INDEPENDENT ENGINEERING INSPECTION OF THE DISTRICT OF COLUMBIA WATER AND SEWER AUTHORITY'S WASTEWATER AND WATER SYSTEMS

FINDINGS AND RECOMMENDATIONS

FINAL REPORT

Prepared by:

JOHNSON, MIRMIRAN & THOMPSON

July 9, 2013

Table of Contents

Section 1 Introduction

1.1 Purpose

This report presents the findings of an independent engineering assessment of District of Columbia Water and Sewer Authority's (DC Water's or the Authority's) wastewater and water systems, pursuant to the requirements of the Authority's Master Indenture of Trust. The indenture stipulates that:

> *"The Authority shall cause an Independent Consulting Engineer at least once every five years to inspect the System and make a written report thereof which shall include such Independent Engineer's findings and recommendations as to the maintenance of the System and the construction of additions, extensions and improvements to the System and capital replacements thereof."*

DC Water selected, Johnson, Mirmiran & Thompson, Inc. (JMT) of Sparks, MD to conduct the Independent Consulting Engineer Assessment. The most recent Independent Consulting Engineer Assessment was prepared by PB Consult Inc. in 2008 (the "2008 Assessment").This five-year recurring audit of the current state of facilities and the initiatives that the Authority has spearheaded is being executed to comply with the Master Indenture of Trust (quoted above). This report contains a summary of JMT's findings and subsequent recommendations. The information contained within this report is effective as of March 1, 2013.

1.2 Scope and Methodology

This report summarizes the findings and assessments of the Independent Consulting Engineer based on site inspections and interviews with key DC Water and Washington Aqueduct supervisory staff and members of the Program Management Team. Inspections and interview questions focused on the following topics related to water, wastewater and stormwater treatment and conveyance assets:

- Physical condition of assets
- Governance and management processes
- Site assessment of construction activities for capital projects
- Safety programs and risk management
- Current and future capital programs
- Operations and Maintenance
- Cost and schedule performance of construction activities for capital projects
- Consent decree and permit compliance

In addition to site visits and staff interviews, JMT reviewed a number of documents and reports prepared by DC Water staff, Washington Aqueduct staff or consultants retained by either agency. Additional reports and memoranda from agencies responsible for the Potomac River were instrumental in assessing the viability of the river as a dependable source of water. A comprehensive list of the documents reviewed is listed in the Bibliography attached to the end of this report. A few key reports include:

- FY 2012-2021 Capital Improvement Program (CIP) - DC Water
- FY 2013 & Approved 2014 Operating Budget
- D.C. Clean Rivers Quarterly Status Reports
- FY 2014-2023 Capital Improvement Plan - Washington Aqueduct
- 2009 Water and Sewer Facilities Plans (2009 Facilities Plan Update)
- 2010 NPDES Permit
- 2008 Independent Consulting Engineer Assessment (the 2008 Assessment)
- Washington Aqueduct FY 2012 Annual Financial Report
- Washington Aqueduct's Federal Facilities Compliance Agreement
- DC WASA Sewer Overflows Consent Decree (3/25/03)

JMT's approach to the 2013 Independent Consulting Engineer Assessment (the 2013 Assessment) was methodical with the intent to produce an independent assessment while incorporating key staff input. JMT conducted independent research prior to each interview and prepared notes for each interview in order to minimize work flow disruption. Detailed interview notes were taken and field observations were documented for integration into the report. JMT asked to visit and observe as many of the facilities under DC Water's and Washington Aqueduct's control as possible, but exceptions had to be made for facilities where specific safety gear (other than hard hat, safety vest, glasses and steel toe boots) was required or heavy construction was underway.

The 2013 Assessment was unique compared to the 2008 Assessment; this assessment was conducted while many of the construction projects were taking place at DC Water facilities. Comprehensive and aggressive construction activities were underway to comply with Consent Decrees (Wet weather and Total Nitrogen) and NPDES permit requirements. Some facilities were not inspected because they were either under construction or recently overhauled/reconstructed.

JMT used judgment to ascertain where inspections were required or where document research and interviews resulted in confidence in the condition of any particular asset. All findings, conclusions and recommendations, derived from field investigations, document research and interviews, as previously mentioned, take into account professional judgments as to the implications for future system performance and its impacts on DC Water and Washington Aqueduct stakeholders.

A critical aspect part of JMT's information gathering process involved interviews with key DC Water and Washington Aqueduct Staff, as listed in **Exhibit 1-1**. JMT also attended DC Water Board of Directors meetings to obtain supplemental information.

Exhibit 1-1: Summary of Interviews with DC Water and Washington Aqueduct Staff

Interviewee Department/Title	Interviewee Name(s)
Chief Engineer	Leonard Benson (not able to attend scheduled meeting; Dave McLaughlin and Gus Bass stepped in for him)
Engineering & Technical Services	Dave McLaughlin, Gus Bass, Denise Edwards
Wastewater Treatment	Walter Bailey (Asst. General Manager), Aklile Tesfaye, Anthony Mack, Salil Kharkar
Clean Rivers	Carlton Ray (Director), Greg Colzani, John Cassidy, Allen Chilmeran, Donal Barron, Bill Edgerton, Christopher Allen
Asst. General Manager Consumer Services	Charles Kiely
Sewer Services Director	Cuthbert Braveboy
Sewer Services Pumping	Hiram Tanner, Renee Lawrence
Utility Water Services Director	Chuck Sweeney
Finance and Budget	Yvette Downs (Director), Suzette Stona
Washington Aqueduct General Manager	Thomas Jacobus
Washington Aqueduct Chief Planning & Engr. Group	Nathan Cole (Chief), Christopher Waters
DC Water Board - Environmental Quality and Sewerage Services Committee Meeting 3/21/13	DC Water Board of Directors, George Hawkins, Leonard Benson, David McLaughlin, Chris Peot, Walt Bailey, Rosalind Inge, Carlton Ray, Brian McDermott
DC Water Board – Water Quality and Water Services Committee Meeting 3/21/13	DC Water Board of Directors, George Hawkins, Charles Kiely, Roger Gans, Damion Lampley

JMT conducted site visits and performed inspections on major facilities that were made accessible to its staff. Where applicable, unanticipated site conditions and cost/schedule impacts described during interviews were recorded, along with the existence of applicable recovery schedules. For work sites where some construction activities were taking place, JMT focused attention on reviewing construction progress and comparing that progress to contract documents. For sites not undergoing construction activities, the focus of JMT facility inspections was on conformance to industry standards, applicable codes, and safety.

Photographs were taken at most of the sites to document the visits and conditions inspected; however, JMT was sensitive to security concerns. Site visits conducted are listed in **Exhibit 1-2**.

Exhibit 1-2: DC Water and Washington Aqueduct Facilities Visited and Inspected

Facilities Inspected	
• Blue Plains Advanced Wastewater Treatment Plant (BPAWTP)	• Biosolids Processing Facility <<
• Blue Plains Control Center & Process Control System	• Influent Station & Screening Facility
• Blue Plains Degrit Buildings	• Blue Plains Gravity Thickeners
• Blue Plains Dissolved Air Floatation Thickeners	• Blue Plains Multimedia Filtration
• Main Wastewater Pumping Station	• O Street Wastewater Pumping Station
• Bryant Street Water Pumping Station	• Customer Services Facility 810 1st Street
• Dalecarlia Pumping Station	• Blue Plains Tunnel <<
• Foxhall Reservoir	• Soldiers Home Reservoir
• Dalecarlia Water Treatment Plant	• McMillan Water Treatment Plant
• Great Falls Intake	• Crosstown Tunnel<<
• Aqueducts along MacArthur Boulevard	• Division B CSOs 013 & 014 <<
• Dalecarlia Residuals/Solids Recovery	• Division I Diversions <<
• Division C CSO 019 <<	• Division G CSO 007 Diversion Sewer
• Georgetown Reservoirs and Gatehouse	• Earl Place Pumping Station
• Division Y Dewatering Pumping Station and ECF <<	• Rock Creek Pumping Station
• M Street Diversion Sewers CSO 015, 016, 017 <<	• Upper Anacostia Pumping Station
Note: "<<" Indicates facility is Under Construction	

1.3 Johnson, Mirmiran & Thompson, Inc. Qualifications

For more than 40 years, Johnson, Mirmiran & Thompson, Inc. (JMT) has provided quality engineering services to clients in the mid-Atlantic region and has served federal agencies throughout various states. JMT is a full service, multi-disciplined consulting firm and performs as program managers for many agencies, including water and sewer agencies, airports, state agencies, educational institutions, and transportation authorities. JMT is staffed by practicing engineers of all major disciplines and retains former public officials and academics in order to provide broad experience and skill sets to our clients and to the public served by our clients.

1.4 A Note of Thanks

JMT wishes to express its appreciation to all DC Water managers and staff who not only took as much time to convey the achievements accomplished over the past five years, as needed but also represented the pride and enthusiasm so apparent at DC Water. The interviewers are also very appreciative of the sincere hospitality and openness of the Washington Aqueduct managers, while cooperating with JMT as we reviewed the Aqueduct's significant progress over this reporting period.

Section 2 DC Water Overview

2.1 Vision, Mission, Values and Critical Success Factors

JMT has reviewed DC Water's vision, mission, values, and critical success factors. The DC Water Board of Directors adopted the Vision, Mission, Values and Critical Success Factors on July 3, 2008. The Blue Horizon 2020 Strategic Plan (adopted on March 7, 2013) updated the statements as presented below. This 2013 Assessment was performed while being mindful of how DC Water's staff incorporates the DC Water's visions and values into their roles and daily responsibilities.

Vision:

To be a world-class water utility

DC Water's Mission:

Exceed expectations by providing high quality water services in a safe, environmentally friendly, and efficient manner

DC Water's Values:

RESPECT
Serve with a positive attitude, courtesy, and respect that engender collaboration and trust

ETHICS
Maintain high ethical standards, accountability, and honesty as we advance the greater good

VIGILANCE
Attend to public health, the environment, quality, efficiency, and sustainability of our enterprise

ACCOUNTABILITY
Address challenges promptly, implement effective solutions, and provide excellent service as a committed team

DC Water's Critical Success Factors

"Critical Success Factors and Objectives represent the most significant aspects of the Authority's ability to execute its mission and achieve its world-class performance. These factors provide the basis for the refinement of concrete metrics, targets, and accountabilities for improvement."

The Board and Executive Management discussed the following Critical Success Factors that are important to the long-term success of DC Water as part of the strategic plan:

IMPORTANCE OF COMMUNICATIONS AND OUTREACH
Effective communication with the broad array of DC Water stakeholders should continue and be enhanced. DC Water is vital to the community and its importance should be clearly communicated.

INCREASING THE VALUE OF WATER
Marketing water with the theme of “Water is Life” has been successful and should continue to be developed and enhanced. Rates for water utility services will necessarily increase as a result of increasing regulation and customer service level requirements. However, it should be clear to all that the value of this resource far exceeds the costs to ratepayers.

ALTERNATIVE REVENUE STREAMS
As a premier provider of water-related services, DC Water may be in a unique position to provide additional valuable services to customers, which may offset some otherwise necessary rate increases. These ideas will be identified, evaluate, prioritized and, if appropriate, implemented.

SUSTAINABILITY
Sustainability is receiving increased attention from the water sector industry and DC Water should consider sustainability from a “triple bottom line” perspective (economic, environmental, and social sustainability).

EFFICIENCY
DC Water commits to being an efficient operation that identifies and implements best practices, uses technology strategically, and develops and maintains an efficient and motivated workforce.

REGIONAL COOPERATION AND PARTNERSHIPS
As a regional utility with a broad group of customers and stakeholders, DC Water will improve its operation by collaborating locally, regionally, and nationally to provide the best possible solutions for the benefit of its customers and communities.

2.2 Governance and Organization

District of Columbia Water and Sewer Authority, previously referred to as DC WASA, was established in 1996 as a semiautonomous entity by action of the District of Columbia (DC) government and the federal government. Other stakeholders who participated in the creation of the Authority included the Wholesale Customers of Blue Plains Advanced Wastewater Treatment Plant (BPAWTP). The InterMunicipal Agreement (IMA) identifies the Wholesale Customers. The Authority has autonomy over most aspects of its operations, management, and financing. The Authority’s enabling acts --an act of the Council of the District entitled the “Water and Sewer Authority and Public Works Reorganization Act of 1996 (as amended)” and an act of the United States Congress entitled the “District of Columbia Water and Sewer Authority Act of 1996”—set forth the responsibilities and powers of the Authority and outlined the general structure of governance. In 2010, the Authority initiated a rebranding campaign and is now known as DC Water as an unofficial trade name.

2.2.1 Governance

DC Water’s 22-Member Board of Director’s establishes policies and guides the strategic planning process. The Authority is governed by a Board of Directors consisting of 11 principal and 11 alternate members, each appointed for a staggered four-year term. Six principal members (appointed by the

Mayor of the District with the advice and consent of the Council) represent the District and five principal members (appointed by the Mayor on recommendations of the Wholesale Customers) represent the Wholesale Customers, two each from Prince George's and Montgomery Counties in Maryland, and one from Fairfax County, Virginia. The powers of the Authority are vested in and exercised by the Board at meetings duly called and held where a quorum of at least six members is present. All Board members participate in decisions directly affecting the management of joint-use facilities which are those facilities used by all three jurisdictions. Only the District members participate in those matters that affect District ratepayers and in setting fees for various services that affect only District residents. The Board meets monthly and operates through various standing and ad-hoc committees. The committees include Environmental Quality and Sewerage Services, Water Quality and Water Services, Finance and Budget, Human Resources and Labor Relations, Audit, Strategic Planning, Governance, and District of Columbia Retail Water and Sewer Rates.

Article 3.01 of the DC Water Board of Director's Bylaws defines what a "meeting" is and how meetings are to be conducted in relation to the public. All meetings are open to the public and the news media. Meetings are required to be documented by transcription and/or by electronic recording devices, as well as video, and those documents shall be made available to the general public. Article 4.01 of the DC Water Board of Director's Bylaws defines the Officers of the Board, their duties, term in office and resignation and removal of officers. The selected Chairperson's duties include: calling emergency meetings, determining agenda, presiding over meetings, establishing Committees and appointing members to Committees. A Nominating Committee elected Vice-Chairperson has the authority to execute the duties of the Chairperson in their absence.

Article 5.01 of the DC Water Board of Director's Bylaws establishes standing Committees of the Board. There are eight Committees of the Board:

- Finance and Budget Committee
- Strategic Planning Committee
- Audit Committee
- Governance Committee
- D.C. Retail Water and Sewer Rates Committee
- Human Resources and Labor Relations Committee
- Environmental Quality and Sewerage Services Committee
- Water Quality and Water Services Committee

The Board of Directors can create additional Committees as it deems necessary; the principal duty of any Committee shall be to recommend proposed action to the Board of Directors.

Article 6.01 of the DC Water Board of Director's Bylaws gives the Board the authority to hire a General Manager who will be the Chief Administrative officer of DC Water. The General Manager candidate requires the affirmative vote of 8 voting members to become the DC Water General Manager. The General Manager has supervisory and management responsibilities concerning DC Water's business, affairs, agents and employees. The General Manager can be removed from his/her position by 8 affirmative votes from the Board.

JMT attended the DC Water Board of Director's Environmental Quality and Sewerage Services Committee Meeting and the Water Quality and Water Services Committee Meeting on March 21, 2013. The Committee members viewed presentations by some of DC Water's key managers who reported progress on crucial initiatives that were currently underway. Those initiatives included:

- Processing Cambi Digested Sludges into a profitable soil admixture.
- New St. Elizabeth's Hospital Water Tower
- Performance of Permit Operations and the Permit Office Relocation
- Fire Hydrant tracking and repair.
- Pump Station Rehabilitation Issues
- Green Infrastructure as a way to reduce Consent Decree Construction Projects

In JMT's professional opinion, the meeting that took place on March 21, 2013 was productive and effective in accomplishing the objectives of the meeting. DC Water ensures organizational transparency by making meeting schedules and materials available online and making these meetings accessible to the general public. The Committee members showed a high level of engagement and concern in the success of DC Water operations. Examples of these assertions for the March 21, 2013 meeting are outlined below:

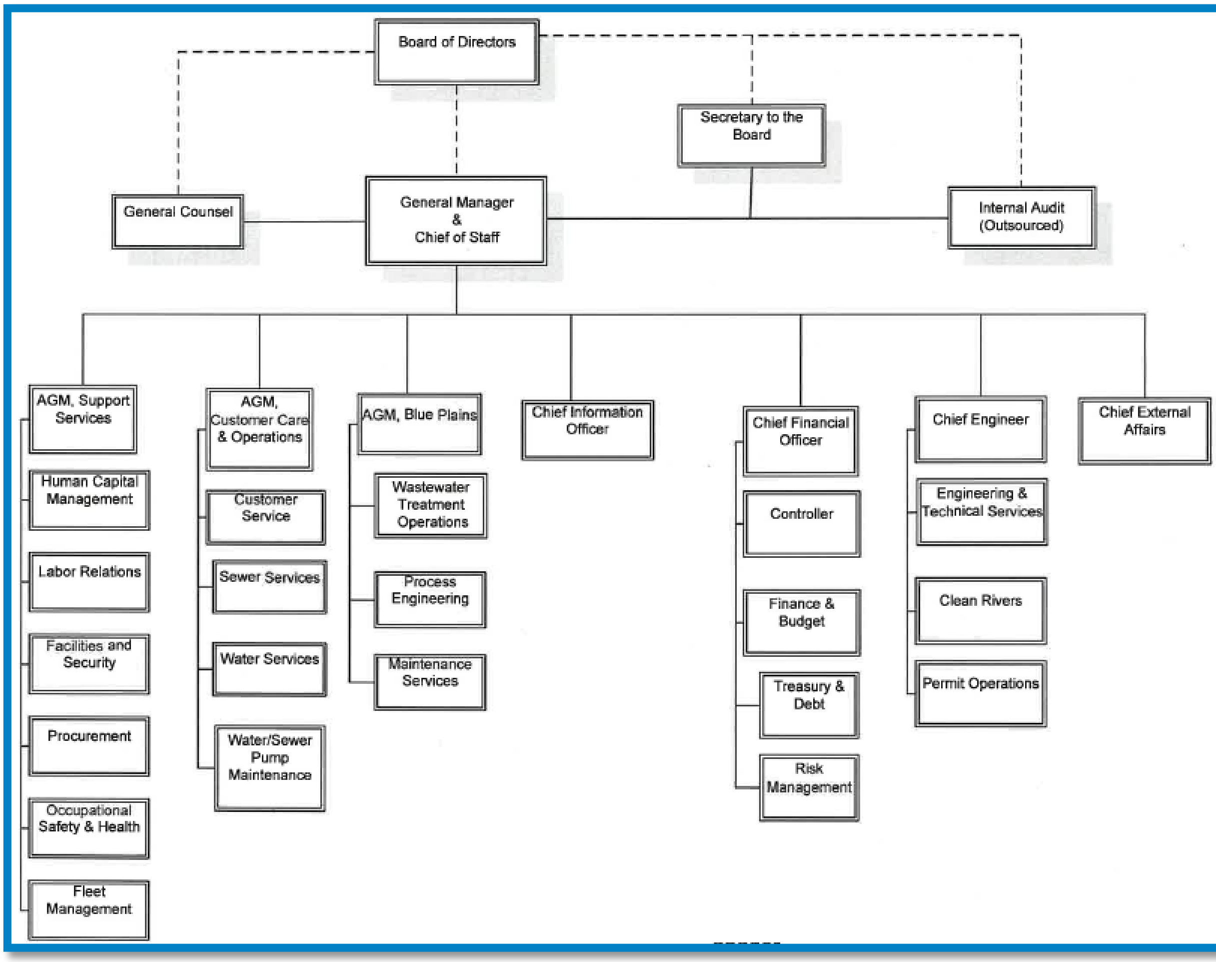
- The meeting was easily accessed by the general public. Public attendance at the meeting was 11.
- The Committee generally demonstrated support and appreciation for the DC Water management. During the meeting, performance metrics and improvement reports on past underperformances were presented to the Committee. Two examples of this include: performance metrics on permits and fire hydrant up-time/repairs.
- One Board member expressed concern about equal attention being paid to fire hydrant repairs across the District of Columbia.

