Objective

Produce information necessary to support the design and implementation of a groundwater remediation project to prevent or cleanup contamination of groundwater that serves or has served as a source of drinking water.

Background

The South Basin remedial investigation (RI) will investigate a comingled plume originating from more than 20 industrial locations. The plume is two miles long and more than one mile wide. The contaminants of concern (COCs) include volatile organic compounds (VOCs) and perchlorate.

The plume, located in Santa Ana, Irvine, and Tustin, CA is bounded by Edinger Avenue, Main Street, the I-405 Freeway, Red Hill, and Von Karman. The uncontrolled plume occurs predominately in the shallow aquifer at 100-foot depth which flows into a deeper Principal Aquifer, bringing VOC contaminants with it. So far, contaminants have arrived in two municipal drinking water wells.

The Principal Aquifer provides 350,000-acre feet per year or 77 percent of the potable water supply for 2.4 million people in central and northern Orange County. The Project includes a RI and feasibility study (RI/FS) performed in compliance with the National Contingency Plan (NCP).

Groundwater in the South Basin contamination plume is located within two Groundwater Management Zones established by the Santa Ana Regional Water Quality Control Board (Region 8) in the Santa Ana Water Quality Control Plan. These zones are the Orange Groundwater Management Zone and the Irvine Groundwater Management Zone. Beneficial uses for these two Groundwater Management Zones are municipal and domestic supply, agricultural supply, industrial service supply and industrial process supply.

The purpose of this study is to analyze options and select an interim remedial action plan that will protect the underlying drinking water aquifers. Much work has been done in the South Basin over the past several decades, however most of it in piecemeal fashion. Only in limited instances has the work included the capture and restoration of groundwater downgradient of the various source sites. This RI/FS will look at the overall comingled plume and make plume-wide recommendations on its control and restoration.

The South Basin includes more than 60 sites that in some cases consist of small-scale plumes limited within the property line of the offending industry and in other cases are much larger, with plumes extending great distances offsite. In most cases, the off-site plumes have comiled into the overall south basin plume more than two miles long. The regulatory agencies overseeing these many sites include the RWQCB and the DTSC. While the OCWD appreciates their work and the directives issued to responsible parties over the past 30 years, we cannot wait for that PRP group to someday come together for characterizing and cleaning up the offsite contamination. After more than a decade without a comprehensive PRP response, the OCWD now sees the need to move forward with the RI/FS on its own initiative. The District has signed a cost reimbursement agreement with the RWQCB. NCP-compliant work products that are part of the RI/FS will be submitted to RWQCB and DTSC for their review and comment.
Figure 1 - Project Area
Monitoring Well Installations

A database has been prepared for the South Basin project. The database has been reviewed and existing information has been evaluated to assess data gaps. A draft RI work plan (Field Sampling Plan [FSP]), updating the Quality Assurance Project Plan (QAPP)) has been prepared to address identified data gaps. Presently, seven data gap locations have been identified in which clusters of monitoring wells will be installed at multiple depths to obtain water quality and hydrogeologic data needed to complete the FS. Six well cluster locations that are being addressed now include constructing four monitoring wells in each location, aquifer testing and water sampling. The work is complete. It is expected that the vapor intrusion pathway will be conducted by PRPs as part of their site investigations and cleanup, therefore assessing this pathway will not be done as part of the District’s efforts on the RI/FS.

The grant agreement approves a study that included twenty-one (21) monitoring wells in seven (7) well-clusters at locations shown on Figure 1. As the project progressed one of those originally proposed wells (SAM-12), not shown, was removed from the study at the request of the DTSC. The remainder of the wells have already been installed. These wells will assess the lateral and vertical distribution of volatile organic compounds (VOCs) and other contaminants in shallow groundwater. All of the monitoring wells will be installed in public rights-of-way (ROWs), with one cluster in the City of Santa Ana and the other five in the City of Irvine.

Using roto-sonic drilling, OCWD’s well drilling contractor will advance a boring to around 130 feet below ground surface (bgs) and install the deepest of the four wells in each of the six clusters. The lithologic logs from the sonic borings will be used to design the screened intervals for up to three shallower wells in each cluster, which will be drilled using a hollow-stem auger (HSA) rig. A single drilling contractor with both sonic and HSA capabilities was used to permit, install, and develop the monitoring wells.

