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October 4, 2016

Mr. Adam Harris
Washington State Department of Ecology
Toxics Cleanup Program, SWRO
P.O. Box 47775
Olympia, Washington 98504-7775

Subject: Site Characterization Work Plan
U-Haul Facility No. 881090 / Former Church of God in Christ Facility
9201 Pacific Avenue South, Tacoma (Pierce County) Washington 98444
Facility/Site No. 19947
Cleanup Site ID No. 12404
VCP Project ID No. SW1531
ATC Project No. 1052109001

Dear Mr. Harris:

On behalf of AMERCO Real Estate Company (AREC) and pursuant to the Washington State Department of Ecology (Ecology) Further Action opinion letter dated August 26, 2015, ATC Group Services LLC (ATC) has prepared this work plan to characterize the extent and degree of chlorinated volatile organic compounds (VOC) associated with historic dry cleaning operations at the subject site.

SITE DESCRIPTION AND BACKGROUND

The subject site is approximately 8.9 acres with 670 feet of frontage on Pacific Avenue South, approximately 1,000 feet north of the 96th Street intersection (attached **Figure 1, Site Vicinity Map**). The subject site is at an approximate elevation of 385 feet above mean sea level. Pierce County Assessor's Office identifies the subject site as Tax Parcel Number 032033-3-309. The rectangular shaped parcel includes one centrally located approximate 61,419 square foot single-story brick/block walled commercial building surrounded by a primarily asphalt surfaced parking lot. Pacific Avenue South bounds the subject site to the west; mixed light commercial and residential use is predominant to the north, east (beyond A Street South) and west (beyond Pacific Avenue South). The south adjoining property is vacant land; mixed light commercial and residential use extends beyond the vacant lot (attached **Figure 2, Site and Surrounding Properties**).

A previous Phase I Environmental Site Assessment (ESA; Andersen Environmental [Andersen], 2014) indicated that the subject site was developed as a commercial nursery as early as 1941 through at least 1965. In circa 1965, the subject site was re-developed as a strip mall known as the Pacific Center and functioned in this capacity through 1997. Tenants within the strip mall included the Pacific Launder Center (from 1965 through at least 1974) and the Tacoma Dry Cleaning & Laundry Center (from as early as 1979 through at least 1984). The dry cleaners reportedly operated in the north end of the building. The subject site was reportedly purchased by the Church of God in Christ in 1999 and was operated as a place of worship/religious convention center with a child daycare facility through 2013, when the property was transferred into receivership. Andersen identified the former dry cleaning operations as a recognized environmental condition and recommended a Phase II ESA to address potential impacts.

Andersen performed Phase II subsurface investigations in December 2014 and March 2015, which included drilling a total of 13 soil borings to depths ranging between seven and 21 feet below ground surface (bgs; [Andersen, 2015]). Five borings (B7 through B11) were advanced through the foundation inside the north end of the building to facilitate collection of soil samples; groundwater grab samples were collected at borings B7 and B9. Eight additional borings (B1 through B6, B12 and B13) were advanced in the parking lot northwest, north and northeast of the building to facilitate collection of soil samples; groundwater grab samples were collected at borings B5 and B12. Four of the exterior boring locations were completed as permanent groundwater monitor wells (B1, B3, B6 and B13 were completed as MW1, MW2, MW3 and MW4, respectively); the wells were constructed with a five-foot screen interval extending to a maximum depth of 19 feet bgs. The boring logs indicated that first encountered groundwater occurred between 14 and 17 feet bgs, with static water levels in the completed wells ranged between 8.7 and 14.4 feet below top of well casing (suggesting a confined or semi-confined aquifer). Soil was described as predominantly un-weathered glacial till consisting of outwash gravel, sand and surficial loam to the maximum extent explored (21 feet bgs). The underlying hydrogeologic unit at the subject site is classified as Quaternary Vashon Till (Qvt), a semi-confining unit consisting of a grey, unsorted, highly compact mixture of clay, silt, sand, and gravel with occasional glacial erratics that extends to an approximate depth of 325 feet above mean sea level (United States Geological Survey [USGS], 1999). The 2015 Phase II incorporated the findings of an earlier (but previously unavailable) limited subsurface investigation conducted by Environmental Associates, Inc. (EA, 2013) which included soil and groundwater grab sampling and analyses at six borings (B-1 through B-6). Soil and groundwater laboratory analytical data obtained during both Phase II investigations quantified chlorinated VOC commonly associated with dry cleaning operations, including trichloroethene (TCE) and tetrachloroethene (PCE) at concentrations exceeding Model Toxics Control Act (MTCA) Method A Cleanup Levels.

Based on the data, Andersen concluded that the TCE and PCE concentrations in soil did not represent a significant risk to human health. Regarding the groundwater, Andersen concluded that monitored natural attenuation (MNA) was a feasible option based on the concentrations, groundwater flow direction (generally toward the north) and the absence of sensitive receptors in the vicinity of the dissolved phase plume. Andersen recommended three additional quarters of groundwater monitoring and sampling to establish groundwater elevation and flow direction trends and to monitor concentrations of chemicals of concern. Attached **Appendix A** includes select tabulated soil and groundwater laboratory analytical data and figures depicting the boring and monitor well locations, calculated groundwater gradient and potentiometric contour map and the estimate extent of dissolved phase PCE as interpreted by Andersen.

The subject site was purchased by AREC at auction in January 2016. Based on a brief review of the 2015 Phase II report, AREC believed that the apparently limited environmental risks would be sufficiently addressed by the suggested MNA groundwater sampling schedule. Following acquisition, AREC requested ATC to evaluate the Phase II reports and execute the proposed scope of work or develop an alternative approach as needed. Following a review of the 2015 Phase II report by Andersen, several data gaps were noted including the absence of a soil vapor survey. An investigative search in Ecology's intranet database (Fortress) yielded the aforementioned Further Action opinion letter addressed to Andersen and dated August 26, 2015. Per the Ecology correspondence, Andersen had requested an opinion for their proposed independent cleanup of the Church of God in Christ facility, which had an Ecology-assigned Voluntary Cleanup Program (VCP) project number. The opinions presented by Ecology were based on the 2013 limited subsurface investigation, the 2014 Phase I and the 2015 Phase II. A copy of the Ecology opinions letter is included in attached **Appendix B**.

Following a discussion with the VCP Case Manager in April 2016, ATC submitted a VCP application (to re-assign the designated responsible party from Andersen to AREC). In correspondence dated June 8, 2016, Ecology notified AREC that their VCP application had been accepted (with the original Church of God in Christ retained as the VCP site name).

SITE CHARACTERIZATION WORK PLAN

The City of Tacoma Planning and Development Services provided architectural plans (dated 1965) including an Equipment Installation Floor Plan. The floor plan (included in **Appendix C**) cites 'Philco-Bendix 6-Pac' dry cleaning equipment located along the north wall and west of the entrance doors. The floor plan also identifies a boiler room including a 2-inch floor drain located south of the dry cleaning equipment.

Building specifications as surveyed in September 2015 depict the interior walls; the floor plan layout for the north end of the building is included in **Appendix C**. Based on the dimensions, entrance doorway and building exterior concrete masonry unit piers identified on the 1965 Equipment Installation Floor Plan, the approximate location of the dry cleaner suite (including the dry cleaning equipment and 2-inch floor drain) within the present day configuration is depicted on attached **Figure 3, Site Plan Detail/Proposed Sampling Locations.** The dry cleaner suite's west wall and most of the interior build-out features depicted on the 1965 layout have been modified or removed. Based on the floor plan, exterior ingress/egress to the dry cleaner suite was limited to the north end of the building; the doors on the south side of the suite exited to the general mall area. The public right-of-way/utility easement sewer layout (both sanitary and storm water) as obtained from the City of Tacoma intranet site are included in **Appendix C**.

The objective of this Site Characterization Work Plan (Work Plan) is to better define the human health risk potential at the subject site. Specific components of the proposed investigation include: preparation of a Health and Safety Plan (HASP); indoor air quality survey; underground utility clearance; soil boring, soil sampling, sub-slab and soil vapor probe installation, sub-slab and soil vapor sampling and laboratory analysis; groundwater sampling and laboratory analyses; investigation derived waste disposal; and, data evaluation and report preparation. Each activity is described below.

1. HEALTH AND SAFETY PLAN

ATC's primary mechanism to ensure employee, environmental and public safety at the project site is the HASP. Prior to conducting field activities ATC will prepare for implementation a site- and task-specific HASP for this project. All individuals working under the purview of ATC will be required to read and sign the HASP to acknowledge their understanding of the information contained therein.

2. INDOOR AIR QUALITY SURVEY

To evaluate indoor air for potential accumulation of migrating VOC vapors, ATC proposes to place two laboratory-certified 6-liter capacity Summa® canisters inside the north end of the building (depicted as IA1 and IA2 on **Figure 3**). Prior to placement of the indoor air sampling canisters, ATC will inventory and remove or isolate any potential rogue sources of VOC to minimize their potential to contribute to the indoor air measurements. In conjunction with the indoor air sampling activities, a third Summa® canister will be secured in an outdoor location upwind of the prevailing wind direction to evaluate ambient air conditions. All three canisters will be equipped with a 24-hour time integrated sampler. ATC will return at the conclusion of the 24-hour sampling period to collect the canisters and record final vacuum readings. All three samples will be submitted for VOC analyses utilizing United States Environmental Protection Agency (EPA) Method TO-15.

3. UNDERGROUND UTILITY CLEARANCE

Prior to initiating subsurface activities, ATC will delineate the proposed drilling locations and contact Washington One-Call (811) to locate public utilities in the vicinity of the proposed investigation. As an additional precaution, a private subsurface utility survey will be performed prior to initiation of the proposed subsurface activities.

4. SUB-SLAB AND SOIL VAPOR INVESTIGATION

Six sub-slab soil vapor probes (interior locations; SSV1 through SSV6) and three soil vapor probes (exterior locations; SV7 through SV9) are proposed at the north end of the building as depicted on **Figure 3**. The appropriate electronic Notice of Intent (NoI) forms will be completed and submitted on-line to the Ecology Water Resources Program. Each boring will be completed as a semi-permanent soil vapor probe in general accordance with the specification depicted on attached **Figure 4, Proposed Soil Vapor Probe Construction Diagrams**.

a. SUB-SLAB SOIL VAPOR PROBES

ATC will drill six borings through the concrete slab inside the north end of the building. The borings will be located at least three feet inside the foundation edge. The borings will be advanced through the concrete floor using a hammer drill. Each boring will be completed as a semi-permanent sub-slab vapor probe utilizing a Vapor Pin™ sampling device (as depicted on **Figure 4**). The Vapor Pin™ sampling device was designed by Cox-Colvin & Associates, Inc. (Cox-Colvin) specifically for the collection of sub-slab soil vapor samples. These probes will be installed in general accordance with Cox-Colvin's Standard Operating Procedure (included in attached **Appendix D**). The maximum depth of the sub-slab soil vapor probes will not exceed two inches below the slab (by design, the vapor inlet should be in the engineered fill). At the completion of sub-slab vapor sampling activities, a stainless steel cover will be used to secure the sampling device. No soil sampling is proposed for these locations. The locations of SSV1 and SSV2 were selected to evaluate sub-slab soil vapors at the former dry cleaning equipment area and floor drain, respectively. The remaining SSV locations were intended to provide lateral sub-slab soil vapor data.

b. SOIL VAPOR PROBE

ATC will advance three borings through the parking lot north of the building. These borings will be advanced into the native soil to an approximate depth of five feet below surface grade using direct-push technology (DPT) drilling equipment. Soil samples will be collected at approximate depths of 2.5 feet and five feet (the boring terminus) and prepared/submitted for laboratory analyses of VOC, lead and arsenic utilizing EPA Methods 8260B and 3050/6010, respectively. Soil sampling will be performed in general accordance with ATC's Standard Operating Procedure – Direct-Push Drilling and Sampling (**Appendix D**). The soil sampling and analyses is proposed to determine if the VOC concentrations are increasing, decreasing or remaining constant in the uppermost five feet. The boring will be completed as a semi-permanent soil vapor probe with a flush-mounted traffic-rated vault identified as a monitor well. Proposed soil vapor probe construction details are presented on **Figure 4**.

Following installation and a 48-hour equilibration period, the interior and exterior vapor probes will be purged of three internal volumes (probe tip, tubing and [as applicable to the soil vapor probe] filter pack voids) at a flow rate not exceeding 200 milliliters per minute. Prior to sampling, a shut-in test will be performed at each vapor probe. Following purging, a soil vapor sample will be collected in a laboratory-certified Summa® canister. During sampling activities, sample train integrity will be verified by placing a cloth infused with a leak check compound (1,1-difluoroethane [DFA]) near the canister intake port.

Up to 12 soil vapor samples will be collected and submitted for analyses of VOC utilizing EPA Method TO-15; this includes nine primary samples, one duplicate sample, one ambient and one trip blank. The primary and duplicate vapor samples will also be analyzed for DFA.

Sub-slab and soil vapor probe installation and sampling will be performed in general accordance with ATC's Standard Operating Procedure – Soil Vapor Well Installation and Sampling (**Appendix D**) and Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Draft, dated October 2009).

5. GROUNDWATER INVESTIGATION

To evaluate VOC in groundwater, ATC proposes to advance one soil boring through the asphalt parking lot near the north edge of the building (depicted as EB1 on **Figure 3**). Prior to drilling, the appropriate electronic NoI Form will be completed and submitted on-line to Ecology's Water Resources Program. The boring will be advanced using hollow-stem auger (HSA) tooling on a mobile drill rig and will be sampled at five foot vertical intervals for laboratory analyses and descriptive purposes in general accordance with ATC Standard Operating Procedure – Hollow-Stem Auger Drilling and Soil Sampling (**Appendix D**).

ATC acknowledges Ecology's recommendation to collect groundwater samples at depth discrete zones within the aquifer and at the base of the aquifer. However, based on the semi-confining characteristics of the Qvt hydrogeologic unit and the documented low-level groundwater impacts at existing monitor wells, ATC proposes to terminate boring EB1 at an approximate depth of 40 feet bgs. Boring EB1 will be completed as groundwater monitor well MW5, with a screened interval extending from approximately 30 feet to 40 feet bgs. Proposed well construction specification are presented on the attached **Figure 5**. The annular bentonite seal at proposed well MW5 will ensure a minimum of nine vertical feet between the lower limit of the existing monitor wells (approximately 19 feet bgs) and the upper limit of the sand pack at MW5 (approximately 28 feet bgs). As proposed, this well is intended to yield groundwater samples approximately 11 to 12 feet below the existing monitor wells. If dissolved phase VOC are absent in groundwater samples collected at MW5, the vertical extent will be considered defined. If dissolved phase VOC are present in groundwater samples collected at MW5, the need for additional vertical delineation will be evaluated.

The well will be installed and developed in general accordance with ATC's Standard Operating Procedure (**Appendix D**). Following installation, the new well will be surveyed (top of well casing and latitude/longitude).

As part of the groundwater investigation, ATC will gauge, low-flow purge and sample the existing set of four groundwater monitor wells (MW1 through MW4; **Figure 2**) concurrent with MW5 (**Figure 3**). Purging and sampling activities will be completed in general accordance with ATC's Standard Operating Procedure (**Appendix D**).

All soil and groundwater samples will be submitted for VOC analyses utilizing EPA Method 8260B. No further evaluation of lead or arsenic in soil samples collected at EB1 is proposed.

