



An RT Regulatory Program Summary

NJDEP ISSUES DRAFT VAPOR INTRUSION GUIDANCE

In mid-June, the New Jersey Department of Environmental Protection issued draft Vapor Intrusion Guidance, which is very important, because procedures and approaches in the Guidance are already being used at a significant number of New Jersey solvent and petroleum release sites. DEP has proposed using a phased approach to investigate the vapor intrusion (VI) pathway, that follows basic provisions of EPA Guidance, while incorporating New Jersey specific factors and policies, as appropriate.

The guidance includes a discussion of the VI pathway, VI screening levels to be used during the site evaluation process, sampling and analytical requirements, site specific screening options, remedial options, monitoring and maintenance requirements, community outreach, and a methodology to evaluate background indoor air volatile organic concentrations at a site.

Key highlights of the guidance are as follows:

- The objective of the guidance document is to determine whether site contaminant VI is occurring, and to highlight what actions are appropriate. VI is defined as the migration of volatile chemicals from the subsurface into overlying buildings. VI can sometimes occur along preferential pathways, such as underground utilities lines, or directly through soil, potentially impacting the indoor air quality of the affected building with volatile organic compounds.
- DEP believes the basis for the guidance is in the Technical Requirements for Site Remediation, as updated in 2003, which, in NJAC Sections 7:26E-1.11, and 7:26E-1.13, includes remedial action priority to limit movement of contaminants through any pathway, and ensure that releases of contaminants do not result in the release reaching structures or air in concentrations that pose a threat to human health.
- Further, Section 7:26E-3.5, stipulates that site investigation of building interiors shall be conducted when contaminants outside the building have potential to migrate into the building. Vapor hazards and risks are also discussed in 7:26E-4.4 (h) 3viii and 7:26E-6.3 (d) 7.
- DEP intends for the guidance to be used at VOC contaminated sites, and, in particular, if water and/or soil remediation systems are proposed such as air injection, bioremediation, bioventing, and chemical oxidation, which processes themselves could produce increased soil vapor.
- DEP while acknowledging that the document is guidance, expects that the guidance will be used, and that the regulated community will consult with the Department before implementing any methodology or procedures not included in their document. DEP has developed a pathway investigation strategy as follows:

VI Pathway Investigative Strategy

- Preliminary Assessment
 - Stage 1 Assess potential for vapor intrusion
 - Stage 2 Immediate Environmental Concern Determination
- Remedial Investigation
 - Stage 3 Evaluate existing data against screening levels

- Stage 4 Develop & implement VI Investigation Workplan
 - 4A. Delineate GW contamination
 - 4B. Investigate soil gas
 - 4C. Conduct sub-slab & indoor air sampling
 - Stage 5 Evaluate RI data using generic screening levels
 - Stage 6 Prepare & implement site-specific investigation
 - Stage 7 Evaluate data using generic or site-specific screening levels
 - Remediation & Monitoring
 - Determine appropriate remedial action
 - Implement remedial action
 - Establish a long-term monitoring program
 - Assess ability to terminate remedial action
- DEP intends to update its guidance from time to time, and updates to screening levels and other sections of guidance will be posted at www.state.nj.us/dep/srp/guidance/vaporintrusion/.
- DEP recommends developing a conceptual site model (CSM), which describes the contamination, subsurface conditions, including whether residual or mobile non-aqueous phase liquids are present. The CSM serves to identify complete or potentially complete pathway to receptors and identifies the potential for future risk. DEP expects that the CSM will include all relevant site specific data, historical information, and relevant general concepts and information, and offsite and regional information (e.g., aerial photographs, GIS data, historical and current tax maps should be consulted as well.). Particular sources of concern include free-phase or residual NAPL above or near the top of the saturated zone, contaminated soil in the vadose zone and shallow dissolve phase contamination in groundwater. Release of vapors can also occur from underground tanks or piping in certain types of underground facilities that use VOC during operations (DEP calls this source a “vapor cloud”).
- The CSM should identify major and minor migration pathways, including:
 - Diffusion of vapors from sources in the unsaturated zone
 - Diffusion of vapors from sources in shallow groundwater
 - Advective/convective transport of vapors
 - Vapor migration through preferential pathways
- Within the guidance, there is much discussion of advective and convective transport near buildings. These are demonstrated in the following diagram

