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October 11, 2013

Ms. Cynthia Johnson
N2634 Jefferson Road
Neosho, WI 53059

Subject: Subslab Vapor and Indoor Air Results for the Property Located at 7219 West Center Street Wauwautosa, WI

Dear Ms. Johnson:

The following is a discussion on the results of subslab vapor and indoor air sampling at your commercial property located at the address described above. I've included the subslab vapor results for the property that was submitted by ARCADIS on February 10, 2010 (October 21, 2009 results) and by Enviroforensics on September 26, 2013. (September 5, 2013 results). The Wisconsin Department of Natural Resources ("the Department") has published a guidance document called, *"Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin"*, PUB-RR-800 (December 2010) that may be downloaded from our website:

http://dnr.wi.gov/files/pdf/pubs/rr/rr800.pdf

This guidance references a number of links to USEPA regional screening tables and USEPA guidance's. The goals of investigating the vapor intrusion pathway are to identify the vapor source and the pathway(s) of vapor movement into buildings (on- or off-site), to determine whether vapor migration is a risk to current or future users of the building and where necessary, to aid in designing and implementing remedial actions to interrupt or eliminate the exposure pathway.

Indoor air vapor action screening levels for various volatile organic compounds (VOCs) used by the Department can be found at http://dnr.wi.gov/topic/Brownfields/documents/vapor/vapor-quick.pdf (see enclosed table). This table will be used to assess and discuss the sample results from the two consulting companies.

The Department categorizes two types of property building uses: residential and non-residential (commercial/industrial) for vapor intrusion evaluations. Your property is listed as a commercial property, but for discussion purposes, I will discuss the results for both residential and non-residential properties.

Indoor Air Results

The table below shows the results of the indoor air sampling on September 4, 2013 by Enviroforensics. Tetrachloroethylene (PCE) and Trichloroethylene (TCE) results indicate that the indoor air results are lower than the residential and non-residential vapor action levels.

Sample	PCE (ug/m^3)	TCE (ug/m^3)
7219-1A (indoor air)	9.16	<1.07
Non-Residential	**180**	**8.8**
Residential	**42**	**2.1**

Cynthia Johnson Property
7219 W Center St.
Wauwautosa, WI

Subslab Vapor Results

The table below shows the results for both ARCADIS and Enviroforensics subslab vapor samples collected in 2009 and 2013. Initially, the 2009 sample results (244,000) were above the residential (420) and non-residential (1800) vapor risk screening levels for PCE. But, in 2013, the PCE levels had decreased below both screening levels. TCE (110) was above both levels in 2009, but has also decreased below the screening levels in 2013.

	PCE (ug/m^3)	**TCE (ug/m^3)**
ARCADIS SS-1 (10.21.09)	244,000	<110
Enviroforensics (9.4.13)		
7219-SSV-1	298	8.54
7219 SSV-2	36.6	<1.07
Non-Residential	**1800**	**88**
Residential	**420**	**21**

Based on the wide variation of the subslab vapor sample results for PCE, going from 244,000 ug/m^3 in 2009 down to 298 ug/m^3 in 2013, the Department would also like to have another subslab vapor and indoor air test sample be completed in the winter time as recommended by Enviroforensics, in order to see if these levels are consistent over time and continue to be below the risk screening levels for subslab vapor and indoor air.

If you have any questions, please call me at 414-263-8644, or Pam Mylotta at 414-263-8561.

Sincerely,

John J. Hnat, P.G., C.P.G.
Project Manager\Hydrogeologist
Southeast Region
Remediation and Redevelopment

Enclosures: Vapor Intrusion Assessment Results 7219 West Center Street, Enviroforensics
Table 2, Summary of Vapor Probe Sampling Analytical Results, Arcadis
Indoor Air Vapor Action Levels for Various VOCs Quick Look-Up Table

C: Wayne Fassbender, Enviroforensics
WDNR SER Files

Vapor Intrusion Assessment Results
7219 West Center Street

Table 1: Sub-Slab Vapor Sample Results

Sample Identification	Sample Date	Tetrachloroethylene	Trichloroethylene
7219-SSV-1	9/5/2013	**298**	**8.54**
7219-SSV-2	9/5/2013	**36.6**	<1.07
Vapor Risk Screening Level		**1,800**	**88**

