DRAFT
Remedial Action Plan

Streetlight Maintenance Headquarters
611 North Hoover Street
Los Angeles, California

January 2021

Prepared for:

City of Los Angeles Department of Water and Power
Environmental Affairs
111 North Hope Street
Los Angeles, California 90012

Prepared by:

Tetra Tech, Inc.
3475 East Foothill Boulevard
Pasadena, California 91107

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LADWP Agreement No. 47503B-9 – Task Assignment No. TT-08
Project No. 102-ENV-T47503B-9.08

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Robert M. Sabater
Project Manager

Cari Ferrell, PE
Project Engineer

Mark Feldman, PG, CHG, CEG
Principal Geologist

Alexis M. Bahou, PE
Principal Engineer

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BOE	City of Los Angeles Bureau of Engineering
BTEX	benzene, toluene, ethylbenzene, and xylenes
Cal/OSHA	California Division of Occupation Safety and Health
CDMG	California Division of Mines and Geology (presently California Geologic Survey)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CLU-IN	Contaminated Site Clean-Up Information
COC	contaminant of concern
COPC	chemical of potential concern
CY	cubic yard
DCE	dichlorethene
DNAPL	dense non-aqueous phase liquid
DTSC	Department of Toxic Substance Control
DTSC-SLs	DTSC Human Health Risk Assessment Note 3 screening levels
DWR	California Department of Water Resources
ERH	electrical resistance heating
ESL	Environmental Screening Levels
ESTCP	Environmental Security Technology Certification Program
FRTR	Federal Remedial Technologies Roundtable
GRA	general response action
IDW	investigation-derived waste
ISCO	In-situ chemical oxidation
ITRC	Interstate Technical & Regulatory Council
LADBS	Department of Building and Safety
LADBS-IB	LADBS Inspection Bureau
LADWP	Los Angeles Department of Water and Power
LARWQCB	California Regional Water Quality Control Board, Los Angeles Region
LUC	land use covenant
MCL	State Water Resources Control Board Division of Drinking Water Maximum Contaminant Level
MIP	membrane interface probe
mg/L	milligrams per liter
µg/m^3	micrograms per cubic meter
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MNA	monitored natural attenuation
MWD	Metropolitan Water District of Southern California
msl	mean sea level
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NPDES	National Pollution Discharge Elimination System
NL	State Water Resources Control Board Division of Drinking Water Notification Levels
O&M	operation and maintenance
OM&M	operation, monitoring, and maintenance
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PID	photoionization detector
PRB	permeable reactive barrier

ACRONYMS CONTINUED

QA/QC	quality assurance/quality control
RAO	remedial action objective
RAP	remedial action plan
RSL	USEPA Regional Screening Level
SCAQMD	South Coast Air Quality Management District
SERDP	Strategic Environmental Research and Development Program
SLIC	State Water Resources Control Board - Spills, Leaks, Investigations and Cleanup Program
SMP	soil management plan
SOD	soil oxidant demand
STLC	soluble threshold limit concentration
SVE	soil vapor extraction
SWRCB	State Water Resources Control Board
TBC	to be considered
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
Tetra Tech	Tetra Tech, Inc.
TMB	trimethylbenzene
TMV	Toxicity, Mobility, or Volume
TPH	total petroleum hydrocarbons
TPHg	total petroleum hydrocarbons as gasoline
TTLC	total threshold limits concentration
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
WDR	Waste Discharge Requirements

1. INTRODUCTION

On behalf of the Los Angeles Department of Water and Power (LADWP), Tetra Tech, Inc. (Tetra Tech) has prepared this Remedial Action Plan (RAP) for the LADWP Streetlight Maintenance Headquarters facility, located at 611 North Hoover Street, Los Angeles, California (the Site). The location of the Site is shown on Figure 1.

During an underground storage tank (UST) removal conducted at the Site in 1990 (LADWP, 1990), total petroleum hydrocarbons as gasoline (TPHg) and benzene, toluene, ethylbenzene, and xylenes (BTEX) were detected in soil beneath a 7,500-gallon UST. A subsurface investigation was conducted to delineate the extent of petroleum-impacted soil (Earth Technology, 1991), and found that groundwater at the Site was also impacted by TPHg and BTEX. During subsequent groundwater monitoring, tetrachloroethene (PCE) and other chlorinated volatile organic compounds (VOCs) were also detected in groundwater. In 1998, the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) issued a case closure letter for the USTs (LARWQCB, 1998), and the Site was transferred from the UST Program to the Site Cleanup Program.

To date, a number of additional subsurface investigations, indoor air evaluations, a remedial treatability study, and quarterly groundwater monitoring have been conducted at the Site. The investigation work has included drilling and sampling numerous soil borings, installing groundwater monitoring wells and conducting quarterly groundwater monitoring from March 2001 through the present, and collecting groundwater grab samples, soil gas samples and indoor air samples.

An upgradient dry-cleaning facility (Jesse Cleaners) has been identified as a likely source to the subsurface PCE impacts beneath the Site. Based on the available data from environmental investigations conducted at Jesse Cleaners, a maximum PCE concentration of 1,350,085 micrograms per kilogram (µg/kg) was reported in the soil at 7 to 10 feet below ground surface (bgs). According to the LARWQCB, additional site characterization work including soil, soil gas and groundwater is planned for the former Jesse Cleaners property in 2021.

Based on sitewide contamination attributed to both on and offsite sources and planned redevelopment for the site, this RAP has been prepared to develop and evaluate the most appropriate remedial approach to address the chlorinated solvent and petroleum hydrocarbon impacts in the subsurface.

The RAP is organized into the following sections:

- Section 1 – Introduction: provides an overview and purpose of the RAP.
- Section 2 – Conceptual Site Model: provides a description of the Site, current and historical land use, geology and hydrogeology, and nature of onsite contamination.
- Section 3 – Remedial Action Objectives and Cleanup Goals: provides a description of the applicable or relevant and appropriate requirements (ARARs), site-specific remedial action objectives (RAOs), and the proposed cleanup goals for onsite soil and groundwater.
- Section 4 – Feasibility Study: provides an overview of the screening and evaluation of remedial alternatives and a description of the preferred alternative.
- Section 5 – Additional Data Needs: provides a summary of the additional data needs for the refinement of the preferred remedial alternative selection and design.
- Section 6 – Cost Estimate: provides an engineering cost estimate for implementing the preferred remedial alternative.
- Section 7 – Sampling and Analysis Plan: provides a description of sampling and analysis conducted as part of the remedial alternative implementation.
- Section 8 – Permitting: provides a description of permitting anticipated for implementation of the preferred remedial alternative.

- Section 9 – Schedule: provides an estimated timeline for implementation of the preferred remedial alternative.
- Section 10 – Health and Safety: provides a description of health and safety practices for implementation of the preferred remedial alternative.
- Section 11 – References: provides a list of reference materials used in preparation of this RAP.

2. CONCEPTUAL SITE MODEL

The following sections describe the conceptual site model for the Site.

2.1 SITE DESCRIPTION

The Site is located at 611 North Hoover Street, Los Angeles, California (Figure 1). It is approximately 2.4 acres in size and is bounded by Hoover Street on the east, Clinton Street on the south, Commonwealth Avenue on the west, and residential properties on the north. The Site is developed with seven buildings, which were formerly used to store, maintain, and service vehicles, electrical parts, and equipment (LADWP, 2000). Distributing Station 15, an electrical facility which reduces incoming voltage from 34,500 to 4,800 volts for local power distribution, is located at the intersection of Clinton Street and Commonwealth Avenue, and is not a part of the Site. Jesse Cleaners (SLIC Case No. 1232), a former dry cleaning facility, is located to the northeast of the Site, across Hoover Street. Historical city directory listings indicate that the Jesse Cleaners property was a dry cleaner since at least 1983, and possibly as early as 1968 (Parsons, 2002). Figure 2 presents the former site usage and surrounding properties.

The Site is completely paved with asphalt or concrete. Surface drainage in the eastern portion of the Site is toward a grated drain located west of the Warehouse building; surface drainage in the western portion of the Site is generally to the southwest or south, toward Commonwealth Avenue and Clinton Street. Currently, the Site is vacant and is being prepared for demolition and future redevelopment.

2.2 SITE HISTORY AND OPERATIONS

Prior to 1925, the Site was used for residential purposes. Portions of the Site have been used by LADWP from 1925 to the present. Buildings and other features at the Site (Figure 2) include the following:

- Warehouse: Single-story reinforced concrete building with a basement underlying the western half, constructed in 1925. Warehouse and storage areas are currently located in the basement; warehouse and storage areas, a repair shop, a lunchroom, restrooms, an office, a loading dock, and truck sheds are located on the ground floor. The ground floor repair shop overlies the basement. The building has a hydraulic elevator. An out-of-service clarifier is in the southern portion of the building. A former paint shop is located at the southern end of the basement.
- Office and Fleet Maintenance Building: Two-story reinforced concrete block building, constructed in 1957. The building includes a vehicle maintenance pit and storage area, restrooms, and locker room are on the first floor; offices and a meeting room are shown on the second floor.
- Office and Toolroom Building: One-story wood-frame building, constructed in 1938. The building has offices, a meeting room, a restroom, and a toolroom. This building was used as office and storage space by the LADWP Communications group.
- Fleet Maintenance Shop: One-story reinforced concrete block building with four repair bays, constructed in 1954. This building has two vehicle service bays, a storage room, and a locker room. A three-stage clarifier and two hydraulic hoists are present in the service bay area.
- Truck Shed North: Open front building with reinforced concrete block and plaster walls and metal roof, constructed in 1953. The building was used as a truck shed.
- Meter Truck Shed: Open building with one reinforced concrete retaining wall and metal roof, constructed in 1938. This building was used as a truck shed and storage area.
- Truck Shed South: Open building with metal roof, date of construction unknown. The building was used as a truck shed.

In addition, a metal storage container used for storage of hazardous materials was located near the northwest corner of the Warehouse building.

According to a 1997 chemical inventory for the Site provided by LADWP, hazardous substances (other than compressed gases, janitorial and building maintenance supplies, and solid materials such as solder and blasting abrasive) used at the Site include the following: various materials associated with vehicle fueling and maintenance (i.e., diesel fuel, gasoline, motor oil, waste motor oil, used oil filters, SAE 80/90 oil, transmission fluid, antifreeze, waste antifreeze, and cleaner/degreaser), various oils and oil wastes associated with electrical equipment maintenance (e.g., inhibited oil, inhibited oil waste, electrical insulating oil, waste insulating oil, and inhibited transformer oil), hydraulic oil, spray paint and paint thinner, and miscellaneous wastes (oil-contaminated debris waste, unspecified oil-containing waste, waste products – 1 pint cans). The types of chemicals listed above are generally consistent with those noted in 1997 during a Phase I ESA conducted by Los Angeles Unified School District (LAUSD, 1997). A more recent chemical inventory, conducted in 2017, was found to be consistent with earlier documentation.

Although chemicals noted above were used and stored throughout the Site, the main areas of chemical use and storage were the hazardous materials storage container, the Fleet Maintenance Shop, and the Warehouse Building.

Several USTs were formerly present at the Site, including a 7,500-gallon gasoline UST and a 500-gallon waste oil UST, which were both removed in October 1990; and a 12,000-gallon split tank used for gasoline and diesel, a 550-gallon waste oil tank, and associated dispensers and piping, which were all removed in October 2019. All of the USTs were located in the east-central portion of the Site (Figure 2).

2.3 PREVIOUS INVESTIGATIONS AND REMEDIAL EVALUATIONS

Several subsurface site investigations have been conducted at the Site since the removal of the USTs in 1990. Additionally, LADWP has evaluated various remedial alternatives for the Site for protection of onsite workers based on its previous use as well as future redevelopment. The following provides a timeline and brief summary of these investigations and evaluations:

- *Site Assessment (Earth Technology, 1991)*: In 1991, a total of 14 soil borings were advanced (B-1 through B-14) and one groundwater monitoring well was installed (MW-1) at the Site. Elevated TPH and VOCs were detected in multiple borings.

- *Groundwater and Soil Gas (Meredith/Boli and Associates, 1993)*: In February/March 1993, LADWP conducted soil gas sampling and converted two soil vapor wells into groundwater monitoring wells (MW-2 and MW-3).

- *Soil Vapor Survey and Groundwater Sampling (LADWP, 2000)*: In April 2000, LADWP conducted a soil vapor survey at 20 locations (SG-1 through SG-20) and collected groundwater samples from three monitoring wells. Low concentrations of PCE were detected in the vadose zone throughout the site. Additionally, two soil borings were advanced (SB-1 and SB-3).

- *Quarterly Groundwater Monitoring (LADWP, 2001 to 2021)*: LADWP began conducting quarterly groundwater monitoring in 2001. Quarterly monitoring is on-going for all on- and off-site wells.

- *Supplemental Soil, Groundwater, and Soil Gas Site Investigations (Parsons, 2001 and 2003)*: Parsons conducted a soil and groundwater investigation in March 2001 including one soil boring (BH-1) and installation of 4 groundwater monitoring wells (MW-4 through MW-7). In 2003, Parsons conducted a supplemental soil, groundwater, and soil-gas site investigation. A total of five locations were used for soil, groundwater, and soil gas sampling (CPT-1 through CPT-5).

- *Environmental Investigation (URS, 2004 and 2005)*: URS conducted a site investigation in November and December 2004. Soil, soil gas, and groundwater samples were collected from six soil borings (B-1 through B-6), seven new groundwater monitoring wells (MW-8 through MW-14), and 15 soil gas sampling locations (SV-1 through SV-15). In August 2005, URS conducted an additional soil investigation. A total of 26 soil borings (B-7 through B-32) were completed to assess two areas where PCE contamination was detected.

- *Additional Soil, Groundwater, and Soil Gas Investigation (Tetra Tech, 2009b)*: In 2008, Tetra Tech conducted a site investigation that included 7 soil borings (B101 through B107), 9 groundwater grab samples (B101 through B106 and CPT101a through CPT103), and 10 soil gas sampling locations (SG101 through SG110).

- *In-Situ Chemical Oxidation Bench and Pilot Testing (Tetra Tech, 2012)*: In July 2009, three groundwater monitoring wells (MW-15 through MW-17) were installed to collect samples for bench-scale testing of in-situ chemical oxidation (ISCO). Based on the results of the bench-scale tests, sodium permanganate was selected for implementation in a pilot study. In 2012, LADWP conducted the pilot testing for ISCO. During the pilot study, minor flow (0.5 gpm) of injectate was observed in one injection point, and no-flow conditions were found at three other locations. Following several attempts to improve flow, injection activities were discontinued at the four injection locations.

- *Remedial Alternative Engineering Evaluation/Cost Analysis* (EE/CA; Kleinfelder, 2015): In 2015, Kleinfelder evaluated the following options: 1) No action; 2) Soil excavation, barrier/reactor installation for bioremediation, and groundwater monitoring; 3) Limited excavation, in-situ application of amendments (bioremediation-enhancing or ISCO/ISCR), and groundwater monitoring; 4) Thermally enhanced recovery, soil vapor extraction, barrier installation using in-situ application of amendments (bioremediation-enhancing or ISCO/ISCR), and groundwater monitoring. Kleinfelder also made a number of recommendations for additional assessment and testing (indoor air, groundwater, dense non-aqueous phase liquid [DNAPL], gravity feed injection, baited biotraps).

- *Groundwater Well Installation (Kleinfelder, 2016b)*: A total of three additional monitoring wells (MW-18, MW-19, and MW-20) were installed to characterize deeper groundwater and it's relationship to the shallow water-bearing zone beneath the Site.

- *Membrane Interface Probe (MIP) Investigation (Kleinfelder, 2020)*: In 2016, an MIP investigation was performed to evaluate the presence and extent of potential DNAPL near the northeast entrance of the Site. Based on the data from the MIP investigation, DNAPL (or groundwater with very high chlorinated hydrocarbon concentrations) appears to occur within the sandy horizons and likely migrated along them during the release, with vertical migration potentially along structures such as fractures.

  The LARWQCB-approved Additional Assessment Work Plan (Kleinfelder, 2016c), which included the MIP investigation, also included conducting microbial studies using Bio-Trap passive samplers and performing a potable water injection test under gravity-feed conditions. Because of plans for site redevelopment, assumptions in past documents were no longer applicable.

- *LADWP Letter to LARWQCB (LADWP, 2020):* On January 22, 2020, LADWP met with LARWQCB to provide an update on the current plans for the Site. Based on Site redevelopment plans, LADWP reassessed the path forward for the Site and proposed a new remedial strategy that included the following:

  - Excavation and off-site disposal of contaminated soil;

  - Dewatering, storage, treatment and discharge or off-site disposal of removed groundwater encountered during excavation; and

  - Installation of a permeable reactive barrier (PRB) for the migration of off-site groundwater impacts.

This RAP presents the approach for the implementation of the remedial strategy outlined above.

2.4 GEOLOGY AND HYDROGEOLOGY

The following subsections summarize the geologic and hydrogeologic setting of the Site.

2.4.1 Regional Geology

The Site is located in the Los Angeles Basin, a structurally-complex Miocene-age depositional basin which encompasses the entire Los Angeles physiographic basin, as well as the Santa Monica Mountains, San Fernando Valley, San Gabriel Valley, the southern foothills of the San Gabriel Mountains, much of the northern Santa Ana Mountains, and the San Joaquin and Palos Verdes Hills (Yerkes et al, 1965). Crystalline basement rocks are exposed in the eastern portion of the Santa Monica Mountains and the Verdugo Mountains. Superjacent rocks, comprised of Late Cretaceous to Pleistocene marine clastics and middle Miocene volcanics, attain a thickness of up to 14,500 feet in the eastern Santa Monica Mountains. The Miocene superjacent rocks are overlain by Pleistocene-age alluvial deposits of the San Pedro and Lakewood formations, and Recent alluvium (California Department of Water Resources [DWR], 1961).

The Site is located on the western flank of the Elysian Hills. The Elysian Hills are the surface expression of the Elysian Park anticline, an anticlinal structure which extends southeast from the Elysian Hills across the Los Angeles Narrows to the Repetto Hills (DWR, 1961). Superjacent rocks, consisting of Miocene-age marine sedimentary rocks of the Puente Formation, are exposed in the Elysian Hills (DWR, 1961). The Puente Formation consists of up to 11,000 feet of shale interbedded with siliceous shale, sandstone, and conglomerate. Mapping of the Quaternary geology of the Hollywood Quadrangle by the California Division of Mines and Geology (CDMG, 1998) indicates that the Site is in an area of pre-Quaternary bedrock, which is inferred to be Puente Formation.

2.4.2 Site Geology

A review of boring logs prepared for previous subsurface investigations by Earth Technology (1991), Parsons (2001, 2003), URS (2004, 2005), and Tetra Tech (2008b) indicate that shallow soils underlying the Site consist of 8 to 20 feet of predominantly fine-grained soils (silts and clays), with lesser amounts of clayey sand, silty sand, and sand. These materials appear to consist primarily of deeply weathered rocks of the Puente Formation, although debris was locally noted in the boring logs, indicating that at least some of the shallow soil is artificial fill. The shallow soils are underlain by less-weathered Miocene-age siltstone, sandstone, and shale of the Puente formation to a depth of at least 80 feet bgs, the maximum depth investigated.

2.4.3 Regional Hydrogeology

The Miocene-age Puente Formation, exposed in the Elysian Hills, is not considered to be a source of water supply within the Los Angeles Basin (DWR, 1961). To the west of the Elysian Hills and downgradient from the Site is the Hollywood Subbasin of the Coastal Plain of Los Angeles Groundwater Basin (Basin No. 4.11-02; DWR, 2004). The Hollywood Subbasin is bounded to the north by the Santa Monica Mountains and Hollywood Fault, to the east by the Elysian Hills, to the west by the Newport-Inglewood fault zone, and to the south by the La Brea High, an anticlinal structure which partially restricts groundwater flow to the south. According to the Metropolitan Water District of Southern California (MWD, 2007), Pleistocene-age sediments extend to a maximum depth of approximately 660 feet bgs within the Subbasin. Aquifers within the Pleistocene sediments include the Exposition and Gage aquifers (Lakewood formation), and the Jefferson, Lynwood, Silverado, and Sunnyside aquifers (San Pedro formation). The Gage aquifer is the major water-bearing unit in the Hollywood Subbasin, but in general, the aquifers of the Hollywood Subbasin are not highly transmissive, and only yield significant amounts of groundwater in the western portion of the Subbasin (MWD, 2007).

According to DWR (2004) and MWD (2007), the only current groundwater production within the Subbasin is by the City of Beverly Hills, which operates water supply wells in the western portion of the Subbasin. Groundwater accounts for approximately 10% of the City of Beverly Hills water supply; the balance is imported water. Water quality within the Subbasin is only fair, due to total dissolved solids (TDS) concentrations exceeding the secondary California Maximum Contaminant Level (MCL) of 500 milligrams per liter (mg/L) (MWD, 2007).

2.4.4 Site Hydrogeology

Between 1991 and 2016, the LADWP installed 20 groundwater monitoring wells at the Site and in the easterly adjacent public rights-of-way, including 17 shallow wells (screened over various intervals from 2 to 60 feet bgs) and three deep wells (screened from 70 to 80 feet bgs). During the third quarter 2020 groundwater monitoring event, depth to groundwater in the shallow on-Site monitoring wells ranged from approximately 11.6 to 19.5 feet bgs (elevation 296.85 to 311.41 feet relative to mean sea level [msl]). The direction of shallow groundwater flow was generally to the southwest, at a gradient of approximately 0.04 feet per foot (Figure 3). The depth to groundwater in the deep monitoring wells ranged from approximately 11.5 to 16.5 feet bgs (elevation 307.86 to 308.91 feet msl). The direction of deep groundwater flow was generally to the north, at a gradient of approximately 0.006 feet per foot (Figure 4). Vertical gradients ranged from upward at approximately –0.017 to downward at approximately +0.080. Historically, both upward and downward gradients have been observed between the shallow and deep wells.

Observations made during field work by Tetra Tech (2008b) suggest that shallow groundwater at the Site is locally present in a relatively thin permeable zone between 26 and 29 feet bgs. Less permeable fine-grained soils and bedrock are present above and below this depth interval to a maximum depth of approximately 43 feet bgs. These observations suggest that groundwater at the Site is at least locally present under confined to semiconfined conditions. The results of discrete depth groundwater sampling conducted by Tetra Tech (2008b) suggest that water yields from the 29- to 43-foot bgs depth interval are likely to be low due to the limited permeability of the Puente Formation bedrock. It is not known whether fracture or bedding plane permeability is significant at the Site.

2.5 NATURE AND EXTENT OF SOIL CONTAMINATION

The following subsections summarize the nature and extent of soil contamination at the Site.

2.5.1 Chemicals of Potential Concern in Soil

VOCs detected in soil samples collected on-Site include chlorinated compounds (i.e., PCE, and trichloroethene [TCE]), and petroleum hydrocarbons and related compounds commonly associated with fuel releases (i.e., BTEX, n- and sec-butylbenzene, isopropylbenzene, propylbenzene, 1,2,4-trimethylbenzene [TMB], 1,3,5-TMB, p-isopropyltoluene, and naphthalene). The maximum onsite concentrations of each of these chemicals are compared with soil screening levels for the protection of human health and groundwater quality in Table 2-1. It should be noted that the purpose of this comparison is to evaluate which of the detected chemicals represent a potential environmental concern. The screening levels are not intended to be used as cleanup levels for soil. The screening levels used for comparison with the data in Table 2-1 include the following:

- California Department of Toxic Substances Control (DTSC) Human Health Risk Assessment Note 3 screening levels (DTSC-SLs) for residential and commercial/industrial land use (DTSC, 2020). The DTSC-SLs are human health screening levels based on conservative default exposure assumptions for residential (unrestricted) land use. The DTSC-SLs are calculated for a target risk of 10^{-6} and a target hazard index of 1.0; the lower of the carcinogenic and non-carcinogenic screening levels are provided in Table 2-1.
- United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs; USEPA, 2020a) for residential and commercial/industrial land use. The RSLs are human health screening levels derived using a methodology similar to the DTSC-SL, the primary difference being the values used for certain toxicological parameters.

- Soil-to-Groundwater RSLs (USEPA, 2020a). The soil-to-groundwater RSLs are calculated using the USEPA Soil Screening Guidance partitioning model (USEPA, 1997), with no dilution-attenuation factor applied, and are calculated using either the MCL or a risk-based level as an endpoint.

Table 2-1 shows that PCE and naphthalene are the only compounds detected at the Site which exceed both the residential and commercial/industrial screening levels for soil. Benzene and n-propylbenzene concentrations exceed the residential, but not the commercial/industrial screening levels. The maximum concentrations of several compounds, including benzene, n-butylbenzene, ethylbenzene, isopropylbenzene, naphthalene, n-propylbenzene, PCE, TCE, toluene, and 1,3,5-TMB exceed the RSL soil-to-groundwater screening criteria.

Based on the comparison with soil screening levels, PCE and benzene are considered to be the primary chemicals of potential concern (COPCs) in soil at the Site; the remaining compounds are considered to be secondary COPCs in soil.

2.5.2 Extent of Impacted Soil

The available data for PCE in unsaturated zone soils are plotted and contoured on Figure 5; the available historical data is also provided by Kleinfelder (2016c). The highest detected concentration at each boring location was used for the purpose of contouring. The principal features of the data shown on Figure 5 are as follows:

- Two distinct areas of PCE-impacted soil are present at the Site: one in the northern portion of the Site, which appears to extend into the Hoover Street right-of-way (Area 1), and one located in the southern portion of the Site, located near the southern driveway area (Area 3) (Figure 5).
- Very high concentrations of PCE were detected in soil at the upgradient Jesse Cleaners facility (Western Environmental Engineers Company, 2006: referenced in JMK Environmental Solutions, Inc., 2008), and relatively high PCE concentrations of 1,100 and 405 µg/kg were detected in borings CPT-2 and CPT-3, respectively, both of which are located upgradient from the Site on the eastern side of Hoover Street, adjacent to the Jesse Cleaners facility (Parsons, 2003). These results suggest that Jesse Cleaners is the source of the PCE detected in soil at Area 1.

Soil impacted by benzene and other petroleum hydrocarbons is limited to the area of the former fuel USTs (Area 2) with benzene detected in Earth Tech borings B-1, B-4, B-5, and B-7 at depths between 10 and 20 ft bgs (Earth Technology, 1991).

2.6 NATURE AND EXTENT OF GROUNDWATER CONTAMINATION

The following sections summarize the nature and extent of groundwater contamination at the Site.

2.6.1 Chemicals of Potential Concern in Groundwater

Maximum concentrations of all compounds detected on-Site during the four most recent quarterly groundwater monitoring events conducted at the Site are compared with water quality criteria (MCLs, State Water Resources Control Board (SWRCB) Notification Levels for drinking water [NLs]), DTSC-SLs for drinking water, and RSLs for tapwater in Table 2-2. A total of 20 VOCs, including chlorinated compounds (PCE, TCE, *cis*-1,2-dichloroethene [DCE], *trans*-1,2-DCE, 1,1-DCE, vinyl chloride, chloroform, and chlorobenzene), petroleum hydrocarbons and related compounds commonly associated with fuel releases (i.e., BTEX, 1,2,4-TMB, 1,3,5-TMB, isopropylbenzene, n-propylbenzene, and naphthalene), and other VOCs (acetone, 2-butanone, and carbon disulfide) were detected in onsite groundwater. Compounds detected above either MCLs or NLs include PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, vinyl chloride, chlorobenzene, and benzene. PCE and benzene are considered to be the primary COPCs in groundwater at the Site. Most of the remaining compounds are well-known byproducts of anaerobic PCE biodegradation, and are considered to be secondary COPCs in groundwater.

2.6.2 Extent of Impacted Groundwater

The available data for PCE in groundwater are plotted and contoured on a drawing of the Site in Figure 6. The principal features of the data shown on Figure 6 are as follows:

- The PCE plume appears to be related to PCE releases at the former Jesse Cleaners facility.
- A second area of PCE-impacted groundwater, apparently related to Area 3, was identified in grab groundwater samples (Tetra Tech, 2008). The highest detected PCE concentration in this area was 40.6 µg/L.
- PCE concentrations in monitoring wells MW-6 and MW-17, located in Area 1, exceed 10% of the aqueous solubility of PCE (approximately 210,000 µg/L). Based on the PCE detected in groundwater, it is possible that PCE may be present as a DNAPL in the vicinity of Area 1 or the offsite area upgradient of Area 1.

Benzene-impacted groundwater is limited to the vicinity of the former gasoline UST. The lateral extent of benzene-impacted groundwater is adequately defined.

2.7 NON-AQUEOUS PHASE LIQUID

Kleinfelder (2020) used a membrane interface probe (MIP) and hydraulic profiling tools to characterize hydrogeologic conditions and potential DNAPL in Area 1. The area where MIP testing was performed is shown in Figure 7. Kleinfelder (2020) interpreted the results of this study as indicating that DNAPL was potentially present in narrow bands, which appear to correspond with thin sandy zones in the subsurface. This interpretation is based on assumptions with respect to detector response that were not verified in the field by comparison with laboratory analytical data. The MIP observations are also consistent with the presence of highly contaminated groundwater (rather than DNAPL) in thin sandy zones. This distinction is difficult to make under most circumstances. It is also an important distinction, because the mass of PCE in a DNAPL source zone is expected to be much larger than the mass in an area containing impacted groundwater only.

2.8 SOIL GAS AND INDOOR AIR

Soil gas and indoor air investigations have been performed at the Site to evaluate the potential for vapor intrusion into indoor air, particularly with respect to PCE. The available soil gas data for PCE are plotted and contoured on a drawing of the Site in Figure 8. The available data are all for a depth of approximately four to five feet; except for two locations surface elevations are higher than for the remainder of the Site. The highest PCE concentrations are found at Area 1, where PCE concentrations in soil and groundwater are also highest.

Two indoor air investigations have been performed to evaluate potential vapor intrusion concerns at the Site. Tetra Tech (2009a) collected indoor and outdoor air samples in the Office and Toolroom Building and the basement of the Warehouse. The results for the Office and Toolroom building indicated that there was an incremental risk for indoor air inhalation, but that risk was at a level which is typically acceptable to DTSC for commercial/industrial workers. No significant incremental risk was identified for the Warehouse basement.

Kleinfelder (2016a) performed subslab and indoor air sampling in the Office and Toolroom Building, the Warehouse, the Office and Fleet Maintenance Building, and the Fleet Maintenance Shop. PCE concentrations in most of the subslab samples exceeded screening levels, but PCE concentrations in the indoor air samples did not exceed screening levels, and were not considered to require further investigation, mitigation, or remediation.

2.9 TREATABILITY STUDIES

Bench-and pilot-scale studies of in-situ chemical oxidation were performed to evaluate whether this remedial technology could be effective for the Site. The bench-scale testing was performed using sodium permanganate and both iron- and alkaline-activated sodium persulfate. Soil oxidant demand (SOD) for all of the oxidants was much higher than anticipated, which may have been due to the presence of reactive material, such as iron-bearing minerals or naturally-occurring organic matter in the mudstone aquifer. The study found that sodium permanganate was the most effective oxidant of the group, and was therefore chosen for use in pilot-scale testing (Tetra Tech, 2009b).

An in-situ chemical oxidation (ISCO) pilot test was conducted at the Site in 2012. Approximately 2,400 gallons of sodium permanganate solution was to be injected into the aquifer during the pilot test, but only 10 gallons could actually be injected. Based on this result, ISCO was not considered to be implementable at the Site (Tetra Tech, 2012).

3. REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS

3.1 REMEDIAL ACTION OBJECTIVES

The following four primary RAOs were developed for the Site:

- RAO S1: Protection of human receptors from exposure to COCs in soil through ingestion, inhalation, and dermal contact at concentrations exceeding protective levels
- RAO GW1: Protection of human receptors from exposure to COCs in groundwater by ingestion, dermal contact, and inhalation at concentrations exceeding protective levels
- RAO GW2: Protection of groundwater resources by limiting the migration of COCs to the Hollywood Subbasin at concentrations exceeding levels that protect designated beneficial uses
- RAO GW3: Protection of groundwater resources by limiting the migration of COCs to the Site at concentrations that inhibit potential for monitored natural attenuation (MNA)

Additional details of the RAOs are provided below.

3.1.1 RAO S1 Protection of Human Receptors from COCs in Soil

This RAO addresses potential health risks resulting from exposure of human receptors (site workers and construction workers) to contaminants present in soil. The ingestion, dermal contact, and inhalation pathways are all potentially complete for construction workers during Site redevelopment. The ingestion and dermal contact pathways for future Site workers are incomplete because the impacted soil will be excavated and appropriately disposed offsite and the Site will be covered by buildings or parking after redevelopment is completed. However, inhalation via the vapor intrusion pathway may be a complete pathway for onsite workers. This RAO may be addressed by eliminating the relevant exposure pathway (for example, through engineering controls), or by reducing exposure point concentrations to protective levels.

3.1.2 RAO GW1 Protection of Human Receptors from COCs in Groundwater

This RAO addresses potential human health risks resulting from exposure of human receptors to contaminated groundwater. The ingestion, dermal contact, and inhalation pathways are all potentially complete for construction workers during redevelopment (such as during pile installation) and excavation of the subterranean garage due to shallow groundwater. The ingestion and dermal contact pathways for future Site workers are likely incomplete because groundwater is not currently used for drinking water supply. However, inhalation via vapor intrusion may be a complete pathway for onsite workers, and vapor intrusion may also be a complete pathway for offsite residents and offsite commercial workers. This RAO may be addressed either by eliminating exposure pathways or by reducing exposure point concentrations to levels that do not present a potential health risk.

3.1.3 RAO GW2 Protection of Downgradient Groundwater Resources

This RAO addresses the protection of beneficial uses of groundwater (the primary concern of the LARWQCB) rather than potential human health effects. Actual and potential beneficial uses of groundwaters in the Los Angeles Region are designated in the Water Quality Control Plan for the Los Angeles Region (LARWQCB, 2014). Although the Site is not located within a groundwater basin designated in the Basin Plan, it is located in an area that is a tributary to the Hollywood Subbasin of the Coastal Plain of the Los Angeles Groundwater Basin. Groundwaters that are not specifically listed in the Basin plan have the same beneficial uses as the groundwater basins or subbasins to which they are a tributary. Designated beneficial uses of groundwater in the Hollywood Subbasin include municipal and domestic supply, industrial service supply, industrial process supply, agricultural supply, and aquaculture.

3.1.4 RAO GW3 Protection of Onsite Groundwater Resources

This RAO specifically addresses contamination originating from Jesse Cleaners, a likely source of PCE to soil and groundwater located immediately upgradient from the Site. Jesse Cleaners is believed to be the source of the PCE in soil and groundwater at the Site, and will continue to impact the Site until offsite remediation is implemented by others. The ingestion and dermal contact pathways for future Site workers are likely incomplete because groundwater is not currently used for drinking water supply. However, inhalation via the vapor intrusion pathway may be a complete pathway for onsite workers, and vapor intrusion may also be a complete pathway for offsite residents and offsite commercial workers. This RAO may be addressed by 1) reducing the concentrations of contamination coming onsite and eliminating exposure pathways or 2) reducing exposure point concentrations to levels that do not present a potential health risk.

3.2 Applicable or Relevant and Appropriate Requirements

Section 121(d) of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires that remedial actions implemented at CERCLA sites attain any federal or more stringent state environmental standards, criteria, or limitations that are determined to be either applicable or relevant and appropriate, unless a waiver is justified and granted in the decision document. Potential ARARs that could affect remedial alternative selection at the Site are identified and evaluated in this section.

"Applicable" requirements are those cleanup standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. A requirement is applicable if the jurisdictional prerequisites of the environmental standard show a direct correspondence when objectively compared with the conditions at the Site.

