

SOIL STERILANTS PROGRAM (SSP) – 2024 ANNUAL SHARING EVENT

PROJECT #2 - STERILANT SAMPLING BEST MANAGEMENT PRACTICES



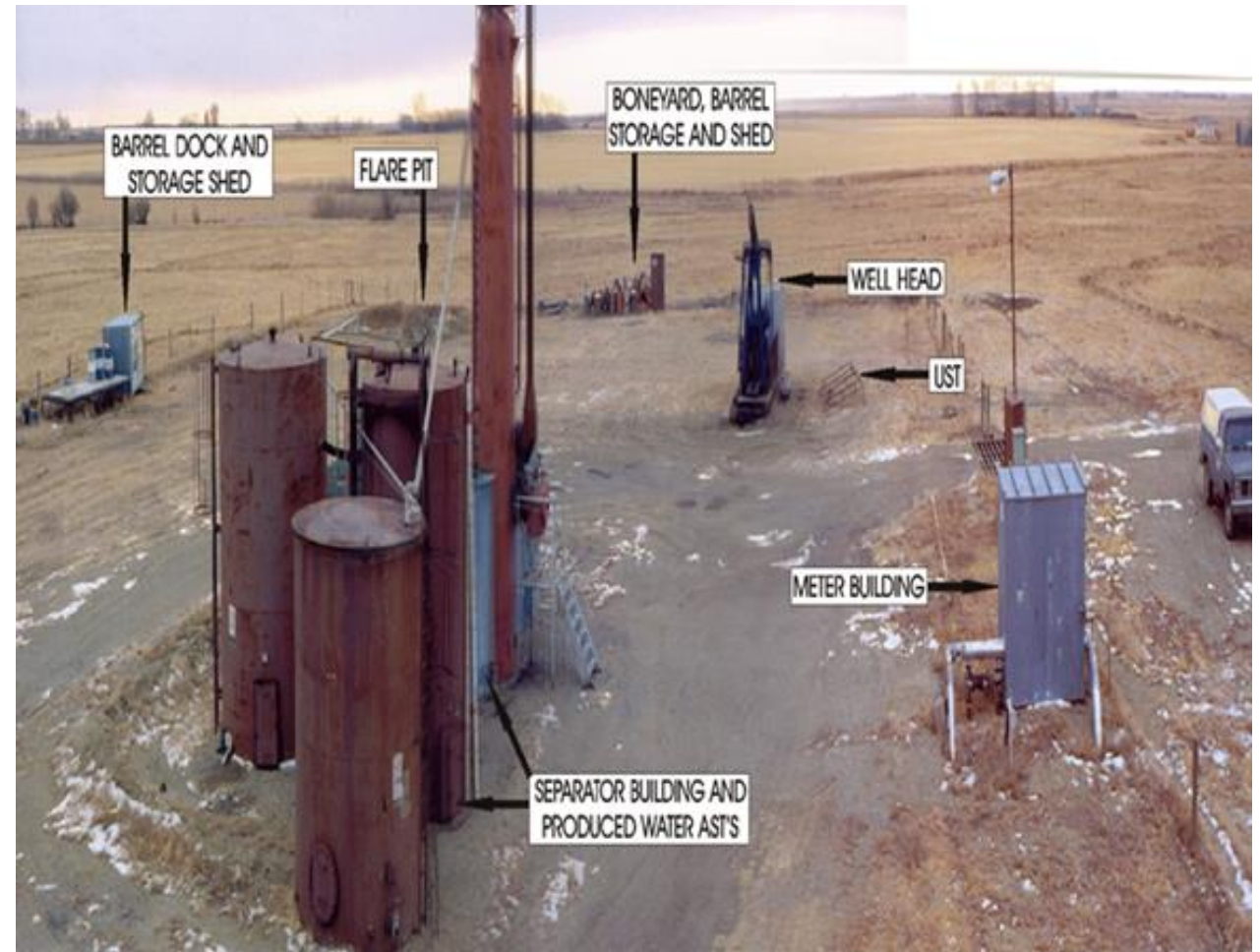
KATHRYN BESSIE (RETIRED)

TYREL HEMSLEY, M.SC., P.AG. (EPA)

AZIZ SHAIKH, M.SC., P.ENG (TETRA TECH CANADA INC.)