Tasks such as mobilization were billed on a lump sum basis; however, drilling and well installation are billed on a per foot basis, giving the drilling contractor considerable incentive to complete the work as efficiently as possible. Geologists were responsible for providing field oversight, logging the borings, designing the monitoring wells, documenting well construction and development, installing dedicated pumps and pressure transducers in each well, conducting aquifer tests, and conducting two rounds of baseline groundwater sampling. The quality of the lithologic logs from the sonic borings, the resulting well designs, and the groundwater level and quality data obtained from the wells are critical to the success of the RI. The schedule and planning process allowed for flexibility to accommodate the challenges associated with working in public ROWs.

A realistic and achievable goal was set to install the six sonic borings sequentially in a single mobilization with one, two, or three HSA rigs following behind to install the shallower wells, also in a single mobilization. Another goal was to clear the well locations for subsurface obstructions before the drill rig arrives on site.

Schedule was based on beginning the project at the SAM-7 site with a roto-sonic drilling rig to drill and sample the deepest well in that cluster, SAM-7D, for the estimated 3 to 4 days required to design and install SAM-7D. Once SAM-7D was installed, the sonic rig moved to the deep well in the SAM-8 cluster, repeat the process outlined above, move to the SAM-9 cluster, and so on. Concurrent with moving the roto-sonic rig to the SAM-8 cluster, the first HSA rig (HSA #1) will start installing the three shallow wells in the SAM-7 cluster. Whereas roto-sonic drilling and deep well construction will take 3 to 4 days, installation of the up to three shallow HSA wells at each cluster will take between 7 and 8 days. Thus, as the project progresses, the roto-sonic rig will “pull-ahead” of the HSA rig such that by the time the sonic rig completes SAM-9D, the driller could mobilize a second HSA rig (HSA #2) to start construction of the shallow SAM-9 wells.

When the deep wells were completed, and the roto-sonic drill rig demobilized, a third HSA rig (HSA #3) was mobilized to install the three shallow wells in the SAM-11 cluster. The drilling operations followed this type of program to maximize the utilization of drillers, staff and time. Video surveys documented each well following development. If any evidence of damage or material deficiencies is observed, it was
repaired or the well replaced. Copies of the video surveys will be included in the Well Construction Report.

Aquifer Pump Testing:

**Well Development** - On average, it took one day to develop each of the wells in each cluster. Each was developed within 48 hours of installation of the last well in the cluster, thereby minimizing work in the public ROW. At the end of well development, step-rate pumping tests in each well were performed to estimate sustainable pumping rates for dedicated pump sizing and constant-rate aquifer testing purposes. Using this information, dedicated pumps and related equipment were sized and ordered. Following development of all the wells in a cluster, a composite water sample representing the four wells was collected, submitted to the project laboratory, and analyzed for compliance with the Orange County Sanitation District’s (OCSD’s) discharge limits. This information was provided to OCSD in compliance with a Special Purpose Discharge Permit allowing for direct discharge of aquifer test water to the sanitary sewer, thereby eliminating the costs associated with temporary containment.

**Aquifer Testing** - The aquifer performance test(s) at each cluster were performed between May 30 and August 16, 2017. During this period, encroachment permits were obtained from the cities of Irvine and Santa Ana and the dedicated pumps and transducers installed and tested. In addition, final arrangements for direct discharge of the produced water to the sanitary sewer will be made with the OCSD. Prior to test initiation, the Level Troll data loggers were programed to log measurements with an initial high frequency to record water level changes in the pumping and observation wells. Allowing sufficient pre-test time to document static conditions and post-test time to monitor recovery, each 6-hour pumping test was performed over one long day. The dedicated equipment was installed, the aquifer tests performed, and aquifer data downloaded and analyzed to provide hydraulic parameter estimates of the various transmissive zones.

