



→ **Maggie Popek**
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Contaminated Site Assess & Remed

An Innovative Approach to In-Situ Soil Mixing Applied at a Chlorinated Solvent- Impacted Site in Batavia, New York

Welcome

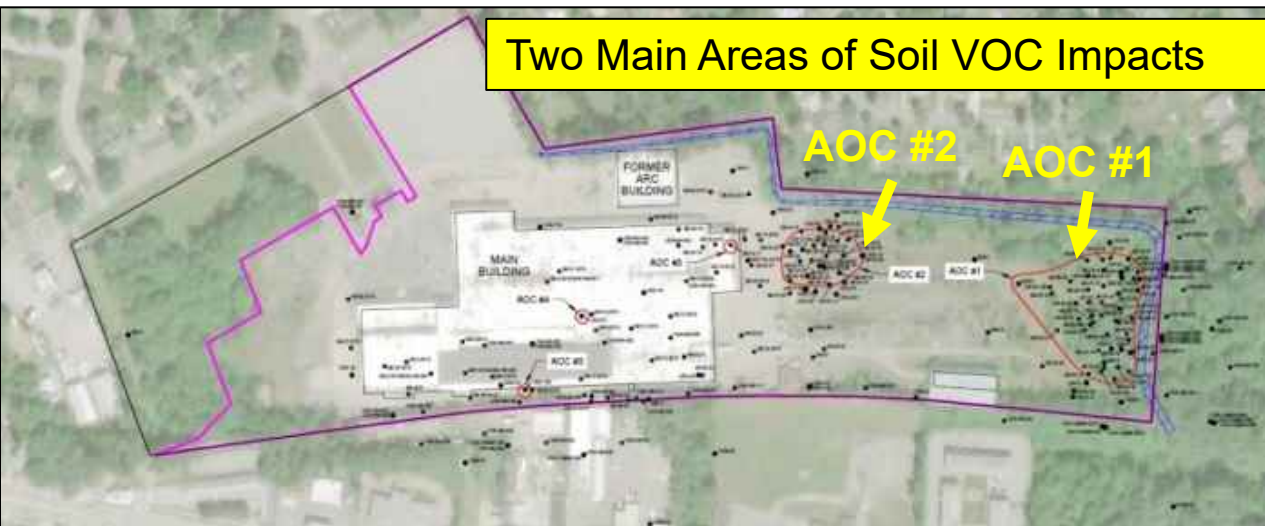
Site Overview



Project Location: Batavia, New York

NYSDEC Brownfield Cleanup Program

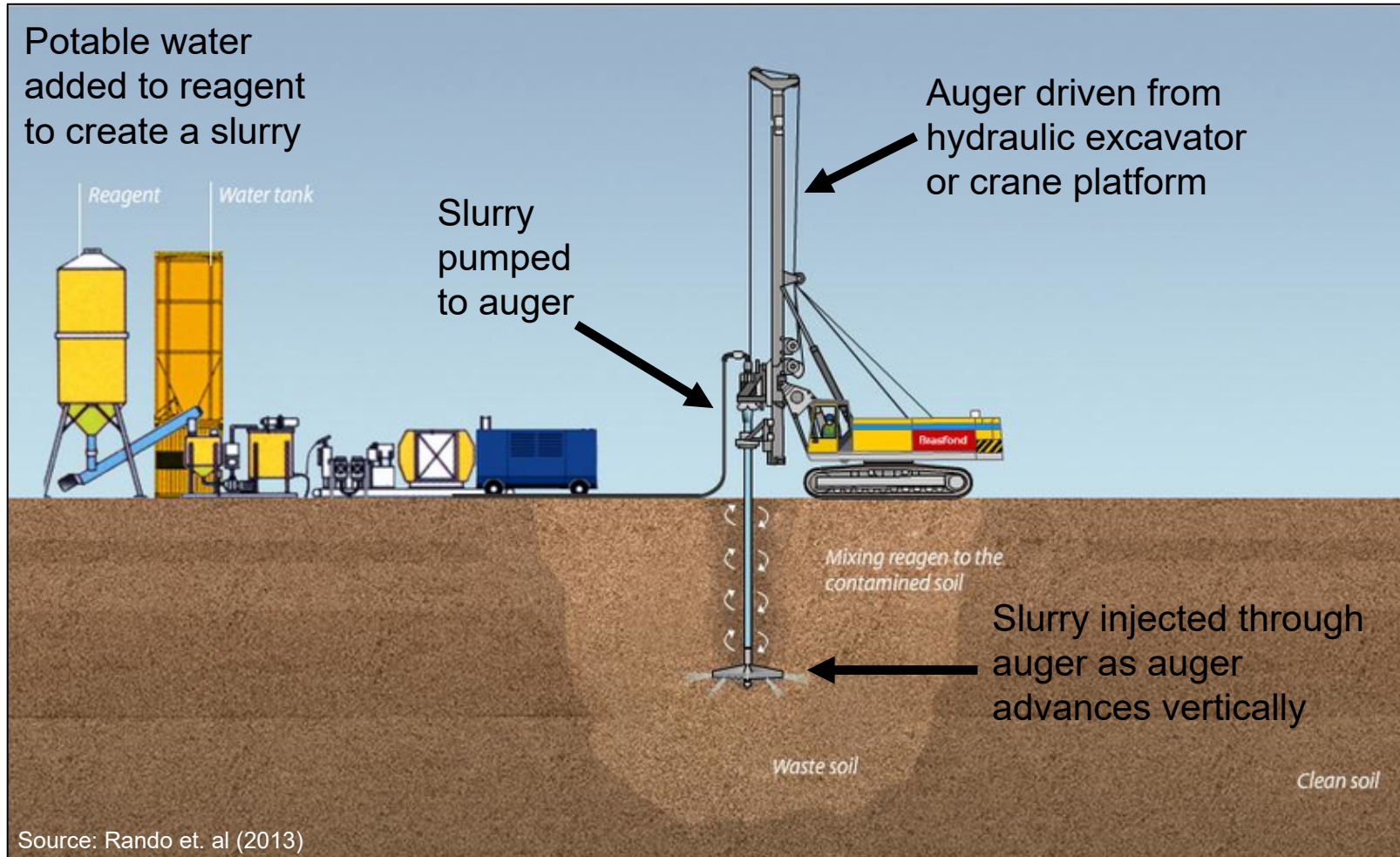
