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Mr. Karel Detterman, P.G.
Hazardous Materials Specialist
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502
San Francisco, CA 94102

Re: Groundwater Sampling and Enhanced Bioremediation Pilot Study Work Plan,
3093 Broadway, Oakland, CA
Site Cleanup Program Case No. Ro0000199

Dear Ms. Detterman,

Please find attached, for your review and comment, *Groundwater Sampling and Enhanced Bioremediation Pilot Study Work Plan*, at the Former Connell Oldsmobile site, located at 3093 Broadway in Oakland, California. The Work Plan has been prepared by Langan Treadwell Rollo.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge.

OWNER:

3093 BROADWAY HOLDINGS, L.L.C.

By: ______________________ 4/22/15

Name: DAVID MARTIN

Title: CHAIRMAN INVESTMENT COMMITTEE

17 April 2015

Ms. Karel Detterman, P.G.
Hazardous Materials Specialist
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502

Re: Groundwater Sampling and Enhanced Bioremediation Pilot Study Work Plan
3093 Broadway
Oakland, California
ACEH Case No.: RO0000199
Langan Project No.: 730637001

Dear Ms. Detterman,

On behalf of 3093 Broadway Holdings, L.L.C. ("Broadway Holdings"), Langan Treadwell Rollo (Langan) has prepared this *Enhanced Bioremediation Pilot Study and Groundwater Sampling Work Plan* ("Work Plan") at the Former Connell Oldsmobile site ("site"), located at 3093 Broadway in Oakland, California (Figure 1). This Work Plan has been prepared in conjunction with the Feasibility Study and Corrective Action Plan (FS/CAP), as requested in a 12 December 2014 meeting with the Alameda County Department of Environmental Health (ACEH). The objectives of the groundwater sampling and pilot study are, respectively: 1) to obtain additional design parameters and 2) to demonstrate the implementability of the proposed groundwater corrective action. This Work Plan presents the well installation, groundwater sampling, and pilot test implementation activities.

BACKGROUND

The site is located in a mixed-use area, near commercial, medical, and residential properties. The approximately 3.4-acre site is bounded by Hawthorne Street to the north, Broadway to the east, Webster Street to the west, and a surface parking lot to the south (Figure 2). Site facilities include a vacant, two-story concrete structure that was formerly a car dealership. Currently, the parking areas west and south of the site structure are used to store automobiles for other nearby dealerships.

Three underground storage tanks (USTs) that previously contained gasoline, diesel, and waste oil were removed from beneath the Hawthorne Avenue sidewalk, north of the service bay in December 1989. Soil and groundwater investigations have been ongoing since 1990. The chemicals of concern in groundwater at the site include benzene, toluene, ethylbenzene, and xylenes (BTEX), 1,2-dichloroethane, and naphthalene. Previous investigations concluded that methyl tertiary butyl ether (MTBE) is not present at the site.

We understand the existing buildings will be demolished, with the exception of a portion of the show room in the northeast corner of the Site. A multi-story mixed use building will occupy the entire property. The ground floor will consist of parking and retail space. The upper levels will include residential units. Site excavation for the development is planned to reduce existing grade by approximately 3 to 18 feet; the ground floor will be roughly level with Broadway.

Site Geology and Hydrogeology

The site elevation ranges from approximately 52 to 70 feet above mean sea level. The site slopes downward to the southeast, from Webster Street to Broadway. The site is underlain by unconsolidated sediments ranging from silty clays to sandy gravels. Based on geotechnical drilling conducted by Langan at the site, unconsolidated sediments extend to at least 50 feet below ground surface. The site surficial geology is mapped as the Temescal Formation, which consists of quaternary age alluvial fan deposits comprised of interbedded layers of silt, sand, clay, and gravel (Radbrush, 1957)[1]. Alluvial fan deposits are characterized by laterally discontinuous and heterogeneous layers of irregular thickness. The depth to groundwater (Langan, 2014)[2] beneath the site ranges from approximately 16 to 27 feet. Groundwater beneath the site flows toward the southeast (Langan, 2014)[3] at an estimated seepage velocity ranging from 0.2 to 20 feet per year.

Previous Remedial Actions

A detailed history of environmental investigations and remediation is provided in the FS/CAP. The remedial actions performed at the site are summarized below:

- December 1989: Removal of one 2,000-gallon gasoline tank, one 650-gallon diesel tank, and one 425-gallon waste oil tank beneath the Hawthorne Street sidewalk. Visually contaminated soil in the former UST area was excavated at depth up to 12 feet below grade and the excavation was backfilled with imported fill material.

- 1991 to 2010: Manual removal of separate phase hydrocarbons (SPH) from site monitoring wells.

- October 1996 to March 1998: A soil vapor extraction (SVE) remediation system was used at the site to remove volatilized contaminants from soil and soil vapor. The SVE system removed approximately 1,421 pounds (lbs) of hydrocarbons.

- September 2000: Feasibility testing for dual phase extraction (DPE) was performed.

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1 Radbrush, Dorothy. 1957, Areal and Engineering Geology of the Oakland West Quadrangle, California.

2 Langan Treadwell Rollo, 2014. Results of May 2014 Groundwater Monitoring – Revised Transmittal, Case # RO0000199, Former Connell Oldsmobile Site, 3093 Broadway, Oakland. 30 October.

3 Langan Treadwell Rollo, Inc., 2014. Conceptual Site Model, 3093 Broadway, Oakland, California. 24 October.

- April 2011 to June 2013: An air sparging and DPE remediation system (AS/DPE) operated at the site to remove hydrocarbons through the extraction of SPH, groundwater, and soil vapor. The AS/DPE system removed approximately 8,882 lbs of gasoline-range Total Petroleum Hydrocarbons (TPHg) and 545 lbs benzene.

The remedial activities performed at the site removed mobile light non-aqueous phase liquid (LNAPL). However, the benzene concentrations in groundwater exceed the closure criteria in the State Water Resource Control Board's (State Board's) Low-Threat Underground Storage Tank Case Closure Policy (LTCP). Additional groundwater remediation has been requested by ACEH to accelerate the timeframe for restoration of groundwater quality.

MONITORING WELL INSTALLATION

Two groundwater wells (MW-18 and MW-19) are proposed to obtain additional soil and groundwater data under the showroom. The proposed monitoring well locations were selected after evaluating existing data; including past and present hydrogeologic conditions and chemical distribution patterns. During the November 2014 sampling activities, groundwater grab samples could not be collected through direct push borings at these locations due to the low-permeability formation. However, the highest soil gas concentration was detected under the showroom at soil vapor point SV-10. Currently, there are no monitoring wells under the showroom and this area was likely outside of the zone of influence of the former remediation system. The installation and sampling of these monitoring wells will provide additional chemical data, remediation parameters, and water level data for the full-scale corrective action design.

