MERRIMACK VILLAGE DISTRICT

ASSET MANAGEMENT PLAN

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Executive Summary

Merrimack Village District (MVD) has made significant investments to build and expand its water infrastructure. Future replacement of these assets as they age requires long term capital planning. This Asset Management Plan was developed in parallel with the 2014 Master Plan Update for MVD.

Goal of Asset Management

Asset Management is a way of doing business intended to ensure the long-term sustainability of the water system. The goal of AM is to maintain a desired level of service for what you want your assets to provide at the lowest life cycle cost (EPA, 2008).

AM is a way of doing business to provide the required level of service in the most cost effective way.

The framework of this AM plan is the five core steps of Asset Management (EPA, 2008).

- **Asset Inventory -** What does the system own and what is its condition?
- **Level of Service -** What level is needed and how does the system actually perform?
- **Critical Assets -** What are the most important risks to manage?
- **Life Cycle Costing -** What will it cost and when?
- **Long-Term Funding Strategy -** How does the system pay the costs?

Asset Inventory

Asset inventory spreadsheets for the major facilities were developed using a top-down approach to be comprehensive but manageable (Appendix B). Building off the 2012 Distribution CIP Report, water distribution mapping was updated based on recent GIS information from MVD including estimated year of installation (Table ES-1).

Table ES-1. Water Main Length by Age

Decade	Length (Feet)	Percent	Primary Material
1950’s	31,327	3.6%	AC
1960’s	88,178	10.1%	AC
1970’s	259,378	29.6%	AC / DI
1980’s	245,790	28.0%	DI
1990’s	87,253	9.9%	PVC
2000’s	125,962	14.4%	DI / PVC
2010’s	27,829	3.2%	DI
Unknown	11,241	1.3%	-
Total	**876,958**	**-**	**-**

Level of Service

The Level of Service (LOS) Statement defines the way in which the utility managers and operators want the system to perform to over the long term (NMEFC, 2006). The suggested LOS for MVD was expanded from MVD's Mission Statement and Supply Capacity Criteria (Table ES-2)

MVD Mission Statement

"The Merrimack Village District will develop, operate and maintain our water system in a cost effective manner".

MVD Supply Capacity Criteria (Adopted October 2010)

- Meet all current and future Summer Average Day Demands and as much of the Maximum Day Demands as economically practicable using only groundwater sources controlled by MVD
- Meet Maximum Day Demands with all sources on 24 hrs/day
- Meet Summer Average Day Demands with all sources on 24 hrs/day and largest well off (i.e. out of service)

Table ES-2. Level of Service Statement

Area of Service	Service Performance	Target Performance Level
Quality	Maintain clean and safe drinking water in compliance with State and Federal Regulations	100% of time
	Maintain aesthetically high quality water within Secondary Standards as much as possible	When feasible
Availability	Make water available to as many residents in Merrimack as economically feasible	Where feasible
Supply Capacity /Conservation	Minimize complete watering bans Allow outside watering on odd/even days to balance conservation with demands Provide adequate and uninterrupted supply per supply capacity criteria	Except for extreme shortages
Distribution	The minimum working pressure in the distribution system should be 35 psi and the normal working pressure preferably 60 to 80 psi. Max pressure 100 psi. Min pressure 20 psi during fire flows.	95% of time
Reliability	Maximum duration of 24 hours for any disruption in supply Notification of 48 hours prior to planned shutdowns Respond to supply or quality issues affecting a significant level of customers within 1 to 2 hours Repair unplanned shutdowns and breaks within 8 hours where feasible	95% of time
Affordability and Value	Review and adjust rates every 1 - 2 years to fair levels to fund operating and capital needs while minimizing rate shocks	Comparable to systems with similar service

Critical Assets and Priority Projects

The purpose of defining critical assets is to determine where limited resources should be allocated to meet the required LOS.

Risk = Probability of Failure X Consequence of Failure

Table ES-3. Critical Assets

Asset	Importance	Concerns	Action
Well #2	Largest well, best water quality	Recent pump motor failure	Motor replaced
Well #3	Average and Max day flows	Water quality - Iron/Mn	Consider treatment
Well #7	Max day flows	Water quality - Iron/Mn	Building treatment plant
Well #8	Max day flows	Water quality - Iron/Mn	Building treatment plant
Lime stations	Need for water quality	Equipment and structures nearing end of life	Evaluate replacement
Turkey Hill Booster Station	Supply to High Pressure Zone	Pumps are Confined space structure	Evaluate replacement
Turkey Hill Tank	Only storage for Main Pressure Zone	Minor roof repairs, mixing	Roof to be repaired; evaluate mixing

MVD's existing distribution system is generally in good condition with no significant break history or hydraulic issues. Therefore critical water mains were identified as those with the highest impact of failure based on the following criteria (see map in Appendix A):

- Major transmission mains
- Service to critical customers
- Importance of street/bridge
- Lack of pipe loops/redundancy.

Life Cycle Costing

The life cycle costing step evaluates long term capital needs for major refurbishment and replacement of assets. Life cycle costing is a defensible tool to help support necessary funding levels for sustainability.

Planning level replacement costs and schedules for MVD's assets were determined from their estimated life expectancy (Table ES-4, Figure ES-1).

Table ES-4. Long Term Water System Replacement Costs (2014 dollars)

	0 to 50 Years Out	50 to 100 Years Out
Supply	$9,410,000	$6,900,000
Pumping Stations	$1,850,000	$500,000
Storage	$1,400,000	$6,500,000
Other	$1,300,000	$1,400,000
Distribution	$70,050,000	$74,952,000
Total	**$84,010,000**	**$90,252,000**
Average cost per year	**$1,680,000**	**$1,805,000**

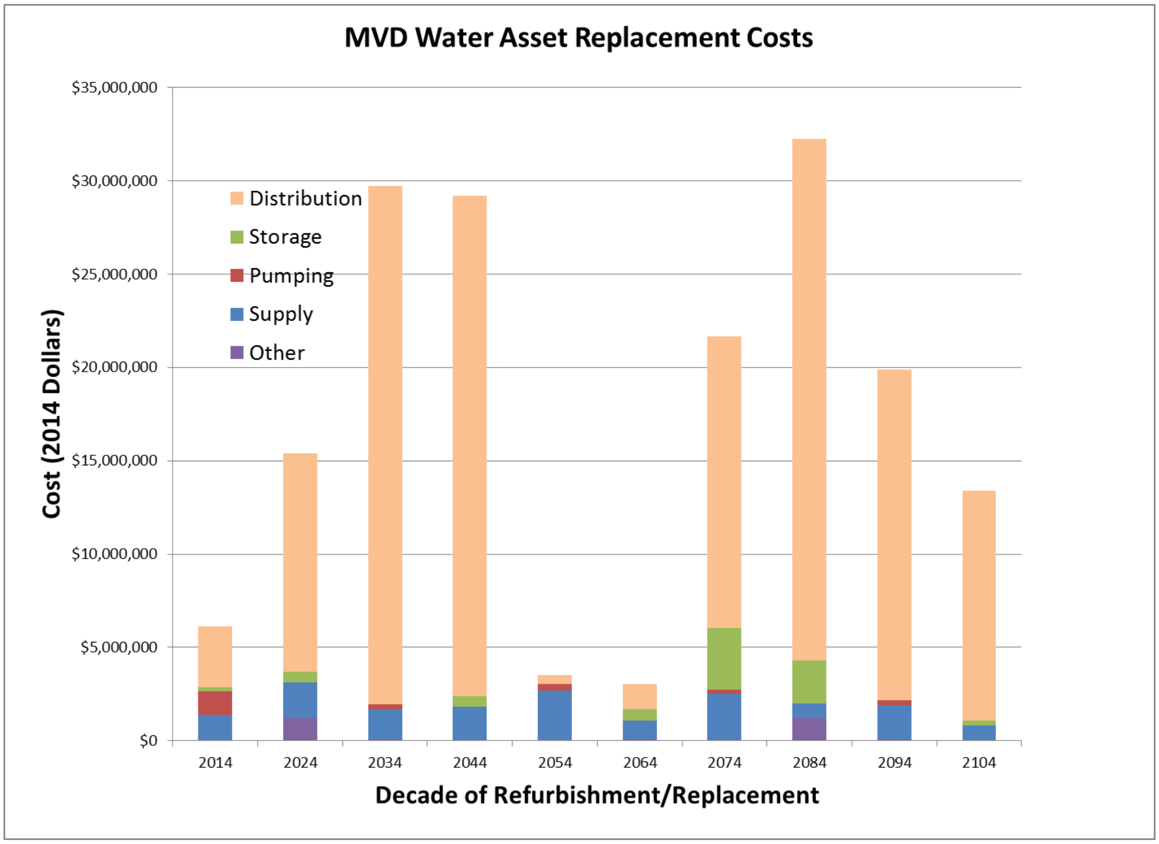


Figure ES-1. Asset Replacement Costs

Long Term Funding Plan

Long term planning is required because the funding needs are unmanageable if deferred until the future. Level funding is recommended to spread out the high cost of future projected replacements, particularly in the 2040's.

Capital reserve requirements are estimated at 50% of the total costs to limit the impact on current users, assuming the balance of costs will be funded by future debt or possibly grants. Costs should be further offset by future life cycle optimization and business case evaluations. The suggested initial range to set aside for capital reserves is 50% to 100% of the capital reserve requirement or **$420,000 to $840,000** (Table ES-6).

Table ES-6. Long Term Funding for Asset Replacements (next 50 years)

Funding Options	Cost
Total Annual Funding Requirement for future Replacement	$1,680,000
Assume 50% funding from Capital Reserves, Annual Requirement	$840,000
Initial Capital Reserves funding range (50% to 100%)	**$420,000 to $840,000**
Current operating budget (FY 2015)	$2,930,000
Surplus required to contribute additional capital reserves, %	**14% to 28%**

This contribution is in addition to the $200,000/year in the current operating budget for Capital Reserves. The current reserve funding is assumed to be for enhancement and growth projects that are in the CIP but not in the asset management plan.

Current surpluses allow the option of increasing contributions by up to $350,000 (total = $550,000) to fund future asset renewals, based on the Rate Study Update (April 4, 2014). This assumes the recommended rate increase is implemented to support debt service for the Iron/Manganese treatment plant.

Assets identified in the first 10 year renewal period of this AM Plan are also included in the 10 year CIP included in the 2014 Master Plan Update. These projects should be further evaluated to refine costs and alternatives and support rational decisions.

The required Capital Reserves depends on the level of future Risk

Recommendations

AM Plan Implementation

- Continue to collect asset data and update inventory/condition assessment as assets are replaced or refurbished.
- Record service, replacement, and failure history for assets to refine estimated useful life.
- Assign a staff member to maintain the asset inventory and data sheets.
- Update GIS and distribution mapping as necessary.
- Review and adopt the Level of Service (LOS).
- Monitor performance data, complaints etc. to track LOS provided.
- Update critical assets as they are replaced or refurbished.
- Update lifecycle costs as budgets are refined.
- Submit plan to DES for Asset Management Grant Reimbursement.

CIP

- Evaluate cost effective alternatives for proposed projects.
- Refine the scope, cost, and schedule for projects.
- Update CIP funding needs in future rate evaluations.
- Implement recommended capital improvements.

Long Term Funding and Financial Planning

- Increase annual capital reserve contributions by **$420,000 to $840,000** to support long term asset renewals.
- The required capital reserve depends on the level of future risk that is accepted.

Communication and Training

- Develop an Asset Management Charter for staff (see example in Appendix E).
- Conduct team meetings on strategic goals, record keeping, and asset management decisions.
- Allow asset information to be accessible and shared by staff.
- Establish a Communication Program for customers, demonstrating the value of service and justifying funding needs to sustain assets. Program elements may include:
    - AM brochure mailings
    - AM content on MVD website
    - Public information meetings for major projects
    - Customer surveys

1. Introduction

Safe and reliable drinking water is critical to the public health, economic prosperity, and quality of life in our communities. Significant investments have been made to build and expand water infrastructure, but these systems are aging. Many of these investments are not being sustained with long-term capital planning for replacement. There is growing recognition that utilities will be faced with excessive costs to maintain service. Public drinking water systems in New Hampshire have a total funding need of $1,713M for just the next 20 years according to a recent study (Wright-Pierce, 2011).

Asset Management (AM) is an approach to mitigating the infrastructure challenge and making informed decisions. This Asset Management Plan was developed in parallel with the 2014 Master Plan Update to cost effectively maintain their aging infrastructure.

1.1. What is Asset Management?

Asset Management is a way of doing business intended to ensure the long-term sustainability of the water system. The goal of AM is to maintain a desired level of service for what you want your assets to provide at the lowest life cycle cost (EPA, 2008).

Successful Asset Management planning brings together the key elements to managing a water system sustainably:

- Stakeholders - from staff to customers
- Budgeting and Funding
- Sustainable Practices
- Information and data control

AM is a way of doing business to provide the required level of service in the most cost effective way.

1.2. Benefits

Benefits that MVD intends to achieve by implementing an AM Plan include:

- Improving system knowledge and data.
- Meeting service expectations and regulatory requirements.
- More efficient allocation of capital funds to critical assets
- Prolonging asset life and aiding in rehabilitate /repair/replacement decisions through efficient and focused maintenance and replacements.
- Establishing defendable budgets for sustainability.

1.3. Core Components

The framework of this AM plan is the five core steps of Asset Management (EPA, 2008).

- **Asset Inventory -** What does the system own and what is its condition?
- **Level of Service -** What level is needed and how does the system actually perform?
- **Critical Assets -** What are the most important risks to manage?
- **Life Cycle Costing -** What will it cost and when?
- **Long-Term Funding Strategy -** How does the system pay the costs?

The development of the plan is followed by Implementation, an ongoing process of action, evaluation, and revision (Figure 1-1).

Figure 1-1. Flow Chart for the Core Steps of Asset Management

1.4. Goals

This Asset Management Plan is intended to establish an initial AM Program for the Merrimack Village District to make more informed decisions for sustainable operation. Goals for the AM Plan as outlined in the scope of work include:

- Update the inventory of major water system assets.
- Identify criteria for the level of service to be maintained.
- Identify critical assets and priority projects for replacement/rehabilitation.
- Evaluate life cycle costs for major assets.
- Identify long term planning and funding strategies for improvements, in phases, that are in line with the fiscal capacity of MVD.
- Identify a communication plan to inform customers of the asset management plan
- Identify a training plan for MVD staff

Keys to Successful AM

Keep it simple
Form a living document
Bring everyone on board

1.5. Related Asset Management Work

This Asset Management plan complements and builds on other previously completed or ongoing work including:

- Distribution System Hydraulics Evaluation (UE, 2007)
- Water Supply Evaluation Update (UE, 2010)
- Distribution System CIP Planning (UE, Nov 2012)
- Rate Study Update (UE, April 2014)
- Master Plan Update (UE, 2014)

The Distribution System CIP Planning completed in November 2012 was a macro look at the long term replacement needs for distribution piping. Key findings and recommendations of the study were:

- Estimated total water main is approximately 893,000 ± LF
- 41% or 368,000 LF is AC pipe that will reach end of life (70 years) in 2020 to 2050.
- Total replacement cost is approximately $150 million (2012 dollars).
- Reserve $700,000/year for the first phase of future water main replacement (2020 – 2060)

2. Asset Inventory

The Asset Inventory and Assessment is the first step of AM. The inventory collects and organizes data in a useful way to make better management decisions. Information should include:

- List of assets
- Location
- Condition
- Age
- Remaining useful life
- Service history
- Replacement cost
- Noteworthy issues

MVD is improving the storage of system data. A GIS database has been developed using the Town's base mapping and includes water mains, hydrants, valves, services, etc. As-built information is very limited for most existing water mains, but record drawings are available for projects built since about 2010. The initial inventory and assessment for MVD was developed from sources including:

- GIS Data provided by MVD including water main size, length and location
- Service history information from MVD
- Site visits and discussions with MVD Staff
- Previous engineering reports by UE and others
- Tank inspection reports
- NHDES Sanitary Survey Reports
- Record drawings

2.1. Utility Overview

The Merrimack Village District provides water to most of the Town of Merrimack, NH through approximately 6,553 metered service connections (UE Rate Study Update, 2014). The water sources for MVD are in three different groundwater aquifers. There are six active and one inactive sand and gravel pack wells located in the Towns of Merrimack and Hollis. The water is treated at each well site with chlorine for disinfection, a corrosion control chemical, and lime prior to pumping into the main pressure zone (MPZ) of the distribution system. A booster pumping station supplies the high pressure zone (HPZ). Water is stored in two active storage tanks, and a third tank is currently off line.

2.2. Supply and Treatment

MVD's existing sources of supply are summarized in Table 2-1 based on the Water Supply Evaluation Update (UE, 2010) and Master Plan Update (UE, 2014).

Table 2-1. Supply Wells Summary

Well	Notes	Capacity (gpm)
Well 2	*Active* – Approved by NHDES for 1,500 gpm.	1,100
Well 3	*Active* – Has had Fe & Mn issues in the past.	800
Wells 4 & 5	*Both Active* – Wells are pumped through a common station for treatment at Well 5. Total aquifer capacity is 625 gpm.	625
Well 6	*Inactive* – Original capacity was 1,400 gpm. Not used due to VOC contamination.	0
Well 7	*Active* – Fe and Mn issues; used only when necessary. Limited to 470 gpm by existing motor.	500
Well 8	*Active* - Treated commonly at Well #7 station. Currently not used due to Fe and Mn issues.	750
Total Capacity		**3,775 (5.44 MGD)**

Lime treatment stations are installed at Well 2, Well 3, Well 5, Well 6 (inactive), and Well 7 (integral with well house). MVD is currently constructing an iron and manganese treatment facility that will treat both Wells 7 and 8. It is anticipated to be substantially complete early 2016.

2.3. Water Storage

MVD owns, operates, and maintains three water storage tanks (Table 2-2). Currently, only the Hutchinson and Turkey Hill Tanks are in use, providing one tank for each pressure zone.

Table 2-2. Water Storage Facility Summary

Tank	Pressure Zone	Capacity (Mgal)	HGL (overflow, ft. MSL)	Type	Year Built	Diameter	Height
Turkey Hill Tank	MPZ	4.0	391’	Pre-stressed Concrete	1978	150’	32’
Hutchinson Tank	HPZ	1.0	538’	Welded Steel	1987	58’	53.6’
Lake Road Tank	HPZ	0.75	538’	Fluted Steel Elevated	1988	64’	53’

MVD is interested in optimizing the frequency of tank inspection and cleanings to reduce costs. If sediment is builds up greater than 6 inches in depth, an additional day of cleaning at $4,000/day is required.

2.4. Booster Pumping Stations

The Turkey Hill booster pumping station is located at the base of the access road to the Turkey Hill Storage Tank. The Turkey Hill pumping station is critical to supply water to the high pressure zone since no supplies are connected to the HPZ. The Belmont booster pumping station located on Belmont Ave serves a small number of houses on a closed system. Booster station data is summarized in Table 2-3.

Table 2-3. Booster Pumping Station Summary

	Turkey Hill Station	Belmont Station
Installation Date	1988	2000
Capacity, gpm	1,400	80
Description	2 vertical double suction pumps. Factory built system in steel can, below grade. Allis Chalmer Pumps.	2 end suction skid Flowtronix factory built skid with pump. Inside wood frame shed at grade. pumps
Flow Meter	12" Magmeter	1.5" Turbine

2.5. Distribution System

Merrimack Village District (MVD) owns and operates approximately 877,000 LF (166 miles) of water main of various materials, age, and sizes. Recent improvements have focused on reducing the hydraulic "bottleneck" between the supply sources in the south and the demand areas in the north. Projects constructed in 2010-2012 include approximately 17,000 LF of 16" ductile iron water main on Continental Boulevard, Camp Sargent Road, and Turkey Hill Road and approximately 7,700 LF of 16" ductile iron water main at the Merrimack Premium Outlets to create a loop (Distribution CIP Report, UE 2012).

At the time of the 2012 Report, the GIS database did not include projects after 2008 but UE manually added these to the inventory. The GIS database has been recently updated to include projects completed 2010 to 2012. In addition, age information was added for each pipe. Estimated dates of installation were assigned by MVD based on the dates cast on hydrants and other system records and knowledge.

Tables 2-4, 2-5, and 2-6 below summarize the distribution system GIS data by material, size, and age. Distribution maps show pipe locations by material, size, and age (Appendix A). Although material and age may not correlate with failure, this information may help to locate older more critical pipes in the future as pipe break data is documented.

Table 2-4. Water Mains Summarized by Material

Material	Length (Feet)	Percent of System	Installation Period Approximate
AC	368,061	42.0%	1950’s to 1970’s
CI	2,685	0.3%	1970’s
DI	307,495	35.1%	1980’s to present
PVC	117,412	13.4%	1990’s
Unknown	81,057	9.2%	-
Total	**876,959**	**100%**	**-**

Table 2-5. Water Mains Summarized by Size

Size	Length (Feet)	Percent of System
2"	22,601	2.6%
4"	5,608	0.6%
6"	122,513	14.0%
8"	397,966	45.4%
10"	17,709	2.0%
12"	235,873	26.9%
16"	51,535	5.8%
20"	18,944	2.2%
24"	61	0.0%
Unknown	4,550	0.5%
Total	**876,959**	-

Table 2-6. Water Mains Summarized by Age

Decade	Length (Feet)	Percent	Primary Material
1950’s	31,327	3.6%	AC
1960’s	88,178	10.1%	AC
1970’s	259,378	29.6%	AC / DI
1980’s	245,790	28.0%	DI
1990’s	87,253	9.9%	PVC
2000’s	125,962	14.4%	DI / PVC
2010’s	27,829	3.2%	DI
Unknown	11,241	1.3%	-
Total	**876,959**	**100%**	**-**

2.6. Other Assets

Other major assets included in this AM plan include:

- Administration building “Office”
- Maintenance facility “Warehouse”
- Portable generator

Other minor assets are assumed to be managed under MVD’s current maintenance programs and the annual operating budget. These assets include:

- Vehicles
- SCADA/telemetry systems
- Equipment and tools
- Spare parts and materials

2.7. AM Inventory Worksheets

The assets managed under this plan are summarized in the distribution system mapping (Appendix A) and Asset Inventory worksheets (Appendix B). More detailed information for each major asset is contained in the data sheets completed under the Master Plan.

