Kingston Water Supply Management Protocol – A SWMI Grant Project

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Presentation Outline

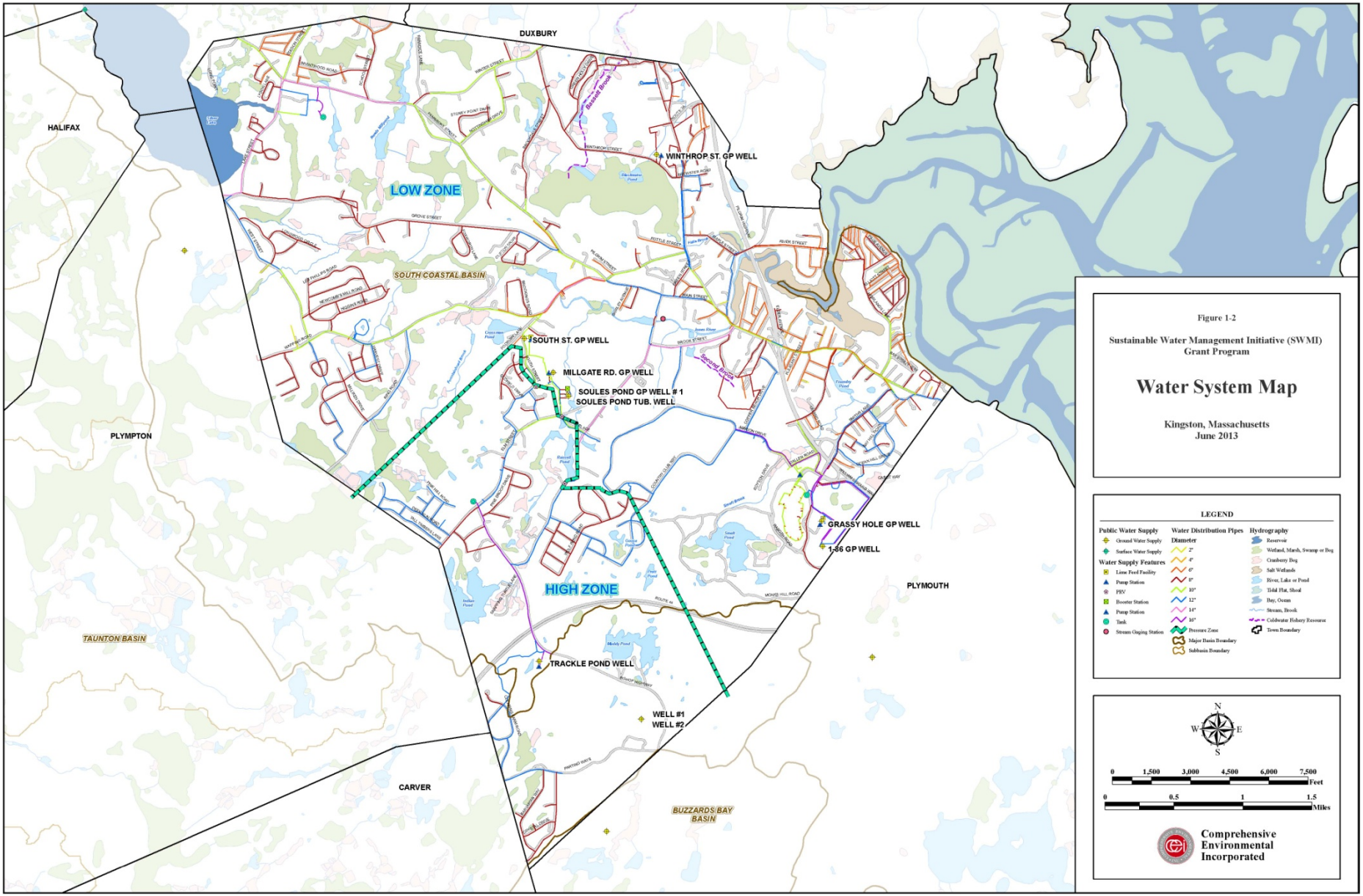
- Objective
- System Overview
- Specific Goals and Challenges
- Historical Data
- Hydraulic Model and Scenario Simulations
- Findings and Summary

Objectives

- Purpose - Demonstrate how Massachusetts communities can shift withdrawals between their wells for benefit of drinking water supply and environment (optimization and/or minimization depending on specifics)
- Balance water quality, cost to customers and compliance with WMA permits and pending SWMI regulations

System Overview

- Two pressure zones: High and Low
- 3 water storage tanks: 2 in Low, 1 in High
- 10-yr Average Day Demand: 1.19 – 1.47 mgd
- 10-yr Max Day Demand: 2.38 – 3.05 mgd
- Summer Average Day Demands
  - Low Zone ≈ 1.3 mgd
  - High Zone ≈ 0.4 mgd
- Sources in Unassessed GWL Basin – South Coastal Basin
- Sources both Registered and Permitted
  - Low Zone: 5 Wells Registered – 0.99 mgd Authorized
  - Low Zone: 1 Well Permitted – 0.81 mgd Authorized
  - High Zone: 1 Well Permitted – 1.44 mgd Authorized


DUXBURY
HALIFAX
PLYMPTON
PLYMOUTH
CARVER
TAUNTON BASIN
BUZZARDS BAY BASIN
SOUTH COASTAL BASIN
LOW ZONE
HIGH ZONE
WINTHROP ST. GP WELL
SOUTH ST. GP WELL
MILLGATE RD. GP WELL
SOULES POND GP WELL # 1
SOULES POND TUB. WELL
GRASSY HOLE GP WELL
1-66 GP WELL
TRACKLE POND WELL
WELL #1
WELL #2
Figure 1-2
Sustainable Water Management Initiative (SWMI)
Grant Program
Water System Map
Kingston, Massachusetts
June 2013
LEGEND
Public Water Supply
Ground Water Supply
Surface Water Supply
Water Supply Features
Lime Feed Facility
Pump Station
PRV
Booster Station
Pump Station
Tank
Stream Gaging Station
Water Distribution Pipes
Diameter
2"
4"
6"
8"
10"
12"
14"
16"
Pressure Zone
Major Basin Boundary
Subbasin Boundary
Hydrography
Reservoir
Wetland, Marsh, Swamp or Bog
Cranberry Bog
Salt Wetlands
River, Lake or Pond
Tidal Flat, Shoal
Bay, Ocean
Stream, Brook
Coldwater Fishery Resource
Town Boundary
N
W
E
S
0 1,500 3,000 4,500 6,000 7,500 Feet
0 0.5 1 1.5 Miles
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Specific Goals

