Early Warning Monitoring as part of a Source Water Protection Program

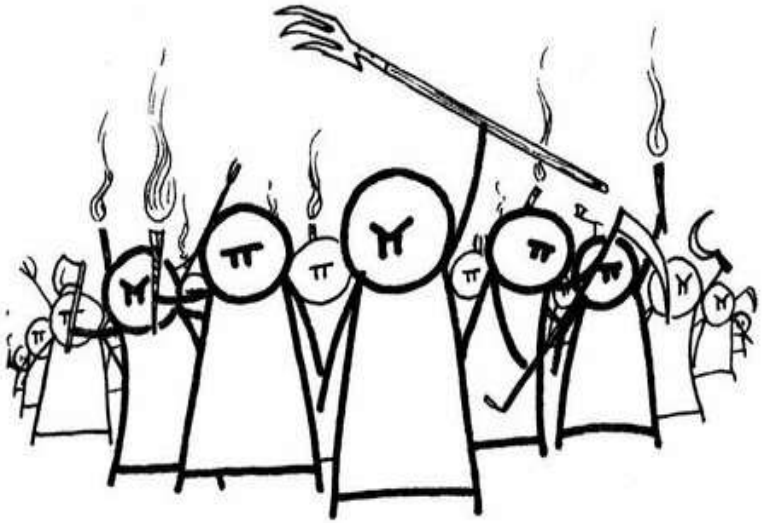
presented by Paul J. Stork

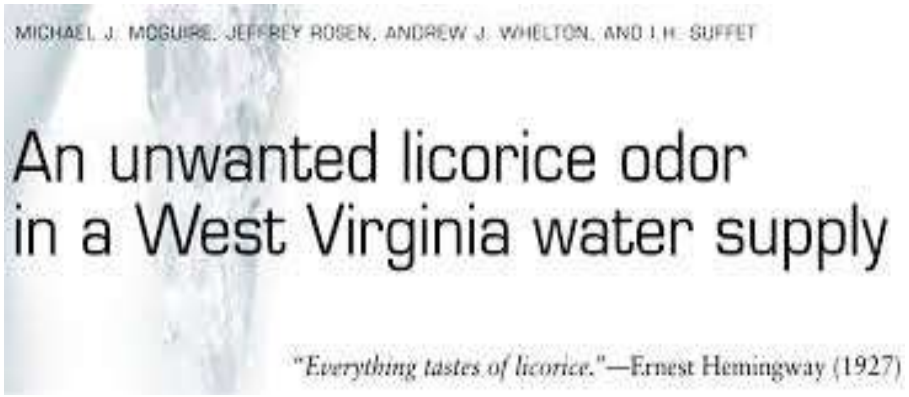
amec foster wheeler

Presentation Overview

- Introduction
  - *Source Water Protection Process/Steps*
  - *Ensure a Safe and Reliable Drinking Water Supply*
- Early Warning Monitoring Considerations
- SWAP Failures and Challenges
- Summary/Closing

Not a Good Thing…….





Not a Good Thing…….

A state of Emergency was declared in Toledo after a water treatment plant tested positive for microcystin, a toxin that can cause liver and kidney damage. The microcystin toxin is a product of cyanobacteria, a typically harmless form of blue-green algae, which has reportedly been in abundance in nearby Lake Erie.

Source Water Contamination Does Occur

- Stay ahead of these issues
- You don’t want to have to implement your contingency plan
- There are tools available to help you plan

SWAP Introduction/Background

- 1974 Authorization of the Safe Drinking Water Act (SDWA)
  - *Directed USEPA to set maximum contaminant levels in drinking water*
- 1986 SDWA Reauthorized to include wellhead and sole source aquifer protection
- 1992 Ohio EPA issued Ohio's Wellhead Protection Program
- 1996 the SDWA was Reauthorized to include the Source Water Assessment and Protection Program
  - *Federal funds were provided to complete delineations, inventories, and "Susceptibility Analysis"*

SWAP Background

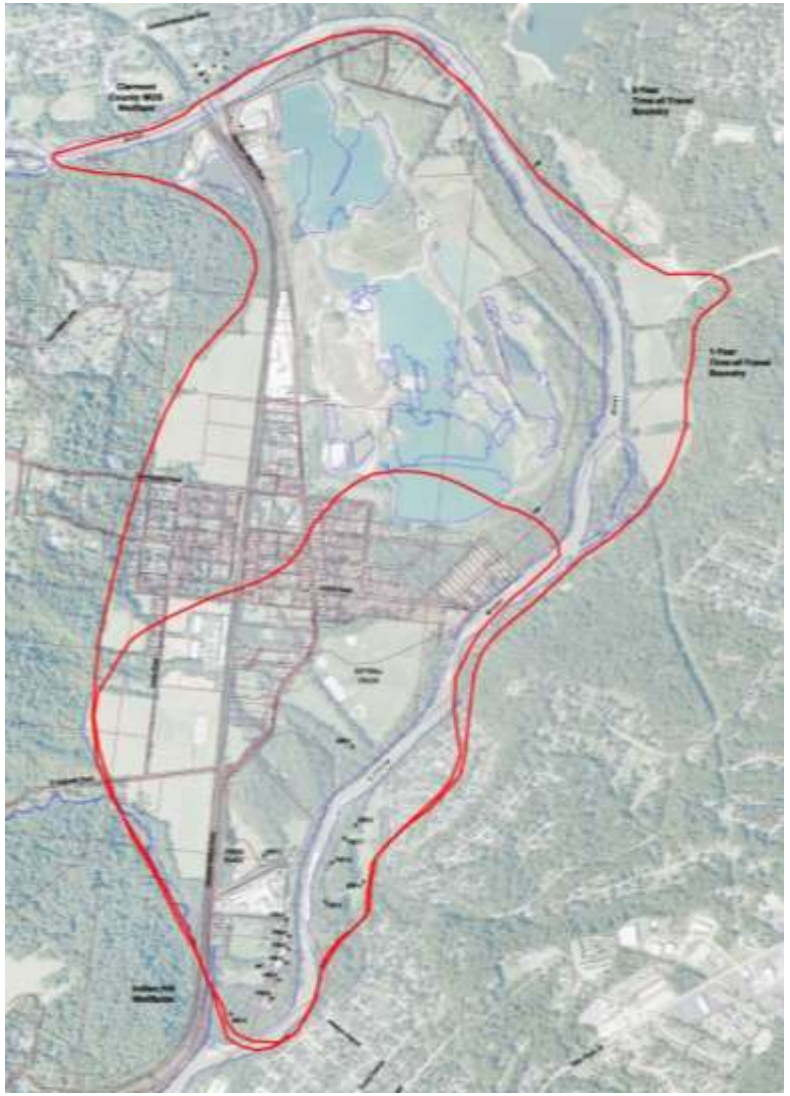
- 1999 US EPA approved Ohio's SWAP Program
- 1998 – 2003 Ohio EPA completed basic "Source Water Protection Reports" for 4,500 public water systems in Ohio. Only details source of water supply and susceptibility to contamination.
- As of December 2016 there are 216 SWAP plans for Municipal Water Systems endorsed by the Ohio EPA

Source Water Protection

- Delineation
- Potential Contaminant Source Inventory
- Source Water Protection Plan
  - Introduction / Executive Summary
  - Education and Outreach
  - Drinking Water Shortage / Emergency Response
  - Potential Contaminant Source Control Strategies
  - Early Warning Monitoring

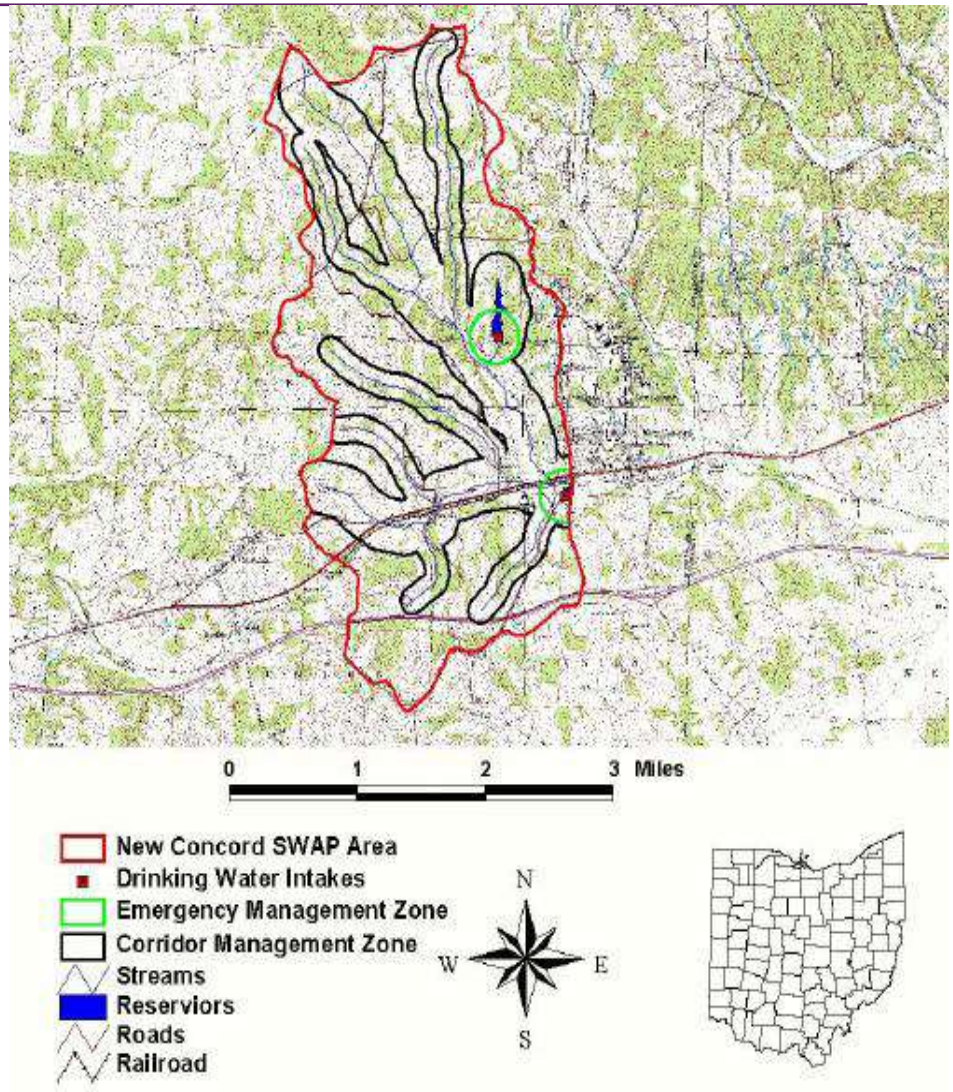
Source Water Protection

- **Delineation**
  - For groundwater sources there are numerical groundwater flow models
  - A groundwater delineation Figure is shown



Source Water Protection

- **Watershed Delineation**
  - For surface water sources a watershed model is good beginning point.
  - A surface watershed delineation is shown in the Figure to the right



Source Water Protection

- **Potential Contaminant Source Inventory**
  - Perform an Inventory in Delineation Areas
  - Review Databases (RCRA, CERCLA & USTs)
  - Review Historical Land Use
  - Conduct Visual Survey
  - Description of Visual Survey/Site Tour
  - Description of Historical Land Use
  - Table of Potential Contaminant Sources

Source Water Protection

▶ Potential Contaminant Source Inventory Table

FACILITY NAME/ADDRESS	MAP ID #	LAND USE	GENERAL LOCATION	Potential Pollution Source	Suspected Chemicals of Concern	Priority
City Water Works	PPS1	M	1 yr TOT	Salt Storage, Chemical Storage, Septic Tank, Petroleum Storage for emergency generator	Fluoride, Sodium Hypochlorite, Phosphates, Diesel Fuel, Sewage	Medium-Low
City Public Works	PPS2	M	1 yr TOT	Vehicle maintenance, Road Salt Storage, Petroleum Storage and Dispensers, Fertilizer/Pesticide Storage	Diesel Fuel, Gasoline, Waste Oil, Lubricants, Paint, Herbicides, Pesticides, Sewage	High
Advisors of Ohio	PPS3	M	5 yr TOT	Cement Kiln, Septic System and Drain Field, USTs (removed)	Barium, Lead, Total Hydrocarbons, Mercury, Gasoline, Waste Oil, Sewage	Medium
Firing Range	PPS4	M	1 yr TOT	Bullets/Bullet Fragments Septic Tank and Drain Field	Lead, Sewage	Medium-Low
Valley Preserve	PPS5	M	1-5 yr TOT	Petroleum storage (de minimus), Parking Areas	Gasoline, Diesel fuel	Low
Burial and Vault	PPS6	I	5 yr TOT	USTs (removed), Septic System and Drain Field	Barium, Lead, Gasoline, Sewage	Medium-Low
Camp Park	PPS7	M	1 yr TOT	Parking Areas, Grass Maintenance	Gasoline, Diesel Fuel, Fertilizer, Pesticides, Herbicides	Low
Mill Park	PPS8	M	1 yr TOT	Parking Areas, Grass Maintenance	Gasoline, Diesel Fuel, Fertilizer, Pesticides, Herbicides	Low
Stables	PPS9	A	1 yr TOT	Animal Waste Storage, Insect Application, Septic System and Drain Field	Animal Waste, Pesticides, Sewage	Medium-Low
Holdings Inc	PPS10	I	5 yr TOT	Machine Shop, Septic System and Drain Field	Lubricants, Sewage	Medium
Cemetery	PPS12	C	1 yr TOT	Cemetery, Grass Maintenance, Parking	Formaldehyde, Arsenic, Gasoline, Diesel, pesticides, herbicides, fertilizer	Low

