



Warwick Sewer Authority

Flood Response, Recovery & Mitigation

**Presentation to the New England Water
Environment Association
September 26, 2017**

City of Warwick

Wastewater Infrastructure

- 39 miles of coastline
- 300+ miles of sewer pipe in ground
- 48 sewage pumping stations
 - 29 in FEMA-designated flood zones on the coast and along the Pawtuxet River
 - More in low-lying areas adjacent to water bodies (i.e., Buckeye Brook, Warwick Pond, Gorton Lake)
- More coastal sewers in design and planned for construction

Pawtuxet River

Three Ponds

95

95

13

Sharpe Dr

Ross Simmons Dr

Arthur W Devine Blvd

Access Rd

Plain Way

Service Ave

Graystone St

Cottage St

Blackburn St

Quimby St

Jefferson Blvd

Bay State Ave

Vermont Ave

Ohio Ave

Illinois Ave

March 15th, 2010 – the “Little Flood”

- Historical peak in Pawtuxet River elevations at Cranston USGS gauge
- 3 pumping stations significantly impacted
- Staff working around the clock to address emergency situations, prevent sewer overflows
- Approximately \$50K in damages
- Analysis of system-wide vulnerabilities initiated

View of Western Side of Levee on March 15, 2010






Knight Street Pumping Station – March 15, 2010

March 30th – The Great Flood

- Treatment Facility flows reached 5 times average daily flows; intermittent power losses all day
- Several pump stations along the river shut down in an attempt to save the facility
- Removed portable equipment to overpass; moved computers and important records to second floor of operations building
- Reverse 911 calls to residents
- Non-essential staff evacuated at 1 PM; river crests levee at 1:15 PM; remaining staff escapes at 1:45 PM.

Western Side of Levee – March 30, 2010



An aerial photograph showing a multi-lane highway, Route 95 N, running diagonally from the bottom left towards the top right. The highway is partially submerged in floodwater, which is a murky brown color. To the left of the highway, there is a flooded area with bare trees and a small structure. To the right, there is a large, flooded wooded area. In the background, there is a commercial area with various buildings, parking lots, and a large, empty lot. A light blue arrow points from the text 'Wastewater Treatment Facility' to a specific location in the background. Another black arrow points from the text 'Route 95 N' to the highway.

Wastewater Treatment Facility

Route 95 N









Bellows Street Pumping Station

03.30.2010 23:11

Damage Assessment

Main Expense Categories

Electrical Systems	\$7 Million
Other Facility Systems & Equipment	\$3.5 Million
Building Restoration & Contents	\$2 Million
Dewatering & Site Clean Up	\$1 Million
Road Repairs	\$0.25 Million
Engineering	\$0.25 Million
Total Damages:	\$14 Million

Paid for By

Insurance	\$10 Million
FEMA (90%)	\$3.6 Million
WSA	\$400,000

Opportunities After The Flood

Numerous Grants to Rebuild Infrastructure and Mitigate Future Flood Damages:

- \$980K from RIOER (and significant National Grid rebates)
- \$721K from EDA for new elevated pump station (matched with CDBG-DR funds)
- CDBG-DR funds for study/design of flood protection measures
- RIEMA Hazard Mitigation grants
- Additional \$3.6 million from FEMA/RIEMA for levee improvements



