

# MEMORANDUM

**TO:** Mike Unger, P.E., NH DES

**FROM:** Jeffrey Provost, P.E., Weston & Sampson Engineers, Inc.

**DATE:** July 18, 2022

**SUBJECT:** Londonderry Water System Expansion – Phase 1: Water Source Investigation and  
Phase 2: Water Distribution System Expansion – **FINAL REPORT**

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## Purpose

The following memorandum reports engineering findings for Phase 1 and Phase 2 of the Londonderry Water System Expansion project. PFAS concentrations were mapped to determine the extents of where existing public water supply can be extended to furnish potable water to residents whose wells have been contaminated with PFAS above regulatory limits. The scope of this study was limited to investigating only those areas impacted by PFAS above regulatory limits. Any water main extensions beyond these areas is possible but further investigation is warranted. Existing Manchester Water Works (MWW) and Pennichuck East Utilities (PEU) infrastructure was evaluated to determine the recommended transmission route(s) to supply drinking water to the impacted areas of Londonderry. PFAS levels for tested properties and existing infrastructure within MWW and PEU franchise areas are shown in Attachment A. The following presents the results of our findings.

## Area of Impact

The area of impact, which is the subject of this study, includes the town of Londonderry, NH. A region in western Londonderry (shown shaded in pink on Attachment A) represents the extent of the “Outer Boundary” defined in a Consent Decree between NHDES and Saint-Gobain Performance Plastics dated March 2018. In this area of Londonderry, Saint Gobain is responsible for furnishing alternative potable water (that meets current State and Federal regulations) to all residents whose private wells contain PFAS concentrations that don’t currently meet drinking water standards due to release of PFAS from their facility located in Merrimack, New Hampshire. East of the “Outer Boundary”, PFAS contamination has been detected in hundreds of private wells within the town. NHDES and the town of Londonderry requested a review of these areas and an assessment on how to furnish public water to those areas where PFAS concentrations exceed regulatory limits. The figure in Attachment A includes PFAS sample results, as obtained from NHDES, shown as color coded points. The points where PFAS concentrations were greater than the Ambient Groundwater Quality Standards (AGQS) or Maximum Contaminant Level (MCL) are shown in orange and wells that exceed 70 ppt for PFOA are shown in red. The remaining sample results in Attachment A, which are below the AGQS/MCL limits, are identified in green.

PFAS sample points which fall within the “Outer Boundary” are identified in Attachment A by a diamond shape. All other PFAS sample points east of the “Outer Boundary” in the town of Londonderry are shown as circular points.

The NH state AGQS/MCLs for each regulated PFAS compound are outlined in Table 1 below.

**Table 1 – NH State PFAS AGQS/MCL's:**

PFAS Compound Name	Abbreviated Name	AGQS/MCL (ppt)
Perfluorooctanoic acid	PFOA	12
Perfluorooctane sulfonic acid	PFOS	15
Perfluorononanoic acid*	PFNA	11
Perfluorohexane sulfonic acid*	PFHxS	18

\*Per NHDES program staff, PFOA and PFOS are the predominant species detected in this area, and exceedances of PFNA and PFHxS typically co-occur with PFOS and/or PFOA.

## Existing Water Systems

Existing water systems in Londonderry and surrounding towns are shown on the map in Attachment A. Water mains shown on the map include the existing PEU water systems in Londonderry, the existing MWW water system in northern Londonderry (and a portion of southern Manchester), the existing Derry franchise area in northern Londonderry (serving predominantly the Lorden Commons development) and small, private water systems that currently operate independent of PEU, MWW or Derry (located mostly in central and southern Londonderry). The franchise boundary line separating the MWW and PEU franchise areas is shown as a red dashed line in Attachment A (the Derry franchise area is shown as a green dashed line). In addition to existing water systems in Londonderry, portions of the Litchfield and Hudson water systems located in proximity to the Londonderry town line are included in Attachment A. Pipes are color coded by diameter in the map and other prominent water system infrastructure (e.g. water storage tanks, pump stations, pressure reducing valves) are also included.

## Water Demand Development

### Existing Demand

PEU provided Weston & Sampson with water demands for the existing PEU water systems in Londonderry. It should be noted that PEU estimates the Maximum Day Demand (MDD) to be approximately 1.4 times the Average Day Demand (ADD) in their Londonderry water systems. This multiplier (1.4x) was used in establishing all proposed and future Londonderry demands in this study.

The largest expansion of the PEU water system in Londonderry is the portion of the water system that will serve the Woodmont Commons development. This development is currently being constructed and while the parcels of land are not yet fully developed, future demands have been estimated by PEU for the full development area. Table 2 below shows the estimated 2020 MDD demands for the larger existing PEU service areas, as used in the model.

Table 2 – 2020 Estimate MDD per PEU Service Area (supplied by MWW):

Service Area	MDD (gpd)	MDD (gpm)
PEU Core System <sup>1</sup>	893,000	620.1
Brook Park <sup>2</sup>	146,000	101.4
Springwood Hills	22,500	15.6
<b>Total</b>	<b>1,061,500</b>	<b>737.1</b>

<sup>1</sup> - Flows based on the Cohas Mammoth Road Meter Readings from June through September 2020. PEU Core System includes the following service areas: Cohas Landing, Mountain Home Estates, Nesenkeag, Woodmont Commons and Gilcreast.

<sup>2</sup> - Flows based on the Harvey Road Meter Readings from June through September 2020.

The following table provides the breakdown of demand for those smaller water systems in Londonderry that are not currently supplied water by MWW.

Table 3 – 2020 Estimated MDD per PEU Service Area (not supplied by MWW):

Service Area	MDD (gpd)	MDD (gpm)
Wiley Hill Road/Alan Circle	12,600	8.7
Harvest Village	16,884	11.7
Hickory Woods & Avery Estates	37,296	25.9
Pinehaven	9,072	6.3
<b>Total</b>	<b>75,852</b>	<b>52.6</b>

As mentioned earlier in the report, several, private water systems operate within the town of Londonderry. Due to PFAS contamination of their water supplies, these small systems have expressed an interest in connecting to the PEU water system and have reached out to NHDES and the PFAS Remediation Loan Fund (RLF). Without access to existing demand information for most of these systems, as of the writing of this report, the existing demands were estimated using the number of services per water system (obtained through DES OneStop data review) and the NH Code of Administrative Rules Env-Wq 1008.03, when necessary. Table 4 below shows the Unit Design Flow requirements for different dwelling types as outlined in NH Code of Administrative Rules Env-Wq 1008.03. Each design flow is assumed to represent a MDD for that dwelling.

