EXHIBIT 6

The State of New Hampshire
Department of Environmental Services

Robert R. Scott, Commissioner

Harold Morse
Hampstead Area Water Company, Inc.
54 Sawyer Avenue
Atkinson, NH 03811

August 27, 2019

Subject: Drinking Water and Groundwater Trust Fund
Southern New Hampshire Regional Water Interconnection Project – HAWC Infrastructure
DWGT-39 Grant Agreement

Dear Mr. Morse:

Congratulations on your grant offer from the Drinking Water and Groundwater Trust Fund (Trust Fund). The Trust Fund Advisory Commission authorized the award of up to **$3,283,750** in grant funds to the Hampstead Area Water Company, Inc. (HAWC) for the HAWC Infrastructure related to the Southern New Hampshire Regional Water Interconnection Project. The next step is to enter into a grant agreement and obtain Governor and Executive Council approval.

Enclosed is the grant agreement paperwork. Please have the appropriate party review these documents carefully. If everything is satisfactory please submit **single-sided hard copy versions** of the following documents to my attention no later than August 30, 2019 at the address below:

1. **Original signed and notarized Grant Agreement** (attached). Sign page 1 and initial and date pages 2 and 3.

2. **Original Exhibits A-C** (attached). Initial and date at the bottom.

3. **Original signed "Consent in Lieu of Special Meeting of the Board of Directors" Form** with the revisions outlined below.

- The form needs to identify what the authorization is needed for – to enter into a grant agreement for the subject project.
- The form needs to identify who the Vice President the form is referring to.

Once the required paperwork is returned, NHDES will submit the funding package to Governor and Council for approval. If you have any questions, please do not hesitate to contact me.

Sincerely,

Erin Holmes, P.E.
Drinking Water and Groundwater Trust Fund Administrator

Enclosures: Grant Agreement with Exhibits A-C

EXHIBIT 7

SOUTHERN NEW HAMPSHIRE REGIONAL WATER INITIATIVE

Cost of Service Study – Hampstead Area Water Company

Final Report / June 27, 2019

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

RAFTELIS

June 27, 2019

Mr. Jeffery W. McClure, P.E.
Senior Associate
Weston & Sampson
100 International Drive, Suite 152
Portsmouth, NH 03801

Subject: Southern New Hampshire Regional Water Initiative Cost of Service Study – Hampstead Area Water Company

Dear Mr. McClure,

Raftelis Financial Consultants, Inc. (Raftelis) is pleased to provide this Cost of Service Report to Weston & Sampson for the New Hampshire Department of Environmental Services' project, the Southern New Hampshire Regional Water Initiative (SNHRWI).

The major objectives of the study include the following:

- Develop a cost of service methodology and model to appropriately functionalize, allocate, and distribute costs in order to understand the cost of wheeling, or providing bulk wholesale water, from one community to another;
- Utilizing said methodology and model, the following scenarios were to be analyzed:
    - Calculate a cost justified volumetric rate that the Town of Salem (Salem) can assess the Town of Windham (Windham) for providing wholesale water wheeling services;
    - Calculate a cost justified volumetric rate that Salem can assess the Hampstead Area Water Company (HAWC) for providing wholesale water wheeling services;
    - Calculate a cost justified volumetric rate that HAWC can assess the Town of Plaistow for providing wholesale water wheeling services.

This draft report summarizes the key findings and recommendations related to the development of the cost of service analyses for HAWC. We expect this initial report will result in further discussions with all stakeholders and that some modifications may be necessary to finalize a set of methodologies and rates that all agree to. It has been a pleasure working with you, and we look forward to continuing our work with you to finalize this important project for the region.

Sincerely,

Dave Fox
Manager

1.1. Background

In late 2018, Raftelis was contracted by Weston & Sampson to perform wholesale water cost of service studies for the Southern New Hampshire Regional Water Initiative (SNHRWI), directed by the New Hampshire Department of Environmental Services (DES). The proposed SNHRWI includes the potential connection of water systems maintained by Manchester Water Works (MWW), the Hampstead Area Water Company (HAWC), and the towns of Salem, Derry, and Plaistow. The project would supplement domestic water demands water demands in the towns of Windham, Salem, Atkinson, Hampstead, and Plaistow through a regional water supply partnership.

1.1.1. OBJECTIVES OF THE STUDY

Raftelis was engaged with the primary objective of develop a cost of service-based rate study for developing wholesale, or wheeling, rates for water transported through the region's transmission systems of the SNHRWI. This report serves to summarize our findings, results, and recommendations for wheeling charge calculations for the Hampstead Area Water Company (HAWC) portion of the SNHRWI.

The charges to be calculated through this study include developing a cost justified volumetric rate that HAWC can assess the Town of Plaistow for providing wholesale water wheeling services.

1.2. Wholesale Cost of Service Methodology

Based on the objectives for this study and our understanding of the SNHRWI proposed system, Raftelis determined that the most appropriate methodology for calculating a wheeling rate is to use the Utility Approach to rate setting. The Utility Approach to rate setting is consistent with industry standards and guidelines for determining wholesale rates and charges and is recommended by the American Water Works Association. The Utility Approach to rate setting focuses on three primary cost components:

- A proportionate share of the annual depreciation expense associated with the assets that provide service to wholesale customers;
- A rate of return applied to the utility's investment in these assets; and
- A proportionate share of the operating and maintenance (O&M) expenses related to these assets.

The aforementioned components were developed utilizing a test year of calendar year 2017, which complete and audited data is present. In addition to audited 2017 data, expected and measurable changes to accommodate the proposed SNHRWI operations were added in for a complete measure of the cost of service. It should be noted that it was assumed that Salem's purchases from Salem, of approximately 250,000 gallons per day, will be assessed at a rate of $3.06 per one hundred cubic feet (Ccf), which is draft and contingent on the finalizing of our similar report to Salem which presented the calculation of wholesale rates for HAWC as well as the Town of Windham. Table 1 presents the test year full cost components for HAWC. These cost components will be utilized later in this report to demonstrate the functionalization, allocation, and distribution required to provide wheeling services only.

Table 1: Test Year Costs

Cost Component	Test Year
Source of Supply	$ 396,052
Pumping Expenses	284,516
Water Treatment Expenses	170,729
Transmission and Distribution Expense	83,991
Customer Accounts Expense	113,121
Administrative and General Expenses	504,818
MSDC Charges	64,070
Additional Support	55,000
Chloramine Conversion (for 20 stations)	66,367
Shannon Road Booster Station	11,593
Rate of Return	499,547
Taxes Other Than Income	159,664
Income Taxes	144,869
CIAC	219,204
Depreciation	500,470
Total	$ 3,274,011

Once the test year costs were developed, a cost of service analysis, utilizing the aforementioned Utility Approach, was performed. The basic principle in the establishment of cost of service rates is to achieve general fairness in the recovery of costs from various classes of customers. The approach used in this study is based on the principles endorsed by the American Water Works Association (AWWA); which allows DES and the SNHRWI communities to demonstrate rates have not been set in an arbitrary or capricious manner and one class of customer is not subsidizing another to an unjustifiable extent. Costs have been allocated between customer classes based on their estimated demand requirements and recognizing the different costs associated with serving different customer classes.

These costs were allocated proportionately to water customers based on how they use the system. The appropriate level of detail required for a cost of service analysis is contingent on system characteristics, and the accuracy and availability of data necessary to support the analysis. Based on discussions with HAWC staff, it was determined that water cost components should be allocated into functional components consistent with the most significant cost causative characteristics of the customer base. The water components included source of supply, treatment, transmission, distribution, storage, meters, fire protection, billing (customer service), and administration support. Summarizing this allocation process, costs were grouped into three categories: General Water, Fire Service, and Customer Service. Table 2 presents the allocation of test year costs into these categories.

Table 2: Test Year Costs by General Function

Cost Component	General Water	Fire Service	Customer Service
Source of Supply	$ 394,071	$ 1,980	$ -
Pumping Expenses	283,093	1,423	-
Water Treatment Expenses	169,875	854	-
Transmission and Distribution Expense	34,113	2,252	47,626
Customer Accounts Expense	-	-	113,121
Administrative and General Expenses	424,283	3,134	77,401
MSDC Charges	63,750	320	-
Additional Support	46,226	341	8,433
Chloramine Conversion (for 20 stations)	55,779	412	10,176
Shannon Road Booster Station	9,744	72	1,778
Rate of Return	393,149	5,984	100,415
Taxes Other Than Income	125,657	1,912	32,094
Income Taxes	114,013	1,735	29,120
CIAC	172,516	2,626	44,062
Depreciation	393,875	5,995	100,600
Total	**$ 2,680,145**	**$ 29,040**	**$ 564,826**

The aforementioned functional Fire Service and Customer Service costs were then discarded from the remainder of the analysis, as these costs are typically not recovered through wholesale rates. The general water functional costs that remained were then allocated to their cost components in accordance with how facilities are designed. Water cost components allocations included base, extra-capacity, and categories reflecting costs that are explicitly incurred for retail-only or wholesale-only service. Specifically, water cost components related to the functional aspects of the system including water source of supply, treatment, transmission and distribution, and storage were assigned based on a base-extra capacity cost allocation approach. This approach allocates a portion of these costs to serving a base demand and peak demand. Reasonable allocation factors were determined for each of these components, and are consistent with industry standards and practices and utilized flow data from HAWC's customer demand characteristics and water production facilities. A summary of this process is presented in Table 3.

Table 3: Test Year Costs by Cost Component

Cost Component	Base	Extra Capacity	Wholesale-only	Retail-only
Source of Supply	$ 10,226	$ 12,499	$ 371,346	$ -
Pumping Expenses	127,392	155,701	-	-
Water Treatment Expenses	-	-	-	169,875
Transmission and Distribution Expense	21,668	12,445	-	-
Customer Accounts Expense	-	-	-	-
Administrative and General Expenses	132,565	150,340	-	141,378
MSDC Charges	-	-	-	63,750
Additional Support	20,802	25,424	-	-
Chloramine Conversion (for 20 stations)	25,101	30,679	-	-
Shannon Road Booster Station	4,385	5,359	-	-
Rate of Return	216,442	156,206	-	20,501
Taxes Other Than Income	69,179	49,926	-	6,553
Income Taxes	62,768	45,300	-	5,945
CIAC	94,976	68,544	-	8,996
Depreciation	216,841	156,495	-	20,539
Total	**$ 1,002,343**	**$ 868,917**	**$ 371,346**	**$ 437,538**

Similar to how Fire Service and Customer Service costs were discarded, so were extra capacity and retail-only costs. These costs are typically incurred to only provide service to retail customers, and hence should be excluded from costs to be recovered from wholesale rates. These remaining costs were then distributed to wholesale only customers by utilizing projected wholesale flows as a percentage of total projected water productions and purchases. A similar process was completed for HAWC's calculated non-operating expenses such as its depreciation and rate of return.

The following table (Table 4) presents the final rate calculation that HAWC could assess the Town of Plaistow.

Table 4: Calculation of Wholesale Rate (per Ccf)

	Plaistow
Cost of Service	
Operating Expenses	$ 201,917
Rate of Return	141,372
Depreciation	52,380
Other Non-Operating	85,516
Total: Cost of Service	$ 481,185
Estimated Flow (Ccf)	121,992
Calculated Rate per Ccf	$ 3.94

APPENDIX A:

FULL COST OF SERVICE ALLOCATIONS

Operations and Maintenance Expense		Functional Category	Functional Categories		
			General Water	Fire Service	Customer Service
Source of Supply					
Operations					
Operation Supervision and Engineering	$ -	General Water	99.5%	0.5%	0.0%
Operation Labor and Expenses	4,832	General Water	99.5%	0.5%	0.0%
Purchased Water	373,213	General Water	99.5%	0.5%	0.0%
Miscellaneous Expenses	23	General Water	99.5%	0.5%	0.0%
Rents	-	General Water	99.5%	0.5%	0.0%
Maintenance					
Maintenance Supervision and Engineering	$ 1,677	General Water	99.5%	0.5%	0.0%
Maintenance of Structures and Improvements	4,647	General Water	99.5%	0.5%	0.0%
Maintenance of Collecting and Impounding Reservoirs	-	General Water	99.5%	0.5%	0.0%
Maintenance of Lake, River, and Other Intakes	-	General Water	99.5%	0.5%	0.0%
Maintenance of Wells and Springs	11,660	General Water	99.5%	0.5%	0.0%
Maintenance of Infiltration Galleries and Tunnels	-	General Water	99.5%	0.5%	0.0%
Maintenance of Supply Mains	-	General Water	99.5%	0.5%	0.0%
Maintenance of Miscellaneous Water Source Plant	-	General Water	99.5%	0.5%	0.0%
Subtotal: Source of Supply	$ 396,052		$ 394,071	$ 1,980	$ -
Pumping Expenses					
Operations					
Operation Supervision and Engineering	$ -	General Water	99.5%	0.5%	0.0%
Fuel for Power Production	-	General Water	99.5%	0.5%	0.0%
Power Production Labor and Expenses	-	General Water	99.5%	0.5%	0.0%
Fuel or Power Purchased for Pumping	177,913	General Water	99.5%	0.5%	0.0%
Pumping Labor and Expenses	23,050	General Water	99.5%	0.5%	0.0%
Expenses Transferred-Credit	-	General Water	99.5%	0.5%	0.0%
Miscellaneous Expenses	16,254	General Water	99.5%	0.5%	0.0%
Rents	-	General Water	99.5%	0.5%	0.0%
Maintenance					
Maintenance Supervision and Engineering	$ -	General Water	99.5%	0.5%	0.0%
Maintenance of Structures and Improvements	31,112	General Water	99.5%	0.5%	0.0%
Maintenance of Power Production Equipment	-	General Water	99.5%	0.5%	0.0%
Maintenance of Pumping Equipment	36,187	General Water	99.5%	0.5%	0.0%
Subtotal: Pumping Expenses	$ 284,516		$ 283,093	$ 1,423	$ -
Water Treatment Expenses					
Operations					
Operation Supervision and Engineering	$ -	General Water	99.5%	0.5%	0.0%
Chemicals	10,961	General Water	99.5%	0.5%	0.0%
Operation Labor and Expenses	149,034	General Water	99.5%	0.5%	0.0%
Miscellaneous Expenses	-	General Water	99.5%	0.5%	0.0%
Rents	-	General Water	99.5%	0.5%	0.0%
Maintenance					
Operation Supervision and Engineering	$ -	General Water	99.5%	0.5%	0.0%
Maintenance of Structures and Improvements	-	General Water	99.5%	0.5%	0.0%
Maintenance of Water Treatment Equipment	10,734	General Water	99.5%	0.5%	0.0%
Subtotal: Water Treatment Expenses	$ 170,729		$ 169,875	$ 854	$ -
Transmission and Distribution Expense					
Operations					
Operation Supervision and Engineering	$ -	T&D Supervision	40.6%	2.7%	56.7%
Storage Facilities Expenses	-	General Water	99.5%	0.5%	0.0%
Transmission and Distribution Lines Expenses	13,300	General Water	99.5%	0.5%	0.0%
Meter Expenses	16,564	Customer Service	0.0%	0.0%	100.0%
Customer Installations Expenses	1,228	Customer Service	0.0%	0.0%	100.0%
Miscellaneous Expenses	2,138	General Water	99.5%	0.5%	0.0%
Rents	-	General Water	99.5%	0.5%	0.0%
Maintenance					
Maintenance Supervision and Engineering	$ -	T&D Supervision	40.6%	2.7%	56.7%
Maintenance of Structures and Improvements	-	General Water	99.5%	0.5%	0.0%
Maintenance of Distribution Reservoirs and Standpipes	7,026	Storage	100.0%	0.0%	0.0%
Maintenance of Transmission and Distribution Mains	11,774	General Water	99.5%	0.5%	0.0%
Maintenance of Fire Mains	-	Hydrants	0.5%	99.5%	0.0%
Maintenance of Services	23,035	Customer Service	0.0%	0.0%	100.0%
Maintenance of Meters	6,799	Customer Service	0.0%	0.0%	100.0%
Maintenance of Hydrants	2,127	Hydrants	0.5%	99.5%	0.0%
Maintenance of Miscallenous Equipment	-	T&D Supervision	40.6%	2.7%	56.7%
Subtotal: Transmission and Distribution Expense	$ 83,991		$ 34,113	$ 2,252	$ 47,626

Customer Accounts Expense					
Operations					
Supervision	$ -	Customer Service	0.0%	0.0%	100.0%
Meter Reading Expenses	12,787	Customer Service	0.0%	0.0%	100.0%
Customer Records and Collection Expenses	100,334	Customer Service	0.0%	0.0%	100.0%
Uncollectible Accounts	-	Customer Service	0.0%	0.0%	100.0%
Miscellaneous Customer Accounts Expenses	-	Customer Service	0.0%	0.0%	100.0%
Subtotal: Customer Accounts Expense	$ 113,121		$ -	$ -	$ 113,121
Sales Expenses					
Operations					
Sales Expenses	$ -	General Water	99.5%	0.5%	0.0%
Subtotal: Sales Expenses	$ -		$ -	$ -	$ -
Administrative and General Expenses					
Operations					
Administrative and General Salaries	$ 16,542	Total O&M	84.0%	0.6%	15.3%
Office Supplies and Other Expenses	46,764	Total O&M	84.0%	0.6%	15.3%
Administrative Expenses Transferred-Cr.	-	Total O&M	84.0%	0.6%	15.3%
Outside Services Employed	259,165	Total O&M	84.0%	0.6%	15.3%
Property Insurance	-	Total O&M	84.0%	0.6%	15.3%
Injuries and Damages	35,731	Total O&M	84.0%	0.6%	15.3%
Employee Pension and Benefits	85,838	Total O&M	84.0%	0.6%	15.3%
Franchise Requirements	5,520	Total O&M	84.0%	0.6%	15.3%
Regulatory Commission Expenses	6,408	Total O&M	84.0%	0.6%	15.3%
Duplicate Charges Cr.	-	Total O&M	84.0%	0.6%	15.3%
Miscellaneous Expenses	31,950	Total O&M	84.0%	0.6%	15.3%
General Rents	16,900	Total O&M	84.0%	0.6%	15.3%
Maintenance					
Maintenance of General Plant	$ -	Total O&M	84.0%	0.6%	15.3%
Subtotal: Administrative and General Expenses	$ 504,818		$ 424,283	$ 3,134	$ 77,401
MSDC Charges					
Annual Expense	$ 64,070	General Water	99.5%	0.5%	0.0%
Subtotal: MSDC Charges	$ 64,070		$ 63,750	$ 320	$ -
Additional Support					
FTE to support new water flows and chloramination	$ 55,000	Total O&M	84.0%	0.6%	15.3%
Subtotal: Additional Support	$ 55,000		$ 46,226	$ 341	$ 8,433
Chloramine Conversion (for 20 stations)					
Chloramine Pump Package System	$ 14,000	Total O&M	84.0%	0.6%	15.3%
Ammonia Analyzer	15,200	Total O&M	84.0%	0.6%	15.3%
Chlorine cost	5,990	Total O&M	84.0%	0.6%	15.3%
Ammonia cost	10,837	Total O&M	84.0%	0.6%	15.3%
Pump House Updates	20,000	Total O&M	84.0%	0.6%	15.3%
Electricity for chemical system only	340	Total O&M	84.0%	0.6%	15.3%
Subtotal: Chloramine Conversion (for 20 stations)	$ 66,367		$ 55,779	$ 412	$ 10,176
Shannon Road Booster Station					
Pumps	$ 3,500	Total O&M	84.0%	0.6%	15.3%
Mag-meter	833	Total O&M	84.0%	0.6%	15.3%
SCADA Monitoring & Equipment	1,500	Total O&M	84.0%	0.6%	15.3%
Electricity	5,760	Total O&M	84.0%	0.6%	15.3%
Subtotal: Shannon Road Booster Station	$ 11,593		$ 9,744	$ 72	$ 1,778
Contingency					
	$ -	Total O&M	84.0%	0.6%	15.3%
Subtotal: Contingency	$ -		$ -	$ -	$ -
Total: Operating & Maintenance Expenses	**$ 1,750,257**		**$ 1,480,934**	**$ 10,789**	**$ 258,534**
	$ 12.87				
Plant in Service					
Intangible Plan					
Intangible Plant - Franchise	$ 36,583	Plant Investment	78.7%	1.2%	20.1%
Subtotal: Intangible Plan	$ 36,583		$ 28,791	$ 438	$ 7,354
Source of Supply and Pumping					
Land and Land Rights	$ 76,185	General Water	99.5%	0.5%	0.0%
Stuctures & Improvements	1,276,644	General Water	99.5%	0.5%	0.0%
Wells & Springs	921,763	General Water	99.5%	0.5%	0.0%
Supply Mains	106,525	General Water	99.5%	0.5%	0.0%
Pumping Equipment	1,656,980	General Water	99.5%	0.5%	0.0%
Subtotal: Source of Supply and Pumping	$ 4,038,098		$ 4,017,907	$ 20,190	$ -

Water Treatment					
Water Treatment Equipment	$ 735,971	General Water	99.5%	0.5%	0.0%
Subtotal: Water Treatment	$ 735,971		$ 732,291	$ 3,680	$ -
Transmission & Distribution					
Distribution Reservoirs & Standpipes	$ 2,795,608	Storage	100.0%	0.0%	0.0%
T&D Mains	6,240,925	General Water	99.5%	0.5%	0.0%
Services	2,250,484	Customer Service	0.0%	0.0%	100.0%
Meters and Meter Installations	1,340,115	Customer Service	0.0%	0.0%	100.0%
Hydrants	158,156	Hydrants	0.5%	99.5%	0.0%
Other	303,311	General Water	99.5%	0.5%	0.0%
Subtotal: Transmission & Distribution	$ 13,088,598		$ 9,307,914	$ 190,087	$ 3,590,598
General Plant					
Office Furniture and Equipment	$ 1,420	Plant Investment	78.7%	1.2%	20.1%
Transportation Equipment	153,990	Plant Investment	78.7%	1.2%	20.1%
Tools, Shop and Garage Equipment	3,975	Plant Investment	78.7%	1.2%	20.1%
Computer Equipment	97,088	Plant Investment	78.7%	1.2%	20.1%
Subtotal: General Plant	$ 256,473		$ 201,847	$ 3,072	$ 51,554
Total: Plant in Service	**$ 18,155,723**		**$ 14,288,750**	**$ 217,467**	**$ 3,649,506**
Depreciation					
Intangible Plan					
Intangible Plant - Franchise	$ 915	Depreciation	72.4%	0.9%	26.7%
Subtotal: Intangible Plan	$ 915		$ 662	$ 9	$ 244
Source of Supply and Pumping					
Land and Land Rights	$ 1,905	General Water	99.5%	0.5%	0.0%
Stuctures & Improvements	31,074	General Water	99.5%	0.5%	0.0%
Wells & Springs	29,303	General Water	99.5%	0.5%	0.0%
Supply Mains	1,530	General Water	99.5%	0.5%	0.0%
Pumping Equipment	64,129	General Water	99.5%	0.5%	0.0%
Subtotal: Source of Supply and Pumping	$ 127,941		$ 127,301	$ 640	$ -
Water Treatment					
Water Treatment Equipment	$ 31,316	General Water	99.5%	0.5%	0.0%
Subtotal: Water Treatment	$ 31,316		$ 31,159	$ 157	$ -
Transmission & Distribution					
Distribution Reservoirs & Standpipes	$ 36,760	Storage	100.0%	0.0%	0.0%
T&D Mains	129,952	General Water	99.5%	0.5%	0.0%
Services	51,959	Customer Service	0.0%	0.0%	100.0%
Meters and Meter Installations	76,485	Customer Service	0.0%	0.0%	100.0%
Hydrants	3,019	Hydrants	0.5%	99.5%	0.0%
Other	24,428	General Water	99.5%	0.5%	0.0%
Subtotal: Transmission & Distribution	$ 322,604		$ 190,384	$ 3,776	$ 128,444
General Plant					
Office Furniture and Equipment	$ -	Depreciation	72.4%	0.9%	26.7%
Transportation Equipment	12,731	Depreciation	72.4%	0.9%	26.7%
Tools, Shop and Garage Equipment	205	Depreciation	72.4%	0.9%	26.7%
Computer Equipment	4,759	Depreciation	72.4%	0.9%	26.7%
Subtotal: General Plant	$ 17,695		$ 12,810	$ 168	$ 4,717
Total: Depreciation	**$ 500,470**		**$ 362,317**	**$ 4,748**	**$ 133,405**
Taxes					
Taxes Other Than Income					
Utility Property Tax	$ 30,274	Plant Investment	78.7%	1.2%	20.1%
Real Estate	129,390	Plant Investment	78.7%	1.2%	20.1%
Subtotal: Taxes Other Than Income	$ 159,664		$ 125,657	$ 1,912	$ 32,094
Income Taxes					
Business Enterprise Tax	$ 144,869	General Water	99.5%	0.5%	0.0%
Subtotal: Income Taxes	$ 144,869		$ 144,144	$ 724	$ -
Total: Taxes	**$ 304,533**		**$ 269,802**	**$ 2,637**	**$ 32,094**
Amortization					
CIAC	$ 216,489	Plant Investment	78.7%	1.2%	20.1%
Other	2,715	Plant Investment	78.7%	1.2%	20.1%
Total: Amortization	**$ 219,204**		**$ 172,516**	**$ 2,626**	**$ 44,062**
Return					
Estimate	$ 499,547	Plant Investment	78.7%	1.2%	20.1%
Total: Return	**$ 499,547**		**$ 393,149**	**$ 5,984**	**$ 100,415**

O&M Expenses			Water Cost Drivers			
			Base	Extra Capacity	Wholesale Only	Retail Only
Source of Supply						
Operations						
Operation Supervision and Engineering	$ -	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Operation Labor and Expenses	4,808	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Purchased Water	371,346	Purchased Water	0.00%	0.00%	100.00%	0.00%
Miscellaneous Expenses	23	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Rents	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance						
Maintenance Supervision and Engineering	$ 1,669	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Structures and Improvements	4,624	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Collecting and Impounding Reservoirs	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Lake, River, and Other Intakes	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Wells and Springs	11,602	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Infiltration Galleries and Tunnels	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Supply Mains	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Miscellaneous Water Source Plant	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Source of Supply	$ 394,071		$ 10,226	$ 12,499	$ 371,346	$ -
Pumping Expenses						
Operations						
Operation Supervision and Engineering	$ -	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Fuel for Power Production	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Power Production Labor and Expenses	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Fuel or Power Purchased for Pumping	177,023	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Pumping Labor and Expenses	22,935	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Expenses Transferred-Credit	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Miscellaneous Expenses	16,173	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Rents	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance						
Maintenance Supervision and Engineering	$ -	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Structures and Improvements	30,956	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Power Production Equipment	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Maintenance of Pumping Equipment	36,006	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Pumping Expenses	$ 283,093		$ 127,392	$ 155,701	$ -	$ -
Water Treatment Expenses						
Operations						
Operation Supervision and Engineering	$ -	Treatment	0.00%	0.00%	0.00%	100.00%
Chemicals	10,906	Treatment	0.00%	0.00%	0.00%	100.00%
Operation Labor and Expenses	148,289	Treatment	0.00%	0.00%	0.00%	100.00%
Miscellaneous Expenses	-	Treatment	0.00%	0.00%	0.00%	100.00%
Rents	-	Treatment	0.00%	0.00%	0.00%	100.00%
Maintenance						
Operation Supervision and Engineering	$ -	Treatment	0.00%	0.00%	0.00%	100.00%
Maintenance of Structures and Improvements	-	Treatment	0.00%	0.00%	0.00%	100.00%
Maintenance of Water Treatment Equipment	10,680	Treatment	0.00%	0.00%	0.00%	100.00%
Subtotal: Water Treatment Expenses	$ 169,875		$ -	$ -	$ -	$ 169,875
Transmission and Distribution Expense						
Operations						
Operation Supervision and Engineering	$ -	T&D Mains	63.52%	36.48%	0.00%	0.00%
Storage Facilities Expenses	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Transmission and Distribution Lines Expenses	13,234	T&D Mains	63.52%	36.48%	0.00%	0.00%
Meter Expenses	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Customer Installations Expenses	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Miscellaneous Expenses	2,127	T&D Mains	63.52%	36.48%	0.00%	0.00%
Rents	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance						
Maintenance Supervision and Engineering	$ -	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Structures and Improvements	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Distribution Reservoirs and Standpipes	7,026	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Transmission and Distribution Mains	11,715	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Fire Mains	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Services	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Meters	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Hydrants	11	T&D Mains	63.52%	36.48%	0.00%	0.00%
Maintenance of Miscallenous Equipment	-	T&D Mains	63.52%	36.48%	0.00%	0.00%
Subtotal: Transmission and Distribution Expense	$ 34,113		$ 21,668	$ 12,445	$ -	$ -
Customer Accounts Expense						
Operations						
Supervision	$ -	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Meter Reading Expenses	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Customer Records and Collection Expenses	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Uncollectible Accounts	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Miscellaneous Customer Accounts Expenses	-	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Customer Accounts Expense	$ -		$ -	$ -	$ -	$ -
Sales Expenses						
Operations						
Sales Expenses	$ -	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Sales Expenses	$ -		$ -	$ -	$ -	$ -

Administrative and General Expenses						
Operations						
Administrative and General Salaries	$ 13,903	Total O&M	31.24%	35.43%	0.00%	33.32%
Office Supplies and Other Expenses	39,304	Total O&M	31.24%	35.43%	0.00%	33.32%
Administrative Expenses Transferred-Cr.	-	Total O&M	31.24%	35.43%	0.00%	33.32%
Outside Services Employed	217,820	Total O&M	31.24%	35.43%	0.00%	33.32%
Property Insurance	-	Total O&M	31.24%	35.43%	0.00%	33.32%
Injuries and Damages	30,031	Total O&M	31.24%	35.43%	0.00%	33.32%
Employee Pension and Benefits	72,144	Total O&M	31.24%	35.43%	0.00%	33.32%
Franchise Requirements	4,639	Total O&M	31.24%	35.43%	0.00%	33.32%
Regulatory Commission Expenses	5,386	Total O&M	31.24%	35.43%	0.00%	33.32%
Duplicate Charges Cr.	-	Total O&M	31.24%	35.43%	0.00%	33.32%
Miscellaneous Expenses	26,853	Total O&M	31.24%	35.43%	0.00%	33.32%
General Rents	14,204	Total O&M	31.24%	35.43%	0.00%	33.32%
Maintenance						
Maintenance of General Plant	$ -	Total O&M	31.24%	35.43%	0.00%	33.32%
Subtotal: Administrative and General Expenses	$ 424,283		$ 132,565	$ 150,340	$ -	$ 141,378
MSDC Charges						
Annual Expense	$ 63,750	Treatment	0.00%	0.00%	0.00%	100.00%
Subtotal: MSDC Charges	$ 63,750		$ -	$ -	$ -	$ 63,750
Additional Support						
FTE to support new water flows and chloramination	$ 46,226	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Additional Support	$ 46,226		$ 20,802	$ 25,424	$ -	$ -
Chloramine Conversion (for 20 stations)						
Chloramine Pump Package System	$ 11,767	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Ammonia Analyzer	12,775	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Chlorine cost	5,034	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Ammonia cost	9,108	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Pump House Updates	16,809	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Electricity for chemical system only	286	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Chloramine Conversion (for 20 stations)	$ 55,779		$ 25,101	$ 30,679	$ -	$ -
Shannon Road Booster Station						
Pumps	$ 2,942	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Mag-meter	700	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
SCADA Monitoring & Equipment	1,261	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Electricity	4,841	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Shannon Road Booster Station	$ 9,744		$ 4,385	$ 5,359	$ -	$ -
Contingency						
	$ -	Production & Pumping Costs	45.00%	55.00%	0.00%	0.00%
Subtotal: Contingency	$ -		$ -	$ -	$ -	$ -
Total: Operating & Maintenance Expenses	**$ 1,480,934**		**$ 342,138**	**$ 392,447**	**$ 371,346**	**$ 375,003**
Check	$ -					
Plant in Service						
Intangible Plan						
Intangible Plant - Franchise	$ 28,791	Plant Investment	55.1%	39.7%	0.0%	5.2%
Subtotal: Intangible Plan	$ 28,791		$ 15,851	$ 11,439	$ -	$ 1,501
Source of Supply and Pumping						
Land and Land Rights	$ 75,804	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Stuctures & Improvements	1,270,261	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Wells & Springs	917,154	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Supply Mains	105,993	T&D Mains	63.5%	36.5%	0.0%	0.0%
Pumping Equipment	1,648,695	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Subtotal: Source of Supply and Pumping	$ 4,017,907		$ 1,827,687	$ 2,190,220	$ -	$ -
Water Treatment						
Water Treatment Equipment	$ 732,291	Treatment	0.0%	0.0%	0.0%	100.0%
Subtotal: Water Treatment	$ 732,291		$ -	$ -	$ -	$ 732,291
Transmission & Distribution						
Distribution Reservoirs & Standpipes	$ 2,795,608	T&D Mains	63.5%	36.5%	0.0%	0.0%
T&D Mains	6,209,720	T&D Mains	63.5%	36.5%	0.0%	0.0%
Services	-	Treatment	0.0%	0.0%	0.0%	100.0%
Meters and Meter Installations	-	Treatment	0.0%	0.0%	0.0%	100.0%
Hydrants	791	Treatment	0.0%	0.0%	0.0%	100.0%
Other	301,794	T&D Mains	63.5%	36.5%	0.0%	0.0%
Subtotal: Transmission & Distribution	$ 9,307,914		$ 5,911,773	$ 3,395,350	$ -	$ 791
General Plant						
Office Furniture and Equipment	$ 1,118	Plant Investment	55.1%	39.7%	0.0%	5.2%
Transportation Equipment	121,192	Plant Investment	55.1%	39.7%	0.0%	5.2%
Tools, Shop and Garage Equipment	3,128	Plant Investment	55.1%	39.7%	0.0%	5.2%
Computer Equipment	76,409	Plant Investment	55.1%	39.7%	0.0%	5.2%
Subtotal: General Plant	$ 201,847		$ 111,123	$ 80,198	$ -	$ 10,526
Total: Plant in Service	**$ 14,288,750**		**$ 7,866,434**	**$ 5,677,208**	**$ -**	**$ 745,109**

Depreciation						
Intangible Plan						
Intangible Plant - Franchise	$ 662	Depreciation	51.1%	40.0%	0.0%	8.9%
Subtotal: Intangible Plan	$ 662		$ 338	$ 265	$ -	$ 59
Source of Supply and Pumping						
Land and Land Rights	$ 1,895	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Stuctures & Improvements	30,919	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Wells & Springs	29,156	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Supply Mains	1,523	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Pumping Equipment	63,809	Production & Pumping Costs	45.0%	55.0%	0.0%	0.0%
Subtotal: Source of Supply and Pumping	$ 127,301		$ 57,285	$ 70,016	$ -	$ -
Water Treatment						
Water Treatment Equipment	$ 31,159	Treatment	0.0%	0.0%	0.0%	100.0%
Subtotal: Water Treatment	$ 31,159		$ -	$ -	$ -	$ 31,159
Transmission & Distribution						
Distribution Reservoirs & Standpipes	$ 36,760	T&D Mains	63.5%	36.5%	0.0%	0.0%
T&D Mains	129,303	T&D Mains	63.5%	36.5%	0.0%	0.0%
Services	-	Treatment	0.0%	0.0%	0.0%	100.0%
Meters and Meter Installations	-	Treatment	0.0%	0.0%	0.0%	100.0%
Hydrants	15	Treatment	0.0%	0.0%	0.0%	100.0%
Other	24,306	T&D Mains	63.5%	36.5%	0.0%	0.0%
Subtotal: Transmission & Distribution	$ 190,384		$ 120,920	$ 69,449	$ -	$ 15
General Plant						
Office Furniture and Equipment	$ -	Depreciation	51.1%	40.0%	0.0%	8.9%
Transportation Equipment	9,217	Depreciation	51.1%	40.0%	0.0%	8.9%
Tools, Shop and Garage Equipment	148	Depreciation	51.1%	40.0%	0.0%	8.9%
Computer Equipment	3,445	Depreciation	51.1%	40.0%	0.0%	8.9%
Subtotal: General Plant	$ 12,810		$ 6,544	$ 5,122	$ -	$ 1,145
Total: Depreciation	**$ 362,317**		**$ 185,088**	**$ 144,851**	**$ -**	**$ 32,378**
Taxes						
Taxes Other Than Income						
Utility Property Tax	$ 23,826	Plant Investment	55.1%	39.7%	0.0%	5.2%
Real Estate	101,831	Plant Investment	55.1%	39.7%	0.0%	5.2%
Subtotal: Taxes Other Than Income	$ 125,657		$ 69,179	$ 49,926	$ -	$ 6,553
Income Taxes						
Business Enterprise Tax	$ 144,144	Total O&M	31.2%	35.4%	0.0%	33.3%
Subtotal: Income Taxes	$ 144,144		$ 45,037	$ 51,076	$ -	$ 48,031
Total: Taxes	**$ 269,802**		**$ 114,216**	**$ 101,002**	**$ -**	**$ 54,584**
Amortization						
CIAC	$ 170,379	Depreciation	51.1%	40.0%	0.0%	8.9%
Other	2,137	Depreciation	51.1%	40.0%	0.0%	8.9%
Total: Amortization	**$ 172,516**		**$ 88,129**	**$ 68,970**	**$ -**	**$ 15,417**
Return						
Estimate	$ 393,149	Plant Investment	55.1%	39.7%	0.0%	5.2%
Total: Return	**$ 393,149**		**$ 216,442**	**$ 156,206**	**$ -**	**$ 20,501**

EXHIBIT 8

STATE OF NEW HAMPSHIRE
Inter-Department Communication

DATE: April 22, 2019

FROM: K. Allen Brooks KAB **AT (OFFICE)** Department of Justice
Senior Assistant Attorney General Environmental Protection Bureau

SUBJECT: Southern Interconnect Agreement Approval Pursuant to RSA ch. 53-A

TO: Erin L. Holmes, Administrator III
Waste Management Division
Department of Environmental Services

The attached agreement has been approved by the Office of the Attorney General as meeting the applicable requirements of RSA ch. 53-A. I note that there appears to be unintentional underlining on pages 3 and 5. In addition, the page numbering indicates 26 pages; however, three of those pages are attachment cover pages which are non-sequential.

