Executive Summary

The city of Los Angeles encompasses an area of 465 square miles with a population of nearly 4 million residents and an annual average water consumption of approximately 215 billion gallons. Local groundwater has provided approximately 11 percent of the city's total water supply, and provided up to 30 percent of the city's total supply in drought years.

Unfortunately, nearly 50 percent of the Los Angeles Department of Water and Power's (LADWP) groundwater production wells in the San Fernando Basin (SFB) have been inactivated because of contamination. The SFB is an aquifer that provides drinking water to a large portion of residents within the city. If effective remediation and cleanup measures are not put in place within the next decade, then various contaminants found in the SFB will continue to spread and degrade this local resource.

In response to this continued degradation of water quality, LADWP implemented the SFB Groundwater System Improvement Study (GSIS). The GSIS study area is shown on Figure ES-1. Its objective is to develop a comprehensive remediation and cleanup program to address the groundwater contamination in the SFB to preserve public and environmental benefits.

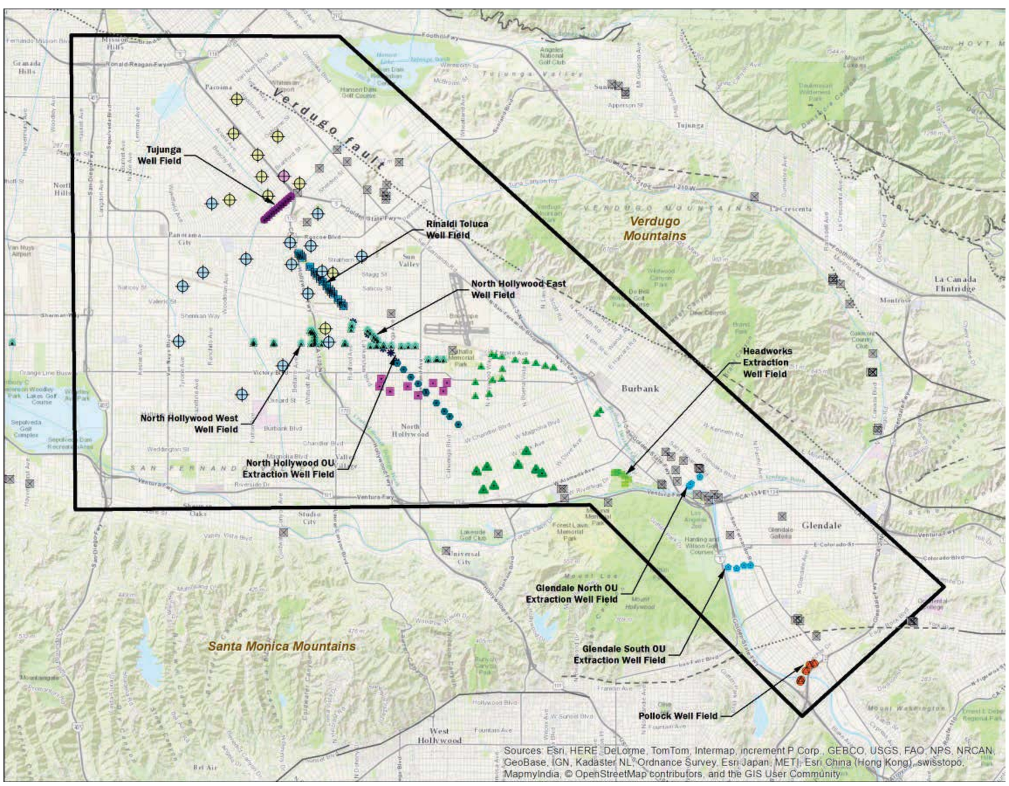

Figure ES-1. GSIS study area

By summarizing investigative results from the GSIS as well as other data sources and updating the current conceptual understanding of the SFB, this Remedial Investigation (RI) Update Report achieves one component of this objective. This report is considered an update to the 1992 RI Report for the San Fernando Valley (SFV) (JMM 1992), herein referred to as the 1992 RI, because many of the findings from that report form the basis of the current conceptual model. This RI Update Report presents LADWP's latest understanding of the groundwater basin physical characteristics, nature and extent of contamination, fate and transport characteristics, and the contaminants' risk to human health and the environment. Simultaneously, the GSIS is developing a Draft Feasibility Study (FS) Report for evaluating various alternatives to remediate portions of the SFB impacted by the contamination.

With the completion of the RI Update and Draft FS, LADWP will be able to proceed with the necessary environmental reviews, design, permitting, construction, and startup of the groundwater remediation facilities to effectively clean and remove contaminants from SFB groundwater. The groundwater remediation facilities are anticipated to be operational by the mid-2020s.

Purpose of Report

The United States Environmental Protection Agency (USEPA) declared portions of the eastern SFB with contaminated supply wells as National Priorities List (NPL) sites in 1986 and subsequently completed a comprehensive investigation near the NPL sites. The 1992 RI focused efforts within the NPL sites; however, it did not characterize the groundwater conditions to the north and west of LADWP's North Hollywood (NH), Rinaldi-Toluca (RT), and Tujunga (TJ) well fields, which were outside the NPL site boundaries. Hence, the purpose of the GSIS and this RI Report Update is to complete the characterization in those areas and update the nature and extent of the contamination impacting these well fields. The specific objectives of the RI Update are as follows:

1. Assemble existing data, with an emphasis on hydrogeology and water quality, to identify data gaps within the study area
2. Conduct additional field investigation to fill data gaps
3. Update characterization of the groundwater basin based on the analysis of the data, with respect to:
    - Geology
    - Hydrogeology
    - Nature and extent of contamination
4. Present factors (e.g., retardation, degradation, etc.) that influence the fate and transport of compounds in groundwater
5. Provide recommendations for future investigations, if any

This report is prepared in accordance with the guidelines outlined in the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act of 1980) and is in substantial compliance with the National Oil and Hazardous Substances Pollution Contingency Plan (also known as NCP).

