PILLSBURY LAKE VILLAGE DISTRICT
WEBSTER, NH

JANUARY 2021

Water System Asset Management Plan

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PILLSBURY LAKE VILLAGE DISTRICT

WATER SYSTEM ASSET MANAGEMENT PLAN

WEBSTER, NH

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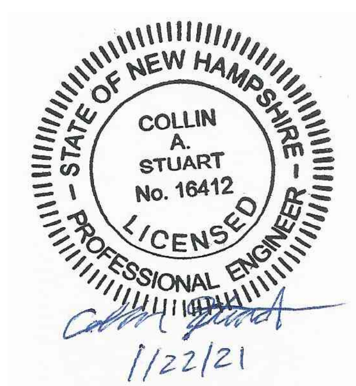

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WATER SYSTEM ASSET MANAGEMENT PLAN

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION AND BACKGROUND

The Pillsbury Lake Village District (PLVD) is private residential community formed in 1967 and consists of approximately 68 customers. PLVD provides water service to a portion of Webster, New Hampshire which primarily consists of residents in the area surrounding Pillsbury Lake.

Since construction of the original system, the distribution system has grown to include five active bedrock wells, two pump stations, and approximately 5.9 miles of distribution system piping. Prudent continual investment is needed to maintain the water system, to prepare for the future and to provide reliable service to PLVD customers.

In 2020, PLVD commissioned this study to develop an asset management program based on sound financial principles geared towards providing an adequate level of service to the District's water customers. This report was funded in part by a matching grant from the New Hampshire Department of Environmental Services.

ES.2 STUDY OBJECTIVES

The purpose of this plan is outlined in the following objectives:

- *Existing Infrastructure Evaluation* – Inventory and estimate the condition of the system's existing distribution and supply assets.
- *Facility Evaluation* – Evaluate the condition of distribution system pump stations. Develop recommendations for vertical assets using a weighted business risk evaluation matrix.
- *Develop Hydraulic Model* – Develop a hydraulic computer model of the PLVD distributions system using record documents.
- *Distribution System Hydraulic Evaluation* – Evaluate the distribution system using the hydraulic model created for this study and identify mains for replacement or renewal.

Develop recommendations for distribution system mains using a weighted business risk evaluation matrix.

- *Water Audit* – Using historic water use data, pumped water data, known unbilled water sources, and information from leak detection efforts prepare a water audit to determine unaccounted for water in the system.
- *Level of Service* – Develop a level of service (LOS) document outlining the LOS that best serves the Customer and District goals for the water system.
- *Capital Improvement Plan* – Prioritize improvement projects developed during this study over the 10-year planning period.
- *Financial Implementation Plan* – Incorporate PLVD's projected income and operating expenses in a plan which incorporates improvement projects listed in the CIP.

The intent of the study was to develop a strategic plan to meet the District's water system needs for the next 10 years. The financial implementation plan includes recommended improvements to the system and defines the revenue requirements to fund these improvements.

ES.3 FACILITY EVALUATION

The condition of assets in each distribution system facility were evaluated in order to estimate replacement dates which will be used to plan funding. Each asset was evaluated using a risk-based process described in Section 3. The assets needing replacement in the 10-year planning window are included below in **Tables ES-1** and **ES-2**.

TABLE ES-1
PENINSULA PUMP HOUSE
RECOMMENDED IMPROVEMENTS

Asset ID	Asset Description	Recommended Management Strategy	Estimated Renewal Date	Replacement Cost in 2020 Dollars
100-101-CO-03	Auto Dialing Controls	Opportunistic R&R	2021	$5,000
100-101-PP-04	Well Pump 6	Critical R&R	2021	$6,000
100-101-CF-01	Chemical Metering Pump for Chlorine	Add PdM Schedule	2023	$1,000
100-101-CF-02	Chemical Metering Pump for Orthophosphate	Add PdM Schedule	2023	$1,000
100-101-FI-01	Cartridge Filter	Run to Fail	2026	$300
100-101-SD-01	Part of SCADA Equipment	Rt or PM Schedule	2030	$25,000
100-101-CG-01	System Pressure Gauge	Run to Fail	2030	$150
100-101-CO-02	Tank and Well Alarm Controls	Rt or PM Schedule	2030	$10,000
			Total	**$48,450**

TABLE ES-2
FRANKLIN PIERCE PUMP HOUSE
RECOMMENDED IMPROVEMENTS

Asset ID	Asset Description	Recommended Management Strategy	Estimated Renewal Date	Replacement Cost in 2020 Dollars
100-102-CO-02	Submersible Pump Controls Well 4	Priority R&R	2020	$10,000
100-102-CO-03	Submersible Pump Controls Well 7	Priority R&R	2020	$10,000
100-102-HV-01	Heater	Add PdM Schedule	2020	$500
100-102-TM-02	Pressure Transmitter Booster Pump 1	Add PdM Schedule	2020	$500
100-102-TM-01	Pressure Transmitter Booster Pump 2	Add PdM Schedule	2020	$500
100-102-SI-01	Pump Control Switch for Compressor	Add PdM Schedule	2020	$2,000
100-102-CO-01	Control Panel for All The Pumps	Add PdM Schedule	2020	$10,000
100-102-TK-01	Storage Tank	Priority R&R	2026	$28,000
100-102-LE-01	Storage Tank Level Indicator	Run to Fail	2030	$500
			Total	**$62,000**

ES.4 DISTRIBUTION SYSTEM EVALUATON

The distribution system was evaluated under a variety of expected hydraulic stress conditions to assess its strength. The evaluation was primarily conducted using a computer-based hydraulic model. A risk-based analysis of the existing distribution system was also completed to determine the areas in the distribution system where the risk of pipe failure is most significant.

The PLVD distribution piping was found to be generally sufficient for the range of expected demand conditions. The distribution system is not designed to provide or support fire flows. The major driver of investment in the distribution is replacement of water mains that are leaking or actively breaking with a number of water main segments falling into the high likelihood of failure category. All distribution system water mains were prioritized for replacement using a risk-based matrix which considered pipe age, material, operating pressure, break history, diameter, how critical the pipe is to the operation of the distribution system, and how many customers the main serves. Recommendations resulting from the distribution system evaluation are below.

Water Main Replacement Recommendations

- **Concord Drive Water Main:** This water main had the highest risk score due to number of customers served, leak history, and criticality. If funds become available to complete additional water main projects in the short-term, we recommend replacing other critical risk water mains.

Dead-end Mains & Pipe Looping

We do not recommend looping any dead-end mains at this time due to funding limitations and because there are more pressing water main improvement projects within the distribution system. However, the following streets contain water mains but no customers, therefore, we recommend abandonment of these mains:

- Brookfield Circle
- Manchester Drive (past New London Drive)
- Merrimack Circle
- New London Drive (one branch)
- Newport Circle
- Windsor Terrace

Miscellaneous Recommendations

- *Flushing Program* – An annual system-wide flushing is recommended. System operators are in the process of developing a flushing plan and intend to implement once drought conditions subside and adequate water supply can be maintained.
- *Valve Exercise* – A routine valve exercise program is recommended. Distribution valves should be exercised yearly.

- *Tank Maintenance* – It is not known when the system storage tanks when the system storage tanks were last inspected. We recommend that each tank be cleaned and inspected to ensure structural integrity and water quality. In addition, we highly recommend that each hydropneumatic tank be evaluated by a registered structural engineer to ensure the safety of all District staff and operators. Joggle welds on hydropneumatics tanks installed prior to 1970 are vulnerable to explosion through failed welds.

ES.5 WATER AUDIT

Water production data was compared to customer billing data to determine non-revenue water in the distribution system. It is important to understand non-revenue water within the distribution system because eliminating this lost water can save the PLVD money in production costs and alleviate water shortages that have plagued the District. **Table ES-3** contains the results of the Water Audit.

TABLE ES-3
WATER AUDIT RESULTS

Month	Total Production (Gallons)	Billed Consumption (Gallons)	Non-Revenue Water	% Non Revenue Water
June	896,913	139,436	757,477	84%
July	859,472	224,149	635,323	74%
August	613,697	98,460	515,237	84%
September	641,878	108,352	533,526	83%
October	828,064	151,064	677,000	82%
November	751,121	101,556	649,565	86%
December	691,505	110,843	580,662	84%
June-December 2020 Total	**5,282,650**	**933,860**	**4,348,790**	**82%**

ES.6 LEVEL OF SERVICE GOALS

A Level of Service Agreement (LOS) defines the way in which the utility owners, managers, and operators want the system to perform over the long term. Establishing the level of service in a utility is a critical first step in creating an asset management plan. The LOS becomes a fundamental part of how the system is operated, how assets are replaced and renewed, and how performance is benchmarked and reported to the public.

A LOS was developed for PLVD after a series of workshops to define critical performance benchmarks in the following areas:

- Customer service
- Workplace environment
- Definition of critical assets
- Tools for assessing overall system performance
- Establishing links between costs and service
- Management and operational goals
- Regulatory goals
- Annual reporting

The goals set forth in the level of service plan included herein are summarized in **Table ES-4**. The major drivers for these LOS goals are exceeding regulatory requirements and customer expectations.

TABLE ES-4
LEVEL OF SERVICE GOALS

Goal	Measurement
1. All Federal and State water quality regulations will be met.	Is it measurable? *Yes* How often would you measure? *Review annually*
2. Water balance unmetered/unbilled water is less than 15%	Is it measurable? *Yes* How often would you measure? *Review annually*
3. The system will maintain a minimum working pressure of 35 psi	Is it measurable? *Yes* How often would you measure? *Each Complaint*
4. All customer complaints will be investigated within 1 business days of reporting the complaint.	Is it measurable? *Yes* How often would you measure? *Review complaint logs annually*
5. Breaks will be repaired within 24 hours of being reported 95% of the time.	Is it measurable? *Yes* How often would you measure? *Review monthly*
6. Contact the Board of Commissioners at least 48 hours prior to water main shutdown in planned situations and ASAP in emergency situations.	Is it measurable? *Yes* How often would you measure? *Review events monthly*
7. No bulk water deliveries	Is it measurable? *Yes* How often would you measure? *Review annually*
8. Maintain a full inventory of distribution system parts	Is it measurable? *Yes* How often would you measure? *Review annually*

Goal	Measurement
9. Ensure all treatment operators are a training level of Grade 1A or better.	Is it measurable? *Yes* How often would you measure? *Review annually*
10. Ensure all distribution operators are a training level of Grade 1A or better.	Is it measurable? *Yes* How often will you measure? *Review annually*
11. Ensure GIS is up to date.	Is it measurable? *Yes* How often will you measure? *Review annually*
12. Perform backflow testing at appropriate frequency.	Is it measurable? *Yes* How often will you measure? *Review annually*
13. Maintain a safety committee and deliver service in the safest manner possible.	Is it measurable? *Yes* How often will you measure? *Review annually*
14. Maintain water system facilities power and communications capacity.	Is it measurable? *Yes* How often will you measure? *Reviewed annually*

ES.7 CAPITAL IMPROVEMENT PLANNING

A Capital Improvement Plan (CIP) has been prepared to assist the PLVD with planning and implementation of the recommendations. The following is a summary of the priority and secondary recommendations. The CIP is presented in **Table ES-5**.

Facilities (Section 3):

Peninsula Pump House Improvements: Process improvements associated with filter components, chemical metering pumps, and system controls are recommended at this facility to improve system operations, ensure compliance with water quality regulations, and extend asset life.

Franklin Pierce Pump House Improvements: Improvements associated with system controls, HVAC, and the storage tank are recommended at this facility to improve system operations, ensure compliance with water quality regulations, and extend asset life.

Distribution System (Section 4)

1. **Replacement of Concord Drive Water Main:** This water main had the highest risk score due to number of customers served, leak history, and criticality. If funds become available to complete additional water main projects in the short-term, we recommend replacing other critical risk water mains.

TABLE ES-5
CAPITAL IMPROVEMENTS PLAN

Improvement Description	Purpose of Improvement	Length (feet)	Existing Diameter (inch)	Proposed Diameter (inch)	Unit Cost	Construction Cost	E&C (40%)	Total Project Cost
Priority Improvements								
Water Storage Tank Inspection & Cleaning	Maintenance	-	-	-	-	-	-	$5,000
Concord Drive Water Main Replacement	Breaks, Age, Criticality	1,900	2	2	$275	$375,000	$150,000	$525,000
Franklin Pierce Pump House Improvements	Condition	-	-	-	-	-	-	$33,500
Peninsula Pump House Improvements	Condition	-	-	-	-	-	-	$13,000
	Subtotal	1,900	-	-	-	$375,000	$150,000	**$576,500**
Secondary Improvements								
Franklin Pierce Pump House Improvements	Condition	-	-	-	-	-	-	$28,500
Peninsula Pump House Improvements	Condition	-	-	-	-	-	-	$35,450
Water Storage Tank Inspection & Cleaning	Maintenance	-	-	-	-	-	-	$5,000
	Subtotal	-	-	-	-	-	-	**$68,950**
	Total	**1,900**	**-**	**-**	**-**	**-**	**-**	**$645,450**

ES.8 FINANCIAL IMPLEMENTATION PROGRAM

The required revenue requirements to fund the short-term capital improvement recommendations have been incorporated into a financial planning spreadsheet and are discussed in Section 7.

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

The Pillsbury Lake Village District (PLVD) is a private residential community surrounding Pillsbury Lake in Webster, NH. Originally, PLVD consisted of seasonal homes surrounding the lake but has transitioned into primary homes for a majority of its residents in recent years. The District was formed in 1967 and now consists of five bedrock wells, two pump stations which serve two separate service zones, and a network of small diameter water mains ranging from 2 to 6-inches in diameter.

The PLVD is managed by a Board of Commissioners who are responsible for maintenance of the water supply and distribution system, hunting preserve, recreational areas, and the Pillsbury Lake Dam. PLVD turned over ownership and maintenance of District roads to the Town of Webster in 1976. Like several other small residential lakeside communities in New Hampshire, PLVD contracts the operation of their water system to a private water system operator.

In recent years, PLVD has struggled to meet system demands due to inadequate supply source capacity and excessive system leakage. Because of this, PLVD has resorted to nighttime system shutdowns to allow supply sources time to recharge and have had to supplement their groundwater supply with bulk water deliveries during drought and high demand periods. Approximately $30,000 was spent on bulk water deliveries in 2019 and approximately $2,575 was spent in 2020. The inconsistent water supply has caused the system to lose approximately 47 customers to private wells in the last few years, from approximately 115 customers in 2019 to 68 customers by the Fall of 2020.

In an effort to remedy recent system struggles and better serve their community, PLVD parted ways with their previous water system operator in the Spring of 2020. In May 2020, Aquamen Water Solutions, LLC was hired to take over the operation and maintenance of the PLVD water supply and distribution system.

PLVD also hired Wright-Pierce in the Spring of 2020 to complete a Phase I Source Water Evaluation which was intended to outline potential opportunities for the District to increase their source water capacity and eliminate the need for bulk water deliveries. This evaluation was completed in July 2020 and is included in **Appendix A** of this report.

Additionally, Wright-Pierce has been retained by PLVD to prepare a Water System Asset Management Plan using the Drinking Water Asset Management Grant Program. The New Hampshire Drinking Water and Groundwater Bureau is supporting this project through a matching grant.

1.2 PURPOSE AND SCOPE OF STUDY

The Asset Management Plan includes a Capital Improvement Plan (CIP) and Financial Implementation Plan (FIP) which will guide drinking water infrastructure investment decisions in the next 10 years.

The primary focus areas of this study include:

- *Existing Infrastructure Evaluation* – Inventory and estimate the condition of the system's existing distribution and supply assets.
- *Develop Hydraulic Model* – Develop a hydraulic computer model of the PLVD distributions system using record documents.
- *Distribution System Hydraulic Evaluation* – Evaluate the distribution system using the hydraulic model created for this study and identify mains for replacement or renewal. Develop recommendations for distribution system mains using a weighted business risk evaluation matrix.
- *Facility Evaluation* – Evaluate the condition of distribution system pump stations. Develop recommendations for vertical assets using a weighted business risk evaluation matrix.

- *Water Audit* – Using historic water use data, pumped water data, known unbilled water sources, and information from leak detection efforts prepare a water audit to determine unaccounted for water in the system.
- *Level of Service* – Develop a level of service (LOS) document outlining the LOS that best serves the Customer and District goals for the water system.
- *Capital Improvement Plan* – Prioritize improvement projects developed during this study over the 10-year planning period.
- *Financial Implementation Plan* – Incorporate PLVD's projected income and operating expenses in a plan which incorporates improvement projects listed in the CIP.

1.3 PRIOR STUDIES

Prior studies completed by PLVD and used in the development of this report include:

- Franklin Pierce Zone Sanitary Survey, August 2019, NHDES
- Peninsula Zone Sanitary Survey, August 2019, NHDES
- Well #6 Deepening & Hydrofracking Memo, October 2012, Nobis Engineering
- Hydrofracking Report, June 7, 2012, Contoocook Artesian Well Company
- Water Quality Results, June and September 2012, Eastern Analytical Inc.

1.4 ORGANIZATION OF REPORT

The report is organized into seven sections as follows:

- Section 1 – Introduction
- Section 2 – Existing System Review
- Section 3 – Facility Evaluation
- Section 4 – Distribution System Evaluation
- Section 5 – Level of Service
- Section 6 – Capital Improvement Plan
- Section 7 – Financial Implementation Plan

2

SECTION 2

EXISTING SYSTEM REVIEW

2.1 GENERAL

The purpose of this section is to provide a general overview of the water distribution system infrastructure, review historical system water demands, and project future water demands which will be used to evaluate the distribution system later in the report.

2.2 DISTRIBUTION SYSTEM OVERVIEW

The Pillsbury Lake Village District (PLVD) water distribution system consists of two service areas (Franklin Pierce and Peninsula) and does not have interconnections with any neighboring water utilities. **Figure 2-1** depicts the approximate extents of the existing water distribution system service areas and includes pipe diameter, and locations of district facilities, blowoffs, and flushing hydrants.

2.2.1 Distribution Piping

The water distribution system consists of approximately 5.9 miles of water main piping ranging in size from 2 – 6-inch in diameter. In addition, there are approximately 11 flushing hydrants, 65 gate valves, and 68 metered service connections (September 2020). The distribution system also contains approximately 2.9 miles of abandoned water mains. The PLVD does not provide fire protection through its water system. A breakdown of piping length by material type and diameter is presented in **Table 2-1**.

TABLE 2-1
DISTRIBUTION SYSTEM PIPING

Pipe Material	Diameter (inches)	Length (feet)	% Total System
PVC	2	27,682	87.3%
	3	634	2.0%
	4	2,121	6.7%
	6	1,285	4.0%
	Total	**31,722**	**100%**

*PVC = polyvinyl chloride.


Active Well
Abandoned Well
2" Water Line
3" Water Line
4" Water Line
6" Water Line
Abandoned Line
2" Valve
3" Valve
4" Valve
6" Valve
Capped Line
Blowoff
Flushing Hydrant
Peninsula Zone
Franklin Pierce Zone
Franklin Pierce Pump House
Peninsula Pump House
NEW HAMPSHIRE DR
GRANITE WAY
WEBSTER LN
FRANKLIN PIERCE DR
NEW LONDON DR
MANCHESTER RD
CONCORD DR
PENACOOK CIR
CENTENNIAL DR
GENERAL STARK DR
RUMFORD DR
CHRISTOPHER ROBERT DR
BROOKFIELD CIR
MOUNT VERNON TER
NEWPORT CIR
WINDSOR TER
WINDSOR TERRACE
MERRIMACK DR
CORN HILL RD
DEER MEADOW RD
BASHAN HOLLOW RD
N
0 150 300 600 Feet
Water System Overview
Pillsbury Lake Village District, NH
PROJ NO: 20319A
DATE: 12/15/2020
FIGURE: 2-1
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2.2.2 Groundwater Supplies

PLVD source water comes from five bedrock wells (BRW) at two pump houses. In 2019, New Hampshire Department of Environmental Services (NHDES) completed a Sanitary Survey and estimated source capacities in the process. **Table 2-2** lists the current estimated capacities of each water supply source. In 2020, Wright-Pierce completed a separate Source Water Evaluation where District-owned properties were reviewed for source water potential. Refer to **Appendix A** for a copy this report. This study focuses on existing asset condition and their adequacy to meet existing and projected demands.

TABLE 2-2
WATER SUPPLY SOURCES

Source	Name/ Location	Year Installed	Well Depth (ft)	Estimated Original Well Capacity (GPD)	Estimated Current Well Capacity (GPD)
BRW 4	Franklin Pierce Pump House	1966	1,040	28,800	10,160
BRW 7	Franklin Pierce Pump House	1998	1,060	10,080	2,880
BRW 8*	Franklin Pierce Pump House	2019	598	31,680	9,216
Sub-Total				**70,560**	**32,256**
BRW 5	Peninsula Pump House	1980	300	43,200	10,080
BRW 6	Peninsula Pump House	1982	305	18,720	24,192
Sub-Total				**61,920**	**34,272**
TOTAL				**132,480**	**66,528**

*Currently permitted as an emergency use well, anticipated to be permitted as a permanent well in 2021.

2.2.3 System Controls

The Franklin Pierce Zone Pump House and Peninsula Pump House are operated manually. PLVD does not have a supervisory control and data acquisition (SCADA) system for remote operation of the water system. All pump controls for each service zone are located within each pump house.

2.2.4 Historical Water Demands & Projections

As stated earlier in this report, PLVD has struggled to produce enough water with their existing sources to meet customer demands. This has been attributed to the reduced pumping capacities of each source as well as leaks within the distribution system. In addition to struggling to meet system demands, historical water production data was not adequately recorded by the previous water system operator making it difficult to develop any useful historical production trends. In 2019, NHDES completed Sanitary Surveys of the Franklin Pierce and Peninsula Zones. In each service zone, NHDES cited *Inadequate Record Keeping* under the Significant Deficiencies portion of the report. Additional deficiencies cited by NHDES are discussed throughout this report.

In 2019, customers began cancelling their water service with the PLVD and drilling private wells. This was largely due to the lack of adequate water supply and water quality withing the District. As of the end of September 2020, the total number of PLVD service connections was reduced to 68 from approximately 115 in 2019. The dramatic reduction of customers has led to a substantial reduction in the amount of water needed to be pumped by each source well. Since the start of this study, the total amount of service connections has been further reduced to approximately 55 across both service zones. However, for the purposes of this study, and because of the unstable customer population, 68 service connections were used as a starting point for future demand projections.

In May 2020, PLVD appointed a new water system operator to manage their water supply and distribution system assets. **Table 2-3** contains PLVD water production data in the Franklin Pierce Zone since June 2020 (Operator's first full month) and **Table 2-4** contains PLVD water production data in the Peninsula Zone over the same time period. Flow meters are equipped at each source well in addition to the discharge pipe in each facility. Because the source wells have struggled to meet customer demands, bulk water deliveries were required in the summers of 2019 and 2020. Bulk water deliveries are received in each service zones pumping facility prior to the discharge pipe's flow meter. Therefore, the "Total Flow" column in **Tables 2-3 and 2-4** contain both the water produced from the source wells and water attributed to bulk water deliveries. The tables also include the average daily demand (ADD), number of customer service connections, and the estimated ADD per customer for each month.

TABLE 2-3
HISTORICAL DEMAND TRENDS – FRANKLIN PIERCE ZONE

Month	Total Flow (Gallons)	Average-Day Demand (GPD)	Service Connections	ADD per Service
June	420,864	15,031	38	396
July	434,701	13,584	37	367
August	280,378	9,044	37	244
September	293,459	10,481	37	283
Average	**357,351**	**12,035**		**323**

*GPD – gallons per day.

TABLE 2-4
HISTORICAL DEMAND TRENDS – PENINSULA ZONE

Month	Total Flow (Gallons)	Average-Day Demand (GPD)	Service Connections	ADD per Service
June	476,049	15,868	42	378
July	424,771	13,274	41	324
August	333,319	10,752	41	262
September	348,419	12,444	41	304
Average	**395,640**	**13,085**		**317**

Since the number of customers served by the PLVD has declined dramatically over the last year, it is difficult to predict population trends within the District. This study makes the assumption that the majority of remaining customers will stay on water service and the trend of customers leaving the system will plateau. As stated above, the base point chosen for demand projections is 68 total District service connections (36 in Franklin Pierce and 32 in Peninsula). Since PLVD is a small residential community, we anticipate that growth will be slow. For the purposes of this study, we assumed that one house will be added to each service zone each year.

This is likely a conservative estimate, but projecting demands conservatively will give PLVD a glimpse of how the system may perform under increased demand scenarios. Additionally, the data contained in the tables above align with typical peak demand season. For most water systems, the summer months are when the most water is used by customers. **Table 2-5** contains projected service connections for 1, 5, and 10 years into the future for each service zone. PLVD contains many undeveloped properties which could be used to expand PLVD service in the future.

TABLE 2-5
SERVICE CONNECTION PROJECTIONS

Year	Estimated Franklin Pierce Zone Services	Estimated Peninsula Zone Services
2021	37	33
2026	42	38
2031	47	43

Typically we prefer 5-10 years of production data for the purposes of projecting demands, but since PLVD's historical production data is unreliable/incomplete and because the customer base has been greatly reduced in a short period of time, we determined that the most recent production data is the data most representative of the current system. For the purposes of this report, we considered the last 4 months of data when evaluating trends (presented in **Tables 2-3 and 2-4**).

We estimated future demands by multiplying the 4-month average ADD per service listed in **Tables-2-3** and **2-4** (323 gpd/service for Franklin Pierce and 317 gpd/service for Peninsula) with the projected service connections listed in **Table 2-5**. The resulting ADD projections are presented in **Table 2-6** below.

TABLE 2-6
PROJECTED AVERAGE DAY DEMANDS

Year	Franklin Pierce Zone ADD (GPD)	Peninsula Zone ADD (GPD)
2021	11,936	10,455
2026	13,549	12,040
2031	15,162	13,624

Maximum-day demand (MDD) is defined as the maximum amount of water used on any given day during a year. The MDD is required to size pumping units, transmission mains, treatment processes, and storage facilities. For the analysis of the PLVD system, it will be used to check the adequacy of the existing water distribution system pipes. Projected MDDs were calculated using the projected ADD in **Table 2-6** and a peak factor of two, which is typical for systems of a similar size. Projected MDD for the 10-year planning period are presented in **Table 2-7**.