"Relevant and appropriate" requirements are those cleanup standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations sufficiently similar to the circumstances of the proposed response action and are well suited to the conditions of the Site. USEPA ARAR guidance provides for screening of the "relevant" requirements to determine which are also "appropriate" and hence an ARAR. Relevant requirements would not also be considered appropriate when:

- "…another requirement is available that more fully matches the circumstances at the Site."
- "…another requirement is available that has been designed to apply to that specific situation, reflecting an explicit decision about the requirements appropriate to that situation."

For a state requirement to qualify as an ARAR, it must be promulgated, legally enforceable, more stringent than any corresponding federal requirement, consistently applied, and identified in a timely manner (Title 40 Code of Federal Regulations [CFR], Section [§] 300.400(g)(4)). The criteria for determining relevance and appropriateness are listed in 40 CFR §300.400(g)(2).

In addition to ARARs, nonpromulgated advisories, guidance, or criteria issued by federal or state agencies that are not legally binding may provide useful information or recommended procedures for remedial action, and thus may be considered when developing remedial alternatives. These to be considered criteria (TBCs) do not meet the definition of an ARAR, but still may be useful in determining whether to take action at a site, or to what degree action is necessary, particularly when there are no ARARs for a site, action, or contaminant. Although TBCs do not have the status of ARARs, they are typically considered together with ARARs to establish the required level of cleanup for protection of health or the environment. The critical difference between a TBC and an ARAR is that an entity is not required to comply with or meet a TBC when implementing a remedial action. TBCs are defined in 40 CFR §300.400(g)(3).

ARARs and TBCs are generally classified as chemical-specific, location-specific, or action-specific. These categories were developed to help define ARARs; however, ARARs in three categories do not fall precisely within one group. These three categories of ARARs are defined below.

Chemical-specific ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set numerical health- or risk-based concentration limits or discharge limitations for specific hazardous substances. If, in a specific situation, a chemical is subject to more than one discharge or exposure limit, the most stringent of the requirements would generally be applied. An example of a chemical-specific ARAR is a drinking water standard.

Location-specific ARARs are those requirements that relate to the geographical or physical position of the Site, rather than the nature of the contaminants or the proposed remedial actions. These requirements may limit the placement of a remedial action or impose additional constraints on a remedial action. Examples of location-specific ARARs are regulations that limit activities near endangered species habitat, wetlands, or areas of historical significance.

Action-specific ARARs are requirements that apply to specific actions associated with site remediation. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy, and often define acceptable handling, treatment, and disposal procedures for hazardous substances. Examples of action-specific ARARs include requirements applicable to landfill closure, wastewater discharge, hazardous waste disposal, and air emissions.

Lists of potential chemical-specific and action-specific ARARs and TBCs are included in Tables 3-1 and 3-2, respectively. No location-specific ARARs were identified. The identification of ARARs for the Site will be an iterative process, with the lists updated as appropriate during remedial action planning and implementation.

3.2.1 Potential Chemical-Specific ARARs

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. Six potential federal and state chemical-specific ARARs/TBCs have been identified for the Site including the following:

- Safe Drinking Water Act (42 USC §300 et seq.) including MCLs, maximum contaminant level goals, and secondary MCLs
- USEPA Superfund Guidance including RSLs and health advisories
- Toxic Substances Control Act (15 USC §2601 et seq)
- California Safe Drinking Water Act (HSC §116270 et seq.) including MCLs, secondary MCLs, public health goals, and drinking water notification levels (NLs)
- Porter-Cologne Water Quality Control Act (CWC §13000 et seq.)
- DTSC Risk Assessment Guidance

The details of the ARAR/TBC criteria are provided in Table 3-1.

3.2.2 Potential Action-Specific ARARs

Action-specific ARARs apply to actions such as waste handling, treatment, and disposal that are associated with specific site remediation activities and, as such, will vary based upon the final remedy(ies) selected for implementation. Fifteen federal and state potential ARARs/TBCs were identified that address compliance with these regulations including the following:

- Clean Water Act (33 USC §1251 et seq.) including NPDES

- Resource Conservation and Recovery Act (42 USC §6901 et seq.) including hazardous waste requirements
- Hazardous Material Transportation Act (49 USC §5101 et seq.)
- Clean Air Act (42 USC §7400 et seq.) including emission standards and air quality standards
- Occupational Safety and Health Act (29 USC §651 et seq.)
- Emergency Planning and Community Right to Know Act of 1986
- Porter-Cologne Water Quality Control Act (CWC §13000 et seq.) including WDR and LARWQCB guidance
- Hazardous Waste Control Act (HSC §25100 et seq)
- South Coast Air Quality Management District Regulations
- California Occupational Safety and Health Act (CLC §6300 et seq.)
- California Health and Safety Code, Miscellaneous Health and Safety Provisions (HSC §24000 et seq. and 22 CCR) including institutional controls, land use controls, and requirements for land-use covenants (LUCs)
- California Civil Code §1457 et seq. (Transfer of Obligations) including land use controls
- California Well Standards
- City of Los Angeles Bureau of Engineering (BOE) including construction and excavation permits
- City of Los Angeles Bureau of Sanitation (BOS) including wastewater discharge permit
- City of Los Angeles Department of Building and Safety (LADBS) including grading permits
- Los Angeles County Ordinances including well installation and decommissioning permits

The details of the potential action-specific ARAR/TBC criteria are provided in Table 3-2.

3.3 PROPOSED CLEANUP GOALS

Cleanup goals proposed for the Site are summarized below.

3.3.1 Soil Cleanup Goals

Relevant criteria for soils at the Site include the following:

- Commercial/industrial DTSC-SLs or commercial/industrial RSLs, which are soil criteria protective of human health.
- Leaching to groundwater Environmental Screening Levels (ESLs) developed by the Regional Water Quality Control Board, San Francisco Bay Region, or the protection of groundwater RSLs, either risk- or MCL-based. These soil criteria are protective of the beneficial uses of groundwater resources.

Table 3-3 summarizes the above cleanup criteria for the compounds identified as COPCs in Section 2.4.1. The lowest of the human health and groundwater protection criteria are proposed as the cleanup goal for soil.

3.3.2 Groundwater Cleanup Goals

The Site is located within the Elysian Hills, in an area mapped as Puente Formation by CDMG (CDMG,1998). The Puente Formation is not recognized as a potential source of water supply by the California Department of Water Resources (DWR, 1961), and shallow groundwater at the Site is not directly utilized for drinking water purposes. It is recognized, however, that hydraulic connections may exist between shallow groundwater at the Site and the aquifers of the Hollywood Subbasin, which have municipal supply designated as a beneficial use (LARWQCB, 2014). Given the location of the Site outside of a groundwater basin, it is reasonable to assume that the chemical concentrations would appreciably attenuate during transport from the Site to the Hollywood Subbasin. For this reason, drinking water criteria (the California MCLs or NLs) multiplied by an attenuation factor of 10 are proposed as cleanup goals for shallow groundwater.

The California MCLs and NLs for the compounds identified as COPCs in Section 2.5.1 and the proposed cleanup goals are listed in Table 3-4.

4. FEASIBILITY STUDY

This section of the RAP documents the development of the preferred remedial alternative for the Site, and addresses the following topics:

- The development of general response actions (GRAs), which are actions that can be taken to satisfy the RAOs.
- Identification of remedial technologies and process options applicable to each GRA, and evaluation and screening of remedial technologies and process options based on their implementability, effectiveness, and relative cost.
- Development of remedial alternatives, which consist of various combinations of the retained remedial technologies, and a detailed and comparative analysis of the alternatives based on the nine criteria summarized in the United States Environmental Protection Agency (USEPA) National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR], Part 300).

4.1 GENERAL RESPONSE ACTIONS

GRAs (i.e., general types of actions that can be taken to satisfy the RAOs) developed for soil and groundwater at the Site include the following:

- No Action: This GRA is required to be retained for evaluation per guidance from CERLA (40 CFR §300.430). This GRA assumes that no remedial actions, other than those that have previously been conducted at the Site, will be performed.
- Monitoring (groundwater only): Periodic groundwater monitoring identifies the effectiveness of other actions, such as containment, treatment, or extraction actions. Natural attenuation monitoring identifies the effectiveness of natural processes in reducing contaminant concentrations.
- Institutional and Engineering Controls: Institutional and engineering controls are used to prevent exposure to contaminants. Examples include LUCs, which are used to prohibit land uses that may involve exposure to sensitive receptors such as human residents, and vapor controls, which prevent receptors from being exposed to VOCs in indoor air.
- Containment: Containment is used to eliminate exposure pathways or reduce the mobility of contaminants. Examples include groundwater pumping, which can be used to hydraulically contain impacted groundwater; and PRBs, which can be used to prevent groundwater contaminants from migrating beyond a specified location.
- Treatment: In situ or ex situ treatment reduces contaminant concentrations in impacted soil or groundwater. In some instances, in situ treatment may be used to eliminate exposure pathways, and may also decrease contaminant mobility or volume, depending upon the level of treatment and properties of the contaminants and impacted media.
- Removal, Transportation, and Disposal (soil only): Removal reduces the volume of impacted soil. Removal may be combined with ex situ treatment to reduce contaminant concentrations in excavated impacted soil, or may be combined with transportation and offsite disposal to reduce the volume of impacted soil. The disposal component of this GRA also includes onsite reuse of treated soil.
- Extraction, Transportation, and Disposal (groundwater only): Groundwater extraction reduces the volume of impacted groundwater and contaminant concentrations in impacted groundwater. Extraction is usually combined with ex situ treatment and discharge of treated groundwater to the

storm drain or through a local utility provider such as the sanitary sewer. Offsite disposal is usually reserved for treatment residuals.

4.2 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

The following subsections describe the process used to identify and screen remedial technologies for the Site.

4.2.1 Technology Identification

Following the development of the GRAs outlined above, potentially applicable technologies were identified by media for each GRA. For example, the treatment for soil was expanded to include five technology types: in-situ and ex-situ physical, biological, chemical, and thermal treatment.

Each identified technology type was then populated with one or more representative process options for further screening. Process options were obtained from several sources, including in-house experience with a variety of remedial technologies, and a search of readily available literature on remedial technologies and applications. Major sources for technology information included the following:

- USEPA: The USEPA Technology Innovation and Field Services Division Contaminated Site Clean-Up Information (CLU-IN) website (USEPA, 2020b) contains a variety of technology-specific and contaminant-specific remediation resources, including brief web-based treatment technology overviews and links to publications issued by the USEPA and others.
- Federal Remedial Technologies Roundtable (FRTR): The FRTR website (FRTR, 2020) has numerous technology resources, including the Technology Screening Matrix and a searchable cost and performance case studies database.
- Interstate Technology & Regulatory Council (ITRC): The ITRC has prepared a number of contaminant-specific and technology-specific technology review documents, which are available on the ITRC website (ITRC, 2020).
- Environmental Security Technology Certification Program (ESTCP) and Strategic Environmental Research and Development Program (SERDP): The ESTCP and SERDP have sponsored a wide range of remediation technology research, including the development of protocols for monitoring assessment and demonstrations of a variety of remediation technologies.

A complete listing of the media-specific process options considered for the Site, including a brief description of each option, is provided in Tables 4-1 (soil technologies) and 4-2 (groundwater technologies). Details on the criteria used in the technology screening and evaluation are provided in Section 4.3.1.

4.2.2 Technology and Process Option Screening Criteria

Each process option was evaluated based on the CERCLA evaluation criteria of effectiveness, implementability, and cost (USEPA, 1988). The effectiveness screening includes three evaluation factors: the effectiveness of the process option in handling the estimated areas or volumes of impacted media and in meeting the RAOs; potential short-term impacts to human health and the environment during remedial construction and implementation; and whether the process is proven and reliable with respect to the contaminants and conditions at the Site (USEPA, 1988). The implementability evaluation considers the overall implementability of the process option, including institutional implementability (i.e., potential permitting issues, the availability of services, equipment, and/or workers) as well as technical implementability. The cost evaluation was limited to evaluation of relative costs within a given technology type.

4.2.3 Technology Screening Results

The technology screening consisted of qualitatively ranking each process option as high, medium, or low for each of the evaluation criteria, as indicated in Tables 4-1 and 4-2. Then the process options considered to be the best suited for Site conditions were retained for use in developing remedial alternatives. Rejected process options are shaded in gray in Tables 4-1 and 4-2. No action was retained for comparison purposes in accordance with USEPA guidance. The retained technologies and process options include the following:

Soil Technologies

- No action
- Land use controls
- Vapor control
- Excavation
- Transportation (retained in combination with excavation and offsite disposal)
- In situ physical treatment
- Offsite disposal (retained as a disposal option in combination with excavation and transportation)

Groundwater Technologies

- No action
- Sampling and analysis
- Monitored natural attenuation (MNA)
- Land use controls
- Vapor control
- Hydraulic Containment (retained in combination with ex situ chemical and/or physical groundwater treatment and on- and/or offsite disposal)
- PRB
- In situ thermal treatment
- Ex situ chemical and physical treatment (individual process options are retained singly or in combination as treatment train options for hydraulic containment and/or groundwater extraction)
- Onsite disposal (retained as a disposal option for treated groundwater)
- Offsite disposal (retained as a disposal option for ex situ treatment residuals)

4.3 Development of Remedial Alternatives

After the initial screening, the technology and processes for each general response action that were retained were combined to prepare remedial action alternatives. The remedial action alternatives developed for soil and groundwater include the following:

1) No action (baseline)
2) Soil excavation, offsite disposal, and groundwater pump and treat
3) Soil excavation, offsite disposal, and PRB,
4) Electrical resistance heating (ERH) and soil vapor extraction (SVE)

Additionally, land use controls, vapor barrier, and groundwater MNA would be paired with each alternative to achieve the Site RAOs.

4.3.1 Evaluation Criteria

Nine basic evaluation criteria set forth by the NCP, Part 300.430 will be used for the comparative analysis on the selected remedial alternative. The nine criteria include the following:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume (TMV) through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

The first two criteria are considered "threshold criteria" that all alternatives must achieve. The next five are "primary balancing criteria" that serve to ensure that decision-makers are informed of the uncertainties and significant aspects associated with each alternative. The remaining two criteria are "modifying criteria" that require state and community input and acceptance of the preferred alternative and are not included in the following evaluation. State acceptance will be determined by acceptance of the RAP by the LARWQCB and community acceptance will be determined through a public review and comment process.

4.3.2 Alternative 1: No Action (Baseline)

The no action alternative is included as a baseline for comparison to other alternatives. The no action alternative includes no actions to address contamination at the Site (e.g. no monitoring, remedial action, and/or institutional controls).

Overall Protection of Human Health and the Environment

This alternative would not be protective of human health and the environment as it does not control or reduce the human health risks present.

Compliance with ARARs

This alternative does not comply with the ARARs for left in-place contamination. However, compliance with ARARs is not required for the No Action alternative per CERCLA Section 121, "Cleanup Standards", which requires compliance for remedial/response actions only.

Long-Term Effectiveness and Permanence

This alternative does not address the RAOs and is not considered to be effective and leaves potential exposure to future receptors.

Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of onsite contamination would occur via intrinsic biodegradation, dilution, and dispersion over an extended period of time. Primary COCs may degrade to a more toxic secondary COC such as vinyl chloride and potentially migrate offsite.

Short-Term Effectiveness

This alternative would produce no short-term adverse effects to the local community or the environment due to cleanup activities, because no action would be undertaken. This alternative would not achieve the RAOs and though the cleanup goals might eventually be achieved through natural attenuation, there would be no verification through monitoring and therefore is not considered to be effective.

Implementability

Implementability for this alternative is not applicable.

Cost

Cost for this alternative is not applicable.

4.3.3 Alternative 2: Soil Excavation, Offsite Disposal, and Groundwater pump and treat

This alternative would include excavation of contaminated soil at the locations identified on Figure 9 to an estimated depth of 20 feet and transportation and offsite disposal (or offsite treatment) of excavated soil. Excavation may be performed using conventional excavation equipment, with shoring and dewatering as needed to reach the required depth.

Both onsite and upgradient PCE groundwater contamination to the northeast would be addressed with a groundwater pump and treat system utilizing closely spaced extraction wells as shown on Figure 9 and an onsite groundwater treatment system. Treated groundwater would most likely be discharge to the sanitary sewer. The design and layout of the groundwater extraction wells would be dependent on hydraulic conditions of the Site and would require additional data. MNA of groundwater may be implemented after decommissioning of the groundwater pump and treat system when asymptotic conditions are reached.

Institutional controls including LUCs and a soil management plan (SMP) would be implemented for areas and depths not excavated. Engineering controls would a include vapor barrier integrated with new buildings constructed onsite to address potential vapor intrusion concerns.

Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment. The onsite soil contamination would be initially removed and contaminated groundwater would be recovered over a period of time. The groundwater extraction system would also provide hydraulic control of the groundwater plume to address potential offsite migration. Groundwater monitoring could be utilized to determine when the RAOs are achieved via pump and treat and/or MNA. Institutional controls would minimize potential for receptors' exposure to soil and groundwater. Engineering controls such as a vapor barrier would mitigate vapor intrusion from the potential partitioning of groundwater contamination until RAOs are met.

Compliance with ARARs

The selected alternative could be implemented within the ARARs for the Site. ARARs from state, federal, and local regulatory agencies would be applied during remediation activities including 1) City of Los Angeles BOS permit for discharge of treated groundwater to the sanitary sewer; 2) South Coast Air Quality Management District (SCAQMD) Rules 401, 402, 403, 1166, and 1466 related to soil excavation activities; 3) USEPA; 4) DTSC; 5) Occupational Safety and Health Administration (OSHA); and 6) California Division of Occupation Safety and Health (Cal/OSHA).

Long-Term Effectiveness and Permanence

Excavation and transportation for offsite disposal/treatment is a widely used and very reliable option for soil contamination. It is highly effective in the long-term due to the permanence of removing the contaminated soil. Groundwater pump and treat is also widely used and reliable. Onsite contamination would be removed by the extraction well system and onsite treatment system. Long-term effectiveness of the pump and treat system would be dependent on the placement and installation depth of the extraction wells, proper operation and maintenance (O&M), and the effectiveness of the capture of offsite contamination migrating onsite. Preferential pathways in the subsurface may limit the total capture of contamination in groundwater. When asymptomatic conditions are reached, additional measures or MNA may be utilized requiring continued monitoring. Overall, the long-term reliability of this alternative is good. Vapor barriers and associated monitoring systems are effective at mitigating vapor intrusion to site workers associated with subsurface contamination.

Reduction of Toxicity, Mobility, or Volume through Treatment

Excavation and offsite disposal of soil removes the contaminant mass from the Site to a landfill. Offsite treatment may be used if applicable to reduce or eliminate toxicity and mobility of the contaminants. Waste characterization is necessary to determine if the excavated soil may be treated offsite or if landfill disposal would be required. The groundwater pump and treat system would reduce the mobility and volume of the dissolved contamination. MNA may decrease the toxicity of the contamination, but biodegradation of PCE may lead to the creation of vinyl chloride which is more toxic.

Short-Term Effectiveness

Exposure to equipment emissions, COCs, and fugitive dust may occur during remedial activities. The potential for exposure would be increased during excavation from volatilization during the excavation, handling, and transportation of VOC-impacted soil. The transportation risk would include truck accidents and potential spills of hazardous waste on highways and would require numerous trucks to transport the hazardous waste several hundred miles. Compliance with local air regulations, permitting, and safety protocols would minimize risk of exposure to potential receptors. Any well abandonment, installation, or reinstallation would also be performed under appropriate health and safety practices. Short-term risks could be effectively managed and minimized with the proper mitigation measures.

Implementability

Excavation of the contaminated soil, offsite transportation to disposal and/or treatment facilities, and backfill of clean import fill material could be performed with conventional earth-moving and construction equipment. Groundwater pump and treat is constructed with conventional drilling and construction equipment. However, due to Site conditions, closely spaced extraction wells would be needed to produce an effective radius of influence because of the tight formation characteristics of the subsurface geology. Additionally, with the slow recharge/recovery rates that have been experienced during the purging of existing Site monitoring wells, a low pumping volume may not effectively capture the contaminated mass.

Cost

The estimated remediation cost for this alternative would be relatively high due to initial labor, equipment, transportation, disposal, and capital costs associated with soil excavation, construction of the groundwater pump and treatment system, and the vapor barrier. The O&M costs for the pump and treat system would include labor, equipment maintenance, carbon changeouts, and power consumption. Long term monitoring and maintenance costs of the vapor barrier system would also be required. Future demolition costs would also be incurred when the RAOs are met or the system is no longer effective (e.g. asymptotic conditions).

4.3.4 Alternative 3: Soil Excavation, Offsite Disposal, and PRB

This alternative would include excavation of contaminated soil at the locations identified in Figure 10 to an estimated depth of 40 to 50 feet bgs in Area 1 and 20 feet in Areas 2 and 3 and offsite transportation and disposal or treatment of excavated soil. Excavation and dewatering in these areas would remove chemical impacts in the upper 20 feet and PCE impacted soil and potential DNAPL between 20 and 50 feet bgs. The vertical extent of excavation at Area 1 may be modified based on additional investigation completed as described in Section 5.

Further onsite groundwater contamination would be addressed using MNA monitoring and may be paired with in-situ bioaugmentation (e.g. via soil mixing) to decrease the time frame of MNA monitoring. Upgradient PCE groundwater contamination to the northeast and parallel to Hoover Street as shown in Figure 6 would be addressed with a PRB installed parallel to Hoover Street in the northeastern portion of the Site as shown on Figures 11 and 12 to control the migration of offsite contamination onto the Site. Institutional controls including LUC and a SMP would be implemented for areas and depths not excavated. Engineering controls would include vapor barriers for new buildings constructed onsite. This alternative would be the most implementable in conjunction with the proposed redevelopment of the Site.

Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment at the Site. The onsite soil contamination would be removed and the PRB would either prevent or reduce the migration of offsite contamination onto the Site. Groundwater monitoring would be utilized to determine when the RAOs are achieved via MNA. Current risk levels for exposure to groundwater or vapor partitioning remain but would decrease over time as the offsite source is mitigated via the PRB and MNA. Institutional controls would minimize potential for receptors exposure to soil and groundwater. Engineering controls such as a vapor barrier would mitigate vapor intrusion from the potential partitioning of groundwater contamination until RAOs are met.

Compliance with ARARs

The selected alternative could be implemented within the ARARs for the Site. ARARs from state, federal, and local regulatory agencies would be applied during remediation activities including 1) LARWQCB, 2) SCAQMD, 3) USEPA, 4) DTSC, 5) OSHA, and 6) Cal/OSHA.

Long-Term Effectiveness and Permanence

Excavation and transportation for offsite disposal/treatment is a widely used and very reliable option. It is highly effective in the long-term due to the permanence of removing the contaminated soil. PRB is a well-known technology with demonstrated success for controlling plume migration. Selection of the substrate used in the PRB would impact the long-term effectiveness of the alternative. The long-term effectiveness of groundwater MNA would depend on geochemical conditions after completion of the soil excavation. Additional remedial actions may be required to meet RAOs if conditions are not favorable.

Reduction of Toxicity, Mobility, or Volume through Treatment

Excavation and offsite disposal of soil removes the contaminant mass from the Site to a landfill. Offsite treatment may be used if applicable to reduce or eliminate toxicity and mobility of the contaminants. Waste characterization is necessary to determine if the excavated soil could be treated offsite or if landfill disposal is required. The PRB would decrease the mobility of offsite contamination moving onsite thus reducing the volume that would be mitigated with MNA. Remediation of dissolved contaminants in groundwater by MNA would also eliminate chemical toxicity, mobility, and volume of the groundwater plume. MNA may decrease the toxicity of the contamination, but biodegradation of PCE may lead to the creation of vinyl chloride which is more toxic. The timeframe for all dissolved contaminants to attain RAOs in this alternative would be long term.

Short-Term Effectiveness

Exposure to equipment emissions, COCs, and fugitive dust may occur during remedial activities. The potential for exposure would be increased during excavation from volatilization during the excavation, handling, and transportation of VOC-impacted soil. The transportation risk would include truck accidents and potential spills of hazardous waste on highways and requires numerous trucks to transport the hazardous waste several hundred miles. Compliance with local air regulations, permitting, and safety protocols would minimize risk of exposure to potential receptors. Any well abandonment, installation, or reinstallation would also be performed under appropriate health and safety practices. Short-term risks could be effectively managed and minimized with the proper mitigation measures.

Implementability

Excavation of the contaminated soil, offsite transportation to disposal and/or treatment facilities, and backfill of clean import fill material could be performed with conventional earth-moving and construction equipment. Construction of the PRB could be completed using conventional construction equipment concurrent with the backfill of the soil excavations or with specialty trenching equipment, if necessary, to reach depth. The PRB would be packed with reactive substrate, which are proven oxidants for chlorinated ethenes in groundwater, selected from a bench scale test.

Cost

The estimated remediation costs for this alternative would be high due to initial labor, equipment, transportation, disposal, and capital costs associated with soil excavation, and construction of PRB and the vapor barrier. Ongoing maintenance and monitoring costs for this alternative would be relatively low.

4.3.5 Alternative 4: Electrical Resistance Heating and Soil Vapor Extraction

This alternative would include ERH to complete in situ thermal remediation of chlorinated solvents (e.g. PCE, TCE) in soil and groundwater at the Site. ERH consists of heating the saturated zone to volatilize VOCs or petroleum contaminants, which would be collected using an SVE system. Nested thermal point/SVE wells would be installed in the PCE- and TCE-impacted area in the northeastern portion of the Site and in the impacted area offsite between the Site and the former Jesse Cleaners as shown on Figure 13. Heat or steam would be introduced into the heating points, which would enhance volatilization of the chlorinated solvents and allow the collection of volatilized VOCs by the SVE wells. Additional heating points and vapor extraction wells may need to be added to the network to optimize recovery of chlorinated VOCs. Collected vapors would require treatment via thermal oxidizer with scrubber, a condensation/chiller unit to liquefy and store chlorinated VOCs, or vapor-phase carbon, depending upon the concentrations of the chlorinated VOCs extracted from the subsurface. This technology is also effective for remediation of non-aqueous phase liquids (NAPLs). Electrical or natural gas service for the system would be required. Confirmation borings would be completed to verify cleanup goals are achieved.

This alternative would also include excavation of contaminated soil at Areas 2 and 3 identified on Figure 9 to an estimated depth of 20 feet and transportation and offsite disposal (or offsite treatment) of excavated soil. Excavation may be performed using conventional excavation equipment, with shoring and dewatering as needed to reach the required depth.

Institutional controls including LUC and an SMP and groundwater MNA would be implemented for areas and depths not remediated. Engineering controls would include vapor barriers for new buildings constructed onsite.

Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment at the Site. The onsite soil contamination would be removed. Full capture of the vapors would be needed to be protective of human health. The ERH and SVE would be followed by groundwater monitoring to determine when the RAOs are achieved via MNA. Institutional controls would minimize potential for receptors exposure to soil and groundwater as needed. Engineering controls such as a vapor barrier would mitigate vapor intrusion from the potential partitioning of groundwater contamination until RAOs are met.

Compliance with ARARs

The selected alternative could be implemented within the ARARs for the Site. ARARs from state, federal, and local regulatory agencies would be applied during remediation activities including 1) LARWQCB, 2) South Coast Air Quality Management District (SCAQMD) Rules 401, 402, 403, 1166, and 1466 related to soil excavation activities; 2) , 3) USEPA, 4) DTSC, 5) OSHA, and 6) Cal/OSHA.

Long-Term Effectiveness and Permanence

This alternative has been demonstrated to be highly effective for chlorinated solvents and petroleum products and the process is irreversible. Excavation and transportation for offsite disposal/treatment is a widely used and very reliable option.

Reduction of Toxicity, Mobility, or Volume through Treatment

The onsite treatment via ERH removes the contaminant mass from the Site within the treatment area in a relatively short time frame. ERH may increase the mobility of NAPL and require extraction to prevent migration. It does not reduce toxicity, mobility, and volume outside the treatment zone. Excavation and offsite disposal of soil removes the contaminant mass from the Site to a landfill. Offsite treatment may be used if applicable to reduce or eliminate toxicity and mobility of the contaminants. Waste characterization is necessary to determine if the excavated soil may be treated offsite or if landfill disposal would be required.

Short-Term Effectiveness

Exposure to equipment emissions, COCs, and fugitive dust may occur during remedial activities. The potential for exposure would be increased during excavation from volatilization during the excavation, handling, and transportation of VOC-impacted soil. The transportation risk would include truck accidents and potential spills of hazardous waste on highways and would require numerous trucks to transport the hazardous waste several hundred miles.

Any anode and associated equipment installation and abandonment would be performed under appropriate health and safety practices. Compliance with local air regulations, permitting, and safety protocols would minimize risk of exposure to potential receptors. Short-term risks could be effectively managed and minimized with the proper mitigation measures.

Implementability

ERH may be installed through conventional drilling technology, above or underground wiring, and above or underground piping. Discharge of treated vapors should be permitted with the SCAQMD and the discharge of treated condensed liquids to the sewer system may be permitted under an industrial wastewater permit. Implementability may be challenging with potential impacts to utilities, street closures, and permitting. Additional safety precautions may be installed onsite such as cameras, secure fencing around the treatment zone, and automatic shutoff controls to prevent any accidental exposure from the electrical conduits.

Excavation of the contaminated soil, offsite transportation to disposal and/or treatment facilities, and backfill of clean import fill material could be performed with conventional earth-moving and construction equipment.

Cost

The estimated remediation cost for this alternative would be high initially due to design, labor, equipment, and capital costs associated with the ERH, SVE system, soil excavation, and the vapor barrier. Operation and maintenance (O&M) costs of the ERH and SVE would include high power usage costs. Ongoing costs after completion of ERH and SVE treatment for this alternative would be relatively low.

4.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

In the comparative analysis, the remedial alternatives were evaluated in relation to one another to identify the relative advantages and disadvantages of each with respect to the evaluation criteria.

4.4.1 Overall Protection of Human Health and the Environment

Alternative 1, the no action alternative, would not protect human health and the environment because contaminants in soil that currently exceed human health and ecological risk goals would not be addressed, institutional controls would not be enforced, and contaminated groundwater would be left in place and allowed to migrate off-property. Additionally, the offsite groundwater contamination would continue to contribute to onsite contamination.

Alternatives 2, 3, and 4 would protect human health and the environment through the following actions:

- Addressing risks to human and ecological receptors by excavation and offsite disposal;
- Addressing human exposure to contaminants in onsite groundwater through reduction of volume of mass through various treatment methods and reduction in toxicity and mobility by monitoring for MNA; and
- Implementing LUCs and engineering controls to further protect site workers and occupants from subsurface contamination

Additionally, Alternative 3 would addresses potential human exposure to contaminants in onsite groundwater by preventing the continued migration of offsite contamination using a PRB. Groundwater in-situ bioremediation would temporarily reduce contaminant mass and would also reduce the overall time for groundwater restoration, but these actions would not be expected to remove the need for MNA and would still have an extended remedial period.

Alternatives 2 and 3 are considered to be most protective of human health and the environment.

4.4.2 Compliance with ARARs

All of the alternatives, except Alternative 1 (no action), would comply with ARARs.

Most of the identified chemical-specific ARARs are either water quality standards for drinking water or documents specifying beneficial uses of groundwater resources. These standards do not apply to groundwater beneath the property because onsite groundwater is not currently used for drinking water supply. Alternative 2 would comply with chemical-specific ARARs by the extraction of contaminated groundwater in the source area (northeast portion) of the Site. Alternatives 3 and 4 would comply with chemical-specific ARARs by MNA preceded by the addition of a bioaugmentation amendment, use of a PBR, and/or thermal treatment.

Alternatives 2, 3, and 4 would comply with action-specific ARARs by obtaining all required permits and permissions, including WDRs for the installation of the PRB and/or addition of bioremediation amendment(s), NPDES for the discharge of treated groundwater, and City of Los Angeles excavation permit.

4.4.3 Long-Term Effectiveness and Permanence

Alternative 1 does not provide long-term effectiveness or permanence because contaminants in soil would not be addressed, institutional controls would not be enforced, and contaminated groundwater would be left in place and allowed to migrate off-property. Additionally, the offsite groundwater contamination would continue to contribute to onsite contamination.

Alternatives 2 and 3 would have identical long-term effectiveness for soil risk as contaminated soil is excavated and removed from the Site. Alternatives 2, 3, and 4 would have similar degrees of long-term effectiveness for groundwater, although the time to reach RAOs varies for each with the shortest time frame anticipated for Alternative 2 and the longest time frame anticipated for Alternative 3. Long-term effectiveness of Alternative 2 may be impacted by the migration of offsite contamination onsite.

4.4.4 Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 1 (no action) provides no reduction in TMV of the contaminants through treatment.

Alternatives 2 and 3 would similarly reduce the TMV by excavation and offsite disposal and/or treatment. Alternative 2 would remove more contaminant mass from groundwater and reduce the mobility through hydraulic capture. However, Alternative 3 would reduce the toxicity and mobility of contaminants in groundwater over a longer period of time. Alternative 4 would remove and destroy contaminant mass in soil and groundwater to the extent of the treatment zone but addressing the mobility of the off-gassing may be challenging.

4.4.5 Short-Term Effectiveness

Alternative 1 (no action) has no short-term impacts to the community, workers, or the environment because no actions would be taken. However, this alternative would not achieve the RAOs, and risks to human health and the environment would remain as they are currently.

Alternatives 2 and 3 would have similar impacts to the community and the environment. However, risks to workers are considered to be greater for Alternative 2, due to the greater amount of construction and O&M associated with these alternatives, and the higher potential for exposure to contaminated soil and groundwater. Alternative 4 would have a smaller impact to the community and the environment due to the in-situ thermal treatment approach reducing the volume of soil excavation of contaminated soil.

4.4.6 Implementability

Alternative 1 requires no action and is therefore readily implementable.

Alternatives 2, 3, and 4 would have similar implementability in terms of availability of technology and effectiveness of monitoring, but Alternatives 2 and 4 would entail increased complexity and permitting and would be less adaptable due to the equipment installations required. With respect to the proposed Site redevelopment, Alternatives 2 and 4 would be more difficult to implement due to space needed for ex-situ treatment systems and the need to address offsite impacts. In addition, the reliability of groundwater extraction for reducing contaminant mass proposed for Alternative 2 is dependent on subsurface conditions.

Of the alternatives that involve remedial actions, Alternative 3 is considered to the most implementable, followed by Alternatives 2 then 4 with similar complexity.

4.4.7 Cost

Alternative 1 (no action) has no associated costs.

Costs for Alternatives 2, 3, and 4 are all considered to be relatively high and are similar magnitudes.

4.5 PREFERRED REMEDIAL ACTION ALTERNATIVE

Based on the results of the screening and evaluation of alternatives, Alternative 3 consisting of soil excavation, offsite disposal, PRB, and a vapor barrier has been selected at this time and will be further refined following the collection of additional Site data as discussed in Section 5 to support the final selected remedial approach.

This remedial alternative will include source removal of PCE impacts in the soil and potentially DNAPL in the areas indicated on Figures 10 through 12. Reduction of upgradient PCE groundwater contamination to the northeast and parallel to Hoover Street will be addressed with the PRB. Institutional and engineering controls and groundwater MNA monitoring will be implemented as part of the alternative. Engineering controls will include a vapor barrier to prevent vapor intrusion from residual soil contamination and PCE impacted groundwater at the site. This alternative meets the RAOs and is the most implementable with regards to planned Site redevelopment.

The preferred remedial alternative (Alternative 3) is anticipated to consist of the following:

- Abandonment of groundwater monitoring wells located within the proposed excavation areas
- Placement of excavation shoring

- Excavation of contaminated soil and soil sloping
- Offsite disposal of contaminated soil with concentrations exceeding site-specific cleanup goals
- Backfill of excavation with clean import fill soil or clean excavated soil determined acceptable for reuse
- Installation of a PRB along the northeastern boundary of the Site
- Installation of WDR and MNA groundwater monitoring wells
- MNA
- Preparation of an SMP
- Implementation of a LUC
- Installation of a vapor barrier prior to site redevelopment including building structures

The proposed excavation extents, PRB location, and overall remedy layout are provided on Figures 10, 11, and 12, respectively. The proposed actions to complete the remedial activities for the preferred alternative are detailed below.

