NATURAL
RESOURCE
TECHNOLOGY
ENVIRONMENTAL CONSULTANTS

234 W. FLORIDA STREET, FIFTH FLOOR
MILWAUKEE, WISCONSIN 53204
(P) 414.837.3607
(F) 414.837.3608

December 23, 2015
(1508)

Mr. Frank Dombrowski
We Energies
333 W Everett Street, A231
Milwaukee, WI 53203

RE: **December 2015 Technical Memorandum**
April 2015 through September 2015
Appleton City (Coal Tar), aka Appleton MGP, 337 Water Street, Appleton, Wisconsin
WDNR BRRTs Activity #02-45-000042
FID #445033380

Dear Mr. Dombrowski,

Natural Resource Technology, Inc. (NRT) is providing this 2015 Technical Memorandum (Tech Memo) for the former manufactured gas plant (MGP) site located at 337 Water Street in Appleton, Wisconsin (Figure 1). This Tech Memo includes discussion of previously completed soil, groundwater, soil vapor, and vapor intrusion screening activities that took place between April and September 2015 to evaluate the vapor intrusion (VI) pathway at the Fox River Mills apartment complex, specifically, apartment Building 415. We also include a proposal for continued VI evaluation using the high volume purge sampling method.

The organization of this technical memorandum is sequenced chronologically and intended to follow the iterative approach We Energies took to evaluate site conditions; Section 1.0 Previous Groundwater Results triggered Section 2.0 and Section 3.0 activities, which in turn triggered Section 4.0, etc. Included in this tech memo are the following sections:

- Section 1.0 Previous Groundwater Results: Summary of groundwater results and free phase product observations near Building 415 which warranted evaluation of the vapor intrusion pathway
- Section 2.0 Soil Vapor Investigation: Summary of soil vapor probe installation and sample results
- Section 3.0 Groundwater Results at New Well Locations: Summary of installation of new wells and groundwater results
- Section 4.0 Sub-Slab Vapor Screening: Summary of investigation activities to determine building conditions beneath the garage floor/slab of the lowest occupied space and results of sub-slab soil vapor screening at 5 locations within the garage
- Section 5.0 Proposed High Purge Volume Sampling: Using high volume purge sampling methods to collect sub-slab soil gas and complete the evaluation of the vapor intrusion pathway at Building 415.
- Section 6.0 Summary

Please do not hesitate to contact with any questions or comments.

Sincerely,

NATURAL RESOURCE TECHNOLOGY, INC.

Brian G. Hennings, PG
Hydrogeologist

Patrick M. Hoefle
Hydrogeologist

WWW.NATURALRT.COM

1.0 Previous Groundwater Results

Shallow bedrock piezometer PZ-26 was installed approximately 30 feet south of Building 415 in April, 2014 to define the extent of shallow bedrock groundwater impacts east of PZ-23. Groundwater results at PZ-26 have been above the preventative action limit (PAL) and enforcement standards (ES) and contain measureable amounts of dense non-aqueous phase liquid (DNAPL). Groundwater analytical results can be found in the most recent annual groundwater report (NRT, 2014) and Sample Results Notification letters (NRT, 2015) provided to WDNR and the property owner (Fox River Mills). DNAPL is currently being recovered from PZ-26 during quarterly sampling events and will be discussed in greater detail in the 2015 annual report.

In response to the groundwater observations at PZ-26, additional wells were completed in 2015 to further characterize groundwater quality and flow in the area; these wells are discussed further in Section 3.0. Soil vapor probes were also proposed at 4 locations along the south and west face of Building 415 and an additional 2 locations in a central courtyard, though the proposed locations in the courtyard could not be completed due to building constraints discussed below.

2.0 Soil Vapor Investigation

Soil vapor probes were installed at 4 locations along the south and western faces of Building 415 (Figure 2). Three locations (SV-1 through SV-3) along the south face of the building were screened at two depths (approximately 3 and 5 feet below ground surface, Table 1). The location on the west face (SV-4) could not be screened at separate depths due to shallow groundwater. Two additional soil vapor probes were proposed in a central courtyard area just north of SV-1 and SV-2; however, saturated soil was encountered less than three feet below ground surface (bgs) and the ground surface was a mixture of weathered pavement and raised landscape beds which prevented the construction of soil gas probes that would not be compromised by short-circuiting to the atmosphere, so the probes were not completed.

Soil vapor samples (total of 14) were collected in April and July of 2015. Samples were analyzed for BTEX and Naphthalene at all locations during both sampling events. Ambient air temperatures during the sampling event in April were between 50 and 65 ^{0}F which are representative of heating season conditions when vapors are more likely to migrate towards heated buildings. Results of the soil vapor analysis can be found in Table 1 and the May and August 2015 Sample Results Notification letters (NRT, 2015). Soil gas samples collected during warm and cold weather did not exceed any of the residential sub-slab and shallow soil gas vapor risk screening levels (VRSLs), Table 1.

3.0 Groundwater Results at New Well Locations

New monitoring wells (MW-26, MW-27, MW-28, PZ-27, and PZ-28) were installed in April 2015 to characterize groundwater flow and quality in the water table and shallow bedrock around Building 415. The 5 new wells are listed below and can also be found on Figure 2:

- MW-26 – Shallow well located to the south of Building 415 and nested with well PZ-26
- MW-27 – Shallow well to the west of Building 415
- PZ- 27 – Bedrock well to the west of Building 415 and nested with MW-27
- MW-28 – Shallow well to the southwest of Building 415
- PZ-28 – Bedrock well to the southwest of Building 415 and nested with MW-28

Groundwater elevation measurements collected from the wells near Building 415 indicate shallow groundwater generally flows from west to east (toward building 415). Groundwater elevations in the shallow wells are generally higher than those of the deeper wells set in the shallow bedrock, indicating the presence of downward gradients, with the exception of nest MW-27/PZ-27 where upward gradients were observed in April and July 2015. During a site visit in September 2015, floor drains were observed that are likely responsible for redirecting groundwater below Building 415 and discharging it in the river near SG-4 between Buildings 415 and 405 (Figure 2).

A portion of a historic needle dam structure that predates the current dam was identified during site investigation activities in 2015 (Figure 2). Groundwater elevations observed between wells MW-28 and MW-26 indicate this feature acts as a barrier to groundwater flow from the east to the west side of the structure. Well nest MW-26/PZ-26 characterizes groundwater in a pocket of land bounded by the historic needle dam, the current dam, and Building 415. Well nests MW-23/PZ-23, MW-27/PZ-27, and MW-28/PZ-28 were completed to characterize groundwater west of the historic needle dam and Building 415. Groundwater flow will also be discussed in more detail in the 2015 Annual Report that will be submitted in early 2016.

Groundwater analytical results (Table 2) indicate benzene and naphthalene are present in groundwater above the enforcement standard in watertable and shallow bedrock wells; including two of the watertable wells closest to Building 415 (MW-26 and MW-27).

The lowest level of Building 415 is used for a combination of occupied space (apartments), storage, boiler room, and parking; with the majority of the space used for parking. The garage floor was previously surveyed at an elevation of 715.01 feet. Groundwater elevations from MW-26 and MW-27 were observed at 712.1 and 715.1 respectively, in July 2015. With groundwater containing VOCs in close proximity to the elevation of the garage floor, additional investigation of sub-slab conditions was initiated to supplement the soil gas sampling results for evaluation of the VI pathway.

4.0 Sub-Slab Vapor Screening

4.1 Visual Inspection of Slab conditions

A site visit was completed in September 2015 to evaluate sub-slab conditions of Building 415. The underground garage is present throughout a majority the building (blue areas, Figure 2). Approximately 6 units on the south side of the building have access to living space on the same level as the parking garage (green area, Figure 2). Most of these Units have doorways that open to the courtyard in the center of the building (unshaded area, Figure 2) at the garage floor level and a doorway on the first floor level that opens to the lawn south of the building.

The primary objectives of the site visit included inspection of the crawlspaces previously observed south of the boiler room, the elevator shafts, and completion of 2-inch boreholes through the garage floor to determine where saturated conditions occurred. Based on the groundwater elevations, it was important to determine if groundwater was in contact with the slab which would prevent the collection of sub-slab soil gas samples. A total VOC ppb Rae (photo-ionization detector) with 10.6 eV lamp was used to measure total VOCs in parts per billion by volume (ppbv) in areas of investigation. Because sub-slab conditions were unknown, sub-slab screening samples (collected with the ppb Rae and Summa™ canisters) were proposed in the event that sub-slab soil gas could be collected.

The boiler room on the south side of Building 415 (orange shaded are on Figure 2) provided access to a large crawl space that appears to be present beneath the garage floor in the southwest corner of the building (purple shaded area on Figure 2). The crawl space can be accessed from the south wall of the boiler room (Attachment A, Photo 1) where a 1.25 foot gap (Attachment A, Photo 2) was observed between the slab and a series of old brick crib-like structures that are connected to the southern wall of the building. Each crib has an opening approximately 16 feet long and 4 feet wide that extends to the south face of Building 415 (Attachment A, Photo 3). The floor of the crawl space beneath the boiler room and north of the cribs was covered in standing water and debris including cinder blocks, wood, brick, and debris (Attachment A, Photo 4). A long bladed spade was used to probe into the standing water and encountered refusal at approximately 1-foot below the water. Depth to water was measured at 4-feet below the surface of the garage floor (~711 feet) and refusal was about 1-foot lower (~710 feet). Using a camera to view into the crawlspace underneath the boiler room, void space was noted with no clear end point to the north. Another gap between the garage floor and the building wall was also observed near the south side of the entrance to the garage (Attachment A, Photos 5 & 6). Void space was also observed through this gap that suggests the large crawlspace extends as far as the garage entrance along the western wall of the building.

From the south side of the boiler room looking east toward the nearest occupied space, the eastern wall of the boiler room was observed to extend beneath the boiler room and define the eastern limit of the large crawlspace. However, a small archway (approximately 3 feet wide by 2 feet tall) was visible through that wall southeast of the boiler room and appears to continue east in the direction of the nearest occupied space (Attachment A, Photo 7). Using a camera to look into the archway, void space was observed beyond the archway eastward through the wall. Moving water was also observed among the bricks and debris at the base of the archway. The water appeared to be moving east and the extent of the void space to the east beyond the wall is unknown. Figure 2 shows the areas in purple where void spaces were viewed beneath the garage floor and boiler room.

There are two elevator shafts in Building 415, one along the western wall and one along the northern wall. With assistance from an employee of Fox River Mills both elevator shafts were visually inspected. Both elevators have access to the garage level of the building and have pits that are approximately 4-feet below the garage floor slab. Both elevator pits were dry with the exception of a small amount of condensation on the floor. No odors were observed during investigation activities and there were no recorded detections of VOCs on the ppb Rae in the northern elevator shaft while the western shaft had a maximum reading of 16 ppb.

The exterior of Building 415 was also examined to determine how groundwater might be diverted from beneath the building, which must be occurring because the crawl space below the slab and elevator shafts are dry at elevations approximately 4 feet lower than groundwater in nearby wells. Two PVC drain pipes were identified near SG-4 between Buildings 415 and 405 (Attachment A, Photos 8 through 10). These pipes are suspected to be connected to storm and/or floor drains around Building 415 such as the drain observed at the entrance of the parking garage. Water was observed flowing from the western drain pipe (Attachment A, Photo 9) near SG-4. The surface water of the Fox River was at the elevation of the western pipe (Attachment A, Photo 10) so it could not be determined if there was any flow during the site visit. A third opening in the wall of Building 415 may indicate the presence of another drain though no pipe or flowing water were observed from this opening (Attachment A, Photo 8). Surface water was measured during the site visit from SG-4 at an elevation of 709.6 which is approximately 1.5 feet lower that the level of water observed in the large crawlspace and approximately 5.5 feet lower that the slab of the garage floor.

The eastern wall of Building 415 can be accessed via a catwalk that leads to a small area of gravel and sand beneath Olde Oneida Street. The floor of the parking garage is approximately 4 feet above the ground surface beneath the bridge (Attachment A, Photo 11). The window in the photograph looks into the parking garage. Two archways were observed just south of the window in the picture. Each archway is lined with brick and contained stagnant water from the Fox River as far back as the eye could see (Attachment A, Photo 12). No drain pipes were observed along this wall of the building.

Based on the observations above, it was determined that boreholes would be completed at 5 locations in the underground garage (SS-1 through SS-5, Figure 2) to evaluate sub-slab conditions. Soil was encountered beneath the slab at all 5 locations. Boreholes were drilled using a hammer drill with a 2-inch diameter bit (Attachment A, Photo 13). The concrete floor ranged from 5 to 9 inches thick, with a median of 6 inches. A drive point soil sampler was used to collect soil from the hole through the slab. A combination of sand and some gravel was found at all locations. Samples were pushed between 12 and 30 inches beneath the concrete slab. Moist to wet sand was noted in the tip of the sampler when it encountered refusal 21 inches below the slab at SS-3. All other soil recovered was dry. Recovered material was screened with the ppb Rae with no detections.

Based on current observations, including soil below the slab at SS-1 and SS-2 and the wall beneath the eastern edge of the boiler room, the large void space/ crawlspace beneath the garage floor does not extend north past the garage entrance; nor does it extent east past the boiler room (Figure 2). However, a much smaller crawl space was observed through a 3-foot by 2-foot hole in the wall east of the boiler room wall. The extent of this smaller crawl space to the east is currently not known. No odors were observed during building investigation and there were no recorded detections of VOCs on the ppb Rae (which detects total VOCs down to 1 ppb) in portions of the crawl space that were accessible from the boiler room, near the garage entrance, or the cribs south of the boiler room.

4.2 Screening of Sub-Slab Soil Gas

Sub-slab soil gas screening samples were taken just below the concrete slab of the underground garage floor at each borehole location (SS-1 through SS-5, Figure 2). After each borehole was completed the intake of the ppb Rae was lowered into the core hole to screen for total VOCs. Locations SS-4 and SS-5 had readings of 21 and 1,090 ppbv respectively (Table 1). No detections were observed at any other locations and no odors were detected from any location. To collect samples in Summa™ canisters a length of new inert (Teflon) tubing was placed into the core hole of the slab just above the sub-grade material at each location and sealed to the floor with non-toxic Play-Doh (Photo 14). Prior to connecting the Summa™ canister, a differential pressure manometer was connected to the tubing to record the difference in pressure between the garage and the sub-slab; however, there was no measureable difference in pressure at any location.

After ppb Rae and pressure measurements were collected, sub-slab screening samples were collected from each location using a 1L Summa™ canister. No leak test was performed on the system before taking the samples. Screening samples were analyzed for BTEX and naphthalene, similar to previously collected soil gas locations (SV-1 through SV-4, Table 1). Results are included in Attachment B. None of the screening samples exceeded Wisconsin Vapor Risk Screening Levels for sub-slab and shallow soil gas (Table 1) and there is ample oxygen for biodegradation of petroleum hydrocarbons. Following collection of the screening samples, the core holes were sealed with cement.

All vapor sampling to date (exterior soil gas and sub-slab screening) suggests that soil vapors are not present in significant concentration to make the vapor intrusion (VI) pathway complete for residential or commercial occupants. However, the sub-slab screening samples were not collected in accordance with recommended procedures identified in WDNR guidance (RR-986 and RR-800) and the lowest level is a large structure that could require more than 5 sample locations for VI evaluation using sub-slab sample probes. For these reasons, we propose high purge volume sampling during the heating season (typically November 15th – March 15th) when vapors are most likely to migrate towards occupied structures to complete the evaluation of the VI pathway.

5.0 Proposed High Purge Volume Sub-Slab Sampling

Section II A. of WDNR sub-slab vapor sampling guidance RR-986 has recommendations for the number of sub-slab probes to evaluate single family homes and commercial/ small industrial buildings. In large buildings (like Building 415) where those sampling distributions are unworkable the guidance recommends consideration of high purge volume sampling. The apartment building was a former mill with a footprint of approximately 30,000 square feet. This is a large building with mixed use (as described above) that would benefit from high purge volume sampling to evaluate the VI pathway. Sub-slab screening locations SS-1 through SS-5 would be reoccupied for collection of high purge volume sampling to evaluate sub-slab soil gas beneath the parking garage and adjacent occupied spaces (Figure 2). A schematic of the equipment set up for high purge volume sampling is included in Attachment C. Samples will be collected as follows:

- The sealed core holes at locations SS-1 through SS-5 will be reopened and observation ports (1/4- inch core holes through the slab) will be completed at varying distances (e.g., 10 and 30 feet) from each location to take manometer readings and determine the radius of influence at each location during sampling.
- Soil vapor extraction observation points will be monitored during vapor extraction and sampling with a magnehelic gauge which monitors the amount of vacuum at that distance from the extraction point. In addition, the flow rate (feet per minute), vacuum (inches of water), total VOCs, percent oxygen, percent carbon dioxide and percent methane will be monitored with real-time equipment at the extraction point during the extraction / sampling process.
- A six-liter Summa™ canister will be used to collect soil vapors during the extraction period of approximately 30 minutes. The soil vapor samples will be analyzed for the same parameters as previous samples: benzene, toluene, ethylbenzene, xylenes and naphthalene by Method TO-15 and carbon dioxide, oxygen and methane by Method EPA 3C. A National Environmental Laboratory Accredited Program laboratory will perform the analysis.
- NRT will follow standard operating procedure (NRT SOP 07-09-05, Attachment C) Sub-Slab Sample Port Installation, Sampling and Abandonment, as appropriate.
- Analytical results from the 6-Liter Summa™ Canisters will be tabulated and compared to the most current Residential Vapor Risk Screening Levels for Sub-Slab and Shallow Soil Gas to complete the evaluation of the VI risk pathway.

If the results are below applicable screening levels and the confirmed radius of influence at locations SS-1 and SS-5 extend below the area of occupied space on the garage level the pathway will be considered incomplete for Building 415 as indicated by multiple rounds of soil and sub-slab sampling with concentrations below screening levels supported by non-detectible ppb Rae measurements from crawl spaces. The garage, which accounts for most of the lowest level, is also actively ventilated to prevent carbon monoxide (and other vapors) from accumulating.

If the results are above applicable screening levels and/or the radius of influence at locations SS-1 and SS-5 are insufficient to characterize sub-slab vapor below the occupied space, the need for and scope of further evaluation focused on the occupied spaces will be evaluated.

Following discussion with WDNR, high purge volume sampling will be coordinated with the Fox River Mills Apartments as soon as possible to occur during the remaining heating season January through March 2016.

