

**DOVER, NH
WATER SYSTEM
ASSET MANAGEMENT PRESENTATION
DOVER UTILITIES COMMISSION**



OCT 19TH, 2015

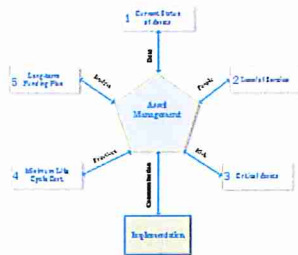
UNDERWOOD
ENGINEERS

Topics

- What is Asset Management?
- Dover's Water System/Asset Inventory
- Level of Service
- Critical Assets
- Life Cycle Costing and Funding
- Recommendations

Goal of Asset Management

- AM is improving "the way we do business" to provide services most cost effectively.

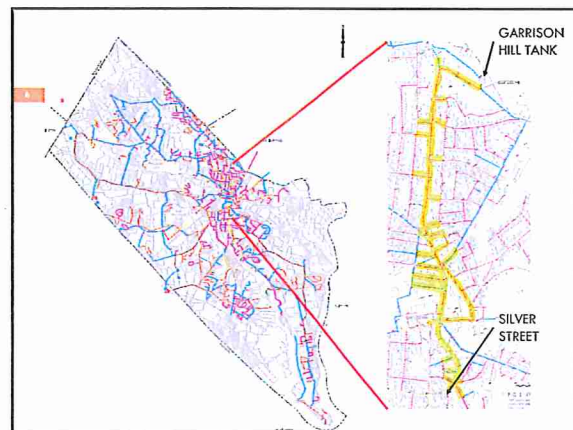


Benefits of Asset Management

- Improved system knowledge and sharing (age, condition, location, etc.)
- Meet service expectations and regulations
- Efficient spending on critical assets
- Improved decisions for rehabilitating or replacing assets
- Defendable budgets
- Long-term funding

Goals of this Project

- Build upon City's ongoing AM efforts
- Identify areas for improvement
- Develop methodology for ranking critical assets
- Update inventory, identify critical assets, and develop 10-year CIP for Focus Area
- Identify long-term planning and funding strategies
- Identify training and communication plan

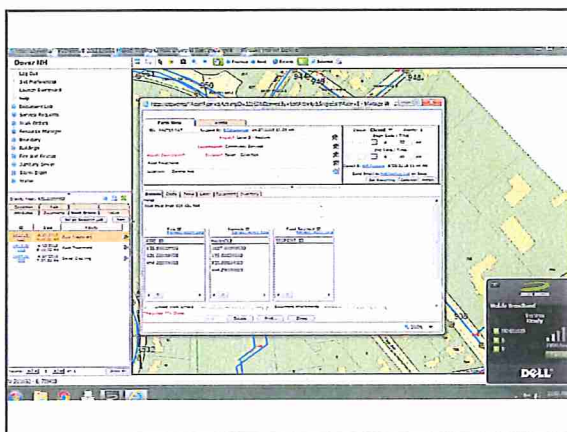
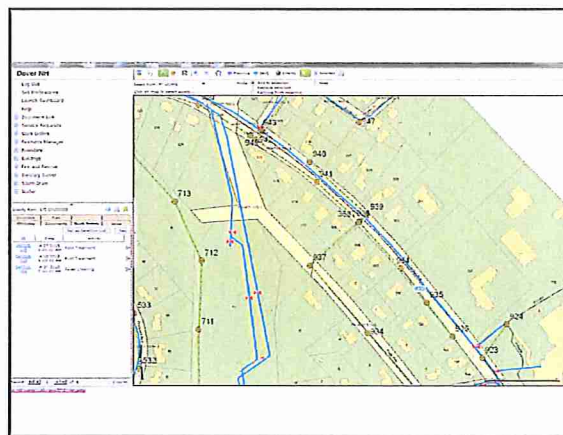
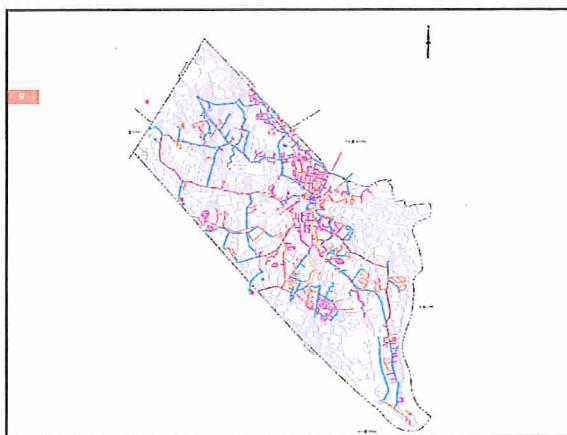


