

The Remediation Standard Regulations

Connecticut Department of Energy
and Environmental Protection
and
Environmental Professionals Organization
of Connecticut, Inc.

DEEP Disclaimer

The following presentation was performed by the Remediation Division of the Connecticut Department of Energy and Environmental Protection in March and April 2014 for the Environmental Professionals of Connecticut (EPOC). The presentation is intended to be an overview of the Remediation Standard Regulation (RSRs), section 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies, which became effective on January 30, 1996 and revised in June 27, 2013. This overview is designed to answer general questions and provide basic information. You should refer to the appropriate statutes for the specific language. It is your responsibility to comply with all applicable laws. The information contained in this presentation is intended only to acquaint you with the Remediation Standard Regulations and does not constitute the Department's interpretation of the applicable laws.

Remediation Standard Regulations - Introduction



The Remediation Standard Regulations (“RSRs”)

- ◆ Sections 22a-133k-1 through -3 of the Regulations of Connecticut State Agencies (“RCSA”)
- ◆ Section 22a-133q-1 RCSA
- ◆ On DEEP website (www.ct.gov/deep)

Update Effective June 27, 2013

Structure

- ◆ Definitions - 22a-133k-1
- ◆ Applicability - 22a-133k-1(b)
- ◆ Soil Remediation Standards - 22a-133k-2
- ◆ Groundwater Remediation Standards - 22a-133k-3
- ◆ Environmental Land Use Restrictions - 22a-133q-1

Structure

- ◆ Section 22a-133k-3
 - ◆ Subsection 22a-133k-3(a)
 - ◆ Subdivision 22a-133k-3(a)(1)
 - ◆ Subparagraph 22a-133k-3(a)(1)(A)
 - ◆ Clause 22a-133k-3(a)(1)(A)(i)
 - ◆ Subclause 22a-133k-3(a)(1)(A)(i)(aa)

Section 22a-133k-3(b)(1)

Surface Water Protection Criteria

Except as provided in subdivision (2) of this subsection, remediation of a ground water plume which discharges to a surface water body shall result in the reduction of each substance therein to a concentration which is consistent with subdivision (2)(C) of subsection (g) of this section and which is equal to or less than the surface water protection criterion or an alternative surface water protection criterion established in accordance with subdivision (3) of this subsection.

Section 22a-133k-3(b)(1) Surface Water Protection Criteria

Except as provided in subdivision (2) of this subsection (WETLAND), remediation of a ground water plume which discharges to a surface water body shall result in the reduction of each substance therein to a concentration which is consistent with subdivision (2)(**C**) of subsection (**g**) of this section (DEMONSTRATE COMPLIANCE) and which is equal to or less than the surface water protection criterion or an alternative surface water protection criterion established in accordance with subdivision (3) of this subsection (ALTERNATIVE CALC).

Definitions

See important terms such as:

- ◆ Analytical detection limit
- ◆ Upgradient/downgradient area
- ◆ Background concentration (different definitions for soil and groundwater)
- ◆ Polluted soil
- ◆ Polluted fill
- ◆ Release area



Definitions

New Definitions Added:

- ◆ Dilution Factor
- ◆ Dilution and Attenuation Factor /
Dilution Attenuation Factor
- ◆ Engineered Control
- ◆ ETPH
- ◆ 95% Upper Confidence Level of the
Arithmetic Mean

Common Acronyms

- ◆ CSM – Conceptual Site Model
- ◆ AOC – Area of Concern
- ◆ COC – Contaminant /Chemical/Constituent of Concern
- ◆ APS – Additional Polluting Substance
- ◆ SCGD – Site Characterization Guidance Document
- ◆ NAPL – Non-Aqueous Phase Liquid
- ◆ DNAPL/LNAPL – Dense NAPL/Light NAPL
- ◆ UST/AST – Underground Storage Tank/
Above ground Storage Tank
- ◆ PCB – Polychlorinated Biphenyls
- ◆ TPH – Total Petroleum Hydrocarbons
- ◆ ETPH – Extractable Total Petroleum Hydrocarbons

Common Acronyms

- ◆ ND – Non-Detect
- ◆ BRL/BDL – Below Reporting Limit/Below Detection Limit
- ◆ SPLP/TCLP – Synthetic Precipitation Leaching Procedure/
Toxicity Characteristic Leaching Procedure
- ◆ WQS – Water Quality Standards
- ◆ GWPC/SWPC – Groundwater Protection Criteria/
Surface Water Protection Criteria
- ◆ VolC – Volatilization Criteria
- ◆ DPH – Department of Public Health
- ◆ CFR – Code of Federal Regulations
- ◆ CGS – Connecticut General Statutes
- ◆ RCSA - Regulations of Connecticut State Agencies

Applicability

The RSRs apply to any action taken to remediate polluted soil, surface water, or a groundwater plume emanating from a release area, provided the action is either:

1. Required by a regulation, statute, or order of the Commissioner pursuant to Chapter 445, 446k, or Section 22a-208a(c)(2) of the Connecticut General Statutes (CGS), or
2. LEP actions required to be taken pursuant to the property transfer program and voluntary cleanup provisions of Sec's. 22a-134a, 22a-133x, or 22a-133y of the CGS.

22a-133k-1(b)

Applicability

- ◆ Lots of remediation occurs outside established programs
- ◆ DEEP recommends use of RSRs in these situations
- ◆ Also consider public notice requirements of remediation programs (i.e., Property Transfer Program)
- ◆ This may avoid having to do work over in the future



Purpose of RSRs



- ◆ Establish soil and water clean-up levels that protect human health
- ◆ Protect the environment in a manner consistent with the state's Water Quality Standards
- ◆ *RSRs define clean-up endpoints, not why, how, or when to reach the endpoints*

Scope

Do the RSRs require that further remedial actions be taken at sites for which remediation was previously completed and approved by the Commissioner?

- ◆ No, if work completed and received written approval
- ◆ For work underway, must meet RSR criteria
- ◆ Subsequent actions (property transfer, enforcement, UST regulations) could require additional work

Scope

What timeframe is required?

- ◆ RSRs do not set a timeframe for achieving clean-up criteria
- ◆ Timeframes set by implementing mechanisms such as property transfer, enforcement action, RCRA corrective action, UST regulations, etc.
- ◆ Commissioner can expedite timeframe to be protective, if needed

Scope

What happens if the regulations change during remediation?

- ◆ Must achieve levels protective of human health and the environment to receive approval
- ◆ If cleanup not yet verified, the regulations in effect at the time of verification would apply

Representativeness of Sampling Program

- ◆ Sampling program used in the decision making process must be representative of the conditions in the environment
- ◆ Therefore, it is expected that all COCs have been identified and their distribution and variability in the environment have been determined
- ◆ Conceptual Site Model (CSM) important

Refer to Site Characterization Guidance (SCGD)

Guidance Documents

- ◆ Represent an approach DEEP finds acceptable and their use may expedite review and approval
- ◆ Developed by consensus of DEEP and stakeholders
- ◆ Other approaches may be acceptable
- ◆ DEEP recognizes that technology evolves

Existing Guidance Documents

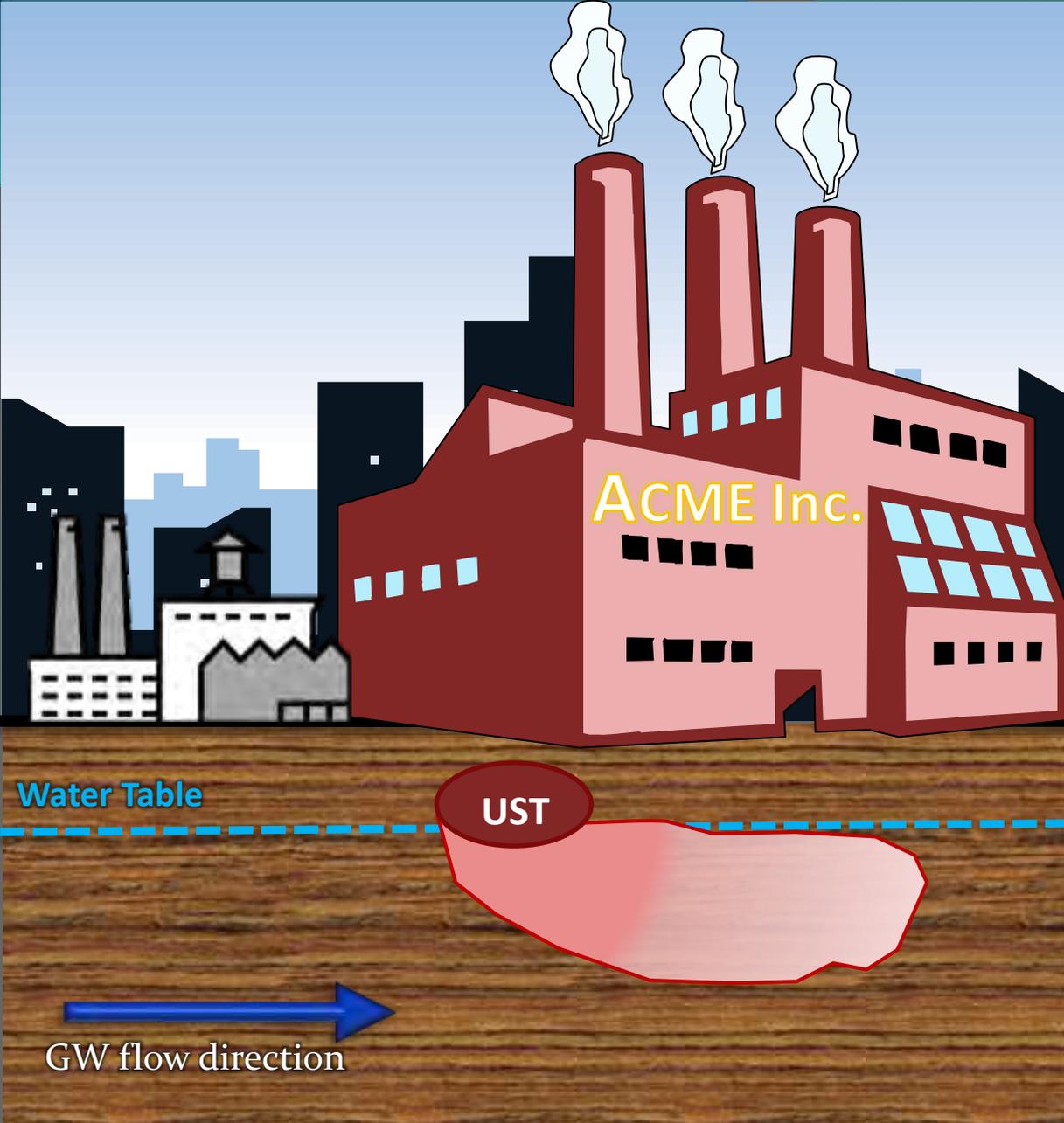
- ◆ Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds
- ◆ Laboratory Quality Assurance Quality Control Reasonable Confidence Protocols
- ◆ Laboratory Quality Control Assurance and Quality Control, Data Quality Assessment and Data Usability Evaluation Guidance Document
- ◆ Environmental Land Use Restriction Guidance Document
- ◆ Site Characterization Guidance Document

Existing Guidance Documents

- ◆ Guidance for Groundwater Monitoring for Demonstrating Compliance with the Connecticut Remediation Standard Regulations
- ◆ Engineered Control Guidance Document
- ◆ Verification Report Guidance Document (Updated Dec 1, 2013)
- ◆ Water Supply Well Receptor Guidance Document
- ◆ Use of Filters for Groundwater Sampling Technical Memorandum and Guidance
- ◆ Targeted Brownfield Remedy Guidance Document

“New” Guidance Documents

- ◆ Guidance for Calculating the 95% Upper Confidence Level for Demonstrating Compliance with the Remediation Standard Regulations
- ◆ [DRAFT] Guidance for Applying Technical Impracticability of Groundwater Remediation Variance Pursuant to the Remediation Standard Regulations
- ◆ RSR Wave 1 Update Guidance:
 - ◆ Rendering Soil Inaccessible Using Pavement
 - ◆ Pollutant Mobility Criteria Exception for Groundwater Infiltration
 - ◆ Exemptions for Incidental Sources
- ◆ Groundwater Compliance Monitoring Requirements -Fact Sheet dated November, 2014



History of ACME Inc.

- Neighborhood utilized during Industrial Revolution to manufacture clocks
- Historically high metals concentration in soil
- Groundwater – GB
- Public water available in area
- GW flow to the Southeast
- Sensitive receptors – Little Brook
- Manufactured ACME Widgets since 1965
- Waste Oil UST release of TPH with mixture of VOCs

Not to Scale

Soil Standards - Direct Exposure Criteria

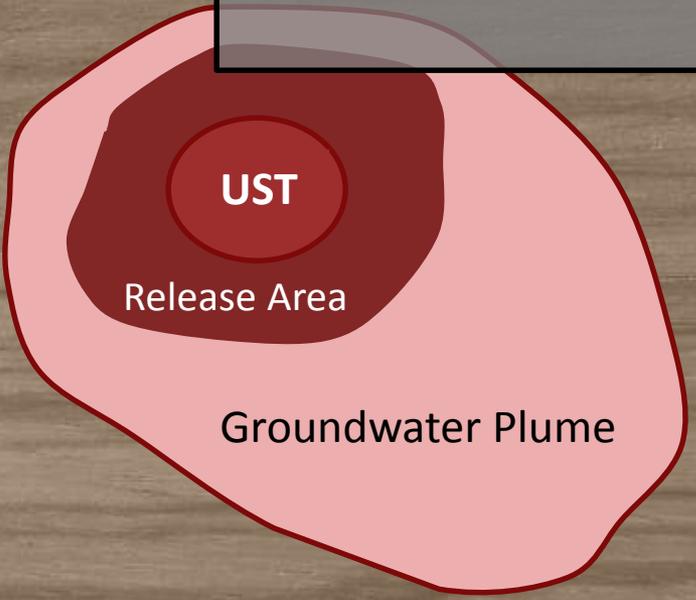
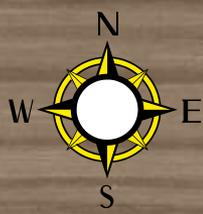
Soil Remediation Standards

Important Concepts

- ◆ Regulated by *release area*
- ◆ Regulated by *substance*
- ◆ “Release area” defined by extent of polluted soil (where detected at all, not just where $>$ criteria)



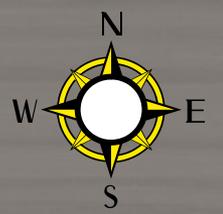
Release Area



Not to Scale

Release Area

ACME Inc.



Source Area

Groundwater plume

-  GW Monitoring Well
-  Soil Boring

 ND

 ND

 10ppm

 100ppm

 500 ppb

 25ppm

 10ppm

 5ppm

 ND

 30 ppb

 ND

 15 ppb

 1ppm

 ND

 5 ppb

 ND



Not to Scale

Soil Remediation Standards

Important Concepts (cont'd)

- ◆ Baseline criteria
- ◆ Additional Polluting Substances (APS)
- ◆ Options & Alternatives
 - ◆ Based on different human exposure assumptions or hydrologic conditions
- ◆ Environmental Land Use Restrictions

Soil Remediation Standards

Important Concepts (cont'd)

- ◆ Exceptions
 - ◆ Some require Commissioner's approval
- ◆ Variances
 - ◆ All require Commissioner's approval
- ◆ Exceptions and Variances are based on preventing or controlling exposures

Soil Criteria

Polluted soil at a release area shall be remediated to a concentration that meets either:

- ◆ **Direct Exposure Criteria**

- ◆ dependent on land use

&

- ◆ **Pollutant Mobility Criteria**

- ◆ dependent on groundwater classification

OR

- ◆ **Background**

- ◆ concentration that naturally occurs in soil
- ◆ dependent on local (not regional) sampling data

Cleanup to Background

- ◆ Requires notice to Commissioner –

Which includes:

- ◆ Description of subject area & soil characteristics
- ◆ Map of subject release area, other release areas in the vicinity, and all soil samples collected for the purpose of determining background
- ◆ Laboratory results of such samples

Direct Exposure Criteria (DEC)

Purpose - minimize health risk from direct contact and ingestion of soil

Apply - to polluted soil within 15 feet of the surface (regardless of the location of the water table in relation to the ground surface)

Direct Exposure Criteria

◆ *Residential*

- ◆ Applies to Residential *and* I/C property (if I/C - property can choose I/C option instead)

◆ *Industrial/Commercial (I/C)*

- ◆ Option (alternative to Residential criteria) if site will not be used for residential purposes *and ELUR recorded by owner*
- ◆ should consider zoning

Both Criteria listed in Appendix A



DEC Criteria Change - Lead

Residential DEC for Lead changed from 500 mg/kg to 400 mg/kg to match federal standards

Transition Period (where 500 mg/kg can still be used):

- ◆ Prior to June 27, 2013 – RAP completed or Remediation initiated
- ◆ Prior to June 27, 2015 - Remediation completed

Direct Exposure Criteria Compliance

- ◆ Laboratory analyses of all samples from the release are below applicable criteria

or

- ◆ 95% Upper Confidence Level (95% UCL) of the arithmetic mean for each substance from the release area, which is a statistically derived value which equals or exceeds the true mean 95% of the time, is below applicable criteria

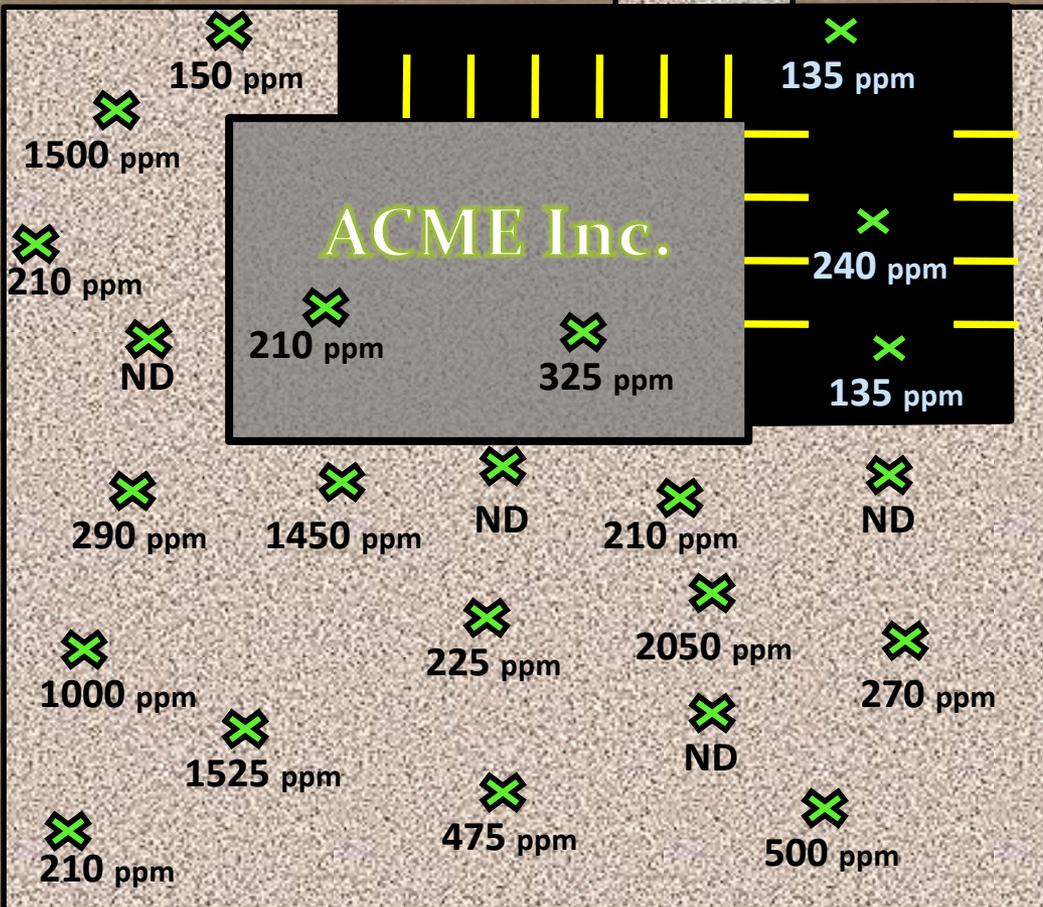
95% UCL Application Example



Property Boundary

ACME Inc.

GW flow direction



- Contaminant – Nickel
- RDEC - 1400 ppm
- 23 samples collected
- 95% UCL calculation
- Detection Limit = 50 ppm

Not to Scale

Direct Exposure Criteria Additional Polluting Substances

- ◆ For substance for which a DEC criterion does not exist, one must be developed
- ◆ Department of Public Health (DPH) will help review proposed DEC (toxicology & exposure)
- ◆ Commissioner of DEEP must approve

Direct Exposure Criteria Additional Polluting Substances

- ◆ Proposed criteria can be calculated
- ◆ Risk of 10^{-6} (for carcinogens)
- ◆ Hazard Index of 1 (for non-carcinogens)
- ◆ Commissioner will consider proposed criteria and any other relevant information

Additional Polluting Substances

2008 Draft RSRs

- ◆ Some APS criteria were calculated as part of the proposed 2008 RSR Revision. Contact DEEP Staff to determine if an APS is on that list and what criteria is proposed
- ◆ Request for site-specific use must be submitted for approval
- ◆ DEEP will expedite the approval process
- ◆ Approvable criteria subject to change as toxicology information is updated

Direct Exposure Criteria Additional Polluting Substances

- ◆ Reasoning: The proposed APS criteria have not been approved through the regulatory review process, so official site-specific requests for approval need to be made to use these criteria according to the RSRs
- ◆ If the APS does not have a proposed DEEP criteria, one needs to be calculated and the request needs to document the calculations and toxicology data used

Additional Polluting Substances

EPH/VPH/APH

- ◆ Form developed in 2012 to request approval of methodology and associated criteria
- ◆ Risk based criteria to evaluate petroleum releases
- ◆ Expedited review and approval process
- ◆ From available on DEEP website:
http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/deep-rem_eph-vph-aph.pdf

Direct Exposure Criteria

Alternative Criteria and

Alternative Method of Determining Compliance

- ◆ Submit risk assessment for Commissioner's approval (*use transmittal form*)
- ◆ Need to demonstrate that exposure pathways are substantially different than baseline assumptions
- ◆ For one substance
 - ◆ Risk of 10^{-6} (for carcinogens)
 - ◆ Hazard Index of 1 (for non-carcinogens)
- ◆ For multiple substances
 - ◆ Cumulative risk of 10^{-5}
 - ◆ Cumulative Hazard Index of 1
- ◆ PCBs must be consistent with 40 CFR 761 and "Guidance on Remedial Actions at Superfund Sites with PCB Contamination" 22a-133k-2(d)(2)&(7)

Direct Exposure Criteria

“Alternative Criteria” for Substances with 2008 APS

- ◆ Alternative criteria different than DEEP calculated criteria (2008) can be requested for different site-specific exposure assumptions
- ◆ These requests for alternative criteria will require documentation of the calculations and the reasoning for the site-specific exposure assumptions. They also will require a more thorough review (for DEC, this includes consultation with DPH) and therefore will take more time to process



Commissioner Prescribed Transmittal Form

Transmittal Form available at DEEP web page:

[http://www.ct.gov/deep/lib/deep/site_clean_up/property transfer program/RSR Approval Request transmittal form.doc](http://www.ct.gov/deep/lib/deep/site_clean_up/property_transfer_program/RSR_Approval_Request_transmittal_form.doc)

Transmittal Form shall be submitted along with:

- ◆ Any request for approval by Commissioner
- ◆ Any required notice to the Commissioner

Use of Transmittal Form helps DEEP be aware that the request/notice has been made and track the requests.



Extractable Total Petroleum Hydrocarbons (ETPH)

- ◆ ETPH Method added to RSRs
- ◆ ETPH criteria added for DEC (along with PMC and GWPC):
 - ◆ No longer needs to be requested as an Additional Polluting Substance
 - ◆ Criteria added match what was being approved as an APS (500 mg/kg Residential and 2500 mg/kg Industrial/Commercial)



Direct Exposure Criteria

Exception – Incidental Sources

DEC does not apply (self-implementing) to metals, petroleum hydrocarbons, and SVOCs in soil, if:

- ◆ Pollution is due to normal operation of motor vehicles (which cannot include refueling, repair, or maintenance of motor vehicles); or
- ◆ Normal paving and maintenance of asphalt, providing that such pavement has been maintained for its intended purpose

Guidance available on DEEP Website

Direct Exposure Criteria

Exception - Inaccessible Soil

- ◆ More than four feet below surface
- ◆ More than two feet below 3-inch paved surface (pavement sub-base included)
- ◆ Beneath an existing building
- ◆ Beneath other permanent structure with written notice provided to the Commissioner (*use transmittal form*)



Direct Exposure Criteria

Exception - Inaccessible Soil Cont'd

New Concept added to Inaccessible Soil

- ◆ Polluted fill beneath 3-inch paved surface is considered inaccessible, as long as such fill is:
 - ◆ Polluted only by SVOCs or Petroleum Hydrocarbons that are normal constituents of asphalt;
 - ◆ Polluted by metals in concentrations not in excess of 2x the applicable DEC; or
 - ◆ Any combination of the two conditions
- ◆ 2' of clean fill not needed when the above criteria are met – Guidance on DEEP Website

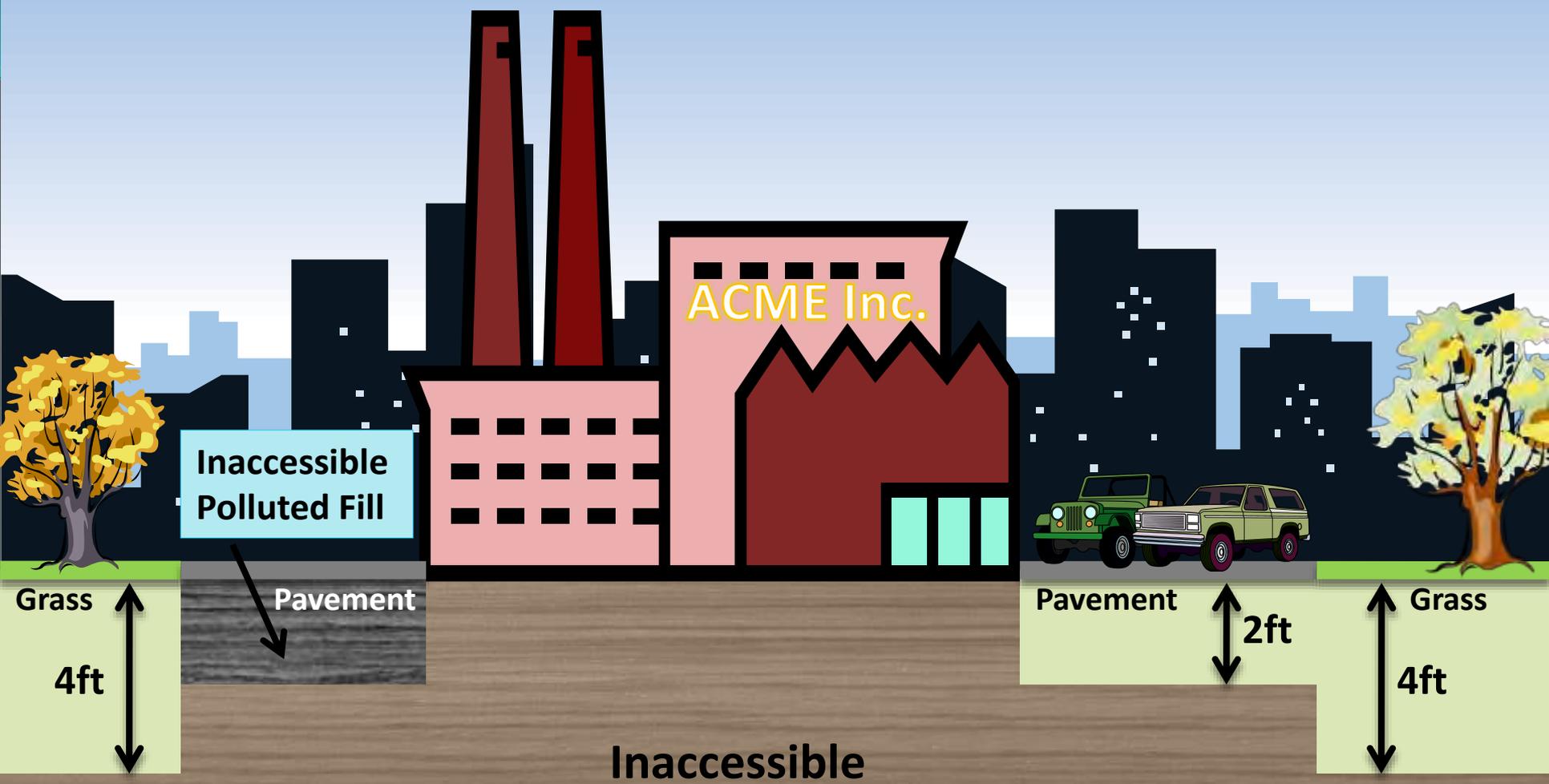
Direct Exposure Criteria

Inaccessible Soil - ELUR

- ◆ An Environmental Land Use Restriction (“ELUR”) must be recorded for Inaccessible Soil before remediation is considered complete - Only the landowner can record an ELUR
- ◆ ELUR must require that inaccessible soil will not be excavated or disturbed and any overlying building will not be demolished unless ELUR is released



Direct Exposure Criteria



Not to Scale



Direct Exposure Criteria

Variance – Engineered Control

- ◆ Concept of a “DEC only” Engineered Control formally added to the RSRs
- ◆ Engineered Control was formerly a PMC concept only (although it has always been acknowledged to control Direct Exposure, as well)
- ◆ Engineered Controls to be discussed further in next section (PMC)

Direct Exposure Criteria PCBs

- ◆ Residential = 1 ppm
- ◆ Industrial/Commercial for outdoor electrical substation or “restricted access” = 10 ppm
- ◆ Other restricted access location = as defined in 40 CFR 761.123
- ◆ ELUR required for “other restricted access location” area



Direct Exposure Criteria PCBs

- ◆ Only substance with a criteria for inaccessible soil
 - ◆ Inaccessible criteria (w/ required ELUR) = 10 ppm
 - ◆ “Other restricted access location” = 25 ppm
 - ◆ “Outdoor electrical substation”, as defined in 40 CFR 761.123 = 25 ppm
 - ◆ Substation with label or notice, in accordance with 40 CFR 761 = 50 ppm

Direct Exposure Recap

◆ Baseline

- ◆ Appendix A or Naturally Occurring Background (notice)
- ◆ Additional Polluting Substances (needs approval)

◆ Options

- ◆ Industrial Criteria (with ELUR – also in Appendix A)
- ◆ Alternative Criteria (needs approval)

◆ Exceptions

- ◆ Incidental Sources (self-implementing)
- ◆ Inaccessible Soil (with ELUR)

◆ Variance

- ◆ Engineered Control (with ELUR/Financial Assurance)

Question 1

During a Phase I Investigation, it has been determined that PCE, TCE, and Tetrahydrofuran have historically been used as solvents at the site. Which chemicals need to be analyzed for during the subsequent investigations?

