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Mitigating Other's Messes: A Brownfields Case Study

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What Are Brownfields?

In the United States, there are more than **450,000 brownfields**.

Brownfields are properties that contain or may contain a hazardous substance, pollutant or contaminant, complicating efforts to expand, redevelop or reuse them. Cleaning up and reinvesting in these properties:

- Improves and protects the environment.
- Increases local tax bases.
- Facilitates job growth.
- Makes use of existing infrastructure.
- Takes development pressures off green spaces and working lands.

Source: EPA.gov

Site History

- Early 1900's – former mine (lead, zinc, cadmium)
- 1950s – Tool & Die Facility
- 1960s – Metal Plating Facility
- 2002 – Ownership change
- 2019 – Business sold to new investors

Source: EDR

1938 – former mine

1961 – original building, tool & die

1974

1980-present

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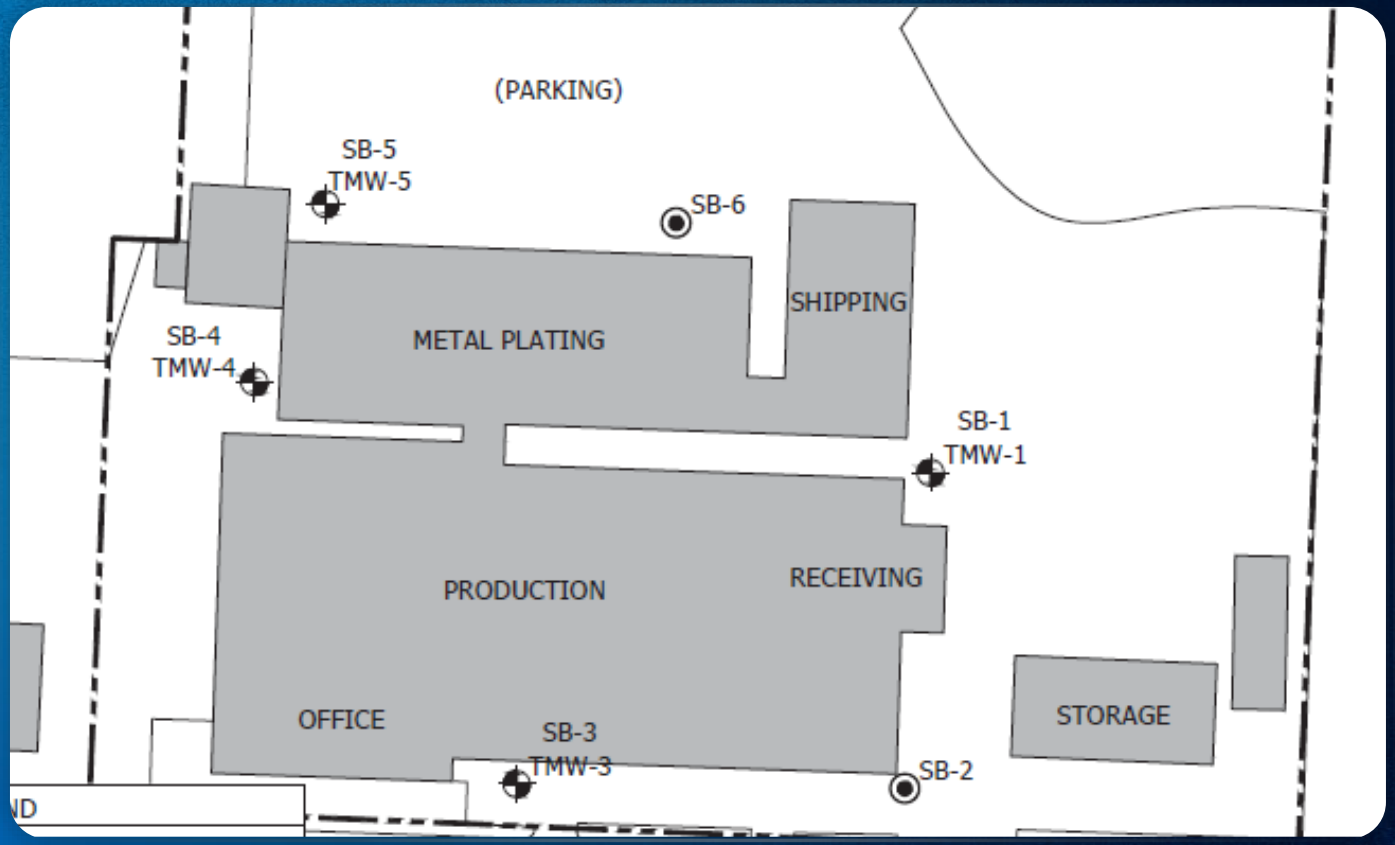
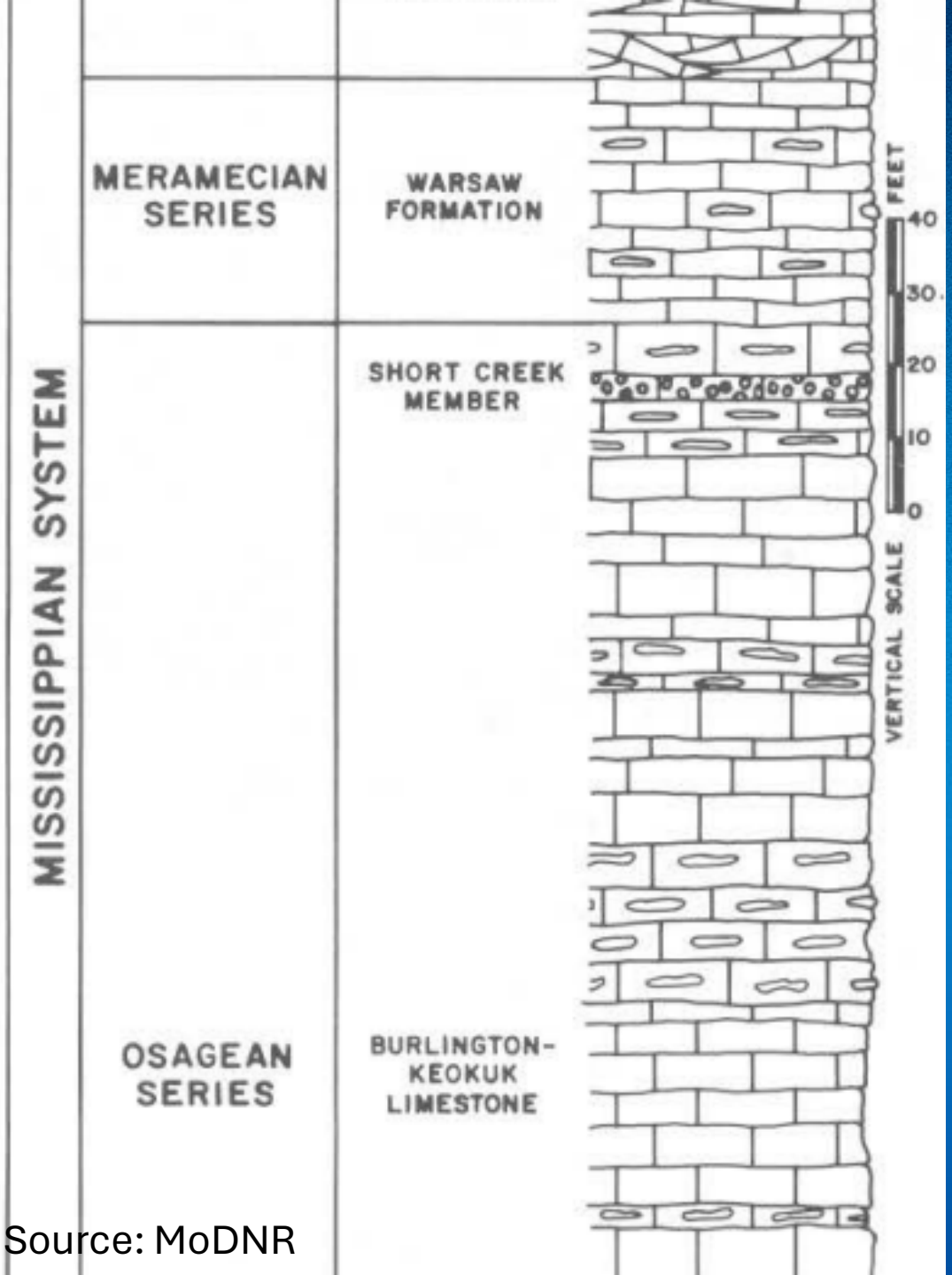
Release Discovery

- Phase II subsurface Investigation as part of potential sale
  - Soil and GW over Missouri screening levels - TCE
  - Mostly near Metal Plating Building
- Enrolled Client in the Brownfields Voluntary Cleanup Program (BVCP)
- Met with BVCP in advance of work plan prep to discuss scope