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Dover Water System

Dover Water System

- ❑ Average daily demand = 2.4 million gal./day
- ❑ 776,491 linear feet of water main
- ❑ Eight well pumping stations
- ❑ Three water treatment facilities
- ❑ Two artificial recharge facilities
- ❑ Two storage tanks
- ❑ One booster pumping station



Dover Water Mains by Age

Decode	Length (Feet)	Percent
1880's	20,678	2.6 %
1920's	2,428	0.3 %
1960's	575	0.1 %
1970's	1,451	0.2 %
1980's	2,330	0.3 %
2000's	1,224	0.2 %
Unknown	747,805	96.3 %
Total	776,491	

Dover Water Mains by Material

Material	Length (Feet)	Percent of System
AC	174,668	22.5 %
CI	148,214	19.1 %
Copper	1,304	0.2 %
CTS	1,586	0.2 %
DI	423,911	54.6 %
HDPE	8,110	1.0 %
PVC	5,366	0.7 %
Steel	350	0.0 %
Unknown	12,982	1.7 %
Total	776,491	

Dover Water Mains by Diameter

Size	Length (Feet)	Percent of System
1	1,029	0.1 %
2	6,683	0.9 %
4	7,052	0.9 %
6	189,563	24.4 %
8	238,549	30.7 %
10	13,557	1.7 %
12	233,695	30.1 %
14	7,392	1.0 %
16	66,417	8.6 %
Unknown	12,554	1.6 %
Total	776,491	

Asset Inventory

ID	Category	Street Name	From	To	Size (inches)	Length (feet)	Material	Year Installed	Typical Useful Life (Years)	Age
1	Water Main	Alley Street	Garrison Rd	Central Ave	15	1,113	CP	1019	115	127
2	Water Main	Angle St	Academy St	Central Ave	4	242	CP	1019	115	126
3	Water Main	Ark St	Ida Venable	Central Ave	4	242	CP	1019	115	127
4	Water Main	Bloch St	Third St	Central Ave	6	311	AC		115	
5	Water Main	Bancroft	St John St	Central Ave	12	525	CI	1978	119	45
6	Water Main	Central Ave	Elm St	Washington St	12	574	CP	1019	115	126
7	Water Main	Central Ave	Jefferson St	Washington St	12	574	CP	1019	115	127
8	Water Main	Central Ave	Washington St	Bridge	12	458	CP	1019	115	127
9	Water Main	Central Ave	Union Street	Bridge	12	295	CP	1019	115	127
10	Water Main	Central Ave	Bridge	Page St	12	47	CP	1019	115	127
11	Water Main	Central Ave	Page St	Second St	12	204	CP	1019	115	127
12	Water Main	Central Ave	Second St	Third St	12	124	CP	1019	115	127
13	Water Main	Central Ave	Third St	Bancroft	12	115	CP	1019	115	127
14	Water Main	Central Ave	Fourth St	Bancroft Street	12	431	CP	1019	115	127
15	Water Main	Central Ave	Under 8th Street	Bancroft Street	12	12	CP	1019	115	127
16	Water Main	Central Ave	Bancroft Street	Bridge St	12	12	CP	1019	115	127
17	Water Main	Central Ave	Bridge St	Fourth St	12	218	CP	1019	115	127
18	Water Main	Central Ave	Fourth St	Smith St	12	35	CP	1019	115	127
19	Water Main	Central Ave	Smith St	Third York St	12	202	CP	1019	115	127
20	Water Main	Central Ave	Third York St	Garky St	12	512	CP	1019	115	127
21	Water Main	Central Ave	Garky St	Charles Church	12		CP	1019	115	127

