Rebuild or Replace? It Depends

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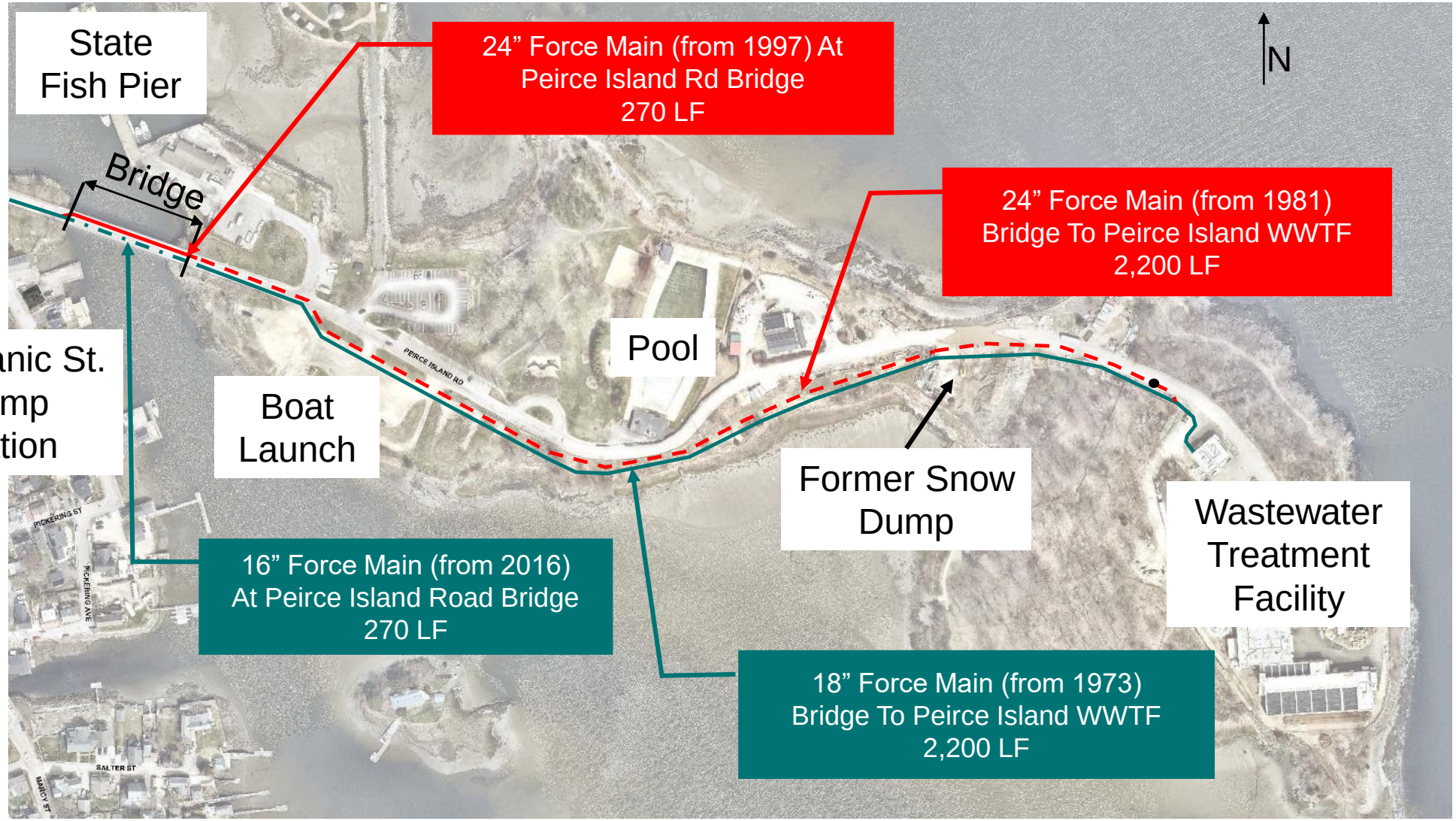
Agenda

- Background
- Initial Force Main Leak
- Force Main Failure
- Temporary Force Main
- Failure Analysis
- Design
- Construction

