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17 March 2017
Project 731641602

Mr. Keith Nowell, PG
Alameda County Health Care Services Agency
Environmental Health Department
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

Subject: Work Plan for Additional Environmental Investigation and Sampling
Cleanup Case No. Ro03236
3000 Broadway SPE LLC
260 30th Street
Oakland, California
Langan Project: 731635602

Dear Mr. Nowell:

I have read and acknowledge the content, recommendations and/or conclusions contained in the attached document submitted on my behalf to ACDEH's FTP server and the SWRCB's GeoTracker website.

Sincerely yours,

Alan Chamorro
3000 Broadway SPE LLC

WORK PLAN FOR ADDITIONAL ENVIRONMENTAL SAMPLING AND MONITORING

260 30th Street
Oakland, California 94611

Prepared For:

Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502

Prepared By:

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Principal

17 March 2017
750635602

LANGAN

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Technical Excellence
Practical Experience
Client Responsiveness

17 March 2017

Mr. Keith Nowell, PG
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502

Re: Work Plan for Additional Environmental Sampling and Monitoring
Cleanup Program Site - Case No. RO03236
260 30th Street
Oakland, California
Langan Proposal No.: 750635602

Dear Mr. Nowell,

Langan Engineering and Environmental Services, Inc. (Langan), on behalf of 3000 Broadway SPE LLC (Client), is pleased to submit this *Work Plan for Additional Environmental Sampling and Monitoring* (Work Plan) to further evaluate soil and groundwater at the 260 30th Street (site) property in Oakland, California. The Work Plan also outlines methods to collect soil gas samples, install and sample monitoring wells, and evaluate remedial alternatives.

Our recent February 2017 subsurface investigation, conducted at the site encountered both soil and groundwater that was impacted by total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and/or to a much lesser extent, polycyclic aromatic hydrocarbons (PAHs). The sampling activities and analytical results of our recent February 2017 investigation were summarized in our *Additional Environmental Site Characterization* report dated 8 March 2017.

If you have any questions or need any information clarified, please call Joshua Graber at (510) 874-7086.

Sincerely yours,
Langan Engineering and Environmental Services, Inc.

Karianne Staehlin
Senior Staff Scientist

Joshua Graber, CHMM
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cc: Alan Chamorro – Lowe Enterprises Real Estate Group

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260 30th Street
Oakland, California

1.0 INTRODUCTION

On behalf of 3000 Broadway SPE LLC (Client), Langan Engineering and Environmental Services, Inc. (Langan) has prepared this *Work Plan for Additional Environmental Sampling and Monitoring* (Work Plan) for the property located at 260 30th Street (site) in Oakland, California (Figure 1). The site is part of a larger redevelopment project (3000 Broadway Redevelopment) consisting of four warehouse-like structures (250, 260, and 288 30th Streets and 3020 Broadway), including one former restaurant (3000 Broadway), and two private residential properties (3007 and 3009 Brook Street) in a fully developed mixed-use area of Oakland, commonly referred to as Auto Row. The additional environmental sampling and monitoring proposed is intended to further evaluate current conditions prior to redevelopment and to evaluate future remediation and mitigation measures to address the soil and groundwater impacts during and after redevelopment.

Our recent February 2017 subsurface investigation, conducted at site and adjacent properties encountered both soil and groundwater which was impacted by total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and/or to a much lesser extent, polycyclic aromatic hydrocarbons (PAHs). The sampling activities and analytical results of our recent February 2017 investigation were summarized and submitted to the Alameda County Department of Environmental Health (ACEH) in our *Additional Environmental Site Characterization* report dated 8 March 2017.

The site is currently in the Alameda County Local Oversight Program (LOP) and is associated with active cleanup program site RO03236. Case RO03236 was opened following the discovery of TPH and VOC impacts in soil during a geotechnical investigation in November 2016. We believe the impacts are related to a nearby floor drain system, which is proposed for removal during site redevelopment. Additionally, TPH impacts are located near former floor hoists, which, according to the former owner, were mounted on the concrete slab along the eastern portion of the site.

The site is also in the LOP with an active fuel leak case number of RO0000247. However, we do not believe the recently discovered TPH, VOC, and PAH-impacted soil and groundwater are related to the former underground storage tank (UST) located in the sidewalk of 30th Street due to the upgradient location of the impacts relative to the former UST.

The purpose of the additional environmental sampling and monitoring proposed in this Work Plan is to:

1) Further investigate and delineate subsurface conditions near the floor drain and former floor hoists located at the site to determine the extent of removal during excavation;
2) Install shallow groundwater monitoring wells at and downgradient of the site to establish a monitoring well network, determine a groundwater flow direction, monitor groundwater elevations, and collect groundwater samples for remedial design purposes;
3) Complete deeper (greater than 20 feet below ground surface [bgs]) groundwater sampling near the floor drain and along the eastern portion of site near the former floor hoists to evaluate vertical impacts to groundwater (if any);
4) Evaluate downgradient groundwater contamination by collecting grab-groundwater samples from the area southeast of the site along 30th Street;
5) Evaluate the potential for vapor intrusion at site-adjacent properties by collecting soil vapor samples downgradient from the site; and
6) Characterize the site soil planned for excavation and off-site disposal.

A summary of our proposed additional environmental sampling and monitoring, including sampling and analytical testing methods, are presented in this Work Plan.

Following the completion of the additional subsurface investigation, we will prepare a technical report summarizing our field activities, sampling methods, analytical results and further recommendations. We will also share and discuss the results with ACEH.

1.1 Site Description and Proposed Redevelopment

The site is part of a larger redevelopment project (3000 Broadway Redevelopment) consisting of four warehouse-like structures (250, 260, and 288 30th Streets and 3020 Broadway), including one former restaurant (3000 Broadway), and two private residential properties (3007 and 3009 Brook Street) in a fully developed mixed-use area of Oakland, commonly referred to as Auto Row. Until recently, the warehouse-like structures were utilized as automobile sales, repair and service shops, a restaurant, or were vacant. Currently, only the 288 30th Street address is an active business (XYZ Motors). The restaurant (3000 Broadway) recently closed; the former showroom (3020 Broadway) is vacant; and the two private residences (3007 and 3009 Brook Street) are vacant and planned for either relocation or demolition.

As show in Figure 2, the larger development area is bound by a commercial property and asphalt parking area to the north, Brook Street to the east, 30th Street to the south, and Broadway to the west. The site and surrounding area generally slopes to the southeast. The larger development area has an approximate high elevation of 50 feet above mean sea level (MSL) at the northwest corner along Broadway, and an approximate low elevation of 30 feet above MSL at the southeast corner near the corner of 30th and Brook Streets.

Current development plans for the site and surrounding area include the construction of a five-story, wood-frame apartment building, over a one- to two-story concrete podium with parking. The proposed development will have a single level basement along Broadway leveling out to the current grade at Brook Street, as the ground surface elevation drops. The entrance to the partial below grade parking will be along Brook Street. The partial below grade parking level will be naturally ventilated along the southern and eastern faces of the site. Mechanical ventilation will be provided on the interior parking area. All residential and commercial units are situated above the parking podium. A maximum excavation depth of 18 to 20 feet is expected along Broadway and a minimum excavation of seven to eight feet along Brook Street is expected. The data proposed for collection as part of this Work Plan will be used, in part, to evaluate soil to be excavated and also soil to be left in place as part of the redevelopment.

The site is generally blanketed by medium dense clayey sand fill underlain by alternating layers of medium stiff to stiff clays and medium dense to very dense sands. During our previous February 2017 sampling, Langan inserted 1-inch PVC temporary casings in each boring in order to record groundwater level measurements and also to collect grab-groundwater samples (all borings with the exception of B-29). The temporary wells were left open overnight to allow groundwater levels to stabilize. A summary of rough groundwater elevation measurements and flow directions are provided below.

Groundwater at the site is anticipated to flow in a southeasterly direction towards the Glen Echo Creek, which is located over 300 feet away from the site boundary. Groundwater elevations measured in November 2016 at the site ranged from about 21 feet above MSL in boring B-13 located in the 3020 Broadway parcel to about 9 feet above MSL in boring B-16 located in the 260 30th Street parcel. Groundwater elevations measured in February 2017 at the site were significantly higher than those observed in November 2016. February 2017 groundwater elevations ranged from about 29 feet above MSL in boring B-29 located in the 3020 Broadway parcel to an average of about 26 feet above MSL in borings located in the 260 30th Street parcel. Above average rainfall occurred at the site between November 2016 and February 2017, which contributed to the significant rise in groundwater elevation beneath the site. Additionally, the 3007 and 3009 Brook Street properties, which are located upgradient to the northwest of the 260 30th Street parcel, have unpaved backyards. The presence of unpaved backyards in the upgradient and uphill location relative to the 260 30th Street parcel likely contributed to the greater rise in groundwater elevation along the eastern portion of the site relative to the western portion of the site, due to rainfall infiltration and southeasterly flow towards 260 30th Street.

2.0 RECENT INVESTIGATION

This Work Plan was developed based on the results of our most recent subsurface investigation, which was summarized in the following report:

- Langan Engineering and Environmental Services, Inc., *Additional Environmental Site Characterization, 250 and 260 30th Street, Oakland, California* dated 8 March 2017.

The recent *Additional Environmental Site Characterization* (ESC) summarized the sampling activities and analytical results associated with our recent additional subsurface investigation, which was outlined in our *Work Plan for Additional Environmental Sampling* dated 5 January 2017 and approved by the ACEH in a letter dated 30 January 2017. The primary objective of the recent ESC was to further evaluate subsurface conditions prior to redevelopment, specifically related to impacted soil encountered during a recent geotechnical investigation at boring B-16 located in the 260 30th Street property and near a floor drain system.

A total of 14 exploratory borings (B-17 through B-30) were drilled to a maximum depth of 28 feet bgs between 1 and 3 February 2017. Based on field observations in borings B-24, indicating the presence of soil impacts and the lack of clear soil impacts observed in boring B-17, additional borings were completed along the eastern portion of the site, which were not originally proposed, to evaluate observed contamination in boring B-24. One additional boring was advanced within the 288 30th Street property, at the request of the ACEH, and one additional boring was advanced within the 3020 Broadway property to determine the depth to groundwater for design purposes. The additional borings were completed following verbal approval by the ACEH.