Level of Service

Dover – 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. Maintain aesthetically high quality water within Secondary Standards as much as possible.	100% of time When feasible
Availability	Make water available to as many residents in Dover as economically feasible. Fire flows will be maintained in accordance with ISO requirements except in extreme instances where cost is prohibitive.	Where feasible
Supply Capacity / Conservation	Minimize complete watering bans. Minimize non-revenue water and manage bleeders. Meet 10 State Standards for Supply Capacity as referenced by State Regulations. • Meet average day demands with largest well out of service • Meet maximum day demands with all wells in service • Comply with the conditions of the City's Conservation Plan	Except for extreme shortages

Dover – Level of Service Statement

Area of Service	Service Performance	Target Performance Level
Water Pressure	The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed 15 feet. The minimum working pressure in the distribution system should be 35 psi and the normal working pressure preferably 60 to 80 psi. Max pressure 130 psi. (Plumbing code requires 80 psi maximum at building which can be accomplished with pressure reducing valves.) Min pressure 20 psi during fire flows.	95% of time
Reliability	Notification of 48 hours prior to planned shutdowns. Respond to emergencies within 1 hour. Respond to supply or quality issues by phone or visit within 2 hours and resolve issue by end of next business day if possible. Repair unplanned shutdowns and breaks within 24 hours where feasible	95% of time

19 **Critical Assets**

Critical Assets / Risk Assessment

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Risk =
Probability of Failure X Consequence of Failure

Grading Matrices

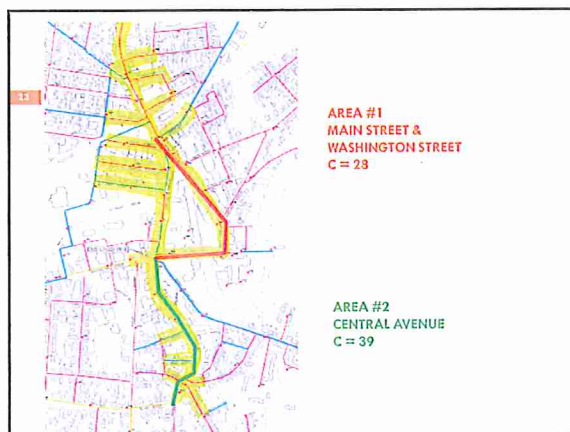
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	Probability of Failure			
	1	2	3	4
Asset Condition	Asset is brand new, or in brand new condition. Does not have any operational issues and requires no maintenance other than preventative maintenance.	Asset visibly shows signs of wear, but still considered to be reliable	Asset is in poor condition. Showing signs of significant wear	Asset is in poor condition. Showing signs of significant wear
Failure History	Asset has been installed for a considerable amount of time and not experienced any issues/required unscheduled maintenance. New assets have a manufacturer with a proven track record for quality products.	Asset has a history of failure and needed repairs in the past. Future failures may or may not be expected.	Asset has failed repeatedly and frequently in the past	Asset has failed repeatedly and frequently in the past
Age	Installed within 5 years	Asset is about half-way through its expected useful life	Asset has past its expected useful life	Asset has past its expected useful life
General Knowledge	Asset was known to be installed correctly according to manufacturer's specifications. Manufacturer has been used before and consistently provided a quality product trusted by the operational staff.	Installation methods unknown, manufacturer not used before.	Installation methods known to be incorrect, and may have possibly affected condition of asset. Manufacturer known to provide poor quality product	Installation methods known to be incorrect, and may have possibly affected condition of asset. Manufacturer known to provide poor quality product
Ability to Provide Level of Service	Asset consistently able to provide the desired level of service. No history of negatively impacting the performance of the system and its ability to provide the desired level of service	Asset has not failed in the traditional sense and is still operational, but consistently prevents the system from providing the desired level of service	Asset has not failed in the traditional sense and is still operational, but consistently prevents the system from providing the desired level of service	Asset has not failed in the traditional sense and is still operational, but consistently prevents the system from providing the desired level of service

