# In-Situ Stabilization of Impacted Organic Peat During Ongoing Development

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# Introduction

- Site History
- Why ISS?
  - Reagents and Key Benefits
  - Environmental Remediation Goals
  - ISS Method – Bucket
  - Site Implementation Considerations
- Basis of Design
  - Treatability Study
  - Site Layout and Laydown Area
  - Sequence
- ISS Implementation
  - Equipment
  - Quality Control
- Project Challenges

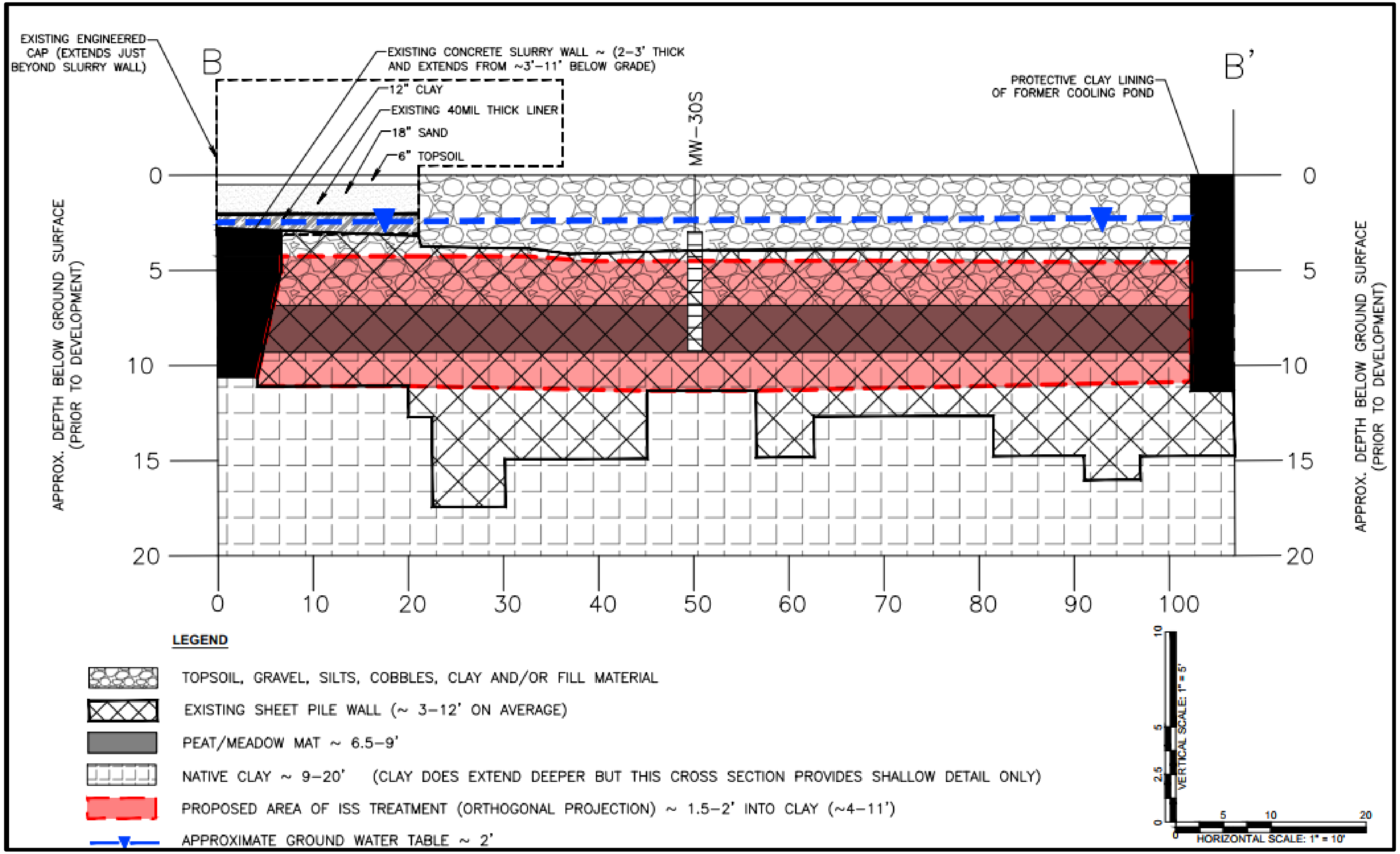
# Site History

- Former chemical manufacturing facility
  - Closed in 2002
  - Dormant until 2016
- NJ Brownfields Program – slated for development of a warehouse
- Fast timeline for regulatory closure

