

## **Response to Comments**

received on the  
New York State Department of Health's  
*Guidance for Evaluating Soil Vapor Intrusion  
in the State of New York*  
(Public comment draft dated February 2005)

**October 2006**

NOTE: Updates to the final guidance are available at  
[http://health.ny.gov/environmental/indoors/vapor\\_intrusion/update.htm](http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm)

Prepared by:



**NEW YORK STATE DEPARTMENT OF HEALTH**  
Center for Environmental Health  
Bureau of Environmental Exposure Investigation

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## PREFACE

In February 2005 the New York State Department of Health (NYSDOH) released the draft *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* for public comment. The comment period ended in May 2005. Over 800 comments were received from 33 commenters, including 11 consultants, 2 community groups, 2 private citizens, 7 industry representatives, 6 government groups, and 5 environmental organizations (including non-profit), watchdog groups, and coalitions.

All comments were compiled by topic and reviewed. For the sake of brevity, individual comments were paraphrased where appropriate and similar comments were combined into single comments. Responses to each paraphrased comment and individual comment were prepared by the NYSDOH in consultation with the New York State Department of Environmental Conservation (NYSDEC) — collectively referred to as "the State" throughout this document.

This document contains the comments received (paraphrased or original) and the responses prepared. A brief discussion of the key issues raised by the commenters is first provided in an Executive Summary. The comments and responses are then presented by topic (as shown in the Table of Contents) in seven parts, which generally parallel sections of the guidance:

- Part A** — General Comments;
- Part B** — Guidance Section 1: Introduction;
- Part C** — Guidance Section 2: Investigation;
- Part D** — Guidance Section 3: Data Evaluation;
- Part E** — Guidance Section 4: Soil Vapor Intrusion Mitigation;
- Part F** — Guidance Section 5: Community Outreach; and
- Part G** — General Reactions to the Guidance.

Many of the comments have notes in their titles, such as "(paraphrased, # commenters, # comments)." These notes include any or all of the following information: whether the comment has been paraphrased from the original submission, how many commenters submitted the comment, and how many comments were submitted. In some cases, the number of commenters exceeds the number of comments. This is indicative of multiple parties submitting an identical comment. In other cases, the number of comments exceeds the number of commenters. This is indicative of one or more commenters submitting multiple comments on the same subject. If the note does not indicate the comment has been paraphrased, then the comment represents the original submission. Similarly, if the title has no note, then the comment represents the original submission (*verbatim*) by one commenter.

To assist commenters in identifying where their comments and responses are located in this document, a reference table of commenters and applicable comments and responses is provided in Appendix 1.

This document is a companion to the NYSDOH's *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). The final guidance reflects revisions made in response to the comments received. Where applicable, revisions to the guidance are noted in the responses contained herein.

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## ACRONYMNS and ABBREVIATIONS

BCA	Brownfield Cleanup Act	mcg/m <sup>3</sup>	micrograms per cubic meter
BCP	Brownfield Cleanup Program	OM&M	Operation, Maintenance and Monitoring
COC	Chemical of Concern		
CSM	Conceptual Site Model	OSHA	Occupational Safety and Health Administration
DAR	Division of Air Resources [NYSDEC]	PCE	Tetrachloroethene or Perchloroethylene
DQO	Data Quality Objective	PID	Photoionization Detector
DUSR	Data Usability Summary Report	PRP	Potentially Responsible Party
EI	Environmental Indicator	QA/QC	Quality Assurance/Quality Control
DER	Division of Environmental Remediation [NYSDEC]	RCRA	Resource Conservation and Recovery Act
DOH	Department of Health	SF <sub>6</sub>	Sulfur Hexafluoride
ELAP	Environmental Laboratory Approval Program	SIM	Selective Ion Monitoring
ERP	Environmental Restoration Program	SVOCs	Semi-volatile Organic Compounds
HVAC	Heating, Ventilating and Air-conditioning	SSD	Sub-slab Depressurization System
IBM	International Business Machines	SVE	Soil Vapor Extraction
JEM	Johnson & Ettinger Model	SVI	Soil Vapor Intrusion
GPRA	Government Performance Results Act	TAGA	Trace Atmospheric Gas Analyzer
NELAC	National Environmental Laboratory Accreditation Conference	TAGM	Technical and Administrative Guidance Memorandum
NELAP	National Environmental Laboratory Accreditation Program	TCA	Trichloroethane
NYCRR	Official Compilation of NY State Codes, Rules and Regulations	TCE	Trichloroethene
NYS	New York State	TOGS	Technical Operating Guidance Series
NYSDEC	New York State Department of Environmental Conservation	EPA	United States Environmental Protection Agency
NYSDOH	New York State Department of Health	VCP	Voluntary Cleanup Program
		VOCs	Volatile Organic Compounds

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## EXECUTIVE SUMMARY

This Executive Summary highlights key issues and concerns raised by the commenters. More detailed discussions of these issues are included in the remainder of the document, which contains all of the comments received (paraphrased or original) and the responses prepared.

### **RULE-MAKING** [Part A.2]

The NYSDOH received approximately five comments claiming the guidance is a rule or regulation, and not guidance, because various provisions of the document are non-discretionary, mandatory compliance requirements.

The guidance is not a regulation, rule or requirement. The guidance describes the methodology by which the State (i.e., the New York State Departments of Environmental Conservation and Health) addresses soil vapor intrusion at a site. It reflects our experience in conducting soil vapor intrusion investigations and presents a reasonable and practical approach to identifying and addressing current and potential human exposures to contaminated subsurface vapors associated with known or suspected volatile chemical contamination (in terms of environmental contamination only). The approach presented is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns.

One of the reasons why the guidance was prepared was to promote consistency in addressing the issue of soil vapor intrusion. While approaches for meeting the objectives discussed in the guidance may vary, the objectives themselves remain consistent from site to site. The document has been revised throughout to reflect that the guidance is providing recommendations, not requirements. Text has been eliminated that might create a contrary impression.

### **NYSDOH's AUTHORITY** [Parts A.1, A.5 and A.8]

More than 20 comments were received claiming that the guidance appears to overstep the NYSDOH's jurisdictional bounds and conflicts with the NYSDEC's proposed policy on soil vapor intrusion. Commenters believe the development of guidance on the method of sampling environmental media, the number of samples taken, the frequency of monitoring, and decisions on remedial measures for vapor intrusion pathways is within NYSDEC's purview, not the NYSDOH's.

The NYSDOH, in cooperation with NYSDEC, is responsible for assessing potential human exposure pathways at contaminated sites. The guidance provides recommendations on how to investigate and address a specific exposure pathway (soil vapor intrusion) that may exist at a site. As discussed in the NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* [NYSDEC 2006], this pathway will be evaluated at all completed, current and future sites in New York State. The NYSDOH's guidance complements the NYSDEC's policy by providing recommendations on how to evaluate soil vapor intrusion. The guidance was drafted in consultation with the NYSDEC and should not be interpreted as the NYSDOH operating separately from the NYSDEC. The combined goal of the policy and guidance documents is to conduct soil vapor intrusion evaluations as efficiently and effectively as possible at all remedial sites in New York.

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### **NYSDOH's OVERALL APPROACH** [Parts A.8 and A.9]

Over 40 comments were received from approximately half of the commenters noting that the approach to evaluating soil vapor intrusion in the guidance differs from those developed by other state and federal agencies. Numerous comments encouraged the NYSDOH to adopt an approach more analogous to those of others -- one that includes screening levels in environmental media, distance criteria, modeling results alone, default attenuation factors, a tiered approach, a weight-of-evidence approach, etc.

The State believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion that is

- analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns, and
- supported by data collected during soil vapor intrusion investigations throughout New York State to date.

The guidance is intended to provide recommendations on how to investigate and address exposures related to soil vapor intrusion. As discussed in Section 1.8 of the guidance, the investigation, evaluation, mitigation and remediation of soil vapor and soil vapor intrusion are evolving disciplines. The guidance provides as detailed recommendations as possible given the current state of knowledge and our experience to date. To make the guidance more prescriptive would not allow for the flexibility needed in investigating and addressing this complex exposure pathway and may not be appropriate for all sites.

The overall approach presented in the guidance remains the same as that in the public comment draft. However, if the results of future investigations indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate or are unnecessarily vague, then the guidance will be revised or amended accordingly.

### **EXPOSURES IN NON-RESIDENTIAL SETTINGS** [Part A.3]

Approximately 20 complex legal and policy comments were received regarding the approach taken to address soil vapor intrusion in non-residential buildings, particularly those in occupational settings. The commenters believe the Occupational Safety and Health Administration (OSHA) standards are the applicable standards for addressing workplace exposures regardless of the source of the volatile chemicals found in workplace air. The commenters recommended that, consistent with EPA's guidance and the approach taken by several other states, the NYSDOH guidance should only apply to potential exposures not regulated under OSHA.

The NYSDOH's document provides guidance on identifying and addressing current and potential involuntary human exposures to contaminated subsurface vapors associated with known or suspected volatile chemical contamination. It does not constitute a rule or regulation.

One of the areas of the EPA's draft guidance that generated much comment from states, industry, and other federal authorities, was the guidance's applicability to workplace settings. The EPA will be addressing this issue in their revised guidance. Contrary to the comment regarding the use of OSHA standards by other states, we have found that the soil vapor intrusion guidance of other states such as Alaska, 2005; California, 2004; Colorado, 2004; New Hampshire, 2005; New Jersey, 2005; and

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Ohio, 2005, generally defer to OSHA standards only when the chemical(s) in soil vapor are routinely used as part of regular operations in the building.

**NYSDOH's GUIDELINE FOR TRICHLOROETHENE (TCE) IN AIR** [Part A.4]

The NYSDOH received approximately 5 comments regarding the guideline established by the NYSDOH for TCE in air (5 micrograms per cubic meter).

Comments pertaining to the derivation of the guideline for TCE in air are outside the scope of the guidance document. In August 2005, the NYSDOH issued a 300-page draft report entitled *Trichloroethene (TCE) Air Criteria Document*. We convened a Peer Review Panel of national experts selected from nominations solicited from interested parties. The Panel reviewed the report and requested that we consider

- a number of technical comments related to some health endpoints,
- childhood vulnerabilities to a greater extent, and
- adding more detail about the selection of the guideline.

The Peer Review Panel comments along with others that we received and our responses are in the final TCE guideline document [NYSDOH 2006b].

**SOIL VAPOR/INDOOR AIR MATRICES**

The following revisions were made to the Soil Vapor/Indoor Air Matrices in Section 3.4 of the guidance based on comments received on the NYSDOH's draft report entitled *Trichloroethene (TCE) Air Criteria Document* (NYSDOH 2005):

- Matrix 1: changed the boundary between the indoor air concentration ranges in Columns 2 and 3 from 2.5 to 1 mcg/m<sup>3</sup> and added "Monitor/Mitigate" as a recommended action in Box 10; and
- Matrix 2: added Monitor/Mitigate action to Box 6.

For additional information, please see the memorandum from N. Kim to R. Tramontano dated October 12, 2006, provided in Appendix 2.

**ACTION LEVELS FOR MITIGATION** [Parts D.11 and D.12]

Approximately 10 comments were received expressing concern that variable air quality action levels have been permitted on a site-by-site basis. Commenters requested that the decision matrices be created as conservatively as possible with the best interest of the residents in mind. They also requested that the NYSDOH protect all of the State's residents equally by demanding remediation at consistent and conservative air quality action levels. Specifically, several commenters recommended that homes with TCE detected in the indoor air or sub-slab vapor be mitigated.

The decision to install sub-slab depressurization systems at structures where TCE is detected is made on a site-specific basis with many factors considered. The NYSDOH has developed two decision matrices that are general risk management tools used to guide decisions on appropriate actions to address exposures related to soil vapor intrusion in the context of a particular site. In other words, they are not intended to be prescriptive or to mandate universal decisions without accounting for the multitude of site-specific and building-specific considerations. The matrices provide indoor air and sub-slab vapor concentration ranges for four volatile chemicals (TCE,

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tetrachloroethene, 1,1,1-trichloroethane and carbon tetrachloride) and corresponding recommendations for action, from a human health perspective. The actions are both protective of human health and appropriate to addressing current and potential exposures related to soil vapor intrusion. As discussed in Note 1 of the matrices, actions more protective of public health than those specified within the matrix may be proposed at any time. Such approaches are usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.). As a result, actions may vary from site to site in their degree of protectiveness. Nevertheless, the protection of human health serves as the foundation of all actions taken at sites, and this foundation is reflected in both the guidance and the decision matrices.

### **NEW YORK STATE BROWNFIELD CLEANUP PROGRAM (BCP) [Part A.6]**

Two comments were received claiming the guidance undercuts the purpose and intent of the Brownfield Cleanup Act. The NYSDOH also received approximately 10 comments expressing concerns that the requirements of the soil vapor intrusion guidance will discourage parties to voluntarily clean-up brownfield sites. Reluctance may be due to uncertainty in the level and the length of remedial activities that may be required or an inability to get financing to remediate and develop the site. In addition, there may be lingering concerns about liability issues, such as in locations of area-wide groundwater contamination.

The purpose and intent of the "Brownfield Cleanup Program" is to encourage cleanup and redevelopment of brownfield sites using remedies that are fully protective of public health and the environment. The guidance provides an approach that will accomplish these goals at brownfields. Specifically, the guidance will help ensure that responsible parties seeking to investigate and remediate brownfield soil contamination will consider important site-specific factors such as the toxic potential of the contaminant(s) present, the extent of contamination, preferential pathways, subsurface hydrology, soil properties, existing structures, and anticipated future use.

The guidance allows for flexibility in site redevelopment and should not preclude satisfactory redevelopment of sites. In many cases, mitigation systems have been installed on new or existing buildings as preventative measures to address concerns about soil vapor intrusion and radon. This may be prudent in areas of wide-spread groundwater contamination. While areas of site-wide groundwater contamination of an unknown source may present redevelopment difficulties, the State will be responsible for addressing or identifying the responsible party to address sources of contaminants not attributable to the site itself. To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. If a soil vapor intrusion investigation is needed but it is not the responsibility of the participant in a specific environmental remediation program, then the NYSDEC and NYSDOH will make sure appropriate actions are taken to complete the investigation and remediation, as well as to address exposures. This would include identifying any additional responsible parties and enrolling them into an appropriate remedial program.

### **RESPONSIBILITY FOR MITIGATION [Part A.11]**

The NYSDOH received approximately 15 comments expressing concerns that the guidance may impose mitigation and remedial obligations on a party where the indoor air impacts do not result from soil or groundwater contamination or from subsurface sources alone.

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To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

### **PETROLEUM HYDROCARBON SITES** [Part A.10]

Approximately 8 comments were received where commenters recommended that special considerations (e.g., biodegradation, screening levels, default attenuation factors, etc.) for petroleum hydrocarbon sites be incorporated into the guidance or that a separate guidance document be prepared.

To date, the assessment of petroleum hydrocarbon sites has been based on soil vapor sampling results, indoor air results, model predictions, or some combination thereof. The information currently available does not support the use of soil vapor or groundwater screening values or of default factors for attenuation, dilution or degradation to presumptively rule out sub-slab vapor or indoor air sampling. Specifically, field data demonstrating the following are scarce:

- the relationship between the results of sampling outside of buildings (soil vapor) and within buildings (sub-slab vapor and indoor air),
- the relationship between sub-slab vapor and indoor air concentrations, and
- the effect of biodegradation on sub-slab vapor concentrations.

The guidance is intended to provide an approach for investigating and addressing the potential for soil vapor intrusion at sites with volatile chemical contamination, regardless of the nature of the contamination. If field data across the state demonstrate the validity of the considerations presented by the commenters, the State will update or amend the guidance accordingly.

### **SAMPLING BUILDINGS DURING THE HEATING SEASON** [Part C.5]

Approximately half of the commenters submitted over 40 comments disagreeing with the emphasis placed on sampling buildings in the heating season. Commenters offered many reasons for allowing sampling at different times of the year or throughout the year, including the following: the heating season may not represent a worst case scenario for all buildings (e.g., buildings with complex heating, ventilation and air-conditioning systems) and indoor air concentrations are not expected to vary during the year.

The State agrees that all available information about a site and potentially affected buildings (including operation of heating, ventilation and air-conditioning systems) should be considered in planning and timing an investigation. The guidance has been revised to clarify that a soil vapor intrusion investigation should be performed when the likelihood of vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions).

The NYSDEC and NYSDOH intend to collect samples at several sites across the state over the course of a year to improve our understanding of how subsurface vapor concentrations and corresponding indoor air concentrations may or may not fluctuate

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with seasonal changes. If the results indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate, then the guidance will be revised or amended accordingly.

### **PURPOSE OF SOIL VAPOR SAMPLING** [Part C.3]

Approximately 8 comments were received where commenters requested clarification on the utility of soil vapor data and recommended that the guidance be revised to include the use of soil vapor data to rule out the need for structure sampling.

Soil vapor samples are collected to characterize the nature and extent of contamination in this environmental medium. The results can be useful tools for guiding the selection of structures to perform sampling (sub-slab vapor, indoor air, outdoor air). Soil vapor data are typically not sufficient as a single determinant for considering an investigation complete because, in our experience to date, soil vapor (alone and in conjunction with modeling) has not been shown to be a reliable tool for predicting concentrations immediately beneath a building's slab or in the indoor air. However, to the extent that existing site data are sufficient to meet the investigation objectives outlined in Section 1.5 of the guidance, no further sampling may be appropriate. These determinations are made on a site-specific basis.

### **METHODS OF MITIGATION** [Part E.2]

The NYSDOH received over 10 comments stating that the mitigation methods required in the guidance (e.g., sub-slab depressurization systems) are not always technically or financially feasible and may not be the most appropriate means of control. Commenters requested that other methods, such as passive ventilation systems and vapor barriers, also be allowed.

Due to their effectiveness, energy-efficiency and ease in monitoring, the State strongly recommends the installation of sub-slab depressurization systems to prevent vapor intrusion and subsequent human exposures. However, the State acknowledges throughout Section 4.0 of the guidance, that the installation of a sub-slab depressurization system may not be feasible or practical in all circumstances. Alternative mitigation methods, including modification of heating, ventilation and air-conditioning systems, sealing, room pressurization, or vapor barriers, may be considered if the effectiveness of the mitigation method can be documented and maintained for as long as the potential for soil vapor intrusion exists at the structure and if they are installed and maintained in accordance with the United States Environmental Protection Agency's radon guidance (where applicable). All proposed mitigation technologies will be reviewed on a case-by-case, site-by-site basis.

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## PART A GENERAL COMMENTS

### **A.1 TOPIC: New York State Department of Health's (NYSDOH's) authority to issue guidance**

Comment A.1.1 (paraphrased, 2 commenters, 7 comments):

The NYSDOH's guidance does not identify the statutory authority on which it is based, or explain how it implements a statutory scheme. The NYSDOH lacks the statutory authority to implement guidance concerning environmental cleanup.

#### Response A.1.1:

The NYSDOH has substantial authority to issue guidance for evaluating soil vapor intrusion. The sources of this authority are provisions of the Public Health Law (e.g. Sections 206(1)(a), 206(1)(d), 201(1)(n), 1300(1), 1389-b(1)(a), 1389-b(2), 1389-b(3)), the Environmental Conservation Law (e.g. Sections 27-1305(2)(b), 27-1415(4), 27-1415(7)(c), 27-1415(9)) and the Navigation Law (e.g. Sections 177-a(4) and (5)), which empower the NYSDOH to respond to conditions, including soil vapor intrusion, that may adversely affect public health. The statutory authority empowers the NYSDOH to assess and address threats to the public health, nuisances, inactive hazardous waste disposal sites, brownfield sites and petroleum discharges. The NYSDOH regularly investigates, assesses and participates in the development of response actions at sites where soil vapor intrusion has been identified. The NYSDOH's authority to issue guidance for evaluating soil vapor intrusion is implicit in this statutory authority. The guidance does not exceed the NYSDOH's authority or impermissibly intrude upon the purview of the New York State Department of Environmental Conservation (NYSDEC).

### **A.2 TOPIC: NYSDOH's guidance is a rule or regulation**

Comment A.2.1 (paraphrased, 3 commenters, 5 comments):

The NYSDOH's guidance is a rule or regulation under the New York State Administrative Procedure Act that is subject to the substantive and procedural requirements of that act. The guidance sets a standard of conduct that is applicable in all circumstances. Many provisions of the document are non-discretionary, mandatory compliance requirements. The guidance is a rule because its use of the term "must" and other prescriptive requirements demonstrate that it is a fixed general principle applied without regard to other facts and circumstances.

#### Response A.2.1:

The February 2005 draft of the guidance does not constitute a rule or regulation because it is not a "fixed, general principle to be applied by an administrative agency without regard to other facts and circumstances...." [Reference: Roman Catholic Diocese of Albany v. New York State Department of Health, 66 NY2d 948, 951 (1985)]. See, for example, the following:

- Section 1.5 — "[s]ince no two sites are exactly alike, the approach to evaluating soil vapor intrusion is dependent upon site-specific conditions. ... each site presents its own unique set of circumstances.";
- Section 2 — "... no two sites are exactly alike. Site-specific and/or building-specific conditions may warrant modifying the recommendations herein.";

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- Section 3.4.2(a) — "The [decision] matrices are generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions...and/or factors provided in Section 3.2 of the guidance...."

Nonetheless, the document has been revised throughout to clarify that the guidance is not a rule, and to eliminate text that might create a contrary impression.

### **A.3 TOPIC: Occupational Safety and Health Administration (OSHA) regulation**

#### Comment A.3.1 (paraphrased, 3 commenters, 9 comments):

The NYSDOH's guidance is attempting to regulate workplace health and safety by requiring investigation and remediation of workplace environments.

##### Response A.3.1:

The guidance is not a regulation, rule or requirement [see Comment A.2.1] and does not require investigation and remediation of workplace environments. As discussed in Comment A.3.2, the guidance provides a reasonable and practical approach for addressing involuntary exposures and health risks associated with soil vapor intrusion. [See also Comments D.5.3 and D.12.8.]

#### Comment A.3.2 (paraphrased, 9 commenters, 22 comments):

Complex legal and policy comments were received regarding the approach taken to address soil vapor intrusion in non-residential buildings, particularly those in occupational settings. These commenters believe OSHA standards are the applicable standards for addressing workplace exposures regardless of the source of the volatile organic compounds (VOCs) found in workplace air. In light of OSHA preemption, the commenters believe that, consistent with the United States Environmental Protection Agency (EPA) and the approach taken by several other states, the NYSDOH guidance should only apply to potential exposures not regulated under OSHA.

##### Response A.3.2:

The document provides guidance on identifying and addressing current and potential involuntary human exposures to contaminated subsurface vapors associated with known or suspected volatile chemical contamination. It does not constitute a rule or regulation.

One of the areas of the EPA's draft guidance that generated much comment from states, industry, and other federal authorities, was the guidance's applicability to workplace settings. The EPA will be addressing this issue in their revised guidance. Contrary to the comment regarding the use of OSHA standards by other states, we have found that the soil vapor intrusion guidance of other states such as Alaska, 2005; California, 2004; Colorado, 2004; New Hampshire, 2005; New Jersey, 2005; and Ohio, 2005, generally defer to OSHA standards only when the chemical(s) in soil vapor are routinely used as part of regular operations in the building. [See also Comments A.3.1, D.5.3 and D.12.8.]

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**A.4 TOPIC: NYSDOH's guideline for trichloroethene (TCE) in air**

*Additional comments and responses on the application of the TCE air guideline when evaluating soil vapor intrusion are provided in Part D of this document.*

Comment A.4.1 (paraphrased, 1 commenter, 1 comment):

The NYSDOH should revise the guideline to reflect the most protective assumptions about toxicity and exposure supported by science.

Response A.4.1:

Comments pertaining to the derivation of the guideline for TCE in air are outside the scope of the guidance document. In August 2005, the NYSDOH issued a 300-page draft report entitled *Trichloroethene (TCE) Air Criteria Document*. We convened a Peer Review Panel of national experts selected from nominations solicited from interested parties. The Panel reviewed the report and requested that we consider

- a number of technical comments related to some health endpoints,
- childhood vulnerabilities to a greater extent, and
- adding more detail about the selection of the guideline.

The Peer Review Panel comments along with others that we received and our responses are in the final TCE criteria document [NYSDOH 2006b].

Comment A.4.2 (paraphrased, 1 commenter, 1 comment):

The air guideline value for TCE should be changed to correspond to an excess cancer risk of one-in-one million, which is the target risk level for site remediation established under the new Brownfield Cleanup Program (BCP) statute and the required risk level for the development of soil cleanup objectives under the same statute.

Response A.4.2:

The guideline for TCE in air is not a remediation standard. Rather, it is tool to help make decisions about exposures. Our fact sheet *Trichloroethene (TCE) in Indoor and Outdoor Air* (included in Appendix H of the guidance) describes how the guideline should be used. We emphasize that the guideline is a risk management tool for anyone to use in any situation. The fact sheet states, "The purpose of the guideline is to help guide decisions about the nature of the efforts to reduce TCE exposure. Reasonable and practical actions should be taken to reduce TCE exposure when indoor air levels are above background, even when they are below the guideline of 5 mcg/m<sup>3</sup>. The urgency to take actions increases as indoor air levels increase, especially when they are above the guideline. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce TCE levels in indoor air to as close to background as practical."

The guideline is based on criteria derived using risk assessment methods that are more likely to overestimate than underestimate health risks. This is especially true for exposures that occur for less than a lifetime. The risks estimated at the guideline are based on the assumption that people are continuously exposed to TCE in air all day, every day for as long as a lifetime, which is rarely the case. Most people, if exposed, are more likely to be exposed for only part of the day and part of their lifetime.

At soil vapor intrusion sites, the TCE guideline is used as an action level for shorter term or intermittent exposures. Doing so is warranted given the high level of concern in communities around the state and our responsibility to weigh uncertainties when we seek to protect public health. We cannot emphasize more emphatically that our TCE guideline is not a threshold below which no action is taken. This is exemplified in the

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decision matrix for TCE (Soil Vapor/Indoor Air Matrix 1 in the guidance), which provides for response at levels of TCE in indoor air that are less than 0.25 mcg/m<sup>3</sup>, a level that is in the risk range of one-in-one million for developing cancer over a lifetime of exposure.

Comment A.4.3 (paraphrased, 1 commenter, 1 comment):

We do not feel the scientific evidence justifies the regulation of TCE at the low level of 5 mcg/m<sup>3</sup>, which is barely detectable by current methods, especially given in the context of other uncertainties associated with the soil vapor intrusion pathway.

Response A.4.3:

The scientific evidence supporting the TCE guideline (it is not a standard or regulation) is addressed and documented in the report *Trichloroethene (TCE) Air Criteria Document* (NYSDOH 2006b), which was recently finalized following peer review by a panel of scientific experts selected from nominations solicited from interested parties. Contrary to the commenters assertion, the level of 5 mcg/m<sup>3</sup> is detectable by current methods. New York State Law requires laboratories analyzing environmental samples from New York State to have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte/matrix combinations. At present, samples are analyzed by methods that can achieve minimum reporting limits to allow for comparison to background levels (e.g., for halogenated volatile organic chemicals, including TCE, this value is typically 1 mcg/m<sup>3</sup> or less) and levels presented in the decision matrices (as low as 0.25 mcg/m<sup>3</sup> for TCE). Thus, laboratories certified by NYS should be capable of detecting TCE in air and measuring it reliably at the appropriate reporting limit.

Comment A.4.4 (paraphrased, 1 commenter, 1 comment):

A guideline of 5 mcg/m<sup>3</sup> for TCE in air seems quite low, especially since background ranges up to 4.5 mcg/m<sup>3</sup>. We urge the NYSDOH to assemble background levels of volatile chemicals in urban settings before it proceeds with its 5 mcg/m<sup>3</sup> TCE guidance.

Response A.4.4:

Several studies have been conducted, both nationally and in the State of New York, to determine indoor and outdoor air background levels of volatile chemicals in a variety of settings (e.g., residential and commercial buildings). The primary databases used when evaluating indoor and outdoor air data are summarized in Section 3.2.4 and Appendix C of the guidance. Both of the EPA studies summarized in Appendix C include data from urban settings. In addition, a study recently published by the Health Effects Institute (HEI), *Relationships of Indoor, Outdoor, and Personal Air (RIOPA). Part I. Collection Methods and Descriptive Analyses. November 2005*, which includes data from Los Angeles, CA, Houston, TX, and Elizabeth, NJ, has been added to the guidance (Section 3.2.4 and Appendix C). Additional studies of background levels of TCE and other chemicals will be considered as they become available.

Overall, these data show that although background indoor air TCE levels have exceeded 5 mcg/m<sup>3</sup> in a small number of cases, they generally do not exceed 1 mcg/m<sup>3</sup> with a high proportion (34 to 81%) of sites sampled having no detectable levels of TCE (i.e. TCE levels are <0.2 mcg/m<sup>3</sup>). Similarly, local, site-specific background levels of TCE in outdoor air are generally below 1 mcg/m<sup>3</sup> but have been higher in a small number of cases. Determination of local, site-specific TCE levels in outdoor air is recommended during investigations at soil vapor intrusion sites. Section 3 of the guidance describes how background levels in indoor and outdoor air should be

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considered during data evaluation and the development of recommendations for action in soil vapor intrusion investigations. The TCE guideline of 5 mcg/m<sup>3</sup> is an action level applied within the context of the soil vapor/indoor air matrix and in conjunction with other site-specific information to guide remedial decisions. An overview of how NYSDOH develops air guidelines is provided in Appendix D of the guidance document. A discussion of how background was considered in the development of the TCE guideline can be found in the report *Trichloroethene (TCE) Air Criteria Document* (NYSDOH 2006b), which was recently revised to include more detail about selection of the guideline, as recommended by peer review panel of national experts selected from nominations submitted by interested parties.

Comment A.4.5 (paraphrased, 2 commenters, 2 comments):

We urge the NYSDOH to explain why its guideline for TCE is (5 mcg/m<sup>3</sup>) is 20 times lower than that for PCE (100 mcg/m<sup>3</sup>), which we believe has an approximately equivalent toxicity.

Response A.4.5:

Derivation of the NYSDOH's guidelines for TCE and PCE was a two-step process. The first step was a risk assessment, which provided a range of health-based criteria based on consideration of non-cancer and cancer endpoints. The second step involved derivation of a guideline for use in evaluating exposures, which considered the health-based criteria as well as other factors.

In the first step, criteria based on non-cancer and cancer effects were derived from the available scientific information on TCE and PCE using generally accepted standard risk assessment methods (for PCE, see NYSDOH 1997a; for TCE, see NYSDOH 2006b). Criteria based on non-cancer effects are estimates of air concentrations of TCE or PCE expected to be without any appreciable risk of non-cancer health effects over a lifetime of continuous exposure. The non-cancer criterion (10 mcg/m<sup>3</sup>) for TCE is about 10x lower than the non-cancer criterion (100 mcg/m<sup>3</sup>) for PCE. This difference might reflect actual differences in toxicity, but it could also reflect differences in the nature of the databases available at the time of criteria development. Criteria-based cancer effects are estimates of air concentrations associated with specific levels of excess risk after a lifetime of continuous exposure. Estimates of the concentrations of TCE and PCE in air associated with an excess cancer risk of one-in-one million are similar, about 1.5 mcg/m<sup>3</sup> and 1 mcg/m<sup>3</sup>, respectively.

In the second step of air guideline derivation, other factors are considered such as acceptable levels of risk, analytical techniques, background levels, data gaps, and intended uses of the guidelines to support risk management decisions. This step combines risk assessment and risk management principles. These considerations resulted in a TCE guideline of 5 mcg/m<sup>3</sup> and a PCE guideline of 100 mcg/m<sup>3</sup> (see NYSDOH, 1997a,b,c; 2003, 2005, 2006b). The difference in the values does not solely represent a difference in toxicity. Margins-of-exposure between each guideline and air concentrations associated with non-cancer effects in animals or humans are consistent with recommended procedures. Similarly, the estimated increased human cancer risks associated with lifetime continuous exposure at each guideline are in the risk range generally used by regulatory agencies when making decisions. In both cases, the NYSDOH recommends that steps to reduce exposure should be considered when levels are above background.

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Comment A.4.6 (paraphrased, 4 commenters, 3 comments):

It is important that the department has committed to a peer review of its guideline of 5 mcg/m<sup>3</sup> for TCE. Public review and comment on the guideline is needed and will help to ensure that all relevant technical data have been considered. Toward this end, the peer review committee being convened to review the NYSDOH's TCE guideline should be balanced among scientists recommended by government, business, public health and environmental organizations, and affected citizens.

Response A.4.6:

Comment noted. The peer review panel consisted of scientific experts selected from nominations solicited from interested parties.

## **A.5 TOPIC: Enforcement, regulating agency and regulations**

Comment A.5.1 (paraphrased, 2 commenters, 2 comments):

The guidance appears to be inconsistent with the existing regulatory scheme for remedy selection at an inactive hazardous waste site.

Response A.5.1:

The existing regulatory scheme identifies several criteria that are considered during the remedy selection process at an inactive hazardous waste site. One of these criteria is the protection of human health and the environment, which involves identifying and addressing potential routes of human exposure associated with the environmental contamination. The guidance is consistent with the regulatory scheme in that it provides recommendations on how to investigate and address a specific exposure pathway (soil vapor intrusion) that may exist at a site. While the guidance recommends that the environmental contamination itself (i.e., subsurface vapors) be remediated (either directly or indirectly) and identifies factors that should be considered when selecting a remedy, it does not indicate specific methods that must be used to remediate a site nor does it modify the existing regulatory scheme for remedy selection.

Comment A.5.2 (paraphrased, 1 commenters, 1 comment):

Because the guidance appears to be inconsistent with the existing regulatory scheme for remedy selection under Environmental Conservation Law Article 27, Title 13, as well as 6 NYCRR Part 375, it cannot be justified as an implementation of the inactive hazardous waste disposal site program.

Response A.5.2:

The guidance is not inconsistent with the existing regulatory scheme as it provides general recommendations on how to investigate and address a specific exposure pathway (soil vapor intrusion) that may exist at a site. [See also Comment A.5.1.]

Comment A.5.3 (paraphrased, 1 commenter, 1 comment):

We urge the NYSDOH to revise its soil vapor intrusion guidance to clarify what regulatory program the NYSDOH intends to implement to carry it out. Is the NYSDOH prepared to administer a regulatory program for soil vapor outside of the NYSDEC's current remedial programs, where the NYSDEC refers to the NYSDOH soil vapor issues arising in the BCP, Voluntary Cleanup Program (VCP), State Superfund program, and Environmental Restoration Program (ERP)? Does the NYSDOH intend to regulate soil vapor at projects that

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are outside the NYSDEC's remedial programs? Does the NYSDOH intend to regulate soil vapor intrusion at existing structures such as homes, businesses, and schools that are located over areas with existing groundwater contamination? If not, revised guidance might instruct such property owners, who are outside of the NYSDOH's soil vapor regulatory program, on how they might proceed. Perhaps the NYSDOH should work with lenders to encourage financial institutions to require that a soil vapor test be conducted as a prerequisite to closing.

Response A.5.3:

The NYSDOH does not intend to regulate soil vapor intrusion. The guidance is not a regulation, rule or requirement [see Comment A.2.1].

As discussed in the NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* [NYSDEC 2006], soil vapor intrusion will be evaluated at all completed, current and future sites in the state's environmental remediation programs. Generally, evaluation of the pathway will be included in the program's overall requirements to investigate and remediate environmental contamination at a site. The NYSDOH's guidance complements the NYSDEC's policy by providing recommendations on how to evaluate soil vapor intrusion. The combined goal of the policy and guidance documents is to conduct soil vapor intrusion evaluations as efficiently and effectively as possible at all remedial sites in New York. However, the guidance should be considered anywhere soil vapor intrusion is evaluated in the State of New York, whether the evaluation is undertaken voluntarily by a corporation, a municipality, or private citizen, or whether it is performed under one of the state's environmental remediation programs. Section 1.7 of the guidance has been revised to reflect this recommendation.

Comment A.5.4 (paraphrased, 1 commenter, 6 comments):

Statements in the guidance that pathways "must be investigated" if there is an existing or likely subsurface source of volatile chemicals, or if groundwater or subsurface soil contain volatile chemicals in excess of standard or guidance criteria, and that purport to require sub-slab vapor and indoor air testing for all buildings above or adjacent to known or suspected areas of subsurface contamination, address remedial investigation decisions best left to, and required by law to be left to, the NYSDEC. The "requirement" that samples be tested for a "wide range of volatile chemicals," rather than the volatile chemicals of concern at a particular site, is a sign that the guidance inappropriately seeks to divest NYSDEC of remedial decision-making. The NYSDOH should defer to the NYSDEC on the technical issues involved with sampling to address the soil vapor intrusion to indoor air pathway. It is not appropriate for the NYSDOH to mandate testing where the NYSDEC does not.

Response A.5.4:

The intent of the guidance is to provide recommendations on how to investigate and address exposures related to soil vapor intrusion, not to mandate actions like those described in the comment. To clarify this intent, the document has been revised throughout to reflect that the guidance is not a rule, and text has been eliminated that might create a contrary impression.

The guidance was drafted in consultation with the NYSDEC and should not be interpreted as the NYSDOH operating separately from the NYSDEC. The NYSDEC and NYSDOH work cooperatively as "the State" to develop an investigation and remediation process for sites on an individual basis that is protective of human health and the environment. Toward this end, the State recommends investigation as necessary to ensure sufficient information exists to determine the validity of decisions

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made regarding public health. Like the investigation of other environmental media, subsurface vapor investigations will continue to be a cooperative effort between the NYSDEC, NYSDOH, EPA and, in some cases, other applicable parties.

Comment A.5.5 (paraphrased, 1 commenter, 4 comments):

The NYSDOH's jurisdiction extends only to assessing "serious health problems" resulting from a particular site. Investigations of inactive hazardous waste sites should be deferred to the NYSDEC, unless and until a "serious health problem" or "dangerous condition" is demonstrated.

Response A.5.5:

The NYSDEC and NYSDOH work cooperatively as "the State" to develop an investigation and remediation process for sites on an individual basis that is protective of human health and the environment. Toward this end, the State recommends investigation as necessary to ensure sufficient information exists to determine the validity of decisions made regarding public health. Like the investigation of other environmental media, subsurface vapor investigations will continue to be a cooperative effort between the NYSDEC, NYSDOH, EPA and, in some cases, other applicable parties.

Comment A.5.6 (paraphrased, 1 commenter, 1 comment):

The NYSDOH's role should focus on those sites where indoor air quality data indicate that a serious health problem or condition dangerous to life or health results from the site.

Response A.5.6:

The NYSDOH and NYSDEC work cooperatively in the investigation and remediation of sites in New York State. During this process, the NYSDOH is responsible for making sure both current and potential human exposures associated with the environmental contamination (e.g., contaminated soil, groundwater, soil vapor, sediments, etc.) are identified and addressed. Placing the focus of a soil vapor intrusion evaluation on indoor air quality data alone, as suggested in the comment, does not allow for an evaluation of the potential for future exposures.

Comment A.5.7 (paraphrased, 1 commenter, 1 comment):

Section 4: Soil Vapor Intrusion Mitigation — The guidance indicates that significant testing, design, operation and maintenance as well as public participation are all required, yet does not address which agency (NYSDEC or NYSDOH) will manage and run the program. How is all of the reporting supposed to be carried out in accordance with the guidance and who/what agency will give appropriate signoffs where mitigation is not required or when it is completed?

Response A.5.7:

The intent of Sections 4 and 5 of the guidance is to provide recommendations on how to address exposures related to soil vapor intrusion and how to keep the community informed, not to mandate actions as those described in the comment. To clarify this intent, the document has been revised to reflect that the guidance is not a rule, and text has been eliminated that might create a contrary impression.

Generally, the process for implementing and managing mitigation actions is analogous to that employed for other interim remedial measures. The extent of the testing,

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outreach, operation and maintenance, etc. will vary and should be determined on a site-specific basis. The proposed activities are presented in applicable site-specific work plans, such as an interim remedial measure work plan, a site management plan (formerly referred to as an operation, maintenance and monitoring plan), or a citizen participation plan. These plans are submitted to the NYSDEC and the NYSDOH, who work cooperatively in reviewing and approving such plans. Activities are subsequently carried out in accordance with approved work plans. Completed actions are usually summarized in reports. Once again, the NYSDEC and NYSDOH work cooperatively in reviewing and approving such reports. In general, final sign-offs are issued by the regulating agency, the NYSDEC, in consultation with the NYSDOH.

Comment A.5.8:

Does the state expect that the City of New York will enforce soil vapor guidance at all sites within its borders? The City presently does not regulate sites outside environmental review or designation processes, and much of this review is for pre-development activities.

Response A.5.8:

The NYSDEC and NYSDEC do not expect that local government will "enforce" this guidance. The Agencies intend to use the guidance in the evaluation of vapor intrusion at every site in which they are involved, and recommend that the guidance be considered anywhere soil vapor intrusion is evaluated in the State of New York.

Comment A.5.9 (paraphrased, 1 commenter, 1 comment):

Given the complex nature and potential impacts represented by soil vapor intrusion, we believe that it is important for the Agencies to promulgate regulations for the monitoring, measurement and mitigation of contaminated subsurface vapors and to discontinue their past and current practice of managing vapor intrusion in the State of New York through guidance documents and policies.

Response A.5.9:

The evaluation of the vapor intrusion pathway is an emerging science. The NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* [NYSDEC 2006] and the NYSDOH's guidance provide the necessary framework for evaluating soil vapor intrusion at remedial sites across New York. At this time, the Agencies do not intend to promulgate regulations for the monitoring, measurement and mitigation of contaminated soil vapor but will, as appropriate, make any soil vapor intrusion mitigation or monitoring plans part of the remediation plans for a site.

**A.6 TOPIC: Guidance with respect to the New York State Brownfield Cleanup Program (BCP)**

Comment A.6.1 (paraphrased, 1 commenter, 2 comments):

Because Section 2.1 of the guidance states that investigation is required when the soil cleanup standards are exceeded or when there is an existing subsurface source or likely subsurface source of volatile chemicals, regardless of whether NYSDEC soil cleanup standards are exceeded, the guidance undercuts the purpose and intent of the Brownfield Cleanup Act.

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Response A.6.1:

The purpose and intent of the "Brownfield Cleanup Program" is to encourage cleanup and redevelopment of brownfield sites using remedies that are fully protective of public health and the environment. The guidance provides an approach that will accomplish these goals at brownfields. Specifically, the guidance will help ensure that responsible parties seeking to investigate and remediate brownfield soil contamination will consider important site-specific factors such as the toxic potential of the contaminant(s) present, the extent of contamination, preferential pathways, subsurface hydrology, soil properties, existing structures, and anticipated future use.

Comment A.6.2 (paraphrased, 1 commenter, 1 comment):

The guidance states that action should be taken to reduce exposures when indoor air levels are "above background," even if those levels are below current guidance values (p. 33). This position is contrary to the NYSDOH's approach to drinking water quality, and effectively negates the approach taken by other air quality guidance documents published by the NYSDEC, including DAR-1.

The guidance states that "the goal of the recommended [corrective] actions is to reduce chemical levels in indoor air to as close to background as possible." The objective of all remedial programs was recently articulated by the Legislature in the Brownfield Cleanup Act (BCA) as the attainment of levels of contaminants protective of human health. The fact that this is not the objective of the guidance indicates that the NYSDOH is overreaching. We recommend that the objective of the guidance be restated as the attainment of levels of contaminants in indoor air that are protective of human health given the use to which the building is put.

Response A.6.2:

The guidance is not inconsistent with our approach to other media (such as contaminated groundwater or soil), where the reduction of exposure is a primary objective. Therefore, the guidance has not been revised as suggested.

The reference that reasonable and practical action (not necessarily mitigation) should be taken to reduce exposure to chemicals when indoor air levels are above background (even when they are below the guideline) is intended to address exposures which may be due to indoor and/or outdoor sources rather than soil vapor intrusion. The guidance is not prescriptive on what actions need to be taken or by whom. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation. Section 3 of the guidance has been revised to clarify this point.

[See also Comment D.10.23 (applicability of DAR-1 air guidelines).]

Comment A.6.3 (paraphrased, 1 commenter, 1 comment):

How will the mitigation requirements (testing, design, operation and maintenance, and public participation) set forth in this guidance be coordinated with the NYSDEC Brownfield Cleanup Program?

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Response A.6.3:

Generally, the process for implementing and managing mitigation actions within the BCP is analogous to that employed for other interim remedial measures. The extent of the testing, outreach, operation and maintenance, etc. will vary and should be determined on a site-specific basis. Activities appropriate for the site should be included in site-specific work plans and reports submitted to the NYSDEC and NYSDOH as part of the BCP. Such plans and reports may pertain to interim remedial measures, operations, maintenance and monitoring, and citizen participation. [See also Comment A.5.7.]

Comment A.6.4 (paraphrased, 1 commenter, 1 comment):

The passage of the New York State (NYS) Brownfields Law was a major step towards addressing the uncertainty associated with the cleanup and redevelopment of brownfield sites. We are concerned that the guidance will have the unintended consequence of impeding brownfields redevelopment due to its ambiguity and lack of clarity, particularly at sites where the profit margins are narrow. If the guidance can be tightened up so that brownfield stakeholders are provided clear requirements that can be carried out efficiently, the NYSDOH has an opportunity to protect the public from vapor intrusion and promote the safe redevelopment of brownfield sites.

Response A.6.4:

The intent of the guidance is to provide recommendations on how to investigate and address exposures related to soil vapor intrusion. As discussed in Section 1.8 of the guidance, the investigation, evaluation, mitigation and remediation of soil vapor and soil vapor intrusion are evolving disciplines. The guidance provides as detailed recommendations as possible given the current state of knowledge and our experience. To make the guidance more prescriptive would not allow for the flexibility needed in investigating and addressing this complex exposure pathway and may not be appropriate for all sites. The guidance has not been revised in response to this comment. However, if the results of future investigations indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate or are unnecessarily vague, then the guidance will be revised or amended accordingly.

Comment A.6.5:

In the context of the NYS Brownfield Cleanup Program, we have some concerns about how the issue of off-site vapor migration might be dealt with when the BCP applicant is a volunteer. On-site vapor intrusion can be dealt with easily with engineering controls. However, in the absence of some threshold values that link soil vapor values with off-site levels of vapor in buildings, the State of New York and the regulated community may be confronting a challenge of immense proportions.

Response A.6.5:

Data collected to date from the investigation of sites in New York State do not support the use of soil vapor results to predict or model indoor air concentrations reliably. However, soil vapor results along with the results of sampling other environmental media and the conceptual site model can be used to indicate whether soil vapor may be migrating off-site and representing an off-site exposure concern. In accordance with the BCP, the Volunteer should include this potential route of exposure in the Qualitative Off-site Public Health Exposure Assessment for the site. As with other environmental media, the NYSDEC (not the Volunteer), in consultation with the

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NYSDOH, would be responsible for addressing off-site contamination. This includes identifying any potential responsible parties and enrolling them into an appropriate remedial program. [See also Comment A.11.1.]

Comment A.6.6 (paraphrased, 1 commenter, 1 comment):

In brownfield redevelopment situations, the uncertainty and risk associated with vapor intrusion studies may detract from such redevelopment. While the likelihood of vapor intrusion can be investigated during the design, the guidance states that a final assessment cannot be performed until at least 30 days after site redevelopment is complete, presuming this occurs during the heating season. The site facility could only be re-occupied if monitoring results are favorable. If results are not favorable, a plan may need to be implemented for additional mitigation measures, which are not assured to work. We are concerned that uncertainty about achieving acceptable soil vapor levels may discourage parties from entering the BCP.

Response A.6.6:

The comment refers to the recommendation that after a sub-slab depressurization (SSD) system is installed, its effectiveness should be confirmed. As described in Section 4.3.1 of the guidance, chemical testing is recommended no sooner than 30 days after the system is installed. If the system is installed outside of the heating season or at the end of a season, post-mitigation sampling may be postponed. In the absence of chemical testing, physical testing (e.g., demonstrating the system is depressurizing the entire slab) can be used to demonstrate the effectiveness of the system at any time. The use of SSD systems to mitigate the potential for soil vapor intrusion is a proven technology and the likelihood of failure is small. Therefore, the recommendation for post-mitigation sampling is not expected to preclude the occupancy of an on-site building that is being mitigated or the redevelopment of a brownfield site.

Comment A.6.7 (paraphrased, 3 commenters, 5 comments):

The requirements of the vapor intrusion guidance will discourage parties to voluntarily clean-up brownfield sites. Reluctance may be due to uncertainty in the level and the length of remedial activities that may be required or an inability to get financing to remediate and develop the site. In addition, there may be lingering concerns about liability issues, such as in locations of area-wide groundwater contamination.

Response A.6.7:

The guidance allows for flexibility in site redevelopment and should not preclude satisfactory redevelopment of sites. In many cases, mitigation systems have been installed on new or existing buildings as preventative measures to address concerns about soil vapor intrusion and radon. This may be prudent in areas of wide-spread groundwater contamination. While areas of site-wide groundwater contamination of an unknown source may present redevelopment difficulties, the State will be responsible for addressing or identifying the responsible party to address sources of contaminants not attributable to the site itself. To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. If a soil vapor intrusion investigation is needed but it is not the responsibility of the participant in a specific environmental remediation program, then the NYSDEC and NYSDOH will make sure appropriate actions are taken to complete the investigation and remediation, as well as to address exposures. This

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would include identifying any additional responsible parties and enrolling them into an appropriate remedial program.

### **A.7 TOPIC: Guidance with respect to the Resource Conservation and Recovery Act (RCRA) Program**

#### Comment A.7.1 (1 commenter, 1 comment):

NYSDOH appears to be applying these residential air guidelines to all sites without regard to site operations or other regulatory programs governing human exposures. The *Current Human Exposures Under Control* environmental indicator (EI) under the Government Performance Results Act (GPRA) is an interim milestone developed by and for the Environmental Protection Agency, providing a measure of progress toward controlling human exposures to contamination at facilities subject to Resource Conservation and Recovery Act (RCRA) Corrective Action. For operating RCRA facilities subject to the GPRA, the exposure criteria used to meet the *Current Human Exposures Under Control* EI should therefore be consistent with current operations and exposure scenarios rather than a potential future land use human exposure scenario.

#### Response A.7.1:

All sites and projects must be evaluated based upon the individual conditions at each one. The State understands that EIs are performed periodically at RCRA regulated facilities. These periodic EIs document that human exposures are under control at a particular point in time. However, potential future exposures must be taken into account before a RCRA regulated facility can be dismissed from the RCRA program.

### **A.8 TOPIC: Guidance with respect to other vapor intrusion guidance or policies**

#### Comment A.8.1 (paraphrased, 13 commenters, 40 comments):

Commenters noted that the approach to evaluating soil vapor intrusion in the guidance differs from those developed by other state and federal agencies. Numerous comments were received encouraging the NYSDOH to adopt an approach more analogous to those of others due to the scientific uncertainty in this developing field. They believe the approach outlined in the guidance does not allow for a focused vapor intrusion study and recommended the following key considerations be incorporated into the guidance:

- an iterative process, i.e., start with available data and collect only additional data to meet the needs of making informed decisions;
- development of an accurate site conceptual model that is representative of site conditions to ensure proper use of the data when evaluating the potential vapor to indoor air pathway under both generic and site-specific evaluations;
- flexibility to enable the use of professional judgement given site-specific circumstances;
- use of distance criteria (such as the "100-foot criterion" presented in the NYSDEC's November 2004 Draft Program Policy) to eliminate sites or buildings from vapor intrusion investigation;
- a site-specific evaluation using modeling, soil vapor sampling, indoor air sampling or mitigation at any point in the process;
- use of default attenuation factors as a first tier to allow screening of either soil vapor or sub-slab vapor data and as a tool to determine whether repeated monitoring of indoor air is necessary;

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- a tiered approach that allows for the collection and use of both generic and site-specific information/data and comparisons to risk-based screening levels prior to sampling sub-slab vapor and indoor air;
- use of multiple lines of evidence, including modeling from the subsurface, to determine if chemicals detected in indoor air are due to vapor intrusion or other potential sources;
- near-gas sampling or a weight-of-evidence approach (including building construction details, depth to source) to preclude sub-slab vapor and indoor air sampling; and
- use of screening levels, including use-specific (i.e., residential and commercial) screening levels, in environmental media to identify sites where a detailed investigation of vapor intrusion is not required.

Furthermore, commenters recommended that (at a minimum) the state should accept and adopt the soil vapor screening levels and default attenuation factors presented in the EPA's guidance (EPA 2002) (including any subsequent revisions to this document). They also requested that the NYSDOH explain why data collected from the IBM Endicott site -- data which support the conclusion that these attenuation factors are conservative -- have not been incorporated into the guidance for the development of realistic attenuation factors.

#### Response A.8.1:

The guidance is intended to provide general approaches and strategies to collect appropriate and relevant data with respect to evaluating the soil vapor intrusion pathway. The State recognizes that each site is unique and that the approach to evaluating soil vapor intrusion is dependent upon site-specific characteristics. As such, the guidance outlines a phased iterative approach to investigation in which existing environmental site data are evaluated to define the nature and scope of subsequent investigation and/or remediation. The guidance also allows for consideration of measures to mitigate exposures or to remediate subsurface vapor contamination at any time during the investigation and remediation of a site (see also Comment A.16.1). The phased iterative nature of the investigation is similar to investigation of other environmental media (e.g., soil, groundwater, etc.) and analytical data collected as part of this effort are intended to be incorporated into a conceptual site model. As discussed in Part B.7 (TOPIC: Conceptual site model), Section 1.6 of the guidance has been revised to describe the relationship between the general approach to evaluating soil vapor intrusion and a conceptual site model.

As discussed in Section 3.0, the results of individual soil vapor, sub-slab vapor, indoor air and outdoor air samples are not reviewed in isolation. Rather, data are evaluated using a multiple-lines-of-evidence approach in which many factors, such as the nature and extent of contamination in all media, background sources of volatile chemicals in indoor air, sources of volatile chemicals, factors that affect vapor migration and intrusion, current and future site use, applicable standards, criteria and guidance values are considered. This approach is used to identify the need for additional investigation and to select appropriate actions to address exposures related to soil vapor intrusion.

With regard to generic distance criteria, soil vapor intrusion data collected to date do not support the use of such criteria to screen-out sites for further evaluation. As such, the NYSDEC has decided to revise its draft policy (referenced in the comment; NYSDEC 2004) and not apply a generic threshold criterion based on distance from a source of contamination to an occupied structure. [See also Comments A.12.5, C.2.2 and D.10.3.]

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With regard to "screening" criteria, soil vapor intrusion data collected to date do not support the development of such criteria (based on soil, groundwater or near-slab vapor data) or the generic application of the EPA's criteria. For example, the State acknowledges that in many instances near-slab vapor concentrations are similar to sub-slab vapor concentrations. However, a sufficient number of cases exist where sub-slab concentrations are elevated with respect to near-slab concentrations, sometimes by an order of magnitude or more. This may be due to differences in factors such as soil moisture content and pressure gradient. Therefore, use of near-slab vapor data to predict sub-slab vapor or indoor air concentrations is not considered protective of public health. The State has no plans at this time to develop soil, soil vapor or groundwater screening criteria for determining the need for investigation of the soil vapor intrusion pathway. [See also Comments D.5.5 and D.10.3.]

With regard to attenuation factors, although an extensive data set from the IBM Endicott site has been collected, data from other sites have not indicated that a single attenuation factor can be universally applied at a site or between sites at this time. Our data indicate that soil vapor and sub-slab soil vapor concentrations can be highly variable and cannot accurately and reliably predict or model expected indoor air concentrations. Given these uncertainties, the application of a generic attenuation factor is not considered to be protective of public health. [See also Comments D.10.12, D.12.9 and E.2.12.]