TABLE 2-7
PROJECTED MAXIMUM DAY DEMANDS

Year	Franklin Pierce Zone MDD (GPD)	Peninsula Zone MDD (GPD)
2021	23,872	20,911
2026	27,098	24,079
2031	30,324	27,247

The demand projections presented herein were used to assess the hydraulic adequacy of the distribution piping, the results of which are presented in **Section 4** of this report.

2.2.5 Leak Detection Efforts

A major component of PLVD's past struggles to meet system demands can be attributed to water main and service leaks in the distribution system. Over the past 5 years, the water system has experienced approximately 50 leaks. However, water loss associated with these leaks was not estimated until May 2020. **Figure 2-2** depicts the general location of these leak repairs.

According to NHDES:

"Chronic leakage is a common occurrence for aging water systems. Proactive leak detection and repair can reduce a water system's pumping and treatment costs, protect water supply quality and quantity, and allow better management and prioritization of system projects. The amount of leakage can be estimated by measurement of night flow (1 a.m. to 5 a.m.)."

NHDES recommends that when estimating night flow, residents be asked not to use water between 1 a.m. and 5 a.m. and water supply sources be turned off. The water system operator should note any change in the water level in the vented storage tanks. Any large usage of water can be attributed to system leaks.

PLVD's current water system operators have been aggressively investigating the distribution system for potential leaks. When repairs are made, the water loss associated with each leak is estimated. Several leaks were caused by plastic/nylon fitting that failed, all repairs were made with brass insert fittings and stainless-steel clamps. Additionally, when the system was installed stubs were left for future service connections. These stubs have begun to leak and are repaired as leaks are discovered. **Table 2-8** contains a list of leak repairs made since May 2020 and their estimated leakage. PLVD also recently decommission water mains on Rogers Drive, Rumford Drive, and Rumford Drive Extension due to excessive leakage and there being no active customers in this portion of the system.

TABLE 2-8
LEAKS REPAIRS SINCE MAY 2020

Location	Estimated Leakage
524 Dear Meadow Road	2 gpm
New London Drive	2 gpm
113 New Hampshire Drive	1 gpm
Rumford Extension (Abandoned)	10 gpm
100 New Hampshire Drive	6-8 gpm
Concord Drive/Franklin Pierce Intersection	8-9 gpm
Franklin Pierce Drive	4-6 gpm

*gpm – gallons per minute.

Regular system-wide leak detection surveys can help pinpoint active leaks within the distribution system. The force associated with water leaking from a pipe can erode sand particles surrounding the pipe and result in total failure of the pipe. Geophones can be used to detect the noise associated with leaking water before the leak makes its way to the surface. We recommend that operations staff continue their leak detection efforts and complete a system wide leak detection survey at least once annually. Tracking non-revenue water can save the District money in operation and treatment costs moving forward.


Leak Repairs
2" Water Line
3" Water Line
4" Water Line
6" Water Line
Abandoned Line
CORN HILL RD
NEW HAMPSHIRE DR
GRANITE WAY
MANCHESTER DR
CONCORD DR
WEBSTER LN
FRANKLIN PIERCE DR
NEW LONDON DR
PENACOOK CIR
DEER MEADOW RD
MERRIMACK CIR
BASHAN HOLLOW RD
CENTENNIAL DR
GENERAL STARK DR
RUMFORD DR
CHRISTOPHER ROBERT DR
BROOKFIELD CIR
NEWPORT DR
WINDSOR TERRACE
0 150 300 600 Feet
Water System Breaks
Pillsbury Lake Village District, NH
PROJ NO: 20319A
DATE: 11/20/2020
FIGURE: 2-2
WRIGHT-PIERCE
Engineering a Better Environment

2.2.6 Water Audit

A water audit is a formal procedure to define sources of non-revenue water within the distribution system and determine if the sources can be remedied in a cost-effective manner. The audit should be developed in accordance with the guidelines of the American Water Works Association (AWWA) Manual of Water Supply Practices entitled "Water Audits and Leak Detection, AWWA M36". A water audit characterizes a variety of sources of lost water and includes a plan to address and account for sources of non-revenue water.

In general, revenue water is water-use that has been metered and billed to customers while non-revenue water is water-use that is not metered or results from inaccuracies of metering and other sources. **Table 2-9** presents a breakdown of typical revenue and non-revenue sources in a system. The following is a list of definitions for the various terms used therein:

- Total Production Volume - The annual volume input to the water supply system.
- Authorized Consumption - The annual volume of metered and/or unmetered water taken by any user authorized to do so.
- Water Losses - The difference between Total Production Volume and Authorized Consumption, consisting of Apparent Losses plus Real Losses.
- Apparent Losses - Unauthorized Consumption, all types of metering inaccuracies and data handling errors.
- Real Losses - The annual volumes lost through all types of leaks, breaks, and overflows on mains and service connections, up to the point of customer metering. Commonly referred to as lost water.
- Revenue Water - Those components of Total Production Volume which are billed and produce revenue.
- Non-Revenue Water - The difference between Total Production Volume and Billed Authorized Consumption.

TABLE 2-9
REVENUE AND NON-REVENUE WATER USE CATEGORIES*

<table>
<tr><td rowspan="10">Total Production Volume (corrected for known errors)</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption (including water exported)</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="8">Non-Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="6">Water Losses</td><td rowspan="3">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td>Data Handling Errors</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer metering</td></tr>
</table>

*** From AWWA M36.**

Some non-revenue water uses can be confidently estimated and are therefore considered "authorized uses" of water. The remaining volume is considered water losses. Industry standards suggest that total water loss volume should be no higher than 20% of the total production volume while real losses, by definition, true unaccounted for water (UAW), should be 10-15% of the total production volume. The State of New Hampshire has adopted rules under Env-Ws 390, which require applicants for development of new sources to demonstrate that UAW is less than 15%.

Leaks are often the largest contributor to UAW. Leaks can originate from anywhere in the system. The largest sources of leakage typically occur on main lines or through valves. Other sources of leaks include service-lines, residential meter boxes, residential leakage on the customer side of the service and other miscellaneous types.

Since non-revenue water-use attributed to system leakage and flushing was not recorded in the past, records from the master meter located on the discharge pipe at each pumping facility and customer billing records were used as the baseline for determining the PLVD revenue and non-revenue water-use. **Table 2-10** presents data comparing these records beginning in June 2020. Production data prior to the data below was thought to be unreliable by the District. It should also be noted that a Water Audit typically reviews a year's worth of data, but due to unreliable historical data we reviewed revenue and non-revenue water over the most recent 6-month window.

TABLE 2-10
REVENUE AND NON-REVENUE WATER REVIEW

Month	Total Production (Gallons)	Billed Consumption (Gallons)	Non-Revenue Water	% Non Revenue Water
June	896,913	139,436	757,477	84%
July	859,472	224,149	635,323	74%
August	613,697	98,460	515,237	84%
September	641,878	108,352	533,526	83%
October	828,064	151,064	677,000	82%
November	751,121	101,556	649,565	86%
December	691,505	110,843	580,662	84%
June-December 2020 Total	**5,282,650**	**933,860**	**4,348,790**	**82%**

As shown in **Table 2-10**, total produced water exceeds consumption in all months and is consistent with reported observation that PLVD has had trouble meeting the demand in the system. The vast majority of the source water production cannot leakage is rampant in the distribution system. The estimate of non-revenue water in the system for the period June-December 2020 *is 82% non-revenue.*

Approximately 18% of the customer service meters either do not read or read flow inaccurately contributing to a significant portion unbilled unmetered consumption contributing to nonrevenue water in the system. PLVD is in the process of repairing or replacing these problem meters with the meter supplier. As stated previously, water loss in the system through system leaks and system flushing are not recorded. estimate of water losses within the PLVD system cannot be made.

PLVD operators have begun replacing faulty customer meters in recent months, repairing leaks and estimating lost volumes, and intend to implement a seasonal flushing program where water-use will be recorded.

When importing this data as an aggregate into the AWWA Water Audit Software, the software indicates that there is significant issues with authorized consumption values. This is in line with our assessment and discussion above. The tool recommends areas where water audit data validity can be improved. These focus areas are

- Source water volume metering
- Billed metered volumes
- Customer metering inaccuracies

Additionally, and most importantly, distribution system leakage seems to be the largest contributor to non-revenue water. Assessing where leakage is occurring and reducing this volume is critical to bringing water loss into acceptable norms.

We recommend the PLVD continuing to monitor their water balance on a semi-annual basis to ensure. The AWWA water audit tool included in the Appendix A is helpful in quickly and effectively updating this information. Administrative and operations recommendations to improve water balance information are as follows:

- Calibrate production flow meters at the well facilities on an annual basis to ensure accurate production volume data from each well source and pumping facility,
- Replace faulty customer meters as soon as possible to ensure accurate billing data is being collected,
- Adhere to a proactive meter replacement program for customer and to minimize the potential for meter failure or reduction metering accuracy.
- Track estimates of unbilled unmetered water due to leaks,
- Track estimates of unbilled unmetered used during system maintenance activities such as flushing.
- Reduce unmetered usage as much as possible.

- Evaluate shutting down or eliminating portions the water system that do not actively serve existing customers.

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3

SECTION 3

FACILITY EVALUATION

3.1 GENERAL

Distribution system pump stations provide a means for moving water and controlling pressure within the system. The purpose of this section is to provide a condition assessment of the assets within the two existing Pillsbury Lake Village District (PLVD) pump stations. The evaluation was completed using observations from New Hampshire Department of Environmental Services (NHDES) and Wright-Pierce (WP) inspections of each facility, conversations with the District and system operator, and reviewing record documents.

3.2 FACILITY RISK ANYALYSIS CONCEPT

Not all assets are equally important to a pump station’s operation; some assets are highly critical to operations and others are much less so. Furthermore, the definition of a critical asset is completely system specific. A community must examine its own water system assets very carefully to determine which current assets are critical and why.

Analyzing the existing water system assets to determine the probability of failure (PoF), and the consequence of failure (CoF), provides valuable information about assets in the system. The scope of this risk analysis is limited to the pump stations within the distribution system. This risk analysis evaluation provides the foundation for the development of the most cost-effective asset management planning allowing the PLVD to add risk modeling to the process and ensure money is allocated where risk can best be mitigated within the distribution system.

3.2.1 Probability of Failure

As a first step in determining risk, a system needs to look at what it knows about the PoF of a given asset. There are four primary failure models of which an asset can fail. The primary failure modes are:

- Capacity – the asset is operational, but growth or expansion is making it unable to deliver the required capacity
- Level of Service – the asset is operational, but is causing violations in the level of service (LOS) agreement, codes, permits, or safety
- Mortality – physical deterioration of the asset, it is no longer operational. This is the most common mode of failure.
- Efficiency – the asset is operational but costs more to maintain and operate then alternatives.

An asset may be highly likely to fail if it is old, has a long history of failure, has a known failure record in other locations, or has a poor condition rating. An asset may be much less likely to fail if it is newer, has little to no history of failure and has a good to excellent condition assessment rating.

3.2.2 Consequence of Failure

In terms of the CoF, it is important to consider various possible costs of failure. The costs potentially include: public health impact, social cost associated with the loss of the asset, repair/replacement costs related to collateral damage caused by the failure, legal costs related to additional damage caused by the failure, environmental costs created by the failure, and any other associated costs or asset losses. The CoF can be high if any of these costs are significant or if there are several of these costs that will occur with a failure.

3.2.3 Risk Analysis

Assessing risk requires an examination of the PoF and the CoF as discussed above. To assess the risk for each particular asset, the two measures of failure are combined into a risk matrix.

Using this methodology, the PLVD's risk of failure for a given asset is evaluated and the most cost-effective management strategy is determined in order to minimize that risk. Risk can be reduced by decreasing the PoF through augmentation, repair, replacement, or refurbishment. Also, by decreasing the CoF through redundancy, relocation, insurance, or alarms. In most cases, reducing the CoF is not cost-effective, so it has to be evaluated on a case-by-case basis.

Normally, the most cost-effective means of reducing risk for aging assets is to reduce the PoF through infrastructure replacement projects. The assets that have the greatest PoF and the greatest consequences associated with the failure will be the assets that have the greatest risk and should be further evaluated to determine ways to reduce the risk.

3.3 FACILITY RISK ANALYSIS SCORING

Due to the variety of components within each pump station, the categories used in analyzing facility assets need to be broad enough to assess performance of many different types of assets. **Table 3-1** summarizes the categories used to determine risk for facility assets.

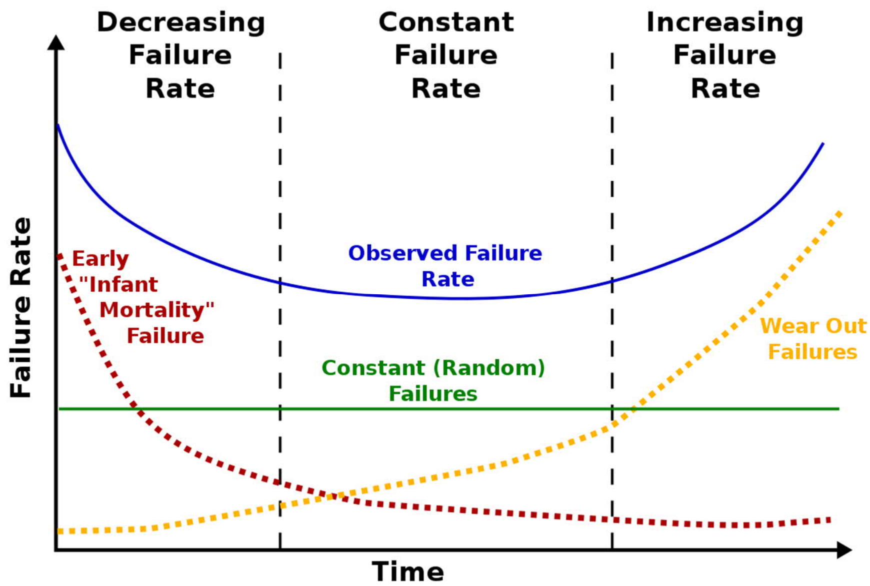
TABLE 3-1
RISK CATEGORIES FOR FACILITIES ANALYSIS

Probability of Failure	Consequence of Failure
Physical Condition	Social/ Community
Reliability	Economic/ Financial
Performance	Environmental
Maintainability	Replacement Time
	Redundancy

3.3.1 Probability of Failure

As a first step in determining risk, a conditional assessment is needed to determine the probability that any asset is subject to fail. The PoF score is determined from the results of the Weibull analysis that is performed on each asset. Using both the condition and reliability ratings the remaining life is determined. This is then used to perform the Weibull analysis and produce the PoF. This is based off the bathtub curve, as shown in **Figure 3-1** below, the probability is determined based on where it falls on the curve. To determine the final PoF score you adjust the probability score from the Weibull analysis based on the performance and maintainability ratings.

FIGURE 3-1
BATHTUB CURVE



Physical Condition Rating – The condition is based off several factors including vibration, noise, temperature, coating condition, wear or corrosion, leakage, etc. The following are the possible condition ratings:

- 1-New or Excellent Condition
- 2-Very Good Condition
- 3-Minor Defects Only
- 4-Some Defects and Deterioration
- 5-Moderate Deterioration
- 6-Moderate to Significant Deterioration
- 7-Significant Deterioration
- 8-Significant Deterioration w/ Major Repairs Performed on Equipment
- 9-Virtually Unserviceable
- 10-Unserviceable

Reliability Rating – The reliability is based on the history of the asset and relates the number of reported breakdowns or unplanned maintenance calls and potential downtime related to the availability of parts and service for the asset. The following are the possible reliability ratings:

- 1-Exceptional (No Problems)
- 2-Random Breakdown (Every 5 Years)
- 3-Occasional Breakdown (Every 2 Years)
- 4-Periodic Breakdown (Once per Year)
- 5-Continuous Breakdown (Multiple Times per Year)

Current Performance Rating – The performance is defined in terms of meeting demands, efficiency, and attention required. The following are the possible performance ratings:

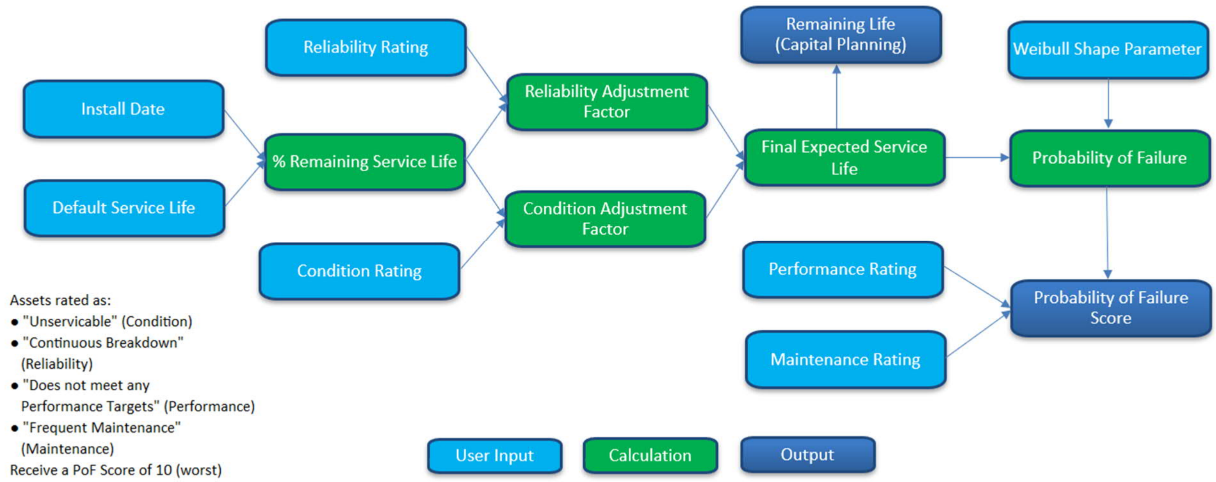
- 1-Meets or Exceeds all Performance Targets
- 2-Minor Performance Deficiencies
- 3-Considerable Performance Deficiencies
- 4-Major Performance Deficiencies
- 5-Does not meet any Performance Targets

Maintainability Rating – The maintainability is based on the level and frequency of maintenance as well as the monitoring required to keep the asset operational. The following are the possible maintainability ratings:

- 1-Easily Maintained
- 3-Largely Preventative Maintenance
- 5-Periodic Corrective Maintenance
- 7-More Frequent Corrective Maintenance
- 9-Work Orders Well Above Average
- 10-Corrective Maintenance has become Routine

Figure 3-2 provides a visual depiction of how inputted factors contribute to PoF score calculation.

FIGURE 3-2
PROBABILITY OF FAILURE SCORE CALCULATION



3.3.2 Consequence of Failure

In terms of the CoF, it is important to consider various possible costs of failure. The costs potentially include: social costs associated with the loss of the asset, repair/replacement costs related to collateral damage caused by the failure, legal costs related to additional damage caused by the failure, environmental costs created by the failure, and any other associated costs or asset losses. The CoF can be high if any of these costs are significant or if there are several of these costs that will occur with a failure. The CoF score is a sum of the factors listed below normalized to a 1-10 scale. These weighting factors have been selected for the District to appropriately reflect the potential risk for each factor in PLVD.

TABLE 3-2
CONSEQUENCE OF FAILURE FACTOR WEIGHTING

Factor	Weighting
Social/Community	40%
Economic/Financial	40%
Environmental	20%

***Social/Community* –** This factor gives weight to the social/community consequences that would occur if a given asset were to fail. Potential consequences included in this factor are of three types (Loss of Service, Safety, and PLVD's Image).

TABLE 3-3
SOCIAL/COMMUNITY SCORING

Loss of Service	Can be out of service indefinitely	Cannot be down a month	Cannot be down a week	Cannot be down a day	Cannot be down 8 hours	Cannot be down one hour
Safety	No impact	Minimal Impact	Minor injury	Moderate Impact on Public Safety	Significant Impact to Public Safety	Significant and Immediate Impact to Public Safety
PLVD's Image	No media or no consequence	Neutral coverage	Adverse media	Widely adverse media	Continual; political opposition	Nationally adverse media
Score	1	3	5	7	9	10

***Economic/Financial Scoring* –** This factor gives weight to the economic/financial consequences that would occur if a given asset were to fail. Potential consequences included in this factor are of two types (Economic and Financial).

TABLE 3-4
ECONOMIC/FINANCIAL SCORING

Economic Impact	Low cost	Moderate cost	High cost	High cost; diverts $	Painful change of priorities	Likely to trigger rate increase, staff changes
Financial Impact	Insignificant	<$10k	<$50k	<$100K	<$1 million	>$1 million
Score	1	3	5	7	9	10

***Environmental* –** This factor gives weight to the environmental consequences that would occur if a given asset were to fail. Potential consequences included in this factor are of two types (Spill/ Flood and Permit Compliance).

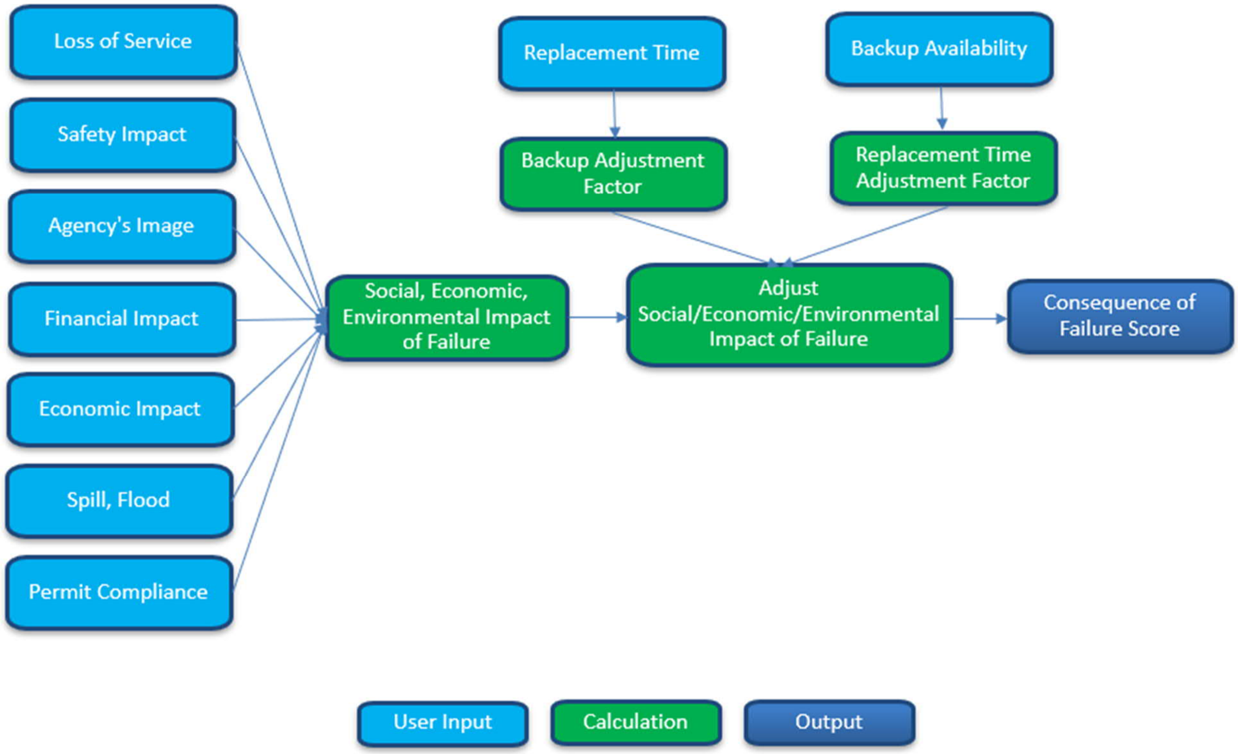
TABLE 3-5
ENVIRONMENTAL SCORING

Spill/ Flood	No Impact	Short duration, small quantity	Moderate flooding, some offsite spillage	Many inconvenienced; moderate health and habitat issues	Severe health and habitat issues; some mandatory vacation of premises	Large areas vacated and closed to public access; extensive specialized containment cleanup required
Permit Compliance	No consequence	Minor violation - reporting only	Regulatory sanction possible	Regulatory sanction likely; Damage reversible less than one year	Extensive regulatory sanction virtually assured; damage reversible in one to five years	Severe sanctions; damage reversible in five years or more
Score	1	3	5	7	9	10

After the score is calculated the replacement time and redundancy factors are considered. Those factors adjust the score up or down by a certain percentage based on the level of redundancy and replacement time for each asset.

Figure 3-3 provides a visual depiction of how inputted factors contribute to CoF score calculation.

FIGURE 3-3
CONSEQUENCE OF FAILURE SCORE CALCULATION



3.3.3 Management Strategies

Once the final scores for PoF and CoF are determined they are put into the risk matrix shown in **Figure 3-4** below. Based on the group that each asset falls in, it will be assigned a management strategy to maximize cost-effective maintenance practices and reduce the risk associated with the asset.

FIGURE 3-4
ASSIGNMENT OF MANAGEMENT STRATEGIES

Probability of Failure	Consequence of Failure: 1	2	3	4	5	6	7	8	9	10
10	D	D	B	B	A	A	A	A	A	A
9	D	D	B	B	A	A	A	A	A	A
8	D	D	C	B	B	B	A	A	A	A
7	D	D	C	B	B	B	B	B	A	A
6	F	F	C	C	C	B	B	B	B	B
5	F	F	F	C	C	C	C	C	C	C
4	F	F	F	E	C	C	C	C	C	C
3	F	F	F	E	E	E	E	C	C	C
2	F	F	F	E	E	E	E	E	E	E
1	F	F	F	E	E	E	E	E	E	E

3.4 FACILITY RISK ANALYSIS

Each facilities' assets were evaluated using Fulcrum, a cloud-based data collection software. WP staff toured each facility with District staff and entered pertinent condition and operational performance information for each asset into Fulcrum using a tablet. Ratings were assigned to each asset based on industry standards for asset management, including physical condition, reliability, current performance and maintainability in order to categorize risk.