Table 4 – NH Code Unit Design Flow\*:

Dwelling Type	Unit Design Flow (gpd)
Apartment (2 bedrooms)	300
Single-Family Home (3 bedrooms)	450

\*Source: Table 1008-1 of the NH Code of Administrative Rules Env-Wq.

Table 5 provides MDD estimates for the private water systems that have engaged the PFAS RLF. The locations of these systems are identified on the existing system map by a pink outline (see Attachment A).

Table 5 – 2020 Estimated MDD per Private Water System (Engaged w/ PFAS RLF)

Water System Name	Type of Development	Number of Services	Estimated Bedrooms/ Service	MDD (gpd)	MDD (gpm)
Century Village	Townhouses	384	N/A	57,500*	39.9*
Midridge Condos	Condos	40	2	12,000	8.3
Olde Country Village	Condos	53	2	15,900	11.0
Rolling Meadows I	Apartments	32	2	9,600	6.7
Rolling Meadows III	Apartments	20	2	6,000	4.2
Rolling Meadows IV	Apartments	15	2	4,500	3.1
<b>Total:</b>				<b>105,500</b>	<b>73.2</b>

\*Average Day Demand (40,955 gpd) calculated based on well flow data for Century Village between 2018 – 2020. MDD estimated based on 1.4 times ADD.

In addition to the six independent small water systems listed above, there are six additional independent water systems in Londonderry that have not engaged the PFAS RLF but may do so in the future. Under the scope of this project, estimating water demand or evaluating connections to each of the additional independent water systems were not performed. Those six water systems are listed below and shown, for reference only, on Attachment A.:

- Wagon Wheel
- Southview Condominiums
- Boumil Grove Condonminiums
- Bitim Apartments
- Ponderosa MHP
- Oakridge Condominiums

#### Future Demand

PEU previously provided future demand estimates for their Core water system in Londonderry. The predominant driver in the increase in projected MDD is the Woodmont Commons development. **According to PEU, the estimated 2030 MDD to serve the Core PEU service area is 1.3 MGD (902.8 gpm). Note, 1.3 MGD is the 2030 MDD estimate prior to furnishing additional supply to PFAS impacted properties.** The remaining PEU and private service areas listed in Tables 2, 3 and 5 were not anticipated to have major projected growth as of the writing of this report. For this reason, the existing service area MDD's were used for the future MDD estimates, where applicable, in our hydraulic assessments.

The following table outlines the estimated 2030 MDD in the PEU Core System and Brook Park system prior to water system extensions established to serve additional demand to areas impacted by PFAS in well water above the MCL's.

Table 6 – 2030 Estimate MDD for PEU Core and Brook Park (supplied by MWW):

Service Area	MDD (gpd)	MDD (gpm)
PEU Core System	1,300,000	902.8
Brook Park	146,000	101.4
<b>Total</b>	<b>1,446,000</b>	<b>1,004.2</b>

For future water service estimates to existing properties with well water that exceeds the PFAS MCL's, we utilized the following approach in developing our water demand estimates. The NHDES-provided PFAS sample data included information on land use and water service type, when available. The majority of the properties were single-family homes and residential water services.

It was assumed that the residential homes in the area would have, on average, three bedrooms per dwelling. Using the NH Code of Administrative Rules, described in Table 4, a 3-bedroom dwelling is estimated to have an MDD of 450 gpd (0.31 gpm). There are approximately 785 total properties that were identified from the NHDES PFAS sample results data as properties with well water that exceeds PFAS MCL's in the Town of Londonderry. **Therefore, the total estimate of MDD for these properties is 353,250 gpd (245.3 gpm).** It should be noted that all monitoring well PFAS data furnished by NHDES were not used to calculate the total water demand estimates since we assumed that monitoring wells are not furnishing potable water supply.

**Overall, the estimated MDD for additional customers in Londonderry due to well water PFAS concentrations above the PFAS MCL's totaled 458,750 gpd (including the private water system services described in Table 5) or approximately 318.6 gpm.** It should be noted that an estimated 6,750 gpd of the 458,750 gpd MDD estimate is located in the MWW and Derry franchise area in Londonderry. The remaining MDD is located in the PEU franchise area.

Upon extending water mains to serve the properties with well water containing PFAS concentrations above the MCL, other residences in close proximity may want to connect to the public water system. Future MDD for this additional customer base were estimated based on the residents' proximity to a property with an orange or red symbol on the map in Attachment A. **It was assumed that approximately 50% of these properties (856 properties) would want to connect to the new water mains and receive public water service.** The additional customers were assumed to all be residential, with an average of three bedrooms per dwelling, resulting in an estimated MDD of 450 gpd (0.31 gpm) per dwelling. **Overall, future estimated MDD for the additional properties totaled approximately 385,425 gpd (267.7 gpm).** This demand was broken down into three zones based on water system franchise; MWW/Derry and PEU (within and outside of the Consent Decree Outer Boundary) in Londonderry. The total estimated additional MDD is summarized in the following table.

Table 7 – Additional MDD in Londonderry to serve PFAS-impacted Areas

Region of Londonderry	MDD Estimate PFAS MCL Exceedance (gpd)	MDD Estimate Additional Residential Demand – In Proximity to PFAS Exceedance Properties(gpd)	Total MDD (gpd)	Total MDD (gpm)
Mostly outside the Consent Decree Outer Boundary (MWW/Derry Franchise)	6,750	11,925	18,675	13.0
Within the Consent Decree Outer Boundary (PEU Franchise)	114,300	76,950	191,250	132.8
Outside the Consent Decree Outer Boundary (PEU Franchise)	337,700*	296,550	634,250*	440.5*
<b>Total:</b>	<b>458,750</b>	<b>385,425</b>	<b>844,175</b>	<b>586.3</b>

\*Includes six private water systems listed in Table 5.

