UCT
UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | JANUARY 25-27, 2022 | FORT WORTH, TEXAS

Pump Station Discharge Pipe Rehabilitation with FRP

Firat Sever, PhD, PE
QuakeWrap, Inc.
Tucson, Arizona

Sid Lockhart, PE
Oakland County Water Resources Commissioner's Office

QuakeWrap

OAKLAND COUNTY MICHIGAN

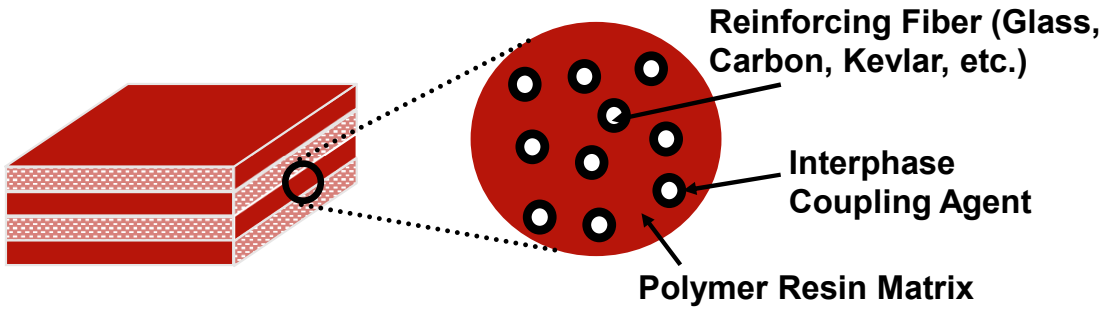
MACOMB COUNTY MICHIGAN 1818

NTH Consultants, Ltd.
Infrastructure Engineering
and Environmental Services