4.5.1 Pre-Excavation Activities

All necessary permits will be obtained prior to commencing remedial activities including excavation, grading, well abandonment, and WDR as detailed in Section 8. Any necessary notifications will be made to the appropriate agencies.

A geophysical survey will be conducted to verify subsurface features within the limits of construction and a DigAlert will be submitted at least 48 hours prior to commencement of any subsurface disturbance.

Prior to excavation of contaminated soil, all groundwater monitoring wells within the proposed excavation area(s) will be abandoned via overdrilling. Implementation of the preferred alternative assumes onsite buildings will be demolished to grade surface by others prior to implementation. It is our understanding the basement associated with the existing Warehouse will not be removed during demolition.

Baseline groundwater monitoring for the WDR will be conducted prior to excavation and installation of the PRB. The baseline monitoring will be conducted as detailed in Section 7. Quarterly WDR reporting will be necessary after the permit is issued regardless of the status of remedial activities.

4.5.2 Excavation Activities

Three areas of soil contamination have been identified for excavation and offsite disposal. The estimated excavation extents are shown on Figure 10 and the depth of Area 1 will be refined pending further vertical delineation as detailed in Section 5. The estimated extents of each excavation area are detailed as follows:

- Area 1 (northern PCE/TCE impacted soil) excavation: excavation to two distinct depths with approximately 1,900 square feet of overlapping area
    - Sub Area 1A: approximately 3,400 square feet to be excavated to 20 feet bgs; estimated volume of soil excavated is 2,500 cubic yards (CY)
    - Sub Area 1B: approximately 3,600 square feet to be excavated to 40 or 50 feet bgs; estimated volume of soil excavated is 4,000 to 5,300 CY dependent on the final depth of the deep excavation area (not including the overlapped portion of Sub Area 1A)
- Area 2 (petroleum impacted soil) excavation: approximately 1,200 square feet to be excavated to 20 feet bgs; estimated volume of soil excavated is 900 CY

- Area 3 (southern PCE/TCE impacted soil) excavation: approximately 9,500 square feet to be excavated to 20 feet bgs; estimated volume of soil excavated is 7,000 CY

To reach the estimated depths for each area, soil excavation could be conducted using conventional excavation equipment such as a track mounted excavator and shoring in conjunction with sidewall sloping where deemed appropriate in consultation with a geotechnical engineer.

Shoring and Sloping

Shoring and soil sloping will likely be required for the three excavations along Hoover Street and along Clinton Street to reach the estimated depths. Excavation of Areas 1 through 3 may incorporate construction of the PRB during backfill and compaction activities as detailed below. Shoring options may include sheet piles with whalers and corner braces and/or soldier piles, wood lagging, and tiebacks. Given the current estimated depths of the proposed excavations and PRB (ranging between 20 and 50 feet bgs) and the shallow depth to groundwater at approximately 15 feet bgs, dewatering of contaminated groundwater will likely be required during excavation and backfill. To minimize the volume of soil movement and dewatering, excavation using sheet piles should be considered in consultation with a geotechnical engineer. Sheet piles may be driven in segments to depth on all sides where shoring is necessary, and locking sections could be sealed with slurry to minimize water seepage along the sidewalls and limit dewatering to the base of the excavation.

Sloping may be required for the excavation sidewalls that are not structurally supported by shoring. The extents of the estimated sloping should be determined in consultation with a geotechnical engineer. However, given the soil types, the slope is anticipated to be no less than 2:1 (horizontal to vertical).

Dewatering

Groundwater is expected to be encountered at approximately 15 feet below grade; therefore, dewatering will be required in conjunction with deeper excavation activities.

The number of wells, location and volume of dewatering required will vary depending on the selected shoring methodology and hydraulic characteristics of the subsurface. Dewatering needs for shallower excavations Area 2 and Area 3 will depend on the actual encountered groundwater depth. The groundwater collected during dewatering will be managed and disposed as VOC-impacted waste. The dewatering system design including well configuration, groundwater storage, treatment, and disposal system will be a necessary part of the remedial design document.

Backfilling

The excavation will be backfilled using clean import fill soil and clean excavated soil determined suitable for reuse. The backfill soil should meet the criteria as detailed in Section 7 and be approved by the Geotechnical Engineer of Record. The backfill will be completed concurrent with construction of the PRB as described below. The backfill of excavations will be completed and compacted in lifts as required by the Geotechnical Engineer of Record. Typically, backfilling proceeds in approximately 6- to 8-inch lifts with compaction (using a sheepsfoot roller or by wheel rolling with a rubber-tired loader) between each successive lift. The shoring materials including lagging any hardened slurry should be removed as the excavation and trench are backfilled to allow groundwater flow through the PRB.

Soil Management

Contaminated or suspected contaminated soil can be segregated into stockpiles prior to offsite transportation and disposal or onsite reuse. Segregation of stockpiles should be guided by waste profiling, current and historical soil sampling data, excavation location, visual observations of soil discoloration, and field screening using a photo-ionization detector. Impacted soil will be transported offsite for treatment/disposal. Alternately, contaminated soil may be direct loaded into trucks for offsite disposal where existing data provides a complete waste profile.

4.5.3 PRB Installation

A PRB trench will be installed parallel to N. Hoover Street to prevent the migration of offsite groundwater contamination onsite. The PRB trench is anticipated to be approximately 3 feet wide, 225 feet long, and 50 feet deep, and setback 13.5-feet from the sidewalk face to the centerline of the barrier as shown on Figure 11. The dimensions of the PRB may be adjusted based on additional data collected as detailed in Section 5.

The PRB could be constructed concurrent with the excavation and backfill of Area 1. In this approach, once Area 1 is excavated to depth, the PRB could be constructed in 5-foot lifts as the excavation is backfilled. The trench may be lined with geotextile material to minimize the migration of fine soil particles into the PRB during implementation. The PRB could be backfilled with permeable materials such as pea gravel, sand, and other materials such as shredded tires or lignin to serve as an adsorption material for the substrate while eliminating or minimizing future settlement. Injection points for future recharge of the PRB will need to be installed during construction and may include process piping routed from the barrier to an onsite remedial compound equipped with piping, instrumentation, mixing equipment to recharge the PRB in the future.

The PRB could be installed from the bottom of the excavation, or approximately 50 feet bgs, to approximately 15 feet bgs. Clean soil would then be used to complete the backfill to grade surface. A substrate would be injected into the PRB to reduce the migration of offsite contamination. Bench scale testing would be conducted as detailed in Section 5 to determine the final recommended substrate. It is anticipated that the substrate used would be an organic substrate such as EOS_{100}, ferrous sulfate, sodium bicarbonate, and/or diammonium phosphate.

Alternately, the PRB could be constructed using alternate trenching techniques after backfill of the Area 1 excavation such as one-pass trenching. One-pass trenching is a trenching technique that uses specialized equipment that backfills the trench as the equipment excavates. However, one-pass trenching would not allow for the installation of a geotextile liner, if needed.

4.5.4 MNA Monitoring Well Installation

After completion of the excavation and PRB installation, groundwater monitoring wells will be installed to monitor MNA. The monitoring well network and sampling plan will be prepared as part of an operation, monitoring, and maintenance (OM&M) plan for the Site remediation. The sampling and analysis will be conducted in accordance with the RWQCB-approved Monitoring and Reporting Program.

4.5.5 Vapor Barrier

New building construction at the Site could require the installation of a vapor barrier to prevent vapor intrusion from residual soil contamination and the PCE impacted groundwater. The type of vapor barrier that would be required (e.g., passive venting or subslab depressurization) depends on sitewide groundwater levels and agency acceptance of the final proposed design. Due to the widespread impacts of soil and groundwater contamination at the Site and the proposed Site redevelopment plans including a building structure in the southern portion of the Site and a subterranean garage across the entire Site, the vapor barrier design will likely cover the entire Site. Due to shallow groundwater and the depth of the proposed subterranean garage of approximately 15 feet bgs, groundwater levels should be evaluated to determine if a vapor collection system integrated with the vapor barrier design would properly function or be needed during seasonal groundwater fluctuations.

4.5.6 Institutional Controls

Institutional controls would be implemented at the Site to control onsite groundwater and land usage. These actions would prevent direct exposure to COCs by prohibiting the use of onsite untreated groundwater and would ensure that indoor air vapor intrusion risk does not exceed acceptable levels by preventing any residential land usage at the Site in areas impacted by contamination. Groundwater and land use restrictions will remain in effect until the time that RAOs have been met.

Prior to any soil handling activities, an SMP will be prepared and implemented to minimize potential exposure to contaminants in soil and groundwater. The SMP will include guidance on screening, handling, and safely removing or stabilizing contamination discovered in Site soils and will cover post-remediation redevelopment.

5. ADDITIONAL DATA NEEDS

Additional Site data are needed to support the final remedy and remedial design requirements including the refinement of remediation target areas, final selection of remedial technologies, and determination of design parameters. The proposed investigation is detailed in the work plan in Appendix A and includes the following elements:

- Vertical Profile Soil and Groundwater Sampling: This element addresses the vertical extent of groundwater contamination within Area 1. Nested monitoring wells with short (5-foot) screen intervals will be installed in Area 1 at 10 foot depth intervals to evaluate the vertical extent of groundwater contamination. The groundwater data, together with data from soil samples collected during drilling, will be used to evaluate the vertical extent of soil contamination.
- Horizontal Extent Groundwater Sampling: This element includes installing groundwater monitoring wells as close as possible to the PRB transect to delineate the northern and southern limits of the groundwater plume along the proposed PRB transect.
- Hydraulic Assessment: This element includes hydraulic testing to assess groundwater velocity and hydraulic conductivity. Hydraulic testing will be performed in the immediate vicinity of the vertical profile monitoring wells in Area 1.
- Bench Testing: This element includes laboratory testing of potential permeable reactive barrier media. Batch tests will be used to screen and select potential media for further testing; column tests will then be conducted to further evaluate media performance. The bench testing will be performed by a subcontract treatability laboratory using groundwater obtained from the Site.

6. COST ESTIMATE

The engineering cost estimate for the implementation of the RAP is $15,300,000 including a 20 percent contingency and could range between $7,600,000 (-50%) and $30,600,000 (+100%). This estimate includes permitting, planning, design package, construction and installation of the PRB, excavation and disposal of the impacted soil, installation of the vapor barrier, and 30 years of O&M, groundwater monitoring and reporting. A summary of the costs is provided below.

PRB, Excavation, Vapor Barrier, and Monitoring		
Item	Task Name	Cost
1	Permitting, Planning, & Design	$ 400,000
2	PRB Construction and Installation	$ 1,600,000
3	Excavation and Disposal of Areas 1, 2, and 3)	$ 3,200,000
4	Vapor Barrier Construction and Installation	$ 3,000,000
5	Remedial System Construction Reporting	$ 100,000
6	O&M and Reporting for 30 Years	$ 1,700,000
7	Groundwater Monitoring and Reporting for 30 Years	$ 2,800,000
	Subtotal Cost	$ 12,700,000
	Contingency =	$ 2,500,000
	Total Engineering Cost Estimate	$ 15,300,000
	- 50% Cost w/ Contingency	$ 7,600,000
	+100% Cost w/ Contingency	$ 30,600,000

7. SAMPLING AND ANALYSIS PLAN

7.1 IMPORT FILL AND REUSE SOIL

Import fill material and clean excavated material will be reused onsite to backfill the soil excavations. Import fill material will be sampled in accordance with the sampling frequency and chemical testing requirements recommended in the DTSC Information Advisory for Clean Imported Fill Material (DTSC, 2001). Import fill soil will not be acceptable if any contaminants are detected above the Site cleanup goals and/or applicable screening criteria (e.g. hazardous waste criteria).

Additional geotechnical analysis will be required to ensure structural suitability of the backfill material.

7.2 SOIL CONFIRMATION SAMPLE COLLECTION PROCEDURES

Soil samples should be collected from the excavation sidewalls and bottom at the defined limits of excavation to document the left-in-place contaminant concentrations. Sidewall samples would be collected at the vertical midpoint of the sidewall for each depth interval (every 10 feet of depth) with horizontal spacing every 20 feet. Bottom samples would be collected in a grid pattern with one sample for every 400 square feet for a minimum of two bottom samples per excavation. The samples may be collected directly into the sample containers from the excavation or from the excavator bucket depending on accessibility and safety. The location of each sample should be documented using GPS equipment at the time of sample collection. Sidewall and bottom samples should be analyzed as appropriate for the COCs in each of the excavation areas. It is anticipated that samples from Areas 1 and 3 would be sampled and analyzed for VOCs (USEPA Method 8260B) and samples from Area 2 would be sampled and analyzed for TPH (USEPA Method 5035/8015B) and BTEX (USEPA Method 8260B).

All samples should be collected and preserved for transportation to an analytical laboratory under chain of custody procedures. The results of the excavation verification sampling should be provided in a remedial action completion report.

7.3 WASTE DISPOSAL CLASSIFICATION SAMPLING

Waste anticipated to be generated during the implementation of the preferred alternative includes contaminated soil, contaminated groundwater, and potential construction waste. All waste would be profiled prior to disposal at the appropriate facilities.

Contaminated soil may be stockpiled onsite in accordance with requirements of SCAQMD Rule 1166. The results of soil data collected from the additional data collected as detailed in Section 5 may be used to characterize and profile the waste. If needed, the stockpile soil samples would be tested to profile the excavated soil prior to disposal. Waste profile testing may include the following analyses:

- TPH (USEPA Method 5035/8015B)
- VOCs (USEPA Method 8260B)
- Title 22 metals including mercury (USEPA Method 6010B/7471A)
- Asbestos (Polarized Light Microscopy)

Contaminated groundwater collected during dewatering of the excavations may be collected in temporary storage tanks. If offsite disposal is used for managing the wastewater, grab samples would be collected to profile the waste prior to offsite disposal/treatment for the following analyses:

- TPH (USEPA Method 5035/8015B)
- VOCs (USEPA Method 8260B)
- Title 22 metals including mercury (USEPA Method 6010B/7471A)

Additional analyses may be required by the selected disposal/treatment facility. Generator knowledge may be utilized for characterizing the construction waste (e.g., contaminated soil contact).

7.3.1 Waste Disposal Facilities

Waste classification will determine the appropriate disposal facility to be utilized for final disposition of the excavated material and incidental waste water. The following classifications are anticipated:

- Non-RCRA, California Hazardous Waste (exceeds total threshold limits concentration [TTLC] or soluble threshold limit concentration [STLC] but less than toxicity characteristic leaching procedure [TCLP])
- Non-Hazardous, TPH-contaminated Waste (less than TTLC, STLC, and TCLP and determined by receiving facility limits)
- Non-Hazardous Waste (less than STLC and TCLP)

RCRA-hazardous waste is not anticipated. Other facilities may be selected for accepting project waste as appropriate.

7.3.2 Waste Transportation

Waste will be transported in accordance with a traffic plan approved by the City of Los Angeles. All trucks must have appropriate licenses and the waste will be transported under appropriate waste manifests signed by LADWP or an approved representative. All trucks will be covered before leaving the Site to minimize exposure during transport.

7.4 GROUNDWATER MONITORING

Groundwater monitoring will be conducted to characterize groundwater conditions after the installation of the proposed PRB. Additionally, groundwater monitoring would be required to fulfill the requirements of the WDR permit and monitoring for MNA parameters would be needed to fulfill the selected remedial alternative. The monitoring network and sampling plan would be prepared as part of an OM&M plan.

7.4.1 Post-Excavation Groundwater Characterization

After completion of the soil excavation and backfill, groundwater monitoring wells would be installed to monitor groundwater after completion of the excavation. The monitoring network and sampling plan would be prepared as part of the OM&M plan. It is anticipated that the characterization monitoring would be conducted approximately one month after installation of the PRB and concurrent with the WDR monitoring.

7.4.2 Groundwater WDR Monitoring

Groundwater monitoring under the WDR permit would be conducted prior to well abandonment and excavation to establish baseline conditions and then monthly after the installation of the PRB followed by quarterly monitoring for at least one year. It is anticipated that the quarterly WDR monitoring would be conducted quarterly concurrent with the MNA monitoring for two years after which it will be conducted annually or as otherwise accepted by the LARWQCB to facilitate Site redevelopment. The monitoring network and sampling plan would be prepared as part of the WDR permit application and/or as part of an OM&M plan. The sampling and analysis would be conducted in accordance with the RWQCB-approved monitoring and reporting program.

7.4.3 Groundwater MNA Monitoring

Groundwater monitoring for MNA would be conducted quarterly for the first two years and annually thereafter until site-specific cleanup goals are achieved or as otherwise accepted by the LARWQCB to facilitate Site redevelopment. The monitoring network and sampling plan would be prepared as part of the OM&M plan. The OM&M plan would also specify the criteria that indicate the need for additional remedial measures.

7.4.4 Quality Assurance/ Quality Control Samples

Quality assurance/quality control (QA/QC) samples would include trip blanks, equipment blanks, and field duplicate groundwater samples. The OM&M plan would specify the type and frequency of QA/QC sampling and analysis.

7.4.5 Waste Management

Investigation-derived waste (IDW) consisting of purge water generated from well development and sampling, and decontamination water generated from cleaning the field sampling equipment, would be temporarily stored at the Site pending analysis. LADWP would manage the profiling and disposal of the accumulated IDW.

8. PERMITTING

The following regulatory requirements and permits may be required for implementation of the preferred remedial alternative:

- SQAQMD
  - Rule 401 Visible emissions
  - Rule 402 Nuisance, including odors
  - Rule 403 Fugitive dust
  - Rule 1166 Excavation of VOC-impacted soil
  - Rule 1466 Control of Particulate Emissions from Soils with Toxic Air Contaminants
- LARWQCB
  - General WDR (Order No. R4-2014-0187) for In-Situ Groundwater Remediation and Groundwater Re-Injection
- County of Los Angeles
  - Well installation
  - Well abandonment
- City of Los Angeles permits
  - BOE Excavation "E" permit for excavation adjacent to a public street
  - BOE Revocable "R" permit for conditional encroachment of the public right-of-way
  - BOE Construction "A" permit for sidewalk installation and repair and curb and gutter repair
  - BOE "U" permit for installation of monitoring wells in the public right-of-way
  - LADBS grading permit for placement of compacted fill soil
- California Environmental Quality Act (CEQA)

Details of the required regulations and permits are provided in the following sections. All necessary permits and approvals required would be obtained prior to implementing the actions described in this RAP. The removal actions would be performed in accordance with the details described in this RAP by a California licensed General "A" Engineering Contractor, certified for hazardous material removal. The RAP implementation would be overseen by a California-registered Professional Geologist (PG) or Professional Civil Engineer (PE).

8.1 SQACMD

Rule 401, requires that discharges into the atmosphere from a single source of emission for periods aggregating more than three minutes in any one hour shall not be as dark or darker in shade as that designated No. 1 on the Ringelmann Chart or of such opacity as to obscure an observer's view equal or to a greater degree than smoke of the previously described shade.

Rule 402, requires that a discharge from any source does not contain air contaminants or other material which causes injury, detriment, nuisance, or annoyance to any considerable number of persons or the public, or which endanger the comfort repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

Rule 403, requires mitigation of fugitive dust for the excavation, loading, and transport of impacted soils. In addition, notification to SCAQMD and a Fugitive Dust Emission Control Plan are required for large operations under Rule 403.

Rule 1166 applies to excavation of soil containing VOCs above the Rule 1166 threshold. A Rule 1166 permit is required for the proposed excavation work. Notifications and reporting are required to comply with the Rule 1166 permit. In general, permit requirements will include setting up an onsite meteorological station capable of measuring wind speed and direction on a continuous basis. Upwind and downwind VOC monitoring stations will be required, and monitoring of VOC emissions at each excavation face at a frequency of at least 15 minutes will be required. If VOC emissions measured with a photoionization detector (PID), calibrated to 50 ppm hexane, exceed 50 ppm at a distance of 3 inches from the excavated soil face or stockpile, then mitigation measures must be implemented. Mitigation measures include application of vapor suppressant such as spraying with water or other vapor suppressant solution. If VOC emissions exceed 1,000 ppm at three inches from the excavated soil face or stockpile for a sustained 15-second duration, then excavation activities must cease and the excavation or stockpile covered to limit emissions. Finally, if the wind speed exceeds 25 mph on a continual basis, excavation activities must cease until the wind speed decreases.

Rule 1466 requires mitigation measures to address toxic air contaminants in soil for earth-moving operations that result in increased particulate matter 10 micrometers or less in diameter (PM_{10}) emissions. Toxic air contaminants regulated under this Rule include arsenic, asbestos, cadmium, herbicides, hexavalent chromium, lead, mercury, nickel, pesticides, PCBs, and other volatile compounds. If an increase in PM_{10} concentration by 25 micrograms per cubic meter ($\mu g/m^3$) averaged over one hour or more, then excavation activities must cease and dust control measures must be implemented until the increase in PM_{10} concentration is less than 25 $\mu g/m^3$ averaged over 30 minutes.

8.2 LARWQCB

A WDR permit are required for installation of a PRB. The proposed substrates that may be used are included in the general WDR permit, which shortens the permitting process. Baseline monitoring before treatment WDR monitoring and reporting would be conducted as required by the WDR Monitoring and Reporting Program.

8.3 COUNTY OF LOS ANGELES

Permits from the Los Angeles County Department Health Services (Environmental Health – Bureau of Environmental Protection) are be required for the destruction of existing groundwater wells and the installation of groundwater wells. The destruction and installation of required wells will be performed according to DWR Water Well Standards (Bulletin 74-81 [DWR, 1981] and Bulletin 74-90 [DWR, 1991]).

8.4 CITY OF LOS ANGELES

All BOE permits including the "E", "R", and "A" permits will be obtained by LADWP.

The "E" permit is required for excavation on private property adjacent to a public street where lateral support to such street or improvements or property within such street is imperiled by the excavation. The permit includes safety requirements and peak hour restrictions including maintaining a passageway for pedestrians, barriers, lights, and signage and conducting any work in the public street or right of way between 9:00 am to 3:30 pm.

The "R" permit is required to obtain conditional encroachment of the public right-of-way and is a mechanism to allow, in special circumstances, placement of private structures in the public right-of-way due to constraints within private property. The "R" permit may be needed for the installation of the shoring and tie-backs for the installation of the PRB. The permit includes safety requirements including maintaining a passageway for pedestrians, barriers, lights, and signage. No public notification is required, but the District Engineer may require notification for properties adjacent to the construction work.

The "A" permit is required to conduct minor street construction including sidewalk installation and repair, curb and gutter repair, and street repairs for minor excavations in or near the street. Under this permit, the established flowline of the gutter and the existing grade of the sidewalk cannot be altered. The permit includes safety requirements and peak hour restrictions including maintaining a passageway for pedestrians, barriers, lights, and signage and conducting any work in the public street or right of way between 9:00 am to 3:30 pm. No public notification is required, but is encouraged to notify neighbors of the construction work.

The LADBS grading permit is required for the placement of compacted fill soil. Inspections are required by the LADBS Inspection Bureau (LADBS-IB) Grading Division for subgrade observation prior to placing of compacted fill and installations of onsite wastewater treatment systems.

8.5 CEQA

Prior to implementation, the selected remedial actions would require an evaluation under CEQA in which state and local agencies identify the significant environmental impacts of their actions and avoid or mitigate those impacts, if feasible. All CEQA requirements would be handled by LADWP.

9. SCHEDULE

The following summarizes an estimated project schedule from the preparation of this RAP through the finalization of the remedial design only. The implementation of the design will depend on LADWP's schedule to redevelop the Site.

Task Name	Duration	Start	Finish
Remedial Design Investigation	**247 days**	**Mon 3/22/21**	**Thu 3/10/22**
Permitting	40 days	Mon 3/22/21	Fri 5/14/21
Los Angeles County Permits (well/boring)	10 days	Mon 3/22/21	Fri 4/2/21
City of Los Angeles Permits (BOE, DOT, BSS)	40 days	Mon 3/22/21	Fri 5/14/21
Field Implementation	65 days	Mon 4/5/21	Tue 7/6/21
Vertical Profile Soil Boring/Well Installations	12 days	Mon 4/5/21	Tue 4/20/21
Laboratory Analysis (LADWP)	30 days	Wed 4/21/21	Wed 6/2/21
Hydraulic Assessment	10 days	Wed 4/21/21	Tue 5/4/21
Install Horizontal Extent Monitoring Wells (Hoover St)	20 days	Tue 6/8/21	Tue 7/6/21
Bench Scale Test	132 days	Mon 4/12/21	Fri 10/15/21
Collect Samples	23 days	Mon 4/12/21	Wed 5/12/21
Laboratory Bench Scale Testing	120 days	Wed 4/28/21	Fri 10/15/21
Groundwater Monitoring	227 days	Mon 4/19/21	Thu 3/10/22
1st Qtr Groundwater Sampling	5 days	Mon 4/19/21	Fri 4/23/21
Laboratory Analysis (LADWP)	30 days	Mon 4/26/21	Mon 6/7/21
2nd Round of 1st Qtr Sampling	5 days	Mon 5/24/21	Fri 5/28/21
Laboratory Analysis (LADWP)	30 days	Tue 6/1/21	Tue 7/13/21
2nd Qtr Groundwater Sampling	5 days	Wed 7/21/21	Tue 7/27/21
Laboratory Analysis (LADWP)	30 days	Wed 7/28/21	Wed 9/8/21
3rd Qtr Groundwater Sampling	5 days	Tue 10/19/21	Mon 10/25/21
Laboratory Analysis (LADWP)	30 days	Tue 10/26/21	Wed 12/8/21
4th Qtr Groundwater Sampling	5 days	Fri 1/21/22	Thu 1/27/22
Laboratory Analysis (LADWP)	30 days	Fri 1/28/22	Thu 3/10/22
RAP Addendum	**90 days**	**Wed 7/14/21**	**Wed 11/17/21**
Prepare Draft RAP Addendum	30 days	Wed 7/14/21	Tue 8/24/21
LADWP Review	10 days	Wed 8/25/21	Wed 9/8/21
Revise Draft RAP Addendum	10 days	Thu 9/9/21	Wed 9/22/21
Submit RAP Addendum to LARWQCB	0 days	Wed 9/22/21	Wed 9/22/21
LARWQCB Review	40 days	Thu 9/23/21	Wed 11/17/21
LARWQCB Approval of RAP Addendum	0 days	Wed 11/17/21	Wed 11/17/21
RAP Design and Implementation	**700 days**	**Thu 11/18/21**	**Mon 8/12/24**
Redevelopment Design and Construction	**1144 days**	**Tue 8/13/24**	**Fri 12/29/28**

10. HEALTH AND SAFETY

Prior to the start of the implementation of the RAP, the implementing contractor will prepare a Health and Safety plan to address the potential chemical and physical hazards associated with the work in accordance with all applicable OSHA requirements.

11. REFERENCES

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FIGURES

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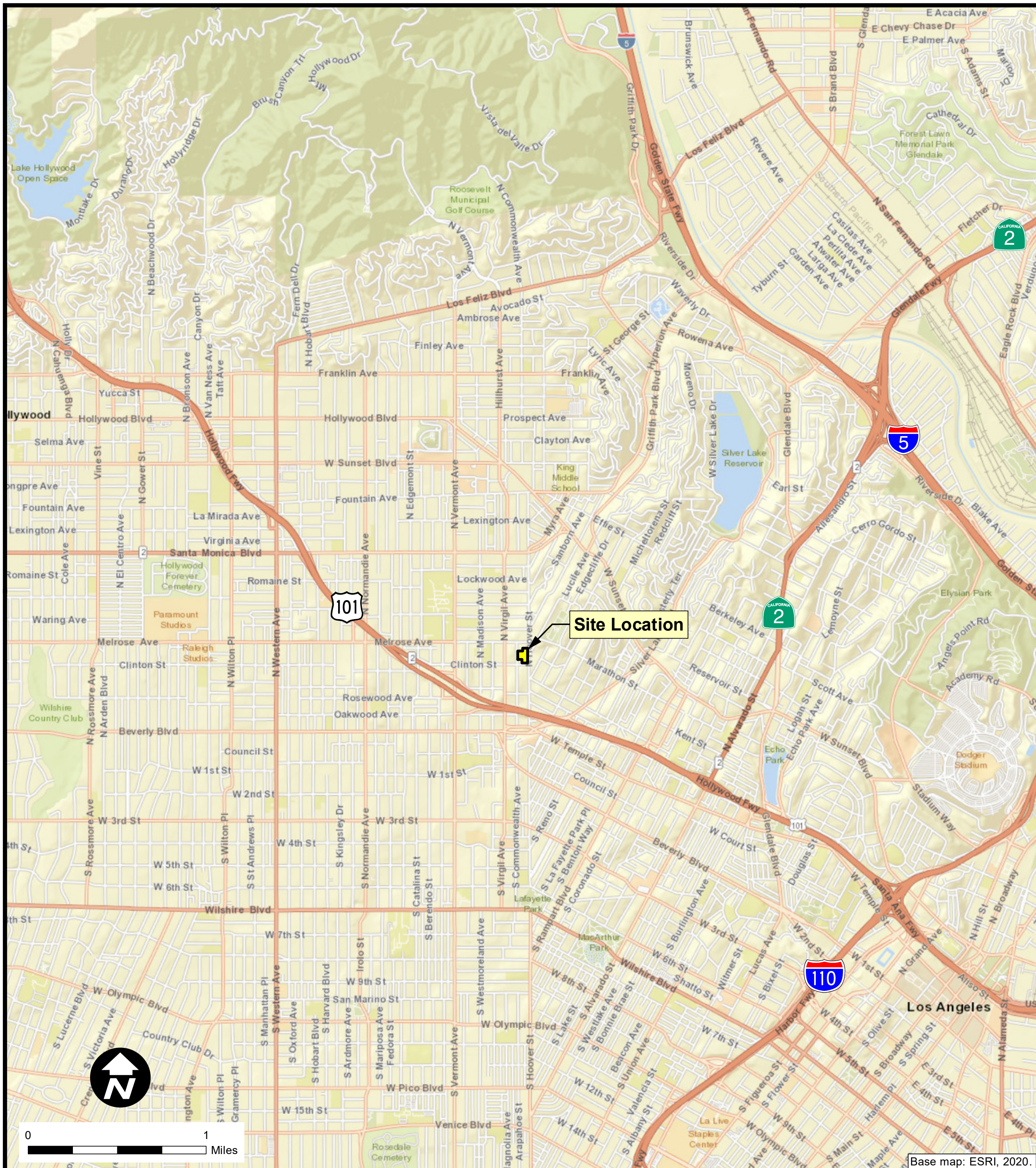

Streetlight Maintenance Headquarters Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 1

Site Location

TETRA TECH

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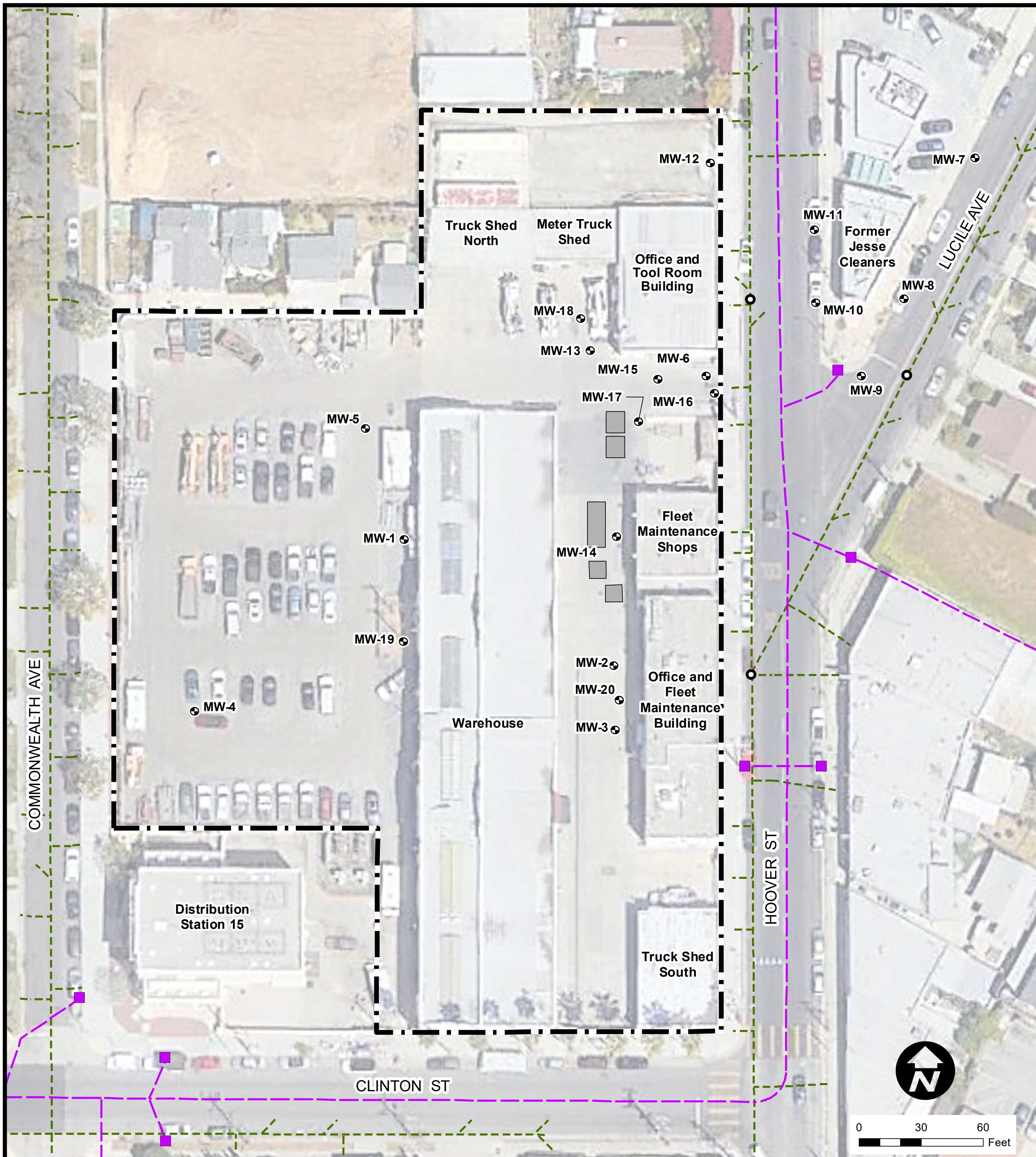