2.7.1. Organization

The asset inventory for MVD was developed using a top-down approach, starting with the major facilities. These were segregated into processes or equipment items where appropriate to account for differences in properties such as service life:

- Facilities
  - Supply/Treatment: wells, structures, pumps/controls, treatment systems
  - Storage: tanks
  - Pumping Stations: structures, pumps/controls
- Distribution System: mains

The inventory can be expanded in the future with other asset categories and/or further breakdown. Assets need only be included if they are cost effective to actively manage.

2.7.2. Condition

As an asset's condition deteriorates it is more likely to fail or need replacement. Condition scores were assigned based on site visits by UE in 2013-2014 and discussions with operators (Table 2-7). Significant issues are noted in the "Remarks" column of the Inventory Worksheet.

Table 2-7. Condition Scoring of Assets

Rating	Description
1 - Excellent	Like new, in full working order
2 - Good	Fully functional, minor maintenance needed only
3 - Fair	Functional, needs some refurbishment
4 - Poor	Not fully functional, near end of life, needs repair or replacement
5 - Very Poor	Non-functional, beyond end of life, needs repair or replacement

2.7.3. Remaining Useful Life

Remaining useful life for each asset was initially determined by subtracting the Number of Years in Service from the typical range of life assuming routine maintenance (Table 2-8). Then an Adjusted Useful Life was entered based on the operating history, past refurbishment, current condition, etc. The estimated lifetimes should be refined as MVD builds experience and collects data.

Table 2-8. Estimated Useful Lives of Assets

Asset	Years
Wells	40 - 60
Treatment Equipment	15 - 20
Storage Tanks	60 - 100
Pumps	10 - 20
Buildings	40 - 60
Distribution Mains	70 - 100
Meters	10 - 15
Service Lines	30 - 50
Hydrants	40 - 60

References: AWWA (2013), UE experience, manufacturers specs

3. Level of Service

3.1. Introduction

The Level of Service (LOS) Statement defines the way the utility managers and operators want the system to perform to over the long term (NMEFC, 2006). The LOS must include standards for regulatory compliance and may include additional components such as quality, quantity, reliability.

Important functions of the Level of Service include:

- Determining critical assets
- Assessing utility performance
- Linking costs and services
- Communicating the system's operation to customers

3.2. Mission Statement

MVD's general level of service begins with their mission statement (as revised by Board of Commissioners, September 16, 2013):

MVD Mission Statement

"The Merrimack Village District will develop, operate and maintain our water system in a cost effective manner".

3.3. Level of Service Statement

To build the initial LOS Statement, keys areas of service are suggested in Table 3-1. Specific service items should provide criteria for measuring performance. Standards included in the LOS should also be relevant, achievable, and in line with customers' expectations. These standards can grow as Asset Management continues to be implemented.

Table 3-1. Level of Service Statement

Area of Service	Service Performance	Target Performance Level
Quality	Maintain clean and safe drinking water in compliance with State and Federal Regulations	100% of time
	Maintain aesthetically high quality water within Secondary Standards as much as possible	When feasible
Availability	Make water available to as many residents in Merrimack as economically feasible	Where feasible
Supply Capacity /Conservation	Minimize complete watering bans Allow outside watering on odd/even days to balance conservation with demands Provide adequate and uninterrupted supply per supply capacity criteria (see below)	Except for extreme shortages
Distribution	The minimum working pressure in the distribution system should be 35 psi and the normal working pressure preferably 60 to 80 psi. Max pressure 100 psi. Min pressure 20 psi during fire flows.	95% of time
Reliability	Maximum duration of 24 hours for any disruption in supply Notification of 48 hours prior to planned shutdowns Respond to supply or quality issues affecting a significant level of customers within 1 to 2 hours Repair unplanned shutdowns and breaks within 8 hours where feasible	95% of time
Affordability and Value	Review and adjust rates every 1 - 2 years to fair levels to fund operating and capital needs while minimizing rate shocks	Comparable to systems with similar service

MVD Supply Capacity Criteria (Adopted October 2010)

- Meet all current and future Summer Average Day Demands and as much of the Maximum Day Demands as economically practicable using only groundwater sources controlled by MVD
- Meet Maximum Day Demands with all sources on 24 hrs/day
- Meet Summer Average Day Demands with all sources on 24 hrs/day and largest well off (i.e. out of service)

3.4. Level of Service Performance

Currently, MVD appears to provide a high level of service, with minimal reports of customer complaints and water main breaks. Current general performance is summarized in Table 3-2. Collecting and tracking additional data for performance metrics is needed to verify what the utility is providing.

Table 3-2. Level of Service Performance

Area of Performance	Performance Achieved
Water Quality	• In compliance with regulations. • Secondary standards for Fe/Mn sometimes cannot be met during higher summer time demands. • Bi-annual flushing and strategic operation of the best quality wells has improved water quality and reduced complaints. • Constructing Fe/Mn WTP to improve high quality water supply and meet demands year round
Reliability	• MVD has started tracking water main breaks in GIS. • Approx. 6 recorded breaks in past few years.
Water Pressure	• Within guidelines of LOS, based on water model.
Water Supply	• Capacity criteria cannot be met without Well #8, which is not feasible due to poor quality. Treatment Facility is under construction. • PWW connection is available in an emergency. • Irrigation bans last needed in 2010.
Affordability/Value	• Rates last reviewed 2010/2011, currently being updated for 2013/2014. • MVD's rates are below many similar systems in NH (see Rate Update 2014 and MVD website).

4. Critical Assets and Priority Projects

Often there are not financial and physical resources to address all infrastructure needs at the same time. Some assets are very important to system operation while others are not. The purpose of defining critical assets is to determine where limited resources should be allocated to meet the required LOS. MVD recognizes that its critical infrastructure includes the wells, tanks, pumping stations, and transmission mains. The assets among these with the highest criticality or risk should be prioritized for improvements.

4.1. Procedure for Ranking/Criteria

A common approach to determining risk is by the combination of probability of failure and consequence of failure (NMEFC, 2006). These measures are defined in the sections that follow. Risk scoring provides a defensible prioritization for replacement, rehabilitation, or maintenance and is graphically represented in Figure 2. "Risk" is short for "Business Risk Exposure".

Risk = Probability of Failure X Consequence of Failure

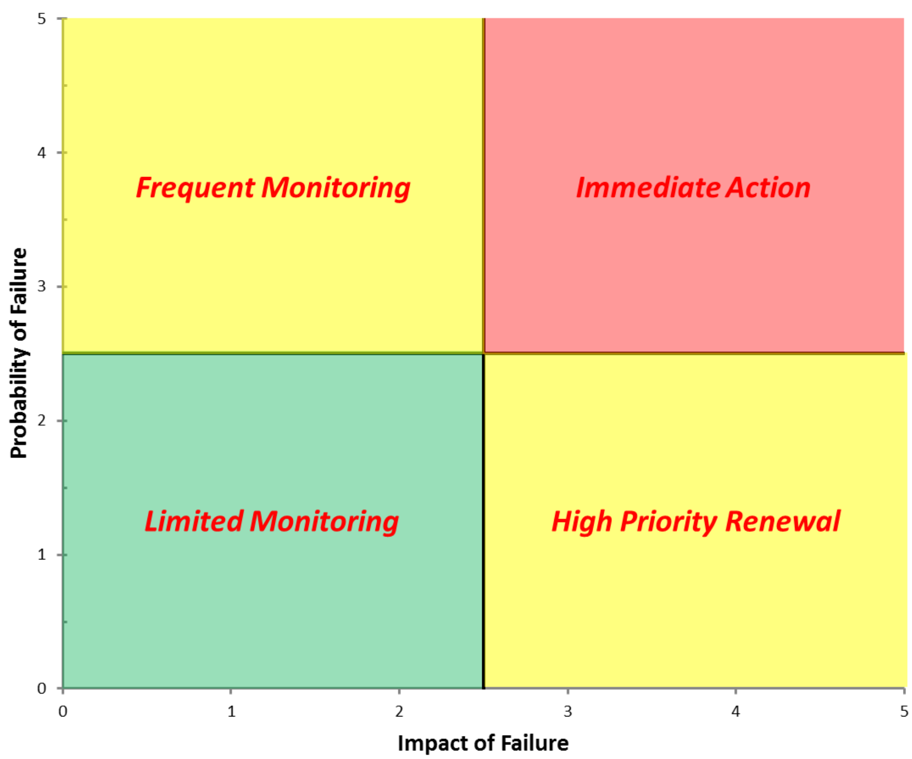


Figure 4-1. General Criticality Matrix

The most critical assets, with the highest risk score, are those that are more likely to fail and have major consequences for failure. Replacing these assets over others may provide the greatest benefit (reduction in risk).

Management of each asset depends on how its risk is rated Figure 2):

- Low probability of failure and low consequence of failure: Only limited monitoring is needed and "run to failure" may be appropriate.
- High probability of failure and low consequence of failure: Capital improvements should be prioritized.
- Low probability of failure and high consequence of failure: More frequent or direct assessment should be done.
- High probability of failure and high consequence of failure: Immediate attention is needed to prevent a catastrophic failure.

4.2. Probability of Failure

The Probability of Failure for each asset was ranked from 1 to 5 with 5 being the highest probability (Table 4-1). Engineering judgment was used to score assets relative to similar assets based on information collected during the Inventory phase, including:

- Ability to provide required Level of Service
- Remaining useful life
- Condition
- Operating history and past failures
- Consideration of how failure could occur.

Table 4-1. Probability of Failure Scoring

Rating	Description
1	**Very low -** Asset is extremely reliable
2	**Low -** Sporadic failures possible
3	**Moderate** - Possibility of failure
4	**High** - Asset sometimes does not meet current LOS
5	**Very High** - Asset is certain to fail or has failed to meet LOS, needs immediate attention

4.3. Failure History

Keeping records of past failures, including frequencies and causes, can provide some indication of the likelihood of future failure. MVD has limited data for past failures but is improving on recordkeeping. Examples of known past failures of significance are summarized in Table 4-2.

Table 4-2. Asset Failure History

Area	Failure	Date
Supply	Well 6 - Contamination with VOC's; well is no longer used.	1988
	Well 2 – Damaged due to operator error during cleaning. New adjacent well was drilled.	1995
	Well 1 – Screen failed, allowing sand to pass, no longer used; capacity regained by increasing Well 2 pumping from same aquifer	2004+-
	Well 2 – Pump VFD failures; replaced with soft start	2005, 2008
	Well 4 - Pump failure, out of service for 9 months for repairs.	Oct 2009-June 2010
	Well 7 – Pump motor starter failure	2012
	Well 2 – Pump motor failure	2014
Storage	Water main break due to contractor error at base of the tank caused loss of storage and impact to wetlands. Tank isolated and system pressure controlled manually until repairs made. Wetlands restoration and road repairs required.	2011
Pumping	Turkey Hill station pumps damaged by sand, due to above break. Expensive repairs required several months.	2010
Distribution	Approximately 6 breaks recorded by MVD since begin tracking in recent years	various

4.4. Consequence of Failure

Each asset was assigned a score for Consequences of Failure from 1 to 5, with 5 being the highest impact (Table 4-3). Consideration was given to how each asset could fail and what would happen if it did. Consequences of failure may include:

- Regulatory noncompliance
- Reduced Level of Service
- Social cost/inconvenience to customer
- Cost of repair
- Collateral damage
- Legal costs
- Environmental costs
- Safety concerns

Table 4-3. Consequence of Failure Scoring

Rating	Description
1	**Very low -** Asset is unimportant or has full redundancy
2	**Low -** Limited loss of service, minor costs
3	**Moderate** – Minor loss of service, low cost
4	**High** - Significant loss of service or cost
5	**Very High** - critical to maintaining service and has no redundancy. Major cost and inconvenience if fails.

4.5. Identification of Critical Assets

The Criticality Assessment and Asset Prioritization Worksheet (Appendix B) summarizes an initial critically ranking for MVD's assets, other than water mains. Results are illustrated in the Critically Matrix chart (Appendix B). A detailed critical analysis was beyond the scope of this current study. Future analysis should be done to update priorities and provide more details.

Assets with the highest priority are summarized in Table 4-4:

Table 4-4. Critical Assets

Asset	Importance	Concerns	Action
Well #2	Largest well, best water quality	Recent pump motor failure	Motor replaced
Well #3	Average and Max day flows	Water quality - Iron/Mn	Consider treatment
Well #7	Max day flows	Water quality - Iron/Mn	Building treatment plant
Well #8	Max day flows	Water quality - Iron/Mn	Building treatment plant
Lime stations	Need for water quality	Equipment and structures nearing end of life	Evaluate replacement
Turkey Hill Booster Station	Supply to High Pressure Zone	Pumps are Confined space structure	Evaluate replacement
Turkey Hill Tank	Only storage for Main Pressure Zone	Coating repairs, mixing	Evaluate coating repairs and mixing

4.6. Critical Water Mains

Critical water mains can be identified by the general criteria in Table 4-5. MVD's existing distribution system is generally in good condition with no significant break history or hydraulic issues. Therefore the most critical water mains were identified as those with the highest impact of failure. These critical mains are shown on the Critical Water Mains and Services Map (Appendix A).

Table 4-5. Critical Pipe Analysis Criteria

Probability of Pipe Failure	Consequences of Pipe Failure
• Pipe material • Pipe age • Hydraulic capacity • Breakage history	• Major transmission mans • Service to critical customers • Importance of street/bridge • Number of customers affected • Lack of pipe loops/redundancy

5. Life Cycle Costing

The life cycle costing step evaluates long term capital needs for major refurbishment and replacement of assets. Life cycle costing is a defensible tool to help support necessary funding levels for sustainability of the system.

5.1. Life Cycle Costs

For the purposes of initial planning, the following assumptions were used to evaluate life cycle costs:

- Costs are conceptual (order of magnitude), including engineering and contingency
- Costs are in today's dollars (2014).
- Assets are replaced per their estimated life expectancy determined in the Inventory and Assessment step.
- Assets are replaced with current best materials/technology.
- Major recurring capital reinvestment costs such as tank maintenance (recoating) or major pump overhauls are included in life cycle costs.
- Minor maintenance and repairs are assumed to be in the annual operating budget and are not included.

Replacement costs for facility assets (other than water mains) were estimated for the next 100 years using Worksheet 4 (Appendix B). Water main replacement costs are based on the Distribution CIP (Appendix D). Total water system replacement costs are summarized in Table 5-1. Beyond 20 years, the projections are more speculative but they allow planning for very long lived assets. The estimated replacement costs per decade for these assets are shown in Figure 5-1. Most of the costs are associated with distribution mains.

Table 5-1. Long Term Water System Replacement Costs (2014 dollars)

	0 to 50 Years Out	50 to 100 Years Out
Supply	$9,410,000	$6,900,000
Pumping Stations	$1,850,000	$500,000
Storage	$1,400,000	$6,500,000
Other	$1,300,000	$1,400,000
Distribution	$70,050,000	$74,952,000
Total	**$84,010,000**	**$90,252,000**
Average cost per year	**$1,680,000**	**$1,805,000**

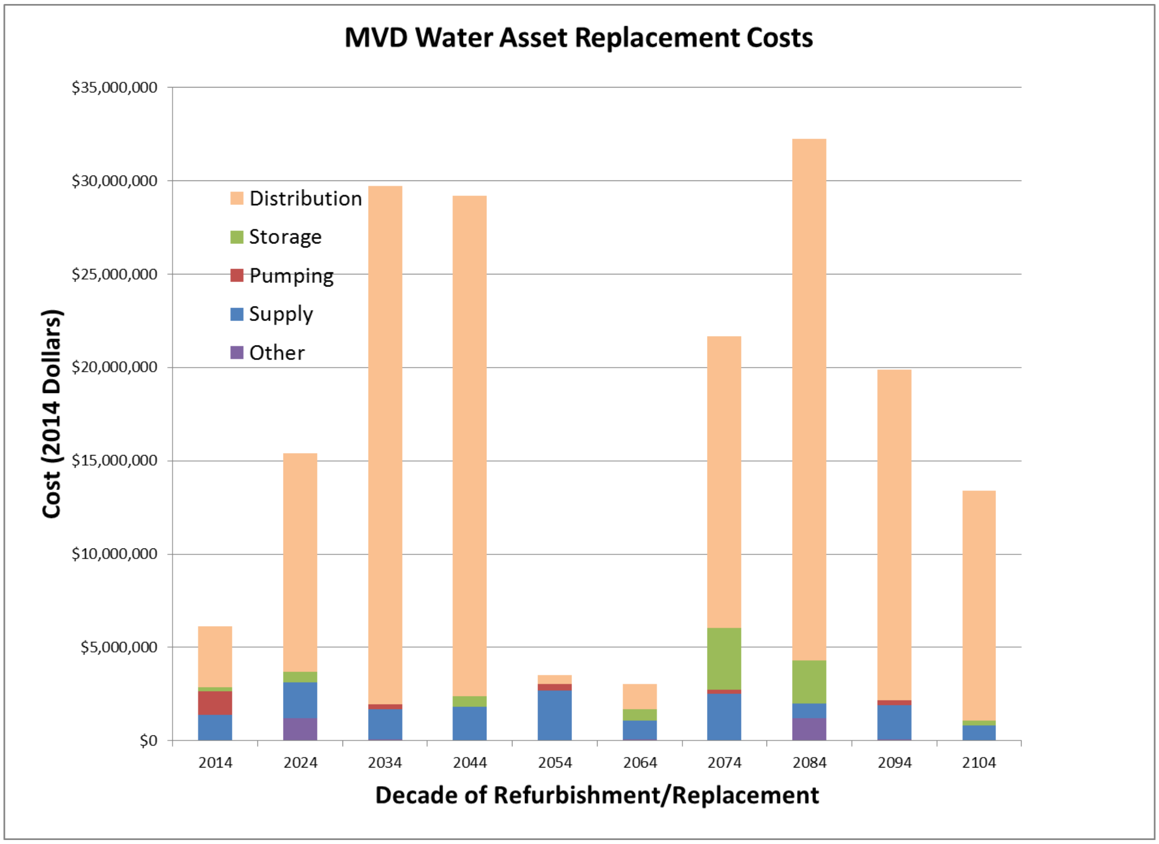


Figure 5-1. Water Asset Replacement Costs

5.2. Life Cycle Planning

There are four basic options for dealing with assets over time (NMEFC, 2006). Asset Management is intended to optimize spending between these options while meeting the required level of service:

- Repair the assets as they fail
- Operate and maintain the existing assets
- Rehabilitate the assets
- Replace the assets

Provided the level of service is met, it is generally appropriate to replace certain assets when the cost of ownership exceeds the cost of replacement. Annual costs of ownership include risk costs, repairs, and maintenance. Risk costs are the cost impacts of a failure and associated emergency repairs. The Criticality step helps to prioritize projects by risk, but the costs of renewal must also be considered for a complete benefit/cost analysis.

An asset should be renewed when its cost of ownership exceeds the cost of replacement

The primary tool for life-cycle planning of major assets is the Business Case Evaluation (BCE). It is a defendable way to determine if a project is needed and how best to address it (Brown and Caldwell, 2004). The BCE supports rational decisions to select the lowest lifecycle cost alternative and minimize risk, thus providing the greatest value to the customer.

The Business Case Evaluation is recommended for major assets that do not meet the current LOS or are nearing the end of useful life. The basic BCE Steps are

- Define the problem and drivers.
- Identify and screen alternatives, including "no action".
- Develop life cycle costs including capital, operational, and maintenance costs, for each alternative.
- Define risk costs (financial, environmental, and social = "triple bottom line").
- Recommend the alternative with the lowest net present value that meets the LOS.

MVD recently applied the BCE process to address the need for additional supply. The Water Supply Evaluation Update report (UE, 2010) helped MVD to select the alternative with the best value to renew supply infrastructure.

Benefit/Cost analysis using the BCE process should be applied to MVD's major assets as they approach the end of useful life. Further study is recommended in the near term for the following assets (Table 5-2):

5.3. Optimizing Pipe Renewals

The previous Distribution CIP Study identified pipe life cycle costs for budget planning but does not say with certainty when and where water mains should be replaced. Unknown factors and insufficient information make accurate predictions for work that is far in the future impossible. Future tactical modeling is required to optimize the replacement year for each pipe segment.

An approach used in models such as the AWWA BNL Modeling Tool is to define the service life based on the tolerance for risk. The risk of failure or break rate for pipe generally increases with age. Pipes identified as more critical or higher risk have a shorter service life and are cost effective to replace sooner. Conversely, pipes with low consequences of failure allow a higher break rate to be tolerated and a longer time to replacement. As more data is collected in the future, defensible criteria for replacement can be developed to prioritize and optimize pipe renewals.

Table 5-2. Asset Renewals/Enhancements Requiring Further Analysis

Asset	Problem	Questions/Alternatives
Well Level, Conductivity Monitoring and SCADA improvements	No installed level monitoring systems to observe long term performance	• What are costs and modifications needed to install monitoring? • Scope of SCADA improvements?
Well #3 Treatment	High iron and manganese levels impact water quality	• Feasibility of constructing treatment for Well #3?
Lime Treatment Stations (Wells #2, #3, #4/5)	Stations are obsolete and nearing end of life	• Should stations be refurbished or replaced? • Alternative treatment processes?
Turkey Hill Booster Station	Pumps are no longer made and expensive to refurbish; below grade; confined access	• What are alternative locations?
Storage Tank Mixing Systems	No mixing systems currently exist	• Which tanks need mixing? • Which mixer system? • Can the work be done more cost effectively with other tank refurbishment?
Future Water Main Replacements	Which mains should be prioritized for replacement?	• Break rate and tolerance for risk of failure. • Coordination with Town road or sewer improvements • System deficiencies and/or hydraulic constraints, if any • Future development and expansion

6. Funding Plan

The long term funding step evaluates how to best meet the costs of repair, rehabilitation, and replacement of assets. Long term planning is required because the funding needs may have too high an impact if deferred until the future.

