Hampton System Water Storage Tank Siting Analysis

TO: Mark Fois and Carl McMorran, Aquarion Water Company

FROM: Amanda Keyes, Tighe & Bond

COPY: Peter Galant and James Collins, Tighe & Bond

DATE: January 10, 2020

Executive Summary

This memo discusses the site alternatives evaluation performed by Aquarion Water Company (Aquarion) for a new water storage tank supporting the water system serving approximately 8,500 homes and businesses in the towns of Hampton, North Hampton and Rye. Three locations for the new water storage tank were evaluated and the Exeter Road Tank site was selected because:

- It is the best site for maintaining the water quality, allowing current operating practices and eliminating the need for additional controls or treatment.
- It is the best site for delivering fire flows to meet the needs of the Town of Hampton.
- It limits construction impacts on the environment, reducing the need for clearing and site disturbance.
- It is on land owned by Aquarion and avoids costly and uncertain property acquisition.
- It is on a parcel already containing a storage tank and the necessary infrastructure (water mains, electrical, and access) are there.
- It is the lowest cost option, which reduces the rate impact to Aquarion's customers.

1. Background and History

Across Hampton, North Hampton and Rye, residents and businesses use more than 2 million gallons of water a day to support daily essential needs such as drinking, cooking and bathing. Drinking water comes from 16 wells and is delivered via 136 miles of pipes, pumps and storage tanks.

Aquarion's four storage tanks enable the community to have adequate water supplies to meet high water demands on hot summer days and to fight fires. Much higher flows are required for fire fighting – for context, the average domestic flow for a home in the Aquarion NH system is 150 gallons per day while fire-fighting requires 500 gallons per minute (GPM) or greater depending on the building location, size, type of construction, and use. The amount of water flow available to fight a fire at a given location in the system while maintaining sufficient pressure is called the available fire flow (AFF).

Because Aquarion provides this critical service, new investment is needed to improve the water system. To address water storage maintenance needs and water system resiliency, Aquarion is planning the rehabilitation of the Exeter Road Tank on Falcone Circle and building a new storage tank. The Exeter Road Tank is the primary source of water storage and pressure for the water system. This makes the tank an essential part of the water system. While the

tank continues to serve the system adequately, it is overdue for rehabilitation, including painting and preventive maintenance. Due to the significant role the tank plays in the water system, the rehabilitation of the tank presents unique challenges. But it also provides an opportunity to improve the water system. The system overall would benefit from an additional tank in the primary pressure zone. Over the years, as demand for water has grown, the need for redundancy and more robust storage/pressure has grown. The rehabilitation of the existing Exeter Road Tank provides a unique opportunity to not only improve existing system infrastructure (by upgrading the existing tank) but to add needed infrastructure (an additional tank) to improve the system resiliency.

2. Introduction

The existing 0.75 million-gallon (MG) Exeter Road Tank (Photo 1) is the primary source of water storage pressure for the main pressure zone in Aquarion's Hampton water system. The tank is overdue for maintenance, repair, and painting. The tank was constructed in 1983, has the original interior and exterior paint coatings, and needs steel repairs. The tank must be removed from service for approximately 6 months for steel repairs and painting.

Photo 1
Exeter Road Tank

If the Exeter Road Tank is taken out of service, there needs to be a reliable alternative to pressurize the water system. Due to the critical role the Exeter Road Tank plays in the overall system, any alternative needs to be as robust and reliable as possible. The highest standard in our industry for pressurization is gravity storage (the use of tanks). In lieu of tanks, pumping would be an alternative means of pressurizing the system to meet domestic and fire flow demands. However, pumped service is less reliable than gravity storage (tanks) and requires additional facilities to prevent over- or under-pressurizing the system. Appropriate pressurization is an absolute necessity in operating a water system as variations in pressure come with significant risk. For example, over-pressurization can result in water main breaks, damage to equipment, damage to home water lines and boil water notices. If there is not enough pressure (under-pressurization), a water system could suffer from inadequate service pressures and fire flows. Because pumping is a less reliable pressurization option and comes with unacceptable operating risks, construction of an additional storage tank is the best way to pressurize the system when the existing tank is taken offline for repair.

Furthermore, an additional water tank is the best option because with the Exeter Road Tank out of service, the other three tanks in the water system are not large enough to make up for its absence. While the other three tanks in the Hampton water system perform similar functions to the Exeter Road Tank, they do not collectively have the ability to provide service to the entire system while the existing Exeter Road tank is out of service, owing to their elevation and overall storage volume (Figure 1).

A second tank in the main pressure zone needs to be constructed at the same elevation as the Exeter Road Tank (249 feet above mean sea level) to provide appropriate water pressure

