Tier II Vapor Intrusion Assessment Sampling and Analysis Plan

TOC Holdings Co. Site 01-323
301 North Central Avenue, Kent, Washington

Prepared for:

TOC Holdings Co.
c/o Mr. Mark Chandler
2737 W. Commodore Way
Seattle, Washington

May 12, 2016

Prepared by:

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by HydroCon Environmental, LLC (HydroCon) on behalf of TOC Holdings Co. to describe sampling procedures and methods for the Tier II Vapor Intrusion Assessment (VIA) that will be performed in support of the proposed remedial action that will be conducted at TOC Holdings Co. Facility No. 01-323, located at 301 Central Avenue North, Kent, Washington (Figure 1).

This SAP supports implementation components described in the Remedial Investigation/Feasibility Study (RI/FS, HydroCon 2016a). The purpose of the SAP is to ensure sample collection, handling, and analysis conducted as part of a Tier II VIA will result in data that meets the data quality objectives for refining the existing RI/FS data in advance of remedial action implementation at the Property. The SAP includes requirements for sample number and location, analytical testing, documentation, and quality assurance/quality control.

1.1 Responsible Agency

The Washington State Department of Ecology (Ecology) is the lead regulatory agency for the cleanup action at the Property as promulgated in the Model Toxics Control Act (MTCA). The cleanup action is being conducted as an independent remedial action in accordance with Washington Administrative Code (WAC) 173-340-515 of the MTCA.

1.2 Project Organization

The names and responsibilities of key project representatives and personnel involved in the cleanup action at the Site are listed below:

- Mark Chandler, TOC Holdings Co., Client
- Craig Hultgren, HydroCon, Project Manager
- Rob Honsberger, HydroCon, Field Lead
- Allison Greiner, Eureka Project Solutions LLC, Quality Assurance Officer
- Michael Warfel, Ecology, Project Manager

2.0 BACKGROUND INFORMATION

The following section provides a summary of the site location and description, geologic setting, and historical site operations on the Site. For additional Site details, refer to the RI/FS (HydroCon 2016a).

2.1 Site Location and Description

The Property is a square-shaped lot located at 301 Central Avenue North, Kent, Washington 97032. Property addresses also include 305 Central Avenue North and 215 East Smith Street. The Property consists of a 0.31-acre lot comprised of two tax lots (King County tax parcels Nos. 917960-1735 and 917960-1745) in Kent, King County, Washington. The Site is currently owned by the Vivolo Family Trust LLC.

A 1,656-square foot restaurant, Taqueria El Rinconsito, is located in the southeastern portion of the Site. A paved parking lot and a drive-thru lane south of the restaurant comprise the remainder of the Property.

2.2 Geologic & Hydrogeological Setting

The Site lies within the Duwamish Valley, located between the Cascades and Puget Sound. The Duwamish Valley is a former extension of the Puget Sound waterway that became partly filled to above sea level with lacustrine and alluvial deposits. The alluvium, primarily from the Green and White Rivers, forms a thick deposit that fills the deep glacial trough that is now the Duwamish Valley. Postglacial sediments have accumulated continuously in the Duwamish Valley since retreat of the Vashon glacier. Shallow soils typically consist of channel gravels and sands that occur in present and abandoned channels of the main rivers or silt, clay and peat of overbank deposits (Mullineaux, 1970).

Soils in the Duwamish Valley typically consist of the Oridia-Seattle-Woodinville association. These soils are generally poorly-drained silt loams. The alluvium in much of the lower Duwamish Valley is characterized by medium- to medium to fine-grained sand and silt that was deposited in a delta complex when the valley was a submerged marine embayment; these sediments generally do not yield appreciable volumes of water to wells (Woodward et. al., 1995).
The main aquifer in the area is the recent alluvial aquifer (Qal) that occurs with the Pacific/Algona/Auburn area, and the Renton area. The Qal aquifer generally occurs at depths of less than 100 feet, is unconfined, and is in hydraulic connection with multiple surface water systems (White, Green and Cedar rivers). Aquifer recharge is from direct infiltration of the ground surface, and lateral groundwater inflow from deeper aquifers in adjacent uplands. Natural aquifer discharge is to the rivers. Other alluvial aquifers, mapped as Qvr, Qva, Qc_2, Qc_3 and Qc_3 are also present in the area and contribute to the Kent water supply system (Pace 2011).

The locations of borings and wells advanced at the Site are shown in Figure 2. Based on the results of the investigations summarized in later sections of this report, subsurface soil beneath the Property, to a depth of 15 feet, consists primarily of sand with varying amounts of silt. Silt is present at the bottom of

Boring HC07. Gravel and gravel fill are present in some borings to a depth of approximately 3 feet. Groundwater was present in monitoring wells at a depth of approximately 7 bgs.

2.3 Historical Operations

HydroCon reviewed a Limited Site Investigation (LSI) report prepared by Terracon Consultants, Inc. (Terracon 2013) for the Vivolo Family Trust LLC. The LSI includes information from a Phase I Environmental Site Assessment (ESA) prepared by Aerotech Environmental Consulting (Aerotech 2010, as reported in Terracon 2013).

According to Aerotech, a gas station was historically located in the eastern portion of the Property from at least 1935 to 1953 and the facilities included two 500-gallon underground storage tanks (USTs), a fuel pump island and canopy, and a service bay with a “grease shed” and hoist. The 1953 gas station was demolished and replaced by Wagner’s Sav-Way gas station. The new service building was reportedly built in the western central portion of the Site. The gas station was demolished in approximately 1972 and replaced by the current restaurant structure.

Site reconnaissance conducted by Aerotech identified a concrete patch with two apparent UST fill ports north of the restaurant, which Aerotech interpreted as evidence of the presence of possible USTs left in place. Aerotech identified the on-Site USTs, the historical Site use as gas stations, potential additional USTs, and the subsurface components of the hoist, as Recognized Environmental Conditions (RECs). Site features are shown on Figure 2.

According to historical assessor records obtained by Terracon, Time Oil Co. was identified as the owner of a car wash building built in 1963 in the south central portion of the Site.

Terracon (2013) reviewed historical aerial photographs to obtain information on the history of development of the Property and nearby areas. The Property was developed as a gas station as early as 1936 and all gas station structures had been removed by 1972. The current building was present in 1990. Two adjoining properties were reviewed: Strains Cascade Facility/Jack in the Box and Burdic Feed. Terracon concluded that an off-site release at the former Strains Cascade Facility may have impacted the Property. This conclusion was based on known releases and site investigations, the relative position of the properties, and groundwater flow direction.

3.0 CONCEPTUAL SITE MODEL

As detailed in the RI/FS, extensive site investigation has been completed between 2010 and the present. This section presents portions of the conceptual understanding of the Site derived from previous site investigations that are pertinent to the Tier II VIA and identifies potential or suspected sources of hazardous substances, types and concentrations of hazardous substances, potentially contaminated media, and a preliminary vapor pathway exposure assessment.

3.1 Site Definition

Based on the findings from the investigations conducted by HydroCon and others between 2010 and the present, the Site is defined as portions of the Property and adjoining areas with petroleum-contaminated soil or groundwater at concentrations exceeding the MTCA Method A cleanup levels (CULs) or soil gas exceeding MTCA Method B screening levels (SLs). At present, the lateral extent of soil and groundwater impacted at concentrations exceeding Method A CULs appears to be restricted to the southeastern portion of the Property and extends approximately 10 feet to the south of the Property in the City of Kent's E. Smith Street ROW. Site features are shown in Figure 2.

3.2 Chemicals and Media of Concern

Based on the findings of the investigations conducted on and adjacent to the Property, the primary COCs for the Site in soil and groundwater are gasoline-; diesel-; and oil-range petroleum hydrocarbons (GRPH, DRPH, and ORPH, respectively); benzene, toluene, ethylbenzene, and xylene (BTEX), and naphthalene.

A Tier I VIA, conducted by HydroCon as part of the December 2015 Additional Site Investigation (ASI, HydroCon 2016b), detected concentrations of VOCs in soil gas that included benzene, 1,2-dichloroethane (EDC); ethylbenzene; n-hexane; naphthalene; ortho- and meta-xylenes; C5 to C8 aliphatic air-phase petroleum hydrocarbons (APH); C9 to C12 aliphatic APH; and C9 to C10 aromatic APH exceeding Ecology's sub-slab screening levels (SLs) (Ecology 2015b). Based on these Tier I VIA findings, HydroCon recommended the Tier II VIA described herein. The Tier II VIA will include shallow soil gas, outdoor air, and indoor air sampling to further evaluate the vapor intrusion pathway in accordance with Ecology's guidance. It is anticipated that the list of COCs and media of concern for APH will be finalized after the completion of the Tier II VIA.

3.3 Confirmed and Suspected Source Areas

The historical investigations confirmed elevated concentrations of COCs present in soil and groundwater beneath the Property as a result of a release of petroleum hydrocarbons from the former USTs and fuel-dispensing pump islands that were formerly located at the Property (Figure 2).

3.4 Distribution of Contaminants in Soil

Petroleum-contaminated soil generally extends to the south and east of the existing restaurant building ranging between 5 and 15 feet bgs. An area surrounding sampling HC08 to the northeast of the existing building exhibits soil contamination above CULs (limited to DRPH) at a depth of 5 feet bgs.

3.5 Distribution of Contaminants in Groundwater

The area of petroleum-contaminated groundwater that resulted from the Property's historical use as a retail gasoline station generally coincides with the area of soil contamination except there is no groundwater contamination in the vicinity of soil boring HC08.

3.6 Distribution of Contaminants in Soil Gas and Air

The Tier I VIA identified site COCs in soil gas samples collected from temporary borings located adjacent to the east and southeast sides of the site restaurant building foundation at concentrations that exceed Ecology's sub-slab SLs. The lateral extent of the shallow soil gas plume has not been delineated and the concentrations of Site COCs in background outdoor air and indoor air in the Site building have not been evaluated. The Tier II VIA described herein is intended to further evaluate the lateral extent of the shallow soil gas plume, background outdoor air concentrations of site COCs, and indoor air concentrations of site COCs.