Source: MoDNR

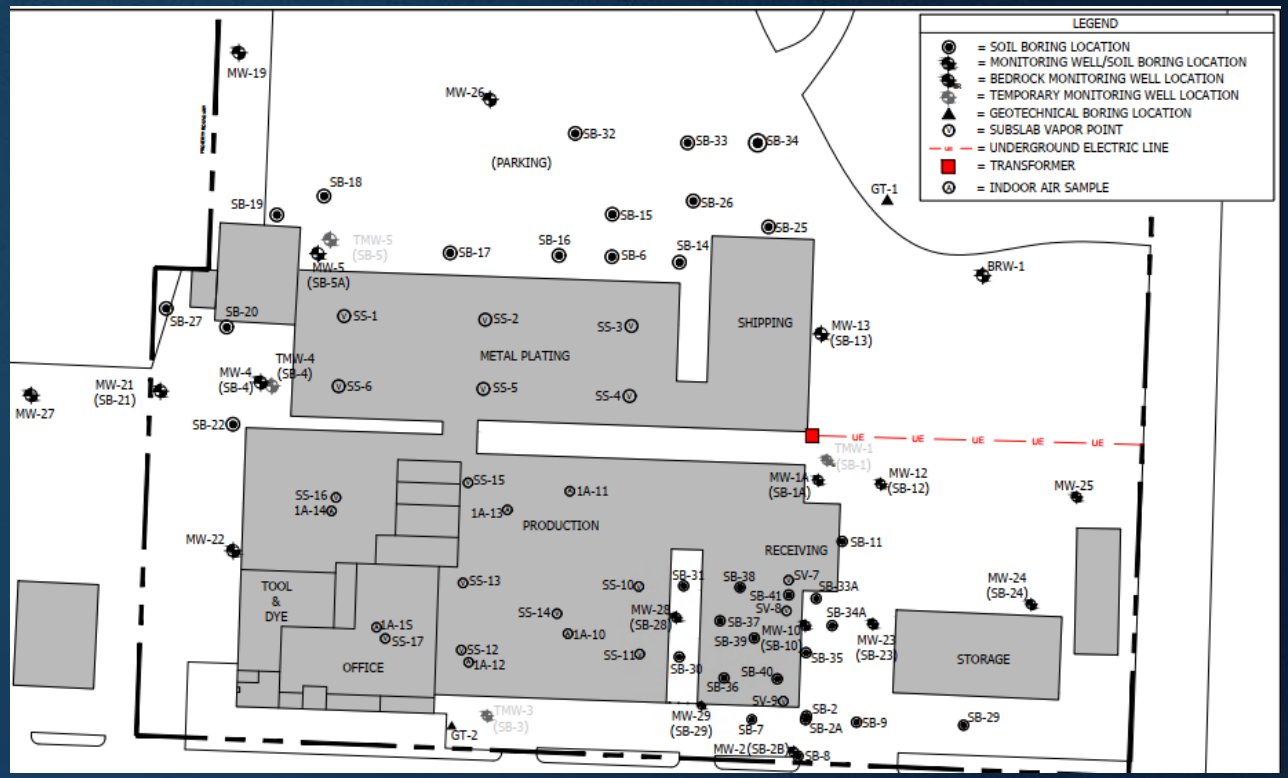
Site Conceptual Model (aka “what we know”)

- Water Well Construction limited by regulation due to Tri-State Mining District
- Uppermost Bedrock – Mississippian Warsaw Formation (interbedded limestone & shale)
- Former mine shafts as potential preferential pathways
- Zoned for Heavy Manufacturing, but residences nearby to north and south
- Indoor inhalation concerns related to TCE – need sub-slab vapor monitoring points around the building
- No TCE use onsite since the 1980s

Site Characterization

- 41 borings
- 17 unconsolidated wells
- 1 bedrock monitoring well (cased to 80’)
- 94 soil samples
- 17 sub-slab soil vapor points
- 11 indoor air sampling locations

FINDINGS: impact highest near southeast building – “former TCE shed area” per interviews with tenured employees



Risk Drivers

No current/future residential use onsite

Drinking water use pathway – incomplete

Soil & Groundwater impact delineated onsite (no-offsite risks)