Borings B-17 through B-26 were advanced within the 250 and 260 30th Street properties to assess soil and groundwater impacts upgradient, around, and downgradient of the floor drains located within each property. Two borings (B-27 and B-28) were drilled within the Brook Street right-of-way to a maximum depth of 16 feet bgs to facilitate the collection of soil and groundwater samples downgradient of the site. Due to the higher groundwater levels, a single exploratory environmental boring (B-29) was drilled to an approximate depth of 28 feet bgs within the 3020 Broadway property, to document upgradient groundwater elevation changes only. No soil or groundwater samples were collected from this boring due to the proximity of boring B-13, which had groundwater previously collected. In their 30 January 2017 Work Plan approval letter, ACEH requested that an additional boring be drilled within the 288 30th Street property, to investigate the subsurface conditions in the vicinity of former USTs. The additional boring (B-30) was drilled to an approximate depth of 24 feet bgs. All drilling was conducted by Gregg Drilling and Testing of Martinez, California (Gregg) using hydraulically-driven, direct push technology. Soil sampling was conducted using a macrocore sampler, lined with clean acetylene liners driven 48-inches into the soil. Grab-groundwater samples were collected from all borings, except B-29. Grab-groundwater samples were collected using a clean stainless steel bailer, decontaminated after each use, and decanted into laboratory supplied containers. The previous drilling and sampling locations are shown on Figure 2.

Based on the results of the ESC, including soil and groundwater analytical results, Langan concluded the following:

> *Soil and groundwater samples collected as part of our February 2017 investigation were collected in general accordance with our work plan. Soil vapor samples were not collected due to significantly higher groundwater elevations and moisture content observed at the proposed sample depths. The increase in groundwater elevation and moisture content in soil are related to the above average rainfall in the winter of 2017. Soil and groundwater analytical results collected as part of this characterization effort indicate the 260 30th Street property is impacted with TPH, VOCs and to a much lesser extent PAHs. TPH and VOC concentrations in soil above the RWQCB Tier 1 Environmental Screening Levels (ESLs) appear to be limited to the upper 10 feet beneath the site.*
>
> *The most significant TPH impacts in soil and/or groundwater appear to be limited to the eastern portion of the site in borings B-16, B-20, B-23, B-24, B-25, and B-26 with concentrations diminishing within Brook Street and lower concentrations detected near*

the floor drain. Borings with the highest TPH impacts are located near former floor hoists, which, according to the former owner, were mounted on the concrete slab along the eastern portion of the site.

VOCs, predominantly tetrachloroethene (PCE), trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE), were also detected in soil and groundwater. The highest concentrations of these compounds were detected in soil and groundwater near and downgradient of the floor drain location in borings B-18, B-20 and B-22 at the site. Concentrations decrease downgradient towards Brook Street and are significantly lower in the cross-gradient direction to the north in borings B-19 and B-21 and to the south in boring B-26. PCE, TCE and cis-1,2-DCE were not detected in the groundwater sample collected in April 2016 from boring B-12, located just north of the corner of 30th Street and Brook Street.

VOCs present in soil and groundwater pose a potential vapor intrusion to indoor air risk and appropriate risk mitigation measures will be employed in the building design. Confirmation sample results will be used to assess risk and the appropriate mitigation measures

Based on the findings, analytical results, and conclusions, Langan's ESC also went on to recommend the following next steps:

Langan recommends that soil with concentrations exceeding Tier 1 ESLs be removed during construction to approximately 10 feet bgs. Additional soil screening and sampling at the 260 30th Street parcel is needed to delineate the soil volume exceeding screening criteria, and recommended for over-excavation. Additional soil and groundwater chemistry data will also be obtained to evaluate groundwater cleanup alternatives.

Langan recommends the following with respect to groundwater remediation planning.

- *Complete deeper (>20 feet bgs) groundwater sampling near the floor drain and along the eastern portion of 260 30th Street;*
- *Install groundwater monitoring wells to collect groundwater verification samples, monitor groundwater elevations and evaluate risk management and remedial measures in the 260 30th Street parcel and downgradient within Brook Street;*
- *Perform groundwater sampling at the site wells and Brook Street wells and downgradient within 30th Street to evaluate downgradient groundwater conditions.*

Langan also recommends collecting soil vapor samples in the parking lane of Brook Street to assess potential vapor intrusion risk to offsite building occupants, if possible. Langan is preparing an additional work plan that will present additional sampling locations, methodology and analytical procedures. The work plan will also present *methods to evaluate vapor intrusion risk and potential mitigation measures which will be incorporated into the building design. The work plan and mitigation strategy will be submitted to the ACEH for approval prior to implementation.*

Langan recommends preparing a Soil Management Plan (SMP) that presents soil and groundwater management protocols for excavation, handling and grading activities that may occur during site redevelopment. The physical area covered by the SMP will cover the area proposed for soil disturbance, transport and soil storage or stockpiling. The SMP includes measures to mitigate potential risks to the environment and to protect on-site construction workers and/or pedestrians/site visitors from potential exposure to hazardous substances that may be encountered during soil intrusive or development activities at the site.

3.0 ADDITIONAL ENVIRONMENTAL SAMPLING

Langan proposes to conduct additional subsurface sampling and analyses at the site, within the adjacent properties and downgradient right-of-ways. The additional environmental sampling is proposed to:

1) Further investigate and delineate subsurface conditions near the floor drain and former floor hoists located at the site to determine the extent of removal during excavation;

2) Install shallow groundwater monitoring wells at and downgradient of the site to establish a monitoring well network, determine a groundwater flow direction, monitor groundwater elevations, and collect groundwater samples for remedial design purposes;

3) Complete deeper (greater than 20 feet below ground surface [bgs]) groundwater sampling near the floor drain and along the eastern portion of site near the former floor hoists to evaluate vertical impacts to groundwater (if any);

4) Evaluate downgradient groundwater contamination by collecting grab-groundwater samples from the area southeast of the site along 30th Street;

5) Evaluate the potential for vapor intrusion at site-adjacent properties by collecting soil vapor samples downgradient from the site; and

6) Characterize the site soil planned for excavation and off-site disposal.

The proposed sampling locations are shown on Figure 2, and include the following:

- Two borings (MIP-1 and MIP-2) to a maximum depth of 30 feet bgs with membrane interface probe (MIP) technology to determine depth and concentration of previously encountered contaminants, including TPH, VOCs, and PAHs;
- Six borings (B-31 through B-36) with dual-tube/hydropunch or pre-packed temporary well screen technology to a maximum depth of 20 feet bgs for the collection of soil and/or grab-groundwater samples;
- Two borings (GGW-1 and GGW-2) with dual-tube/hydropunch or pre-packed temporary well screen technology to collect deeper grab-groundwater samples;
- Three shallow borings (SV-1 through SV-3) for the installation of temporary soil vapor wells and the collection of soil vapor samples;
- Nine borings (B-37 through B-45) for composite soil sampling and analysis to characterize soil for off-site disposal purposes; and
- Installation, development, surveying and sampling of five groundwater monitoring wells (GW-1 through GW-5), as described in Section 4.0.

3.1 Site Specific Health and Safety Plan

A Site-specific *Health and Safety Plan* will be prepared by Langan as required by the Occupational Health and Safety Administration Standard "Hazardous Waste Operations and Emergency Response" guidelines (29 CFR 1910.120). The Health and Safety Plan will be reviewed and signed by Langan personnel and subcontractors performing work at the site, prior to conducting field activities.

3.2 Pre-investigation Tasks

We will coordinate site access with all appropriate parties prior to sampling. At least 72 hours prior to all field activities, we will visit the site to mark out the sample locations and to notify the Underground Service Alert One-Call Notification Center (USA). In addition, we will engage the services of a private utility locator to clear the proposed sample locations for underground utilities. Langan will also procure the required permits from Alameda County Public Works

Agency-Water Resources Department (ACPWA) and/or ACEH and the City of Oakland for the completion of temporary soil vapor wells and all drilling activities.

3.3 Sampling Activities

This section outlines the proposed soil, groundwater, and soil vapor sampling activities. Proposed soil, groundwater, and soil vapor sampling locations and depths are presented in a sampling and analysis plan listed on Table 1. All proposed drilling and sampling locations are shown on Figure 2.

3.3.1 Exploratory Borings with Geoprobe® MIP Technology

Two borings (MIP-1 and MIP-2) will be advanced to an approximate depth of 30 feet bgs using a direct-push drill rig utilizing Geoprobe® MIP technology and operated by Gregg. Borings may be advanced deeper (40 feet bgs) if indications of impacts exist at 30 feet bgs. MIP technology is an in situ logging tool used for the detection and relative measurement of petroleum hydrocarbon compounds, VOCs and PAHs within the soil subsurface. A heated probe adjacent to a permeable membrane is advanced at a rate of no greater than one foot per minute to the desired investigation depth in soil. Volatiles in the subsurface cross the membrane, enter into the carrier gas stream, and are swept to gas phase detectors at ground surface for real-time measurement.

The primary purpose of the proposed MIP borings is to determine the vertical distribution of volatile contaminants that were previously encountered during our recent February 2017 investigation. The continuously logged data from the proposed MIP locations will also help establish discrete shallow and deep groundwater sampling intervals and aid in the installation of groundwater monitoring wells as discussed in Section 4.0.

3.3.2 Soil and Grab-groundwater Sampling

Borings B-31 through B-36 will be advanced using a direct-push drill rig utilizing Geoprobe® technology or hollow stem auger methods and operated by Gregg. If necessary, the borings will be advanced to five feet bgs with a hand auger to clear the location for buried utilities and will be drilled to a maximum depth of 20 feet bgs, depending on field conditions and the depth of groundwater.

Soil materials encountered during drilling activities will be logged in the field by a Langan geologist or engineer following the Unified Soil Classification System (USCS). Soils will be examined in the field for evidence of contamination (including visible staining, odors, and/or elevated readings on a PID). Soil samples proposed for collection from each boring are listed on Table 1. Sample depths are proposed but may be altered in the field based on field conditions and observations. Discreet soil samples will be retained starting at eight feet bgs since this is the estimated excavation depth in this area.

Groundwater samples will only be collected from borings B-31, B-34, B-35, and B-36. Once the boring depth has been achieved, a temporary PVC casing will be placed in the boreholes to measure the groundwater level each location. A hydropunch sampler will be advanced to the desired groundwater interval in an adjacent borehole to facilitate the collection of a grab groundwater sample using a clean stainless steel bailer, decontaminated between each use. Borings B-32 and B-33 are located near the proposed monitoring well GW-1 and grab groundwater location GGW-1 and therefore, are not proposed for groundwater sampling.