2.2.3 Advective/convective transport of vapors

The horizontal and vertical movement of vapors located near a building foundation is often affected within an area referred to as the “zone of influence” (see Figure 2-4). Chemicals entering this zone are drawn into the building via soil gas advection and convection resulting from building interiors that exhibit a negative pressure relative to the outdoors and the surrounding soil. The reasons for this pressure differential include: 1) factors relating to operation of HVAC system including inadequate combustion or makeup air and unbalanced air supply and exhaust

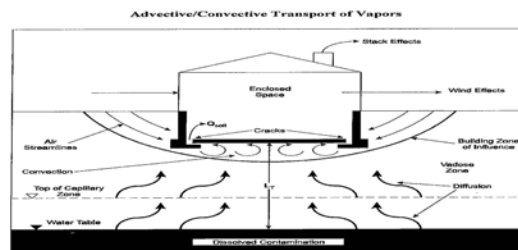


Figure 2-4. Advective and Convective Transport Near Buildings
Source: USEPA 2003a

- The guidance also discusses that vapor migration can occur along preferential pathways, which can be either natural or man made. An example of a natural preferential pathway is shallow rock or vertically fractured soil, and a common man made pathway is buried utilities. Crushed stone placed beneath the slab or foundation is another example of man made preferential pathway. Investigators should evaluate the potential for a VI situation where a preferential pathway leading to a structure runs near to but not through a source area. DEP expects that receptors be properly identified, by the investigator. These include residential and nonresidential settings. The Guidance acknowledges that occupational settings that fall under the purview of OSHA may be handled differently than those not subject to OSHA regulations when indoor air concentrations from occupational practices cannot be ruled out.
- DEP believes that the key factors affecting vapor migration are:
 - Biodegradation (of VOCs as they migrate in the vadose zone)
 - Site Stratigraphy
 - Soil Moisture and Groundwater Recharge
 - Fluctuations in Water Table Elevation
 - Ventilation Systems in Commercial/Industrial Buildings.

It also should be noted that HVAC systems can be designed, to prevent vapor intrusion. For buildings where retro fitting a building with a vapor barrier is impossible, use of a "positive pressure" HVAC system is the best alternative. At a site in Massachusetts, with significant perchlorethlene dry cleaning releases, RT recommended installation of positive pressure HVAC system, which has been successfully controlling VI concerns, for more than five years.

- DEP has developed groundwater to indoor air screening levels, which are based, in part, on the widely recognized Jackson and Ettinger Model, adopted by USEPA. Based on updates from EPA, NJDEP intends to update screening levels from time to time; these will be posted on the following DEP website: <http://www.state.nj.us/dep/srp/guidance/vaporintrusion/>.
- DEP has made some adjustments to groundwater indoor air screen levels, in particular, those for BTEX compounds. This adjustment was made based on the recognition that petroleum hydrocarbons have higher degradation rates than other types of volatile organic contaminants. Specific indoor air screening levels have been developed. DEP notes that there should be interface with the OSHA Program, and OSHA PEL concentration levels still be considered when contaminants of concern associated with industrial operations, are still present in a building. Also, indoor air screening levels should be superceded by background contaminant levels, as it is acknowledged that DEP does not require remediation to levels below background concentrations. Background determinations are to be made on a site specific basis, as determined in consultation with DEP. Further, alternate air concentration levels may be developed on a site specific basis, based on chemical toxicity factor changes on IRIS, or USEPA Region III RBC Table values not yet reflected in recent NJDEP Vapor Intrusion Guidance.
- DEP has also developed indoor air action levels, which will require immediate action to be taken, for thirteen chemicals that DEP has found to be the primary contaminants that drive remedial actions at VI impacted sites. In situations where these values are exceeded, local health departments, and consultation with DEP, would be given information to make a decision regarding the need for emergency actions, such as the evacuation of a building.
- Soil gas screening levels, are also provided.