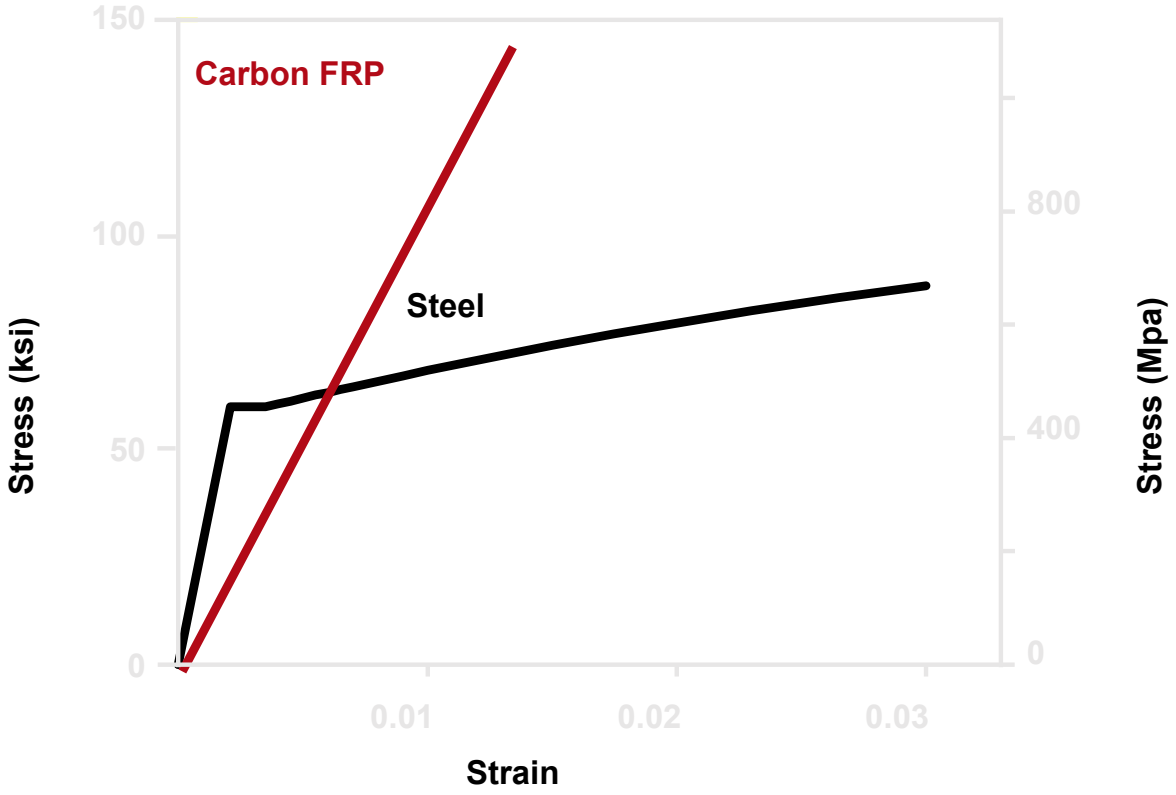
MARRA SERVICES INC.
An SBE/WBE Company

Fiber Reinforced Polymer (FRP)

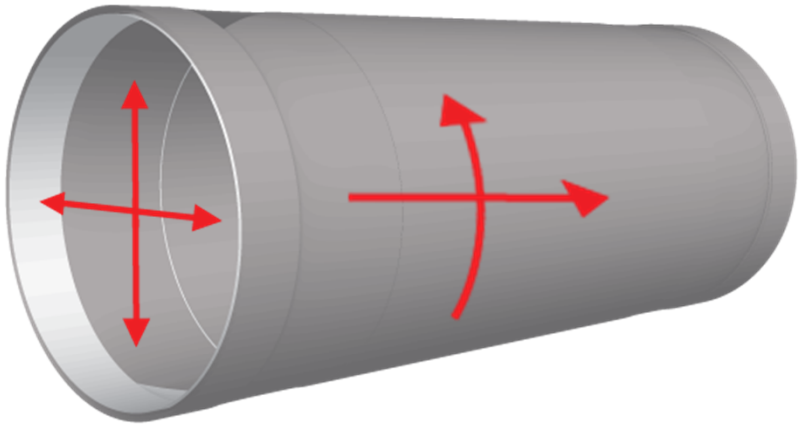
- A Polymer (i.e. epoxy, vinyl ester, etc.) that has been reinforced with a Fiber (e.g. carbon, glass, etc.)
- FRP is *non-homogeneous*.
- FRP does not have the same strength in all directions; these types of materials are called *anisotropic*.



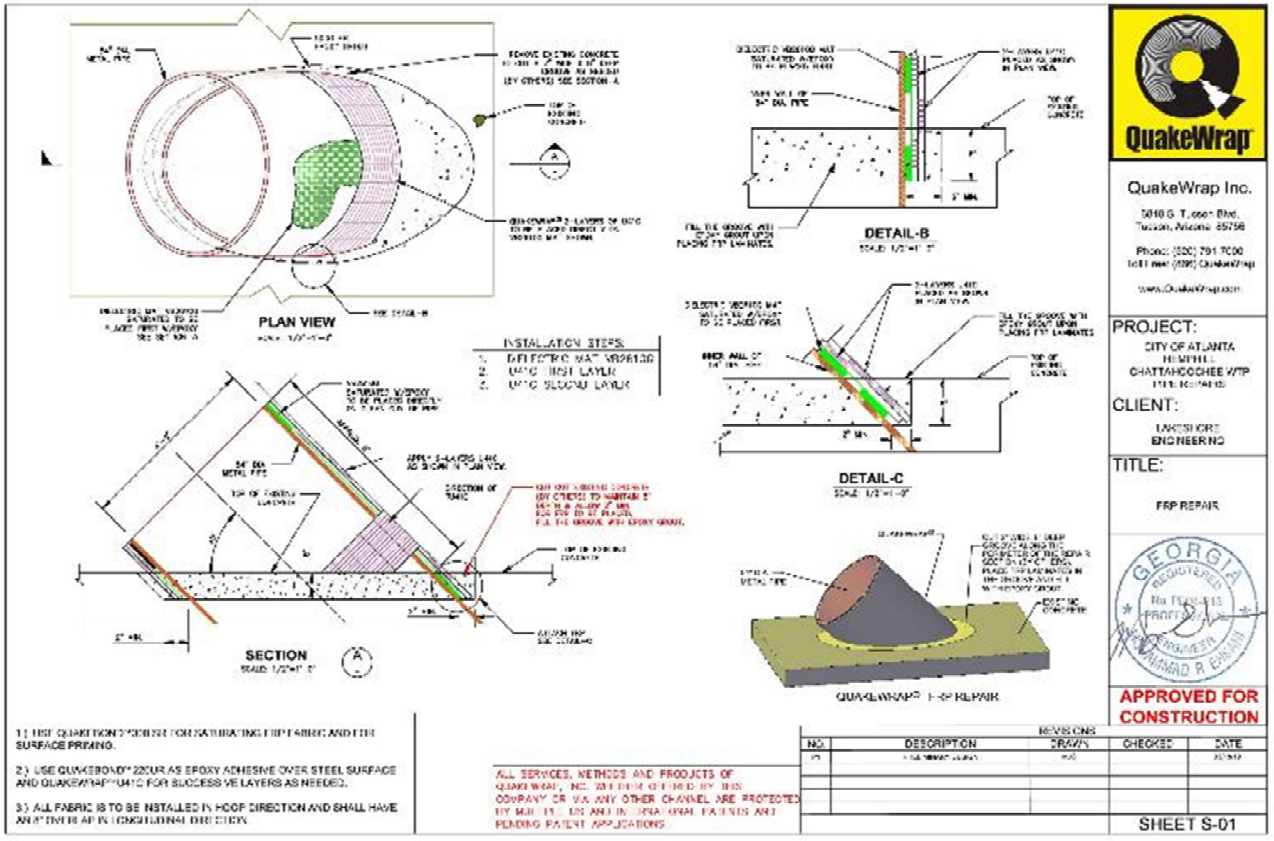
Stress vs. Strain for Steel and Composites