Groundwater well MW-18 will be installed in the vicinity of soil vapor point SV-10 and groundwater well MW-19 will be installed approximately 50 feet east-southeast of MW-19, to evaluate the extent of impacts underneath the showroom (Figure 2). A cross-section illustrating the lithology (based on previous borings), and existing and proposed monitoring well locations is presented in Figure 3. The monitoring well locations may be altered in the field due to subsurface utility locations or access issues.

The groundwater monitoring well installation and sampling procedures are described below.

Permitting and Utility Clearance

Prior to installing the groundwater wells, drilling permits will be obtained from the Alameda County Public Works Agency Water Resources Section (ACPWA).

A private utility locator will be subcontracted to confirm the presence/absence of subsurface utilities at the well installation locations. Prior to initiating the fieldwork, Underground Services Alert, a regional subsurface utility notification center, will be notified of the work at least 48 hours before work begins. Work will be performed in accordance with a site-specific health and safety plan.

Boring Advancement and Field Screening

A California-licensed (C-57) drilling contractor will advance the borings for groundwater wells MW-18 and MW-19 to a depth of approximately 30 to 35 feet below ground surface (bgs) within the existing showroom portion of the building. Access into the showroom is restricted by doors that are 7.5 feet wide by 6.5 feet high, so a limited access drill rig equipped with 8-inch diameter hollow-stem augers will be used. The approximately six-inch concrete slab within the showroom will be cored at each location to prepare for drilling. Continuous soil cores will be collected from each location using direct push for logging purposes prior to monitoring well drilling using hollow stem augers.

Field staff, under the direct supervision of a California Professional Geologist, will log the recovered soil cores using the visual-manual procedures of ASTM International Standard D2488 for guidance, which is based on the Unified Soil Classification System. Soil cores will be field screened for organic vapors using a photoionization detector (PID) and examined for visual staining and/or unusual odors.

Soil Sampling and Analysis

As part of the drilling effort, soil samples will be collected for laboratory analysis at a minimum frequency of one sample every 5 feet. If petroleum staining or elevated PID readings are observed, soil sampling will include, at a minimum: (1) one sample above the stained zone, (2) a sample near the top of the stained zone, (3) a sample immediately above the water table, (4) a sample near the bottom of the stained zone, and (5) a sample beneath the stained zone.

Soil samples will be analyzed by a California-certified analytical laboratory for:

- Gasoline-range Total Petroleum Hydrocarbons (TPHg) using U.S. EPA Method 8015B;
- Diesel-range TPH (TPHd) using U.S. EPA Method 8015M with silica gel cleanup; and
- BTEX, MTBE, naphthalene, and 1,2-DCA using U.S. EPA Method 8260B.

Monitoring Well Installation

After soil logging, the drilling contractor will advance a larger borehole using 8-inch hollow stem augers for monitoring well construction. The driller will use 2-inch Schedule 40 polyvinyl chloride (PVC) flush-threaded well casing with up to 10 feet of 0.020-inch factory-slotted screen. The groundwater monitoring wells will be screened from approximately 2 to 3 feet above the water table, to approximately 7 to 8 feet below the water table, which is expected to be approximately 20 to 30 feet below the ground surface within the showroom. Groundwater levels on the far eastern portion of the site have been observed to be on the order of 10 feet lower than the upgradient portion of the site, which will be taken into account in determining the well screen intervals. The annular space for the wells will be filled with #2/16 filter pack sand from total depth to approximately one foot above the top of the screen.

After construction of the well casing and filter pack, the depth to water in the casing will be measured and compared to water level measurements taken during drilling and from nearby site monitoring wells. If the groundwater has not recharged to the well casing, or if water levels have not stabilized, then installation of the well seal will be deferred until later that same day or until the following day. Once the groundwater level in the well casing has stabilized, and the screened interval is confirmed to be across the water table, then the well seal will be installed and the well construction completed.

A one-foot thick hydrated bentonite-chip seal will be placed above the filter pack. A Type I/II Portland cement seal will extend from the top of the bentonite seal to approximately 3 feet bgs in the well boring. To accommodate field conditions, the Professional Geologist may modify the well construction specifications following advancement of the soil boring and interpretation of the boring log. Well installation procedures are detailed in the Langan Treadwell Rollo Well Installation SOP (Appendix A).

The groundwater well will be encased at ground surface with a flush-mounted, traffic-rated well box set in concrete, and the well casing will be sealed with a locking expansion cap. Groundwater well construction records (California Department of Water Resources (DWR) Form 188) will be submitted to the DWR and Alameda County in accordance with the permit requirements. The groundwater well will be constructed in accordance with the California Well Standards (California Department of Water Resources Bulletins 74-81 and 74-90) and ACPWA and City of Oakland requirements.

Monitoring Well Development and Surveying

After allowing the cement well seals to cure for at least 24 hours, the groundwater wells will be developed by a combination of surging and bailing using a stainless steel bailer and pumping with a submersible pump or a peristaltic pump connected to downhole tubing. During pumping, water quality parameters (including temperature, pH, specific electrical conductance, oxidation-reduction potential [ORP], and dissolved oxygen [DO]) will be measured. The groundwater well will be developed until at least 10 casing volumes of water have been removed from the well and water quality parameters have stabilized to within 10 percent of previous readings, or until the well is dry. Field instruments for measuring water level or water quality parameters will be calibrated prior to use and calibration information will be documented. The groundwater well will not be sampled for at least 72 hours after well development. The detailed development procedures for the new monitoring wells are presented in our Monitoring Well Development SOP presented in Appendix A.

Additionally, we propose to remove the remediation-related piping from former remediation wells RW-3A and RW-3B and develop the wells before sampling in the pre-remediation event. Wells RW-3A and RW-3B have not been used for extraction since January 2012 and June 2011, respectively. This well development will be performed at the same time and using the same procedures as the development of the new monitoring wells MW-18 and MW-19.

A State of California registered surveyor will measure the horizontal location and vertical elevation of MW-18 and MW-19 following their installation, in accordance with the State of California's Geotracker (Geotracker) requirements. The survey data for new monitoring wells will be uploaded to the Geotracker system.

Investigation-Derived Waste Management

Investigation derived waste, including drill cuttings, equipment wash water, and well development water will be placed in labeled 55-gallon DOT-approved steel drums, sealed, and temporarily stored on-site pending off-site disposal.

