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Standard Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions[1]

This standard is issued under the fixed designation E2600; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 *Purpose*—The purpose of this guide is to provide practical guidance and a useful process for conducting a *vapor encroachment screen (VES)* on a property parcel involved in a *real estate transaction* in the United States of America with respect to *chemicals of concern (COC)* that may migrate as vapors ~~onto~~ into the vadose zone of a property as a result of contaminated soil ~~and~~and/or groundwater on or near the property. This guide may be used in conjunction with Practice E1527 but does not alter or in any way define the scope of that practice. In addition, performance of this guide is not a requirement of and does not constitute, expand, or in any way define "all appropriate inquiry" as defined and approved by the U.S. Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the regulations there under, including 40 CFR Sec. 312.11.

1.1.1 *Vapor Encroachment Condition (VEC)*—The goal of conducting a *VES*, as established by this guide, on a parcel of property is to identify a *vapor encroachment condition (VEC)*, which is the presence or likely presence of *COC* vapors in the ~~sub-surface~~ vadose zone of the *target property (TP)* caused by the release of vapors from contaminated soil ~~or~~and/or groundwater either on or near the *TP* as identified by Tier 1 (see Section 8) or Tier 2 (see Section 9) procedures.

1.1.2 *Federal, State, and Local Environmental Laws*—This guide does not address requirements of any federal, state, or local laws with respect to vapor intrusion. *Users* are cautioned that federal, state, and local laws, regulations, or policy may impose vapor encroachment screening or vapor intrusion assessment obligations that are beyond the scope of this guide (information is provided in Appendix X5 and Appendix X9). *Users* should also be aware that there may be other legal obligations, for example, disclosure, with regard to *COC* or *COC* vapors discovered on the *TP* that are not addressed in this guide.

1.1.3 *Documentation*—The scope of this guide includes investigation and reporting actions. Sufficient documentation of all sources, records, and resources used in the investigation procedures that are set out in this guide should be provided in the *VES report* (refer to Section 10).

1.2 *Objectives*—Objectives guiding the development of this guide are: *(1)* to synthesize and put into writing a practical guide for conducting a *VES* on a property involved in a *real estate transaction* and *(2)* to provide that the process to screen for a *VEC* is practical and reasonable.

1.3 *Considerations Outside the Scope*—The use of this guide is strictly limited to the scope set forth in this section. Section 11 of this guide identifies, for informational purposes, certain tasks (not an all-inclusive list) that may be conducted on a property that are beyond the scope of this guide but that may warrant consideration by parties to a *real estate transaction*. Whether to include an investigation of any such conditions in the *environmental professional's* scope of services should be evaluated by the *user* and should be agreed upon between the *user* and *environmental professional* as additional services beyond the scope of this guide before initiation of a *Phase I ESA* conducted in conjunction with a *VES* or initiation of an independent *VES*.

1.4 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *Organization of ~~This~~this Guide*—This guide has eleven sections and nine appendices. The appendices are included for informational purposes and are not part of the procedures prescribed in this guide.

Section 1	contains the scope of the guide.
Section 2	includes the referenced documents.

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Section 3	has definitions of terms pertinent to this guide, terms used in this guide but defined in Practice E1527, and acronyms.
Section 4	is directed at the significance and use of this guide.
Section 5	discusses the relationship between this guide and Practice E1527.
Section 6	describes the *user's* responsibilities under this guide.
Sections 7 – 10	consist of the main body of the *VES* process, including evaluation and *report* preparation.
Section 11	provides information regarding non-scope considerations (see 1.3).
~~Appendix X1~~	~~provides legal background in support of vapor encroachment screening.~~
Appendix X1	provides legal background for vapor encroachment screening.
Appendix X2	provides guidance on suggested qualifications for the *environmental professional* conducting the *VES*.
Appendix X3	provides a sample questionnaire for the *environmental professional* to obtain pertinent information for the *VES* from the *property owner/operator/occupants*.
Appendix X4	provides a recommended table of contents and report format for the *VES* investigation when not incorporated into a *Phase I ESA* report.
Appendix X5	includes a listing of federal and state agency web sites that discuss vapor intrusion assessment policies and guidance.
~~Appendix X6~~	~~includes a list of typical *chemicals of concern*.~~
Appendix X6	includes a list of *chemicals of potential concern*.
Appendix X7	provides general guidance for vapor intrusion assessment and mitigation.
Appendix X8	provides general guidance and references for data collection in the conduct of vapor intrusion investigations.
Appendix X9	provides a supplemental bibliography of federal and state vapor intrusion guidance and other publications that may assist the *environmental professional* conducting a *VES* or vapor intrusion assessment.

1.6 *This guide does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this guide to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This guide cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM guide is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this guide be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the guide has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1527 Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

E1903 Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process

2.2 *Federal Statutes:*

42 U.S.C. U.S. Code, Title 42, The Public Health and Welfare, Solid Waste Disposal, Identification and Listing of Hazardous Wastes, §6901, 6903, 6921; 42 U.S.C. U.S. Code, Title 42, Comprehensive Environmental Response, Compensation and Liability Act, 9605, 9601, *et seq*.

2.3 *USEPA Documents:*

40 CFR Title 40, Protection of Environment, Chapter 1, Environmental Protection Agency, Parts 300, 302, 312, 355, *et seq*.

OSWER Publication 9200.2-154, OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air, June 2015

EPA 510-R-15-001, Technical Guide for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites, June 2015

2.4 *Other Documents:*

NTP National Toxicology Program, "Annual Report on Carcinogens," (latest edition)

IARC International Agency for Research on Cancer "Monographs" (latest editions)

NIOSH National Institute for Occupational Safety and Health, "Registry of Toxic Effects of Chemical Substances"

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3. Terminology

3.1 This section provides definitions and descriptions of terms used in this ~~guide and of~~ guide, terms used in this guide extracted from Practice E1527 (some of which have been modified to be consistent with this guide), and a list of acronyms for keywords used in this guide. The terms are an integral part of this guide and are critical to an understanding of the guide and its use.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *approximate minimum search distance, n*—defined in ~~subsections~~subsection ~~8.3.1~~8.1.3 and ~~8.3.2 and is~~ also defines the default *area of concern (AOC)*.