Soil samples will be collected into acetate liners and sealed with Teflon and plastic end caps. Grab-groundwater samples will be collected into laboratory provided bottles with and without preservatives. All samples will be placed on ice in a cooler following collection and shipped under chain-of-custody (COC) procedures to a State of California-certified analytical laboratory.

To avoid cross contamination, all sampling equipment used during the investigation activities will be thoroughly cleaned between sample locations. All borings will be backfilled with neat cement grout and the surface cover will be restored in accordance with ACPWA requirements.

3.3.3 Deeper Grab-groundwater Sampling

Borings GGW-1 and GGW-2 will be advanced using a direct-push drill rig utilizing Geoprobe® hydropunch technology and operated by Gregg. The primary purpose of the proposed deeper grab-groundwater sampling is to determine the vertical extent of impacts to groundwater and plan for future remediation. The proposed borings will be advanced to an approximate depth of 28 feet bgs, depending on field conditions and the depth of groundwater.

One grab-groundwater sample will be collected from each boring using a clean stainless steel or new disposable bailer, decontaminated between each use. Grab-groundwater samples will be collected into laboratory provided bottles with and without preservatives. All samples will be placed on ice in a cooler following collection and shipped under COC procedures to a State of California-certified analytical laboratory. To avoid cross contamination, all non-dedicated sampling equipment used during the investigation activities will be thoroughly cleaned between sample locations. All borings will be backfilled with neat cement grout and the surface cover will be restored in accordance with ACPWA requirements.

3.3.4 Soil Vapor Sampling

Soil vapor sampling will be performed following the installation and sampling of monitoring well GW-4, if groundwater concentrations exceed RWQCB ESLs for residential vapor intrusion (mixed soil type). If warranted, the soil vapor sampling will be conducted in general accordance with the California Department of Toxic Substances Control's (DTSC) documents titled "*Advisory – Active Soil Gas Investigation*" dated July 2015 and "*Final, Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*" dated October 2011. Gregg will install up to three shallow temporary soil vapor wells (SV-1 through SV-3) along the Brook Street right-of-way, north of the intersection of Brook and 30th Streets (Figure 2).

3.3.4.1 Temporary Soil Vapor Probe Installation

Temporary soil vapor wells will be installed at an approximate depth of five feet below the existing street level. Soil vapor samples will not be collected if the depth to water is less than five feet. To install the temporary soil vapor probe, 1/8-inch diameter disposable Teflon tubing will be threaded onto the top of a 1.5-inch long, 3/8-inch diameter nylon soil vapor screen implant. The assembly will then be placed into the boring. The soil vapor screen implant will be surrounded by approximately one-foot of sand filter pack. A three- to six-inch layer of dry bentonite chips will be placed above the sand filter pack. Hydrated bentonite chips will be placed above the dry bentonite to create a seal around the tubing to prevent ambient air intrusion into the soil vapor sample. The Teflon tubing attached to the soil vapor probe will extend at least two feet above the surface and will be fitted with a sealable sample valve or port at the end. The temporary soil vapor wells will be installed using direct push macrocore technology. The vapor probes will be allowed to equilibrate for a minimum of two hours before sampling. After the equilibration period, shut-in testing and leak testing (using a helium shroud) will be performed at each location prior to purging and sample collection.

Clean, laboratory-supplied one-liter summa canisters will be used for both purging and sample collection along with flow controllers set to a maximum rate of 200 milliliters per minute (mL/min). Following sample collection, summa canisters will be delivered to a State of California certified laboratory.

3.3.4.2 Sampling Train Assembly

The sampling train will be assembled using the following steps:

1. The initial vacuum of the summa canister (or equivalent) will be recorded prior to sampling. If the initial vacuum reading is less than 26 inches mercury (Hg), the canister will not be used. In addition, the canister will be inspected for damage and a canister that has visible damage will not be used.

2. Following the initial inspection, a dedicated flow controller and vacuum gauge will be attached to the summa canister and sealed with a compression fitting cap (e.g., Swagelok or equivalent).

3. The sample port and sampling manifold will be connected using ¼-inch outside diameter (OD) Teflon tubing and stainless steel compression fitting nut and ferrules. The sampling manifold consists of compression fittings with three valves and one pressure gauge to attach the probe tubing to the summa canister.

4. A syringe will also be connected to the sampling manifold using ¼-inch OD Teflon tubing and stainless steel compression fitting nut and ferrules.

5. The assembled summa canister, flow controller, and pressure gauge shall be connected to the sampling manifold using stainless steel compression fitting nut and ferrules.

3.3.4.3 Shut-in Test

Prior to soil vapor purging and sample collection, a shut-in test will be performed to check for leaks in the aboveground sampling train assembly:

1. The valve that connects the soil vapor probe to the sampling manifold will be closed and the valve that connects to the summa canister will be closed.

2. The syringe will then be pulled to empty air from the manifold.

3. A leak-free system will be evident by observing no loss of vacuum within the sampling manifold system. Noted leaks will be repaired prior to sample collection by checking and tightening the compression fittings on the manifold. The manifold will then be re-checked to make sure it passes the physical leak check before proceeding.

3.3.4.4 Leak Check

Helium will be used as a leak-check tracer gas around the Teflon tubing during sampling as a quality assurance/quality control (QA/QC) measure to confirm the sample integrity. The leak check will be conducted using the following steps:

1. The helium shroud is placed over the soil vapor probe at ground surface, along with the entire sampling train (sampling manifold, pump, and sampling canister).
2. A minimum helium atmosphere of approximately ten percent will be induced within the shroud. The atmosphere within the shroud will be monitored using the Dielectric MGD 2002 instrument (or equivalent), inserted through a small aperture in the shroud. Following the three-volume purge, a small aliquot of soil vapor will be collected into the syringe for helium screening.
3. If helium is detected in the aliquot of purged soil vapor at a concentration less than five percent of the atmosphere induced under the shroud during the purge (e.g., if the helium concentration under the shroud is ten percent, the purged soil vapor should contain less than 0.5 percent helium), the sample flow train integrity will be considered adequate and within an acceptable range (DTSC, 2016).
4. The leak check test is performed during purging and sample collection at each soil vapor sampling location.

3.3.4.5 Sample Collection Methodology

Langan will collect one soil vapor sample from each temporary well. According to DTSC guidelines, if soil vapor wells are installed via hand augering then soil vapor samples will be collected after withdrawing three purge volumes and at least 48 hours after installation of the temporary soil vapor monitoring wells. If soil vapor wells are installed via direct push then soil vapor samples will be collected after withdrawing three purge volumes and at least two hours after installation of the temporary soil vapor monitoring wells. The samples will be collected in a one-liter Summa canister, following protocols:

1. Before collecting the sample, confirm that the sampling system valves are set as follows: 1) the syringe valve is confirmed to be closed, 2) the soil vapor probe valve is open, and 3) the summa canister valve is open;

2. Helium will be reintroduced into the shroud and be allowed to stabilize until at least a ten percent helium concentration has been reached;

3. Upon reaching a stable helium concentration, the summa canister inlet valve will be slowly opened (counter-clockwise) one full turn to begin sample collection at approximately 200 mL/min. During the sample collection, the helium concentration will be monitored using a Dielectric MGD 2002 helium detector and the approximate average concentration will be recorded on the sample field data sheet;

4. The start time and initial vacuum reading from the vacuum gauge will be recorded on the sample label, chain of custody records, and on the field log, along with the summa canister and flow controller identifications;

5. The valve will remain open until the final vacuum reading on the vacuum gauge on the summa canister is between two to four inches Hg. It is important to leave two to four inches of vacuum remaining in the summa canister so the receiving analytical laboratory can verify that the sample was not compromised during shipment;

6. The valve on the summa canister will be closed clockwise until it is finger-tight.

7. Turn off the helium and close the valve at the soil vapor probe tubing;

8. The stop time and final vacuum reading will be recorded on the sample label, chain of custody record, and on the field log. The sampling information on the chain of custody records will be completed and checked against the sample labels and field log; and

9. The summa canister will be removed from the sampling manifold and placed in the laboratory-supplied cardboard boxes.

The soil vapor samples will be submitted under chain of custody protocol to a State of California-certified analytical laboratory.

3.3.4.6 Temporary Soil Vapor Well Decommissioning

After soil vapor sampling is completed, the temporary soil vapor wells will be abandoned by removing the tubing assembly and sand pack from the temporary soil vapor well location and the borehole will be grouted and sealed at the surface with a cold asphalt patch.

3.4 Laboratory Analyses

Based on field observations, we anticipate analyzing up to three soil samples each from borings B-31 through B-36. The soil samples will be submitted for some or all of the following analyses on a standard turnaround time.

- TPHg, TPHd, and TPHmo by EPA Method 8015;
- VOCs by EPA Method 8260; and
- PAHs by EPA Method 8270.

Soil samples without significant TPH concentrations may not be analyzed for PAHs, as PAHs have generally not exceeded ESLs at the site. Additionally, up to three soil samples will be collected and analyzed for soil oxidant demand (SOD) and chromium for remedial planning purposes.

The grab-groundwater samples will be submitted for some or all of the following analyses on a standard turnaround time.

- TPHg, TPHd, and TPHmo by EPA Method 8015;
- VOCs by EPA Method 8260; and
- PAHs by EPA Method 8270.

The soil vapor samples, if collected, will be submitted for the following analyses on a standard turnaround time.

- VOCs by EPA Method TO-15;
- Methane by ASTM D-1946; and
- Helium by ASTM D-1946.

3.5 Sample Identification

Sample nomenclature shall be assigned, as follows:

- Soil samples shall be identified by boring location and bottom depth of sample (i.e. a sample collected at boring location B-31 at a depth of 7.5 to 8.0 feet bgs will be labeled as B-31-8.0);

- Grab-groundwater samples shall be identified by boring location (i.e. B-31-GW);
- Deeper grab-groundwater samples shall be identified by boring location and the mid-point of the screened interval from which it was collected (i.e. GGW-1-24 would have been collected from boring GGW-1 with a screen set between 21.5 and 26.5 feet bgs); and
- Soil vapor samples shall be sequentially identified by the temporary soil vapor well location and depth of sample (i.e. SV-1-4 would have been collected from boring SV-1 at a depth of 4 feet bgs).