PRE-REMEDIATION GROUNDWATER SAMPLING

A round of pre-remediation groundwater monitoring will be performed prior to implementing the selected groundwater remedy and performing the pilot test. The proposed groundwater corrective action is presented in the subsequent sections of this Work Plan. The objective of the pre-remediation sampling is to collect data describing groundwater conditions before initiating enhanced bioremediation of dissolved petroleum compounds. As presented in Table 6 of the Additional Investigation Results Letter dated 5 December 2014, semivolatile organic compounds (SVOCs) in groundwater were analyzed in monitoring wells from 1995 to 2002. Naphthalene and 2-methylnaphalene were detected at monitoring wells MW-1, MW-4, MW-14 and MW-15. Because the 2-methylnaphathalene and naphthalene results are co-located, and naphthalene is present at higher concentrations, the naphthalene results will be used to delineate the treatment area. The groundwater sampling analysis plan summarizing the monitoring wells to be sampled, sample parameters, and analytical methods, is presented in Table 1. Figure 2 shows the locations of the monitoring wells prior to site construction activities.

Sampling will be performed using U.S. EPA low-flow sampling procedures. Using a flow-through cell, during low-flow pumping, water quality parameters (including temperature, pH, specific electrical conductance, ORP, and DO) will be measured.

At least 72 hours following MW-18 and MW-19 well installation and development, groundwater samples will be collected and analyzed for BTEX, MTBE, TPHg, TPHd, 1,2-DCA, and naphthalene. The following wells will be sampled:

- Existing wells within the upper groundwater plume: MW-1 and MW-14;
- Existing wells within the lower groundwater plume: MW-4, MW-6, RW-3A, and RW-3B;
- An existing well located cross-gradient to the plume: MW-3;
- Existing downgradient delineation wells: MW-5, MW-7, and MW-8;And proposed wells at the showroom: MW-18 and MW-19.

Proposed replacement downgradient wells MW-25, MW-26 and MW-27 will also be sampled and added to the monitoring program. This selection of wells is likely to be sufficient to monitor the remediation progress, because it provides lateral coverage of the treatment area and includes the most highly impacted wells. Wells MW-1, MW-4, MW-14, MW-18, and RW-3A will be replaced after construction grading for ongoing remediation progress monitoring. Well MW-6 will not be replaced, because it will be located within the retail portion of the proposed development. It is unlikely that cross-gradient well MW-3 and downgradient well MW-19 would need to be replaced. This assumption will be confirmed following the pre-remediation monitoring event.

In addition to analysis of petroleum-related compounds, selected wells will also be analyzed for additional compounds for remedial design. These wells represent the different portions of the groundwater plume, and also include one cross-gradient and one downgradient location for comparison as background. Groundwater from monitoring wells MW-1, MW-3, MW-6, MW-8, and MW-18 will be analyzed for:

- Electron acceptors (nitrate, nitrite, total manganese, total iron, ferrous iron, sulfate, sulfite, sulfide, and dissolved methane),
- Nutrients (total nitrogen and total phosphorus),
- Water quality parameters (total organic carbon, total dissolved solids, and alkalinity), and
- Sulfate-reducing bacteria populations.

Additionally, groundwater samples from MW-1, MW-6, and MW-18 will be analyzed for California Title 22 (CAM17) metals to evaluate the potential for metal sulfides precipitation in the treatment area. Groundwater samples for metals analyses will be field-filtered using 0.45-micron filters to remove sediment and turbidity.

PROPOSED GROUNDWATER CORRECTIVE ACTION

An overview of the proposed full-scale groundwater corrective action is presented in this section to provide a context for the pilot test implementation activities. A detailed discussion of the proposed full-scale groundwater correction action alternatives and design is presented in the FS/CAP.

The biological degradation of petroleum hydrocarbons in site groundwater is limited by the availability of electron acceptors such as oxygen, nitrate, and sulfate. Bioremediation can be accelerated by introducing an electron acceptor into the subsurface. To minimize the need for periodic replenishment of electron donor, emplacement of calcium sulfate (i.e., gypsum) is proposed as a slow-release source of sulfate. The gypsum will dissolve over several years. Gypsum is commonly used as construction wallboard, plaster, and is a fertilizer and soil additive. The solubility of gypsum is approximately 2 to 2.5 g/L, which corresponds to a maximum sulfate concentration of approximately 1.1 to 1.4 g/L in groundwater. These levels of sulfate in groundwater would be effective in stimulating natural populations of sulfate-reducing bacteria (SRB). The microbially-mediated sulfate reduction coupled with petroleum hydrocarbons (represented by octane) oxidation is represented by the following reaction:

$$C_8H_{18} + 6.25\, SO_4^{2-} \rightarrow 8\, CO_2 + 9\, H_2O + \ 6.25\, S^{2-},$$

where sulfate is reduced to sulfide and the hydrocarbons are oxidized to carbon dioxide and water.

The strategy is to emplace gypsum in the upgradient (northwestern) portions of the two major benzene-impacted areas and allow the dissolved sulfate to flow downgradient with the natural groundwater gradient. Gypsum will be introduced into the subsurface by drilling boreholes into the saturated zone and backfilling with a mixture of gypsum pellets and sand. As shown on Figure 4, the full-scale scope will include approximately 40 borings installed in rows perpendicular to the direction of groundwater flow. The number and placement of borings are subject to change based on the geotechnical foundation design plans, drilling rig accessibility in the existing buildings, and field conditions encountered. The remediation boring locations located near SV-10 may be changed or removed based on the pre-design investigation groundwater data.

The majority of the borings will be placed in two offset rows of barriers spanning the width of the 1,000 µg/L benzene plume. Within each row, the borings will be drilled with an on center spacing of 10 feet. The second row will be located approximately 20 feet downgradient of the first row, so the groundwater travel time is approximately one year between the two rows based on the upper range of the estimated groundwater seepage velocity of 20 feet per year.

The pilot study described in this report includes installing seven of the remediation boring locations in an earlier mobilization to anticipate challenges and refine procedures prior to full-scale implementation.

PILOT TEST IMPLEMENTATION

A pilot study is planned prior to full-scale implementation to evaluate and refine the process of drilling and installing the gypsum borings inside the existing building. Specifically, the objectives of the pilot test include establishing the boring installation workflow within the service bay, including concrete coring, drilling, and mixing and emplacement of biostimulation media. The lessons learned from the pilot test will be used to plan and scale up the full-scale remediation scope.

The scope of the pilot study will include installation of seven borings in a row south of the location of the former USTs, as shown on Figure 4. These borings are located in the far upgradient portion of the contaminant plume and is within the former source area, near the USTs and potential UST piping. These boring locations were selected for the pilot test to provide the most remedial benefit and to anticipate the worst-case challenges of working inside buildings, such as clearance issues or potential presence of underground utilities or structures.

Permitting and Utility Clearance

Prior to installing the remediation borings, drilling permits will be obtained from the Alameda County Public Works Agency Water Resources Section (ACPWA).