Table 2: Indoor/Outdoor Air Sample Results

Sample Identification	Sample Date	Tetrachloroethylene	Trichloroethylene
7219-IA	9/4/2013	**9.16**	<1.07
7219-OA	9/4/2013	**22.4**	**1.07**
Vapor Action Level		**180**	**8.8**

Notes:

All concentrations reported in units of micrograms per cubic meter (ug/m3)

Bolded values are above laboratory method detection limits

Bolded and shaded values exceed the Vapor Action Level/ Vapor Risk Screening Level

The Vapor Risk Screening Levels and Vapor Action Levels were calculated according to the procedures described in WDNR Publication RR-800.

IA = Indoor Air

OA = Outdoor Air

Arcadis Report Feb 10, 2010

Table 2. Summary of Vapor Probe Sampling Analytical Results, Hoffman's Valet Cleaners, Wauwautosa, Wisconsin.

Sample Name	Table 3C		Basement Sump		SG-1		SS-1		SS-2	
Sample Date	Screening Levels		07/26/06		07/28/06		10/21/09		11/16/09	
Property Owner			Hoffman		Hoffman		Johnson		Viruet	
Units	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3	ppbv	µg/m^3
Acetone	150,000	350,000	230	550	<500	<1,200	<20	<43	NA	NA
Carbon disulfide	220,000	700,000	40	120	<50	<160	<20	<64	0.693	2.16
Cyclohexane	NE	NE	53	180	<20	<69	<20	<69	<0.5	<1.7
1,2-Dichloroethene (total)	NE	NE	7	28	<20	<79	<20	<79	<0.5	<1.7
cis-1,2-Dichloroethene	NE	NE	7	28	<20	<79	<20	<79	<0.5	<1.7
n-Hexane	57,000	200,000	26	110	<50	<180	<20	<70	0.97	3.42
Isopropyl Alcohol	NE	NE	400	980	<500	<1,200	<500	<1,200	NA	NA
Methyl Ethyl Ketone	340,000	1,000,000	18	53	<50	<150	<50	<150	NA	NA
Toluene	110,000	400,00	13	49	<20	<75	<20	<75	0.627	2.36
Tetrachloroethene	120	810	750	5,100	3,000	20,000	36,000	244,000	12	81
Trichloroethene	4.1	22	10	54	<20	<110	<20	<110	<0.5	<2.7

Results are reported in parts per billion by volume (ppbv) and micrograms per cubic meter (µg/m^3).

Note: Only analytes detected in vapor samples are presented.

Vapor Probe Samples analyzed for VOCs by EPA Method TO-15.

[ ] Value is above the Table 3C Screening Value presented in the U.S. EPA's Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway

Indoor Air Vapor Action Levels for Various VOCs
Quick Look-Up Table[1]
Based on **May 2013** Regional Screening Level Summary Table

Chemical	Non-Residential (1-in-100,000 risk for carcinogens)		Residential (1-in-100,000 risk for carcinogens)		Molecular Weight (MW)	Basis of RSL[2]
	ppbV*	µg/m³	ppbV*	µg/m³	g/mole	
Benzene	4.9	16.0	0.95	3.1	78.11	c
Carbon Tetrachloride	3.1	20	0.64	4.1	153.82	c
Chloroform	1.1	5.3	0.22	1.1	119.38	c
Chloromethane	190	390	45	94	50.49	n
Dichlorodifluoromethane	88	440	20	100	120.91	n
1,1 – Dichloroethane (1,1-DCA)	19	77	3.6	15	98.96	c
1,2-Dichloroethane (1,2-DCA)	1.1	4.7	0.23	0.94	98.96	c
1,1 -Dichloroethylene (1,1-DCE)	220	880	52	210	96.94	n
1,2-Dichloroethene (cis and mixed)	NA	NA	NA	NA	96.94	n
1,2-Dichloroethene (trans)	65	260	16	63	96.94	n
Ethylbenzene	11	49	2.2	9.7	106.17	c
Methyl-tert-Butyl Ether (MTBE)	130	470	26	94	88.15	c
Methylene Chloride	740	2600	180	630	84.93	n
Naphthalene	0.68	3.6	0.14	0.72	128.18	c
Tetrachloroethylene	27	180	6.2	42	165.83	n
Toluene	5700	22,000	1400	5200	92.14	n
1,1,1 - Trichloroethane	4000	22,000	940	5200	133.41	n
Trichloroethylene	1.6	8.8	0.39	2.1	131.39	n
Trichlorofluromethane	540	3100	130	730	137.37	n
Trimethylbenzene (1,2,4)	6.2	31	1.5	7.3	120.2	n
Trimethylbenzene (1,3,5)	NA	NA	NA	NA	120.2	n
Vinyl Chloride	11	28	0.62	1.6	62.5	c
Xylene (mix)	100	440	23	100	106.17	n
Xylene (n,m,o separately)	100	440	23	100	106.17	n

