

APPENDIX G

Derivation of the Generic Screening Levels

DERIVATION OF THE GENERIC SCREENING LEVELS

The basis for the development of the Ground Water Screening Levels (GWSL), Indoor Air Screening Levels (IASL), and Soil Gas Screening Levels (SGSL) listed in Table 1 is presented below. As discussed in Chapter 4, the screening levels are to be used in the evaluation of a site for the vapor intrusion (VI) pathway.

1.0 DETERMINATION OF THE LIST OF VOLATILE ORGANIC CHEMICALS

VI is a potential concern when soil, soil gas or ground water is contaminated with volatile organic compounds (VOC) since volatile vapors may readily migrate through the subsurface into building basements and living areas. The USEPA Draft Vapor Intrusion Guidance (USEPA 2002b) defines VOC as chemicals with a Henry's Law constant greater than or equal to $1 \times 10^{-5} \text{ atm m}^{-3} \text{ mol}^{-1}$ at room temperature. A chemical's Henry's Law constant is approximately equal to the ratio of the chemical's vapor pressure divided by its water solubility. Thus, the Henry's Law constant takes into account a chemical's most fundamental measure of volatility (vapor pressure) and its tendency to volatilize from water. Chemicals with high Henry's Law constants are those with relatively high vapor pressures and relatively low water solubilities.

The use of Henry's Law criteria alone in the evaluation of potential VI can lead to anomalous results. For example, the USEPA Draft Vapor Intrusion Guidance lists p,p-dichlorodiphenyldichloroethylene (DDE), dieldrin and di-n-octyl phthalate as VOC. These chemicals are not identified as VOC by the Department since they have low vapor pressures and are highly adsorbed to soil. In contrast, chemicals commonly viewed as VOC (benzene, trichloroethylene, etc.) typically are liquids, have vapor pressures of several hundred to several thousand mm Hg at room temperature, and are weakly adsorbed to soil (K_{oc} values of 10-1000 ml/g). Borderline volatile chemicals, such as

dichlorobenzene and trimethylbenzenes, may have vapor pressures between 1 and 10 mm Hg. Since the vapor pressure of a chemical is the most fundamental measure of volatility, the Department is applying vapor pressure as a secondary parameter in the definition of a VOC. Consideration of the vapor pressure in the definition is also compatible with current VOC analytical methods, which do not include low vapor pressure chemicals, such as those discussed above. The Department is therefore considering a chemical to be 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.

The VOC with screening levels listed in this document are based on the chemicals included in the Department's state contract for USEPA Method TO-15 (NJDEP 2003b; NJDEP 2003c). Consideration of those chemicals listed in the USEPA TO-15 analytical method in the evaluation of the VI pathway is necessary since some chemicals considered VOC are not readily analyzed using currently available and standard analytical methods. The above definition used to determine the VOC chemicals of concern for the pathway resulted in the removal of the anomalous chemicals discussed previously that are included in the USEPA Draft Vapor Intrusion Guidance. Tert-butyl alcohol (TBA) is the only chemical on New Jersey's TO-15 list that fails the Henry's law constant criteria, with a value of $9.0\text{E-}06$ atm m⁻³ mol⁻¹. However, this value is very close to the 10^{-5} cutoff and its vapor pressure (40 mm Hg) meets the vapor pressure cutoff. TBA is also an important gasoline additive associated with leaking underground storage tanks. TBA has, therefore, been included in the list of chemicals and is considered a VOC.

Two other USEPA Method TO-15 chemicals (hexachlorobutadiene and 1,2,4-trichlorobenzene) meet the Henry's Law constant criteria but do not meet the vapor pressure criteria, with vapor pressures of 0.22 mm Hg and 0.46 mm Hg, respectively. These values, however, are close to the 1 mm Hg cutoff criteria, and are sufficiently volatile to be analyzed by USEPA Method TO-15. The chemicals have, therefore, been included on the list of chemicals in this guidance. Additional volatile compounds will be added to the list in future updates to the document based on new information and modifications pertaining to the VOC analytical methods.

1.1 Rounding of the Screening Level Values

The screening level values have been rounded to 2 significant figures for a value greater than or equal to 10, and to 1 significant figure for a value less than 10, including those less than 1. This approach is used by the USEPA Office of Solid Waste and Emergency Response and is described in the Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, (USEPA 2001a). The rounding rules specified below are contained in Hurlbert (1994).

The screening levels and analytical reporting limits were rounded as follows:

- If the first number beyond the last significant digit is less than 5, the last significant number remains the same; and the remaining numbers are dropped. For example, 4.438 is rounded to one significant figure, 4; and 44.38 is rounded to 2 significant figures, 44.
- If the first number beyond the last significant digit is more than 5, the last significant number increases by one and the remaining numbers are dropped. For example, 4.638 is rounded to one significant figure, 5; and 46.68 is rounded to 2 significant figures, 47.
- If the first number beyond the last significant digit is exactly 5, then the last digit is rounded to the closest even number. For example, 4.5 is rounded to one significant figure, 4; and 45.5 is rounded to two significant figures, 46.

2.0 GROUND WATER SCREENING LEVELS

To develop the screening levels, the Department evaluated the USEPA Draft Vapor Intrusion Guidance (USEPA 2002b). The USEPA Draft Vapor Intrusion Guidance calculates screening levels using indoor air criteria, the Henry's law constant for the chemical, and an assumed dilution attenuation factor of 1×10^{-3} between the ground

water and indoor air (USEPA 2002b). This approach was found to be protective of 95% of the residences studied where paired ground water and indoor air measurements were available.

An alternate approach is to use the J&E model to calculate ground water screening levels (Johnson and Ettinger 1991; USEPA 2002b). This approach is somewhat more rigorous, in that it calculates chemical specific dilution attenuation factors, which vary according to chemical properties such as diffusivity and the Henry's law constant. Additionally, a series of spreadsheets for evaluating the J&E model has recently been released by the USEPA that allows adjustment of the Henry's law constant for the ground water temperature (USEPA 2004d). The simpler method described in the USEPA Draft Vapor Intrusion Guidance uses Henry's law constants at a temperature of 25°C, which is considerably higher than ground water temperatures in New Jersey. New Jersey ground water temperatures typically range from 10-15°C (United States Geological Survey, 2003). A lower ground water temperature reduces the Henry's law constant. This reduces the source vapor concentration and moderately raises the ground water screening level. Screening levels calculated using the J&E model compare favorably with the simpler USEPA approach (USEPA 2002b), and it has been used successfully by several other states for calculation of screening levels for the VI pathway (Connecticut, Massachusetts, Michigan). Therefore, this model was utilized by the Department with New Jersey specific factors (where appropriate) instead of the simple USEPA approach for calculation of the GWSL.