Six-hour, constant-rate aquifer tests were performed in the eight highest-yielding monitoring wells between the dates of December 5 and 15. Short-term (i.e., one to two hours), variable-rate tests were performed in the other thirteen, low-yield wells during purging associated with the first groundwater sampling event. The variable-rate tests were performed between the dates of December 18 and 27. Short-term step-rate tests were performed in all twenty-one wells at the conclusion of development to provide estimates of specific capacity for sizing of the dedicated sampling pumps and aquifer test planning. In addition, the variable-rate tests conducted during well purging were generally conducted in a step-rate fashion. The tests consisted removing known volumes of water from the wells at controlled rates and monitoring the water level response to the stress. Because the wells in each cluster are completed with different designs (i.e., none of the wells were true observation wells), all of the aquifer tests were considered single-well tests for analysis purposes. Because single-well aquifer tests are known to provide unreliable estimates of storativity, the estimated hydraulic parameters are limited to transmissivity and hydraulic conductivity.

Baseline sampling of the wells was initiated approximately 48 hours after the aquifer tests were completed using dedicated pumps to purge three well volumes prior to sample collection. Baseline and confirmation sampling was performed in accordance with in accordance with the procedures in the SAP. A second, confirmation sampling event, utilizing the same methods and procedures but with an abbreviated laboratory program was conducted four weeks after completion of the baseline sampling event. Purge water generated during well sampling was discharged to the sanitary sewer pursuant to a Special Purpose Discharge Permit.
Addressing Data Gaps:

The RI study being performed in the South Basin is focused on the filling of data gaps. As already described, the study area extends more than 2 square miles and includes dozens of sources, many that have seen investigations before. In addition, the OCWD has performed transient analysis of shallow groundwater using an extensive installation of direct-push temporary geo-probes. That data and other published information were reviewed and brought current by the OCWD consulting firms hired to perform this NCP-compliant remedial investigation.

The Additional Groundwater Assessment Field Sampling Plan and Quality Assurance Project Plan Addendum (FSP) for the OCWD South Basin describes additional assessment activities to be conducted in support of the Remedial Investigation and Feasibility Study (RI/FS) primarily located in the cities of Santa Ana, Irvine, and Tustin, California (the Study Area). Specifically, the FSP describes additional groundwater assessment activities that will be conducted to further characterize the hydrogeology and extent of contamination in areas of the SBGPP that have been identified as having key data gaps; and provide data to support the development of appropriate remedial actions.

A description of the process of identifying key data gaps and results of the analysis follows. Following implementation of the additional groundwater assessment activities described in the FSP, results of the assessment will be evaluated and any potential new or additional data gaps requiring further assessment will be identified. There was a small network of regional groundwater monitoring wells within the South Basin area and more than 500 monitoring wells installed as part of contaminant investigation programs at many “source sites” located within the SB. Since 2008, the OCWD has conducted groundwater RI activities and maintains a database of groundwater data including data from the OCWD regional monitoring wells as well as individual “source site” monitoring wells for which data is readily available for download from the California State Water Resources Control Board GEOTRACKER.

A Preliminary RI report prepared by a separate OCWD consultant (Aquilogic), dated October 2015, was available for review in preparation for this plan. Results of that investigation indicated that contaminants have been detected at concentrations exceeding one thousand times maximum contaminant levels (MCLs) in the groundwater in the shallow aquifers less than approximately 100 feet below land surface (bfs). The principal COCs within the SBGPP include trichloroethene (TCE), tetrachloroethene (PCE, also known as perchloroethylene), 1,1-dichloroethene (1,1-DCE), 1,4-dioxane, perchlorate, and hexavalent chromium (Cr(VI)). Detections of contaminants have also been reported in water supply wells that withdraw groundwater from the deeper aquifer units, notably supply well IRWD-3 which is screened in both the Principal Aquifer and Deep Aquifer systems. Non-pumping groundwater levels in supply well IRWD-3 and Shallow Aquifer system monitor wells SAM-4/1 to SAM-4/3 indicate a downward vertical gradient exists between the Shallow Aquifer System and the Principal/Deep Aquifer systems (Figure 1). The downward vertical gradient indicates the potential for downward migration of principal COCs from within and to below the Shallow Aquifer System. This vertical migration potential is of primary concern and needs to be addressed by existing and proposed additional RI monitor wells within the Study Area.