Hoop and Longitudinal Stress



3D Drawing/Modeling



WET LAYUP PROCESS

"Conventional" way of installing FRP

Surface prep

Saturating machine

Different types of resins used as adhesives, saturants, and top (protective) coats

FORCE MAIN REHABILITATION WITH FRP

SLIPLINING WITH FRP COMPOSITE SYSTEM

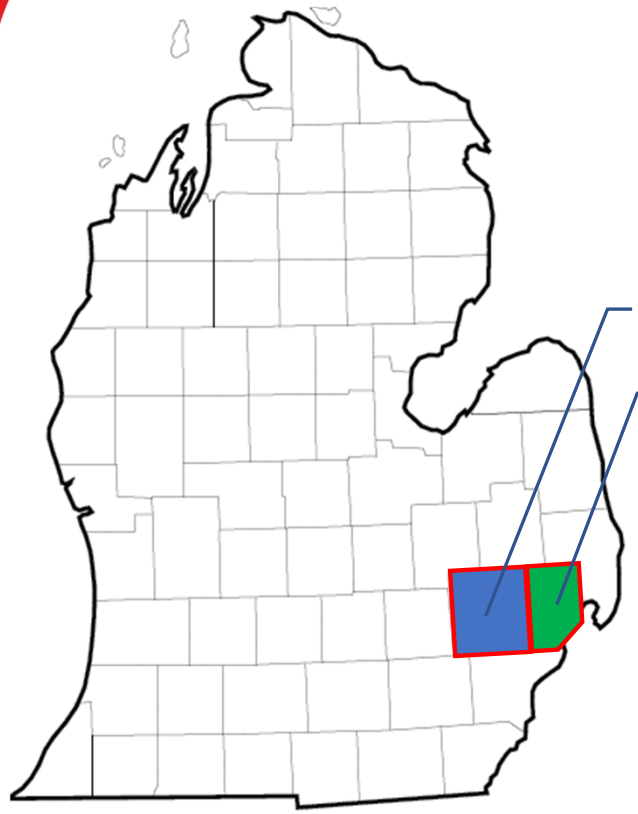
A proprietary core layer added for improved ring stiffness