3.2.2 *aquifer, n*—rock or sediment in a formation, a group of formations, or part of a formation that is saturated and sufficiently permeable to transmit water to wells or springs.

3.2.3 *area of concern (AOC), n*—defined in subsections ~~8.2.1~~8.1.2, ~~8.3.1~~8.1.3, and ~~8.3.2~~8.1.4 and is ~~also~~ defined by the *approximate minimum search ~~distance.~~distance* adjusted as appropriate. When the *AOC* is defined by the *approximate minimum search distance* without adjustment, the *AOC* is the default *AOC*.

3.2.4 *biodegradation, n*—process by which microbial organisms transform or alter (through metabolic, enzymatic, or other action) the structure of chemicals present in the environment.

3.2.5 *chemical(s) of concern, COC, n*—chemical that is present in the subsurface ~~environment~~ environment, has a vapor pressure greater than 1 mm of mercury, or a Henry's Law Constant greater than 1×10^{-5} atm m^3~~and~~/mole at ambient temperature and pressure, and can potentially migrate as a vapor into the ~~sub-surface~~ vadose zone of the *TP*.

3.2.5.1 *Discussion*—

COC generally meet specific criteria for *volatility* (see 3.2.39) and *toxicity* (see 3.2.34) and include volatile organic compounds, semi-volatile organic compounds, petroleum hydrocarbons, and volatile inorganic analytes (such as mercury). ~~Common~~ A list of *COC* ~~are~~is presented in Appendix X6. A chemical's molecular weight has also been suggested as a criterion for volatility (with a threshold of 200 g/mole). However, EPA indicated in its June 2015 Vapor Intrusion Guidance that it is not considering a chemical's molecular weight because molecular weight is only a weak predictor of volatility. Those chemicals with a molecular weight greater than 200 g/mole are identified with an asterisk in Appendix X6.

3.2.6 *conduit, n*—preferential pathway along which vapors released from contaminated soil ~~or~~and/or groundwater may migrate onto the *TP* or away from the *TP*.

3.2.7 *contaminant, n*—any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

3.2.8 *contaminated plume, n*—plume in which concentrations of *COC* are known to be present in the soil or groundwater or both at concentrations exceeding levels that generally would be the subject of an enforcement action if brought to the attention of appropriate governmental agencies.

3.2.8.1 *Discussion*—

A *contaminated plume* can take the form of a groundwater *contaminated plume* or a soil *contaminated plume*. In a groundwater *contaminated plume*,*COC* ~~are~~ may be conveyed as *solutes* away from the point at which they were introduced into groundwater. They move with the migrating groundwater mass in the direction of groundwater flow. When dispersion within the groundwater *contaminated plume* brings a dissolved *COC* to the groundwater-soil gas interface, the *COC* may transition from the dissolved state to the vapor state and migrate from groundwater into soil gas in the vadose zone. Once a *COC* ~~gets~~migrates into soil gas in the vadose zone, its migration may no longer be dependent on or related to groundwater movement. In a soil *contaminated plume*, *COC* volatilized from the soil mix freely with soil gas that exists within soil voids in the vadose zone. *COC* in the soil gas can also be introduced from underlying contaminated groundwater, as a result of a liquid spill into vadose zone soils, or by the direct release of vapors from a leaking underground source. Migration of ~~the~~ *COC* contaminated soil gas through the vadose zone may be in any direction; however, it preferentially follows the path of least resistance. Fluctuations in barometric pressure may cause movement of air and vapors into and out of the vadose zone through preferential pathways.

3.2.9 *contaminated property, n*—property on which soil or groundwater or both contains *chemicals of concern (COC)* or otherwise hazardous substances at concentrations exceeding levels that generally would be the subject of an enforcement action if brought to the attention of appropriate governmental agencies.

3.2.10 *critical distance, n*—defined in subsection 9.2.

3.2.11 *dwelling, n*—structure or portion thereof used for residential habitation.

3.2.12 *environmental professional, n*—person meeting the education, training, and experience requirements as set forth in 40 CFR 312.10(b), which is the requirement set forth in Practice E1527 (see subsection 3.3.5).

3.2.13 *findings, n*—defined in subsection 10.2.2.

3.2.14 *fracture, n*—break in a rock formation.

3.2.14.1 *Discussion*—

Faults, shears, joints, and planes of fracture cleavage are ~~all~~ types of fractures. The presence of fractures may accelerate migration of *COCs* along the fracture.

3.2.15 *groundwater, n*—water contained in the pore spaces of saturated geologic media.

3.2.16 *Henry's law, n*—relationship between the partial pressure of a compound in air and the concentration of that compound in water under equilibrium conditions; *Henry's law* constants are temperature dependent.

3.2.17 *hydrocarbon, n*—chemical compound composed only of carbon and hydrogen atoms.

3.2.18 *moisture content (of soil), n*—amount of water lost from soil upon drying to a constant weight expressed as the weight per unit weight of dry soil or as the volume of water per unit bulk volume of the soil.

3.2.18.1 *Discussion*—

For a fully saturated medium, moisture content expressed as a volume fraction equals the porosity.

3.2.19 *nonaqueous phase liquid, NAPL, n*—substances that do not dissolve readily in water and that remain in the original bulk liquid form in the subsurface.

3.2.19.1 *Discussion*—

Light NAPL (LNAPL), such as gasoline, is less dense than water and can accumulate above the water table, while dense NAPL (DNAPL), such as many chlorinated solvents, including trichloroethylene and perchloroethylene, are more dense than water and can penetrate into the water table.

3.2.20 *permeability, n*—qualitative description of the relative ease with which rock, soil, or sediment will transmit a fluid (that is, a liquid or gas).

3.2.21 *petroleum, n*—crude oil or any fraction thereof that is liquid at standard conditions of temperature and pressure (60°F at 14.7 psia).

3.2.21.1 *Discussion*—

The term includes substances comprised of a complex blend of hydrocarbons derived from crude oil through the process of separation, conversion, upgrading, and finishing, such as motor fuels, jet oils, lubricants, and petroleum solvents, and also includes used oils.