3.6 Field Documentation

Field activity logs will be completed for each site visit. Field activity logs shall identify the following: site name and address, date and time on-site, on-site field personnel, general weather conditions, purpose of site visit, a summary of field activities, and any other important details.

3.7 Chain of Custody

Samples will be collected and transported to the analytical laboratory following chain of custody (COC) procedures. The COC documents the identity and integrity of the sample from the time of collection through receipt at the laboratory. The COC will be completed as samples are collected, and will include the following information: sample ID, date of sample collection, time of sample collection, sample type, and sampler name(s). Additionally, the starting and ending pressures for the summa canisters will be noted on the COC form for the soil vapor samples.

3.8 Sample Packing and Shipping

Samples will be packed in boxes and transported, by shipment or courier, to the respective certified analytical laboratories. Each sample will be individually labeled and will be accompanied by the COC. All samples will be transported to the respective analytical laboratories after sample collection. The COC will be signed by the sampler and relinquished to the sample custodian.

3.9 Investigation Derived Waste

Investigation derived waste including soil cuttings, used sampling equipment, and decontamination rinsate will be placed in 55-gallon drums, sealed and labeled. The drums will be stored on-site, pending analytical profiling and proper disposal.

4.0 GROUNDWATER MONITORING WELL INSTALLATION AND MONITORING ACTIVITIES

Langan proposes to install groundwater monitoring wells within the site boundary and downgradient of the site, within the Brook Street right-of-way. Groundwater wells will be used to monitor groundwater elevations prior to and during the construction activities associated with the proposed 3000 Broadway Redevelopment and will be used to facilitate the collection of groundwater samples both on the site and downgradient.

4.1 Groundwater Monitoring Well Installation

A total of five groundwater monitoring wells (GW-1 through GW-5) will be installed, two of which will be installed within the site building (GW-1 and GW-2), and three of which will be installed outside of and downgradient of the site building along Brook Street (GW-3, GW-4, and GW-5). The approximate locations of the proposed groundwater monitoring wells are shown on Figure 2. Prior to the installation of the wells, drilling permits from both ACPWA and the City of Oakland will be obtained, locations will be marked and Underground Service Alert (USA) notified of the planned subsurface activities. Each borehole location will be cleared by a private utility locator, and the upper five feet will advanced by hand auger, if necessary. The well borings will be advanced using hollow-stem auger technology to the following approximate depths (proposed well and screened interval depths may be adjusted based on field observations):

- Two shallow groundwater monitoring wells (GW-1 and GW-2) will be installed within the site building; GW-1 near the floor drain and GW-2 along the eastern portion of the site. Both monitoring wells will be installed to approximate depths of 18 feet.; and

- Three well borings (GW-3 through GW-5) will be advanced along the Brook Street right-of-way to an approximate depth of 15 feet bgs.

The wells will be constructed in an 8-inch borehole by a installing 10 feet of two-inch diameter, 0.010-inch slotted PVC well screen at the bottom of each boring, and blank PVC casing to the ground surface. Monterey kiln-dried #2/12 sand will be placed in the annular borehole space around the screen interval and approximately two feet above the top of screen, a two-foot bentonite seal will placed above the sand filter pack and the borehole will be grouted to the surface. Due to the anticipated temporary nature of the wells within the building (due to construction), a well box will not be installed. The wells will not be exposed to surface runoff since they are interior wells and will be protected from damage by placement of sonotubes.

Wells along Brook Street will be completed to the surface with a flush-mounted, traffic-rated well box. Wells will be installed in general accordance with our well installation standard operating procedure (SOP) presented in Appendix A.

4.2 Groundwater Monitoring Well Surveying and Development

Following construction of the wells, the top-of-casing will be surveyed and the wells developed by bailing and surging using a surge block. Typical water quality parameters (including turbidity, temperature, dissolved oxygen, pH, and oxidation reduction potential) will be recorded during the development of the wells. Following development, the wells will be allowed to stand for a minimum of 24 hours prior to sampling. Wells will be developed in general accordance with our well development SOP presented in Appendix A.

4.3 Groundwater Monitoring Well Sampling and Monitoring

Groundwater monitoring wells will be purged and sampled using low-flow sampling methods, using a low-flow peristaltic pump. Subsequent to the purging of the wells, groundwater samples will be collected. The purged groundwater will be diverted through a YSI water quality meter fitted with a flow through cell and water quality parameters recorded until stabilization of parameters is indicated or three casing volumes are purged from the well. Wells will be sampled in general accordance with our SOP presented in Appendix A.

After purging, groundwater samples will be collected and the samples placed in clean, laboratory-supplied appropriate glass-ware which will be sealed, labeled, and placed in a chilled cooler with ice. Samples will be transported under chain-of-custody protocol to McCampbell Analytical of Pittsburg, California, for chemical analysis.

Groundwater samples from wells GW-1 and GW-2 during the initial sampling event will be analyzed for the following chemical analyses and parameters to assess the area for future remedial planning:

- Dissolved gases: ethene, ethane, and methane;
- Bioattenuation and natural attenuation and chemical oxidation parameters: dissolved oxygen (DO), oxidation-reduction potential (ORP), nitrate, nitrite, iron III, California assessment metals (CAM) 17, sulfate, sulfite, chloride, alkalinity, pH, temperature, and chemical oxygen demand (COD); and
- Microbial cell counts for bioremediation: qPCR for dehalocooides, both for presence of

genes and expression of genes.

Additionally, groundwater samples from all of the monitoring wells will be analyzed for the following:

- TPHg, TPHd, and TPHmo by EPA Method 8015;
- VOCs by EPA Method 8260; and
- PAHs by EPA 8270.

5.0 ADDITIONAL SAMPLING FOR FUTURE REDEVELOPMENT ACTIVITIES

Langan proposes to conduct additional subsurface sampling throughout the larger 3000 Broadway Redevelopment project site, in order to further characterize the soil planned for excavation and off-site disposal.

A total of nine additional borings are proposed to be advanced for the characterization of the shallow subsurface, and their locations are shown on Figure 2. Five borings (B-37 through B-41) will be advanced by Gregg to a maximum depth of 20 feet bgs using a direct-push drill rig utilizing Geoprobe® technology, along the western portion of the 3000 Broadway Redevelopment along Broadway. Soil samples will be collected at the following approximate depths: 1.5, 3, 5, 10, 15, and 20 feet bgs. Four borings (B-42 through B-45) will be advanced by Gregg to a maximum depth of eight feet bgs using a manual hand auger, within the northeastern portion of the 3000 Broadway Redevelopment at the former residential properties. Soil samples will be collected at the following approximate depths: 1.5, 3, 5, and 8 feet bgs. The proposed sampling and analysis plan is listed on Table 1.

Soil materials encountered during drilling activities will be logged in the field by a Langan geologist or engineer following the USCS. Soils will be examined in the field for evidence of contamination (including visible staining, odors, and/or elevated readings on a PID). To avoid cross contamination, all sampling equipment used during the investigation activities will be thoroughly cleaned and decontaminated between sample locations. All borings will be backfilled with neat cement grout and the surface cover will be restored in accordance with ACPWA requirements.

Soil samples will be collected into acetate liners and sealed with Teflon and plastic end caps. All samples will be placed on ice in a cooler following collection and shipped under COC procedures to a State of California-certified analytical laboratory.

5.1 Laboratory Analyses

Soil samples collected from similar depths will be composited in the laboratory and analyzed for the following analyses on a standard turnaround time.

- TPHg, TPHd, and TPHmo by EPA Method 8015;
- Organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) by EPA Method 8081/8082;
- PAHs by EPA Method 8270/8310;
- California Assessment Manual (CAM) 17 Metals by EPA Method 6020;
- Asbestos by CARB 435; and
- One discreet soil sample per boring will be analyzed for VOCs by EPA Method 8260.

6.0 DATA EVALUATION, MONITORING AND REPORTING

Upon the completion of the field activities and analytical testing, Langan will prepare a technical report summarizing our field activities, sampling methods, analytical results and recommendations. The report will compare the analytical results to ESLs and describe the nature and extent of contaminant impacts. Based on the results of our environmental sampling and the proposed redevelopment plan, we will recommend appropriate remedial and environmental mitigation measures.

7.0 PROJECT SCHEDULE

We are requesting your review and approval of this Work Plan for completion of field activities that are estimated to require approximately five to six days. Laboratory analyses are expected to be completed within one to two weeks after sample collection. The complete technical report is anticipated to be complete within four weeks of receipt of all laboratory analytical data.

REFERENCES

Department of Toxic Substances Control (DTSC), *Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance)* dated October 2011;

DTSC, *Advisory – Active Soil Gas Investigations* dated July 2015; and

Langan Engineering and Environmental Services, Inc., *Additional Environmental Site Characterization, 250 and 260 30th Street, Oakland, California* dated 8 March 2017.

