoring	Probes in wells VW-40-01, -02, -03, -04, and -06, and nested probes in MW-40-32, -34, -35, -36, and -37 and IW-1, -3, -7, and 10	Methane, oxygen, carbon dioxide, hydrogen sulfide, VOCs, and carbon monoxide	Field testing
12/18 and 12/19	Soil vapor sampling	Probes in wells VW-40-02, 03, 04, and VW-40-06, and nested probes in MW-40-32 and -37, and IW-1 and IW-3	VOCs and fixed gases	Laboratory analysis

Notes:

[a] Refer to figures for well/sampling locations.

Abbreviations and Acronyms:

COD – chemical oxygen demand
DNA – deoxyribonucleic acid
TDS – total dissolved solid
TOC – total organic carbon
VOC – volatile organic compound

TABLE 2

CONCENTRATIONS OF COCs IN GROUNDWATER

Location	PCE (µg/L)	TCE (µg/L)	cis-1,2-DCE (µg/L)	VC (µg/L)
IW-2	<0.50U	<0.50U	<0.50U	<0.50U
IW-4	<0.50U	<0.50U	0.59J	0.96J
IW-10	<0.50U	0.64J	1.3	1.6
IW-18	<0.50U	1.3	0.75J	0.50J
MW-40-07	<0.50U	1.9	2.8	7.5
MW-40-08	<0.50U	<0.50U	25	1.7
MW-40-14	<0.50U	1.2	3.0	3.5
MW-40-22	<0.50U	<0.50U	1.1	1.3
MW-40-27	<0.50U	0.96J	<0.50U	0.53J
MW-40-30	<0.50U	<0.50U	3.4	3.6
MW-40-31	<0.50U	<0.50U	<0.50U	<0.50U
MW-40-32	<0.50U	<0.50U	0.94J	0.88J
MW-40-35	<0.50U	<0.50U	0.99J	0.34J
MW-40-36	<0.50U	1.2	6.0	3.5
MW-40-37	<0.50U	0.48J	33	4.9

Notes:

J – estimated value
U – not detected above the associated reporting limit

Abbreviations and Acronyms:

µg/L – micrograms per liter
PCE – tetrachloroethene
TCE – trichloroethene
DCE – dichloroethene
VC – vinyl chloride

TABLE 3

Groundwater Field Parameter Data
Dissolved Oxygen, Oxygen Reduction Potential, AND pH

Location	DO (mg/L)	ORP (mV)	pH (pH units)
IW-2	0.54	-136.2	6.84
IW-4	0.36	-113.6	6.37
IW-10	0.89	-158.5	6.34
IW-18	0.34	-151.7	6.35
MW-40-07	0.23	-118.4	6.41
MW-40-08	0.75	-169.7	6.67
MW-40-14	0.30	-162.4	6.40
MW-40-22	0.21	-138.2	7.03
MW-40-27	0.61	-162.8	6.90
MW-40-30	0.62	-139.9	6.29
MW-40-31	0.61	-158.2	6.66
MW-40-32	0.81	-158.6	6.40
MW-40-35	0.20	-176.8	6.65
MW-40-36	0.24	-136.4	6.36
MW-40-37	0.51	-123.4	6.65

Abbreviations and Acronyms:

DO – dissolved oxygen
mg/L – milligrams per liter
mV – millivolt
ND – not detected
ORP – oxidation/reduction potential
TDS – total dissolved solids
TOC – total organic carbon
U – not detected above the associated reporting limit

TABLE 4

SOIL GAS FIELD PARAMETER DATA

Probe/Well ID	Oxygen (%)	Carbon Dioxide (%)	Methane (%)	Barometric Pressure (in.Hg)	Hydrogen Sulfide (ppm)	Carbon Monoxide (ppm)	VOCs (ppm)
IW-1	0.0	14.5	4.1	29.83	7	0	0.0
IW-3	0.0	15.9	24.2	29.83	6	1	0.0
IW-7	0.0	22.4	71.5	29.75	7	1	0.0
IW-10	12.7	6.3	0.0	29.85	0	0	0.0
MW-40-32	3.7	10.7	0.0	23.79	0	0	0.0
MW-40-34	0.0	16.3	7.4	27.82	0	0	0.0
MW-40-35	0.0	28.1	63.1	27.83	4	0	0.0
MW-40-36	0.0	16.9	15.5	29.70	3	0	0.0
MW-40-37	0.0	26.4	20.8	29.78	40	0	0.0
VW-40-01	0.0	16.4	40.6	27.83	4	1	0.0
VW-40-02	0.0	16.8	36.2	29.72	15	2	0.0
VW-40-03	0.0	24.6	57.6	29.78	1	0	0.0
VW-40-04	18.5	3.9	0.0	29.96	0	0	0.0
VW-40-06	0.0	26.1	21.8	28.16	11	1	0.0