6.0 Summary

Based on the vapor intrusion investigation activities described in detail above, the following observations indicate the vapor intrusion pathway is incomplete:

- Soil gas samples collected under warm and cold weather conditions (total of 14 samples) did not exceed the Residential Vapor Risk Screening Level for sub-slab and shallow soil gas (Table 1).The soil gas probes are well positioned to evaluate risk, located adjacent to the building between the residential occupied spaces and the monitoring wells that contain NAPL.
- Building inspection and investigation of sub-slab conditions indicates groundwater is not in contact with the slab of the lowest level. The building was constructed with drains that redirect groundwater into the tail-water of the dam which creates approximately 4 feet of void space and unsaturated conditions below the slab of the lowest occupied level of the building.
- No odors were observed during building investigation and there were no recorded detections of VOCs on the ppb Rae (equipped with a 10.6 eV lamp which detects total PVOCs down to 1 ppb) in portions of the crawl space that were accessible from the boiler room, near the garage entrance, or the cribs south of the boiler room, which indicates the water observed in these areas is not releasing vapors that could pose a risk.
- Sub-slab screening samples collected with Summa canisters from five locations through the garage floor slab did not exceed the Residential Vapor Risk Screening Levels for sub-slab and shallow soil gas and there is ample oxygen present for biodegradation. Sub-slab screening samples also collected using the ppb Rae were very low to non-detect with a maximum reading of 1,090 ppbv (1 ppm on a standard PID).

In recognition that the sub-slab screening samples were not collected in accordance with recommended procedures identified in current WDNR guidance (RR-986 and RR-800) and the lowest level is a large structure that could require more than 5 sample locations for VI evaluation using sub-slab sample probes, we propose one round of high purge volume sampling (detailed above) to be completed during the heating season (November 15th – March 15th) when vapors are most likely to migrate towards occupied structures to complete the evaluation of the VI pathway (i.e., sampling methodology and meteorologic conditions being representative of “worst case” conditions for soil vapor intrusion). Should the results of the high purge volume sampling indicate concentrations of COCs below applicable WDNR screening values as expected, the VI pathway will be considered incomplete for the off site property.

Attachments:

Figure 1	Site Features
Figure 2	Building 415 Features
Table 1	Summary of Soil Vapor Results
Table 2	Summary of Groundwater Results
Attachment A	September 2015 Photo Log
Attachment B	Sub-Slab Screening Laboratory Report
Attachment C	High Purge Volume Schematic and Sub-Slab Sampling SOP

References:

Natural Resource Technology, Inc., December 2014. *2014 Annual Groundwater Monitoring Report*

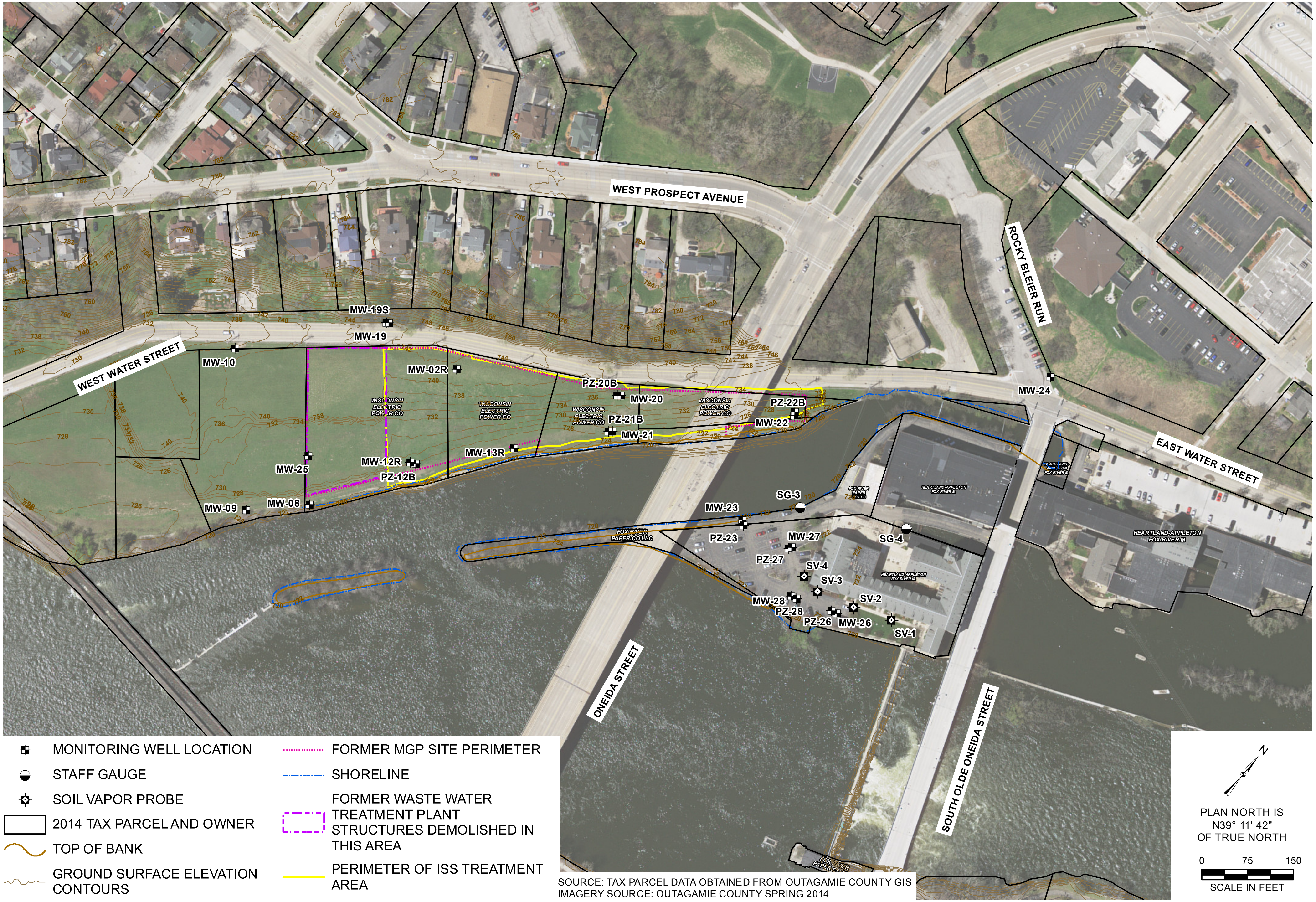
Natural Resource Technology, Inc., May 2015. *May 2015 Sample results Notification*

Natural Resource Technology, Inc., August 2015. *August 2015 Sample Results Notification*

Wisconsin Department of Natural Resources, December 2010, *Addressing Vapor Intrusion at Remediation and Redevelopment Sites in Wisconsin*, RR-800

Wisconsin Department of Natural Resources, July 2014, *Sub-Slab Vapor Sampling Procedure*, RR-986

FIGURES



▪	MONITORING WELL LOCATION
◒	STAFF GAUGE
◈	SOIL VAPOR PROBE
☐	2014 TAX PARCEL AND OWNER
⌒	TOP OF BANK
～	GROUND SURFACE ELEVATION CONTOURS
┈	FORMER MGP SITE PERIMETER
─·─	SHORELINE
⬚	FORMER WASTE WATER TREATMENT PLANT STRUCTURES DEMOLISHED IN THIS AREA
─	PERIMETER OF ISS TREATMENT AREA

SOURCE: TAX PARCEL DATA OBTAINED FROM OUTAGAMIE COUNTY GIS
IMAGERY SOURCE: OUTAGAMIE COUNTY SPRING 2014

DRAWN BY/DATE: DMD 11/23/15
REVIEWED BY/DATE: BGH 12/21/15
APPROVED BY/DATE: BGH 12/21/15

SITE FEATURES

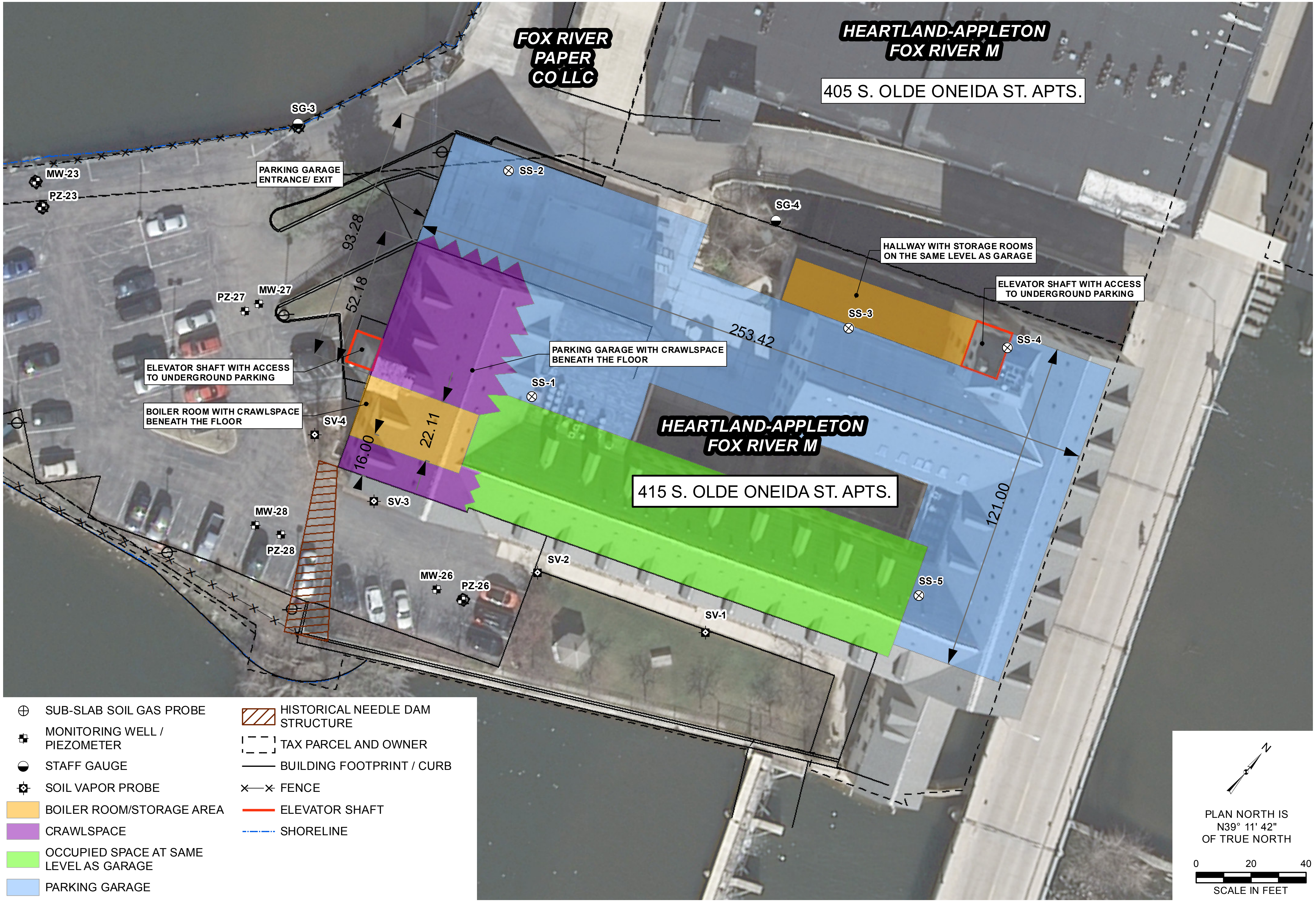
DECEMBER 2015 TECHNICAL MEMORANDUM
FORMER APPLETON MANUFACTURED GAS PLANT (MGP) FACILITY
WE ENERGIES
APPLETON, WISCONSIN

PROJECT NO: 1508

FIGURE NO: 1

NATURAL RESOURCE TECHNOLOGY

Y:\GIS\Projects\15\1508\MXD\VI Tech Memo\Figure 1_Site_Features.mxd   Author: tcushman;   Date/Time: 12/21/2015, 2:41:20 PM



DRAWN BY/DATE: DMD 10/28/15
REVIEWED BY/DATE: BGH 12/21/15
APPROVED BY/DATE: BGH 12/21/15

415 S. OLDE ONEIDA STREET APARTMENT BUILDING FEATURES

DECEMBER 2015 TECHNICAL MEMORANDUM
FORMER APPLETON MANUFACTURED GAS PLANT (MGP) FACILITY
WE ENERGIES
APPLETON, WISCONSIN

PROJECT NO: 1508

FIGURE NO: 2

NATURAL RESOURCE TECHNOLOGY

Y:\GIS\Projects\15\1508\MXD\Tech Memo\Figure 2_415 S Olde Oneida St Apt Build Features.mxd Author: tcushman; Date/Time: 12/21/2015, 2:44:07 PM

TABLES

Table 1. Summary of Soil Vapor Results

December 2015 Technical Memorandum
We Energies, Appleton City (Coal Tar), aka Appleton MGP
WDNR ERP Case #02-45-000042

				Volatile Organic Compounds					Organics & Inorganics			ppbRae[2]
Field Sample ID	Sample Location	Screened Interval (ft bgs)	Sample Date	Benzene (ug/m3)	Ethylbenzene (ug/m3)	Naphthalene (ug/m3)	Toluene (ug/m3)	Xylenes, Total (ug/m3)	Carbon Dioxide (mol %)	Methane (mol %)	Oxygen (mol %)	Total VOC with 10.6 eV Lamp (ppbv)
Residential Vapor Risk Screening Level for Sub-Slab and Shallow Soil Gas [1]				**120**	**366**	**27**	**173,333**	**3,333**	**NS**	**NS**	**NS**	**NS**
041415007	SV01D	5.8 - 6.3	4/14/2015	4.2	7.9	2.9	310	33	0.67	0.76	1.34	--
071515006	SV01D	5.8-6.3	7/15/2015	0.44 J	0.30 J	0.63 J	2.3	1.5 J	7.41	1.42	2.88	--
041415008	SV01S	2.8 - 3.3	4/14/2015	8.1	11	4.2	410	46	0.21	< 0.02	15.5	--
071515007	SV01S	2.8-3.3	7/15/2015	0.44 J	0.26 J	0.83 J	1.2 J	1.5 J	3.59	< 0.10 U	12.1	--
041415005	SV02D	5.3 - 5.8	4/14/2015	1.9	3	3.2	70	16	0.44	< 0.02	13.4	--
071515004	SV02D	5.3-5.8	7/15/2015	0.42 J	0.81 J	2.1	1.6	5.5	3.91	< 0.10 U	1.48	--
041415006	SV02S	2.3 - 2.8	4/14/2015	1.4	2.1	3.1	63	11	0.11	< 0.02	15.5	--
071515005	SV02S	2.3-2.8	7/15/2015	0.65 J	0.35 J	1.2 J	1.8	1.8 J	6.39	< 0.10 U	5.03	--
041415003	SV03D	5.3 - 5.8	4/14/2015	14	12	3.9	100	58	0.55	10.4	10.2	--
071515002	SV03D	5.3-5.8	7/15/2015	0.48 J	2.5	3.4	5.6	14	6.04	3.22	7.12	--
071515003	DUP01 (SV03D)	5.3-5.8	7/15/2015	0.51 J	2.4	3.4	5.8	14	5.99	3.19	7.43	--
041415004	SV03S	2.3 - 2.8	4/14/2015	10	8.5	3.5	61	41	0.32	0.43	15.6	--
041415001	SV04	3.8 - 4.3	4/14/2015	0.56 J	3.1	1.9	6.8	16	0.14	< 0.02	16.8	--
041415002	DUP01 (SV04)	3.8 - 4.3	4/14/2015	0.49 J	3.1	1.7 J	7.1	16	0.12	< 0.02	17	--
071515001	SV04	3.8-4.3	7/15/2015	0.28 J	0.38 J	3.3	1.6	2.4 J	0.736	< 0.10 U	16	--
091015002	SS01	sub-slab	9/10/2015	2.3	2	1.1 J	8.6	8.6	0.09	< 0.10	17.3	0.0
091015001	SS02	sub-slab	9/10/2015	1.0 J	0.96 J	1.7 J	4.8	4.5 J	< 0.08	< 0.10	17.5	0.0
091015003	SS03	sub-slab	9/10/2015	8.4	7.6	2.1	31	33	< 0.08	< 0.10	17.4	0.0
091015004	SS04	sub-slab	9/10/2015	3.2	1.8	2.9	9.6	8.5	< 0.08	< 0.10	17.3	21
091015005	SS05	sub-slab	9/10/2015	10	6.7	1.7 J	40	26	< 0.08	< 0.10	17.5	1,090
--	North Elevator Shaft		9/10/2015	--	--	--	--	--	--	--	--	0.0
--	West Elevator Shaft		9/10/2015	--	--	--	--	--	--	--	--	16
--	Crawl spaces		9/10/2015	--	--	--	--	--	--	--	--	0.0

[O:AJS C:ECK 12/2/15]

Notes:

< = less than
J Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
NS = no standard
DUP = Duplicate quality control sample
ft bgs = feet below ground surface
mol % = mole percent
ppbv = parts per billion volume
ug/m3 = micrograms per cubic meter

[1] Source - http://dnr.wi.gov/topic/Brownfields/documents/vapor/VRSLvaporquick.pdf "Sub-slab Vapor Risk Screening Levels (VRSL) for Selected VOCs" based on the most recent USEPA updates provided in June 2015

[2] Maximum observed field screening result collected by placing the intake of the ppb Rae (photoionization detector)

