# Geopolymer Lining of Large-Diameter Box Culvert and Storm System in Memphis, TN

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# Presentation Outline

- Overview of Geopolymers and Spray Applied Linings (SAPL)

- Memphis Project Overview and Details
  - Initial Inspection
  - Design Principles
  - Pipe Preparation (Surface and Infiltration)
  - Geopolymer Spray Application
  - Inspection and Quality Control

- Lessons Learned and Project Completion

# Geopolymer Overview

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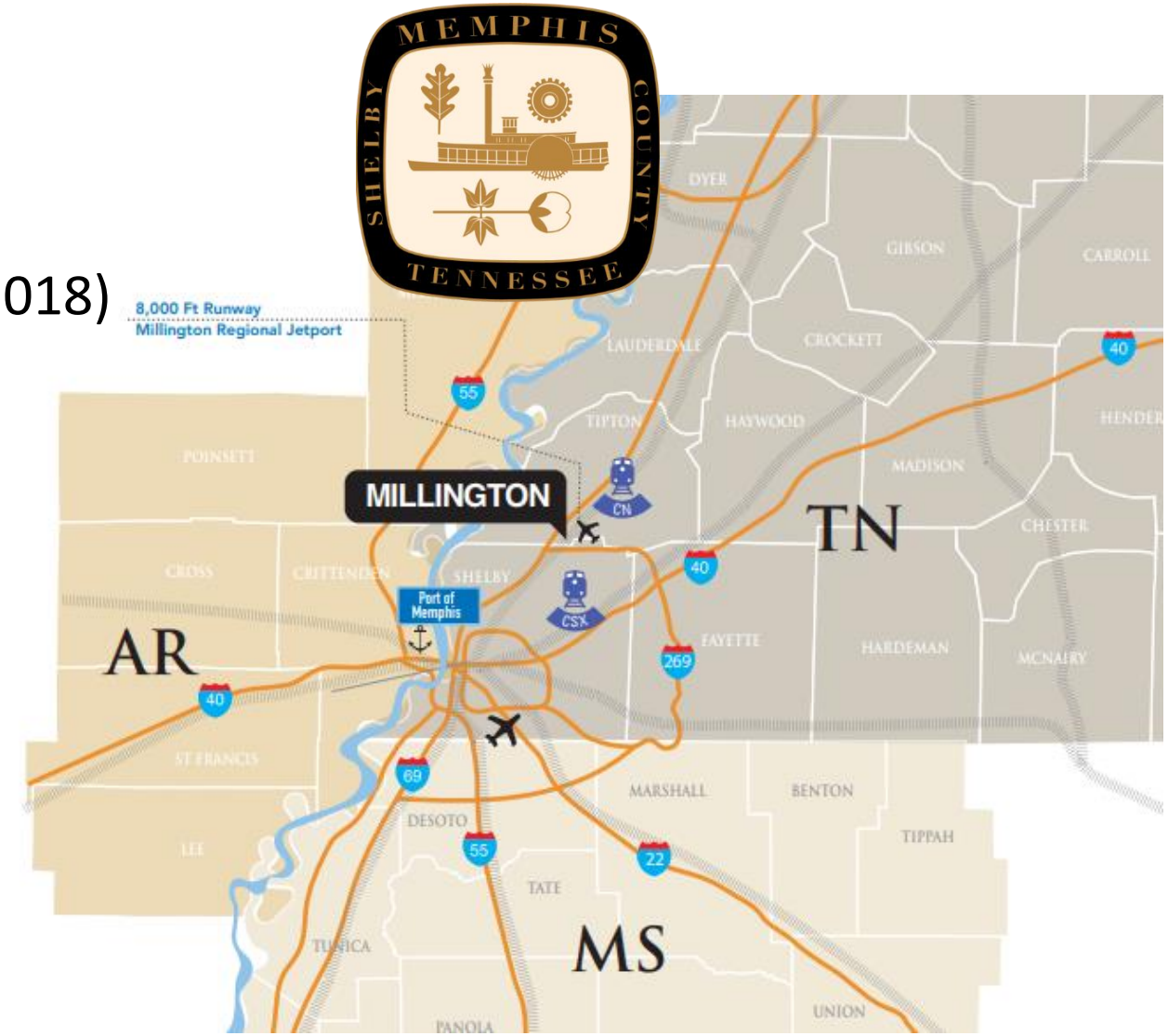
- Not a Plastic
  - Not HDPE/PVC/Epoxy
- Looks and feels like cement
  - Workability
  - Material Properties
  - Service Life
- Chemical structure like natural stone
  - Monolithic
  - Durable
  - Corrosion Resistant