Mitigation Approach/Execution

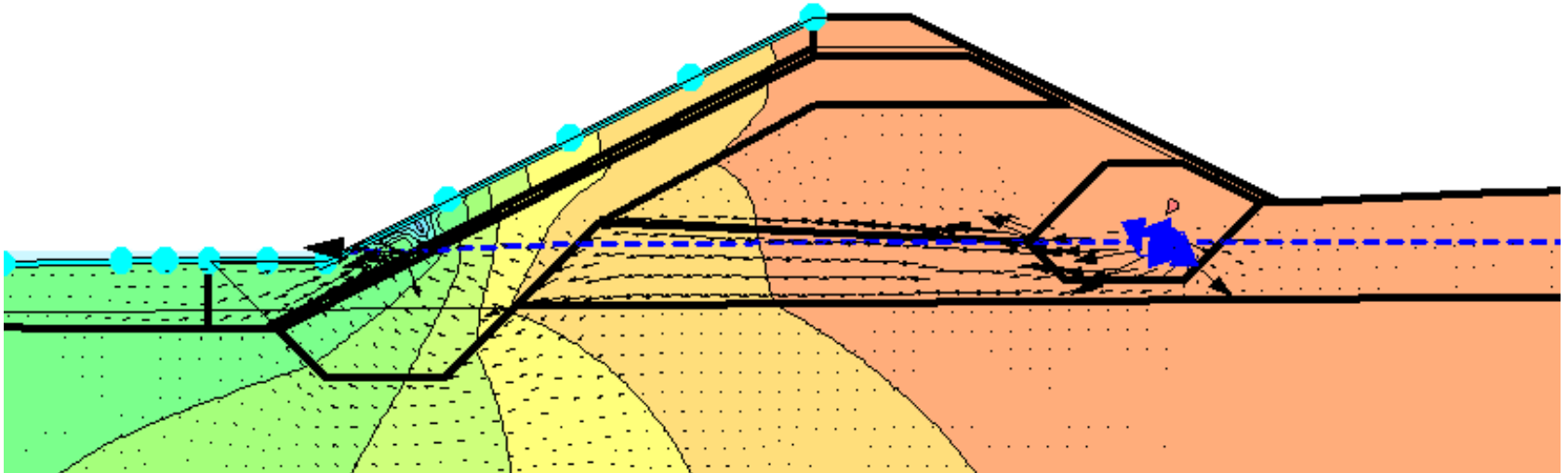
- **Design**
 - **Gather Available Information**
 - **Discuss Goals with Owner**
 - **Evaluate Pre-construction Conditions**
- **Construction**
 - **Quality Control**
 - **On-site Soils Testing**
 - **Accuracy of Historic Information**
- **Regular Inspection and Maintenance**