Overall, as discussed in Section 1.8 of the guidance, the investigation, evaluation, mitigation and remediation of soil vapor and soil vapor intrusion are evolving disciplines. The guidance provides as detailed recommendations as possible given the current state of our knowledge and experience. To make the guidance more prescriptive precludes the flexibility needed in investigating and addressing this complex exposure pathway and may not be appropriate for all sites. The State believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion that is

- analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns, and
- supported by data collected during soil vapor intrusion investigations throughout New York State to date.

[See also Comments A.9.8, A.10.3 and D.15.7.]

Comment A.8.2 (paraphrased, 1 commenter, 2 comments):

The guidance seems to overstep the NYSDOH's jurisdictional bounds, and potentially conflicts with the NYSDEC's proposed soil vapor intrusion guidance, by directing whether, when and where soil vapor samples should be taken. The development of guidance on the method of sampling environmental media, the number of samples taken, the frequency of monitoring, and decisions on remedial measures for vapor intrusion pathways is within NYSDEC's purview, not the NYSDOH's.

Response A.8.2:

The NYSDOH, in cooperation with NYSDEC, is responsible for assessing potential human exposure pathways at contaminated sites. The guidance provides recommendations on how to investigate and address a specific exposure pathway (soil vapor intrusion) that may exist at a site. As discussed in the NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* [NYSDEC 2006], this pathway will be evaluated at all completed, current and

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future sites in New York State. The NYSDOH's guidance complements the NYSDEC's policy by providing recommendations on how to evaluate soil vapor intrusion. The guidance was drafted in consultation with the NYSDEC and should not be interpreted as the NYSDOH operating separately from the NYSDEC. The combined goal of the policy and guidance documents is to conduct soil vapor intrusion evaluations as efficiently and effectively as possible at all remedial sites in New York.

Comment A.8.3 (paraphrased, 1 commenter, 1 comment):

We are concerned that the guidance presents an "all or nothing" approach to testing for soil vapor intrusion. The guidance fails to present the type of tiered approach recently articulated by the NYSDEC in its Draft Soil Vapor Intrusion Guidance document entitled "Evaluating the Potential for Vapor Intrusion at Past, Current and Future Sites." The guidance indicates that full protocol for soil vapor testing is "necessary" at any site where there is even a possibility of soil vapor intrusion.

Response A.8.3:

As a point of clarification, the document referenced in the comment is the NYSDEC's *Draft Program Policy Evaluating the Potential for Vapor Intrusion at Past, Current, and Future Sites* [November 22, 2004, draft]. This policy does not present a tiered approach to screen sites out of investigation, as suggested in the comment. Rather, the policy states that the soil vapor intrusion pathway will be evaluated at all completed, current and future sites in New York State. It also provides a strategy for prioritizing the evaluation of the soil vapor intrusion pathway at sites where remedial decisions have already been made (i.e., past sites). The strategy was developed due to the large number of past sites and to the lack of resources to evaluate soil vapor intrusion at all of the past sites simultaneously. The NYSDOH's guidance complements the NYSDEC's policy by providing recommendations on how to evaluate soil vapor intrusion. The combined goal of the policy and guidance documents is to conduct soil vapor intrusion evaluations as efficiently and effectively as possible at all remedial sites in New York.

The State believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion that is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns. Therefore, the guidance has not been revised in response to the comment.

Comment A.8.4 (paraphrased, 2 commenters, 2 comments):

Petroleum hydrocarbon sites are recognized as being of lower threat than chlorinated solvent sites in the NYSDEC's guidance "Evaluating the Potential for Vapor Intrusion at Past, Current, and Future Sites." However, no distinction is made in the NYSDOH's guidance.

Response A.8.4:

The referenced document, the NYSDEC's *Draft Program Policy Evaluating the Potential for Vapor Intrusion at Past, Current, and Future Sites* [November 22, 2004, draft], provides a strategy for prioritizing the evaluation of the soil vapor intrusion pathway at sites where remedial decisions have already been made (i.e., past sites). The strategy was developed due to the large number of past sites and to the lack of resources to evaluate soil vapor intrusion at all of the past sites simultaneously. Therefore, for the purposes of prioritization, past sites with petroleum hydrocarbon contamination were considered to be a lower concern for soil vapor intrusion than past sites with chlorinated solvent contamination. The NYSDOH's guidance is intended to provide an

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approach for investigating and addressing the potential for soil vapor intrusion at sites (past, present and future) with volatile chemical contamination, regardless of the nature of the contamination.

### **A.9 TOPIC: Approach to evaluating soil vapor intrusion – New York State's general approach**

#### Comment A.9.1 (paraphrased, 1 commenter, 1 comment):

The goal of New York State's vapor intrusion policy should be to reduce the risk to human health to an excess cancer risk of one-in-one million and a hazard index of one for non-cancer end points.

#### Response A.9.1:

As set forth in the guidance, the overall goal of recommended actions is to reduce contaminant levels in indoor air to as close to background as practical. [See also Comment A.4.2.]

#### Comment A.9.2 (paraphrased, 1 commenter, 3 comments):

The economic benefits in terms of incremental reduction in health risk often will not justify the cost of the sampling and/or mitigation that the guidance would call for. The guidance encourages considerable resources to be devoted to reducing risk levels that will have little public health benefit. The guidance should not be constructed in a manner that identifies through exhaustive investigation all situations in which the vapor intrusion pathway could — under any hypothetical circumstances — present risks in excess of stringent criteria. Rather, it should embody a philosophical approach that pursues situations where vapor intrusion is plausibly a significant threat.

#### Response A.9.2:

In environmental remediation, decisions rarely come down to a simple cost-benefit analysis. Cost is one of many factors that weigh in the determination of the best path forward for any given site. One of the goals of New York State's environmental remediation programs is to minimize, to the extent practicable, human exposure to site-related contamination through all potential exposure pathways, including the soil vapor intrusion pathway. The guidance, as presented, is consistent with that goal.

#### Comment A.9.3 (2 commenters, 1 comment):

In the absence of a preliminary risk-based screening step, all results including soil vapor and subslab are compared to background indoor or outdoor air concentrations. Without the inclusion of a screening step, NYSDOH should explain how vapor intrusion evaluations will be focused to avoid background issues and inconclusive sampling results.

#### Response A.9.3:

The State acknowledges that an understanding of background sources is a crucial part of the data evaluation process. Section 2.11 of the guidance recommends ways to identify alternate sources of volatile chemicals in the indoor air and, where appropriate, to minimize potential sampling interferences. As discussed in Section 3, a multiple-lines-of-evidence approach is recommended to identify sources of volatile chemicals to the indoor air and to select appropriate steps to address exposures. With respect to soil vapor data, a "whole picture" approach is recommended to identify trends and spatial variations in the data (Section 3.3.1). Background issues are

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addressed by looking at the data as a whole and with consideration of the conceptual site model and factors discussed in Section 3.

Comment A.9.4:

Since the guidance does not allow no further action based on modeling and does not have any soil or groundwater criteria for screening that could lead to no further action, soil vapor, indoor air, outdoor air and sub-slab sampling will have to be collected at a minimum. Existing environmental data (groundwater and soil) are only used to select soil vapor, indoor air and sub-slab sampling locations. However, the guidance is very subjective on how this data is used. Integration of the Data Quality Objectives (DQO) process to develop sampling plans would alleviate concerns about the guidance's subjective treatment of data. There are no options for saving costs through screening. In some instances, perhaps skipping sampling and going straight to mitigation could be the most economical option.

Response A.9.4:

Comment noted.

Comment A.9.5 (paraphrased, 1 commenter, 1 comment):

The final guidance document must be clear in that, at most, its provisions provide a default approach that is acceptable to the NYSDOH, and that the NYSDOH may review and accept alternative approaches that are consistent with statutory and regulatory requirements.

Response A.9.5:

The intent of the guidance is to provide recommendations on how to investigate and address exposures related to soil vapor intrusion. As discussed in Section 1.8 of the guidance, the investigation, evaluation, mitigation and remediation of soil vapor and soil vapor intrusion are evolving disciplines. The guidance provides as detailed recommendations as possible given the current state of knowledge and our experience to date. Alternative approaches to evaluating soil vapor intrusion, may be proposed and described thoroughly in applicable site-specific work plans submitted for review by the State (e.g., investigation plans, citizen participation plans, interim remedial measure plans, etc.). The NYSDEC and NYSDOH work cooperatively in reviewing and approving such plans. To the extent that other approaches meet the objectives discussed in Section 1.5 and throughout the guidance, they will be considered.

Comment A.9.6 (paraphrased, 1 commenter, 1 comment):

Many soil vapor intrusion studies will be done in the context of remedial investigation activities at contaminated sites. There will be a wealth of soil, groundwater, and often, soil vapor data available concerning the nature and extent of contamination. Potentially Responsible Parties (PRPs) should not be required to implement the guidance's rigid protocol which appears to be designed to provide a scientific site-wide model of the areal and vertical extent of soil vapor as it changes over time, when so much data is already available.

Response A.9.6:

Acknowledged. As discussed in Section 1.5, "...the approach to evaluating soil vapor intrusion is dependent upon site-specific conditions. A thorough understanding of the site...is used to develop an investigation plan. Existing information is reviewed to determine what data are available and what additional data should be collected, as well as to guide the investigation." If existing site data are sufficient to characterize

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the nature and extent of subsurface vapor contamination, to evaluate current and potential exposures to contaminated subsurface vapors, and to determine what actions, if any, are needed to address exposures and to remediate contaminated subsurface vapors, then additional data are not necessary.

Comment A.9.7 (paraphrased, 2 commenters, 2 comments):

The guidance creates a substantial (and arguably insurmountable) burden of proof in relation to showing that there is no chance of future vapor migration and that no further action is needed. The circumstances that define these scenarios are so limited that they are seemingly unrealistic.

Response A.9.7:

The State believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion that is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns. The State does not believe that the approach recommended in the guidance is overly burdensome or unrealistic. "No further action" decisions have been made at sites. Additionally, the delineation of subsurface contamination in terms of identifying buildings where no further action to address exposures related to soil vapor intrusion has been accomplished. [See also Part D.15 (TOPIC: Site close-out — no further action or completion determinations).]

Comment A.9.8 (paraphrased, 1 commenter, 1 comment):

The procedure and requirements outlined in this document differ drastically from all other existing or proposed Federal or State vapor intrusion policy around the country. The primary question that New York State needs to ask itself is whether it wants to have a policy that is inconsistent with the rest of the country.

Response A.9.8:

While there are differences between our guidance and the guidance provided by others, we believe that our guidance provides a reasonable and practical approach to evaluating soil vapor intrusion that is

- analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns, and
- supported by data collected during soil vapor intrusion investigations throughout New York State to date.

[See also Comment A.8.1.]

Comment A.9.9:

There needs to be a more common sense approach that addresses the urban sites both from the perspective of investigation requirements and remedial measures. One possibility is to identify the circumstance, based on site investigation results, that a basic measure, e.g., an engineered barrier, could be applied without the need for extensive vapor investigation.

Response A.9.9:

Measures to mitigate exposures or to remediate subsurface vapor contamination can be considered and agreed upon at any time during the investigation and remediation

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of a site. Implementation of such measures may eliminate or limit the need for soil vapor intrusion investigations. These determinations are made on a site-specific basis. [See also Part A.16 (TOPIC: Presumptive remedies).]

#### Comment A.9.10:

The guidance leaves significant flexibility in terms of evaluation of data and determination of vapor intrusion. Although the flexibility is appropriate to handle the wide variations of site conditions across the state, it also leaves open a significant potential for inconsistent application of the guidance from one region to the next. How does the State plan to manage potential consistency issues? Will it make available a database of decisions made by state agencies across the state? Will decisions made for sites under State responsibility be consistent with sites under private responsibility?

#### Response A.9.10:

One of the reasons why the guidance was prepared was to promote consistency in addressing the issue of soil vapor intrusion. While approaches for meeting the objectives discussed in the guidance may vary, the objectives themselves remain consistent from site to site. The State will use the guidance in the evaluation of vapor intrusion at every site that it is involved in and recommends that the guidance be considered anywhere soil vapor intrusion is evaluated in the State of New York — whether the evaluation is being undertaken voluntarily by a corporation, a municipality, or private citizen, or under one of the state's environmental remediation programs.

Training sessions on the State's approach to evaluating soil vapor intrusion were conducted throughout the state to supplement the guidance. Audiences included state, local and regional DOH and NYSDEC staff, the regulated community, and the general public. Completion of training, with updated training sessions as needed, is intended to provide a uniform level of knowledge regarding soil vapor intrusion.

In addition to these efforts, consistency issues will be handled in a manner similar to that used when investigating other environmental media. For sites in one of the State's environmental remediation programs, consistency is addressed through the submittal, review and approval of work plans and reports. In accordance with these programs, decisions made and actions taken are intended to be protective of public health and the environment. A database of soil vapor intrusion decisions is not planned at this time.

#### Comment A.9.11 (paraphrased, 3 commenters, 3 comments):

The guidance would be more helpful if it was less vague and not as reliant on interpretation. The NYSDOH must ensure that flexibility does not require unnecessary sampling and over analysis and that the guidance provides a clearer process for conducting analyses and interpretation of the results.

#### Response A.9.11:

The intent of the guidance is to provide recommendations on how to investigate and address exposures related to soil vapor intrusion. As discussed in Section 1.8 of the guidance, the investigation, evaluation, mitigation and remediation of soil vapor and soil vapor intrusion are evolving disciplines. The guidance provides as detailed recommendations as possible given the current state of knowledge and our experience to date. To make the guidance more prescriptive would not allow for the flexibility needed in investigating and addressing this complex exposure pathway and may not

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be appropriate for all sites. The appropriate amount of sampling will vary and is therefore determined on a site-specific basis.

The guidance has not been revised in response to this comment. However, if the results of future investigations indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate or are unnecessarily vague, then the guidance will be revised or amended accordingly.

### **A.10 TOPIC: Approach to evaluating soil vapor intrusion – Petroleum hydrocarbon sites**

Comment A.10.1 (paraphrased, 1 commenter, 1 comment):

The agency may want to consider adopting separate vapor intrusion guidance relating to petroleum hydrocarbons.

Response A.10.1:

The guidance is intended to provide an approach for investigating and addressing the potential for soil vapor intrusion at sites with volatile chemical contamination, regardless of the nature of the contamination. If investigations of sites indicate a particular type of site warrants special considerations (e.g., petroleum hydrocarbon sites, manufactured gas plant sites, dry cleaner sites, etc.), then these considerations will be included in revisions or amendments to the guidance.

Comment A.10.2 (paraphrased, 3 commenters, 7 comments):

Several commenters recommended special considerations for petroleum hydrocarbon sites. These considerations are summarized as follows:

- To reflect the lower potential threat associated with petroleum hydrocarbon sites accurately, the guidance should require less extensive vapor intrusion investigations.
- Methods for evaluating the significance of biodegradation through a multiple-lines-of-evidence type of approach should be included to avoid the likelihood of sampling indoor air and sub-slab soil vapor.
- For biodegradable compounds, conservative default dilution or degradation factors, as well as a subsurface vapor to indoor air attenuation factors, could be adopted.
- Screening levels for certain petroleum hydrocarbons should be considered. There is likely to be many, if not a majority of cases for petroleum VOCs (in particular, dissolved phase sources), where soil-gas data can be used to demonstrate an incomplete pathway (i.e., soil-gas concentrations fall below levels of detection, outdoor air, or background concentrations).
- The agency should consider a tiered or phased approach based on the analysis of groundwater and soil vapor with comparison to risk-based screening levels.

Response A.10.2:

To date, the assessment of petroleum hydrocarbon sites has been based on soil vapor sampling results, indoor air results, model predictions, or some combination thereof. The information currently available does not support the use of soil vapor or groundwater screening values or of default factors for attenuation, dilution or degradation to presumptively rule out sub-slab vapor or indoor air sampling. Specifically, field data demonstrating the following are scarce:

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- the relationship between the results of sampling outside of buildings (soil vapor) and within buildings (sub-slab vapor and indoor air),
- the relationship between sub-slab vapor and indoor air concentrations, and
- the effect of biodegradation on sub-slab vapor concentrations.

If field data across the state demonstrate the validity of the considerations presented by the commenters, the State will update or amend the guidance accordingly.

[See also Comments A.8.1 and B.4.1.]

Comment A.10.3 (paraphrased, 2 commenters, 2 comments):

Fitting petroleum compounds into the existing matrices would be difficult and applying highly compound-specific matrices to the broad list of petroleum compounds may be too confusing.

Response A.10.3:

Comment noted.

**A.11 TOPIC: Party responsible for investigating and taking action(s) to address exposures**

Comment A.11.1 (paraphrased, 1 commenter, 1 comment):

The guidance does not clearly address potential issues that often arise at Brownfields sites. In particular, who should investigate and take appropriate measures for the off-site sources of airborne contaminants? What is the building owner supposed to do if elevated levels are found in the building that are attributable to off-site sources, even if the conclusion is that it is an ambient condition? Also, should a BCP volunteer be responsible for off-site effects of contamination emanating from his property in the vadose zone? Under the BCP the volunteer only needs to deal with on-site contamination and qualitatively assess off-site impacts. Will the participant alert off-site building owners that a soil vapor intrusion threat exists and trigger expenditures on their part? Will more financial responsibility be required or expected of the volunteer?

Response A.11.1:

Should a BCP Volunteer document elevated volatile chemical levels that are determined, by the NYSDEC and NYSDOH, to originate from an off-site source and represent a potential significant threat, the NYSDEC will notify the responsible party of the findings and enroll them into one of NYSDEC's remedial programs. Should the off-site source property owner refuse to participate or if a responsible party does not exist, the NYSDEC, in consultation with the NYSDOH, will be responsible for taking appropriate actions to address exposures in the Volunteer's and other buildings and may undertake cost recovery from the off-site property owner.

Typically, at a minimum, a Volunteer would be expected to intercept a site-related soil vapor plume at the property line (as would be expected with a groundwater plume). Off-site impacts resulting from contamination migrating from a BCP Volunteer's property will be addressed by the NYSDEC in accordance with the BCP. The NYSDEC, in cooperation with the NYSDOH, is responsible for notifying off-site property owners that the potential for soil vapor intrusion may need to be evaluated on their properties. The responsibility for subsequent costs will be determined by the NYSDEC. [See also Comment A.6.5.]

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Comment A.11.2:

The Draft SVI [Soil Vapor Intrusion] Guidance does not seem to take into account that there are stages in the investigation process in which NYSDEC may determine that the Potentially Responsible Party (PRP) is not responsible for further investigation. Such decisions must be made on a site-by-site basis by the NYSDEC personnel responsible for the investigation and remediation. For example, one indoor air sample or groundwater sample or soil vapor sample may lead to a determination that soil vapor intrusion is not an issue at a particular site. It is very important that the NYSDEC have the flexibility to make determinations based on actual site conditions and experience.

Response A.11.2:

The NYSDEC, in consultation with the NYSDOH, makes decisions based on "actual site conditions," among other factors, and uses the guidance to help make those decisions. Should the agencies determine, based on an evaluation of all the available data, that soil vapor intrusion is not an issue or potential issue of concern (e.g., should property use change) at a particular site, then the property owner or responsible party has no further obligation regarding soil vapor intrusion. On the other hand, should the agencies determine, based on an evaluation of all the available data, that soil vapor intrusion is an issue or potential issue of concern beyond the site's boundaries, the NYSDEC will decide who is responsible for further investigation and any necessary remediation.

Comment A.11.3 (paraphrased, 1 commenter, 1 comment):

This guidance requires outdoor air samples to be taken simultaneously with indoor air samples. However, time-specific background readings have little relationship to same-time indoor air readings; ambient background levels can vary widely over time and during the course of a day. The exchange between indoor and outdoor air is not instantaneous. A distinction needs to be made between a homeowner's, a PRP's, and the state's responsibilities. If sub-slab vapor concentrations are below indoor air action levels, no additional action is necessary by the PRP. Any additional action becomes the responsibility of the homeowner or the NYSDOH.

Response A.11.3:

As discussed in Section 3 of the guidance, outdoor air results are one of many factors considered when determining the likely source(s) of volatile chemicals to the indoor air and the appropriate steps to address exposures (if necessary). If the agencies determine, based on an evaluation of all the available data, that soil vapor intrusion is not an issue or potential issue of concern (e.g., should property use change) at a particular site, then the property owner or responsible party has no further obligation regarding soil vapor intrusion. In general, if indoor exposures represent a concern due to indoor sources, then the State (not the PRP) will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the PRP.

Comment A.11.4 (paraphrased, 8 commenters, 14 comments):

The guidance may impose mitigation and remedial obligations on a party where the indoor air impacts do not result from soil and groundwater contamination, or from subsurface sources alone.

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Response A.11.4:

As discussed in Section 3 of the guidance, many factors are considered when determining the likely source(s) of volatile chemicals to the indoor air and the appropriate steps to address exposures (if necessary). To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

**A.12 TOPIC: Resources**

Comment A.12.1 (paraphrased, 1 commenter, 1 comment):

Given how extensive this guidance is, it is unclear what NYSDOH staff are available to advise on and review soil vapor activities and documentation. We are concerned that long delays will impede timely investigations. Who will be responsible for performing investigations, evaluating data, and oversight? Does the NYSDOH have adequate resources to do this?

Response A.12.1:

Generally, the responsibility for conducting soil vapor intrusion investigations will vary depending upon the environmental remedial program (e.g., State, EPA, PRP, Volunteer, etc.). In all cases, regulatory staff will evaluate data generated to determine the appropriate next course of action. Regulatory staff review and approve site-specific work plans and reports. Staff are also available to provide guidance in developing these plans and reports. While delays in site investigations are certainly possible, the NYSDEC and NYSDOH are working cooperatively to conduct soil vapor intrusion evaluations as efficiently and effectively as possible.

Comment A.12.2 (paraphrased, 1 commenter, 1 comment):

If a soil vapor investigation will be required at every site with a soil or groundwater exceedance of Technical and Administrative Guidance Memorandum (TAGM) or Technical Operating Guidance Series (TOGs) for VOCs, requiring detailed NYSDOH review and approval of data and potential future site requirements in support of the NYSDEC, how will the NYSDOH provide staff for such oversight at all these sites to ensure that issues are resolved in a timely manner?

This guidance will require a significant increase in regulatory staffing and funding to address the prior approval or discussion requirements of the guidance, such as discussion with agency prior to conducting modeling, prior approval for modifications to the prescribed sampling protocols, prior approval for proposing alternative sources of volatiles in indoor air, and approval for alternative mitigation systems. Delays in the investigation and cleanup of sites with VOCs will occur unless sufficient resources are procured prior to implementing this guidance in this form.

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Response A.12.2:

Investigating the potential for soil vapor intrusion is a cooperative effort between the NYSDEC, NYSDOH, EPA at federal sites, and the responsible party. The NYSDEC and NYSDOH encourage parties to consider the guidance when developing investigation work plans in order to expedite the entire review and approval process by reducing the necessity for repeated comment letters and conference calls between the agencies and environmental consultants. Prior to the development of this guidance and the decision matrices therein, the evaluation of results could be time consuming. The State believes that once all parties become more familiar with the guidance, any delays will be reduced. [See also Comment A.13.1.]

Comment A.12.3 (paraphrased, 2 commenters, 3 comments):

We are concerned about the reality of ubiquitous chlorinated solvent contamination in aquifers in certain urban areas in our state. To be consistent with requirements for privately remediated and developed sites, will the NYSDOH fund soil vapor investigations and remediation for New York State areas with known regional groundwater contamination? For properties overlying regional groundwater plumes, this guidance appears to place the burden of investigation and remediation on the property owners, prospective buyers, or developers of individual properties within a regional groundwater plume.

Response A.12.3:

In general, the State will request responsible parties to conduct soil vapor intrusion evaluations at their sites. In locales where there may not be a viable responsible party or where the source of the contamination is unknown, the State will conduct the vapor intrusion evaluations as appropriate where the potential for significant threat exists for the protection of human health.

Comment A.12.4 (paraphrased, 1 commenter, 1 comment):

We are concerned that installation of a mitigation system into an existing building could get quite expensive. The NYSDOH should make a case that there are public health benefits as a result of such measures, and should provide realistic urban background concentrations and conditions before going forward with a program of this nature.

Response A.12.4:

In the State's experience, sub-slab depressurization systems have been proven to be up to 99 percent effective in preventing vapor intrusion and therefore, result in a significant reduction in human exposure via soil vapor intrusion.

During an investigation of potential vapor intrusion, outdoor air samples must be collected to identify any potential background interference (i.e., actual urban background, etc.) that are considered in determining the need for recommended actions.

Comment A.12.5 (paraphrased, 1 commenter, 1 comment):

You are the only Federal or State agency I know of that has put no distance criteria in their site screening criteria. This will bring in an enormous amount of sites. Who is to pay for all of this?

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Response A.12.5:

At all current and new remedial sites in New York, soil vapor, like soil and groundwater, will be evaluated, as part of on-going and proposed site investigation. The evaluation of the soil vapor intrusion pathway will proceed in a similar fashion to the evaluation of other environmental media of concern (soil, groundwater) and will be performed by the appropriate party, which may include the State of New York, the EPA or a responsible party. [See also Comment A.8.1 (distance criterion).]

Comment A.12.6 (paraphrased, 1 commenter, 1 comment):

Section 2.2 identifies four types of samples (soil vapor, sub-slab vapor, indoor and outdoor air) and indicates multiple sample locations may be required in a given round. The additional sampling requirements will be very costly.

Response A.12.6:

Comment noted.

### **A.13 TOPIC: Tracking systems**

Comment A.13.1:

The policy for tracking known contamination so that it does not impact on other sites in the future should be identified. As the issue of vapor intrusion has demonstrated, contaminants continue to migrate through soil and groundwater, resulting in exposures in areas far removed from the origin of the contaminant release. While the preference should be to remediate the source, there remains the potential for vapor intrusion as has been witnessed at several federal and State superfund sites. To minimize future impacts, the final Guidance should include a reference to the measures that will be taken by the State to track and remediate such contamination, as provided in the Brownfield Cleanup Program.

Response A.13.1:

The potential for the off-site migration of on-site contamination is typically identified in the site investigation process. How the migration is managed, and by whom (e.g., State, EPA, PRP, Volunteer, etc.) depends upon the environmental remediation program. Generally, it is addressed in site management plans (formerly referred to as operation, maintenance and monitoring plans) and reports for a site. For example, at sites with groundwater contamination, if there are concerns for exposure (e.g., off-site private residential wells), groundwater sampling locations are selected to monitor the potential for groundwater migration toward those residences. If there are concerns about on-site contamination migrating off-site in the future, groundwater is monitored at the site's boundary. The results of these monitoring programs are submitted to the State. If the monitoring results indicate a need for additional actions to evaluate exposures or to investigate or remediate the environmental contamination further, then appropriate actions are taken. In addition to OM&M activities, institutional controls may be used to prevent exposures related to residual contamination (e.g., groundwater use restrictions). Soil vapor contamination should be addressed in an analogous manner.

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#### **A.14 TOPIC: Access issues**

##### Comment A.14.1 (paraphrased, 2 commenters, 3 comments):

The guidance does not address access issues. Because many groundwater plumes may have migrated under private residences or buildings, the guidance document should contain protocols for obtaining access and communicating the potential risk to residents or building workers from vapor intrusion.

##### Response A.14.1:

Protocols for obtaining access to private properties are outside the scope of this guidance document. However, in our experience, access is rarely denied. When a property owner has been reluctant to grant access or has outright refused access for whatever reason, the State has found that access might be gained following a phone call, letter, or meeting between the property owner and the NYSDEC and/or NYSDOH. Situations where reasonable actions have been taken to gain access, but access continues to be denied, are addressed on a site-specific and building-specific basis. In some cases, subject to the NYSDEC and NYSDOH's approval, decisions pertaining to appropriate actions may need to be made without sampling a particular property and by using other investigation results and information known about the site. As always, any problems obtaining access should to be brought to the attention of the NYSDEC and NYSDOH so that the agencies might facilitate a favorable outcome.

The guidance provides a discussion on community outreach methods in Section 5 and includes fact sheets that provide limited health risk information. As discussed in Section 5, there are many different approaches to risk communication and outreach. The type, or types, of techniques selected for a site will vary depending upon the community's needs, site-specific conditions and remedial program-specific requirements. Once indoor air and outdoor air results are obtained, the NYSDOH can provide chemical-specific health risk information based on the volatile chemicals identified, their concentrations, and exposure potential.

##### Comment A.14.2 (paraphrased, 1 commenter, 1 comment):

The guidance allows soil vapor sampling external to buildings only for scoping of internal investigations (sub-slab vapor and indoor air sampling), and not for final determinations, attributed to the "hit-and-miss" nature of soil vapor data (Section 3.3.1). Due to ownership issues, concerns about floor damage, and other access constraints, it is not always feasible to perform sampling in or under the target structure. Requiring building access could significantly impede the ability of Responsible Parties to obtain site closure or complete real estate transactions and may represent an unreasonable burden. A soil vapor sample directly outside a building and at an appropriate depth would generate valid data for final determinations.

##### Response A.14.2:

The State acknowledges that obtaining access to properties under investigation can be difficult at times. However, our experiences indicate that these instances are not widespread and at times can be worked out by a phone call, letter, or meeting between the property owner and the NYSDEC and/or NYSDOH. Situations where reasonable actions have been taken to gain access, but access continues to be denied, are addressed on a site-specific and building-specific basis. In some cases, subject to the NYSDEC and NYSDOH's approval, decisions pertaining to appropriate actions may need to be made without sampling a particular property and by using other investigation results and information known about the site. Even in these cases, soil vapor results are still not used as the sole factor in determining appropriate actions (as

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discussed in Sections 2.2.1 and 3.3.1 of the guidance). Rather, soil vapor results are considered in conjunction with many factors including, but not limited to, soil results, groundwater results, sub-slab vapor results at adjacent properties, and identified or likely preferential pathways. [See also Comment D.10.6.]

### **A.15 TOPIC: Privacy issues**

Comment A.15.1 (paraphrased, 1 commenter, 1 comment):

Discuss privacy issues for home and business owners. For example, how and with whom should Indoor Air Questionnaires be filed? How should samples be identified to avoid use of addresses and public release of monitoring data in site characterization reports? For contractors working for private clients, other state agencies, or federal agencies, what are the minimum reporting requirements for the NYSDOH?

Response A.15.1:

In order for the State to evaluate the potential for soil vapor intrusion thoroughly, all data collected during sampling, including the completed Indoor Air Questionnaires, should be submitted to the State. Sample identifiers are determined on a site-by-site basis, with consideration of occupant and owner privacy issues. Once the information is submitted to the State it becomes public information. The State makes every reasonable attempt to protect the privacy of individual structure owners and occupants where it legally can. For example, maps displayed at public meetings that have results of structure sampling are constructed in a manner that they display pertinent information while protecting privacy to the maximum extent possible. Sampling reports that are released to the public may contain generic identifiers (e.g., Residence 1).

### **A.16 TOPIC: Presumptive remedies**

Comment A.16.1 (paraphrased, 2 commenters, 4 comments):

The guidance sets up a very comprehensive and rigorous framework for investigation of soil vapor and the implementation of remedial measures. However, it should also discuss the option of implementing presumptive remedies without the need for investigation. For example, a developer may wish to avoid time-consuming and costly sampling by designing and installing mitigation measures. Another example would be if VOCs are present in soil, or groundwater, or soil vapor, and a decision is reached that a potential exposure scenario and unacceptable risk may exist, the affected party should be allowed to proceed with active mitigation in lieu of indoor air sampling or exhaustive soil vapor sampling.

Response A.16.1:

Measures to mitigate exposures or to remediate subsurface vapor contamination can be considered at any time during the investigation and remediation of a site. Implementation of such measures may eliminate or limit the need for soil vapor intrusion investigations. These determinations are made on a site-specific basis.

### **A.17 TOPIC: Exit strategies**

Comment A.17.1:

The document is not clear enough about exit strategies. It should provide guidance about items such as how to screen sites for various mitigation actions, when sampling activities

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can be considered completed, and when a mitigation or monitoring system can be turned off. For example, Section 2.5 indicates that more than one round of sampling may be necessary due to various concerns. Several factors are given for condition variance. Who will determine when a sufficient number of rounds have been complete? If the first round indicates there is no problem, will that be sufficient? Where the above information is provided or an undeveloped site has mitigation designed into the construction based on either data or prevention, the data should be considered sufficient for [NYS]DOH to provide an approval, signoff, or closure of an issue.

Response A.17.1:

Both the NYSDEC and NYSDOH, in consultation with other involved agencies, will make the determination of when adequate data has been gathered to move to the next step. Designing mitigation measures into future construction is always a good approach. Implementation of such measures may eliminate or limit the need for soil vapor intrusion investigations. These determinations are made on a site-specific basis. [See also Part C.6 (TOPIC: Number of sampling rounds required) and Part E.7 (TOPIC: Termination of mitigation system operations).]

**A.18 TOPIC: Opportunities to review proposed guidance**

Comment A.18.1 (paraphrased, 3 commenters, 4 comments):

The document should outline the process by which the regulated community and other stakeholders can review new air guidelines, matrices, and updates to the guidance document.

Response A.18.1:

The development of air guidelines is not within the scope of the guidance. Opportunities for the public to comment on new air guidelines will be determined at the time of the guideline's development and the public will be notified accordingly.

Revisions or amendments (e.g., new matrices) to the guidance will be posted on the NYSDOH's web site. The web address is provided in the "New York State Departments of Health and Environmental Conservation — Web Sites on Soil Vapor Intrusion" section at the beginning of the guidance. Revisions or amendments may also be announced by other means (e.g., the Environmental Notice Bulletin). The State does not expect to designate formal, set comment periods with these releases. Rather, comments and questions may be sent at any time to the NYSDOH's Bureau of Environmental Exposure Investigation (see the "Contact Information" section at the beginning of the guidance). Comments received will be considered for any future updates of the document. Information about the State's web sites, the availability of materials, and the submission of comments or questions has been added to the guidance. At the time any changes are made, and when appropriate, information on how to comment will be provided.

**A.19 TOPIC: IBM Endicott site**

Comment A.19.1 (paraphrased, 1 commenter, 1 comment):

We encourage the NYSDOH to discuss what happened at Endicott, NY, to give the guidance more credibility with the regulated community. The NYSDOH has published a useful link to events at Endicott on its web site at <http://www.health.state.ny.us/nysdoh/gas/soilgas.htm>, but this site is nowhere found in the soil vapor guidance. The NYSDOH should more

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thoroughly describe the range of TCE values found at Endicott, how they are above NYSDOH guidance but below levels that will harm human health, and describe how the indoor air concentrations in Endicott homes differed from what the NYSDEC and NYSDOH anticipated would be found from the remediated IBM groundwater plume.

Response A.19.1:

Data collected from the evaluation of sites across New York to date indicate that each site is unique and that the approach to evaluating soil vapor intrusion is dependent upon site-specific characteristics. The guidance is intended to present generic steps and strategies that may be applied when approaching an investigation of soil vapor intrusion. While the data set from the Endicott site is the most extensive soil vapor intrusion data set in New York to date, the State does not intend to incorporate the Endicott site data, or other specific site data, into the guidance as this is inconsistent with the general approach and intent of the guidance. The guidance has not been revised in response to the comment.

**A.20 TOPIC: Miscellaneous editorial comments**

Comment A.20.1:

Chapters 2, 3 and 4 should be re-structured to eliminate multiple redundancies.

Response A.20.1:

These sections describe several phases of a soil vapor intrusion evaluation, which are generally performed to meet the same stated objectives. Therefore, some redundancy is inherent. Should portions of the document be used without reference to other sections, this redundancy will allow for follow through of important objectives without jeopardizing the relevance of the information gathered. The guidance has not been revised in response to this comment.

Comment A.20.2:

References to other sections require verification. For example:

Pg. 35 – Reference to occupational exposures should be Section 2.12, not 2.11.

Pg. 39 – Reference to sampling during heating season should be Section 2.4, not 2.6.3.

Response A.20.2:

Cross-references in the guidance have been checked and revisions have been made, including the corrections mentioned in the comment.

Comment A.20.3:

Section 3.4.2, fourth sentence: Insert "be" between "will developed."

Response A.20.3:

Comment noted.

**A.21 TOPIC: References in guidance**

Comment A.21.1:

Throughout the document, references to peer-reviewed scientific literature and other pertinent background information, including the EPA website and guidance on vapor

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intrusion should be included. For example, the first four references following Table 3.1 (used to set NYSDOH air guideline values) are not available on the NYSDOH website and should be provided in full. The use of "letters" and "re-entry guidelines" to set policy is questionable, and in addition these documents are also 17-20 years old.

Response A.21.1:

References are included as appropriate. For copies of any references that are not currently posted on the NYSDOH's web site, please contact the NYSDOH and we will provide copies to the requester (see the Contact Information section at the beginning of the guidance). Guidance documents are dated the year they were implemented and are only updated as needed. The guidance has not been revised in response to the comment.

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## **PART B**

### **GUIDANCE SECTION 1: INTRODUCTION**

#### **B.1 TOPIC: General comments on Section 1 of the guidance**

Comment B.1.1 (paraphrased, 2 commenters, 2 comments):

We feel that this section is very well written, very complete, and provides a thorough overview of the definition and scope of the vapor intrusion issue.

Response B.1.1:

Comment noted.

Comment B.1.2:

The guidance does a careful job of defining the concept of vapor intrusion for the uninitiated. Further, Section 1 offers an excellent overview of the various pathways and factors affecting vapor intrusion. By listing the environmental and building factors, and the various sources of volatile chemicals the guidance is bringing vapor intrusion into a context we can all understand – a highly desirable outcome.

It is also noteworthy that Section 1 points out that, "[e]xposure to a volatile chemical due to vapor intrusion does not necessarily mean that health effects will occur." Understanding this will be important when the remediation and redevelopment of brownfields in urban areas is undertaken.

It is also logical, and Section 1 provides, that the guidance document is a general approach to evaluating vapor intrusion. With no two sites being the same, a site-specific flexible approach must be taken when conducting a vapor intrusion investigation.

Also, it is significant that the guidance provides, "[t]he need for actions to minimize or prevent exposures typically does not preclude the site from being used for a desired purpose or from being developed." This is particularly important in the context of the remediation and redevelopment of urban brownfields.

Response B.1.2:

Comment noted.

#### **B.2 TOPIC: Definitions**

Comment B.2.1 (paraphrased, 2 commenters, 2 comments):

Volatile chemicals with the potential to cause vapor intrusion impacts should be defined based on vapor pressure and Henry's Law constant.

Response B.2.1:

Chemical fate and transport in unsaturated soils (i.e., the vadose zone) is complex and dynamic, and is not dependent upon vapor pressure and Henry's Law constants alone. It is difficult to generically predict chemical behavior (and hence a chemical's potential to cause vapor intrusion impacts) in the vadose zone without information about both site-specific conditions (e.g., soil moisture content, soil organic content, volume of

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contaminated soils at a site, porosity, depth to groundwater, concentrations in groundwater, etc.) and chemical-specific properties (e.g., sorption partition coefficient ( $K_d$ ), Henry's Law constant ( $K_H$ ), etc.). Therefore, the definition in the guidance remains as follows: "Chemicals that can emit vapors are called 'volatile chemicals.' Volatile chemicals include volatile organic compounds (VOCs), some semi-volatile organic compounds (SVOCs), and some inorganic substances such as elemental mercury."

#### Comment B.2.2:

Volatile chemicals are defined to include volatile organic chemicals, elemental mercury and some semi-volatile chemicals. The semi-volatile chemicals of concern are loosely discussed in the guidance but these are related primarily to petroleum compounds which are identified as having low odor thresholds and therefore are noticeable before they are a health issue. Semi-volatiles are frequently found in NYC [New York City] sites due to historic fill and fuel spills. The guidance should indicate that they too are either not a concern or it should set forth a specific list of semi-volatiles and concentrations that would trigger application of the guidance.

#### Response B.2.2:

The guidance does not differentiate among semi-volatile organic compounds. At this time, not enough is known about the behavior of different semi-volatile chemicals to support classifying them as "not a concern" or generating a list of "trigger" concentrations (as suggested). The guidance has not been revised as suggested in the comment.

#### Comment B.2.3 (paraphrased, 2 commenters, 2 comments):

The definition of "potential exposures" and other similar phrases is unclear or too broad.

#### Response B.2.3:

An exposure pathway is the way a chemical may contact or enter a person's body to cause a health effect. An exposure pathway includes the following five elements:

- [1] a source of a chemical's release,
- [2] chemical movement,
- [3] a place where people can come into contact with the chemical,
- [4] a route of human exposure (i.e., the manner in which the chemical actually enters the body), and
- [5] a population that could be exposed.

In a potential exposure pathway, at least one pathway element is missing or is uncertain, thus indicating that exposure to a chemical could have occurred in the past, could be occurring, or could occur in the future. These concepts are reflected in the discussion of soil vapor intrusion and human exposure, as well as in the definition of "potential exposures," provided in Section 1.2 of the guidance.

#### Comment B.2.4:

A definition of a "site" (e.g., specific spill locations or entire facility footprint) would be helpful in identifying "sites" at which a vapor intrusion pathway investigation is required.

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Response B.2.4:

Acknowledged. The word "site" refers to the location of known or suspected environmental contamination. A site may include a location being evaluated voluntarily by a corporation, a municipality, or private citizen. A site may also include a location being evaluated within one of New York State's environmental remediation programs. Examples of the latter include RCRA Corrective Action sites, inactive hazardous waste disposal sites (State Superfund), Voluntary Cleanup Program sites, Brownfield Cleanup Program sites, Environmental Restoration Program sites, and petroleum spill sites. Sections 1.2 and 1.7 of the guidance have been revised for clarification.

Comment B.2.5:

A clearer definition of a subsurface source of volatile chemicals would be useful in determining if a vapor intrusion pathway investigation is necessary when groundwater or subsurface soils do not exceed appropriate criteria. As written, a subsurface source could be interpreted to be separate from groundwater or subsurface soil containing concentrations of volatile chemicals.

Response B.2.5:

Section 1.1 of the guidance identifies potential subsurface sources of volatile chemicals. Data collected to date has demonstrated that soil vapor contamination may result from any concentration of volatile chemicals present in subsurface soil or groundwater. Therefore, the current state of knowledge regarding soil vapor intrusion does not support the use of pre-determined concentrations of volatile chemicals (i.e., screening criteria) in either groundwater or soil vapor to trigger a need for a soil vapor intrusion investigation. Section 2.1 of the guidance has been revised to clarify this point.

Comment B.2.6:

The document mentions the "State" without any reference to a specific agency (e.g., NYSDOH or the New York State Department of Environmental Conservation (NYSDEC)). It would be more meaningful to replace "State" with the specific agency which would have approval authority.

Response B.2.6:

The term "State" refers to the NYSDEC and the NYSDOH, which work cooperatively to evaluate soil vapor intrusion at remedial sites throughout New York State. Text has been added to the Preface and Section 2.3 of the guidance to define the term.

### **B.3 TOPIC: Description of soil vapor intrusion**

Comment B.3.1:

Section 1.1 — We suggest that the first sentence be re-worded to read: "When contaminated vapors are present in the vicinity of, or under the foundation of a building,...". Underground conduits (sewers, utility connections, etc.) can provide a means of transport to structures not "directly next to" a contaminated zone.

**NOTE: Updates to the final guidance are available at [http://health.ny.gov/environmental/indoors/vapor\\_intrusion/update.htm](http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm)**

Response B.3.1:

This comment refers to the third paragraph of Section 1.1. The comment is accurate. However, the language in the guidance (that contaminated vapors "present in the zone directly next to or under the foundation of a building" make vapor intrusion possible) allows for this: vapors must be present in conduits outside the building in order to be transported into the building. Table 1.1 does refer specifically to underground conduits as a possible preferential pathway for soil vapor migration.

#### **B.4 TOPIC: Factors affecting soil vapor migration and intrusion**

Comment B.4.1:

Impacts of biodegradation on limiting vapor intrusion impacts for certain classes of VOCs should be discussed.

Response B.4.1:

The guidance continues to identify biodegradation processes as an environmental factor that may affect soil vapor intrusion (Table 1.1). Given the lack of data collected at sites where biodegradation is believed to be minimizing the potential for soil vapor intrusion, a detailed discussion of the effects of biodegradation (as suggested in the comment) has not been added to the guidance. [See also Comment A.10.2.]

Comment B.4.2:

Section 1.3 — The first paragraph suggests that vapor intrusion potential cannot be predicted based on the locations of groundwater plumes when, in fact, review of groundwater data is the first logical step when evaluating vapor intrusion and the geographic area requiring further investigation (e.g., see EPA, 2002 and the NYSDEC Program Policy). While soil vapor concentrations might not exactly mimic groundwater contaminant plumes patterns, empirical data have shown that the overall extent of potential vapor intrusion impacts is generally bounded by the groundwater contaminant plume footprint (e.g., see Folkes 2002). Vapor intrusion impacts are unlikely to be seen more than 100 feet + beyond the edges of the groundwater contaminant plume, absent significant preferential pathways, consistent with diffusion theory (e.g., Eklund and Lowell, 2004) and the 100 foot criteria used by EPA (2002) and the NYSDEC Program Policy (at p.5). The general relationship between groundwater contaminant plumes and the likely maximum extent of vapor impacts, if any, should be explained more clearly in this section of the guidance.

Response B.4.2:

Data collected thus far in New York State do not support the development of criteria like these that would be generally applicable and protective at sites throughout the state. As such, the NYSDEC has removed the reference to a 100 foot criterion from their policy document (NYSDEC 2006). As discussed throughout Section 2 of the guidance, decisions about the scope of a vapor investigation are made on a site-by-site basis by considering, among other factors, the information available about the nature and location of a vapor source. The guidance has not been revised as suggested in the comment.

Comment B.4.3:

**NOTE: Updates to the final guidance are available at [http://health.ny.gov/environmental/indoors/vapor\\_intrusion/update.htm](http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm)**

Section 1.3 — The Guidance states: Operation of kitchen vents in restaurants, or elevators in office buildings may induce pressure gradients that result in migration of vapor-phase contaminants away from a groundwater source and toward these buildings. Although such conclusion may have been inferred from a small number of past projects, our experience suggests that significant lateral migration under pressure gradients would depend on relatively unique site conditions. We believe that the inclusion of this discussion in the Guidance puts too much emphasis on inference derived from limited and perhaps undocumented observations.

Response B.4.3:

Kitchen vents and elevators are mentioned as examples of the types of building operations that may affect vapor intrusion, and the discussion remains in the guidance. Furthermore, mention of the operation of heating, ventilating and air-conditioning (HVAC) equipment has also been added to the section.

Comment B.4.4:

The guidance should also clarify that operation of typical residential HVAC equipment is unlikely to cause convective flow of vapors more than 1 to 2 m from the building foundations (e.g., see EPA 2002). We are not aware of any literature documenting the potential for commercial HVAC equipment and elevator operation to pull vapors from a significantly larger distance (e.g., say more than 100 feet) that would affect estimations of the extent of potential vapor intrusion impacts. This issue should be addressed on a case-by-case basis (clearly, this equipment could result in greater building depressurization and larger soil vapor fluxes into the buildings, but this is a different issue).

Response B.4.4:

The State has observed cases where restaurant kitchen hoods and elevators have resulted in convective flow of contaminated vapors much greater than 1 to 2 meters from the building foundation. There have been special circumstances in these cases, such as differential permeability in utility bedding material and native soil, as well as surface confining layers (e.g., blacktop) between the source and the receptor. We agree that these issues should be addressed on a case-by-case basis. The guidance has not been revised as suggested in the comment.

## **B.5 TOPIC: Tables 1.1, 1.2 and 1.3**

Comment B.5.1:

Tables 1.1, 1.2 and 1.3: These tables provide a useful summary of important factors to be considered when evaluating the vapor intrusion pathway.

Response B.5.1:

Comment noted.

Comment B.5.2:

We also recommend that more emphasis be placed on developing a site conceptual model that considers both environmental and building conditions in developing an appropriate scope of investigative work and such considerations should be reflected in the discussions in Tables 1.1 and 1.2.

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Response B.5.2:

Section 1 of the guidance provides discussion of the conceptual site model components respective to the vapor intrusion pathway: potential sources, pathways and receptors. As discussed in the comments and responses provided in Part B.7, references to the development of a conceptual site model have been added to Section 1.6 of the guidance. The tables given in Section 1 are intended as an overview of factors to be considered when evaluating vapor intrusion at a site. The tables have not been changed as recommended in the comment.

Comment B.5.3:

The relationship among the various environmental and building factors that may affect vapor intrusion is complex. The text and tables should note that many of the descriptions of individual environmental and building factors reflect general concepts. For this reason, we recommend that the tables in Section 1.3 be re-titled "Factors that May Influence Vapor Intrusion Potential" or "Considerations in Assessing Vapor Intrusion Potential."

Response B.5.3:

Acknowledged. The information in Tables 1.1 and 1.2 is intended to give a general overview of environmental and building factors that may affect vapor intrusion and that should be considered when evaluating vapor intrusion at a site. The word "may" has been added to the titles of Tables 1.1 and 1.2 to reflect this intent better.

Comment B.5.4:

Table 1.1 — Weather conditions also affect movement of subsurface vapors to outdoor air and introduction of outdoor air into the soil. In addition to biodegradation processes, soil adsorption/desorption processes and soil pore water solution/volatilization process may affect migration of VOCs and [semi-volatile organic compounds] SVOCs.

Response B.5.4:

The word "indoor" has been deleted from description of "weather conditions" in Table 1.1, so that it covers the effects of weather on the exchange of soil vapor and outdoor air (which may, in turn, affect vapor intrusion). Adsorption, desorption, pore-water solution and volatilization are among the processes that contribute to the effect of "soil conditions" on vapor intrusion.

Comment B.5.5:

Table 1.1 — The Guidance should add a discussion of sources in soil vapor including ambient air and indoor air (the reverse of vapor intrusion), and sources not from a site but present in urban soil gas from fill, gasoline stations, etc. or refer to this discussion provided in 3.2.3, p. 29.

Response B.5.5:

Section 1 of the guidance discusses factors affecting soil vapor migration and intrusion, not potential sources. Tables 1.1 and 1.2 are provided to complement this discussion and, as such, have not been modified to include a discussion of potential sources in soil vapor. See also Comment D.3.1 (reverse process from soil vapor intrusion).

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Comment B.5.6:

Table 1.1 — The Guidance should acknowledge that there are biological sources of VOCs in subsurface. For example, acetone and other ketones are oxidation products of humic materials in soil.

(<http://www.inchem.org/documents/ehc/ehc/ehc207.htm#SectionNumber:3.1>)

Response B.5.6:

Agreed. "Biodegradation of natural organic matter in soil" has been added to the list of sources of subsurface vapors in Section 3.2.3 of the guidance.

Comment B.5.7:

In Table 1.1 under "volatile chemical concentrations," it is stated that "the potential for vapor intrusion generally increases with increasing concentrations of volatile chemicals in groundwater..." While such statement may be *generally* accurate, however, based on the interrelationships and variability among other environmental factors, it may not always be accurate. We believe that a footnote to the table qualifying the statement is warranted (e.g. significant variability may result from the actual interaction among the environmental factors in a given setting.)

Response B.5.7:

The information in Table 1.1 is intended as a general overview of factors that may affect vapor intrusion. Therefore, Table 1.1 has not been changed in response to this comment.

Comment B.5.8:

In Table 1.1, under "soil conditions," it should be noted that understanding vadose zone stratigraphy is important to assessing vapor intrusion potential. For example, the presence of even thin layers or zones of finer-grained soils at higher volumetric moisture contents may significantly influence vapor migration potential and hydrology.

Response B.5.8:

The description of "soil conditions" in Table 1.1 indicates that soil grain size and moisture content may affect vapor intrusion. Therefore, Table 1.1 has not been changed in response to this comment.

Comment B.5.9:

In Table 1.1, under "fractures in bedrock and/or tight soils" it should be noted that fractures in bedrock and/or tight soils may increase potential for vapor intrusion over what would be expected for the bulk-unfractured matrix.

Response B.5.9:

Agreed. The description in Table 1.1 has been changed as suggested.

Comment B.5.10:

In Table 1.1, under "underground conduits," it should be noted that under certain circumstances underground conduits may serve as preferential pathways, generally where the native soils are fine grained and have high moisture contents.

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Response B.5.10:

The description, which refers to conduits "with highly permeable bedding materials relative to native materials," has not been changed.

Comment B.5.11:

The Guidance should allow for documentation of positive pressure ventilation conditions as a means for screening out buildings for further assessment of vapor intrusion. For this reason, in Table 1.2 we recommend that it be noted that "Buildings operated with positive pressure HVAC systems may be effectively protected from vapor intrusion. Positive pressure ventilation is one of many acceptable mitigation techniques."

Also in Table 1.2, under "air exchange rates," it should be noted that exchanges of indoor air occur under natural draft conditions and draft conditions induced by HVAC systems. Newer energy efficient construction may increase the stack effect due to combustion drafts; this does not necessarily cause accumulation of vapors.

Response B.5.11:

Table 1.2 describes general building factors that may affect vapor intrusion. Mitigation techniques are discussed in Section 4 of the guidance, not in the discussions of Section 1.3 or Table 1.2. The table indicates that limiting the exchange of indoor and outdoor air may increase the effect of vapor intrusion on indoor air quality. Therefore, Table 1.2 has not been changed in response to this comment.

Comment B.5.12:

Although conventionally, earthen floors and fieldstone walls may be expected to increase vapor intrusion potential, field observations and vapor transport modeling sensitivity analyses indicate that the fraction of foundation surface area that is open to the subsurface is not a sensitive parameter to vapor intrusion. For this reason, in Table 1.2, under "foundation types," it should be noted that earthen floor and fieldstone walls may be significant conditions to be addressed during implementation of substructure ventilation systems.

Response B.5.12:

This change is inappropriate for Table 1.2. Construction of substructure ventilation systems is discussed in Section 4 of the guidance, not in Section 1.3. Table 1.2 has not been revised as suggested in the comment.

Comment B.5.13:

In Table 1.3, under "off-gassing," inclusion of contaminated groundwater infiltration into a basement is not consistent with the definition of alternate source provided in this subsection, where alternate sources in indoor air are attributed to chemicals found in indoor air of homes are not caused by contamination of groundwater or soil vapor.

Response B.5.13:

Acknowledged. The text in Section 1.4 has been changed to read "...chemicals are found in indoor air of homes not affected by intrusion of contaminated soil vapor." Both infiltration of contaminated groundwater and off-gassing from contaminated tap water are still mentioned in the table.

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Comment B.5.14:

In Table 1.3, under "occupant activities," there should be a discussion regarding the past use of volatile chemicals, as the indoor air quality may be influenced by past uses of chemicals.

Response B.5.14:

Agreed. Historical use of volatile chemicals has been added to Table 1.3 under "Off-gassing." [See also Comment D.7.1 (consideration of historic building uses).]

Comment B.5.15:

There should be a text clarification that external sources of VOCs such as dry cleaners and gas stations can be considered part of ambient (outdoor air) anthropogenic background so long as a release to the subsurface has not occurred.

Response B.5.15:

As stated in Section 1.4 of the guidance, "Certain commercial and industrial facilities, such as gasoline stations and dry cleaners, and vehicle exhaust are examples of possible sources of volatile chemicals in outdoor air." Table 1.3 mentions dry cleaners and gasoline stations because their active operations may be sources of volatile chemicals detected in air due to the exchange of outdoor and indoor air in buildings through natural ventilation, mechanical ventilation or infiltration; releases to the subsurface are irrelevant to this consideration. The guidance has not been revised as suggested in the comment.