Custom sizing
Light weight / High strength

Higher material, lower installation cost

Minimal annular space can be grouted with cementitious or polymeric grout

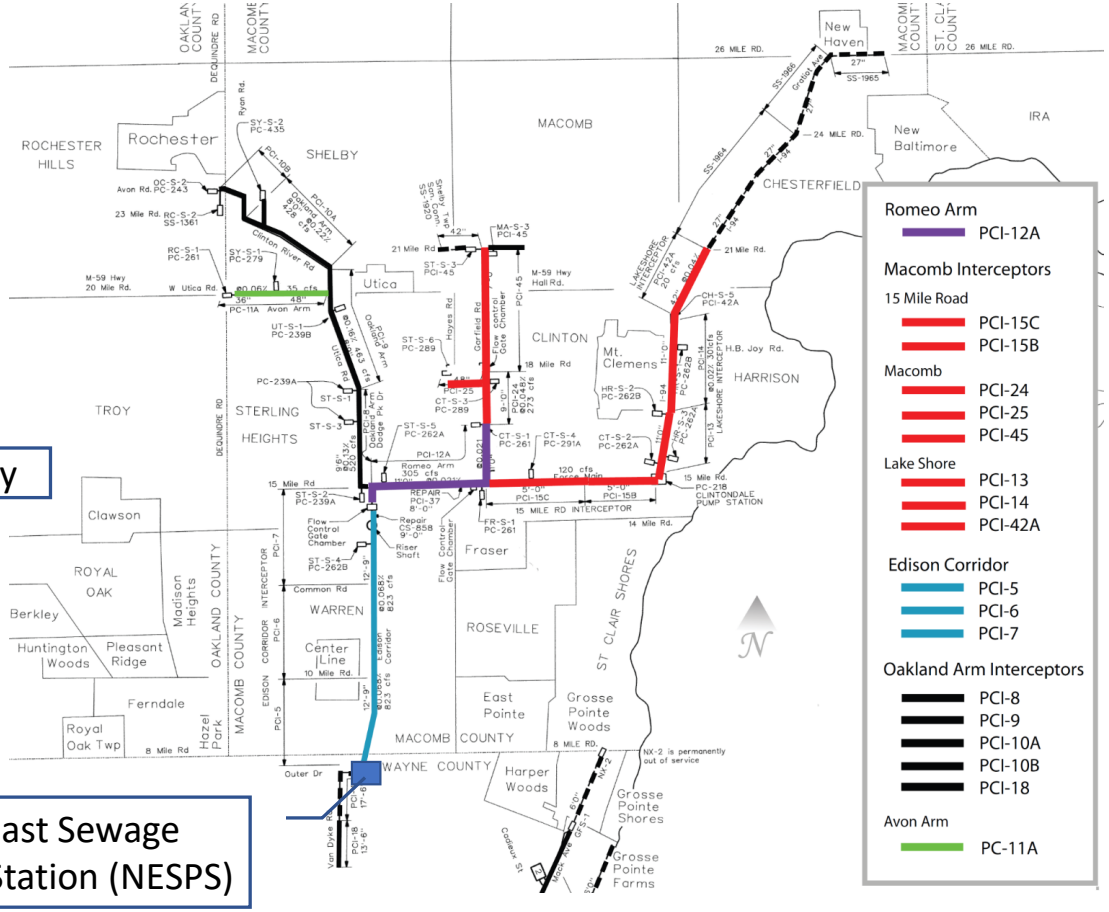
OMIDDD LOCATION AND OVERVIEW



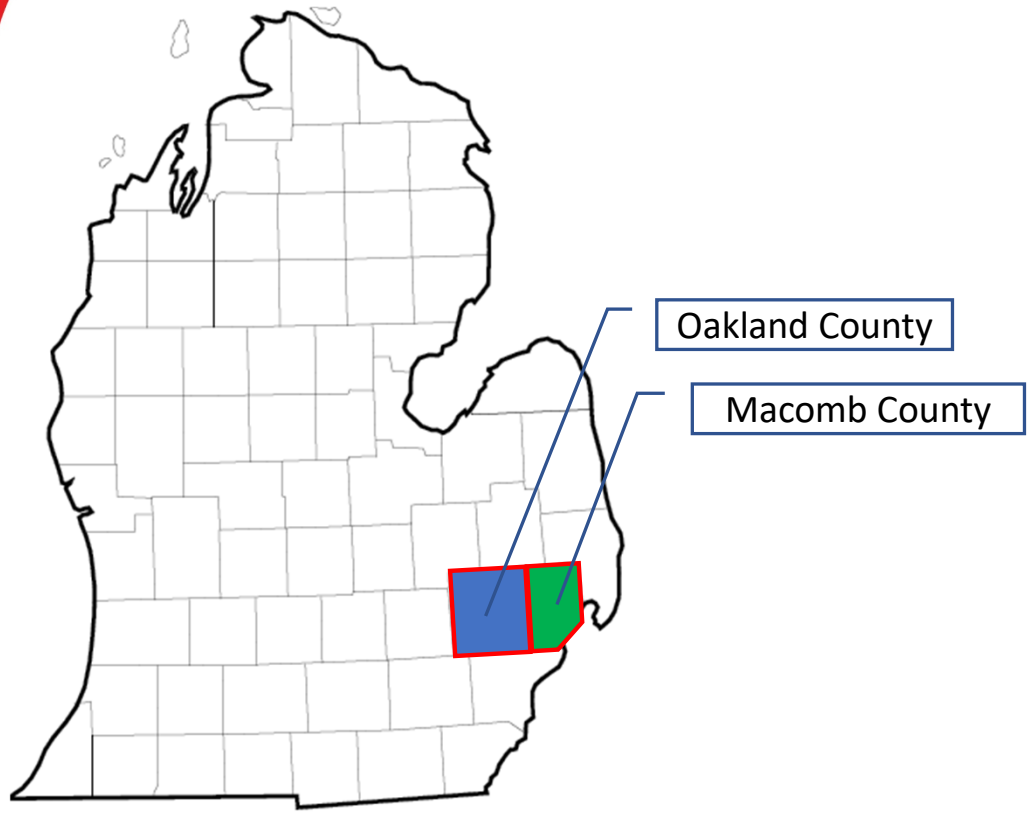
Oakland County

Macomb County

Northeast Sewage Pumping Station (NESPS)



OMIDDD LOCATION AND OVERVIEW



- Oakland Macomb Interceptor Drain Drainage District (OMIDDD) is a joint entity between Oakland and Macomb Counties and the State of Michigan
- Located in southeast Michigan, OMIDDD is responsible for operating and maintaining large diameter interceptor sewers that serve nearly 1 million people in the suburban Detroit area
- A key part of the drainage system is the Northeast Sewage Pumping Station (NESPS), which is located at the downstream end of the Oakland Macomb Interceptor Drain (OMID)
- NESPS lifts the sewage flow at the terminus of OMID on the north side of the facility into the North Interceptor East Arm (NI-EA) sewer located at the south side of the facility