6. INVESTIGATION DERIVED WASTE DISPOSAL

Investigation derived wastes (IDW) consisting of soil (generated from HSA drilling activities) and liquid (well development and purge activities and equipment decontamination rinseate water) will be separately contained in labeled Department of Transportation (DOT) approved steel drums and stored temporarily at the site. After acceptance of waste profiles, the drums will be removed from the site and transported to an appropriate facility for disposal.

7. DATA EVALUATION AND REPORT PREPARATION

ATC will prepare a report summarizing the results of the investigation. This report will contain tables, figures and accompanying text covering the following elements:

- A narrative summary of activities performed by ATC including a description of field operations and procedures and deviations from the Work Plan, if applicable. The summary will include an updated Conceptual Site Model (CSM).
- Tables summarizing laboratory analytical results of soil, soil vapor and sub-slab vapor and all groundwater samples. Soil data will be compared to MTCA Method A Cleanup Levels. Indoor air, soil vapor and groundwater data will be compared to MTCA Method B Cleanup Levels (as updated by Ecology in 2015)
- Figures depicting the site vicinity, groundwater investigation boring/well location, indoor air, sub-slab and soil vapor probe locations, vapor probe construction details and groundwater conditions. Geologic cross-sections will be prepared based on soil boring logs.
- Appendices providing supporting documentation including but not limited to: soil boring logs; analytical laboratory data reports with chain of custody documents; and, IDW disposal records.

All field activities related to the proposed investigation will be conducted under the supervision of a Washington Licensed Geologist (L.G.). Technical documents submitted to Ecology will be reviewed, signed and stamped by a Washington L.G.

8. REFERENCES

Andersen Environmental (Andersen), 2015. Phase II Environmental Site Investigation Report. April 20.

Andersen, 2014. Phase I Environmental Site Assessment Report. September 16.

Environmental Associates, Inc., 2013. Limited Soil and Groundwater Sampling and Testing. April 26.

United States Geological Survey, 1999. Ground-Water Hydrology of the Tacoma-Puyallup Area, Pierce County, Washington (Water Resources Investigations Report 99-4013).

If you have any questions or comments regarding this Work Plan, please contact Edwin Vandegrift at (480) 355-4672.

Sincerely,
ATC Group Services LLC

2806
Edwin T. Vandegrift

2790
Girard E. Morgan

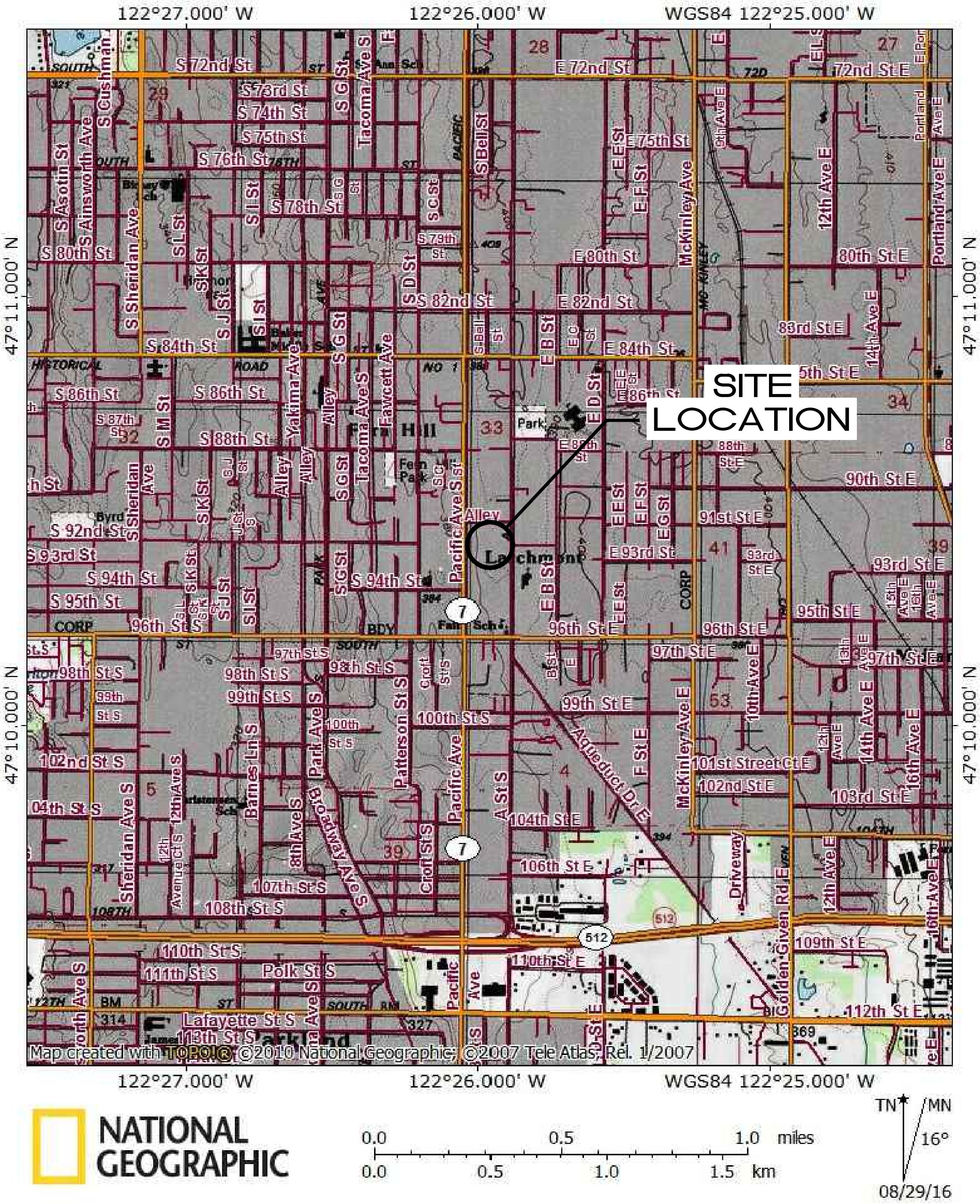
Edwin Vandegrift, L.G.
Senior Project Manager
Email: edwin.vandegrift@atcassociates.com

Girard E. Morgan, L.G.
Principal Geologist
Email: ric.morgan@atcassociates.com

Attachments: As stated.

cc: Larry Hine, AMERCO Real Estate Company

Figures



SOURCE: USGS TOPO MAP, TACOMA SOUTH, WA, QUAD, 2014

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SITE VICINITY MAP

U-HAUL FACILITY NO. 881090
9201 PACIFIC AVENUE SOUTH
TACOMA, WASHINGTON 98444

PROJECT NUMBER:	1052109001	DATE:	9/30/16	FIGURE
APPROVED BY:	EV	DRAWN BY:	BK	1

ATC
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Tempe, Arizona 85284-2912
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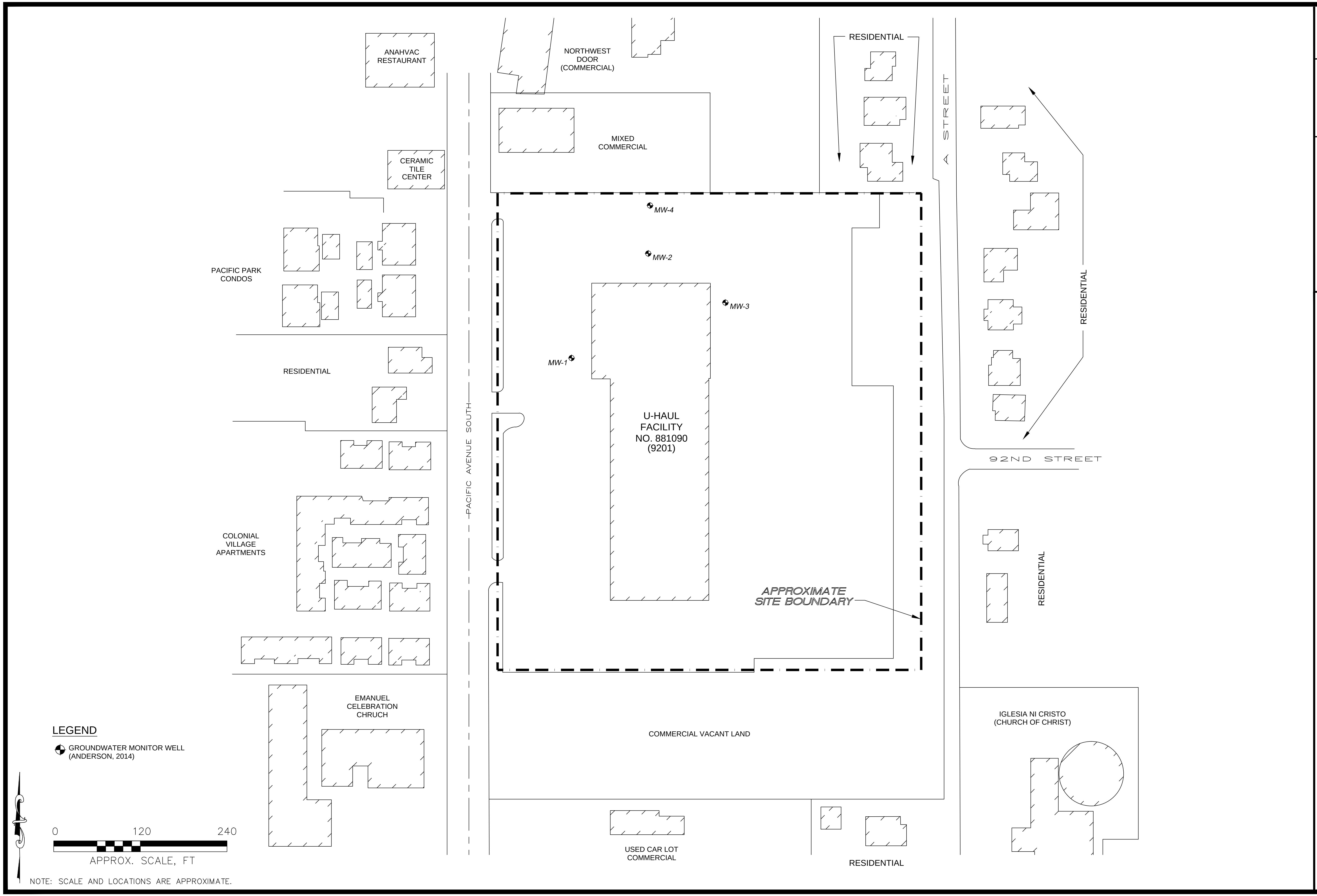

SITE AND SURROUNDING PROPERTIES

U-HAUL FACILITY NO. 881090
9201 PACIFIC AVENUE SOUTH
TACOMA, WASHINGTON 98444

PROJECT NUMBER: 1052109001	DATE: 9/30/16	FIGURE
APPROVED BY: EV	DRAWN BY: BK	2

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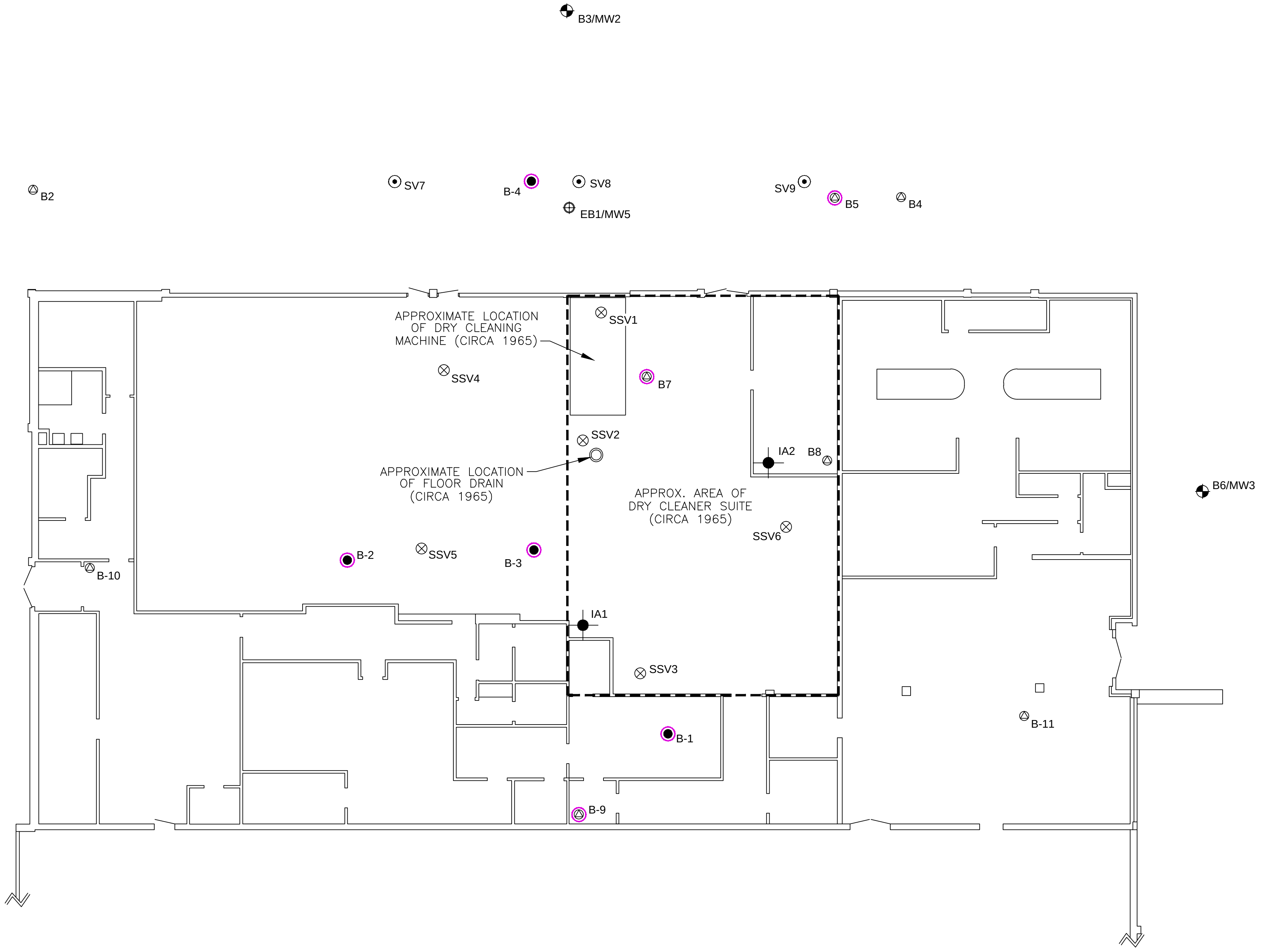
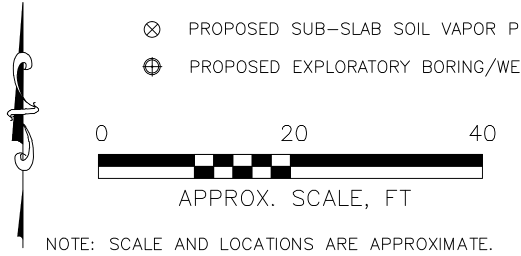


LEGEND

- ⯐ GROUNDWATER MONITOR WELL (ANDERSEN, 2014)
- △ SOIL BORING (ANDERSEN, 2014)
- ● SOIL BORING (ENVIRONMENTAL ASSOCIATES, 2013)
- ○ DENOTES GROUNDWATER GRAB SAMPLE LOCATION (2013, 2014)
- ● PROPOSED INDOOR AIR SAMPLE
- ⊙ PROPOSED SOIL VAPOR PROBE
- ⊗ PROPOSED SUB-SLAB SOIL VAPOR PROBE
- ⊕ PROPOSED EXPLORATORY BORING/WELL



NOTE: SCALE AND LOCATIONS ARE APPROXIMATE.