The condition assessments of the pump house assets are primarily based on visual and auditory observations and were limited to accessible areas. No permit-required confined space entry was performed during the evaluations, as well as destructive testing of construction materials (concrete, paint, metal, insulation, etc.) to determine the condition of assets. While some non-destructive testing (auditory, vibration, thermal) was performed during the evaluation, the results of those observations were limited to the timeframe allowed for each site inspection and using commonly available tools. The tools used during the evaluations were not specifically calibrated for each use but rather the results were used as an indicator to identify assets that are performing outside their expected performance range. It is recommended that all assets be re-evaluated every 5 years.

Assets from the Peninsula Pump House and Franklin Pierce Pump House were evaluated using the methods and scoring strategies outlined above. **Figures 3-5** and **3-6** depict the resulting asset management strategies for the PLVD vertical assets.

FIGURE 3-5
PLVD MANAGEMENT STRATEGY OUTPUTS

Probability of Failure \ Consequence of Failure	1	2	3	4	5	6	7	8	9	10
10	-	1	2	-	1	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
8	-	-	1	-	-	-	-	-	-	-
7	-	-	2	3	1	-	-	-	-	-
6	-	-	-	-	1	1	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	1	-	-	-	-	-
3	-	1	2	6	2	1	-	-	-	-
2	-	1	7	6	1	1	-	-	-	-
1	1	6	8	12	1	1	-	-	-	-

FIGURE 3-6
SUMMARY OF PLVD ASSETS BY STRATEGY

Group	Strategy	Count	% Assets
A	Critical R&R	1	1%
B	Priority R&R	7	10%
C	Add PdM Schedule	5	7%
D	Opportunisitic R&R	1	1%
E	Rt or PM Schedule	31	44%
F	Run to Fail	26	37%
G	(undefined)	0	0%

3.4.1 Asset Class Descriptions

WP developed an asset hierarchy that encompasses the PLVD pump houses. The purpose of the asset hierarchy is to assign definitive titles to each asset and differentiate one asset from another. An example of the asset naming structure and how the hierarchy applies to PLVD assets is listed below.

Example #1: Asset ID: 100-101-CF-01,

100 = Pump Station
- 101 = Peninsula Pump House
  - CP = Centrifugal Pump
    - 01 = Pump #

Example #2: Asset ID is 100-102-HV-01,

100 = Pump Station
- 101 = Franklin Pierce Pump House
  - HV = Heating, Ventilating, and Air Conditioning
    - 01 = HVAC Asset #

Table 3-6 contains common abbreviations included in Asset ID tags.

TABLE 3-6
VERTICAL ASSET DESCRIPTIONS

Asset Class	Estimated Service Life	Description
BL	25	Blower, Air Compressor
CF	10	Chemical Feed System
CP	30	Centrifugal Pump
CS	60	Building
EE	30	Electrical Equipment
EP	25	Electric Panel
FI	10	Filter Membrane/Sand
GN	35	Generator
HV	15	Heating, Ventilating, and Air Conditioning
IC	15	Instrumentation and Controls
MO	20	Motor
PE	20	Process Equipment
PP	20	Pump
TK	25, 50	Tank, Storage Tank
TX	25	Transformer, Transfer Switch
VD	20	VFD, Motor Starter

3.4.2 Peninsula Pump House

The Peninsula Pump House is located off New Hampshire Drive and houses equipment associated with bedrock wells (BRW) 5 and BRW 6. Water pumped from each well enters the pump house through individual water lines that include a check valve, source tap, and meter. The individual water lines then combine and pass through a Harmsco filter which is used for iron and sediment removal and four non-backwashing filter units for arsenic removal. Chlorine is injected for taste and odor control and a sequestering agent is injected for manganese control. The water then enters a 15,000-gallon buried atmospheric storage tank before it is delivered to the distribution system via two 5 Hp variable frequency drive booster pumps through two water lines. A detailed description of Peninsula Pump House operations is included in **Appendix B**.

In August 2019, NHDES completed a sanitary survey inspection of the Peninsula Pump House. The report lists several deficiencies related to asset condition, water quality, and District operational practices. We listed the significant deficiencies below that affected our review of the PLVD vertical assets:

- Standpipes of both BRW 5 and BRW 6 are corroding near the ground surface,
- Treatment for manganese should be improved,
- Buried 1960’s vintage storage tank has reportedly never been cleaned.

WP performed a risk analysis on the Peninsula Pump House assets following the method and scoring system outlined above. Approximately 45 assets were evaluated. **Appendix C** contains the results of the Peninsula Pump House asset evaluation. **Table 3-7** contains assets with replacement dates within the 10-year planning period. The renewal of each asset has been included in the Capital Improvement Plan (CIP) in Section 6.

TABLE 3-7
PENINSULA PUMP HOUSE
RECOMMENDED IMPROVEMENTS

Asset ID	Asset Description	Recommended Management Strategy	Estimated Renewal Date	Replacement Cost in 2020 Dollars
100-101-CO-03	Auto Dialing Controls	Opportunistic R&R	2021	$5,000
100-101-PP-04	Well Pump 6	Critical R&R	2021	$6,000
100-101-CF-01	Chemical Metering Pump for Chlorine	Add PdM Schedule	2023	$1,000
100-101-CF-02	Chemical Metering Pump for Orthophosphate	Add PdM Schedule	2023	$1,000
100-101-FI-01	Cartridge Filter	Run to Fail	2026	$300
100-101-SD-01	Part of SCADA Equipment	Rt or PM Schedule	2030	$25,000
100-101-CG-01	System Pressure Gauge	Run to Fail	2030	$150
100-101-CO-02	Tank and Well Alarm Controls	Rt or PM Schedule	2030	$10,000
			Total	**$48,450**

3.4.3 Franklin Pierce Pump House

The Franklin Pierce Pump House is located at the intersection of New Hampshire Drive and Franklin Pierce Drive and houses equipment associated with BRW 4, BRW 7, and BRW 8. Water pumped from each well enters the pump house through individual water lines that include a check valve, source tap, and meter. The individual water lines then combine and enter a 20,000-gallon steel atmospheric storage tank and a 2,740-gallon hydropneumatic storage tank via two booster pumps before being transferred to the distribution system. Water from these source wells receive no additional disinfection or treatment. A detailed description of Franklin Pierce Pump House operations is included in **Appendix B**.

In August 2019, NHDES completed a sanitary survey inspection of the Franklin-Pierce Pump House. The report lists several deficiencies related to asset condition, water quality, and District operational practices. We listed the significant deficiencies below that affected our review of the PLVD vertical assets:

- BRW 7 is inadequately constructed due to a lack of a vent.

WP performed a risk analysis on the Franklin-Pierce Pump House assets following the method and scoring system outlined above. Approximately 26 assets were evaluated. **Appendix C** contains the results of the Franklin-Pierce Pump House asset evaluation. **Table 3-8** contains assets with renewal dates within the 10-year planning period. The renewal of each asset has been included in the CIP in Section 6.

TABLE 3-8
FRANKLIN PIERCE PUMP HOUSE
RECOMMENDED IMPROVEMENTS

Asset ID	Asset Description	Recommended Management Strategy	Estimated Renewal Date	Replacement Cost in 2020 Dollars
100-102-CO-02	Submersible Pump Controls Well 4	Priority R&R	2021	$10,000
100-102-CO-03	Submersible Pump Controls Well 7	Priority R&R	2021	$10,000
100-102-HV-01	Heater	Add PdM Schedule	2021	$500
100-102-TM-02	Pressure Transmitter Booster Pump 1	Add PdM Schedule	2021	$500
100-102-TM-01	Pressure Transmitter Booster Pump 2	Add PdM Schedule	2021	$500
100-102-SI-01	Pump Control Switch for Compressor	Add PdM Schedule	2021	$2,000
100-102-CO-01	Control Panel for All The Pumps	Add PdM Schedule	2021	$10,000
100-102-TK-01	Storage Tank	Priority R&R	2026	$28,000
100-102-LE-01	Storage Tank Level Indicator	Run to Fail	2030	$500
			Total	**$62,000**

4

SECTION 4

DISTRIBUTION SYSTEM EVALUATION

4.1 GENERAL

The purpose of the distribution system evaluation is to assess the hydraulic adequacy of the Pillsbury Lake Village District (PLVD) water system and infrastructure and its ability to satisfy both existing and projected demand conditions. The scope of the evaluation focused on the following:

- Water System Pressure,
- Pipe Velocities & Headloss,
- Dead-End Mains & Pipe Looping,
- Pipe Reliability & Redundancy,
- Pipe Criticality

Water systems are analyzed, planned, and designed primarily through the application of basic hydraulic principles. A computer hydraulic model was developed and used as the hydraulic tool to assess the condition and adequacy of current infrastructure under existing and projected demands and to guide future improvement recommendations. The evaluation was based on compliance with State of New Hampshire code requirements and standard water works engineering practice. Recommendations are presented at the end of this section.

4.2 DISTRIBUTION SYSTEM HYDRAULIC MODEL DEVELOPMENT

One of the goals of this study was to develop a hydraulic computer model of the PLVD water distribution system to be used as an engineering tool to assess the system. The hydraulic model was developed using the Innovyze InfoWater hydraulic modeling platform. Existing water system data was used to construct the model including pipe diameter, pipe geometry, ground elevation at pipe intersections, hydraulic grade line elevations, and total system demand.

The hydraulic model was used to evaluate the adequacy of the system under existing and future demands by assessing a variety of operating criteria such as pressures, hydraulic grade line, and velocities and head losses within each pipe. Where deficiencies were identified, improvements were simulated to assess the benefit of the proposed improvement.

4.2.1 Distribution System Mapping

Prior to creating the hydraulic model, PLVD representatives reviewed the existing mapping to verify and validate pipe diameters and material. It is critical that actual details of the subsurface piping network be clearly understood in order to validate the necessity of improvements. As more accurate data is identified, and when updates to the system are made, the model network and Geographic Information Systems (GIS) database should be updated as well.

The model represents pipes as lines, and pipe intersections are represented as nodes. Each pipe is assigned specific physical information including diameter, length between nodes, material of construction, and C-value. Nodes are assigned elevation and demands. Supply sources are represented as pipes connected to a single node to which the hydraulic attributes of the source or storage facility is assigned.

4.2.2 Water System Demand

Existing customer demands were evenly distributed throughout the model network. In some instances, if geolocated customer data is available, existing customer demands are assigned to a model based on actual customer meter records by address geocoding the customer data to the map. Geocoding involves the conversion of physical address and data associated with the address (billing data) to an x and y coordinate system which can then be linked to the distribution network through GIS. Often, the demands of the top ten water users are geocoded and the remaining demand is distributed evenly throughout the network. This method of demand apportionment can more closely represent actual demands throughout the system. Because geolocated customer demand data was unable to be obtained for this analysis, existing customer demands were assigned through the traditional method of evenly distributing all customer demands across the model network. PLVD is a residential community, therefore, it is unlikely that this method of demand distribution will significantly impact the accuracy of the model. Demands were apportioned by zone.

Once the customer demands were apportioned to each of the nodes, simulations of varying usage conditions can be applied to the network through application of new demand data to the customer demand for maximum day demand (MDD) conditions. Traditional methods of multiplying the average-day demands (ADD) by an appropriate factor for MDD data can be applied in lieu of collecting and incorporating new customer demand data. A detailed description of the development of the demand projections used in the hydraulic model is summarized in Section 2.

4.2.3 C-Value Determination

The Hazen-Williams C-value is a relative measure of the hydraulic capacity of a water main. New pipe C-values are established by the piping and engineering industry. However, the C-value of existing pipe must be estimated. Pipes having a C-value less than a new pipe of the same diameter have less carrying capacity than the new pipe. For example, a 12-inch pipe having a C-value of 50 will transmit half the water, with the same pressure drop, as a 12-inch pipe of the same length with a C-value of 100.

The water mains in the PLVD distribution system are made of polyvinyl chloride (PVC). Because pipe-specific C-values were not provided, typical C-values for new pipes based on pipe material were used for model simulations. For the PLVD model, pipes were modeled with a C-value of 140 which is typical for these materials.

Pipe roughness is then calculated by using the Hazen-Williams equation:

$$C = \frac{3.54Q}{D^{2.63}\left(\frac{h}{L}\right)^{0.54}} \quad \text{where,}$$

C = Hazen-Williams C-factor
Q = Flow in gallons per minute
D = Pipe diameter in inches
h = Head loss in feet
L = Length of test section in feet

4.3 WATER SYSTEM EVALUATION

The approach used to evaluate the PLVD distribution system was first to establish the existing and projected hydraulic requirements of the system. The second approach was to evaluate the adequacy and limitations of the system under the existing and projected demand conditions. The system was evaluated against a number of key operating and engineering principles and industry standards.

Because flow information was not available for the PLVD system, the primary stress condition for model simulation was projected future MDD conditions, as described in Section 2.

Under MDD conditions, a water system is considered adequate if a minimum pressure of 35 pounds per square inch (psi) can be provided at ground level to the entire service area. Where it can be provided, we recommend that systems be designed to provide 35 psi to the second story of a building (i.e., 15 feet above ground elevation). We recognize that this is not always practical or possible. For the purposes of this study, our evaluation will consider pressure at ground level.

Conditions are evaluated under varying demands, and where the system does not meet the criteria set forth, alternative improvements are modeled, and recommendations are made based on the hydraulic and cost-effectiveness of the improvements.

4.3.1 Water System Pressure

A water system should be designed to accommodate a range of pressures within minimum and maximum guidelines. Low system pressures result in customer complaints, may affect the accuracy of meters, and result in backflow conditions in the event of a water main break. Higher pressures can contribute to increased water loss from leakage, can increase maintenance on equipment, lead to higher energy costs, and tend to increase consumption.

Variations in customer demand, changes in elevation and proximity to pumping facilities and sources of supply will affect water pressure. In general, when customer demands increase, pressure will decrease. Areas with higher elevations typically have lower pressures.

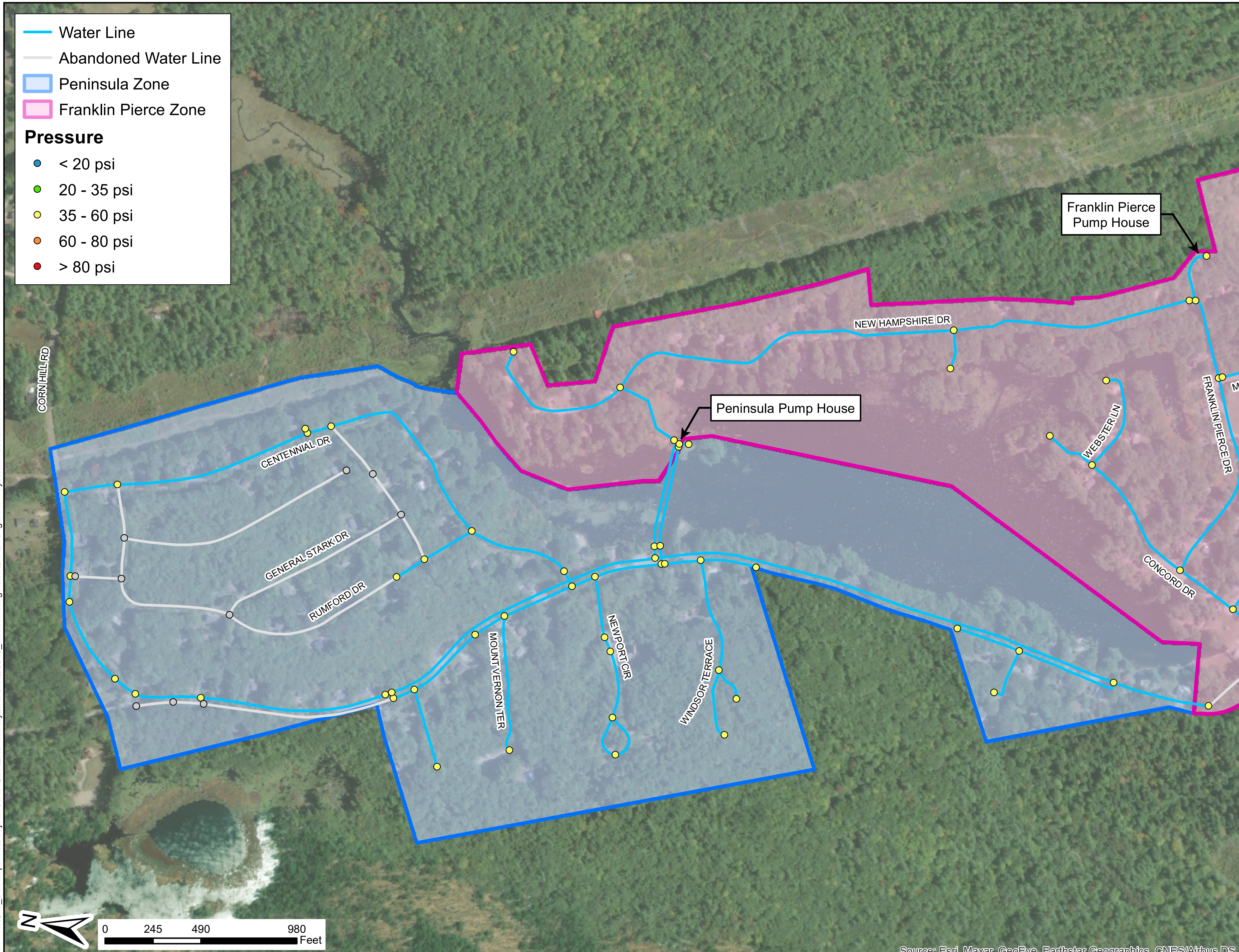
Standard water works practice and New Hampshire Department of Environmental Services (NHDES) standards requires that municipal water systems be designed with a normal operating pressure range of 60-80 psi and no less than 35 psi at all locations in the distribution system, including under MDD conditions. Pressures throughout the system should be maintained above 20 psi at all locations at all times. Where pressures exceed 80 psi, pressure reducing valves should be considered on service connections. Reducing excessive consumer pressure can be an effective water conservation measure.

Pressures throughout PLVD were found to be generally adequate, with most of the system within a pressure range of 50 - 80 psi. While no areas of the system were found to be below 35 psi, the lowest pressures at the extents of Windsor Terrace were found to be approximately 40 psi. Based on the hydraulic analysis, pressures in the Franklin Pierce Zone were found to be slightly higher (in general 5-10 psi greater) than pressures in the Peninsula Zone. **Figure 4-1** presents modeled pressures across the system under future projected ADD conditions.

4.3.2 Pipe Velocities and Headloss

Optimally, pipe velocities should be maintained below 2 feet per second (fps) to prevent resuspension of accumulated sediments in the pipeline, which can cause aesthetic problems. Velocities of 2 - 5 fps are accepted during stressed circumstances such as peak hour demand. Velocities greater than 5 fps during average or MDD conditions contribute to increased head loss which in turn requires pumps to work harder and results in higher energy costs. Higher velocities can also scour the interior of the pipe, reducing its useful life.

Pipe velocities were evaluated under MDD conditions. Under both existing and projected future conditions, all of the pipes in the system were found to have velocities 2 fps or less, with the exception of the 2-inch main connecting the Franklin Pierce Pump House to the system at Franklin Pierce Drive. This approximately 300-foot section of main was found to have a velocity between 2 - 3 fps under MDD conditions. System-wide pipe velocities under future MDD conditions are presented in **Figure 4-2**.

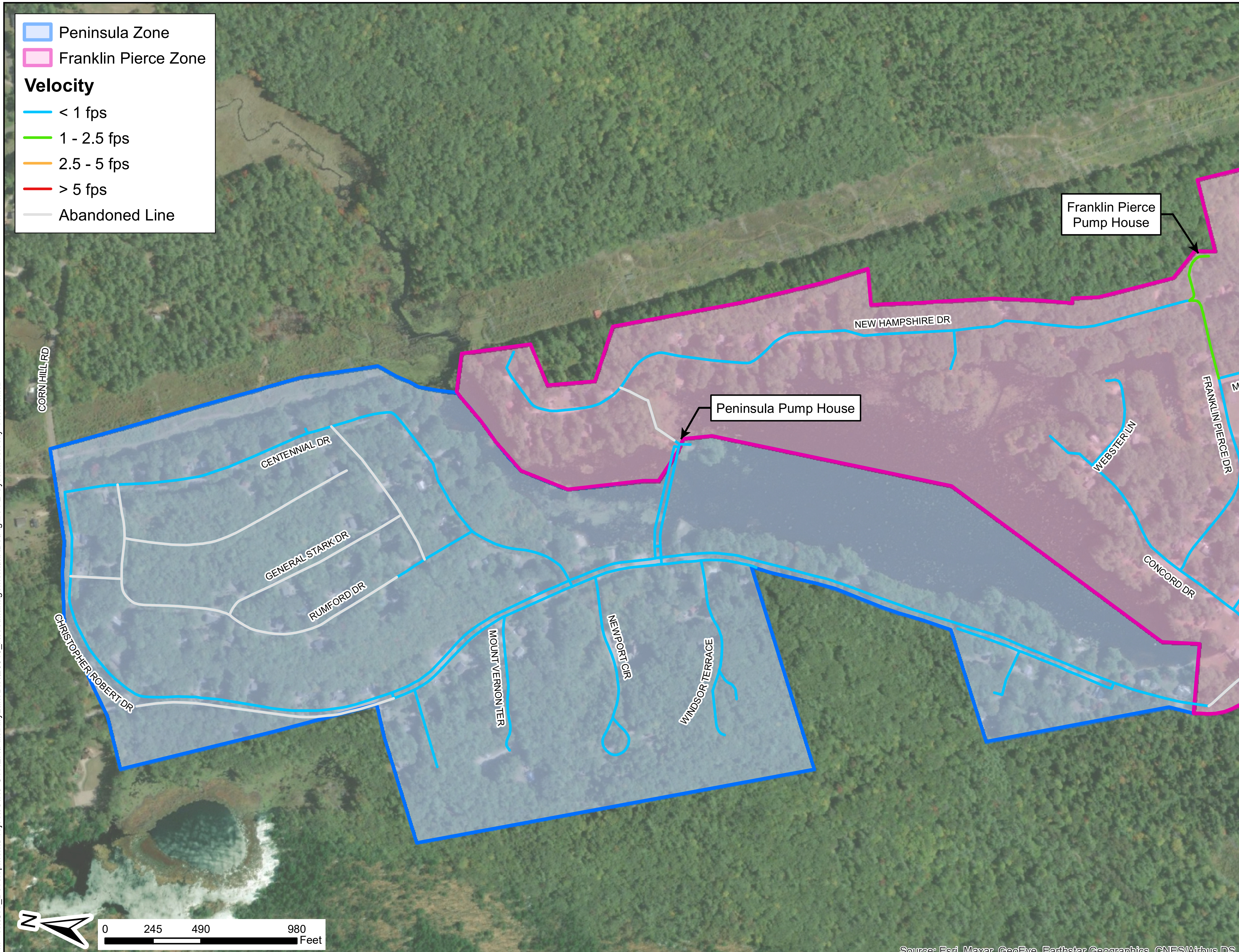


Distribution System Pressure
Pillsbury Lake Village District, NH

PROJ NO:	DATE:
20319A	11/25/2020

WRIGHT-PIERCE Engineering a Better Environment

FIGURE: 4-1



Distribution System Velocity
Pillsbury Lake Village District, NH

PROJ NO: 20319A
DATE: 11/24/2020
WRIGHT-PIERCE Engineering a Better Environment
FIGURE: 4-2

4.3.3 Dead-End Mains and Pipe Looping

Dead-end mains in a water system present a number of operational issues because water velocities in these pipes tend to be very low. This condition can cause sediment build-up and contribute to poor water quality. In winter months, pipes having low velocities can be prone to freezing. Generally, the only way to improve this condition is to regularly flush the ends of these pipes, add bleeders or loop the pipe into another location in the distribution system.

Flushing can be labor intensive and, if not done on a regular basis, will have little effect in improving conditions. Bleeders can be effective in improving water quality and help prevent freezing, but this method increases unbilled water and electrical pumping costs. PLVD currently has six bleeders and 11 flushing hydrants across the distribution system. These bleeders and flushing hydrants have not recently been used by system operators due to the lack of water supply capacity.

The PLVD distribution system contains numerous dead-end mains spread throughout the system. Existing dead ends mains are located on:

- Amherst Drive (2)
- Brookfield Circle
- Concord Drive (2)
- Deer Meadow Road (2)
- Manchester Drive
- Merrimack Circle
- Mt. Vernon Terrace Road
- New Hampshire Drive
- New London Drive (2)
- Penacock Circle
- Webster Lane
- Windsor Terrace (2)

Looping water main requires capital investment in new piping, and in some cases, it may not be practical to loop pipes because of physical or environmental impediments or simply the cost of investment exceeds the benefit. For PLVD the cost of investment exceeds the benefit given system leak history and supply capacity issues. Because of this, we do not recommend looping any dead-end mains until supply capacity is restored. Once supply capacity is restored, the system can begin to flush mains to improve water quality.

4.3.4 Piping Reliability and Redundancy

Piping reliability is defined as the ability of the piping network to supply service to an area of the system in the event of isolated or catastrophic disruptions. Isolated disruptions include shutdowns required to repair main breaks, replace valves or services, flush hydrants, etc. In some cases, the measure of reliability is a function of the redundancy of piping. Adequacy relates to the ability of the network piping to convey the required demands under all conditions.

In general, plastic pipe such as PVC has a useful life of approximately 75-100 years. This assumes that the materials of construction were proper for the application, that the size is adequate for the flows, that the pipes were properly installed and protected, and that water quality and pipe bedding materials are not aggressive to the interior and exterior of the pipe respectively.

In most cases, older pipe 6-inch in diameter and less should be replaced with a minimum of 8-inch diameter piping as opportunities arise (i.e. local road projects, new developments etc.). However, in PLVDs case it is acceptable to maintain a network of 2 to 6-inch pipe due to system demand and because the system does not provide fire protection. The water distribution system hydraulic model should be used to verify the pipe size required for new construction.

As shown in **Figure 2-2**, the PLVD distribution system has experienced a large number of water main leaks in recent years. The streets experiencing the largest number of leaks include:

- Concord Drive
- Dear Meadow Road
- New London Drive
- Mt. Vernon Terrace Road

Leak history was one of the factors used to prioritize water main replacement in the risk analysis below.