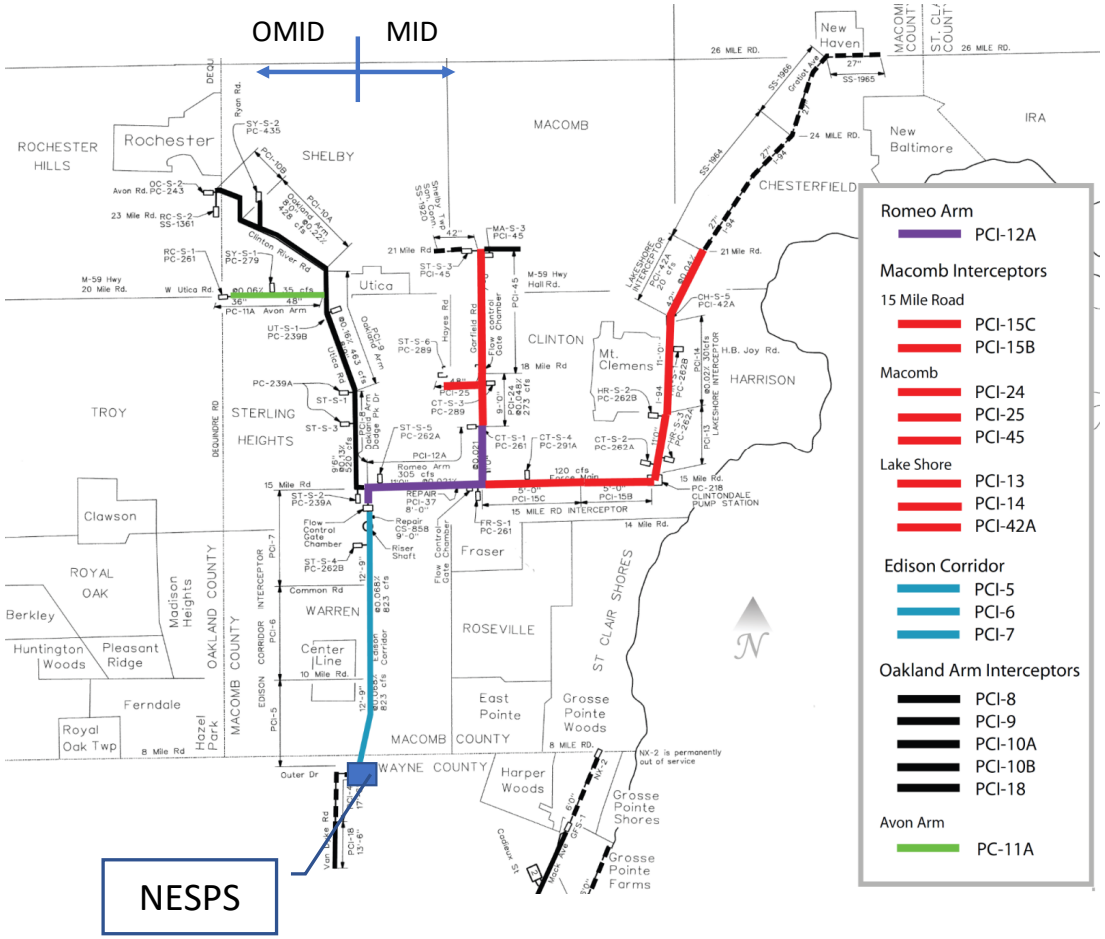
OMIDDD SYSTEM OVERVIEW

Oakland Macomb Interceptor Drain (OMID)

- Sewer system located upstream of NESPS; Constructed between 1970 and 1972
- Approximately 21.5 miles long
- Primarily 12’-9” in diameter
- Up to 110 ft deep
- Multiple flow control structures in the system

Northeast Sewage Pumping Station (NESPS)