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SITE PLAN DETAIL/PROPOSED SAMPLING LOCATIONS

U-HAUL FACILITY NO. 881090
9201 PACIFIC AVENUE SOUTH
TACOMA, WASHINGTON 98444

PROJECT NUMBER: 1052109001
APPROVED BY: EV
DATE: 10/4/16
DRAWN BY: BK
FIGURE 3

ATC
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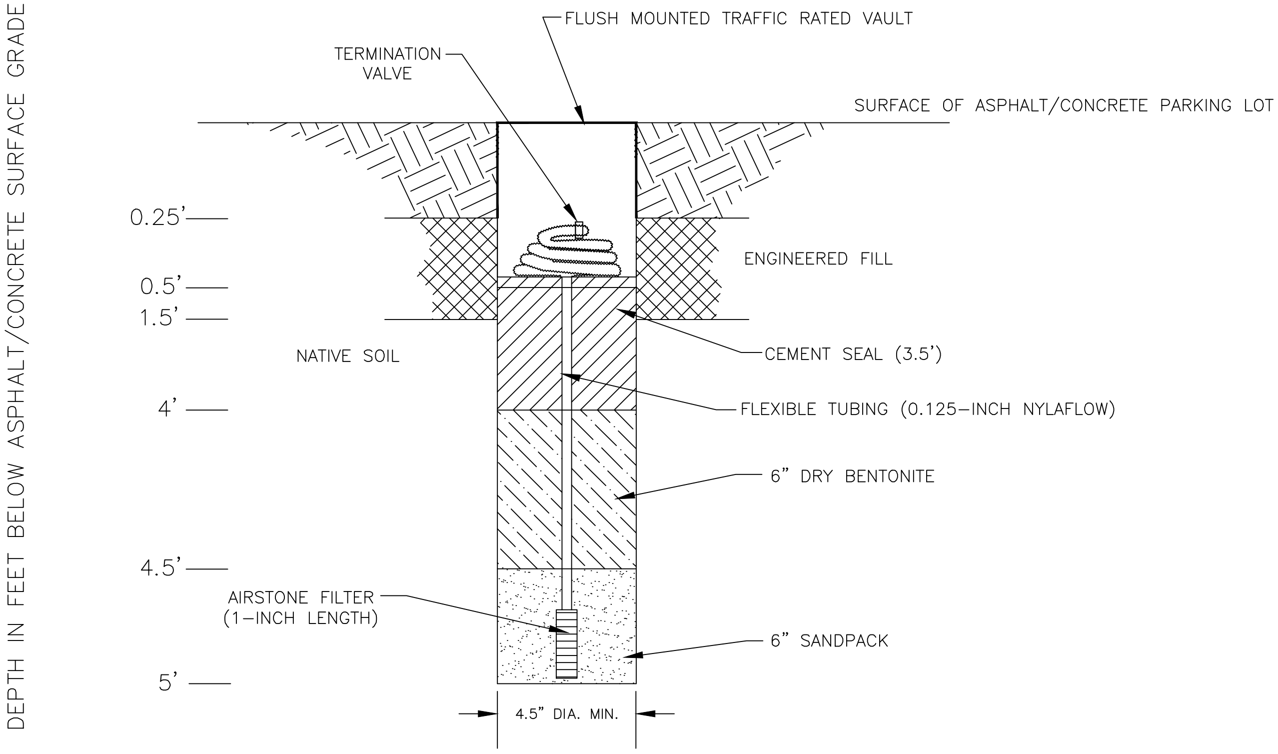
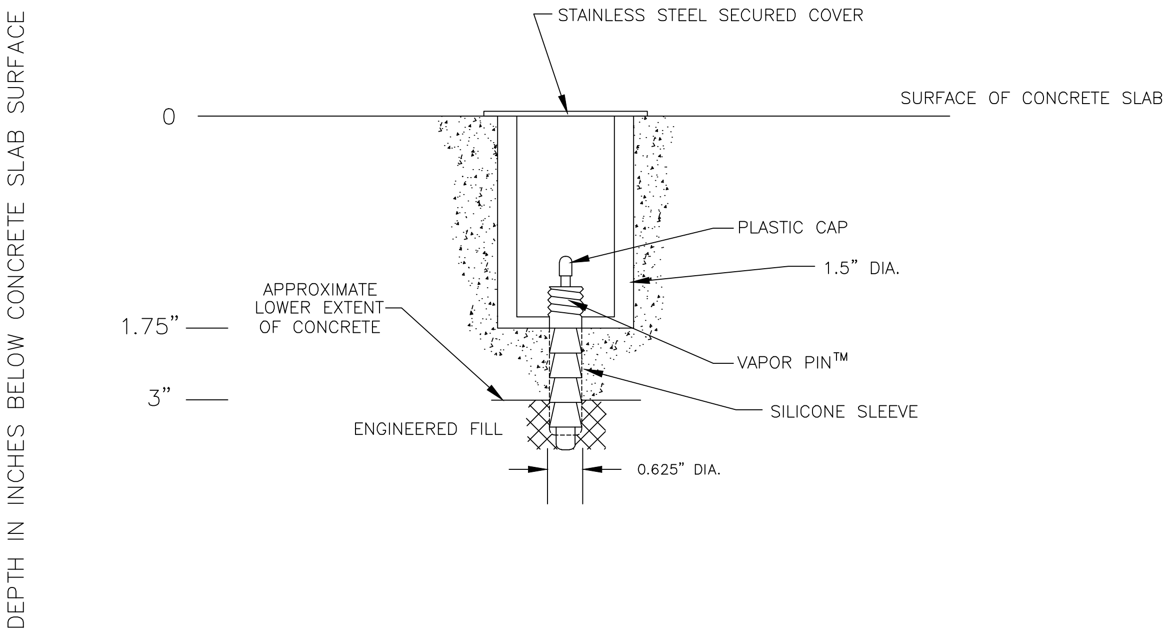


SEMI-PERMANENT SOIL VAPOR PROBE

NOT TO SCALE



SEMI-PERMANENT SUB-SLAB SOIL VAPOR PROBE

NOT TO SCALE

PROPOSED SOIL VAPOR PROBE
CONSTRUCTION DIAGRAMS
U-HAUL FACILITY NO. 881090
9201 PACIFIC AVENUE SOUTH
TACOMA, WASHINGTON 98444

PROJECT NUMBER:	1052109001	DATE:	9/30/16	FIGURE 4
APPROVED BY:	EV	DRAWN BY:	BK	

ATC
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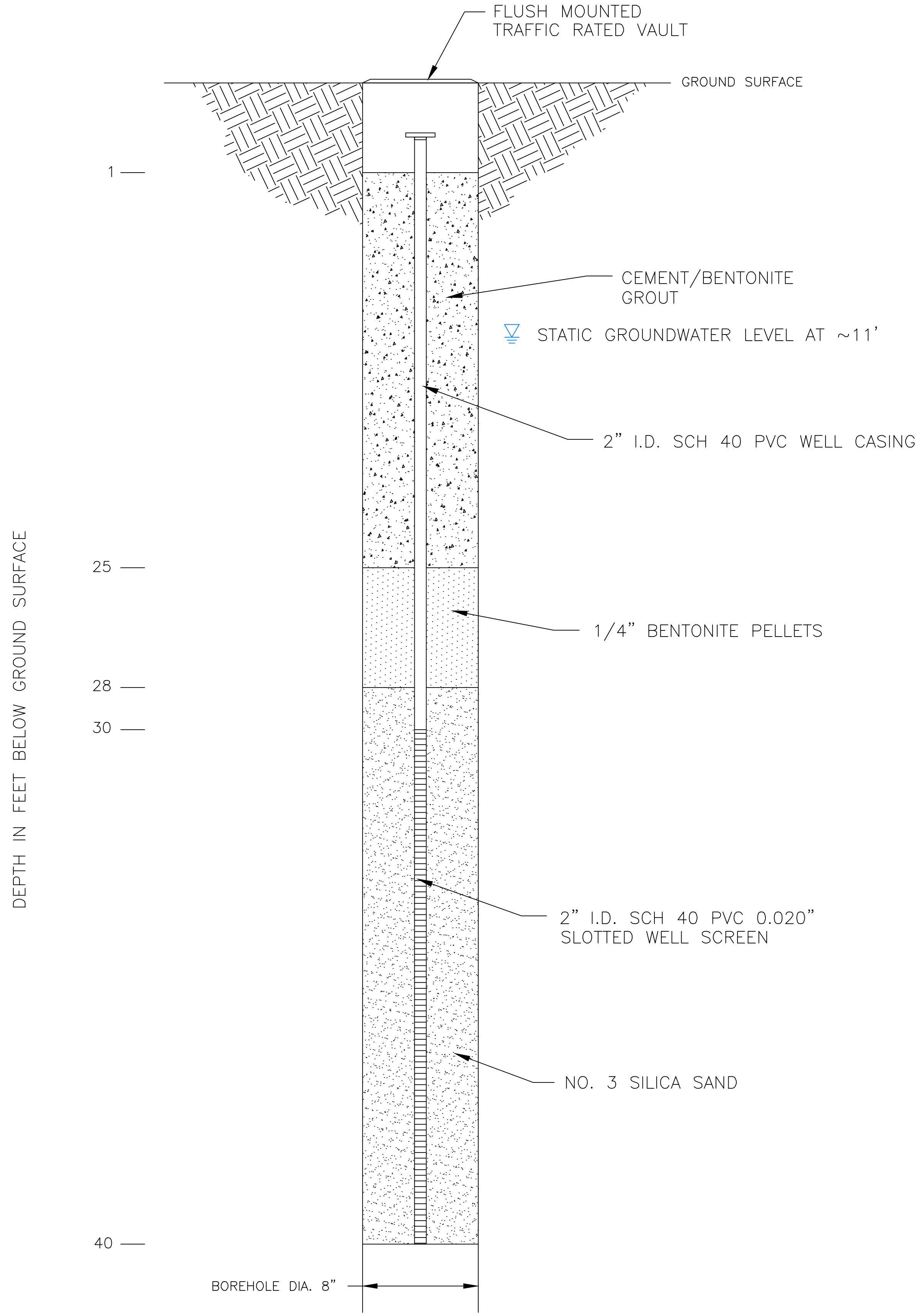

NOT TO SCALE

PROPOSED GROUNDWATER MONITOR
WELL CONSTRUCTION DIAGRAM
U-HAUL FACILITY NO. 881090
9201 PACIFIC AVENUE SOUTH
TACOMA, WASHINGTON 98444

PROJECT NUMBER:	1052109001	DATE:	10/3/16
APPROVED BY:	EV	DRAWN BY:	BK

FIGURE
5

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Appendix A

Select Tables and Figures from Andersen Environmental Phase II Environmental Site Investigation Report (2015)

Table 1: Volatile Organic Compounds in Soil
COGIC Property
9201 South Pacific Avenue, Tacoma, Washington 98444

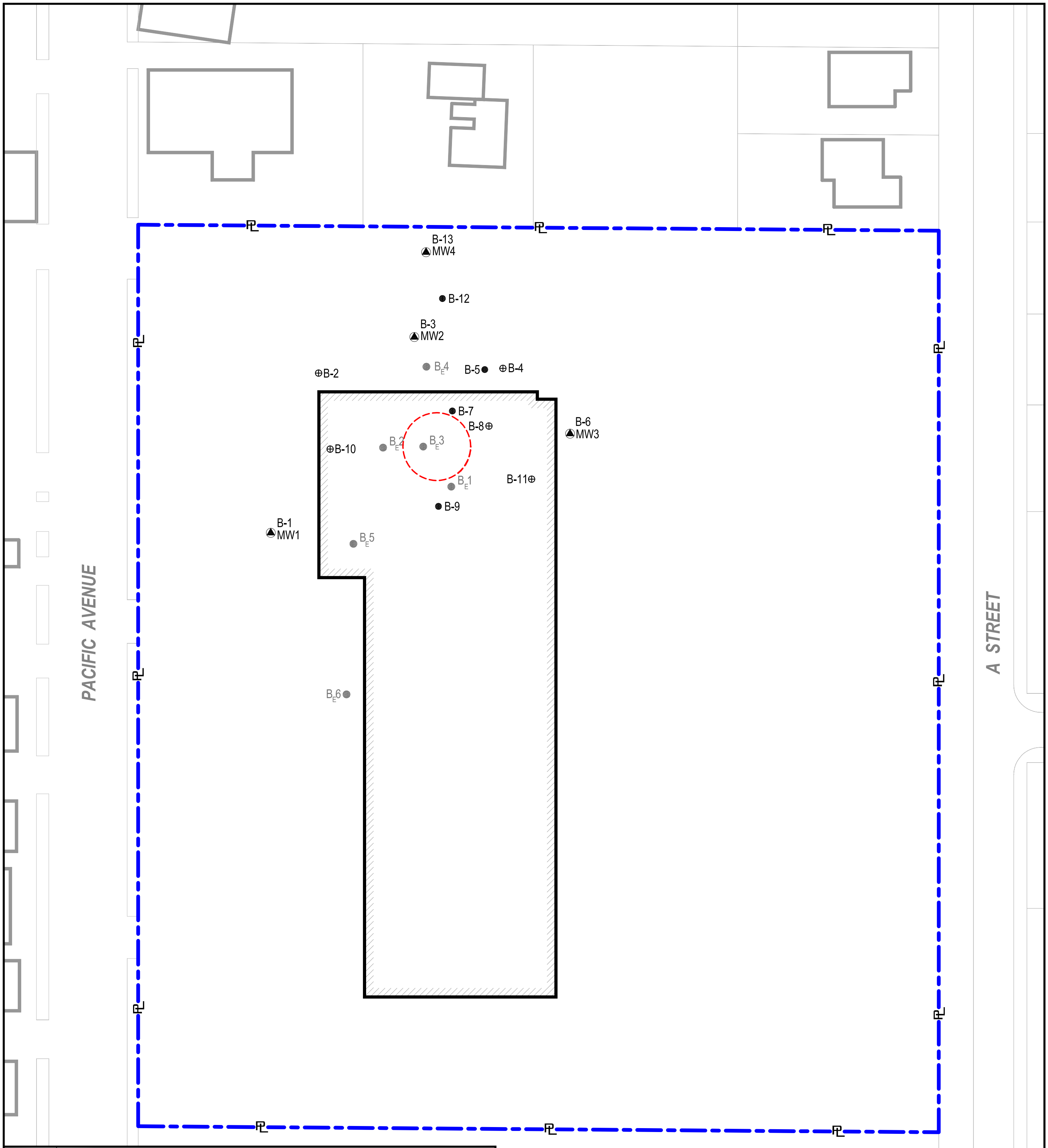
Sample ID	Sample Date	Sample Depth (ft bgs)	EPA Method 8260C (mg/kg)										
			Tetrachloro-ethylene (PCE)	Trichloro-ethylene (TCE)	cis-1,2,Dichloro-ethylene	trans-1,2,Dichloro-ethylene	Vinyl Chloride	1,2, Dichloro-ethane	1,1,1,Trichloro-ethane	Napthalene	1,2,4,Trimethyl-benzene	Acetone	All Other 8260C VOC Analytes
B_E1-3	4/17/2013	3	ND<0.02	**0.03**	**0.05**	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.25	ND
B_E1-3dup	4/17/2013	3	ND<0.02	**0.04**	**0.05**	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.25	ND
B_E2-3	4/17/2013	3	ND<0.02	**0.03**	**0.25**	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.25	ND
B_E3-4	4/17/2013	4	**1.2**	**0.5**	**0.19**	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.25	ND
B_E4-3	4/17/2013	3	**0.03**	ND<0.02	**0.17**	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.25	ND
B_E5-15	4/17/2013	15	ND<0.02	ND<0.02	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.25	ND
B_E6-15	4/17/2013	15	ND<0.02	ND<0.02	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.05	ND<0.25	ND
B1-12	12/29/14	12	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	**0.011 Y**	ND
B2-14	12/29/14	14	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B3-13	12/29/14	13	**0.0091**	**0.0015**	**0.0019**	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B4-14	12/29/14	14	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B5-14	12/29/14	14	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B6-15	12/29/14	15	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	**0.27**	**0.0015**	ND<0.0056	ND
B7-17	12/30/14	17	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B8-10	12/30/14	10	**0.0069**	**0.0012**	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B9-10	12/30/14	10	**0.014**	**0.0023**	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B10-7	12/30/14	7	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B11-10	12/30/14	10	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B12-16	02/25/15	16	**0.011**	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
B13-14	02/25/15	14	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.0011	ND<0.048	ND<0.2000	ND<0.0056	ND
CUL			**0.05(A)**	**0.03(A)**	**160(B)**	**1600(B)**	**240(B)**	**1600(A)**	**2.0(A)**	**5.0(A)**	**NE**	**7200(B)**	**Varies**