Background

During the late 1800s, the SFV was dominated by agriculture and farming activities. The early 1900s gave rise to early industrialization and urbanization. By the 1940s, rapid industrialization of the SFV was under way, including aerospace and defense manufacturing, machinery degreasing, dry cleaning, metal plating, and more. Rapid industrialization coincided with the unregulated chemical waste disposal practices of the times.

In the early 1980s, groundwater monitoring in the SFV detected concentrations of chlorinated volatile organic compounds (VOCs), including trichloroethene (TCE) and tetrachloroethene (PCE) in excess of state and federal drinking water standards. These solvents were widely used in a number of industries in the SFV. In 1981, LADWP began a 2-year study to assess the severity of groundwater contamination at several of its municipal water supply well fields in the SFV. Contamination was found in approximately 45 percent of LADWP's existing SFV water supply wells.

Shortly thereafter, USEPA and other agencies became involved in coordinating efforts to address the large-scale contamination in the SFB. A Cooperative Agreement between USEPA and LADWP was signed in 1987 to perform an RI of groundwater contamination in the eastern SFV. The 1992 RI served to delineate the nature and extent of widespread contamination in the SFB, both vertically and horizontally. The majority of contamination in groundwater was found in the shallow groundwater, with the most prevalent compounds detected being TCE and PCE. In effect, the 1992 RI provided a basis for a FS to address possible strategies for remediation of contaminated groundwater on a basin-wide scale. It also identified the need for further investigation on a more localized scale. USEPA identified five operable units (OUs) to focus remediation efforts and to accelerate regional cleanup:

- North Hollywood OU (NHOU)
- Burbank OU (BOU)
- Glendale North OU (GNOU)
- Glendale South OU (GSOU)
- Glendale Chromium OU (GCOU) (established in 2007 as the fifth OU to investigate chromium in groundwater within the Glendale area)

Despite regional cleanup efforts, full containment of VOC contamination has not been achieved, and the groundwater in the eastern SFB remains contaminated. Some plumes have escaped containment and continued to spread while new contamination sources were discovered, adversely impacting LADWP wells and further degrading the local groundwater resources. The migration of VOC contamination is further complicated by the detection of contaminants of emerging concern, such as 1,4-dioxane, hexavalent chromium [Cr(VI)], n-Nitrosodimethylamine (NDMA), and perchlorate.

Study Area

The SFV is a diverse area with a history of mixed land uses, including agricultural, residential, and industrial, and a large population of residents and workers who rely on its groundwater supply infrastructure. The SFV is approximately 23 miles long from east to west, and approximately 12 miles wide from north to south. Mountains and hills surround the valley: the San Gabriel Mountains on the north and northeast, Santa Susana Mountains on the northwest, Santa Monica Mountains on the south, Simi Hills on the west, and San Rafael and Repetto hills on the southeast. The Los Angeles River is an important physiographic feature in the SFV, as well as the many streams and washes that drain the surrounding mountains. The Los Angeles River flows through the SFV from west to east, and turns south between the Santa Monica Mountains and the Repetto Hills. The topographic constriction in the southern reach of the river is the Los Angeles River Narrows.

The study area encompasses all of LADWP's current production well fields in the SFB. Groundwater extraction from the SFB is limited by the court-defined water rights recorded in the *Judgment of the California Superior Court in Case No. 650079, The City of Los Angeles vs. The City of San Fernando, et al.*, dated January 26, 1979 (Judgment) and managed by the Upper Los Angeles River Area (ULARA) Watermaster. LADWP operates nine of the well fields in the SFB: TJ, RT, NH, Whitnall, Erwin, Verdugo, Headworks, Crystal Springs, and Pollock. Annual well water production has steadily declined since 2000 with just under 50,000 acre-feet (AF) being extracted between 2011 and 2012. This decline in some production wells has been the result of the spread of contamination and degradation of water quality in the SFB.

Description of Remedial Investigation Activities

A fundamental goal of the GSIS was to fill data gaps and provide a structure to collect data to assess overall eastern SFB groundwater quality. To identify and fill these data gaps, a dynamic approach following the CERCLA investigation process was developed, as illustrated in Figure ES-2.

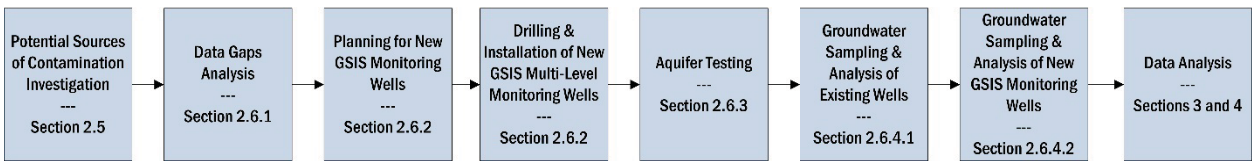

Figure ES-2. Investigation process for GSIS

The GSIS was executed as an iterative and dynamic study, whereby data gaps were identified, addressed, and then re-assessed as the project was executed.