MVD's potential sources of funding include:

- Revenues
  - Water rates
  - System development charges (SDC)
- Capital reserve funds
  - Set aside by budget or surpluses
  - Current funding is $200,000/year by budget
- Debt
- Grants

6.1. Long Term Funding Strategy

Level funding is recommended to spread out the high cost of future projected replacements, particularly in the 2040's. A feasible funding level was developed as follows.

Capital reserve requirements are estimated at 50% of the total costs to limit the impact on current users, assuming the balance of costs will be funded by future debt or possibly grants. Future costs should be further offset by future life cycle optimization and business case evaluations. The suggested initial range to set aside for capital reserves is 50% to 100% of the capital reserve requirement or **$420,000 to $840,000** (Table 6-1).

Table 6-1. Long Term Funding for Asset Replacements (next 50 years)

Funding Options	Cost
Total Annual Funding Requirement for future Replacement (Table 16)	$1,680,000
Assume 50% funding from Capital Reserves, Annual Requirement	$840,000
Initial Capital Reserves funding range (50% to 100%)	**$420,000 to $840,000**
Current operating budget (FY 2015)	$2,930,000
Surplus required to contribute additional capital reserves, %	**14% to 28%**

This contribution is in addition to the $200,000/year in the current operating budget for Capital Reserves. The current reserve funding is assumed to be for enhancement and growth projects that are in the CIP but not in the asset management plan.

Current surpluses allow the option of increasing contributions by up to $350,000 (total = $550,000) to fund future asset renewals, based on the Rate Study Update (April 4, 2014). This assumes the recommended rate increase is implemented to support debt service for the Iron/Manganese treatment plant.

Assets identified in the first 10 year renewal period of this AM Plan are also included in the 10 year CIP included in the 2014 Master Plan Update (Worksheet 6, Appendix B). These projects should be further evaluated to refine costs and alternatives and support rational decisions.

Higher levels of reserves reduce future risk but place a greater burden on current users through rate impacts. The target amount of capital reserves to set aside depends on the level of future risk that MVD accepts. As the system ages, future evaluations should better quantify risk and adjust the required capital reserves if necessary.

The required Capital Reserves depends on the level of future Risk

7. Recommendations

7.1. AM Plan Implementation

- Continue to collect asset data and update inventory/condition assessment as assets are replaced or refurbished.
- Record service, replacement, and failure history for assets to refine estimated useful life.
- Assign a staff member to maintain the asset inventory and data sheets.
- Update GIS and distribution mapping as necessary.
- Review and adopt the Level of Service (LOS).
- Monitor performance data, complaints etc. to track LOS provided.
- Update critical assets as they are replaced or refurbished.
- Update lifecycle costs as budgets are refined.
- Submit plan to DES for Asset Management Grant Reimbursement.

7.2. CIP

- Evaluate cost effective alternatives for proposed projects.
- Refine the scope, cost, and schedule for projects.
- Update CIP funding needs in future rate evaluations.
- Implement recommended capital improvements.

7.3. Long Term Funding and Financial Planning

- Increase annual capital reserve contributions by **$420,000 to $840,000** to support long term asset renewals.
- The required capital reserve depends on the level of future risk that is accepted.

7.4. Communication and Training

- Develop an Asset Management Charter for staff (see example in Appendix E).
- Conduct team meetings on strategic goals, record keeping, and asset management decisions.
- Allow asset information to be accessible and shared by staff.
- Establish a Communication Program for customers, demonstrating the value of service and justifying funding needs to sustain assets. Program elements may include:
  - AM brochure mailings
  - AM content on MVD website
  - Public information meetings for major projects
  - Customer surveys

8. References

AWWA (2013) *Buried No Longer: Confronting America's Water Infrastructure Challenge*. Available at: http://www.awwa.org/portals/0/files/legreg/documents/buriednolonger.pdf (Accessed March 17, 2014).

AWWA (2014) *Sample Utility Communications Plan.* Available at: http://www.awwa.org/resources-tools/public-affairs/communications-tools/public-communications-toolkit/sample-utility-communications-plan.aspx (Accessed April 2, 2014).

Brown and Caldwell (2009) *Asset Management Program: Tools for Achieving Expected Levels of Service* Available at: http://www.lottcleanwater.org/pdf/summary.pdf (Accessed March 27, 2014).

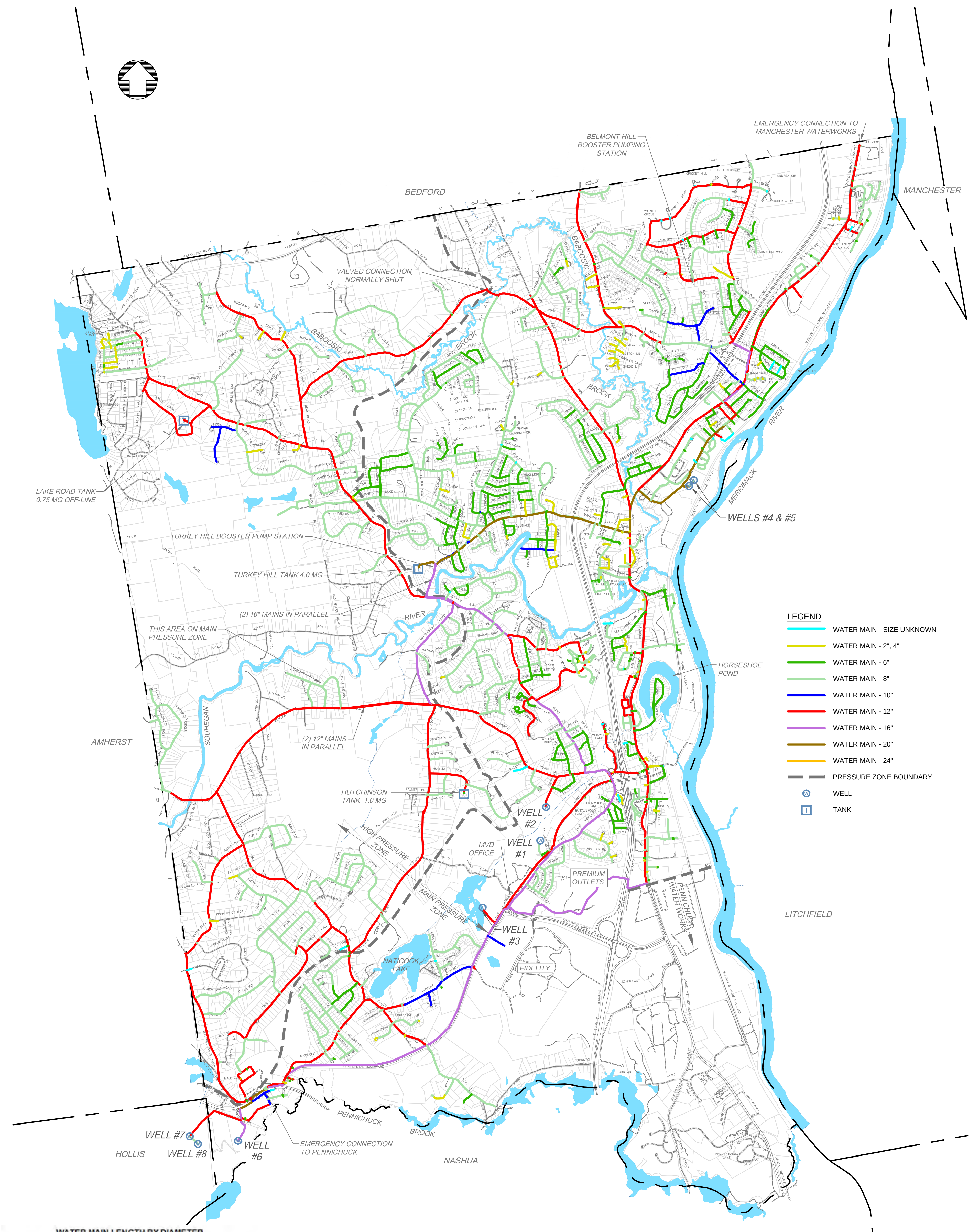
EPA (2008) *Asset Management: A Best Practices Guide*. Available at http://water.epa.gov/infrastructure/sustain/am_resources.cfm (Accessed March 17, 2014).

New Mexico Environmental Finance Center (2006) *Asset Management: A Guide For Water and Wastewater Systems*. Available at: http://water.epa.gov/infrastructure/sustain/am_resources.cfm (Accessed March 17, 2014).

Wright-Pierce (2011) *Drinking Water Infrastructure in New Hampshire: A Capital Investment Needs Analysis.* [Online] Available at http://des.nh.gov/organization/divisions/water/dwgb/documents/dw-infrastructure-exec-smry.pdf (Accessed March 17, 2014)

APPENDIX A

DISTRIBUTION SYSTEM MAPS



WATER MAIN LENGTH BY DIAMETER

DIAMETER	LENGTH (FEET)	LENGTH (MILES)	PERCENT
2"	22,601	4.3	2.6%
4"	5,608	1.1	0.6%
6"	122,513	23.2	14.0%
8"	397,966	75.4	45.4%
10"	17,709	3.4	2.0%
12"	235,873	44.7	26.9%
16"	51,135	9.7	5.8%
20"	18,944	3.6	2.2%
24"	61	0.01	0.0%
UNKNOWN	4,550	0.9	0.5%
TOTAL	**876,959**	**166.1**	-

NOTES:
1. BASE PLAN AND WATER MAIN INFORMATION COMPILED FROM GIS SHAPE FILES PROVIDED BY NASHUA REGIONAL PLANNING COMMISSION (NRPC) 3/27/2012. WATER MAIN INFORMATION UPDATED APRIL, 2014, BASED ON INFORMATION PROVIDED BY MERRIMACK VILLAGE DISTRICT.
2. BASE PLAN DATUM IS NEW HAMPSHIRE STATE PLANE NAD 83 US FOOT.

DATE		TITLE	FIG.
11/12/14	UNDERWOOD engineers 25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733	EXISTING DISTRIBUTION MAINS –SIZE– MERRIMACK VILLAGE DISTRICT MERRIMACK, NEW HAMPSHIRE	1
PROJECT 1786			

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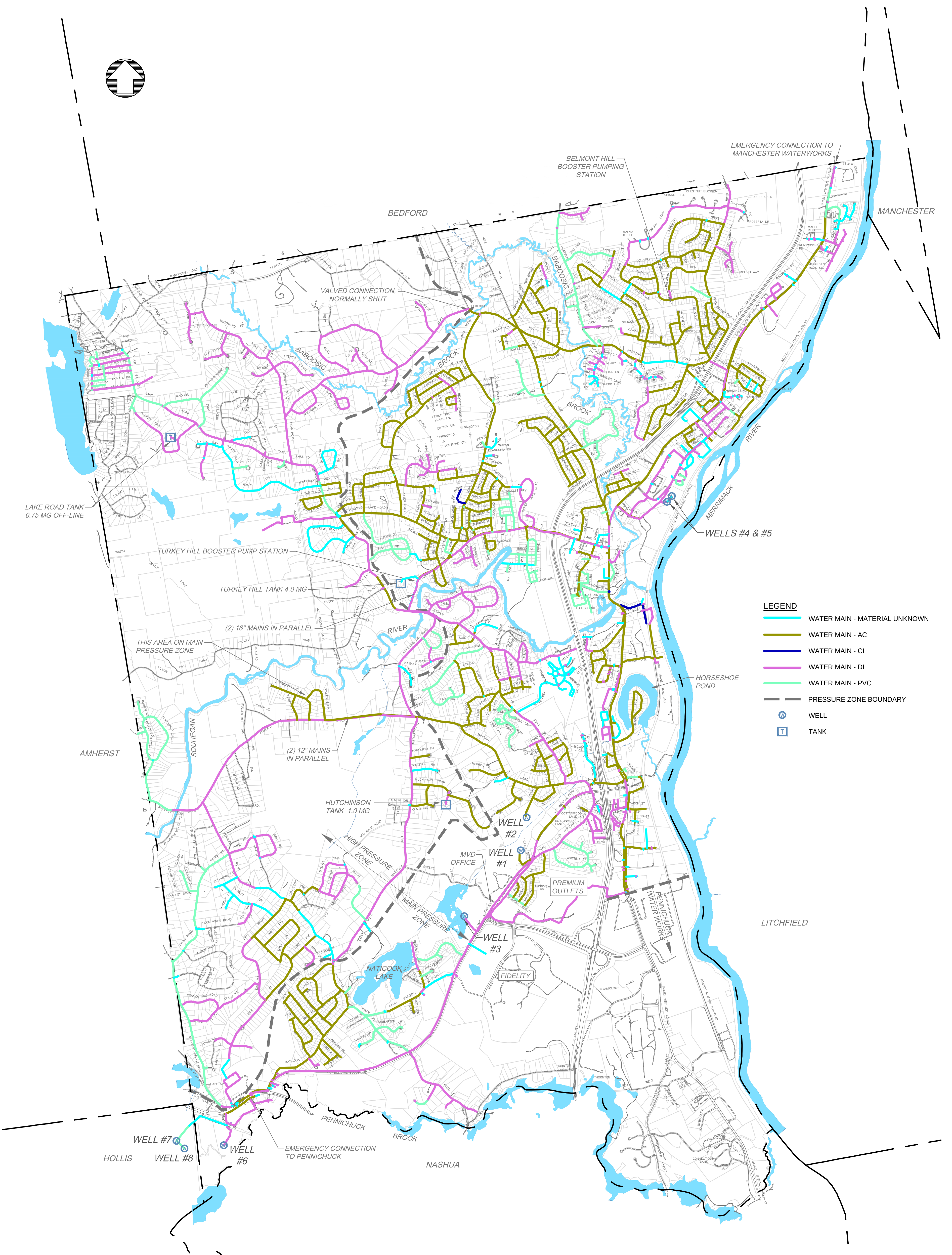
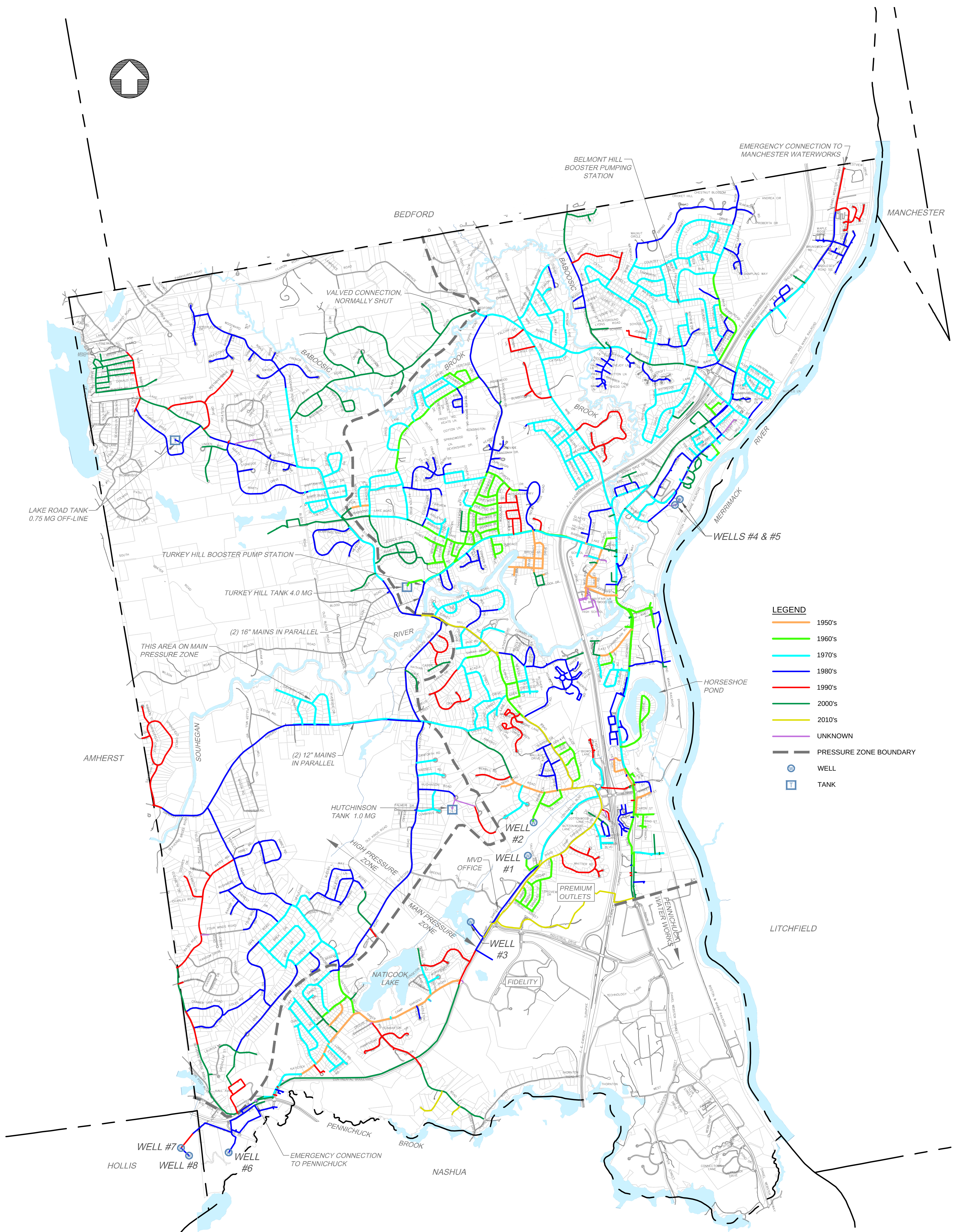


WATER MAIN LENGTH BY MATERIAL

MATERIAL	LENGTH (FEET)	LENGTH (MILES)	PERCENT
AC	368,310	69.8	42.0%
CI	2,685	0.5	0.3%
DI	307,495	58.2	35.1%
PVC	117,412	22.2	13.4%
UNKNOWN	81,057	15.4	9.2%
TOTAL	**876,959**	**166.1**	-

NOTES:
1. BASE PLAN AND WATER MAIN INFORMATION COMPILED FROM GIS SHAPE FILES PROVIDED BY NASHUA REGIONAL PLANNING COMMISSION (NRPC) 3/27/2012. WATER MAIN INFORMATION UPDATED APRIL, 2014, BASED ON INFORMATION PROVIDED BY MERRIMACK VILLAGE DISTRICT.
2. BASE PLAN DATUM IS NEW HAMPSHIRE STATE PLANE NAD 83 US FOOT.

DATE		EXISTING DISTRIBUTION SYSTEM – MATERIAL – MERRIMACK VILLAGE DISTRICT MERRIMACK, NEW HAMPSHIRE	FIG.
11/12/14	UNDERWOOD engineers		2
PROJECT 1786	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733		



WATER MAIN LENGTH BY AGE

DECADE	LENGTH (FEET)	LENGTH (MILES)	PERCENT	PRIMARY MATERIAL
1950's	31,327	5.9	3.6%	AC
1960's	88,178	16.7	10.1%	AC
1970's	259,378	49.1	29.6%	AC / DI
1980's	245,790	46.6	28.0%	DI
1990's	87,253	16.5	9.9%	PVC
2000's	125,962	23.9	14.4%	DI / PVC
2010's	27,829	5.3	3.2%	DI
UNKNOWN	11,241	2.1	1.3%	-
TOTAL	**876,959**	**166.1**	-	-

NOTES:

1. BASE PLAN AND WATER MAIN INFORMATION COMPILED FROM GIS SHAPE FILES PROVIDED BY NASHUA REGIONAL PLANNING COMMISSION (NRPC) 3/27/2012. WATER MAIN INFORMATION UPDATED APRIL, 2014, BASED ON INFORMATION PROVIDED BY MERRIMACK VILLAGE DISTRICT.
2. BASE PLAN DATUM IS NEW HAMPSHIRE STATE PLANE NAD 83 US FOOT.