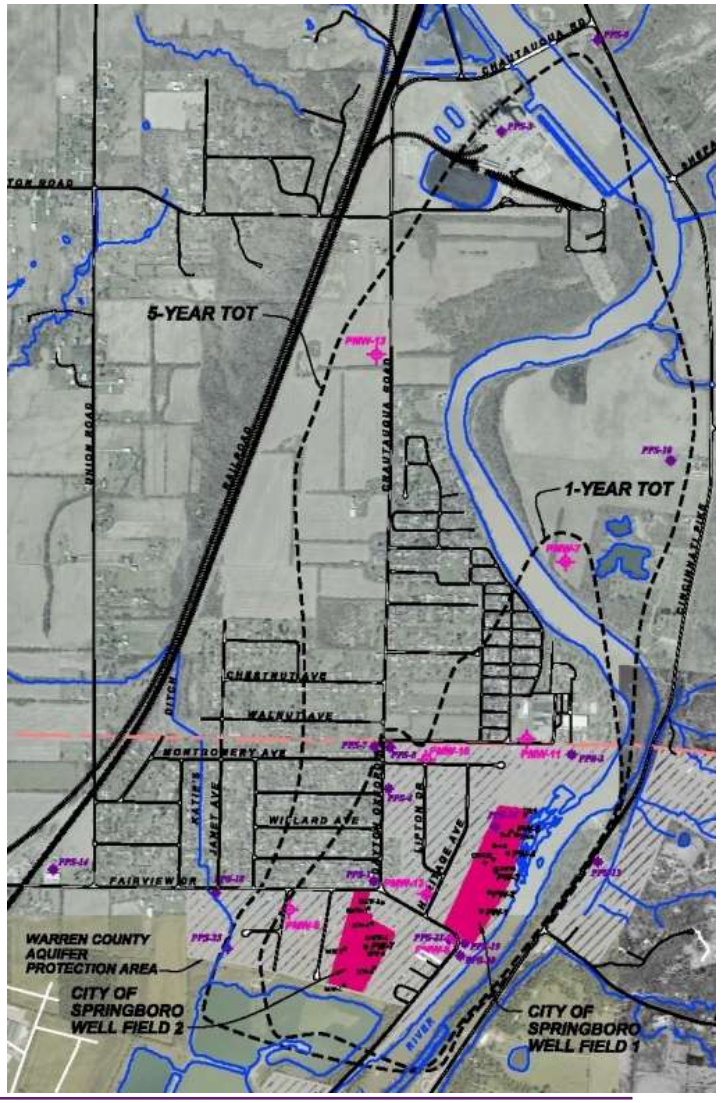
Source Water Protection

- **Potential Contaminant Source Inventory Table**

  - Facility Name and Address
  - Map ID Number
  - General Location, 1 or 5 year TOT or Emergency Management Zone or Corridor Management Zone
  - Potential Pollution Source
  - Suspected Chemical of Concern
  - Priority (low, medium or high)

Source Water Protection

- **Potential Contaminant Source Inventory** (Continued)
  - Map of Potential Contaminant Sources
    - Location of Sources (including oil & gas wells)
    - Location of Public Water Supply Wells
    - Major Transportation Routes (highways & railroads)
  - Map showing Areas without Sanitary Sewers
  - Identify Areas with Underground Fuel Oil Tanks
  - Identify Areas with Storm Drainage Wells
  - Indentify Abandoned Water Wells



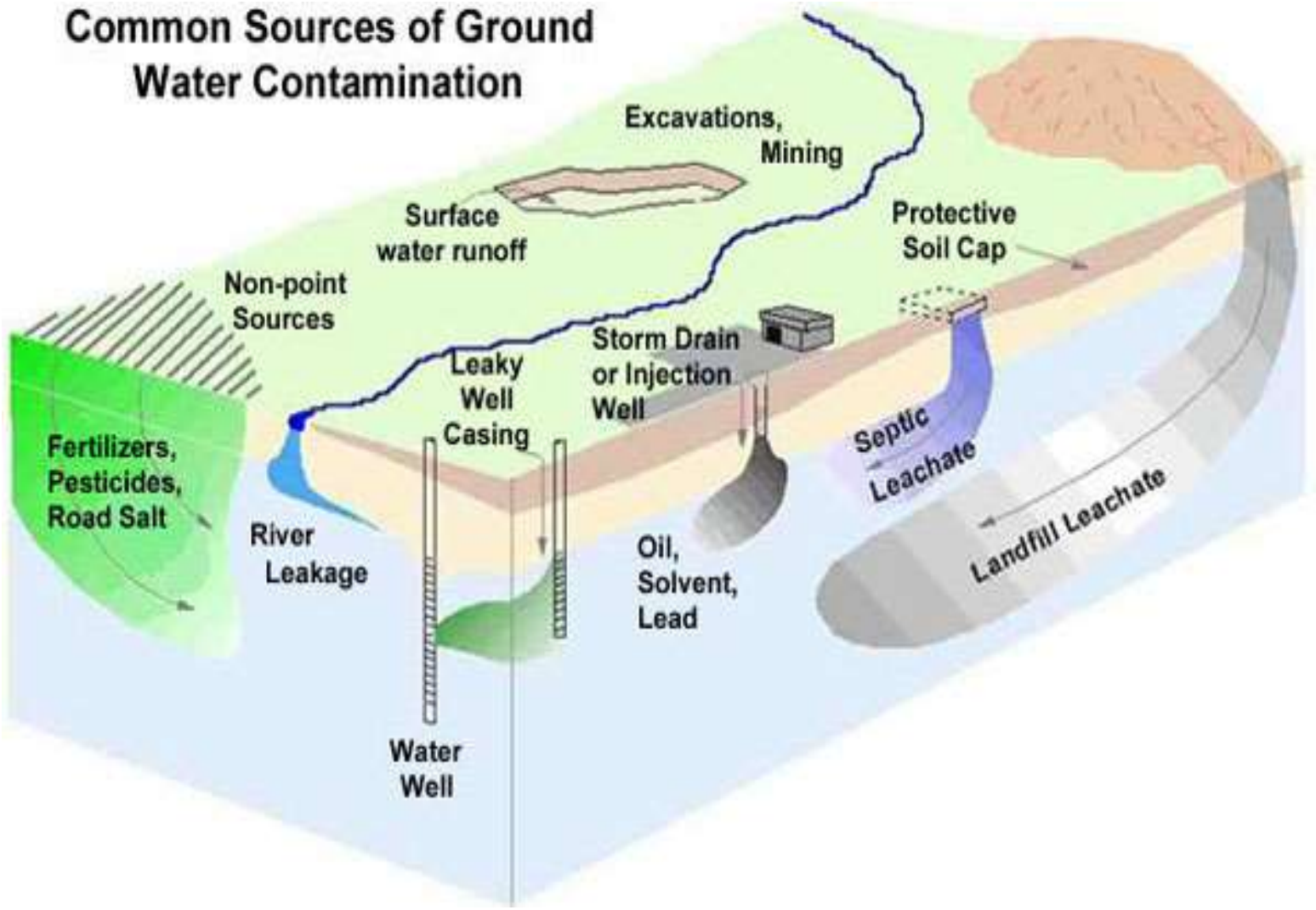
Source Water Protection

- **Source Water Protection Plan**
  - Introduction / Executive Summary
  - Education and Outreach
  - Drinking Water Shortage / Emergency Response
  - Potential Contaminant Source Control Strategies
  - **Early Warning Monitoring**

Early Warning Monitoring

- Assess need for monitoring
- Explanation of why monitoring needed
- Map of area showing:
  - Proposed monitoring wells & Public supply wells
  - Drinking water source protection area
  - Contaminant sources
- Description of the pollution source and contaminants that are intended to be monitored
- Construction details of planned wells showing:
  - Total depth & Screened intervals
- Sampling schedule and frequency of monitoring
- List of parameters to be monitored

Potential Contaminant Sources for Monitoring

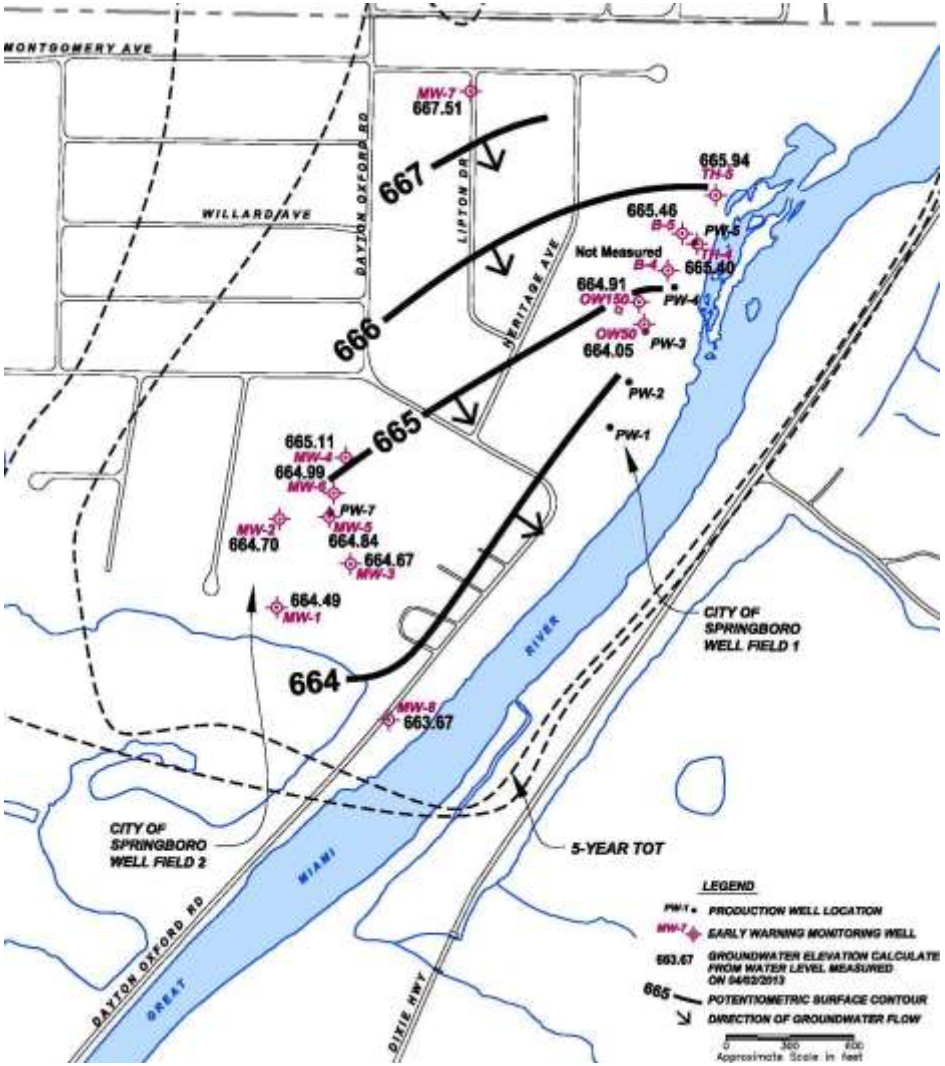


Potential Contaminants for Monitoring

Extent of pollution	*Source of pollution*	*Main pollutants*
Point	Industry	Heavy metals (Pb, Zn, Cd, Cr), arsenic, phenols, petroleum products and additives, high BOD, suspended solids, chloride, sulphide, alkaline effluents, low pH, chlorinated hydrocarbons, PAHs, synthetic organic and organometalic compounds
	Mining	Heavy metals, salts (chloride, sulphate), low pH, high TDS, cyanide, PAHs, petroleum products
	Waste disposal sites including deep disposal wells	Heavy metals, ammonium, sulphate, chloride, phenols, various biodegradable and non-biodegradable organics, feacal pathogens
	Radioactive wastes	^{3}H - Tritium, ^{90}Sr, ^{137}Cs, ^{239}Pu, ^{129}I, ^{226}Ra, toxic metals
	Cattle – breading lots	High suspended solids, BOD, total nitrogen, chloride, feacal pathogens
Multipoint	Urban areas	Heavy metals (Pb, Zn), ammonia, chloride, sulphate, petroleum products, chlorinated hydrocarbons, surfactants
	Rural settlements	Ammonia, nitrate, chloride, sulphate, surfactants, iron, manganese, feacal pathogens
	Military areas	Petroleum products, heavy metals
Non-point (diffuse)	Agriculture Crop and root-crop farming, irrigation	Fertilizers (organic and inorganic): nitrate, ammonia, chloride, phosphate, natrium, potassium, feacal pathogens, salinity Pesticides: organochlorine compounds (aldrine, heptachlore), carbamate insecticides (atrazine), polyphosphate, organometalic compounds (fungicides)
Line	Roads	High suspended solids, salts, petroleum products, solvents
	Railways	Petroleum products, organic chemicals
	Oil pipelines	Petroleum products
	Sewerage systems	High suspended solids, nutrients, chloride, high BOD, feacal pathogens
	Streams	Nitrate, ammonia, iron, manganese, phenols
Areal	Acid depositions	Aluminium, low pH, nitrate, sulphate
Coastal areas	Salinisation	Sodium, magnesium, chloride, sulphate, high salinity and TDS

Groundwater Monitoring Well Locations

- Monitoring wells should be located between the potential contaminant source and the production wells



Early Warning Monitoring Rational

Monitoring Well	Sampling Parameters	Sampling Schedule
MW-1	VOCs; Nitrate; Chloride	Annual-2014
MW-2(D)	Metals; Sulfate; VOCs; Chloride	Triennial-2014
MW-2(S)	VOCs; Nitrate; Group A SOCs	Annual-2014
MW-3(D)	VOCs; Metals	Triennial-2014
MW-3(S)	Group A SOCs; Nitrate; Chloride	Annual-2014
MW-4(S)	Group A SOCs; Nitrate; Chloride	Annual-2014
MW-5	Nitrate; Chloride	Annual-2014
MW-5	**Group A SOCs; VOCs**	**Biennial-2014**
MW-6	Nitrate; Chloride; Group A SOCs	Annual-2014
MW-6	**VOCs**	**Biennial-2014**
MW-7	Nitrate; Chloride	Annual-2014
MW-7	**Group A SOCs**	**Biennial-2014**
MW-8	VOCs; Nitrate; Chloride; Metals; Sulfate; Group A SOCs	Proposed Monitoring Wells, Not Established
MW-9	VOCs; Nitrate; Chloride; Metals; Sulfate; Group A SOCs	Proposed Monitoring Wells, Not Established
PW-6	Nitrate; Chloride	Annual-2014