## **B.6 TOPIC: Description of the general approach to evaluating soil vapor intrusion**

Comment B.6.1 (paraphrased, 1 commenter, 1 comment):

Section 1.5 should discuss, in general terms, that the vapor intrusion pathway must be complete in order to proceed with an investigation.

Response B.6.1:

The investigative process is necessary to determine whether the vapor intrusion pathway exists and whether current or potential exposures to contaminated subsurface vapors could occur via soil vapor intrusion. As stated in the guidance, under certain circumstances (e.g., undeveloped parcels), the investigation may be delayed where the data is not necessary to address potential current exposures or to identify remedial actions. However, a vapor intrusion investigation may be necessary at a later date should the property use change (e.g., construction of a building on the property).

Comment B.6.2 (paraphrased, 1 commenter, 1 comment):

We suggest re-wording the second paragraph of Section 1.5 to "This data gathering and review process should be repeated until each of the following questions can be answered:".

Response B.6.2:

Agreed. Section 1.5 of the guidance has been revised accordingly.

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Comment B.6.3 (paraphrased, 1 commenter, 1 comment):

The criterion to repeat data gathering and review process until it is determined whether subsurface vapors are contaminated is vague because "contamination" could be defined by any degree of VOC presence. For clarification, we recommend that the criterion be revised to say, "Do subsurface vapors exhibit contamination that indicates conditions substantially different from background?"

Response B.6.3:

As discussed in Section 3.3.1, there are currently no databases available of background levels of volatile chemicals in soil vapor. In the absence of this information, the guidance recommends that soil vapor results be compared to many factors, including the following: themselves "as a whole" to identify trends and spatial variations in the data, background outdoor air levels (from databases and from site-specific results), NYSDOH's guidelines for volatile chemicals in air, the results of other environmental sampling, and the site conceptual model. The overall objective of the comparisons is to put the soil vapor results into perspective. This is consistent with the intent of the comment. Therefore, Section 1.5 of the guidance has not been revised as suggested.

Comment B.6.4:

Section 1.5: Defining the "nature and extent of contamination" should be focused exclusively on volatile organic chemicals (VOCs) for the purposes of this guidance document.

Response B.6.4:

The guidance indicates that the focus of a soil vapor intrusion evaluation is on volatile chemicals, not just VOCs. As stated in Section 1.1, "Volatile chemicals include volatile organic compounds (VOCs), some semi-volatile organic compounds (SVOCs), and some inorganic substances such as elemental mercury." Therefore, Section 1.5 has not been changed in response to this comment.

Comment B.6.5:

Section 1.5: There are typically not "exposures" to subsurface vapors; exposure occurs at the point of human contact, which would be inside the building of concern.

Response B.6.5:

Agreed. The section refers to the evaluation of a soil vapor intrusion pathway, of which the point of exposure is one component. Section 1.5 of the guidance has been revised for clarification.

## **B.7 TOPIC: Conceptual site model**

Comment B.7.1:

The Guidance should, from the beginning, describe a conceptual site model that includes all sources, all pathways, and all receptors. It may be that some of the sources or pathways are beyond the scope or jurisdiction of those conducting the evaluation, but I believe there is no way to conduct a comprehensive investigation without understanding them. If the agency or private party conducting an investigation is not in a position to address a source

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or pathway, then those who are responsible should be notified, at the very least. The receptors — the affected residents or other people in the area — deserve no less.

Response B.7.1:

In accordance with the NYSDEC's *Draft DER-10: Technical Guidance for Site Investigation and Remediation* (NYSDEC 2002), subsurface vapors and soil vapor intrusion should be included in an overall conceptual model for the site. The components of a conceptual site model specific to soil vapor intrusion are provided in Section 1.5, and throughout Section 1 of the guidance. The general approach for evaluating soil vapor intrusion described in Section 1.5 is analogous to the development of a conceptual site model specific to soil vapor intrusion. Section 1.6 of the guidance has been revised to describe the relationship between the described general approach to evaluating soil vapor intrusion and a conceptual site model. The conceptual site model will vary from site to site. Therefore, a description of a specific conceptual site model in the guidance is not considered appropriate.

For additional information about the use of conceptual site models in the investigation and remediation of sites or a description of the conceptual site model process, the reader is referred to the NYSDEC's technical guidance.

If a soil vapor intrusion investigation needs to continue beyond the boundaries set forth in the requirements for a participant in a specific environmental remediation program, then the NYSDEC and NYSDOH will make sure appropriate actions are taken to complete the investigation and remediation, as well as to address exposures. This would include identifying any additional responsible parties and enrolling them into an appropriate remedial program.

Comment B.7.2 (paraphrased, 1 commenter, 1 comment):

By requiring collection and evaluation of soil gas concurrent with soil and groundwater characterization, the NYSDOH does not allow for development of a conceptual site model (CSM). For example, the CSM provides critical information on the types of chemicals likely to be found at a site. If a site's chemicals of potential concern have been characterized based on groundwater data, subsurface soil data, or information about site-related chemical uses, soil vapor intrusion sampling and analysis should only be performed for those select chemicals.

Response B.7.2:

As discussed in Section 2.3 of the guidance, there is no single phase of an investigation during which soil vapor samples must be taken. Additionally, the guidance does not require that soil vapor samples be collected concurrently with groundwater and soil samples. The phased, iterative nature of the soil vapor intrusion investigation is similar to investigation of other environmental media (e.g., soil, groundwater, etc.) and analytical data collected as part of this effort are intended to be incorporated into a conceptual site model. Section 1.6 of the guidance has been revised to describe the relationship between the general approach to evaluating soil vapor intrusion and a conceptual site model.

As discussed in Section 2.9, the analyte list for a soil vapor intrusion investigation is typically determined on a site-specific basis in consideration of several variables, including the status of the site investigation and the site-specific sampling objectives. If the site's chemicals of potential concern have been adequately characterized, then a

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site-specific analyte list may be considered for the vapor intrusion investigation. Sections 2.9.1 and 2.9.2 of the guidance have been revised to clarify this point.

## **B.8 TOPIC: Applicability of guidance**

### Comment B.8.1 (paraphrased, 6 commenters, 6 comments):

The phrase "anywhere a soil vapor intrusion investigation is warranted" is ambiguous and without definition. A more definitive statement is needed; for instance, "This guidance is applicable for any soil vapor intrusion investigation conducted within the state, whether that investigation is mandated by one or more State agencies, or whether it is undertaken voluntarily."

#### Response B.8.1:

Acknowledged. Section 1.7 of the guidance has been revised as follows: "This guidance should be considered anywhere soil vapor intrusion is evaluated in the State of New York, whether the evaluation is being undertaken voluntarily by a corporation, a municipality, or private citizen, or under one of the state's environmental remediation programs."

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## **PART C**

### **GUIDANCE SECTION 2: INVESTIGATION**

#### **C.1 TOPIC: General comments on Section 2 of the guidance**

##### Comment C.1.1:

The guidance provides an excellent framework for developing a sampling regime to investigate the vapor intrusion pathway. It is especially helpful as it covers steps in the investigation that could be utilized for all of the different types of vapor intrusion scenarios that are available.

##### Response C.1.1:

Comment noted.

##### Comment C.1.2 (paraphrased, 1 commenter, 1 comment):

We concur with the sampling methods and protocols established in Section 2 of the guidance. Keeping in mind this guidance document is a generalized approach to the investigation of soil vapor intrusion pathways and each investigation must be conducted based on the specific characteristics of the individual site.

##### Response C.1.2:

Comment noted.

##### Comment C.1.3:

The first paragraph [of Section 2] states: *Therefore, guidance provided in this section is presented in terms of general steps and strategies that should be applied when approaching an investigation of soil vapor intrusion.* Since general steps and strategies can leave a lot of room for interpretation, the evaluation process will depend on individual interpretation and inconsistent application.

##### Response C.1.3:

The guidance recognizes that each site is unique and, therefore, the level of investigation necessary to evaluate the potential for soil vapor intrusion adequately is often site-specific as well. However, for sites being investigated under one of the state's environmental remediation programs, the soil vapor intrusion evaluation process generally follows a standard procedure including the submittal, review and approval of work plans. This process is intended to provide consistency. Additionally, training sessions on the State's approach to evaluating soil vapor intrusion were conducted throughout the State. Target audiences included State, local and regional DOH and DEC staff as well as the regulated public. Completion of training, with updated training sessions as needed, is intended to provide a uniform level of knowledge and practical application regarding soil vapor intrusion.

##### Comment C.1.4:

Section 2.0 is too prescriptive and onerous to be truly effective at all but the largest and most complicated sites. While it is recognized that some complicated sites may require the level of investigation specified in Section 2.0, this level of investigative effort is not warranted at most sites. While the introduction to this section states that specific site

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conditions may warrant modifying the recommendations, many of the subsections are very prescriptive and suggest that data will not be usable for decision making if the specific procedures are not followed.

Response C.1.4:

The guidance is intended to provide general steps and strategies for the investigation of the soil vapor intrusion pathway, regardless of the size or complexity of the site. The guidance recognizes that each site is unique and, therefore, the level of investigation necessary to adequately evaluate the potential for soil vapor intrusion is often site-specific as well. At all types of sites, analytical data that do not meet site-specific data quality objectives may preclude adequate data evaluation.

Comment C.1.5:

Several statements in this section [Section 2] assume that the presence of vapors in the subsurface will cause on-going human exposures. Section 2.0 should be rewritten to state that subsurface vapors might cause human exposures but that the mere presence of subsurface vapors does not mean exposures are occurring. Further, exposures do not automatically result in any significant additional risk. Similar to the investigation approach for soil and groundwater, investigation of soil vapors is in an iterative process, and this process should be more thoroughly discussed in Section 2.0.

Response C.1.5:

Section 1.2 of the guidance defines both current and potential exposures and the State's consideration of both current and potential exposures in a soil vapor intrusion evaluation, which is typically an iterative process. Section 1.2 also states that exposure to a volatile chemical due to vapor intrusion does not necessarily mean that health effects will occur. Section 2 of the guidance provides general steps and strategies for a soil vapor intrusion investigation and does not state a causal link between the presence of vapors in the subsurface and on-going human exposures. As discussed in Section 2.5, we agree that the investigation of subsurface vapor contamination and exposures associated with it is an iterative process.

Comment C.1.6:

Soils vapors are a conduit for volatiles to enter a building, not an "exposure medium," as described.

Response C.1.6:

Section 2 of the guidance describes soil vapor as an *environmental* medium, not an *exposure* medium.

**C.2 TOPIC: Sites at which an investigation is necessary**

Comment C.2.1 (paraphrased, 8 commenters, 10 comments)

The NYSDOH should clarify what concentrations of volatile chemicals in groundwater and soil gas and/or contravention of what standards, criteria and guidelines (Section 2.1) would trigger the need for a soil vapor intrusion investigation, or conversely screen out sites to determine no further action is necessary. Furthermore, the NYSDOH should state what types of sites are affected.

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Response C.2.1

Concentrations of volatile chemicals or identification of a site as a certain "type" should not be the only factor considered when determining whether or not there is a need for a soil vapor intrusion investigation. Data collected to date from the investigation of sites both within and outside of New York State demonstrate that soil vapor contamination may result from very low concentrations of volatile chemicals present in subsurface soil, soil vapor or groundwater at a variety of sites. Current exposures to subsurface contaminants, via the soil vapor intrusion pathway, have been demonstrated at sites where soil and/or groundwater concentrations have not contravened applicable standards, criteria and guidelines (such as TAGM 4046 soil values, TOGS 1.1.1 groundwater values, etc.). While the level of investigation may vary from site to site, investigation of the soil vapor intrusion pathway is generally recommended at sites with a subsurface source of volatile chemical contamination. Section 2.1 of the guidance has been revised to reflect this.

Comment C.2.2 (paraphrased, 4 commenters, 4 comments):

Section 2.1 should be expanded to define sites where investigation of vapor intrusion is not required based on the type of chemical of concern (CO<sub>C</sub>) present and the distance between VOC source and vapor intrusion receptor (i.e., "near").

Response C.2.2:

While the level of investigation may vary from site to site, investigation of the soil vapor intrusion pathway is generally recommended at sites with a subsurface source of volatile chemical contamination, regardless of the type of volatile chemical. Section 2.1 of the guidance has been revised to reflect this. [See also Comment B.2.1 (definition of volatile chemical).]

Soil vapor intrusion data collected to date do not support the use of a generic distance criterion to screen-out sites for further evaluation. Therefore, the guidance continues to recommend a general approach for a soil vapor intrusion investigation that is similar to the investigation of other environmental media. Existing site data and a conceptual site model should be considered to scope the investigation. Similar to other types of site investigations, the investigation typically starts at a source and works outward, as necessary, until human exposures associated with soil vapor intrusion have been identified and addressed. [See also Comment A.8.1 (default distance criteria).]

Comment C.2.3 (paraphrased, 2 commenters, 1 comment):

Soil vapor intrusion investigations should be limited to sites with known existing sources of volatile contaminants.

Response C.2.3:

Soil and groundwater investigations are conducted at sites throughout New York State based on the potential for a subsurface source of contamination, often based on current and/or past use of a site. Soil vapor is an environmental medium of concern, like soil and groundwater, that should be characterized similarly.

Comment C.2.4 (paraphrased, 1 commenter, 1 comment):

The presence of a source alone should not spur investigation of the vapor intrusion pathway. The presence of existing or potential receptors should also be considered. For

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example, a remote landfill or spill site with no buildings and no known potential for development should be investigated for environmental impacts, but not necessarily vapor intrusion.

Response C.2.4:

The level of evaluation necessary for soil vapor intrusion is determined on a site-by-site basis and with consideration of many factors, including current/future property use and current/potential receptors. Existing and potential receptors are considered in Section 2.1.b of the guidance.

Comment C.2.5:

The proposed vapor guidance requires investigation where there is the potential for volatile chemical contaminants to be present, whether it be from an on-site or off-site source.

Response C.2.5:

That is correct and the party responsible for conducting any investigation depends upon the source of the subsurface contamination (as mentioned in the comment) and the requirements of the specific environmental remediation program the site falls under. [See also Part A.11 (TOPIC: Party responsible for investigating and taking action(s) to address exposures).]

Comment C.2.6:

"Active" investigation of the pathway under the supposition that a building may be present in the future is extreme and may very well be misleading, depending on the time elapsed between investigation and construction, and other remedial actions (if any) undertaken at the site.

Response C.2.6:

As discussed in Section 2.3 of the guidance, there is flexibility in determining when to conduct a soil vapor intrusion investigation at a site. Many factors are considered when making this determination, including the current and future property use, completed and proposed remedial actions, and the estimated time between investigation or remediation and site development. For example, at many sites where new development is planned, parties have opted (with the State's approval) to incorporate a sub-slab depressurization system into the development plans (due to the relative costs of installing a system at the time of construction versus retrofitting a system post-construction) and to perform sampling after the site is developed to determine whether or not the system should be activated to address exposures related to soil vapor intrusion.

### **C.3 TOPIC: Types of samples needed**

Comment C.3.1:

Since this is a risk-based evaluation, soil vapor and/or indoor air sampling should be focused on obtaining information related to current or potential exposures rather than on broader fate and transport issues.

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Response C.3.1:

The primary purpose of a soil vapor intrusion investigation is to determine whether contaminated soil vapors are migrating or could migrate into occupied structures, resulting in exposure.

Comment C.3.2:

Soil vapor samples could also be collected to indirectly evaluate the effectiveness of ground water remediation if ground water is the source of the contamination. Consider an added sentence [Section 2.2.1].

Response C.3.2:

Agreed. The text in Section 2.2.1 of the guidance has been revised as follows: "Soil vapor sampling results are also used when evaluating the effectiveness of direct or indirect measures to remediate contaminated subsurface vapors. (Soil vapor extraction is an example of a direct remedial measure, and groundwater pumping and treating an indirect measure.)"

Comment C.3.3 (paraphrased, 1 commenter, 1 comment):

Section 2.2.1 of the guidance should be revised to include the use of soil vapor data to rule out the need for structure sampling, especially when the soil vapor data is consistent with the site conceptual model and demonstrates that subsurface conditions serve as a barrier to vapor migration.

Response C.3.3:

Soil vapor samples (as differentiated from sub-slab vapor samples) are useful tools to guide soil vapor intrusion evaluations. However, given the limitations associated with soil vapor samples (as discussed in Sections 2.2.1 and 3.3.1 of the guidance), soil vapor data alone cannot be accurately and reliably used to predict or model expected indoor air or sub-slab vapor volatile chemical concentrations. Therefore, soil vapor data are typically not sufficient as a single determinant for considering an investigation complete. To the extent that the existing site data are sufficient to meet the investigation objectives outlined in Section 1.5 of the guidance, no further sampling may be appropriate. These determinations are made on a site-specific basis.

Comment C.3.4 (paraphrased, 5 commenters, 7 comments):

Given the absence of screening values and standards, criteria or guidelines for soil vapor data and the fact that "there are no concentrations of volatile chemicals in soil vapor that automatically trigger action or no further action," we recommend that the utility of the soil gas data be more clearly explained and that the limitations of these data be discussed in detail.

Response C.3.4:

Soil vapor samples are collected to characterize the nature and extent of contamination in this medium and the results are useful tools for guiding the selection of structures to perform sampling (sub-slab vapor, indoor air, outdoor air) in. The types of samples collected should be selected to meet the stated objectives of the specific investigation, which may differ from site to site and may not necessarily include the collection of soil vapor samples. Soil vapor data are typically not sufficient as a single determinant for considering an investigation complete. However, to the

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extent that the existing site data are sufficient to meet the investigation objectives outlined in Section 1.5 of the guidance, no further sampling may be appropriate. These determinations are made on a site-specific basis.

Comment C.3.5:

There are many potential scenarios in which soil vapor testing would not be a wise use of scarce resources.

Response C.3.5:

Comment noted.

Comment C.3.6 (paraphrased, 2 commenters, 2 comments):

Section 2.2.2 of the guidance states that sub-slab vapor samples are collected after soil and groundwater characterization "indicate a need." The guidance should provide clear criteria for determining when this need exists and how this need is defined in terms of human exposures. Additionally, clarification on how sub-slab vapor sample results are used for evaluating exposures is requested.

Response C.3.6:

Generally, if soil or groundwater samples contain volatile chemicals, soil vapor samples should be collected to determine whether this environmental medium is also affected. Depending upon site-specific conditions, sub-slab vapor sampling, rather than soil vapor sampling, may be more appropriate to yield more direct information about the potential for soil vapor intrusion. As discussed in Section 1.1 of the guidance, when contaminated vapors are present in the zone directly next to or under the foundation of a building, there is a possibility for soil vapor intrusion and associated exposures.

As discussed in Section 3, sub-slab vapor results are evaluated in conjunction with indoor air data and outdoor air data to determine whether current exposures are occurring, and, if so, whether they are a result of subsurface environmental contamination or of indoor or outdoor sources. Understanding the source is crucial for selecting the most appropriate method for addressing exposures. Sub-slab vapor results are also evaluated in conjunction with the conceptual site model, groundwater and soil concentrations, site-specific conditions, and structure-specific conditions to determine whether the potential exists for vapor intrusion to occur in the future should environmental, site or building conditions change.

Comment C.3.7:

This section [Section 2.2.2] is confusing since it appears to suggest that sub-slab vapor sampling results are used to evaluate current and potential exposures. Such suggestion is inconsistent with the discussion in Section 3.3.2 as in that section, it suggests that detection of chemicals in sub-slab vapor samples does not necessarily indicate soil vapor intrusion is occurring or actions are needed to address exposures. In Section 2.2.2, it should be made clear that to assess current and potential exposures, sub-slab vapor sampling results must be considered together with indoor air and ambient air sampling results.

Response C.3.7:

Agreed. Section 2.2.2 of the guidance has been revised as follows: "Sub-slab vapor sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating..."

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Comment C.3.8:

Please clarify whether the potential for a change in the structural integrity or use of a building must be evaluated in a human exposure assessment for all sites or if the assessment of human exposure based on these changes is required only if such changes are likely to occur.

Response C.3.8:

The potential for structural integrity or building use to change does not need to be formally evaluated at every site. However, unless there are restrictions in place, the possibility that current conditions could change in the future should be assumed.

Comment C.3.9 (paraphrased, 2 commenters, 2 comments):

Basement probes may compromise the integrity of the foundation system (including possibly a vapor barrier), and therefore, create a preferential pathway for vapor migration and increase the risk of indoor exposure(s) in the distant future. The requirement to conduct sub-slab sampling should be flexible, especially for sites where impermeable membranes are present since such sampling may damage the integrity of the membrane and may draw contaminants toward the building and beneath the slab. Alternative methods for evaluating vapor intrusion (i.e., soil vapor probes adjacent to building foundations in lieu of sub-slab samples) should be provided.

Response C.3.9:

Installation of a sub-slab soil vapor probe involves a small diameter (typically one-inch) penetration through the slab. Sub-slab soil vapor implants are sealed to the surface and, for temporary installations, the implant hole is backfilled and the slab is restored after sampling has been completed. Thus, we believe the potential for sub-slab soil vapor probes to create preferential pathways in foundation systems where impermeable membranes are not currently present is unlikely. We acknowledge that penetrating an existing impermeable membrane could compromise the integrity of the membrane and potentially worsen site conditions. This is an example of a special consideration that should be discussed when determining the best approach for evaluating the potential for soil vapor intrusion in the building. As stated throughout the guidance, the types of samples collected in a soil vapor intrusion investigation are typically determined on a site-specific and, in some cases, a building-specific basis.

Comment C.3.10 (paraphrased, 1 commenter, 1 comment):

Investigation of the vapor intrusion pathway should focus on sub-slab sampling. For existing and future buildings in the vicinity of contaminated land or groundwater, this should focus on sub-slab monitoring over indoor air sampling. In general, we propose that no interior testing for soil vapor intrusion be done prior to the time a foundation venting system is required due to the potential for cross-contamination of interior samples.

Response C.3.10:

The types of samples collected in a soil vapor intrusion investigation are typically determined on a site-specific basis in consideration of many factors, including existing site data and the site-specific sampling objectives. Indoor air sampling, however, is a key component to determining whether soil vapor intrusion is actually occurring. We believe that if the sampling protocols provided in Section 2.7 of the guidance are followed, cross-contamination of interior samples is unlikely.

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Comment C.3.11 (paraphrased, 1 commenter, 1 comment):

The current draft guidance requires concurrent sub-slab vapor sampling when performing indoor air sampling (except when evaluating immediate inhalation hazards). However, in the event that no indoor air hazards are found during indoor air sampling and analysis, we question the need for sub-slab vapor sampling.

Response C.3.11:

As discussed in Section 3.3.3 of the guidance, sub-slab vapor results and outdoor air results are important when evaluating indoor air results to determine whether current exposures are occurring via the soil vapor intrusion pathway. As discussed in Section 2.2.2, we also recommend sub-slab vapor samples be collected to evaluate the potential for future indoor air impacts and exposures to occur via soil vapor intrusion in the event that building or environmental conditions change.

Comment C.3.12:

The guidance should include that radon should also be measured as a tracer when conducting sub-slab sampling to confirm if vapor intrusion is occurring.

Response C.3.12:

The preface of the guidance document acknowledges that vapor intrusion may also occur with "naturally occurring" subsurface gases, such as radon. However, the intent of the guidance document is to provide strategies to address human exposures to contaminated subsurface vapors associated with known or suspected environmental contamination.

Comment C.3.13 (paraphrased, 1 commenter, 1 comment):

Section 2.2.3, Indoor air: How the evaluation of current human exposure and potential for future exposures is going to be used is not clear. Will this evaluation be based on Risk Assessment Guidance for Superfund or just a comparison with background and outdoor air?

Response C.3.13:

The evaluation will not be based on Risk Assessment Guidance for Superfund. Rather, as discussed in Section 3 of the guidance, the evaluation will be based on the consideration of many factors (including those mentioned in the comment). This evaluation of current and potential exposures will be used to guide the investigation and decision-making process.

Comment C.3.14 (paraphrased, 1 commenter, 2 comments):

Based on our experience, we do not recommend simply collecting indoor air samples in response to certain situations mentioned in Section 2.2.3 (including response to odor complaints and if a sump is present and overflowing/filled). For odor complaints, we recommend collecting information regarding potential releases and chemical usage in the area, then collecting appropriate subsurface samples, and then, as warranted, sampling indoor air. If an overflowing/filled sump is present, it would be prudent to first collect a water sample.

Response C.3.14:

Section 2.2.4 of the guidance (formerly Section 2.2.3 in the public comment draft) is intended to discuss situations in which the collection of indoor air samples might be

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applicable, both concurrently with sub-slab soil vapor and outdoor air samples as well as without concurrent sub-slab/outdoor air sampling. This section is not intended to identify situations in which indoor air sampling is mandatory as a response measure. The type and number of samples is typically determined on a site-specific basis in consideration with particular site or building characteristics, such as sumps. Similarly, the time at which the samples are collected (such as when odors are identified or after releases in the area are identified first) will also depend upon site-specific circumstances. Section 2.2.4 of the guidance has been revised to indicate that collection of water samples from a sump may be appropriate.

Comment C.3.15 (paraphrased, 1 commenter, 1 comment):

How the collection of air samples from crawl spaces aids in the evaluation of potential health threats to building occupants is unclear given the exposure point of concern is the location where human contact with these release-related volatiles occurs, such as in the living space of a home or office building or school.

Response C.3.15:

The collection of crawl space samples may be applicable in situations where no basement area is present or a basement and separate crawl space area is present. Data provided from indoor air living space sampling alone typically are not adequate to evaluate the cause or source of exposure. Qualitative and quantitative comparisons between indoor air results obtained from different locations within a building (i.e., different floors, including crawl spaces) are used to determine the likely cause or source of the exposure so that appropriate actions can be taken to address the exposure.

Comment C.3.16:

It is unclear why it is necessary to sample outdoor air when confirming the effectiveness of a mitigation system. Outdoor air data is only likely to be informative if post mitigation indoor air results are unexpectedly high, and no discernable indoor sources are present.

Response C.3.16:

Outdoor air samples are collected concurrently with indoor air samples during post-mitigation sampling for the same reason they are collected pre-mitigation: to evaluate the extent outdoor air may be influencing indoor air quality. This information is used when interpreting indoor air results and identifying likely sources of volatile chemicals.

Comment C.3.17 (paraphrased, 1 commenter, 1 comment):

Why not allow the consultant to decide if outdoor air samples need to be collected at the same time as indoor air samples? To suggest this is one thing, to require it is another.

Response C.3.17:

The collection of outdoor air samples concurrently with indoor air samples and sub-slab soil vapor samples is recommended to identify likely source(s) of volatile chemicals in the indoor air. It is not required. However, data evaluation could be difficult or inconclusive without comparative data from the concurrent collection of indoor air samples, sub-slab soil vapor samples and outdoor air samples.

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**C.4 TOPIC: Phase of a site investigation in which to sample**

Comment C.4.1:

What samples is this section [Section 2.3] referring to? Groundwater, soil vapor, sub-slab vapor, indoor air, or all of the above?

Response C.4.1:

This section refers to sampling as part of a soil vapor intrusion evaluation. The types of samples collected are typically determined on a site-specific basis, but may include soil vapor, sub-slab soil vapor, indoor air and outdoor air samples (as discussed in Section 2.2).

Comment C.4.2:

Section 2.3.a.1: Remove the word "adequately."

Response C.4.2:

Agreed. Section 2.3.a.1 of the guidance has been revised accordingly.

Comment C.4.3:

Section 2.3.b: An example of a typical measure that would "assure" the State the parcel will not be developed without addressing exposure concerns should be provided. Possibly institutional controls could be used to meet this criteria.

Response C.4.3:

Appropriate measures to assure the parcel will not be developed without addressing exposure concerns are typically made on a site-specific basis. In some cases, institutional controls may be appropriate. Examples of appropriate measures are discussed in Section 3.6 of the guidance. Section 3.6 is referenced in Section 2.3.b. Therefore, no additional revisions have been made to Section 2.3.b in response to this comment.

**C.5 TOPIC: Time of year in which to sample**

Comment C.5.1 (paraphrased, 11 commenters, 16 comments):

The heating season may not be the "worst-case scenario" for many industrial and commercial buildings. At some sites, other factors, such as seasonal variation in the water table, may play as great a role in affecting vapor intrusion as seasonal changes in building ventilation.

Response C.5.1:

Agreed. All available information about a site and potentially affected buildings (including HVAC operations and all of the other factors discussed in Section 1.3) should be considered in planning and timing an investigation. Section 2.4 of the guidance has been revised to emphasize the need to confirm results at the time of year when soil vapor intrusion is expected to have the greatest impact on air quality in a structure. Decisions to take no further action or to continue monitoring should be shown to be protective during worst case conditions.

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Comment C.5.2:

There may be some merit in testing for vapor intrusion during the non-heating season by activating the furnace and closing up the building for a 24-hour period to simulate the heating season conditions. Has the Department considered this approach?

Response C.5.2:

Vapor intrusion evaluations should be conducted during what is thought to be the worst case scenario with respect to vapor intrusion. The State is open to any proposals that will show or simulate worst case conditions. Section 2.4 of the guidance has been revised to emphasize the need to confirm results at the time of year when soil vapor intrusion is expected to have the greatest impact on air quality in a structure.

Comment C.5.3 (paraphrased, 3 commenters, 3 comments):

Investigation should include the sampling of structures during all seasons of the year and under different weather conditions. This approach would account for variation in sub-slab and indoor air contaminant levels based on fluctuations in weather, barometric pressure, soil conditions, geology and the presence of preferential pathways and would be representative of potential human exposure resulting from vapor intrusion under a wider range of seasonal conditions and actual patterns of human occupancy. Site closure decisions should be based on more realistic exposure concentrations that are more representative of long term exposures.

Response C.5.3:

Section 2.4 of the guidance has been revised to clarify that a soil vapor intrusion investigation should be performed when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). Samples collected during this time are considered sufficient to speak to exposures and decisions made under these conditions are believed to be protective throughout the year. If there are concerns to the contrary, then additional sampling may be recommended.

The NYSDEC and NYSDOH intend to collect samples at several sites across the state over the course of a year to improve our understanding of how subsurface vapor concentrations and corresponding indoor air concentrations may or may not fluctuate with seasonal changes. If the results indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate, then the guidance will be revised or amended accordingly.

Comment C.5.4 (paraphrased, 4 commenters, 4 comments):

Sampling should not be biased toward a "worst-case scenario." Rather, decisions should be made based on a long-term exposure scenario.

Response C.5.4:

When environmental data suggest a need to take action to reduce exposures, it is preferable to do so, rather than to wait until additional, long-term data are collected.

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Comment C.5.5 (paraphrased, 7 commenters, 7 comments):

Published data from various vapor intrusion sites show that indoor VOC concentrations vary seasonally by less than an order of magnitude. Given this, the guidance should allow decisions to be made based on data collected at any time of year.

Response C.5.5:

Decisions are not based on indoor air sample results alone. As discussed in Section 1.2 and throughout the guidance, when evaluating exposures related to soil vapor intrusion, both current and potential exposures are addressed. Generally, indoor air results represent current exposures and sub-slab vapor results represent the potential for future exposures or the source of current exposures.

As discussed in Section 1.3, soil vapor intrusion is affected by many factors, many of which vary from site to site and building to building. Some of these factors are well understood, and others are not. One such factor is how sub-slab vapor concentrations vary seasonally. The NYSDEC and NYSDOH intend to collect samples at several sites across the state over the course of a year to improve our understanding of how subsurface vapor concentrations and corresponding indoor air concentrations may or may not fluctuate with seasonal changes. If the results indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate, then the guidance will be revised or amended accordingly.

Comment C.5.6 (paraphrased, 5 commenters, 7 comments):

Requiring sampling during the heating season will discourage responsible parties from collecting samples at other times of the year and may delay real-estate transactions during the warmer months.

Response C.5.6:

Acknowledged. However, samples are typically collected during the heating season because soil vapor intrusion is more likely to occur when a building's heating system is in operation and doors and windows are closed. Samples may also be collected outside of the heating season, such as when exposures related to soil vapor intrusion appear likely or if the concern for vapor intrusion is greater during another time of the year. Section 2.4 of the guidance has been revised for clarification.

Comment C.5.7 (paraphrased, 1 commenter, 2 comments):

Specific dates (for the heating season) are misleading in a guidance document and should be deleted.

Response C.5.7:

The dates are intended as a general guide and are qualified by the following statement: "However, these dates are not absolute; the timeframe for sampling may vary depending on factors such as the location of the site (e.g., upstate versus downstate) and the weather conditions for a particular year."

Comment C.5.8:

The first full paragraph of Section 2.4 at page 9 should be modified as follows: "Sub-slab vapor samples and, unless there is an immediate need for sampling, indoor air samples are typically collected during the heating season because soil vapor intrusion potential may be

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greater when a building's heating system is in operation and the building is sealed/winterized. In general, for discussion purposes, the heating season, is considered to be November 15<sup>th</sup> through March 31<sup>st</sup> throughout the State. However, this timeframe may vary depending on factors, such as the location of the site (e.g. upstate versus downstate) and the weather conditions for a particular year."

Response C.5.8:

The paragraph has been modified in a manner similar to that suggested.

## **C.6 TOPIC: Number of sampling rounds required**

Comment C.6.1 (paraphrased, 9 commenters, 9 comments):

Commenters requested clarification on the number of sampling rounds required in a soil vapor intrusion evaluation (Section 2.5 of the guidance). Additionally, clarification on the identity of the individual or body that determines whether additional sampling is necessary was requested.

Response C.6.1:

Similar to investigations of soil and groundwater, there is no pre-determined number of sampling rounds required for the investigation of the soil vapor intrusion pathway. However, as stated in the guidance, investigating the soil vapor intrusion pathway usually involves more than one round of sampling. The number of sample rounds is based on a review of the site data, in consideration with multiple factors (see Section 3.2 of the guidance) and is determined on a site-specific basis. To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring and the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion evaluation would be considered complete.

The NYSDOH and the NYSDEC (the Agencies) work cooperatively to review sampling proposals, to evaluate data collected during a soil vapor intrusion investigation, and to make appropriate recommendations on the need for additional sampling.

Comment C.6.2 (paraphrased, 2 commenters, 2 comments):

The guidance suggests that multiple sampling rounds are required to evaluate fluctuations in concentrations due to seasonal effects and changes in building conditions, such as HVAC operation. Because only heating season results are considered for decision making in Matrix 1 and Matrix 2 (Section 2.4) it appears unnecessary to characterize seasonal variations. Changes in building conditions, such as HVAC system operation, are also unlikely to occur during sampling if the sampling protocol in Section 2.11.1 of the guidance is followed.

Response C.6.2:

All available information about a site and potentially affected buildings (including HVAC operations and all of the other factors discussed in Section 1.3) should be considered in planning and timing an investigation. Section 2.4 of the guidance has been revised to emphasize that samples may be collected at any time of the year and that decisions to take no further action or to monitor should be shown to be protective when soil vapor intrusion is believed to be most likely.

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Comment C.6.3:

A significant reason for conducting multiple sampling rounds is to aid in confirming sampling results in cases where either prior data indicate some lesser vapor intrusion potential relative to [NYS]DOH action guidelines or in recognition of possible temporal variations.

Response C.6.3:

Agreed. Confirming sampling results and evaluating temporal variations are given as examples in Section 2.5 of the guidance.

Comment C.6.4:

Multiple rounds of sampling will not be sufficient for the design of an [soil vapor extraction] SVE system. This inference seems like an apples/oranges comparison. Pre-design sampling may be necessary during pilot studies to evaluate design parameters such as the radius of influence of the system and its potential effectiveness.

Response C.6.4:

Acknowledged. Section 2.5 of the guidance discusses multiple rounds of sampling associated with the investigation phase to identify the nature and extent of subsurface vapor contamination that should be addressed by the remedy. However, samples may also be collected during the remedial design phase to evaluate the design parameters such as those mentioned in the comment.

## **C.7 TOPIC: Sampling locations and requirements – soil vapor**

Comment C.7.1 (paraphrased, 1 commenter, 1 comment):

We recommend that Section 2.6.1 be clarified to suggest that, where appropriate, testing should be between the building and the location of the suspected contamination. While this may seem obvious, the clarification may prevent some misunderstanding.

Response C.7.1:

Agreed. This recommendation is provided in Section 2.6.1.a.1 of the guidance.

Comment C.7.2 (paraphrased, 2 commenters, 2 comments):

Section 2.6.1(b)(1): Please clarify what is meant by "samples should be collected...in areas of varying isoconcentrations of contamination in the upper groundwater...."

Response C.7.2:

Section 2.6.1.b.1 discusses examples of sample locations in particular areas of concern on an undeveloped parcel to characterize soil vapor, such as areas with either known or suspected subsurface sources of volatile chemicals, areas where elevated readings were obtained with field equipment during previous environmental investigations, and areas of varying shallow groundwater contaminant concentrations. The phrase "varying isoconcentrations" is contradictory. Therefore, Section 2.6.1.b.1 has been revised as follows: "...and in areas of varying concentrations of contamination in the upper groundwater...."

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Comment C.7.3:

Section 2.6.1(b)(2): Please insert the word "contaminated" before "area" to clarify that grid sampling may be required within a contaminated area, not just an area.

Response C.7.3:

The word "contaminated" is provided in the first part of the paragraph (Section 2.6.1.b). However, the intent of Section 2.6.1.b is to provide examples of how locations may be selected to collect representative samples to characterize soil vapor on undeveloped parcels, which may or may not be "contaminated."

Comment C.7.4 (paraphrased, 2 commenters, 2 comments):

The purpose of vapor sampling to characterize contamination in the vadose zone is unclear (Section 2.6.1.e). Soil contamination should be characterized by soil sampling and analysis. Additionally, it is unclear whether the preceding paragraphs apply to the vadose zone.

Response C.7.4:

The phrase "vadose zone" refers to the unsaturated, subsurface region between the water table and the land surface. Soil vapor is the air found in the pore spaces between soil particles. Section 2.6.1.e of the guidance and preceding paragraphs refer to soil vapor, and by definition, refer to the vapor present in the vadose zone.

Comment C.7.5:

Requirement for [soil vapor] sampling at multiple depths [Section 2.6.1.f]: While this type of study may be interesting for research regarding the mechanisms of influence, it may not be appropriate for site investigations focused on evaluation of vapor intrusion. The [responsible party] should only be required to do vertical profiling if there is a specific question regarding source or the nature and extent of contamination that needs to be addressed. Samples deeper than the foundation would not serve the purpose of most vapor intrusion evaluations.

Response C.7.5:

Acknowledged. The discussion of multiple soil vapor probe depths in Section 2.6.1.f of the guidance is an example of selecting sample locations to meet particular sampling objectives (i.e., to determine the influence of contaminated groundwater on soil vapor; to obtain a vertical profile of soil vapor, etc.). Sampling objectives vary from site to site. Vertical profiling of soil vapor may not meet the sampling objectives of a particular site. Section 2.6 has been revised to emphasize that the specific sampling approach will be dependent upon site-specific and building-specific conditions.

Comment C.7.6 (paraphrased, 3 commenters, 4 comments):

Several comments were received pertaining to vapor sampling along utility corridors, a site's perimeter or across the site in a grid pattern. Commenters questioned the justification for requiring such sampling, the need for such sampling if a portion of the site is bounded by vapor barriers (e.g., a large river), and the need for more than three soil vapor samples at a site.

Response C.7.6:

These types of samples are not automatically required at every site, they are provided as examples of locations designed to meet differing sampling objectives. As described

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in Section 2.6.1 of the guidance, many factors are considered when planning the extent of vapor sampling and identifying the specific locations to collect samples, including site-specific characteristics and the objective(s) of the sampling. Examples of reasons why these types of samples are collected are given in Section 2.6.1. As with groundwater and soil, there is no prescribed number of soil vapor samples that are needed to characterize this environmental medium.

Comment C.7.7 (paraphrased, 1 commenter, 1 comment):

Section 2.6.1 indicates soil vapor samples collected at less than 5 feet may be prone to bias from surface air. The NYSDOH should provide more information to support this statement. Will data from areas where groundwater or natural conditions and bedrock prevent deeper samples from being collected be accepted? Using low-flow techniques and the surface sealing inert gas procedure, there should be no question regarding the depth of sampling.

Response C.7.7:

As discussed in Section 2.6.1, site-specific circumstances may warrant collection of soil vapor samples from depths less than 5 feet below ground surface. Under such circumstances, sample collection in accordance with the guidance (e.g., the use of low sample collection rates and tracer gas) should serve to verify that the samples are representative of the soil vapor concentration at the sampling interval of concern. These determinations will be made on a site-specific basis.

Comment C.7.8 (paraphrased, 3 commenters, 3 comments):

The requirement to sample [soil vapor] at least one foot above the water table in areas where the groundwater table is less than six feet below grade is not practicable for shallow groundwater. The height above the water table should be based on the type of soil and the corresponding height of the capillary fringe.

Response C.7.8:

The guidance specifies a minimum separation between the sample interval and the water table, but, at sites where it is not practicable to include a one foot separation above the water table, an alternate soil vapor collection configuration will be considered.

Comment C.7.9 (paraphrased, 4 commenters, 4 comments):

The guidance indicates that soil vapor samples should be collected 10 feet away from buildings when no confining layers are present (e.g., pavement) to avoid sampling areas affected by building operations (which might be pulling ambient air into the soil adjacent to the building). This is not supported by conceptual models of vapor intrusion (e.g., EPA 2002) and modeling studies (e.g., Abreu and Johnson, 2005) which indicate that sampling soil vapor adjacent to the building, at depths of 5 feet or more below the foundations, is preferred. If the purpose of sampling is to collect samples representative of soil vapor that could be entering a building via soil vapor intrusion, then soil vapor samples should be collected as close to the building as possible. There is no technical basis for indicating that the zone of a building influence is 10 feet. Also, what is the recommended procedure if there is a surface confining layer (asphalt or concrete).

Response C.7.9:

Under all conditions, samples should be collected from locations which are representative. The rationale behind collecting samples away from a structure is to

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avoid sampling in fill materials or other non-native materials that may be present immediately surrounding the building, and thus may not be representative for the purposes of evaluating soil vapor contamination. The distance of 10-feet is provided in the guidance for the purposes of example and is not intended to be a set distance criteria. Surface confining layers, such as pavement, may temporarily or permanently retard the migration of subsurface vapors to the outdoor air and may indicate a need to collect samples closer to a structure. The extent to which a surface confining layer affects the location of soil vapor samples is determined on a site-specific basis.

Comment C.7.10 (paraphrased, 1 commenter, 1 comment):

The objective of the investigation should be to "identify" the extent of soil vapors, and not to "adequately address" them. Section 2.6 goes on to state that "[i]nvestigations of soil vapor contamination should proceed outward from known or suspected subsurface sources, as necessary, on an areal basis until potential and current exposures have been adequately addressed." (p.12). We recommend that the words "adequately addressed" should be replaced with "identified."

Response C.7.10:

Acknowledged. The word adequately has been removed from Section 2.6.1 of the guidance.

**C.8 TOPIC: Sampling locations and requirements – sub-slab vapor and indoor air**

Comment C.8.1 (paraphrased, 2 commenters, 2 comments):

The scope of testing described in this section of the guidance [Section 2.6.3] is needlessly burdensome. In many cases, limited indoor air testing in the lowest potential living space (i.e., the most likely space to be impacted by vapor intrusion) is sufficient for decision-making. Additionally, the locations of indoor air sampling should be tied to use of the area. The testing protocol described by this section should only be necessary when background sources are suspected and cannot readily be ruled out or confirmed by other lines of evidence.

Response C.8.1:

The type, number and location of samples included in a vapor intrusion evaluation is typically determined on a site-specific basis. In most cases, data provided from indoor air living space sampling alone typically are not adequate to evaluate the cause or source of exposure. Comparisons between sub-slab vapor, outdoor air, and indoor air results obtained from different locations within a building (i.e., different floors), as well as the information gathered in the building surveys, are used when determining the likely cause or source of the exposure. These steps are necessary so that appropriate actions can be identified to address exposures. While indoor air samples in the lowest level of a building, in conjunction with sub-slab vapor and outdoor air samples, may be adequate to determine whether soil vapor intrusion is occurring, the sample may not be representative of actual exposures occurring within the building. Therefore, we also recommend that an indoor air sample be collected from the lowest level living space. In some cases, such as a basement bedroom or finished living room, the lowest level may also represent the lowest level living space.

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Comment C.8.2:

Although it is true that special consideration be given to [sampling] buildings that are used by sensitive populations, a child would be more likely to have a greater exposure in a residential dwelling. Guidelines "a" and "c" [in Section 2.6.2] should be combined.

Response C.8.2:

Section 2.6.2 identifies buildings that should be considered when selecting sub-slab vapor and indoor air sampling locations. The selection is not based on relative exposure duration. Furthermore, combining the guidelines as recommended would overlook the possibility that a child may be exposed at a facility (located within an area of subsurface vapor contamination), but not at home (located outside of the area of subsurface vapor contamination). The guidance has not been revised in response to this comment.

Comment C.8.3 (paraphrased, 1 commenter, 1 comment):

We request clarification and supporting data concerning the identity of "sensitive population groups."

Response C.8.3:

The identification of sensitive population or sensitive subgroups will vary with the nature of the exposure, the identity of the chemical and its effects, and the characteristics of various members of the exposed population (EPA 2006a,b). A sensitive subgroup for one type of exposure may not be the sensitive population for a different type of exposure. Typically, however, subgroups that might be more sensitive to chemical exposures than average healthy adults are pregnant women, infants and children, the sick, those nutritionally or immunologically compromised, and the elderly (ATSDR 1996; EPA 2001; 2006a,b).

Comment C.8.4 (paraphrased, 3 commenters, 4 comments):

The guidance states that buildings "located above or directly adjacent to known or suspected areas of subsurface volatile chemical contamination should be sampled." This is an overly broad statement that could be interpreted to require sub-slab vapor testing in all buildings over or adjacent to areas where contamination is merely suspected, or where concentrations are simply detected. This requirement is also contrary to the following statement: investigations of sub-slab vapor and/or indoor air contamination should radiate outward from the area of greatest concern until the potential for vapor intrusion exposures is adequately addressed. Clearly, testing should cease when test data and other lines of evidence indicate that vapor intrusion impacts, if any, have been adequately delineated, and should not be required in each and every building regardless of prior test results. Clarification is needed in the guidance as to whether the vagueness of the document will allow for elimination of buildings or areas from investigation.

Response C.8.4:

Every site is unique. The sampling approach that may be appropriate at one site may not be appropriate at another. The methodology discussed in the guidance is general in nature and is provided so that the applicant can develop an appropriate site-specific sampling plan. Elimination of buildings or areas from investigation is considered on a site-by-site basis in consultation with the Agencies. However, data collected to date do not support a universal distance criterion to screen-out sites or buildings from consideration. Typically, the relative relationship between sub-slab soil vapor, indoor

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air and outdoor air concentrations are considered essential to evaluate exposures related to soil vapor intrusion.

Comment C.8.5 (paraphrased, 4 commenters, 4 comments):

The guidance states that indoor air samples should be taken in buildings "in which elevated concentrations of contaminants were measured in sub-slab vapor samples." The term "elevated" is too vague and should be explained further.

Response C.8.5:

Section 2.6.3 of the guidance provides a general discussion of various factors that should be considered when selecting buildings for indoor air sampling. The guidance recommends that indoor air samples be collected concurrently with sub-slab vapor and outdoor air samples. If only sub-slab vapor samples were collected during the heating season, we recommend indoor air samples be collected in those buildings with elevated concentrations of contaminants in sub-slab vapor samples. Section 3.3.2 of the guidance identifies factors that are considered when evaluating sub-slab vapor results, such as background concentrations in air, the NYSDOH's guidelines for volatile chemicals in air, human health risks associated with exposure, attenuation factors, and concentrations provided in the NYSDOH's decision matrices.

Comment C.8.6:

Buildings should be prioritized for sampling based on use and relative sub-slab concentrations.

Response C.8.6:

Acknowledged. As discussed in Section 2.6 of the guidance, the specific sampling approach will vary at each site depending upon site-specific and building-specific conditions. In many cases, prioritization of structure sampling (as recommended in the comment) has been considered when developing sampling work plans.

Comment C.8.7 (paraphrased, 5 commenters, 5 comments):

The guidance states that indoor air or sub-slab vapor sampling should be conducted in "buildings in which positive responses with field equipment (e.g., photoionization detector (PID)) were obtained." Commenters noted that PIDs are screening-level instruments and caution should be used in applying results. They also provided the following suggestions to clarify the intent of this statement:

- specify that the PID response triggering sampling should be above background and from unidentified sources,
- clarify the type and sensitivity of the screening device on which a positive reading leads to a presumption that indoor air testing is necessary,
- either add other field instrumentation as presented later in the guidance or qualify this statement to acknowledge that the utility of typical field screening instruments may be limited by instrument sensitivity, and
- indicate PID readings showing an increasing gradient from indoor air to obvious vapor intrusion points, such as cracks in a slab, may be more useful for determining the need for additional sampling.

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Response C.8.7:

Acknowledged. The statement referenced in the comment has been revised as follows: "...buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled...."

Comment C.8.8:

NYSDOH should define what constitutes a building. Clarification is needed to determine if this includes all building type structures (e.g., garden storage sheds, pole barns, lumber storage sheds) or just normally occupied structures.

Response C.8.8:

Building use and occupancy are considered in evaluating the potential for exposures via the soil vapor intrusion pathway. Structures which are not occupied and/or are not intended to be occupied, or structures which, based on their construction, do not present a potential for vapor intrusion (i.e., a pole-barn, storage sheds, etc.) are typically not included in a soil vapor intrusion evaluation. However, as both current and future exposures are considered in this evaluation, a structure that is currently unoccupied but may be occupied in the future may be included in the investigation. These determinations are made on a site-specific basis.

Comment C.8.9 (paraphrased, 2 commenters, 2 comments):

The guidance suggests collecting sub-slab vapor samples near the center of the slab, away from footings. However, it is generally believed that the majority of vapors enter the slabs around the edges and concentrations near perimeter construction joints may be more representative of sub-slab vapors with the potential to enter the building. Additionally, a one-point data set, such as a single sub-slab sample collected from the center of the slab of a small residence, may be difficult to interpret. More than one sample, and at locations around the slab edges, is encouraged.

Response C.8.9:

Samples collected near the edge of a building or near footings may not be representative of sub-slab soil vapor beneath that structure due to "short-circuiting" effects which may occur due to fill materials, conduits or other conditions near the building's periphery. Each site and building is unique. In some cases, sub-slab concentrations could be higher under one portion of the building than the other due to the location of the subsurface vapor source. As such, the number of samples and sampling locations should be determined based on the particular building, the slab conditions, and the objectives of the sampling. For example, in a small residence with a single slab, one sub-slab soil vapor sample (biased toward the source location) may be sufficient. For larger structures, or structures with more than one slab, additional samples may be recommended. Section 2.6.2 of the guidance has been revised to clarify that at least one sub-slab vapor sample should be collected.

Comment C.8.10:

The requirement to collect sub-slab vapor samples from each slab area is overly prescriptive. In some large buildings, subsurface sources may only exist below a portion of the building, and various data may adequately indicate that testing may be restricted to a

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certain area. In other cases, samples collected in the worst case area may be sufficient to show no impact, or allow other risk management decisions.

Response C.8.10:

Acknowledged. While we generally recommend that at least one sub-slab vapor sample be collected from each representative area, and as discussed in the introduction to Section 2 of the guidance, site-specific or building-specific conditions may warrant modifying the recommendation. The comment contains examples of conditions that should be considered when determining the best approach for evaluating the potential for soil vapor intrusion in the building.

Comment C.8.11 (paraphrased, 1 commenter, 1 comment):

The guidance does not address sample number requirements with respect to large, slab-on-grade facilities, whose footprint is often measured in acres, not square feet. Buildings of this magnitude may actually be affected by more than one source of contamination, therefore, we recommend that a minimum sample number requirement be established (i.e., one indoor air sample per every 25,000 square feet of building floor for example).

Response C.8.11:

Indoor air and sub-slab soil vapor sampling needs are variable and are, therefore, addressed on a case-by-case basis in consideration of particular site conditions. The guidance has not been revised in response to this comment.

Comment C.8.12:

Section 2.6.3 discusses indoor air sampling and identifies areas likely to be impacted by vapor intrusion. We recommend specifically identifying basement areas near sump pumps or indoor wells, as these features provide a direct conduit from subsurface sources to indoor air.

Response C.8.12:

Agreed. Section 2.6.3.b of the guidance has been revised accordingly.

Comment C.8.13 (paraphrased, 2 commenters, 2 comments):

Why the draft guidance indicates that the samples should be taken at a height of three feet in the basement is not clear. People do not usually sit or sleep in the basement, particularly in commercial or industrial settings. Furthermore, indoor air sampling should include measurements of the lower airspace frequently occupied by children.

Response C.8.13:

The State considered this comment and decided not to change the default indoor air sampling height at this time. We are not aware of any data indicating that chemicals entering homes via soil vapor intrusion have different concentrations at different heights above the floor. Indoor air near a source of intruding soil vapors, such as a wall outlet, foundation crack, perimeter drain, or sump pit, may contain higher levels of soil vapor contaminants than air at other places in a home. However, we would expect concentrations of soil vapor contaminants to rapidly equilibrate with increased distance from a source. However, the State will investigate the potential for higher levels of soil vapor contaminants at sampling heights below the default indoor air sampling height. The State anticipates implementing these investigations as soon as

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feasible and will post any appropriate revisions or amendments to the guidance on the NYSDOH's soil vapor intrusion web page:  
[http://www.health.state.ny.us/environmental/indoors/vapor\\_intrusion/](http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/).

Comment C.8.14:

Testing should ensure that contaminants are measured as accurately as possible, and citizens with legitimate concerns regarding the potential for vapor intrusion into their homes should have their homes tested.

Response C.8.14:

The guidance is intended to provide recommendations for sampling to ensure that high quality data are obtained and that all exposures associated with soil vapor intrusion at a site are identified and addressed. This involves sampling potentially affected homes until sufficient data are collected for appropriate decisions to be made. In some cases, sampling a representative number of homes may be sufficient for making decisions on an area-wide basis.

Comment C.8.15:

The guidance suggests that building testing would proceed "outward, as necessary, on an areal basis until potential and current human exposures have been adequately addressed" (Section 3.3.1); however, elsewhere it states: "[a]t a minimum... buildings, including residential dwellings, located above or directly adjacent to known or suspected subsurface sources of volatile chemicals or known soil vapor contamination should be sampled" (Section 2.6.3). This appears to indicate that building tests must proceed to the edges of a groundwater plume, even if testing on an areal basis indicates that the area of building impacts (if any) is smaller. Section 2.6.3 must be deleted or modified to the approach outlined in Section 3.3.1, which is more technically justifiable and cost-effective.

Response C.8.15:

Acknowledged. We generally recommend that "...buildings, including residential dwellings, located above or directly adjacent to known or suspected subsurface sources of volatile chemicals or known soil vapor contamination should be sampled" in Sections 2.6.2.a and 2.6.3.b of the guidance. However, as discussed in the introduction to Section 2, site-specific conditions may warrant modifying the recommendation. The comment contains an example of site-specific conditions that should be considered when determining the best sampling approach for evaluating the potential for soil vapor intrusion. In all cases, the investigation should proceed until the level of data is sufficient to evaluate what actions, if any, are necessary to address exposures related to soil vapor intrusion.

Comment C.8.16:

Section 2.6.2, third paragraph and Section 2.6.3, last paragraph: Confirmation sampling outside of known or suspected areas of subsurface contamination should be performed because unidentified migration pathways (e.g., due to soil heterogeneities) may affect the direction and extent of vapor migration.