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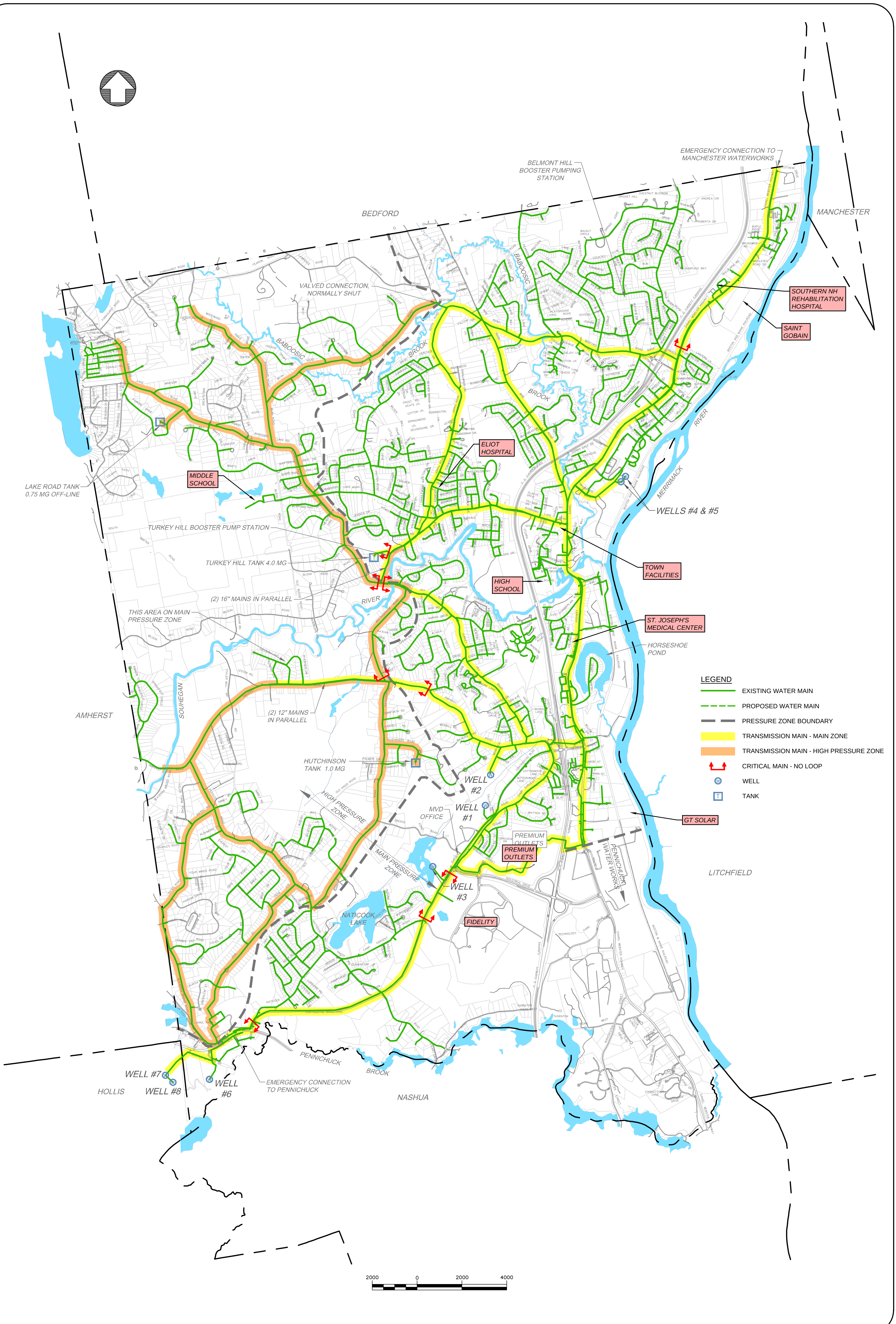
DATE 11/12/14

PROJECT 1786

UNDERWOOD engineers
25 Vaughan Mall, Portsmouth, N.H. 03801
Tel. 603-436-6192 Fax. 603-431-4733

EXISTING DISTRIBUTION MAINS – AGE –
MERRIMACK VILLAGE DISTRICT
MERRIMACK, NEW HAMPSHIRE

FIG. 3



NOTES:

1. BASE PLAN AND WATER MAIN INFORMATION COMPILED FROM GIS SHAPE FILES PROVIDED BY NASHUA REGIONAL PLANNING COMMISSION (NRPC) 3/27/2012. WATER MAIN INFORMATION UPDATED APRIL, 2014, BASED ON INFORMATION PROVIDED BY MERRIMACK VILLAGE DISTRICT.
2. BASE PLAN DATUM IS NEW HAMPSHIRE STATE PLANE NAD 83 US FOOT.

DATE	UNDERWOOD engineers	CRITICAL WATER MAINS AND SERVICES	FIG.
11/12/14	25 Vaughan Mall, Portsmouth, N.H. 03801	MERRIMACK VILLAGE DISTRICT	4
PROJECT 1786	Tel. 603-436-6192 Fax. 603-431-4733	MERRIMACK, NEW HAMPSHIRE	

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APPENDIX B

WORK SHEETS

WATER ASSET MANAGEMENT MODEL

for

Merrimack Village District

<u>PREPARED BY:</u>

UNDERWOOD ENGINEERS, INC.
25 Vaughan Mall
Portsmouth, NH 03801
603-436-6192

4-Nov-14

Asset Management Plan - Worksheet Instructions

Merrimack Village District

Date Worksheet Updated	**11/4/2014**

General

Cell color coding:

Input data

Calculated data

1. Asset Inventory Worksheet

The Inventory is formed with a "top down" approach.

List major water system assets for which asset management is appropriate.

Minor assets that are not worth asset management and are covered under the operating budget should not be included.

2. Asset Condition Assessment

Identify the state of each asset including capacity, age, condition, remaining life, etc.

Assign a condition based on suggested scale below, with additional qualitative notes.

Condition Rating	*Description*
1-Excellent	New or like new, in full working order with no issues
2-Good	Fully functional, minor maintenance may be needed only, few known issues
3-Fair	Functional, needs some refurbishment, known issues may impact functionality in next few years
4-Poor	Not fully functional, needs repair or replacement to restore performance
5-Very Poor	Non functional, at or beyond useful life, needs repair or replacement

Above is suggested categories by UE, based on ranking scale examples at Iowa Rural Water and elsewhere

Useful Life: Enter the Typical Useful Life based on the suggested ranges below.

Expected Useful Lives of Assets

Asset	*Years*
Wells	40 to 60
Treatment Equipment	10 to 20
Storage Tanks	60 to 100
Pumps	10 to 20
Electrical equipment	15 to 25
Buildings/Structure	60 to 70
Distribution Mains	70 to 100
Meters	10 to 15
Service Lines	30 to 50
Hydrants	40 to 60

Above table based on NMEFC Asset Management Guide, EPA Asset Management: Handbook for Small Water Systems, and other sources.

Assets are assumed to be reasonably maintained.

Remaining Life: This is calculated by subtracting age from typical useful life

Enter an Adjusted Useful life based on experience and condition for the particular asset at this time.

3. Asset Prioritization and Criticality Assessment Worksheet

Rate the Probability of Failure Score (1 to 5) based on age, condition, failure history, experience, etc.

Rate the Consequence of Failure Score (1 to 5) based on cost of repair, impacts to customers, collateral damage, environmental costs, reduced level of service, etc.

Risk Score or Criticality Factor = Probability of Failure x Consequence of Failure.

For a more robust analysis, calculate the Risk Cost = the probability of failure in a year multiplied by the cost of failure.

Probability or Consequence of Failure Rating
1 - Very Low
2 - Low
3 - Moderate
4 - High
5 - Very High

Priority to Address: suggested ratings are:

1 = equipment needs to be replaced now or very near term to ensure reliability; safety issue or impacts current level of service.

2 = correction needed in next 5 to 10 years

3 = other long term imporvements.

4. Asset Life Cycle Costs

Enter estimated replacement cost based on technology that would be used for replacement.

Based on remaining useful life, determine estimated decade of replacement.

Enter cost in appropriate column for the decade of replacement.

Costs for each decade are totalled and illustrated in Chart for Replacement Costs.
Copy near-term projects (within 5 to 10 years) into CIP Table for more definitive scheduling.

5. Long Term Funding and Planning

Summary of long term funding needs.
Enter years to save reserves and % allocated from capital reserves.
Calculates reserve contributions needed per year assuming level funding.
Replacement cost charts are linked to this sheet

6. Ten Year CIP Worksheet

List priority projects from Asset Management Program in next 5 to 10 years.
Costs and schedule should be refined with further study.

Asset Management Worksheet

Merrimack Village District, Merrimack, New Hampshire

Date Worksheet Updated	11/4/14	Current Year	2014

1. Inventory of Assets				2. Condition of Assets									3. Criticality Assessment and Asset Prioritization				
ID#	Category	Group	Asset Name	Capacity	Condition	Service History	Year Installed	Typical Useful Life (Years)	Age	Remaining Useful Life (Years)	Adjusted Remaining Life (Years)	Remarks	Probability of Failure	Consequence of Failure	Risk Score	Priority to Address	Remarks/ General Experience
1	Supply	Well #2	Well #2 Gravel Pack Well	1500 gpm	good	Clean and surge 2008	1995	50	19	31	31	Replaced well 1995, original well installed 1962	1	5	5		Best well for capacity and quality
2	Supply	Well #2	Well #2 Pump	1100 gpm, 100 HP	good	Replaced in 2008; motor replaced July 2014	2008	20	6	14	14	Well pump needs upgrade to meet full well approved capacity	2	4	8		
3	Supply	Well #2	Well #2 Pump Building		good	Built 1962, Rebuilt 1978, enlarged 1995?	1995	60	19	41	41	Concrete block	1	1	1		
4	Supply	Well #2	Well #2 Lime Treatment System	50 gal batch system	fair		1988	20	26	-6	**5**	Equipment and instruments are aged. Lime feed pump replaced approx 2011.	2	4	8	2	
5	Supply	Well #2	Well #2 Lime Treatment Building		poor		1988	40	26	14	**5**	Pre-fab concrete building, poor condition, cramped space, confined access.	2	1	2	2	
6	Supply	Well #2	Well #3 Gravel Pack Well	800 gpm	fair	Clean and surge 2008	1972	50	42	8	8	Needs regular cleaning to maintain capacity; iron and managanese issues	2	3	6	2	Yield declines rapidly with use after cleaning. Fe/Mn Issues sometimes
7	Supply	Well #2	Well #3 Pump	800 - 100 gpm, 100 HP	good	Pump replaced 2007	2007	20	7	13	13	Pump replacement and electrical upgrades 2007. epoxy coated column installed.	2	3	6	2	
8	Supply	Well #3	Well #3 Pump Building		good	Rehab and update 1980.	1972	60	42	18	18	Concrete block	1	1	1		
9	Supply	Well #3	Well #3 Lime Treatment System		fair		1988	20	26	-6	**5**	Equipment and instruments are aged. Lime feed pump replaced approx 2011.	2	3	6	2	
10	Supply	Well #3	Well #3 Lime Treatment Building		fair		1988	40	26	14	**5**	Pre-fab concrete building, poor condition, cramped space, confined access.	1	1	1	2	
11	Supply	Well #4	Well #4 Gravel Pack Well	200 gpm	good	Clean and surge 2009	1956	50	58	-8	10	Approved aquifer capacity can be used by pumping Well #5 only.	2	2	4		Low capacity, safe yield of aquifer can be met with Well 5
12	Supply	Well #4	Well #4 Pump	200 gpm	good	Repaired pump 2009	1991	20	23	-3	10	Electrical upgrades and epoxy coated pump column installed 2007. Emergency repairs to pump, motor, shaft 2009	2	2	4		
13	Supply	Well 4	Well #4 Pump Building		good		1975	60	39	21	21		1	1	1		
14	Supply	Well #5	Well #5 Gravel Pack Well	625 gpm (inc. well #4)	good	Clean and surge 2006	1970	50	44	6	10	Clean and surge 2006	1	4	4		High quality source
15	Supply	Well #5	Well #5 Pump	625 gpm (inc. well #4)	good	Last serviced 2011	1991	20	23	-3	**5**	Reconditioned motor, pump 2006. Electrical upgrades 2007. Lighting strikes, pump rebuilt 2008. Motor, pump serviced 2011.	3	4	12	2	
16	Supply	Well #5	Well #5 Pump Building		good		1970	60	44	16	20	Concrete block	1	1	1		
17	Supply	Well #5	Well # 5 Lime Treatment System		fair		1988	20	26	-6	**5**	Equipment and instruments are aged. Lime feed pump replaced approx 2011.	2	3	6	2	Provides treatment for Well 4 also
18	Supply	Well #5	Well #5 Lime Treatment Building		poor		1988	50	26	24	**5**	Pre-fab concrete building, poor condition, cramped space, confined access.	1	1	1	2	
19	Supply	Well #6	Well #6 Gravel Pack Well (inactive)	600 - 800 gpm	inactive	contamination issues	1981	50	33	17	20		5	0	0		Well 6 impact rated 0 since offline (contaminated)
20	Supply	Well #6	Well #6 Pump		fair	Operated for sampling/pilot testing only	1981	20	33	-13	0	not currently installed	2	0	0		pump not installed
21	Supply	Well #6	Well # 6 Pump Building		poor	needs refurbishment	1981	60	33	27	0	Poor condition, needs refurbishment	5	0	0		
22	Supply	Well #6	Well #6 Lime Treatment System		very poor	Cannibalized for other stations	1988	20	26	-6	0	Needs complete refurbishment or replacement	5	0	0		
23	Supply	Well #6	Well #6 Lime Treatment Building		very poor	Not maintained	1988	40	26	14	0	Poor condition, needs replacememt	5	0	0		
24	Supply	Well #7	Well #7 Gravel Pack Well	500 gpm	fair	Clean and surge 2009	1997	50	17	33	33	Fe/Mn issues	3	3	9	1	Fe/Mn Treatment Required
25	Supply	Well #7	Well #7 Pump	500 gpm	fair	Eelctrical repairs 2005, Starter repaired 2012?	1997	20	17	3	**5**	Pump motor cannot handle full pump capacity. Pump to be replaced for new Fe/Mn plant	3	3	9	1	Motor starter has had issues
26	Supply	Well #7	Well #7 Pump/Treatment Building		good	Refurbished after 2007 flood	1997	60	17	43	43	Only building with adequate space for lime treatment	1	1	1		
27	Supply	Well #7	Well #7 Lime Treatment System		good	Refurbished after 2007 flood	1997	20	17	3	**10**	Some refurb to be done with Fe/Mn plant	2	3	6	2	Provides treatment for Well 8 also
28	Supply	Well #8	Well #8 Gravel Pack Well	750 gpm	poor	Clean and surge 2009	1999	60	15	45	45	Severe Fe/Mn issues. Last used for production 2007.	5	2	10	1	Well #8 not currently used. Fe/Mn Treatment Required.
29	Supply	Well #8	Well #8 Pump	750gpm	good	Electrical repairs 2005	1999	20	15	5	**5**	Pump to be replaced for new Fe/Mn plant	2	2	4	1	
30	Supply	Well #8	Well #8 Pump Building		good		1999	60	15	45	45	Concrete block, limited space	1	1	1		
31	Supply	WTP	Iron/Manganese Treatment Plant	1250 gpm	to be built		2015		-1			Proposed plant to be substantially complete in 2015	1	3	3		Assume refurbishment every 20 years
32	Pump Station	Turkey Hill Booster Station	Turkey Hill Booster Station Structure		fair		1988	40	26	14	5	Steel prefab, Confined space and entry issues	4	2	8	1	Existing confined space/access issues
33	Pump Station	Turkey Hill Booster Station	Turkey Hill Booster Station pumps	1700 gpm	fair	Pumps rebuilt approx. 2009, 2010	1988	20	26	-6	5	Pump model no longer manufacturered	2	4	8	1	Duplex pumps; Controls are aged; pumps have required rebuilding; no emergency power? but have storage
34	Pump Station	Belmont Booster Station	Belmont Booster Station		good		2000	50	14	36	36	Small shack	1	1	1		
35	Pump Station	Belmont Booster Station	Belmont Booster Station pumps	80	good		2000	20	14	6	6	Verify pump installation date.	1.5	2	3		Duplex pumps; condition not certain. Users still have pressure if pumps fail.

Asset Management Worksheet

Merrimack Village District, Merrimack, New Hampshire

Date Worksheet Updated	11/4/14	Current Year	2014

1. Inventory of Assets				2. Condition of Assets									3. Criticality Assessment and Asset Prioritization				
ID#	**Category**	**Group**	**Asset Name**	**Capacity**	**Condition**	**Service History**	**Year Installed**	**Typical Useful Life (Years)**	**Age**	**Remaining Useful Life (Years)**	**Adjusted Remaining Life (Years)**	**Remarks**	**Probability of Failure**	**Consequence of Failure**	**Risk Score**	**Priority to Address**	**Remarks/ General Experience**
36	Storage	Turkey Hill Tank	Turkey Hill Tank	4.0 MG	good; roof needs repairs	Interior inspected and cleaned by divers 2010; power washed 2013	1978	100	36	64	64	Prestressed concrete	0.5	5	2.5	1	see 2010 inspection report
37	Storage	Hutchinson Tank	Hutchinson Tank	1.0 MG	good; roof needs recoating	Recoated 2005, Interior inspected and cleaned by divers 2011, power washed exterior 2013	1987	100	27	73	74	Steel tank. Roof recoating in FY 2015 budget?	0.5	4	2		see 2011 inspection report
38	Storage	Lake Road Tank	Lake Road Tank (inactive)	0.75 MG	off-line	Currently used for storage only	1988	100	26	74	74	Tank does not turnover sufficiently; not in service	4	1	4		Tank is offline due to inadequate turnover
39	Other	Office	MVD Administration Office					60				Not reviewed	1	1	1		Space issues
40	Other	Warehouse	MVD "Warehouse/Maintenance Facility					60				Not reviewed	1	1	1		
41	Other	Generator	Portable Generator	230 KW	Good		2012	30		20	20	purchased used 2012?	2	2	4		
			TOTAL														

Notes

See Asset Data Sheets for more information.

Asset Management Worksheet

Merrimack Village District, Merrimack, New Hampsh

Date Worksheet Updated	11/4/14

Current Year	2014

Decade Start	2014

1. Inventory of Assets				4. Life Cycle Costs					
ID#	Category	Group	Asset Name	Management Strategy	Replacement Cost	Year Action Required	Reoccurrance of Action (Years)	Action Required Next 6 to 10 Years	Remarks
1	Supply	Well #2	Well #2 Gravel Pack Well		$500,000	2045	50		
2	Supply	Well #2	Well #2 Pump		$200,000	2028	20		
3	Supply	Well #2	Well #2 Pump Building		$300,000	2055	60		
4	Supply	Well #2	Well #2 Lime Treatment System		$200,000	2019	20	Yes	
5	Supply	Well #2	Well #2 Lime Treatment Building		$200,000	2019	50	Yes	
6	Supply	Well #2	Well #3 Gravel Pack Well		$500,000	2022	50		Consider Fe/Mn treatment
7	Supply	Well #2	Well #3 Pump		$200,000	2027	20		
8	Supply	Well #3	Well #3 Pump Building		$300,000	2032	50		
9	Supply	Well #3	Well #3 Lime Treatment System		$200,000	2019	20	Yes	
10	Supply	Well #3	Well #3 Lime Treatment Building		$200,000	2019	50	Yes	
11	Supply	Well #4	Well #4 Gravel Pack Well		$400,000	2024	50		Assume well is not replaced, decommissioned only
12	Supply	Well #4	Well #4 Pump		$200,000	2024	20		Only refurb if low cost
13	Supply	Well 4	Well #4 Pump Building		$200,000	2035	50		Assume well is not replaced, decommissioned only
14	Supply	Well #5	Well #5 Gravel Pack Well		$500,000	2024	50		
15	Supply	Well #5	Well #5 Pump		$200,000	2019	20	yes	
16	Supply	Well #5	Well #5 Pump Building		$300,000	2034	50		
17	Supply	Well #5	Well # 5 Lime Treatment System		$200,000	2019	20	Yes	
18	Supply	Well #5	Well #5 Lime Treatment Building		$200,000	2019	50	Yes	
19	Supply	Well #6	Well #6 Gravel Pack Well (inactive)			2034			Additional treatment required to return to service
20	Supply	Well #6	Well #6 Pump			2014			Assume renewed in 50+ years
21	Supply	Well #6	Well # 6 Pump Building			2014			Assume renewed in 50+ years
22	Supply	Well #6	Well #6 Lime Treatment System			2014			Assume renewed in 50+ years
23	Supply	Well #6	Well #6 Lime Treatment Building			2014			Assume renewed in 50+ years
24	Supply	Well #7	Well #7 Gravel Pack Well		$500,000	2047	50		
25	Supply	Well #7	Well #7 Pump		$200,000	2019	20	Yes	To be replaced with new WTP
26	Supply	Well #7	Well #7 Pump/Treatment Building		$400,000	2057	50		
27	Supply	Well #7	Well #7 Lime Treatment System		$200,000	2024	20	Yes	
28	Supply	Well #8	Well #8 Gravel Pack Well		$500,000	2059	50		
29	Supply	Well #8	Well #8 Pump		$200,000	2019	20	Yes	To be replaced with new WTP
30	Supply	Well #8	Well #8 Pump Building		$200,000	2059	50		
31	Supply	WTP	Iron/Manganese Treatment Plant		$4,300,000		20		Equipment refurbishment every 20 years
32	Pump Station	Turkey Hill Booster Station	Turkey Hill Booster Station Structure		$1,000,000	2019	50	Yes	New structure and equipment required
33	Pump Station	Turkey Hill Booster Station	Turkey Hill Booster Station pumps		$200,000	2019	20	Yes	
34	Pump Station	Belmont Booster Station	Belmont Booster Station		$100,000	2050	50		
35	Pump Station	Belmont Booster Station	Belmont Booster Station pumps		$50,000	2020	20	Yes	

ID#	Long Term Replacement/Renewal Costs - by Decade starting...									
	2014	2024	2034	2044	2054	2064	2074	2084	2094	2104
1				$500,000					$500,000	
2		$200,000		$200,000		$200,000		$200,000		$200,000
3					$300,000					
4	$200,000		$200,000		$200,000		$200,000		$200,000	
5	$200,000						$200,000			
6		$500,000					$500,000			
7		$200,000		$200,000		$200,000		$200,000		$200,000
8		$300,000					$300,000			
9	$200,000			$200,000		$200,000		$200,000		$200,000
10	$200,000						$200,000			
11		$10,000								
12										
13										
14		$500,000								
15	$200,000		$200,000		$200,000		$200,000		$200,000	
16			$300,000							
17	$200,000		$200,000		$200,000		$200,000		$200,000	
18	$200,000					$200,000				
19										
20										
21										
22										
23										
24				$500,000						
25	$0		$200,000		$200,000		$200,000		$200,000	
26					$400,000					
27		$200,000		$200,000		$200,000		$200,000		$200,000
28					$500,000					
29	$0		$200,000		$200,000		$200,000		$200,000	
30					$200,000					
31			$300,000		$300,000		$300,000		$300,000	
32	$1,000,000									
33	$200,000		$200,000		$200,000		$200,000		$200,000	
34					$100,000					
35	$50,000		$50,000		$50,000		$50,000		$50,000	

Asset Management Worksheet

Merrimack Village District, Merrimack, New Hampsh

Date Worksheet Updated	11/4/14	Current Year	2014	Decade Start	2014

1. Inventory of Assets				4. Life Cycle Costs					
ID#	Category	Group	Asset Name	Management Strategy	Replacement Cost	Year Action Required	Reoccurrance of Action (Years)	Action Required Next 6 to 10 Years	Remarks
36	Storage	Turkey Hill Tank	Turkey Hill Tank		$3,300,000	2078	100	Yes	Refurbishment required every 10 to 20 years, assume in budget. Add Tank Mixing $100k
37	Storage	Hutchinson Tank	Hutchinson Tank		$2,000,000	2088	100	Yes	recoating required every 10 to 20 years. Assume replace with concrete tank. Add tank mixing $100k
38	Storage	Lake Road Tank	Lake Road Tank (inactive)		$2,000,000	2088	100		recoating required every 10 to 20 years.
39	Other	Office	MVD Administration Office		$600,000	2050			Assume replacement 10+ years out
40	Other	Warehouse	MVD "Warehouse/Maintenance Facility		$600,000	2050			Assume replacement 10+ years out
41	Other	Generator	Portable Generator		$100,000	2050	20		
			TOTAL		$21,450,000				

Notes
See Asset Data Sheets for more information.