3.2.22 *petroleum hydrocarbon chemicals of concern, n*—for the purpose of this guide, those volatile petroleum hydrocarbon compounds ~~that~~ are a subset of *COC* and ~~that~~ readily biodegrade to carbon dioxide and water by soil microbes in aerated environments.

3.2.22.1 *Discussion*—

Petroleum hydrocarbon chemicals of concern may be present in several forms in environmental media, including adsorbed to soil, as constituents of LNAPL above the water table, as dissolved solutes in groundwater, or as vapors in soil gas.

3.2.23 *Phase I environmental site assessment, ESA, n*—process described in Practice E1527.

3.2.24 *porosity, n*—volume fraction of a rock or unconsolidated sediment not occupied by solid material but usually occupied by liquids, gas, and/or air.

3.2.25 *preferential pathway, n*—pathway that has the least amount of constraint on the migration of *COC* vapors.

3.2.25.1 *Discussion*—

Preferential pathways are natural or man-made and may provide direct contact between the subsurface of a property and the vapor contaminant source (that is, the location on a property where the contaminated vapor intersects the preferential pathway). Natural preferential pathways may include, for example, vertically fractured bedrock where the fractures are interconnected and in direct

contact with the subsurface of a property and the vapor contaminant source. Man-made preferential pathways may include, for example, utility conduits and sewers. The presence of preferential pathways may also direct migrating *COC* vapors away from a *TP.*

3.2.26 *real estate, n*—undeveloped real property, real property used for industrial, retail, office, agricultural, other commercial, medical, or educational purposes, or property used as a single family or multi-family residential *dwelling*.

3.2.27 *real estate transaction, n*—transfer of title to or possession of real property or receipt of a security interest in real property.

3.2.28 *report, n*—document prepared by an *environmental professional* pursuant to Section 10.

3.2.29 *saturated zone, n*—zone in which all of the voids in the rock or soil are filled with water at a pressure that is greater than atmospheric.

3.2.29.1 *Discussion*—

The *water table* is the top of the *saturated zone* in an unconfined *aquifer*.

3.2.30 *semi-volatile organic compound, n*—general term for an organic compound that has sufficient vapor pressure at standard temperature (20°C) and pressure (1 atm) to vaporize (albeit at a slower rate than *volatile organic compounds*) and enter the atmosphere.

3.2.31 *solute, n*—substance such as a contaminant that is dissolved in another substance such as groundwater.

3.2.32 *target property, TP, n*—property involved in the *real estate transaction* that is the subject of the *VES* defined by this guide.

3.2.33 *toxic chemical, n*—chemical whose vapor concentration of the pure component poses either an incremental lifetime cancer risk (ILCR) or a ~~noncancer~~non-cancer hazard quotient greater than acceptable values established by applicable federal, state, or local regulatory agencies.

3.2.34 *toxicity, n*—effect on human health that is exhibited by a *toxic ~~chemical.~~chemical*; for the purposes of this guide, toxicity is defined as a chemical exhibiting an incremental lifetime cancer risk greater than 10^{-6} or a non-cancer Hazard Index greater than 1.

3.2.35 *user, n*—party who commissions the performance of a *VES* pursuant to this guide.

3.2.35.1 *Discussion*—

Commonly, the *user* is the prospective purchaser of a parcel of property.

3.2.36 *vadose zone (or unsaturated zone), n*—zone between the land surface and the water table within which moisture content is less than saturation (except in the capillary fringe) and pressure is less than atmospheric.

3.2.36.1 *Discussion*—

Soil pore space typically contains air or other gases. The capillary fringe is included in the *vadose zone*.

3.2.37 *vapor encroachment condition, VEC, n*—presence or likely presence of *COC* vapors in the ~~subsurface~~ vadose zone of the *TP* caused by the release of vapors from contaminated soil ~~or~~and/or groundwater ~~or both~~ either on or near the *TP* as identified by the Tier 1 (see Section 8) or Tier 2 (see Section 9) procedures in this guide.

3.2.37.1 *Discussion*—

Conditions may exist where there could be no vadose zone, such as the case of a building foundation sitting below the water table. In this case, it may be possible for *COC* vapors to adversely impact the indoor air without migrating through a vadose zone.

3.2.38 *volatile organic compound, VOC, n*—general term for an organic compound that has sufficient vapor pressure (for example, greater than ~~0.5 to~~ 1 mm Hg) at standard temperature (20°C) and pressure (1 atm) to significantly vaporize and enter the atmosphere.

3.2.39 *volatility, n*—chemical is considered to be sufficiently *volatile* if its *Henry's law* constant is greater than 10^{-5} atm-m^3-mol^{-1} and its vapor pressure is greater than 1 mm Hg at room temperature.

3.2.39.1 *Discussion*—

A chemical's molecular weight has also been used as an indicator of volatility, with the threshold molecular weight being

approximately 200 g/mole. EPA in its June 2015 Vapor Intrusion Guidance does not use the molecular weight criterion because this criterion is believed to be only a weak predictor of volatility.

3.2.40 *water table, n*—top of the *saturated zone* in an unconfined *aquifer*.

3.3 *Practice E1527 Terms Used in This Guide*—Some terms have been modified to be consistent with this guide.

3.3.1 *adjoining properties, n*—any real property or properties the border of which is contiguous or partially contiguous with that of the *target property*, or that would be contiguous or partially contiguous with that of the *target property* but for a street, road, or other public thoroughfare separating them.

3.3.2 *business environmental risk, n*—risk that can have a material environmental or environmentally driven impact on the transaction or the business associated with the current or planned use of a parcel of *real estate*, not limited to environmental issues that are investigated pursuant to this guide. Consideration of *business environmental risk* issues may involve addressing one or more non-scope considerations, some of which are identified in Section 11 of this guide.

3.3.3 *Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), n*—list of sites compiled by EPA that EPA has investigated or is currently investigating for potential *hazardous substance* contamination and for possible inclusion on the *National Priorities ~~List.~~List* (the CERCLIS information system supporting CERCLA has been retired by EPA and replaced by SEMS, the Superfund Enterprise Management System).