The March 21, 2013 Committee meeting is viewed as representative of previous meetings based upon JMT attendance at previous meetings, review of earlier meeting handouts and minutes, and feedback from DC Water staff during interviews.

2.2.2 Organization

DC Water's current organization chart is shown as **Exhibit 2-1**. The organization continues to evolve as DC Water conducts internal analysis and studies that identify opportunities to improve effectiveness and reduce costs.

Exhibit 2-1: DC Water Organization Chart



At the end of FY 2012, DC Water had 1,051 filled positions out of an authorized total of 1,202. Over the long term, the authorized level is a reduction of 20% from 1,508 authorized positions in FY 1998. Since the 2008 Assessment, however, staffing level at DC Water has increased. Currently, there are 1,260 positions approved for FY 2014, compared to the 1,124 positions in 2008. As noted in the FY 2013 Budget in Brief, a major source of the personnel increases is related to the integration of CIP projects by DC Water personnel with a resulting reduction in the reliance of DC Water and contracted service personnel. During interviews, the gap between filled and unfilled positions was discussed with managers. The in-sourcing initiatives are being pursued by finding qualified individuals. Out-sourcing, in the meantime, is continuing to accomplish workloads and to meet schedules.

The increased staff from the 2008 level addresses service to customers and operational quality as defined by the Critical Success Factors, thereby elevating services since the 2008 Assessment. In fact, customer service capabilities were a topic of pride with the interviewed managers and staff. Morale of interviewed staff and encountered personnel is, in the opinion of JMT, above the parameters in evidence in many of the other agencies where JMT interacts. Based on earlier investigations, the principal investigator experienced anecdotal evidence that morale is at a higher level than in earlier years.

DC Water provides its employees with comprehensive fringe benefit packages, including coverage for: health insurance, group term life insurance, dental care, vision care, disabilities and retirement plans.

2.3 Management and Operations

The Board and General Manager are actively involved in the operation and management of DC Water. Executive and Senior managers indicate that they are provided with the tools and resources to fulfill DC Water's mission. Staffing levels, facilities, budgets, and schedules are adequately vetted and planned. Training has been identified as a priority and funding is in place for the planned training. The level of communications is well documented. Knowledge and direction of current activities were expressed by interviewed managers, indicating that all sections had an understanding and agreement with the overall focus and status of DC Water efforts and successes.

2.3.1 Finance

DC Water produces a two-year operating budget and a 10-year CIP annually. Both of these documents are subject to the approval of the Board of Directors, and are released to the public for review and comment. DC Water's financial management system monitors spending to prevent unauthorized expenditures. The Department of Finance and Budget prepares monthly reports that are reviewed each month to ensure compliance with authorized budgets.

Since its creation in 1996, the Authority's Board has adopted a number of policies that support financial planning and promote reliable revenue forecasting. Given the Authority's substantial borrowing needs over the next ten years, DC Water's continuing adherence to these policies supports it ability to cost-effectively access the capital markets and retain the Authority's credibility with customers and regulators.

DC Water maintains financial practices and policies that are intended to maintain a high-quality investment-grade bond rating so as to ensure the lowest practical cost of debt necessary to finance DC Water's long-term capital program. The current financial policies of the Board are summarized below.

- DC Water will establish strong levels of operating cash reserves, equivalent to 120 days of budgeted operations and maintenance costs, calculated on an average daily balance basis, with the objective of maintaining at least $125.5 million in operating reserves. Any one-time cash receipts go directly into cash reserves until they are at the appropriate level.
- DC Water will establish strong debt service coverage requirements that are consistent with DC Water's bond-rating objectives.
- After establishing adequate cash reserves, DC Water will use a prudent amount of operating cash, generated as a result of its debt service coverage requirements, for capital financing.

- DC Water will, whenever possible, use the least costly type of financing for capital projects, based on a careful evaluation of DC Water's capital and operating requirements and financial position for each year.
- DC Water will attempt to match the period of debt repayment, in total, with the service life of each of the assets financed by any such debt.
- DC Water will finance its capital equipment needs with operating cash or short-term financing instruments with the same or shorter lives as the related assets.

The rate-setting policies of the Board are presented below.

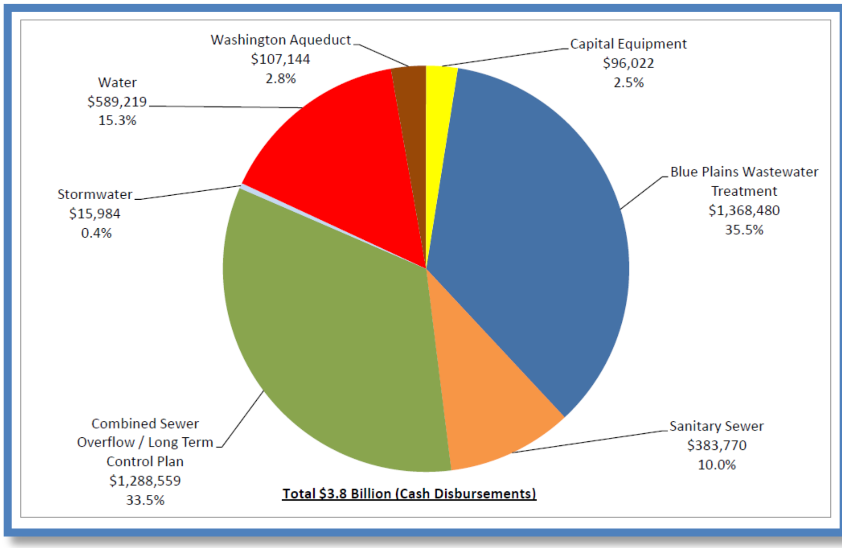
- Rates that, together with other revenue sources, cover current costs and meet or exceed all bond and other financial requirements as well as goals set by the Board.
- Rates that yield a reliable and predictable stream of revenues, taking into account trends in costs and in units of service.
- Rates based on annually updated forecasts of operating and capital budgets.
- Rate structures that are legally defensible, based on objective criteria, and transparently designed.
- Rate structures that customers can understand and DC Water can implement efficiently.
- Rates increases, if required, are implemented transparently and predictably.
- To the extent annual revenues exceed costs, the Board's policy will continue to utilize all available options to mitigate future customer impacts and annual rate increases, including transferring some or all of such excess funds to the Rate Stabilization Fund.

2.3.2 Facilities Planning and Capital Programming

DC Water is required by enabling legislation to adopt and submit a financial plan incorporating operating and capital costs with a minimum of five-years. DC Water continues to surpass that requirement and annually adopt a ten-year Financial Plan and Capital Improvement Program and manages the capital investments necessary to fulfill its mission, to comply with regulatory requirements and to preserve its infrastructure.

The Authority's adopted FY 2012 – FY 2021 CIP is budgeted for $3.8 billion for the 10-year period. This budget includes disbursements for improvements to the BPAWTP, sanitary and stormwater collection systems, water pumping and distribution system, Washington Aqueduct improvements and Capital Equipment. The distribution of the CIP is shown in **Exhibit 2-2** below.

Exhibit 2-2: FY 2012 – FY 2021 Capital Improvement Program ($ in 000's)



The Authority develops and priorities capital projects based on a specific set of criteria and requirements:

- **1A - Court Ordered, Stipulated Agreements, etc.** - Projects that are undertaken to comply with court orders, stipulated agreements, regulatory requirements and requirements of Authority's the National Pollution Discharge Elimination System permits.
- **2A - Health and Safety** – Projects that are required to eliminate or mitigate impacts on public health or safety and/or to ensure compliance with NPDES permit requirements.
- **2B - Board Policy, DC Water's Commitments to Outside Agencies** – Projects resulting from policies/resolutions of the Board and outside agency commitments.
- **2C - Potential Failure, Ability to Continue Meeting Permit Requirements** – Projects undertaken to construct/rehabilitate facilities and/or equipment in danger of failing and thus endangering the ability to continue meeting permit requirements.
- **2D - High Profile, Good Neighbor Policy** – Projects undertaken to address concerns expressed by public officials or citizens.
- **3A - Good Engineering, High Payback, Mission/Function** – Projects that are needed for rehabilitation/upgrade of facilities and infrastructure that are mission critical, projects that resolve operational issues and inefficiencies that result in operational and maintenance cost savings.
- **3B - Good Engineering, Low Mission/Function over Long-term** – Projects that are needed for rehabilitation/upgrade of facilities and infrastructure but are lower priority.

The Master Plan prioritizes projects according to the ranking system below.

- **Priority 1: Critical Projects -** Projects needed to resolve emergencies or critical threats to public health or safety; and projects needed to prevent imminent system failure.

- **Priority 2: Essential Projects -** Projects to meet basic performance requirements and service needs; projects needed to comply with legal, statutory, or regulatory requirements; projects needed to avert breakdown of key facilities; and projects needed to resolve major facility shortfalls.
- **Priority 3: Necessary Projects -** Projects needed to rehabilitate or replace system infrastructure where it is seriously deteriorated; projects needed to improve the effectiveness or reliability of system operations or service; and projects to protect the usefulness of system assets.
- **Priority 4: Important Projects -** Projects to maintain the integrity of system infrastructure on a routine basis; projects that will produce significant cost savings; projects to provide acceptable working conditions for staff; and projects to assist in maintaining reliable service to customers.
- **Priority 5: Desirable Projects -** Projects that will yield cost savings; projects to address future problems; and projects to improve system operation.

2.3.3 Project Delivery

DC Water relies on its Department of Engineering and Technical Services (DETS) and DC Clean Rivers Project (DCCR) to plan and execute its major capital projects. Since the 2008 Assessment, DCCR was created for the CSO-LTCP. Additional project delivery is performed by DC Water groups such as Water Services, Sewer Services, Information Technology, Facilities, and Customer Services. Financial expectations and limitations for CIP projects are provided by the CFO and GM.

The program management consultants, under various Engineering Program Management Consultant (EPMC) contracts and DCCR's Program Consultants Organization (PCO), have been very effective in managing and delivering a structured approach to capital improvements. As specifically presented in Section 5, DC Clean Rivers, the integration of DC Water staff and PCO engineers are managing an extraordinary program that is complex with construction sites in various areas of DC performing under a stipulated schedule. Section 4.3, BPAWTP, is also evidence that Project Delivery is very effective at DC Water.

2.4 General Conclusions Related to DC Water's Structure, Organization and Management Processes

A conclusion of JMT is that considerable progress has been made by DC Water since the 2008 Assessment in meeting the needs and goals of the organization, stakeholders, regulators and the environment. During the intervening period, DC Water underwent a change in executive management with transitional changes within the senior management ranks. Transition did not impede progress, but inserted an energy and re-focus on the mission and the core values of the Authority. The general tone during interviews, inspections and public meetings was positive with equal weight and recognition for employees and stakeholders, which reinforces the partnership that promotes DC Water's value to be "respectful, responsive, and sensitive to the needs of our customers and employees."

Overall, the independent Authority is structured to be responsive to providing retail service to the District of Columbia and its residents, along with providing wholesale wastewater service. DC Water's governance and organization give voice and decision-making participation for the wholesale customers that are comprised of the surrounding Maryland and Northern Virginia counties.

The organizational structure within DC Water has undergone reporting changes that have reduced the verticality of authority and have improved communications within DC Water. There were title or role changes that, in JMT's opinion, better reflect definition and mission of the affected sections. For example, Public Affairs was renamed as External Affairs. Another example is the elevation of Mr. Walter Bailey of Blue Plains to Assistant General Manager of Wastewater Treatment has provided Mr. Bailey and his staff the benefit of direct interface with the General Manager and established Blue Plains as a major service branch of DC Water. Also, by having the Assistant General Manager for Consumer Services directly report to the General Manager, DC Water has streamlined the retail utility services in order to improve the partnership with stakeholders within the District of Columbia and to facilitate working relationships with other services.

2.5 Major Initiatives, Recent Accomplishments and Key Trends

Section 2.5 highlights some of the Authority's key initiatives and accomplishments.

Water Quality

Lead and Copper rule compliance has been very effective in meeting regulations and has been responsive to the well-being of customers and ratepayers. As of March 2013, Lead and Copper rule monitoring has been in compliance for approximately 8 years.

Washington Aqueduct monitors the finished water and in some cases the Potomac River raw water source for cryptosporidium and other pollutants of concern such as pharmaceuticals and personal care products (PPCPs). The Aqueduct also participated in the USDA's Pesticide Data Program.

Permit Compliance

Both Washington Aqueduct and DC Water continue to meet the various permit requirements established for the drinking water and wastewater systems.

Water Supply/Treatment

The Washington Aqueduct's successful completion of the $110 million Basin Waste Recovery/Residuals Disposal project has been the prominent achievement in environmental improvement in the last five years.

Total Nitrogen Removal and Wet Weather Plan (TN/WW Plan)

DC Water has accomplished considerable progress since the 2008 Assessment in meeting the requirements of the Consent Decree and the Total Maximum Daily Load (TMDL) stipulations established in the National Pollutant Discharge Elimination System (NPDES) permit. All inspections and interviews verified the progress as reported in the numerous documents and public briefings prepared by DC Water. The TN/WW Plan is a highly complex undertaking which requires considerable coordination within the limited footprint of BPAWTP. This is evidenced by the tightly controlled maintenance of traffic plan for BPAWTP. In addition, TN/WW Plan construction sites removed from BPAWTP have well planned maintenance of traffic controls and construction activities where interaction with stakeholders and ratepayers. See Section 4.3.1 Permit Compliance for more information.

Capital Equipment

DC Water defines Capital Equipment as having a life of at least 3 years, a cost exceeding $5,000 and is financed with short-term debt or cash. The FY 2012 -2021 CIP allocates $96,022,000 or 2.5% of the budget to capital equipment. This is a slight reduction from the ten-year projection referenced in the 2008 Assessment of over $100 million; however the continued capitalization has equipped the organization adequately. The slight dip is attributable to the economic recession since the 2008 Assessment.

DC Water BPAWTP is currently building a new parts warehouse. What's unique about this facility is that it's smaller than its predecessor. BPAWTP will be implementing a new just-in-time (JIT) equipment replacement part program that uses a computerized system to track parts inventories and order the parts in time for scheduled replacement. This program is anticipated to significantly reduce the number of parts on the shelf, which in turn, releases capital for other uses that would otherwise be sitting idle on the shelves.

Asset Management

DC Water has prioritized establishing best management practices of its assets with the goal to maximize service life while minimizing costs and ensuring sustainability. Asset management includes: managing inventories of assets with supporting data that can be used to prioritize maintenance; used to prioritize capital projects; and assist long range decision making and financial planning. DC Water is facing the challenge of improving asset management of its current assets while looking ahead to managing $3.6 billion over the next 10 years with new tunnel and shaft assets coming online that are currently under construction. DC Water has convened its "Team Blue" Asset Management Program. The program is budgeted up to $20 million with disbursements over 5 years to establish a "world class" asset management program. Achieving a world-class asset management program means benchmarking DC Water's current asset management program with other cities known for their excellence in asset management.

DC Water's Team Blue (George S. Hawkins, General Manager, launched the Team Blue program to engage front line staff in improving the enterprise) plans to maximize the use of DC Water's current information technology (IT) asset tracking tools which include its Geographical Information System (GIS) and its MAXIMO system at BPAWTP. In addition, stakeholders will be integrated into the program and will eventually receive the necessary training to make the new asset management program a success. Since this is a relatively new initiative, it's too early to form an opinion on its effectiveness. JMT feels the approach is a good one, however, it should be audited periodically to ensure the program is meetings its targets and goals. Another major initiative is the Engineering Document Management System. This $2.4M project will provide a centralized electronic source for all critical DC Water documents. This will allow departments efficient and real time access to data and information thereby increasing the base of knowledge available to all DC Water employees.

Customer Service

DC Water's Automated Meter Reading system (AMR) is capable of providing customers with twice a day readings. Along with the accuracy and dependability of monthly billing readings, this automated system is effective in identifying leakage. Overall customer service has been emphasized noticeably in the past few years as DC Water has committed to being a leader and active participant in the community.

A significant example of the current trend towards improved customer service within the community is the First Street Tunnel Contract within the Bloomingdale community. The Bloomingdale Community has been on DC Water's priority list of areas requiring significant combined sewer capacity improvements for quite some time and is included in the CSO-LTCP. Although this community is on a slope, this neighborhood floods during modest rain storms because it is served by undersized combined sewers. Basements in this neighborhood are flooded during these events causing significant property damage and making basements unusable as a living or storage space.

DCCR initially had relief coming to this neighborhood in 2025 via the First Street Tunnel as part of the Northeast Boundary Tunnel portion of the Anacostia River Project. However, the public complained that 2025 was too long to wait for relief. Through recent discussions and collaboration between DC Water, the Mayor of the District of Columbia, and the community, the Northeast Boundary work has been accelerated to significantly reduce the flooding. DC Water pushed up the procurement of the First Street Tunnel to 2013 and modified the tunnel design to include a temporary pump station that would be in service until the Northeast Tunnel System was constructed. An interim, fast-tracked design-build project is underway to provide up to 6 million gallons of combined sewage storage by converting McMillan WTP underground sand filtration basins into retention basins. Combined sewer flood relief for the neighborhood is now scheduled for 2016; 9 years earlier than initially planned. Greater relief will be in 2022 which represents 3 years ahead of the CSO-LTCP schedule. The fast-tracking of this project requires earlier financing of approximately $110 million of planned construction.

Information Technology

The Department of Information Technology has made considerable progress in both internal and external upgrades in providing informational services. Core infrastructure upgrades have been completed that improve virtual machine capabilities and provide redundancy and additional bandwidth. Total Management System (TEAMS-Maximo), a maintenance organization program, and Geographic Information Systems (GIS) have been integrated and deployed at DC Water, improving management of maintenance and repairs for the Authority's equipment, buildings and grounds, and water/sewer infrastructure. AMR systems have been upgraded to provide second generation Data Collector Units

(DCUs), providing new user interfaces and valuable control and monitoring features. The Livelink Enterprise Document Management System has been deployed, improving the availability and management of DC Water documents and files.

Maintenance of Infrastructure

DC Water has established a 1% per annum replacement goal for aging infrastructure. This corresponds with the expected 100-year life of pipelines. This has required an increase in engineering design/inspection staff and funding for operations staff to complete repairs and replacement of water and sewer infrastructure. DC Water improvements have an increased presence in neighborhoods where ratepayer funds are in evidence as water and sewer mains are being replaced in order to meet the 1% goal. Interviews with Utility Services and Sewer Services verified the efficacy of the replacement programs. Unaccounted for water has decreased (leakage) on the Utility side, for example. Sewer Services reports the rehabilitation of sewers and sewer laterals have reduced infiltration and inflow into the sewerage.

