Ground Water Assessment

Investigation, Protection, Classification, and Response Requirements

OAC 3745-300-10 and
parts of 3745-300-07

Certified Professional
8-Hour Training

Investigating Ground Water: Discussion Topics

- Soil/Leaching Investigations
- Identification and Protection of Ground Water Zones
- Classification of Ground Water Zones
- Ground Water Response Requirements

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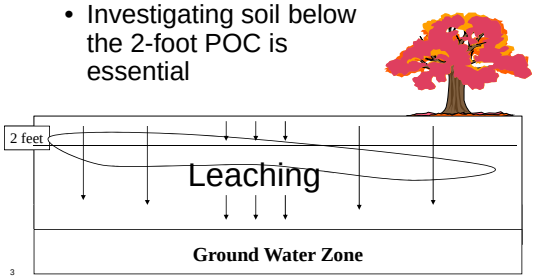
Soil Impacts to Ground Water

- Investigating soil below the 2-foot POC is essential



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Evaluating Leaching Potential

- Comparison to Leach-Based Soil Values
  - Use Generic Ohio EPA Derived LBSVs
  - Calculate Property Specific LBSVs
- Weight-of-Evidence Demonstration

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Ohio EPA Derived Generic LBSVs for Organics

Chemical (Organics)	Soil Type I (mg/kg)	Soil Type II (mg/kg)	Soil Type III (mg/kg)
Benzene	0.017	0.0090	0.015
Toluene	6.8	4.1	7.7
Ethylbenzene	12	7.9	16
Total Xylenes	160	96	190
Styrene	0.46	0.37	0.62
Naphthalene	2.3	2.4	3.0
***n*-Hexane**	120,000	110,000	130,000
Methyl Ethyl Ketone	1.8	1.7	1.8
Phenol	2.2	2.3	2.3
Carbon Tetrachloride	0.25	Not Available	0.28
1,2-Dichloroethane	0.0030	0.0020	0.0030
1,1,1-Trichloroethane	1.2	0.74	1.3
Vinyl Chloride	0.0090	0.0050	0.012
1,1-Dichloroethene	0.28	0.10	0.24
***cis*-1,2-Dichloroethene**	0.12	0.070	0.12
***trans*-1,2-Dichloroethene**	0.41	0.23	0.40
Trichloroethene	0.036	0.023	0.048
Tetrachloroethene	0.15	0.11	0.27

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Assumptions for Use of Generic LBSVs

Organics
- COCs in unconsolidated materials
- Depth to ground water is greater than 5 feet
- Saturated K_v of vadose zone is less than $1x10^{-3}$ cm/sec
- Thin soils (< 5 feet) do not overlay bedrock

Inorganics
- Soil pH is between 5 and 9
- Soil contains at least 10% fines

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Dilution/Attenuation Factors

Inorganics (Dilution/Attenuation Factor)

- Based on US EPA Soil Screening Guidance
- Multipliers of 10 (source > ½ acre) or 20 (source < ½ acre)

Organics (Dilution Factor only)

- Assumptions used for SESOIL modeling already account for attenuation
- Derived using Summer's Equation
  - CP should check to ensure that default values and assumptions are appropriate for VAP property

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Ohio EPA Derived Dilution Factors for Organics

Dilution Factors for Soil Type I: Clean Sand and Gravel. (Recharge rate = 12.5)

Hydraulic conductivity of the aquifer (cm/sec)	Size of source area (acres)			
	≤ 0.5	> 0.5 to 1	>1 to 5	> 5 to 10
≥ 1.0×10^{-1}	15	10	5.3	4.0
≥ 1.0×10^{-2} but < 1.0×10^{-1}	2.3	2.0	1.4	1.3
≥ 1.0×10^{-3} but < 1.0×10^{-2}	1.1	1.1	1.0	1.0

Dilution Factors for Soil Type II: Silty Sand. (Recharge rate = 8.0 in/yr)

Hydraulic conductivity of the aquifer (cm/sec)	Size of source area (acres)			
	≤ 0.5	> 0.5 to 1	>1 to 5	> 5 to 10
≥ 1.0×10^{-1}	22	16	7.6	5.7
≥ 1.0×10^{-2} but < 1.0×10^{-1}	3.1	2.5	1.7	1.5
≥ 1.0×10^{-3} but < 1.0×10^{-2}	1.2	1.1	1.1	1.0