4.3.5 Pipe Criticality

In addition to considering adequacy and reliability, the analysis evaluated the distribution network to identify those mains considered "critical" to maintaining continuous service. Critical mains were identified based on assumed consequences should a failure occur. Water mains that feed many customers, connect different portions of the District, and connect supply sources to the distribution system were all considered critical mains. The most critical mains identified in PLVD's water system include the following:

- All water pipes from sources.
- Centennial Drive
- Concord Drive
- Dear Meadow Road
- Franklin Pierce Drive
- New Hampshire Drive
- Submerged pipes between Peninsula Pump House and Dear Meadow Road

4.4 INTERCONNECTION OPPORTUNITIES

A back-up/emergency water supply in the form of a connection to a neighboring water distribution system was reviewed in this study. The closest neighboring water systems to PLVD are the Hopkinton and Pennacook-Boscawen water systems. Each system is located approximately 3-4 miles from PLVD's system making a connection infeasible. The cost to make such a connection would financially limit PLVD moving forward and would not address higher priority projects needed within the system. Therefore, an interconnection with a neighboring water system is not recommended at this time.

4.5 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this evaluation was to assess the strengths and weakness of the distribution system under existing and projected future demand conditions. Based on the evaluations presented, the following conclusions and recommendations are offered.

4.5.1 Operations and Maintenance Recommendations

In August 2019, NHDES completed a sanitary survey inspection of the distribution system. The report lists several deficiencies related to system leakage, flushing, and operational practices. We listed the deficiencies that relate to the operation of the PLVD distribution system below:

- There is an insufficient source capacity due to leakage and possibly impaired pump performance. This has led to incomplete flushing of the distribution system and repeated instances of insufficient supply.
- The distribution is not flushed sufficiently based on customer complaints and consultation with the Primary Operator.

The status of each system operating program and our recommendations follow:

Valve Exercise Program

In the past and due to the regularity of distribution system pipe breaks, valves were not routinely exercised. We recommend that PLVD implement a valve exercise program. The current water system operator is in the process of creating a list of curb stops and isolation valves and intend to section the overall distribution system into four sections. Once the four sections are delineated, the operator intends to exercise one section of valves per quarter.

Flushing Program

Pipe velocities were evaluated under MDD conditions. The analysis found that a majority of the mains throughout the system have velocities below 2 fps. Low velocities are generally desired in distribution piping to reduce headloss and to avoid the possibility of resuspending sediment in pipes during typical operations. The collection of deposits can become problematic if not flushed on a regular basis. PLVD intends to implement a system-wide flushing program once drought conditions stabilize and the system has the capacity to support such activities. System operators intend to flush the system once a year.

Tank Maintenance

It is not known when the system storage tanks when the system storage tanks were last inspected. We recommend that each tank be cleaned and inspected to ensure structural integrity and water quality.

In addition, NHDES stated that,

"Hydropneumatic tanks that were constructed using joggle welds (typically during the 1960s and 1970s) are vulnerable to explosion through failed welds, and under normal operating pressures a few have catastrophically failed, some destroying pump houses and killing workers. All metal vessels used as hydropneumatic or surge tanks must be constructed to American Society of Mechanical Engineers (ASME) standards or be Code-certified. This can often be verified by reviewing the manufacturer's plate installed at the time of construction. Tanks without an ASME plate should be structurally evaluated by a registered engineer if the tank will continue to be pressurized."

We highly recommend that each hydropneumatic tank be evaluated by a registered structural engineer to ensure the safety of all District staff and operators.

4.5.2 Distribution System Improvement Recommendations

WP used a risk analysis strategy to prioritize water main replacement in the PLVD distribution system. Distribution system improvements separate from the risk analysis evaluation are included below.

Dead-end Mains & Pipe Looping

We do not recommend looping any dead-end mains at this time due to funding limitations and because there are more pressing water main improvement projects within the distribution system. However, the following streets contain water mains but no customers, therefore, we recommend abandonment of these mains:

- Brookfield Circle
- Manchester Drive (past New London Drive)
- Merrimack Circle
- New London Drive (one branch)
- Newport Circle
- Windsor Terrace

These water mains can be abandoned by system operators and are therefore not listed in the Capital Improvement Plan (CIP).

4.6 PRIORITIZATION OF DISTRIBUTION PIPES

Wright-Pierce compiled available data and made a condition assessment of the PLVD distribution system. Not all system pipes are equally important to the system operations; some pipes are highly critical to operations and others are much less so. To assist the PLVD in determining the level of risk associated with the loss of any one asset, we developed a rating and level of risk model for the water system pipes using guidance from the United States Environmental Protection Agency (EPA) Sustainable Water Infrastructure – Asset Management for Water and Wastewater Utilities guidance program.

The EPA guidance uses the probability of failure (PoF) and the consequence of failure (CoF) to calculate Business Risk Exposure (BRE) of the asset (business refers to the PLVD). Analyzing the existing distribution system to determine the PoF and the CoF provides valuable information about locations in the distribution system that have the BRE. This evaluation methodology is additionally beneficial to the development of a cost-effective CIP.

4.6.1 Probability of Failure

A water main may have a high PoF if it is old and past its useful life expectancy, has a history of failure, is made of less reliable pipe materials, or has a poor condition rating. A main may be much less likely to fail if it is newer, is made of modern materials, has little to no history of failure, and has a good to excellent condition rating.

4.6.2 Consequence of Failure

A water main may have a high CoF if it feeds important facilities or businesses, is located on a major roadway, or is large in diameter. Should a water main break occur and one of these factors be true, it is likely to draw more attention from the public and regulatory agencies. A main may have a low CoF score if the main is located on a road-less-traveled, have a small diameter, or is in a residential area.

4.6.3 Risk Analysis

The BRE score combines PoF and CoF scores into one number that can be used to sort and rank assets for further analysis.

BRE = PoF x CoF

With regard to water mains, risk can be reduced by decreasing either the PoF (through replacement or refurbishment) or decreasing the CoF (through redundancy or relocation). In most cases it is not cost effective to install redundant infrastructure and sometimes, in the case of distribution systems, too much redundancy can often be detrimental to water quality in the system.

In most cases a significant amount of risk can be mitigated through replacement. For example, BRE for an existing 2-inch PVC pipe installed in 1967 will go from a BRE score of 70.1 to a BRE score of 14.6 after replacement with 2-inch PVC pipe (**Table 4-1**). The replacement of an existing pipe with a new pipe reduces the PoF thus reducing the BRE score.

TABLE 4-1
IMPACT OF REPLACEMENT ON BRE SCORES

Description	Existing 2" PVC Pipe Score	Proposed 2" PVC Pipe Score
Probability of Failure Score	*7.7*	*1.6*
Consequence of Failure Score	*9.1*	*9.1*
Business Risk Exposure Score	**70.1**	**14.6**

4.7 DISTRIBUTION SYSTEM RISK ANALYSIS SCORING

The distribution system BRE assessment was developed to utilize specific available geographic information system (GIS) attributes to assign risk for each pipe segment in the water system network. **Table 4-2** contains PoF an CoF factors used to determine BRE scores for system assets.

TABLE 4-2
BRE CATEGORIES FOR DISTRIBUTION SYSTEM ANALYSIS

Probability of Failure	Consequence of Failure
Asset Life Consumed	Number of Customers per Pipe
Material	Pipe Diameter
Static Pressure	Critical Pipes
Break History	

4.7.1 Probability of Failure

The PoF score is a sum of the factors presented in **Table 4-3** normalized to a 1-10 scale by weighting each factor. These weighting factors have been selected to appropriately reflect the potential risk in the PLVD system.

TABLE 4-3
PROBABILITY OF FAILURE FACTOR WEIGHTING

Factor	Weighting
Asset Life Consumed	0.10
Material Type	0.10
Static Pressure	0.10
Break History	0.70
TOTAL	1.00

4.7.1.1 Asset Life Consumed – This factor gives weight to the age of a pipe. This factor assumes a conservative useful lifespan of 70 years for plastic (PE and PVC) pipes. The scoring is a ratio of current time in service for each pipe by the expected lifespan. When a pipe has exceeded it's expected useful life, it is more likely to fail when compared to a newly installed pipe. Because the exact installation year for PLVD pipes are unknown and most of the pipes were installed around the same time period, this factor was given a lower weight. This ratio is multiplied by 10 to adjust the ratio to the 1-10 scoring mechanism as shown below.

All pipes:

- Score = (Current Year - Installation Year)/Useful Life*100)

4.7.1.2 Material Type – This factor gives weight to the type of pipe material in the distribution system. Some types of pipe are more susceptible to failure than others. However, since PLVD only has PVC pipes and PVC pipe is a reliable pipe material, we assigned this item a low risk score and low weight. Installation conditions can also contribute to a pipe's susceptibility to failure. Weighting factors are presented in **Table 4-4**.

TABLE 4-4
PIPE MATERIAL SCORING

Material	Score
PVC	2

4.7.1.3 Static Pressure – This factor gives weight to areas where static pressures are highest and/or above recommended maximums. High pressure adds additional stress on a pipe and can lead to premature failure. Weighting factors are presented in **Table 4-5**.

TABLE 4-5
STATIC PRESSURE SCORING

Static Pressure (psi)	Score
0-20	1
20-40	3
40-60	7
60-80	9
80-100	10

4.7.1.4 Leak History – This factor gives weight to streets that have experienced water main leaks at higher than normal intervals. Water mains that experience a higher number of leaks are likely to leak more often. Streets containing such water mains are prime candidates for water main replacement. Therefore, this category was assigned the highest weight factor. Weighting factors are presented in **Table 4-6**.

TABLE 4-6
LEAK HISTORY SCORING

# of Breaks	Score
0	1
1	3
2	5
3	7
4	9

4.7.2 Consequence of Failure

The CoF score is a sum of the factors presented in **Table 4-7** normalized to a 1-10 scale. These weighting factors have been selected to appropriately reflect the potential risk for each factor in PLVD.

TABLE 4-7
CONSEQUENCE OF FAILURE FACTOR WEIGHTING

Factor	Weighting
Number of Customers per Pipe	0.4
Pipe Diameter	0.1
Critical Pipes	0.5

4.7.2.1 Number of Customers **–** This factor gives weight to sections of the distribution system with the most customers. If a water main breaks on a road with more customers, the PLVD is likely to get more complaints. Since customer satisfaction is a high priority of PLVD, this item was given a larger weight. Weighting factors are presented in **Table 4-8**. Refer to **Figure 4-3** for a depiction of pipes with the most customer connections.

TABLE 4-8
NUMBER OF CUSTOMERS SCORING

# of Customers	Score
0-5	1
5-10	5
10-15	10

4.7.2.2 Pipe Diameter – This factor gives weight to pipes of different diameters. The larger the pipe diameter, the more difficult the repair and more water will be lost. However, the PLVD distribution system contains small pipe diameters, so weighting factors remained relatively low. Weighting factors are presented in **Table 4-9**. Refer to **Figure 2-1** for system pipe diameters.

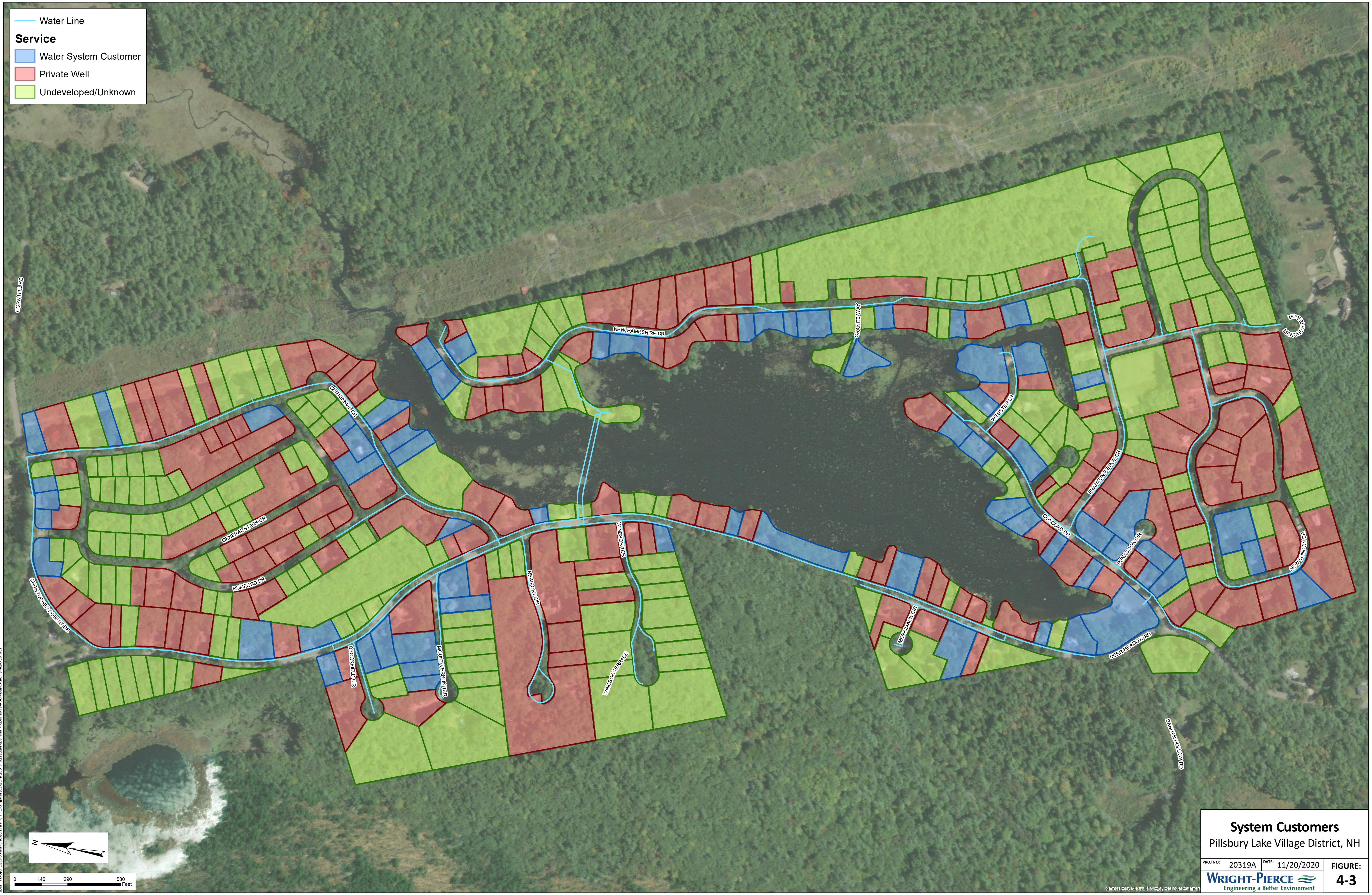
TABLE 4-9
PIPE DIAMETER SCORING

Diameter	Score
2	1
3	1
4	3
6	5

4.7.2.3 Critical Pipes – This factor gives weight to pipes in the distribution system that supply large parts of the system. This factor was given the highest weight as it will give weight to the most important mains in the system. Weighting factors are presented in **Table 4-10**. **Figure 4-4** depicts critical system pipes.

TABLE 4-10
CRITICAL PIPES SCORING

Critical Pipe (Y/N)	Score
Yes	10
No	1



Water Line
Service
Water System Customer
Private Well
Undeveloped/Unknown
System Customers
Pillsbury Lake Village District, NH
PROJ NO: 20319A
DATE: 11/20/2020
FIGURE: 4-3
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Criticality
Critical
Not Critical
CORN HILL RD
NEW HAMPSHIRE DR
GRANITE WAY
CENTENNIAL DR
GENERAL STARK DR
RUMFORD DR
CHRISTOPHER ROBERT DR
BROOKFIELD CIR
MOUNT VERNON TER
NEWPORT CIR
WINDSOR TER
WINDSOR TERRACE
MERRIMACK CIR
WEBSTER LN
FRANKLIN PIERCE DR
CONCORD DR
PENACOOK CIR
DEER MEADOW RD
NEW LONDON DR
MANCHESTER
BASHAW HOLLOW RD
N
0 145 290 580 Feet
Critical Pipes
Pillsbury Lake Village District, NH
PROJ NO: 20319A
DATE: 11/20/2020
FIGURE: 4-4
WRIGHT-PIERCE
Engineering a Better Environment

4.8 DISTRIBUTION SYSTEM RISK ANALYSIS

Figure 4-5 shows the water distribution system pipe BRE scores in the PLVD. As shown in the figure, the highest risk water mains are located on:

- Concord Drive
- Dear Meadow Road
- Centennial Drive
- New Hampshire Drive

Plotting the PoF scores against the CoF scores for all pipes in the system on a graph provides another visual means of reviewing this information (**Figure 4-6**). There are a few "critical" risk assets in the distribution system. These mains are considered critical because they serve a large number of customers, had a high number of breaks, connect distant portions of the system, or connect supply sources to the distribution system. These critical-risk water mains should be replaced prior to replacing mains elsewhere in the system. There are also a small number of "high" risk assets in the distribution system. These assets should be systematically targeted for replacement. Close monitoring of these high-risk assets is recommended. If the maintenance frequency of these assets starts to increase, replacement or relocation is recommended. In most cases, as older water main is replaced, there is significant reduction in the PoF score and therefore the BRE score. A copy of the BRE water main spreadsheet is included in **Appendix D**.

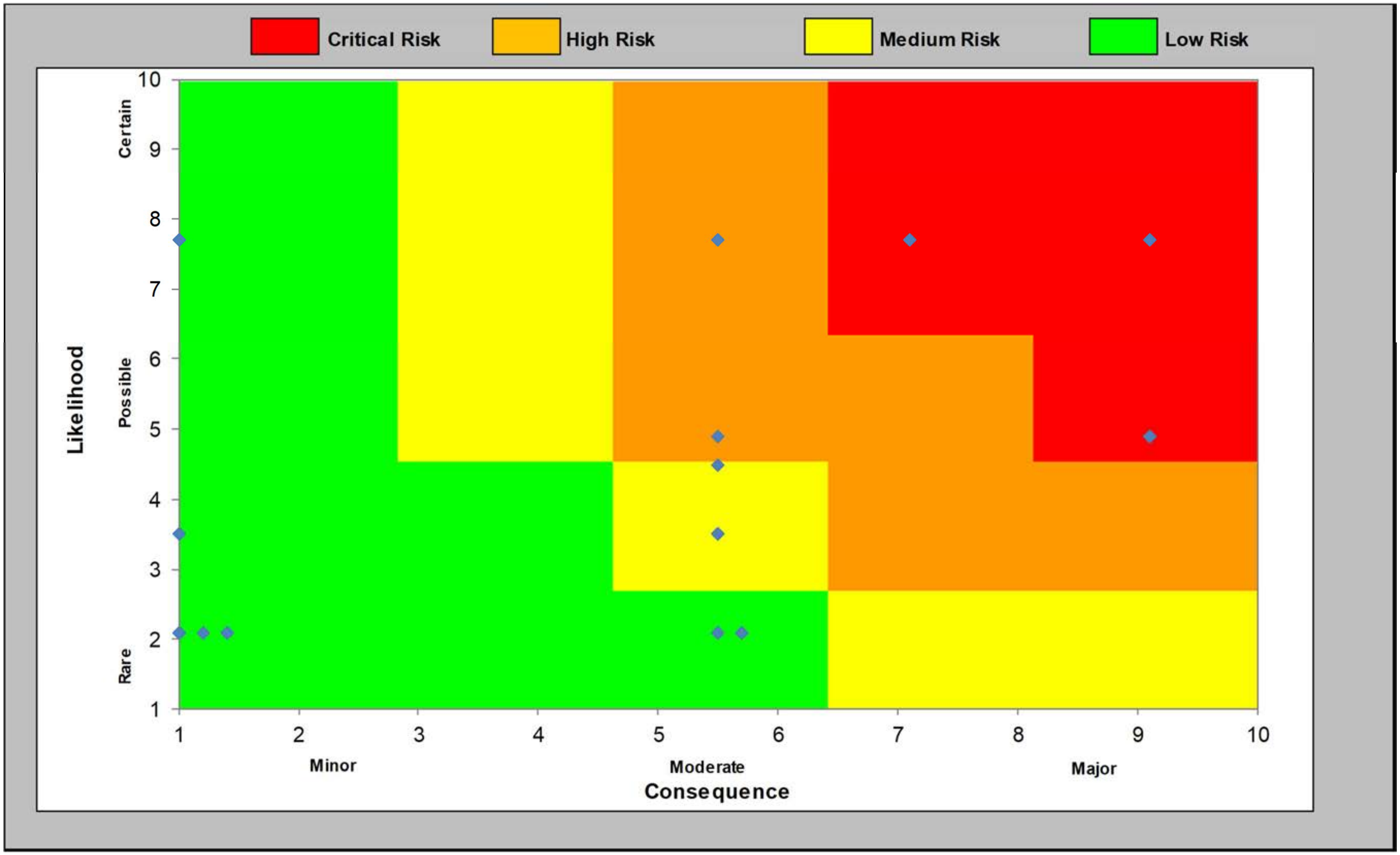
In July 2020, PLVD was awarded a $500,000 loan through the Drinking Water State Revolving Fund (SRF) to improve water mains in the distribution system. With this loan, we recommend PLVD complete the following improvement:

- Replace approximately 1,900 feet of existing 2-inch PVC main on Concord Drive from Dear Meadow Road to the dead-end on Concord Drive with new 4-inch PVC water main.

Because of funding limitations in the District, we only recommend replacing one water main over the 10-year planning period. Should funding opportunities arise, we recommend replacement of the remaining critical-risk water mains.


BRE
0 - 20
20 - 40
> 40
CORN HILL RD
CENTENNIAL DR
GENERAL STARK DR
RUMFORD DR
CHRISTOPHER ROBERT DR
BROOKFIELD CR
MOUNT VERNON TER
NEWPORT CIR
WINDSOR TERRACE
DEER MEADOW RD
NEW HAMPSHIRE DR
GRANITE WAY
WEBSTER LN
FRANKLIN PIERCE DR
MANCHESTER DR
CONCORD DR
PENACOOK CIR
NEW LONDON DR
N
0 150 300 600 Feet
System BRE Scores
Pillsbury Lake Village District, NH
PROJ NO: 20319A
DATE: 11/25/2020
FIGURE: 4-5
WRIGHT-PIERCE
Engineering a Better Environment

FIGURE 4-6
DISTRIBUTION SYSTEM BUSINESS RISK EXPOSURE: ALL PIPES



5

SECTION 5

LEVEL OF SERVICE

5.1 INTRODUCTION

A Level of Service Agreement (LOS) defines the way in which the utility owners, managers, and operators want the system to perform over the long term. Establishing the LOS in a utility is a critical first step in creating an asset management plan. The LOS can include any technical, managerial, or financial components the Pillsbury Lake Village District (PLVD) wishes, provided all regulatory requirements are met. The LOS will become a fundamental part of how the system is operated and how assets are managed.

For the PLVD system, a workshop was conducted to develop the LOS plan described herein. The LOS goals and objectives were defined and the asset management plan in this document was developed to meet this vision for the water system.

5.2 LEVEL OF SERVICE DEVELOPMENT

5.2.1 Overview

There are two key facets to asset management, (1) defining the LOS the system will strive to provide its customers over the long term and, (2) determining the most efficient and economical way to deliver that service. Therefore, determining and detailing the LOS that the system is going to provide is a key step in the overall process.

The LOS Agreement – the document that will spell out the service the system wishes to provide – is a multi-faceted tool that can fulfill a wide array of purposes as described below. Further explanation regarding each of these items follows:

- Customer Communication
- Determine critical assets
- Provide a means of assessing overall system performance
- Provide a direct link between costs and service

- Serve as an internal guide for system management and operations staff
- Provide information for system annual report or annual meeting presentation

5.2.1.1 Customer Communication

It is important for a water utility to communicate with its customers to avoid confusion, hard feelings, accusations of improper operation, and to make clear what the customer's expectations should be. Effective communication aligns the utilities and customers' expectations on issues such as water quality, water rates, service responses and other issues related to how a water utility is operated and managed.

5.2.1.2 Determine Critical Assets

The LOS can be one factor in determining critical assets. An example of how the LOS can impact criticality is where a system's LOS includes the factor "water will be delivered to customers 99% of the time." If the system has only one water source, the source will be a critical asset for the system. The source must be operational at all times to meet this criteria.

5.2.1.3 Provide a Means for Assessing Overall System Performance

LOS factors should include measurable items. The system can keep information regarding how well they are meeting these criteria and use the criteria as a benchmark in assessing the overall operation. *For example*, consider a system that includes the following measures in its LOS:

- Breaks will be repaired within 5 hours of initiation of repair 95% of the time
- Customer complaints will be responded to within 24 hours, Monday through Friday
- Losses will be kept to less than 15% as measured by gallons pumped each month – gallons sold each month
- System will meet all state and federal regulations

All items in this ***generic example*** are measurable if the system collects the appropriate data. Assume the system has the following data from its first year of operation.

- 10 breaks occurred, 5 were fixed in less than 5 hours
- 30 complaints were received, all 30 responded to within 24 hours
- Losses over the year as follows: January 12%, February 10%, March 19%, April 14%, May 9%, June 13%, July 9%, August 10%, September 12%, October 9%, November 10%, December 12%
- System met all regulations; no violations

Based on this data, the system met some, but not all, of its LOS factors. The following items were met: The customer complaints were responded to on time and the system met all the state and federal regulations. The following items were not met, breaks were not repaired within 5 hours and the losses were not kept to less than 15% in all months. The system can look at these results and determine the items that it needs to work harder on to meet the LOS requirements.

It is important to note that data collected on LOS items must be consistently collected and recorded at given intervals (daily, weekly, monthly or quarterly) to be able to assess and make changes in the system as necessary.

5.2.1.4 Provide a Direct Link between Costs and Service

There is a direct link between the LOS provided and the cost to the customer. When a higher LOS is provided, the costs to the customers will likely increase. This relationship provides an opportunity for the water system to have an open dialogue with its customers regarding the LOS desired and the amount the customers are willing to pay for this LOS or increased service.

For example, customers may complain about aesthetic contaminants in the water – those contaminants that cause taste, odor, or color issues in the water, but not health concerns – and wish to have these contaminants removed. The water system can install treatment to remove these contaminants, but it will cost each customer more for their water each month. The water system can have a dialogue with the customers to explain what the treatment would entail, what the finished water quality would be, and how much it would cost the customers. Following the discussions, the customers could decide whether or not they are willing to pay for the additional treatment. In this way, the LOS sets desired services and provides information to the customers regarding what the costs of their LOS will be.