3.7 Contaminant Fate and Transport

3.7.1 Transport Mechanisms Affecting Distribution of Petroleum Hydrocarbons

The environmental transport mechanisms of petroleum hydrocarbons are related to its separate phases in the subsurface. The four phases of petroleum contamination in the subsurface are vapor (in soil gas), residual (sorbed contamination on soil particles), aqueous phase (contaminants dissolved in groundwater), and light non-aqueous phase liquids (LNAPL). At steady state conditions, each phase is in equilibrium with the other phases in the subsurface, and the relative ratio of total subsurface contamination by petroleum hydrocarbons between the four phases is controlled by dissolution, volatilization, and sorption.

Petroleum hydrocarbons observed in soil and groundwater beneath the Site have been transported from source areas and distributed throughout the Site primarily by dispersive transport mechanisms within the saturated zone and by soil vapor transport. As with other chemicals, petroleum hydrocarbons tend to spread out as groundwater flows away from the source area. The extent of the hydrocarbon plume depends on the volume of the release, soil density, particle size, and seepage velocity.

3.7.2 Environmental Fate

The significant processes controlling the fate of petroleum hydrocarbons in the environment are dissolution, volatilization, sorption, and bioattenuation. Petroleum hydrocarbons are comprised of hundreds of organic compounds that exhibit a wide range of physical and chemical properties. These compounds range from low molecular weight, low-boiling point compounds with high vapor pressure (i.e. highly volatile) exhibiting moderate aqueous solubility to those that exhibit a high molecular weight, high-boiling point, low vapor pressure, and extremely low aqueous solubility. Gasoline represents the lower molecular weight compounds that exhibit a higher relative capacity for dissolution, volatilization, and bioattenuation. These compounds are therefore more mobile in the environment and less persistent over time. The moderate molecular weight compounds representative of diesel fuel exhibit a lower relative capacity for dissolution, volatilization, and bioattenuation compared to gasoline. The highest molecular weight compounds represented by motor oil, paraffins, asphaltenes, and PAHs exhibit an even lower capacity for dissolution, volatilization, and bioattenuation, and are therefore less mobile and more persistent over time.

3.8 Vapor Pathway Preliminary Exposure Assessment

Volatile COCs have been identified in shallow soil gas at concentrations exceeding Ecology's SLs. Because shallow soil gas concentrations exceed the SLs for these VOCs in close proximity to the onsite building, the vapor intrusion exposure pathway is considered to be potentially complete at the Site. The Tier II VIA described in this SAP is intended to further evaluate site conditions as they pertain to exposure through the indoor air pathway.

Tier II VIA sampling is intended to provide data to complete the evaluation of the vapor intrusion exposure pathway for the Site building. The Tier II VIA sampling will include the following:

- Collection of shallow soil gas samples from eight locations distributed across the Site.
- Collection of outdoor air samples from up to three locations distributed across the Site.
- Collection of indoor air samples from three locations within the Site building.
- Obtaining atmospheric data (e.g. wind speed, wind direction, barometric pressure, precipitation) for the sampling period from the National Weather Service (NWS) monitoring station in the Site vicinity (KSEA - Seattle Tacoma International Airport).

All field operations will be supervised by personnel experienced in site assessment and sampling activities. Field operations will be performed in accordance with the Site's Health and Safety Plan.

4.1 Shallow Soil Gas Sampling

HydroCon will install semi-permanent soil gas sampling points utilizing Cox-Colvin & Associates (Cox-Colvin) Vapor Pin™ soil gas sampling devices. Traditional sub-slab soil-gas sampling methods are time consuming, expensive, and prone to leaks. Cox-Colvin designed the Vapor Pin™ specifically to eliminate many of the problems associated with traditional sub-slab soil gas sampling methods. Advantages of the Vapor Pin™ over traditional methods include:

- Design reduces the potential for leaks during sample collection, improving sample quality;
- Built-in disposable seal eliminates the need for grout, increasing productivity;
- Connects easily to sampling equipment;
- Easily installed, sampled, and retrieved for reuse;
- Reduces damage to concrete pavement in the sampling location;
- Improves diagnostic testing;
- Improves spatial resolution;
- Reduces sampling time allowing collection of more samples for less cost, and thus provides a better understanding of site conditions.

Installation methods for the Vapor Pin™ soil gas sampling devices are presented in SOP 6 in Appendix A. Proposed Vapor Pin™ sampling locations are illustrated in Figure 4 and the rationale for each location is described below.

- VP-1 - Southeast corner of the Property. Data from this location will be used to determine if the shallow soil gas plume is migrating offsite to the southeast.
- VP-2 - South of the south wall of the restaurant building. Data from this location will be used to evaluate whether the shallow soil gas plume extends beneath the building or is migrating offsite to the south.
- VP-3 - Southwest corner of the Property. Data from this location will be used to determine if the shallow soil gas plume is migrating offsite to the southwest.
- VP-4 - West of the west wall of the restaurant building. Data from this location will be used to evaluate whether the shallow soil gas plume extends beneath the building or is migrating offsite to the west.
- VP-5 - Northwest corner of the Property. Data from this location will be used to determine if the shallow soil gas plume is migrating offsite to the northwest.
- VP-6 - North of the north wall of the restaurant building. Data from this location will be used to evaluate whether the shallow soil gas plume extends beneath the building or is migrating offsite to the north.
- VP-7 - Northeast corner of the Property. Data from this location will be used to determine if the shallow soil gas plume is migrating offsite to the northeast.
- VP-8 - East of the east wall of the restaurant building. Data from this location will be used to evaluate whether the shallow soil gas plume extends beneath the building or is migrating offsite to the east.

Soil gas samples will be collected from each sampling location in one-liter Summa canisters equipped with 10-minute flow controllers in accordance with the soil gas sampling methodology described in SOP 3 in Appendix A. Collected soil gas samples will be described in a soil gas sampling form as presented in Appendix B.

4.2 Outdoor Air Sampling

HydroCon will collect up to two outdoor air samples at separate locations upwind of the Property to characterize background ambient air concentrations of COCs migrating onto the Property. The actual air sampling locations will depend on the prevailing wind direction(s) during the sampling event. Two samples are planned to ensure that an upwind air sample is collected if the prevailing wind direction shifts during the sampling duration (planned for 8-hours). The results from the two sample locations will be compared to the compiled wind direction data to ascertain how to best interpret the results. For example, if one sample was positioned to collect upwind data during the sampling period but the other was not positioned properly, the data from the properly positioned sample would be considered appropriately used to characterize background ambient air. If the wind direction shifts during sample collection and both locations are positioned correctly, the data from both samples would be considered appropriately used to characterize background ambient air quality. For example, data collected in the latter scenario might be averaged from both locations. Data that is determined to appropriately characterize background ambient air would be used to evaluate the potential contribution of outdoor air to the concentrations of COCs detected in indoor air.

Outdoor air samples (A-1 and A-2) will be collected in six-liter Summa canisters equipped with 8-hour flow controllers in accordance with the outdoor air sampling methodology described in SOP 5 in Appendix A. Collected samples will be described in an outdoor air sampling form as presented in Appendix B.

4.3 Indoor Air Sampling

HydroCon will collect indoor air samples at three locations within the restaurant building. Indoor air sampling locations are illustrated on Figure 4 and described below.

- A-3 - Food preparation area in the west half of the restaurant building. Data from this location will be used to evaluate indoor air conditions and potential occupational exposure of restaurant staff.
- A-4 - Customer service counter area in the center of the restaurant building. Data from this location will be used to evaluate indoor air conditions and potential occupational exposure of restaurant staff and short-term exposure of customers.
- A-5 - Customer seating area in the east half of the restaurant building. Data from this location will be used to evaluate indoor air conditions and potential occupational exposure of restaurant staff and short-term exposure of customers.

Indoor air samples will be collected from each sampling location in six-liter Summa canisters equipped with 8-hour flow controllers in accordance with the indoor air sampling methodology described in SOP 4 in Appendix A. Collected samples will be described in an indoor air sampling form as presented in Appendix B.

4.4 Atmospheric Conditions

HydroCon will obtain and compile atmospheric data (e.g. wind speed, wind direction, barometric pressure, precipitation) for the Tier II VIA sampling period from the National Weather Service (NWS) monitoring station located in the Site vicinity (KSEA - Seattle Tacoma International Airport). This data will be used to describe the atmospheric conditions at the Site during the sampling event.

4.5 Analytical Methods

Based on findings from previous investigations and results of the RI conducted on and adjacent to the Property, the primary chemicals of concern for soil gas and air samples collected at the Site include volatile organic compounds known to be gasoline range petroleum hydrocarbon constituents. Soil gas, indoor, and outdoor air samples will be submitted to a laboratory certified to perform the requested analyses at the required minimum detection limits. The requested analytes, associated analytical methods, and minimum required detection limits are summarized in Table 1. Table 2 summarizes sample container types, preservation (if any), and holding times for the respective analyses.

In addition to investigative samples, quality assurance/quality control (QA/QC) samples will also be collected for laboratory analysis. These samples will include one duplicate sample for soil gas and one duplicate for indoor/outdoor air samples

5.0 SAMPLE DOCUMENTATION AND SHIPMENT

5.1 Field Forms

HydroCon will document field activity with the following forms found in Attachment B:

- Soil gas sampling collection forms will be used to document sample information and observations and measurements made during soil gas sampling.
- Air sampling forms (indoor and outdoor) will be used to document sample information and observations and measurements made during air sampling.
- Field reports will be used to document field activity, decision making, communication and other relevant topics during each day of the field work.
- Chain-of-custody forms will be filled out to direct the analytical requirements for soil gas and air (indoor and outdoor) samples collected at the site.

5.2 Packaging and Shipping

All samples shall be packaged and shipped to the laboratory according to procedures described in SOP 7 and required by the laboratory.

5.3 Sample Chain-of-Custody Forms and Custody Seals

A chain-of-custody (COC) form will be completed with all required information and accompany all samples, see attachments for form. The COC provides a record document of the transfer of sample custody from the field sampler to the laboratory. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record.

Custody seals will be used on the shipping containers when samples are shipped to the laboratory to inhibit sample tampering during transportation (see attachments for forms).