TABLE

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Table 1
Sampling Plan
260 30th Street
Oakland, California

Boring ID	Rationale	Approximate Sample Depth[1] (ft below top of slab)	Sample ID	Media	Analytical Suite [2, 3]
260 30th Street Sampling					
MIP-1	To further delineate vertical distribution of VOCs and select groundwater sampling intervals	40	No Samples Proposed	No Samples Proposed	No Samples Proposed
MIP-2	To further delineate vertical distribution of VOCs and select groundwater sampling intervals	40	No Samples Proposed	No Samples Proposed	No Samples Proposed
B-31	To further delineate impacts from 260 30th Street floor drain	8	B-31-8	Soil	TPH-g, -d, and -mo, VOCs, and PAHs
		10	B-31-10		
		12.5	B-31-12.5		
		15	B-31-15		
		20	B-31-20		
		10	B-31-GW	Water	TPH-g, -d, -mo, VOCs, PAHs
B-32	To further delineate impacts from 260 30th Street floor drain	8	B-32-8	Soil	TPH-g, -d, and -mo, VOCs, and PAHs
		10	B-32-10		
		12.5	B-32-12.5		
		15	B-32-15		
		20	B-32-20		
B-33	To further delineate impacts from 260 30th Street floor drain	8	B-33-8	Soil	TPH-g, -d, and -mo, VOCs, and PAHs
		10	B-33-10		
		12.5	B-33-12.5		
		15	B-33-15		
		20	B-33-20		
B-34	To further delineate impacts from 260 30th Street floor drain	8	B-34-8	Soil	TPH-g, -d, and -mo, VOCs, and PAHs
		10	B-34-10		
		12.5	B-34-12.5		
		15	B-34-15		
		20	B-34-20		
		10	B-34-GW	Water	TPH-g, -d, -mo, VOCs, PAHs
B-35	To further delineate impacts from 260 30th Street floor drain	8	B-35-8	Soil	TPH-g, -d, and -mo, VOCs, and PAHs
		10	B-35-10		
		12.5	B-35-12.5		
		15	B-35-15		
		20	B-35-20		
		10	B-35-GW	Water	TPH-g, -d, -mo, VOCs, PAHs
B-36	To further delineate impacts from 260 30th Street floor drain	1.5	B-36-1.5	Soil	TPH-g, -d, and -mo, VOCs, and PAHs
		3	B-36-3		
		5	B-36-5		
		10	B-36-10		
		15	B-36-15		
		5	B-36-GW	Water	TPH-g, -d, -mo, VOCs, PAHs
GGW-1	To further delineate impacts from 260 30th Street floor drain	28	GGW-1	Water	TPH-g, -d, -mo, VOCs, PAHs
GGW-2	To further delineate impacts from 260 30th Street floor drain	28	GGW-2	Water	TPH-g, -d, -mo, VOCs, PAHs
SV-1	To assess off-site vapor intrusion potential	4	SV-1	Soil Vapor	VOCs, Methane, and Helium
SV-2	To assess off-site vapor intrusion potential	4	SV-2	Soil Vapor	VOCs, Methane, and Helium
SV-3	To assess off-site vapor intrusion potential	4	SV-3	Soil Vapor	VOCs, Methane, and Helium
Groundwater Monitoring Wells					
GW-1	To further delineate and monitor impacts from 260 30th Street floor drain	8-18	GW-1-MM-DD-YY	Water	TPH-g, -d, -mo, VOCs, PAHs, and natural attenuation and remedial parameters
GW-2	To further delineate and monitor impacts from 260 30th Street floor drain	8-18	GW-2-MM-DD-YY	Water	TPH-g, -d, -mo, VOCs, PAHs and natural attenuation and remedial parameters
GW-3	To further delineate and monitor impacts from 260 30th Street floor drain	5-15	GW-3-MM-DD-YY	Water	TPH-g, -d, -mo, VOCs, PAHs and natural attenuation parameters
GW-4	To further delineate and monitor impacts from 260 30th Street floor drain	5-15	GW-4-MM-DD-YY	Water	TPH-g, -d, -mo, VOCs, PAHs and natural attenuation parameters
GW-5	To further delineate and monitor impacts from 260 30th Street floor drain	5-15	GW-5-MM-DD-YY	Water	TPH-g, -d, -mo, VOCs, PAHs and natural attenuation parameters
3000 Broadway Redevelopment Characterization					
B-37	Characterization for off-site disposal	1.5	B-37-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-37-3.0		
		5	B-37-5.0		
		10	B-37-10.0		
		15	B-37-15.0		
		20	B-37-20.0		
B-38	Characterization for off-site disposal	1.5	B-38-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-38-3.0		
		5	B-38-5.0		
		10	B-38-10.0		
		15	B-38-15.0		
		20	B-38-20.0		
B-39	Characterization for off-site disposal	1.5	B-39-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-39-3.0		
		5	B-39-5.0		
		10	B-39-10.0		
		15	B-39-15.0		
		20	B-39-20.0		
B-40	Characterization for off-site disposal	1.5	B-40-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-40-3.0		
		5	B-40-5.0		
		10	B-40-10.0		
		15	B-40-15.0		
		20	B-40-20.0		
B-41	Characterization for off-site disposal	1.5	B-41-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-41-3.0		
		5	B-41-5.0		
		10	B-41-10.0		
		15	B-41-15.0		
		20	B-41-20.0		
B-42	Characterization for off-site disposal	1.5	B-42-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-42-3.0		
		5	B-42-5.0		
		8	B-42-8.0		
B-43	Characterization for off-site disposal	1.5	B-43-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-43-3.0		
		5	B-43-5.0		
		8	B-43-8.0		
B-44	Characterization for off-site disposal	1.5	B-44-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-44-3.0		
		5	B-44-5.0		
		8	B-44-8.0		
B-45	Characterization for off-site disposal	1.5	B-45-1.5	Soil	TPH-g, -d, and -mo, VOCs, OCPs, PCBs, PAHs, Asbestos, and CAM-17
		3	B-45-3.0		
		5	B-45-5.0		
		8	B-45-8.0		

Notes:

1 - Sample depths and number are approximate and will be determined in the field based on observations. Up to three soil samples will be analyzed at each boring location.

2 - Soil samples will only be analyzed for PAHs if significant TPH compounds are detected, as PAH concentrations have generally been below Environmental Screening Levels at the site.

3 - Up to three soil samples will be analyzed for soil oxidant demand and chromium from borings B-31 through B-36 for remedial planning purpo

Laboratory methods for each analysis are listed in the Section 3.4 of the report.

Natural attenuation and remedial parameters are listed in Section 4.3 of the report.

Acronyms:

TPHg - Total Petroleum Hydrocarbons as Gasoline, EPA Method 8015B

TPHd - Total Petroleum Hydrocarbons as Diesel Range, EPA Method 8015B

TPHmo - Total Petroleum Hydrocarbons as Motor Oil, EPA Method 8015B

VOCs - Volatile Organic Compounds, EPA Method 8260 for soil and groundwater and EPA Method TO-15 for soil vapor

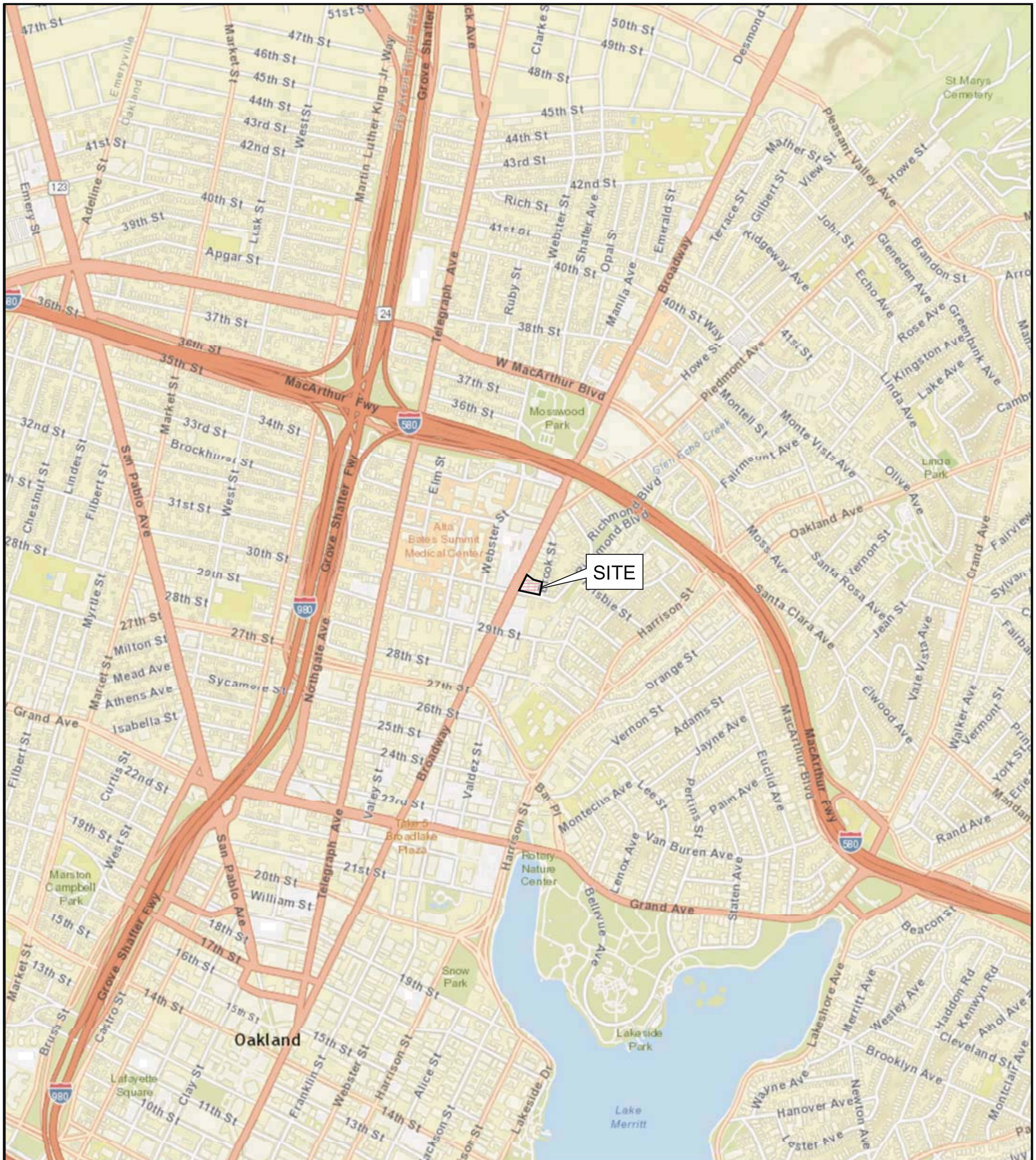
OCPs - Organochlorine pesticides, EPA Method 8081/8082