5.2.1.5 Serve as an Internal Guide to System Operation and Management

It is much easier to operate or manage a water system when the operations and maintenance staff, as well as the management staff, understand the goals of the operation, defining the LOS sets these goals for the system. These goals allow the operations staff to have a better understanding of what is desired from them and the management has a better understanding of how to use staff and other resources more efficiently and effectively. Checking how well the system is meeting LOS also allows the management to shift resources, if need be, from one task to another to meet all the goals more effectively.

5.2.1.6 Provide Information for Annual Report or Meeting

If the system tracks information regarding how well it is meeting the LOS criteria on a weekly or monthly basis, it can use this information to prepare an annual report regarding how well the system met these criteria over the course of a year. This information can be presented to the Board of Commissioners or customers at an annual meeting so that customers are aware of how well the system met the overall goals for the operations of the system.

This meeting would also be an opportunity to discuss any changes needed in the LOS, based on the operations data. Perhaps some of the LOS conditions are not possible to be met given the current staff or resources. If that is the case, the system will either have to reduce the LOS provided or increase staff or other resources in order to meet the current LOS. The decision to increase staff or other resources or decrease LOS will directly impact customers, so it is important to use the opportunity of the annual meeting to discuss the potential options with them.

Alternatively, the system may decide that some criteria are very easily met and may not be stringent enough. The system may find that it can increase the LOS for particular criteria without impacting costs and may wish to discuss the changes with the customers at the annual meeting.

In the PLVD, this process helps define capital needs for presentation at the annual community meeting and to engage customers and community leaders on the need for improvements and investment in the water system.

5.2.2 Level of Service Goals

The proposed PLVD LOS operations goals are listed below:

1. *All Federal and State water quality regulations will be met* – Set to a target goal of 100% compliance. This goal is driven by the Environmental Protection Agency (EPA) Safe Drinking Water Act and New Hampshire Department of Environmental Services (NHDES) drinking water compliance rules and will be measured using annual compliance reports. This goal is important because its compliance is state and federally mandated to ensure safe public drinking water supplies.
2. *Maintain a water balance, unmetered/unbilled water use value of less than 15%* – This goal is driven by NHDES and is set at a target goal of unmetered/unbilled water use of less than 15%. This goal will help the water system appropriately account for water used and ensure revenue is not lost through main leakage. It will be estimated annually using residential metered water use records, source water metered usage records, and estimated unmetered water use records.
3. *Maintain a minimum normal working system pressure of 35 pounds per square inch (psi)* – This goal is driven by NHDES and is set at a target goal of a normal working system pressure of 35 psi. Customer pressure complaints and further investigation reports.
4. *All customer complaints will be investigated within 1 business days of reporting the complaint* – This goal is self-imposed and set to a target of greater than 95% compliance. This goal is measured annually through work records. Compliance with this goal will increase customer satisfaction.
5. *Breaks will be repaired within 24 hours of being reported 95% of the time* – This goal is self-imposed and a target of greater than 95% compliance. This goal will be measured monthly using work order records. This goal is important because breaks increase UAW and increase District expenses. Breaks in distribution mains are also costly to repair in terms of time, labor, parts, and an inconvenience to customers.

6. *Contact the Board of Commissioners at least 48 hours prior to water main shutdown in planned situations and ASAP in emergency situation* – This goal is self-imposed and set to a target goal of 100% compliance. The goal will be measured by reviewing monthly word order records.
7. *No bulk water deliveries* – This goal is self-imposed and is set to a target goal of 0 deliveries each year. Bulk water deliveries are costly for the District and lead to customer dissatisfaction. This goal will be measured by reviewing annual operations expense reports.
8. *Maintain a full inventory of distribution system parts* – Set to a target of 100% compliance. Inventory shall be monitored and recorded annually. This goal is driven by the NHDES. Work order records and purchase order invoices will be used to track changes in inventory. This goal is important because compliance will avoid intervention by the NHDES, minimize service disruptions to customers, and reduce response time for repairs.
9. *Treatment system operator training level* – This goal is driven by State Regulations and has been set at all treatment system operators being Grade 1 or better. This goal will be measured annually using certification records. Compliance with this goal is required by the state and helps increase the depth of knowledge among treatment operators.
10. *Distribution system operator training level* – This goal is driven by State Regulations and has been set at all distribution system operators being Grade 1 or better. This goal will be measured annually using certification records. Compliance with this goal is required by the state and helps increase the depth of knowledge among distribution operators.
11. *Ensure GIS is up to date* – This goal is driven by a need for records maintenance and is set at a target goal of 100% compliance. It will be measured annually by reviewing data sets from GIS. This goal helps to avoid major system maintenance later.
12. *Perform backflow testing at appropriate frequency* – This goal is set at 100% compliance, is driven by NHDES, and is measured annually by percent complete of total.
13. *Maintain a safety committee and deliver service in the safest possible manner* – This goal is driven by Department of Labor and OSHA regulations. The target for this goal has been set at 0 accidents per year as measured by accident reports. Compliance with this goal not only helps meet DOL and OSHA standards but should also always be the number one priority of any workplace.
14. *Maintain water system facilities power and communications capacity* – Set at a target of greater than 95% compliance and is driven by the NHDES. This will be measured annually using the

District's SCADA system. Compliance with this goal is required by the NHDES and helps ensure that the water infrastructure will be operational during an emergency.

5.2.3 Level of Service Agreement

The LOS goals described above provides the basis for the proposed PLVD LOS agreement. This agreement defines the way in which the water commissioners, managers, operators, and customers want the system to perform over the long term and by what means this performance is measured. The LOS agreement is consolidated in **Table 5-1**. **Table 5-2** provides a means for PLVD to track LOS goals outline in the LOS agreement.

5.2.4 Recommendations

The PLVD should review and report on the LOS agreement annually to evaluate its effectiveness for delineating the necessary effort required to provide clean safe drinking water to the community in the most efficient, economical, and sustainable way. The LOS Agreement in its entirety, or in excerpts, is an excellent tool to communicate how the PLVD is operating and how well the community is being served.

If the PLVD finds that an alternative method for measurement better fits a LOS goal or that a LOS goal target should be modified, changes to the document should be recommended to the Board and discussed annually. We have included a table at the end of this section that the PLVD can use to track LOS goal progress.

TABLE 5-1
LEVEL OF SERVICE AGREEMENT

Goal	Measurement
1. All Federal and State water quality regulations will be met.	Is it measurable? *Yes* How often would you measure? *Review annually*
2. Water balance unmetered/unbilled water is less than 15%	Is it measurable? *Yes* How often would you measure? *Review annually*
3. The system will maintain a minimum working pressure of 35 psi	Is it measurable? *Yes* How often would you measure? *Each Complaint*
4. All customer complaints will be investigated within 1 business days of reporting the complaint.	Is it measurable? *Yes* How often would you measure? *Review complaint logs annually*
5. Breaks will be repaired within 24 hours of being reported 95% of the time.	Is it measurable? *Yes* How often would you measure? *Review monthly*
6. Contact the Board of Commissioners at least 48 hours prior to water main shutdown in planned situations and ASAP in emergency situations.	Is it measurable? *Yes* How often would you measure? *Review events monthly*
7. No bulk water deliveries	Is it measurable? *Yes* How often would you measure? *Review annually*
8. Maintain a full inventory of distribution system parts	Is it measurable? *Yes* How often would you measure? *Review annually*

Goal	Measurement
9. Ensure all treatment operators are a training level of Grade 1A or better.	Is it measurable? *Yes* How often would you measure? *Review annually*
10. Ensure all distribution operators are a training level of Grade 1A or better.	Is it measurable? *Yes* How often will you measure? *Review annually*
11. Ensure GIS is up to date.	Is it measurable? *Yes* How often will you measure? *Review annually*
12. Perform backflow testing at appropriate frequency.	Is it measurable? *Yes* How often will you measure? *Review annually*
13. Maintain a safety committee and deliver service in the safest manner possible.	Is it measurable? *Yes* How often will you measure? *Review annually*
14. Maintain water system facilities power and communications capacity.	Is it measurable? *Yes* How often will you measure? *Reviewed annually*

TABLE 5-2
LEVEL OF SERVICE TEMPLATE

Goal	Target Level	Frequency of Measurement	Goal Date	Goal Outcome
1. All federal and state water quality regulations will be met	<MCL	Annually		
2. Water balance unmetered/unbilled water less than 15%	<15%	Annually		
3. The system will maintain a minimum pressure of 35 psi	>35 psi	Each Complaint		
4. All customer complaints will be investigated within 1 business days of reporting the complaint.	1 day	Annually		
5. Breaks will be repaired within 24 hours of being reported 95% of the time.	> 95%	Monthly		
6. Contact the Board of Commissioners at least 48 hours prior to water main shutdown in planned situations and ASAP in emergency situations.	< 48 hrs	Monthly		
7. No bulk water deliveries.	0	Annually		
8. Maintain a full inventory of distribution system parts.	100%	Annually		
9. Treatment operator training level.	Grade IA	Annually		
10. Distribution operator training level.	Grade IA	Annually		
11. Ensure GIS is up to date.	100%	Annually		

TABLE 5-2
LEVEL OF SERVICE TEMPLATE

Goal	Target Level	Frequency of Measurement	Goal Date	Goal Outcome
12. Perform backflow testing at appropriate frequency.	100%	Annually		
13. Maintain a safety committee and deliver service in the safest possible manner.	0 accidents	Annually		
14. Maintain water system facilities power and communications capacity.	95%	Annually		

6

SECTION 6

CAPITAL IMPROVEMENT PLAN

6.1 OBJECTIVE

The following is a compilation of the capital improvement recommendations made throughout the report. The proposed recommendations are sequenced and summarized in a tabular capital improvement plan (CIP) plan to offer a comprehensive approach to address the immediate and long term future needs to assure that the Pillsbury Lake Village District (PLVD) can sustain reliable water service to its customers throughout and beyond the planning period of this study.

6.2 OVERVIEW OF FINDINGS

In recent years, the PLVD has struggled to meet system demands due to inadequate and underperforming water supplies, drought conditions, and distribution system leaks. Many of the system supply sources are run 24/7/365. PLVD also received bulk water deliveries on several occasions in 2019 and 2020 due to lack of source water and excessive water main breaks. NHDES requires that no new construction, addition or alteration involving the source, treatment, distribution or storage of water begin without approval by the Department.

Vertical and horizontal assets across the system were evaluated to estimate condition and remaining useful life. The priority improvements recommended for PLVD include the following:

Facilities (Section 3)

Peninsula Pump House Improvements: Process improvements associated with filter components, chemical metering pumps, and system controls are recommended at this facility to improve system operations, ensure compliance with water quality regulations, and extend asset life.

Franklin Pierce Pump House Improvements: Improvements associated with system controls, HVAC, and the storage tank are recommended at this facility to improve system operations, ensure compliance with water quality regulations, and extend asset life.

Distribution System (Section 4)

1. **Replacement of Concord Drive Water Main:** This water main had the highest risk score due to number of customers served, leak history, and criticality. If funds become available to complete additional water main projects in the short-term, we recommend replacing other critical risk water mains.

6.2.1 Basis of Cost Estimates

The recommended project cost estimates are based on recent, similar publicly bid construction projects, pricing referenced to the October 2020 Engineering News Record (ENR) 20 City average construction cost index of 14837.

Cost estimates for piping recommendations have been based upon an average unit price for similar publicly bid and constructed projects (unless otherwise noted) inclusive of the installation of water mains and appurtenances, services, ledge, paving and restoration. All the project costs listed include an additional 40% construction and engineering contingencies unless otherwise noted.

6.2.2 Capital Improvement Plan

The purpose of the CIP is the following:

- To prioritize and schedule recommended improvements identified as part of this study.
- To position the PLVD to provide an appropriate Level of Service (LOS) and to meet the needs of the community.
- To sustain the viability of the water system infrastructure through routine maintenance and replacement programs.
- To meet current, pending and future federal and state regulatory requirements.

The CIP presented is intended to be flexible and subject to adjustment and modification, as required, to respond to changes in demands and as water regulations are promulgated. Long-term recommendations should be reviewed and re-evaluated periodically to ensure that initial assumptions used to generate specific recommended projects remain relevant and accurate. The priority of improvements within each priority category should also be periodically reassessed with the District's budget to assure the highest priorities in the system are being addressed in any given year. A summary of the recommendations is presented in **Table 6-1**.

6.2.3 Short-Term Improvements (High Priority)

Short-term improvements are the highest priority projects which have been identified for completion over a five-year period of 2021 to 2025. These short-term improvements include projects which are needed to improve safety, reliability and meet the desired LOS in the distribution system.

6.2.4 Secondary Improvements (Medium Priority)

Secondary improvements are recommended for completion from 2026 to 2030. They include recommended long-term investment, improvement, and upgrade projects which are anticipated to continue to improve reliability and LOS in the water system.

6.2.5 Unscheduled Long-Term Improvements (Low Priority)

Unscheduled long-term improvements are recommended for completion outside of the current planning period and were not included in the CIP. They include recommended long-term investment, improvement, and upgrade projects which are anticipated to be required at some time beyond the 10-year planning period and are difficult to schedule with any precision because their timing is directly related to factors beyond the control of the PLVD. Refer to **Appendix D** for a comprehensive list of PLVD assets and their estimated replacement year.

TABLE 6-1
RECOMMENDED IMPROVEMENT PROJECTS

Improvement Description	Purpose of Improvement	Length (feet)	Existing Diameter (inch)	Proposed Diameter (inch)	Unit Cost	Construction Cost	E&C (40%)	Total Project Cost
Priority Improvements								
Water Storage Tank Inspection & Cleaning	Maintenance	-	-	-	-	-	-	$5,000
Concord Drive Water Main Replacement	Breaks, Age, Criticality	1,900	2	4	$275	$375,000	$150,000	$525,000
Franklin Pierce Pump House Improvements	Condition	-	-	-	-	-	-	$33,500
Peninsula Pump House Improvements	Condition	-	-	-	-	-	-	$13,000
	Subtotal	1,900	-	-	-	$375,000	$150,000	**$576,500**
Secondary Improvements								
Franklin Pierce Pump House Improvements	Condition	-	-	-	-	-	-	$28,500
Peninsula Pump House Improvements	Condition	-	-	-	-	-	-	$35,450
Water Storage Tank Inspection & Cleaning	Maintenance	-	-	-	-	-	-	$5,000
	Subtotal	-	-	-	-	-	-	**$68,950**
	Total	**1,900**	**-**	**-**	**-**	**-**	**-**	**$645,450**

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SECTION 7

FINANCIAL IMPLEMENTATION PLAN

7.1 EXISTING FINANCIAL PLANNING

The Pillsbury Lake Village District (PLVD) manages and forecasts the District's finances annually and gains approval for fund disbursement at the annual District Meeting. A brief explanation of revenue and expense terms used herein follows:

- **Water Bills & Meter Charges** – This is the annual revenue associated with the base rate a water customer is charged regardless of water use and the annual revenue associated with the volume of water passing through each customer's service meter.
- **Cash in Hand** – Carry over funds from previous financial year.
- **Funding** – Includes sources of revenue not associated with customer water usage.
- **Taxes** – Revenue associated with PLVD annual property taxes.
- **Town Dam Fund** – Funding available annually to maintain operation of the PLVD dam.
- **Reserves** – Emergency funding source, not available for planning period.
- **Operating Expenses** – The cost associated with staff salaries and benefits, supplies, equipment, chemicals, energy, electrical and other expenses. The budget assumes an annual inflation of 3% for these items.
- **Debt Service –** Expenses associated with projects the District is currently or were recently paying off. The PLVD recently serviced debt for two capital projects including:
    - **Bond Payment (Meter)** – This project was paid off in year 2020.
    - **Bond Payment (Filtration)** – This project was paid off in year 2020.
- **Proposed Capital Projects** – Projects developed in Section 6 of the Asset Management Plan.
- **Net Operating Budget** – The net operating budget is reported as the difference between revenue and expenses including planned capital projects and maintenance.

7.2 PROPOSED CAPITAL PROJECTS TO MEET ASSET MANAGEMENT OBJECTIVES

New capital projects and the recommended priority for these improvements are shown in **Table 7-1**. This Table reflects all the recommended improvements from the plan, beginning in 2021. Capital projects include:

- **Storage Tank Maintenance** – The budget includes tank cleaning and inspections with minimal improvement and maintenance activities. Cost for these activities are assumed to be include in annual operating cost and will not be bonded projects.
- **Concord Drive Water Main Replacement** – This project includes replacing approximately 1,900 linear feet of 2-inch PVC water main with 4-inch PVC water main along a critical portion of the distribution system. PLVD has received funding for this project through the State SRF program.
- **Pump House Improvements** – The CIP includes projects associated with upgrading equipment that has reached the end of its useful life in each pump house. These projects are assumed to have a 20-year note and an interest rate of 3%.

7.3 PROPOSED 10-YEAR FINANCIAL IMPLEMENTATION PLAN

Wright-Pierce completed a 10-year financial forecast of PLVD finances based on budgetary information provided by the District for 2021-2022. **Table 7-1** depicts the PLVD finances over the 10-year planning period without the addition of CIP projects.

Table 7-2 incorporates the CIP projects into the financial forecast. The CIP projects have been spread out over the planning period and the project costs were escalated at an annual inflation rate of 3%. Adding the CIP projects to the financial forecast does not result in a deficit in the Net Operating Budget assuming the District rolls over surplus operating funds from the previous year. No water rate increases were made for this forecast. Given the number of customers that have recently left the system, a water rate increase would likely not be well received.

If PLVD can take advantage of grants, principle forgiveness and low interest loans through state and federal programs, the economic impact of the individual projects to the District rate payer will decrease. This could allow the City to accelerate the replacement schedule of other failing water assets or reduce the cost of these improvements to the customers.

TABLE 7-1
FIP – WITHOUT CAPITAL PROJECTS

	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2030
REVENUE														
Revenue from Customers														
Water Bills + Meter Charges	69,595.15	95,318.00	110,322.30	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00
Cash In Hand	-	-	-	55,108.79	126,297.79	185,786.79	245,410.46	305,172.84	365,078.09	425,130.50	485,334.48	545,694.58	606,215.49	666,902.02
Taxes	185,922.00	207,393.00	207,393.00	181,000.00	175,000.00	180,250.00	185,657.50	191,227.23	196,964.04	202,872.96	208,959.15	215,227.93	221,684.76	228,335.31
Town Dam Fund	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00
Total Customers Revenue	***265,517.15***	***312,711.00***	***327,715.30***	***291,108.79***	***356,297.79***	***421,036.79***	***486,067.96***	***551,400.07***	***617,042.13***	***683,003.46***	***749,293.63***	***815,922.51***	***882,900.25***	***950,237.32***
Reserves														
ETF	110,000.00	30,000.00												
De-weeding		10,000.00												
Total Reserves	***110,000.00***	***40,000.00***												
EXPENSES														
Operating Expenses														
Commissioners Stipends	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,090.00	3,182.70	3,278.18	3,376.53	3,477.82	3,582.16	3,689.62	3,800.31	3,914.32
Clerk Stipend	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,030.00	1,060.90	1,092.73	1,125.51	1,159.27	1,194.05	1,229.87	1,266.77	1,304.77
Treasurer Stipend	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,150.00	5,304.50	5,463.64	5,627.54	5,796.37	5,970.26	6,149.37	6,333.85	6,523.87
Moderator Stipend	50.00	50.00	50.00	50.00	50.00	51.50	53.05	54.64	56.28	57.96	59.70	61.49	63.34	65.24
Auditor	1.00	500.00	10,000.00	500.00	10,000.00	10,300.00	10,609.00	10,927.27	11,255.09	11,592.74	11,940.52	12,298.74	12,667.70	13,047.73
Legal Fees	50.00	50.00	50.00	50.00	50.00	51.50	53.05	54.64	56.28	57.96	59.70	61.49	63.34	65.24
Building Maintenance	3,000.00	1,000.00	500.00	500.00	500.00	515.00	530.45	546.36	562.75	579.64	597.03	614.94	633.39	652.39
Property Maintenance-plowing	3,500.00	4,000.00	3,000.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Insurance	4,500.00	4,100.00	5,100.00	4,500.00	4,500.00	4,635.00	4,774.05	4,917.27	5,064.79	5,216.73	5,373.24	5,534.43	5,700.47	5,871.48
Office Expenses	3,500.00	4,500.00	4,500.00	3,500.00	3,500.00	3,605.00	3,713.15	3,824.54	3,939.28	4,057.46	4,179.18	4,304.56	4,433.70	4,566.71
Electricity	20,000.00	20,000.00	21,000.00	20,000.00	20,000.00	20,600.00	21,218.00	21,854.54	22,510.18	23,185.48	23,881.05	24,597.48	25,335.40	26,095.46
Gas	1,500.00	1,500.00	1,600.00	2,000.00	2,000.00	2,060.00	2,121.80	2,185.45	2,251.02	2,318.55	2,388.10	2,459.75	2,533.54	2,609.55
Licensed Operator Service	18,000.00	18,000.00	18,000.00	30,600.00	30,600.00	31,518.00	32,463.54	33,437.45	34,440.57	35,473.79	36,538.00	37,634.14	38,763.16	39,926.06
Permit to Operate Dam	400.00	400.00	400.00	400.00	400.00	412.00	424.36	437.09	450.20	463.71	477.62	491.95	506.71	521.91
Telephone	1,300.00	1,500.00	1,400.00	1,400.00	1,400.00	1,442.00	1,485.26	1,529.82	1,575.71	1,622.98	1,671.67	1,721.82	1,773.48	1,826.68
Water Meter Software	2,000.00	3,500.00	3,500.00	2,500.00	2,500.00	2,575.00	2,652.25	2,731.82	2,813.77	2,898.19	2,985.13	3,074.68	3,166.93	3,261.93
Water Service Alarm Monitoring System	300.00	1,000.00	1,000.00	500.00	500.00	515.00	530.45	546.36	562.75	579.64	597.03	614.94	633.39	652.39
System Maintenance	75,000.00	85,000.00	90,000.00	84,000.00	80,000.00	82,400.00	84,872.00	87,418.16	90,040.70	92,741.93	95,524.18	98,389.91	101,341.61	104,381.85
Water Testing	1,600.00	1,800.00	3,500.00	1.00	1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23	1.27	1.30
Parks and Recreation	2,500.00	500.00	500.00	500.00	1,000.00	1,030.00	1,060.90	1,092.73	1,125.51	1,159.27	1,194.05	1,229.87	1,266.77	1,304.77
Automobile	200.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Weed Control	5,500.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Property Maintenance-mowing	1,500.00	3,000.00	1,800.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Tax Anticipation Interest	10.00	10.00	10.00	10.00	10.00	10.30	10.61	10.93	11.26	11.59	11.94	12.30	12.67	13.05
Property Maintence plowing/mowing	0.00	0.00	0.00	3,500.00	3,500.00	3,605.00	3,713.15	3,824.54	3,939.28	4,057.46	4,179.18	4,304.56	4,433.70	4,566.71
Property Maintence Equiptment	0.00	0.00	0.00	1,300.00	1,000.00	1,030.00	1,060.90	1,092.73	1,125.51	1,159.27	1,194.05	1,229.87	1,266.77	1,304.77
Total Operating Expenses	*153,411.00*	*159,410.00*	*174,910.00*	*164,811.00*	*170,511.00*	*175,626.33*	*180,895.12*	*186,321.97*	*191,911.63*	*197,668.98*	*203,599.05*	*209,707.02*	*215,998.23*	*222,478.18*
Deer Meadow Project	167,017.26	7,200.00												
Leak Repair/Paving Road Project	60,933.72	65,665.35	36335.24											
Total Project Expenses	*227,950.98*	*72,865.35*	*36,335.24*											
Debt Service														
Bond Payment	23,246.88	22,821.88	22,396.88											
Bond Interest	4,046.88	3,621.88	3,621.88											
DES Payment	27,977.96	27,978.19	27,978.00											
DES Interest	7,365.77	7,365.76	7,364.51											
Total Existing Debt	*62,637.49*	*61,787.71*	*61,361.27*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Total Funds	***375,517.15***	***352,711.00***	***327,715.30***	***291,108.79***	***356,297.79***	***421,036.79***	***486,067.96***	***551,400.07***	***617,042.13***	***683,003.46***	***749,293.63***	***815,922.51***	***882,900.25***	***950,237.32***
Total Expenses	***443,999.47***	***294,063.06***	***272,606.51***	***164,811.00***	***170,511.00***	***175,626.33***	***180,895.12***	***186,321.97***	***191,911.63***	***197,668.98***	***203,599.05***	***209,707.02***	***215,998.23***	***222,478.18***
Net Profit/Loss	**-68,482.32**	**58,647.94**	**55,108.79**	**126,297.79**	**185,786.79**	**245,410.46**	**305,172.84**	**365,078.09**	**425,130.50**	**485,334.48**	**545,694.58**	**606,215.49**	**666,902.02**	**727,759.14**