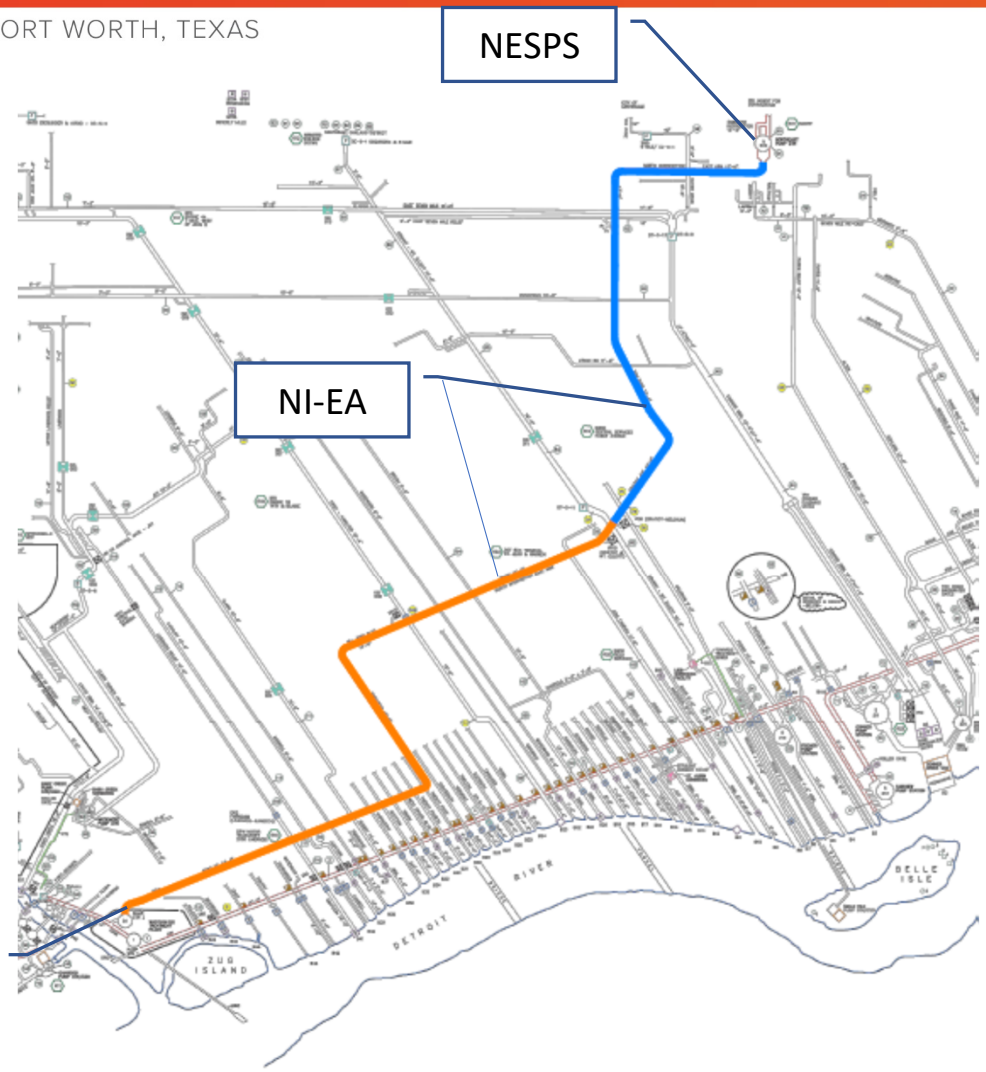
- Constructed in 1972; Receives flow from both OMID and Macomb Interceptor Drain (MID) systems
- Typical range of dry weather pumping flow rates varies from 97 to 134 cfs
- Total pumping flow rate capacity is 550 cfs; however, under normal pumping protocols the wet weather flow rate is 423 cfs
- Hydrogen sulfide concentration up to 200 ppmv