[1] Regional Screening Tables: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
[2] Basis for Regional Screening Level – n = non-carcinogen; c = carcinogen. Non-carcinogen RSL table values are based on a HI = 1; therefore, no multiple should be applied to the table values. Carcinogen RSL (cRSL) table values are listed for 1-in-1,000,000; in Wisconsin, 1-in-100,000 excess lifetime cancer risk is used for screening indoor air. **This table of Vapor Action Levels was developed by multiplying the cRSL values by 10 or applying HI=1 for non-carcinogens.** Screening levels are rounded to 2 significant digits.
* Conversions from µg/m³ to ppbV in this table based on T = 20°C or 68 °F; P = 1 atm or 101.325 kPA (see next page)

Update: December 11, 2012

Convert µg/m^3 to ppbV

On-line calculator: Indoor Air Unit Conversion
http://www.epa.gov/athens/learn2model/part-two/onsite/ia_unit_conversion.html
At 20°C and 1 atm:

$$ppbV = \frac{\mu g/m^3}{MW} \times 8.3144 \left[\frac{L \cdot kPa}{mol \cdot °K}\right] \times [T_{°C} + 273.15]°K \times \frac{1}{101.325\,kPa}$$ OR ppbV = (µg/m^3 x **24.05**)/molecular weight

Using indoor vapor action levels (VAL) to determine vapor risk screening levels (VRSL)

Vapor risk screening levels are used to estimate indoor air concentrations from sub-slab vapor, soil gas or groundwater concentrations. Standard attenuation factors are applied to each media. This table lists the attenuation factor ($AF = C_{IA}/C_{source}$) and the dilution factor (inverse of the AF). The VAL is divided by the AF or multiplied by the dilution factor to calculate the vapor risk screening level.

Media Screened	Residential / Small Commercial Buildings		Large Commercial / Industrial Buildings	
	Attenuation Factor	*Dilution Factor*	*Attenuation Factor*	*Dilution Factor*
Sub-slab vapor	0.1	10	0.01	100
Deep soil gas	0.01	100	0.001	1000
Groundwater	0.001	1000	0.0001	10,000

Determining the Vapor Risk Screening Level for Groundwater
(at what concentration would groundwater potentially cause an indoor air exceedance)

$$C_{gw} = \frac{C_{IA}}{\left(H \times AF_{gw} \times 1000\,L/m^3\right)}$$

Where: C_{gw} = groundwater concentration (**µg/L**)
C_{IA} = indoor air concentration (from Quick look-up table, **µg/m^3**)
H = Henry's Law constant (dimensionless) from Chemical Specific Parameter Table: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
AF_{gw} = attenuation factor between groundwater and indoor air

Note: The default attenuation factor for groundwater to indoor air is 0.001. However, if the contaminated groundwater is located at the building foundation, the attenuation factor should be increased to 0.1 (i.e., treated as a sub-slab concentration). If contaminated groundwater is located close to the foundation (but not in contact with the foundation), the default attenuation factor of 0.001 may not be predictive of indoor air concentration. In that case, sub-slab sampling should be conducted.

Update: December 11, 2012