Ohio Environmental Protection Agency

GUIDANCE DOCUMENT

RECOMMENDATIONS REGARDING RESPONSE ACTION LEVELS AND TIMEFRAMES FOR COMMON CONTAMINANTS OF CONCERN AT VAPOR INTRUSION SITES IN OHIO

August 2016

Disclaimer

This guidance has been shown to the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency (USEPA). USEPA provided a letter indicating concurrence with these response levels and timeframes for response. As such, this guidance represents the Division of Environmental Response and Revitalizations approach to sites that have subsurface vapor intrusion into homes and businesses. The Ohio EPA recommends these action levels and timeframes, but recognizes other governmental agencies may use a different approach. As such this guidance does not have the force of law.

Purpose

This memorandum establishes response actions and timeframes for concentrations of common chemicals encountered during vapor intrusion (VI) investigations when receptors are present. Response actions may include sampling, mitigation, and/or activities to reduce exposure to elevated concentrations of chemicals due to vapor intrusion.

Vapor Intrusion Overview

Ohio EPA and U.S. EPA use a multiple lines of evidence approach to investigate potential VI risk to receptors. This step-wise approach typically evaluates whether a complete exposure pathway exists by sampling soil, ground water, soil gas, sub-slab gas or indoor air as appropriate. Concentrations of chemicals are evaluated using defined risk assessment procedures or screening values. Following this risk evaluation and discussions between appropriate parties, decisions may include:

- no further action
- source removal
- monitoring
- passive or active engineering controls

Conceptual Site Model

Ohio EPA's Vapor Intrusion Guidance[1] and U.S. EPA Vapor Intrusion Guidance[2] emphasize a multiple lines of evidence approach to evaluate whether the potential for VI exists from releases at CERCLA, RCRA, or voluntary action sites. Therefore, developing a conceptual site model is helpful in evaluating spatial and temporal variability and in identifying potentially exposed receptors.

Conceptual site models should be developed and updated as site information and data collection progress. Lines of evidence are typically evaluated in a step-wise fashion beginning with source delineation, soil gas data collection, vapor entry routes into buildings, sub-slab, and/or indoor air sampling. Enough data must be collected and compared against appropriate screening levels to determine if additional sampling or a remedy is necessary. However, presumptive remedies may be employed during any part of VI assessment. Ohio EPA relies primarily on contaminant source strength, migration routes, and sub-slab concentrations when determining VI potential, as indoor air concentrations are often variable at any given sample event and may be influenced by other sources. Therefore, remedial decisions should be based on multiple site-specific factors. If sub-slab concentrations are elevated, a remedy may be necessary even if indoor air concentrations meet risk or hazard levels when based on limited sampling. When indoor air samples exceed risk or hazard levels, remedial action is usually warranted. For more information on the various factors that affect the VI pathway, see *Conceptual Model Scenarios for the Vapor Intrusion Pathway* (USEPA, 2012a).[3]

Response Time Frames

For most contaminants of concern, screening and/or remediation levels are not based on short-term exposures. Response actions and remedial decisions are typically vetted through a defined process, including preliminary assessment, remedial investigation, feasibility study, remedial design, and finally remedial action. This process often takes a year or more to complete.

However, the National Contingency Plan preamble (55 *FR* 8704) states “EPA expects to take early action at sites where appropriate…to eliminate, reduce, or control the hazards posed by a site.” As a policy, U.S. EPA considers possible early action at concentrations exceeding either an excess lifetime cancer risk of 1E-04, or a non-cancer hazard quotient of 3, also known as Removal Management Levels (RMLs). However, U.S. EPA also recognizes that site specific conditions may alter response actions:

> ***….comparison of site concentrations to RMLs is only one factor used in determining the need for a removal action at a site. While EPA's expectation is that removal actions are generally justifiable above the RML, EPA has the flexibility to determine that case-specific conditions do not warrant a removal action*.**
>
> (https://www.epa.gov/risk/regional-removal-management-levels-rmls-users-guide)

Ohio EPA will also evaluate response actions based on case-specific conditions.