/cmc
Enclosure

AGREEMENT

REGARDING

THE SOUTHERN NEW HAMPSHIRE REGIONAL WATER

INTERCONNECTION PROJECT

This Agreement regarding the Southern New Hampshire Regional Water Interconnection Project ("Agreement") is entered into by and among the following parties: The Town of Derry, New Hampshire ("Derry"); Manchester Water Works ("MWW"); the Town of Plaistow, New Hampshire ("Plaistow"); the Town of Windham, New Hampshire ("Windham"); the Town of Salem, New Hampshire ("Salem"); Hampstead Area Water Company, Inc. ("HAWC"); and Pennichuck East Utility, Inc. ("PEU"), individually "a Party", and collectively, "the Parties".

RECITALS

WHEREAS, MWW is a duly established municipal water works entity that develops new water sources and owns and operates a public water system in the City of Manchester, New Hampshire and whereas MWW also supplies water to Derry under a wholesale water agreement dated March 26, 2013.

WHEREAS, Derry is a municipality duly established and existing under N.H. RSA 31 that owns and operates a public water system providing water service in Derry and that purchases water for said water system from MWW pursuant to a wholesale water agreement dated March 26, 2013.

WHEREAS, PEU is a privately-owned water utility authorized by the New Hampshire Public Utilities Commission to provide water service within Windham.

WHEREAS, Windham is a municipality duly established and existing under N.H. RSA 31 that is interested in procuring, either on its own or through another entity, new water sources to replace existing contaminated water sources in Windham and to serve new customers in certain areas within Windham.

WHEREAS, Salem is a municipality duly established and existing under N.H. RSA 31 that owns and operates a public water system providing water service in Salem.

WHEREAS, HAWC is a privately-owned water utility authorized by the New Hampshire Public Utilities Commission to provide water service in portions of the towns of Atkinson and Hampstead, New Hampshire.

WHEREAS, Plaistow is a municipality duly established and existing under N.H. RSA 31 that does not currently own, operate or provide water service to residents of Plaistow but that, by warrant article P-18-25 voted on by Town Meeting on March 13, 2018, has approved conversion of its current fire suppression water system to a potable water and fire suppression system and to establish a municipal water system pursuant to RSA 38:4.

WHEREAS, RSA 53-A authorizes political subdivisions of the State of New Hampshire, quasi-municipal corporations, and privately owned water utilities to enter into agreements for joint public works programs such as those relating to the provision of water services.

WHEREAS, water issues exist within Windham, Salem, Plaistow and within HAWC's service territory all of which require resolution, and whereas these include: properties in Windham that have private wells contaminated by MtBE, including but not limited to properties associated with Klemm's Mobil on the Run (NHDES Site #199008001); Windham's potential need for additional water capacity; the contamination and abandonment of Turner/Campbell production wells in Salem; HAWC's requirement for additional water capacity; private wells in Plaistow that are contaminated by MtBE and other contaminants; and Plaistow's lack of a water supply source.

WHEREAS, pursuant to a Memorandum of Understanding between and among the Parties and the New Hampshire Department of Environmental Services ("NHDES"), the Parties and NHDES have expressed their intent to work collaboratively to facilitate the development, construction and operation of infrastructure that interconnects the water systems of MWW, Derry, Salem, HAWC (in Atkinson and Hampstead) and Plaistow to enable potable water to flow from the MWW source through the aforementioned entities' water systems or service territories ("the Project").

WHEREAS, the Project's goal is to ensure that a flow of safe and reliable drinking water is supplied from MWW and delivered to the water systems of Salem, HAWC (in Atkinson and Hampstead), and Plaistow, and to potential new customers in Windham, in quantities described herein.

WHEREAS, the New Hampshire Drinking Water and Groundwater Trust Fund Advisory Commission ("the Commission") voted on April 18, 2018 to provide $19.6 million for Phase 1 of the Project from the New Hampshire Drinking Water and Groundwater Trust Fund established pursuant to RSA 6-D:1 and for disbursement of $11,174,100 for the Merrimack Source Development Charge ("MSDC") associated with the Project and later amended this vote on August 30, 2018 to allow NHDES to use the funds either to pay the MSDC directly or otherwise secure the MSDC capacity needed for the Project, and further to negotiate the terms of the expenditure, resale of MSDC capacity and any recoupment or refund of these funds.

WHEREAS, N.H. RSA 485-F:3, VII (a) requires that all loans or grants provided by the New Hampshire Drinking Water and Groundwater Trust Fund be approved by the Governor and Executive Council.

WHEREAS, on March 21, 2019, NHDES requested approval to fund $7.3 million of the Project using MtBE settlement funds, and the New Hampshire Department of Justice ("NHDOJ") approved this request on March 22, 2019, such approval being pursuant to a Memorandum of Understanding between NHDES and NHDOJ approved by the Joint Legislative Fiscal Committee on November 22, 2013, and approved by Governor and Executive Council on December 4, 2013.

NOW THEREFORE, in consideration of the foregoing and the mutual covenants and agreements set forth below, the Parties hereby agree as follows:

ARTICLE I. Definitions and Abbreviations

"Agreement" means this agreement including all attachments to it.

"Average Daily Flow" or "ADF" means the total volume of water measured in gallons or cubic feet at a Project metering station or stations during the two highest consecutive monthly MWW billing periods divided by the actual number of days in the applicable billing periods.

"Basis of Design Memo" means the Regional Basis of Design Memorandum prepared by Weston & Sampson on behalf of NHDES dated January 4, 2019 and attached to this Agreement as Attachment A.

"Capacity" means the ability to provide a specified volume of water.

"Ccf" means 100 cubic feet.

"Commission" means the New Hampshire Drinking Water and Groundwater Trust Fund Advisory Commission.

"Disinfection Report" means the Disinfection Study Report prepared by Weston & Sampson on behalf of NHDES dated January 7, 2019 and attached to this Agreement as Attachment B.

"Fire Flow" means water withdrawn from a water system for the express purpose of extinguishing a fire and is not considered typical daily consumption.

"In-town rate" means the rate charged by MWW to retail franchise customers within the geographic boundary of the City of Manchester.

"Maximum Daily Flow" or "MDF" means the highest total volume of water measured in gallons or cubic feet at a Project metering station over any consecutive twenty-four (24) hour period.

"Merrimack Source Development Charge" or "MSDC" means a capital charge assessed by MWW in accordance with Manchester Water Works Rules and Regulations, RSA 38:27 and RSA 38:28 for the purpose of constructing, acquiring, improving, enlarging and/or operating the Manchester Water Works' system. Specifically, all funds collected from the MSDC will be utilized to develop the Merrimack River as an additional source of water supply for MWW.

"MSDC Agreement" means a grant agreement between MWW and NHDES which is attached hereto and made part of this Agreement as Attachment C.

"MSDC Capacity" means capacity reserved for a specific Water Recipient who has paid the associated MSDC.

"MGD" means million gallons of water per day.

"NHDES" means the New Hampshire Department of Environmental Services.

"NHPUC" means the New Hampshire Public Utilities Commission.

"Out-of-Town rate" means the rated charged by MWW to retail franchise customers outside the geographic boundary of the City of Manchester.

"Phase 1" means the time period beginning on December 31, 2020[1] and ending at the beginning of Phase 2 unless the parties hereto agree to an earlier date.

"Phase 2" means the time period beginning on December 31, 2023, and ending at the termination of this Agreement unless the parties hereto agree to an earlier date.

"Project" means the Southern New Hampshire Regional Water Interconnection Project described herein and initially described in the Memorandum of Understanding signed by NHDES on October 5, 2018, and also signed by MWW, Derry, Salem, Windham, PEU, HAWC and Plaistow.

"Trust Fund" means the New Hampshire Drinking Water and Groundwater Trust Fund.

"Water" means potable water unless used in the context of fire suppression in which case it shall mean all water.

"Water Provider" means MWW and Derry, whose role in the Project is to provide water to the Water Recipients consistent with this Agreement.

"Water Recipients" means Salem, Windham, HAWC, and Plaistow.

"Water System" means facilities for collection, storage, supply, distribution, treatment, pumping, metering or transmission of water.

ARTICLE II. – Parties' Rights and Obligations

A. INDIVIDUAL PARTIES

MWW

Infrastructure:

- Prior to Phase 1, MWW shall increase the intake pipe diameter of the existing Cohas Avenue pump station, located on Cohas Avenue, Manchester, New Hampshire, from 20 inches to 24 inches to increase future throughput of the pump station to meet the Project's long-term water demand of 3.13 MGD ADF and 4.07 MGD MDF.
- MWW shall apply to the Trust Fund for the funds related to Phase 2 at a time and in a manner necessary to meet its Phase 2 obligations.
- If the Trust Fund approves funding for MWW's Phase 2 obligations, MWW shall complete capital improvements to its water system necessary to enable a total of up to 3.13 MGD ADF and up to 4.07 MGD MDF of water to be provided to the Water Recipients, including but not limited to possible upgrades to the Cohas Avenue pump station and an increase of one or more water mains.
- MWW will not be financially responsible for capital improvements necessitated by and solely related to Phase 2 of the Project.

[1] Although the firm deadline for Phase 1 is December 31, 2020, all parties must make all reasonable efforts to complete Phase I improvements by May 1, 2020 as indicated in Article II. B. 2 of this Agreement.

Operation:

- Throughout Phase 1, MWW shall supply a total of up to 1.0 MGD ADF and up to 1.3 MGD MDF of water to the Water Recipients, consistent with and subject to the provisions of the MSDC Agreement attached as Attachment C.
- Throughout Phase 2, MWW shall supply a total of up to 3.13 MGD average daily flow and up to 4.07 MGD maximum daily flow of water to the Water Recipients, consistent with and subject to the provisions of the MSDC Agreement attached as Attachment C.
- MWW shall be responsible for all of its operation and maintenance costs, including rehabilitation and replacement of infrastructure, whether or not such costs are associated with the Project.

Rates:

- The rates charged by MWW per cubic foot or gallon used by Water Recipients shall be in accordance with the MSDC Agreement attached as Attachment C.

Other:

MWW shall read the meter at the Londonderry-Derry town line and at the Derry-Windham town line to determine the amount of Project water flowing through the Derry water system and received by Salem at the Derry-Windham town line. MWW shall then bill Salem directly for the amount of water received by Salem. Said billings shall reflect the rates to be paid by Salem to MWW as described herein and in the MSDC Agreement attached as Attachment C, and to Derry as described below. Upon receipt of payment, MWW shall remit to Derry the amount that Derry is due under this Agreement. MWW shall invoice Salem on a monthly basis in arrears. Payments on such invoices shall be made within thirty (30) days.

TOWN OF DERRY

Infrastructure:

Prior to Phase 1, and consistent with the Basis of Design Memo and Disinfection Study, Derry shall design, construct, own, operate, and maintain:

- A new meter station including pumps near the Londonderry-Derry town line on Manchester Road (Route 28);
- Upgrades to the existing Rockingham Road (Route 28) pump station;
- Approximately 7,400 linear feet of 16-inch water main in Rockingham Road (Route 28) from the terminus of the existing Derry water system to the intersection of Route 28 and Goodhue Road south of the Derry-Windham town line; and
- A pressure reducing valve (PRV), in Derry near the Derry-Windham town line consistent with the Basis of Design Memo.
- Derry's capital costs for Phase 1 shall be paid in accordance with the approval by the Commission dated April 18, 2018.

All of the above-described infrastructure is for the purpose of conveying 1 MGD ADF and/or 1 MGD MDF to the Water Recipients through the end of Phase 1 and up to 3.13 MGD ADF and/or 3.13 MGD MDF throughout Phase 2.

Prior to Phase 2, Derry shall:

- Complete capital improvements to its water system necessary to convey a total of up to 3.13 MGD ADF and/or up to 3.13 MGD MDF of water as applicable to the Water Recipients possibly including but not limited to upgrading the pump station at the Londonderry-Derry town line, upgrades to the water main on Manchester Road, upgrades to the water main between Manchester Road and the Tsienneto Road Tank, upgrades to the water main on Rockingham Road, upgrades to the Rockingham Road pump station, and potential localized water main improvements.
- Apply, in a timely manner, to the Commission for the funds necessary to complete all other capital improvements to Derry's water system necessary to convey a total of up to 3.13 MGD ADF and/or 3.13 MGD MDF of water as applicable to downstream Water Recipients.
- If funding is approved, Derry shall design, construct, own, operate, and maintain all other infrastructure necessary to convey a total of up to 3.13 MGD ADF and/or 3.13 MGD MDF of water to Salem, Windham, HAWC, and Plaistow.
- Derry will not be responsible for the cost of capital improvements necessitated by and solely related to the Project.

Operation:

- Throughout Phase 1, Derry shall convey a total of up to 1.0 MGD ADF and/or up to 1.0 MGD MDF of water as applicable to the meter station near the Derry-Windham town line that will measure water provided to Salem at that location.
- Throughout Phase 2, Derry shall convey a total of up to 3.13 MGD ADF and/or up to 3.13 MGD MDF of water as applicable to a meter station or stations to be identified by Windham, Salem and HAWC prior to Phase 2.
- Derry shall own, operate and maintain the meter to be located in the new Rockingham Road (Route 28) station in Windham near the Derry-Windham town line to be constructed by Salem for the purpose of billing Salem.
- Derry shall be responsible for all of its operation and maintenance costs, including rehabilitation and replacement of infrastructure, whether or not such costs are associated with the Project.

Rates:

- Derry shall charge Salem $1.00 per Ccf for Project-related water until the year 2035, and such charge shall be billed and collected by MWW. After 2035, any party other

than MWW and PEU may seek a change to the rate charged by Derry. If Derry and the Water Recipients agree to a new rate, this Agreement shall be amended to reflect the new rate. If Derry and the Water Recipients cannot reach agreement, they may engage in dispute resolution as set forth in paragraph 32 of this Agreement. Unless and until a new rate is set, the rate described above shall remain in effect, and Derry shall not charge Salem any other fees or costs.

Other:

- All Water Recipients shall be responsible for maintaining their own fire flows and Derry will not be liable for any damages resulting from inadequate fire flows as a result of this Agreement.
- Derry shall not divert or otherwise use any portion of the MWW water delivered to Derry under this Agreement which is intended for use by the Water Recipients.
- Derry and MWW are parties to a wholesale water agreement which requires Derry to participate financially in MWW capital improvements undertaken to maintain/improve MWW service to Derry. Derry's capital improvement financial obligations to MWW under the aforementioned wholesale water agreement will not be triggered by Derry's obligations under this Agreement. In addition, nothing in this Agreement shall impair Derry's or MWW's rights under the aforementioned wholesale water agreement.

TOWN OF SALEM

Infrastructure Related to Service to Salem and HAWC:

Prior to Phase 1, and consistent with the Basis of Design Memo and Disinfection Report, Salem shall design, construct, own, operate, and maintain:

- Approximately 14,000 linear feet of 20-inch transmission water main along Rockingham Road (Route 28) from the intersection of Route 28 and Goodhue Road south of the Derry-Windham town line to the intersection of Rockingham Road (Route 28) and Route 111 in Windham;
- Approximately 2,200 linear feet of 16-inch water main in Rockingham Road (Route 28) from the intersection with Route 111 in Windham to the Windham-Salem town line;
- A meter station including pressure reducing valve ("PRV") and chemical feed system on Rockingham Road (Route 28) in Windham near the intersection of Goodhue Road and Route 28, with the meter located in the station to be owned, operated and maintained by Derry;
- A meter station on Route 111 in Windham near the intersection of Rockingham Road (Route 28) and Route 111;
- A meter station including pressure reducing valve ("PRV") and chemical feed system on Rockingham Road (Route 28) near the Windham-Salem town line; and

- Approximately 650 linear feet of 16-inch water main in Rockingham Road (Route 28) from the Windham-Salem town line to the existing Salem water system.

All of the above-described infrastructure is for the purpose of conveying 1 MGD ADF and/or 1 MGD MDF to the Water Recipients through the end of Phase 1 and up to 3.13 MGD ADF and/or 3.13 MGD MDF throughout Phase 2.

Also prior to Phase 1, and consistent with the Basis of Design Memo and Disinfection Report, Salem shall design, construct, own, operate, and maintain:

- Approximately 1,100 linear feet of 12-inch water main in Shannon Road and Westside Drive from the terminus of the existing Salem water system in Salem to a new meter station to be constructed by HAWC near the Salem-Atkinson town line in Atkinson.

All of the above-described infrastructure is for the purpose of conveying up to 500,000 gallons per day ADF and/or 500,000 gallons per day MDF as applicable through the end of Phase 1 and up to 1.32 MGD ADF and/or 1.32 MGD MDF as applicable throughout Phase 2 from Salem's existing water system into HAWC's water system.

In addition, Salem shall design and construct the following infrastructure and deliver it to HAWC and shall further give HAWC permission to own and maintain said infrastructure within the Town of Salem right-of-way:

- Approximately 2,500 linear feet of 12-inch water main from the new meter station on Westside Drive in Atkinson along Westside Drive in Atkinson and Salem, Shannon Road in Salem, and Providence Hill Road in Salem and Atkinson, to the existing HAWC water system in Providence Hill Road near Atkinson Farm Road in Atkinson.

The full cost of all Phase 1 capital improvements shall be paid by a combination of the MTBE Settlement Fund and the Trust Fund. The capital costs associated with Salem for Phase 1 were approved by the Commission on April 18, 2018.

Infrastructure Related to Service to Windham:

Prior to Phase I, and consistent with the Basis of Design Memo and Disinfection Report, Salem shall design, construct, own, operate, and maintain:

- Approximately 4,500 linear feet of 12-inch water transmission main to be located along Route 111 from the meter located at the intersection of Rockingham Road (Route 28) to the west side of the intersection of Route 111 (Indian Rock Road) and Route 111A (Range Road) in Windham.

All of the above-described infrastructure is for the purpose of conveying approximately 200,000 gallons per day ADF and/or 200,000 gallons per day MDF as applicable through the end of Phase 1 and up to 310,000 gallons per day ADF and/or 310,000 gallons per day MDF as applicable throughout Phase 2. Salem shall place this transmission main in service as soon as possible but no later than six (6) months after construction of the transmission main is completed. To protect water quality, Salem shall ensure at least 20,000 gallons of flow each day prior to placing this water main in service. Salem may serve retail customers from this 12-inch

main and from the transmission main to be located along Route 28 in Windham, including customers in Windham, provided it obtains any necessary NHPUC approval. Salem shall only be required to fulfill its obligations under this paragraph if all of the costs of capital improvements associated with the 12-inch main leading to the area in the vicinity of Klemm's Mobil Gas Station ("Klemm's") are paid for by the MtBE Settlement Fund and/or the Trust Fund. These requirements, however, are not contingent on the Trust Fund paying for any additional costs for the purpose of serving retail customers in Windham, including the cost of connections, water main construction, operation and maintenance, or capital costs.[2]

Prior to Phase 2, and consistent with the Basis of Design Memo and Disinfection Report, Salem shall construct, own, operate, and maintain capital improvements necessary to convey a total of up to 310,000 gallons per day ADF and/or 310,000 gallons per day MDF of water as applicable for use within the Town of Windham and a total of up to 1.32 MGD ADF and/or 1.32 MGD MDF of water as applicable to HAWC.

Operation:

- Salem shall own, operate and maintain the meter to be located in the new Route 111 station in Windham to be constructed by Salem.
- Throughout Phase 1, Salem shall convey a total of up to 200,000 gallons per day ADF and 200,000 gallons per day MDF for use within Windham.
- Also throughout Phase 1, Salem shall convey a total of up to 500,000 gallons per day ADF and 500,000 gallons per day MDF to HAWC.
- Throughout Phase 2, Salem shall convey a total of up to 310,000 gallons per day ADF and 310,000 gallons per day MDF for use within the Town of Windham.
- Also throughout Phase 2, Salem shall convey a total of up to 1.32 MGD ADF and 1.32 MGD MDF to HAWC.
- Salem shall own, operate and maintain the meter to be located in the new Westside Drive station in Atkinson near the Salem-Atkinson town line to be constructed by HAWC.
- Salem shall be responsible for all of its operation and maintenance costs, including rehabilitation and replacement of infrastructure, whether or not such costs are associated with the Project.
- Salem shall own and operate the 12-inch water transmission main leading to the area in the vicinity of Klemm's upon such terms and conditions as shall be agreed upon by Salem and Windham and consistent with the Agreement.
- Nothing herein shall prohibit Salem from selling water to other municipalities that are parties to this Agreement or from selling water directly to the residents and businesses located within those municipalities.

[2] To the extent Salem or Windham requests a grant or loan from the Trust Fund for any other capital costs, such as further water transmission main on Route 111, it is anticipated that such a request will be reviewed by the Commission in the normal course.

Rates:

- Pursuant to RSA 362:4, III-a(a)(1), Salem will charge retail customers in Windham a rate agreed to by Salem and Windham which may be no higher than 15% above the rate charged by Salem to its in-town retail customers.
- Salem will charge wholesale customers in Windham, if any, 50 cents more per Ccf than the combined rates charged to Salem by MWW and Derry for water usage.
- Salem will charge HAWC 50 cents more per Ccf than the combined rates charged to Salem by MWW and Derry for water usage.
- Wholesale rates shall be valid until the year 2035. After 2035, any Water Recipient may seek a change to the rate charged by Salem. If the Water Recipients agree to a new rate, this Agreement shall be amended to reflect the new rate. If the Water Recipients cannot reach agreement, they may engage in dispute resolution as set forth in paragraph 32 of this Agreement. Unless and until a new rate is set, the wholesale rates described above shall remain in effect.

Other:

- All Water Recipients shall be responsible for maintaining their own fire flows and Salem will not be liable for any damages resulting from inadequate fire flows as a result of this Agreement.
- For general Project purposes, Salem shall ensure a 250,000 gallons per day minimum usage of Project water calculated as the six (6) month average within the period of January 1 to June 30, and within the six (6) month period of July 1 and December 31, throughout Phase 1 and continuing for the term of the Agreement. For water quality purposes, Salem shall ensure a flow of at least 100,000 gallons each day. Water conveyed by Salem that is used within Windham and Salem shall count toward Salem's minimum usage.

PEU

To the extent that NHPUC approvals may be required for Salem to operate a wholesale water system in Windham and/or to serve retail water customers in Windham, and/or for Windham to establish a municipal water system to serve customers in Windham, PEU will not object to such approvals, including but not limited to surrender of its franchise rights in those areas of Windham that PEU, Salem and/or Windham as applicable have agreed upon, and shall cooperate with Salem and/or Windham in making required filings with the NHPUC.

TOWN OF WINDHAM

Windham agrees to allow all of the activities described in this Agreement to occur. Windham may assume the responsibilities in this Agreement occurring within Windham currently attributable to Salem, and may thereafter assign such responsibilities to another entity, provided that Windham,

Salem, and NHDES agree in writing and subject to necessary regulatory approvals. Windham and Salem shall cooperate to the fullest extent necessary for Salem to design, construct, own, operate and maintain infrastructure in Windham consistent with the Basis of Design Memo and this Agreement.

HAWC

Infrastructure:

Prior to Phase 1, and consistent with the Basis of Design Memo and Disinfection Report, HAWC shall design, construct, own, operate, and maintain:

- A new meter station including pumps and chemical feed along Westside Drive near the Salem-Atkinson town line in Atkinson;
- Approximately 600 linear feet of 12-inch water main in Westside Drive in Atkinson from the new meter station to the existing HAWC water system;
- Upgrades to the existing pressure reducing valve ("PRV") along Main Street in Atkinson;
- Chemical feed upgrades to existing pumping and treatment stations as necessitated by and solely related to the Project;
- A 1 million gallon water storage tank near Winslow Drive in Atkinson.

In addition, HAWC shall own, operate and maintain the following infrastructure to be designed and constructed by Salem:

- Approximately 2,500 linear feet of 12-inch water main from the new meter station on Westside Drive in Atkinson along Westside Drive in Atkinson and Salem, Shannon Road in Salem, and Providence Hill Road in Salem and Atkinson, to the existing HAWC water system in Providence Hill Road near Atkinson Farm Road in Atkinson.

All of the above-described infrastructure is for the purpose of conveying 500,000 gallons per day ADF and/or 500,000 gallons per day MDF as applicable through the end of Phase 1 and up to 1.32 MGD ADF and/or 1.32 MGD MDF as applicable throughout Phase 2 from the Salem-Atkinson town line.

The Parties recognize that certain costs of the above-described infrastructure were approved by the Commission on April 18, 2018.

Prior to Phase 2, and consistent with the Basis of Design Memo and Disinfection Report, and for the purpose of conveying 500,000 gallons per day ADF and/or 500,000 gallons per day MDF as applicable through the end of Phase 1 and up to 1.32 MGD ADF and/or 1.32 MGD MDF as applicable throughout Phase 2 from the Salem-Atkinson town line, HAWC shall design, construct, own, operate, and maintain all other capital improvements necessary for the Project possibly including, but not limited to, an upgrade of water main in Westside Drive and Village Drive in Atkinson.

Operation:

- Throughout Phase 1, HAWC shall convey a total of up to 250,000 gallons per day ADF and 250,000 gallons MDF to Plaistow.
- Throughout Phase 2, HAWC shall convey a total of up to 570,000 gallons per day ADF and 570,000 gallons MDF to Plaistow.
- HAWC shall own, operate and maintain and read the meter to be located in the new meter station near the Atkinson-Plaistow town line to be constructed by Plaistow to determine the amount of Project water flowing to Plaistow. HAWC shall then bill Plaistow directly for the amount of water received by Plaistow.
- HAWC shall be responsible for all of its operation and maintenance costs, including rehabilitation and replacement of infrastructure, whether or not such costs are associated with the Project.

Rates:

- HAWC shall charge Plaistow 54 cents more per Ccf than HAWC is being charged by Salem. This rate shall be valid until the year 2035. After 2035, Plaistow or HAWC may seek a change to the rate charged by HAWC. If Plaistow and HAWC agree to a new rate, this Agreement shall be amended to reflect the new rate. If Plaistow and HAWC cannot reach agreement, they may engage in dispute resolution as set forth in paragraph 32 of this Agreement. Unless and until a new rate is set, the rate described above shall remain in effect.

Other:

- HAWC shall cooperate with Plaistow to enable Plaistow to construct approximately 1,500 linear feet of 12-inch water transmission main from the terminus of the existing HAWC system in Bryant Woods Road to the Atkinson-Plaistow town line. Such cooperation may include Plaistow leasing or transferring title to HAWC of the main located in Atkinson downstream of the pumping station after it is constructed by Plaistow. It is Plaistow's intent to transfer ownership of the upstream portion (suction side of the pump/meter) of the line to HAWC.
- HAWC will not be responsible for maintaining fire flows to Plaistow; however, HAWC shall make 50% of the storage capacity associated with the Atkinson water storage tank available to Plaistow for fire protection. HAWC will not be liable for any damages resulting from inadequate fire flows in Plaistow.
- HAWC shall ensure a 250,000 gallons per day minimum use of Project water calculated as the six (6) month average within the period of January 1 to June 30, and within the six (6) month period of July 1 and December 31, throughout Phase 1 and continuing for the term of the Agreement.
- HAWC will be responsible for maintaining its own fire flows.

TOWN OF PLAISTOW

Infrastructure:

Prior to receiving Project water, and no later than June 1, 2025 consistent with the Basis of Design Memo and Disinfection Report, Plaistow shall design, construct, own, operate, and maintain:

- A meter station including pumps and chemical feed on East Road or Bryant Woods Road near the Atkinson-Plaistow town line;
- Approximately 1,500 linear feet of 12-inch water transmission main from the terminus of the existing HAWC system in Bryant Woods Road to the Atkinson-Plaistow town line.[3] After constructing this main, Plaistow will cooperate with HAWC to enable HAWC to serve customers from this main. Such cooperation may include Plaistow leasing or transferring title to HAWC of the main located in Atkinson downstream of the pumping station after it is constructed by Plaistow. It is Plaistow's intent to transfer ownership of the upstream portion (suction side of the pump/meter) of the line to HAWC.
- Approximately 2,900 linear feet of 12-inch water main in East Road from the Atkinson-Plaistow town line to the existing Plaistow fire suppression system ("FSS");
- A 400,000-gallon water storage tank on Sweet Hill Road;
- Approximately 5,300 linear feet of 12-inch water main in Sweet Hill Road from the existing Plaistow FSS via Palmer Avenue or Hale Spring Road to the site of the water storage tank;
- Approximately 1,000 linear feet of 8-inch water main in Wentworth Avenue from the terminus of the existing FSS to serve MtBE-impacted properties;
- Approximately 2,300 linear feet of 8-inch water main in Westville Road from Plaistow Road easterly to serve MtBE-impacted properties; and,
- Service connections including individual service meters to a minimum of 56 MtBE-impacted properties.

Funding sources for these capital improvements, to the extent they are necessitated solely by the Project, shall be a combination of the MTBE Settlement Fund and the Trust Fund. The capital costs associated with Phase 1 of the Project were approved by the Commission on April 18, 2018.

Operation:

- Plaistow shall be responsible for all of its operation and maintenance costs, including rehabilitation and replacement of infrastructure, whether or not such costs are associated with the Project.

Rates:

- The rate charged by Plaistow to its customers is not subject to this agreement.

[3] This water main must be constructed to convey 570,000 gallons per day.

Other:

- Plaistow shall be responsible for fire protection and fire flows within Plaistow utilizing the Project water and the storage capacity associated with 50% of the Atkinson water storage tank and 100% of the Sweet Hill water storage tank. It is also recognized that Project water is the only water source available for Plaistow and, as such, it is the source for fire flow needs. As a result, emergency fire-related conditions may result in a maximum daily usage above the amount identified above.
- No later than June 1, 2025, Plaistow shall ensure a minimum flow necessary to protect water quality which shall be at least 40,000 gallons each day.

B. ALL PARTIES

1. Obligations Contingent Upon Award of Funds from Trust Fund. No Party shall be responsible for any obligation under this Agreement identified as being funded by the Trust Fund or MtBE settlement funds unless and until the Party has been awarded funds for infrastructure identified herein as being paid for by the Trust Fund or MtBE settlement funds.

2. Connections and Project Construction. Any and all connections of one Party's water system infrastructure to another Party's water system infrastructure necessary to effectuate this Agreement shall be of good design and constructed in a workmanlike manner. Before any Party begins Project-related construction, all design plans and specifications for such construction must be approved by NHDES and all Parties except PEU. Such approval shall not be unreasonably withheld. Project design shall be consistent with the Basis of Design Memo, any agreed upon regional design changes presented in writing to NHDES and approved by NHDES, and specifications provided by others and approved by NHDES. Meters incorporated into the construction for the purposes of monitoring and conveying water usage information shall be in accordance with the design specifications set forth by MWW. All parties must make reasonable efforts to complete their Phase 1 improvements by May 1, 2020 and must complete all of their Phase 1 improvements no later than December 31, 2020.

3. Easements/real property acquisitions. Each Party shall be responsible for acquiring any and all easements and/or other interests in real property needed for the construction and installation of those Project facilities or portions thereof which the Party is responsible for constructing. Such Party may seek reimbursement from the Trust Fund for expenses associated with obtaining easements or other property interests needed for and solely related to the Project.

4. Infrastructure Ownership. Each Party's ownership of any infrastructure and any easement and other property rights acquired as part of the Project shall survive the termination of this Agreement.

5. Operation and Maintenance of Facilities. Parties shall operate and maintain Project facilities and their respective water systems or portions thereof used for the Project in accordance with customary engineering and water industry standards. No Party assumes any responsibility for

operating or maintaining any portion of the water system of any other Party unless otherwise specified. Parties shall take steps to control leaks and minimize wasteful water use within their respective service areas.

6. Maintenance and Testing of Metering Devices.

6.1 Any and all metering devices installed pursuant to this Agreement shall be inspected and calibrated by the Party owning the metering device in the manner specified by regulations of the NHPUC. The cost for inspection and calibration will be the responsibility of the Party owning the meter. Each Party conducting such inspection and calibration shall cause a copy of its inspection and calibration reports to be filed at MWW's offices. Said reports shall be available for examination by any Water Recipient, Derry or NHDES at the offices of MWW during normal business hours.

6.2 MWW may request any Water Recipient or Town of Derry to test and certify as to the accuracy of any metering device owned by the Party at any time. MWW must submit such requests in writing to the Party. If the metering device reads within specifications accepted by the NHPUC, the cost of such tests shall be borne by MWW. If the average error over different test rates is greater than that allowed by the NHPUC, the cost of the tests shall be paid by the relevant Party.

6.3 In the case of missing or inaccurate flow records, due to faulty metering device operation or other circumstances, an estimate of flow shall be made by MWW based on past records for a comparable period. The estimates shall be used by MWW to calculate the amount of payments due from Salem.

6.4 Other Parties conducting meter readings for billing or other purposes may use methods comparable to those used by MWW.

7. Measurement of Water Flows. Each Party performing meter readings in connection with this Agreement shall provide other Parties except PEU with access to such meter readings. The measurement of water delivered to all Parties under this Agreement shall be made available by MWW to all Parties for the purpose of determining MSDC capacity, ADF and MDF. These flow measurements will be used in determining flow usage pursuant to the quantities of water outlined in Article II.A. Such flow measurements shall be made by one or more metering devices placed at locations selected by the Parties.