OVERVIEW

- Project Objective
- Sampling Best Management Practices
 - Sterilant Specific Considerations
 - Alberta Scenarios
 - Sampling Considerations
 - Sampling Strategies
 - Sampling Containers
 - Equipment Cleaning Procedures- Triple Rinse Method
 - Soil Sampling Methods
 - Groundwater Sampling Methods
 - Data Assessment
- Learnings

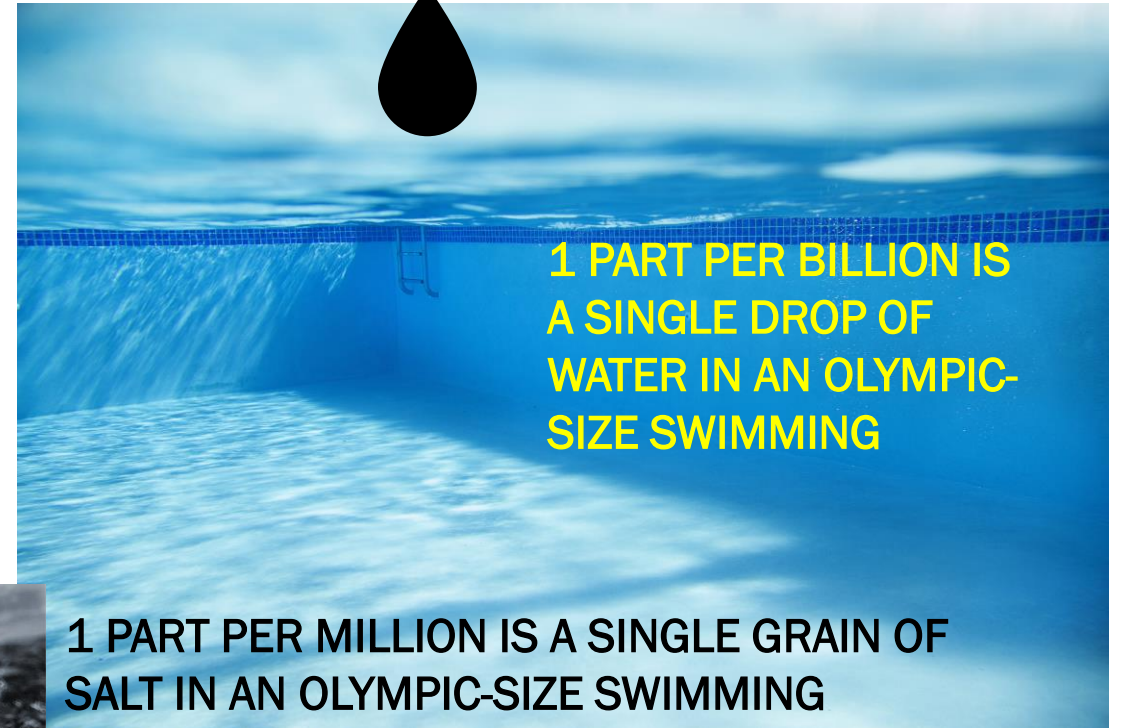


PROJECT OBJECTIVE

- Develop *Sterilant Sampling Best Management Practices* (BMP) to provide specific sampling guidance for low level concentrations of bromacil and tebuthiuron in soil and groundwater in Alberta.

STERILANT SPECIFIC CONSIDERATIONS

- High Potential for Cross Contamination
- Low Level Guidelines
 - ppm, ppb, ppt
- Low Level Sampling (≤ 0.2 mg/kg; USEPA 2020)
 - Delineation Assessment and Confirmatory