Groundwater Monitoring Well

Manhole

Catch Basin

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 2

Site Plan

TETRA TECH

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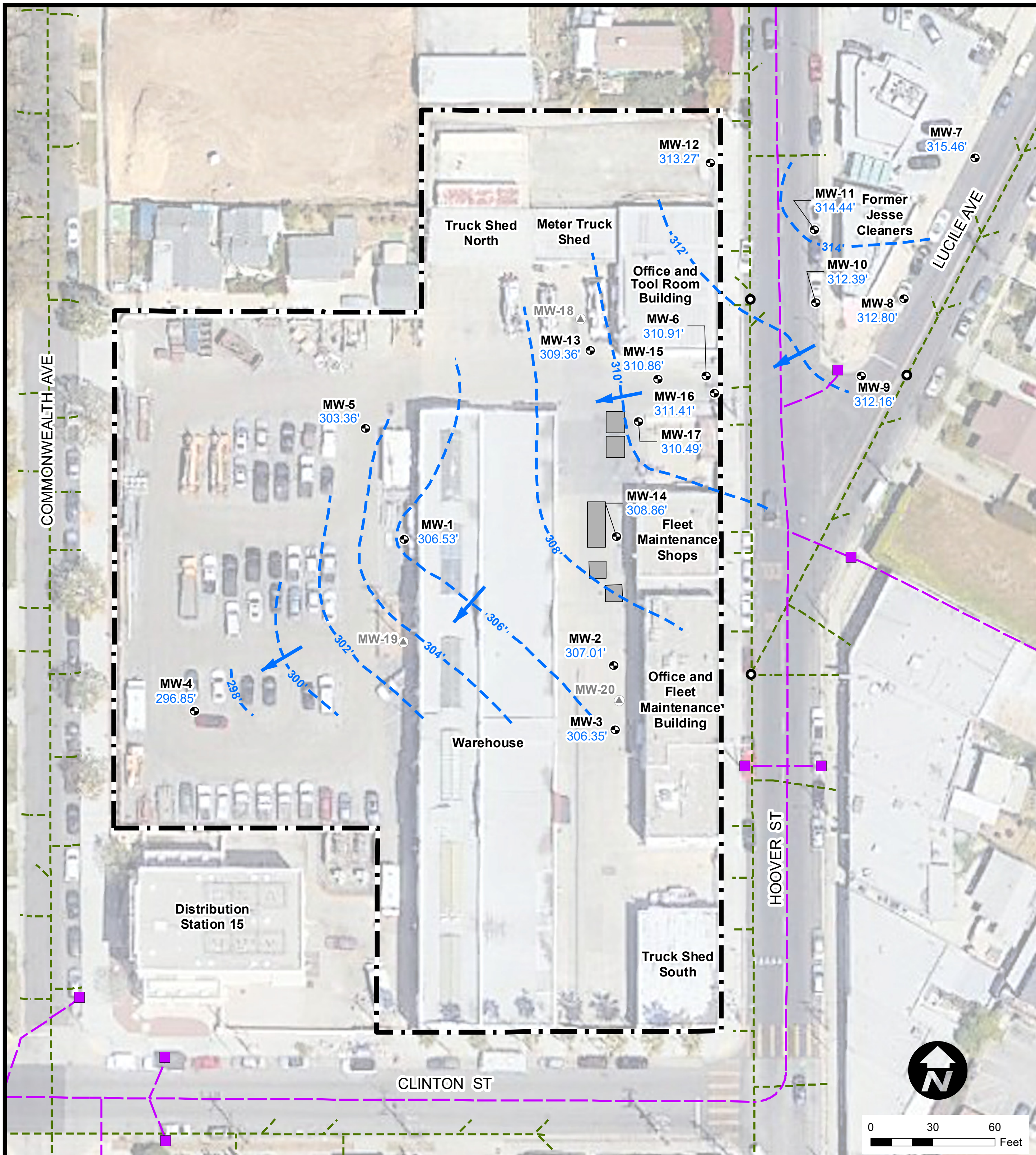

Monitoring Well (Shallow) with Groundwater Elevation (ft msl)	Stormdrain
Monitoring Well (Deep)	Sewer
Manhole	Former Underground Storage Tank (UST)
Catch Basin	Site Boundary
Groundwater Elevation Contour (ft msl) (dashed where inferred)	
Approximate Groundwater Flow Direction	

Notes:
ft msl - feet above mean sea level
Monitoring well MW-7 was not used for contouring.
Groundwater elevations and contours from Kleinfelder, August 2020

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 3
Shallow Groundwater Elevations (August 2020)

TETRA TECH

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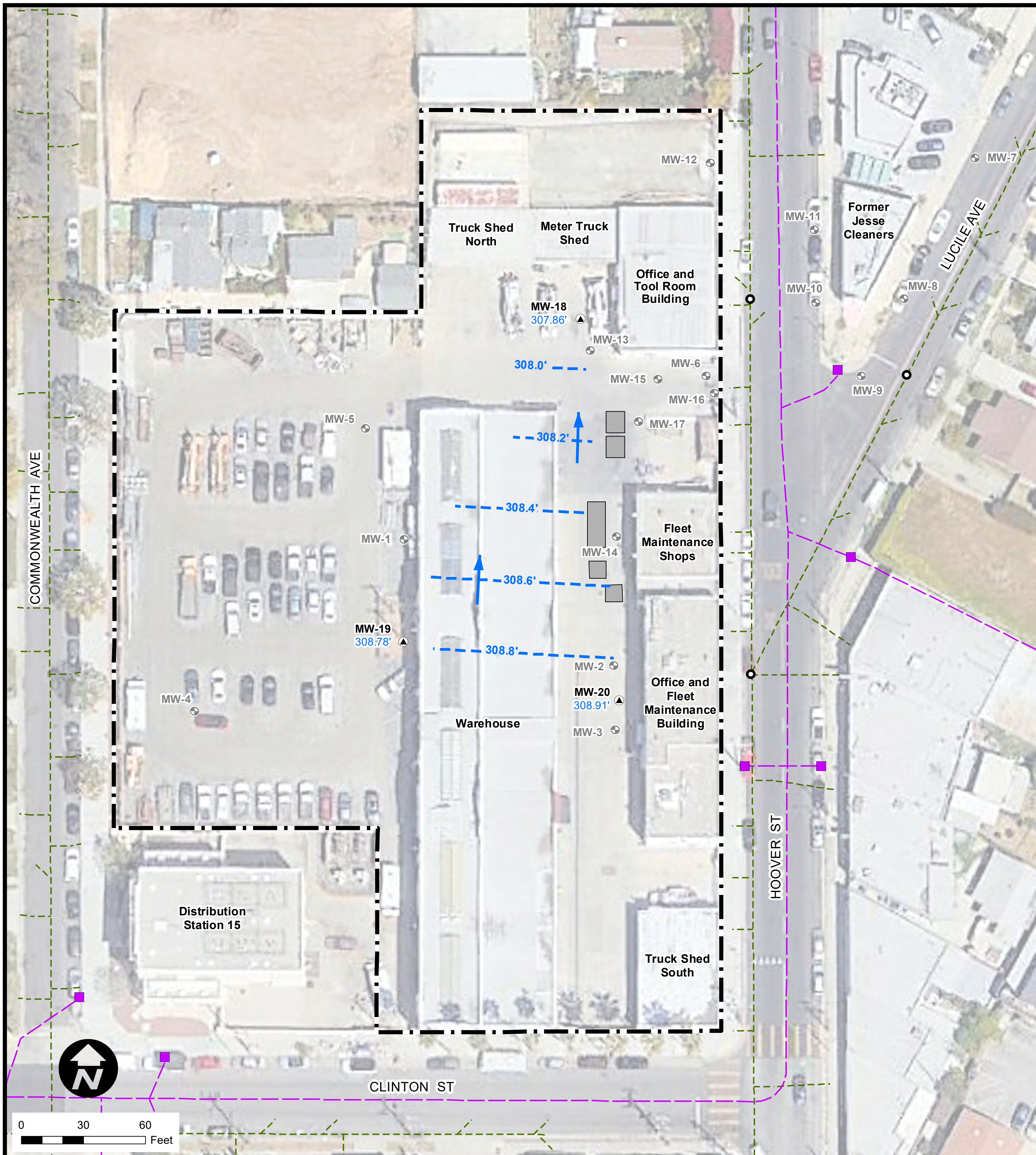

Monitoring Well (Shallow)

Monitoring Well (Deep) with Groundwater Elevation (ft msl)

Manhole

Catch Basin

Groundwater Elevation Contour (ft msl) (dashed where inferred)

Approximate Groundwater Flow Direction

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

Notes:
ft msl - feet above mean sea level
Monitoring well MW-7 was not used for contouring.
Groundwater elevations and contours from Kleinfelder, August 2020

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 4

Deep Groundwater Elevations (August 2020)

TETRA TECH

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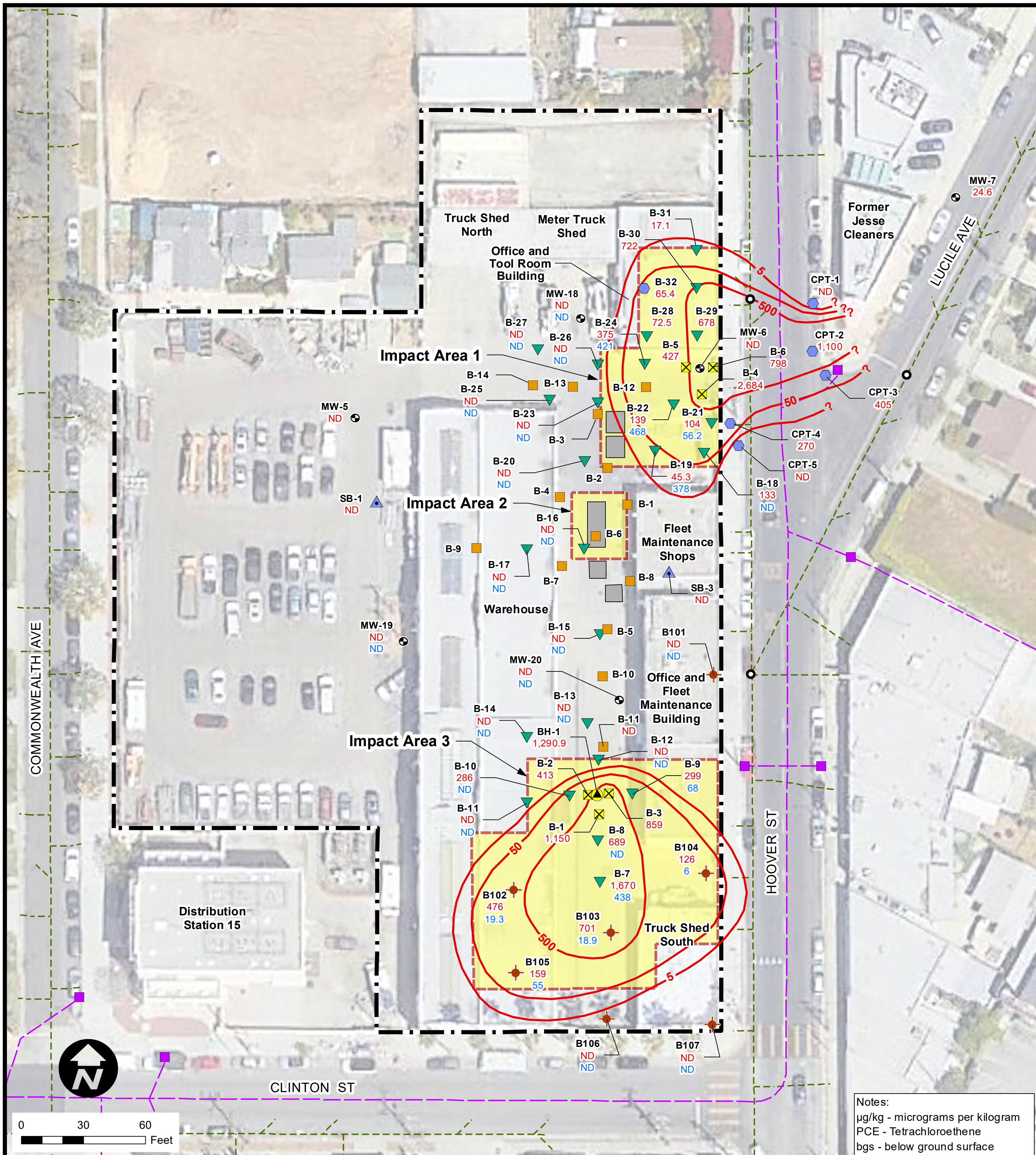

PCE Sample Location with Concentration
1-10 feet bgs (µg/kg), 15-20 feet bgs (µg/kg)

- Earth Tech (1991)
- URS (2004)
- LADWP (2000)
- URS (2005)
- Parsons (2001)
- Tetra Tech (2008)
- Parsons (2003)
- Well
- Manhole
- Catch Basin
- PCE in Soil Isocontour (µg/kg)
- Stormdrain
- Sewer
- Impact Area
- Former Underground Storage Tank (UST)
- Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 5

Extent of PCE in Soil

TETRA TECH

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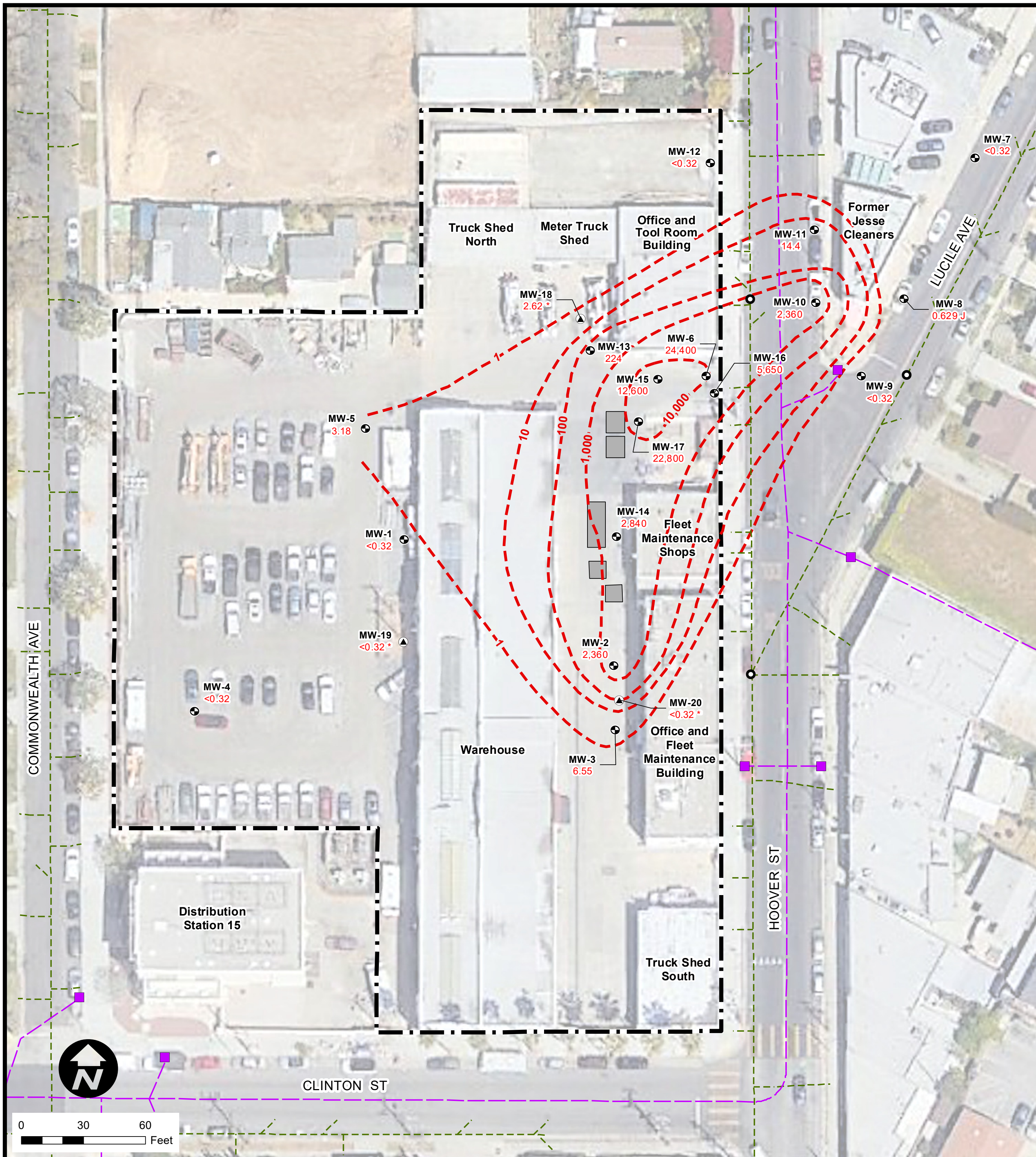

Monitoring Well (Shallow) with PCE Concentration (µg/L)

Monitoring Well (Deep) with PCE Concentration (µg/L)

Manhole

Catch Basin

PCE in Groundwater Isocontour (µg/L) (dashed where inferred)

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

Notes:
µg/L - micrograms per liter
PCE - Tetrachloroethene
* - Deep well not included in contouring
PCE isocontours and concentrations from Kleindfelder, August 2020.

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 6

Extent of PCE in Groundwater

TETRA TECH

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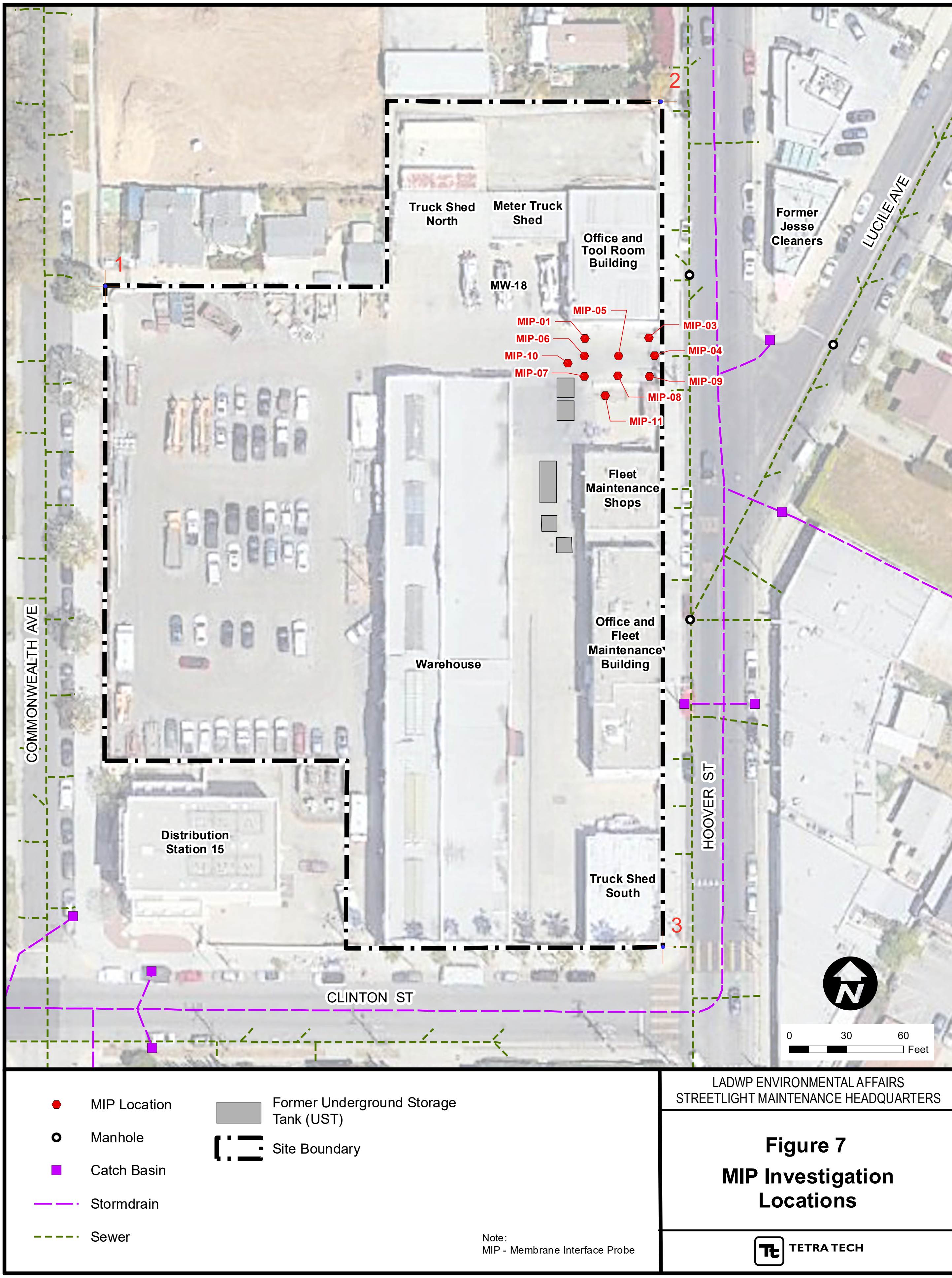

Note:
MIP - Membrane Interface Probe

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 7

MIP Investigation Locations

TETRA TECH

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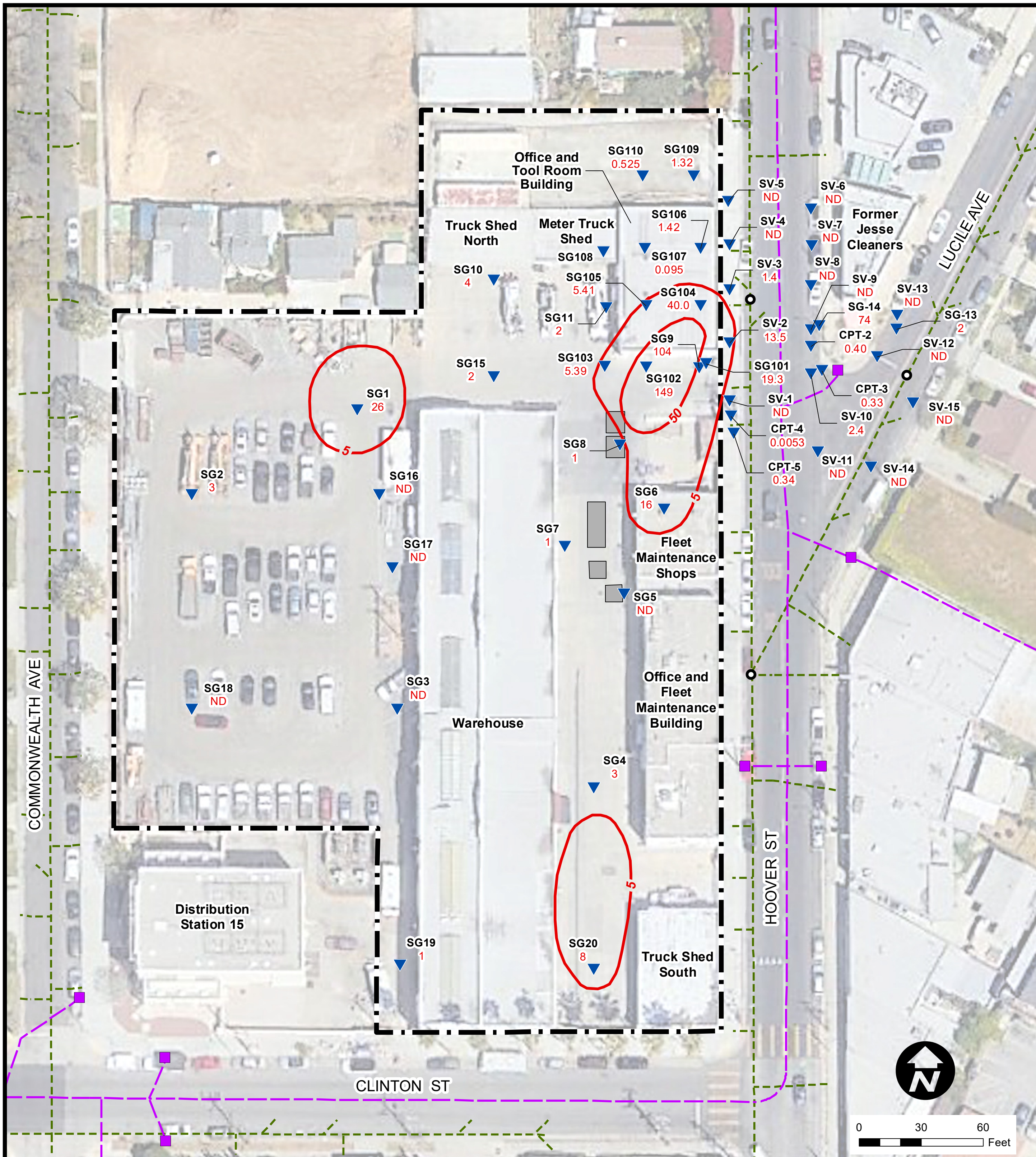


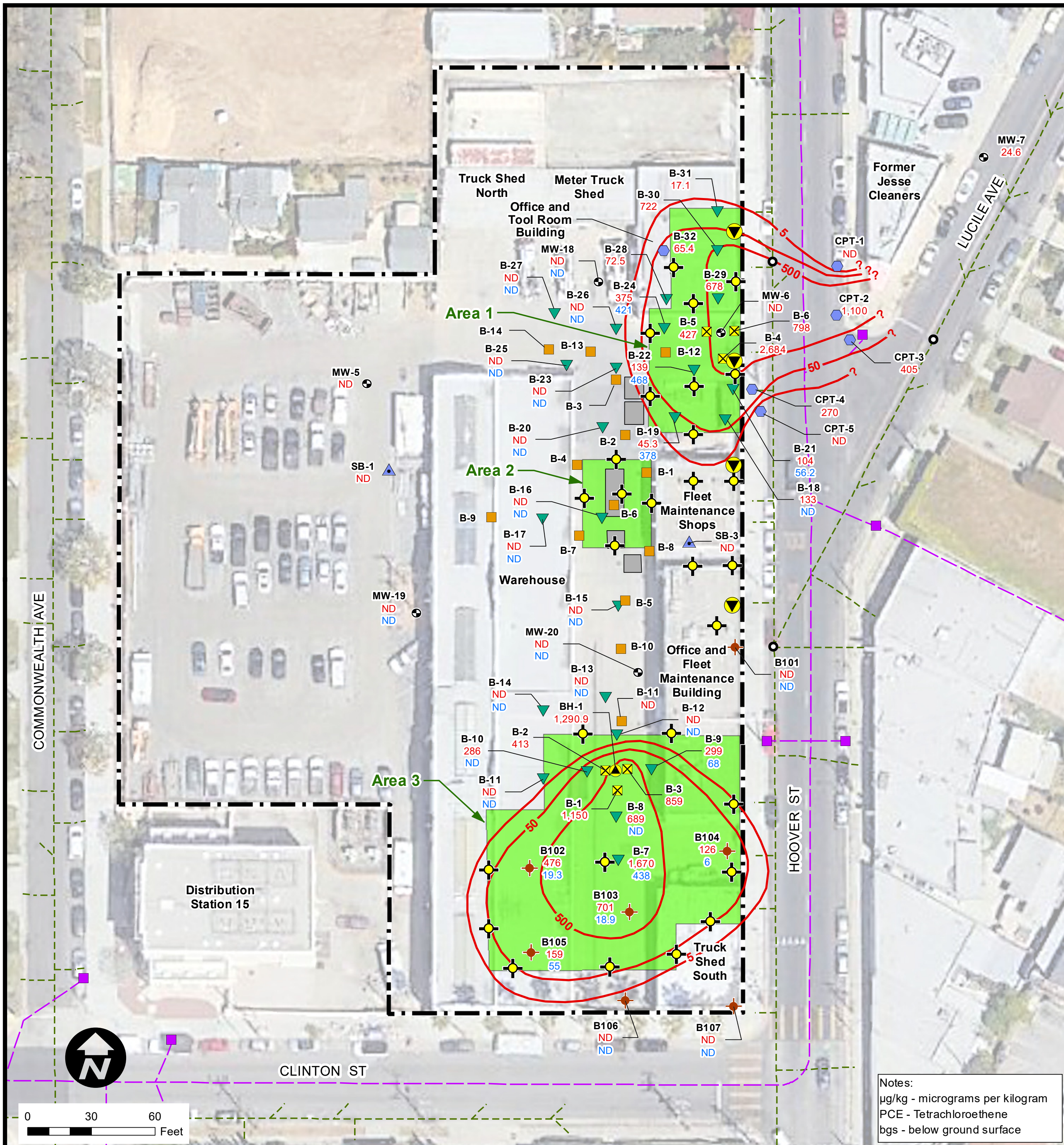
▼	PCE Soil Gas Sampling Location with concentration in µg/L
○	Manhole
■	Catch Basin
～	PCE Isoconcentration Contour
— —	Stormdrain
- - -	Sewer
▭	Former Underground Storage Tank (UST)
▭	Site Boundary

Note:
MIP - Membrane Interface Probe
µg/L - micrograms per liter

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 8
PCE Concentrations in Soil Gas

TETRA TECH



Manhole
Catch Basin
Proposed Extraction Well
PCE in Soil Isocontour (1-10 feet bgs) (µg/kg)
Stormdrain
Sewer
Contaminated Soil Excavation Area (depth to 20-ft bgs)

Former Underground Storage Tank (UST)
Site Boundary

PCE Sample Location with Concentration
1-10 feet bgs (µg/kg), 15-20 feet bgs (µg/kg)

Earth Tech (1991)
LADWP (2000)
Parsons (2001)
Parsons (2003)
URS (2004)
URS (2005)
Tetra Tech (2008)
Well

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 9

Alternative 2 Excavation and Pump and Treat Areas

TETRA TECH

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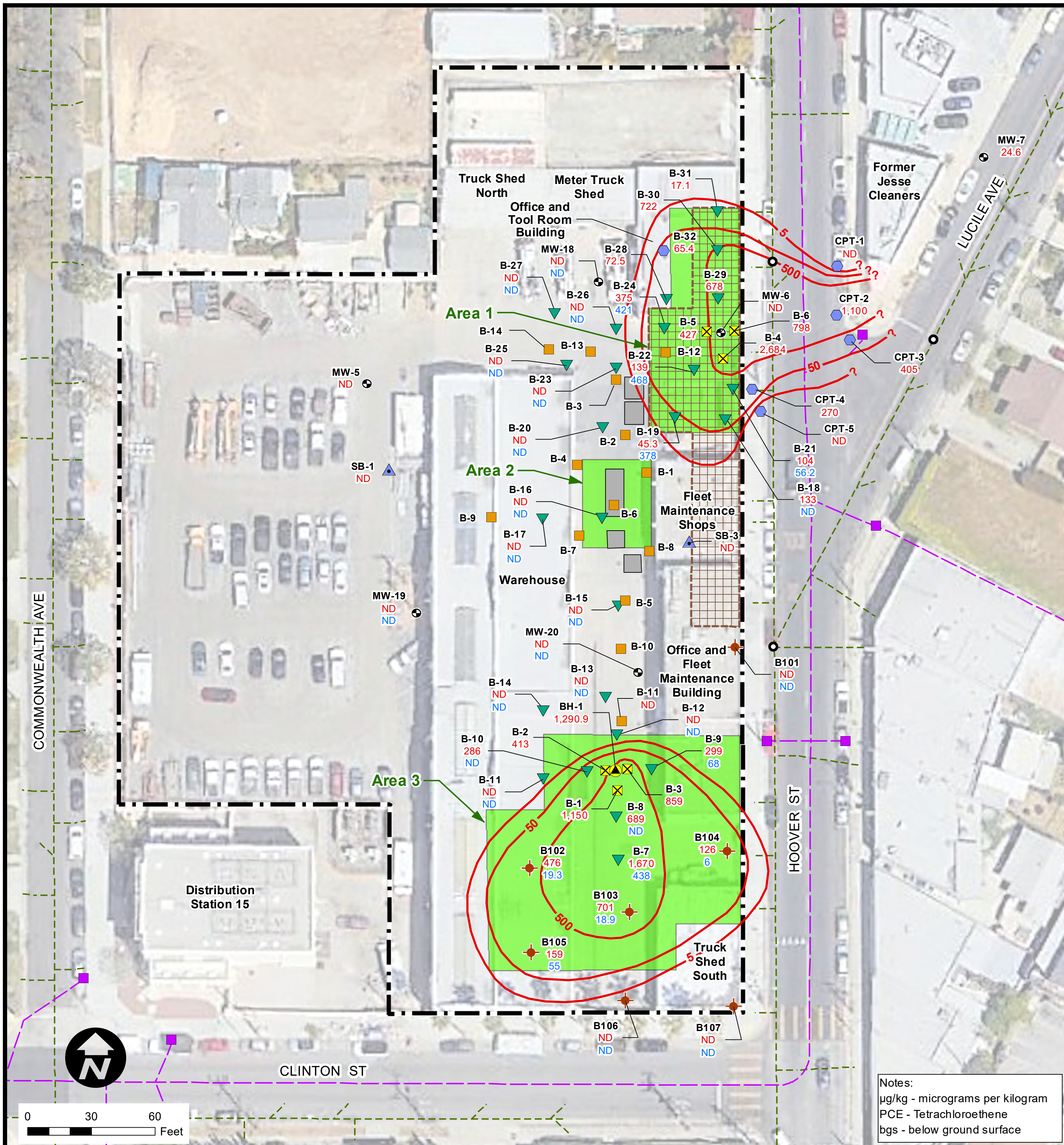

Notes:
µg/kg - micrograms per kilogram
PCE - Tetrachloroethene
bgs - below ground surface

Legend

- Manhole
- Catch Basin
- PCE in Soil Isocontour (1-10 feet bgs) (µg/kg)
- Stormdrain
- Sewer
- Contaminated Soil Excavation Area (depth to 20-ft bgs)
- Excavation Area (depth to 40 to 50-ft bgs)
- Former Underground Storage Tank (UST)
- Site Boundary

PCE Sample Location with Concentration
1-10 feet bgs (µg/kg), 15-20 feet bgs (µg/kg)

- Earth Tech (1991)
- LADWP (2000)
- Parsons (2001)
- Parsons (2003)
- URS (2004)
- URS (2005)
- Tetra Tech (2008)
- Well

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 10

Alternative 3 Contaminated Soil Excavation Areas

TETRA TECH

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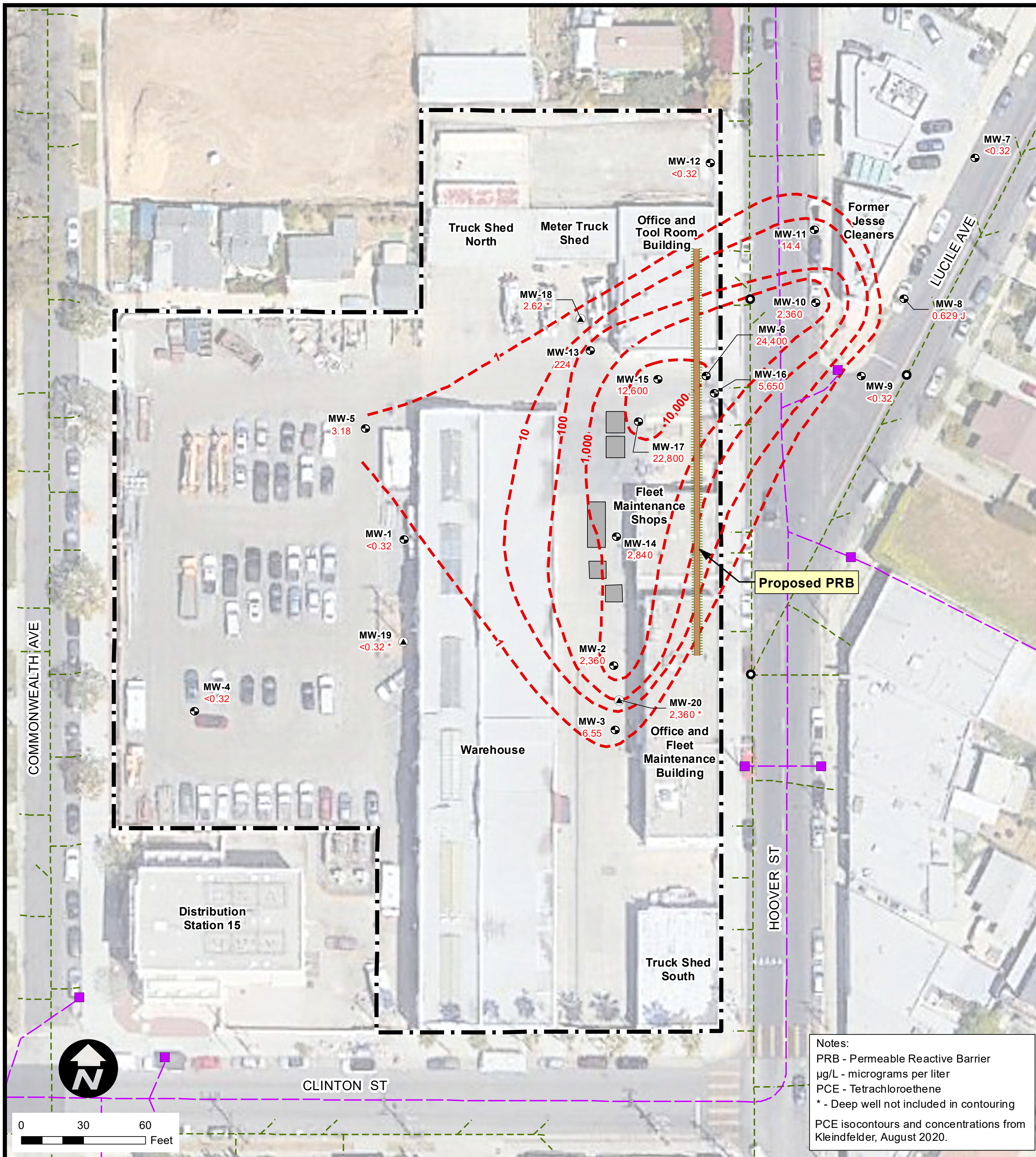