6.0 INVESTIGATION DERIVED WASTE

No investigation derived waste (IDW) is expected to be generated during this phase of site investigation. Solid waste, (used gloves, garbage, disposable equipment, etc.) will be disposed of in the onsite dumpster.

7.0 REPORTING

Analytical results collected as part of this SAP will be subjected to data validation to confirm that the data is suitable for its intended use in comparing to Ecology's screening (soil gas) and cleanup levels (indoor air). These screening and cleanup levels are summarized in Table 1. A Tier II VIA Report will be prepared to provide a summary of field activities, tabulated analytical results including a comparison of the detected concentrations with the respective regulatory screening and cleanup levels (Table 1) and a discussion on the results of data validation. A concluding discussion will summarize the findings of the investigation and provide recommendations for further investigation or response actions based on the findings.

8.0 SCHEDULE OF IMPLEMENTATION

The Tier II VIA Site investigation work is scheduled to occur on or before June 1, 2016.

9.0 QUALIFICATIONS

HydroCon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time period. HydroCon makes no warranties, either expressed or implied, regarding the findings, conclusions or recommendations. Please note that HydroCon does not warrant the work of laboratories, regulatory agencies, or other third parties supplying information used in the preparation of the report.

Findings and conclusions resulting from these services are based upon information derived from the on-Site activities and other services performed under this scope of work; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, non-detectable or not present during these services, and we cannot represent that the Site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified during this monitoring. Subsurface conditions may vary from those encountered at specific sampling locations or during other surveys, tests, assessments, investigations, or exploratory services; the data, interpretations and findings are based solely upon data obtained at the time and within the scope of these services.

This report is intended for the sole use of **TOC Holdings Co.** This report may not be used or relied upon by any other party without the written consent of HydroCon. The scope of services performed in execution of this evaluation may not be appropriate to satisfy the needs of other users, and use or re-use of this document or the findings, conclusions, or recommendations is at the risk of said user.

The conclusions presented in this report are, in part, based upon subsurface sampling performed at selected locations and depths. There may be conditions between borings or samples that differ significantly from those presented in this report and which cannot be predicted by this study.

Signature:

Report Prepared By:

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State of Washington
Hydrogeologist
1809
Licensed Geologist
CRAIG HULTGREN

Report Reviewed By:

Craig Hultgren, LHG

10.0 REFERENCES

HydroCon, 2016a. Remedial Investigation/Feasibility Study, TOC Holdings Co. Facility No. 01-323; 301 Central Avenue North, Kent, Washington. Prepared for TOC Holdings Co. March.

HydroCon, 2016b. Additional Site Investigation, TOC Holdings Co. Facility No. 01-323, 301 Central Avenue North, Kent, Washington. Prepared for TOC Holdings Co. March.

Massachusetts Department of Environmental Protection (MDEP). 2010. WSC-CAM-IX A; Quality Control Requirements and Performance Standards for the *Analysis of Air-Phase Petroleum Hydrocarbons (APH) by Gas Chromatography/Mass Spectrometry (GC/MS)* in Support of Response Actions under the Massachusetts Contingency Plan (MCP). Bureau of Waste Site Cleanup. July 1.

Mullineaux, Donald R., 1970. Geology of the Renton, Auburn, and Black Diamond Quadrangle, King County Washington. U.S. Geological Survey Professional Paper 672.

Pace Engineering, Inc., 2011. City of Kent. 2011 Water Systems Plan. Prepared for the City of Kent Public Works Department.

Terracon Consultants, Inc. (Terracon). 2013. Limited Site Investigation; Taqueria El Rinconsito Restaurant; 301 and 305 Central Avenue North & 215 East Smith Street; Kent; King County, Washington. Prepared for Vivolo Family Trust LLC c/o Union Bank, N.A. as Trustee, Orange, California. November 20.

Terracon, 2014. UST Decommissioning and Soil Interim Action Report. Taqueria El Rinconsito Restaurant 301/305 Central Avenue North & 215 East Smith Street. Kent, King County, Washington. July 3.

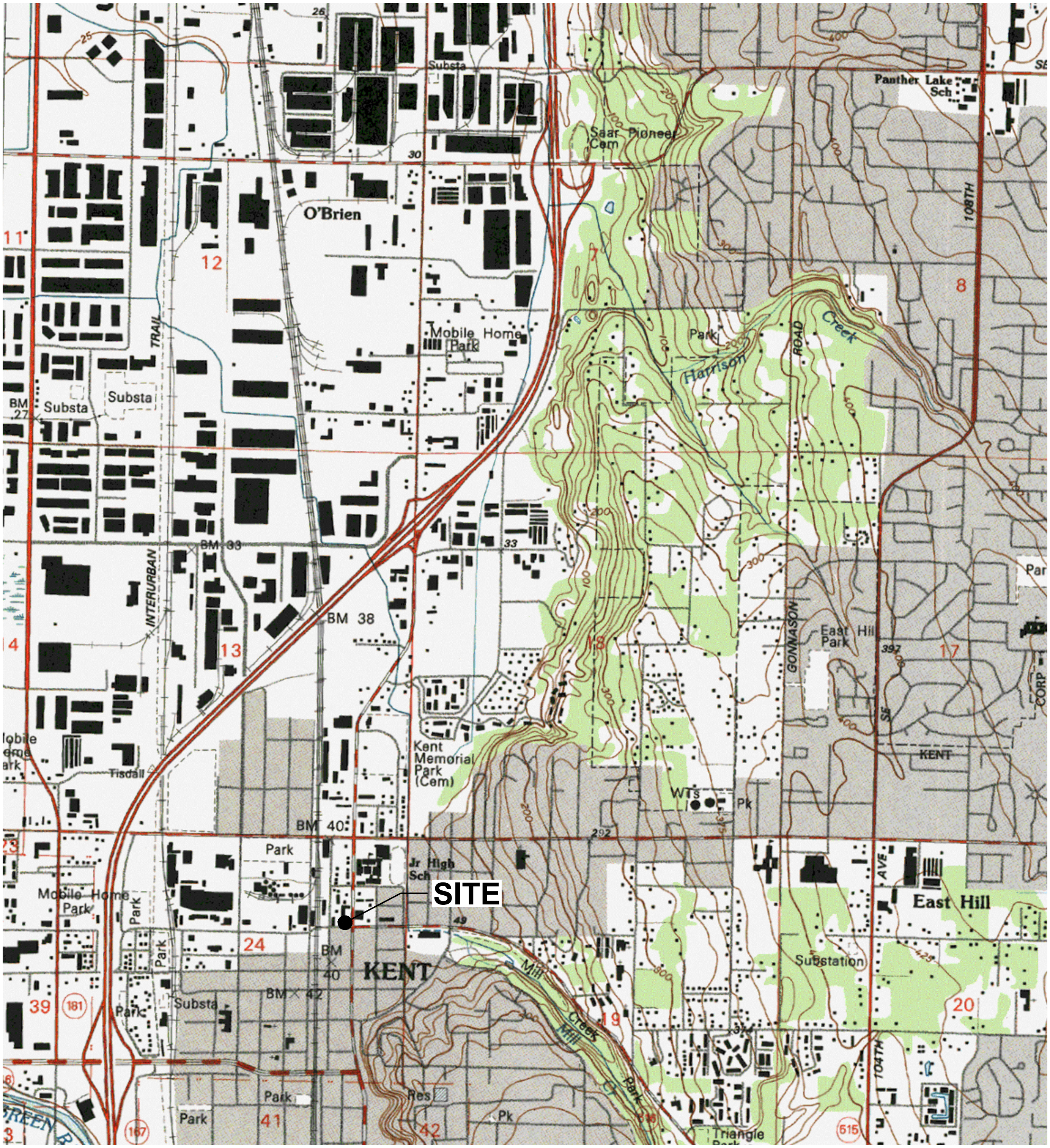
Washington State Department of Ecology (Ecology). 1997. Analytical Methods for Petroleum Hydrocarbons. Toxics Cleanup Program and the Ecology Environmental Laboratory. Publication No. ECY 97-602. June.

_________________2015. Guidance for Evaluating Soil Vapor Intrusion in the Washington State – Investigation and Remedial Action; Publication No. 09-09-047. Toxics Cleanup Program. October 2009. Table B-1, updated April 2015.

_________________2016. Updated Process for Initially Assessing the Potential for Petroleum Vapor Intrusion; Implementation Memorandum No. 14; from: Jeff Johnston, Section Manager, Information & Policy Section, Toxic Cleanup Program to: Interested Persons. March 31.

Woodward, D.G., F. A. Packard, N. P. Dion, and S. S. Sumioka, 1995. Occurrence and Quality of Ground Water in Southwestern King County, Washington. U.S. Geological Survey Water Resources Investigations Report 92-4098.