**1 PART PER MILLION IS A SINGLE GRAIN OF
SALT IN AN OLYMPIC-SIZE SWIMMING**

STERILANT SPECIFIC CONSIDERATIONS

Application- Total or Area Focused



Total Vegetation Control

Flare Pit Berm

Age of Site- Young vs Old



<30 years

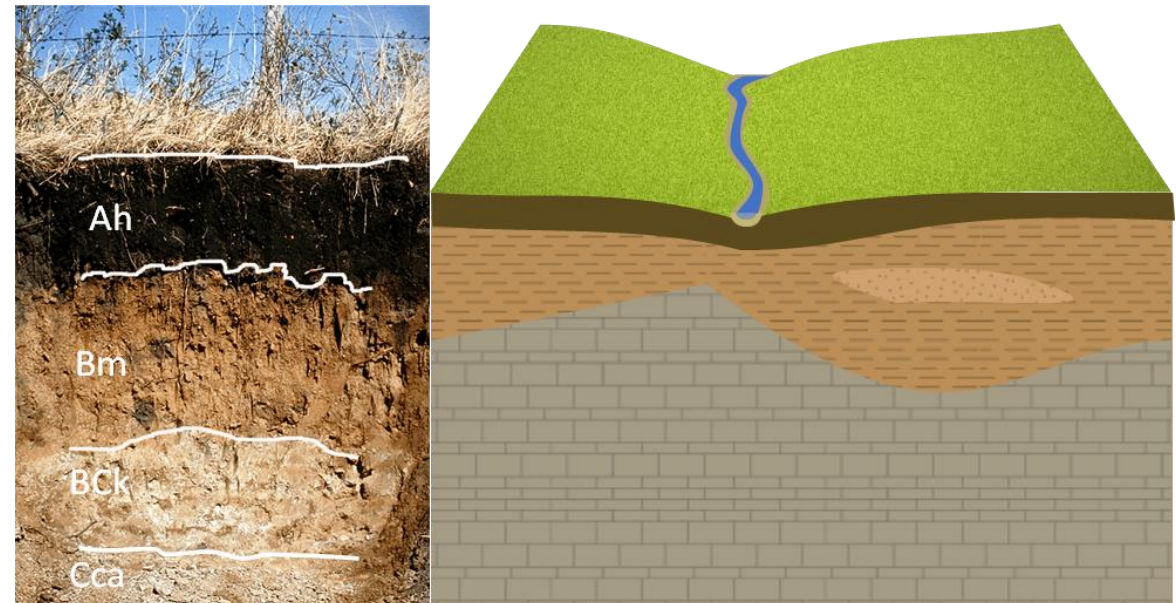
>60 years

STERILANT SPECIFIC CONSIDERATIONS

Site Topography



Soil Classification / Lithology



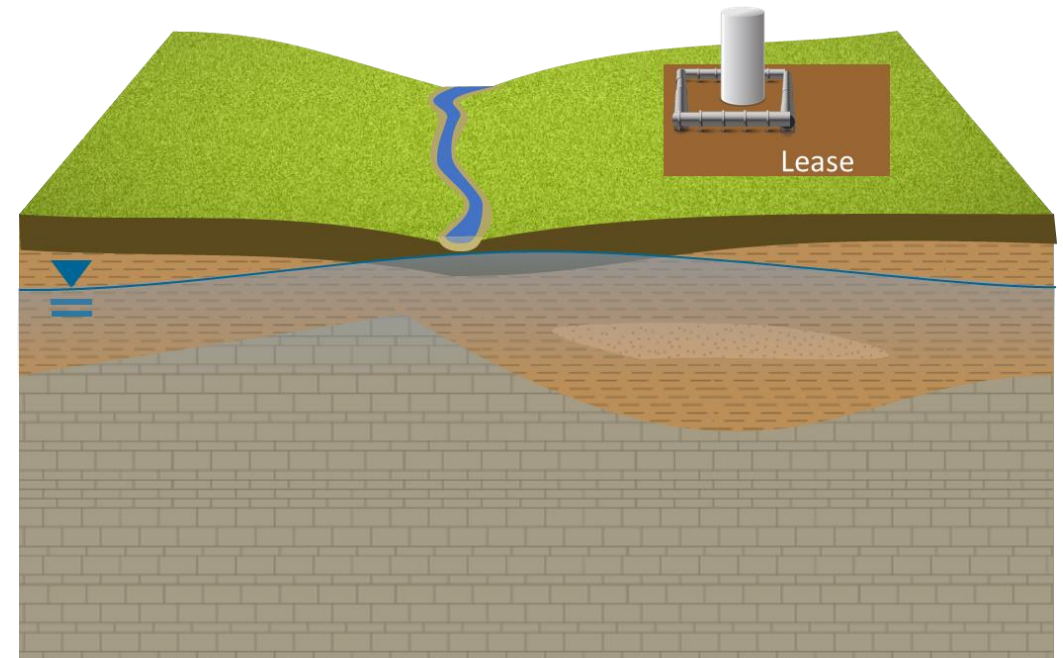
STERILANT SPECIFIC CONSIDERATIONS

Groundwater

- Depth to groundwater
- Horizontal and vertical gradients
- Groundwater flow direction and velocity
- Hydraulic Conductivity
- Sand Lens or Multiple water bearing zones in till

Nearest Surface Waterbody

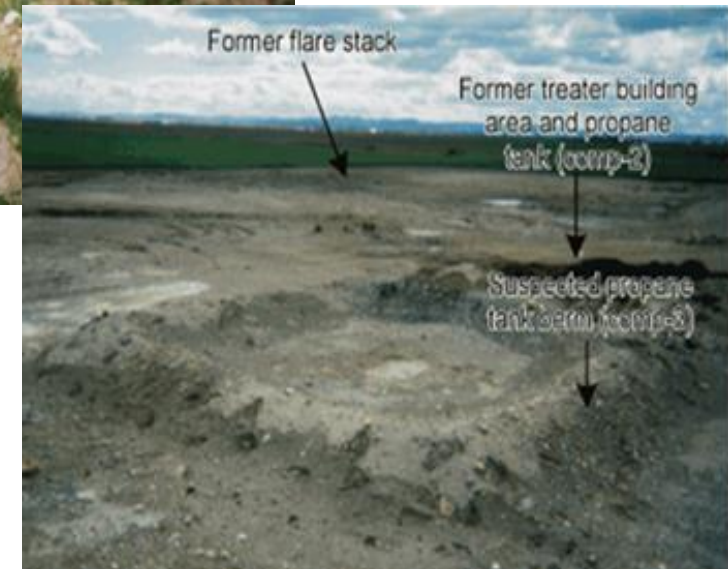
- Wetland
- Lake, River, or Creek



ALBERTA SCENARIOS

Flare Pit Berms or Tank Berms

- Small volume
- Typically not much depth penetration initially due to slopes on berms
- Fill material
- Due to small volume, during remediation/reclamation is usually landfilled off-site if impacted