Response C.8.16:

Acknowledged. The specific number and location of samples necessary to address human exposures associated with soil vapor intrusion should be determined on a site-

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specific basis and with consideration of the site conceptual model and factors that may affect soil vapor migration and intrusion (as discussed in Section 1 of the guidance).

Comment C.8.17 (paraphrased, 1 commenter, 1 comment):

It is important not to rely blindly on existing contour maps for the purpose of selecting buildings for sampling based on the identification of known subsurface sources of volatile chemicals. Either field sampling should confirm the plume boundaries, or sub-slab and indoor sampling should be conducted within a larger "buffer zone" of potential contamination.

Response C.8.17:

Acknowledged. The guidance suggests a phased, iterative approach to investigation where existing site data and site information are used to guide subsequent phases of the investigation. We agree that the type and quality of the data should be sufficient to guide subsequent investigative phases.

## **C.9 TOPIC: Sampling locations and requirements – outdoor air**

Comment C.9.1:

Consider rephrasing the first sentence [Section 2.6.4] because it is confusing. Indoor and outdoor samples cannot be collected "together," though they can be collected simultaneously.

Response C.9.1:

Acknowledged. Section 2.2.5 of the guidance states "Outdoor air samples should be collected simultaneously with indoor air samples...." In addition, Section 2.6.4 has been revised as follows: "Typically, an outdoor air sample is collected outside of each building where an indoor air sample is collected."

Comment C.9.2:

Outdoor air samples may not be necessary at each indoor air test location if sufficient data are available for the area to characterize ambient air levels, and these levels do not impact decision making (e.g., concentrations are consistently below background ambient air levels). The requirement for outdoor air sampling at every building where indoor air sampling is conducted is unnecessary except where gross differences in outdoor air concentrations are expected based on local sources. For non-industrial settings, outdoor air at a site would not be expected to be significantly variable from location to location or from day to day. This is especially the case with chlorinated VOCs. A statistically representative number of locations and samples should be more than sufficient to characterize background outdoor air. Location-specific outdoor air samples can always be collected during re-testing of buildings with anomalous results.

Response C.9.2:

Acknowledged. Outdoor air samples are necessary for each sampling event to characterize outdoor air quality during the specific time period. However, we agree that outdoor air sampling may not be necessary at every building and that representative locations are adequate when multiple locations are being tested during the same time period. Section 2.6.4 of the guidance has been revised to reflect this point. The specific number and locations of outdoor air samples are determined on a site-specific basis.

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Comment C.9.3 (paraphrased, 4 commenters, 4 comments):

Outdoor background sampling locations should be based on actual conditions and not artificially created to minimize VOC levels. The draft guidance (p. 29) states that sampling locations should not be near known sources of VOCs. However, the background sample should be collected to reflect actual conditions, even if the subject building is near a source of VOCs.

Response C.9.3:

The State agrees that the outdoor air sample should be representative of actual outdoor air conditions to provide data to assist in determining the likely source(s) of volatile compounds in the indoor air so appropriate actions can be taken to address exposures. However, the collection of an outdoor air sample near an obvious source of contamination may bias the sample and prevent an evaluation of likely source(s) of volatile contaminants in the indoor air. The location should be a reasonable compromise that is an upwind location representative of outdoor conditions.

Comment C.9.4 (paraphrased, 3 commenters, 3 comments):

The discussion of outdoor air samples should be expanded to include collection of samples at exterior air intakes of buildings equipped with HVAC systems that draw outdoor air into a building. The indoor air quality in such a building would be more a function of the air quality at the intake, which may be on the rooftop or side of the building.

Response C.9.4:

Agreed. Section 2.6.4 of the guidance has been revised accordingly.

## **C.10 TOPIC: Sampling protocols, technologies and equipment in general**

Comment C.10.1:

Section 2: Do you want to add some other possible vapor intrusion tools/tests here, such as:

- flux chambers,
- indoor ventilation rate determination (this is a good one to allow),
- determination of slab specific alpha using a conservative tracer (e.g. radon),
- documentation of bioattenuation, and
- pressure measurements?

Response C.10.1:

Section 2 of the guidance presents general approaches to investigating the soil vapor intrusion pathway. As discussed in the introduction to Section 2.7, the State will consider all proposed methods to evaluate soil vapor intrusion. Data from any investigative technique can be used as part of the conceptual site model process for hypothesis testing as long as the technique is appropriate and can be supported. However, we may request that chemical testing be used to verify that the objective of the proposed method has been met.

Comment C.10.2 (paraphrased, 2 commenters, 2 comments):

We believe it is prudent for the state of New York (and other states) to include an in-depth discussion on passive vapor sampling as it pertains to vapor intrusion investigations. While

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there are limitations to these methods (e.g., results typically reported on a mass rather than concentration basis), they are simple to use and their efficacy in characterizing the extent of subsurface contamination is well documented. This technology should be considered, especially for identification of zones of contamination in which vapor intrusion sampling into buildings will then be conducted.

Response C.10.2:

As discussed in the introduction to Section 2.7, to the extent that proposed soil vapor intrusion methods meet the sampling objectives and the requirements for the sampling and analytical methods, they will be considered. In-depth discussions of alternate technologies and methodologies, such as passive vapor sampling, have not been added to the guidance. Passive vapor sampling devices may be appropriate in some situations, such as to delineate the general nature and extent of vapor contamination at a site. These determinations will be made on a site-specific basis.

Comment C.10.3 (paraphrased, 1 commenter, 1 comment):

The section on sampling protocols is too prescriptive. A performance based objective for each subsection (soil vapor, sub-slab vapor, etc.) should be presented. Details of sampling protocols in most cases will be provided in a sampling plan, which will require approval by the Agency overseeing the site investigation.

Response C.10.3:

As discussed in the introduction to Section 2.7 of the guidance, investigation procedures will vary from site to site and should be tailored to the site-specific sampling objectives. The objective of Section 2.7 is to provide a basis from which a sampling plan can be generated. The overall objectives of the sampling and data review processes are outlined in Section 1.5 of the guidance.

Comment C.10.4:

The sampling protocols are very detailed. Although proper and consistent sampling procedures are needed in order to ensure the integrity of the data collected, deviations from this protocol should be permitted without prior NYDOH approval provided that these deviations do not undermine the integrity of the data. This flexibility will ensure that minor deviations in sampling protocol do not result in unnecessary rejection of useful data.

Response C.10.4:

Acknowledged. Deviations from the standard protocol are common when faced with unforeseen events resulting from site-specific conditions. To the extent practicable an attempt should be made to incorporate any potential deviations in the work plan. As stated in the introduction to Section 2.7 of the guidance, "...the procedures that were implemented in the field should be documented and included in the final report of the sampling results." Deviations do not necessarily mean that the data collected will be rejected. However, it is critical that proper documentation be provided so that any changes can be considered during the data evaluation phase.

Comment C.10.5 (paraphrased, 2 commenters, 1 comment):

Throughout the discussion of sampling methods and strategies, the NYSDOH does not provide sufficient detail to ensure that implementation will meet NYSDOH goals and objectives. Examples include: (1) the minimum inside to outside temperature difference

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required to prevent questions later about whether it was "unseasonably" warm; (2) the minimum time between sampling rounds; (3) the distance considered to be "in the vicinity" of a building foundation or "along the site's perimeter;" (4) concentrations considered to be elevated readings based on field equipment; and (5) distance considered to be appropriate in grid spacing intervals. Further clarification of these requirements is needed to ensure that sampling will be acceptable to NYSDOH and useful for evaluating the vapor intrusion pathway.

Response C.10.5:

Site-specific conditions will determine the details of the sampling approach. Prescribing many of the factors mentioned in the comment would not allow for the flexibility needed in investigating this complex exposure pathway and may not be appropriate for all sites. Concerns about whether the proposed sampling approach is acceptable will be addressed through the process of developing a site-specific sampling plan, in consultation with the NYSDEC and NYSDOH, and these Agencies' review and approval of the work plan.

Comment C.10.6 (paraphrased, 4 commenters, 4 comments):

The guidance does not provide specificity on sample time duration per sampling event, thereby allowing discrepancies between individual sites that may be similar in nature. The sample duration should be of long enough duration to reflect actual conditions accurately. A 24-hour sample is not adequate to measure long-term exposure. Additionally, one-hour samples do not appear to be compatible with any exposure scenario. However, if the objective is collection of indoor air quality under controlled conditions so that interference from indoor sources can be minimized and vapor intrusion can be more clearly evaluated, then a short duration (e.g., one hour) could be more appropriate.

Response C.10.6:

Sampling duration is generally discussed in Section 2.7 of the guidance. The duration should be selected to achieve the minimum reporting limits and to meet the particular sampling objectives. Indoor air sampling durations should reflect the exposure scenario being evaluated without compromising the minimum reporting limit or sample collection flow rate. These determinations are made on a site-specific basis.

Comment C.10.7 (paraphrased, 1 commenter, 1 comment):

Section 2.7.3.a implies that the NYSDOH guidance should be used in situations where workers may be exposed to subsurface vapors. If this is the case, then the NYSDOH's position should be clearly stated.

Response C.10.7:

Section 1.7.1 of the guidance discusses the applicability of the guidance to non-residential settings. [See also Part A.3 (TOPIC: Occupational Safety and Health Administration (OSHA) regulation).]

Comment C.10.8:

The Guidance does not specify that canisters (Summa®) are the only type of containers to be used for sampling; it is implied (or unclear) that other sample containers are authorized for use (e.g., Tedlar bags, sorption tubes, etc.). We are not aware of certification processes for Tedlar bags.

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Response C.10.8:

As stated throughout Section 2.7, samples should be collected in an appropriate container. An appropriate container is one that meets the sampling objectives, meets the requirements of the sampling and analytical methods, and is certified clean by the laboratory. If these criteria cannot be achieved, such as certification of Tedlar® bags, then the container would not be considered appropriate.

Comment C.10.9:

We request clarification as to whether existing soil borings may be used to test for soil vapor intrusion.

Response C.10.9:

Soil borings are typically larger in diameter than soil vapor implants, increasing the amount of backfill material needed and possibly increasing the likelihood that short-circuiting will occur. In the event that existing soil borings are used, care should be taken to show that short-circuiting is not occurring. The decision to use existing soil borings should be made on a site-by-site basis.

Comment C.10.10 (paraphrased, 1 commenter, 1 comment):

I do not believe it is in NYSDOH's best interest to mention specific makes and models of vapor monitoring equipment (e.g., Jerome, RAE Systems). This implies preference by the State for specific corporations.

Response C.10.10:

Agreed. The Preface of the guidance has been revised to include a disclaimer to address this point.

## **C.11 TOPIC: Sampling protocol – soil vapor**

Comment C.11.1:

Section 2.7 indicates cross sectional diagrams for soil gas point installation. Can commonly available probes also be used rather than the screen that is indicated? A number of companies have manufactured and tooled equipment that has been approved by [NYS]DEC for soil gas sampling for almost 20 years. These include points that are actually driven into the ground and the point is the widest part of the hole. The annulus is filled similarly to the diagram in the manual but it is not as large. This is the preferred and in many cases the only way to install gas sampling points indoors. They should also be approved for outside sampling as well.

Response C.11.1:

The purpose of Figure 2.2 is to illustrate the primary components of a soil vapor probe. For clarification, the title of Figure 2.2 has been revised as follows: "Schematics of a generic permanent soil vapor probe and permanent nested soil vapor probes. [Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]"

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Comment C.11.2 (paraphrased, 1 commenter, 1 comment):

Can multiple nested probes be installed in the same boring annulus with bentonite seals above and below sampling ports, in lieu of the construction detail shown in Figure 2.2?

Response C.11.2:

Multiple nested probes can be used. However, measures need to be taken to demonstrate that each probe is sampling from a discrete interval and that communication or short-circuiting within the system is not occurring. Such measures might include the use of a pump and micromanometer and/or tracer gas.

Comment C.11.3 (paraphrased, 3 commenters, 4 comments):

For soil vapor and sub-slab vapor sampling, nylon tubing may be superior to both polyethylene and Teflon. The guidance states that polyethylene or Teflon tubing must be used for sub-slab soil vapor samples. This section of the guidance does not allow inert tubing to be used, but the Figure 2.3 shows it. The guidance should specify the desired attributes of the tubing, rather than restricting material type.

Response C.11.3:

Acknowledged. Section 2.7.1.c and Section 2.7.2.b of the guidance have been revised to indicate that tubing should be inert, of laboratory or food grade quality, and of the appropriate size. Furthermore, in each of these sections, nylon has been added to the list of examples of inert tubing.

Comment C.11.4 (paraphrased, 2 commenters, 2 comments):

Figure 2.2 shows a stainless steel screen and backfill with "clean material." Are these requirements? The guidance should depict use of bentonite or bentonite grout to fill the annular space above the bentonite seal and allow for alternate screen types. It would seem to allow the use of soil removed from the borehole, filter sand, or other potentially highly air permeable material to backfill the borehole, creating the potential preferential vapor migration path across what may be stratified soils with limiting zones.

Response C.11.4:

The purpose of Figure 2.2 is to illustrate the primary components of a soil vapor probe. For clarification, the title of Figure 2.2 has been revised as follows: "Schematics of a generic permanent soil vapor probe and permanent nested soil vapor probes. [Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]" Accordingly, alternate probe installations can be proposed; however, the materials used should be inert and appropriate for the sampling. These determinations will be made on a site-specific basis.

Comment C.11.5:

Grouting appears to be in conflict with the preference for using direct push technology. If grouting is necessary at a site, then an initial borehole can first be augered to a depth less than the sampling depth. The sampling probe can then be pushed to the sampling depth, and the grout can be placed in the annular space between the probe and the borehole. However, the problem of outdoor air infiltrating into soil gas samples has not been observed in practice using direct push probes. Tracer gas (helium) tests have confirmed this.

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Response C.11.5:

The guidance document provides general recommendations. Alternate installations may be proposed. To the extent that other installations meet the sampling objectives and requirements of the analytical methods, they will be considered. Section 2.7 of the guidance has been revised to reflect this point.

Comment C.11.6 (paraphrased, 3 commenters, 3 comments):

The use of glass beads to create a sampling zone appears to be in conflict with the preference for using direct push technology. It is common to encounter significant void space beneath the slab due to settling of sub-grade fill material. In these instances it is not feasible to cover the probe tip with coarse sand or glass beads. Additionally, sand can act as a sink for volatiles. Introduction of additional materials is not recommended because it is unknown to what extent they may be a potential source of VOCs. Washed #1 crushed stone works well as a substitute.

Response C.11.6:

Acknowledged. Section 2.7.1.b and Section 2.7.2.d of the guidance have been revised as follows: "...porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.)..." Alternate backfill materials may be proposed and used; however, materials should be inert.

Comment C.11.7 (paraphrased, 1 commenter, 1 comment):

We recommend that a PRP should not be required to pay for permanent probes unless there is a documented, completed exposure pathway presenting a risk to human health.

Response C.11.7:

Section 2.7.1 of the guidance has been revised to reflect the fact that permanent soil vapor probes are not "required," but that "permanent or semi-permanent installations are preferred for data consistency reasons and to ensure outdoor air infiltration does not occur." We agree that permanent probes should be used when needed to meet the objectives of the sampling. For example, permanent probes are recommended when repeated soil vapor sampling from a particular location is needed (e.g., as part of a long-term soil vapor monitoring program).

Comment C.11.8:

For permanent installations, consider sloping the ground surface to direct water away from the borehole much like a monitoring well.

Response C.11.8:

Agreed. Section 2.7.1.f of the guidance has been revised to include this consideration.

Comment C.11.9:

The draft policy is heavily weighted toward permanent soil probe installations that are very similar in construction to groundwater monitoring wells. There are other vapor sampling methods such as installation of a temporary driven steel rod and membrane-tipped probes driven with a geoprobe. These techniques are less expensive and are not permanent

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devices. Although the draft guidance (Section 2.7) states that temporary devices could be used, the draft language should be revised to provide more sampling flexibility.

Response C.11.9:

Acknowledged. The examples provided in Section 2.7.1 are intended to provide guidance for collecting soil vapor samples from discrete zones with minimal ambient air infiltration. However, the section has been revised to acknowledge the use of temporary probes and to recommend their use only if "measures are taken to ensure that an adequate surface seal is created to prevent outdoor air infiltration and if tracer gas is used at every sampling location."

Comment C.11.10:

In this section the distinction between temporary, semi-permanent and permanent soil vapor probe installations is not clear. It appears the only difference between soil vapor implants would be the methods by which implants are completed at the ground surface (i.e., with or without a road box). It should be clarified that a temporary soil vapor point is one where probes are pushed to depth and the probe rods are bumped back to expose a small interval of the formation; once the sample is collected the probe rods are removed and no constructed material is left in the ground.

Response C.11.10:

The intent of the guidance is to provide general recommendations and strategies for conducting a soil vapor intrusion investigation. The probe installations described in the guidance are generally similar in construction. However, alternate installations may be proposed. To the extent that other installations meet the sampling objectives and requirements of the analytical methods they will be considered.

Comment C.11.11:

Provide acceptable procedures for temporary vapor sampling installations. For example, is a direct push vapor probe (e.g., Geoprobe) with a surface bentonite seal, which is commonly used for soil vapor sampling, acceptable?

Response C.11.11:

The guidance is intended to provide general strategies for a soil vapor intrusion evaluation and acknowledges that there are alternate methods for probe installation. To the extent that installations meet the sampling objectives and requirements of the analytical methods they will be considered. With respect to temporary soil vapor probes, Section 2.7.1 of the guidance has been revised as follows: "Temporary probes should only be used if measures are taken to ensure that an adequate surface seal is created to prevent outdoor air infiltration and if tracer gas is used at every sampling location."

Comment C.11.12:

The use of direct push for installation of soil-gas probes should be questioned, in particular, in fine-grained soils, because of the potential for smearing along the borehole walls during rod insertion. This practice could lead to an increased potential for vapors to short circuit, potentially with the atmosphere. The use of tracers and vacuum testing during sampling would be useful in helping determine whether short-circuiting occurs. Care should be taken both in using this type of approach in fine-grained soil settings.

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Response C.11.12:

Acknowledged. Under certain circumstances, smearing could be a problem. The use of tracer gas as part of the sampling approach should be capable of identifying sample locations where short-circuiting is a problem. In some settings, such as those described in the comment, the use of hollow stem augers may be more likely to reduce smearing. Section 2.7.1.a of the guidance has been revised to incorporate the consideration of smearing when selecting the method of probe installation.

Comment C.11.13:

Section 2.7.1(a) references only augers or direct push technology. The Guidance should allow for other drilling methods as may be appropriate based on site conditions. Drilling for nested implants should include continuous sampling of soil in the deepest borehole to aid in characterizing vadose zone conditions. If possible, nested implants should target zones just above and below potential limiting soil zones (fine-grained high moisture content soils to aid in documenting potential vapor profiles and effects of limiting zones).

Response C.11.13:

We agree that drilling methods should be selected based on site conditions. Section 2.7.1.a of the guidance has been revised to clarify this point. The collection of soil samples should be considered on a case-by-case basis.

Comment C.11.14:

Describe procedures for soil and sub-slab vapor sampling in the presence of groundwater, especially due to seasonal fluctuations and affects on permanent probe installations.

Response C.11.14:

The use of semi-permanent probes may be more appropriate in areas exhibiting substantial fluctuations in the groundwater table. If groundwater is present immediately beneath a building's slab, then sub-slab vapor sampling would not be recommended. In these cases, indoor air sampling and a water sample from a sump may be more appropriate. These determinations should be made on a site-specific basis.

Comment C.11.15:

The guidance should stipulate requirements for when to sample based on weather conditions rather than just requiring the documentation of weather conditions. Precipitation can influence soil gas and indoor air sample results. Therefore, [NYS]DOH should provide guidance on weather conditions under which sampling is or is not recommended.

Response C.11.15:

While heavy rains can potentially produce a short-term surface confining layer, we have not observed significant limitations on subsurface vapor or indoor air sampling. Determinations regarding factors that may influence the quality of the sampling data (i.e., weather conditions) will be made on a site-specific basis. A discussion acknowledging the potential limitations of weather conditions on soil vapor sampling has been added to Section 2.7.1 of the guidance.

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Comment C.11.16:

Some mention should be made of the difficulty associated with sampling during the winter. Condensation is a particular issue that should be mentioned.

Response C.11.16:

Acknowledged. A discussion acknowledging the potential limitations of weather conditions on soil vapor sampling has been added to Section 2.7.1 of the guidance. In the discussion, condensation is mentioned as an example.

Comment C.11.17:

Weather conditions such as outdoor temperature and barometric pressure have little effect on soil gas samples collected 5 feet or deeper. Why require this information?

Response C.11.17:

We agree that other factors, such as moisture content, would be more likely to affect concentrations of volatile chemicals in soil vapor collected from deeper locations than barometric pressure. Section 2.7.1 of the guidance has been revised to reflect that while information about the barometric pressure is not required, the information could be gathered to assist in the interpretation of the results. For example, this information is easily obtained and can be collected in a consistent fashion for all sampling events. Having consistent information corresponding with soil vapor concentrations can help to evaluate trends and demonstrate what effect these parameters might have on soil vapor concentrations at 5 feet or deeper.

Comment C.11.18:

The guidance does not recommend particular capping mechanisms for the sample tubes or the surface access covers. We have had problems with some capping mechanisms that have led to false readings (e.g. glues attaching the rubber gasket on the surface access cover released VOCs in warm weather, lubrication in valves that was used to cap the tube). Does [NYS]DOH have a recommendation for capping mechanisms that will not contaminate samples?

Response C.11.18:

No, the State does not have specific recommendations for capping mechanisms. However, care should be taken in specifying the materials that are used for capping the ends of probes to ensure that they do not interfere with the objectives of the sampling, such as lubricants used in valves and in the adhesives used in gaskets.

Comment C.11.19:

If you are going to recommend more than one sampling round in a different season, it may or may not be wise to leave the implants in the ground. Tampering becomes a concern.

Response C.11.19:

Acknowledged. We generally recommend permanent probes for data consistency reasons. However, as discussed in the introduction to Section 2 of the guidance, site-specific conditions may warrant modifying the recommendation. The comment contains an example of a concern that should be considered when selecting the appropriate probe type. The concern of tampering may be particularly relevant if there is a history of tampering at the site, such as with groundwater monitoring wells.

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Comment C.11.20 (paraphrased, 2 commenters, 2 comments):

I recommend adding a reference to the necessity of contacting the Underground Facilities Protection Organization (Dig Safely New York) when collecting soil vapor samples along, above and adjacent to utility beddings, such as during an evaluation of preferential pathways.

Response C.11.20:

The party responsible for conducting subsurface sampling is responsible for ensuring that areas to be sampled are clear of underground utilities. The guidance has not been revised in response to the comment.

Comment C.11.21 (paraphrased, 1 commenter, 1 comment):

Is there a technical basis for the 24-hour wait time for permanent soil vapor probes? If the sand pack is purged out, then no wait time should be necessary.

Response C.11.21:

Based on past experience, the primary cause of outdoor air infiltration into soil vapor probes is an improperly set surface seal. The proper wait time is the length of time that it takes for the seal to fully set (typically 24 hours).

Comment C.11.22 (paraphrased, 2 commenters, 2 comments):

A restriction on the rate at which soil gas samples are collected should not be imposed for samples collected at depth. The rate at which deep samples are collected is limited only by the permeability of the soil. As long as it can be demonstrated that the flow rate does not exceed the rate at which soil gas moves through the soil, the flow rate should not be restricted for deep soil gas samples since air infiltration is not of concern. The guidance should allow for proposal of alternate rates of sampling based on site-specific soil conditions.

Response C.11.22:

A low flow rate is recommended to minimize the infiltration of outside air and to minimize disruptions to the natural equilibrium conditions in the sampling zone, which has been demonstrated to occur at high flow rates. When using low volume sampling techniques, this should not be overly restrictive.

## **C.12 TOPIC: Sampling protocol – sub-slab vapor**

Comment C.12.1 (paraphrased, 1 commenter, 1 comment):

Given the schematic in Figure 2.3 and the accompanying discussion in the text, the Guidance does not address construction of sub-slab sample ports for relatively thin slabs (2 inches or less) that are commonly encountered in older structures, particularly residential structures. The Guidance should develop provisions for sub-slab samples at these "thinner slab" locations, perhaps considering a plugged port that is finished above floor grade.

Response C.12.1:

Figure 2.3 and the accompanying text provide general recommendations and approaches for sub-slab soil vapor sampling. The sub-slab probe should be installed in a manner that will provide representative data. If site circumstances indicate that a representative sub-slab soil vapor sample cannot be obtained, alternate approaches

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should be discussed with the Agencies. These determinations are made on a site-specific basis.

Comment C.12.2:

As indicated in Figure 2.3, the sub-slab sample port is recessed below floor grade; presumably, the diameter of the hole drilled in the slab at the top of the port would need to be sufficiently large to allow for manipulating hand tools to remove the cap from the port fitting. The point itself would need to be anchored with a hand tool when unthreading the cap or plug on the port fitting; if not, the torque applied when attempting to remove the cap or plug from the port could eventually cause rotation of the entire point, thereby compromising the surface seal.

Response C.12.2:

Comment noted.

Comment C.12.3:

When a sub-slab vapor probe is installed in accordance with the depiction in Figure 2.3, the recessed sub-slab sample port should be capped at the floor slab grade, perhaps with a hollowed out plug.

Response C.12.3:

Comment noted.

Comment C.12.4:

Section 2.7.2 e.: Is bentonite acceptable for sealing the penetration? What about modeler's clay?

Response C.12.4:

We recommend that the material used for sealing should be inert and should allow for an adequate seal. Section 2.7.2.e of the guidance has been revised to clarify this point. Sealing materials that accomplish these objectives are considered appropriate.

Comment C.12.5:

If sub-slab samples are collected concurrently with indoor air samples, then they would need to be installed prior to the indoor air sampling. However, drilling through the concrete and creating a temporary open in the slab could temporarily impact indoor air quality in the immediate vicinity, which could cross-contaminate the indoor air samples. Instead, the indoor air samples should be collected first, and the sub-slab samples should be collected immediately after, on the same day if possible. The difference of a few hours will not change sub-slab VOC concentrations.

Response C.12.5:

Tight surface seals (such as with beeswax) can be installed immediately after the hole is drilled and the sub-slab vapor sampling tube (temporarily capped) is inserted. This procedure, combined with the effects of dilution processes, is not expected to substantially affect indoor air quality. Although a longer sampling duration (e.g., 24 hours) may not be necessary to collect representative sub-slab vapor samples, we

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continue to recommend concurrent sampling of sub-slab vapor, indoor air and outdoor air because it

- is feasible,
- minimizes disruptions to the occupants (in terms of the number of visits to set-up and take-out), and
- facilitates direct comparisons of the data.

Comment C.12.6 (paraphrased, 2 commenters, 2 comments):

Based on experience at other sites, it is probably unnecessary to sample sub-slab soil vapor over the same time period as concurrent indoor air samples. Under most conditions, the subsurface vapor flux is unlikely to vary significantly over the course of 24 hours. A sub-slab "grab" sample of approximately 10 to 30 minutes duration is generally considered to be representative.

Response C.12.6:

Acknowledged. However, we recommend that concurrent samples be collected from multiple points (sub-slab, indoor, outdoor) to aid the data evaluation process by allowing for direct comparisons over the same time period and to minimizing the potential for discrepancies in the data and the need to resample. [See also Comment C.12.5.]

Comment C.12.7:

Under item a. at the top of page 18 (i.e., actions that should be taken to document conditions during sampling and ultimately to aid in the interpretation of sampling, when sub-slab vapor samples are collected) documentation of uses of volatile chemicals in residential buildings should be added.

Response C.12.7:

Acknowledged. Typically, knowing the indoor use of volatile chemicals is more relevant when sampling sub-slab vapor alone in commercial or industrial buildings, rather than residential buildings, due to the potential for large-scale use of the products and for complex HVAC systems that may operate under a positive pressure. Section 2.7.2.a of the guidance has been revised to reflect this point. As discussed in Sections 2.7.3 and 2.11, volatile chemical usage should be documented in all buildings (commercial, industrial, residential, etc.) when indoor air samples are collected.

Comment C.12.8 (paraphrased, 2 commenters, 2 comments):

All of the steps you require on page 18 (a through h) for sub-slab vapor samples are not always necessary and are overkill that will drive up costs.

Response C.12.8:

We agree that not all of the items specified in the list need to be documented in every case. Therefore, Section 2.7.2 of the guidance has been revised to differentiate between the items that we recommend be documented every time and those that should be considered.

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Comment C.12.9:

It would also be useful to measure the direction and magnitude of the differential pressure between the sub-slab and indoor air using a sensitive pressure gauge (e.g. an appropriately sensitive magnahelic or digital micromanometer). This measurement will provide quantitative data regarding the potential for vapor intrusion instead of relying simply on the observations made regarding the possible upward pressure differential due to use of HVAC systems, etc. The pressure differential value is used as an input to the [Johnson & Ettinger Model] JEM.

Response C.12.9:

Agreed. However, this information may not be needed in every case. As stated in Sections 2.7.2 and 2.7.3, "Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas)..."

Comment C.12.10:

Evaluation of flow patterns between floors is an extreme diagnostic step that should only be necessary if risk-management decisions cannot be made on the basis of indoor air test results. In general, the guidance appears to approach testing of each building as a research project, resulting in far more data collection than is necessary at most sites.

Response C.12.10:

We agree that an evaluation of airflow patterns may not be necessary to make decisions in all cases. Therefore, Sections 2.7.2 and 2.7.3 have been revised as follows: "Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas)..."

Comment C.12.11:

The requirement to operate the heating system prior to and during sub-slab sampling should be based on the design of the heating system, since systems that create a positive pressure inside the building will limit vapor intrusion during operation.

Response C.12.11:

Acknowledged. We generally recommend that heating systems be operational because this typically represents the conditions under which soil vapor intrusion is more likely to occur. However, as discussed in the introduction to Section 2 of the guidance, building-specific conditions may warrant modifying the recommendation. All available information about a site and potentially affected buildings (including HVAC operations and all of the other factors discussed in Section 1.3) should be considered in planning and timing an investigation. The comment contains an example of a building condition that should be considered when selecting the appropriate sampling approach.

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### **C.13 TOPIC: Sampling protocol – indoor and outdoor air**

#### Comment C.13.1 (paraphrased, 2 commenters, 2 comments):

While tetrachloroethene (PCE) badges are a less expensive alternative, the quality of the data that are generated from such badges is much less reliable than data generated from collecting air samples followed by laboratory analysis. They have higher detection limits and higher rates of laboratory contamination relative to Summa® canisters. We recommend that this section either be eliminated or that additional language be provided to explain why this type of technology is recommended.

#### Response C.13.1:

A minimum reporting limit appropriate for data evaluation can be achieved with PCE badges. The guidance includes a discussion of the passive air monitors in Section 2.7.3 because they are often used at sites with PCE contamination. At these sites, the use of badges is often appropriate for the sampling objectives (e.g., to evaluate the potential for intrusion of vapors containing PCE into a building) and is often a more cost-effective approach. Quality assurance/quality control measures in place at Environmental Laboratory Approval Program (ELAP)-certified laboratories ensure data obtained from passive air monitors are reliable.

#### Comment C.13.2 (paraphrased, 1 commenter, 2 comments):

All of the steps you require on page 19 (a through h) for indoor air samples and on page 20 (a through c) for outdoor air samples are not always necessary and are overkill that will drive up costs.

#### Response C.13.2:

We agree that not all of the items specified in the list need to be documented in every case. Therefore, Section 2.7.3 of the guidance has been revised to differentiate between the items that we recommend be documented every time and those that should be considered.

### **C.14 TOPIC: Use of tracer gas**

#### Comment C.14.1 (paraphrased, 1 commenter, 2 comments):

Tracers should be required for all [soil vapor] samples to ensure no leaks in the sampling system, which can happen on any sample if fittings are not tightened. I recommend that tracers should be required on all samples or [non-detects] won't be legally defensible.

#### Response C.14.1:

If there are concerns about leaks in the sampling system (not just at the soil vapor probe/ground interface), then steps should be taken to ensure that the tracer gas is in contact with the entire sampling train. Field personnel may wish to use liquid tracers for this purpose. Section 2.7.5 of the guidance has been revised to include these considerations.

If the party conducting the investigation wants to use tracers at each soil vapor sampling location during each sampling event, they may do so. However, the guidance continues to recognize that the frequency of tracer gas use may be reconsidered after the results of initial soil vapor sampling (as differentiated from sub-slab vapor sampling) indicate that the tracer gas protocol being employed is adequate [Section 2.7.5].

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Comment C.14.2 (paraphrased, 2 commenters, 1 comment):

The guidance recommends using a tracer gas for all initial soil vapor, sub-slab vapor or indoor air samples. As the NYSDOH is likely aware, the methodology presented for conducting the tracer gas study is complicated and time consuming. The NYSDOH should at most require 10% of initial samples undergo a tracer analysis. If these results show that there is no leakage, tracer gas analysis should no longer be required. As another alternative, the NYSDOH should consider allowing pressure testing as a method of leak detection. Using a micro-manometer and a simple hand operated pump, it is possible to measure the pressure drop over time in the sealed enclosure enveloping the sample port. These results can then be used to calculate a percent leakage.

Response C.14.2:

The use of tracer gas is recommended when collecting soil vapor samples, not sub-slab vapor or indoor air samples. Tracer gas should always be used as one element of the quality assurance/quality control elements in the soil vapor sampling program. The guidance provides the flexibility to reduce the percentage of soil vapor sampling points at which a tracer gas is used based on the demonstrated performance of the sampling technique. The pressure technique proposed in the comment would not allow the sampler to identify the source of the leakage.

Comment C.14.3:

The requirement for continued use of a tracer gas after a demonstration that air infiltration is not occurring seems contradictory with section 2.7.1 (e), where the guidance states that "continued use of the tracer gas may be reconsidered."

Response C.14.3:

Agreed. The statement has been removed from Section 2.7.1 (e). The guidance now refers the reader to Section 2.7.5, which describes the State's recommendations for using tracer gas when collecting soil vapor samples.

Comment C.14.4 (paraphrased, 3 commenters, 3 comments):

Commenters expressed the following concerns regarding the use of sulfur hexafluoride (SF<sub>6</sub>) and "off-the-shelf" butane as tracer compounds:

- SF<sub>6</sub> is heavier than air and should not be used in situations where multiple samples will be collected from the same location,
- SF<sub>6</sub> can cost anywhere from \$100-\$400 to purchase depending on the cylinder size,
- SF<sub>6</sub> presents health and safety issues with transporting compressed gas into the field,
- recovery of SF<sub>6</sub> in SUMMA<sup>®</sup> canisters may be compromised since it is an extremely reactive compound which may react with stainless steel; therefore, this would require an additional separate analysis (either in the field or in the lab) for the SF<sub>6</sub> tracer, and
- "off-the-shelf" butane contains oil and should not be used.

Unless performing a real-time field analysis for the tracer compound, one commenter recommended the use of a more readily available and cost effective tracer, such as shaving cream (contains butane & isobutane), isopropyl alcohol, nail polish remover (contains acetone and/or ethyl acetate) or computer keyboard cleaners (contains Freons). All of these tracer compounds can easily be seen in a routine EPA Method TO-15 analysis, thus eliminating the need for additional field equipment/analyses.

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One commenter recommended that liquid tracers be allowed also, such as isopropyl alcohol, pentane, etc. The logistics for using them are much easier, plus, most importantly, you can apply them to all locations that might be the source of a leak, including at the top of the rod or at all of the fittings on the collection train. It is too difficult logistically to have gaseous tracers such as helium, SF<sub>6</sub>, etc. applied to all locations at once. Lastly, liquids are easier for soil gas collectors to handle and apply.

Response C.14.4:

As stated in Section 2.7.5 of the guidance, "Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer." Several compounds that are commonly used are also provided as examples. The guidance does not require that any one particular compound be used as a tracer. Accordingly, use of any of the compounds mentioned in the comment may be appropriate, provided it meets project-specific data quality objectives. Section 2.7.5 has been revised to reflect this point.

Comment C.14.5 (paraphrased, 2 commenters, 1 comment):

The tracer gases recommended by NYSDOH are not included in the standard EPA Method TO-15 analyte list. As a result, either portable equipment must be used or other laboratory analytical methods must be used to detect the tracer thereby doubling the effort.

Response C.14.5:

The tracer gases mentioned in Section 2.7.5 of the guidance are provided as examples only. The guidance does not require that any one particular compound be used as a tracer. The selection of a tracer should be made on a site-by-site basis, taking into account the concerns mentioned in the comment.

Comment C.14.6:

If care is not taken when injecting tracer gas into a container such as a pail, then the zone around the probe could become pressurized, forcing soil vapors away from the probe and tracer into the soil. To avoid this, a pressure relief hole should be considered for the container. If the tracer gas is heavier than air, the relief hole should be near the top of the container to allow air to escape as the tracer fills the container from the bottom up. If a lighter-than-air tracer gas is used, it may accumulate at the top of the container and not remain in contact with the probe/ground interface. Therefore, sampling from the probe must be conducted quickly after injection of the tracer while it is still reasonably mixed with the air inside the container, before stratification can occur.

Response C.14.6:

Depending on the nature of the tracer gas apparatus, the use of a pressure relief valve may be warranted. Typically, the goal is to maintain an atmosphere of 100% tracer gas at the contact point between the probe and the ground surface. This can be accomplished with only a slight positive pressure in the tracer gas container.

Comment C.14.7 (paraphrased, 2 commenters, 3 comments):

The discussion of tracer gas appears to neglect potential leakage through sample apparatus fittings.

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Response C.14.7:

We agree that leakage from fitting connections could bias the sampling results. Although the use of tracers at the fittings has merit, visual and manual inspection of the connections should typically suffice to ensure that they are functioning properly.

Comment C.14.8 (paraphrased, 3 commenters, 3 comments):

We recommend that the NYSDOH clarify the acceptance criteria for detection of tracer compounds (i.e., what percentage of tracer versus target compounds is considered acceptable and not indicative of a leak). Additionally, a 20% leak rate is very generous.

Response C.14.8:

Agreed. Based on public comment and experience in the field, the description of "high concentrations of tracer gas" in Section 2.7.5 of the guidance has been revised to 10%. This percentage refers to the concentration of tracer in the soil vapor sample. As discussed in Section 2.7.5, the probe seal should be enhanced to reduce the infiltration of outdoor air if high concentrations (> 10%) of tracer gas are observed in a sample.

Comment C.14.9:

The stated tracer gas criterion is 20%. However, in our experience, a bentonite or clay seal at the surface of soil vapor and sub-slab has always been capable of creating a seal allowing less than 2% of the tracer gas to be detected in the sample (helium was used). The Guidance should provide field data studies showing that the occurrence of greater than 20% leakage occurs and that this procedure is really warranted when appropriate procedures are followed.

Response C.14.9:

We agree that a bentonite clay seal is capable of functioning as described by the commenter – if it is installed properly and if it is allowed to hydrate adequately prior to sample collection. The guidance provides the flexibility to reduce the percentage of monitoring points at which a tracer gas is used based on the demonstrated performance of the sampling technique.

The State has sites at which 100% tracer gas has been observed. The guidance is intended to present general recommendations on steps and strategies that may be applied when evaluating soil vapor intrusion. Specific site data have not been incorporated into the guidance, as this is inconsistent with the general approach and intent of the guidance.

Comment C.14.10:

Please clarify what type of demonstration is required for [NYS]DOH to determine that the use of a tracer gas is no longer required.

Response C.14.10:

As discussed in Section 2.7.5 of the guidance, the use of tracer gas is recommended at all locations during the initial phase of the investigation. If the data collected during that phase indicate that the probe seals are functioning as intended, the continued use of a tracer gas on each probe may be re-evaluated. The frequency may be decreased after approval from the NYSDEC and NYSDOH is obtained, but we recommend that at

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least 10% of the subsequent samples be supported with tracer gas analyses. If the results from the subsequent samples indicate problems with inadequate seals, resampling may be necessary and the frequency of tracer gas use may need to be increased.

### **C.15 TOPIC: Quality assurance/quality control (QA/QC)**

#### Comment C.15.1:

We suggest that the reference to extreme care be removed and replaced with "an appropriate level of care" to limit potential biases. Unless the [NYS]DOH can precisely define "extreme care," it is a standard that cannot be understood.

#### Response C.15.1:

Acknowledged. Section 2.8 of the guidance has been revised as follows: "In general, appropriate QA/QC procedures should be followed during all aspects of sample collection and analysis to ensure that sampling error is minimized and high quality data are obtained."

#### Comment C.15.2 (paraphrased, 1 commenter, 3 comments):

You should not require certified-clean Summa<sup>®</sup> canisters. This should be left up to the judgment of the consultant based upon required detection levels. Recommending them for low target levels (< 10 mcg/m<sup>3</sup>) is more appropriate.

#### Response C.15.2:

We generally recommend that canisters be certified clean, as defined in the EPA TO-15 method ([www.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf](http://www.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf)), to achieve data quality objectives. As discussed in Section 2.9 of the guidance, samples should be analyzed by methods that can achieve minimum reporting limits to allow comparison of the results to background levels. Background concentrations for most compounds are often much less than 10 mcg/m<sup>3</sup>. If there is a reason to achieve different minimum reporting limits due to site-specific conditions, such as scoping out the extent of a source area where high concentrations are expected, then an alternate sampling and analysis approach may be appropriate.

#### Comment C.15.3 (paraphrased, 1 commenter, 1 comment):

The main quality assurance issue associated with the selective ion monitoring (SIM) technique is the proper cleaning and certification of all sample media (i.e., canisters and flow controllers). We strongly recommend that all media be certified as clean down to the lower SIM reporting limits prior to sampling. Selecting media based on past use, separating low level versus high level canisters, or individually certifying media may be desirable and/or necessary for programs looking to monitor very low concentrations of VOCs.

#### Response C.15.3:

Comment noted.

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Comment C.15.4 (paraphrased, 2 commenters, 2 comments):

A regulatory preference between "individually" certified or "batch" certified canisters should be established. We believe that standard laboratory protocols call for batch-certification of containers, unless individual container certification is requested.

Response C.15.4:

Certification on either a batch or individual basis is currently recommended.

Comment C.15.5:

Discuss the applicability of field duplicate and split samples. I do not believe that it is appropriate to collect duplicates/splits for soil or sub-slab vapor samples due to inherent heterogeneities in the subsurface. Two sequential samples from a single location or two concurrent but competing samples from different locations are bound to yield different results due to even the smallest differences in subsurface flow paths and changes in pressure with time. Duplicates/splits may be collected for indoor and outdoor ambient air samples as long as the collection rate is low enough to minimize pressure gradients created at the sample vessel's intake.

Response C.15.5:

Agreed. As stated in Section 2.8 of the guidance, "Duplicate and/or split samples should be collected in accordance with the sampling and analytical methods being implemented." Field duplicate and split samples of soil vapor and sub-slab vapor samples may not be appropriate for the reasons stated in the comment, and are recommended if required by the sampling and analytical method being implemented.

Comment C.15.6:

The document states in Sections 2.8 and 3.1 that a [data usability summary report] DUSR must be prepared for soil gas samples. There should be guidance on how to perform trip blanks, field blanks, matrix spikes and matrix spikes duplicates on summa canister samples. If these are not required, a soil gas specific DUSR protocol should be prepared.

Response C.15.6:

As stated in Section 2.8 of the guidance, "For certain regulatory programs, a Data Usability Summary Report (DUSR) or equivalent report may be required to determine whether or not the data, as presented, meets the site or project specific criteria for data quality and data use. This requirement may dictate the level of QC and the category of data deliverable to request from the laboratory. Guidance on preparing these reports is available by contacting the NYSDEC's Division of Environmental Remediation." Questions on whether a DUSR is needed at a particular site should be directed to the NYSDEC's Division of Environmental Remediation.

Comment C.15.7 (paraphrased, 1 commenter, 1 comment):

We recommend that NYSDOH allow National Environmental Laboratory Accreditation Conference (NELAC) certified laboratories in addition to NYSDOH certified laboratories analyze environmental samples collected within New York State for the purposes of vapor intrusion evaluations.

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Response C.15.7:

NELAC is a voluntary association of State and Federal agencies formed to adopt and promote mutually acceptable performance standards for the inspection and operation of environmental laboratories. The National Environmental Laboratory Accreditation Program (NELAP) is the program that implements the NELAC standards. States and Federal agencies serve as Accrediting Authorities with coordination facilitated by the EPA to assure uniformity. The ELAP standards conform to those standards adopted by NELAC, and ELAP is an approved accrediting authority under NELAP. Therefore, as required by NELAP and as authorized by the ELAP regulations, ELAP will recognize the accreditation of laboratories by other NELAP accrediting authorities as part of the ELAP accreditation process. Only laboratories approved by ELAP for the analytes of interest using ELAP-approved methods in the appropriate matrix categories are acceptable for use.

### **C.16 TOPIC: Analytical methods**

Comment C.16.1 (paraphrased, 2 commenters, 2 comments):

We think you are doing yourself a disservice here. There are a number of analytical methods that are appropriate for soil gas samples besides the TO-15 method, such as 8260, 8021, 8015. These methods can yield results comparable to TO-15 and can meet QA/QC criteria and low detection limits.

Response C.16.1:

In Section 2.9 of the guidance, EPA Method TO-15 and NYSDOH Method 311-9 are provided as two examples of commonly used analytical methods. The guidance does not require that any one particular method be used. Accordingly, use of any of the methods mentioned in the comment may be appropriate, provided it meets project-specific data quality objectives.

Comment C.16.2:

It is agreed that a 1 mcg/m<sup>3</sup> level is a suitable detection limit for decision-making purposes. Lower limits are unnecessary unless some action will be taken at the lower level.

Response C.16.2:

The guidance does not indicate that a minimum reporting limit of 1 microgram per cubic meter (1 mcg/m<sup>3</sup>) is suitable for decision-making purposes for all volatile chemicals or all types of samples (e.g., indoor air, sub-slab vapor, soil vapor, etc.). While a minimum reporting limit of 1 mcg/m<sup>3</sup> is typically sufficient for most analytes, a lower reporting limit may be necessary to meet data quality objectives (e.g., to make comparisons to background levels or to use the matrices as a decision-making tool). These determinations are made on a site-specific basis. Section 2.9 of the guidance has been revised to emphasize this point.

Comment C.16.3 (paraphrased, 1 commenter, 1 comment):

We recommend that NYSDOH address the issue of using SIM analysis in conjunction with the standard EPA TO-15 analysis in order to obtain lower reporting limits. NYSDOH states that the analytical laboratory should be able to obtain reporting limits in the range of "background;" these background levels are often slightly below a typical laboratory's normal reporting limit (reporting limits are equal to the lowest calibration standard, typically

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0.50 ppbv for the TO-15 analysis). The SIM technique is used to obtain lower reporting limits.

Response C.16.3:

Acknowledged. A minimum reporting limit of 1 microgram per cubic meter or less is typically sufficient for most analytes. In some cases, a lower reporting limit may be necessary to meet data quality objectives. EPA Method TO-15 with SIM is often used to achieve lower limits (e.g., 0.25 micrograms per cubic meter TCE). Section 2.9 of the guidance has been revised to include EPA Method TO-15 with SIM in the list of examples of commonly used methods to reflect this point. However, the method is not the only method available or recommended for this purpose.

Comment C.16.4:

The minimum reporting limits of 1 microgram per cubic meter or less should be replaced with language that allows for establishment of reporting limits for individual compounds in consideration of benchmark values such as statistical measures of typical background, applicable air guidelines, and soil vapor to indoor air attenuation factors. The minimum reporting limit of 1 microgram per cubic meter may be insufficient for certain compounds while unnecessarily restrictive for others.

Response C.16.4:

While a minimum reporting limit of 1 microgram per cubic meter (1 mcg/m<sup>3</sup>) is typically sufficient for most analytes, a lower or higher reporting limit may be appropriate for meeting data quality objectives. These determinations are made on chemical-specific and site-specific bases. Section 2.9 of the guidance has been revised to emphasize this point.

Comment C.16.5:

I suggest including a table of minimum required reporting limits for common analytes. Please differentiate or specify method/instrument detection limits and/or practical quantitation/reporting limits.

Response C.16.5:

When selecting appropriate minimum reporting limits, site-specific data quality objectives should be considered. Comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels and the levels presented in the matrices. Typically, a minimum reporting limit of 1 microgram per cubic meter or less is sufficient for most analytes. Section 2.9 of the guidance has been revised to reflect these points. The discussions of background concentrations for common analytes provided in Sections 3.2.4 and Appendix C, and the decision matrices provided in Section 3.4.2, can be used to guide the selection of appropriate minimum reporting limits. An additional table has not been added to the guidance.

Comment C.16.6 (paraphrased, 2 commenters, 1 comment):

The guidance indicates that samples should be analyzed by methods that can obtain reporting limits of 1 mcg/m<sup>3</sup> or less. It is unclear how these results will be used in

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conjunction with the comparison to background values. As shown in Section 3.2.4, the majority of background levels are less than 1 mcg/m<sup>3</sup>. As a result, it may be possible to get detection limits of 1 mcg/m<sup>3</sup>, but still be above the background concentration. The guidance provides no information on how these results will be interpreted.

Response C.16.6:

When selecting appropriate minimum reporting limits, site-specific data quality objectives should be considered. As discussed in Section 3 of the guidance, comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels (given the background database(s) being used in the data evaluation process) and the levels presented in the matrices. The affect of higher minimum reporting limits (as suggested in the comment) on the data evaluation process will depend on several factors, such as how much higher the limit is above background levels and whether the volatile chemical is a chemical of concern. In some cases, conclusive interpretation of the data has not been feasible and resampling has been necessary to meet the sampling objectives.

Comment C.16.7 (2 commenters, 1 comment):

The guidance provides conflicting recommendations for indoor air analytical detection limits. Section 2.9 discusses the analytical detection limits needed for vapor samples. As presented in this section, samples should be analyzed by methods that can achieve a minimum reporting limit of 1 mcg/m<sup>3</sup>. In contrast, the notes to Air Matrix 1 and Air Matrix 2 indicate that detection limits of 0.25 mcg/m<sup>3</sup> and 3 mcg/m<sup>3</sup> are needed, respectively. Although it appears that the Air Matrix notes are specific to TCE, tetrachloroethene (PCE), and 1,1,1-trichloroethane (1,1,1-TCA), the NYSDOH states that it intends to apply these matrices to other constituents. If and when this occurs, the current recommendations are likely to cause confusion among the regulated community.

Response C.16.7:

Acknowledged. When selecting appropriate minimum reporting limits, site-specific data quality objectives should be considered. Comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels and the levels presented in the matrices. Typically, a minimum reporting limit of 1 microgram per cubic meter or less is sufficient for most analytes. Section 2.9 of the guidance has been revised to reflect these points.

Comment C.16.8:

Is the TO-15 analyte list equivalent to a "wide range of volatiles?" If so, the guidance should state this understanding.

Response C.16.8:

Agreed. Section 2.9 of the guidance has been revised accordingly.

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Comment C.16.9 (paraphrased, 5 commenters, 7 comments):

The NYSDOH should encourage the analysis of vapor intrusion samples for targeted analytes rather than for a wide range of chemicals since a wide range is likely to lead to the identification of many chemicals not related to the site. For example, the analyte list for vapor intrusion sampling should be limited to those found in previously collected subsurface vapor samples or to those that can be linked to subsurface source areas (soil, groundwater, etc.).

Response C.16.9:

As discussed in Section 2.9.1 and Section 2.9.2 of the guidance, we agree a targeted analyte list may be appropriate based on initial subsurface vapor sampling results. The approach discussed in these sections of the guidance is consistent with the phased, iterative approach taken when investigating other environmental media. When developing a targeted analyte list, the results of previous environmental investigations (e.g., subsurface vapors, groundwater, soil, etc.), site-specific sampling objectives, and the conceptual site model [Section 1.5] should be considered. Sections 2.9.1 and 2.9.2 have been revised for clarification.

Comment C.16.10 (paraphrased, 4 commenters, 3 comments):

Commenters expressed the following concerns regarding the examples of indicator compounds provided in Section 2.9.1 of the guidance:

- supporting information on analytical methods and background concentrations are needed in the guidance to supplement the examples, especially given that many of the indicator chemicals are not standard analytes;
- an explanation of how sampling these indicator compounds would be of benefit and how these lists were developed is needed;
- clarification that many of the constituents will not be applicable to all sites is needed;
- clarification on how the indicator compounds are to be used in evaluating human exposures given that many of the compounds listed do not have toxicity criteria; and
- justification should be provided for the recommendations given in the guidance (e.g., indicator compounds should only be included on the analyte list if specific data are available to suggest their presence and if accurate and precise analytical procedures are available).

Response C.16.10:

The first step in a soil vapor intrusion investigation is determining whether or not soil vapor intrusion is, in fact, occurring. Indicator compounds can be a useful tool during this process to help distinguish between site-related and non-site-related volatile chemicals. For petroleum products, laboratories may not have standards for every constituent compound, but the information obtained from the analytical chromatograms and tentatively identified compounds may be used to distinguish between sources of contamination. In some cases, indicator compounds have also been used to tailor site-specific analyte lists. Indicator compounds are provided in Section 2.9.1 of the guidance as examples (not requirements) based on our experience in collecting data at a variety of sites (e.g., gasoline spill, manufactured gas plant, etc.).

Once data is obtained from the investigation, they are evaluated to determine whether actions are needed to address current or potential exposures related to soil vapor intrusion. Whether or not a single compound of concern or multiple compounds of concern will drive these decisions at petroleum sites is uncertain given the data

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currently available from the investigation of these sites to date. If one compound serves as the driver, the NYSDOH will determine whether to assign the chemical to one of the existing matrices or to develop a new matrix. If multiple compounds serve as the driver, the NYSDOH will determine whether a modified matrix or an alternate risk management tool should be developed. Absence of toxicity criteria for some chemicals is not expected to prevent the data evaluation process, as it is only one of many factors considered. [See also Comment D.12.4 (application of the matrices to other volatile chemicals).]

Comment C.16.11:

Please provide specific methods for evaluation vapor intrusion associated with petroleum compounds. It is unclear whether an evaluation of VOCs and SVOCs is sufficient, given the example compounds used as indicator compounds.

Response C.16.11:

Petroleum products are often a mixture of many individual compounds. Specific aromatic and aliphatic compounds can be good indicators for individual petroleum products (e.g., gasoline, diesel, fuel oil, and kerosene). The primary aromatic compounds benzene, toluene, ethylbenzene, xylenes (BTEX), and trimethylbenzenes should be included in all analyses. Analytical methods (e.g., EPA TO-15) using a mass spectrometer detector allow for the identification and quantitation of aromatic and aliphatic hydrocarbons and for oxygenated compounds such as ethanol and methyl tertiary butyl ether (MTBE). Analyzing for specific indicator compounds can aid in differentiating potential petroleum sources.

Indicator compounds for gasoline may include BTEX, trimethylbenzene isomers, the appropriate oxygenate additives (MTBE, ethanol, etc.), and the individual C-4 to C-8 aliphatics (e.g., hexane, cyclohexane, dimethylpentane, and 2,2,4-trimethylpentane [iso-octane]).

Indicator compounds for middle distillate fuels (#2 fuel oil, diesel, and kerosene) may include n-nonane, n-decane, n-undecane, n-dodecane, ethylbenzene, xylenes, trimethylbenzene isomers, tetramethylbenzene isomers, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.

Although tetramethylbenzene, naphthalene and methyl-naphthalene are listed as indicators for middle distillate fuels, we recognize that they may not be available as standard analytes on VOC analyses, but may be reported as tentatively identified compounds in some cases. We are not requiring additional semi-volatile analyses to obtain data for these compounds in these instances unless these SVOCs are the primary compounds of concern at a site.