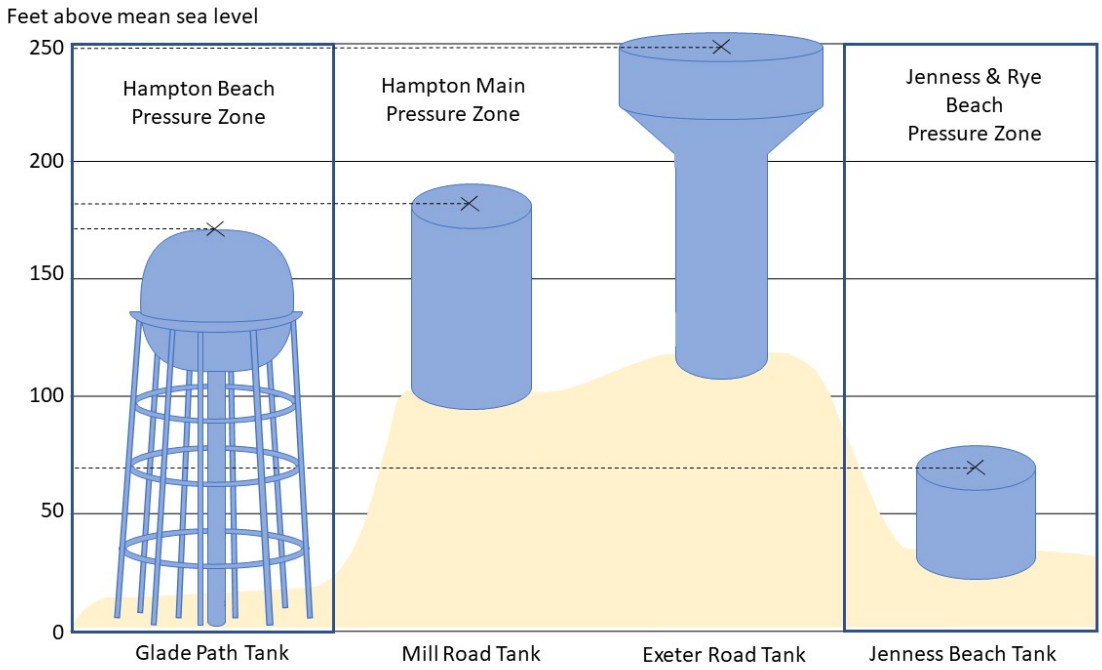

Figure 1
Storage Tank Elevations

without supplemental pumping and so that one tank doesn't overflow before the other fills. The required elevation limits the number of sites that are feasible for constructing a new tank.

An evaluation of the service area was performed to determine suitable locations for a proposed tank. The following criteria were used to identify potential sites:

- Ground surface elevation of 110 feet or above – This criteria was selected due to the high cost associated with the construction of a elevated water storage tanks. The overflow elevation of the tank needs to match the existing tank overflow of 249 feet. A tank at an elevation lower than 110 feet would need to be greater than existing tank height of 140 feet.
- Property available to Aquarion to build on – This criteria identified properties that Aquarion owns, are available to purchase, or available to obtain an easement.
- Located close to large water mains (12" or larger) – This criteria would allow Aquarion to construct the tank in a location that is hydraulically favorable for delivering water to the rest of the system and would not require upgrades to existing water mains.

Only three sites satisfied these criteria (Figure 2):

1. A site off Boutilier Lane in North Hampton (Boutilier Lane Site)
2. A site located near the intersection of Lafayette Road and Breakfast Hill in Rye (Rye Site)
3. The Exeter Road Tank site (constructing a twin tank at the existing site)

Stratham
Greenland
Portsmouth
North Hampton
Rye
North Hampton
Hampton
Hampton Falls
Seabrook
Alternative Rye Tank Site
Alternative Boutillier Lane Tank Site
Proposed Exeter Twin Tank Site
Lafayette Rd
Lang Rd
Tehias Rd
Wallis Rd
Washington Rd
Libbey Ln
Walker Ln
Central Cemetery
Locke Rd
Recreation Rd
Harbor Rd
Central Rd
Dump Rd
Grove Rd
Garland Rd
West Rd
Spring Rd
Old Beach Rd
Surf Ln
Big Rock Rd
Pine St
Perkins Rd
South Rd
Love Ln
Ocean Blvd
Red Mill Ln
Church Rd
Pond Path
Old Locke Rd
Willow Ave
Chapel Rd
Maple Rd
Cotton Farm Ln
Woodland Rd
Atlantic Ave
Cedar Rd
Pine Rd
Mill Rd
Fern Rd
Sylvan Rd
Garrett Dr
Steve Rd
Snip Rock Rd
Runnymede Dr
Sea Rd
Rockrimmon Rd
Mumsey Dr
Great Gate Dr
Appledore Ave
Huckleberry Ln
Briar Rd
Robin Ln
Glen Rd
Katie Ln
Hunter Dr
Little River Rd
Bonnie Ln
Norton Rd
Taylor St
Tobey St
Elliot St
High St
Hutchins Dr
Kings Hwy
Hedman Ave
Sanborn Rd
Alexander Dr
Esker Rd
Leavitt Rd
Colby St
Gill St
Thorwald Ave
No Name
Holly Ln
Winnacunnet Rd
Park Ave
Playhouse Cir
Hardardt's Way
Tide Mill Rd
NH Route 101
Landing Rd
Glade Path
Island Path
Cole St
Brown Ave
Ashworth Ave
Harris Ave
N St
O St
River Ave
Millbery Ave
Mace Rd
Dearborn Ave
Scott Rd
Baron Rd
Bourn Ave
Anns Ln
Tower Dr
Barbour Rd
Whites Ln
Jonty's Ln
Lamson Ln
Sicard St
Watsons Ln
Stowecroft Dr
Burgundy Dr
Seavey St
Carolan Ave
Fairfield Dr
Forest Dr
No Name
Langdale Dr
Liberty Ln E
Interstate 95 N
Interstate 95 S
NB Rest Area
Timber Swamp Rd
Hemlock Haven
Towle Farm Rd
Drakeside Rd
Taylor River Estates
Goss Rd
Bashby Rd
Pashby Rd
Olde Rd
NH Route 101 E
NH Route 101 W
St Cyr Dr
Deer Run Rd
Winnicut Rd
Lovering Rd
Walnut Ave
Evergreen Dr
North Rd
Knowles Field Rd
Juniper Rd
Birch Rd
Highland Dr
Granite Dr
Aspen Way
Hickory Ave
Oak Dr
Bunnette Dr
Randolph Dr
Fern Ave
Lafayette Rd
Park Cir
New Rd
Post Rd
Kimberly Dr
Sylvan Rd
Fern Rd
Garrett Dr
Steve Rd
Pine Rd
Cedar Rd
Mill Rd
Atlantic Ave
Maple Rd
Cotton Farm Ln
Woodland Rd
Chapel Rd
Willow Ave
Sea Rd
Rockrimmon Rd
Mumsey Dr
Great Gate Dr
Appledore Ave
Huckleberry Ln
Briar Rd
Robin Ln
Glen Rd
Katie Ln
Hunter Dr
Little River Rd
Bonnie Ln
Norton Rd
Taylor St
Tobey St
Elliot St
High St
Hutchins Dr
Kings Hwy
Hedman Ave
Sanborn Rd
Alexander Dr
Esker Rd
Leavitt Rd
Colby St
Gill St
Thorwald Ave
No Name
Holly Ln
Winnacunnet Rd
Park Ave
Playhouse Cir
Hardardt's Way
Tide Mill Rd
NH Route 101
Landing Rd
Glade Path
Island Path
Cole St
Brown Ave
Ashworth Ave
Harris Ave
N St
O St
River Ave
Millbery Ave
Mace Rd
Dearborn Ave
Scott Rd
Baron Rd
Bourn Ave
Anns Ln
Tower Dr
Barbour Rd
Whites Ln
Jonty's Ln
Lamson Ln
Sicard St
Watsons Ln
Stowecroft Dr
Burgundy Dr
Seavey St
Carolan Ave
Fairfield Dr
Forest Dr
No Name
Langdale Dr
Liberty Ln E
Interstate 95 N
Interstate 95 S
NB Rest Area
Timber Swamp Rd
Hemlock Haven
Towle Farm Rd
Drakeside Rd
Taylor River Estates
Goss Rd
Bashby Rd
Pashby Rd
Olde Rd
NH Route 101 E
NH Route 101 W
St Cyr Dr
Deer Run Rd
Winnicut Rd
Lovering Rd
Walnut Ave
Evergreen Dr
North Rd
Knowles Field Rd
Juniper Rd
Birch Rd
Highland Dr
Granite Dr
Aspen Way
Hickory Ave
Oak Dr
Bunnette Dr
Randolph Dr
Fern Ave
Lafayette Rd
Park Cir
New Rd
Post Rd
Kimberly Dr