A private utility locator will be subcontracted to confirm the presence/absence of subsurface utilities at the well installation locations. Prior to initiating the fieldwork, Underground Services Alert, a regional subsurface utility notification center, will be notified of the work at least 48 hours before work begins. Work will be performed in accordance with the site-specific health and safety plan.

Remediation Boring Drilling

The remediation borings will be installed by advancing 8-inch hollow stem augers to 15 feet below the seasonally high water table, or approximately 25 feet MSL for the majority of the treatment area (Figure 5). As presented in the FS/CAP, the May 2014 water levels are approximately 1.5 feet higher than the historical average for the monitoring period and historical levels have ranged from approximately two feet higher to six feet lower than the May 2014 levels. Therefore, the gypsum will be placed at depths approximately 13 feet below to 2 feet above the observed water level to fully target the smear zone. In the eastern portion of the site, near MW-6, the borings may be up to 10 feet deeper due to lower observed water levels. Prior to drilling, the water levels at nearby wells will be gauged to verify that the gypsum will be emplaced within the saturated zone.

Drilling will be performed by a California-licensed driller. The pilot study will be performed prior to building demolition. Therefore, the drilling will be performed inside the service bay concrete coring will be required through the approximately 6-inch thick concrete slab. Each concrete core will be 10- to 12-inches in diameter to allow for sufficient spacing for the 8-inch augers. Waste generated during drilling will be placed into 55-gallon drums, chemically tested, and disposed of properly.

Mixing and Emplacement

As shown on the remediation boring detail on Figure 5, the bottom 15 feet of the boring will be filled with a mixture of 50% #2/12 sand and 50% gypsum pellets by volume. The higher permeability of the sand and gypsum mix will allow for more groundwater flow through the biostimulation media and will reduce the impacts of potential clogging from metal sulfides precipitation. Two feet of hydrated bentonite will be placed above the biostimulation media and the borehole will be finished with neat cement grout.

The sand and gypsum will be mixed above-ground in a mixing tank or hopper until the materials are evenly mixed. Each borehole will require approximately 600 pounds of gypsum and 1,000 pounds of sand. The total amount of gypsum and sand for all seven borings are approximately 4,200 pounds and 7,000 pounds, respectively.

After the borehole is drilled to the design depth, the sand-gypsum mixture will be poured into the borehole through the hollow-stem auger as the augers are slowly lifted out of the borehole. This will avoid the collapse of the borehole prior to material emplacement. Care will be taken to check that the mixture is not getting stuck, or bridging, within the augers. The amount of materials used for each borehole will be estimated and recorded in field implementation logs.

Field Modifications

Field modifications may be required due to unforeseen circumstances. If an obstruction is encountered, the boring will be sealed with neat cement grout and reinstalled at an adjacent location that is southeast (downgradient) of the intended location.

REPORTING

A technical memorandum will be prepared to document the findings from the monitoring well installation, pre-remediation groundwater sampling, and pilot test implementation activities, and to finalize the full-scale remediation plan based on the data collected. Specifically, the memorandum will:

- Summarize the lithologic and groundwater level observations, and if necessary, update the hydrogeologic description of the site to incorporate the boring logs and water levels from the new wells;
- Summarize the analytical results and visual observations of residual LNAPL, and if necessary, update the remediation treatment area;
- Revise the design or calculations based on the groundwater remedial design parameters, if needed;
- Develop drilling and remediation boring installation procedures based on the pilot study implementation; and
- Finalize the full-scale remediation boring locations based on the updated treatment area and the foundation plans for the proposed development.

ANTICIPATED SCHEDULE

Well installation is currently planned for late May 2015, with pre-remediation sampling and the pilot study to be performed in June 2015. The anticipated implementation schedule is presented in the FS/CAP.

If you have any questions, please do not hesitate to call us at 415-955-5200.

Sincerely yours,
Langan Treadwell Rollo

Christopher Glenn, PE, LEED GA
Senior Project Manager

Robert W. Schultz, CHG
Senior Project Manager

cc: Mr. Tony Cardoza and Mr. Stephen Siri, 3093 Broadway Holdings, L.L.C.
555 California Street, 10th Floor
San Francisco, CA 94104

Enclosures
Table 1 – Groundwater Sampling Analytical Summary
Figure 1 – Site Location Map
Figure 2 – Site Plan and Proposed Monitoring Well Locations
Figure 3 – Geologic Cross Section A-A'
Figure 4 – Proposed Remediation and Monitoring Well Network
Figure 5 – Remediation Boring Construction Detail
Appendix A – Well Installation and Development Standard Operating Procedures

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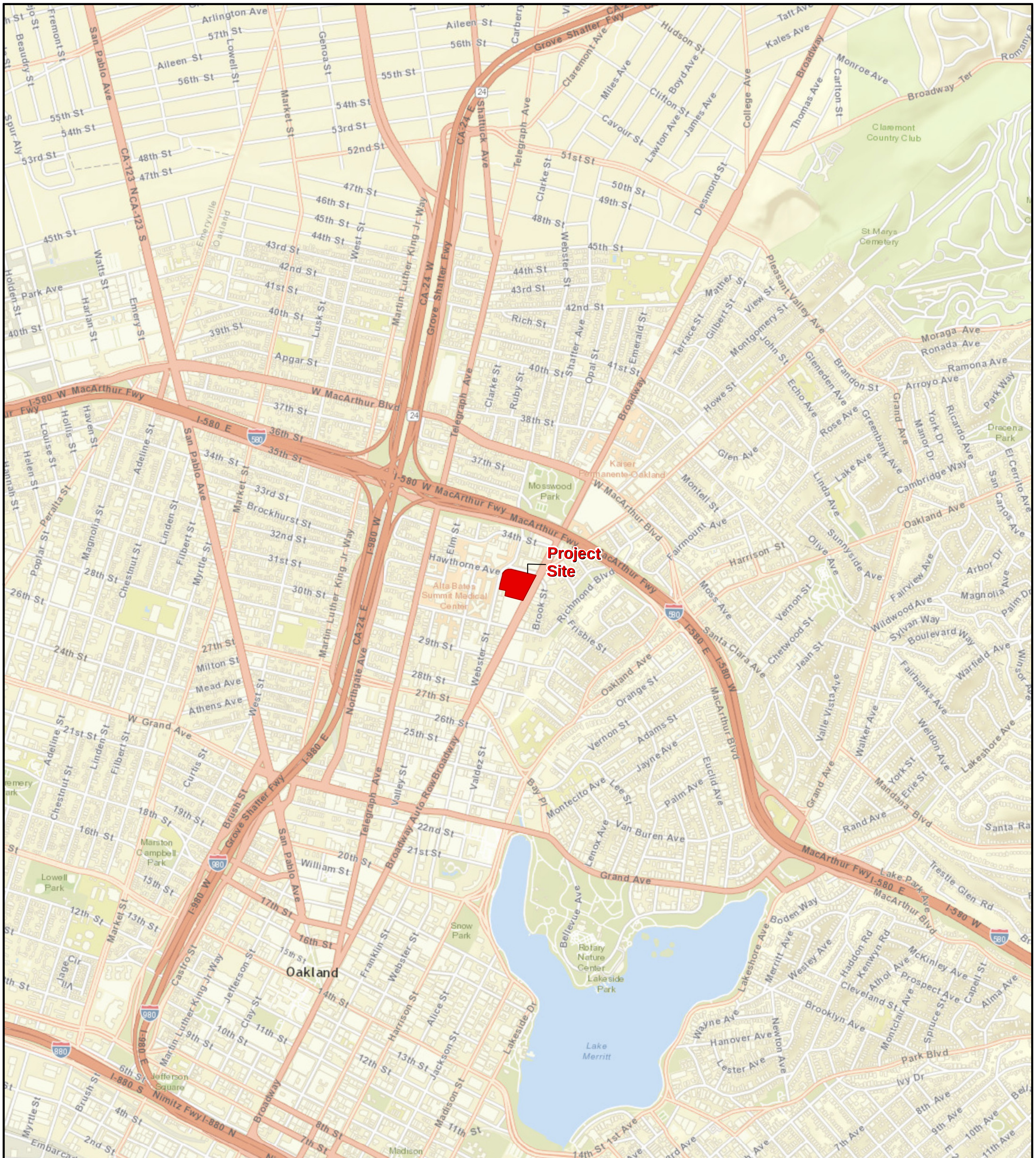
TABLE