Comment C.16.12 (paraphrased, 1 commenter, 1 comment):

Naturally occurring soil vapors are not properly the subject of investigation and/or remediation. Section 2.9.1 states that propane, propene, butane, iso-butane etc., are indicator compounds which indicate that natural gas has been used at sites. The presence of natural gas on a site is just that, natural. We recommend that the guidance be revised to state that PRPs cannot be required to conduct investigation or remediation due to naturally occurring compounds.

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Response C.16.12:

In Section 2.9.1.d of the guidance, the term "natural gas" is the generic term that describes commercially supplied pipeline gas used for heating, etc. Although pipeline gas consists primarily of methane, it can include a number of other aromatic and aliphatic hydrocarbons. Testing for indicator compounds of pipeline gas helps to identify potential leaks and sources of petroleum compounds that might indicate a source other than site-related contaminants. As stated in the Preface to the guidance, the guidance discusses soil vapor intrusion in terms of environmental contamination only. If a substance is naturally occurring at a site (e.g., gas produced from decaying vegetation or gases from gas and petroleum producing areas of the state), the PRP is not required to investigate or remediate the naturally occurring compounds.

### **C.17 TOPIC: Field laboratories and mobile gas chromatographs**

Comment C.17.1 (paraphrased, 2 commenters, 2 comments):

Section 2.10 unnecessarily downplays the usefulness of non-certified mobile laboratories (does NYSDOH ELAP certify mobile labs?). On-site data can be beneficial when used as part of a tiered sampling approach that also includes samples collected for analysis by an ELAP-certified laboratory.

Response C.17.1:

As discussed in Section 2.10 of the guidance, on-site laboratories or gas chromatographs can provide beneficial information when used appropriately. On-site data are very useful for screening purposes. However, in accordance with New York State's Public Health Law, samples collected for the purpose of evaluating exposures must be analyzed by an ELAP-certified laboratory. Therefore, field screening must be verified with ELAP-certified data for decision-making purposes.

As also discussed in Section 2.10, the NYSDOH ELAP does certify mobile laboratories. Mobile laboratory certification is a separate process from stationary laboratory certification and certification is not transferable from one to the other. Questions regarding a mobile laboratory's certification should be directed to the laboratory itself.

Comment C.17.2:

The last paragraph of Section 2.6.1 talks about step-outs. This is much more feasible and effective if real-time analysis is available. So, you should modify your section on mobile laboratories to encourage their use, not discourage as presently written.

Response C.17.2:

The use of mobile laboratories is not discouraged. As discussed in Section 2.10 of the guidance, the use of a mobile laboratory to screen samples and to help focus the investigation may be appropriate. These determinations should be made on a site-specific basis. However, in accordance with New York State's Public Health Law, any remedial decisions must be based on data from an ELAP-approved laboratory.

### **C.18 TOPIC: Surveys and pre-sampling building preparation**

Comment C.18.1:

The section on identifying preferential pathways (page 31) is strong, but it could be strengthened more by expanding the discussion of real-time field sampling that may be

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used to home in on such pathways. Real-time and near-real-time sampling devices, such as EPA's Trace Atmospheric Gas Analyzer (TAGA), have proven effective for this purpose. The TAGA—and presumably similar equipment—can be used to identify preferential pathways and confounding sources such as household products. It can also correlate concentrations with variable meteorological conditions such as wind, temperature, and atmospheric pressure.

Response C.18.1:

Although the results obtained from field instrumentation should not be used as the sole basis for determining appropriate actions to address exposures related to soil vapor intrusion, we agree that field instrumentation can be helpful in identifying preferential pathways for soil vapor intrusion. The EPA's TAGA is a fairly sophisticated example of such a device that can assist in a more detailed investigation of preferential pathways. Simpler handheld instruments (e.g., PIDs, mercury vapor analyzers, etc.) and even the detection of odors during a building inventory can also help identify such pathways. A recommendation that field instruments be used to help identify preferential pathways has been added to the discussion on the pre-sampling building inspection in Section 2.11.1 of the guidance.

Comment C.18.2:

The Guidance states that the pre-sampling inspection should be performed prior to each sampling event to identify and minimize conditions that may interfere with the proposed testing. We suggest that the wording be modified to read "limit to the extent practicable" given dependence on cooperation of property owners and tenants. In our experience, few tenants and property owners have fully cooperated with removal of indoor source materials.

Response C.18.2:

Acknowledged. Section 2.11.1 of the guidance has been revised as follows: "Potential interference from products or activities releasing volatile chemicals should be controlled to the extent practicable."

Comment C.18.3 (paraphrased, 2 commenters, 2 comments):

Tight sealing of containers is not guaranteed to eliminate vapors from these sources. In some cases, even unused product containers have been shown to be emitting VOC vapors and cannot be sealed further.

Response C.18.3:

Acknowledged. However, tight sealing may cut down on some of the volatilization and help to improve overall air quality and minimize the potential for interference with the sampling results.

Comment C.18.4:

We agree with [NYS]DOH that the inability to eliminate potential interferences is a justification for not testing indoor air.

Response C.18.4:

Comment noted.

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Comment C.18.5:

Ventilation of a building for only 24 hours after removal of an indoor source is inadequate to guarantee complete dissipation of residual contaminants. Research on dissipation of PCE after dry cleaning is brought into a home suggests that several weeks may be necessary. This does not mean that testing should not be conducted if dry cleaning has been brought into a house over the past several weeks; it should simply be recognized that any number of sources may contribute to background levels of volatile chemicals in a building, some of which may no longer be present or identifiable. As a result, the guidance must allow a weight of evidence approach to background determinations, and not just rely on the overly conservative values in the table on page 31.

Response C.18.5:

Acknowledged. Section 2.11.1 of the guidance has been revised to emphasize that ventilation may be appropriate to minimize, not eliminate, residual contamination in the air. The intent of the discussion in Section 2.11 is to recommend ways to identify alternate sources of volatile chemicals in the indoor air and, where appropriate, to minimize potential sampling interferences. These steps are recommended to facilitate the data evaluation process. As discussed in Section 3, we agree that an understanding of background sources is a crucial part of the data evaluation process and recommend that a multiple-lines-of-evidence approach be used to identify sources of volatile chemicals to the indoor air and to select appropriate steps to address exposures.

Comment C.18.6:

Section 2.11.1, List of activities to avoid prior to sampling — Consider adding that dry cleaning should not be brought home for 24 to 48 hours prior to sampling.

Response C.18.6:

Agreed. The document has been revised accordingly.

Comment C.18.7 (paraphrased, 2 commenters, 2 comments):

The guidance recommends that efforts be made to avoid opening windows, fireplace damper, and vents for 24 hours prior to indoor sampling. Doing so may bias sampling results. When characterizing typical long-term exposure conditions, sampling should be conducted under "normal" building operating conditions rather than artificial conditions that may serve to either over or under-estimate typical exposure concentrations.

Response C.18.7:

In general, most people do not leave windows and/or vents open during the heating season, which in most cases, is when sampling occurs. We make this recommendation to facilitate conditions under which vapor intrusion is more likely to occur and to avoid collecting samples that are biased low.

Comment C.18.8:

If sources of VOCs are typically stored inside a building, an artificial sampling environment should not be created by removing these sources. Removal of such sources for a short time period (e.g., 24 hours) before sampling is not adequate, but gives the false impression that no indoor sources could remain. Furthermore, the removal of indoor sources of VOCs is often not feasible, especially in residential or third party settings. [NYS]DOH all but

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acknowledges this by stating that no post-abatement samples should be collected for a period of at least 30 days.

Response C.18.8:

Collection of samples under "normal operating conditions" can be useful, but in most cases the goal of these investigations is to determine whether soil vapor intrusion is a concern. Therefore, the intent of the discussion in Section 2.11 is to recommend ways to identify alternate sources of volatile chemicals in the indoor air and, where appropriate, to minimize potential sampling interferences. These steps are recommended to facilitate the data evaluation process.

We acknowledge that removing indoor sources of volatile chemicals is not always feasible. Section 2.11.1 of the guidance has been revised as follows: "Potential interference from products or activities releasing volatile chemicals should be controlled to the extent practicable."

Comment C.18.9 (paraphrased, 3 commenters, 3 comments):

The protocol in section 2.11.1 listing activities that should be avoided for 24 hours prior to sampling is impractical, especially in multiple dwellings. Furthermore, these precautions may not be necessary in all cases, depending on the specific compounds of concern. For example, if chlorinated VOCs represent the target compounds, then smoking by building residents or using a wood stove would not affect the outcome of the analyses.

Response C.18.9:

Acknowledged. We recognize that avoiding the activities referenced in the comment is not always possible. Toward this end, Section 2.11.1 has been revised to state "To avoid potential interferences and dilution effects, occupants should make a reasonable effort to avoid the following for 24 hours prior to sampling..." The intent of the discussion is to provide general recommendations. However, as discussed in the introduction to Section 2, site-specific or building-specific conditions may warrant modifying the recommendations. The comment contains examples of such conditions (e.g., multiple tenant spaces, site-specific analyte lists, tenant activities, etc.) that should be considered when selecting an appropriate approach to minimize potential interfering sources of volatile chemicals to the indoor air and to meet the sampling objectives.

Comment C.18.10 (paraphrased, 1 commenter, 1 comment):

The form presented to perform a chemical inventory of a building (Appendix B) is based on a residential setting where it is possible to identify the number and types of chemicals being used. It is not practical to identify each and every chemical being used, including size and numbers, in an industrial facility that may employ 500 to 2,300 employees. To perform such an inventory would require several days. Also, to distinguish between manufacturing background levels and environmental levels during the inventory, as well as during the sampling event, manufacturing activities, such as painting, cleaning, operating powered industrial trucks, etc., would have to be terminated. As such, the vapor intrusion pathway should be focused on the known chemicals of concern.

Response C.18.10:

Acknowledged. We recommend that a product inventory be completed to "identify potential air sampling interference by characterizing the occurrence and use of chemicals and products throughout the building, keeping in mind the goal of the

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investigation and site-specific contaminants of concern." However, as discussed in the introduction to Section 2 of the guidance, site-specific or building-specific conditions may warrant modifying the recommendation. The comment contains an example of building-specific conditions and operations that should be considered when selecting an appropriate approach to identify and minimize potential interfering sources of volatile chemicals to the indoor air and to meet the sampling objectives.

Comment C.18.11:

Sampling during the winter months can be performed and should be accompanied by a basic air flow diagram of the current heating system that indicates the locations of air supply for heating combustion and exhaust (not including an HVAC engineering diagram or flow and pressure measurements). Sampling during non-winter months can also be performed, and the same information needs to be provided to include air conditioning systems for the space under consideration. In addition, any heating equipment (water boilers) that remain on all year should be included again with the same general air diagram.

Response C.18.11:

As discussed in Section 2.7.3 and Section 2.11.1 of the guidance, we agree that an air flow diagram or any other information about a building's HVAC system would be a valuable addition to a vapor intrusion investigation. This information is particularly useful for larger industrial buildings.

**C.19 TOPIC: Role of modeling**

Comment C.19.1:

[NYS]DOH should explain its current assessment of the utility of the Johnson & Ettinger model to predict indoor soil gas vapor concentration from vapor levels in soil and to what extent the Johnson & Ettinger model failed to predict Endicott.

Response C.19.1:

Modeling may serve as a useful tool in the soil vapor evaluation process. However, conclusions drawn from modeling should be verified with actual field data. Based on our experience, the presence of relatively small stratigraphic and geographic heterogeneities in site geology can have a marked impact on the observed concentrations in shallow and sub-slab soil vapor. We have sub-slab vapor data from numerous locales in which the concentration of sub-slab soil vapor differs by more than two orders of magnitude from one structure to the next. The Johnson and Ettinger modeling that was performed for the Endicott investigations supported the decision to conduct a vapor intrusion investigation, but was not used to identify the areal extent of structures at which mitigation systems were needed. Overall, the State does not view the Johnson and Ettinger model as a substitute decision-making tool.

Comment C.19.2 (paraphrased, 1 commenter, 1 comment):

The NYSDOH guidance should allow modeling to be used in conjunction with soil vapor sampling to justify taking "no further action" without collection of sub-slab or indoor air samples. "No further action" should be acceptable when actual soil vapor concentrations are below those predicted by the model and are below EPA's screening values.

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Response C.19.2:

The use of any model, in conjunction with soil vapor sampling, to justify taking "no further action" at sites without the collection of sub-slab vapor or indoor air samples is not recommended at this time. Rather, sub-slab vapor and/or indoor air data are the most reliable and appropriate samples to collect to evaluate the potential for human exposures related to soil vapor intrusion. Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site conditions and do not necessarily follow model predictions or correlate to soil vapor results. Therefore, the State does not believe that decisions based solely on modeling and/or soil vapor results are sufficiently protective of human health. The guidance has not been revised as suggested in the comment.

Comment C.19.3 (paraphrased, 6 commenters, 5 comments):

The guidance should allow modeling alone to justify taking "no further action" when predicted indoor air impacts from vapor intrusion are well below background levels (or levels of health concern). This is particularly relevant to undeveloped sites, where sub-slab and indoor air data cannot be collected.

Response C.19.3:

At this time, our experience with vapor intrusion does not allow us to be confident that decisions based on modeling alone are sufficiently predictive of current or potential sub-slab vapor and indoor air impacts. The guidance continues to state that actual field data should be collected and used for decision-making when there is a potential for human exposures. In the case of undeveloped sites, we recommend that an environmental easement be placed on affected parcels to ensure that evaluation of the potential for vapor intrusion will occur as properties are developed.

Comment C.19.4 (paraphrased, 8 commenters, 7 comments):

The guidance should allow for the use of the Johnson and Ettinger model, as incorporated into the EPA's vapor intrusion guidance, at any site, without prior approval by the state. The use of modeling as a screening step can reduce the amount of sampling required.

Response C.19.4:

The use of any model, including the Johnson and Ettinger model, to "screen out" sites without the collection of actual field data is not recommended at this time. Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site conditions and do not necessarily follow model predictions. Therefore, we do not believe that decisions based on modeling alone are sufficiently protective of human health. The guidance has not been revised as suggested in the comment.

There are situations in which modeling may be useful as a tool in a vapor intrusion investigation; some of these are discussed in Section 2.12 of the guidance. We strongly recommend that the use of any model be discussed with the Agencies beforehand to assure that all parties have the same expectations as to how the model's results will be used.

Comment C.19.5 (paraphrased, 1 commenter, 1 comment):

The guidance says that model results must be verified by "actual field data," but it then goes on to state that either indoor air or sub-slab sampling is required. This seems to

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indicate that sub-slab vapor data is field data that are sufficient to support a decision, even though sub-slab vapor is not a medium to which people are exposed. In many cases, the best way to estimate the relationship between sub-slab vapor and indoor air is through modeling. The guidance should clarify that modeling may be appropriate under certain conditions to estimate indoor air impacts from subsurface media.

Response C.19.5:

The example given in Section 2.12 of the guidance (formerly Section 2.13 in the public comment draft) has been revised to indicate that indoor air, outdoor air and sub-slab vapor data should be collected. However, we acknowledge that sometimes the appropriate sampling is not possible or practical (due to access issues, interference from indoor sources, or other issues). In these situations, site-specific decisions are made. In some cases, modeling may be a part of the approach, but this decision would be made on a case-by-case basis.

Comment C.19.6 (paraphrased, 1 commenter, 1 comment):

I support the policy of requiring model predictions to be verified with data. However, the guidance suggests that sub-slab vapor data may be sufficient verification. People located near or above sources of volatile contamination are unlikely to be satisfied with sub-slab vapor data in the absence of indoor air data, even if the sub-slab vapor data indicate no further action is needed.

Response C.19.6:

Acknowledged. The example given in Section 2.12 of the guidance (formerly Section 2.13 in the public comment draft) has been revised to indicate that indoor air, outdoor air and sub-slab vapor data should be collected.

Comment C.19.7 (paraphrased, 2 commenters, 2 comments):

More clarification is needed as to why modeling would be used to estimate past exposures. This seems likely to be controversial and unreliable.

Response C.19.7:

Acknowledged. The discussion of the use of modeling to estimate past exposures has been removed from the guidance.

Comment C.19.8 (paraphrased, 1 commenter, 1 comment):

To improve the applicability of modeling results further, the guidance should discuss appropriate tests to characterize stratigraphy (porosity, moisture content, and other parameters).

Response C.19.8:

Specific recommendations regarding the use of models and the collection of field data to use as input parameters will vary depending on the objective of the modeling and should be made on a site-by-site basis. This information is beyond the scope of this guidance document.

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Comment C.19.9 (paraphrased, 1 commenter, 1 comment):

The use of site-specific soil condition data, such as soil moisture content, may not be appropriate, as discussed in the EPA's modeling guidance. The EPA has established low moisture contents that should be used to evaluate long-term exposures, since one-time soil moisture sampling is not representative of long term site conditions and may underestimate indoor air concentrations.

Response C.19.9:

Acknowledged. Section 2.12 of the guidance (formerly Section 2.13 in the public comment draft) has been revised as follows: "If a model is used, it should incorporate appropriate site-specific parameters...."

Comment C.19.10 (paraphrased, 3 commenters, 4 comments):

The guidance should include the option of modeling the potential for vapor intrusion from environmental media, such as groundwater VOC concentrations. An allowance should also be made where there is an indoor (background) source of the subsurface volatile contaminant(s) of concern. Additionally, groundwater samples should be included in the discussion of types of samples needed since the Johnson and Ettinger model can predict contaminant concentrations in indoor air based on concentrations in groundwater.

Response C.19.10:

The use of any model to evaluate the potential for vapor intrusion at sites without the collection of actual field data is not recommended at this time. Rather, sub-slab vapor and/or indoor air data are the most reliable and appropriate samples to collect to evaluate the potential for human exposures related to soil vapor intrusion. Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site conditions and do not necessarily follow model predictions. Therefore, we do not believe that decisions based on modeling alone are sufficiently protective of human health. The guidance has not been revised as suggested in the comment.

As described in Section 2.12 of the guidance document, modeling may be a useful tool in the evaluation process. However, specific recommendations regarding the collection of field data (e.g., groundwater, porosity, etc.) to use as input parameters to a model will vary depending on the objective of the modeling and should be made on a site-by-site basis. This information is beyond the scope of this guidance document.

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## **PART D**

### **GUIDANCE SECTION 3: DATA EVALUATION**

#### **D.1 TOPIC: General comments on Section 3 of the guidance**

##### Comment D.1.1:

This section clearly illustrates that the evaluation of the vapor intrusion pathway is complex and often requires data from multiple sources.

##### Response D.1.1:

Comment noted.

##### Comment D.1.2 (paraphrased, 1 commenter, 1 comment):

To address future concerns for potential exposures associated with soil vapor intrusion, we recommend that the NYSDOH work with the building construction industry to recommend sub-slab depressurization systems and to develop construction specifications for new construction in residential communities in or near proximity to locations that have area-wide contamination concerns.

##### Response D.1.2:

The State will continue to work with involved parties to recommend an appropriate course of action for addressing current and potential soil vapor intrusion exposures on a site-by-site basis. There has not been an attempt to apply the recommendations of the guidance on an industry-wide basis as suggested by the comment. (Note: Local codes of some communities may already include requirements for the installation of sub-slab depressurization systems to address concerns about radon.)

#### **D.2 TOPIC: Factors considered when evaluating data**

##### Comment D.2.1 (paraphrased, 1 commenter, 2 comments):

We recommend that the list of factors considered by the NYSDOH in making testing and mitigation decisions, in addition to contaminant concentrations (pages 28-35), be expanded to include the following:

- [a] overall protectiveness of public health and the environment, including the potential for impacts on children and other sensitive populations;
- [b] the potential for multiple pathways of exposure, exposure to multiple sources of contamination, and/or exposure to multiple contaminants with similar and/or additive toxic effects;
- [c] the degree of uncertainty associated with measuring sub-slab vapor and indoor air contamination at a site or in individual homes or other structures potentially impacted by a site;
- [d] the degree of uncertainty associated with fully characterizing groundwater and soil contamination, the movement of such contamination through groundwater, soil or bedrock, and predicting the impact of such contamination on indoor air;
- [e] short-term and long-term effectiveness;
- [f] implementability;
- [g] cost effectiveness, including the relative cost of mitigation as compared to monitoring;

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[h] the potential for inequitable outcomes; and

[i] community acceptance.

The entire set of factors should be used in a fashion similar to the remedy selection criteria used under the National Contingency Plan, the State Superfund Program, and the new Brownfield Cleanup Program to assist in making agency decision-making more transparent and readily understandable to the public.

Response D.2.1:

Section 3 of the guidance provides a list of factors considered when interpreting data and deciding on the next steps of an investigation. The data evaluation process recommended by the guidance is similar to the process used in evaluating data for other media (soil, groundwater, etc.) in the State Superfund Program and other environmental programs. The factors in the comment are more like those used in evaluating potential remedies in the various cleanup programs. When mitigation of soil vapor intrusion is included in a remedy for a site in one of these programs, it will be evaluated relative to criteria like those above, just as the other components of the remedy would be.

The State strongly believes that community outreach is an essential component to the evaluation of soil vapor intrusion. As discussed in Section 5 of the guidance, there are many types of outreach techniques that may be useful in keeping the community informed and involved throughout the process. Such outreach is often effective at addressing the concerns expressed in the comment about maintaining a level of transparency.

In response to the specific factors mentioned in the comment:

- [a] The protection of public health serves as the foundation of all actions taken to address exposures related to soil vapor intrusion at sites. The potential for impacts on children and other sensitive population groups was considered when deriving the Soil Vapor/Indoor Air Decision Matrices (provided in Section 3.4 of the guidance), which are decision-making tools used at soil vapor intrusion sites. Because the matrices are risk management tools and consider a number of factors, the NYSDOH intends to assign chemicals to one of them, where appropriate. The matrices will be modified or additional matrices will be developed when a chemical's toxicological properties, background concentrations, or analytical capabilities suggest major revisions are needed. Health risks, including the potential for impacts on children and other sensitive populations are considered when we evaluate a chemical's toxicological properties.
- [b] The NYSDOH agrees that all potential exposure pathways to environmental contamination should be considered. The NYSDOH identifies and recommends ways to address these pathways as sites are investigated under the various regulatory programs. The guidance, however, is intended to provide recommendations on how to investigate and address a specific exposure pathway (soil vapor intrusion) where the exposure is primarily via inhalation. The potential for similar and/or additive toxic effects will be addressed if exposure to multiple contaminants via soil vapor intrusion becomes an issue at a site.
- [c and d] Although the evaluation of the vapor intrusion pathway is an emerging science, the guidance provides the necessary framework for dealing with the uncertainties described in the comment and gives recommendations on how to obtain representative and reliable data upon which to base decisions.

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[e – i] Section 3 of the guidance presents an overview of the many factors that are considered when evaluating the data and a summary of actions recommended from a public health perspective. Some of the factors presented in the comment do not serve as the bases for these actions (e.g., relative costs, community acceptance, potential for inequitable outcomes, implementability, etc.) and have therefore not been added to the guidance as recommended. Furthermore, the NYSDOH believes the actions are both protective of public health and appropriate to addressing current and potential exposures related to soil vapor intrusion, both in the short-term and long-term.

Comment D.2.2 (paraphrased, 1 commenter, 1 comment):

The NYSDOH should provide a more substantive discussion regarding the role each factor plays in deciding whether to test or mitigate at structures (i.e., an idea of how much weight each factor is given).

Response D.2.2:

Section 3 of the guidance is intended to present an overview of many of the factors considered when evaluating the information obtained during the investigation and to provide general recommendations on appropriate next steps. As discussed throughout Section 3, appropriate actions (e.g., additional sampling, monitoring, mitigation, etc.) are determined on site-specific and building-specific bases. A prescribed universal "factor weighing system" has not been incorporated into the guidance, as this is inconsistent with the general approach and intent of the guidance.

Comment D.2.3 (2 commenters, 2 comments):

Human health risks should be considered when evaluating all vapor intrusion sampling results. The guidance only includes the consideration of human health risks in the evaluation of sub-slab vapor results (Section 3.3.2). The NYSDOH provides no explanation why human health risks are not also considered as part of the evaluation of soil vapor and indoor air concentrations. Clearly, human health risk should be included in the evaluation of all vapor intrusion results. Such an approach allows the data to be assessed objectively considering exposure concentrations, potential intake, and chemical-specific toxicity. Moreover, incorporation of human health risks into the evaluation process is important because NYSDOH does not have indoor air guidelines for most chemicals. Failing to consider human health risks will result in undue regulation and mitigation, potentially misdirecting resources away from those sites with actual human health risks.

Response D.2.3:

Human health risks are one of many factors considered when evaluating the results of a soil vapor intrusion investigation. Sections 3.3.2 - 3.3.4 of the guidance have been revised to clarify this point.

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Comment D.2.4:

The guidance states that the results of individual soil vapor, sub-slab vapor, indoor air and outdoor air samples are evaluated with the consideration of several additional factors including applicable standards, criteria and guidance values. However, the guidance does not present applicable standards, criteria and guidance values.

Response D.2.4:

Applicable standards, criteria and guidance values are described in *Section 3.2.5 Applicable standards, criteria and guidance values.*

### **D.3 TOPIC: Sources of volatile chemicals**

Comment D.3.1:

The guidance should also point out that indoor air sources may impact sub-slab vapors, either through diffusion or through advection if pressure gradients are negative (downwards). Even periodic downward flow of air into the sub-slab soils could result in residual concentrations of COCs that linger well after the indoor source has been removed.

Response D.3.1:

Acknowledged. This phenomenon is mentioned in the discussion of subsurface vapors in Section 3.2.3.a of the guidance. No additional discussion has been added to the guidance.

Comment D.3.2:

Section 3.2.3: Potential sources of VOCs in outdoor air include all internal combustion engines and is not limited to automobiles and lawn mowers, as suggested in the draft guidance.

Response D.3.2:

Acknowledged. Examples of sources of volatile chemicals to the outdoor air are provided in both Section 3.2.3.c of the guidance and Table 1.3. The lists of examples are not intended to be all-inclusive. Therefore, the guidance has not been revised in response to this comment.

For additional discussions on sources of volatile chemicals to subsurface vapors, indoor air and outdoor air, see Comments B5.5, B.5.6, B.5.13, and B.5.15.

### **D.4 TOPIC: Background levels of volatile chemicals in air**

Comment D.4.1 (paraphrased, 3 commenters, 3 comments):

The benefit of using published background levels in the decision-making process is not clear. For example, Section 3.3.3 on indoor air only provides options related to a background comparison. Such an approach indicates that the State is using the background values as more than screening values (as stated in Section 3.2.4). Background values should not be used to establish the site-specific remedial action objectives for abatement of intruding soil vapor. Rather, it is incumbent upon the NYSDOH to develop indoor air quality guidelines. Until such time, the NYSDEC should use relevant and appropriate guidance, such as DAR-1's Annual Guideline Concentrations, and perhaps even TOGS 1.1.1, in

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addition to the "background" levels to determine the applicable site-specific no further action levels.

Response D.4.1:

Published background levels are helpful in interpreting indoor and outdoor air data, particularly in assessing whether the detection of a chemical may indicate a source that can be addressed to reduce exposures (as discussed in the Section 3.3.3 of the guidance). Background data allow for quantitative comparisons and are one tool used in a multiple-lines-of-evidence approach to data evaluation and decision-making. As such, background databases are not the sole factor for determining if additional action is necessary. The discussion in Section 3.3.3 has been revised to elaborate on the factors that are considered when evaluating indoor air results.

Air guidelines, like background values, are not used as sole determining factors in the evaluation process. As discussed in Section 3.2.5, the purpose of an air guideline is to help guide decisions about the nature of efforts to reduce exposure to a chemical. Reasonable and practical actions should be taken to reduce exposures when indoor air levels are above background, even when they are below a guideline.

DAR-1's Annual Guideline Concentrations and TOGS 1.1.1 are not appropriate for use in the evaluation of soil vapor intrusion data as suggested in the comment. Applicable standards, criteria and guidance values are discussed in Section 3.2.5 of the guidance. [See also Comment D.10.23.]

Comment D.4.2 (paraphrased, 3 commenters, 2 comments):

No information is provided on how to address chemicals without background concentrations.

Response D.4.2:

Background concentration ranges are available for many volatile chemicals. Where background data exist for a chemical, statistical measures of typical background can be calculated for it. A more detailed description of each database along with statistical measures of background levels are provided in Appendix C. If not present in the databases, additional literature research may be needed to identify background values. For chemicals where typical background ranges are not available, additional studies may be needed to establish background values. The State will evaluate the need for additional background data on a case-by-case basis.

The absence of background levels for some compounds should not preclude the collection of samples and data evaluation. As explained in the guidance, background data are just one of several tools in a multiple-lines-of-evidence approach to data evaluation and decision-making. Other factors, including those described in Section 3.2, should be considered in evaluating indoor and outdoor air data in these situations.

Comment D.4.3:

The guidance recommends priority sampling for buildings with sensitive populations (i.e., day care, hospital, etc.). The discussion of indoor background should include these types of buildings as buildings which are likely to have sources of indoor VOCs for cleaners, disinfectants, and other sources which may not be easy to eliminate prior to sampling.

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Response D.4.3:

All buildings are likely to contain indoor sources of volatile chemicals, not just those buildings listed in the comment. As such, the State strongly recommends that a product inventory be completed during indoor air sampling [as discussed in the Sections 2.7.3 and 2.11.2 of the guidance]. A specific discussion as suggested in the comment has not been incorporated into the guidance, as this is inconsistent with the general approach and intent of the guidance.

Comment D.4.4 (paraphrased, 8 commenters, 8 comments):

We disagree with the proposed definition of background that would preclude the lowest 25 percent and highest 25 percent of background readings included in select databases (Section 3.2.4). These background ranges are conservative and may not be representative of certain areas, such as metropolitan areas. A more reasonable approach would be to define background as including a broader range, such as 90 percent of the measured values in databases. Alternatively, the NYSDOH should incorporate a comparison based upon other statistical measures (e.g., the arithmetic mean, geometric mean, 95<sup>th</sup> upper confidence level of the mean, minimum and maximum values, number of data points, and frequency of detection).

Response D.4.4:

Section 3.2.4 of the guidance has been revised to clarify that "background levels" are not defined as concentrations that fall within the 25<sup>th</sup> to 75<sup>th</sup> percentile range. In addition, a more detailed description of each database along with statistical measures of background levels are provided in Appendix C.

Comment D.4.5:

As discussed in the guidance, the distribution of indoor background VOCs concentrations are lognormal. As a result, VOC concentrations that are 10x or more above the 75<sup>th</sup> percentile concentration (provided in the Section 3.2.4 summary table) may be detected in a small, but significant, number of houses (i.e., 1-5%) due to background sources of VOCs. The discussion of background should be expanded to clarify that even these elevated VOC concentrations may not be indicative of vapor intrusion impacts.

Response D.4.5:

A determination that soil vapor intrusion is or is not occurring is not based on a comparison of indoor air results to background levels (whether the 75<sup>th</sup>, 90<sup>th</sup> or 95<sup>th</sup> percentile concentration) alone. As discussed in Section 3.3.3 of the guidance, the data evaluation process includes comparing indoor air, outdoor air and soil vapor concentrations in addition to reviewing household product inventory information. The likely source (e.g., indoor source, outdoor source or sub-slab vapors) of elevated indoor air levels should be uncovered during this process. Section 3.2.4 of the guidance has been revised to clarify that "background levels" are not defined as concentrations that fall within the 25<sup>th</sup> to 75<sup>th</sup> percentile range. In addition, a more detailed description of each database along with statistical measures of background levels are provided in Appendix C.

Comment D.4.6 (paraphrased, 1 commenter, 1 comment):

Section 3.2.4.a -- The NYSDOH should state that the background study of fuel oil heated homes was conducted in NYSDOH employees' homes without screening the property locations for soil vapor intrusion potential. We understand that this testing was not

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originally intended to test for chlorinated VOCs. For this reason, NYSDOH employees would not have been motivated to remove VOC-containing materials.

Response D.4.6:

The NYSDOH Study of Volatile Organic Chemicals in Air of Fuel Heated Homes was conducted in the homes of volunteers, some of which were NYSDOH employees or acquaintances. Part of the selection process included screening out homes that had been affected by a past oil spill or were located near known sources of contamination. Although the protocol contained a requirement that certain activities not be carried out 24-hours prior to sample collection, there were no requirements for removing VOC-containing household products prior to sampling. We believe this is more representative of "typical" household indoor air. Although petroleum-related VOCs were a primary focus of the study, the NYSDOH also intended to obtain information on halogenated VOCs. The guidance has not been revised in response to this comment.

Comment D.4.7 (paraphrased, 2 commenters, 2 comments):

We believe the listing of background studies included in the draft guidance is too limited. The four data sets presented are limited and may be outdated, with data collected using multiple methods. The five boroughs of New York City were excluded from the NYSDOH's primary data set (Section 3.2.4.a). There is concern that the NYSDOH lacks any background levels of volatile chemicals in the air of the five boroughs of New York City.

Response D.4.7:

There are limitations to the data available in all background studies. The guidance acknowledges this and points out some of the limitations of each study in Section 3.2.4 and in Appendix C. Section 3.2.4 of the guidance has been revised to include a discussion of a fifth database: the Health Effects Institute's Relationship of Indoor, Outdoor and Personal Air. Although the older studies (Section 3.2.4.c and 3.2.4.d) could possibly be considered outdated, the databases described in the guidance are the most recent and applicable ones available that the State has had the opportunity to review.

The five boroughs of New York City were not included in the 2003 NYSDOH study, but, at this point, we have no reason to believe that indoor air levels there would be substantially different based on outdoor air sources. For instance, the NYSDEC routinely collects data on outdoor air concentrations of VOCs from its ambient air monitoring stations in New York City and across the state. They report that typical outdoor air levels of benzene in rural and urban areas are similar to or less than those reported in the 2003 NYSDOH study.

If information is available from other background studies in the five boroughs or elsewhere, it may be appropriate to use on a case-by-case basis. In these cases, the State encourages parties to discuss their proposed database with the agencies to assure that all parties understand what background data will be used during data evaluation and the basis for the site-specific decision.

Comment D.4.8 (paraphrased, 2 commenters, 2 comments):

This guidance document presents limited number of studies on background levels for volatiles (p. 29 to 32). As this is a guidance document, it is appropriate that it include representative studies of background concentrations. However, since it is guidance and not regulation, it should not preclude the consideration of other peer-reviewed, published background studies that are shown to be applicable to site specific circumstances.

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Response D.4.8:

The guidance acknowledges the potential use of other databases in Section 3.2.4. To the extent that other background studies are representative and are used appropriately, they will be considered. These determinations are made on a site-specific basis. In these cases, the State encourages parties to discuss their proposed database with the agencies to assure that all parties understand what background data will be used during data evaluation and the basis for the site-specific decision.

Comment D.4.9:

We recommend that separate background values (see Section 3.2.4, 2nd paragraph, pp.29-30) should be provided for a variety of settings, including urban, suburban, and rural settings. The USEPA is currently conducting a review of indoor air background data sets in the recent literature. We recommend that [NYS]DOH incorporate the results of USEPA's review.

Response D.4.9:

There is not enough information available for the State to provide background values for various settings as recommended in the comment. A comparative review of suburban and rural settings from the NYSDOH 2003 study (described in Section 3.2.4.a of the guidance) has not identified statistical differences based on setting types. However, if other databases do show significant differences based on setting, they may be considered on a site-by-site basis [see Comment D.4.8]. The State will consider the EPA's review when it is available, and, if appropriate, will incorporate it into the guidance.

Comment D.4.10:

It appears that the only background studies of commercial type buildings were for office type buildings. Background studies for other types of commercial buildings (e.g., analytical laboratories, hardware stores, machine shops, automotive repair facilities) should be conducted. This information would be useful to have for these types of buildings to provide reasonable background values for industrial/commercial buildings.

Response D.4.10:

Acknowledged. As the comment suggests, background studies of office settings may not be applicable to the settings described, especially due to occupational use of chemicals. However, the State does not have plans to conduct a study of background in industrial or commercial settings at this time. The absence of background levels in these settings should not preclude the collection of samples and data evaluation. As explained in the guidance, background data are just one of several tools in a multiple-lines-of-evidence approach to data evaluation and decision-making. Other factors, including those described in Sections 3.2 and 3.4, should be considered in evaluating indoor and outdoor air data in these situations.

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Comment D.4.11:

The statement that "[The tabulated] background levels may not be the same as what would be expected if indoor air were sampled in randomly selected homes" is certainly true. The NYSDOH background study is clearly not applicable to residences where residents have hobbies or home businesses that use volatile-compound-containing products. We strongly recommend that the guidance specifically allow a weight of evidence approach to background evaluations, such as described in the recent draft indoor air guidance proposed by Colorado.

Response D.4.11:

A determination that soil vapor intrusion is or is not occurring is not based on a comparison of indoor air results to background levels alone. As discussed throughout Section 3 of the guidance, background data are just one of several tools in a multiple-lines-of-evidence approach to data evaluation and decision-making. A number of additional factors, including indoor sources of volatile chemicals (Section 3.2.3.b), are also used in the evaluation process. The guidance has not been revised as recommended in the comment.

Comment D.4.12:

The datasets for background levels in indoor and outdoor air are relatively small. Is NYSDOH continuing to collect additional background data and will updates to the background ranges be made? Will there be any attempt to determine typical background ranges for compounds in soil or sub-slab vapors?

Response D.4.12:

The NYSDOH plans to test an additional set of homes that heat with natural gas to determine whether there are statistical differences and whether they are associated with heating fuel type. We are considering including sub-slab soil vapors in this study and are also considering a number of other studies to look at spatial and temporal variation of source concentration in sub-slab soil vapor. Results of these studies will be incorporated into, or used to amend, the guidance accordingly. Additionally, Section 3.2.4 of the guidance has been revised to include a discussion of a fifth database: the Health Effects Institute's Relationship of Indoor, Outdoor and Personal Air, and a more detailed description of each database along with statistical measures of background levels are provided in Appendix C.

Comment D.4.13 (paraphrased, 1 commenter, 1 comment):

We recommend providing a hierarchy of when each study should be used, or additional guidance on how a user can determine which background study is most appropriate to apply to a site. Due to the variability in the results of each study, it would be helpful to provide additional guidance on which study is best suited for application at a site investigation.

Response D.4.13:

As discussed in Section 3.2.4 of the guidance, the database or combination of databases that best represents site-specific and building-specific conditions should be used as a basis of comparison. Among the databases, the Upper Fence values from the NYSDOH Fuel Oil Study data may be used as initial benchmarks when evaluating residential indoor air and the 90th percentile values from the EPA BASE data for indoor air in office and commercial buildings. These initial benchmark values should be considered along with the overall distribution of results in the background database to characterize sampling results from a single building or from multiple buildings in a

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community. Additional site-specific guidance can be obtained during discussions with the NYSDEC and NYSDOH project managers.

Comment D.4.14 (paraphrased, 3 commenters, 2 comments):

The NYSDOH should clarify that exceedance of a background indoor or outdoor air screening level does not equal a potential human health risk.

Response D.4.14:

See Comment D.4.15.

Comment D.4.15 (paraphrased, 2 commenters, 2 comments):

As part of the guidance, the NYSDOH should more clearly define the level of exposure and level of exceedance of the background concentrations, if any, that may be associated with potential human health risks.

Response D.4.15:

The potential for health effects to occur from chemical exposure depends on many variables, including the toxicity of the chemical, the duration and route of exposure and how sensitive the person is to the chemical. Assessing this information for a large number of chemicals as suggested in the comment is beyond the scope of the guidance.

Comment D.4.16:

Since the NYSDOH guidance will rely only on heating season indoor air results for decisions, the background samples used for comparison should also be from the heating season only (not heating season and non-heating season as for the NYSDOH background study of fuel oil heated homes in Appendix C). Alternatively, NYSDOH should allow decision-making based on test results from other seasons.

Response D.4.16:

In the NYSDOH 2003 study, heating and non-heating season data were not statistically different and were therefore combined into one data table. Separating the data into heating and non-heating season components would have little or no impact on the background ranges for that study. Therefore, the guidance has not been revised in response to this comment. [See also comments in Part C.5 (Topic: Time of year in which to sample).]

Comment D.4.17 (paraphrased, 1 commenter, 1 comment):

We disagree with the assertion that "Background levels are used as screening tools when determining appropriate actions to address exposure. They are not standards and are not meant to be interpreted as such" (Section 3.2.4). Background levels are more than simply screening tools in that they represent the level below which it is technically impracticable to delineate or mitigate contributions from subsurface contamination. Indoor air quality will not improve beyond background conditions.

Response D.4.17:

Comment noted.

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Comment D.4.18 (paraphrased, 1 commenter, 1 comment):

Throughout Section 3.2.4 and other sections, the term "background" as related to the statistical measures would be more clearly denoted as "statistical measures of typical background" because background level varies. The guidance also should note that assuming that the statistical measures are representative of background conditions, one-quarter of properties sampled would be expected to yield indoor air concentrations exceeding the typical background statistics for any given compound.

Response D.4.18:

Acknowledged. Where appropriate, the term "background" has been revised to "statistical measures of typical background."

## **D.5 TOPIC: Applicable standards, criteria and guidance values**

Comment D.5.1 (paraphrased, 8 commenters, 7 comments):

The guidance currently provides indoor air guideline values for only five compounds and it is unclear what values the NYSDOH intends to use for other volatile compounds. It is not reasonable for the Agencies to expect responsible parties to begin soil vapor intrusion evaluations unless guidelines are available for all compounds of concern, so that rational decisions can be made regarding the need for mitigation or monitoring, if any.

Response D.5.1:

The NYSDOH acknowledges the usefulness of guidelines in interpreting air data, and will evaluate the need for and develop additional air guideline values as necessary. The absence of guidelines for some compounds should not preclude the collection of samples and data evaluation. As explained in the guidance, air guidelines are just one of several tools in a multiple-lines-of-evidence approach to data evaluation and decision-making. Other factors, including those described in Sections 3.2 and 3.4, should be considered in evaluating indoor air data to determine what actions are appropriate for addressing exposures. The NYSDOH believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion.

Comment D.5.2:

Table 3.1 does not include 1,1,1-TCA; however, the applicability of Matrix 2 to this compound implies that the air guideline for 1,1,1-TCA is that same as that of PCE (100 mcg/m<sup>3</sup>).

Response D.5.2:

To imply that all chemicals assigned to Matrix 2 must have the same guideline value as PCE is inappropriate. As discussed in Section 3.4 of the guidance, the NYSDOH included two matrices in the guidance document to be used as tools in making decisions when soil vapor may be entering a building. Matrix 1 was originally developed for TCE and Matrix 2 was originally developed for PCE. Because the matrices are risk management tools and consider a number of factors, the NYSDOH intends to assign chemicals to one of them, where appropriate. The NYSDOH has not developed a specific air guideline for 1,1,1-TCA. After consideration of its toxicological properties, gaps in its toxicological database, background concentrations in indoor air and currently available analytical capabilities, the NYSDOH believes that application of 1,1,1-TCA to Matrix 2 is a reasonable and practical approach to protecting public health.

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Comment D.5.3 (paraphrased, 1 commenter, 1 comment):

When the proposed air guideline values [Section 3.2.5] should be applied as opposed to those established by other regulatory agencies (i.e., OSHA, National Institute of Occupational Safety and Health (NIOSH), or American Conference of Governmental Industrial Hygienist (ACGIH) guidance values for Occupational Settings) is not clear. The NYSDOH should adopt a similar policy to that of the California Department of Toxic Substances Control (CA DTSC) with respect to the use of OSHA Permissible Exposure Limits (PELs) at active Resource Conservation and Recovery Act (RCRA) facilities.

Response D.5.3:

The guideline values discussed in Section 3.2.5 are one of the factors discussed in Section 3 of the guidance that should be considered when addressing involuntary exposures and health risks associated with soil vapor intrusion.

With respect to the use of OSHA PELs at RCRA sites, California's vapor intrusion guidance (California 2004; pages C-4, C-5, and F-1, F-2) clearly sets forth the CA DTSC policy that, for vapor intrusion sites, OSHA PELs should not be used as protective concentrations regardless of whether the exposure scenario is residential, commercial, or industrial.

"The CA DTSC regulates chemicals in the subsurface and any human exposure derived from associated contaminant migration, and OSHA regulates workspace and any associated exposure derived from an industrial process."

In California, the one exception where OSHA PEL endpoints may be considered is for operating RCRA facilities pursuant to the EPA's Environmental Indicators Program. The OSHA PELs are used only as an interim measure to evaluate buildings that house a commercial or industrial process. These buildings must house a process that involves the use of chemicals that are similar to the chemical subject to soil vapor intrusion due to prior releases to the environment. OSHA PELs are not used for final remedies at RCRA corrective action sites in California. The guidance has not been revised in response to this comment.

Comment D.5.4 (paraphrased, 1 commenter, 1 comment):

The Minimal Risk Levels (MRLs) established by the ATSDR should be considered as an appropriate exposure level between occupational standards and typical background levels when dealing with workplace soil vapor intrusion issues.

Response D.5.4:

An ATSDR MRL is "An estimate of a daily human exposure to a hazardous substance that is likely to be without applicable risk of adverse non-cancer health effects over a specified duration of exposure." They are developed to be protective of the most sensitive members of the general population. MRLs are based on non-cancer health effects only and do not consider cancer effects. In addition, MRLs are not always available for chemicals of concern (e.g., ATSDR has not developed an MRL for chronic exposure to trichloroethene in air) and, in some cases, may not have been updated or reviewed for many years.

When it is determined that a soil vapor intrusion issue should be addressed using the guidance, decision matrices are one of the risk management tools that should be used to address current and potential exposures. The matrices encapsulate the data evaluation processes and actions recommended to address exposures. Indoor air and

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sub-slab vapor concentration ranges in a matrix are selected based on consideration of a number of factors including, but not limited to, the following:

- human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;
- the NYSDOH's guidelines for volatile chemicals in air;
- background concentrations of volatile chemicals in air;
- analytical capabilities currently available; and
- attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

ATSDR MRLs are included in the consideration of human health risks.

The State believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion impacts in workplace settings. Therefore, the guidance has not been revised in response to this comment.

Comment D.5.5 (paraphrased, 2 commenters, 2 comments):

We recommend that the guidance contain references to other sources of indoor, outdoor and soil vapor criteria developed by other state (e.g., Connecticut and California) and federal agencies (e.g., ATSDR), including the EPA Region 9 Preliminary Risk-based Concentration Table for indoor air and EPA's values established for shallow and deeper soil gas that are protective of residential land use. This information will be helpful in guiding the user to appropriate comparison values for contaminants of potential concern for soil vapor intrusion investigations.

Response D.5.5:

The State does not necessarily agree that the comparison values provided in the guidance documents of other agencies are appropriate. Therefore, references to other guidance have not been incorporated into the guidance as recommended in the comment. [See also Comment A.8.1 (default screening values).]

Comment D.5.6 (paraphrased, 1 commenter, 4 comments):

We request and recommend that the NYSDOH continue with its efforts to develop indoor air quality guidelines for volatile organic compounds, as it has done with respect to TCE, PCE, PCBs, methylene chloride and dioxin. Those guidelines could be used both to determine when exposure levels are so minimal that agency and industry environmental compliance efforts could be safely focused elsewhere, as well as to guide both agency and industry design objectives for remediation.

Response D.5.6:

The NYSDOH will continue to consider the need for guidelines for other volatile organic compounds and develop them as necessary. However, a guideline is not a threshold below which no action is taken and it is not used as the sole determinant in selecting appropriate actions for addressing exposures related to soil vapor intrusion. As discussed in Section 3.2.5 of the guidance, the purpose of an air guideline is to help guide decisions about the nature of efforts to reduce exposure to a chemical. Reasonable and practical actions should be taken to reduce exposures when indoor air levels are above background, even when they are below a guideline. [See also Part A.11 (TOPIC: Party responsible for investigating and taking action(s) to address exposures).]

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Comment D.5.7 (paraphrased, 2 commenters, 2 comments):

The discussion of the guideline values in the guidance document should be expanded to include additional information on their derivation, including if they are developed for chronic, subchronic or acute exposures, if they represent not-to-exceed concentrations, if they are set at a specific carcinogenic risk level or they take into account analytical/sampling limitations, chemical hazard data considered, target risks employed, exposure assumptions and other factors.

Response D.5.7:

An expanded discussion of the derivation of the guideline values is beyond the scope of the guidance document. The bases for the guidelines can be found in the references provided in the footnotes to Table 3.1.

Comment D.5.8 (paraphrased, 1 commenter, 1 comment):

Section 3.2.5.b (air guidelines) states that "Reasonable and practical actions should be taken to reduce exposures when indoor air levels are above background, even when they are below the guideline....In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce chemical levels in indoor air to as close to background as practical."

The use of indoor air guidelines and background values separately and inconsistently is confusing. Several states in the Northeast U.S. (i.e., Connecticut, Massachusetts) incorporate background quantitatively into their numerical criteria for the vapor intrusion pathway. We recommend this approach to incorporate background values quantitatively into the derivation of indoor air guidelines, and the guideline set equal to the higher of the risk-based or background values.

Response D.5.8:

As discussed throughout Section 3 of the guidance, background data and indoor air guidelines are two of several tools in a multiple-lines-of-evidence approach to data evaluation and decision-making. They are not intended to be all-inclusive or to serve as single determinants for further action. The air guidelines themselves are not derived solely on the basis of risk-based criteria, but also consider overall uncertainties and data gaps in the toxicological database, analytical capabilities using routine effective analytical methods, and background concentrations. Thus, while the NYSDOH does consider background levels when deriving guidelines, it does not believe that guidelines should be *a priori* set to the higher of the risk-based or background levels. The NYSDOH will continue to follow the process outlined in Appendix D when developing guidelines for volatile chemicals in air.

Comment D.5.9 (paraphrased, 7 commenters, 13 comments):

For the NYSDOH to use air guideline values that are based on continuous exposure over a lifetime and in some cases (e.g., PCE) may be based on the potential for effects in children is not appropriate. Although these assumptions may be appropriate for a residential exposure scenario, they are overly protective for a commercial or industrial receptor who is likely an adult exposed only during normal working hours. The NYSDOH should take a more focused, land-use approach to establish different guideline levels for indoor air in a commercial setting as opposed to a residential setting. This distinction is justified in light the recent New York State Brownfields legislation that incorporates a land-use approach to develop the cleanup standards.

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Response D.5.9:

As a point of clarification, the NYSDOH's guidelines for TCE, PCE and methylene chloride are guidelines for these chemicals in indoor and outdoor air (i.e., air), not just indoor air and not intended for use just at soil vapor intrusion sites.

The NYSDOH takes many factors into account when developing air guidelines to ensure that they are protective of human health. These factors include, but are not limited to, a person's exposure to background levels and exposure of sensitive population groups (e.g., children, pregnant women, those with pre-existing health conditions, etc.). The development of one air guideline value instead of separate exposure-specific values (as suggested in the comment) is similar to the development of a drinking water standard for a chemical, which applies to drinking water whether the water is being consumed at the workplace or at home.

The development of one air guideline value is appropriate given the purpose of the guideline -- to help guide decisions about the nature of efforts to reduce exposure to the chemical. They do not represent a bright line between air levels that cause health effects and those that do not, and they do not represent remedial goals. Furthermore, they are not used as the sole determinant in selecting appropriate actions for addressing exposures related to soil vapor intrusion (see Section 3 of the guidance). The NYSDOH will continue to follow the process outlined in Appendix D when developing guidelines for volatile chemicals in air.

"A commercial or industrial receptor" could be a pregnant woman. Moreover, infants and children could be present in a commercial setting. Thus, the use of a guideline based on the potential health effects in children (who could also serve as surrogates for pregnant women and perhaps other sensitive adults) as a risk management tool in the soil vapor intrusion program is a necessary health-protective choice. This is readily apparent when one realizes that the purpose of the guidelines is to help guide decisions about the nature of efforts to reduce exposure. Reasonable and practical actions should be taken to reduce exposure when indoor air levels are above background, even when they are below the guidelines. The urgency to take actions increases as indoor air levels increase, especially when air levels are above a guideline. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce levels in indoor air to as close to background as practical.

[See also Comments A.3.1 and A.3.2 (applicability of guidance in nonresidential settings).]

Comment D.5.10 (paraphrased, 2 commenters, 1 comment):

Each air guideline value developed by the NYSDOH should be based on health-based criteria, including OSHA PELs where applicable, not background or other arbitrary levels, and should be subject to public review and comment.

Response D.5.10:

Appendix D provides an overview of how the NYSDOH develops guideline values for volatile chemicals in air. We believe that this is a reasonable and scientifically valid approach that is protective of public health. As discussed in Section 3.2.5 of the guidance, each of the guidelines developed to date (including the guideline for TCE) went through a peer review process in which scientific experts outside of the NYSDOH reviewed the technical documentation that describes the scientific basis for the guideline value. The peer reviewers provided technical comments on the data and

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methods used to derive the guidelines, each of which were assessed by the NYSDOH when the guidelines were finalized.

[See also Comment D.5.3 and Part A.3 (applicability of OSHA PELs), Comment D.5.9 (development of guidelines for residential and commercial settings), and Comment A.18.1 (public review of proposed air guidelines).]

## **D.6 TOPIC: Completed or proposed remedial actions**

### Comment D.6.1 (paraphrased, 2 commenters, 1 comment):

Section 3.2.6 describes how the effectiveness of remedial actions influences the evaluation of soil vapor intrusion results. However, Section 3.2.6 fails to consider potential changes in indoor air concentrations. Mitigation or remediation actions (i.e., sealing basement cracks) could reduce indoor air concentrations without a significant decrease in subsurface vapors. Under these conditions, additional sampling or other remedial actions would not be necessary. The guidance should be revised to be based on actual exposures and not only subsurface vapor concentrations.

#### Response D.6.1:

Section 3.2.6 of the guidance describes how on-going remedial actions (intended to remediate a source or one or more contaminated media) may affect decisions about the need for additional sampling and the selection of mitigation measures for soil vapor intrusion. Section 3.2.6 has been revised to clarify this point. The discussion is not referring to actions taken to address exposures related to soil vapor intrusion (e.g., sealing, installing sub-slab depressurization systems, etc.) or post-mitigation sampling as discussed in Section 4.

Actions taken to mitigate exposures related to soil vapor intrusion (sealing basement cracks, installing a sub-slab depressurization system, etc.) are not intended to reduce subsurface vapor concentrations. Given that soil vapor is an environmental medium of concern, remediation of the source of the vapors (either directly or indirectly) is the ultimate goal. Mitigation or other recommended actions are considered to be interim measures to address exposures until the source is remediated. Furthermore, when evaluating soil vapor intrusion, both current and potential exposures are considered. The guidance has not been revised as suggested in the comment.

### Comment D.6.2:

Section 3.2.6.a: The fact that concentrations show negligible improvement post remediation could imply that contamination was not actually coming from the subsurface. This is a reasonable conclusion that has been presented by the EPA in their seminars.

#### Response D.6.2:

Section 3.2.6 of the guidance describes how on-going remedial actions (intended to remediate a source or one or more contaminated media) may affect decisions about the need for additional sampling and the selection of mitigation measures for soil vapor intrusion. Section 3.2.6 has been revised to clarify this point. The discussion is not referring to the results of post-mitigation sampling or confirmation testing as discussed in Section 4.3.

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### **D.7 TOPIC: Past, current and future land and building uses**

#### Comment D.7.1 (paraphrased, 4 commenters, 6 comments):

In commercial and industrial settings, current and/or past use of chemicals may impact indoor air and confound soil vapor intrusion investigations. Incremental risk due to soil vapor intrusion exposures may be negligible compared with other exposures in the workplace. The guidance should emphasize the importance of reviewing the analytical data for each structure sampled within the context of both current and historic uses of the structure.