ALBERTA SCENARIOS

Perimeter Berms

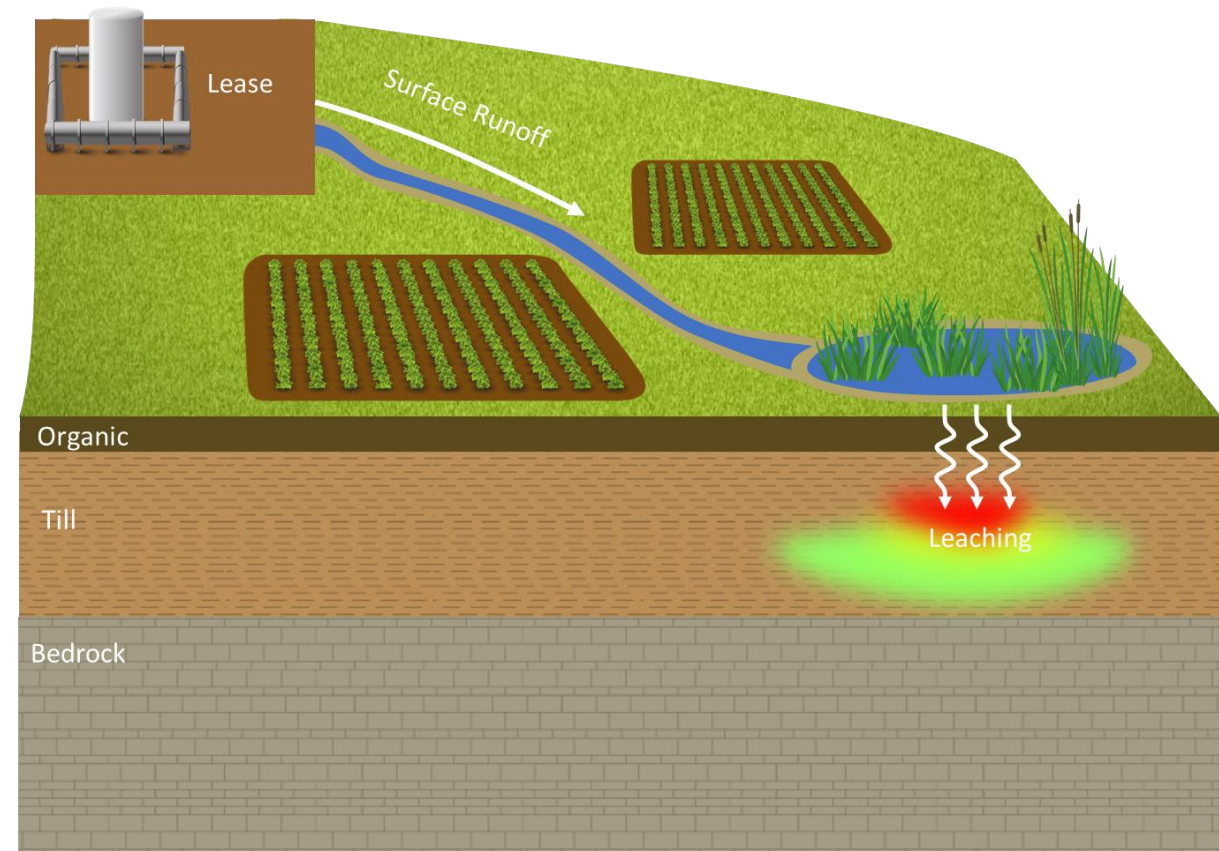
- Higher potential to extend off-site
- Off-site could be agricultural land use (cultivated or pasture land) and the area impacted is usually long and narrow (e.g. 5 m x 40 m)
- Off-site portion was commonly treated with activated charcoal and/or manure from mid 1980s to current day