The two primary data gaps identified during initial evaluation of available data included the following:

- Comprehensive water quality data to identify the chemicals of concern (COCs), including emerging and future contaminants, as identified by the California Department of the Drinking Water (DDW), as well as their distribution in groundwater in the eastern SFB
- Refinement and update of the site physical characteristics of the eastern SFB, specifically in areas of North Hollywood West (NHW), RT, and TJ, and the updated Hydrogeologic Conceptual Site Model (HCSM)

LADWP, along with Brown and Caldwell (BC), developed a monitoring well installation, sampling and analysis program in order to fill these data gaps. As shown on Figure ES-3, 26 locations were identified for completion of multi-level clustered monitoring wells for collection of hydrogeologic and water quality data. The monitoring well installation, performed between 2013 and 2014, included the collection of the following data to assist with the updated HCSM of the SFB:

- Lithologic data was collected through logging of soils by an onsite geologist and geophysical logging of the borehole. This information, along with data from adjacent wells, was also used to determine the appropriate screened intervals for the multi-level monitoring wells.
- Soil properties (e.g., soil bulk density, porosity and hydraulic conductivity) through geotechnical testing of select soil samples.
- Water quality data was collected during advancement of the borehole, and after well installation during well development.

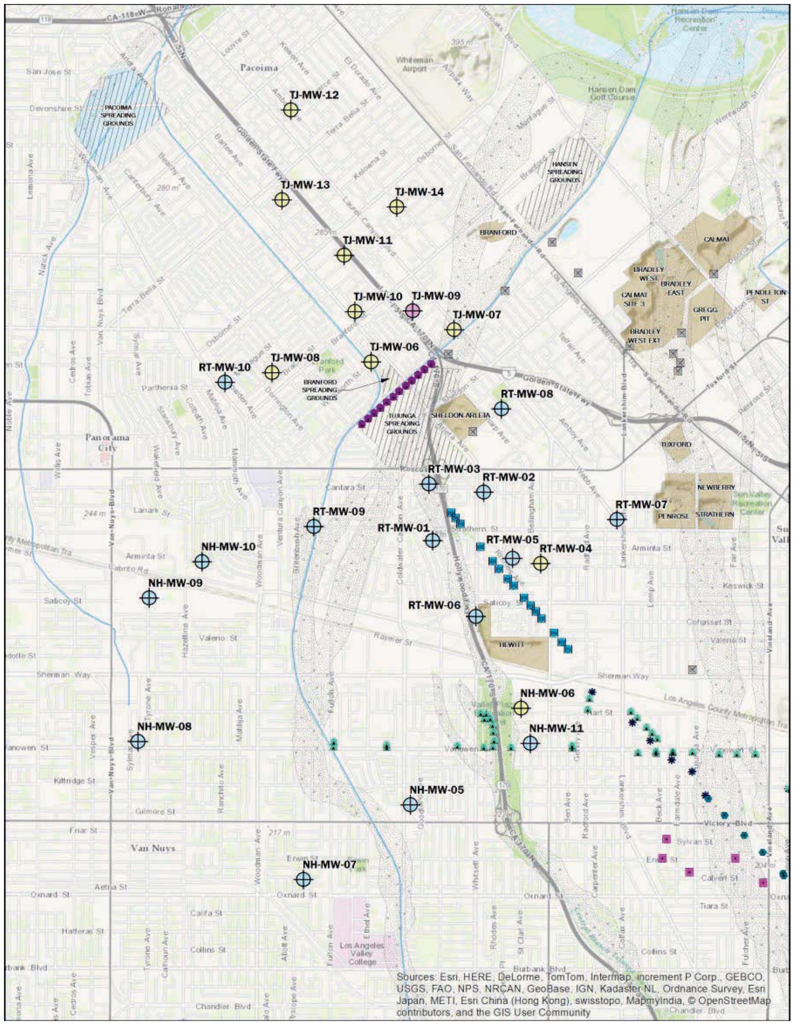

Figure ES-3. GSIS Monitoring Well Installation Map

Following well development, water quality data was collected from existing monitoring wells and production wells (a total of 67 wells sampled in 2012/2013) and the 26 newly-installed multi-level clustered wells (a total of 75 wells at the 26 locations sampled during 2014). These sampling events included a comprehensive list of more than 400 chemicals that were analyzed and then subjected to Level 2a data validation to ensure a robust and defensible data set for establishing COCs and their extent in groundwater.

Additional Data Sources

The two additional data sources used as part of this RI Update Report are presented below:

- **LADWP Laboratory Information Management System (LIMS) database:** LADWP conducts groundwater sampling of its SFB production wells in accordance with specifications in its Domestic Water Supply Permit and includes monthly sampling for VOCs and other select chemicals. Sampling results are input into LADWP's LIMS database.

- **USEPA SFV database:** As part of the 1992 RI, 84 groundwater monitoring wells were constructed and the USEPA Groundwater Monitoring Program (GMP) periodically collects, analyzes, and reports data from these wells. In addition, groundwater quality data are received from potentially responsible parties (PRPs). All of these data are housed in the USEPA SFV database, which was accessed and used for the identification of COCs and for characterization of the nature and extent of contamination in this report. The SFV GMP has served as a regional monitoring program that is used to track changes in contaminant distribution, monitor water level and contaminant trends, and provide data for various regional data evaluation activities conducted by a variety of stakeholders.