## Hydraulic Modeling Development

The existing PEU Londonderry water system hydraulic model was obtained from Underwood Engineers, Inc. (UEI) in the Innovyze InfoWater software format. The model had last been updated for a report dated February 2020 by UEI and several recent improvements had not been included in the pipe network. PEU provided shapefiles of the existing pipe network, which included available information on pipe diameter, material, age, length, year of install, etc. The shapefiles were used to update the hydraulic model with recent improvements including the Woodmont Commons area. The existing hydraulic model from UEI had also only included the core PEU-Londonderry system (referred to as Cohas Landing, Mountain Home Estates, Nesenkeag and Gilcreast service areas) and the Springwood Hills area. The PEU shapefiles were used to expand the model by adding the missing service systems. Nodes were added to the model (with elevations assigned using available LIDAR information) along with pipes, pumps, valves and water sources. Existing pumps for the small water systems were added to the model for Phase 1 of this project based on PEU provided information. Pressure Reducing Valves (PRVs) were also included in the model to simulate the actual reduced Hydraulic Grade Lines (HGLs) where applicable. The MDD of the existing water systems, as provided by PEU and described in Table 3 and Table 6, were used to build future MDD estimates and populated where appropriate in the model. Additional MDD, as defined in Table 7, was then added to the model.

Once the existing PEU hydraulic model had been checked for accuracy and expanded, the Londonderry model was combined with the existing Southern New Hampshire Regional Water (SNHRW) master hydraulic model. Since the existing SNHRW model was created in Bentley WaterCAD format, the newly updated PEU-Londonderry model was exported from InfoWater and imported into the WaterCAD program. After combining the two models, assessment of the water system improvements commenced.

## PHASE 1 – WATER SOURCE INVESTIGATION

### MWW Supply Transmission Assessment

In order to establish transmission of additional public water supply into areas of Londonderry that are not currently served by public water, we assessed water main routes for transmitting this additional supply from the MWW system into the PEU franchise area. Previous results from our past reviews of the Londonderry portion of MWW's water system were incorporated into our assessment. The water main improvements that were recommended under Phase 2 of the SNHRW system effort (including improvements to Cohas Avenue pump station and additional 20-inch water main in Cohas Avenue in Manchester) and recommended improvements for alleviating low pressure in the MWW's Londonderry system (installing 30-inch water main from the MWW-Londonderry Tanks to Rockingham Road via the Vista Ridge area) were present in the existing water model during our current assessment.

In order to transmit an additional 844,175 gpd of water from MWW during MDD conditions, our assessment identified the South Willow Street corridor in Manchester for furnishing the additional supply. Currently, a PRV is located near the intersection of South Willow Street and Perimeter Road. At or near this location, we assessed removing the PRV and adding a pump station to transmit water into the town of Londonderry. This new pump station would supplement the existing Cohas Avenue pump station and reduce the strain of having all water supplied into Londonderry (and the SNHRW system outside of Londonderry) from one station. It should be noted that the High Service System in MWW water system would serve this proposed South Willow Street pump station. The Low Service System currently serves the Cohas Avenue Pump Station. Refer to Attachment B for the location of the South Willow Street pump station.

Under this assessment, we sized the proposed South Willow Street pump station to transmit up to 1,000 gpm to supplement Cohas pump station when serving the additional 844,175 gpd MDD in Londonderry, only. However, the final sizing of the South Willow Street pump station should be coordinated with MWW and PEU to ascertain the optimal design flow to best serve all projected future demand in Londonderry.

### PEU Transmission Assessment

Upon installing the South Willow Street pump station, the additional 844,175 gpd of water to serve Londonderry customers can be wheeled through the MWW system in northern Londonderry. As demonstrated in Table 7, a majority of this additional demand would be furnished to the PEU franchise area. To determine the PEU transmission route, we first hydraulically assessed the existing PEU water systems. Both the PEU Core system and the Brook Park system connect directly to the MWW system near the intersection of Rockingham Road/Mammoth Road and Harvey Road/Aviation Park Drive, respectively. The first part of the PEU Core system, referred to as Cohas Landing, is served by the MWW 480' HGL but PEU has historically observed a HGL of 465' within the Cohas Landing service area. It should be noted that Cohas Landing provides water to the suction side of the Mountain Home pump station. Mountain Home pump station raises the HGL of the water system to 620' to serve higher elevation areas in the PEU Core system south of Mountain Home pump station. Upon initial review of the ground elevations throughout the Mountain Home Estates service area, it appears that several areas served by the 620' HGL could be served by a lower grade line. We are uncertain of the reason why 620' was originally chosen for this area. Further discussion with PEU is recommended to obtain an explanation.

Brook Park is also served by the MWW HGL of 480'. Similar to Cohas Landing, PEU has historically experienced an available HGL in Brook Park to be lower than 480'. PEU has indicated that an HGL of

450' currently serves the Brook Park area.

An initial assessment of the ground elevations throughout the PEU franchise area in Londonderry indicates that all areas projected to be served in the future are below 500-foot ground elevation. In addition, due to the location of several areas impacted by PFAS concentrations above MCL's, extending transmission water main south down High Range Road from the current limits of the Brook Park service area appear to be warranted as the best means for serving the additional demand from MWW supply. Between the Brook Park Service area and the Nesenkeag service area along High Range Road, the ground elevation increases from approximately 275 feet to 400 feet. In this vicinity, we identified the need to add a pump station to provide adequate service further into Londonderry beyond this point. The initial location identified for this pump station is at the end of Davis Drive (with water main installed in a proposed utility easement within the existing electric utility easement between High Range Road and the end of Davis Drive). Similar to the South Willow Street pump station, we initially sized the Davis Drive pump station to have a 1,000 gpm pump capacity. During final station siting, land acquisition availability will need to be reviewed under a separate contract.

At the conceptual location for the Davis Drive pump station, water would be boosted from a HGL of 450' to a HGL of 620'. We added additional water main in the existing electrical easement between the proposed Davis Drive pump station and Shasta Drive. We modeled a connection with the PEU Core System (Mountain Home Estates service area – HGL 620') by extending 16-inch water main from the Davis Drive pump station, cross country through the electric utility easement and along the entire length of Shasta Drive to the intersection of Mammoth Road. By adding a pump station at the end of Davis Drive, redundancy is provided for furnishing water into the PEU franchise area from MWW. By drawing more water through the Brook Park service area, water is better distributed through the MWW water system in Londonderry, too, while serving the PEU franchise area. Refer to Attachment B for the location of the proposed Davis Drive pump station and the proposed transmission water mains located in High Range Road, Shasta Drive and Mammoth Road.