Table 1
Proposed Groundwater Sampling and Analysis Schedule
3093 Broadway
Oakland, California

Sampling Location	Location	TOC Elevation	Casing Diameter	Screened Interval	Depth to Groundwater (May 2014)	Contaminants				Electron Acceptors/Reduced Electron Acceptors					Nutrients		Metals	Water Quality Parameters			Microbial
						BTEX/ MTBE	TPH-Gasoline and Diesel	1,2-DCA	Naphthalene	Nitrate/ Nitrite	Total Manganese	Total Iron/ Ferrous Iron	Sulfate/ Sulfite/ Sulfide	Dissolved Methane	Total Nitrogen	Total Phosphorus	CAM17 Metals	Total Organic Carbon (TOC)	Total Dissolved Solids (TDS)	Alkalinity	Sulfate Reducing Bacteria
Analytical Methods						8260B	8015B	8260B	8260B	E300.1	E200.8	E200.8 SM 3500Fe	E300.1	RSK175	SM4500-N	SM4500-P	E200.8	E415.3	SM2540C	SM2320B	CENSUS APS
		feet a-msl	inches	feet bgs	feet bgs	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L $CaCO_3$	cells/mL
Pre-Construction Sampling - once at pre-remediation event (2015)																					
MW-1	In plume	60.57	2	19 to 35	22.13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW-3	Cross-gradient	56.87	2	20 to 35	19.51	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
MW-4	In plume	55.67	2	15 to 30	18.15	X	X	X	X				X								
MW-5	Downgradient	51.7	2	15 to 35	25.97	X	X	X	X				X								
MW-6	In plume	51.65	2	15 to 35	22.93	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW-7	Downgradient	52.25	2	13.5 to 33.5	16.99	X	X	X	X				X								
MW-8	Downgradient	52.30	6	19.5 to 40	26.14	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
MW-14	In plume	61.5[b]	--	10 to 40	--	X	X	X	X				X								
MW-18	Assumed in plume	52[a]	2	20 to 30[a]	--	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MW-19	Downgradient	52[a]	2	20 to 30[a]	--	X	X	X	X				X								
RW-3A	In plume	54[b]	4	16 to 26	--	X	X	X	X				X								
RW-3B	In plume	54[b]	4	32 to 37	--	X	X	X	X				X								
MW-25	Downgradient	52[a]	2	20 to 30[a]	--	X	X	X	X				X								
MW-26	Downgradient	52[a]	2	13 to 23[a]	--	X	X	X	X				X								
MW-27	Downgradient	52[a]	2	15 to 25[a]	--	X	X	X	X				X								
Post-Development Sampling - quarterly for one year (estimated 2017)																					
MW-20	In plume	52[a]	2	10 to 20[a]	--	X	X	X	X				X								
MW-21	In plume	52[a]	2	10 to 20[a]	--	X	X	X	X				X								
MW-22	In plume	52[a]	2	20 to 30[a]	--	X	X	X	X				X								
MW-23	In plume	52[a]	2	10 to 20[a]	--	X	X	X	X				X								
MW-24	In plume	52[a]	2	15 to 25[a]	--	X	X	X	X				X								
MW-25	Downgradient	52[a]	2	20 to 30[a]	--	X	X	X	X				X								
MW-26	Downgradient	52[a]	2	13 to 23[a]	--	X	X	X	X				X								
MW-27	Downgradient	52[a]	2	15 to 25[a]	--	X	X	X	X				X								

Notes:
a. Estimated value for proposed well, screened interval selected be 10 feet long and intersecting the top of the water table.
b. Estimated value based on topographic contour
a-msl = above mean sea level
bgs = below ground surface
BTEX/MTBE = benzene, toluene, ethylbenzene, xylenes, methyl tertiary butyl ether
TPH = total petroleum hydrocarbons
µg/L = micrograms per liter
-- not applicable
Wells are to be sampled using low-flow sampling methodology and field parameters will be collected: including turbidity, pH, dissolved oxygen, oxidation-reduction potential, specific conductivity and temperature.
Additional parameters may be added to the post-development sampling as needed based on remediation progress.

FIGURES



Notes:

1. World street basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online. Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN.
2. Map displayed in California State Plane Coordinate System, Zone III, North American Datum of 1983 (NAD83), US Survey Feet.