# Site History

- COCs
  - Benzene
  - Chlorobenzene
  - TCE
  - Evidence of LNAPL and DNAPL
- Mostly high impacts in variable thicknesses of meadow mat (peat)
- Cascade was contacted for permeability enhancement of meadow mat for amendment injection
- To achieve schedule and reduce mobility of contaminants, Cascade recommended ISS

# ISS Target Depth



# Why ISS?

- Cost-effective alternative to conventional remediation options
- Scalable technology from 1,000 cy to 100,000 cy
- Nationally accepted metrics to measure success of treatment
- Provides an opportunity to incorporate a variety of reagents to promote binding &/or destruction
- Can effectively treat broad range of contaminants
- Technology eliminates landfilling and trucking of waste; and trucking backfill to and from the site and the purchase of imported backfill
- Improves subsurface through addition of various amendments
- Reduces carbon footprint from dig and haul

# Reagents and Key Benefits

Typical reagents used for fixation of inorganics and sequestration of leachable organic compounds as part of a containment approach include:

- **Portland Cement (PC)** – used to improve unconfined compressive strength (UCS) and provide higher early strength and cure
- **Ground Granulated Blast Furnace Slag (GGBFS)** – used to provide reduced permeability and higher strength with longer cure in the final matrix
- Bentonite – used for a variety of purposes including permeability reduction, fluid loss mitigation and mixing tool lubrication
- Carbon – used for entraining certain organic contaminates and reducing leachability
- ISCO/ISCR - oxidizing or reducing reagents like peroxides, permanganates, persulfate, zero-valent iron, etc.
- Accelerators for early strength

# Environmental Remediation Goals

- Creation of a uniform soil-reagent mass or monolith throughout the entire treatment zone with improved properties:
  - Increased unconfined compressive strength > 50 psi
  - Decreased permeability < 1 X $10^{-6}$ cm/sec
  - Decreased contaminant solubility, leachability to meet SPLP, ANSI 1610, LEAF, etc.

# ISS Methods - Bucket


- Excavator-based
- Depths of 30 feet or less
- Lower cost
- Mixing in vertical and horizontal planes
- More suitable with subsurface obstructions
- Native clays mixed/dispersed vertically

- Less mixing energy
- Reagent distribution keyed to mixing technique and effort

# ISS Methods - Auger

- Large diameter up to 10 feet
- Depths upwards of 100 feet
- Mix greater soil volumes with each column
- Excellent mixing energy and distribution of reagents

- Higher costs
- Not conducive with high degree of subsurface obstructions
- Mixing in horizontal plane
- Continual circulation of fluid during mixing

# Site Implementation Considerations

- Site layout and ISS sequencing needs to be carefully planned for both implementation and future redevelopment of a property
- Locating and configuring Support System for both Resource Delivery as well as ISS implementation
- Depth of Initial Excavation to manage Swell Generation while ensuring Final Grade and Restoration Plans can be achieved
- Redevelopment goals, structural integrity and utility corridors to minimize disturbance of final ISS monolith after