Background



- Average Flow = 4.5 MGD
- Peak Flow = 22 MGD

Initial Force Main Leak

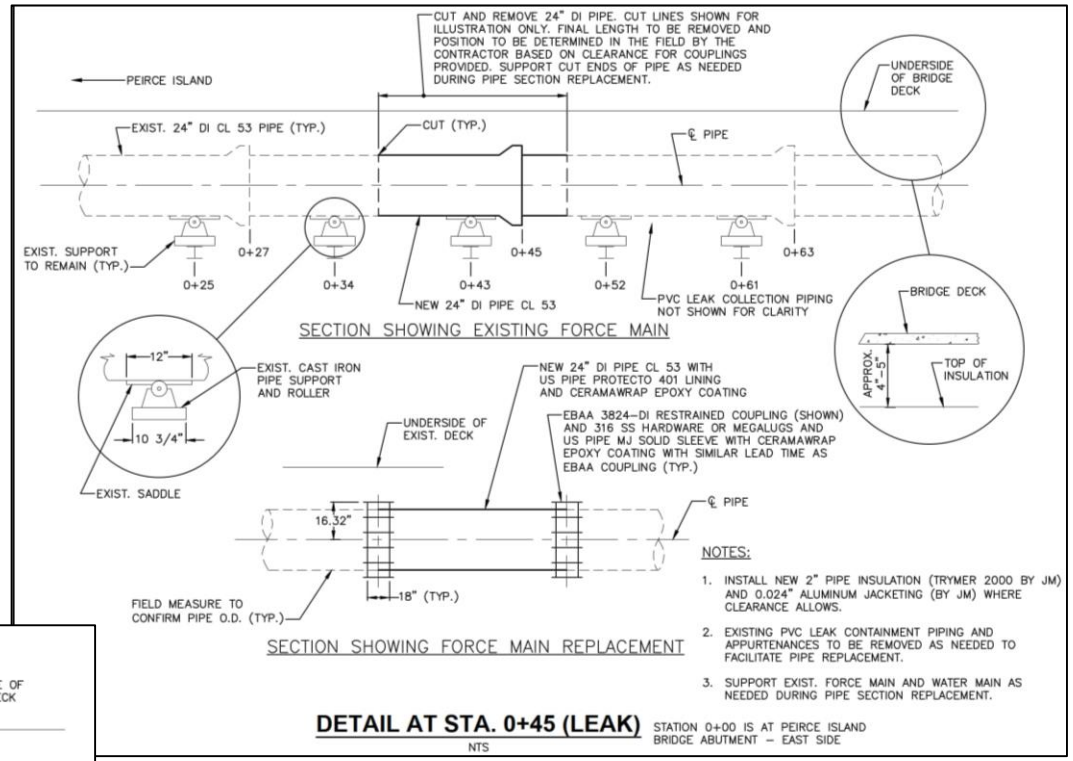
- May 15, 2020 – Leak discovered in 24” FM under Peirce Island Rd. Bridge
- 24” FM isolated and removed from service
- Two major areas of concern:
  - Leak at STA 0+45
  - Crack at STA 1+34