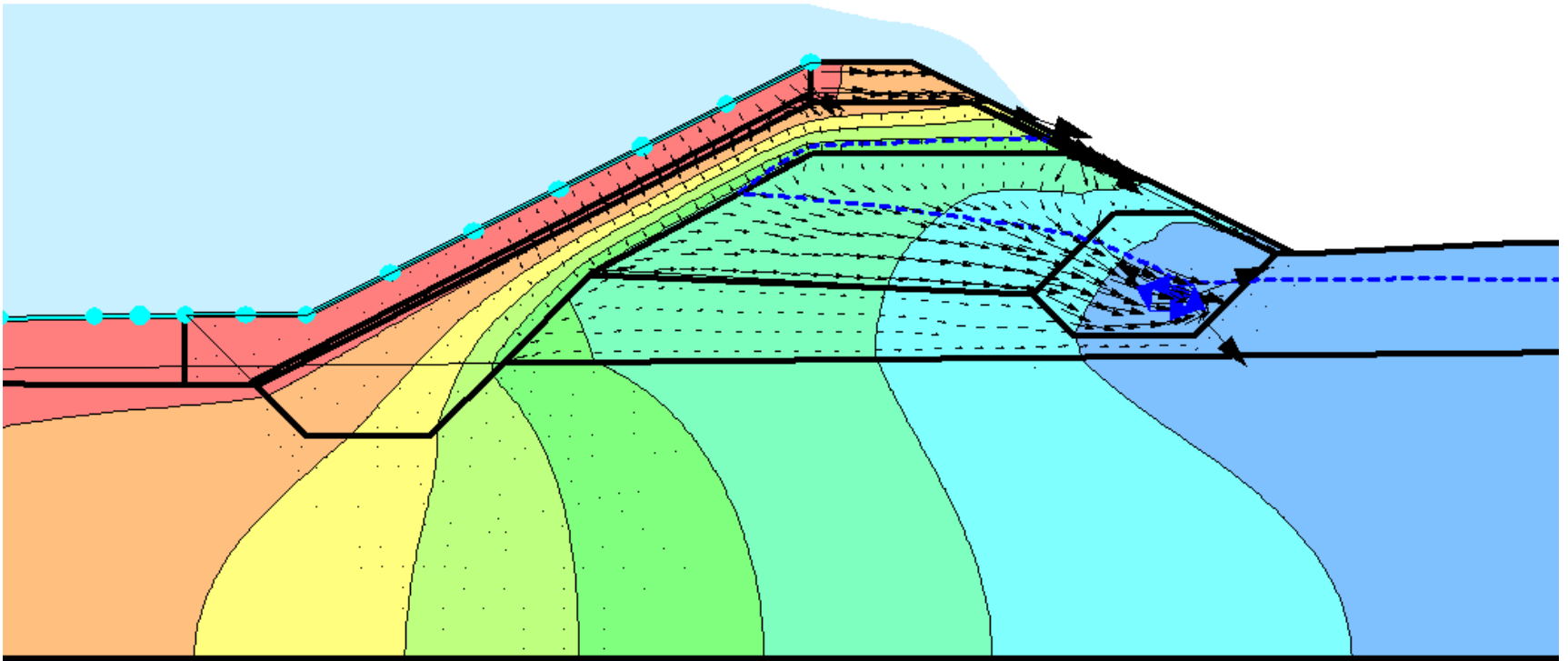
Design Flood Data

- March 31, 2010 – River peaked at 32.4 feet
- Existing Top of Levee 28.1 to 29.5 feet
- USGS Flood Elevations
 - 100-Year Flood: 27.5 feet
 - 500-Year Flood: 31.5 feet
- Freeboard Requirements
 - No state mandated requirements
 - FEMA 1 to 3 feet recommended
- 500-Year Flood +3 feet of freeboard, 34.5 feet