Table 2. Summary of Groundwater Results

December 2015 Technical Memorandum

We Energies, Appleton City (Coal Tar), Appleton MGP

WDNR ERP Case #02-45-000042

		BTEX						VOC																	
Field Sample ID	Sample Date	Benzene (ug/L)	Ethylbenzene (ug/L)	Toluene (ug/L)	Xylene, o (ug/L)	Xylenes, m + p (ug/L)	Xylenes, Total (ug/l) [1]	1,1,1,2-Tetrachloroethane (ug/L)	1,1,1-Trichloroethane (ug/L)	1,1,2,2-Tetrachloroethane (ug/L)	1,1,2-Trichloroethane (ug/L)	1,1-Dichloroethane (ug/L)	1,1-Dichloroethene (ug/L)	1,1-Dichloropropene (ug/L)	1,2,3-Trichlorobenzene (ug/L)	1,2,3-Trichloropropane (ug/L)	1,2,4-Trichlorobenzene (ug/L)	1,2,4-Trimethylbenzene (ug/L)	1,2-Dibromo-3-chloropropane (ug/L)	1,2-Dibromoethane (ug/L)	1,2-Dichlorobenzene (ug/L)	1,2-Dichloroethane (ug/L)	1,2-Dichloropropane (ug/L)	1,3,5-Trimethylbenzene (ug/L)	1,3-Dichlorobenzene (ug/L)
WI Groundwater PAL:		*0.5*	*140*	*160*	*NS*	*NS*	*400*	*7*	*40*	*0.02*	*0.5*	*85*	*0.7*	*NS*	*NS*	*12*	*14*	*NS*	*0.02*	*0.005*	*60*	*0.5*	*0.5*	*NS*	*120*
WI Groundwater ES:		**5**	**700**	**800**	**NS**	**NS**	**2,000**	**70**	**200**	**0.2**	**5**	**850**	**7**	**NS**	**NS**	**60**	**70**	**NS**	**0.2**	**0.05**	**600**	**5**	**5**	**NS**	**600**
MW-23	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-26	04/22/15	**18.9**	2.4	1	1.7 J	1.7	3.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-26	07/14/15	**71.1**	6.5	0.57 J	3.6	2.5	6.1	< 0.18 U	< 0.50 U	< 0.25 U	< 0.20 U	< 0.24 U	< 0.41 U	< 0.44 U	< 2.1 U	< 0.50 U	< 2.2 U	2.7	< 2.2 U	< 0.18 U	< 0.50 U	< 0.17 U	< 0.23 U	0.80 J	< 0.50 U
MW-27	04/22/15	**207**	47.8	2.1 J	5.7 J	7.8	13.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-27	07/14/15	**474**	91.2	2.2 J	11.9	8.6	20.5	< 0.72 U	< 2.0 U	< 1.0 U	< 0.79 U	< 0.97 U	< 1.6 U	< 1.8 U	< 8.5 U	< 2.0 U	< 8.8 U	8.5	< 8.7 U	< 0.71 U	< 2.0 U	< 0.67 U	< 0.93 U	< 2.0 U	< 2.0 U
MW-28	04/22/15	< 0.50 U	< 0.50 U	< 0.50 U	< 1.0 U	< 0.50 U	< 1.0 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-28	07/14/15	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.0 U	< 1.0	< 0.18 U	< 0.50 U	< 0.25 U	< 0.20 U	< 0.24 U	< 0.41 U	< 0.44 U	< 2.1 U	< 0.50 U	< 2.2 U	< 0.50 U	< 2.2 U	< 0.18 U	< 0.50 U	< 0.17 U	< 0.23 U	< 0.50 U	< 0.50 U
PZ-23	04/22/15	**512**	55.9	5.3	9.4 J	14.2	23.6 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-23	07/14/15	**567**	48.4	< 5.0 U	10.6	< 10.0 U	10.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-26[2]	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-27	04/22/15	**259**	40.4	3.4 J	9.6	9.4	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-27	07/14/15	**439**	46.5	2.2 J	10.1	7.8 J	17.9	< 0.72 U	< 2.0 U	< 1.0 U	< 0.79 U	< 0.97 U	< 1.6 U	< 1.8 U	< 8.5 U	< 2.0 U	< 8.8 U	7.3	< 8.7 U	< 0.71 U	< 2.0 U	< 0.67 U	< 0.93 U	< 2.0 U	< 2.0 U
PZ-28	04/22/15	**4,880**	**748**	*721*	679	346	*1,025*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-28[2]	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QC-1 MW-27	07/14/15	**436**	80.1	< 5.0 U	9.2 J	< 10.0 U	9.2	< 1.8 U	< 5.0 U	< 2.5 U	< 2.0 U	< 2.4 U	< 4.1 U	< 4.4 U	< 21.3 U	< 5.0 U	< 22.1 U	9.2 J	< 21.6 U	< 1.8 U	< 5.0 U	< 1.7 U	< 2.3 U	< 5.0 U	< 5.0 U
QC-1 PZ-23	04/22/15	**452**	50.3	5.5 J	< 10.0 U	11.1	11.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QCFB	04/21/15	< 0.50 U	< 0.50 U	< 0.50 U	< 1.0 U	< 0.50 U	< 1.0 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TRIP BLANK	04/21/15	< 0.50 U	< 0.50 U	< 0.50 U	< 1.0 U	< 0.50 U	< 1.0 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QCFB	07/14/15	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.0 U	< 1.0	< 0.18 U	< 0.50 U	< 0.25 U	< 0.20 U	< 0.24 U	< 0.41 U	< 0.44 U	< 2.1 U	< 0.50 U	< 2.2 U	< 0.50 U	< 2.2 U	< 0.18 U	< 0.50 U	< 0.17 U	< 0.23 U	< 0.50 U	< 0.50 U
TRIP BLANK	07/14/15	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.0 U	< 1.0	< 0.18 U	< 0.50 U	< 0.25 U	< 0.20 U	< 0.24 U	< 0.41 U	< 0.44 U	< 2.1 U	< 0.50 U	< 2.2 U	< 0.50 U	< 2.2 U	< 0.18 U	< 0.50 U	< 0.17 U	< 0.23 U	< 0.50 U	< 0.50 U

NOTES:

Italic underline value exceeds the Preventative Action Limit

BOLD Value exceeds the Enforcement Standard

U = Parameter not detected above the Limit of Detection indicated

J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit

Definitions for additional data qualifiers can be found in associated laboratory and validation reports

[1] Results for Xylenes, Total were calculated by NRT.

[2] Well was not sampled due to free product present in the purge water

QC = Quality control sample

QCFB = Quality control field blank

< = Concentration is less than reported limit

-- = Analysis not performed

NS = No Standard

ES = Enforcement Standard

PAL = Preventive Action Limit

BTEX = benzene, toluene, ethylbenzene and xylenes

VOC = volatile organic compound

RNA = remediation by natural attenuation

NTU = nephelometric turbidity units

ft = feet

mg/L = milligrams per liter

MGP = manufactured gas plant

mmhos/cm = millimhos per centimeter

ug/L = micrograms per liter

Table 2. Summary of Groundwater Results

December 2015 Technical Memorandum
We Energies, Appleton City (Coal Tar), Appleton MGP
WDNR ERP Case #02-45-000042

		VOC																								
Field Sample ID	Sample Date	1,3-Dichloropropane (ug/L)	1,4-Dichlorobenzene (ug/L)	2,2-Dichloropropane (ug/L)	2-Chlorotoluene (ug/L)	4-Chlorotoluene (ug/L)	Bromobenzene (ug/L)	Bromochloromethane (ug/L)	Bromodichloromethane (ug/L)	Bromoform (ug/L)	Bromomethane (ug/L)	Carbon Tetrachloride (ug/L)	Chlorobenzene (ug/L)	Chloroethane (ug/L)	Chloroform (ug/L)	Chloromethane (ug/L)	cis-1,2-Dichloroethene (ug/L)	cis-1,3-Dichloropropene (ug/L)	Dibromochloromethane (ug/L)	Dibromomethane (ug/L)	Dichloromethane (ug/L)	Diisopropyl Ether (ug/L)	Freon 12 (ug/L)	Hexachlorobutadiene (ug/L)	Isopropylbenzene (ug/L)	Methyl-tert-butyl-ether (ug/L)
WI Groundwater PAL:		*NS*	*15*	*NS*	*NS*	*NS*	*NS*	*NS*	*0.06*	*0.44*	*1*	*0.5*	*NS*	*80*	*0.6*	*3*	*7*	*0.04*	*6*	*NS*	*0.5*	*NS*	*200*	*NS*	*NS*	*12*
WI Groundwater ES:		**NS**	**75**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.6**	**4.4**	**10**	**5**	**NS**	**400**	**6**	**30**	**70**	**0.4**	**60**	**NS**	**5**	**NS**	**1,000**	**NS**	**NS**	**60**
MW-23	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-26	04/22/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-26	07/14/15	< 0.50 U	< 0.50 U	< 0.48 U	< 0.50 U	< 0.21 U	< 0.23 U	< 0.34 U	< 0.50 U	< 0.50 U	< 2.4 U	< 0.50 U	< 0.50 U	< 0.37 U	< 2.5 U	< 0.50 U	< 0.26 U	< 0.50 U	< 0.50 U	< 0.43 U	< 0.23 U	< 0.50 U	< 0.22 U	< 2.1 U	0.68 J	< 0.17 U
MW-27	04/22/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-27	07/14/15	< 2.0 U	< 2.0 U	< 1.9 U	< 2.0 U	< 0.85 U	< 0.92 U	< 1.4 U	< 2.0 U	< 2.0 U	< 9.7 U	< 2.0 U	< 2.0 U	< 1.5 U	< 10.0 U	< 2.0 U	< 1.0 U	< 2.0 U	< 2.0 U	< 1.7 U	< 0.93 U	< 2.0 U	< 0.90 U	< 8.4 U	3.7 J	< 0.70 U
MW-28	04/22/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-28	07/14/15	< 0.50 U	< 0.50 U	< 0.48 U	< 0.50 U	< 0.21 U	< 0.23 U	< 0.34 U	< 0.50 U	< 0.50 U	< 2.4 U	< 0.50 U	< 0.50 U	< 0.37 U	< 2.5 U	< 0.50 U	< 0.26 U	< 0.50 U	< 0.50 U	< 0.43 U	< 0.23 U	< 0.50 U	< 0.22 U	< 2.1 U	< 0.14 U	< 0.17 U
PZ-23	04/22/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-23	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-26	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-27	04/22/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-27	07/14/15	< 2.0 U	< 2.0 U	< 1.9 U	< 2.0 U	< 0.85 U	< 0.92 U	< 1.4 U	< 2.0 U	< 2.0 U	< 9.7 U	< 2.0 U	< 2.0 U	< 1.5 U	< 10.0 U	< 2.0 U	< 1.0 U	< 2.0 U	< 2.0 U	< 1.7 U	< 0.93 U	< 2.0 U	< 0.90 U	< 8.4 U	3.8 J	< 0.70 U
PZ-28	04/22/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PZ-28	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QC-1 MW-27	07/14/15	< 5.0 U	< 5.0 U	< 4.8 U	< 5.0 U	< 2.1 U	< 2.3 U	< 3.4 U	< 5.0 U	< 5.0 U	< 24.3 U	< 5.0 U	< 5.0 U	< 3.7 U	< 25.0 U	< 5.0 U	< 2.6 U	< 5.0 U	< 5.0 U	< 4.3 U	< 2.3 U	< 5.0 U	< 2.2 U	< 21.1 U	< 1.4 U	< 1.7 U
QC-1 PZ-23	04/22/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QCFB	04/21/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TRIP BLANK	04/21/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QCFB	07/14/15	< 0.50 U	< 0.50 U	< 0.48 U	< 0.50 U	< 0.21 U	< 0.23 U	< 0.34 U	< 0.50 U	< 0.50 U	< 2.4 U	< 0.50 U	< 0.50 U	< 0.37 U	< 2.5 U	< 0.50 U	< 0.26 U	< 0.50 U	< 0.50 U	< 0.43 U	< 0.23 U	< 0.50 U	< 0.22 U	< 2.1 U	< 0.14 U	< 0.17 U
TRIP BLANK	07/14/15	< 0.50 U	< 0.50 U	< 0.48 U	< 0.50 U	< 0.21 U	< 0.23 U	< 0.34 U	< 0.50 U	< 0.50 U	< 2.4 U	< 0.50 U	< 0.50 U	< 0.37 U	< 2.5 U	< 0.50 U	< 0.26 U	< 0.50 U	< 0.50 U	< 0.43 U	< 0.23 U	< 0.50 U	< 0.22 U	< 2.1 U	< 0.14 U	< 0.17 U

NOTES:
Italic underline value exceeds the Preventative Action Limit
BOLD Value exceeds the Enforcement Standard
U = Parameter not detected above the Limit of Detection indicated
J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
Definitions for additional data qualifiers can be found in associated laboratory and validation reports
[1] Results for Xylenes, Total were calculated by NRT.
[2] Well was not sampled due to free product present in the purge water
QC = Quality control sample
QCFB = Quality control field blank
< = Concentration is less than reported limit
-- = Analysis not performed
NS = No Standard
ES = Enforcement Standard
PAL = Preventive Action Limit
BTEX = benzene, toluene, ethylbenzene and xylenes
VOC = volatile organic compound
RNA = remediation by natural attenuation
NTU = nephelometric turbidity units
ft = feet
mg/L = milligrams per liter
MGP = manufactured gas plant
mmhos/cm = millimhos per centimeter
ug/L = micrograms per liter

Table 2. Summary of Groundwater Results

December 2015 Technical Memorandum

We Energies, Appleton City (Coal Tar), Appleton MGP

WDNR ERP Case #02-45-000042

		VOC													Metals			Organics, Inorganics, and Lab RNA				Field RNA						
Field Sample ID	Sample Date	n-Butylbenzene (ug/L)	n-Propylbenzene (ug/L)	Naphthalene (ug/L)	p-Isopropyltoluene (ug/L)	sec-Butylbenzene (ug/L)	Styrene (ug/L)	tert-Butylbenzene (ug/L)	Tetrachloroethene (ug/L)	trans-1,2-Dichloroethene (ug/L)	trans-1,3-Dichloropropene (ug/L)	Trichloroethene (ug/L)	Trichlorofluoromethane (ug/L)	Vinyl Chloride (ug/L)	Arsenic, Dissolved (ug/l)	Iron, Dissolved (ug/L)	Manganese, Dissolved (ug/L)	Alkalinity, Total (mg/L)	Methane (mg/L)	Nitrate, Nitrogen, Total (mg/L)	Sulfate, Total (mg/L)	Dissolved Oxygen (mg/l)	Groundwater, depth to (ft)	Oxidation Reduction Potential (millivolts)	pH, Field (Standard Units)	Specific Conductance, Field (mmhos/cm)	Temperature, Water (Degrees Centigrade)	Turbidity, Quantitative (NTU)
WI Groundwater PAL:		*NS*	*NS*	*10*	*NS*	*NS*	*10*	*NS*	*0.5*	*20*	*0.04*	*0.5*	*NS*	*0.02*	*1*	*150*	*25*	*NS*	*NS*	*2*	*125*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
WI Groundwater ES:		**NS**	**NS**	**100**	**NS**	**NS**	**100**	**NS**	**5**	**100**	**0.4**	**5**	**NS**	**0.2**	**10**	**300**	**50**	**NS**	**NS**	**10**	**250**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
MW-23	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.03	--	--	--	--	--
MW-26	04/22/15	--	--	*19.8*	--	--	--	--	--	--	--	--	--	--	**67.2**	66.5 JB	**379**	252	2,920	< 0.15 U	41.4	0.42	10.8	-50	7.5	1263	8.1	3.5
MW-26	07/14/15	< 0.50 U	< 0.50 U	**53.1**	< 0.50 U	< 2.2 U	< 0.50 U	< 0.18 U	< 0.50 U	< 0.26 U	< 0.23 U	< 0.33 U	< 0.18 U	< 0.18 U	--	**378**	**317**	284	2	< 0.15 U	21.4	0.77	10.8	-127	7.7	1046	15.8	1.7
MW-27	04/22/15	--	--	**382**	--	--	--	--	--	--	--	--	--	--	*7.7 J*	**511 B**	**105**	222	2,030	< 0.15 U	7	0.51	7.71	-107	7.6	800	7.4	2
MW-27	07/14/15	< 2.0 U	< 2.0 U	**633**	< 2.0 U	< 8.7 U	< 2.0 U	< 0.72 U	< 2.0 U	< 1.0 U	< 0.92 U	< 1.3 U	< 0.74 U	< 0.70 U	--	**829**	**124**	253	3.13	< 0.15 U	2.6 J	0.6	7.69	-153	7.6	821	17.5	0.6
MW-28	04/22/15	--	--	< 2.5 U	--	--	--	--	--	--	--	--	--	--	**34.5**	64.6 JB	**149**	188	2,470	< 0.15 U	12	0.82	4.95	-99	8.3	2430	6.4	1
MW-28	07/14/15	< 0.50 U	< 0.50 U	< 2.5 U	< 0.50 U	< 2.2 U	< 0.50 U	< 0.18 U	< 0.50 U	< 0.26 U	< 0.23 U	< 0.33 U	< 0.18 U	< 0.18 U	--	*224 J*	**150**	210	1.09 M1	< 0.15 U	5.3	0.54	6.05	-190	8.2	1640	16.7	2
PZ-23	04/22/15	--	--	**619**	--	--	--	--	--	--	--	--	--	--	**13.7 J**	**646**	**107**	222	2,940	< 0.15 U	5.3	0.49	4.95	-125	7.6	693	7	0.59
PZ-23	07/14/15	--	--	**488**	--	--	--	--	--	--	--	--	--	--	--	**599**	**111**	235	2.95	< 0.15 U	2.8 J	1	5.33	-184	7.7	412	15	0.6
PZ-26	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.3	--	--	--	--	--
PZ-27	04/22/15	--	--	**527**	--	--	--	--	--	--	--	--	--	--	< 7.2 U	*152 B*	**160**	229	2,820	< 0.15 U	3.1 J	0.5	4.31	-58	7.4	743	8.4	6.2
PZ-27	07/14/15	< 2.0 U	< 2.0 U	**543**	< 2.0 U	< 8.7 U	< 2.0 U	< 0.72 U	< 2.0 U	< 1.0 U	< 0.92 U	< 1.3 U	< 0.74 U	< 0.70 U	--	**681**	**165**	233	3.38	< 0.15 U	2.4 J	0.5	4.62	-141	7.5	738	16.2	23
PZ-28	04/22/15	--	--	**3,720**	--	--	--	--	--	--	--	--	--	--	< 7.2 U	*224 B*	**59**	302	5,480	< 0.15 U	4.8	0.42	6.15	-116	7.8	900	7.9	1.1
PZ-28	07/14/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.48	--	--	--	--	--
QC-1 MW-27	07/14/15	< 5.0 U	< 5.0 U	**615**	< 5.0 U	< 21.9 U	< 5.0 U	< 1.8 U	< 5.0 U	< 2.6 U	< 2.3 U	< 3.3 U	< 1.8 U	< 1.8 U	--	**803**	**122**	253	3.84	< 0.15 U	2.6 J	0.6	7.69	-153	7.6	821	17.5	0.6
QC-1 PZ-23	04/22/15	--	--	**508**	--	--	--	--	--	--	--	--	--	--	*9.7 J*	**644**	**105**	208	2,460	< 0.15 U	5.1	0.49	4.95	-125	7.6	693	7	0.59
QCFB	04/21/15	--	--	< 2.5 U	--	--	--	--	--	--	--	--	--	--	< 7.2 U	< 12.9 U	< 1.4 U	< 7.5 U	< 1.4 U	< 0.15 U	< 2.0 U	--	--	--	--	--	--	--
TRIP BLANK	04/21/15	--	--	< 2.5 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QCFB	07/14/15	< 0.50 U	< 0.50 U	< 2.5 U	< 0.50 U	< 2.2 U	< 0.50 U	< 0.18 U	< 0.50 U	< 0.26 U	< 0.23 U	< 0.33 U	< 0.18 U	< 0.18 U	--	< 10.0 U	< 0.18 U	< 7.5 U	< 0.0014 U	< 0.15 U	< 2.0 U	3.45	--	-150	7.1	5	24.5	--
TRIP BLANK	07/14/15	< 0.50 U	< 0.50 U	< 2.5 U	< 0.50 U	< 2.2 U	< 0.50 U	< 0.18 U	< 0.50 U	< 0.26 U	< 0.23 U	< 0.33 U	< 0.18 U	< 0.18 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--

[O:AJS C:ECK 12/2/15]

NOTES:

Italic underline value exceeds the Preventative Action Limit

BOLD Value exceeds the Enforcement Standard

U = Parameter not detected above the Limit of Detection indicated

J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit

Definitions for additional data qualifiers can be found in associated laboratory and validation reports

[1] Results for Xylenes, Total were calculated by NRT.

[2] Well was not sampled due to free product present in the purge water

QC = Quality control sample

QCFB = Quality control field blank

< = Concentration is less than reported limit

-- = Analysis not performed

NS = No Standard

ES = Enforcement Standard

PAL = Preventive Action Limit

BTEX = benzene, toluene, ethylbenzene and xylenes

VOC = volatile organic compound

RNA = remediation by natural attenuation

NTU = nephelometric turbidity units

ft = feet

mg/L = milligrams per liter

MGP = manufactured gas plant

mmhos/cm = millimhos per centimeter

ug/L = micrograms per liter

ATTACHMENT A

SEPTEMBER 2015 PHOTO LOG

Photo 1. Looking south into the boiler room. Access to crawlspace and brick cribs is through the dry wall.