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During a Phase I Investigation, it has been determined that PCE, TCE, and Tetrahydrofuran have historically been used as solvents at the site. Which chemicals need to be analyzed for during the subsequent investigations?

- a. Just PCE and TCE need to be analyzed for since there is no criterion established for Tetrahydrofuran.
- b. All three would need to be analyzed for but nothing would need to be done about any Tetrahydrofuran detections because there is no criterion established.
- c. All three would need to be analyzed for and an additional polluting substance criteria would need to be developed for Tetrahydrofuran if it is detected.

Question 1

During a Phase I Investigation, it has been determined that PCE, TCE, and Tetrahydrofuran have historically been used as solvents at the site. Which chemicals need to be analyzed for during the subsequent investigations?

c. All three would need to be analyzed for and an additional polluting substance criteria would need to be developed for Tetrahydrofuran if it is detected.

22a-133k-2(a) – “polluted soil at a release area shall be remediated to a concentration which meets (1) (A) the direct exposure criteria set forth in subsection (b) of this section or alternative direct exposure criteria established in accordance with subdivision (2) or subdivision (7) of subsection (d) of this section;”

22a-133k-2(b)(4) Additional Pollution Substances – Subdivision (4) of subsection (b) included in the subsection (b) reference in 22a-133k-2(a)

Question 2

During an investigation at a site in a GA area, it has been determined that there has been a surface release. 14 Samples collected from within the release area were analyzed for ETPH with a maximum detection in one area of 650 mg/kg (Res DEC = 500 mg/kg). What should you do to deal with the release area?

Question 2

During an investigation at a site in a GA area, it has been determined that there has been a surface release. 14 Samples collected from within the release area were analyzed for ETPH with a maximum detection in one area of 650 mg/kg (Res DEC = 500 mg/kg). What should you do to deal with the release area?

- a. Average the readings (because that is close enough to 95% UCL of the arithmetic mean) to demonstrate compliance.
- b. Remove the 650 mg/kg area and collect confirmation samples from the sides and bottom of the excavation to demonstrate compliance.
- c. Determine if the current sampling is representative of the release area. Then, perform a 95% UCL calculation to demonstrate compliance.
- d. Either b. or c.

Question 2

During an investigation at a site in a GA area, it has been determined that there has been a surface release. 14 Samples collected from within the release area were analyzed for ETPH with a maximum detection in one area of 650 mg/kg (APS DEC = 500 mg/kg). What should you do to deal with the release area?

- b. Remove the 650 mg/kg area and collect confirmation samples from the sides and bottom of the excavation to demonstrate compliance.
- c. Determine if the current sampling is representative of the release area. Then, perform a 95% UCL calculation to demonstrate compliance.
- d. Either b. or c.

22a-133k-2(e)(1) – “compliance with a direct exposure criteria is achieved when (A) the ninety-five percent upper confidence level of the arithmetic mean of all sample results of laboratory analyses of soil from the subject release area is equal to or less than such criterion or (B) the results of all laboratory analyses of samples from the subject release area are equal to or less than the applicable direct exposure criterion.”

Soil Standards - Pollutant Mobility Criteria

Pollutant Mobility Criteria

Purpose

- ◆ GA - to prevent *any* pollution of the groundwater
- ◆ GB - to prevent unacceptable *further degradation* of the groundwater

Pollutant Mobility Criteria

- ◆ Applies to polluted soil above the seasonal *low* water table
- ◆ EXCEPT it applies to polluted soil above the seasonal *high* water table if one or more of the following conditions are met:
 - ◆ Remediation is not technically practicable (burden of proof required at verification) *or*
 - ◆ Remediation would not result in permanent elimination of source (also requires burden of proof at verification) *or*
 - ◆ In GB area



Pollutant Mobility Criteria

Exception to GB use

- ◆ If at a release area the groundwater classification is GB, but elevation of water table is below top of bedrock, the release area must be remediated to GA PMC
- ◆ Because no benefit of dilution/attenuation from flow through soil if soil lacking

Pollutant Mobility Criteria

Exception for *Environmentally Isolated Soil*

- ◆ Beneath existing building or other structure approved by the Commissioner

Note - Building includes roof, walls, floor, etc.

Other structure examples - bridge abutment, large AST, clarifier, etc.

- ◆ Other conditions on next slide:

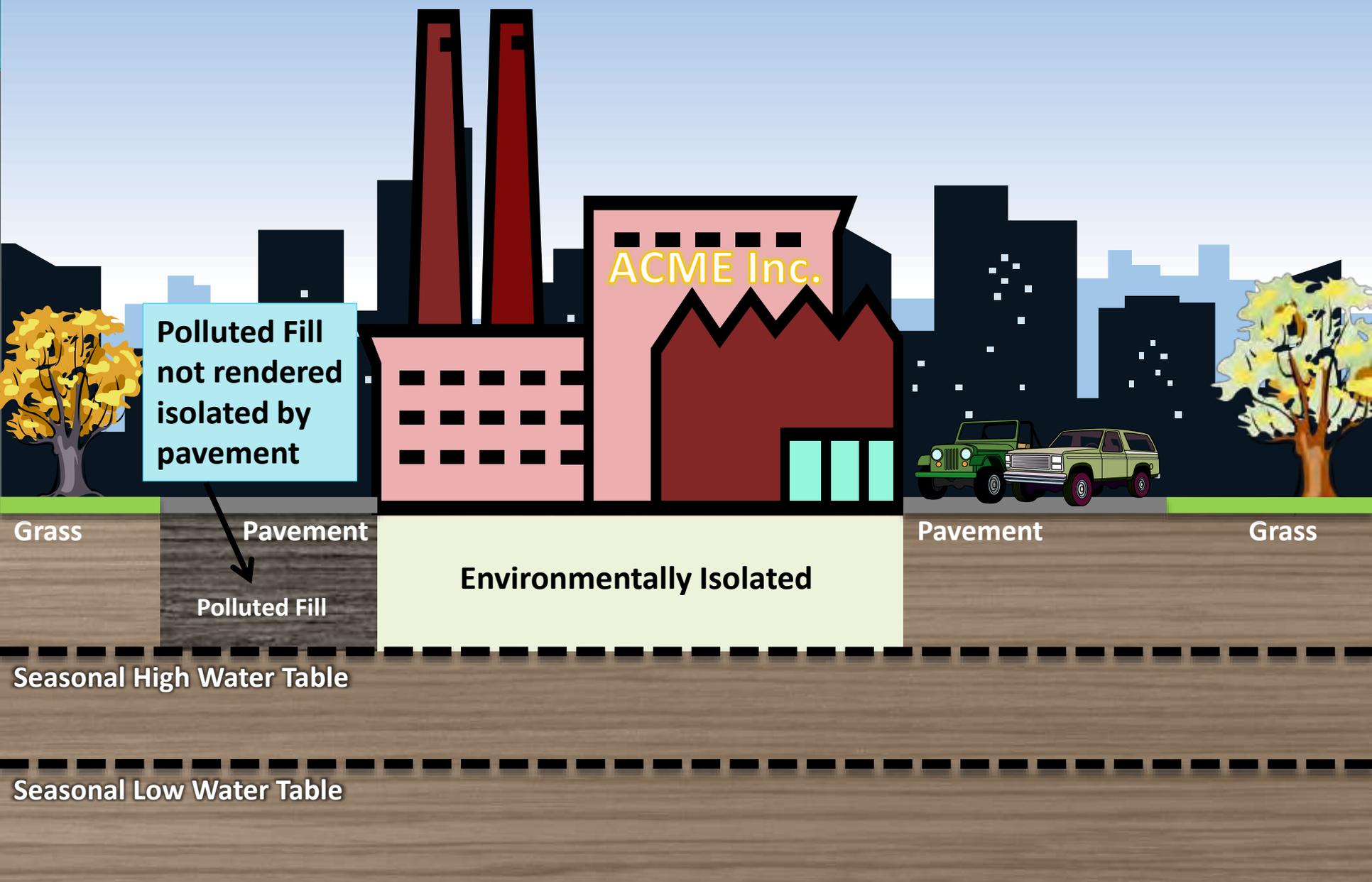
Pollutant Mobility Criteria

Exception for *Environmentally Isolated Soil*

Must meet the following conditions:

- ◆ Not a continuing source of pollution (i.e. no NAPL present)
- ◆ Not polluted with VOCs (or if polluted with VOCs, they have been remediated to the maximum extent prudent because VOCs can migrate to building interior or groundwater through the vapor phase)
- ◆ Above seasonal high water table (does not come in contact with the overburden aquifer)
- ◆ Requires the recordation of an ELUR

Pollutant Mobility Criteria



Not to Scale

Pollutant Mobility Criteria Exception for Polluted Fill

PMC does not apply to fill material solely polluted with coal ash, wood ash or asphalt fragments, provided:

- ◆ VOCs not present above applicable PMC;
- ◆ meets direct exposure criteria;
- ◆ the water supply is and will not be affected;
- ◆ public water available within 200 feet; and
- ◆ the fill was not placed illegally.



Pollutant Mobility Criteria

Exception for Groundwater Infiltration

PMC does not apply to substances, other than VOCs, in soil, if:

- ◆ (Self-Implementing) 80% of release area has been subject to infiltration (not obstructed by anthropogenic features) for five years, **or**
- ◆ (Commissioner's Approval) release area has been subject to sufficient infiltration, **and**

(NOTE: Further Guidance available on DEEP Website)



Pollutant Mobility Criteria

Exception for Groundwater Infiltration Cont'd (GA Areas)

Groundwater sampled for four consecutive quarters:

- ◆ Groundwater must meet GWPC and SWPC
- ◆ Groundwater samples must be collected in locations most likely to be contaminated
- ◆ Groundwater sample locations must be representative of the plume and the areal extent of plume must not be increasing over time, except for seasonal variations



Pollutant Mobility Criteria

Exception for Groundwater Infiltration Cont'd (GB Areas)

Groundwater sampled for four consecutive quarters:

- ◆ Groundwater must meet SWPC
- ◆ Groundwater must also meet GWPC in aquifer protection area or other area used as drinking water source
- ◆ Groundwater samples must be collected in locations most likely to be contaminated
- ◆ Sample locations must be representative of the plume and the areal extent of plume must not be increasing over time, except for seasonal variations



Pollutant Mobility Criteria

Exception for Incidental Sources

PMC does not apply (self-implementing) to metals, petroleum hydrocarbons, and SVOCs in soil, if:

- ◆ Pollution is due to normal operation of motor vehicles (which cannot include refueling, repair, or maintenance of motor vehicles); or
- ◆ Normal paving and maintenance of asphalt, providing that such pavement has been maintained for its intended purpose

Guidance available on DEEP Website

Pollutant Mobility Criteria

Baseline - VOCs, SVOCs, & TPH

- ◆ Mass concentration compared to appropriate pollutant mobility criteria (mg/kg)
- ◆ Appendix B to RSRs
- ◆ See 2006 guidance on VOC sample collection (defines level of care expected during collection of samples for comparison with the RSRs)
- ◆ http://www.ct.gov/deep/lib/deep/site_clean_up/guidance/soil_sampling_voc_final_wcomments.pdf

Pollutant Mobility Criteria

Baseline - Inorganics and PCBs

- ◆ TCLP/ SPLP result (mg/L) compared to appropriate pollutant mobility criteria
- ◆ Also in Appendix B to RSRs

NOTE: Mass result divided by 20 may be compared to the pollutant mobility criteria (mg/L) for site characterization – This “Rule of Thumb” is not valid for demonstration of compliance with the RSRs



Pollutant Mobility Criteria

Option for VOCs, SVOCs, & TPH (GA Area)

- ◆ May use TCLP/SPLP compared to groundwater protection criteria (GWPC) in Appendix C

except TCLP/SPLP may NEVER be used

for the following compounds:

- ◆ 1,2 dichlorobenzene
- ◆ ethyl benzene
- ◆ toluene
- ◆ xylenes
- ◆ TPH

Pollutant Mobility Criteria Self-Implementing Options

In GA areas for VOCs:

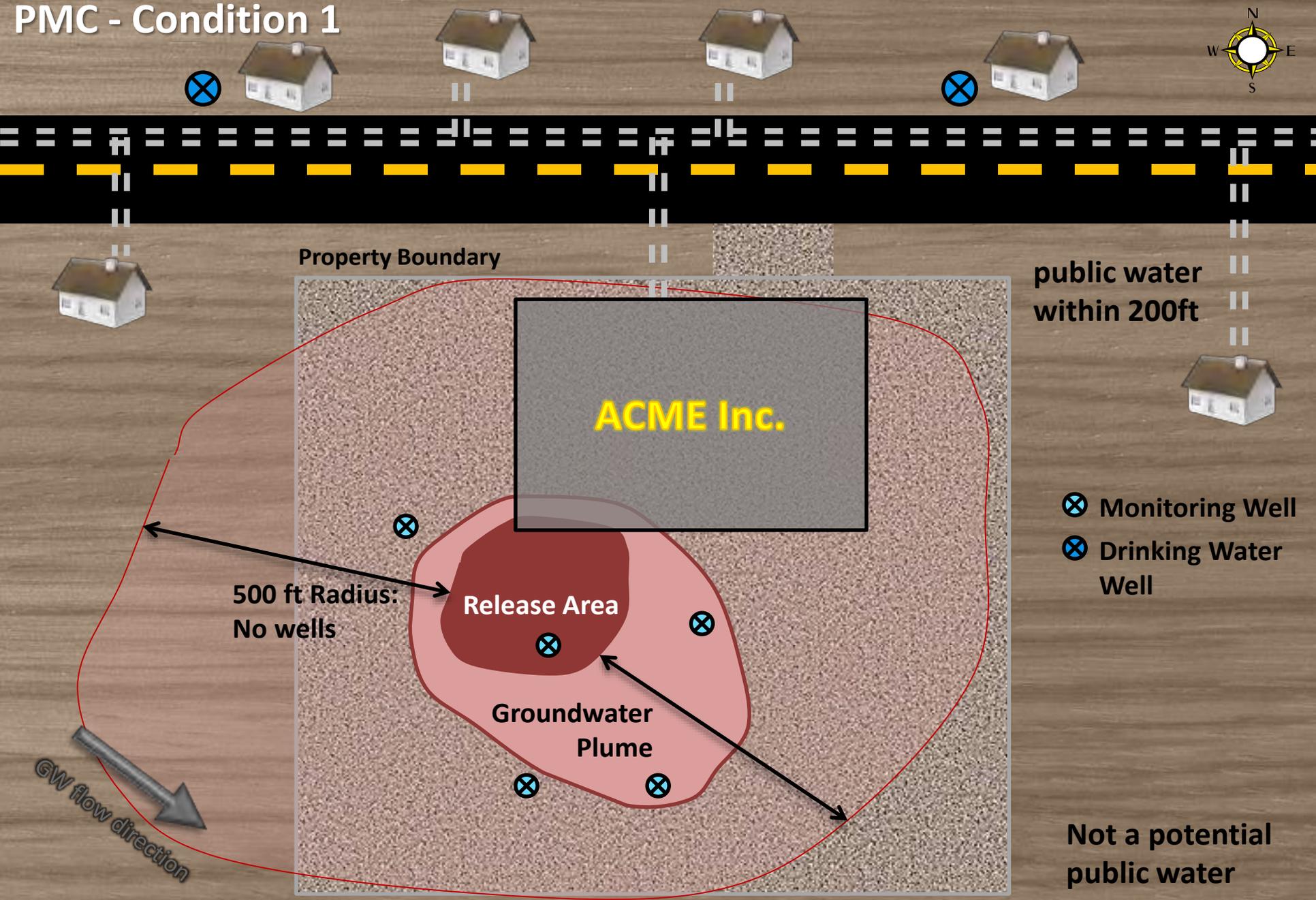
- ◆ TCLP/SPLP compared to 10x GWPC, or
- ◆ Mass compared to 10x PMC, or
- ◆ Mass compared to PMC x approved dilution or dilution/attenuation factor, **if**
 - ◆ No NAPL
 - ◆ Water table at least 15 feet above bedrock
 - ◆ Downward vertical flow less than horizontal flow **and**
 - ◆ 1 of 3 conditions are met

Pollutant Mobility Criteria

VOC GA 10x - *Condition 1*

- ◆ Public water supply available within 200 feet of the subject parcel, all adjacent parcels, and any parcels within the areal extent of the groundwater plume caused by the subject release area
- ◆ Groundwater within the plume not used for drinking
- ◆ No supply wells within 500 feet of release area
- ◆ Not a potential public water supply resource

PMC - Condition 1



500 ft Radius:
No wells

Release Area

Groundwater
Plume

ACME Inc.

Property Boundary

public water
within 200ft

- ⊗ Monitoring Well
- ⊗ Drinking Water Well

Not a potential
public water
supply resource

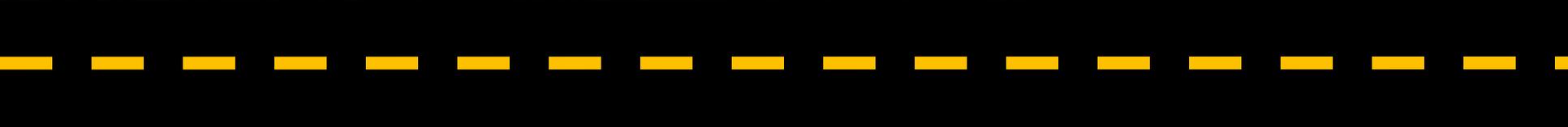
Not to Scale

Pollutant Mobility Criteria

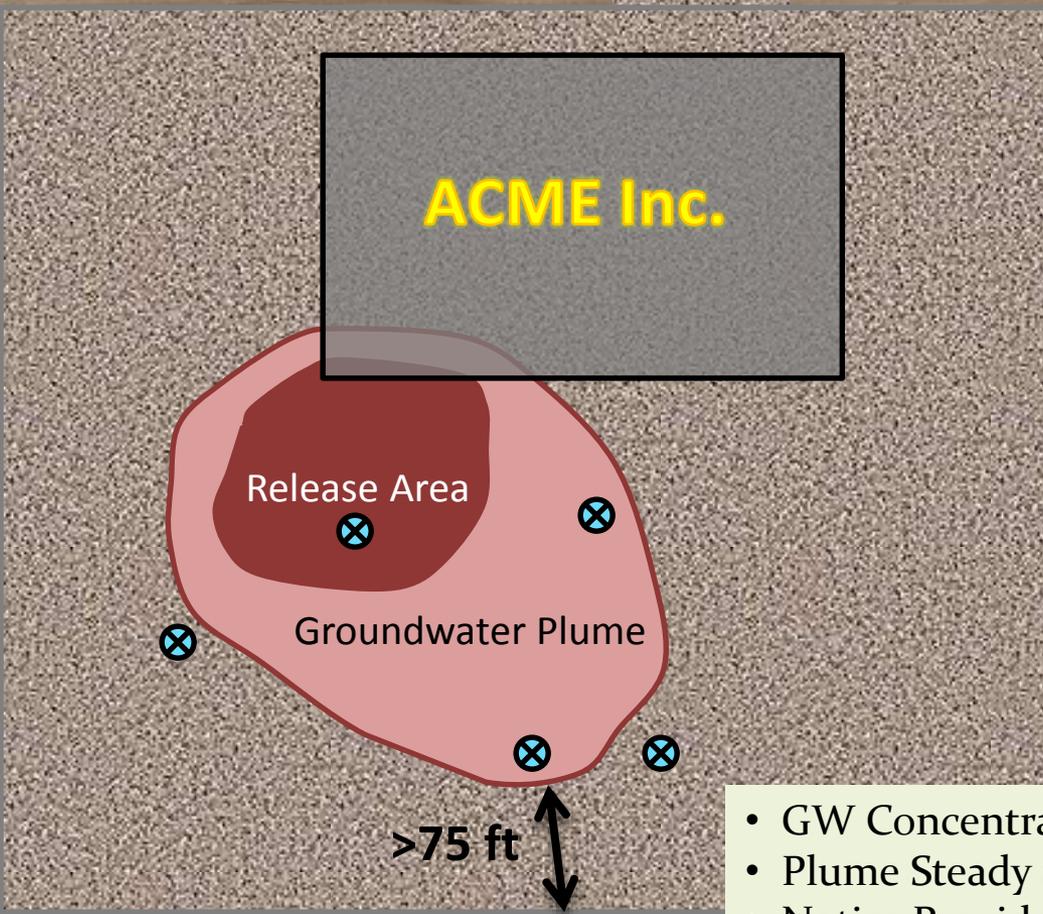
VOC GA 10x - Condition 2

- ◆ Concentration of plume within 75 feet of the downgradient property line below GWPC
- ◆ Steady state plume
- ◆ Notice provided to Commissioner (*Form available on DEEP Website*)

PMC - Condition 2



Property Boundary



- ⊗ Monitoring Well
- ⊗ Drinking Water Well

GW flow direction

- GW Concentration <GWPC
- Plume Steady State
- Notice Provided

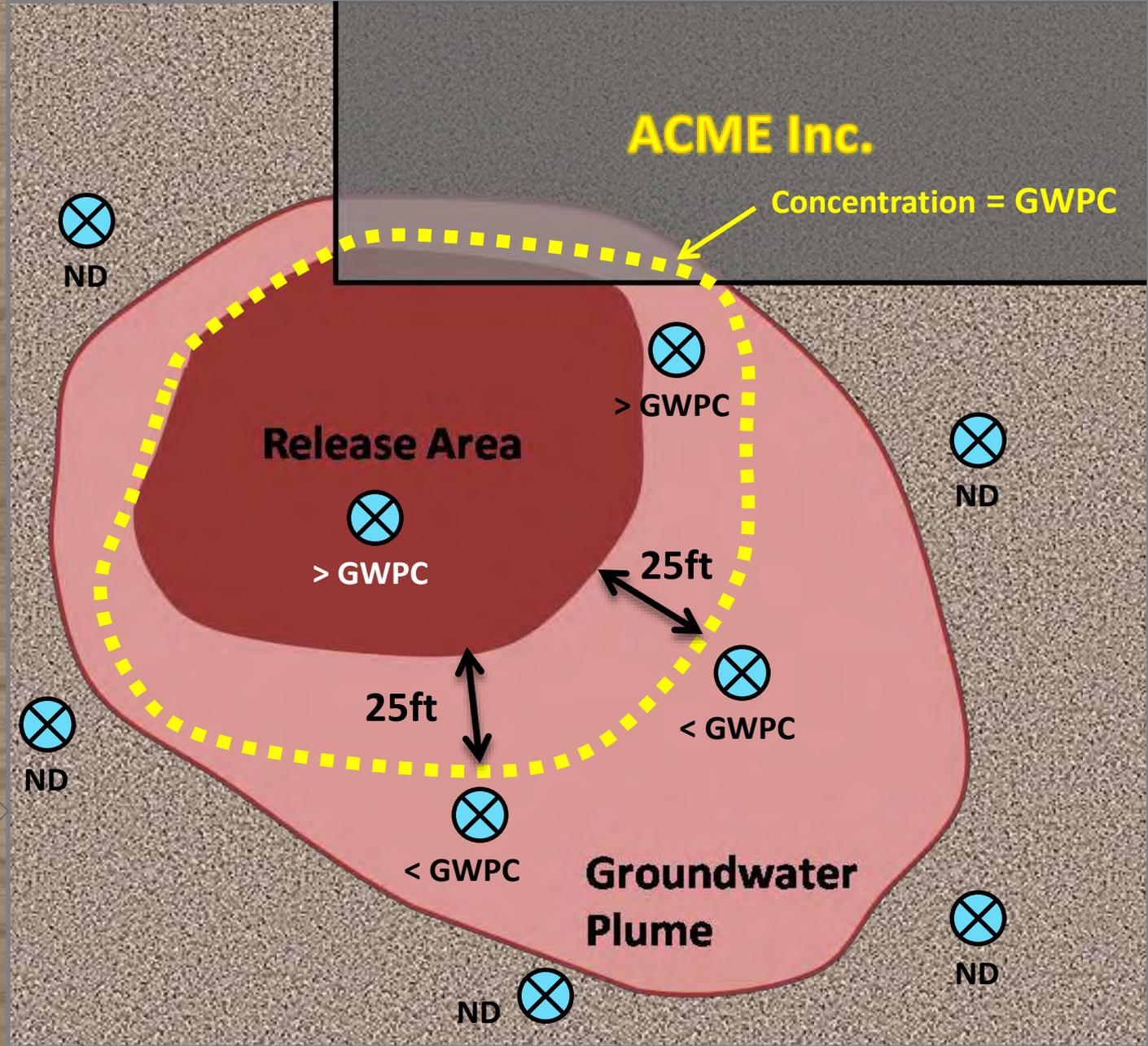
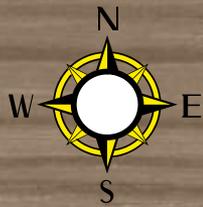
Not to Scale