8. Quality of Water. Water Providers and Water Recipients shall operate and maintain their water systems so as to supply water meeting the drinking water quality criteria established from time to time by the United States Environmental Protection Agency and the State of New Hampshire, NHDES.

9. Supply impairment. Water Providers and Water Recipients shall take all reasonable steps to prevent impairment, interruption and reduction of supply of water to the Water Recipients under this Agreement. In the event that such water supply is impaired or otherwise interrupted or reduced by a Water Provider or Water Recipient, the Water Recipients shall, to the extent

possible, adjust their usage of the water supplied in amounts proportional to the water capacity made available to them under this Agreement.

10. Operation and Maintenance Costs. As stated in Article II.A, each Party shall be responsible for all of its operation and maintenance costs and no Party may seek reimbursement from the Trust Fund for such costs associated with Project facilities.

11. Record keeping/documentation requirements. Each Party shall maintain records of its financial and other transactions conducted pursuant to this Agreement, and these records shall be available for inspection by any NHDES and/or any other Party except PEU at each Party's business office during normal business hours.

12. Administration by Joint Board. No separate legal entity is created by this Agreement. Notwithstanding the foregoing, in accordance with RSA 53-A:3, III (a), a Joint Board comprised of a representative of Derry, MWW, Plaistow, Windham, Salem and HAWC will administer the joint cooperative undertaking described in this Agreement. Responsibilities of the Joint Board shall be limited to coordination of the responsibilities arising under the Agreement and no Party, through this Agreement, cedes to the Joint Board any authority over its water system. Said Joint Board shall meet at such times and places as are necessary and convenient to discuss issues of concern to two or more parties.

13. MSDC Purchase and Sale/Water Use. The purchase and sale of the water capacity is described in the MSDC Agreement attached hereto and made part of this Agreement as Attachment C. Among other things, NHDES is providing MWW $11,174,100 from the Trust Fund to ensure that MWW makes MSDC capacity of up to 3.13 MGD ADF available for purchase by the Water Recipients in the manner and at the prices specified within the MSDC Agreement attached as Attachment C. Subject to the MSDC Agreement:

    13.01 MWW shall make water capacity available for purchase by the Water Recipients for use throughout Phase 1 in the manner described below in sections 13.02 through 13.05. To the extent that any Party does not purchase the portion of the Phase 1 MSDC capacity allotted to it by May 1, 2022, MWW shall make the unsold portion available to all of the Parties on a first-come, first-served basis.

    13.02 MSDC capacity in the amount of 300,000 gallons per day shall be made available by MWW for purchase by the Town of Salem.

    13.03 MSDC capacity in the amount of 200,000 gallons per day shall be made available for purchase directly by Windham, or by Salem if authorized by Windham's Board of Selectmen, for use within the geographical boundaries of Windham in accordance with this Agreement.

    13.04 MSDC capacity in the amount of 250,000 gallons per day shall be made available for purchase by HAWC.

    13.05 MSDC capacity in the amount of 250,000 gallons per day shall be made available for purchase by Plaistow.

13.06 MWW shall make MSDC capacity available for purchase by the Water Recipients for use throughout Phase 2 in the manner described below in sections 13.07 through 13.10. To the extent that any Water Recipient does not purchase the portion of the Phase 2 MSDC capacity allotted to it by May 1, 2025, MWW shall make the unsold portion available to all of the Water Recipients on a first-come, first-served basis.

13.07 MSDC capacity in the amount of 1.2 MGD shall be made available for purchase by the Town of Salem. This amount is in addition to the Phase 1 capacity allotted to Salem.

13.08 MSDC capacity in the amount of 110,000 gallons per day shall be made available for purchase directly by Windham, or by Salem if authorized by Windham's Board of Selectmen, for use within the geographical boundaries of Windham in accordance with this Agreement. This amount is in addition to the Phase 1 capacity allotted for use within Windham.

13.09 MSDC capacity in the amount of 500,000 gallons per day shall be made available for purchase by HAWC. This amount is in addition to the Phase 1 capacity allotted to HAWC.

13.10 MSDC capacity in the amount of 320,000 gallons per day shall be made available for purchase by Plaistow. This amount is in addition to the Phase 1 capacity allotted to Plaistow.

13.11 In the event of any conflict between any provision of this Agreement and the provisions of the MSDC Agreement attached as Attachment C, the MSDC Agreement shall control.

13.12 Water Use. Use of Project water by a Party shall not exceed that Party's capacity unless otherwise specified in this Agreement.

14. Fluoride. MWW currently fluoridates its water. Therefore, pursuant to RSA 485:14, if the registered voters of a municipality being supplied by this Agreement have not already voted to approve the use of fluoridated water, the public water system serving water users within that municipality must provide written information to such water users that includes the following:

a. A statement, approved by the NHDES, that the water contains fluoride for the purpose of improving community oral health and, in the event the fluoride levels are diluted from other sources of water or degraded, that the fluoride levels may be too low to effectively prevent tooth decay;
b. An identification of the source of the fluoridated water; and
c. The most recent compliance sample result for fluoride that the supplier of water that fluoridated the water has submitted to NHDES.

ARTICLE III. – General Provisions

15. Term and Termination. This Agreement shall be effective as of the date when MWW, Derry, Salem, and HAWC have all signed the Agreement, and shall terminate December 31, 2058, unless terminated sooner or extended by the Parties in writing. This Agreement may be terminated in its entirety by the consent of all Parties.

16. Approvals, Permitting and Other Agreements. This Agreement shall be subject to the receipt of all necessary additional State, local or other approvals. Each Party shall expeditiously seek all approvals needed by it to implement this Agreement so as to ensure completion of Phase 1 by December 31, 2020. Each Party shall provide a copy of the Agreement executed by it to NHDES. Pursuant to RSA 53-A, after NHDES reviews the Agreement, it is anticipated that NHDES will submit the Agreement to the Office of the Attorney General for review. Once approval is obtained from the Office of the Attorney General, it is anticipated that NHDES will file the agreement with the N.H. Secretary of State. Each Party shall file a copy of the agreement with the clerk of the municipality in which that Party is located.

17. Compliance with Laws and Regulations. Each Party shall comply with all applicable State and Federal laws and regulations at its own expense.

18. Assignment. The permanent or temporary assignment or transfer of water capacity and concomitant water use is permitted among Water Recipients only; however, no Party shall assign its rights under this Agreement, including, but not limited to the right to receive the quantities of water specified under this Agreement, or any portion of said quantities, to another Party or person without the express written consent of the affected Parties and NHDES, except that any town may assign its rights to an entity providing water within its town boundary without such consent. The Parties may only use or distribute water purchased from MWW pursuant to this agreement within the geographical boundaries of the towns of Derry, Salem, Windham, Atkinson, Hampstead, and Plaistow.

19. Transferees, Successors, and Assigns. This Agreement in its entirety applies to, inures to the benefit of, and is binding upon and enforceable against the Parties, their lawful successors, and permitted assigns.

20. Limitation of Liability for Certain Events. No Party shall be liable in damages or otherwise for failure to perform any obligation under this Agreement, which failure is occasioned by or in consequence of any act of God, act of public enemy, wars, blockades, insurrections, riots, epidemics, landslides, lightning, earth quakes, drought, fires, storms, floods, winter freeze, washouts, vandalism, arrests and restraints of rulers and peoples, civil disturbances, labor strikes, power failures, explosions, breakage or accident to machinery or lines of pipe, failure or want of water supply, the binding order of any court or governmental authority which has been resisted in good faith by all reasonable legal means, and any other cause, whether of the kind herein enumerated or otherwise, not within the control of such party and which act, omission of circumstance such party is unable to prevent or overcome by the exercise of reasonable care.

21. Liability for Negligent and Intentional Acts. No Party shall be relieved of liability for loss resulting from its negligence, intentional actions, or its failure to act or for its failure to use due diligence to remedy the situation and remove the cause in an adequate manner and with all reasonable dispatch, nor shall such causes or contingencies affecting performance relieve any Party from its obligations to make payments of amounts then due with respect to water theretofore supplied.

22. Severability. If any term, clause or provision of this Agreement is judged by a court of competent jurisdiction to be invalid and/or unenforceable, the validity and/or enforceability of all other terms, clauses or provisions in this Agreement will not be affected thereby and shall remain in full force and effect.

23. Captions. The captions of the Articles or sections of this Agreement are to assist the Parties in reading this Agreement and are not part of the terms or provisions of this Agreement.

24. Counterparts. This Agreement may be executed in one or more counterparts, each of which will be deemed an original and all of which, when taken together, will be deemed to be one instrument.

25. Amendment. No modification, waiver, amendment, discharge or change of this Agreement will be valid unless approved by NHDES in writing and unless approved in writing and signed by the affected Parties.

26. Waiver. Failure of any Party to exercise any right under this Agreement shall not be deemed a waiver of such right.

27. Expenditures/Funding. Unless indicated otherwise in this Agreement, each Party shall bear its own expenses associated with the Project, and nothing in this Agreement binds the Parties or any other entity or person to making any expenditure or otherwise committing resources to the Project.

28. Sovereign Immunity. This Agreement is not intended to and does not waive sovereign immunity or any other immunity inuring to the benefit of any Party to the Agreement.

29. Governing Law. This Agreement shall be governed by the laws of the State of New Hampshire and the right and obligations of the Parties hereunder will be construed and enforced exclusively in accordance with the laws of the State of New Hampshire.

30. Third Party Beneficiaries. The parties hereto do not intend to benefit any third parties and this Agreement shall not be construed to confer any such benefit except that the State of New Hampshire, NHDES, the Commission, and the Trust Fund are intended to benefit by this Agreement and may enforce the terms of this Agreement. None of the Parties to this Agreement shall object to such enforcement on the basis of standing.

31. Notices. Notices and other writings required by this Agreement shall be addressed to the Parties as indicated below:

For the Town of Derry: Derry Department of Public Works
Attention: Director
14 Manning Street
Derry, NH 03038

For MWW:	Manchester Water Works Attention: Director 281 Lincoln Street Manchester, NH 03103
For the Town of Plaistow:	Plaistow Town Offices Attention: Board of Selectmen 145 Main Street Plaistow, NH 03865
For the Town of Windham:	Windham Town Offices Attention: Town Administrator 3 N Lowell Road Windham, NH 03087
For the Town of Salem:	Town of Salem Municipal Services Department Attention: Director 33 Geremonty Drive Salem, NH 03079
For HAWC:	Hampstead Area Water Company, Inc. Attention: President 54 Sawyer Avenue Atkinson, NH 03811
For PEU:	Pennichuck Corporation Attention: Chief Operating Officer 25 Manchester Street Merrimack, NH 03054

32. Dispute Resolution. The Parties shall first attempt to resolve any dispute with regard to the terms of this Agreement between or among themselves informally by negotiation. If the Parties are unable to resolve a dispute informally, then any Party may initiate non-binding mediation by giving the other Party or Parties written notice of the need to mediate and providing a list of no more than 3 names and qualifications of persons who the initiating Party believes would be qualified to mediate the dispute. Within 15 days after the delivery of the mediation notice, the receiving Party or Parties shall provide notice to the initiating Party designating a mediator from among the 3 persons listed by the initiating Party. If the initiating Party receives no response to the mediation notice within the time specified above, the initiating Party may select the mediator from the 3 persons listed in the mediation notice. The initiating Party shall expeditiously notify the mediator of his/her selection. The mediator shall schedule the mediation session within 2 weeks of being notified of his/her selection. The Parties to the mediation shall make themselves available to attend the mediation session as scheduled by the mediator. The mediation shall be conducted according to the procedures determined by the mediator. All disclosures, discussions, and any determinations or proposals made pursuant to the mediation process shall remain confidential and be treated as compromise and settlement negotiations, and shall not be offered or admissible as evidence in any other proceeding. The expenses of the mediation shall be shared equally by the Parties participating in the mediation.

Disputes regarding rates charged by Parties other than MWW shall be governed by the provisions in this section. With respect to rates only, beginning in the year 2035, any party may, after using the process above, submit a dispute to binding arbitration. The purpose of arbitration will be to determine a reasonable rate. Arbitration shall include all affected Parties and shall be conducted in accordance with procedures promulgated by the American Arbitration Association. The arbitration shall take place before a panel of three arbitrators in Rockingham County unless otherwise agreed to by the Parties involved. The arbitration award shall conform to all applicable rules and laws. This provision shall not apply to the rate charged by MWW.

33. Authority to execute Agreement. MWW, Derry, Windham, Salem and Plaistow represent that they have obtained authority to execute this Agreement through appropriate action by municipal ordinance, resolution or action pursuant to law of their governing bodies. HAWC and PEU represent that they have obtained authority to execute this Agreement through appropriate action in accordance with their corporate by-laws.

IN WITNESS WHEREOF the Parties have caused this Agreement to be executed as of the dates written below.

TOWN OF DERRY, NEW HAMPSHIRE

By:_____

David Caron, Town Administrator

Date: 4/17/19

_____

Witness

MANCHESTER WATER WORKS

By:_____

William R. Trombly, Jr.

President, Board of Water Commissioners

Date:_____

_____

Witness

TOWN OF SALEM, NEW HAMPSHIRE

_____

Christopher Dillon, Town Manager

Date:_____

_____

Witness

TOWN OF WINDHAM, NEW HAMPSHIRE

_____

David Sullivan, Town Administrator

Date:_____

_____

Witness

HAMPSTEAD AREA WATER COMPANY, INC.

By:_____

Name:_____

Title:_____

Date:_____

_____

Witness

TOWN OF DERRY, NEW HAMPSHIRE

By:_____

David Caron, Town Administrator

_____

Witness

Date:_____

MANCHESTER WATER WORKS

By:_____

William R. Trombly, Jr.

President, Board of Water Commissioners

Date: 4-11-2019

_____

Witness

TOWN OF SALEM, NEW HAMPSHIRE

_____

Christopher Dillon, Town Manager

Date:_____

_____

Witness

TOWN OF WINDHAM, NEW HAMPSHIRE

_____

David Sullivan, Town Administrator

Date:_____

_____

Witness

HAMPSTEAD AREA WATER COMPANY, INC.

By:_____

Name:_____

Title:_____

Date:_____

_____

Witness

TOWN OF DERRY, NEW HAMPSHIRE

By:_____ _____

David Caron, Town Administrator Witness

Date:_____

MANCHESTER WATER WORKS

By:_____ _____

William R. Trombly, Jr. Witness

President, Board of Water Commissioners

Date:_____

TOWN OF SALEM, NEW HAMPSHIRE

_____ _____

Christopher Dillon, Town Manager Witness

Date: 4/16/19

TOWN OF WINDHAM, NEW HAMPSHIRE

_____ _____

David Sullivan, Town Administrator Witness

Date:_____

HAMPSTEAD AREA WATER COMPANY, INC.

By:_____ _____

Name:_____ Witness

Title:_____

Date:_____

TOWN OF DERRY, NEW HAMPSHIRE

By:_____ _____

David Caron, Town Administrator Witness

Date:_____

MANCHESTER WATER WORKS

By:_____ _____

William R. Trombly, Jr. Witness

President, Board of Water Commissioners

Date:_____

TOWN OF SALEM, NEW HAMPSHIRE

_____ _____

Christopher Dillon, Town Manager Witness

Date:_____

TOWN OF WINDHAM, NEW HAMPSHIRE

_____

David Sullivan, Town Administrator Witness

Date: 4/16/19

HAMPSTEAD AREA WATER COMPANY, INC.

By:_____ _____

Name:_____ Witness

Title:_____

Date:_____

TOWN OF DERRY, NEW HAMPSHIRE

By:_____ _____

David Caron, Town Administrator Witness

Date:_____

MANCHESTER WATER WORKS

By:_____ _____

William R. Trombly, Jr. Witness

President, Board of Water Commissioners

Date:_____

TOWN OF SALEM, NEW HAMPSHIRE

_____ _____

Christopher Dillon, Town Manager Witness

Date:_____

TOWN OF WINDHAM, NEW HAMPSHIRE

_____ _____

David Sullivan, Town Administrator Witness

Date:_____

HAMPSTEAD AREA WATER COMPANY, INC.

By:_____ _____

Name: Harold J Morse Witness

Title: President

Date: 04/10/2019

PENNICHUCK EAST UTILITY, INC.

By: _____

Name: CEO, LARRY D. GOODNUE

Title: CEO/CFO/TREASURER

Date: 4/15/19

_____

Witness

TOWN OF PLAISTOW, NEW HAMPSHIRE

_____

Mark A. Pearson, Town Manager

Date: _____

_____

Witness

PENNICHUCK EAST UTILITY, INC.

By:_____

Name:_____

Title:_____

Date:_____

_____

Witness

TOWN OF PLAISTOW, NEW HAMPSHIRE

Mark A. Pearson, Town Manager

Date: April 15, 2019

Witness

ATTACHMENT A

Regional Basis of Design Memorandum, dated January 4, 2019

Weston & Sampson

100 International Drive, Suite 152, Portsmouth, NH 03801
Tel: 603.431.3937

MEMORANDUM

TO: Erin Holmes, P.E. and Michael Unger, P.E.

FROM: Jeff McClure, P.E., Jeff Provost, P.E.

DATE: January 4, 2019

SUBJECT: Regional Supply Basis of Design - **FINAL**

The purpose of this memorandum is to summarize the basis of design for the Southern New Hampshire Regional Water (SNHRW) project. The project identified how to transmit water supply from Manchester Water Works (MWW) to meet domestic water demands in the towns of Windham, Salem, Atkinson, Hampstead and Plaistow. Two supply volumes from MWW were to assessed as part of this project; 1.0 million gallons a day (MGD) defined as Phase I flows and 3.13 MGD defined as Phase II flows. The following provides a summary of the basis of design.

PREVIOUS WORK

The following is a listing of all reports that were developed as part of the SNHRW project.

Weston & Sampson Reports

- Town of Windham, NH – Route 111 and Salem Extensions, DES Site Name: Exit 3 Water Main Extension, DES Site No. 201605008 dated April 5, 2017
- Southern New Hampshire Regional Water Main Extension Alternatives - DES Site #201605008 dated April 21, 2017
- Town of Salem Water Supply Study dated February 20, 2018
- Plaistow & Haverhill Interconnection Report Review, Regional Water Main Options, DES Site #201605008 dated March 27, 2018
- Town of Derry, NH – Derry Water System Alternatives Analysis dated June 5, 2018
- Route 111 Water Main Extension Study – Routing Memo dated July 16, 2018
- Field Testing Program Technical Results dated August 2, 2018
- Town of Plaistow, NH – Proposed Potable Water System Basis of Design for Appropriation Budgeting – Final dated October 24, 2018
- Route 28 Water Main Design – Preliminary Design Report - Draft dated November 30, 2018
- HAWC Chloramine Study, DES Site #201605008 - Draft dated November 2, 2018
- Manchester Water Works Hydraulic Modeling Results dated January 2019 - Pending

- Water Rate Cost of Service Study, DES Site # 201605008 – Southern NH Regional Water Supply Options Report – Draft dated November 30, 2018

Underwood Engineers Inc. Reports

- Hydraulics and Alternatives Analysis – East Derry Route – Plaistow Water Feasibility Study dated December 22, 2017
- Water Supply Improvements Phasing – Plaistow Water Feasibility Study dated January 9, 2018
- Water Supply Option from Haverhill – Plaistow Water Feasibility Study dated February 20, 2018
- Peer Review – Derry Water System Alternatives Analysis – Regional Water Supply dated September 12, 2018
- Design of Plaistow Regional Water Improvements – Final dated November 16, 2018

Normandeau Associates Reports

- Town of Plaistow Potable Water Supply Feasibility Study Summary Report, NHDES Site # 198903017, Plaistow Lido, MtBE dated April 4, 2016
- Potable Water Supply Feasibility Study Phase II Technical Submittal, Plaistow Lido, MtBE, NHDES Site # 198903017 dated March 27, 2017

Wright Pierce Reports

- Water Interconnection Study for the City of Haverhill, MA Water Division dated January 2018.

CDM Smith Reports

- Salem/Methuen Interconnection Evaluation – Phase 1 dated March 26, 2018

Town of Plaistow Reports

- Plaistow, NH – Potable Water User Rates & Needs Assessment dated December 14, 2017 (Confidential)

Hampstead Area Water Company, Inc. Technical Documents

- Proposed Page Farm Water Tank Site – Hampstead Area Water Company dated January 9, 2018 and May 8, 2018

DEMANDS/FLOWS

The initial basis of the demand allocation to each water system/community was developed in the April 21, 2017 Southern New Hampshire Regional Water Main Extension Alternatives memo by Weston & Sampson. The initial, estimated Maximum Day Demand (MDD) and brief basis for the demand is summarized in Table 1:

TABLE 1
ORIGINAL ESTIMATED MAXIMUM DAY WATER DEMAND APPROPRIATIONS – April 21, 2017

Water System	Estimated Maximum Day Demand (MGD)
Windham – Exit 3 Area	0.3
Salem Public Water System	1.0
HAWC Water System	0.25
Plaistow	0.5
Total	**2.05**

- Windham – Exit 3 Area: Provide a maximum day demand of 0.3 MGD to supply the MTBE affected Klemm's Mobil property, as well as the existing W&E water system operated by Pennichuck Water Works (PWW) since the MTBE bureau has also identified MTBE as being present in the W&E system [below the ambient groundwater quality standard (AGQS)].

- Salem Public Water System: Provide a maximum day demand of 1.0 MGD to offset the loss of the MTBE-contaminated Turner Campbell Well.

- HAWC Water System: Provide an initial maximum day demand of 0.25 MGD to the HAWC system to allow relief for the existing water supply system. HAWC has indicated that a future maximum day demand of approximately 0.5 – 0.75 MGD may be desired, however the final demand supplied to the system will be determined later.

- Plaistow: Provide an estimated future maximum day demand of 0.5 MGD. Future demand is approximately equivalent to the Phase 2 demand presented by Normandeau Associates in Table 1 of a March 27, 2017 report titled "Potable Water Supply Feasibility Study Phase II Technical Submittal". In that report, the Max Day demand estimate 10 years after the Plaistow potable water system is established is 0.557 MGD.

As the project developed from April 2017 to January 2018, the total MDD requested to serve the four water systems described above increased to 3.13 MGD from 2.05 MGD predominantly due to additional supply requested by Salem and HAWC. In Salem, the Tuscan Village development, among others, prompted a request for additional

supply. In HAWC, there wasn't a particular development that prompted the additional supply request. Per the December 22, 2017 memo by Underwood Engineers, HAWC requested 0.5 MGD supplemental supply from the SNHRW project to meet the 10-year estimated maximum day demands in HAWC. From that same memo, HAWC also requested 1.0 MGD supplemental supply from the SNHRW project to meet the 20-year estimated maximum day demands in HAWC. The Windham demand estimate changed from 0.3 to 0.31 MGD because a transcription error was carried forward during MSDC estimating conducted in early 2018. From the March 27, 2017 Underwood report, the 10-year Max Day demand estimate for Plaistow was 0.557 MGD. However, a transcription error carried forward the value of 0.57 MGD and formed the basis of the 3.13 MGD total SNHRW Max Day demand estimate.

After review of the initial budgetary cost estimate to supply 3.13 MGD to the SNHRW project area, DES requested that the project be divided into two phases; Phase 1A (now referred to as Phase I) and Phase 1B (now referred to as Phase II), in order to reduce the initial capital cost of the project. Under Phase I, the total water supply into the regional system was limited to a total maximum daily flow of 1.0 MGD to serve the four water systems. The maximum amount of water MWW can deliver to the SNHRW project without a new water treatment plant (as of the writing of this memo) under the Merrimack Supply Development Charge (MSDC) program is approximately 1.0 MGD. Table 2 provides a breakdown of the Phase I and Phase II supply appropriations, as approved by DES.

TABLE 2
REVISED ESTIMATED MAXIMUM DAY WATER DEMAND APPROPRIATIONS – PHASE I & II

Water System	Estimated Maximum Day Demand (Phase I) (MGD)	Estimated Maximum Day Demand (Phase II) (MGD)	Estimated Maximum Day Demand (Total) (MGD)
Windham – Exit 3 Area	0.2	0.11	0.31
Salem Public Water System	0.3	1.2	1.5
HAWC Water System	0.25	0.5	0.75
Plaistow	0.25	0.32	0.57
Total	**1.0**	**2.13**	**3.13**

SNHRW Supply Limitations

The SNHRW supply conceptual design is based on supplying domestic demand only (no fire flow) to all end users defined in Table 2. The domestic demand provided will be to satisfy or supplement (depending on the user)

maximum day demands only, except for Windham where all conditions of domestic demand including peak hour, will be met with SNHRW supply.

Water storage tanks are present or are proposed as part of the SNHRW project in Salem, HAWC and Plaistow. Storage tanks, by definition, are designed to provide storage to meet peak hour demands in a water system. Since a water storage tank is not present or proposed under the SNHRW project for Windham, peak hour demands need to be satisfied via pumping capacity at the Rockingham Road Pump Station in Derry. **The estimated peak hour demand for Windham under Phase I is 417 gpm.** Upgrades to Rockingham Road Pump Station, however, should be limited to 1.0 MGD (694 gpm) capacity (for Phase 1 of the SNHRW project) because the impacts on the Derry water system were only evaluated for 1.0 MGD under Phase 1. Any additional SNHRW supply flow under Phase 1 could require additional upgrades to the Derry water system. During a peak hour event in Windham, storage tanks in Salem, HAWC and Plaistow should be able to meet domestic demand for all normal conditions of flow in those water systems while the peak hour demand in Windham is being satisfied by the Rockingham Road Pump Station. Back pressure sustaining valves or other flow control valves should be incorporated into the SNHWR designs to allow this hydraulic condition to occur. It should be noted that in addition to the SNHRW demand, the Rockingham Road Pump Station is satisfying all normal conditions of flow (including peak hour demands) and fire flow in South Derry.

Allocation of Design Flow per Each Component of Project

DES requested that each component of the project (e.g. booster pumping station, transmission main, pressure reducing valve, etc.) be listed with the design flow that the component would convey. The following tables represent the design flow conveyance through each project component for Phase I and Phase II. One element of the design basis for each component was to have "no regrets" of the component from Phase I to Phase II. Therefore, each component that is listed under Phase I of the project was sized to accommodate Phase II flows, too.

TABLE 3
CONVEYANCE OF FLOW THROUGH EACH PHASE I PROJECT COMPONENT

Water System	Phase I Component	SNHRW Design Flow Phase I	SNHRW Design Flow Phase II
Derry	Pump Station @ Derry/Londonderry town line*	1.0 MGD	3.13 MGD
	Upgrade Rockingham Road Pump Station*	1.0 MGD	3.13 MGD
	7,400 LF of 16-inch water main in Route 28 from end of existing Derry water system to Derry/Windham town line	1.0 MGD	3.13 MGD

TABLE 3 (cont.)
CONVEYANCE OF FLOW THROUGH EACH PHASE I PROJECT COMPONENT

Water System	Phase I Component	SNHRW Design Flow Phase I	SNHRW Design Flow Phase II
Derry (cont.)	Pressure Reducing Valve (PRV) and meter near Derry/Windham town line*	1.0 MGD	3.13 MGD
Pennichuck East Utility (PEU)	4,500 LF of 12-inch water main in Route 111 from Route 28 to Klemm's Mobil gas station	0.2 MGD	0.31 MGD
Salem	14,000 LF of 20-inch water main in Route 28 from Derry town line to Route 111 (in Windham)	1.0 MGD	3.13 MGD
	PRV and chemical feed station near Derry town line on Route 28 (in Windham)*	1.0 MGD	3.13 MGD
	Meter pit on Route 111 near Route 28 (in Windham)	0.2 MGD	0.31 MGD
	2,200 LF of 16-inch water main in Route 28 from Route 111 to Salem town line (in Windham)	0.8 MGD	2.82 MGD
	PRV near Salem/Windham town line*	0.8 MGD	2.82 MGD
	650 LF of 16-inch water main in Route 28 from Salem town line to the existing Salem water system	0.8 MGD	2.82 MGD
	1,100 LF of 12-inch water main in Shannon Road from end of Salem water system to Salem/Atkinson town line	0.5 MGD	1.32 MGD
HAWC	Pump Station and meter near the Salem/Atkinson town line on Westside Drive in Atkinson*	0.5 MGD	1.32 MGD
	600 LF of 12-inch water main in Westside Drive in Atkinson from proposed pump station to existing HAWC water system and 2,500 LF of 12-inch water main from proposed pump station to existing HAWC water system in Providence Hill Road near Atkinson Farm Road in Atkinson	0.5 MGD	1.32 MGD
	1.0 MG storage tank near Winslow Drive in Atkinson	0.5 MGD	1.32 MGD
	Chloramine conversion at Midpoint & Midpoint Island, Settlers Ridge Pope Road and Jameson Ridge well stations in Atkinson	0.25 MGD	
	Main Street PRV vault improvements in Atkinson*	0.25 MGD	0.57 MGD
	1,500 LF of 12-inch water main in Bryant Woods Road and East Road in Atkinson from end of HAWC water system to Atkinson/Plaistow town line	0.25 MGD	0.57 MGD
Plaistow	Pump Station and meter near Plaistow/Atkinson town line*	0.25 MGD	0.57 MGD

TABLE 3 (cont.)
CONVEYANCE OF FLOW THROUGH EACH PHASE I PROJECT COMPONENT

Water System	Phase I Component	SNHRW Design Flow Phase I	SNHRW Design Flow Phase II
Plaistow (cont.)	2,900 LF of 12-inch water main in East Road from Plaistow/Atkinson town line to existing Plaistow fire suppression system	0.25 MGD	0.57 MGD
	5,300 LF of 12-inch water main in Sweet Hill Road from existing Plaistow fire suppression system to proposed tank site	0.25 MGD	0.57 MGD
	0.4 MG storage tank on Sweet Hill tank site	0.25 MGD	0.57 MGD
	2,300 LF of 8-inch water main in Westville Road from end of existing fire suppression system near Plaistow Road northeasterly for 2,300 feet.	**	**
	1,000 LF of 8-inch water main in Wentworth Avenue from end of existing fire suppression system westerly for 1,000 feet.	**	**
	Connections to MtBE contaminated parcels	N/A	N/A
	System Flushing & Disinfection	N/A	N/A

* - Phase II improvements to include modifications/replacement of pumps, valves, etc. to accommodate the higher Phase II flows. Building footprint, pipe sizing, etc. was established in Phase I to accommodate Phase II improvements. Refer to Table 4 for listing of Phase II improvements.
** - Improvements recommended to serve MtBE contaminated areas in Plaistow.

Phase II Water Main Routing Alternatives

Table 4 provides a listing of additional project components that would be necessary to convey 3.13 MGD through the Regional project area. It should be noted that the components listed in Table 4 represent one design concept alternative. Other Phase II alternative routes include, but are not limited to, the Warner Hill Loop in Derry, a Londonderry to Windham connection and an East Derry Route to HAWC.

TABLE 4
CONVEYANCE OF FLOW THROUGH EACH PHASE II PROJECT COMPONENT

Water System	Phase II Component	SNHRW Design Flow Phase II
MWW	Upgrade Cohas Avenue Pump Station	3.13 MGD
	2,700 LF of 20-inch water main in Cohas Avenue from the pump station to Bodwell Road	3.13 MGD
Derry	Upgrade pump station at Derry/Londonderry town line	3.13 MGD
	2,000 LF of 24-inch water main in Manchester Road	3.13 MGD

TABLE 4 (cont.)
CONVEYANCE OF FLOW THROUGH EACH PHASE II PROJECT COMPONENT

Water System	Phase II Component	SNHRW Design Flow Phase II
Derry (cont.)	1,200 LF of 16-inch water main in Manchester Road	*
	4,200 LF of 12-inch water main between Manchester Road and Tsienneto Road tank	*
	1,300 LF of 12-inch water main in Rockingham Road	*
	12,300 LF of 16-inch water main in Rockingham Road	3.13 MGD
	Upgrade Rockingham Road Pump Station	3.13 MGD
	Localized water main improvements (TBD)	TBD
Salem	Localized water main improvements (TBD)	TBD
HAWC	2,700 LF of 12-inch water main in Westside Drive and Village Drive between Woodlock Park Lane and Wellington Circle in Atkinson	0.66 MGD

* - Improvement recommended to allow 3.13 MGD to be conveyed through the Derry water system

HYDRAULIC GRADE LINE

In order to convey water from the source (MWW) to the end users (Windham, Salem, HAWC and Plaistow), an assessment of the hydraulic gradeline (HGL) in each existing and proposed water system was necessary. At the interface of each system, a pump station or a PRV was identified to allow conveyance of the design flow from one system to the next. Table 5 below and Figure 1 provide a summary of the HGL for each system.

TABLE 5
SNHRW HGL's

Water System	HGL (ft)
MWW - Londonderry	480.6
Derry Main Service System	471
Derry – Rockingham Road Pump Station Service System	590 – 615*
Derry – Route 28 Reduced Pressure Area	TBD*
Salem & PWW (in Windham)	420*
Salem	346.5
HAWC Main Service System	437
HAWC – Bryant Woods Service System	260*

TABLE 5 (cont.)
SNHRW HGL's

Water System	HGL (ft)
Plaistow	280*

* - To be confirmed during final design

COSTS

Budgetary costs estimates were developed for each component of each phase of the project. The costs presented in the tables below reflect what the current budgetary costs are for Phase I and Phase II for the SNHRW project. It should be noted that refinements in the conceptual design layout have occurred since the original budgetary cost estimates were established. Where different components are being proposed a new cost estimate is presented below.