### **PWW Supply Alternative**

In addition to our original scope of services, which was to review only MWW supplying the additional water for Londonderry, NHDES requested we review a scenario in which a portion of the water supply to serve the town of Londonderry is furnished from the PWW Water Supply via PWW- and PEU-owned and operated systems in Merrimack and Litchfield. This second supply would supplement the existing MWW supply from the north. As part of this review, we were tasked with assessing transmission of the PWW supply in Londonderry only. Our review did not assess any concepts developed by others to transmit this water supply into Londonderry. As a result, we modeled approximately 9,000 linear feet of proposed 16-inch transmission main cross-country through property owned by Continental Paving, Inc. in the southwestern corner of Londonderry. This 16-inch main would connect to existing 16-inch water main in Pilgrim Drive in Litchfield and upon passage through Continental's property would be installed in Recovery Way in Londonderry. The proposed 16-inch water main would then travel northwesterly up West Road to Elwood Road and northeasterly up Elwood Road to Elwood Orchards. On Elwood Orchards property, PEU is proposing to install a 1.0 – 1.5 MG atmospheric storage tank with an overflow elevation of 314' to match the Litchfield Dame-Ducharme HGL. Finally, at the base of the proposed tank would be a booster station to transmit water into the Londonderry water system at 498' HGL. Refer to Attachment C for the location of the conceptual transmission infrastructure described in this section.

Weston & Sampson incorporated each component described above into the model and conducted our assessment with the assumption that the proposed tank at Elwood Orchards would fill as necessary from PWW supply/PEU infrastructure under all Londonderry scenarios we assessed per the scope of

this project. Further assessment and confirmation of the storage and supply requirements for this option is necessary and should be conducted separately under future assessment.

It should be noted that, although we did not assess the location of the pump station as proposed by PEU, we did assess the pump requirements with a pump station located at Elwood Orchards. Our model efforts simulated water being drawn from a proposed tank located on the Elwood site and furnishing water into Londonderry at select flow rates, total dynamic head conditions and methods for automated controls of the pump station.

### **Hudson Water System Alternative Supply**

As an alternative to supplemental water supply being transmitted into Londonderry as described above, NHDES and the town of Londonderry should consider if water supply from Hudson is a viable alternative. The Hudson water system includes 12-inch diameter water main in Old Derry Road at the Hudson/Litchfield town line. Extension of the water system from this location could be accomplished by extending approximately 8,300 linear feet of water main up Old Derry Road and Robinson Road in Hudson to connect with existing Hudson water infrastructure in the northern portion of Hudson near the Londonderry town line. Under this scenario, water supply would be furnished from the Marsh Road service area in Hudson which is operated at a HGL between 500' and 510'. Further assessment is warranted however supply entering this portion of Londonderry would serve the proposed 498' HGL and may result in reduced infrastructure requirements as compared to the PWW supply alternative described above.

### **Merrimack Source Development Charge (MSDC)**

The MSDC was established to help MWW address future water supply needs. It is assessed in accordance with RSA 38:27 and RSA 38:28 for the purpose of constructing, acquiring, improving, enlarging, and/or operating the MWW system. Specifically, all funds collected from the MSDC will be utilized to develop the Merrimack River as an additional source of supply for MWW. As of January 1, 2022, the MSDC is \$4.02 per gallon, per day of capacity requested. The MSDC shall be increased 3% annually effective each January 1<sup>st</sup>.

Prior to a water system receiving water supply from MWW, payment of the MSDC for the volume of water requested shall be rendered. Currently, PEU maintains a reserve of MSDC credits that have previously been purchased for those systems that are supplied by MWW and owned and/or operated by PEU. Under the water supply scenario in which MWW supplies all additional water to Londonderry, as described above, PEU would likely need to purchase additional MSDC credits from MWW for most if not all of the additional water supply needs in Londonderry related to PFAS. Further discussion with MWW is warranted for more detail on the process of requesting additional MSDC credits. For the water supply scenario in which PWW supplements the MWW supply and furnishes a supply of water equivalent to the additional water needs related to PFAS, no additional MSDC credits are anticipated to supply the Londonderry water system.

## **PHASE 2 – LONDONDERRY WATER DISTRIBUTION SYSTEM EXPANSION**

### **Water Distribution System Assessment**

We established two assessments based on the two supply scenarios described above;

Phase 2A – All supply for Londonderry furnished by MWW (see Attachment B);

Phase 2B – Londonderry supply furnished by both MWW and PEU (see Attachment C).

## **Phase 2A – Distribution Improvements with All Supply for Londonderry furnished by MWW**

### Existing and Proposed PEU Water System

Our approach for developing a proposed water system expansion in Londonderry was to utilize and expand the existing service systems and minimize the amount of different pressure zones across Londonderry. We modeled the water system expansion to mimic the Mountain Home Pump Station/proposed Woodmont Commons Tank and Michels Way Pump Station configuration anticipated to be employed by PEU once the components are in service (Woodmont Commons Tank/Michels Way Pump Station final approvals are anticipated soon).

The four predominant service areas in the PEU franchise area of Londonderry are as follows:

Brook Park – HGL 450'  
Cohas Landing – HGL 465'  
Mountain Home Estates – HGL 620'  
Gilcreast – HGL 498'

Under the anticipated, future water system configuration, Mountain Home Pump Station draws water from MWW (via Cohas Landing) and raises the HGL in the water system to 620' to serve the Mountain Home Estates service area. When Mountain Home Pump Station is in service, the highest ground elevations in Londonderry are served, under constant pressure service, while filling the Woodmont Commons Tank when the water level of the tank reaches a predetermined low level and signals for Mountain Home Pump Station to turn on. Mountain Home station continues filling Woodmont Commons Tank while simultaneously meeting the Mountain Homes Service Area demand and serving the Gilcreast service area of Londonderry through a pressure reducing valve located in Michels Way Pump Station. The Woodmont Commons Tank is proposed to be an atmospheric tank with an overflow elevation located at 498'. When the tank is full, the Mountain Home Pump Station would be called to turn off and the Michels Way Pump Station would be signaled to turn on. The Mountain Home Estates Service Area would then be furnished with uninterrupted constant pressure from Michels Way Pump Station while supply is drawn from the Woodmont Commons Tank. The Gilcreast service area in Londonderry (HGL 498') would be returned to gravity-based water service from the Woodmont Commons Tank until the tank reaches a low water level setting and Mountain Home Pump Station would be called to refill the tank.