LEGEND

- Proposed Water Tank
- Existing Water Tank
- Streets
- Stream
- Waterbody
- Town Boundaries
- Other Town Boundary

Pressure Zones:

- Hampton Beach Pressure Zone
- Hampton Main Pressure Zone
- Jenness & Rye Beach Pressure Zone

1:42,000

0 1,750 3,500

Feet

N

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Source:
Aquarion Water Company and CTDEEP, Office of Information Management.
The data in this map is provided by Aquarion.
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FIGURE 2
PROPOSED TANK LOCATIONS
HAMPTON STORAGE EVALUATION

Hampton, New Hampshire
Aquarion Water Company of New Hampshire

January 2020

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3. Construction Considerations

3.1.Boutilier Lane Site (Figure 3)

For a variety of reasons, the Boutilier site is too challenging as a tank site. The Boutilier Lane site is a 1 acre wooded and undeveloped parcel located west of the Boutilier Lane neighborhood. The parcel is land-locked and lacks an easement from the site to either Boutilier Lane or Atlantic Avenue, where it could tie in to existing mains. A tank at this location would introduce a new, non-conforming use to this neighborhood. There were two alternatives evaluated for connecting this site to existing water mains:

Alternative 1: A connection to the existing Boutilier Lane water main would require obtaining an easement between two residential parcels, tree clearing, and constructing 175 feet of water main, electrical service, and an access road. The yellow line in Figure 3 shows the location of the easement and water main for this Alternative.

Alternative 2: Utilize the existing easement approximately 2,300 feet of water main along the easement and 4,875 feet of water main in Mill Road to the intersection of Atlantic Avenue would be required. The blue line in Figure 3 shows the proposed water main for this alternative.