ALBERTA SCENARIOS

Off-Lease Run-off onto Agricultural Fields in Ephemeral Drainage Channels

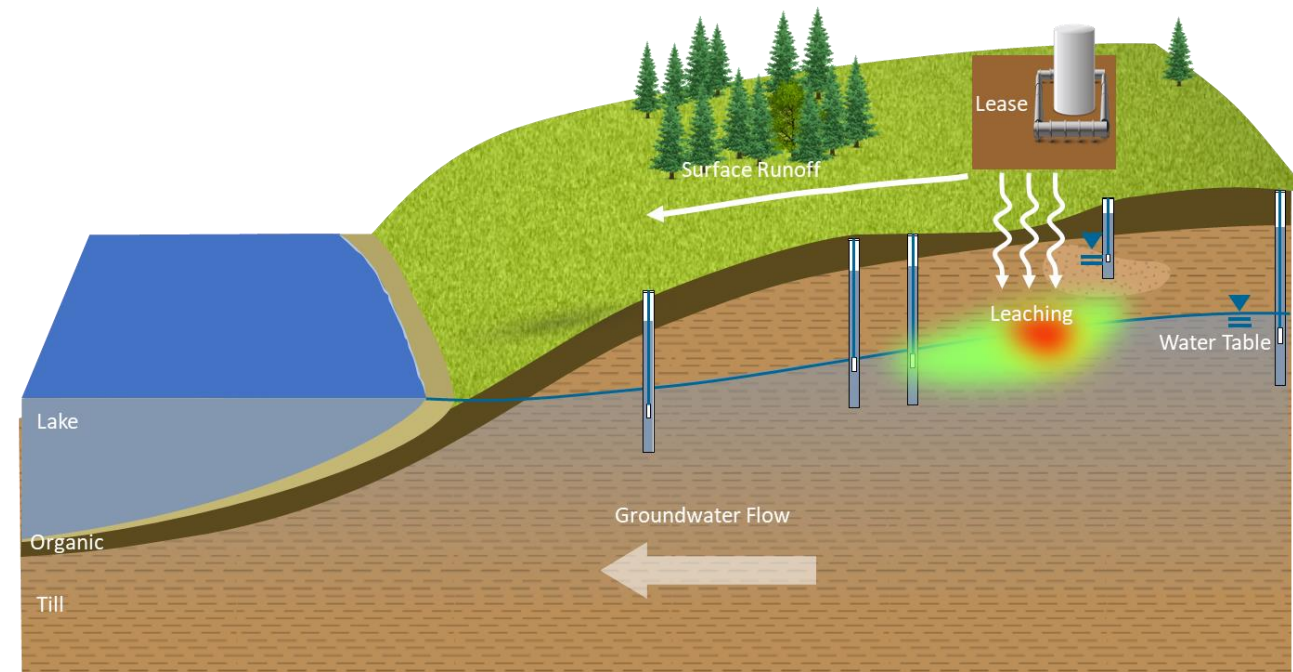
- Moderate volume
- Infiltration is usually less on steeper slopes, but over time can move into subsoil (<1 mbgs, typically)
- Often multiple applications and run-off events so can be re-contaminated
- Sterilants can accumulate in wetland areas (low areas) penetrating deeper plus impact surface water
- Some sites treated with activated charcoal and/or manure in mid-1980s to current



ALBERTA SCENARIOS

Full Lease Area

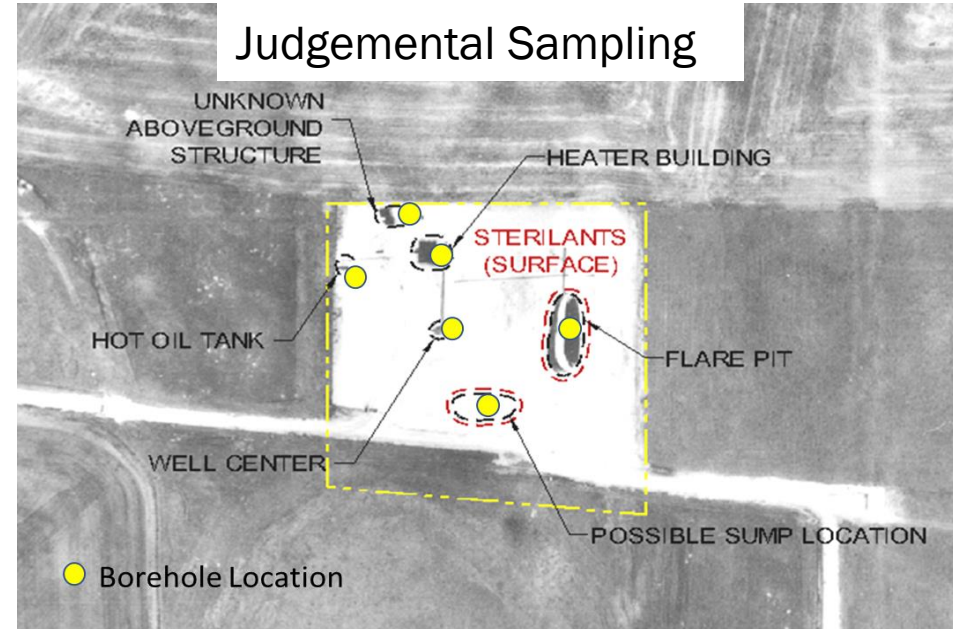
- Large volume, 100 m x 100 m or larger and level
- Typically has gravel over fill or subsoil
- Multiple applications to entire lease area, often with various sterilants and herbicides
- May have co-contaminate impacts (hydrocarbons, salts, metals)
- Soil impacts
 - 4.5 mbgs in fine textured
 - 6 mbgs in coarse textured
- Shallow groundwater is often impacted



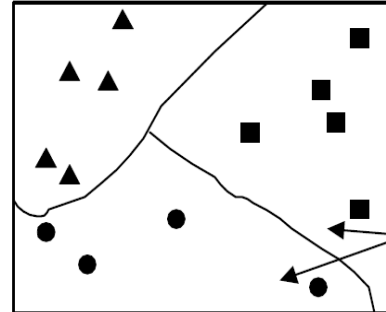
Bedrock

SAMPLING STRATEGIES

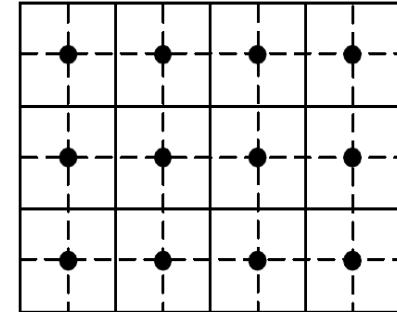
- Preliminary Assessment
 - Initial Phase 2 ESA