Dilution Factors for Soil Type III: Till/Clay and Silt. (Recharge rate = 2.5 in/yr)

Hydraulic conductivity of the aquifer (cm/sec)	Size of source area (acres)			
	≤ 0.5	> 0.5 to 1	>1 to 5	> 5 to 10
≥ 1.0×10^{-1}	68	49	22	16
≥ 1.0×10^{-2} but < 1.0×10^{-1}	7.7	5.8	3.1	2.5
≥ 1.0×10^{-3} but < 1.0×10^{-2}	1.7	1.5	1.2	1.1

8

Partitioning Equation for Organics

$$C_s = C_w\left(K_{oc} \times f_{oc} + \frac{\theta_w + \theta_a H'}{\rho_b}\right)$$

- C_s = screening level in soils, mg/kg
- C_w = target ground water concentration, mg/L
- K_{oc} = soil organic carbon-water partitioning coefficient, L/kg
- f_{oc} = fraction of organic carbon content, mg/mg
- H' = Henry's law constant
- θ_w = water-filled porosity
- θ_a = air-filled porosity
- ρ_b = bulk density, kg/L

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Partitioning Equation for Metals

$$C_s = C_w\left(K_d + \frac{\theta_w}{\rho_b}\right)$$

- C_s = screening level in soils, mg/kg
- C_w = target ground water concentration, mg/L
- K_d = soil-water partitioning coefficient, L/kg
- θ_w = water-filled porosity
- ρ_b = bulk density, kg/L

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Geotechnical Testing

- Site-specific values can be used in lieu of default or conservative values
- VAP does not certify labs for geotechnical testing (i.e. use of a CL is not applicable)
- VAP ~~TDC~~ TGC documents and DDAGW's Technical Guidance Manual provides some guidance on parameter testing

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Weight-of-Evidence Demonstration

- Nature and age of release
- Type and concentration of COCs
- Separation distance between COCs and ground water
- Physical characteristics of soil
- Modeling/calculation results (optional)
- Man-made structures/preferential pathways
- Impacts from off-property sources

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Evaluating Leaching Potential -- Review

- Comparison to Leach-Based Soil Values
  - Use Generic Ohio EPA Derived LBSVs
  - Calculate Property Specific LBSVs
- Weight-of-Evidence Demonstration

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Protecting "Clean" Ground Water

- Protection of Ground Water Meeting Unrestricted Potable Use Standards, a.k.a. POGWMUPUS
- Clean ground water must be protected from exceeding UPUS in the future

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Is Ground Water an Issue?

- Time and money can be saved if ground water does not have to be investigated

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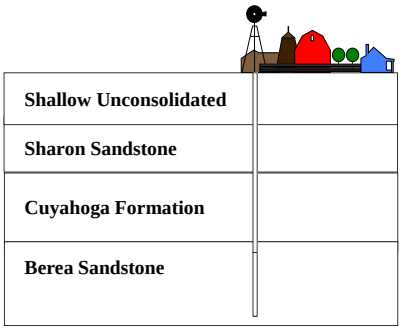
Which Units Do I Investigate?



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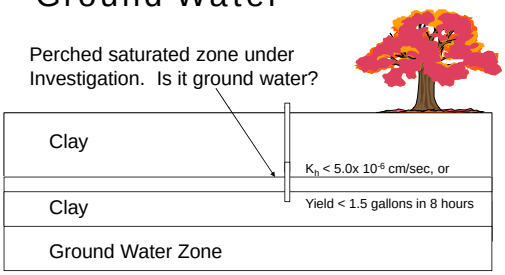
Determining if it is Ground Water



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Evaluating Ground Water Contamination

- Proper placement of wells is essential
  - What is your ground water flow direction?
  - Adequate numbers of well are needed
  - Sampling must be down gradient of source area
  - Double casing may be necessary to protect ground water zones

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Evaluating Ground Water Contamination

- Proper well development is crucial for representative ground water sampling
  - DDAGW's Technical Guidance Manual
  - Low-flow or micro-purge techniques may be used
  - Filtering for metals analysis is allowed in certain circumstances (refer to guidance)

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Determining if UPUS is Exceeded