- Optimize use of Trackle Pond Well located in High Zone
- Minimize use of Registered wells located in Low Zone, proximate to Jones River
- No direct correlation has been made between Kingston water source pumpage and Jones River streamflow, but Town is a Green Community and supports efforts to minimize perceived environmental impacts

Supply Challenges

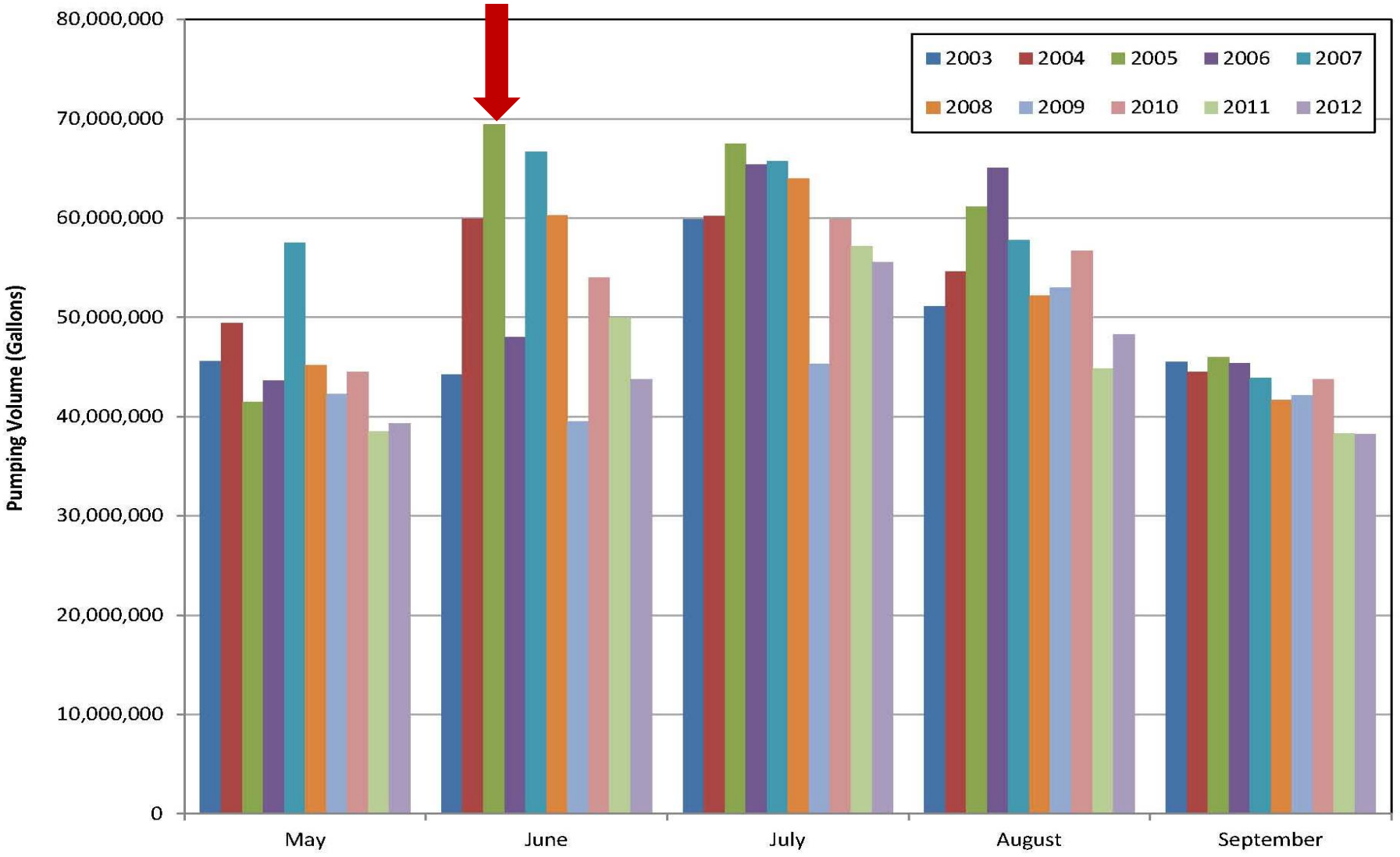
- WMA Constraints – Withdrawal Balancing
  - Total withdrawal from Registered wells
  - Individual withdrawals from Permitted wells
- Varying Water Quality of Sources
- System Hydraulics (existing PRV uncontrolled flows, vault, not communications)
- Future blending of Chlorinated water with water from untreated sources
- Concerns over Potential Environmental Impacts to Jones River streamflow