TABLE 6
CURRENT BUDGETARY COST ESTIMATE - PHASE I

Water System	Phase I Component	SNHRW Phase I Cost
Derry	Pump Station @ Derry/Londonderry town line	$1,000,000*
	Upgrade Rockingham Road Pump Station	$750,000
	7,400 LF of 16-inch water main in Route 28 from end of existing Derry water system to Derry/Windham town line	$2,405,000
	Pressure Reducing Valve (PRV) and meter near Derry/Windham town line	$850,000*
PEU	4,500 LF of 12-inch water main in Route 111 from Route 28 to Klemm's Mobil gas station (in Windham)**	$1,215,000
Salem	14,000 LF of 20-inch water main in Route 28 from Derry town line to Route 111 (in Windham)	$5,600,000
	PRV between Derry town line and Route 111 (in Windham)***	$1,000,000*
	Meter pit on Route 111 near Route 28 (in Windham)	$350,000*
	2,200 LF of 16-inch water main in Route 28 from Route 111 to Salem town line (in Windham)	$715,000
	PRV near Salem/Windham town line	$900,000*
	650 LF of 16-inch water main in Route 28 from Salem town line to the existing Salem water system	$215,000
	1,100 LF of 12-inch water main in Shannon Road from end of Salem water system to Salem/Atkinson town line	$300,000
HAWC	Pump Station and meter near the Salem/Atkinson town line on Westside Drive in Atkinson***	$1,000,000*

TABLE 6 (cont.)
CURRENT BUDGETARY COST ESTIMATE - PHASE I

Water System	Phase I Component	SNHRW Phase I Cost
HAWC (cont.)	600 LF of 12-inch water main in Westside Drive in Atkinson from proposed pump station to existing HAWC water system	$165,000
	2,500 LF of 12-inch water main from proposed pump station to existing HAWC water system in Providence Hill Road near Atkinson Farm Road in Atkinson	$675,000
	1.0 MG storage tank near Winslow Drive in Atkinson	$1,130,000
	1,500 LF of 12-inch water main in Bryant Woods Road and East Road in Atkinson from end of HAWC water system to Atkinson/Plaistow town line	$405,000
	Main Street PRV improvements	TBD
	Chloramine conversion improvements to Settler's Ridge Pope Road, Midpoint & Midpoint Island and Jameson Ridge well stations	$300,000
Plaistow	Pump Station and meter near Plaistow/Atkinson town line***	$850,000*
	2,900 LF of 12-inch water main in East Road from Plaistow/Atkinson town line to existing Plaistow fire suppression system	$785,000
	5,300 LF of 12-inch water main in Sweet Hill Road from existing Plaistow fire suppression system to proposed tank site	$1,435,000
	2,300 LF of 8-inch water main in Westville Road from end of existing fire suppression system near Plaistow Road northeasterly for 2,300 feet.	$345,000****
	1,000 LF of 8-inch water main in Wentworth Avenue from end of existing fire suppression system westerly for 1,000 feet.	$150,000****
	0.4 MG storage tank on Sweet Hill tank site	$1,100,000*
	56 connections to MtBE contaminated parcels	$560,000
	System Flushing & Disinfection	$150,000

TABLE 6 (cont.)
CURRENT BUDGETARY COST ESTIMATE - PHASE I

Water System	Phase I Component	SNHRW Phase I Cost
Phase I Subtotal		$24,201,500
Phase I Contingency (11.1%)		$2,698,500
Phase I Total		**$26,900,000**
Original Phase I Budget		$26,900,000

*Budgetary cost includes $100,000 for land acquisition/easement costs. These costs are eligible for reimbursement upon approval by NHDES.
**Project is eligible for reimbursement for cost of 12-inch pipe only. However, per the Route 111 Water Main Extension Study – Routing Memo dated July 16, 2018, 16-inch water main is recommended.
***Budgetary cost estimate includes cost for backpressure sustaining valve and chemical feed equipment. Chemical feed equipment is TBD contingent upon the results of further water quality assessment.
****Budgetary cost estimated by Weston & Sampson based upon available information provided by UEI

TABLE 7
CURRENT DESIGN COST ESTIMATE – PHASE II*

Water System	Phase II Component	SNHRW Phase II Cost
MWW	Upgrade Cohas Avenue Pump Station	$920,000
	2,700 LF of 20-inch water main in Cohas Avenue from the pump station to Bodwell Road	$1,080,000
Derry	Upgrade pump station at Derry/Londonderry town line	$250,000
	2,000 LF of 24-inch water main in Manchester Road	$900,000
	1,200 LF of 16-inch water main in Manchester Road	$390,000
	4,200 LF of 12-inch water main between Manchester Road and Tsienneto Road tank	$1,135,000
	1,300 LF of 12-inch water main in Rockingham Road	$355,000
	12,300 LF of 16-inch water main in Rockingham Road	$4,000,000
	Upgrade Rockingham Road Pump Station	$250,000
	Localized water main improvements (TBD)	$1,000,000
Salem	Localized water main improvements (TBD)	$1,000,000

TABLE 7 (cont.)
CURRENT DESIGN COST ESTIMATE – PHASE II

Water System	Phase II Component	SNHRW Phase II Cost
HAWC	2,700 LF of 12-inch water main in Westside Drive and Village Drive between Woodlock Park Lane and Wellington Circle	$730,000
Phase II Subtotal		$12,010,000
Phase II Contingency (15%)		$1,801,500
Phase II Total		**$13,811,500**

*Costs for Phase II have not been considered, voted on, or approved by the DWG Advisory Commission. Phase II costs are for planning only. DES makes no commitment to funding Phase II at this time. Phase II improvements are not eligible for MtBE settlement funds since Phase I will address the MtBE impacts. In addition, the improvements listed in Table 7 represent one design concept for conveying 3.13 MGD through the Regional project area. Other possible alternatives for Phase II have been suggested including but not limited to the Warner Hill Loop in Derry, a Londonderry to Windham connection and an East Derry Route to HAWC.

SCHEDULE

The following is a conceptual Phase I project schedule based upon the current understanding of expected project completion dates.

TABLE 8
CONCEPTUAL PROJECT SCHEDULE - PHASE I

Water System	Project Deliverable	Date
Derry	30% Design Completion	1/2019
	Final Design Completion	6/2019
	Construction Completion	6/2020
Salem/PEU	30% Design Completion	12/2018
	Final Design Completion	6/2019
	Construction Completion – Route 28 Water Main	6/2020*
	Construction Completion – PEU water main in Windham and work near Salem/Atkinson border	12/2020
HAWC	30% Design Completion	3/2019
	Final Design Completion	9/2019
	Construction Completion	9/2020
Plaistow	30% Design Completion	3/2019
	Final Design Completion	9/2019
	Construction Completion	12/2020

*Date requested by DES to have SNHRW supply available at the Windham/Salem border

It is unknown when Phase II design and construction would be scheduled. For the purpose of this memo, we assume that the conceptual project schedule for Phase II will be determined at a later date.

RECOMMENDATIONS FOR FURTHER STUDY

As part of the Phase I 30% design process, the following items should be further reviewed by the appropriate parties:

Work in Progress

- Determine ownership and location of the pump station between MWW and Derry water systems (UEI);
- Determine the optimal location of the PRV on Route 28 in Derry (UEI);
- Determine the optimal location of the PRV on Route 28 in Windham (UEI and W&S discussing);
- Identify the local improvements necessary, if any, within the Salem water system (W&S);
- Identify if any chemical feed infrastructure is needed to adjust the water quality of MWW finished water prior to it mixing with Salem finished water (W&S);
- Determine the minimum daily flows that each partner in the Joint Public Works Agreement (JPWA) will be required to use to ensure proper turnover of water in the SNHRW project area;
- Identify if any improvements are needed at the existing Main Street PRV in Atkinson.

Other Recommendations for Study (not currently under contract)

- Conduct further analysis of the Bryant Woods service area in Atkinson. Identify if the limits of the service area could be modified to better serve the highest ground elevation water users in that area of the HAWC system;
- Conduct further analysis regarding disinfection byproduct and/or corrosion control issues derived from Salem/MWW finished water mixing with the HAWC finished water;
- Identify if any chemical feed infrastructure is needed to adjust the water quality of Salem/MWW finished water prior to mixing with HAWC finished water;
- Evaluate chemical feed needs at HAWC/Plaistow border;
- Evaluate impacts of project on disinfection byproducts and recommend updated DBP monitoring sites as appropriate;
- Prepare emergency response plans (water main break, pump failure, water quality issue, natural disaster, etc.

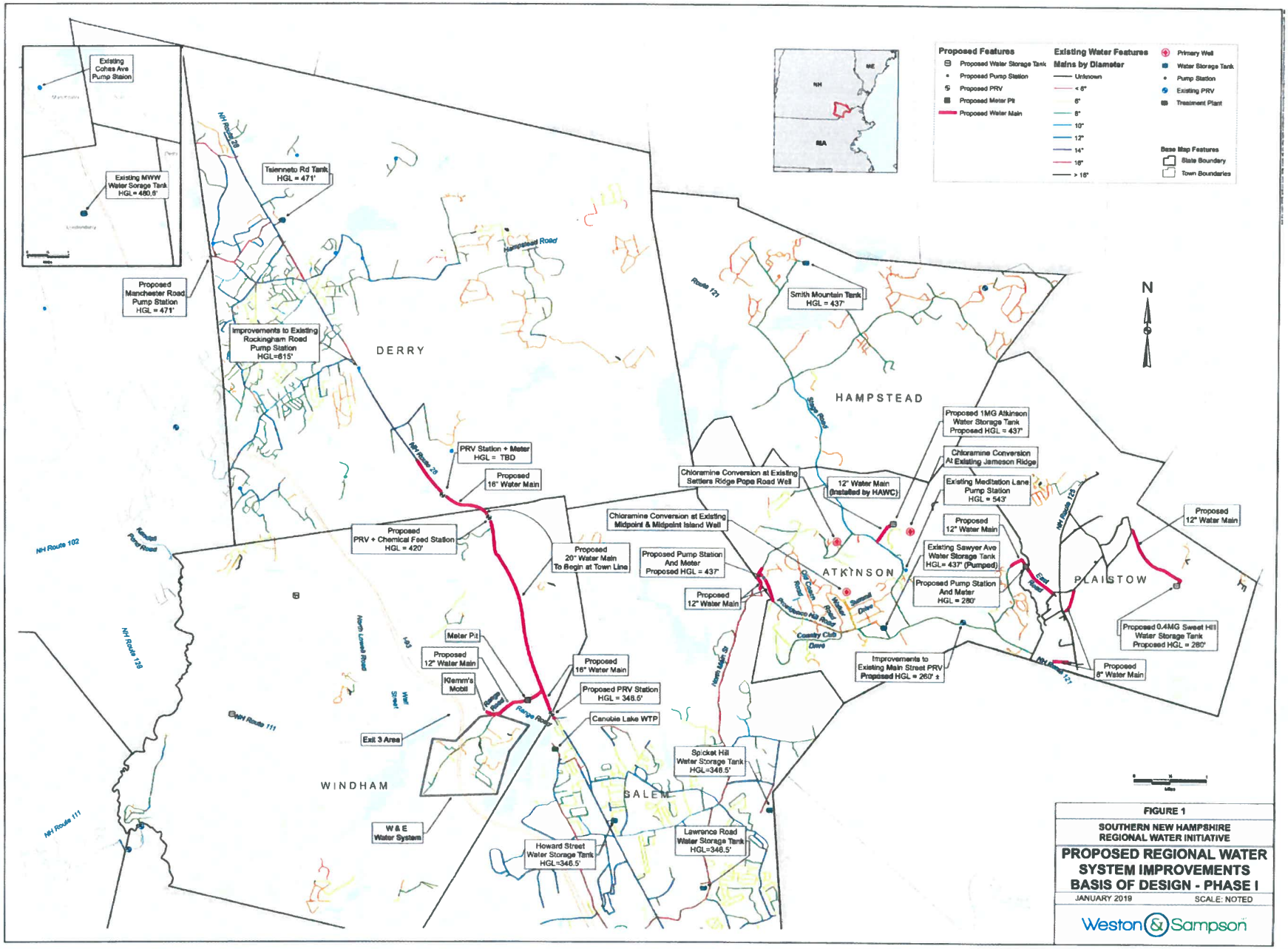


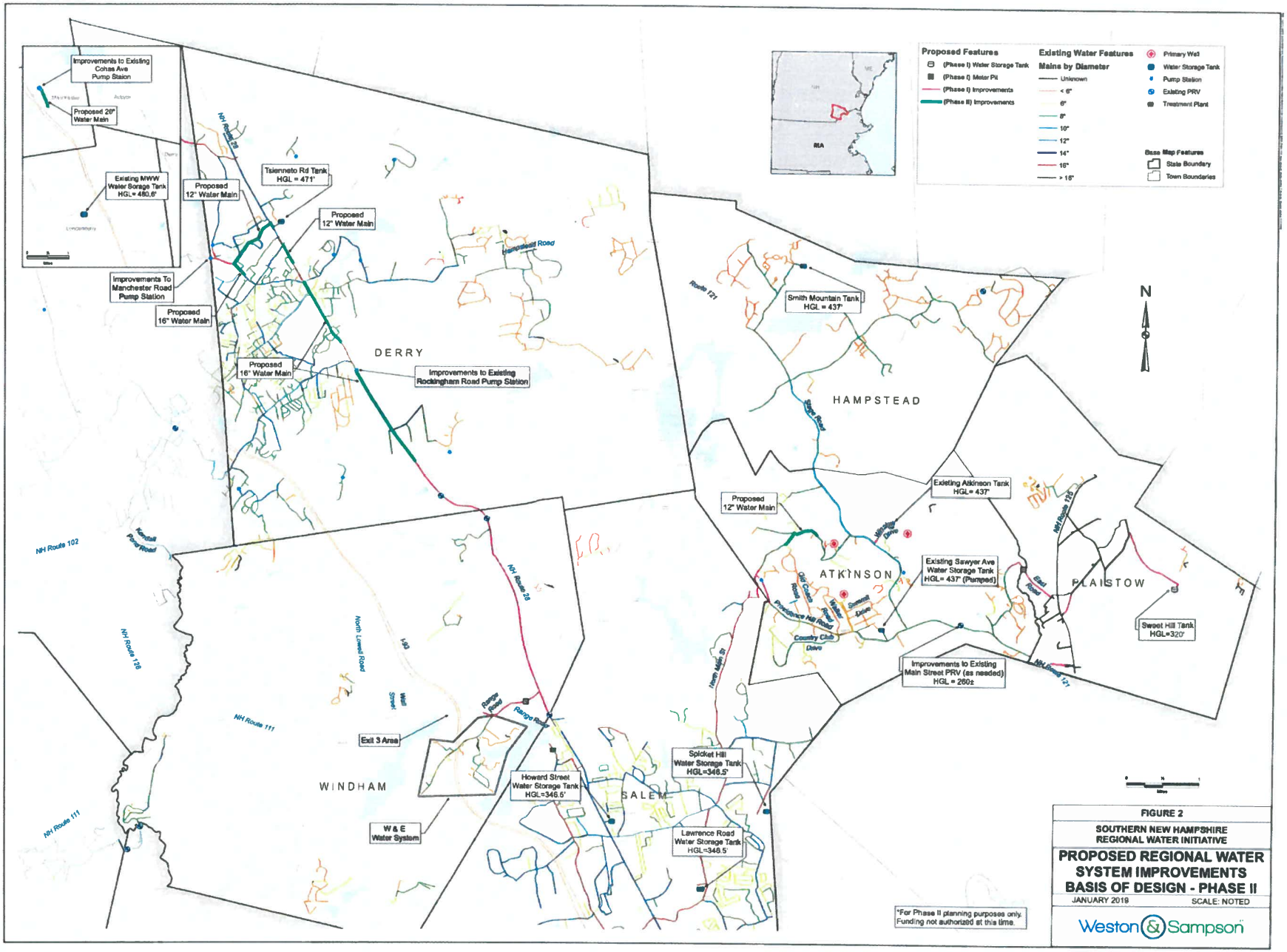
FIGURE 1

SOUTHERN NEW HAMPSHIRE REGIONAL WATER INITIATIVE

PROPOSED REGIONAL WATER SYSTEM IMPROVEMENTS BASIS OF DESIGN - PHASE I

JANUARY 2019 SCALE: NOTED

Weston & Sampson


Improvements to Existing Cohas Ave Pump Station
Proposed 20" Water Main
Existing MWW Water Storage Tank HGL= 480.6'
Improvements To Manchester Road Pump Station
Proposed 16" Water Main
Proposed 12" Water Main
Tsienneto Rd Tank HGL = 471'
Proposed 12" Water Main
Proposed 16" Water Main
Improvements to Existing Rockingham Road Pump Station
DERRY
Hampstead Road
NH Route 28
Route 121
Smith Mountain Tank HGL = 437'
HAMPSTEAD
Stage Road
Existing Atkinson Tank HGL= 437'
Proposed 12" Water Main
Jewett Drive
Old Coach Road
Providence Hill Road
Country Club Drive
Summit Drive
Existing Sawyer Ave Water Storage Tank HGL= 437' (Pumped)
ATKINSON
East Road
NH Route 125
PLAISTOW
Sweet Hill Tank HGL=320'
Improvements to Existing Main Street PRV (as needed) HGL = 260±
NH Route 121
Main St
NH Route 102
Kendall Pond Road
NH Route 128
NH Route 111
North Lowell Road
I-93
Mill Street
Range Road
Exit 3 Area
WINDHAM
Howard Street Water Storage Tank HGL=346.5'
W & E Water System
SALEM
Spicket Hill Water Storage Tank HGL=346.5'
Lawrence Road Water Storage Tank HGL=346.5'
N
Proposed Features
(Phase I) Water Storage Tank
(Phase I) Meter Pit
(Phase I) Improvements
(Phase II) Improvements
Existing Water Features
Mains by Diameter
Unknown
< 6"
6"
8"
10"
12"
14"
16"
> 16"
Primary Well
Water Storage Tank
Pump Station
Existing PRV
Treatment Plant
Base Map Features
State Boundary
Town Boundaries
*For Phase II planning purposes only. Funding not authorized at this time.
FIGURE 2
SOUTHERN NEW HAMPSHIRE REGIONAL WATER INITIATIVE
PROPOSED REGIONAL WATER SYSTEM IMPROVEMENTS BASIS OF DESIGN - PHASE II
JANUARY 2019
SCALE: NOTED
Weston & Sampson

ATTACHMENT B

Disinfection Study Report, dated January 7, 2019

Weston & Sampson

100 International Drive, Suite 152, Portsmouth, NH 03801
Tel: 603.431.3937

MEMORANDUM

TO: Erin Holmes, P.E., Mike Unger, P.E.

FROM: Jeff McClure, P.E., Jeff Provost, P.E.

DATE: January 7, 2019

SUBJECT: Hampstead Area Water Company (HAWC) – Chloramine Study - **FINAL**
DES Site #201605008, PWS #1031010 & #0112080

As part of the Southern New Hampshire Regional Water (SNHRW) project, chloraminated water from Salem will be transmitted into the HAWC chlorinated water system at the Salem/Atkinson town line to provide water supply for HAWC and the neighboring community of Plaistow. Plaistow does not have a municipal potable water system at present but will serve the demands of all their water customers with water supplied by HAWC once a potable water system is established.

Mixing of chlorinated and chloraminated water can produce several unwanted water quality issues. In the transition zone, where chlorine and chloramines mix, water quality complaints from customers can be numerous. Low chlorine residuals, bad taste and odor issues and high levels of disinfection byproducts are often times present in these areas. It should also be noted that the transition zone can migrate depending on the demand patterns in the system making it challenging to monitor all areas being impacted negatively.

Since water quality can be impacted negatively when chloraminated and chlorinated waters mix, DES requested we conduct a study to investigate different options for transmitting chloraminated SNHRW water from Salem into the chlorinated HAWC water system. In addition to Weston & Sampson, Dr. James Malley of the University of New Hampshire (UNH) was consulted on this matter and contributed to the findings in this memorandum. This memo presents a summary of our findings for the following items;

1. Chloramine/Chlorine Mixing Case Study;
2. Chloramine Conversion Assessment;
3. Water System Separation Assessment;
4. Chloramine Destruction Options;
5. Chloramine Monitoring/Sampling Program Development;
6. Lead Service Investigation.

Chloramine/Chlorine Mixing Case Study

The mixing of chloraminated water with chlorinated water is a practice that occurs on a temporary basis in some potable water systems in New England. Most notably, the Massachusetts Water Resource Authority (MWRA) in Massachusetts furnishes chloraminated water to several Massachusetts municipalities that chlorinate their primary source of drinking water but require MWRA chloraminated water to meet demand on an emergency or short-term basis.

On July 13, 2018 representatives from Weston & Sampson, NHDES and UNH attended a presentation at MWRA by Dr. Mandu Inyang and Dr. Betsy Reilly on the Impacts of Blending on Distribution System Water Quality. The following is a brief summary of key issues that the MWRA identified for a water system that blends chloraminated water with chlorinated water:

- Controlling water age in the distribution system is important. High water age is more susceptible to nitrification issues.
- Water age issues are even more critical in areas of unlined cast iron water mains.
- Eliminate any closed valves in the distribution system that are meant to be normally open. This will minimize potential water age issues.
- Maintain optimal storage tank cycling/turnover. Water age can become an issue in tanks that do not properly cycle.
- Maintaining an adequate level of secondary disinfectant whether it be free chlorine or chloramines is also a key parameter in controlling many of the concerns including nitrification, taste, odor and color issues, biofilms and increased bacterial counts as well as potential corrosion control issues from changing oxidation-reduction potential (ORP) in the system.
- Mixing chloramines with chlorine can increase free chlorine levels in the distribution system if breakpoint chlorine is reached during blending. If disinfection byproduct precursors (e.g. organic carbons) are present in the distribution system, increasing free chlorine levels could impact the formation of disinfection byproducts. Nitrogen products can also be released from the breakdown of chloramines if breakpoint chlorination occurs during blending.
- Water quality blending impacts are compounded by different corrosion control strategies and disinfection types. The corrosivity potential of the blended water may be impacted (positively or negatively) after the water is blended. Interior pipe coatings, maintained as part of a routine corrosion control practice, could also be impacted.
- Discolored water is the most frequent water customer complaint in areas where transitional changes occur in water quality. For instance, if high manganese is present in a water system, there may be precipitation of the manganese that occurs at the mixing zone. Odor and taste complaints might also be expected.
- A public information/education plan should be developed that informs the water customers of impending changes to the water system and the potential for temporary water quality impacts.

The following is a summary of monitoring strategies that the MWRA recommends and/or has observed among the chlorinated water communities they furnish chloraminated water to:

- At a minimum, ***daily*** sampling at selected total coliform rule (TCR) sites is recommended for chlorine residual (free and total), pH, turbidity, temperature and conductivity. Monitoring these parameters is important to assess any impacts that may develop on water corrosivity after the two different waters blend. Alkalinity should also be monitored especially at the mixing zones.
- Calculating corrosion indices based on current water quality data for the two water systems will be helpful to determine if water corrosivity is increased by blending the two waters.
- Heterotrophic plate counts (HPCs) sampling should be conducted if chlorine residual is undetectable. Otherwise, HPC testing should be conducted from time to time. Monitoring for HPCs provides an indication of microbial presence and growth within the distribution system. Rising HPC values may be an indication of nitrogen levels in the distribution system (due to the breakdown of chloramines) or ineffective disinfection (low chlorine residual).
- Microbial monitoring, (e.g. E.coli and total coliform) is performed by communities at TCR sites as part of their routine sampling protocol. Typical monitoring frequency is daily or weekly at these sites. If routine TCR sites are also used for monitoring water corrosivity (see above) then additional E.coli and total coliform testing within the distribution system would most likely not be necessary. If other sites (not designated for TCR monitoring) are chosen for monitoring for water corrosivity, then additional E.coli and total coliform sampling should be considered at those sites.
- Disinfection byproduct (DBP) formation is a concern if either blended water source is high in total organic carbon content. A stringent DBP monitoring program should be conducted initially to develop a baseline and level of understanding of the DBP formation potential within the distribution system.

American Water Works Association (AWWA) Distribution System Monitoring

If simple "Tier I" screening data (such as the monitoring described above) show trends of concern then further evaluation needs to occur involving chlorine to ammonia ratio, nitrite-nitrogen and nitrate-nitrogen. According to Partnership Resources (2014),

> "Chloramination and Nitrification Monitoring
>
> There is not one single parameter that can be used for chloramination and nitrification monitoring that will provide comprehensive information about the water's chemistry. Whether in the plant or in the distribution system, testing a combination of parameters is required to fully understand and control the process. Areas where chloramination and nitrification parameters are tested are recommended to include the treatment plant where monochloramine is being formed, areas in the distribution system that may be at higher risk for nitrification, and any area in the system where disinfectant residual may be boosted. A

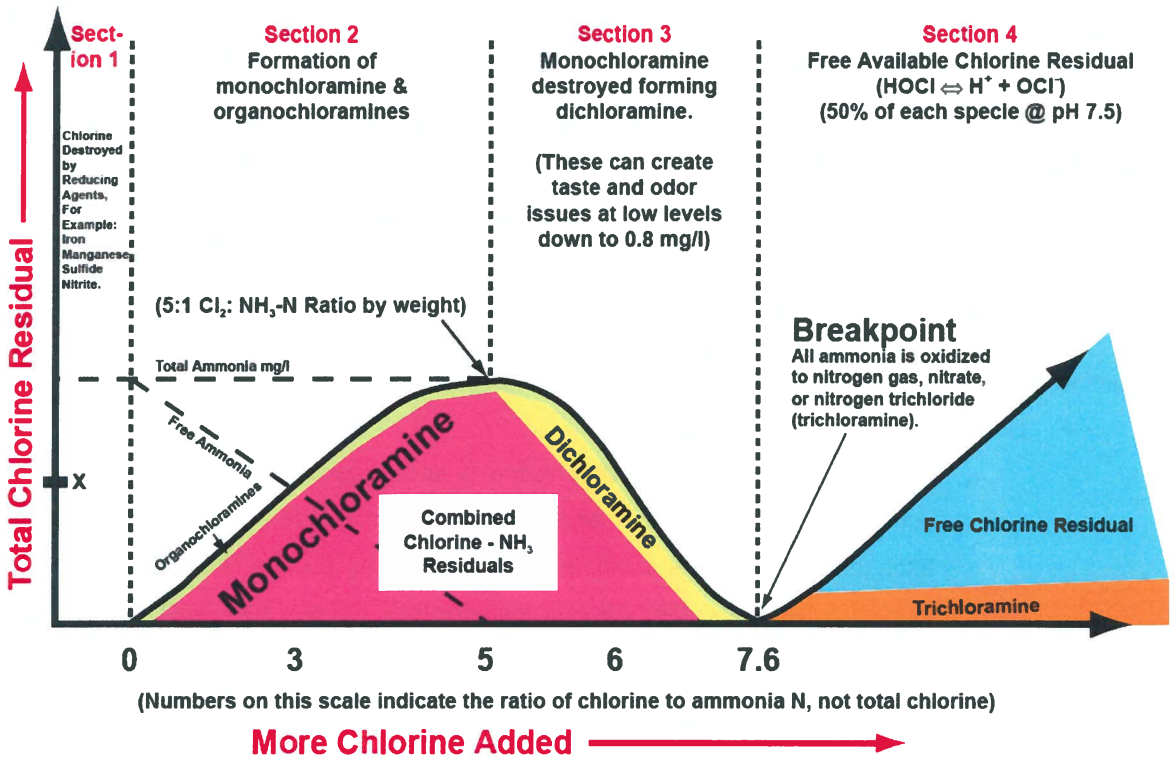
distribution system hydraulic model may assist in identifying and locating these sampling sites. Examples of key sampling sites for nitrification monitoring include:

- Water treatment plant (point of monochloramine formation for process control)
- Distribution system storage tanks
- Pressure zone boundaries
- Areas with the potential for high water age and/or low usage
- Dead ends

Parameters recommended for monitoring chloramine formation and nitrification include the following:

- Chlorine residual
  - Monitoring for free and total chlorine is recommended in many cases. However operators should be aware that accurately measuring free chlorine in the presence of total chlorine using the colorimetric DPD chemistry can be challenging. Even when running a test using free chlorine reagent, total chlorine can react to oxidize DPD, potentially resulting in a false positive result. Consult the reagent manufacturer for more information about performing tests in this application.
- Monochloramine
- Free ammonia
- Total ammonia
- Nitrite
- pH
- HPC

A single monochloramine or total chlorine measurement does not provide sufficient information about water chemistry to identify where the water is relative to the chloramination curve (see figure below). Without additional information, the same total chlorine results could indicate incomplete monochloramine formation, dichloramine and trichloramine formation, or even breakpoint chlorination. The combination of multiple parameters listed above, for example monochloramine, total chlorine, and free/total ammonia, allows utilities to better understand where they reside on the chloramination curve, their level of nitrification risk, and steps that must be taken to maintain process or system control. Field, bench, and continuously monitoring instrumentation is available for the analysis of these parameters, and utilities are encouraged to select the analysis platform that best fits their needs.



There are many steps that can be taken to prevent and control nitrification. For example, nitrification prevention can begin at the water treatment plant by maintaining a chlorine to ammonia ratio that is optimal for monochloramine formation. Steps can be taken to reduce water age in the distribution system, such as adding loops to the system. Tank stratification can be prevented by the addition of mixing. Once established, nitrification may require steps such as flushing to restore water quality.

In any case, utilities that chloraminate should consider developing action plans and procedures to address the potential for nitrification and take steps to proactively address any issues to occur. Many systems develop tiered action plans, in which different actions are to be taken depending on the relative concentrations of different parameters in the system. As with any procedure, staff should be trained in its implementation to help ensure that is carried out correctly.

Good understanding of nitrification, its causes, and its impact on distribution system water quality and operations give utilities the tools they need to work towards achieving optimization.

References

This article presents a brief overview of chloramination and nitrification. Many comprehensive resources exist to provide more detailed information about these topics including:

Water Chlorination Principles and Practices – AWWA Manual M20

Nitrification Prevention and Control in Drinking Water – AWWA Manual M56" (Chloramination and Nitrification Monitoring section).

Chloraminated and Chlorinated Water System Case Studies

Weston & Sampson has not identified a community in New England that practices the blending of free chlorine and chloramines on a sustained basis. The following is a listing of a few communities that blend MWRA water with their own water on an emergency or temporary basis. Each community listed below maintains their own sources of supply and their own disinfection and corrosion control practices, as applicable. It should be noted that each community has their own monitoring protocols which are highly dependent on the capabilities of the individual community. While some communities monitor several parameters on a frequent basis other communities may only monitor a couple of parameters:

- *Burlington, MA* – Burlington is a chloraminated system which receives chloraminated MWRA water on an emergency basis. While receiving MWRA water, Burlington performed weekly sampling at TCR sites for the following parameters: chlorine residual (free and total), pH, turbidity, temperature, color, fluoride, iron, manganese and nitrate/nitrite.
- *Lynn, MA* – MWRA conducted a bench top study of Lynn's water system to study the impacts of corrosion control when blending MWRA water with Lynn water sources. Lynn chlorinated their surface water supply (with a target of 0.8 – 1.4 mg/L of free chlorine residual leaving their water treatment plant (WTP)) at the time of the MWRA study. MWRA chloraminates their surface water supply with a target of 2.5 – 3.0 mg/L total chlorine residual leaving their WTP. Lynn uses zinc orthophosphate for their corrosion control with a target of 0.5 -0.6 mg/L of phosphate residual. The target pH in the Lynn distribution system is 7.2. MWRA uses soda ash for their corrosion control practices and targets a pH of 9.5 in the distribution system. The purpose of the MWRA study was to understand water quality impacts from blending MWRA water with local water sources in emergency-supplied communities and to determine corrosion control impacts or potential pipe scale modification in the distribution system.

  The MWRA study looked at four source water blending ratios; 100% Lynn/0% MWRA, 75% Lynn/25% MWRA, 50% Lynn/50% MWRA, 0% Lynn/100% MWRA. Water quality parameters such as pH, alkalinity, sulfate, free and total chlorine and phosphate were measured. In addition, the following four corrosion indices of the blended water samples were assessed; chloride to sulfate mass ratio (CSMR), Larson Ratio (LR), Langelier Saturation Index (LSI), Rzynar Saturation Index (RSI). For each corrosion index, the blended water became less corrosive when more MWRA water was introduced. For this study, MWRA water tended to precipitate calcium carbonate which made the Lynn water less corrosive. However, a reduction in zinc and phosphate levels from zinc phosphate used for corrosion control was observed with increasing MWRA water blend which may be impactful to distribution pipe coating in the Lynn distribution system.
- *Peabody, MA* – Peabody chloraminates their surface water supplies. A fire at the Coolidge Avenue Water Treatment Plant in Peabody shut down the WTP. As a result, Peabody increased the MWRA supply in the area of the distribution system served by the Coolidge Avenue plant from 25% MWRA/75% Coolidge water to 100% MWRA water. Desktop modeling predicted that the increase to 100% MWRA water could modify the potential mineral deposits in this portion of the Peabody distribution system. As a result, additional

sampling was performed in the distribution system to identify if the increase in mineral deposits would occur. Several parameters (e.g. Aluminum, Calcium, Chloride, Nitrate, Potassium, Sulfate and Zinc) were found to be significantly elevated at one sampling site. Upon investigation, a buried, closed gate valve was found causing stagnation conditions in the pipe. Upon opening the gate valve, all water quality parameters at the sampling site returned to levels comparable to the levels measured at all other sampling sites in the distribution system. Water age should therefore be closely monitored (and minimized where possible) in all areas of a distribution system to avoid the potential for elevated levels of water quality parameters.

HAWC Options for Receiving SNHRW Water

Water from the SNHRW project will be transmitted through the Salem water distribution system and pumped into Atkinson near the Salem/Atkinson town line near the intersection of Providence Hill Road and Shannon Road in Salem. The exact location of the pump station is still being determined as of the writing of this memo. Water from the chloraminated Salem water system will be a blend of water that is supplied by chloraminated water from Manchester Water Works (MWW) and the town of Salem at the entry point into Atkinson. An estimate of the water quality of the mixture including pH, total organic carbon (TOC), alkalinity and hardness and the potential for disinfection byproduct (DBP) formation was not established under the scope of this study. However, estimating these parameters is recommended.

HAWC currently operates 20 well systems in Hampstead and Atkinson. Each groundwater source is currently chlorinated. As part of the SNHRW project, water will be supplied to HAWC to supplement the existing water sources in HAWC. Additionally, water will be transmitted through HAWC to supply water for the town of Plaistow.

The SNHRW project has been divided into two phases; Phase I is being designed as of the writing of this memo and is anticipated to be online by the end of 2020. Phase II is a future phase of the project that is preliminarily scheduled for 10 to 15 years in the future (however, the actual schedule for Phase II will depend on individual water systems' needs and participation). The following is a breakdown of the SNHRW supply that is scheduled for each water system per phase:

Table 1 – SNHRW Supply for HAWC and Plaistow

Phase	Water System	Supply (MGD)
Phase I	HAWC	0.25
Phase II	HAWC	0.5
HAWC Total		*0.75*
Phase I	Plaistow	0.25
Phase II	Plaistow	0.32
Plaistow Total		*0.57*

Since the SNHRW water is chloraminated and the HAWC water is currently chlorinated, DES requested we review the options for supplying chloraminated water to HAWC. The following sections present our findings for;

1. Converting existing HAWC disinfection systems from chlorine to chloramine;
2. Separating the HAWC water system to create chlorinated and chloraminated zones in the water system;
3. Destroying chloramines from the Salem source water prior to entry into the HAWC water system.

HAWC WATER MODEL DEVELOPMENT

Prior to assessing the HAWC water distribution system, we rebuilt the HAWC water model based upon existing GIS data that HAWC provided to us at the beginning of this project. Pipe location, pipe diameters and available pipe material were imported from the GIS data and incorporated into the model. We utilized individual water customer account billing records provided by HAWC to reassign water demand throughout the HAWC system. This was accomplished by geocoding the billing data linking information to the town parcel data. This allowed us to assign actual water demand to the nearest nodes throughout the water model thereby establishing a far more accurate depiction of water demands.

Elevations of model nodes, pump stations, storage tanks, pressure reducing valves and water supplies were assigned using light detection and ranging (LiDAR) data and existing information. Hydraulic information pertaining to each well in Hampstead and Atkinson, the Smith Road Tank in Hampstead and the Sawyer Avenue Tank in Atkinson were also provided to us by HAWC and incorporated into the model.

As part of model development, a roughness coefficient of the inside of the water mains, known as a C value, needs to be assigned to each pipe segment. C-values assigned to existing HAWC water system pipes were obtained from a previous hydraulic model of the HAWC water system and checked for general compliance. However, hydrant flow or other field tests were not performed under the scope of this study to confirm the accuracy of the C-values. Any new pipes added to the model were assigned initial C-values based on available pipe information (pipe diameter and pipe material type).

Once the model was complete, we were able to assess the HAWC water system with more precision. We identified four pressure zones (the Main service system, the Bartlett Brook and Woodland Pond system, the Jameson Ridge system and the Bryant Woods system). This allowed us to better assess which HAWC water supplies could be removed from service to allow for a more manageable source system and it allowed us to identify which existing wells would need to be converted to a chloramine disinfection system.