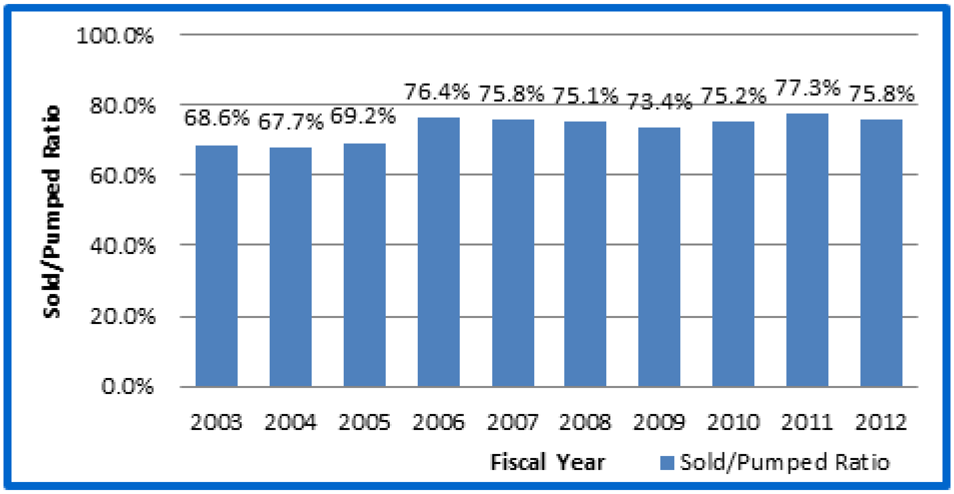
Fire Hydrant Replacement Program

As described in Section 3.6.5.3.1, Fire Hydrants, the replacement and repair of fire hydrants has been significantly increased since the 2008 Assessment. The Director of Utility Services reports that approximately one-half of the public fire hydrants have been replaced. 5,000 of over 9,000 total have been replaced through FY 2012. The program has been outsourced and Utility Services currently is utilizing two in-sourced crews on a full-time basis. This is a significant effort as JMT is not aware of any other urban program to replace 100% of the fire hydrants.

Water Sold/Pumped Ratio

Since 2008, the Authority's sold/pumped ratio has remained approximately 75% while infrastructure Leakage Index Values for the system have been decreasing. The internal audit of DC Water's infrastructure found an Infrastructure Leakage Index (ILI) Value of 8.31 for 2012, down from an ILI of 9.6 reported in 2008. The implication is that leakage has been reduced through the system, though non-revenue water percentage has remained around 25%. The ILI value reported for 2012 of 8.31 is typical of older distributions systems located in water rich areas in the US and puts DC Water's distribution system in the category of relatively efficient. The sold/pumped ration since 2003 is shown in Exhibit 2-3.

Exhibit 2-3: DC Water Sold/Pumped Ratio



Process Control System (PCS)

After entering the design phase in 1998, the plant wide Process Control and Computer System (PCS) is substantially complete, with an end date of March 2014. The PCS is currently in operation and provides monitoring and control of the treatment system from a central control room, functions that previously were performed manually. Processes integrated into the PCS include the Raw Wastewater Pumping Stations, Grit and Screen Facilities, Primary and Secondary Treatment Facilities, additional Chemical Systems, alternate Disinfection and additional Dewatering Systems, Nitrification, Filtration and Disinfection Facilities, and Gravity Thickening. This has significantly improved the treatment process function and substantially aided in optimizing labor, chemical and electrical costs.

Biosolids Management Plan

The Biosolids Management Plan involves an overhaul of the current solids completion process. This plan involves the construction of four Cambi thermal hydrolysis trains and digesters, new dewatering equipment and a combined heat and power plant. This project is expected to be completed late 2014, and will improve the biosolids quality to Grade A while reducing solids volume and producing electricity. The reduced volume will also reduce hauling costs. Grade A quality biosolids provide more certainty to land-application locations. Details for this project can be found in Section 4, B.4 Sludge Digestion Facilities.

CSO - LTCP

The CSO-LTCP is an initiative to meet the 2005 consent decree by improving control over wet weather related pollution. This massive undertaking involves multiple construction projects including the construction of an 8 mile tunnel under the Anacostia River, new sewer facilities and pumping stations and drop shafts. Details of this project are discussed in Section 4.4.1.2 and Section 5.

Awards

The National Association of Clean Water Agencies (NACWA) presented awards for achievements to DC Water in 2010. The National Environmental Achievement Award recognized the development of innovative technology with global application and the Platinum Peak Performance Award acknowledged the five-year record for BPAWTP in achieving outstanding compliance with U.S. Environmental Protection Agency standards for improving water quality in the Potomac River and Chesapeake Bay.

The National Environmental Achievement Award was won by DC Water for creating new research and technology design and operating criteria for enhanced nitrogen removal from wastewater in 2009 and 2010. The focus of this particular research is to turn solid nitrogen in wastewater into nitrogen gas, thereby rendering it harmless to the receiving waters. In their assessment, the personnel at BPAWTP concluded this to be a compact and cost-effective environmental technology that gives an alternative solution to utilities across the country. The innovation by the DC Water team has the potential for global impact in protecting aquatic life in waterways that receive wastewater discharges. When employed at BPAWTP, these technologies are expected to help protect the Potomac River and Chesapeake Bay.

NACWA also presented DC Water with the Platinum Peak Performance Award for five consecutive years of 100 percent annual National Pollutant Discharge Elimination System (NPDES) permit compliance. The NPDES permit, issued by the EPA, regulates the effluent, or treated wastewater, that Blue Plains discharges to the Potomac River. Blue Plains is held to one of the most stringent permits in the country. This is the first time that Blue Plains has received the Platinum Award.

DC Water Technical Papers

Engineers at BPAWTP are prolific in publishing their research, with more than 1,000 abstracts among them in just the last 10 years. These technical papers have been presented at wastewater conferences across the country touting BPAWTP’s implementation of advanced wastewater treatment processes.

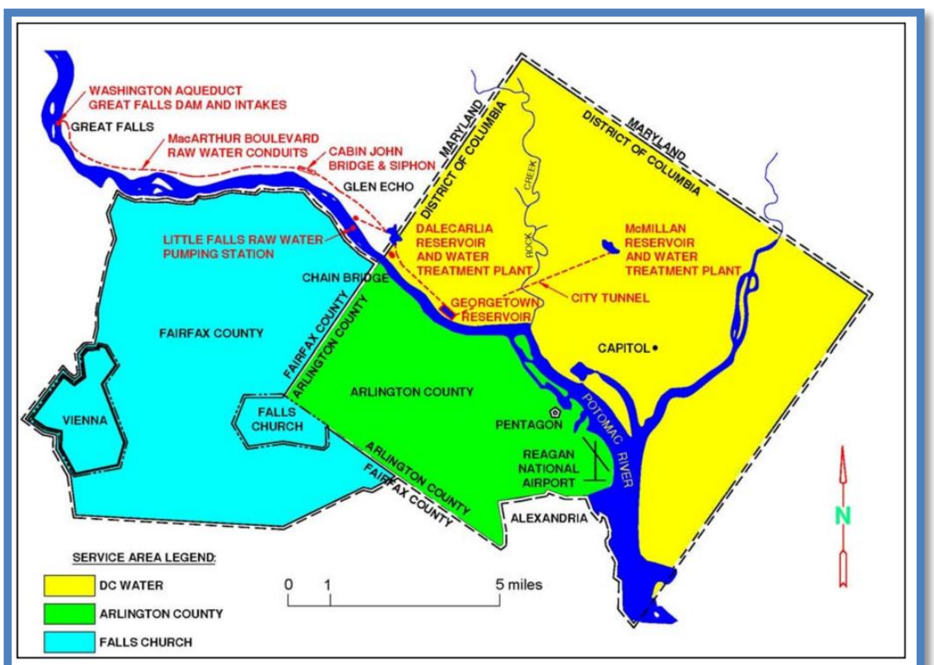
Section 3 Drinking Water Systems

3.1 Overview

DC Water provides drinking water to the residents, businesses and institutional facilities within the District of Columbia. DC Water is a consecutive system conveying and distributing potable water purchased from the Washington Aqueduct Division, which is chartered to treat Potomac River water for the District and parts of Northern Virginia. This section of the engineering assessment addresses the investigation of both Washington Aqueduct and the engineering and utility services of DC Water dedicated to the drinking water system.

In assessing the drinking water system, water supply, treatment facilities, transmission, pumping stations, storage facilities, and the distribution system were reviewed. Facilities owned and operated by Washington Aqueduct are presented separately from those owned and operated by DC Water. In general, Washington Aqueduct owns and operates the raw water intakes, conduits and raw water pumping facilities; treatment facilities; and finished water reservoirs. DC Water owns and operates transmission conduits, storage facilities, pumping station facilities and the water distribution system. **Exhibit 3-1** outlines the Aqueduct's service area and major assets.

Exhibit 3-1: Aqueduct Service Area and Major Assets



3.2 THE WASHINGTON AQUEDUCT DIVISION

3.2.1 Structure, Organization and Management Processes

The Washington Aqueduct (the Aqueduct) produces drinking water for approximately 1.8 million citizens living, working, or visiting in the District of Columbia, Arlington County Virginia, the City of Falls Church, Virginia, and its service area located in Fairfax County Virginia. A division of the Baltimore District, U.S. Army Corps of Engineers (the Corps), the Aqueduct is a federally owned and operated public water supply agency that produces an average of 180 million gallons of water per day at two treatment plants located in the District of Columbia. The Corps designed, built, and, in 1859, began operating the Aqueduct. Since then, the Corps has substantially expanded and improved the capacity and function of the Aqueduct from its original mission of supplying raw river water to a sparsely populated District of Columbia to today's mission of providing safe drinking water to a much larger and more populous service area.

The Aqueduct is proud of its tradition of providing a reliable and safe water supply. In its treatment brochure, the Aqueduct quotes George Washington from 1798:

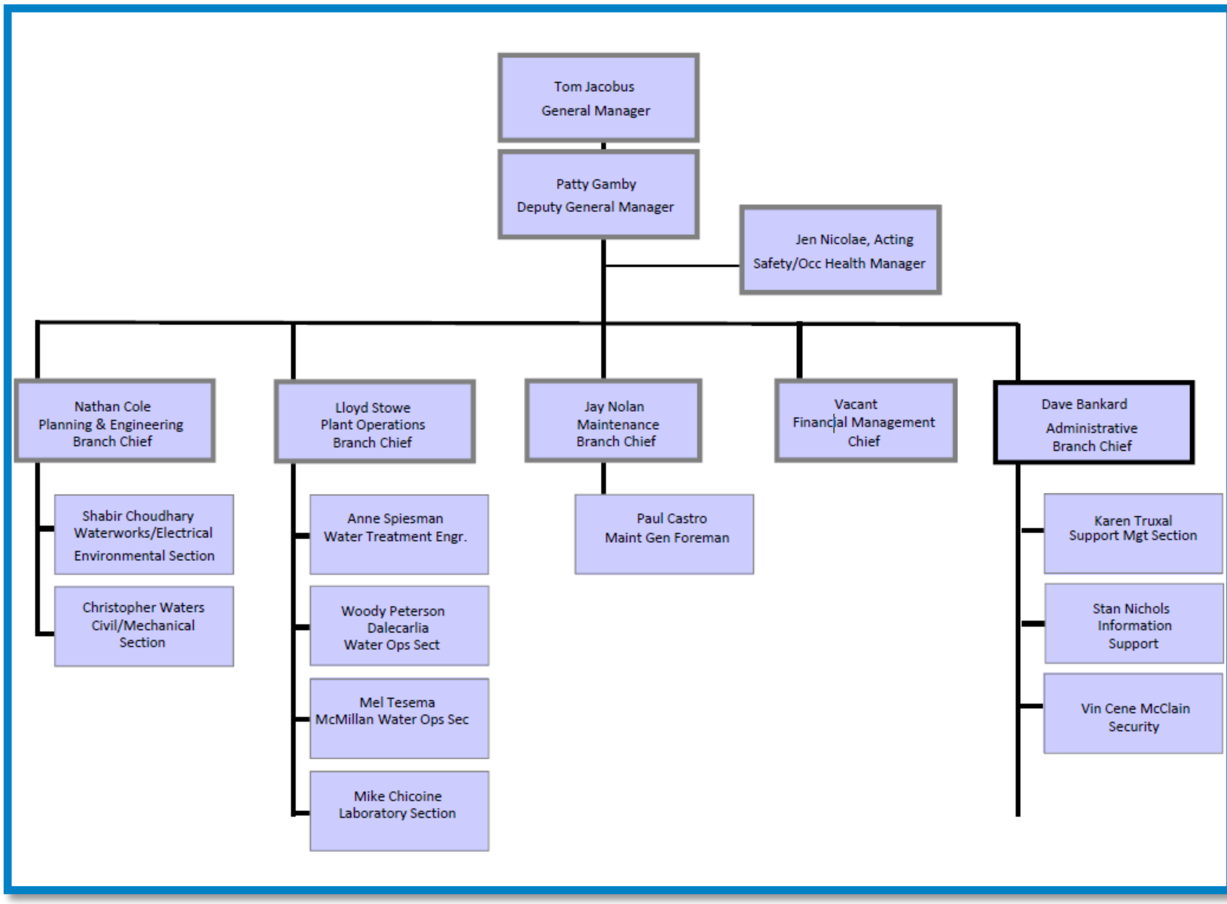
"The water of the Potomac may, and will be brought from above the Great Falls into the Federal City, which would, in future, afford an ample supply of this object."

The Aqueduct continues to supply an ample amount of water operating from clearly defined agreements and divisions of responsibility.

In 1998, Washington Aqueduct's customers (District of Columbia Water and Sewer Authority; Arlington County, Virginia; and the City of Falls Church, Virginia) entered into a memorandum of understanding (MOU) with the U.S. Army Corps of Engineers. The MOU established a Wholesale Customer Board to govern the operation of the Aqueduct and retained the Corps as owner and operator of the Aqueduct. The Wholesale Customer Board, comprised of executives from the member entities in the MOU, approves Washington Aqueduct's operating and capital budgets. Water rates paid by these customers fund operating and maintenance needs. The capital construction requirements are met on a pay-as-you go basis by each customer. The capital funding requirement has been approximately $14 million per year to sustain the infrastructure. Occasionally a larger project may be required for operational improvements or regulatory compliance purposes. Customers plan for and provide capital funding for these projects as needed. The Washington Aqueduct Capital Improvements Plan FY 2014 -2023 ranges from $14,650,000 to $16,000,000 per year with FY 2017 having the highest planned expenditures. The reprogrammed FY 2013 expenditures are $14,450,000.

The executive management of Washington Aqueduct is comprised of a General Manager and Deputy General Manager who are supported in managing the Aqueduct by four Branch Chiefs. The Financial Management Chief position was vacant at the time of this report. The various branches of the Aqueduct provide for the streamlining of the functional requirements for operating and managing the water utility. The Aqueduct's organizational chart is presented as **Exhibit 3-2** below:

Exhibit 3-2: Washington Aqueduct Division Organizational Chart



The Aqueduct has authorized 179 positions for FY 2012, which is a reduction from the 2009 authorized level of 194 positions. The Aqueduct has outsourced some of its staffing requirements for support activities. Janitorial, grounds keeping, security, and certain facilities maintenance activities are currently performed by external providers under contract to the Aqueduct. In addition, the staffing level is below the authorized level as the Aqueduct is in the process of hiring replacements for the aging workforce as employees head into retirement. This increase in retirements is being experienced by many utilities. The Aqueduct continues to perform its mission and places a high priority on securing qualified personnel.

The Aqueduct funds all its capital improvements on a pay-as-you-go basis with pro-rata contributions from its three municipal customers. Each fiscal year, the Aqueduct submits a proposed capital program to these wholesale customers (constituting the Wholesale Customer Board) for approval and inclusion in their respective budgets. The Aqueduct enjoys some latitude to request reprogramming after approval by its customers.

Before advertising any contract, and under federal regulations (applicable to the Aqueduct as an agency under the US Army), the customers deposit the required contribution with the US Treasury.

3.2.2 General Conclusions as to the Aqueduct's Structure, Organization and Management Processes

The Aqueduct operates in a well-organized manner with relatively minor changes in managerial staff even as baby-boomers retire throughout the rest of the industry. This assessment did not consider whether the Aqueduct could operate more efficiently: DC Water is pursuing a separate study of the efficiency of Aqueduct capital and operating programs. Compliance reports are submitted on a regular timeline to the Region 3 EPA office located in Philadelphia, PA. Permits are handled differently from other water agencies as there is no formal permitting process that the Agency employs. Rather, changes to the system are submitted as written explanations to the Region 3 EPA office. In particular, the Aqueduct benefits from meaningful participation by the wholesale customers.

The Aqueduct meets regulatory requirements through its Capital Improvements Plan. The Aqueduct also shows foresight in developing and managing future needs and capabilities through the plan. The 10-year 2014 to 2023 Capital Improvements Plan projects $151,750,000 in capital improvements. The $110 million basin waste recovery/residuals disposal project that eliminates discharge of settled residual solids back into the Potomac River is essentially complete, as discussed further within this section. Subsequently, the Capital Improvements Plan addresses infrastructure needs under a three-tiered priority ranking as shown in **Exhibit 3-3**. Improvements and upgrades to the raw water transmission system, the Dalecarlia and McMillan water treatment plants and pumping stations, along with further hardening of various sites, constitute the bulk of the CIP. DC Water's approximate 73% prorated contribution to these projects is projected by Washington Aqueduct at approximately $110.8 million.

Exhibit 3-3: Washington Aqueduct Capital Improvements Plan FY 2014-2023

Capital Improvements Plan Item	FY2014 - FY2023 Total
1A: Meet Legal Obligations	$0
1B: Required to Provide Safe Water in a Safe Manner	$27,850,000
2: Required to Improve Process & Public Confidence	$8,000,000
3A: Required to Provide Reliable Water Service	$96,600,000
3B: Required to Sustain Infrastructure	$19,300,000
Total	**$151,750,000**

Under the tiered priority system, the following major maintenance projects were accomplished between 2008 and 2012:

- Residuals Collection & Treatment Facility ($110M)
- Hypochlorite System and Associated Facilities ($16.9M)
- Security System Upgrades, Ph. II ($7.1M)
- McMillan Filter Media and Valve Replacements ($3.7M)
- Booster Pumping Station Renovation ($2.7M)
- McMillan Pumping Station Upgrades ($2.4M)
- Dalecarlia PS Power Protection System Upgrades ($2.0M)
- McMillan Reservoir Cove Area Dredging and Hauling ($1.8M)
- Dalecarlia Pumping Station HVAC Improvements ($1.7M)

- McMillan Chemical Bldg. HVAC Improvements ($1.7M)
- McMillan Polymer Feed Improvement ($0.4M)
- 3rd High Main Bridge Repairs ($1.6M)
- 30 MG Clearwell Gatehouse Rebuilding ($0.7M)

3.3 Water Supply Management and Coordination

The Potomac River is the sole source of raw water available for Washington Aqueduct's two drinking water treatment plants. In addition to Washington Aqueduct's demand on the river supply, the Potomac River is the main source of water for the region, as the river also is the supply for the Fairfax County Water Authority (Fairfax Water) and the Washington Suburban Sanitation Commission (WSSC). The region is very cognizant of the sensitivity to drought and the threat of contamination inherent to the river supply. The JMT review of research, studies and reports for the 2013 Assessment provides reassurance that the river continues to provide a sufficient supply of good quality raw water to meet the needs of Washington Aqueduct and the other water utilities in the region. Interviews at Washington Aqueduct reinforced confidence in the planning and emergency operational plans in place during low flows and any possible contaminating events.

The Interstate Commission on the Potomac River Basin (ICPRB) was created with an interstate compact established by Congress in 1940 to help the Potomac basin states and the federal government to enhance, protect, and conserve the water and associated land resources of the Potomac River basin through regional and interstate cooperation. The ICPRB jurisdictions are represented by appointed Commissioners from Maryland, Pennsylvania, Virginia, West Virginia, the District of Columbia, and the federal government.

3.3.1 Water Supply Coordination Agreement

In 1978, a Low Flow Allocation Agreement (LFAA) was signed by the states and by the major utilities, recognizing the need to maintain a minimum flow in the Potomac River that would be sufficient to sustain aquatic resources. The agreement established a set of stages for low river flow that would trigger actions on the part of each signatory to monitor and eventually restrict water withdrawals. It further established a formula for allocating Potomac River water during times of shortage.

In 1982, The Water Supply Coordination Agreement was developed among Fairfax Water, WSSC, Washington Aqueduct, and ICPRB. The ICPRB Section for Cooperative Water Supply Operations on the Potomac (CO-OP) was designated by the Water Supply Coordination Agreement to be responsible for coordination of water resources during times of low flow. The management objectives embodied in the agreement and practiced by CO-OP are to keep the off-Potomac reservoir resources balanced while meeting environmental requirements and municipal demands for water. Each of the three utilities gives up a small measure of autonomy in order to gain the substantial benefits of reduced capital costs through coordinated cooperative operations of their individually and jointly owned resources.