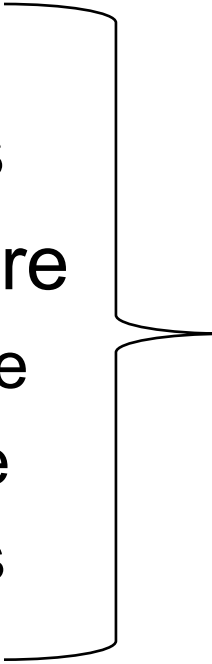
Existing Conditions



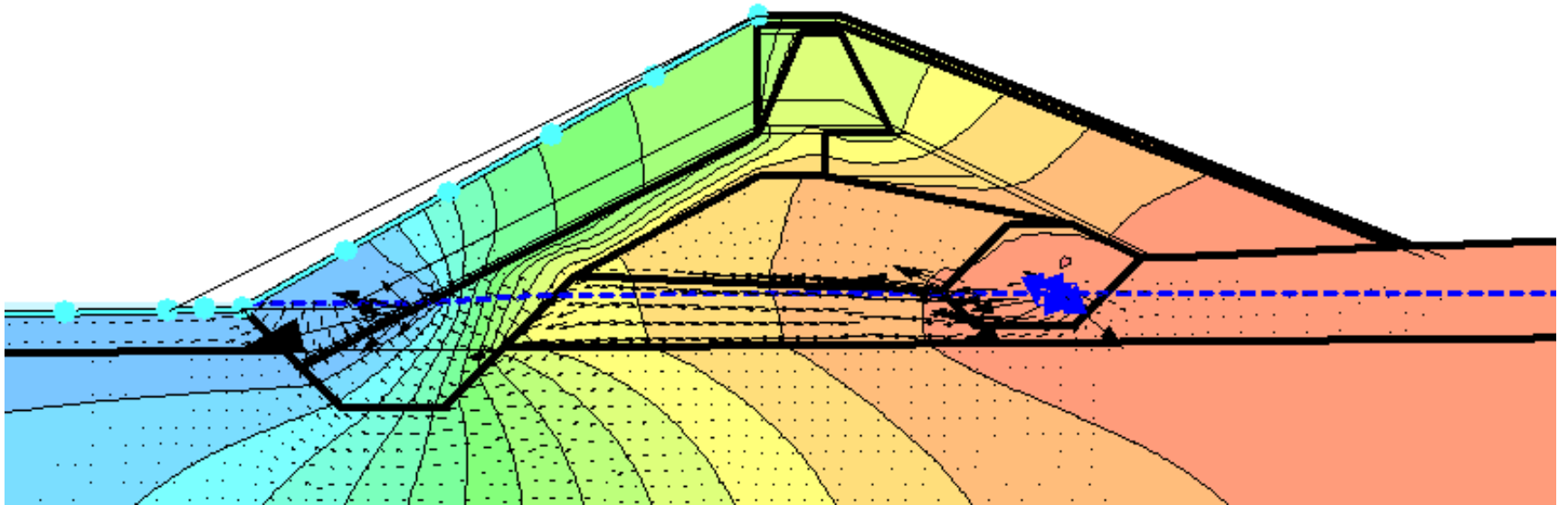
Existing Conditions



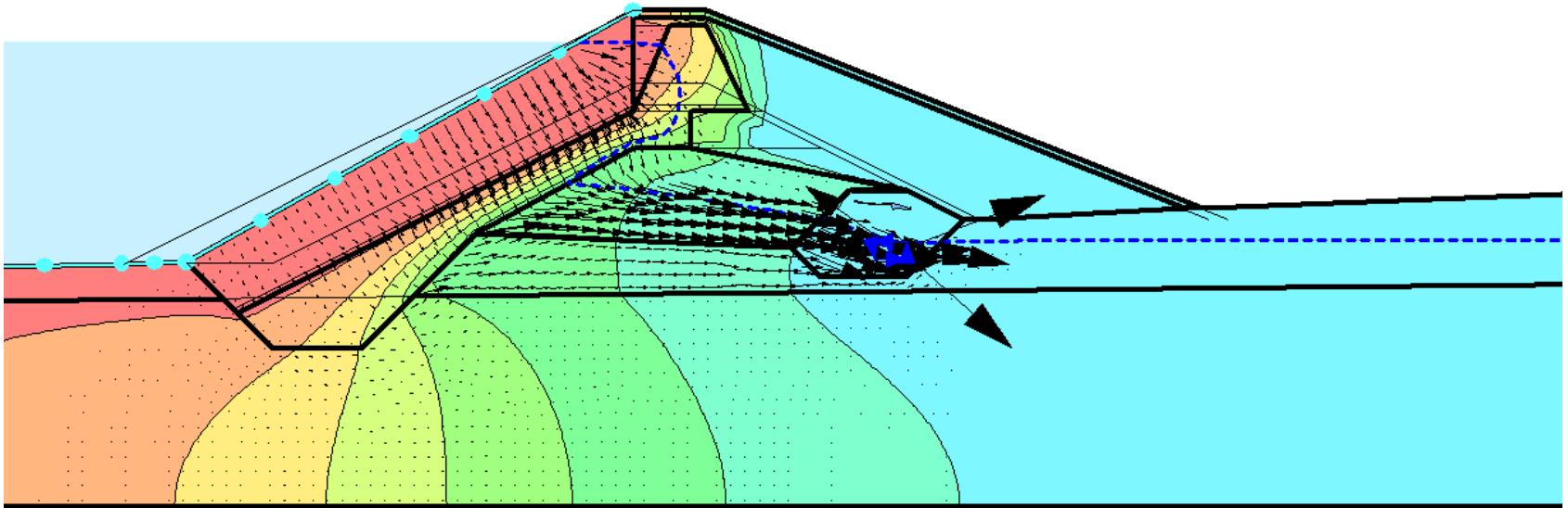
Design Conditions

- Small Footprint
 - Outbound Wetlands
 - Existing Infrastructure
 - 36" dia. site drainage
 - 48" dia. effluent pipe
 - Secondary Clarifiers
 - Delivery Routes
 - Site Operability
 - I-95 Right of Way
- 
- Slopes and Walls
 - Verify Strengths
 - Maintain Access
- Project Specifications
 - RIDOT Permits