Monitoring Well (Shallow) with PCE Concentration (µg/L)

Monitoring Well (Deep) with PCE Concentration (µg/L)

Manhole

Catch Basin

Permeable Reactive Barrier

PCE in Groundwater Isocontour (µg/L) (dashed where inferred)

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 11

Alternative 3
PRB Location

TETRA TECH

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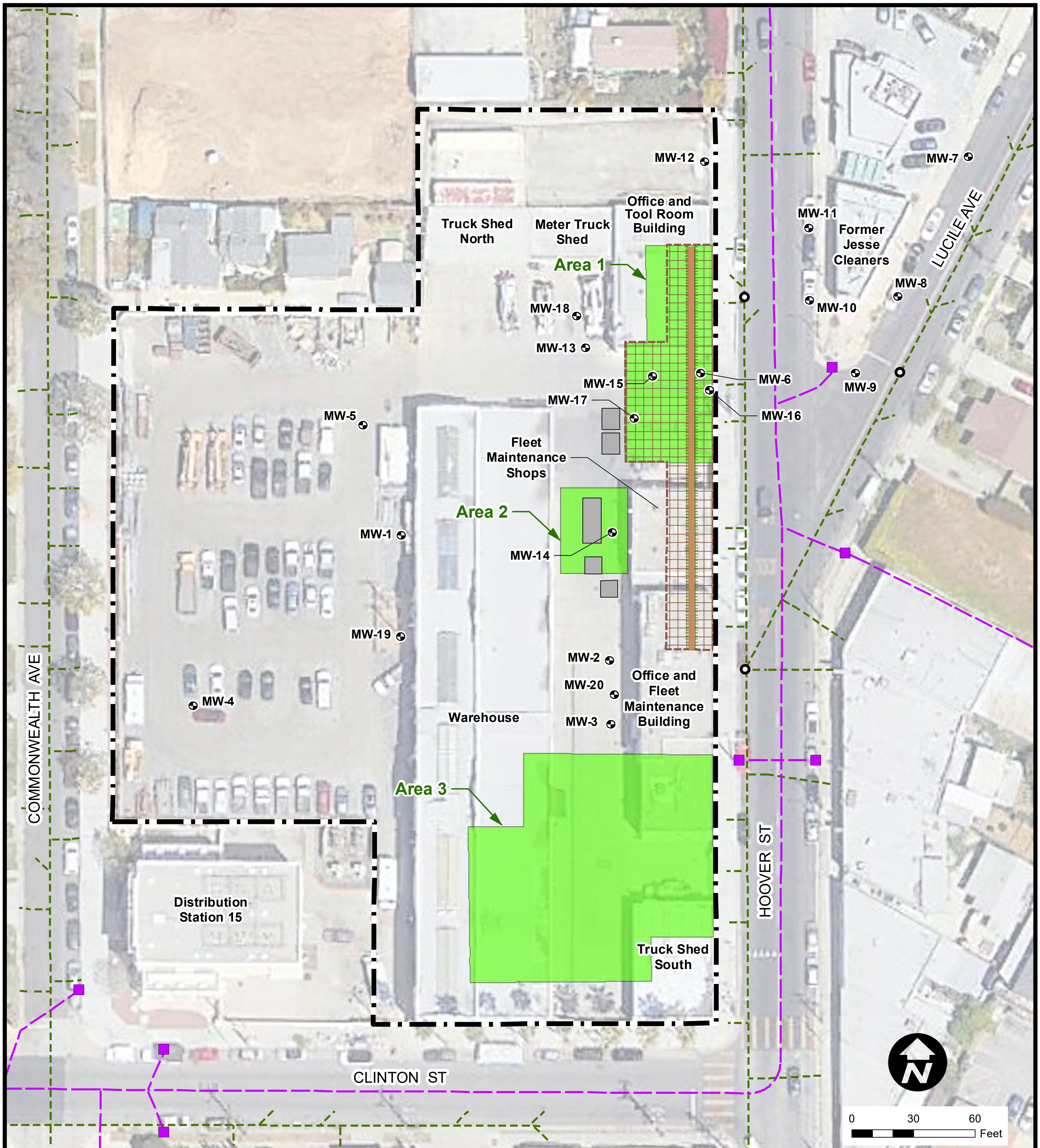

Groundwater Monitoring Well

Manhole

Catch Basin

Permeable Reactive Barrier

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

Excavation Area (depth to 20-ft bgs)

Excavation Area (depth to 40 to 50-ft bgs)

Note:
bgs - below ground surface

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 12

Alternative 3
Excavation and PRB Areas

TETRA TECH

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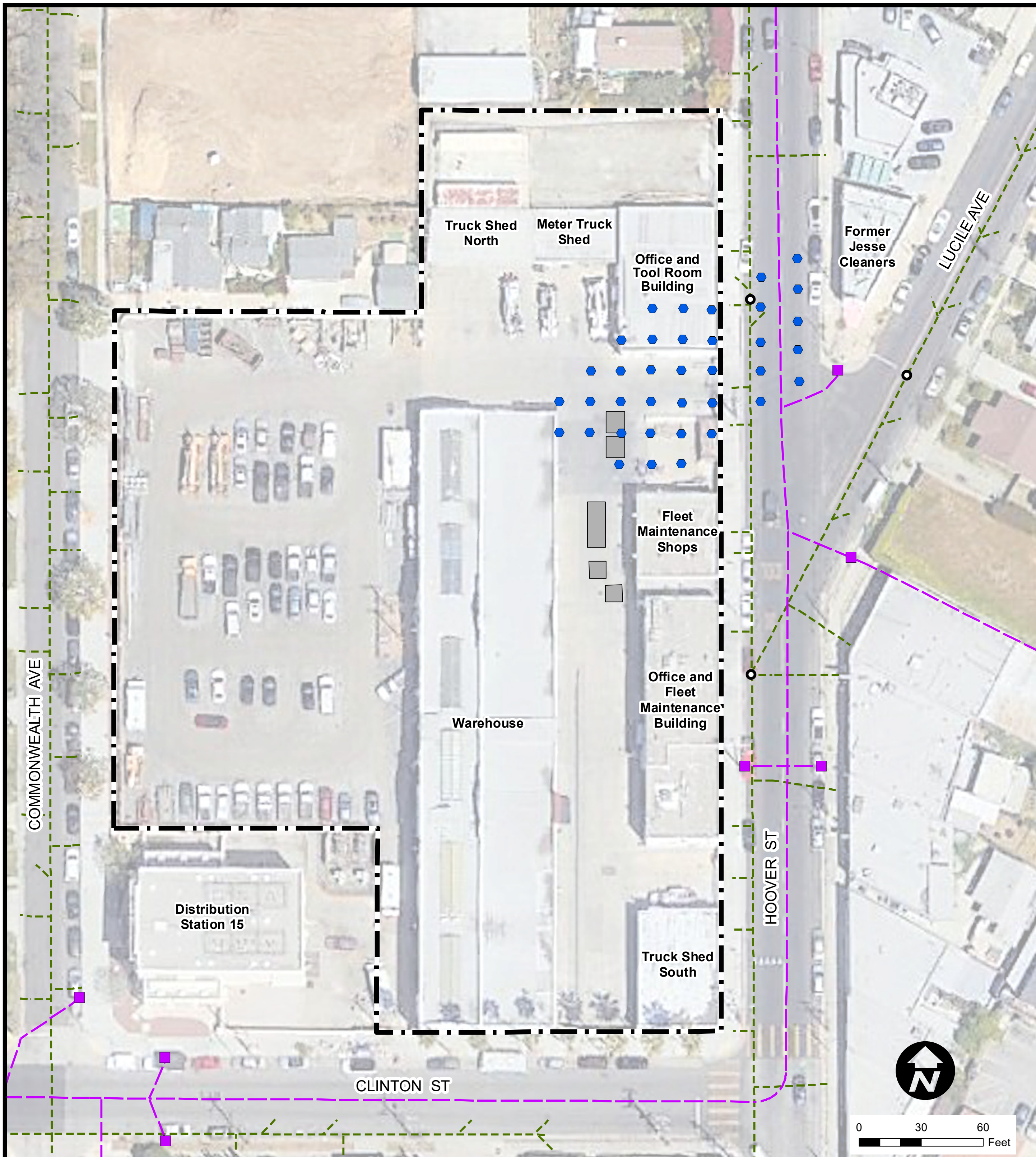

Electrical Resistance Heating (Thermal Desportion) and Soil Vapor Extraction Location

Manhole

Catch Basin

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

Note:
ERH - Electrical Resistance Heating
SVE - Soil Vapor Extraction

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 13

Alternative 4
ERH and SVE Areas

TETRA TECH

TABLES

Table 2-1
Comparison of Maximum Chemical Concentrations in Soil with Screening Criteria
Streetlight Maintenance Headquarters

Compound	Maximum Concen-tration (µg/kg)	Human Health Criteria			Soil-to-GW Criteria	
		Residential (µg/kg)	Commercial/ Industrial (µg/kg)	Source	RSL (µg/kg)	Source
Benzene	**602**	330	1,400	DTSC-SL	2.6	MCL
n-Butylbenzene	6,160	2,400,000	18,000,000	DTSC-SL	3,200	Risk
sec-Butylbenzene	1,810	2,200,000	12,000,000	DTSC-SL	5,900	Risk
Ethylbenzene	3,500	5,800	25,000	RSL	780.0	MCL
Isopropylbenzene	4,230	1,900,000	9,900,000	RSL	740	Risk
p-Isopropyltoluene	285	--	--	--	--	--
Naphthalene	***8,090***	2,000	6,500	DTSC-SL	0.38	Risk
n-Propylbenzene	**16,500**	3,800	24,000	RSL	1,200	Risk
Tetrachloroethene	***2,800***	590	2,700	DTSC-SL	2.3	MCL
Trichloroethene	54.2	940	6,000	RSL	1.8	MCL
Toluene	1,200	1,100,000	5,300,000	DTSC-SL	690	MCL
1,2,4-Trimethylbenzene	39.8	300,000	1,800,000	RSL	81	Risk
1,3,5-Trimethylbenzene	193	270,000	1,500,000	RSL	87	Risk
m,p-Xylenes	8,800	550,000	2,400,000	RSL	9,900	MCL

Notes:
µg/kg: micrograms per kilogram
-- indicates value not available.
Bold indicates concentration exceeding residential screening criteria.
Bold italics indicates concentration exceeding residential and commercial/industrial screening criteria.
Shading indicates concentration exceeding soil-to-groundwater screening criteria.
DTSC-SL: DTSC HHRA Note 3 screening level for soil.
RSL: USEPA Regional Screening Level for soil.
MCL: USEPA MCL-based soil-to-groundwater RSL.
Risk: USEPA risk-based soil-to-groundwater RSL.

Table 2-2
Comparison of Maximum Chemical Concentrations in Groundwater with Screening Criteria
Streetlight Maintenance Headquarters

Compound	Maximum Detected Concentration (µg/L)				Screening Level (µg/L)	Source
	3rd Quarter 2020	4th Quarter 2020	1st Quarter 2020	3rd Quarter 2020		
Acetone	1.74	73.6	81	<10.1	14,000	RSL
Benzene	**113**	**573**	**305**	**177**	1	MCL
2-Butanone	<0.31	48.7	58.7	<0.18	5,600	RSL
Carbon disulfide	<0.35	0.357	0.326	0.347	160	NL
Chlorobenzene	**101**	**93.2**	**103**	**104**	70	MCL
Chloroform	1.24	0.495	0.818	0.594	80	MCL
1,1-Dichloroethene	**125**	**91.7**	**112**	**110**	6	MCL
cis-1,2-Dichloroethene	**454**	**387**	**124**	**296**	6	MCL
trans-1,2-Dichloroethene	**378**	**330**	**92.5**	**144**	10	MCL
Ethylbenzene	<0.11	24.4	202	86.6	300	MCL
Isopropylbenzene	<0.16	11.4	72.5	22.1	770	NL
Naphthalene	<0.09	<0.09	**618**	**33**	17	NL
n-Propylbenzene	<0.14	<0.14	118	48	260	NL
Tetrachloroethene	**41,200**	**30,000**	**31,400**	**24,700**	5	MCL
Toluene	107	89	95.3	103	150	MCL
Trichloroethene	**1,240**	**1,260**	**237**	**214**	5	MCL
1,2,4-Trimethylbenzene	<0.16	<0.16	9.89	6.22	330	NL
1,3,5-Trimethylbenzene	<0.17	<0.17	5.82	<0.084	330	NL
Vinyl chloride	<0.18	<0.18	<0.148	**39.6**	0.5	MCL
Total Xylenes	<0.27	<0.27	15.8	20.3	1,750	MCL

Notes:
µg/L: micrograms per liter
--: Screening level not available.
Bold indicates concentration exceeding groundwater screening criteria.
MCL: California Maximum Contaminant Level for drinking water.
NL: California Notification level for drinking water.
RSL: USEPA Regional Screening Level for tapwater

Table 3-1
Potential Chemical-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Federal ARARs and TBCs				
Safe Drinking Water Act (42 USC §300 et seq.)				
National Primary Drinking Water Standards (MCLs)	40 CFR §141.61 – 141.62	Enforceable, chemical-specific drinking water standards	Relevant and appropriate	Not applicable because they are applied at the tap for drinking water supply systems; relevant and appropriate for groundwater that is a potential drinking water supply source.
Maximum Contaminant Level Goals (MCLGs)	40 CFR §141.50 – 141.51	Chemical-specific drinking water criteria pertaining to known or anticipated health effects	To be considered	To be considered for groundwater that may be a potential source of drinking water, and that has multiple chemicals of concern or multiple exposure pathways. Non-zero MCLGs are non-enforceable, and MCLGs that are equal to zero are not considered ARARs or TBCs.
National Secondary Drinking Water Standards (Secondary MCLs)	40 CFR §143.3	Chemical-specific standards for consumer acceptance of drinking water	To be considered	Secondary MCLs are based on aesthetic criteria, and are therefore not risk-based.
USEPA Superfund Guidance				
USEPA Region 9 Regional Screening Levels (RSLs)	USEPA Region 9	RSLs include numeric human health-based criteria for soil and tap water. The RSLs assume either residential or commercial/industrial worker receptors.	To be considered	RSLs are advisory only.
USEPA Health Advisories	USEPA	Health advisories are non-enforceable human health-based criteria for unregulated chemicals.	To be considered	Health advisories are non-enforceable guidance values.
Toxic Substances Control Act (15 USC §2601 et seq)				
Regulations pertaining to PCB-contaminated materials	40 C.F.R. §761.61(a)(4), (b), and ©	Regulates storage and disposal of materials contaminated with PCBs at concentrations greater than 50 mg/kg.	Potentially applicable	Requirements are applicable if PCB concentrations greater than 50 ppm are discovered during remedial actions.
State ARARs and TBCs				
California Safe Drinking Water Act (HSC §116270 et seq.)				
California Primary Drinking Water Standards (California MCLs)	22 CCR §64421 - 64444	Enforceable, chemical-specific drinking water standards. California MCLs that are more stringent than federal MCLs, or which apply to chemicals not addressed by federal MCLs, are considered to be potential ARARs.	Relevant and appropriate	Applicable at the tap for drinking water supply systems; relevant and appropriate for groundwater that has the potential to be used as drinking water.
California Secondary Drinking Water Standards (California Secondary MCLs)	22 CCR §64449	Chemical-specific standards for consumer acceptance of drinking water. Secondary MCLs are based on aesthetic criteria, and are therefore not risk-based.	To be considered	Secondary MCLs are based on aesthetic criteria, and are therefore not risk-based.
California Public Health Goals (PHGs)	HSC §116365	PHGs are drinking water contaminant levels developed by the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA), which are protective of human health over a lifetime of exposure.	To be considered	PHGs are advisory only; public water systems are not required to comply with PHGs.

Table 3-1
Potential Chemical-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
California Drinking Water Notification Levels (DWNLs) and Response Levels	HSC §116455	DWNLs are health-based advisory levels established by the State Water Resources Control Board (SWRCB), Division of Drinking Water (DDW), for contaminants in drinking water for which MCLs have not been established. Response levels are levels at which the DDW recommends removal of a drinking water source from service. Response levels are chemical-dependent, and range from 10 to 100 times the DWNL. DWNLs are established as precautionary measures for contaminants that may be considered candidates for establishment of MCLs, but have not yet undergone or completed the regulatory standard-setting process prescribed for the development of MCLs.	To be considered	DWNLs and Response Levels are non-regulatory and are not drinking water standards.
Porter-Cologne Water Quality Control Act (CWC §13000 et seq.)				
Intent of legislature with respect to water quality	CWC §13000	Defines the legislative intent to attain the highest water quality reasonable, considering all of the demands that are being made on those waters and the total values involved.	Applicable	Applicable for establishing the need for cleanup; relevant and appropriate for actions which involve reinjection
Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304	SWRCB Resolution 92-49, as amended on April 21, 1994 and October 2, 1996	Requires that dischargers "clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored."	Applicable	Applicable narrative standards for establishing groundwater cleanup levels
Sources of Drinking Water Policy	SWRCB Resolution. 88-63, as revised by SWRCB Resolution No. 2006-0008	Designates all surface water and groundwater in the state as suitable or potentially suitable for municipal or domestic use. Specific exceptions include 1) waters where total dissolved solids exceed 3,000 milligrams per liter (mg/L) or electrical conductivity exceeds 5,000 micro Siemens per centimeter (µS/cm); 2) waters with contamination, unrelated to the specific pollution incident, that cannot reasonably be treated for domestic use; 3) water sources which do not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day (0.14 gallons per minute); 4) waters regulated as a geothermal resource or exempted for the purpose of injection of fluids for production of geothermal energy or hydrocarbons; or 5) waters located in certain treatment systems or a system designed to convey or store agricultural drainage.	Applicable	Applicable narrative criteria for establishing the beneficial uses of surface water and groundwater

Table 3-1
Potential Chemical-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Cal/EPA Brownfields Guidance				
DTSC-Modified Screening Levels (DTSC-SLs)	Human Health Risk Assessment Note 3	HHRA Note Number 3 presents recommended screening levels (derived using DTSC-modified exposure and toxicity factors) for constituents in soil, tap water, and ambient air. RSLs include numeric human health-based criteria for soil and tap water. The RSLs assume either residential or commercial/industrial worker receptors. For certain chemicals, DTSC recommends the use of DTSC-modified screening levels summarized in Human Health Risk Assessment (HHRA) Note 3. If a DTSC-modified screening levels is not available, USEPA RSLs are recommended.	To be considered	DTSL-SLs are advisory only

Acronyms and Abbreviations:

AGR: agricultural supply

ARAR: Applicable or Relevant and Appropriate Requirements

Cal/EPA: California Environmental Protection Agency

CCR: California Code of Regulations

CFR: Code of Federal Regulations

CWC: California Water Code

DDW: SWRCB Division of Drinking Water

DTSC: Department of Toxic Substances Control

DWNLs: California Drinking Water Notification Levels

GWR: groundwater recharge

HSC: California Health and Safety Code

MCL: Maximum Contaminant Level

MCLGs: Maximum Contaminant Level Goals

mg/L: milligrams per liter

µS/cm: micro Siemens per centimeter

OEHHA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment

PHGs: Public Health Goals

RSLs: Regional Screening Levels

SWRCB: State Water Resources Control Board

TBC: To be considered

USEPA: United States Environmental Protection Agency

USC: United States Code

Table 3-2
Potential Action-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Federal ARARs and TBCs				
Clean Water Act (33 USC §1251 et seq.)				
National Pollution Discharge Elimination System (NPDES) Permit for Discharge of Treatment System Effluent	40 CFR §122 et seq.	Criteria for discharge of pollutants to surface water, including NPDES permit requirements	Potentially applicable	Applicable to actions that involve the discharge of treated groundwater to surface waters or a storm drain
NPDES Stormwater Permit	40 CFR §122 et seq;	Criteria for stormwater discharges, including NPDES Stormwater Permit requirements	Potentially applicable	Applicable to actions which involve the disturbance of more than 1 acre of land
National Pretreatment Standards for Discharges to Publicly Owned Treatment Works (POTWs)	40 CFR 403	Substantive requirements are ARARs for discharges of treated ground water to POTWs. Requirements are administered through discharge permits issued by Los Angeles County Public Works Department.	Potentially applicable	Applicable to actions that involve the discharge of treated groundwater to a POTW or industrial sewer
Resource Conservation and Recovery Act (42 USC §6901 et seq.)				
Definition of RCRA hazardous waste	22 CCR §66261 40 CFR §261	Defines RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil or drill cuttings, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous waste generator requirements	22 CCR §66262 40 CFR §262	Standards for generators of hazardous waste, including accumulation, storage, manifesting, recordkeeping, and reporting requirements. Applies to both RCRA and non-RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil or drill cuttings, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous waste transporter requirements	22 CCR §66263 40 CFR §263	Standards for transporters of hazardous waste, including manifesting and recordkeeping requirements. Applies to both RCRA and non-RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil or drill cuttings, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous waste treatment, storage, and disposal requirements	22 CCR §66264 et seq 40 CFR §264 et seq.	Includes standards for disposal of hazardous wastes, including land disposal restrictions, treatment standards, and technology requirements. Applies to both RCRA and non-RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil or drill cuttings, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous Material Transportation Act (49 USC §5101 et seq.)				
Hazardous material transportation requirements	40 CFR §171 et seq.	Standards for transportation of hazardous materials	Potentially applicable	Applicable to actions which involve off-site treatment or disposal of excavated contaminated soil or drill cuttings, extracted groundwater, or treatment residuals.

Table 3-2
Potential Action-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Clean Air Act (42 USC §7400 et seq.)				
National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR §61	Establishes emissions standards for designated hazardous air pollutants and sources, and sets emissions standards for fugitive emissions due to equipment leaks.	Potentially relevant and appropriate	NESHAPs have not been established for specific activities associated with potential actions at the site, but are potentially relevant and appropriate for emissions of designated pollutants. In general, toxic air pollutants are reviewed by SCAQMD as part of its permitting process.
National Ambient Air Quality Standards (NAAQS)	40 CFR §50	Primary and secondary standards for six criteria pollutants	Potentially applicable	The NAAQS for particulates is applicable to actions involving grading.
New Source Review (NSR) / Prevention of Significant Deterioration (PSD)	40 CFR 51	NSR or PSD regulations pertaining to remedial actions are applicable only if action results in a non-fugitive major emission source. State regulations under CAA are implemented through SCAQMD.	Potentially applicable	Applicable to actions that involve the treatment of groundwater.
New Source Performance Standards (NSPS)	40 CFR §60	Establishes emissions standards for new stationary sources of air pollutants.	Potentially applicable	The NSPS are applicable to actions that involve the treatment of groundwater.
Air Pollution Prevention Control	42 USC §7401 - 7642	State implementation plans contain specific regulations that govern the emission rates for "major sources" and non-attainment areas.	Potentially applicable	Cleanup of the Site is not likely to result in classification as a "major source" under the CAA unless emissions equal to or exceed 100 tons per year of pollutants, at which time, the Site is designated non-attainment.
Occupational Safety and Health Act (29 USC §651 et seq.)				
Worker safety requirements	29 CFR Part 1910	Establishes Occupational Safety and Health Administration (OSHA) standards for worker safety. Includes 29 CFR §1910.120 (Hazardous Waste Operations and Emergency Response) regulations.	Applicable	Relevant portions of OSHA regulations, including 29 CFR §1910.120, are applicable to all actions at the site.
Emergency Planning and Community Right to Know Act of 1986				
Community Notification	40 CFR 355, 370, and 372	Establishes potential notification requirements for hazardous waste and chemical storage activities related to implementation of certain remedial actions. Most of these requirements are administered by local emergency response organizations under the state business plan requirements specified in California H&SC, Section 25503, and the remaining requirements are administered by the USEPA.	Potentially applicable	Applicable for hazardous waste and chemical storage activities related to implementation of certain remedial actions.
State ARARs and TBCs				
Porter-Cologne Water Quality Control Act (CWC §13000 et seq.)				
Laboratory certification requirements	CWC §13176	Analysis of materials required under CWC §13000 et seq. must be performed in a State certified laboratory.	Potentially applicable	Applicable to actions regulated by the SWRCB or RWQCB; relevant and appropriate for actions that include analysis of soil or groundwater samples

Table 3-2
Potential Action-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Statement of Policy With Respect to Maintaining High Quality of Waters in California ("Anti-Degradation Policy")	SWRCB Resolution 68-16	Establishes requirements for activities involving the discharge of contamination directly into surface water and groundwater. Specifically, "Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."	Potentially applicable	Applicable to actions which include the injection or discharge of treated effluent to groundwater or surface water, or injection of amendments into the subsurface. Applicable to migration of contaminants from soil to groundwater or contaminated groundwater into non-contaminated groundwater.
Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304	SWRCB Resolution 92-49, as amended on April 21, 1994, and October 2, 1996	Establishes criteria for "containment zones," which are specific portions of a water bearing unit where it is unreasonable to remediate to the level that achieves water quality objectives. Dischargers are required to take all actions necessary to prevent the migration of pollutants beyond the boundaries of the containment zone in concentrations which exceed water quality objectives, and must verify containment with an approved monitoring program and must provide reasonable mitigation measures to compensate for any significant adverse environmental impacts attributable to the discharge.	Potentially relevant and appropriate	Relevant and appropriate for actions that include groundwater containment.
NPDES, General Permit for Discharges of Storm Water Associated with Construction Activity	Water Quality Order No. 99-08-DWQ	Requires containment or control of storm water in areas where construction and earthmoving activities result in the disturbance of at least one acre.	Potentially applicable	Applicable to actions that involve clearing, grading, excavation, and stockpiling of soil or other materials
Groundwater Monitoring	23 CCR 2550.0-2550.9	Provision regarding groundwater monitoring for corrective action; the requirements substantially duplicate the California Hazardous Waste Control Act (22 CCR 66264.90-66264.99).	Potentially applicable	Applicable to actions involving groundwater treatment
Corrective Action	23 CCR 2550.10	Provision regarding corrective action goals, monitoring, and termination of corrective action.	Potentially applicable	Applicable to actions involving groundwater treatment
LARWQCB Revised General Waste Discharge Requirements for Groundwater Remediation and Petroleum Hydrocarbon Fuel, Volatile Organic Compound, and/or Hexavalent Chromium Impacted Sites	LARWQCB Order No. R4-2007-0019 (File No. 01-116)	This general WDR provides guidance relative to groundwater remediation at petroleum hydrocarbon fuel and/or volatile organic compound impacted sites. The WDR is for in-situ groundwater remediation/cleanup or the extraction of polluted groundwater with above ground treatment and includes use and application of chemical, biological, and physical treatment processes, such as chemical oxidation, chemical reduction, oxygen enhanced process, nutrient or chemical addition for enhanced biodegradation, or groundwater pump and treat technology with the return of treated groundwater to the same aquifer zone in some cases.	Applicable	This WDR may apply since in-situ processes are being considered.

Table 3-2
Potential Action-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
LARWQCB Interim Site Assessment and Cleanup Guidance	LARWQCB Interim Site Assessment and Cleanup Guidebook for Los Angeles and Ventura Counties (May 1996)	The guidebook provides LARWQCB's overall approach to the site assessment and cleanup process. It also include decision-making tools for determining when and how a cleanup should be conducted for petroleum and VOC impacted sites. Guidance and recommend ended attenuation factors used for preparing soil cleanup screening levels for VOCs above a drinking water or non-drinking water aquifer, based on contaminant concentrations at various depths, depth to the water, vadose zone lithology between detections and water, and water quality standard are included.	Potentially applicable	Guidance can be used to estimate the concentrations of soil VOCs that can be left at the site.
LARWQCB General Waste Discharge Requirements for Discharge of Non-hazardous Contaminated Soils and Other Wastes in LA River and Santa Clara River Basins	LARWQCB Order No. 91-93 (Adopted July 22, 1991)	This General WDR provides specific guidance to streamline land disposal of non-hazardous soils contaminated by petroleum hydrocarbons, metals, and other special wastes at properly engineered and managed Class II landfill. The conditions under this General WDR include (1) 100,000 cubic yards (CY) or less of contaminated soils/similar wastes, (2) TPH should not exceed and average concentration of 1,000 mg/kg, (3) disposal to be completed in 90 days, (4) adequate characterization of soil contamination, and (5) insignificant impact to the groundwater. LARWQCB has subsequently adopted the 1,000 mg/kg of TPH as a general non-hazardous criterion for soils with unrestricted uses (sometimes a more restricted 100 mg/kg value has been used for soil in contact with water).	Potentially applicable	This WDR may apply if contaminants are present in soil generated during excavation and/or treatment requiring disposal.
Amendment to Waste Discharge Requirements, Amendments to WDR for Disposal and Onsite Use of Non-designated/Non-hazardous Contaminated Soils and Related Wastes at Municipal Solid Waste Landfills	Amendment to Waste Discharge Requirements Order No. R4-2011-0052 (March 3, 2011)	This LARWQCB adopted Order No. R4-2011-0052 to establish requirements for the disposal or on-site use of contaminated soils at municipal solid waste landfills in the Region. The Order requires specific procedures for acceptance, disposal, and on-site use of contaminated soils (includes TPH, VOCs, PCBS, and metals) and expanded stormwater pollution prevention plans to be protective of the quality of the waters of the State.	Applicable	This WDR may apply if contaminants are present in soil generated during excavation and/or treatment requiring disposal.
Approve a Substitute Environmental Document and Adopt a Proposed Quality Control Policy for Low-Threat Underground Storage Ttank Closure	State Water Resources Control Board Resolution No. 2012-0016	This Policy establishes consistent statewide case closure criteria for a subset of low-threat petroleum Underground Storage Tank (UST) sites. The Policy provides direction to responsible parties, their service providers and regulatory agencies. The low-threat UST Policy seeks to increase UST clean up process efficiency.	To be considered	The site has USTs which that have not been closed.
Hazardous Waste Control Act (HSC §25100 et seq)				
Definition of non-RCRA (California) hazardous waste	22 CCR §66261.101	Defines non-RCRA (California) hazardous wastes. Generator, transporter, and treatment, storage, and disposal requirements are discussed (above in this table) under RCRA.	Potentially applicable	Potentially applicable to excavated contaminated soil or drill cuttings, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.

Table 3-2
Potential Action-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Requirements for land use covenants	22 CFR §6739.1	DTSC requirements for establishing land use covenants on property where hazardous waste, hazardous material or constituents, or hazardous substances remain on the property	Potentially applicable	Applicable for locations where hazardous waste, hazardous material or constituents, or hazardous substances will remain after remedial action
Land Disposal Restrictions	22 CCR 66268.7 et seq.	Establishes standards for treatment and land disposal of hazardous waste.	Applicable	Requirements are applicable if hazardous materials are generated from soil removal and treatment requiring disposal.
Hazardous Waste Hauler Registration and Requirements for Transporters of Hazardous Waste	22 CCR 66263.10-66263.46	Hazardous waste must be transported by a hauler registered by the state.	Applicable	Requirements are applicable if hazardous materials are generated from soil removal and treatment requiring disposal.
South Coast Air Quality Management District Regulations				
Rule 401 (Visible Emissions)	SCAQMD Regulation IV (Prohibitions)	Limits visible emissions from any single source	Potentially applicable	Applicable to actions involving soil surface disturbance
Rule 402 (Nuisance)	SCAQMD Regulation IV (Prohibitions)	Prohibits discharge of any material, including odorous compounds, that causes injury, detriment, nuisance, or annoyance to the public; endangers human health, comfort, repose, or safety; or has a natural tendency to cause injury or damage to business or property.	Potentially applicable	Applicable to actions involving soil surface disturbance
Rule 403 (Fugitive Dust)	SCAQMD Regulation IV (Prohibitions)	Limits site activities or man-made conditions so that the concentrations of fugitive dust beyond the property line shall not be visible and the downwind particulate concentration shall not be more than 50 mg/m3 above upwind concentrations.	Potentially applicable	Applicable to actions involving soil surface disturbance
Rule 404 (Particulate Matter)	SCAQMD Regulation IV (Prohibitions)	Limits particulate matter for volumetric gas flow.	Potentially applicable	Potentially applicable to actions involving certain onsite groundwater treatment
Rule 466 (Pumps and Compressors)	SCAQMD Regulation IV (Prohibitions)	Limits liquid and gas leakage from pumps and compressors handling reactive organic compounds.	Potentially applicable	Potentially applicable to actions involving certain onsite groundwater treatment
Rule 466.1 (Valves and Flanges)	SCAQMD Regulation IV (Prohibitions)	Limits liquid and gas leakage from valves and flanges.	Potentially applicable	Potentially applicable to actions involving certain onsite groundwater treatment
Rule 467 (Pressure Relief Devices)	SCAQMD Regulation IV (Prohibitions)	Requires pressure relief valves to be vented to a vapor recovery or disposal system, or subject to inspection and maintenance requirements.	Potentially applicable	Potentially applicable to actions involving certain onsite groundwater treatment
Rule 1166 (Volatile Organic Compound Emissions from Decontamination of Soil)	SCAQMD Regulation XI (Source Specific Standards)	Requires control of VOC emissions from VOC-contaminated soils.	Potentially applicable	Applicable to actions involving grading in areas with VOC contamination
Rule 1401 (New Source Review of Toxic Air Contaminants)	SCAQMD Regulation XIV (Toxics and other Non-Criteria Pollutants)	Establishes risk standards for permitting stationary sources.	Potentially applicable	Potentially applicable to actions involving certain onsite groundwater treatment

Table 3-2
Potential Action-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
California Occupational Safety and Health Act (CLC §6300 et seq.)				
Worker safety requirements	8 CCR Division 1, Chapter 4	Establishes Cal/OSHA standards for worker safety in California.	Applicable	Relevant portions of Cal/OSHA regulations are applicable to all actions at the site.
California Department of Industrial Relations, Division of Occupational Safety and Health (DOSH), Permit Application for Buildings/Structures, Scaffolding/Falsework, Demolition, Trenches/Excavations	Labor Code, Section 6500, 6501, and 6502	Certain activities, which by their nature involve substantial risk of injury, may not be performed without a permit issued by DOSH. A permit will not be issued until evidence has been demonstrated that the place of employment will be safe and healthful.	Applicable	Permit required for trenches/excavations.
California Health and Safety Code, Miscellaneous Health and Safety Provisions (HSC §24000 et seq. and 22 CCR)				
Institutional Controls	HSC §25220 et seq.	Requires notification to the planning and building department of each city, county, or regional council of governments of any recorded land use restriction imposed within the jurisdiction of the local agency	Applicable	Applicable to actions that include institutional controls
Land Use Controls	HSC §25355.5(a)(1)	Establishes a process for an agency to enter into an enforceable agreement with land owners to restrict the use of property.	Applicable	Applicable to actions that include land use controls.
Requirements for Land Use Covenants	22 CCR 67391.1	Land Use covenants imposed appropriate limitations on land use is to be executed and recorded when 1) corrective action, remedial or removal actions, or other response actions are undertaken in accordance with Division 20 of the H&SC and 2) hazardous materials, hazardous wastes or constituents, or hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land.	Applicable	Applicable to actions that include land use controls.
California Civil Code §1457 et seq. (Transfer of Obligations)				
Land Use Controls	California Civil Code §1471	Establishes conditions under which land use controls will apply to successive owners of land.	Potentially applicable	Applicable to actions that include land use controls.
California Well Standards				
California Well Standards	California Department of Water Resources Bulletin 74-91, as supplemented by Bulletin 74-90	Standards for the construction and decommissioning of public water supply wells.	Potentially relevant and appropriate	Relevant and appropriate to actions that involve the installation and/or decommissioning of groundwater monitoring, extraction, or injection wells
City of Los Angeles Bureau of Engineering				
Construction "A" Permit	City of Los Angeles	The Construction "A" permit is to allow minor street construction of sidewalk, bike racks, planter and parklet on a downtown street in the public right-of-way. The public right-of-way generally consists of street easements that contain City streets, lanes, alleys, parkways, and sidewalks. The public right-of-way also includes public easements and unimproved streets. Construction within the public right-of-way is under the jurisdiction of the Department of Public Works, Bureau of Engineering.	Applicable	Applicable to actions that work activities in the public right-of-way.