3.3.4 *CORRACTS list, n*—list of *hazardous waste* treatment, storage, or disposal facilities and other RCRA-regulated facilities (because of past interim status or storage of *hazardous waste* beyond 90 days) that have been notified by the EPA to undertake corrective action under RCRA. The *CORRACTS list* can be derived from the EPA database that manages RCRA data.

3.3.5 *environmental professional, n*—person meeting the education, training, and experience requirements as set forth in 40 CFR 312.10(b). The person may be an independent contractor or an employee of the *user*.

3.3.6 *environmental site assessment, ESA, n*—process by which a person or entity seeks to determine if a particular parcel of real property (including improvements) is subject to *recognized environmental conditions* (see subsection 3.3.22).

3.3.7 *fire insurance maps, n*—maps produced for private fire insurance map companies that indicate uses of properties at specified dates and that encompass the property. These maps are often available at local libraries, historical societies, private resellers, or from the map companies who produced them.

3.3.8 *hazardous substance, n*—substance defined as a *hazardous substance* pursuant to CERCLA 42 U.S.C. 9601(14), as interpreted by EPA regulations and the courts.

3.3.9 *hazardous waste, n*—any *hazardous waste* having the characteristics identified under or listed pursuant to Section 3001 of RCRA, as amended (42 U.S.C. 6921) (but not including any waste the regulation of which under RCRA (42 U.S.C. 6901-6992k) has been excluded by Act of Congress). RCRA defines a *hazardous waste*, at 42 U.S.C. 6903, as: "a solid waste, or combination of solid wastes, which because of its quantity, concentration or physical, chemical or infectious characteristics may (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed."

3.3.10 *landfill, n*—place, location, tract of land, area, or premises used for the disposal of solid wastes as defined by state solid waste regulations. The term is synonymous with the term *solid waste disposal site* and is also known as a garbage dump, trash dump, or similar term.

3.3.11 *local government agencies, n*—those agencies of municipal or county government having jurisdiction over the *target property*. Municipal and county government agencies include but are not limited to cities, parishes, townships, and similar entities.

3.3.12 *local street directories, n*—directories published by private (or sometimes government) sources that show ownership, occupancy, and/or use of sites by reference to street addresses. Often *local street directories* are available at libraries, or historical societies, and/or local municipal offices.

3.3.13 *National Priorities List, NPL, n*—list compiled by EPA pursuant to CERCLA 42 U.S.C. §9605(a)(8)(B) of properties with the highest priority for cleanup pursuant to EPA's Hazard Ranking System. See 40 C.F.R. Part 300.

3.3.13.1 *Discussion—*

The CERCLIS information system supporting CERCLA has been retired by EPA and replaced by SEMS, the Superfund Enterprise Management System.

3.3.14 *obvious, adv*—that which is plain or evident; a condition or fact that could not be ignored or overlooked by a reasonable observer while visually or physically observing the property.

3.3.15 *occupants, n*—those tenants, subtenants, or other persons or entities using a property or a portion of the property.

3.3.16 *operator, n*—person responsible for the overall operation of a facility.

3.3.17 *owner, n*—generally the fee *owner* of record of the property.

3.3.18 *petroleum products, n*—those substances included within the meaning of the petroleum exclusion to CERCLA, 42 U.S.C. §9601(14), as interpreted by the courts and EPA, that is: petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a *hazardous substance* under Subparagraphs (A) through (F) of 42 U.S.C. §9601(14), natural gas, natural gas liquids, liquefied natural gas, and synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). (The word fraction refers to certain distillates of crude oil, including but not limited to gasoline, kerosene, diesel oil, jet fuels, and fuel oil, pursuant to Standard Definitions of Petroleum Statistics.[3])

3.3.19 *publicly available, ~~adv—~~adj—*information that is *publicly available* means that the source of the information allows access to the information by anyone upon request.

3.3.20 *practically reviewable, ~~adv—~~adj—*information that is *practically reviewable* means that the information is provided by the source in a manner and in a form that, upon examination, yields information relevant to the property without the need for extraordinary analysis of irrelevant data. The form of the information should be such that the *user* can review the records for a limited geographic area. Records that cannot be feasibly retrieved by reference to the location of the property or a geographic area in which the property is located are not generally *practically reviewable*. Most databases of public records are *practically reviewable* if they can be obtained from the source agency by the county, city, zip code, or other geographic area of the facilities listed in the record system. Records that are sorted, filed, organized, or maintained by the source agency only chronologically are not generally *practically reviewable*. Listings in *publicly available* records that do not have adequate address information to be located geographically are not generally considered *practically reviewable*.

3.3.21 *reasonably ascertainable, ~~adv—~~adj—*information that is *(1)publicly available*,*(2)* obtainable from its source within reasonable time and cost constraints, and *(3) practically reviewable*.

3.3.22 *recognized environmental condition, REC, n*—the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: *(1)* ~~on a~~due to ~~target property~~any release to the environment; *(2)* under conditions ~~*that indicate an existing release, a past release, or a material threat*~~*indicative of a release* ~~of any~~to the ~~hazardous substances~~environment; or ~~*petroleum products*~~*(3)* ~~into structures on the target property or into the ground, groundwater, or surface water of the target property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include~~ under conditions ~~de minimis conditions~~that ~~generally do not present~~ pose a material ~~risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be~~ threat of a future release to the environment.~~de minimis are not RECs.~~

[3] *Standard Definitions of Petroleum Statistics*, American Petroleum Institute, Fourth Edition, 1988.

3.3.22.1 *Discussion—*

de minimis conditions—The *REC* term is not intended to include *de minimis conditions* that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be *de minimis* are not *RECs*.

3.3.23 *records review, n*—that part that is contained in Section 8 of this guide that addresses which records should or may be reviewed.

3.3.24 *solid waste disposal site, n*—place, location, tract of land, area, or premises used for the disposal of solid wastes as defined by state solid waste regulations. The term is synonymous with the term *landfill* and is also known as a garbage dump, trash dump, or similar term.

3.3.25 *solvent, n*—chemical compound that is capable of dissolving another substance and may itself be a *hazardous substance*, used in a number of manufacturing/industrial processes including but not limited to the manufacture of paints and coatings for industrial and household purposes, equipment clean-up, and surface degreasing in metal fabricating industries.