Pollutant Mobility Criteria

VOC GA 10x - *Condition 3*

- ◆ Concentration of plume 25 feet downgradient of the release area is below GWPC
- ◆ Notice provided to Commissioner (*Form available on DEEP Website*)

PMC - Condition 3



Not to Scale

Property Boundary

Pollutant Mobility Criteria Self-Implementing Options

For Inorganics, SVOCs, PCBs, & Pesticides in a
GA area:

- ◆ TCLP/SPLP compared to 10x GWPC, or
- ◆ Mass compared to 10x PMC, **if**
 - ◆ Release area at least 25 feet from downgradient property line
 - ◆ no NAPL
 - ◆ water table at least 15 feet above bedrock

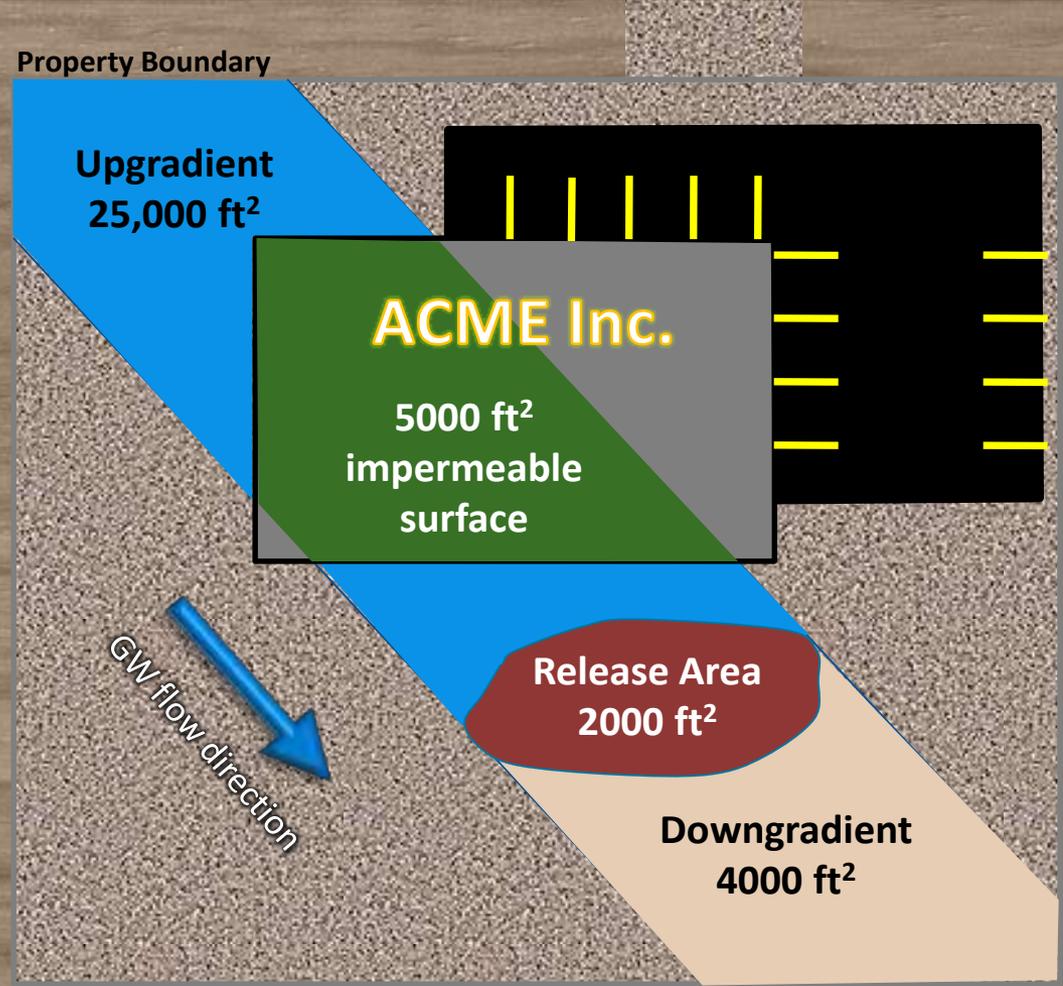
Pollutant Mobility Criteria Self-Implementing Options

In a GB area, provided that no NAPL is present per 22a-133k-2(c)(3):

TCLP or SPLP compared to GWPC times:

- ◆ 10
- ◆ Ratio of the summation of the on-site areas up and downgradient of the release area to the release area (≤ 500) “Ratio Method”
- ◆ Alternative Dilution or Dilution/Attenuation Factor

GB ADF Based on Upgradient & Downgradient Areas



Since Building is impermeable the effective upgradient area is

$$25,000 \text{ ft}^2 - 5,000 \text{ ft}^2 = 20,000 \text{ ft}^2$$

$$(20,000 \text{ ft}^2 + 4000 \text{ ft}^2) / 2000 \text{ ft}^2 = 12$$

ADF = 12
Acceptable <500

Not to Scale

Pollutant Mobility Criteria Self-Implementing Options

In a GB area, TCLP or SPLP compared to GWPC times a DF or Mass compared to GA PMC times a DF:

- ◆ $DF = (1 + K_{id}/IL)(1 - F_{adj})$
- ◆ Provided that:
 - ◆ No NAPL
 - ◆ Notice to Commissioner (*Form on DEEP Website*)
 - ◆ Need at least 15 feet of unconsolidated aquifer above bedrock
 - ◆ Downward vertical flow less than horizontal

$$DF = (1 + K_{id}/IL)(1 - F_{adj})$$

DF = site specific dilution factor

K = hydraulic conductivity

i = horizontal gradient

d = 15' (depth) (specified)

I = infiltration rate (specified)

L = length of release area parallel to flow

F_{adj} = background concentration for groundwater divided by the GWPC



Pollutant Mobility Criteria

Additional Polluting Substances

- ◆ For substances for which a PMC does not exist, one must be developed
- ◆ Process will be the same as was discussed for Direct Exposure Criteria (expedited process in place)
- ◆ Criteria for ETPH added that match what was previously being approved as an APS (500 mg/kg GA and 2500 mg/kg GB)

Pollutant Mobility Criteria *Alternatives*

- ◆ Alternative Pollutant Mobility Criterion
- ◆ Alternative means of compliance
- ◆ Alternative Dilution Factor or Dilution Attenuation Factor
- ◆ Submit for Commissioner's approval
(Form on DEEP Website)

Alternative PMC for GA Areas

(inc. Alternative Dilution and Dilution and Attenuation Factor)

Request for approval of alternative PMC must demonstrate that release area will not degrade groundwater (exceed the GWPC) and/or prevent attainment of applicable groundwater remediation standards

Alternative PMC for GB Areas

(inc. Alternative Dilution and Dilution and Attenuation Factor)

Request for approval of alternative PMC must demonstrate that groundwater at nearest downgradient property line will not exceed the GWPC

Application of Pollutant Mobility Criteria

- ◆ Sampling needs to be representative of release area
- ◆ Two scenarios:
 - ◆ Less than 20 samples
 - ◆ More than 20 samples

Applying the PMC - Less than 20 Samples

All samples must be below
the applicable criteria

Applying the PMC - More than 20 Samples

- ◆ All samples must meet applicable criteria
or
- ◆ The 95% UCL of the arithmetic mean of all samples is less than applicable criteria



Upper Confidence Level

- ◆ “Ninety-five percent upper confidence level of the arithmetic mean” is defined as a value that, when repeatedly calculated for randomly drawn subsets of size n from a population, equals or exceeds the population arithmetic mean ninety-five percent of the time.

Upper Confidence Level

- ◆ Provides a conservative estimate that is protective of potential receptors
- ◆ Accounts for uncertainties within data set
- ◆ The greater the number of samples collected, the more confidence that the 95% UCL will not underestimate the true mean of the data set (and the closer the 95% UCL will be to the true mean)

Calculating the 95% UCL

- ◆ Guidance documents for calculating the UCL
 - ◆ http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/95ucl_guidance.pdf - Guidance for Calculating the 95% Upper Confidence Level for Demonstrating Compliance with the Remediation Standard Regulations
 - ◆ http://www.epa.gov/oswer/riskassessment/pdf/1992_0622_concentrationterm.pdf - Supplemental Guidance to RAGS: Calculating the Concentration Term
- ◆ Use EPA or other software to calculate the UCL
 - ◆ <http://www.epa.gov/osp/hstl/tsc/software.htm> - ProUCL (current version 5.0)

95% UCL - Number of Samples

- ◆ *Collect sufficient number of discrete samples (not ND) to adequately characterize each release area*
- ◆ EPA Guidance (1992)
 - ◆ <10 samples per area of concern provide poor estimates of mean
 - ◆ 10-20 samples per area of concern provide somewhat better estimates of the mean
 - ◆ 20+ samples per area of concern provide fairly consistent estimates of mean

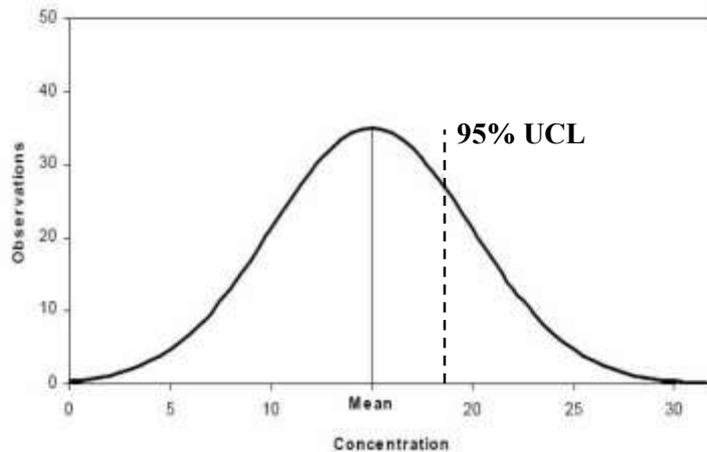
Data Distributions

- ◆ Data distribution
 - ◆ Environmental data is commonly Lognormal
 - ◆ ProUCL tests for Normal, Lognormal, and Gamma Distributions
- ◆ Use different 95% UCL calculation methods for different distributions:
 - ◆ Normal, Lognormal, and Gamma distributions have different calculation methods
 - ◆ ProUCL also has Non-parametric (no known distribution) methods

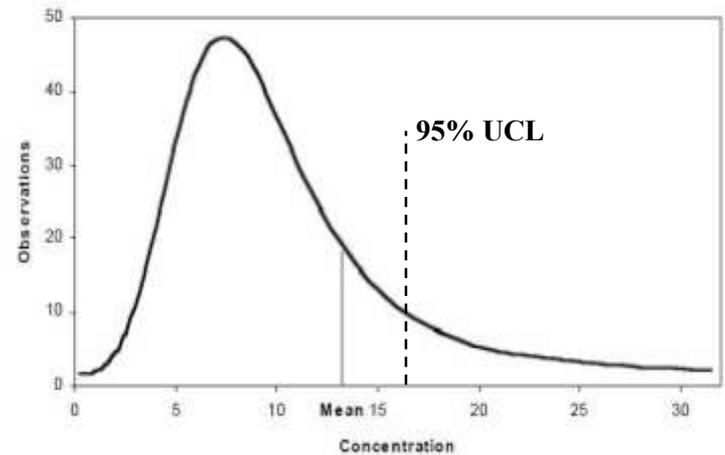
Data Distributions cont'd

◆ Normal vs. Lognormal data distribution

EXAMPLE OF A NORMAL DISTRIBUTION



EXAMPLE OF A LOGNORMAL DISTRIBUTION



95% UCL – Handling NDs

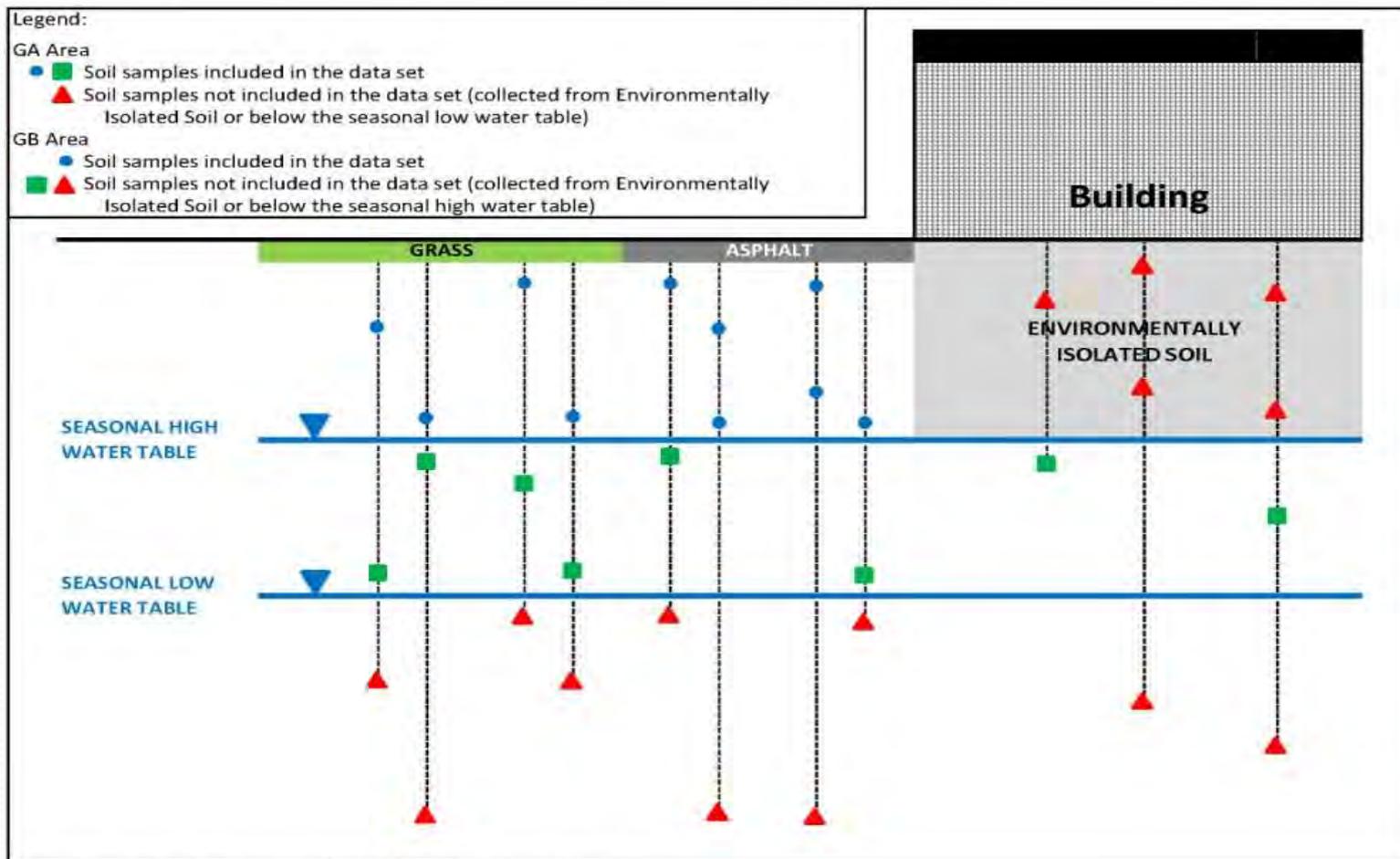
- ◆ Appropriateness of the use of the NDs in the data set needs to be evaluated:
 - ◆ Delineate or Within Release Area?
 - ◆ Other lines of evidence?
- ◆ Proper estimation method needs to be used:
 - ◆ Normal, Lognormal, and Gamma Distributions - Regression on Order Statistics (ROS Method)
 - ◆ Non-parametric Distributions - Kaplan-Meier (KM Method)
 - ◆ $\frac{1}{2}$ Detection Limit no longer recommended

95% UCL Data Sets

- ◆ Important to consider the representativeness of the data set – does the sampled distribution match the distribution in the ground?
- ◆ Assessment should be made to determine if the sampling program had the potential to bias and “skew” the sampled data set
- ◆ Just because you have enough samples to complete characterization does not mean that the data set is appropriate for use when estimating the 95% UCL – more samples may be needed

95% UCL Data Set Applicability

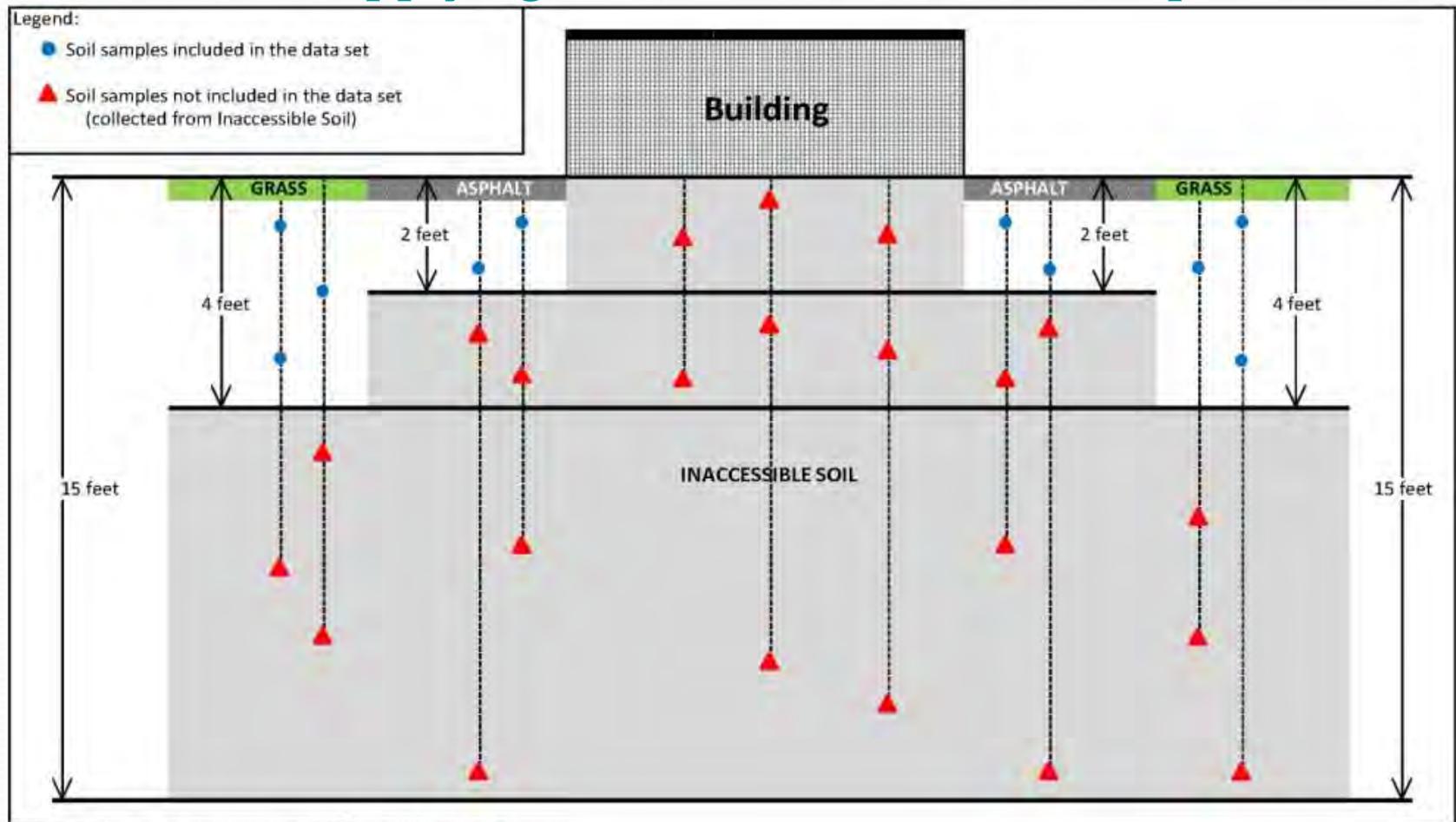
Release Area Sample Selection for PMC 95% UCL Calculation
When Applying the Environmentally Isolated Soil Exception



Note: All samples shown were collected from the Release Area

95% UCL Data Set Applicability

Release Area Sample Selection for DEC 95% UCL Calculation
When Applying the Inaccessible Soil Exception



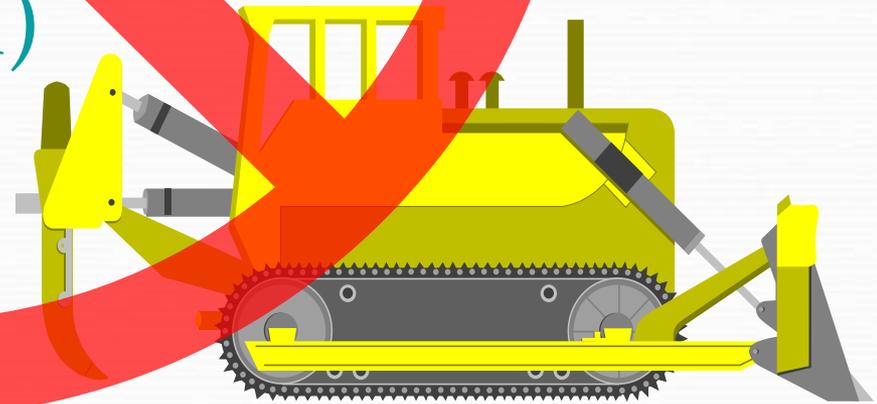
Note: All samples shown were collected from the Release Area



Applying the PMC –

If Excavation is the Remedial Method

- ◆ All samples must be below the criteria
- ◆ Can remove hot spots then use 95% UCL if there is good understanding of release area (this variance requires request and approval)



Variance from PMC

WIDESPREAD polluted fill

PMC does not apply if:

- ◆ Geographically extensive (regional condition - not just site)
 - ◆ Example - fill areas near coastal harbors
- ◆ Meets Direct Exposure Criteria
- ◆ Will not affect drinking water supply
- ◆ Placement was not prohibited by law
- ◆ No VOCs

Variations from PMC (and/or DEC) **Engineered Control of Polluted Soil**

Variance from PMC (and DEC) can be requested if:

- ◆ Commissioner authorized disposal
- ◆ Remediation of substance not technically practicable
- ◆ Commissioner determines that the removal creates unacceptable risk to human health
- ◆ Commissioner determines, after providing opportunity for public input, that control is acceptable because the cost of removal outweighs risk to human health and the environment if the engineered control fails



Variances from PMC (and/or DEC) **Engineered Control of Polluted Soil**

Definition:

"Engineered control" means any physical barrier, system, technology or method, that permanently renders pollution in soil environmentally isolated or inaccessible, when combined with appropriate long-term inspection, maintenance or monitoring.

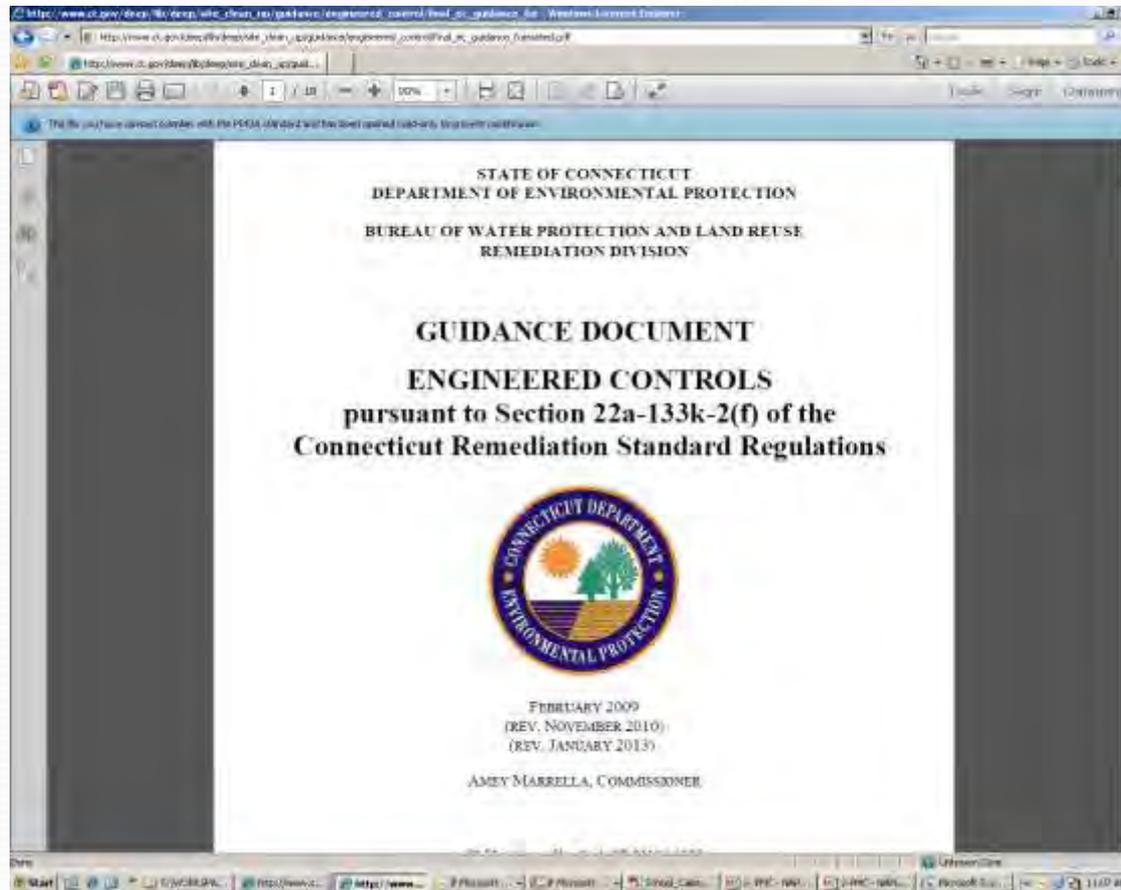
Variations from PMC (and/or DEC) Engineered Control of Polluted Soil

An Engineered Control must accomplish the following performance standards:

- ◆ Physically isolate polluted soil
- ◆ Minimize migration of liquids – permeability $< 10^{-6}$ (PMC only)
- ◆ Ensure that cap is and remains effective
- ◆ Plan for monitoring groundwater to ensure that any substances migrating will be detected (PMC only)
- ◆ Maintenance plan
- ◆ ELUR
- ◆ Financial Assurance

Engineered Control Guidance available on DEEP Website

http://www.ct.gov/deep/lib/deep/site_clean_up/guidance/engineered_control/final_ec_guidance_formated.pdf



PMC Recap

◆ **Baseline Criteria**

- ◆ Appendix B or Background
- ◆ Additional Polluting Substances

◆ **Other Options**

- ◆ (c)(2) Additional dilution factors (GA and GB) (self implementing)
- ◆ (d)(3),(5) Alternative criteria (needs approval)
- ◆ (d)(4),(6) Alternative dilution or attenuation factors (needs approval)

PMC Recap cont'd

◆ Exceptions

- ◆ Environmentally isolated soil (needs ELUR)
- ◆ Polluted fill (coal ash, wood ash, asphalt paving fragments) (self implementing)
- ◆ Incidental Sources (vehicles/parking lot) (self implementing)
- ◆ Groundwater Infiltration (both self implementing and Commissioner approval options)

PMC Recap cont'd

◆ Variances

- ◆ Widespread polluted fill (PMC) (needs Commissioner approval)
- ◆ Engineered control (PMC and/or DEC) (needs Commissioner approval and ELUR/Financial Assurance)

Question 1

During the investigation of a site, you discover a release area that has soil contaminated above the PMC. How should you deal with the contaminated soil?

Question 1

During the investigation of a site, you discover a release area that has soil contaminated above the PMC. How should you deal with the contaminated soil?