TABLE 7-2
FIP – INCLUDING CAPITAL PROJECTS

	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030	Year 2030
REVENUE														
Revenue from Customers														
Water Bills + Meter Charges	69,595.15	95,318.00	110,322.30	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00	45,000.00
Cash In Hand	-	-	-	55,108.79	40,024.54	64,225.30	86,375.27	110,849.40	135,466.41	126,438.89	151,354.62	176,426.48	201,659.13	179,146.80
Taxes	185,922.00	207,393.00	207,393.00	181,000.00	175,000.00	180,250.00	185,657.50	191,227.23	196,964.04	202,872.96	208,959.15	215,227.93	221,684.76	228,335.31
Town Dam Fund	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00
Total Customers Revenue	***265,517.15***	***312,711.00***	***327,715.30***	***291,108.79***	***270,024.54***	***299,475.30***	***327,032.77***	***357,076.63***	***387,430.45***	***384,311.85***	***415,313.77***	***446,654.40***	***478,343.90***	***462,482.11***
Reserves														
ETF	110,000.00	30,000.00												
De-weeding		10,000.00												
Total Reserves	***110,000.00***	***40,000.00***												
EXPENSES														
Operating Expenses														
Commissioners Stipends	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,090.00	3,182.70	3,278.18	3,376.53	3,477.82	3,582.16	3,689.62	3,800.31	3,914.32
Clerk Stipend	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,030.00	1,060.90	1,092.73	1,125.51	1,159.27	1,194.05	1,229.87	1,266.77	1,304.77
Treasurer Stipend	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,150.00	5,304.50	5,463.64	5,627.54	5,796.37	5,970.26	6,149.37	6,333.85	6,523.87
Moderator Stipend	50.00	50.00	50.00	50.00	50.00	51.50	53.05	54.64	56.28	57.96	59.70	61.49	63.34	65.24
Auditor	1.00	500.00	10,000.00	500.00	10,000.00	10,300.00	10,609.00	10,927.27	11,255.09	11,592.74	11,940.52	12,298.74	12,667.70	13,047.73
Legal Fees	50.00	50.00	50.00	50.00	50.00	51.50	53.05	54.64	56.28	57.96	59.70	61.49	63.34	65.24
Building Maintenance	3,000.00	1,000.00	500.00	500.00	500.00	515.00	530.45	546.36	562.75	579.64	597.03	614.94	633.39	652.39
Property Maintenance-plowing	3,500.00	4,000.00	3,000.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Insurance	4,500.00	4,100.00	5,100.00	4,500.00	4,500.00	4,635.00	4,774.05	4,917.27	5,064.79	5,216.73	5,373.24	5,534.43	5,700.47	5,871.48
Office Expenses	3,500.00	4,500.00	4,500.00	3,500.00	3,500.00	3,605.00	3,713.15	3,824.54	3,939.28	4,057.46	4,179.18	4,304.56	4,433.70	4,566.71
Electricity	20,000.00	20,000.00	21,000.00	20,000.00	20,000.00	20,600.00	21,218.00	21,854.54	22,510.18	23,185.48	23,881.05	24,597.48	25,335.40	26,095.46
Gas	1,500.00	1,500.00	1,600.00	2,000.00	2,000.00	2,060.00	2,121.80	2,185.45	2,251.02	2,318.55	2,388.10	2,459.75	2,533.54	2,609.55
Licensed Operator Service	18,000.00	18,000.00	18,000.00	30,600.00	30,600.00	31,518.00	32,463.54	33,437.45	34,440.57	35,473.79	36,538.00	37,634.14	38,763.16	39,926.06
Permit to Operate Dam	400.00	400.00	400.00	400.00	400.00	412.00	424.36	437.09	450.20	463.71	477.62	491.95	506.71	521.91
Telephone	1,300.00	1,500.00	1,400.00	1,400.00	1,400.00	1,442.00	1,485.26	1,529.82	1,575.71	1,622.98	1,671.67	1,721.82	1,773.48	1,826.68
Water Meter Software	2,000.00	3,500.00	3,500.00	2,500.00	2,500.00	2,575.00	2,652.25	2,731.82	2,813.77	2,898.19	2,985.13	3,074.68	3,166.93	3,261.93
Water Service Alarm Monitoring System	300.00	1,000.00	1,000.00	500.00	500.00	515.00	530.45	546.36	562.75	579.64	597.03	614.94	633.39	652.39
System Maintenance	75,000.00	85,000.00	90,000.00	84,000.00	80,000.00	82,400.00	84,872.00	87,418.16	90,040.70	92,741.93	95,524.18	98,389.91	101,341.61	104,381.85
Water Testing	1,600.00	1,800.00	3,500.00	1.00	1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23	1.27	1.30
Parks and Recreation	2,500.00	500.00	500.00	500.00	1,000.00	1,030.00	1,060.90	1,092.73	1,125.51	1,159.27	1,194.05	1,229.87	1,266.77	1,304.77
Automobile	200.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Weed Control	5,500.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Property Maintenance-mowing	1,500.00	3,000.00	1,800.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Tax Anticipation Interest	10.00	10.00	10.00	10.00	10.00	10.30	10.61	10.93	11.26	11.59	11.94	12.30	12.67	13.05
Property Maintence plowing/mowing	0.00	0.00	0.00	3,500.00	3,500.00	3,605.00	3,713.15	3,824.54	3,939.28	4,057.46	4,179.18	4,304.56	4,433.70	4,566.71
Property Maintence Equiptment	0.00	0.00	0.00	1,300.00	1,000.00	1,030.00	1,060.90	1,092.73	1,125.51	1,159.27	1,194.05	1,229.87	1,266.77	1,304.77
Total Operating Expenses	*153,411.00*	*159,410.00*	*174,910.00*	*164,811.00*	*170,511.00*	*175,626.33*	*180,895.12*	*186,321.97*	*191,911.63*	*197,668.98*	*203,599.05*	*209,707.02*	*215,998.23*	*222,478.18*
Deer Meadow Project	167,017.26	7,200.00												
Leak Repair/Paving Road Project	60,933.72	65,665.35	36335.24											
Total Project Expenses	*227,950.98*	*72,865.35*	*36,335.24*											
Debt Service														
Bond Payment	23,246.88	22,821.88	22,396.88											
Bond Interest	4,046.88	3,621.88	3,621.88											
DES Payment	27,977.96	27,978.19	27,978.00											
DES Interest	7,365.77	7,365.76	7,364.51											
Total Existing Debt	*62,637.49*	*61,787.71*	*61,361.27*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Proposed Capital Improvements		**Estimated Project Cost**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Water Storage Tank Inspection & Cleaning				5,150										
*Concord Drive Water Main Replacement**		525,000.00		35,288	35,288	35,288	35,288	35,288	35,288	35,288	35,288	35,288	35,288	35,288
Franklin Pierce Pump House Improvements				34,505					33,433				672	
Peninsula Pump House Improvements				11,330		2,185			358				47,239	
Total Proposed Debt			*0.00*	*86,273.25*	*35,288.25*	*37,473.70*	*35,288.25*	*35,288.25*	*69,079.93*	*35,288.25*	*35,288.25*	*35,288.25*	*83,198.87*	*35,288.25*
Total Funds	***375,517.15***	***352,711.00***	***327,715.30***	***291,108.79***	***270,024.54***	***299,475.30***	***327,032.77***	***357,076.63***	***387,430.45***	***384,311.85***	***415,313.77***	***446,654.40***	***478,343.90***	***462,482.11***
Total Expenses	***443,999.47***	***294,063.06***	***272,606.51***	***251,084.25***	***205,799.25***	***213,100.03***	***216,183.37***	***221,610.22***	***260,991.56***	***232,957.23***	***238,887.30***	***244,995.27***	***299,197.10***	***257,766.43***
Net Profit/Loss	**-68,482.32**	**58,647.94**	**55,108.79**	**40,024.54**	**64,225.30**	**86,375.27**	**110,849.40**	**135,466.41**	**126,438.89**	**151,354.62**	**176,426.48**	**201,659.13**	**179,146.80**	**204,715.68**

APPENDIX A
Phase I Groundwater Well Source Investigation Report

WRIGHT-PIERCE
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July 20, 2020
W-P Project No. 20267A

Ms. Ali Vasquez
Pillsbury Lake Village District
34 Franklin Pierce Dr.
Webster, NH 03303

Subject: DRAFT - Phase I Groundwater Well Source Investigation
Pillsbury Lake District, Webster, New Hampshire

Dear Ms. Vasquez:

Per request of the Pillsbury Lake Village District (PLVD), Wright-Pierce (WP) has prepared the following Phase I Groundwater Well Source Investigation for the potential development of a new groundwater well source in Webster, NH (**Figure 1, Attachment A**). The current sources serving PLVD consists of four bedrock wells from two water systems referred to as Peninsula (PWSID: 2462050) and Franklin Pierce (PWSID: 2462040). The performance of these bedrock wells has declined over time resulting in an insufficient supply for the water system. The current yield of the combined systems is reported to be 9-13 gpm with a demand of 15-16 gpm.

A new groundwater well source(s) less than 40 gpm will require a permitting under *ENV-DW 302 Large Production Wells and Wells for Large Community Water Systems* or *ENV-DW 305 Small Production Wells for Small Community Water Systems* for new groundwater well sources under New Hampshire Department of Environmental Services (NHDES) regulations. A determination will be required by NHDES which rules are applicable based on their records and understanding of the system. The following report is a summary of the findings and recommendations regarding the existing groundwater well sources and the potential for the development of a new groundwater source.

GEOLOGY

Bedrock Geology

According to the "Bedrock Geologic Map of New Hampshire," (Bennett et al. 2006), PLVD system area is underlain by Kinsman Formation which is primarily foliated granite & granodiorite and Spaulding Formation which is weakly foliated biotite quartz diorite (**Figure 2**). East of the system area is mapped as Madrid Formation and Perry Mountain Formation. A fault is mapped along the contact between the Madrid Formation/Kinsman Formation and Perry Mountain Formation. A small area of the Littleton formation is located northwest of the water system which consists primarily of metamorphosed sedimentary rocks. The following is a more detailed geologic description of bedrock near PLVD.

- Kinsman Granodiorite (Dk2x) - Early devonian plutonic and associated volcanic rocks (Kinsman Quartz Monzonite) foliated granite, grandiorite, tonalite, and minor quartz diorite, large megacrysts of potassium feldspar characteristic garnet locally abundant.
- Spaulding Tonalite (Ds1-6) - Weakly foliated to nonfoliated, spotted biotite quartz diorite, tonalite, granodiorite, and granite; garnet and muscovite may or may not be present.
- Madrid Formation (Sm) - Massive to weakly foliated, purple biotite-feldspar granofels, layered calc-silicate, and dark pelitic-sulfidic schist containing calc-silicate pods in upper member.
- Perry Mountain Formation (Sp) - Sharply interbedded quartzites, light-gray nongraphitic metapelite, and "fast-graded" meta-turbidites with coticule layers common.
- Littleton Formation (DI) - Devonian gray metapelite and metawacke and subordinate metavolcanics rocks.

PLVD wells were drilled in areas mapped as the Spaulding Formation and the Kinsman Granodiorite. Water quality varies in these wells, particularly with respect to arsenic associated with the Spaulding formation. It is not recommended that bedrock wells be drilled in the Spaulding formation due to higher costs associated with arsenic treatment.

Bedrock Fracture/Lineament Analysis

A fracture trace or lineament analysis was performed as part of our assessment of the underlying bedrock structure within the town limits. Lineaments are linear or curvi-linear surficial expression of potentially fractured bedrock and have been successfully used to site high-yield bedrock wells throughout New England. Lineaments may also result from the expression of cultural features or mark the direction of the last glacial advance due to preferential scouring.

A lineament analysis was performed on digital elevation model (DEM) derived from lidar data. Lidar data is useful to identify topographically accentuated linear features, while aerial photographs are useful to identify tonal features in areas where the surface expression of fractured bedrock is muted by overlying soils.

Multiple sets of aerial photography were also used as part of the lineament analysis. It is important to use varying imagery as a part of this process in order to develop a robust lineament analysis and to identify reproducible lineaments with a higher likelihood of identifying high capacity bedrock aquifers. The following aerial photographs were used in the lineament analysis:

- National Agricultural Imagery Program (NAIP) 2019
- NAIP 2013
- 1998 Digital Orthophoto 1-12K Scale
- CIR (Color Infra-red) 2015

Coincident lineaments (reproducible on two or more figures) were identified using aerial photographs and digital elevation model data as part of this effort. These lineaments were compared with published USGS large scale mapping to identify probable locations for constructing a well in a fractured bedrock aquifer. Lineaments are shown on **Figure 3**.

Mapped Aquifers

Based on review of information published by NHDES and the USGS, mapped aquifers are located in close proximity to PLVD (**Figure 4**). Review of the Water Resources Investigations Report 92-4154 (Harte & Johnson) shows stratified drift aquifers to the north of Corn Hill Road and south of Pillsbury Lake. The mapped aquifers are described as stratified drift aquifer within or beneath glacial lake bottom deposits.

The mapped aquifer south of Pillsbury Lake is more extensive and extends south where transmissivity is indicated to increase. Transmissivity for these aquifers is estimated to be less than 1,000 feet squared per day. This is due to the relatively shallow aquifer in this area. However, PLVD requires low yields (~20 gpm) for a sand and gravel well and it is likely that well(s) could be developed within the mapped aquifers capable of meeting the water district's needs.

Mapped Soils

The United States Department of Agriculture (USDA) has developed soil maps for the area. These maps are highly detailed and show soil types at a high resolution. A review of this data indicates that soils outside of the mapped aquifers are largely glacial till (grainsize clay to boulders) and are typically not suitable for public supply wells due to low permeability.

Soil data for the area was obtained from the Natural Resources Conservation Service (NRCS) Soil Survey and is shown on **Figure 5**. The Chocorua Mucky Peat is mapped in the aquifer north of Corn Hill Road at the northern system area. These soils are described as deep, poorly drained soils underlain by stratified sand and gravel on outwash plains, lake plains, and glacial till uplands. The Croghan Fine Sandy Loam is mapped in the aquifer northwest of the system area. These soils are described as very deep, moderately well drained soils formed in deltaic or glacio-fluvial deposits with high estimated saturated hydraulic conductivity. The Naumberg Sandy Loam is similar to the Croghan soils but is more permeable (coarser-soils) and are the most favorable soils within the study area. These soil types appear to have good potential for the development of a sand and gravel well source. Both soils are mapped to the south of Pillsbury Lake and the system area in mapped stratified drift aquifer. The Chocorua Mucky Peat is mapped in the western portion and The Croghan Fine Sandy Loam is mapped in the eastern portion.

Well Data

Well data available on the NHDES Onestop database indicates that the depth to bedrock is generally shallow in the area near Pillsbury Lake and ranges from five to 30 feet in thickness (**Figure 4**). With regards to overburden wells (sand and gravel) the deeper the productive soils the greater the yield. However given that the District is seeking to develop capacity less than 40 gpm, soils on the order of 20 feet thick could easily produce these rates if moderately low producing sand and gravel and reasonable recharge to the well is present.

Well yield for the water well inventory was mapped using the NHDES Onestop well data. **Figure 3** shows well yield for all wells in the data set near PLVD. The majority of these wells are bedrock wells and very few overburden well sources are drilled for private homeowners. This dataset can be used to correlate well yield with lineaments to identify areas with higher potential for the development of a bedrock well source.

Two wells of note located north of Pillsbury Lake have reported yields of 100 gpm. These wells indicate excellent potential for the development of a high yield bedrock well source in this area. However, these wells are located in the Spaulding formation and may have elevated dissolved arsenic.

POTENTIAL CONTAMINANT SOURCES

One of the most important factors in the development of a new supply is to locate the new source in an area that limits the potential for existing and future potential contamination sites (PCSs). The NHDES Onestop database was used to identify potential contaminant sources near PLVD. Above ground and underground storage tanks, auto salvage yards, asbestos sites, hazardous waste generators, remediation sites and solid waste facilities (landfills) were mapped on **Figure 6**.

Contaminant threats were identified near PLVD including several remediation sites. The Peninsula pump station was identified as an underground injection control site. It is unclear what the nature of this is, however, it is suspected to be relative to the waste generated from arsenic treatment for the Peninsula Wells.

Webster Abandoned Dump, Webster Abandoned Dump #2, and Webster Abandoned Dump #3 are located north of, within, and west of the system area respectively. These are all old dumps that are no longer operating. These sites could present a risk to a nearby groundwater source from any leached contaminants at these sites.

Other contaminant threats in the NHDES database were not identified. A windshield survey of the area did not identify any unmapped contaminant threats.

DOCUMENT REVIEW

A document review was conducted regarding the existing wells. Documents obtained from PLVD and NHDES files were reviewed as a part of this work. Well permitting data and operational data from 2018 to 2019 was used to estimate capacity for each of the wells. The following **Table 1** is a summary of the water system:

TABLE 1
WATER SUPPLY SOURCES

	Peninsula Wells (gpm) PWSID: 2462050			Franklin Pierce Wells (gpm) PWSID: 2462040			Total Output of Combined Systems	
	Well 5	**Well 6**	**Output**	**Well 4**	**Well 7**	**Output**	**(gpm)**	**(gpd)**
Original Tested Yield (gpm)	30	10	40	15	5.4	20.4	60.4	86,976
Well Depth (feet)	300	1000	NA	1020	1060	NA	NA	NA
Average Daily Demand (gpm)*	1.7	8.1	13.4	4.2	1.2	8	21.4	30,816
Maximum Demand (gpm)*	6.8	13.1	24.5	17.1	3.5	16.1	40.6	58,464
Minimum Demand (gpm) *(on non-zero days)	0.41	0.83	5.73	0.2	0.3	3.5		
2011 Estimate of Yield	>5.2	>5.2		14	2			
2012 Estimate of Yield (combined wells 5 and 6 due to hydraulic connection)	28.2							

*Data obtained from water usage 1Q 2018 – 2Q 2019

This assessment indicates that the yield of the PLVD wells have declined over time. PLVD has attempted to increase yield by deepening and hydrofracturing these wells. WP does not recommend this approach for future work. Well deepening is not typically effective for bedrock wells greater than 600 feet deep due to lithostatic pressure closing fracture zones. This means that the overlying weight of the rock will close off fracture zones at greater depths, resulting in a precipitous decline for the probability of obtaining significant additional yield.

EXISTING WELL YIELD

The Franklin Pierce Wells include BRW4 and BRW7 and serve a population of 155 with 62 service connections. A well video performed in March 2011 of BRW4 found the bottom of bore to be 280 feet deep. Well depth was initially reported to be 500 feet in 1966 and gradually decreased in reported depth over the years indicating a cave-in. The reported well yield at the time of the well video was 6-7 gpm which increased following deepening. The well was deepened to 1020 feet and the borehole was reamed to 6 inches in diameter.

A report from August 2019 indicated BRW4 has a 3 Hp pump set at 600 feet. This report indicates that BRW7 has a 1.5 Hp pump set at 850 feet. BRW7 was reportedly drilled in 1998 and deepened to 1060 feet in 2002 with a reported yield of 7 gpm which decreased to 3 gpm in 2011. A pumping test from August 2011 indicated that BRW7 sustainable yield was 2 gpm and BRW4 sustainable yield was 14 gpm giving this system (Franklin Pierce) an original combined yield of 16 gpm with NHDES approval for these Permitted Production Volumes. No treatment is needed for the Franklin Pierce Wells.

The Peninsula Wells include BRW5 and BRW6 and serve a population of 130 with 52 service connections. An interconnection exists between the systems from an emergency interconnection in 2008. A well video performed in March 2011 of BRW6 found the bottom of bore to be 300 feet deep. This well was deepened to 1000 feet in June 2012 and an airlift yield of 18 gpm was reported for the deepened well. The well was hydrofractured at two depths.

BRW5 is reported to be 300 feet deep with a 5 Hp pump set at 280 feet. The two wells are hydraulically connected, and results of the pumping test indicated a sustainable yield of at least 23.8 gpm for the two wells in the Peninsula Wellfield. BRW5 was pumped at 4.4 gpm during initial testing of the well. The Peninsula Wellfield is reported to have high arsenic, iron, and manganese and requires treatment. Reports from 2011 indicate that BRW 5 and 8 can produce 13 gpm through the treatment system.

Decline in well yield was observed for both the Peninsula and Franklin Pierce Wells. The storage of water in bedrock fractures can be easily depleted, particularly when multiple wells are relying on the same localized storage for a portion of the yield. Both systems rely on these two hydraulically connected bedrock wells.

Once local storage is depleted, and fractures are dewatered, limited water from fractures result in a decline of the pumping level and well yield. Once a fracture zone is dewatered, the flow into the well bore is cascading and inefficient as air becomes entrained in fractures. This allows for iron/manganese bacteria growth to proliferate within the fractures choking off the ability of the well to produce water. This is the most likely scenario for the decline in yield of the Peninsula and Franklin Pierce Wells.

In cases where this has occurred, the well can be rehabilitated using chemicals and mechanical agitation of the fracture zones. However, this would require the well and nearby wells to be shutdown for up to a week. Currently PLVD cannot afford to rehabilitate the wells due to significant system leaks and demand in excess of the alternative capacity. However, the development of an additional source would provide PLVD with the ability to meet system demand and complete rehabilitation of its existing sources, as needed.

FAVORABLE AREAS FOR GROUNDWATER EXPLORATION

All data collected was used to identify potential areas with the greatest probability for the development of a new groundwater source. The areas identified are all overburden well targets. Bedrock wells are not recommended at this time for several reasons:

1) The cost for overburden well exploration is significantly less than that of bedrock wells.
2) Overburden wells typically have better water quality than bedrock wells.
3) Overburden wells are more predictable in their long-term pumping response if properly maintained.
4) The presence of sand and gravel around Pillsbury Lake which were observed in multiple datasets indicates multiple options for the developing sources on the order of 20 to 40 gpm.

A key part of identifying parcels is that the PLVD would need to own, or control through easements, the protective radius around the new source. For a new community well, a sanitary protective radius of 150 feet is required for a well less than 10 gpm, 175 for yield of 10-20 gpm and a protective radius of 200 feet is required for a well less than 40 gpm. Developing a well in excess of 40 gpm is not recommended as it triggers a Large Groundwater Withdrawal Permit (LGWP) which is the highest level of well permitting in New Hampshire. LGWPs are expensive and time consuming and should be avoided for a smaller system like PLVD, if not required.

Structures, subsurface waste disposal systems, etc. cannot be within this state mandated protective radius. However, adjacent parcels that are undevelopable due to wetlands or are in conservation can effectively provide a protective radius and a waiver can be obtained by PLVD. As such, properties have been selected with the potential to meet the NHDES protective radius requirements. However, some easements onto adjacent properties may be needed depending on the actual location of a new well source.

PLVD is considered to be a Small Community system and new sources can be permitted under these regulations. Groundwater wells less than 40 gpm require a Small Groundwater Withdrawal Permit under *ENV-DW 305 Small Production Wells for Small Community Water Systems* for new groundwater well sources under New Hampshire Department of Environmental Services (NHDES) regulations.

The following is a summary of properties that are considered favorable for groundwater exploration and property locations are shown on **Figure 7**.

Sand and Gravel Well Site

<u>South Aquifer</u>
Lots 10-1, 10-1-AB, 9-41, 9-48-1– These parcels are privately owned and are south of the Pillsbury Lake Community Center. Land use indicates unmanaged pine and hardwood forests, wetlands, and residential use. The larger lot sizes of unmanaged land would provide greater setbacks for a well source at these sites. Soils in this area are mapped as Chocorua Mucky Peat and Croghan Fine Sandy Loam indicating favorable geologic conditions. This area should be considered a secondary target for groundwater exploration.

<u>North Aquifer</u>
Lots 6-46-6, 6-47, 6-47-1, 6-48 – These lots are privately owned properties consisting of residential land and forest. Soils at the site are mapped as Chocorua Mucky Peat described as underlain by stratified sand and gravel. Geology suggests that a 20 to 40 gpm groundwater source could be developed in this area. Negotiations with landowners would be required. WP can assist with these efforts if owners indicate a willingness to work with PLVD.

Lot 10-2-44 is owned by PLVD and abuts Pillsbury Lake. The lake would provide an excellent source of recharge for a sand and gravel well source on this property and limit a wells susceptibility to drought. Lot 10-8 is owned by the Town of Webster and may be compatible with the development of a well source. Data does not suggest this lot is in conservation which can exclude properties from well source development (additional research should be completed to confirm).

Soil data suggest that bedrock is on the order of 20 feet deep at both these properties. For lot 10-8, well data indicates relatively shallow depth to bedrock to the north with increasing soil thickness to the south. This indicates that a buried bedrock trough in this area. Furthermore, well data suggests that gravel is present in the bedrock trough. Productive sand and gravel is deposited from moving water and moving water is most often at the deepest part of a valley. This suggests that these two properties have potential for the development of a sand and gravel well source.

However, it's likely that bedrock becomes somewhat deeper approaching Pillsbury Lake. The NH Fish and Game Department bathymetry maps for the lake indicate that the lake is shallow, and depths may be on the order of 10 feet near this property which indicates that soils may become thicker approaching the lake.

CONCLUSIONS AND RECOMMENDATIONS

The following is a summary of our conclusions and recommendations regarding source capacity for PLVD:

- Lots 10-2-44 and 10-8 should be considered primary targets based on ownership, available data and proximity to the water system. Other lots in the north aquifer as shown above should be considered the second tier of favorability and lots south of Pillsbury Lake have the lowest favorability for overburden well development. Sand and gravel targets are much less expensive to explore relative to bedrock wells. These sites are located on larger lots of land, providing more potential for the sanitary protective radius to be encompassed within the property. The relatively low yield requirements for these sources would require only moderately productive soils to provide the required yields. Arsenic treatment of the Peninsula wells may require costly upgrades with the new lower state drinking water standard coming into effect in July 2021. Replacing the Peninsula wells with one of better water quality could result in significant operational cost savings for PLVD. WP's hydrogeology group specializes in alternative well designs that can develop yield from geologic conditions that conventional wells are not suited for. We recommend that PLVD focus on sand and gravel sites to develop additional capacity for the system.
- We estimate that a new sand and gravel well source on the order of 20 gpm would be sufficient to supply the system given the available data. While 20 gpm from a sand and gravel source is generally a low target rate, limited soil thickness throughout the area makes source development somewhat more difficult. However, relatively thin soils would result in much lower costs for sand and gravel test well drilling. Given the potential for variable water quality, relatively small property size and shallow soils, we recommend test well drilling at a minimum of two to four properties.

- The existing bedrock wells have shown a continued decline in yield. Developing additional source capacity would allow for these wells to recover as they have been over pumped. There is potential for rehabilitation of some of these wells. Potential future work regarding the existing bedrock wells would include:
  - Assess the specific capacity of the wells relative to when the wells were permitted after reasonable recovery of water levels has been achieved.
  - Rehabilitate the wells if a decline in specific capacity was observed.
  - The Peninsula Wells could be taken offline if sufficient yield can be developed. The District has expressed a desire to take these wells offline as they are expensive to operate and maintain relative to the Franklin Pierce wells.
- PLVD should implement a water level monitoring program to assess the performance of the bedrock wells. We recommend pressure transducers be installed and monitored in all wells to collect data that can be correlated with pumping rates over time. This data is essential for assessing well performance, determining whether maintenance/rehabilitation is required and will allow operators to avoid dewatering key water bearing fracture zones and avoid a decline in well performance over time. We are currently working with Emerald Lake Village Water District on a similar effort and have developed a cost-effective solution to meet these data collection needs.

Thank you for the opportunity to assess PLVD's water sources and review the potential for additional groundwater development to sustainably meet the District's capacity needs. Please do not hesitate to call me with any questions.