Stratified Random Sampling



Systematic Grid Sampling



Strata

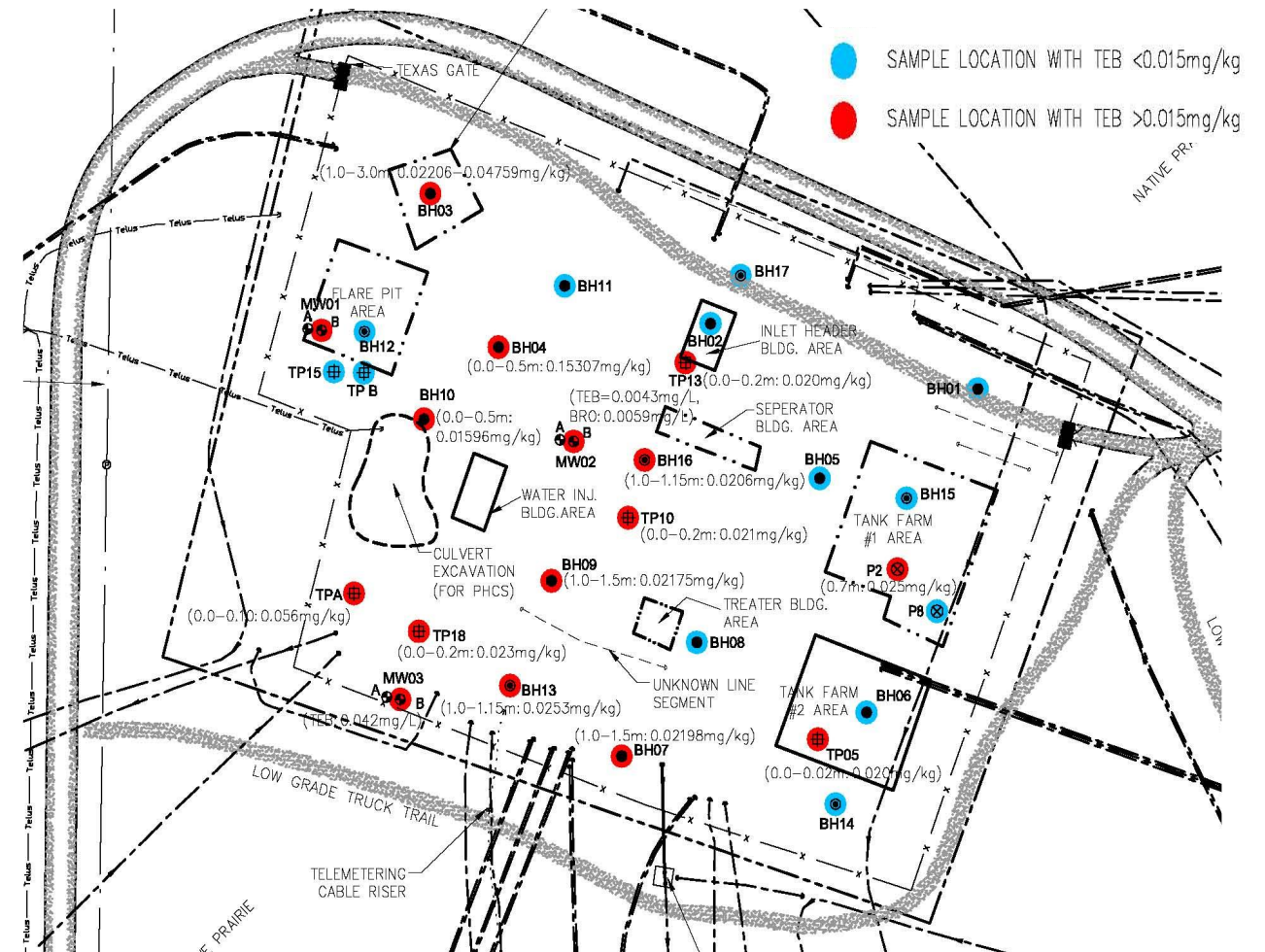
SAMPLING STRATEGIES

- Preliminary Assessment
- Vegetation Assessment
 - Phase 2 ESA
 - growth patterns, chlorosis, rusting on leaves



SAMPLING STRATEGIES

- Preliminary Assessment
- Vegetation Assessment
- Delineation Assessment



SAMPLING STRATEGIES

- Preliminary Assessment
- Vegetation Assessment
- Delineation Assessment
- Confirmatory Sampling



SAMPLING STRATEGIES

Berm Sampling



- Typically co-contaminated with hydrocarbons or salts
- Composite sampling- collecting equal portions (aliquot) of soil of the upper 0 to 0.15 m every 0.5 m for each wall
- 4 composite samples composed of at least 3 equal aliquots.