HAWC System-Wide Chloramine Conversion Assessment Option

This option involves converting existing chlorine feed systems at select HAWC well sites to chloramine feed systems. Ammonia storage and new chemical feed pumps would be necessary to produce chloramine at each site. This option also includes the addition of new analyzers in the well stations to monitor for free ammonia, monochloramine and total ammonia. Under SNHRW Phase I supply for HAWC (250,000 gpd Max.) and present day HAWC Max Day demands (1.0 MGD), the following 13 well stations would need to be converted to chloramine. The well yields listed in Table 2 are the current yields. Should the yields change over time, the stations that would

need to be converted to chloramine could change. Refer to Figure 1 for the location of each well site:

Table 2 –HAWC Well Station Designations – Phase I

Well Station Name	Location of Well	Current Yield (gpm)	Station Designation
SNHRW Supply	N/A	173	N/A
Kent Farm System	Hampstead	110	Primary Chloramine
Settlers Ridge Pope Road	Atkinson	85	Primary Chloramine
Village Green System	Hampstead	65	Primary Chloramine
Midpoint & Midpoint Island	Atkinson	65	Primary Chloramine
Bryant Woods System	Atkinson	45	Primary Chloramine
Cranberry Meadows	Hampstead	40	Primary Chloramine
Angle Pond	Hampstead	40	Primary Chloramine
Jameson Ridge	Atkinson	25	Primary Chloramine
Tanglewood System	Hampstead	18	Primary Chloramine
Total Primary Chloramine Phase I Supply		666 gpm (959,000 gpd)	
Total Primary Chloramine Phase I Demand		652 gpm (939,000 gpd)	
Granite Village	Hampstead	35	Redundant Chloramine
Eastwood Place	Hampstead	35	Redundant Chloramine
Putnam Place System	Hampstead	25	Redundant Chloramine
Jesse Page System	Atkinson	25	Redundant Chloramine
*Total Redundant Phase I Supply**		120 gpm (172,800 gpd)	
Bartlett Brook	Hampstead	40	Chlorine-Only
Woodland Pond #5	Hampstead	18	Chlorine-Only
Woodland Pond #6	Hampstead	18	Chlorine-Only
Total Chlorine-Only Phase I Supply		76 gpm (110,000 gpd)	
Total Chlorine-Only Phase I Demand		42 gpm (60,500 gpd)	
Total Phase I Supply		**742 gpm (1.07 MGD)**	
Total Phase I Demand		**694 gpm (1.00 MGD)**	

*Redundant Supply not included within total phase I supply amount

Please note, under normal operation, the nine wells listed as 'Primary Chloramine' in Table 2 would supplement the SNHRW supply to meet maximum day demands in the proposed chloraminated section of HAWC. The four wells listed as 'Redundant Chloramine' in Table 2 would provide redundancy with the largest well (Kent Farm) out of service. Alternately, if Salem's water system could provide additional chloraminated supply on a temporary basis, HAWC could explore providing redundancy for the Kent Farm System with Salem water temporarily. However, for this study, we assessed what the requirements would be for HAWC to supplement Kent Farm using

their own sources. We should also note, if additional water supply is developed in HAWC then the number and/or location of the wells that need to provide primary or redundant chloraminated supply in HAWC will change.

It should be also noted that Woodland Pond site #5 and #6, as well as the Bartlett Brook System in Hampstead would remain as separate chlorinated systems under the scenario described above. On Figure 1, these systems are listed as "Cl_2-only well sites". If these systems require conversion to chloramine these three service systems would need to be converted.

Under SNHRW Phase II supply conditions (750,000 gpd Max.), and 2030 estimated maximum day demands for HAWC (approximately 1.3 MGD) the number of well stations that would need to operate as chloraminated stations would decrease from 13 to nine (with six stations as Primary and three stations as Redundant). Woodland Pond #5, Woodland Pond #6 and Bartlett Brook, would remain as chlorine-only stations under Phase II conditions. Refer to Table 3 and Figure 2.

Table 3 –HAWC Well Station Designations – Phase II

Well Station Name	Location of Well	Current Yield (gpm)	Station Designation
SNHRW Supply	N/A	520	N/A
Kent Farm System	Hampstead	110	Primary Chloramine
Settlers Ridge Pope Road	Atkinson	85	Primary Chloramine
Village Green System	Hampstead	65	Primary Chloramine
Midpoint & Midpoint Island	Atkinson	65	Primary Chloramine
Bryant Woods System	Atkinson	45	Primary Chloramine
Cranberry Meadows	Hampstead	40	Primary Chloramine
Total Primary Chloramine Phase II Supply		930 gpm (1.34 MGD)	
Total Primary Chloramine Phase II Demand		897 gpm (1.29 MGD)	
Angle Pond	Hampstead	40	Redundant Chloramine
Granite Village	Hampstead	35	Redundant Chloramine
Eastwood Place	Hampstead	35	Redundant Chloramine
*Total Redundant Phase II Supply**		115 gpm (165,600 gpd)	
Bartlett Brook	Hampstead	40	Chlorine-Only
Woodland Pond #5	Hampstead	18	Chlorine-Only
Woodland Pond #6	Hampstead	18	Chlorine-Only
Total Chlorine-Only Phase II Supply		76 gpm (110,000 gpd)	
Total Chlorine-Only Phase II Demand		57 gpm (82,000 gpd)	
Total Phase II Supply		**1,006 gpm (1.45 MGD)**	
Total Phase II Demand		**955 gpm (1.30 MGD)**	

*Redundant Supply not included within total phase II supply amount

HAWC Water System Separation Assessment

For this option, the HAWC water system would be separated to prevent the mixing of chloraminated and chlorinated water under normal conditions of operation. Conversion of some existing well stations from chlorine to chloramine feed would be included in this option. Under Phase I, the boundary line between chlorine and chloramine would be as shown on Figure 3. ***The location of system separation as shown on Figure 3 would allow for the proposed 1.0 MG storage tank near Winslow Drive in Atkinson to serve the chloraminated section of HAWC and the future Plaistow potable water system.***

The boundary line would be located north of the intersection of Woodlock Park Lane and Main Street in Atkinson. The two largest wells in Atkinson, Settlers Ridge Pope Road and Midpoint & Midpoint Island, as well as Jameson Ridge would be converted to a chloramine feed system and include the necessary ammonia and chlorine feed, storage and monitoring equipment. All other Atkinson wells would be removed from service. The chlorinated section of the HAWC system would be supplied by the remaining wells in Hampstead as shown on Figure 3. The following table provides a summary of the supply and demand scenario for the chloraminated and chlorinated sections of a separated HAWC system:

Table 4 – Separated HAWC System Supply and Demand Values – Phase I

HAWC System Section	Supply Source	Supply Amount (gpm)	Max Day Demand (gpm)
Chloraminated	Settlers Ridge Pope Road	85	N/A
	Midpoint & Midpoint Island	65	N/A
	Jameson Ridge	25	N/A
	SNHRW	173	N/A
	Total Chloraminated Phase I Supply/Demand	348	329
Chlorinated	*Total Chlorinated Phase I Supply/Demand*	444	365
	Total Phase I Supply/Demand	**792 gpm**	**694 gpm**

The demand values listed in Table 4 were determined after the water billing information, provided by HAWC, was used to reassign demand in the hydraulic model. It should be noted that to account for the largest well out of service in the chloraminated section, Settlers Ridge Pope Road, supplemental supply could be provided from Salem's water system. Bryant Woods, Jesse Page and Cogswell Farm wells could also be converted to chloramines and maintained as redundant supply facilities.

For the chlorinated section of HAWC, if the largest well (Kent Farm in Hampstead) were out of service then chloraminated water from Salem, via Atkinson, could temporarily be used to meet demands in Hampstead. Chloraminated water would mix with chlorinated water on a temporary basis. A monitoring program would need to be established and executed if and when chloraminated water is introduced into the chlorinated water portion

of the HAWC system.

Under SNHRW Phase II, the three well stations described above (Settlers Ridge Pope Road, Midpoint & Midpoint Island and Jameson Ridge) could be removed from service since the additional supply from SNHRW (520 gpm Max.) would meet all of Atkinson's demand. The three well stations could also remain in service to provide an additional source of supply as desired. Refer to Table 5 and Figure 3.

Table 5 – Separated HAWC System Supply and Demand Values – Phase II

HAWC System Section	Supply Amount (gpm)	Max Day Demand (gpm)
Chloraminated	520	518
Chlorinated	444	437
Total Phase II Supply/Demand	*964 gpm*	*955 gpm*

Under SNHRW Phase II, the boundary line between the chloraminated system and the chlorinated system would be near the intersection of Stage Road and W Street in Hampstead. HAWC officials could also choose to locate the boundary line between chloramine and chlorine at a point in Atkinson that would allow some existing supply in Atkinson, such as the Settlers Ridge Pope Road Wells, to remain active and available to supply chlorinated water to Hampstead (the proposed chloramine system for Settlers Ridge Pope Road would be decommissioned in this scenario). This could be accomplished with the construction of nominal water main to link Settlers Ridge with the 10-inch pipe in Main Street.

Chloramine Conversion Requirements

To convert the HAWC well stations listed in Table 2, 3 and 4 from feeding chlorine for disinfection to feeding chloramine for disinfection, several upgrades will need to occur at each station. The following section outlines some of the upgrades that would be required. Please note, under the scope of this study, we did not visit each station to assess if upgrades would be necessary to support the storage and operation of additional chemical feed systems. ***Additional investigation should occur to assess if building improvements are necessary to support chloramine feed upgrades.***

Existing Chlorine Equipment

Upon speaking with the operator of the HAWC water system, we were informed that the following chemical feed pumps are utilized in the HAWC system:

- Chemtec Pulsafeeder XP (rated for 4 – 80 gpd) & XPV (rated for 8 – 100 gpd) Series, which operate at either a fixed pumping rate due to production ability or are flow paced. The type of tube used in each pump is the 2H or the 8GPD tube, installed throughout the HAWC system except for Putnam Place and Woodland 5 & 6 well systems. No information was provided as to the chemical feed pumps located at those well stations. Please note, for a peristaltic pump, the flow rate is determined by both the size of

the tubing and the pump speed. Larger tubing produces faster flow rates. Depending on the required feed rate for creating chloramines, the existing tubing (8 gpd) for each peristaltic pump may need to be replaced.

- For chemical storage, HAWC currently uses liquid chlorine stored in 35- to 55-gallon drums at each well site. The target chlorine residual leaving each well station is 0.2 to 0.5 mg/L, currently.

To convert each well station from chlorine disinfection to chloramine disinfection, the addition of ammonia storage and chemical feed pumps for feeding ammonia is necessary at each station described above. For small systems, ammonia sulfate is often recommended as it is much safer and easier to handle than other ammonia options. Typically, a ratio of 4 parts chlorine to 1-part nitrogen is recommended as a starting ratio to form chloramines. In practice, the ideal ratio for each site could be anywhere from 3:1 up to 5:1. Table 6 provides an example of the chlorine (as sodium hypochlorite) and nitrogen (as ammonia sulfate) requirements for the Kent Farm well site assuming a ratio of 4 parts chlorine to 1-part nitrogen for monochloramine production.

Table 6 – Kent Farm Well Station Chloramine Chemical Needs

Flow	Sodium Hypochlorite Dose	Sodium Hypochlorite Feed	Sodium Hypochlorite 30-day storage	Ammonia Sulfate Dose	Ammonia Sulfate Feed	Ammonia Sulfate 30-day storage
110 gpm (0.158 MGD)	2.0 mg/L	2.1 gpd*	64 gallons*	3.55 mg/L	1.2 gpd*	35 gallons*

*Calculation is based on well operating 24-hours/day. 30-day volumes will be less depending on actual operating conditions at the well.

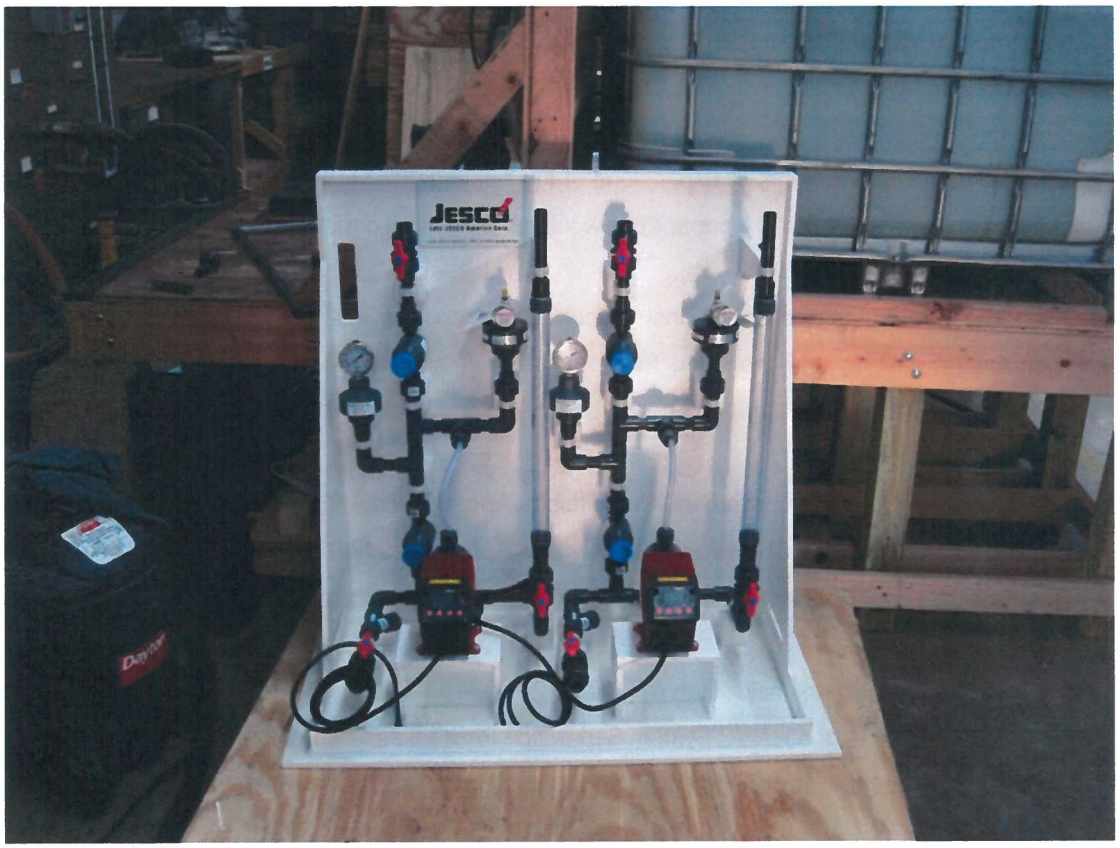
The above table is indicative of the chemical requirements needed to create chloramines at each well site (Kent Farm specifically in the above example). Several well sites in the HAWC system operate Greensand Plus filters for iron and manganese treatment. At these sites, chlorine is also used for oxidation. In general, approximately 1 mg/L of chlorine is needed for oxidation purposes. Therefore, for each well site where Greensand Plus filtration and chloramine disinfection would be present the chemical feed pumps and chemical storage requirements need to be sized and able to feed chlorine pre- and post-filter as necessary to achieve oxidation and disinfection requirements. The existing chlorine feed pumps appear to be sized appropriately to meet the additional chlorine feed demands. However, separate chlorine pumps for pre- and post-filter may be necessary. Each well site should be assessed to determine the requirements necessary to house additional chemical feed equipment as applicable.

As demonstrated in Table 6, ammonia storage requirements will be minimal at each well facility. Available space still needs to be assessed at each well site. Ammonia chemical feed pumps will also need to be added at each well site that will produce chloramines. We contacted equipment vendors to obtain information on a typical

chemical feed pump assembly for feeding ammonia to produce chloramines at small system locations. One such chloramine package system is the Lutz Jesco system. The following provides a summary of the system:

- 2-pump package system (includes fully assembled chemical piping, valves, etc) for sodium hypochlorite and ammonia pumping.
- Estimated material cost only - $5,000-7,000 per two-pump system.

The following is an example assembly of the Lutz Jesco system.



Although the existing chlorine feed pumps at the well sites may be sized appropriately to provide the necessary pumping capacity to feed chlorine for chloramine production, the above 2-pump package system could operate as two ammonia feed pumps (with one pump on standby).

In addition to total chlorine analyzers, continuous ammonia monitoring is recommended at each well station that produces chloramines. This is critical to determine if the appropriate chlorine to nitrogen ratio is being maintained. The following are two ammonia monitoring devices with associated material costs that would provide monitoring, depending on the level of ammonia monitoring desired:

- Ammonia monitor - Gas Sensing – Q46N ammonia monitor
    - Total ammonia only - $6,100
    - Free ammonia, monochloramine, total ammonia - $7,600

The prices listed above are the material costs only to purchase the equipment from the vendors. The following is the budgetary capital total project cost estimate (including engineering design, bidding assistance, construction oversight and construction of the project) for the two chloramine conversion options described in the previous sections of this memo:

- **To upgrade 13 well stations (HAWC System-Wide Chloramine Conversion – Approximately $1.3 million**
- **To upgrade three well stations (HAWC System Separation) – Approximately $300,000**

Any necessary building improvements or expansions of the existing well stations would be an additional capital cost. Also, any improvements to SCADA capabilities would be additional capital cost.

In addition to the capital costs, the operational difficulties and costs of managing up to 13 small chloramine systems given limited staffing and the need for daily attention and monitoring should be considered when assessing the above options. The estimated operation & maintenance costs for each option are as follows:

- **O&M for HAWC System-Wide Chloramine Conversion - Approximately $35,000 (in 2018 dollars) for Phase I**
- **O&M for HAWC System-Wide Chloramine Conversion - Approximately $26,500 (in 2018 dollars) for Phase II**
- **O&M for HAWC System Separation – Approximately $9,500 (2018 dollars) for Phase I**

Note, the above O&M costs do not include an allowance for additional labor that may be required to operate the chloramine systems. **Also note, the HAWC System Separation Phase II assumes all water is provided by SNHRW. If HAWC maintains the three well stations under Phase II conditions, the O&M estimate is approximately $9,500.**

Chloramine Destruction Options

Chloramine destruction at the Salem/Atkinson town line is one option identified. In this option, chloramine would be reduced prior to entry into Atkinson. Free chlorine would then be added to restore a desired residual concentration. Two options were explored to destruct chloramine; ultraviolet (UV) light and carbon filtration. The following sections provide a brief summary of each option.

UV Treatment

Chloramine destruction through use of medium pressure UV lamps has been proven effective for destruction of chloramines in aquatic environments such as swimming pools and for aquatic life. Optimal chlorine dissociation with UV light occurs between 180-200nm, while chloramine dissociation occurs between 245-365nm. This makes medium

pressure UV more desirable as it can achieve these ranges more effectively than typical low-pressure lamps, which are limited to only 254nm. Monochloramine, which is formed in water having a pH greater than 7, is the typical chlorine compound used for disinfection and is dissociated most effectively at 245nm.

We contacted UV vendors and identified the following material costs for treating the Phase I and II flows that would be transmitted into HAWC (equivalent to 500,000 gpd Max. Phase I design flow and 1.32 MGD Max. Phase II design flow). Please note, the cost differences presented below present a range of costs based on the UV transmittance (UVT) of the finished water at the Salem/Atkinson town line and the design flow.

- Evoqua ETS has provided material cost estimates only for two separate in-line reactor treatment options for chloramine destruction:
    1. Reactor 1 – $94,000 material cost for (2) 10-inch medium pressure UV reactors (housing 4 lamps each). One reactor provides redundancy. Each active reactor destroys approximately 1 log (90%) of chloramine. For preliminary sizing, an assumed chloramine concentration of no greater than 2 ppm, a UVT of 90% and a flow of 500,000 gpd Max. was assumed.
    2. Reactor 2 – $160,000 material cost for (2) 16-inch medium pressure UV reactors (housing 6 lamps each). One reactor provides redundancy. Each active reactor destroys approximately 1 log (90%) of chloramine. For the sake of preliminary sizing, an assumed chloramine concentration of no greater than 2 ppm, a UVT of 85% and a flow of 500,000 MGD Max. was assumed at the Salem/Atkinson town line. If a UVT of 90% or greater is available, 16-inch diameter reactors could serve a flow rate of 1.32 MGD Max. (Phase II flow).

Under Phase I conditions, assuming a UVT of 90% or greater, Reactor 1 as described above would be installed for an estimated total project cost of approximately $900,000 (engineering and construction). This estimate includes the cost to furnish and install the UV units, expand the proposed pump station at the Salem/Atkinson town line to provide necessary space for the UV reactors, control panel, additional piping and valving, etc. The estimated cost also includes engineering and construction costs for the necessary chemical feed equipment and storage for adding free chlorine at the station after chloramines are destroyed. Note, the station expansion, piping, valving, electrical, etc. would be sized with a "no-regrets" design principal so the station could be upgraded under Phase II with minimal improvements required.

Under Phase II conditions, assuming a UVT of 90% or greater, Reactor 2 as described above would be installed for an estimated total project cost of approximately $500,000 (engineering and construction). This estimate includes the cost to furnish and install the larger UV reactors and to perform chemical feed upgrades required to treat the increased flow conditions.

In addition to the capital costs, **the yearly operation & maintenance costs for UV are estimated to be approximately $35,000 for Phase I, and $60,000 for Phase II (in 2018 dollars).** These costs are inclusive of the electricity required to power the UV lamps, chemical costs for adding a chlorine residual, and annual UV bulb replacement. The O&M costs

do not include an allowance for any additional labor necessary to operate the UV system.

Carbon Treatment

Activated carbon (referred to as catalytic carbon), is a possible alternative for chloramine destruction. Different than typical granular activated carbon (GAC), surface enhanced activated carbons have been developed to more efficiently remove chloramine from water. The catalytic activity of carbon is typically measured by the rate at which carbon decomposes hydrogen peroxide. The peroxide number is represented in time (minutes), that is required to decompose a fixed amount of peroxide.

Carbon media manufacturers have conducted a comparative analysis of traditional GAC versus surface enhanced activated carbon to evaluate how effectively each filter media can remove chloramines from water. During a quick bench-scale test, 0.2 grams of various GAC products were added to 400mL of water containing chloramines to determine their removal effectiveness. The traditional GAC required a minimum empty bed contact time (EBCT) of 10 minutes to achieve approximately 40% removal. The surface enhanced activated carbon was able to remove 40% of the chloramine concentration in only 1 minute, and achieved approximately 90% removal after 10 minutes.

We contacted GAC media vendors and received the following material costs for treating the Phase I flows that would be transmitted into HAWC (equivalent to 500,000 gpd Max. design flow).

- EVOQUA model HP810SYS (ASME certified) carbon filter system - $229,000 (includes two (2) 8-foot diameter filter vessels, delivery, initial fill of 20,000 lbs recommended carbon media)

Under Phase I conditions, utilizing the enhanced carbon filtration system, the estimated total project cost would be approximately $4.25 million (engineering and construction). This includes the cost for land, for a building to house the filters, process piping, electrical, SCADA, mechanical, bathroom and laboratory facilities required to operate the activated carbon treatment system to remove chloramine. The estimated cost includes engineering and construction costs for the necessary chemical feed equipment and storage for adding free chlorine after chloramines are destroyed. This cost also includes funds for land acquisition to construct the treatment building. Note, the treatment building, piping, valving, electrical, etc. would be sized with a "no-regrets" design principal so the treatment system could be expanded under Phase II without expanding the size of the building.

Under Phase II, two (2) additional 8-foot diameter filters would be required to effectively treat the increased flow conditions (1.32 MGD Max.). **The Phase II estimated total project cost for the additional filters, associated process piping, valving, instrumentation, electrical, chemical feed upgrades, etc. is approximately $950,000 (engineering and construction).**

In addition to the capital costs listed above, the operation & maintenance costs required for carbon treatment are estimated to be approximately $40,000 for Phase I and $70,000 for Phase II annually (in 2018 dollars). These costs are

inclusive of the electrical, chemical costs and activated carbon media replacement costs. These costs do not include building heating and cooling costs or an allowance for additional labor necessary to operate the GAC treatment facility.

The following is a brief listing of some pros and cons of using a GAC system for removal of chloramines:

Pros:

- Effective on turbid water
- Can remove many types of contaminants
- Minimal daily O&M

Cons:

- Replace/dispose of spent carbon
- Existing TOC in water can cause carbon to be spent faster
- Cost of media replacement

Chloramine Destruction Options Conclusion

The use of UV or carbon filtration could reduce chloramine concentrations prior to entry into the HAWC water system. However, the total costs to install either system to meet Phase I and II flows are more expensive than converting the HAWC system to chloramines or separating the HAWC water system into a chloraminated and chlorinated system. In addition, adding free chlorine (after the reduction of chloramines) could lead to disinfection by-product (DBP) formation depending on the presence and levels of disinfection byproduct precursors (e.g. total organic carbon) in the Salem/MWW water. As stated in each section above, the reduction of chloramines may be limited to 90% removal. Pilot testing would be necessary to examine if each alternative could effectively remove chloramines from the Salem/MWW water and to determine what percent removal could be expected. If a small percent of chloramines were to remain in the water and were mixed with free chlorine on a sustained basis, it is unknown what the water quality impacts might be without additional investigation.

Chloramine Monitoring/Sampling Program Development

The following section summarizes the recommended corrosion control and water quality monitoring prior to and during start-up of chloramine secondary disinfection practices in the HAWC system. We also provide a recommended monitoring program for the first year of operation later in this section.

Water Quality Sampling at the Chloramine Converted Well Sites

The following sampling protocol is recommended at all well sites that convert to chloramine disinfection starting two days before the switch to monochloramine.

Parameter	Location & Sample Type	Frequency
Free chlorine	100-foot finished water sample tap	Continuous
Total chlorine	100-foot finished water sample tap	Continuous
Total chlorine	100-foot finished water sample tap, grab	Daily
Free chlorine	100-foot finished water sample tap, grab	Daily
pH	100-foot finished water sample tap, grab	Daily
Monochloramine*	100-foot finished water sample tap, grab	Twice Daily
Total ammonia*	100-foot finished water sample tap, grab	Twice Daily
Free ammonia*	100-foot finished water sample tap, grab	Twice Daily
Dichloramine	100-foot finished water sample tap, grab	Weekly for first 4 weeks, then monthly

* If continuous monitoring of these parameters is installed then the location of the sample is from the 100-foot finished water sample tap at each station

Technical literature suggests that free ammonia at the well station effluent should be as low as possible, preferably less than 0.05 mg/L as N, but no more than 0.10 mg/L. The chlorine to ammonia-N ratio should be between 3:1 to 5:1. We recommend starting at a ratio of 4:1. If this ratio is easily maintainable without going over a 5:1 ratio, then we recommend increasing the ratio to 4.5:1, as long as the ratio is always maintained below 5:1. We recommend maintaining a minimum total chlorine concentration leaving the well stations at 2.0 mg/L. Based on how this residual is maintained in the distribution system and potential nitrification occurrences, HAWC may want to increase this to 2.5 mg/L and higher if necessary. However, the regulatory limit for total chlorine is 4.0 mg/L.

Please note, monitoring will show the normal dynamic variations in these parameters and it is recommended that system specific control charts be developed with the monitoring data so, over time, upper and lower control limits can be established and trends can be identified to determine if corrections need to be made prior to problems developing.

Distribution System Sampling

HAWC is required to continue monitoring the total chlorine disinfection residual at all their total coliform rule (TCR) locations. We recommend trending residuals at each site graphically. Technical literature suggests that, after converting to chloramines, the total chlorine concentration at all monitoring points be maintained at 1.5 mg/l to 2.0 mg/L.

For the proposed chloraminated section of the HAWC service area we recommend that the parameters listed below be monitored at each tank in the proposed chloraminated zone and at three water distribution sample locations in the service area. When taking samples from the tanks, the tanks must be draining. One sample point will be representative of average water age in the system. The other three sample locations should represent more remote locations in the service area where water age may be older, and water quality should be closely monitored.

For the first year of monitoring, we recommend the following distribution sampling protocol. After the first year of monochloramine application, HAWC may be able to reduce the monitoring frequency for certain parameters. Also, after the first year of sampling, HAWC may be able to reduce the sampling frequency and locations based on results.

Parameter	Sample Type	Frequency
Nitrite	Grab	Twice a month
Free Ammonia	Grab	Twice a month
Total Ammonia	Grab	Twice a month
Temperature	Grab	Twice a month
Alkalinity	Grab	Twice a month
pH	Grab	Twice a month
Nitrate	Grab	If detecting nitrite
Free Chlorine	Grab	Weekly for two months, then twice a month
Total Chlorine	Grab	Weekly for two months, then twice a month
HPC	Grab	Weekly for two months, then twice a month

We recommend spring and fall flushing of the distribution system. Flushing will also help in areas that may be more susceptible to nitrification.

Corrosion Control Sampling

The 90th percentile sample results for both lead and copper are historically below the maximum contaminant levels (MCLs) in the HAWC system. The lead and copper samples taken prior to start up of the proposed chloramine system start ups should be used to compare to post monochloramine conversion lead and copper samples. We recommend sampling and monitoring three sample sites (preferably the sample sites will be located in areas that experience the longest water age and if appropriate sample during the warmest water periods) in the proposed chloraminated section of the HAWC service area every 60 days for the first 6 months after the chloramine systems go online. If the lead and copper results from the three sites indicate no significant change in lead and copper levels, then all 20 existing monitoring sites should be tested for lead and copper and associated distribution water quality parameters including pH. This will give the chloramines sufficient time to move through the distribution system, and any effects the chloramines may have on corrosion control can be observed. If lead and copper levels remain low, no further action should be required. If lead and copper levels significantly increase, system oxidation-reduction potential (ORP) levels should be evaluated, monitoring for nitrification should occur and any appropriate changes proposed to DES.

Example Start Up and Initial Operation Plan

As stated above, HAWC should consider starting the chloramine production at a chlorine to ammonia-N ratio (calculated

as mg Cl per mg N) of 4:1. If this ratio is easily maintainable without going over a 5:1 ratio, then we recommend increasing the ratio to 4.5:1, as long as the ratio is always maintained below 5:1. The goal is to prevent residual ammonia by not adding enough chlorine that contributes to nitrification risk and also to minimize the potential hazards of dichloramine which can include taste, odors, poor disinfection and potential for NDMA formation by adding too much chlorine.

We recommend starting at a total chlorine concentration of (1.0 to 1.3 mg/L) as measured at the CT sample points. After two days, we recommend the total chlorine concentration leaving (as measured at the 100-foot sample taps) the well stations be adjusted to 2.0 mg/L total chlorine.

The Cl to N ratio and the total chlorine levels shall always be monitored carefully. Please note, when calculating the chlorine to ammonia ratio, two common errors often happen; the ratio is calculated as Cl2 to N or as Cl2 to NH3. If the chlorine to ammonia ratio is calculated using those parameters you do not get the ratio value necessary to assess if ideal chlorine to ammonia concentrations are present. The ratio shall always be calculated as Cl to N only.

If the total chlorine residual at the 100 foot sample tap is not present, the ammonium sulfate feed pumps shall be locked out and an alarm shall be activated to notify the operators.

The goal for total chlorine residual at all distribution sample sites should be 1.5 mg/L to 2.0 mg/L. Once the distribution system water quality data indicates the system has been fully converted to monochloramine, the residual dosage as measured at the well station 100-foot sample taps should be adjusted accordingly (the maximum chloramine dosage should not exceed 2.5 mg/L without special monitoring).

Nitrification Action Plan (NAP)

Nitrite (NO2-) is a primary indicator for nitrification and is typically used as the basis for nitrification response activities. The following table presents one example of a NAP.

Action Level	Nitrite Levels (mg/L)	Response
Level 1	less than 0.01	Background NO2-N Continue bi-weekly monitoring
Level 2	0.01 to less than 0.015	Decrease free ammonia nitrogen Increase monitoring to weekly Start HPC monitoring at tanks and high water age distribution sites
Level 3	0.015 to 0.025	Decrease free ammonia feed Increase to daily monitoring
Level 4	greater than 0.025	Corrective action needed

The above table represents one example of a NAP. However, field testing kits for nitrite can be difficult to reliably

distinguish between 0.01 and 0.02 mg/L of nitirite. Please refer to a second NAP example (prepared by the Texas Commission on Environmental Quality (TCEQ)) in Appendix A.

In addition, control charts for ammonia/nitrite/nitrate and HPCs from routine monitoring could be effectively used as an early detection of nitrification in the system.

If corrective action is needed, HAWC should consider flushing, draining storage tanks, adjusting the chlorine to ammonia-N ratio, and/or increasing the total chlorine dosage. If none of these techniques address the nitrification issue, then a free chlorine burn of the system should be considered. Also, it should be noted that it is possible that corrective active may be required in one section of the distribution system and not necessarily in another section.

Monochloramine Start-Up Plan

Prior to Week 1:

- Final notice to public of water system transition
- Calibration of analyzers
- Testing of alarms for ammonium pumps

Day 1 of Transition:

- Check/monitor chlorine pump
- Check/monitor ammonia pump
- Begin daily sampling of free ammonia/chlorine

Day 2:

- Review sampling data for free ammonia/free chlorine, total chlorine
- Adjust pumps as needed for desired residual

Day 3:

- Review sampling data for free ammonia/free chlorine, total chlorine
- Adjust pumps as needed for desired residual
- Sample at existing distribution system sampling locations for monochloramine residual

Day 7:

- If monochloramine residual is consistent throughout sampling locations, begin monthly distribution testing program as outlined within the *Monitoring/Sampling Plan*
- If inconsistent or undesirable, continue daily monitoring schedule

Day 30:

- Review distribution sampling data, adjust chlorine/ammonia feed systems as needed

Day 90-180:

- Review lead and copper sampling data, determine if increased sampling/corrosion control action is necessary
- Review distribution data and residual level, adjust chlorine/ammonia feed systems as needed

Lead Service Investigation

HAWC officials have notified us that they don't believe there are any lead water services in the HAWC distribution system. The water system is predominantly PVC distribution pipe with the oldest pipe dating back to the mid-1970's. Lead plumbing could be present in houses, however.

The following figures display the historical lead and copper sampling results obtained within both Hampstead and Atkinson portions of the HAWC System.

Figure 4 – Hampstead Lead and Copper Sampling Data

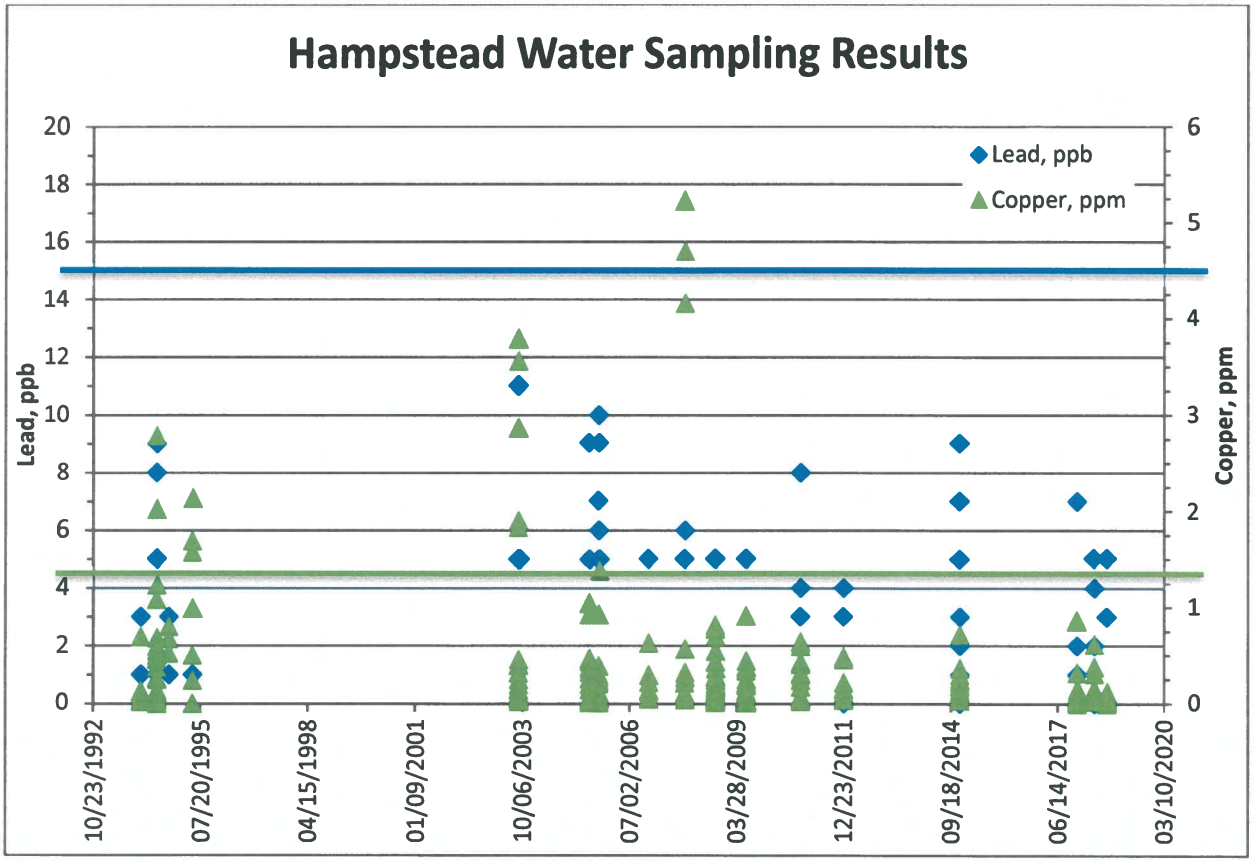


Figure 4 shows that recent sampling results for both lead and copper concentrations within the Hampstead area of the water system are below the regulatory action levels of 15 ppb and 1.3 ppm, respectively. It should be noted that Figure 4 does show historical copper levels above 1.3, however.