Abbreviations and Acronyms:

in.Hg – inches of mercury
J – estimated value
ppm – parts per million
U – not detected above the associated reporting limit

TABLE 5

CONCENTRATIONS OF COCs IN SOIL GAS

Probe/Well ID	PCE		TCE		cis-1,2-DCE		Vinyl Chloride		methane
	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	%v
IW-1	3.6	24.4	92	494.2	250	990.8	500	1277.6	3.71
IW-3	0.28J	1.9J	1.0	5.4	2.2	8.7	170	434.4	20.7
MW-40-32	4.3	29.2	4.4	23.6	1.5	5.9	0.34J	0.9J	0.255U
MW-40-37	4.7	31.9	20	107.4	120	475.6	250	638.8	18.4
VW-40-02	2.0	13.6	12	64.5	930	3685.8	1,700	4343.7	31.9
VW-40-03	3.0	20.3	200	1074.4	490	1942.0	1,200	3066.1	51.3
VW-40-04	41	278.0	0.6	3.2	0.2U	0.8U	0.5U	1.3U	0.255U
VW-40-06	2.3	15.6	22	118.2	22	87.2	140	357.7	19.3

Abbreviations and Acronyms:

%v – percent by volume
µg/m^3 – micrograms per cubic meter
DCE – dichloroethene
ID – identification
J – estimated value
PCE – tetrachloroethene
ppbv – parts per billion by volume
TCE – trichloroethene
U – not detected above the associated reporting limit

FIGURES

ANALYTICAL NOTES:

Water results are reported in ug/L
Vapor results are reported in ppb (v/v)
Methane results are reported in %/vol
U = Not detected at level shown
J = Estimated value between detection limit and reporting limit
NA = Not Analyzed

PCE = Tetrachloroethene
TCE = Trichloroethene
DCE = cis-1,2-Dichloroethene
VC = Vinyl Chloride

** Values in red exceed action limits

LEGEND

- Shallow-Interval Monitoring Well
- Middle-Interval Monitoring Well
- Soil Vapor Monitoring Well
- Injection Well

N

MW-40-21
MW-40-03
MW-40-04
MW-40-11
MW-40-01
MW-40-02
IW-2
IW-1
MW-40-10
MW-40-26
MW-40-09
MW-40-06
MW-40-28
MW-40-25
MW-40-22
VW-40-02
MW-40-24
MW-40-29
IW-3
IW-4
MW-40-30
MW-40-38
IW-9
MW-40-32
IW-10
MW-40-31
MW-40-12
MW-40-08
VW-40-4
VW-40-5
MW-40-17
MW-40-18
IW-6
IW-8
MW-40-27
VW-40-3
MW-40-14
IW-7
MW-40-36
MW-40-35
VW-40-6
IW-15
MW-40-37
IW-11
IW-12
IW-13
IW-14
MW-40-34
IW-16
IW-17
IW-18
IW-19
MW-40-07
MW-40-13
MW-40-33
MW-40-20
MW-40-19
MW-40-15
MW-40-16

Concrete Pad
Asphalt Pavement
Concrete Pad
BUILDING 240
BLDG 260
BUILDING 239
ANCHOR ROAD

IW-02	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	<0.5U	<0.5U	<0.5U
VC	<0.5U	<0.5U	<0.5U

IW-04	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	<0.5U	<0.5U	0.59J
VC	1.2	0.75J	0.96J

MW-40-30	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	0.95	1.2	3.4
VC	1.2	0.96J	3.6

MW-40-31	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	<0.5U	<0.5U	<0.5U
VC	<0.5U	<0.5U	<0.5U

MW-40-22	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	7.9	0.96J	1.1
VC	4.8	0.72J	1.3

MW-40-32	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	0.72	0.98J	0.94J
VC	0.80	0.55J	0.88J

IW-10	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	0.84J	0.64J
DCE	0.72J	1.3	1.3
VC	0.64	0.90J	1.6