OMIDDD SYSTEM OVERVIEW CONTD..

North Interceptor-East Arm (NI-EA)

- Located downstream of NESPS; Constructed in the 70's
- Total length of the NI-EA is approximately 15 miles (from NESPS to Detroit Water Resource Recovery Facility)
- A portion of the NI-EA (approximately 6.5 miles of sewer downstream of the NESPS) is maintained by the OMIDDD.
- Diameters of sewer range from 17.5 ft to 12 ft
- Depths of sewer range from 40 ft to 75 ft
- High concentrations of hydrogen sulfide (similar to NESPS)



CORROSIVE ENVIRONMENT

- The corrosive environment can generally be described as containing moderate to high concentrations of hydrogen sulfide, and smaller quantities of other potentially corrosive compounds, including petroleum products
- At the facility and downstream sewer, hydrogen sulfide concentrations of up to 200 ppmv were recorded historically

NESPS 72-in dia. Pump Discharge Pipe Corrosion

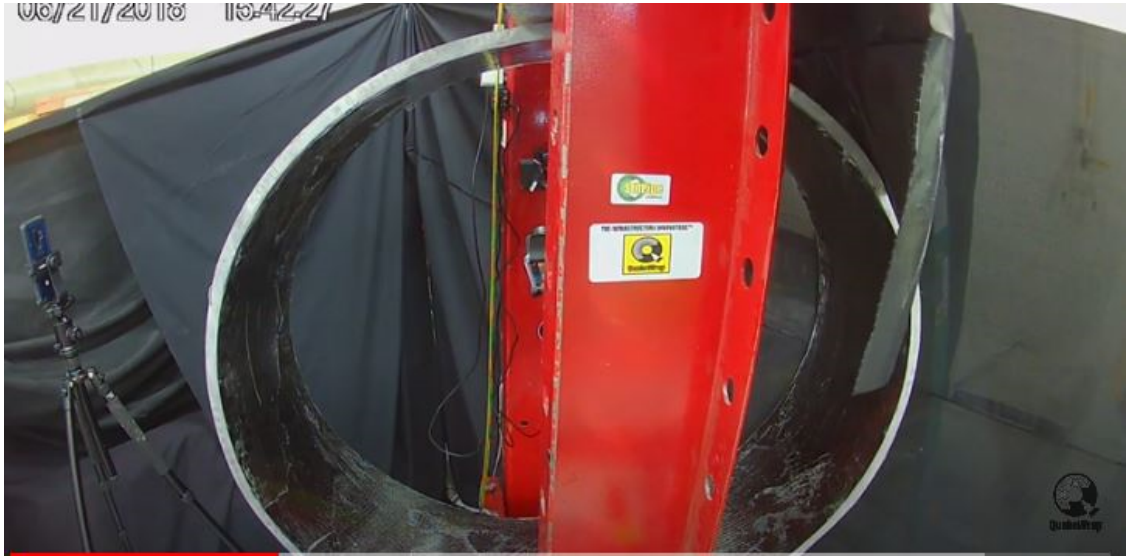
17.5 ft. dia. NI-EA Sewer Concrete Deterioration d/s of NESPS