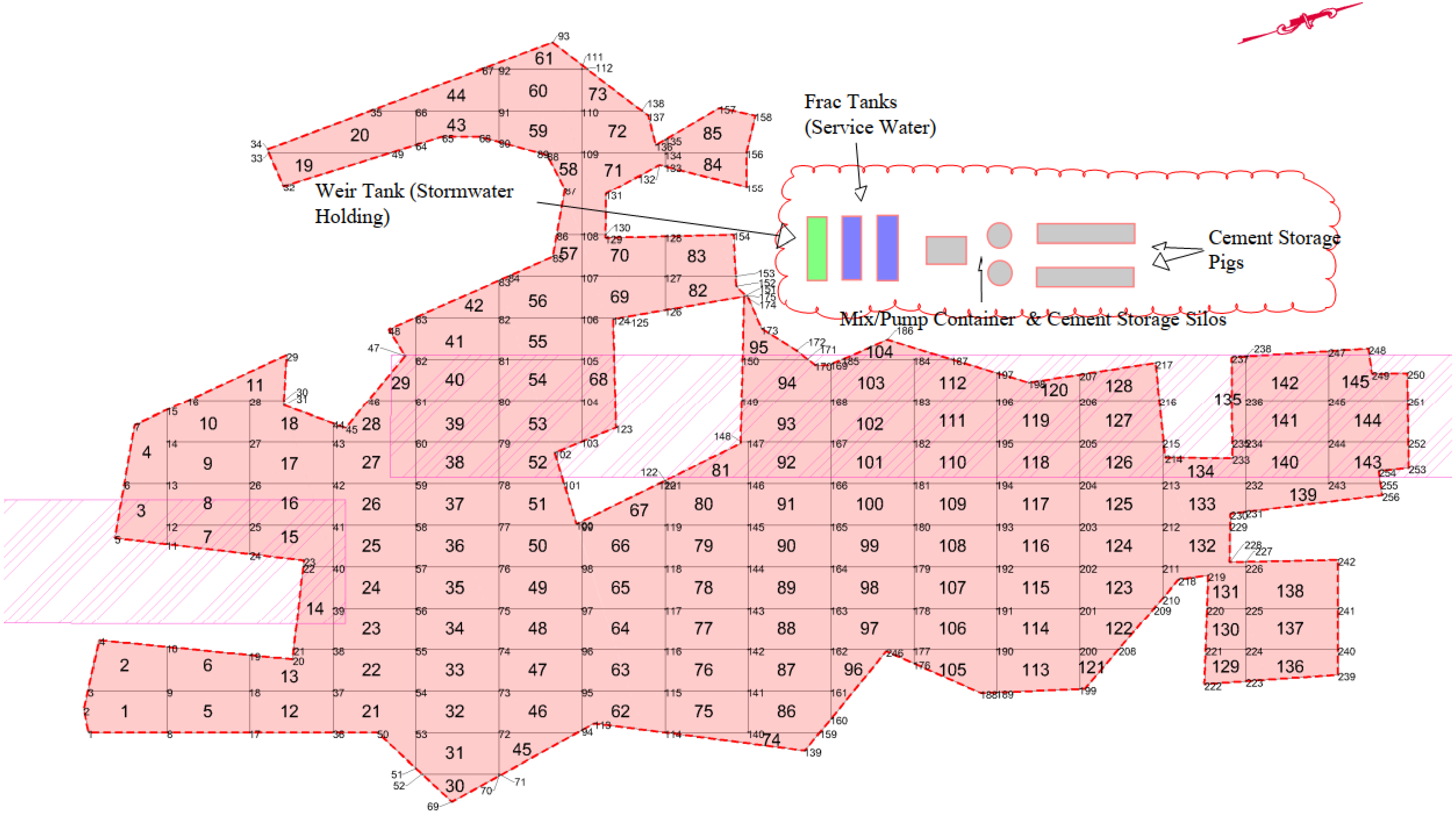
# Basis of Design

- Treatability study to optimize reagent formulation
- Modified mixing technique and amendment due to organic peat
  - Excavator bucket mixing with specialized skeleton bucket for homogeneous mixing within each cell and through meadow mat to and into a confining clay unit
  - Cement accelerator and adjustment to water to reagents ratio conducted to improve rates of curing and performance
- Pre-delineated high contaminant cells were excavated, treated and sent off-site for disposal
- Site layout and sequence to stay in front of pile installation contractor

# Treatability Study

- Sample Collection from Treatment Zone
- Baseline sample for Total and SPLP
  - VOCs, SVOCs, TAL Metals
  - Grain size distribution and dry/unit wet weight
- Composite material mixed with various ratios of PC, GGBFS and water
- Cast in 3x6 inch molds and cured at ambient temperature
- Analyzed at 7, 14 and 28 days
  - UCS
  - Permeability
  - Leachability
- **Mix Design**
  - **8% GGBFS, 4% PC, 2% CaCl2**
  - **Water to reagent ratio of 0.5**