Hydrogeologic Conceptual Site Model Update

The completion of the investigative work significantly improved the understanding of the physical characteristics of the SFB, specifically the subsurface conditions around the TJ, RT, and NHW well fields. An HCSM is used to organize and communicate technical information about site characteristics, and is typically a precursor to and the basis for a numerical groundwater model. Prior to the GSIS, the most complete HCSM for the SFB was described in the 1992 RI. The HCSM presented in this RI Update Report is based upon new subsurface data generated during the last several years as part of the GSIS and installation of new multi-depth nested monitoring wells.

The hydrostratigraphic units of the SFB have been defined in various investigations and are summarized in Figure ES-4. Each investigation developed its units for the specific objectives of its investigation. The objective of the GSIS investigation was to update the HCSM presented in the 1992 RI report in order to refine the hydrogeologic understanding of the eastern SFB and to help with the numerical model layering for subsequent model updates.

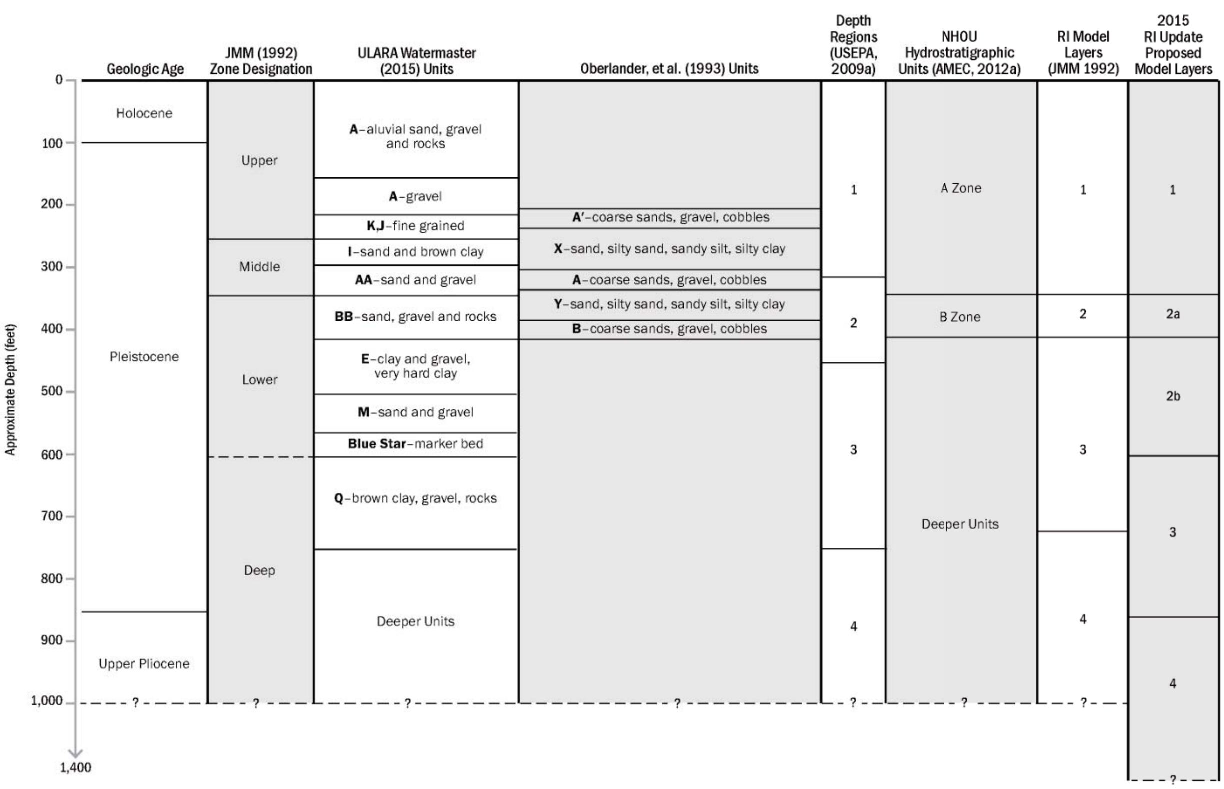

Figure ES-4. Hydrostratigraphic Unit Comparison Map

Hydrostratigraphy

The five hydrostratigraphic units (or layers) defined by the GSIS are proposed herein. The layer interpretations are based upon the 1992 RI HCSM and were modified where geophysical data and geologic descriptions of soil cuttings from the new GSIS monitoring wells warranted a change.

Layer 1 is generally the same as the 1992 RI model Layer 1, with the base of the layer coincident with the base of the Middle Zone where present. The Middle Zone is important both as the base of Layer 1 and as potentially behaving as a lower permeability unit. Based upon new data, it is evident that the Middle Zone does not exist west of Coldwater Canyon Avenue as a distinguishable unit. In fact, most of the identifiable units in the NHOU area become less distinguishable west of Coldwater Canyon Avenue.