The J&E model assumes contaminants volatilize from the surface of the water table in accordance with Henry's law. Contaminants then diffuse through the capillary zone of the soil column and the unsaturated soil zone, as controlled by air and water diffusion coefficients, the Henry's law constant, and soil properties (soil texture, soil moisture content, soil porosity). Upon nearing a building foundation, contaminants enter a zone of influence where soil gas advection and/or convection may occur, which may then transport the contaminant into a structure of concern via bulk soil gas flow. The magnitude of this transport is dependent on the magnitude of building depressurization, if

any, and the extent of openings in the building foundation (e.g. cracks in the foundation slab and the magnitude of the crack size between the foundation slab and the foundation wall). In some cases, building depressurization may be minimal or absent, and contaminants will diffuse through these openings via diffusion. The J&E model calculates the relative contribution of each of these transport mechanisms. Contaminants entering the building are assumed to immediately mix with building interior air. The amount of contaminant dilution that occurs upon entry into the building depends on the soil gas entry rate, the building air exchange rate and the building size.

USEPA discusses the various input parameters that are used in the J&E model and provides recommended quantitative values for them based on the most current information available in the USEPA Draft Vapor Intrusion Guidance (USEPA 2002b). In 2003, the USEPA released several EXCEL spreadsheets incorporating various versions of the J&E Model (USEPA 2004d). These spreadsheets incorporate the current recommended parameter values. The screening spreadsheet (GW-SCREEN) was used by the Department to calculate ground water screening levels for the VI pathway.

In accordance with departmental policy, when calculated health-based screening values are below the current New Jersey Ground Water Quality Standards (GWQS), the screening levels are set at the higher GWQS instead of the calculated values. Table G-1 presents the calculated health-based screening values and the applicable GWQS. Table 1 presents the GWSL after consideration of the calculated values and the GWQS.

2.1 Input Parameters for the Johnson and Ettinger (J&E) Model

Input parameter values used in the development of the ground water screening levels presented in Table G-1 were largely adopted as per USEPA recommendation, with the exception of ground water temperature. For the sensitivity analyses discussed below, all parameters except the one under study were held at the base value.

2.1.1 Soil Texture

Soil texture should be specified in the J&E spreadsheet and has a large effect on contaminant diffusion rates through the capillary zone and the unsaturated soil zone. The calculated Ground Water Screening Levels (GWSL) are therefore quite sensitive to this parameter. Sandy soil is common in much of the southern half of New Jersey (Tedrow 1986). This soil texture results in the most conservative estimates of ground water screening levels for the VI pathway, since heavier soil types (sandy loam, loam, etc.) provide more resistance to contaminant diffusion through the soil column. Additionally, the USEPA generic ground water screening levels use an attenuation factor of 1×10^{-3} , which corresponds to the approximate attenuation factor calculated using the J&E model with sand soil. Therefore, this soil texture was selected for development of GWSL, and was used in all locations in the spreadsheet where a soil texture was required (soil texture just above water table, soil texture in vadose zone for estimation of soil physicochemical properties, and soil texture to estimate soil permeability).

Sensitivity of Tetrachloroethene Screening Level to Soil Texture

<i>Soil Texture</i>	<i>Screening Level (ug/L)</i>
Sand	0.755
Loamy sand	1.8
Sandy loam	4.7
Loam	7.3

2.1.2 Soil Chemical and Physical Properties

These parameters are pre-set in the spreadsheet according to the soil texture. Since sand was used for the calculations, the following values were incorporated: Vadose zone dry soil bulk density, 1.66 gm/cm^3 ; vadose zone soil total porosity, 0.375, vadose zone soil water-filled porosity, 0.054; vadose zone soil effective permeability, $9.96\text{E-}08 \text{ cm}^2$. The soil organic carbon fraction is fixed at 0.002 in the GW-SCREEN spreadsheet, but does not affect results when the source of the contamination is the ground water. Dry soil bulk densities typically range from 1.2 to 1.8 g/cm^3 (USEPA 2004d). The screening level is unaffected by the value of this parameter.

Total soil porosity generally varies from 0.3 to 0.5. At a given soil moisture level, sensitivity of the screening level to this parameter is non-linear, and becomes more pronounced at low porosity due to the lack of air space for contaminant diffusion:

Sensitivity of Tetrachloroethene Screening Level to Total Soil Porosity

<i>Total Soil Porosity</i>	<i>Screening Level (ug/L)</i>
0.3	6.2
0.375	0.755
0.4	0.589
0.5	0.376

Vadose zone water-filled porosity may vary from 0.02 to 0.43 and has a large non-linear effect on screening levels. The high screening levels at high soil moisture levels are due to the lack of available soil airspace for contaminant diffusion.

Sensitivity of Tetrachloroethene Screening Level to Water-Filled Porosity

<i>Water-Filled Soil Porosity</i>	<i>Screening Level (ug/L)</i>
0.02	0.722
0.054	0.755
0.2	1.6
0.3	161
0.375	262

Soil permeabilities range from 10^{-6} to 10^{-12} cm² (USEPA 2004d). This parameter may be used to calculate the soil gas entry rate from the zone of influence into the building. However, as recommended by USEPA, the soil gas entry rate is fixed at 5 L/min (see below). Thus, the soil permeability is not used in the calculation of the Department’s screening levels.

2.1.3 Chemical Properties

Sources for chemical properties are consistent across the USEPA Soil Screening Guidance Document (USEPA 1996a), the USEPA Draft Vapor Intrusion Guidance (USEPA 2002b) and the chemical database built into the J&E spreadsheet (USEPA 2004d). Therefore, chemical properties contained in the J&E spreadsheet were used whenever possible. As discussed above, the chemicals currently investigated by the Department for this exposure pathway are the chemicals listed under the state contract for USEPA Method TO-15 (NJDEP 2003b). Not all of these chemicals are included in the J&E spreadsheet. For these chemicals, the data sources used in the above USEPA documents were first consulted to obtain chemical properties if possible. If unavailable, alternate data sources were used, and are noted in Table G-2. The chemical properties used in the J&E spreadsheet are the organic carbon partition coefficient, the diffusivity in air, the diffusivity in water, the water solubility, the Henry's law constant, the boiling point, the critical temperature, and the enthalpy of vaporization.