Grading Matrices

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	Consequence of Failure			
	1	2	3	4
Regulatory Compliance	The failure of the asset will not hinder the Water System's ability to meet regulatory standards.	The failure of the asset will result in failure to comply with secondary standards.	The failure of the asset will result in failure to meet critical aspects of the Level of Service	The failure of the asset will result in failure to comply with Primary Standards set by State and/or Federal agencies
Reduced Level of Service	The failure of the asset will not hinder the Water System's ability to meet any of the desired Level of Service Goals	The failure of the asset will result in failure to meet the non-critical aspects of the Level of Service	The failure of the asset will result in failure to meet critical aspects of the Level of Service	The failure of the asset will result in failure to meet critical aspects of the Level of Service
Cost of Repair	The cost to repair this asset is low, or a replacement for the asset is readily available/already on-hand	The cost of repair is moderate and will not strain maintenance budget. Replacement parts/equipment may not be readily available	The cost of the repair is high, and replacement parts/equipment is not readily available	The cost of the repair is high, and replacement parts/equipment is not readily available
Social Cost	Failure of the asset will have little impact on the community. There are no large users or hospitals/schools that will be impacted by the failure of this asset	Failure of the asset has potential to impact large users or hospital/school. Repairs will be in a moderately trafficked section of the community	Failure of the asset will have a large impact on the community. Service to a large user or hospital/school may be interrupted. Repairs will take place in high traffic area	Failure of the asset will have a large impact on the community. Service to a large user or hospital/school may be interrupted. Repairs will take place in high traffic area
Collateral Damage	The failure of the asset will not have an effect on other assets in the system, or cause any other assets in the system to fail	Failure of the asset may cause strain on other assets in the system, but is not necessary for meeting Level of Service	Failure of the asset is expected to cause a significant strain on other assets in the system in order to meet level of service	Failure of the asset is expected to cause a significant strain on other assets in the system in order to meet level of service



Critical Assets in Focus Area

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Asset	Recommended Action	Priority	Time Action Required
Water Main Branch installed on Main Street from Broadway to Washington Street to interconnect with Central Avenue. Replace with 12-inch DI.	Replace with 12-inch DI	1	ASAP*
Water Main 10-inch installed on Central Avenue from Washington Street to Silver Street	Replace with 12-inch DI	2	ASAP*
Water Main 10-inch installed on Central Avenue from Gannon Mill Tank to Broadway and 18-inch lined on Central Avenue from Broadway to Washington Street	Monitor for leaks/breaks. Install additional line valves to improve isolation of critical segments (Figure 2)	3	Ongoing. Next 1-2 years.
Water Main under Railroad on Central Avenue	Confirm pipe is sleeved and inspect condition	3	Next 1-2 years.

* These segments of water main have exceeded their estimated useful life (115 years). They should be addressed as soon as funding is available and/or coordinated with other infrastructure projects on these streets.

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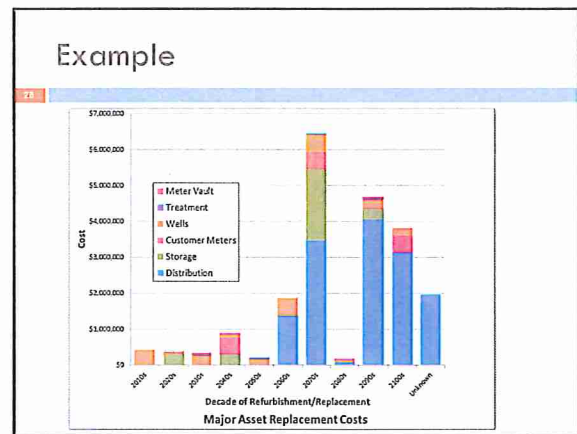
Life Cycle Costing

Water Main Replacement Costs – Focus Area

Replacement Decade	Length (ft)	Cost
1990's	16,560	\$6,790,000
2070's	1,312	\$538,000
2080's	648	\$266,000
2100's	1,105	\$453,000
Unknown	561	\$230,000
Total	20,186	\$8,276,000

Water Main Replacement Costs – Entire City

Replacement Decade	Length (ft)	Cost
1990's	20,678	\$6,410,000
2020's	2,428	\$753,000
2050's	575	\$178,000
2070's	1,451	\$450,000
2080's	2,330	\$722,000
2100's	1,224	\$379,000
Unknown	747,804	\$231,819,000
Total	776,488	\$240,711,000
Average cost per year (100 years)		\$2,407,000