0 1,000 2,000 4,000

Feet

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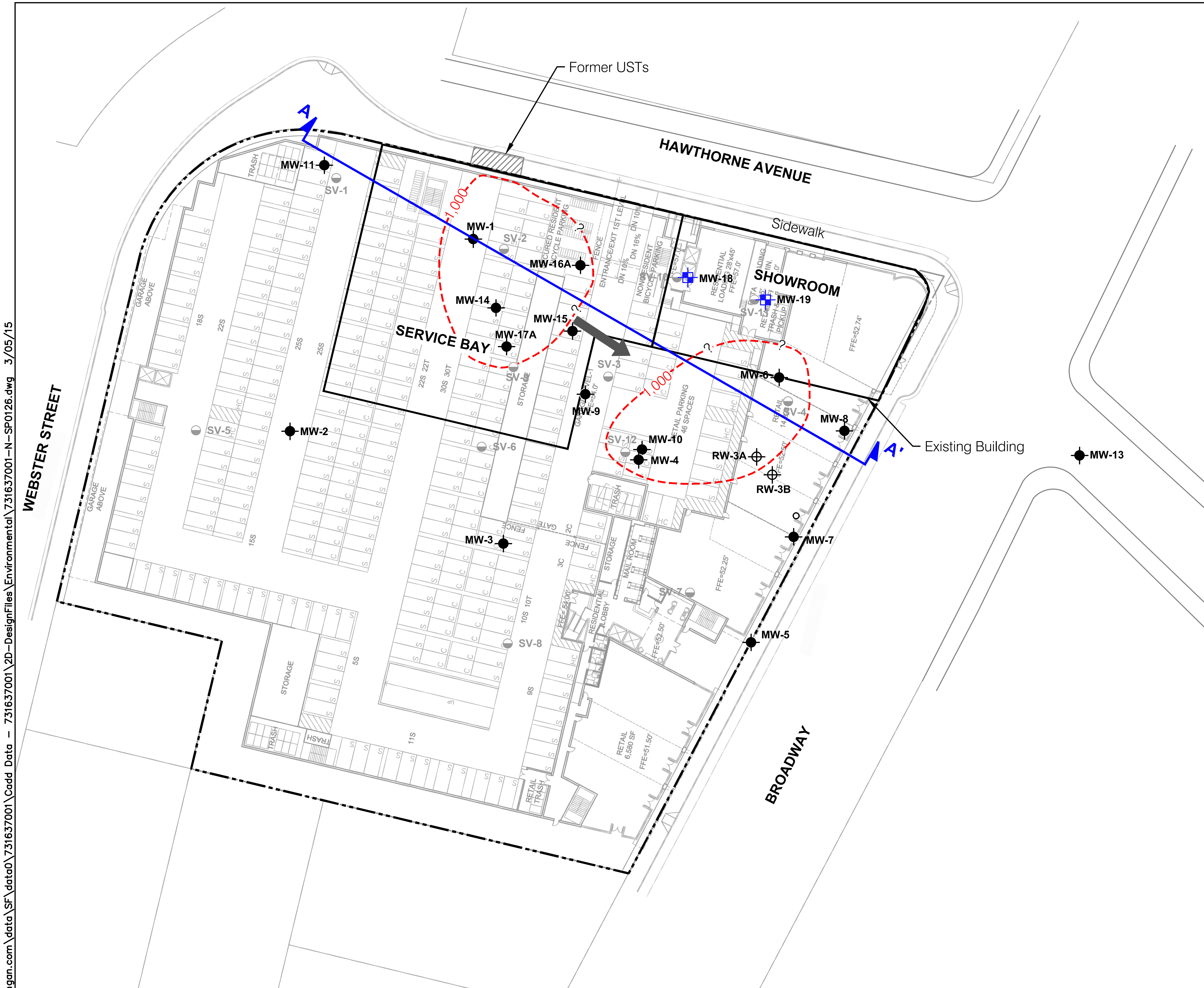
3093 BROADWAY Oakland, California	**SITE LOCATION MAP**
LANGAN TREADWELL ROLLO	Date 3/4/2015 | Project 7316317001 | Figure 1



EXPLANATION

MW-18 — Proposed groundwater monitoring well location

SV-1 — Soil vapor well location

MW-1 — Monitoring well location

RW-4 — Remediation monitoring well location

1,000 — Benzene Isoconcentration in water, queried where uncertain (May 2014)

Site boundary

A — A' Cross Section Line

Direction of Groundwater flow

0 — 60 Feet

Approximate scale

3093 BROADWAY
Oakland, California

SITE PLAN AND PROPOSED PRE-REMEDIATION GROUNDWATER MONITORING WELL LOCATIONS

Date 02/13/15	Project No. 731637001	Figure 2

LANGAN TREADWELL ROLLO

Reference: Base map from a drawing titled "C2.0 Conceptual Grading Plan," by BKF, dated 08/19/14 and "First Floor Plan," by Van Tilburg, Babvard & Soderbergh, AIA, dated 10/03/14.