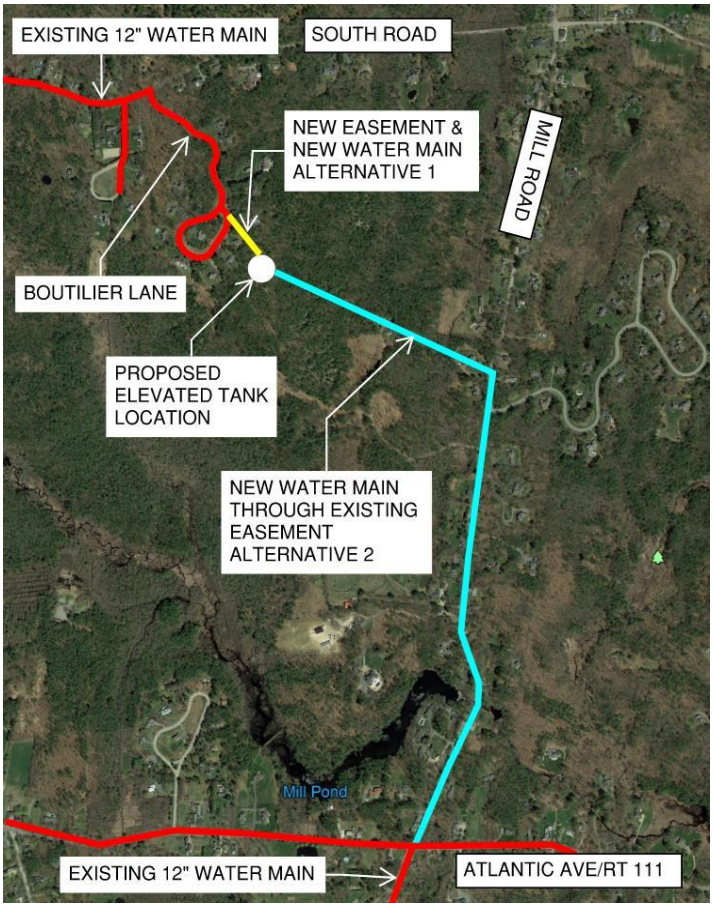


Figure 3
Boutilier Tank Site

Both Boutilier Lane alternatives compare negatively to the Exeter Road site.

- Higher potential for negative impacts on water quality, requiring a change in operating practices and the need for additional controls or treatment to address negative impacts on water quality.
- Negative impacts on fire protection in Hampton, requiring water main and pumping upgrades to match existing conditions without Exeter Road Tank in service.
- Negative impacts on environment, requiring additional tree clearing and grading.
- Additional distribution water main required
- Easement Acquisition required for Alternative No. 1

3.2. Rye Site (Figure 4)

The Rye site, like the Boutilier site, has too many negatives to make it a viable tank site. The Rye site is owned by Eversource Energy and contains an electric substation and high voltage power lines. The power lines bisect the site and would need to be crossed for construction and future maintenance of a new tank. A tank in this location would require approximately 700 feet of new water main in Lafayette Road. Aquarion would need to purchase an easement across the property. Eversource has indicated that an easement is feasible but the cost is not known. The property is owned by Aquarion's parent company but the Public Utilities Commission requires that Aquarion pay fair market value for any land or easement acquisitions.

The portion of the Rye site available for construction is wooded and steeply sloped down to the neighboring property line. The site would require site clearing and significant grading to level the site for the tank foundation.

- Higher potential for negative impacts on water quality, requiring a change in operating practices and the need for additional controls or treatment to address negative impacts on water quality.
- Negative impacts on fire protection in Hampton, requiring water main and pumping upgrades to match existing conditions without Exeter Road Tank in service.
- Negative impacts on environment, requiring additional tree clearing and grading.
- Additional distribution water main required
- Land or easement acquisition required

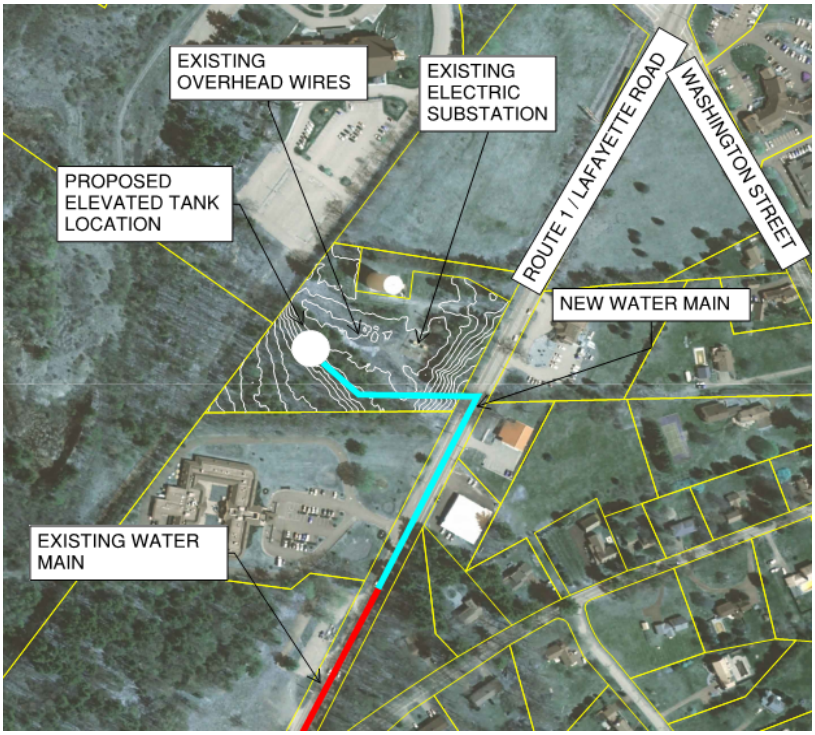


Figure 4
Rye Tank Site

3.3. Exeter Road Tank Site (Figure 5)

The existing Exeter Road tank site is the best site for an additional storage tank. A twin Exeter Road Tank would be constructed on the same parcel as the existing tank. The site is located in an area zoned industrial (Zone I) and a second tank would be consistent with the existing use of the property.

The Exeter Site is bound by a residential neighborhood to the east and Route 101 to the west. The second tank would be located to the west of the existing tank to reduce its visual impact on the neighborhood.

Additional clearing and site piping would be required to construct the second tank on the Exeter Tank Site, but no additional distribution main would be required.