Water Quality – Manganese Issues

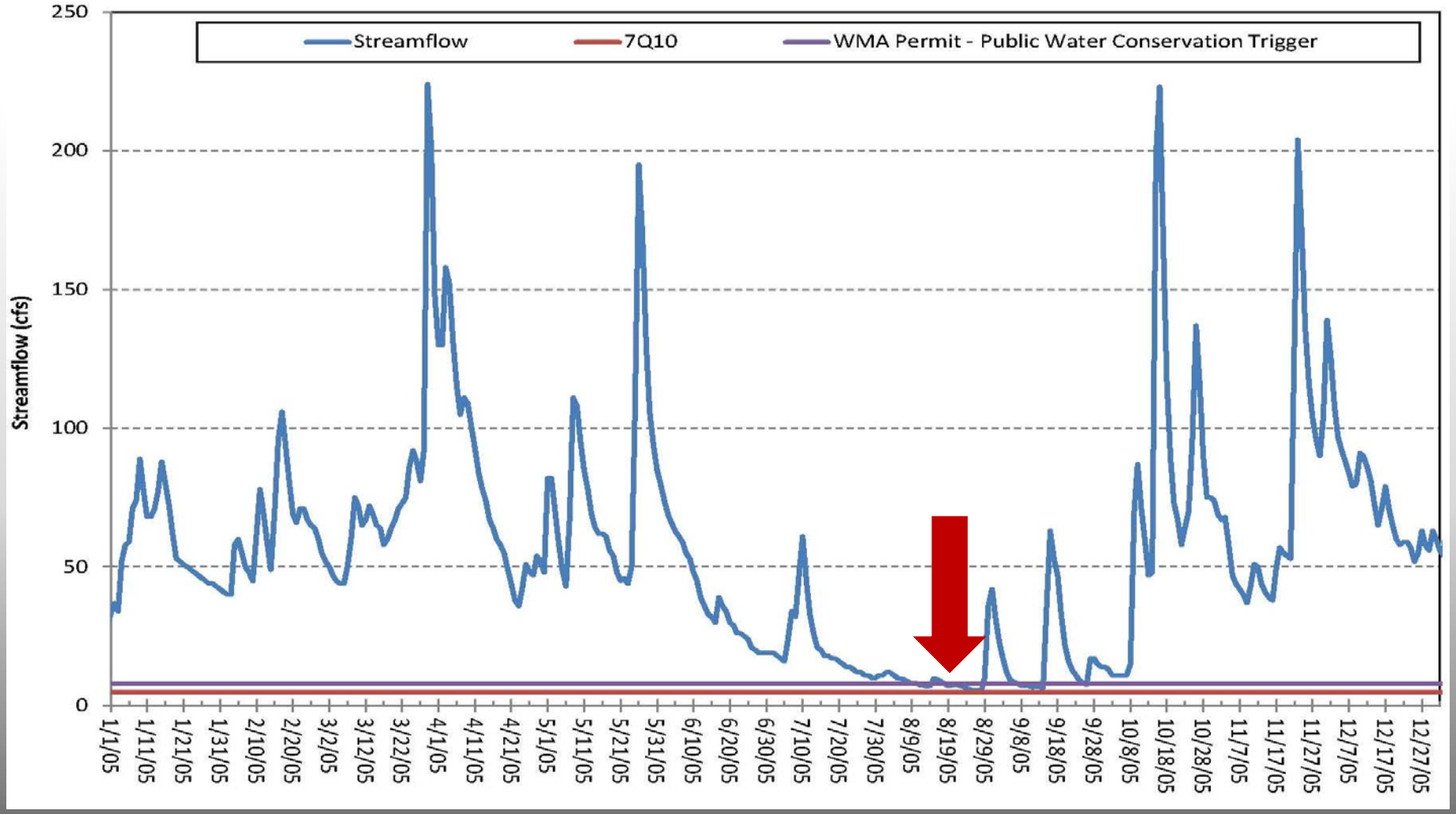
- SMCL for manganese is 0.05 mg/L
- Trackle Pond Well Mn ≈ 0.15 mg/L
  - Recent years reduced pumping rate from 1,000 gpm to 300 gpm to mitigate Mn & compalints
  - Pumping more would introduce more Mn into the distribution system
  - Currently constructing Manganese Removal Treatment Facility
  - Residual chlorine leaving facility will be ≈ 0.2 mg/L