Organic carbon partition coefficients for the compounds regulated vary from about 0.5 to 5×10^4 cm³/g. Under the assumed scenario, the value of this parameter had no effect on calculated screening levels, since it is only used to calculate source vapor concentrations when the soil is the source of contamination. Air diffusivities for the chemicals regulated range from about 1.5E-02 cm²/sec to 2.7E-1 cm²/sec and have a moderate effect on the calculated screening level:

Sensitivity of Tetrachloroethene Screening Level to the Air Diffusivity

<i>Diffusivity in air (cm²/sec)</i>	<i>Screening Level (ug/L)</i>
1.40E-02	2.9
4.00E-02	1.2
7.20E-02	0.755
1.00E-01	0.611
2.70E-01	0.374

Water diffusivities range only from about 7.8E-06 cm²/sec to 1.2E-05 cm²/sec and had no effect on the screening level. Water solubilities are not used in the model calculations; rather, they are used as an upper limit for the allowed soil water concentration. If a calculated screening level is above the water solubility, it means the indoor air criteria

cannot be exceeded at any ground water concentration. This did not occur with any of the calculated screening levels.

Henry's law constants for the regulated compounds vary over several orders of magnitude and the sensitivity of the screening level to this parameter varies over an equally wide range:

Sensitivity of Tetrachloroethene Screening Level to the Henry's Law Constant

<i>Henry's Law Constant at 25°C (dimensionless)</i>	<i>Screening Level (ug/L)</i>
3.71E-04	836
3.20E-02	17.2
7.53E-01	0.755
3.01E+00	0.189
6.80E+01	0.0084

Most Henry's law constants for VOC, however, lie within the range of 10^{-1} and 10^{-2} . Within this range, screening levels vary by approximately an order of magnitude.

The boiling point, critical temperature and enthalpy of vaporization are used to adjust the Henry's law constant for ground water temperature, and are not directly used in the model. The values used for these fundamental parameters are relatively accurate.

2.1.4 Chemical Toxicological Properties

USEPA Region III toxicological parameters and assumptions were used to derive ground water screening numbers (USEPA 2005). The J&E model back-calculates screening values from allowed inhalation exposures. The required parameters are the unit risk factor (URF) for carcinogens and the reference concentration (RfC) for noncarcinogens (Table G-3). For a few parameters, Region III values were not available, and other sources were used. Four chemicals listed under the Department's Method TO-15 contract do not have toxicological information (1,2-dichlorotetrafluoroethane, 4-ethyltoluene, n-heptane, and 2,2,4-trimethylpentane). GWSL were not calculated for these chemicals.

The screening level is inversely related to the URF (i.e., doubling the URF will cause the screening level to drop by one-half when the carcinogenic endpoint controls the screening level). The RfC is linearly related to the screening level (i.e. doubling the RfC doubles the screening level when the noncarcinogenic endpoint controls the screening level).

2.1.5 Exposure Parameters

USEPA Region III exposure assumptions were used. This includes a target risk level of 10^{-6} for carcinogens and a target hazard quotient of 1 for noncarcinogens. These values are also in accordance with departmental policy. Other exposure assumptions, with one exception, were consistent across USEPA Region III, the USEPA Soil Screening Guidance and the USEPA Draft Vapor Intrusion Guidance. These parameter values were: averaging time for carcinogens, 70 years; averaging time for noncarcinogens, 30 years; exposure duration, 30 years; exposure frequency, 350 days/year. The exception pertains to body weight and inhalation rates during the exposure period. USEPA Region III includes an exposure adjustment for carcinogens when determining acceptable air concentrations that factor in the different contact rates of children to chemical vapors. This adjustment results in a 26% reduction in the GWSL calculated assuming adult only exposure. Since the J&E spreadsheet cannot make this adjustment, the screening levels obtained from the spreadsheet were multiplied by 74% to obtain the ground water screening level when the value was controlled by a carcinogenic endpoint.

The 74% child exposure adjustment factor, discussed above, used in the development of the carcinogenic effects based GWSL is not appropriate for vinyl chloride because the risk assessment approach for this chemical differs from that used for the other chemicals. Region III uses a non-prorated early lifetime exposure segment in the development of their risk based air concentration to account for early exposure to vinyl chloride.

To develop an appropriate child exposure adjustment factor for vinyl chloride, the Department compared the target vinyl chloride air concentration (0.28 ug/m^3) generated using the USEPA Draft Vapor Intrusion Guidance (USEPA 2002b) approach, that does

not include an age adjustment factor, to the Region III risk based air concentration (0.072 ug/m³) that incorporates an exposure adjustment for children. Based on this comparison, the appropriate carcinogenic effects child exposure adjustment factor is 26% for vinyl chloride, rather than the 74% adjustment factor used for other chemicals. This factor is reflected in the GWSL for vinyl chloride presented in Tables G-1, 1 and 3.

Screening levels are linearly related to the target risk level for carcinogens, and the target hazard quotient for noncarcinogens (i.e. doubling either of these factors will double the screening level in ground water). The averaging time for carcinogens should be set at the average lifetime (70 years) and is nonadjustable. The averaging time for noncarcinogens should be set equal to the exposure duration. Modification of the exposure duration is only relevant for carcinogens. This factor is inversely related to the screening level for carcinogens (i.e. doubling the exposure duration will halve the allowed screening level for carcinogens).

2.1.6 Building Parameters

As recommended and discussed in the USEPA Draft Vapor Intrusion Guidance, the soil gas entry rate (Q_{soil}) was set at 5 L/min. The building air exchange rate is fixed in GW-SCREEN at 0.25/hr according to USEPA recommendations. The building type used for generation of screening numbers was the generic size recommended for buildings with basements – a floor area of 10 m by 10 m and a height of 3.66 m. Contaminants entering the building are assumed to immediately mix into this volume.

Q_{soil} values generally vary from 1 to 10 L/min for typical residences (USEPA 2004d). Within this range, the screening level varies by about a factor of three:

Sensitivity of Tetrachloroethene Screening Level to the Air Infiltration Rate, Q_{soil}

<i>Q_{soil} (L/min)</i>	<i>Screening Level (ug/L)</i>
1.00E+00	1.69
3.00E+00	0.918
5.00E+00	0.755

7.00E+00	0.691
1.00E+01	0.642

The building air exchange rate and building size (volume) are fixed in GW-SCREEN. However, if they were adjustable, the GWSL would show a linear dependence on the exchange rate and the building size (doubling either parameter would double the screening level).

2.1.7 Other Parameters

The depth to ground water was fixed at 352.5 cm below ground surface. This is equivalent to 5 feet below the building foundation (which extends to a depth of 200 cm, or 6.5 feet) and is the minimum separation between the building and the ground water recommended for using the J&E model (USEPA 2002b). The depth to ground water has a relatively small effect on the ground water screening level. The building foundation depth is only significant in that it affects the depth interval between the foundation and the water table.