Early Warning Monitoring

- **Can Consist of Groundwater Monitoring**
  - Typically 2-inch diameter wells (well depths vary)

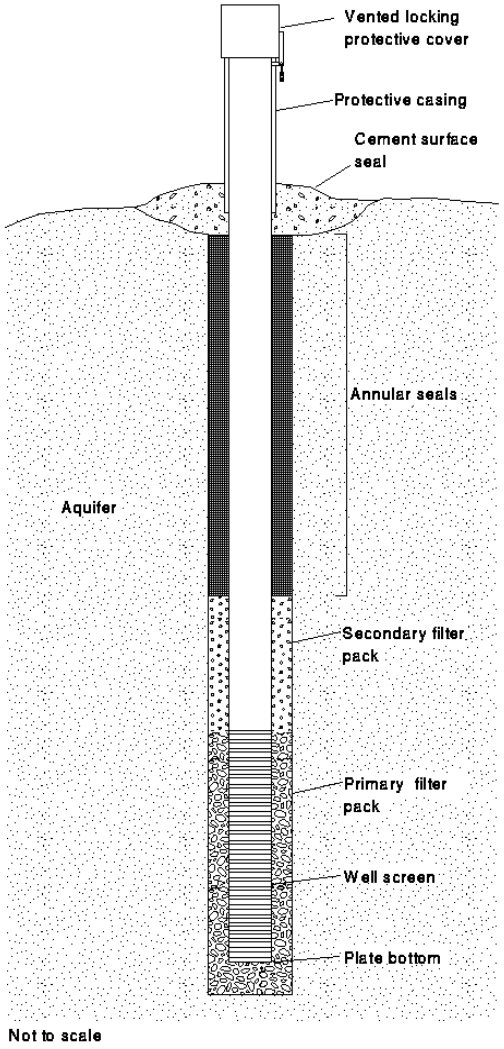
or

- **Surface Water Monitoring**
  - Typically automated samplers deployed in critical areas of the water shed

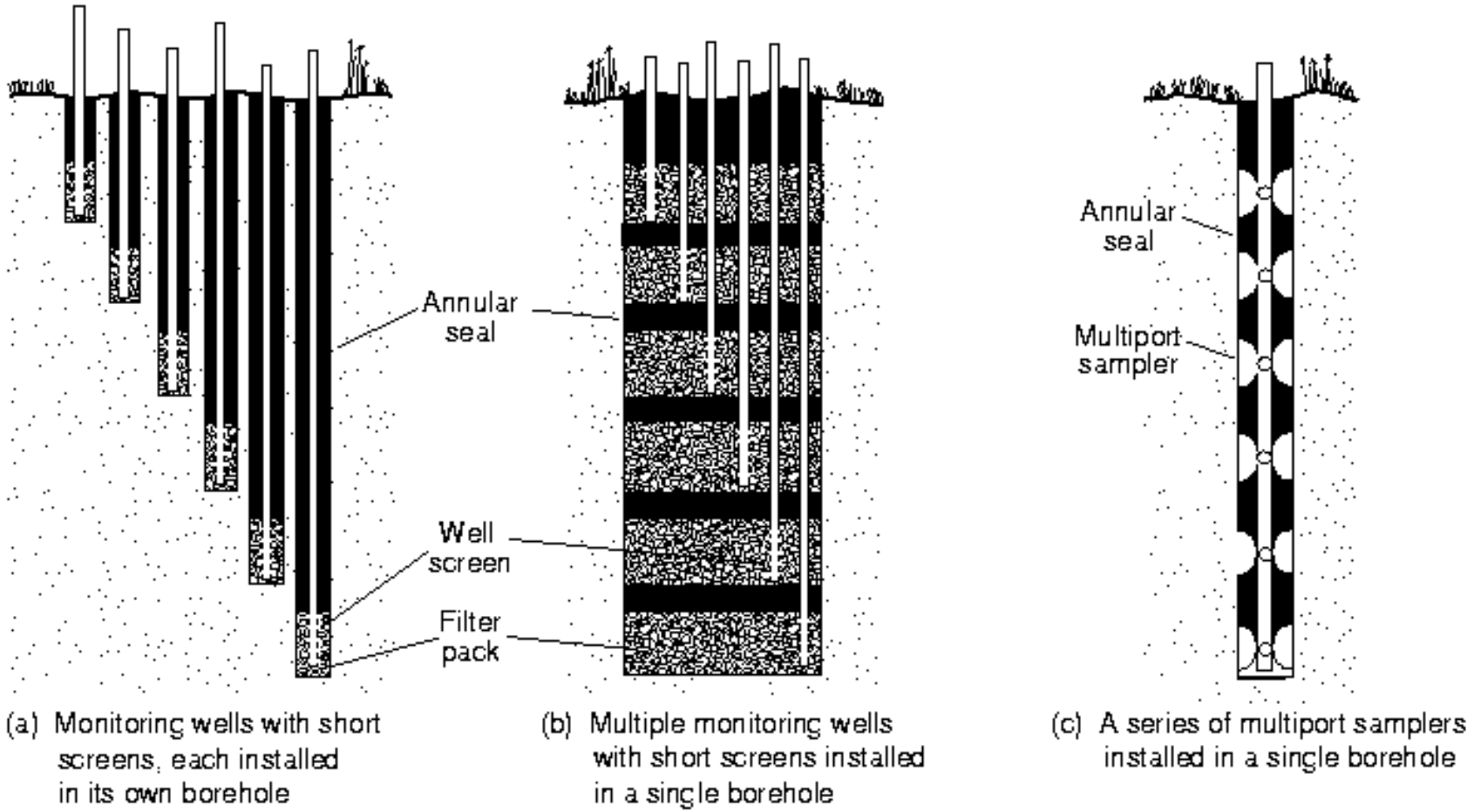
ISCO Sampler for Surface Water

Surface Water Sampling Locations

Typical Groundwater Monitoring Well



Multi-Level Groundwater Monitoring Wells



(a) Monitoring wells with short screens, each installed in its own borehole

(b) Multiple monitoring wells with short screens installed in a single borehole

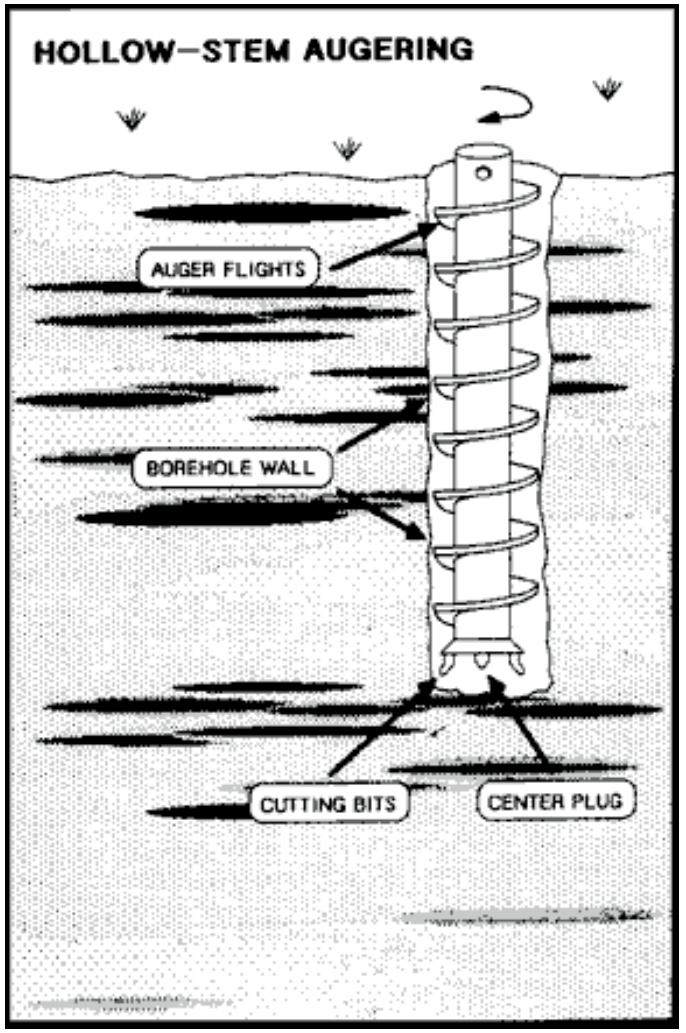
(c) A series of multiport samplers installed in a single borehole

Groundwater Monitoring Well Installation Techniques

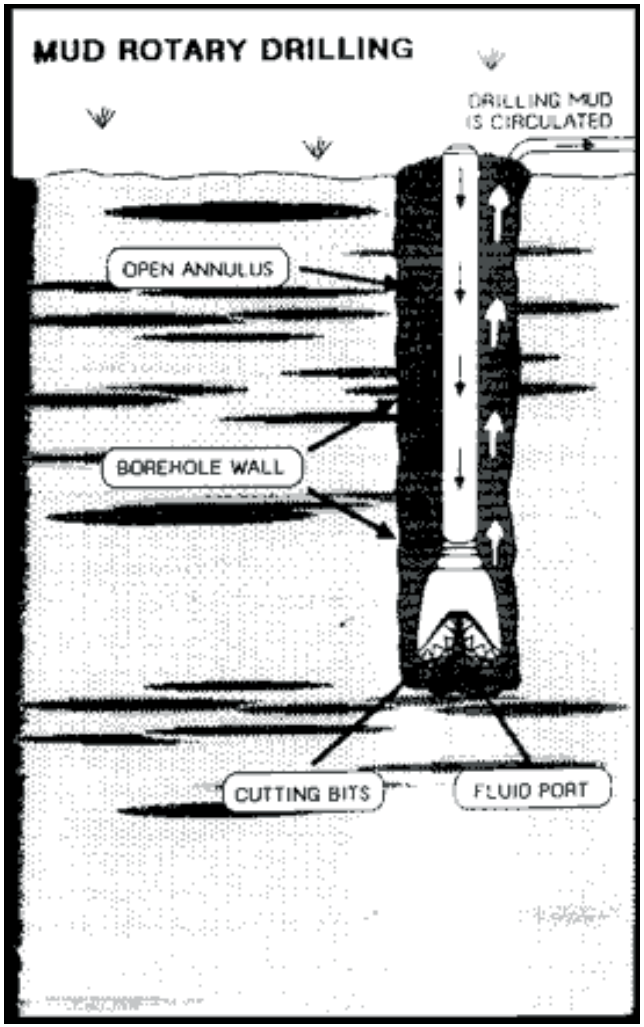
- Monitoring Well Installation depth is determined by the type of soil and aquifer.
- Soil sampling is an important consideration when selecting the Drilling method
  - Hollow Stem Augers
  - Rota Sonic
  - Direct Push
  - Air Rotary
  - Cable Tool
  - Mud-Rotary

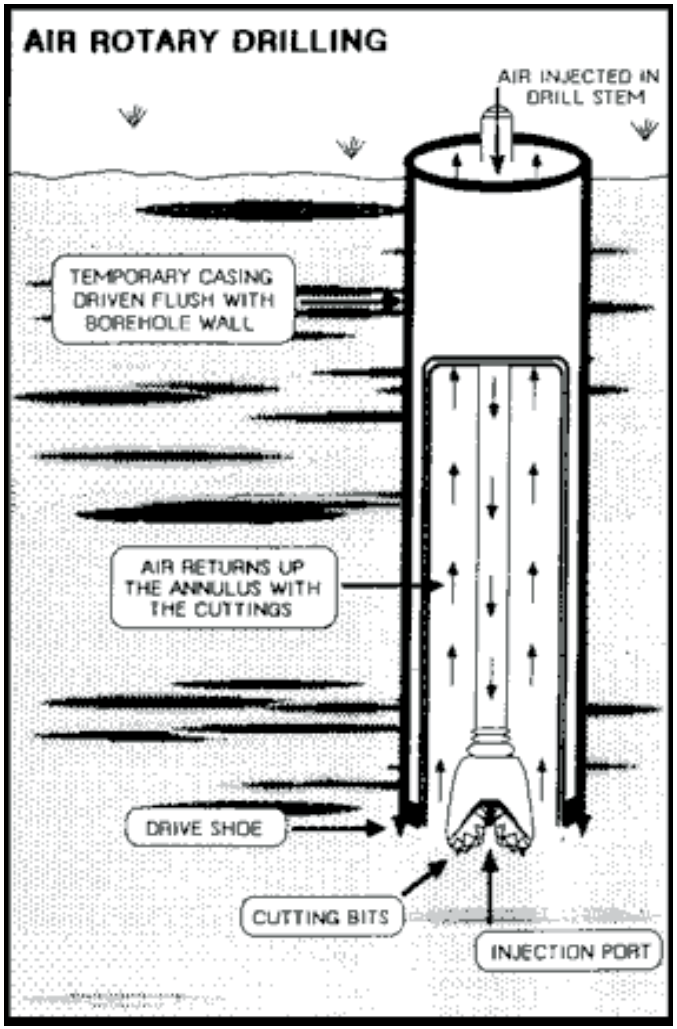
Groundwater Monitoring Well Installation Techniques

- Monitoring Well Installation can be completed using many types of drilling methods:
  - Hollow Stem Augers
  - Mud-Rotary
  - Air Rotary
  - Rota Sonic
  - Cable Tool, or
  - Direct Push