# Site Layout and Laydown Area



# Site Layout – 30,000 CY

# Equipment

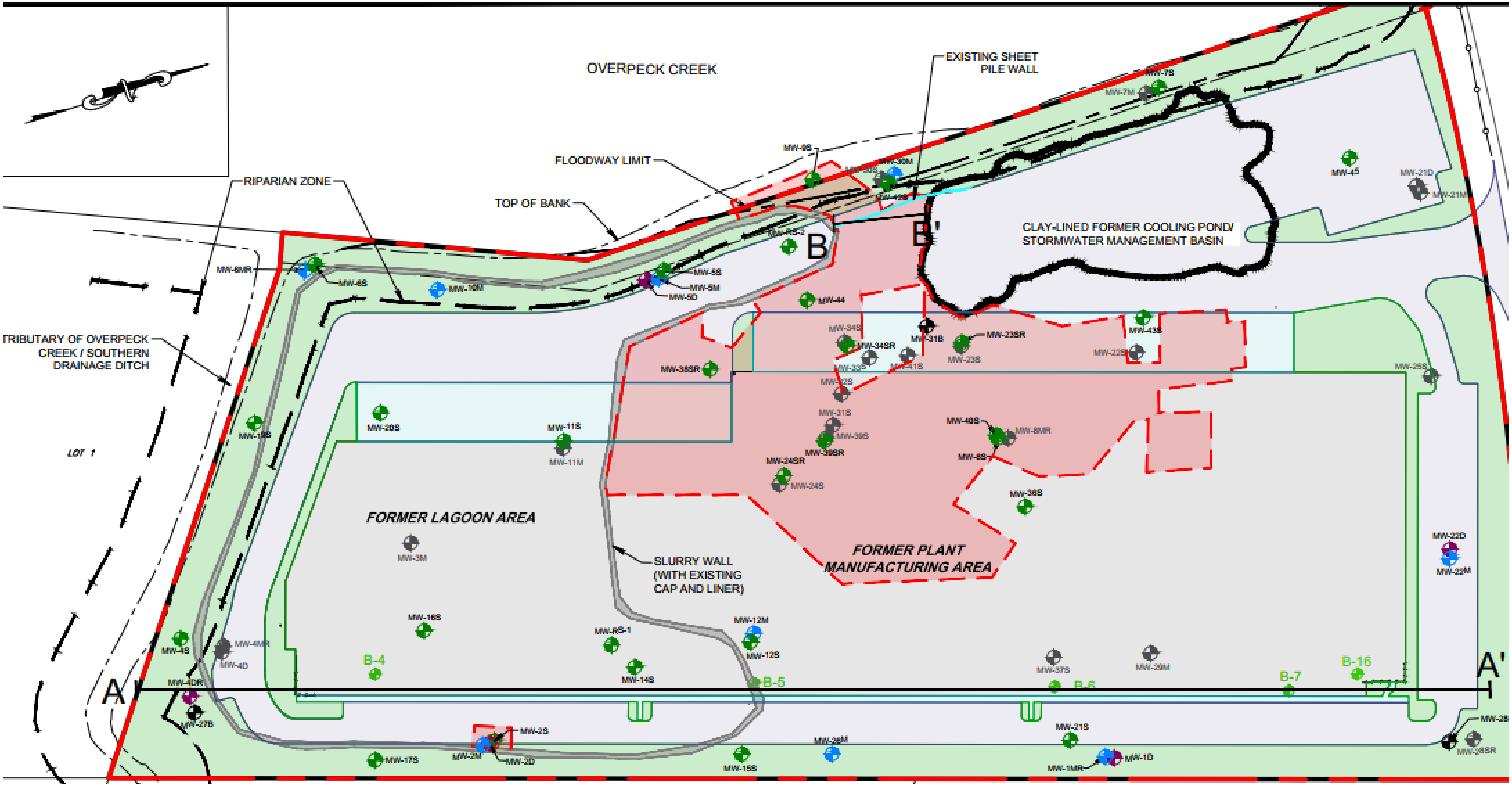
- 100,000-lb excavator with skeleton bucket
- Scheltzke Batch plant (capable of 40,000 gal slurry/day)
- Two 60 ton silos
- Two storage bins or pigs for additional capacity
- Air compressor
- Office trailer