NEW LIMITS

GWIASL - Groundwater to Indoor Air Screening Level

IASL - Indoor Air Screening Level

IECIAAL - Immediate Environmental Concern Indoor Air Action Level

SGSL - Soil Gas Screening Level

- In addition to developing a conceptual site model, DEP will require preparation of a Vapor Intrusion Work Plan. Interim remedial measures will be required to be implemented immediately after prompt collection of indoor air and sub-slab soil gas sample if there is an identified "Immediate Environmental Concern" in most instances, that level of response will not be necessary, and the investigator will move to the next decision point, which include evaluating the potential for VI where groundwater is present in excess of NJDEP Groundwater Indoor Air Screening Level (GWIASL) Limits (to be discussed later).
- Generally, groundwater sampling data provides the first level of information as to whether vapor intrusion may be a problem. Soil gas sampling will be needed at many sites, and, sub-slab soil gas sampling (below the foundation slab), near slab (within 10 feet horizontally of the foundation), or exterior, outside of the 10 perimeter can be used. Data can also be obtained from passive soil gas sampling procedures. Sub-slab soil gas sampling is recommended when groundwater contamination in excess of GWIASL extends under the buildings.
- DEP acknowledges that sub-slab or indoor air samples are not possible without a structure on a parcel, and in such instance, a grid sampling approach is recommended, with suggested soil gas sample depths of 8 to 10 feet below ground surface (equivalent to a typical basement depth). Where soil gas samples are being obtained to assess the future use scenario, the results will be compared to the SGSL results of sub-slab and near slab soil gas samples compared to the Soil Gas Screening Level (SGSL).
- SGSL criteria are applied to samples collected at a minimum depth of 5 feet below the ground surface and vadose zone but no closer than 1 foot above the capillary fringe. DEP has included in the Guidance capillary fringe criteria for different soil types. The only exception to the 5 foot rule for soil gas samples is where samples are selected from a location below a shallow or at grade impermeable slab, including driveways, parking lots, building slabs and garage floors.
- Soil gas data are the preferable investigation tools where vapor leaks (with vapor clouds) are suspected.
- When indoor sampling is used, DEP acknowledges that background indoor air contamination can confound representative sampling to determine what impacts are occurring from subsurface sources. Therefore, DEP requires the collection of sub-slab and ambient air samples in conjunction with indoor air sampling events to assist in the evaluation of background contaminant sources. DEP considers indoor air sampling necessary when the following occur:
 - Exceedances of the SGSL;
 - A shallow groundwater table is present that prevents the collection of soil gas data;
 - A site specific approach is utilized which requires supplemental data in support of the conclusions;
 - Preferential pathways exist that may negate or limit the usefulness of groundwater or soil gas data;
 - Stage 2 conditions that require a more immediate response;
 - VOC in bedrock near or at the surface which eliminates the use of the J&E Model; and,

- Other site specific factors.
- In the above context, Stage 2 refers to the condition where an Intermediate Environmental Concern has not been identified, during Stage 1, but a more problematic condition is found during subsequent Stage 2 VI investigation work. DEP expects indoor air samples should be taken at breathing zone height, as far away auto traffic or other potential sources as possible. Ambient air outdoor background concentration also are to be measured. During initial investigation work, DEP expects that in most cases, two rounds of indoor samples will be needed to rule out a VI concern. When Immediate Environmental Concern Indoor Air Action Level (IECIAAL) conditions exist, immediate confirmation sampling is required.
- Prior to completing soil gas sampling work, utility preferential pathways must be investigated.
- Once VI work is complete, a report must be submitted to DEP, including the following:
 - Copies of the Indoor Air Building Survey & Sampling form;
 - Scaled site maps identifying the site, adjacent streets, buildings sampled (soil gas/indoor air), ambient air sample locations;
 - Photographs of sample locations (as appropriate) or other pertinent site features;
 - Readings from field instrumentation;
 - Any documentation, including scaled maps, on the assessment of preferential pathways; and,
 - Scaled floor plans that note location of indoor air and sub-slab soil gas samples, observed stains and major cracks in slabs/foundations, sumps, French drains, existing radon systems, chemical storage areas (or other potential background sources), HVAC systems, utility entrances into buildings, etc.
- DEP also expects that saturated features affecting vapor intrusion, will be considered by the investigator. These include the following:
 - Clean Water Lens
 - Depth to Saturated Zone and Stratigraphy
 - Fluctuations in Depth to Saturated Zone
 - Complex Hydrogeologic Settings
 - Proximity to Preferential Pathways
 - Potential for Contaminant Degradation

Criteria on how to take these into account are included in the Guidance.