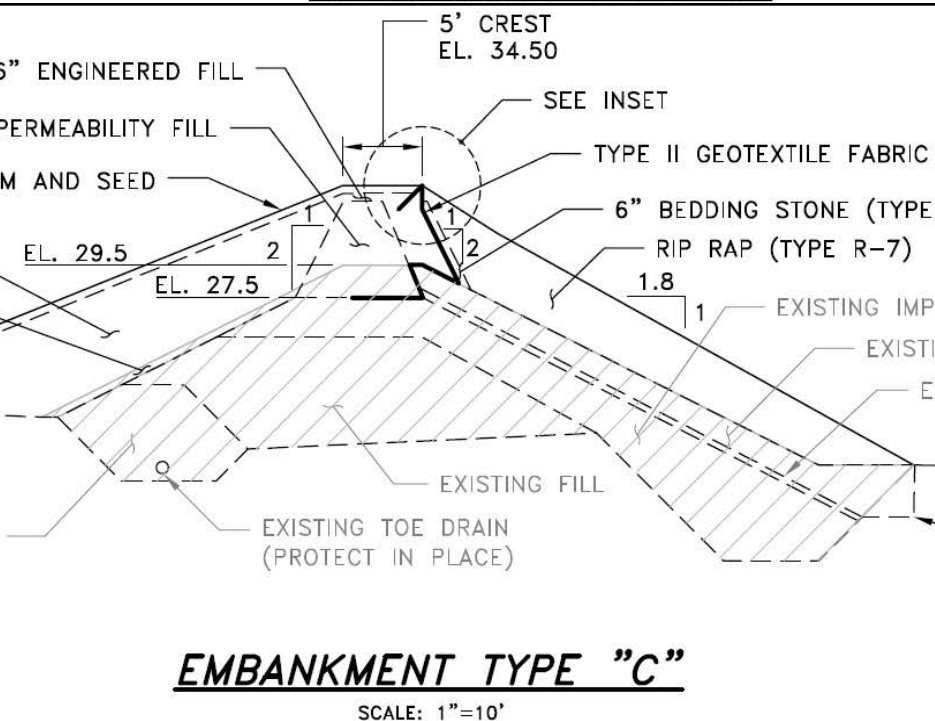
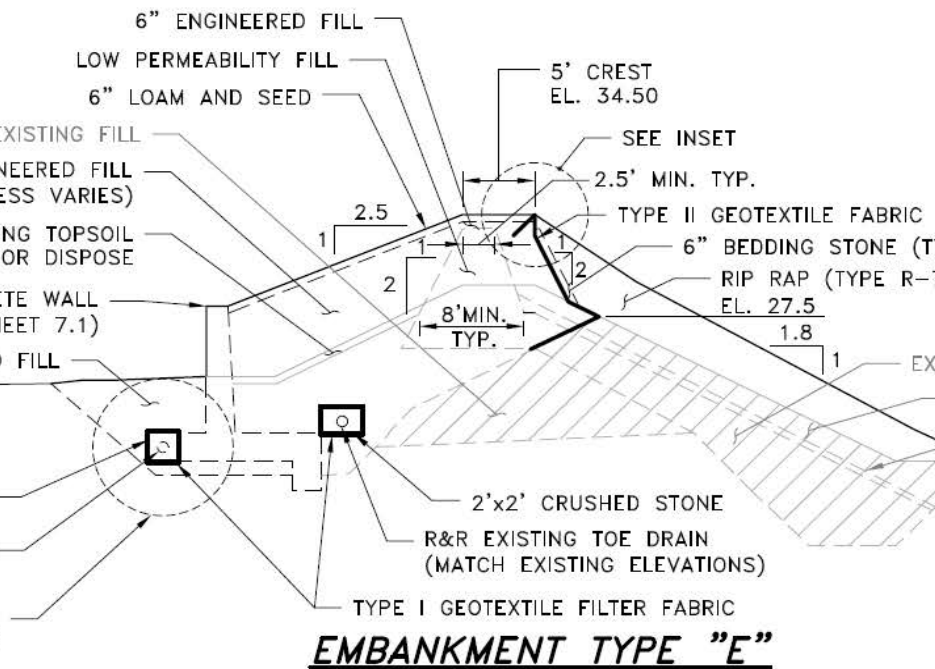
Proposed Conditions



Proposed Conditions







*Note photos have been mirrored for clarity.



Before



After



LESSONS LEARNED FROM THE GREAT FLOOD



- #1 – Have a plan**
- #2 – Take advantage of the “opportunity”**
- #3 – Ask for help**
- #4 – Collaborate**
- #5 – Communicate**
- #6 – Mitigate**
- #7 - Record**