In order to avoid the possibility of withdrawing all the flow of the river, Maryland Department of Natural Resources conducted the Potomac River Environmental Flow-By Study (1981). The parties to the LFAA agreed to abide by the study's recommendations for the maintenance of in-stream flow to meet minimum aquatic habitat requirements.

3.3.2 Off-Potomac Storage Reservoirs

The Potomac River is the primary source of raw water for the WMA water suppliers, providing approximately 78 percent of the total water used. As stated earlier, Washington Aqueduct relies solely on the Potomac River to supply 100% of DC Water's drinking water. The Occoquan Reservoir in Virginia and the Patuxent River reservoirs in Maryland provide the remaining 22 percent of the total WMA demand. The WMA water suppliers jointly pay the capital and operating costs to reserve a portion of the water stored in two reservoirs available to augment the natural flow of the Potomac River.

The Jennings Randolph Reservoir, located on the North Branch of the Potomac River approximately 200 miles upstream of Washington, D.C., is an Army Corps of Engineers' owned and operated facility on the North Fork of the Potomac River. The impoundment has a capacity of 13.4 billion gallons of usable storage, which has been contracted for and can be shared by Washington Aqueduct, Fairfax Water, and WSSC. Because of its distance from the WMA water suppliers' intakes, releases take more than a week to travel downstream during times of low flow (nine days is the current modeling travel time). Jennings Randolph Reservoir, the system's largest reservoir, appears to be losing storage capacity due to sedimentation at a rate that is higher than estimated in the past.

The Little Seneca Reservoir, located in Montgomery County, Maryland Little Seneca Reservoir, at a usable storage capacity of 3.8 billion gallons, is much smaller and closer to the area's water supply intakes and can be used to provide more immediate augmentation to the river, allowing for more-efficient operation of Jennings Randolph Reservoir. The reservoir is located in Montgomery County, Maryland, and is owned by WSSC, with storage capacity being shared by Washington Aqueduct, Fairfax Water, and WSSC. Together, these two reservoirs, used as a system to ensure adequate river flows, can furnish more than 17 billion gallons of water to supplement naturally occurring flows in the Potomac. The Little Seneca Reservoir, located hydraulically within the WMA, is available to 'fine tune' the larger flows from the larger reservoirs. This strategy allows a more conservative approach to upstream releases while maintaining the required minimum flows at the Little Falls dam.

The Savage River Reservoir, with an estimated storage capacity of 6.3 bg, is used for water quality improvement, to provide flow for industrial processes, incidental flood control, and, historically, to dilute relatively acidic flows, which were experienced in the past, in the North Branch of the Potomac. These operations allow concurrent Savage releases during Jennings Randolph releases for water quality purposes. These concurrent Savage releases are also referred to as "matched" releases.

3.3.3 2010 CO-OP Drought Operations

The Section for Cooperative Water Supply Operations of the Interstate Commission on the Potomac River Basin (CO-OP) began in the early 1960s and has helped coordinate water supply operations of Washington Aqueduct, Fairfax Water, and WSSC during times of drought.

Drought conditions in the summer and fall of 2010 caused flow in the Potomac River to fall to levels requiring augmentation from upstream reservoirs for the third time since establishment of the cooperative system in the early 1980s. Reservoir releases were also required in 1999 and 2002. These releases were directed by ICPRB CO-OP based on existing and projected water demand, status of other reservoirs, and weather conditions.

The Metropolitan Washington Council of Government's (MWCOG) **Metropolitan Washington Water Supply and Drought Awareness Response Plan: Potomac River System** is a coordinated response plan for the region that details various triggers, actions, and messages for three different water restriction stages (Watch, Warning, and Emergency). The Drought Coordination Committee (DCC), whose members consist of the Chief Administrative Officers from the 21 member governments of MWCOG, the general managers of area water utilities, water supply officials from the Maryland Department of the Environment and the Virginia Department of Environmental Quality, and ICPRB CO-OP staff, declare each of three drought stages: Monitoring, warning and Emergency. The Emergency stage is declared when there is a 50 percent probability of not being able to meet water supply demands over the next month.

Several flow forecasting tools were used during the drought operations to determine the need for releases from Jennings Randolph Reservoir and the need for load shifting (Fairfax Water and WSSC reliance on the Occoquan and Patuxent systems). On September 10, the nine-day flow forecasts prompted the CO-OP staff to request releases from the North Branch reservoirs to meet the 100 mgd environmental flow at Little Falls. During the drought operations, Jennings Randolph Reservoir water supply releases were first initiated on September 10 and continued until September 21. A second water supply release from the same reservoir was made on September 23 and 24.

The 2010 drought operations were a substantiation of the efficacy of drought planning and coordination within WMA. Washington Aqueduct, Fairfax Water and WSSC have demonstrated the appropriate level of planning and coordination implementing measures to protect the quality and adequacy of water supplies. MWCOG has supported the drought task force. Beyond developing a public appreciation for the wise use of water, DCC has demonstrated that Washington Aqueduct will have sufficient water supply as part of the coordinated WMA water system planning. The 2010 Drought Operations demonstrated effective management and allocation of resources, identifying areas of improvement based on lesson learned.

3.4 Treatment Processes and Related Facilities

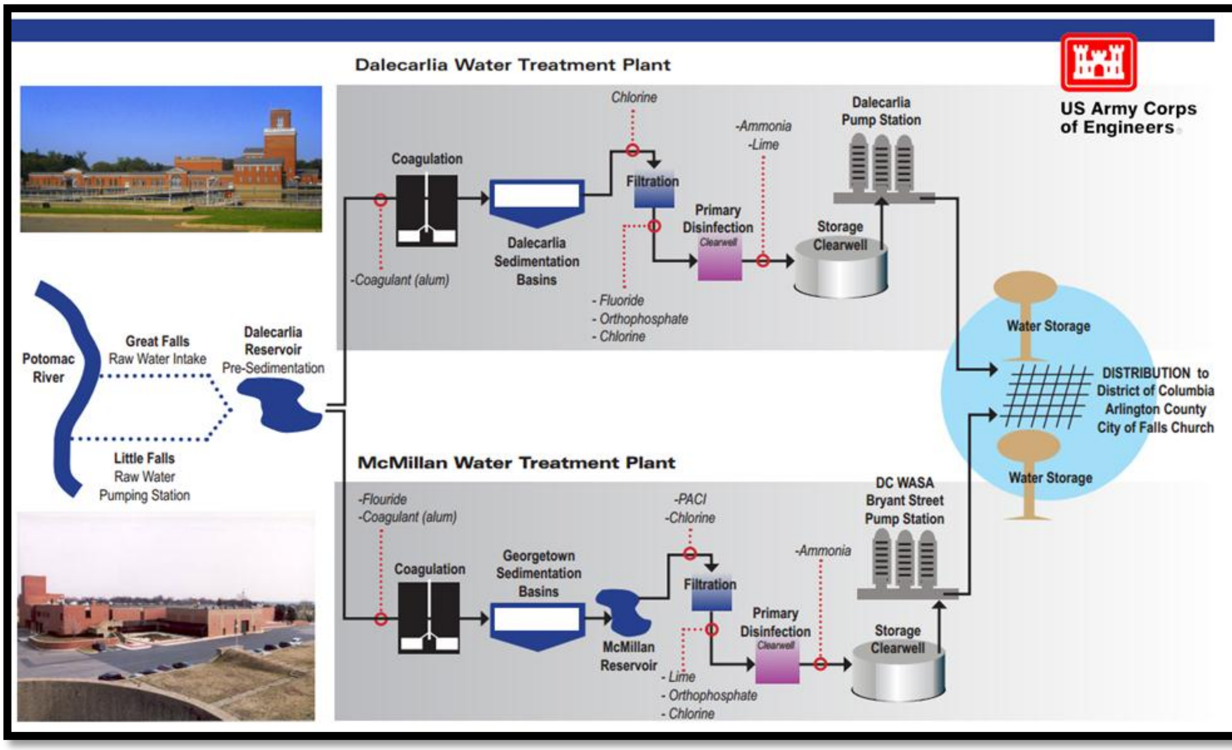
3.4.1 Raw Water Supply

Raw water from the Potomac River flows by gravity from the Great Falls intake structure, upstream of the dam, via the aqueduct/conduit to a forebay adjacent, and prior, to the Dalecarlia Reservoir. The original facilities at the Great Falls Dam and Intake were built in 1869, with major renovations undertaken in 1969. The Great Falls Dam and Intake may supply a total of up to 217 mgd to the Dalecarlia Reservoir.

In addition to the gravity flow from Great Falls, a second intake is at Little Falls, from where water is pumped directly to the Dalecarlia Reservoir. The Little Falls Pumping Station and Intake were built in

1958 and have the capacity to deliver 525 mgd of water to the Dalecarlia Reservoir. See **Exhibit 3-4** below.

Exhibit 3-4: Water Treatment Process



3.4.2 Pretreatment Storage

The Dalecarlia Reservoir is a 238 million gallon earthen basin that serves primarily as a pretreatment reservoir for both the Dalecarlia and McMillan water treatment plants. Retention of raw water in this reservoir allows some of the suspended solids to separate from the aqueous portion of the untreated water. Sediments retained in the Dalecarlia Reservoir are removed via a dredging system and conveyed to the Basin Recovery Facility. The Dalecarlia Reservoir transmits water by gravity feed to both the Dalecarlia Water Treatment Plant (Dalecarlia sedimentation basins) and the Georgetown Reservoir.

3.4.3 Water Treatment

The Dalecarlia Water Treatment Plant is the larger of Washington Aqueduct's two water treatment plants. The original facility was built in 1928. The plant capacity was increased in the 1950s by the addition of two additional sedimentation basins, a 30-mg clear well, a 577-mgd finished water pumping station and additional filters. A new chemical building and an additional filter building were completed in 1964. The plant currently has a capacity of 164 mgd, based on filtration rates of two gallons per minute per square foot (gpm/sf), and a maximum capacity of 264 mgd. Water from the Georgetown Reservoir (sedimentation basins) is delivered to the McMillan Water Treatment Plant via the Washington City Tunnel. Originally constructed in 1905 as a slow sand filter plant, the McMillan WTP was replaced in 1985 and is now a rapid sand filtration plant. This plant has a design capacity of 120 mg, based on a filter design rate of 4 gpm/sf, with a maximum capacity of 180 mgd.

Both of these plants employ the following treatment technologies:

Screening - On its way from the river to the Dalecarlia and McMillan treatment plants, raw water passes through a series of screens designed to remove debris such as twigs and leaves.

Pre-sedimentation - While the water moves slowly through Dalecarlia Reservoir, much of the sand and silt settles to the bottom.

Coagulation - A coagulant, aluminum sulfate (alum), is added to the water as it flows to sedimentation basins. Coagulants aid in the removal of suspended particles by causing them to consolidate and settle. Alum contains positively charged atoms called ions which attract the negatively charged particles suspended in water causing them to gather into clumps of particles heavy enough to settle.

Flocculation - The water is gently stirred with large paddles to distribute the coagulant; this causes particles to combine and grow large and heavy enough to settle. This process takes approximately 25 minutes.

Sedimentation - The water flows into quiet sedimentation basins where the flocculated particles settle to the bottom. After about four hours, approximately 85 percent of the suspended material settles.

Filtration - Water at the top of the basins flows to large gravity filters, where the water flows down through filter media consisting of layers of small pieces of hard coal (anthracite), sand, and gravel placed in the bottom of deep, concrete-walled boxes. Filtered water passes through to a collecting system underneath.

Disinfection - Chlorine is added with precision equipment to kill pathogenic microscopic life such as bacteria or viruses. Ammonia can be then added. The chlorine and ammonia combine to form chloramine compounds. The concentration of chloramines in the water is closely monitored from the time it is added at the treatment plants to points near the farthest points of the distribution systems.

In addition, orthophosphate is added to control corrosion in pipes, service lines, and household plumbing throughout the distribution system. This will be discussed further in the water distribution section. Fluoride, in the form of hydrofluorosilic acid, is added to reduce tooth decay, which is a common practice in public drinking water systems. Powdered activated carbon is occasionally used for taste and odor control, which is a safeguard against raw water quality fluctuations associated with a river supply.

3.4.4 Recent Improvements

The Aqueduct identified projects for improvements to both the Dalecarlia and McMillan Treatment Plants. (Please see **Exhibit 3-5** below.) The $110 million Basin Waste Recovery/Residuals Disposal project was completed and placed in service, officially, on November 22, 2012. This facility allows the Aqueduct to be in full compliance with the Federal Facilities Compliance Agreement, which eliminates discharges of solids to the Potomac River. The project generates 7-9 truckloads of residual solids per day transported to a permitted landfill for disposal. The residuals disposal represents a major operating expense. An innovative feature is the return residuals pipeline to the Residuals Collection & Treatment Facility from the Georgetown Reservoirs. The dredged residuals are conveyed to the facility located at Dalecarlia via a pipeline installed within the much larger Georgetown Viaduct, which conveys raw water from the Dalecarlia Reservoir to the Georgetown reservoirs on its way to the McMillan Water Treatment Plant. In essence this pipe within a pipe allows a reverse flow of the concentrated solids. This trenchless technology approach was both a cost savings and a minimization of disruption to the public and the environment.

Also, new chemical storage and handling facilities at both water treatment plants allow the Aqueduct to disinfect using sodium hypochloride (‘hypo’) vs. liquid chlorine. ‘Hypo’ is a much safer chemical to store and handle than gaseous/liquid chlorine. ‘Hypo’ also allows for a less intensive pH control system. The pH control system has been upgraded to accommodate the pH characteristics of hypo. This change in the treatment process was approved by United States Environmental Protection Agency (EPA) on December 11, 2009. The new chemical processes at both plants came on line between May 2010 and July 2011. The following chart depicts the timeline for the chemical upgrades:

Exhibit 3-5: Timeline for Chemical Upgrades at Dalecarlia and McMillan WTPs

Project Milestone	Dalecarlia WTP	McMillan WTP
Initial Addition Of Caustic Soda	May 10, 2011	May 18, 2011
Substantial Completion Of Caustic Soda Addition Project	July 2011	July 2011
Initial Addition Of Sodium Hypochlorite	May 31, 2011	May 24, 2010
Substantial Completion Of Sodium Hypochlorite Addition Project	July 2011	July 2010
Final Addition Of Gaseous Chlorine	July 6, 2011	June 21, 2010

Inspections made in January 2013 for the purpose of this report found the new facilities to be operating effectively and safely.

Per Federal legislation and a 1997 memorandum of understanding between the Washington Aqueduct and Northern Virginia partners, oversight of the Aqueduct's operations and CIP is shared between the partnership. DC Water purchases nearly 75 percent of the water produced by the Washington Aqueduct and thus contributes significantly to the Washington Aqueduct's CIP. DC Water's FY 2012 – FY 2021 CIP budget includes $107 million dedicated to Washington to Aqueduct Projects. The Washington Aqueduct CIP projects in which DC Water participates are listed in **Exhibit 3-6**.

Exhibit 3-6: DC Water's Washington Aqueduct CIP Participation

Washington Aqueduct Projects	Recommended Improvements	Cost	Timeline
WAD121	Basin Waste Recovery	$98.1M	Completed
WAD122	Dalecarlia Pumping Station	$7.9M	Completion Oct 2017
WAD123	Cabin John Bridge	$0.913M	Completion Oct 2015
WAD126	McMillian WTP Improvements	$26.3M	Completion Oct 2017
WAD 127	Appurtenant Transmission and Storage Facilities	$45.2M	Completion Oct 2017
Wad128	Dalecarlia WTP Improvements	$52.2M	Completion Oct 2017
Wad 130	Alternate Treatment Methods	$1.2M	Completion Oct 2017

3.4.5 Permit Compliance

The Aqueduct treats the surface water in accordance with EPA regulations. Existing Washington Aqueduct treatment processes are meeting or exceeding promulgated federal SDWA regulations, including physical, chemical, radiological, and bacteriological standards. The Aqueduct has taken necessary steps to exceed the requirements in the Enhanced Surface Water Treatment rule to ensure that turbidity is well below any level which could impact any cryptosporidium impact to the public as discussed further in the water Quality section.

3.4.6 Future Regulatory Issues

The Washington Aqueduct tracks emerging water quality issues and developments in regulations that could affect operations. Continuing regulatory and public pressure to reduce levels of disinfection byproducts and detection of emerging parameters of concern in drinking water, such as PPCPs, have to be addressed with preliminary planning and funding.

The Aqueduct participated in the USDA's Pesticide Data Program, which included an occurrence study of about two dozen pharmaceuticals, in addition to dozens of pesticides, in raw and finished water. Participation in national studies improves the Aqueduct's knowledge and understanding of pharmaceuticals and emerging contaminants in source and treated water to be in the forefront of needed treatment technologies. This knowledge and understanding is a foundation for possible future solutions for emerging contaminants. Although future treatment requirements have not been identified, the Aqueduct's knowledge and understanding better prepares the Wholesale Customers for any, as of yet unidentified, future capital improvements to meet future regulations.

3.4.7 Water Quality

Water supplied by the Aqueduct to its wholesale customers meets or exceeds all standards established in these federal regulations, including physical, chemical, radiological, and bacteriological standards. A key measure of drinking water quality is filtered water turbidity, which is an indicator of the solids content in water. Under the Enhanced Surface Water Treatment Rule, composite filtered water turbidity must be less than 0.3 NTU (nephelometric turbidity units). The Aqueduct has met this minimum requirement and has also established its own target for each individual filter to operate under 0.1 NTU. This is an aggressive target given that one of the main characteristics of the Potomac River is extreme variations in turbidity. The operations staff has written procedures to maintain the individual filters' effluent (IFE) at a threshold of 0.1 NTU. The absence of turbidity reflects the treatment process's safeguard against cryptosporidium.

Prominent federal regulations are the Lead and Copper Rule, Total Coliform Rule, Disinfectants/Disinfection Byproducts Rule (D/DBP), and the Enhanced Surface Water Treatment Rule. The Aqueduct has consistently reported monthly samples below maximum acceptable levels as published in the Aqueduct's annual Water Quality Report as required by the EPA.

Annually, Washington Aqueduct's EPA-certified laboratory conducts more than 65,000 individual tests on water samples. The analytical testing investigates the presence of bacteria, organic and inorganic compounds and metals. The Aqueduct possesses and maintains up-to-date laboratory equipment. The analyses measure hundreds of elements and compounds, although many elements and compounds are below the detectable limit.

As reported in the 2008 Assessment, orthophosphate treatment was initiated in August 2004. It has been operating continuously at the targets set by the optimal corrosion control treatment directive from EPA Region 3. The dose has been established at 2.4 milligrams per liter (mg/L) since February 2006. Improvements as measured in the concentration of Lead in the compliance samples obtained by DC Water from the designated homes have been sustained. DC Water has continuously met the Lead and Copper Rule requirement of the 90th percentile of the samples being less than 15 micrograms per liter since 2005.

3.4.8 Operations, Maintenance and Security

The operations of the Dalecarlia and McMillan Treatment Plants are the responsibility of the Plant Operations Branch of the Aqueduct. The Aqueduct's Maintenance Branch performs much of the work required to keep the treatment plants and related facilities operational and contracts certain non-core functions. The Aqueduct maintains the prerequisite skills for central maintenance functions pertaining to instrumentation repair, high-voltage electrical work, machining, welding, plumbing and pipefitting. The Maintenance Branch performs excavations and repair of pipework and appurtenances.

The January 2013 inspection of the Dalecarlia and Georgetown facilities verified on-going operations and the performance of routine and critical maintenance.