Concentrations slightly above screening levels (*i.e.*, not above RMLs) typically do not require a prompt action response. However, if media concentrations near receptors exceed RMLs as developed by U.S. EPA, further sampling and/or remedial activities are required to be conducted at an accelerated pace. Note that indoor air is the criterion for determining if there is a complete VI pathway. Ground water and sub-slab gas concentrations may dictate further data collection or support a presumptive remedy, but the timeframes given for remedial action are based on indoor air concentrations.

These recommended risk or hazard levels and response actions will establish a consistent approach to VI risk management across the state of Ohio.

Timeframes for Trichloroethylene (TCE)

Ohio EPA uses U.S. EPA's Integrated Risk Information System (IRIS) as the primary source for toxicity information for human health risk assessments and establishing cleanup values. In September, 2011, IRIS updated the toxicity assessment for TCE which concluded, in part, that women in the first trimester of pregnancy are one of the most sensitive populations to TCE inhalation exposure due to the potential for fetal cardiac malformations. Because the key steps for cardiac development occur within the first 8 to 10 weeks of pregnancy, exposure to TCE during early pregnancy is of concern. Subsequent to the IRIS toxicity update for TCE, U.S. EPA compiled information thats support early or interim actions at TCE contaminated sites.[4]

U.S. EPA Vapor Intrusion Guidance discusses prompt actions to be taken when measured indoor air concentrations pose an unacceptable human health risk for an acute or short-term exposure scenario (See Sections 7.5 and 8.2.1 of OSWER Technical Guide[2]); and U.S. EPA Region 9[5] and other states (*e.g.*, MA, CT, NJ, NH) have developed accelerated response action levels for measured indoor air TCE concentrations in structures occupied by women of childbearing age. Because of the short window of potential exposure, response actions are accelerated when sampling indicates possible or actual exposure to TCE in indoor air above protective levels and women of childbearing age are present.

Ohio EPA recommends that results from media samples be compared to the TCE concentrations in Tables 1-3 below to determine the appropriate response actions.

For all other chemicals of concern (COCs) exceeding their chronic response action levels, action within days or weeks is generally not warranted. However, when concentrations are above U.S. EPA RML levels, timing of response actions (further sampling and/or mitigation) is accelerated beyond which is typical in a remedial action. Table 4 lists recommended response actions when receptors are exposed or potentially exposed above the listed values for compounds other than TCE. Action levels of typical contaminants at VI sites are listed in Table 5.

All values were generated using U.S. EPA's Vapor Intrusion Screening Level (VISL) Calculator, version 3.4.6 (https://www.epa.gov/vaporintrusion), except the imminent hazard response action level for TCE (Table 1) which were obtained directly from Massachusetts DEP, 2014[6]. All values are subject to revision based on toxicity updates. The VISL calculator provides values based on standard exposure assumptions (*i.e.*, 24 hours/day for residential receptor, 8 hours a day for commercial receptors). If receptors are present that may be exposed for other duration periods, contact an Ohio EPA Division of Remedial Response and Revitalization (DERR) risk assessor.

Please refer to the VISL calculator for COCs not on Table 5 or contact an Ohio EPA, DERR risk assessor.