Layer 2a largely corresponds with the original 1992 RI Layer 2 and comprises the coarse-grained, high-permeability and high-resistivity layer observed in many of the geologic and geophysical logs from wells in the area of the NH and RT well fields. The top of this layer generally occurs at a depth of approximately 360 feet below ground surface (bgs) and is marked by a sharp increase in resistivity values from geophysical logs. The bottom of Layer 2a is approximately 470 feet bgs and is indicated in the geophysical logs as a sharp decrease in resistivity. The top of Layer 2a generally correlates with the top of the screened intervals of the production wells in the Rinaldi-Toluca well field, and the Zone 1 (uppermost) screened intervals of the new GSIS nested monitoring wells are partially or completely within Layer 2a.

The base of Layer 2b correlates with the base of the Watermaster-defined Blue Star Marker Bed (ULARA Watermaster, 2015), a high resistivity layer that occurs at a depth of approximately 650 feet bgs and dips to the south at an angle similar to the ground surface. Layer 2b exhibits alternating high and low resistivity layers, but is generally characterized as lower resistivity than Layer 2a. The majority of the Zone 2 (middle) screened intervals of the new GSIS nested monitoring wells are located within Layer 2b.

The base of Layer 3 occurs at a depth of approximately 850 to 900 feet bgs and dips parallel to ground surface. The base of Layer 3 is delineated by another sedimentary layer (similar to that of Layer 2a) that exhibits high resistivity values in geophysical logs. Layer 3 includes the deepest zone from which existing production wells are screened. The majority of the Zone 3 (deep) screened intervals of the new GSIS nested monitoring wells are located within Layer 3.

Layer 4 occurs from the base of Layer 3 to the top of the non-water-bearing basement rock. The base of Layer 4 remains relatively undefined, as few wells in the SFB have encountered non-water-bearing material. New data from TJ-MW-06 indicate that the non-water-bearing basement rock is greater than 1,400 feet bgs in this area, several hundred feet deeper than the RI model Layer 4. Few, if any, wells in the SFB are screened in Layer 4.

Groundwater Levels

A groundwater elevation contour map was prepared as part of the HCSM update that includes data from various sources, primarily from fall 2013 (Figure ES-5). Groundwater elevations in the eastern portion of the SFB range from approximately 550 feet in the east to less than 320 feet above mean sea level (msl) in the southeast where the SFB discharges south to the Central Groundwater Basin. The regional groundwater gradient is approximately 0.0017 to the east and southeast within the main SFB and increases to approximately 0.0051 through the Los Angeles River Narrows. Localized pumping depressions occur around the main well fields, including TJ, RT and NHW, and the Burbank and Glendale OUs. The groundwater elevation contours indicate groundwater mounding near the

Pacoima groundwater recharge basins and along the historical Tujunga Wash below the Hansen Dam, a location where the Verdugo Fault Zone may be less restrictive to groundwater flow.

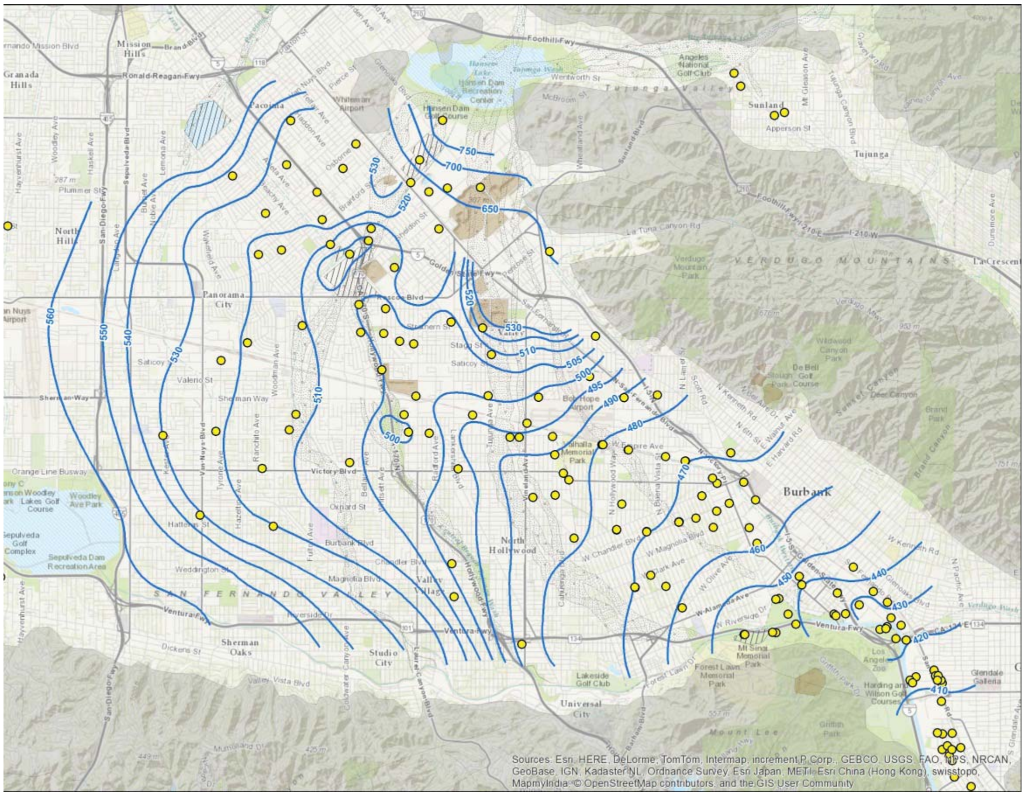

Figure ES-5. Groundwater Level Contour Map

Nature and Extent of Contamination

Chemical releases in the SFB have originated from multiple anthropogenic activities. For chlorinated solvents and Cr(VI), the primary releases were typically leaking storage tanks or piping, leaching from sumps or other disposal practices, and spills or generally poor housekeeping from the aerospace manufacturers and supporting industries. For other chemicals, such as nutrients (nitrate and manganese) and other inorganic chemicals (e.g., perchlorate), there are multiple potential sources such as historic agricultural, other industrial, and/or municipal practices in the basin including historical landfills. It should be noted that metals, such as Cr(VI), can also be naturally occurring based on the generally aerobic and oxidizing nature of groundwater in the SFB.