- a. Collect enough samples (20) to be able to perform a 95% UCL calculation to demonstrate compliance
- b. Perform no remediation
- c. Cover with an Engineered Control (requiring Financial Assurance and ELUR)
- d. Excavate or Remediate Soil
- e. Potentially any of the above

Question 1

An excavation has been used on a site to clean up a release area by the removal of the contamination. The confirmation samples include detections above the PMC criteria. How would you proceed to demonstrate compliance?

e. Potentially any of the above

Depending on the site conditions:

- a. Collect enough samples (20) to be able to perform a 95% UCL calculation to demonstrate compliance - appropriate if the data/calculation supports it
- b. Perform no remediation - possible if the release area is 80% uncovered and there is no groundwater contamination **or** if the contamination is due to an incidental source (automobile use/parking lot run-off)
- c. Cover with an Engineered Control (requiring Financial Assurance and ELUR) - possibly the best choice if DEC is also an issue

Question 2

During the investigation of a site, you discover a release area that is half-covered by a parking lot and contains soil contaminated above the PMC. Can you use the lack of a plume resulting from the release area to demonstrate compliance with the PMC?

Question 2

During the investigation of a site, you discover a release area that is half-covered by a parking lot and contains soil contaminated above the PMC. Can you use the lack of a plume resulting from the release area to demonstrate compliance with the PMC?

No. The self-implementing exception that allows PMC to not apply to a release area based on the lack of a resulting groundwater plume has a requirement that the release area be at least 80% uncovered by anthropogenic features, like the parking lot.

While the parking lot is not considered impermeable to render the soil environmentally isolated, it still affects the infiltration of water through the contaminated soil to the point that there is a concern that there may be a plume if the parking lot was to be removed (change in site conditions).

NAPL, Matrix Interference, Soil Reuse

Light Non-Aqueous Phase Liquids (LNAPL)

- ◆ LNAPL must be removed in accordance with RCRA 22a-449(d)-106(f) (UST regs)
- ◆ This means to the maximum extent practicable (e.g. cost not a consideration)
- ◆ Chlorinated solvents, coal tars, etc. can under some circumstances be LNAPLs

Dense Non-Aqueous Phase Liquids (DNAPL)

- ◆ DNAPL must be contained or removed from soil and groundwater to the maximum extent prudent
- ◆ “Prudent” considers cost – see RSR definition @ 22a-133k-1(a)(54)

Non-Aqueous Phase Liquids (NAPL)

- ◆ Non-recoverable NAPL can still pollute groundwater
- ◆ Oil under buildings may not be easily recovered, but can still flow (#4 oil, etc.)

Matrix Interferences

- ◆ Requirements: After remediation is complete - must demonstrate compliance with applicable remediation criteria contained in RSRs
- ◆ Quantification at criteria levels is required
- ◆ Analytical methodology is specified in RSRs

Overcoming Matrix Interference

- ◆ Evaluate analytical method
- ◆ Use more sensitive (approved) method
- ◆ Use flexibility within method
- ◆ Compliance is achieved at lowest concentration which can be consistently & accurately quantified
- ◆ Submit summary of measures taken for approval

Commissioner May Require Additional Remediation of Soil

- ◆ To prevent or abate any threat to human health or the environment
- ◆ Multiple substances, especially carcinogens
- ◆ Unacceptable ecological risk
- ◆ Soil eroding into surface water body



Reuse of excavated soil depends on category

Hazardous Waste

Treatment, storage, disposal, and transportation of hazardous waste must be done in accordance with Hazardous Waste Management Regulations and RCRA

Special Waste

- ◆ Commissioner may authorize polluted soil which is not a hazardous waste to be disposed of as a special waste under the Solid Waste Regulations
- ◆ Obtain Special Waste Disposal Authorization

Reuse Rules for Polluted Soil

Polluted soil which meets applicable DEC and PMC may be re-used on-site (notice required) or on another parcel approved by the Commissioner (approval required), **if:**

Reuse Rules for Polluted Soil Cont'd

- ◆ Location of re-use is documented with map(s) submitted to Commissioner
- ◆ Soil not placed below water table
- ◆ Soil not placed in an area subject to erosion
- ◆ If the soil exceeds GA PMC, such soil may not be placed over soil and groundwater which is unaffected by a release, regardless of groundwater class
- ◆ For PCBs, Commissioner must issue written approval (even if reused on-site)

Re-Use Rules for Polluted Soil

Soil handling also subject to:

- ◆ General Permit for Contaminated Soil and/or Sediment Management (Solid Waste Permit)

Soil/sediment is contaminated if affected by known or suspected release & determined or reasonably suspected to be > RDEC or > GA PMC

Re-Use Rules for Polluted Soil

General Permit for Contaminated Soil and/or Sediment Management available on DEEP website:

[http://www.ct.gov/deep/lib/deep/Permits and Licenses /Waste General Permits/soilstaging_gp.pdf](http://www.ct.gov/deep/lib/deep/Permits%20and%20Licenses/Waste%20General%20Permits/soilstaging_gp.pdf)

Natural Soil

May be used at any parcel if:

- ◆ no naturally-occurring substance exceeds background
- ◆ no man-made compounds are detectable above analytical detection limit



Clean Fill

Definition of clean fill in solid waste regulations includes natural soil and polluted soil treated to meet DEC and PMC *reused in accordance with the RSR re-use rules.*

Question 1

There is a site that is currently undeveloped. Investigations have determined that there have been surface releases at several locations around the site. These releases have resulted in several areas that have soils that contain contaminants at concentrations greater than the Residential DEC and GA PMC. Under the soil re-use rules, can these areas be consolidated into a single location and then be rendered inaccessible and environmentally isolated by the construction of a building?

Question 1

There is a site that is currently undeveloped. Investigations have determined that there have been surface releases at several locations around the site. These releases have resulted in several areas that have soils that contain contaminants at concentrations greater than the Residential DEC and GA PMC. Under the soil re-use rules, can these areas be consolidated into a single location and then be rendered inaccessible and environmentally isolated by the construction of a building?

Yes, as long as the following regulations are followed:

- 22a-133k-2(h)(3): Re-use of polluted soil requires that notice (including a map showing location and depth) are provided to the Commissioner. The soil cannot be placed below the water table and cannot be placed above soil and groundwater which have not been affected by a release at the parcel (means that the consolidation would need to be at one of the release areas).
- 22a-133k-2(b)(3) & (c)(4)(A): Soil must comply with the definitions of inaccessible and environmentally isolated and ELUR must be in place to ensure that the conditions will not change for the soil to be excepted from the DEC and PMC.
- 22a-133k-1(a)(18) & (32): Definitions of inaccessible and environmentally isolated require that the soil be beneath existing building, not be a continuing source of pollution, not be polluted with VOCs (or if so, remediated to the maximum extent prudent), and be above the seasonal high water table.

NOTE: “Existing building” means existing at the time of ELUR recordation and site verification, not necessarily existing at the time of investigation/remediation.

Significant Environmental Hazards

Reporting of certain Significant Environmental Hazard

- ◆ Section 22a-6u of the Connecticut General Statutes
- ◆ Established - October 1, 1998



Background

- ◆ Triggered by particular release or site condition
- ◆ Notification statute assumes that short-term risk is discovered during site investigation
- ◆ Short-term risk is determined through reference to the RSRs
- ◆ DEEP can require actions to mitigate short-term risk – may or may not be to RSRs

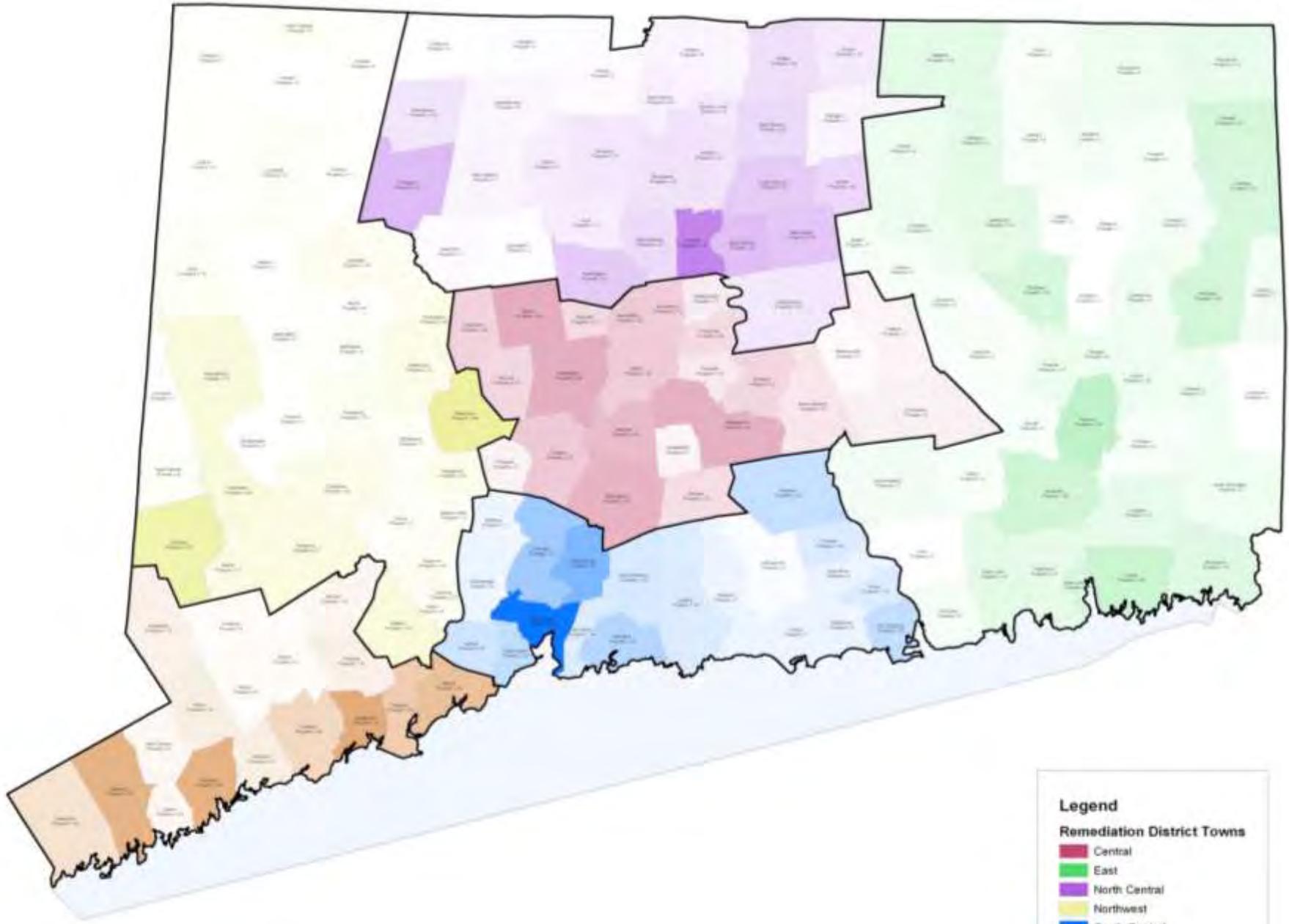
Background

- ◆ Sites under Order/Consent Order to investigate pollution are not subject to Hazard Notifications
- ◆ Both a TEP or LEP must notify their client and the owner of the parcel
- ◆ Does not address the LEP's obligation to hold human health and the environment paramount under CGS 22a-133v
- ◆ 7 types of hazard conditions require notification

Requirements

- ◆ DEEP is required to acknowledge Hazard within 10 days of receiving notice
- ◆ Within Acknowledgement letter, DEEP may direct owner to conduct initial action
- ◆ SEH and Acknowledgment Letter submitted to:
 - Town Elected Official
 - Town Manager
 - Local Health Official
 - State Representative
 - State Senator
 - Department of Labor
 - Local OSHA Official

Remediation Districts



Requirements

- ◆ DEEP is required to acknowledge Hazard within 10 days of receiving notice
- ◆ Within Acknowledgement letter, DEEP may direct owner to conduct initial action
- ◆ SEH and Acknowledgment Letter submitted to:
 - Town Elected Official
 - Town Manager
 - Local Health Official
 - State Representative
 - State Senator
 - Department of Labor
 - Local OSHA Official

2. Drinking Water Well below standard

- ◆ Drinking water supply well is polluted below GWPC
 - ◆ TEP Notify owner & client – 7 days
 - ◆ Owner Notify DEEP – 7 days

3. Groundwater above standards threatens wells

- ◆ Groundwater contamination in a monitoring well exceeds the GWPC
- ◆ Drinking water well is within 500 ft downgradient
 - ◆ TEP Notify owner & client – 7 days
 - ◆ Owner Notify DEEP – 7 days
- ◆ Receptor Survey needed - CSM

4. Direct Exposure threat from surface soil

- ◆ Soil within 2ft of the surface exceeds 30 times the DEC (except petroleum)
 - ◆ TEP Notify owner & client – 7 days
 - ◆ Owner Notify DEEP – 90 days
- ◆ Do not need to notify if soil inaccessible or remediated, treated and disposed within 90 days

5. Volatilization Threat To A Building

- ◆ Groundwater within 15 feet beneath a building is contaminated with VOCs above 30 times volatilization criteria
 - ◆ TEP Notify owner & client – 7 days
 - ◆ Owner Notify DEEP – 30 days

6. Surface Water Threat

- ◆ Groundwater is contaminated and discharges to a surface water body
- ◆ Discharging groundwater is above 10 times the acute toxicity levels
 - ◆ TEP Notify owner & client – 7 days
 - ◆ Owner Notify DEEP – 7 days

7. Explosion Risk

- ◆ Groundwater plume with vapors that pose an explosion hazard is migrating under a building or utility line
 - ◆ TEP Notify owner & client – 24 hrs
 - ◆ Owner Notify DEEP and Fire Marshal
 - 2 hrs verbally
 - 5 days written
 - ◆ Client Notify DEEP if Owner doesn't

Common Confusion

- ◆ Free Product should be a trigger for a SEH even if not tested (to be enacted on July 1, 2015)
- ◆ If SEH is identified, the TEP must notify their client
- ◆ TEP must notify property owner of the parcel where the pollution is originating.
- ◆ Owner where pollution originates not always the same as client

Common Confusion

- ◆ For groundwater SEH, triggering criteria is GWPC not DWAL
- ◆ If source of pollution is unknown notification by the property owner of the investigated parcel is still necessary for some SEH
- ◆ Receptor Survey and topography not acceptable to conclude there are no downgradient wells to justify no SEH condition

Online Resource



DEPARTMENT OF ENERGY & ENVIRONMENTAL PROTECTION
ENVIRONMENTAL PROTECTION



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List of Significant Environmental Hazards Reported to DEEP

(pursuant to Section 22a-6(u) of the Connecticut General Statutes)

The Connecticut Department of Energy & Environmental Protection (DEEP) is required to provide a list of Significant Environmental Hazards reported to DEEP on the DEEP website. The list is updated periodically as additional hazard notices are received, and it contains information on hazard notices reported to DEEP for the period shown in the upper right corner of each page. The published list contains information on hazard notifications submitted to DEEP after August 1, 2002. Historic hazard reports dating back to October 1, 1998 will be added to the list as time permits.

Property owners are required to submit information on certain types of environmental conditions to DEEP when such conditions are encountered during an environmental site investigation or remediation of a parcel. DEEP refers to the reporting of these conditions as "reporting of significant environmental hazards" or "hazard notifications".

The [List](#) linked below contains the following information for each entry:

http://www.ct.gov/deep/cw/p/view.asp?a=2715&q=324972&depNav_GID=1626

- ◆ SEH Report includes:
 - Type of hazard
 - DEEP Response
 - Action taken

List of Significant Environmental Hazards Reported to the DEEP Period covering 8/01/2002 through 1/31/2012

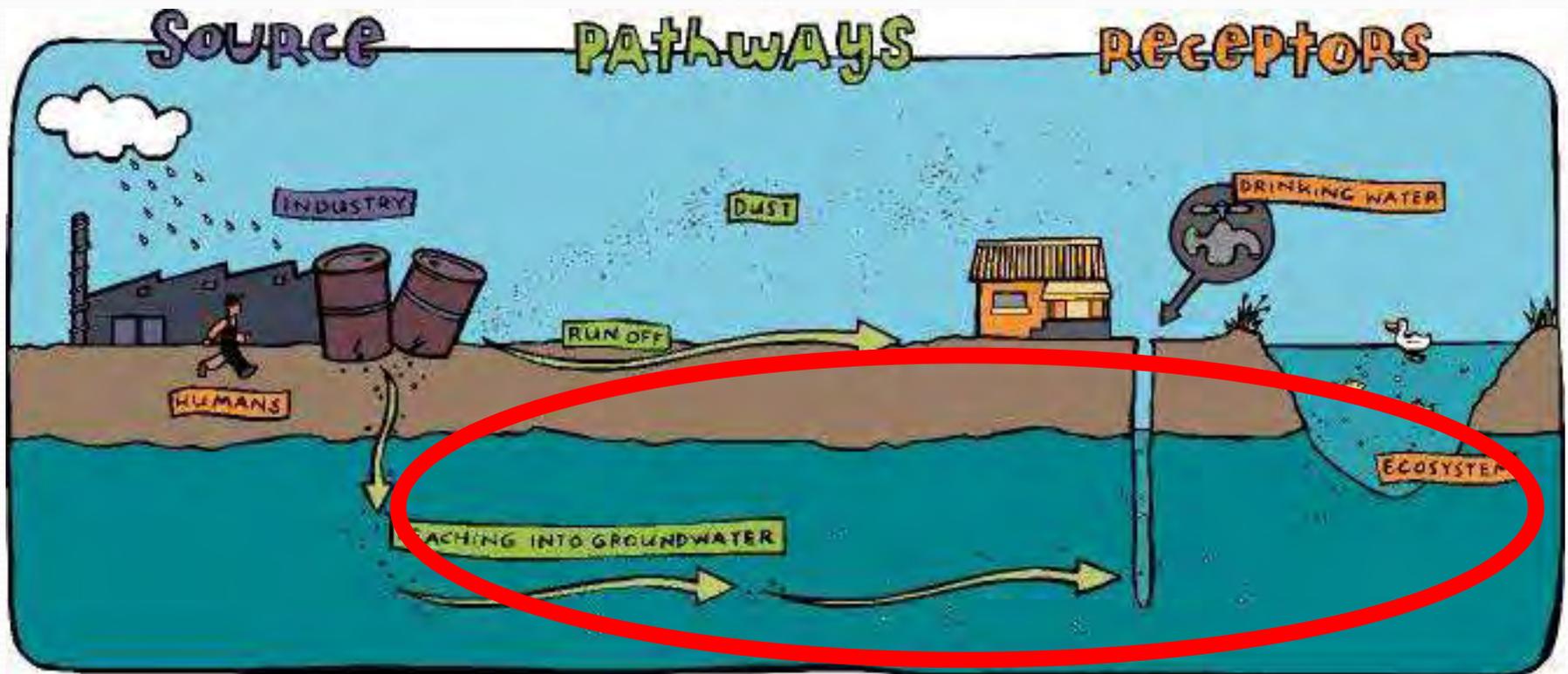
Ashford				
Site Location	Date Notified	Type of Hazard	Response	Action
Residential Property To Fairy Hill Road	8/21/2002	Pollutants detected in groundwater above standards may threaten a drinking water well	DEEP discussed with the environmental consultant additional sampling data obtained for nearby threatened wells that shows there was no pollution at the wells. DEEP requested that the data be submitted for detailed review.	Action pending
Avon				
Site Location	Date Notified	Type of Hazard	Response	Action
Avon Municipal Landfill 281 Haskinsberry Hill Road	7/15/2007	Pollutants were detected in a supply well but at below standards.	DEEP directed the town to identify wells within 500 feet and continue to conduct an already approved landfill monitoring program.	Sampled residential wells and installed new monitoring well for landfill. Monitoring program continuing.
Mail Delivery Station No. 01-503 411 West Main Street	8/9/2010	Pollutants detected in groundwater above standards may threaten a drinking water well.	The DEEP directed the property owner to confirm if a neighboring supply well exists and, if so, sample the well for constituents of concern.	Action pending
Village Green & Tavern 102 West Main Street	11/23/2008	Pollutants detected in groundwater above standards may threaten a drinking water well.	DEEP directed the property owner to sample the onsite supply well, identify supply wells within 500 feet, and sample any identified wells for pollutants detected at the site.	Five wells identified within 500 feet but they are upgraded and not at risk. Volatile organic compounds not detected in on-site drinking water supply well. Site is undergoing investigation and remediation under Property Transfer Program.

Groundwater Criteria

Background, GWPC, & SWPC

Groundwater Remediation Standards

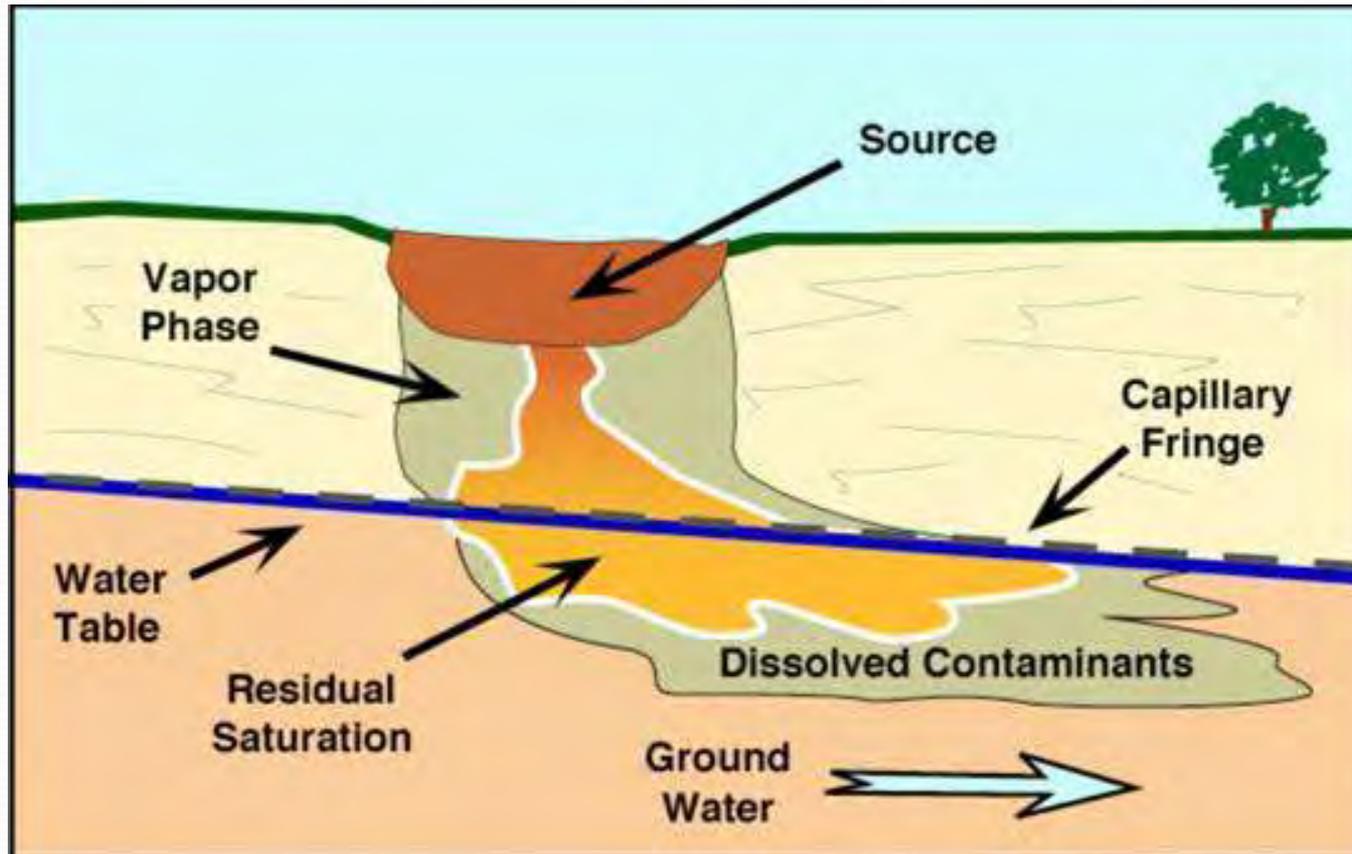
- ◆ Section 22a-133k-3 of the Regulations of Connecticut State Agencies



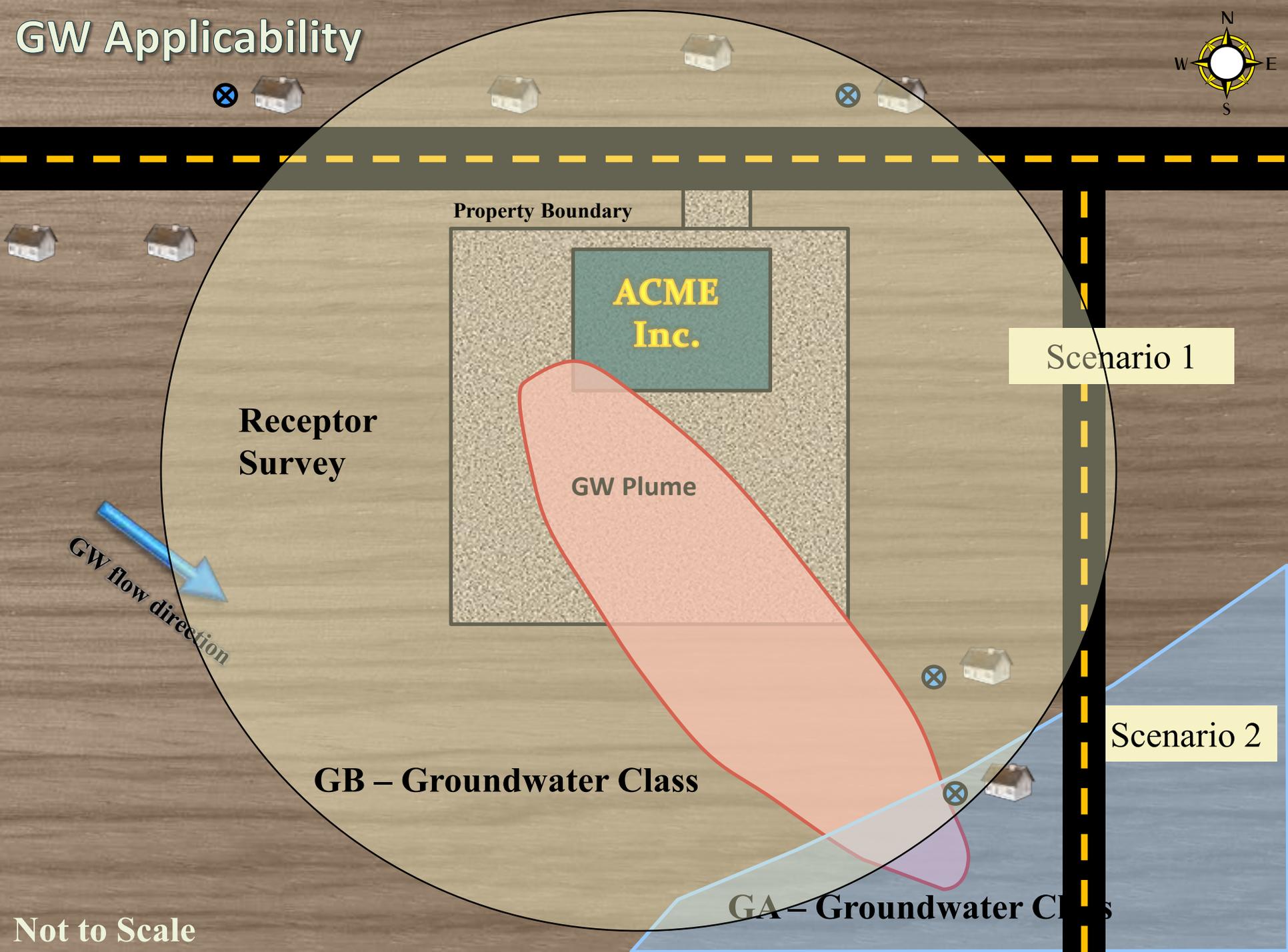
Groundwater Remediation Standards

Important Concepts

- ◆ Regulated by groundwater plume



GW Applicability



Property Boundary

ACME Inc.