Long Term Replacement/Renewal Costs - by Decade starting...									
2014	2024	2034	2044	2054	2064	2074	2084	2094	2104
$100,000						$3,300,000			
$100,000	$300,000		$300,000		$300,000		$2,000,000		
	$300,000		$300,000		$300,000		$300,000		$300,000
	$600,000						$600,000		
	$600,000						$600,000		
		$100,000			$100,000			$100,000	
$2,850,000	**$3,710,000**	**$1,950,000**	**$2,400,000**	**$3,050,000**	**$1,700,000**	**$6,050,000**	**$4,300,000**	**$2,150,000**	**$1,100,000**

Notes
Copy and paste formula to set costs in desired decade

Asset Management Worksheet **5. Long Term Funding and Planning**

Merrimack Village District, Merrimack, New Hampshire

Date Worksheet Updated		11/4/2014

		Summary of Long Term Replacement/Renewal Costs - by Decade									
Asset Category	**Replacement Cost**	**2014**	**2024**	**2034**	**2044**	**2054**	**2064**	**2074**	**2084**	**2094**	**2104**
Supply	$11,500,000	$1,400,000	$1,910,000	$1,600,000	$1,800,000	$2,700,000	$1,000,000	$2,500,000	$800,000	$1,800,000	$800,000
Pumping Stations	$1,350,000	$1,250,000	$0	$250,000	$0	$350,000	$0	$250,000	$0	$250,000	$0
Storage	$7,300,000	$200,000	$600,000	$0	$600,000	$0	$600,000	$3,300,000	$2,300,000	$0	$300,000
Other	$1,300,000	$0	$1,200,000	$100,000	$0	$0	$100,000	$0	$1,200,000	$100,000	$0
Facilities Subtotal	**$21,450,000**	**$2,850,000**	**$3,710,000**	**$1,950,000**	**$2,400,000**	**$3,050,000**	**$1,700,000**	**$6,050,000**	**$4,300,000**	**$2,150,000**	**$1,100,000**
Distribution	$150,000,000	$3,300,000	$11,710,000	$27,780,000	$26,780,000	$480,000	$1,340,000	$15,598,000	$27,950,000	$17,752,000	$12,312,000
Total Assets	**$171,450,000**	**$6,150,000**	**$15,420,000**	**$29,730,000**	**$29,180,000**	**$3,530,000**	**$3,040,000**	**$21,648,000**	**$32,250,000**	**$19,902,000**	**$13,412,000**
New 10 Year CIP Projects		$12,150,000									
Total 10 Year AM and new CIP		**$18,300,000**									

Long Term Funding Summary

	Planning Period		
Asset Category	**0 to 50 Years**	**50 to 100 Years**	**Total**
Supply	$9,410,000	$6,900,000	$16,310,000
Pumping Stations	$1,850,000	$500,000	$2,350,000
Storage	$1,400,000	$6,500,000	$7,900,000
Other	$1,300,000	$1,400,000	$2,700,000
Distribution	$70,050,000	$74,952,000	$145,002,000
Total Assets	**$84,010,000**	**$90,252,000**	**$174,262,000**
Years to build reserves	50	50	100
Total Reserves needed per year	**$1,680,000**	**$1,805,000**	**$1,743,000**
Capital Reserves Funding, %	50%	50%	
Capital Reserves Contributions/year	**$840,000**	**$902,500**	

Capital Reserves Annual Funding Range next 50 years	**$420,000**	**$840,000**

Notes

Balance assumed funded by Future Debt or other offsets

Fund 50% to 100% of Capital Reserves, depending on level of risk:

6. Ten Year CIP Worksheet

Merrimack Village District, Merrimack, New Hampshire

Date Worksheet Updated	11/4/2014

Current Year	2014

Project	Amount	Funding Source	Type	Growth/Enhancement Cost not in AM Plan	Priority	Year Action Required	Remarks
Current CIP Projects updated FY 2014-2015							
Increase production in Well #2	$0	Capital Reserves	Enhancement		3	on hold	$300,000 "on hold"
New MVD Office	$0	Capital Reserves	Enhancement		3	on hold	$600,000 "on hold"
Final Design and Construction for Iron and Manganese Treatment Facility	$4,750,000	Debt (SRF)	Enhancement	$4,750,000	1	2014-2016	In progress
Land Purchase - site TBD	$400,000	Capital Reserves	Growth	$400,000	2	2015	New supply
New well site development	$400,000	Capital Reserves	Growth	$400,000	2	2015	New supply
Pipe Replacement; (may include Dogleg/parallel pipe Removal)	$3,300,000	Capital Reserves/Debt	Renewal		3	2020+	2020's Replacement Period per Distribution CIP. Schedule, locations TBD. Dog
Proposed New Projects for 10 Year CIP							
Naticook Lake water main extension	$300,000	Capital Reserves	Growth	$300,000	2	2014	with Town sewer/road project
New Well Site Installation	$1,500,000	Capital Reserves/debt	Growth	$1,500,000	2	tbd	Scope, feasibility TBD. Schedule?
New Well Treatment	TBD	Capital Reserves/debt	Growth	TBD	2	tbd	Scope, feasibility TBD. Schedule?
Storage Tank Improvements (Mixing)	$200,000	Capital reserves	Renewal/Enhancement		1	tbd	Feasibility TBD
Turkey Hill Booster Station Replacement	$1,200,000	Capital Reserves/debt	Renewal/Enhancement		1	tbd	Location, feasibility TBD
Well 3 Treatment	$4,500,000	Capital Reserves/debt	Enhancement	$4,500,000	3	tbd	Feasibility TBD
Well 5 Pump/Controls Replacement	$200,000	Capital reserves	Renewal		2	2019	Replace at 20 year life approx 2019
Belmont Booster Station Pumps/Controls Replacement	$50,000	Capital reserves	Renewal		2	2020	Replace at 20 year life approx 2020
Lime Station Improvements? (Wells 2, 3 and 5)	$1,200,000	Capital Reserves/debt	Renewal		1	tbd	Feasibility TBD. Replace or refurbish? Alternative treatment?
Well level monitoring, SCADA/GIS/IT Improvements (Wells 2, 3, 5; booster stations, tanks)?	$300,000	Capital reserves	Renewal/Enhancement	$300,000	2	tbd	Scope, feasibility TBD. Wells 7, 8 included in WTP project
Total CIP	**$18,300,000**			**$12,150,000**			
Total in AM Plan							

Schedule and Costs by Fiscal Year

2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Current CIP Projects updated FY 2014-2015									
$4,750,000									
	$400,000								
	$400,000								
						$825,000	$825,000	$825,000	$825,000
Proposed New Projects for 10 Year CIP									
	$300,000								
			$1,500,000						
			TBD						
		$200,000							
		$1,200,000							
						$4,500,000			
					$200,000				
						$50,000			
			$1,200,000						
			$300,000						
$4,750,000	**$1,100,000**	**$1,400,000**	**$3,000,000**	**$0**	**$200,000**	**$5,375,000**	**$825,000**	**$825,000**	**$825,000**

Notes

1. Project types may be renewal, growth, or enhancement.
2. Conceptual costs are for initial planning only and require further study and refinement
3. Priority rankings are: 1 = necessary now or in near term to maintain level of service
   2 = recommended to plan in next 5 -10 years
   3 = low priority
4. Funding sources are preliminary, to be confirmed.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL
Capital Reserves	$450,000	$1,100,000	$200,000	$300,000	$0	$200,000	$875,000	$0	$825,000	$0	**$3,950,000**
Debt	$4,300,000	$0	$1,200,000	$2,700,000	$0	$0	$4,500,000	$825,000	$0	$825,000	**$14,350,000**
											$18,300,000

Figure 1. Water Asset Criticality Matrix - MVD

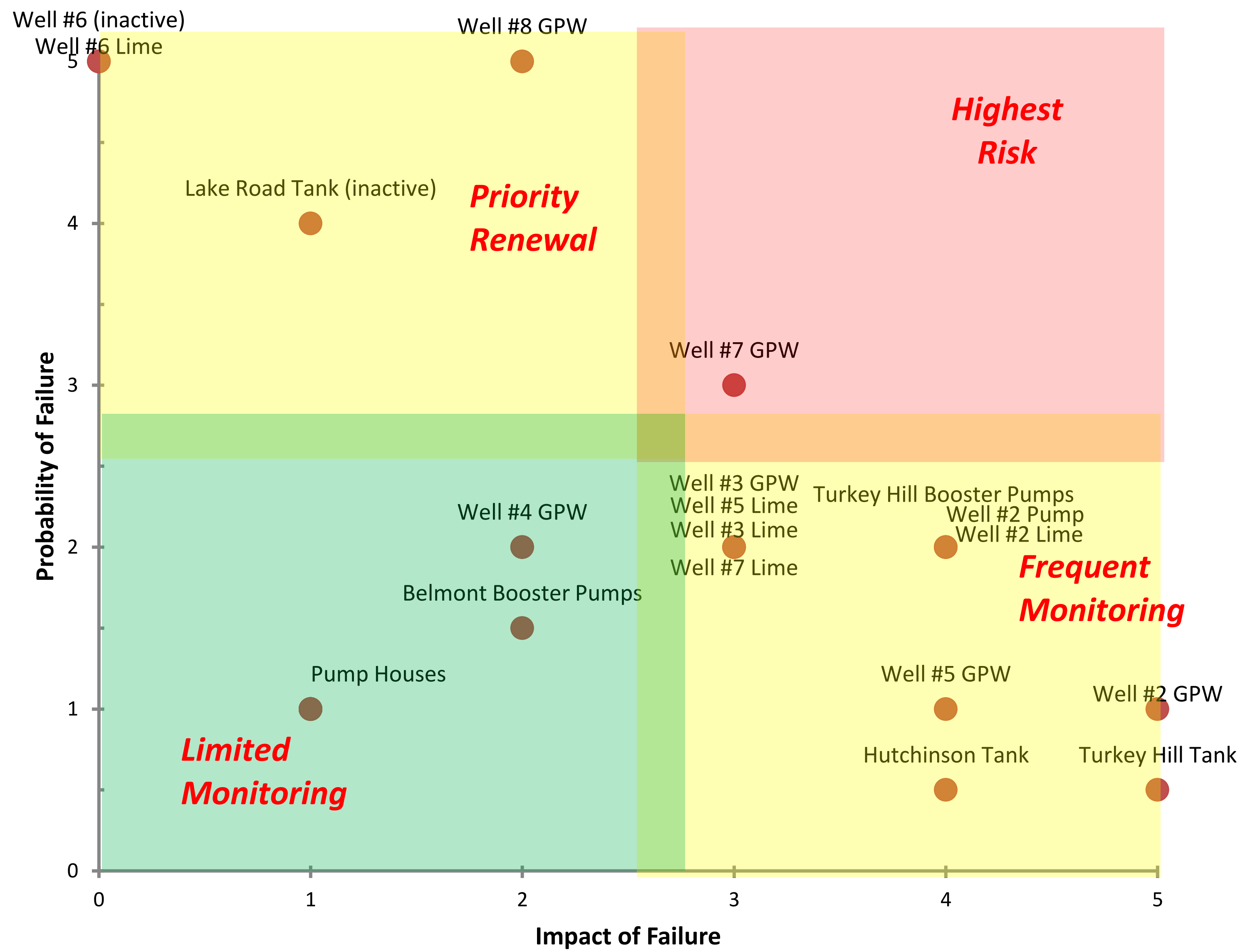
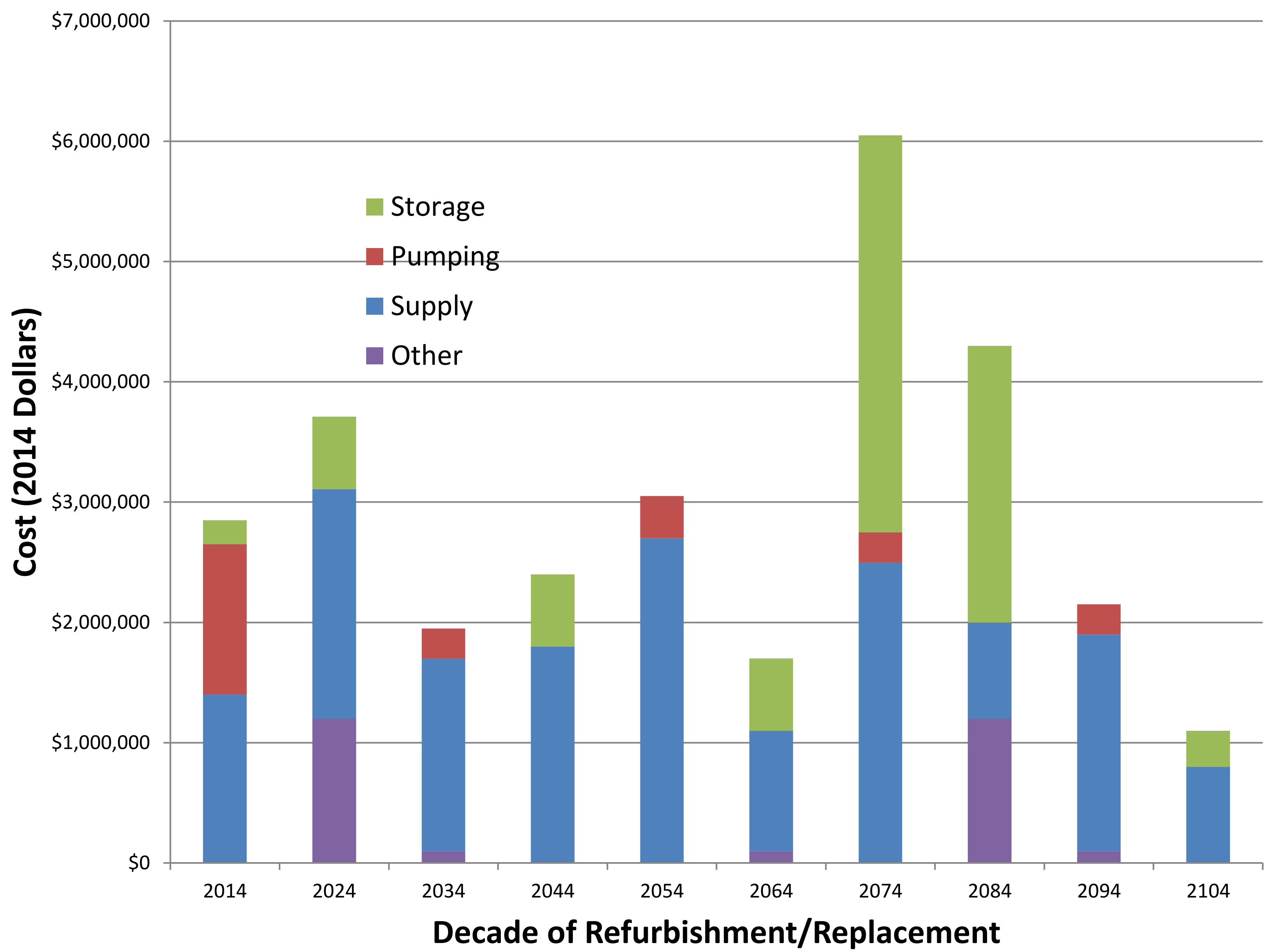
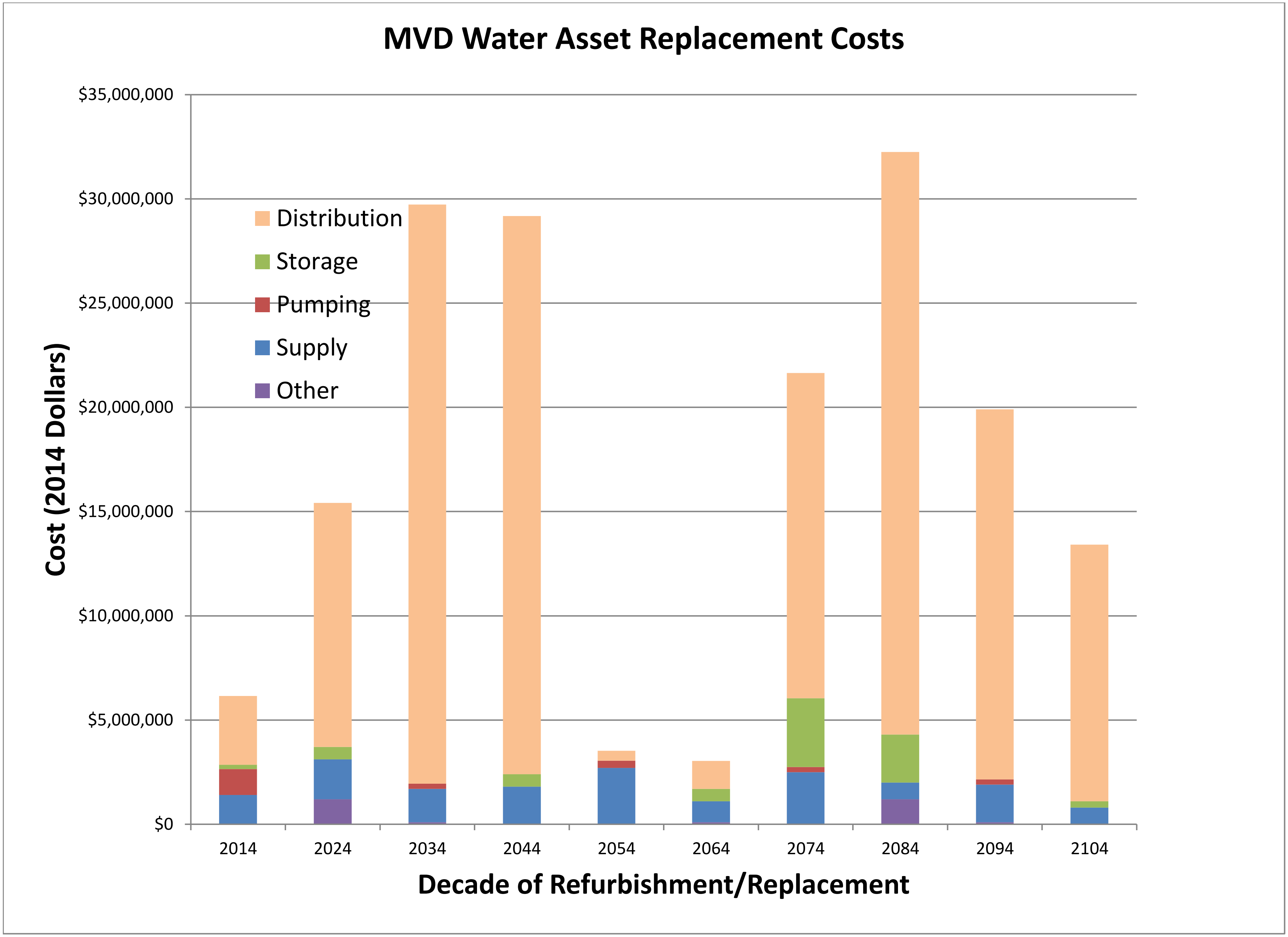


Figure 2. Major Asset Replacement Costs





MVD Water Asset Replacement Costs
$35,000,000
$30,000,000
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$0
Cost (2014 Dollars)
Distribution
Storage
Pumping
Supply
Other
2014
2024
2034
2044
2054
2064
2074
2084
2094
2104
Decade of Refurbishment/Replacement

Distribution CIP Table 6. Required Reserve Worksheet						
Date Work Completed/Updated:						
Asset/Replacement Period	**Size (inches)**	**Length (feet)**	**Unit Cost ($/ft)**	**Year Installed**	**Years Until Action Needed**	**Total Cost ($)**
1. Water Main (2020's)	8	30,000	$ 155.00	1950's	15	$ 4,650,000
	12	20,000	$ 180.00			$ 3,600,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 8,250,000**
2. Water Main (2030's)	8	80,000	$ 155.00	1960's	25	$ 12,400,000
	12	25,000	$ 180.00			$ 4,500,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 16,900,000**
3. Water Main (2040's)	8	180,000	$ 155.00	1970's	35	$ 27,900,000
	12	90,000	$ 180.00			$ 16,200,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 44,100,000**
4. Water Main (2050's)	8	4,000	$ 155.00	1980's	45	$ 620,000
	12	1,000	$ 180.00			$ 180,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 800,000**
5. Water Main (2060's)	8	-	$ 155.00			$ -
	12	-	$ 180.00			$ -
	16	-	$ 220.00			$ -
					Subtotal:	$ -
5. Water Main (2070's)	8	10,000	$ 155.00			$ 1,550,000
	12	10,000	$ 180.00			$ 1,800,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 3,350,000**
5. Water Main (2080's)	8	106,000	$ 155.00	1980's	75	$ 16,430,000
	12	84,000	$ 180.00			$ 15,120,000
	16	11,000	$ 220.00			$ 2,420,000
					Subtotal:	**$ 33,970,000**
6. Water Main (2090's)	8	60,000	$ 155.00	1990's	85	$ 9,300,000
	12	40,000	$ 180.00			$ 7,200,000
	16	11,000	$ 220.00			$ 2,420,000
					Subtotal:	**$ 18,920,000**
6. Water Main (2100's)	8	80,000	$ 155.00	2000's	95	$ 12,400,000
	12	20,000	$ 180.00			$ 3,600,000
	16		$ 220.00			$ -
					Subtotal:	**$ 16,000,000**
6. Water Main (2110's)	8	-	$ 155.00	2010's	105	$ -
	12	1,000	$ 180.00			$ 180,000
	16	30,000	$ 220.00			$ 6,600,000
	Total Pipe Length:	**893,000**			**Subtotal:**	**$ 6,780,000**
Total Reserve Required for Watermain Replacement (2020 - 2060):						**$ 70,050,000**
Total Reserve Required for Watermain Replacement (2070 - 2120):						**$ 79,020,000**
Grand Total Reserve Required for Watermain Replacement:						**$ 149,070,000**
Note: This Required Reserve Worksheet shows costs to replace water mains. O&M Costs are not included.						