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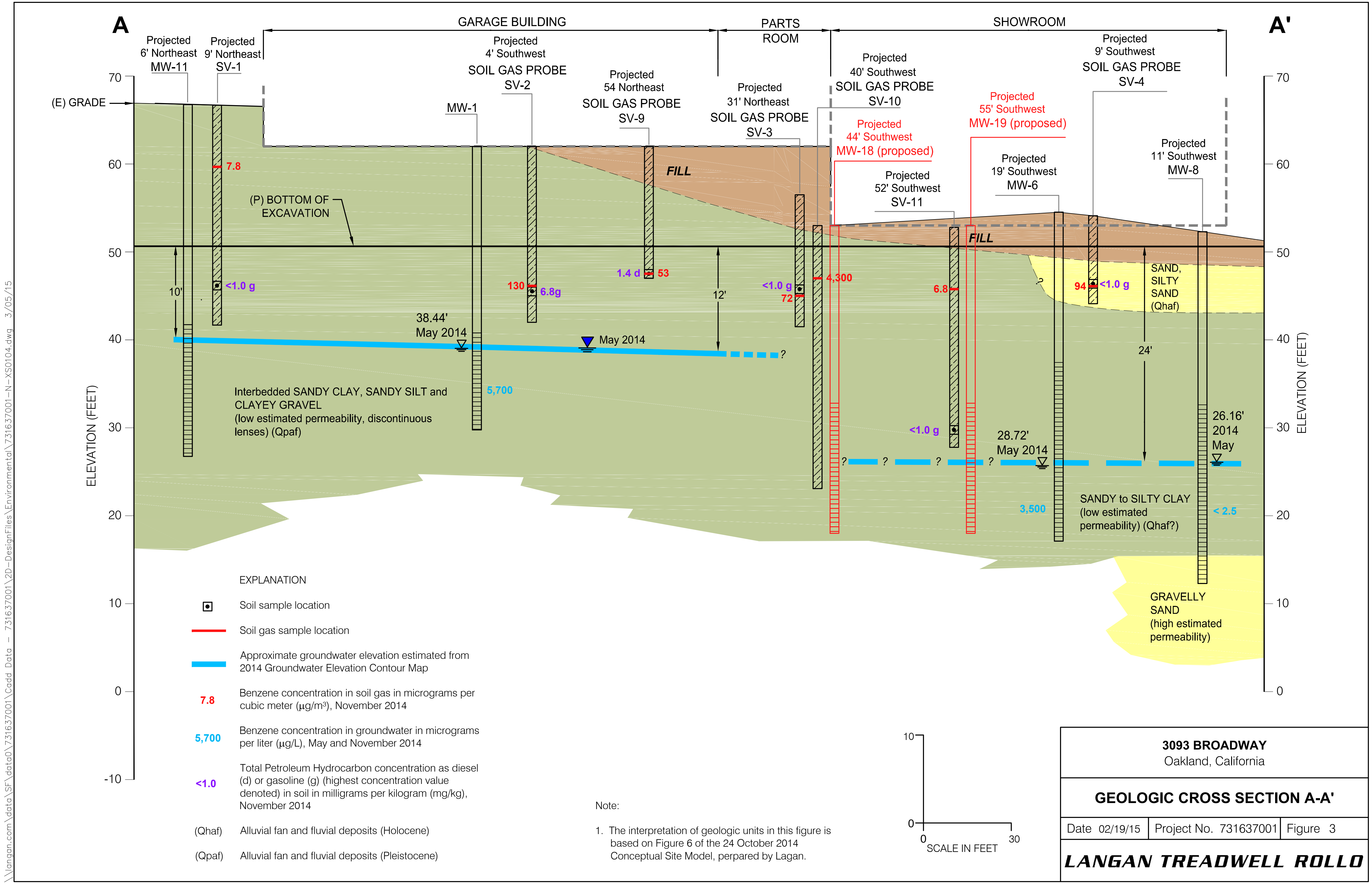
A
A'
GARAGE BUILDING
PARTS ROOM
SHOWROOM
Projected 6' Northeast MW-11
Projected 9' Northeast SV-1
Projected 4' Southwest SOIL GAS PROBE SV-2
MW-1
Projected 54 Northeast SOIL GAS PROBE SV-9
Projected 31' Northeast SOIL GAS PROBE SV-3
Projected 40' Southwest SOIL GAS PROBE SV-10
Projected 44' Southwest MW-18 (proposed)
Projected 55' Southwest MW-19 (proposed)
Projected 52' Southwest SV-11
Projected 19' Southwest MW-6
Projected 9' Southwest SOIL GAS PROBE SV-4
Projected 11' Southwest MW-8
(E) GRADE
(P) BOTTOM OF EXCAVATION
FILL
FILL
7.8
<1.0 g
130
6.8g
1.4 d
53
<1.0 g
72
4,300
6.8
94
<1.0 g
<1.0 g
10'
12'
24'
38.44' May 2014
May 2014
28.72' May 2014
26.16' 2014 May
5,700
3,500
< 2.5
Interbedded SANDY CLAY, SANDY SILT and CLAYEY GRAVEL (low estimated permeability, discontinuous lenses) (Qpaf)
SAND, SILTY SAND (Qhaf)
SANDY to SILTY CLAY (low estimated permeability) (Qhaf?)
GRAVELLY SAND (high estimated permeability)
ELEVATION (FEET)
70
60
50
40
30
20
10
0
-10
EXPLANATION
Soil sample location
Soil gas sample location
Approximate groundwater elevation estimated from 2014 Groundwater Elevation Contour Map
7.8 Benzene concentration in soil gas in micrograms per cubic meter (µg/m³), November 2014
5,700 Benzene concentration in groundwater in micrograms per liter (µg/L), May and November 2014
<1.0 Total Petroleum Hydrocarbon concentration as diesel (d) or gasoline (g) (highest concentration value denoted) in soil in milligrams per kilogram (mg/kg), November 2014
(Qhaf) Alluvial fan and fluvial deposits (Holocene)
(Qpaf) Alluvial fan and fluvial deposits (Pleistocene)
Note:
1. The interpretation of geologic units in this figure is based on Figure 6 of the 24 October 2014 Conceptual Site Model, perpared by Lagan.
10
0
0
30
SCALE IN FEET
3093 BROADWAY
Oakland, California
GEOLOGIC CROSS SECTION A-A'
Date 02/19/15
Project No. 731637001
Figure 3
LANGAN TREADWELL ROLLO
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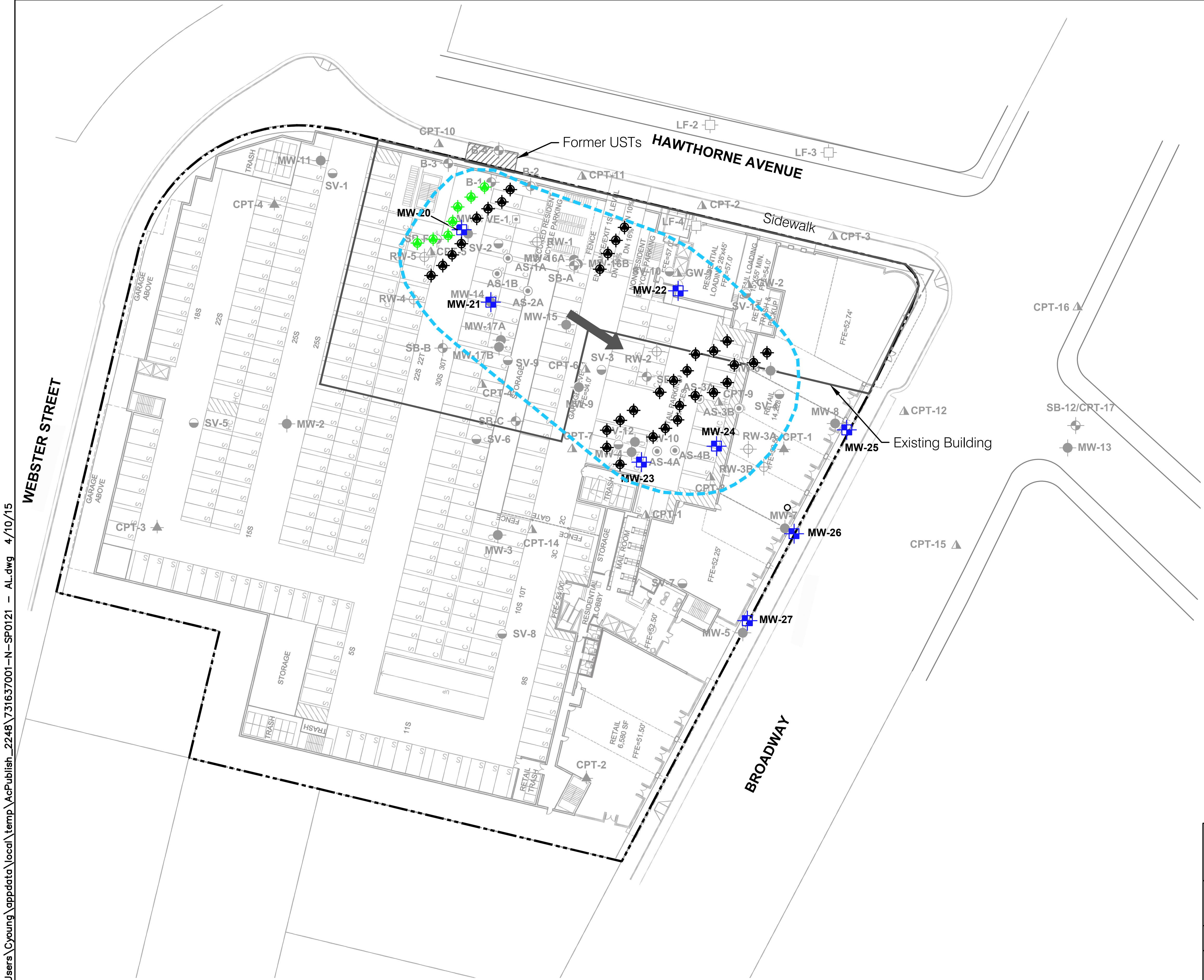