Notes:
"B_E1-3" - Environmental Associates, 2013
"B1-12" - Andersen Environmental, 2014 - 2015
ND - Analyte not detected above Practical Quanitation Limit
NE - Not Established
PQL - Practical Quantitation Limit
CUL - Existing CleanUp Level under MTCA Method (A) or Method (B)
Detections in bold, detections exceeding screening criteria shaded in gray
Y - Laboratory calibration parameters not within nominal range. See laboratory report.
mg/kg = milligrams per kilogram

Table 2: Volatile Organic Compounds in Groundwater
COGIC Property
9201 South Pacific Avenue, Tacoma, Washington 98444

Sample ID	Sample Date	EPA Method 8260C (µg/l)														
		Tetrachloro-ethylene (PCE)	Trichloro-ethylene (TCE)	cis-1,2,Dichloro-ethylene	trans-1,2,Dichloro-ethylene	Vinyl Chloride	1,2,Dichloro-ethane	Chloroform	Benzene	Ethyl-benzene	Total Xylenes	Isopropyl-benzene	sec-Butyl-benzene	1,2,4,Tri-methyl-benzene	Acetone	All Other 8260C VOC Analytes
B_E1	4/17/2013	**2.4**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<10	ND
B_E1-dup	4/17/2013	**2.3**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<10	ND
B_E2	4/17/2013	**21**	**4.7**	**26**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<10	ND
B_E3	4/17/2013	**44**	**16**	**32**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<10	ND
B_E4	4/17/2013	**7**	**2.4**	**9.3**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<10	ND
B_E5	4/17/2013	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<10	ND
B_E6	4/17/2013	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<10	ND
B1/MW1	12/29/14	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	**0.33**	ND<0.2	**0.4**	**0.29**	**1.55**	**0.26**	**0.36**	**0.43**	ND<5	ND
B3/MW2	12/29/14	**40**	**11**	**39**	**0.78**	ND<0.2	ND<0.2	**0.24**	ND<0.2	ND<0.2	**0.72**	ND<0.2	ND<0.2	ND<0.2	ND<5	ND
B5	12/29/14	ND<0.2	ND	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	**0.41**	**1.92**	ND<0.2	ND<0.2	ND<0.2	ND<5	ND
B6/MW3	01/23/15	ND<0.2	ND	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.04	ND<0.2	ND<0.2	ND<0.2	ND<5	ND
B7	12/30/14	**16**	**3.3**	**6.9**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	**0.35**	**1.25**	ND<0.2	ND<0.2	ND<0.2	ND<5	ND
B9	12/30/14	**5.6**	**0.96**	**0.67**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	**0.2**	**0.42**	**1.45**	ND<0.2	ND<0.2	ND<0.2	**10 Y**	ND
B12	02/25/15	**25**	**5.5**	**17**	**0.21**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.04	ND<0.2	ND<0.2	ND<0.2	ND<5	ND
B13/MW4	02/25/15	**1.1**	ND<0.2	**0.21**	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.04	ND<0.2	ND<0.2	ND<0.2	ND<5	ND
Trip Blank	10/30/14	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.2	ND<0.04	ND<0.2	ND<0.2	ND<0.2	ND<5	ND
CUL		**5**	**5**	**80**	**160**	**0.2**	**5**	**80**	**5**	**700**	**1000**	**NE**	**80**	**80**	**7200**	**Varies**

Notes:
"BE1" - Environmental Associates, 2013
"B1" - Andersen Environmental, 2014 - 2015
ND - Analyte not detected above Practical Quanitation Limit
NE - Not established
PQL - Practical Quanitation Limit
CUL - Existing CleanUp Level under MTCA Method A or CLARC Tables
Detections in bold, detections exceeding screening levels shaded in gray



LEGEND

ℙ (blue dash line)	SUBJECT PROPERTY
▨	SITE STRUCTURE
B-6 MW3 ▲	SOIL BORING CONVERTED TO PERMANENT GROUNDWATER MONITORING WELL (ANDERSEN, 2014 - 2015)
B-5 ●	SOIL BORING & GROUNDWATER GRAB SAMPLING LOCATION (ANDERSEN, 2014 - 2015)
B-10 ⊕	SOIL BORING (ANDERSEN, 2014)
B$_E$6 ●	FORMER SOIL BORING & GROUNDWATER SAMPLING LOCATION (ENVIRONMENTAL ASSOCIATES, 2013)
◠	APPROX. AREA OF SOURCE ZONE

FIGURE 2	SITE PLAN
ADDRESS:	9201 PACIFIC AVENUE TACOMA, CALIFORNIA 98444
SOURCE:	ANDERSEN ENVIRONMENTAL
PROJECT NO.:	1412-2091
DRAWN BY:	JOHN ESCALONA
CHECKED BY:	BRIAN MARTASIN
DATE:	04/13/2015

ANDERSEN ENVIRONMENTAL

APPROX. SCALE: 1"= 100'

0' 50' 100'

K:\AE 2014\Projects 2014\1412-2091_9201 Pacific Ave Tacoma WA 98444_PH II\05 1412-2091_Reports\From Nels\CAD

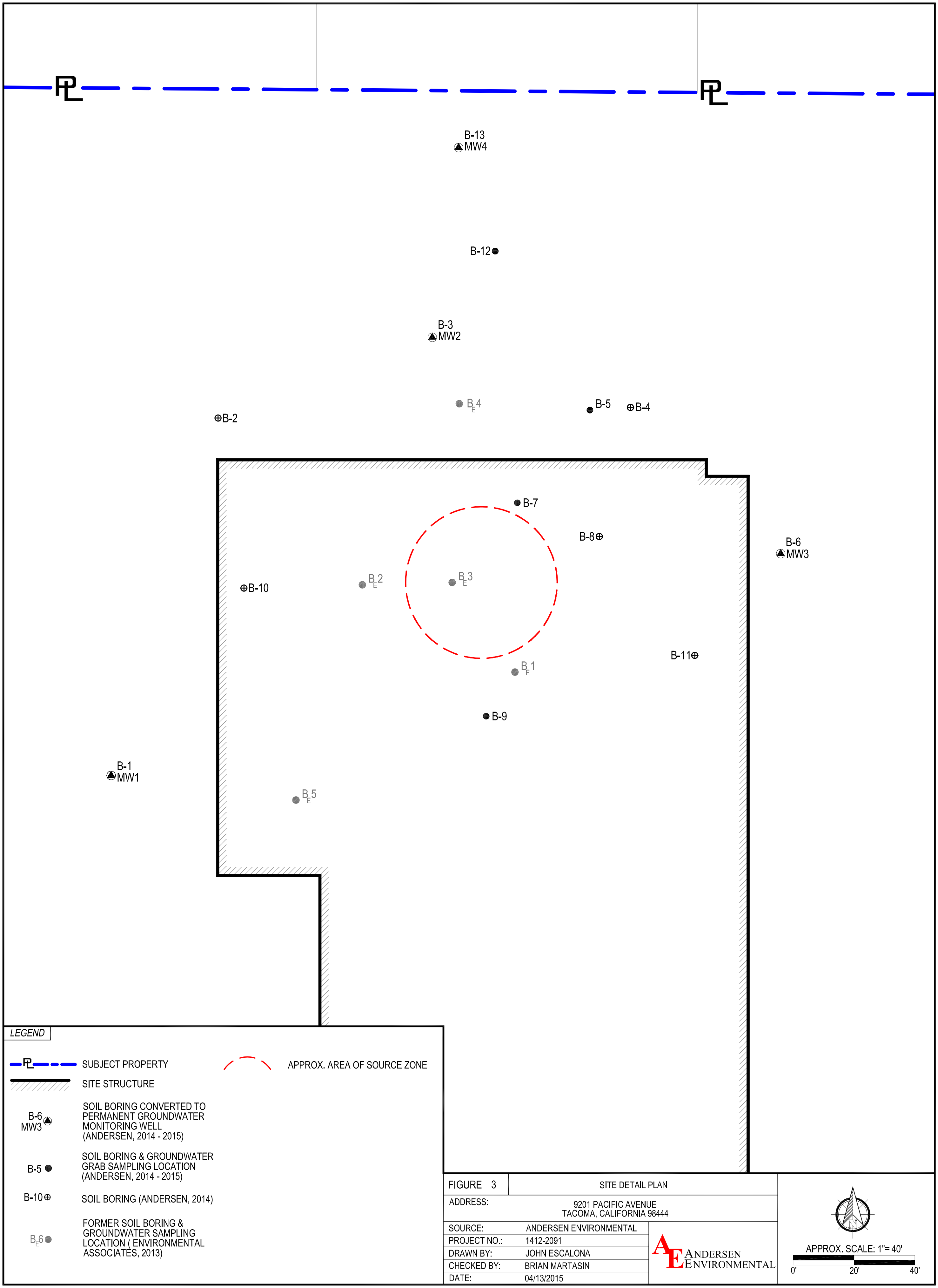


FIGURE 3

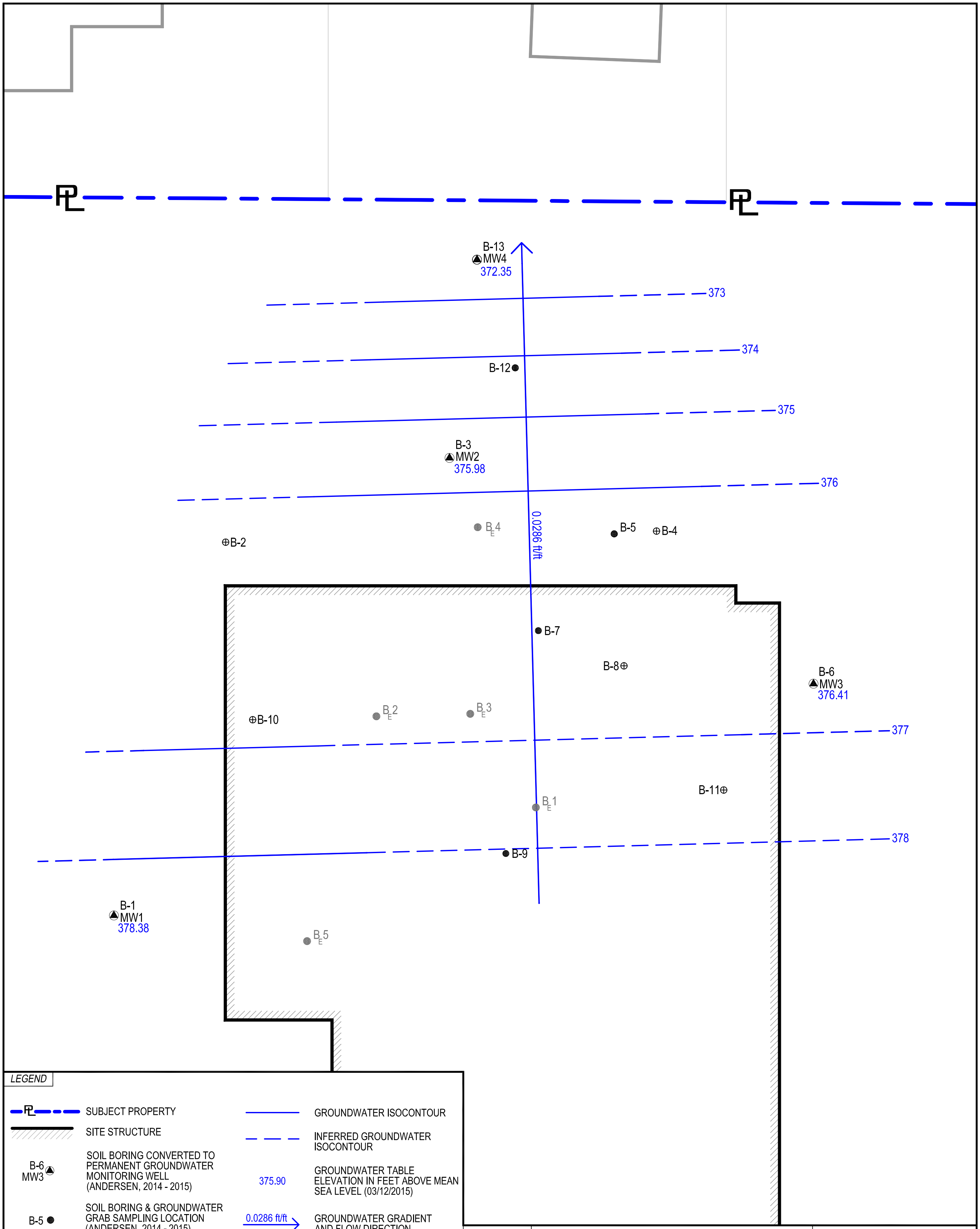
SITE DETAIL PLAN

ADDRESS:
9201 PACIFIC AVENUE
TACOMA, CALIFORNIA 98444

SOURCE:	ANDERSEN ENVIRONMENTAL
PROJECT NO.:	1412-2091
DRAWN BY:	JOHN ESCALONA
CHECKED BY:	BRIAN MARTASIN
DATE:	04/13/2015

AE ANDERSEN ENVIRONMENTAL

K:\AE 2014\Projects 2014\1412-2091_9201 Pacific Ave Tacoma WA 98444_PH II\05 1412-2091_Reports\From Nels\CAD



LEGEND

PL	SUBJECT PROPERTY
▨	SITE STRUCTURE
B-6 MW3 ▲	SOIL BORING CONVERTED TO PERMANENT GROUNDWATER MONITORING WELL (ANDERSEN, 2014 - 2015)
B-5 ●	SOIL BORING & GROUNDWATER GRAB SAMPLING LOCATION (ANDERSEN, 2014 - 2015)
B-10 ⊕	SOIL BORING (ANDERSEN, 2014)
BE6 ●	FORMER SOIL BORING & GROUNDWATER SAMPLING LOCATION (ENVIRONMENTAL ASSOCIATES, 2013)
———	GROUNDWATER ISOCONTOUR
— — —	INFERRED GROUNDWATER ISOCONTOUR
375.90	GROUNDWATER TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL (03/12/2015)
0.0286 ft/ft →	GROUNDWATER GRADIENT AND FLOW DIRECTION