Sensitivity of Tetrachloroethene Screening Level to the Ground Water Depth (building foundation fixed at 6.5 feet)

<i>Depth to Ground Water (ft)</i>	<i>Screening Level (ug/L)</i>
7.5	0.644
9.8	0.71
11.6	0.755
13.1	0.799
16.4	0.895
19.7	0.992
23.0	1.1
26.2	1.2

29.5	1.3
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The ground water temperature for the Department’s screening criteria was set at 13°C. This is equivalent to the average temperature of two shallow ground water monitoring wells in the Kirkwood-Cohansey aquifer that had installed temperature monitors at depth (United States Geological Survey 2003). The ground water temperature has a moderate effect on the Henry’s law constant and therefore the GWSL. However, shallow ground water temperatures in New Jersey generally fluctuate between 10 and 15°C. This is significantly lower than the 25°C assumed generically in the USEPA Draft Vapor Intrusion Guidance, and it frequently results in a near doubling of the screening level.

**Sensitivity of Tetrachloroethene Screening Level
to the Ground Water Temperature**

<i>Ground Water Temperature (°C)</i>	<i>Henry’s Law Constant (dimensionless)</i>	<i>Screening Level (ug/L)</i>
5	0.251	1.21
10	0.336	0.895
13	0.398	0.755
15	0.445	0.679
20	0.581	0.520
25	0.750	0.403

2.1.8 Summary of Sensitivity Analysis of the J&E Model

As noted in the table below, the parameters with the largest effects on the GWSL are the soil texture and the water-filled porosity. Parameters with significant, but more moderate effects are soil total porosity, the air diffusivity, the Henry’s law constant, the unit risk factor, reference concentration, the risk level, the target hazard quotient, the exposure duration, the soil gas entry rate, building air exchange rate, building size, and ground water temperature. The depth to ground water had only a small effect on the screening

level for sand soil. Several parameters (soil organic carbon content, soil effective permeability, organic carbon partition coefficient, and diffusivity in water) had no effect on the ground water screening level.

<i>Parameter</i>	<i>GWSL Sensitivity</i>
Soil Texture	High
Soil Bulk Density	None
Soil Porosity	Moderate
Soil Water-Filled Porosity	High
Soil Effective Permeability	None
Soil Organic Carbon Fraction	None
Organic Carbon Partition Coefficient	None
Diffusivity in Air	Moderate (non-linear)
Diffusivity in Water	None
Henry's Law Constant	Moderate (non-linear)
Unit Risk Factor	Moderate (inverse linear)
Reference Concentration	Moderate (linear)
Target Risk Level	Moderate (linear)
Hazard Quotient	Moderate (linear)
Exposure Duration	Moderate (inverse linear)
Soil Gas Entry Rate	Moderate (non-linear)
Building Air Exchange Rate	Moderate (linear)
Building Size	Moderate (linear)
Depth to Ground Water	Low
Ground Water Temperature	Moderate (non-linear)

2.2 Calculated Ground Water Screening Values

The chemical specific dilution attenuation factors for the calculated health-based ground water screening values varied slightly above and below 1×10^{-3} , with a maximum of 2.13×10^{-3} , a minimum of 3.05×10^{-4} , and a mean of 1.12×10^{-3} . These factors are close to the generic USEPA factor of 1×10^{-3} . The USEPA factor was selected to be protective of nearly worst case conditions and was found to be adequately conservative for 95% of residences in which empirical ground water and indoor air data were available. The scenario assumed by the Department for the J&E model was also nearly worst case (sand soil, 5 feet to water table from building foundation). The similarity in the J&E model predicted worst case attenuation factors and the conservative empirical USEPA attenuation factor was noted by the USEPA and gives support to the use of the model

(USEPA 2002b). The lower ground water temperature assumed for the Department's scenario (13°C versus 25°C for the USEPA approach) results in a lower source vapor concentration just above the water table (typically about a factor of 0.5 lower). This results in ground water screening levels that are in most cases slightly higher than those calculated using the USEPA approach.

3.0 INDOOR AIR SCREENING LEVELS

3.1 Comparison of Risk Based Approaches

The Department considered the methodologies used by USEPA in the Draft Vapor Intrusion Guidance (USEPA 2002b) and the *Region III Risk Based Concentration (RBC) Table* (USEPA 2005) in the development of the health-based indoor air screening values. The Department is adopting the USEPA Region III approach since the Region III risk based air concentrations have historically been used by the Department in the evaluation of indoor air data and the approach has been approved by the New Jersey Department of Health and Senior Services (NJDHSS). The Region III approach also incorporates a combined childhood and adult exposure scenario when evaluating carcinogenic effects. Incorporation of childhood exposure parameters in the carcinogenic effects equation results in lower (approximately 26%), more protective health-based indoor air screening values when compared with the USEPA Draft Vapor Intrusion Guidance values.

3.2 USEPA Draft Vapor Intrusion Guidance

The USEPA Draft Vapor Intrusion Guidance includes target risk based indoor air concentrations under a residential exposure scenario using a chemical's noncancer based RfC or cancer based URF. The RfC is a "provisional estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects

during a lifetime (USEPA 1997). The inhalation RfC is expressed as a concentration in $\mu\text{g}/\text{m}^3$ or mg/m^3 units. The URF value is the quantitative estimate of cancer risk from inhalation exposure per $\mu\text{g}/\text{m}^3$ of air breathed (USEPA IRIS).

The USEPA guidance uses the RfC value as the target noncancer based indoor air concentration and does not include modification of the RfC value based on the typical residential exposure duration of 30 years and exposure frequency of 350 days per year. The cancer based indoor air concentration is calculated using the URF with the residential exposure assumptions noted above, as outlined in the USEPA Supplemental Guidance for Developing Soil Screening Levels (USEPA 2001a). The USEPA guidance does not incorporate the analytical reporting limit in the development of the indoor air concentrations.

3.3 NJDEP Residential Health-Based Indoor Air Screening Values

The USEPA Region III (USEPA 2005) risk based concentration equations (Equations 1, 2 and 3 included below) have been used in the development of the residential health-based indoor air screening values presented in Table G-4. The USEPA Region III risk based approach differs from the USEPA Draft Vapor Intrusion Guidance in that the Region III approach includes conversion of the RfC/URF values to reference dose inhalation (RfDi) and cancer potency slope inhalation (CPSi) values. This conversion allows risks to be evaluated under various exposure scenarios. The Region III approach includes the use of an age adjusted factor (Equation 2) in the residential carcinogenic effects equation. The age adjusted factor allows consideration of the child in the calculations by integrating the different exposures that occur from birth through age 30. The adjustment factor combines contact rates, body weights, and exposure durations for small children and adults.

Due to special considerations for vinyl chloride, the residential health-based indoor air screening value for vinyl chloride presented in Table G-4 is not based on the carcinogenic effects Equation 1 and 2 below but includes consideration of a non-prorated early lifetime

exposure in the development of the screening level. Details on the development of the residential health-based indoor air screening value for vinyl chloride is presented in the USEPA Region III May 6, 2001 *Derivation of Vinyl Chloride RBCs* memorandum that can be accessed at the Region III web site located at <http://www.epa.gov/reg3hwmd/risk/human/info/vcrbc.pdf>.