EXPLANATION

- MW-20 — Proposed post construction monitoring well
- Remediation boring location
- Pilot study remediation boring location
- SV-1 — Soil vapor well location
- MW-1 — Monitoring well location
- RW-4 — Remediation monitoring well location
- AS-1B — Air sparge well location
- VE-1 — Vapor extraction well location
- SB-A — Soil boring
- CPT-6 — Penetration test boring - 1992
- CPT-4 — Penetration test boring - 2014
- LF-2 — Abandoned monitoring well location
- Approximate targeted treatment area
- Site boundary
- Direction of groundwater flow

0 — 60 Feet
Approximate scale

3093 BROADWAY
Oakland, California

PROPOSED REMEDIATION SITE PLAN AND MONITORING WELL NETWORK

Date 02/13/15 | Project No. 731637001 | Figure 4

LANGAN TREADWELL ROLLO

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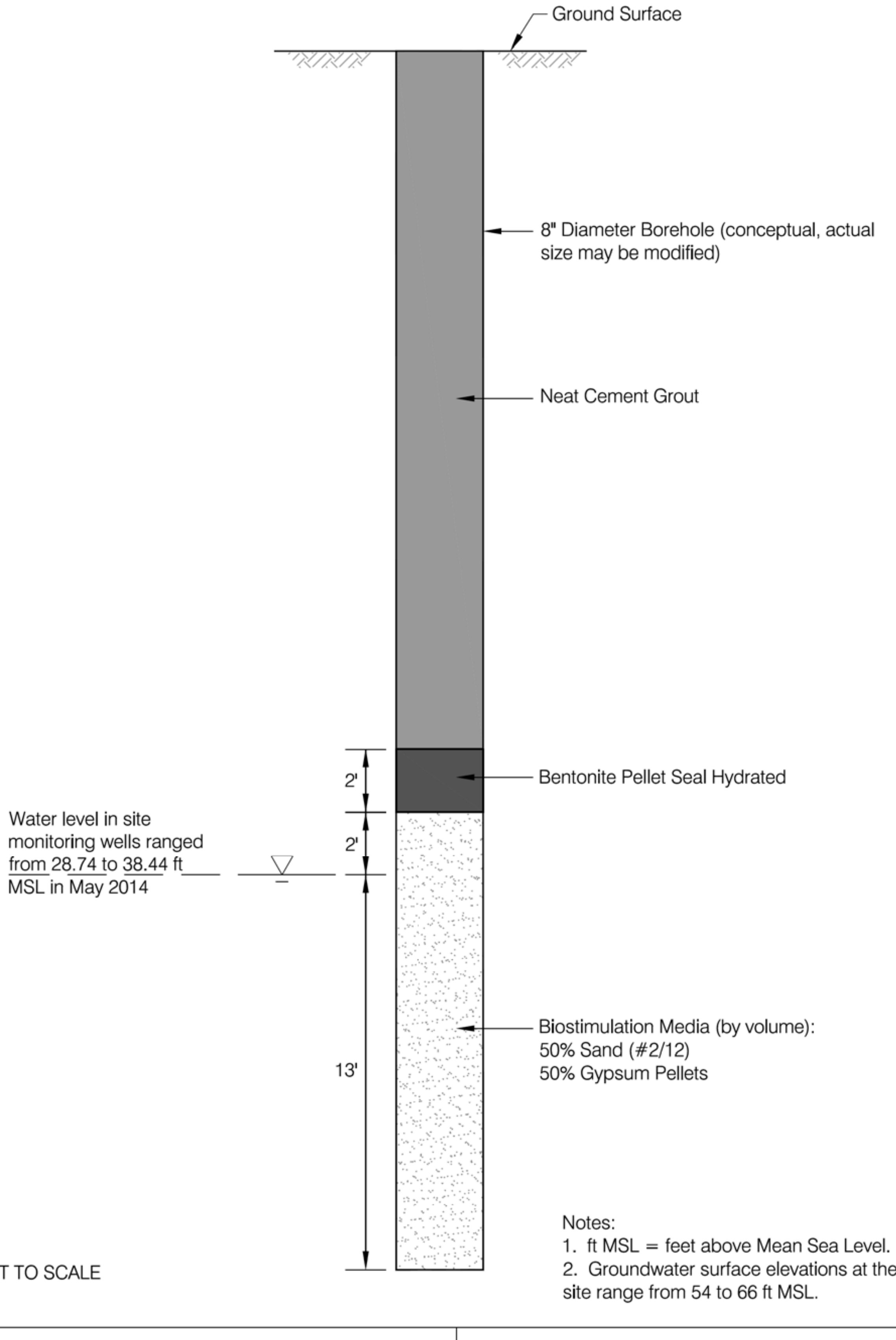
Reference: Base map from a drawing titled "C2.0 Conceptual Grading Plan," by BKF, dated 08/19/14 and "First Floor Plan," by Van Tilburg, Babvard & Soderbergh, AIA, dated 10/03/14.



NOT TO SCALE

Notes:
1. ft MSL = feet above Mean Sea Level.
2. Groundwater surface elevations at the site range from 54 to 66 ft MSL.

3093 BROADWAY
Oakland, California

LANGAN TREADWELL ROLLO

REMEDIATION BORING CONSTRUCTION DETAIL

Date 02/13/15	Project No. 731637001	Figure 5

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APPENDIX A

WELL INSTALLATION AND DEVELOPMENT 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.

REFERENCES

A ller, Linda, *et al.*, 1989. Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, National Water Well Association

Cohen, Robert M., and Mercer, James W. 1993. DNAPL Site Evaluation, CRC Press, Inc.

EPA Groundwater Handbook 1989

Nielsen, David M., 1993. Correct Well Design Improves Monitoring in "Environmental Protection", Vol.4, No.7, July 1993

USATHAMA, 1987. Geotechnical Requirements for Drilling. Monitoring Wells, Data Acquisition, and Reports, March 1987

ASTM D 5092-90 Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers

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.