Figure 5 – Atkinson Lead and Copper Sampling Data

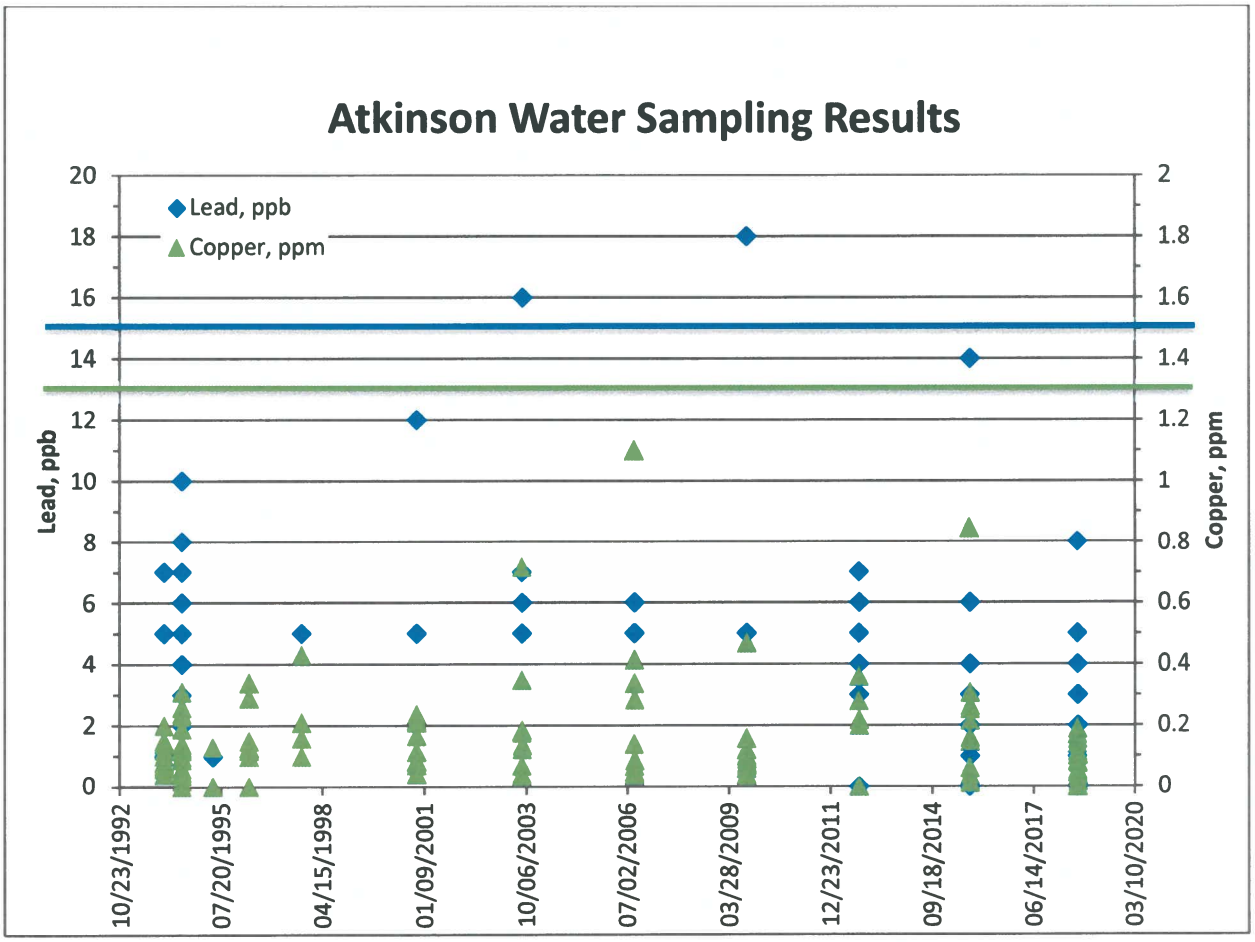


Figure 5 shows that recent sampling results for both lead and copper concentrations within the Atkinson area of the water system are below the regulatory action levels of 15 ppb and 1.3 ppm, respectively. However, Figure 5 shows historical lead levels have been above 15 ppb.

The above figures can be used to assist with identifying areas for additional lead and copper monitoring during chloramination start up activities.

The complete list of sampling data and corresponding sampling locations has been included at the end of this report under Appendix B.

Dr. James Malley Chloramine Study Review Comments

The following is a summary of comments from Dr. Malley after his review of this document:

"After review of the document and checking it against references on industry practice such as AWWA manuals and EPA guidance the following are my summary comments:

1. As we look at the three options reviewed here, it is my view that the option that would be best to implement for long-term operational success and public health protection would be the proposed Water System Separation and Water Storage tank.

2. My suggestion for the chloraminated systems would be to strive for minimum total chlorine residual to be 1 mg/L as Cl2 and an optimum total chlorine residual to be 1.5 mg/L as Cl2 based on the current state of the art and findings in research by EPA and AWWA.

3. The monitoring plans proposed should be expanded at least for the first several years of operation to ensure that issues with chloramine dosing and control, nitrification, dichloramine formation and potential for changes in the systems corrosion potential are minimized. I am particularly skeptical of reliance solely on low level nitrite monitoring. Once systems are stable and monitoring is pointing towards ways of making the monitoring more focused and efficient then reduction in what is monitored and/or how frequently can be approved. In addition, it is strongly recommended to develop from the monitoring results a control chart process control approach that would easily allow trends to be identified before any problems in the water quality or in the DS can get too far out of the operating limits."

Summary

Weston & Sampson has not identified a community in New England that practices the blending of free chlorine and chloramines on a sustained basis. In lieu of sustained blending, this report summarizes our findings regarding the options available for HAWC's chlorinated system to receive chloraminated SNHRW supply. The options explored include the destruction of chloramines prior to entry into HAWC's water system or converting HAWC's water system to chloramines. The use of UV or carbon filtration for chloramine destruction could reduce chloramine concentrations prior to entry into the HAWC water system. However, since free chlorine would need to be added to the water (after the reduction of chloramines occurs) disinfection by-product (DBP) formation could occur depending on the presence and levels of disinfection byproduct precursors (e.g. total organic carbon) in the Salem/MWW water. Also, it is unknown how much chloramines could be reduced through either destruction method without conducting pilot studies.

Converting HAWC's system to chloramines allows the chloraminated SNHRW supply to mix with chloraminated HAWC supplies. Although mixing can occur, intensive distribution system sampling, monitoring for nitrification and monitoring for proper, sustained chlorine to nitrogen ratios will be critical through the first year of chloramine operation throughout the HAWC water system. The operational difficulties and costs of managing up to 13 small

chloramine systems given limited staffing and the need for daily attention and monitoring should be considered when assessing the approach to converting HAWC's system from chlorine to chloramines. Converting a portion of the HAWC water system from chlorine to chloramine (rather than the entire HAWC water system at first) would allow HAWC's operators to understand the challenges of operating a chloramine system. After the chloramine system has been operated and maintained for a period of time, HAWC officials could reassess the advantages and disadvantages of converting the entire HAWC water system to chloramines.

Recommended Additional Work

The following items are outside the original scope of work for this project. The following is an initial list of recommended additional work to be considered for this project:

1. The water quality from Salem prior to entry into HAWC should be reviewed. Specifically, the predicted water quality from a blended SNHRW water supply and the Salem water supply should be estimated and used to assess if any additional issues or design considerations should be established (e.g. pH or alkalinity adjustment, etc.). Conducting an RTW model of the water sources is recommended at this time. Investigating any disinfection byproduct concerns, different pH and/or alkalinity concerns and water age concerns should be reviewed.

2. A cursory review of each existing HAWC well station that is scheduled to be modified for chloramine production is required. Preliminary chemical handling review and chloramine conversion design (such as chemical pump sizing, chemical storage sizing, building modification design (if applicable)) should be performed at this time.

3. A mixer in the proposed 1.0 MG storage tank near Winslow Drive in Atkinson is recommended to decrease water age concerns in the chloraminated section of the HAWC distribution system. Designing a mixer for the tank should be performed at this time.

4. A review of TTHM and HAA5 sampling sites should occur. The potential for DBP formation should be examined, contingent upon the option chosen for furnishing HAWC with chloraminated SNHRW supply. Using the SNHRW model, new monitoring locations should be recommended in the HAWC water system. Lead and copper sites should also be reviewed and recommendations made regarding locations to monitor during chloramine start up and initial operations. Distribution system sampling parameters should also be expanded to include DBP sampling protocol.

References

Partnership Resources (2014) A Closer Look at Chloramine and Nitrification Monitoring. Available at https://www.awwa.org/AWWA-Articles/ArticleId/2486/TECH-TIP-a-closer-look-at-chloramine-and-nitrification-monitoring

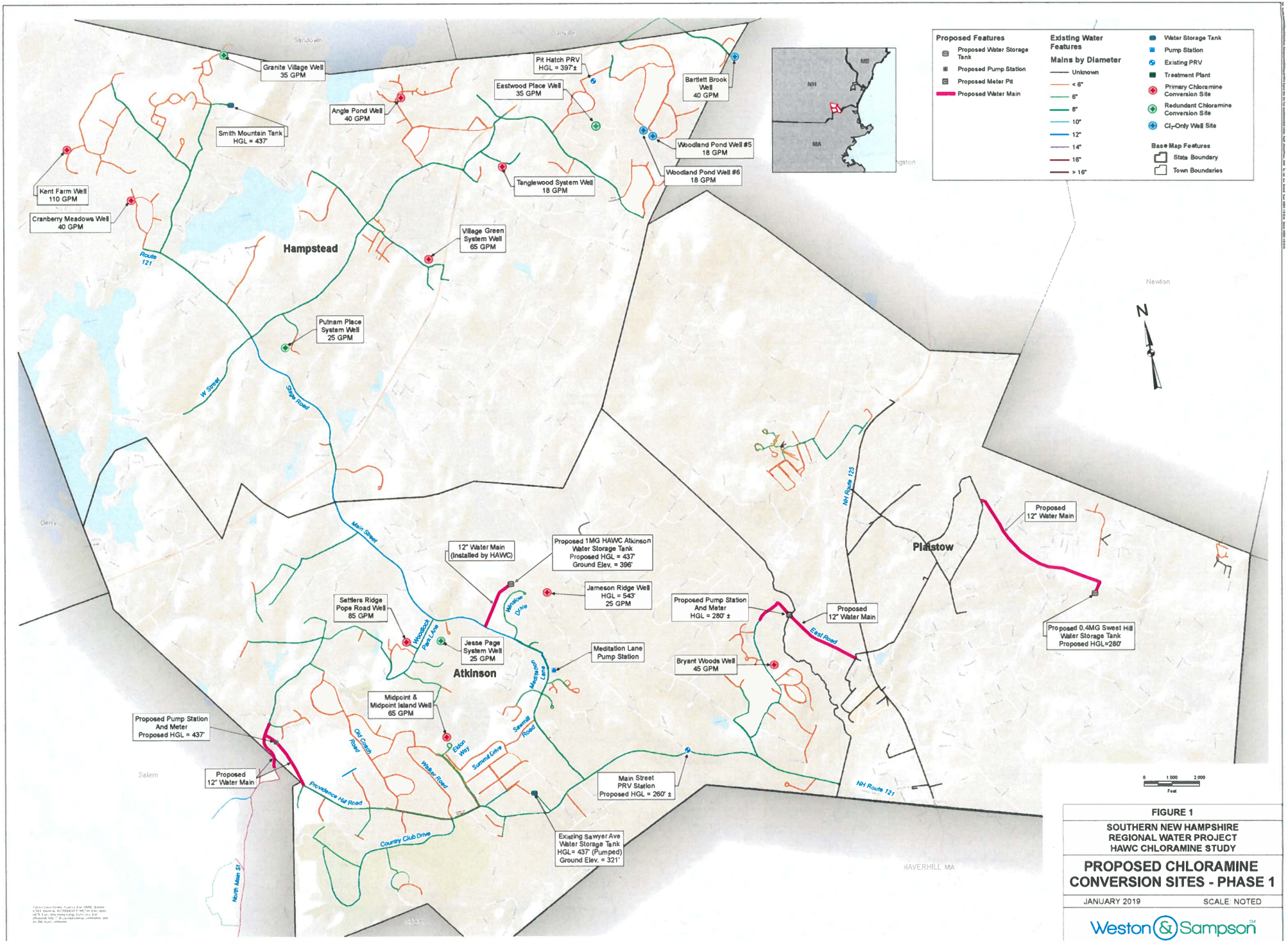


FIGURE 1

SOUTHERN NEW HAMPSHIRE REGIONAL WATER PROJECT
HAWC CHLORAMINE STUDY

PROPOSED CHLORAMINE CONVERSION SITES - PHASE 1

JANUARY 2019 SCALE: NOTED

Weston & Sampson

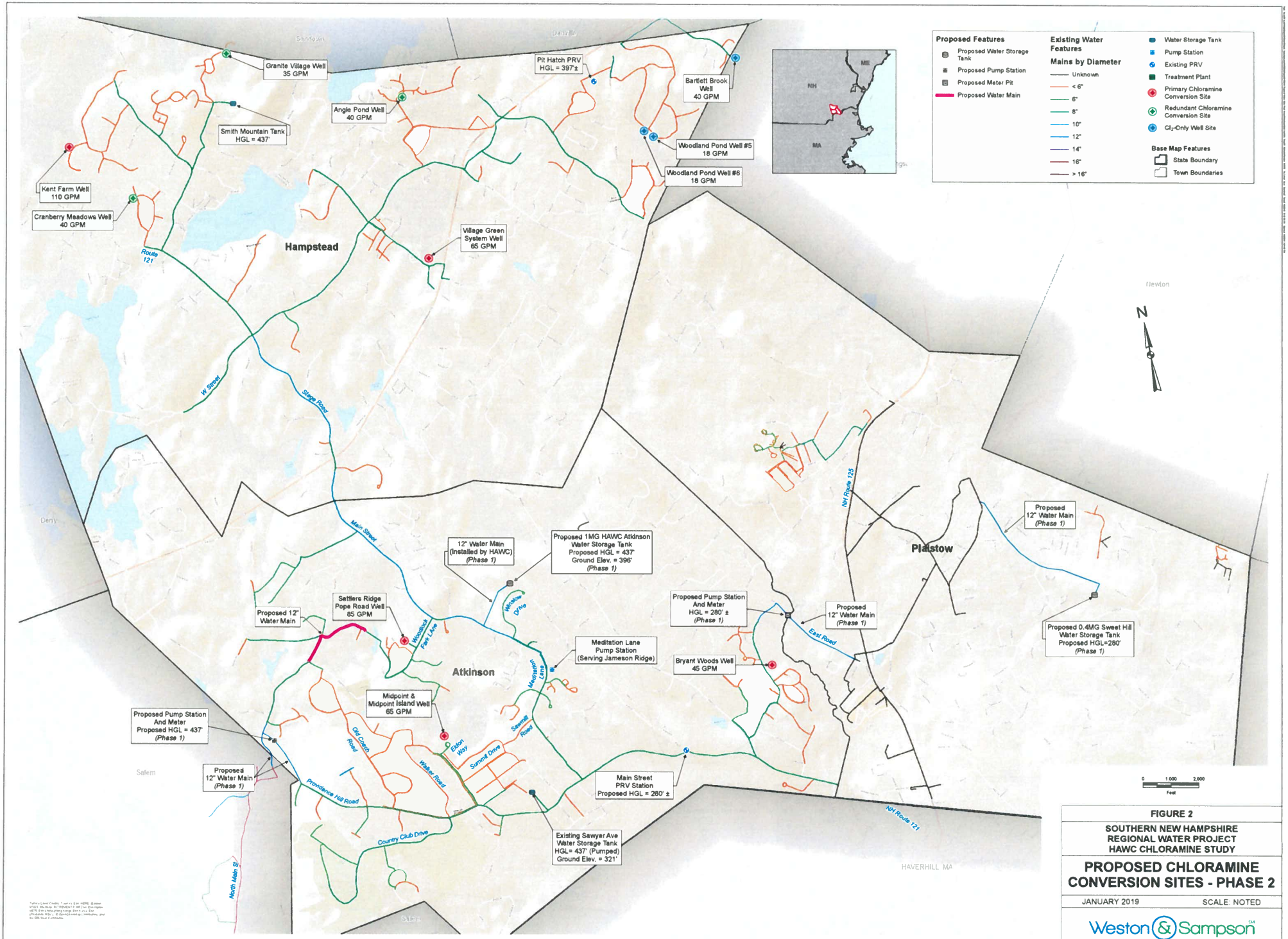


FIGURE 2

SOUTHERN NEW HAMPSHIRE REGIONAL WATER PROJECT HAWC CHLORAMINE STUDY

PROPOSED CHLORAMINE CONVERSION SITES - PHASE 2

JANUARY 2019 SCALE: NOTED

Weston & Sampson

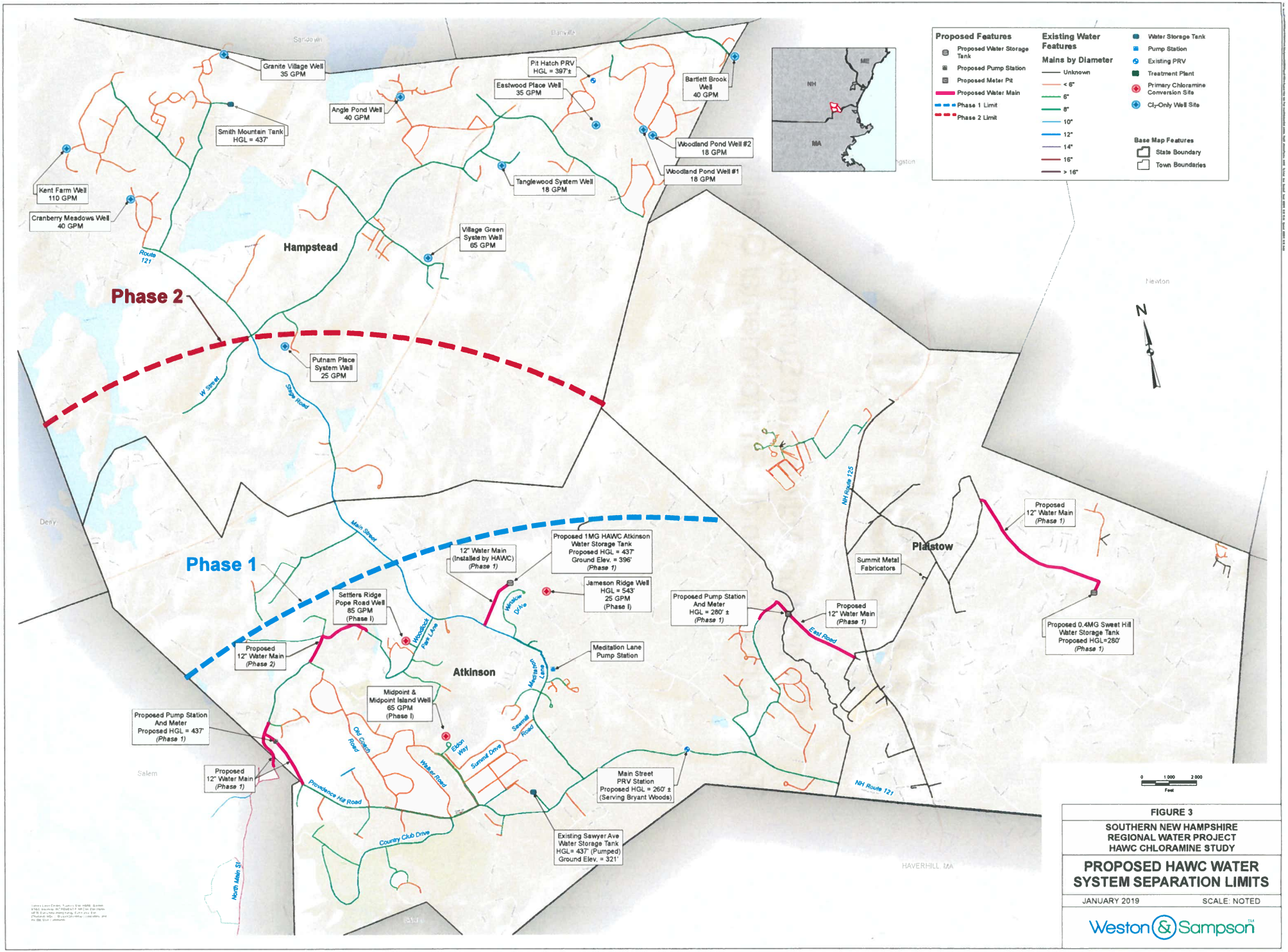


FIGURE 3

SOUTHERN NEW HAMPSHIRE REGIONAL WATER PROJECT
HAWC CHLORAMINE STUDY

PROPOSED HAWC WATER SYSTEM SEPARATION LIMITS

JANUARY 2019 SCALE: NOTED

Weston & Sampson

Appendix A

Nitrification Action Plan Summary
Texas Commission on Environmental Quality

Nitrification Action Plan (NAP) Summary

The Texas Commission on Environmental Quality (TCEQ) has information about nitrification on our web site at: www.tceq.texas.gov/drinkingwater/disinfection/nitrification.html.

The TCEQ's data for Texas public water systems (PWSs) is available at: http://dww2.tceq.texas.gov/DWW/.

This summary is intended to describe and supplement the rule requirements of Title 30, Texas Administrative Code (30 TAC) Chapter 290. In the event of any unintended discrepancy between the rule and this guidance, the rule language shall apply.

Purpose of NAP: The purpose of a Nitrification Action Plan (NAP) is to ensure that chloramine disinfection is successful by preventing and/or responding to nitrification.

NAP Sampling: The rule gives the minimum requirements. It may be necessary for PWSs to perform additional sampling to characterize the adequacy of disinfection in their distribution system.

Critical Control Conditions for Chloramination

Total Chlorine	• Total chlorine is the **sum of all active chlorine species.** It is the regulated level. • The minimum allowable total chlorine residual is 0.5 mg/L throughout the distribution. • The maximum residual disinfectant level (MRDL) for total chlorine is 4.0 mg/L based on the running annual average (RAA) of all samples collected in distribution. Maintaining a residual over the 4.0 mg/L at entry points is not a violation in and of itself. • The minimum and maximum residuals in distribution are reported on the Disinfectant Level Quarterly Operating Report (DLQOR) or the Surface Water Monthly Operating Report (SWMOR).
Mono-chloramine	• Monochloramine is the disinfecting member of the chloramine family. • Ideally, all of the total chlorine will be present as monochloramine. • Keeping track of the ratio of monochloramine to total chlorine can help alert you to possible nitrification.
Free Ammonia	• Free ammonia reacts with free chlorine to make monochloramine and other chloramines. Then, as the monochloramine decays, free ammonia is released. • Free ammonia and total ammonia may be present in source water.
Nitrite	• Nitrite is formed by ammonia-oxidizing bacteria which 'eat' ammonia. • Nitrite may be present in source water. • Nitrite has a health-based maximum contaminant level (MCL) of 1 mg/L at entry points, but is not regulated at distribution system sample sites. However, it is still a public health concern when it is over the MCL.
Nitrate	• Nitrate is formed by nitrite-oxidizing bacteria which 'eat' nitrite. • Nitrate is often present in source water, especially groundwater. • Nitrate has a MCL of 10 mg/L at entry points, but is not regulated at distribution system sample sites. However, it is still a public health concern when over the MCL.

Other process management parameters

Free Chlorine	• You are not required to measure free chlorine, except during a temporary conversion to free chlorine performed as a preventive or corrective action.
pH	• A decrease in pH can indicate nitrification. Therefore, pH measurement is recommended at systems with low alkalinity. • PWSs that use pH elevation for corrosion or nitrification control should also monitor pH in the distribution system. • Some PWSs are required to measure pH as part of the Lead and Copper Rule requirements for WQP (water quality parameter) testing.
HPC	• HPC means 'heterotrophic plate count' bacteria. • HPC can be a useful tool to measure the concentration of a broad range of bacteria. An increase in HPC can indicate nitrification. • PWSs are not required to measure HPC.

Other process management parameters	
Other indicators	*Nitrification/denitrification indicators used in wastewater treatment such as dissolved oxygen, alkalinity, oxidation-reduction potential may be useful for drinking water in future, but need further research.*

NAP Sample Sites

Sample sites must represent the distribution system and all entry points. In addition to routine NAP sample sites, additional locations will need to be sampled when taking action to identify the area where nitrification is happening.

Storage Tanks: Storage facilities can increase water age. Consider the impact of storage when determining sample sites.

Sample Sites Before and After Chemical Injection	
Sources	
Groundwater	• All wells are required to have pre-disinfection sample taps representing the raw water. • If only **one well and one entry point** are present, entry point nitrite/nitrate sample results may be used to represent source water nitrite/nitrate levels. • If more than one well feeds one entry point**, nitrite, nitrate, and free ammonia sampling must be performed at each well.**
Surface water (and GUI)	• Surface water systems must monitor raw water for nitrite, nitrate, and free ammonia representing each raw water intake. • GUI is groundwater under the direct influence of surface water. GUI must meet the requirements for surface water.
Purchased Water	• For purchased water, the source sample site is usually the entry point sample site. • Systems that purchase and redistribute potable water must measure total chlorine, monochloramine, free ammonia, nitrite, and nitrate immediately after the water enters their system.

Entry Point(s)

- Entry points are defined as a point where treated water enters distribution. All entry points are required to have a representative tap.
- Entry points are numbered. You can verify this number on TCEQ's website: 'Drinking Water Watch' at http://dww2.tceq.texas.gov/DWW/.
- For the purposes of a NAP, entry point sampling is the same regardless of the water source type.

Sampling is required to make sure that the correct chlorine-to-ammonia (Cl:N) ratio exists. The Cl:N ratio is calculated from the mass of free chlorine to the mass of free-ammonia-nitrogen.

- The desired range of Cl:N is ~4:1 to 5:1.
- The range from 5:1 to 8:1 is undesirable because of di-and trichloramine formation; above 8:1 all nitrogen is lost and free chlorine is present.

PWS staff should become familiar with breakpoint chemistry. Good mixing during treatment is very important. Poor mixing can cause ineffective disinfection.

Order of addition	• When chlorine is injected upstream of any other disinfectant, the ammonia injection point must be downstream of the chlorine injection point. • When chlorine and ammonia are added to distribution water that has a chloramine residual, ammonia should be added first. • When chlorine and ammonia are added to distribution water that has a free chlorine residual, chlorine should be added first.

Entry Point(s)	
Before chemical addition	• Sampling must be performed upstream of the chlorine or ammonia chemical injection point, whichever is furthest upstream. • If free ammonia is present in the source, raw water sampling should be performed weekly. • If the source is purchased potable water, total chlorine, monochloramine, and free ammonia must be monitored at least weekly and dosing should consider influent levels.
During treatment	• Chlorine must be injected before ammonia. • Sampling must be performed downstream of all the chlorine and ammonia chemical injection points.
Booster disinfection	• The free ammonia (as nitrogen) and monochloramine residuals must all be monitored if the treatment occurs in the distribution system. The monitoring must occur at the same time as a total chlorine compliance sample. • If potable water is redisinfected, the disinfectant residual must not fall below the minimum anywhere, including right before treatment. • The residual of the chemical injected upstream should be determined to properly dose the downstream chemical.

Distribution System Sample Sites	
• Routine coliform and/or disinfectant residual sites may be used for NAP sample sites. • Sites must represent the distribution system and represent average and high water age. Small systems may be adequately represented with two or three sites; medium and large systems will need to specify more sites to adequately detect and prevent potential nitrification. The rule does not specify the exact number of sample sites because of the diversity among PWSs. • It is recommended that 'critical control points' be selected. In distribution, these may be at interconnections between major mains, storage facilities, pump stations, and interconnections with other PWSs. • Sample sites must represent all pressure planes	
Average water age	• As a first estimate, average water age can be estimated from historical data as locations with average total chlorine residual. • Enough average water age sites must be selected to represent multiple pressure planes.
High water age	• High water age may occur at the far reaches of the distribution system, in under-used areas, or as a result of storage. • Sites should represent all pressure planes.

NAP Sample Frequency

Sample Frequency: The rule lists the minimum sampling requirements. It may be necessary for PWSs to perform additional sampling to characterize their distribution system.

	At or after all **Entry Point(s)**	In the **distribution system**	Before and after any **chlorine or ammonia injection points**
Total Chlorine	Weekly.	Daily/weekly.[a]	Weekly and before and after adjusting the chlorine or ammonia feed rate.
Mono-chloramine		At least weekly.[b]	
Free Ammonia			
Nitrite and Nitrate	Monthly for six (6) months, then quarterly.	At least quarterly and in response to action triggers.	Routine sampling not required.

[a.] Total chlorine must be collected weekly or daily, based on the system size, in accordance with §290.110.
[b.] When collecting a routine sample such as a bacteriological or routine disinfectant residual sample.

Methods

The methods used must be accurate enough to measure changes that can indicate nitrification. You must document the method and/or laboratory for total chlorine on your PWS Laboratory Approval Form (Form # TCEQ-10450) attached to your Monitoring Plan. The methods and/or laboratories used for monochloramine, free ammonia, nitrite and nitrate must be documented in your NAP.

	Required Accuracy	
Total Chlorine	0.1 mg/L	• Total chlorine must be analyzed in the field. • Amperometric titration, DPD ferrous titration, or DPD colorimetric are the required methods. • Check the range of your kit. If a sample is outside range, dilute and reanalyze.
Mono-chloramine	0.15 mg/L	• Monochloramine must be analyzed in the field. • Any method approved for the drinking water matrix is acceptable.
Free Ammonia (as nitrogen)	0.1 mg/L	• Free ammonia must be analyzed in the field. • Ammonia is measured as 'free available ammonia as nitrogen.' • Check the range of your kit. The most common one pegs out at 0.55 mg/L. Samples over that level must be diluted and re-analyzed. • Any method approved for the drinking water matrix is acceptable.
Nitrite (as nitrogen)	0.01 mg/L	• Nitrite and nitrate may be analyzed in the field and/or in an accredited or approved lab. • If samples are analyzed at an outside approved lab, keep a copy of that lab's accreditation documents with your NAP.
Nitrate (as nitrogen)	0.1 mg/L	

Goals and Baselines

Goals and baselines are the normal, good levels at each point in the distribution system.

- **'Goals' are set for total chlorine, monochloramine, and free ammonia** to make sure that disinfection is maintained correctly.
- **'Baselines' are set for nitrite and nitrate**, because they come from source water, and are less under a system's control.

Initial results and historical data are used to set goals and baselines.

Ongoing, routine sampling is used to detect potential nitrification and take appropriate action.

Total chlorine and Mono-chloramine Goals	• Total chlorine and monochloramine should always be about the same, so their goals can be set at the same value. • The entry point goal should be high enough so that the maximum water age site can achieve its goal over the minimum of 0.5 mg/L plus a safety factor.
Free ammonia Goal	• Ideally, water at entry points just after treatment would have zero free ammonia residual because free ammonia is 'food' for the nitrifying bacteria. • Having a trace of free ammonia shows that the water is in the monochloramine zone. • Free ammonia naturally increases with time. The free ammonia goals in average and high water age locations should represent good, normal operating conditions.
Nitrite and nitrate Baselines	• The nitrite and nitrate baselines are the concentrations in the source water. • The nitrite and nitrate in the distribution system should always be the same as the source water. • The only thing that can change them is either nitrification, backflow or cross connection, or source water changes.

Triggers: Yellow Flag Alerts, Red Flag Alarms	
Yellow flag 'alert' triggers: Yellow flag levels are somewhat out of the norm, indicating that nitrification may have started. Some action to get back to normal is needed, but it is probably a routine type of action like flushing.	
Red flag 'alarm' triggers: Red flag levels happen when it becomes difficult to maintain a compliant total chlorine residual, and there is a strong possibility that nitrification is the culprit. If routine actions don't get the system back to normal, more intense action will be needed.	
Total chlorine	• Total chlorine is the regulated value, so most systems have more data for total chlorine than any other constituent. Therefore, PWSs should have at least a year of historical weekly or daily data to use for setting triggers. • If a nitrification event has occurred, the exact levels where nitrification took place can be used. Otherwise, yellow and red trigger levels should be estimated.
Mono-chloramine	• Ideally, 100% of the total chlorine should be present as monochloramine. • Systems may have characteristic ratios of monochloramine-to-total, for example: 80% or 90%.
Free ammonia	• Ammonia will decrease during nitrification. If ammonia is not detected, nitrification is the likely cause.
Nitrite	• Nitrite may increase or decrease during nitrification. Therefore, any significant deviation of the nitrite level could indicate nitrification. • During the initial stages of nitrification, nitrite will increase; as nitrification progresses, nitrite will drop as it is converted to nitrate.
Nitrate	• Nitrate increases when nitrification is very bad. • The only possible reasons to for nitrate to increase are: o Nitrification, o Cross-connection, backflow, or backsiphonage of sewage or fertilizer, or o Source water contamination. Any of these is a major issue.

Actions	
Note: The TCEQ provides these examples of actions for guidance only. Each PWS that uses chloramines must select actions appropriate to its unique circumstances.	
• **Normal operations:** When disinfection is going well, preventive actions are used to keep it going that way. This is the 'green zone.'	
• **Yellow flag 'alert' actions:** When your nitrification indicators hit yellow flag levels, some action is needed to get back to normal. Often these corrective actions are similar to the preventive actions, like sampling and flushing.	
• **Red flag 'alarm' actions:** When the total chlorine residual drops to low levels, nitrification may have progressed far enough that more extreme measures are needed to get back on track. If not, there may be another problem like cross-connection or treatment failure that needs attention.	
Routine Preventive Actions / Yellow Flag Alert Corrective Actions	
Sample verification	• Before making a decision on what further action to take, it's a good idea to double-check the first measurement. • It is a good idea to double-check accuracy routinely to document the variability of the analysis method.
Nitrite/ nitrate sampling	• Nitrite is a key indicator of nitrification. If chloramine-effectiveness measurements are off-spec, nitrite and nitrate sampling is necessary to determine if nitrification is happening. • Although the rule only requires 6 samples to set baselines, more nitrite and nitrate data will improve your ability to respond to potential nitrification.
Determine affected area	• Nitrification is a biological process, so it can 'bloom' in one portion of the distribution system while other areas remain okay. Determining what area is affected will allow a targeted response to effectively stop the nitrification.