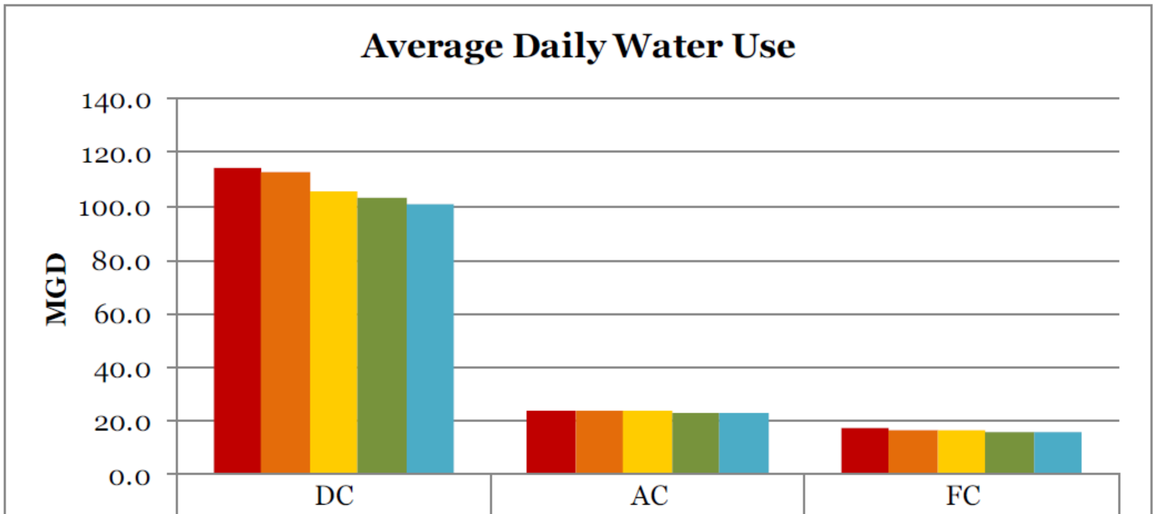
All Washington Aqueduct facilities have controlled access. Since the 2008 Assessment, an additional iteration of hardening the various sites has taken place. Additional steps are programmed within the Capital Improvement Plan to safeguard the facilities, reflecting the greater concern that unauthorized persons may enter facilities and compromise the ability of the Aqueduct to deliver sustained quantities of safe drinking water.

The $7.1M Security System Upgrades project included major security improvements to the main entrances at both the Dalecarlia and McMillan water treatment plants, security hardening at remote facilities and the installation of security surveillance and cameras using intelligent video, which allow for real-time monitoring of all Washington Aqueduct facilities from centralized locations. The next phase of this project will be conducted after a security study and assessment and will include further fence hardening of facilities. Hardening of the various Aqueduct sites is a programmed, iterative process where security is enhanced systematically. The security upgrades allow the Aqueduct to keep pace with emerging threats.

3.5 WATER DEMAND HISTORY

The Aqueduct's systems combine for a raw water capacity of 700 mgd and the combined treatment capacity of the Dalecarlia and McMillan water treatment plants is 350 mgd. In FY 2012, the Aqueduct produced an average of 139 million gallons per day, which represents a continuing reduction in water demand. The reduction represents a 1.7% decrease from FY 2011. The 2008 Assessment reported a decrease from 180 mgd to 175 mgd. In FY 2012 36.9 million gallons of water were provided to the District as compared to 37.6 million gallons in FY 2011 and significantly less than the 43 million gallons provided in FY 2007. The reductions can be attributed to efficiencies within the distribution system, the point of use devices such as low flow fixtures and customer conservation. Both water treatment plants are located in the District. **Exhibit 3-7** below summarizes water demand from FY 2008 through FY 2012, where DC represents DC Water, AC represents Arlington County, and FC represents the City of Falls Church. Over the period from FY 2008 to FY 2012, the Aqueduct experienced an average annual reduction in water demand of 2.7% and 3.1% average annual decline in water demand from DC Water.

Exhibit 3-7: Water Purchases by Customers, 2007-2011



	DC	AC	FC
2008	114.6	23.5	17.2
2009	113.0	23.4	16.9
2010	105.7	23.5	16.6
2011	102.9	22.6	15.8
2012	100.9	22.7	15.6

3.6 Water System Service Area

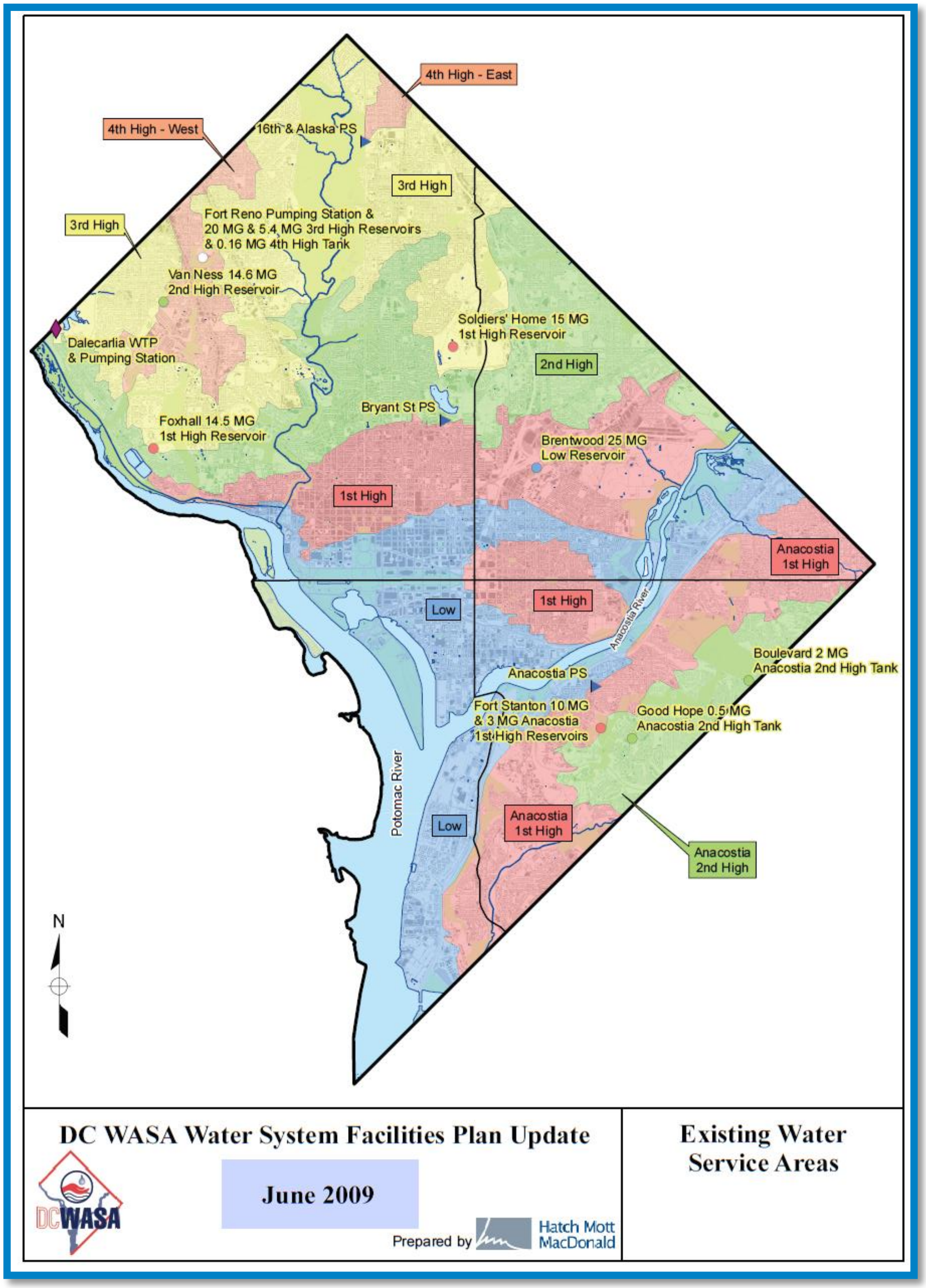
Potable drinking water is delivered to DC Water from the two Washington Aqueduct water treatment plants. The distribution system is a combination of DC Water-owned and controlled assets and particular facilities owned by the Aqueduct. DC Water serves its retail customers through a distribution network consisting of underground reservoirs, elevated tanks, pipes, valves and various system appurtenances. Both the Authority and the Aqueduct own aspects of the distribution network.

DC Water's distribution system consists of approximately 1,300 miles of pipe with over 36,000 valves for controlling the flow. An important function of the system is to provide fire protection for the District of Columbia. The system includes over 9,000 public fire hydrants. DC Water maintains 8 storage tanks – 3 elevated tanks and 5 ground reservoirs. In addition, there are four water pumping stations with the largest being the Bryant Street Station with a capacity of 204.5 mgd.

3.6.1 System Overview

The water distribution system has been configured to provide a service pressure of approximately 50 pounds per square inch (psi). To maintain suitable pressures for domestic use, the water distribution system is divided into seven pressure zones following topographical changes. The current service areas, or zones, are listed in **Exhibit 3-8**:

Exhibit 3-8: Existing Water Service Areas



These service areas are served by a system consisting of five pumping stations, eleven reservoirs and elevated tanks. One of the pumping stations is operated by the Washington Aqueduct Division as are three of the reservoirs.

Low Service Area corresponds to places with ground elevations between 0 and 70 feet and includes areas along the Potomac and Anacostia Rivers. This area is served by the Dalecarlia Pumping Station (operated by the Washington Aqueduct Division), and the Bryant Street Pumping Station. The pressure in the Low Service Area is controlled by the water level in Brentwood Reservoir.

First High Service Area is located on the west side of the Anacostia River where the ground elevations range between approximately 70 and 140 feet above sea level. This area is served by the Dalecarlia and Bryant Street pumping stations. The pressure in the First High Service Area is controlled by the water levels in the Fox Hall Reservoir and the Soldier's Home Reservoir. The Fox Hall Reservoir is owned by the Washington Aqueduct Division, while the Soldier's Home Reservoir is owned by DC Water.

Anacostia First High Service Area serves communities located southeast of the Anacostia River and having ground elevations between 70 and 170 feet. Water to this zone is supplied by the Anacostia Pumping Station. The pressure in this area is controlled by the water level in Fort Stanton Reservoirs No.1 and No.2.

Second High Service Area serves the area west of the Anacostia River between Rock Creek Park and Eastern Avenue with ground elevations between 140 and 210 feet. As with the First High Service Area, this area is served by the Dalecarlia and Bryant Street pumping stations. The pressure in the Second High Service Area is governed by the water level in the Van Ness Reservoir. The Van Ness Reservoir is owned and operated by Washington Aqueduct.

Anacostia Second High Service Area serves the area located southeast of the Anacostia River along Southern Avenue and having ground elevations above 170 feet. This area is served by the Anacostia Pumping Station. The pressure in this area is controlled by the water level in the Good Hope Road Elevated Tank and the Boulevard Elevated Tank.

Third High Service Area is located west of the Anacostia River with ground elevations between 210 and 350 feet above sea level. This area is served by the Dalecarlia and Bryant Street pumping stations. The water supply to the Third High Service Area comes from both the Dalecarlia Pumping Station and the Bryant Street Pumping Station. The service pressure is governed by the water level in the two Fort Reno reservoirs, Fort Reno Reservoir No. 1 and Fort Reno Reservoir No.2. The Fort Reno Reservoir #2 is owned and operated by the Washington Aqueduct Division.

Fourth High Service Area serves the area west of the Anacostia River, separated by Rock Creek Park, bounded by Eastern and Western Avenues, and with ground elevation above 350 feet. The Fourth High Service Area is further subdivided into an eastern portion and a western portion. The Fort Reno Pumping Station supplies the western portion. The Fort Reno Pumping Station pumps from water that is supplied from the Third High Service Area. The western system pressure is controlled by the water level in the 0.16 MG Fort Reno Elevated Tank. The system pressure for the eastern portion of the Fourth High Service Area is provided by the 16th and Alaska Pumping Station.

The DC Water distribution system is configured in the same pressure areas as reported in the 2008 Assessment. **Exhibit 3-9** summarizes the zone configuration.

Exhibit 3-9: Water Service Area Pressure Zones

Pressure Zone	Ground Elevation	Maximum Static Hydraulic Grade Line
Low	0 to 70 feet	172 feet
First High	70 to 140 feet	250 feet
Anacostia First High	70 to 170 feet	258 feet
Second High	140 to 210 feet	335 feet
Anacostia Second High	Above 170 feet	382 feet
Third High	210 to 350 feet	424 feet
Fourth High	Above 350 feet	485 feet

3.6.2 Pumping Stations

Exhibit 3-10 summarizes the five pumping stations serving the pressure zones. One of these stations, the Dalecarlia Pumping Station, is owned and operated by the Aqueduct. As part of the regional water system serving the D.C. area, DC Water utilizes the pumping capabilities of the Aqueduct. Beyond the pressure levels served by the Dalecarlia pumping facility, DC Water maintains four pumping stations that draw water from lower pressure zones, pressurizing the water delivered to higher zones.

Exhibit 3-10: Drinking Water Pumping Facilities

Facility	Date Placed in Service	Service Area	Capacity
Dalecarlia Pumping Station (Aqueduct operated)	1928	Low, First High, and Third High	310 mgd
Bryant Street pumping Station	1905	Low, First High, Second High, and Third High	204.5 mgd
Fort Reno Pumping Station	1977	From Third High to Fourth High	15.7 mgd
16th & Alaska Pumping Station	1993	From Third High to Fourth High	3.5 mgd
Anacostia Pumping Station	1913	From Low to Anacostia First and Second High	82.8 mgd

3.6.2.1 Washington Aqueduct Pumping Capabilities

Dalecarlia Pumping Station: As part of the Dalecarlia Water Treatment Plant, this station was built in 1928. The pumping station has a total capacity of 310 mgd and provides service to Low, First High, Second High, and the Third High Service Areas while serving the City of Falls Church and Arlington County in addition to the District of Columbia.

3.6.2.2 DC Water Pumping Stations

Bryant Street Pumping Station:

The Bryant Street Pumping Station was built in 1905 and pumps water to the Low, First High, Second High, and Third High Services Areas. At a capacity of 204.5 mgd, it is DC Water's largest pumping station. Major renovations of the Bryant Street Pumping station have been completed. The Bryant Street Pumping Station is the nerve center for the water distribution for DC Water. The renovations have made the station and its operating center both effective and efficient in the reliable delivery of drinking water.

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.

Condition Assessment

DC Water will soon complete projects that will remedy some of the structural and mechanical components of the Bryant Street Pumping Station as reported in the 2008 Assessment. **Exhibit 3.6.2.2-1** provides a list of these projects.

Exhibit 3.6.2.2-1: Bryant Street Pumping Station CIP Projects

Project ID	Project Title	Cost	Timeline
DU	Water System Laboratory Facilities – Provides laboratory facilities for the Water Quality Division at the Bryant Street Pumping Station	$0.6M	Construction Jan 2015
FD	Water Facilities Security System Upgrades – Provides security system upgrades to water storage facilities	$2.0M	Construction Jan 2014
FH	Discharge Piping Bryant Street Pumping Station – Provides replacement for highly corroded discharge pipes	$13.4M	Completion Mar 2016
HE	New Parking Structure and Building Modifications at Bryant Street Pumping Station	$13.5M	Design Jan 2016
HV	Bryant Street Pump Station Spill Header Flow Control – Provides replacement of manual PRVs with actuated PRVs	$1.4M	Construction Sep 2014
JB	Bryant Street Pumping Station Improvements – Phase II – Provides modifications and structural reinforcement of warehouse and shop buildings on Bryant Street Pumping Station Site	$7.0M	Construction Sep 2013
M6	Rehabilitation of Bryant Street Pumping Station – Rehabilitates and upgrades pumping station	$62.7M	Completion Aug 2014

The current state of the Bryant Street Pumping Station was provided during interviews on May 6th and 7th, 2013. There were no improvement needs observed or discussed.

Fort Reno Pumping Station:

The Fort Reno Pumping Station was placed in service in 1977. It has a pumping capacity of 15.7 mg and pumps water from the Third High Service Area to the Fourth High 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 former 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.

Condition Assessment

DC Water will soon complete projects that will remedy some of the structural and mechanical components of the Fort Reno Pumping Station as reported in the 2008 Assessment. **Exhibit 3.6.2.2-2** provides a list of these projects.

Exhibit 3.6.2.2-2: Fort Reno Pumping Station CIP Projects

Project ID	Project Title	Cost	Timeline
AY	Upgrades to Ft. Reno Pumping Station – Provides for upgrades and improvements to the pumping station and control systems	$11.3M	Completion Expected Oct 2016
HF	New Maintenance Facility at Fort Reno – Provides for demolition of existing structures and the construction of new facilities	$3.0M	Design Sep 2016

The current state of the Bryant Street Pumping Station was provided during interviews on May 6th and 7th, 2013. There were no improvement needs observed or discussed.

16th and Alaska Pumping Station:

At a 3.5 mgd capacity, the 16th and Alaska Pumping Station pumps water from the Third High Service Area to the Fourth High Service Area. The pumping station was built in 1993. 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.

Condition Assessment

DC Water will soon complete a project that will remedy some of the structural and mechanical components of the 16th and Alaska Pumping Station as reported in the 2008 Assessment. **Exhibit 3.6.2.2-3** describes the project.

Exhibit 3.6.2.2-3: 16th and Alaska Pumping Station CIP Project

Project ID	Project Title	Cost	Timeline
F8	16th and Alaska Avenue Pumping Station – upgrades the pumping station and increases reliability and serviceability.	$4.6M	Completion Oct 2014

CIP project F8 addresses the improvements required for serving the 4th High Service Area.

3.6.3 Water Storage Facilities

Exhibit 3-11 summarizes the eight storage facilities DC Water owns and operates. Five of these facilities are underground reservoirs and three are elevated tanks. Three additional underground reservoirs owned and operated by the Aqueduct, these facilities are the Foxhall and Van Ness Reservoirs and the Fort Reno Reservoir No. 2.These facilities combine for a total storage capacity of 110 million gallons and provide adequate storage for DC Water's service area.

Exhibit 3-11: Water 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 five storage reservoirs and three elevated tanks operated by DC Water 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.

3.6.3.1 Washington Aqueduct Storage Facilities

Foxhall Reservoir:
The Foxhall Reservoir stores drinking water for distribution in the First High Service Area. This reservoir is a 14.5 mg, below-ground facility and was built in 1941. Water levels in the reservoir are operated to control pressure in the First High Service Area.

Van Ness Reservoir:
Built in 1931, the Van Ness Reservoir provides drinking water storage for delivery to the Second High Service Area. This below-ground reservoir has a storage capacity of 14.6 mg and overflow elevation of 335 feet. The water level in this reservoir is operated to control pressure in the Second High Service Area.

Fort Reno Reservoir No.2:
This reservoir was built as a 20-mg drinking water storage facility in 1955. Along with Fort Reno Reservoir No. 1 (owned and operated by DC Water), this reservoir provides water to the Third High Service Area and is used to control pressure in this service area. Fort Reno Reservoir No. 2 has an overflow elevation of 423.5 feet.

3.6.3.2 DC Water Storage Reservoirs and Elevated Tanks

DC Water completed major reservoir rehabilitation after the year 2000. In FY2007, DC Water implemented a new three-year inspection program for all tanks and reservoirs. Under this program, assessments are routinely conducted to evaluate the condition of all the storage reservoirs/tanks facilities and provide recommendations for repairs or rehabilitation. DC Water is following best practices in assessing the condition and security of water storage facilities.

DC Water’s current CIP includes a project known as the St. Elizabeth Water Tank Project, MA. This project will provide a new elevated storage tank with a 2 mg capacity and will be built on the St. Elizabeth Hospital complex. This project is vital to providing sufficient potable water flow and pressure to the Anacostia 1st High South Service Area and adequate pressure for fire protection. Due to the importance of this project, construction should commence as soon as possible. However, the architectural screening for this project has proven to be a major hurdle and has extended the critical path of the project.