Photo 2. Gap (1.25 feet) between brick cribs and floor slab.

Photo 3. Looking south into crib structure from boiler room toward south wall of building.

Photo 4. Looking down into large crawlspace, standing water is present below the debris.

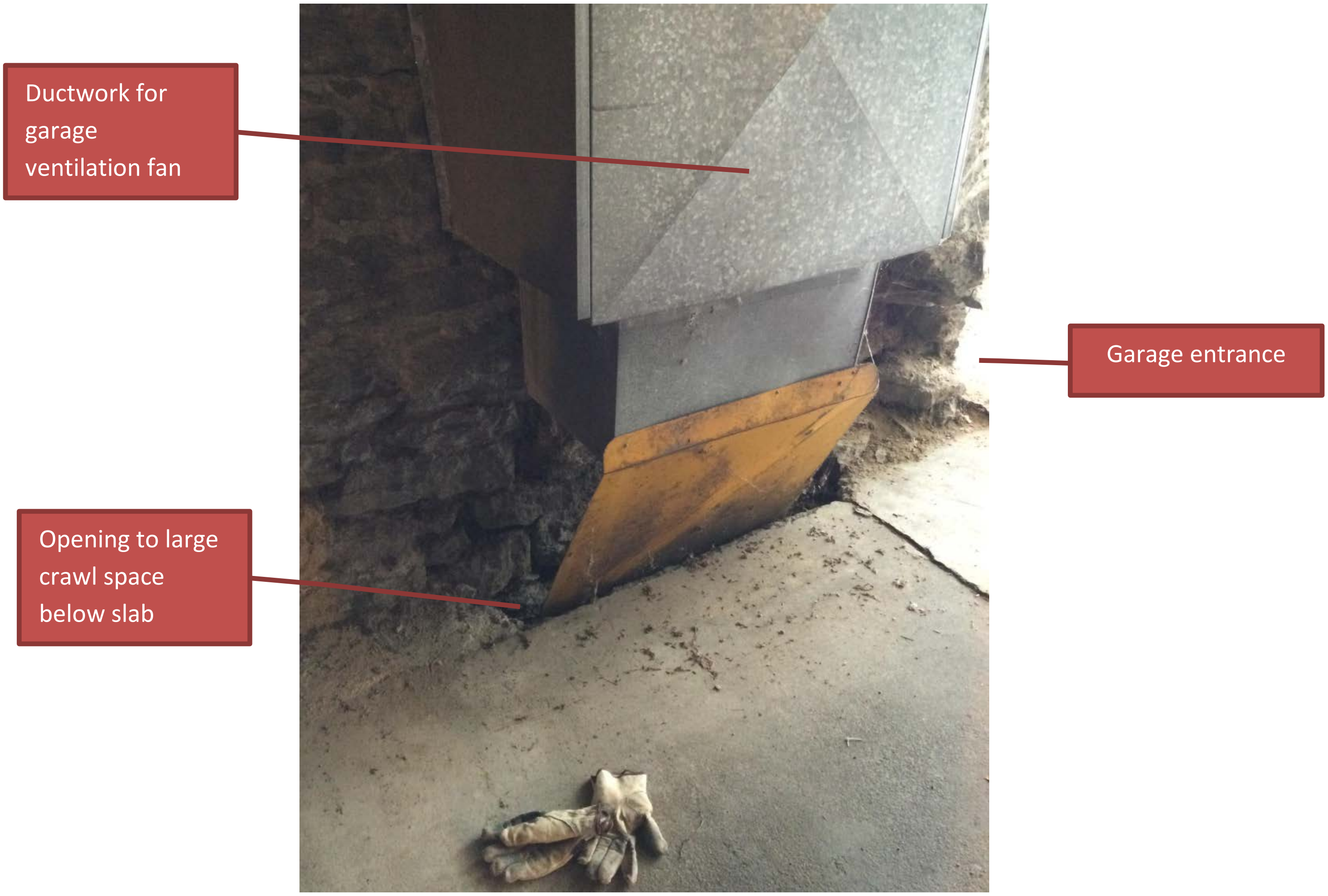


Photo 5. Access to large crawl space through garage floor just south of garage entrance.

Photo 6. Looking into the opening between the slab and the building wall south of the garage entrance.

Archway with opening to the east

Water moving to the east is not visible in photo

Open drum containing debris

Ground is covered in debris but dry

Photo 7. Looking southeast through the dry wall of the boiler room at the archway through the east wall of the boiler room.

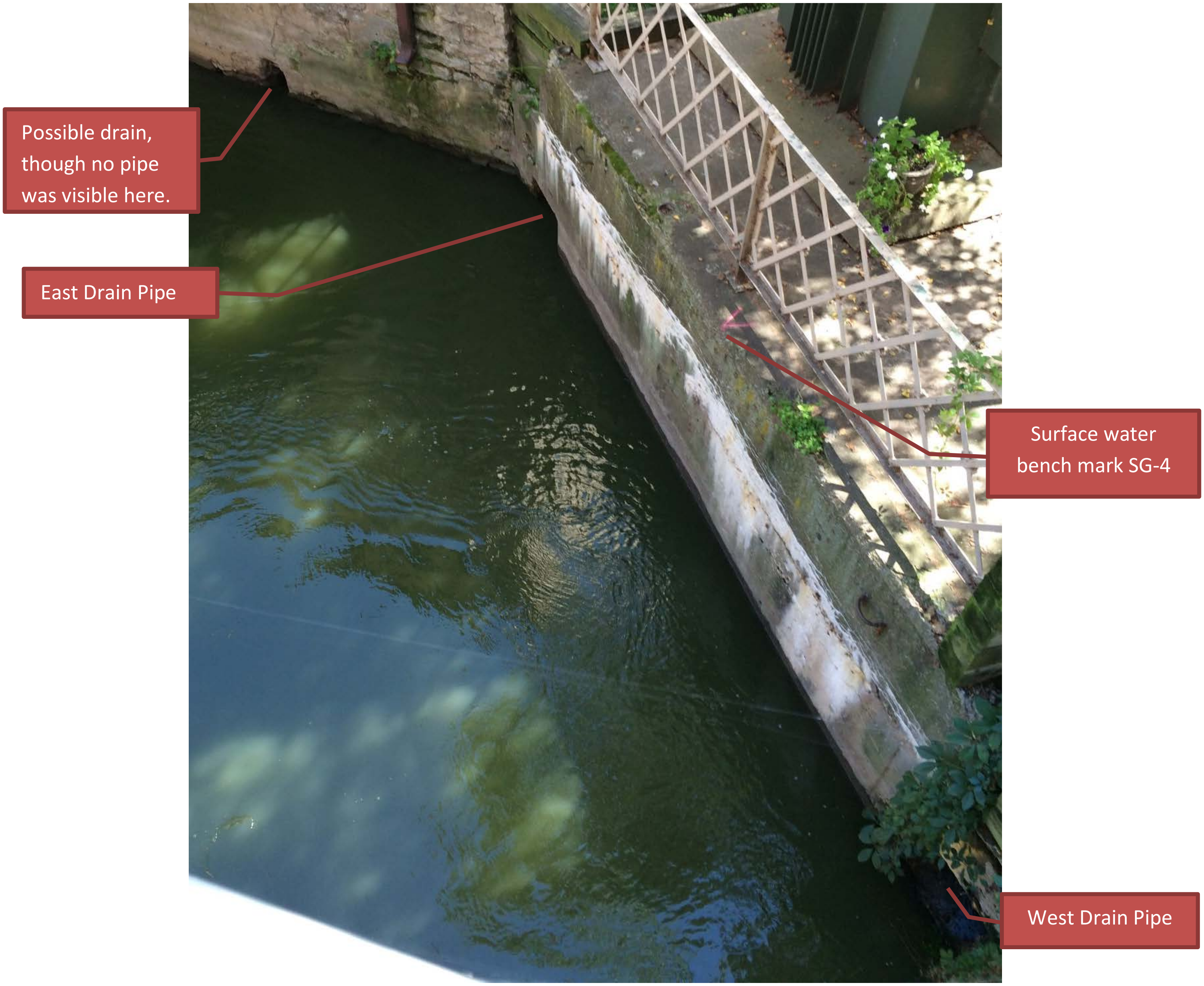


Photo 8. Looking south at SG-4 and east and west drain pipes located between Buildings 405 and 415. Surface water measured from SG-4 was at elevation 709.06 feet during the site visit.

Photo 9. Close up of water flowing out of the west drain pipe.

Photo 10. Close up of east drain pipe at water level.

Photo 11. Looking west at the southeast corner of Building 415 from under Olde Oneida Street. The garage floor is approximately 4-feet above ground surface. There is no evidence of drainage structures however, archways like the one in the lower left of the photo extend west under the building and are filled with stagnant backwater from the Fox River Canal.

Photo 12. Looking west into the archway in the lower left of Photo 12.

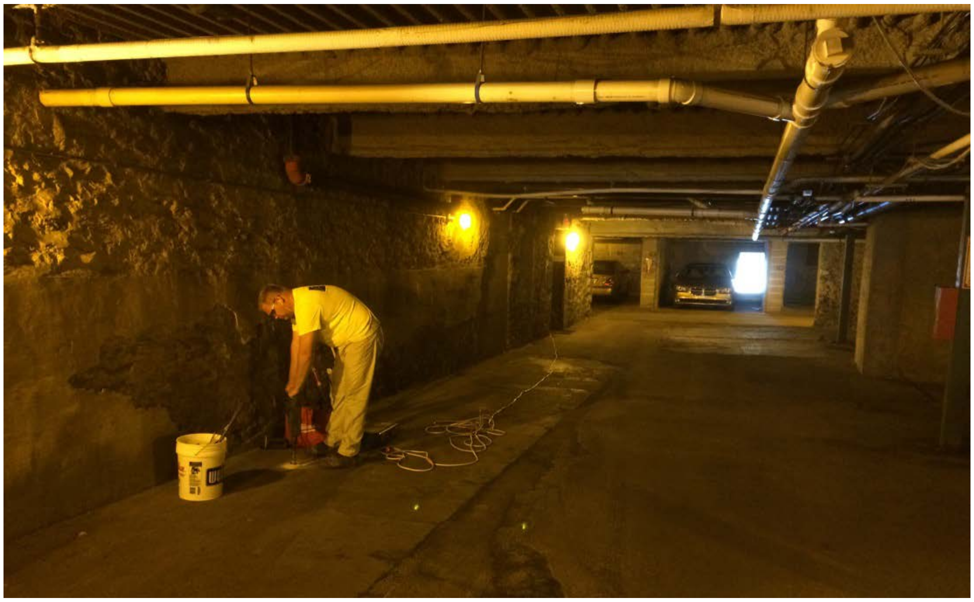


Photo 13. Coring through the slab at SS-3, looking east.

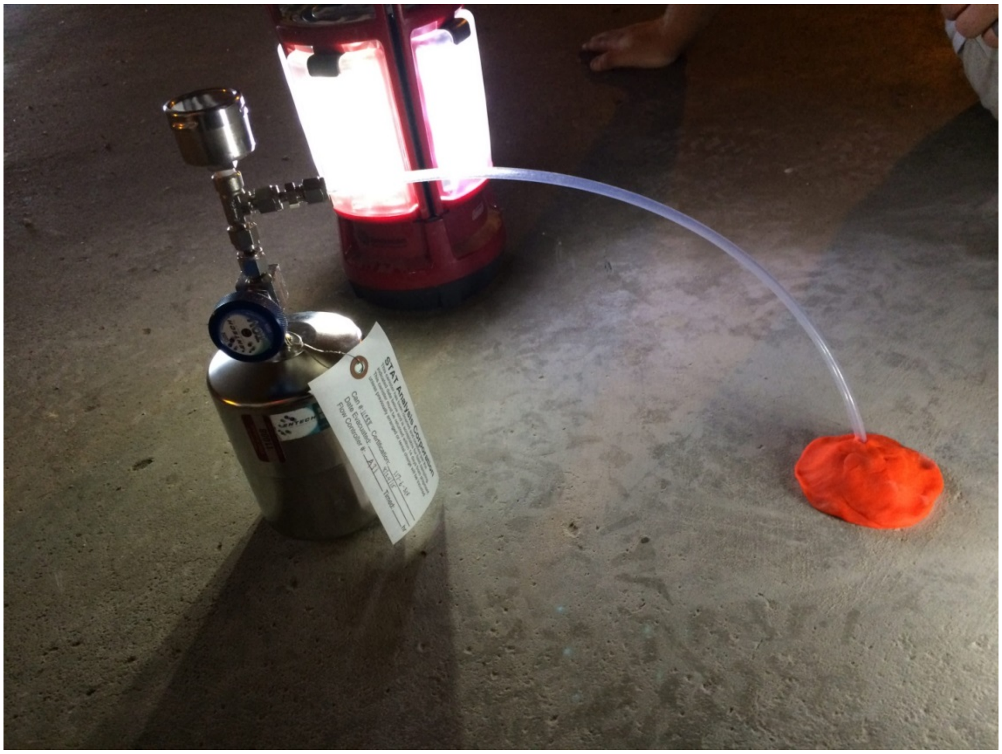


Photo 14. Summa canister screening sample collected from a sub-slab core hole sealed with non-toxic Play-Doh.

ATTACHMENT B

SUB-SLAB SCREENING LABORATORY REPORT

STAT Analysis Corporation
2242 West Harrison St., Suite 200, Chicago, IL 60612-3766
Tel: (312) 733-0551 Fax: (312) 733-2386 STATinfo@STATAnalysis.com
Accreditations: IEPA ELAP 100445; ORELAP IL300001; AIHA-LAP, LLC 101160; NVLAP LabCode 101202-0

September 21, 2015

Natural Resource Technology, Inc.
415A S. 3rd Street
Milwaukee, WI 53204
Telephone: (414) 837-3607
Fax: (262) 523-9001

Analytical Report for STAT Work Order: 15090426 Revision 0

RE: 1508.1, Appleton Former MGP, Appleton, WI

Dear Brian Hennings:

STAT Analysis received 5 samples for the referenced project on 9/11/2015 3:23:00 PM. The analytical results are presented in the following report.

All analyses were performed in accordance with the requirements of 35 IAC Part 186 / NELAC standards. Analyses were performed in accordance with methods as referenced on the analytical report. Those analytical results expressed on a dry weight basis are also noted on the analytical report.

All analyses were performed within established holding time criteria, and all Quality Control criteria met EPA or laboratory specifications except when noted in the Case Narrative or Analytical Report. If required, an estimate of uncertainty for the analyses can be provided. A listing of accredited methods/parameters can also be provided.

Thank you for the opportunity to serve you and I look forward to working with you in the future. If you have any questions regarding the enclosed materials, please contact me at (312) 733-0551.

Sincerely,

Craig Chawla
Project Manager

Client: Natural Resource Technology, Inc.
Project: 1508.1, Appleton Former MGP, Appleton, WI
Work Order: 15090426 Revision 0

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
15090426-001A	091015001		9/10/2015 11:26:00 AM	9/11/2015
15090426-002A	091015002		9/10/2015 10:54:00 AM	9/11/2015
15090426-003A	091015003		9/10/2015 11:49:00 AM	9/11/2015
15090426-004A	091015004		9/10/2015 12:10:00 PM	9/11/2015
15090426-005A	091015005		9/10/2015 12:34:00 PM	9/11/2015

CASE NARRATIVE

Results that are reported in µg/m³ are calculated based on a temperature of 25°C, atmospheric pressure of 760 mm Hg, and the molecular weight of the analyte.

Date Reported: September 21, 2015
Date Printed: September 21, 2015

ANALYTICAL RESULTS

Client: Natural Resource Technology, Inc.
Project: 1508.1, Appleton Former MGP, Appleton, WI
Work Order: 15090426 Revision 0

Lab ID: 15090426-001
Collection Date: 9/10/2015 11:26:00 AM
Client Sample ID: 091015001
Matrix: Air

Analyses	Result	RL	MDL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **9/16/2015**			Analyst: **VP**
Benzene	1.0	1.2	0.047	J	µg/m³	1	9/16/2015
Ethylbenzene	0.96	1.6	0.042	J	µg/m³	1	9/16/2015
Naphthalene	1.7	1.9	0.38	J	µg/m³	1	9/16/2015
Toluene	4.8	1.4	0.034		µg/m³	1	9/16/2015
Xylenes, Total	4.5	4.8	0.34	J	µg/m³	1	9/16/2015
Landfill Gases by EPA Method 3c	**METHOD 3C**			Prep Date:			Analyst: **NLM**
Carbon Dioxide	ND	0.08	0.02		mol %	2	9/15/2015
Methane	ND	0.10	0.02		mol %	2	9/15/2015
Oxygen	17.5	0.80	0.02		mol %	2	9/15/2015

Lab ID: 15090426-002
Collection Date: 9/10/2015 10:54:00 AM
Client Sample ID: 091015002
Matrix: Air

Analyses	Result	RL	MDL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **9/16/2015**			Analyst: **VP**
Benzene	2.3	1.4	0.054		µg/m³	1	9/16/2015
Ethylbenzene	2.0	1.8	0.048		µg/m³	1	9/16/2015
Naphthalene	1.1	2.2	0.43	J	µg/m³	1	9/16/2015
Toluene	8.6	1.6	0.039		µg/m³	1	9/16/2015
Xylenes, Total	8.6	5.5	0.39		µg/m³	1	9/16/2015
Landfill Gases by EPA Method 3c	**METHOD 3C**			Prep Date:			Analyst: **NLM**
Carbon Dioxide	0.09	0.08	0.02		mol %	2	9/15/2015
Methane	ND	0.10	0.02		mol %	2	9/15/2015
Oxygen	17.3	0.80	0.02		mol %	2	9/15/2015

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below reporting limit
B - Analyte detected in the associated Method Blank
HT - Sample received past holding time
* - Non-accredited parameter

RL/MDL - Reporting Limit / Method Detection Limit for the analysis
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
H - Holding time exceeded

Date Reported: September 21, 2015
Date Printed: September 21, 2015

ANALYTICAL RESULTS

Client: Natural Resource Technology, Inc.
Project: 1508.1, Appleton Former MGP, Appleton, WI
Work Order: 15090426 Revision 0

Lab ID: 15090426-003
Collection Date: 9/10/2015 11:49:00 AM
Client Sample ID: 091015003
Matrix: Air

Analyses	Result	RL	MDL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **9/16/2015**			Analyst: **VP**
Benzene	8.4	1.3	0.051		µg/m³	1	9/16/2015
Ethylbenzene	7.6	1.7	0.045		µg/m³	1	9/16/2015
Naphthalene	2.1	2.0	0.4		µg/m³	1	9/16/2015
Toluene	31	1.5	0.037		µg/m³	1	9/16/2015
Xylenes, Total	33	5.2	0.37		µg/m³	1	9/16/2015
Landfill Gases by EPA Method 3c	**METHOD 3C**			Prep Date:			Analyst: **NLM**
Carbon Dioxide	ND	0.08	0.02		mol %	2	9/15/2015
Methane	ND	0.10	0.02		mol %	2	9/15/2015
Oxygen	17.4	0.80	0.02		mol %	2	9/15/2015