Stockpile Sampling

Scenario	Stockpile Size	Sampling	Number of Samples Analyzed
Small Volume Stockpile	10 m ³ to 50 m ³	1 discrete sample per cell (cell sample to represent 2 m ³ to 10 m ³) for a total of 5 discrete samples 1 composite sample combined from equal portions of the 5 discrete samples	At least one discrete sample inferred to have highest contamination and one composite sample
Large Volume Stockpile	50 m ³ to 250 m ³	1 discrete sample per cell (cell sample to represent 10 m ³ to 50 m ³) for a total of 5 discrete samples 1 composite sample combined from equal portions of the 5 discrete samples	At least two discrete samples inferred to have highest contamination and one composite sample

SAMPLING CONTAINERS

- Special care must be taken to not cross-contaminate samples
- Soil
 - Glass jars with Teflon™ lids- preferred over plastic bags
 - Stainless steel liners – Delineation and Confirmatory Sampling
 - Clean smeared soil off sample
- Groundwater
 - Amber glass bottle with Teflon™ lined lids
 - Collect sample facing upwind to minimize introduction of contamination
 - Only open the container when you will be adding sample, and close promptly once filled
- Samples suspected with high concentrations of contaminants should be handled and stored separately



TRIPLE RINSE METHOD

- Use for Delineation and Confirmatory Sampling
- Partially fill a 5-gallon pail with distilled water, add liquinox and mix
- Set up another three 5-gallon pails and partially fill each with distilled water (enough water to submerge sampling equipment)
- Immerse sampling equipment in liquinox/water mixture (first 5-gallon pail), scrub equipment thoroughly and shake off excess moisture
- Then rinse the equipment in each of the remaining three 5-gallon pails.



SOIL SAMPLING METHODS

Surface Soils (≤ 1.5 mbgs)

- Best view of soil horizons/layers-excavations (shovel or test pit)

Preliminary Assessments

- Manual Sampling
 - Shovel and hand auger –Off-site and possibly On-site
- Mechanical Sampling
 - Backhoe/Excavator- On-site
 - Drill rig- Off-site and On-site
 - Augers
 - Shelby Tube/3' Long Agriculture Core Barrel
 - Standard Split Spoon

Delineation Assessment and Confirmatory Sampling

- Shovel
- California Split Spoon



Hand Auger



Soil from core barrel



Test Pit Wall

SOIL SAMPLING METHODS

Subsoils (>1.5 mbgs)

- Preliminary Assessment



Auger



Standard Split Spoon



Hollow Stem Drilling



Shelby Tube/ 3' Long
Agriculture Core Barrel



Direct Push

SOIL SAMPLING METHODS

Subsoils (>1.5 mbgs)

- Delineation Assessment and Confirmatory Sampling



California Split Spoon
Core Barrel, Stainless Steel Sleeves
and Hollow Stem Auger