The available water level, water quality, and hydrostratigraphic data was compiled and reviewed to evaluate the critical data gaps in portions of the Study Area downgradient of “source sites”. Specifically, the following key questions were addressed during the data gap review:

- What is the lateral/vertical extent of principal COCs exceeding drinking water MCLs and/or Notification Levels (NL)?
- What is nature of hydrostratigraphic units and principal COC migration pathways in the Shallow Aquifer System?
- What is the direction of groundwater flow and gradient in and between hydrostratigraphic units?
The focus of the data gaps assessment was on evaluating monitor well coverage within the SB at different depth intervals within the Shallow Aquifer System. Based on data from wells SAM-1 through SAM-6 and the OCWD Basin model, the bottom of the Shallow Aquifer System (Alpha Aquifer) within the Study Area ranges from approximately 100 to 190 feet bsl. The depth intervals evaluated for the Data Gaps analysis are as follows:

- Less than 35 feet bsl
- 35 to 55 feet bsl
- 55 to 75 feet bsl
- 75 to 130 feet bsl
- 130 to 200 feet bsl

The 10-microgram per liter plume contour for the most widespread principal COCs (TCE, PCE, 1,1-DCE), and perchlorate in the three units above 75 feet bsl from the 2012 plume maps presented in the Preliminary RI report were posted and compared to locations of existing monitor wells known to be screened within the respective depth interval. Additionally, 1,4-dioxane is a widespread principal COC that is not depicted as the extent lies within the extent of TCE, PCE, and 1,1-DCE.

Since plume maps were not prepared for the depth intervals greater than 75 feet bsl in the Preliminary RI investigation, the approach for these depth intervals included comparing color coded postings of the most recent (thru 2012) maximum individual concentration of the widespread principal COCs to locations of the existing monitor wells known to be screened within the respective depth interval. This data gaps analysis resulted in identification of seven locations within the SBGPP where additional monitor wells should be installed to further characterize: the lateral/vertical extent of principal COGs; the nature of hydrostratigraphic units; and the direction of groundwater flow/gradient in and between hydrostratigraphic units.

Each monitor well location would comprise 4 to 5 individual monitor wells completed at different depths (monitor well cluster). Two of the monitor well clusters (SAM 6 and SAM 7) are located interior to the commingled plumes in the SB. The remaining 5 monitoring well clusters are located near the perimeter of the Study Area.

Remedial Investigation Workplan Deliverables

- Deliverables to be submitted to the TAC for comments and the Grant Manager for approval:
  - Well Completion Report, including well completion logs
  - MRP to include analytical sampling and water level data for new and existing monitoring wells

GeoTracker

- Final reports will be uploaded to Geo Tracker

Scope Changes

- Changes from the approved Remedial Investigation Workplan will be submitted to the TAC for comments and to the Grant manager for Approval

Remedial Investigation (RI) Report

New investigation data along with existing South Basin data will be summarized in an RI report. The report will describe the nature and extent of groundwater contamination in the South Basin and include a description of the release sites where adequate data exists in the record. The report will also describe how particular sites are acting as a continuing source of groundwater contamination. This RI will not include OCWD access to the private property of PRPs.
The RI Report will follow relevant EPA guidance and incorporate the following: compiled soil and groundwater data from the project database; information from OCWD’s Water Resources Management System (WRMS); previous reports documenting the District’s field investigations; relevant published information; relevant information and interpretations prepared for or on the behalf of the District, particularly as they pertain to the study area’s hydrogeologic conditions.

Since the focus of the interim remedy is prevention of the further migration of contaminants that were released at numerous sites in the South Basin area, the RI will focus on: (1) describing nature and extent of COCs in groundwater in the South Basin area and (2) describing the degree of impact of on-going COC mass flux from respective release sites. The degree of on-going COC mass flux at each site will be evaluated based on soil and groundwater data collected near the respective source features (as compared to screening levels and drinking water standards) and the effectiveness of any existing groundwater remediation to prevent future off-site migration, to the extent that a system currently exists (based on remediation system performance data).

The RI report will also describe the transport of COCs in groundwater within the South Basin area based on observed concentrations of parent/daughter products, where applicable, and published literature pertaining to transport of respective COCs.