Sincerely,
WRIGHT-PIERCE

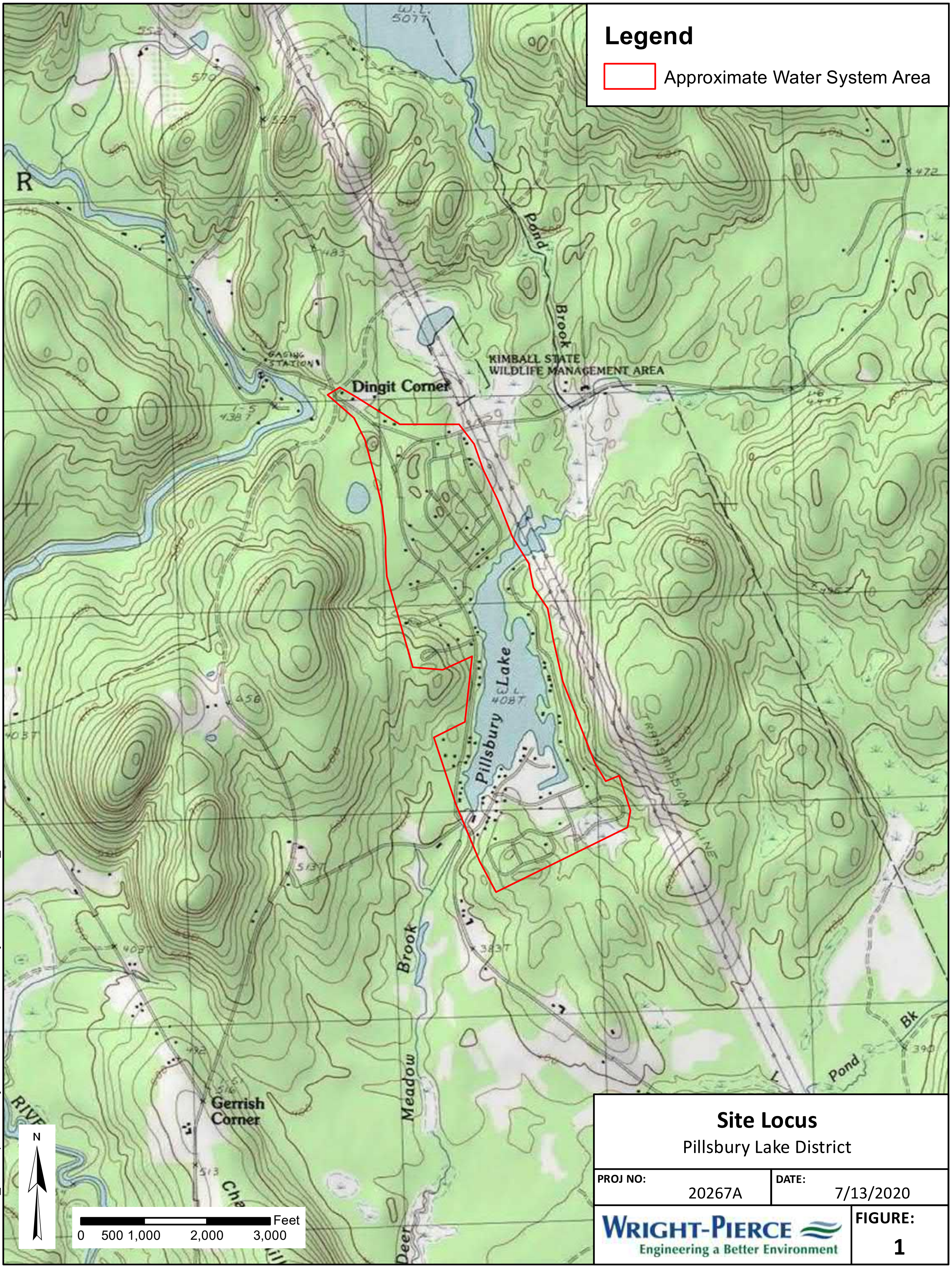
Greg Smith, PG, CG
Senior Hydrogeologist

Christopher Berg, P.E.
Senior Project Manager

Enclosures

ATTACHMENT A

Figures



Site Locus

Pillsbury Lake District

PROJ NO: 20267A

DATE: 7/13/2020

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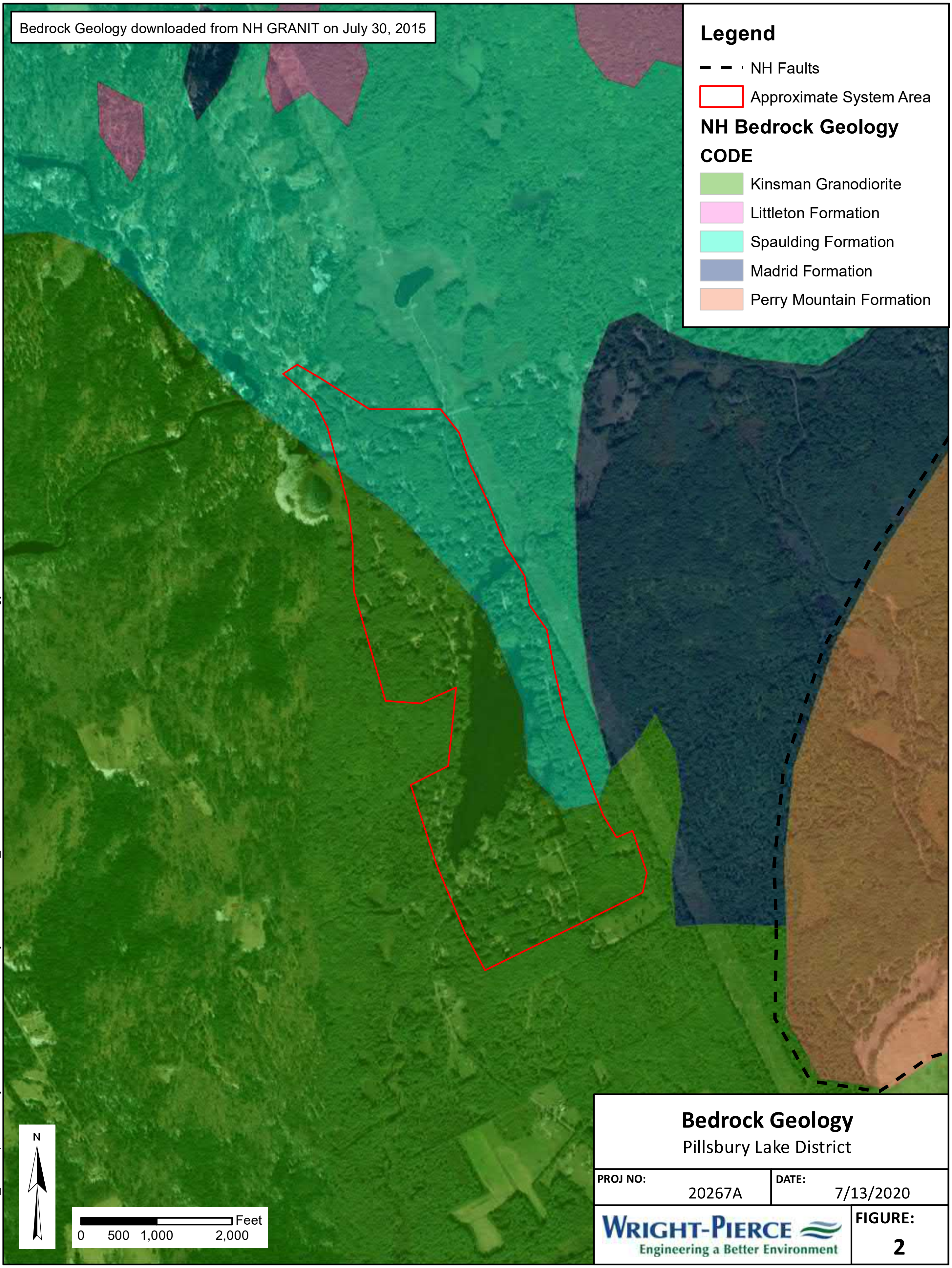
FIGURE: 1

XYZ W:\GIS_Development\Projects\NH\~OTHER\PillsburyLakeDist\20267_GroundwaterSource\MXDs\1. Site Locus.mxd



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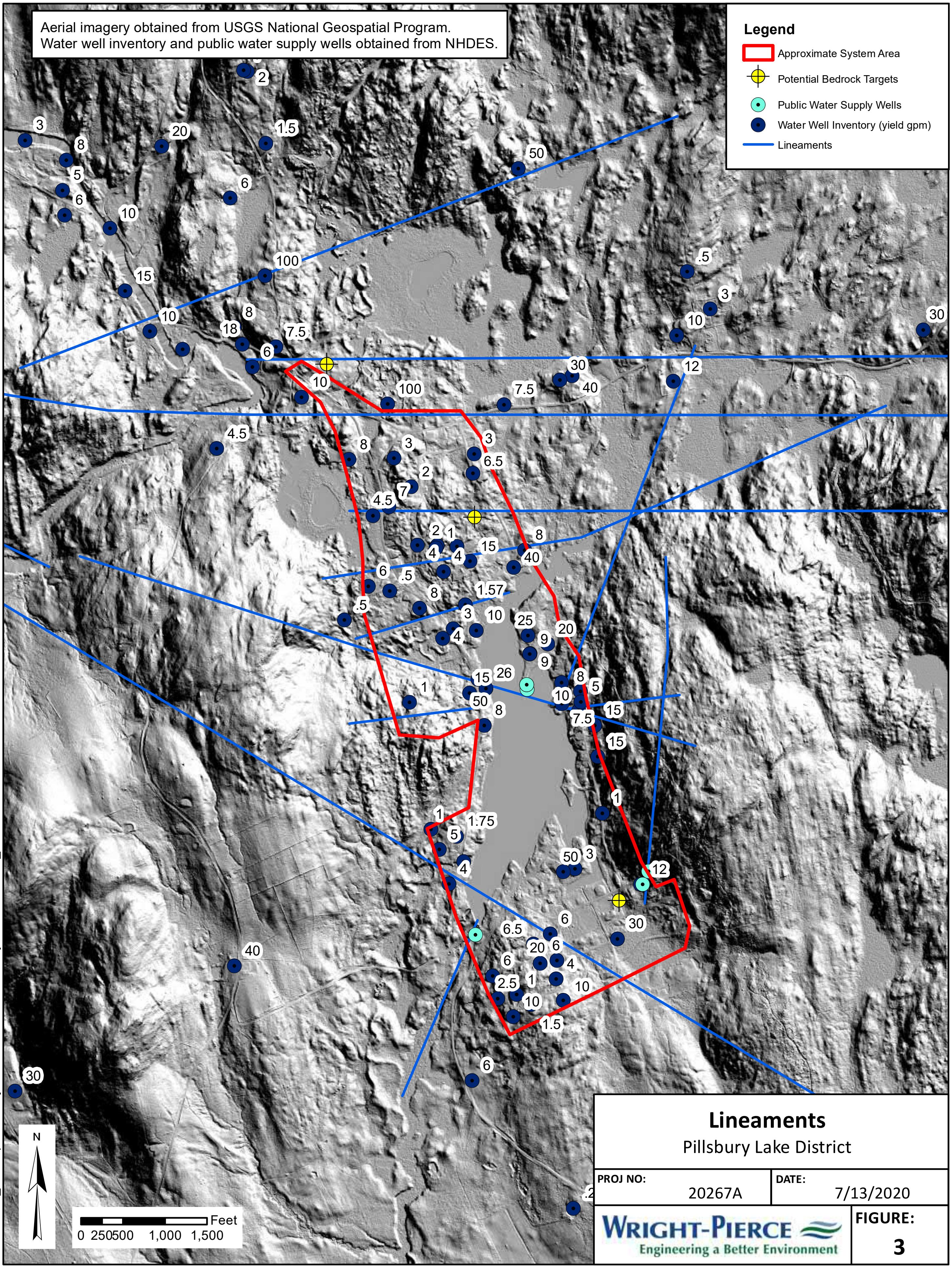

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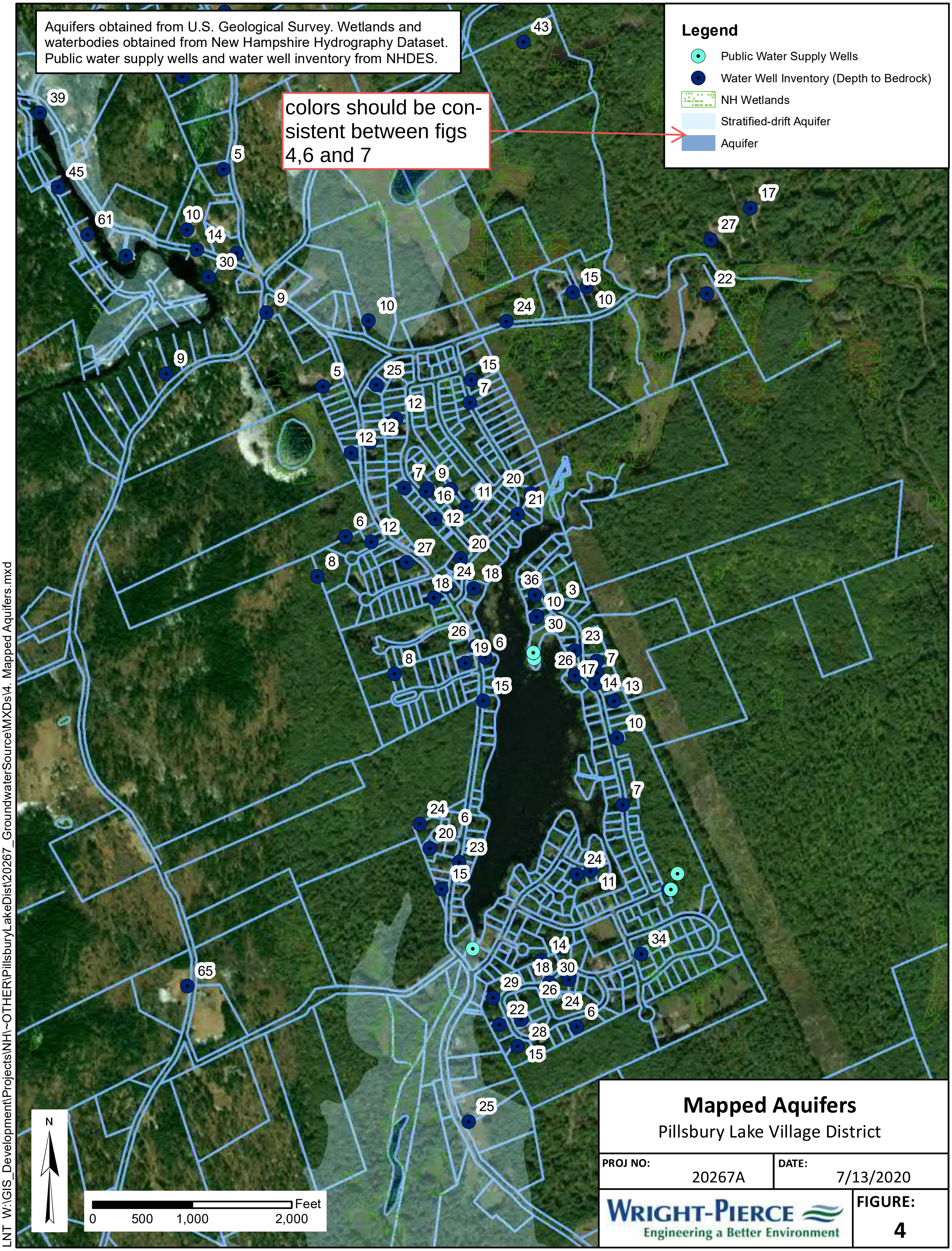
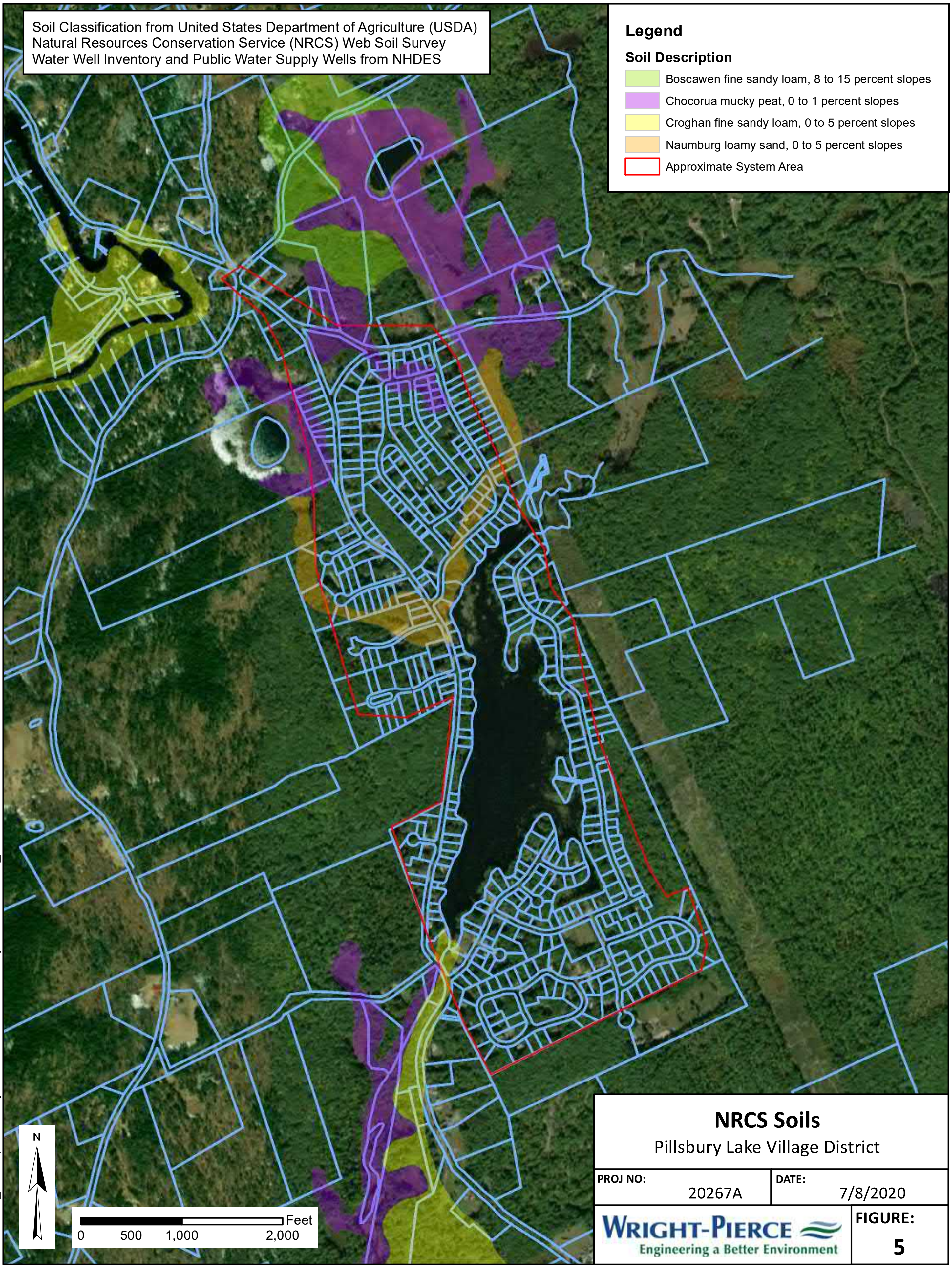

Aquifers obtained from U.S. Geological Survey. Wetlands and waterbodies obtained from New Hampshire Hydrography Dataset. Public water supply wells and water well inventory from NHDES.
colors should be consistent between figs 4,6 and 7
Legend
Public Water Supply Wells
Water Well Inventory (Depth to Bedrock)
NH Wetlands
Stratified-drift Aquifer
Aquifer
N
0 500 1,000 2,000 Feet
Mapped Aquifers
Pillsbury Lake Village District
PROJ NO: 20267A
DATE: 7/13/2020
WRIGHT-PIERCE
Engineering a Better Environment
FIGURE: 4
LNT W:\GIS_Development\Projects\NH\~OTHER\PillsburyLakeDist\20267_GroundwaterSource\MXDs\4. Mapped Aquifers.mxd



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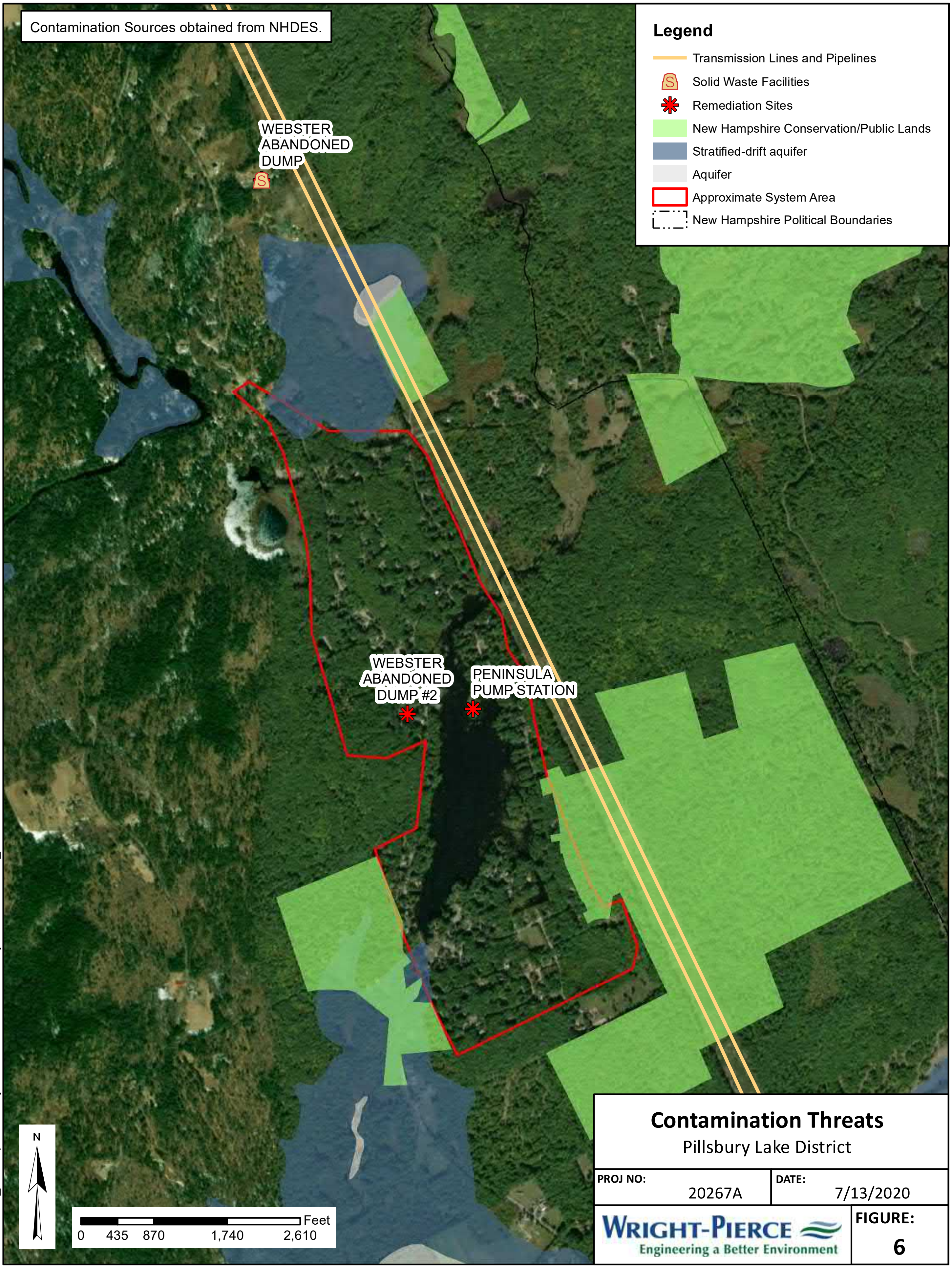

Contamination Threats

Pillsbury Lake District

PROJ NO:	DATE:
20267A	7/13/2020

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FIGURE: 6

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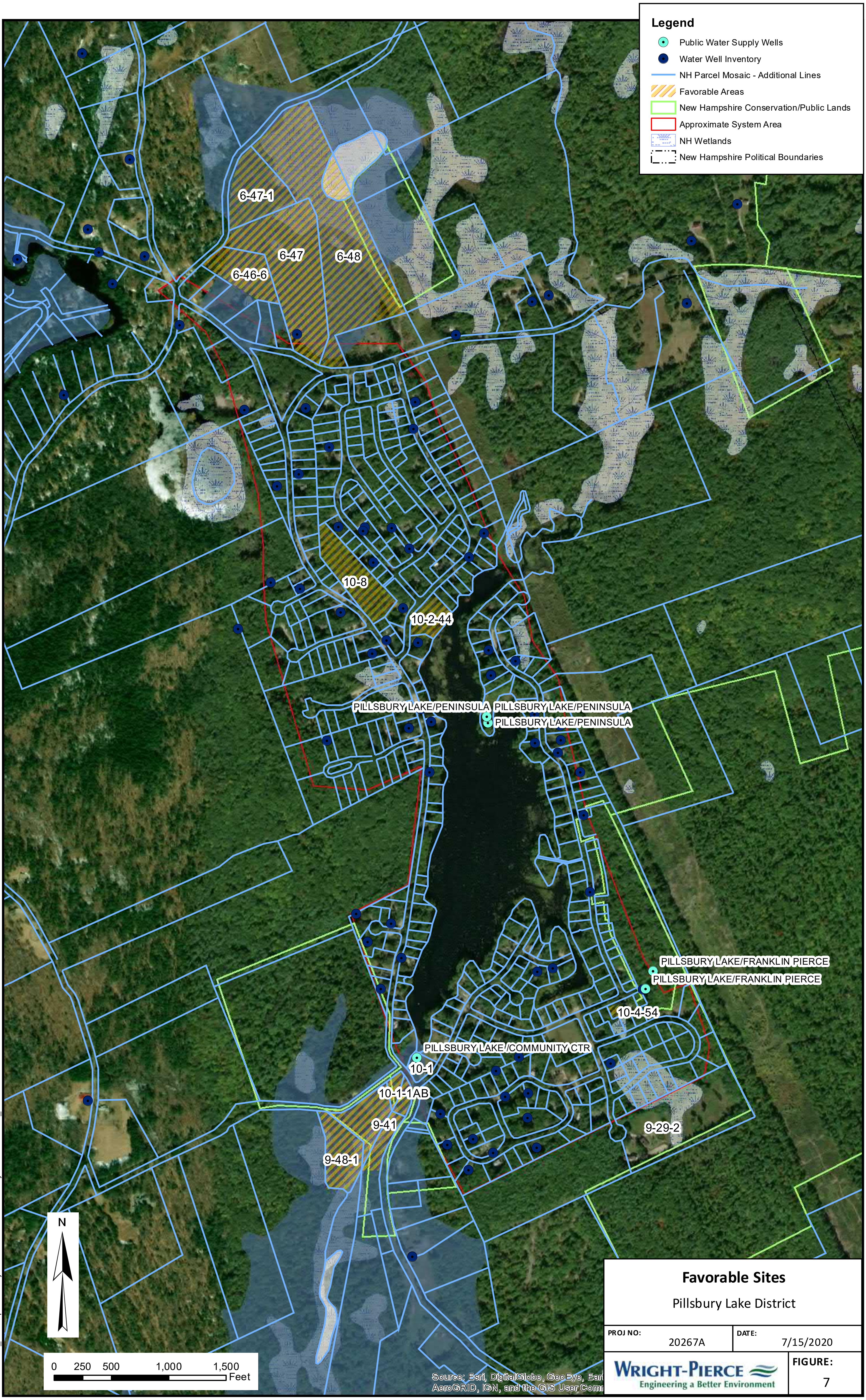

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APPENDIX B
Facility Descriptions

Franklin Pierce Pump House Description
By Aquamen Operators

Water source:

Water is supplied to the Franklin Pierce pump house from 3 bedrock wells. Wells # 4, 7, and 8. See source data information for water source details. Each water source runs through a meter. Well 4 uses a 1" Badger meter, serial # 50080224, model 70 direct read meter. Well 7 uses a 1" Badger meter, serial # 50080227, model 70 direct read meter. Well 8 uses a 1" Sensus meter, serial# 66060334, model SR2 direct read.
Each well source has a source sample tap. All sources feed a single atmospheric storage tank.