Indoor Inhalation (current) – samples show no risk to current employees

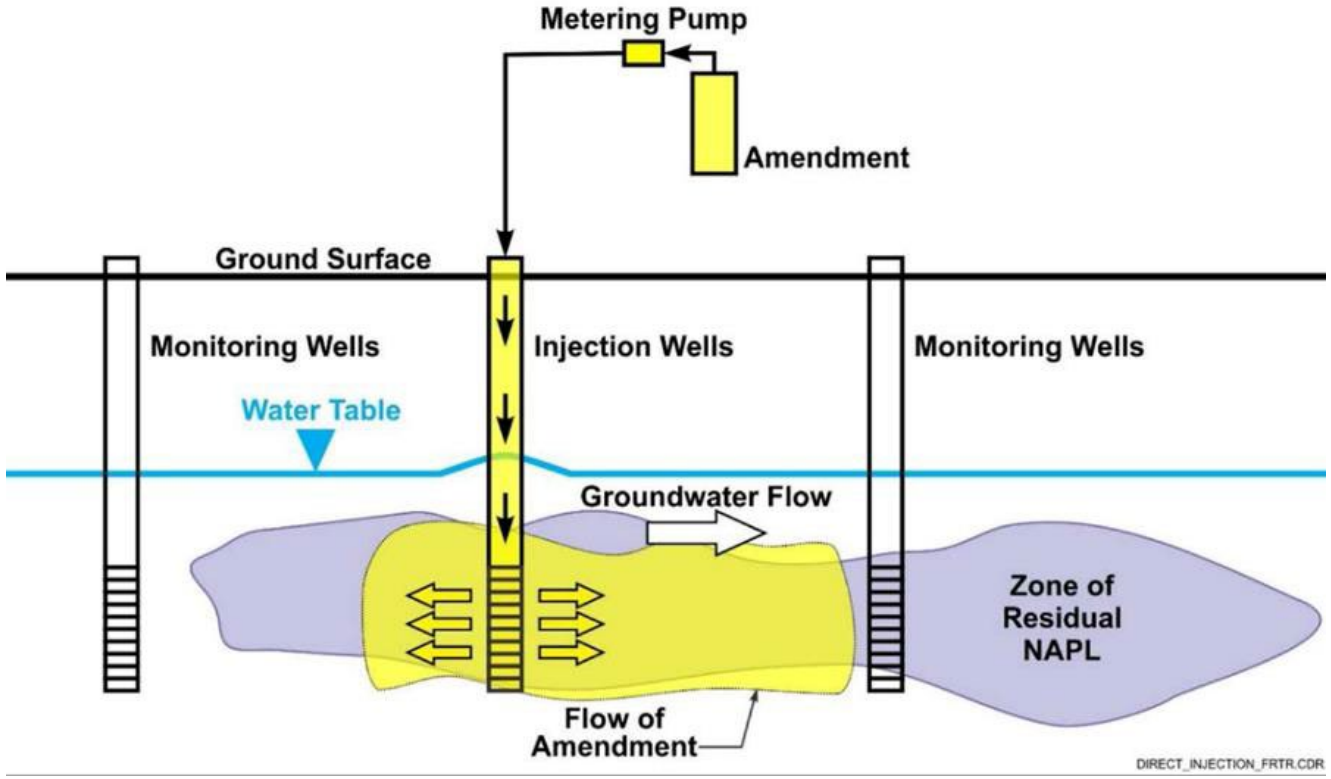
Indoor Inhalation (future) –results indicate concentrations over commercial target levels - Receiving Building only

Construction worker/Surface Soil (future) – heavy metals from mining waste – needs to stay paved or use special contractor for excavation

Remedial Action Plan

Recommended Technologies to Reduce Mass:

- Enhanced Reductive Dechlorination (ERD) – biological
  - Bio-Dechlor Inoculum Plus (BDI-Plus) – anaerobic “bugs” that dehalogenate chlorinated COCs
- In Situ Chemical Reduction (ISCR) – abiotic
  - Sulfidated-MicroZVI (SMZVI) – colloidal zero-valent iron, provides a source of reduced iron to maintain reducing conditions
  - 3-D Microemulsion (3DME) - “vegetable oil” used to extend longevity of both treatments in the subsurface
- Excavation of shallow soil near building to reduce source area.



Source: FRTR.gov

Reductive Dechlorination

- Anaerobic conditions = “reducing conditions” = favorable environment for dehalogenating microbes to strip chlorine atoms & replace with a hydrogen atom.
- “Cheeseburger” Analogy – ISCR & ERD help make sure there’s enough cheeseburgers to keep the bugs happy & working.