FIGURE 4

GROUNDWATER GRADIENT AND CONTOUR MAP

ADDRESS:
9201 PACIFIC AVENUE
TACOMA, CALIFORNIA 98444

SOURCE:	ANDERSEN ENVIRONMENTAL
PROJECT NO.:	1412-2091
DRAWN BY:	JOHN ESCALONA
CHECKED BY:	BRIAN MARTASIN
DATE:	04/13/2015

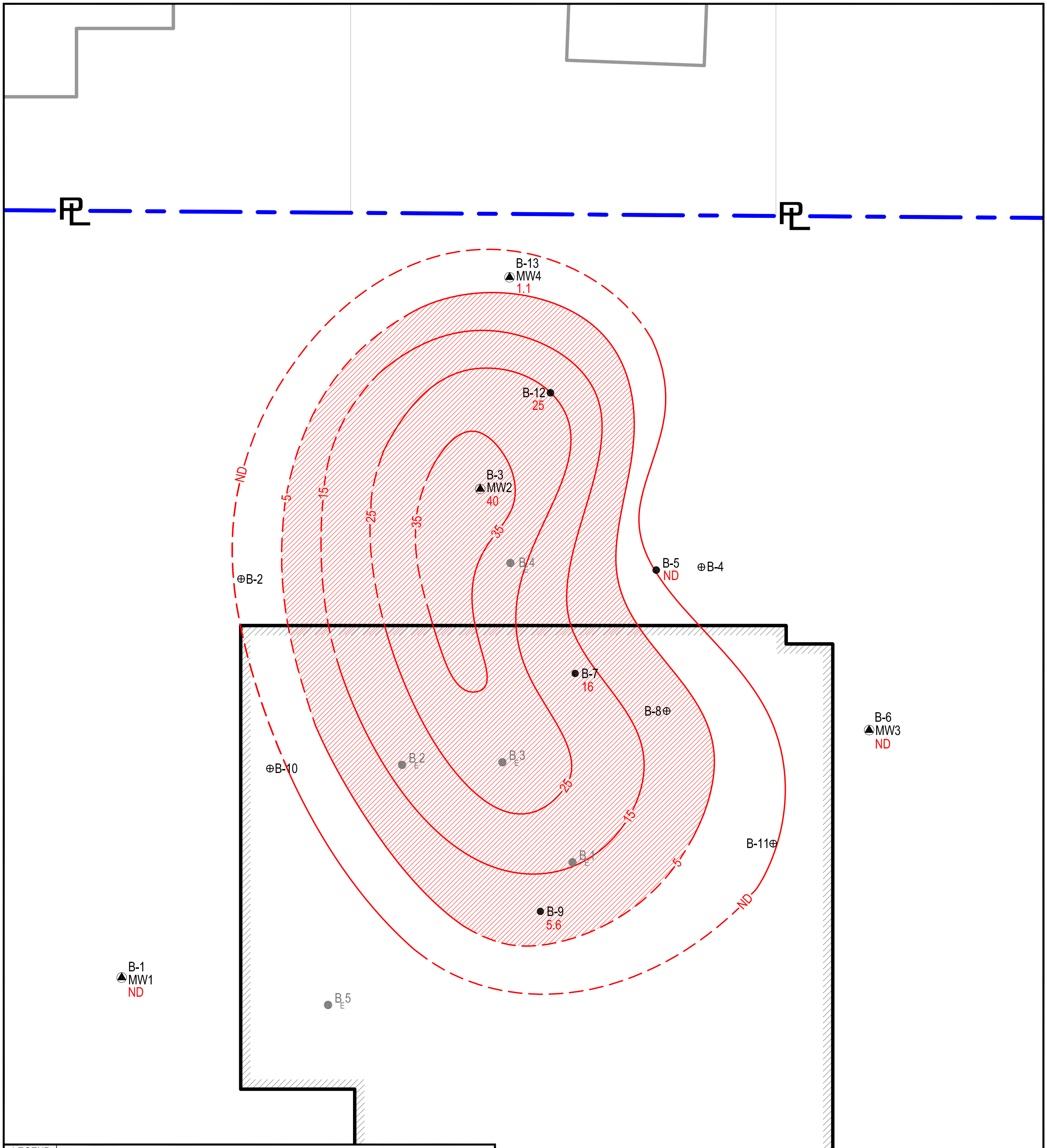
AE ANDERSEN ENVIRONMENTAL

N

APPROX. SCALE: 1"= 40'

0' 20' 40'

K:\AE 2014\Projects 2014\1412-2091_9201 Pacific Ave Tacoma WA 98444_PH II\05 1412-2091_Reports\From Nels\CAD



LEGEND

PL	SUBJECT PROPERTY		ISOCONCENTRATION CONTOUR
	SITE STRUCTURE		INFERRED ISOCONCENTRATION CONTOUR
B-6 MW3	SOIL BORING CONVERTED TO PERMANENT GROUNDWATER MONITORING WELL (ANDERSEN, 2014 - 2015)	40	TETRACHLOROETHENE IN GROUNDWATER (MICROGRAMS PER LITER)
B-5 ●	SOIL BORING & GROUNDWATER GRAB SAMPLING LOCATION (ANDERSEN, 2014 - 2015)	ND	NON-DETECT ABOVE LABORATORY DETECTION LIMIT
B-10⊕	SOIL BORING (ANDERSEN, 2014)	🟥	TETRACHLOETHENE PLUME ABOVE MTCA METHOD A CLEANUP LEVEL
B E 6 ●	FORMER SOIL BORING & GROUNDWATER SAMPLING LOCATION (ENVIRONMENTAL ASSOCIATES, 2013)		

NOTES

A. SAMPLES FROM B-1/MW1, B-3/MW2, B-5 & B-6/MW3 COLLECTED ON 12/29/2014
B. SAMPLES FROM B-7 & B-9 COLLECTED ON 12/30/2014
C. SAMPLES FROM B-12 & B-13/MW4 COLLECTED ON 12/25/2015

FIGURE 5 TETRACHLOROETHENE IN GROUNDWATER

ADDRESS: 9201 PACIFIC AVENUE
TACOMA, CALIFORNIA 98444

SOURCE:	ANDERSEN ENVIRONMENTAL
PROJECT NO.:	1412-2091
DRAWN BY:	JOHN ESCALONA
CHECKED BY:	BRIAN MARTASIN
DATE:	04/13/2015

AE ANDERSEN ENVIRONMENTAL

APPROX. SCALE: 1"= 40'
0' 20' 40'

K:\AE 2014\Projects 2014\1412-2091_9201 Pacific Ave Tacoma WA 98444_PH II\05 1412-2091_Reports\From Nels\CAD

Appendix B

Ecology Opinion Letter (August 26, 2015)

Electronic Copy

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

August 26, 2015

Mr. Nels B. Cone
Andersen Environmental
P.O. Box 85418
Seattle, WA 98145

Re: Further Action at the following Site:

- **Site Name:** Church of God in Christ
- **Site Address:** 9201 Pacific Avenue South, Tacoma, Pierce County
- **Facility/Site No.:** 19947
- **Cleanup Site ID:** 12404
- **VCP Project No.:** SW1467

Dear Mr. Cone:

The Washington State Department of Ecology (Ecology) received your request for an opinion on your proposed independent cleanup of the Church of God in Christ facility (Site). This letter provides our opinion. We are providing this opinion under the authority of the Model Toxics Control Act (MTCA), Chapter 70.105D RCW.

Issue Presented and Opinion

Is further remedial action necessary to clean up contamination at the Site?

YES. Ecology has determined that further remedial action is necessary to clean up contamination at the Site.

This opinion is based on an analysis of whether the remedial action meets the substantive requirements of MTCA, Chapter 70.105D RCW, and its implementing regulations, Chapter 173-340 WAC (collectively "substantive requirements of MTCA"). The analysis is provided below.

Description of the Site

This opinion applies only to the Site described below. The Site is defined by the nature and extent of contamination associated with the following releases:

- Volatile Organic Compounds (VOCs), into the Soil and Groundwater.

Enclosure A includes a detailed description and diagram of the Site, as currently known to Ecology.

Please note the parcel(s) of real property associated with this Site are also located within the projected boundaries of the Tacoma Smelter Plume facility (# 62855481). At this time, we have no information that those parcel(s) are actually affected; however, Ecology recommends that any soil samples collected from the Site be analyzed for lead and arsenic to determine whether the Site has been impacted. This opinion does not apply to any contamination associated with the Tacoma Smelter Plume facility.

Basis for the Opinion

This opinion is based on the information contained in the following documents:

1. Andersen Environmental, Phase II Environmental Site Assessment (ESA) for 9201 Pacifica Avenue South, Tacoma, Washington, dated April 20, 2015.

2. Andersen Environmental, Phase I Environmental Site Assessment (ESA) for 9201 Pacifica Avenue South, Tacoma, Washington, dated September 16, 2014.

3. Limited Soil and Groundwater Sampling and Testing, Commercial Property, 9201 Pacific Avenue, Tacoma, Washington, dated April 26, 2013.

Those documents are kept in the Central Files of the Southwest Regional Office of Ecology (SWRO) for review by appointment only. You can make an appointment by calling the SWRO resource contact at (360) 407-6365.

This opinion is void if any of the information contained in those documents is materially false or misleading.

Analysis of the Cleanup

Ecology has concluded that, upon completion of your proposed cleanup, **further remedial action** will likely be necessary to clean up contamination at the Site. That conclusion is based on the following analysis:

1. Characterization of the Site.

Ecology has determined your characterization of the Site is not sufficient to establish cleanup standards and select a cleanup action. The Site is described above and in **Enclosure A.**

The Site is located at 9201 Pacific Avenue South, Tacoma, Washington, and has been vacant since approximately 2014. The Site is approximately 8.86 acres and is occupied by a one-story building that is approximately 61,230 square feet. The property was originally developed as strip shopping mall, and later occupied by a church and associated activity center. The property was transferred into receivership in approximately 2013.

Previous investigations indicate that the northeast portion of the property building was developed for commercial dry-cleaning operations including the Pacific Launder Center (1969 to 1979) and the Tacoma Dry-Cleaning and Laundry Center (1979 to 1984). The Site was listed on Ecology's Confirmed and Suspected Contaminated Sites List in 2013.

In October 2014, soil and groundwater samples were collected from each boring and analyzed for Volatile Organic Compounds (VOCs), gasoline-range petroleum hydrocarbons (TPH-Gx), and Metals.

Laboratory analytical results for the October 2014 investigation indicated the following:

- VOCs including tetrachloroethylene (PCE), trichloroethylene (TCE), and cis-1,2-Dichloroethene (DCE) in soils beneath the slab foundation to a maximum depth of approximately 4 feet bgs. Concentrations of PCE and TCE were above the respective MTCA Method A Cleanup Levels (CULs).

- Cadmium was detected above the respective MTCA Method A CUL in soil boring B5 at an approximate depth of 3 feet bgs underneath the building's slab foundation.

- In addition, laboratory analytical results indicated concentrations of PCE and/or TCE above MTCA CULs in groundwater samples collected from soil borings B2, B3, and B4.

Between December 2014 and March 2015, an additional investigation was conducted at the Site to further delineate the contamination encountered previously in October 2014. Four of the soil borings were eventually completed as groundwater monitoring wells MW1 through MW4.

Laboratory analytical results for the December 2014 to March 2015 investigation indicated that concentrations of PCE were detected in groundwater samples ranging from 1.1 micrograms per liter (μg/L) at groundwater monitoring well MW-4 to 40 μg/L at groundwater monitoring well MW-3.

Based on a review of the above-listed documents, Ecology has the following comments:

1. Additional information should be added to the Site figures to show the configuration of the dry cleaning business when it was operating, including: the location of the back door; the position of the dry cleaning equipment; location of where the dry cleaning chemicals were offloaded and stored (e.g. loading dock); and whether there are potential preferential pathways such utility vaults, sewer lines, and septic tank/drain-field.

2. The areal and vertical extent of the PCE contamination present at the Site has not been adequately defined. The following comments No. 3 through No. 5 describe Ecology's recommendations for further characterization of vapor, soil and groundwater at the Site.

3. Existing data indicates that the current tenant space may be exposed to a PCE Vapor Intrusion (VI) risk which may threaten the health of future building occupants. The current MTCA Method B vapor intrusion screening level for groundwater is 22.9 μg/L. Since groundwater concentrations exceed the screening level, the Site requires a Tier II assessment (as discussed in Ecology's 2009 Draft VI Guidance) or mitigation is required.

4. The soil source mass that is contributing to the groundwater contamination has not been adequately identified. Historical information about the Site described in comment No. 1 will help in better delineating the source of the soil contamination.

5. The vertical depth of contamination within the aquifer has not been adequately characterized. We recommend collecting groundwater samples from the base of the aquifer, and at depth-discrete zones within the aquifer.

6. Following additional Site characterization, the conceptual site model (CSM) should be refined to show the subsurface conditions beneath the Site (i.e. cross sections). A comprehensive CSM will give a better picture of the confining layers and more permeable zones between the confining layers. In addition, we recommend recalculating the potentiometric surface contours to better depict the groundwater flow direction.

7. Please prepare a work plan for the further characterization activities noted above and provide to Ecology for review. This will help ensure that the additional work meets the substantive requirements of MTCA.

8. In accordance with WAC 173-340-840(5) and Ecology Toxics Cleanup Program Policy 840 (Data Submittal Requirements), data generated for Independent Remedial Actions shall be submitted simultaneously in both a written and electronic format. For additional information regarding electronic format requirements, see the website http://www.ecy.wa.gov/eim. Be advised that according to the policy, any reports containing sampling data that are submitted for Ecology review are considered incomplete until the electronic data has been entered. Please ensure that data generated during on-site activities is submitted pursuant to this policy. Data must be submitted to Ecology in this format for Ecology to issue a No Further Action determination. Please be sure to submit all soil and groundwater data collected to date, as well as any future data, in this format. Data collected prior to August 2005 (effective date of this policy) is not required to be submitted; however, you are encouraged to do so if it is available. Be advised that Ecology requires up to two weeks to process the data once it is received.

2. Establishment of cleanup standards.

Ecology has determined the cleanup levels and points of compliance established for the Site do not meet the substantive requirements of MTCA.

Cleanup standards cannot be established because the Site has yet to be fully defined.

MTCA Method A CULs for soil and groundwater for unrestricted land uses have been used initially to characterize the Site. Standard points of compliance are being used for the Site. The point of compliance for protection of groundwater shall be established in the soils throughout the Site. For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the Site from the ground surface to 15 feet bgs. In addition, the point of compliance for the groundwater shall be established throughout the Site from the uppermost level of the saturated zone extending vertically to the lowermost depth that could potentially be affected by the Site.

3. Selection of cleanup action.

Ecology has determined the cleanup action (Monitored Natural Attenuation of Groundwater) you proposed for the Site does not meet the substantive requirements of MTCA. The Site requires additional characterization before selecting a cleanup action.

4. Cleanup.

No cleanup has been performed at the Site.

Limitations of the Opinion

1. Opinion does not settle liability with the state.

Liable persons are strictly liable, jointly and severally, for all remedial action costs and for all natural resource damages resulting from the release or releases of hazardous substances at the Site. This opinion **does not**:

- Resolve or alter a person's liability to the state.
- Protect liable persons from contribution claims by third parties.

To settle liability with the state and obtain protection from contribution claims, a person must enter into a consent decree with Ecology under RCW 70.105D.040(4).

2. Opinion does not constitute a determination of substantial equivalence.

To recover remedial action costs from other liable persons under MTCA, one must demonstrate that the action is the substantial equivalent of an Ecology-conducted or Ecology-supervised action. This opinion does not determine whether the action you proposed will be substantially equivalent. Courts make that determination. *See* RCW 70.105D.080 and WAC 173-340-545.