- Minimum of two samples needed to show ground water exceeds UPUS
  - Some exceptions are listed in rules
  - Second sample must be collected between 48 hours and 90 days after first sample

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Determining if UPUS is Exceeded

- Temporal variations must be considered when evaluating the number of samples necessary to make this determination
  - Seasonal variations – usually most intense in spring or fall
  - Variations resulting from heterogeneity
  - Variations resulting from transient nature of contaminant transport

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Protection of Ground Water Zones

- Treat Property like an “Onion”
- Investigate each layer from the surface down, as needed
- Determine which zones exceed UPUS
- Determine which zones meet UPUS and need to be protected

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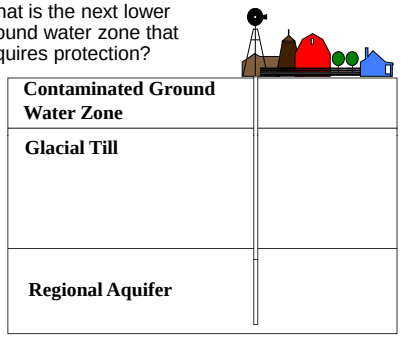
Protection of “Clean” Ground Water

- What is the next lower ground water zone that requires protection?



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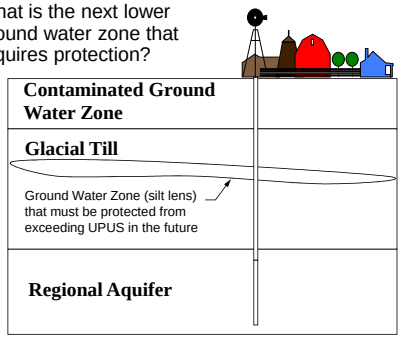

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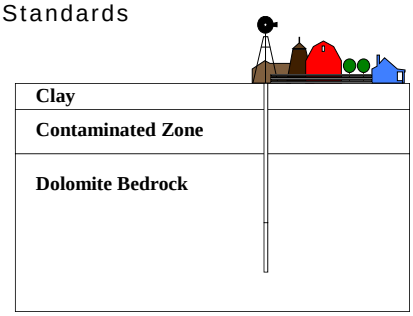
Protection of Ground Water Meeting Unrestricted Potable Use Standards



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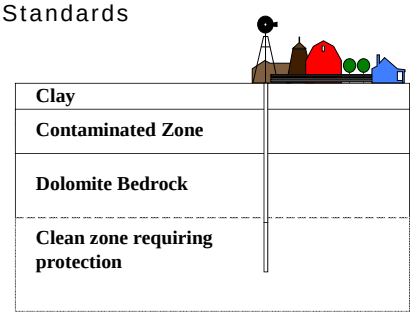

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Evaluating Off-Property Sources of Contamination

- The Phase I evaluated the likelihood of off Property impacts to the VAP property
- Any potential impacts must be assessed during the Phase II
  - VAP rules require assessment to distinguish between contamination from on vs. off property sources

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Evaluating Off-Property Sources of Contamination

- On property receptors will have to be protected even if the source is off property
- Contamination will receive a "pass-through"
  - The evaluation and/or protection of off property receptors is not required

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Ground Water Classification

- Each zone that exceeds UPUS must be classified
  - Only those zones that exceed UPUS are classified
  - Different zones may have different classifications depending on their characteristics

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Ground Water Classification

- Each zones that meets UPUS is not classified but must be protected
  - Protection of next lower zone generally means deeper zones are also protected
- Ground water classification determines the applicable response requirements for that zone

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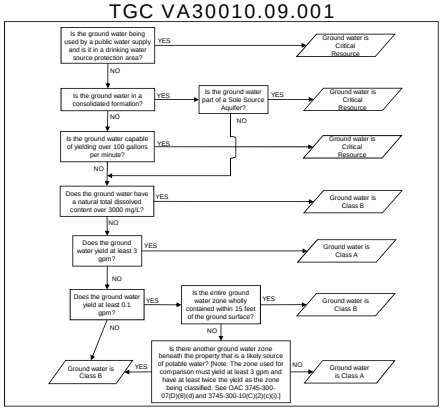
Ground Water Classification Flow Chart – TGC VA30010.09.001



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Ground Water Classification
Critical Resource