FIGURES



NOTE(S):
USGS, RENTON QUADRANGLE
WASHINGTON-KING CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

0 2000 4000
SCALE IN FEET
1" = 2000'

N W E S

Hydro Con

DATE: 9-8-15
DWN: JJT
CHK: NV
APPROVED: CH
PRJ. MGR: RH
PROJECT NO: 01-323

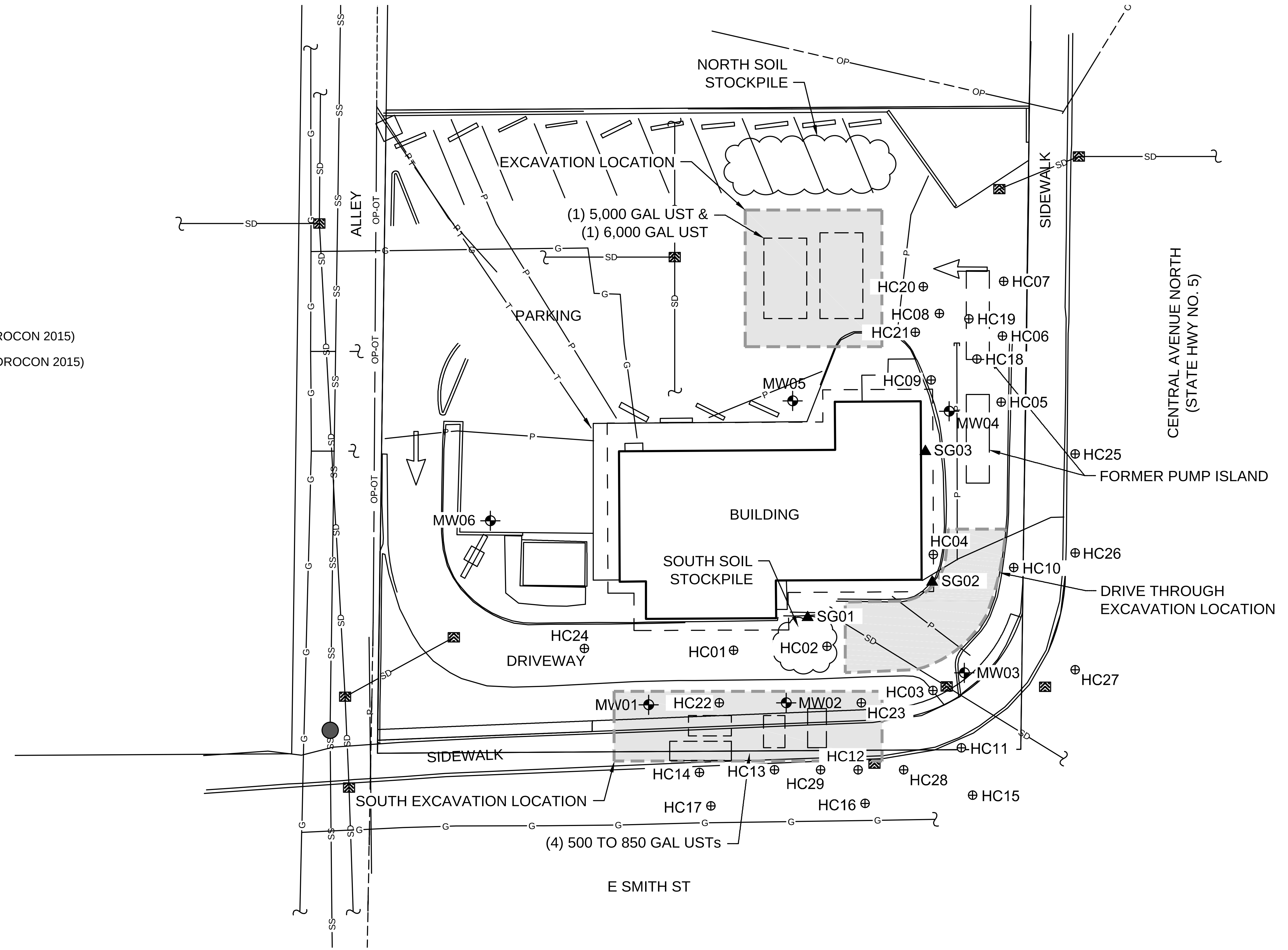
FIGURE 1
SITE LOCATION MAP

TOC HOLDING CO. FACILITY NO. 01-323
301 N CENTRAL AVE
KENT, WA.

C:\Users\Josh\Desktop\Autocad Backup\Hydrocon-Autocad\01-323 Kent\2015\Aug 2015\01-323_BM-083115.dwg 2.17.2014

LEGEND

(line)	BUILDING
MW01 (symbol)	MONITORING WELL
(symbol)	CATCH BASIN
——P——	POWER
——G——	GAS
——SS——	SANITARY SEWER
——SD——	STORM
——T——	TELEPHONE
- - OP - -	OVERHEAD POWER
(shaded)	EXCAVATION LOCATIONS
HC01 ⊕	BORING LOCATIONS (HYDROCON 2015)
SG01 ▲	SOIL GAS LOCATIONS (HYDROCON 2015)



N W E S

0 20 40
SCALE IN FEET
1" = 20'

HydroCon
510 Allen St. Suite B Kelso, Wa 98626, Ph(360)-703-6086

DATE: 2-2-16
DWN: JJT
CHK: NV
APPROVED: CH
PRJ. MGR: CH
PROJECT NO: 01-323

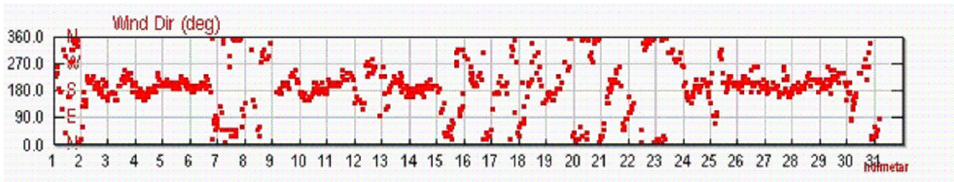
FIGURE 2
SITE FEATURES AND UTILITIES

TOC HOLDING CO. FACILITY NO. 01-323
301 N CENTRAL AVE
KENT, WA.

C:\Users\Josh\Desktop\Autocad Backup\Hydrocon-Autocad\01-323 Kent\2016\Jan 2016\01-323_BM-020216.dwg 2.17.2014

Wind Directions for the Month of April 2011-2015
and the full Year of 2015
Seattle-Tacoma International Airport (NWS Station KSEA)

April 2011



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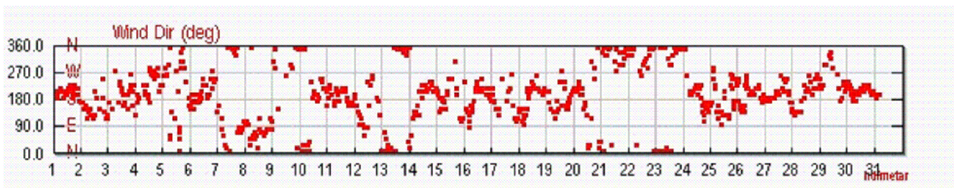

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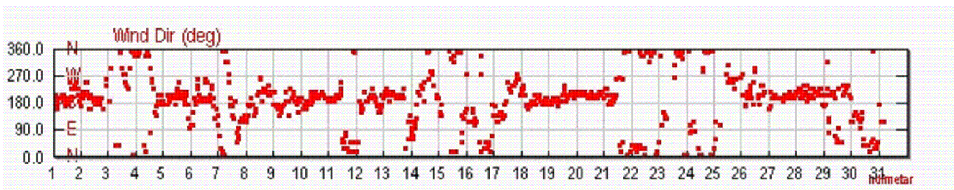

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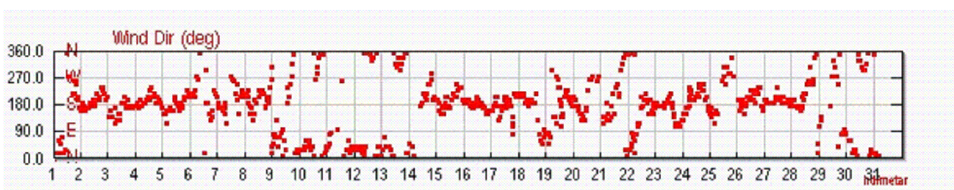

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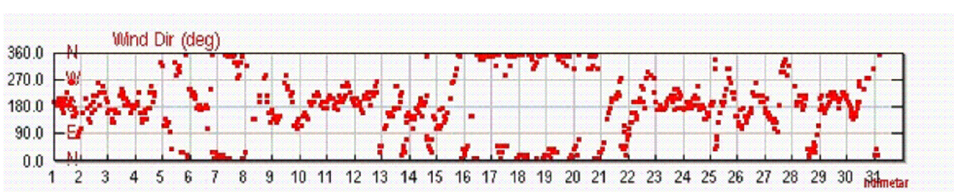
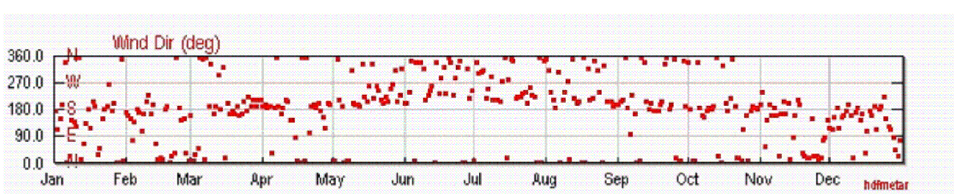


Full Year 2015



Hydro Con

DATE: 3-22-16
DWN: JJT
CHK: NV
APPROVED: NV
PRJ. MGR: CH
PROJECT NO: 01-323

FIGURE 3
WIND DIRECTIONS

TOC HOLDING CO. FACILITY NO. 01-323
301 N CENTRAL AVE
KENT, WA.

C:\Users\Josh\Desktop\Autocad Backup\Hydrocon-Autocad\01-323 Kent\2016\Mar 2016\01-323_BM-031616.dwg 2.17.2014

LEGEND

BUILDING

SG01 ▲ SOIL GAS LOCATIONS (HYDROCON 2015)