Actions	
Flushing	• Flushing can bring fresh water with a strong chloramine residual to a location where disinfectant levels are decreasing. However, it is only a short-term solution because of the conservation, economic and customer relation impacts. • Every PWS is required to flush every dead-end main (DEM) each month.
Uni-directional flushing	• Unidirectional flushing (UDF) is a way of organizing flushing to achieve a velocity of 5 feet-per-second (fps) in the pipe. At 5 fps, suspended sediment is effectively removed. UDF can be used to target a problem area.
Pigging	• Pigging is the process where a cylindrical 'pig' is forced through a water main with hydraulic pressure, forcing sediment to be scraped off the walls then removed at a flush point. Pigging is best used where the system has been designed with entry and exit points for the pig. Pigging is not considered practical for old, weak pipe.
Storage tank operation	• Storage is often a cause of increased water age. Optimizing storage tank operations means selecting the best operating levels, where there is enough water for use, but not so much that it sits in the tank decaying too long.
Free chlorine conversion	• Free chlorine conversion is often called a 'burn', 'shock', or 'refresh'. When free chlorine is present, it starves nitrifying bacteria. • Although a free chlorine conversion is sometimes thought of as an extreme measure, there are numerous PWSs that perform routine, annual free chlorine conversion as a preventive measure. • Email the TCEQ at *DBP@tceq.texas.gov* 30 days before doing a free chlorine conversion.
Red Flag Corrective Actions	
Routine Actions	• The same actions (listed above) that are used for preventive maintenance and yellow-flag correction may be a part of the corrective actions used for red-flag actions.
Free chlorine conversion	• Free chlorine conversion is often used to respond to nitrification. **Contact TCEQ at 512-239-4691 or DBP@tceq.texas.gov to discuss scheduling a free chlorine conversion.**

Seek professional help for engineered modifications	
TCEQ's Plan and Technical Review Section can assist you with questions related to the process of getting approval for engineered solutions at 512-239-4691 or on the web at TCEQ Plan Review Website.	
Looping mains	• If a PWS identifies nitrification due to dead-end mains (DEMs), it may be appropriate to perform infrastructure replacement in the problem area to manage water age. • Every PWS is required to have a program to minimize stagnation of water due to DEMs.
Tank changes	• Tanks can be a source of major water age. In some cases, a PWS may choose to completely eliminate tanks or replace larger tanks with smaller ones. • Some PWSs have found mixing to be helpful in eliminating chloramine residual loss due to tank stratification. • Tanks must always have a compliant disinfectant residual.
Booster disinfection	• If the size and shape of a distribution system are very challenging, the addition of booster chloramination may be appropriate. Usually, both chlorine and ammonia injection should be at the booster station. However, if the water upstream of the booster contains free ammonia, it is possible to inject chlorine to tie up that free ammonia and form monochloramines. In that case, ammonia injection may not be needed.
pH adjustment	• Monochloramine is more stable at a higher pH. Nitrifying organisms grow more rapidly at pH 7.5 than at pH 8. For these reasons, a PWS may choose to adjust pH. If pH adjustment is used, the impact on corrosion control should be considered.

Seek professional help for engineered modifications	
Free chlorine & aeration	• Some groundwater systems with high total organic carbon have used free chlorination followed by aeration to volatize chloroform to make it possible to meet disinfection byproduct regulations with a free chlorine distribution system residual.
Chlorite feed	• Research shows that the presence of chlorite may slow or stop nitrification from developing. It will not necessarily work to stop nitrification that has already started. Chlorite is a regulated disinfection byproduct of chlorine dioxide. A system considering a chlorite feed should be prepared to perform chlorite sampling in distribution.
Other solutions?	*Research continues on nitrification. Some new methods may be snake oil, but others may turn out to be successful. Use professional development opportunities to learn about new technology.*

This is a template for starting a NAP. It is provided for guidance; a PWS must develop a site-specific NAP and map.

Example: Nitrification Action Plan Template
Chloramine-Effectiveness Sample Suite

Site	Chemical	Goal	Yellow Flag		Red Flag	
			Trigger	Actions	Trigger	Actions
Entry Point	Total / Mono	___ mg/L	___ mg/L		___ mg/L	
	Ammonia	___ mg/L	___ mg/L		___ mg/L	
Average water age	Total / Mono	___ mg/L	___ mg/L		___ mg/L	
	Ammonia	___ mg/L	___ mg/L		___ mg/L	
High water age	Total / Mono	___ mg/L	___ mg/L		___ mg/L	
	Ammonia	___ mg/L	___ mg/L		___ mg/L	
Nitrite/Nitrate						
Site	Chemical	Baseline	Yellow Flag		Red Flag	
			Trigger	Actions	Trigger	Actions
Entry Point	Nitrite	___ mg/L	___ mg/L		___ mg/L	
	Nitrate	___ mg/L	___ mg/L		___ mg/L	
Source water(s)	Nitrite	___ mg/L	___ mg/L		___ mg/L	
	Nitrate	___ mg/L	___ mg/L		___ mg/L	
Blended water	Nitrite	___ mg/L	___ mg/L		___ mg/L	
	Nitrate	___ mg/L	___ mg/L		___ mg/L	

Appendix B

HAWC Historical Lead and Copper Results

Sampling Locations - Hampstead	
Site ID	**Site Name**
1	10 VILLAGE GREEN /BLDG A UNIT 8
2	10 VILLAGE GREEN /BLDG B UNIT 6
3	10 VILLAGE GREEN BLDG B UNIT 2
4	10 VILLAGE GREEN /BLDG D UNIT 2
5	16 TANGLEWOOD DRIVE
6	22 TANGLEWOOD DRIVE
7	11 SQUIRE RIDGE ROAD
8	41 SCOTT DRIVE
9	48 SCOTT DR
10	25 WEST RD
11	8 MADISON DR
12	9 MADISON DR
13	233 EMERSON AVE
14	5 HOLLIS DR
15	6 HOLLIS DR
16	25 PARKLANE RD
17	39 SQUIRE RIDGE RD
18	2 MEREDITH DR
19	26 WEST RD
20	42 EMERSON AVE
21	187 E MAIN ST
22	172 BROWNHILL RD
23	43 HARPER RIDGE RD
24	70 HARPER RIDGE RD
25	82 HARPER RIDGE RD
26	13 LEWIS LANE /APT 13
27	8 HOLLIS DRIVE
28	16 PARKLANE RD
29	10 VILLAGE GREEN /BLDG B UNIT 8
30	64 INDIAN RIDGE RD
31	54 INDIAN RIDGE RD
32	5 BARTLETT RD
33	6 BARTLETT RD
34	26 WHEELWRIGHT RD
35	51 WHEELWRIGHT RD
36	6 SYLVESTER RD
37	60 GEISSER LN
38	166 WHEELWRIGHT RD
39	11 GRANITE CIRCLE
40	160 KENT FARM RD
41	13 CARRIAGE LN
42	55 GEISSER LN
43	3 CARRIAGE LN
44	45 GRANITE CIRCLE

Sampling Locations - Hampstead	
Site ID	**Site Name**
45	5 PAGE LN
46	108 LEDGEWOOD DR
47	221 KENT FARM RD
48	106 LEDGEWOOD DR
49	10 BARTLETT RD
50	25 PAGE LN
51	52 GRANITE CIRCLE
52	18 CARRIAGE LN

Sampling Data - Hampstead				
Site ID	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
52	9/27/2018	0	0	0.024
8	9/24/2018	0	0	0.047
11	9/24/2018	0	0	0.03
34	9/23/2018	0	0	0
10	9/22/2018	0	0	0.123
38	9/22/2018	0	0	0
47	9/22/2018	0	0	0
50	9/22/2018	0	0	0
14	9/21/2018	0	0	0.03
15	9/21/2018	0	0	0.04
19	9/21/2018	0	0	0.085
40	9/21/2018	0	0	0.012
41	9/21/2018	3	0.003	0.029
45	9/21/2018	0	0	0
46	9/21/2018	0	0	0.116
12	9/20/2018	5	0.005	0.07
27	9/20/2018	0	0	0.054
43	9/20/2018	0	0	0.04
48	9/20/2018	0	0	0.056
51	9/20/2018	0	0	0.03
39	9/19/2018	0	0	0.06
36	5/25/2018	0	0	0.075
43	5/25/2018	0	0	0.04
52	5/25/2018	0	0	0.027
3	5/24/2018	0	0	0.313
5	5/24/2018	0	0	0.026
6	5/24/2018	0	0	0.048
7	5/24/2018	0	0	0.109
11	5/24/2018	0	0	0.04
12	5/24/2018	5	0.005	0.11
13	5/24/2018	0	0	0.617
19	5/24/2018	0	0	0.067
22	5/24/2018	0	0	0.086
26	5/24/2018	4	0.004	0.053
27	5/24/2018	0	0	0.092
29	5/24/2018	2	0.002	0.382
31	5/24/2018	0	0	0.108
35	5/24/2018	0	0	0.126
39	5/24/2018	2	0.002	0.061
45	5/24/2018	0	0	0.088
50	5/24/2018	0	0	0.15
51	5/24/2018	0	0	0.037
10	12/18/2017	0	0	0.128
11	12/18/2017	1	0.001	0.032

Sampling Data - Hampstead				
Site ID	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
49	12/18/2017	1	0.001	0.151
38	12/15/2017	0	0	0
39	12/15/2017	0	0	0.049
45	12/15/2017	0	0	0.043
46	12/15/2017	1	0.001	0.121
13	12/14/2017	1	0.001	0.861
15	12/14/2017	0	0	0.034
22	12/14/2017	0	0	0.041
27	12/14/2017	0	0	0.059
29	12/14/2017	2	0.002	0.321
30	12/14/2017	7	0.007	0.086
34	12/14/2017	1	0.001	0.075
41	12/14/2017	1	0.001	0.026
43	12/14/2017	0	0	0.032
51	12/14/2017	0	0	0.058
52	12/14/2017	0	0	0.028
5	12/13/2017	0	0	0.024
6	12/13/2017	0	0	0.063
9	12/13/2017	0	0	0.032
17	12/13/2017	0	0	0.035
50	12/11/2014	5	0.005	0.715
8	12/10/2014	0	0	0.038
10	12/10/2014	2	0.002	0.365
12	12/10/2014	9	0.009	0.121
18	12/10/2014	3	0.003	0.138
22	12/10/2014	1	0.001	0.084
24	12/10/2014	0	0	0.104
26	12/10/2014	0	0	0.032
28	12/10/2014	7	0.007	0.198
32	12/10/2014	1	0.001	0.116
34	12/10/2014	0	0	0.176
36	12/10/2014	1	0.001	0.299
38	12/10/2014	0	0	0.184
44	12/10/2014	0	0	0.227
46	12/10/2014	0	0	0.253
48	12/10/2014	0	0	0.133
52	12/10/2014	0	0	0.115
14	12/9/2014	1	0.001	0.11
30	12/9/2014	0	0	0.073
17	12/23/2011	0	0	0.038
19	12/23/2011	0	0	0.054
25	12/23/2011	0	0	0.102
33	12/23/2011	0	0	0.484
41	12/23/2011	0	0	0.115

Sampling Data - Hampstead				
Site ID	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
7	12/22/2011	3	0.003	0.461
23	12/22/2011	0	0	0.058
31	12/22/2011	4	0.004	0.157
39	12/22/2011	0	0	0.15
49	12/22/2011	0	0	0.219
4	11/17/2010	3	0.003	0.593
6	11/17/2010	3	0.003	0.024
8	11/17/2010	3	0.003	0.042
10	11/17/2010	3	0.003	0.06
14	11/17/2010	3	0.003	0.071
18	11/17/2010	4	0.004	0.244
22	11/17/2010	3	0.003	0.06
26	11/17/2010	3	0.003	0.022
28	11/17/2010	3	0.003	0.074
30	11/17/2010	3	0.003	0.318
34	11/17/2010	3	0.003	0.407
36	11/17/2010	3	0.003	0.303
38	11/17/2010	3	0.003	0.049
46	11/17/2010	8	0.008	0.173
48	11/17/2010	3	0.003	0.431
50	11/17/2010	3	0.003	0.641
44	6/30/2009	5	0.005	0.04
45	6/30/2009	5	0.005	0.01
20	6/29/2009	5	0.005	0.017
25	6/29/2009	5	0.005	0.379
31	6/29/2009	5	0.005	0.038
35	6/29/2009	5	0.005	0.021
44	6/29/2009	5	0.005	0.018
22	6/25/2009	5	0.005	0.024
23	6/25/2009	5	0.005	0.191
24	6/25/2009	5	0.005	0.097
26	6/25/2009	5	0.005	0.219
36	6/25/2009	5	0.005	0.443
37	6/25/2009	5	0.005	0.252
42	6/25/2009	5	0.005	0.906
45	6/25/2009	5	0.005	0.383
10	6/24/2009	5	0.005	0.203
34	6/24/2009	5	0.005	0.379
38	6/24/2009	5	0.005	0.116
39	6/24/2009	5	0.005	0.132
40	6/24/2009	5	0.005	0.342
46	9/15/2008	5	0.005	0.367
6	9/14/2008	5	0.005	0.055
26	9/14/2008	5	0.005	0.173

Sampling Data - Hampstead				
Site ID	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
10	9/12/2008	5	0.005	0.171
19	9/12/2008	5	0.005	0.087
21	9/12/2008	5	0.005	0.433
22	9/12/2008	5	0.005	0.03
24	9/12/2008	5	0.005	0.274
30	9/12/2008	5	0.005	0.146
37	9/12/2008	5	0.005	0.207
39	9/12/2008	5	0.005	0.246
45	9/12/2008	5	0.005	0.545
47	9/12/2008	5	0.005	0.289
49	9/12/2008	5	0.005	0.698
52	9/12/2008	5	0.005	0.069
31	9/11/2008	5	0.005	0.036
38	9/11/2008	5	0.005	0.275
41	9/11/2008	5	0.005	0.014
42	9/11/2008	5	0.005	0.117
51	9/11/2008	5	0.005	0.113
34	9/10/2008	5	0.005	0.431
43	9/10/2008	5	0.005	0.091
44	9/10/2008	5	0.005	0.814
48	9/10/2008	5	0.005	0.776
23	9/9/2008	5	0.005	0.049
17	12/4/2007	5	0.005	0.047
19	12/4/2007	5	0.005	0.568
1	12/3/2007	5	0.005	4.7
3	12/3/2007	6	0.006	5.23
7	12/3/2007	5	0.005	0.325
13	12/3/2007	5	0.005	0.269
21	12/3/2007	5	0.005	0.084
23	12/3/2007	5	0.005	0.276
25	12/3/2007	5	0.005	0.059
29	12/3/2007	5	0.005	4.16
15	12/2/2007	5	0.005	0.22
27	11/30/2007	5	0.005	0.116
2	12/29/2006	5	0.005	0.3
8	12/29/2006	5	0.005	0.051
10	12/29/2006	5	0.005	0.629
14	12/29/2006	5	0.005	0.128
18	12/29/2006	5	0.005	0.145
22	12/29/2006	5	0.005	0.056
24	12/29/2006	5	0.005	0.297
26	12/29/2006	5	0.005	0.132
28	12/29/2006	5	0.005	0.072
30	12/29/2006	5	0.005	0.226

Sampling Data - Hampstead				
Site ID	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
9	9/28/2005	5	0.005	0.054
11	9/26/2005	9	0.009	1.38
5	9/15/2005	5	0.005	0.018
7	9/15/2005	6	0.006	0.924
8	9/15/2005	5	0.005	0.022
10	9/15/2005	5	0.005	0.087
13	9/15/2005	5	0.005	0.242
14	9/15/2005	5	0.005	0.121
15	9/15/2005	7	0.007	0.298
17	9/15/2005	5	0.005	0.107
21	9/15/2005	5	0.005	0.119
22	9/15/2005	5	0.005	0.072
23	9/15/2005	5	0.005	0.118
24	9/15/2005	5	0.005	0.272
25	9/15/2005	5	0.005	0.214
26	9/15/2005	5	0.005	0.032
27	9/15/2005	5	0.005	0.093
28	9/15/2005	10	0.01	0.013
30	9/15/2005	5	0.005	0.393
31	9/15/2005	5	0.005	0.01
13	6/22/2005	5	0.005	0.924
15	6/22/2005	5	0.005	0.438
17	6/22/2005	5	0.005	0.045
19	6/22/2005	5	0.005	0.017
21	6/22/2005	5	0.005	1.04
22	6/22/2005	5	0.005	0.067
24	6/22/2005	5	0.005	0.262
26	6/22/2005	5	0.005	0.061
27	6/22/2005	5	0.005	0.329
30	6/22/2005	5	0.005	0.147
5	6/21/2005	5	0.005	0.056
6	6/21/2005	5	0.005	0.043
7	6/21/2005	5	0.005	0.466
8	6/21/2005	5	0.005	0.015
10	6/21/2005	5	0.005	0.062
14	6/21/2005	5	0.005	0.383
23	6/21/2005	5	0.005	0.203
25	6/21/2005	5	0.005	0.365
28	6/21/2005	9	0.009	0.034
31	6/20/2005	5	0.005	0.463
20	9/4/2003	5	0.005	0.097
31	9/3/2003	5	0.005	0.066
6	9/2/2003	5	0.005	0.037
4	8/29/2003	5	0.005	0.405

Sampling Data - Hampstead				
Site ID	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
7	8/29/2003	5	0.005	1.9
10	8/29/2003	5	0.005	0.083
17	8/29/2003	5	0.005	0.051
19	8/29/2003	5	0.005	0.022
21	8/29/2003	5	0.005	0.251
23	8/29/2003	5	0.005	0.199
29	8/29/2003	5	0.005	3.56
30	8/29/2003	5	0.005	0.455
1	8/28/2003	11	0.011	3.79
2	8/28/2003	5	0.005	2.86
5	8/28/2003	5	0.005	0.1
8	8/28/2003	5	0.005	0.148
13	8/28/2003	5	0.005	1.83
22	8/28/2003	5	0.005	0.058
24	8/28/2003	5	0.005	0.323
25	8/28/2003	5	0.005	0.398
10	5/8/1995	1	0.001	1.69
13	5/8/1995	1	0.001	2.13
21	5/8/1995	1	0.001	0.5
22	5/8/1995	1	0.001	0.001
23	5/8/1995	1	0.001	0.001
24	5/8/1995	1	0.001	0.001
25	5/8/1995	1	0.001	0.001
26	5/8/1995	1	0.001	0.24
27	5/8/1995	1	0.001	0.99
28	5/8/1995	1	0.001	1.57
11	9/27/1994	3	0.003	0.8
13	9/27/1994	3	0.003	0.52
20	9/27/1994	1	0.001	0.67
1	6/7/1994	1	0.001	0.25
2	6/7/1994	1	0.001	0.001
3	6/7/1994	1	0.001	0.001
4	6/7/1994	1	0.001	0.001
5	6/7/1994	1	0.001	0.001
6	6/7/1994	1	0.001	0.001
7	6/7/1994	1	0.001	0.001
8	6/7/1994	1	0.001	0.11
9	6/7/1994	1	0.001	0.06
10	6/7/1994	1	0.001	2.78
11	6/7/1994	1	0.001	0.14
12	6/7/1994	1	0.001	0.5
13	6/7/1994	9	0.009	2.02
14	6/7/1994	1	0.001	0.08
15	6/7/1994	1	0.001	0.12

Sampling Data - Hampstead				
Site ID	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
16	6/7/1994	1	0.001	0.55
17	6/7/1994	1	0.001	0.68
18	6/7/1994	1	0.001	0.59
19	6/7/1994	1	0.001	0.04
20	6/7/1994	1	0.001	1.23
14	6/6/1994	5	0.005	1.08
15	6/6/1994	5	0.005	0.38
16	6/6/1994	5	0.005	0.46
17	6/6/1994	8	0.008	0.27
1	1/6/1994	1	0.001	0.69
2	1/6/1994	1	0.001	0.02
3	1/6/1994	1	0.001	0.02
4	1/6/1994	1	0.001	0.02
5	1/6/1994	1	0.001	0.05
6	1/6/1994	1	0.001	0.04
7	1/6/1994	1	0.001	0.03
8	1/6/1994	1	0.001	0.03
9	1/6/1994	1	0.001	0.04
10	1/6/1994	1	0.001	0.13
12	1/6/1994	1	0.001	0.12
18	1/6/1994	3	0.003	0.02
19	1/6/1994	3	0.003	0.02

Sampling Locations - Atkinson	
Site ID	Site Name
1	54 SAWYER AVE
2	56 SAWYER AVE
3	63 OLD COACH RD
4	59 OLD COACH RD
5	13 HOVEY MEADOW RD
6	14 MERRILL DR
7	45 WALKER RD
8	39 WALKER RD
9	10 CHRISTINE DR
10	4 ASPEN DR
11	10 ASPEN DR
12	50 APSEN DR
13	52 RIDGEWOOD DR
14	ATKINSON APT BLDG 6 APT 7
15	14 SAWMILL RD
16	61 SUMMIT DR
17	9 OLD COACH RD
18	25 HAWTHORNE DR
19	19 OLD COACH RD
20	32 OLD COACH RD
21	14 WOOD DRIVE
22	10 IRONWOOD LANE
23	47 RIDGEWOOD DR
24	5 OLD COACH RD
25	21 OLD COACH RD
26	BRYANT WOODS RD /CLUBHOUSE
27	29 OLD COACH RD
28	17 HOVEY MEADOW RD
29	30 WESTSIDE DR
30	46 WESTSIDE DR
31	10 MAPLE AVE
32	6 MAPLE AVE
33	39 SAWER AVE
34	35 MAIN ST

Lead & Copper Sampling Data - Atkinson				
Site	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
1	8/30/2018	0	0	0
28	8/30/2018	2	0.002	0.105
2	8/29/2018	0	0	0.037
12	8/29/2018	0	0	0
18	8/29/2018	0	0	0
22	8/29/2018	0	0	0.017
5	8/28/2018	3	0.003	0.079
7	8/24/2018	2	0.002	0.157
14	8/23/2018	2	0.002	0.056
31	8/23/2018	4	0.004	0.03
13	8/22/2018	4	0.004	0.048
15	8/22/2018	2	0.002	0.117
19	8/22/2018	2	0.002	0.19
3	8/21/2018	3	0.003	0.141
11	8/21/2018	0	0	0.032
17	8/21/2018	1	0.001	0.048
21	8/21/2018	1	0.001	0.103
27	8/21/2018	8	0.008	0.172
33	8/21/2018	0	0	0
9	8/20/2018	5	0.005	0.085
4	9/25/2015	2	0.002	0.161
8	9/25/2015	6	0.006	0.264
1	9/24/2015	0	0	0.011
2	9/24/2015	2	0.002	0.161
6	9/24/2015	1	0.001	0.148
12	9/24/2015	0	0	0.018
14	9/24/2015	14	0.014	0.254
20	9/24/2015	4	0.004	0.217
24	9/24/2015	2	0.002	0.307
10	9/23/2015	0	0	0.038
16	9/23/2015	3	0.003	0.847
22	9/23/2015	2	0.002	0.062
1	9/28/2012	4	0.004	0
2	9/28/2012	0	0	0
4	9/28/2012	4	0.004	0
6	9/28/2012	3	0.003	0
8	9/28/2012	3	0.003	0.22
12	9/28/2012	0	0	0
14	9/28/2012	6	0.006	0.2
18	9/28/2012	3	0.003	0
20	9/28/2012	3	0.003	0
7	9/27/2012	5	0.005	0.36
10	9/27/2012	0	0	0
5	9/26/2012	0	0	0

Lead & Copper Sampling Data - Atkinson				
Site	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
17	9/26/2012	5	0.005	0
19	9/26/2012	0	0	0
23	9/26/2012	7	0.007	0
25	9/26/2012	3	0.003	0.28
6	9/18/2009	5	0.005	0.091
12	9/18/2009	5	0.005	0.071
24	9/18/2009	5	0.005	0.469
28	9/18/2009	5	0.005	0.078
4	9/17/2009	5	0.005	0.061
10	9/17/2009	5	0.005	0.035
14	9/17/2009	18	0.018	0.122
16	9/17/2009	5	0.005	0.158
20	9/17/2009	5	0.005	0.102
22	9/17/2009	5	0.005	0.041
1	9/13/2006	6	0.006	0.086
19	9/12/2006	5	0.005	0.284
3	9/11/2006	5	0.005	0.041
7	9/11/2006	5	0.005	0.338
13	9/11/2006	5	0.005	0.05
15	9/11/2006	5	0.005	1.1
23	9/11/2006	6	0.006	0.068
24	9/11/2006	5	0.005	0.415
11	9/10/2006	5	0.005	0.037
5	9/8/2006	5	0.005	0.14
14	8/28/2003	16	0.016	0.137
8	8/25/2003	6	0.006	0.185
24	8/24/2003	5	0.005	0.124
6	8/22/2003	7	0.007	0.184
12	8/22/2003	5	0.005	0.034
16	8/22/2003	5	0.005	0.717
20	8/22/2003	5	0.005	0.178
22	8/22/2003	5	0.005	0.042
2	8/21/2003	5	0.005	0.349
10	8/21/2003	5	0.005	0.07
1	10/26/2000	5	0.005	0.043
3	10/26/2000	5	0.005	0.236
7	10/26/2000	5	0.005	0.218
9	10/26/2000	5	0.005	0.167
11	10/26/2000	12	0.012	0.116
13	10/26/2000	5	0.005	0.085
15	10/26/2000	5	0.005	0.211
17	10/26/2000	5	0.005	0.072
19	10/26/2000	5	0.005	0.083
28	10/26/2000	5	0.005	0.217

Lead & Copper Sampling Data - Atkinson				
Site	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
2	9/26/1997	5	0.005	0.1
4	9/26/1997	5	0.005	0.1
6	9/26/1997	5	0.005	0.1
8	9/26/1997	5	0.005	0.1
10	9/26/1997	5	0.005	0.1
12	9/26/1997	5	0.005	0.1
14	9/26/1997	5	0.005	0.16
16	9/26/1997	5	0.005	0.43
18	9/26/1997	5	0.005	0.21
20	9/26/1997	5	0.005	0.1
1	4/22/1996	1	0.001	0.001
6	4/22/1996	1	0.001	0.34
8	4/22/1996	1	0.001	0.13
9	4/22/1996	1	0.001	0.15
13	4/22/1996	1	0.001	0.001
16	4/22/1996	1	0.001	0.29
17	4/22/1996	1	0.001	0.001
19	4/22/1996	1	0.001	0.001
22	4/22/1996	1	0.001	0.1
27	4/22/1996	1	0.001	0.12
1	5/2/1995	1	0.001	0.001
3	5/2/1995	1	0.001	0.001
8	5/2/1995	1	0.001	0.001
17	5/2/1995	1	0.001	0.001
24	5/2/1995	1	0.001	0.001
7	5/1/1995	1	0.001	0.001
9	5/1/1995	1	0.001	0.13
11	5/1/1995	1	0.001	0.001
13	5/1/1995	1	0.001	0.001
26	5/1/1995	1	0.001	0.13
1	6/30/1994	1	0.001	0.31
2	6/30/1994	7	0.007	0.14
3	6/30/1994	4	0.004	0.19
4	6/30/1994	8	0.008	0.09
7	6/30/1994	8	0.008	0.24
8	6/30/1994	10	0.01	0.1
9	6/30/1994	1	0.001	0.12
10	6/30/1994	8	0.008	0.26
11	6/30/1994	1	0.001	0.06
12	6/30/1994	1	0.001	0.02
13	6/30/1994	7	0.007	0.001
15	6/30/1994	1	0.001	0.23
17	6/30/1994	6	0.006	0.02
18	6/30/1994	5	0.005	0.05

Lead & Copper Sampling Data - Atkinson				
Site	Sample Date	Lead, ppb	Lead, ppm	Copper, ppm
20	6/30/1994	2	0.002	0.04
22	6/30/1994	1	0.001	0.04
23	6/30/1994	1	0.001	0.001
24	6/30/1994	3	0.003	0.001
25	6/30/1994	1	0.001	0.13
26	6/30/1994	8	0.008	0.1
1	1/6/1994	5	0.005	0.08
2	1/6/1994	5	0.005	0.14
3	1/6/1994	5	0.005	0.06
4	1/6/1994	7	0.007	0.04
5	1/6/1994	5	0.005	0.08
6	1/6/1994	1	0.001	0.04
7	1/6/1994	1	0.001	0.07
8	1/6/1994	5	0.005	0.1
9	1/6/1994	5	0.005	0.07
10	1/6/1994	5	0.005	0.1
11	1/6/1994	5	0.005	0.2
12	1/6/1994	5	0.005	0.2
13	1/6/1994	5	0.005	0.2
14	1/6/1994	5	0.005	0.2
15	1/6/1994	5	0.005	0.2
16	1/6/1994	5	0.005	0.2
17	1/6/1994	1	0.001	0.12
18	1/6/1994	5	0.005	0.2
19	1/6/1994	1	0.001	0.15
20	1/6/1994	5	0.005	0.2

ATTACHMENT C

MSDC Agreement

Subject: Manchester Water Works

AGREEMENT

The State of New Hampshire and the Contractor hereby mutually agree as follows:

GENERAL PROVISIONS

1. **Identification.**

1.1 State Agency Name NH Department of Environmental Services		**1.2 State Agency Address** 29 Hazen Drive, Concord, NH 03301	
1.3 Contractor Name Manchester Water Works		**1.4 Contractor Address** 281 Lincoln St, Manchester, NH 03103	
1.5 Effective Date Upon G&C Approval	**1.6 Completion Date** December 31, 2058	**1.7 Audit Date** N/A	**1.8 Contract Limitation** $11,174,100
1.9 Contract Officer for State Agency Erin Holmes, Drinking Water & Groundwater Bureau, NH Department of Environmental Services		**1.10 State Agency. Telephone Number** 603-271-8321	
1.11 Contractor Signature William R Trombly		**1.12 Name & Title of Contractor Signor** William R. Trombly IR President	

1.13 Acknowledgment: State of ~~New Hampshire~~, County of Hillsborough

On 03/29/19, before the undersigned officer, personally appeared the person identified in block 1.12, or satisfactorily proven to be the person whose name is signed in block 1.11, and acknowledged that s/he executed this document in the capacity indicated in block 1.12.

1.13.1 Signature of Notary Public ~~or Justice of the Peace~~

[SEAL] Monique T. Dodd

MONIQUE T. DODD, Notary Public
State of New Hampshire
My Commission Expires August 26, 2020

1.13.2 Name & Title of Notary Public ~~or Justice of the Peace~~

Monique T. Dodd, M.W.W.O. Administrative Services Manager

1.14 State Agency Signature(s) Robert R Scott	**1.15 Name/Title of State Agency Signor(s)** Robert R. Scott, Commissioner NH Department of Environmental Services

1.16 Approval by Attorney General (Form, Substance and Execution)

By: (K. Allen Brooks) **On:** 4/2/19

1.17 Approval by the Governor and Executive Council

By: **On:**

2. **SCOPE OF WORK.** In exchange for contract funds provided by the state of New Hampshire, acting through the agency identified in block 1.1 (hereinafter referred to as "the State"), pursuant to RSA 21-O, the contractor identified in block 1.3 (hereinafter referred to as "the Contractor"), shall perform that work identified and more particularly described in the scope of work attached hereto as EXHIBIT A (the scope of work being referred to as "the Project").

3. **AREA COVERED.** Except as otherwise specifically provided for herein, the Contractor shall perform the Project in, and with respect to, the State of New Hampshire.

4. **EFFECTIVE DATE; COMPLETION OF PROJECT.**

4.1 This Agreement, and all obligations of the parties hereunder, shall become effective on the date in block 1.5 or on the date of approval of this Agreement by the Governor and Council of the State of New Hampshire (hereinafter referred to as the "Effective Date")

4.2 Except as otherwise specifically provided for herein, the Project, including all reports required by this Agreement, shall be completed in its entirety prior to the date in block 1.6 (hereinafter referred to as the "Completion Date")

5. **CONTRACT AMOUNT; LIMITATION ON AMOUNT; PAYMENT.**

5.1 The Contract Amount is identified and more particularly described in EXHIBIT B, attached hereto.

5.2 The manner of, and schedule of payment shall be as set forth in EXHIBIT B.

5.3 In accordance with the provisions set forth in EXHIBIT B, and in consideration of the satisfactory performance of the Project, as determined by the State, and as limited by subparagraph 5.5 of these general provisions, the State shall pay the Contractor the Contract Amount.

5.4 The payment by the State of the Contract amount shall be the only, and the complete, compensation to the Contractor for all expenses, of whatever nature, incurred by the Contractor in the performance hereof, and shall be the only, and the complete, compensation to the Contractor for the Project. The State shall have no liabilities to the Contractor other than the Contract Amount.

5.5 Notwithstanding anything in this Agreement to the contrary, and notwithstanding unexpected circumstances, in no event shall the total of all payments authorized, or actually made, hereunder exceed the Contract limitation set forth in block 1.8 of these general provisions.

6. **COMPLIANCE BY CONTRACTOR WITH LAWS AND REGULATIONS.** In connection with the performance of the Project, the Contractor shall comply with all statutes, laws, regulations, and orders of federal, state, county, or municipal authorities, which shall impose any obligations, or duty upon the Contractor, including the acquisition of any and all necessary permits.

7. **RECORDS AND ACCOUNTS.**

7.1 Between the Effective Date and the date seven (7) years after the Completion Date the Contractor shall keep detailed accounts of all expenses incurred in connection with the Project, including, but not limited to, costs of administration, transportation, insurance, telephone calls, and clerical materials and services. Such accounts shall be supported by receipts, invoices, bills and other similar documents.

7.2 Between the Effective Date and the date seven (7) years after the Completion Date, at any time during the Contractor's normal business hours, and as often as the State shall demand, the Contractor shall make available to the State all records pertaining to matters covered by this Agreement. The Contractor shall permit the State to audit, examine, and reproduce such records, and to make audits of all contracts, invoices, materials, payrolls, records or personnel, data (as that term is hereinafter defined), and other information relating to all matters covered by this Agreement. As used in this paragraph, "Contractor" includes all persons, natural or fictional, affiliated with, controlled by, or under common ownership with, the entity identified as the Contractor in block 1.3 of these general provisions.

8. **PERSONNEL.**

8.1 The Contractor shall, at its own expense, provide all personnel necessary to perform the Project. The Contractor warrants that all personnel engaged in the Project shall be qualified to perform such Project, and shall be properly licensed and authorized to perform such Project under all applicable laws.

8.2 The Contractor shall not hire, and it shall not permit any subcontractor, subcontractor, or other person, firm or corporation with whom it is engaged in a combined effort to perform such Project, to hire any person who has a contractual relationship with the State, or who is a State officer or employee, elected or appointed.

8.3 The Contractor officer shall be the representative of the State hereunder. In the event of any dispute hereunder, the interpretation of this Agreement by the Contractor Officer, and his/her decision on any dispute, shall be final.

9. **DATA; RETENTION OF DATA; ACCESS.**

9.1 As used in this Agreement, the word data shall mean all information and things developed or obtained during the performance of, or acquired or developed or obtained during the performance of, or acquired or developed by reason of, this Agreement, including, but not limited to, all studies, reports, files, formulae, surveys, maps, charts, sound recordings, video recordings, pictorial reproductions, drawings, analyses, graphic representations, computer programs, computer printouts, notes, letters, memoranda, papers, and documents, all whether finished or unfinished.

9.2 Between the Effective Date and the Completion Date the Contractor shall contract to the State, or any person designated by it, unrestricted access to all data for examination, duplication, publication, translation, sale, disposal, or for any other purpose whatsoever.