- Is in a “drinking water source protection area for a public water system using ground water”
  - This is a defined term in the rules
  - Only applied to the zone used by the public water system

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Ground Water Classification
Critical Resource

- Part of an <u>unconsolidated</u> zone that is capable of yielding 100 gpm over 24 hrs
- Is in a <u>consolidated</u> Sole Source Aquifer

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Ground Water Classification
Class A

- Does not met any of the criteria for critical resource ground water
  - Can assume Class A, if critical resource ground water can be ruled out
  - ODNR Ground Water Resource Maps can help distinguish between Class A and Critical Resource ground water

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Ground Water Classification
Class A

- Zone is used for potable purposes within ½ mile of the property boundary
  - Well search, e.g. ODNR and County Health Dept. records and field survey
- Zone yields greater than 0.1 gpm and has TDS less than 3,000 mg/L
  - Testing for TDS is optional, i.e. can assume TDS is less than 3,000 mg/L

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Ground Water Classification
Class B

- Does not met any of the criteria for Critical Resource or Class A ground water
  - Cannot assume Class B, yield testing of the zone or TDS analysis must be done
  - ODNR Ground Water Resource Maps can help determine if it is worthwhile investigating Class B

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Ground Water Classification
Class B

Two criteria turn an otherwise Class A ground water into Class B

- Class B by comparison to a lower zone
- Class B by depth from ground surface

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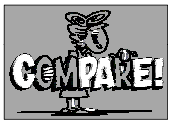
Class B by Comparison

- **Ground water zone being classified must yield less than 3 gpm**



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Class B by Comparison

- **Ground water zone used for comparison must be:**
  - **Beneath the property**
  - **Have a yield at least twice that of the zone being classified, but yield at least 3 gpm**
  - **Be a likely source of potable water within 1 mile**

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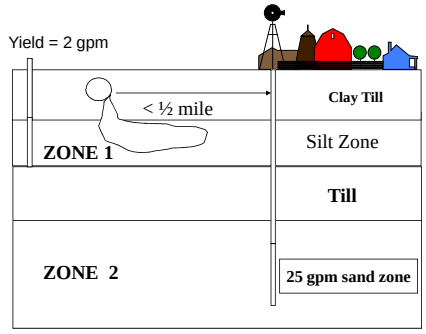
Class B by Comparison



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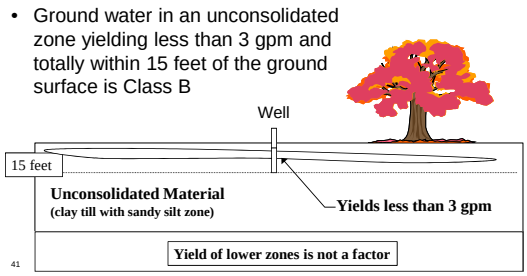
Class B by Depth from Ground Surface

- Ground water in an unconsolidated zone yielding less than 3 gpm and totally within 15 feet of the ground surface is Class B



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Summary of Ground Water Classification

- ODNR has resources that are import screening tools
  - Potable water wells logs
  - Oil and gas well logs
  - Ground water resource maps
- Zones are Critical Resource ground water if:
  - Zone is used by a public water system, and
  - Property is in a “drinking water source protection area for a public water system using ground water”

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Summary of Ground Water Classification

- Can assume Class A, if Critical Resource is ruled out
- Yield testing is required to determine Class B by yield
- Analysis of TDS is only required if TDS is used to make a Class B determination

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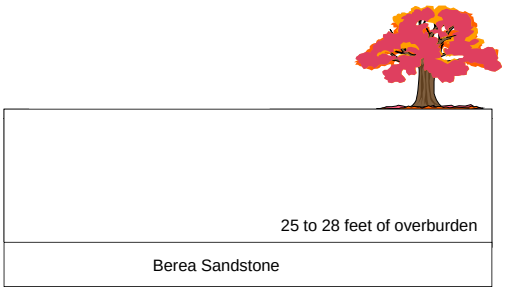
1st Example of Ground Water Classification