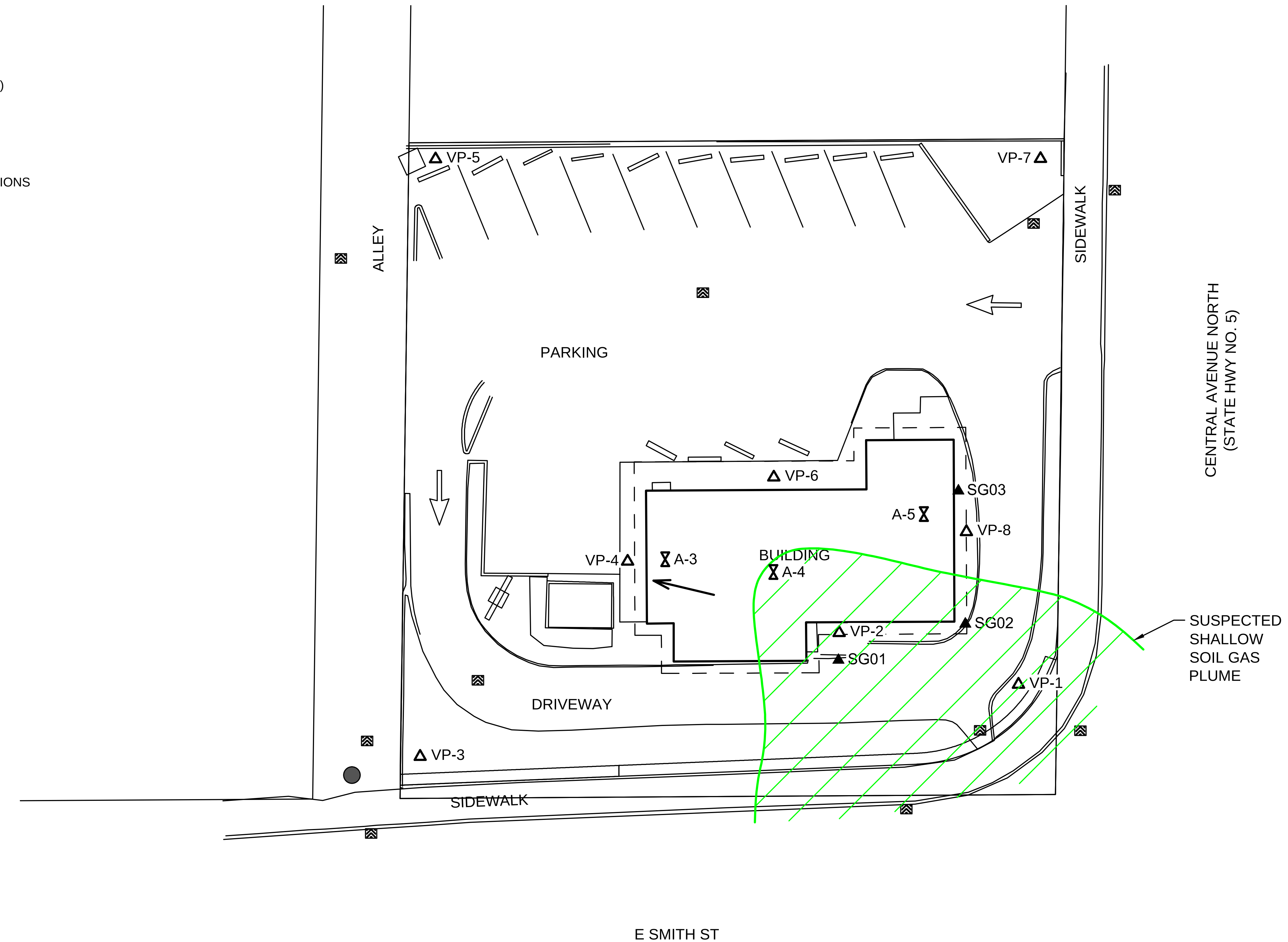
CATCH BASIN

APPROXIMATE GROUNDWATER FLOW DIRECTION

VP-1 △ PROPOSED SOIL GAS SAMPLING LOCATIONS

A-3 PROPOSED INDOOR AIR SAMPLES

NOTE:
UP TO TWO AIR SAMPLES (AS-1 AND AS-2) WILL BE COLLECTED BASED ON THE WIND DIRECTION AT THE TIME OF SAMPLING.



N W E S

0 20 40
SCALE IN FEET
1" = 20'

Hydro Con
510 Allen St. Suite B Kelso, Wa 98626, Ph(360)-703-6086

DATE: 3-22-16
DWN: JJT
CHK: MA
APPROVED: MA
PRJ. MGR: CH
PROJECT NO: 01-323

FIGURE 4
PROPOSED SAMPLE LOCATIONS

TOC HOLDING CO. FACILITY NO. 01-323
301 N CENTRAL AVE
KENT, WA.

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TABLES

Table 1
Tier II Vapor Intrusion Assessment
Analytes, Methods, and Required Detection Limits
TOC Holdings Co. Facility No. 01-323
301 North Central Avenue; Kent, Washington

Analytes Requested for Soil Gas, Indoor, and Outdoor Air Samples	Analytical Method	Ecology Screening and Cleanup Levels Applicable to the Tier II Vapor Intrusion Assessment [1]			
		Indoor and Outdoor Air Samples - Required Detection Limits		Soil Gas Samples -Required Detection Limits	
		2015 Indoor Air Cleanup Level[2] Method B Noncancer ($\mu g/m^3$)	2015 Indoor Air Cleanup Level[2] Method B Cancer ($\mu g/m^3$)	2015 Sub-Slab Soil Gas Screening Level[3] Method B Noncancer ($\mu g/m^3$)	2015 Sub-Slab Soil Gas Screening Level[3] Method B Cancer ($\mu g/m^3$)
benzene	EPA TO-15 with Selective Ion Monitoring (SIM) as needed to achieve required sensitivity	1.37E+01	**3.21E-01**	4.57E+02	**1.07E+01**
dichloroethane;1,2- (EDC)		3.20E+00	**9.62E-02**	1.07E+02	**3.21E+00**
ethylbenzene		**4.57E+02**		**1.52E+04**	
ethylene dibromide (EDB)		4.11E+00	**4.17E-03**	1.37E+02	**1.39E-01**
hexane; n-		**3.20E+02**		**1.07E+04**	
methyl tert-butyl ether		1.37E+03	**9.62E+00**	4.57E+04	**3.21E+02**
naphthalene		1.37E+00	**7.35E-02**	4.57E+01	**2.45E+00**
toluene		**2.29E+03**		**7.62E+04**	
trimethylbenzene; 1,2,4-		**3.20E+00**		**1.07E+02**	
xylene; m-		**4.57E+01**		**1.52E+03**	
xylene; o-		**4.57E+01**		**1.52E+03**	
VPH [EC5-6 aliphatics + EC6-8 aliphatics] fraction	VPH	**2.70E+03**			
VPH [EC8-10 aliphatics + EC 10-12 aliphatics] fraction	VPH	**1.40E+02**			
VPH [EC8-10 aromatics + EC10-12 aromatics] fraction minus [naphthalene]	VPH	**1.80E+02**			
APH [EC5-8 aliphatics] fraction	APH	**2.70E+03**		**9.00E+04**	
APH [EC9-12 aliphatics] fraction	APH	**1.40E+02**		**4.70E+03**	
APH [EC9-10 aromatics] fraction	APH	**1.80E+02**		**6.00E+03**	

Bold Red = Minimum Required Detection Limits

[1] Washington State Department of Ecology (Ecology). 2009. Guidance for Evaluating Soil Vapor Intrusion in Washington State – Investigation and Remedial Action; Publication No. 09-09-047. Toxics Cleanup Program. October. Table B-1; updated April 2015.

[2, 3] If there are two cleanup levels for an analyte, the lower number is the required mininum detection limit for the analytical method requested

Table 2
Air Sample Container Type and Size;
Preservation, and Holding Times
TOC Holdings Co. Facility No. 01-323
301 North Central Avenue; Kent, Washington

Media Sampled	EPA Analytical Methods	Sample Container Count/Size/Type	Field Preservation	Holding Time
Soil Gas (Table 1)	TO-15 (SIM, if needed) Ecology VPH and MDEP APH	One-liter Summa canister equipped with 10-minute flow controller	None	Within 15 days from canister delivery
Indoor and Outdoor Air (Table 1)	TO-15 (SIM, if needed) Ecology VPH and MDEP APH	Six-liter Summa canister equipped with 8-hour flow controller	None	Within 15 days from canister delivery

APH = air-phase petroleum hydrocarbons (MDEP 2010)

MDEP = Massachusetts Department of Environmental Protection

SIM = selective ion monitoring

VPH = volatile petroleum hydrocarbons (Ecology 1997)

ATTACHMENT A
STANDARD OPERATING PROCEDURES

HydroCon

STANDARD OPERATING PROCEDURE
SUB-SLAB VAPOR SAMPLE COLLECTION
VIA SOP 3

This Vapor Intrusion Assessment (VIA) Standard Operating Procedure (SOP) describes the method for sub-slab vapor sample collection from both temporary and permanently installed soil vapor probes (implants). Sub-Slab probe installation/construction methods are detailed in VIA SOP 2. Because each site is unique, these procedures should be viewed as guidelines and will likely require modification based on site and subsurface conditions present.

Personnel performing the soil gas monitoring and sampling will follow site safety procedures as specified in the site-specific Health and Safety Plan.

EQUIPMENT/MATERIALS

- Tubing: ⅛-inch or ¼-inch outer diameter (OD) inert, impermeable tubing such as nylon (Nylaflow®), Teflon® tubing, or stainless steel.
- Sample Containers: Stainless steel Summa canisters (one-liter Summa canisters are preferred; however, the site specific work plan may justify another appropriate size), syringe, or tedlar bag.
- Monitoring and sampling equipment may include the following: Certified flow controllers (if flow controllers are used, ensure flow controllers are dedicated to the canister/sample location), stainless steel t-fitting, stainless-steel particulate filter, photoionization detector (PID), low flow vacuum pump, vacuum gauge, portable weather station, and/or barometric pressure data loggers.
- Leak check equipment using helium or other pre-approved non-reactive tracer gas may include: helium tank, piping, and valve, leak check enclosure (shroud), helium detector, paper towels or rags, and nitrile gloves. Tracer gas should be laboratory grade and the grade noted on the sample form (e.g. 100% pure helium by volume).

COLLECTION PROTOCOL

Since sub-slab sampling is from very shallow depths (typically two to six-inches below surface), minimum purge volumes and low volume samples are preferred to minimize potential breakthrough from the surface. Regardless of sample depth, a 30 minute flow controller (minimum) should be used. Tracer/leak gas (helium is preferred) will be used to ensure breakthrough does not occur. Note that if sub-slab and deeper subsurface soil gas samples are to be collected, they should be collected from separate boring locations in order to maintain a proper seal. Constructing nested sampling points is possible, but breakthrough is more likely and nested construction is not preferred. If possible, shallow samples should be collected prior to deeper samples to ensure surface seal.

Syringe Grab Samples

If only syringe samples are to be collected, connect syringe to probe tubing using the T-valve. If the syringe is connected directly to the probe implant, no purging is required. If a connecting tube is used between the syringe and the implant, purge out one to two dead-volumes of the connecting tubing (approximately one cubic centimeter per foot (cc/ft) for ⅛-inch OD tubing and five cc/ft for ¼-inch OD tubing). Leave syringe connected to implant the tubing. Sample by extracting soil gas via the syringe plunger.