The combination of release site information, hydrogeologic conditions, nature and extent of COCs in South Basin area groundwater, and the transport of respective COCs will be used to develop a conceptual site model (CSM). The CSM will acknowledge known impacts to the underlying water resource currently being used for water supply purposes and will also include potential direct pathways from shallow groundwater to deeper groundwater, such as former irrigation wells and/or windows of higher hydraulic conductivity sediments within intervening aquitard(s).

Regional cross sections presented in the RI Report will be based on existing regional cross sections developed by the District in support of water resource management activities.

**Remedial Investigation Report Table of Contents**

- Deliverables to be submitted to the TAC and SAG for comments, the Grant Manager for approval:
  - Site history, past investigations, and the purpose
  - Project area’s and scope
  - Field work activities completed
  - Methods used
  - Supporting documentation and field notes including: well construction, development, water levels, soil and/or groundwater sampling.
  - Findings
  - Lithology (well logs and geologic cross-sections)
  - Analytical results (laboratory data sheets and chain-of-custody sheets)
  - Water levels (table including date of water level measurement, depths to groundwater, and groundwater elevations)
  - Groundwater gradient and flow direction (groundwater contour map, gradient calculation).
  - Evaluation of data by the Grantee
  - Assessment of the nature and extent of contamination including plume maps for individual contaminants within each water bearing zone and time-series plots.
  - Conclusions and/or suspected source of contamination.
  - Identification of further investigations necessary.
  - Quality assurance and quality control procedures, QAPP
Baseline Human Health Risk Assessment

- Deliverables to be submitted to the TAC for comments and the Grant Manager for approval
- Identifies threats to human health from potential exposure to contaminated groundwater using existing data and information from the remedial investigation.

Feasibility Study (FS) Workplan

- Deliverables to be submitted to the TAC for comments and the Grant Manager for approval
- Objectives and the steps needed for the prevention and/or cleanup of groundwater contamination
- Technical and cost analyses of alternatives
- List of Remedial Action Objectives
- Applicable or relevant and appropriate requirements (ARAR) analysis
- Groundwater flow modeling for evaluating potential implementation projects

Feasibility Study

- Deliverables to be submitted to the TAC and SAG for comments and the Grant Manager for approval
- Evaluate and develop interim remedial alternatives
- Conduct a feasibility study
- Summarizes the activities conducted including the results

Feasibility Study Report Table of Contents

- Project Area’s history, geology, hydrogeology, surface water, local land use, previous investigations, and remedial actions.
- Nature and extent of constituents of concern (COCs)
- Contaminant properties and transport based on soil and aquifer properties.
- Proposed remedial action objectives
- Description of the remedial action alternatives.
- Evaluation of the remedial action alternatives
- Determine the need for treatability studies and additional investigations in the Project area.
- Estimate of life cycle costs and schedule for each alternative.

Public Outreach

- Develop outreach materials including flyers, posters, brochures, and advertisements, website social media web pages to include Project progress and outcomes.
- Provide copies and web links to the Grant Manager.
- Conduct a public workshop, inviting relevant non-governmental organizations and disadvantaged community representatives, prior to finalization of the Feasibility Study
- Submit the workshop materials, sign-in sheet(s), and photo documentation of the workshop to the Grant Manager.

Disclosure Statement

“Funding has been provided in full or in part through an agreement with the State Water Resources Control Board using funds from Proposition 1. The contents of this document do not necessarily reflect the views and policies of the foregoing, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.”
Progress Reports

- Quarterly progress reports due within forty-five (45) days following the end of the calendar quarter (March, June, September, and December) to the Grant Manager.
- Reports will include a brief description of activities and any problems encountered
- An updated schedule for completing the project
- Documentation of activities and expenditures in progress reports, including work performed by contractors.

As Needed Information or Reports

- Reports, data, and information as may be reasonably required by the Division, including but not limited to material necessary or appropriate for evaluation of the funding program or to fulfill any reporting requirements of the state or federal government.

Draft Final Reports

- Draft sent to the Grant Manager for review and approval

Final Project Report

- Addresses, comments made by the Grant Manager on the draft
- One (1) reproducible master copy and an electronic copy of the final.
- Upload an electronic copy of the final report in pdf format to the FAAST system.