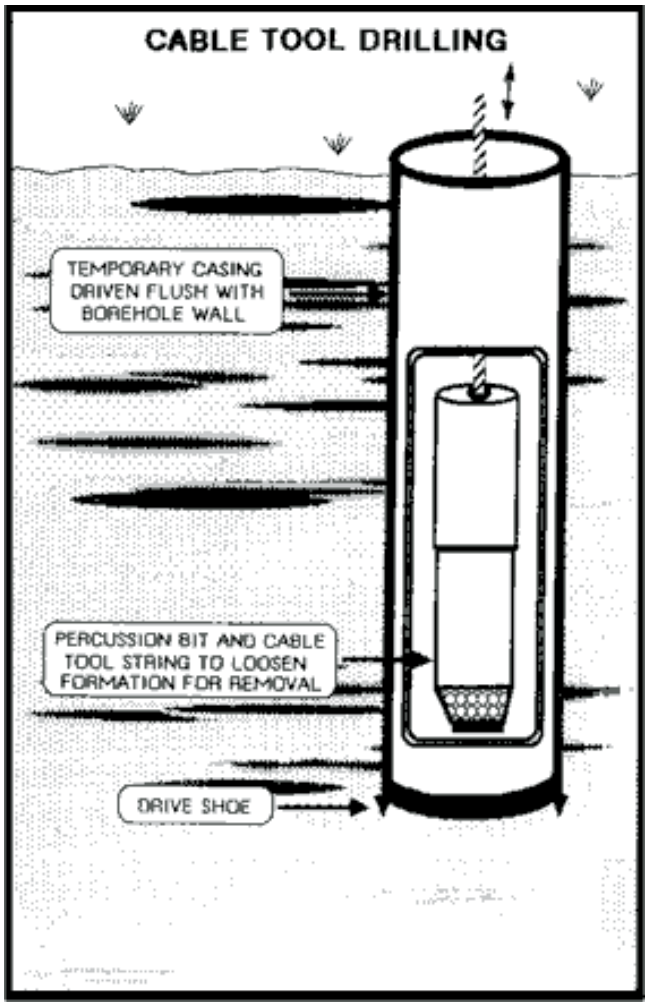


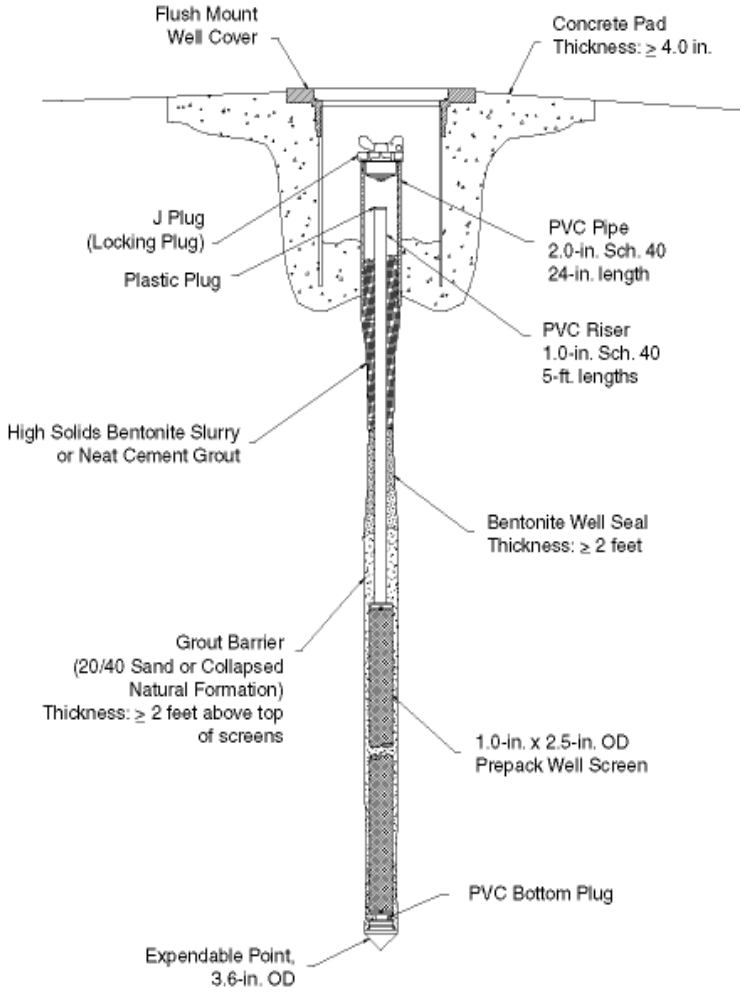
Groundwater Monitoring Well Installation Techniques





Groundwater Monitoring Well Installation Techniques

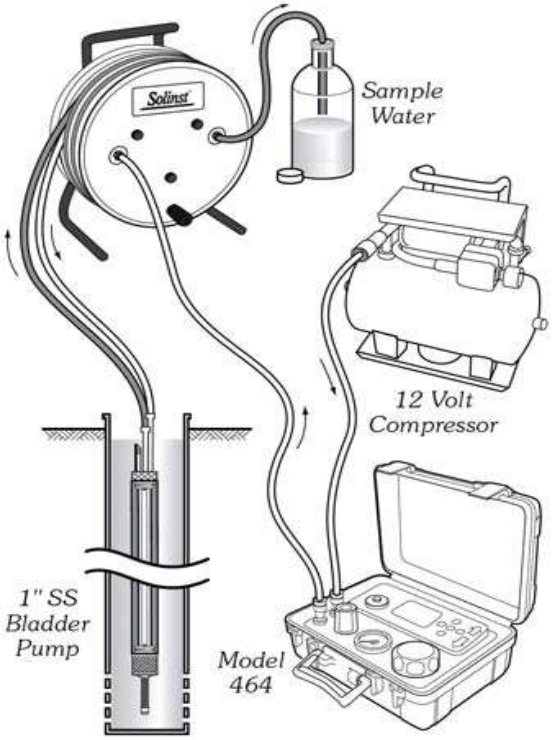




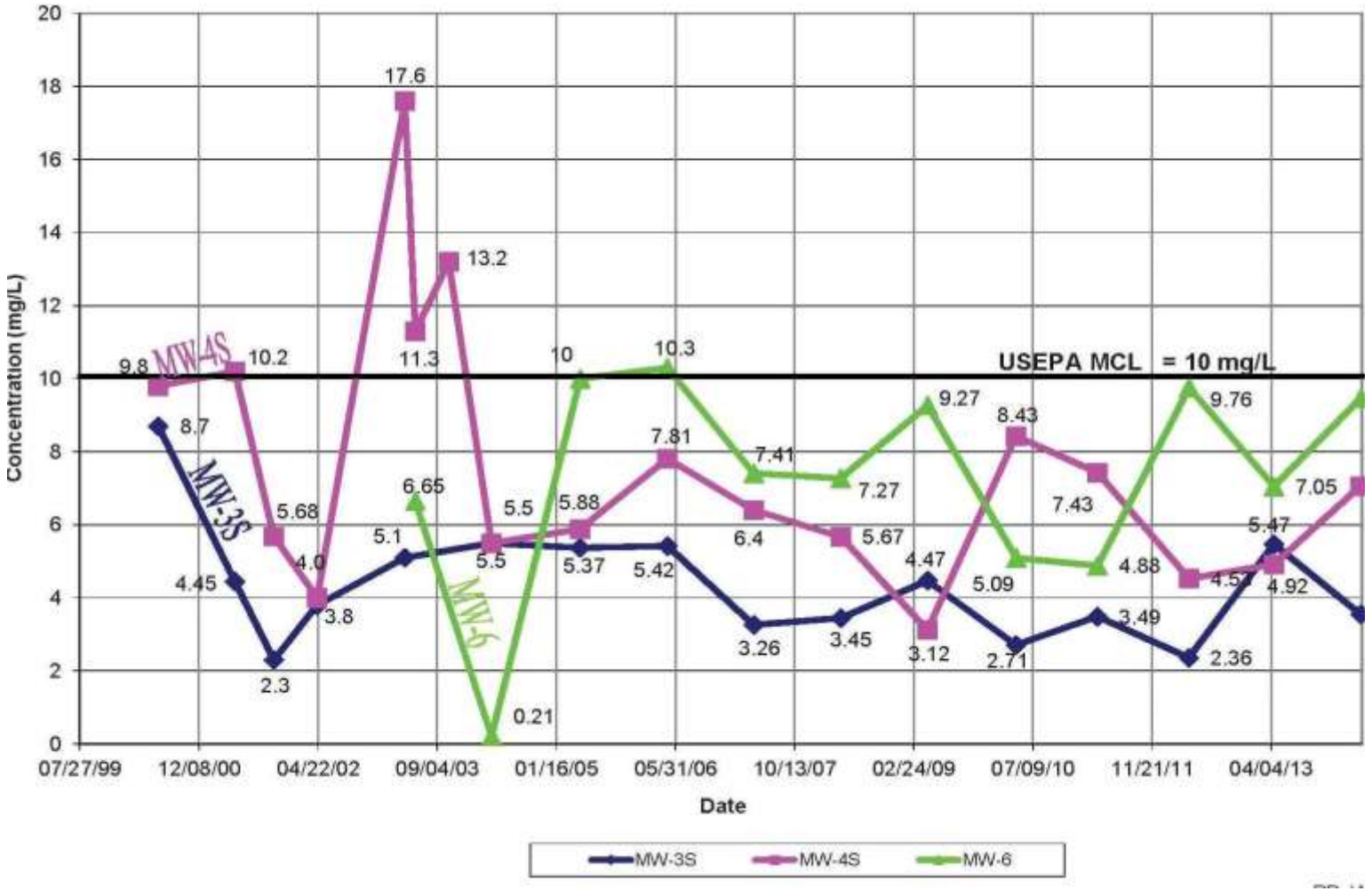
Collection of Groundwater Samples from Monitoring Wells

- Bailers
- Submersible pumps
  - air powered
  - electric
- Peristaltic pumps

Collection of Groundwater Samples from Monitoring Wells



Early Warning Monitoring Data



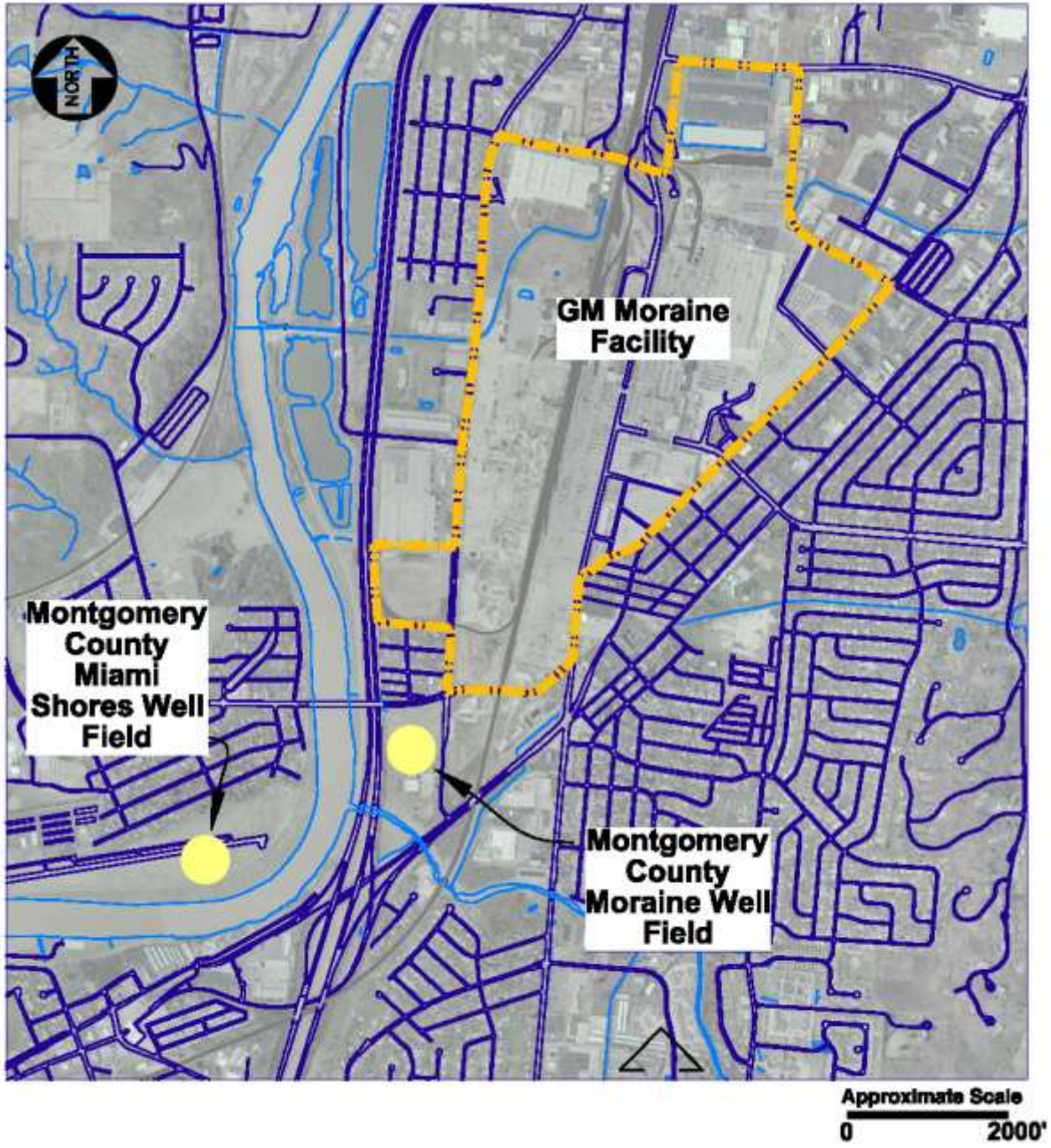
Early Warning Monitoring Limitations

- Groundwater Monitoring wells only evaluate a small portion of the larger aquifer
- Groundwater samples must be collected on a regular basis to establish a baseline
- Groundwater Monitoring wells require periodic maintenance, protective covers, locking caps, and occasionally re-development