Summa Canisters

Inspect the laboratory-provided Summa canister for damage prior to use. Do not use a canister that has visible damage.

Using a wrench, remove the brass cap above the valve on the top of the Summa canister. Measure and record the initial vacuum of Summa canister. If using an external vacuum gauge, cap the gauge and attach it to the canister using a wrench. Open the canister valve only after verifying the gauge is properly capped.

Verify that the vacuum pressure of the canister is equal to that indicated on the laboratory supplied tag. If the vacuum does not match, the canister has likely leaked and should not be used. Record the vacuum pressure on the sample collection form.

The canister will then be fitted with the laboratory-provided steel filter. The sampling train (steel-filter, flow-controller (if used), and Summa canister) will be attached to a T-connector with an in-line vacuum gauge and vacuum tight flow valves at each end. All valves should be closed on the T connector at this time. The valve connected to the sampling train is referred to as the sampling valve. The vacuum pump (truck-mounted or otherwise) is then attached to the second end of the T with the valve closed (referred to as the purge valve).

Lastly, the sample tubing is threaded through the leak-check shroud and connected to the sub-slab sampling point and the third closed valve on the T-connector. The leak-check shroud should then be sealed against the slab surface (see “Leak Check – Probe Point Surface Seal” below).

Leaking Checking - Apparatus

The method described below shall be used to check for leaks in the lines and fittings of the above ground sampling apparatus:

After the sampling system is set up, double check all valves are closed.

Open the purge valve (the valve connecting the purge pump to the apparatus, all other valves remain closed), turn on the purge pump, and apply approximately ten inches of vacuum into the T-connector and valves. Close the purge valve and check to verify that there is no loss of vacuum within the sampling apparatus (T-connector and valves) over a one minute period of time. If there is a loss of vacuum, this indicates a leak in the purge/sample system train that must be remedied.

If necessary, recheck the system to verify that there is no leakage as described above.

Document the date and time the leak check(s) were performed on the sampling form. Ensure all valves remain closed.

Leaking Checking – Probe Point Surface Seal

In addition checking for leaks in the apparatus, the probe point surface seal also needs to be checked for leakage. The preferred method uses helium gas as a tracer and permits checking for and correcting potential leaks in the field prior to sampling. Other tracer gases may be used but approval of their use should be verified prior to the start of the work. The helium tracer gas method is listed in ITRC’s “Technical and Regulatory Guidance, Vapor Intrusion Pathway: A Practical Guideline” dated January 2007 (ITRC, 2007), and as described below. The ITRC guidance from which the text below is derived is consistent with California Environmental Protection Agency and Oregon Department of Environmental Quality guidance (CalEPA, 2005, 2010; DEQ 2010).

Helium Leak Check Method

- Insert sample tubing through the leak check enclosure (also referred to as a shroud) and complete sample tubing connections to the other apparatus (previously described above).

- Place the enclosure shroud flush with the ground surface, placing hydrated bentonite around the shroud to seal the shroud around the sample point.
- Attach helium tubing from the helium tank regulator to the enclosure (the “helium in” tubing).
- Attach the exhaust tubing (“helium out”) to the enclosure and locate the discharge end of the tubing as far as possible from the helium detector.
- Attach the helium detector on the exhaust line from the sample pump.
- Make sure the sample valve (from the sampling probe point) is closed.
- Open the helium tank valve and set the flow at 200 milliliter per minute (ml/min) or less; let it flow for about one minute to fill the leak check enclosure.
- Do an initial check to make sure the helium detector is not detecting any helium.
- Begin purging of soil gas as described in the section on purging below. During purging, continue monitoring helium detector, record readings. If helium is detected at over 5%, this indicates leakage; check/tighten all seals and fittings and repeat procedure. The helium exhaust line should also be monitored so that additional helium can be added to the shroud during sampling if needed.
- Close valves from the probe sampling point and purge pump lines, and turn pump off.
- If the helium detector reading is less than 5%, the system is considered leak free and sampling can be performed (see sampling section below).
- If the helium detector reading continues to be above 5%, leakage is indicated and the sub-slab abandoned.
- Record helium monitoring measurements in field notes.

Soil Gas Purging Procedures

Purging and sampling will be accomplished at a low flow rate (100 to 200 ml/min) to minimize the potential for inducing leakage. Flow rates should not exceed 200 ml/min. Purge vapors will be monitored using a PID for the presence of volatile organic compounds.

Slowly open the vacuum pump purge valve and purge three volumes of vapor from the dead space (volume of tubing and sand pack combined), then close the purge valve. Tubing volume can be estimated at 44 milliliters per foot (mm/ft) of 0.25-inch inner diameter (ID) tubing. For the sand pack volume calculation it is important to note that 1 cubic inch is equivalent to 16.387 milliliters. The sand pack volume can be calculated as shown:

Sand pack volume = $(\Phi*\pi*r_1^2*L_1) - (\pi*r_2^2*L_2)$

Where Φ = sand pack porosity, typically estimated at 30%

r_1 = radius of sand pack

L_1 = length of sand pack

r_2 = outer radius of tubing (half of outer diameter)

L_2 = length of tubing within the sand pack

Care will be taken not to purge an excessive volume, or at an excessive rate, so as to minimize the chances of inducing leakage from the surface. The pump will also be monitored for signs that it is laboring, a possible indication of a clogged probe or tubing.

During purging, check for leaks as described in the section on leak checks above. Record PID measurements of purge vapors on the field form. At the conclusion of purging, immediately close the purge valve and then shut off the purge pump.

Soil Gas Sample Collection Procedures - Grab Sampling

Atmospheric conditions (barometric pressure, temperature, wind speed and direction) will be recorded prior to and after sampling. A portable weather station equipped with a data logger is preferred to log site-specific conditions over the duration of sampling. However, if a weather station cannot be set-up on site, record atmospheric data from the closest weather station.

After leak testing and soil gas purging, soil gas sampling may be performed.

After purging, the purge valve will be closed prior to opening the sampling valve. The sample valve will then be opened followed by slowly opening the Summa canister valve. The canister's valve should be closed when the vacuum gauge shows a vacuum of 5 inches of mercury (in Hg) (pressure of -5 in Hg). The sample valve should then be closed.

Ensure the canister valve is tightly closed. The sample train should be immediately disassembled by removing the steel particulate filter, and the Summa canister. Immediately cap the Summa canister fitting. The final vacuum reading from the canister should be recorded on the chain of custody, sample collection form, and canister identification tag. If the final canister vacuum is less than 0.1 in Hg (more than -0.1 in Hg of pressure, or is a positive pressure), then the sample should be disregarded and a new sample collected.

Soil vapor samples will be shipped to a certified laboratory for analysis.

Sampling Procedures using a flow controller

The sampling procedure is the same as above except that a laboratory certified in-line flow controller for a pre-specified sampling time (i.e. 30 minutes) will be used. The flow controller fits between the laboratory provided steel particulate filter and the Summa canister. The entire sample train (laboratory-provided steel particulate filter, flow-controller, and summa canister) should be pre-assembled prior to connecting to the sampling valve.

Other Collection Notes

For larger canisters (greater than one liter), sample flow rates are not to exceed 200 milliliters per minute (ml/min) to minimize potential for vacuum extraction of contaminants from the soil phase. If large volume canisters is used (three or more liters) without a flow controller to ensure the flow rate remains below 200 ml/min, a purge volume test may be required to ensure sample dilution from other zones is not occurring.

FIELD RECORDS

The field technician maintains a log sheet summarizing:

- Sample Location.
- Sample Identification.
- Date and time of sample collection.
- Sampling depth.
- Tubing type, length, and volume.

- Purge Data (i.e. pump used, volume, PID screening information, purge start and stop time, purge vacuum reading).
- Weather conditions.
- Sampling methods and devices.
- Volume of sampling device.
- Sampling start and end date/time.
- Vacuum of canisters before and after samples collected.
- Apparent moisture content (dry, moist, or saturated, etc.) of the sampling zone.
- Chain of custody protocols and records used to track samples from sampling point to analysis.
- Other notes as applicable to site specific observations, sampling issues and mitigation of problems encountered.

REFERENCES

Cal EPA. *2005 (February 7 rev.). Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air.* Department of Toxic Substances Control, Interim Final. California Environmental Protection Agency.

Cal EPA. 2010 (March). *Advisory – Active Soil Gas Investigation (Draft).* California Environmental Protection Agency.

DEQ. 2010 (March 25). *Guidance for Assessing and Remediating Vapor Intrusion in Buildings.* Oregon Department of Environmental Quality.

ITRC, 2007 (January). *Technical and Regulatory Guidance, Vapor Intrusion Pathway: A Practical Guideline.* Interstate Technology & Regulatory Council.

ITRC, 2014 (January). *Petroleum Vapor Intrusion – Fundamentals of Screening, Investigation, and Management.* Interstate Technology & Regulatory Council.

EPA, 2015 (June). *Technical Guide for Assessing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites*. U.S. Environmental Protection Agency.

EPA, 2015 (June). *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air.* U.S. Environmental Protection Agency.

STANDARD OPERATING PROCEDURE
INDOOR AIR SAMPLING
VIA SOP 4

This vapor intrusion assessment (VIA) standard operating procedure (SOP) describes procedures for collecting indoor air samples. This SOP describes the collection of time-integrated samples from the human breathing zones of areas potentially impacted by volatile environmental contaminants. Because each site is unique, these procedures should be viewed as guidelines and will likely require modification based on site and surface conditions present.

Personnel performing the air sampling will follow site safety procedures as specified in the site-specific Health and Safety Plan.

PRE-SAMPLING BUILDING SURVEY

The physical layout and environment of the building, including potential sample locations, should be evaluated a minimum of two weeks prior to collecting indoor air samples. The purpose of the pre-sampling inspection is to identify conditions that may affect or interfere with sample collection and, as feasible, temporarily mitigate those conditions. This will minimize the potential for background sources to influence sample results. Details of the building survey, including a generic building survey form are attached. The building survey is a vital part of indoor air sample collection and must be completed prior to conducting sampling. If the building poses complications outside of the scope of the generic form attached to this SOP, the site-specific work plan may develop survey forms for individual buildings or individual rooms, as warranted.