APPENDIX C

DATA SHEETS

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #2

Updated: February 2014

General	
Insured value (Primex)	
Treatment building	$100,700
Contents	$45,600
Pump house	$169,200
Contents	$149,300
Total	**$464,800**
Installation dates	
Original Well	1962
Rebuilt building?	1978
Lime feed building	1988
Well Replacement and building	1995, 'installed 12' from original well
Site	
Location	Berry Lane
Map/Lot number	3C-76
Lot size, acres	70
Tax assessed value	$615,600
Road Access	Gravel
Fence	Chain Link
Notes	Well 1 same lot
Process	
Date Pump installed/upgraded	replaced 1995, new or rebuilt? 2008
Pump model	Fairbanks Morse
Pump type	vertical lineshaft turbine, 5 stage per operator
Pump serial number	P2C6233
Pump design point	approx. 1,100 gpm @ 90 psi, design TDH unknown
Motor HP	100 HP
Controls	Seimens Soft Start
Pump column	epoxy coated
Surge control	Parco valve, not in use, high and low pressure switches only used
Chlorinator	Pure Aqua tablet feeder
Corrosion contol	polyphosphate
Lime treatment	Lime feed building and equipment

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Well #2	
Updated: February 2014	
Well Information	
Well type	gravel pack
Casing size, in	
Grade elevation, ft MSL	185 +/- per water model
Suction depth, ft	65
Well depth, ft	98.9
Approved yield, gpm	1,500
Last cleaning date	2008
Water quality	Very good; best quality of all MVD wells
Notes	
Instrumentation	
Flowmeter	8" magmeter, Foxboro
Level monitoring	none
Chorine monitor	Hatch c17, in lime building, replaced 8/2013
pH monitor	FoxboroT222, installed 1988 w/ lime station
Pressure sensor	none
Telemetry	SCADA RTU, radio telemetry, installed approx. 1997
Structural/Architectural	
Size	736 SF
Building walls	CMU
Roof	Flat rubber roof
Doors	single, steel
Lime building	precast concrete, 225 SF
Electrical	
Primary Service	480 V, 3 phase
Emergency power	MTS and plugs for portable generator
Security Protection	Intrusion alarm
Mechanical	
Ventilation	1 ventilation exhaust fan
Heating	2 electric unit heaters
Plumbing	
Operational Notes	
	May 1998 EGGI modeled Naticook Aquifer; see report
	12/2001 Danfoss VFD installed
	8/2008 clean and surge
	2007-2008 lighting strikes, repairs
	10/2008 VFD failed, replaced with soft start
	2008 new pump and 100 HP soft start installed
	2008 New Chessel 392 chart recorder installed
	Check valve slams, issue during power outtages
	6/14/2014 well pump motor failed, 6/18/2014 loaner motor installed

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT	
TOWN OF MERRIMACK, NH	
Name: Well #2	
Updated: February 2014	
Improvements Needed	
	New lime station
	Well level monitoring, SCADA RTU upgrade
	Increase pump capacity to 1500 GPM (new pump, VFD, etc.)
	Provide ramp down (with new VFD)

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Well #3	
Updated: February 2014	

General	
Insured value (Primex)	
Treatment building	$100,700
Contents	$45,600
Pump house	$124,200
Contents	$109,500
Total	$380,000
Installation dates	
Original building	1972
Rebuilt building?	1980
Lime feed building	1998-1999
Pump upgrade	2007
Site	
Location	Off Continental Boulevard near Greens Pond Road
Map/Lot number	3C-39
Lot size, acres	69.341 acres
Tax assessed value	$662,700
Notes	
Process	
Date Pump installed/upgraded	2007
Pump model	Bryon, Jackson (gear drive)
Pump type	vertical lineshaft turbine, 5 stage
Pump serial number	
Pump design point	approx. 800 gpm, up to 1,100 gpm when well clean @ 100 psi, design TDH unknown
Motor HP	100 HP
Controls	Seimens Soft Start
Pump column	epoxy coated
Surge control	Parco valve, not in use, high and low pressure switches only used
Chlorinator	Hammond tablet feeder
Corrosion contol	polyphosphate
Lime treatment	Lime feed building and equipment
Backup Pump/Driver	Amarillo right angle gear driver and propane fired engine, 1000 gal propane tank

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT	
TOWN OF MERRIMACK, NH	
Name: Well #3	
Updated: February 2014	
Well Information	
Well type	gravel pack
Casing size, in	
Grade elevation, ft MSL	205 per water model
Suction depth, ft	45
Well depth, ft	69.65
Approved yield, gpm	800
Last cleaning date	2,008
Water quality	Fe/Mn rise with use
Notes	
Instrumentation	
Flowmeter	8" magmeter
Level monitoring	none
Chorine monitor	Hach CL17
pH monitor	Foxboro T222 in lime station
Pressure sensor	none
Telemetry	SCADA RTU, radio telemetry
Structural/Architectural	
Size	540 SF
Building walls	CMU block
Roof	
Doors	Steel
Lime Building	Precast Concrete, 225 SF
Electrical	
Primary Service	480 V, 3 phase
Emergency power	normal and emergency disconnect switches with single common key; no MTS
Security Protection	Intrusion alarm
Mechanical	
Ventilation	Ventilation exhaust fan
Heating	Dayton propane heater
Plumbing	
Operational Notes	
	Cleaned 12/17/1996, video'd
	2005/2006 electrical upgrade
	4/2008 or 2009? clean and surge, pump replaced/rebuilt, epoxy coated column
	Fe went down 0.9 to 0.25 mg/L after 3 year rest (2000-2003)
	Clean and surged 2008
	radio antennas switched to 465 mhz 2009 (all stations)
	Offline Oct 2013, restarted 4/17/2014

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #3

Updated: February 2014

Improvements Needed	
	New VFD, to allow soft start and turndown
	New chlorinator eventually
	New lime station, additional lime storage
	Well level monitoring, SCADA RTU upgrade
	Fe/Mn treatment

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #4

Updated: February 2014

General	
Insured value (Primex)	
Treatment building	$37,600
Pump house	$37,600
Contents	$29,800
Total	**$105,000**
Installation dates	
Original building	1975
Pump upgrade	1991 - 1993
Well	1952 - 1954 (originally Reeds Ferry well)
Site	
Location	Off Front St.
Map/Lot number	5-D Lot 6
Lot size, acres	18.75
Tax assessed value	$873,400
Notes	same lot as Well 5
Process	
Date Pump installed/upgraded	1991 - 1993
Pump model	Worthington
Pump type	Vertical lineshaft turbine, 5 stage
Pump serial number	
Pump design point	200-220 gpm, design TDH unknown
Motor HP	
Controls	Seimens Soft Start
Pump column	epoxy coated
Surge control	none
Chlorinator	at Well 5
Corrosion contol	at Well 5
Lime treatment	at Well 5

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #4

Updated: February 2014

Well Information	
Well type	gravel pack
Casing size, in	12 inch
Grade elevation, ft MSL	124 per water model
Suction depth, ft	42
Well depth, ft	55
Approved yield, gpm	about 200 gpm; see Well #5 for aquifer limits
Last cleaning date	2009
Water quality	good
Notes	not sure if rescreened
Instrumentation	
Flowmeter	4" magmeter
Level monitoring	none
Chorine monitor	n/a (at well 5)
pH monitor	n/a (at well 5)
Pressure sensor	none
Telemetry	SCADA RTU/Radio telemetry
Structural/Architectural	
Size	183 SF
Building walls	CMU block
Roof	Flat
Doors	Single Steel
Electrical	
Primary Service	480 V, 3 phase
Emergency power	none
Security Protection	Intrusion
Mechanical	
Ventilation	
Heating	
Plumbing	
Operational Notes	
	4/16/2007 electrical upgrade
	Affected by operations at Well 5
	2009 Emergency repairs - pump, motor, shaft
	2009 clean and surge
	9/15/2013 lost one leg on power service
	Foot valve installed to prevent surging when shutdown well

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #4

Updated: February 2014

Improvements Needed

	spare board for soft start
	Consider decommissioning and just using Well 5

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #5

Updated: February 2014

General	
Insured value (Primex)	
Treatment building	$113,800
Contents	$100,400
Pump house	$100,700
Contents	$46,000
Total	**$360,900**
Installation dates	
Original building	1970
Lime feed building	1988
Site	
Location	off Front St.
Map/Lot number	5-D Lot 6
Lot size, acres	18.75
Tax assessed value	Land $873,400
Notes	Well 4 same lot
Process	
Date Pump installed/upgraded	1991 - 1993, last service 2011
Pump model	Bryon Jackson
Pump type	Vertical lineshaft turbine, 5 stage
Pump serial number	
Pump design point	600-800 gpm +/- , design TDH unknown
Motor HP	100 HP
Controls	Seimens Soft Start
Pump column	epoxy coated
Surge control	none
Chlorinator	Hammon tablet feeder/PPG 3015 chlorinator
Corrosion contol	polyphosphate
Lime treatment	Lime feed building and equipment, slurry pump replaced 11/2013

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Well #5	
Updated: February 2014	
Well Information	
Well type	gravel pack
Casing size, in	
Grade elevation, ft MSL	124 per water model
Suction depth, ft	45
Well depth, ft	68
Approved yield, gpm	625 gpm (short term), 420 gpm (annual) for Well 4 and 5 combined
Last cleaning date	2006
Water quality	Good
Notes	
Instrumentation	
Flowmeter	8" Venturi meter, differential pressure sensor
Level monitoring	none
Chorine monitor	Cl-17 analyzer, replaced 4/2012
pH monitor	yes
Pressure sensor	none
Telemetry	SCADA RTU, radio telemetry
Structural/Architectural	
Size	
Building walls	CMU block
Roof	Flat
Doors	Steel, single
Lime building	precast concrete
Electrical	
Primary Service	480 V, 3 phase
Emergency power	MTS, Portable generator connection
Security Protection	Intrusion alarm
Mechanical	
Ventilation	
Heating	
Plumbing	
Operational Notes	
	6/06 clean and surge
	2006 recondition motor, new top shaft, new 8" epoxy coated pipe
	4/16/2007 electrical upgrades
	2008 Lighting strikes twice in summer
	2008 remove and renovate 100 HP motor
	2011 inspection, recondition electric motor, new shaft, machine bowl assembly
Improvements Needed	
	upgrade meter to magmeter
	replace lime station
	level monitoring/ SCADA RTU upgrade
	VFD controls

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #7

Updated: February 2014

General	
Insured value (Primex)	
Contents	$276,000
Pump house / Treatment Building	$313,200
Total	**$589,200**
Installation dates	
Original building	1997
Site	
Location	Tank Road off Hall Ave
Map/Lot number	1A(002), 2A(001), 2A(001A), 2A(003)
Lot size, acres	34
Tax assessed value	$1,047,800
Fence	Chain Link
Notes	Well 8 same lot
Process	
Date Pump installed/upgraded	1997, online 1998 per operator
Pump model	
Pump type	vertical turbine lineshaft, 5 stage
Pump serial number	
Pump design point	500 gpm, TDH unknown
Motor HP	50
Controls	
Pump column	epoxy coated
Surge control	Parco valve
Chlorinator	sodium hypochlorite solution (bleach) feed
Corrosion contol	polyphosphate
Lime treatment	Lime feed building and equipment

ASSET INVENTORY MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Well #7 Updated: February 2014	
Well Information	
Well type	gravel pack
Casing size, in	
Grade elevation, ft MSL	211 per water model
Suction depth, ft	47
Well depth, ft	57
Approved yield, gpm	500
Last cleaning date	2,009
Water quality	Fe/Mn issues
Notes	capacity only 420 - 470gpm to not overload motor
Instrumentation	
Flowmeter	8" magmeter, Foxboro
Level monitoring	none
Chlorine monitor	Hach CL17
pH monitor	Foxboro 873
Pressure sensor	none
Telemetry	SCADA RTU, radio telemetry
Structural/Architectural	
Size	1362 SF
Building walls	CMU block
Roof	shed roof
Doors	steel, double
Electrical	
Primary Service	480 V, 3 phase
Emergency power	none
Security Protection	Intrusion alarm
Mechanical	
Ventilation	
Heating	5 kw upper level, 10kw lower level
Plumbing	
Operational Notes	
	Well 7 used in summer and early fall 2006-2007-2008
	2005 - 2006? Last pump service by Barrie Miller
	2005 electrical repairs
	2007 - 2008: Floods when injector blow out of main caused heavy damage. Lime panel moved upstairs. Installed flood alarm float switch
	Fe/Mn problems in late 2005 on
	Fe/Mn problems increased rapidly
	Last ran Well 7 in 2012, not in 2013
	Replaced starter transformer 2013
	2009 clean and surge, pump service

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Well #7	
Updated: February 2014	
Improvements Needed	
	Replace starter, with new WTP
	New pump and VFD to be installed with new WTP
	Refurbish lime feed equipment
	Emergency power, to be installed with new WTP
	well level monitoring/ SCADA upgraded, to be installed with new WTP

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Well #8

Updated: February 2014

General	
Insured value (Primex)	
Treatment building/Pump House	$51,500
Contents	$60,000
Total	**$111,500**
Installation dates	
Original building	1999
Treatment	1999
Site	
Location	Tank Road off Hall Ave
Map/Lot number	1A(002), 2A(001), 2A(001A), 2A(003)
Lot size, acres	34
Tax assessed value	$1,047,800
Notes	Well 7 same lot
Process	
Date Pump installed/upgraded	1999
Pump model	
Pump type	Vertical turbine lineshaft
Pump serial number	
Pump design point	
Motor HP	75 HP
Controls	Seimens Soft Start
Pump column	epoxy coated
Surge control	Parco valve
Chlorinator	not in use, pump removed
Corrosion contol	polyphosphate
Lime treatment	Lime feed at Well 7

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Well #8	
Updated: February 2014	
Well Information	
Well type	gravel pack
Casing size, in	
Grade elevation, ft MSL	211 per water model
Suction depth, ft	42
Well depth, ft	58
Approved yield, gpm	750
Last cleaning date	2009
Water quality	poor, severe Fe/Mn problems from 2005 on
Notes	
Instrumentation	
Flowmeter	Foxboro 8" magmeter @ Well 7 pump house
Level monitoring	none
Chorine monitor	n/a
pH monitor	n/a
Pressure sensor	none
Telemetry	SCADA RTU, radio telemetry
Structural/Architectural	
Size	224 SF
Building walls	CMU block
Roof	Wood, Gable
Doors	Steel, Single
Electrical	
Primary Service	480 V, 3 phase
Emergency power	none
Security Protection	Intrusion alarm
Mechanical	
Ventilation	
Heating	5 Kw
Plumbing	n/a
Operational Notes	
	Fe/Mn problems in late 2005 to 2008
	Well 8 last used in summer and early fall 2006-2007
	2005 electrical repairs
	2009 clean and surge
Improvements Needed	
	New pump and VFD to be installed with new WTP
	Well level monitoring/ SCADA RTU, with new WTP

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Turkey Hill Tank

Updated: February 2014

General	
Insured value (Primex)	$1,978,100
Installation dates	1978
Last Inspection	September 2010, September 11 & 12 2014
Last Rehab/Repaint	
Site	
Location	Turkey Hill Road
Pressure Zone	Main Pressure Zone
Map/Lot number	5c-004
Lot size, acres	1.936 acre
Fence	Chain link
Tax assessed value	$129,700
Notes	

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Turkey Hill Tank	
Updated: February 2014	
Structural	
Material	Prestressed Concrete
Shape	Circular
Roof Hatch	30" x 30" square hatch
Shell Hatch	N/A
Piping	Common Inlet/Outlet Pipe
Pipe Diameter	12"
Material	
Penetration	
Silt Stop	Yes
Drain Pipe	
Roof Cover	Fixed Roof
Instrumentation	
Telemetry	SCADA - RTV/ radio telemetry
Level	pressure transducer
Hydraulic Data	
Nominal Volume, gallons	4,000,000
Volume, gallons	4,230,100
Useable Volume	4,230,100
Tank diameter	150'
Max Height	32'
Base Elevation ft, MSL	359
Maximum Fill Rate, gpm	
Maximum Draw Rate, gpm	
Electrical	
Primary Service	
Emergency power	
Security Protection	
Operational Notes	
	Possible issues with Poor Turnover
	2010, Underwater Solutions cleaned and inspected w/ diver, removed 10" of sediment.
	Sept 11 and 12, 2014, Underwater Solutions cleaned, reportedly > 8" of sediment.
Improvements Needed	
	Roof Coating needs refurbishment per 2010 inspection
	mixing

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Hutchinson Tank

Updated: February 2014

General	
Insured value (Primex)	$1,030,000
Installation dates	1987
Last Inspection	2011
Last Rehab/Repaint	2005
Site	
Location	Hutchinson Road
Pressure Zone	High Pressure Zone
Map/Lot number	4c - 501 2.26 Acre
Lot size, acres	4c - 502 0.8 Acre
Fence	Chain Link
Tax assessed value	
Notes	
Structural	
Builder	Fisher Tank
Material	Welded Steel
Shape	Circular
Roof Hatch	two 30" circular hatches
Shell Hatch	two 24" circular hatches
Piping	Common Inlet/Outlet Pipe
Pipe Diameter	12"
Pipe Material	Ductile Iron
Penetration	Bottom
Silt Stop	Removable
Drain Pipe	
Roof Cover	Fixed Roof
Instrumentation	
Telemetry	SCADA - RTU/ radio telemetry
Level	pressure transducer
Hydraulic Data	
Nominal Volume, gallons	1,000,000
Volume, gallons	988,200
Useable Volume	988,200
Tank diameter	58' (nameplate)
Wall Height	53' 6" (nameplate)
Max Height	50'
Base Elevation ft, MSL	488
Overflow El, ft MSL	

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT	
TOWN OF MERRIMACK, NH	
Name: Hutchinson Tank	
Updated: February 2014	
Electrical	
Primary Service	
Emergency power	
Security Protection	
Operational Notes	
	Power washed 2013
	Underwater Solutions cleaned and inspected w/ diver. Removed 4" of sediment 2011
Improvements Needed	
	Roof coating needs repair
	Mixing

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Lake Road Tank	
Updated: February 2014	

General	
Insured value (Primex)	
Installation dates	1988
Last Inspection	
Last Rehab/Repaint	
Site	
Location	Lake Road
Pressure Zone	High Pressure Zone
Map/Lot number	
Lot size, acres	
Fence	
Tax assessed value	
Notes	

ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Lake Road Tank	
Updated: February 2014	
Structural	
Material	
Shape	
Roof Hatch	
Shell Hatch	
Piping	
Pipe Diameter	
Material	
Penetration	
Silt Stop	
Drain Pipe	
Roof Cover	
Instrumentation	
Telemetry	
Level	
Hydraulic Data	
Nominal Volume, gallons	750,000
Volume, gallons	
Useable Volume	
Tank diameter	64
Max Height, ft	156
Base Elevation ft, MSL	498
Maximum Fill Rate, gpm	
Maximum Draw Rate, gpm	
Electrical	
Primary Service	
Emergency power	
Security Protection	
Operational Notes	
	Out of service since 2001.
	Tank does not turnover, resulting in low residual.
Improvements Needed	

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT

TOWN OF MERRIMACK, NH

Name: Turkey Hill Road Booster Pumping Station

Updated: February 2014

General	
Insured value (Primex)	
Structure	$69,500
Contents	$140,000
Total	$209,500
Installation date	1988+-
Site	
Location	Turkey Hill Road, base of tank access road
Map/Lot number	5C-001-1
Lot size, acres	.425 acres
Fence	Chain link
Tax assessed value	$129,700
Structural	
Structure	Dakota, factory built, steel can, below grade
Access	Hatch at grade, ladder
Process	
Capacity, gpm	1400 gpm+-
Pressure, psi	Unknown
Number of pumps	2
Pump model	Allis Chalmers
Pump type	Vertical, double suction, split case
Pump serial numbers	
Pump design point	Unknown
Motor HP	100
Controls	
Flowmeter	12" magmeter
Last calibration date	
Chart Recorder	Circular
Operational Notes	
	Electrical upgrades 6/8/2007 per MVD
	Barry Miller rebuilt pumps approx. 2009
	Pumps rebuilt again in 2010 after sand got sucked in from water main break.