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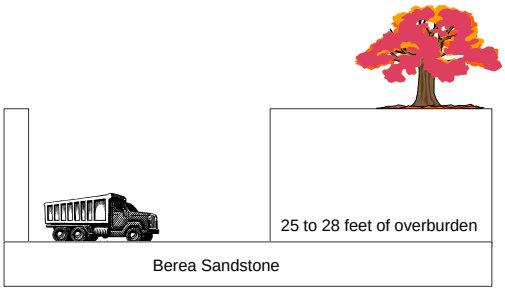

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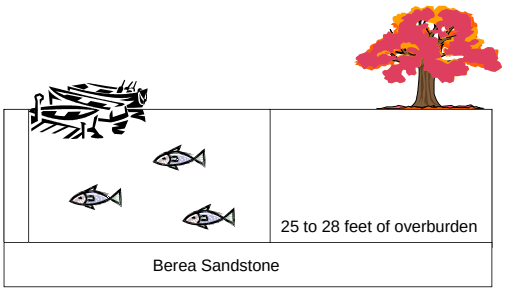

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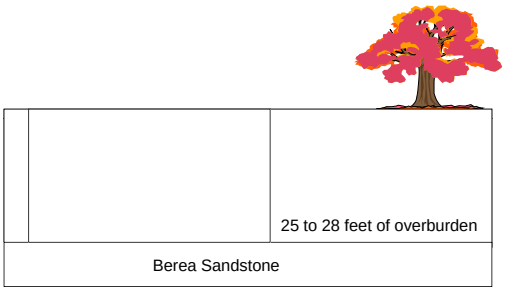

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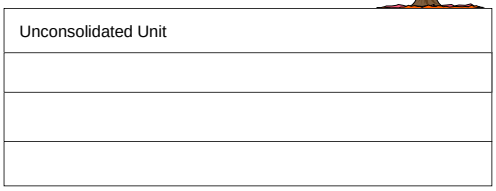
2nd Example of Ground Water Classification

- Both the perched zone and the upper Cuyahoga Shale are contaminated. Are they Class A or Class B?



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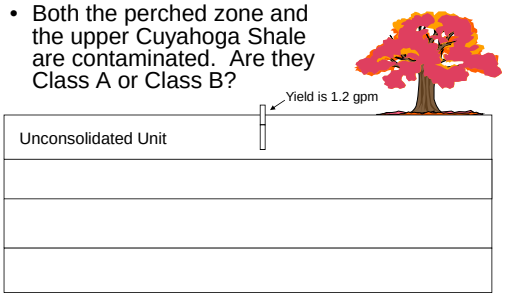

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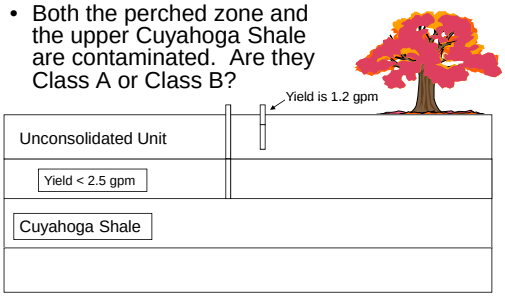

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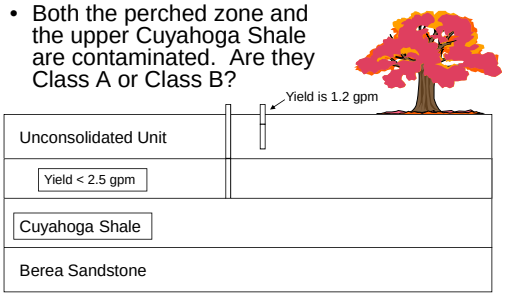

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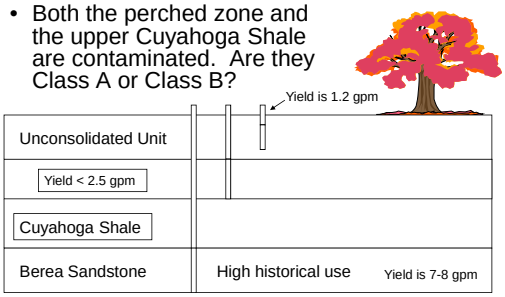

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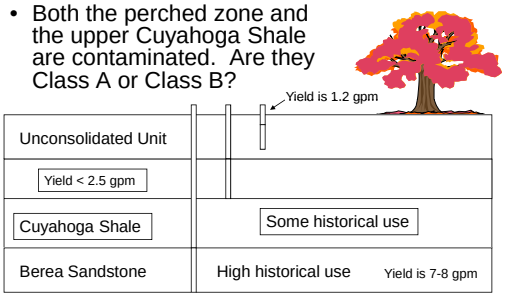