PCBs - Polychlorinated biphenyls, EPAMethod 8081/8082

PAHs - Polycyclic Aromatic Hydrocarbons, EPA Method 8270/8310

CAM 17 - California Assessment Manual 17 Metals, EPA Method 6020

FIGURES



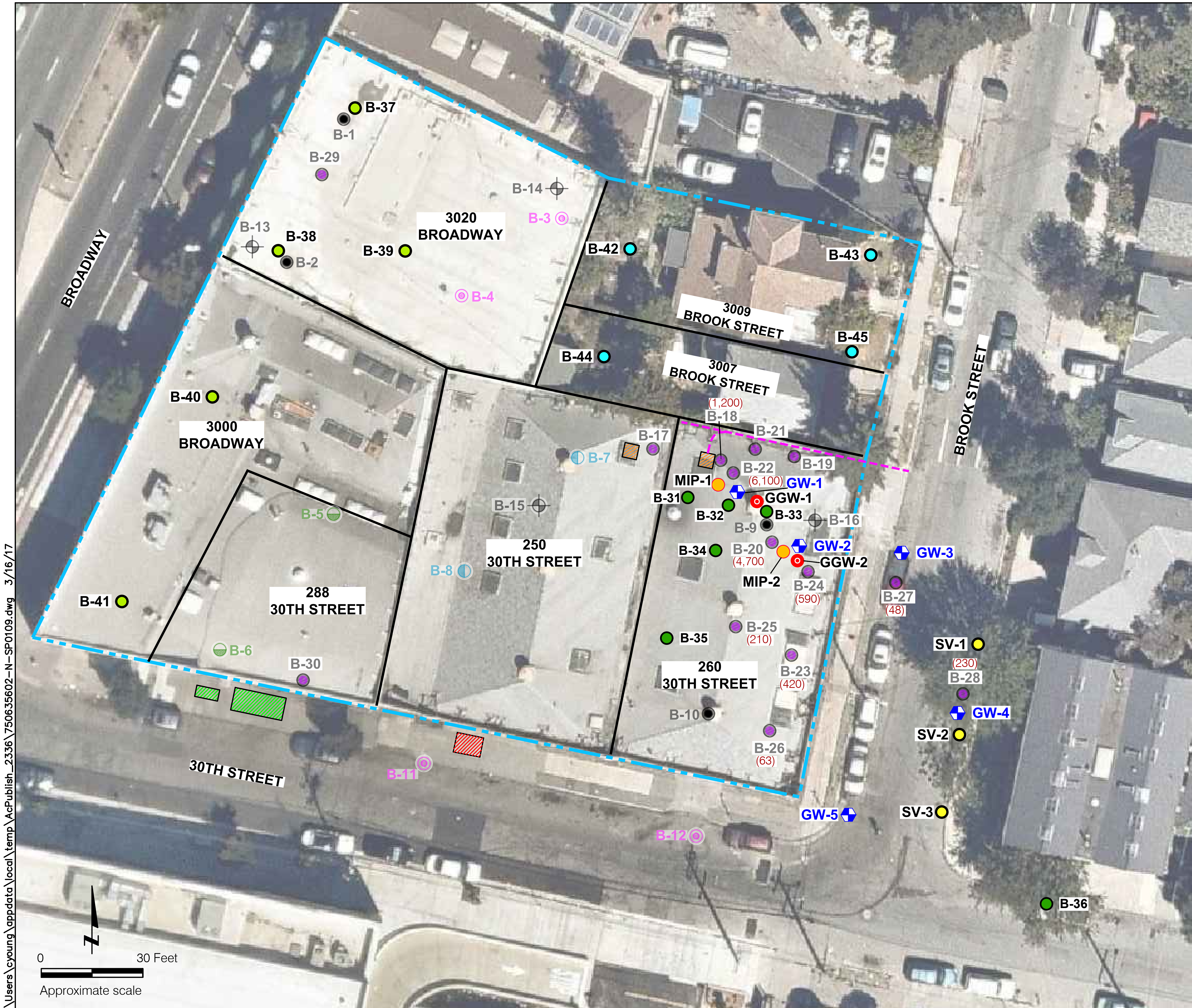
NOTES:

World street basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online.
Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN.

0 1,000 2,000
Feet

N W E S

3000 BROADWAY REDEVELOPMENT **260 30TH STREET** Oakland, California	**SITE LOCATION MAP**
LANGAN	Date 02/08/17 | Project No. 750635602 | Figure 1



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EXPLANATION

- **GGW-1** Approximate location of proposed deep grab groundwater sample
- **GW-1** Approximate location of proposed groundwater monitoring well
- **SV-1** Approximate location of proposed soil gas sample
- **MIP-1** Approximate location of proposed MIP
- **B-31** Approximate location of proposed soil and/or groundwater boring
- **B-37** Approximate location of proposed soil sampling boring for composite characterization, 20 feet bgs
- **B-42** Approximate location of proposed boring for composite characterization, 8 feet bgs
- B-17 Approximate location of environmental boring by Langan, February 2017
- B-13 Approximate location of geotechnical boring by Langan, November 2016
- B-1 Approximate location of 5-foot boring by Langan Treadwell Rollo, April 2016
- B-3 Approximate location of 20-foot boring by Langan Treadwell Rollo, April 2016
- B-5 Approximate location of 15-foot boring by Langan Treadwell Rollo, April 2016
- B-7 Approximate location of 10-foot boring by Langan Treadwell Rollo, April 2016
- Approximate location of abandoned in-place 1,000-gallon waste oil UST, March 1997
- Approximate location of former USTs (350-gallon gasoline and 1,000-gallon diesel), removed in July 1992
- Approximate location of floor drain
- Approximate footprint of proposed 3000 Broadway Redevelopment
- Approximate location of drain line piping
- (230) Concentration of trichloroethene (TCE) in groundwater. Units in micrograms per liter (ug/L

3000 BROADWAY REDEVELOPMENT
260 30TH STREET
Oakland, California

SITE PLAN WITH PROPOSED SAMPLING LOCATIONS

Date 03/16/17	Project No. 750635602	Figure 2

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APPENDIX A
STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE FOR MONITORING WELL INSTALLATION

PURPOSE

The purpose of this standard operating procedure is to delineate the quality control measures required to ensure the accurate installation of monitoring wells.

FIELD SUPPLIES

Drilling Equipment

- Appropriately sized drill adequately equipped with augers, bits, drill stem, etc.
- Steam cleaner and water obtained from approved source for decontaminating drilling equipment
- PID, LEL-Oxygen monitor, and other air monitoring as required
- Water level indicator
- Weighted Steel tape measure
- Drums, bins or other storage containers of generated wastes (drill cuttings, contaminated PPE, decon solutions, etc.)
- Source of approved water
- Waste container labels
- Heavy plastic sheeting

Well Installation Materials

- Well screen :

  Screen will be constructed of appropriate materials (PVC, stainless steel, etc.) cleaned and prepackaged by manufacturer or decontaminated and wrapped in plastic before use.

- Riser pipe:

  Riser will be cleaned and prepackaged by manufacturer or decontaminated and wrapped in plastic before use.

- Plugs or sump: a cap or a 2-foot length of capped riser to be used as a sump.
- Filter pack: chemically and texturally clean sand of appropriate grain size distribution.
- Bentonite seal: bentonite pellets (3/8-inch diam.)
- Cement: Portland Cement

- Steel Monitoring well monument: lockable water-tight flush mount or aboveground stove pipe set in place with cement and protected with zinc-plated steel crash posts.

- Containers for purged water, as required.

- Submersible pump or bailer of appropriate capacity, and surge block sized to fit well.

- PH, specific conductivity, and temperature meters

- Electric well sounder and measuring tape

- PPE as required by HSP

Documentation

- Copy of appropriate work plan and field sampling plan

- Copy of approved Health And Safety Plan

- Copies of well and excavation permits

- Boring log forms

- Well completion diagram form

- Well development form

Lithologic Logging equipment

- Hand lens

- Unified Soil Classification System chart

- Munsell color chart

PROCEDURE

Drilling

- The objective of the selected drilling technique is to ensure that the drilling, method provides representative data while minimizing subsurface contamination, cross contamination of aquifers, and drilling costs. The common drilling methods are hollow-stem auger and direct-push techniques.

- A Field Geologist will be present during all well drilling and installation activities and will fully document all tasks performed in support of these activities into a field book. The Field Geologist will be responsible for the logging of samples, monitoring, of drilling operations, recording, of water losses/gains and groundwater data, preparing the boring logs and well diagrams, and recording the well installation procedures of the rig. The

Field Geologist will have onsite sufficient equipment in operable condition to perform efficiently his/her duties as outlined in the field sampling plan.

- Surface runoff or other fluids will not be allowed to enter any boring or well during or after drilling/construction.

- An accurate measurement of the water level will be made upon encountering water in the borehole and later upon stabilization. Levels will be periodically checked throughout the course of drilling. Any unusual change in the water level in the hole such as a sudden rise of a few inches may indicate artesian pressure in a confined aquifer will be the basis for cessation of drilling. The geologist will immediately contact his or her supervisor. Particular attention for such water-level changes will be given after penetrating any clay or silt bed, regardless of thickness, which has the potential to act as a confining layer.

- If required, drilling will continue 2-foot into the confining clay layer to allow for the installation of a sump beneath the screened section.

Lithologic Logging

All borings for monitoring wells will be logged by a geologist. Logs will be recorded in a field logbook and/or a boring log. If the information is recorded in a logbook, it will be transferred to Boring Log Forms on a daily basis. Field notes are to include, as a minimum:

- Boring Number
- Material Description (as listed below)
- Weather conditions
- Evidence of Contamination
- Water Conditions (including measured water levels)
- Daily Drilling Footage and Quantities (for billing purposes)
- Drilling Method and Bore Hole Diameter
- Any Deviations from Established Field Plans
- Blow Counts for Standard Penetration Tests
- Core and Split-Spoon Recoveries
- Well construction details: quantities of materials used, material types and dimensions

Material description for soil samples include, as appropriate:

- Classification
- Unified Soil Classification Symbol
- Secondary Components and Estimated Percentages
- Color
- Plasticity
- Consistency
- Density
- Moisture Content
- Texture/Fabric/Bedding and Orientation
- Grain Angularity
- Depositional Environment and Formation
- Incidental odors
- PID readings
- Staining

Material description for rock samples include, as appropriate:

- Classification
- Lithologic Characteristics
- Bedding/Banding Characteristics
- Color
- Hardness
- Degree of Cementation
- Texture
- Structure and Orientation
- Degree of Weathering

- Solution or Void Conditions
- Primary and Secondary Permeability
- Sample Recovery
- Incidental odors
- PID readings
- Staining

Well Construction

After the hole is drilled and logged, backfill hole as required for proper screen/sump placement.

In unconfined aquifers where floating product and/or tidal fluctuation is anticipated, the screen will extend 2 feet above the water table. If feasible, the bottom of the screened section will rest at or just below the top of the aquitard. The 2-foot length of plugged riser section will be in place below the screen, if a sump is required.