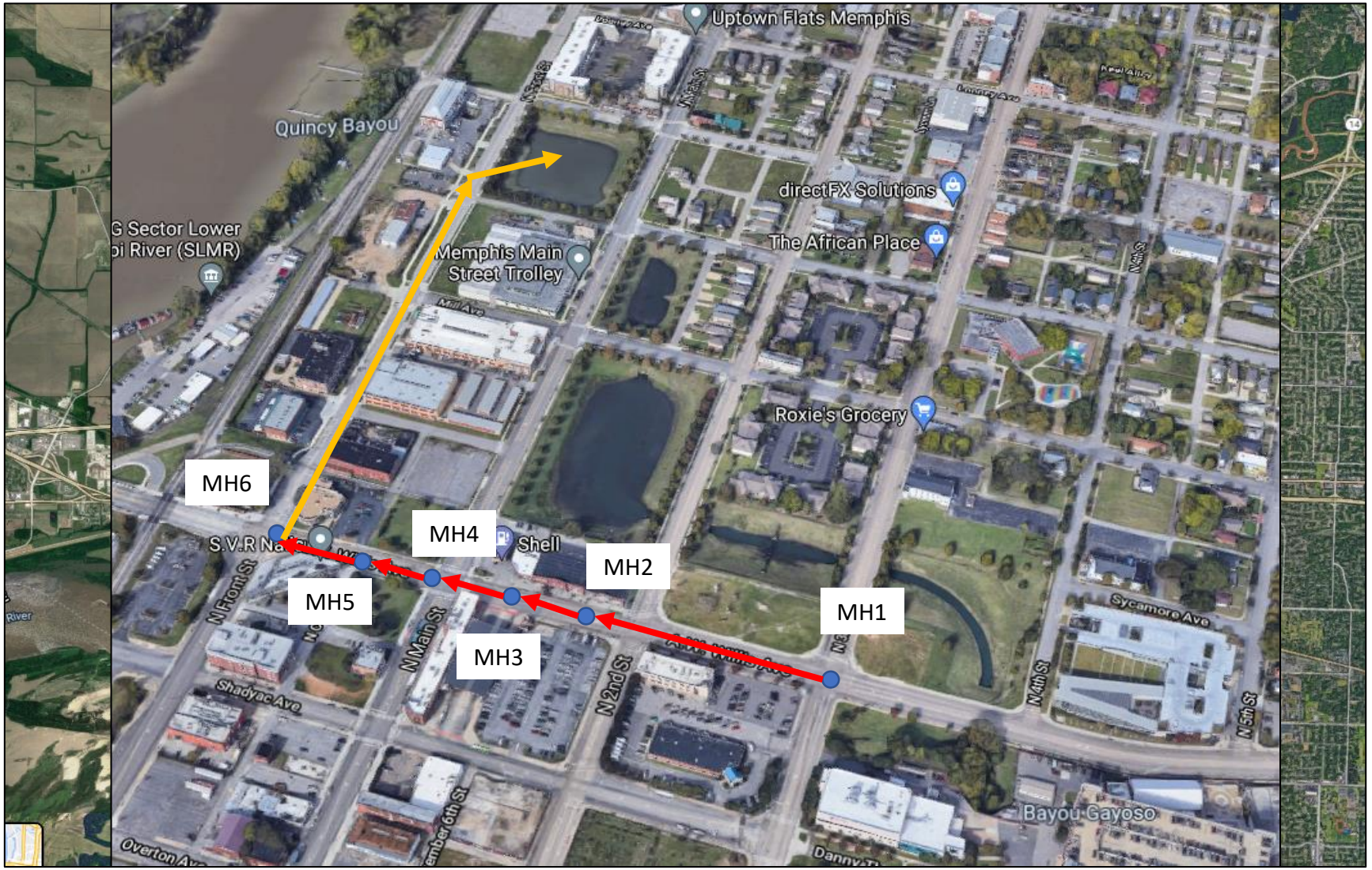
# Project Overview

## AW Willis / Crosstown Culvert Rehab

- 1000 linear ft of 8ft Concrete Box Culvert (2018)
- 1300 linear ft of 54” RCP (2020)
- Project Awarded 2017
- Box culvert and RCP piped lined with 1.5” geopolymer mortar