3. State is immune from liability.

The state, Ecology, and its officers and employees are immune from all liability, and no cause of action of any nature may arise from any act or omission in providing this opinion. *See* RCW 70.105D.030(1)(i).

Contact Information

Thank you for choosing to clean up the Site under the Voluntary Cleanup Program (VCP). After you have addressed our concerns, you may request another review of your cleanup. Please do not hesitate to request additional services as your cleanup progresses. We look forward to working with you.

For more information about the VCP and the cleanup process, please visit our web site: www.ecy.wa.gov/programs/tcp/vcp/vcpmain.htm. If you have any questions about this opinion, please contact me by phone at (360) 407-6265 or e-mail at john.rapp@ecy.wa.gov.

Sincerely,

John Rapp

John F Rapp, LHG
Project manager
SWRO Toxics Cleanup Program

JFR: knf

Enclosures: A – Description and Diagrams of the Site

By certified mail: 9171082133393970418566

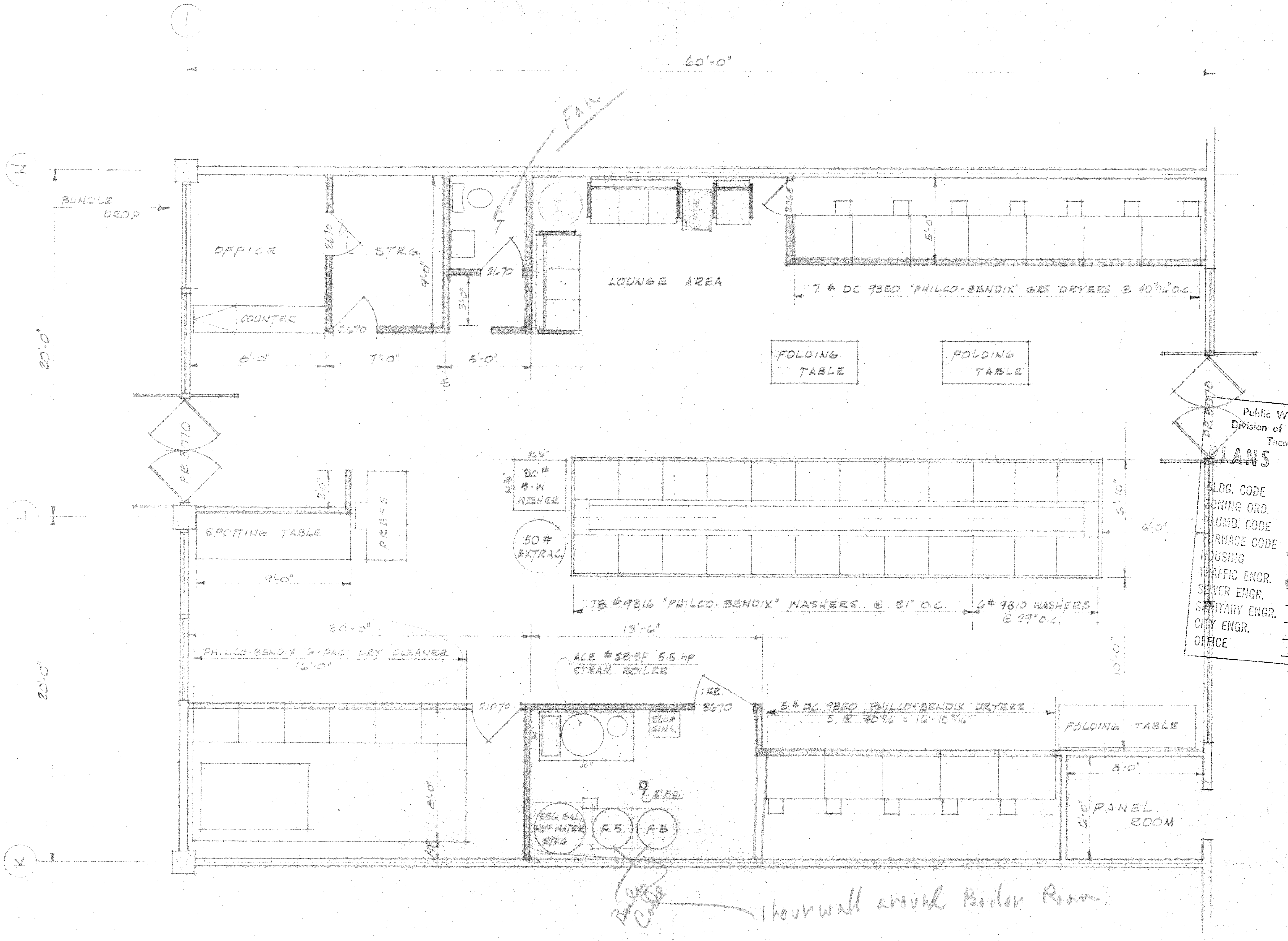
cc: Mr. Brian Martisan, Andersen Environmental
Ms. Sharon Bell, Tacoma-Pierce County Health Department
Ms. Richelle Perez, Ecology
Mr. Steve Teel, Ecology
Ms. Dolores Mitchell, Ecology

Appendix C

Architectural Plans from 1965 (Source: City of Tacoma Planning and Development Services)

Sewer & Storm Sewer Layout (Source: http://govME.org)

Water Line & Associated Meters (Source: Tacoma Water)



EQUIPMENT INSTALLATION FLOOR PLAN · SCALE 1/4" = 1'-0"

Public Works Department
Division of Building Inspection
Tacoma, Wash.

PLANS APPROVED

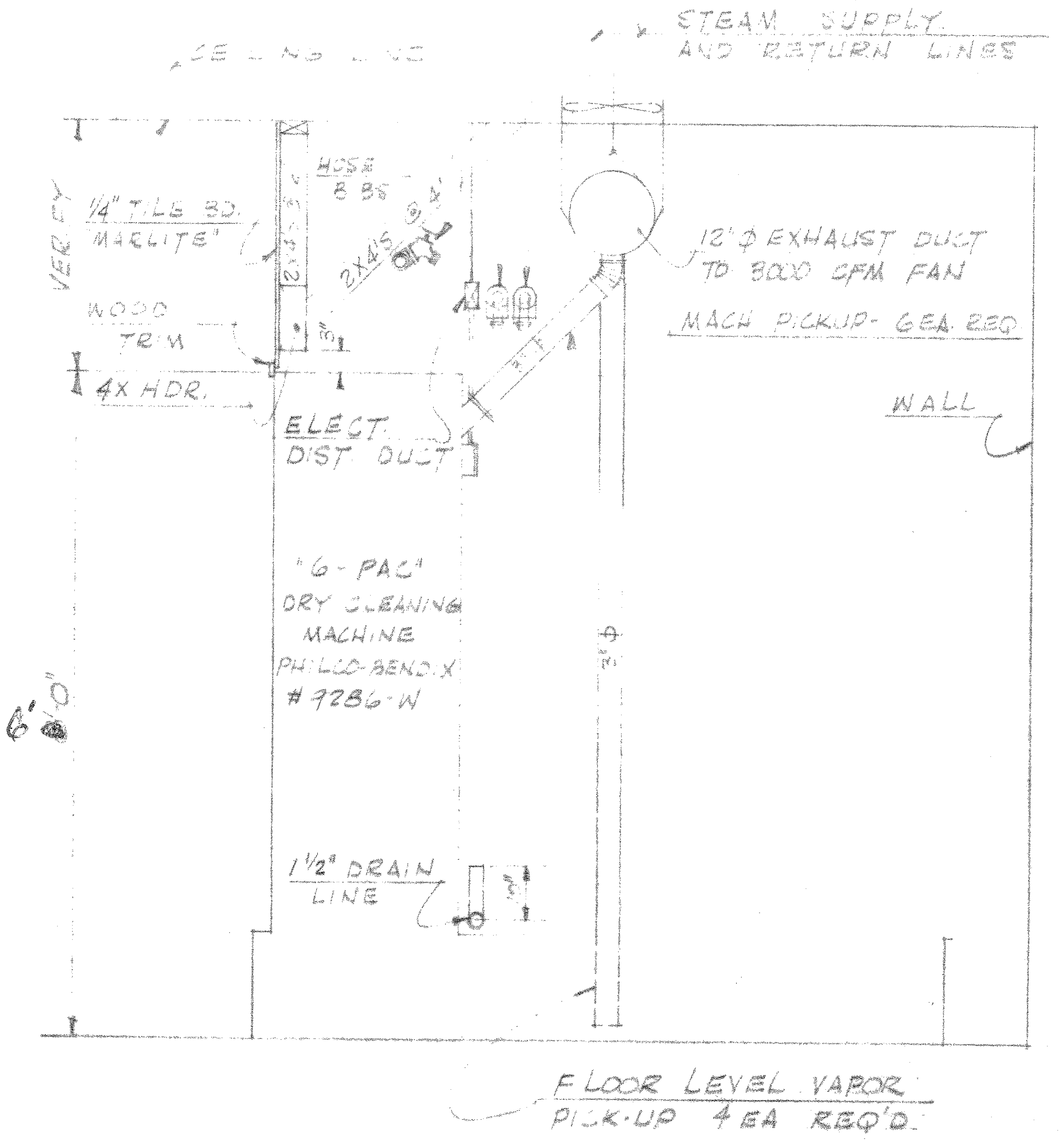
	BY	DATE
BLDG. CODE	RB	
ZONING ORD.		
PLUMB. CODE		
FURNACE CODE		
HOUSING		
TRAFFIC ENGR.		
SEWER ENGR.		
SANITARY ENGR.		
CITY ENGR.		
OFFICE		

No dry cleaning

COIN-OP LAUNDRY & DRY CLEANING SHOP
FOR MESSR'S ALTON & ALFRED NELSON
9201 PACIFIC AVE., TACOMA, WASH.

REGISTERED ARCHITECT
SETH W. YERRINGTON
STATE OF WASHINGTON

EQUIPMENT INSTALLATION PLAN
DRAWN BY: S.Y. 10/4/65
ARCHITECT
11311 - 31ST AVENUE N.E.
SEATTLE, WASH. · 98125
AREA CODE 206 · EM2-8587

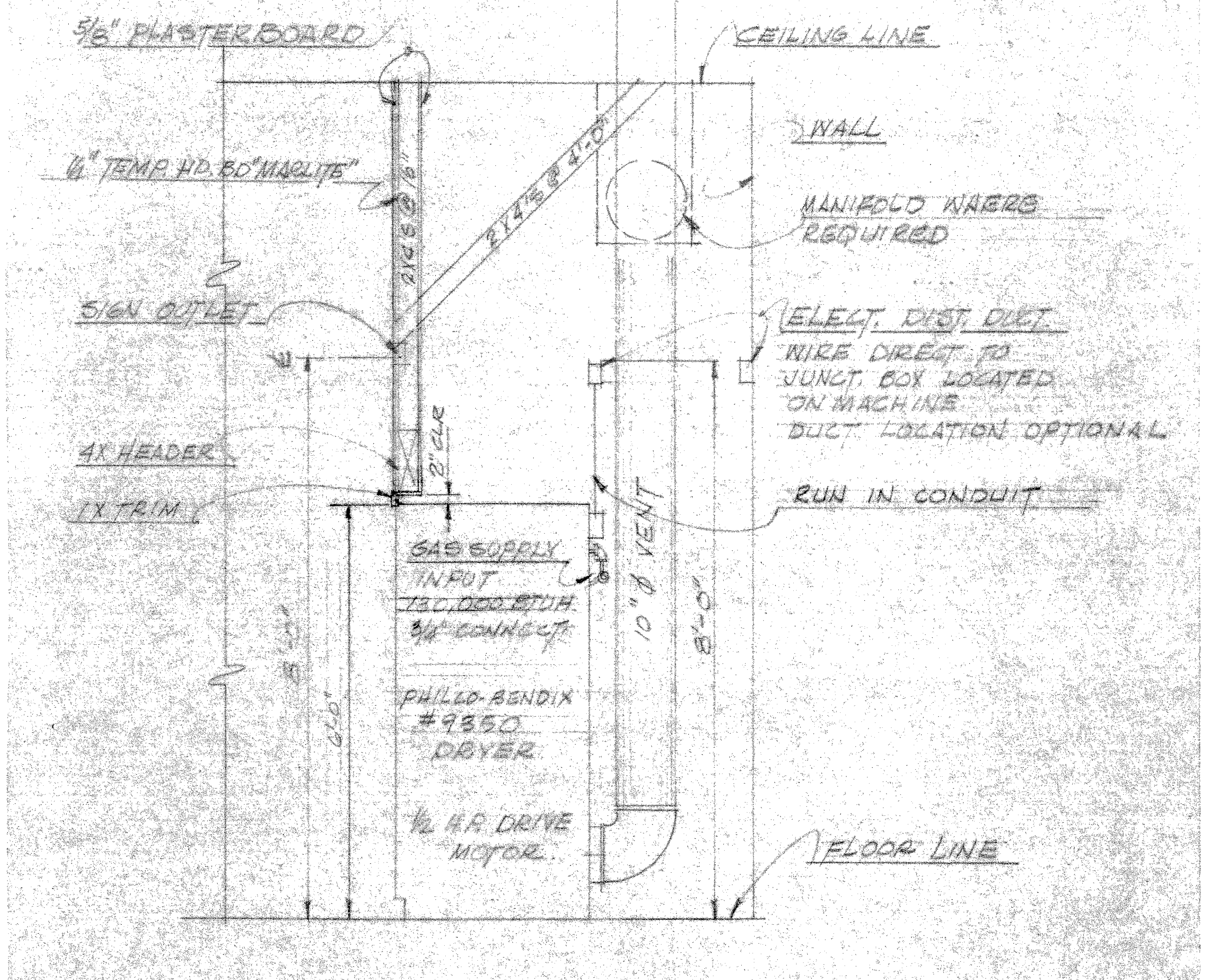


SECTION THRU "6-PAC" DRY CLEANING MACHINE

SCALE: 1/2" = 1'-0"