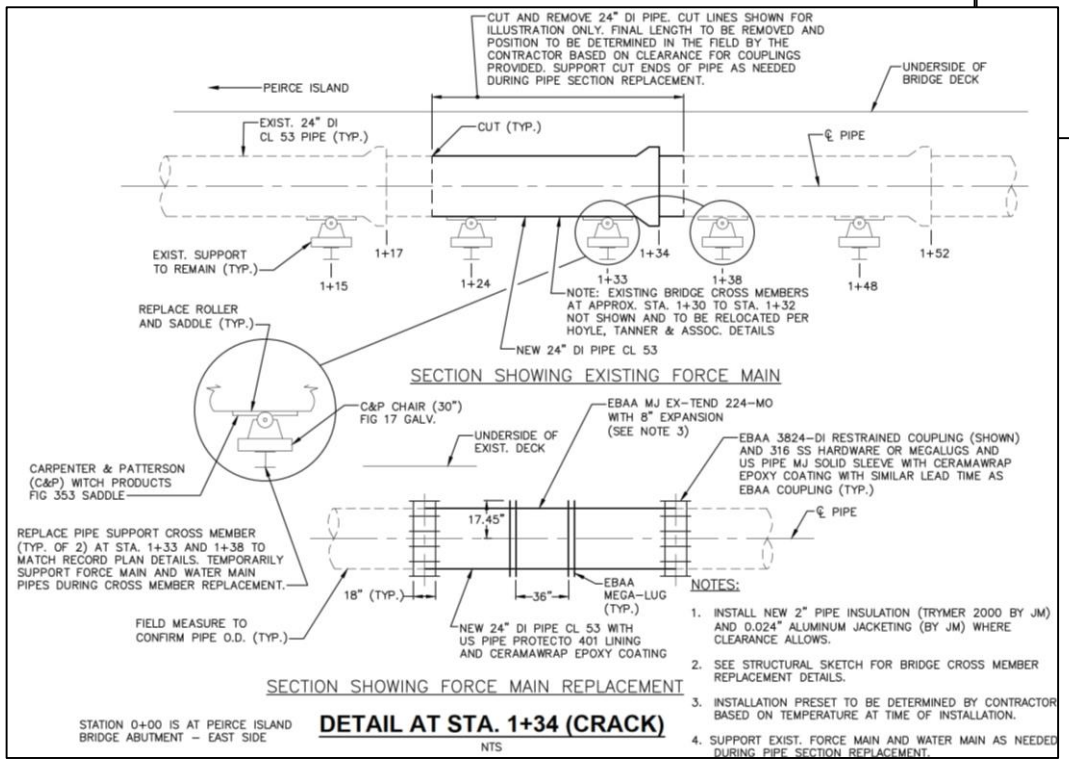
Initial Force Main Leak

- Temporary saddle and drain pipe installed
- 24” FM put back online for wet weather only with temporary fixes
- Repair details developed but materials not available until October 2020

Initial Force Main Leak

- Leak repair details consisted of cutting out damaged piping and replacement with new glass-lined pipe.
- Emergency repair contract executed
- Required construction of suspended scaffolding and coordination with Harbormaster, USCG, and State Police





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Force Main Failure

- September 10, 2020 – Leak discovered near former snow dump in 24” FM
- Subsequent internal video inspection showed multiple leaks – not economical to repair

Temporary Force Main

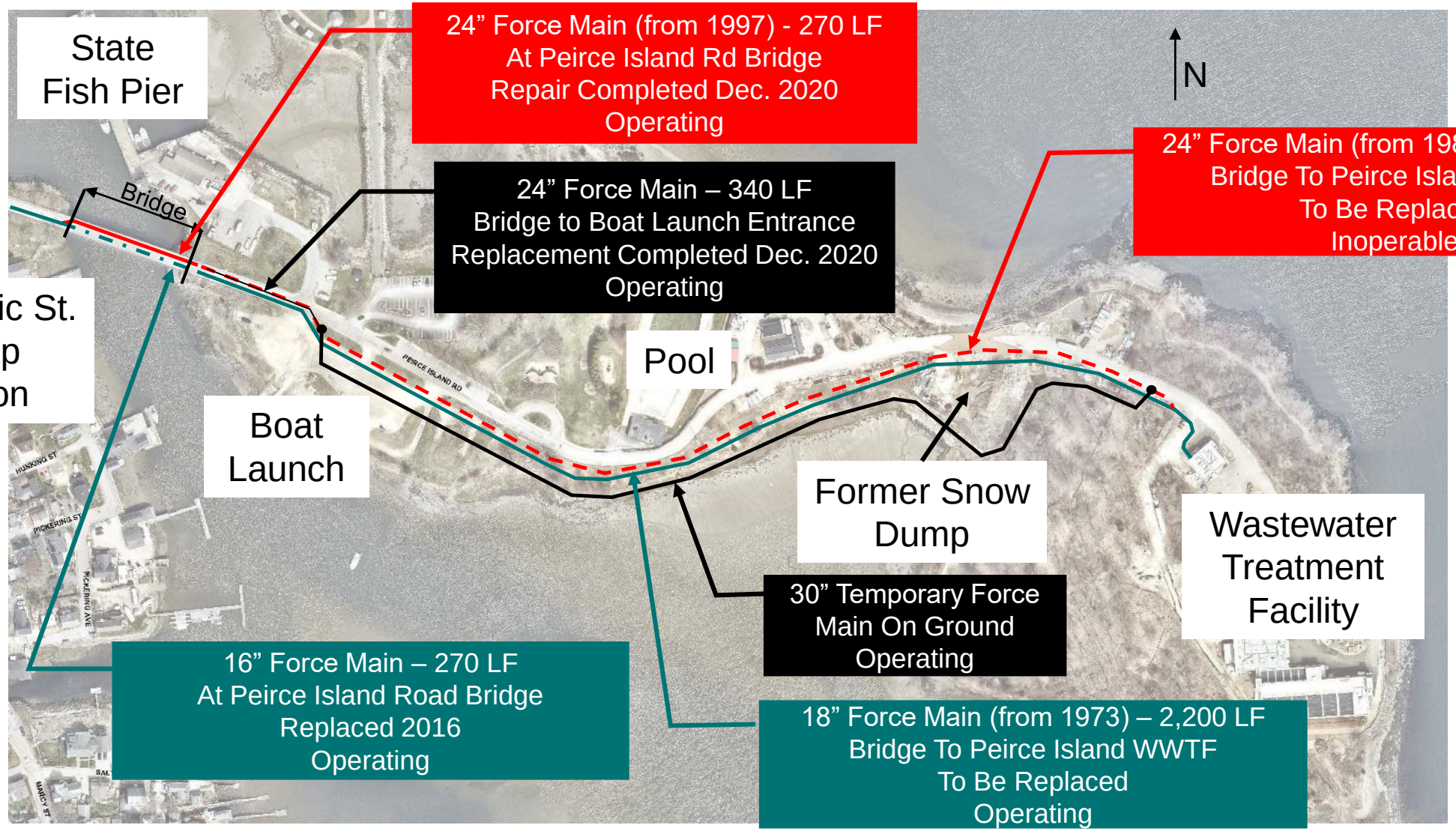
– Temporary 30” HDPE Force Main Installed October 2020