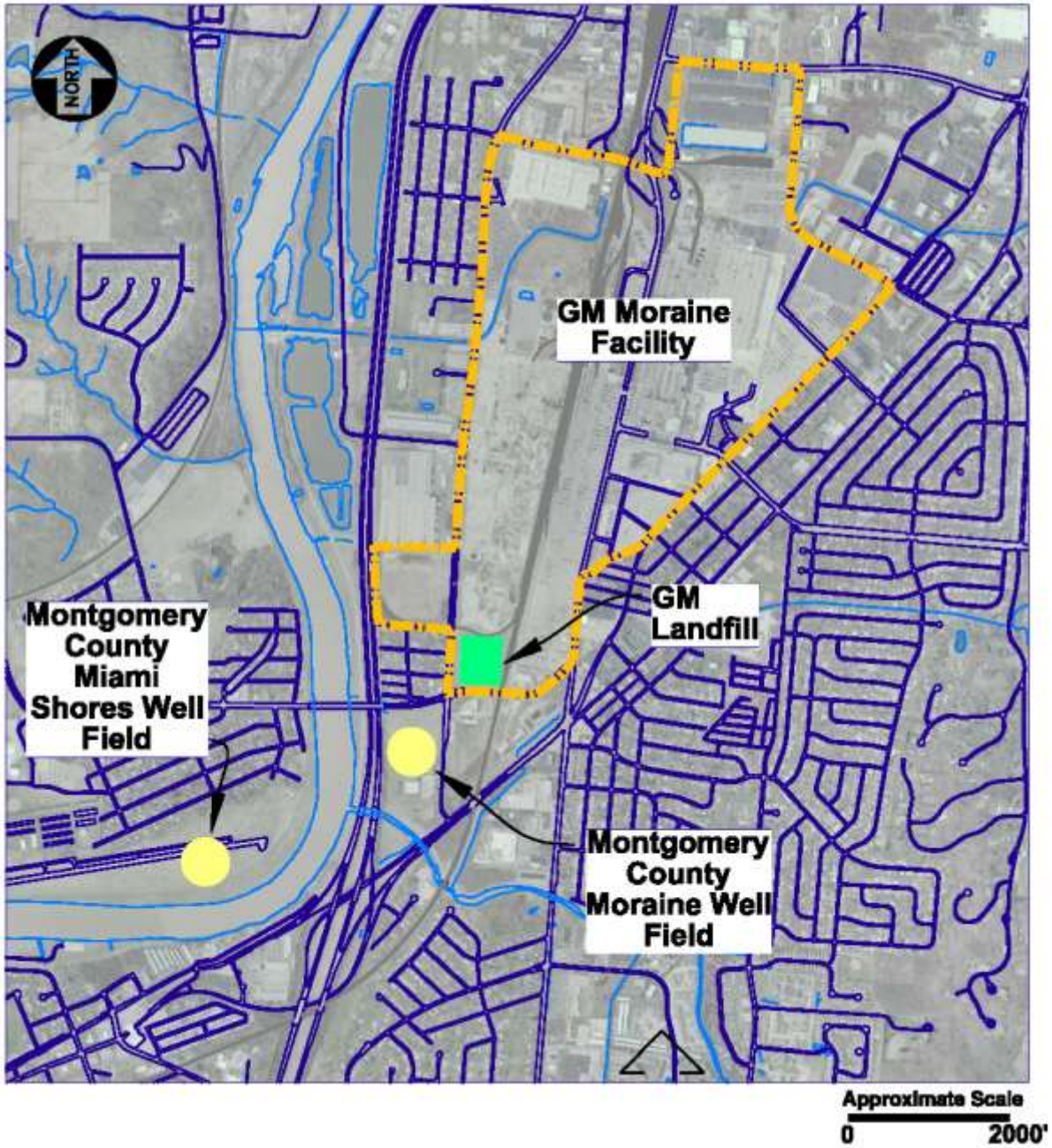
SWAP Failures and Challenges

SWAP Failures and Challenges

- This section presents contamination that has occurred and the challenges required to address the contamination
- An Early Warning Monitoring Program could have prevented some of these failures
- Some of the following slides were provided by the Ohio EPA



General Site Location of the Former General Motors Moraine Facility Dayton, Ohio



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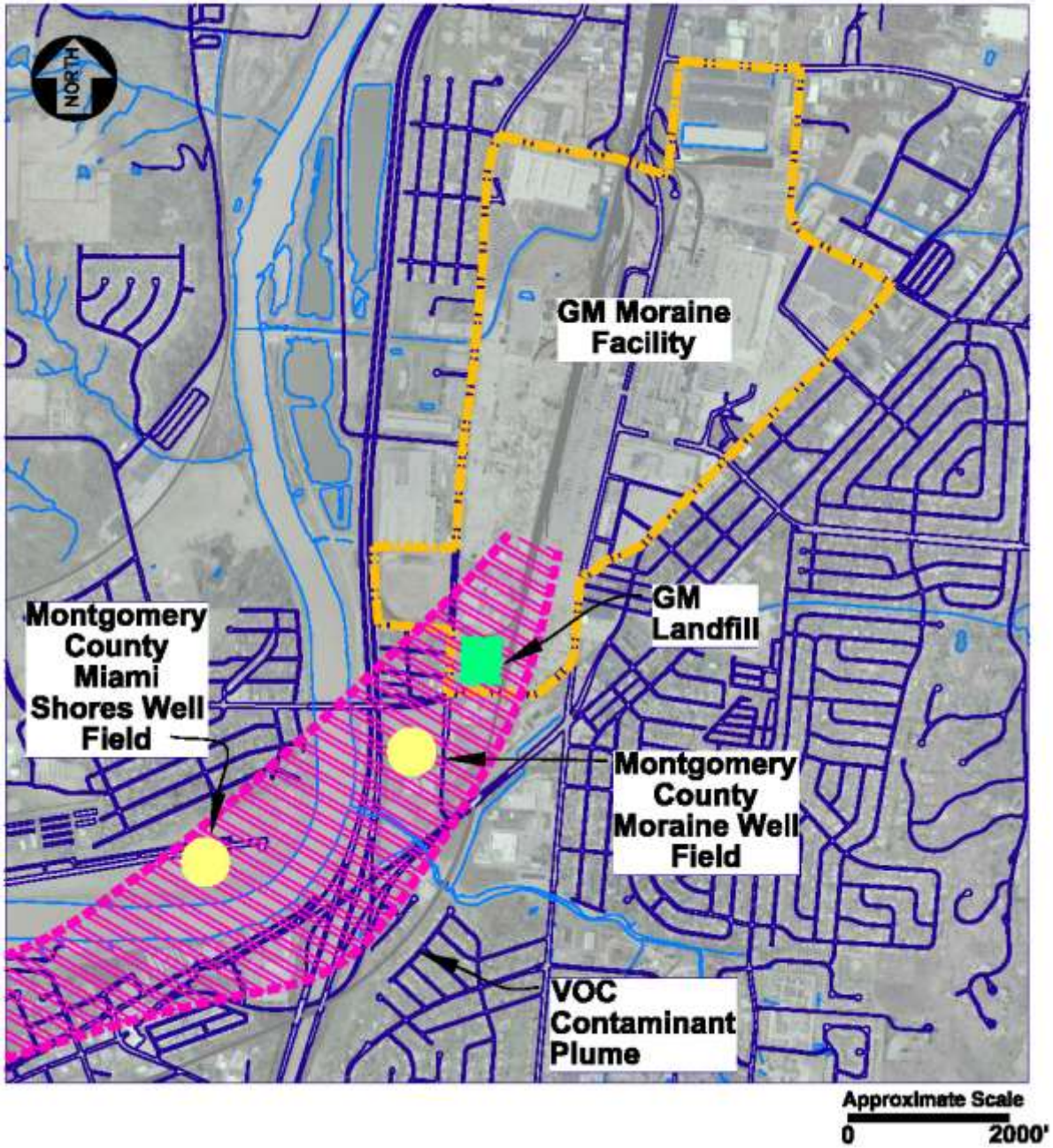
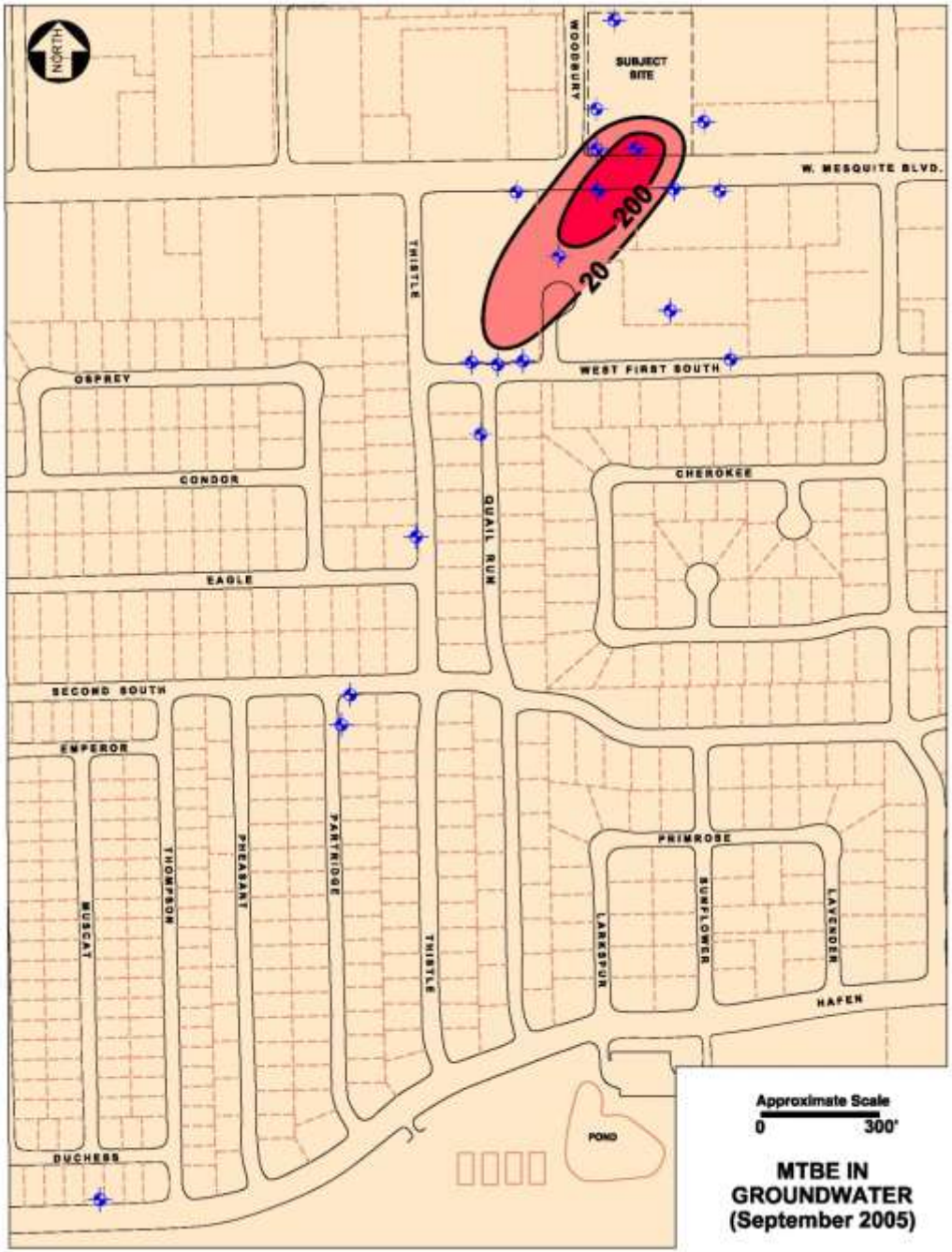
Landfill Location Former General Motors Moraine Facility Dayton, Ohio