The Department, as mandated by the Brownfield Contaminated Site Remediation Act (NJSA 58:10B-1 et seq), has used an incremental lifetime cancer risk of 10^{-6} and a hazard quotient (HQ) of 1 in the development of the health-based indoor air screening values. Both cancer and noncancer endpoint indoor air concentrations were calculated with the health-based indoor air screening value determined as the more stringent of the cancer or noncancer based values. The USEPA Region III equations along with the residential exposure parameters used in the calculations are presented below.

Residential Health-Based Indoor Air Screening Value Equations

EQUATION 1- Carcinogenic Effect

$$RBC \frac{\mu g}{m^3} = \frac{TR * ATc * 1000 \frac{\mu g}{mg}}{Efr * IFAadj * CPSi}$$

EQUATION 2-Carcinogenic Effect Age-Adjusted Factor

$$IFAadj \frac{m^3 * y}{kg * d} = \frac{EDc * IRAc}{BWc} + \frac{(EDtot - EDc) * IRAa}{BWA}$$

EQUATION 3- Noncarcinogenic Effect

$$RBC \frac{\mu g}{m^3} = \frac{THQ * RfDi * BWA * ATn * 1000 \frac{\mu g}{mg}}{Efr * EDtot * IRAa}$$

Parameter/Description	Default
CPSi/ carcinogenic potency slope inhaled	Chemical specific (risk per mg/kg/day)
RfDi/ reference dose inhaled	Chemical specific (mg/kg/day)
TR/ target cancer risk	1×10^{-6}
THQ/ target hazard quotient	1
BWa/ body weight, adult	70 kg
BWc/ body weight, child (age 1-6)	15 kg
ATc/ averaging time, carcinogenic effect	25550 days
ATn/ averaging time, non-carcinogenic effect	ED * 365 days
IRAA/ inhalation rate, adult	20 m ³ /day
IRAc/ inhalation rate, child	12 m ³ /day
IFAadj/ inhalation factor, age adjusted	11.66 m ³ -y/kg-day
EFr/ exposure frequency	350 days/year
Edtot/ exposure duration, total	30 years
EDc/ exposure duration child, age 1-6	6 years

3.4 NJDEP Nonresidential Health-Based Indoor Air Screening Values

The USEPA Draft Vapor Intrusion Guidance does not present target indoor air concentrations under a nonresidential exposure scenario in the document. Since the Department has found that the evaluation of VI at sites under review frequently includes the collection of indoor air samples at nonresidential facilities, health-based nonresidential indoor air screening values have been developed and are included in Table G-4. The carcinogenic and noncarcinogenic effect equations and the exposure parameters used in the calculations are presented below. The nonresidential health-based indoor air concentration equations are based on the Region III equations with the child related exposure parameters removed from the carcinogenic effect equation. The typical indoor worker exposure frequency of 250 days per year and exposure duration of 25 years included in USEPA's Supplemental Guidance for Developing Soil Screening Levels (USEPA 2001a) has been used in the calculations.

The nonresidential health-based screening values are appropriate for the typical commercial/ industrial indoor use of a site and are based on the adult worker as the most

sensitive receptor. Equations 4 and 5 used in the development of the nonresidential IASL are presented below.

Nonresidential Health-Based Indoor Air Screening Value Equations

EQUATION 4-Carcinogenic Effect

$$RBC \frac{\mu g}{m^3} = \frac{TR * ATc * BWa * 1000 \frac{\mu g}{mg}}{EFo * EDo * IRAa * CPSi}$$

EQUATION 5-Noncarcinogenic Effect

$$RBC \frac{\mu g}{m^3} = \frac{THQ * RfDi * BWa * ATn * 1000 \frac{\mu g}{mg}}{EFo * EDo * IRAa}$$

PARAMETER/DESCRIPTION	DEFAULT
CPSi/ carcinogenic potency slope, inhaled	Chemical specific (risk per mg/kg/day)
RfDi/ reference dose, inhaled	Chemical specific (mg/kg/day)
TR/ target cancer risk	1 x 10 ⁻⁶
THQ/ target hazard quotient	1
BWa/ body weight, adult	70 kg
ATc/ averaging time, carcinogenic effect	25550 days
ATn/ averaging time, non-carcinogenic effect	ED * 365 days
IRAa/ inhalation rate, adult	20 m ³ /day
EFo/ exposure frequency, occupational	250 days/year
EDo/ exposure duration, occupational	25 years

3.5 Chemical Toxicity Factors

The Department has adopted the latest USEPA Region III RBC Table toxicity factors in the generation of the screening levels (USEPA 2005). Table G-5 lists toxicity factors and sources of the toxicity factors used in the calculations. As noted above, Region III converts the RfC/URF values to dose based RfDi and CPSi values. Equations 6 and 7 used to convert the RfC and URF toxicity factors to RfDi and CPSi dose base values are

presented below (USEPA 2004c). Consistent with USEPA Region III, inhalation based toxicity factors have been used when available in the calculations. Oral based toxicity factors were used in the absence of available inhalation based values and are noted in Table G-5.

Inhalation Toxicity Factor Conversion Equations

EQUATION 6- Carcinogenic Effect- Carcinogenic Potency Slope Inhaled (CPSi)

$$CPSi \frac{(kg - day)}{(mg)} = URF (m^3 / ug) * \frac{day}{20m^3} * 70kg * \frac{10^3 ug}{mg}$$

EQUATION 7- Noncarcinogenic Effect-Reference Dose Inhaled (RfDi)

$$RfDi \frac{mg}{(kg - day)} = RfC (mg / m^3) * \frac{20m^3}{day} * \frac{1}{70kg}$$

USEPA Region III toxicity factors were not available for 3-chloropropene and tertiary butyl alcohol (TBA). The toxicity factors used for 3-chloropropene were obtained from the USEPA Integrated Risk Information System (IRIS) and the California EPA. The 3-chloropropene RfDi and CPSi values, along with the sources of the values, are noted in Table G-5. The toxicity factor used for TBA is based on an oral RfD value developed by the Department's Division of Science Research and Technology (DSRT). The oral RfD value is also the basis of the soil standard for TBA currently included in the Department's soil standard development effort. The TBA toxicity factor is also presented in Table G-5.

Toxicity factors were not available for four of the fifty-six chemicals obtained from the Department's state contract for USEPA Method TO-15 (NJDEP 2003b). The four chemicals include 1,2-dichlorotetrafluoroethane, 4-ethyltoluene, n-heptane and 2,2,4-trimethylpentane.