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Long Term Funding

Long-Term Funding (next 100 years)

Funding Component	Cost
Total Annual Funding Required for Future Replacement	\$2,407,000
Assume 50% funding from Capital Reserves, Annual Requirement	\$1,203,500

10-year CIP for Focus Area

Project	Priority	Year	Cost
#1 Main Street / Washington Street Water Main: 8-inch unlined CI on Main Street from Broadway to Washington Street to intersection with Central Avenue. Replace with 12-inch DI. (2,250 LF +/-)	1	2017	\$922,500
#2 Central Avenue Water Main: 10-inch unlined CI on Central Avenue from Washington Street to Silver Street. Replace with 12-inch DI. (1,800 LF +/-)	2	2020	\$738,000

Project	2016	2017	2018	2019	2020	2021
Main Replacement - City Wide	\$75,000	\$75,000	\$75,000	\$75,000	\$75,000	\$75,000
Keating/Birchwood	\$50,000	\$500,000				
Nelson	\$200,000					
Union	\$150,000					
Main/Washington		\$100,000			\$1,000,000	
Piscataqua/Drew		\$300,000	\$1,000,000	\$900,000		
Richardson		\$40,000				
Tanglewood		\$50,000				
Elm Street Area				\$100,000		\$725,000
Oak/Broadway Area					\$1,250,000	
Spur Road					\$100,000	
Central Avenue Lower						\$100,000
Central Avenue Upper						\$75,000
Littleworth						\$100,000
Totals	\$475,000	\$1,065,000	\$1,075,000	\$1,075,000	\$2,425,000	\$1,075,000

Next Steps

- ❑ Continue to update and maintain GIS data.
- ❑ Expand Risk/Priority scoring to entire system.
- ❑ Expand life cycle costing to entire system.
- ❑ Review and adopt the Level of Service statement.
- ❑ Communicate AM efforts and goals to staff and public.
- ❑ Implement recommended capital improvements.
- ❑ Increase annual funding for water main R&R.
- ❑ Apply for upcoming AM grants through DES.

Executive Summary

Asset Management (AM) is an approach to maintaining aging infrastructure through informed decision making. AM Plans have many benefits and are crucial to utilities for cost effectively maintaining their aging infrastructure. 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?

This Asset Management Plan is intended to establish an initial AM Program for Dover to make more informed decisions for sustainable operation. The scope of this initial effort is limited to a Focus Area of water mains along Central Avenue from the Garrison Hill Reservoir to the Silver Street intersection. The City will be able to build off this guide and expand the AM Plan to the entire system, including distribution, supplies and vertical assets (i.e. pumping stations, treatment plants, storage).

Asset Inventory

The Asset Inventory and Assessment is the necessary first step of AM. The inventory collects and organizes data in a useful way to make better management decisions. The City has started to inventory water system assets in its GIS. Most water main segments are included with diameter and material. The City intends to add detail over time including installation dates.

Underwood Engineers developed a detailed inventory of Dover's assets in the Focus Area (Appendix B).

Water system distribution maps (Appendix A) were plotted based on information provided by the City of Dover to display pipe age, size, and material.

Level of Service

The Level of Service (LOS) Statement defines the way in which the utility managers and operators want the system to perform over the long term (NMEFC, 2006). The LOS must include standards for regulatory compliance and may include additional components such as quality, quantity, and reliability. The LOS was developed through a series of discussions and meetings with Dover staff, and was made to fit their desired service. The LOS is summarized in Table ES-1.