- Existing groundwater data, or new groundwater data, will typically be used to evaluate the VI pathway. Direct post sampling methods and passive diffusion bag sampling are two groundwater sampling methods recommended by DEP pertaining to screening level samples. Vertical profiling will be needed for some sites. Groundwater sampling methods for vapor intrusion investigation are summarized in the following Table:

GROUNDWATER SAMPLING METHODS FOR VAPOR INTRUSION INVESTIGATIONS

METHODS	SAMPLING PROCEDURE GUIDANCE DOCUMENTS	ADVANTAGES OR DISADVANTAGES
<p>Direct Push and Alternate Groundwater Sampling Methods (alternate to permanent monitoring well installation)</p>	<p>NJDEP Field Sampling Procedures Manual (2005); NJDEP Alternative Groundwater Sampling Techniques Guide found at http://www.nj.gov/dep/srp/regs/guidace.htm#techguide.</p>	<ul style="list-style-type: none"> - Can do vertical profiling - Can do discrete interval sampling at defined depth intervals - Rapid sampling at multiple locations - More difficult to repeat sampling in same locations - Some methods limited to unconsolidated formations
<p>Passive Diffusion Bag Samplers (PDBS)</p>	<p>NJDEP Field Sampling Procedures Manual (2005); USGS User's Guide for Polyethylene-Based PDBS to Obtain VOC Concentrations in Wells, Part 1 available at http://www.itrcweb.org/gd_DS.asp; ITRC Technical & Regulatory Guidance for Using PDBS to Monitor VOC in Groundwater available at http://www.itrcweb.org/gd_DS.asp.</p>	<p>Can use existing wells for:</p> <ul style="list-style-type: none"> - Vertical profiling in discrete intervals - ongoing monitoring <p>May not be adequate where/for:</p> <ul style="list-style-type: none"> - VOC highly soluble in water (such as MTBE) - in-well vertical flow occurs - Discrete interval sample not obtained
<p>Low Flow Purging and Sampling (LFPS)</p>	<p>NJDEP Low-Flow Purging & Sampling Guidance available at http://www.nj.gov/dep/srp/guidance/lowflow/.</p>	<ul style="list-style-type: none"> - May generally target interval closer to the water table in some settings - Discrete interval sample not obtained
<p>Traditional Purge and Sample Method</p>	<p>NJDEP Field Sampling Procedures Manual (2005)</p>	<p>Not recommended to generate new groundwater data specifically for VI investigations</p>

There are specific criteria in the Guidance on how to screen wells, how to complete vertical profiling (which should be done in at least boring or well, targeting the 0 to 3 foot, 3 to 6 foot, and at least one additional sample from the 6 foot interval or the water table, should be obtained. Criteria for use of passive diffusion bag samplers (PDBS) is also included. Where PDBS is used, should be deployed in a well for a minimum of two weeks, to allow for equal operation. PDBS sampling is not recommended where formations hydraulic conductivity of less than 1×10^{-6} centimeters per second.

- Unless vertical contaminant profiling is recommended, NJDEP may accept low flow purging and sampling if the vertical thickness of the water column is 10 feet or less. But, traditional purging sampling methods are not recommended when obtaining new data specifically geared for a VI investigation. LPS should not be used where there is evidence of vertical cross flow in a well, unless certain other criteria are met. Criteria are included in the Guidance for Installation of New Monitoring Wells, and for ongoing groundwater monitoring, conducted for VI investigation purposes.
- Criteria also included in the Guidance for Exterior or Near Slab Soil Gas Sampling Procedures.

