1 **Generic Numerical Standards/ Property-Specific Risk Assessment**  
OAC 3745-300-08  
OAC 3745-300-09

Certified Professional  
8-Hour Training

2 **Applicable Standards**  
• Clean up values that are protective of human health and the environment.  
• Concentrations of COCs within environmental media that are considered by the VAP to satisfy the above statement.

3 **Environmental Media**  
• Soil, sediment, surface water, and ground water  
• Also includes naturally occurring transitional zones such as bedrock, soil gas, and air

4 **Generic Standards**  
• Standards for hazardous substances or petroleum derived for soil, indoor air, and ground water  
• Generic numerical direct-contact soil standards  
• Generic indoor air standards due to vapor intrusion  
• Generic unrestricted potable use standards (UPUS)

5 **Phase I and Phase II assessments**  
• Release history  
• Selection of COCs  
• Pathway analysis  
• Exposure point concentration  
• Demonstration of compliance with applicable standards

6 **Guidance documents**  
• Risk Assessment Guidance for Superfund  
• Support Document for the Development of Generic Numerical Standards and Risk Assessment Procedures  
• Soil Screening Guidance, User’s Guide and Technical Background Document  
• Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites

7 **Soil direct-contact pathway**  
• Incidental ingestion of contaminated soil  
• Inhalation of contaminated soil particulates  
• Inhalation of volatile COCs from soil  
• Dermal contact with non-volatile COCs in soil
Property-specific risk assessment if:
- Exposure pathways not considered in development of generic standards
- Exposure scenarios are different than those listed in the tables
- COCs are not listed in rule 08 tables

PSRA if (cont.)
- Complete exposure pathways to important ecological resources
- Standards exceeded for sediment or surface water

Petroleum Standards
GNS = BUSTR ORC 3737.882 (B)
- Pathways included in BUSTR standards do not have to be assessed separately in VAP
- If BUSTR NFA has been issued the requirement to identify as an IA has been removed

Free Product
- Definition: a separate liquid hydrocarbon phase that has a measurable thickness of greater than one one-hundredth of a foot.

Generic Standards for Soils
Table I - residential land use
- Direct contact is assumed from surface to 10 feet below surface
  - 10 foot point of compliance
- Protective for, and may be applied to, all land use categories, without restriction

Generic Standards for Soils
Table II – commercial/industrial land use
- Direct contact is assumed from surface to 2 feet below surface.
  - 2 foot point of compliance
- Requires an environmental covenant as a remedy

Generic Numerical Standards for Soils
Table III – construction/excavation activities
- Point of compliance is the anticipated depth of activity

OAC 3745-300-08
Generic Numerical Standards
- Support Document for the Development of Generic Numerical Standards and Risk Assessment Procedures
- A transparent description of procedures used to derive generic standards
- Describes PSRA procedures

How are the standards generated?
Generic standards have historically been generated using a probabilistic method
- program runs 10,000 times, randomly selecting values from the distributions
- The 90th percentile value selected as the cleanup standard

How are the standards generated?
- Point values - deterministic method uses one value for each input
- Default US EPA assumptions already used within the RSLs, except:
  - Construction Worker standards; and
  - Ohio-specific Particulate Emission Factor and Volatilizations Factors
US EPA Regional Screening Levels Default Inputs
- Consistent with Remedial Response (RR) and RCRA
  - RSLs can be used as screening levels in RR & RCRA
  - VAP does not use RSLs as cleanup levels
- The Ohio Risk Goal and Hazard Index at 1E-05 and HI of 1 remain the same

Exposure Factors
- Exposure Duration (years)
- Exposure Frequency (days/year)
- Exposure Time (hours/day)
- Body Weight (kg)
- Soil Ingestion Rate (mg/day)
- Fraction Contaminated Soil (assume 50 percent)
- Surface Area of exposed skin (cm²)
- Soil Skin Adherence Factor (mg/cm²)

Standardized modeling assumptions for soil and climatic parameters
- Fraction vegetative cover
- Soil porosity
- Soil bulk density
- Fraction organic matter
- Wind speed
- Diffusion height...etc..

COC parameters
Physical Properties
- molecular weight
- Henry's Law constant
- organic carbon adsorption coefficient
- solubility
- air and water diffusivity
- melting point

Use of appropriate toxicity criteria
- U.S. EPA
  - IRIS
- Ohio EPA
  - Provisional Peer-Reviewed Toxicity Values (PPRTVs)
    - ATSDR
  - California EPA and other states

Toxicity Changes in 2014
- Mutagenic mode of action in the chemical’s toxicological profile in IRIS (Methylene Chloride and TCE are examples)
- Arsenic and Vinyl chloride have new understandings adopted

Generic Numeric Direct Contact Soil Standard
- Single chemical standard is lowest of cancer, non-cancer, or soil saturation value
• Must account for the presence of multiple chemicals

**Soil Saturation**

\[ C_{SAT} = \frac{S}{\rho_b} \left( K_d \rho_b + \theta_w + H' \theta_a \right) \]