### Phase 2A – Expanded Water System Development

Under the Phase 1 MWW Supply portion of this study, we assessed having a second water transmission route into Londonderry through the Brook Park service area. We extended 16-inch water main from Brook Park southerly down High Range Road and conceptualized continuing service into Londonderry via a pump station located at the end of Davis Drive.

Under Phase 2A, we conducted a thorough analysis of transmitting and distributing water through areas of Londonderry that are not currently served public water. We maintained the existing Mountain Home Estates Service Area boundary as previously established by PEU (see Phase 2A: Attachment B) and expanded the Gilcreast service area to serve properties at lower ground elevations.

We extended large diameter water mains (16- and 12-inch diameter) from the High Range Road corridor to equivalent sized transmission mains located in the Mountain Home Estates and Gilcreast service areas. From the transmission mains, we extended distribution mains (8-inch diameter) to serve remaining areas in Londonderry where PFAS exceeded AGQS MCLs. Some proposed small diameter mains approach the PEU franchise area via the MWW franchise area and as a result some minor franchise area adjustments may be needed to implement the entire plan as presented.

Upon initially building the expanded water system, as described above, we ran the model to determine if the existing Mountain Home Pump Station/proposed Woodmont Commons Tank and Michels Way Pump Station, supplemented by the proposed Davis Drive Pump Station, could serve not only the existing Mountain Home Estates service area and the existing Gilcreast service area but the increased service needs inside the Mountain Home Estates service area and the expanded Gilcreast service area. **Our modeling efforts found that the proposed Woodmont Commons Tank and Michels Way Pump Station alone could not maintain domestic service to serve all existing water customers while serving all proposed customers.**

To improve water service for the existing and proposed water customers, we developed a second tank and pump station to mimic the proposed Woodmont Commons Tank and Michels Way Pump Station (with their operational controls as described above). To accomplish this, we needed to identify a potential site for a gravity-based storage tank with an overflow elevation set at 498' (to match the proposed Woodmont Commons Tank). We identified the Londonderry DPW yard site with ground elevation at approximately 400' as an ideal location for a second tank to serve the expanded Londonderry system. The conceptual size of the DPW Yard tank used in our analysis is 1.0 MG. Additional tank siting analysis including a review of the Manchester-Boston Regional Airport flight path restrictions and a more detailed storage analysis will need to be conducted under a separate study.

Near the proposed location of the DPW Yard tank we located the DPW Yard Pump Station, with associated PRV infrastructure, to match the proposed form and function of the Michels Way Pump Station.

The model was rerun with both the Davis Drive Pump Station and Mountain Home Pump Station running in tandem to fill the proposed DPW Yard tank and Woodmont Commons tank. Once the tanks reached their high water levels in the model, the DPW Yard Pump Station and Michels Way Pump Station turned on to maintain service in the Mountain Home Estates service area while the DPW Yard tank and Woodmont Commons tank provided gravity-fed water service to the expanded Gilcreast service area.

Upon incorporating the DPW Yard Tank and Pump Station in the model, we continued our hydraulic assessment of the expanded water system. As we reviewed the range of water pressures in the expanded Gilcreast service area, we identified areas to the west and south with elevated static pressures. To alleviate these elevated static pressures, we identified areas to locate PRVs and reduce the hydraulic gradeline. We identified five PRV stations (three in the western part of Londonderry on Royal Lane, Colonial Drive and Wiley Hill Road) and two in the southern portion of town (located on South Road and Merlin Place). For each of these PRV stations, we modeled a PRV setting that set a 420' HGL for the downstream areas (except the Royal Lane PRV which was modeled with a PRV setting of 498' HGL).

### Small System Connections

Table 3 and 5 above list several of the small water systems that are present in Londonderry. Table 3 provides a listing of the PEU small water systems while Table 5 provides a listing of the six independent

water systems that currently have public water supplies contaminated with PFAS above the AGQS MCLs and have engaged with the PFAS RLF.

In addition to the small water systems listed in Table 3 and 5, there are four additional small water systems/service areas in the PEU franchise area as follows:

Springwood Hills – HGL 623'  
Meeting House Road – HGL 590'  
MacGregor's Cut – HGL 574'  
Nesenkeag – HGL 540'

Springwood Hills is located east of Interstate 93 and is served by a separate connection to the MWW system. Under the terms of this study, there were no properties located within proximity to Springwood Hills that warranted a water main extension due to PFAS concentrations above the AGQS MCLs. As a result, Springwood Hills remained as it is currently configured and was not connected to the expanded Londonderry water system as described above.

Meeting House Road also remained a separate water system under the scope of this study. Although the expanded water system could be extended to incorporate and serve the Meeting House Road service area, water extensions were not assessed at this time.

MacGregor's Cut service area, located on Stonehenge Road, is currently served by PEU via a connection to the Cohas Landing service area. Just north of this service area is a concentration of properties with well water PFAS concentrations above the AGQS MCLs. The ground elevation in this area (Bartley Hill Road/Perkins Road area) warrants a gradeline between 575' and 600' to furnish domestic water service to all impacted properties.

We assessed various scenarios to serve this area public water supply. The option that was selected was upgrading/replacing the existing MacGregor's Cut Pump Station and expanding the MacGregor's Cut service area to include the properties in the Bartley Hill Road/Perkins Road area. Additional assessment is warranted to ascertain ownership and operation of the expanded pump station and service area and to identify the basis of design for the pump station.

Nesenkeag service area serves a small area located in the Raintree Drive neighborhood west of High Range Road. Ground elevations begin to lower in this area and warrant a reduced pressure zone (HGL 540') to serve these water customers. Just north of the existing service area (the Mayflower Drive area) is a concentration of properties with well water PFAS concentrations above the AGQS MCLs. Upon assessing the various ways to serve this area, the option that was chosen was to expand the Nesenkeag service area and maintain the gradeline at 540'. A separate assessment of the existing Nesenkeag PRV will need to be conducted to determine any improvements necessary to provide service to the expanded area.

Lastly, there are several small water extensions that we added within the town of Londonderry to serve properties that have well water PFAS concentrations above the MCLs. These locations would be served by either MWW or through the Derry water system in northern and eastern Londonderry, respectively. Refer to the Phase 2A (Attachment B) and 2B (Attachment C) figures for the exact locations of these small water main extensions. Connection of these small water extensions to the MWW and/or Derry water system requires further investigation on how to best serve these properties. One additional small connection that should be mentioned is within the PEU water system franchise for the Apple Tree Mall

area. Information was obtained from NHDES and a water main extension to serve the impacted residences in this area was added to the model accordingly.