EQUIPMENT/MATERIALS

Indoor air sampling generally requires the following equipment:

- Certified clean and evacuated Summa canister, typically six-liter (based on analytical method and desired reporting limits).
- Certified clean flow controller, set at desired sampling rate, typically between eight and 24 hours based on project-specific work scope.
- Shipping container suitable for protection of Summa canisters during shipment.
- Wrenches and tools appropriate for connecting fittings and making adjustments to the flow controller, if necessary.
- Negative pressure (vacuum) gauge (oil free and clean) either installed within the sample train or an external gauge used to check canister vacuum prior to and after sampling is complete. In-line gauges are preferred.
- Field data sheets including air sample collection form and daily field notes form.
- Timepiece (to record start and end time of sample collection).
- On-site weather station and barometric pressure data loggers, if available.

INDOOR AIR SAMPLING PROCEDURE

In general, the air sample should be collected under normal seasonal building conditions (i.e. ventilation or heating systems operating normally for routine building occupation). Normally, buildings will be inventoried and products containing volatile chemicals will be removed with the building ventilated at least 48 hours prior to indoor air sampling.

However, the site specific work plan should explicitly state the desired building conditions at the time of sampling as some situations may require windows be closed and ventilation systems be shut-off prior to collecting samples.

Clean sampling procedures must be followed at all times when handling and collecting samples. This includes care in packaging, storing, shipping, and use of the sampling equipment. Individuals performing the sampling must not smoke, must not wear perfume or strong deodorants, and must wear clean clothing (not dry cleaned) and proper personal protective equipment.

Sample Preparation

The following steps should be followed when preparing to collect indoor air samples:

- Inspect the canister for damage. Do not use a canister that has visible damage.
- Using a wrench, remove the brass cap above the valve on the top of the Summa canister.
- If using an external vacuum gauge, cap the gauge and attach it to the canister using a wrench. Open the canister valve only after verifying the gauge is properly capped.
- Verify that the vacuum pressure of the canister is equal to that indicated on the laboratory supplied tag. If the vacuum does not match, the canister has likely leaked and should not be used. Record the vacuum pressure on the sample collection form.
- Close the canister valve and remove the vacuum gauge if the flow controller is fitted with an independent gauge. Otherwise, leave the gauge in place.
- On the sample collection form, record the sample location, sample date, sample collection height, and canister and flow controller serial numbers. Record notes regarding sample location (i.e. room number/identifier, sample number, location relative to pertinent building infrastructure, etc.). Also note any other observations which could influence analytical results.
- Connect the laboratory certified flow controller to the canister. Pay special attention to air flow arrows or “OUT” notation on the flow controller so that it is correctly fitted to the canister. Tighten the fitting, as to be leak free but do not over tighten (¼ turn past finger snug is usually sufficient).
- Place the canister(s) at locations within the structure where representative sampling will occur in the breathing zone (typically between three and five feet above ground surface). The occupants and uses of the building should be considered. For example, a daycare with small children should be sampled closer to the ground. The site specific work plan should have incorporated these considerations and specify a sample collection height.
- Remove all work articles that will not remain with the sampling apparatus from the sampling area, including tools, vehicles, personnel, and any other equipment.

Sample Collection

When ready to begin sample collection follow the steps listed below:

- Record the sample start time on the sample collection form.
- Slowly open the valve on the canister approximately one full turn.
- Document pertinent weather information on the sample collection form, including temperature, wind speed and direction, humidity, atmospheric pressure, and

overall outdoor weather conditions (sunny, cloudy, rainy, etc.). If a weather station is not set-up on site, record this information from the closest weather station.

- At the end of the sample period, verify residual vacuum remains in sample canister (optimally 5 inches Mercury [in Hg] vacuum [-5 in Hg total pressure]), then close the canister valve finger tight. If using an external vacuum gauge one must remove the closed canister from the sample train, securely fix the external vacuum gauge to the canister, and open the canister to verify the vacuum. Immediately close the canister after recording the final vacuum pressure. If the final canister vacuum is less than 0.1 in Hg (more than -0.1 in Hg total pressure, or is a positive pressure), then the sample should be disregarded and a new sample collected. Record the sample end time on the collection form and record the final weather conditions.
- Ensure the canister valve is tightly closed. Remove the flow controller and external vacuum gauge, if used. Document the final canister vacuum on the sample collection form. The Summa canister should have remaining vacuum, optimally -5 in Hg total pressure, but at a minimum less than -0.1 in Hg. Replace the brass cap and tighten gently.
- Record on the sample tag the sample date, time, project number, sample location/name, initial and final canister vacuum, and attach it to the canister.
- Prepare the chain-of-custody form and indicate analysis requested to be performed by the lab. Initial and final canister vacuum should be noted on the chain-of-custody.
- When packaging for shipment, verify that the valve and valve caps are snug and use sufficient clean packaging to prevent the valves from rubbing against any hard surfaces.

STANDARD OPERATING PROCEDURE
AMBIENT OUTDOOR AIR SAMPLING
VIA SOP 5

This vapor intrusion assessment (VIA) standard operating procedure (SOP) describes procedures for collecting ambient outdoor air samples. This SOP describes the collection of time-integrated samples from the human breathing zones and/or other areas potentially impacted by environmental contaminants. Because each site is unique, these procedures should be viewed as guidelines and will likely require modification based on site and surface conditions present.

Personnel performing the outdoor air sampling will follow site safety procedures as specified in the site-specific Health and Safety Plan.

EQUIPMENT/MATERIALS

Outdoor air sampling generally requires the following equipment:

- Wind sock, flag, or other device for observing wind direction. An on-site weather station capable of logging weather conditions (i.e. temperature, wind speed, wind direction, barometric pressure, humidity) over the sampling period is preferred.
- Certified clean and evacuated Summa canister, typically six-liter (based on analytical method and desired reporting limits).
- Certified clean flow controller, set at desired sampling rate, typically between eight and 24 hours based on project-specific work scope.
- Shipping container suitable for protection of Summa canisters during shipment.
- Wrenches and tools appropriate for connecting fittings and making adjustments to the flow controller if necessary.
- Negative pressure (vacuum) gauge (oil free and clean) either installed on the canister or used externally to check canister vacuum.
- Field data sheets including air sample collection form and daily field notes form.
- Timepiece (to record start and end time of sample collection).

OUTDOOR AIR SAMPLING PROCEDURE

As a general practice, when outdoor air samples are collected as part of an indoor vapor intrusion evaluation, one or more outdoor air samples should be collected upwind from the building at the same time as indoor air samples are collected. The site-specific work plan will include sampling rationale and related details. Clean sampling procedures must be followed at times when handling and collecting samples. This includes care in packaging, storing, shipping, and use of the sampling equipment. Individuals performing the sampling must not smoke, must not wear perfume or strong deodorants, and must wear clean clothing (not dry cleaned) and proper personal protective equipment.

Sample Preparation

The following steps should be followed when preparing to collect outdoor air samples:

- If raining/snowing or dusty environment, sample canister and air intake should be adequately protected from the elements.
- Use the on-site weather station, or if unavailable, a wind sock, flag, or other device as appropriate to verify and observe wind direction. Unless otherwise

specified, the outdoor air sample(s) should be collected in an unobstructed upwind location relative to the building of concern.

- Inspect the Summa canister for damage. Do not use a Summa canister that has visible damage.
- Using a wrench, remove the brass cap above the valve on the top of the Summa canister.
- If using an external vacuum gauge, cap the gauge and attach it to the canister using a wrench. Open the canister valve only after verifying the gauge is properly capped.
- Verify that the vacuum pressure of the canister is equal to that indicated on the laboratory supplied tag. If the vacuum does not match, the canister has likely leaked and should not be used. Record the vacuum pressure on the sample collection form.
- Close the canister valve and remove the vacuum gauge if the flow controller is fitted with an independent gauge. Otherwise, leave the gauge in place.
- On the sample collection form, record the sample location, sample date, sample collection height, and canister and flow controller serial numbers. Record notes regarding sample location (i.e. under an awning, near a fence post, southwest corner of the building, etc.) and nearby buildings/business (i.e. gas stations, industrial/manufacturing plants, dry cleaners, etc.) which could influence analytical results.
- Connect the laboratory certified flow controller to the canister. Pay special attention to air flow arrows or "OUT" notation on the flow controller so that it is correctly fitted to the canister. Tighten the fitting, as to be leak free but do not over tighten (¼ turn past finger snug is usually sufficient).
- Place the canister(s) at a height representative of the breathing zone (typically between three and five feet above ground surface). The occupants and uses of the outdoor space and adjacent buildings should be considered. For example, if a daycare with small children is adjacent to the outdoor sample location, samples should be collected closer to the ground. The site specific work plan should have incorporated these considerations and specify a sample collection height.
- Remove all work articles that will not remain with the sampling apparatus from the sampling area, including tools, vehicles, personnel, and any other equipment.

Sample Collection

When ready to begin sample collection follow the steps listed below:

- Record the sample start time on the sample collection form.
- Slowly open the valve on the canister approximately one full turn.
- Document pertinent weather information on the sample collection form, including temperature, wind speed and direction, humidity, and atmospheric pressure. If a weather station is not set-up on site, record this information from the closest weather station.
- At the end of the sample period, verify residual vacuum remains in sample canister (optimally 5 inches Mercury [in Hg vacuum]), then close the canister valve finger tight. If the final canister vacuum is less than 0.1 in Hg (or is a positive pressure), then the sample should be disregarded and a new sample collected. Record the sample end time on the collection form and record the final weather conditions.

- Remove the flow controller and external vacuum gauge, if used. Document the final canister vacuum on the sample collection form. The Summa canister should have some remaining vacuum, preferably between approximately -0.1 and -5 in Hg. Replace the brass cap and tighten gently.
- Record on the sample tag the sample date, time, project number, and sample location/name and attach it to the canister.
- Prepare the chain-of-custody form and indicate analysis requested to be performed by the lab.
- When packaging for shipment, verify that the valve and valve caps are snug and use sufficient clean packaging to prevent the valves from rubbing against any hard surfaces.