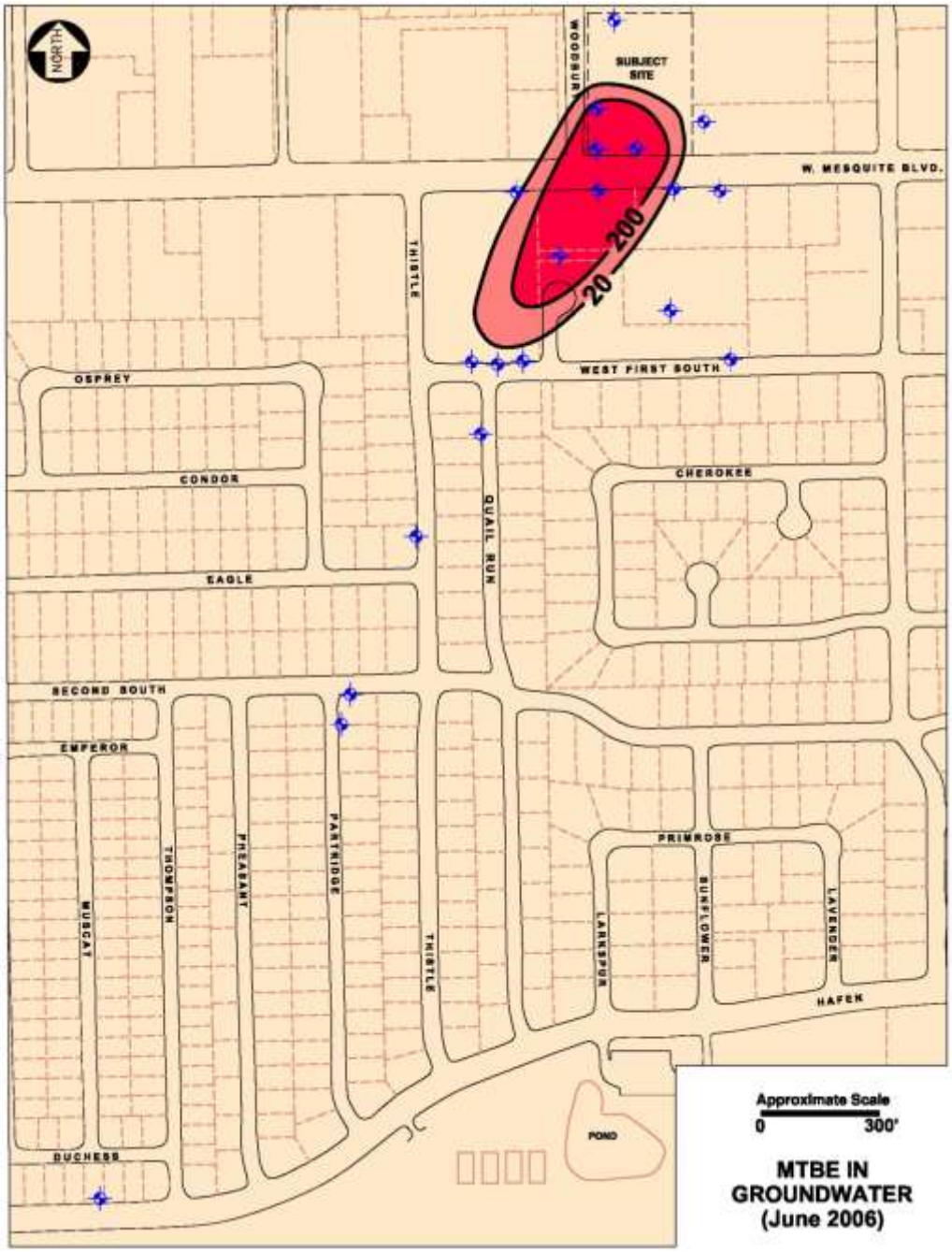
VOC Contaminant Plume Former General Motors Moraine Facility Dayton, Ohio

MTBE Plume Migration
Former Truck Stop, Nevada

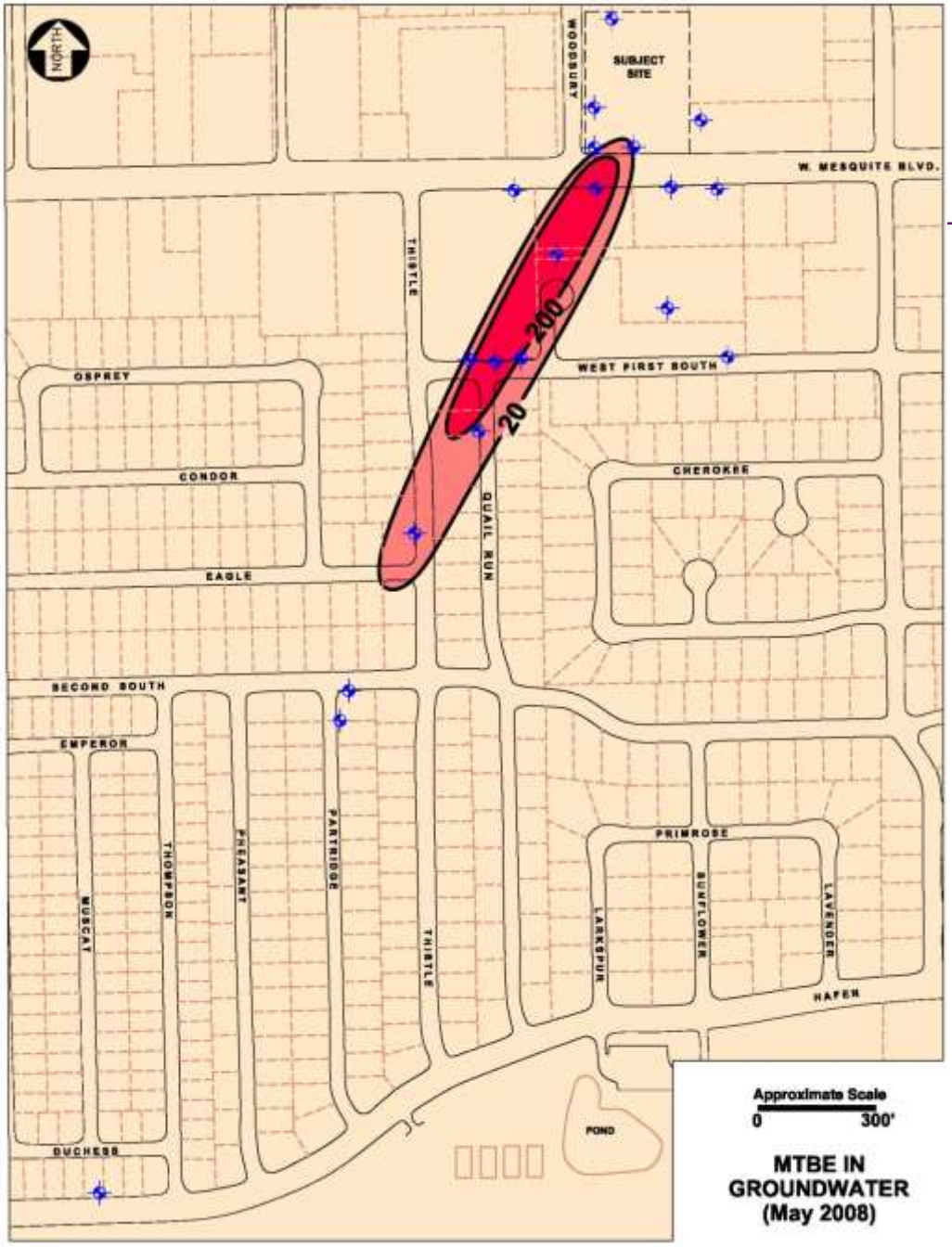
- The following slides demonstrate the migration of methyl-tert butyl ether (MTBE) contamination through sandy soils



MTBE September 2005 Former Truck Stop, Nevada



MTBE June 2006 Former Truck Stop, Nevada



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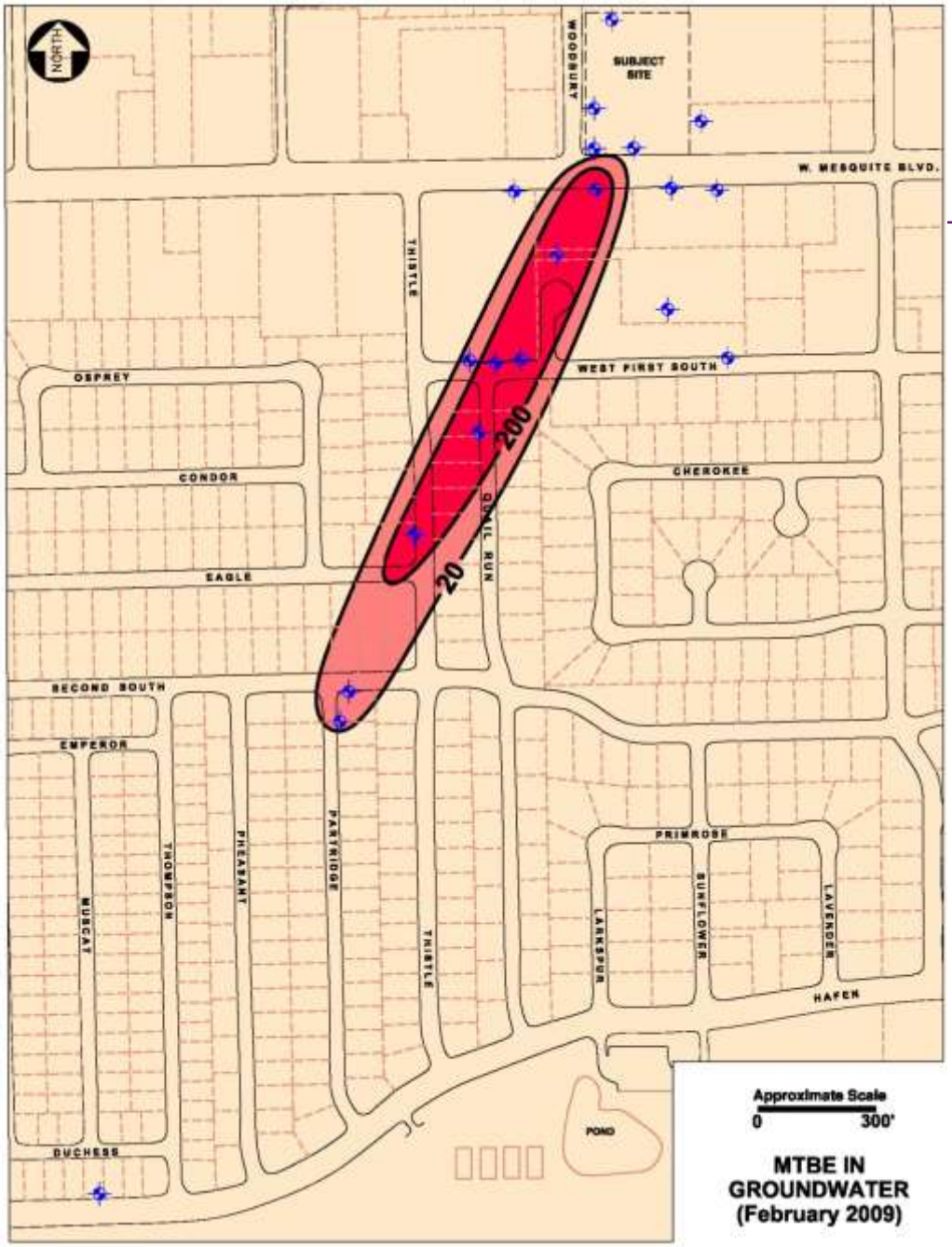
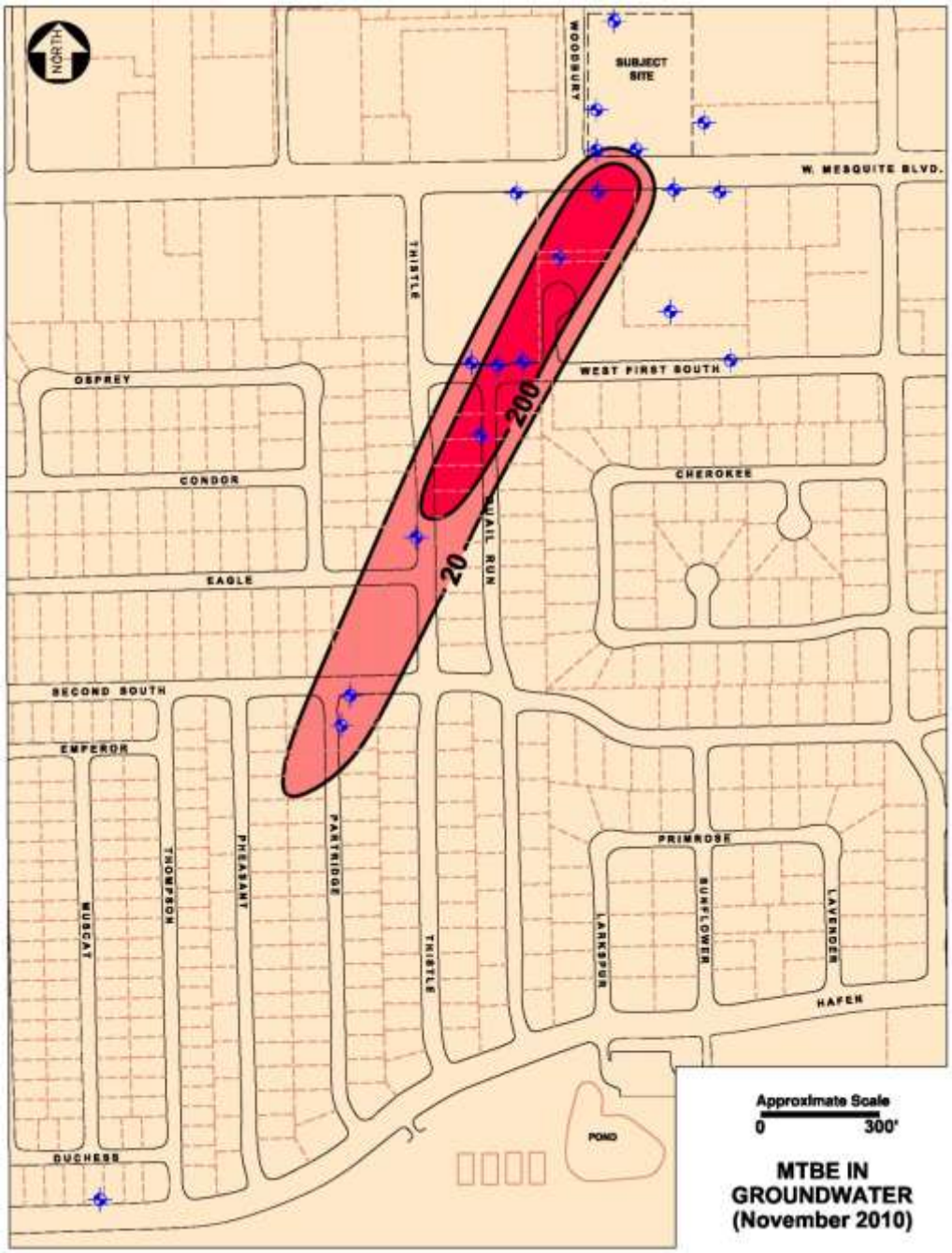
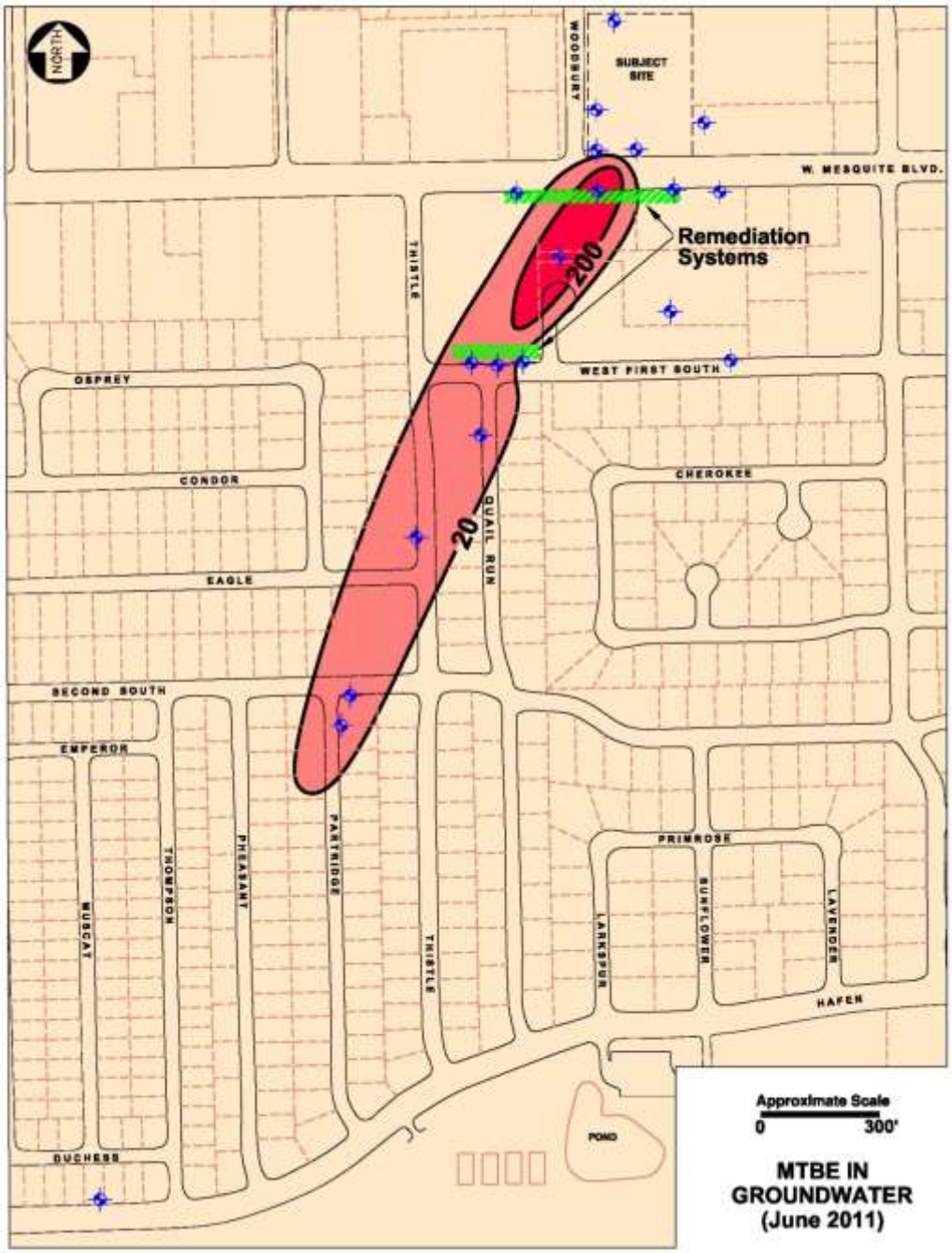
MTBE May 2008 Former Truck Stop, Nevada