- The installation of monitoring wells in uncased or partially cased holes will begin within 12 hours of completion of drilling, or if the hole is to be logged, within 12 hours of well logging, and within 48 hours for holes fully cased with temporary drill casings. Once installation has begun, work will continue until the well has been grouted and the drill casing has been removed.
- Well screens, casings, and fittings will conform to National Sanitation Foundation Standard 14 or American Society for Testing and Materials (ASTM) equivalent for potable water usage. Material used will be new and essentially chemically inert to the site environment.
- Filter pack will extend from the bottom of the screened section (top of aquitard) to a height of 2 ft above the top of the screen. If the water table is relatively close to the ground surface, the filter pack may extend less than 2 ft above the screen to avoid surface water infiltration into the well and to allow for placement of the bentonite seal, grout, and protective casing. If the hole is less than 20 ft deep, the filter pack may be poured into the annulus directly. If the hole is deeper than 20 ft, the filter pack must be tremied into place.
  - Granular filter packs will be chemically and texturally clean, inert, and siliceous.
  - Filter pack grain size will be based on formation grain-size analysis.
  - Calculations regarding filter pack volumes will be entered into the Field Logbook along with any discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10 % exists between calculated and actual volumes, an explanation for the discrepancy will also be entered in the Logbook.

- Bentonite seals will be no less than one foot or more than three feet thick as measured immediately after placement.

- Grout

  Grout used in construction will be composed by weight of:

  – 20 parts cement (Portland cement, type II)

  – 0.6 to 1 part (max.)(3-5%) bentonite = 2.8 lbs to 4.7 lbs of bentonite to one 94 lb bag of cement

  – 6.5 gallons approved water per 94-lb bag of cement.

  Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

  - All grout material will be combined in an above-ground container and mechanically blended to produce a thick, lump-free mixture. Mixing of the grout will be performed by mixing the bentonite powder and water before adding cement. The mixed grout will be recirculated through the grout pump prior to placement.

  - Grout placement will be performed using a commercially available grout pump and a rigid, side discharge tremie pipe.

  - The following will be noted in the Field Investigation Daily Report: a) predicted grout volumes, b) amounts of cement, bentonite, and water used in mixing grout, c) actual volume of grout placed in the hole, d) discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10% exists between calculated and actual volumes, an explanation for the discrepancy will also be entered in the Logbook.

  Well protective casings will be installed around all monitoring wells on the same day as the initial grout placement around the well. Any annulus formed between the outside of the protective casing and the borehole will be filled to ground surface with cement.

  The construction of each well will be depicted as built in a well construction diagram. The diagram will be attached to the boring log and will graphically denote:

  - Screen location, length

  - Joint location

  - Granular filter pack

  - Seal

- Grout
- Cave-in
- Centralizers
- Height of riser
- Protective casing detail

Monitoring Well Installation and Completion

- Assemble appropriate decontaminated lengths of pipe, screen, and end cap/sump. Make sure these are clean and free of grease, soil, and residue.
- Attach the end cap/sump to the bottom of the screened section. Lower the screen and each section of pipe into the borehole, one at a time, screwing each section securely into the section below it. No grease, lubricant, polytetrafluoroethleyene (PTFE) tape or glue, may be used in joining the pipe and screen sections.
- If a well extends below 50 ft, centralizers should be installed at 50 ft and every 50 ft thereafter except within screened interval and bentonite seal. Centralizer material will be PVC, PTFE, or stainless steel. Centralizer material should be of the same material as the well screen.
- Cut the riser with a pipe cutter approximately 2-2.5 ft above grade. All pipe cuts MUST be square to ensure that the elevation between the highest and lowest point of the well casing is less than or equal to 0.02 ft. Notch, file, or otherwise scribe a permanent reference point on the top of the casing.
- If a flush-mounted well is required at a given location, an internal pressure cap must be used to ensure that rainwater cannot pool around the wellhead and enter the well through the cap.
- When the well is set to the bottom of the hole, temporarily place a cap on top of the pipe to keep the well interior clean.
- Place the appropriate filter pack. Monitor the rise annulus with a weighted tape to assure that bridging is not occurring.
- After the pack is in place, wait three to five minutes for the material to settle, tamp and level a capped PVC pipe, and check its depth with a weighted steel tape.
- Install the bentonite seal (2 ft to 5 ft thick) by dropping bentonite pellets into the hole gradually. If the well is deeper than 30 feet, a tremie pipe should be used to place either bentonite pellets or slurry.
- Wait for the pellets to hydrate and swell. Hydration times will be determined by field test or by manufacturer's instructions. Normally this will be 30 to 45 minutes.

Document the hydration time in the field notebook. If the pellets are above the water level in the hole, add several buckets of clean water to the boring. Document the amount of water added to the hole.

- Mix an appropriate cement-bentonite slurry. Be sure the mixture is thoroughly mixed and as thick as is practicable.
- Lower a side discharge tremie pipe into the annulus to the level of the pellet seal.
- Pump the grout slurry into the annulus while withdrawing the tremie pipe and temporary casing.
- Continue the grout fill to the ground surface. Seat the protective casing in the grout, allowing no more than 0.2 ft between the top of the well casing and the bottom of the protective casing cap. Lock the cap.
- Fill the outer annulus (between the casing and the borehole) with neat cement. Allow the cement to mound above ground level and finish to a 2-ft square 6-in thick cement pad. If needed, install crash posts to protect above-ground completion.

PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during well development activities.

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STANDARD OPERATING PROCEDURE FOR MONITORING WELL DEVELOPMENT

PURPOSE

The purpose of this standard operating procedure is to delineate protocols for monitoring well development.

FIELD SUPPLIES

- Well Development Form
- Boring Log and Well Completion Diagram for the well
- Containers for purified water, as required
- Decontaminated submersible pump or bailer of appropriate capacity, and surge block sized to fit well
- Conductivity, pH, temperature and turbidity meters
- Electric well sounder and measuring tape

PROCEDURE

- Well development is the process by which drilling fluids, solids, and other mobile particulates within the vicinity of the newly installed monitoring well have been removed to restore the aquifer hydraulic conductivity. Development corrects damage to or clogging of the aquifer caused by drilling, increases the porosity of the aquifer in the vicinity of the well, and stabilizes the formation and filter pack sands around the well screen.

- Well development will be initiated after 48 consecutive hours but no longer than 7 calendar days following grouting and or placement of surface protection.

- Multiple well development techniques, bailing, over pumping, and surging, will be employed in tandem. Over pumping is simply pumping the well at a rate higher than recharge. Surging a method of forcing water to flow into and out of the screen by operating of a plunger up and down within the well casing, similar to a piston in a cylinder.

- Pump or bail the well to ensure that water flows into it, and to remove some of the fine materials from the well. Removal of a minimum of one well volume is initially recommended. The rate of removal should be high enough to stress the well by lowering the water level to approximately one-half its original level, if well recharge allows.

- Slowly lower a close-fitting surge block into the well until it rests below the static water level, but above the screened interval, if possible.

- Begin a gentle surging motion that will allow any material blocking the screen to break up, go into suspension, and move into the well. Continue surging for 5-10 minutes, remove surge block, and pump or bail the well, rapidly removing at least one well volume.

- Repeat previous step at successively lower levels within the well screen until the bottom of the well is reached. Note that development should always begin above, or at the top of, the screen and move progressively downward to prevent the surge block from becoming sand locked in the well casing. As development progresses, successive surging can be more vigorous and of longer duration as long as the amount of sediment in the screen is kept to a minimum.

- At a minimum, 3 to 5 well volumes are removed during development.

WATER QUALITY MONITORING

- Monitor water quality parameters before beginning development procedures, and after removing each well volume.

- If water quality parameters have stabilized over the three readings, the well will be considered developed.

- If the parameters have not stabilized after these three readings, continue pumping the well to develop, but stop surging. Monitor the stabilization parameters every one-half well volume.

- When the parameters have stabilized over three consecutive readings at one-half well volume intervals, the well is considered developed.

DOCUMENTATION

Record all data as required on a Monitoring Well Developing Record. These data include:

- Depths and dimensions of the well, the casing, and the screen, obtained from the Monitoring Well Construction Form.

- Water losses and uses during drilling, obtained from the boring log for the well.

- Water levels.

- Using a properly calibrated water quality meter, measure the following indicator parameters: turbidity, pH, conductivity, oxidation-reduction potential (Eh), dissolved oxygen, and temperature.

- Target values for the indicator parameters listed above are as follows: pH - stabilize, conductivity - stabilize, temperature - stabilize, turbidity NTU 10 or stabilize. A value is considered to have stabilized when 3 consecutive readings taken at one-half well volume intervals are within 10% of each other (pH stabilization = 0.2 pH units).

- Notes on characteristics of the development water.
- Data on the equipment and technique used for development.

PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during well development activities.

REFERENCES

Fletcher G. Driscoll, 1986, "Groundwater and Wells", 2nd Addition.

STANDARD OPERATING PROCEDURE FOR GROUNDWATER MONITORING WELL SAMPLING

PURPOSE

The purpose of this standard operating procedure is to delineate protocols for the collection of groundwater samples from monitoring wells using normal and slow purging technique.

FIELD SUPPLIES

- Specific Conductivity meter - or YSI 3800
- Thermometer (optional) - or YSI 3800
- pH meter or YSI 3800
- Turbidity meter
- Flow-through-cell, if dissolved oxygen (DO) and oxidation reduction potential (ORP) measurements are needed.
- Water-level indicator
- Peristaltic, bladder, or submersible positive-displacement pump with adjustable discharge rate
- Sample bottles, labels, sample cooler, ice, chain-of-custody forms
- Logbook or Field Investigation Daily Forms and Groundwater Sampling Forms
- Teflon or teflon-lined polyethylene tubing and T fittings, hose clamps
- Photoionization Detector (PID) Organic Vapor Analyzer
- oil/water interface probe
- PPE
- Graduated cylinders
- Generator
- Laboratory contact name and number
- List of wells and sampling order.
- Decontamination equipment (buckets, non-phosphate detergent, and distilled water)
- Calibration fluids

PROCEDURE

- Upon arrival at the well site, visually inspect integrity of wells including condition of well casing, well vaults, grout pad and grout seal, and record the findings in the well inspection forms. Set up and organize the purging and sampling equipment.

- Don appropriate PPE. Open well. Measure the depth to Light Non-Aqueous Phase Liquid (LNAPL), if any, and to water (to 0.01 ft) using an interface probe. Record any obstructions encountered on the Groundwater Sampling Form.