Historical Pumping Data

Representative Dry Year - 2005

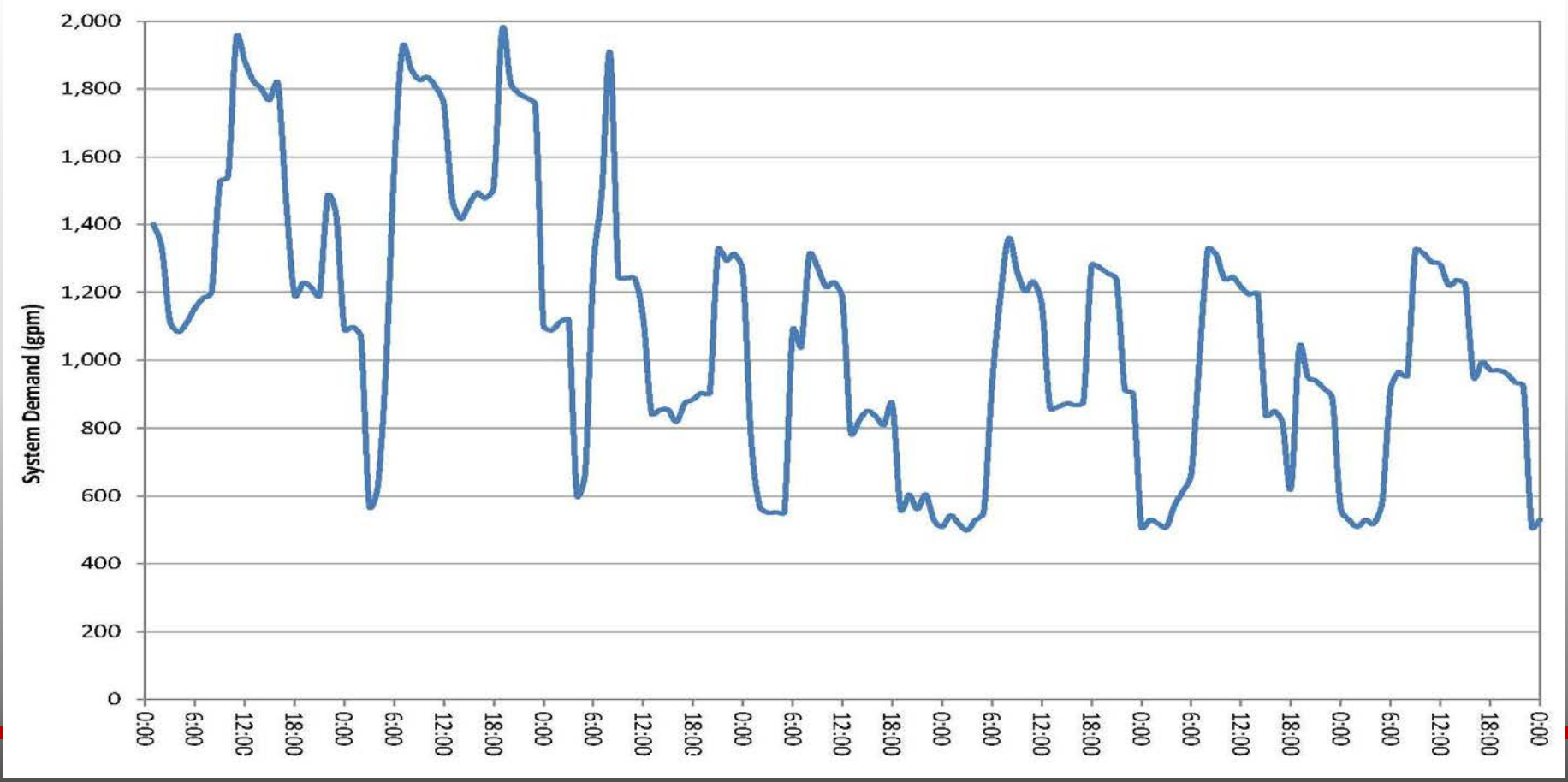


2005 Streamflow Data
Jones River USGS 01105870



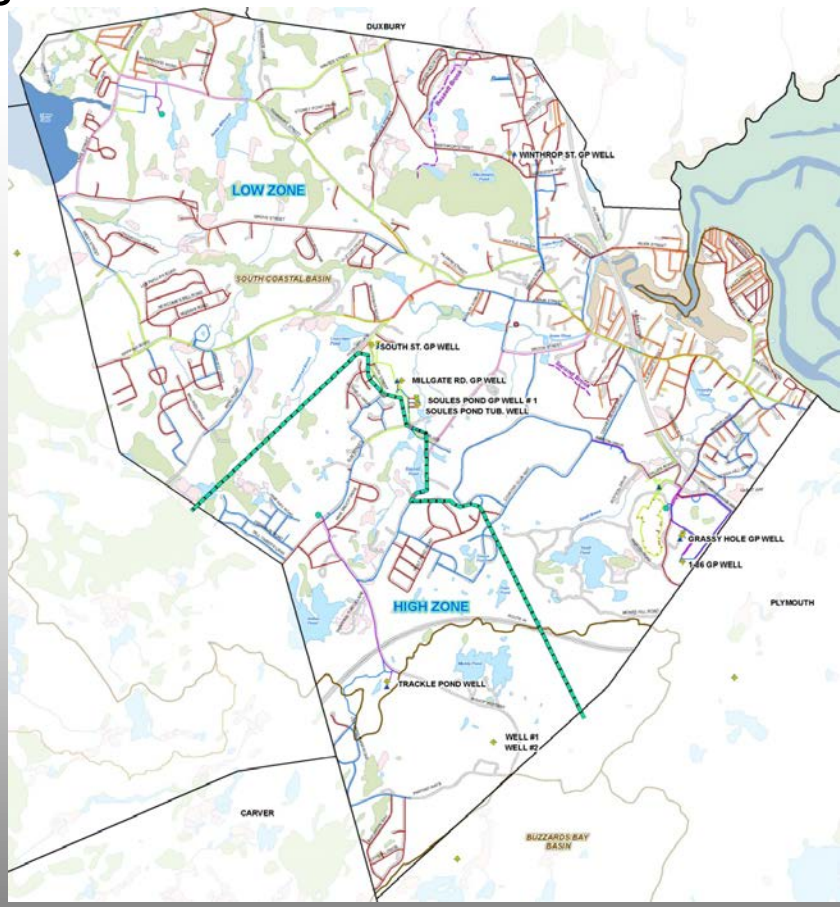
Hydraulic Model

- Programmed model to simulate extended day runs with hourly demand changing throughout the day based on peak week