#### Response D.7.1:

Agreed. The discussions presented in the following sections and tables of the guidance have been revised to emphasize both historic and current uses of volatile chemicals: Table 1.3 (alternate sources of volatile chemicals in indoor air – off-gassing), Section 2.7.2 (sub-slab vapor sampling), Section 2.7.3 (indoor air sampling), Section 3.2.3 (sources of volatile chemicals – indoor air), and Section 3.2.7 (current and future land uses).

### **D.8 TOPIC: Multiple exposures**

#### Comment D.8.1:

It's essential to consider all potential exposures to the types of contaminant normally evaluated for vapor intrusion because they all add to the health risk. U.S. EPA's 2001 Health Risk Assessment for TCE concluded that people exposed to "background" levels of TCE or similar compounds are more likely to be affected by additional exposures to TCE than people who receive the same TCE exposures without the "background" exposure. The chemicals, or at least their metabolic products, have an additive impact on organs such as the liver and kidneys. That is, people exposed to TCE in their indoor air alone may be less at risk than people who are also breathing PCE or TCA in their outdoor air or ingesting TCE, PCE or TCA in their drinking water.

#### Response D.8.1:

The NYSDOH agrees that all potential exposure pathways to environmental contamination should be considered. The NYSDOH identifies and recommends ways to address these pathways as sites are investigated under the various regulatory programs. The guidance is intended to provide recommendations on how to investigate and address a specific exposure pathway (soil vapor intrusion) where the exposure is primarily via inhalation. The potential for additive toxic effects from other exposures will be addressed on a site-by-site basis as necessary depending on the presence of other contaminants and/or exposure routes. Additional discussion related to this tissue can be found in the final *Trichloroethene (TCE) Air Criteria Document* (NYSDOH 2006b).

### **D.9 TOPIC: Health effects information and risk determinations**

#### Comment D.9.1 (paraphrased, 1 commenter, 1 comment):

The guidance would benefit from a discussion of the effects of various chemicals on human health (e.g. chlorinated solvents and liver damage).

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Response D.9.1:

Comprehensive health effects information for chemicals that may be found in indoor air is beyond the scope of the guidance document. Therefore, the guidance has not been revised in response to this comment.

Alternate resources are available that provide this information. The NYSDOH has developed fact sheets for some chemicals that discuss potential effects related to exposure; fact sheets for TCE and PCE are included in a Appendix H of the guidance. The NYSDOH will develop fact sheets for other chemicals as warranted. Another source of information about the effects of chemical exposure is a series of fact sheets developed by the federal Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR "ToxFAQs" sheets may be found on the Internet at <http://www.atsdr.cdc.gov/toxfaq.html>.

Comment D.9.2 (paraphrased, 1 commenter, 1 comment):

We request clarification concerning the means by which the NYSDOH will ascertain the level of risk associated with a particular exposure to soil vapor intrusion, given all of the other routine daily exposures to volatile chemicals.

Response D.9.2:

As discussed in Section 3, there are "background levels" of some chemicals typically found in indoor and outdoor air, and people may be exposed to these levels on a regular basis. The NYSDOH does not intend to determine the "level of risk" associated with each potential or actual exposure. Rather, we are ascertaining the level of contribution associated with soil vapor intrusion versus other sources of indoor air contamination. This is accomplished by a comparison of indoor air, outdoor air, and sub-slab vapor results, as well as considering possible sources of volatile chemicals to the indoor air (e.g., information documented in the building questionnaire and product inventory form). On the basis of this evaluation, recommendations on how to reduce exposures (if necessary) are provided.

## **D.10 TOPIC: Sampling results and recommended actions**

Comment D.10.1 (paraphrased, 1 commenter, 1 comment):

The guidance contains a broad definition of "potential exposure" that is not fully addressed in the guidance document. This creates difficulties. For example, if sub-slab vapor samples exceed certain values for existing buildings, then monitoring or mitigation is required (due to the potential for exposure), even if the indoor air is "clean."

Response D.10.1:

See Comment B.2.3 for a discussion of the definition for potential exposures. As discussed throughout the guidance, both current and potential exposures should be considered when evaluating soil vapor intrusion. In the example scenario, there is a possibility that a building may change in the future (e.g., the structure may be altered, ventilation systems may be changed, etc.). The situation requires active management (through monitoring or other measures) to ensure that the indoor air continues to be protected against soil vapor intrusion.

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Comment D.10.2 (paraphrased, 3 commenters, 3 comments):

Comparison of soil vapor data to background levels of volatile chemicals in outdoor air is inappropriate.

Response D.10.2:

The guidance recommends comparing soil vapor data with outdoor air data as a way to put some perspective on the data in the absence of standards, criteria or guidance values for volatile chemicals in soil vapor. This comparison is not intended to serve as the sole determinant as to whether or not additional actions should be taken. Such a determination also considers the results of soil vapor sampling and the results of other environmental sampling as a whole to identify trends and spatial variations and to check consistency with the site conceptual model. Section 3.3.1 of the guidance has been revised to reflect this intent.

Comment D.10.3 (paraphrased, 2 commenters, 4 comments):

As the guidance states, soil vapor results should also be "reviewed 'as a whole' to identify trends and spatial variations in the data." While individual soil vapor results may follow a "hit and miss" pattern in some cases, the overall trend may still indicate a lack of significant vapor impact. For example, if soil vapor data and patterns, supplemented by groundwater data and a knowledge of fate and transport mechanisms indicate that soil vapor impacts are unlikely to exist within 100 feet of a building, then these lines of evidence should be sufficient for a no further action decision. The EPA's soil vapor screening levels can be used as a tool to determine the likelihood. In other settings more conducive to soil vapor collection, soil vapor test results may correlate with groundwater data and should be considered at face value when making risk management decisions, including no further action recommendations.

Response D.10.3:

The State agrees that soil vapor results should be reviewed as a whole and with due consideration of the results of other environmental sampling and the conceptual site model. Section 3.3.1 of the guidance has been revised to clarify this point. In some cases, the review may indicate that soil vapor intrusion in nearby buildings is not likely. However, sampling may be recommended to demonstrate the absence of impacts and to support such a conclusion. In our experience to date, soil vapor and groundwater sampling have not been shown to be reliable tools for predicting concentrations immediately beneath a slab. Therefore, the State does not support the use of default soil vapor or groundwater screening levels, including those given in the EPA's guidance (EPA 2002), as the sole determinant to make decisions regarding the potential for exposures in nearby structures at this time. [See also Comment A.8.1 (distance criterion and screening levels).]

Comment D.10.4 (paraphrased, 1 commenter, 1 comment):

Item b of Section 3.3.1 states that soil vapor will be used to help "select the best approach to conduct sub-slab, indoor air and outdoor air sampling." The meaning of the phrase "best approach to conduct...sampling" is not clear. Does this mean a way to identify homes or buildings most likely to be impacted by the potential for vapor intrusion, or an approach to sample sub-slab vapors as an indicator for the potential for vapor intrusion, or something else? We recommend that this language be revised to more clearly state the intended use of the data.

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Response D.10.4:

Acknowledged. Soil vapor sample results are considered useful tools for guiding the soil vapor intrusion investigation and for selecting buildings for sub-slab vapor, indoor air and outdoor air sampling. Section 3.3.1.b of the guidance has been revised for clarification.

Comment D.10.5:

Section 3.3.1 states that NYSDOH's experience suggests that "concentrations of volatile chemicals in sub-slab vapor samples may be substantially higher than those found in soil vapor samples at 8 feet below grade near the building." However, sub-slab sampling is intrusive and may often lead to legal complications. According to Fick's Law, the sub-slab concentration can be no higher than the source concentration. Therefore, volatile chemical concentrations measured in soil vapor samples between the source and the slab are an appropriate measure of concentrations that may potentially migrate through the slab. In addition, if high concentrations of oxygen are present around a building's slab at a shallow depth, it is highly possible that aeration beneath the slab is occurring which would cause sub-slab soil vapor concentrations to be lower than perimeter soil vapor concentrations.

Response D.10.5:

The State agrees that sub-slab vapor concentrations should be no higher than source concentrations. However, soil vapor sampling between the source and the slab has not been shown to predict concentrations immediately beneath a slab reliably. As discussed in the guidance, understanding sub-slab vapor conditions is important for evaluating potential exposures and for identifying likely sources of volatile chemicals in indoor air. Although sub-slab vapor sampling is more intrusive than soil vapor sampling, the State believes that sub-slab vapor samples are more appropriate for achieving these goals given our experiences to date.

Comment D.10.6 (paraphrased, 1 commenter, 1 comment):

Soil vapor samples should be allowed to represent sub-slab conditions when it is not practical to collect sub-slab samples (such as due to radiant floor heating) provided that the soil vapor sample is collected in close proximity and at the same depth as the slab.

Response D.10.6:

Sub-slab sampling is preferable, and, where such samples are desired, attempts should be made to collect sub-slab samples if it is at all possible. If sub-slab vapor sampling is not feasible, it may be necessary to make decisions based on soil vapor data and other information known about the site. Under such conditions, conservative assumptions about the relationship between soil vapor, sub-slab vapor, and indoor air are recommended. These situations are handled on site-specific and building-specific bases. [See also Comment A.14.2.]

Comment D.10.7:

Section 3.3.2 – Sub-slab vapor: There are a number of possible actions recommended based on the outcome of sampling including no further action, additional sampling, and mitigation. Consistent with the soil vapor/indoor air matrices, a fourth possible action should be added to this list; reasonable and practical actions to identify source(s) and reduce exposures.

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Response D.10.7:

Agreed. The guidance has been revised accordingly.

Comment D.10.8:

The guidance evaluation focuses entirely on comparisons between indoor air, soil vapor, and sub-slab, but it is very vague on how much difference is needed between concentrations to make a determination for additional sampling, since the matrices only use indoor air and sub-slab.

Response D.10.8:

Data evaluation for soil vapor intrusion relies heavily on comparisons. However, there is no prescribed difference (e.g., 10 %, 20%, etc.) that triggers a need for additional sampling. As discussed in Section 3 of the guidance, the need for additional sampling will depend on several factors including whether the sampling accomplished the desired goal. In general, additional sampling is recommended when more information is needed to determine the nature and extent of environmental contamination, the source of the contamination, whether there are current or potential exposures to the contamination, and what actions, if any, are needed to mitigate exposures and remediate the environmental contamination.

Comment D.10.9:

Section 3.3.3, Indoor air: The guidance states "To determine the likely cause, the following assessment is completed: a. qualitative and quantitative comparisons are made between the types and concentrations of the contaminants found in the indoor air sample(s) and those found in the outdoor air and sub-slab vapor sample;". The existence of considerable differences between the concentrations is an ideal case. More often, usually the data collected does not show clear-cut differences between the types and concentrations of contaminants found in indoor air, outdoor air and sub-slab samples. Therefore, the guidance should provide recommendations on how to use background data. Can it be subtracted from indoor air concentrations?

Response D.10.9:

The comparison mentioned in the comment is one of several comparisons that should be made, as part of a multiple-lines-of-evidence approach, when assessing the data and determining the likely sources of volatile chemicals to the indoor air. The comparison is not used as the sole determinant. How background concentrations are used in this process is described in Section 3.3.3 of the guidance. In general, the representative background levels presented in the guidance are used for comparison purposes; subtracting them from indoor or outdoor air levels will not provide useful information. Background ranges simply provide a perspective on what levels might be expected in air samples in the absence of known environmental impacts. Comparing air levels to typical background ranges is one way of assessing whether ambient air data suggest that there is a source of volatile chemicals that could be addressed to reduce exposures.

Comment D.10.10:

Section 3.3.3, page 40, d.1.: Define "when sub-slab vapor concentrations are *relatively elevated*."

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Response D.10.10:

The reference to "relatively elevated" sub-slab vapor concentrations has been removed from Section 3.3.3 of the guidance.

Comment D.10.11:

Section 3.3.3, first paragraph after c. and Section 3.3.4, fourth paragraph: Define "substantially above background levels." This is too vague and makes the evaluation process too subjective.

Response D.10.11:

The references have been removed from the document.

Comment D.10.12:

Section 3.3.3: The proposed assessment method for determining the likely cause of elevated indoor air concentrations is very general. For example, how are quantitative comparisons made between the types and concentrations of contaminants in indoor air and those in the sub-slab? What is expected for vapor intrusion? A discussion of expected sub-slab to indoor air attenuation and conservation of COC ratios between soil vapor and indoor air would be appropriate here. In item (b), how are quantitative comparisons made between indoor air results from different locations within a building? What is expected for a vapor intrusion source? In item (c), how does a comparison of indoor air results to the product inventory provide information about "building characteristics affecting indoor air quality"?

Response D.10.12:

The relative relationship between soil vapor, sub-slab vapor, indoor air and outdoor air concentrations are considered in the evaluation of soil vapor intrusion data. The discussion referenced in Section 3.3.3 of the guidance is intended to provide a general overview of the assessment because every site and every building is unique. To provide prescriptive quantities or differentials that indicate a specific source is not consistent with the intent of the guidance and may not be appropriate for all sites or buildings [see also Comment D.10.8]. For example, there is no expected attenuation factor. Data collected to date do not support universal soil vapor to indoor air or sub-slab vapor to indoor air attenuation factors to demonstrate soil vapor intrusion is occurring [see also Comment A.8.1]. In buildings where soil vapor intrusion is occurring, a decreasing gradient in concentrations of volatile chemicals in air from the basement to the upper floors may be expected. However, such a gradient may not always exist even though soil vapor intrusion is occurring. This may be because of the building's layout and airflow patterns and/or the fact that there are also contributions from indoor sources on the upper floors. Lastly, the reference to "building characteristics" has been removed from Section 3.3.3.c to reflect the intent of the comparison.

Comment D.10.13:

The ultimate intent of the evaluation of the vapor intrusion pathway is to ensure that people who inhabit residences or other buildings will not be exposed to harmful levels of VOCs in indoor air that have migrated from the subsurface into these occupied structures. Importantly, the evaluation of this pathway is related only to the presence of VOCs in environmental media that are related to a regulated "release" of oil or hazardous materials. It is vital that background sources of these same chemicals be distinguished from the

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release-related sources. There should be discussion of the presence of internal gradients within the building as an indicator of whether there is a subsurface source of contamination. That is, if a subsurface environmental source is the cause of the indoor air contamination, one would expect to see higher levels in the basement/lower floors and lower levels on the upper floors.

Response D.10.13:

Acknowledged. Section 2.6.3 of the guidance discusses how indoor air samples should be collected from the basement and lowest level living space (if different from the basement). One of the reasons for this sampling is to characterize contaminant trends within the building. Section 3.3.3 discusses the comparisons between indoor air results obtained from different locations within a building (i.e. different floors) as part of the evaluation of the source of volatile chemicals in indoor air. However, the presence or absence of a gradient should not be used as the sole indicator of soil vapor intrusion. For example, while a concentration gradient may be expected, such a gradient may not always exist even though soil vapor intrusion is occurring. This may be because of the building's layout and airflow patterns and/or the fact that there are also contributions from indoor sources on the upper floors. As discussed in Section 3, this comparison is one of many comparisons made when evaluating the data as part of a multiple-lines-of evidence approach.

Comment D.10.14:

Section 3.3.3: Item (c) indicates that the contributions of indoor sources are not identifiable if the indoor air questionnaire and building inventory forms are incomplete. This is an over-generalization. Even if they are complete, there is no guarantee that indoor sources can be identified from the information gathered (e.g. because of off-gassing from flooring adhesives, carpet, pressed wood products and other furnishings and building materials). The recommendation of re-sampling "after interferences are removed" suffers from the same problems. For item (c), given that indoor air and sub slab samples are available, there are other means available for discrimination of indoor versus vapor intrusion source (e.g. COC ratios).

Response D.10.14:

Sections 3.3.3.c of the guidance identifies the incomplete or incorrectly filling out of the indoor air quality questionnaire and product inventory form as one of the more common reasons why likely sources may not be evident from a review of the data alone. While information included in the form is important for interpreting the data, the guidance does not state that sources of volatile chemicals to indoor air cannot be identified with confidence unless the form is filled out completely (as indicated in the comment). As discussed throughout Section 3, the information contained in the form is considered along with many other factors when evaluating the data as part of a multiple-lines-of-evidence approach.

The discussion of "resampling after interferences are removed" in Section 3.3.3.a is in the context of a particular example. In some cases, removing the interferences may not be practical, feasible or appropriate. However, in other cases, indoor sources have been removed and resampling has indicated whether actions to address exposures related to soil vapor intrusion are appropriate.

Comment D.10.15:

Section 3.3.3, c.: It seems that resampling should not always be required in cases where the Indoor Air Quality Questionnaire and Building Inventory form is incomplete. If there

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have been little or no substantial changes within a building since sampling occurred, then a return visit to complete the form without full resampling is appropriate.

Response D.10.15:

Section 3.3.3.c of the guidance discusses the questionnaire and inventory in the context of an example of a situation where appropriate actions cannot be recommended given the information available and where resampling is typically recommended. The guidance does not recommend that resampling be conducted in all cases where the form is incomplete or incorrect. For example, resampling due to an incomplete product inventory may not be recommended if indoor air levels do not represent a concern.

However, completing the form without resampling may not be appropriate (as suggested in the comment). This determination is made on a case-by-case basis with the consideration of several factors, such as the chemical of concern, the amount of time passed since the original results were obtained, the confidence that current building conditions are still representative of those at the time the samples were collected, activities of building occupants (e.g., painting or cleaning), etc.

Comment D.10.16 (paraphrased, 2 commenters, 1 comment):

Section 3.3.3 indicates that additional sampling of indoor air may be necessary if subsurface conditions change over time, even if indoor air concentrations are below background. The conditions requiring additional sampling must be clarified.

Response D.10.16:

The comment refers to additional sampling that would be recommended based upon the results of monitoring subsurface vapor conditions. There are no prescribed conditions that would trigger a need for additional sampling. As with groundwater monitoring for the protection of a private well, additional sampling would be based upon site-specific conditions (e.g., the nature and extent of subsurface contamination, the effectiveness of remedial measures implemented or being implemented to address environmental contamination, the monitoring results to date, etc.).

Comment D.10.17 (paraphrased, 1 commenter, 1 comment):

With respect to monitoring, can the NYSDOH specify a typical frequency for sampling? This would require site-specific modification based on trends in soil vapor or other environmental monitoring data, sensitivity of receptors, etc., but it would be helpful to lay the basic framework for follow-up monitoring.

Response D.10.17:

Monitoring is typically recommended every year until contaminated environmental media are remediated or until monitoring at this frequency is no longer needed to address exposures related to soil vapor intrusion. However, as discussed in Section 3.4 of the guidance, the frequency and type of monitoring are determined on a site-specific basis, with applicable environmental data and building operating conditions taken into account.

Comment D.10.18:

The guidance states: Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure HVAC systems) are maintaining the desired

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mitigation endpoint and to determine whether changes are needed. What endpoints are being considered, indoor air concentration, cancer risk, and pressure differential?

Response D.10.18:

If current building conditions appear to be preventing or minimizing soil vapor intrusion satisfactorily, then the goal of the monitoring is to make sure that the conditions continue to prevent or minimize exposures as much as possible. How these conditions are documented (e.g., physical tests, chemical tests, visual inspections, or a combination of these) is determined on a building-specific basis, with indoor air concentrations, sub-slab vapor concentrations, building features and operations, and other factors considered.

Comment D.10.19 (paraphrased, 1 commenter, 1 comment):

When indoor air data evaluation indicates the need for monitoring in accordance with the soil vapor/indoor air matrices (and the accompanying guidance text), it is not clear under what conditions monitoring can be terminated.

Response D.10.19:

In general, decisions to initiate and to terminate monitoring are made on a case-by-case basis. Monitoring may be terminated under conditions such as the following:

- when monitoring data demonstrate that soil vapor intrusion is not expected to occur;
- when environmental contamination is remediated and soil vapor intrusion is no longer a concern; or
- when other measures (e.g., installation of a sub-slab depressurization system) are taken to address exposures.

Comment D.10.20 (paraphrased, 1 commenter, 1 comment):

In lieu of on-going indoor air monitoring, an area-wide soil vapor implant monitoring program can be used in conjunction with groundwater monitoring to monitor for the presence of VOCs in the subsurface and to monitor the effectiveness of remediation of contaminated environmental media.

Response D.10.20:

Sufficient data are not yet available to demonstrate that such an approach would be appropriate at all sites. Therefore, the guidance has not been revised to incorporate the approach at this time. However, if the approach mentioned in the comment can be demonstrated to meet the monitoring objectives for a particular site, then the approach will be considered.

Comment D.10.21 (paraphrased, 1 commenter, 1 comment):

Automatic monitoring without regard to choice of abatement technology is arbitrary. The matrices also indicate that monitoring will always be required no matter what technology is employed to abate the soil vapor intrusion. This position appears completely arbitrary and capricious where new construction employs a membrane plastic liner placed under the building slab to avoid any volatiles from permeating up through the floor. With an effort like that, we cannot understand why the PRP would need to be burdened with continued indoor air sampling. We recommend that there be certain "Best Available Technology" standards that one could revert to instead of the requirement of never ending indoor air sampling.

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Response D.10.21:

Monitoring is recommended to ensure conditions (e.g., building operations, mitigation actions, etc.) are continuing to address current or potential exposures associated with soil vapor intrusion. As discussed in Sections 3.4.3 and 4.4 of the guidance, and in the "Monitor" note of the matrices, the type and frequency of the monitoring is determined based on site-specific and building-specific conditions, with applicable environmental data, building operating conditions, and mitigation methods employed (including the installation of a membrane plastic liner) taken into account. In many cases, monitoring can be accomplished with physical testing, rather than chemical testing. The State believes that the recommendations on monitoring presented in the guidance are reasonable and practical. "Best Available Technology" standards have not been added as suggested in the comment.

Comment D.10.22 (paraphrased, 2 commenters, 1 comment):

Monitoring or mitigation of exposures related to vapor intrusion should be considered more than interim measures.

Response D.10.22:

Given that soil vapor is an environmental medium of concern, remediation of the source of the vapors (either directly or indirectly) is the ultimate goal. Mitigation or other recommended actions to prevent exposures related to soil vapor intrusion continue to be considered interim measures to address exposures until the source is remediated. This approach is consistent with that taken for other environmental media. For example, filters on private wells are used as interim measures to prevent exposures to contaminated groundwater while the groundwater is remediated.

Comment D.10.23 (paraphrased, 3 commenters, 3 comments):

Three commenters noted that comparison of outdoor air data to background levels of volatile chemicals in outdoor air is inappropriate because

- [a] the purpose of an investigation is to determine the extent to which volatile contamination in soil or groundwater is impacting indoor air, not to ascertain the exposure risk to chemicals in outdoor air; or
- [b] the more applicable comparison for outdoor air levels may be to those levels contained in DAR-1.

Response D.10.23:

- [a] As discussed in Sections 2.2.4 and 3.3.4 of the guidance, outdoor air sampling results are primarily used to evaluate the extent to which outdoor air may be affecting indoor air quality. They are not intended to represent a comprehensive investigation of outdoor air quality. However, people are also exposed to the outdoor air and the outdoor air results are indicative of outdoor air conditions. As such, outdoor air results are reviewed to determine whether outdoor air conditions present a potential concern that requires further investigation. The guidance has been revised to clarify the intent of outdoor air sampling. A comparison to background levels helps to put the outdoor air results into perspective and is one part of the data evaluation process.
- [b] DAR-1 provides annual and short-term guideline concentrations (AGCs & SGCs) to help guide NYSDEC air permitting decisions for facilities under 6NYCRR Part 212. Although the AGCs and SGCs are useful risk management tools for permitting purposes, they are not intended to guide decisions on how to address human

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exposures. As discussed in the guidance, background levels are one tool used for this purpose.

#### **D.11 TOPIC: Action levels**

##### Comment D.11.1:

The guidance is vague and unclear about when remediation is necessary if vapors are detected "under the slab." Triggers for remediation and the remediation methods must be clarified further.

##### Response D.11.1:

The NYSDOH has developed two decision matrices that are used as risk management tools in the decision-making process. The matrices currently apply to TCE and carbon tetrachloride (Matrix 1) and PCE and 1,1,1-trichloroethane (Matrix 2). These matrices provide indoor air and sub-slab vapor concentration ranges and corresponding recommendations for action. We believe that the decision matrices provide clear guidance on the sub-slab vapor levels that will result in recommendations to mitigate or take other actions to address exposures. For compounds without matrices refer to the response to Comment D.12.4, which explains the application of the matrices to other volatile chemicals.

Methods for mitigating exposures related to soil vapor intrusion are described in Section 4 of the guidance. Other actions to reduce exposures will depend upon the source(s).

##### Comment D.11.2 (paraphrased, 2 commenters, 2 comments):

As presented in the matrices, 250 mcg/m<sup>3</sup> TCE and 1,000 mcg/m<sup>3</sup> PCE and 1,1,1,-TCA appear to be action levels for sub-slab vapor results. However, in other sections of the guidance, statements such as "New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in subsurface vapors" are made. Please provide clarification.

##### Response D.11.2:

The NYSDOH has developed two decision matrices to be used as risk management tools in the decision-making process. These matrices provide indoor air and sub-slab vapor concentration ranges for four volatile chemicals (TCE, PCE, 1,1,1-TCA and carbon tetrachloride) and corresponding recommendations for action. The action levels presented in the matrix are not standards, criteria or guidance values. The levels are also not "action levels" in the traditional sense because (as discussed in Note 1 of both matrices) final actions are determined after considering not only the recommendations given in the matrices, but also site-specific and building-specific conditions and/or factors discussed in Section 3.2 of the guidance.

##### Comment D.11.3 (paraphrased, 7 commenters, 7 comments):

Actions should not be required when indoor air levels are above background, but below indoor air guidelines or health-based risk levels, especially if long-term remedies will be implemented to address the source of the vapors (e.g., soil or groundwater contamination). Please clarify why action needs to be taken in this circumstance. Additionally, the NYSDOH should specify when a background concentration should be used over an air guideline value.

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Response D.11.3:

Reasonable and practical actions to identify source(s) and reduce exposures may be recommended when concentrations of volatile chemicals in the indoor air are detected at levels above background and below air guidelines. We make this recommendation because, consistent with the approach taken with other environmental media, reducing exposures wherever possible is a primary objective. However, this does not necessarily mean that the party doing the soil vapor intrusion investigation (e.g., PRP, Volunteer, etc.) is responsible for implementing the recommended actions. For example, the State does not expect a responsible party to address exposures related to releases from indoor sources alone (e.g., exposures to methylene chloride related to the storage of paint strippers in a basement).

If current and potential exposures related to soil vapor intrusion will be addressed concurrently (and within a reasonable timeframe) by a method selected to remediate subsurface contamination, then additional actions to address exposures (e.g., installation of a sub-slab depressurization system or monitoring) may not be appropriate. These determinations are made on site-specific and building-specific bases.

As discussed throughout Section 3 of the guidance, background data and indoor air guidelines are two of several tools in a multiple-lines-of-evidence approach to data evaluation and decision-making. Published background levels are helpful in interpreting indoor and outdoor air data, particularly in assessing whether the detection of a chemical may indicate a source that can be addressed to reduce exposures. Air guidelines are used to help guide decisions about the nature of efforts to reduce exposure to a chemical. For example, the urgency to complete actions to reduce exposures to volatile chemicals in indoor air increases with indoor air levels, particularly when air levels are above guidelines. Neither background levels nor air guidelines are intended to serve as single determinants for further action, with one preferred over the other.

Comment D.11.4 (paraphrased, 1 commenter, 1 comment):

Mitigation decisions must be based upon documented risk to human health determined by health-based criteria.

Response D.11.4:

While human health risks were considered in developing the guidance, we take a risk management approach to recommending actions for addressing exposures related to soil vapor intrusion. Furthermore, the State believes both current (i.e., documented exposures) and potential exposures should be addressed.

Comment D.11.5:

The air guidelines that the NYSDOH has adopted for TCE and PCE is a concern. The EPA for the Hopewell Precision Site during an on going extensive ground water investigation adopted a level of .38 mcg/m<sup>3</sup> for TCE and 30 mcg/m<sup>3</sup> for PCE as sub-slab action levels required to mitigate a home. The NYSDOH has adopted numbers that are significantly higher and based on indoor air results. It is my hope that the NYSDOH will consider following the Environmental Protection Agency's lead by adopting a more stringent action guideline.

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Response D.11.5:

As a point of clarification, the site-specific actions being taken by the EPA at the Hopewell Precision Site and the concentrations of TCE and PCE corresponding to these actions are as follows:

- the EPA is applying a sub-slab vapor action level for TCE (i.e., the level at which a sub-slab depressurization system is automatically installed). This action level is 50 mcg/m<sup>3</sup> TCE, not 0.38 mcg/m<sup>3</sup> TCE as indicated in the comment;
- the EPA is applying a sub-slab vapor screening level for TCE (i.e., the level at which indoor air sampling will be conducted). This screening level is 2.7 mcg/m<sup>3</sup> TCE;
- the EPA is mitigating homes where sub-slab vapor concentrations of TCE exceed the screening level and indoor air testing shows TCE is detected (i.e., greater than or equal to a TCE concentration of 0.38 mcg/m<sup>3</sup>, a detection level that the EPA believes mitigation systems can achieve at the Hopewell Precision site); and
- contrary to the comment, the EPA has not applied any sub-slab vapor or indoor air action level for PCE.

The State does not use air guidelines as the sole determinant for taking actions to address exposures related to soil vapor intrusion. In other words, the guidelines are not thresholds below which no action is taken. This is exemplified, for example, in the decision matrix for TCE (Soil Vapor/Indoor Air Matrix 1 in the guidance), which provides for response at levels of TCE in indoor air that are less than 0.25 mcg/m<sup>3</sup>.

Region 2 of the EPA, which includes New York, uses a very similar decision matrix. There have, however, been many reports that Region 2 uses a clean up number for TCE of 0.38 mcg/m<sup>3</sup>. At the Hopewell Precision site, Region 2 found that it was more efficient to install vapor mitigation systems than to carry out long-term monitoring and that when the systems were installed they could expect to achieve levels in the indoor air below the analytical detection limit of 0.38 mcg/m<sup>3</sup> for TCE. This decision was based on cost and the ability to bring an investigation to a close, not on derived health criteria that represents any given level of exposure and therefore a given level of estimated risk. Application of this number (0.38 mcg/m<sup>3</sup> TCE) was then stated by Region 2 program staff as the cleanup goal of the site. The number came to be reported as the Region 2 response level. Like the State, Region 2 makes decisions on a case-by-case basis.

[See Comments D.11.6, D.11.7 and D.12.2 for additional discussion about site-specific, non-health-based decisions to install sub-slab depressurization systems; Comments A.4.1, A.4.2, A.4.3, A.4.4 and A.4.5 for additional discussion about the NYSDOH's air guidelines; and Comments D.5.1 and D.5.8 for additional discussion on how air guidelines are used in data evaluation.]

Comment D.11.6:

CAE Electronics, a responsible party, agreed to fund ventilation systems in homes in Hillcrest with TCE levels as low as 0.14 micrograms per cubic meter. IBM, a responsible party, should do nothing less. The State of New York should demand nothing less. The people of this community are demanding nothing less.

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Response D.11.6:

For clarification, decisions to install sub-slab depressurization systems on homes are not based on indoor air results alone (as suggested in the comment). The State has implemented a site-specific blanket mitigation approach at the Hillcrest site. As a result, homes that have never been tested may have received a sub-slab depressurization system or homes with non-detectable or low levels of TCE in their indoor air may have received systems. For houses outside of the blanket mitigation areas, the decision matrices presented in Section 3.4 of the guidance are being used as the bases for taking action. The State, not CAE Electronics, is currently paying for all activities associated with investigating and addressing soil vapor intrusion at the Hillcrest site.

A comparison of only the indoor air results of homes that have received sub-slab depressurization systems (as presented in the comment) is often misleading because numerous factors, not just indoor air results, are considered when selecting actions to address exposures related to soil vapor intrusion (see Section 3 of the guidance for additional information). The goal of soil vapor intrusion investigations is to take actions that are protective of public health. If this goal is being achieved, then the State cannot demand additional actions or take additional actions for health-based reasons. This is the case at the IBM Endicott site, where the approach being implemented is similar to that being taken at Hillcrest.

Recommending actions at a specific site is not within the scope of the guidance. To express concerns about actions being taken at a specific site or to discuss the actions, contact the NYSDEC or NYSDOH project manager for the site.

Comment D.11.7 (paraphrased, 2 commenters, 2 comments):

We request homes with TCE levels detected be vented for the following reasons:

- [a] we know mitigation units work;
- [b] installing a system is cheaper than resampling and is protective;
- [c] any home with TCE under the foundation could crack and indoor TCE levels could dramatically increase and go undetected for years and years, which could prove to be fatal for people living there and their unborn children; and
- [d] why should people, especially children who are more sensitive to TCE, be subjected to breathing this chemical?

Response D.11.7:

The guidance is intended to provide recommendations for actions that are protective of public health. Decision Matrix 1 reflects this intent for TCE. The matrix provides a summary of actions recommended from a public health perspective. The actions are both protective of public health and appropriate to addressing current and potential exposures related to soil vapor intrusion. However, as discussed in Note 1 of the matrices, actions more protective of public health than those specified within the matrix may be proposed at any time. Such approaches are usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.). As such, the decision to install sub-slab depressurization (SSD) systems at structures where TCE is detected is made on a site-specific basis with many factors considered.

Responses to the individual reasons provided in the comment follow.

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- [a] SSD systems are effective at addressing exposures related to soil vapor intrusion. However, if current exposures within a home are due to indoor or outdoor sources rather than the infiltration of sub-surface vapors, then they are not an effective mitigation measure for addressing the exposure. This emphasizes the need to identify the source of chemicals detected in the indoor air before deciding to install a system.
- [b] Installation of a SSD system is an example of one protective action that may be taken to address exposures related to soil vapor intrusion. Depending upon site-specific and building-specific conditions, other actions, such as monitoring, may also be protective from a public health perspective. Matrix 1 (TCE) reflects this point.
- Experience has shown that the installation of a SSD system is not necessarily cheaper than resampling or monitoring. This may be due to building-specific conditions that need to be accommodated so that the system may be installed properly and may operate effectively. This may also be due to site-specific or building-specific conditions that are considered when determining the frequency and types of samples appropriate for monitoring or resampling.
- [c] The actions recommended in the decision matrices consider the potential for exposures to occur should building conditions change (e.g., cracks develop, HVAC systems are adjusted, etc.). Where sub-slab vapor concentrations represent a concern for future exposures, monitoring or mitigation actions are recommended. Therefore, should building conditions change, the situation would not go undetected as described in the comment.
- [d] As explained in Section 1.2 of the guidance, exposure to a volatile chemical due to vapor intrusion does not necessarily mean that health effects will occur. Whether or not a person experiences health effects depends on several factors, including the length of exposure (short-term or acute versus long-term or chronic), the amount of exposure (i.e., dose), the frequency of exposure, the toxicity of the volatile chemical and the individual's sensitivity to the chemical. The recommendations for action presented in Matrix 1 considered all pertinent toxicological and epidemiological data available for TCE (including that pertaining to children).

Comment D.11.8 (paraphrased, 2 commenters, 3 comments):

We recommend that the NYSDOH and NYSDEC adopt a policy that establishes a presumption for the mitigation of structures wherever measurable levels of VOCs are detected in sub-slab or indoor air and evidence exists that the source of such contamination may be a contaminated site. However, an exception could be made in cases where substantial evidence indicates that such levels are not due to contamination from a site; or the costs of mitigation are unreasonably high, measured levels of contamination are extremely low, and a high degree of certainty exists regarding the accuracy of such measurements. In other words, a presumption for mitigation would not eliminate the need to consider all the various factors described in the guidance that may affect vapor intrusion. In contrast to the guidance, NYSDOH and NYSDEC would be required to document fully and transparently their reasoning behind a decision not to mitigate where contamination has been found.

This recommendation is supported by the findings from the Committee's hearings across the state, which follow.

- [a] A number of protective guidelines for TCE (e.g., EPA Regions 3 and 6, Colorado, and EPA Region 9) are equal to or below the detection limit for TCE. Because detect levels

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and protective guidelines are so comparable, establishing a presumption for mitigation at detect would be comparable to acting on the most protective assumptions about TCE toxicity and exposure supported by science.

- [b] VOCs are difficult to measure accurately, both under the sub-slab and in indoor air. Given the variability of vapor intrusion and the difficulty inherent in mapping intrusion pathways accurately, it would be better to act quickly to implement mitigation measures in each structure that could potentially be affected. Money would be better spent on mitigation than on extensive air sampling and analysis.
- [c] The costs of mitigation and monitoring are comparable, and a number of responsible parties and agencies have made risk management decisions at individual sites to mitigate at detect in order to save time and money.
- [d] Mitigating at detect will reduce the potential for inequitable outcomes, where some residences will have their exposures mitigated but others exposed to the same level of contamination will not.
- [e] Living with uncertainty is one of the most difficult aspects of living at or near a contaminated site. The government has a responsibility to relieve the distress associated with uncertainty to the extent practicable. Implementing mitigation where measurable levels of contaminants have been detected and can plausibly be associated with a contaminated site is a reasonable and effective approach.

Response D.11.8:

To have a policy that defaults to mitigation as recommended in the comment is not a practical approach for most volatile chemicals, as they are often found at background concentrations in indoor air and in subsurface vapors. Furthermore, the NYSDEC does not have the legal authority to implement remedial actions at soil vapor sites based solely on the mere presence of a contaminant in subsurface vapors. There must be a determination that a significant public health threat exists as a result of the contamination in order for the NYSDEC to act. Overall, the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion that is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns.

Responses to the individual findings provided in the comment follow.

- [a] We have continually evaluated the work and programs of others, and will continue to do so, and can say with confidence that our approach protects human health and is conservative. Matrix 1 provides a summary of actions recommended from a public health perspective. All pertinent toxicological and epidemiological data available for TCE were considered in the development of the matrix. The NYSDOH believes the actions recommended are both protective of public health and appropriate to addressing current and potential exposures related to soil vapor intrusion (including recommending actions when indoor air levels are less than 0.25 mcg/m<sup>3</sup>). Furthermore, the guidance allows for a blanket mitigation approach of installing systems on a neighborhood basis rather than on the results of individual buildings, so that mitigation is provided for homes that would not necessarily receive it by using the criteria in the matrix alone. Therefore, neither the guidance nor the matrix has been revised in response to the comment.
- [b] Although the evaluation of the vapor intrusion pathway is an emerging science, the guidance provides the necessary framework for dealing with the uncertainties described in the comment and gives recommendations on how to obtain representative and reliable data to base decisions on in a timely manner. However, measures to mitigate exposures or to remediate

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subsurface vapor contamination can be considered at any time during the investigation and remediation of a site. These determinations are made on a site-specific basis. [See also Comment C.5.3 (sampling with respect to seasonal variations in sub-slab and indoor air contaminant levels).]

- [c] Experience has shown that costs associated with mitigation are not always comparable to the costs associated with monitoring. This may be due to building-specific conditions that need to be accommodated so that the system may be installed properly and may operate effectively. This may also be due to site-specific or building-specific conditions that are considered when determining the frequency and types of samples appropriate for monitoring. Therefore, the cost-benefit analysis of monitoring versus mitigating is appropriate on a building-specific or site-specific basis, especially if monitoring is protective of public health.
- [d] As with taking actions to address exposures in other environmental media (e.g., soil, groundwater, etc.), actions taken to address exposures related to soil vapor intrusion may vary from site to site in their degree of protectiveness. However, the protection of human health serves as the foundation of all actions taken at sites, and this foundation is reflected in both the guidance and the decision matrices. [See also Comment D.12.2 (variable action levels applied at sites).]
- [e] The State recognizes that living with uncertainty is difficult. The State strongly believes that community outreach is an essential component to the evaluation of soil vapor intrusion. As discussed in Section 5 of the guidance, there are many types of outreach techniques that may be useful in keeping the community informed and involved throughout the process. Such outreach is often effective at addressing the concerns expressed in the comment about maintaining a level of transparency and relieving the distress associated with uncertainty.

Comment D.11.9 (paraphrased, 1 commenter, 1 comment):

The discussion of background levels doesn't really explain the significance of ambient air concentrations of volatile contaminants. If any of these compounds are found in the air above health protective levels, then it's important to determine where they come from and to take appropriate steps to address exposures.

Response D.11.9:

Section 3.2.4 of the guidance, background levels of volatile chemicals in air, recognizes that volatile compounds may be present in both indoor and outdoor air not affected by environmental contamination. The State agrees that actions may be necessary if outdoor air results are substantially above outdoor air background concentrations or above the NYSDOH's guidelines for volatile chemicals in air. In these cases, the State will determine the appropriate next steps, including identifying potentially responsible parties. A discussion of this issue is given in Section 3.3.4.

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**D.12 TOPIC: Decision matrices**

*As mentioned in the Executive Summary, revisions were made to the Soil Vapor/Indoor Air Matrices in Section 3.4 of the guidance based on comments received on the NYSDOH's draft report entitled Trichloroethene (TCE) Air Criteria Document (NYSDOH 2005). Please see Appendix 2 for additional information.*

Comment D.12.1 (paraphrased, 7 commenters, 8 comments):

The guidance should explain how the matrices were derived. The rationale for selecting all thresholds used must be clearly articulated. How background plays a role should be explained. Also, the guidance should specify what exposure scenarios were considered. Such information will also allow the matrices to be more easily applied to other chemicals.

Response D.12.1:

There is no boilerplate formula for deriving the decision matrices (e.g., by using default attenuation factors and health risks alone). Therefore, such a description has not been added to the guidance. As discussed in Section 3.4 of the guidance, the matrices are developed after the careful consideration of multiple factors, including human health risks, the NYSDOH's guidelines for volatile chemicals in air, background concentrations of volatile chemicals in air, analytical capabilities currently available, and attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations). The NYSDOH has developed two decision matrices to be used as risk management tools. To date, four chemicals have been assigned to the two matrices -- TCE, PCE, 1,1,1-TCA and carbon tetrachloride. For compounds without matrices refer to the response to Comment D.12.4, which explains the application of the matrices to other volatile chemicals.

As discussed in Section 3.2.4 of the guidance, background levels of volatile chemicals are one of the factors considered when evaluating sampling results at a site. Furthermore, they are used as the goal when taking actions to reduce exposures. These points are reflected in the matrices in that actions are recommended in the matrices even when indoor air concentrations are below applicable air guidelines. The actions recommended vary depending upon whether sub-slab vapor concentrations indicate the indoor air is likely or unlikely to be affected due to soil vapor intrusion. In addition, no further action is recommended when indoor air concentrations are comparable to background and sub-slab vapor concentrations are not expected to significantly affect indoor air quality. [See Section 3 for additional information on how background levels are considered during the data evaluation process.]

As discussed in the response to Comment D.12.8, the decision matrices are not intended to be prescriptive to a certain setting or exposure scenario, such as commercial, industrial or residential, but for environmental exposures in general.

Comment D.12.2 (paraphrased, 2 commenters, 2 comments):

Our understanding is that there is no "bright line" to separate safe (the amount of the dose you do not want to exceed) versus unsafe exposure levels and that decision matrices are used as risk management tools to determine whether "action" at a site is warranted. Our further understanding is that variable air quality action levels have been permitted on a site-by-site basis and pre-2003 sites have been separated from newer sites. We strongly believe that all citizens deserve the same degree of protection. Therefore, we respectfully request that the NYSDOH protect all of the State's residents equally by demanding remediation at consistent and conservative air quality action levels. Furthermore, we request that the decision matrices be created as conservatively as possible with the best interest of the residents in mind.

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Response D.12.2:

As a point of clarification, although pre-2003 sites have been separated from newer sites, the NYSDEC and NYSDOH intend to use the guidance in the evaluation of vapor intrusion at every site in which they are involved, and recommend that the guidance be considered anywhere soil vapor intrusion is evaluated in the State of New York [see the NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* (NYSDEC 2006)].

The NYSDOH has developed two decision matrices to be used as risk management tools in the decision-making process. These matrices provide indoor air and sub-slab vapor concentration ranges for four volatile chemicals (TCE, PCE, 1,1,1-TCA and carbon tetrachloride) and corresponding recommendations for action, from a human health perspective. The actions are both protective of public health and appropriate to addressing current and potential exposures related to soil vapor intrusion. As discussed in Note 1 of the matrices, actions more protective of public health than those specified within the matrix may be proposed at any time. Such approaches are usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.). As a result, actions may vary from site to site in their degree of protectiveness. Nevertheless, the protection of human health serves as the foundation of all actions taken at sites, and this foundation is reflected in both the guidance and the decision matrices. Therefore, neither has been revised in response to the comment.

Comment D.12.3 (paraphrased, 2 commenters, 3 comments):

The draft decision matrices place too much emphasis on only two factors: sub-slab vapor and indoor air contaminant levels. As drafted, it seems that actions are clearly tied to those levels, and as a result, although additional factors to be considered are listed, those factors are afforded much less importance. Any matrices that are used in the final guidance should be clearly identified as a flexible decision-making tool that the NYSDOH will consider as one factor among many others in evaluating the needs of a site.

Response D.12.3:

The recommendations provided in the matrices are based primarily on the results of sub-slab vapor and indoor air results. This is because our experience to date has demonstrated the importance of having sub-slab vapor and indoor air data, rather than relying on other environmental data, to evaluate current and potential exposures related to soil vapor intrusion at a particular building. They are also important when selecting appropriate actions to address exposures. However, as discussed in Note 1 of both matrices, the matrices are general risk management tools used to guide decisions in the context of a particular site. In other words, they are not intended to be prescriptive or to mandate universal decisions without accounting for the multitude of site-specific and building-specific considerations. Note 1 is consistent with Section 3 of the guidance, in which a multiple-lines-of-evidence approach to data evaluation is recommended and described. Therefore, neither the matrices nor the guidance have been revised in response to this comment.

Comment D.12.4 (paraphrased, 2 commenters, 2 comments):

The guidance is incomplete in that there are matrices for only 3 compounds — TCE, PCE and 1,1,1-TCA. The guidance should explain how these matrices are applied to other VOCs, such as degradation products.

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Response D.12.4:

TCE, PCE and 1,1,1-TCA were the first compounds assigned to decision matrices because our experience indicated that these compounds drive most of the decisions with respect to soil vapor intrusion at sites. If a chemical other than those already assigned to a matrix is identified as a chemical of concern during a soil vapor intrusion investigation, assignment of that chemical into one of the existing decision matrices will be considered by the NYSDOH. Assignment will be based on a review of the chemical's toxicological properties and background levels, current analytical capabilities, and any other relevant factors. If the NYSDOH determines that the assignment of the chemical into an existing matrix is inappropriate, then the NYSDOH will develop a new matrix and revise or amend the guidance accordingly. Section 3.4.2 of the guidance has been revised to clarify this process. Such a process was followed with carbon tetrachloride, which has been assigned to Matrix 1.

Comment D.12.5 (paraphrased, 5 commenters, 5 comments):

A matrix developed for a specific contaminant (TCE and PCE) being used for other contaminants is problematic. There is no evidence that the specific human health risks, data gaps, background concentrations, and analytical capabilities available for these specific contaminants will be appropriate for use with other contaminants (e.g., fitting toluene into a PCE matrix may be inappropriate). If a matrix is to be used as a decision making tool, then any matrix should be developed based on a chemical's toxicological properties and a chemical should not be "force fit" into a particular matrix.

Response D.12.5:

Because the matrices are risk management tools that consider a number of factors, not just a chemical's toxicological properties, assignment of more than one chemical to a matrix may be appropriate. The NYSDOH will make this determination based on a review of the chemical's toxicological properties and background levels, current analytical capabilities, and any other relevant factors. However, the NYSDOH does not intend to "force fit" a chemical into an existing matrix. If the NYSDOH determines that the assignment of the chemical into an existing matrix is inappropriate, then the NYSDOH will develop a new matrix.

Comment D.12.6 (paraphrased, 2 commenters, 1 comment):

The NYSDOH states the intent to divide chemicals into two classes (i.e., to assign chemicals to one of the two matrices). This approach is too broad to accommodate the range of constituents potentially present in the subsurface. For example, estimates of indoor air concentrations can be obtained from the Johnson and Ettinger Model by using the soil vapor concentrations that trigger a need for mitigation in the matrices (e.g., 250 mcg/m<sup>3</sup> and 1,000 mcg/m<sup>3</sup>). According to these conservative estimates, the decision matrix may indicate monitoring or even mitigation in cases where predicted indoor air concentrations do not represent an unacceptable health risk or even where predicted indoor air concentrations are well below the lowest trigger levels in the matrix. The NYSDOH seems to have proposed an overly simplistic and arbitrary scheme specifically to avoid using standard risk assessment and modeling tools, as well as screening levels for individual constituents in deeper soil vapor and shallow soil vapor, that are recommended and used by other state and federal agencies.

Response D.12.6:

Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site and building conditions and do not necessarily follow

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model predictions or correlate to soil vapor results. Therefore, the State does not believe that decisions based solely on modeling and/or soil vapor results are sufficiently protective of human health. Rather, sub-slab vapor and/or indoor air data are more reliable and appropriate for evaluating the potential for human exposures related to soil vapor intrusion. As such, the NYSDOH developed the matrices (in conjunction with other agencies) to provide guidance about actions that are recommended to address exposures.

The matrices reflect that the recommendations are based primarily on the results of sub-slab vapor and indoor air sampling for a particular building. They also reflect that actions may be recommended to address potential exposures, not just current exposures (as emphasized in the comment). For example, monitor or mitigate actions may be recommended even if the chemical is not detected in the indoor air or is detected in the indoor air at a concentration below applicable air guidelines. As discussed in the response to Comment D.12.5, the NYSDOH does not intend to "force fit" a chemical into an existing matrix. If the NYSDOH determines that the assignment of the chemical into an existing matrix is inappropriate, then the NYSDOH will develop a new matrix. Overall, the State believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion. [See also Part A.8 (TOPIC: Guidance with respect to other vapor intrusion guidance or policies).]

Comment D.12.7 (paraphrased, 4 commenters, 6 comments):

We recommend the matrix approach be abandoned. Once decision-making is reduced to a rote formula or matrix, these formulae and matrices tend to become cast in stone and regulatory staff may be very reluctant to deviate from the standard version. While a matrix evaluation may be easy to apply, the matrices do not allow for a weight of evidence evaluation and do not include the consideration of background or other sources not associated with vapor intrusion. Assuming the preferential pathways have been properly evaluated, soil vapor, sub-slab vapor or indoor air concentrations alone should be sufficient for the evaluation of potential vapor intrusion impacts. An alternative approach is to replace the matrices with tables of soil vapor/sub-slab vapor screening criteria based on acceptable indoor air concentrations multiplied by a default attenuation factor.

Response D.12.7:

As discussed in Note 1 of both matrices, the matrices are general risk management tools used to guide decisions in the context of a particular site. In other words, they are not intended to be prescriptive or to mandate universal decisions without accounting for the multitude of site-specific and building-specific considerations. Note 1 is consistent with Section 3 of the guidance, in which a multiple-lines-of-evidence approach to data evaluation is recommended and described. Blind application of the matrices by regulatory staff (as described in the comment) is not expected because staff attended training sessions in which this multiple-lines-of-evidence approach was emphasized and because such application would be inconsistent with the guidance.

With respect to the alternate approach discussed in the comment, data collected to date from the investigation of sites across New York State do not support the application of generic soil vapor/sub-slab vapor screening criteria or the application of a default attenuation factor (see the response to comment A.8.1). Therefore, the matrix approach has not been abandoned as recommended in the comment.

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Comment D.12.8 (paraphrased, 2 commenters, 2 comments):

How are these matrices to be applied for commercial settings? Each matrix requires a Responsible Party to conduct mitigation if indoor air levels exceed the guidelines, which are protective of residential exposures. The notes do not mention modification of requirements for land uses other than residential. Such uses should be considered in determining whether mitigation is warranted under other land uses, such as commercial/industrial, to ensure protection of public health.

Response D.12.8:

The decision matrices are not intended to be prescriptive to a certain setting, such as commercial or residential. As discussed in Note 1 of both matrices, they are general risk management tools used to guide decisions in the context of a particular site. The matrices should be used to address involuntary exposures and their associated health risks in commercial as well as residential settings. [See also Comments A.3.1, A.3.2, and D.5.3 (applicability of OSHA standards) and D.5.9 (NYSDOH air guidelines — commercial/industrial exposures).]

Comment D.12.9 (paraphrased, 4 commenters, 3 comments):

The NYSDOH's decision matrices (i.e., Matrix 1 and 2) do not provide a rational basis for mitigation or monitoring decision-making (Section 3.4) for several reasons, including the following:

- [a] they require remedial actions in instances where indoor air concentrations are below either the state's guidance values, background levels or both,
- [b] mitigation is required in cases where the ratio of sub-slab vapor to indoor air concentrations was almost as low as 10; when empirical data presented by McDonald and Wertz (2004) show that ratios of less than 100 are most likely due to background sources,
- [c] although sufficient evidence should be required to demonstrate that soil vapor intrusion is not the source of indoor air impacts, the responsible party should not be responsible for specifically identifying and mitigating indoor or ambient air sources, and
- [d] when indoor air concentrations are higher than sub-slab concentrations, it is very possible that sub-slab vapors are being impacted by indoor air.

Response D.12.9:

The matrices are general risk management tools used to guide decisions in the context of a particular site. As discussed below in the responses to the specific reasons given in the comment, the NYSDOH believes that the actions recommended in the matrices are reasonable and protective of human health and that the matrices encompass a practical, multiple-lines-of-evidence approach to evaluating the data and selecting appropriate actions to address exposures.

In response to the specific reasons above:

- [a] As stated in the Additional Notes section of both decision matrices, the matrices are intended to recommend actions that address current and potential exposures related to soil vapor intrusion. Making decisions on the basis of indoor air results alone is inappropriate, as this approach does not address the potential for future exposures. Furthermore, actions are recommended when indoor air concentrations are below air guidelines and sub-slab vapor concentrations are elevated both because soil vapor intrusion does not always result in an exceedance of an air guideline and because air guidelines do not represent a

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threshold that below which no actions are taken. [See Comments D.11.3 and D.12.10 for additional discussion on this issue.]

- [b] The data set referenced in the comment is representative of one site in New York State. Many additional site investigations have since been conducted. While some of the results collected to date are consistent with the findings of the referenced data set, many results do not support the assumption that data represent background sources and not soil vapor intrusion if the ratio of sub-slab vapor to indoor air concentrations is less than 100. The matrices reflect this point and acknowledge, in Note 1 of both matrices, that modification of the recommended actions may be appropriate depending on site-specific or building-specific conditions (e.g., if the data indicate exposures are attributable to background sources rather than soil vapor intrusion). [See also Comment A.8.1 (default attenuation factors).]
- [c] To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring (i.e., indoor air concentrations are the result of indoor sources, outdoor sources or other non-site-related sources), the soil vapor intrusion investigation would be considered complete. Further action to address indoor or outdoor sources of volatile chemicals in the indoor air would be taken by the appropriate party, which may or may not be the party responsible for the soil vapor intrusion investigation. [See also Part A.11 (TOPIC: Party responsible for investigating and taking action(s) to address exposures).]
- [d] Section 3.2.3.a of the guidance discusses indoor sources and building conditions as possible sources of volatile chemicals to the subsurface. As discussed in Note 1 of both matrices, modification of the actions recommended in the matrix may be appropriate depending on site-specific or building-specific conditions (e.g., if the data indicate that exposures are associated with indoor sources rather than soil vapor intrusion). [See also Comments D.12.12 and D.12.15 for clarification on the intent of the actions recommended in Boxes 3 and 4 of the matrices.]