NESPS Discharge Chamber Concrete Deterioration

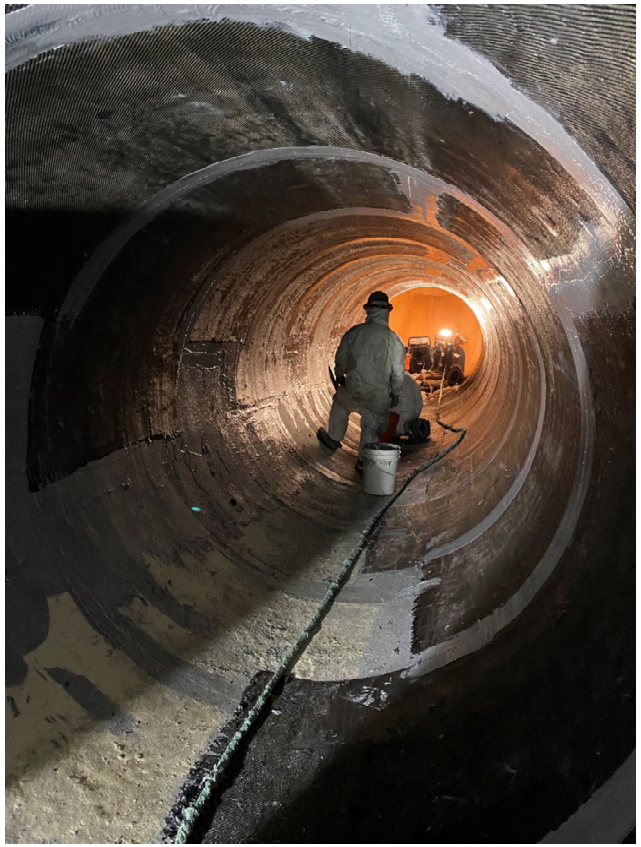
NESPS 78-IN DISCHARGE PIPE – EXISTING CONDITIONS

NESPS 78-IN DISCHARGE PIPE – DESIGN

- Utilizes AWWA C305, C950, and ASTM D2412
- Low pressure (15 psi)
- External (hydrostatic) load – Ring stiffness dictates the design
- More economical to use a core layer (StifPipe®)
- Corrosion and abrasion resistant top-coat (80 mils thick)



NESPS 78-IN DISCHARGE PIPE – INSTALLATION



Enter termination with dual compression seal – air test per AWWA C621

Quality Assurance/Control

- Record Lot #
- Adhesion Test (ASTM D7234) (200 psi min.)
- Witness Panel (ASTM D3039); 5 glass and 5 carbon FRP coupons
- International Code Council (ICC) Certified for strength & durability

Conclusions

- Installation executed to the plan
- Leaks may not be apparent until the pipe is completely drained
- Be prepared for leak sealing to avoid delays
- Design loads important to choose the right system
- Seek corrosion and abrasion resistance
- Good teamwork among contractors, owner, engineer is key

Acknowledgements

- Oakland-Macomb Interceptor Drain Drainage District (OMIDDD)
- NTH Consultants
  - Saju Sachidanandan, PE
  - Larry Gilbert, PE
  - Abdulnasser Almadhoun, PE
- Walsh Group
- QuakeWrap
  - Prof Mo Ehsani, PhD, PE
  - Owen Yan, PhD
  - McKay Barley

Questions?