Portsmouth to begin work to replace Peirce Island sewer line

Posted Oct 9, 2020 at 11:52 AM

PORTSMOUTH — The city will begin preparations to replace a pipe that carries wastewater from the Mechanic Street pumping station to the Peirce Island treatment plant.

Temporary Force Main – December 2020 Status



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Failure Analysis

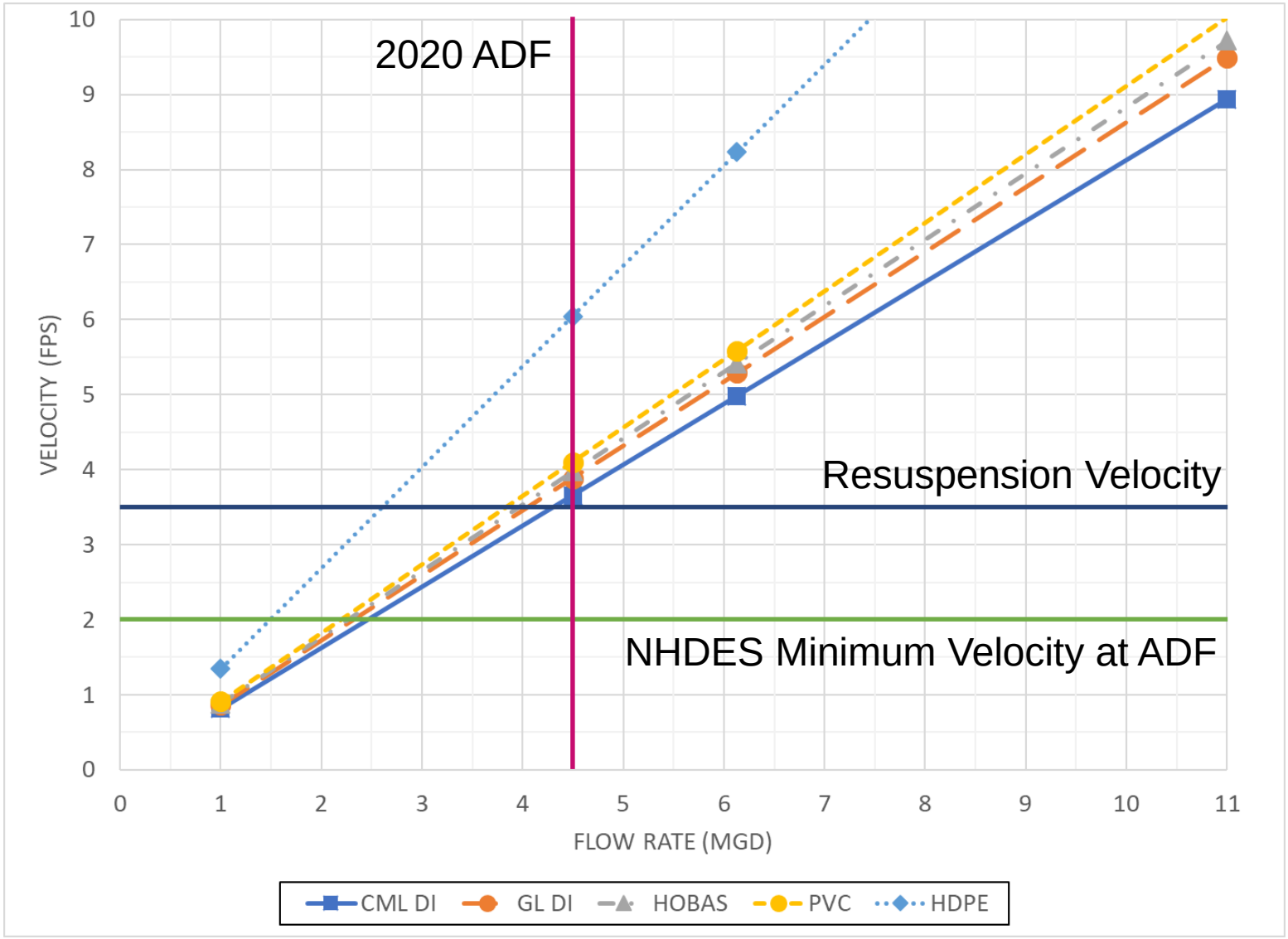
- Conducted in concert with Corrosion Probe, Inc.
- Minimum scour velocities not achieved during dry weather resulting in sediment buildup
- Resuspension of grit during wet weather causing abrasion-erosion of linings
- Once linings breached, under-deposit corrosion of ductile iron
- Cyclic dry-weather sediment build-up followed by wet-weather resuspension causes fresh ductile iron to be exposed and eventual perforation of pipe wall
- Cement mortar lining failure more widespread than glass lining