References

1. Ohio EPA, 2010. *Sample Collection and Evaluation of Vapor Intrusion to Indoor Air for Remedial Response and Voluntary Action Programs* http://www.epa.ohio.gov/portals/30/rules/Vapor%20Intrusion%20to%20Indoor%20Air.pdf

2. U.S. EPA, Office of Solid Waste and Emergency Response, 2015. *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air.* OSWER Publication 9200.2-154 http://www.epa.gov/vaporintrusion/technical-guide-assessing-and-mitigating-vapor-intrusion-pathway-subsurface-vapor

3. U.S. EPA, Office of Solid Waste and Emergency Response, 2012. *Conceptual Model Scenarios for the Vapor Intrusion Pathway*, EPA 530-R-10-003 http://www.epa.gov/vaporintrusion/conceptual-model-scenarios-vapor-intrusion-pathway

4. U.S. EPA, Office of Solid Waste and Emergency Response, 2014. *Compilation of Information Relating to Early/Interim Actions at Superfund Sites and The TCE IRIS Assessment.* https://clu-in.org/download/contaminantfocus/tce/TCE-compilation-final-2014.pdf

5. U.S. EPA, Region 9, 2014. *EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion* http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/6a24ed351efe25b888257d16007659e8/$FILE/R9%20TCE%20Action%20Levels%20and%20Recs%20Memo%207_14.pdf

6. Massachusetts Department of Environmental Protection, 2014. *U.S. EPA Trichloroethylene Toxicity Values and Office of Research and Standards Recommendations Regarding Remediation Targets and Timeframes to Address Potential Developmental Risks* http://www.mass.gov/eea/docs/dep/cleanup/laws/tcevalsm.pdf

Table 1 –Accelerated, Urgent, and Imminent Hazard Response Action Levels for TCE in Indoor Air

Exposure Scenario	Accelerated Response Action Level (HQ=1)		Urgent Response Action Level (HQ=3)		Imminent Hazard Response Action Level [6]	
	μg/m³	**ppbv**	**μg/m³**	**ppbv**	**μg/m³**	**ppbv**
Residential	>2.1	>0.39	>6.3	>1.2	>20	>3.7
Commercial (8 hour workday)	>8.8	>1.6	>26	>4.8	>60	>11
Response	Coordinate with appropriate state, local and health authorities. Early or interim response measures evaluated and implemented **within a few weeks:** - Increase building pressure and/or ventilation - Seal potential conduits were vapors may enter - Install indoor air purification systems - Install sub-slab or crawl space depressurization systems		Coordinate with appropriate state, local and health authorities. Early or interim response measures listed in previous column evaluated and implemented **within a few days.** Temporary relocation of receptors may be necessary to prevent additional exposure if other mitigation measures are not available or effective.		Coordinate with appropriate state, local and health authorities. Relocate receptors until post-remedy indoor air samples are below the accelerated response action levels.	

In all cases, notify receptors and vent the basement or lower level by opening windows until interim measures employed (as long as building is occupied). Evaluation of subsurface VI for long term exposure will continue.

Ohio EPA will evaluate the above response actions based on case-specific conditions.

NOTE – All table values are rounded to two significant figures.

Table 2 –Accelerated and Urgent Response Action Levels for TCE in Ground Water

Exposure Scenario	Sandy or unknown soils (HQ=1)	Fine-course scenario⁺ (HQ=1)	Sandy or unknown soils (HQ=3)	Fine-course scenario⁺ (HQ=3)
	Accelerated Response Action Level (μg/L)		Urgent Response Action Level (μg/L)	
Residential (24 hours)	>11	>21	>32	>63
Commercial (8 hour workday)	>44	>89	>130	>270
Response	**Within a few days to two weeks:** Sample sub-slab soil gas, if feasible; or Sample soil gas near ground water interface, if capillary fringe is greater than 5 feet bgs Follow response actions in Table 3		**Within a few days:** Sample sub-slab and indoor air concurrently. Follow response actions in Table 1 and/or Table 3	

Ohio EPA will evaluate the above response actions based on case-specific conditions.

⁺Fine course scenario –ground water screening level concentration using an attenuation factor (AF) of 0.0005 for low-permeability soils. See Table 6.6 of the US EPA OSWER Technical Guide[2].