Where:
- \( S \) = solubility in water
- \( \rho_b \) = dry soil bulk density
- \( K_d \) = soil/water partition coefficient
- \( \theta_w \) = water – filled soil porosity
- \( H' \) = Henry’s Law constant (chemical specific)
- \( \theta_a \) = air – filled soil porosity

**Generic Numerical Standards for Indoor Air due to Vapor Intrusion**

• Table IV – Residential Land Use
• Table V – Commercial/Industrial Land Use
• These values can be used to evaluate volatile chemicals in ground water or soil gas with use of attenuation factors
Conceptual model of the vapor intrusion exposure pathway
32 **Unrestricted Potable Use Standards (UPUS)**
- Table VI – Maximum Contaminant Levels (MCLs)
- Table VII – risk-derived
  - Ingestion
  - Inhalation
  - Dermal contact while showering

33 **Surface Water Generic Numerical Standards**
- Outside the Mixing Zone Average (OMZA) - OAC 3745-1
- Compared to 30-day average value from:
  - Adjacent ground water monitoring wells
  - Surface water on the property
  - Off-property surface water locations

34 **Surface Water**
- All regulated point source discharges must comply with all permit requirements.
- Includes general storm water permits.
- VAP relies on permit limits as meeting applicable standards for point sources.

35 **Sediments**
- Complete exposure pathways on the property
- Contaminated sediments migrating from the property
- Ohio EPA “Sediment Sampling Guide and Methodology”

36 **Human Health Evaluation**
- COCs are persistent, bioaccumulative and toxic
- Surface water produces edible-sized fish, supports wading, swimming, boating
- Property-specific risk assessment

37 **Exposure of Important Ecological Resources to Sediments**
- Sample sediments directly
- Compare to reference values in Ohio EPA “Guidance for Conducting Ecological Risk Assessment”

38 **Exposure of Important Ecological Resources to Sediments**
- If no SRVs, compare to consensus-based threshold effects concentration values in MacDonald, et al.
- Conduct PSRA if COCs are persistent, bioaccumulative and toxic

39 **Exposure of Important Ecological Resources to Sediments**
If sediments not compared to values, or COC concentrations exceed values, then bioassay or biocriteria surveys must be conducted.

40 **Multiple Chemical Adjustment**
- Technical Guidance Compendium document
- For all COCs listed in Tables I, II, III, IV, V and VII.
- MCA for soil and ground water done separately - generic standards only
- Inappropriate for Lead, Background, or MCLs (Table VI)

41 **Adjusting for Multiple Chemicals**
- Separate cancer/non cancer end points
- Divide site concentration by single chemical standard
• Add ratios
  • If cumulative ratio < 1.0, the soil concentrations meet the multiple chemical standard

Adjusting for Multiple Chemicals
  • Alternatively, can divide the standard for each COC by number of COCs
  • Compare adjusted value to site concentration

Adjusting for Multiple Chemicals
  • If ratio sum > 1.0, then one or more COCs must be remedied until the ratio equals 1.0.
  • Can derive a “flexible” multiple chemical standard by utilizing the buffer of risk from all COCs

Example of MCA

Example of MCA
  • Noncancer ratio < 1
    – Acenaphthene: 90/3,500 = .03
    – Anthracene: 500/18,000 = .03
  • Cancer ratio > 1
    – Benzo(a)anthracene: 12/11 = 1.09
    – Benzo(a)pyrene: 8/1.1 = 7.27

MCA
  • Alternatively, can calculate MCA by dividing standard by the number of COCs.
  • Determine if site concentration exceeds standard
  • Can adjust the standard to make up for “extra risk” in other COCs

Soil Standards - COC Concentrations From Soil to Ground Water
  • Concentrations that meet UPUS for GW when GW meets UPUS
  • Any other pathway requirements that must be met when GW exceeds UPUS

Property-Specific Risk Assessment
  • Based on same principles as generic numeric standards
  • Elective or mandatory application
    – Use of property-specific information as algorithm inputs

PSRA - Mandatory Applications
  • Exposure pathways not included in generic standards
  • COC does not have a generic standard
  • Concentrations of COCs exceed standards in surface water or sediment

PSRA - Mandatory Applications
  • Complete exposure pathway to important ecological resource
  • COCs are persistent, bioaccumulative and toxic

PSRA - Risk Goals
  • Same as for generic numerical standards
  • Industrial risk goal of 1E-04 for carcinogenic COCs
  • Petroleum release assessment dependent on petroleum fraction of product

Human Health Risk Assessment
  • Selection of COCs
  • Exposure assessment
• Toxicity assessment
• Risk and Hazard Characterization
  – Incremental and cumulative risk from multiple pathways
  – Uncertainty analysis (optional)

53 Human Health Risk Assessment
• Exposure Assessment
  – Identify receptors
  – Evaluation of exposure pathways
  – Quantification of intake

54 Human Health Risk Assessment
• Toxicity Assessment
  – IRIS updates
• Risk Characterization
  – Calculation of incremental risk
  • For each cancer and non cancer COC and for each exposure pathway
  – Calculate cumulative risk across complete pathways for each receptor

55 Calculation of Site-Wide Risk (cancer)

56 Important Ecological Resources
  – Excluding sediment and surface water
  – Rare, endangered or threatened species
  – Wildlife populations and their important nesting areas and food resources