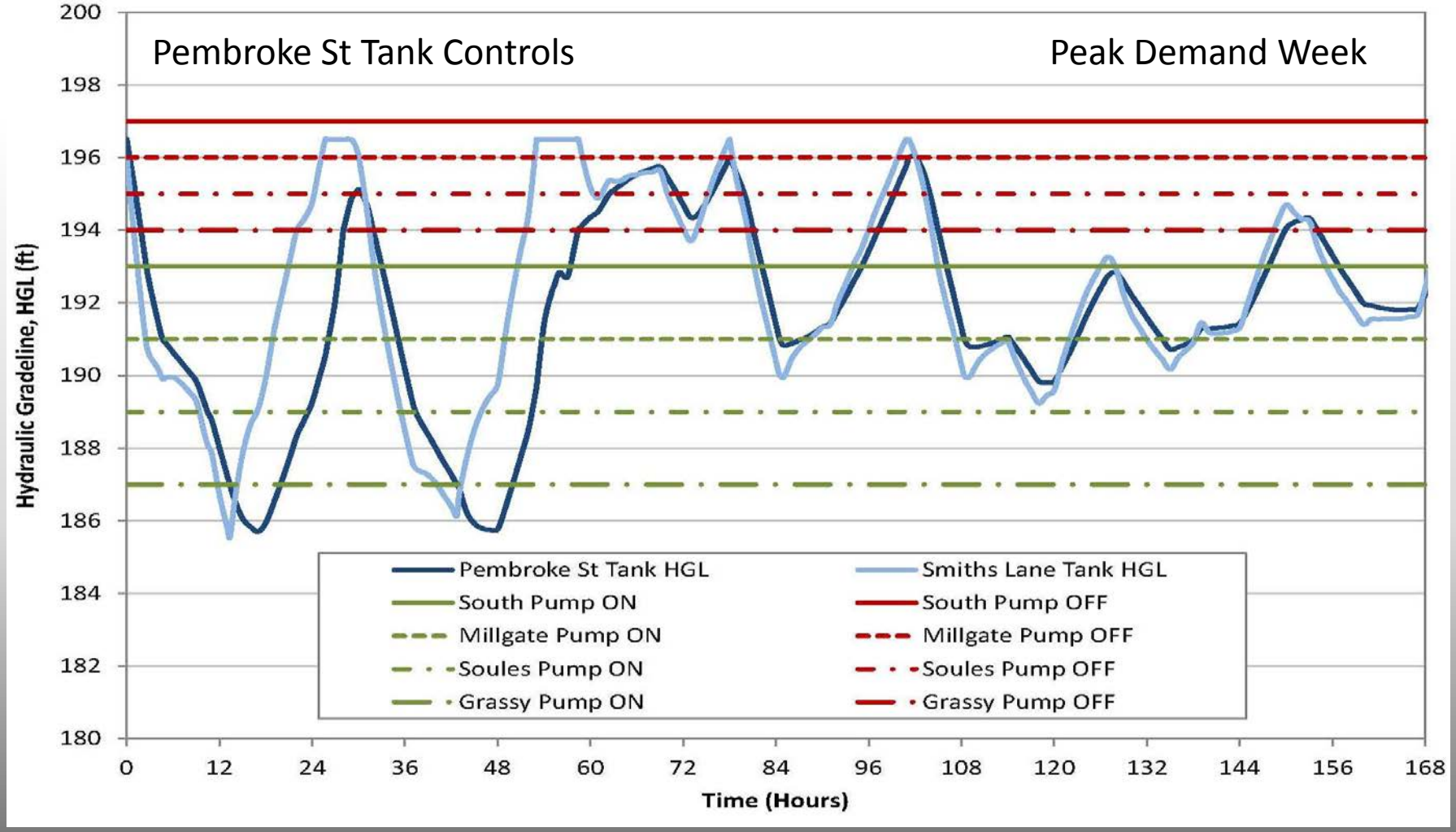


Simulations

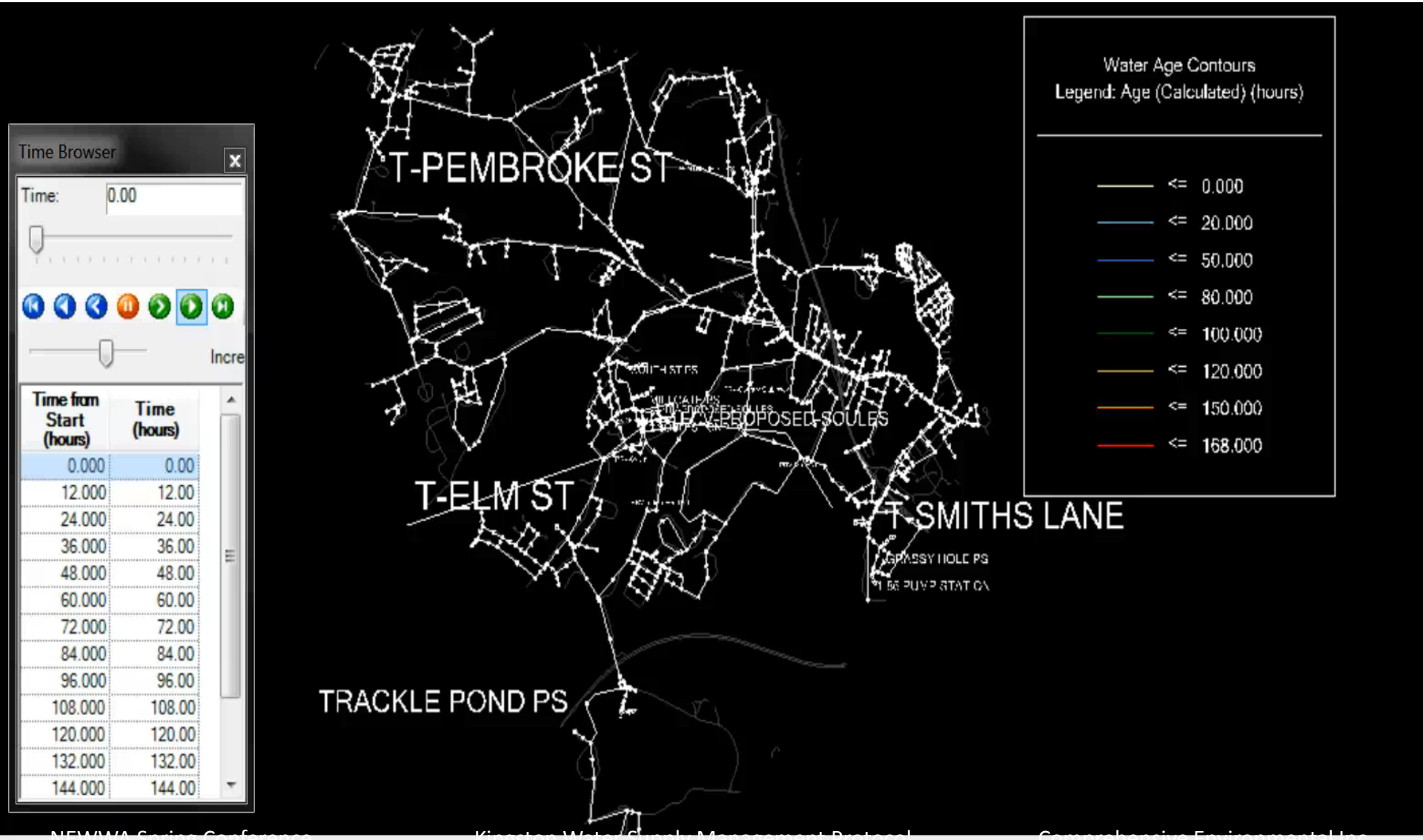
- Current Operation as Separate Zones
  - Scenario 1 – South St Lead
  - Scenario 2 – Grassy Hole Lead
- PRV Transfer from High to Low (similar to existing ability)
  - Scenario 3 – South St Lead
  - Scenario 4 – Grassy Hole Lead
- FCV Transfer from High to Low
  - Scenario 5 – South St Lead
  - Scenario 6 – Grassy Hole Lead
- FCV Transfer from High to Low
  - Scenario 7 – FCV Lead, South St 2nd
  - Scenario 8 – FCV Lead, Grassy Hole 2nd