Comment D.12.10 (paraphrased, 8 commenters, 8 comments):

Several commenters noted that the matrices require mitigation if indoor air concentrations are below NYSDOH indoor air guidelines, below background levels or below detection limits, and concentrations are above a certain level in sub-slab vapor. Their comments submitted on this point are summarized as follows.

- [a] Why mitigation is required in these circumstances, especially if samples are collected during the heating season, is not clear.
- [b] Mitigation should not be necessary when existing conditions are adequate to protect the building air to levels far below indoor air guidelines.
- [c] Mitigation is not warranted, especially in cases where structure characteristics would substantially limit soil vapor intrusion potential.
- [d] Under these circumstances, why monitoring is not also an option as there are no current human health risks or exposures is not clear.

Response D.12.10:

- [a] Indoor air results collected when vapor intrusion is expected to have its greatest effect on indoor air quality (e.g., during the heating season) may indicate soil vapor intrusion is not occurring or is not affecting indoor air quality above the NYSDOH's air guidelines. However, as discussed in Section 1.2 of the guidance, both current and potential exposures should be considered when evaluating soil vapor intrusion at sites. Furthermore, the NYSDOH's air guidelines do not

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represent thresholds below which no actions are taken. The matrices reflect these points and summarize actions recommended, from a human health perspective, to address exposures related to soil vapor intrusion. For example, depending upon the sub-slab vapor concentration, monitoring or mitigation may be recommended to address both current exposures (e.g., indoor air concentrations are below air guidelines, but above background levels) and potential exposures (e.g., if indoor air concentrations are below background levels or not detected and sub-slab vapor levels are elevated) related to soil vapor intrusion. [See also Comments D.11.3 and D.12.9 for additional discussion on this issue.]

- [b and c] If current building-specific or site-specific conditions appear to be preventing or minimizing soil vapor intrusion satisfactorily, then additional mitigation actions may not be appropriate. These determinations are made on a case-by-case basis (as discussed in the Additional Notes section in both matrices). However, additional monitoring actions may be needed to make sure that the conditions continue to prevent or minimize exposures as much as possible (as discussed in the Monitor Note of each matrix). How these conditions are documented (e.g., physical tests, chemical tests, visual inspections, or a combination of these) is determined on a building-specific basis, with indoor air concentrations, sub-slab vapor concentrations, building features and operations, and other factors considered.
- [d] Mitigation is recommended in Boxes 13 through 15 in Matrix 1 and in Boxes 9 through 11 of Matrix 2 because sub-slab vapor concentrations represent a significant concern with respect to soil vapor intrusion should existing building conditions change. While routine confirmation that the conditions have not changed (i.e., monitoring) is appropriate in some cases (e.g., lower sub-slab vapor concentrations), mitigation is preferred in the referenced circumstances because it involves constant protection of the building.

Comment D.12.11:

Note 4 on both soil vapor/indoor air matrices indicates that if samples are collected outside of the heating season, it may be necessary to resample during the heating season to evaluate exposures "accurately." We suggest modifying this language to read, "it may be necessary to resample during the heating season to assess seasonal/temporal variability." We believe that use of the word "accurately" is not consistent with typical use of the term regarding data quality objectives. Likewise under note 3, the term "extreme" care should be replaced with appropriate care.

Response D.12.11:

Acknowledged. Note 3 on both matrices have been revised as recommended. Note 4 on both matrices has been revised to state that resampling may be appropriate during "worst-case" conditions, not just the heating season [see Comment C.5.1], to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

Comment D.12.12:

The footnote for the Monitor action indicates that monitoring is an interim step to address exposures related to soil vapor intrusion until contaminated environmental media are remediated. Not all conditions in the matrix that require "monitoring" will necessarily require remediation of the environmental media. For example, if the sub-slab concentrations are below the NYSDOH guidelines, there may be no source to remediate. This footnote should be clarified.

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Response D.12.12:

As a point of clarification, the matrices recommend actions to address current and potential exposures related to soil vapor intrusion. They do not dictate when remediation of subsurface environmental contamination is or is not necessary.

The use of the word "Monitor" in both decision matrices indicates (as described in the "Monitor" note) that monitoring is recommended to address exposures related to soil vapor intrusion. The exceptions are Boxes 3 and 4 in both matrices, where "Monitor" is employed in a more general sense to address exposures that may or may not be related to soil vapor intrusion. Boxes 3 and 4 of both matrices have been revised to rectify this inconsistency and to reflect the true intent of the recommendations given.

Comment D.12.13 (paraphrased, 1 commenter, 2 comments):

The matrices suggest that mitigation is required if sub-slab vapor is found at a concentration of 10 to 50 times the guidance values even when indoor air is not affected. Other studies, including data collected at the IBM Endicott site, demonstrate that attenuation factors on the order of 1,000 are appropriate for soil vapor to indoor air and in the range of 100 to 1,000 for sub-slab vapor to indoor air. Based on this information, we believe that where indoor air quality is acceptable during the heating season, only sub-slab detections in excess of 1,000 times the indoor air quality guideline warrant repeated monitoring of indoor air (and even that may be too stringent). Therefore, we request that each matrix be revised accordingly to use a 1,000x factor.

Response D.12.13:

An attenuation factor of 100:1 or greater was observed for many typical buildings sampled as part of the soil vapor intrusion investigation at the IBM Endicott site. Attenuation factors lower than 100:1 were also observed perhaps due to background or other confounding factors or due to adverse building conditions (major foundation penetrations, large pressure differentials, minimal air exchange, etc.). Since the collection of that data set, many additional soil vapor intrusion investigations have been conducted in New York State. While some of the results collected to date are consistent with the findings of the IBM Endicott data set, many results do not support the assumption that a default attenuation factor in the range of 100 to 1,000 for sub-slab vapor to indoor air is appropriate for use at all sites. The matrices reflect this point and have not been revised in response to this comment.

Comment D.12.14 (paraphrased, 1 commenter, 1 comment):

Any matrix used by the NYSDOH should include "mitigate" as an option in any quadrant where sub-slab or indoor air contamination levels are at or above detect. Other considerations can then be used to justify those situations where mitigation is not carried out.

Response D.12.14:

The NYSDOH believes the actions presented in the matrices are reasonable and protective of human health. The decision matrices are intended to summarize the actions recommended, from a human health perspective, to address exposures related to soil vapor intrusion. As discussed in Section 3.4.2 of the guidance and in Note 1 of Matrices 1 and 2, actions more protective of public health than those specified within the matrix may be proposed at any time. The commenter's proposed revision to the matrices (to use mitigation as a default action whenever a chemical is detected in either indoor air or sub-slab vapor, unless other actions can be justified) is not a

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responsible approach to protecting public health. Therefore, the matrices have not been revised in response to this comment.

Comment D.12.15 (paraphrased, 1 commenter, 1 comment):

The description of the mitigate action on the decision matrices is misleading, because it implies that all boxes labeled "mitigate" are related to exposures associated with vapor intrusion.

Response D.12.15:

The use of the word "Mitigate" in both decision matrices indicates (as described in the "Mitigate" note) that mitigation is recommended to address exposures related to soil vapor intrusion. The exception is Box 4 in both matrices, where "Mitigate" is employed in a more general sense to address exposures that may or may not be related to soil vapor intrusion. Box 4 of both matrices has been revised to rectify this inconsistency and to reflect the true intent of the recommendations given.

Comment D.12.16 (paraphrased, 1 commenter, 1 comment):

The decision matrix developed by the EPA Region 2 Superfund program is based solely on health-based concentrations that are developed to protect against either carcinogenic effects or non-cancer effects, as required by CERCLA and the NCP, and the increments (i.e., attenuation factors or cancer risk levels) between columns and rows remain constant between each row and/or column and for each chemical. In comparison to the general format developed by the EPA Region 2, the NYSDOH's concentration ranges in the decision matrices do not follow a linear pattern. We recommend the NYSDOH adopt a risk-based approach, like EPA's, to developing chemical-specific matrices.

Response D.12.16:

The matrices do not follow a linear pattern because they were developed with the consideration of several chemical-specific factors (as discussed in Section 3.4.1 of the guidance document). They were not developed based on health risks and default attenuation factors alone. As discussed in the response to Comment D.12.5, because the matrices are risk management tools that consider a number of factors, not just a chemical's toxicological properties, assignment of more than one chemical to a matrix may be appropriate. The matrices reflect the goal of reducing exposures in that actions to address exposures are recommended not only when the volatile chemical is detected above the NYSDOH's air guidelines, but also when it is detected above background concentrations. The NYSDOH believes that the actions recommended in the matrices are reasonable and protective of human health and that the matrices encompass a practical, multiple-lines-of-evidence approach to evaluating the data and selecting appropriate actions to address exposures. Therefore, the NYSDOH has not adopted the approach recommended in the comment.

Comment D.12.17:

It is unclear how the proximity of a building to identified subsurface contamination would modify the recommended actions in the matrices. Does this imply that more stringent actions could be imposed for buildings, regardless of the results of the exhaustive sub-slab and indoor air testing?

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Response D.12.17:

The matrices are general risk management tools used to guide decisions in the context of a particular site. As discussed throughout Section 3 of the guidance, sub-slab vapor and indoor air data do not by themselves determine whether actions are needed to address exposures related to soil vapor intrusion. Rather, these data are evaluated within a multiple-lines-of-evidence approach, in which many factors, including the proximity of a building to identified subsurface contamination, are considered. The example was intended to be representative of a situation where the sampling results may not be representative of long-term conditions (such as in the case of a recent spill) or may not be consistent with the conceptual site model. To avoid confusion, this example has been removed from the guidance.

Comment D.12.18:

We recommend that an option for site-specific risk assessment be included in the decision matrices as an option at any point in the decision process. This approach could be modeled on the "Tier 4" approach established in Title 14/Brownfield Act, which allows for site remediation to be conducted based upon site-specific risk assessments, if approved by the DEC commissioner.

Response D.12.18:

The NYSDOH considered human health risks when developing the guidance and the matrices. Section 3 of the guidance describes a risk management approach to addressing both current and potential exposures related to soil vapor intrusion that considers site-specific and building-specific conditions and is protective of human health. While site-specific risk assessment or statistical analyses of the data collected during a soil vapor intrusion investigation may be performed, decisions are not based on human health risks alone. The decision matrices have not been revised as recommended.

Comment D.12.19:

Though the guidance elsewhere mentions the possibility of remediation as a solution to vapor intrusion, the matrices and text should make it clear that in normal circumstances remediation — that is, source removal or treatment — is the only acceptable long-term solution to vapor intrusion. The response to vapor intrusion, where exposures are on-going, should include consideration of remedial technologies that accelerate removal or destruction of contamination. The matrices should clearly indicate that requirement.

Response D.12.19:

Agreed. The "monitor" note, the "mitigate" note, and Note 2 on both matrices speak to the remediation of contaminated environmental media. Therefore, no additional discussion of the topic has been added to the matrices as recommended in the comment. [See also Comment E.2.9 (source removal).]

Comment D.12.20 (paraphrased, 2 commenters, 2 comments):

Either the matrices need a list of applicable compounds in the header or an additional table should be added to cross-reference compounds with the applicable matrix. This will become especially important as the list of compounds and number of matrices grows.

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Response D.12.20:

Agreed. A table (Table 3.3) showing which chemicals correspond to which matrices has been added to Section 3.4.2 of the guidance.

Comment D.12.21:

You are the only agency, Federal or State, with such a matrix requiring both types of data.

Response D.12.21:

At the time the comment period ended (May 2005), EPA Region 2 had developed similar matrices relating sub-slab vapor concentrations to indoor air concentrations and recommendations for actions. In October 2005, the New Jersey Department of Environmental Protection released their finalized soil vapor intrusion guidance. Their guidance contains a remedial decision matrix to clarify the remedial action assessment better in regard to the relationship between sub-slab vapor and indoor air data.

### **D.13 TOPIC: Blanket mitigation approach**

Comment D.13.1:

Section 3.3.1: The "blanket mitigation" strategy (page 37) appears to describe the approach taken in Endicott. Homes were provided subslab ventilation system whether or not they had been tested individually. When I questioned if there is a way to know whether mitigation is working, without before-and-after monitoring, New York officials explained that they are able to verify the success of ventilation using statistical methods. That monitoring strategy is essential to blanket mitigation, and it should be explained, or at least offered as a case study, in the guidance.

Response D.13.1:

When any mitigation system is installed, its effectiveness and proper installation should be confirmed. Recommendations on post-mitigation or confirmation testing are provided in Section 4.3 of the guidance. In general, chemical testing is recommended in buildings where pre-mitigation testing was completed [see the discussion in Section 4.3.1.e], but physical testing is the primary means of confirming system operations -- whether the system was installed as part of a blanket mitigation approach or not.

A blanket mitigation approach has been applied at several sites in New York State, not just at the IBM Endicott site. The State does not intend to incorporate specific site data or approaches, into the guidance as this is inconsistent with the general approach and intent of the guidance. Therefore, the guidance has not been revised in response to the comment.

Comment D.13.2:

Regarding "blanket mitigation," it is unclear whether indoor air sampling is still required if the blanket mitigation approach is selected.

Response D.13.2:

Mitigation systems have been installed as part of a blanket mitigation approach on buildings that have not been sampled (sub-slab vapor, indoor air or outdoor air). From a health perspective, indoor air sampling is not necessary to determine whether action should be taken to address current exposures related to soil vapor intrusion because the sub-slab depressurization system will address existing and potential

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exposures that may be occurring. However, indoor air, outdoor air, and sub-slab vapor samples are needed to speak to exposures related to soil vapor intrusion if the property owner wants to know. Therefore, the State recommends that sampling be offered to property owners in a "blanket mitigation" area.

#### **D.14 TOPIC: Undeveloped parcels**

##### Comment D.14.1:

For every undeveloped site with a potential soil vapor issue, the issue cannot be resolved until after a new building is constructed and subslab vapor is tested. This will force every new building to include a soil vapor system, whether one is actually needed or not and for developers to deal with an open-ended risk issue after substantial capital funding has been committed. This will have a negative effect on the financing and backing for many redevelopment projects, since the viability/public perception of a redevelopment project will remain uncertain and in the hands of [NYS]DOH until sites have been redeveloped.

##### Response D.14.1:

The guidance is not intended to limit the development of sites, but to limit the potential for human exposure to volatile chemicals related to soil vapor intrusion. If volatile chemical contamination is a concern at an undeveloped site, steps should be taken to ensure that future construction will not create a situation where occupants would be exposed to the contamination. These steps may include investigation at a later date (post-development), incorporation of measures to mitigate exposures to soil vapor intrusion in the development process, remediation of subsurface environmental contamination, etc. The best approach for redeveloping a site while addressing concerns related to soil vapor intrusion should be determined on a case-by-case basis.

##### Comment D.14.2 (paraphrased, 1 commenter, 1 comment):

The guidance contains a broad definition of "potential exposure" that is not fully addressed in the guidance document. This creates difficulties. For instance, on sites where buildings have not been built, only groundwater or soil vapor data can be collected. The guidance does not allow this kind of data to be used to reach No Further Action. Instead, it specifies that you must have sub-slab, indoor air, and outdoor air data. Thus, there is no way to screen out sites that do not currently have buildings.

##### Response D.14.2:

Soil, groundwater, and soil vapor data may be collected from such sites. If volatile chemicals are not present, the soil vapor intrusion evaluation may be considered complete. If volatile chemicals are present, steps should be taken to ensure that future construction will not create a situation where occupants would be exposed to the contamination. These steps may include investigation at a later date (post-development), incorporation of measures to mitigate exposures to soil vapor intrusion in the development process, remediation of subsurface environmental contamination, etc. and are determined on a case-by-case basis. [See also Comment B.2.3 (potential exposures definition).]

##### Comment D.14.3:

There needs to be a way to resolve soil vapor evaluations prior to new construction based on an evaluation of actual development plans for a site and a valid scientific review of data and applicable risk-based criteria.

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Response D.14.3:

Soil, groundwater, and soil vapor data may be collected from such sites. If volatile chemicals are not present, the soil vapor intrusion evaluation may be considered complete. If volatile chemicals are present, steps should be taken to ensure that future construction will not create a situation where occupants would be exposed to the contamination. These steps may include investigation at a later date (post-development), incorporation of measures to mitigate exposures to soil vapor intrusion in the development process, remediation of subsurface environmental contamination, etc. and are determined on a case-by-case basis.

Comment D.14.4:

Although the draft guidance provides for the use of easements if a site will not be developed in the foreseeable future, it is not clear what criteria will be utilized for the investigation of such sites when development is pursued. The current draft Guidance focuses on the relationships between sub-slab vapors and indoor air contamination levels, which will not be applicable at undeveloped sites. The final Guidance should set out the criteria that will be used to determine whether there is a potential for vapor intrusion and, if so, what actions should be taken. For example, California's Vapor Intrusion Guidance provides engineering controls that need to be installed in any future buildings.

Response D.14.4:

At sites where remediation is being overseen by the State, environmental easements will be required to ensure that the evaluation of soil vapor intrusion occurs as properties are developed -- unless soil, groundwater and soil vapor data indicate the soil vapor intrusion evaluation may be considered complete (as discussed in the responses to Comments D.14.2 and D.14.3). The soil vapor intrusion guidance that exists at that time will be used in the investigation and evaluation. In our experience to date, soil vapor and groundwater sampling have not been shown to be reliable tools for predicting concentrations immediately beneath a slab or in the indoor air of a building. Therefore, the State does not support the use of default soil vapor or groundwater screening levels to make decisions regarding the potential for exposures in future buildings at this time.

Comment D.14.5 (paraphrased, 1 commenter, 1 comment):

The draft guidance requires assessment of "potential exposure" in unoccupied buildings and potential construction on vacant land (Section 2.2, pp. 7 to 8). This is a significant issue, especially at undeveloped parcels; it is unclear how one would establish likely exposure scenarios once a site is developed, raising concerns that site assessments based on potential exposures will not be applicable to actual site development. It is inappropriate to require a vapor intrusion assessment to account for unanticipated potential future uses of a site or structure. Institutional controls may be utilized as another tool, on a case-by-case basis, to prevent potential exposure and establish future use limitations. It is not necessary to consider all potential future use scenarios when investigating soil vapor. This process is currently used for soil and groundwater investigation/remediation and should also be applied to future soil vapor assessments/remedial actions.

Response D.14.5:

Section 2.2 of the guidance discusses the types of samples that are collected to investigate the soil vapor intrusion pathway, why the samples may be collected (i.e., what the results are used for), and generally when they are collected relative to one

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another. As discussed in Section 2.3, the State recognizes that a delay in the investigation of undeveloped parcels may be appropriate given the uncertainties associated with predicting the likelihood for exposure based on groundwater, soil and soil vapor data. Section 3.6 includes a discussion of the use of institutional controls. Both Sections 2.3 and 3.6 have been revised to include unoccupied buildings in the discussion. As discussed in Section 3.2.7, past, current and future lands uses (including land uses dictated by using institutional controls) should be considered when evaluating the investigation data and determining appropriate actions for further investigation or measures to address exposures. However, if current or future uses are unknown or are unrestricted, an approach that assumes residential use should be taken. Overall, the State believes that the guidance provides a reasonable and practical approach to evaluating soil vapor intrusion that is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns.

Note: For undeveloped parcels, institutional controls can be used to ensure that proper precautions are taken for future development. Actions taken to minimize or prevent exposures typically do not preclude the site from being used for a desired purpose or from being developed. Furthermore, the costs associated with installing a system at the time of a building's construction are often considerably less than the costs associated with retrofitting a system to the building after construction is completed. Section 1.5 of the guidance has been revised to emphasize these points.

Comment D.14.6 (paraphrased, 1 commenter, 2 comments):

Many contracts are structured so that a developer will only agree to develop a property once the owner has received a No Further Action Decision or Certificate of Completion from the State. There appears to be no avenue for issuance of a No Further Action Letter or Certificate of Completion for undeveloped sites. Therefore, implementation of this guidance will have significant impact on development of undeveloped properties in New York State. The guidance should provide a method for site closure for undeveloped properties.

Response D.14.6:

This guidance is intended for use in all of the State's environmental remediation programs, as well as for any other sites where soil vapor intrusion is a concern. The circumstances under which various milestones may be reached in remedial programs (such as a No Further Action letter or Certificate of Completion) depend on the program. In general, no further action or completion determinations will depend upon the nature and extent of subsurface contamination, what actions have been or are being taken to address exposures related to the contamination, and what actions have been or are being taken to address the environmental contamination. [See also Part D.15 (TOPIC: Site close-out — no further action or completion determinations).]

Note: For undeveloped parcels, institutional controls can be used to ensure that proper precautions are taken for future development. Actions taken to minimize or prevent exposures typically do not preclude the site from being used for a desired purpose or from being developed. Furthermore, the costs associated with installing a system at the time of a building's construction are often considerably less than the costs associated with retrofitting a system to the building after construction is completed. Section 1.5 of the guidance has been revised to emphasize these points.

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Comment D.14.7:

New development at potential vapor intrusion sites should not depend solely upon mitigation, be it vapor-resistant membranes or ventilation, to minimize the hazards of vapor intrusion. There is no guarantee that such mitigation will continue effectively over the life of the hazard. Therefore, maximum practical remediation should be required before structures are built. This approach is not only more health protective, but it may also be more cost effective over the life of the hazard.

Response D.14.7:

The State agrees that remediation of environmental contamination is the ultimate goal. The guidance emphasizes that mitigation or other recommended actions to prevent exposures related to soil vapor intrusion are considered to be interim measures to address exposures until contaminated environmental media are remediated, or until the action is no longer needed. Concurrent remediation and development of a site may be possible. The timing of remedial and site development activities (concurrent, consecutive, mixed, etc.) is determined on a site-specific basis.

Comment D.14.8 (paraphrased, 1 commenter, 1 comment):

The guidance's preference for monitoring and/or mitigation any time vapors will potentially exceed background will inhibit the much-needed development of brownfield sites. As the NYSDOH is aware, the Legislature has made the redevelopment of brownfield sites a priority. We recommend that absolute limitation on development absent abatement be limited to residential uses. Institutional controls that limit the use of such areas to industrial or commercial applications appear to be a sensible alternative to mandatory abatement.

We further recommend that the guidance be amended to ensure that NYSDEC is responsible for determining whether and what institutional controls are necessary, and that, for the purpose of soil vapor intrusion, such measures are only necessary if there is demonstrated contamination by soil vapor concentrations found to exceed, or are reasonably anticipated to exceed, guidelines in indoor air.

Response D.14.8:

The guidance is not intended to limit the development of sites, but to limit the potential for human exposure to volatile chemicals related to soil vapor intrusion. If volatile chemical contamination is a concern at an undeveloped site, steps should be taken to ensure that future construction will not create a situation where occupants would be exposed to the contamination. These steps may include investigation at a later date (post-development), incorporation of measures to mitigate exposures to soil vapor intrusion in the development process, remediation of subsurface environmental contamination, etc. The guidance does not place a limitation on development absent abatement (i.e., mandatory abatement) as stated in the comment. The best approach for redeveloping a site while addressing concerns related to soil vapor intrusion should be determined on a case-by-case basis. This determination should consider future land use; however, industrial and commercial uses may not change a recommendation for actions to address exposures related to soil vapor intrusion (as suggested in the comment). [See also Comments A.3.2 and D.5.9.]

At sites where remediation is overseen by the State, the NYSDEC, in consultation with the NYSDOH, is ultimately responsible for determining what institutional controls are necessary and for ensuring that those controls remain in place as long as they are necessary -- regardless of the environmental media. Furthermore, there are no prescribed concentrations of volatile chemicals in soil vapor that trigger a need for

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institutional controls. Therefore, the guidance has not been amended as recommended in the comment.

Comment D.14.9:

Use of environmental easements should pertain to vacant buildings as well as undeveloped parcels.

Response D.14.9:

Agreed. Section 3.6 of the guidance has been revised accordingly.

**D.15 TOPIC: Site close-out – no further action or completion determinations**

Comment D.15.1 (paraphrased, 3 commenters, 3 comments):

The guidance needs to provide clear criteria for a "no further action" determination. The current guidance only provides for this in the final step of the investigation process; exit criteria need to be provided at each step of the investigation.

Response D.15.1:

Overall, no further action determinations are made once the nature and extent of subsurface vapor contamination and any exposures associated with the contamination are identified and addressed appropriately. This is analogous to the investigation and remediation of other environmental media (e.g., groundwater, soil, etc.). With respect to soil vapor intrusion at a specific building, "no further action" is generally appropriate when the evaluation indicates that soil vapor intrusion is not occurring and the potential for it to occur is not expected. Sections 1.5, 2.5 and 3 (including Section 3.4, the decision matrices) of the guidance describe data and site characterization information needed to determine the appropriate next step at a given site. [See also Part A.17 (TOPIC: Exit strategies).]

Comment D.15.2 (paraphrased, 1 commenter, 2 comments):

Please clarify if it is the NYSDOH's intent that no further action is only recommended if volatile chemicals are not detected in indoor air. If it is, why?

Response D.15.2:

The guidance describes actions to reduce exposures and protect human health and does not indicate who is responsible for taking these actions. As indicated in the decision matrices, actions to take reasonable and practical actions to identify source(s) and reduce exposures may be recommended when concentrations of volatile chemicals are detected in the indoor air. However, this does not necessarily mean that the party doing the soil vapor intrusion investigation (e.g., PRP, Volunteer, etc.) is responsible for implementing the recommended actions. For example, the State does not expect a responsible party to address exposures related to releases from indoor sources alone (e.g., exposures to methylene chloride related to the storage of paint strippers in a basement). With respect to soil vapor intrusion at a specific building, "no further action" is generally appropriate when the evaluation indicates that soil vapor intrusion is not occurring and the potential for it to occur is not expected. [See also Part A.11 (TOPIC: Party responsible for investigating and taking action(s) to address exposures).]

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Comment D.15.3 (paraphrased, 2 commenters, 2 comments):

Section 3.3.2, as well as Section 3.4.3 and Matrix 1 and 2, all suggest that no further action can only be achieved if VOCs are not detected in indoor air. This decision will then be dependent on analytical method, laboratory, and improvements in detection limits over time. It would be more appropriate to allow no further action decisions if VOCs could not be discerned from a) a conservative background table value or b) the building-specific background levels based on the weight of evidence, or were less than a risk-based concentration, whichever was highest.

Response D.15.3:

As discussed throughout Section 3 of the guidance, many factors, not just indoor air data, are considered when determining whether additional actions (if any) are appropriate. Therefore, a "no further action" decision with respect to a specific building would not be made on the basis of indoor air data alone, regardless of how indoor air levels compare to background levels or guidance values. The guidance has not been revised in response to this comment. [See also Comment D.15.2.]

Comment D.15.4 (paraphrased, 1 commenter, 2 comments):

Section 3.4.3 states that no further action is warranted "when the volatile chemical is not detected in the indoor air sample and the concentration detected in the corresponding sub-slab vapor is not expected to substantially affect indoor air quality." No further action may be appropriate in other situations as well. No further action may be warranted if it is determined that the PRP is not responsible for the contamination which is affecting indoor air quality or that other indoor sources of volatiles are presenting more of a risk to human health. No further action also seems to be appropriate when volatile chemical concentrations in the indoor air are less than half of the NYSDOH's guidelines. No further action may be warranted where the responsible party has demonstrated that sub-slab vapor concentrations are below guidance values and there are low concentrations in indoor air. Responsible parties should not be required to pay for an elaborate monitoring program, particularly when both sub-slab and indoor air concentrations are below guidance values.

Response D.15.4:

We believe reasonable and practical actions should be taken to reduce exposures when indoor air levels are above background, even when they are below a guideline. However, the detection of a volatile chemical in the indoor air does not necessarily mean that the party doing the soil vapor intrusion investigation (e.g., the PRP, Volunteer, etc.) is responsible for implementing actions recommended to address exposures (see Comment D.15.2). With respect to soil vapor intrusion at a specific building, "no further action" is generally appropriate when the evaluation indicates that soil vapor intrusion is not occurring and the potential for it to occur is not expected. As discussed throughout Section 3 of the guidance, many factors, not just indoor air data, are considered during this evaluation.

Comment D.15.5 (paraphrased, 1 commenter, 1 comment):

The recommended minimum reporting limits for "no further action" for TCE (0.25), PCE (3.0) and 1,1,1-TCA (3.0) are significantly less than the 75<sup>th</sup> percentile of the EPA BASE background data for commercial buildings. Thus, a high percentage of tested commercial buildings with background levels of VOCs would be expected to require multiple rounds of testing prior to a no further action decision.

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Response D.15.5:

As stated in Section 3.3.3 of the guidance, "if the results are comparable to background levels, then no further action to address *current* human exposures is appropriate. However, additional sampling may be appropriate if samples were collected at times when soil vapor intrusion is not expected to have its greatest effect on indoor air quality..., the potential for exposures related to soil vapor intrusion should be monitored based on the sub-slab vapor results..., and/or subsurface conditions change over time (e.g., due to the migration of contaminated groundwater or vapors)."

Furthermore, the detection of a volatile chemical in the indoor air at a level above background does not necessarily mean that the party doing the soil vapor intrusion investigation (e.g., PRP, Volunteer, etc.) is responsible for implementing actions recommended to address exposures (see Comment D.15.2). [See also Comment D.15.3.]

Comment D.15.6 (paraphrased, 1 commenter, 2 comments):

The guidance does not provide for a "no further action" option even when site contamination (VOCs in groundwater, soil, soil vapor) has been established to be in steady concentrations (i.e., asymptotic levels).

Response D.15.6:

If volatile chemicals are present in the subsurface, even at steady state concentrations, then there is a continuing potential source of volatile chemicals to soil vapor. A no further action determination under these circumstances will depend upon the nature and extent of subsurface contamination, what actions have been or are being taken to address exposures related to the contamination, and what actions have been or are being taken to address the environmental contamination. Therefore, the guidance has not been revised in response to this comment.

Comment D.15.7:

The current guidance provides criteria for no further action based only on the observed relationship between measured sub-slab and indoor air VOC concentrations. As a result, it appears that both sub-slab and indoor sampling will be required at all sites where vapor intrusion investigations are conducted. In order to limit the scope of vapor intrusion investigations at sites where preliminary investigation results clearly indicate no potential for vapor intrusion impacts, additional criteria for no further action should be provided based on i) source characterization, ii) measured soil gas concentrations, and iii) evaluation of indoor VOC concentrations relative to typical background.

Response D.15.7:

To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring or is not expected to occur, the soil vapor intrusion investigation would be considered complete. The types of samples included in a soil vapor intrusion investigation are typically determined on a site-specific basis. However, if existing site data indicate that the potential for soil vapor intrusion exists, structure sampling (including the collection of sub-slab soil vapor, indoor air and outdoor air samples) is typically appropriate. The guidance has not been revised in response to this comment. [See also Comments A.8.1, C.2.1, C.3.3, C.19.2, and D.15.3.]

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Comment D.15.8 (paraphrased, 11 commenters, 12 comments):

The State should rely more heavily on soil vapor sample data and/or use soil vapor data to reach "no further action" decisions.

Response D.15.8:

Data collected to date at the investigation of sites throughout New York indicate that soil vapor concentrations do not follow a traditional "plume-like" pattern, can be highly variable across a site, and cannot accurately and reliably be used to predict or model expected sub-slab vapor or indoor air concentrations. Therefore, use of soil vapor data as a single determinant for additional investigation is not considered to be protective of public health. Rather, as discussed in Section 3 of the guidance, evaluation of soil vapor intrusion data involves a multiple-lines-of-evidence approach considering contamination in all environmental media and other site-specific conditions. [See also Comment D.15.1.]

Comment D.15.9:

We recommend that "no further action" decisions should be permitted if soil vapor concentrations predicted by properly conducted, site-specific modeling are confirmed (in select locations) by actual soil vapor data, and these concentrations are below EPA (2002) soil vapor screening levels, adjusted for non-residential building construction, air exchange rates, and building volume, or other factors, if applicable.

Response D.15.9:

The use of any model, in conjunction with soil vapor sampling, to justify taking "no further action" at sites without the collection of sub-slab vapor or indoor air samples is not recommended at this time. Rather, sub-slab vapor and/or indoor air data are more reliable and appropriate for evaluating the potential for human exposures related to soil vapor intrusion. Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site and building conditions and do not necessarily follow model predictions or correlate to soil vapor results. Therefore, the State does not believe that decisions based solely on modeling and/or soil vapor results are sufficiently protective of human health. The guidance has not been revised as suggested in the comment.

Comment D.15.10:

The draft guidance contains no specificity on how soil vapor sample results will be evaluated and how sites will get closed-out, except if VOCs are not detected in soil and groundwater. The "gray areas" in interpreting results will tend to keep sites in the system for on-going evaluation, at considerable expense, when there is no conclusive evidence that an actual soil vapor impact will ever be exhibited.

Response D.15.10:

Soil vapor results are not used as the sole determinant for closing out a site. Rather, the results are reviewed with the consideration of other factors, as discussed in Section 3 of the guidance. Recommendations for additional actions (investigation, mitigation, remediation, etc.) will depend upon site-specific and building-specific conditions. The guidance is intended to encourage the completion of soil vapor intrusion evaluations as efficiently and effectively as possible, not to keep sites in a never-ending cycle of investigation.

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Comment D.15.11:

This guidance should address sites in the Voluntary Cleanup Program or Brownfields Cleanup Program and under what circumstances a No Further Action Letter or Certificate of Completion will be issued if completion of groundwater remediation is not a viable option (such as in the case of regional groundwater contamination), or if soil vapor issues cannot be resolved until after a building is constructed.

Response D.15.11:

The guidance is intended to present generic steps and strategies that may be applied when approaching an investigation of soil vapor intrusion. The State recommends that the guidance be considered anywhere soil vapor intrusion is evaluated in the State of New York, whether the evaluation is undertaken voluntarily by a corporation, a municipality, or private citizen, or whether it is performed under one of the state's environmental remediation programs. To incorporate discussions of specific environmental programs, or program requirements, into the guidance would be inconsistent with the general approach and intent of the guidance. Therefore, the guidance has not been revised as suggested in the comment.

The circumstances under which a "no further action letter" or "certificate of completion" is issued will depend upon the specific environmental program. In general, no further action or completion determinations will depend upon the nature and extent of subsurface contamination, what actions have been or are being taken to address exposures related to the contamination, and what actions have been or are being taken to address the environmental contamination. [See also Comments D.14.2 and D.14.6.]

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## **PART E**

### **GUIDANCE SECTION 4: SOIL VAPOR INTRUSION MITIGATION**

#### **E.1 TOPIC: General comments on Section 4 of the guidance**

##### Comment E.1.1:

The department provides a broad overview of the methods of mitigation and the installation and design of mitigation systems. Additionally, the guidance provides a thorough outline for the operation and maintenance and monitoring of mitigation systems and the annual certification and notification requirements.

##### Response E.1.1:

Comment noted.

#### **E.2 TOPIC: Methods of mitigation for soil vapor intrusion**

##### Comment E.2.1 (paraphrased, 1 commenter, 1 comment):

We support the use of sub-slab depressurization systems, equivalent to radon mitigation systems, to remove soil gas vapors from beneath a building's slab and into ambient air at brownfield and other remediation sites to address soil vapor buildup. We believe such radon-equivalent mitigation systems as opposed to remediation systems can be built and installed at reasonable cost and effectively reduce exposures where mitigation is warranted.

##### Response E.2.1:

Comment noted.

##### Comment E.2.2 (paraphrased, 5 commenters, 9 comments):

Mitigation methods required by the NYSDOH, as presented in Section 4.1, are not always technically or financially feasible, may not be the most appropriate means of control, and may create or amplify other vapor migration pathways. Other methods that are effective at mitigating exposures, such as crawl space venting and sealing (listed as secondary choices in the guidance), may be more easily implemented and may provide more consistent results.

The NYSDOH should

- [a] allow the use of all available and useful mitigation methods, such as vapor barriers, moisture barriers (e.g., Liquid Boot), passive venting systems, or sealing alone; and
- [b] provide other options that may be considered.

##### Response E.2.2:

The methods described in the guidance are strongly recommended due to their proven effectiveness. However, we acknowledge that in certain circumstances other technologies may be appropriate. To clarify this, the following text has been added to the opening paragraph of Section 4.1 of the guidance: "This section describes methods of mitigation that are expected to be the most reliable options under a wide range of circumstances. Occasionally, there are site-specific or building-specific conditions under which alternative methods (such as HVAC modification, sealing, room

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pressurization, passive ventilation systems, or vapor barriers) may be more appropriate. Such mitigation proposals may be considered on a case-by-case basis."

In response to the specific issues above:

- [a] Due to their effectiveness, energy-efficiency and ease in monitoring, the State prefers the installation of sub-slab depressurization (SSD) systems to prevent vapor intrusion and subsequent human exposures. However, the State acknowledges throughout Section 4.0, that the installation of a SSD systems may not be feasible or practical in all circumstances. Alternative mitigation methods, including HVAC modification, sealing, room pressurization, or vapor barriers, may be considered if they are installed and maintained in accordance with the EPA's radon guidance (where applicable) and if the effectiveness can be documented and maintained for as long as the potential for soil vapor intrusion exists at the structure. All proposed mitigation technologies will be reviewed on a case-by-case, site-by-site basis.
- [b] More detailed information regarding alternative mitigation technologies can be found on the EPA's radon web site at <http://www.epa.gov/iaq/radon/pubs/index.html>.

Comment E.2.3:

The Guidance indicates that an active sub-slab depressurization system (SSD system) "must" be used in buildings with a basement slab or slab-on-grade. We suggest modifying this sentence to read "must be used in buildings with a basement slab or slab-on-grade, unless it can be demonstrated that an alternative engineering design, such as a positive pressure HVAC system, can be installed and operated to effectively mitigate vapor intrusion."

Response E.2.3:

The text in Section 4.1.1 of the guidance has been changed to read, "...an active *sub-slab depressurization system* (SSD system) is the preferred mitigation method for buildings with a basement slab or slab-on-grade foundation."

Comment E.2.4:

The Guidance indicates that a soil vapor retarder with sub-membrane depressurization (SMD) system must be used in buildings with a crawlspace foundation. We suggest modifying this sentence to read "must be used in buildings with a crawlspace foundation, unless it can be demonstrated that an alternative engineering design can be installed and operated to effectively mitigate vapor intrusion."

Response E.2.4:

The text in Section 4.1.2 of the guidance has been changed to read, "A *soil vapor retarder with sub-membrane depressurization (SMD) system* is the preferred mitigation method for buildings with a crawl space foundation."

Comment E.2.5:

We propose the following text change (shown in **bold**) to Section 4.1.1(b): *Soil vapor extraction (SVE) system* — a technique used to remediate contaminated subsurface soil vapor. SVE systems use high flow rates **or induced pressures or both** to collect and remove contamination, while SSD systems use a minimal flow rate to effect the minimum

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pressure gradient (0.004 inch water) needed to reverse air flow across a building's foundation.

Response E.2.5:

The text in Section 4.1.1(b) has been revised to read "SVE systems use high flow rates, induced vacuum or both to collect and remove contamination..." With regard to the minimum pressure gradient, EPA's radon guidance (EPA 1993) recommends negative pressure of 0.025 to 0.035 inches of water for mild weather and no exhaust fans running to provide a cushion for building exhaust and weather challenges and negative pressure of 0.001 to 0.002 inches of water if weather is cold and exhaust fans are on during the system test. There is no basis for changing the guidance to 0.004.

Comment E.2.6 (paraphrased, 3 commenters, 2 comments):

Use of passive ventilation systems should be seriously considered since, under certain site conditions, they can be as or more effective than active systems. Furthermore, the guidance should be revised to state that sub-slab vapor control systems can remain passive until it is proven by indoor air sampling that activation of the system is needed to control soil vapor entry.

Response E.2.6:

Passive venting is not recommended due to the competing pressures from various sources and forces that can cause vapor flow one way or the other. Further, active sub-slab depressurization reduces the number of depressurization pits that might otherwise be necessary for a passive system. As such, the guidance continues to recommend the use of sub-slab depressurization systems. If sampling demonstrates that an alternate mitigation method may be appropriate given building-specific or site-specific conditions, the method will be considered. Section 4.1 has been revised to clarify this point.

Comment E.2.7 (2 commenters, 1 comment):

*Recommended depressurization methods are expected to be less than effective.* Section 4.1.1 describes methods for achieving depressurization beneath a slab. Included in this description are the use of drain tile, sump hole, and block wall suction. In contrast to recommendations by NYSDOH, it has been our experience that these points will have limited effectiveness, especially if they are not a conduit or path for infiltration. In particular, drain tiles and sump holes are not usually tightly sealed to the slab and by allowing water movement, would not usually be effective in generating a pressure field across even a short distance. Given that the effectiveness of these methods to generate a wide pressure field is doubtful, they should be given much lower prominence and priority as a potential mitigation method. If NYSDOH has examples where these types of holes have been used successfully, this information should be made publicly available.

Response E.2.7:

The EPA, in their "Consumer's Guide to Radon Reduction" (EPA 402-K-03-002; revised February 2003), lists these approaches as ways to reduce radon levels in a building, either in place of the more common sub-slab suction point method or in conjunction with that method. The depressurization approach, or combination of approaches, selected should be determined on a building-specific basis. For example, if the contaminants are entering the building through a block wall, block wall suction in conjunction with traditional sub-slab depressurization may be more effective at

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minimizing exposures related to soil vapor intrusion rather than sub-slab depressurization alone. Reference to the EPA's document has been added to Section 4.1.1 of the guidance.

Comment E.2.8 (paraphrased, 1 commenter, 2 comments):

The guidance states that engineering controls are considered temporary measures until source removal permanently addresses the potential vapor intrusion pathway. However, source removal is not always necessary to address vapor intrusion concerns. Furthermore, in some situations, source removal may not be feasible due to ownership issues (i.e., a leased property) or other issues (e.g., access restrictions, financial considerations, etc.). Engineering controls that mitigate vapor intrusion should be acceptable in lieu of source removal.

Response E.2.8:

As building and environmental conditions may change over time, source removal is the most reliable method to minimize current and potential exposures associated with vapor intrusion. As with all environmental media, sources of vapor contamination should be removed or eliminated to the extent feasible. The guidance continues to state that implementation of a mitigation system is considered to be an interim measure to address exposures until the contaminated environmental media are remediated, or until the system is no longer needed to address exposures related to soil vapor intrusion.

Comment E.2.9 (paraphrased, 1 commenter, 1 comment):

We recommend that source removal be included in the discussion of soil vapor intrusion mitigation.

Response E.2.9:

Given that soil vapor is an environmental medium of concern, source removal is the ultimate remedial goal. Mitigation or other recommended actions are considered to be interim measures to address exposures until the source is remediated, or until such actions are no longer needed to address exposures related to soil vapor intrusion. Text has been added to the introduction of Section 4 in the guidance to reflect this concept.

Comment E.2.10:

Section 4.1.5 describes what to do when "...sampling results indicate a need to mitigate exposures in buildings that may be constructed..." Since there are no buildings, the samples cannot be indoor air or sub-slab. Thus it is assumed the samples would be soil vapor or groundwater. It is unreasonable to base a decision to mitigate buildings that do not yet exist based on sampling and modeling that may not be used to determine No Further Action.

Response E.2.10:

A decision to install mitigation systems in new construction can reasonably be made, because such a decision can readily be shown to be protective of human health. Developers, property owners, or other parties often choose to incorporate systems into new construction, particularly for a property at which subsurface vapor contamination has been detected or is suspected. The recommendations in Section 4.1.5 should be followed when mitigation systems are planned as a component of new construction.

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Comment E.2.11 (paraphrased, 2 commenters, 2 comments):

The guidance should not restrict mitigation options for undeveloped parcels to SSD or SMD systems. While these systems are commonly the most cost-effective, it is premature to dictate designs when nothing is known about the use, construction, or operation of the future building. We suggest modifying Section 4.1.5 to state that these systems "must be used based upon the design of the proposed buildings, unless it can be demonstrated that an alternative engineering design can be installed and operated to effectively mitigate vapor intrusion." This allows for engineering judgment during the design process, yet recognizes the need to meet a rigorous performance standard, namely, effective mitigation of vapor intrusion.

Response E.2.11:

The guidance recommends active depressurization systems in this situation, although other mitigation methods that would prevent exposures to future occupants of the site can be considered. The text of Section 4.1.5 in the guidance has been modified to state that "...a SSD system with sealing, or a SMD system with a soil vapor retarder, or a combination of these methods is recommended, as appropriate to the design of the proposed buildings."

Comment E.2.12:

The slab-attenuation factor is highly site specific. Sufficient sub-slab and indoor air data have been collected by EPA (Truesdale et al. 2005) and NYDOH (McDonald and Wertz, 2005) to support high slab attenuation (>100) or even greater (>1000) at some sites, especially if sealing work has been performed. It is not clear whether additional measures beyond sealing work (e.g., active mitigation – sub-slab depressurization, HVAC pressurization) would be required at sites where indoor air concentrations are below human health risk-based levels, yet sub-slab concentrations are > 1000x human health risk-based levels. In these cases, active systems may not be needed.

Response E.2.12:

Data collected thus far in New York State do not support the development and use of default attenuation factors (as suggested) that would be generally applicable and protective at sites throughout the state [See also Comments A.8.1 and D.12.9 (default attenuation factors)]. Therefore, the guidance recommends that active systems be used in these situations. An active system, when combined with sealing work, is far more reliable than sealing alone and provides an added measure of protection against changing building and environmental conditions.

### **E.3 TOPIC: Design and installation of mitigation systems**

Comment E.3.1:

Section 4, paragraph 2 — Substituting "as soon as reasonably possible" for "without delay" would allow for reasonable flexibility.

Response E.3.1:

Acknowledged. The guidance has been revised as follows: "Once it is determined that steps should be taken to address exposures associated with soil vapor intrusion, they should be implemented with all due expediency."

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Comment E.3.2 (paraphrased, 3 commenters, 6 comments):

There are too many references to the similarities between vapor intrusion mitigation systems and radon mitigation systems. Radon mitigation contractors are not necessarily qualified to design and install effective vapor-intrusion mitigation systems. Vapor intrusion systems must be designed by evaluating a number of property-specific parameters pertaining to building design and construction and geological conditions. The State should consider developing specific design protocols and a proficiency program for installers of vapor intrusion mitigation systems.

Response E.3.2:

The design standards for radon mitigation systems and vapor intrusion mitigation systems are essentially the same. Radon mitigation contractors have received the minimum training needed to address the basic system design and installation concepts. The State considers established EPA radon mitigation protocols to be sufficient for the design and construction of vapor intrusion mitigation systems. No additional design manuals are planned for development at this time. The State does not currently have a proficiency program for radon mitigators and has no plans for doing so for soil vapor intrusion mitigation or differentiating between the two.

Comment E.3.3 (2 commenters, 1 comment):

Specific recommendations are needed for sealing materials. Section 4.2.2 lists several sealing materials that can be used as part of a mitigation system. As currently presented, the list of recommendations is too vague to provide any useful information. The Vapor Intrusion Guidance should be revised to provide example sealing materials or specific references.

Response E.3.3:

The document provides examples of types of sealants, but it does not provide a list of specific sealants to be used. It would be outside the scope of this document to provide list of specific materials or products for use in sealing or other components of mitigation systems. The designer and installer of a mitigation system is responsible for specifying and using appropriate materials. A sentence has been added to Section 4.2.2(a) of the guidance advising that some effective sealants may contain volatile organic compounds, which may be a consideration in choosing an appropriate sealing material.

Comment E.3.4 (paraphrased, 1 commenter, 1 comment):

Section 4.2.2.b.2 — Seams in vapor-retarding membranes should be thermo-sealed rather than solvent- or mastic-sealed.

Response E.3.4:

The guidance does not recommend a specific sealing method. Seams should be sealed using manufacturer-approved materials and processes.

Comment E.3.5:

The following sentence should be added at the end of Section 4.2.2(c)(3): "Based on communication test results, multiple suction points may be required to achieve the required effectiveness of the vapor intrusion mitigation system."

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Response E.3.5:

Acknowledged. Section 4.2.2(c)(3) of the guidance has been revised as follows:  
"Depending on test results, multiple suction points may be needed to achieve the desired effectiveness of the system."

Comment E.3.6:

We propose the following text change (shown in **bold**) to Section 4.2.2(c)(5): The vent fan and discharge piping must not be located in or below a livable or occupied area of the building to avoid entry of subsurface vapors into the building in the event of a fan **or pipe** leak.

Response E.3.6:

Agreed. Section 4.2.2(c)(5) of the guidance has been revised accordingly.

Comment E.3.7:

The guidance should permit conducting smoke or pressure tests at the time of system installation, rather than requiring such tests before hand. In many cases, it is more efficient to install a system using standard design configurations based on prior experience in an area, to test the system as installed, then to upgrade the system (by installing additional suction points or a larger fan) if required. From a practical standpoint, there are often few choices for locating the primary system due to house construction and finished areas, and no advantage is gained by making two trips to a building to install a system. When a large number of houses need to be mitigated in a short time frame, experience has shown this to be a very effective approach to design and installation of radon systems.

Response E.3.7:

Acknowledged. The mention of testing performed prior to system installation is as part of a discussion of the steps involved in system design and installation [Section 4.2.2.c.3 of the guidance]. We agree that these tests can be performed at the time of installation with the ultimate goal of having an adequate mitigation system.

Comment E.3.8 (2 commenters, 1 comment):

*Smoke testing is not an effective method.* Contrary to recommendations in the Vapor Intrusion Guidance, smoke testing is generally not the most effective means to identify small cracks or identify pressure changes. In most cases, the leak may be very small so placing a smoke source on the high pressure side and seeing it on the other side is highly unlikely. Any leak identified using this approach would be large enough to detect without smoke testing. Instead, we recommend using a hot-wire anemometer or tracer gas (Freon, SF6) to detect draft leaks. Overall, the best confirmation test is subsequent testing for exposure. If it is sufficiently low, the goal is achieved. Similarly, as identified in Section 4.3.1.c, a micro manometer is the only acceptable method for detecting pressure changes. Based on these recommendations, the text should be revised to eliminate discussion of smoke testing and provide other more quantitative methods for evaluating mitigation systems.

Response E.3.8:

Smoke testing, in addition to other methods, is effective for demonstrating a pressure field extension in test holes. Although it is advantageous to seal larger openings and others to the best extent practicable, small cracks are unlikely to adversely alter the

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effectiveness of the system operation, especially if a pressure field extending under the entire slab is demonstrated. Therefore, the discussion of smoke testing has not been removed from the guidance. Other methods, such as those mentioned in the comment, may also be used to test a system.

Comment E.3.9 (2 commenters, 1 comment):

*The discussion of crawlspace ventilation is unclear.* Section 4.2.2.e.2 describes the requirements for crawlspace ventilation. However, as currently worded, the requirements are confusing and unclear. It appears that NYSDOH meant to say that air in the crawlspace should be prevented from entering into building spaces.

Response E.3.9:

The intent of the recommendation is actually to prevent conditioned indoor air from being drawn into the crawl space, as well as to prevent the reverse. While drawing indoor air into a crawl space is not likely to affect indoor air quality, it has the potential to impart a substantial increased heating/cooling cost and should be avoided. Section 4.2.2.e.2 has been revised as follows: "Openings and cracks in floors above the crawl space that would permit conditioned air to pass into or out of the occupied spaces of the building, should be identified, closed and sealed."

#### **E.4 TOPIC: Emissions from mitigation systems**

Comment E.4.1 (paraphrased, 5 commenters, 5 comments):

Comments regarding the need for permitting and emissions controls on mitigation systems were as follows:

- Emission controls on such systems would likely be neither warranted for the protection of public health or the environment nor cost-effective, and should not be required by the State;
- Chemicals are being removed from the ground and put into the outdoor air. We want to breathe clean air. It is our right. Protect us. Install state of the art filters on all the sub-slab depressurization systems; and
- Sub-slab depressurization systems result in a transfer of contaminants from one medium (soil vapor) to another (air), a practice typically not accepted by the NYSDEC. Clarification is needed on the NYSDEC's position on this issue, as well as whether permitting will be necessary.

Response E.4.1:

Mitigation systems related to sites in the State's Inactive Hazardous Waste Program, the Environmental Restoration Program, or Brownfield Cleanup Program would be exempt from obtaining permits in accordance with the laws and regulations governing these programs. Even outside of these programs, mitigation system exhausts would qualify as trivial activities under Part 201 and permits would not be required. However, air controls (such as vapor phase carbon) may be required if reduction in emissions is necessary to protect human health and the environment. Part 212 is the applicable air regulation that specifies when such controls are required.

To date, our evaluations of these exhausts have concluded that controls are not necessary. An ambient air quality study is currently being conducted to evaluate our assessment that these systems are not expected to cause unacceptable levels in the

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outdoor environment. If the results of the study indicate otherwise, appropriate actions will be taken.

## **E.5 TOPIC: Post-mitigation or confirmation testing**

### Comment E.5.1 (paraphrased, 1 commenter, 2 comments):

Given the potential complicating factors associated with indoor air results (e.g., current use of products/materials and outdoor air influences), indoor air sampling should not necessarily be required as proof that a sub-slab depressurization system is effective, nor should it be required to demonstrate that the system is no longer necessary. More emphasis should be placed on demonstrating system performance through other means.

#### Response E.5.1:

The State acknowledges that there are several factors that demonstrate the effectiveness of a SSD system in preventing soil vapor intrusion. As discussed in Section 4.3.1 of the guidance, physical testing is relied upon in all cases and chemical testing in most cases. Where chemical testing is conducted, the sampling should include the completion of a thorough product inventory to assist in identifying products that may interfere with indoor air sampling as described in Section 2.11.2.

### Comment E.5.2 (paraphrased, 3 commenters, 2 comments):

Should a mitigation system be installed, post-mitigation sampling should be discontinued once it is shown that the system is working properly.

#### Response E.5.2:

The extent of post mitigation sampling is determined on a site-by-site basis using the guidance provided in Section 4.

### Comment E.5.3 (paraphrased, 2 commenters, 1 comment):

Additional information on post-mitigation testing is needed. Section 4.3 provides no guidance on the amount or duration of samples needed.

#### Response E.5.3:

As stated in Section 4.4.1 of the guidance, "generally air monitoring is not required if the system has been installed properly and is maintaining a vacuum beneath the slab." However, since the design and installation of each system is different, there is no pre-established number of post-mitigation sampling events necessary. This is determined on a site-by-site or building-specific basis. Post-mitigation sampling protocols should be consistent with the guidance provided in Section 2.7.

### Comment E.5.4 (paraphrased, 2 commenters, 5 comments):

Section 4.3.1(e): The text that reads "at a minimum, post-mitigation indoor and outdoor air sampling must be conducted in buildings where pre-mitigation samples were collected..." should be changed. The phrase "must be conducted" should be changed to "may be conducted, if required by the State." Alternatively, the phrase "at a minimum" should be replaced with "except as indicated below," to call the reader's attention to the fact that, depending upon the extent of the vapor intrusion mitigation, it may not be necessary to sample indoor air at every location where a mitigation system is installed.

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Similar text changes should be made to Sections 4.3.2 (SMD Systems with Soil Vapor Retarder), 4.3.3 (HVAC Modifications), and 4.3.4 (Crawl space Ventilation with Sealing).

Response E.5.4:

Acknowledged. The phrase "at a minimum" in Section 4.3.1 of the guidance has been changed to "except as indicated below." Text in Sections 4.3.2, Section 4.3.3 and 4.3.4 refers to Section 4.3.1. When HVAC modifications have been made, post-mitigation air sampling is recommended at each affected structure, as HVAC modification is not considered a "blanket mitigation" approach.

Comment E.5.5 (2 commenters, 1 comment):

*Performance of a soil vapor extraction (SVE) system should be based on vapor sampling results.* Section 4.2.2.f.3 indicates that performance of an SVE system will be judged based on the system radius of influence. Certainly, the radius of influence is one measure that is useful in evaluating the effectiveness of the SVE system; however, decisions should not be based only on this information. More importantly, the SVE system should be judged based on its ability to remove the vapor intrusion pathway and prevent the volatilization of VOCs into indoor air. This may be confirmed with post-mitigation sampling.