### Water Main Size Review with Fire Flow Assessment

Assigning domestic water demand is essential to performing hydraulic modeling for a distribution system, however, it is not specifically used for sizing new water mains. For that reason, fire flow was used to confirm preliminary sizing of the water main extensions throughout the study area. Pipeline sizing was adjusted as necessary to accommodate fire flows.

The Insurance Services Office (ISO) is an independent organization that provides ratings for town insurance pricing on systems providing fire protection. ISO estimates needed fire flow requirements at representative locations throughout communities and publishes their methodology and guidance for calculating needed fire flow for individual buildings in their "Guide for Determination of Needed Fire Flow." Typically, a minimum of 750 gpm is recommended for residential areas with sufficient spacing (greater than 30 feet) between buildings. As nearly all water main extensions we assessed were within residential areas in Londonderry with residences spaced at or greater than 30 feet apart, a fire flow of 1,000 gpm was assumed (not 750 gpm to account for areas that may need a higher fire flow) and evaluated at select locations throughout the water main extension areas. Each fire flow was run under Maximum Day demands and assessed for the water system's ability to deliver the fire flow and maintain residual pressures throughout the water system at greater than 20 psi.

Fire flows were analyzed for most 8-inch, dead-end water main extensions, locations of high elevation (relative to the surrounding area), locations with low static pressures (relative to the surrounding area), and several points throughout the extended system. All analyzed locations were found to meet fire flow requirements.

After we reviewed the ability of the water system to furnish fire flow to all proposed water system expansion areas and made necessary adjustments to pipe diameters, water main connections, service area extents, etc., we conducted one final review of the water system to ensure that all domestic service was furnished throughout the water system with the criteria listed as follows:

- Maintain headloss of 10 feet/1,000 feet of pipe or less in all pipes.
- Maintain velocities of 4.0 feet per second or less in all distribution pipes.
- Maintain pressures greater than 35 psi under all normal conditions of flow

Our review found that the proposed water system was able to maintain headloss, velocities and minimum pressures within the criteria stated.

## **Phase 2B – Distribution Improvements with Supply for Londonderry furnished by MWW and PWW**

### Alternative Water System Development

The Phase 2B water system assessment incorporated water supply from PWW/PEU to supplement the MWW water supply. As shown in Table 6 above, MWW is projected to supply approximately 1.5 MGD to existing PEU customers to serve 2030 Maximum Day demands. As part of our assessment, we assumed MWW would maintain this level of supply into the PEU franchise area and PEU would supplement this supply to meet all new water demands in Londonderry. As part of this assessment, the two water supplies would mix within the expanded Londonderry water system as opposed to remaining separate and serving isolated areas.

A significant portion of the expanded Londonderry water system (as developed under Phase 2A) remained unchanged under the Phase 2B assessment. The biggest difference between the two water system concepts is the method of introducing supply into the water system. Under Phase 2A, the existing infrastructure was maintained and modified, as necessary, to furnish water from MWW into Londonderry via Mountain Home Pump Station. A separate connection to the MWW water supply was developed through the Brook Park service area as described in detail above.

For Phase 2B, we maintained the existing Mountain Home Pump Station and supporting infrastructure as the connection with MWW but removed the upgrades that were made in the Brook Park service area (including the inclusion of the Davis Drive Pump Station). We also removed the 16-inch water main upgrades that were made in Mammoth Road north of Mountain Home Pump Station and removed the South Willow Street Pump Station from this scenario. In lieu of the water supply upgrades that were made under Phase 2A, a connection to the PEU water supply was made in south Londonderry as described in detail earlier in this report.

To furnish all necessary supply into Londonderry under the Phase 2B scenario, we modeled control of the Elwood Orchards Pump Station in the same manner as we modeled the Davis Drive Pump Station. Elwood Orchards Pump Station and Mountain Home Pump Station would therefore work in tandem to fill the DPW Tank and Woodmont Commons Tank and shut off after the tanks reached their high water levels.

#### *Distribution System Changes between Phase 2A and Phase 2B*

A majority of the system infrastructure remained the same between the Phase 2A and Phase 2B water system expansion scenarios. In addition to the water supply infrastructure changes that were made, as described above, the following changes were also incorporated into the Phase 2B water system expansion concept:

- Inclusion of a 12-inch water main from the Wiley Hill Road service area to the Elwood Orchards Pump Station to serve as a redundant back up supply. The gradeline serving the Willey Hill Road service area is 420' and pressure reduction capabilities would be included for this emergency connection (with on/off flow control). This connection is envisioned to be normally closed but could be used as a redundant feed from the PEU water supply if warranted. The supply from Litchfield (treated with free chlorine) would transmit through the PRV and be converted from free chlorine to chloramines at the Elwood Orchards Pump Station, then enter into the core Londonderry system.
- In lieu of the Davis Drive Pump Station, a PRV station would be installed at the same location. The PRV would be set to furnish water service at a gradeline of 450' to areas between the PRV station and the Brook Park service area west and east of High Range Road.
- Lastly, as mentioned above, the existing Brook Park service area would remain on MWW water supply. To separate the expanded water system with the existing Brook Park service area, two normally closed valves were added to this scenario (located on Litchfield Road and High Range Road at or near the Brook Park service boundary line).

Upon incorporating all changes into the model for Phase 2B, we reran the fire flow analysis to confirm the pipe sizes were adequate under this scenario and made modifications where necessary. We also reviewed headloss, velocity and minimum pressures (as performed for Phase 2A) before finalizing the recommended pipeline expansions. Once again, some small diameter mains approach the PEU franchise area via the MWW franchise area and therefore some minor franchise area adjustments may be needed to implement the entire plan as presented.

### Water Quality Considerations

Under Phase 2A, new water customers who aren't currently served from a public water system will need to be educated on the quality of water supplied by MWW and transmitted by PEU. In that regard, a public education campaign should be considered to educate customers about chloramine disinfection and the presence of fluoride in the water supply. For those small public water systems, this will be especially important since many of these customers may be served chlorinated water supply without any fluoride.