9.3 No data shall be subject to copyright in the United States or any other country by anyone other than the State.

9.4 On and after the Effective Date all data, and any property which has been received from the State or purchased with funds provided for that purpose under this Agreement, shall be the property of the State, and shall be returned to the State upon demand or upon termination of this Agreement for any reason, whichever shall first occur.

9.5 The State, and anyone it shall designate, shall have unrestricted authority to publish, disclose, distribute and otherwise use, in whole or in part, all data.

10. **CONDITIONAL NATURE OR AGREEMENT.** Notwithstanding anything in this Agreement to the contrary, all obligations of the State hereunder, including without limitation, the continuance of payments hereunder, are contingent upon the availability or continued appropriation of funds, and in no event shall the State be liable for any payments hereunder in excess of such available or appropriated funds. In the event of a reduction or termination of those funds, the State shall have the right to withhold payment until such funds become available, if ever, and shall have the right to terminate this Agreement immediately upon giving the Contractor notice of such termination.

11. **EVENT OF DEFAULT; REMEDIES.**

11.1 Any one or more of the following acts or omissions of the Contractor shall constitute an event of default hereunder (hereinafter referred to as "Events of Default"):

11.1.1 failure to perform the Project satisfactorily or on schedule; or

11.1.2 failure to submit any report required hereunder; or

11.1.3 failure to maintain, or permit access to, the records required hereunder; or

11.1.4 failure to perform any of the other covenants and conditions of this Agreement.

11.2 Upon the occurrence of any Event of Default, the State may take any one, or more, or all, of the following actions:

11.2.1 give the Contractor a written notice specifying the Event of Default and requiring it to be remedied within, in the absence of a greater or lesser specification of time, thirty (30) days from the date of the notice; and if the Event of Default is not timely remedied, terminate this Agreement, effective two (2) days after giving the Contractor notice of termination; and

11.2.2 give the Contractor a written notice specifying the Event of Default and suspending all payments to be made under this Agreement and ordering that the portion of the contract amount which would otherwise accrue to the Contractor during the period from the date of such notice until such time as the State determines that the Contractor has cured the Event of Default shall never be paid to the Contractor; and

11.2.3 set off against any other obligation the State may owe to the Contractor any damages the State suffers by reason of any Event of Default; and

11.2.4 treat the Agreement as breached and pursue any of its remedies at law or in equity, or both.

12. **TERMINATION.**

12.1 In the event of any early termination of this Agreement for any reason other than the completion of the Project, the Contractor shall deliver to the Contract Officer, not later than fifteen (15) days after the date of termination, a report ("Termination Report") describing in detail all Project Work performed, and the Contract Amount earned, to and including the date of termination.

12.2 In the event of Termination under paragraphs 10 or 12.4 of these general provisions, the approval of such a Termination Report by the State shall entitle the Contractor to receive that portion of the Contract amount earned to and including the date of termination.

12.3 In the event of Termination under paragraphs 10 or 12.4 of these general provisions, the approval of such a Termination Report by the State shall in no event relieve the Contractor from any and all liability for damages sustained

or incurred by the State as a result of the Contractor's breach of its obligations hereunder.

12.4 Notwithstanding anything in this Agreement to the contrary, either the State or except where notice default has been given to the Contractor hereunder, the Contractor, may terminate this Agreement without cause upon thirty (30) days written notice.

13. **CONFLICT OF INTEREST.** No officer, member or employee of the Contractor and no representative, officer of employee of the State of New Hampshire or of the governing body of the locality or localities in which the Project is to be performed, who exercises any functions or responsibilities in the review or approval of the undertaking or carrying out of such Project, shall participate in any decision relating to this Agreement which affects his or her personal interests or the interest of any corporation, partnership, or association in which he or she is directly or indirectly interested, nor shall he or she have any personal or pecuniary interest, direct or indirect, in this Agreement or the proceeds thereof.

14. **CONTRACTOR'S RELATION TO THE STATE.** In the performance of this Agreement the Contractor, its employees, and any subcontractor or subcontractor of the Contractor are in all respects independent contractors, and are neither agents nor employees of the State. Neither the Contractor nor any of its officers, employees, agents, members, subcontractors or subcontractors, shall have authority to bind the State nor are they entitled to any of the benefits, workers' compensation or emoluments provided by the State to its employees.

15. **ASSIGNMENT AND SUBCONTRACTS.** The Contractor shall not assign, or otherwise transfer any interest in this Agreement without the prior written consent of the State. None of the Project Work shall be subcontracted or subcontractor by the Contractor other than as set forth in Exhibit A without the prior written consent of the State.

16. **INDEMNIFICATION.** The Contractor shall defend, indemnify and hold harmless the State, its officers and employees, from and against any and all losses suffered by the State, its officers and employees, and any and all claims, liabilities or penalties asserted against the State, its officers and employees, by or on behalf of any person, on account of, based on or resulting from, arising out of (or which may be claimed to arise out of) the acts or omissions of the Contractor of Subcontractor, or subcontractor or other agent of the Contractor. Notwithstanding the foregoing, nothing herein contained shall be deemed to constitute a waiver of the sovereign immunity of the State, which immunity is hereby reserved to the State. This covenant shall survive the termination of this Agreement.

17. **INSURANCE AND BOND.**

17.1 The Contractor shall, at its sole expense, obtain and maintain in force, or shall require any subcontractor, subcontractor or assignee performing Project work to obtain and maintain in force, both for the benefit of the State, the following insurance:

17.1.1 statutory workers' compensation and employees liability insurance for all employees engaged in the performance of the Project, and

17.1.2 comprehensive public liability insurance against all claims of bodily injuries, death or property damage, in amounts not less than $2,000,000 for bodily injury or death any one incident, and $500,000 for property damage in any one incident; and

17.2 The policies described in subparagraph 18.1 of this paragraph shall be the standard form employed in the State of New Hampshire, issued by underwriters acceptable to the State, and authorized to do business in the State of New Hampshire. Each policy shall contain a clause prohibiting cancellation of modification of the policy earlier than ten (10) days after written notice the of has been received by the State.

18. **WAIVER OF BREACH.** No failure by the State to enforce any provisions hereof after any Event of Default shall be deemed a waiver of its rights with regard to that Event, or any subsequent Event. No express waiver of any Event of Default shall be deemed a waiver of any provisions hereof. No such failure or waiver shall be deemed a waiver of the right of the State to enforce each and all of the provisions hereof upon any further or other default on the part of the Contractor.

19. **NOTICE.** Any notice by a party hereto the other party shall be deemed to have been duly delivered or given at the time of mailing by certified mail, postage prepaid, in a United States Post Office addressed to the parties at the addresses first above given.

20. **AMENDMENT.** This Agreement may be amended, waived or discharged only by an instrument in writing signed by the parties hereto and only after approval of such amendment, waiver or discharge by the Governor and Council of the State of New Hampshire.

21. **CONSTRUCTION OF AGREEMENT AND TERMS.** This Agreement shall be construed in accordance with the law of the State of New Hampshire, and is binding upon and inures to the benefit of the parties and their respective successors and assignees. The captions and contents of the "subject" blank are used only as a matter of convenience, and are not to be considered a part of this Agreement or to be used in determining the intent of the parties hereto.

22. **THIRD PARTIES.** The parties hereto do not intend to benefit any third parties and this Agreement shall not be construed to confer any such benefit.

23. **ENTIRE AGREEMENT.** This Agreement, which may be executed in a number of counterparts, each of which shall be deemed an original, constitutes the entire Agreement and understanding between the parties, and supersedes all prior Agreements and understandings relating hereto.

ATTACHMENT C

EXHIBIT A

SCOPE OF SERVICES

DEFINITIONS:

"Agreement" means this agreement including all exhibits to the agreement.

"Average Daily Flow" or "ADF" means the total volume of water measured in gallons or cubic feet at a metering station or stations during the two highest consecutive MWW monthly billing periods divided by the actual number of days in the applicable billing periods.

"Capacity" means the ability to provide a specified amount of water.

"DES" or the "Department" means the N.H. Dept. of Environmental Services.

"Fund" means the New Hampshire Drinking Water and Groundwater Trust Fund established in RSA 6-D.

"In-town rate" means the retail rate charged to MWW customers within the geographic boundary of the City of Manchester.

"Maximum Daily Flow" or "MDF" means the highest total volume of water measured in gallons or cubic feet at a Project metering station over any consecutive twenty-four (24) hour period.

"Merrimack Source Development Charge" or "MSDC" means a capital charge assessed by MWW in accordance with Manchester Water Works Rules and Regulations, RSA 38:27 and RSA 38:28 for the purpose of constructing, acquiring, improving, enlarging and/or operating the Manchester Water Works system. Specifically, all funds collected from the MSDC will be utilized to develop the Merrimack River as an additional source of supply for MWW.

"MGD" means million gallons per day.

"Out-of-Town rate" means the rate charged by MWW to retail franchise customers outside the geographic boundary of the City of Manchester.

"Phase 1" means the time period beginning on December 31, 2020[1] and ending at the beginning of Phase 2 unless the parties hereto agree to an earlier date.

[1] Although the firm deadline for Phase 1 is December 31, 2020, all parties must make all reasonable efforts to complete Phase 1 improvements by May 1, 2020 as indicated in Article II.B.2 of the SIA.

Grantee Initials MRT
Date 3-29-19

"Phase 2" means the time period beginning on December 31, 2023, and ending at the termination of this Agreement unless the parties hereto agree to an earlier date.

"Project" means the Southern New Hampshire Regional Water Interconnection Project identified in the Memorandum of Understanding ("MOU") signed by the Department on October 5, 2018, and also signed by Manchester Water Works ("MWW"), the Town of Derry ("Derry"), the Town of Salem ("Salem"), the Town of Windham ("Windham"), Pennichuck East Utilities ("PEU"), the Hampstead Area Water Company, Inc. ("HAWC"), and the Town of Plaistow ("Plaistow"), and as further identified in an Agreement Regarding Southern New Hampshire Regional Water Interconnection Project or "Southern Interconnection Agreement" ("SIA") as further described below.

"SIA" means the "Agreement Regarding Southern New Hampshire Regional Water Interconnection Project" or "Southern Interconnection Agreement" to be signed by the Water Recipients, MWW, PEU and Derry, or similar parties, pursuant to RSA 53-A.

"Tariff" means rules and regulations of MWW.

"Water" means potable water.

"Water Recipients" means Salem, Windham, HAWC, and Plaistow.

"Waterworks" means facilities for collection, storage, supply, distribution, treatment, pumping, metering or transmission of water.

PURPOSE:

The purpose of this Agreement is to further the Project. Specifically, the Fund, through the Department, is providing $11,174,100 to MWW to ensure that MWW makes up to 3.13 MGD of capacity available for the Project, with the MSDC corresponding to said capacity to be paid by the Water Recipients in the manner and at the prices specified below. The actual amount of capacity so reserved will depend on the date on which the Department transfers $11,174,100 to MWW as described below.

REQUIREMENTS:

1. The Fund, through the Department, shall be under no obligation to provide funds to MWW unless the Department obtains and approves a properly executed agreement

Grantee Initials WJT
Date 3-29-19

binding the Water Recipients and Derry to abide by the terms set forth herein and in the SIA. The determination as to whether the Water Recipients and Derry have bound themselves to abide by the terms set forth herein and in the SIA shall be in the sole discretion of the Department. However, if the Department does not obtain such agreement by December 31, 2019, this Agreement shall become null and void.

2. If the Fund, through the Department, transfers $11,174,100 to MWW prior to June 1, 2019, MWW shall upon receipt of those funds, begin to develop and reserve capacity in a manner necessary to ensure that 1.00 MGD ADF and 1.30 MGD MDF is available to the Project at the transfer of such funds and through the end of Phase 1, and to ensure that 3.13 MGD ADF and 4.07 MGD MDF of water is available to the Project at the start of Phase 2 and thereafter. If the Department transfers $11,174,100 to MWW on or after June 1, 2019, MWW shall immediately upon receipt of those funds, begin to develop and reserve capacity for the Project in an amount equivalent to that which could be purchased for said amount at the prevailing MSDC rate at the time of purchase to ensure that the above-stated ADF and MDF amounts are available to the Project at the above-stated times. All payments are contingent on approval by the Governor and Executive Council.
3. The procurement of MSDC capacity described herein is in addition to any pre-existing or separate agreement that a Water Recipient or Derry may have with MWW for capacity procurement which is unrelated to or outside of the scope of the Project.
4. If the Department transfers $11,174,100 to MWW prior to June 1, 2019, the Department shall be charged the 2018 MSDC rate, and MWW shall make capacity available to the Project in the manner set forth below. If the Department transfers $11,174,100 to MWW on or after June 1, 2019, the Department shall be charged the prevailing MSDC rate, and the amount of capacity that MWW must provide shall be adjusted accordingly.
5. Upon execution of this Agreement and subject to Paragraphs 6 and 7 below, MWW shall make the full amount of capacity related to the Project available for purchase to the Water Recipients. Use of such capacity shall be governed by the SIA. Although MWW shall sell capacity to the Water Recipients according to the following allocations, MWW's only obligation, unless otherwise specifically stated herein, shall be to deliver water for use by the Project to the Derry water system in an amount equal to 1.00 MGD ADF and 1.30 MGD MDF at the time of the transfer of funds described above and through the end of Phase 1, and 3.13 MGD ADF and 4.07 MGD MDF at the start of Phase 2 and thereafter.
6. Subject to the second sentence of Sections 2 and 4, MWW shall make capacity available for purchase by the Water Recipients for use beginning after the transfer of funds described above and through the end of Phase 1 in the following manner:
    a. Capacity in the amount of 0.30 MGD ADF (0.39 MGD MDF) shall be made available for purchase by Salem.

Grantee Initials WRH
Date 3-29-19

b. Capacity in the amount of 0.20 MGD ADF (0.26 MGD MDF) shall be made available for purchase by Windham or Salem, in either case for use within the geographical boundaries of Windham.

c. Capacity in the amount of 0.25 MGD ADF (0.33 MGD MDF) shall be made available for purchase by HAWC.

d. Capacity in the amount of 0.25 MGD ADF (0.33 MGD MDF) shall be made available for purchase by Plaistow.

7. Subject to the second sentences of Sections 2 and 4, MWW shall make additional capacity available for purchase to the Water Recipients for use in Phase 2 and thereafter in the following manner:

   a. Capacity in the amount of 1.20 MGD ADF (1.56 MGD MDF) shall be made available for purchase by Salem. This amount is in addition to the Phase 1 capacity allotted to Salem.

   b. Capacity in the amount of 0.11 MGD ADF (0.14 MGD MDF) shall be made available to Windham or Salem, in either case for use within the geographical boundaries of Windham. This amount shall be in additional to the Phase 1 capacity allotted for use within Windham.

   c. Capacity in the amount of 0.50 MGD ADF (0.65 MGD MDF) shall be made available for purchase by HAWC. This amount is in addition to the Phase 1 capacity allotted to HAWC.

   d. Capacity in the amount of 0.32 MGD ADF (0.42 MGD MDF) shall be made available for purchase by Plaistow. This amount is in addition to the Phase 1 capacity allotted to Plaistow.

8. The MSDC rate charged by MWW to the Water Recipients for any capacity purchased prior to June 30, 2019, shall be $3.57 per gallon per day. If a Water Recipient purchases 100% of its allotted Phase 1 capacity prior to June 30, 2019, the MSDC rate charged by MWW to that Recipient for any portion of its allotted Phase 2 capacity shall be $3.57 per gallon per day provided such capacity is purchased no later than sixty (60) days after the date the New Hampshire Drinking Water and Groundwater Trust Fund Advisory Commission votes to fund Phase 2 of the Project. Otherwise, the rate charged by MWW for capacity purchases shall be MWW's prevailing MSDC rate.

9. To the extent any Water Recipient does not purchase the portion of the Phase 1 capacity allotted to it above by May 1, 2022, MWW shall make the unsold portion available to all of the Water Recipients on a first-come, first-served basis.

10. To the extent any Water Recipient does not purchase the portion of the Phase 2 capacity allotted to it above by May 1, 2025, MWW shall make the unsold portion available to all of the Water Recipients on a first-come, first-served basis.

Grantee Initials WRT Jr.
Date 3-25-19

11. Any sales by MWW of capacity to any Water Recipient shall be made from the capacity reserved by this agreement up to the limit of the total capacity available for the Project as set forth herein until all of this capacity is sold. Sales of additional capacity beyond the total capacity identified herein shall be handled by MWW in the same manner as any other sale of its capacity. Upon termination of this Agreement, MWW shall transfer any un-purchased capacity associated with the Agreement to the party or parties within the Project area designated by the Department and upon payment terms determined by the Department.
12. MWW shall read the meter at the Londonderry-Derry town line and at the Derry-Windham town line to determine the amount of Project water flowing through the Derry water system and received by Salem at the Derry-Windham town line. MWW shall then bill Salem directly for the amount of water received by Salem. Said billings shall reflect the rates to be paid by Salem under this Agreement and the SIA. Upon receipt of payment, MWW shall remit to Derry the amount that Derry is due under the SIA. MWW shall invoice Salem on a monthly basis in arrears. Payments on such invoices shall be made within thirty (30) days.
13. MWW shall remit to the Trust Fund all of the money received from the Water Recipients for their capacity purchases described in this Agreement less an administrative fee of one tenth of one percent (0.1%). Such remittance shall be made within thirty (30) days of payment by a Water Recipient to MWW.
14. By ensuring capacity as described above, and subject to Sections 2 and 4 and the capital improvement funding provisions in Article II of the SIA, MWW shall ensure the ability to deliver an equivalent amount of water to the Project; specifically up to a total of 1.00 MGD ADF and up to a total of 1.30 MGD MDF beginning at the transfer of funds and through the end of Phase 1 of the Project. MWW shall further ensure the ability to deliver a total of up to 3.13 MGD ADF and up to a total of 4.07 MGD MDF of water to the Project at the start of Phase 2 and thereafter. All such water deliveries by MWW shall be made in the manner set forth herein and in accordance with water system industry practice and MWW's applicable tariff provisions, water delivery rules, regulations, procedures, and restrictions. MWW shall complete all capital improvements necessary to supply this water.
15. MWW will monitor and report to the Department on a quarterly basis the status of all capacity purchases related to the Project.
16. MWW will notify any Water Recipient if it is using water in an amount that exceeds the level of water use for which the Water Recipient purchased capacity. MWW may also notify any Water Recipient that the Water Recipient is about to exceed the level of water use for which the Water Recipient purchased capacity.
17. **MWW shall provide water to the Water Recipients under the following terms and conditions unless otherwise specified in the SIA:**

Grantee Initials WRT
Date 3-29-19

17. 1. **Limitation of Rights -** Nothing in this Agreement is intended as a grant by MWW of any exclusive right or privilege. In any period in which a Water Recipient receives water pursuant to this Agreement, the Water Recipient shall comply in all respects with applicable provisions of MWW's Tariff, except as otherwise specified herein.

17. 2. **Charges and Fees** – Timely payments of all charges described in this Agreement shall be made in accordance with the terms of this Agreement.

17. 3. **Quantity of Water** –For purposes of the Project, MWW shall have no responsibility to supply water in excess of the amounts stated in this Agreement. In addition, regardless of which Water Recipient purchases the capacity under this Agreement, MWW shall only be responsible for ensuring that such water is supplied to the metering point where water is currently delivered from MWW to Derry, the meter located at New Hampshire Route 28 (Rockingham Road) at the Londonderry-Derry town line.

17.4. **Capacity Rights Not Assignable** – Once purchased, a Water Recipient may not assign its water quantity rights to another party without the express written consent of the Department except that any town may assign its rights to an entity providing water within its town boundary without such consent. If a Water Recipient makes an assignment of capacity rights without necessary consent, such assignment shall be null and void. The Water Recipients may only use or distribute water from the capacity purchased from MWW pursuant to this Agreement within the geographical boundaries of the towns of Derry, Salem, Windham, Atkinson, Hampstead, and Plaistow.

17.5. **Control of System Leaks and Wasteful Use** – The Water Recipients shall operate and maintain their waterworks in accordance with customary engineering and waterworks practices and with the guidelines set forth below.

The Water Recipients shall minimize any wasteful use of water within their service areas.

In any period in which a Water Recipient receives water from the capacity purchased pursuant to this Agreement, the Water Recipient shall impose the same voluntary or mandatory restrictions on water use by its customers (e.g. sprinkling bans) as MWW shall impose on its franchise customers within one week of being informed of such imposition by MWW. The imposition and removal of any restrictions shall be within the sole and exclusive discretion of MWW. Nothing in this Agreement shall prevent the Water Recipients from imposing their own restrictions which are more restrictive than those imposed by MWW.

17.6. **Conformance of Law** – The Water Recipients shall comply and shall make all reasonable efforts to ensure that their customers and any private water systems connected to them comply with all applicable laws of the United States and of the State of New Hampshire, including but not limited to all applicable rules and regulations of

Grantee Initials WRT/m.
Date 3-29-19.

the Department, and all applicable rules and regulations of the New Hampshire Public Utilities Commission (NHPUC). If, after sixty (60) days' written notice from MWW of a known violation, any Water Recipient fails to comply or to make prompt, substantial or reasonable efforts to comply within such time, the Water Recipient may forfeit the right to receive water under this Agreement until such time as they demonstrate compliance.

17.7. **Quality of Water** - MWW shall make all reasonable effort and shall maintain and operate the supply system so as to supply water meeting the drinking water quality criteria established from time to time by the United States Environmental Protection Agency (EPA) and the Department. This obligation shall be limited to the water when it is supplied to the metering point where water is delivered from MWW to Derry on New Hampshire Route 28 (Rockingham Road) at the Londonderry-Derry town line.

17.8. **Construction of Connection** - Any and all connections between MWW's waterworks and Derry's waterworks, including modifications or upgrades which may be necessary to effectuate this Agreement, including but not limited to meter vaults and metering devices, shall be designed by Derry, or after notification to MWW, constructed by any subcontractors as Derry shall choose to employ subject to the requirements of Derry's municipal procurement code, such decision to be made by Derry. The cost of all design and construction undertaken to construct, modify or upgrade the connection of MWW's waterworks to Derry's waterworks, including the purchase of metering devices and appurtenances, shall be paid by the Project either through the Fund or the Water Recipients. The necessity of and selection of all materials and equipment and the location thereof shall be decided by Derry upon approval of MWW. Such approval shall not be unreasonably withheld.

17.9. **Ownership of Connection Facilities** - Piping, valves and vaults constructed to make the connection necessary beyond the Londonderry-Derry town line shall be the property of the individual Water Recipients and shall be maintained by each Water Recipient.

17.10. **Maintenance of Metering Devices**

Any and all metering devices installed pursuant to this Agreement shall be inspected and calibrated by the party owning the metering device in the manner provided by regulations of the NHPUC. The cost for inspection and calibration will be the responsibility of the party owning the meter. Each party conducting such inspection and calibration shall cause a copy of its inspection and calibration reports to be filed at MWW's offices. Said reports shall be available for examination by any Water Recipient, Derry, or the Department at the offices of MWW during normal business hours.

Grantee Initials _____
Date 3-29-19.

MWW may request any Water Recipient or Derry to test and certify the accuracy of any metering device at any time. MWW must submit such requests in writing to the party. If the metering device reads within specifications accepted by the NHPUC, the cost of such tests shall be borne by MWW. If the average error over different test rates is greater than that allowed by the NHPUC, the cost of the tests shall be paid by the relevant party.

In the case of missing or inaccurate flow records, due to faulty metering device operation or other circumstances, an estimate of flow shall be made by MWW based on past records for a comparable period. The estimates shall be used by MWW to calculate the amount of payments due from Salem for water usage only, not MSDC.

17.11. **Records, Calculations** - MWW shall maintain records of all calculations in determining capacity for all Water Recipients, and these records shall be available for inspection by any Water Recipient or the Department at the office of MWW during normal business hours. The Department may also require MWW to send such records to it electronically. Said records shall be available for inspection by other parties only upon presentation to MWW of a written authorization from the Department or a Water Recipient.

17.12. **Responsibility for System Operation and Maintenance** - MWW assumes no responsibility for operation and maintenance of waterworks constructed and owned by any other party. MWW's sole duty hereunder shall be to make capacity available and supply water up to the maximum amounts specified in this Agreement at the locations specified subject to the terms and conditions contained in this Agreement.

17.13. **Impairment of Supply** - Existing customers of MWW have first right to any water supplied by MWW, and this Agreement shall not impair the supply of water to them. If MWW is unable to supply both its other customers and the Water Recipients with water for any reason other than the negligence of MWW, the Water Recipients cannot compel MWW to supply them with water, nor shall they be entitled to any damages from MWW as a result of MWW's failure to supply them with water. MWW shall not make such demand upon the Water Recipients until it has made reasonable attempts to seek reductions in demand from its existing customers unless the cause of such impairment is isolated to the Water Recipients' supply from MWW. In addition, MWW cannot be compelled to furnish the Water Recipients with water if MWW's waterworks or the source upon which MWW is dependent for its supply of water is impaired, and the Water Recipients shall be entitled to no damages from MWW as a result of MWW's failure to supply them with water, except in the case of MWW's negligence or intentional acts as indicated in section 17.15. MWW shall be the sole judge as to whether the water available to it is adequate to supply both the Water Recipients and MWW's other customers and whether MWW's waterworks or source of supply is impaired, which decision shall be final and binding on the Water Recipients.

Grantee Initials GET A.
Date 3-29-19

Notwithstanding the foregoing, if MWW reduces the amount of water which it supplies to the Water Recipients pursuant to this Section, such reduction shall be proportional to reductions made to each other wholesale customer of MWW, based on the average amount of water received by each wholesale customer during the ninety (90) days preceding such reduction from MWW.

17.14. **Liability for Accident** - Neither MWW, the Department, nor the Water Recipients shall be liable in damages or otherwise for failure to perform any obligation under this Agreement, which failure is occasioned by or in consequence of any act of God, act of public enemy, wars, blockades, insurrections, riots, epidemics, landslides, lightning, earthquakes, drought, fires, storms, floods, winter freeze, washouts, vandalism, arrests and restraints of rulers and peoples, civil disturbances, labor strikes, power failures, explosions, breakage or accident to machinery or lines of pipe, failure or want of water supply, the binding order of any court or governmental authority which has been resisted in good faith by all reasonable legal means, and any other cause, whether of the kind herein enumerated or otherwise, not within the control of such party and which act, omission or circumstances such party is unable to prevent or overcome by the exercise of reasonable care.

17.15. **Liability Resulting from Negligence and Intentional Acts** – No party shall be relieved of liability for loss resulting from its negligence, intentional actions, or its failure to use due diligence to remedy the situation and remove the cause in an adequate manner and with all reasonable dispatch, nor shall such causes or contingencies affecting performance relieve any Water Recipient from its obligations to make payments of amounts then due with respect to water theretofore supplied.

17.16. **Notices** - All notices and other writings sent pursuant to this Agreement shall be addressed to the Director of MWW at:

Manchester Water Works

Attention: Director

281 Lincoln Street

Manchester, NH 03103

and to Derry at:

Derry Department of Public Works

Attention: Director

14 Manning Street

Grantee Initials WRH

Date 3-29-15

Derry, NH 03038

and to Salem at: Salem Municipal Services Department
Attention: Director of Municipal Services
21 Cross Street
Salem, NH 03079

and to HAWC at: Hampstead Area Water
Attention: President
54 Sawyer Ave.
Atkinson, NH 03811

and to Plaistow at: Town of Plaistow
Attention: Town Manager
145 Main Street
Plaistow, NH 03865

and to Windham at: Town of Windham
Attention: Town Administrator
3 N Lowell Road
Windham, NH 03087

17.17. **Rate per 100 Cubic Feet (CCF)** –Rates charged by MWW for all water related to the Project shall be calculated in the manner described in Exhibit C to this Agreement.

17.18. **Purchase of Additional Capacity** –Capacity purchases related to the Project shall be limited to the amounts as set forth above and in no event shall they be more than the

Grantee Initials LRT Jr.
Date 3·29·19

equivalent of 3.13 MGD in the aggregate. Purchase of additional capacity beyond Project limits, including penalties for exceeding allotted capacity, shall be in accordance with MWW's normal practices and procedures unless otherwise specified herein.

17.19. **Excess Use** – Should the Project use water supplied by MWW in excess of 1.0 MGD ADF and 1.3 MGD MDF prior to the end of Phase 1, or in excess of 3.13 MGD ADF and 4.07 MDG MDF during Phase 2 and thereafter, and if MWW in its absolute discretion agrees to supply such additional water, MWW may identify the Water Recipient that used water in excess of its capacity obtained through this Agreement and the SIA. Any Water Recipient so identified by MWW under this section, shall pay an "excess water use charge" directly to MWW in addition the charge for water already being paid by the Water Recipient. The amount of the "excess water use charge" shall be equal to the water rate then being charged by MWW and shall be applied to the amount of water exceeding the Water Recipient's allotted capacity. Nothing in this section shall be construed as giving any Water Recipient or the Project a right to water supply or capacity in excess of the limits specified herein. MWW shall have sole and exclusive discretion as to the determination of the available water in excess of the limits stated herein and the determination of the length of any prolonged use in excess of the amounts so stated.

17.20 **Billing Cycle** - MWW shall issue invoices on a monthly basis in arrears for amounts due to MWW under this agreement. Payment on invoices shall be due within thirty (30) days.

17.21. **Delinquent Bills** - Invoices remaining unpaid for thirty (30) days or longer from the invoice date shall be subject to one and one-half (1 1/2) percent interest per month on the unpaid balance from the original due date. If such an event occurs, MWW may require the Water Recipient to post a deposit and make payments more frequently than at monthly intervals.

17.22. **Expansion and/or Upgrading of MWW** - In all cases, MWW reserves the right to determine as to all improvements, additions or expansions to its waterworks, provided that the undertaking of such improvements, additions or expansions does not impair the ability of MWW to provide water to the Water Recipients pursuant to this Agreement.

18. MISCELLANEOUS PROVISIONS:

Status of Current Agreement – It is the intention of the parties that both this Agreement and MWW's current Derry Wholesale Water Agreement (Derry Agreement) dated March 26, 2013, shall be read together to fully implement the purposes and provision of both.

Grantee Initials WRJ NAS
Date 4-3-19 4-3-19
KAB 4-3-19

EXHIBIT B

BUDGET & PAYMENT METHOD

Upon receipt of a properly executed Trust Fund Disbursement form, the Department may pay MWW up to $11,174,100 from the Fund on or before December 31, 2019 in accordance with the requirements of this Agreement.

EXHIBIT C

SPECIAL PROVISIONS

1. Paragraph 22 (THIRD PARTIES) of the Agreement is revised to as follows:

The parties hereto do not intend to benefit any third parties other than Water Recipients, and this Agreement shall not be construed to confer any such benefit. MWW assumes no responsibility for any facility not included in its waterworks, and in the event that a facility of a third party shall be involved in the furnishing of service to, or the receipt of service from any Water Recipient to this Agreement, that Water Recipient shall look solely to such third party for any such services. All Water Recipients assume sole responsibility for compliance with this Agreement by all third party users or customers of its waterworks.

2. As a condition to receiving funds under this Agreement, MWW agrees to be bound by the terms of the SIA.

3. General liability insurance shall be limited to 1,000,000 each occurrence and $325,000 for each person.

RATES

Rate per 100 Cubic Feet (CCF) - The rate charged by MWW for water supplied as part of the Project through the Route 28 meter at the Londonderry-Derry town line and received by any Water Recipient shall be equal to the in-town rate per hundred cubic feet ("CcF") for City of

Manchester water customers including any increase in such rate to in-town customers approved by the Manchester Water Works Board of Water Commissioners. This rate shall apply from the commencement of this Agreement through the tenth (10th) year of this Agreement. In years 11 through 15, rates shall escalate as indicated below such that in year 15 and thereafter, the rate shall be MWW's out-of-town rate.

Any increases in the rate charged under this Agreement shall be effective as of the same date on which the increase in rates charged to customers residing inside the City of Manchester is effective.

Escalation of Rate from In-town (City of Manchester) to Out-of-Town Rate –Beginning in the eleventh (11th) year of this Agreement, the rate per CcF described above will increase in the following manner over a five (5) year period until it is equal to the out-of-town rate charged by MWW: In year 11, the rate will be the sum of the in-effect in-town rate plus one-fifth (1/5th) of the difference between the in-effect in-town rate and the in-effect out-of-town rate; in year 12, the rate will be the sum of the in-effect in-town rate plus one fourth (1/4) of the difference between the in-effect in-town rate and the in-effect out-of-town rate; in year 13, the rate will be the sum of the in-effect in-town rate plus one third (1/3) of the difference between the in-effect in-town rate and the in-effect out-of-town rate; in year 14, the rate will be the sum of the in-effect in-town rate plus one half (1/2) of the difference between the in-effect in-town rate and the in-effect out-of-town rate; in year 15 all subsequent years, the rate will be equal to the in-effect out-of-town rate.

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Grantee Initials WEH
Date 3-29-19

Certificate of Vote of Authorization

MANCHESTER WATER WORKS
281 Lincoln Street, Manchester, NH 03103

I, Philip W. Croasdale, Director of the Manchester Water Works do hereby certify that at a meeting held on March 28, 2019 the Manchester Water Works Board of Water Commissioners voted to enter into a Drinking Water and Groundwater Trust Fund grant agreement with the NH Department Environmental Services to fund a water system improvement project.

The Manchester Water Works further authorized William R. Trombly, Jr., President, Board of Water Commissioners to execute any documents which may be necessary to effectuate this grant agreement.

IN WITNESS WHEREOF, I have hereunto set me hand as Director of the Manchester Water Works the 29th day of March 2019.

Signature Philip W. Croasdale

STATE OF NEW HAMPSHIRE County of Hillsborough

On this 29 day of March, 2019, before me Monique T. Dodd (Notary Public) the undersigned Officer, personally appeared. William R. Trombly, Jr., who acknowledged himself to be the President of the Board of Water Commissioners of the Manchester Water Works, being authorized so to do, execute the foregoing instrument for the purpose therein contained.

In witness thereof, I have set my hand and official seal.

Notary Public Monique T. Dodd My commission expires: MONIQUE T. DODD, Notary Public State of New Hampshire My Commission Expires August 26, 2020

Kevin J. O'Neil
Risk Manager

CITY OF MANCHESTER

Office of Risk Management

CERTIFICATE OF COVERAGE

NH DEPARTMENT OF ENVIRONMENTAL SERVICES
Drinking & Ground Water Bureau
29 Hazen Drive
Concord, New Hampshire 03302-0095

This certificate is issued as a matter of information only and confers no rights upon the certificate holder. This certificate does not amend, extend or alter the coverage within the financial limits of RSA 507-B as follows:

	Limits of Liability (in thousands 000)	
GENERAL LIABILITY	Bodily Injury and Property Damage	
	Each Person	325
	Each Occurrence	1000
AUTOMOBILE LIABILITY	Bodily Injury and Property Damage	
	Each Person	325
	Each Occurrence	1000
WORKER'S COMPENSATION	Statutory Limits	

The City of Manchester, New Hampshire maintains a Self-Insured, Self-Funded Program and retains outside claim service administration. All coverages are continuous until otherwise notified. Effective on the date Certificate issued and expiring upon completion of contract. Notwithstanding any requirements, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, the coverage afforded by the limits described herein is subject to all the terms, exclusions and conditions of RSA 507-B.

DESCRIPTION OF OPERATIONS/LOCATION/CONTRACT PERIOD
For the Southern New Hampshire Region Water Interconnection project beginning on March 29, 2019.

Issued the 2nd day of April, 2019.

Risk Manager

One City Hall Plaza • Manchester, New Hampshire 03101 • (603) 624-6503 • FAX: (603) 624-6528
TTY: 1-800-735-2964
E-Mail: koneil@manchesternh.gov • Website: www.manchesternh.gov