GW Plume

Receptor Survey

GW flow direction

Scenario 1

Scenario 2

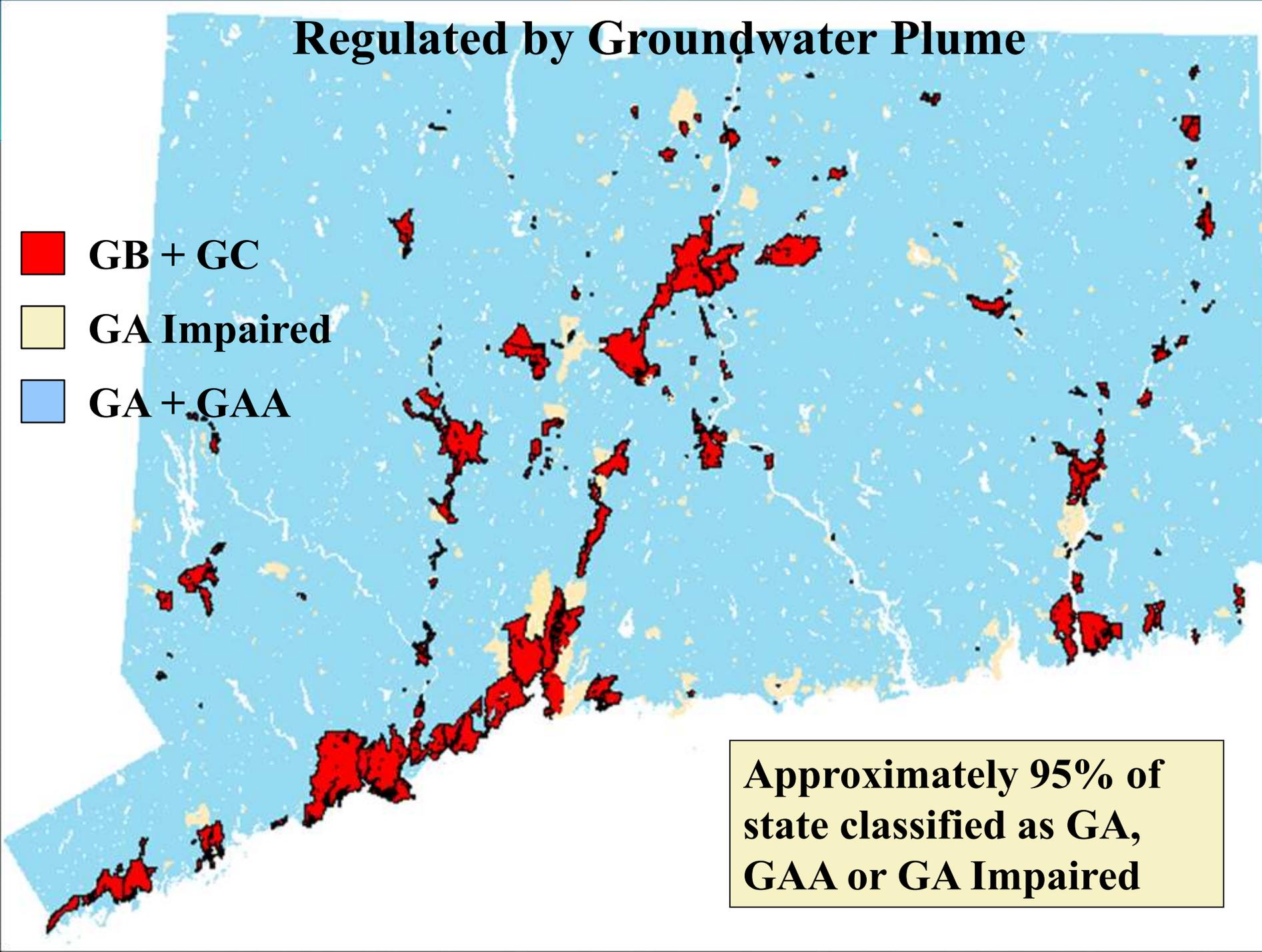
GB - Groundwater Class

GA - Groundwater Class

Not to Scale

Regulated by Groundwater Plume

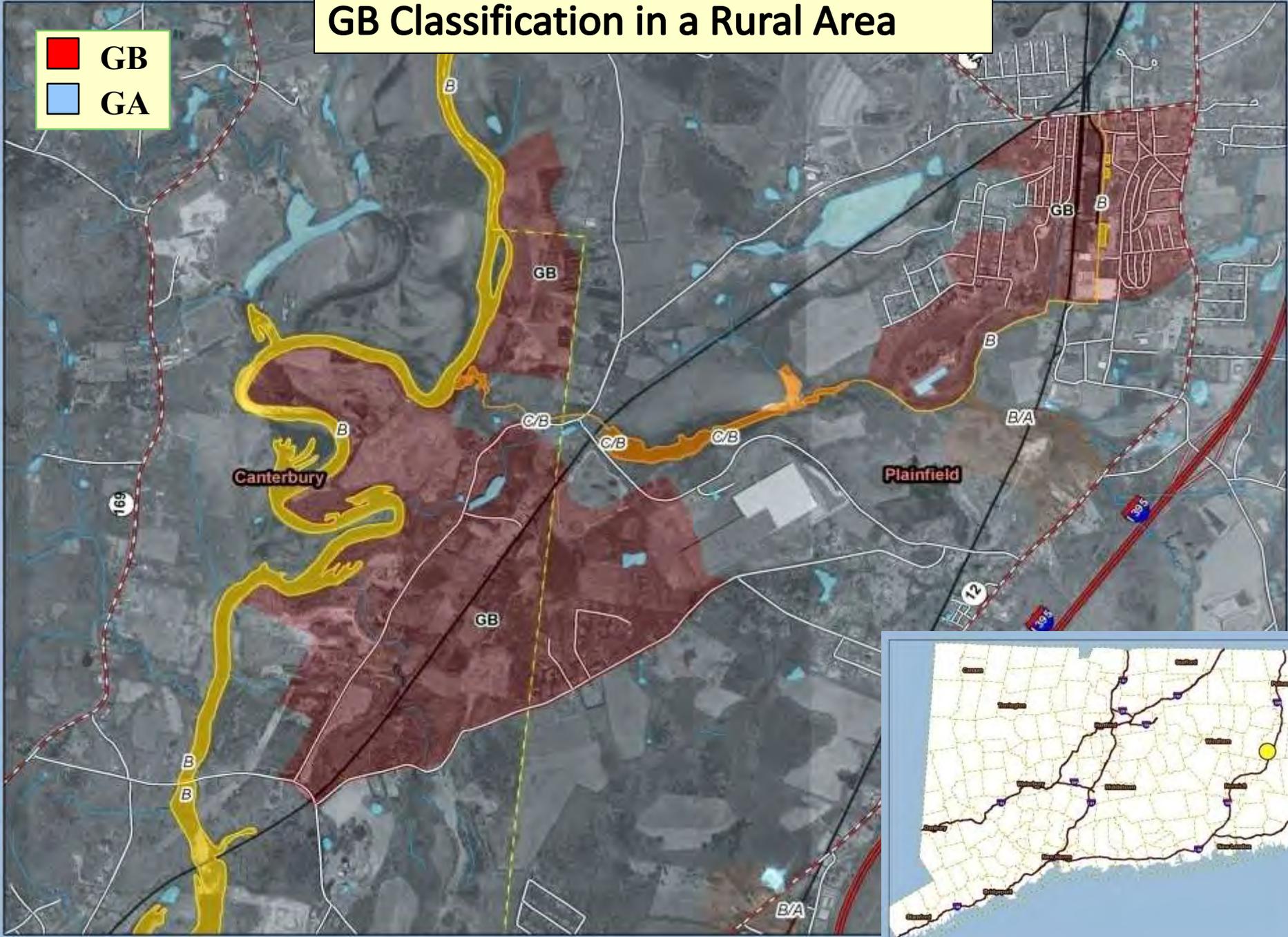
-  **GB + GC**
-  **GA Impaired**
-  **GA + GAA**



**Approximately 95% of
state classified as GA,
GAA or GA Impaired**

GB Classification in a Rural Area

- GB
- GA



Groundwater Remediation Standards

Important Concepts

- ◆ Regulated by substance



Development of GWPC

- ◆ Risk based number protects people drinking groundwater (10^{-6} carcinogens; HI = 1)
- ◆ Basis – Federal MCL, State Action Level or risk-based calculated using RSR formula
- ◆ Adjusted upward based on detection limit
- ◆ Adjusted downward based on ceiling level

Additional Polluting Substances

- ◆ Risk-based groundwater protection using formula provided (different formulas for carcinogens and non-carcinogens)
- ◆ Requires Commissioner's approval after consultation with Department of Public Health
- ◆ Transmittal Form available at DEEP web page:
http://www.ct.gov/deep/lib/deep/site_clean_up/property_transfer_program/rsr_approval_request_transmittal_form.pdf

Groundwater Exception – Incidental Sources



Groundwater criteria do not apply to groundwater impacted with

- **Trihalomethanes from public water system**
- Metals, petroleum hydrocarbons, and SVOCs, if:
 - ◆ Groundwater Pollution is due to normal operation of motor vehicles (which cannot include refueling, repair, or maintenance of motor vehicles); or
 - ◆ Normal paving and maintenance of asphalt, providing that such pavement has been maintained for its intended purpose

Guidance available on DEEP Website

Overall Goals of Groundwater Remediation

- ◆ Protect and preserve groundwater in GA areas as a natural resource
- ◆ Protect existing use of groundwater regardless of groundwater classification
- ◆ Prevent further degradation of groundwater quality
- ◆ Prevent degradation of surface-water from discharges of contaminated groundwater
- ◆ Protect human health

Representativeness of Sampling Program

- ◆ Key to correct application of RSRs
- ◆ Used in the decision making process to represent the conditions in the environment
- ◆ Expected that all substances of concern
 - have been identified
 - distribution in the environment determined
- ◆ Refer to Site Characterization Guidance

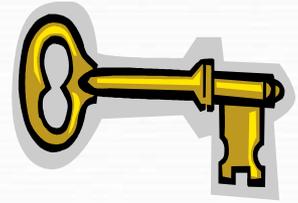
Representativeness of Sampling Program

- ◆ Elements that go into gathering representative samples
 - Utilizing all knowledge of the release
 - Size of release area
 - Size of the plume (3D)
 - Type of contaminant
 - Flow direction
 - Multiple rounds
 - Capture variability in water table
 - Steady state

Major Components

- ◆ Groundwater Protection Criteria (GWPC)
- ◆ Surface water Protection Criteria (SWPC)
- ◆ Volatilization Criteria (VolC)
- ◆ Background
- ◆ Applying the appropriate criteria
- ◆ Groundwater monitoring
- ◆ Technical Impracticability (TI)

Key Definitions



- ◆ **Background** concentration of ground water
- ◆ Groundwater **plume** [3-D]
- ◆ Areal extent of groundwater plume [2-D]
- ◆ Groundwater **Flow Direction**



Groundwater Remediation Requirements

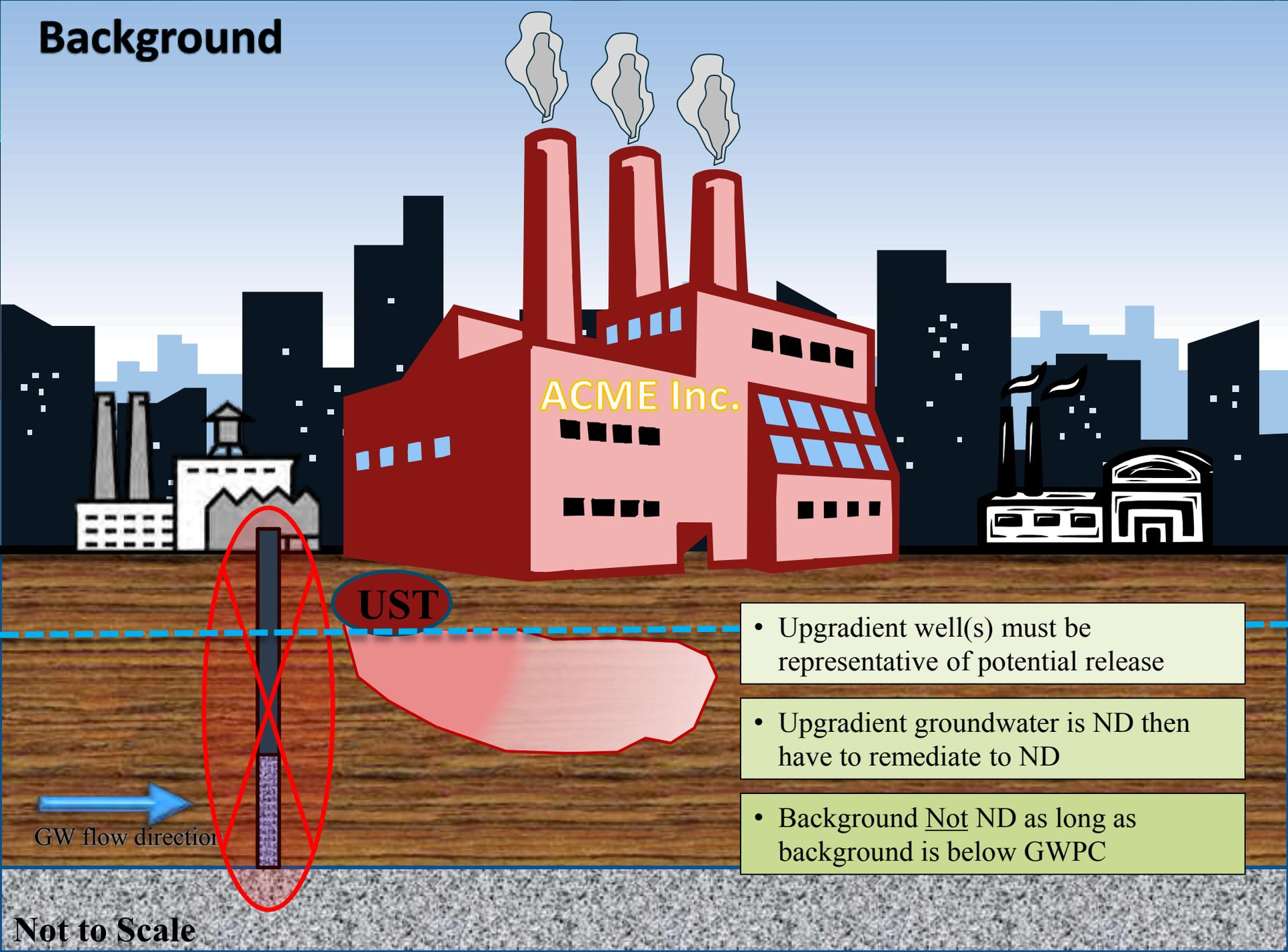
- ◆ Meet surface water protection criteria (SWPC) or alternative
- ◆ Meet volatilization criteria (VolC) or alternative
- ◆ Attain goal for groundwater classification area

Only after soil and groundwater is characterized can you apply appropriate criteria

Groundwater Remediation Goal in GA Area / GAA Area

- ◆ Remediation to BACKGROUND
- ◆ Two exceptions

Background



- Upgradient well(s) must be representative of potential release

- Upgradient groundwater is ND then have to remediate to ND

- Background Not ND as long as background is below GWPC

GW flow direction

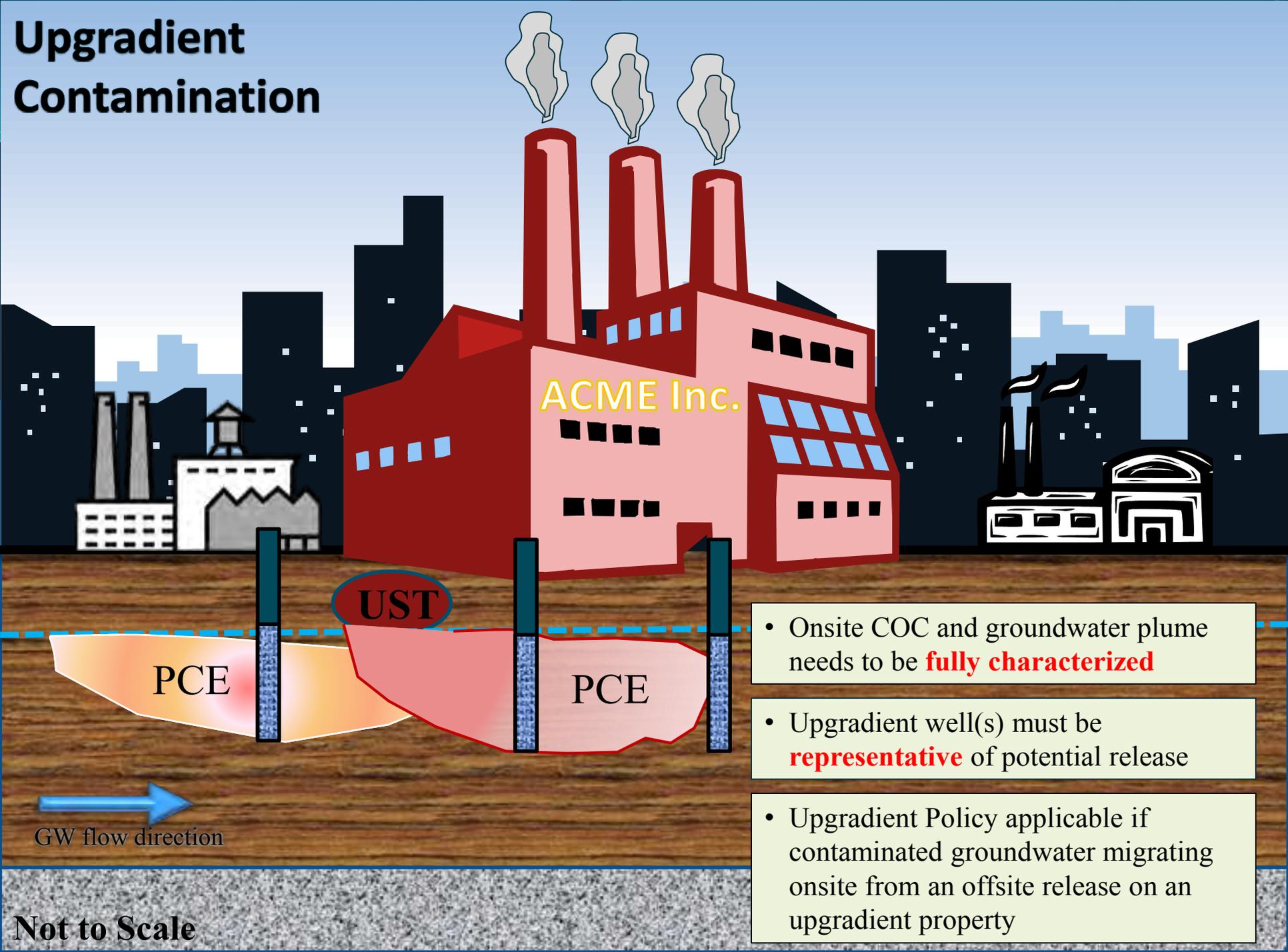
Not to Scale

Policy on Upgradient Contamination

- ◆ In accordance with the Remediation Standard Regulations (RCSA Section 22a-133k-1 through 133k-3),
- ◆ Down gradient property owner is not responsible for remediating groundwater contamination flowing onto his or her property from another site
- ◆ As long as the contamination is present solely as a result of the off-site source(s).

This policy became effective on August 28, 1997.

Upgradient Contamination



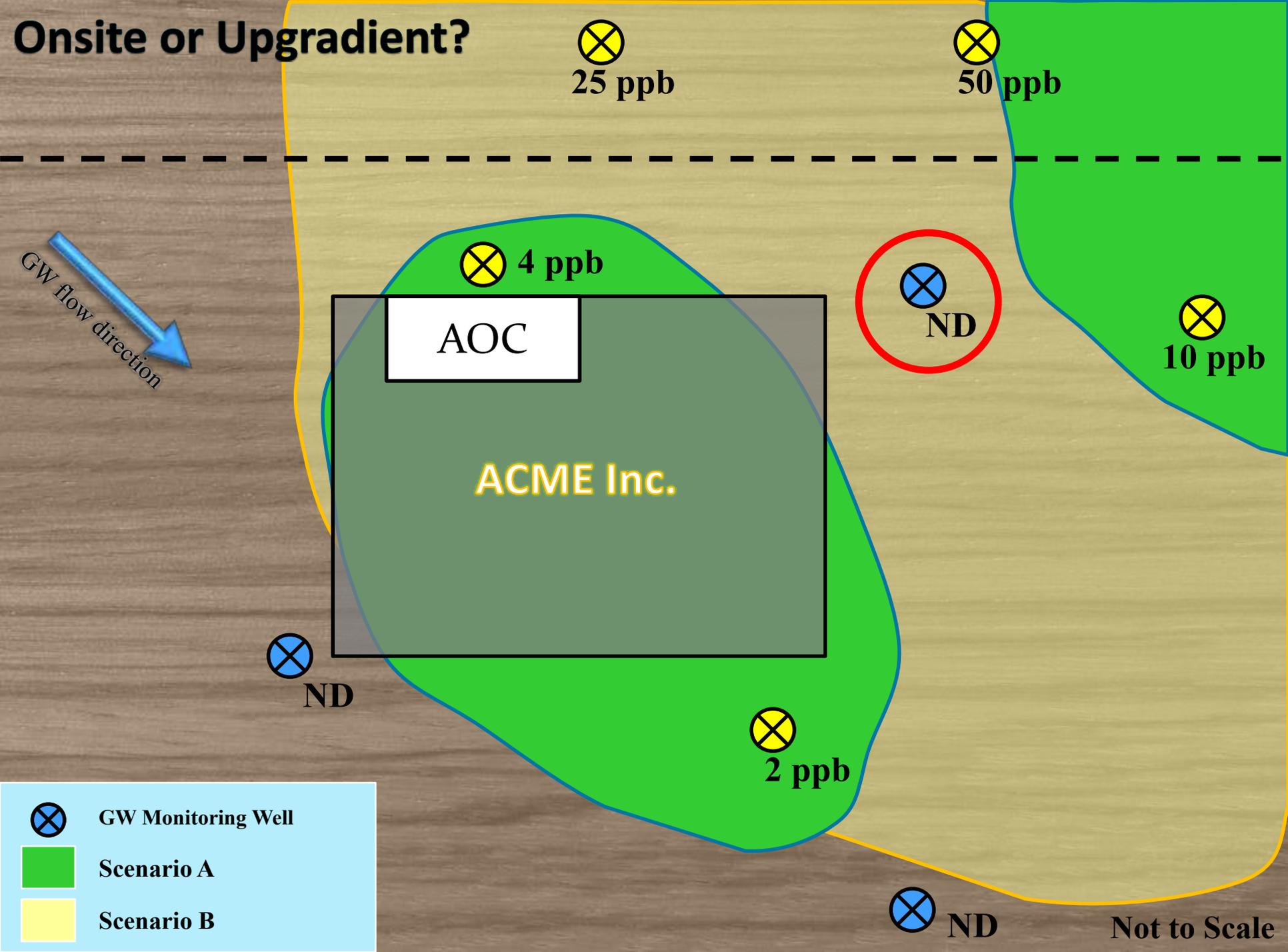
- Onsite COC and groundwater plume needs to be **fully characterized**

- Upgradient well(s) must be **representative** of potential release

- Upgradient Policy applicable if contaminated groundwater migrating onsite from an offsite release on an upgradient property

Not to Scale

Onsite or Upgradient?



25 ppb

50 ppb

4 ppb

ND

10 ppb

AOC

ACME Inc.

2 ppb

ND

ND

Not to Scale

GW flow direction

- GW Monitoring Well
- Scenario A
- Scenario B

First Exception in a GA Area

When certain conditions are met:

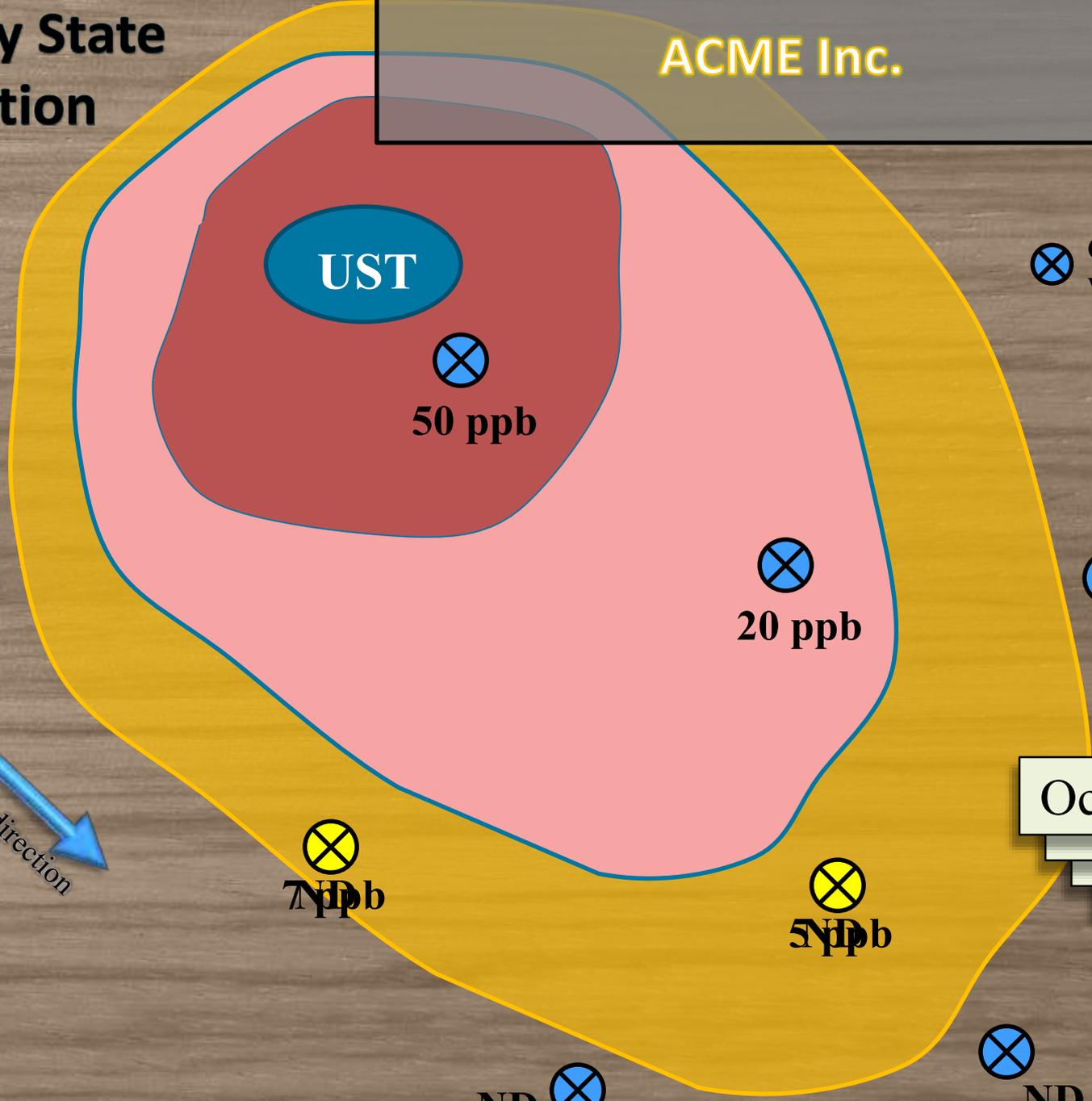
- ◆ a public water system is available within 200 feet of property line
- ◆ not an aquifer protection area
- ◆ not within area of influence of public supply well

Second Exception in a GA Area

If prior to active remediation, the maximum concentration in the plume was less than or equal to the GWPC:

- ◆ The plume must be diminishing or in a steady state
- ◆ Source removed
 - Expected groundwater will be restored, achieving GWPC in the short term

Steady State Condition



ND

UST

50 ppb

20 ppb

GW Monitoring Well

ND

GW flow direction

7 ppb

5 ppb

October

ND

ND

Not to Scale

Groundwater Remediation Goal in GB Area

- ◆ Remediate the groundwater plume to concentration that does not interfere with any existing uses of the ground water
- ◆ Must consider that drinking water wells or other domestic uses may be present even though municipal water supply available
- ◆ If groundwater used for domestic purposes need to remediate to GWPC

Question 1

When should a potable water receptor survey be conducted?