Table 3-2
Potential Action-Specific ARARs and TBC Criteria
Streetlight Maintenance Headquarters

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Revocable "R" Permit	City of Los Angeles	This permit grants conditional encroachment of the public right-of-way by private parties not authorized to occupy the right-of-way.	Applicable	Applicable to actions that work activities in the public right-of-way.
Excavation "E" Permits	City of Los Angeles	An Excavation "E" permit is requried for the installations, inspection, repair, abandonment or removal of any tank, pipe, conduit duct, tunnel, or footing, or for any other purpose, or for any excavation on private property adjacent to a public street where lateral support to such street or improvements or property within such street is imperiled by the excavation.	Applicable	Applicable to actions that include excavations adjacent to a public street.
Excavation "U" Permits	City of Los Angeles	The Excavation "U" permit is issued to public utilities and telecommunication companies regulated by the Public Utilities Commission of the State of California to install public utilities in the public right-of-way issued to entities with the authority to occupy the public right-of-way, which is typically given under a City or State Franchise Agreement, a Certificate of Public Convenience and Necessity from the State Public Utilities Commission, or some other legal authority. In general, U-Permits are issued to utility companies for construction activities on their utility facilities.	To be considered	Applicable to actions that include excavations in the public right-of-way.
City of Los Angeles Department of Building and Safety				
Grading Permits	City of Los Angeles	A grading permit is needed when any grading (cutting or filling operation), or any earth materials are planned to be imported or exported to or from any grading site.	Applicable	Applicable to actions that include grading.
Los Angeles County Ordinances				
Well Permits	County of Los Angeles Environmental Health	Requires permits for installation of non-production wells (construction, decommission, monitoring, piezo, injection, water extraction, sparge, test) and soil borings to groundwater.	Applicable	Applicable to actions that include installation of non-production wells or soil borings to groundwater.

Acronyms and Abbreviations:

ARAR: Applicable or Relevant and Appropriate
CAA: Clean Air Act
Cal/OSHA: California OSHA
CCR: California Code of Regulations
CFR: Code of Federal Regulations
CWC: California Water Code
DTSC: Department of Toxic Substances Control
H&SC: Health and Safety Code
MCL: Maximum Contaminant Level

mg/m^3: milligrams per cubic meter
NAAQS: National Ambient Air Quality Standards
NESHAPs: Ntl Emission Standards for Hazardous Air Pollutants
NPDES: National Pollution Discharge Elimination System
NSPS: New Source Performance Standards
NSR: New Source Review
Ntl: National
OSHA: Occupational Safety and Health Administration
POTW: publicly owned treatment works

PRC: California Public Resources Code
PSD: Prevention of Significant Deterioration
RCRA: Resource Conservation and Recovery Act
SCAQMD: South Coast Air Quality Management District
SWRCB: State Water Resources Control Board
TBC: To be considered criteria
USC: United States Code
VOC: volatile organic compounds

Table 3-3
Proposed Cleanup Goals for Soil
Streetlight Maintenance Headquarters

Compound	Human Health Criteria (µg/kg)	Source	Leaching to Ground-water Criteria (µg/kg)	Source	Proposed Cleanup Goals (µg/kg)
Benzene	1,400	DTSC-SL	25	ESL	25
n-Butylbenzene	18,000,000	DTSC-SL	3,200	Risk	3,200
Ethylbenzene	25,000	RSL	43	ESL	43
Isopropylbenzene	9,900,000	RSL	740	Risk	740
Naphthalene	6,500	DTSC-SL	42	ESL	42
n-Propylbenzene	24,000	RSL	1,200	Risk	1,200
Tetrachloroethene	2,700	DTSC-SL	80	ESL	80
Trichloroethene	6,000	RSL	85	ESL	85
Toluene	5,300,000	DTSC-SL	3,200	MCL	3,200
1,3,5-Trimethylbenzene	1,500,000	RSL	87	Risk	87

Notes:
µg/kg: micrograms per kilogram
DTSC-SL: DTSC HHRA Note 3 screening level for soil.
RSL: USEPA Regional Screening Level for soil.
ESL: San Francisco Bay Regional Water Quality Control Board Environmental Screening Level for leaching to groundwater.
MCL: USEPA MCL-based soil-to-groundwater RSL.
Risk: USEPA risk-based soil-to-groundwater RSL.

Table 3-4
Proposed Cleanup Goals for Groundwater
Streetlight Maintenance Headquarters

Compound	Water Quality Criteria (µg/L)	Source	Proposed Cleanup Goals (µg/L)
Benzene	1	MCL	10
Chlorobenzene	70	MCL	700
1,1-Dichloroethene	6	MCL	60
cis-1,2-Dichloroethene	6	MCL	60
trans-1,2-Dichloroethene	10	MCL	100
Naphthalene	17	NL	170
Tetrachloroethene	5	MCL	50
Trichloroethene	5	MCL	50
Vinyl chloride	0.5	MCL	5

Notes:
µg/L: micrograms per liter
--: Screening level not available.
MCL: California Maximum Contaminant Level for drinking water.
NL: California Notification level for drinking water.

Table 4-1
Soil Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Technology Type	Process Option	Description	Effectiveness (Primary)			Implement-ability	Relative Cost	Numeric Score	Retain or Reject	Screening Comments
				Effectiveness in Handling Volume of Impacted Media	Impacts During Implemen-tation	Reliability					
No Action	N/A	N/A	No action is taken for site contamination.	Low	Low	Low	High	Low	6.7	Retain	Baseline for comparison with other technologies
Institutional and Engineering Controls	Land Use Controls	Land Use Covenants	Land use covenants are recorded with the County Assessor to restrict future land use.	High	Low	Medium	High	Low	9.2	Retain	Restrictions on on-site land use have already been recorded with County Assessor; may not be implementable for downgradient properties.
	Vapor Control	Vapor Barrier	An impermeable membrane, with or without a venting system, is placed below the ground surface to reduce upward migration of volatiles.	High	Low	Medium	High	Moderate	7.9	Retain	Vapor control not anticipated to be necessary to protect human and ecological receptors
Containment	Capping	Geomembrane Cap	A geomembrane is placed over impacted area or landfill to reduce leaching of contaminants by infiltrating water and prevent contact with contaminated soil or landfill waste.	Low	Low	Medium	Low	Low	5.0	Reject	Capping not compatable with planned redevelopment.
		Earthen Cap	A clean compacted soil layer is placed over impacted area or landfill to prevent direct contact with contaminated soil or landfill waste.	Low	Low	Medium	Low	Low	5.0	Reject	Capping not compatable with planned redevelopment.
		Landfill Cap	An engineered landfill cap is constructed over impacted area or landfill to reduce leaching of contaminants by infiltrating water and prevent contact with contaminated soil or landfill waste.	Low	Low	Medium	Low	Low	5.0	Reject	Capping not compatable with planned redevelopment.
		Evapotranspiration Cap	An engineered evapotranspiration cap is constructed over impacted area or landfill to reduce leaching of contaminants by infiltrating water and prevent contact with contaminated soil or landfill waste.	Low	Low	Medium	Low	Low	5.0	Reject	Capping not compatable with planned redevelopment.
	Grouting	Source Area Grouting	Conventional grout or chemical grout is injected into vadose zone and/or saturated zone source areas to reduce leaching of contaminants.	Low	Medium	Low	Low	High	0.8	Reject	Low permeability bedrock limits implementability.
Removal	Excavation	Conventional Excavation	Contaminanted soils are excavated using construction equipment from unsloped, sloped or shored excavations.	High	Medium	High	Medium	Low	7.9	Retain	Effective for site contaminants; depth of contamination may affect implementablility; must be combined with *ex situ* treatment or transportation and disposal options.
		Large-Diameter Auger Borings	Contaminated soils are excavated using overlapping large-diameter soil borings; borings are backfilled with slurry to allow for overlap.	High	Medium	High	Medium	Moderate	6.7	Retain	Effective for site contaminants; depth of contamination may affect implementablility; must be combined with ex situ treatment or transportation and disposal options.
	Transportation	Trucking	Excavated soil is moved on-site or off-site by means of construction equipment or trucks.	High	High	High	High	Low	8.3	Retain	Must be combined with excavation and *ex situ* treatment or disposal options
In Situ Treatment	*In Situ* Biological Treatment	Enhanced Bioremediation	Electron donor, electron acceptors, and/or nutrients are introduced into the subsurface using wells or infiltration galleries to stimulate or increase the rate of contaminant degradation by microorganisms.	High	Low	Medium	Low	Moderate	5.4	Reject	Effective for site contaminants; low permeability bedrock limits implementability; contaminants may be flushed to groundwater, where they will require treatment or recovery.
		Enhanced Bio. (Gaseous Electron Donor)	A gaseous electron donor (e.g. hydrogen, propane, etc.) is delivered to contaminated soils to stimulate anaerobic biodegradation.	Medium	Low	Medium	Medium	Moderate	5.8	Reject	Effective for site contaminants; low permeability bedrock limits implementability.

Table 4-1
Soil Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Technology Type	Process Option	Description	Effectiveness (Primary): Effectiveness in Handling Volume of Impacted Media	Effectiveness (Primary): Impacts During Implementation	Effectiveness (Primary): Reliability	Implementability	Relative Cost	Numeric Score	Retain or Reject	Screening Comments
In Situ Treatment	*In Situ* Biological Treatment	Bioventing	Atmospheric air is delivered to contaminated unsaturated soils by forced air movement to increase oxygen concentrations and stimulate aerobic biodegradation.	Low	Low	Low	Low	Low	4.2	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions; heterogeneous bedrock geology limits implementability.
		Phytoremediation	Plants are used to remove, transfer, stabilize, and/or destroy contaminants in soil and sediment.	Medium	Medium	Low	Low	Low	4.2	Reject	Effective for site contaminants; time and space required for treatment may not be compatable with planned redevelopment schedule.
	In Situ Physical Treatment	Water Flushing	Water is introduced into the vadose zone to transport soluble contaminants to the groundwater for treatment or recovery. This technology excludes flushing with electron donor solutions (see Enhanced Bioremediation).	Low	Low	Medium	Low	Low	5.0	Reject	Not effective for site contaminannts; low permeability bedrock limits implementability.
		Surfactant Flushing	An aqueous surfactant solution is infiltrated or injected into the vadose zone to mobilize contaminants to the saturated zone for treatment or recovery.	High	Low	Low	Medium	Moderate	5.8	Reject	Not effective for site contaminants, which do not include free-phase petroleum or chlorinated solvents in the unsaturated zone; low permeability bedrock limits implementability.
		Soil Vapor Extraction	A vacuum is applied to induce a controlled flow of air to remove volatile and some semivolatile contaminants from soil. Enhancement technologies include steam or hot-air injection, radio frequency or electrical heating, etc.	High	Low	Medium	Medium	Low	7.9	Retain	Presumptive remedy for VOCs in soil; effective for site contaminant; heterogeneous bedrock geology limits implementability
		Solidification	Contaminants are bound physically in a solid matrix by *in situ* mixing of soil with a binding agent such as portland or pozzolanic cement.	Low	Medium	Low	Medium	Moderate	3.3	Reject	Not effective for site contaminants; low permeability bedrock limits implementability.
		Stabilization	Stabilizing agents are introduced into soil to reduce the mobility of contaminants.	Low	Medium	Low	Medium	Moderate	3.3	Reject	Not effective for site contaminants; low permeability bedrock limits implementability.
	In Situ Chemical Treatment	Chemical Oxidation (liquid oxidants)	Strong oxidizing agents are introduced or injected into the subsurface to convert contaminants to less-toxic or non-toxic compounds. Oxidants may include permanganate, persulfate, and Fenton's reagent.	High	Medium	Low	Low	Moderate	3.8	Reject	Effective for site contaminants; low permeability bedrock and need for direct contact with reagents limits implementability.
		Chemical Oxidation (gaseous oxidants)	Ozone is injected into the subsurface to convert contaminants to less-toxic or non-toxic compounds.	High	Medium	Low	Low	Moderate	3.8	Reject	Effective for site contaminants; low permeability bedrock and need for direct contact with reagents limits implementability.
		Chemical Reduction	Reducing agents are injected into the subsurface to convert contaminants to less-toxic or non-toxic compounds. This technology excludes injection of electron donor.	Low	Medium	Low	Low	Moderate	2.1	Reject	Not effective for site contaminants; low permeability bedrock and need for direct contact with reagents limits implementability.
	In Situ Thermal Treatment	Vitrification	Soils are brought to their melting point, typically with an electrical current, to form a glass. Contaminants are driven off, decomposed, or immobilized by this process.	Low	High	High	Low	High	1.7	Reject	Very high energy and equipment costs; resulting glassy mass not suitable for planned redevelopment.
Ex Situ Treatment	*Ex Situ* Physical Treatment	Separation	Contaminants or foreign materials (such as trash) are separated from soil using a variety of methods, including gravity, magnetic, or size separation (screening); also includes retrieval by hand-picking.	Medium	Medium	Medium	Low	Moderate	3.8	Reject	Effective for site contaminants; time and space required for treatment may not be compatable with planned redevelopment schedule.
		Soil Washing	Contaminants are separated from excavated soil by washing in an aqueous solution, which may be amended with leaching agents, surfactants, or chelating agents.	Medium	Medium	Medium	Low	Moderate	3.8	Reject	Effective for site contaminants; time and space required for treatment may not be compatable with planned redevelopment schedule.

Table 4-1
Soil Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Technology Type	Process Option	Description	Effectiveness (Primary): Effectiveness in Handling Volume of Impacted Media	Effectiveness (Primary): Impacts During Implementation	Effectiveness (Primary): Reliability	Implementability	Relative Cost	Numeric Score	Retain or Reject	Screening Comments
Ex Situ Treatment	*Ex Situ* Physical Treatment	Solidification	Contaminants are physically bound by mixing excavated soil with a binding agent, such as asphalt or portland cement, to reduce mobility.	Low	Medium	Low	Low	Moderate	2.1	Reject	Not effective for site contaminants; time and space required for treatment may not be compatable with planned redevelopment schedule.
		Stabilization	Stabilizing agents are added to soil to reduce the mobility of contaminants.	Low	Medium	Low	Low	Moderate	2.1	Reject	Not effective for site contaminants; time and space required for treatment may not be compatable with planned redevelopment schedule.
	Ex Situ Chemical Treatment	Chemical Oxidation	Strong oxidizing agents are mixed with excavated soil to convert contaminants to less-toxic or non-toxic compounds. Oxidants include permanganate, persulfate, Fenton's reagent, etc.	High	Medium	Medium	Low	Moderate	4.6	Reject	Effective for site contaminants; difficult to implement due to health and safety issues associated with reagents; time and space required for treatment may not be compatable with planned redevelopment schedule.
		Chemical Reduction	Reducing agents are mixed with excavated soil to convert contaminants to less-toxic or non-toxic compounds. This technology excludes addition of electron donor (discussed under *Ex Situ* Biological Treatment).	Medium	Medium	Medium	Low	Moderate	3.8	Reject	Not effective for site contaminants; difficult to implement due to health and safety issues associated with reagents; time and space required for treatment may not be compatable with planned redevelopment schedule.
		Dehalogenation	Excavated soil is heated with a reagent (sodium bicarbonate or polyethylene glycolate) to decompose or dehalogenate chlorinated organic compounds to reduce toxicity.	Medium	Medium	Medium	Low	Moderate	3.8	Reject	Not effective for site contaminants (primarily used for semivolatile compounds); time and space required for treatment may not be compatable with planned redevelopment schedule.
		Chemical Extraction	Contaminants are separated from excavated soil by a chemical extraction process, typically using acids or solvents. (Extraction using water as solvent is discussed under Soil Washing.)	Medium	Medium	Medium	Low	Moderate	3.8	Reject	Not effective for site contaminants; difficult to implement due to health and safety issues associated with reagents; time and space required for treatment may not be compatable with planned redevelopment schedule.
	Ex Situ Biological Treatment	*Ex Situ* Bioremediation	Excavated contaminated soil is mixed with electron donor, bulking agents, or other amendments to promote aerobic or anaerobic biologic activity.	High	Medium	High	Low	Moderate	5.4	Reject	Effective for site contaminants; time and space required for treatment may not be compatable with planned redevelopment schedule.
		Phytoremediation	Plants are used to remove, transfer, stabilize, or destroy contaminants in excavated soil or sediment.	Medium	Medium	Medium	Low	Low	5.0	Reject	Effective for site contaminants; time and space required for treatment may not be compatable with planned redevelopment schedule.
		Landfarming	Excavated contaminated soil is placed in beds and periodically turned to aerate and promote biologic activity.	Medium	Medium	Low	Low	Low	4.2	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions; time and space required for treatment may not be compatable with planned redevelopment schedule.
		Biopiles	Excavated contaminated soil is mixed with amendments and actively aerated to promote biologic activity.	Medium	Medium	Low	Low	Low	4.2	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions; time and space required for treatment may not be compatable with planned redevelopment schedule.
	Ex Situ Thermal Treatment	Thermal Desorption	Contaminated soil is heated to moderate temperatures to volatilize water and contaminants. The contaminants are captured in an air stream for treatment.	High	Medium	Medium	Medium	Moderate	5.8	Reject	Effective for site contaminants; treated soil must be disposed offsite because most of site will be excavated to construct underground parking.
		Incineration	Excavated soil is heated to high temperatures (>1,000 °F) to volatilize and combust organic compounds.	Medium	High	Low	Low	High	0.8	Reject	Effective for site contaminants, but difficult to implement because no incineration facilities are located near site; most applicable to PCBs, SVOC, dioxins, and explosives
		Pyrolysis	Excavated soil is heated to moderate temperatures (~800 °F) in the absence of oxygen to decompose organic compounds.	Medium	High	Low	Low	High	0.8	Reject	Effective for site contaminants, but difficult to implement because no facilities are located near site; most applicable to SVOCs and pesticides

Table 4-1
Soil Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Technology Type	Process Option	Description	Effectiveness (Primary)			Implement-ability	Relative Cost	Numeric Score	Retain or Reject	Screening Comments
				Effectiveness in Handling Volume of Impacted Media	Impacts During Implemen-tation	Reliability					
Disposal	On-site Disposal	Reuse of Treated Soil	Treated soil is reused on-site as excavation backfill or fill material.	Low	Medium	Medium	Low	Low	4.2	Reject	Most of site will be excavated to construct underground parking, which limits implementability.
		On-site Landfill	Treated or untreated soil is disposed in an authorized on-site repository or landfill.	Low	Medium	Medium	Low	Moderate	2.9	Reject	Most of site will be excavated to construct underground parking, which limits implementability.
	Off-site Disposal	Landfill	Excavated soil is transported off-site for treatment or disposal at an authorized facility.	High	Low	High	High	Moderate	8.8	Retain	Permanently removes contaminants from site; must be combined with excavation and transportation options

Notes:
Shading indicates process option or technology screened out.

Scoring Notes (scores are listed in order from best to worst):
Effectiveness in handling volumes of impacted media
High: Process option can readily handle both anticipated volumes of media and anticipated contaminant concentrations.
Medium: Process option can readily handle either anticipated volumes of media or anticipated contaminant concentrations.
Low: Process option can readily handle neither anticipated volumes of media nor anticipated contaminant concentrations.
Impacts during implementation
Low: Implementation expected to have few temporary impacts.
Medium: Implementation expected to have moderate temporary impacts.
High: Implementation expected to have large temporary impacts or unmitigatable impacts.
Reliability
High: Process option is reliable and permanent for all contaminants.
Medium: Process option is reliable and permanent for perchlorate, but not for 1,4-dioxane and/or VOC.
Low: Process option is not reliable for perchlorate or not reliable for any site contaminants.
Implementability
High: Simple and straightforward to construct; administrative approvals readily obtained.
Medium: Construction feasible, but complicated by site-specific geology/hydrogeology; administrative approval moderately difficult to obtain.
Low: Implementation severely impacted by site-specific geology/hydrogeology; administrative approvals difficult to obtain.
Cost
Low: Cost low relative to other process options.
Moderate: Cost moderate relative to other process options.
High: Cost high relative to other process options.

Acronyms and Abreviations:
CDFG: California Department of Fish and Game
CIWMB: California Integrated Waste Management Board
DTSC: California Department of Toxic Substances Control
N/A: not applicable
PCBs: Polychlorinated biphenyls
RCWMD: Riverside County Waste Management Department
SVOC: Semivolatile organic compound
T&E: Threatened and endangered
VOC: Volatile organic compound
WDR: Waste Discharge Requirements

Table 4-2
Groundwater Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness: Effectiveness in Handling Volumes of Impacted Media	Effectiveness: Impacts During Implement-ation	Effectiveness: Reliability	Implement-ability	Relative Cost	Retain or Reject	Screening Comments
No Action	N/A	N/A	No action is taken for site contamination.	Low	Low	Low	High	Low	Retain	Baseline for comparison with other technologies
Monitoring	Sampling and Analysis	Groundwater Monitoring	Samples are collected and analyzed to monitor contamination.	High	Low	High	High	Low	Retain	Likely to be required as a component of any groundwater remedy.
	Monitored Natural Attenuation	Monitored Natural Attenuation	Samples are collected and analyzed to monitor contaminant attenuation.	High	Low	Medium	High	Low	Retain	Potential component of groundwater remedy.
Institutional and Engineering Controls	Land Use Controls	Land Use Controls	Land use covenants are recorded with the County Assessor to restrict future groundwater use.	High	Low	Medium	High	Low	Retain	Can be implmented for site, unlikely to be implementable for downgradient properties.
	Vapor Control	Vapor Barrier	An impermeable membrane, with or without a venting system, is placed below occupied structures to reduce intrusion of volatiles into indoor air.	High	Low	Medium	High	Moderate	Retain	Can be implmented for site, unlikely to be implementable for downgradient properties.
Containment	Physical Barriers	Slurry Wall	A trench is excavated into the saturated zone and filled with a bentonite slurry to retard or divert groundwater flow.	Medium	Medium	Medium	Medium	High	Reject	Effective for site contaminants; implementability depends on depth of contamination; groundwater extraction may be needed to minimize undesired hydraulic effects.
		Grout Curtain	Conventional or chemical grout is injected into the saturated zone through closely-spaced injection points to form a continuous low-permeability vertical curtain which retards or diverts groundwater flow.	Medium	Medium	Medium	Medium	High	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability; groundwater extraction may be needed to minimize undesired hydraulic effects.
		Driven Pile Wall	Interlocking sheet pile is driven into the saturated zone to retard or divert groundwater flow.	Medium	High	Medium	Medium	High	Reject	Effective for site contaminants; implementability depends on depth of contamination; groundwater extraction may be needed to minimize undesired hydraulic effects.
	Hydraulic Containment	Groundwater Extraction	Groundwater is extracted to create a groundwater depression that prevents contaminated groundwater from flowing in an undesired direction. Groundwater extraction and treatment technologies are described elsewhere.	High	Low	High	High	Moderate	Retain	Effective for site contaminants; must be combined with *ex situ* treatment and disposal options.
		Injection Barrier	Water in injected to create a groundwater divide that prevents contaminated groundwater from flowing in an undesired direction.	Medium	Low	Medium	Low	Low	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability; must be combined with groundwater extraction and *ex situ* treatment or an alternate water source.
	Permeable Reactive Barrier	Biobarrier	Groundwater passively flows through a permeable barrier where electron donors, electron acceptors, and/or nutrients are added to promote biologic activity. Various configurations possible (trenches, funnel-and-gate, injection, etc.).	High	Medium	High	Medium	Moderate	Retain	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability of injections; depth of contamination may limit implementability of trench.
		Zero-Valent Iron Barrier	Groundwater passively flows through a permeable barrier containing ZVI, that promotes destruction of chlorinated compounds. Various configurations possible (trenches, funnel-and-gate, injection, etc.).	High	Medium	High	Medium	Moderate	Retain	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability of injections; depth of contamination may limit implementability of trench.
		Metal-Enhanced Reduction Barrier	Groundwater passively flows through a permeable barrier containing basic oxygen furnace slag. Various configurations possible (trenches, funnel-and-gate, etc.).	Low	Medium	Low	Medium	Moderate	Reject	Not effective for site contaminants.

Table 4-2
Groundwater Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness: Effectiveness in Handling Volumes of Impacted Media	Effectiveness: Impacts During Implement-ation	Effectiveness: Reliability	Implement-ability	Relative Cost	Retain or Reject	Screening Comments
Containment	Permeable Reactive Barrier	pH Control Barrier	Groundwater passively flows through a permeable barrier containing limestone to adjust pH. Various configurations possible (trenches, funnel-and-gate, etc.).	Low	Medium	Low	Medium	Moderate	Reject	Not effective for site contaminants.
		Redox Barrier	Groundwater passively flows through a permeable barrier containing calcium polysulfide, sodium dithionite, or other reducing agents. Various configurations possible (trenches, funnel-and-gate, injection, etc.).	Low	Medium	Low	Medium	Moderate	Reject	Not effective for site contaminants.
		Sorptive Barrier	Groundwater passively flows through a permeable barrier containing sorptive material (GAC, zeolite, ion exchange resin, apatite, etc.) to remove contaminants. Various configurations possible (trenches, funnel-and-gate, etc.).	High	Medium	High	Medium	High	Reject	Effective for site contaminants; redevelopment of site may limit access to trench for replacing sorptive media.
	Immobilization	Source Area Grouting	Grout or chemical grout is injected into the saturated zone through closely-spaced injection points to reduce groundwater flux through a submerged source area.	Medium	Medium	Medium	Low	High	Reject	Heterogeneous, low permeability bedrock limits implementability; may need to be combined with groundwater extraction and ex situ treatment to minimize undesired hydraulic effects.
		Chemical Fixation	Chemical reagents are introduced to the subsurface to change the valance state or solubility of contaminants to reduce their mobility	Medium	Medium	Low	Medium	High	Reject	Not effective for site contaminants.
In Situ Treatment	*In Situ* Biological Treatment	Enhanced Bioremediation	Amendments (electron donor, nutrients, etc) are injected into the saturated zone to promote biologic activity.	High	Low	High	Low	Low	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability of injections.
		Thermally Enhanced Bioremediation	Portions of the subsurface are heated to moderate temperatures to enhance biodegradation rates.	High	Low	High	Low	Moderate	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability of injections. No advantage over enhanced bioremediation for site climate.
		Biosparging	Atmospheric air is injected into the saturated zone at a low rate to promote aerobic biologic activity.	Low	Low	Medium	Low	Low	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions; heterogeneous, low permeability bedrock limits implementability of air injection.
		Phytoremediation	Phreatophyte plants are used to remove, transfer, stabilize, and/or destroy contaminants in the saturated zone.	Medium	Low	Low	Low	Low	Reject	Not implementable because depth to groundwater is >10-15 feet throughout site.
	In Situ Physical Treatment	Air Sparging	Air is injected into the saturated zone to volatilize contaminants, which are collected or treated in the vadose zone.	Medium	Low	Low	Low	Low	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability of air injection; soil vapor extration required to recover contaminants.
		Bioslurping	Contaminants in the saturated zone are treated through a combination of bioventing and vacuum-enhanced free product recovery.	Low	Low	Low	Medium	Low	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions.
	In Situ Physical Treatment	In-Well Air Stripping	Air is injected into a dual-screen well, causing water to be drawn in through the lower screen and forced out of the upper screen. VOCs are removed from the water by air stripping action in well.	Low	Low	Low	Low	Moderate	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability.
	In Situ Thermal Treatment	Steam Injection	Steam is injected into the saturated zone to heat and increase the volatility of contaminants in the saturated zone. Contaminants are recovered with recovery wells or from the vadose zone by vapor extraction.	High	Medium	Low	Medium	High	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability; soil vapor extraction required to recover contaminants.

Table 4-2
Groundwater Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness: Effectiveness in Handling Volumes of Impacted Media	Effectiveness: Impacts During Implement-ation	Effectiveness: Reliability	Implement-ability	Relative Cost	Retain or Reject	Screening Comments
In Situ Treatment	*In Situ* Thermal Treatment	Radio Frequency Heating	Radio frequency electromagnetic energy is used to heat and increase the volatility of contaminants in the saturated zone to facilitate extraction with recovery wells or from the vadose zone by vapor extraction.	High	Medium	High	Medium	High	Reject	Effective for site contaminants; other thermal treatment options are more cost effective; soil vapor extraction required to recover contaminants.
		Electrical Resistance Heating	An electrical current is used to heat and increase the volatility of contaminants in the saturated zone to facility extraction with recovery wells or from the vadose zone by vapor extraction.	High	Medium	High	High	Moderate	Retain	Effective for site contaminants; soil vapor extraction required to recover contaminants.
	In Situ Chemical Treatment	Chemical Oxidation (liquid injection)	Strong oxidizing agents are injected into the saturated zone to convert contaminants to less-toxic or non-toxic compounds. Oxidants may include permanganate, persulfate, Fenton's reagent, etc.	High	Low	Low	Low	Moderate	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability.
		Ozone Sparging	Ozone is injected into the saturated zone to oxidize contaminants to less-toxic or non-toxic compounds	High	Low	Low	Low	Moderate	Reject	Effective for site contaminants; heterogeneous, low permeability bedrock limits implementability.
		Chemical Reduction	Reducing agents are injected into the saturated zone to convert contaminants to less-toxic or non-toxic compounds.	Low	Low	Low	Low	Moderate	Reject	Not effective for site contaminants.
Ex Situ Treatment	*Ex Situ* Chemical Treatment	Adsorption	Dissolved contaminants are concentrated at the surface of an adsorption agent (other than granular organic carbon), reducing concentrations in the bulk solution.	Low	Low	Low	High	Moderate	Reject	Not effective for site contaminants.
		GAC	Groundwater pumped through a series of canisters containing granular activated carbon, which adsorbs organic contaminants.	High	Low	High	High	Moderate	Retain	Effective for site contaminants; standard, well-understood process option.
		TGAC	Groundwater pumped through a series of canisters containing tailored granular activated carbon (GAC with an additional surface coating), which adsorbs contaminants.	Medium	Low	Medium	High	High	Reject	No benefit over GAC for site contaminants.
		Advanced Oxidation	Contaminants in water are oxidized using a combination of UV radiation, ozone, and/or hydrogen peroxide.	High	Low	High	High	Moderate	Retain	Effective for site contaminants; standard, well-understood process option.
		Ion Exchange	Groundwater pumped through a series of canisters containing an ion exchange resin, which removes inorganic contaminants.	Low	Low	Low	High	Moderate	Reject	Not effective for site contaminants.
		Precipitation	Dissolved contaminants are removed from water by pH adjustment or addition of a precipitating agent.	High	Low	Low	Low	Moderate	Reject	Not effective for site contaminants.
		Batch Chemical Reduction	Groundwater is batch treated in storage tanks by addition of strong reducing agents that convert contaminants to less-toxic or non-toxic compounds	Low	Medium	Low	Low	Moderate	Reject	Potentially applicable for treatment of liquid residuals; however, no treatment options that produce liquid residuals are retained.
		Batch Chemical Oxidation	Groundwater is batch treated in storage tanks by addition of strong oxidants that convert contaminants to less-toxic or non-toxic compounds.	Low	Medium	High	Low	Moderate	Reject	Potentially applicable for treatment of liquid residuals; however, no treatment options that produce liquid residuals are retained.

Table 4-2
Groundwater Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness			Implement-ability	Relative Cost	Retain or Reject	Screening Comments
				Effectiveness in Handling Volumes of Impacted Media	Impacts During Implement-ation	Reliability				
Ex Situ Treatment	*Ex Situ* Biological Treatment	Bioreactor	Contaminated water is brought into contact with an attached or suspended biological system to destroy contaminants.	High	Medium	Medium	Low	Moderate	Reject	Effective for site contaminants; need for systems to handle biosolids limits implementability after site redevelopment.
		Batch Biotreatment	Groundwater is batch treated in storage tanks by addition of amendments (electron donor, nutrients, etc) to promote biologic activity.	Low	Medium	High	Low	Moderate	Reject	Potentially applicable for treatment of liquid residuals; however, no treatment options that produce liquid residuals are retained.
	Ex Situ Physical Treatment	Air Stripping/ Air Diffusing	Volatile organics are removed from groundwater by increasing the surface area exposed to air.	High	Low	High	High	Low	Retain	Effective for site contaminants; standard, well-understood process option.
		Distillation	Contaminants are removed from groundwater by distillation.	Medium	Low	Medium	Medium	Moderate	Reject	Not effective for mixture of organic and inorganic contaminants found at site; not implementable for low concentrations of organic contaminants.
		Reverse Osmosis	Contaminants are removed from groundwater by reverse osmosis.	Medium	Low	Medium	Medium	Moderate	Reject	Very high equipment and energy costs; waste stream containing concentrated contaminants still requires treatment or disposal.
		Membrane Pervaporation	Extracted groundwater is heated, and contaminants are removed by diffusion through a membrane, where they are collected and condensed as a liquid.	Medium	Low	Medium	Medium	Moderate	Reject	Effective for site contaminants; treatability study needed to evaluate technology under site conditions.
		Evaporation	Volume of extracted groundwater or treatment residual is reduced by evaporation.	Medium	Low	Medium	Low	Low	Reject	Effective for reducing volume of liquid treatment residuals; however, no treatment options that produce liquid residuals are retained.
Extraction	Extraction	Extraction	Groundwater is extracted from vertical wells, horizontal wells, or extraction trenches.	High	Low	High	High	Moderate	Retain	Requires ex situ treatment and disposal of extracted groundwater.
		Dual-Phase Extraction (dual pump)	Groundwater and air are simultaneously extracted from wells using separate pump systems. The application of vacuum increases the rate of groundwater extraction.	High	Low	Medium	Medium	Moderate	Retain	Most effective for VOCs and LNAPL; advantages are limited for 1,4-dioxane and perchlorate in low hydraulic conductivity conditions. Requires *ex situ* treatment and disposal of extracted groundwater.
		Multi-Phase Extraction (total fluids)	Groundwater and air are simultaneously extracted by applying a vacuum to a dip tube set below the water table.	High	Low	Medium	Medium	Moderate	Retain	Most effective where LNAPL is present; advantages are limited for DNAPL sites. Requires *ex situ* treatment and disposal of extracted groundwater.
		French Drains	Drains are installed to redirect groundwater away from building foundations or low areas.	Low	Low	Medium	Low	Low	Reject	Dewatering of foundations may not be necessary.
		Pumped Excavations	Groundwater is extracted from an existing open excavation using sump pumps.	Low	Low	High	Low	Low	Reject	Excavation dewatering

Table 4-2
Groundwater Technology Screening Summary
Streetlight Maintenance Headquarters

General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness: Effectiveness in Handling Volumes of Impacted Media	Effectiveness: Impacts During Implement-ation	Effectiveness: Reliability	Implement-ability	Relative Cost	Retain or Reject	Screening Comments
Disposal	Onsite Disposal	Reinjection	Treated groundwater is disposed on-site by reinjection into contaminated aquifer.	Medium	Medium	Medium	Medium	Moderate	Reject	Will require UIC and WDR permits.
		Deep Well Injection	Treated or untreated groundwater is disposed on-site by deep well injection.	Low	Medium	Medium	Low	High	Reject	Suitable injection well not avafilable
		Sewer Discharge	Treated or untreated groundwater is disposed to the sanitary sewer.	High	Low	High	Medium	Moderate	Retain	No sewer connection at or in vicinity of site.
		Surface Discharge	Treated groundwater is disposed to the surface water drainage channel.	High	Low	High	Medium	Low	Retain	Will require NPDES permit.
		Infiltration	Treated groundwater is disposed on-site by infiltration.	Low	Low	Medium	Medium	Low	Reject	Space needed for infiltration not require UIC and WDR permits.
	Offsite Disposal	Off-site Treatment	Extracted groundwater or treatment residual is transported off-site to an authorized facility for treatment.	High	Low	High	High	Moderate	Retain	Effective for disposal of wastes generated from treatment processes (e.g., activated carbon).
		Off-site Disposal	Extracted groundwater or treatment residual is transported off-site to an authorized facility for disposal.	High	Low	High	High	Moderate	Retain	Effective for disposal of wastes generated from treatment processes (e.g., activated carbon).