Remediated June 2023 – November 2023



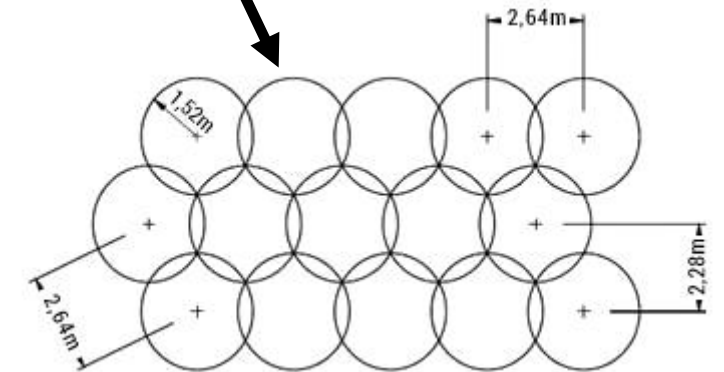
Site used for heavy equipment manufacturing from 1920 – 1996

Chlorinated VOC impacts in soil and groundwater

“Traditional” Large-Diameter Auger Soil Mixing



Mixing columns advanced on a grid system with overlap



Source: Rando et. al (2013)

“Traditional” Large-Diameter Auger Soil Mixing



Photo used with permission of Geo-Solutions, Inc.