3.6 Analytical Reporting Limits

The analytical reporting limits for each of the Table G-4 chemicals are based on the method detection limit of 0.5 ppbv using USEPA Method TO-15. The reporting limit is the value at which an instrument can accurately measure an analyte at a specific concentration with a defined degree of confidence that can be applied to the reproducibility and reliability of the data. The reporting limit is above the statistical method detection limit and is set at the concentration of the lowest calibration standard. The reporting limit values will be updated to reflect advances in the analytical methods and their associated reporting limits.

3.7 IASL Table Values

The residential and nonresidential health-based indoor air screening values, along with the USEPA Method TO-15 reporting limit, are presented in Table G-4. The applicable IASL for the chemical of concern is based on the higher of the health-based screening value and the USEPA Method TO-15 reporting limit. As an example, the applicable residential IASL for tetrachloroethene (PCE) is 3 ug/m³ since the reporting limit value of 3 ug/m³ is greater than the residential health-based screening value of 0.3 ug/m³. The nonresidential IASL for PCE also defaults to the reporting limit value of 3 ug/m³ since the health-based nonresidential indoor air screening value of 0.7 ug/m³ is lower than the analytical reporting limit. The Department bases the applicable IASL on the analytical reporting limit, when higher, due to questions regarding the ability to accurately measure levels detected below the reporting limit. The table values have been rounded to 2 significant figures for a value greater than or equal to 10, and to 1 significant figure for a value less than 10, including those less than 1.

4.0 SOIL GAS SCREENING LEVELS

Table G-6 presents the calculated health-based screening values and the USEPA TO-15 Method reporting limits used in the development of the screening levels. As presented in

the USEPA Draft Vapor Intrusion Guidance (USEPA 2002b), the health-based soil gas screening values were calculated by dividing the health-based indoor air values, presented in Table G-4, by an appropriate attenuation factor (α). Equation 8, below, presents the calculations used to derive the screening levels.

Equation 8: Health-Based Soil Gas Screening Value

$$\text{Health-based Screening Value} \left(\frac{\mu\text{g}}{\text{m}^3} \right) = \text{Health-based Indoor Air Value} \left(\frac{\mu\text{g}}{\text{m}^3} \right) / \alpha$$

USEPA defines the attenuation factor as the factor by which subsurface vapor concentrations migrating into indoor air spaces are reduced due to diffusive, advective and/or other attenuating mechanisms (USEPA 2002b). The attenuation factor is noted to be the ratio of the indoor air concentration measured in a residence to the vapor concentration measured in the subsurface materials underlying or adjacent to the residence (USEPA 2002b). The attenuation factor is represented in Equation 9 below.

Equation 9: Attenuation Factor (α)

$$\alpha = \frac{C_{\text{indoor}}}{C_{\text{subslab}}}$$

The USEPA Draft Vapor Intrusion Guidance uses an attenuation factor of 0.1 in the development of the document's target shallow soil gas concentrations based on the information included in the USEPA Vapor Intrusion Database that was available when the 2002 USEPA guidance was drafted. USEPA's current reevaluation of the database, that includes additional empirical data, suggests that a reduced attenuation factor may be more appropriate in the development of sub-slab SGSL. Discussions at two recent USEPA VI attenuation factor workshops suggest that an attenuation factor between sub-slab soil vapor and indoor air in the range of 0.01 to 0.05 may be adequately protective (USEPA 2004a; USEPA 2004b).

Based on this information, the Department has selected an attenuation factor of 0.02 in the development of the health-based soil gas screening values. The resulting health-based soil gas screening values are presented in Table G-6. The attenuation factor and health-based soil gas screening values will be updated as the state of the science advances and as new information becomes available. Site-specific attenuation factors and SGSL may be developed as a part of the remedial investigation (see Chapter 5).

Consistent with the development of the IASL, the SGSL default to the analytical reporting limit, when higher than the health-based values. The soil gas analytical reporting limits presented in Table G-6 are generally 5.0 ppbv or a factor of 10 higher than the indoor air analytical reporting limits for several reasons. These reasons include:

- 1) the use of 1 liter canisters that limit the amount of available sample volume and result in an automatic dilution of 10 to the sample results,
- 2) the required sample dilutions due to the presence of high contaminant concentrations exceeding the calibration range in undiluted samples; and,
- 3) the potential presence of methane and carbon dioxide in the soil gas sample that can shut down the instrument system and result in the need to dilute the sample to eliminate the interference of these two compounds.

The reporting limits for acetone and tert-butyl alcohol (TBA) have been elevated to 90 ppbv and 100 ppbv respectively, to address concerns within the laboratory community.

TABLE 1
NJDEP MASTER TABLE
GENERIC VAPOR INTRUSION SCREENING LEVELS

Chemical	Ground Water Screening Levels	Soil Gas Screening Levels				Indoor Air Screening Levels			
		Residential		Nonresidential		Residential		Nonresidential	
	$\mu\text{g/L}$	$\mu\text{g/m}^3$	ppbv	$\mu\text{g/m}^3$	ppbv	$\mu\text{g/m}^3$	ppbv	$\mu\text{g/m}^3$	ppbv
METHOD TO-15 PARAMETERS									
Acetone (2-propanone)	1,900,000	160,000	69,000	230,000	97,000	3,300	1,400	4,600	1,900
Benzene	15	16	5	26	8	2	0.5	2	0.5
Bromodichloromethane	5	34	5	34	5	3	0.5	3	0.5
Bromoethene (vinyl bromide)	0.1	22	5	22	5	2	0.5	2	0.5
Bromoform	370	80	8	180	18	5	0.5	5	0.5
Bromomethane (methyl bromide)	29	260	66	360	92	5	1	7	2
1,3-Butadiene (vinyl ethylene)	0.01	11	5	11	5	1	0.5	1	0.5
2-Butanone (methyl ethyl ketone)	2,700,000	260,000	87,000	360,000	120,000	5,100	1,700	7,200	2,400
Carbon disulfide	710	36,000	12,000	51,000	16,000	730	230	1,000	330
Carbon tetrachloride	1	31	5	31	5	3	0.5	3	0.5
Chlorobenzene	640	2,600	550	3,600	780	51	11	72	16
Chloroethane (ethyl chloride)	4	110	41	250	93	2	0.8	5	2
Chloroform	70	24	5	24	5	2	0.5	2	0.5
Chloromethane (methyl chloride)	240	4,700	2,300	6,600	3,200	95	46	130	64
3-Chloropropene (allyl chloride)	0.8	16	5	34	11	2	0.5	2	0.5
2-Chlorotoluene (o-chlorotoluene)	1,200	3,600	700	5,100	990	73	14	100	20
Cyclohexane	1,200	310,000	90,000	430,000	130,000	6,200	1,800	8,700	2,500
Dibromochloromethane	9	43	5	43	5	4	0.5	4	0.5
1,2-Dibromoethane (ethylene dibromide)	0.4	38	5	38	5	4	0.5	4	0.5
1,2-Dichlorobenzene (o)	5,900	7,300	1,200	10,000	1,700	150	24	200	34
1,3-Dichlorobenzene (m)	600	550	91	770	130	11	2	15	3
1,4-Dichlorobenzene (p)	75	30	5	32	5	3	0.5	3	0.5
Dichlorodifluoromethane (Freon 12)	1,000	9,100	1,800	13,000	2,600	180	37	260	52
1,1-Dichloroethane	3,600	26,000	6,300	36,000	8,800	510	130	720	180
1,2-Dichloroethane	2	20	5	20	5	2	0.5	2	0.5
1,1-Dichloroethene	250	11,000	2,800	15,000	3,900	220	55	310	77
** 1,2-Dichloroethene (cis)	350	1,800	460	2,600	640	36	9	51	13
1,2-Dichloroethene (trans)	300	3,600	920	5,100	1,300	73	18	100	26
1,2-Dichloroethene (total) ^d	190	1,600	410	2,300	580	33	8	46	12
1,2-Dichloropropane	1	23	5	23	5	2	0.5	2	0.5
1,3-Dichloropropene (total) ^d	1	31	7	72	16	2	0.5	2	0.5
Ethylbenzene	61,000	53,000	12,000	74,000	17,000	1,100	240	1,500	340
Hexachlorobutadiene	1	53	5	53	5	5	0.5	5	0.5