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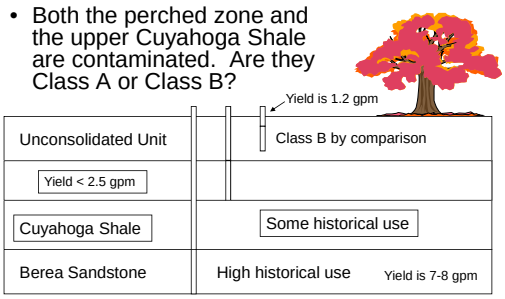

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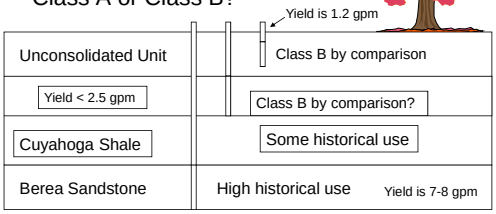

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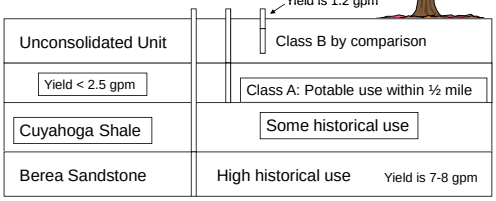

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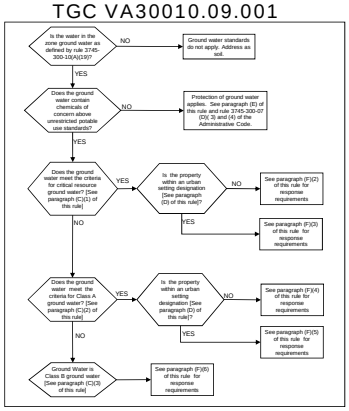
Ground Water Response Requirements Flow Chart TGC VA30010.09.001



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Urban Setting Designation

- Evaluates the use of ground water as a potable resource
- Eliminates the off-property potable use pathway near a VAP Property
- Changes the POC for ground water response requirements

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How a USD Changes the Point of Compliance

- Class B: No change
  - Potable use pathway is already eliminated off property
- Class A: Do not need to meet UPUS at the property boundary
  - The effect is that it has the same response requirements as Class B

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How a USD Changes the Point of Compliance

- Critical Resource: POC for UPUS is moved to ½ mile from the property or the USD boundary, whichever is greater

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USD Threshold Criteria

- USD located within a city or township with at least 20,000 residents
- Municipal water system has a connection rate of at least 90% of parcels (Some exception apply – refer to rule and TDC VA30010.03.003)

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USD Threshold Criteria

- Water system capable of meeting future water needs
- Located outside of a ground water source water protection area (there are some exceptions – refer to rule)

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USD Threshold Criteria

- No potable wells within ½ miles of USD boundary (there are some exceptions – refer to rule)
- If USD area overlies vital ground water zones, must demonstrate no new potable wells will be installed within ½ miles of USD boundary (refer to rule for details)

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Use of USD to Support an NFA Letter

- CP must demonstrate in the NFA Letter that certain USD criteria are still valid when the NFA Letter is issued (refer to rule for details)
  - CP may rely upon Director's determination, if it is recent

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Use of USD to Support an NFA Letter

- Director has the authority to periodically review USDs to determine whether criteria are still valid
  - Ohio EPA reviews area wide USDs once every five years
  - USD may be eliminated or its may be boundaries reduced
  - Any action will be public noticed and all CPs will be notified
  - Changes to a USD only affect new NFA Letters, i.e. a CNS already issued is still valid

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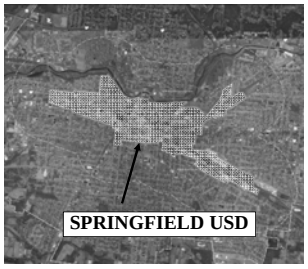
Communities with Area Wide USDs

- Akron
- Cleveland
- Columbus
- Lancaster
- Mansfield
- Springfield
- Toledo/Oregon