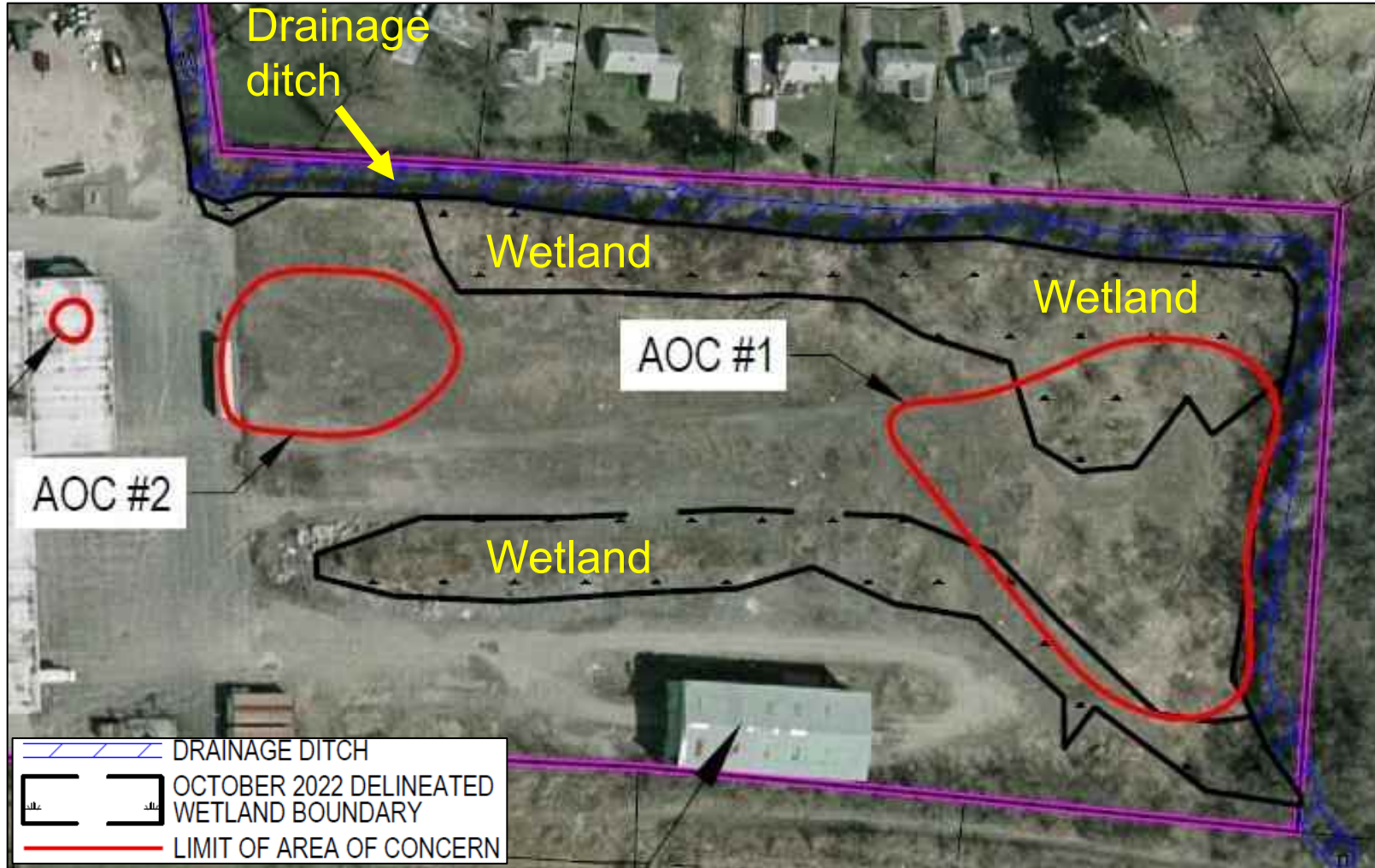
Significant volume of water used

Creates a “pond”

Typically 2-3 feet of soil is excavated prior to mixing to contain the “pond”

Soil excavated in pre-cut typically sent to landfill for disposal

Wetlands



Drainage ditch empties into a large off-site federal wetland

Regulator concerned that fluidization of soils during soil mixing would cause transport of VOC-impacted soils from the mixing areas into the adjacent ditch and wetlands

Needed to prevent potential discharge during construction (soil mixing) → very high priority