Response E.5.5:

There are several ways to assess the effectiveness of an SVE system in mitigating vapor intrusion, one of which is post-mitigation indoor air sampling. However, it is generally recommended that the radius of influence of an SVE system be measured to ensure that the system is addressing the building(s) in need of mitigation. As the discussed in Section 4.2.2.f.3 of the guidance, if a system's radius of influence does not completely extend beneath a building, a complementary air monitoring program may be the appropriate way to confirm that exposures are being addressed adequately.

Comment E.5.6:

...So if you find TCE levels in a home above .38 micrograms [per cubic meter], the guidance number the EPA is using here at my site [Hopewell Precision site], please install the mitigation system! Then test the air 1 year later.

Response E.5.6:

Risk management decisions are made on a site-specific basis. In some cases, blanket mitigation may make sense, in others it may not. The decisions to mitigate and monitor are not only based on the results from individual structures, but also on the overall context of the site (including nature and extent of soil gas and groundwater contamination).

As discussed in Section 4.3.1.e of the guidance, we recommend that post-mitigation sampling be conducted no sooner than 30 days after installing a sub-slab depressurization system.

Comment E.5.7:

It may not be practicable to seal all leaks in a finished room. This should not be required if other tests (e.g., indoor air tests) indicate that performance is satisfactory.

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Response E.5.7:

Acknowledged. Sections 4.3.1, 4.3.2 and 4.3.4 of the guidance have been revised as follows: "Reasonable and practical actions should be taken to identify and fix leaks." However, the presence of identified, inaccessible leaks may indicate a need for a more substantial post-mitigation indoor air-monitoring program.

Comment E.5.8 (paraphrased, 1 commenter, 2 comments):

We propose the following text change (shown in **bold**) to section 4.3.1(b): Therefore, in buildings with natural draft combustion appliances, the building must be tested for backdrafting of the appliances. **Delete "If necessary,"** The backdrafting condition must be corrected before the depressurization system is placed in operation. Similar changes are recommended for Sections 4.3.2(b), 4.3.3(b), 4.3.4(b), and 4.3.5(a).

Response E.5.8:

Agreed. The guidance has been revised accordingly.

## **E.6 TOPIC: Operation, maintenance and monitoring of mitigation systems**

Comment E.6.1:

Section 4.4.1 states "If significant changes are made to the system or when the system's performance is unacceptable, the system may need to be redesigned and restarted. Many, if not all, of the post-mitigation testing activities, as described in Sections 4.3.1 and/or 4.3.2, may need to be performed." The document should indicate how it is determined that a system's performance is "unacceptable."

Response E.6.1:

Measures of system performance are described in Section 4.3 of the guidance.

Comment E.6.2:

Section 4.4.2 states "For other mitigation systems (e.g., HVAC modifications, crawlspace ventilation, etc.), routine maintenance activities are generally comparable to post-mitigation testing activities [Section 4.3]. Activities typically include a visual inspection of the complete system, and identification and repair of leaks. System performance checks, such as vacuum of suction points, also should be performed." The State should require similar quantitative performance measurements for sub-slab depressurization systems to verify the continued effective operation of the systems. These measurements would be "generally comparable to post-mitigation testing activities" i.e., sub-slab communication testing.

Response E.6.2:

The maintenance activities for SSD and SMD systems (described in Section 4.4.1) do include visual inspection and repair of leaks. The other component is an inspection of the warning device or indicator. The device or indicator is intended to warn building occupants if the system stops functioning properly (that is, it is no longer maintaining an adequate pressure gradient across the slab). Ensuring proper functioning of the device or indicator is considered to be a check on the system's performance.

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Comment E.6.3:

The guidance should also recommend procedures to identify changes made to buildings (such as building additions, heating systems, etc.) that can affect mitigation system performance.

Response E.6.3:

Section 4.4.3 of the guidance describes some of these changes. A reference to Table 1.2 (building factors that may affect vapor intrusion) has been added to this section because significant changes to any of these factors may affect system performance.

## **E.7 TOPIC: Termination of mitigation system operations**

Comment E.7.1 (paraphrased, 1 commenter, 1 comment):

The NYSDOH should allow discontinuation of operating a mitigation system once it is established (via a risk-based evaluation of soil vapor or sub-slab concentrations) that public health will be protected in the absence of the mitigation system.

Response E.7.1:

The appropriate time to discontinue operating a mitigation system is determined by following the guidance provided in Section 4.5 and by using the guidance provided in Section 3 to evaluate data and information supporting the proposal to discontinue a mitigation system.

Comment E.7.2 (paraphrased, 1 commenter, 1 comment):

The NYSDOH (or NYSDEC) should define: After a building is occupied and future sub-slab monitoring is no longer possible, when can this non-permitted, unregulated [sub-slab depressurization] system be shut off?

Response E.7.2:

Section 4.5 provides guidance as to the termination of mitigation systems. Sub-slab monitoring of occupied buildings is routinely conducted and does not present a significant interference to occupants.

Comment E.7.3:

The draft guidance states that operation of mitigation systems (p. 60 to 61) can be terminated if there is no "significant" impact on indoor air after the system is turned off, or if residual contamination in subsurface vapor "is not affecting indoor air quality." These vague criteria provide no clear guidance to either the state, the PRP, or the property owner. They should be replaced with specific criteria, such as the achievement and maintenance of the higher of AVGs or background levels.

Response E.7.3:

Section 4.5 states that a number of factors are considered in deciding whether to terminate operation of a system. One of these factors is whether any residual contamination is affecting indoor air quality with the system turned off; however, there are many other considerations, as well. There are no specific criteria that can be applied generically to all sites. The appropriate time to discontinue operating a mitigation system is determined by following the guidance provided in Section 4.5 and

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by using the guidance provided in Section 3 to evaluate data and information supporting the proposal to discontinue a mitigation system.

Comment E.7.4 (2 commenters, 1 comment):

NYSDOH must provide additional clarification on discontinuing mitigation systems. Section 4.5 discusses the factors that will be considered prior to discontinuing a vapor mitigation system. Although the Vapor Intrusion Guidance lists the factors that must be considered, these factors are sufficiently vague as not to provide any clear guidance. For example, NYSDOH does not specify how the determination that "subsurface vapors have been remediated" will be made. Will this require indoor air sampling and a comparison to background concentrations? Or will it be sufficient to collect soil vapor or sub-slab data? NYSDOH should base the decision to turn off a mitigation system on a risk-based evaluation of soil vapor or sub-slab concentrations. The ultimate goal of the mitigation system is to protect public health. As a result, turning off the system should be based on whether public health will continue to be protected in the absence of the mitigation system.

Response E.7.4:

As stated in Section 4.5, "Systems should remain in place and operational until they are no longer needed to address current or potential exposures related to soil vapor intrusion." This approach is protective of public health. The type and amount of sampling needed to make this determination is made based on the conditions at each individual site. Data and information gathered in support of a proposal to terminate the operation of a system are evaluated by using the guidance provided in Section 3.

Comment E.7.5:

In Paragraph d at page 60 of this subsection [Section 4.5], the Guidance indicates that the decision to terminate mitigation system operation depends in part upon indoor air, outdoor air and sub-slab vapor sampling from the building over a time period, which will depend upon site-specific conditions. We suggest changing the words "will depend on site-specific conditions" to "may be required depending upon site-specific conditions." This allows flexibility in determining whether or not vapor intrusion-related indoor air sampling is necessary at a given location to support termination of mitigation system operation.

Response E.7.5:

The paragraph referred to in the comment says that one criterion for termination is that "there is no 'rebound' effect that requires additional mitigation efforts observed when the mitigation system is turned off for prolonged periods of time." Samples of indoor air, outdoor air, and/or sub-slab vapor would be necessary to verify this. The length of time needed to determine that there is no rebound may depend on site-specific conditions. Therefore, the text in Section 4.5.d of the guidance has been revised as follows: "This determination should be based upon indoor air, outdoor air and/or sub-slab vapor sampling from the building over a time period, determined by site-specific conditions."

Comment E.7.6:

We propose the following text change (shown in *italics*) to Section 4.5: Given the prevalence of radon throughout the State of New York, consideration should be given to leaving the system in place and operating to address exposures related to radon intrusion *if radon testing indicates radon concentrations above regulatory standards*. After concurrence

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is reached that the system is no longer needed to mitigate exposures related to soil vapor intrusion.

Response E.7.6:

Neither the State nor the federal government has a regulatory standard for radon, but the State generally follows EPA guidance for radon. People may wish to have the protection of a system regardless of current radon levels. The discussion on leaving the system in place with the owner's permission at the end of Section 4.5 remains unchanged.

**E.8 TOPIC: Annual certification and notification**

Comment E.8.1 (2 commenters, 1 comment):

After first refusal, property owners should be responsible for requesting mitigation. The Vapor Intrusion Guidance (Section 4.6) currently requires responsible parties to re-offer mitigation systems to property owners on an annual basis, if they initially refuse such a system. We disagree with this approach. If an owner refuses to have a system installed, it should be the owner's responsibility to request the system in the future. The offer should be valid until environmental conditions change and mitigation is no longer warranted.

Response E.8.1:

The State agrees that the offer to mitigate should continue until environmental conditions change and mitigation is no longer necessary. However, the State does not agree that it should be the property owner's responsibility to contact a responsible party, etc. in the future if a system is desired. Change in property use and ownership may leave a property owner uninformed; therefore, the responsible party should contact the property owners on a yearly basis until such time as a system is no longer needed to address exposures related to soil vapor intrusion.

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## **PART F**

### **GUIDANCE SECTION 5: COMMUNITY OUTREACH**

#### **F.1 TOPIC: General comments on Section 5 of the guidance**

Comment F.1.1 (paraphrased, 1 commenter, 1 comment):

Section 5 describes the community outreach that should accompany vapor intrusion investigations. We agree with the recommendations and plans detailed in this section.

Response F.1.1:

Comment noted.

Comment F.1.2:

We commend the department for its development of the community outreach protocols. By establishing requirements for Fact Sheets and public meetings, this section will ensure that residents near a site that is undergoing a vapor intrusion investigation or remediation are kept up to date on exactly what is being done, and what the next steps will be. The need for transparency and public outreach cannot be overstated. If the public is not informed there is an increased likelihood that a project may face opposition.

Response F.1.2:

Comment noted.

#### **F.2 TOPIC: Outreach requirements**

Comment F.2.1:

In general, we expect that most vapor intrusion investigation/abatement projects will be undertaken under statutory programs, either state superfund (Title 13), the brownfield act (Title 14), RCRA corrective actions, and/or the Navigation Law's oil spill program. Title 13 and Title 14, and related regulations, contain specific requirements regarding citizen participation, and the Department has issued citizen participation guidance specific to those programs. This vapor intrusion policy should make clear that where existing statutory and regulatory requirements exist for remediation programs, those CP [citizen participation] requirements apply.

Response F.2.1:

Agreed. As stated in Section 5 of the guidance, "the type, or types, of techniques selected for a site will vary depending upon the community's needs, site-specific conditions and program-specific requirements." To clarify this point we have revised the guidance to say "...*remedial* program-specific requirements."

Comment F.2.2:

Community outreach should consider Brownfield sites as a separate category. The community outreach program should be implemented in a manner equivalent to the magnitude and knowledge of the threat. Efforts should be made to control sensationalism and direct energies to providing understanding of the problem and measures that can be implemented to protect those exposed to the intruded vapors as well as ambient levels of any other chemicals detected during the monitoring.

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Response F.2.2:

The guidance presents strategies to evaluate the soil vapor intrusion pathway and determines the likely source(s) of volatile contamination. Under this approach, the nature and extent of action, if taken, is determined on a site-specific basis, with an understanding of the site data and particular site considerations. At all sites, community outreach efforts are tailored to the specific needs of the site and surrounding community, as well as to remedial program-specific requirements.

Comment F.2.3 (paraphrased, 2 commenters, 4 comments):

The level of community outreach needed by the guidance will be burdensome to implement. Furthermore, it would create unnecessary risk of litigation from the community.

Response F.2.3:

The intent of Section 5 of the guidance is to provide an overview of the types of communication tools that are commonly used during a soil vapor intrusion evaluation, not to provide a list of all tools required at all sites. The level of community outreach implemented at a site will vary depending upon the community's needs, site-specific conditions and remedial program-specific requirements. Community outreach is an essential component of the investigation and remediation of any site. The goal of outreach efforts is to keep the community informed and involved through the process, not to promote litigation.

Comment F.2.4 (paraphrased, 1 commenter, 1 comment):

There should be no requirement to notify building residents or the public [about sampling or the results] until there is conclusive evidence of actual vapor intrusion into a building and the need for an active system.

Response F.2.4:

We have found that informing building occupants of the potential for exposure leads to a more positive relationship between building occupants, building owners and regulatory agencies. Keeping building occupants informed from the beginning of the investigative process provides the foundation for a working relationship based on mutual understanding and full disclosure.

Comment F.2.5 (paraphrased, 1 commenter, 1 comment)

As NYSDOH is likely aware, potential health effects and environmental easements tied to the mitigation of vapor intrusion issues can have a very negative effect on the value and cash flow of a commercial building. In particular, the easement would affect the financial viability of the building, the owner's ability to continue operations, and to install and operate protective measures. When an owner is notified, what are their responsibilities for notifying the tenants and workers in the building? What other issues and unintended consequences may arise from the indoor air monitoring?

Response F.2.5:

When an owner or manager of a building is provided with sampling results, we recommend that these results be provided to tenants and workers in the building.

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### **F.3 TOPIC: Fact sheets**

#### Comment F.3.1 (paraphrased, 3 commenters, 2 comments):

Commenters requested two new fact sheets. One regarding a list of common household products that could lead to elevated indoor air concentrations and one regarding a one-page flyer describing to home owners what they should/should not do before sampling and what will be involved with the IAQ Questionnaire and Building Inventory.

##### Response F.3.1:

The NYSDOH intends to develop fact sheets to supplement those provided in the Appendix H of the guidance. The recommendations provided by the commenters will be considered during this process. Once prepared, new fact sheets will be available from the NYSDOH's soil vapor intrusion web page:  
[http://www.health.state.ny.us/environmental/indoors/vapor\\_intrusion/](http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/).

Please note that information about household products and their ingredients are available on web sites, such as the National Institute of Health's site at  
<http://householdproducts.nlm.nih.gov>.

### **F.4 TOPIC: Risk communication**

#### Comment F.4.1:

We recommend that communications with the community include, to the extent possible, a discussion of relative risk including the possible exposure to the same types of substances in everyday life, such as in hairspray or nail polish, even where the Department feels constrained by the paucity of health effects data. This will aid in putting the risks associated with soil vapor intrusion into perspective.

##### Response F.4.1:

The NYSDOH has and will continue to communicate information pertaining to human exposures and health risks as clearly as possible and using relative risk comparisons, as appropriate. In addition, the NYSDOH will consider the commenter's recommendation when developing fact sheets to supplement those provided in the Appendix H of the guidance. [See also Response to Comment F.3.1.]

### **F.5 TOPIC: Involvement by the responsible party**

#### Comment F.5.1 (paraphrased, 1 commenter, 2 comments):

The principal responsible party (PRP) must be included on the "project team." The PRP should be allowed to review and comment on the site contact sheet and to receive copies of information packets for the medical community before these items are released to the public.

##### Response F.5.1:

As defined in Section 5.1 of the guidance, the PRP is an active member of the "project team." The extent of the PRP's involvement in various outreach activities is determined on a site-specific basis.

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## **F.6 TOPIC: Letters transmitting results**

### Comment F.6.1 (paraphrased, 2 commenters, 1 comment):

The NYSDOH should be aware that developing definitive conclusions regarding a site or a particular home may take more than one round of sampling or a detailed evaluation considering data other than that collected from a home. As a result, we recommend providing results; however, caution should be used prior to also including conclusions and/or next steps.

#### Response F.6.1:

Transmittal letters should contain any and all relevant information that is available. Any conclusions should be based on the data, even if the "conclusion" recommends additional sampling.

### Comment F.6.2 (paraphrased, 1 commenter, 1 comment):

When potentially responsible parties are carrying out indoor air sampling, it is common for access agreements to be executed between such a party and the property owner. Consequently, results transmittal letters should be sent to the property owner, and where feasible by prior arrangement with the property owner and/or tenant, with a copy to the tenant.

#### Response F.6.2:

Acknowledged. A discussion recognizing this situation has been added to Section 5.5 of the guidance.

### Comment F.6.3:

Section 5.5, second paragraph: Suggested rewording the introductory language as follows: "It is recommended that the transmittal letter include the following elements (as applicable):"

#### Response F.6.3:

The text has been revised as follows: "A transmittal letter should include the following (as applicable):...."

## **F.7 TOPIC: Door-to-door visits**

### Comment F.7.1:

Section 5.8, first paragraph: last sentence, reword as follows: "Team members should be aware of the specifics..."

#### Response F.7.1:

The text has been revised as follows: "All team members should be aware of the specifics of the door-to-door visits (e.g., who will be conducting the visits, the reason, the dates, etc.)."

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**F.8 TOPIC: Community advisory groups**

Comment F.8.1:

Where there is sufficient community interest, the Guidance should recommend the formation of community advisory groups. Such groups build trust among the parties — affected residents, responsible parties, regulators, and other officials — and over a period of time they raise the level of understanding, even of highly technical issues, among regular community participants. Those participants, in turn, are able to explain technical issues to their neighbors as well as to bring neighborhood concerns to the attention of other parties.

Response F.8.1:

When there is sufficient community interest, our experience has shown that community groups form on their own initiative. We agree that such groups can be beneficial to the outreach effort. As discussed in Section 5.4 of the guidance, we acknowledge that community group meetings can be a useful avenue for exchanging information between project staff and the community.

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## **PART G GENERAL REACTIONS TO THE GUIDANCE**

*The following comments include the commenters' reactions to the guidance. They are provided here for general interest. No responses are needed.*

### Comment G.1 (paraphrased, 2 commenters, 1 comment):

Review of the Vapor Intrusion Guidance identified several overall concerns that limit the ability to fully implement the guidance to address vapor intrusion issues in a timely fashion.

### Comment G.2:

Compared to other jurisdictions across the country, New York State has been a leader in taking swift and comprehensive action to respond to this newly identified health threat. I appreciate that [NYS]DOH has acted quickly in drafting this guidance, and it is clear that a tremendous amount of work has been invested in its development. I commend everyone involved. New York has also been one of the few jurisdictions to establish and begin implementation of a process to review so-called "legacy" sites: sites that have already been remediated, but where vapor intrusion may pose on-going problems.

### Comment G.3:

Your policy differs from all current Federal & State policies across the country. It will also drive up costs. If I was operating a business in NY, I'd flee.

### Comment G.4 (paraphrased, 1 commenter, 2 comments):

The Assembly Committee on Environmental Conservation has held a series of hearings on vapor intrusion across New York State. Testimony from State and federal officials, public health and environmental experts, and concerned citizens has underscored the need for clear guidance on addressing vapor intrusion in New York, and for the development of conservative, protective public health standards. The guiding principles behind any vapor intrusion policy adopted by New York State should be protectiveness, caution, fairness, and transparency. The State's vapor intrusion policy must afford every resident the same level of protection.

### Comment G.5:

We appreciate that dealing with vapor intrusion impacts is an emerging issue, and we appreciate the complex technical, scientific, legal and political issues confronting the Departments of Health and Environmental Conservation in developing this draft guidance. We also appreciate the willingness of the Departments to circulate this draft guidance for public review and comment. This is an important first step in addressing significant concerns of affected parties.

### Comment G.6 (paraphrased, 1 commenter, 1 comment):

We commend the NYSDOH on its thorough and thoughtful approach to the development of the Draft Guidance for Evaluating Soil Vapor Intrusion in the State of New York and for developing guidance that will ensure that the environment and public health are being protected.

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Comment G.7 (paraphrased, 1 commenter, 1 comment):

We commend the NYSDOH for their efforts in addressing vapor intrusion impacts. Vapor intrusion is a developing science and we appreciate the complex issues confronting the NYSDOH in preparing the draft guidance.

Comment G.8:

Overall this document offers some useful technical guidelines for consideration during investigation activities. The NYSDOH has acknowledged a range of important issues, including background and the use of modeling. There also seems to be willingness to consider reasonable measures such as sealing cracks and adjusting building pressures as mitigation, which could be useful and less expensive than other alternatives.

Comment G.9:

The document reflects New York's extensive and growing practical experience in evaluating vapor exposures. As a handbook, it is invaluable. However, as a policy guidance, it should be more protective of human health.

Comment G.10:

The draft guidance is well written and easy to understand. The document is well organized, with separate sections on investigation methods, data evaluation, and mitigation methods.

Comment G.11:

We commend the [NYS]DOH for their efforts in addressing the issue of vapor intrusion in such a timely fashion. It is clear that as with any subsurface transport, understanding vapor migration is dependent upon a thorough knowledge of geologic conditions and how those affect vapor migration. One of our greatest concerns relates to the lack of certainty with respect to how vapor transport behaves in certain settings and how vapor soil monitoring data can be used in a more concrete fashion to assess the risk of off-site exposure in buildings. Many of our members collect soil and groundwater chemical information on a regular basis. We are all aware of the fact that in a state like New York, with a long history of industrial activities, the presence of volatile organics is a common occurrence.

Comment G.12 (paraphrased, 1 commenter, 1 comment):

The Department is to be commended for its effort to address the complex issue of indoor air quality/vapor intrusion into habitable structures from subsurface media. In general, the Draft SVI Guidance is succinct and well written. Notwithstanding, we have significant concerns with the technical approach and some policy decisions inherent in the Draft SVI Guidance.

Comment G.13 (paraphrased, 1 commenter, 1 comment):

As owners of both open and closed inactive hazardous waste disposal sites, Resource Conservation and Recovery Act (RCRA) Corrective Action Sites, Brownfield sites, and Voluntary Cleanup Program sites, we are concerned that the proposed soil vapor intrusion policy would, without adequate legal safeguards, result in the attempted assessment of

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additional cost at sites for which remedial decisions have already been made, and do so without any corresponding human health or environmental benefit.

Comment G.14 (paraphrased, 1 commenter, 1 comment):

We commend the NYSDOH on preparing a thoughtful and comprehensive document describing the situations when vapor intrusion may be of concern, methods for assessing the potential significance of this pathway, and how to interpret the data once they are collected. However, we offer suggestions on how to increase the clarity and consistency of the document.

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[http://health.ny.gov/environmental/indoors/vapor\\_intrusion/update.htm](http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm)

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Wertz, W. and G. McDonald. 2004. "Vapor Intrusion in Endicott, NY: Observed Differences in the Concentrations of Chlorinated Volatile Organic Vapors(CVOCs) in Basement and Subslab Samples." Presented at EPA Vapor Intrusion Attenuation Workshop, March 15, 2004, San Diego, CA.

**NOTE: Updates to the final guidance are available at [http://health.ny.gov/environmental/indoors/vapor\\_intrusion/update.htm](http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm)**

## APPENDIX 1 Reference Chart for Commenters

Over 800 comments were received from 33 commenters. Below is a chart that serves as a reference to guide the commenters to where their comments and responses are provided in this document.

Commenter	Applicable Comments and Responses							
ARCADIS G&M, Inc. Nadine Weinberg	A.2.1 A.4.6 A.8.1 A.9.3 A.9.11 A.11.4 A.14.1	C.2.3 C.6.1 C.10.5 C.14.2 C.14.5 C.16.6	C.16.7 C.16.9 C.16.10 C.19.3 C.19.4	D.2.3 D.4.1 D.4.2 D.4.4 D.4.14 D.4.15 D.5.1 D.6.1	D.10.2 D.10.16 D.10.22 D.11.3 D.12.1 D.12.10 D.15.8	E.2.2 E.2.6 E.2.7 E.3.2 E.3.3 E.3.8 E.3.9	E.5.2 E.5.3 E.5.5 E.7.4 E.8.1	F.3.1 F.6.1 G.1
Assembly of the State of New York Assemblyman Thomas P. DiNapoli	A.4.1 A.4.2 A.4.6 A.9.1 A.13.1	C.5.3 C.8.13 C.8.14 C.10.6	D.2.1 D.2.2 D.11.8 D.12.1 D.12.2	D.12.3 D.12.5 D.12.14 D.14.4	G.2 G.4			
The Business Council of New York State, Inc. Kenneth J. Pokalsky	A.1.1 A.2.1 A.3.1 A.3.2 A.5.1 A.5.2 A.8.1 A.10.2 A.11.3 A.11.4 A.12.3 A.16.1 A.18.1 A.9.5	B.7.2 B.8.1 C.1.4 C.1.5 C.2.1 C.5.1 C.5.4 C.5.5	C.5.6 C.5.7 C.6.1 C.8.15 C.9.3 C.10.3 C.11.9 C.18.8 C.18.10 C.19.5 C.19.7	D.3.2 D.4.4 D.4.7 D.4.8 D.4.9 D.4.17 D.5.1 D.5.3 D.5.7	D.5.8 D.5.9 D.5.10 D.7.1 D.10.2 D.11.2 D.12.3 D.12.5 D.12.6 D.12.7	D.12.9 D.12.10 D.12.18 D.14.5 D.15.1 D.15.3 D.15.6 D.15.8 D.15.9	E.2.2 E.2.8 E.4.1 E.5.1 E.5.2 E.7.1 E.7.3	F.2.1 G.5
CA Rich Consultants, Inc. Eric A. Weinstock	C.15.6							
Cambridge Environmental Stephen G. Zemba, Ph.D., P.E. Laura C. Green, Ph.D., D.A.B.T.	A.4.3 A.9.2	D.4.4						
Center for Public Environmental Oversight Mountainview, CA Lenny Siegel	A.4.5 A.11.4	B.7.1	C.8.17 C.18.1 C.19.6	D.8.1 D.11.8 D.11.9	D.12.19 D.13.1 D.14.7	F.8.1	G.9	
City of New York NYC Office of Environmental Coordination Robert Kulikowski	A.4.5 A.5.3 A.5.8 A.6.6 A.8.4	A.10.3 A.12.1 A.12.4 A.12.6 A.17.1 A.19.1	B.8.1	C.2.1 C.2.2 C.3.9 C.5.1 C.5.6 C.7.7	C.11.1 C.11.2 C.11.18 C.18.9 C.18.11 C.19.1	D.4.7 D.5.9 D.9.1 D.11.1	E.2.1 E.4.1 E.7.2	

RESPONSE TO COMMENTS

NYSDOH CEH BEEI Soil Vapor Intrusion Guidance

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Commenter	Applicable Comments and Responses							
Community affected by the health statistics review (NYSDOH 2005) – - Endicott area, Town of Union, Broome County, New York  Bernadette Patrick, Betty Havel, Priscilla Garringer, Joseph Nirchi Sr., Grace Conklin, Daniel Greco, Theresa Kondrach, Dave Lambert, James Michael, C.A.R.E. (Citizens Acting to Restore Endicott/Endwell's Environment)	D.11.6 D.11.7	E.4.1						
Department of the Air Force  Bobby N. Ficquette	A.3.2 A.4.4 A.8.1 A.9.4 A.9.11	B.2.3	C.1.3 C.2.1 C.3.4 C.3.6 C.3.12 C.3.13 C.5.1	C.6.1 C.7.6 C.8.2 C.8.4 C.8.5 C.9.3	C.16.1 C.16.9 C.17.1 C.19.3 C.19.4 C.19.7	D.2.4 D.6.2 D.10.1 D.10.8 D.10.9 D.10.18	D.11.2 D.11.3 D.12.1 D.12.4 D.14.2 D.15.8	E.2.10
Department of Energy  Schenectady Naval Reactors Office  J. Hughes Robillard	A.3.2 A.7.1 A.18.1	B.2.4 B.2.5 B.2.6 B.8.1	C.2.1 C.6.1 C.8.8	D.1.2 D.4.10 D.5.4	D.12.1 D.12.10 D.12.12	E.3.1 E.4.1		
Dutchess County Legislature  Shannon Martin Lafrance, Gerald Hutchings, Mary Swartz, and David P. Kelly	D.12.2							
Eastman Kodak  David J. Mitchell, P.G., P.E.	A.3.2 A.8.1 A.11.4	C.8.4 C.19.2	D.5.1 D.5.10 D.10.3 D.11.4	D.12.9 D.12.10 D.15.8				
ENSR International  Daniel Shearer, P.E.	A.8.1	B.5.1	C.3.11 C.5.1 C.5.6	C.6.1 C.8.11 C.10.6	C.14.4 C.14.8 C.15.3	C.15.4 C.15.7 C.16.3	C.19.4	D.10.5 D.12.7
EnviroGroup Limited  David J. Folkes, P.E.	A.3.2 A.8.1 A.11.4	C.2.1 C.2.2 C.3.6 C.3.16	C.5.5 C.6.2 C.7.9 C.8.1 C.8.4 C.5.1 C.5.4	C.9.2 C.11.3 C.12.6 C.12.10 C.18.3 C.18.5 C.18.9	D.3.1 D.4.11 D.4.16 D.5.1 D.10.3 D.10.12	D.10.14 D.11.3 D.12.1 D.12.7 D.12.9	D.12.15 D.12.17 D.15.3 D.15.5 D.15.8	E.2.11 E.3.7 E.5.7
Environmental Advocates of New York  Timothy L. Sweeney	A.4.6	B.1.2	C.1.2	E.1.1	F.1.2	G.6		
Environmental Business Association of New York State, Inc.  Brownfields Task Force  Kelly J. Bennett	A.3.2 A.9.7 A.11.4	D.5.9	G.7					
Environmental Energy Alliance of New York  MGP Workgroup  John G. Holsapple	A.14.2 A.20.1 A.21.1	C.5.1 C.5.4 C.5.6 C.6.1 C.7.4 C.7.5 C.7.6 C.7.9	C.8.5 C.8.6 C.8.7 C.9.4 C.10.6 C.11.5 C.11.6 C.11.20	C.12.5 C.12.9 C.14.9 C.19.3 C.19.4 C.19.10	D.4.4 D.7.1 D.5.9 D.12.4 D.12.6 D.12.10 D.15.8	E.2.2 E.3.4	F.2.3	G.8

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Commenter	Applicable Comments and Responses							
ExxonMobil Global Remediation Mark Malander	A.8.1 A.8.4 A.10.2	B.2.1 B.4.1 B.8.1	C.2.1 C.2.2 C.3.4 C.5.5	C.6.1 C.10.4 C.16.9 C.18.7	D.4.3 D.4.5 D.12.7	D.15.1 D.15.7 D.15.8	G.10	
H&P Mobile Geochemistry Dr. Blayne Hartman	A.8.1 A.9.8 A.12.5	B.1.1	C.3.4 C.3.17 C.5.5 C.7.9 C.8.9 C.10.1	C.11.3 C.11.4 C.11.17 C.11.19 C.11.21 C.12.6	C.12.8 C.13.2 C.14.1 C.14.4 C.14.7 C.14.8	C.15.2 C.16.1 C.17.1 C.17.2	D.12.8 D.12.21	G.3
Hopewell Junction Citizens for Clean Water Debra Hall	D.11.7	E.5.6						
IBM Corporation Mitchell E. Meyers	A.3.1 A.3.2 A.5.9	B.2.3 B.4.3 B.5.2 B.5.3 B.5.7 B.5.8 B.5.9 B.5.10 B.5.11 B.5.12 B.5.13 B.5.14	C.3.3 C.3.7 C.5.1 C.5.3 C.5.5 C.5.8 C.6.3 C.7.6 C.7.8 C.8.7 C.9.4 C.10.8	C.11.4 C.11.6 C.11.10 C.11.13 C.11.22 C.12.1 C.12.2 C.12.3 C.12.7 C.14.7 C.15.1 C.15.4	C.16.4 C.18.2 C.18.3 C.18.4 C.18.9	D.4.4 D.4.6 D.4.18 D.5.1 D.7.1 D.10.7 D.10.19 D.10.20 D.12.9 D.12.10 D.12.11	E.2.3 E.2.4 E.2.11 E.5.4 E.7.5	F.6.2
National Brownfield Association The New York Chapter Technical Committee	A.4.6 A.6.7 A.8.1 A.9.3 A.9.11 A.11.1 A.11.4 A.14.1	C.2.3 C.3.10 C.6.1 C.10.5 C.14.2 C.14.5 C.16.6	C.16.7 C.16.9 C.16.10 C.19.3 C.19.4 C.19.8	D.2.3 D.4.1 D.4.2 D.4.4 D.4.14 D.4.15 D.5.1 D.6.1	D.10.2 D.10.16 D.10.22 D.11.3 D.12.1 D.12.10 D.15.8	E.2.2 E.2.6 E.2.7 E.3.2 E.3.3 E.3.8	E.3.9 E.5.2 E.5.3 E.5.5 E.7.4 E.8.1	F.2.2 F.2.5 F.3.1 F.6.1 G.1
New Partners for Community Revitalization, Inc. Jody Kass and Mathy Stanislaus	A.5.7 A.6.3 A.6.4	A.6.7 A.9.9 A.16.1	B.2.2	C.2.5	D.5.1			
New York State Council of Professional Geologists Marjory Rinaldo-Lee	A.3.2 A.6.5	A.9.7 A.11.4	D.5.9	G.11				
New York State Petroleum Council Michael R. Doyle	A.8.1 A.10.1 A.10.2 A.10.3 A.20.2	B.2.1	C.2.1 C.5.1 C.5.5	C.11.12 C.16.10 C.18.7	D.15.8	E.2.12		
The New York State Superfund Coalition, Inc. Thomas F. Walsh, Esq.	A.1.1 A.2.1 A.3.1 A.3.2 A.5.4 A.5.5 A.5.6 A.6.1	A.6.2 A.8.1 A.8.2 A.8.3 A.9.6 A.11.2 B.8.1	C.3.4 C.3.5 C.7.1 C.7.9 C.7.10 C.8.1 C.8.3 C.8.5	C.8.7 C.8.13 C.10.9 C.11.7 C.12.8 C.16.12 C.19.3 C.19.4	D.4.1 D.4.4 D.4.8 D.4.14 D.5.6 D.5.9 D.7.1 D.9.2	D.10.21 D.10.23 D.11.3 D.12.5 D.12.13 D.14.8 D.15.4 D.15.8	E.4.1 F.4.1 F.5.1	G.12 G.13

RESPONSE TO COMMENTS

NYSDOH CEH BEEI Soil Vapor Intrusion Guidance

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Commenter	Applicable Comments and Responses							
O'Brien & Gere John F. Sutphen	A.9.10	B.3.1 B.6.1 B.6.2 B.8.1	C.2.6 C.3.2 C.4.2 C.4.3 C.5.2 C.6.4 C.9.1 C.10.6	C.10.7 C.11.6 C.11.8 C.11.16 C.14.4 C.16.2 C.16.8	D.10.6 D.10.23 D.11.3 D.12.5 D.12.20 D.13.2 D.14.9	E.2.5 E.3.2 E.3.5 E.3.6 E.5.4	E.5.8 E.6.1 E.6.2 E.6.3 E.7.6	F.6.3 F.7.1
Richard M. Watt Professional Geologist	A.15.1 A.18.1 A.20.3	C.2.2 C.2.4 C.7.2 C.7.4 C.7.8	C.8.7 C.8.16 C.10.2 C.10.10 C.11.3	C.11.11 C.11.14 C.11.20 C.12.4 C.14.6	C.14.8 C.15.5 C.16.5 C.18.6	D.4.12 D.5.2 D.10.10 D.10.11	D.10.15 D.10.17 D.12.20	F.3.1
TRC Environmental Corporation Katarina Rutkowski	A.6.7 A.8.1 A.12.2 A.12.3	C.2.1 C.3.8 C.3.9 C.5.1 C.5.3 C.5.4 C.7.2	C.7.3 C.7.8 C.9.3 C.9.4 C.11.15 C.11.22 C.12.11 C.14.3	C.14.10 C.16.9 C.16.10 C.16.11 C.19.3 C.19.4 C.19.9	D.5.5 D.10.23 D.11.3 D.12.8 D.14.1	D.14.3 D.14.6 D.15.2 D.15.10 D.15.11	E.2.2 E.2.6	F.2.4 F.2.3
U.S. EPA — Region 2 William McCabe	B.1.1	C.1.1 C.3.4 C.5.1 C.5.5	C.8.12 C.13.1 C.19.10	D.1.1 D.4.2 D.4.4 D.4.13 D.5.1 D.5.5	D.5.7 D.10.4 D.12.1	D.12.5 D.12.16 D.15.8	E.2.9	F.1.1
William and Nellie Borell Hopewell Junction, New York	D.11.5							
W. L. Gore & Associates, Inc. Jay W. Hodny, Ph.D.	C.10.2							
Woodard & Curran, Inc. Lisa Campe, MPH, LSP	A.8.1	B.6.4 B.6.5 B.5.15	C.1.6 C.3.1 C.3.14 C.3.15	C.5.1 C.5.6 C.8.5 C.8.7	C.6.1 C.6.2 C.9.3	C.13.1 C.19.4 C.19.10	D.10.13 D.12.10 D.15.1	G.14

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## **APPENDIX 2**

### **Modifications to the Soil Vapor / Indoor Air Matrices**

The following revisions were made to the Soil Vapor/Indoor Air Matrices in Section 3.4 of the guidance based on comments received on the NYSDOH's draft report entitled *Trichloroethene (TCE) Air Criteria Document* (NYSDOH 2005):

- Matrix 1: changed the boundary between the indoor air concentration ranges in Columns 2 and 3 from 2.5 to 1 mcg/m<sup>3</sup> and added "Monitor/Mitigate" as a recommended action in Box 10; and
- Matrix 2: added Monitor/Mitigate action to Box 6.

Additional information on these changes can be found in the memorandum from N. Kim to R. Tramontano dated October 12, 2006, provided on page App2-3.

**NOTE: Updates to the final guidance are available at**

[http://health.ny.gov/environmental/indoors/vapor\\_intrusion/update.htm](http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm)

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**STATE OF NEW YORK - DEPARTMENT OF HEALTH  
INTEROFFICE MEMORANDUM**

**TO:** Ronald Tramontano, Director  
Center for Environmental Health

**FROM:** Nancy K. Kim, Director *N.K.*  
Division of Environmental Health Assessment

**SUBJECT:** Trichloroethene

**DATE:** October 12, 2006

Center for Environmental Health staff in the New York State Department of Health (DOH) have written several documents to address health concerns about exposure to trichloroethene (TCE) from soil vapor intrusion and are revising those documents in response to comments from a scientific review panel and the public. The documents and related reports are:

- Draft Report Trichloroethene Air Criteria Document (DOH, 2005)(contains the derivation of the TCE guideline),
- Comments of the Trichloroethene (TCE) Panel (letter from Henry Anderson, M.D. to Nancy K. Kim, Ph.D. dated November 1, 2005),
- Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft (DOH, 2005), which includes the
  - Soil Vapor/Indoor Air Matrix 1 and Matrix 2 (both are a decision making tool for soil vapor and indoor air levels), and
  - TCE in Indoor and Outdoor Air (fact sheet), and
- Assessing the Human Health Risks of Trichloroethylene: Key Scientific Issues, a report issued by the National Research Council (NRC) of the National Academy of Sciences (July, 2006).

After reviewing these materials, I am recommending that we change Matrix 1. The 2.5 micrograms of trichloroethene per cubic meter of indoor air ( $2.5 \text{ mcg/m}^3$ ) in the column headings for Indoor Air Concentration of Compound in Matrix 1 should be reduced to  $1.0 \text{ mcg/m}^3$ . I am also recommending that mitigate be included as an option in Box 10 of Matrix 1 and Box 6 of Matrix 2.

**Use of the Air Guideline**

The purpose of the air guideline for TCE of  $5 \text{ mcg/m}^3$  given in the fact sheet, "...is to help guide decisions about the nature of the efforts to reduce TCE exposures. Reasonable and practical actions should be taken to reduce TCE exposure when indoor air levels are above background, even when they are below the guideline of  $5 \text{ mcg/m}^3$ . The urgency to take actions increases as indoor air levels increase, especially when air

levels are above the guideline. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended action is to reduce TCE levels in indoor air to as close to background as practical.” This general advice applies to all situations including the following:

an individual wants to know if he should keep a closed bottle of TCE in his house,  
a school asks DOH if it has a problem with a bottle of TCE being in a shop, and  
an office wants to know if it should do anything about residual exposure from past TCE use.

DOH also uses the guideline to make decisions about the need for remedial actions because of state regulated sources or sites. DOH would use this value to decide if it needs to work with the New York State Department of Environmental Conservation to reduce outdoor air levels of TCE. DOH also uses this value in Matrix 1, a decision making tool for responding to soil vapor intrusion problems; for this use, the guideline is considered to be a TCE concentration that should not be exceeded in indoor air.

### **Indoor Air Concentrations**

Several different studies provide information about background levels of TCE in indoor air. These data differ because of a number of factors such as the criteria for choosing sampling locations, the time period of the studies, etc. Three studies give a 50<sup>th</sup> percentile (less than 0.25 mcg/m<sup>3</sup>, less than 1.4 mcg/m<sup>3</sup> and 0.12 mcg/m<sup>3</sup>) and a 95<sup>th</sup> percentile (less than 0.25 mcg/m<sup>3</sup>, 1.36 mcg/m<sup>3</sup> and 4.2 mcg/m<sup>3</sup>). Two studies provide a 75<sup>th</sup> percentile (less than 0.25 mcg/m<sup>3</sup> and 1.2 mcg/m<sup>3</sup>). One way to characterize these values is to state that background values are mostly less than 1 mcg/m<sup>3</sup> and frequently less than 0.25 mcg/m<sup>3</sup>. (References: DOH 2003, USEPA 2001, and HEI, 2005)

### **Peer Review of the Derivation of the TCE Air Guideline**

After receiving the TCE panel’s comments, the Department considered changes in the guideline or Matrix 1. The TCE panel was asked to answer technical questions about the derivation of the guideline and a specific question on the guideline itself (Is the summary transparent and does it adequately justify the guideline of 5 mg/m<sup>3</sup>?). In responding to the latter question, several panel members voiced their opinion about what they would select as a guideline. The consensus comment from the panel was “Some panel members suggested that additional consideration be given to lowering the guideline value.”

The panel also commented on aspects of the guideline when answering questions about cancer risk estimates.

One of the panel’s consensus comment was:

“The fact that TCE is a multi-species and multi-site carcinogen with a combination of both malignant and benign tumors should be further emphasized in the document

because these data coupled with the human data have led several authoritative bodies (EPA, NTP, & IARC) to the conclusion that TCE is on the cusp between a known and probable (likely, reasonably anticipated to be) human carcinogen. Thus, the NYSDOH should have flexibility in using risk levels of both 1 in  $10^{-6}$  and 1 in  $10^{-5}$ ." (Part of response to question 4 of the TCE Panel's comments.)

Another consensus comment was:

"The rationale to utilize the human epidemiologic studies for weight of evidence support for the animal carcinogenicity studies rather than as the primary for the quantitative cancer risk assessment is appropriate. The weaknesses of the exposure estimates and potential confounding exposures support this decision. However, the DOH may want to consider the human studies to a greater extent when weighting the cancer evidence to establish a guideline." (Part of response to question 5 of the TCE Panel's comments)

Other, individual comments on the guideline follow.

George Lucier, Ph.D.

"Based on the available data, especially the cancer data, a guideline in the range of 1-5 mcg/m<sup>3</sup> could be justified. After all, a linear model cannot be rejected, for some sites acceptable risk levels are less than 5 mcg/m<sup>3</sup> and in some cases less than 1 mcg/m<sup>3</sup> and EPA has stated that TCE is highly likely to be a human carcinogen. The NYSDOH may wish to consider an acceptable risk level to be 3-5 cancers per million since TCE appears to be on the cusp between a known human carcinogen and a probable human carcinogen."

James Dix, Ph.D.

"The extensive review of the cancer literature in the draft document seems to indicate TCE levels giving  $1 \times 10^{-6}$  increased cancer risk can be in the range 0.1-1 mcg/m<sup>3</sup> (e.g., p. 132, 133, 141, 147, 149, and 150 of the draft document), which prima facia (sic) would support an air criterion of below 1  $\mu$ /m<sup>3</sup>(sic). The DOH weighted these studies less. However, given the support on this scientific review panel for weighting the non-Hodgkin's lymphoma more strongly, an air criterion of less than 1  $\mu$ g/m<sup>3</sup> might be justified."

### **NRC Report on Trichloroethene**

In July 2006, the NRC released its report on TCE. We have reviewed that report. The approaches and methods we used to derive health-based air criteria for TCE are consistent with the recommendations of the NRC Committee. For example, both NRC and DOH identified kidney cancer, liver cancer, central nervous system effects, reproductive problems and developmental problems as human health endpoints that might be sensitive to the effects of TCE. NRC recommended that animal data, not human health data, be used to derive quantitative estimates of human cancer risks from TCE exposure and that the available human data be used only for validation. DOH used this approach in evaluating cancer risks.

## Integration, Matrix 1 and Matrix 2

The attached tables compare the TCE criteria in the draft document with the revised TCE criteria in the final document. These data indicate that the guideline of 5 mcg/m<sup>3</sup> is below the recommended health-based criteria for non-cancer effects and that the excess lifetime cancer risks at the guideline are in the lower end of the risk range that is generally used by regulatory agencies when setting guidelines or standards. However, Matrix 1 is a major determinant for remediation in the soil vapor intrusion program, a state program addressing involuntary risks, and two revisions would help to align decisions in that program with the goals stated in the DOH TCE fact sheet and with the requirements of the Brownfields legislation.

In the current state program, mitigation is recommended when the potential for soil vapor intrusion to affect indoor air is high (sub-slab levels are equal to or greater than 250 mcg/m<sup>3</sup>) regardless of the measured indoor air levels. However, when the potential for soil vapor intrusion to affect indoor air is moderate (sub-slab concentrations are equal to or greater than 50 mcg/m<sup>3</sup>, but less than 250 mcg/m<sup>3</sup>), mitigation is only recommended when an indoor air level is equal to or greater than 2.5 mcg/m<sup>3</sup>. The excess risk levels associated with 2.5 mcg/m<sup>3</sup> range from 0.3 to 8 x 10<sup>-6</sup>; the upper end of this range exceeds the 3 to 5 cancers per million recommended by Dr. Lucier and the 1 x 10<sup>-6</sup> risk level given in the Brownfields legislation. This concentration also exceeds most background concentrations for TCE, a goal stated in the TCE fact sheet. Reducing 2.5 mcg/m<sup>3</sup> to 1.0 mcg/m<sup>3</sup> in Matrix 1 would result in recommending remediation at levels above most background levels and at risk levels of 0.1 to 3 x 10<sup>-6</sup>.

In Matrix 1 of the draft soil vapor intrusion guidance, Box 10 (sub-slab vapor levels of 50 mcg/m<sup>3</sup> or greater to less than 250 mcg/m<sup>3</sup> and indoor air levels of 0.25 mcg/m<sup>3</sup> or greater to less than 2.5 mcg/m<sup>3</sup>) recommends monitoring. (The recommendation in the previous paragraph would change 2.5 mcg/m<sup>3</sup> to 1.0 mcg/m<sup>3</sup>.) Box 10 addresses situations where the potential for soil vapor to affect indoor air is moderate, but indoor air levels are in the range of most background levels. Recommending an option for mitigation in Box 10 when environmental factors for a specific site suggest a high potential for indoor air concentrations to increase is consistent with the goals outlined in the previous paragraph. A similar mitigation option is recommended for Box 6 of Matrix 2.

## Attachments

**Table 1. Non-Carcinogenic Effects: Draft and Final Criteria Used in Guideline Derivation.**

Organ/System/ Lifestage	Study*	Recommended TCE Air Criteria (mcg/m <sup>3</sup> )			
		Draft		Final	
		Study	System	Study	System
CNS	Arito et al. (1994)	40	40	4 (childhood)	10
	Rasmussen et al. (1993)	40		11 (adult & childhood)	
Liver	Kjellstrand et al. (1983)	160	160	160 (adult & childhood)	160
Kidney	Kjellstrand et al. (1983)	165	165	160 (adult & childhood)	160
	Land et al. (1981)	32	32	32	
Reproduction	DuTeaux et al. (2004)	110		32	
	Kumar et al. (2000; 2001a)	not done	20		
	NTP (1986)	not done	110		
Developmental	Dawson et al. (1993)	11	11	11 (supporting study)	20
	Healy et al. (1982)	38		38	
	Isaacson & Taylor (1989)	19		19	
	NTP (1986)	not done		22	

\*References from Trichloroethene Air Criteria Document.

**Table 2. Carcinogenic Effects: Draft and Final Criteria Used in Guideline Derivation.**

Cancer	Recommended TCE Air Criteria (mcg/m <sup>3</sup> )*					
	Draft			Final		
	LADE		LADD (PBPK)	LADE		LADD (PBPK)
Unadjusted	Adjusted**		Unadjusted	Adjusted**		
<b>Animal Data</b> (Fukuda et al., 1983; Henschler et al., 1980; Maltoni et al., 1986)***						
liver	1.8	not done	1.4	1.8	1.1	1.4
kidney	13	not done	3100	13	7.8	3100
lymphoma	not a recommended site			0.3	not done	not done given uncertainty in appropriate internal dose & mode of action
testes (benign)	not a recommended site					
lung	not a recommended site					
<b>Human Data</b> (Hansen et al., 2001)***						
esophagus	0.077 – 1.2#	not done	not done	0.36 – 1.2##	not done	not done
NHL	0.062 – 0.91#	not done	not done	0.29 – 0.91##	not done	not done

\*Air concentrations associated with an excess lifetime human risk of  $1 \times 10^{-6}$  are provided for comparative purposes, air concentrations associated with excess risks  $1 \times 10^{-5}$  and  $1 \times 10^{-4}$  are 10X and 100X the given concentration.

\*\*The LADE (lifetime average daily exposure) estimates based on linear low-dose extrapolation are unadjusted and adjusted for the potential increased sensitivity of children to the early-life TCE exposures following US EPA guidance. Adjusted values were not calculated using age-specific internal dose metrics (LADD, lifetime average daily dose) because validated TCE PBPK models for children are unavailable and because of additional uncertainties associated with estimating model parameter values for children. Adjusted values were not calculated based on lymphomas because the mode-of-action for those cancers is unknown, and in such cases, the US EPA guidance recommends using unadjusted values.

\*\*\*References from Trichloroethene Air Criteria Document.

# Range of values based on two measures of relative risk, two occupational exposure levels, and three estimates of exposure duration.

## Range of values based on two measures of relative risk, one occupational exposure level, and three estimates of exposure duration.

# Soil Vapor/Indoor Air Matrix 1

WORKING DRAFT 02.23.05

SUBJECT TO CHANGE

INDOOR AIR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )	< 0.25	0.25 to < 2.5	2.5 to < 5.0
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor
5 to < 50	5. No further action	6. Monitor	7. Monitor
50 to < 250	9. Monitor	10. Monitor	11. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE
			4. MITIGATE — or — Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor
			5.0 and above
			8. MITIGATE
			12. MITIGATE
			16. MITIGATE

**No further action:** Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

**Take steps to identify source(s) and reduce exposures:** The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed).

**Monitor as appropriate:** Monitoring is needed to confirm concentrations in the indoor air have not increased due to changes in pressure gradients (e.g., deterioration of building foundation) or to evaluate temporal trends for relevant environmental data. Monitoring may also be needed to verify that existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are minimizing potential effects associated with soil vapor intrusion. The type and frequency of monitoring is determined on a site-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**Mitigate:** Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

See additional notes on page 2.

## ADDITIONAL NOTES FOR MATRIX 1

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This matrix provides guidance on actions that should be taken to address current and potential exposures related to soil vapor intrusion. To use the matrix accurately as a tool in the decision-making process, the following must be noted:

- [1] The matrix is generic. As such, it may be necessary to modify recommended actions to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or site-specific conditions (e.g., proximity of building to identified subsurface contamination) for the protection of public health. Additionally, actions more conservative than those specified within the matrix may be implemented at any time. For example, the decision to implement more conservative actions may be based on a comparison of the costs associated with resampling or monitoring to the costs associated with installation and monitoring of a mitigation system.
- [2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude the need to investigate possible sources of vapor contamination, nor does it preclude the need to remediate contaminated soil vapors or the source of soil vapor contamination.
- [3] Extreme care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples must be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples, and typically 1 microgram per cubic meter for subsurface vapor samples.
- [4] Sub-slab vapor and indoor air samples are typically collected during the heating season since soil vapor intrusion is more likely to occur when a building's heating system is in operation and air is being drawn into the building. If samples are collected during other times of the year, it may be necessary to resample during the heating season to evaluate exposures accurately.
- [5] When current exposures are attributed to sources other than vapor intrusion, the agencies must be provided documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

# Soil Vapor/Indoor Air Matrix 2

WORKING DRAFT 02.23.05

SUBJECT TO CHANGE

INDOOR AIR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )				
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor	4. MITIGATE — or — Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor
100 to < 1,000	5. Monitor	6. Monitor	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

**No further action:** Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

**Take steps to identify source(s) and reduce exposures:** The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed).

**Monitor:** Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**Mitigate:** Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is an interim measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

## ADDITIONAL NOTES FOR MATRIX 2

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This matrix provides guidance on actions that should be taken to address current and potential exposures related to soil vapor intrusion. To use the matrix accurately as a tool in the decision-making process, the following must be noted:

- [1] The matrix is generic. As such, it may be necessary to modify recommended actions to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or site-specific conditions (e.g., proximity of building to identified subsurface contamination) for the protection of public health. Additionally, actions more conservative than those specified within the matrix may be implemented at any time. More conservative actions are often cost-based (e.g., the cost of additional sampling versus the cost of mitigation) rather than health-based.
- [2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude the need to investigate possible sources of vapor contamination, nor does it preclude the need to remediate contaminated soil vapors or the source of soil vapor contamination.
- [3] Extreme care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples must be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter.
- [4] Sub-slab vapor and indoor air samples (basement and lowest occupied living space) are typically collected during the heating season since soil vapor intrusion is more likely to occur when a building's heating system is in operation and air is being drawn into the building. If samples are collected during other times of the year, it may be necessary to resample during the heating season to evaluate exposures accurately.
- [5] When current exposures are attributed to sources other than vapor intrusion, the agencies must be provided documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

# Soil Vapor/Indoor Air Matrix 1

## October 2006

INDOOR AIR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )				
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )	< 0.25	0.25 to < 1	1 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
5 to < 50	5. No further action	6. MONITOR	7. MONITOR	8. MITIGATE
50 to < 250	9. MONITOR	10. MONITOR / MITIGATE	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

**No further action:**

Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

**Take reasonable and practical actions to identify source(s) and reduce exposures:**

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

**MONITOR:**

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MITIGATE:**

Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MONITOR / MITIGATE:**

Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

## ADDITIONAL NOTES FOR MATRIX 1

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This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

- [1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).
- [2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.
- [3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended for buildings with full slab foundations, and 1 microgram per cubic meter for buildings with less than a full slab foundation.
- [4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.
- [5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.
- [6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

# Soil Vapor/Indoor Air Matrix 2

October 2006

INDOOR AIR CONCENTRATION OF COMPOUND (mcg/m <sup>3</sup> )				
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
100 to < 1,000	5. MONITOR	6. MONITOR / MITIGATE	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

**No further action:**

Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

**Take reasonable and practical actions to identify source(s) and reduce exposures:**

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

**MONITOR:**

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MITIGATE:**

Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MONITOR / MITIGATE:**

Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

## ADDITIONAL NOTES FOR MATRIX 2

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This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

- [1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).
- [2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.
- [3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended.
- [4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.
- [5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.
- [6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.