3.3.26 *standard environmental record sources, n*—those records specified in subsection ~~8.3.1~~8.1.3 of this guide.

3.3.27 *standard historical sources, n*—those sources of information about the history of uses of a property as specified in subsection 8.4 of this guide.

3.4 *Acronyms:*

3.4.1 *AOC*—Area of concern

3.4.2 *CERCLA*—Comprehensive Environmental Response, Compensation and Liability Act of 1980 (as amended, 42 U.S.C. §§9601 *et seq.*)

3.4.3 *CFR*—Code of Federal Regulations

3.4.4 *COC*—Chemical(s) of concern

3.4.5 *DNAPL*—Dense nonaqueous phase liquid ~~(often referred to as a "sinker" that can penetrate the water table)~~(a separate phase groundwater contaminant that is both denser than water and its concentration exceeds its solubility in water)

3.4.6 *EPA*—United States Environmental Protection Agency

3.4.7 *ESA*—Environmental site assessment

3.4.8 *LNAPL*—Light nonaqueous phase liquid ~~(often referred to as a "floater" that can accumulate on the water table)~~(a separate phase groundwater contaminant that is less dense than water and its concentration exceeds its solubility in water)

3.4.9 *NAPL*—Nonaqueous phase liquid

3.4.10 *NPL*—National Priorities List

3.4.11 *REC*—Recognized environmental condition

3.4.12 *TP*—Target property

3.4.13 *USC*—United States Code

3.4.14 *USGS*—United States Geological Survey

3.4.15 *VEC*—Vapor encroachment condition

3.4.16 *VES*—Vapor encroachment screen

3.4.17 *VOC*—Volatile organic compound

4. Significance and Use

4.1 *Uses*—This guide is intended for use on a voluntary basis by parties who wish to conduct a *VES* on a parcel of *real estate* to determine if a *VEC* is identified for the *TP* (that is, the presence or likely presence of *COC* vapors in the ~~subsurface~~ vadose zone of the *TP* caused by the release of vapors from contaminated soil and/or groundwater either on or near the TP as identified by the Tier 1 or Tier 2 procedures in this guide). The process defined in this guide is a screening process that requires information similar to information generally collected as part of a Practice E1527 *Phase I ESA* as well as additional information described in subsection 5.3 and Section 8 of this guide. If a *VEC* is identified by this screening process, the *user* may conduct further investigation. This guide, however, defines a procedure for ~~identifying~~determining in connection with a property involved in a *real estate transaction* whether a *VEC* ~~exists, likely exists, cannot be ruled out, or can be ruled out because a~~ exists or does not exist. A "*VEC* exists" determination is appropriate, for example, when there is known *COC* contamination in, at or on the *TP,* such as may be the case when *COC*-contaminated groundwater exists in the subsurface of the *TP.* A "*VEC* does not ~~or is~~ exist" determination is appropriate, for example, when subsurface sampling has confirmed that *COC's* ~~not likely to exist.~~ are not present. The guide can be applied to property with existing structures, property with structures that will be substantially rehabilitated, property without existing structures but having planned structures (for example, property in development), or property without existing structures and with no planned structures (for example, undeveloped property with no planned development).

4.2 *Clarifications on Use:*

4.2.1 *Use in Conjunction with Practice E1527 Phase I ESA*—This guide, when used in conjunction with Practice E1527 *Phase I ESA*, may assist the *user* and *environmental professional* in developing information about *VECs* associated with a *TP*. This guide has utility for a wide range of persons, including those who may not be involved in a *real estate transaction*.

4.2.2 *Independent Use*—This guide may be used independent of a Practice E1527 *Phase I ESA* to determine if a *VEC* ~~exists, likely exists, cannot be ruled out, or can be ruled out because a~~ exists or ~~VEC~~does not ~~or is not likely to~~ exist.

4.2.3 *Site-Specific*—This guide is property specific in that it relates to screening of *VECs* associated with a specific parcel of *real estate*. Consequently, this guide does not address many additional issues raised in transactions such as purchases of business entities or interests therein, or of their assets, that may well involve environmental liabilities pertaining to properties previously owned or operated or other off-site environmental liabilities. The guide does not replace a *Phase I ESA* conducted by an *environmental professional* or any obligation of the *environmental professional* under Practice E1527 to identify all *recognized environmental conditions (RECs)* related to the *TP*.

4.3 *Who May Conduct*—A *VES* should be performed by an *environmental professional*. No practical standard can be designed to eliminate the role of professional judgment and the value and need for experience in the party performing the investigation. The professional judgment of an *environmental professional* is, consequently, vital to the performance of this ~~screening.~~screening (refer also to Appendix X2).

4.4 *Additional Services Contracted For*—Additional services may be contracted for between the *user* and the *environmental professional*. Such additional services may include *business environmental risk* issues not included within the scope of this guide (see subsection 11.3 for some possible examples).

4.5 *Principles*—The following principles are an integral part of this guide and are intended to be referred to in resolving any ambiguity or exercising such discretion as is accorded the *user* or *environmental professional* in performing a *VES*.

4.5.1 *Uncertainty Not Eliminated in Screening*—No vapor encroachment screen, such as included in Sections 8 and 9 of this guide, can wholly eliminate uncertainty regarding the identification of *VECs* in connection with a *TP*. Screening is intended to reduce, but not eliminate, uncertainty regarding whether or not a *VEC* exists in connection with a property.

4.5.2 *Not Exhaustive*—The guide is not meant to be an exhaustive screening. There is a point at which the cost of information obtained or the time required to gather it outweighs the usefulness of the information and, in fact, may be a material detriment to the orderly completion of *real estate transactions*. One of the purposes of this guide is to identify a balance between the competing goals of limiting the costs and time demands inherent in performing a *VES* and the reduction of uncertainty about unknown conditions resulting from additional information.

4.5.3 *Level of Investigation is Variable*—Not every property will warrant the same level of screening. The appropriate level of screening should be guided by the ~~type~~nature of the property subject to screening and the information already available or developed in the course of the investigation.