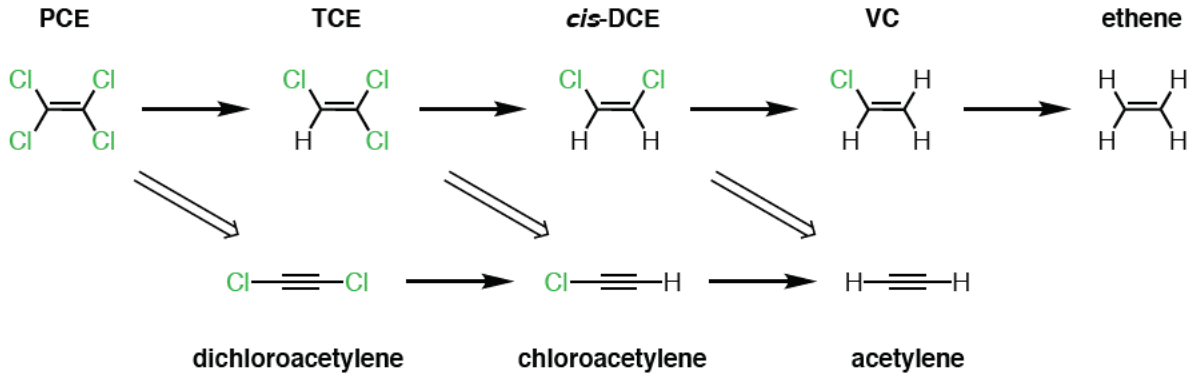


Figure 1: *Chlorinated ethene degradation pathways and products. The top pathway with single line arrows represent the reductive dechlorination (hydrogenolysis) pathway. The lower pathway with downward facing double line arrows represent the beta-elimination pathway.*

Source: Regenesis

Remedial Injection

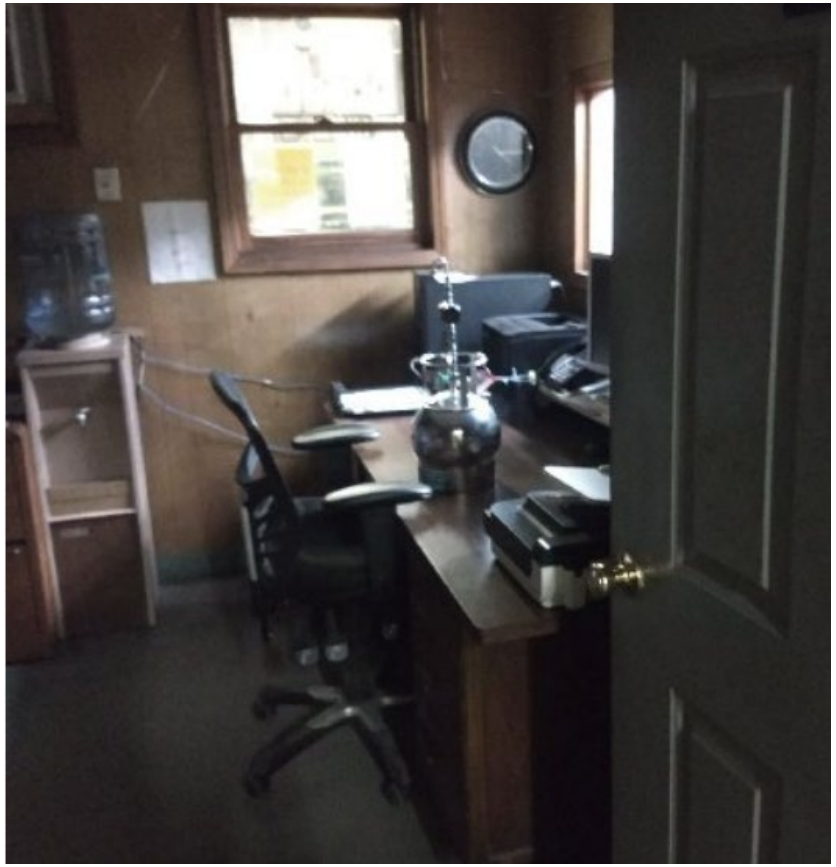
- Grid of 25 points outside
- 4 point inside the building

Excavation

- Approximately 25’ x 35’ area
- Max depth 3-4 ft bgs
- Targeting elevated TCE concentrations 1-2 ft bgs (11-122 mg/kg)
- Approximately 133 tons of soil removed