Final Project Summary

- Consists of a brief summary of the information contained in the Final Project Report, using a format provided by the Grant Manager, and include accomplishments, recommendations, and lessons learned, as appropriate.
- Upload an electronic copy of the Final Project Summary in pdf format to the FAAST system.

Notification Section

- OCWD will notify DFA/TAC 3-4 weeks in advance of any field activities in the SB for site visits.

Attachment 1: Well Construction Details
Attachment 2: Groundwater Contour Maps
Attachment 3: Plume Maps
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<td>20</td>
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**Notes:**
1. Elevation based on North American Vertical Datum of 1988 (NAVD88) in feet above mean sea level (amsl). Elevations taken from "top metal plate" of well head assembly, unless otherwise noted.
2. Bottom of borehole backfill material: 3/8-inch coated bentonite pellets.
4. Sanitary seal material: Neat cement with 5% bentonite.
5. SAM-7X was destroyed by drilling out and backfilling with neat cement on July 27 & 28, 2017. (Information shown in italics represents prior-to-abandonment well details).
6. Elevation = top of 4-inch PVC well casing (not top of metal plate assembly).

*Note:* All wells completed at surface inside traffic-rated, 12-inch diameter, cast aluminum EMCO vaults (PN A0721-112)
FIGURE 1A
GROUNDWATER ELEVATIONS
SAM-#A WELL COMPLETIONS
MARCH 27, 2018
OCWD SBGWPP
ORANGE COUNTY, CALIFORNIA

EXPLANATION

- SAM MONITORING WELL LOCATION
- GROUNDWATER ELEVATION IN FEET AMSL, MARCH 27, 2018
- APPROXIMATE GROUNDWATER ELEVATION CONTOUR IN FEET AMSL
- GROUNDWATER FLOW DIRECTION

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
FIGURE 1B
GROUNDWATER ELEVATIONS
SAM-#B WELL COMPLETIONS
MARCH 27, 2018
OCWD SBGWPP
ORANGE COUNTY, CALIFORNIA

EXPLANATION
SAM MONITORING WELL LOCATION
GROUNDWATER ELEVATION IN FEET AMSL,
MARCH 27, 2018
APPROXIMATE GROUNDWATER ELEVATION
CONTOUR IN FEET AMSL
GROUNDWATER FLOW DIRECTION

0 600 1,200 FEET
0 1 2 3 4
EXPLANATION

- SAM MONITORING WELL LOCATION
- GROUNDWATER ELEVATION IN FEET AMSL
- MARCH 27, 2018
- APPROXIMATE GROUNDWATER ELEVATION
- CONTOUR IN FEET AMSL
- GROUNDWATER FLOW DIRECTION

FIGURE 1D
GROUNDWATER ELEVATIONS
SAM-#D WELL COMPLETIONS
MARCH 27, 2018

OCWD SBGWPP
ORANGE COUNTY, CALIFORNIA

0 600 1,200
FEET
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

TCE Concentration (µg/L)
100 - 1,000
10 - 100
1 - 10

Trichloroethene Isocontour Line
(0 - 35 FDI)

Source Site
Parcel Boundary
Study Area

Scale: Feet

Date: 2/2/2015  Project #: 002-01  Figure 8.1a
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

TCE Concentration (µg/L)
- ≥ 1,000
- 100 - 1,000
- 10 - 100
- 1 - 10

Trichloroethene Isocontour Line
(55 - 75 FDI)

Source Site
Parcel Boundary
Study Area

Figure 8.1c
Tetrachloroethene Isocontour Line
(0 - 35 FDI)

NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

PCP Concentration (µg/L)
≥ 10,000
10 - 100
1 - 10
100 - 1,000
1,000 - 10,000

Source Site
Parcel Boundary
Study Area

Date: 2/3/2015
Project #: 002-01

Orange County Water District
Tetrachloroethene in Groundwater
0 - 35 FDI

Figure 8.2a
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

PCE Concentration (µg/L)

≥ 1,000
100 - 1,000
10 - 100
1 - 10

Tetrachloroethene Isocontour Line
(35 - 55 FDI)
Source Site
Parcel Boundary
Study Area

Date: 2/3/2015
Project #: 002-01
Figure 8.2b
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