Nominal Diameter	Force Main Velocity (fps)				
	1 MGD	4.5 MGD	6.13 MGD	11 MGD	15 MGD
	Min. Dry Weather Flow	2020 Approx. Annual Average Flow	Design Average Flow	Max. Flow in 18” Force Main	68% of Peak Flow (22 MGD)
18"	0.81	3.66	4.98	8.94	-
24"	0.46	2.06	2.80	5.02	6.85

Failure Analysis

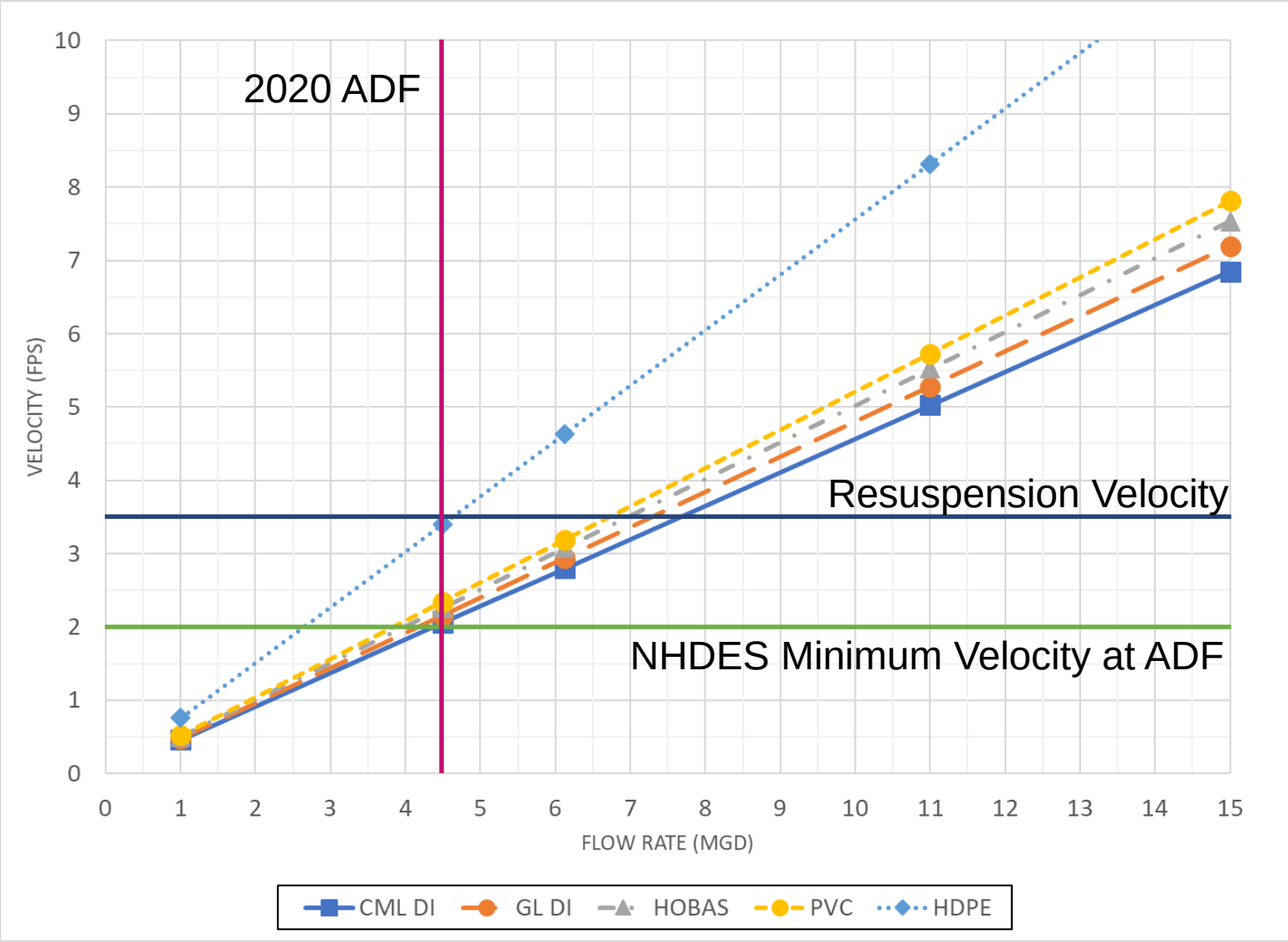
- Corrosion occurred on both cement lined and glass lined pipe
- How to prevent this in the future?