Atmospheric storage tank:

20,000-gallon A.S.T. Wall thickness is ¼". Manufactured February 1998 by Crown Tanks Inc. in Taunton Massachusetts. Supply is 3" galvanized steel with a 3" brass gate valve. The discharge is 3" galvanized steel also with a 3" brass gate valve. There is a 3" quick connect camlock for bulk water delivery also with a 3" gate valve. Combination drain connection and site tube constructed of ¾" galvanized steel with a ¾" ball valve as the master shutoff. ¾" gate valve as the end shutoff also connects the ½" site tube assembly for visual tank level indication. Tank has an 18-bolt access hatch port for inspections and cleaning. Last tank inspection, cleaning, and flushing are unknown. Tank vent assembly is 2" sch. 80 pvc which also provides the access port for tank level controls and alarm floats. There are two 1" access ports currently plugged and two ¾" access ports currently plugged. Exact tank dimensions are unknown at this time.

Booster Pump Assembly:

Suction line reduces from 3" galvanized steel to 2" galvanized steel. On the suction side there are 2" brass line check valves and 2" brass gate valves. Feeding two 5 hp, single phase, 60 Hz booster pumps. Model # 70HB15013. Made by Goulds Pump. Baldor Industrial Motor catalog # JML1409. Frame # 184CZ. Discharge size is 2" galvanized steel with 2 brass gate valves along with a 2" ball valve at the entry point of the hydropneumatic tank with a ¾" 75 psi pressure relief valve.

Hydropneumatic Tank:

Capacity is 2,740 gallons dated February 1998. Working pressure 75 psi, total pressure is 115 psi. 12" X 16" access port for inspection and service. Two ¾" ports with a visual tank level indication. One 2" port threaded at the top of the tank, plugged. One 1" threaded port, plugged. Air volume control assembly consists of 1" galvanized steel with 1" ball valves on the top and bottom for servicing the system. Air volume is controlled by a McDonnell and Miller model # 150S air volume control valve. Fed by a GAST air compressor. Model # 4Z706. Serial # 68CA-12-M616X. 1 Hp, 115/230V motor. No manufacturer dates.

Hydropneumatic Tank Discharge to Distribution:

Starts with 3" galvanized with a 3" brass ball valve. Transitions to a 3" Sensus Omni meter. Serial # 73382832. Running as a direct read with remote capabilities. Distribution line exiting meter is 3" sch 40 pvc with flanged connections. Then splits and feeds two distribution lines. At this point is the distribution sample tap where it continues with two 3" brass gate valves. That exit in 4" sch 80 through the pump house floor.

Hydropneumatic Pressure Controls:

2 Mercoid mercury switches set up lead/lag, type DA-31-31804-6. Serial # T13J-S80516201. 120/240V.
Panel large, condition is poor. Manufacturer is Ohio Electric Control Inc. 230V.

Control Panel:

The control panel houses all the main electrical controls and switches for all the water systems major components. From this panel well pumps, booster pumps, the compressor and the alternators can be controlled by hand operation, set in automatic operation (normal operation) or turned off. The control panel is supplied with 230 volts, single phase power from a 100-amp supply braker in the main electrical panel mounted to the right of the control panel. L1, L2 and the neutral wires are connected to a main terminal block and the ground wire to a separate dedicated grounding terminal. From the main power supply terminal block power is supplied to individual shut off breakers as outlined below.

Circuit breakers are designated CB1 through CB6:

CB-1: This circuit controls Motor 1, well pump #7. The circuit breaker is made by Furnas (now Siemens). Breaker rating is 30 amp. Power leaving the breaker then runs to Furnas Electric definite purpose controller (contactor). This is a 3-phase contactor running as a single phase 230-volt contactor. The contactor is rated 3 hp to 15 hp depending on Phase power with up to 50 amps per pole. Power leaves the contactor and runs through a Furnas Bi-Metal OL relay (heater/overload). Rating for the overload is 600 VAC Max. If the element burns out the relay will need to be replaced. The overload relay is equipped with an auto reset once the circuit cools or a manual override reset can be attempted, but if the circuit is too hot it will not manually reset. Electrical leaves the thermal overload and goes to the Aquavar Solo drive for the pump. HOA switch and run indicator lamp electrical supply come off of the contractor, and before the thermal overload relay.

CB-2: This circuit controls Motor 2, well pump #4. The circuit breaker is made by Furnas (now Siemens). Breaker rating is 30 amp. Power leaving the breaker then runs to Furnas Electric definite purpose controller (contactor). This is a 3-phase contactor running as a single phase 230-volt contactor. The contactor is rated 3 hp to 15 hp depending on Phase power with up to 50 amps per pole. Power leaves the contactor and runs through a Furnas Bi-Metal OL relay (heater/overload). Rating for the overload is 600 VAC Max. If the element burns out the relay will need to be replaced. The overload relay is equipped with an auto reset once the circuit cools or a manual override reset can be attempted, but if the circuit is too hot it will not manually reset. Electrical leaves the thermal overload and goes to the Aquavar Solo drive for the pump. As of 11-20-2020 thermal overload has been bypassed. HOA switch and run indicator lamp electrical supply come off of the contractor, and before the thermal overload relay.

CB-3: This circuit controls Motor 3, booster pump #1. The circuit breaker is made by Furnas (now Siemens). Breaker rating is 30 amp. Power leaving the breaker then runs to an Eaton Electric definite purpose controller (contactor). This is a 3-phase contactor running as a single phase 230-volt contactor. The contactor is rated 5 hp to 15 hp depending on Phase power with up to 50 amps per pole. Power leaves the contactor and runs through a Furnas Bi-Metal OL relay (heater/overload). Rating for the overload is 600 VAC Max. If the element burns out the relay will need to be replaced. The overload relay is equipped with an auto reset once the circuit cools or a manual override reset can be attempted, but if the circuit is too hot it will not manually reset. Electrical leaves the thermal overload and goes to the Aquavar Solo drive for the pump. HOA switch and run indicator lamp electrical supply come off of the contractor, and before the thermal overload relay. As of 11-20-2020 CB-3 is turned off due to leak in booster 3.

CB-4: This circuit controls Motor 4, booster pump #2. The circuit breaker is made by Furnas (now Siemens). Breaker rating is 30 amp. Power leaving the breaker then runs to an Eaton Electric definite purpose controller (contactor). This is a 3-phase contactor running as a single phase 230-volt contactor. The contactor is rated 5hp to 15 hp depending on Phase power with up to 50 amps per pole. Power leaves the contactor and runs through a Furnas Bi-Metal OL relay (heater/overload). Rating for the overload is 600 VAC Max. If the element burns out the relay will need to be replaced. The overload relay is equipped with an auto reset once the circuit cools or a manual override reset can be attempted, but if the circuit is too hot it will not manually reset. Electrical leaves the thermal overload and goes to the Aquavar Solo drive for the pump. HOA switch and run indicator lamp electrical supply come off of the contractor, and before the thermal overload relay.

CB-5: This circuit controls Motor 5, 1.5 hp Compressor. The circuit breaker is made by Furnas (now Siemens). Breaker rating is 30 amp. Power leaving the breaker then runs to Furnas Electric definite purpose controller (contactor) for a hermetic compressor. This is a 3-phase contactor running as a single phase 230-volt contactor. The contactor is rated 3 hp to 7.5hp depending on Phase power with up to 50 amps per pole. Full load amps are 25, lock rotor amps are 150. Power leaves the contactor and runs through a Furnas Bi-Metal OL relay (heater/overload). Rating for the overload is 600 VAC Max. If the element burns out the relay will need to be replaced. The overload relay is equipped with an auto reset once the circuit cools or a manual override reset can be attempted, but if the circuit is too hot it will not manually reset. HOA switch and run indicator lamp electrical supply come off of the contractor, and before the thermal overload relay.

CB-6: 115-volt single pole breaker. This controls the alternating function of the booster pumps, well pump start/stop controls, well pump override control, low water alarm control, booster pump restores control, booster pump cutout control, and ground/reference control. Also ties into HOA controls. Leaving CB-6 circuit goes into a 3-amp glass fuse. Circuit then goes through a pair of alternators, pair of ice cube relays, down through terminal strips, and out to various controls.

Liquid Level Control: Utilize BW controls with liquid level sensors in the atmospheric storage tank.

CB-7: 30-amp breaker located in the main electrical panel, right of control panel. Power supply goes directly out of electrical panel and into the Aquavar Solo drive which utilizes and ice cube relay in the control panel to send run/stop signal to the drive, and ties into HOA switch that has been added to the control panel.

APPENDIX C
Vertical Asset Evaluation Outputs

HOME

WRIGHT-PIERCE Engineering a Better Environment

10 Dorrance Street, Suite 840, Providence, RI
Tel: 401-383-2276 Fax: 401-383-2924

Management Strategies | Capital Improvement Plan | Capital Improvement Plan Graphs

	A	B	C	D	E	F	G	H	I
6	ASSET INFORMATION				PLANNING OUTPUTS				
7	Asset ID	Equipment Description	Location	Discipline	Recommended Management Strategy	Risk Mitigation Strategy	Estimated Renewal Date	Approximate Value of Equipment Cost at Renewal Date	Replacement Cost in Year 2020 Dollars ($)
8	100-101-LP-01	Lighting panel	Chemical injection room and bc	Electrical	Rt or PM Schedule		2042	$ 5,320.00	$ 10,000.00
9	100-101-CO-01	Control panel for booster pumps	Treatment and booster pump rc	Electrical	Rt or PM Schedule		2037	$ 6,240.00	$ 10,000.00
10	100-101-SD-01	Part os SCADA equipment	Chemical treatment and booste	I&C	Rt or PM Schedule		2030	$ 19,150.00	$ 25,000.00
11	100-101-ES-01	Inverter	Chemical treatment and booste	Electrical	Rt or PM Schedule		2041	$ 820.00	$ 1,500.00
12	100-101-MT-01	1" meter raw water from well 5	Chemical treatment and booste	I&C	Run to Fail		2036	$ 320.00	$ 500.00
13	100-101-VD-01	Variable Frequency Drive for booster pump 1	Chemical treatment and booste	Electrical	Rt or PM Schedule		2037	$ 740.00	$ 1,200.00
14	100-101-VD-02	Variable Frequency Drive for booster pump 2	Chemical treatment and booste	Electrical	Rt or PM Schedule		2037	$ 740.00	$ 1,200.00
15	100-101-GN-01	Standby power	Chemical treatment and booste	Electrical	Rt or PM Schedule		2051	$ 4,010.00	$ 10,000.00
16	100-101-MT-02	1" Raw water meter from well 6	Chemical and booster pump bu	Process	Run to Fail		2032	$ 360.00	$ 500.00
17	100-101-CG-02	Storage tank pressure gauge	Chemical treatment and booste	Process	Run to Fail		2035	$ 100.00	$ 150.00
18	100-101-CG-01	System pressure gauge	Chemical treatment and booste	Process	Run to Fail		2030	$ 110.00	$ 150.00
19	100-101-TM-02	System pressure transmitter	Chemical treatment and booste	Process	Rt or PM Schedule		2033	$ 350.00	$ 500.00
20	100-101-TM-01	Pressure transmitter from tank	Chemical treatment and booste	Process	Rt or PM Schedule		2033	$ 350.00	$ 500.00
21	100-101-TM-03	Pressure transmitter to start booster pump	Chemical treatment and booste	Process	Run to Fail		2033	$ 350.00	$ 500.00
22	100-101-PP-02	Secondary booster pump #2	Chemical treatment and booste	Process	Run to Fail		2033	$ 1,600.00	$ 2,300.00
23	100-101-MO-01	Motor for booster pump #1	Chemical treatment and booste	Process	Rt or PM Schedule		2033	$ 350.00	$ 500.00
24	100-101-PP-01	Primary booster pump #1	Chemical treatment and booste	Process	Run to Fail		2035	$ 1,500.00	$ 2,300.00
25	100-101-MO-02	Motor for booster pump #2	Chemical treatment and booste	Process	Rt or PM Schedule		2033	$ 350.00	$ 500.00
26	100-101-FI-01	Cartridge filter	Chemical treatment and booste	Process	Run to Fail		2027	$ 250.00	$ 300.00
27	100-101-FI-02	Arsenic removal vessel A1	Chemical treatment and booste	Process	Run to Fail		2044	$ 3,470.00	$ 7,000.00
28	100-101-FI-03	Arsenic removal vessel A2	Chemical treatment and booste	Process	Run to Fail		2044	$ 3,470.00	$ 7,000.00
29	100-101-FI-04	Arsenic removal vessel B1	Chemical treatment and booste	Process	Run to Fail		2043	$ 3,580.00	$ 7,000.00
30	100-101-FI-05	Arsenic removal vessel B2	Chemical treatment and booste	Process	Run to Fail		2038	$ 4,230.00	$ 7,000.00
31	100-101-MT-03	Flow meter for treated water into storage tank	Chemical treatment and booste	Process	Run to Fail		2034	$ 130.00	$ 200.00
32	100-101-MT-04	Treated water out of storage tank into distribution system	Chemical treatment and booste	Process	Run to Fail		2033	$ 690.00	$ 1,000.00
33	100-101-TK-01	Pressure control vessel	Chemical treatment and booste	Process	Rt or PM Schedule		2042	$ 640.00	$ 1,200.00
34	100-101-TK-03	Day tank for orthophosphate	Chemical treatment and booste	Process	Run to Fail		2042	$ 270.00	$ 500.00
35	100-101-TK-02	Day tank for chlorine	Chemical treatment and booste	Process	Run to Fail		2042	$ 270.00	$ 500.00
36	100-101-CF-01	Chemical dosing pump for chlorine	Chemical treatment and booste	Process	Add PdM Schedule		2023	$ 960.00	$ 1,000.00
37	100-101-MT-05	Flow meter control for chemical pumps	Chemical treatment and booste	Process	Run to Fail		2035	$ 650.00	$ 1,000.00
38	100-101-MX-01	Mixer for orthophosphate	Chemical treatment and booste	Process	Run to Fail		2033	$ 690.00	$ 1,000.00
39	100-101-CF-02	Chemical metering pump for orthophosphate	Chemical treatment and booste	Process	Priority R&R		2023	$ 960.00	$ 1,000.00
40	100-101-CO-02	Tank and well alarm controls	Chemical treatment and booste	Process	Rt or PM Schedule		2030	$ 7,660.00	$ 10,000.00
41	100-101-CO-03	Auto dialing controls	Chemical treatment and booste	Process	Opportunisitic R&R		2021	$ 5,000.00	$ 5,000.00
42	100-101-TK-04	Tight tank in front of building	In front of chemical treatment a	Process	Run to Fail		2046	$ 4,670.00	$ 10,000.00
43	100-101-TS-01	Transfer switch for generator	On out side of chemical treatme	Process	Rt or PM Schedule		2041	$ 1,090.00	$ 2,000.00
44	100-101-ES-02	Surge protector for generator	On outside of chemical treatme	Process	Rt or PM Schedule		2046	$ 470.00	$ 1,000.00
45	100-101-CO-04	Power control panel for well pump 5 and 6	Outside wall of chemical treatm	Process	Rt or PM Schedule		2045	$ 4,890.00	$ 10,000.00
46	100-101-DT-02	Disconnect switch for well 5	Outside wall of chemical treatm	Process	Run to Fail		2044	$ 250.00	$ 500.00
47	100-101-TK-05	Storage tank	Front left of chemical treatment	Process	Rt or PM Schedule		2046	$ 23,350.00	$ 50,000.00
48	100-101-DT-06	Disconnect switch for well pump 6	Left hand side of driveway appr	Process	Rt or PM Schedule		2041	$ 270.00	$ 500.00
49	100-101-PP-04	Well pump 6	Left hand side of driveway appr	Process	Critical R&R		2021	$ 6,000.00	$ 6,000.00
50	100-101-PP-05	Well pump 5	Left of chemical treatment and	Process	Add PdM Schedule		2034	$ 4,040.00	$ 6,000.00
51	100-101-TK-06	Propane tank	Left rear of chemical treatment	Process	Rt or PM Schedule		2041	$ -	$ -
52	100-101-BB-01	Chemical treatment and booster pump building	Chemical treatment and booste	Process	Rt or PM Schedule		2053	$ 18,870.00	$ 50,000.00
53	100-102-DH-01	Dehumidifier	Franklin pierce	Process	Run to Fail		2035	$ 130.00	$ 200.00
54	100-102-CO-02	Submersible pump controls well 4	Franklin pierce	Electrical	Priority R&R		2021	$ 10,000.00	$ 10,000.00
55	100-102-CO-03	Submersible pump controls well 7	Franklin pierce	Electrical	Priority R&R		2021	$ 10,000.00	$ 10,000.00
56	100-102-CO-04	Submersible pump controls	Franklin pierce	Electrical	Run to Fail		2035	$ 6,530.00	$ 10,000.00
57	100-102-MT-01	Raw water meter from well 8	Franklin pierce	Process	Run to Fail		2034	$ 340.00	$ 500.00
58	100-102-MT-02	Raw water meter from well 4	Franklin pierce	Process	Rt or PM Schedule		2036	$ 320.00	$ 500.00
59	100-102-MT-03	Raw water meter from well 7	Franklin pierce	Process	Rt or PM Schedule		2036	$ 320.00	$ 500.00
60	100-102-TK-01	Storage tank	Franklin pierce	Process	Priority R&R		2026	$ 24,040.00	$ 28,000.00
61	100-102-MO-01	Motor for booster pump 2	Franklin pierce	Electrical	Rt or PM Schedule		2032	$ 360.00	$ 500.00
62	100-102-MO-02	Motor for booster pump 1	Franklin pierce	Electrical	Rt or PM Schedule		2037	$ 310.00	$ 500.00
63	100-102-PP-01	Booster pump 2	Franklin pierce	Process	Run to Fail		2035	$ 1,520.00	$ 2,300.00
64	100-102-PP-02	Booster pump 1	Franklin pierce	Process	Run to Fail		2043	$ 1,190.00	$ 2,300.00
65	100-102-MT-04	Flow meter to distribution system	Franklin pierce	Process	Rt or PM Schedule		2034	$ 670.00	$ 1,000.00
66	100-102-TK-02	Hydro pneumatic pressure tank	Franklin pierce	Process	Add PdM Schedule		2034	$ 1,340.00	$ 2,000.00
67	100-102-AC-01	Air compressor for hydro pneumatic pressure tank	Booster pump building	Process	Rt or PM Schedule		2034	$ 800.00	$ 1,200.00
68	100-102-HV-01	Heater	Franklin pierce	Process	Add PdM Schedule		2021	$ 500.00	$ 500.00
69	100-102-TM-02	Pressure transmitter booster pump 1	Franklin pierce	Process	Add PdM Schedule		2021	$ 500.00	$ 500.00
70	100-102-TM-01	Pressure transmitter booster pump 2	Franklin pierce	Process	Priority R&R		2021	$ 500.00	$ 500.00
71	100-102-SI-01	Pump control switch for compressor	Franklin pierce	Process	Priority R&R		2021	$ 2,000.00	$ 2,000.00
72	100-102-CO-01	This is main control for all the pumps	Franklin pierce	Process	Priority R&R		2021	$ 10,000.00	$ 10,000.00
73	100-102-LP-01	Main lighting panel	Franklin pierce	Process	Rt or PM Schedule		2034	$ 3,340.00	$ 5,000.00
74	100-102-BB-01	Booster pump building	Franklin pierce	Process	Rt or PM Schedule		2055	$ 17,750.00	$ 50,000.00
75	100-102-PP-07	Submersible pump and well 7	Franklin pierce	Process	Rt or PM Schedule		2038	$ 3,570.00	$ 6,000.00
76	100-102-PP-08	Submersible pump and well 8	Franklin pierce	Process	Rt or PM Schedule		2040	$ 3,360.00	$ 6,000.00
77	100-102-PP-04	Submersible pump and well 4	Franklin pierce	Process	Rt or PM Schedule		2035	$ 3,920.00	$ 6,000.00
78	100-102-LE-01	Storage tank level indicator	Franklin pierce	Process	Run to Fail		2030	$ 380.00	$ 500.00
79	0	0	0	0					$ -
80	0	0	0	0					$ -
81	0	0	0	0					$ -
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184	0	0	0	0					$ -

APPENDIX D
Horizontal Asset Evaluation Outputs

Water Distribution System Business Risk Exposure Matrix
2020

BRE Object ID	Street Name	Asset Life	Asset Life Consumed 2		Asset Life Consumed	Material	Static Pressure	Break History	Probability of Failure	Number of Customers	Diameter	Criticality	Consequence of Failure	Business Risk Exposure
					0.1	0.1	0.1	0.7	1-10	0.4	0.1	0.5	1-10	LoF*CoF
WL0000	Concord Dr	100	0.53		5	2	7.0	9.0	7.7	10.0	1	10	9.1	70.1
WL0001	Deer Meadow Rd	100	0.53		5	2	7.0	9.0	7.7	5.0	1	10	7.1	54.7
WL0002	Merrimack Cir	100	0.53		5	2	7.0	1.0	2.1	1.0	3	1	1.2	2.5
WL0003	Penacook Cir	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0004	Windsor Terrace	100	0.53		5	2	7.0	3.0	3.5	1.0	1	1	1.0	3.5
WL0005	Deer Meadow Rd	100	0.53		5	2	7.0	1.0	2.1	1.0	3	10	5.7	12.0
WL0006	-	100	0.53		5	2	7.0	1.0	2.1	1.0	3	10	5.7	12.0
WL0007	-	100	0.53		5	2	7.0	3.0	3.5	1.0	1	10	5.5	19.3
WL0008	Newport Cir	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0009	Newport Cir	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0010	Mount Vernon Ter	100	0.53		5	2	7.0	9.0	7.7	1.0	1	1	1.0	7.7
WL0011	Brookfield Cir	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0012	Centennial Dr	100	0.53		5	2	7.0	1.0	2.1	1.0	3	10	5.7	12.0
WL0013	Centennial Dr	100	0.53		5	2	7.0	5.0	4.9	10.0	1	10	9.1	44.6
WL0014	Rumford Dr	100	0.53		5	2	7.0	3.0	3.5	1.0	1	1	1.0	3.5
WL0021	Deer Meadow Rd	100	0.53		5	2	7.0	9.0	7.7	1.0	1	10	5.5	42.4
WL0022	Christopher Robert Dr	100	0.53		5	2	7.0	1.0	2.1	1.0	5	1	1.4	2.9
WL0023	Corn Hill Rd	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0028	New Hampshire Dr	100	0.53		5	2	7.0	5.0	4.9	10.0	1	10	9.1	44.6
WL0029	-	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0030	Franklin Pierce Dr	100	0.53		5	2	7.0	3.0	3.5	1.0	1	10	5.5	19.3
WL0031	Manchester Dr	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0032	Manchester Dr	100	0.53		5	2	7.0	1.0	2.1	1.0	5	1	1.4	2.9
WL0033	New London Dr	100	0.53		5	2	7.0	1.0	2.1	1.0	5	1	1.4	2.9
WL0034	New London Dr	100	0.53		5	2	7.0	9.0	7.7	1.0	1	1	1.0	7.7
WL0036	-	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0038	-	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0040	Webster Ln	100	0.53		5	2	7.0	3.0	3.5	1.0	1	1	1.0	3.5
WL0041	Granite Way	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0042	-	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0044	Christopher Robert Dr	100	0.53		5	2	7.0	1.0	2.1	1.0	1	1	1.0	2.1
WL0045	-	100	0.53		5	2	7.0	1.0	2.1	1.0	5	1	1.4	2.9
WL0046	Deer Meadow Rd	100	0.53		5	2	7.0	1.0	2.1	1.0	1	10	5.5	11.6
WL0047	Deer Meadow Rd	100	0.53		5	2	7.0	1.0	2.1	1.0	1	10	5.5	11.6
WL0048	Deer Meadow Rd	100	0.53		5	2	7.0	5.0	4.9	1.0	1	10	5.5	27.0
WL0049	Deer Meadow Rd	100	0.53		5	2	7.0	3.0	3.5	1.0	1	10	5.5	19.3
WL0050	Deer Meadow Rd	100	0.01		1	2	7.0	5.0	4.5	1.0	1	10	5.5	24.8

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