The CIP adequately addresses DC Water’s storage reservoir and elevated tank requirements. The operating budgets for FY2013 and FY2014 fund the on-going cleaning and disinfection of the storage facilities performed by outsourced services on a three year cycle. Re-coating of the tanks is programmed for FY2020.

Brentwood Reservoir:
The Brentwood Reservoir provides storage for the Low Service Area and is also used to control water pressure in this area. Built in 1959, this is DC Water’s largest drinking water reservoir, with a storage capacity of 25 million gallons. The reservoir is a below-ground facility with an overflow elevation of 172 feet.

Condition Assessment

DC Water will soon complete upgrades that will remedy some of the structural and mechanical components of the Brentwood Reservoir as reported in the 2008 Assessment. **Exhibit 3.6.2.2-1** presents this project.

Exhibit 3.6.3.2-1: Brentwood Reservoir CIP Project

Project ID	Project Title	Cost	Timeline
FD	Water Facility Security System Upgrades	$2.0M	Construction Jun 2014

The current state of the Brentwood Reservoir was provided during an interview on May 6th and 7th, 2013. There were no improvement needs observed or discussed.

Soldier's Home Reservoir:

The Soldier's Home Reservoir was built in 1939, and has a capacity of 15 mg. It provides storage for the First High Service Area. The pressure in the First High Service Area is controlled by the water levels in the Soldier's Home and Fox Hall (operated by the Aqueduct). Both of these below-ground reservoirs have overflow elevations of 250 feet.

Condition Assessment

DC Water will soon complete a project that will remedy some of the structural and mechanical components of the Soldier's Home Reservoir as reported in the 2008 Assessment. **Exhibit 3.6.2.2-2** presents this project.

Exhibit 3.6.3.2-2: Soldier's Home Reservoir CIP Project

Project ID	Project Title	Cost	Timeline
FD	Water Facility Security System Upgrades	$2.0M	Construction Jun 2014

The current state of the Soldier's Home Reservoir was provided during an interview on May 6th and 7th, 2013. There were no additional improvements discussed.

Fort Reno Reservoir No. 1:

The Fort Reno Reservoir No. 1 is one of the drinking water storage facilities serving the Authority's Third High Service Area. The reservoir was built in 1928 and is a below-ground facility with storage capacity for 5.4 million gallons of water. Water levels in this reservoir, along with Fort Reno Reservoir No. 2, are used to control pressure in the Third High Service Area. The reservoir has an overflow elevation of 424 feet.

Condition Assessment

There are currently no projects in the CIP that address the Fort Reno Reservoir No. 1. The current state of the reservoir was provided during an interview on May 6th and 7th, 2013. There were no improvement needs observed or discussed.

Fort Reno Elevated Tank No.2:

Fort Reno Elevated Tank No.2 is one of three elevated tanks currently operated by the Authority. Its sister tank, Fort Reno Elevated Tank No. 1, was taken off line by the Authority a number of years ago.

The 0.16-mg Fort Reno Elevated Tank No. 2 was built in 1926, and currently provides storage for the Fourth High Service Area and has a total capacity of 0.16 mg. This elevated tank has an overflow elevation of 485 feet.

Condition Assessment

DC Water will soon complete a project that will remedy some of the structural and mechanical components of the Fort Reno Elevated Tank No. 2 as reported in the 2008 Assessment. **Exhibit 3.6.2.2-3** presents this project.

Exhibit 3.6.3.2-3: Fort Reno Elevated Tank No. 2 CIP Projects

Project ID	Project Title	Cost	Timeline
WH	Rehabilitation of Elevated Tanks	$7.0M	Design Apr 2019

The current state of the Fort Reno Elevated Tank No. 2 was provided during an interview on May 6th and 7th, 2013. There were no additional improvements discussed.

Fort Stanton Reservoir No. 1 and Fort Stanton Reservoir No. 2:

Both of these reservoirs are located at the Fort Stanton storage compound. Fort Stanton Reservoir No. 1 was built in 1932 and has a storage capacity of 3 mg. This reservoir provides drinking water storage for Anacostia First High. At a capacity of 10 mg, the Fort Stanton Reservoir No.2 is the larger of the two Fort Stanton reservoirs. It was built in 1943, and also provides storage for the Anacostia First.

Condition Assessment

DC Water will soon complete projects that will remedy some of the structural and mechanical components of the Fort Stanton Reservoir No. 1 and Fort Stanton Reservoir No. 2 as reported in the 2008 Assessment. **Exhibit 3.6.2.2-4** provides a list of these projects.

Exhibit 3.6.3.2-4: Fort Stanton Reservoir No. 1 and Fort Stanton Reservoir No. 2 CIP Projects

Project ID	Project Title	Cost	Timeline
MK	877A1 – 24" Wtmain Ft. Stanton Res to MLK Ave – Project provides for the installation of a new 24" water main to connect the Reservoir to the MLK water main	$16.4M	Completed Apr 2013
FD	Water Facility Security System Upgrades	$2.0M	Construction Jun 2014
FA	Water Storage Facility Upgrades – Rehabilitates Tort Stanton Reservoir	$23.4M	Completion Feb2021

The current state of the Fort Stanton Reservoir No. 1 and Fort Stanton Reservoir No. 2 was provided during an interview on May 6th and 7th, 2013. There were no additional improvements discussed.

Good Hope Elevated Tank:

The Good Hope Elevated Tank is one of two tanks serving the Anacostia Second High Service Area. The tank was built in 1937, and has a capacity of 0.5 mg.

Condition Assessment

DC Water will soon complete projects that will remedy some of the structural and mechanical components of the Good Hope Elevated Tank as reported in the 2008 Assessment. **Exhibit 3.6.2.2-5** provides a list of these projects.

Exhibit 3.6.3.2-5: Good Hope Elevated Tank CIP Projects

Project ID	Project Title	Cost	Timeline
WH	Rehabilitation of Elevated Tanks	$7.0M	Design Apr 2019
FD	Water Facility Security System Upgrades	$2.0M	Construction Jun 2014

The current state of the Good Hope Elevated Tank was provided during an interview on May 6th and 7th, 2013. There were no additional improvements discussed.

Boulevard Elevated Tank:

Built in 1945, the Boulevard Elevated Tank has a storage capacity of 2 mg. It provides drinking water storage for the Anacostia Second High Service Area.

Condition Assessment

DC Water will soon complete projects that will remedy some of the structural and mechanical components of the Boulevard Elevated Tank as reported in the 2008 Assessment. **Exhibit 3.6.3.2-6** provides a tabular list of those projects.

Exhibit 3.6.2.2-6: Boulevard Elevation Tank CIP Projects

Project ID	Project Title	Cost	Timeline
HW	Rehabilitation of Elevated Water Tanks – Rehabilitation of coating systems	$7.0M	Design Apr 2019
FD	Water Facilities Security System Upgrades – Provides updated security systems	$2.0M	Construction Jun 2014

3.6.4 Water System Facilities Plan Update

In June 2009, DC Water's consultant completed the update of the original 2000 Facilities Plan. This 2009 Water and Sewer Facilities Plans (2009 Facilities Plan Update) provided a comprehensive evaluation of DC Water's water system and provides the current strategy for improvements as DC

Water continues to provide safe, adequate, and reliable service to its customers. The 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 CIP projects;
- Led to the Board's policy of the replacement of water mains at the 1% per annum rate.

The 2009 Facilities Plan Update is comprehensive and current. Based on the accomplishments of DC Water in implementing the 2000 Water Facilities Plan, DC Water ratepayers can be assured that the recommendations and schedules of the Facility Plan are being implemented.

3.6.4.1 Plan Update – Pumping Stations

The plan update calls for in excess of $1 billion in water facility upgrades and improvements. In particular, the Capital Improvement Program approved FY 2012-2021, programs $161.4 million for pumping facilities for fourteen projects. The largest project, mentioned earlier, is the completed Bryant Street Pumping Station. Two major, on-going projects are the Fort Reno Upgrade ($11 million) and the 16th & Alaska Avenue Pumping Station Upgrades ($4.5 million.) Water pumping facilities projects are listed below in **Exhibit 3-12**.

Exhibit 3-12: Water Pumping Facilities CIP projects

Water Pumping Facilities Projects	Recommended Improvements	Cost	Timeline
AY	Upgrades to Ft. Reno Pumping Station	$11.3M	Completion Jul 2016
DU	Water System Laboratory Facilities Upgrade	$0.643M	Construction Jan 2015
F8	16th & Alaska Avenue Pumping Station Upgrades	$4.6M	Completion Sep 2014
FD	Water Facilities Security System Upgrades	$2.0M	Construction Jun 2014
FH	Discharge Piping Bryant Street Pumping Station	$13.4M	Completion Mar 2016
HA	DWS Water Pumping Project	$1.6M	Completion Sep 2015
HD	Conversion of Anacostia PS to Customer Service	$0.502M	Construction May 2013
HE	New Parking Structure & Building Modifications Bryant St PS	$13.5M	Design Jan 2016
HF	New Maintenance Facility at Fort Reno	$3.0M	Design Sep 2016
HV	Bryant St Pump Station – Spill Header Flow Control	$1.4M	Construction Sep 2014
JB	Bryant Street Pump Station Improvements (Phase II)	$7.0M	Construction Sep 2013
JJ	Bryant Street Pump Station Improvements (Phase III)	$1.1M	Construction Sep 2014
M6	WPFA1-Rehabilatation Bryant St. Pumping Station	$62.7M	Completion Aug 2014
M7	WPFA3-Replacement of Anacostia Pump Station	$32.7M	Completion Oct 2015

3.6.4.2 Plan Update – Storage Facilities

The plan has led to the development of $74.3 million in storage improvements, new tanks and a new reservoir. **Exhibit 3-13** from the 2009 Facilities Plan Update presents the storage adequacy by pressure zone.

Exhibit 3-13: Storage Facility Adequacy

Service Area	Storage Facility	Storage Surplus (+)/Deficit (-) (MG)
Low (1)	Brentwood Reservoir	5.2
1st	Soldiers' Home & Foxhall Reservoirs	19.45
2nd	Van Ness Reservoir	11
3rd	Fort Reno Reservoirs	18.1
4th West	Fort Reno Tank 2	-1.23
4th East	No Existing Storage	1
Proposed Anacostia 1st High	Project MA – Proposed Tank	-0.77
Proposed Anacostia 3rd High	Good Hope & Boulevard Tank	1.14

$7.9 million has been programmed for additional storage in the 4th High Service Area - West (project MQ.) This project addresses the deficit of storage in the zone. $21.9 million is currently funded for the St. Elizabeth Water Tank (project MA) as part of the creation of an Anacostia 3rd High pressure zone. The new tank will provide storage for the reconfigured Anacostia 2nd High zone. The third new storage facility is the planned 2nd High Service Area's 5 mg reservoir programmed at $15.5 million. In addition to the new structures, additional capital improvement projects address the rehabilitation needs of the storage facilities. The storage facility projects are listed below in **Exhibit 3-14**.

Exhibit 3-14: Storage Facilities

Water Storage Facilities Projects	Recommended Improvements	Cost	Timeline
FA	Water Storage Facility Upgrades	$23.4M	Completion Feb 2021
HW	Rehabilitation of Elevated Water Tanks	$7.0M	Design Apr 2019
MA	St. Elizabeth Water Tank	$21.9M	Jan 2017
MQ	878A1-2MG 4th High Storage Tank	$7.9M	Design Jun 2015
MR	5MG 2nd High Reservoir	$15.5M	Design Nov 2013

3.6.5 Transmission & Distribution Mains and Appurtenances

3.6.5.1 Transmission Mains

DC Water owns and maintains approximately 250 miles of transmission mains (16-inch diameter and greater.) DC Water has an existing Large Diameter Water Main Rehabilitation/Replacement program (LDWM). A detailed field analysis of existing transmission mains, as designated for the 2009 Facilities Plan Update, was focused on an evaluation of the large diameter steel mains, which are critical hydraulic elements. Steel pipe in the 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 the high occurrence of breaks in steel 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. This is typical for steel transmission mains that are not adequately protected against corrosion. The lining of the 24-inch steel main at Rock Creek (project DF) is approximately $1 million in capital improvements addressing the steel mains that have been identified as having a potential for failure. Project F6, Steel Water Mains Rehabilitation Phase I, is an $8.3 million program addressing cathodic protection rehabilitation or installation in order to protect high priority mains. Noteworthy transmission main CIP projects are listed in **Exhibit 3-15**.

Project C9, Large Diameter Water Mains 1, calls for the replacement of a 30-inch cast iron main installed in 1859. By all measures, the main, located in MacArthur Boulevard and points south, is one of the oldest large mains in the country. The $18.4 million project is programmed for FY 2014.

Exhibit 3-15: Transmission Main Projects

Transmission Mains Projects	Recommended Improvements	Cost	Timeline
C9	Large Diameter Water Mains 1	$18.4M	Design Dec 2014
F6	Steel Water Mains Rehabilitation Phase I	$9.3M	Completion 2015
FE	20" Lowe Service Main & PRV	$4.9M	Construction Oct 2013
FT	Steel Water Mains Rehabilitation Phase II	$38.5M	Design Apr 2017
GU	Crosstown Water Main Rehabilitation	$12.7M	Completion Apr 2014
GX	Large Diameter Water Main Replacement II	$20.0M	Design Apr 2018
NA	863A1 – Clean & Line 20" 4th High Water Main	$4.5M	Completion Oct 2014
S5	WDSC6 – Large Diameter Water Main Int. Repairs	$14.5M	Completion 2015

Condition Assessment

The current state of the transmission mains was provided during an interview on May 6th and 7th, 2013. There were no improvement needs observed or discussed.

3.6.5.2 Distribution Mains

The installation history and general material of construction of the distribution mains (12-inch diameter and smaller) is well documented in DC Water records. 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. The 2009 Facilities Plan Update identifies 170 miles of pipe over a hundred years old. There are many factors that dictate replacement theory; however it is generally accepted that the useful life of water mains is 100 years. The 2009 Facilities Plan update recommended that the existing small diameter water main rehabilitation program be increased to at least $30 million, which would meet the renewal parameter of 1% per year. The FY 2012-2021 Capital Improvement Program adheres to the 1% per year replacement as recommended. The new replacement program began in FY 2010 with full implementation of the small water main program in FY 2014 and the large water main program in FY 2016.

Distribution main projects are listed below in **Exhibit 3-16**.

Exhibit 3-16: Distribution Main Projects

Distribution Mains Projects	Recommended Improvements	Cost	Timeline
DE	Small Diameter Water Main Rehab 12	$38.4M	Design Apr 2015
F1	Small Diameter Water Main Rehab 13	$39.6M	Design Apr 2016
F2	Small Diameter Water Main Rehab 14	$40.5M	Design Apr 2017
GR	Small Diameter Water Main Rehab 15	$39.8M	Design Apr 2018
MV	Small Diameter Water Main Rehab 03	$15.5M	Completion Nov 2015
MX	Small Diameter Water Main Rehab 05	$13.3M	Completion Jan 2016
N8	Small Diameter Water Main Rehab 06	$13.2M	Completion Dec 2013
N9	Small Diameter Water Main Rehab 07	$18.5M	Completion Jan 2015
O0	Small Diameter Water Main Rehab 08	$18.8M	Completion July 2015
O1	Small Diameter Water Main Rehab 09	$23.7M	Construction Nov 2013
O2	Small Diameter Water Main Rehab 10	$28.5M	Construction Sep 2014
O3	Small Diameter Water Main Rehab 11	$37.5M	Design Apr 2014

Condition Assessment

The current state of the Brentwood Reservoir was provided during an interview on May 6th and 7th, 2013. There were no improvement needs observed or discussed.

3.6.5.3 Appurtenances

Control valves are often referred to as the heart of a distribution system. The ability to isolate sections of water mains for repairs is vital to providing a safe and dependable supply of water. In particular to the concern for corroding transmission mains, Project BZ, Large Valve Replacement, is an $11.9 million replacement effort for the replacement of 40 broken valves on large diameter mains. Functioning valves reduce the service interruption during emergencies. Most importantly, the number of customers affected is greatly reduced as the isolation does not require expanding the shut-off zone in order to reach operable valves.

Condition Assessment

DC Water has completed and will soon complete projects that will remedy some of the outdated and defective appurtenances that are part of the water distribution system. **Exhibit 3 -17** provides a list of these projects.

Exhibit 3-17: Appurtenances Projects

Appurtenances Projects	Recommended Improvements	Cost	Timeline
BZ	Large Valve Replacement(Contract 08-09)	$12.3M	Completion 2015
D4	Small Valve Replacement – 5	$0.757M	Completed
GQ	Fire Hydrant Replacement Program (Phase II)	$28.2M	Completion Dec 2018
I8	Large Valve Replacement (Contract 11-13)	$17.7M	Construction Oct 2013
IA	Large Valve Replacement (Contract 14-16)	$18.4M	Design May 2015
IB	Large Valve Replacement (Contract 17-19)	$20.0M	Design May 2018
S3	Large Valve Replacement (Contract 03-07)	$23.0M	Completion Aug 2015

The current state of the valves, in particular the large valves, was provided during an interview on May 6th and 7th, 2013. Valves are highly critical to uninterrupted water service and fire protection. In the absence of regulations or consent decrees mandating proper care and management of DC Water's valves, the rating priorities for obsolete valves have not had justified the funding priority necessary in DC Water's CIP to meet industry standards.

3.6.5.3.1 Fire Hydrants

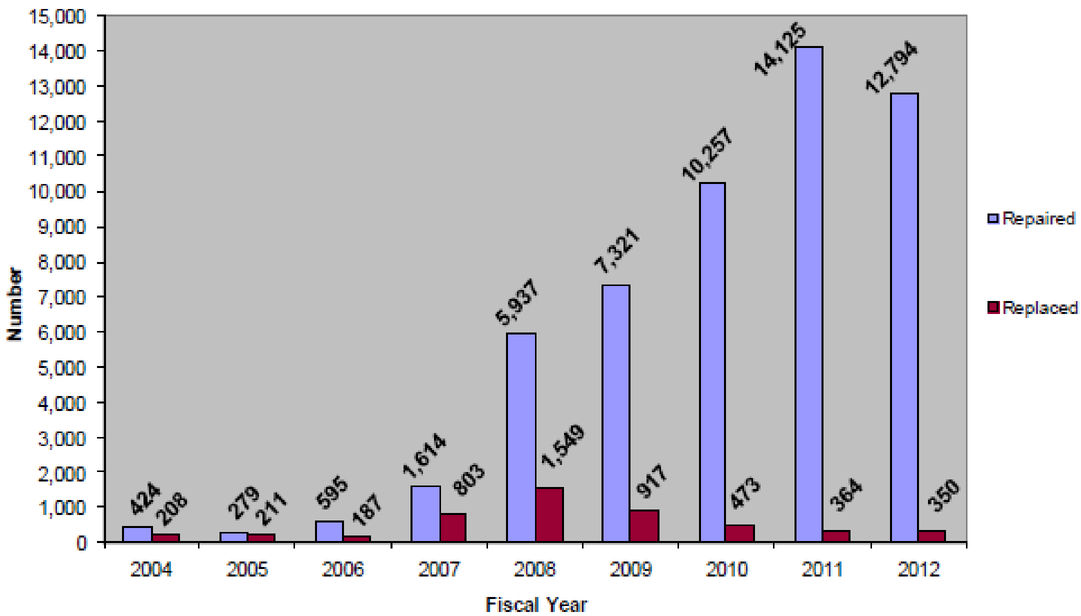
A Memorandum of Understanding between DC Water and the District of Columbia through the District of Columbia Fire and Emergency Medical Services Department was signed between parties on October 25, 2007. This agreement implemented an improvement program that continues into the present. DC Water is firmly committed to ensuring the availability and accessibility of public fire hydrants to the District of Columbia Fire Department (DCFD) so that they can provide superior fire protection within the District of Columbia. DC Water instituted a Fire Hydrant Service Status Program that measures the performance of maintenance, repair and replacement of public fire hydrants in the District while simultaneously keeping the public informed. The report measures the number of public hydrants, how many are out of service, maps the locations, how many require repair or replacement, and identifies reason for being out of service. These measures are continuously monitored and a detailed report and explanation is provided every month to the DC Retail Water and Sewer Rates Committee and the full Board of Directors.