Lab ID: 15090426-004
Collection Date: 9/10/2015 12:10:00 PM
Client Sample ID: 091015004
Matrix: Air

Analyses	Result	RL	MDL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **9/16/2015**			Analyst: **VP**
Benzene	3.2	1.4	0.054		µg/m³	1	9/16/2015
Ethylbenzene	1.8	1.8	0.048		µg/m³	1	9/16/2015
Naphthalene	2.9	2.2	0.43		µg/m³	1	9/16/2015
Toluene	9.6	1.6	0.039		µg/m³	1	9/16/2015
Xylenes, Total	8.5	5.5	0.39		µg/m³	1	9/16/2015
Landfill Gases by EPA Method 3c	**METHOD 3C**			Prep Date:			Analyst: **NLM**
Carbon Dioxide	ND	0.08	0.02		mol %	2	9/15/2015
Methane	ND	0.10	0.02		mol %	2	9/15/2015
Oxygen	17.3	0.80	0.02		mol %	2	9/15/2015

Qualifiers:

ND - Not Detected at the Reporting Limit	RL/MDL - Reporting Limit / Method Detection Limit for the analysis
J - Analyte detected below reporting limit	S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank	R - RPD outside accepted recovery limits
HT - Sample received past holding time	E - Value above quantitation range
* - Non-accredited parameter	H - Holding time exceeded

Date Reported: September 21, 2015
Date Printed: September 21, 2015

ANALYTICAL RESULTS

Client: Natural Resource Technology, Inc.
Project: 1508.1, Appleton Former MGP, Appleton, WI
Work Order: 15090426 Revision 0

Lab ID: 15090426-005
Collection Date: 9/10/2015 12:34:00 PM
Client Sample ID: 091015005
Matrix: Air

Analyses	Result	RL	MDL	Qualifier	Units	DF	Date Analyzed
Volatile Organic Compounds in Air by GC/MS	**TO-15**			Prep Date: **9/16/2015**			Analyst: **VP**
Benzene	10	1.2	0.049		µg/m³	1	9/16/2015
Ethylbenzene	6.7	1.7	0.043		µg/m³	1	9/16/2015
Naphthalene	1.7	2.0	0.39	J	µg/m³	1	9/16/2015
Toluene	40	1.4	0.035		µg/m³	1	9/16/2015
Xylenes, Total	26	5.0	0.35		µg/m³	1	9/16/2015
Landfill Gases by EPA Method 3c	**METHOD 3C**			Prep Date:			Analyst: **NLM**
Carbon Dioxide	ND	0.08	0.02		mol %	2	9/15/2015
Methane	ND	0.10	0.02		mol %	2	9/15/2015
Oxygen	17.5	0.80	0.02		mol %	2	9/15/2015

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below reporting limit
B - Analyte detected in the associated Method Blank
HT - Sample received past holding time
* - Non-accredited parameter

RL/MDL - Reporting Limit / Method Detection Limit for the analysis
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
H - Holding time exceeded

STAT Analysis Corporation
2242 W. Harrison Suite 200, Chicago, Illinois 60612 Phone: (312) 733-0551 Fax: (312) 733-2386
e-mail address: STATinfo@STATAnalysis.com

PMH 9/10/15

CHAIN OF CUSTODY RECORD

N^o: NRT000001 **Page :** 1 **of** 1

Company: Natural Resource Technology
Project Number: 1508.1 Client Tracking No.:
Project Name: Appleton Former MGP
Project Location: Appleton, WI
Sampler(s): Patrick M. Hoefle
Report To: Data@naturalrt.com Phone: 414-837-3644
bhennings@naturalrt.com Fax:
QC Level: 1 ___ 2 X 3 ___ 4 ___ e-mail:

P.O. No.:
Quote No.:
Turn Around:
Results Needed: / / am/pm

Client Sample Number/Description:	Date Taken	Time Taken	Matrix	Comp.	Grab	Preserv.	No. of Containers	TO 15 BTEX + Naph	EPA 3C O2, CO2, CH4	Remarks	Lab No.:
091015001	9/10/15	11:26 AM	SV		X		1			can - 11092	001
091015002	9/10/15	10:54 AM	SV		X		1			can - 11088	002
091015003	9/10/15	11:49 AM	SV		X		1			can - 11080	003
091015004	9/10/15	12:10 PM	SV		X		1			can - 11084	004
091015005	9/10/15	12:34 PM	SV		X		1			can - 11111	005

PMH 9/10/15

Relinquished by: (Signature) Date/Time: 9/10/15 3:00 PM
Received by: (Signature) FEDEX 781309818653 Date/Time: 09/10/15 1450
Relinquished by: (Signature) FEDEX 781309818653 Date/Time: 09/11/15 1523
Received by: (Signature) Martin Kucan Date/Time: 09/11/15 1523
Relinquished by: (Signature) Date/Time:
Received by: (Signature) Date/Time:

Comments:

Preservation Code: A = None B = HNO_3 C = NaOH
D = H_2SO_4 E = HCl F = 5035/EnCore G = Other

Laboratory Work Order No.: 15090426

Received on Ice: Yes ☐ No ☒

Temperature: AMB °C

STAT Analysis Corporation

Sample Receipt Checklist

Client Name NRT

Date and Time Received: 9/11/2015 3:23:00 PM

Work Order Number 15090426

Received by: MGK

Checklist completed by: Martin Kucan 9/11/15
Signature Date

Reviewed by: FL 9/15/15
Initials Date

Matrix:

Carrier name FedEx

Shipping container/cooler in good condition?	Yes ✓	No	Not Present
Custody seals intact on shippping container/cooler?	Yes	No	Not Present ✓
Custody seals intact on sample bottles?	Yes	No	Not Present ✓
Chain of custody present?	Yes ✓	No	
Chain of custody signed when relinquished and received?	Yes ✓	No	
Chain of custody agrees with sample labels/containers?	Yes ✓	No	
Samples in proper container/bottle?	Yes ✓	No	
Sample containers intact?	Yes ✓	No	
Sufficient sample volume for indicated test?	Yes ✓	No	
All samples received within holding time?	Yes ✓	No	
Container or Temp Blank temperature in compliance?	Yes ✓	No	Temperature Ambient °C
Water - VOA vials have zero headspace?	No VOA vials submitted	Yes	No
Water - Samples pH checked?	Yes	No	Checked by:
Water - Samples properly preserved?	Yes	No	pH Adjusted?

Any No response must be detailed in the comments section below.

Comments:

Client / Person contacted:

Date contacted:

Contacted by:

Response:

CLIENT: Natural Resource Technology, Inc.
Work Order: 15090426
Project: 1508.1, Appleton Former MGP, Appleton, WI

ANALYTICAL QC SUMMARY REPORT

Air Toxics

BatchID: R114155

ANALYTICAL RUN SUMMARY

SeqNo	Sample ID	Type	Test Code	Batch	DF	Date Analyzed
3089803	BFB091515-6	TUNE	BFB	R114155	1	09/15/2015 18:14
3089804	CCV091515-6 10.0	CCV	TO_15A+	R114155	1	09/15/2015 18:14
3089806	LCS091515-6 5.0	LCS	TO_15MG+	R114155	1	09/15/2015 19:24
3091105	LCS091515-6 5.0	LCS	TO_15A+	R114155	1	09/15/2015 19:24
3091115	LCS091515-6 5.0	LCS	TO_15UG+	R114155	1	09/15/2015 19:24
3089807	LCSD091515-6 5.0	LCSD	TO_15MG+	R114155	1	09/15/2015 19:58
3091106	LCSD091515-6 5.0	LCSD	TO_15A+	R114155	1	09/15/2015 19:58
3091116	LCSD091515-6 5.0	LCSD	TO_15UG+	R114155	1	09/15/2015 19:58
3089808	15090372-012A	SAMP	TO_15MG+	87121	20	09/15/2015 20:32
3089809	15090372-013A	SAMP	TO_15MG+	87121	10	09/15/2015 21:07
3091107	15090428-008A	SAMP	TO_15A+	87120	1	09/15/2015 21:40
3091117	15090428-008A	SAMP	TO_15UG+	87120	1	09/15/2015 21:40
3091108	15090428-009A	SAMP	TO_15A+	87120	1	09/15/2015 22:14
3091118	15090428-009A	SAMP	TO_15UG+	87120	1	09/15/2015 22:14
3091109	15090428-010A	SAMP	TO_15A+	87120	1	09/15/2015 22:48
3091119	15090428-010A	SAMP	TO_15UG+	87120	1	09/15/2015 22:48
3091110	15090428-011A	SAMP	TO_15A+	87120	1	09/15/2015 23:22
3091120	15090428-011A	SAMP	TO_15UG+	87120	1	09/15/2015 23:22
3091111	15090428-012A	SAMP	TO_15A+	87120	1	09/15/2015 23:57
3091121	15090428-012A	SAMP	TO_15UG+	87120	1	09/15/2015 23:57
3091112	15090428-013A	SAMP	TO_15A+	87120	1	09/16/2015 00:31
3091122	15090428-013A	SAMP	TO_15UG+	87120	1	09/16/2015 00:31
3091113	15090428-014A	SAMP	TO_15A+	87120	1	09/16/2015 01:05
3091123	15090428-014A	SAMP	TO_15UG+	87120	1	09/16/2015 01:05
3089805	MB091515-6	MBLK	TO_15MG+	R114155	1	09/16/2015 11:48
3091104	MB091515-6	MBLK	TO_15A+	R114155	1	09/16/2015 11:48
3091114	MB091515-6	MBLK	TO_15UG+	R114155	1	09/16/2015 11:48
3089815	15090470-004A	SAMP	TO_15MG+	87121	20	09/16/2015 12:22
3089816	15090470-006A	SAMP	TO_15MG+	87121	20	09/16/2015 12:56
3089810	15090426-001A	SAMP	TO_15MG+	87121	1	09/16/2015 13:30
3091124	15090426-001A	SAMP	TO_15UG+	87121	1	09/16/2015 13:30
3089811	15090426-002A	SAMP	TO_15MG+	87121	1	09/16/2015 14:04
3091125	15090426-002A	SAMP	TO_15UG+	87121	1	09/16/2015 14:04
3089812	15090426-003A	SAMP	TO_15MG+	87121	1	09/16/2015 14:38
3091126	15090426-003A	SAMP	TO_15UG+	87121	1	09/16/2015 14:38
3089813	15090426-004A	SAMP	TO_15MG+	87121	1	09/16/2015 15:12
3091127	15090426-004A	SAMP	TO_15UG+	87121	1	09/16/2015 15:12
3089814	15090426-005A	SAMP	TO_15MG+	87121	1	09/16/2015 15:50
3091128	15090426-005A	SAMP	TO_15UG+	87121	1	09/16/2015 15:50
3089817	15090470-005A	SAMP	TO_15MG+	87121	20	09/16/2015 16:24
3089818	15090470-007A	SAMP	TO_15MG+	87121	20	09/16/2015 16:58
3089819	15090470-008A	SAMP	TO_15MG+	87121	20	09/16/2015 17:32

QC SUMMARY

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

ANALYTICAL QC SUMMARY REPORT

Air Toxics

BatchID: R114155

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB091515-6	**ZZZZZ**	**MBLK**	**µg/m³**	**TO-15**		**9/16/2015**	**VOA-6_150915A**	**3091114**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Benzene	0.1278	0.64									J
Ethylbenzene	ND	0.87									
Naphthalene	ND	1.0									
Toluene	ND	0.75									
Xylenes, Total	ND	2.6									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCS091515-6 5.0	**ZZZZZ**	**LCS**	**µg/m³**	**TO-15**		**9/15/2015**	**VOA-6_150915A**	**3091115**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Benzene	13.9	0.64	15.97	0.1278	86.2	70	130	0	0		
Ethylbenzene	21.84	0.87	21.71	0	101	70	130	0	0		
Naphthalene	24.9	1.0	26.21	0	95	70	130	0	0		
Toluene	18.73	0.75	18.84	0	99.4	70	130	0	0		
Xylenes, Total	64.91	2.6	65.13	0	99.7	70	130	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCSD091515-6 5.0	**ZZZZZ**	**LCSD**	**µg/m³**	**TO-15**		**9/15/2015**	**VOA-6_150915A**	**3091116**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Benzene	13.93	0.64	15.97	0.1278	86.4	70	130	13.9	0.230	25	
Ethylbenzene	21.71	0.87	21.71	0	100	70	130	21.84	0.598	25	
Naphthalene	27.15	1.0	26.21	0	104	70	130	24.9	8.66	25	
Toluene	18.73	0.75	18.84	0	99.4	70	130	18.73	0	25	
Xylenes, Total	64.61	2.6	65.13	0	99.2	70	130	64.91	0.469	25	

Qualifiers:

ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits	B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits	E - Value above quantitation range
* - Non Accredited Parameter	H/HT - Holding Time Exceeded	

CLIENT: Natural Resource Technology, Inc.
Work Order: 15090426
Project: 1508.1, Appleton Former MGP, Appleton, WI

ANALYTICAL QC SUMMARY REPORT

Air Toxics

BatchID: R113857

ANALYTICAL RUN SUMMARY

SeqNo	Sample ID	Type	Test Code	Batch	DF	Date Analyzed
3086956	CCV091515-3C L3	CCV	EPA_3C	R113857	1	09/15/2015 13:01
3086957	LCS091515-3C L3	LCS	EPA_3C	R113857	2	09/15/2015 13:58
3086958	MB091515-3C	MBLK	EPA_3C	R113857	2	09/15/2015 14:15
3086959	15090426-001A	SAMP	EPA_3C	R113857	2	09/15/2015 14:32
3086960	15090426-001A	DUP	EPA_3C	R113857	2	09/15/2015 14:48
3086961	15090426-002A	SAMP	EPA_3C	R113857	2	09/15/2015 15:04
3086962	15090426-002A	DUP	EPA_3C	R113857	2	09/15/2015 15:19
3086963	15090426-003A	SAMP	EPA_3C	R113857	2	09/15/2015 15:33
3086964	15090426-003A	DUP	EPA_3C	R113857	2	09/15/2015 15:47
3086965	15090426-004A	SAMP	EPA_3C	R113857	2	09/15/2015 16:01
3086966	15090426-004A	DUP	EPA_3C	R113857	2	09/15/2015 16:16
3086967	15090426-005A	SAMP	EPA_3C	R113857	2	09/15/2015 16:32
3086968	15090426-005A	DUP	EPA_3C	R113857	2	09/15/2015 16:48
3086969	CCV091515C-3C L3	CCV	EPA_3C	R113857	1	09/15/2015 17:08

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB091515-3C	**ZZZZZ**	**MBLK**	**mol %**	**Method 3c**		**9/15/2015**	**GC-TCD1_150915A**	**3086958**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Carbon Dioxide	ND	0.0800									
Methane	ND	0.100									
Oxygen	ND	0.800									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCS091515-3C L3	**ZZZZZ**	**LCS**	**mol %**	**Method 3c**		**9/15/2015**	**GC-TCD1_150915A**	**3086957**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Carbon Dioxide	0.604	0.0800	0.6	0	101	80	120	0	0		
Methane	1.028	0.100	1	0	103	80	120	0	0		
Oxygen	0.812	0.800	0.8	0	102	80	120	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
15090426-001A	**091015001**	**DUP**	**mol %**	**Method 3c**		**9/15/2015**	**GC-TCD1_150915A**	**3086960**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Carbon Dioxide	ND	0.0800	0	0	0	0	0	0	0	5	
Methane	ND	0.100	0	0	0	0	0	0	0	5	
Oxygen	17.48	0.800	0	0	0	0	0	17.45	0.149	5	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
15090426-002A	**091015002**	**DUP**	**mol %**	**Method 3c**		**9/15/2015**	**GC-TCD1_150915A**	**3086962**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Carbon Dioxide	0.072	0.0800	0	0	0	0	0	0.086	0	5	J
Methane	ND	0.100	0	0	0	0	0	0	0	5	
Oxygen	17.18	0.800	0	0	0	0	0	17.32	0.765	5	

Qualifiers:

ND - Not Detected at the Reporting Limit	S - Spike Recovery outside accepted recovery limits	B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits	E - Value above quantitation range
* - Non Accredited Parameter	H/HT - Holding Time Exceeded	

CLIENT: Natural Resource Technology, Inc.
Work Order: 15090426
Project: 1508.1, Appleton Former MGP, Appleton, WI

ANALYTICAL QC SUMMARY REPORT

Air Toxics

BatchID: R113857

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
15090426-003A	**091015003**	**DUP**	**mol %**	**Method 3c**		**9/15/2015**	**GC-TCD1_150915A**	**3086964**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Carbon Dioxide	ND	0.0800	0	0	0	0	0	0	0	5	
Methane	ND	0.100	0	0	0	0	0	0	0	5	
Oxygen	17.25	0.800	0	0	0	0	0	17.35	0.578	5	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
15090426-004A	**091015004**	**DUP**	**mol %**	**Method 3c**		**9/15/2015**	**GC-TCD1_150915A**	**3086966**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Carbon Dioxide	ND	0.0800	0	0	0	0	0	0	0	5	
Methane	ND	0.100	0	0	0	0	0	0	0	5	
Oxygen	17.06	0.800	0	0	0	0	0	17.33	1.56	5	

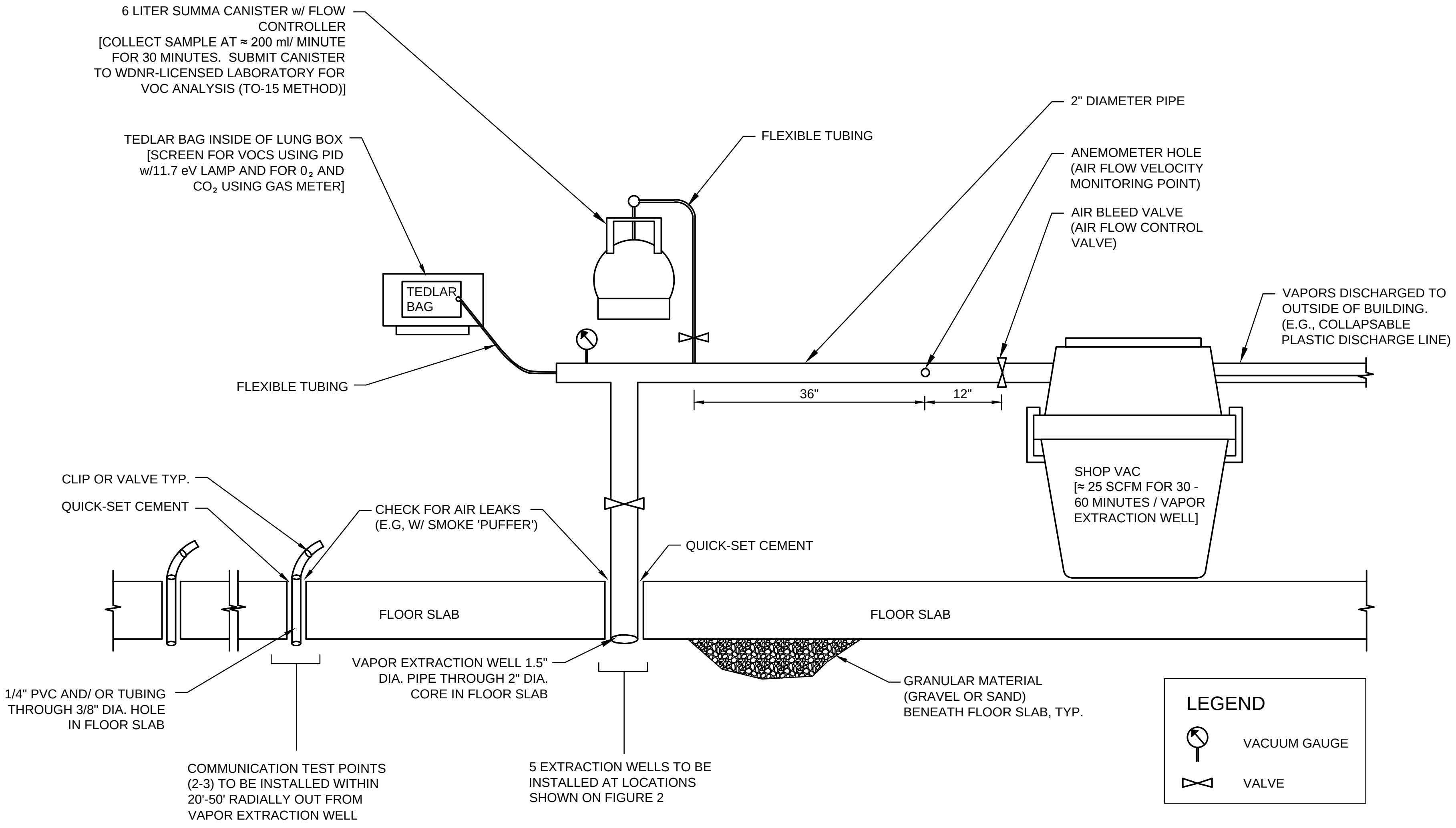
Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
15090426-005A	**091015005**	**DUP**	**mol %**	**Method 3c**		**9/15/2015**	**GC-TCD1_150915A**	**3086968**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Carbon Dioxide	ND	0.0800	0	0	0	0	0	0	0	5	
Methane	ND	0.100	0	0	0	0	0	0	0	5	
Oxygen	17.36	0.800	0	0	0	0	0	17.46	0.563	5	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

ATTACHMENT C

HIGH PURGE VOLUME SCHEMATIC AND NRT SUB-SLAB SAMPLING SOP



HIGH PURGE VOLUME SUB-SLAB VAPOR SAMPLING SCHEMATIC

NATURAL
RESOURCE
TECHNOLOGY

PROJECT NO.