Design – Buried Piping



Velocities in an 18” Force Main (Running Alone)

Design – Buried Piping



Velocities in a 24” Force Main (Running Alone)

Design – Buried Piping

Pipeline Material	Advantages	Disadvantages
PVC	1. Shorter lead time 2. Less expensive	1. More joints requiring restraint & polyethylene bag wrap due to the use of metallic joint restraints (unless butt-fused joints are used) 2. More brittle and susceptible to cracking 3. Large diameter PVC fittings not recommended. DI fittings have erosion/corrosion potential.
HDPE	1. More flexible 2. Greater abrasion resistance 3. Fewer joints 4. Fused joints do not require additional restraint	1. Thermal expansion/contraction concerns 2. Significantly thicker pipe wall may result in larger diameters 3. Requires longer open trench 4. Requires careful QA/QC on fused joints 5. Chlorine can negatively impact HDPE

Design – Buried Piping

- Similar inner diameters to existing piping desired to minimize impacts to existing pump station
- HDPE's thicker sidewall impacts selection – 20" & 30" HDPE equivalent to 18" & 24" DI
- Long-term recommendation to operate one force main at a time during dry weather to increase fluid velocities & limit deposition
- Using only 20" HDPE would result in poor pump performance

→ Twin 24" HDPE Force Mains (DR 11)

Design – Bridge Section

- Replacement with Glass-Lined DI? Corrosion concerns
- Replacement with HDPE? Support, thermal expansion & hydraulic concerns
- Lining? Host pipe integrity concerns
- Bridge scheduled for replacement within 10 years – short-term solution desired

20” Fusible PVC Slipliner

Construction Fun Facts

- 4,200 LF of buried 24” HDPE force main
- 315 LF of FPVC slipliner
- 900 LF of 12” DI water main
- 2,100 CY rock excavation
- Notice to Proceed: November 17, 2021
- Substantial Completion: April 28, 2022
- Six bids; Revoli low bidder
- Engineer’s Estimate: $3.71M
- Bid Price: $3.56M
- Final Price: $3.43M

Construction

Construction

Conclusions

– So, rebuild or replace?

  It depends…

- Replaced all the buried piping that had failed or was at risk of imminent failure
- Rebuilt piping under the bridge with slipliner that is due to be replaced in the future when bridge is replaced

– Conclusions:

- Good reminder that minimum force main velocities are important
- Consider regular force main flushing to resuspend sediment

Thank you.

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