4.5.4 *Comparison with Subsequent Investigation*—It should not be concluded or assumed that an investigation was not adequate because the investigation did not identify *VECs* in connection with a property. The *VES* must be evaluated based on the reasonableness of judgments made at the time and under the circumstances in which they were made. Subsequent *VESs* should not be considered valid bases to judge the appropriateness of any prior screening if based on hindsight, new information, use of developing technology or analytical techniques, or similar factors.

4.6 *Continued Viability of VES*—Subject to subsection 4.7, a *VES* conducted according to the procedures presented in this guide and completed less than 180 days before the date of acquisition of the property or, for transactions not involving an acquisition, the date of the intended use of the *VES*, is presumed to be valid. Subject to subsection 4.7 and the *user's* responsibilities set forth in Section 6, a *VES* conducted according to the procedures presented in this guide and for which the information was collected or updated within one year before the date of acquisition of the property or, for transactions not involving an acquisition, the date of the intended use of the *VES* may be used provided that the following components of the investigation were conducted or updated within 180 days of the date of purchase or the date of the intended transaction:

4.6.1 Reviews of federal, tribal, state, and local government records;

4.6.2 Update on the operations existing at the *TP*;

4.6.3 Evaluation of any new ~~significant~~ potential preferential pathways for vapor migration;

4.6.4 Screening of any new *contaminated plume* migration that might cause a *VEC* on the *TP*; and

4.6.5 Screening of any new contaminant releases in the *AOC* that might cause a *VEC* on the *TP*.

4.7 *Use of a Prior VES Screen*—This guide recognizes that *VESs* performed in accordance with this guide will include information that subsequent *users* may want to use to avoid undertaking duplicative screening procedures. Therefore, this guide describes procedures to be followed to assist *users* in determining the appropriateness of using information in *VESs* performed more than one year prior to the date of acquisition of the property or, for transactions not involving an acquisition, the date of the intended use of the *VES*. The use of a prior *VES* is based on the following principles that should be adhered to in addition to the specific procedures set forth elsewhere in this guide:

4.7.1 *Use of Prior Information*—Subject to the criteria set forth in subsection 4.6, *users* and *environmental professionals* may use information in a prior *VES* provided such information was generated as a result of procedures that are consistent with the procedures presented in this guide. However, such information should not be used without current investigation of conditions likely to affect *VECs* in connection with the *TP*. Additional investigation may be necessary to document conditions that may have changed materially since the prior *VES* was conducted.

4.7.2 *Contractual Issues Regarding Use of a Prior VES*—The contractual and legal obligations between prior and subsequent *users* of a *VES* or between *environmental professionals* who conducted the prior *VES* and those who would like to use such a prior *VES* are beyond the scope of this guide.

4.8 *Actual Knowledge Exception*—If the *user* or *environmental professional* conducting a *VES* has *actual knowledge* that the information being used from a prior *VES* is not accurate or if it is *obvious*, based on other information obtained by means of a Phase I and/or Phase II *ESA* or known to the person conducting the Phase I and/or Phase II *ESA*, that the information being used is not accurate, such information from a prior *VES* may not be used.

4.9 *Rules of Engagement*—The contractual and legal obligations between an *environmental professional* and a *user* (and other parties, if any) are outside the scope of this guide. No specific legal relationship between the *environmental professional* and the *user* is necessary for the *user* to implement the procedures presented in this guide.

5. Relationship to Practice E1527 Phase I ESA

5.1 *Identification of a REC Pursuant to a Phase I ESA—RECs* are identified only through the performance of a Practice E1527 *Phase I ESA*. Thus, a finding pursuant to this guide that a *VEC* exists ~~or likely exists~~ at the *TP* ~~or that a VEC cannot be ruled out for the TP~~is not a determination that a *REC* ~~is identified~~ exists at the *TP*. Whether a *REC* exists at a *TP* as a result of the impact of possible vapor migration ~~to~~into the ~~subsurface~~ vadose zone of the *TP* is a separate determination to be made by the *environmental professional* pursuant to Practice E1527. This guide does not constitute or meet the requirements for conducting "all appropriate inquiry" or any part of "all appropriate inquiry" as defined by U.S. EPA under CERCLA and the regulations there under, including 40 CFR Sec. 312.11.

5.2 *VES*—The *VES* established by this guide is intended to be used independently of or in conjunction with Practice E1527 *Phase I ESA*.

5.2.1 The *VES* may be conducted concurrently with the Practice E1527 *Phase I ESA*.

5.2.2 The *VES* may be conducted independent of a Practice E1527 *Phase I ESA*. When conducting a *VES* pursuant to this guide, the data collection actions specified in this guide should be implemented (see subsection 5.3 and Section 8).

5.3 *Use of Information Collected in a Phase I ESA Conducted in Accordance with the Practice E1527 Standard*—The screening (see Section 8) identified in this guide makes use of information similar to information generally collected as part of a Practice E1527 *Phase I ESA* as well as additional information described ~~in the following and~~ below and in Section 8 of this guide. The information that should be collected includes, but is not limited to, federal, state, local, and tribal government records, chemical use and historical records of prior uses on the *TP* and within the *AOC* surrounding the *TP* as determined by the procedures set out in Section 8, soil characteristics, geological characteristics, contaminant characteristics, *contaminated plume* migration, significant conduits that might provide preferential pathways for vapor migration, groundwater depth and groundwater flow direction data, and property information data.

5.4 *Assumptions Made in the Practice E1527 Phase I ESA*—Any assumptions or limitations made in the conduct of a *Phase I ESA* on the *TP* and that are applicable in the *VES* process as described in this guide should be specifically identified.

6. User's Responsibilities

6.1 *Scope*—The purpose of this section is to describe tasks that should be performed by the *user* that will help the *environmental professional* identify the possibility for a *VEC* to exist in connection with the *TP*. These tasks do not require the technical expertise of an *environmental professional*, although a *user* could ask the *environmental professional* to perform those tasks that could be performed by an *environmental professional*. In a *real estate transaction*, it is common to find the *user* to be the prospective property purchaser (although the *user* could be a lender or other entity with an interest in conducting a screening pursuant to this guide), with the *environmental professional* working for the *user*. Although the property *owner* (that is, the seller), *operator*, and/or *occupants* may possess information that would be useful to the *VES* established by this guide, absent an applicable legal requirement, the property *owner*,*operator*, and/or *occupants* are not required to provide the *user* with information about the *TP*. The *user* or the *environmental professional* or both need to determine the best methods for obtaining information that may be useful in the conduct of the ~~*VES.*~~*VES,* recognizing that, absent an applicable legal requirement, the property *user*,*operator*, and/or *occupants* are not required to provide such information to the *user* or the *environmental professional*. Subsection Appendix X3 provides a sample questionnaire that identifies information on the *TP* that may be useful in conducting a *VES* and identifying *VECs* in connection with the *TP*.