DRAWING NO.

FIGURE NO.
Figure 1

DRAWN: DMD DATE: 07/28/14 CHK'D: . DATE: . APP'D: KWY DATE: 07/30/14

Prepared By:	SGW	Date Prepared:	01-13-2015
Corporate Officer:	JMN	Date Approved:	02-20-2015

SUB-SLAB SAMPLE PORT INSTALLATION, SAMPLING AND ABANDONMENT

1.1. Scope and Application

This standard operating procedure (SOP) is applicable for the installation of sub-slab sample ports, soil vapor sampling and abandonment of the sub-slab port. This standard describes procedures for monitoring of permanent and semi-permanent soil vapor probes for evaluation of subsurface vapor migration. When sampling has been completed this standard also describes proper abandonment of the sub slab port. Note that these methods may be modified as necessary to meet State or Federal guidelines for sample collection. Refer to project-specific documents for variances to this SOP.

As of July 2014 proposed WDNR sub-slab guidance document RR 986 “Sub-Slab Vapor Sampling Procedures” contains recommendations for approximately 1 probe for each 2,000 square feet of commercial buildings, if this is unworkable, high purge volume (HPV) sampling procedures should be considered[1]. This SOP does not discuss the HPV method of sample collection. If high volume sampling is to be performed, the methods should be included in a site-specific work plan.

1.2. Health and Safety Warnings

Follow Natural Resource Technology, Inc. (NRT) Health and Safety standard operating procedures (06-05) when working with potentially hazardous material or with material of unknown origin. In addition follow all safety procedures when using electric tools, compressed gases and generators. Project Health and Safety Plans will contain additional practices, as necessary, to mitigate site-specific hazards. Sample Identification.

1.3. Sub-Slab Installation Procedures

Review site drawings for the location of on-site utilities prior to the start of work and locate the sub-slab port away from any known utility and out of the way of high foot traffic areas. Clear all utilities prior to the

---

[1] McAlary, T., et.al., *High Purge Volume Sampling – a New Paradigm for Subslab Soil Gas Monitoring*, Ground Water Monitoring & Remediation, V. 30, no. 2, Spring 2010, pp. 73-85.

start of any drilling through the slabs. A private utility locator will be required in most instances. The following equipment and materials will be required to install the sub-slab sampling port:

- Large rotary hammer drill
- Small (3/8-inch) rotary hammer drill
- Two masonry bits for the rotary hammers (2-inch solid stem or coring bit and ¼-inch [one foot long])
- Generator (2000 watt or larger), as needed
- Extension cord(s) (three prong grounded) for use with hammer drill and vacuum cleaner
- ¼-inch outer diameter (O.D.) stainless steel tubing
- ¼-inch Swagelok fitting
- Cap (hex plug) for Swagelok fitting
- ¼-inch O.D. Teflon or stainless-steel compression fittings
- Or sub-slab sample port kit (such as Cox Colvin Vapor Pin^{TM})
- Probe/well location maps
- Soil vapor toolbox (crescent wrenches, tubing cutter, hex wrenches, screwdrivers)
- Hydraulic cement (VOC free)
- 4-inch metal plate (type used to cover electrical boxes) and/or 1.5-inch circular caps used to cover openings in electrical boxes. The 1.5-inch caps work very well in combination with the 2-inch coring bit.
- Vacuum cleaner

Attach the 2-inch masonry bit or coring bit to the large rotary hammer drill. Drill an approximately 1.5 to 2 inch deep pilot hole into the concrete at the desired probe location but do not drill entirely through the concrete with the 2–inch bit. Clean concrete dust and any chips out of the hole. Attach the ¼-inch bit to the small rotary hammer drill and drill into the center of the pilot hole through the bottom of the concrete slab.

Cut an approximate 1.5-inch length of stainless steel tubing and attach it to the Swagelok fitting. Use a crescent wrench to tighten the Swagelok fitting around the tubing. Attach a stainless steel cap onto the Swagelok fitting. Place the tubing with Swagelok fitting attached into the hole in the concrete slab. Check to make sure the top of the Swagelok fitting is below the level of the slab. If it is not below floor level use the 2-inch bit to drill the pilot hole deeper. Once the fitting is at the desired depth, mix the hydraulic cement and place the cement in the hole around the fitting sealing it off from surface air and holding it in place. Approximately ½ of the fitting will be in the hydraulic cement, leaving enough of the fitting exposed to get a wrench onto it. If using a metal plate to cover the probe, drill holes in the floor with the small hammer drill so screws can be used to attach the 4 inch plate to the floor such that it covers the sub-slab soil vapor probe. If using 1.5-inch circular cap, use a pliers to adjust the prongs on the bottom of the cap such that it clips into the 2-inch hole the probe is set into.

Allow the hydraulic cement to cure prior to sample collection (typically 12 hours). If using a sub-slab probe with a silicone seal, allow 1-2 hours for the sub-slab soil gas to equilibrate prior to sample collection.

During installation of the sub-slab vapor probe, record the methods, location information, and other observations using the Sub-Slab Probe Construction Form (Attachment C). Attach a sketch or a site map with the location of the sub-slab vapor probe(s) to the form. One map may be sufficient for a site with multiple probes. Observations should include approximate thickness of the slab and type of material present beneath the slab based on depth the drill bit exits the slab, presence or absence of material felt below the slab, and visual observations of soils on the drill bit, if present.

1.4. Sub-Slab Soil Vapor Sample Collection

The following sections describe the equipment, set-up, sampling procedures, and post sampling handling of soil vapor samples.

1.4.1. Sub-Slab Soil Vapor Sampling Equipment

Typically, a soil vapor sample will be collected from the sub-slab soil vapor port and analyzed for volatile organic compounds (VOCs) by Method TO-15 (or equivalent) and potentially other parameters. Sample collection from a sub slab vapor probe is similar to other soil gas sampling and contains references to SOP 07-09-07 “Soil Vapor Sampling”. The following equipment may be required to collect a sub-slab soil vapor sample:

- Digital manometer (Dwyer Series 475 Mark III Digital Manometer or equivalent) or magnehelic differential pressure gauge (0-20 inches of water)
- Calibrated vacuum gauge for measuring initial and final vacuum readings. Digital is preferred though analog is acceptable, especially when working outside operational temperatures for

digital gauge. Vacuum gauges will be calibrated according to manufacturer's instructions and will be submitted for recalibration a minimum of once per year. Gauges will be sent to a certified facility to be checked against masters traceable to the National Institute of Standards and Technology (NIST).

- Landtec GEM 2000 (or equivalent) landfill gas meter (methane, carbon dioxide, oxygen, and nitrogen)
- Dielectric Technologies MGP 2002 helium detector
- Helium. Technical Grade (99% purity) is the standard. Use of lower grade helium must be evaluated on a site specific basis and may require agency approval prior to sample collection.
- Plastic shroud to cover probe
- 1-liter Tedlar™ bags, and lung box (if required)
- Tygon™ or silicone tubing (cut to length)
- ¼-inch O.D. inert tubing (e.g., Teflon™) cut to length
- GeoTech peristaltic pump or equivalent
- BIOS DC-LITE flow calibrator, calibrated rotometer, or equivalent
- New or dedicated 3-way valves for purging and sampling
- New or dedicated 2-way valves for purging
- 1 or 6-liter Summa™ (or equivalent) canisters (batch certified)
- Summa™ canister regulator set at approximately 150 milliliters per minute (mL/min)
- ¼-inch O.D. Teflon sample line
- ¼-inch O.D. Teflon or stainless-steel compression fittings
- Probe/well location maps
- Chain of custody forms and seals
- Field logbook and field data air sampling forms
- Instrument calibration forms
- Health and Safety Plan

1.4.2. Soil Vapor Sample Set-Up

Field sampling staff shall complete the sample set-up of a Summa™ (or equivalent) canister prior to sample collection. Each Summa™ (or equivalent) canister shall be vacuum tested with a calibrated digital or analog vacuum gauge attached to the canister inlet. The canister vacuum is checked by opening the canister valve and noting the initial vacuum reading. The vacuum should indicate between 25 and 30-inches of mercury. The canister shall not be used if the starting vacuum is less than 25-inches of mercury. If the vacuum does not stabilize, the gauge or associated fittings are leaking. Upon completion of the vacuum check, close the Summa™ canister valve and remove the vacuum gauge. Attach the sample regulator to the Summa™ canister. This regulator need not be dedicated if zero grade laboratory air is available to purge/decontaminate it between samples.

When setting up over a sub-slab sample probe, prepare a dedicated stainless steel fitting with threads wrapped in Teflon™ tape on one end for connecting to the Swagelok sub-slab probe and a compression fitting connected to ¼ inch O.D. inert tubing on the other end. The inert tubing will be capped by a dedicated 3-way micro-valve with the valve position closed to the vapor probe. Detailed directions on the use of the 3-way micro-valve are provided in Attachment A of this SOP “Guide to the 3-way Micro-valve”. Remove the hex plug on the sub-slab probe and attach the stainless steel fitting rapidly to minimize the amount of time the probe is exposed to the atmosphere. If the probe is exposed to the atmosphere, the probe shall be sealed and left to re-equilibrate for 30 minutes prior to purging.

A helium shroud, consisting of a solid plastic container with a recommended height of less than 6 inches and a volume less than 6L, will be placed over the 3-way micro-valve around the exposed portion of the soil vapor probe. Inert tubing will be connected to the other two ends of the micro-valve and pass through ¼-inch holes in the helium shroud sealed with a pass-through compression fitting (or some other material) to prevent the helium from escaping the shroud. One length of tubing will connect with the Summa™ canister and the other length will attach to a purge apparatus. All fittings and tubing will be dedicated to avoid cross-contamination between probes.

The helium shroud will contain two additional holes no more than three inches above the base of the shroud for connections to the helium source and helium detector. It is especially important that the hole for the helium detector is near the base of the shroud to get an accurate reading of the percentage of helium near the surface seal of the vapor probe. Lengths of inert tubing will be inserted into the side of the shroud and sealed using a compression fitting or other inert material to prevent helium from escaping the shroud. One length of tubing will be connected to the helium cylinder and the other to the helium detector outside of the shroud.

The tubing coming out from the shroud connected to one outlet of the 3-way micro-valve will be connected directly to the flow controller and Summa™ canister assembly. The tubing coming out from the shroud connected to the other outlet of the 3-way micro-valve will be connected to a 2-way stopcock with the valve position closed to the vapor probe. The 2-way stopcock will then be connected to a purge apparatus that will fill a 1L Tedlar™ (or equivalent) bag. The purge apparatus must be able to fill the Tedlar™ bag at a rate similar to grab sample collection (100 to 200 milliliters per minute).The preferred purge method is to connect the Tedlar™ bag.to a peristaltic or gas sampling pump and directly fill the Tedlar™ bag. An alternate purge method may include the use of a lung box. Details of sample purging are discussed in Section 1.4.5 below. A new pair of Nitrile gloves should be worn while connecting the sample assembly for each soil vapor probe. The total length of inert tubing should not exceed 5 feet.

1.4.3. Summa TM Canister Preparation and Quality Assurance/Quality Control

A Summa™ canister is a stainless steel container which has had its internal surfaces passivated (at the laboratory) using the “Summa™” process. The process uses an electro-polishing step in conjunction with chemical deactivation. The overall process results in a chemically inert interior surface of the media which allows for the collection and subsequent analysis of samples containing very low concentrations of VOCs. The Summa™ media is available in a number of different sizes. Note that water should never be allowed to enter a Summa™ canister because it may render the canister unusable.

Once the laboratory cleaning process is completed, the Summa™ canisters are prepared by the laboratory for use in the field. Each canister is evacuated to achieve a vacuum pressure of approximately 30-inches of mercury. The pressure differential between the canister and atmosphere allows for the Summa™ canister to sample without the use of a separate sample pump. Depending on the project requirements, either grab or integrated samples may be collected. The holding time (shelf life) for Summa™ canisters that have been prepared for use in the field is 30-days. If the canister has not been used within this time-period, it shall be returned to the contracted laboratory for re-conditioning.

Summa™ canisters undergo either an individual or batch certification process. The individual certification process requires that each canister undergo a comprehensive Quality Assurance/Quality Control (QA/QC) procedure that results in analysis documentation for each canister, verifying that there are no residual compound concentrations above a pre-determined level. Individual certifications add greatly to the cost. Typically, individually certified canisters are used for indoor and ambient air sampling programs that require very low method detection limits. Batch certified canisters undergo the same re-conditioning process as the individually certified canisters. However, only 5-percent of randomly chosen canisters are analyzed for residual constituents. If any of the selected canisters do not meet specific certification criteria, all of the canisters in that batch are required to undergo the entire cleaning and QA/QC process again. This process is repeated until all QA/QC re-conditioning criteria are met.

A picture of a typical 6-liter Summa™ canister and a 30-minute sample flow controller are provided below. 1-liter canisters are smaller, but have the same general appearance. Flow controllers may vary significantly in appearance.

30-Minute Flow Controller with Vacuum Gauge

Summa Canister (6-Liter)

1.4.4. Differential Pressure Gauge Measurement Procedure

A Dwyer digital manometer or magnehelic differential pressure gauge or equivalent (herein referred to as the “gauging instrument”) shall be used to measure the pressure or vacuum of the soil vapor port to be sampled. Immediately prior to use, the gauging instrument shall be zeroed at atmospheric pressure. Vacuum/pressure measurements shall be obtained using the following procedure.

The positive fitting on the gauging instrument shall be connected to the 3-way micro-valve, previously installed to the top of the sampling port, using small diameter silicone tubing of appropriate size. The negative fitting on the gauging instrument shall remain open to the atmosphere. The 3-way valve shall be opened to the port and closed to the atmosphere. The gauging instrument shall be allowed a maximum of ten (10) minutes to stabilize before the vacuum/pressure is recorded. If the gauging instrument does not stabilize within the 10 minute period, the range in which the vacuum/pressure reading fluctuates over an additional one (1) minute period will be documented in the field logbook and/or on the appropriate field form. The highest reading observed within the observed range will be recorded in the field logbook and/or on the appropriate field form as the primary measurement. (Please note: If the gauging instrument reading fluctuates between two vacuums, the lowest/weakest vacuum observed will be recorded as the primary measurement. If the gauging instrument reading fluctuates between a vacuum and a pressure, the highest pressure observed will be recorded as the primary measurement. If the manometer reading fluctuates between two pressures, the highest/strongest pressure observed will be recorded as the primary measurement. In all cases, the range in the gauging instrument readings over the additional one-minute period will be recorded in the field logbook and/or on the appropriate field form.) The vacuum/pressure measurement shall be recorded to the nearest hundredth of an inch of water column in the field logbook and/or on the appropriate field. Please note a field form, if used, is considered the record document. Immediately following the recording of the vacuum/pressure measurement, the 3-way valve shall be closed to the well and open to the atmosphere and the gauging instrument shall be detached from the silicone tubing and 3-way valve (see Attachment A: Guide to the 3-way Micro-Valve).

A picture of a typical vacuum/pressure gauging set-up is provided below.

1.4.5. Sampling Port Purging

Upon completion of any vacuum/pressure measurements and prior to soil vapor sample collection, each probe shall be purged a predetermined volume (in liters or milliliters) based on the volume of the probe riser (tubing length). The purge volume shall be equivalent to a minimum of three tubing volumes. Volume of air in the tubing will be calculated using the formula: πr2l, where r is the inside radius of the tubing and l is the length of tubing. For typical ¼-inch outer diameter 3/16–inch inner diameter tubing, there will be 5.4 milliliters of air per foot of tubing. Multiplying that volume by 3, results in a purge volume of 16.3mL of air per foot of tubing. The total purge volume can be calculated by multiplying the length of tubing (in feet) from the Tedlar™ bag to the top of the vapor probe by 16.3 mL. Typically, the 1-liter volume removed during the chemical leak test is more than adequate to also purge the sample probe.

As discussed above, a purging apparatus will be connected to the 2-way stopcock. The purpose of the 2-way stopcock is to prevent the vapor probe from coming into contact with the ambient atmosphere. For this reason, the two way stopcock should always be closed to the vapor probe except during sample purging. Once sample purging is complete, the valve must be closed prior to stopping the vacuum/air pump to prevent backflow of ambient air into the vapor probe. Note, if any portion of the sample train is exposed to ambient air after purging, the sample train must be resealed and allowed to re-equilibrate for 30 minutes and be repurged prior to sampling.

Using the preferred purging apparatus, the inlet of the gas sampling pump will connect to the outlet of the 2-way stopcock. The outlet of the gas sampling pump will be connected to the inlet of a flow meter (rotameter) to monitor the rate at which the probe is purged. Then the outlet of the rotameter will be connected to the inlet of the Tedlar™ bag.