# Project Location



# Existing Site Conditions

# Site Prep - Cleaning

# Site Preparation – Surface Prep


# Site Preparation – Surface Prep

# Site Preparation – Surface Prep

# Site Preparation – Surface Prep

# Site Preparation – Surface Prep

# Site Preparation – Surface Prep

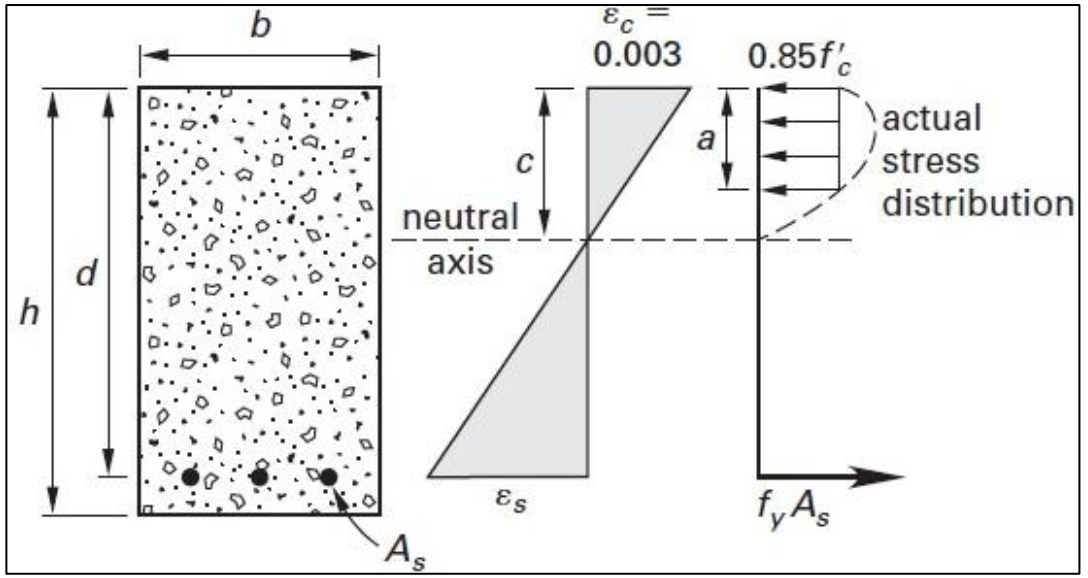
# Design Principles

**Fully Deteriorated:** Soil, Hydraulic & Live

Most large box structures will not require FD design. The existing structure is often capable but spalling, steel corrosion and erosion are the driving concerns.

**Partially Deteriorated:** Hydraulic Only

**"Structural Enhancement":** Composite design intended to return the structure to its original structural state.




***Design: Replace Corroded Steel ($A_s$), Replace Spalled Material, Protect***

# Above Ground Job Site

# Geopolymer Lining Application

# Depth Gauge, Thickness Verification

# Application in Progress

# Completed Geopolymer Lining

# Completed Geopolymer Lining

# Stopping Infiltration and Touch Up

# Quality Control

## Design Thickness

## Inspections

## Material Properties

### Mortar Mix Design Data

| | | | | | |
|---|---|---|---|---|---|
| **Mix ID:** | 8000 OSM Mortar | **Slump (in):** | 1.00-3.00 | **Unit Weight (pcf):** | |
| **Supplier:** | On site mix | **Air (%):** | 4.0-6.0 | **Comp Strength (psi):** | |
| **Admixtures:** | | | | | |

### Field Test Data

4" x 8" Cylinder

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Set No:** | 2 | **Ticket No:** | | **Slump (in):** | 1.50 | **Cast Date:** | 10-03-2018 |
| **Samples in Set:** | 6 | **Truck No:** | | **Air (%):** | 5.5 | **Ambient Temp (F):** | 65 |
| **Lab Cures:** | 6 | **Conc Temp (F):** | 55 | **Water Added Onsite (gal):** | 1 | | |
| **Field Cures:** | 0 | **Unit Weight (pcf):** | | **Cast By:** | Janelle Snook | | |
| **Location:** | Storm Drain Pipe #2 | | | | | | |

**Laboratory Compressive Strength Test Results**

| Sample No | Test Date | Test Age (Days) | Area (in²) | Max Load (LBS) | Strength (PSI) | % of Design | Break Type |
|---|---|---|---|---|---|---|---|
| 2-QC-A | 10-10-2018 | 7 | 12.56 | 82000 | 6529 | 81.6% | 3 |
| 2-QC-B | 10-10-2018 | 7 | 12.56 | 84000 | 6688 | 83.6% | 3 |
| 2-QC-C | 10-31-2018 | 28 | 12.56 | 127000 | 10111 | 126.4% | 3 |
| 2-QC-D | 10-31-2018 | 28 | 12.56 | 136500 | 10868 | 135.8% | 3 |
| 2-QC-E | 10-31-2018 | 28 | 12.56 | 135000 | 10748 | 134.4% | 3 |

**Notes:**

All samples and testing completed in accordance to applicable ASTM methods including: C1077, C42, C192, C670, C670, C873, E9, E74, C31, C39, C138, C172, C173, C143, C232, C123, C78, C470, C511, C1064.

# Questions?

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