- No fire protection impacts
- Fewer environmental impacts
- No additional distribution main required
- No land or easement acquisition required

Figure 5
Exeter Road Tank Site

4. Fire Protection

Available fire flow (AFF) in the water system with the existing Exeter Road Tank out of service for rehabilitation was compared with the preferred scenario under which a new tank was in operation, for each of the site alternatives. The evaluation was done under maximum day demand conditions and took into account the fire flows requested by the Town of Hampton, as follows:

- Hydrant AFF greater than 1,500 GPM
- AFF greater than 2,500 GPM AFF at Foss Manufacturing.

A second tank at the Exeter Road Tank location produced the best fire protection results, with the largest number of hydrants predicted to have AFF greater than the 1,500 GPM target while maintaining at least 2,500 GPM AFF at Foss Manufacturing.

Figures 6 - 9 present the results of AFF analyses at hydrants in Hampton with a tank at each of the site alternatives. In each condition, the existing Exeter Road Tank is out of service and the proposed tank is active. Hydrants colored red in each figure indicate hydrants with AFF less than the desired 1,500 GPM.

5. Water Quality

The location of a tank in the distribution system has important water quality implications. Unless a large portion of water stored in a tank turns over each day, chlorine levels decline which increases the risk of microbiological contamination. Tanks at the ends of water mains, such as the Boutilier and Rye sites, would require additional new facilities to satisfy water quality standards, such as control valves and re-chlorination facilities, in addition to changes to operating procedures. These changes would result in additional capital and operational costs to the system as well as adding operational complexity.

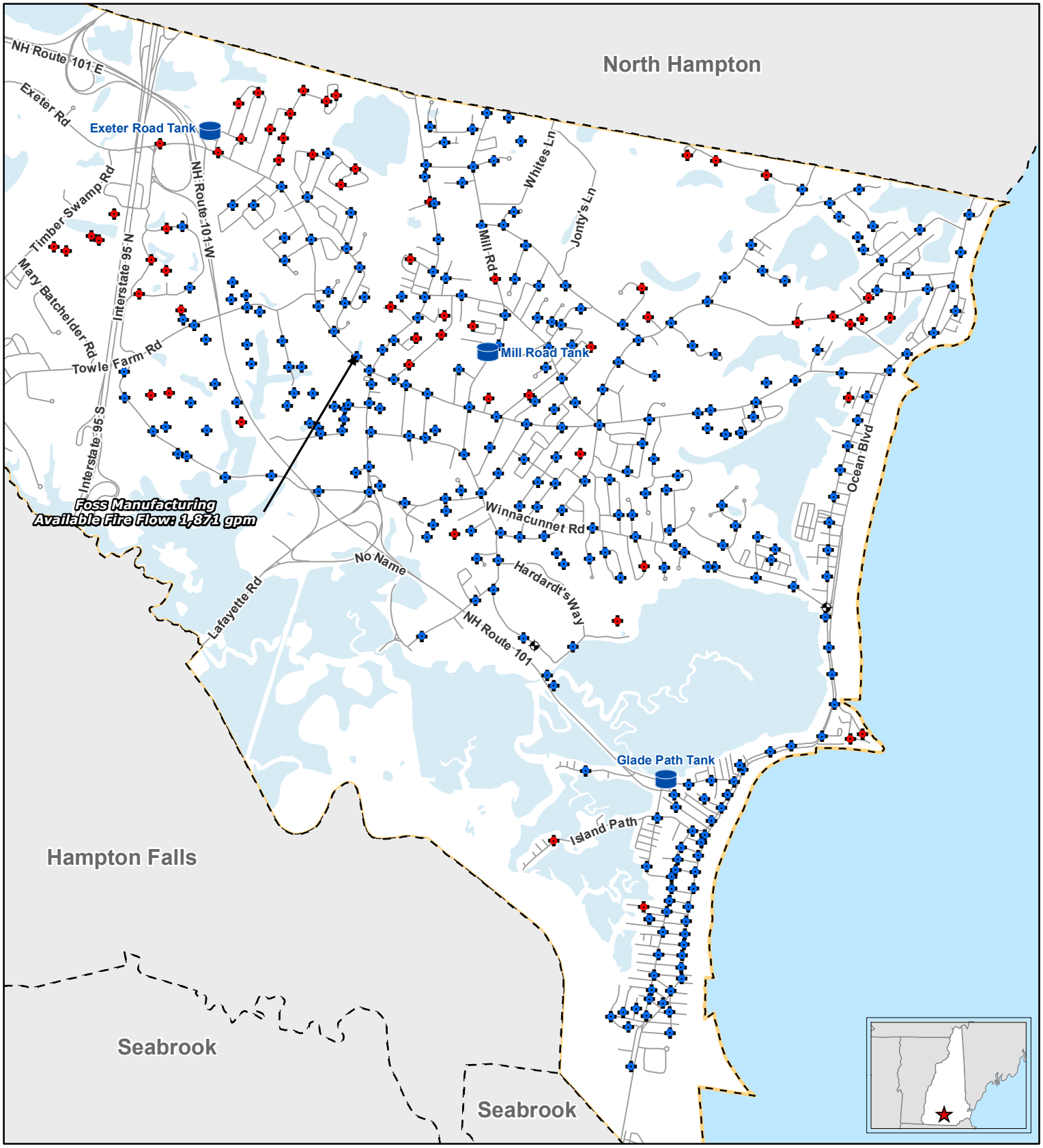
A hydraulic model was used to estimate water age in the distribution system with a new tank at each of the three site alternatives. All sites resulted in increased water age in the distribution system. However, a tank at the Rye or Boutilier site would drain and fill more slowly than a twin tank system at the Exeter Road Tank site, resulting in higher water age. The Rye or Boutilier site would also require additional distribution system and/or treatment facilities and operational changes to manage water quality.