To evaluate the nature of groundwater contamination in the SFB, the GSIS performed two sampling events: one in 2012/2013 of existing wells and one in 2014 of newly-installed wells. A total of 31 production wells and 61 monitoring wells (151 sampling intervals including multi-level and clustered monitoring wells) were sampled during the two events. The samples were analyzed for a comprehensive list of chemicals (over 400 individual chemicals or compounds), including organic and inorganic chemicals, general water chemistry, pharmaceuticals, radionuclides, and bacterial indicators.

Using the data from the above monitoring events, in combination with the additional data sources identified above, a total of 93 chemicals have been identified as being detected in the groundwater above a regulatory threshold at least once since the start of monitoring in 1980. Only a portion of these chemicals pose a long-term risk to human health or the environment, and require attention during the evaluation and design of remedial alternatives in the Draft FS. To prioritize these COCs, each of the 93 chemicals were evaluated with respect to occurrence in the SFB and LADWP production wells, toxicity, and relation to regulatory thresholds, as well as treatment requirements. Using these criteria, a total of 12 COCs were identified as "high priority," which consist of the following:

- **Organic Chemicals**
  - TCE
  - PCE
  - Cis-1,2-Dichloroethene (cis-1,2-DCE)
  - 1,1-Dichloroethene (1,1-DCE)
  - 1,2-Dichloroethane (1,2-DCA)
  - Carbon tetrachloride
  - 1,2,3-Trichloropropane (1,2,3-TCP)
  - 1,4-Dioxane
  - NDMA
- **Inorganic Chemicals**
  - Cr(VI)
  - Perchlorate
  - Nitrate

The remaining chemicals were reported at least once above established regulatory limits, and should therefore continue to be evaluated, but are considered lower priority. In fact, when treatment is considered, many will be addressed through treatment technologies for the high-priority COCs.

Extent of Contamination

A comprehensive examination of both the vertical and horizontal distribution of the COCs in the SFB was performed. Trends in the concentrations of the COCs over time were also evaluated. Because of the long-term industrial and agricultural history of the SFB, there are multiple sources of these chemicals. The dynamic nature (e.g., lithology, groundwater flow, and usage) of the groundwater system has allowed some of the COCs to become widely dispersed in the basin, both horizontally and vertically. A description of the extent of the high-priority chemicals is presented below.

Volatile Organic Compounds and 1,4-Dioxane. Eight of the high-priority COCs are VOCs related to either primary chlorinated solvent releases (TCE, PCE, and 1,2,3-TCP), degradation of chlorinated compounds (cis-1,2-DCE, 1,1-DCE, and 1,2-DCA), or associated with solvents as a stabilizer (1,4-dioxane). The source areas for these chemicals are generally around known or suspected PRPs. The VOCs and 1,4-dioxane are generally co-located, largely attributable to their use and release at similar locations and time intervals. VOCs are generally concentrated in shallow groundwater and decrease with depth.

TCE is the most prevalent VOC reported above the maximum contaminant level (MCL) (at over 30 percent of samples collected in the SFB). The plume occurs in a substantial part of the SFB occupying an area of approximately 22 square miles (Figure ES-6).