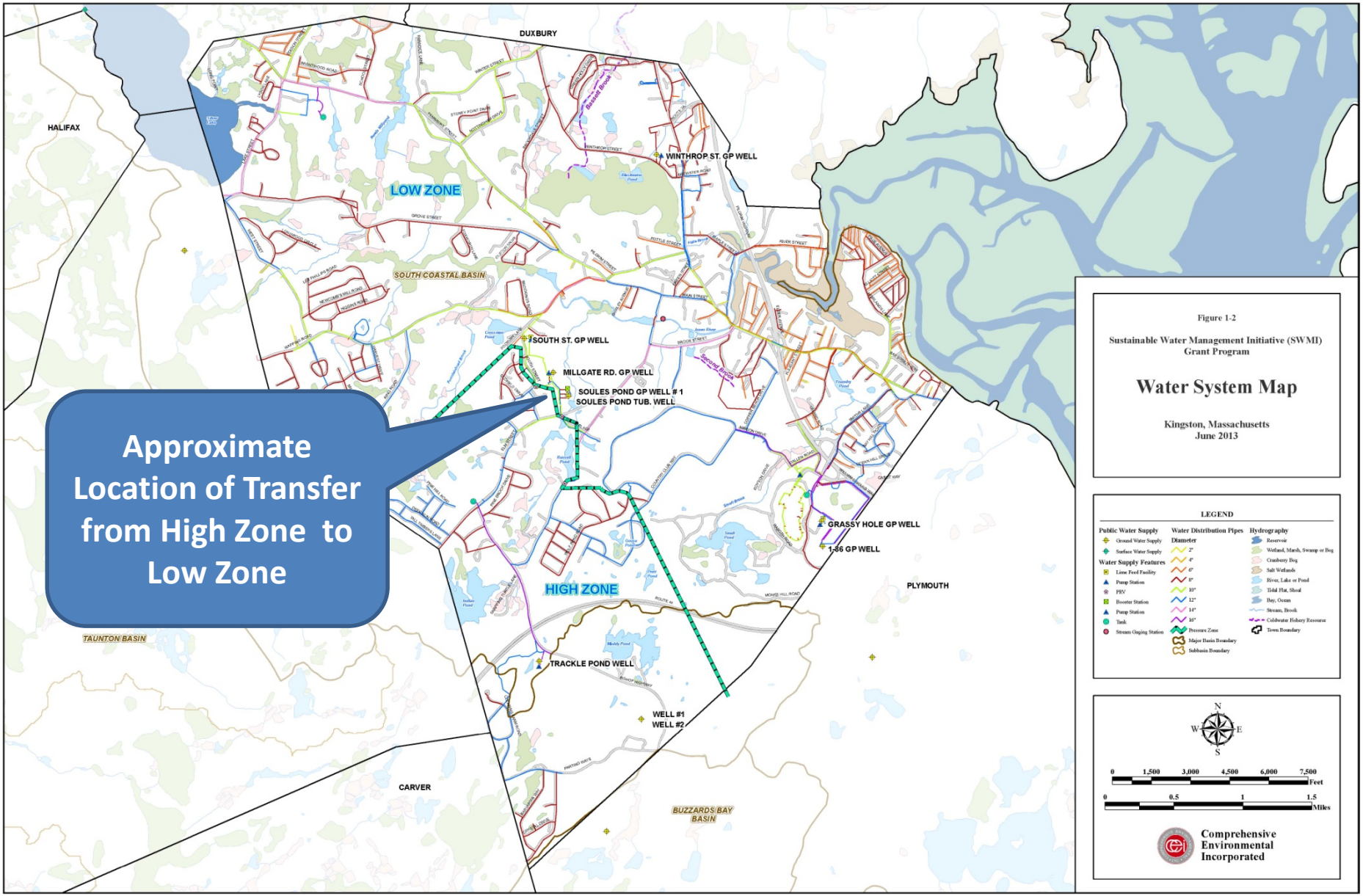
Scenario 1 - Current Operation as Separate Zones – South St Lead



Scenario 1 – Water Age



X: 777,143.73 ft, Y: 357,929.31 ft Zoom Level: 18.4 %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Approximate Location of Transfer from High Zone to Low Zone
Figure 1-2
Sustainable Water Management Initiative (SWMI) Grant Program
Water System Map
Kingston, Massachusetts
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Coldwater Fishery Resource
Town Boundary
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E
S
0 1,500 3,000 4,500 6,000 7,500 Feet
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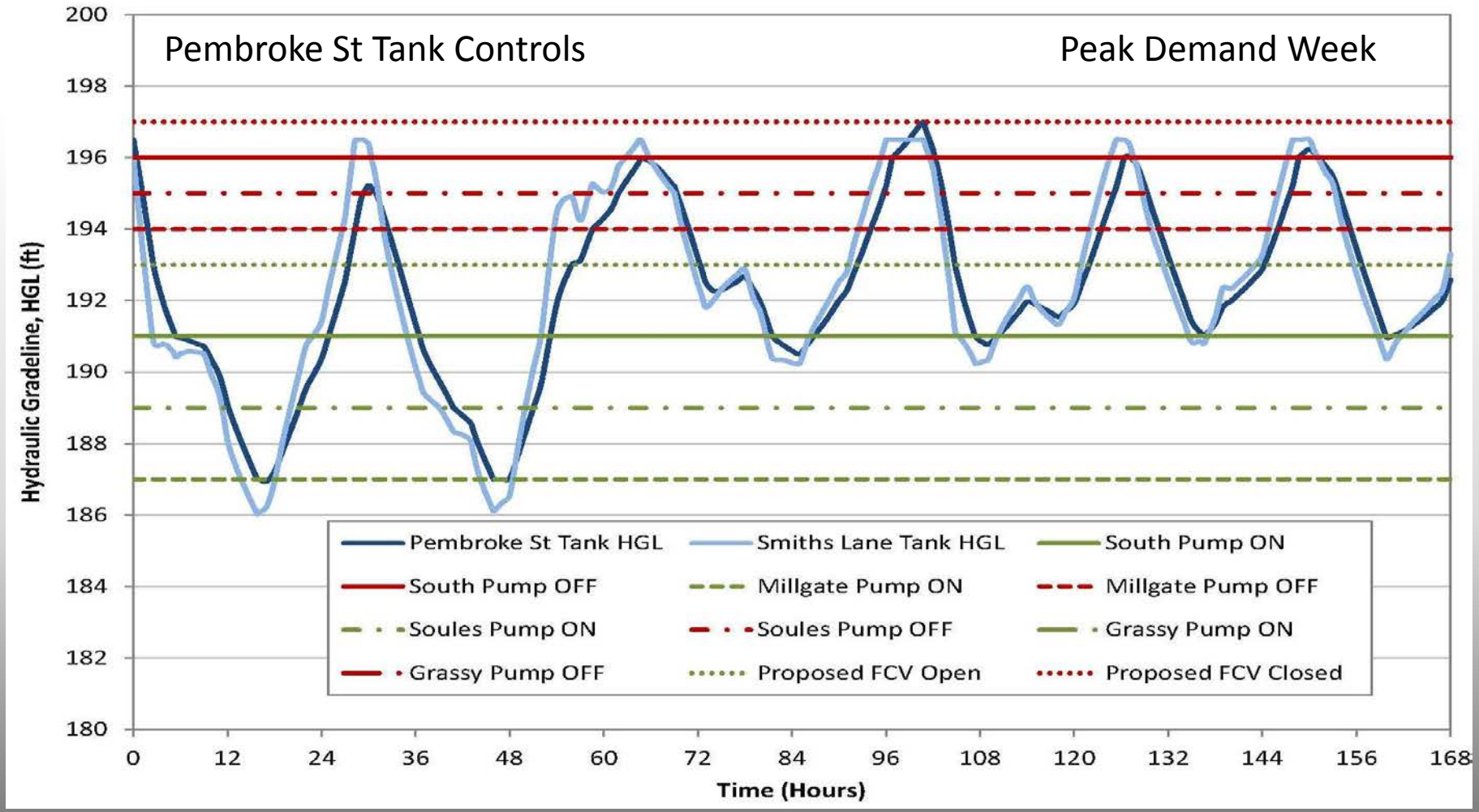
Scenarios with PRV