TABLE 1
NJDEP MASTER TABLE
GENERIC VAPOR INTRUSION SCREENING LEVELS

Chemical	Ground Water Screening Levels	Soil Gas Screening Levels				Indoor Air Screening Levels			
		Residential		Nonresidential		Residential		Nonresidential	
	$\mu\text{g/L}$	$\mu\text{g/m}^3$	ppbv	$\mu\text{g/m}^3$	ppbv	$\mu\text{g/m}^3$	ppbv	$\mu\text{g/m}^3$	ppbv
n-Hexane	30	36,000	10,000	51,000	14,000	730	210	1,000	290
Methylene chloride (dichloromethane)	53	190	55	430	120	4	1	9	2
4-Methyl-2-pentanone (MIBK)	880,000	160,000	38,000	220,000	54,000	3,100	770	4,400	1,100
MTBE (methyl tert butyl ether)	78	78	22	180	50	2	0.5	4	1
Styrene	18,000	52,000	12,000	73,000	17,000	1,000	250	1,500	340
Tertiary butyl alcohol (TBA)	170,000	3,300	1,100	4,600	1,500	66	22	92	30
1,1,2,2-Tetrachloroethane	4	34	5	34	5	3	0.5	3	0.5
Tetrachloroethene (PCE)	1	34	5	36	5	3	0.5	3	0.5
Toluene	310,000	260,000	68,000	360,000	95,000	5,100	1,400	7,200	1,900
1,2,4-Trichlorobenzene	2,800	1,800	250	2,600	340	36	5	51	7
1,1,1-Trichloroethane	2,300	51,000	9,400	72,000	13,000	1,000	190	1,400	260
1,1,2-Trichloroethane	5	27	5	27	5	3	0.5	3	0.5
Trichloroethene (TCE)	1	27	5	27	5	3	0.5	3	0.5
Trichlorofluoromethane (Freon 11)	2,000	36,000	6,500	51,000	9,100	730	130	1,000	180
1,1,2-Trichloro-1,2,2-trifluoroethane	2,400	1,600,000	200,000	2,200,000	290,000	31,000	4,100	44,000	5,700
Vinyl chloride	1	13	5	48	19	1	0.5	1	0.5
Xylenes (total) ^a	7,000	5,500	1,300	7,700	1,800	110	25	150	35
ADDITIONAL PARAMETERS									
** Mercury (elemental) ^b	NA	NA	NA	NA	NA	0.3	NA	0.4	NA
NOTES									
** Values updated from previous Table 1(dated May 2006) based on the latest USEPA Region III RBC Table (10/31/2006) toxicity factors or latest NJDEP GWQS.									
^a The concentrations of each isomer are added if multiple isomers are present and the results compared to the total screening level.									
^b Indoor Air Screening Level is health-based and does not consider the analytical reporting limit due to varying collection-specific factors. The analytical method and collection procedures used should attempt to attain a reporting limit as close as possible to the health-based criteria. The laboratory, in consultation with the environmental consultant, must submit their reporting limit prior to sampling.									
NA = Not available									
Screening levels are unavailable for six NJDEP state contract Method TO-15 chemicals (1,2-dichlorotetrafluoroethane, 4-ethyl toluene, n-heptane, 2,2,4-trimethylpentane, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene) due to the absence of toxicity information.									
See Appendix G of the NJDEP Vapor Intrusion Guidance for details on the development of the screening levels.									
When comparing site data with the screening levels, the data and the screening levels must be in the same units (i.e., ppbv or $\mu\text{g/m}^3$).									
Due to routine updates to the table, the user should refer to the NJDEP website for the latest information.									

TABLE 2
NJDEP ACTION LEVELS FOR INDOOR AIR

March 2007

Chemical	Cancer/ Noncancer ^a	Residential Screening Levels ^b		Rapid Action Levels ^c (RAL)		Health Department Notification Levels ^d (HDNL)	
		$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv
Acetone (2-propanone)	N	3,300	1,400	6,600	2,800	31,000 ^e	13,000 ^e
** Benzene	C	2*	0.5*	14 ^j	4 ^j	14 ^e	4 ^e
Carbon tetrachloride	C	3*	0.5*	10	2	100	20
Chloroform	C	2*	0.5*	8	2	80	20
1,2-Dichloroethene (total) ⁱ	N	33	8	66	16	400 ^e	100 ^e
Ethylbenzene	N	1,100	240	2,200	480	4,300 ^f	1,000 ^f
Methylene chloride (dichloromethane)	C	4	1	400	100	1,000 ^e	300 ^e
MTBE (methyl tert-butyl ether)	C	2*	0.5*	200	40	2,000	400
Tetrachloroethene (PCE)	C	3*	0.5*	30	5	300	50
Toluene	N	5,100	1,400	10,000	2,800	> 5,100 ^h	> 1,400 ^h
Trichloroethene (TCE)	C	3*	0.5*	20 ^g	3 ^g	20	3
Vinyl chloride	C	1*	0.5*	7	3	70	30
** Xylenes (total) ⁱ	N	110	25	220	50	4,300 ^e	1,000 ^e

NOTES

* Screening level is based on the higher analytical reporting limit.