# Quality Control

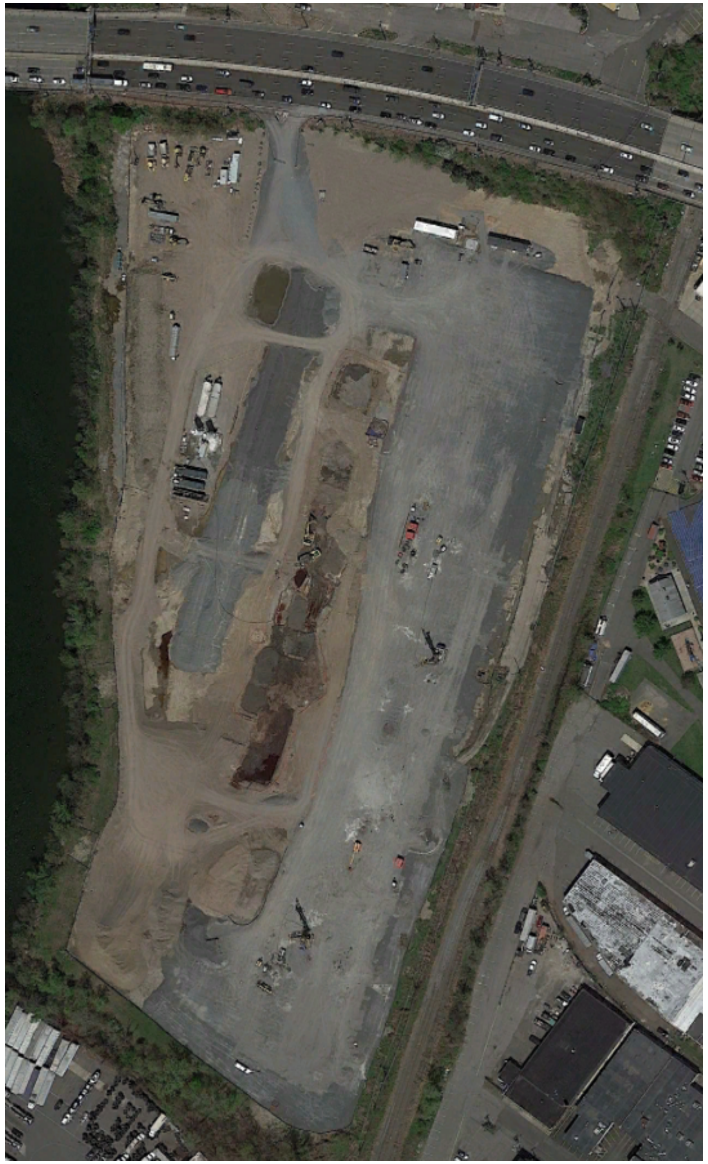
- Discrete sampling - 1/500 CY
- GPS Tracking
- Batch calculations with logged inputs
- Logged outputs – volumes, flow rates and pressures
- QC Production Master – Design vs Actual
- Reagent Tracking
- Sample Tracking and Split sampling with Client

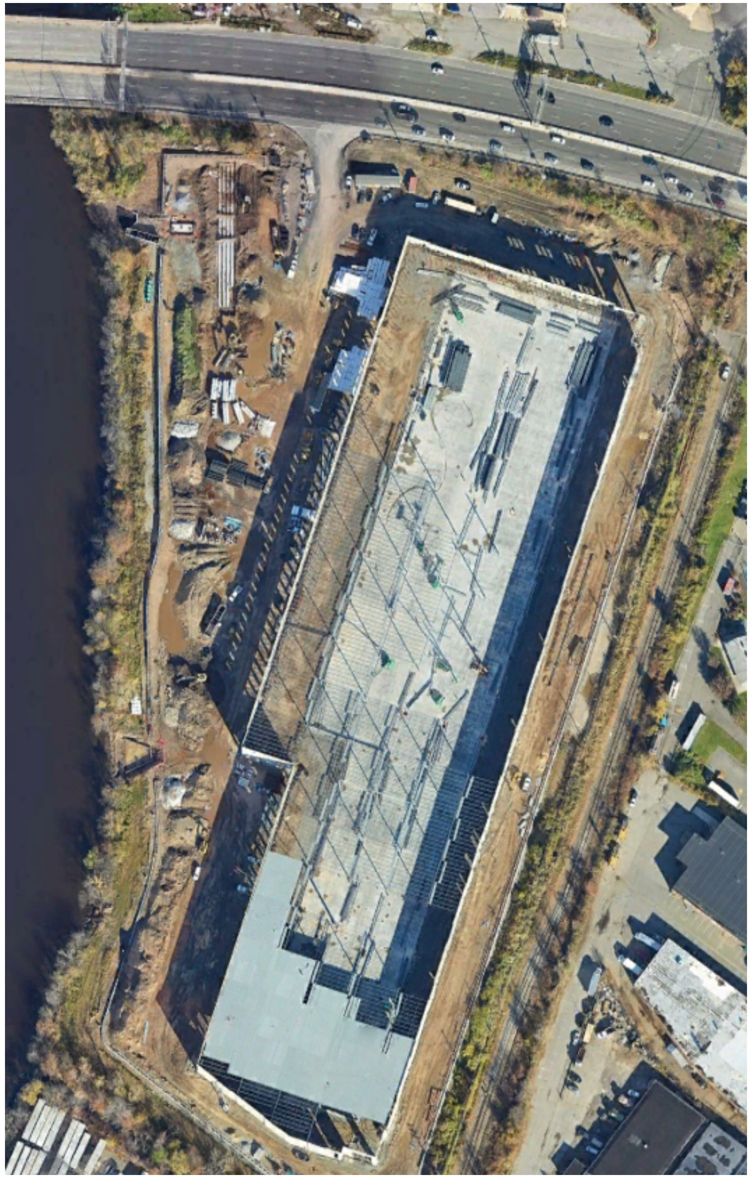
- **Averaged Results**
    - **UCS – 451.8 psi in 7 days**
    - **Permeability – 2.16 x $10^{-7}$ cm/sec in 7 days**