TL 1143
REGISTERED ARCHITECT
Seth W. Yerrington
SETH W. YERRINGTON
STATE OF WASHINGTON

10/7/65

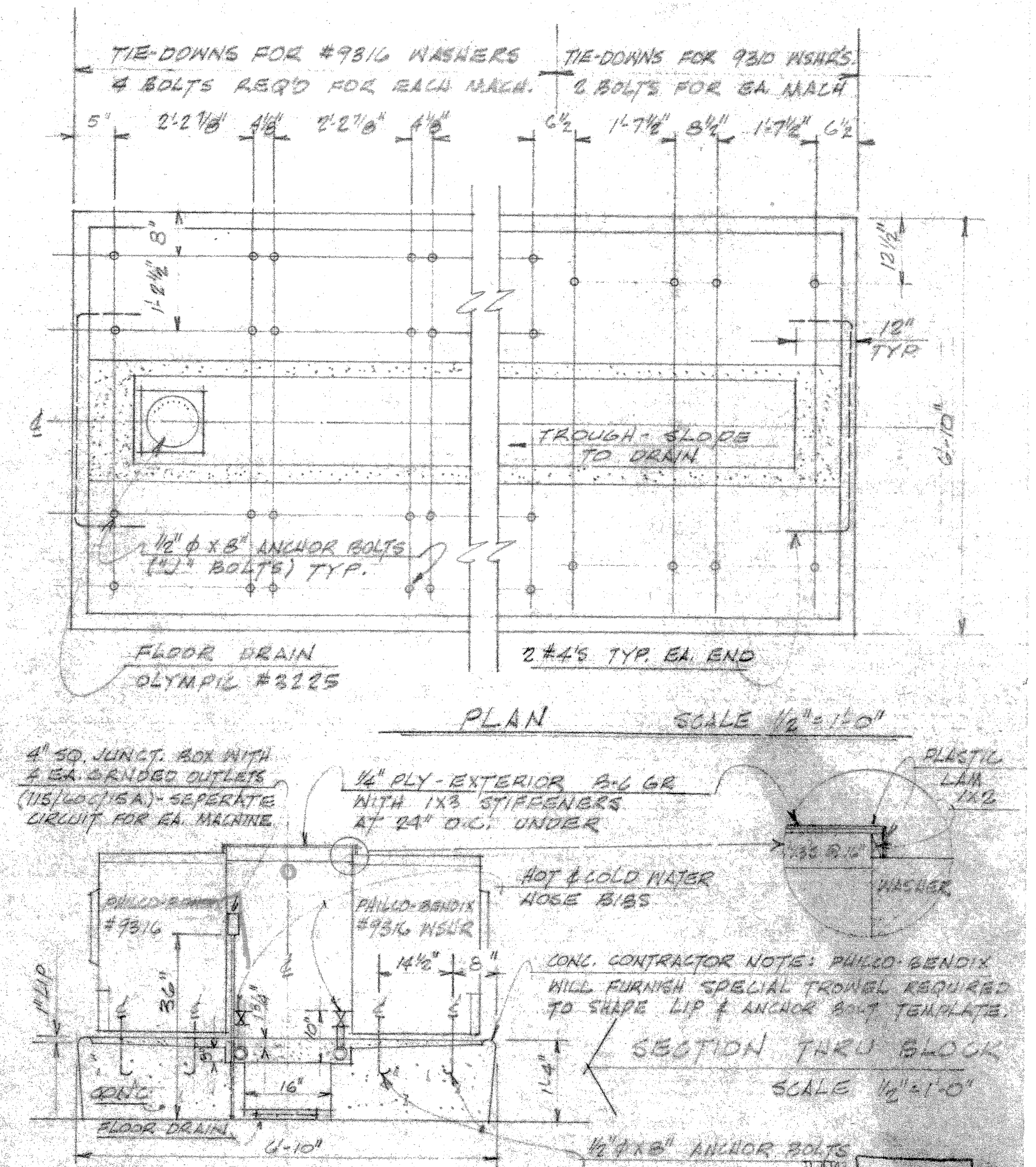


TYP. SECT. THRU # 9350 GAS DRYER

1/2" = 1'-0"

TL 1143
REGISTERED ARCHITECT
Seth W. Yerrington
SETH W. YERRINGTON
STATE OF WASHINGTON

4/20/65



TYPICAL WASHER BASE

("VALVAMATIC DISCHARGE)

TL 1143
REGISTERED ARCHITECT
Seth W. Yerrington
SETH W. YERRINGTON
STATE OF WASHINGTON

4/20/65

9201 Pacific Avenue

http://govME.org/map

Property

- ★ **Address Selected**
- ● **Address**
- ▭ **Parcel**

Sewer - Sanitary

- \- - **Sanitary Sewer**

Sewer - Storm

- ━ **Storm Sewer**
- ━ **Storm Sewer (Private)**

Sanitary Sewer Assets

- ✚ **Sanitary Abandon**
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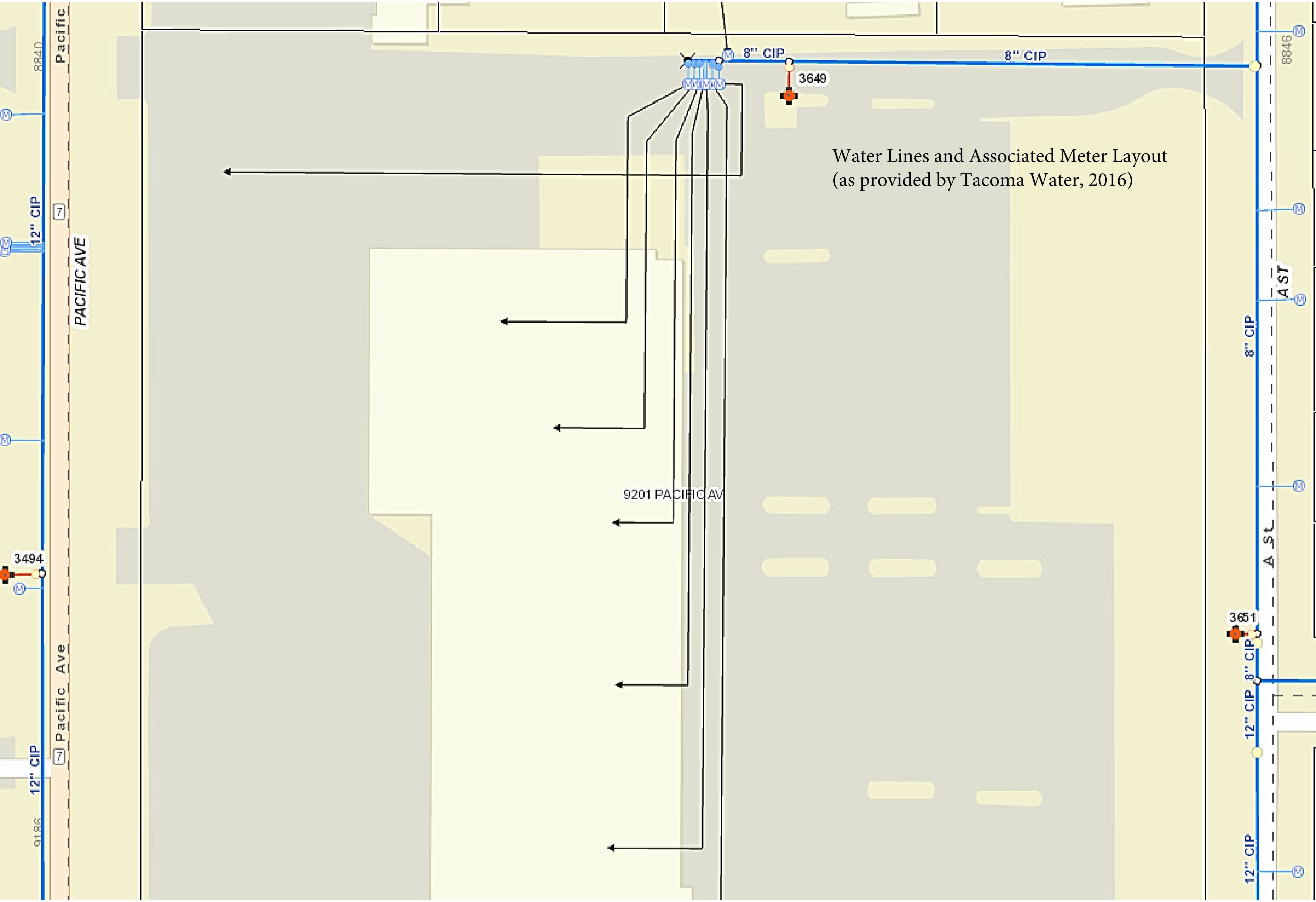

Water Lines and Associated Meter Layout
(as provided by Tacoma Water, 2016)

Appendix D

Cox-Colvin Vapor Pin™ Standard Operating Procedure

ATC Standard Operating Procedures

Standard Operating Procedure Installation and Extraction of the Vapor Pin™

Updated April 3, 2015

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™ for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples or pressure readings.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve(Figure 1)]; Because of sharp edges, gloves are recommended for sleeve installation;
- Hammer drill;
- 5/8-inch (16mm) diameter hammer bit (hole **must** be 5/8-inch (16mm) diameter to ensure seal. It is recommended that you use the drill guide). (Hilti™ TE-YX 5/8" x 22" (400 mm) #00206514 or equivalent);
- 1½-inch (38mm) diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch (19mm) diameter bottle brush;
- Wet/Dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, if desired;
- Vapor Pin™ drilling guide, if desired;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel for repairing the hole following the extraction of the Vapor Pin™.

Figure 1. Assembled Vapor Pin™

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) If a flush mount installation is required, drill a 1½-inch (38mm) diameter hole at least 1¾-inches (45mm) into the slab. Use of a Vapor Pin™ drilling guide is recommended.

4) Drill a 5/8-inch (16mm) diameter hole through the slab and approximately 1-inch (25mm) into the underlying soil to form a void. Hole **must** be 5/8-inch (16mm) in diameter to ensure seal. It is recommended that you use the drill guide.

5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.

6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool over the Vapor Pin™ to protect the barb fitting, and tap the Vapor Pin™ into place using a dead blow hammer (Figure 2). Make sure the installation/extraction tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.

Figure 2. Installing the Vapor Pin™.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 3).

Figure 3. Installed Vapor Pin™

7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover (Figure 4).

Figure 4. Secure Cover Installed

8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to re-equilibrate prior to sampling.

9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™. This connection can be made using a short piece of Tygon™ tubing to join the Vapor Pin™ with the Nylaflow

tubing (Figure 5). Put the Nylaflow tubing as close to the Vapor Pin as possible to minimize contact between soil gas and Tygon™ tubing.

Figure 5. Vapor Pin™ sample connection.

10) Conduct leak tests in accordance with applicable guidance. If the method of leak testing is not specified, an alternative can be the use of a water dam and vacuum pump, as described in SOP Leak Testing the Vapor Pin™ via Mechanical Means (Figure 6). For flush-mount installations, distilled water can be poured directly into the 1 1/2 inch (38mm) hole.

Figure 6. Water dam used for leak detection

11) Collect sub-slab soil gas sample or pressure reading. When finished, replace the protective cap and flush mount cover until the next event. If the sampling is complete, extract the Vapor Pin™.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue turning the tool clockwise to pull the Vapor Pin™ from the hole into the installation/extraction tool.

2) Fill the void with hydraulic cement and smooth with a trowel or putty knife.

Figure 7. Removing the Vapor Pin™.

3) Prior to reuse, remove the silicone sleeve and protective cap and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 265° F (130° C) for 15 to 30 minutes.

The Vapor Pin™ to designed be used repeatedly, however, replacement parts and supplies will be required periodically. These parts are available on-line at VaporPin.CoxColvin.com.

ATC STANDARD OPERATING PROCEDURE
DIRECT-PUSH DRILLING AND SAMPLING

Direct-push soil borings are advanced using a truck-mounted, hydraulically-powered, soil probing machine which utilizes static force and percussion to advance small diameter sampling tools into the subsurface. Soil samples are collected from each boring at depths specified by the supervising ATC Field Manager. Typically, soil samples are collected continuously or at five-foot intervals. The samples are collected in a five-foot by 1.5-inch outside diameter core sampler lined with a chemically inert sleeve. The Field Manager examines representative portions of the soil samples and prepares soil boring logs that describe the encountered soil in general accordance with American Society of Testing and Materials (ASTM) Method D 2488. The soil boring logs indicate the depth of the various strata, and record other pertinent information regarding the advancement and sampling of each borehole.

A portion of each soil sample may be retained for possible laboratory analysis. The samples are collected in an acetate liner. The liners are cut at the desired sample depth and sealed with Teflon® tape and plastic caps at each end, or alternatively the samples may be transferred to in-field extraction kits provided by the analytical laboratory. All samples are stored in an ice chest cooled to approximately four degrees Celsius with wet ice. Other portions of the soil samples may be analyzed in the field with a photoionization detector (PID) for the presence of organic vapors.

All downhole equipment is cleaned with phosphate-free soap and then rinsed with water before any sampling is performed, and after each borehole, to reduce the potential for cross-contamination.

Groundwater samples may be collected from selected borings by placing one-inch diameter casing with 0.01-inch slots to the bottom of the boring, then using dedicated bailers, or other dedicated sampling equipment, to withdraw groundwater.

Each soil and groundwater sample is collected in a suitable container, preserved correctly for the intended analysis, and stored for no longer than the maximum allowable holding time. Each sample container is labeled to identify the job number, sampler, date and time of collection, and a unique sample number. All samples are submitted to a State-certified laboratory to perform the requested analyses. A chain of custody (COC) form is used to record possession of the samples from the time of collection to arrival at the laboratory. When the samples are shipped, the person in custody of the samples relinquishes them by signing the COC and noting the time. The sample control officer at the laboratory records the condition of the samples upon arrival.

Each borehole is backfilled with neat cement/bentonite slurry or chips following completion of the sampling event. The ground surface is returned to its near-original condition.

ATC STANDARD OPERATING PROCEDURE
SOIL VAPOR WELL INSTALLATION AND SAMPLING

Preliminary Activities

Prior to the onset of field activities at the site, ATC obtains the appropriate permit(s) from the governing agencies. Advance notification is made as required by the agencies prior to the start of work. ATC marks the borehole locations and contacts the local one call utility locating service at least 48 hours prior to the start of work to mark buried utilities. Borehole locations may also be checked for buried utilities by a private geophysical surveyor. Prior to drilling, the borehole location is cleared in accordance with the client's procedures. Fieldwork is conducted under the advisement of a registered professional geologist and in accordance with an updated site-specific safety plan prepared for the project, which is available at the job site during field activities.

Soil Vapor Well Construction

The borehole is advanced to the desired depth using either a direct-push rig, hand auger, or air vacuum rig. Lithologic conditions are recorded on a boring log during borehole advancement, and select soil matrix sampling may be conducted based on soil characteristics.

Each soil vapor sampling (SVS) well is constructed using inert screen material attached to ⅛- to ¼-inch outer diameter inert tubing. A gas-tight vacuum fitting or valve is attached to the top of each length of tubing using a female compression fitting. Each screen is set within a minimum of a 12-inch thick appropriately sized sand pack, with a minimum of three inches of sand pack above the top of the screen. A minimum of four inches of dry granular bentonite is set above each screen and associated sand pack. In SVS wells with multiple and separate casings and screens, the annular space between the top of the dry granular bentonite above the deep screen and the bottom of the sand pack associated with the shallow screen is sealed with a minimum of 18 inches of hydrated bentonite. The remainder of the annular space of the well is sealed with hydrated bentonite to one foot below ground surface. Wellheads are finished with traffic-rated well boxes set in concrete flush with the surrounding grade. No glues, chemical cements, or solvents are used in well construction.

A boring log is completed with the construction details for each well, including the materials of construction, depth of the borehole, screen length, and annular seal thickness.

Soil Vapor Sampling

Samples are collected using a soil vapor purging and sampling manifold consisting of a flow regulator, vacuum gauges, vacuum pump, shroud, and laboratory-prepared, gas-tight, opaque containers such as Summa™ canisters. Samples may also be collected using a syringe and analyzed by a mobile laboratory. Prior to use, Summa™ canisters are checked to ensure they are under the laboratory induced vacuum between 31 and 25 inches of mercury (in. Hg). New inert tubing is used to purge and sample each well. Prior to purging and sampling each SVS well, the sampling manifold is connected to the gas-tight vacuum fitting or valve at the wellhead, and the downstream tubing and fittings are vacuum tested at approximately 24 to 28 in. Hg. Purging and sampling are conducted only on SVS wells when the tubing and fittings hold the applied vacuum for five minutes per vacuum gauge reading.