PCE Concentration (µg/L)
- ≥ 100
- 10 - 100
- 1 - 10

Tetrachloroethene Isocontour Line
(55 - 75 FDI)

Source
Parcel Boundary
Study Area

Figure 8.2c
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,1-DCE Concentration (µg/L)
≥ 10,000
1,000 - 10,000
10 - 100
1 - 10

1,1-Dichloroethene Isocontour Line
(0 - 35 FDI)

Source Site
Parcel Boundary
Study Area
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,1-DCE Concentration (µg/L)
- ≥ 1,000
- 100 - 1,000
- 10 - 100
- 1 - 10

1,1-Dichloroethene Isocontour Line (35 - 55 FDI)
- Source Site
- Parcel Boundary
- Study Area

Date: 2/3/2015
Project #: 002-01
Figure 8.3b
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,1-DCE Concentration (µg/L)
- ≥ 1,000
- 100 - 1,000
- 10 - 100
- 1 - 10

1,1-Dichloroethene Isocontour Line (55 - 75 FDI)
- Source Site
- Parcel Boundary
- Study Area
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,4-Dioxane Concentration (µg/L)
≥ 10,000
1,000 - 10,000
100 - 1,000
10 - 100
1 - 10

1,4-Dioxane Isocontour Line
(0 - 35 FDI)

Source Site
Parcel Boundary
Study Area

1,4-Dioxane in Groundwater 0 - 35 FDI

Orange County Water District
SBGPP

Date: 2/3/2015
Project #: 002-01
Figure 8.4a
1,4-Dioxane Concentration (µg/L)

1,4-Dioxane Isocontour Line
(35 - 55 FDI)

≥ 1,000
100 - 1,000
10 - 100
1 - 10

Source Site
Parcel Boundary
Study Area

NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface.

1,4-Dioxane Concentration (µg/L)
≥ 1,000
100 - 1,000
10 - 100
1 - 10

1,4-Dioxane Isocontour Line
(55 - 75 FDI)

Source Site
Parcel Boundary
Study Area

Figure 8.4c
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Perchlorate in Groundwater 0 - 35 FDI

Perchlorate Concentration (µg/L)
- ≥ 1,000
- 100 - 1,000
- 10 - 100
- 2 - 10

Perchlorate Isocontour Line
(0 - 35 FDI)

Source Site
Parcel Boundary
Study Area

Orange County Water District
Perchlorate in Groundwater 0 - 35 FDI
Date: 2/3/2015 Project #: 002-01 Figure 8.5a
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Perchlorate Concentration (µg/L)

- ≥ 1,000
- 100 - 1,000
- 10 - 100
- 2 - 10

Perchlorate Isocontour Line
(35 - 55 FDI)

Source Site
Parcel Boundary
Study Area
NOTE:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Perchlorate Concentration (µg/L)

≥ 10
2 - 10

Perchlorate Isocontour Line
(55 - 75 FDI)

Source Site
Parcel Boundary
Study Area

Orange County Water District
SBGPP
Perchlorate in Groundwater 55 - 75 FDI

Date: 2/3/2015
Project #: 002-01
Figure 8.5c
Hexavalent Chromium in Groundwater

Figure 8.6a

NOTES:
See Appendix I for additional detail.

FDI = Foot depth interval below ground surface

Chromium VI Concentration (µg/L)

> 10,000
10,000 - 10,000
1,000 - 10,000
100 - 1,000
10 - 100
1 - 10

Chromium VI Isocontour Line
(0 - 35 FDI)

Source Site
Parcel Boundary
Study Area

Date: 2/3/2015 Project #: 002-01
Orange County Water District
SEBGP

Scale: Feet
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface.
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Freon 11 Concentration (µg/L) 
≥ 1

Freon 11 Isocontour Line
(Zone A1)

Source Site
Parcel Boundary
Study Area
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Freon 11 Concentration (µg/L)

≥ 10
1 - 10

Freon 11 Isocontour Line (35 - 55 FDI)

Source Site
Parcel Boundary
Study Area
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Freon 11 Concentration (µg/L)
≥ 10
1 - 10

Freon 11 Isocontour Line
(55 - 75 FDI)