DEP does not believe that exterior gas soil sampling can be used as exclusive determinant in the assessment of the VI pathway. DEP preference is for the collection of sub-slab over near soil gas samples however, if building occupant cooperation is not possible, near slab soil gas sampling is an alternative. Utilization of near slab soil gas sampling in lieu of sub-slab soil gas sampling must be approved in advance by DEP. In order for near slab soil gas sampling to be acceptable as a Stand Alone Assessment, the following are required:

- The soil gas samples must be collected at the depth corresponding to the range between 2 feet and 5 feet below the depth of the slab (and a minimum of 5 feet below the ground surface);
- The soil gas sample must be collected in the vadose zone, at least one foot above the capillary fringe;
- Soil gas samples shall be collected at a minimum from three sides of the building being investigated (biased towards the groundwater plume or soil contaminant source);
- All sampling procedures provided in this Guidance and the NJDEP's Field Sampling Procedures Manual (latest edition) shall be followed for the collection of soil gas samples; and
- A lab certified for an appropriate air method must analyze the samples (USEPA Method TO-15 using 1-Liter or 6-Liter stainless steel canisters is the most common method).
- Although field screening can be used, field screening soil gas surveys are not a substitute for conventional methodologies. When results are available, contaminant patterns must be established, and background contamination evaluated as appropriate.
- DEP has presented considerable in-depth information on actual sampling procedures, and has also indicated that an update to the NJDEP Field Sampling Procedures Manual, will be forthcoming shortly. There are specific requirements in the Guidance for determining site conditions, including soil conditions, high porosity areas, and low permeability zones, as part of the investigation work, by gaining exterior near slab soil gas samples a minimum of 5 feet below ground surface, providing assurance that an annular seal is maintained, by using tracer gas, or, installing permanent soil gas probes. A Certified Laboratory must be used where sub-slab soil gas sampling is used as a Stand Alone Assessment. Other laboratories can also be considered. There are specific requirements for purge volumes, and sample flow rates, in the Guidance.
- Sample locations, for near slab soil gas samples should be determined based on the end use of the data, as defined in the VI Investigation Work Plan. For a typical single dwelling of 15,000 square feet, one sample per side of building is required.
- When indoor air sampling is completed, one of the two sampling events must take place during the months between November and March, since those months are considered "worst case conditions" for buildings. For installing soil gas probes, licensed drillers may need to be utilized, if the criteria for boring depth and diameter of the boring, or the length of time a probe will remain in the hole are exceeded.
- Procedures for notifying the New Jersey "One Call" utility locating surface are included in the Guidance, and, passive sample collection methodologies can be utilized, following procedures in the DEP 2005 Field Sampling Procedures Manual (which is not yet issued).

- When conducting sub-slab soil gas sampling, a decision on the frequency of sampling shall be determined on a site specific basis. Sub-slab soil gas samples are to be compared to the SGSL. For crawl space air samples, DEP has determined that a attenuation factor of 1.0 is applicable.
- Before sub-slab sample locations are selected, DEP considers that a building walk through is a critical element prior to the investigation of the VI Investigation Work Plan. The following components of a building walk through must be addressed in the Work Plan:
 - Detection of potential background sources of volatile organic compounds
 - Determination of the building construction
 - Recognition of points of VI entry into a structure
 - Identification of possible sample locations
 - Education of the occupants on VI and sampling procedures
- DEP also considers that, particularly when basements are present, that sub-slab samples by themselves may not be adequate, to the degree that vapor intrusion is occurring through utility trenches, sumps, or cracks or other openings in the sidewalls of basements. Investigators are required to note the presence of sumps, cleanouts and/or floor drains when inspecting buildings. Specific procedures are included within the guidance on installing permanent sampling points, and installing temporary sampling points. Sub-slab soil gas samples are to be analyzed using EPA Method TO-15. If sub-slab soil gas sampling is a Stand Alone Assessment a Certified Laboratory using EPA Method TO-15 or TO-17 must be used. There are requirements for purging the vapor probe, prior to actually beginning the sample event. Where there are multi-family residential units in commercial or retail buildings, DEP feels that multiple vapor probes are necessary, with the decision on a number of sub-slab points required based on the CSM.
- DEP expects the investigator will educate occupants on the VI pathway. DEP has provided a one page advisory paper to be utilized for this purpose.
- Procedures are also included in the guidance for completing indoor pathway work. One ambient (outdoor) sample is expected to be taken concurrent with taking indoor air samples, which usually involves collecting a minimum of one indoor air sample from the ground floor living space at each property, typically using a SUMMA canister and analyzing same using EPA Method TO-15. Indoor air samples are expected to be completed over an 8 to 24 period. DEP requires the collection of ambient temperature and pressure readings during the collection of air samples. Either portable meteorological instrumentation can be used, or data can be obtained from the National Weather Service at <http://www.weather.gov>.
- Indoor air results are compared to the Indoor Air Screening (IASL). Crawl space results also get compared to IASL.
- When reviewing the results of the VI investigation work:
 - 6 foot thick lens of groundwater with contaminants below the GWIASL can be considered sufficient justification to conclude that the plume is not a source for vapor intrusion in the immediate vicinity. For lenses between 3 and 6 feet thick, further work to determine whether there is or is not a problem will likely be required. If the lens is less than 3 feet thick, which is over a plume where groundwater concentrations exceed the GWIASL, further investigation work will be required.
 - If sub-slab soil gas results exceed the SGSL, an additional investigation of the VI pathway is needed. Multiple sub-slab soil gas samples may have to be collected.
 - Basement indoor samples get compared to the IASL. If there are exceedences, additional investigation is required, and once data is confirmed, appropriate remedial action must be proposed. Where sub-slab and indoor air sample work is completed concurrently, DEP