Towards that end, DC Water has established the goal of 1% or less Out-of-Service (OOS) for public fire hydrants. The February 4, 2013 report to the DC Water Services Committee showed a 4-month trend between 0.75% and 0.87% OOS. This range is typical of earlier reports.

Through FY 2012, Over 5,000 hydrants have been replaced and almost 53,300 fire hydrant repair work orders have been made as shown in **Exhibit 3-18**. The FY 2012-2021 CIP dedicates $25.5 million to the City Wide Fire Hydrant Program, project DL. This program replaces and upgrades fire hydrants and completion is expected for FY 2015. Replacement and maintenance costs of hydrants are reimbursed by the DC Government. The success of the repair and replacement projects and work orders in **Exhibit 3-18** highlights the progress being achieved by DC Water in improving the reliability of public fire hydrants.

DC Water maintains a high level of transparency for the fire hydrant program by publishing quarterly reports that depict the location and number of fire hydrants that are defective, obstructed, temporary, and under construction. These reports are readily available on DC Waters website, demonstrating DC Water's commitment to maintaining working fire hydrants.

Exhibit 3-18: Department of Water Services Fire Hydrant Repair and Replacement Report



* 2004 to date Fire Hydrants Repaired - 53,346
* 2004 to date Fire Hydrants Replaced - 5,062

3.6.6 Lead Service Line Replacement Policy

It is well documented that some older service lines in the District of Columbia are made from lead. Lead samples from some homes in the District indicated lead leaching from the service lines during a period from 2001 to 2004. Since 2004, following a change in water chemistry, The District of Columbia's drinking water has met federal limits for lead and is in full compliance with U.S. Safe Drinking Water Act regulations. The Lead Service Line Replacement Policy (LSLR) was revised on September 4, 2008 by the Board of Directors. In essence, the modified program encourages property owners to replace the private portion of the lead pipe as well as having DC Water replace the public portion of the service line. Lead lines in public space (between the main and the property line) continue to be replaced with copper pipe in conjunction with DC Water's ongoing water main replacement projects, DDOT projects and developer activities.

3.6.7 Interconnections with Other Jurisdictions

Interconnections with surrounding or neighboring water utilities allow an agency to provide emergency or back-up supplies of water. 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

Washington Aqueduct interconnections serving 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 Water systems. A review of these interconnections was performed by Hatch Mott MacDonald for the 2009 Facilities Plan Update and eight (8) major emergency interconnections were recommended. As of May 2011, the interconnection recommended at Southern Avenue and Suitland road, SE has been authorized by DC Water and WSSC. This project listed in the CIP as, AK - WSSC Interconnections with a cost of $2.7 million, construction is currently underway with an anticipated completion date of FY 2014.

3.6.8 Ratepayer Metering

DC Water was one of the first utilities to automate its meter reading program (AMR) which has been noted as a best practice in the industry. The automated meters use radio frequency and cell phone technology to send daily water usage information from the meter to DC Water. In addition, an application was developed in-house entitled: High Use Notification Application (HUNA). This tool analyzes daily water consumption and provides monthly and yearly averages on an account. It also allows customers access to daily meter readings via the web and has advanced features which alert customers of metering anomalies. The AMR and the Customer Service Information and Billing System help DC Water to minimize the number of estimated billings and the need to send out field personnel, reduce the cycle time needed to identify and correct erroneous billings, identify meter issues, and provide new information-based services. CIP projects relating to AMR are listed in **Exhibit 3-19**.

Exhibit 3-19: AMR Projects

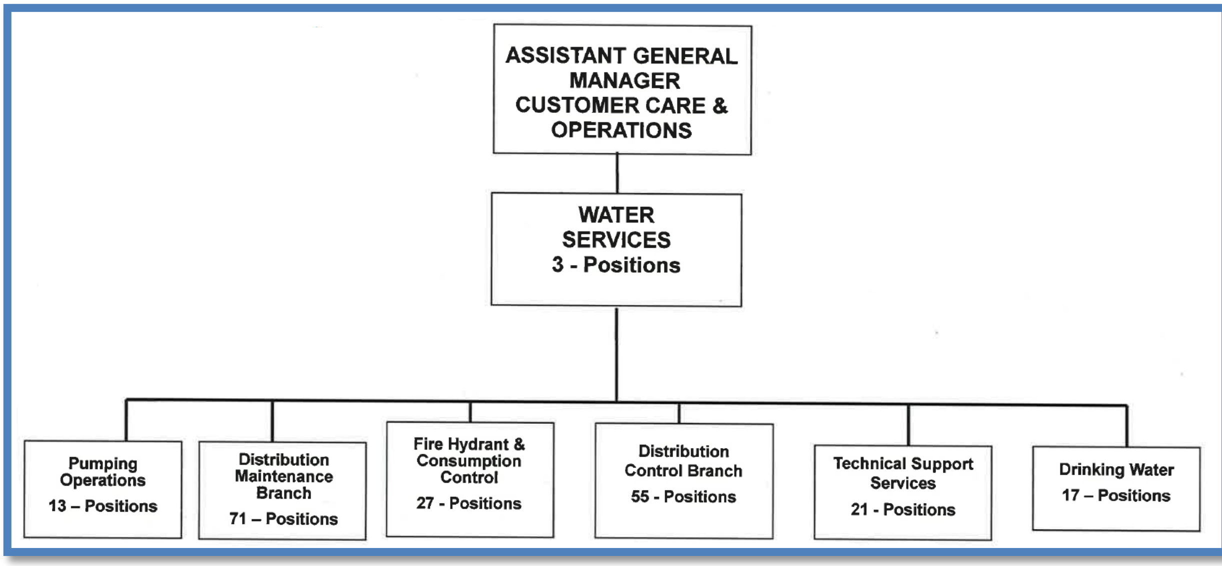
AMR Projects	Recommended Improvements	Cost	Timeline
EM1	Future Meter Replacement	$42.2M	Completion 2021
EM2	Automated Meter Reading Project	$41.1M	Completed
EM6	AMR/Billing System	$8.0M	Completion FY 2014

Within the next few years, DC Water may acquire a new customer information system/billing system which will eliminate the current monthly leasing cost of the third party billing system. In addition to lower costs, the new billing system will be more flexible with respect to rate structure changes and make better use of the data available from the upgraded meters.

3.6.9 Operations, Maintenance and Security

Water Services is comprised of the departments that maintain the water distribution system throughout the District (water mains, valves, pumping stations). Also included within Water Services are the departments that monitor drinking water quality, manage public space restoration, and perform system shuts for capital improvement projects. In total, Utility Services has an authorized 207 full-time employees, an increase of 35 since FY 2011. Two major initiatives have been the upgrade of security measures at all the water facilities and the improved rehabilitation of fire hydrants. The organization chart of Water Services is shown in **Exhibit 3-20**.

Exhibit 3-20: Operations, Maintenance and Security Organization Chart



Section 4 Wastewater Systems

4.1 OVERVIEW

DC Water is the wastewater treatment and collection service provider for the District of Columbia and for wholesale customers in adjacent Maryland and Virginia Counties. The DC Water's wastewater service area is shown graphically in **Exhibit 4.1**.

Collected wastewater is conveyed to DC Water's BPAWTP located in Southeast D.C. near the confluence of the Anacostia and Potomac Rivers. The Plant is located between Bolling Air Force Base and the Woodrow Wilson Bridge. Collection of wastewater is conveyed, largely by gravity, through a complex system of pipes and tunnels, which can exceed 100-years in age, 12 feet in size, and by nine wastewater pumping stations. Wastewater from areas in Virginia and Maryland is conveyed via the Potomac Interceptor, the Anacostia Interceptor and the Rock Creek Interceptor**.**

Treatment at BPAWTP includes liquid processes and residual solids processing. Blue Plains organization and management, as well as this report, is loosely based on these processes. DC Water has also created a management organization, called DC Clean Rivers, mandated to executing projects that prevent wet-weather overflows. This report will assess the DC Clean Rivers projects for the first time in the series of Engineering Assessments in Section 5 of this report. The combined sanitary and storm collection system located within the older communities of Washington DC, and therefore are addressed by the DC Clean Rivers projects, are largely funded by the District and not supported by wholesale customers outside the District of Columbia.

Exhibit 4-1: DC Water Wastewater System Service Area
(Source: DC Water FY 2012 Operating Budget)

4.2 Wastewater Agreements

DC Water is engaged in several contracts that pertain to wastewater collection and treatment. These contracts, summarized in **Exhibit 4-2**, are: the Potomac Interceptor Agreement of 1963; the Chesapeake Bay Agreement of 1983; the IMA of 2012; and the Loudoun County Sanitation Authority Agreement (LSCA) of 1998.

Exhibit 4-2: Wastewater Agreements

Agreement	Date Signed	Parties
Potomac Interceptor Agreement	1963	• The Authority • Dulles International Airport • Department of Navy • National Park Service • Town of Vienna
Chesapeake Bay Agreement	1983	• District of Columbia • Maryland • Pennsylvania • Virginia • U.S. Environmental Protection Agency • Chesapeake Bay Commission
Blue Plains Intermunicipal Agreement (IMA)	2012	• The Authority • Fairfax County, VA • Montgomery County, MD • Prince George's County, MD • Washington Suburban Sanitary Commission
Loudon County Sanitation Authority Agreement	1998	• The Authority • Loudoun County Sanitation Authority

4.2.1 Potomac Interceptor Agreement

The Potomac Interceptor Agreement was signed in 1963. This agreement provided for proportional cost sharing of the Potomac Interceptor construction; equitable cost sharing of capital improvement, operation and maintenance of the interceptor; and the wholesale treatment of wastewater at BPAWTP. Currently, the agreement pertains to the Potomac Interceptor users that are not part of the IMA of 2012. These users include Dulles International Airport, the Department of the Navy, the National Park Service, the Town of Vienna, and the Loudon County Sanitation Authority.

User rates under the Potomac Interceptor Agreement are to be adjusted at three-year or greater intervals. However, billing discrepancies can be addressed and recovered at any time. In 2010, a Cost of Service Study was conducted. On October 1, 2010, new rates were put into place as a result of this study.

4.2.2 Chesapeake Bay Agreement

The Chesapeake Bay Agreement is a regional partnership that is purposed towards the protection and restoration of the Chesapeake Bay. Signed in 1983, the partnership included the state of Maryland, the Commonwealths of Virginia and Pennsylvania, the District of Columbia, the Chesapeake Bay Commission, and the EPA.

This agreement to build and adopt restorative policies for the Chesapeake Bay has subsequently been updated by the participants to include specific goals and timelines. The primary goals of the agreement are to reduce the nitrogen and phosphorous (nutrients) load to the Bay. Targeted pollution sources include point sources such discharges from industries or wastewater treatment plants as well as non-point sources or sources with less distinct origins such as farmlands and roadways. DC Water was the first signatory of the Chesapeake Bay Agreement to meet its goals.

Since the voluntary nitrogen reduction goals from 1987, the United States Environmental Protection Agency (EPA) Chesapeake Bay Program has set more stringent nutrient limits and in 2007, made the limits mandatory to all signatories of the Chesapeake Bay Agreement by modifying NPDES permits. Modifications to DC Water's NPDES permit in 2007 and 2010 have led to the investment of $950 million dollars to reduce the Total Nitrogen discharge effluent limit to 4.7 million pounds per year or 4.2 mg/l at 370MGD. The cost of this new infrastructure has been added to the current CIP.

DC Water expects it will meet its new NPDES permit limits by 2015 when the majority of Total Nitrogen and Combined Sewer Overflow Long Term Control Plan (CSO LTCP) related projects have been completed. The projects include process improvements at the Blue Plains wastewater treatment plant and the large Wet Weather storage tunnel projects that will ensure more treatment of combined storm and sanitary wastewater to remove Nitrogen and Phosphorous prior to discharge to the Potomac and Anacostia Rivers.

4.2.3 Intermunicipal Agreement (IMA)

Established in 1985, the IMA is an inter-governmental agreement that provides a long term financial, administrative and reporting framework for parties relying on the Blue Plains Wastewater Treatment Plant for treatment. The participating entities are the District of Columbia, DC Water, Fairfax County, Virginia; Montgomery County and Prince George's County, Maryland; and the Washington Suburban Sanitary Commission (WSSC). The agreement was established to aid the capacity expansion of the BPAWTP, equitably allocate costs, define the responsibilities of the involved parties, and provide a process for future planning and decision making. In 2012, the IMA was updated to eliminate outdated planning concepts, provide flexibility for updating the IMA, address technical complexities associated with the Chesapeake Bay Program, modernize principles of shared financial responsibility, and incorporate a dispute resolution process.

The IMA is designed to equitably assign the financial burden of the Multi-Jurisdiction Use Facilities (MJUFs) to the participating entities. Allocation of treatment capacity is based off the Blue Plains design flow capacity. Allocation of capital costs are assessed in relation to the allocated flow capacity and peak flow limitations of the participating entities. Operations, maintenance, and overhead costs of the MJUFs are allocated in relation to billing flows. For Non-Party users, DC Water covers all operations maintenance and overhead costs. Allocated treatment capacity at Blue Plains is shown in **Exhibit 4-3**.

Exhibit 4-3: Allocation of Annual Average Treatment Capacity

Entities	Allocations (MGD)
District of Columbia	152.50
Non-Party Users:	
Loudoun County Sanitation Authority, Virginia	13.80
Dulles Airport, Virginia	1.50
Town of Vienna, Virginia	1.50
Naval Ship Research & Development Center, Maryland	0.07
National Park Service, Maryland	0.03
Sub-total	16.90
District of Columbia – Total	**169.40**
WSSC (for Prince George's County & Montgomery County), **Maryland – Total**	**169.60**
Fairfax County, Virginia – Total	**31.00**
Grand Total – Blue Plains Design Flow Capacity	**370.00**

Most wholesale customers in Virginia and Maryland are allocated a predetermined share of the operating and capital costs based upon the IMA. A few smaller users of the Potomac Interceptor Agreement pay through rates that are reconciled and adjusted at three-year intervals. *The IMA became effective April 3, 2013.*

4.2.4 Loudoun County Sanitation Authority (LCSA)

An agreement between the Loudoun County Sanitation Authority (LCSA) and DC Water, executed in 1998, increased LCSA's share of treatment capacity at Blue Plains to 13.8 mgd. The agreement requires the LCSA to pay its share of capital and operating costs on the same basis as the IMA entities.

4.3 Blue Plains Advanced Water Treatment Plant

DC Water's Blue Plains Advanced Wastewater Treatment Plant is the largest advanced wastewater treatment plant in the United States. In its 75 year history, the plant has undergone a number of modernizations, expanding the quality of treatment and the service area. Currently 1.6 million residents are served in an area that includes the District of Columbia, significant portions of Montgomery and Prince George's Counties in Maryland and Fairfax and Loudoun Counties in Virginia.

Blue Plains Advanced Wastewater Treatment Plant is currently in a state of rapid change as it under goes significant construction to meet the aforementioned NPDES permit and Chesapeake Bay Agreement related process improvements. These projects are described in more detail and subsequent sections of this report. **Exhibit 4.3-1** shows the site plan for Blue Plains.

Exhibit 4.3-1: Blue Plains Wastewater Treatment Plant Site Plan (Satellite Image from Google Maps)

4.3.1 Permit Compliance

Blue Plains operates and discharges treated effluent into the Potomac River under an NPDES permit executed September 30, 2010. The current NPDES permit is authorized for 5 years and expires in 2015. Interviews with the Wastewater Treatment Operations personnel on March 8, 2013 confirmed that the Authority is in compliance with all its current permit requirements.

The NPDES permit establishes discharge limits for the Authority's two outfalls in accordance with the provisions and implementing regulations of the Federal Water Pollution Control Act (Clean Water Act, or CWA). The permit standards governing the discharge are among the most stringent effluent limits. Considered an administrative extension, the Authority's 2010 permit effluent limits reflect those of the 2008 permit.

The Clean Water Act prohibits discharges to United States waters that are not authorized under a facility-specific NPDES permit. NPDES permits typically set numerical discharge limits and establish mandated action schedules for treatment plants to meet requirements. Permits also require monitoring and monthly Discharge Monitoring Reports (DMR) be submitted to EPA. In DC Water's case, when a permit violation occurs, the incident is reviewed by the EPA Region III, who will require compliance and could resort to punitive measures.

DC Water has done well meeting their NPDES permit requirements as recognized by the National Association of Clean Water Agencies (NACWA). NACWA recognizes water agencies for their NPDES compliance. For 2010, DC Water received the Platinum Award, the highest honor possible, for meeting their NPDE permit limits for five years in a row. In 2011, DC Water received the Silver Award for having less than six NPDES permit violations.

BPAWTP's two outfalls are both regulated by the NPDES permit. The permit requirements are designed to make allowances for Combined Sewer System Flow (CSSF) instances. Outfall 002 discharges effluent that has passed through the complement barrage of treatment; whereas, outfall 001 is designated as an approved CSO-related bypass in the NPDES permit. During Dry Weather Flow (DWF), only Outfall 002 is utilized. With pending construction of the Enhanced Clarification Facilities, as well as upgrades to the Nitrification and Denitrification Facilities additional allowances are present in the permit. The flow requirements of the permit are detailed in **Exhibit 4.3-2** for Outfall 002 and **Exhibit 4.3-3** for Outfall 001.

Exhibit 4.3-2: Blue Plains Outfall 002 Permit Requirements

Flow Condition and Period	Times	Measured Influent Flow Rates to Receive Complete Treatment
A. DWF	All times	Up to and including 511 mgd
B. CSSF		
1. From Effective date of permit and following placing ECF in operation unless otherwise authorized or approved by EPA.	First 4 hours After 4 hours	Up to and including 555 mgd and Up to and including 511 mgd
2. Until Completion of Nitrification Denitrification Facilities upgrade, but no later than March 1, 2011.	First 4 hours After 4 hours	Up to and including 511 mgd and Up to and including 450 mgd
3. During Construction of Improvements to existing nitrogen removal facilities, period(s) to be determined by permittee and EPA from completion of design and construction schedules.	First 4 hours After 4 hours	Up to and including 511 mgd and Up to and including 450 mgd
4. During Construction of the ECF and tie-ins to the existing facilities. Periods to be determined by permittee and EPA from completion of design and construction schedules.	First 4 hours After 4 hours	Up to and including 511 mgd and Up to and including 450 mgd

Exhibit 4.3-3: Blue Plains Outfall 001 Permit Requirements

Flow Condition and Period	Times	Measured Flow Rates for Outfall 001
A. DWF	All times	No discharge approved
B. CSSF		
1. From Effective date of permit and lasting until ECF is placed in operation	All times	Up to and including 336 mgd above rates to receive complete treatment under Part 1B for Outfall 002
2. Following ECF being placed in operation, for emptying BPT under an operating routine that provides for:	All times	
a. Conveying flow from BPT through the ECF or transfer to complete treatment;		
b. Regulating the discharge of ECF effluent to maintain a rate of 511 mgd through complete treatment while optimizing conditions for maintain the availability of the storage volume in the BPT such that the occurrence of CSO is minimized;		
c. No discharge of flow from BPT from Outfall 001 when DWF conditions exist; and		
d. Limiting discharge of ECF effluent from Outfall 001 to a maximum rate of 225 mgd; provided that any discharge of ECF effluent from Outfall 001 shall not occur except for the purpose of maintaining the availability of the storage volume in the BPT to the extent that the occurrence of CSOs is minimized		

Previously, the Authority's 2008 NPDES permit changed a voluntary goal of meeting an annual total nitrogen mass load of 8,467,200 pound to an amended mandatory permit that reduced the total nitrogen mass load down to 4,689,000 pounds per year (equivalent to 4.2 mg/l of total nitrogen at 370 mgd average annual flow). The current permit for 2010 has been slightly adjusted such that 4,689,000 pounds per year TN represents the cumulative TN loading from both outfalls, with 4,377,580 pounds per year allocated to Outfall 002 and the remaining 311,420 pounds per year allocated to Outfall 001. The EPA has accepted the Authority's proposed plan and schedule to meet these new limits. Upgrades to the plant are expected to be placed in operation by July 1, 2014 and compliance will begin January 1, 2015. Estimated cost for this reduction in TN is $950 million. Due to the effect of weather on the Nitrification Denitrification process, the requirements vary seasonally. The Nitrogen limits as well as other effluent limits are shown in **Exhibit 4.3-4**.