6.2 *Specialized Knowledge or Experience of the User*—The *environmental professional* conducting the *VES* should ask the *user* if the *user* has any specialized knowledge or experience that may be important to the screening of *VECs* in connection with the *TP*. It is the *user's* responsibility to respond to the questions asked by the *environmental professional* with information based on such specialized knowledge or experience. The *user* should respond to the *environmental professional's* questions before the *environmental professional* conducts the *VES*. Such specialized knowledge might include, for example, tenant odor complaints or occupancy-related health issues.

6.3 *Commonly Known or Reasonably Ascertainable Information*—The *environmental professional* conducting the *VES* should ask the *user* if the *user* is aware of any information commonly known or *reasonably ascertainable* within the local community about the *TP* that the *environmental professional* informs the *user* may be important to the screening of *VECs* in connection with the *TP*. It is the *user's* responsibility to respond to questions asked by the *environmental professional*. The *user* should respond to the *environmental professional's* questions before the *environmental professional* conducts the *VES*. Such information might include, for example, the existence locally of publicized area-wide ~~*contaminated*~~ *COC-contaminated groundwater plumes*.

6.4 *Requests for Information from the Property Owner, Operator, and/or Occupants*—Because, absent an applicable legal requirement, the property *owner*,*operator*, and/or *occupants* do not have an obligation to provide information about the *TP* to the *user* or the *environmental professional* or both, any requests for information about the *TP* submitted by the *user* or the *environmental professional* or both to the property *owner*,*operator*, and/or *occupants* should not suggest or imply that such persons are under any obligation to provide the information, unless an applicable legal requirement applies. Accordingly, the *user* or *environmental professional* or both should identify and be prepared to pursue methods for obtaining information about the *TP* relevant to the *VES* other than by obtaining such information from the property *owner*,*operator*, and/or *occupants*.

6.5 *Other*—Either the *user* should ~~make known to~~ inform the *environmental professional* ~~the reason~~ why the user wants to have the *VES* performed or, if the *user* does not identify the purpose of the *VES*, the *environmental professional* should assume the purpose is to identify whether a *VEC* exists at the *TP*. The *user* and the *environmental professional* may also need to modify the scope of services performed under this guide for special circumstances, including, but not limited to, unique local or site-specific conditions.

7. General Vapor Encroachment Screening Process

7.1 The purpose of a *VES* is to ~~identify,~~determine, to the extent feasible pursuant to the procedures presented in this guide, if a *VEC* exists at the *TP*. The *VES* process is intended to be used independently of, or in conjunction with, but not as a replacement

of, the existing Practice E1527 *Phase I ESA*. It is possible that the *VES* process described in this guide may complement requirements of existing federal, state, local, or other applicable vapor encroachment or intrusion laws, regulations, policies, or guidance. Subsections Appendix X5 and Appendix X9 identify selected federal, state, local, and other vapor encroachment and intrusion evaluation resources.

7.2 *General VES Process*—The *VES* process is a two-tiered screening process. The information to conduct a Tier 1 screen is similar to information generally collected as part of a *Phase I ESA* investigation and includes additional information described in subsection 5.3 and Section 8 of this guide and is typically focused on known or ~~suspect~~suspected contaminated properties that may exist in the *AOC* but should not necessarily be so limited. Tier 2 focuses on characteristics of the *contaminated plume* ~~resulting from~~associated with *contaminated properties* and the proximity of ~~the~~said *contaminated plume* to the *TP*. The information to conduct a Tier 2 screen is often found in state regulatory files and may also be obtained from other available documents or may be collected via sampling in the field or both.

7.3 *Report*—A separate *report* should be prepared (see Section 10), unless the *VES* is being performed in conjunction with a *Phase I ESA* conducted on the *TP*, in which case the *VES* findings and conclusions can be provided with the ~~report prepared pursuant to the~~ Phase ~~I ESA.~~1 report.

7.4 *Coordination of Parts:*

7.4.1 *Parts Used in Concert*—The government and historical *records review*, and other information collected, such as from the *Phase I ESA*, are intended to be used in concert with each other. If information from one source indicates the need for more information, other sources may be available to provide information.

7.4.2 *User's Obligations*—The *environmental professional* should note in the *report* whether or not the *user* has reported to the *environmental professional* information pursuant to Section 6 of this guide.

7.5 *Who May Conduct a VES:*

7.5.1 *Environmental Professional's Duties*—The *VES* should be performed by an *environmental professional* or conducted under the supervision of an *environmental professional*. This can be the same individual(s) responsible for conducting the Practice E1527 *Phase I ESA*. The individual(s) conducting the *VES* should possess sufficient training and experience necessary to conduct the screening and evaluation in accordance with this guide and have the ability to identify issues relevant to *VECs* in connection with the ~~*TP.*~~*TP* (refer also to Appendix X2). At a minimum, the *environmental professional* should be involved in planning the screening scope of work and in reviewing and interpreting information upon which the *report* is based.

7.5.2 *Information Obtained From Others*—Information for the *records review* needed for completion of a *VES* may be provided by a number of parties including government agencies, third-party vendors, the *user*, and present and past *owners*,*operators*, and *occupants* of the property, provided that the information is obtained by or under the supervision of an *environmental professional* or is obtained by a third-party vendor specializing in retrieval of ~~the~~such information. Prior *Phase I ESAs* may also contain information that could be appropriate for use in a current *VES*. The *environmental professional(s)* responsible for the *report* should review ~~all of~~ the information provided.

7.5.3 *Reliance*—An *environmental professional* is not required to verify independently the information provided by others and may rely on the information provided unless in the exercise of professional judgment it would be unreasonable to do so or the *environmental professional* has *actual knowledge* that certain information is incorrect or unless it is *obvious* that certain information is incorrect based on other information obtained in the *VES* or otherwise actually known to the *environmental professional*.