- a. In a GA area where public water is available
- b. When there is a drinking water well within 500 ft of the groundwater plume
- c. When the drinking water classification is GB but public water is not available
- d. When the groundwater is impacted regardless of groundwater class

Question 1

When should a potable water receptor survey be conducted?

- a. In a GA area with public water is available
- b. When there is a drinking water well within 500 ft of the groundwater plume
- c. When the drinking water classification is GB but public water is not available
- d. **When the groundwater is impacted regardless of groundwater class**

WATER SUPPLY WELL RECEPTOR SURVEY GUIDANCE DOCUMENT

Regardless of any groundwater classification, if at any time during the site investigation the conceptual site model (CSM) developed in accordance with the SCGD indicates an **existing groundwater plume migrating off-site or the potential for polluted groundwater to migrate off-site**, a water supply well receptor survey is to be completed in accordance with this guidance.

Question 2

What is the remediation criteria for a PCE groundwater plume at a site with a GA groundwater classification?
GWPC for PCE equals $5.0 \mu\text{g/L}$.

- a. Background
- b. $2.5 \mu\text{g/L}$
- c. $5.0 \mu\text{g/L}$

Question 2

What is the remediation criteria for a PCE groundwater plume at a site with a GA groundwater classification? GWPC for PCE equals 5.0 $\mu\text{g/L}$.

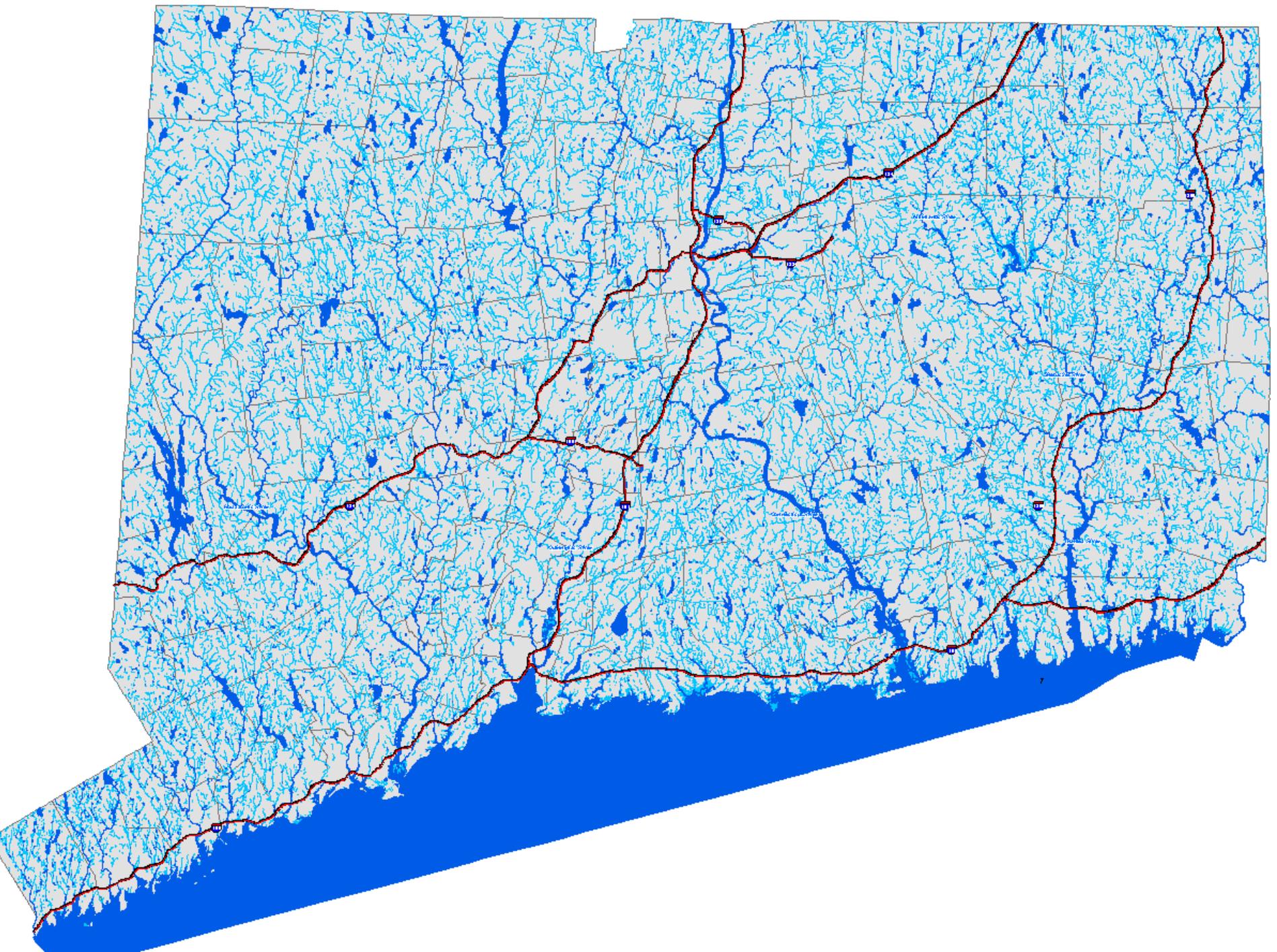
- a. **Background**
- b. 2.5 $\mu\text{g/L}$
- c. 5.0 $\mu\text{g/L}$

22a-133k-3(a)(2) – Remediation of a groundwater plume in a GA area shall also result in the reduction of each substance therein **to a concentration equal to or less than the background concentration** for ground water of such substance, except as provided in subsection (d) of this section.

Surface Water Protection Criteria



- ◆ SWPC Located in Appendix D in RSRs
- ◆ Groundwater **plume** which discharges to a surface water body must be remediated to surface water protection criteria





Development of SWPC

- ◆ Based on State's Ambient Water Quality Criteria & applied dilution factor
- ◆ No dilution applied for wetlands and water bodies w/ intermittent flow
(no water = no dilution)



Additional Polluting Substances

SWPC

- ◆ Remediation of a groundwater plume shall result in the attainment of SWPC or background for each substance in the plume
- ◆ If criteria does not exist, one should be calculated
- ◆ **(as an alternative to remediating the plume to background)**
- ◆ Process will be the same as was discussed for Direct Exposure Criteria - expedited process currently being implemented for use of acceptable criteria

Exceptions to SWPC



- ◆ The remediation goal of a groundwater plume for surface water protection is the chronic aquatic life criteria in Table 3 of the Water Quality Standards IF
 - the plume discharges to a wetland or an intermittent stream
 - the areal extent of the plume occupies more than 0.5% of the upstream drainage basin

Alternative SWPC

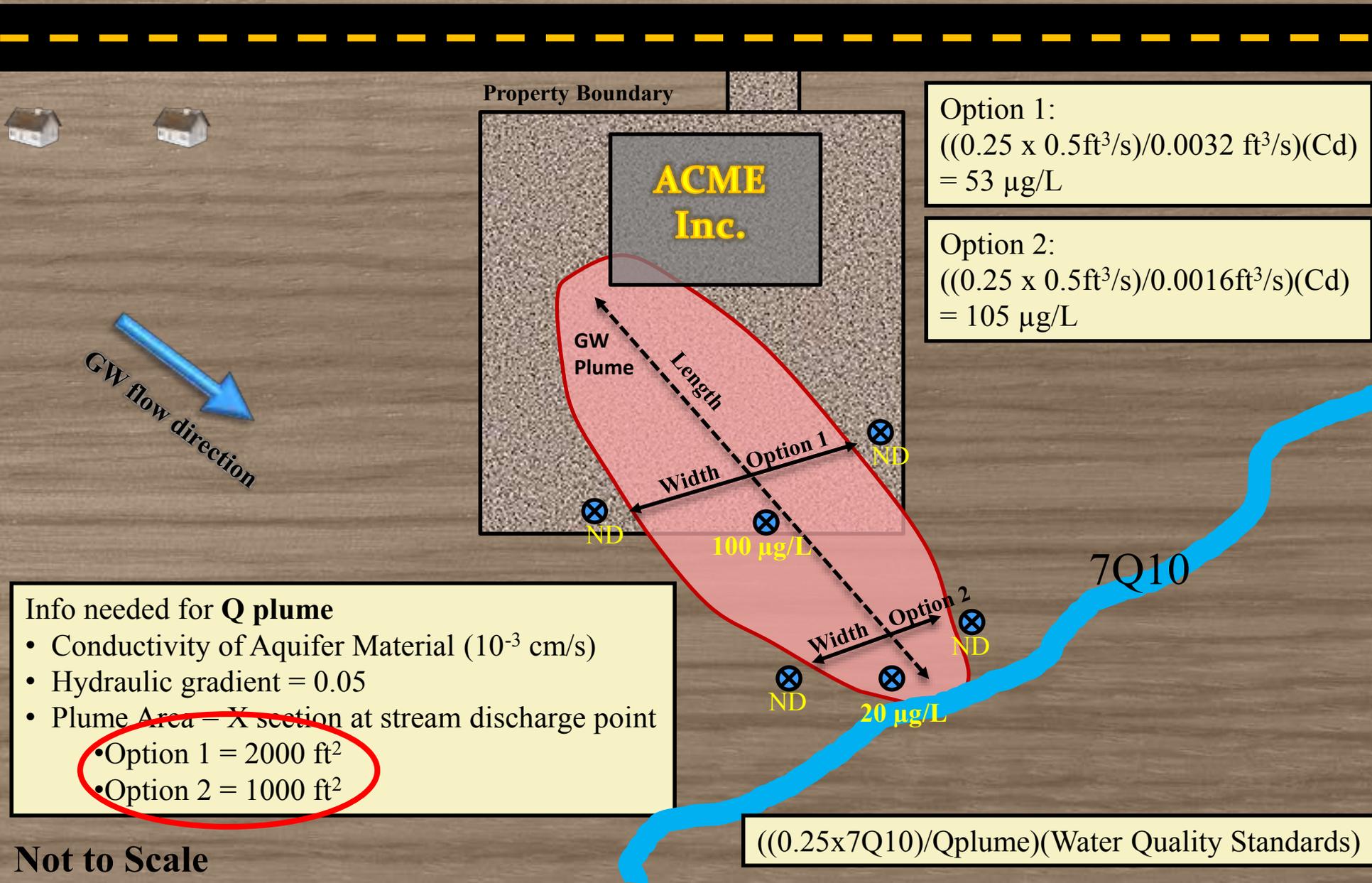
(Self-Implementing Calculation)



$((0.25 \times 7Q10)/Q_{\text{plume}})$ (Appendix D criteria* in Water Quality Standards)

- ◆ * the lower of human health or aquatic life criteria
- ◆ “7Q10” means the lowest 7 consecutive day mean stream discharge rate with a recurrence interval of 10 years

Alternative SWPC



Option 1:
 $((0.25 \times 0.5 \text{ft}^3/\text{s}) / 0.0032 \text{ft}^3/\text{s})(\text{Cd})$
 $= 53 \mu\text{g/L}$

Option 2:
 $((0.25 \times 0.5 \text{ft}^3/\text{s}) / 0.0016 \text{ft}^3/\text{s})(\text{Cd})$
 $= 105 \mu\text{g/L}$

Info needed for Q plume

- Conductivity of Aquifer Material (10^{-3}cm/s)
- Hydraulic gradient = 0.05
- Plume Area – X section at stream discharge point
 - Option 1 = 2000 ft^2
 - Option 2 = 1000 ft^2

$$((0.25 \times 7Q10) / Q_{\text{plume}})(\text{Water Quality Standards})$$

Not to Scale

Site-Specific SWPC

(Requiring Commissioner's Approval)

- ◆ 7Q10
- ◆ Other surface water and groundwater discharges within ½-mile upstream
- ◆ Instream water quality
- ◆ Flow rate of plume discharge
- ◆ Any other information requested by the Commissioner



Tidal Influenced Water Bodies

- ◆ No self implementing option available for alternative surface water protection criteria
 - ◆ No applicable 7Q10 in tidal influences water bodies
 - ◆ Tidal Flow needs to be calculated
- ◆ Tidal Flats: no water = no dilution
- ◆ Any other information requested by the Commissioner





**Groundwater
Monitoring**

Groundwater Monitoring

- ◆ When should groundwater monitoring be conducted?
- ◆ What is groundwater monitoring designed to determine?
- ◆ When can groundwater monitoring start?
- ◆ What is required prior to conducting monitoring?
- ◆ How long is Compliance monitoring timeframe?

Groundwater Monitoring - Shall be conducted for

- ◆ Any release area suspected to impact groundwater
- ◆ Any release area remediated
 - If there is a release area there may be a groundwater plume
- ◆ Any identified groundwater plume

Groundwater Monitoring is designed to determine

- ◆ Effectiveness of soil remediation in preventing pollution of groundwater
- ◆ Effectiveness to render soil environmentally isolated
- ◆ Effectiveness of any remediation taken to eliminate or minimize any risk

Groundwater Monitoring is designed to determine (cont.)

- ◆ Whether applicable requirements have been met
 - SWPC or Alternative SWPC
 - VolC or Alternative VolC
 - Background or GWPC
- ◆ In GB areas whether the plume interferes with any existing use



DEC Exception for Compliance Monitoring

- ◆ Compliance monitoring does not apply if remediation solely to address DEC exceedances
- ◆ Groundwater monitoring is needed
 - to characterize there is no plume

DEC Exception for Compliance Monitoring



To demonstrate there is only a DEC exceedance

- ◆ Document that there is no PMC exceedance
- ◆ Groundwater was not impacted by the release
- ◆ No potential for residual contamination to exist below the water table
- ◆ Nature of the release that caused DEC exceedance(s)
- ◆ Remediation of DEC exceedance conducted

Compliance Monitoring Start After:

- ◆ **Characterization of source of plume complete**
 - Without complete characterization don't know if remediation is necessary hence if compliance monitoring is necessary
- ◆ **Sample locations must also represent extent and degree of plume**
 - Without representative sample locations difficult to characterize plume and determine effectiveness of remediation

Compliance Monitoring Start After:

- ◆ All remedial actions have been completed
 - Pertains to the specific release area(s) that is relevant to the groundwater plume in question
- ◆ If a site-wide clean up is the goal, or commingled plume, site-wide groundwater monitoring can be performed
 - As long as wells are representative of all releases
 - All remedial actions for the site have been conducted

Compliance Monitoring Start After:

- ◆ All monitoring events used for compliance must occur “After” remedial actions “have been concluded”
 - This includes all remedial effects of in situ treatments
- ◆ Except other than natural attenuation of groundwater plume or recording an ELUR
 - Pertains to the continued decrease in concentration (attenuation) during Compliance Monitoring not MNA

Compliance Monitoring Start After:

- ◆ **Aquifer is no longer affected by withdrawal or injection**
 - Monitoring wells need to be properly located to detect groundwater conditions both before and after remediation
- ◆ **Geochemical changes from remediation have stabilized**
 - It may be difficult without proper baseline groundwater conditions to conclude the effects of remediation on groundwater conditions have ended and compliance monitoring can commence

Compliance Monitoring Start After:

- ◆ Concentration is not increasing over-time, except as a result of natural attenuation or seasonal variation
 - This requires knowledge of the groundwater flow direction
 - Proper well screening to determine the three-dimensional extent of the plume
 - Multiple sampling events are needed to document steady state conditions are occurring
 - Increasing concentration cannot occur over-time in any monitoring well representing the plume

Compliance Monitoring Timeframe

After groundwater reached applicable criteria:

- ◆ Compliance monitoring shall be a minimum of **four sampling** events on a quarterly basis within **two years**

Or

- ◆ 95% UCL using 12 consecutive monthly samples

Compliance Monitoring Timeframe

- ◆ 2 years clock starts after first compliance sampling round
- ◆ Not necessarily consecutive, but representative of seasonal variation
- ◆ Samples must represent all four seasons. Ensures samples cover high and low water table events
- ◆ Allows for access or logistical issues
- ◆ Does not prevent sampling for four quarters over a one year period

Compliance Monitoring Timeframe

- ◆ If during the first year of compliance monitoring there are exceedances of applicable criteria during one sample round, it may be acceptable to collect another sample during the same quarter the following year. If that sample and three other quarterly samples meet the applicable criteria, compliance monitoring may be complete

as long as:

Application of 2-year Compliance Monitoring timeframe

- ◆ The anomalous exceedance was consistent with the goal of confirming the effectiveness of the soil or groundwater remediation
- ◆ The exceedance can be explained through secondary lines of evidence
- ◆ The difference between the exceedance and the subsequent compliance round is not due to differences in water table elevation, and
- ◆ If compliance is sought for a site-wide closure the exceedance is not due to a new source area

Commissioner Option

- ◆ Commissioner may approve an alternative method of demonstrating compliance
 - The provision for approval of **“an alternative method for demonstrating compliance”** is to provide the ability to allow use of **innovative approaches** that might be developed in the future

Post-Remediation Monitoring

In a GA Area:

- ◆ **one year** after compliance with **background**
- ◆ **three years** after compliance with the GWPC, assuming all other applicable criteria have been met

In a GB Area:

- ◆ **Two years** after cessation of all remediation
- ◆ **AND** the groundwater is suitable for existing uses

Compliance Monitoring Recap

- ◆ Need to characterize release and extent of plume
- ◆ Groundwater monitoring still needs to determine the effectiveness of remediation
- ◆ Remediation must be completed
- ◆ Groundwater stabilized prior to compliance monitoring
- ◆ Compliance monitoring is 4 quarters within 2 years of first compliance sample round
- ◆ Post-remedial groundwater monitoring no longer standardized

Monitoring Comparison

Old

Groundwater monitoring must determine effectiveness of remediation

Compliance Monitoring:

GA and GB: 1 year, 4 quarterly samples after remediation

Post-Remedial Monitoring

GA: 1 - 3 years depending on applicable criteria

GB: 1 year

New

Groundwater monitoring must determine effectiveness of remediation

Compliance with an applicable criteria shall be collected after:
Remediation, Characterization and Stabilization

Compliance Monitoring:

GA and GB: 4 sample events within 2 years after remediation to show seasonal variability

Demonstrating Compliance with SWPC

- ◆ Must meet all general compliance requirements
 - All remediation complete
 - Plume reached steady state conditions
- ◆ The applicable SWPC has been met for 4 quarters within 2 years of first compliance sample round

Demonstrating Compliance with SWPC

◆ 1st Compliance Point

- 95% UCL
- Representative samples of entire plume
- Use all compliance sampling rounds in calculation
- Replaces Averaging

Demonstrating Compliance with SWPC

◆ 2nd Compliance Point

- Concentration of the substance in the plume immediately upgradient of groundwater discharge to surface water body is less than or equal to applicable criteria and plume is at steady state
- “Immediately upgradient”
 - Does not have to be at the edge of the water
 - Could be most downgradient extent of the plume

Additional Remediation of Groundwater

- ◆ Commissioner has authority to require additional action
- ◆ One example would be if a substance impairs the aesthetic quality of groundwater which is a source of domestic use

Question 1

Is Compliance Monitoring always necessary following Soil Remediation? (Yes/No)

Is Compliance Monitoring always necessary following natural attenuation to the achieve applicable criteria? (Yes/No)

Is Compliance Monitoring necessary if no remediation was necessary? (Yes/No)

Question 1

Is Compliance Monitoring always necessary following Soil Remediation?

No

(If soil remediation for DEC only no Compliance monitoring is needed)

Question 1

Is Compliance Monitoring always necessary following natural attenuation to achieve the applicable criteria?

Yes

(Natural attenuation is a type of groundwater remediation)

Question 1

Is Compliance Monitoring necessary if no remediation was necessary?

No

(If investigation determine no soil or groundwater impacts compliance monitoring not necessary)

22a-133k-3(a)(1) Remediation of a groundwater plume shall result in the attainment of...SWPC, VC and background”

Question 2

A Chromium plume is emanating from a site exceeding the SWPC. One round of off site samples indicate groundwater is below the SWPC. Does anything more need to be done?

Question 2

A Chromium plume is emanating from a site exceeding the SWPC. One round of off site samples indicate groundwater is below the SWPC. Does anything more need to be done?

- a. Nothing more needs to be done
- b. One more round of sampling as long as the average concentration of Chromium plume is still below the SWPC
- c. Additional rounds of sampling are needed until the steady state condition indicates that the portion of the plume that discharges to the water body is below the SWPC

Question 2

A Chromium plume is emanating from a site exceeding the SWPC. One round of off site samples indicate groundwater is below the SWPC. Does anything more need to be done?

- a. Nothing more needs to be done
- b. One more round of sampling as long as the average concentration of Chromium plume is still below the SWPC
- c. **Additional rounds of sampling are needed until the steady state condition indicates that the portion of the plume that discharges to the water body is below the SWPC**

22a-133k-3(g)(2)(A)(i)(IV) – The concentration of such substance at each sampling location that represents the extent and degree of the ground-water plume is not increasing over time, except as a result of either natural attenuation or seasonal variation

Question 3

You were collecting annual monitoring and the groundwater finally meets all applicable criteria in June 2012. The last time you collected a sample round was in June 2012. Can you use that round for compliance monitoring?

Question 3

You were collecting annual monitoring and the groundwater finally meets all applicable criteria in June 2012. The last time you collected a sample round was in June 2012. Can you use that round for compliance monitoring?

- a. **Yes, because the June 2012 round met criteria**
- b. **Yes, because I will collect 3 more rounds this year representing seasonal variation.**
- c. **No, because by the time collect the remaining 3 round the June 2012 sample round will exceeds two year window for collecting compliance monitoring**

Question 3

You were collecting annual monitoring and the groundwater finally meets all applicable criteria in June 2012. The last time you collected a sample round was in June 2012. Can you use that round for compliance monitoring?

- c. **No, because by the time collect the remaining 3 round the June 2012 sample round will exceeds two year window for collecting compliance monitoring**

June 2012, Winter 2014, Spring 2014, Fall 2014

The time between the June 2012 sample and Fall 2014 sample is more than 2 years

Volatilization Criteria

Volatilization Criteria – Basic Concepts

- ◆ Groundwater plumes polluted with VOCs can pose risks to indoor air quality
- ◆ VOCs in groundwater volatilize at water table and accumulate in soil vapor
- ◆ Soil vapor can be drawn in or diffuse into buildings

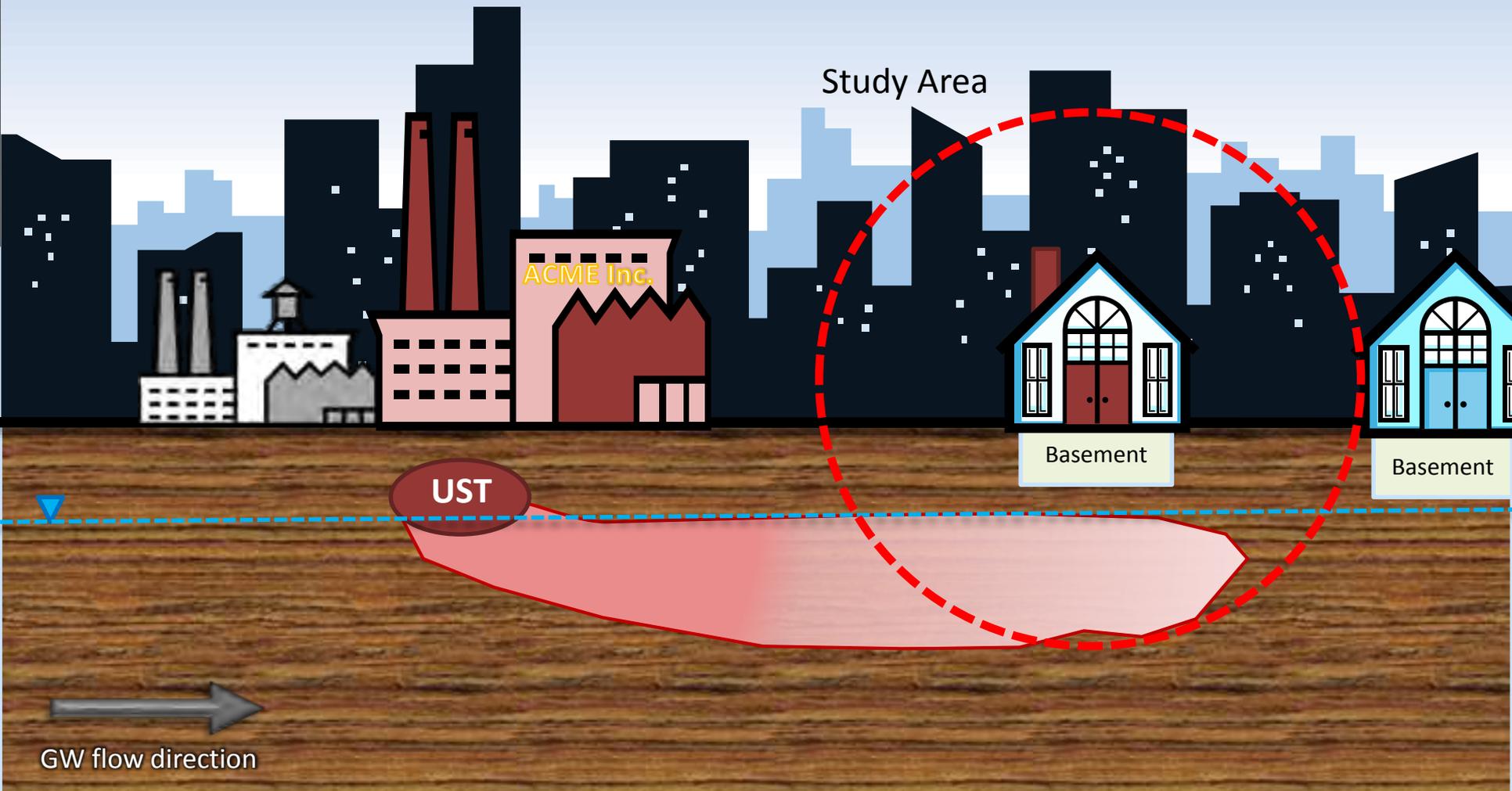
General Volatilization Criteria Requirements

- ◆ Groundwater within 15 feet of the ground surface (or within 15 feet beneath the lowest level of a building) shall be remediated to the residential volatilization criteria