Source Site
Parcel Boundary
Study Area

Orange County Water District
SB/GPP
Freon 11 in Groundwater 55 - 75 FDI
Date: 2/3/2015  Project #: 002-01  Figure 8.7c
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface
NOTE:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Freon 113 Concentration (µg/L)
≥ 100
10 - 100
1 - 10

Freon 113 Isocontour Line
(35 - 55 FDI)

Source Site
Parcel Boundary
Study Area

Date: 2/3/2015  Project #: 092-01  Figure 8.8b
NOTE:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Freon 113 Concentration (µg/L)

≥ 100
10 - 100
1 - 10

Freon 113 Isocontour Line
(55 - 75 FDI)

Source Site
Parcel Boundary
Study Area

Figure 8.8c
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Freon 123 in Groundwater 0 - 35 FDI

Date: 2/3/2015 Project #: 002-01 Figure 8.9a
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Freon 123 Concentration (μg/L)
≥ 1

Freon 123 Isocontour Line
(55 - 75 FDI)

Source Site
Parcel Boundary
Study Area
Figure 8.10a

Vinyl Chloride Concentration (µg/L)
- ≥ 100
- 10 - 100
- 1 - 10

Vinyl Chloride Isocontour Line
(0 - 35 FDI)

NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Orange County Water District
SBBGPP
Vinyl Chloride in Groundwater
0 - 35 FDI

Date: 2/3/2015  Project #: 002-01  Figure 8.10a
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Vinyl Chloride Concentration (µg/L)
- ≥ 100
- 10 - 100
- 1 - 10

Vinyl Chloride Isocontour Line
(35 - 55 FDI)

Source Site
Parcel Boundary
Study Area

Date: 2/3/2015
Project #: 002-01
Figure 8.10b

Orange County Water District
SGEGFP
Vinyl Chloride in Groundwater
35 - 55 FDI
Vinyl Chloride in Groundwater

Vinyl Chloride Isocontour Line
(55 - 75 FDI)

NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

Orange County Water District
WEBPP
Vinyl Chloride in Groundwater
55 - 75 FDI
Date: 2/3/2015
Project #: 002-01
Figure 8.10c
NOTES:
See Appendix I for additional detail.

FDI = Foot depth interval below ground surface

1,1-DCA Concentration (µg/L)

- ≥ 1,000
- 100 - 1,000
- 10 - 100
- 1 - 10

1,1-Dichloroethane Isocontour Line
(0 - 35 FDI)

Source Site
Parcel Boundary
Study Area

Orange County Water District
1,1-Dichloroethane in Groundwater
0 - 35 FDI
Date: 2/3/2015
Project #: 002-01
Figure 8.11a
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,1-DCA Concentration (µg/L)

≥ 100
10 - 100
1 - 10

1,1-Dichloroethane Isocontour Line
(35 - 55 FDI)

Source Site
Parcel Boundary
Study Area

Date: 2/3/2015
Project #: 002-01
Figure 8.11b
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,1-DCA Concentration (µg/L)  
≥ 100  
10 - 100  
1 - 10

1,1-Dichloroethane Isocontour Line  
(55 - 75 FDI)

Source Site  
Parcel Boundary  
Study Area
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,2-DCA Concentration (µg/L)

- 100
- 10 - 100
- 1 - 10

1,2-Dichloroethane Isocontour Line
(0 - 35 FDI)

Source Site
Parcel Boundary
Study Area

Figure 8.12a

Orange County Water District
1,2-Dichloroethane in Groundwater
0 - 35 FDI

aquilogic Inc.

Date: 2/3/2015
Project #: 002-01
Figure 8.12a
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1.2-DCA Concentration (µg/L)

≥ 100
10 - 100
1 - 10

1.2-Dichloroethane Isocontour Line
(35 - 55 FDI)

Source Site
Parcel Boundary
Study Area
NOTES:
See Appendix I for additional detail.
FDI = Foot depth interval below ground surface

1,2-DCA Concentration (µg/L)
≥ 10
1 - 10

1,2-Dichloroethane Isocontour Line
(55 - 75 FDI)
Source Site
Parcel Boundary
Study Area

Date: 2/3/2015
Project #: 002-01
Figure 8.12c