MW-40-25	Water		
	2011	2012	2013
PCE	NA	<0.5U	NS
TCE	NA	<0.5U	NS
DCE	NA	<0.5U	NS
VC	NA	0.72J	NS

MW-40-08	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	56	42	25
VC	0.44J	1.4	1.7

MW-40-27	Water		
	2011	2012	2013
PCE	NA	<0.5U	<0.5U
TCE	NA	0.84J	0.96J
DCE	NA	<0.5U	<0.5U
VC	NA	0.61J	0.53J

MW-40-14	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	1.9	1.5	1.2
DCE	3.7	2.7	3
VC	5.3	3.6	3.5

MW-40-07	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	0.46J	1.9
DCE	<0.5U	0.89J	2.8
VC	0.50	0.98J	7.5

MW-40-35	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	<0.5U	<0.5U	<0.5U
DCE	3.4	1.3	0.99J
VC	0.55	<0.5U	0.34J

MW-40-34	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	NS
TCE	<0.5U	<0.5U	NS
DCE	<0.5U	<0.5U	NS
VC	0.38	<0.5U	NS

MW-40-36	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	0.41J	0.80J	1.2
DCE	1.4	2.8	6.0
VC	1.2	1.6	3.5

IW-18	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	1.8	1.8	1.3
DCE	1.0	0.73J	0.75J
VC	1.3	0.95J	0.50J

MW-40-37	Water		
	2011	2012	2013
PCE	<0.5U	<0.5U	<0.5U
TCE	2.5	0.81J	0.48J
DCE	61	37	33
VC	8.7	3.9	4.9

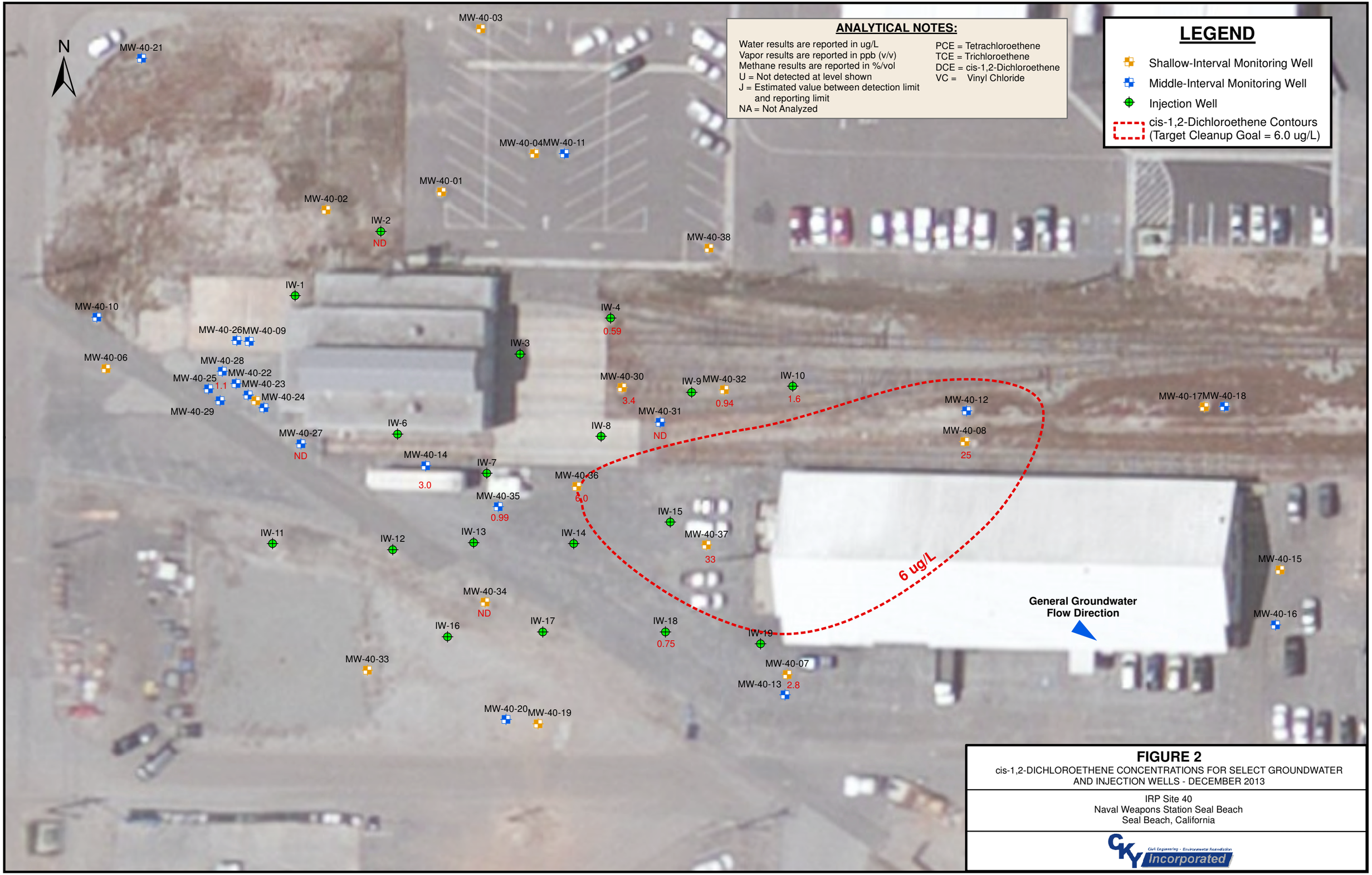
Source: Esri, DigitalGlobe, GeoEye, i-cubed,