Exceptions to Groundwater Volatilization Criteria

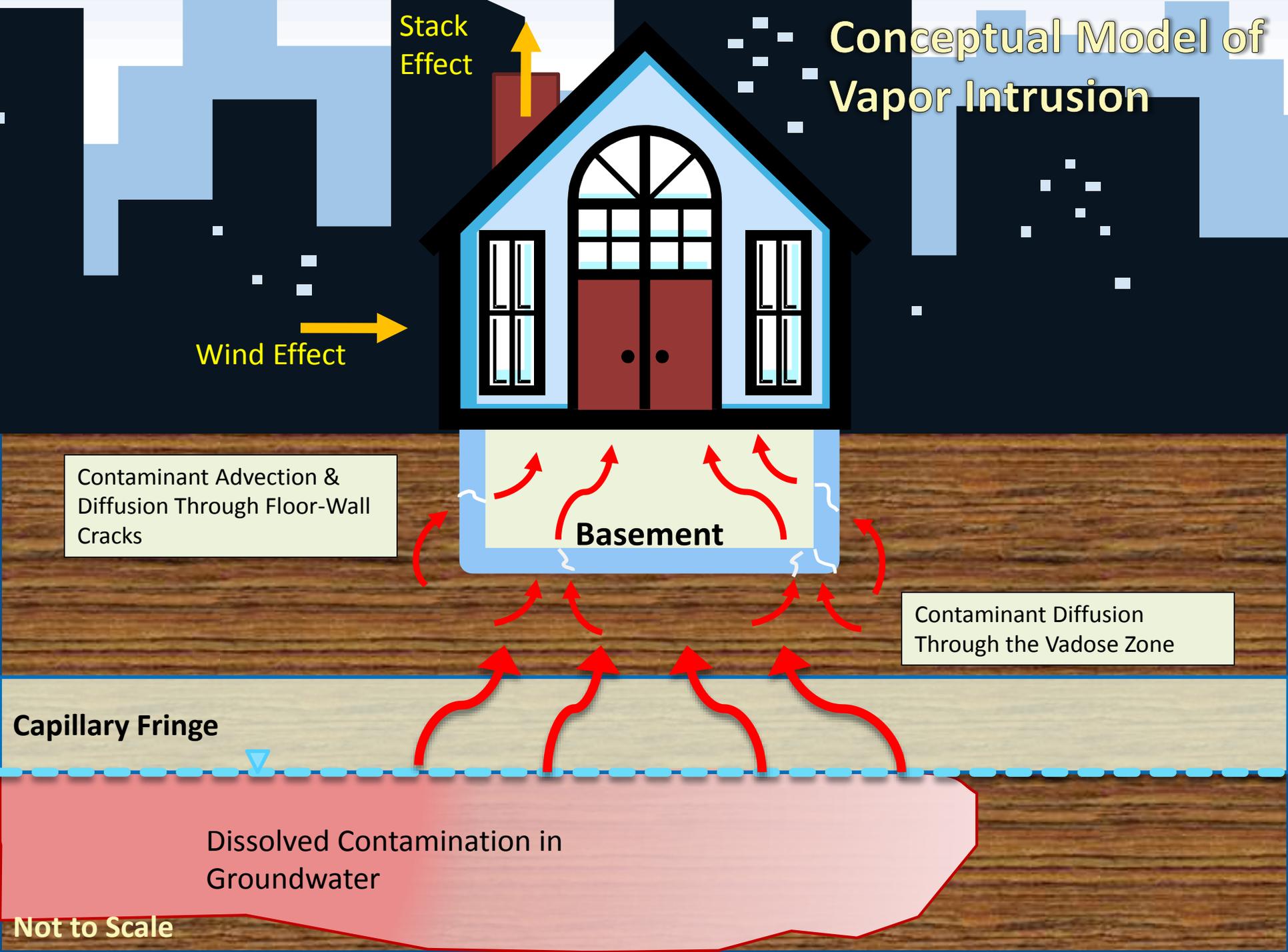
- ◆ If the building is used solely for industrial or commercial activity and an ELUR is in place ensuring no residential use, then groundwater shall be remediated to the industrial/commercial volatilization criteria

Conceptual Model of Vapor Intrusion



Not to Scale

Conceptual Model of Vapor Intrusion



Stack Effect

Wind Effect

Contaminant Advection & Diffusion Through Floor-Wall Cracks

Basement

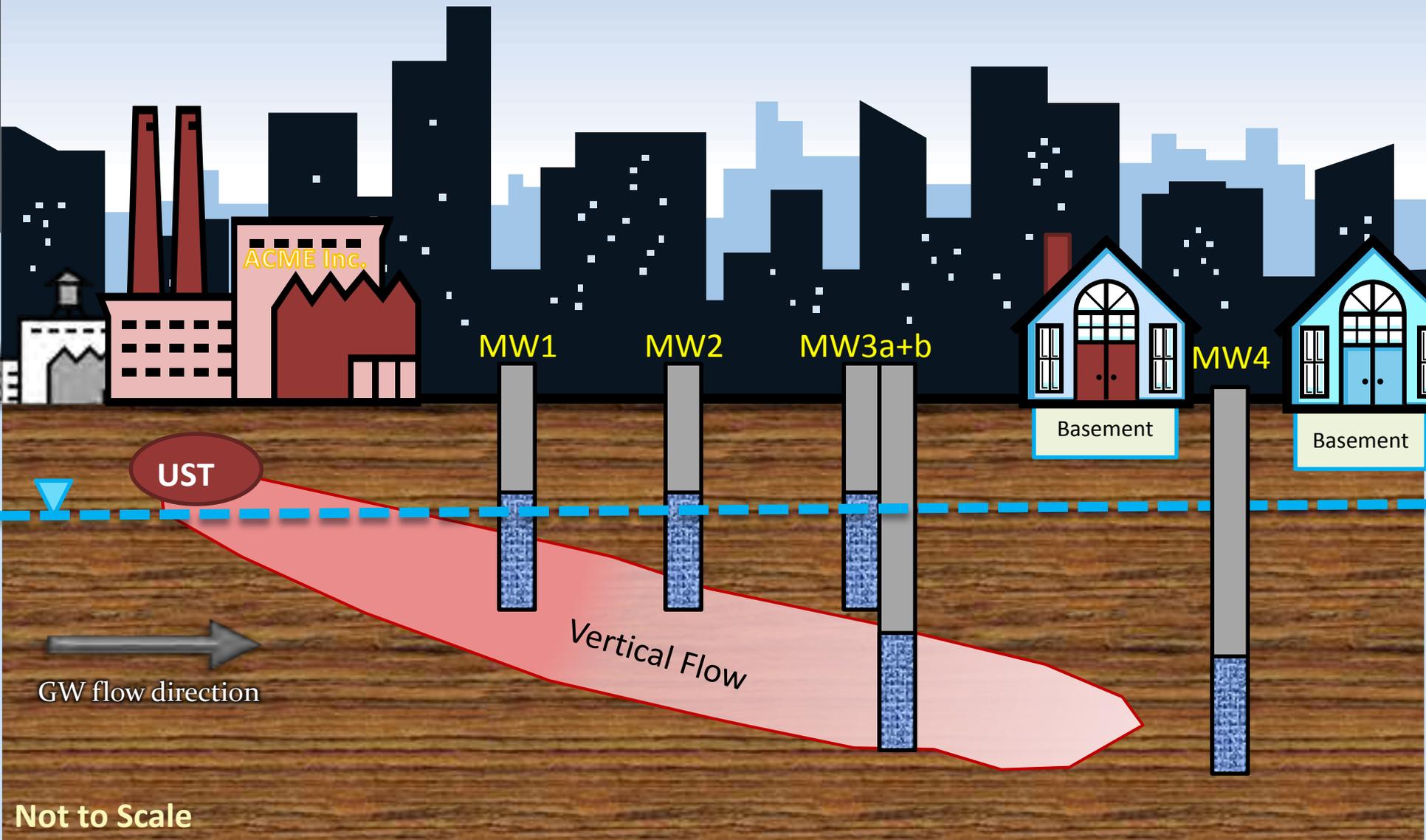
Contaminant Diffusion Through the Vadose Zone

Capillary Fringe

Dissolved Contamination in Groundwater

Not to Scale

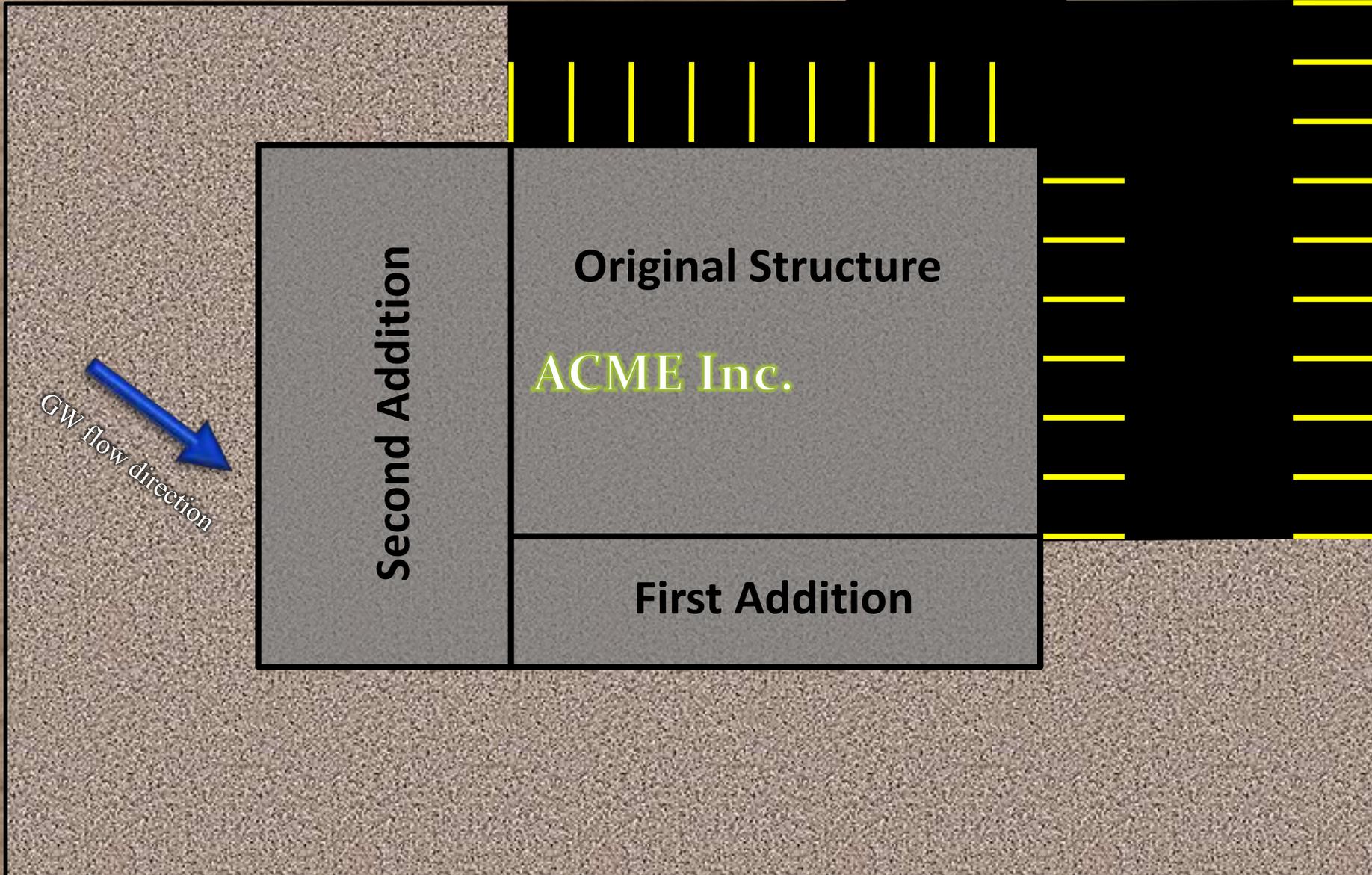
Risk from vapor intrusion only pertains when groundwater is polluted with VOCs at the water table – Standard wells (with representative screens bisecting the water table) are required to demonstrate compliance



Alternative Demonstration of Compliance for Volatilization Criteria

- ◆ If soil gas *beneath a building* is below the residential vapor criteria, no remediation is required
- ◆ If soil gas *beneath a building* is below the industrial/commercial vapor criteria, and the building is not used for residential activities then no remediation is required (ELUR must be recorded)

Soil Vapor Sampling Representativeness - Example



Not to Scale

Exception to Volatilization Criteria – Mitigation

- ◆ Remediation of groundwater is not required if measures acceptable to the Commissioner are taken to prevent the migration of vapors into any overlying building
- ◆ System must be maintained and monitored
- ◆ Notice must be provided to the Commissioner (includes description of plume, description of mitigation, plan for monitoring and maintenance, and a map showing plume, building and mitigation system)
- ◆ Notice needs to be provided w/ proper transmittal form – on DEEP website

Classic Conceptual Model of a Sub-Slab Depressurization System



Not to Scale

Examples of Classic Sub-Slab Depressurization System Installations

Standard Exterior Installation



Interior Piping



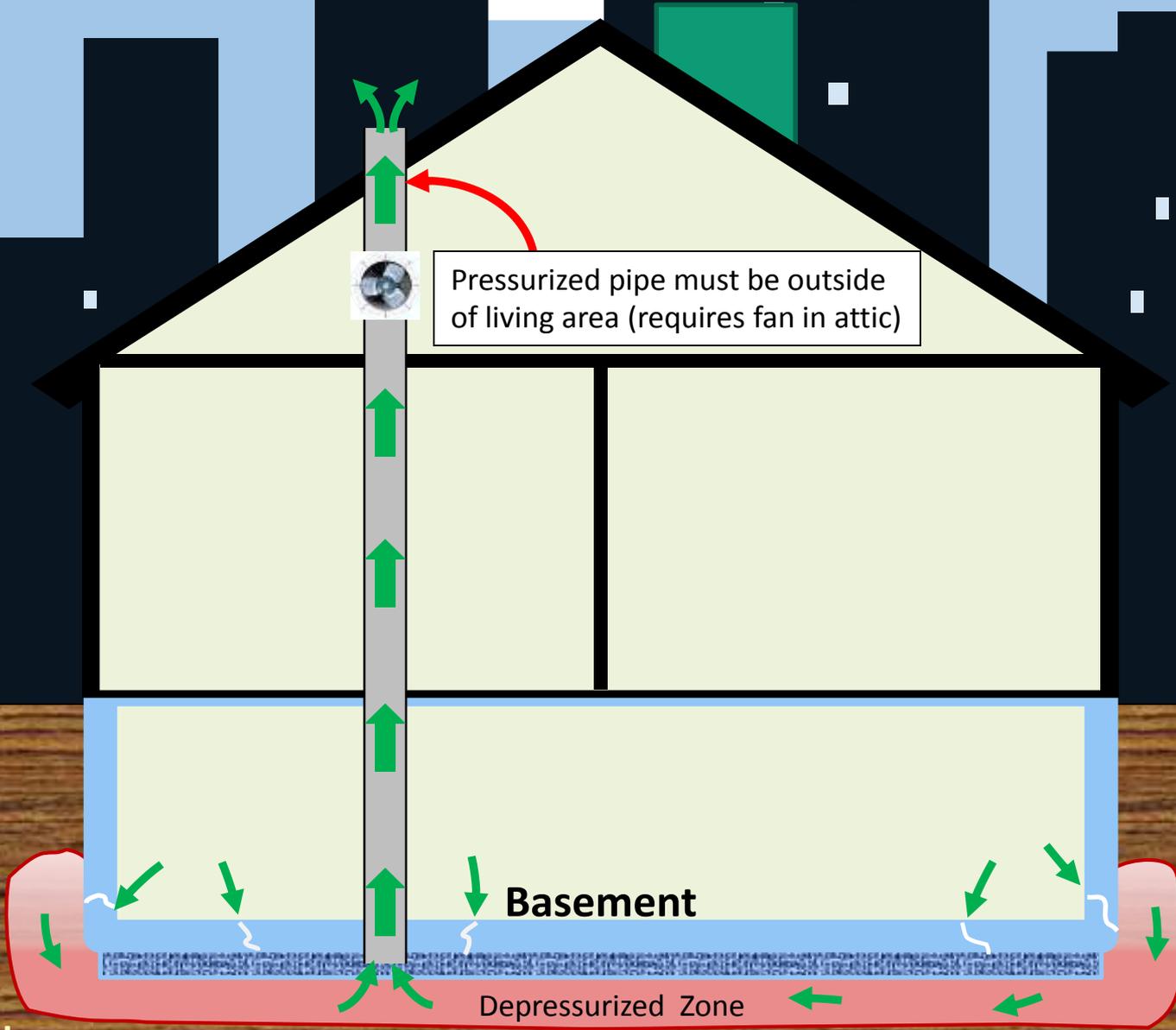
Potential Freezing Issues



Aesthetic Covers



Alternative Conceptual Model of a Sub-Slab Depressurization System



Not to Scale

Examples of Alternative Sub-Slab Depressurization System Installations

Attic Fan Installations



Roof Vent



Interior Piping (Closet Space)



Example of What Not To Do When Installing a Sub-Slab Depressurization System

Fan Mounted in "Living Area"



Vent Location Below Roofline



Site-Specific Volatilization Criteria (Self-Implementing)

- ◆ May be calculated using the equations in Appendix G
- ◆ For groundwater or soil vapor
- ◆ Some parameters are specified
- ◆ Many are site specific

Alternative Volatilization Criteria (Requiring Commissioner's Approval)

- ◆ Must demonstrate that vapors do not accumulate in structure at a concentration which would exceed risk of 10^{-6} for any carcinogenic substance and a hazard index of 1 for any non-carcinogenic substance
- ◆ For **multiple substances** cumulative risk cannot exceed 10^{-5} for carcinogenic substances and a cumulative hazard index of 1 for non-carcinogenic substances
- ◆ Will include Department of Public Health as part of the review (will require the use of current toxicology information and exposure pathway assumptions)

Additional Polluting Substances Volatilization Criteria

- ◆ Remediation of a groundwater plume shall result in the attainment of volatilization criteria or background for each substance in the plume
- ◆ If criteria does not exist, one should be calculated (as an **alternative to remediating the plume to background**)
- ◆ Like the **alternative** volatilization criteria, the requested criteria will include DPH as part of the review and will require the use of current toxicology information and exposure pathway assumptions.
- ◆ Process will be the same as was discussed for Direct Exposure Criteria - expedited process currently being implemented for use of acceptable criteria

Exemptions

from the Volatilization Criteria

◆ If **no building** exists and either

- 1) ELUR is recorded to ensure no building will be constructed over plume or “best efforts” have been made to obtain such ELUR, *or*
- 2) Commissioner has approved a demonstration that no building can be built, *or*
- 3) Commissioner has approved a demonstration that natural attenuation will reduce concentration over 5 years to below applicable volatilization criteria

Exemptions from the Volatilization Criteria as a Result of Indoor Air Quality Data

- ◆ Commissioner must approve monitoring plan
(*use transmittal form*)
- ◆ Plan will be submitted to DPH for review
(will require the use of current toxicology
information and exposure pathway
assumptions)
- ◆ May include measures to control the
concentration in building



Applying the Volatilization Criteria with Representative Sampling

(i) Groundwater – minimum of 4 quarterly samples (representative of seasonal variation) collected over two years \leq to the applicable criteria

or

(ii) Soil Vapor – samples representative of seasonal variations (heating and cooling) \leq to the applicable criteria

Recap for Evaluating Compliance with Volatilization Criteria

- ◆ Groundwater results from defined plume compared to default RSR criteria (GW Volatilization Criteria – Compliance)
- ◆ Soil Vapor results compared to default RSR criteria (SV Volatilization Criteria – Alternative Compliance)
- ◆ Undertake mitigation (Exemption)
- ◆ Conduct indoor air monitoring (Exemption)

Question 1

There is a groundwater plume contaminated with VOCs above the Groundwater Volatilization Criteria (GWVC) in an open (undeveloped) field.

Can soil vapor samples collected from the above the plume be used to demonstrate compliance with the Volatilization Criteria?

Question 1

There is a groundwater plume contaminated with VOCs above the Groundwater Volatilization Criteria (GWVC) in an open (undeveloped) field. Can soil vapor samples collected from above the plume be used to demonstrate compliance with the Volatilization Criteria?

No, the use of soil vapor to demonstrate compliance with the Volatilization Criteria requires that the soil vapor samples be collected from beneath a building:

22a-133k-3(c)(3)(A) “Remediation of a volatile organic substance to the volatilization criterion for ground water shall not be required if the concentration of such substance in **soil vapors below a building** is equal to or less than (i) the residential volatilization criterion for soil vapor...”

Question 2

During the investigation of a site, groundwater samples and soil vapor samples were collected from beneath the building.

The compliance groundwater samples (4 quarterly samples) were not found to contain any contaminants at concentrations greater than the GWVC, while the soil vapor samples did contain contaminants at concentrations greater than the SVVC.

Should the site be considered to be in compliance with the Volatilization Criteria?

Question 2

During the investigation of a site, groundwater samples and soil vapor samples were collected from beneath the building. The compliance groundwater samples (4 quarterly samples) were not found to contain any contaminants at concentrations greater than the GWVC, while the soil vapor samples did contain contaminants at concentrations greater than the SVVC. Should the site be considered to be in compliance with the Volatilization Criteria?

Yes, the site is in compliance with the Volatilization Criteria.

Comparing groundwater samples to the GWVC is the **primary method** of demonstrating compliance with the Volatilization Criteria, whereas comparing the soil vapor samples to the SVVC is only an **alternative method** from meeting the groundwater requirement.

However, if the vapors aren't coming from the groundwater, they must be coming from somewhere which would need to be considered when developing the conceptual site model. If a soil source is found, it will most likely require remediation based on the soil criteria (and would preclude the use of an environmentally isolated ELUR for the PMC until the soil was remediated to the maximum extent prudent).

Question 2

During the investigation of a site, groundwater samples and soil vapor samples were collected from beneath the building. The compliance groundwater samples (4 quarterly samples) were not found to contain any contaminants at concentrations greater than the GWVC, while the soil vapor samples did contain contaminants at concentrations greater than the SVVC. Should the site be considered to be in compliance with the Volatilization Criteria?

Comparing groundwater samples to the GWVC is the primary method of demonstrating compliance with the Volatilization Criteria:

22a-133k-3(c)(1) “Except as specified in subdivisions (2), (3), (4) and (5) of this subsection, **all ground water polluted with a volatile organic substance** within 15 feet of the ground surface or a building, **shall be remediated such that the concentration of each such substance is equal to or less than the applicable residential volatilization criterion** for ground water.”

Comparing the soil vapor samples to the SVVC is only an exception from the groundwater requirement:

22a-133k-3(c)(3)(A) “**Remediation of a volatile organic substance to the volatilization criterion for ground water shall not be required if the concentration of such substance in soil vapors below a building is equal to or less than (i) the residential volatilization criterion for soil vapor.**”

Technical Impracticability

Technical Impracticability (TI) of Groundwater Remediation

- ◆ **Exemption from Background** due to Technical Impracticability
 - ◆ Self Implementing
- ◆ **Variance** Due to Technical Impracticability of Groundwater Remediation
 - ◆ Requiring Commissioner's Approval

Exemption from Background due to Technical Impracticability

- ◆ Remedial goal in a GA area is background:
 - ◆ Measures have reduced the concentration below GWPC but not to background
 - ◆ Technically impracticable to further reduce the concentration to background

THEN:



Exemption from Background due to Technical Impracticability

- ◆ Exemption not designed to be used if MNA will achieve background in the near future
- ◆ Not an exit from additional monitoring
- ◆ If plume can and will reach background it is expected background is applicable criteria
- ◆ Used when plume is no longer degrading

Exemption from Background due to Technical Impracticability

- ◆ No further remediation required, as long as
 - ◆ All applicable GW monitoring has been conducted
 - ◆ Understanding of why plume can not meet background
 - ◆ Notice is required

Technical Impracticability Variance

- ◆ Optional groundwater remedial approach
 - Not a waiver for source area remediation or for addressing potential risks to receptors
 - Still need to addressing the source of the pollution to the maximum extent prudent
 - Mechanism to manage risk where there is no readily available technology to complete remediation
- ◆ Will protect human health and the environment

Technical Impracticability Variance

TI Zone

- ◆ Geographic area where groundwater contamination exceed the applicable criteria
- ◆ Contaminant Specific
- ◆ Public Input prior to DEEP approval
- ◆ The Commissioner has to approve TI variance

Technical Impracticability Variance

1st Scenario

- ◆ Residual Source
 - ◆ Groundwater impacts resulting from NAPL, smears or discontinuous residuals
 - ◆ Cannot be effectively removed or degraded
 - ◆ Typically applies to DNAPL
 - ◆ Contamination removed to the max extent prudent
 - ◆ Groundwater contamination will not extend outside TI Zone

Technical Impracticability Variance

2nd Scenario

- ◆ Persistent Plume
 - ◆ Steady state or slowly diminishing plumes that persist at unacceptable levels
 - ◆ Plume fully characterized (3D)
 - ◆ Will not dissipate within a reasonable timeframe
 - ◆ Source area(s) remediated

Technical Impracticability Variance

- ◆ What is needed:
 - ◆ Demonstrate reducing plume not technically practicable
 - ◆ Any risk to human health must be eliminated
 - ◆ Plan to eliminate future human health risks
 - ◆ Certification that notice has been provided to each property owner overlying the plume
 - ◆ Notice must be provided to the Local Health Director
 - ◆ Apply for reclassification to GB
 - ◆ Map showing areal extent of plume
 - ◆ Anything else requested by Commissioner

Technical Impracticability Variance

- ◆ Recording of an ELUR may be required
 - ◆ Best efforts to ensure that each property owner records an ELUR which ensures that the subject plume will not be used for a drinking water supply.
- ◆ Once the source area(s) has been addressed to the maximum extent prudent, the TI Variance may be suitable to support a final verification

Technical Impracticability Variance

- ◆ Possible long-term obligations
 - ◆ Five year status reports
 - ◆ Continuation of O & M
 - ◆ Long-term monitoring program
 - ◆ Land use monitoring inspections
 - ◆ Receptor updates
 - ◆ Financial assurance for any continued monitoring needs

Question 1

Are you planning on using TI provision in the future?

- a) Yes
- b) No
- c) Maybe

Question 2

If yes or maybe, do you need to read the Technical Impracticability Fact Sheet and Guidance Document?

- a) No, I learned everything I need today
- b) No, I will just call someone at DEEP when I need to know about using a TI.
- c) Yes, I really need to read the **TI fact sheet and Guidance document** if I am planning to use the TI variance

Environmental Land Use Restrictions

Environmental Land Use Restriction (ELUR)

- An ELUR is a **limitation** on the Property to minimize risk of human exposure to pollutants and hazards to the environment by:

Preventing certain types of uses

or



Preventing certain activities

Environmental Use Restrictions

- Regulations of Connecticut State Agencies 22a-133k-1 through 22a-133k-3 (RSRs) and **22a-133q-1** determine the *circumstances* under which an ELUR may be used and provide *templates*
- The remediation of the site must be completed pursuant to the RSRs to record an ELUR

ELUR



- An ELUR is a binding grant of easement
 - Between the Property owner and the Commissioner of DEEP
- The ELUR is recorded on the municipal land records
 - Recorded by the **Property owner only** because the ELUR will affect the Property
 - “Runs with the land” – survives the sale of the Property, bankruptcy, or foreclosure

Types of ELURs (soil)

- **Residential Activity** – to ensure no residential use
- **Inaccessible soil** – to ensure polluted soil will not be exposed
- **Environmentally Isolated Soil** – to ensure polluted soil will not be exposed to infiltration of water
- **Disturbance of Engineered Control** – to ensure no disturbance of the cap or exposure of the polluted soil

Types of ELURs (groundwater)

- **Residential Activity** - to ensure no residential use
- **Residential Activity (soil vapor)** – to ensure no residential use
- **Building Construction**– to ensure no building will be built over the plume
- **Groundwater Use (Technical Impracticability of Groundwater Remediation)** – to ensure polluted groundwater is not used for drinking or other domestic purposes

ELUR Subject Areas for Case Studies



Property Boundary

Subject Area B

ACME Inc.
Subject Area C

Subject Area A

Subject Area D

GW flow direction



Not to Scale

ELUR – Case Study #1



GW flow direction

Property Boundary

120 ppm

ACME Inc.

1652 ppm
ETPH

1700 ppm
ETPH

100 ppm

Subject Area A

50 ppm

70 ppm

175 ppm

75 ppm

Contaminant - Cadmium

- RDEC - 34 ppm
- I/C DEC - 1,000 ppm
- Samples are at a depth of less than 2 feet, below grass

Contaminant - ETPH

- RDEC – 500 ppm
- I/C DEC - 2,500 ppm
- GB PMC applies – 2,500 ppm
- ETPH below building (not all borings shown)

Question: What type of ELUR can be used?