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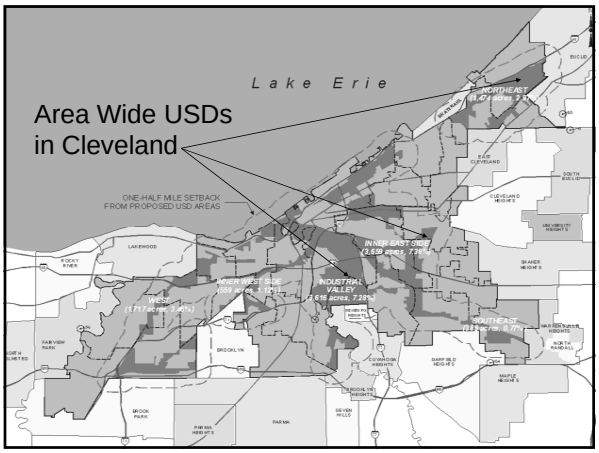
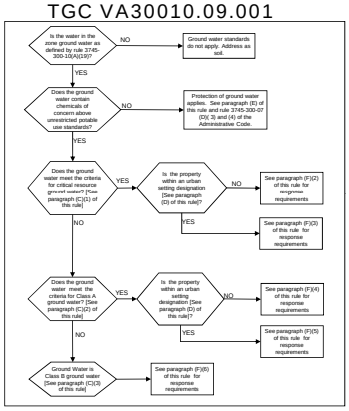


Ground Water Response Requirements Flow Chart
TGC VA30010.09.001



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Ground Water Response Requirements

Requirements Based On:

- Classification of Ground Water Zone
- Location of Sources or Source Areas
  - All on the property
  - All off the property
  - Both on and off the property
- Urban Setting Designation (USD)

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Ground Water Response Requirements - All Cases

- Prevent exposure to humans on the property from exposures to ground water above standards, such as,
  - Prevent potable use
  - Volatilization into buildings
  - Industrial/commercial contact
  - Construction Worker contact
  - Lawn Watering

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Ground Water Response Requirements - All Cases

- Protect on-property ecological receptors from exposures above standards

71

Class B Ground Water

sources all on, no USD

- Prevent people from drinking ground water on the property
  - Implementation of a ground water use restriction is the most common remedy
- Ensure non-drinking exposures to humans on and off property meet applicable standards or remediate
- Protect important ecological resources both on and off property

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Class A Ground Water with a USD

sources all on

- Prevent people from drinking ground water on the property
  - Implementation of a ground water use restriction is the most common remedy
- Ensure non-drinking exposures to humans on and off property meet applicable standards or remediate
- Protect important ecological resources both on and off property

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Class A Ground Water

sources all on, no USD

- Same as Class B, plus…
- The Point of Compliance for UPUS is the property boundary
  - Must ensure ground water above UPUS does not migrate beyond the property boundary

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Class A Ground Water

sources all on, no USD

- Prevent potable use exposures at existing off property wells by:
  - Providing and alternative supply of water,
  - Providing water treatment, OR
  - Remediate ground water to meet UPUS

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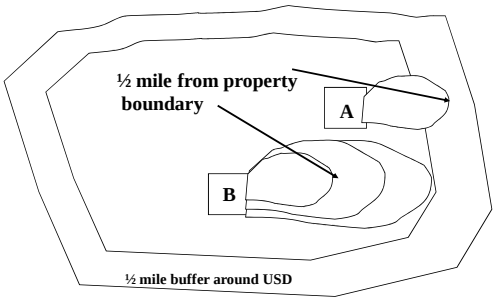
Alternate POC for Critical Resource with USD



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Critical Resource

sources all on, no USD

- Class A, plus…
- Requirement to notify down gradient property owners

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Critical Resource

sources all on, no USD

- Prevent off-property exposures to future potable users of ground water, a.k.a. "the re-opener"
  - Monitoring of ground water use must be included in an O&M Plan

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Last Thoughts...

- Classification is critical because it leads to correct response requirements
- Potable use of ground water is not the only pathway that needs to be considered
- Must also evaluate non-potable ground water pathways both on and off property, e.g.:
  - Direct contact during construction or excavation
  - Indoor air assessment
  - Important ecological resources

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