FIGURE 1

COC CONCENTRATIONS FOR SELECT GROUNDWATER, INJECTION AND VAPOR WELLS - DECEMBER 2013

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

CKY Incorporated
Clark Engineering · Environmental Remediation



ANALYTICAL NOTES:

Water results are reported in ug/L
Vapor results are reported in ppb (v/v)
Methane results are reported in %/vol
U = Not detected at level shown
J = Estimated value between detection limit and reporting limit
NA = Not Analyzed

PCE = Tetrachloroethene
TCE = Trichloroethene
DCE = cis-1,2-Dichloroethene
VC = Vinyl Chloride

LEGEND

- Shallow-Interval Monitoring Well
- Middle-Interval Monitoring Well
- Injection Well
- cis-1,2-Dichloroethene Contours (Target Cleanup Goal = 6.0 ug/L)

FIGURE 2

cis-1,2-DICHLOROETHENE CONCENTRATIONS FOR SELECT GROUNDWATER AND INJECTION WELLS - DECEMBER 2013

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

CKY Incorporated
Civil Engineering - Environmental Remediation

N

ANALYTICAL NOTES:

Water results are reported in ug/L
Vapor results are reported in ppb (v/v)
Methane results are reported in %/vol
U = Not detected at level shown
J = Estimated value between detection limit and reporting limit
NA = Not Analyzed

PCE = Tetrachloroethene
TCE = Trichloroethene
DCE = cis-1,2-Dichloroethene
VC = Vinyl Chloride

LEGEND

- Shallow-Interval Monitoring Well
- Middle-Interval Monitoring Well
- Injection Well
- VC Contours 2013 Action Limit is 0.50 ug/L

MW-40-03
MW-40-21
MW-40-04
MW-40-11
MW-40-01
MW-40-02
IW-2
ND
MW-40-38
IW-1
Concrete Pad
0.5
1.0
2.5
MW-40-10
IW-4
0.96
MW-40-26
MW-40-09
IW-3
MW-40-06
MW-40-28
MW-40-25
MW-40-22
MW-40-23
1.3
MW-40-24
BUILDING 240
MW-40-30
3.6
IW-9
MW-40-32
0.88
IW-10
1.6
MW-40-12
MW-40-17
MW-40-18
MW-40-29
MW-40-31
ND
Asphalt Pavement
IW-6
IW-8
Concrete Pad
MW-40-27
0.53
MW-40-14
3.5
IW-7
MW-40-36
8.5
MW-40-35
0.34
MW-40-08
1.7
IW-15
BLDG 260
MW-40-37
4.9
IW-11
IW-12
IW-13
IW-14
ANCHOR ROAD
5.0
2.5
1.0
0.5
BUILDING 239
MW-40-15
General Groundwater Flow Direction
MW-40-34
IW-16
IW-17
IW-18
0.50
IW-19
MW-40-16
MW-40-07
MW-40-13
7.5
MW-40-33
MW-40-20
MW-40-19