A second tank at the Exeter Road Tank site requires no additional facilities or equipment, and minimal operational changes.

6. Conclusion

The Exeter Road Tank site best serves the interests of maintaining water pressure for fire safety and water quality, with the least uncertainty of outcome and cost to Aquarion's customers. Locating the new tank next to the existing tank makes the Exeter Road site the most favorable choice among the alternatives. And unlike the other site alternatives, it does not require obtaining new easement rights and minimizes site disturbance and related environmental impacts.

Table 1 summarizes the findings of the site alternatives analysis.



LEGEND

- Water Tank
- Pressure Regulating Valve
- Town Boundaries
- Waterbody

MaxDayAFF
- <1,500 gpm
- >1,500 gpm

No. Hydrants less than 1,500 gpm: 64
No. Hydrants greater than 1,500 gpm: 298

1:36,000
0 1,500 3,000
Feet

N

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Note: Available Fire Flow was determined at maximum day demand (MDD) with the tanks at low operating level (~80% full), with well pumps active.

FIGURE 6
AVAILABLE FIRE FLOW
BOUTILIER TANK
CONNECTED AT BOUTILIER LANE
EXETER TANK OFFLINE
MDD CONDITIONS

Hampton System
Aquarion Water Company
of New Hampshire
January 2020

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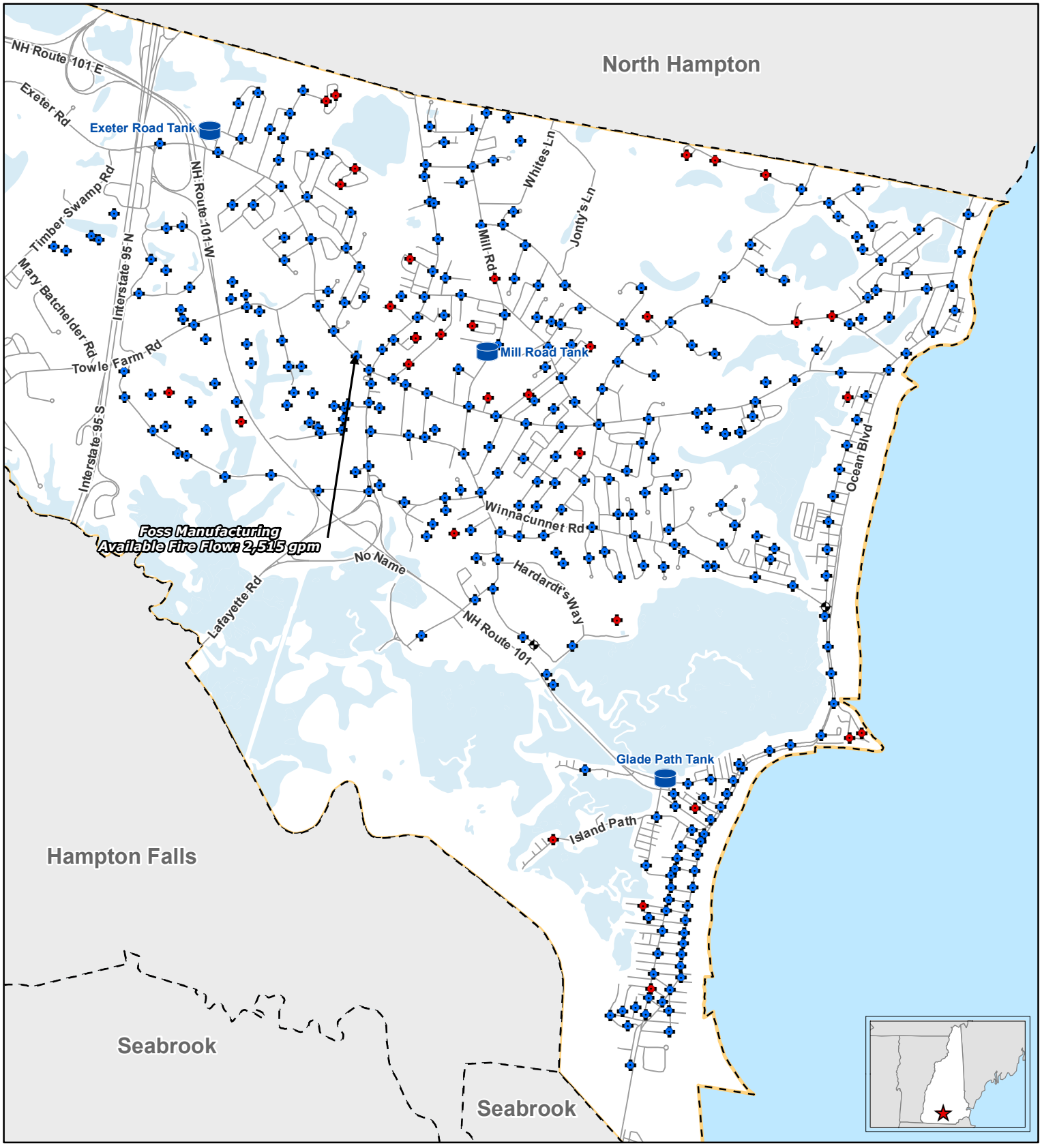

LEGEND

- Water Tank
- Pressure Regulating Valve
- Town Boundaries
- Waterbody

MaxDayAFF
- <1,500 gpm
- >1,500 gpm

No. Hydrants less than 1,500 gpm: 34
No. Hydrants greater than 1,500 gpm: 328

1:36,000
0 1,500 3,000
Feet

N

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Note: Available Fire Flow was determined at maximum day demand (MDD) with the tanks at low operating level (~80% full), with well pumps active.