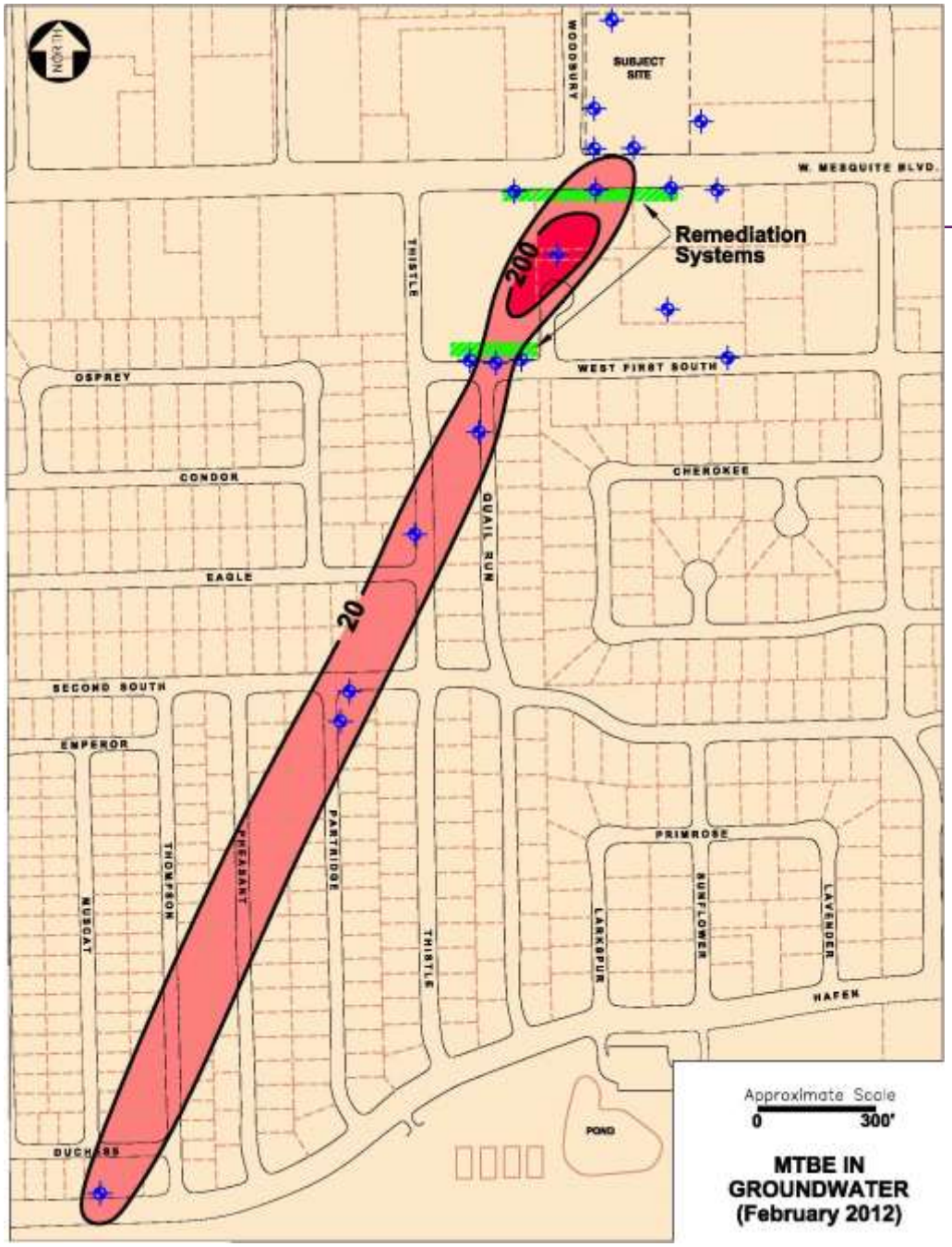
MTBE February 2009 Former Truck Stop, Nevada



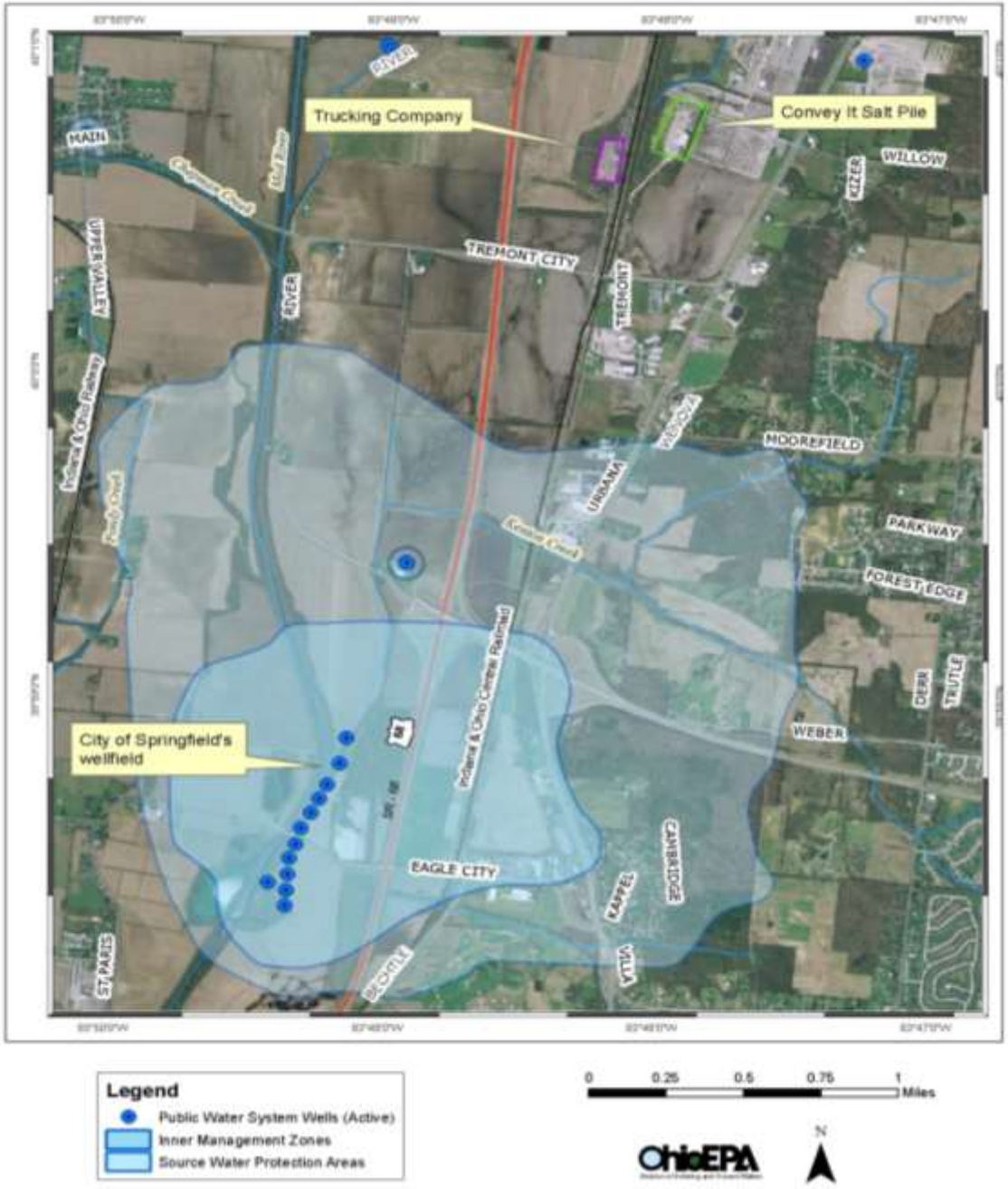
MTBE November 2010 Former Truck Stop, Nevada



MTBE June 2011 Former Truck Stop, Nevada



MTBE February 2012 Former Truck Stop, Nevada



Source Water Protection Areas and Inner Management Zones, Springfield, Ohio

Convey It Salt Pile, Springfield, Ohio

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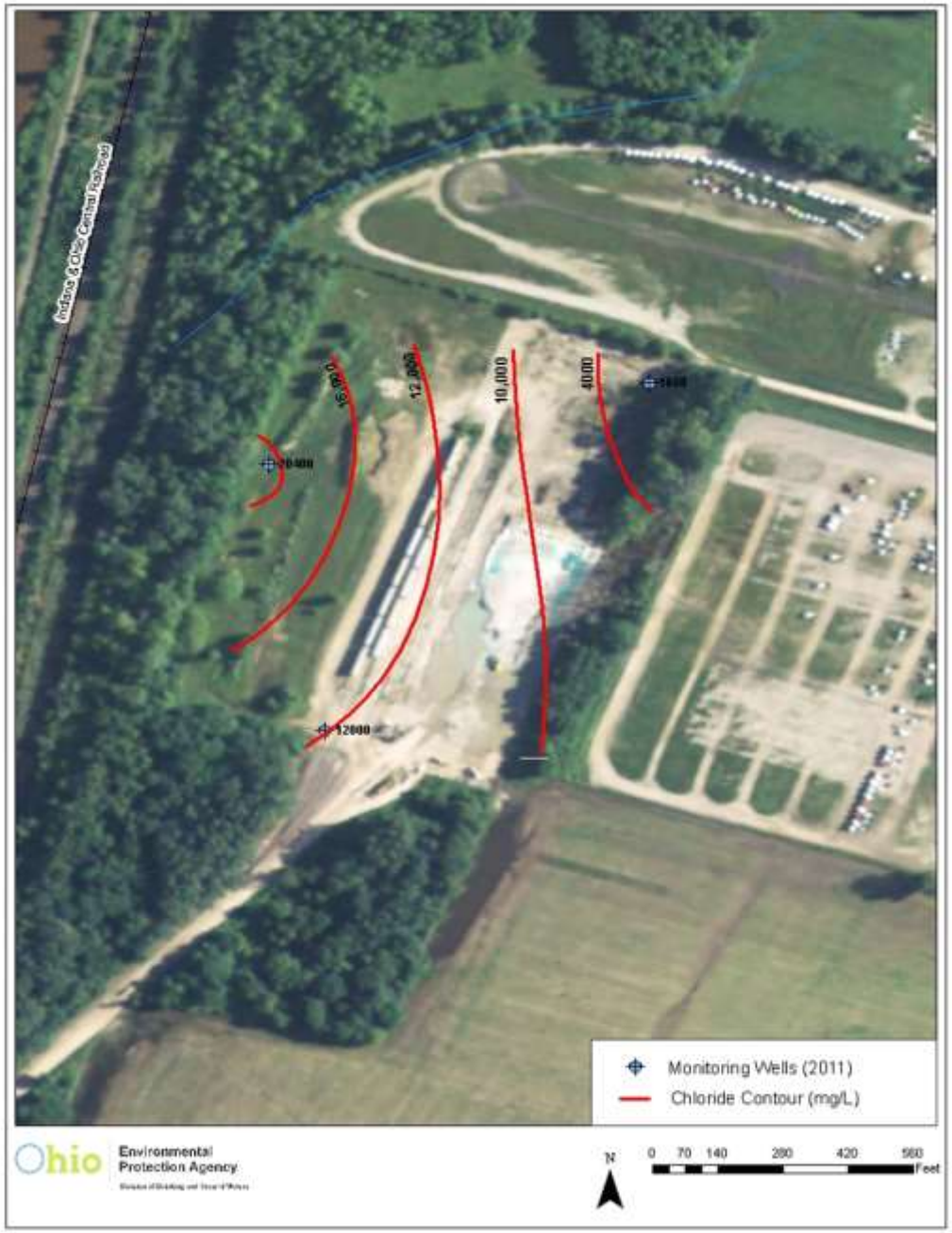