Notes:
Shading indicates process option or technology screened out.

Scoring Notes (scores are listed in order from best to worst):
Effectiveness in handling volumes of impacted media
High: Process option can readily handle both anticipated volumes of media and anticipated contaminant concentrations.
Medium: Process option can readily handle either anticipated volumes of media or anticipated contaminant concentrations.
Low: Process option can readily handle neither anticipated volumes of media nor anticipated contaminant concentrations.
Impacts during implementation
Low: Implementation expected to have few temporary impacts.
Medium: Implementation expected to have moderate temporary impacts.
High: Implementation expected to have large temporary impacts or unmitigatable impacts.
Reliability
High: Process option is reliable and permanent for site contaminants.
Medium: Process option is reliable and permanent for site contaminants, but other site conditions reduce reliability.
Low: Process option is not reliable and permanent for site contaminants.
Implementability
High: Simple and straightforward to construct; administrative approvals readily obtained.
Medium: Construction feasible, but complicated by site-specific geology/hydrogeology; administrative approval moderately difficult to obtain.
Low: Implementation severely impacted by site-specific geology/hydrogeology; administrative approvals difficult to obtain.
Cost
Low: Cost low relative to other process options.
Moderate: Cost moderate relative to other process options.
High: Cost high relative to other process options.

Acronyms and Abreviations:
DNAPL: Dense non-aqueous phase liquid
DTSC: California Department of Toxic Substances Control
GAC: Granular activated carbon
LNAPL: Light non-aqueous phase liquid
N/A: Not applicable
NPDES: National Pollution Discharge Elimination System
TGAC: Tailored granular activated carbon
UIC: Underground Injection Control
UV: Ultraviolet
VOC: Volatile organic compound
WDR: Waste Discharge Requirements
ZVI: Zero-valent iron

APPENDIX A

Remedial Design Investigation Work Plan

DRAFT
Remedial Design Investigation Work Plan

Streetlight Maintenance Headquarters

611 North Hoover Street
Los Angeles, California

January 2021

Prepared for:

City of Los Angeles Department of Water and Power
Environmental Affairs
111 North Hope Street
Los Angeles, California 90012

Prepared by:

Tetra Tech, Inc.
3475 East Foothill Boulevard
Pasadena, California 91107

DRAFT
Remedial Design Investigation Work Plan

Streetlight Maintenance Headquarters
611 North Hoover Street
Los Angeles, California

January 2021
LADWP Agreement No. 47503B-9 – Task Assignment No. TT-08
Project No. 102-ENV-T47503B-9.08

Prepared for:

City of Los Angeles Department of Water and Power
Environmental Affairs
111 North Hope Street
Los Angeles, California 90012

Prepared by:

Tetra Tech, Inc.
3475 East Foothill Boulevard
Pasadena, California 91107

Mark Feldman CHG CEG
Principal Geologist

Robert Sabater
Project Manager

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ACRONYMS

ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CGS	California Geological Survey
COPC	chemical of potential concern
DCE	dichlorethene
DO	dissolved oxygen
DNAPL	dense non-aqueous phase liquid
DTSC	Department of Toxic Substance Control
DTSC-SLs	DTSC Human Health Risk Assessment Note 3 screening levels
DWR	California Department of Water Resources
EC	electrical conductivity
°F	degrees Fahrenheit
ISCO	In-Situ chemical oxidation
LADWP	Los Angeles Department of Water and Power
LARWQCB	California Regional Water Quality Control Board, Los Angeles Region
LAUSD	Los Angeles Unified School District
MCL	Maximum Contaminant Level
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MIP	membrane interface probe
mL	milliliter
MWD	Metropolitan Water District of Southern California
msl	mean sea level
NL	Notification Levels
NTU	nephelometric turbidity unit
OM&M	operation, maintenance, and monitoring
ORP	oxidation reduction potential
PCE	tetrachloroethene
PID	photoionization detector
PRB	permeable reactive barrier
PVC	polyvinyl chloride
RAP	remedial action plan
RSL	USEPA Regional Screening Level
SWRCB	State Water Resources Control Board
TCE	trichloroethene
TPHg	total petroleum hydrocarbons as gasoline
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound

1. INTRODUCTION

On behalf of the Los Angeles Department of Water and Power (LADWP), Tetra Tech, Inc. (Tetra Tech) has prepared this Remedial Design Investigation Work Plan (Work Plan) for the LADWP Streetlight Maintenance Headquarters, located at 611 North Hoover Street, Los Angeles, California (the Site). The location of the Site is shown on Figure 1.

During an underground storage tank (UST) removal conducted at the Site in 1990 (LADWP, 1990), total petroleum hydrocarbons as gasoline (TPHg) and benzene, toluene, ethylbenzene, and xylenes (BTEX) were detected in soil beneath a 7,500-gallon UST. A subsurface investigation was conducted to delineate the extent of petroleum-impacted soil (Earth Technology, 1991), and found that groundwater at the Site was also impacted by TPHg and BTEX. During subsequent groundwater monitoring, tetrachloroethene (PCE) and other chlorinated volatile organic compounds (VOCs) were also detected in groundwater. In 1998, the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) issued a case closure letter for the USTs (LARWQCB, 1998), and the Site was transferred from the UST Program to the Site Cleanup Program.

To date, a number of additional subsurface investigations, indoor air evaluations, a remedial treatability study, and quarterly groundwater monitoring have been conducted at the Site. The investigation work has included drilling and sampling numerous soil borings, installing groundwater monitoring wells and conducting quarterly groundwater monitoring from March 2001 through the present, collecting groundwater grab samples, collecting soil gas samples, and collecting indoor air samples.

Additionally, an upgradient dry-cleaning facility (Jesse Cleaners) has been identified as a potential contributor to the subsurface impacts beneath the Site. Based on the available data from environmental investigations conducted at Jesse Cleaners, a maximum PCE concentration of 1,350,085 micrograms per kilogram (µg/kg) was reported in the soil at 7 to 10 feet below ground surface (bgs). According to the LARWQCB, additional site characterization work is planned for the former Jesse Cleaners property in 2021.

Based on the data collected at the Site, the LARWQCB requested that LADWP prepare a Remedial Action Plan (RAP) to develop and evaluate the most appropriate remedial approach to address the chlorinated solvent and petroleum hydrocarbon impacts in the subsurface. In developing the RAP, additional data needed to prepare the remedial design were identified. This Work Plan describes an investigation to address these data needs.

This Work Plan is organized into the following sections:

- Section 1 – Introduction: provides an overview and purpose of this Work Plan.
- Section 2 – Conceptual Site Model: provides a description of the Site, geology and hydrogeology, and the nature and extent of contamination.
- Section 3 – Proposed Remedy : briefly describes the proposed remedy and the identified remedial design needs.
- Section 4 – Scope of Work: summarizes the scope of the proposed investigation.
- Section 5 – Methodology: describes procedures to be followed during the proposed investigation.
- Section 6 – Reporting: summarizes the contents of the investigation report.
- Section 7 – Schedule: provides a schedule for implementation of the investigation.
- Section 8 – References: lists references cited in the Work Plan.

2. PROPOSED REMEDY AND DESIGN DATA

The following sections describe the preferred remedy presented in the RAP and remedial design data that need to be collected to further develop the site remedial approach. A summary of previous environmental investigations conducted at the Site and the conceptual site model are provided in the RAP.

2.1 REMEDY DESCRIPTION

The RAP prepared for the Site (Tetra Tech, 2020) evaluated four remedial alternatives plus the no action alternative. The preferred remedy in the RAP consists of the following:

- Excavating potential DNAPL- and PCE-impacted soil to a depth of approximately 50 feet bgs in Area 1, and excavating PCE- and petroleum hydrocarbon-impacted soil to a depth of approximately 20 feet bgs in Areas 2 and 3.
- Performing confirmation sampling to verify removal of the impacted soil.
- Constructing a permeable reactive barrier (PRB) parallel to Hoover Street on the upgradient side of the site to control on-site migration of PCE-impacted groundwater from the upgradient former Jesse Cleaners facility.
- Performing operation, maintenance, and monitoring (OM&M) for the PRB, including remedial performance monitoring, sampling and analysis as required by Waste Discharge Requirements, and replenishing the PRB media as necessary.
- Installing a vapor barrier beneath structures planned at the Site to mitigate potential vapor intrusion.
- Implementing natural attenuation monitoring at the Site.
- Implementing land use controls at the Site.

2.2 REMEDIAL DESIGN DATA

LADWP currently anticipates that site remediation will be performed in conjunction with site redevelopment under a single fixed-price design-build or design-bid-build contract. Under this scenario, a general contractor selected by LADWP through a standard bidding process will be responsible for the design and implementation of the remedial actions. For this process to be successful (i.e. for LADWP to obtain bids that represent the best overall value, for the project to be completed without extensive changes to scope, schedule, or budget, and for the remedy to operate as intended), design parameters should be determined prior to the contracting process and provided to bidders to the extent feasible. These parameters generally include excavation locations and dimensions (footprint and depth), and PRB location and dimensions (length, width, and depth)

Specific design parameters which may require additional work to constrain include the following:

- PRB depth: The depth of a PRB is determined by the vertical extent of the groundwater plume that the PRB is intended to treat. The vertical extent of groundwater contamination is not well constrained at the Site. Three deep wells (MW-18, MW-19, and MW-20, which are screened from 70 to 80 feet bgs) have low or non-detectable concentrations of PCE, but these are all located at the periphery of the PCE plume and are not anticipated to be representative of conditions near the Area 1 source area. Furthermore, the depth constraint that these wells provide (*i.e.*, that contamination extends to less than about 70 feet bgs) is not particularly robust. Other constraints on the depth of the groundwater plume are provided by the MIP investigation (Kleinfelder, 2020), which indicates that DNAPL extends to a depth of at least 37 feet bgs in the Area 1 source area. These data only constrain the extent of the high-concentration core of the groundwater plume, rather than the vertical extent of the entire dissolved phase groundwater plume. Additional characterization of the vertical extent of the PCE plume is therefore recommended in Area 1.

- PRB length: The length of the PRB is based primarily on PCE plume contours, which are poorly constrained along the PRB transect, particularly to the north and south of well MW-16. Additional groundwater characterization is recommended in Hoover Street parallel to the PRB transect.
- Hydraulic data: The width of a PRB is typically designed to provide a known retention time as groundwater flows through the PRB, and thus requires an estimate of groundwater flow velocity. No data on aquifer hydraulic properties or flow velocity are currently available for the Site. Hydraulic testing to estimate aquifer hydraulic conductivity and groundwater velocity is recommended in Area 1, where contaminant concentrations are highest and groundwater retention time within the PRB is most critical.
- Treatability testing: The RAP identified a PRB as the preferred technology to control the onsite migration of contamination from former Jesse Cleaners, but did not evaluate specific process options for the PRB. Bench-scale testing of potential process options is recommended to provide data for the selection of the remedial process and PRB media.

3. SCOPE OF WORK

The following sections summarize the scope of the proposed remedial design investigation. All proposed sampling locations are subject to change based on the presence of underground utilities, access restrictions, or similar constraints.

3.1 INVESTIGATION ELEMENTS

As stated in Section 1, the overall objective of the proposed investigation is to collect additional data to support final remedy selection and remedial design activities for the Site, including the refinement of remediation target areas, final selection of remedial technologies, and determination of design parameters.

The following elements are included in the proposed investigation:

- Vertical Profile Soil and Groundwater Sampling: This element addresses the vertical extent of groundwater contamination within Area 1. Nested monitoring wells with short (5-foot) screen intervals will be installed in Area 1 at 10 foot depth intervals to evaluate the vertical extent of groundwater contamination. The groundwater data, together with data from soil samples collected during drilling, will be used to evaluate the vertical extent of soil contamination.
- Horizontal Extent Groundwater Sampling: This element includes installing groundwater monitoring wells as close as possible to the PRB transect to delineate the northern and southern limits of the groundwater plume along the proposed PRB transect.
- Hydraulic Assessment: This element includes hydraulic testing to assess groundwater velocity and hydraulic conductivity. Hydraulic testing will be performed in the immediate vicinity of the vertical profile monitoring wells in Area 1.
- Bench Testing: This element includes laboratory testing of potential permeable reactive barrier media. Batch tests will be used to screen and select potential media for further testing; column tests will then be conducted to further evaluate media performance. The bench testing will be performed by a subcontract treatability laboratory using groundwater obtained from the Site.

3.2 VERTICAL PROFILE SOIL AND GROUNDWATER SAMPLING

The vertical profile groundwater sampling consists of installing and sampling five short-screen monitoring wells in Area 1. The proposed monitoring well locations are shown on Figure 9; well depths and screen intervals are summarized in Table 3. The monitoring wells will be constructed using 2-inch diameter Schedule 40 polyvinyl chloride (PVC) machine slotted well screen and blank casing, and will be installed in a nested configuration, with three completions constructed in one 10-inch diameter soil boring and two completions constructed in a second 10-inch diameter soil boring adjacent to the first boring.

The soil borings will be drilled using the sonic method. Sonic drilling involves the use of drill casing, which is expected to reduce the likelihood of cross-contamination between shallow and deep groundwater during drilling. Soil samples will be collected for laboratory analysis at 5-foot depth intervals during drilling of the deepest boring.

The newly installed monitoring wells will be developed no less than 72 hours after installation, and will be sampled no less than 48 hours after development. The wells will be resampled approximately one month after installation. If the analytical results suggest that cross contamination may have occurred during drilling or well installation due to the low permeability of the aquifer formation, then additional sampling will be performed quarterly for the remainder of the year.

3.3 Horizontal Extent Groundwater Sampling

The horizontal extent groundwater sampling consists of installing and sampling six monitoring wells installed in the Hoover Street right-of-way, as close as practicable to the PRB transect. The proposed monitoring well locations are shown on Figure 9; well depths and screen intervals are summarized in Table 3. The monitoring wells will be constructed using 2-inch diameter Schedule 40 PVC machine slotted well screen and blank casing, and will be installed using the sonic method with one well per boring. Soil samples will be collected for laboratory analysis at 5-foot depth intervals during drilling of all of the borings, and will be analyzed for VOCs using USEPA Method 8260b. Grab groundwater samples may also be collected during drilling of the horizontal extent well borings, to obtain qualitative information on the vertical extent of contamination and to provide additional data to select screen intervals for the wells.

The newly installed monitoring wells will be developed no less than 72 hours after installation, and will be sampled no less than 48 hours after development. The groundwater samples will be analyzed for VOCs using USEPA Method 8260b. The wells will be sampled on a quarterly basis for one year..

Procedures for drilling, well installation and development, and groundwater sampling are provided in Section 5.

3.4 Hydraulic Assessment

The hydraulic assessment consists of performing borehole dilution tests, slug tests, and a 24-hour constant rate test to evaluate hydraulic properties in the high concentration portion of the Area 1 groundwater plume. Proposed work includes:

- Conducting borehole dilution tests (a type of single well tracer test) in the vertical profile monitoring wells in Area 1.
- Conducting slug tests in the vertical profile monitoring wells, and in up to five additional monitoring wells to be selected based on the results of the vertical profile groundwater sampling.
- Installing and developing one 4-inch diameter PVC groundwater extraction well and one 2-inch diameter PVC piezometer.
- Performing an 8-hour step drawdown test and a 24-hour constant rate test using the new extraction well as a pumping well and the new piezometer and vertical profile monitoring wells as observation wells.

Procedures for drilling, well installation and development, and hydraulic testing are provided in Section 5.

3.5 Treatability Testing

Laboratory studies will be performed to evaluate potential PRB media, including typical chemical and biochemical products that facilitate successful field applications of anaerobic biological treatment, chemical treatment, or combinations thereof (typically referred to as biogeochemical treatment) of groundwater. The types of products that are likely to be evaluated (independently or in combination) include but are not limited to carbon substrates such as emulsified vegetable oil, nutrients such as nitrogen, iron/iron compounds, and specialized microorganisms to enhance the degradation of the contaminants of concern in groundwater.

Initial testing will consist of batch microcosms performed using soil and groundwater collected from the Site to identify the most optimal and feasible combinations of materials and dosages under ideal conditions that achieve treatment objectives. Based on the results and outcome of the batch tests, longer-term column tests will be performed to evaluate media performance under conditions that simulate field conditions, including using flow rates similar to actual groundwater flow velocities. Specific items to be evaluated in the column tests include contaminant destruction efficiency, daughter compound production and destruction, degradation timeframe and kinetics, preliminary field design characteristics, preliminary field operation and maintenance requirements, and potential costs for a full-scale system.

4. METHODOLOGY

The following sections summarize the methodologies and procedures that will be used to complete the investigation.

4.1 PERMITTING

Permits required for the proposed investigation will be obtained prior to the start of field work. Required permits are anticipated to include the following:

- Well permits from the Los Angeles County of Public Health for all monitoring wells and for soil borings greater than 10 feet deep.
- Excavation permits from the City of Los Angeles Bureau of Engineering for monitoring wells installed in public rights-of-way.
- Building materials permits from the City of Los Angeles Bureau of Street Services for lane closures in a public right-of-way.
- Traffic plans from the City of Los Angeles Department of Transportation, as required by the excavation and building materials permits.

4.2 UTILITY CLEARANCE

All well and soil boring locations will be cleared for underground utilities prior to field work. Utility clearance will include notifying Underground Service Alert for utility clearance at least 48 hours prior to the start of work and a geophysical survey performed by a private utility locating service. In addition, all locations will be cleared using either air excavation or by hand augering immediately prior to drilling.

4.3 FIELD PROCEDURES

Procedures that will be used for installing and sampling soil borings and monitoring wells are briefly described in the following subsections. Field work will be performed by trained personnel working under the direct supervision of a California-licensed Professional Geologist or Professional Civil Engineer.

4.3.1 Sonic Drilling and Soil Sampling

The sonic drilling method uses a combination of rotation and high frequency vibrations to advance a core barrel or casing through the subsurface. Initially, a core barrel slightly smaller than the sonic drill casing is advanced approximately 10 feet into the subsurface. The core barrel is then retrieved and vibrated to expel the soil or rock sample into a plastic sample bag for examination and sampling. Flush threaded steel casing slightly larger in diameter than the core barrel is then advanced to the bottom of the cored interval. Slough generated as the casing is advanced is then removed by performing a cleanout run with the core barrel. Drilling is then continued by advancing the core barrel 10 feet, advancing the casing 10 feet, and performing a cleanout run. Once the boring is cored to total depth, the casing is advanced to the bottom of the boring.

4.3.2 Soil Sample Handling

Samples for laboratory analysis will be collected using a syringe-type sampler and placed in pre-weighed 40 milliliter (ml) volatile organic analysis (VOA) vials containing either sodium bisulfite or methanol preservative, in accordance with USEPA Method 5035. The syringe samplers and vials will be provided by the laboratory. The vials will then be placed in labeled ziplock-type bags and stored in an ice chest cooled with ice pending transportation to the laboratory under chain-of-custody protocols.

4.3.3 Lithologic Logging

The borings will be logged for lithology during drilling, in general accordance with the Unified Soil Classification System, Visual Manual Method (ASTM International [ASTM] Standard D-2488 06; ASTM, 2006). Logging will be performed by a geologist or engineer working under the direct supervision of a California-licensed Professional Geologist.

4.3.4 Field Headspace Screening

Field headspace screening will be performed by placing a small amount of soil in a labeled plastic ziplock-type bag, which will then be allowed to set for several minutes. Immediately prior to screening, the soil will be disaggregated using finger pressure without opening the bag. Headspace volatile organic compound concentrations will then be measured by inserting the probe of a calibrated photonization detector (PID) into the bag. The highest observed PID reading at each depth interval was recorded on the boring log.

4.3.5 Grab Groundwater Sampling

Samples of first-encountered groundwater will be collected by lowering a disposable polyethylene bailer through the sonic drill casing. The samples will immediately be transferred from the bailer to 40 ml VOA vials containing hydrochloric acid preservative. The vials will then be labeled, placed in plastic ziplock-type bags, and stored in an ice chest pending delivery to the laboratory under chain of custody procedures.

Grab groundwater samples may also be collected below the water table using the "case-and-bail" method. In this method, drilling is temporarily halted and groundwater allowed to accumulate in the sonic drill casing. The accumulated groundwater is then purged from the borehole by bailing or pumping. A groundwater sample is then collected using a disposable bailer and handled as described above.

4.3.6 Well Installation

After drilling and soil sampling have been completed, monitoring or groundwater extraction wells will be constructed. The wells will be constructed by assembling and placing the well casing and screen inside the sonic drill casing. Annular well completion materials (filter pack, transition sand, bentonite well seal, and grout backfill) will be placed as the drill casing is removed. All monitoring wells will be completed at the surface with a traffic-rated well box set in concrete.

4.3.7 Well Development

The wells will be developed no sooner than 72 hours after installation, using a combination of the surge-and-bail and pumping methods. Development will continue until approximately three borehole volumes of groundwater have been removed and water quality parameters stabilize to within the following limits: pH ±0.1 unit, temperature ±1.0 degrees Fahrenheit (°F), electrical conductivity (EC) ±3%, and turbidity less than 10 nephelometric turbidity units (NTU) or ±10%. In the event that a well is pumped dry before three borehole volumes of groundwater have been removed, development will be terminated after three hours.

4.3.8 Groundwater Sampling

Groundwater sampling will be performed using conventional low-flow methods with a non-dedicated sampling pump equipped with a flow cell. Initially, approximately one pump and tubing volume of groundwater will be purged from each well. After the initial purge, water quality parameters will then be measured at approximate 3-minute intervals. Purging will continue until three consecutive sets of measurements stabilize to within the following limits: pH ±0.1 unit, temperature ±1.0 °F, EC ±3%, dissolved oxygen (DO) ±0.3 mg/L, oxidation reduction potential (ORP) ±10 mV, and turbidity less than 10 NTU or ±10%. Groundwater samples will then be collected directly from the pump discharge line into laboratory-provided containers, in order of decreasing volatility. The groundwater sample will be placed in appropriate containers provided by the laboratory, labeled, placed in ziplock-type bags, and stored in an ice chest cooled with ice pending transportation to the laboratory under chain-of-custody protocol.

4.4 HYDRAULIC TESTING

The following sections describe the hydraulic testing procedures.

4.4.1 Borehole Dilution Tests

Borehole dilution tests are a type of single-well tracer test. The tests are performed by adding a tracer compound to a well, and then measuring the rate at which the tracer concentration declines over time due to dilution by groundwater flow. Analysis of this data provides a direct estimate of groundwater flow velocity. Tetra Tech has developed test methodologies that involve using distilled water as a tracer, and electrical conductivity measurements as a proxy for concentration. These methods have been refined for both high- and low-permeability formations.

The tests are performed by pumping groundwater from the bottom of a well while simultaneously adding distilled water to the top of the water column at the same rate, such that the water level in the well is unaffected. When essentially all of the groundwater in the well has been replaced with distilled water, pumping is stopped and electrical conductivity measurements are collected using an electrical conductivity sensor/datalogger unit suspended in the well. The electrical conductivity measurements are used to calculate the fraction of the distilled water tracer remaining in the well at a given time. This tracer "concentration" is then used to estimate groundwater velocity. Test interpretation will be performed by a qualified hydrogeologist working under the direct supervision of a California-licensed Certified Hydrogeologist.

4.4.2 Slug Tests

Slug tests are performed by displacing the water level in a well by inserting or removing a weighted slug from a well, and then measuring the rate of water level recovery. Falling head tests are conducted as the slug is lowered into the well; rising head tests are performed as the slug is removed.

Prior to conducting a test, the water level in the well is measured manually with an electronic water level meter to determine the static groundwater level. An electronic pressure transducer/datalogger is then be suspended in the well, and water level is monitored until static conditions are reestablished. A falling-head test is then conducted by smoothly lowering a weighted PVC slug into the well and securing it in place above the pressure transducer, and recording the rate of water level recovery. Once static conditions are reestablished, a rising-head test is conducted by removing the slug and allowing the water level to again recover to static conditions while recording the rate of recovery. Barometric pressure changes during testing will be monitored and recorded using a pressure transducer placed above the water table.

At the end of each test, the pressure transducer is removed from the well, and the water level displacement data is downloaded to a laptop computer and corrected for barometric pressure effects. The slug test data is then interpreted using AQTESOLV or equivalent aquifer test software. Test interpretation will be performed by a qualified hydrogeologist working under the direct supervision of a California-licensed Certified Hydrogeologist. Whenever possible, both the falling-head and rising-head data will be analyzed to cross-check the interpretation results.

4.4.3 Constant Rate Tests

Constant rate aquifer testing includes conducting an eight-hour step-drawdown tests to select an appropriate flow rate, followed by 24-hour constant rate test. The step drawdown tests are performed by pumping the new extraction wells at two to four rates, depending on the time required for drawdown to stabilize during each step. Groundwater discharge will be monitored during the test with a direct-reading flow meter and a totalizing flow meter, and is adjusted as necessary during the test to maintain the target flow rates for the duration of each step.

Electronic pressure transducer/dataloggers are used to monitor drawdown in the extraction well. The pressure transducers are placed in the well the day before aquifer testing begins to record barometric and diurnal effects on static water levels. Atmospheric pressure is recorded throughout the test period to correct the pressure transducer data for barometric pressure fluctuations. Water levels are also manually monitored and recorded as a backup.

Following the step-drawdown test, a 24-hour constant-rate test will be performed, using the new extraction wells as a pumping wells, and the new observation well and the vertical profile monitoring wells as observation wells. Drawdown will also be monitored in at least one well located outside the likely area of influence of the extraction well. Discharge and drawdown will be monitored in the extraction and observation wells as described above for the step-drawdown test. Recovery data will be collected after the pumping phase of the test has concluded. Recovery will be collected until the extraction and observation wells have recovered to at least 90 percent of the static water levels.

The constant-rate test data will be interpreted using AQTESOLV or equivalent aquifer test software. Test interpretation will be performed by a qualified hydrogeologist working under the direct supervision of a California-licensed Certified Hydrogeologist.

4.5 Equipment Decontamination

All equipment used for sampling contaminated media (soil samplers, groundwater sampling pumps, etc.) will be decontaminated before each use by scrubbing with a non-phosphate detergent, followed by rinses with tap water and distilled water, or by steam cleaning or high-pressure hot water washing in a contained system. Other equipment, such as sonic drill casing or direct push drill rods, will be decontaminated between borings by steam cleaning or high-pressure hot water washing in a contained system.

4.6 Waste Management

Soil generated during drilling and well installation will be stored on-site in 55-gallon drums or covered roll-off bins. Water used for equipment decontamination and purged groundwater from well sampling or aquifer testing will be stored onsite in 55-gallon United States Department of Transportation-approved drums or a bulk storage tank.

Composite soil and groundwater samples will be collected from each roll-off bin, bulk storage container, or group of 55-gallon drum for the purpose of waste profiling. Once approved for disposal by an appropriate state-licensed facility, the wastes will be transported and disposed under a uniform hazardous waste manifest or a non-hazardous manifest.

4.7 Laboratory Methods

The following subsections summarize the methods that will be used for analysis of soil and groundwater samples collected during the investigation.

4.7.1 Groundwater Analysis

Groundwater samples will be analyzed for VOCs using USEPA Method 8260B. All analyses will be performed by a California-certified laboratory.

4.7.2 Soil Analysis

Soil samples will be analyzed for VOCs using USEPA Method 8260B. All analyses will be performed by a California-certified laboratory.

5. REPORTING

After the field investigation has been completed, a report summarizing the results of the investigation will be prepared. The report will include the following:

- Narrative describing the field investigation.
- Tables summarizing the analytical results.
- Figures, including geologic cross sections and drawings illustrating the lateral and vertical extent of soil and groundwater contamination.
- Conclusions and recommendations.
- Appendices, including boring logs, laboratory reports, and aquifer test interpretations.

6. SCHEDULE

The field investigation, including permitting, one round of groundwater sampling, and laboratory analysis, is anticipated to require approximately 3 to 4 months to complete. A second round of groundwater sampling would be performed approximately 1 month after the first. The investigation report is anticipated to require approximately one additional month to prepare.

Assuming that the results from the first two rounds of groundwater sampling are comparable, no further sampling of the newly installed monitoring wells would be performed. However, if there is evidence for cross-contamination that does not resolve within one month, as many as three additional quarters of groundwater sampling may be needed to obtain representative data.

Treatability testing will start after the vertical profile monitoring wells are installed, approximately one month after the start of work. Treatability testing is anticipated to require 5 to 6 months to complete.

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FIGURES

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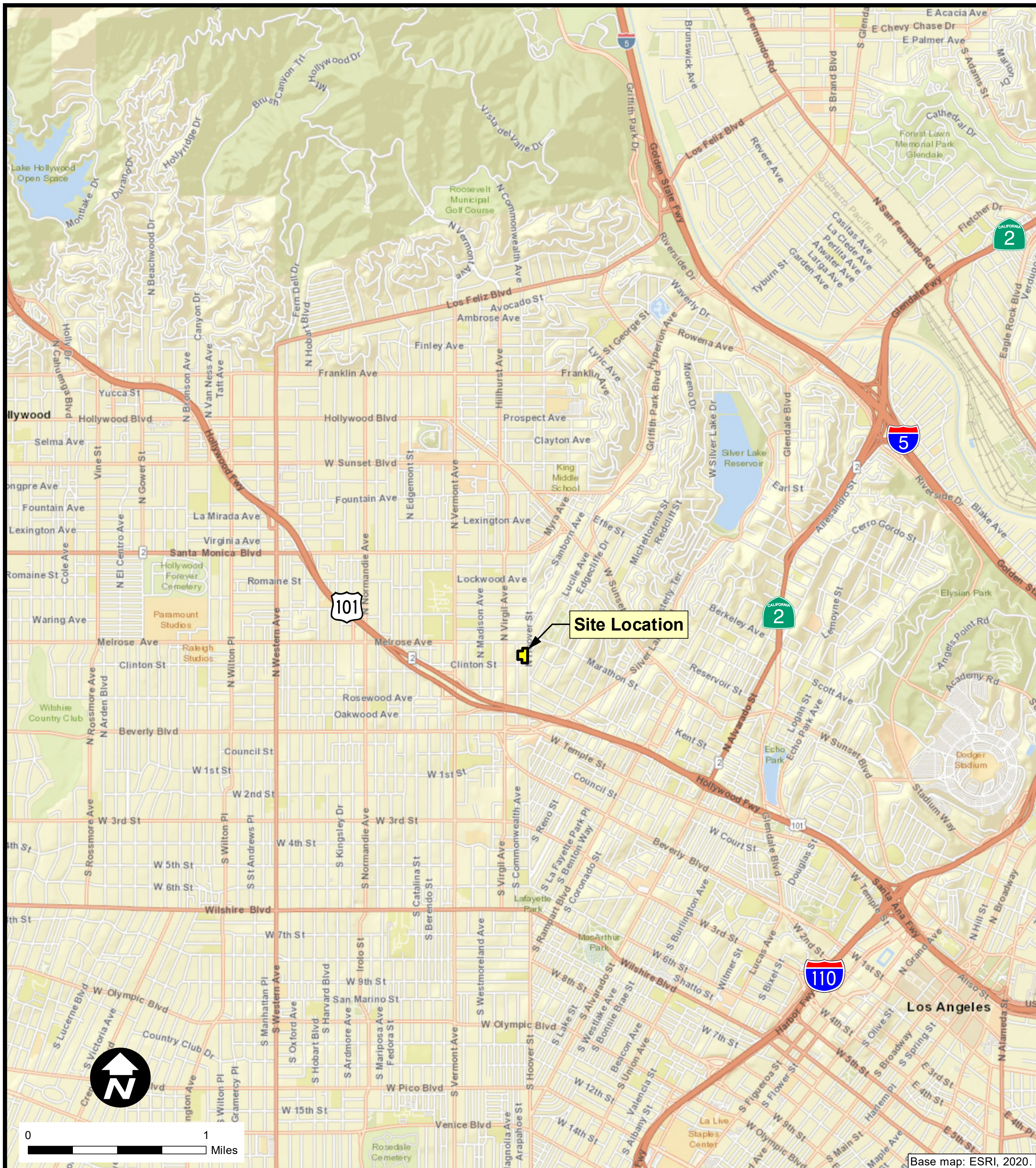

Streetlight Maintenance Headquarters Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 1

Site Location

TETRA TECH

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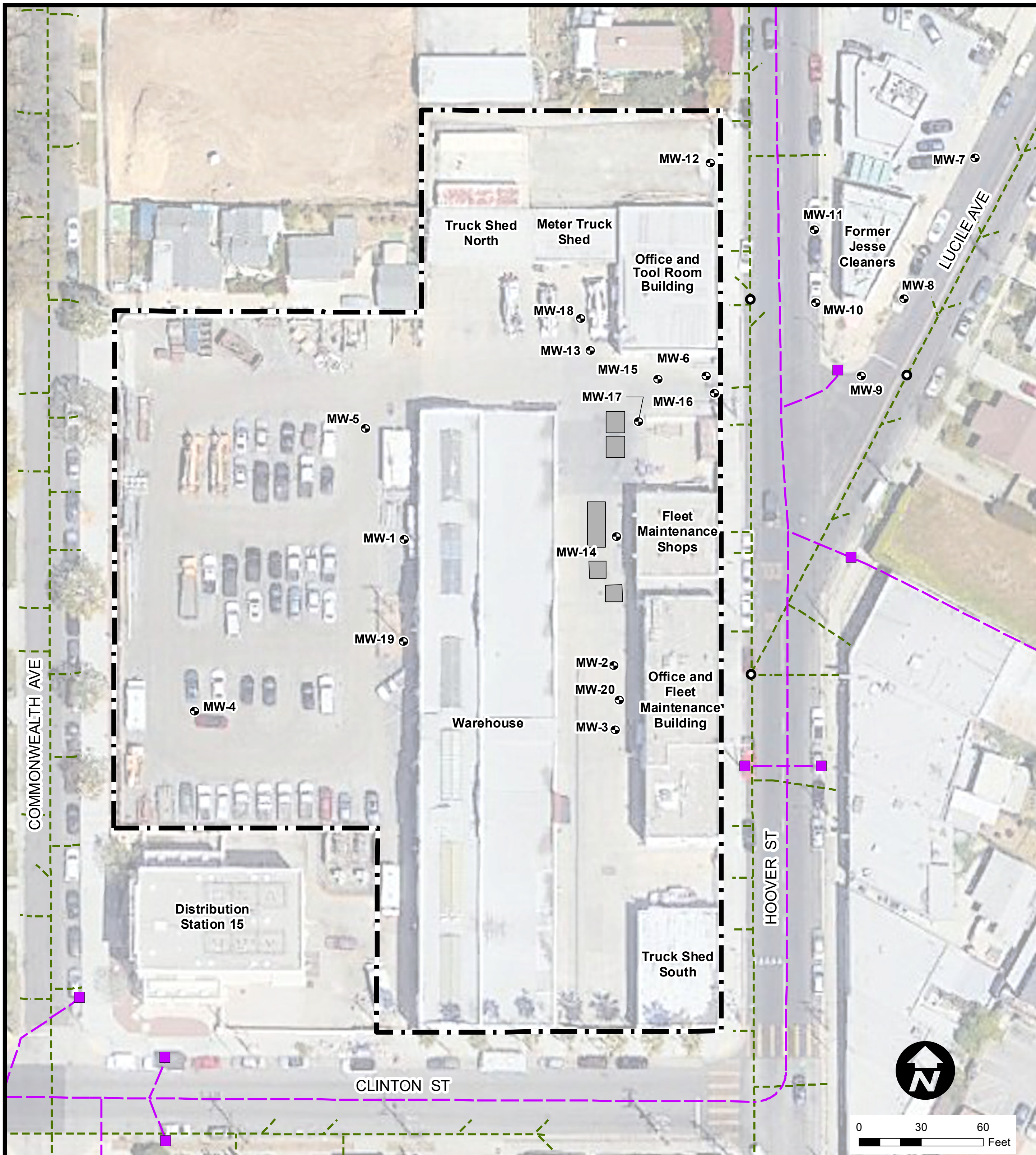

Groundwater Monitoring Well

Manhole

Catch Basin

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 2

Site Plan

TETRA TECH

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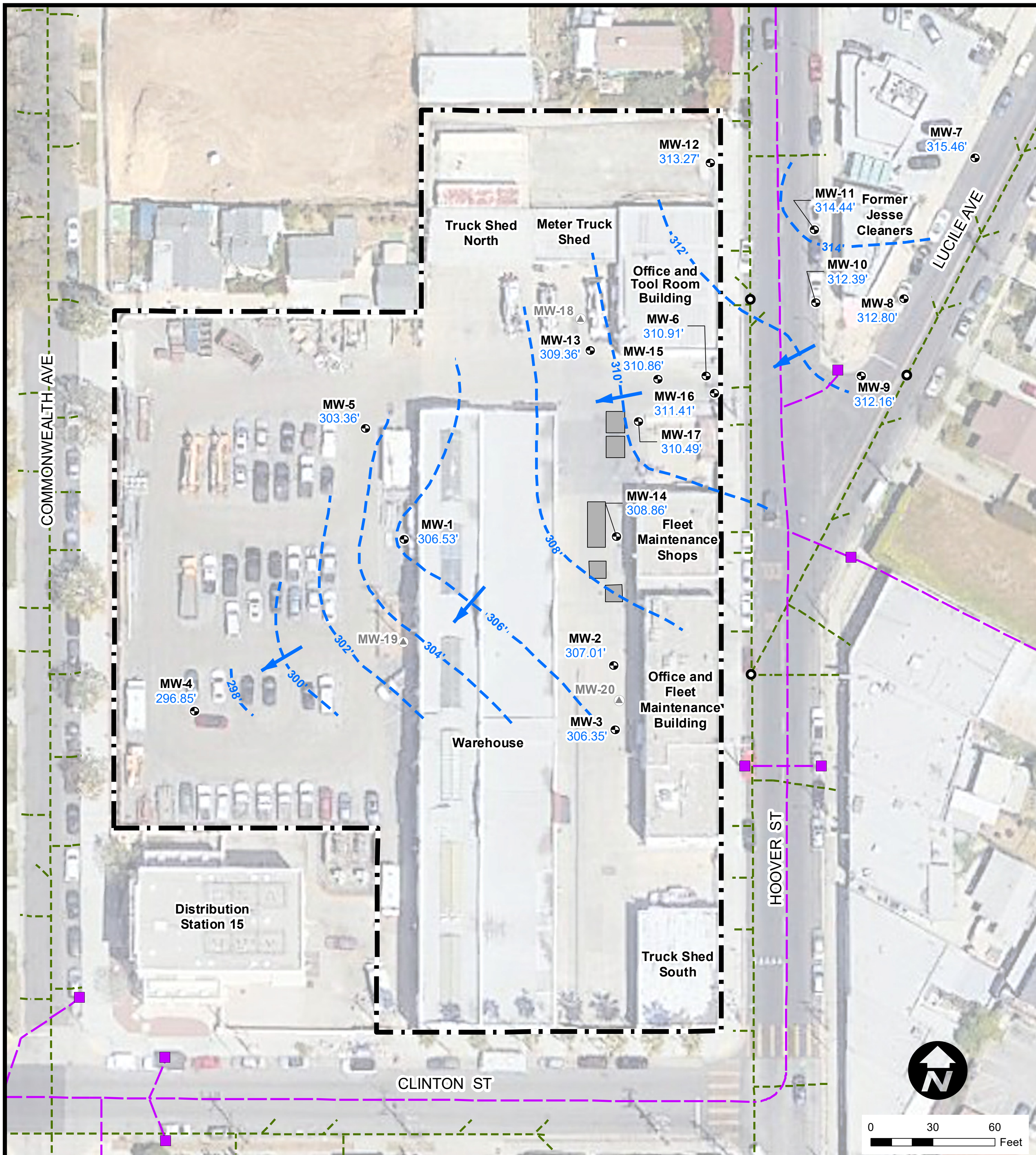

Monitoring Well (Shallow) with Groundwater Elevation (ft msl)

Monitoring Well (Deep)

Manhole

Catch Basin

Groundwater Elevation Contour (ft msl) (dashed where inferred)

Approximate Groundwater Flow Direction

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

Notes:

ft msl - feet above mean sea level

Monitoring well MW-7 was not used for contouring.