believes that a concentration gradient between sub-slab indoor air samples greater than 20 times the sub-slab result strongly suggest that the VI pathway is complete.

- Where the pathway is considered complete, further investigation and/or remediation may be required.
- Indoor air analytical results are compared to the IECAAL. The implementation of an interim remedial measure will be required if sample result exceed the IECAAL:
- Notifications - although investigators may elect to forward results to occupants, NJDEP is responsible for officially notifying property owners and occupants about sampling results. DEP will submit a written report, consisting of a cover letter explaining findings and a table summarizing the results.
- DEP has provided in the Guidance in-depth technical information on petroleum hydrocarbon contamination, and its context in VI studies, as well as approaches to separate background contamination, from VI impacts from releases.
- Remedial Action techniques which are typically implemented when the VI problem is found, are as follows:
 - Sealing openings and cracks with caulk or expanding foam (preferably VOC-free)
 - Repairing compromised areas of the slab or foundation
 - Covering and sealing exposed earth and sump pits
 - Installing a sealed vapor barrier (e.g., plastic sheeting, liquid membrane) over earthen, gravel, etc. floors or crawlspaces
 - Utilizing natural ventilation
 - Installing a subsurface depressurization system
 - Installing a pressurized air curtain
 - Utilizing house pressurization
 - Utilizing heat recovery ventilation
 - Installing a soil vapor extraction system

As surface depressurization systems are most commonly used at existing buildings, DEP suggests that subsurface depressurization system meeting EPA radon Mitigation Guidance be used for design and evaluation purposes. Air permits may be required for discharge from such systems.

- Where properties and parcels have source concentrations above generic screening levels (GWIASL or SGSL), official notification of the property owner is necessary, and institutional controls will be required upon request for closure by a responsible party. Nonresidential screening levels (SGSL or ISL) can be used, contingent upon the responsible party obtaining agreement with the property owner and the implementation of institutional control at the affected structure/property. This agreement is to be submitted as part of the Remedial Action Work Plan.
- Sections are also included in the Guidance under “Remedial Action System Verification Sampling” to confirm that a remediation system is working, and that adequate monitoring and maintenance is being conducted. Remedial Action Progress Reports are also required to be submitted in accordance with 7:26E, the Technical Requirements for Site Remediation. Sections in the Guidance also address community outreach elements for vapor intrusion sites. DEP includes criteria for preparing letters, meeting with the public, and the format and subject matter for providing written reports, which will be submitted to building occupants or property owners.

At RT Review Press Time, RT was preparing comments to DEP, on the Vapor Intrusion Guidance, which will significantly affect redevelopment of Brownfields sites in New Jersey. In RT already has substantial experience in managing VI from all types of sources at solvent and petroleum release sites, including:

- VI screening evaluations
- soil gas and indoor air investigations
- design of vapor barrier liner systems at residential and commercial facilities
- certifying vapor barrier liner system construction.