- Uses Pressure Reducing Valve (PRV) transfer from High to Low
- PRV delivers inconsistent flow from High Zone to Low Zone – Similar to how existing PRVs operate
- When Lag Pump Station are activated, PRV flow decreases - PRV maintains system pressure not flow rate
- Hydraulics in Low Zone indicate preference for well supply pumps over PRV
- Goal is to rely more on Permitted well in High Zone and less on Registered wells in Low Zone

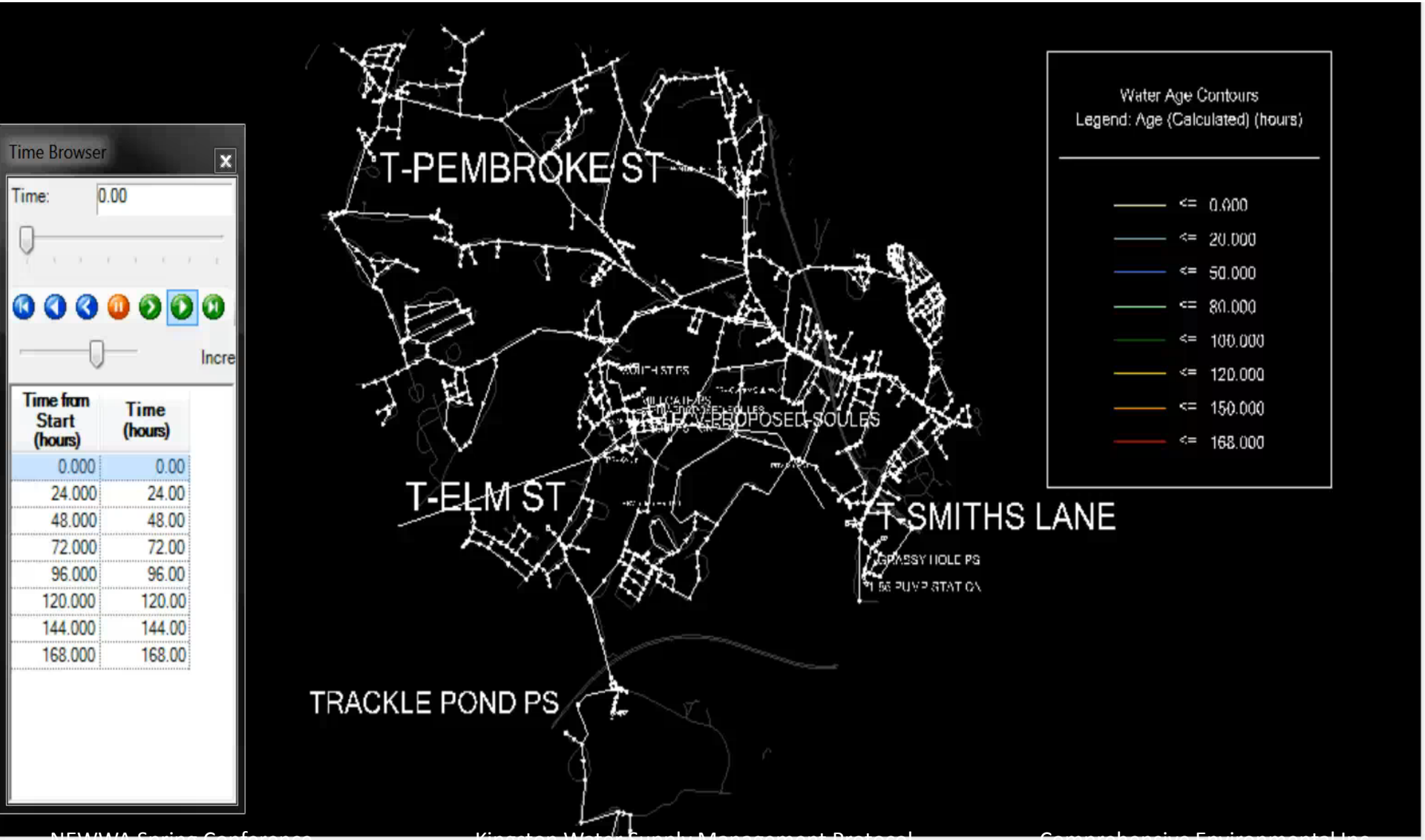
Scenarios with FCV

- Flow Control Valve (FCV) allows for more consistent flow to Low Zone, able to set at consistent rate of 600 gpm
- Evaluated Low Zone supply pumps as lead versus FCV as lead supply in Low Zone
- Programmed model to simulate the progression of chlorine residual from future Trackle Pond Manganese Removal Treatment Facility through the Low Zone
- Some Low Zone wells have manganese (up to 0.15 mg/L) that would adversely react with the residual chlorine