Groundwater elevations and contours from Kleinfelder, August 2020

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 3
Shallow Groundwater Elevations (August 2020)

TETRA TECH

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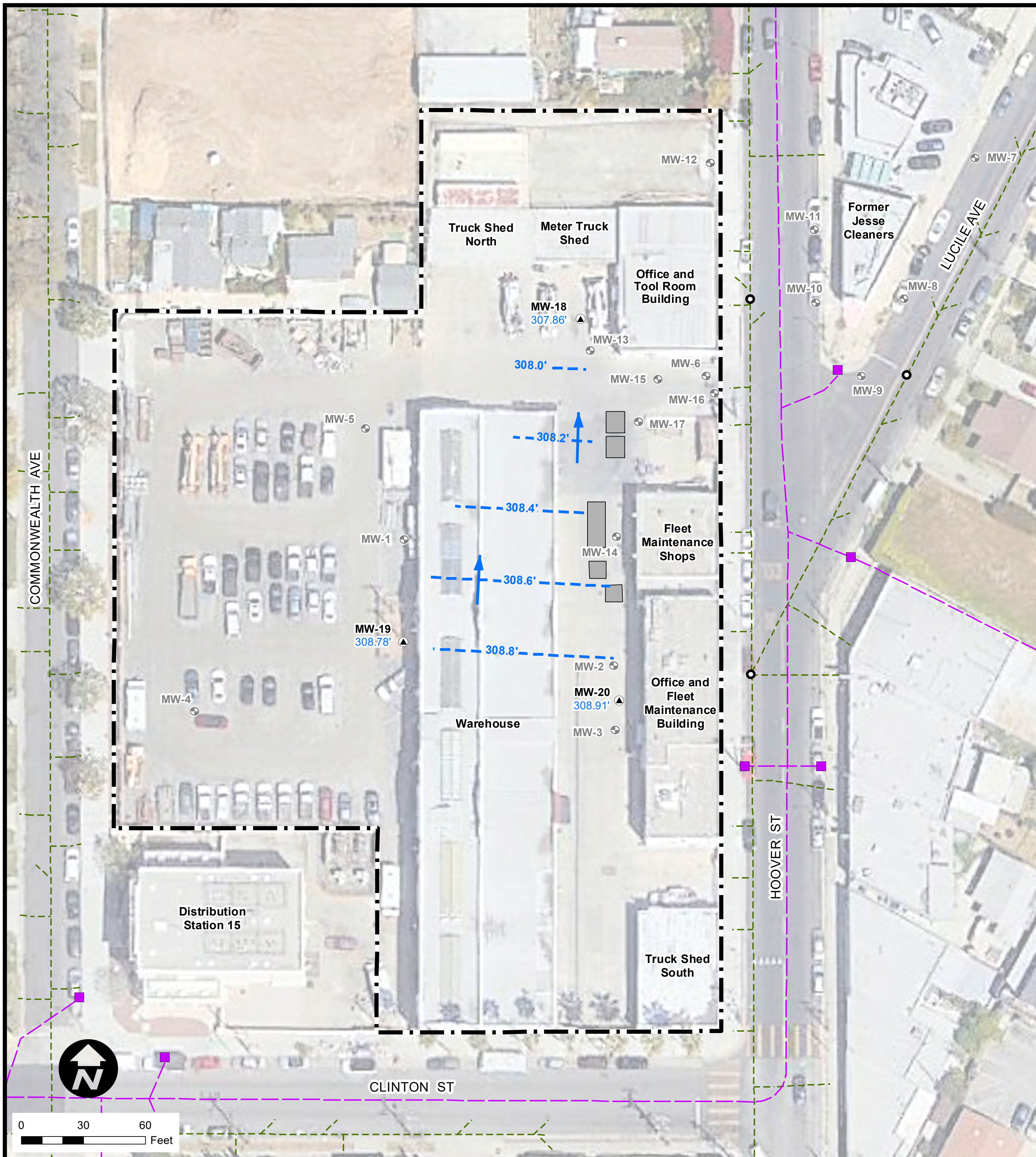

Monitoring Well (Shallow)

Monitoring Well (Deep) with Groundwater Elevation (ft msl)

Manhole

Catch Basin

Groundwater Elevation Contour (ft msl) (dashed where inferred)

Approximate Groundwater Flow Direction

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

Notes:
ft msl - feet above mean sea level
Monitoring well MW-7 was not used for contouring.
Groundwater elevations and contours from Kleinfelder, August 2020

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 4

Deep Groundwater Elevations (August 2020)

TETRA TECH

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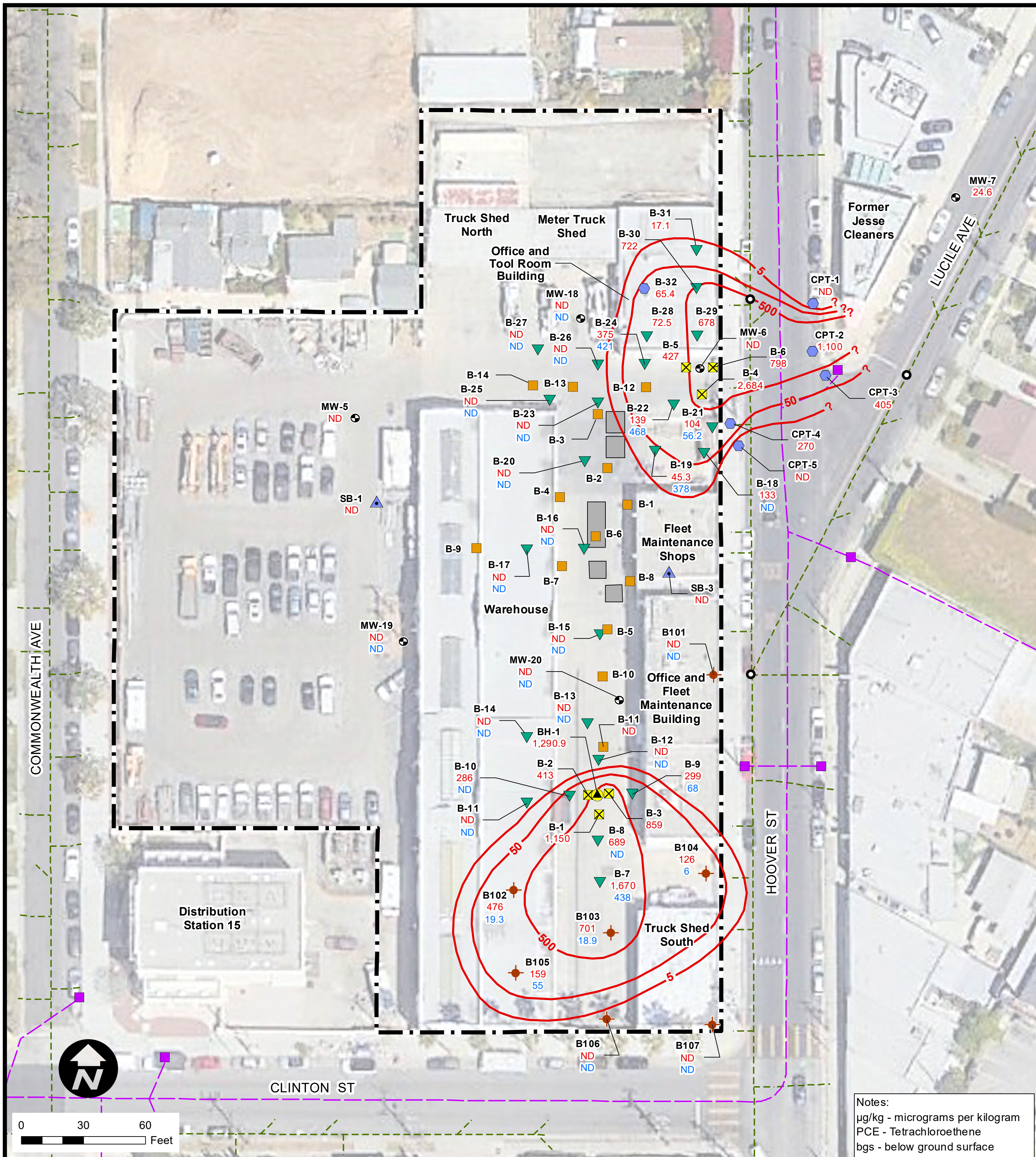

PCE Sample Location with Concentration
1-10 feet bgs (µg/kg), 15-20 feet bgs (µg/kg)

- Earth Tech (1991)
- URS (2004)
- LADWP (2000)
- URS (2005)
- Parsons (2001)
- Tetra Tech (2008)
- Parsons (2003)
- Well
- Manhole
- Catch Basin
- PCE in Soil Isocontour (µg/kg)
- Stormdrain
- Sewer
- Former Underground Storage Tank (UST)
- Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 5

Extent of PCE in Soil

TETRA TECH

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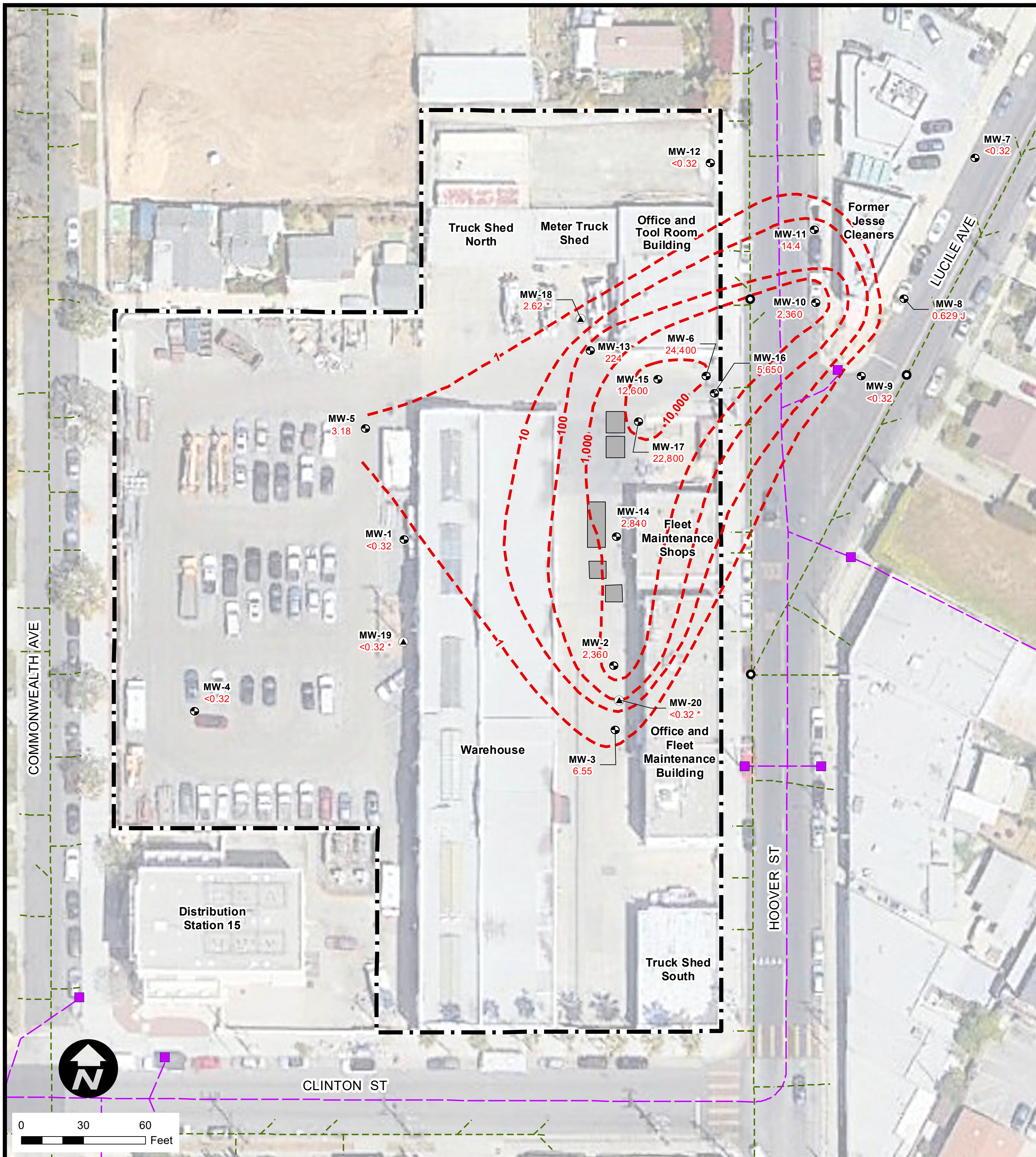


Monitoring Well (Shallow) with PCE Concentration (µg/L)

Monitoring Well (Deep) with PCE Concentration (µg/L)

Manhole

Catch Basin

PCE in Groundwater Isocontour (µg/L) (dashed where inferred)

Stormdrain

Sewer

Former Underground Storage Tank (UST)

Site Boundary

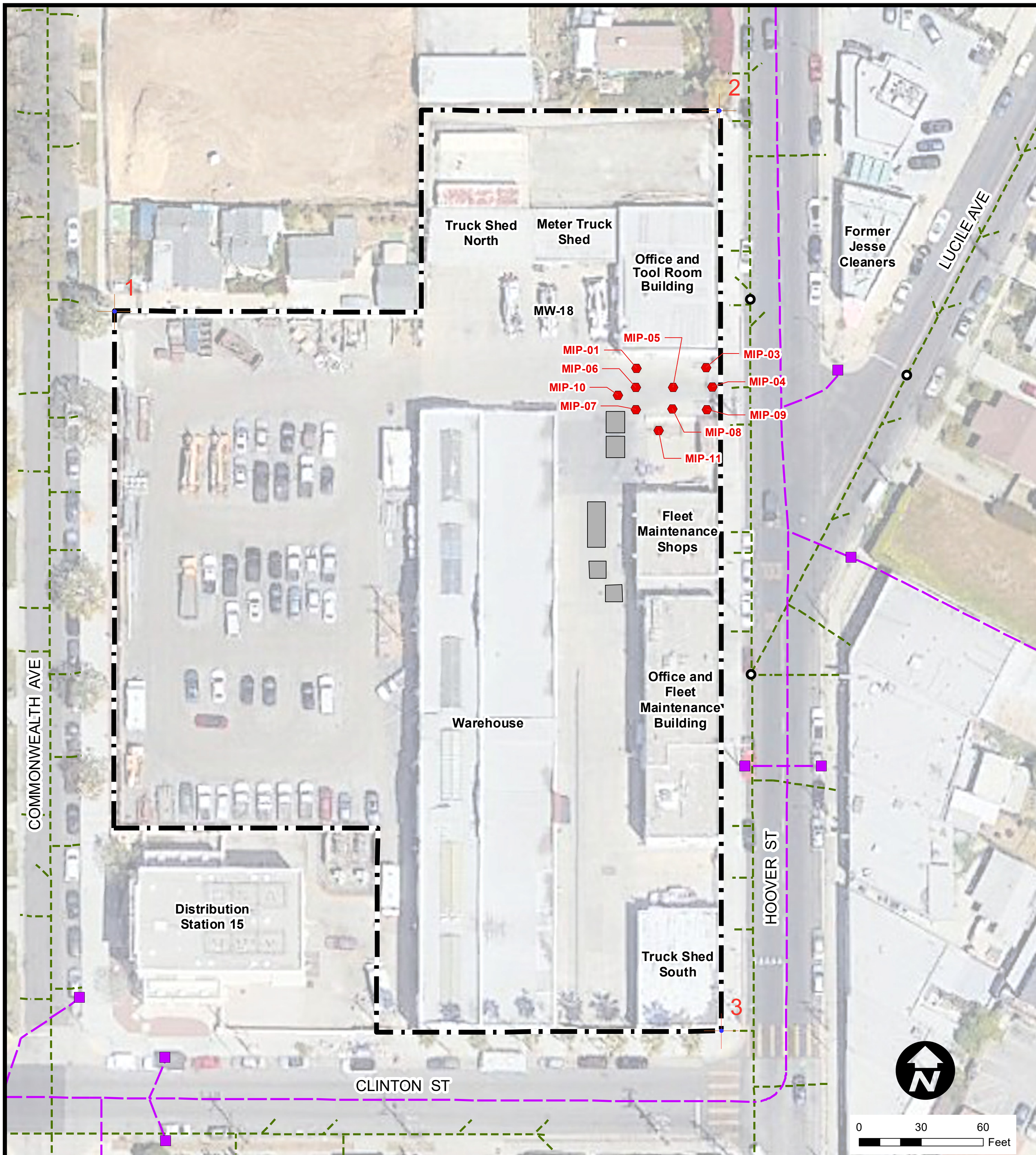
Notes:
µg/L - micrograms per liter
PCE - Tetrachloroethene
* - Deep well not included in contouring
PCE isocontours and concentrations from Kleinfelder, August 2020.

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 6

Extent of PCE in Groundwater

TETRA TECH



- MIP Location
- Manhole
- Catch Basin
- Stormdrain
- Sewer
- Former Underground Storage Tank (UST)
- Site Boundary

Note:
MIP - Membrane Interface Probe

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 7

MIP Investigation Locations

TETRA TECH

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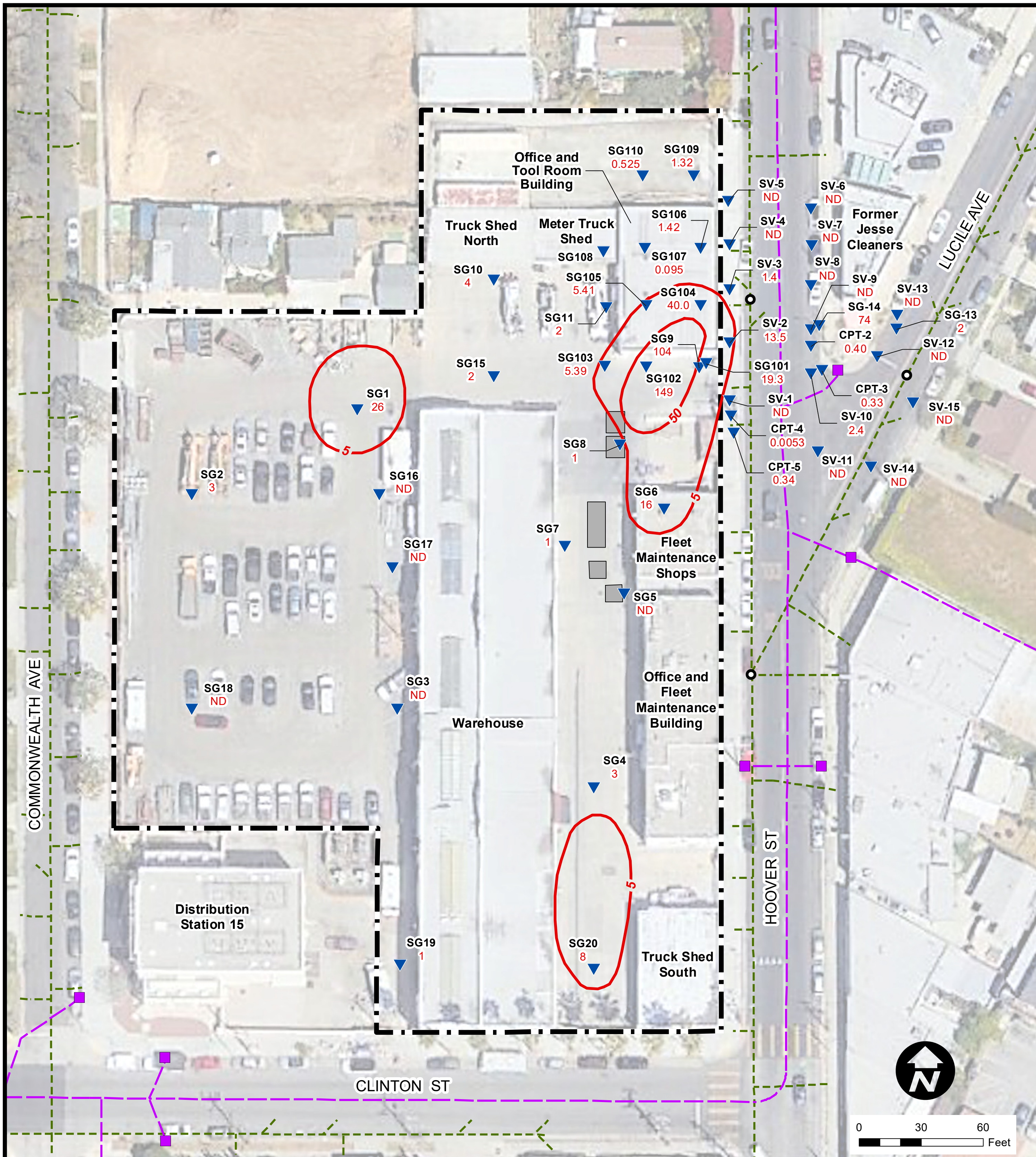

- PCE Soil Gas Sampling Location with concentration in µg/L
- Manhole
- Catch Basin
- PCE Isoconcentration Contour
- Stormdrain
- Sewer
- Former Underground Storage Tank (UST)
- Site Boundary

Note:
MIP - Membrane Interface Probe
µg/L - micrograms per liter

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 8

PCE Concentrations in Soil Gas

TETRA TECH

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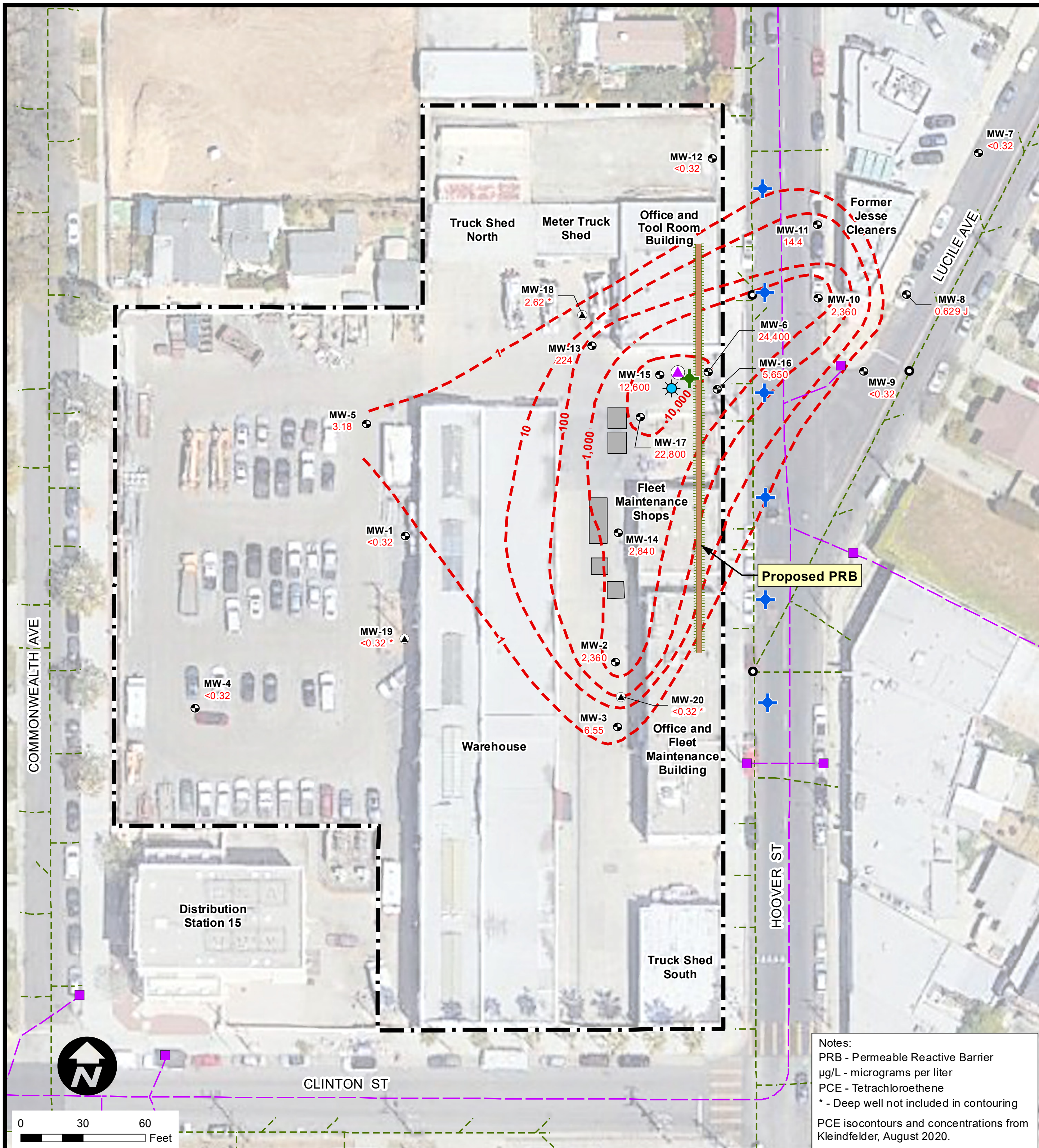

Notes:
PRB - Permeable Reactive Barrier
µg/L - micrograms per liter
PCE - Tetrachloroethene
* - Deep well not included in contouring

PCE isocontours and concentrations from Kleindfelder, August 2020.

- Proposed Vertical Extent Monitoring Well
- Proposed Horizontal Extent Monitoring Well
- Proposed Extraction Well
- Proposed Piezometer
- Monitoring Well (Shallow) with PCE Concentration (µg/L)
- Monitoring Well (Deep) with PCE Concentration (µg/L)
- Manhole
- Catch Basin
- Permeable Reactive Barrier
- PCE in Groundwater Isocontour (µg/L) (dashed where inferred)
- Stormdrain
- Sewer
- Former Underground Storage Tank (UST)
- Site Boundary

LADWP ENVIRONMENTAL AFFAIRS
STREETLIGHT MAINTENANCE HEADQUARTERS

Figure 9

Proposed Well Locations

TETRA TECH

TABLES

Table 1
Comparison of Maximum Chemical Concentrations in Soil with Screening Criteria
LADWP Streetlight Maintenance Headquarters

Compound	Maximum Concentra-tion (µg/kg)	Human Health Criteria			Soil-to-GW Criteria	
		Residential (µg/kg)	Commercial/ Industrial (µg/kg)	Source	RSL (µg/kg)	Source
Tetrachloroethene	***2,800***	590	2,700	DTSC-SL	2.3	MCL
Trichloroethene	54.2	940	6,000	RSL	1.8	MCL
Benzene	**602**	330	1,400	DTSC-SL	2.6	MCL
n-Butylbenzene	6,160	2,400,000	18,000,000	DTSC-SL	3,200	Risk
sec-Butylbenzene	1,810	2,200,000	12,000,000	DTSC-SL	5,900	Risk
Ethylbenzene	3,500	5,800	25,000	RSL	780.0	MCL
Isopropylbenzene	4,230	1,900,000	9,900,000	RSL	740	Risk
p-Isopropyltoluene	285	--	--	--	--	--
Naphthalene	***8,090***	2,000	6,500	DTSC-SL	0.38	Risk
N-Propylbenzene	**16,500**	3,800	24,000	RSL	1,200	Risk
1,2,4-Trimethylbenzene	39.8	300,000	1,800,000	RSL	81	Risk
1,3,5-Trimethylbenzene	193	270,000	1,500,000	RSL	87	Risk
Toluene	1,200	1,100,000	5,300,000	DTSC-SL	690	MCL
m,p-Xylenes	8,800	550,000	2,400,000	RSL	9,900	MCL

Notes:
-- indicates value not available.
Bold indicates concentration exceeding residential screening criteria.
Bold italics indicates concentration exceeding residential and commercial/industrial screening criteria.
Shading indicates concentration exceeding soil-to-groundwater screening criteria.
DTSC-SL: DTSC HHRA Note 3 screening level for soil.
RSL: USEPA Regional Screening Level for soil.
MCL: USEPA MCL-based soil-to-groundwater RSL.
Risk: USEPA risk-based soil-to-groundwater RSL.

Table 2
Comparison of Maximum Chemical Concentrations in Groundwater with Screening Criteria
LADWP Streetlight Maintenance Headquarters

Compound	Maximum Detected Concentration (µg/L)				Screening Level (µg/L)	Source
	3rd Quarter 2020	4th Quarter 2020	1st Quarter 2020	3rd Quarter 2020		
Acetone	1.74	73.6	81	<10.1	14,000	RSL
Benzene	**113**	**573**	**305**	**177**	1	MCL
2-Butanone	<0.31	48.7	58.7	<0.18	5,600	RSL
Carbon disulfide	<0.35	0.357	0.326	0.347	160	NL
Chlorobenzene	**101**	**93.2**	**103**	**104**	70	MCL
Chloroform	1.24	0.495	0.818	0.594	80	MCL
1,1-Dichloroethene	**125**	**91.7**	**112**	**110**	6	MCL
cis-1,2-Dichloroethene	**454**	**387**	**124**	**296**	6	MCL
trans-1,2-Dichloroethene	**378**	**330**	**92.5**	**144**	10	MCL
Ethylbenzene	<0.11	24.4	202	86.6	300	MCL
Isopropylbenzene	<0.16	11.4	72.5	22.1	770	NL
Naphthalene	<0.09	<0.09	**618**	**33**	17	NL
n-Propylbenzene	<0.14	<0.14	118	48	260	NL
Tetrachloroethene	**41,200**	**30,000**	**31,400**	**24,700**	5	MCL
Toluene	107	89	95.3	103	150	MCL
Trichloroethene	**1,240**	**1,260**	**237**	**214**	5	MCL
1,2,4-Trimethylbenzene	<0.16	<0.16	9.89	6.22	330	NL
1,3,5-Trimethylbenzene	<0.17	<0.17	5.82	<0.084	330	NL
Vinyl chloride	<0.18	<0.18	<0.148	**39.6**	0.5	MCL
Total Xylenes	<0.27	<0.27	15.8	20.3	1,750	MCL

Notes:
--: Screening level not available.
MCL: California Maximum Contaminant Level for drinking water.
NL: California Notification level for drinking water.
RSL: USEPA Regional Screening Level for tapwater

Table 3
Proposed Monitoring Well Construction
LADWP Streetlight Maintenance Headquarters

Well ID	Well Diameter (inches)	Well Depth (feet bgs)	Screen Interval (feet bgs)	Notes
Vertical Profile Wells				
VP-1a	2	30	25-30	Nested wells to be installed in Area 1.
VP-1c	2	50	45-50	
VP-1e	2	70	65-70	
VP-1b	2	60	35-40	Nested wells to be installed in Area 1.
VP-1d	2	70	55-60	
Horizontal Extent Wells				
HE-1	2	Note 1	Note 1	Wells to be installed in Hoover Street.
HE-2	2	Note 1	Note 1	
HE-3	2	Note 1	Note 1	
HE-4	2	Note 1	Note 1	
HE-5	2	Note 1	Note 1	
HE-6	2	Note 1	Note 1	
Hydraulic Test Wells				
EW-1	4	Note 1	Note 1	Wells to be installed in Area 1.
PZ-1	2	Note 1	Note 1	

Notes:
Note 1: Well depth and screened interval will be based on the results of the vertical profile groundwater sampling in Area 1.