Table ES-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 Dover as economically feasible	Where feasible
	Fire flows will be maintained in accordance with ISO requirements except in extreme instances where cost is prohibitive.	
Supply Capacity /Conservation	Minimize complete watering bans Minimize non-revenue water and manage bleeders Meet 10 State Standards as referenced by State Regulations • Meet average day demands with largest well out of service • Meet maximum day demands with all wells in service	Except for extreme shortages
Water Pressure	The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed 15 feet. The minimum working pressure in the distribution system should be 35 psi and the normal working pressure preferably 60 to 80 psi. Max pressure 130 psi. (Plumbing code requires 80 psi maximum at building which can be accomplished with pressure reducing valves.) Min pressure 20 psi during fire flows.	95% of time
Reliability	Notification of 48 hours prior to planned shutdowns. Respond to emergencies within 1 hour. Respond to supply or quality issues by phone or visit within 2 hours and resolve issue by end of next business day if possible. Repair unplanned shutdowns and breaks within 24 hours where feasible	95% of time



Critical Assets

The purpose of defining critical assets is to determine where limited resources should be allocated to meet the required LOS. A common approach to determining risk is by the combination of probability of failure and consequence of failure. 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).

Using the methodology described in Section 4.1 and Grading Matrices, the water main assets in the Focus Area were scored for Probability of Failure and Consequence of Failure and given a Risk Score. Results were incorporated into the Asset Management Inventory spreadsheet (**Appendix B**).

UE and City personnel performed hydrant flow testing to help identify which water mains in the focus area required the most immediate attention.

The highest risk assets and recommended replacement years are summarized in Table ES-2.

Table ES-2. Critical Assets in Focus Area

Asset	Recommended Action	Priority	Year Action Required
Water Main: 8-inch unlined CI on Main Street from Broadway to Washington Street to intersection with Central Avenue. Replace with 12-inch DI	Replace with 12-inch DI	1	ASAP*
Water Main: 10-inch unlined CI on Central Avenue from Washington Street to Silver Street	Replace with 12-inch DI	2	ASAP*
Water Main: 16-inch lined CI on Central Avenue from Garrison Hill Tank to Broadway and 14-inch lined CI on Central Avenue from Broadway to Washington Street	Monitor for leaks/breaks. Install additional line valves to improve isolation of critical segments.(Figure 2)	3	Ongoing. Next 1-2 years.
Water Main under Railroad on Central Avenue	Confirm pipe is sleeved and inspection condition	3	Next 1-2 years.

* These segments of water main have exceeded their estimated useful life (115 years). They should be addressed as soon as funding is available and/or coordinated with other infrastructure projects on those streets.



Life Cycle Costing

Life Cycle costing was performed for all water mains in the City of Dover. The life cycle costing step evaluates long term capital needs. Life cycle costing is a defensible tool to help support necessary funding levels for sustainability of the system. Total water system replacement costs are summarized in Table ES-3.

Because the ages for most of the mains throughout the City's distribution system are unknown, a replacement date can only be assumed. Assuming a life expectancy of approximately 100 years, dividing the total replacement cost by 100 gives a first estimate of annual investment needed to replace existing assets when necessary.

Once the City identifies the ages of more water main assets, lifecycle costing can be refined to estimate future replacements costs and funding needs by decade (example figures Appendix H).

Table ES-3. Water Main Replacement Costs - Entire City

Replacement Decade	Length (ft)	Cost
1990's	20,678	\$6,410,000
2020's	2,428	\$753,000
2060's	575	\$178,000
2070's	1,451	\$450,000
2080's	2,330	\$722,000
2100's	1,224	\$379,000
Unknown	747,804	\$231,819,000
Total	776,488	\$240,711,000
Average cost per year (100 years)		\$2,407,000

10-Year CIP for Focus Area

Table ES-4 shows the assets in the Focus Area that should be included in a 10-year Capital Improvements Plan (CIP).

Table ES-4. Recommended 10-year CIP for Focus Area

Project	Priority	Year	Cost
#1 Main Street / Washington Street Water Main: 8-inch unlined CI on Main Street from Broadway to Washington Street to intersection with Central Avenue. Replace with 12-inch DI. (2,250 LF +/-)	1	2017	\$922,500
#2 Central Avenue Water Main: 10-inch unlined CI on Central Avenue from Washington Street to Silver Street. Replace with 12-inch DI. (1,800 LF +/-)	2	2020	\$738,000

Note: See Section 6.1 for basis of costs.



Long-Term Funding

The average annual cost to be set aside for future water main projects is \$2,407,000.

If Dover plans to save 50% of the total cost for future projects, and distributed the cost over the next 100 years, the City will need to **save \$1,203,500 per year**.