Source: Esri, DigitalGlobe, GeoEye, i-cubed,

FIGURE 3

VINYL CHLORIDE CONCENTRATIONS FOR SELECT GROUNDWATER AND INJECTION WELLS - DECEMBER 2013

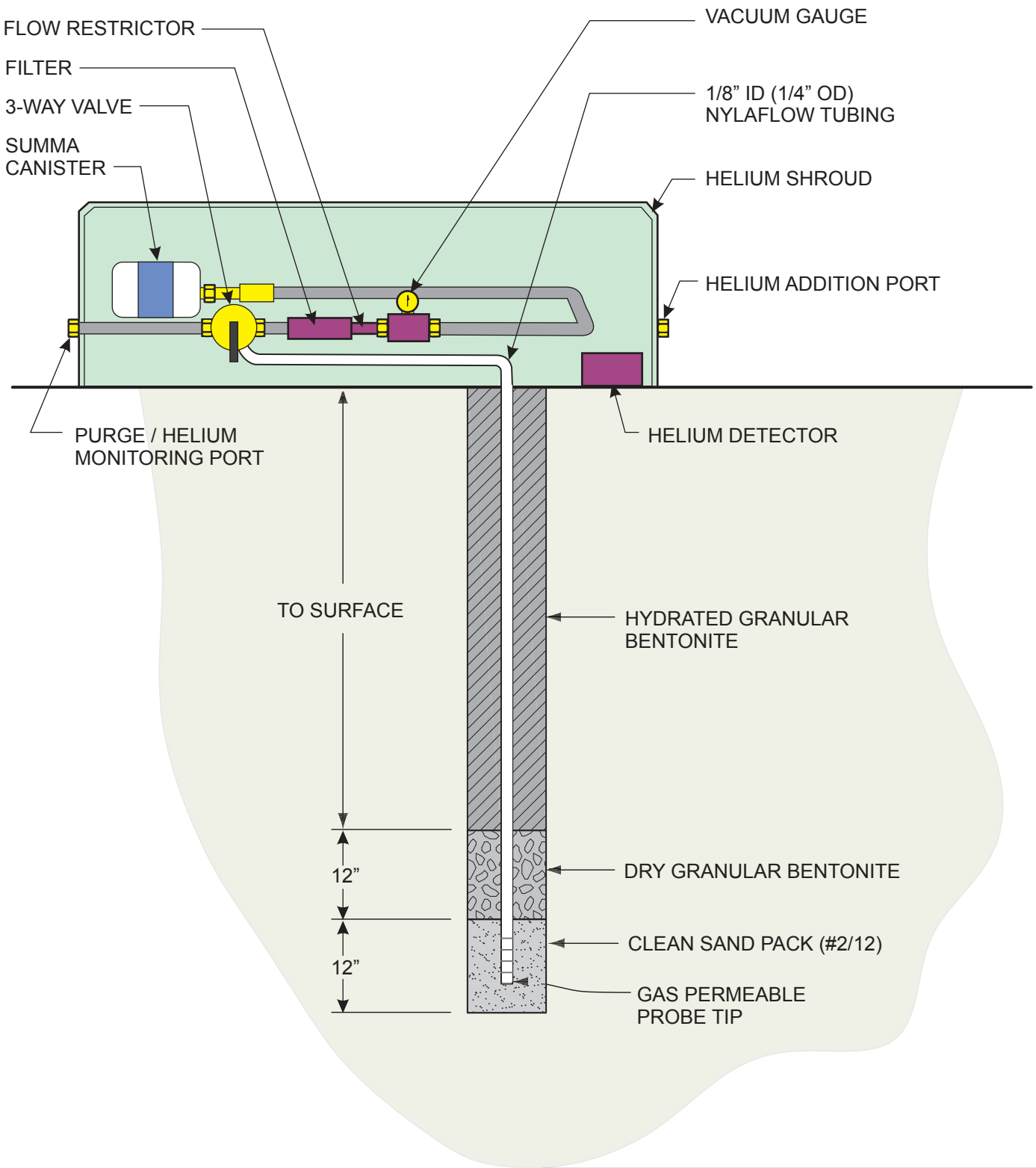
IRP Site 40
Naval Weapons Station Seal Beach
Seal Beach, California

CKY Incorporated
Civil Engineering - Environmental Remediation

FIGURE 4
SOIL GAS SAMPLING LOCATIONS

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

CKY Incorporated
Civil Engineering - Environmental Remediation



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

TYPICAL ACTIVE SOIL GAS INSTALLATION AND SAMPLING TRAIN

CKY Incorporated

IR SITE 40
SOIL GAS INVESTIGATION

FIGURE
5

APPENDIX A
LABORATORY DATA

(Included on CD)