Alternatively, if a lung box is used, the inlet of the Tedlar™ bag will be connected to the outlet of the 2-way stop cock and the Tedlar™ bag will be placed in a lung box large enough to collect the requisite volume of purged soil gas. The gas sampling pump will be connected to the rotameter to monitor the flow rate and evacuate the air inside the lung box to collect soil gas into the 1L Tedlar™ bag.

Purging will be conducted using a flow rate of 100 to 200 mL/min consistent with the rate of sample collection. Given the small volume of the sample probes, purge air can be discharged to the outside atmosphere. Note that Tedlar™ bags should not be discharged within buildings, especially during concurrent indoor air sampling. Care shall be taken to prevent the purged air from being reintroduced into the sampling probe.

1.4.6. Chemical (Helium) Leak Testing

The purpose of the chemical leak test is to ensure that the sample port and probe assembly is properly set and not leaking. A leaking probe assembly could result in leakage of ambient air into the sample, potentially biasing the sample. Prior to sampling, a chemical leak test will be performed using helium as a tracer gas. A shroud will be placed over the soil vapor probe. The ambient air inside the shroud will be replaced with helium graded at 99 percent purity or higher until the atmosphere consists of a minimum of 20 percent helium. The concentration of helium under the shroud shall be continuously monitored and maintained above 20% during purging of the vapor probe. It should be noted that concentrations of 60 percent to 80 percent helium have routinely been observed in the shroud during prior field testing. This will be accomplished by inserting Teflon™ tubing through a ¼ inch hole in the shroud and attaching the other end to the helium canister. The helium canister will then be opened, and the shroud atmosphere will be continuously monitored by a Dielectric Technologies Model MGD-2002 Multi-Gas Detector (or equivalent) until the percentage of helium inside the shroud reaches a minimum of 20 percent. The final helium concentration inside the shroud will be recorded on the Field Data Air Sampling Form. The final helium concentration inside the shroud will be multiplied by 10 percent (0.1) to determine the allowable concentration of helium in the Tedlar™ bag sample. Both the final helium concentration inside the shroud and the calculated allowable concentration in the Tedlar™ bag will be recorded on the Field Data Air Sampling Form (Attachment B).

After the target atmosphere is established (and maintained throughout the period of the chemical leak test), the 3-way stopcock will be opened to the purge apparatus, which fills a 1-liter Tedlar™ bag attached via inert tubing to the sample probe/port. An in-line flow meter will be used to monitor/adjust the flow of air being removed by the purge apparatus. Once filled, the 2-way and 3-way valves between the sampling port and the 1 liter Tedlar bag will be closed to prevent the vapor probe from being exposed to the atmosphere and then the 1-liter Tedlar™ bag will be disconnected. The air inside Tedlar bag will be measured using the Model MGD-2002 Multi-Gas Detector (or equivalent) for the presence of helium. The concentration of helium measured inside the Tedlar™ bag will be recorded on the Field Data Air Sampling Form. If the concentration of helium in the sample is below the calculated allowable concentration (i.e., less than 10 percent of the concentration inside the helium shroud), proceed with the mechanical leak test and sample collection as described in Sections 1.4.7 and 1.4.8. Note that the allowable concentration can vary depending upon the agency that you are working with (e.g., WDNR draft guidance suggests a 5% allowable concentration). The recommended allowable concentration should be confirmed prior to entering the field. Typically, the Tedlar™ bag of air also serves as the required three volume purge of the probe or port.

Corrective actions to mitigate leaks in the sub-slab probe will be performed when the helium concentration in the Tedlar™ bag sample exceeds the allowable concentration in the helium shroud. Corrective actions will be performed in the field and will include checking and tightening all connections. Samples will not be collected for laboratory analysis when the helium concentration in the Tedlar™ bag sample exceeds 10 percent of the helium concentration in the shroud.

1.4.7. Mechanical Leak Testing

The mechanical leak test will be performed immediately after completing the helium leak test. Since the mechanical leak test is performed using the vacuum of the Summa™ canister, it is preferred to complete the chemical leak test before the mechanical leak test to potentially identify leaks in the sample train prior to opening the canister. This reduces the risk of exposing a canister during a failed mechanical leak test. The mechanical leak test will be completed by keeping the 2-way valve closed to the atmosphere and turning the valve on the 3-way valve to close the connection to the sub-slab vapor probe.

Vacuum test the connections between the Summa™ canister and 3-way valve by opening the canister valve to place a test vacuum on the assembly for 10 minutes. The start time and initial vacuum, as well as the stop time and final vacuum, will be recorded on the Field Data Air Sampling Form and in the field logbook. If gauge vacuum cannot be maintained for 10 minutes, work shall be suspended and all fittings in the sample assembly will be checked and corrective actions taken. The initial Summa™ canister that failed shall be discarded and a new canister will be connected to the sample train. Once the sample train is reassembled, the sample assembly will be re-tested. If vacuum still cannot be maintained for 10 minutes, sampling activities will be discontinued until the leak can be identified and addressed.

If gauge vacuum was maintained for 10 minutes, close the canister valve and immediately proceed with sample collection as described in Section 1.4.8. Note that some agencies may request the vacuum for the mechanical test to be introduced using a separate pump and vacuum gauge (rather than use the Summa™ canister to supply the vacuum). In this instance the apparatus used to create the vacuum may be attached to the 2-way valve. Confirm acceptable methods for mechanical leak detection prior to entering the field.

1.4.8. Sample Collection Summa™ Canisters

Sample location information and meteorological conditions (temperature, barometric pressure, wind speed/direction, and relative humidity) shall be recorded on a Field Data Air Sampling Form. Meteorological data will be obtained online from the nearest National Weather Service measuring station. Digital photos may be taken of each sample location and sample assembly. Ambient air measurements of carbon dioxide, oxygen, methane, and nitrogen collected using the Landtec Gem 2000 Plus (or equivalent) meter will be recorded on the field form. These measurements may be required for comparison to concentrations measured in the sample.

Open the 3-way stopcock connecting the Summa™ canister assembly to the soil vapor probe/port. The canister valve will already be open if sampling immediately follows the mechanical leak test. The time and initial vacuum when sample collection starts shall be recorded on the Field Data Air Sampling Form. In addition record the elapsed time and vacuum periodically until sampling is completed. The laboratory-provided flow regulators will have been calibrated for a 5 to 10 minute sample duration, which correlates to a flow rate of 150 to 200 ml/min. Close the Summa™ canister valve when the vacuum gauge indicates approximately 5 inches Hg (mercury) of vacuum remain in the canister. Sample collection should take approximately 5 to 10 minutes for a 1-liter Summa™ canister (depending on the regulator flow rate). Care should be taken to not allow the vacuum to approach ambient pressure. If the final pressure is near ambient (less than 1 inHg), it must be considered an invalid sample. If the vacuum inside the canister approaches ambient pressure, consider completing the sample (closing the valve) and submitting the sample, as collected, to the laboratory for analysis. Final pressure inside the canister before and after sample collection must be recorded and is typically submitted to the laboratory at the time of analysis.

The time at which sample collection was stopped and final vacuum shall be recorded on the Field Data Air Sampling Form. Remove the flow regulator/particulate filter assembly. Attach either the digital or analog vacuum gauge to the canister and record the final vacuum on the Field Data Air Sampling Form. Remove the vacuum gauge and replace the laboratory-supplied brass plug on the canister. Disconnect the sample tubing assembly and replace the protective cover on the soil vapor probe. If water and/or product are encountered during sample collection, this observation shall be documented in the field logbook and/or on the appropriate field form and on the sample tag.

Label the sample canister tag and record on the COC the sample identification, date and time the sample was collected, the canister and flow controller serial numbers, and the final vacuum gauge reading. Samples shall not be chilled or subjected to extreme temperature or pressure fluctuations. Samples will be shipped to the laboratory for analysis of VOC contaminants of concern (as identified in a site specific work plan) by USEPA approved methods, such as Method TO-15. When appropriate, include analysis of carbon dioxide, oxygen, methane, and nitrogen by ASTM Method D1946 or EPA 3C.

1.4.9. Tedlar™ Bag Sample Media

Soil vapor samples for on-site analysis/field screening shall be collected using a Tedlar™ bag media and a peristaltic pump. A sample collected in a TedlarTM bag will follow the same procedure followed for the chemical leak test described in Section 1.4.6.

Sample location information and meteorological conditions (temperature, barometric pressure, wind speed/direction, and relative humidity) shall be recorded on a Field Data Air Sampling Form. Meteorological data will be obtained online from the nearest National Weather Service measuring station.

Digital photos will be taken of each sample location and sample assembly. Record measurements of carbon dioxide, oxygen, methane, and nitrogen during sampling using the Landtec Gem 2000 plus meter (or equivalent). These measurements may be required for comparison to concentrations measured in the sample.

1.4.10. Post-Sample Collection

The sample train shall be dismantled and all non-dedicated lines used for sample collection shall be disposed of. New sample lines at each sample location shall be used, except for dedicated equipment (3-way valves, fittings, and coupling bodies, etc.). The valve shall remain attached to soil vapor probes however; the valve shall be configured so that the probe is closed to atmosphere (see Attachment A: Guide to the 3-way Micro-Valve). Non dedicated, reusable equipment such as the flow regulators and sample T's (for duplicate sample collection) shall be decontaminated by purging with laboratory supplied air.

1.4.11. Quality Control

Field duplicates will be collected during soil vapor sampling activities. Field duplicates will be collected at the rate of one duplicate sample per 20 soil vapor samples (i.e., 5 percent). Duplicate samples shall be collected by repeating the procedure detailed above, with the addition of a "T" splitter, and one canister attached to each end of the "T" Swagelok (compression) or equivalent fitting. A picture of a typical set-up for the collection of a duplicate sample is provided below.

Trip blanks typically will not be analyzed when using Summa™ canisters. Trip blanks shall be utilized if they become a requirement of the sample collection method or as requested in a site specific work plan. Trip blanks can consist of either unopened fully evacuated canisters or canisters that have been fully charged with zero grade air by the laboratory. Since a fully charged canister has no vacuum with which to pull contaminants into the canister, a fully evacuated canister has a better likelihood of capturing potential transit-related contamination. If requested, the trip blank will be provided by the laboratory.

1.4.12. Soil Vapor Sample Handling

Tedlar™ bag samples shall be transported to the onsite field screening location. The holding time for a Tedlar™ bag sample shall not exceed thirty-six (36) hours.

Summa™ canisters samples shall be shipped to the contracted laboratory under chain of custody procedures for offsite laboratory analysis. The holding time for a Summa™ sample shall not exceed laboratory requirements or fourteen (14) days, whichever is more stringent.

1.5. Sub-Slab Port Abandonment

When the sub-slab probe sampling has been completed and sampling is no longer required the sub-slab sampling port shall be abandoned. Be sure to discuss abandonment procedures and restoration of the floor with the property owner or representative, they may have preferences that need to be discussed. The following tools are required for abandonment:

- Hammer
- Chisel
- Granular bentonite
- Hydraulic cement

Remove the steel plate cover from the soil vapor sampling port. Using the hammer and chisel break up the hydraulic cement holding the sample port in place. Remove the sample port. Pour granular bentonite into the hole through the concrete left by the sampling port that had been removed. Remove any loose material (bentonite and cement chips) from the hole. Mix up the hydraulic cement and fill in the hole until it is level with the slab. Smooth the cement.

1.6. Building Observations during Sub-Slab Vapor Sampling

Please note the following building conditions when collecting sub-slab vapor samples:

- Condition of concrete floor slab – cracks, coatings, integrity, thickness, etc.
- Presence of sumps, pits, or other floor penetrations that can provide avenues for vapor migration
- Areas of different floor materials – i.e., some concrete, some crawl space areas
- Dimensions of the basement floor area, especially if different from the first floor foot print
- Presence of air handling units or other equipment that may affect the indoor air pressure relative to ambient

1.7. Data Management

Upon return to the office the following field measurements shall be included in electronic format (electronic sample control log) for capture in the NRT database:

- Sample Data
    - Sample ID
    - Date
    - Sample location
    - Canister serial number
    - Flow regulator
    - Sample depth
    - Sample time
    - QC information
- Initial conditions
    - Start time
    - Initial Field Canister Vacuum
    - Initial Air Temperature
    - Initial Barometric Pressure

- Final conditions
    - Stop time
    - Final Field Canister Vacuum
    - Final Air Temperature
    - Final Barometric Pressure
- Field Instrument Readings
    - PID
    - O2
    - CO2
    - CH4

1.8. References

ASTM International, 2001, ASTM Standard D 5314-92 (2001) Standard Guide for Soil Gas Monitoring in the Vadose Zone.

California Environmental Protection Agency, 2012, Advisory – Active Soil Gas Investigations, Department of Toxic Substances Control and California regional Water Quality Board, Los Angeles and San Francisco Regions, April 2012.

Department of Toxic Substance Control-California Environmental Protection Agency, 2011, Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance) October 2011.

H&P Mobile Geochemistry, Inc., March 2013, Soil Vapor Sampling Evaluation of Leak Check Procedures. Study presented at the Annual International Conference on Soil, Water, Energy and Air, San Diego, California.

ITRC (Interstate Technology & Regulatory Council). 2007. Vapor Intrusion Pathway: A

Practical Guideline. VI-1. Washington, D.C.: Interstate Technology & Regulatory Council, Vapor Intrusion Team. www.itrcweb.org.

Illinois Environmental Protection Agency (IEPA) Tiered Approach to Corrective Action Objectives, 35 Ill. Adm. Code 742 (TACO) amendments regarding the addition of the indoor inhalation exposure route issued May 16, 2013, effective July 15, 2013.

San Diego County, 2004, Site Assessment and Mitigation (SAM) Manual, “Overview of Soil Vapor Survey Methods.”

San Diego County, 2002, Site Assessment and Mitigation (SAM) Manual, “Overview of Soil Vapor Survey Methods” Final Draft 8/20/2002.

USEPA, 1994, SOP # 1703, Rev #: 0.0, Summa™ Canister Cleaning Procedure.

USEPA, 1995, SOP #1704, Rev. #: 0.0, Summa™ Canister Sampling.

USEPA, 1996, SOP # 2042, Rev. #: 0.0, Soil Gas Sampling

USEPA, 1999, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters and Analyzed By Gas Chromatography/Mass Spectrometry GC/MS) in Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, 2nd Ed., EPA Publication 625/R-96/010b.

United States Environmental Protection Agency (USEPA), 2002. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). Office of Solid Waste and Emergency Response. November 29.

USEPA, 2007, Guidance for Preparing Standard Operating Procedures (SOPs), EPA/600/B-07/001.

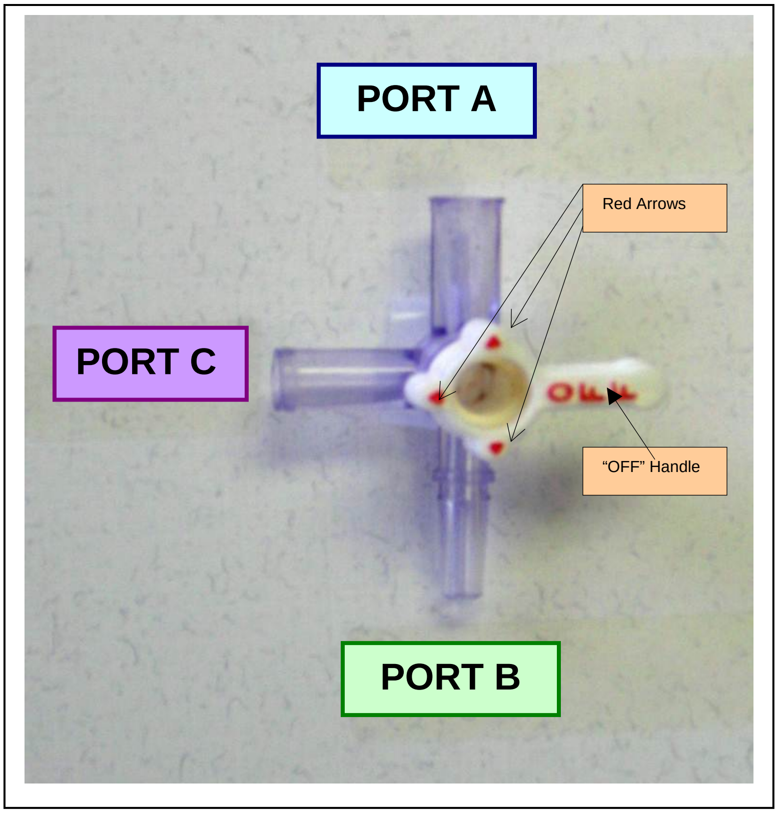
Wisconsin Department of Natural Resources (WDNR), 2010, Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin, PUB-RR-800.

Wisconsin Department of Natural Resources (WDNR), 2014, Sub-Slab Vapor Sampling Procedures, PUB-RR-986.

ATTACHMENT A

GUIDE TO THE 3-way *MICRO-VALVE*

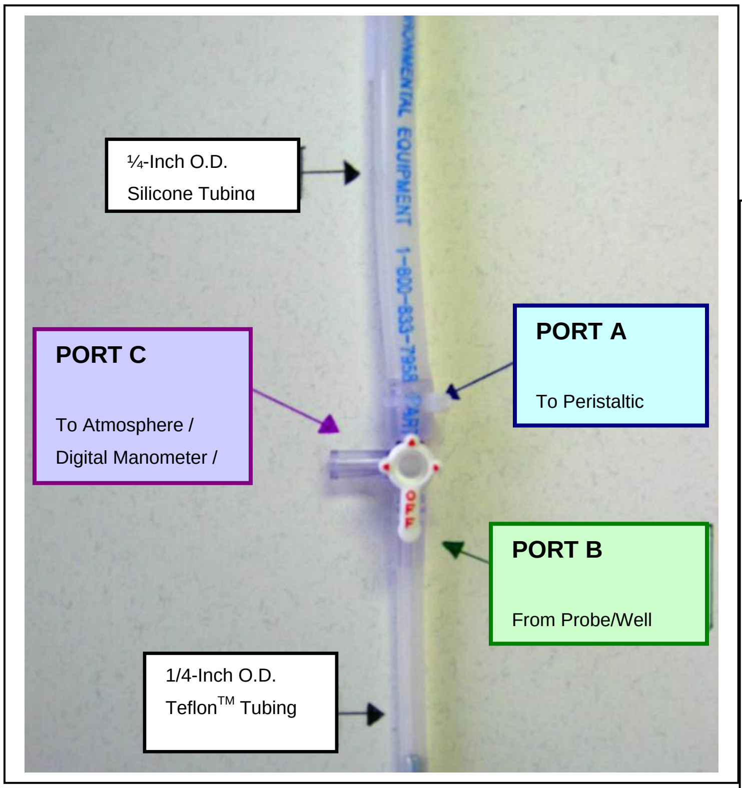
GUIDE TO THE 3-way MICRO-VALVE

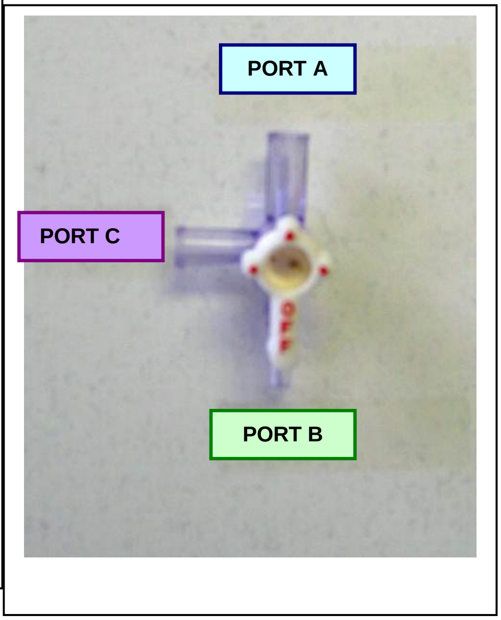


Notes:

1. Red arrows on the 3-way micro-valve indicate the ports that are currently open.
2. The "OFF" handle indicates the port that is currently closed.
3. The designation of ports is alphabetical from the top (opposite the probe/well) going in a clockwise direction.