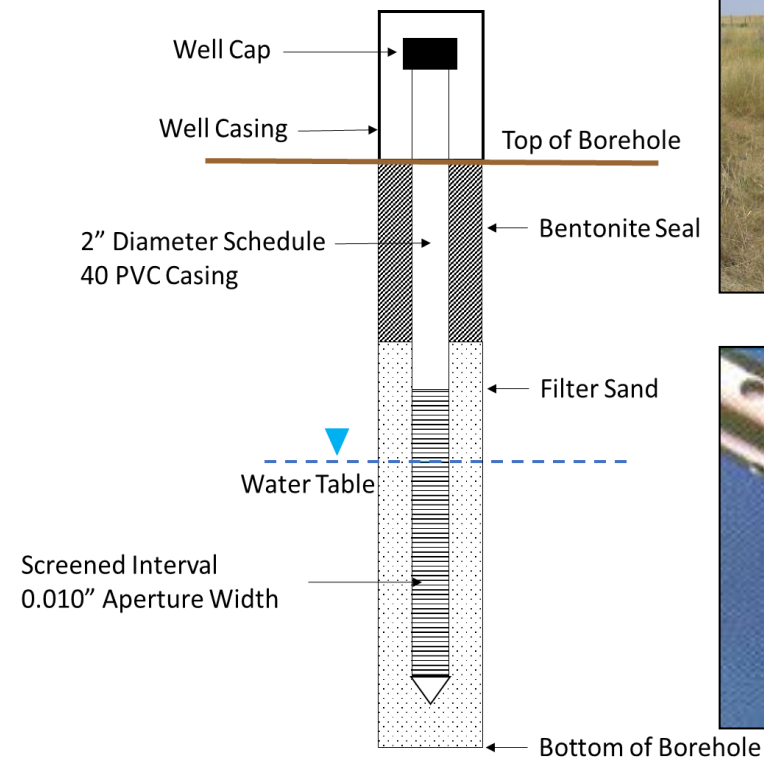


GROUNDWATER SAMPLING

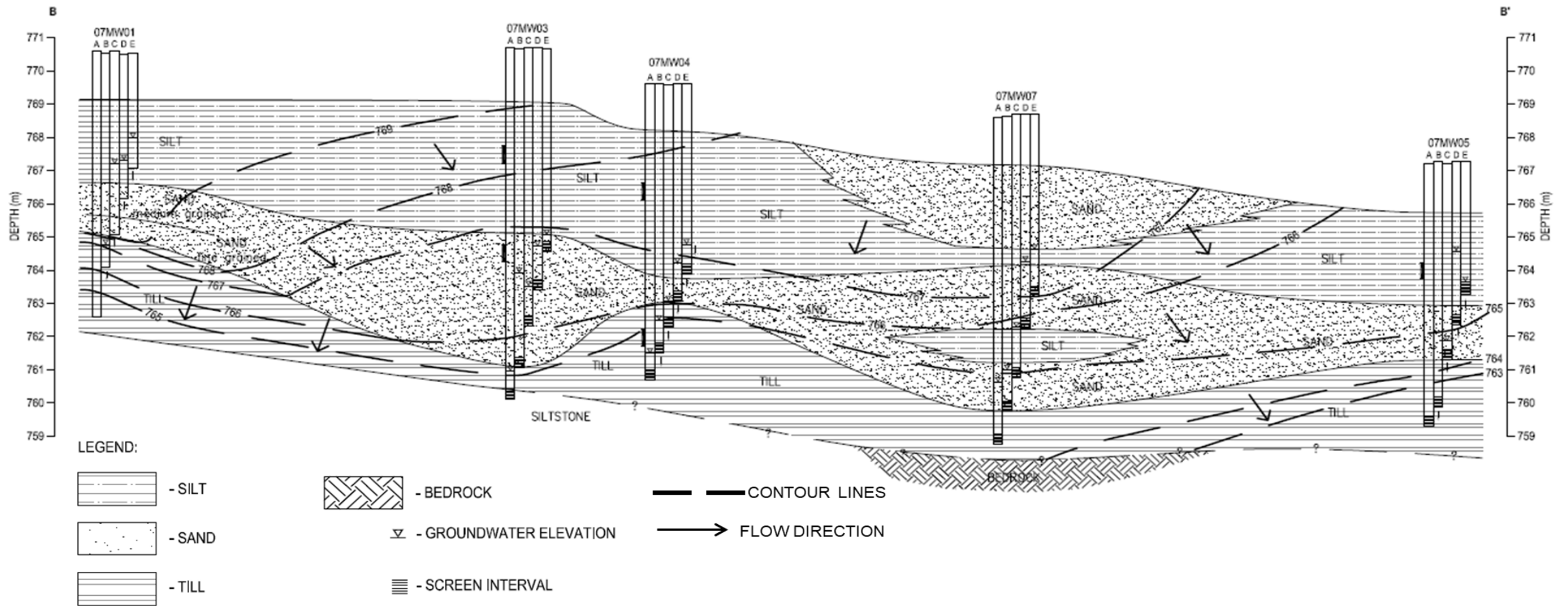
Monitoring Well and Screen Selection

- Minimize cross contamination when installing wells
- Standard Well Procedures (e.g. 1.5 m screen interval)
- Site-Specific Guidance
 - Sand lens with variable thicknesses
 - 0.3 m long stainless steel (0.25 m diameter) screens
 - Drill to target depth and push into soil

Basic Well Design



GROUNDWATER SAMPLING



GROUNDWATER SAMPLING

Well Development

- Minimize cross contamination
- Waterra tubing with surge blocker suggested as more effective than bailer (pumping)

Purging and Sampling

- Standard methods apply
- Preliminary Assessment may use bailer or Wattara tubing
- Delineation and Confirmatory Sampling
 - Low-flow purging and sampling (more accurate and reproducible samples)
- Where possible water from well development and purging should be placed into a storage container, removed from site, and disposed in an appropriate manner



Photo credit Environmental Science and Engineering Magazine, 2015

DATA ASSESSMENT

Soils

- Field duplicates at least 1 sample per every 10 samples (10% of the samples)
- Soils tend to be more variable than water
- Relative percent difference (RPD) measure precision
- RPD of 60% may be suitable concentrations in ppm
- RPD of 75% to 100% near the detection limits (ppb)

Groundwater

- One trip blank per shipping container
- One field equipment blank per day
- One field duplicate for every 10 samples (10% of the samples)
- Obtain at least two groundwater samples on different days from any monitoring well prior to making decisions based on the chemistry data
- RPD of 20% may be suitable concentrations in ppm
- RPD of 40% near the detection limits (ppb/ppt)

LEARNINGS

- Very easy to cross contaminate samples for Bromacil and Tebuthiuron
- Preliminary Assessments
 - Industry standards with focus on minimizing cross contamination for sampling (e.g. scrapping soil, low potential to high potential areas)
- Delineation and Confirmatory Sampling
 - Shovel (surface)
 - California Split Spoon (surface and subsoil)
 - Low-flow purging and sampling

QUESTIONS?