8. Tier 1 Screening

8.1 *Introduction:*

8.1.1 *Objective*—The purpose of Tier 1 is to conduct a screen ~~using~~ for vapor encroachment using information collected in the *Phase I ESA* ~~type information~~ or similar type of investigation to determine if a *VEC* exists at the *TP*. Tier 1 may be performed in conjunction with a Practice E1527 *Phase I ESA* or stand on its own if not conducted in conjunction with a *Phase I ESA*. When used in conjunction with a *Phase I ESA*, the *environmental professional* should use to the maximum extent possible information collected in the *Phase I ESA* and should also use additional information as described in subsection 5.3 and this section. If the Tier 1 screen ~~cannot rule out the possibility of~~ identifies that a *VEC* ~~existing at the~~ exists, ~~TP, then~~ a Tier 2 screen can be ~~conducted.~~conducted to obtain greater certainty.

8.1.2 Tier 1 screening begins with the default *AOC* defined by the *approximate minimum search distances* (see 8.1.3), adjusted as appropriate for local conditions, and then determining if known or suspected contaminated properties with *COCs* exist within the established *AOC*.

8.1.3 *Approximate minimum search distances* surrounding the *TP* to identify the default *AOC* are provided below. The default *AOC* is one third of a mile around the *TP* for *COCs* and one-tenth of a mile for petroleum hydrocarbon *COCs*. The *AOC* is measured from the *TP* boundary to a *contaminated property* with known or suspected *COC* contamination of soil or groundwater or both (for example, a dry cleaner site using perchloroethylene as the cleaning solvent). The term *approximate minimum search distance* is used in lieu of radius to include irregularly shaped properties.

Standard Environmental Record Sources (where available)	Default Approximate Minimum Search Distance—Surrounding the Target Property, miles	
	Chemicals of Concern	Petroleum Hydrocarbon Chemicals of Concern
Federal *NPL* site list	1/3	1/10
Federal CERCLIS list[A]	1/3	1/10
Federal RCRA CORRACTS facilities list	1/3	1/10
Federal RCRA non-CORRACTS TSD facilities list	1/3	1/10
Federal *RCRA generators list*	*property* only	*property* only
Federal institutional control/engineering control registries	*property* only	*property* only
Federal *ERNS list*	*property* only	*property* only
State and tribal lists of *hazardous waste* sites identified for investigation or remediation:		
State- and tribal-equivalent *NPL*	1/3	1/10
State- and tribal-equivalent CERCLIS	1/3	1/10
State and tribal *landfill* and/or *solid waste disposal site* lists	1/3	1/10
State and tribal leaking storage tank lists	1/3	1/10
State and tribal registered storage tank lists	*property* only	*property* only
State and tribal institutional control/ engineering control registries	*property* only	*property* only
State and tribal voluntary cleanup sites	1/3	1/10
State and tribal Brownfield sites	1/3	1/10

[A] The CERCLIS information system supporting CERCLA has been retired by EPA and replaced by SEMS (Superfund Enterprise Management System).

8.1.4 *Adjusting the Default AOC*—The default *AOC* may be expanded or reduced by the *environmental professional* (adjusted *AOC*) using experience and professional judgment. Consideration may be given, for example, to groundwater flow direction, subsurface characteristics, surficial features and man-made features.

8.1.4.1 *Groundwater flow direction.*

(1) If groundwater flow direction is known or can be inferred, for example, from the *Phase I ESA* investigation of the *TP*, the default *AOC* in the down-gradient direction may be reduced to the area within the critical distance, i.e., 100 feet. The *AOC* in the cross-gradient direction may also be reduced, depending upon the *critical distance* and the width of the *COC-contaminated plume* associated with a known or likely *COC-contaminated property* located in a cross-gradient direction from the *TP*. For this guide, the *critical distance* is defined in subsection 9.2.

(2) Down-Gradient Off-Site COC Contaminated Property—For a *COC-contaminated property* identified in Tier 1 located down-gradient from the *TP*, it is not necessary to have information on migrating groundwater *contaminated plume* dimensions as the *critical distance* is measured from the nearest *TP* boundary to the source of contamination at the off-site down-gradient property. In this case, the *AOC* may be reduced to the area within the *critical distance* (see subsection 9.2).

(3) Cross-Gradient Off-Site Contaminated Property—For a *contaminated property* identified in Tier 1 located cross-gradient from the *TP*, the *AOC* will be the area within the *critical distance* plus one half of a reasonable estimation of the *contaminated plume* width (at the point nearest the closest *TP* boundary) that might be associated with the nearby known or suspected *COC-contaminated property* (that is, the *COC-contaminated property* where the groundwater contamination originated). The *environmental professional's* judgment and experience can be used to estimate the width of the *COC-contaminated plume* that might be associated with the nearby known or suspected *COC-contaminated property*. If it is not possible to estimate the *contaminated plume* width, then the *AOC* cannot be reduced in the cross-gradient direction.

8.1.4.2 *Subsurface characteristics.*

(1) Low-permeability soil, such as soil high in clay or silt content or both generally tends to restrict soil gas movement, as also may soil with high-moisture content or high organic carbon content. High permeability soil tends to enhance soil gas movement;

8.1.4.3 *Surface natural features*—Surface natural features such as surface water and wetlands.

8.1.4.4 *Surface man-made features*—Surface man-made features such as the presence of potential vapor interceptors including utility corridors that may direct migrating vapors away from the *TP*.

8.1.5 Once the *AOC* is established, Tier 1 screening ~~begins~~ involves evaluating whether any known or suspected properties that may be associated with ~~*collection*~~*COCs* ~~of specific data (see subsection~~ are located within the established 8.1.3~~).~~*AOC*. If the *VES* is conducted in conjunction with a Practice E1527 *Phase 1 ESA*, Tier 1 uses information collected during the *Phase 1 ESA* process and additional information as described in subsection 5.3 and this section.

8.1.6 ~~The minimum information needed to conduct a~~ It is recommended that, at a minimum, a Tier 1 screen ~~includes:~~include the following information: