DC WASA

Water System Facilities Plan Update

Executive Summary

DC WASA

Hatch Mott MacDonald

June 2009

Note to Readers

This Water System Facilities Plan, drafted in 2008, identifies a comprehensive program to address currently known problems in the water infrastructure and a proactive component for annual system renewal. It specifically addresses the needs of the District of Columbia's water system. The draft reflected consultant recommendations that were evaluated during the year by various stakeholders within DC WASA. This 2009 publication reflects the input and guidance provided by those stakeholders.

The Facilities Plan lays out a recommended 10-year program of water system improvements. The Facilities Plan provides a guiding framework for water system investments that are implemented through the 10-year Capital Improvements Program (CIP). Through the annual CIP process, projects and needs identified in the Facilities Plan are prioritized and the most important projects are budgeted. Ultimately, the CIP reflects consideration of many factors, including impact of the proposed expenditures on customer rates, spending needs for other service areas (e.g., wastewater treatment and sewer infrastructure), and new water system needs that may emerge over the course of the year. Thus, readers are cautioned that the projects and dollars specified in this Plan will be modified through each annual CIP process.

EXECUTIVE SUMMARY

This Water System Facilities Plan Update (2009 Facilities Plan Update) provides a comprehensive evaluation of the District of Columbia Water and Sewer Authority (DC WASA) water system and presents a strategy for improvements to ensure that DC WASA can continue to provide safe, adequate, and reliable service to its customers. Specifically, this 2009 Facilities Plan Update:

- Presents population and demand projections through the year 2030;
- Reviews current and proposed water quality regulations;
- Evaluates pumping, storage, transmission and distribution infrastructure systems and identifies investment needs to continue providing reliable supply at adequate flows and pressures; and
- Presents prioritized Capital Improvement Program (CIP) projects.

0.1 Background

From 1938 to 1996, the District of Columbia Water and Sewer Utility Administration (WASUA) was part of the DC Government. In 1996, DC WASA was created as a financially separate, semi-autonomous municipal utility. DC WASA provides retail drinking water distribution, wastewater collection, and wastewater treatment services to the District of Columbia and provides wholesale wastewater treatment services to certain suburban jurisdictions.

Initially, the focus of DC WASA efforts was to make critical repairs to the water and wastewater infrastructure. As a priority related to the water system, DC WASA addressed an Administrative Order and Consent Decree issued to its predecessor agency (WASUA) to implement improvements needed for water storage facility rehabilitation, cross-connection elimination and various operations-oriented projects. In September 2000, DC WASA completed its first Water System Facilities Plan (2000 Facilities Plan), which was a master document used as guidance in the development of the water system CIP. In general, that 2000 Facilities Plan identified fourteen specific projects and a small diameter water main rehabilitation program. In August 2008, 9 of the 14 projects included in the 2000 Facilities Plan have been completed or are under construction and the small diameter water main rehabilitation program is underway. Also, DC WASA implemented meter replacement, cross

connection elimination, valve replacement, fire hydrant upgrade and other programs including a major program to replace lead services lines in public space.

Moving forward, this 2009 Facilities Plan Update was prepared as a refined master document that can be used as a reference in managing the water service area CIP in the future.

0.2 Overview and Purpose

The 2009 Facilities Plan Update addresses several planning horizons for DC WASA, including:

- A holistic assessment of the water distribution system that can be used in support of the 10-year water service area CIP.
- A 20-year planning period - through 2030.
- Short-term planning - identification of specific projects.
- Long-term planning - highlights potential future investments.

The 2009 Facilities Plan Update summarizes the planning approaches, assesses current and future needs, examines the impacts, provides alternatives, and lists recommendations. Because the 2009 Facilities Plan Update is a guiding document for capital investment, the scope does not include an assessment of the needs and resources related to operating and maintaining the water system. Wherever possible, recommendations have been made to identify those parts of the system that can benefit from capital expenditure; however, it should be expected that operational policies and procedures will both impact and be affected by the 2009 Facilities Plan Update and the future CIP, for example the valve replacement program improves operations; however the valve replacement program necessitates a valve exercise program. Therefore, DC WASA should allow for a certain level of flexibility to respond to both unforeseen engineering and operational challenges in its long-term planning to attain its stated goal of providing safe and reliable drinking water to its customers in an efficient and economical manner. Attempts to quantify this level of flexibility as it relates to capital investment are incorporated into the 2009 Facilities Plan Update.

The 2009 Facilities Plan Update solely includes the assessment of water system facilities operated by DC WASA and does not include a detailed evaluation of the facilities owned / operated by the United States Army Corps of Engineers – Washington Aqueduct Division (WAD). The document does not include a review of the lead service replacement and meter replacement / AMR installation programs, which are listed under the Water Service Area CIP. Also, it is beyond the scope of the 2009 Facilities Plan Update to assess DC WASA's financial procedures and position.

0.3 Planning Principals and Policies

As discussed earlier, the primary goal of the facility planning process is to provide recommendations for the CIP that allows DC WASA to continue to deliver water, supplied from the Washington Aqueduct, through the extensive transmission, distribution, and storage infrastructure that is:

- ***Safe*** – Meet all current and proposed water quality drinking standards and regulations.
- ***Adequate*** – Domestic flow, fire flow capacity, and pressure.
- ***Reliable*** – Dependable delivery of high quality water at adequate pressures.
- ***Economical*** – Cost-effective solutions based upon a life-cycle cost approach.
- ***Secure*** – Mitigate the potential for accidental or malevolent acts that could compromise the delivery of a high quality supply of water.

In order to arrive at the recommendations for capital improvements, applicable planning criteria was applied. In general, guidance for planning was obtained from several sources, including:

1. Regulatory oversight and compliance requirements;
2. Administrative orders;
3. Accepted engineering standards and practices; and
4. Interagency efforts.

0.4 Existing System

Finished water is purchased from WAD and DC WASA is the sole retail distributor of water to the District of Columbia. WAD is responsible for issues of source of supply and treatment, while DC

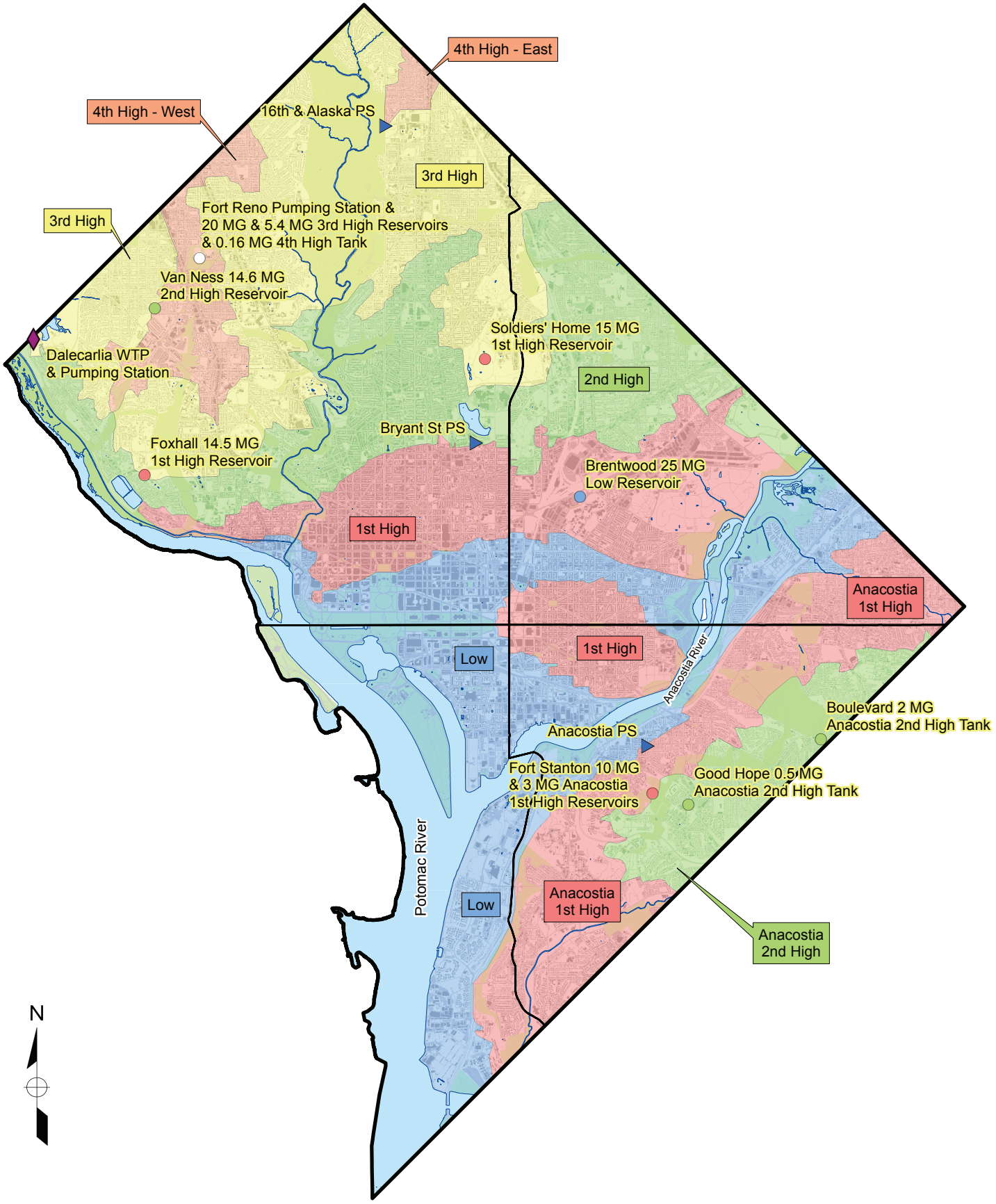
WASA has lead responsibility for finished water distribution in the District of Columbia. Pumping and storage responsibilities are shared between DC WASA and WAD. Also, WAD serves other jurisdictions and assumes ownership and responsibility for certain transmission mains within the District of Columbia independent from DC WASA.

The operation of the DC WASA water system is governed by the physical geography of Washington, DC with the Anacostia River and Rock Creek as natural barriers, which divide the City. In order to deliver adequate pressure given the variations in ground elevations, the distribution system is currently divided into eight different pressure zones called service areas as shown in Figure A.

Currently, DC WASA is implementing a plan to create a new service area in the southern portion of existing Anacostia 1st High Service Area improve pressure conditions in the vicinity of Hadley Hospital, Greater Southeast Hospital, St. Elizabeths Hospital, and Congress Heights. Figure B identifies the limits of the new service area – Proposed Anacostia 2nd High Service Area. This pressure re-zoning plan east of the Anacostia River includes the following projects that are included in the approved CIP:

- Project M7 – Replacement of the Anacostia Pumping Station
- Project MA – 2 MG Proposed Anacostia 2nd High Elevated Storage Tank
- Project MK – Replacement of key transmission mains with a known history of breaks and the installation of new transmission mains.
- Projects MT & MU – Replacement of small diameter distribution mains based upon age and condition that will experience increased pressures.

DC WASA serves approximately 130,000 water service connections, supplying on average 121 million gallons per day (MGD). In general, DC WASA maintains water service connections between the water mains and the property line, while the private property portion is the responsibility of the property owner. The water distribution system facilities managed by DC WASA consist of four pumping stations, five reservoirs, and three elevated storage tanks.



DC WASA Water System Facilities Plan Update

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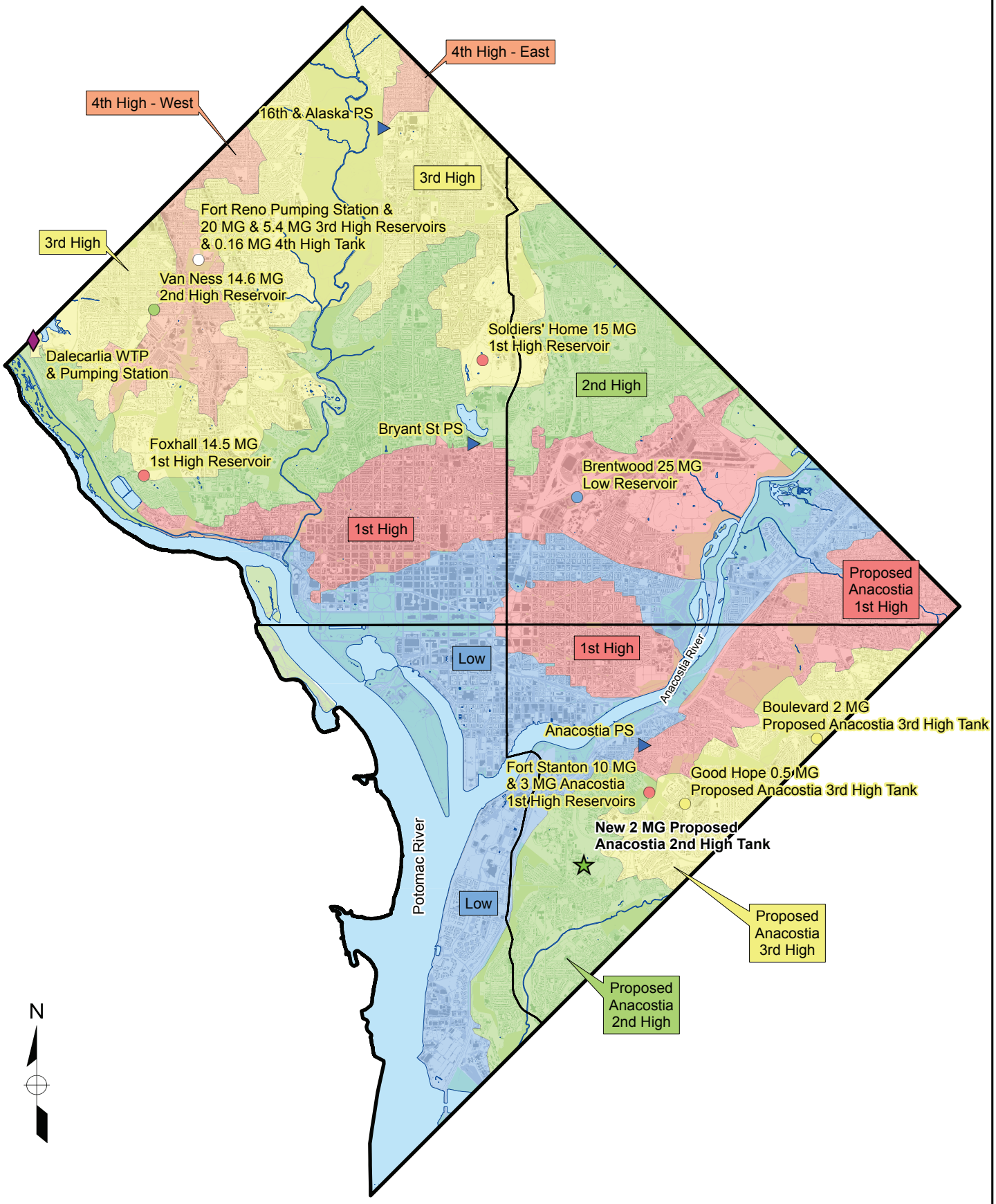
Existing Water Service Areas

Figure A



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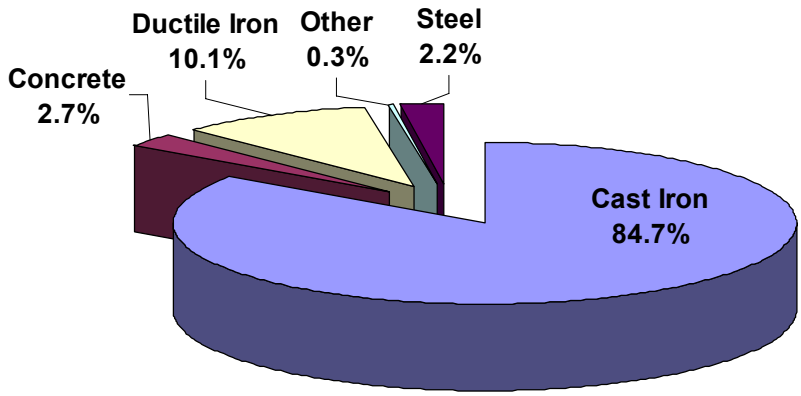
Proposed Water Service Areas

Figure B

DC WASA's water system infrastructure consists of approximately 1,300 miles of pipes, 36,000 valves, and 8,700 hydrants. Pipes / water mains are generally classified as transmission (16-inch diameter and larger) and distribution (12-inch diameter and smaller) with service connections usually from the distribution mains. As shown in Figure C, the vast majority of pipes are either cast or ductile iron (over 90%), with steel and concrete making up about 5%. In 2006, DC WASA installed the first of three PVC water main projects in areas suspected of aggressive corrosion within the distribution system.

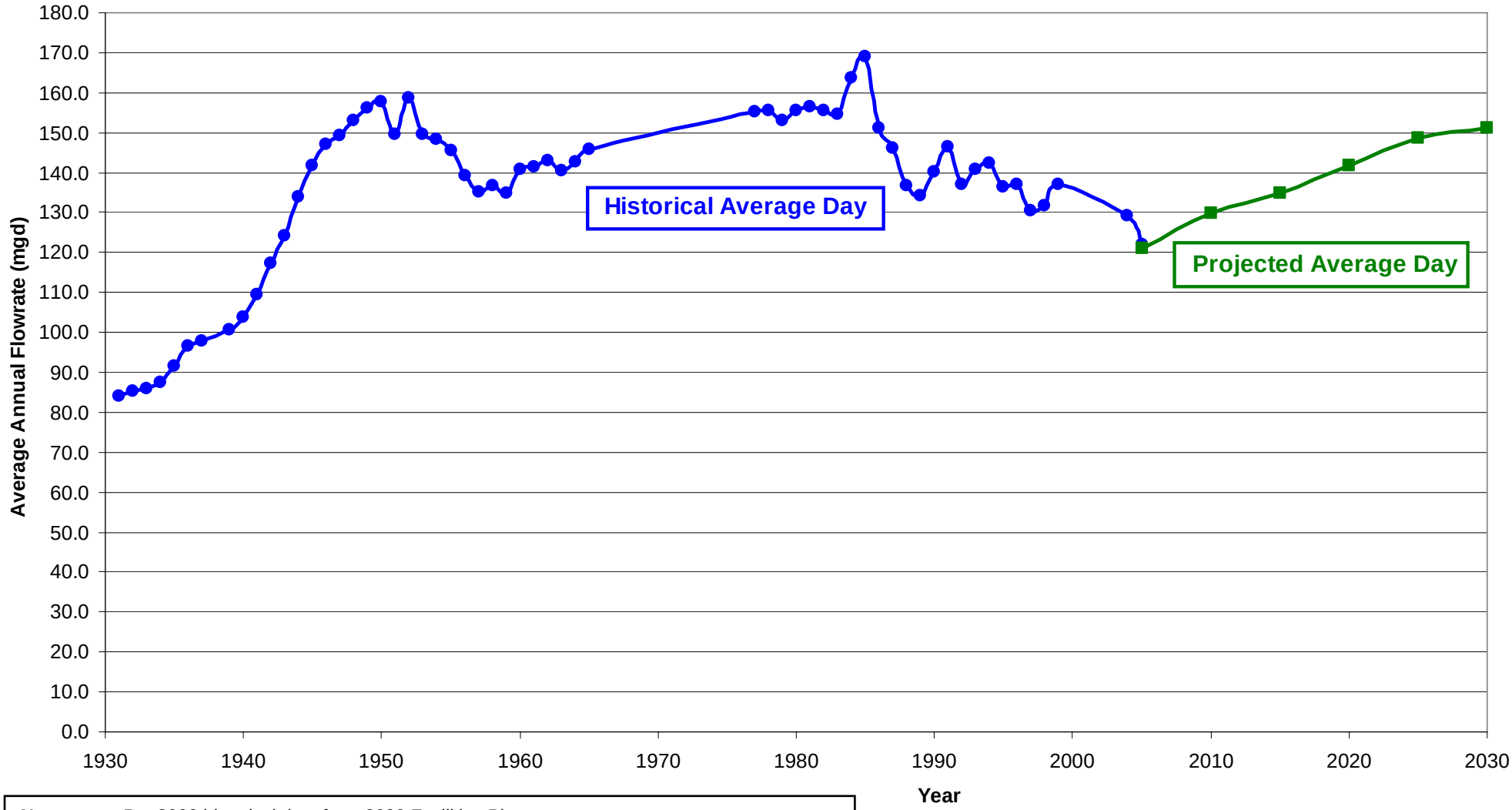
Figure C
Water Main Materials



0.5 Water Demands

Demand projections were developed to provide a basis for evaluating future system needs due to system growth. Projections of the number of customers and their associated demands were developed for the water system until the year 2030. Demographic projections of employment, households and household population for the DC WASA service area were based upon Round 7.1 forecasts developed by the District of Columbia Office of Planning on behalf of the Metropolitan Washington Council of Governments.

Figure D shows historical average day demands as documented in the 2000 Facilities Plan, historical demands from years 2004 and 2005 with the projected demands as further detailed herein. It can be seen that water demands since 1950 have remained relatively constant. The latest data obtained from the monthly water consumption reports shows a continuation of a gradual decreasing trend since the



Notes:
Pre 2000 historical data from 2000 Facilities Plan
2004 and 2005 data from DWS Pumping Division monthly water consumption reports
Data between 2000 and 2004 extrapolated to connect graph

DC WASA Water System Facilities Plan Update

June 2009

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Historical and Projected Water Demands

Figure D

mid-1980s. This is relatively consistent with population decline in DC noted in the 2006 Comprehensive Plan (prepared by the DC Office of Planning), which states that, between 1970 and 2000, the population decreased by almost 25 percent, and the average size of households reduced from 2.72 persons to 2.16 persons.

Monthly water consumption reports provided by the Department of Water Services (DWS) for calendar years 2004, 2005, and 2006 were used to calculate the historical demand and demand forecasts totaled for each service area. Using Geographical Information System (GIS) tools, the total usage per service area was determined. Similar to the 2000 Facilities, an "equivalent population" was calculated for each forecast year in each service area. This equivalent population allows for the estimation of one demand factor for each service area. Using equivalent population requires no assumptions and allows estimated demand factors to be customized to the unique characteristics of each service area. Using population forecasts and historical water usages, water demands were projected for the existing and future service areas.

0.6 Water Quality

The operations of WAD and DC WASA are subject to the water quality requirements of the United States Environmental Protection Agency's (EPA) Safe Drinking Water Act (SDWA) and, in 2007, water quality met or exceeded the SDWA requirements. The most significant water quality regulatory issues impacting DC WASA's distribution system are the Lead and Copper Rule, Total Coliform Rule, and Disinfectants/Disinfection By-Products Rules (D/DBP).

0.6.1 Lead and Copper Rule

Under the Lead and Copper Rule (LCR) promulgated under the Federal SDWA, DC WASA is required to sample water at the customer's tap to determine levels of lead and copper. In general, this sampling and testing determines the effectiveness of the corrosion control treatment in preventing the leaching of lead and copper from buildings' plumbing materials. The LCR establishes Action Levels for lead and copper. In each round of sampling, 90% of the results must be below the Action Levels (AL). Exceedance of the AL in more than 10% of

samples triggers additional requirements for public education and lead service line replacement. Currently, DC WASA is in compliance with the LCR.

In monitoring conducted between 2001 and 2004, more than 10% of the lead sampling test results exceeded the Lead AL. As a result, DC WASA was required by the LCR to replace 7% of lead services each year. Since 2005, less than 10% of the lead sampling test results in each monitoring round have exceeded the LCR Lead AL, therefore DC WASA is no longer required to replace lead service lines under the LCR. However, DC WASA has continued with a lead service replacement program that currently includes public space replacement with water main replacement work and / or where the customer has agreed to replace the private side.

As a water system that has established optimized corrosion control treatment, DC WASA is required by the LCR to monitor for specific water quality parameters in the distribution system. These parameters are related to the corrosivity of the water, and allow the system to determine whether optimal conditions for corrosion control are being maintained. DC WASA presently monitors LCR water quality parameters (pH, nitrite, dissolved orthophosphate, and free ammonia) at ten sites twice per year. EPA has set excursion limits for pH and dissolved orthophosphate for the DC WASA system. DC WASA has developed procedures to follow if an excursion limit is exceeded.

0.6.2 Total Coliform Rule

The Total Coliform Rule (TCR) became effective on December 31, 1990 and requires monthly testing and monitoring of water delivered throughout the system for the presence/absence of total coliform bacteria; an indicator of potential contamination of the potable water system. DC WASA currently monitors for total coliform at over 50 locations within the system. Detection of positive total coliforms in more than 5% of monthly samples or detection of fecal contamination in follow-up sampling triggers public notification. In 2007, DC WASA has been safely within the Federal requirements regarding monthly percentage of positive coliform samples. EPA is currently reviewing the TCR and expects to propose revisions to the rule in 2010.

0.6.3 Disinfectants / Disinfection Byproducts (D/DBP) Rule - Stage 1

The Stage 1 D/DBP rule became effective in February 1999 and establishes maximum residual disinfectant levels (MRDLs) for three chemical disinfectants (chlorine, chloramines, and chlorine dioxide) and maximum contaminant levels (MCLs) for total trihalomethanes (TTHM), haloacetic acids (HAA5), chlorite, and bromate. When the Rule was proposed, the Washington Aqueduct conducted studies and concluded that conversion from free chlorine to chloramines was the most cost-effective approach in achieving compliance. In November 2000, the switch from free chlorine to chloramines was completed, which has resulted in a reduction in the formation of TTHMs. During the period of 2002 – 2007, system-wide average levels of disinfection by-products in DC WASA's distribution system were in compliance with the maximum contamination limits established under the Stage 1 D/DBP Rule.

0.6.4. Stage 2 D/DBP Rule

The Stage 2 D/DBP Rule was finalized in 2006 and strengthens public health protection by requiring systems to meet maximum contaminant levels as an average at each compliance monitoring location (instead of as a system-wide average as in previous rules) for two groups of DBPs, TTHMs, and HAA5. Stage 2 D/DBP Rule monitoring commences in 2009. Based upon recent monitoring, DC WASA's system should be in compliance with the Stage 2 D/DBP Rule.

0.6.5. Long Term 2 Enhanced Surface Water Treatment Rule

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) was finalized in 2006 and supplements existing regulations to further reduce the risk of microbial contamination.

The LT2ESWTR requires EPA to conduct a sanitary survey of the DC WASA system to identify significant deficiencies in source protection, infrastructure, operation and/or maintenance that could increase the risk of microbial contamination of the water supply. Systems are required to submit a written response to EPA within 45 days of receipt of the sanitary survey report, indicating an action plan and schedule for correction of any significant

deficiencies found. The findings of EPA sanitary surveys could require additional capital improvements to the DC WASA facilities.

0.6.6. Anticipated Regulations

Anticipated future Federal regulations include the Radon Rule, which will primarily affect groundwater systems and is not expected to impact the DC WASA water system. Also, EPA is considering establishing an MCL for perchlorate, which is a naturally-occurring and manmade chemical that has recently been identified as a contaminant of concern. WAD has reportedly been monitoring for perchlorate in its drinking water with no detections to date. However, DC WASA is aware of perchlorate contamination in soil in the vicinity of the water sources, so monitoring should continue.

0.6.7. Other Distribution Water Quality Factors

Other factors originating in the distribution system that can also impact water quality are nitrification and tuberculation. A condition in older unlined water pipes, tuberculation is characterized by reddish brown mounds of various heights attached to the interior of the pipe wall. This is a concern due to the 740 miles of unlined cast iron pipe in DC that have tuberculation. In addition to reducing hydraulic efficiency, tuberculation impairs water quality - red water, taste and odor problems, turbidity, and lowers chlorine residual.

0.7 Pumping Stations

As part of this plan, the four (4) pumping stations operated by DC WASA listed in Table A were evaluated with specific needs identified as CIP projects. This evaluation included site visits and interviews with Safety, Department of Maintenance Services (DMS) and DWS operations staff with observations documented, review of the reliability of electrical and control systems, assessment of surge protection and review of firm capacity (largest pump for each zone out of service) versus future maximum day demand forecasts.

Table A
DC WASA Pumping Stations

Facility Name	Service Area	Construction (Latest Renovation)	Firm Capacity
Bryant Street Pumping Station	Pumps to Low, 1st High, 2nd High, and 3rd High	1904 (2006)	204.5 MGD
Fort Reno Pumping Station	Pumps from 3rd High to 4th High West	1977	15.7 MGD
16th & Alaska Pumping Station	Pumps from 3rd High to 4th High East	1993	3.5 MGD
Anacostia Pumping Station	Pumps from Low to: Anacostia 1st and 2nd High *Proposed Anacostia 1st, 2nd and 3rd High*	2009	82.8 MGD

0.7.1 Bryant Street Pumping Station

Bryant Street Pumping Station was originally constructed in 1904, renovated in the mid-1950s, and a major renovation project was completed in 2006. The recent $55 million rehabilitation included rehabilitation/replacement of the eleven (11) pumps and motors, valves, electrical equipment, plumbing and HVAC systems. Also, architectural / structural upgrades to all the buildings were completed along with site and site piping improvements. The firm capacity of Bryant Street Pumping Station with WAD pumping from Dalecarlia exceeds current and projected (2030) maximum day demand conditions plus maximum fire flow demands.

Current CIP projects include the replacement of the hydraulic piping systems for the pump control valves, large valve replacements, pump room painting and other miscellaneous work. In order to improve the reliability and performance of the pumping station, the following improvements are recommended for consideration in the CIP:

- BSPS 001 – Provide back-up power for at least one pump in each service area and to critical areas within the pumping station.
- BSPS 002 – Demolition of the unused existing Foundry building and the Tire Shop building adjacent to the Foundry building.

- BSPS 003 – Rehabilitation / replacement of the rafters, purlins and roof deck above the north and south walls of the Pump Motor Room.
- BSPS 004 – Rehabilitation of the parapet walls on the roof top of the Warehouse and Shops building and replacement of the bridge deck, expansion joints, and bearing plates.
- BSPS 005 – Provide capability to measure flow through spill headers & SCADA control.
- BSPS 006 – Renovate available space at Bryant Street Pumping Station to convert areas on the 3rd floor to professional office space and add a control room to the 2nd floor.
- BSPS 007 – Security system upgrade.
- Rehabilitation / replacement of the large diameter discharge piping.

0.7.2. Fort Reno Pumping Station

The Fort Reno Pumping Station was constructed in 1977 to provide reliable water service to the 4th High (West) service area. The station was equipped with new variable frequency drives in 2003. The station is located on the same site as the Fort Reno Elevated Tank No. 2 and Fort Reno Reservoir Nos. 1 & 2. Also, the abandoned old Fort Reno Pumping Station and Elevated Tank No. 1 are located on the same site. The firm capacity of Fort Reno Pumping Station exceeds current and projected (2030) maximum demand conditions plus maximum fire flow demands with a 3.3 MGD reserve capacity.

The mechanical components of the Pumping Station are in good condition but given the age of the equipment and lack of available spare parts, rehabilitation of the electrical and control systems is recommended. Currently, there is a CIP project that includes modifying the mode of operation requiring replacement of control panels, installation of an altitude valve, upgrades to the surge protection system, installation of pressure sensing sites in the distribution system, and integration with SCADA. This CIP project will allow the 4th High West Service Area to mainly operate at increased pressures (8psi increase) as a "closed system" (no gravity storage) until the new 2 MG elevated storage tank is placed into service in approximately 2017. Based on an assessment of the facility and discussions with DMS and DWS operations staff, the following improvements are recommended for consideration in the CIP:

- FSPS 001 – Replacement of the three (3) existing variable frequency drives.
- FSPS 002 – Replace existing problematic electrical equipment.

- FSPS 003 – Security system upgrades.
- FSPS 004 – Installation of redundant instrumentation equipment.

0.7.3. 16th & Alaska Pumping Station

The 16th & Alaska Pumping Station was placed into service in the 1990s to provide water service to the 4th High Service Area east of Rock Creek Park. The 4th High Service Area east of Rock Creek Park is a "closed system" that is only served by this station. No major design or construction improvements have been conducted to this station since being placed into service. The firm capacity of 16th & Alaska Pumping Station exceeds current and projected 2030 maximum demand conditions with a 2.8 MGD (approximately 2,000 gpm) reserve capacity for fire flow.

Based on an assessment of the facility and discussions with DMS and DWS operating personnel, it is recommended that the following improvements be considered in the CIP:

- ALPS 001 – Installation of redundant discharge and suction headers.
- ALPS 002 – Electrical upgrade to replace existing problematic equipment.
- ALPS 003 – Upgrade of instrumentation and controls.
- ALPS 004 – Installation of permanent air conditioning and dehumidification systems.
- ALPS 005 – Installation of back-up electric service feeder.
- ALPS 006 – 1MG 4th High Elevated Tank East of Rock Creek Park.
- ALPS 007 – Security system upgrades.
- ALPS 008 – Installation of redundant instrumentation equipment.

0.7.4. Anacostia Pumping Station

The old Anacostia Pumping Station was placed into service in 1913, expanded / rehabilitated in 1956 and electrical / back-up power improvements undertaken in 1979. The existing station structure is close to 100 years old, is in need of numerous repairs and was replaced under a current CIP Project M7. Project M7 scope included only abandoning the existing station (structure, pumps, piping and electrical equipment) and demolition of the existing electrical substation is completed.

The new Anacostia Pumping Station constructed under Project M7 provides pumping units to discharge into three different service areas: Proposed Anacostia First High, Proposed Anacostia Second High and Proposed Anacostia Third High. The firm capacity of the new Anacostia Pumping Station exceeds current and projected (2030) maximum day demand conditions plus maximum fire flow demands with greater than 9 MDG of reserve capacity for each service area.

The following project has been identified and it is recommended that this project be considered in the CIP:

- APS 001 – Demolition of the 1913 Anacostia Pumping Station.

0.8 Storage Facilities

As part of this plan, the eight (8) storage facilities operated by DC WASA as listed in Table B were evaluated with specific needs identified as CIP projects. The assessment of the storage facilities included site visits and interviews with DMS and DWS operations staff with observations documented, a general review in terms of worker safety and site security, and review of the following primary sizing components for storage adequacy:

- Equalization – adequate storage volume to meet daily peaks in demand.
- Fire Storage – based upon a defined fire flow rate for a specified period of time.
- Emergency Reserve – additional storage that may be required in the event of an emergency.

Table B
DC WASA Storage Facilities

Facility Name	Service Area	Construction (Latest Upgrade)	Capacity
Brentwood Reservoir	Low Service	1959 (2000)	25 MG
Soldiers' Home Reservoir	1st High	1939 (2003)	15 MG
Fort Reno Reservoir No. 1	3rd High	1928 (2000)	5.4 MG
Fort Reno Elevated Tank No. 2	4th High	1926 (2000)	0.16 MG
Fort Stanton Reservoir No. 1	Anacostia 1st High *(Proposed Anacostia 1st High)*	1932 (2000)	3 MG
Fort Stanton Reservoir No. 2		1943 (2000)	10 MG
Good Hope Elevated Tank	Anacostia 2nd High *(Proposed Anacostia 3rd High)*	1937 (2003)	0.5 MG
Boulevard Elevated Tank		1945 (2003)	2 MG

The following three (3) future water storage facility projects included in the approved CIP were also reviewed for suitability to continue as CIP projects:

- Project MA – 2MG Proposed Anacostia 2nd High Elevated Tank
- Project MQ – 2MG 4th High Elevated Tank West of Rock Creek Park
- Project MR – 5MG 2nd High Storage Reservoir East of Rock Creek Park

The five storage reservoirs and three elevated tanks operated by DC WASA were originally constructed between 1926 and 1959 with an average age of approximately 70 years. Rehabilitation work at these facilities was completed between 2000 and 2003, which mainly included: site improvements; new instrumentation; upgrades to ladders, railings and other safety devices; painting of the steel tanks; upgrades to access hatches; and other miscellaneous work.

A review of storage adequacies by service area is presented in Table C.

Table C
Storage Adequacy - Storage Facilities

Service Area	Storage Facility	Total Available Storage Volume (MG)	Equalizing Storage Required (MG)	Fire and Emergency Storage Required (MG)	Total Storage Requirement (MG)	Storage Surplus (+)/ Deficit (-) (MG)
Low*(1)*	Brentwood Reservoir	25	16.3	3.5	19.8	5.2
1st	Soldiers' Home & Foxhall Reservoirs	29.5	7.15	2.9	10.05	19.45
2nd *(2)*	Van Ness Reservoir	14.6	6.13	2.38	8.51	6.09
3rd *(1)*	Fort Reno Reservoirs	25.4	5.5	1.8	7.3	18.1
4th West	Fort Reno Tank 2	0.2	0.47	0.96	1.43	-1.23
4th East *(3)*	No Existing Storage					
Proposed Anacostia 1st High	Fort Stanton Reservoirs	13	0.81	1.5	2.31	10.69
Proposed Anacostia 2nd High*(4)*	Project MA - Proposed Tank	2	1.23	1.54	2.77	-0.77
Proposed Anacostia 3rd High	Good Hope & Boulevard Tank	2.5	0.53	0.83	1.36	1.14

(1) Demand equalization in Low Service and 3rd High include the demands in Anacostia Service Areas and 4th High, respectively.
(2) Project MQ - Proposed new 5MG Reservoir would increase storage surplus to approximately 11 MG.
(3) Project MR - Proposed new 1MG Tank would provide more than adequate storage for 4th High East.
(4) Demand equalization requirement is based on the assumption that pumping is equal to future Maximum Day Demands. The proposed pumps at the Anacostia Pumping Station are capable of meeting future Maximum Day Demands and demand equalization requirements. Therefore, actual storage requirement for demand equalization and emergency reserve is 1.3 MG.

Starting in FY2007, DC WASA commenced a program to clean, inspect and disinfect each facility every three years. Based on inspections of the facilities it is recommended that the following projects be considered for CIP projects:

- SF 001 – Electrical upgrades to all eight storage facilities mainly including the replacement of electric service, power distribution, auxiliary power services and other related systems.
- SF 002 – Miscellaneous upgrades / improvements as recommended from the recent inspections, such as: replacement or reconfiguration of sampling taps and lines; crack, spall and joint repairs; touch-up painting; clearing vegetation; replace/repair damaged portions of fence; installation of freeze-proof vents; and other miscellaneous improvements.

- SF 003 – Upgrades / improvements to all eight storage facilities based upon future inspections.
- SF 004 – Tank painting in FY2020.
- SF 005 – Three year cleaning, inspection and disinfection program.
- ALPS 006 – 1MG 4th High Elevated Tank East of Rock Creek Park

Also, it is recommended that the following three (3) future water storage facility projects be maintained in the CIP:

- Project MA – 2MG Proposed Anacostia 2nd High Elevated Tank
- Project MQ – 2MG 4th High Elevated Tank West of Rock Creek Park
- Project MR – 5MG 2nd High Storage Reservoir East of Rock Creek Park

0.9 Interconnections

There are a total of seventeen (17) major interconnections between the water distribution system serving DC and the surrounding systems. Four (4) are major wholesale WAD interconnections service the Pentagon (1st High), City of Falls Church (2nd High and 3rd High) and Arlington County (3rd High). The remaining thirteen (13) are emergency interconnections between Washington Suburban Sanitation Commission (WSSC) and DC WASA systems. A review of these interconnections was performed and the following eight (8) major emergency interconnections are recommended:

Anacostia 2nd High (Proposed Anacostia 3rd High)

- Southern Avenue & 25th Street, SE
- Southern Avenue & Suitland Road, SE
- Southern Avenue & 46th Street, SE

Low - East of Anacostia River

- Eastern Avenue & Kenilworth Avenue, NE

3rd High

- Eastern Avenue & 16th Street, NW

4th High East

- Eastern Avenue & Georgia Avenue, NE

4th High West

- Western Avenue & Runnymede Street, NW
- Western Avenue & Connecticut Avenue, NW (Chevy Chase Circle, NW)

Project AK – WSSC Interconnection is included in the approved CIP and it is recommended that Project AK be maintained in the CIP.

0.10 Transmission and Distribution Mains

The DC WASA water system infrastructure consists of approximately 250 miles of transmission mains (16-inch diameter and greater) and 1,100 miles of distribution mains (12-inch diameter and smaller). The history of water mains installed in DC is provided in Figure E as a timeline and the age of these water mains is presented in Figure F.

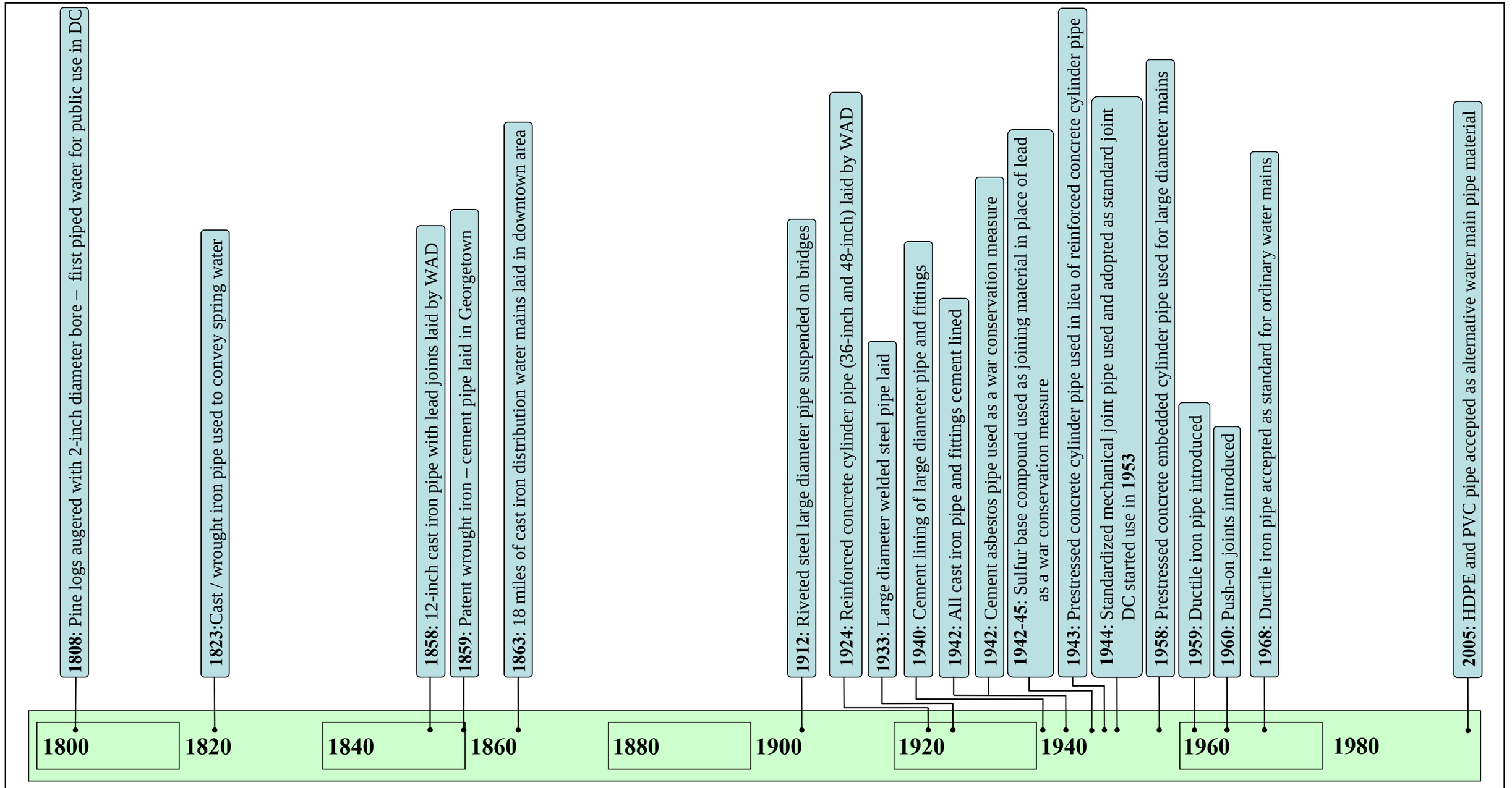
As part of the Facilities Plan update, an analysis of the water transmission and distribution system was performed. This analysis included hydraulic modeling to evaluate system pressures, available fire flows, and pipeline velocities. The analysis also included a reliability and emergency response analysis identifying critical pipelines in the system.

0.10.1 Transmission Mains - Renewal

Based upon the age and condition of the transmission mains in DC, it is recommended that DC WASA continue with the Large Diameter Water Main (LDWM) Rehabilitation / Replacement program based upon future detailed pipe condition assessments. A review of the following existing CIP projects concluded that they should remain in the CIP as follows:

- Project C9 – LDWM 1: Increase funding to allow for the replacement of the 30-inch water main (installed in 1859) in Canal Road / M Street, NW from Georgetown Reservoir to Washington Circle with a new 48-inch water main.
- Project S5 – Internal Joint Repairs Various Locations: Divide into two contracts and increase funding accordingly.

A detailed field analysis of existing transmission mains was focused on an evaluation of the large diameter steel mains, which are critical hydraulic elements. Steel pipe in the DC WASA system accounts for the highest number of breaks in the entire system on a number of breaks per unit length basis. It has been determined that high occurrence of breaks in steel



History of Water Mains

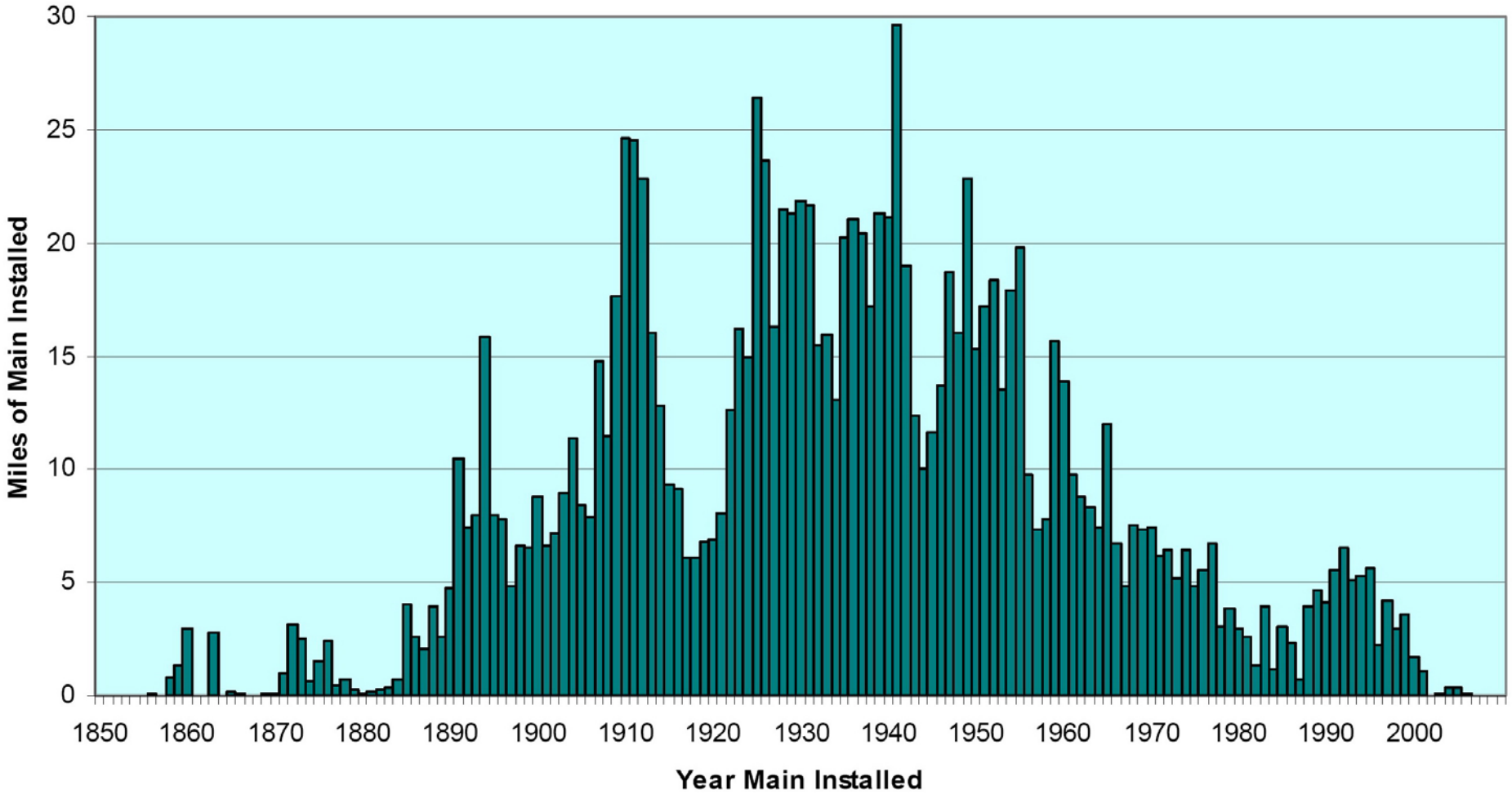
Water System Facilities Plan Update

June 2009

Prepared by Hatch Mott MacDonald

History of Water Mains

Figure E



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Age of Water Mains

Figure F

water mains is most probably due to the effects of corrosion to the pipe material and couplings. As anticipated, very few of the pipelines surveyed were provided with corrosion protection systems, and the systems that were in place appeared to be in disrepair.

A rehabilitation program for large diameter steel pipelines is recommended in two steps:

- Rehabilitation of Large Steel Water Mains - consisting of the design, installation and bi-annual testing of CP systems on the five (5) most critical mains.
- Prioritize the remaining (unprotected) steel pipelines and consider additional phases of this program in the future.

Also, it is recommended that DC WASA:

- Maintain approximately the same level of spending ($10 million per year) on transmission main renewal from FY2018 to FY2030.
- Develop a plan to further inspect and evaluate the Prestressed Concrete Cylinder Pipe (PCCP) water mains ranked as "High Priority".

0.10.2 Transmission Mains – New Improvements

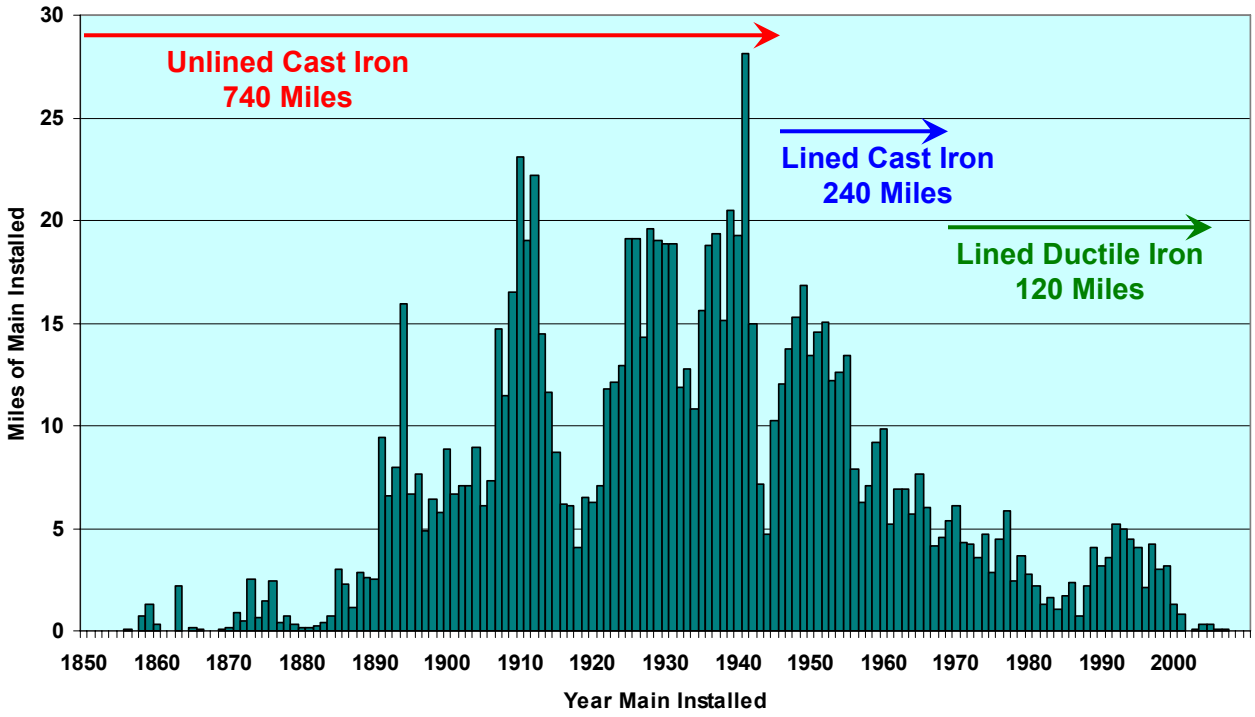
A detailed desktop hydraulic analysis of proposed transmission mains was conducted and it is recommended that the following projects be considered in the CIP:

- 2nd High 48-inch Service Area Water Main Van Ness to east side of Rock Creek
- Low Service Area PRV Potomac & G, SE
- Low Service Area 20-inch Water Main Extension 17th Street, SE/NE
- 2nd High 16-inch Water Main Extension W Street, NW
- 2nd High 36-inch Water Main Extension 16th & Emerson to future 5MG Reservoir
- 2nd High Air / Vacuum Release Valves
- 3rd High 48-inch Service Area Water Main BSPS to Missouri & Georgia, NW
- 4th High Redundant 20-inch Water Main FRPS
- 4th High Relocation / Replacement of 20-inch Water Main crossing Rock Creek Park

0.10.3 Distribution Mains

The installation history and general material of construction of the distribution mains (12-inch diameter and smaller) is shown in Figure G. As discussed earlier, approximately 740 miles of distribution mains are unlined cast iron pipe that are known to be tuberculated, which reduces hydraulic capacity and is a potential water quality concern.

Figure G
Water Distribution Main Material and Installation Date



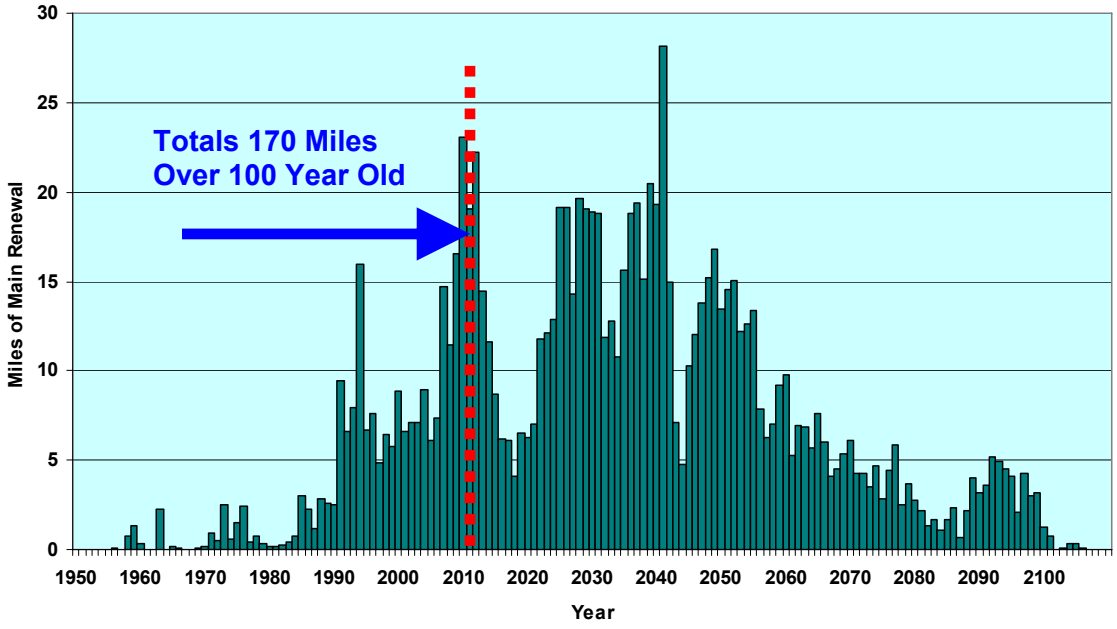
As part of this 2009 Facilities Plan Update, and in addition to the main GIS conversion program, a large amount of other data (main break history, water quality, DDOT paving plan, hydraulic modeling results, etc) was also converted into GIS data, and combined with the main GIS pipe, valve and hydrant datasets to allow effective prioritization and planning. Using basic asset management principles, prioritization was determined by performing water system improvements on those infrastructure assets that provide the highest return in improved level of service, while at the same time reducing existing risks.

The following criteria was included in the analysis:

- Water Main Age and Material
- Water Main Repair History
- Water Quality Data
- External and Internal Corrosion (Existing or Potential)
- Critical Customer Impact
- Number of Lead Services
- Planned Construction Activity (e.g., DDOT Road Overlay or Other CIP Projects)

With the information provided above, the key question concerning how long the pipe will last has not been fully answered. Until DC WASA develops a significant database on actual pipe condition (through analysis of physical pipe coupons along with representative soil samples), a conservative approach must be taken. From a very simplistic standpoint, DC WASA can develop a working hypothesis which indicates that the average useful life of the pipe, when considering all materials and pipe vintages, is 100 years which is consistent with current industry estimations of useful life. Figure H shows a graphic that represents the renewal investment in miles in the upcoming years based upon a 100 year pipe life and indicates that over 170 miles of pipe has reached the end of its useful life and should have been renewed.

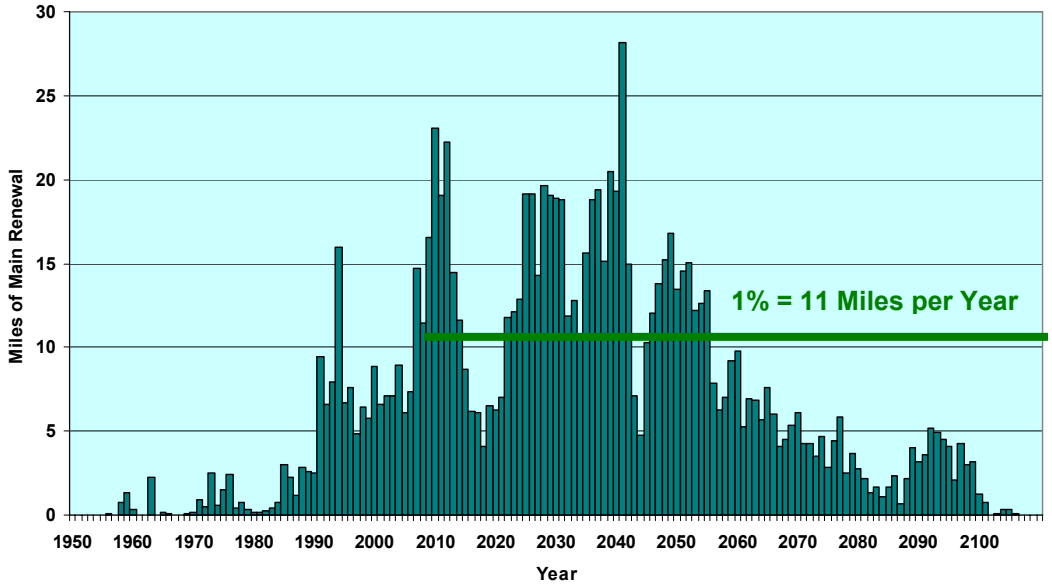
Figure H
100 Year Life Renewal - Water Distribution Mains



In conclusion, our recommendations are as follows:

- The annual cost of the small diameter water main rehabilitation program should be increased to at least $30 million in the CIP based upon a simple working hypothesis of renewing 1% each year as shown in Figure I.

Figure I
100 Year Life Renewal - Water Distribution Mains



- Continuously refine acceptable service levels to improve the working hypothesis for future investment needs under this program.
- Improve the data collection process to collect more information on main breaks and include the collection of pipe coupons and soils samples (as practical) for further analysis.
- Continue to develop GIS databases that will be an integral part for this program and all water system assets.
- Cleaning and lining is a viable / cost effective alternative for rehabilitation for pipes in sound condition (metallurgical analysis performed on coupons) with limited breaks, non-corrosive soils and acceptable pipe to soil potential.
- Further evaluations should be conducted by DC WASA to better quantify the extent of tuberculation within small diameter water mains (age, hydraulic impacts and

confirmation that lined CI or DI pipe are unaffected) and refine the program accordingly.

- Continue to implement the recommendations included in the "Evaluation of Small Diameter Water Mains – Fire Flow Analysis" dated November 15, 2007.

0.11 Summary of Recommendations

Overall, the 2009 Facilities Plan Update recommends CIP projects through 2030 that have a total combined budget that exceeds $1 billion. The plan recommends a proposed $640 million FY2008-2017 CIP budget ($317 million budget increase) for the Water Pumping Stations, Water Storage Facilities, Water Distribution System and Miscellaneous projects as follows:

- $24 million for Water Pumping Station Projects ($21 million increase)
- $53 million for Water Storage Facility Projects ($23 million increase)
- $563 million for Water Distribution System Projects ($273 million increase)

The following is a breakdown of the recommended future CIP budget of approximately $650 million (2008 Dollars) for projects that may not be provided with a specific timeline or are scheduled after the FY2017:

- $8 million for Water Pumping Station Projects and Miscellaneous Projects
- $10 million for Water Storage Facility Projects
- $633 million for Water Distribution System Projects

In addition to the recommendations highlighted above and within this Section, the following is also suggested:

- Increase the capability of valve replacements and ongoing valve maintenance by DWS.
- Replace all older water services in public space in a holistic approach.
- Where new service areas are being implemented, DC WASA should pursue an aggressive public outreach program and consider the installation of pressure reducing valves (PRVs) at locations where the static pressure is increased to over 80 psi.