Table 3 –Accelerated and Urgent Response Action Levels for TCE in Sub-Slab Soil Gas

Exposure Scenario	Accelerated Response Action Level (HQ=1)		Urgent Response Action Level (HQ=3)	
	µg/m³	**ppbv**	**µg/m³**	**ppbv**
Residential (24 hours)	>70	>13	>210	>39
Commercial (8 hour workday)	>290	>54	>880	>160
Response	**Within a few days to two weeks:** Sample indoor air and collect concurrent sub-slab soil gasFollow response actions in Table 1		**Within a few days:** Sample indoor air and collect concurrent sub-slab soil gas sample. Follow response actions in Table 1	

Ohio EPA will evaluate the above response actions based on case-specific conditions.

Table 4. Response Times for VI COCs other than TCE

Media	Chronic Response Action (>HQ=1 or 1E-05 cancer risk)	Accelerated Response Action (>HQ=3 or 1E-04 cancer risk)
Sub-slab soil gas	Install presumptive remedy or sample indoor air within 30-90 days	Indoor air sample required or install presumptive remedy within 60 days
Indoor Air	Resample or install remedy within 30 to 90 days	Coordinate with appropriate state, local and health authorities on response actions

Ohio EPA will evaluate the above response actions based on case-specific conditions.

Table 5. Levels for common COCs in VI investigations

COC	Media	Exposure Scenario	Chronic Response Action Level (HQ=1 or 1E-05 cancer risk)		Removal Management Level (HQ=3 or 1E-04 cancer risk)	
			µg/m³ (air) or ug/L (water)	ppbv (air)	µg/m³ (air) or ug/L (water)	ppbv (air)
Vinyl Chloride	Indoor air	Residential	1.7	0.67	17	6.7
		Commercial	28	11	280	110
	Sub-slab soil gas	Residential	56	22	560	220
		Commercial	930	360	9300	3600
	Ground water*	Residential	2.2 (4.5)	na	22 (45)	na
		Commercial	37(74)	na	370 (740)	na
Tetrachloro-ethylene (PCE)	Indoor air	Residential	42	6.2	130	19
		Commercial	180	27	530	78
	Sub-slab soil gas	Residential	1400	210	4200	620
		Commercial	5800	860	18000	2700
	Ground water*	Residential	130 (260)	na	380 (770)	na
		Commercial	540 (1100)	na	1600 (3200)	na
Chloroform	Indoor air	Residential	1.2	0.25	12	2.5
		Commercial	5.3	1.1	53	11
	Sub-slab soil gas	Residential	41	8.4	410	84
		Commercial	180	37	1800	370
	Ground water*	Residential	15 (30)	na	150 (300)	na
		Commercial	67 (130)	na	670 (1300)	na
Carbon Tetrachloride	Indoor air	Residential	4.7	0.75	47	7.5
		Commercial	20	3.2	200	32
	Sub-slab soil gas	Residential	160	26	1600	260
		Commercial	680	108	6800	1100
	Ground water*	Residential	8.0 (16)	na	80 (160)	na
		Commercial	35 (70)	na	350 (700)	na

COC	Media	Exposure Scenario	Chronic Response Action Level (HQ=1 or 1E-05 cancer risk)		Removal Management Level (HQ=3 or 1E-04 cancer risk)	
			µg/m³ (air) or ug/L (water)	ppbv (air)	µg/m³ (air) or ug/L (water)	ppbv (air)
Naphthalene	**Indoor air**	**Residential**	0.83	0.16	8.3	1.6
		Commercial	3.6	0.69	36	6.9
	Sub-slab soil gas	**Residential**	28	5.3	280	53
		Commercial	120	23	1200	230
	Ground water*	**Residential**	130 (270)	na	1300 (2700)	na
		Commercial	590 (1200)	na	5900 (12000)	na

* Attenuation Factor = 0.001; accounting for henry's law constant. Values in parenthesis represent ground water screening level concentration using an AF of 0.0005 for low-permeability soils. See Table 6.6 of the US EPA OSWER Technical Guide[2].