57 Aquatic Life Use Designation
• Assessment of physical habitat
• Knowledge of what the habitat will support
• Ohio EPA sampled reference sites

58 Aquatic Life Use Designations
  Biological assessment of fish and macroinvertebrates
  • Exceptional warm water habitat (EWH)
  • Warm water habitat (WWH)
  • Modified warm water habitat (MWH)
  • Coldwater habitat (CWH)
  • Seasonal salminid habitat (SSH)

59 Biocriteria
• Measure of attainment of designated use
• Habitat plays an important role
• Metrics provide an analysis of possible effects from site impacts

60 Biological Surveys
• Ohio biocriteria certification training
• Bioassessment under paid technical assistance

61 Sediments - Ecological Risk Assessment
• Demonstrate that COCs on the property are not contributing to the failure to meet, or
• Remedy source and/or sediment
Applicable Standards From a PSRA
- Concentration of COCs meeting human health risk goals;
- Concentration of COCs meeting ecological risk goals
- Sediment standards
- Surface water
- Soil saturation

Risk Assessment Report
- Reason for PSRA
- List of institutional and/or engineering controls
- List of COCs not considered

Risk Assessment Report (cont.)
- List of receptor populations and exposure pathways
- Derivation and application of exposure factors used to quantify intake
- Toxicity values
- Risk characterization

Risk Assessment Report (cont.)
- Uncertainty analysis (if conducted)
- Ecological, sediment, surface water assessment
- Summary of compliance with applicable standards
### SOIL DIRECT-CONTACT PATHWAY

for commercial/industrial land use

<table>
<thead>
<tr>
<th>COC</th>
<th>EPC (mg/kg)</th>
<th>STANDARD FOR A SINGLE CHEMICAL NON-CARCINOGEN (mg/kg)</th>
<th>HAZARD QUOTIENT</th>
<th>STANDARD FOR A SINGLE CHEMICAL CARCINOGEN (mg/kg)</th>
<th>RISK RATIO</th>
<th>SOIL SATURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>B(a)P</td>
<td>4.1</td>
<td>NA</td>
<td>NA</td>
<td>5.8</td>
<td>0.707</td>
<td>NA</td>
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<tr>
<td>LEAD*</td>
<td>120</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>TCE</td>
<td>50</td>
<td>170</td>
<td>0.294</td>
<td>690</td>
<td>0.072</td>
<td>51 ✓</td>
</tr>
<tr>
<td>VINYL CHLORIDE</td>
<td>ND</td>
<td>1,000</td>
<td>NA</td>
<td>50</td>
<td>NA</td>
<td>3,900 ✓</td>
</tr>
</tbody>
</table>

**TOTAL**

|               |            |                                                      |                 |                                                 | 0.3        | 0.8 (8E-06)    |

Table II of OAC 3745-300-08 Appendix A

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### GROUNDWATER TO INDOOR AIR PATHWAY

for commercial/industrial land use

<table>
<thead>
<tr>
<th>COC</th>
<th>EPC (µg/L)</th>
<th>CALCULATED INDOOR AIR CONCENTRATION (µg/m³)</th>
<th>HAZARD QUOTIENT</th>
<th>RISK RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCE</td>
<td>42</td>
<td>8.3</td>
<td>0.95</td>
<td>0.28</td>
</tr>
<tr>
<td>VINYL CHLORIDE</td>
<td>110</td>
<td>82.5</td>
<td>0.19</td>
<td>3.0</td>
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</tbody>
</table>

**TOTAL**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

**U.S. EPA’S VISL Calculator**
<table>
<thead>
<tr>
<th>VOC</th>
<th>EPC (µg/m³)</th>
<th>CALCULATED INDOOR AIR CONCENTRATION (µg/m³)</th>
<th>HAZARD QUOTIENT</th>
<th>RISK RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCE</td>
<td>42</td>
<td>10.2</td>
<td>1.4</td>
<td>0.42</td>
</tr>
<tr>
<td>VINYL CHLORIDE</td>
<td>192</td>
<td>57.6</td>
<td>0.13</td>
<td>2.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2</td>
<td>3</td>
<td>3 (3E-05)</td>
<td></td>
</tr>
</tbody>
</table>

GROUNDWATER TO INDOOR AIR PATHWAY
for commercial/industrial land use
COMMERCIAL/INDUSTRIAL LAND USE

IA-1: FORMER MANUFACTURING FACILITY

IA-2: FORMER PAINT BOOTH

IA-4: FORMER UST

PROPERTY BOUNDARY

WAREHOUSE

BUILDING OCCUPANCY LIMITATION AREA

CUMULATIVE RISK for commercial/industrial land use

<table>
<thead>
<tr>
<th>PATHWAY</th>
<th>HAZARD QUOTIEN</th>
<th>RISK RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOIL DIRECT-CONTACT</td>
<td>0.3</td>
<td>0.8</td>
</tr>
<tr>
<td>SOIL AND GROUNDWATER TO INDOOR AIR</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0.5</td>
<td>0.9</td>
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