Scenario 7 – Proposed FCV Transfer from High to Low – FCV Lead, South St 2nd

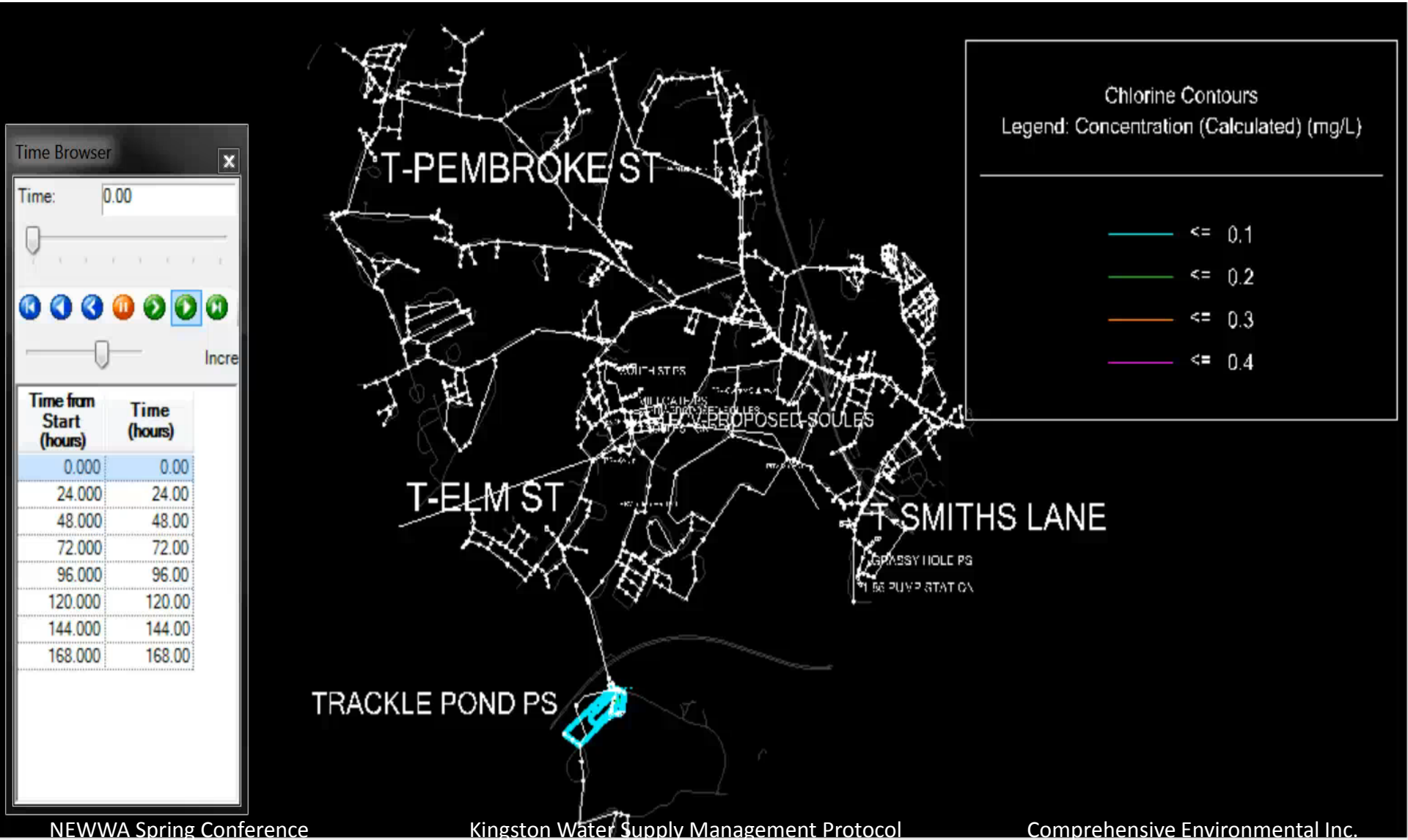


Scenario 7 – Water Age



X: 787,759.55 ft, Y: 346,555.22 ft Zoom Level: 18.4 %

Scenario 7 - Chlorine



Findings

- FCV – No negative impacts on hydraulics
- Residual chlorine progress analysis indicates could have water quality issues in Low Zone
- With FCV as lead supply, residual chlorine could flow to majority of Low Zone
- May need de-chlorination at transfer location

System Modifications

- Work required at existing Booster Pump Station for permanent transfers from High Zone to Low Zone:
  - Removal of one of three booster pumps;
  - Installation of flow control valve and appurtenances and programming;
  - Installation of residual chlorine analyzer;
  - Installation of a de-chlorination system using sodium bisulfite (if needed).

Low Zone Supply Management Protocol

Month	Week 1	Week 2	Week 3	Week 4
April	South St Millgate Soules Pond Grassy Hole	1-86 Soules Pond Millgate South St	South St Millgate Soules Pond Grassy Hole	1-86 Soules Pond Millgate South St
May	HZ Transfer 1-86 Soules Pond Millgate	HZ Transfer South St Millgate Soules Pond	HZ Transfer Grassy Hole Soules Pond Millgate	HZ Transfer 1-86 Soules Pond Millgate
June	HZ Transfer South St Millgate Soules Pond	HZ Transfer Grassy Hole Soules Pond Millgate	HZ Transfer 1-86 Soules Pond Millgate	HZ Transfer South St Millgate Soules Pond
July	HZ Transfer Grassy Hole Soules Pond Millgate	HZ Transfer 1-86 Soules Pond Millgate	HZ Transfer South St Millgate Soules Pond	HZ Transfer Grassy Hole Soules Pond Millgate
August	HZ Transfer 1-86 Soules Pond Millgate	HZ Transfer South St Millgate Soules Pond	HZ Transfer Grassy Hole Soules Pond Millgate	HZ Transfer 1-86 Soules Pond Millgate

Summary

- No direct correlation has been made between pumpage of Town's wells and Jones River streamflow
- Town is willing to optimize authorized (registered and permitted) pumpage to reduce reliance on the wells closest to Jones River in summer
- Implementing High to Low Zone transfers after Trackle Pond Manganese Removal Treatment Facility on-line: FCV installation being funded by 2014 SWMI Grant (with provisions for dechlorination)
- Trackle Pond Well will not be able to supply entire demand - wells in Low Zone will still need to operate during summer and low streamflow periods (peak hour demands reach 2,000 gpm), but at reduced flow rates

Acknowledgements

Town of Kingston Board of Water Commissioners
Matthew Darsch, Superintendent
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SWMI Grant Program Administrators

Questions?

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