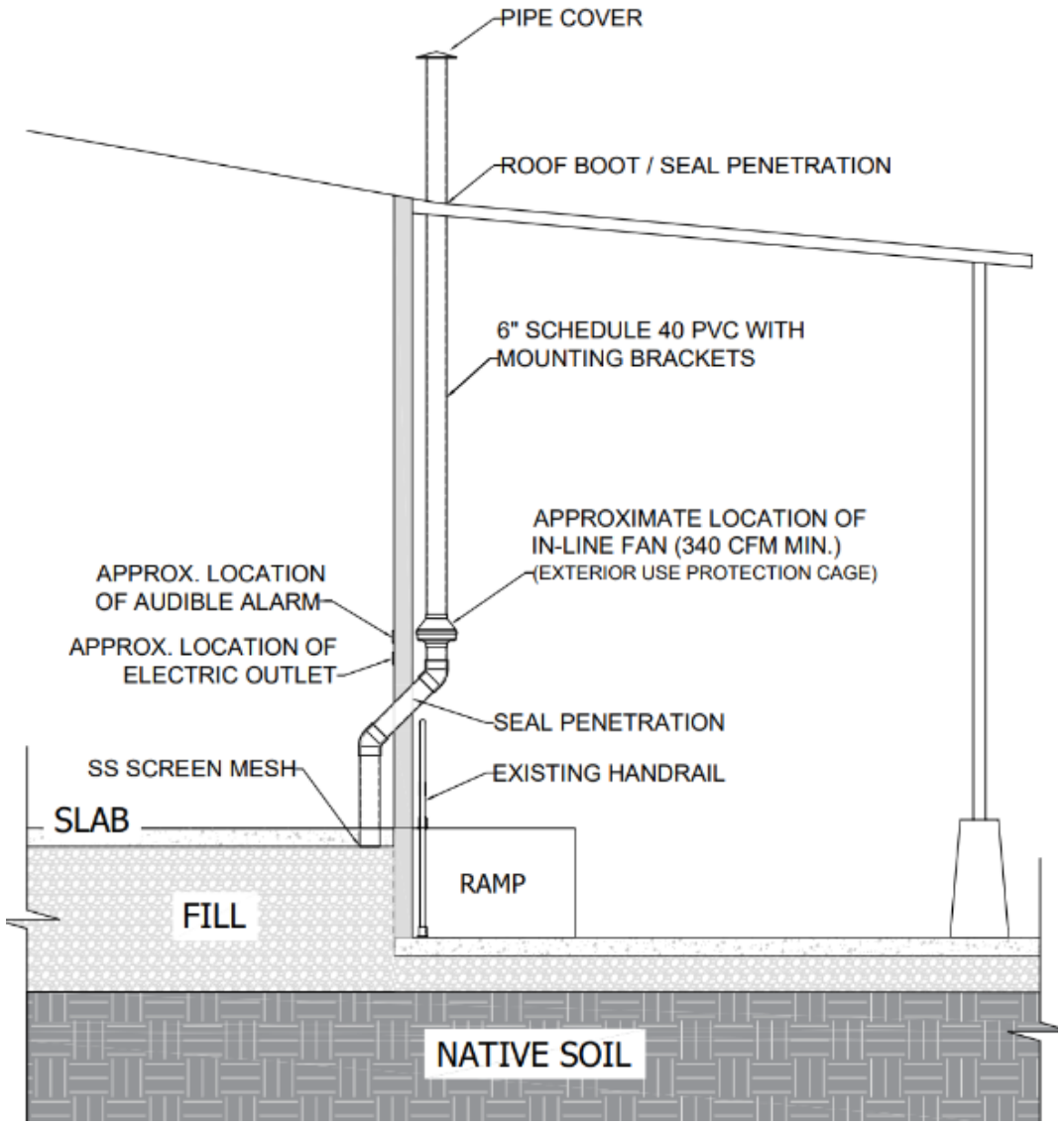
Post-Remediation

- Periodic Groundwater Monitoring, Sub-slab, & Indoor Air Sampling
- Soil Management Plan – to protect future construction workers in area of residual mine waste
- Environmental Covenant / Deed Restriction – no future residential use, no water wells, maintain pavement over high metals areas (or use soil management plan)



Vapor Mitigation System

- Active Sub-Slab Venting
- Similar to Radon System
- Ties into Existing Electrical
- Seal Floor Cracks
- Follow up Indoor Air Sampling – below target levels
- “No Further Action” letter Feb 2024



Questions?

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