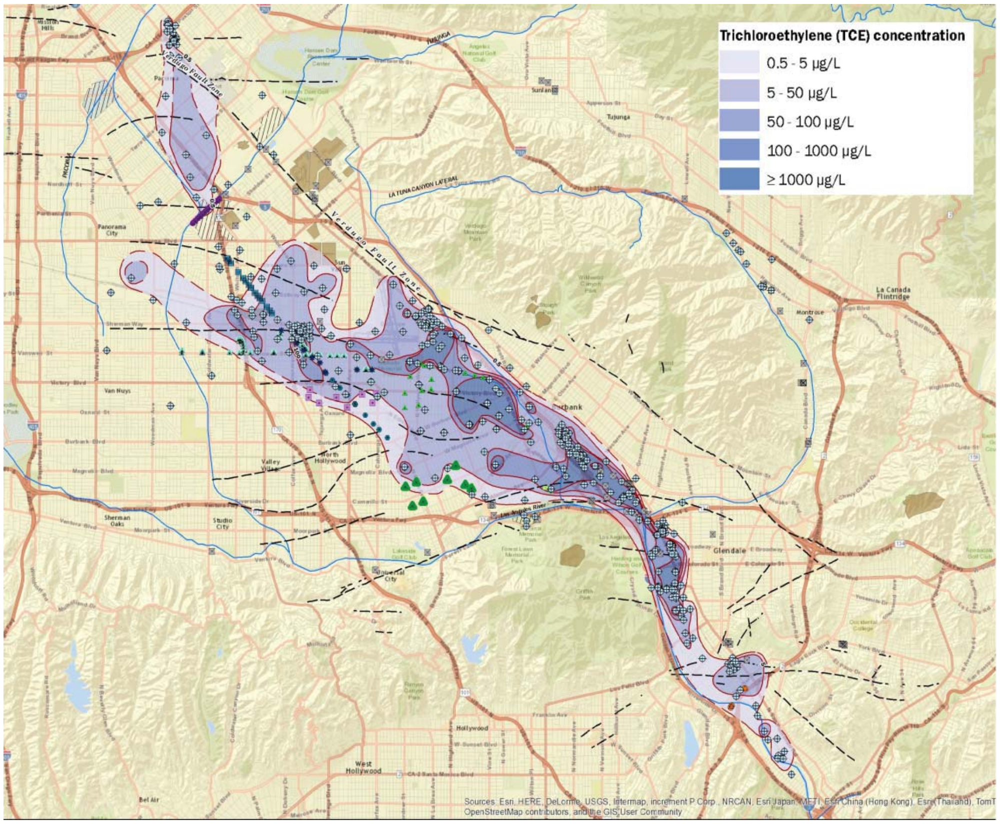

Figure ES-6. TCE Concentration in Shallow Groundwater in the SFB

Unlike some of the other VOCs, TCE is present in all of the TJ, RT, and NH well fields. Concentrations of TCE are generally stable, though some production wells in the RT and NHW well fields have shown increased frequency of detection and higher concentrations since mid-2000.

The other chlorinated compounds noted above mimic TCE, though at generally lower concentrations and smaller extents; however, some notable deviations to this pattern are presented below:

- PCE has a similar distribution to TCE near the Hewitt Pit; near the Strathern, Penrose, and Tuxford landfills; and west of the NHW well field. However, there appear to be separate source areas for PCE with concentrations in these areas being higher than those of TCE. PCE also has a generally increasing trend in the center of the TJ well field and in some of the NHW production wells.
- Similar to PCE, 1,1-DCE is elevated near the Hewitt Pit and the Strathern, Penrose, and Tuxford landfills, and in deeper sampling intervals in the TJ well field. 1,1-DCE and cis,1-2 DCE are generally not reported in the NHW well field, although there are a number of sources and reported concentrations in the North Hollywood East (NHE) downgradient to Pollock.
- 1,2,3-TCP was not reported above the action level (AL) in the TJ, RT, or NHE or NHW well fields during the 2012/2013 and 2014 sampling, although it has historically been reported above the AL in both the TJ and NHE wells. The primary 1,2,3-TCP impacts are located in the eastern section of the SFB near the NHOU, BOU, and Glendale OUs.

- 1,4-Dioxane is most commonly reported in the RT and NHE and NHW well fields, but groundwater impacted with 1,4-dioxane extends from the TJ well field downgradient to the Pollock well field. 1,4-Dioxane has a similar depth pattern to TCE, particularly in the TJ area, where concentrations are greater at depth in the outlying monitoring wells. The highest concentrations are east of the RT well field and just north of the NHW well field near the Hewitt Pit, where concentrations of 1,4-dioxane are above 100 micrograms per liter (µg/L) in some monitoring wells.

NDMA. NDMA is located primarily near NH, and has been reported in the SFB in over 7.5 percent of samples collected. The highest concentrations are located east of the NHE well field and extend southeast in the direction of groundwater flow.

Hexavalent Chromium. Cr(VI) is reported in the majority of samples collected in the SFB at generally low concentrations that are likely natural background values. Overall Cr(VI) is reported in over 20 percent of the samples collected in the SFB above the MCL. Concentrations of Cr(VI) are similar to those of total chromium, so it can be assumed that it makes up the majority of the total chromium in groundwater in the samples. Cr(VI) is most prevalent in the NHE well field. East of the RT and northwest of the NHW well fields, a few wells have concentrations near or over the MCL. The highest Cr(VI) concentrations are located in the southeastern part of the SFB north of Pollock. Cr(VI) is generally confined to shallow groundwater above the Middle Zone. Trends are generally stable in production wells where it is reported.

Perchlorate. Perchlorate has been reported above its respective MCL in less than 3 percent of the samples collected in the SFB. Although reported in a low number of samples, perchlorate concentrations are elevated in the eastern portion of the TJ well field, central to northern portion of the RT well field, and north of the Pollock well field. In the TJ area, perchlorate has been reported in the eastern production wells periodically above the MCL. Since 2011, perchlorate has consistently impacted production wells RT-02, RT-03, and RT-04. Perchlorate is reported in several monitoring wells east of the RT production wells above the MCL, with the highest concentrations reported in the deep screen intervals 630 feet bgs.

Nitrate (as NO3). Nitrate is reported in the majority of monitoring wells and production wells in the SFB, but is reported above the MCL in less than 1 percent of the samples collected. Although not regularly reported above the MCL, there are two areas near the TJ and NH well fields, and also in the southeastern part of the SFB, that have contributed to elevated concentrations in the production wells. Its occurrence is widely attributable to historical agricultural practices in the SFB, and there are not any specific sources areas of nitrate. Nitrate concentrations above the MCL are almost entirely confined to shallow groundwater. This shallow occurrence is expected, given the aerially extensive and presumed downward vertical migration of contamination from fertilizer application, septic tanks, or leaking sewer lines down to groundwater. Trends are generally stable in production wells, with some reduction in concentrations during pumping in the TJ production wells along with an increase in concentrations during pumping in some NHW wells.