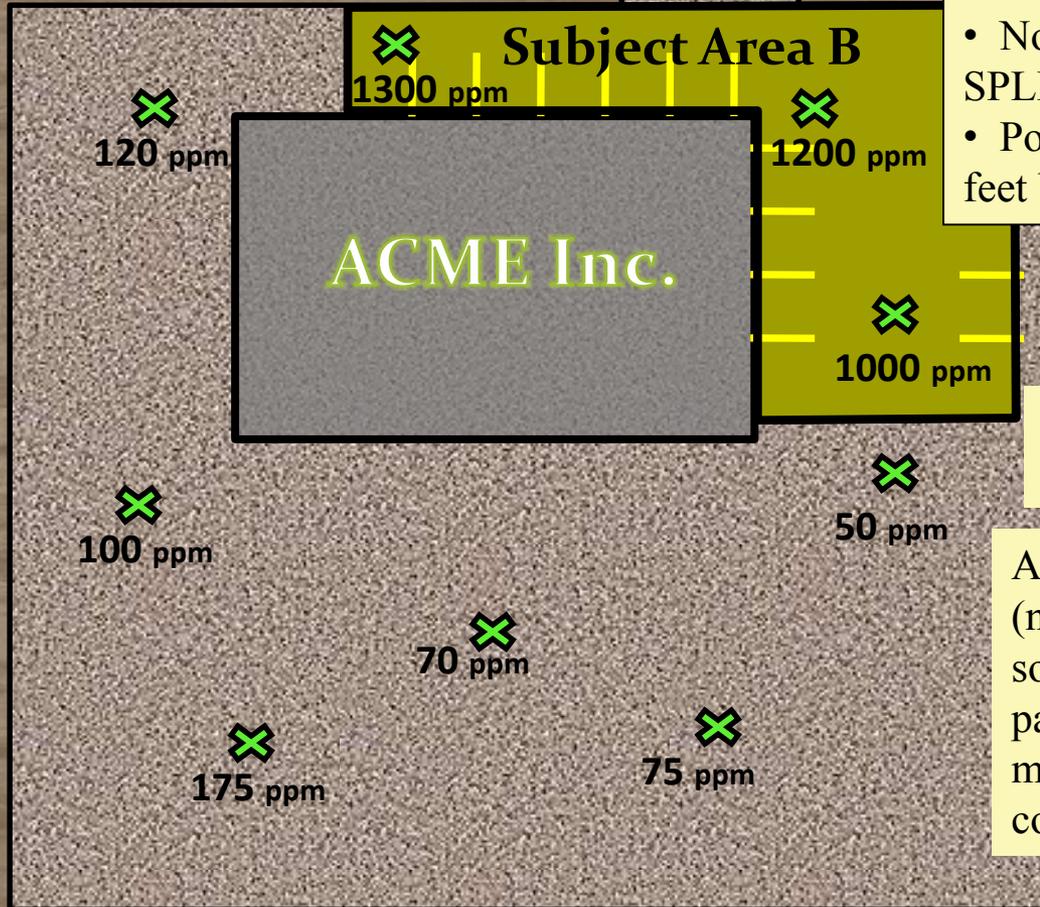
Answer: Property wide residential activity restriction (residential activity prohibited)

Not to Scale

ELUR – Case Study #2a



Property Boundary



Contaminant – Cadmium

- RDEC - 34 ppm
- I/C DEC - 1000 ppm
- No PMC exceedances by SPLP
- Polluted fill located three feet below pavement

Question: What type of ELUR can be used?

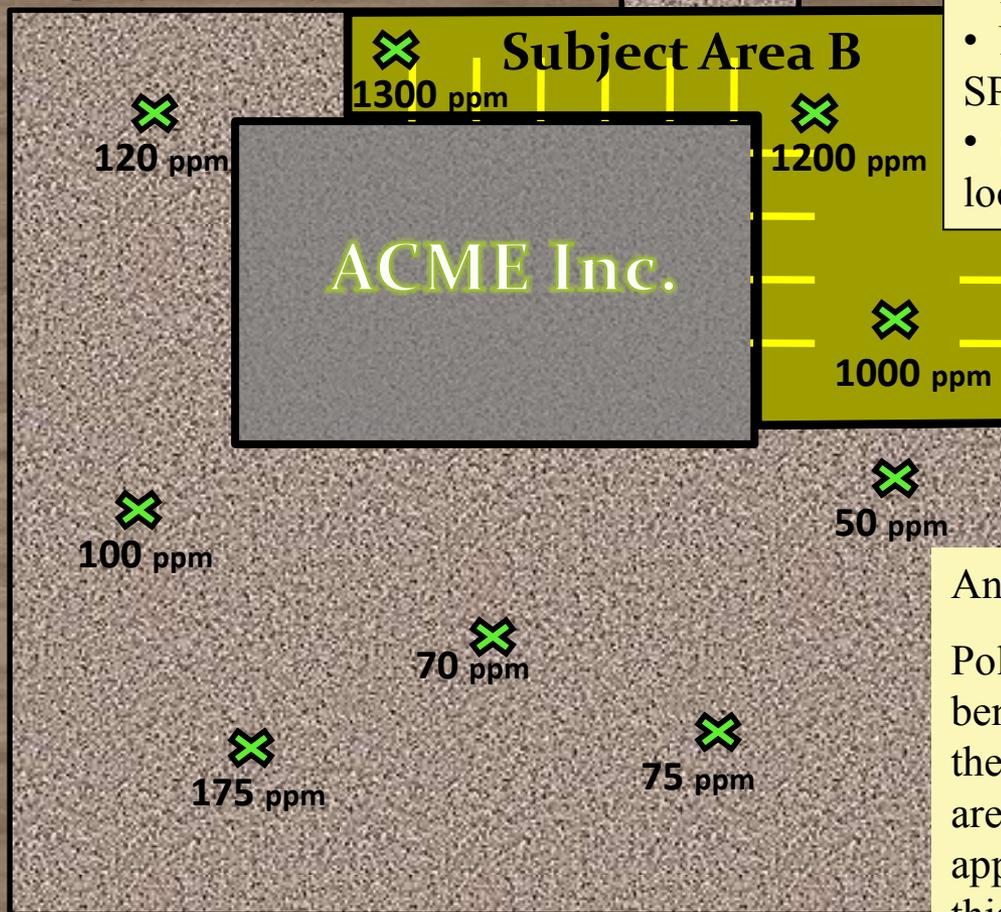
Answer: Inaccessible soil (no exposure of polluted soil or disturbance of pavement, pavement to be maintained in good condition)

Not to Scale

ELUR – Case Study #2b



Property Boundary



Contaminant – Cadmium

- RDEC - 34 ppm
- I/C DEC - 1000 ppm
- No PMC exceedances by SPLP
- Shallow polluted fill located below pavement

Question: What if the contamination is directly beneath the pavement and the site is restricted from Residential use?

Answer: Also, inaccessible soil

Polluted fill can be directly beneath pavement as long as the concentrations of metals are not more than 2x the applicable DEC (I/C DEC in this case).

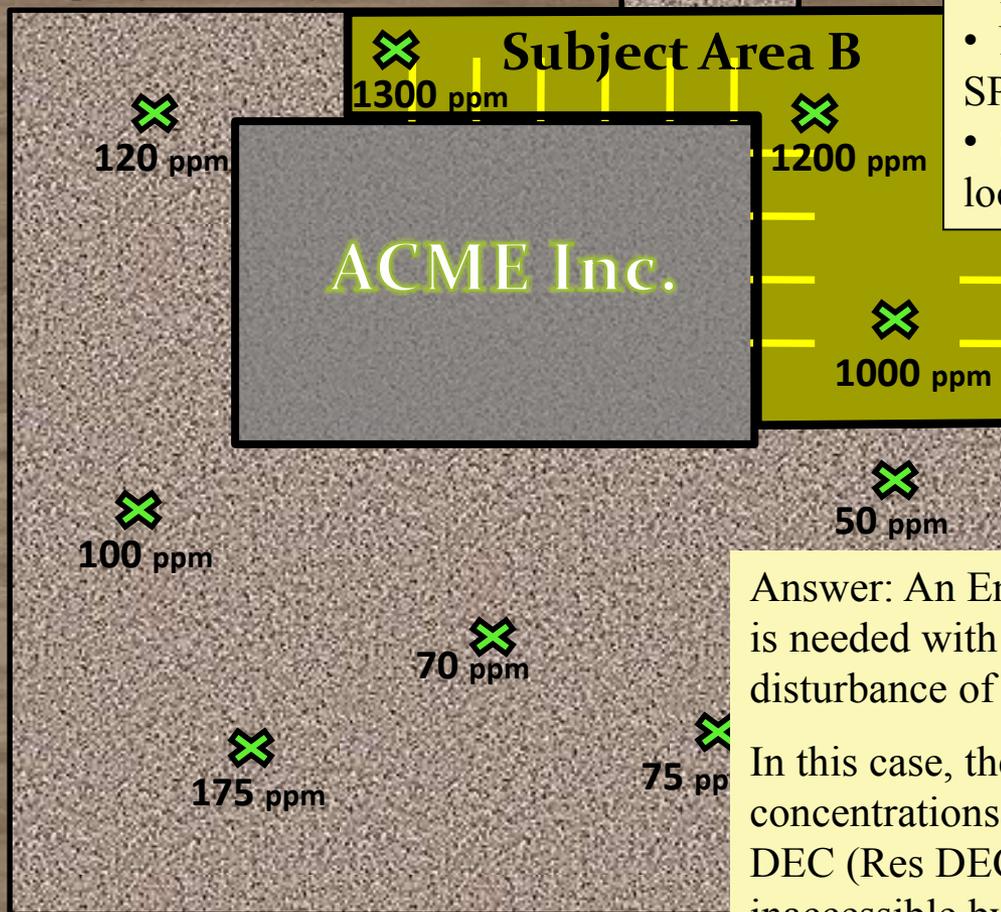
Not to Scale

ELUR – Case Study #2c



Property Boundary

GW flow direction



Contaminant – Cadmium

- RDEC - 34 ppm
- I/C DEC - 1000 ppm
- No PMC exceedances by SPLP
- Shallow polluted fill located below pavement

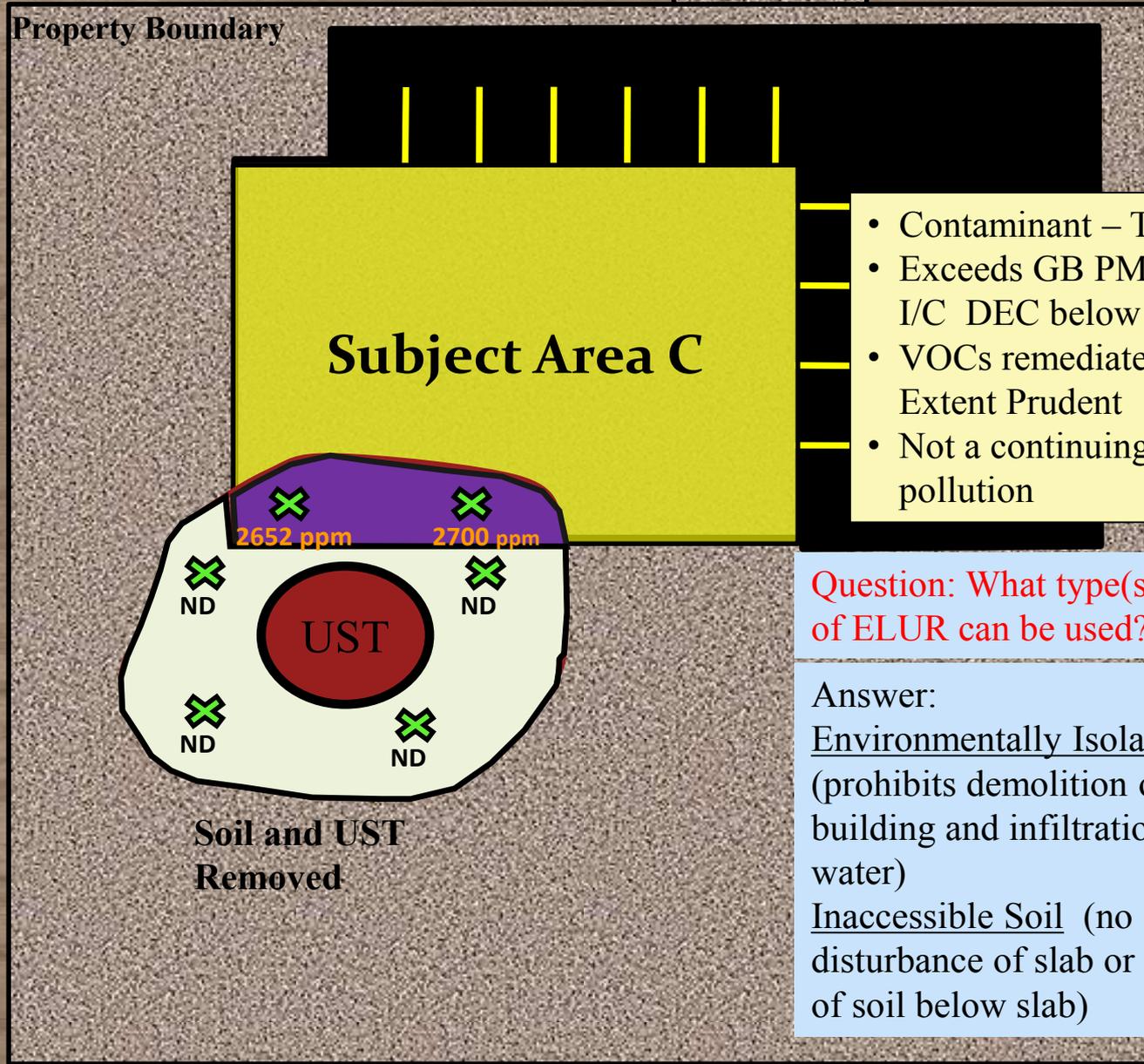
Question: What if the contamination is directly beneath the pavement and the site is NOT restricted from Residential use?

Answer: An Engineered Control for DEC is needed with an ELUR (to prevent disturbance of the EC and exposure of soil)

In this case, the fill would have concentrations more than 2x the applicable DEC (Res DEC) so could not be rendered inaccessible by pavement alone

Not to Scale

ELUR – Case Study #3

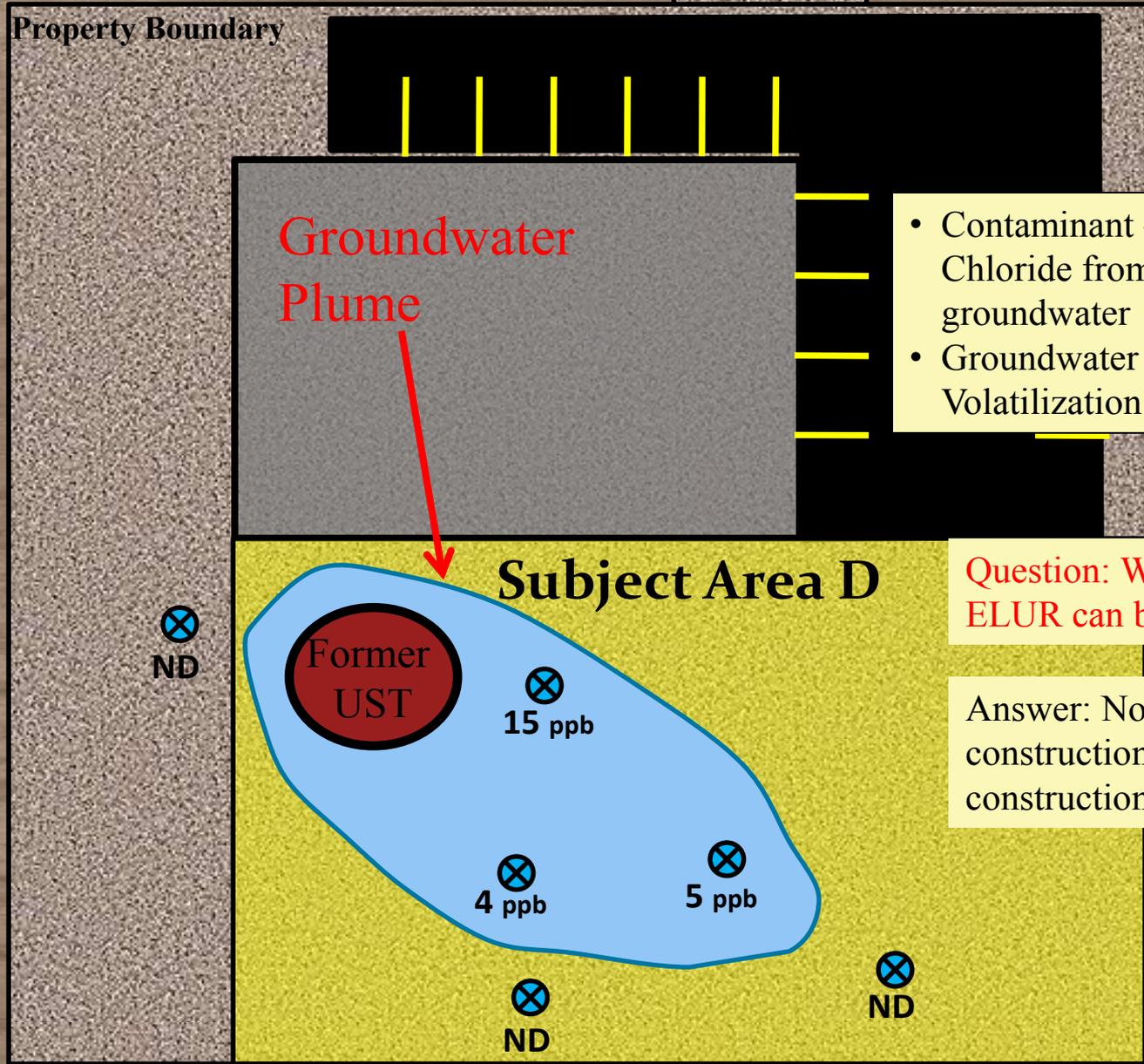


- Contaminant – TPH from UST
- Exceeds GB PMC and I/C DEC below building
- VOCs remediated to Maximum Extent Prudent
- Not a continuing source of pollution

Question: What type(s) of ELUR can be used?

Answer:
Environmentally Isolated Soil (prohibits demolition of building and infiltration of water)
Inaccessible Soil (no disturbance of slab or exposure of soil below slab)

ELUR – Case Study #4



Groundwater Plume

- Contaminant – Vinyl Chloride from UST in groundwater
- Groundwater exceeds I/C Volatilization Criteria

Question: What type of ELUR can be used?

Answer: No building construction (building construction prohibited)

Not to Scale

ELUR Timing

- For **voluntary sites pursuant to 22a-133y** the ELUR is recorded following DEEP approval of the final remedial action report



ELUR Timing

- ELURs may be recorded anytime to set the clean-up goal to:

Industrial/Commercial criteria



ELUR Timing

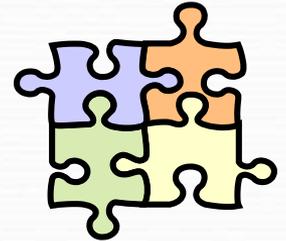
- For Engineered Controls the ELUR is approved following **DEEP approval, and the construction** of the Engineered Control
- Soil must be rendered inaccessible or environmentally isolated before the ELUR is approved





Proposing an ELUR

- The owner of the Property submits the ELUR Application which includes:
 - Draft Declaration Document (unsigned)
 - Property Description [Exhibit A]
 - Proposed Decision Document [Exhibit B]
 - Description of Engineered Control as applicable
 - Draft A-2 Survey [Exhibit C]
(the Instructions and Guidance Document provides an **A-2 Survey Checklist** that can be used as a reference)





Proposing an ELUR (cont.)

- Subordination Agreements and Waiver Requests Form – Analysis of Land Title, A-2 Survey and Property Owner Affidavit

Subordination Agreements

- A party recording an ELUR must record documents that demonstrate that each person with an interest in the land **irrevocably subordinates** such interest to the ELUR
- Includes mortgagee, lessee, lien holder or easement holder
- Commissioner may waive requirement for subordination agreement for minor interests (**Waiver Approval**)
- A certificate of title verifying recording of the ELUR, waivers, and subordination documents must be submitted to the Commissioner



Interests in the Land

- Any right in or potential claim to the Property
 - Includes Mortgages, Liens, Leases, Easements

Affects purpose
of ELUR

Subordination
Agreement

Does NOT
Affect purpose
of ELUR

Waiver
Request

Public Notice

- Public notice of intent to record an ELUR is required
- Public notice must be published in a newspaper of general circulation
- Must provide a **30 day** comment period
- Comments should be directed to DEEP
- **Public notice is not required** if the sole purpose of the ELUR is to limit the parcel to industrial use and **municipal zoning already limits the parcel to such use**



Decision Document

- The purpose is to describe in a manner that future owners and tenants can clearly understand:
 - The **types of pollutants** remaining on the site for which the use limitation is necessary
 - The **location** of such pollutants
 - What **activities or land uses** are **prohibited** and **why** such prohibitions are necessary
- Summarizes public comments and responses to comments



Approval of Decision Document

- Before approving, the Commissioner will consider:
 - All public comments,
 - Whether the restriction will adequately protect human health and the environment, and
 - Whether the restriction is consistent with the RSRs.

LEP Approval

- An LEP may approve an ELUR for remediation conducted under **CGS §22a-133y** (only)
- The LEP must review:
 - The Draft Declaration
 - The proposed Decision Document
 - The Draft ELUR Survey
 - The certification of public notice
- The LEP may only approve if consistent with RSRs
- DEEP is willing to review this type of ELUR if needed
(*Contact DEEP for assistance*)

Recording an ELUR

- *Where* - on the municipal land records
- *When* - within 7 days of execution (by both parties)
- *What* -
 - Declaration Document
 - Exhibit A – Property Description
 - Exhibit B – Decision Document
 - Exhibit B – Engineered Control Description (if applicable)
 - Exhibit C – ELUR Survey
 - Documents demonstrating subordination of interests and/or Waiver Approval



Notice to Local Officials/Others

- Copies of the recorded ELUR must be mailed to:
 - Chief Administrative Officer of the Town
 - Chairman of the Planning/Zoning Commission, the local Director of Health
 - Any person who submitted comments on the ELUR
- Copies of these letters and return receipts should be sent to DEEP within 30 days of recording the ELUR



Release of an ELUR

- A land owner may be released **in whole** or **in part** from an ELUR with DEEP written approval
- Release must be consistent with RSRs
- Release must be recorded on the land records, unless the Commissioner determines that recordation is not necessary



Partial Temporary Release

- Temporary release from part of the ELUR

Examples:

- Utility maintenance – a portion of the ELUR may be released to allow excavation and repair of a utility
- Refitting of a commercial area to accommodate new use
- Requires an approved Soil Management Plan
- Site must be returned to original state, documented in a completion report



Partial Permanent Release

- Permanent release from part of the ELUR

Example:

- Release area remediation – a portion of the ELUR can be released after a Subject Area has been remediated to no longer require the ELUR
- Requires temporary release (with Soil Management Plan) to perform work
- Area of the site can be developed as desired as long as it does not conflict with remaining portions of the ELUR

Whole Temporary Release

- Temporary release from the whole ELUR

Example:

- Site Redevelopment – the ELUR may be released to allow redevelopment of the entire site
- Requires an approved Soil Management Plan to perform work
- Site must be returned to original state, documented in a completion report



Whole Permanent Release

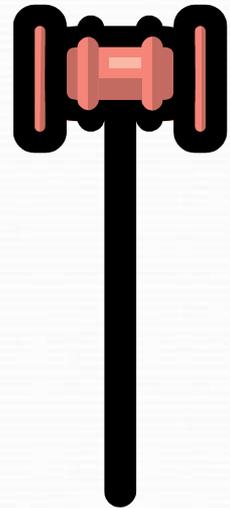
- Permanent release from the whole ELUR

Example:

- Site Remediation/Redevelopment – the entire ELUR may be released after the site is remediated to no longer require the ELUR
- Requires a temporary release (with approved Soil Management Plan) to perform remediation
- Site can be developed with no restrictions since there is no longer an ELUR

Enforcing an ELUR

- The Commissioner may enforce the ELUR by:
 - Issuing an order
 - Referral to the Attorney General for injunctive relief and civil penalties
- CGS 22a-133p = enforcement authority





ELUR Application Form

- Completed electronically
- Regulatory language provided; applicant checks appropriate box (but if needed, space is also provided for suggested alternative language)
- Submitted electronically

Please review **Instructions and Guidance Document** before starting an Application



Connecticut Department of
Energy & Environmental Protection
Bureau of Water Protection & Land Reuse
Remediation Division
79 Elm Street, Hartford, CT 06106-5127
(860) 424-3705 www.ct.gov/deep/remediation

Instructions and Guidance - Application for Environmental Land Use Restriction for the Commissioner's Review and Approval Revised September 2013

In accordance with Section 22a-133q-1(d) of the Regulations of Connecticut State Agencies (RCSA), as amended, when submitting a proposed Environmental Land Use Restriction (ELUR) to the Commissioner for review and approval, the owner of the affected parcel of land (the "Property") shall simultaneously submit a completed application furnished by the Commissioner. The [Application for Environmental Land Use Restriction for the Commissioner's Review and Approval Revised September 2013](#) ("Application"), as provided on the CT Department of Energy and Environmental Protection ("Department") [Environmental Land Use Restrictions](#) webpage, has been developed for this purpose. The instructions and guidance contained herein ("Instructions and Guidance") have been developed to assist the applicant during the ELUR application preparation, submittal and approval process.

The Application guides the applicant to submit the information required by RCSA [Section 22a-133q-1](#), as amended, as well as supplemental information needed to help the Department more efficiently and effectively conduct its review. Throughout the Application and the Instructions and Guidance, the information required pursuant to statute or regulation will make use of the terms "must", "shall" and "required". Additional information requested by the Department will use terms such as "may", "should", "important", "recommends" and "suggests".

These Instructions and Guidance do not substitute or supersede the requirements of any relevant statutes or regulations. It is the applicant's responsibility to review and comply with all applicable laws prior to completing the Application.

Note: The Application is specific to ELURs that will be reviewed and approved by the Commissioner. For ELURs prepared pursuant to Section 22a-133y of the Connecticut General Statutes (CGS), which will be approved by a Licensed Environmental Professional (LEP), please contact the ELUR Coordinator at DEEP_ELUR@ct.gov for further information.

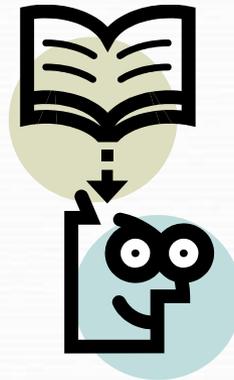
Note: The following Table of Contents (TOC) is included to provide a quick overview of the contents and to help the applicant navigate directly to relevant sections. The headers in the TOC serve as links and the section can be reached by pressing Ctrl-Click. To return to the TOC from within the document, a quick return link is provided in each section.



ELUR Application Materials

- ELUR materials including the **Application, Instructions and Guidance Document, and Supplementary Forms** are posted on the DEEP Remediation Division Web Page at:

http://www.ct.gov/deep/cwp/view.asp?a=2715&q=438254&depNav_GID=1626



ELUR Question #1

During development of the remedial action plan, an easement is discovered for an electric utility line at the location of a proposed Engineered Control. What legal issues should be considered?

Subordination of the easement to the ELUR

ELUR Question #2

A mortgage is found on a title search for the Property. Does this mortgage have to be subordinated to the ELUR?

Yes. This is because if the bank foreclosed on the mortgage, the ELUR could be cleared from the title of the property.

- The mortgage could also be paid in full and released.

ELUR Question #3

At various release areas at a GB site, ETPH was found in soil:

- at concentrations ranging from 450 to 1,900 mg/kg
- at depths from 5 to 8 feet below grade

What type(s) of ELUR are needed?

Residential prohibition and/or inaccessible soil restriction