ASSET INVENTORY MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	
Name: Turkey Hill Road Booster Pumping Station Updated: February 2014	
Improvements Needed	
	Confined space, limited space, limited access
	Pumps are not made anymore; expensive to maintain, takes months to make new impellers

ASSET INVENTORY

MERRIMACK VILLAGE DISTRICT
TOWN OF MERRIMACK, NH

Name: Belmont Drive Booster Pumping Station

Updated: February 2014

General	
Insured value (Primex)	
Structure	$39,100
Contents	$41,400
Total	$80,500
Installation date	2000 (approx)
Site	
Location	Belmont Dr
Map/Lot number	7d-349
	7D-350
Lot size, acres	.959 acres
Tax assessed value	$120,700 (7d-349)
	$121,800 (7D-350)
Fence	none
Structural	
Structure	Wood frame, above grade, approx 50 SF
Door	Steel, single
Roof	Gable
Process	
Capacity, gpm	80 gpm
Pressure, psi	
Number of pumps	2
Pump model	Flowtronex factory built skid mounted booster station, model MCFC-80-2SL-28
Pump type	end suction, close coupled
Pump serial numbers	
Pump design point	80 gpm at 64'
Suction pressure, psi	62
Differential pressure, psi	28
System pressure, psi	90
Motor HP	3
Controls	Flowtronex, custom,
Flowmeter	1.5" turbine
Chart Recorder	Circular

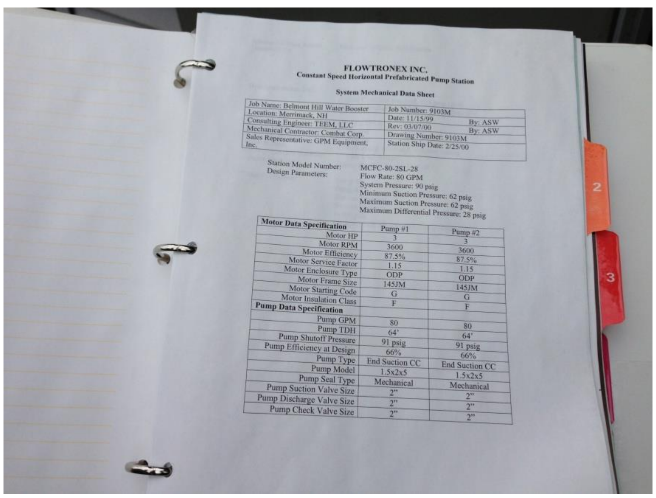
ASSET INVENTORY	
MERRIMACK VILLAGE DISTRICT TOWN OF MERRIMACK, NH	

Name: Belmont Drive Booster Pumping Station

Updated: February 2014

Operational Notes	

Improvements Needed	
	Radio telemetry for alarms/indications
	No backup power, but not critical
	Refurbish door



FLOWTRONEX INC.
Constant Speed Horizontal Prefabricated Pump Station

System Mechanical Data Sheet

Job Name: Belmont Hill Water Booster	Job Number: 9103M
Location: Merrimack, NH	Date: 11/15/99 By: ASW
Consulting Engineer: TEEM, LLC	Rev: 03/07/00 By: ASW
Mechanical Contractor: Combat Corp.	Drawing Number: 9103M
Sales Representative: GPM Equipment, Inc.	Station Ship Date: 2/25/00

Station Model Number: MCFC-80-2SL-28
Design Parameters: Flow Rate: 80 GPM
System Pressure: 90 psig
Minimum Suction Pressure: 62 psig
Maximum Suction Pressure: 62 psig
Maximum Differential Pressure: 28 psig

Motor Data Specification	Pump #1	Pump #2
Motor HP	3	3
Motor RPM	3600	3600
Motor Efficiency	87.5%	87.5%
Motor Service Factor	1.15	1.15
Motor Enclosure Type	ODP	ODP
Motor Frame Size	145JM	145JM
Motor Starting Code	G	G
Motor Insulation Class	F	F
Pump Data Specification		
Pump GPM	80	80
Pump TDH	64'	64'
Pump Shutoff Pressure	91 psig	91 psig
Pump Efficiency at Design	66%	66%
Pump Type	End Suction CC	End Suction CC
Pump Model	1.5x2x5	1.5x2x5
Pump Seal Type	Mechanical	Mechanical
Pump Suction Valve Size	2"	2"
Pump Discharge Valve Size	2"	2"
Pump Check Valve Size	2"	2"

APPENDIX D

2012 DISTRIBUTION CIP REPORT

(EXCERPT)

civil &
environmental
engineering

UNDERWOOD
engineers

1696.00

November 2, 2012

Mr. Ronald Miner, Jr., Superintendent
Merrimack Village District
2 Greens Pond Road
Merrimack, NH 03054

Re: ***Distribution System CIP Planning***
Merrimack Village District
Merrimack, New Hampshire

Dear Mr. Miner:

In accordance with ESR-14, Underwood Engineers (UE) has completed a review of the Merrimack Village District water distribution system. This letter summarizes findings and recommendations for Capital Improvements Planning for the distribution system. Other major assets were identified that need further review for capital planning.

Background

Merrimack Village District (MVD) owns and operates approximately 893,000 LF (169 miles) of water main of various materials, age, and sizes. Recent improvements have focused on reducing the hydraulic "bottleneck" between the supply sources in the south and the demand areas in the north. Projects constructed in 2010-2012 include approximately 17,000 LF of 16" ductile iron water main on Continental Boulevard, Camp Sargent Road, and Turkey Hill Road and approximately 7,700 LF of 16" ductile iron water main at the Merrimack Premium Outlets to create a loop.

To date, no evaluation of water distribution improvements based on age and material has been completed. While MVD does have a capital reserve fund, there is no established program for water main replacement to maintain existing infrastructure. Contributions to Capital Reserves are currently $200,000 per year.

Goals

The goals of this study were:

- Perform a general review of the entire distribution system
- Establish a long term plan to prioritize and fund recommended improvements or replacements for pipes reaching the end of design life.

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25 Vaughan Mall
Portsmouth, NH 03801
underwoodengineers.com

Asset Management Programs are increasingly being developed by utilities to cost effectively maintain their aging infrastructure. Sections in this report follow the basic Asset Management Steps outlined below:

- Asset Inventory
- Level of Service
- Life Cycle Costing
- Long-Term Funding Strategy
- Critical Assets

Sources of Information and Work Completed
UE used the following sources of information:

- GIS Data provided by Nashua Regional Planning Commission (NRPC) (March 2012) showing water main size, length and location
- Record Drawings (UE) for Continental Boulevard Area, Turkey Hill Road Bridge and Premium Outlet Mall water main improvements projects
- Spreadsheet provided by MVD (updated March 2009) showing water main size, material and installation year
- Discussions with MVD

UE developed the following:

- Updated Schematic Maps in AutoCAD based on GIS (Appendix A)
- Water Main Inventory based on GIS (Appendix B)
- Water Main life cycles based on MVD spreadsheet (Appendix C)
- Updated Existing Water Model in WaterCAD 7

Water System Inventory
The current GIS database provided to UE does not include distribution piping information for projects completed since 2010. UE added the recently completed projects to the inventory tabulation from GIS (Table 3 Appendix B) and made other minor corrections for revisions still needed to the GIS. Tables 1 and 2 below summarize the distribution system GIS data:

Table 1. Water Main Length by Material

Material	Length (Feet)	Percent of System	Installation Period Approximate
AC	368,061	41.2%	≤ 1970's
CI	3,035	0.3%	1970's
DI	261,351	29.2%	1980's & ≥ 2000's
PVC	152,119	17.0%	1990's
Unknown	109,207	12.2%	-
Total	**893,772**	**100%**	-

Table 2. Water Main Length by Size		
Size	**Length (Feet)**	**Percent of System**
2"	33,832	3.8%
4"	9,692	1.1%
6"	118,804	13.3%
8"	399,728	44.7%
10"	18,300	2.0%
12"	233,055	26.1%
16"	49,179	5.5%
20"	19,663	2.2%
24"	61	0.0%
Unknown	11,459	1.3%
Total	**893,772**	**100%**

Using spreadsheets provided by MVD (Table 4. Appendix B), water main age was incorporated into the inventory to analyze life cycle costs. Water main age/installation date information is not in the current GIS database but should be added for future planning.

Figures 1 and 2 (Appendix B) illustrate the history of water main construction by size and material. Asbestos cement (AC) pipe was the primary material used for distribution piping from 1956 to 1979. Since then, ductile iron (DI) pipe has been the primary material used, with some polyvinyl chloride (PVC) installed in the 1990's.

Other major water system assets should be considered in future studies (see Preliminary Summary Table 5. Appendix B):

- Tanks (Hutchinson, Lake Road and Turkey Hill)
- Wells (#2,3,4,5,6,7 & 8)
- Booster Stations (Turkey Hill Road, other minor booster stations)
- Administration and maintenance facilities
- Vehicles

Notably the Turkey Hill Booster station appears to need significant upgrades in the near future based on preliminary review by UE.

Level of Service

Asset management is intended to provide the desired level of service in the most economical and efficient way. MVD has defined their general level of service in their mission statement. Specific items for measuring level of service include:

- Water Pressure – provide adequate pressure under all conditions at all locations
- Water Main Breaks – minimize system downtime
- Water Quality – maintain clean and safe drinking water to meet regulatory guidelines
- Supply/Conservation Requirements – minimize water restrictions

In general, MVD provides a high level of service currently, with minimal reports of customer complaints and water main breaks. Therefore for planning purposes, future capital costs in this study were based primarily on replacing water mains as they reach end of useful life.

Life Cycle Costing

The following assumptions were used to evaluate life cycle costs and reserve requirements:

- Costs include engineering and contingency based on recent projects
- Costs are in 2012 dollars
- Existing water main 4"-8" diameter to be replaced with 8" diameter DI when design life is reached
- Existing water main 10"-12" diameter to be replaced with 12" diameter DI when design life is reached
- Existing water main 16" diameter to be replaced with 16" diameter DI when design life is reached
- Life expectancy of water main installed prior to 1985 (AC, CLP, and CI pipe) - 70 years
- Life expectancy of water main installed after 1985 (DI and PVC pipe) - 100 years
- Cost to install 8" DI water main - $155/lf
- Cost to install 12" DI water main - $180/lf
- Cost to install 16" DI water main - $220/lf

Using these assumptions, water main replacement costs have been estimated through 2120 (Table 6. Appendix C). Based on life expectancies of 70 and 100 years, the projected decade when existing water mains reach the end of their service life is shown in Figure 3 and Figure 4. The total estimated cost to replace the existing water mains over the next 100 years is approximately **$150 million** (2012 dollars).

The total replacement value just for water mains is far greater than the reported current value of all capital assets at $16,092.062 (June 30, 2011 Auditors Report). MVD depreciates capital assets using the straight line method and an estimated useful life of 5 to 50 years depending on the asset.

Water Main Planning and Funding

There are two major periods of water main replacement identified: 2020 to 2060 and 2080 to 2120. These are assumed to be funded over 50 year periods each as follows:

Total Reserve Required 2020's – 2050's: $70,050,000
Total Annual Reserve Required: $1,401,000/year (over 50 year period)
50% from Capital Reserves
50% from Future Debt or other funds and offsets
Reserve Amount Annually Required = **$700,500/year** (2020 to 2070)

Note, the high value of projected replacements in the 2040's will require these to be spread out over a greater period.

Total Reserve Required 2080's – 2110's): $79,020,000
Annual Reserve Required: $1,580,400 (over 50 year period)
50% from Capital Reserves
50% from Future Debt or other funds and offsets
Reserve Amount Annually Required = **$790,200** (2070 to 2120)

Capital reserve requirements are estimated above at 50% of the total costs assuming the balance costs would be funded by debt or offset by potential grants, developers' involvement, extended use beyond assumed design life, rehabilitation, or other maintenance to extend useful life. Note that future costs and funding should be adjusted for inflation as necessary.

Rehabilitation of mains in place, instead of replacement, may be considered in some areas to reduce costs and extend useful life. Rehabilitation of AC pipe to improve resistance to fracture is possible using structural liners, which can be installed with minimal excavation and disturbance to pavement. Cleaning and cement lining is applicable to cast iron mains to restore hydraulic capacity, though there is a very limited amount of this type of pipe in MVD's system.

The cost savings for liners vary depending on specific site conditions but may range as follows:
Non-structural (cement or epoxy lining): 50% to 60%
Structural (slip lining): 30% to 40%
Structural (pipe bursting): 20% to 30%.

Critical Assets and Priority Projects

Critical Assets are those which have a high risk and/or high impact of failure and should receive higher priority for funding. Critical assets in order of priority include:

- Sources (wells)
- Storage (tanks)
- Pumping stations
- Transmission mains
- Distribution mains and services

Although this report provides budgeting for replacement based on pipe design life, it is appropriate to replace certain assets only when the cost of repairs exceeds the cost of replacement.

The specific locations for future water main replacements should be based on factors such as:

- Coordination with Town road or sewer improvements
- System deficiencies and/or hydraulic constraints, if any
- Risk of aging water main failure (i.e. design life)
- Future development

Further study is needed on the District's assets that are in addition to the mains. NHDES is offering a grant for asset management and financial planning (applications due October 15, 2012). See Appendix D for more information.

Conclusions

Findings of this study include:

- Estimated total water main is approximately 893,000 ± LF
- 41% or 368,000 LF ± is AC pipe that will reach end of life between 2020 and 2050
- 46% or 416,000 LF ± is DI, PVC, etc. that will reach end of life between 2080 and 2120
- Total replacement cost is approximately $150 million (2012 dollars)
- Replacement cost of the distribution system is far in excess of total current depreciated capital value

Recommendations

UE recommends the following:

- Update GIS to include recent projects and other minor revisions for as-built conditions
- Update GIS to include installation years for water mains and other components
- Update the water model based on the GIS base plan
- Reserve $700,000/year for the first phase of future water main replacement (2020 – 2060) (Current funding = $200,000; additional = $500,000; approx. 18% increase to budget)
- Use updated GIS to evaluate age and replacement needs in specific locations
- Document and measure level of service, based on complaints, breakages, etc.
- Update Capital Improvements Plan (CIP)
- Review and update rates to support future CIP
- Develop Asset Management Plan to prioritize and fund replacement of water main and other assets
- Apply for Asset Management Grant (October 2012 deadline) when a budget is established for the CIP *(Application Submitted, Appendix D)*
- Add the Turkey Hill Booster Station to the current CIP
- Increase maintenance and consider lining to increase useful life cost effectively

- Use capital reserve funds for flexibility to coordinate water main improvements with Town road projects.
- Review and update inventory and revise every 1 to 2 years.

Please call if you have any questions.

Very truly yours,

UNDERWOOD ENGINEERS

Keith A. Pratt, P.E.
President

Thomas G. Page P.E.
Project Manager

KAP/TGP/rla

Enc.

cc. Dave Frederickson (w/enc.)

Appendix B

Water System Inventory (GIS and MVD Summary)

Merrimack Village District
GIS Water Distribution Inventory

Table 3. Length of Water Main by Size and Material (GIS)

	Unknown	AC	CI	DI	PVC	Total	Percent of System
Unknown	11,448	-	-	11	-	**11,459**	**1.3%**
2	402	291	200	-	32,938	**33,832**	**3.8%**
4	5,573	1,696	-	1,355	1,068	**9,692**	**1.1%**
6	7,727	68,062	2,009	24,839	16,167	**118,804**	**13.3%**
8	64,575	180,027	825	89,983	64,317	**399,728**	**44.7%**
10	7,120	10,664	-	517	-	**18,300**	**2.1%**
12	12,361	104,774	-	78,291	37,629	**233,055**	**26.1%**
16	-	-	-	49,179	-	**49,179**	**5.5%**
20	-	2,487	-	17,176	-	**19,663**	**2.2%**
24	-	61	-	-	-	**61**	**0.01%**
Total	**109,207**	**368,061**	**3,035**	**261,351**	**152,119**	**893,772**	**100.00%**
Percent of System	**12.2%**	**41.2%**	**0.3%**	**29.2%**	**17.0%**	**100.0%**	

Table 4. MVD Water Main Summary Spreadsheet

Date	1" Plastic	2" CLP	2" Cast	2" PVC	4" Cast	4" PVC	4" Transite	4" DIP	6" Transite	6" Cast	6" DIP	6" PVC	8" Transite	8" DIP	8" Cast	8" PVC	10" Transite	10" Cast	10" DIP	12" DIP	12" Cast	12" PVC	12" Transite	16" DIP	16" PVC	20" DIP	24" RCP	Totals
1956			136				591		6,925	330			15,613		1,799						2,686		14,445					42,525
1957		1,711							502				741															2,954
1958									112	32																		144
1959									1,454																			1,454
1960									370																			370
1961		418							2,440				811															3,669
1962		120					185		3,274				524															4,103
1963		414							5,661																			6,075
1964		630							8,353				6,816				350						300					16,449
1965	225	294							1,712				477										1,034					3,742
1966		777							2,529				2,500															5,806
1967									3,636				4,389				12,034											20,059
1968				340					4,839				5,250										4,400					14,829
1969		150							4,657				15,974				1,033						5,525					27,339
1970									2,181	10			5,401	100	3					380	6		3,159					11,240
1971		365		60					6,394	70			6,505		4								1,729					15,127
1972		26	260	88	18				2,866	375			14,693	558	1,049			12		680	406		13,496					34,527
1973									2,572	326			14,172	356	2,409								403					20,238
1974					2,780				39,736	362			36,938	1,374	20		5,750	2,100		1,303			32,444			460		123,267
1975									296	130	323		11,666	600						536			11,278					24,829
1976		4							256	91			13,373	534						138			11,062					25,458
1977									921	56	88		6,181	1,036					7	62			4,183			17,501		30,035
1978													2,612							117			80			802		3,611
1979			185								385		1,289	2,166						1,607								5,632
1980		340									260		208	8,918						10,706			299					20,731
1981											1,400			3,947														5,347
1982		21									2,106			2,144					74	70				1,428		2,530		8,373
1983		1,263									818			11,253					2,141	4,348								19,823
1984		504		876							1,121			14,445						1,836								18,782
1985											336			9,376						4,265								13,977
1986				590				922			1,534			10,459					551	39,489				5,778		80		59,403
1987				208				50			2,788			6,048					596	15,971								25,661
1988-1989				1,812							53			22,112						3,863								27,840
1990											57			2,205					503	195							144	3,104
1991-1992								478			123	1,660		1,705		5,180				936		4,760						14,842
1993-1994											111					6,859						5,832			11,050			23,852
1995-1996												460		1,933		6,573												8,966
7/1/96-12/31/97				650		200					52	1,000		1,740		8,484				20		8,452						20,598
1998				144		735						80				8,777				100		14,055						23,891
1999	120			1,266		220		490				51		370		6,949						2,502						11,968
2000				430		360								8,235		3,720				3,350								16,095
2001				100							1,058			5,265						2,680		280						9,383
2002				250				500						9,595						9,300								19,645
2003				260							245	30		13,670		400												14,605
2004				965				140			936			5,598														7,639
2005											8			12,134						876								13,018
2006				452										1,638														2,090
2007														1,420														1,420
2008						620								7,350								590						8,560
2010																				85				26,494				26,579
Total	**345**	**7,037**	**581**	**8,491**	**2,798**	**2,135**	**776**	**2,580**	**101,686**	**1,782**	**13,802**	**3,281**	**166,133**	**168,284**	**5,284**	**46,942**	**19,167**	**2,112**	**3,872**	**102,913**	**3,098**	**36,471**	**103,837**	**33,700**	**11,050**	**21,373**	**144**	**869,674**

Note: Pipe lengths from 1956 through 2008 provided by Merrimack Village District. Pipe lengths for 2010 updated by Underwood Engineers using record drawings for the Continental Boulevard Area, Turkey Hill Road Bridge and Premium Outlets water main improvements projects.