** Values updated from previous Table 2 (dated May 2006) based on the latest USEPA Region III RBC Table (10/31/2006) toxicity factors.

^a Values based on cancer (C) or noncancer (N) effects.

^b Levels represent the higher of the health-based value or the Method TO-15 analytical reporting limit.

^c Levels are based on a factor of 100x for carcinogens and a factor of 2x for noncarcinogens, using the Table G-4 residential health-based values.

^d Levels are based on one-half the Agency for Toxic Substances Disease Registry (ATSDR) acute Minimum Risk Level (MRL) or 1,000x the the cancer health-based residential value in Table G-4, whichever is lower. The intermediate MRL is used in the absence of an acute MRL.

^e HDNL is based on one-half the ATSDR acute MRL.

^f HDNL is based on the ATSDR intermediate MRL.

^g The RAL for TCE is set at the HDNL due to the current controversy over the appropriate toxicity factor for the chemical.

^h The HDNL for toluene is set at exceedence of the residential screening level to reflect recent updates in the reference concentration (RfC) toxicity factor not yet incorporated in the ATSDR acute MRL value.

ⁱ The concentrations of each isomer are added if multiple isomers are present and the results compared to the total screening level.

^j The benzene RAL has been set at the lower HDNL.

Values are based on residential exposure. Due to routine updates, the user should refer to the NJDEP website for the latest information.

TABLE 3
NJDEP

GROUND WATER SCREENING LEVELS FOR ALTERNATE SOIL TEXTURES

Chemical	NJDEP Ground Water Quality Standards (µg/L)	LOAMY SAND: Ground Water Screening Level (µg/L)	SANDY LOAM: Ground Water Screening Level (µg/L)	LOAM: Ground Water Screening Level (µg/L)
Acetone (2-propanone)	6,000	2,000,000	2,200,000	2,700,000
Benzene	1	33 ^b	81 ^b	120 ^b
Bromodichloromethane	1	10	17	24
Bromoethene (vinyl bromide)	NA	0.3	0.7	1
Bromoform	4	440	550	770
Bromomethane (methyl bromide)	10	66	160	250
1,3-Butadiene (vinyl ethylene)	NA	0.02	0.06	0.09
2-Butanone (methyl ethyle ketone)	300	2,900,000	3,300,000	4,100,000
Carbon disulfide	700	1,600	4,000	6,200
Carbon tetrachloride	1	1 ^a	1 ^a	1 ^a
Chlorobenzene	50	1,400	3,400	5,100
Chloroethane (ethyl chloride)	NA	7	17	25
Chloroform	70	70 ^a	70 ^a	70 ^a
Chloromethane (methyl chloride)	NA	510	1,300	2,000
3-Chloropropene (allyl chloride)	NA	2	4	6
2-Chlorotoluene (o)	NA	2,800	6,400	9,600
Cyclohexane	NA	2,700	7,100	11,000
Dibromochloromethane	1	13	18	26
1,2-Dibromoethane (ethylene dibromide)	0.03	0.6	0.7	1
1,2-Dichlorobenzene (o)	600	12,000	26,000	39,000
1,3 Dichlorobenzene (m)	600	600 ^a	980	1,500
1,4-Dichlorobenzene (p)	75	75 ^a	75 ^a	75 ^a
Dichlorodifluoromethane (Freon 12)	1,000	1,000 ^a	1,000 ^a	1,000 ^a

TABLE 3
NJDEP

GROUND WATER SCREENING LEVELS FOR ALTERNATE SOIL TEXTURES

Chemical	NJDEP Ground Water Quality Standards (µg/L)	LOAMY SAND: Ground Water Screening Level (µg/L)	SANDY LOAM: Ground Water Screening Level (µg/L)	LOAM: Ground Water Screening Level (µg/L)
1,1-Dichloroethane	50	8,100	20,000	30,000
1,2-Dichloroethane	2	4	9	12
1,1-Dichloroethene	1	570	1,500	2,300
** 1,2-Dichloroethene (cis)	70	780	1,800	2,800
1,2-Dichloroethene (trans)	100	700	1,800	2,700
1,2_Dichloroethene (total) ^d	NA	440	1,100	1,600
1,2-Dichloropropane	1	3	7	10
1,3-Dichloropropene (total) ^d	1	3	8	12
Ethylbenzene	700	140,000 ^b	— ^c	— ^c
Hexachlorobutadiene	1	2	4	6
n-Hexane	30	30 ^a	45	67
Methylene chloride (dichloromethane)	3	110	240	360
4-Methyl-2-pentanone (MIBK)	NA	1,100,000	1,400,000	1,900,000
MTBE (methyl tert butyl ether)	70	140	250	350
Styrene	100	41,000	92,000	140,000
Tertiary butyl alcohol (TBA)	100	180,000	190,000	220,000
1,1,2,2-Tetrachloroethane	1	6	9	13
Tetrachloroethene (PCE)	1	2	5	7
Toluene	1,000	— ^c	— ^c	— ^c
1,2,4-Trichlorobenzene	9	5,200	8,400	12,000
1,1,1-Trichloroethane	30	5,300	14,000	22,000
1,1,2-Trichloroethane	3	10	18	26
Trichloroethene (TCE)	1	1 ^a	1 ^a	1 ^a

TABLE 3
NJDEP
GROUND WATER SCREENING LEVELS FOR ALTERNATE SOIL TEXTURES

Chemical	NJDEP Ground Water Quality Standards (µg/L)	LOAMY SAND: Ground Water Screening Level (µg/L)	SANDY LOAM: Ground Water Screening Level (µg/L)	LOAM: Ground Water Screening Level (µg/L)
Trichlorofluoromethane (Freon 11)	2,000	2,000 ^a	2,000 ^a	2,300
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon TF)	NA	5,500	15,000	23,000
Vinyl chloride	1	1 ^a	1 ^a	1 ^a
Xylenes (total) ^d	1,000	16,000 ^b	40,000 ^b	61,000 ^b
NOTES				
** Values updated from previous Table 3 (dated May 2006) based on the latest USEPA Region III RBC Table (10/31/2006) toxicity factors or latest NJDEP GWQS.				
^a Value is based on the higher GWQS/PQLs.				
^b Screening level multiplied by a factor of ten to reflect degradation of chemical in the unsaturated soil zone.				
^c Calculated GWSL is above the water solubility limit, indicating that the indoor air screening level cannot be exceeded at any concentration.				
^d The concentrations of each isomer are added if multiple isomers are present and the result compared to the total screening level.				
Screening levels are unavailable for six NJDEP state contract Method TO-15 chemicals (1,2-dichlorotetrafluoroethane, 4-ethyl toluene, n-heptane, 2,2,4-trimethylpentane, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene) due to the absence of toxicity information.				
NA = Not available.				