FIGURE 7
AVAILABLE FIRE FLOW BOUTILIER TANK CONNECTED AT MILL ROAD EXETER TANK OFFLINE MDD CONDITIONS

Hampton System
Aquarion Water Company of New Hampshire
January 2020

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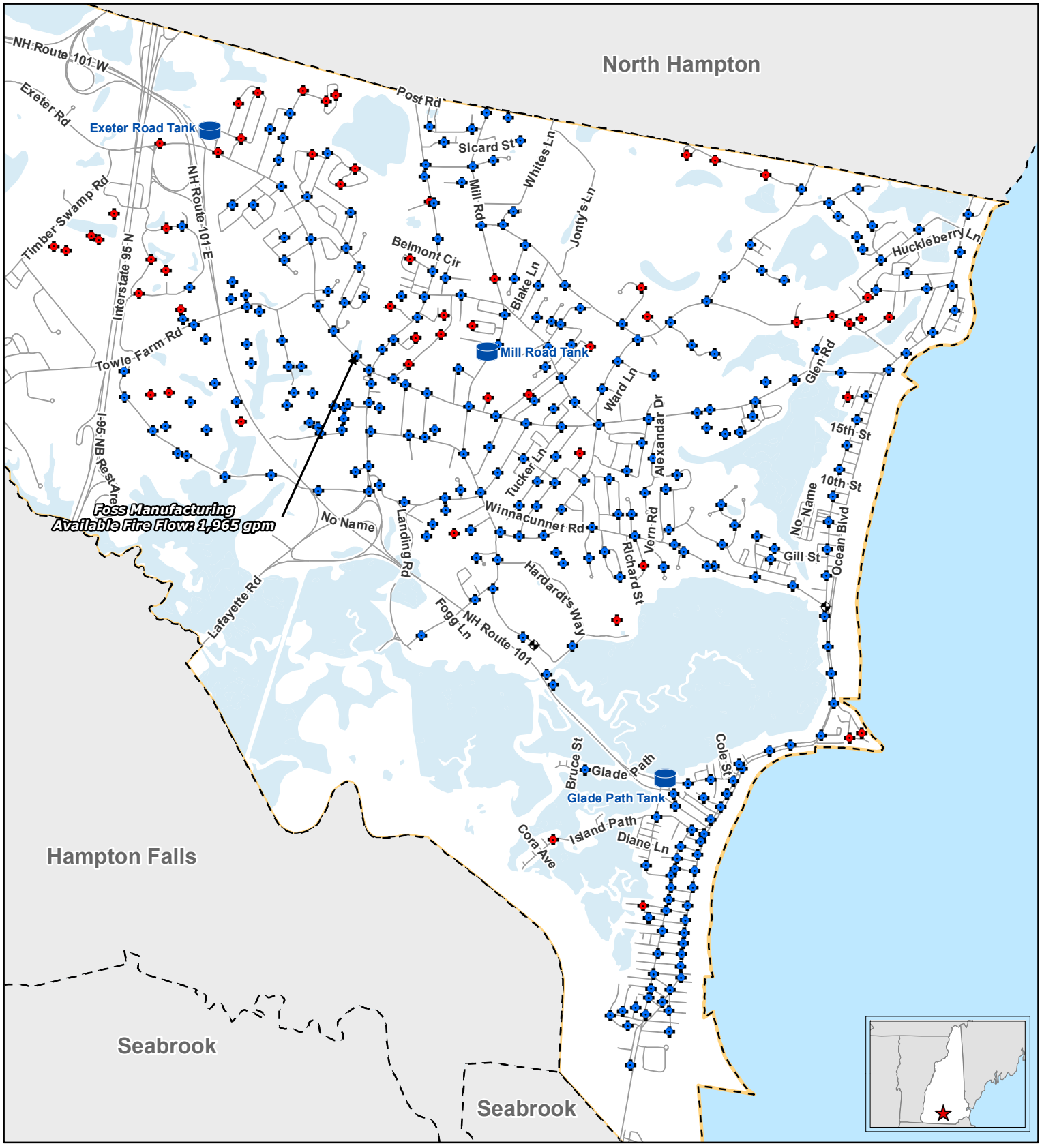

LEGEND

- Water Tank
- Pressure Regulating Valve
- Town Boundaries
- Waterbody

MaxDayAFF
- <1,500 gpm
- >1,500 gpm

No. Hydrants less than 1,500 gpm: 60
No. Hydrants greater than 1,500 gpm: 302

1:36,000
0 1,500 3,000
Feet

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Note: Available Fire Flow was determined at maximum day demand (MDD) with the tanks at low operating level (~80% full), with well pumps active.