We have completed this work at dozens of sites in Pennsylvania, New Jersey, Massachusetts and elsewhere. If you need more information on the proposed NJDEP VI policy, call RT's Craig Hopkins at (856) 467-2276 or by Email at CHOPKINS@RTENVNJ.COM.

**TABLE 1
COMMON CONSTITUENT
GENERIC VAPOR INTRUSION SCREENING LEVELS**

Chemical	Groundwater to Indoor Air Screening Levels*	Soil Gas Screening Levels				Indoor Air Screening Levels			
		Residential		Nonresidential		Residential		Nonresidential	
	µg/L	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Benzene	15	16	5	16	5	2	0.5	2	0.5
Ethylbenzene	61,000	21,000	4,900	30,000	6,800	1,100	240	1,500	340
MTBE (methyl tert butyl ether)	78	31	9	72	20	2	0.5	4	1
Tetrachloroethene (PCE)	1	34	5	34	5	3	0.5	3	0.5
Trichloroethene (TCE)	1	27	5	27	5	3	0.5	3	0.5
Vinyl chloride	5	13	5	19	7	1	0.5	1	0.5

*These Are Applicable to Locations Within 100' of the Receptor

**TABLE 2
COMMON CONSTITUENT IMMEDIATE ACTION LEVELS FOR INDOOR AIR**

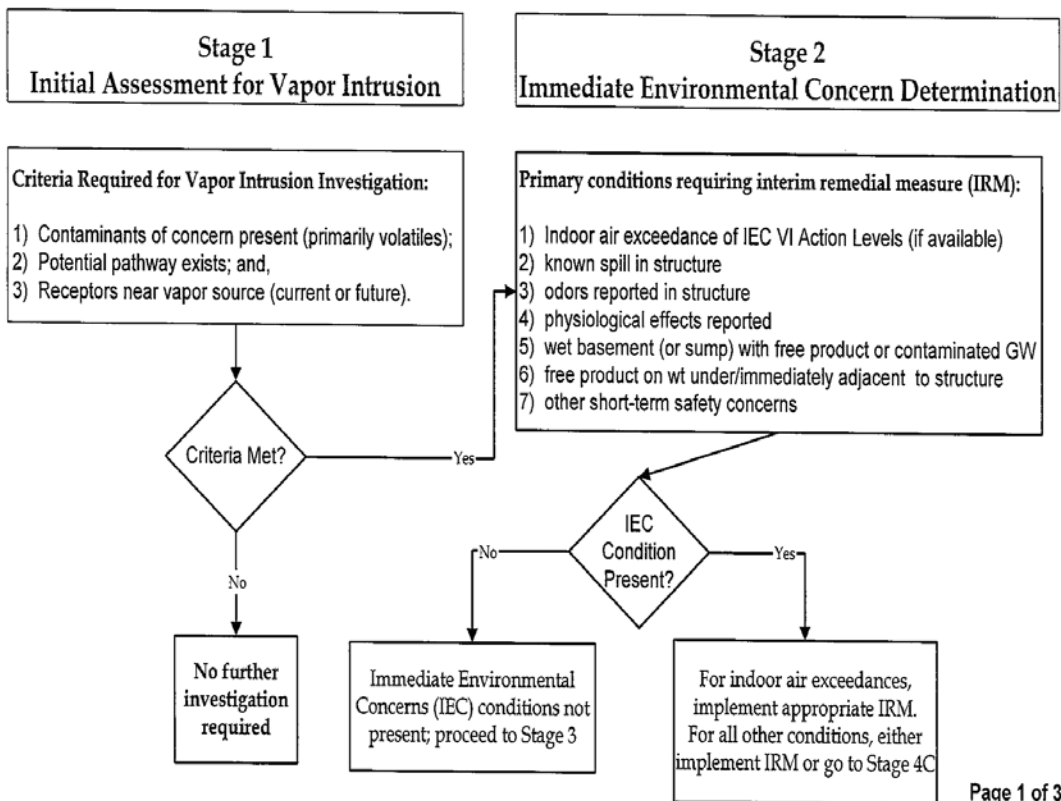
Chemical	Residential Screening Levels ¹		IEC Indoor Air Action Levels ²	
	µg/m ³	ppbv	µg/m ³	ppbv
Benzene	2 * C	0.5 * C	23	7
Ethylbenzene	1,100 N	240 N	2,200	480
MTBE (methyl tert butyl ether)	2 * C	0.5 * C	160	44
Tetrachloroethene (PCE)	3 * C	0.5 * C	31	5
Trichloroethene (TCE)	3 * C	0.5 * C	3*	0.5 *
Vinyl chloride	1 * C	0.5 * C	7	3