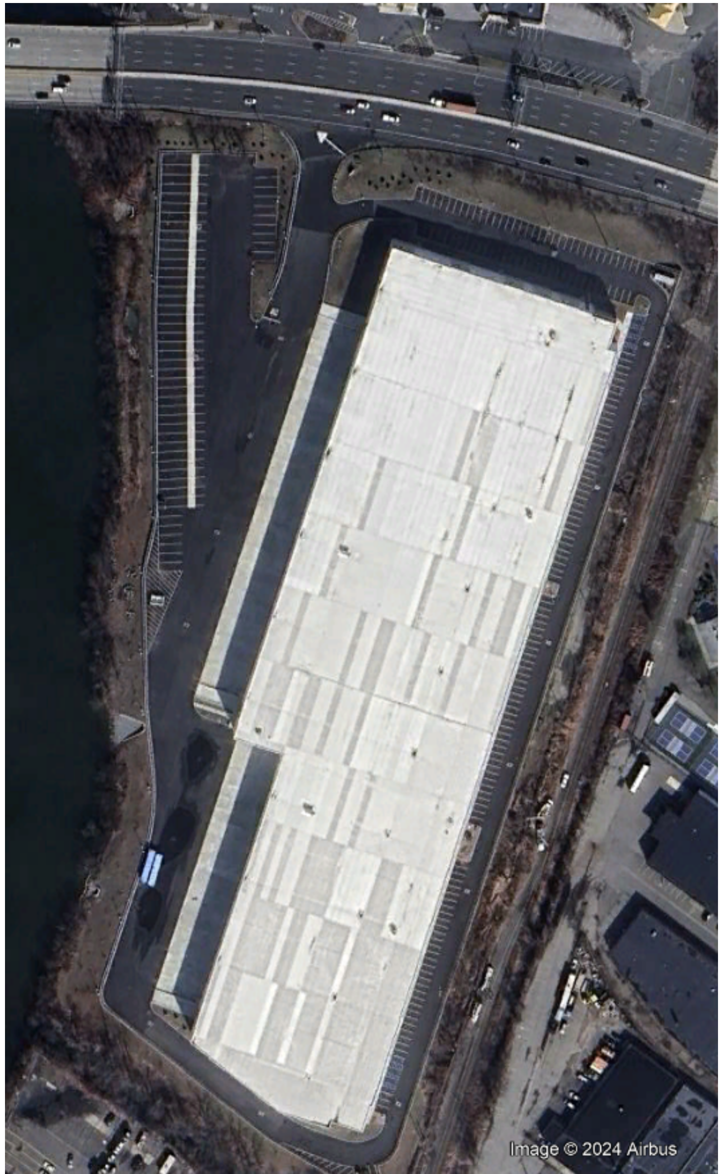
# Project Challenges



# Redevelopment







# QUESTIONS?

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