FIGURE 8
AVAILABLE FIRE FLOW
RYE TANK IN SERVICE
EXETER TANK OFFLINE
MDD CONDITIONS

Hampton System
Aquarion Water Company
of New Hampshire
January 2020

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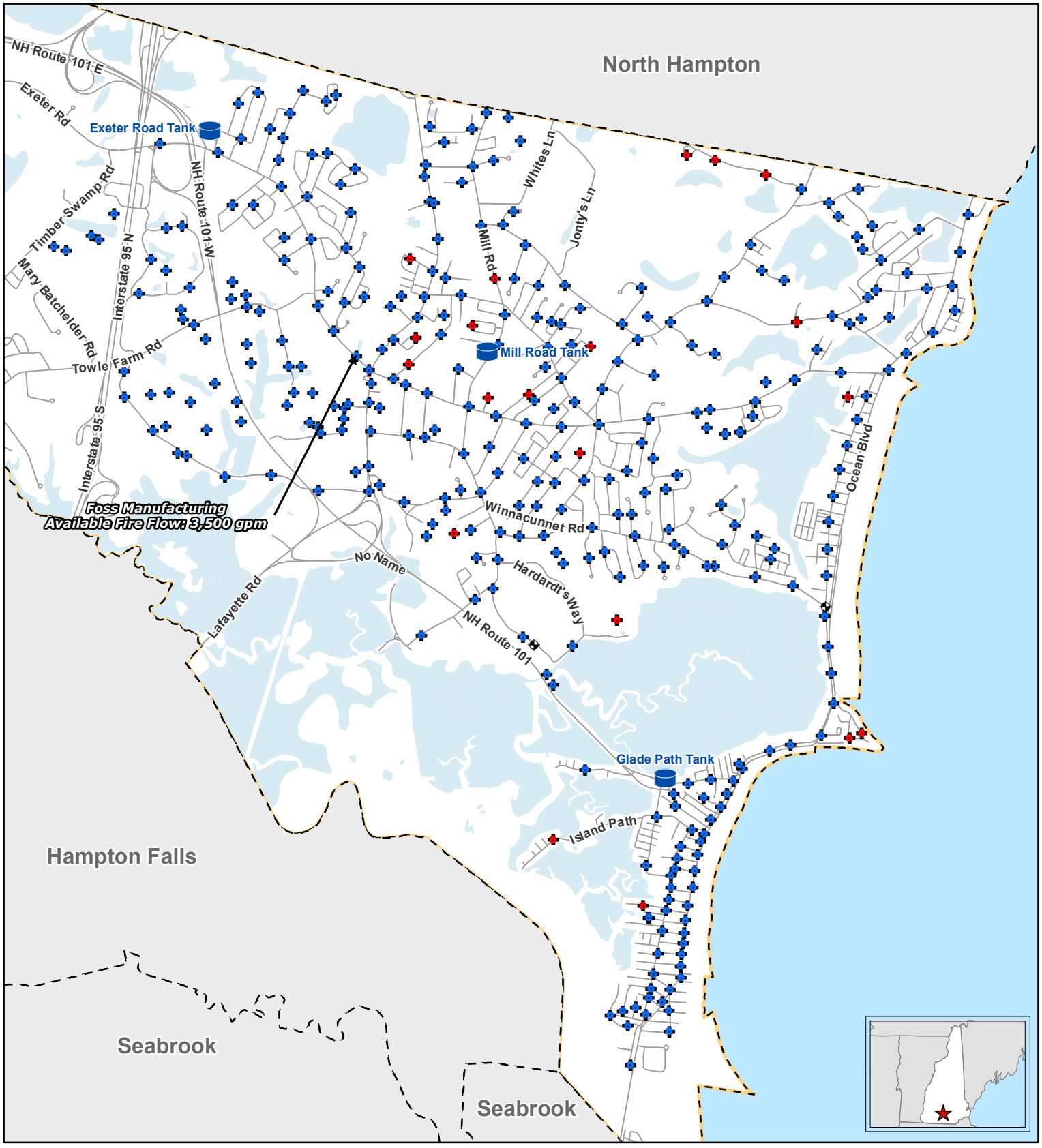

LEGEND

- Water Tank
- Pressure Regulating Valve
- Town Boundaries
- Waterbody

Available Fire Flow (gpm):
- <1,500 gpm
- >1,500 gpm

No. Hydrants less than 1,500 gpm: 23
No. Hydrants greater than 1,500 gpm: 339

1:36,000
0 1,500 3,000
Feet

N

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Note: Available Fire Flow was determined at maximum day demand (MDD) with the tanks at low operating level (~80% full), with well pumps active.

FIGURE 9
AVAILABLE FIRE FLOW SINGLE EXETER TANK ACTIVE MDD CONDITIONS

Hampton System
Aquarion Water Company
of New Hampshire

January 2020

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Table 1: Summary of Tank Site Options

		Fire Protection				
Tank site	**Access**	**Number of hydrants Less Than 1,500 GPM[1]**	**AFF Greater Than 2,500 GPM at Foss Manufacturing[1]**	**Additional Distribution Main Required**	**Water Quality Impacts**	**Estimated Capital Cost[2]**
Boutilier Lane Alternative 1	Requires Easement From Neighbors	64	No	175 LF	Will require additional improvements	$3,330,000[3,5]
Boutilier Lane Alternative 2	Easement Crosses 8 Properties	34	Yes	7,175 LF	Will require additional improvements	$6,180,000[5]
Rye	Requires Easement	60	No	700 LF	Will require additional improvements	$3,510,000[3,5]
Exeter Road Twin Tank	No Required Easement	23[4]	Yes	None Required	No new water quality related improvements required	$3,280,000

1 Analysis conducted at maximum day demand with existing Exeter Road Tank out of service.
2 Water main cost estimated at $225 per linear foot.
3 Does not include the cost of easement or land purchase. It should be noted that obtaining easements in these locations is not guaranteed and it would add time and cost to the project.
4 This alternative results in no change from existing conditions.
5 Costs for improvements to maintain water quality not included. Costs for access road construction include 5" of pavement over 12" of gravel borrow and are based on length. They do not include rock removal or cut and fill associated with obtaining proper roadway grade.