When required, ATC conducts a purge volume versus constituent concentration test on at least one SVS well prior to purging and sampling activities. The purge volume test well is selected based on the location of the anticipated source of chemical constituents at the site and on the location of anticipated maximum soil vapor concentrations based on lithologic conditions. If the SVS well has been in place for more than one week, it is assumed that soil vapor in the sand pack has equilibrated with the surrounding soil, and only the screen and tubing volumes are included in the purge volume calculation. If the SVS well has been in place for less than one week, the volume of the sand pack around the screen is included in the purge volume calculation. A photoionization detector (PID) or on-site mobile laboratory is used to evaluate concentrations of chemical constituents in the vapor stream after one, three, and 10 volumes of vapor have been purged from the SVS well.

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Purging is conducted at a rate of 100 to 200 milliliters per minute (ml/min). The purge volume exhibiting the highest concentration is the volume of vapor purged from each SVS well prior to sampling. If the three separate purge volumes produce equal concentrations a default of three purge volumes is extracted prior to sampling.

Prior to sampling, a leak test is performed at each SVS well, including a summa canister and its fittings, to check for leaks in the SVS annulus. Typically helium or 1,1-difluoroethane (DFA) are utilized as the leak check compound (LCC). To assess the potential for leaks in the SVS well annulus when using helium as the LCC, a shroud is placed over the SVS well and summa canister and the shroud is filled with a measured amount of helium. Helium screening is performed in the field by drawing soil gas into a Tedlar bag via a lung-box and screening the contents of the Tedlar bag with a helium meter. The concentration of helium in the sample divided by the concentration of helium in the shroud provides a measure of the proportion of the sample attributable to leakage. A leak that comprises less than 5% of the sample is insignificant. When DFA is utilized as the LCC, a rag infused with DFA is placed in near the sampling train during the sample intake period. Helium and DFA screening are performed using laboratory analysis of the contents of the summa canister. Sampling is conducted at approximately the same rate of purging, at 100 to 200 ml/min. Soil vapor samples are submitted under chain of custody protocol for the specified laboratory analyses.

At a minimum, weather conditions (temperature, barometric pressure and precipitation), the sampling flow rate, the purge volume, the helium leak detection percentage results, the sample canister identification number, the method of sample collection, and the vacuum of the sampling canister at the start and end of sample collection (if applicable) are recorded on a log for each SVS well purged and sampled.

Decontamination Procedures

If soil samples are collected, ATC or the contracted driller decontaminates the soil sampling equipment between each sampling interval using a non-phosphate solution, followed by a minimum of two tap water rinses. De-ionized water may be used for the final rinse. Downhole drilling equipment is steam-cleaned or triple-rinsed prior to advancing each borehole.

Waste Treatment and Disposal

Soil cuttings generated from the well installation are stored on site in labeled, Department of Transportation-approved, 55-gallon drums or other appropriate storage container. The soil is removed from the site and transported under manifest to a client- and regulatory-approved facility for recycling or disposal. Decontamination water is stored on site in labeled, regulatory-approved storage containers, and is subsequently transported under manifest to a client- and regulatory-approved facility for disposal or treated with a permitted mobile or fixed-base carbon treatment system.

ATC STANDARD OPERATING PROCEDURE
HOLLOW-STEM AUGER DRILLING AND SOIL SAMPLING

Soil borings are drilled using a truck-mounted hollow-stem auger drilling rig equipped with seven to 10-inch nominal outside diameter casing. ATC attempts to obtain representative soil samples at approximate five- to 10-foot intervals in each boring using a using a standard 2.5-inch outside diameter split-barrel sampler in accordance with American Society of Testing and Materials (ASTM) Method D 1586-84. The sampler is loaded with clean three- and/or six-inch long by two-inch diameter brass sample tubes. Samples are collected in the three- or six-inch brass sample tubes contained within the sampler. Soil samples are collected by inserting the sampler through the open end of the drill pipe and driving the sampler with a 140-pound drop hammer on the drill rig free-falling 30 inches. The sampler is driven a maximum of 18 inches into undisturbed soil below the bottom of the auger, or to sampler refusal (greater than 50 blows per six-inch interval). The number of blows required to drive the sampler each six-inch interval is recorded on the boring logs to provide data to evaluate the relative consistency or density of the soil. If an insufficient sample volume is recovered during the initial sampling event, a maximum of two additional attempts are made to obtain an adequate sample volume. In coarse-grained lithologies (i.e., sand and gravel), a sand catcher may be placed inside the sampler to improve sample recovery.

Following sampler retrieval, the sampler is opened and the bottom three- or six-inch brass tube is collected. The bottom sample tube is visually inspected to insure that the tube is completely filled with soil, and no headspace exists in samples submitted for laboratory analysis. The collected brass sample tube is sealed at each end with Teflon® liner squares followed by aluminum foil liners, capped with plastic end-caps, sealed with Teflon® tape, marked for identification and stored in an ice chest cooled to approximately four degrees Celsius with wet ice for delivery to a State-certified laboratory. Alternatively, soil samples for volatile organic compound analysis are extracted in the field using laboratory-provided extraction kits. Chain of custody records are maintained as samples are collected and accompany the samples to the laboratory.

The contents of the second brass sample tube is emptied into a sealable plastic bag and used for field soil vapor monitoring and soil classification purposes. Soil samples are logged by a ATC Field Scientist in general accordance with ASTM Method D 2488 and field boring logs maintained.

To minimize the potential for cross-contamination, a new pair of disposable gloves are worn when preparing a sample for laboratory analysis. Additionally, all downhole sampling equipment is washed in an Alconox® or Liquinox® and tap water solution, rinsed with tap water and rinsed again with distilled water prior to each sampling event. If necessary, the drill pipe and auger bit is high pressure washed between bore holes. Decontamination water is stored in labeled 55-gallon drums and remains on-site pending disposal. Excess drill cuttings are placed in 55-gallon drums or a rolloff-type container and remain on-site pending disposal. Borings are typically backfilled with grout (or other materials deemed acceptable by the permitting agency).

STANDARD OPERATING PROCEDURE
FIELD SOIL VAPOR AND METALS MONITORING

Soil Vapor

The MiniRAE 2000 (or equivalent) photoionization detector (PID) is calibrated on-site at the commencement of each work day to zero and to 100-parts per million by volume (ppmV) using isobutylene-in-air span gas (equivalent to benzene). An appropriate PID lamp is selected based on the ionization potential of the primary chemical(s) of concern relevant to the investigation.

A representative soil sample is collected from each sample location and placed in a sealable plastic bag. The soil sample identifier is marked on the bag above the top of the bag seal. The bag is sealed and the soil disaggregated. At least ten minutes is allowed for the soil to be heated by direct sunlight and for any volatile organic compounds in the soil to accumulate in the headspace of the bag. In cool weather (e.g. below 60 degrees Fahrenheit) or darkness, the soil sample bag is warmed for at least ten minutes inside a heated vehicle.

Volatile gases are then monitored by inserting the probe of the PID into the bag. The PID is equipped with a lamp which is capable of detecting volatile organic compounds at concentrations of 0.1 to 9,999 ppmV. The PID probe remains inside the bag for a period of time sufficient to allow the reading to peak and stabilize. The peak reading is recorded on the soil boring log.

Metals

Soil samples subject to x-ray fluorescence (XRF) analyzer screening are retained in the sealable plastic bag which is wiped clean of debris. The contents of the bag are packed so that the soil in the bag is a minimum of one inch thick below the XRF analyzer window. The XRF analyzer is calibrated to known standards and programmed to measure target metals concentrations in soil. The XRF analyzer window is placed over the packed soil sample and the x-ray trigger engaged for 60 seconds. After 60 seconds, the analysis is terminated and the metals constituent concentrations of interest are recorded along with the unique sample identifier in the field notes (all data are also recorded in the XRF's data logger and are available for later download).

ATC STANDARD OPERATING PROCEDURE
GROUNDWATER MONITOR WELL INSTALLATION AND DEVELOPMENT

Prior to drilling, ATC completes an applicable permit from the regulating agency (varies by state and locality). Copies of the original permits are on-site during drilling operations.

Following completion of each well boring, wells are constructed using two- or four-inch nominal diameter, Schedule 40, 0.020-inch machine slotted, polyvinylchloride (PVC) well screen from the bottom of the borehole to 10 feet above the static depth to groundwater to account for seasonal water level fluctuations. The remaining well string is constructed of Schedule 40 blank PVC casing. Actual well construction specifications are determined on a site-specific basis.

The bottom of the perforated interval is capped with a flush-threaded PVC cap or riveted cap and the monitor well casing is assembled and lowered into the open end of the drill pipe. No PVC cement of other solvents or glues are used in construction of the monitor well. All well casing and screen material is delivered to the site in factory-sealed containers.

The annulus of the well is backfilled with clean #3 Monterey or 8/12 sand (or equivalent) filter pack to approximately three feet above the top of the well screen. In general, the sand filter pack extends to a height above the top of the well screen equivalent to approximately 10% of the well screen length. The top of the filter pack is direct measured with a weighted tape. A minimum 1.5-foot thick layer of bentonite pellets or chips is placed on top of the filter pack and hydrated to form an annular seal. The bentonite pellets are hydrated by adding approximately one gallon of water for each linear foot of bentonite. The remaining annular space to the surface is filled with cement grout. Well construction details are recorded in the boring logs. The well is completed at the ground surface with a watertight, flush-mounted, traffic rated vault.

The well vault lid or surface completion is typically marked with the permit registration number and unique well identifier. The geographic position and elevation of the well is recorded using a handheld global positioning system unit. A permanent mark is made on the north side of the well casing, and this point surveyed for location and elevation. All subsequent groundwater level measurements are recorded from this surveyed point.

A minimum of 24 hours after well completion, the groundwater monitor well is developed to remove sediment and to stabilize the filter pack by a combination of surging, bailing and/or pumping groundwater from the well. Bailing or purging continues until movement of the fine sediment stabilizes or ceases and turbidity stabilizes. Groundwater purged from the well is contained in 55-gallon drums and remains on-site pending the waste profile sample analytical results and subsequent disposal.

ATC STANDARD OPERATING PROCEDURE
LOW-FLOW PURGING AND GROUNDWATER SAMPLING

EQUIPMENT

Pumps: Adjustable rate, positive displacement pumps (e.g., low flow-rate submersible centrifugal or bladder pumps constructed of stainless steel or Teflon). The pump should be easily adjustable and capable of operating reliably at lower flow rates. Adjustable rate peristaltic pumps may be used with caution. Bailers are inappropriate for use in this procedure.

Tubing: Tubing used in purging and sampling each well must be dedicated to that individual well. Once properly located, moving the pump in the well should be avoided. Consequently, the same tubing should be used for purging and sampling. Teflon or Teflon-lined polyethylene tubing must be used to collect samples for organic analysis. For samples collected for inorganic analysis, Teflon or Teflon lined polyethylene, PVC, Tygon or polyethylene tubing may be used. The tubing wall thickness should be maximized (⅜ to ½ inch) and the tubing length should be minimized (i.e. do not have excess tubing outside of the well). Pharmaceutical grade (platinum-cured polyethylene, or equivalent) tubing should be used for the section around the rotor head of the peristaltic pump to minimize gaseous diffusion.

Water level measuring device, 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

Flow measurement supplies (e.g., graduated cylinder and stop watch).

Power source (e.g., generator, located downwind; car battery; nitrogen tank; etc). The generator should not be oversized for the pump.

In-line flow-through cell containing purge criteria parameter monitoring instruments for pH, specific conductance, temperature, oxidation-reduction potential (ORP) and dissolved oxygen (DO). The in-line device should be bypassed or disconnected during sample collection.

Decontamination supplies: distilled water, scrub brushes, Liquinox® soap and three five-gallon buckets are required for three-stage decontamination (Liquinox®/water wash and two distilled water rinse cycles).

Sample Bottles: It is recommended that preservatives are added to sample bottles by the laboratory prior to field activities to reduce potential error or introduction of contaminants.

Sample tags or labels, chain of custody.

Well construction data, location map, field data from last sampling event.

PROCEDURE

1. Measure and record the depth to water (to 0.01 foot) in all wells to be sampled before installing the pump or tubing. Care should be taken to minimize disturbance to the water column and to any particulate matter attached to the sides or at the bottom of the well.

2. Attach and secure the tubing to the low-flow pump. Slowly lower the pump into the well and secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties. For peristaltic pump operation, lower only the Teflon-lined tubing into the well and attach pharmaceutical-grade polyethylene tubing to the portion to be attached to the pump rotor.

3. Pump, safety cable, tubing and electrical lines should be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well (by default), or at a location determined to either be a preferential flow path or zone where contaminants are present. The pump intake should be kept a minimum of two feet, if possible, above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well. Secure the pump and tubing to the well casing to prevent slippage of the tubing into the well during purging and sampling.

4. Measure the water level again with the pump in the well before starting the pump. Start the pump at the lowest rate possible (100 milliliters per minute [mL/min]) while measuring drawdown continuously. Avoid

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surging water from the well. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface. Adjust the pumping rate such that there is little or no water level drawdown in the well (less than 0.3 foot) and the water level should stabilize. If the minimum drawdown that can be achieved exceeds 0.3 foot, but remains stable, continue purging until indicator parameters stabilize without dewatering the well screen, if possible. Water level measurements should be made continuously. Pumping rate changes (both time and rate) should be recorded on the field logs. Precautions should be taken to avoid pump suction loss or air entrainment. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump intake but the operator should attempt to maintain a steady flow rate with the pump to the extent practicable. In these low-yielding wells, where 100 mL/min exceeds the entrance rate of groundwater into the well, it is important to avoid complete dewatering of the well screen interval. In these cases, the pump should remain in place and the water level should be allowed to recover repeatedly until three well volumes have been purged and there is sufficient volume in the well to permit collection of samples (up to four hours). Samples may then be collected even though the indicator field parameters have not stabilized.

5. While purging the well, monitoring of in-line water quality indicator parameters should include specific conductance, pH, DO, temperature and ORP, which must be collected every three to five minutes until all of the parameters have stabilized. Stabilization is achieved when three successive readings are within:
    - ±0.1 for pH;
    - ±3% for conductivity and temperature;
    - ±10 mV ORP; and,
    - ±10% for DO

   A minimum subset of these parameters that can be used to determine stabilization during purging in this procedure is pH, specific conductivity and DO. DO is typically the last parameter to stabilize. Stabilization of indicator parameters is used to indicate that conditions are suitable for sampling to begin. If, after one hour of purging, indicator field parameters have not stabilized, one of three optional courses of action may be taken:
    - Continue purging until stabilization is achieved;
    - Discontinue purging, do not collect any samples, and record in the logbook that stabilization could not be achieved (the documentation must describe attempts to achieve stabilization); or
    - If three well volumes have been evacuated from the well and parameter stabilization has not been achieved, discontinue purging, collect samples, and provide a full explanation of attempts to achieve stabilization in the logbook.
6. Once stabilization has been documented, volatile organic compounds (VOC) and gas sensitive (e.g., Fe^{+2}, CH_4) parameter samples should be immediately collected directly into pre-preserved sample containers. All sample containers should be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. Samples requiring pH adjustment should have their pH checked to assure that the proper pH has been obtained. For VOC samples, this will require that a test sample be collected to determine the amount of preservative required to be added to the sample containers prior to sampling.
7. Filtered metal samples are to be collected with an in-line filter. A high capacity, in-line 0.45-micron particulate filter must be pre-rinsed according to the manufacturer’s recommendations, or with approximately one liter of groundwater following purging and prior to sampling. After the sample is filtered it must be preserved immediately.
8. As each sample is collected, the sample should be labeled and placed into a cooler with proper temperature control. After collection of the samples, the tubing from the pump should be properly discarded or dedicated to the well for re-sampling by hanging the tubing inside the well. When finished, secure the well (close and lock it up).