N - Noncancer effects based value.

C - Cancer effects based value.

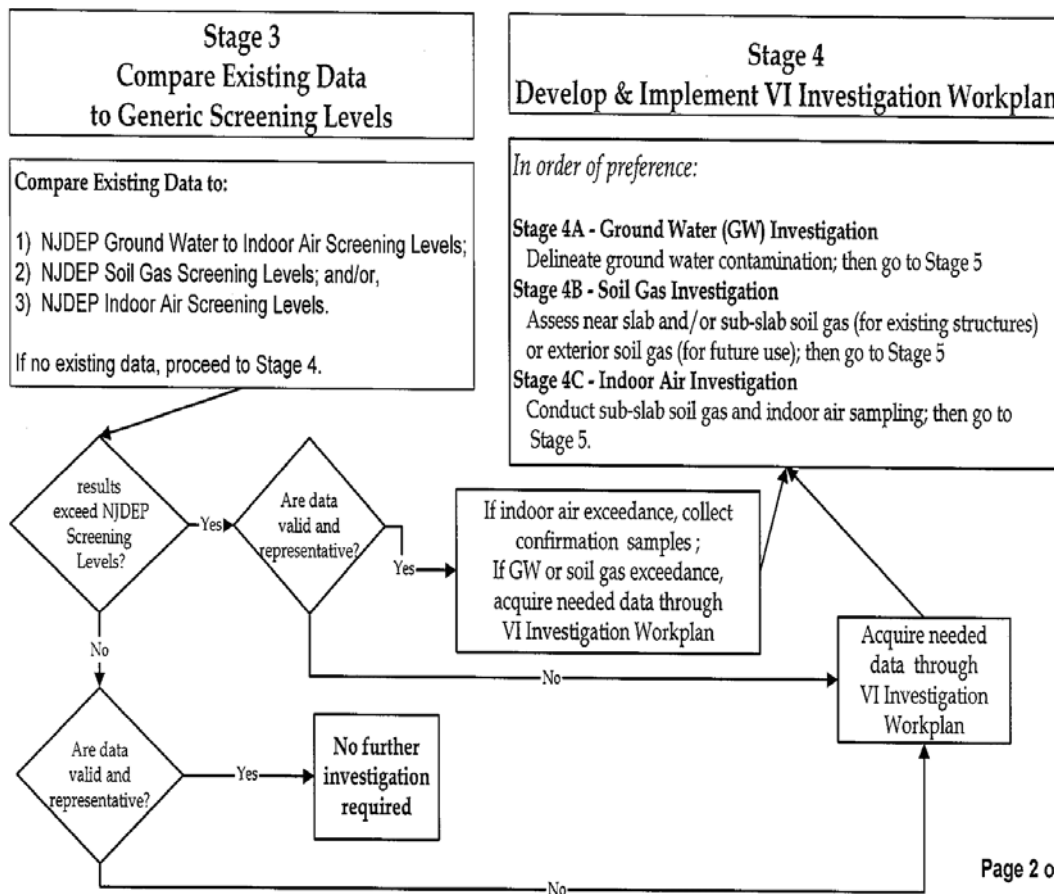
Decision Flow Chart for Vapor Intrusion Pathway

Preliminary Assessment



Decision Flow Chart for Vapor Intrusion Pathway

Remedial Investigation (RI)



Decision Flow Chart for Vapor Intrusion Pathway

Remedial Investigation (RI)