Valve Position #1: Closed to Probe/Well





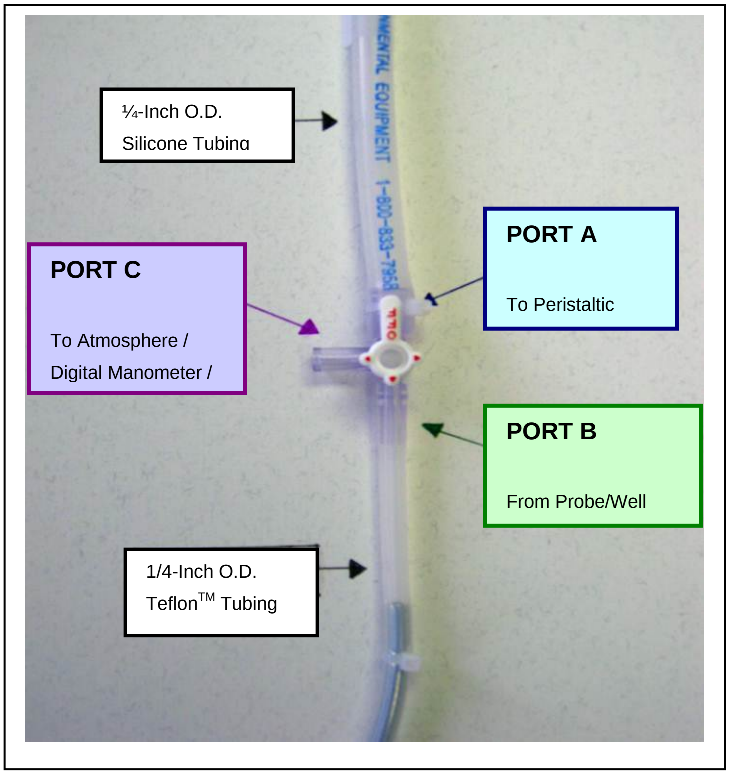
Valve Position #1:

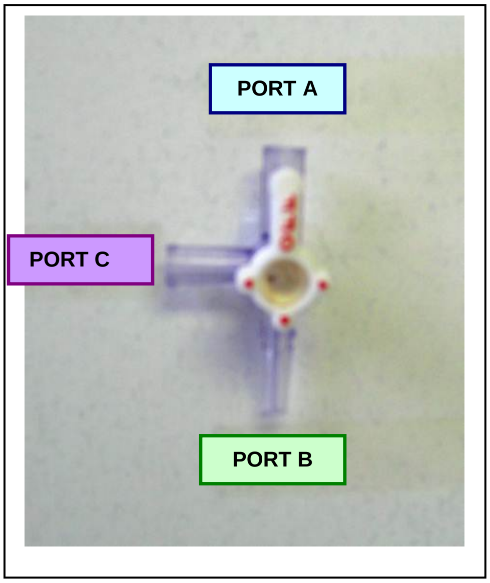
Closed to Port B (Probe/Well);
Open to Port A (Peristaltic Pump / Summa^{TM} Canister)
Open to Port C (Atmosphere / Digital Manometer / 60 mL Syringe)

The "OFF" handle is turned in such a way that it is directly over Port B. The three small, red arrows opposite the "OFF" handle indicate which ports are open (Ports A & C).

In this valve position, the probe/well is not open to the atmosphere and, therefore, will not vent. If the valve is not in this position prior to the start of the monitoring (vacuum/pressure gauging, Tedlar^{TM} bag sample collection, and/or Summa^{TM} canister sample collection, set the valve to Position #1 and return to this location at least 30 minutes later.

Valve Position #2: Open for Vacuum/Pressure Gauging & Purging





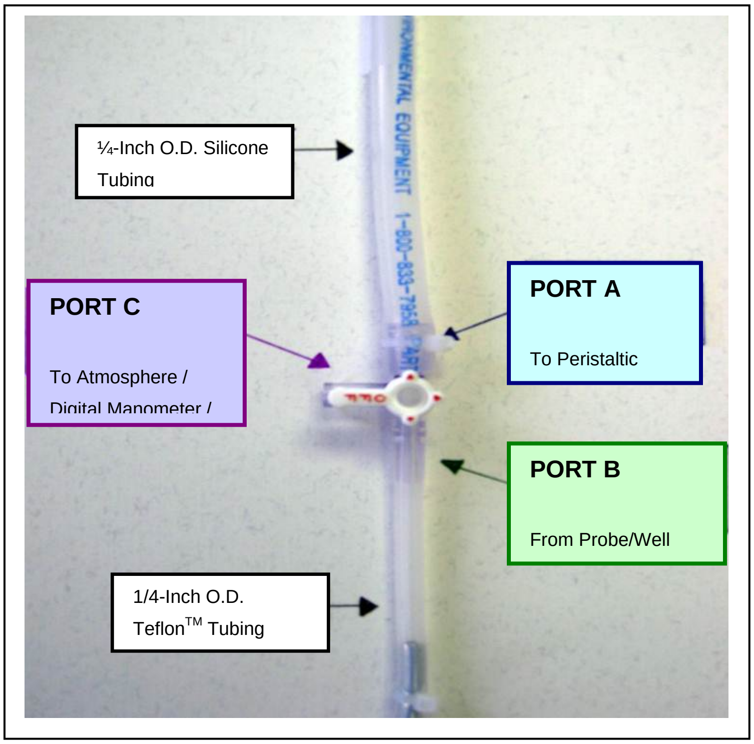
Valve Position #2:

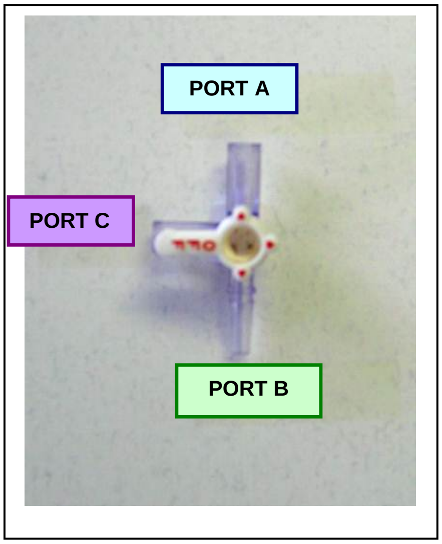
Closed to Port A (Peristaltic Pump / Summa^{TM} Canister);
Open to Port B (Probe/Well)
Open to Port C (Atmosphere / Digital Manometer / 60 mL Syringe)

The "OFF" handle is turned in such a way that it is directly over Port A. The three small, red arrows opposite the "OFF" handle indicate which ports are open (Ports B & C).

In this valve position when the digital manometer is connected to Port C, a vacuum/pressure reading can be obtained from the probe/well. If the valve is in this position prior to the start of the monitoring (vacuum/pressure gauging, Tedlar^{TM} bag sample collection, and/or Summa^{TM} canister sample collection, set the valve to Position #1 and return to this location at least 30 minutes later.

Valve Position #3: Open for Soil Vapor Sample Collection





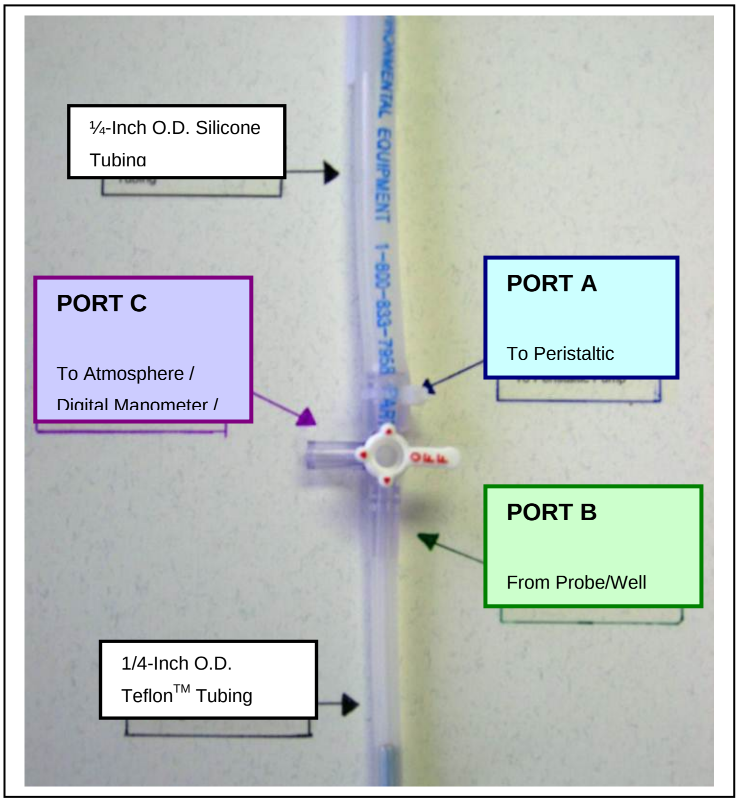
<u>Valve Position #3</u>:

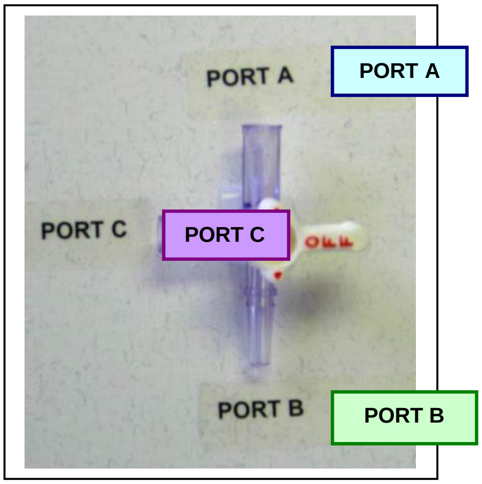
Closed to Port C (Atmosphere / Digital Manometer / 60 mL Syringe);
Open to Port A (Peristaltic Pump / Summa^{TM} Canister)
Open to Port B (Probe/Well)

The "OFF" handle is turned in such a way that it is directly over Port C. The three small, red arrows opposite the "OFF" handle indicate which ports are open (Ports A & B).

In this valve position, a soil vapor sample can be collected from the probe/well using the peristaltic pump and Tedlar^{TM} bag or a Summa^{TM} canister. If the valve is in this position prior to the start of the monitoring (vacuum/pressure gauging, Tedlar^{TM} bag sample collection, and/or Summa^{TM} canister sample collection, set the valve to Position #1 and return to this location at least 30 minutes later.

Valve Position #4: Improper Valve Position





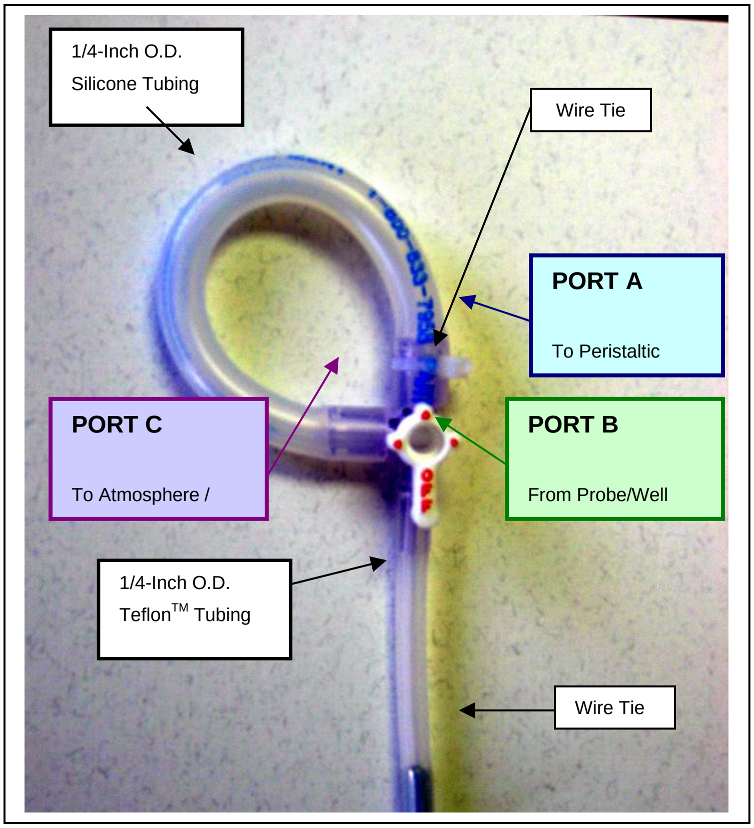
Valve Position #4:

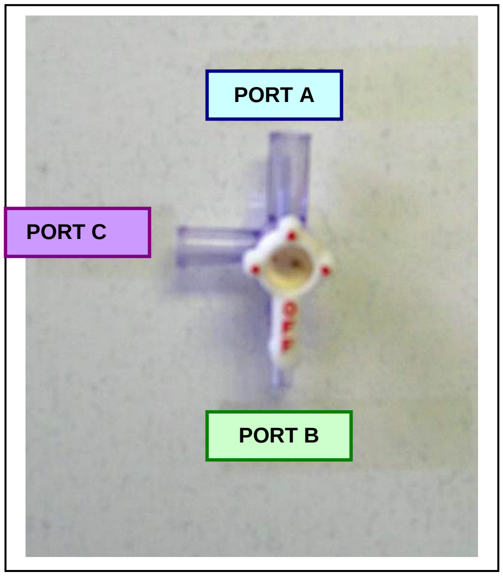
Open to Port A (Peristaltic Pump / Summa^{TM} Canister);
Open to Port B (Probe/Well)
Open to Port C (Atmosphere / Digital Manometer / 60 mL Syringe)

The “OFF” handle is turned in such a way that it is opposite of Port C. The three small, red arrows opposite the “OFF” handle indicate all ports are open (Ports A, B & C).

In this valve position, the probe/well is open to the atmosphere and, therefore, will vent. In addition, this valve position will allow ambient air into the sample train and invalidate the data. If the valve is in this position prior to the start of the monitoring (vacuum/pressure gauging, Tedlar^{TM} bag sample collection, and/or Summa^{TM} canister sample collection, set the valve to Position #1 and return to this location at least 30 minutes later. The valve should never be in this position.

Post-Monitoring Valve and Tubing Configuration





Post-Monitoring Valve and Tubing Configuration:

- Closed to Port B (Probe/Well)
- Open to Port A (Peristaltic Pump / Summa™ Canister)
- Open to Port C (Atmosphere / Digital Manometer / 60 mL Syringe)

The 3-way micro-valve is set to position #1. The "OFF" handle is turned in such a way that it is directly over Port B. The three small, red arrows opposite the "OFF" handle indicate which ports are open (Ports A & C). In addition, the silicone tubing (minimum length of six (6) inches) is configured such that it forms a loop between Port A and Port C and a wire tie is used to secure the silicone tubing to Port A.

In this configuration, the probe/well is not open to the atmosphere and, therefore, will not vent. In addition, this configuration minimizes the water infiltration into the 3-way micro-valve. The valve and tubing should be placed in this configuration following vacuum/pressure gauging and soil vapor sample collection.

ATTACHMENT B

FIELD DATA AIR SAMPLING FORM

FIELD DATA AIR SAMPLING FORM

Site Name:_________________________________ Sampler:________________

Sample Identification:____________/___________ Date Sampled:____________

Sample Location(s):____

____

Canister Serial #:_____________/______________ Flow Regulator Serial #:______________/_____________

Environmental Conditions

Outdoor Temperature:______ Barometric Pressure:______ Relative Humidity:______

Wind Speed/Direction:___________ Comments:_______________________________________

Preliminary Screening

Instrumentation:_________ Calibration Date:__________ Time:_______am/pm

Field Reading(s):CH$_4$_______(%) CO$_2$ _______(%) O$_2$_______(%) Balance_______(%)

Manometer Gauge Reading

*Measured at sub-slab vapor monitoring point only

Pressure Reading: ________(psi)

Mechanical Leak Test

	Time	Pressure
Start:	________am/pm	_______in/Hg
Stop:	________am/pm	_______in/Hg

Chemical Leak Test

Leak Test Compound:_______________

Field Reading(s):______(%) (shroud)

______(%) (Tedlar bag)

Canister Digital Vacuum Reading

Initial Reading:________(in/Hg)

Final Reading:________(in/Hg)

Air Sampling

	Time	Flow Regulator Pressure	Controller Flow
Start:	_______am/pm	_________in/Hg	____________
Stop:	_______am/pm	_________in/Hg	____________

ATTACHMENT C

SUB-SLAB VAPOR PROBE CONSTRUCTION FORM

Natural Resource Technology

SUB-SLAB VAPOR PROBE CONSTRUCTION FORM

PROJECT INFORMATION

Site Name: ______________________________ Project Number/Task: __________________________

Client: __________________________________ Date/Time: ___________________________________

Field Personnel: ____

PROBE INSTALLATION INFORMATION

Probe ID: _______________________________

Installation Equipment: ____

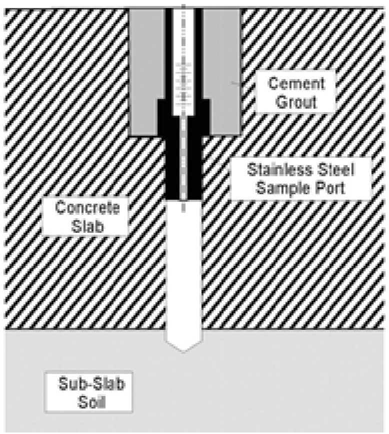
Probe Location Description (attach sketch or map): ____

____

Probe Location Measurements From Walls: ____

____

Material Over Slab (e.g., carpet) ____



*Attach sketch if probe construction differs from diagram.

Size and Construction of Sample Port Connection (e.g. ¼-inch Swagelok): __________________________________

Tubing Type/Length: _____________________________________

Screen Type/Size: _______________________________________

Slab Type/Thickness: _____________________________________

Diameter of Holes in Slab (Inner/Outer):

____

Probe Cover Type: _______________________________________

Sealant Material Type: ____________________________________

Sub-Slab Soil Type (If Applicable):

____

FIELD COMMENTS

Notes: ____

____

____