Table 5. Major Water System Assets

Asset	Year Built	Capacity	Estimated Useful Life	Replacement Cost
Well #2	1962-1963 (new well installed 1995-1996±)	1,100 GPM	50 years	TBD
Well #3	1975	800 GPM	50 years	
Well #4	1952-1954	7,625 GPM	50 years	
Well #5	1978±		50 years	
Well #6 (inactive since 1985)		0 GPM	50 years	
Well #7	1999	1,100 GPM	50 years	
Well #8	2000		50 years	
Turkey Hill Tank		4.0 MG	100 years	
Hutchinson Tank	1988±	1.0 MG	100 years	
Lake Road Tank (inactive)	1988±	0.75 MG	100 years	
Turkey Hill Booster Station	1988±	1,700 GPM	20 years	↓

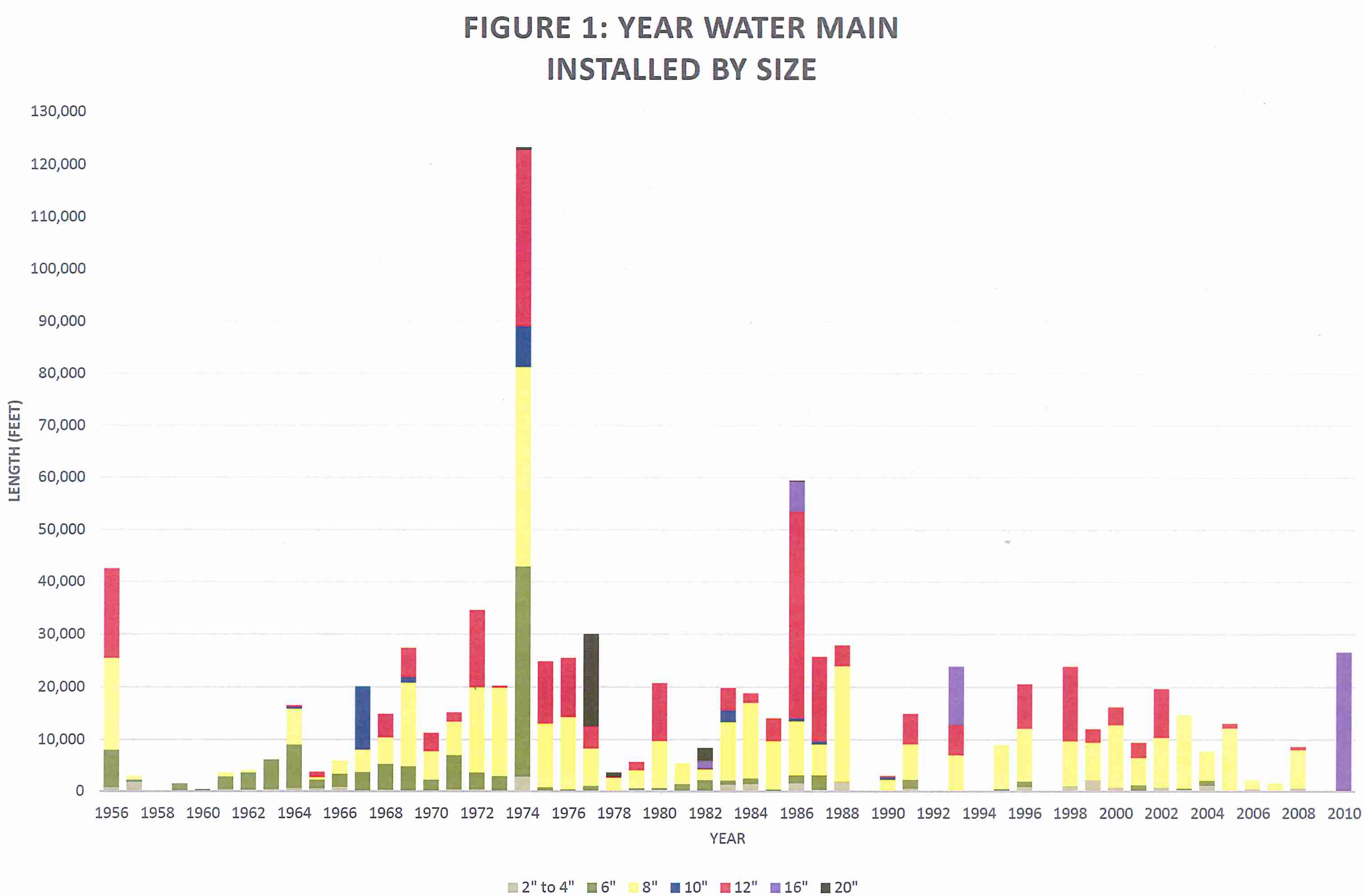

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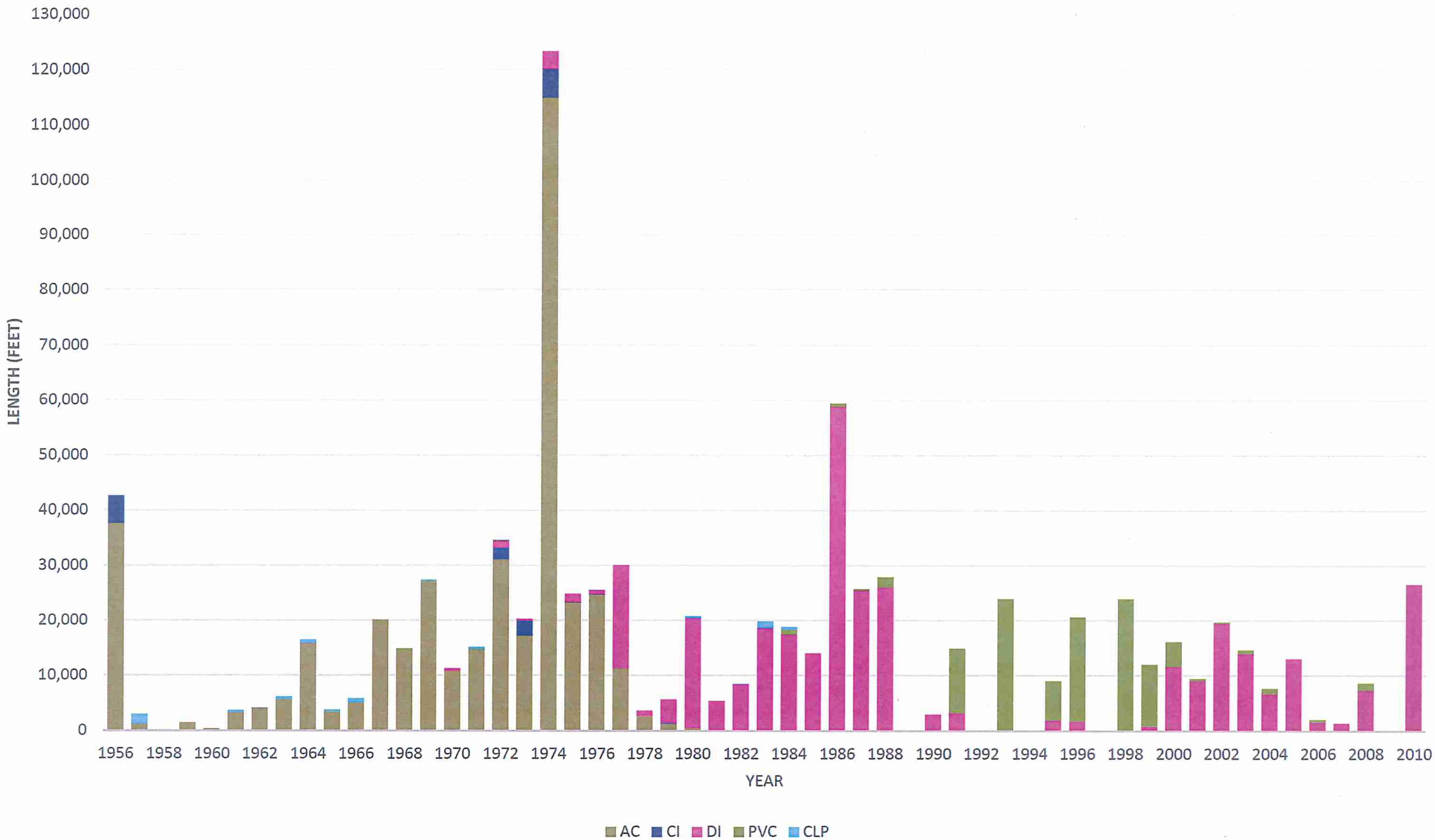
FIGURE 2: YEAR WATER MAIN INSTALLED BY MATERIAL



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Appendix C

Water System Life Cycle Costs

Table 6. Required Reserve Worksheet						
Date Work Completed/Updated:						
Asset/Replacement Period	**Size (inches)**	**Length (feet)**	**Unit Cost ($/ft)**	**Year Installed**	**Years Until Action Needed**	**Total Cost ($)**
1. Water Main (2020's)	8	30,000	$ 155.00	1950's	15	$ 4,650,000
	12	20,000	$ 180.00			$ 3,600,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 8,250,000**
2. Water Main (2030's)	8	80,000	$ 155.00	1960's	25	$ 12,400,000
	12	25,000	$ 180.00			$ 4,500,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 16,900,000**
3. Water Main (2040's)	8	180,000	$ 155.00	1970's	35	$ 27,900,000
	12	90,000	$ 180.00			$ 16,200,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 44,100,000**
4. Water Main (2050's)	8	4,000	$ 155.00	1980's	45	$ 620,000
	12	1,000	$ 180.00			$ 180,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 800,000**
5. Water Main (2060's)	8	-	$ 155.00			$ -
	12	-	$ 180.00			$ -
	16	-	$ 220.00			$ -
					Subtotal:	**$ -**
5. Water Main (2070's)	8	10,000	$ 155.00			$ 1,550,000
	12	10,000	$ 180.00			$ 1,800,000
	16	-	$ 220.00			$ -
					Subtotal:	**$ 3,350,000**
5. Water Main (2080's)	8	106,000	$ 155.00	1980's	75	$ 16,430,000
	12	84,000	$ 180.00			$ 15,120,000
	16	11,000	$ 220.00			$ 2,420,000
					Subtotal:	**$ 33,970,000**
6. Water Main (2090's)	8	60,000	$ 155.00	1990's	85	$ 9,300,000
	12	40,000	$ 180.00			$ 7,200,000
	16	11,000	$ 220.00			$ 2,420,000
					Subtotal:	**$ 18,920,000**
6. Water Main (2100's)	8	80,000	$ 155.00	2000's	95	$ 12,400,000
	12	20,000	$ 180.00			$ 3,600,000
	16		$ 220.00			$ -
					Subtotal:	**$ 16,000,000**
6. Water Main (2110's)	8	-	$ 155.00	2010's	105	$ -
	12	1,000	$ 180.00			$ 180,000
	16	30,000	$ 220.00			$ 6,600,000
	Total Pipe Length:	**893,000**			**Subtotal:**	**$ 6,780,000**
Total Reserve Required for Watermain Replacement (2020 - 2060):						**$ 70,050,000**
Total Reserve Required for Watermain Replacement (2070 - 2120):						**$ 79,020,000**
Grand Total Reserve Required for Watermain Replacement:						**$ 149,070,000**
Note: This Required Reserve Worksheet shows costs to replace water mains. O&M Costs are not included.						

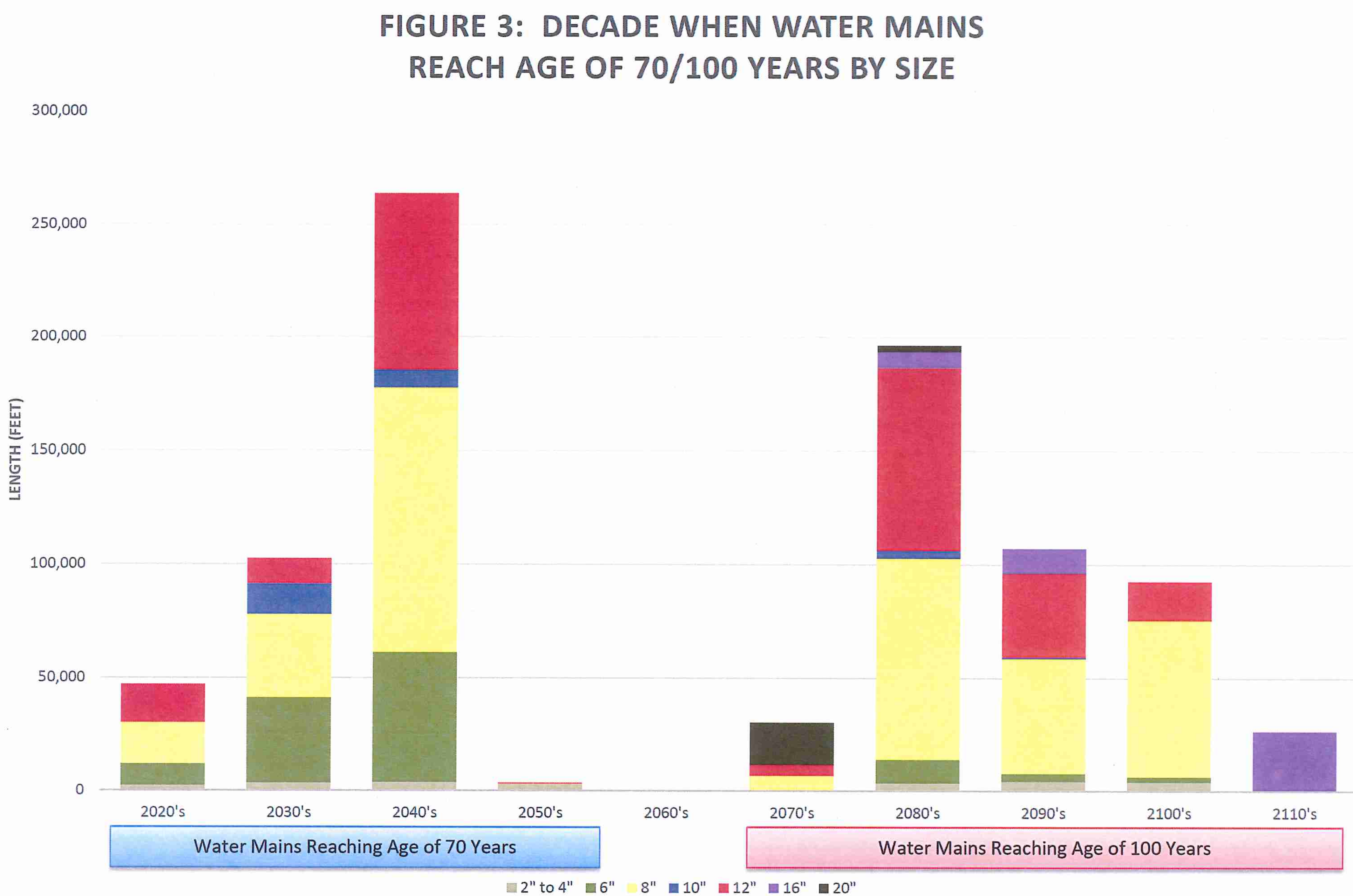

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FIGURE 4: DECADE WHEN WATER MAINS REACH AGE OF 70/100 YEARS BY MATERIAL

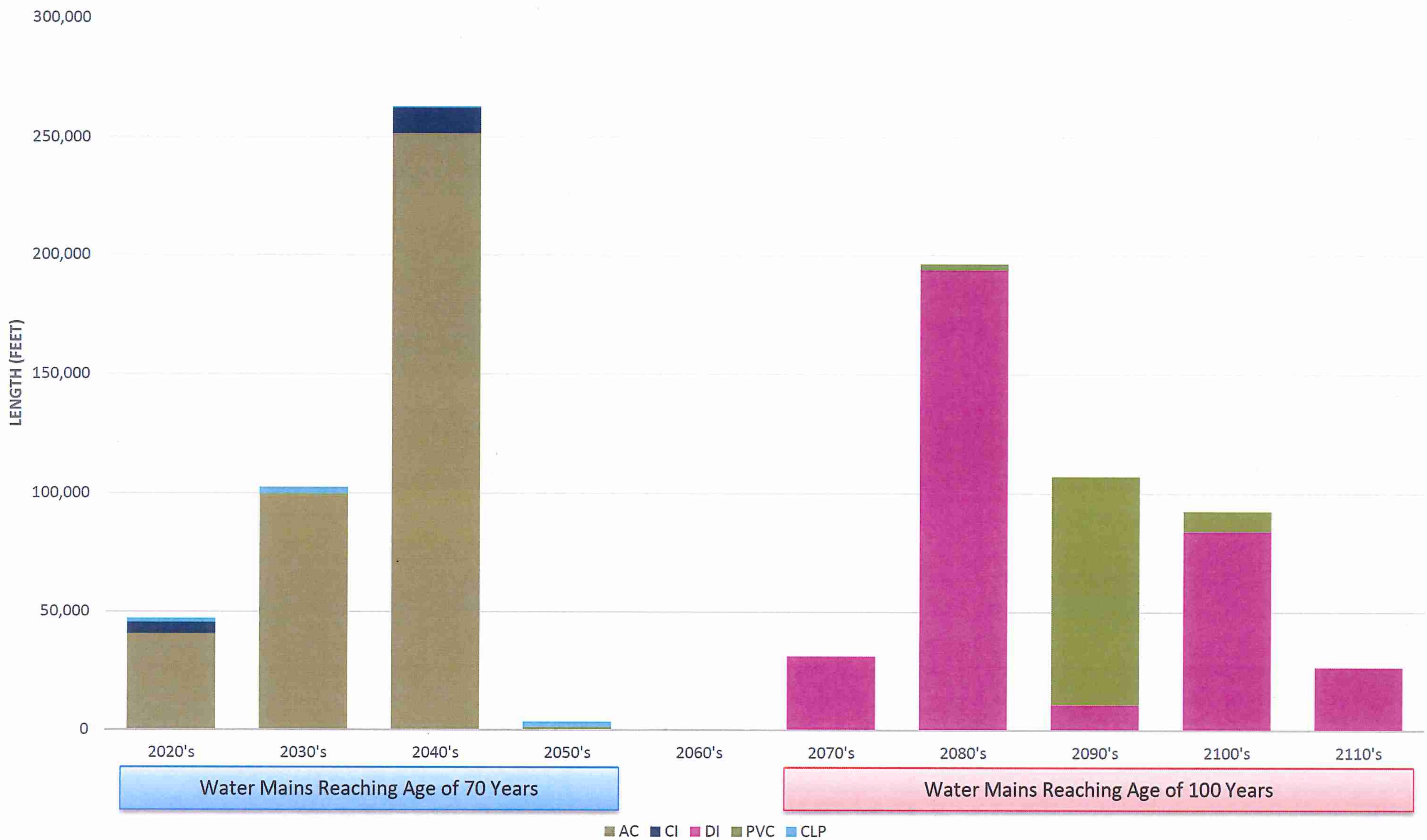

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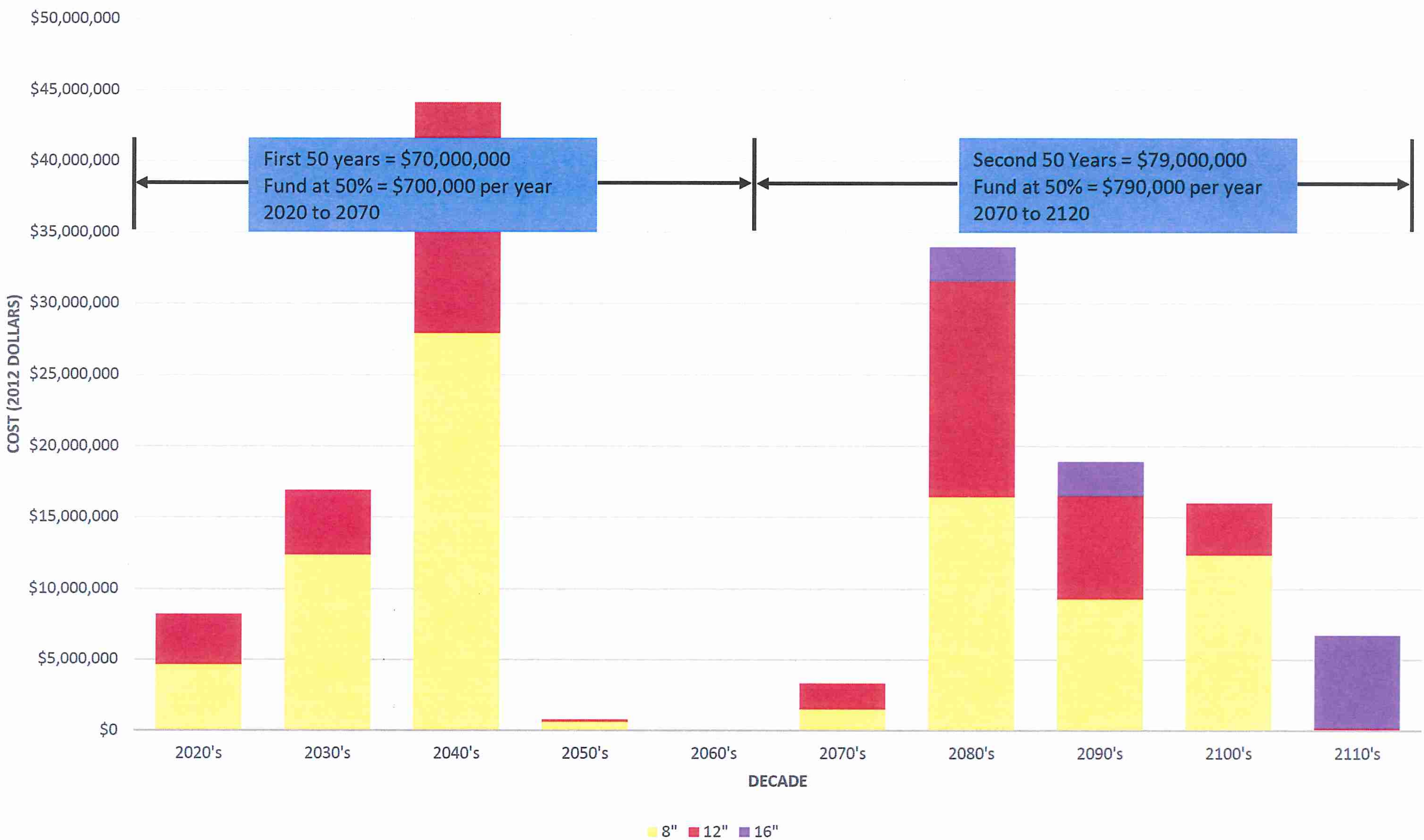
FIGURE 5: WATER MAIN REPLACEMENT COSTS FROM 2020 TO 2110



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APPENDIX E

SAMPLE DOCUMENTS

Our Asset Management Charter

Our organization is embarking on a journey to better manage our assets. Asset Management is a way to evaluate and discuss choices we make in taking care of the bureau's aging infrastructure. The term may be unfamiliar to us, but the principles of Asset Management really are not, having been practiced to some degree throughout our organization since the water delivery system was first created in the late 1800's. We have always done asset management; now we want to become better at it, as an advanced asset management organization.

The current focus on advanced asset management (AAM) is simply an effort to consistently apply accepted principles of science and economics to better determine when certain groups of assets will be maintained or monitored for condition changes; as well as whether to repair or replace those assets that have failed or will likely fail soon.

According to the International Standard, an advanced asset management organization should do the following:

- **Service Level**: Measure the level of service our assets currently deliver, the level of service our customers expect, and our customers' willingness to pay for that level of service.
- **Physical Condition & Criticality of Assets**: Understand and monitor the condition of assets so we can predict what future action will be necessary, and when. Understand the relative criticality of each asset so our focus is on maintaining or replacing those assets most critical to our business of delivering service.
- **Failure Modes of Assets**: Assess and understand the various ways in which an asset may fail and take steps to reduce the risk of failure by preventing or overcoming those failures.
- **Performance of Assets**: Measure and understand the performance of our assets in order to assess the effectiveness of operations, maintenance and capital improvement programs.
- **Prioritization of Projects Based on Value**: Schedule projects to suit available budgets so those with the greatest ratio of benefit to cost are undertaken first. The prioritization should consider lifecycle cost analysis, the triple bottom line (economic, social and environmental factors), and the impact of the project on risk of asset failure and on level of service.
- **Optimization of Operations and Maintenance Activities**: Minimize costs through an optimal blend of planned and unplanned maintenance activities, and by operating the system cost-effectively.

These are our goals. We need your participation and contributions to make this a success.

Portland Water Bureau Management Team

David Shaff, Administrator

Edward Campbell, Director, Resource Protection and Planning

David Hasson, Director, Finance and Support

Kelly Mulholland, Director, Maintenance and Construction

Mike Stuhr, Director, Engineering

Chris Wanner, Director, Operations

PORTLAND WATER BUREAU

FROM FOREST TO FAUCET

January, 2007