Groundwater/Product Level Measurement Data

Well gauging data is reduced in order to convert the water level in each well to an elevation that is relative to a common datum (either assumed or actual). This makes it possible to prepare a map of groundwater gradient across the site. A second function of well gauging data reduction is to remove the effect of floating separate-phase product on the depth to water in a well (separate-phase product will depress the water table beneath it).

- The following information is required in order to reduce the gauging data collected in the field:
  - TOC elevation - note the survey point from which the gauging is measured,
  - depth to water (DTW),
  - depth to product (DTP), if product was detected, and
  - specific gravity (G) of the product (either determined in the field or by laboratory; if not, use an accepted average for the type of product encountered).

- To determine the product thickness (PT), subtract DTP from DTW.

  For example:

  DTW = 2.63 ft.
  DTP = 2.44 ft.
  PT = DTW - DTP = 2.63 - 2.44 = 0.19 ft.

- To determine the hydraulic equivalent (HE) of the product, multiply the product thickness by the product's specific gravity (G).

  For example:

  PT = 0.19 ft.
  G = 0.75
  HE = PT x G = 0.19 x 0.75 = 0.14 ft.

- To determine the correct depth to water (CDTW), subtract the hydraulic equivalent from the measured depth to water.

  For example (see MW-4, Fig. 15-2):

  DTW = 2.63 ft.
  HE = 0.14 ft.
  CDTW = DTW - HE = 2.63 - 0.14 = 2.49 ft.

- To determine the correct water elevation (CWE), subtract the corrected depth to water from the top of casing (TOC) elevation.

  For example:

  TOC = 174.89 ft.
  CDTW = 2.49 ft.
  CWE = TOC - CDTW = 174.89 - 2.49 = 172.40 ft.

  Note: in wells that do not contain product, there is no corrected depth to water. Therefore, the measured depth to water is subtracted from the top of casing elevation to determine the corrected water elevation.

- For wells with measured product:

DTW	=	Depth to Water	=	(measured)
DTP	=	Depth to Product	=	(measured)
TOC	=	Top of Casing Elevation	=	(surveyed)
G	=	Product Specific Gravity	=	(measured or from literature)
PT	=	Product Thickness	=	DTW - DTP
HE	=	Hydraulic Equivalent of Product	=	PT x G
CDTW	=	Corrected Depth to Water	=	DTW - HE
CWE	=	Corrected Water Elevation	=	TOC - CDTW

- For wells containing no product:

  CWE = Corrected Water Elevation = TOC – DTW

Equipment Calibration

Prior to monitoring well purging, the monitoring equipment used to measure pH, DO, turbidity, ORP, and specific conductance should be calibrated or checked according to manufacturer's directions. The pH meter calibration should bracket the pH range of the wells to be sampled (acidic to neutral pH range {4.00 to 7.00} or neutral to basic pH range {7.00 to 10.00}. The DO meter should be calibrated to one point air saturated water. ORP should be calibrated against a known standard, such as a Zobell solution. The instrument should display a millivolt (mv) value that falls within the range set by the manufacturer. The SC meter is calibrated with a known standard, typical standards are 1.0, 10.0, and 50.0 millimhos per centimeter at 25° Celsius.

Conventional / Modified Well Purging

It is necessary to purge a sufficient volume of the stagnant water from the well casing to ensure that a representative sample of formation water is obtained. The volume of water to be purged is typically 3 casing volumes. Monitoring of water quality parameters of the purge water is used to determine when a representative sample can be collected. During purging, the parameters, temperature, pH, and specific conductance, are measured every 3-5 minutes. The groundwater sample is collected when these ground-water quality parameters have stabilized. Parameter stabilization is defined as three successive readings with units of:

Temperature: +\- 0.5° Celsius
pH: +\- 0.2
Specific Conductance: +\- 10%

If groundwater hasn't stabilized, to the above criteria, after 3 well volumes, 2 additional well volumes shall be purged from the well, prior to sample collection. Monitoring well purging will be considered complete after 5 well volumes have been removed from the well. All purge volumes and final water quality parameter readings should be recorded on Groundwater Sampling Logs.

Monitoring wells with a designated "Modified" well sampling technique are generally screened within fine-grained units and are low yielding wells. These select wells should be purged accordingly:

- A purge rate should be selected as to stabilize drawdown. If the well is able to sustain a 0.5 gallon per minute (gpm) purge rate, then once temperature, pH, and specific conductance parameters have stabilized, as listed above, well purging is considered complete. All purge rates and volumes removed will be recorded on Groundwater Sampling Logs.

- If the well is unable to sustain a 0.5 gpm purge rate and the well is pumped dry, then groundwater samples will be collected once the well has recovered a sufficient amount of water to bail. A disposable or properly decontaminated Teflon™ bailer should be used to sample. If the well is purged dry a note will be recorded on the Groundwater Sampling Log.

Techniques for conventional / modified well purging include:

- Acceptable purge/sampling devices for this project shall be submersible positive-displacement type pumps, bailers, and bladder pumps for purging and sampling. It is recommended to purge and sample at similar rates.

- Purging should be accomplished with as minimal disturbance to the surrounding formation as possible.

- Purge water is containerized on-site and stored as directed by the Project Manager.

The following formula may be used to determine the volume of any well:

$$V = 5.875 \times C^2 \times H$$

where: V = volume in gallons
C = casing diameter, in feet
H = height of water column, in feet

Using this formula, the volume per linear foot of well casing of common casing sizes is listed below:

Casing Diameter (inches)	**Volume per Linear Foot (gallons)**
1.5"	0.092
2.0"	0.163
4.0"	0.563
6.0"	1.469

Conventional/Modified Well Sampling

After purging has been completed groundwater samples should be collected either directly from the new or properly decontaminated pump tubing or from a disposable or properly decontaminated Teflon™ bailer equipped with a bottom-emptying device. Appropriate containers with specific preservative should be labeled, according to section 3.2 of the Field Sampling Plan, prior to sampling. Samples should be collected in order of decreasing volatility (*i.e.*, the samples to be analyzed for the volatile constituents should be collected first). The filled sample containers should be immediately placed in a chilled cooler awaiting delivery to the analytical laboratory. All samples should be handled according to Chain of Custody SOPs.

Filtering of samples for dissolved metals analysis will be conducted in the field using a disposable 0.45 micron (µm) in-line filters. Field filtering will be conducted by either:

Sampling by pump:

- Screwing the disposable 0.45 µm filter into the discharge sampling line and sampling directly for the filter after two filter volumes have been run through it.

Sampling by bailer:

- Using a Teflon™ connector to attach the in-line filter to the bottom-emptying device of the bailer, allow gravity to feed the water through the filter. Sampling will begin after two filter volumes have passed through the filter.

Purging and Sampling with Low-Flow Pump

- To obtain representative samples, subsurface disturbances should be kept to a minimum, thereby preventing sample alteration due to sampling actions. The use of low-flow pumps to purge and sample minimizes physical disturbance (turbulence) and chemical changes (aeration). The low-flow pump is the preferred method for both purging and sampling in most cases. For the purposes of this SOP, "low-flow pumps" are defined as variable speed submersible pumps. Practical operational flow rates for these sampling devices range from 0.1 L/min to 30 L/min.

- Lower the pump, safety cable, tubing, and electrical lines into the well, slowly so as not to agitate the water, until the pump is at the mid-point of the screened interval.

- Lower the water level probe into the well behind the pump until it just touches water. This will allow the sampler to monitor the water level while purging and sampling, and prevent drying of the well.

- Measure initial water level.

- Begin purging at the pump's lowest setting, then gradually increase rate until discharge occurs. The well will be pumped at a rate which will cause little or no drawdown in the well (less than 0.3 feet). The water level and pumping rate will be recorded every 3 to 5 minutes (or as appropriate during pumping). Use 1L graduated cylinders to measure flow rate.

- Monitor water chemistry parameters beginning immediately, using an in-line monitoring system, if possible. A flow-through-cell and combination sonde unit can be used.

Stabilization parameters include temperature, specific conductivity, pH, and turbidity measured at 3 to 5 minute intervals. If required and if a flow-through cell is used, dissolved oxygen, turbidity and a Eh will also be monitored. When these stabilization parameters are in agreement within approximately 10% (0.2 pH units) for three consecutive intervals, purging is complete. A T fitting can be installed before the water enters the flow-through-cell. This T fitting can be used to obtain the turbidity sample.

- Record all measurements on the Groundwater Sampling Form.

- Following purging, the flow through cell shall be disconnected, and groundwater samples collected directly from the discharge line. Samples for laboratory analysis will always be collected in order of decreasing volatility (*i.e.*, the samples to be analyzed for the volatile constituents should be collected first.) Deliver the VOC sample to the vial by allowing the water to trickle down the inside wall of the vial at a rate no greater than approximately 100 mL/min. Other samples may be delivered at a faster rate. Sampling rates will at no time exceed 1 L/min. Sample preservation procedures are contained in the QAPP and SOP 015. When collecting samples for volatile analysis care should be taken to prevent analyte loss by volatilization. The following procedures should be adhered to when collecting these samples.

  - Avoid excessive aeration and agitation of sample.
  - Fill pre-preserved vial by slightly tilting the vial so the water runs down the inside wall of the bottle. As vial fills, gradually turn upright such that a reverse meniscus is formed.
  - Place septum cap on vial. If air bubbles are present, properly dispose of that sample and recollect the sample in the same vial and re-preserve.
  - Make sure vial is labeled and <u>immediately</u> transfer the vial to the cooler with ice.

- All samples will be delivered to the laboratory as soon as possible. If possible, samples will be shipped on the same day as they are collected. If samples must be retained due to weekend sampling (Friday through Sunday), the lab shall be notified as to the time sensitive nature of the samples.

- Continue sample collection beginning with the volatile aliquot.

- Filtering of samples for dissolved metals analysis will be conducted in the field using a disposable 0.45 micron (μm) in-line filters. Screw the disposable 0.45 μm filter into the discharge sampling line and sampling directly for the filter after two filter volumes have been run through it.

- After collection, all sample aliquots will be handled per the procedures as described in the FSP, QAPP, and SOPs concerning preservation and sample custody and packing.

- Remove and decontaminate water level probe, the pump and tubing.

PRECAUTIONS

- Refer to the HSP for appropriate PPE.
- Generator must be located downwind.
- Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

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