STANDARD OPERATING PROCEDURE
SUB-SLAB VAPOR PIN™ CONSTRUCTION
VIA SOP 6

This Vapor Intrusion Assessment Standard Operating Procedure (VIA SOP) describes the method for installation of temporary or permanent sub-slab soil vapor sampling and monitoring probes using Cox-Colvin & Associates, Inc. (CCA) Vapor Pin™ equipment and materials.

MATERIALS

Materials needed to construct the Vapor Pins™ are included below.

- Vapor Pin Assembly: Stainless steel or brass Vapor Pin™, Vapor Pin™ silicone sleeve, Vapor Pin™ protective cap. Stainless steel or brass extensions may be added if desired to give a longer screen interval for thicker slabs.
- Surface Termination: Stainless steel or brass flush mount cover. The selection often depends on whether the probes are temporary or permanent and whether they need to be installed flush with the surface. All vapor sampling points should be constructed following the same technique/protocol, which should be explicitly outlined in the site specific work plan and performed in accordance with the CCA SOP for installation (see attachment).

EQUIPMENT

The required equipment includes the following items:

- Hammer Drill; 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00206514 or equivalent)
- 1 1/2-inch diameter hammer bit (Hilti™ TE-YX 1 1/2" x 23" #00293032 or equivalent)
- 3/4-inch diameter bottle brush
- Wet/dry vacuum with HEPA filter
- Vapor Pin™ contractor kit (Vapor Pin™ installation/extraction tool, Vapor Pin™ drilling guide
- #14 spanner wrench
- Dead blow hammer

VAPOR PIN™ INSTALLATION PROTOCOL

The following steps are necessary for the installation of the Vapor Pins™:

- Insure all sub-slab utilities (public and building specific) are marked prior to installation. This includes contacting the public utility notification service and identifying private utilities on-site.
- Review as-built construction logs of existing vapor monitoring points as applicable.
- Sub-slab sample locations should typically be located in the central portion of the slab, away from the floor slab/perimeter foundation junction, where dilution is

more likely to occur. The site specific work-plan should provide justification for all sample locations.

- Set up wet/dry vacuum to collect drill cuttings. Then determine the desired surface termination (flush, recessed, or protruding). If a flush or recessed surface termination is required, drill a 1 1/2-inch diameter hole at least 1 3/4-inches into the slab. Premarking the desired depth on the drill bit with tape will assist in this process.
- Remove cuttings from the hole with the vacuum then place the Vapor Pin™ drilling guide in the hole with the conical end down. The hole is sufficiently deep if the flange of the drilling guide lies flush with the surface of the slab. Deepen the hole as necessary but do not exceed two inches below slab surface. Replace the 1 1/2-inch bit with the 5/8-inch diameter bit, then insert the bit through the hole in the drilling guide and drill the rest of the way through the slab. The drilling guide will center the Vapor Pin™ in the hole and keep the hole perpendicular to the slab.
- Remove the bit and drilling guide, clean the hole again, then install the Vapor Pin™ assembly in accordance with the CCA SOP (see attached). Following installation of the Vapor Pin™ assembly screw the secure cover onto the Vapor Pin™ and tighten using the #14 spanner wrench by rotating it clockwise.
- If the sample point is temporary, remove all sampling equipment after sampling is complete and patch the hole(s) in the concrete slab with cement finishing flush with the concrete surface.

STANDARD OPERATING PROCEDURE
SAMPLE PACKAGING AND SHIPPING
VIA SOP 7

Specific requirements for sample packaging and shipping must be followed to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein.

EQUIPMENT REQUIRED

Specific equipment or supplies necessary to properly pack and ship environmental samples include the following:

- Ice in sealed bags or blue ice
- Sealable airtight bags
- Plastic garbage bags
- Coolers
- Bubble wrap
- Fiber reinforced packing tape
- Scissors
- Chain-of-custody seals
- Airbills for overnight shipment
- Sample analysis request forms.

PROCEDURE

The following steps should be followed to ensure the proper transfer of samples from the field to the laboratories:

- Appropriately document all samples using the proper logbooks and tracking forms.
- Make sure all applicable laboratory quality control sample designations have been made on the sample analysis request forms. Samples that will be archived for future possible analysis should be clearly identified on the sample analysis request (chain-of-custody) form. Such samples should also be labeled on the sample analysis request form as "Do Not Analyze": Hold and archive for possible future analysis" because some laboratories interpret "archive" as meaning to continue holding the residual sample after analysis.
- Notify the laboratory contact and the project quality assurance/quality control (QA/QC) coordinator that samples will be shipped and the estimated arrival time. Send copies of all chain-of-custody, sample analysis request, and packing list forms to the laboratory *QAIQC* coordinator.
- Clean the outside of all dirty sample containers to remove any residual contamination.

- Check sample containers against the chain-of-custody forms to make sure all samples intended for shipment are accounted for.
- Store each sample container in a sealable bag that allows the sample label to be read. Volatile organic analyte (VOA) vials for a single sample must be encased in bubble wrap or foam rubber before being sealed in bags.
- Choose the appropriate size cooler (or coolers) and line with bubble wrap and a plastic garbage bag.
- Fill the cooler with the samples, separating glass containers with bubble wrap and allowing room for ice to keep the samples cold. Add enough ice or blue ice to keep the samples refrigerated overnight. Avoid separating the- samples from the ice with excess bubble wrap because it will insulate the containers from the ice. After all samples and ice have been added to the cooler, use bubble wrap to fill any empty space to keep the samples from shifting during transport.
- Remember to consolidate any VOA samples in a single cooler, and ship them with a trip blank, if the quality assurance project plan calls for one.
- Once all the samples are packed, close the plastic garbage bag and fasten it with a chain-of-custody seal.
- Store the signed chain-of-custody, sample analysis request, and packing list forms in a sealable bag and tape it to the inside of the cooler lid.
- Once the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it shut using fiber reinforced packing tape. Also, if the cooler has a drain at the bottom, it should be taped shut.
- As security against unauthorized handling of the samples, apply one or two chain-of-custody seals across the opening of the cooler lid. Be sure the seals are properly affixed to the cooler so they are not removed during shipment.
- Label the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care."
- If an overnight courier is used, fill out the airbill as required and fasten it to the top of the cooler. The identification number sticker should be taped to the lid, because tracking problems can occur if a sticker is removed during shipment.

ATTACHMENT B

FIELD FORMS

Soil Gas Sample Collection Form

Sample I.D. ________________
Sample Location ________________
Date ________________
Indoor/Outdoor (circle one)

Project Name ________________
Project # ________________
Sampler ________________
Apparent Soil Moisture (dry, moist, saturated)

EQUIPMENT INFORMATION

Canister ID # _______________
Canister Size _______________

Flow Controller ID # ________________
Tubing Diameter and Length ________________

WEATHER CONDITIONS

Initial

Temperature (^{o}F) _____________
Humidity _____________

Wind Direction _____________
Atmospheric Pressure _____________

Final

Temperature (oF) _____________
Humidity _____________

Wind Direction _____________
Atmospheric Pressure _____________

LEAK AND PURGE CHECK DATA

Sample Train Equipment Check

Start Time _______________
Vacuum Pressure __________(inches Hg)
End Time ____________
Vacuum Pressure __________(inches Hg)

Helium Leak Check

Maximum Detection of Helium (%) ___
Pass or Fail (circle one)

Purge Vapors

Volume of Air to Purge – (¼” ID tube) 9.6 ml/ft * ______ ft = _________ml
+ Sandpack volume (2" boring) 30.9 ml/ft * ________ ft = _________ ml = ______ ml
Syringe, pump (circle one)
Purge Rate (ml/min) ___________ Minutes to Purge (volume/rate) _______
Purge Start Time _________ Purge Stop Time _________

Ambient PID Reading (ppmv) __________________
PID Reading during purge (ppmv) __________________ ______________

SAMPLE INFORMATION

Start Time ________________
End Time ________________

Initial Vacuum Pressure (in Hg) _______________
Final Vacuum Pressure (in Hg) _______________

LABORATORY INFORMATION

Laboratory: ____________________

Analytical Method: ________________

NOTES/COMMENTS:

____
____
____
____
____

Sampler’s Signature ____________________

Date ________________

INDOOR AIR SAMPLE COLLECTION

Sample I.D. ______________________________ Project Name______________________________
Sample Location_________________________ Project #__________________________________
Date______________________________________ Sampler__________________________________

WEATHER CONDITIONS

Initial Time: __________
Temperature ___________ Wind Direction _____________
Humidity ___________ Atmospheric Pressure _____________
Final Time: ___________
Temperature ___________ Wind Direction _____________
Humidity ___________ Atmospheric Pressure _____________

EQUIPMENT INFORMATION

Canister ID #__________________________ Flow Controller ID #_________________________
Canister Size __________________________
Initial Vacuum ________(in Hg)

SAMPLE INFORMATION

Start Time (date/time) _______________________ Initial Vacuum _______________(in Hg)
End Time (date/time) __________________________Final Vacuum _______________(in Hg)

LABORATORY INFORMATION

Laboratory: ____

Analytical Method: ____

NOTES/COMMENTS:

____
____
____
____
____

Sampler's Signature____Date__________________________

OUTDOOR AIR SAMPLE COLLECTION

Sample I.D. ______________________________ Project Name_____________________________
Sample Location_________________________ Project #__________________________________
Date_______________________________________ Sampler_________________________________

WEATHER CONDITIONS

Initial Time __________
Temperature ___________ Wind Direction ______________
Humidity ___________ Atmospheric Pressure ______________
Final Time ___________
Temperature ___________ Wind Direction ______________
Humidity ___________ Atmospheric Pressure ______________

EQUIPMENT INFORMATION

Canister ID #_________________________ Flow Controller ID #_________________________
Canister Size _________________________
Initial Vacuum________(in Hg)

SAMPLE INFORMATION

Start Time (date/time) ______________________ Initial Vacuum______________(in Hg)
End Time (date/time) __________________________Final Vacuum_______________(in Hg)

LABORATORY INFORMATION

Laboratory: ____

Analytical Method: ____

NOTES/COMMENTS:

____
____
____
____
____

Sampler's Signature____Date__________________________