By comparison, the City currently puts \$500,000 annually into Capital Reserves, and the CIP includes \$75,000 annually for unspecified water main replacements in addition to specific CIP water main replacement projects year-to-year.

Implementation and Communication

An AM Plan is a working, living document, constantly being updated. Both the staff and customers provide important information that can help to keep AM effective. A communication plan lays out how to get this information, and make sure that both staff and customers understand the importance of AM. A suggested communication plan is shown below (Table ES-5):

Table ES-5. Communication Plan

Audience	Outreach Strategies
Internal - Staff	• Develop Asset Management Charter to hand out to employees (sample attached in Appendix F). • Conduct team meetings on strategic goals, record keeping, and importance of asset management. • Develop form for keeping a log of repairs – make it easy to write down important information.
External - Customers	• Create hotline for calls for construction project suggestions and complaints, and have a response program for addressing both. • Notify customers of system updates (projects, issues, construction location/time) through the following medias: ○ System water bills ○ Brochures (See Appendix F for AM brochure). ○ Local newspapers • Conduct public survey to receive customer's comments about the water system



Recommendations

AM Plan Implementation and Future Tasks

- Continue to collect and update asset data and condition assessment in GIS.
 - Some lengths currently in the GIS database do not match the scaled entity lengths and should be checked and updated.
 - Continue to input estimated installation dates for water main in GIS. 96% of the system currently does not have installation dates.
 - Record service and failure history for assets to refine the estimated useful life. These records can be used to update asset data.
 - Assign a staff member to maintain the asset inventory in GIS.
- Incorporate fields of scoring Probability of Failure, Consequence of Failure and Risk Score (Probability x Consequence) into GIS.
 - Populate fields for Focus Area per this report.
 - Score remaining water main assets City-wide using guidance in Sections 4.3 and 4.4.
- Expand asset management planning to include supplies and vertical assets (pumping stations, treatment plants, storage tanks).
- Apply AM principles (criticality, risk assessment, remaining useful life, etc.) to lower-tier assets (i.e. valves, hydrants, services).
- Review and adopt the Level of Service (LOS).
- Expand asset management planning to include supplies and vertical assets (pumping stations, treatment plants, storage tanks).
- Monitor performance data, complaints, etc. to ensure LOS is being met, and refine LOS Statement as needed.
- Update critical assets as renewals are made and information is collected.
 - As assets are replaced and refurbished, update the “Probability of Failure” ranking to identify which assets are most critical.
- Update life cycle costs and budgeting as needed.
- Submit plan to DES for Asset Management Grant Reimbursement.
- Apply for future rounds for AM Grant funding. Next application due December 5, 2015.

AM Communication

- Establish a Communication Program for customers, demonstrating the value of service and justifying the funding to sustain needs. Program elements may include:
 - Distribute AM brochure to customers (attached in Appendix F).
 - AM content on website.
 - Public information meetings for major projects.
 - Customer surveys.
- Educate and inform all staff on AM principles and process.
- Develop an Asset Management Charter for staff (see example in Appendix F).
- Conduct team meetings on strategic goals, record keeping, and asset management decisions.



- Allow asset information to be accessible and shared by staff.

Administrative Tasks

- Perform an update to the 2014 Water Audit to help track non-revenue water, and reduce lost water.
- Closely monitor piping in the focus area of this Asset Management Plan. Area contains mains that have exceeded life expectancy, and service a critical part of the City.
- Perform a water rate evaluation to assess the potential impact of the recommendations of this report.

CIP – Near Term Projects

- Program the recommended projects for the Focus Area (Section 6.1) into the 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.
- Install additional isolation valves on Central Avenue (Figure 2 and Section 4.3.2). Assumed to be paid out of operating budget.

Long Term Funding

- Increase annual capital reserve contributions to \$1,203,500 to \$2,407,000 per year to support long term asset renewals (50% to 100% of estimated funding need, respectively.)
- The required capital reserve depends on the level of future risk that is accepted.
- Once installation dates are entered into GIS for a larger percentage of the system, estimate remaining useful life and expected replacement year to project long-term funding needs by decade.