Fate and Transport

The properties of a chemical have significant impacts on its fate and transport in groundwater. Chemicals that have high solubility generally have low adsorption and low ability to volatilize, and the opposite is true for low-solubility chemicals. These chemical properties are important for understanding how a chemical may behave and will form the basis for the chemical component of evaluating the fate and transport of contaminants during future remediation.

The fate and transport of COCs in the SFB is dependent not only on natural processes of advection, dispersion, and retardation, but is also highly affected by anthropogenic advection of COCs through groundwater extraction. Under natural groundwater flow conditions, COCs migrate from source areas to the southeast following the natural groundwater flow direction. Highly soluble compounds, such as 1,4-dioxane, flow at the natural groundwater velocity ranging from 290 to 1,330 feet per year (JMM 1992). VOCs flow at somewhat reduced velocities because of retardation, with values of retardation for the organic COCs ranging from 1 to approximately 3.

While there is some natural transport outside of the influence of the pumping, groundwater extraction has a significant impact on the fate and transport of COCs in the SFB. COC concentrations, particularly VOCs, tend to increase in production wells once pumping is started as the plumes from the source area are pulled through the more permeable layers in the aquifer toward the production wells. Despite this mobility in the permeable zones, because of the heterogeneity of the subsurface, there will be the continued diffusing of mass from less permeable materials that will provide a long-term source of COCs to groundwater.

Based on the presence of intermediate degradation products such as cis-1,2-DCE (biotic degradation of PCE and TCE), and 1,1-DCE and 1,2-DCA (abiotic degradation of 1,1,1-Trichloroethane [1,1,1-TCA]), it is evident that biotic and abiotic degradation is limited in the SFB. Although these processes are resulting in some degradation of mass, complete degradation is inhibited because of the relatively low concentrations of the COCs and aerobic nature of the SFB groundwater; therefore, degradation is considered a minor process in the SFB. There is no evidence of degradation or transformation of inorganic COCs.

Risk Assessment

The LADWP SFB well fields are dominated by diverse land uses that range from residential to industrial, and these land uses are generally interspersed throughout the area. As presented in the 1992 RI Report, the exposure pathways of volatilization and inhalation of chemicals in indoor air, along with dermal contact with chemicals in soil and groundwater, are not complete pathway outside of the source areas because of the relatively low concentrations of volatile chemicals and depth to groundwater near the well fields. The primary exposure route is through potable use of the groundwater after extraction (if untreated) including ingestion, dermal contact, and inhalation (i.e., showering). Because the receptor and exposure pathways have not changed, the risk identified in the 1992 RI Report would be similar if not more conservative based on changes in toxicity and methods of performing risk assessments.

An updated baseline risk assessment was not deemed necessary and hence was not conducted as part of the GSIS because the exposure pathways have not changed from the 1992 RI Report. Therefore, notification levels and MCLs (which are established based on risk to human health) as well as other applicable or relevant and appropriate requirements (ARARs) will be used in the evaluation of remedial technologies alternatives in the Draft FS.

Groundwater Modeling

Groundwater modeling was performed as part of this RI Update Report to identify regional flow fields for development of the 2, 5, and 10-year capture zones, and to provide the basis for modeling used in the Draft FS to refine remedial alternatives. Currently, several active groundwater models are being used in the SFB. The primary models include a version of the 1992 RI model being used by LADWP for regional planning and a version of the 1992 RI model used by USEPA for evaluating remedial actions. Both models are based on the 1992 RI model with a number of updates being made over the years as new data have become available. Because of the presence of multiple models, the first task was to select one of the models for the flow and transport modeling as part of this RI Update Report and the Draft FS. Based on the evaluation of the different models, the selected model layering and grid were the USEPA 2009 Focused Feasibility Study (FFS) and 2012 Groundwater Management Program, and the selected modeling code was MODFLOW-SURFACT for this RI Update and the Draft FS.

As part of this RI Update, flow fields were developed to identify the 2, 5, and 10-year capture zones. These capture zones were overlaid on the TCE, PCE, and 1,4-dioxane contour maps to evaluate the capture of these plumes over time. Based on these flow lines in the TJ, RT, and NHW and NHE areas by the end of the 10-year simulation period, all of the plumes are captured or partially captured through operation of LADWP's production wells.

Conclusions

This RI Update Report was developed to present the recent investigative results and update the HCSM of the SFB. Based on the data collected and evaluated as part of the GSIS, the following conclusions can be drawn:

- The identified data gaps have been substantially filled, with the exception of:
  - Additional hydrogeologic definition to complete pathways northeast of the TJ well field; and
  - A short- and long-term GMP to continue to monitor and define the nature and extent of contamination as well as those requiring treatment
- The current understanding of the nature and extent, as well as fate and transport, of COCs is sufficient to move forward with a comprehensive FS and a Proposed Plan, with the understanding that:
  - Source areas (both the soil and groundwater areas below where contamination had originated) are addressed by individual PRPs under various regulatory oversight
  - LADWP actions will remove COC mass and remediate portions of the SFB impacted by those source areas

LADWP has already initiated a permitting process to install monitoring wells at two additional locations north of the TJ well field. LADWP is also in the process of developing a comprehensive Monitoring Plan to address short- and long-term data needs.