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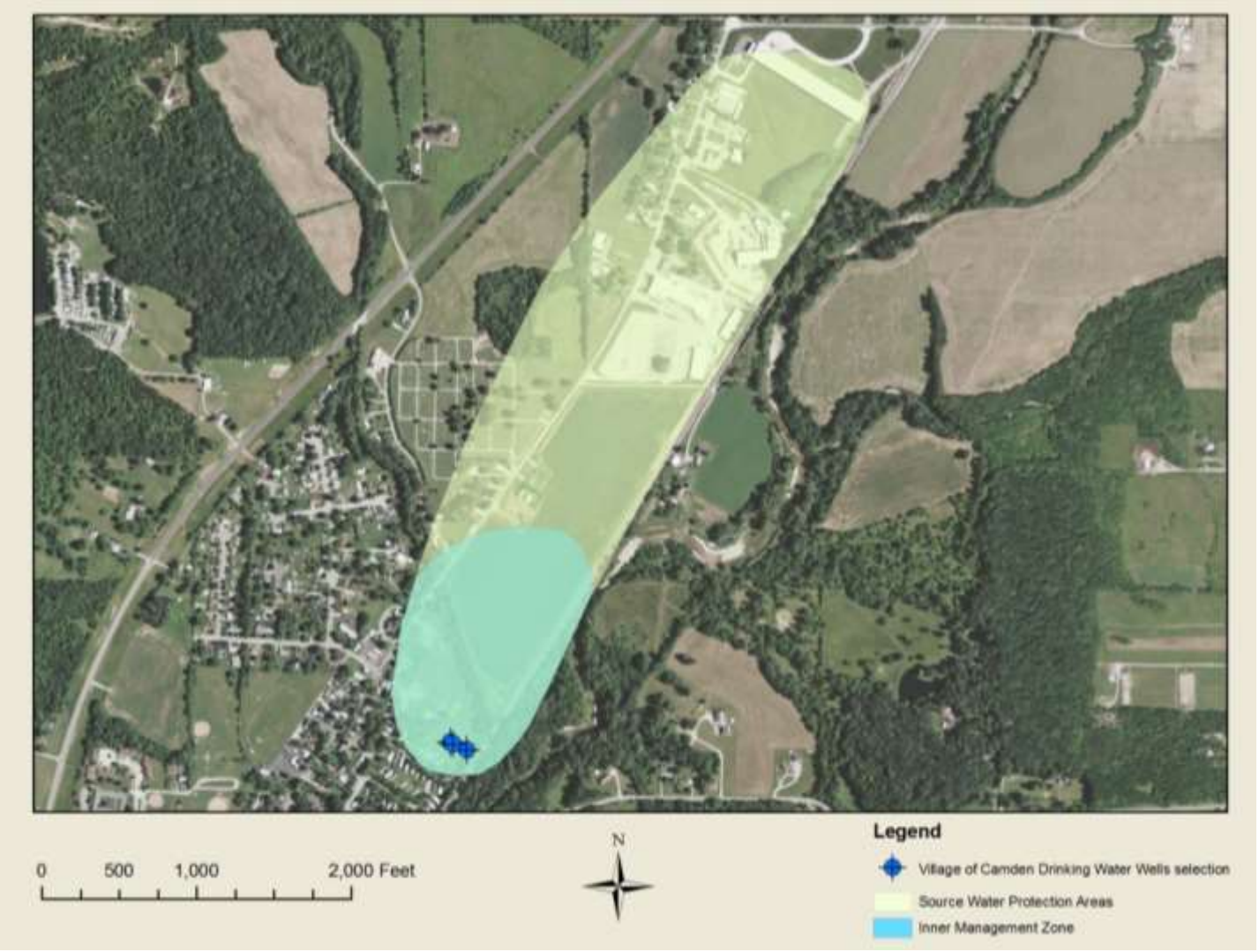
Chloride Concentration Contours, Springfield, Ohio

Road Salt Storage Impact
Village of Camden

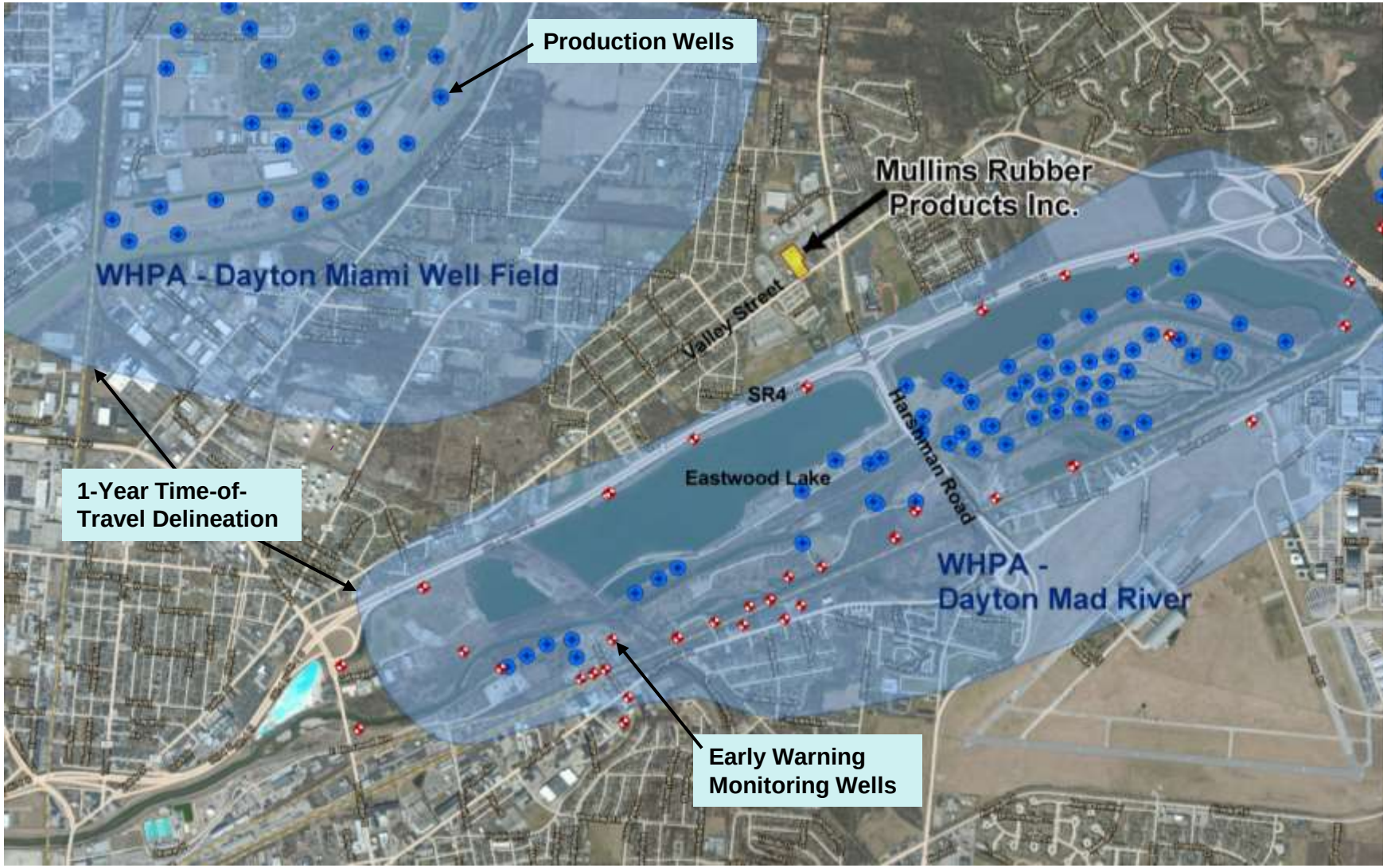
Source Water Protection Area Village of Camden



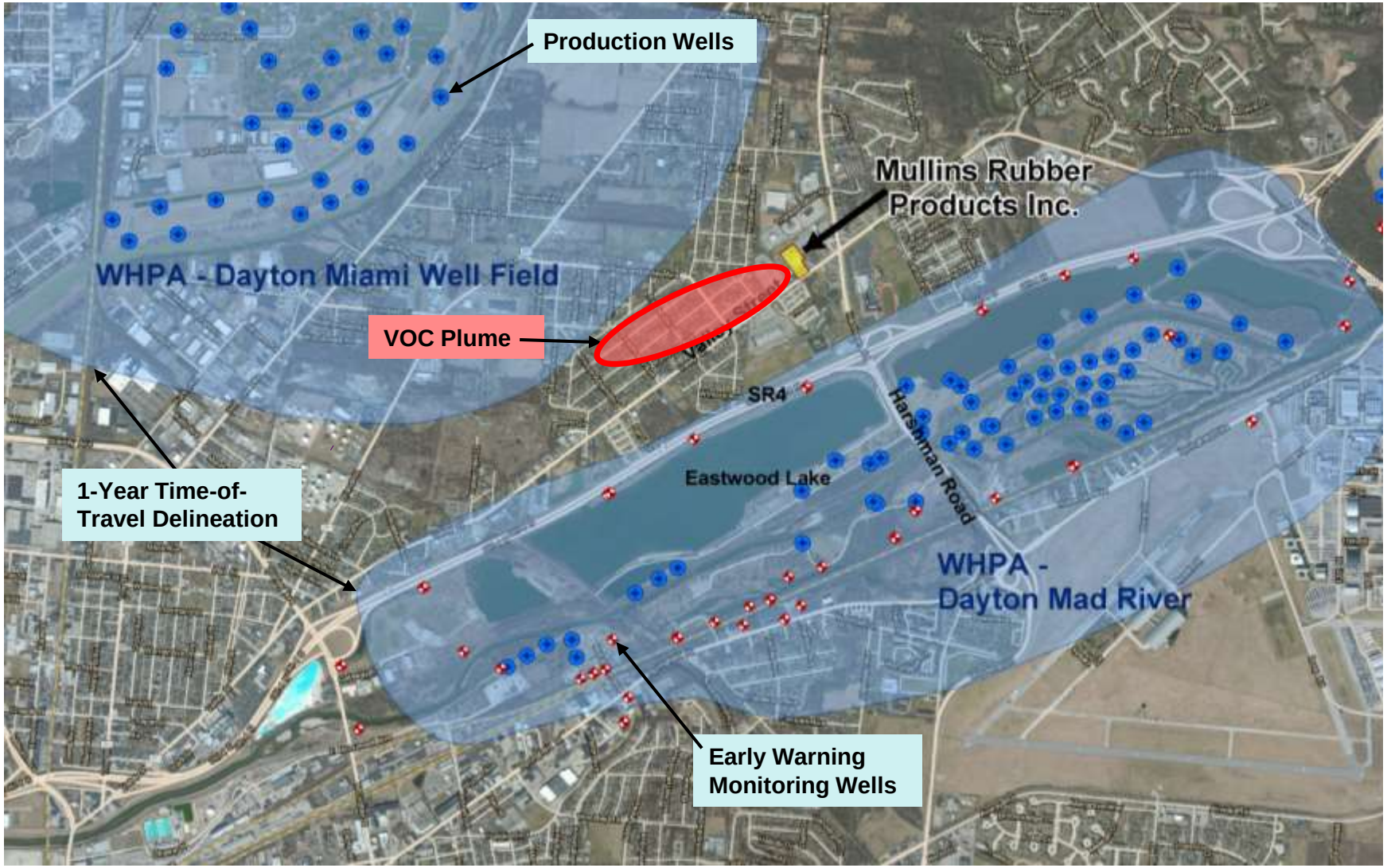
Good Enterprises Salt Pile
Camden, Ohio

Residents Outrage
Village of Camden

Aerial Photo of Dayton Area



Aerial Photo of Dayton Area



What Can You Do?

- Review your Source Water Protection Management Plan
- Become familiar with the Delineation Boundaries
- Drive around your Source Water Protection Area and look for Potential Pollution sources, review your Potential Pollution Contaminant Inventory
- Either collect samples from your existing early warning monitoring system or install one
- Understand what the source water quality is in your SWAP delineation zones

Take Aways

- Threats to our water supply are very real
- In response to the West Virginia incident, the WV Legislature required all public water suppliers to assess the feasibility to establish an early warning monitoring system
- Toledo experienced a water supply crisis
- Contamination can occur

Summary/Closing

- Source Water Protection is an interactive process that involves many stake holders
- There are many challenges to implementing a successful Early Warning Monitoring Program
- By following your Source Water Protection Plan you ensure that you will be providing a Safe and Reliable Source of Drinking Water to your Customers

Questions

- Resources/Additional Information:

- Ohio EPA Source Water Web-Site
- http://www.epa.ohio.gov/ddagw/swap.aspx

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