Under Phase 2B, additional water quality considerations are warranted. Conveying water from PEU water supply while maintaining MWW service would require chemical treatment adjustments within the expanded Londonderry system. PEU chlorinates their supply while MWW provides chloraminated water. In order to blend the source waters in the Londonderry distribution system, it will likely be necessary to convert the chlorinated PEU water to chloraminated water (to match the MWW supply). MWW chloraminates their water to control disinfection byproducts and maintaining a chloramine residual will provide continued control of disinfection byproduct formation. The most ideal location to install this chemical feed process is at the new proposed Elwood Orchards Pump Station prior to PEU water supply entry into the Londonderry water system. This study proposes the Hickory Woods/Avery Estates areas would be supplied by the core Londonderry system rather than from Hudson (where a normally closed valve would be located).

The exact design of the chemical treatment conversion process will take further assessments of the existing water quality, and discussion on ideal total chlorine concentration prior to addition of the ammonia for chloramine treatment. In addition, consideration should be given to adding chloramine boost capabilities to the Mountain Home Pump Station. Subsequently, chloramine boost capabilities should also be considered under Phase 2A for both the Mountain Home and Davis Drive Pump Stations.

As stated above, MWW adds fluoride during their treatment process. PWW does not add fluoride to their treatment process at the Merrimack WTP, so a portion of existing customers in Londonderry that currently have fluoride in their water supply from MWW will see reduced levels as the water supplies mix and the PEU supply dilutes the fluoride levels in the MWW supply. However, PEU does not currently add fluoride during their treatment processes. Costs for a new treatment facility were estimated below, but are very preliminary and subject to change as the needed treatment process is refined.

Lastly, the addition of a new source always has an effect on water quality, and it can be very difficult to predict what that impact may be. A Rothberg Tamburini Windsor (RTW) modeling analysis should be performed to determine if any corrosion control measures may be necessary upon blending the two water supplies. In addition, the lead and copper program currently in place for the existing Londonderry system will need to be reset, with initially more stringent sampling requirements, to establish a baseline for lead and copper levels within the water system in the presence of a blended water supply.

### **Phase 2 Budgetary Cost Estimates**

Budgetary costs estimates were developed for the Phase 2A and Phase 2B improvements described above and are presented in the tables below. The budgetary costs are representative of December 2023 costs and include design through construction.

Table 8 – Budgetary Cost Estimate – Phase 2A:

Water System	Phase 2A Component	Phase 2A Cost
MWW/Derry	8" DI Water Main, 7,863 LF	\$2,280,270
PEU	8" DI Water Main, 193,845 LF	\$56,215,050
PEU	12" DI Water Main, 80,318 LF	\$33,733,560
PEU	16" DI Water Main, 24,524 LF	\$15,204,880
MWW/Derry	Private Service Connections to Properties w/ PFAS > MCL, Internal Plumbing, and Well Decommissioning, 15 Properties	\$300,000
PEU	Private Service Connections to Properties w/ PFAS > MCL, Internal Plumbing, and Well Decommissioning, 770 Properties	\$15,400,000
PEU	Proposed Davis Drive and DPW Yard Pump Stations <sup>(1)</sup>	\$3,000,000
MWW	Proposed South Willow Pump Station	\$1,500,000
PEU	Proposed Upgrades to MacGregors Cut Pump Station	\$500,000
PEU	DPW Yard Water Storage Tank	\$3,500,000
PEU	Pressure Reducing Valve Vaults, Quantity of 5	\$1,000,000
PEU	Existing PEU Small Water System Connections, Quantity of 4	\$400,000
PEU	Small Private Water System Upgrades and Connections, Quantity of 6	\$600,000
PEU	MSDC, 2022 Dollars (844,175 gpd @ \$4.02 gpd)	\$3,393,600
PEU	Land Acquisition and Easements	\$150,000
	Phase 2A SubTotal	\$137,177,360
	Engineering & Contingency (30%)	\$41,153,208
	SubTotal (April 2022)	\$178,330,568
	5% Increase for December 2023 Costs	\$8,916,528
	<b>Phase 2A Total (Dec. 2023)</b>	<b>\$187,247,096<sup>(2)</sup></b>
Notes: 1) Costs do not include booster chloramination at either Mountain Home Estates Pump Station or Davis Drive Pump Station.		
2) Limited Reuse Soil removal costs were not included in the cost estimate developed under this effort		

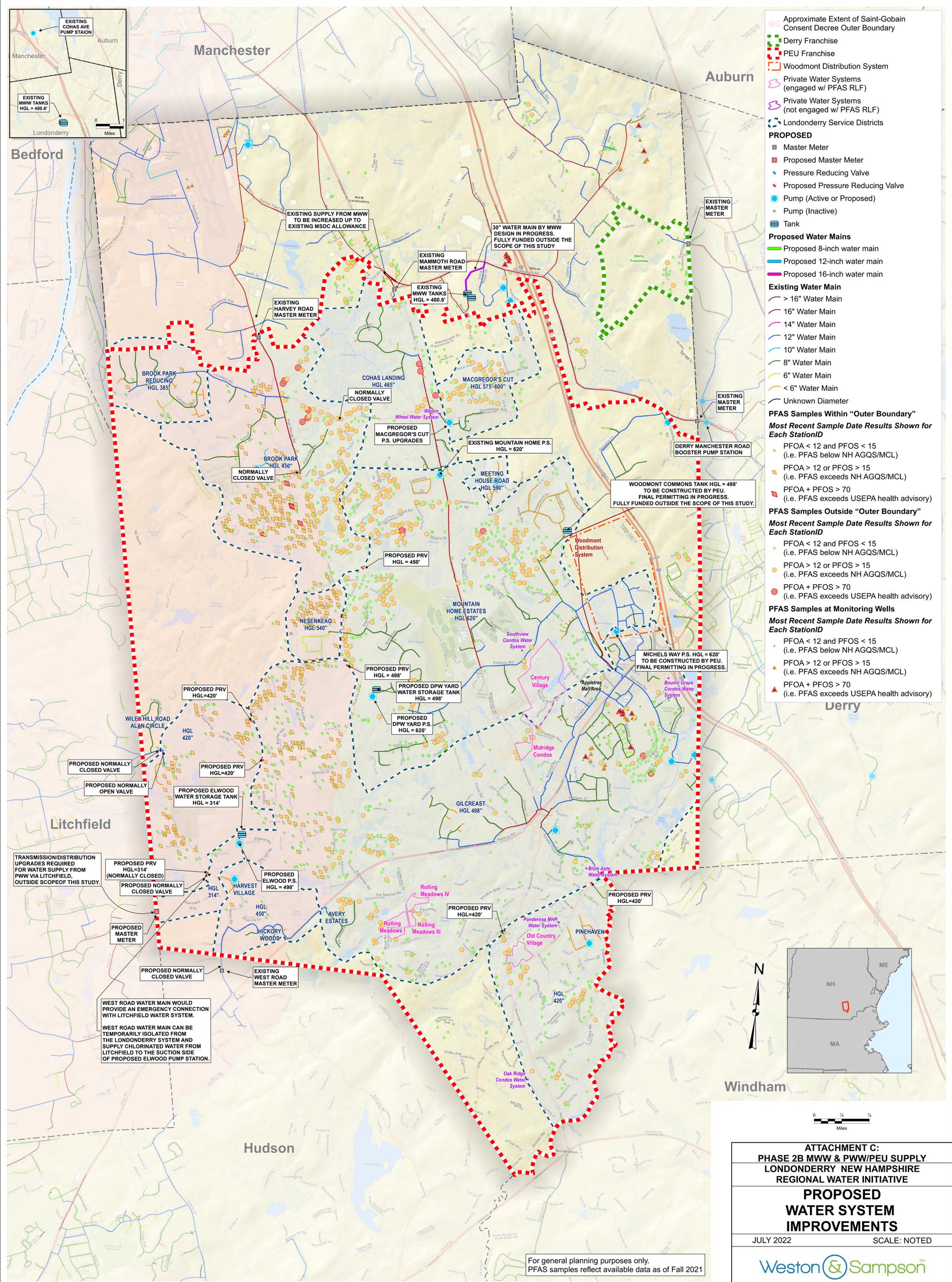
Table 9 – Budgetary Cost Estimate – Phase 2B:

Water System	Phase 2B Component	Phase 2B Cost
MWW/Derry	8" DI Water Main, 7,863 LF	\$2,280,270
PEU	8" DI Water Main, 186,164 LF	\$53,987,560
PEU	12" DI Water Main, 84,684 LF	\$35,567,280
PEU	16" DI Water Main, 33,995 LF	\$21,076,900
MWW/Derry	Private Service Connections to Properties w/ PFAS > MCL, Internal Plumbing, and Well Decommissioning, 15 Properties	\$300,000
PEU	Private Service Connections to Properties w/ PFAS > MCL, Internal Plumbing, and Well Decommissioning, 770 Properties	\$15,400,000
PEU	Proposed Elwood Orchards and DPW Yard Pump Stations <sup>(1)</sup>	\$3,250,000
PEU	Proposed Upgrades to MacGregors Cut Pump Station	\$500,000
PEU	DPW Yard and Elwood Orchards Water Storage Tanks	\$6,000,000
PEU	Pressure Reducing Valve Vaults, Quantity of 7	\$1,400,000
PEU	Existing PEU Small Water System Connections, Quantity of 4	\$400,000
PEU	Small Private Water System Upgrades and Connections, Quantity of 6	\$600,000
PEU	Land Acquisition and Easements	\$150,000
	<b>Phase 2B SubTotal</b>	<b>\$140,912,010</b>
	Engineering & Contingency (30%)	\$42,273,603
	SubTotal (April 2022)	\$183,185,613
	5% Increase for December 2023 Costs	\$9,159,281
	<b>Phase 2B Total (Dec. 2023)</b>	<b>\$192,344,894<sup>(3)</sup></b>
Notes:		
1) Elwood Orchards Pump Station costs include booster chloramination. Meter to be located within Elwood Orchards Pump Station.		
2) Costs presented do not include transmission/distribution upgrades required from PWW Water Treatment Plant to the Londonderry/Litchfield town line. Evaluation and cost are outside the scope of this study.		
3) Limited Reuse Soil removal costs were not included in the cost estimate developed under this effort		

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- Approximate Extent of Saint-Gobain Consent Decree Outer Boundary
- Derry Franchise
- PEU Franchise
- Woodmont Distribution System
- Private Water Systems (engaged w/ PFAS RLF)
- Private Water Systems (not engaged w/ PFAS RLF)
- Londonderry Service Districts
- PROPOSED**
- Master Meter
- Proposed Master Meter
- Pressure Reducing Valve
- Proposed Pressure Reducing Valve
- Pump (Active or Proposed)
- Pump (Inactive)
- Tank
- Proposed Water Mains**
- Proposed 8-inch water main
- Proposed 12-inch water main
- Proposed 16-inch water main
- Existing Water Main**
- > 16" Water Main
- 16" Water Main
- 14" Water Main
- 12" Water Main
- 10" Water Main
- 8" Water Main
- 6" Water Main
- < 6" Water Main
- Unknown Diameter
- PFAS Samples Within "Outer Boundary"**
- Most Recent Sample Date Results Shown for Each StationID**
- PFOA < 12 and PFOS < 15 (i.e. PFAS below NH AGQS/MCL)
- PFOA > 12 or PFOS > 15 (i.e. PFAS exceeds NH AGQS/MCL)
- PFOA + PFOS > 70 (i.e. PFAS exceeds USEPA health advisory)
- PFAS Samples Outside "Outer Boundary"**
- Most Recent Sample Date Results Shown for Each StationID**
- PFOA < 12 and PFOS < 15 (i.e. PFAS below NH AGQS/MCL)
- PFOA > 12 or PFOS > 15 (i.e. PFAS exceeds NH AGQS/MCL)
- PFOA + PFOS > 70 (i.e. PFAS exceeds USEPA health advisory)
- PFAS Samples at Monitoring Wells**
- Most Recent Sample Date Results Shown for Each StationID**
- PFOA < 12 and PFOS < 15 (i.e. PFAS below NH AGQS/MCL)
- PFOA > 12 or PFOS > 15 (i.e. PFAS exceeds NH AGQS/MCL)
- PFOA + PFOS > 70 (i.e. PFAS exceeds USEPA health advisory)



**ATTACHMENT C:**  
**PHASE 2B MWW & PWW/PEU SUPPLY**  
**LONDONDERRY NEW HAMPSHIRE**  
**REGIONAL WATER INITIATIVE**

**PROPOSED**  
**WATER SYSTEM**  
**IMPROVEMENTS**

JULY 2022 SCALE: NOTED

**Weston & Sampson**

For general planning purposes only.  
 PFAS samples reflect available data as of Fall 2021

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