Drainage Ditch and Wetlands



Drainage Ditch and Wetlands



Drainage Ditch and Wetlands

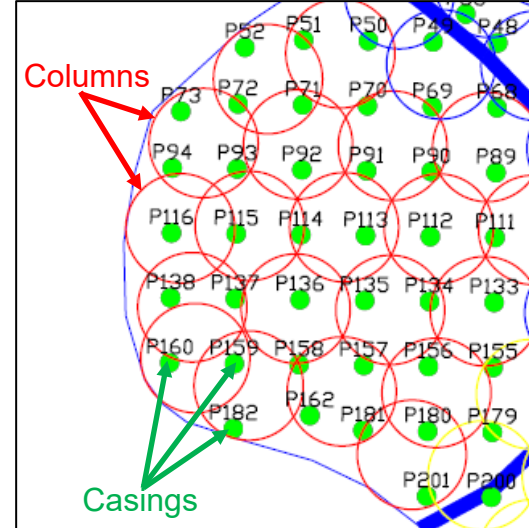


“Casings Method” of Soil Mixing – Developed by Geo-Solutions, Inc.



Remove Casing,
Leaving Reagent
in Subsurface

Install Casing



Install casings on a grid system

Number of casings needed is determined by reagent dosing requirement

Casing spacing must be small enough to promote uniform lateral mixing when considering diameter of mixing auger

May not be suitable for very low reagent doses (casing spacing too high)

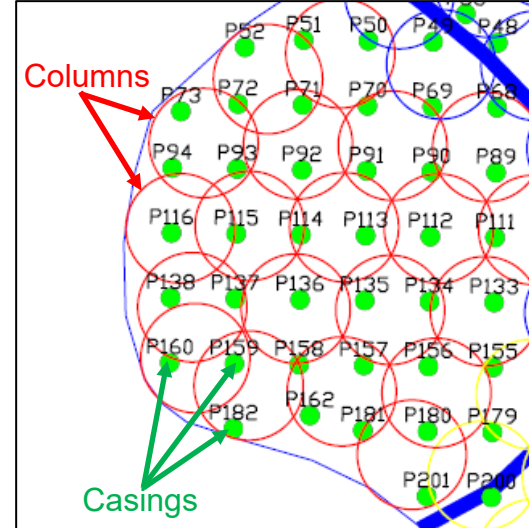
Fill Casing with Reagent



Remove Casing



Mix Column



Columns also mixed on a grid system
Column diameter is diameter of mixing auger
Overlap in columns to prevent unmixed areas

Water is used as drilling fluid, but no need to inject a slurry → Significantly less water introduced into subsurface

Not a Perfect Process...



Sometimes reagent did not entirely slip the casing, resulting in “molehills” of reagent left at the ground surface

“Molehills” subsequently mixed into subsurface with auger, but potential for non-uniform vertical mixing and under-dosing of column

No obvious cause of “molehills” → i.e., tried varying casing extraction rate, etc.

Opportunity for continued innovation

Advantages Over “Traditional” Method

~175,000 gallons of water introduced into subsurface

Estimate ~400,000 – 700,000 gallons of water would have been introduced into subsurface using “traditional” auger mixing method

Minimal fluidization of soil

Less post-mixing swell

Reduced risk of discharge to wetlands and drainage ditch



Minimal Fluidization of Soil, Less Swell



Minimal Fluidization of Soil, Less Swell



More Sustainable Approach



No pre-cut required → No landfill space used

Estimate up to ~4,200 tons of soil would have required excavation and disposal using “traditional” auger mixing method

Less water needed → More sustainable use of water resources

Swell is not highly fluidized → Site in better condition for post-remedial grading and management

Opportunities for Continued Innovation



More complete delivery of reagent to subsurface
→ Minimize occurrence of “molehills”

Test uniformity of horizontal and vertical mixing →
This project did not require post-remedial soil
sampling or quantitative proof of uniform mixing

Cost control → New method more expensive
because of two-step process

Develop additional methods of performing large-
diameter auger mixing to minimize use of water

Quick Stats

Installed 804 casings and mixed 616 columns

Used ~500,000 pounds of Daramend®
(manufactured by Evonik)

Mixing footprint was ~0.58 acres

Treated ~300,000 cubic feet of soil

Treated soil from ground surface to maximum
depth of 16 feet below ground surface

Total Cost = \$3 Million (site prep, subs, reagent, engineering oversight & management)



Questions





*** Thank You**