Exhibit 4.3-4: Blue Plains Outfall Permit Requirements

Parameter	Limit
Total Nitrogen	4.2 mg/L
Carbonaceous Biochemical Oxygen Demand	5.0 mg/L
Total Suspended Solids	7.0 mg/L
Total Phosphorus	0.18 mg/L
Ammonia Nitrogen (NH_3-N) {seasonal limits}:	
5/1-10/31	4.2 mg/L
11/1-2/14	11.1 mg/L
2/15-4/30	12.8 mg/L
Dissolved Oxygen	5.0 mg/L
Total Chlorine Residual	0.02 mg/L
pH	6.0 - 8.5

The Authority's NPDES permit includes sections with detailed information on meeting requirements. These sections relate to pretreatment, standard sludge conditions, chlorination/dechlorination, stormwater management, and BOD reduction. The permit also covers monitoring and operations for different flow conditions with respect to each outfall; scenarios for dealing with various phases of construction; Parameters and monitoring requirements for the Northeast Boundary Swirl Facility discharge into the Anacostia River. Specific reporting requirements for public accountability are included in the permit for the, combined sewer system, nine minimum controls (NMC) program, water quality-based requirements for CSOs, the long term control plan, and CSO status reports and schedules.

General conditions in the Authority's NPDES permit outline the duty to comply with the permit and penalties for violations of permit conditions. Subjects dealing with Toxic Pollutants, Oil and Hazardous Substances, Endangered Species, and other liability issues are also described in the permit. Operation and Maintenance of Pollution Controls is specifically covered in the permit under the following topic areas:

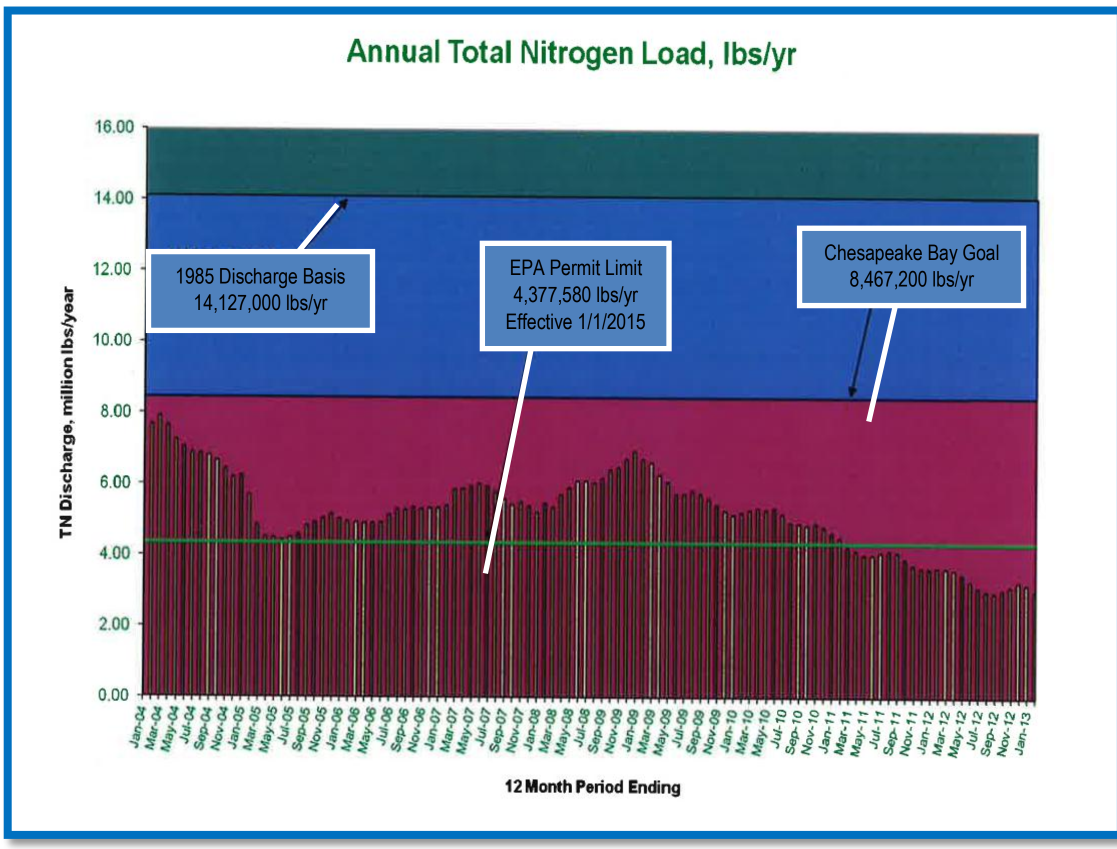
- Proper Operation and Maintenance
- Bypass of Treatment Facilities
- Upset Conditions
- There are detailed explanations of definitions and specific actions necessary in handling these areas of operation and maintenance.
- There is a section that covers the specifics on Monitoring and Records. Details are given under the following topic headings:
- Representative Sampling
- Flow Measurements
- Monitoring Procedures
- Reporting of Monitoring Results
- Monitoring and Analytical Equipment Maintenance
- Analytical Quality Control
- Additional Monitoring by the Permittee

- Retention of Records
- Record Contents
- Inspection and Entry

The Blue Plains treatment facilities are meeting or exceeding the permit and reporting requirements consistently, as evidenced by the NACWA Platinum Award. It is expected that DC Water will continue to comply with the NEPDS permit requirements by following through on schedule with the planned rehabilitation, replacement and other capital improvements. **Exhibit 4.3-5** shows how the NPDES TN limit is consistently meet by Blue Plains.

With the many capital improvements planned and under way a significant amount of attention is dedicated in improvements to DC Water facilities. It is therefore important that operations and maintenance needs are not neglected. The Authority appears to have taken the right steps to keep the plant and facilities in good working order.

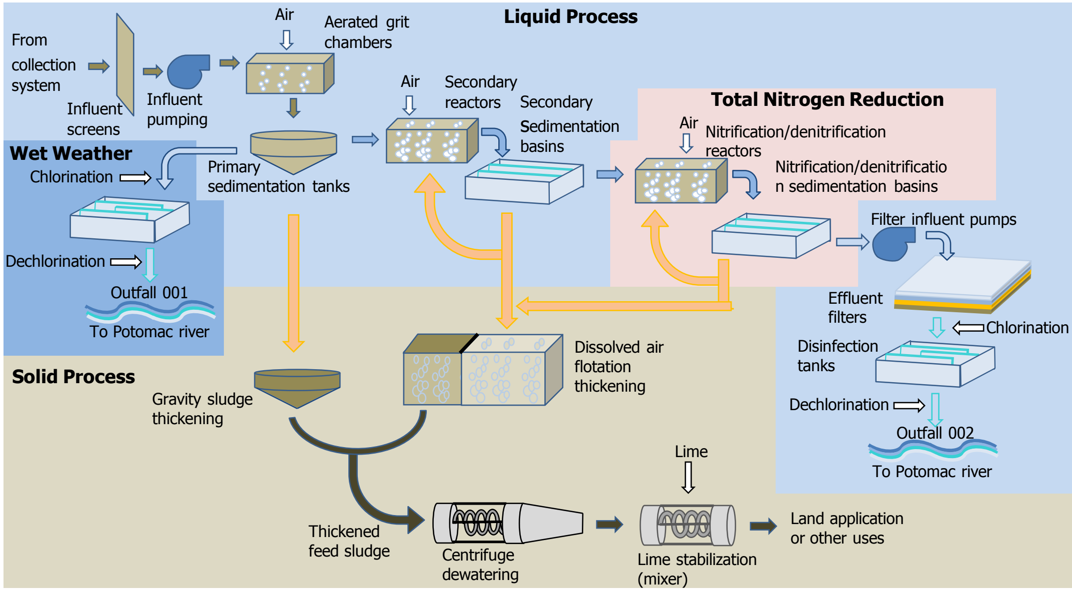
Exhibit 4.3-5: **Effluent Total Nitrogen Loads**



4.3.2 Treatment Processes

Exhibit 4.3-6 below is a graphical representation of the Liquid Processing Treatment Program at Blue PAWTP treatment. Each is described in more detail in subsequent sections.

Exhibit 4.3-6: Blue Plains Treatment Process



4.3.3 Wastewater Pretreatment Requirements

DC Water regulates the quality of the wastewater entering Blue Plains from wholesale and large retail customers to ensure treatment processes and collection systems are not disrupted and the Plant continues to comply with its NPDES permit. Pretreatment programs are required and approved by the EPA to ensure compliance with NPDES federal discharge limitations. DC Water permits and monitors each significant industrial user that has the potential to discharge dangerous levels of pollutants into the sewer system. DC Water also monitors permitted commercial wastewater (domestic or industrial) haulers that discharge and dispose hauled wastewater to the BPAWTP.

DC Water levies fees to cover the costs of DC Water's pretreatment oversight activities. The pretreatment group provides permitting, sampling and inspections for designated Industrial Users of the wastewater system. These pretreatment fees include annual permitting and monitoring fees for industrial users and a permit fee for wastewater trucked or hauled to Blue Plains.

New pretreatment rates and fees went into effect July 1, 2012. Fees had not been updated since 2003. **Exhibit 4.3-7** lists the updated fees.

Exhibit 4.3-7: DC Water New Pretreatment Rates and Fees

Classification	New Permit Fee
Industrial User Annual compliance fees: Permit Initial Fee Permit Renewal Fee	 $2,000.00 $600.00
Industrial User Annual compliance fees:	
Significant or Non-Significant Categorical Industrial User 1 outfall 2 or more outfalls	 $2,500.00 $3,500.00
Significant Non-Categorical Industrial User 1 outfall 2 or more outfalls	 $2,500.00 $3,500.00
Non-Significant Non-Categorical Industrial User 1 outfall 2 or more outfalls	 $550.00 $700.00

JMT reviewed the Annual Pretreatment Program Report -2012 which is submitted to EPA by DC Water. The metrics reported by DC Water indicate 51 Significant Industrial Users (SIUs) with current Control Documents with 55 facilities inspected in 2011. Enforcement metrics indicate active control by DC Water. DC Water reported one SIU in significant non-compliance for reporting discrepancies. The SIU is located in the WSSC service area. JMT considers the pretreatment program to be managed and funded adequately.

4.3.4 Condition Assessment and Planned Improvements

DC Water has assessed BPAWTP facilities for conditions and rehabilitation needs. This information is used to initiate and/or prioritize projects within the 10-year rolling CIP. The 2013 Independent Consulting Engineer Assessment confirms the status of projects that have been completed and initiated since the 2008 Assessment. The following paragraphs below integrate information obtained during DC Water personnel interviews, site inspections by JMT engineering staff and the DC Water FY2012 – FY2021 CIP.

A. LIQUID PROCESSING PROGRAM

A.1 Preliminary Treatment Processes and Facilities

The preliminary treatment process employed at Blue Plains includes:

- Raw wastewater pumping
- Screening
- Grit removal

During preliminary treatment, incoming pumped raw wastewater is screened as it passes through coarse bar screens. Following screening, the wastewater is pumped to aerated grit chambers that accelerate the settling of grit for collection and disposal. While the heavier grit settles, lighter organic solids remain in suspension for removal later in the treatment process. Screened material and grit are collected and trucked to a permitted landfill for disposal. Following preliminary treatment, the effluent wastewater proceeds to primary treatment where more suspended solids and some BOD are removed.

The preliminary processes are split between an Eastside and Westside. The Westside screens and grit removal facilities treat a constant 280 MGD during peak wet weather events. The Eastside screens and grit removal facilities are dedicated to treating up to 900 MGD during peak wet weather events. The strategy behind why the flow isn't divided more evenly between the sides is that staff can largely ignore the Westside and focus intently on treating peak flows on the Eastside.

Condition Assessment

DC Water has completed or will soon complete several projects to remedy the poor condition of the screening system, influent and effluent sluice gates, screens, and screening conveyance reported in the 2008 Assessment. **Exhibit A-1** provides a tabular list of those projects and their status.

Exhibit A-1: Preliminary Treatment Processes and Facilities CIP projects

Project ID	Project Title	Cost	Timeline
TM	Influent Screen Facility – New Fine Screens	$39.1M	Completed
TF	Grit Chamber Building 1 & 2 – New grit removal systems, conveyance and loading systems, and odor control systems.	$70.6M	Completion Expected Mar 2014
UD	Raw Wastewater Pump Station #1 – Rehabilitate pumps and related pumping equipment.	$15.7M	Completion Expected Dec 2013
IX	Headworks HVAC Rehab.	$366K	Completion Expected July 2013
BV	Raw Wastewater Pump Station 2 Upgrades – upgrade vacuum priming, dewatering systems and automatic pump controls.	$27.5M	FY 2016, Construction Starts
BP	Structural and Architectural Upgrade of Grit Building (Phase II)	$5.4M	FY 2015, Design Started

The current state of Preliminary Treatment Processes and Facilities was provided during an interview on March 8, 2013 and inspection on April 10, 2013. There were no improvement needs observed or discussed.

With the improvements constructed on the preliminary treatment facilities completed, there are no anticipated projects needed to improve or maintain process operations or building systems. One recent improvement (not included in the aforementioned projects) was a modification to the highly corrosive grit facility exhaust. The ventilation exhaust duct discharge location was relocated from ground level between the "eastside" screen and grit buildings to a point over the grit facility roof. The relocation was required because the metal building components were experiencing accelerated corrosion. JMT anticipates that the duct reconfiguration should eliminate the issue.

Senior BPAWTP staff members anticipate that the preliminary facilities will be more than sufficient in meeting operational needs for the next 10-15 years. Moreover, they are currently working on a plant-wide odor control master plan which will focus on the preliminary treatment facilities. A new project in the next 5-7 years may be implemented to improve odor control emanating from the screening and grit facilities.

A new, smaller parts warehouse is being constructed. That facility is smaller because the Plant anticipates going to a just-in-time (JIT) parts procurement system that does not require nearly as much space.

A.2 D.C. Clean Rivers Preliminary Treatment Processes and Facilities

D.C. Clean Rivers is constructing two very large shafts within the BPAWTP fences. These shafts will be used for Blue Plains Tunnel construction and Tunnel Boring Machine (TBM) placement and extraction. When the Blue Plains Tunnel is complete and the TBM has been extracted, the shafts will be equipped with a large pumping station and screening/degriting facilities (Design-Build Team currently undergoing selection and award). When these facilities are completed and operating, they will become part of the BPAWTP Liquid Treatment Processes. Future Independent Consulting Engineer Assessments will include these facilities under this chapter dedicated to the BPAWTP Liquid Treatment Processes. For the 2013 Independent Consulting Engineer Assessment, the Preliminary Treatment Processes for the Blue Plains Tunnel will be included in Chapter 5 dedicated to the D.C. Clean Rivers program. **Exhibit A-2** details the Clean Rivers preliminary treatment CIP project.

Exhibit A-2: Clean Rivers Preliminary Treatment CIP Project

Preliminary Treatment Facility	Recommended Improvements	Cost	Timeline
E8 (TN/WW)	Enhanced Clarification Facility – Grit Removal and Screening Treats Excess Flow Stored in Wet Weather Tunnels	$224M	Completion Expected Nov 2018

A.3. Primary Treatment Processes and Facilities

The primary treatment processes and facilities are designed and constructed to remove particles from wastewater by exploiting the differences in density between the particles and water. The primary treatment processes and facilities at Blue Plains include oils/grease/scum separation and primary sedimentation.

Two separated primary treatment "trains" are in use at Blue Plains and are designated as the West side primary process and an East-side primary process; which combined totals 36 primary sedimentation tanks. Each tank is equipped with solids collection rakes to collect denser, settled wastewater solids. Scum skimming devices are used in each basin to collect the lighter, floatables from the wastewater surface. To enhance the settling properties of wastewater suspended solids, metal salts are added to enhance coagulation of suspended solids. Adding metal salts, such as Ferric Chloride, has the added benefit of precipitating phosphorous from the wastewater. Phosphorus removal is a requirement of the Blue Plains NPDES discharge permit. Following primary treatment, the effluent is conveyed to the secondary treatment processes where biological processes reduce the BOD in wastewater. Primary solids (or sludge) settled in the primary sedimentation tanks are pumped to degriting facilities. Following primary sludge degriting, the sludge is then pumped to the gravity thickeners and combined with other sludges produced throughout Blue Plains for treatment. See the section on Solids/Biosolids Treatment Facilities for description of the solids treatment processes.

Condition Assessment

DC Water will soon complete projects that will continue to improve the condition of the primary sedimentation basins. **Exhibit A-3** provides a tabular list of those projects and their status.

Exhibit A-3: Primary Treatment and Facilities CIP projects

Project ID	Project Title	Cost	Timeline
TN	Primary Treatment Facility – Replaced Clarifier Mechanisms	$38.7M	Completion Expected Nov 2013
BQ	Primary Treatment Facilities Phase II–Structural Repairs to Sedimentation Basins (Phase II)	$14.6M	Design Starts FY 2015

The current state of Primary Treatment Processes and Facilities was provided during an interview on March 8, 2013. There were no improvement needs observed or discussed.

The structural repairs to the Sedimentation Basins (Project BQ) were described primarily as a basin sidewalk replacement project. The basins themselves were described as structurally sound. The sedimentation basins (as well as other Liquid Processing Facilities) are anticipated to work more efficiently in the near future when peak flows will be reduced by CSO LTCP projects coming online.

Senior BPAWTP staff anticipates that the preliminary facilities will be in excellent operational order for the next 10-15 years.

A.4 Secondary Treatment Processes and Facilities

The secondary treatment facilities include:

- Step-feed Aeration Basins (Reactors)
- Activated Sludge Return System
- Secondary Blower Facility
- Secondary Sedimentation Basins
- Waste Sludge Pumping System

Secondary treatment begins as a biological wastewater treatment process that converts dissolved or suspended materials into relatively dense flocs that can be separated and settled from the water being treated. Blue Plains uses a modified-aeration step-feed activated sludge process that produces a wastewater mixed liquor that flows to the secondary sedimentation basins for settling and separation. Oxygen is supplied to each reactor to support growth of microorganisms which biological act to consume suspended and dissolved wastes from the wastewater. The secondary treatment process is an important step to remove the majority of BOD and remaining suspended solids from wastewater to meet Blue Plains' NPDES Permit.

The secondary treatment process is divided into a West process train and an East process train, each receiving effluent from the respective West and East side primary sedimentation basin trains. The settled mixed liquor in the secondary sedimentation basins constitutes a sludge that is pumped to two different locations. A large percentage of the pumped sludge (activated sludge) is recycled back to the reactors with the goal to maintain a desirable concentration of microorganisms. The smaller, remaining percentage of sludge (waste sludge) is pumped to the plant's dissolved air flotation thickeners for treatment and disposal. See the section on Solids/Biosolids Treatment Facilities for description of the solids treatment processes.

Condition Assessment

DC Water will soon complete projects that will remedy some of the structural and mechanical components of the secondary treatment facilities as reported in the 2008 Assessment. **Exhibit A-4** provides a tabular list of those projects.

Exhibit A-4: Secondary Treatment Process and Facilities CIP Projects

Project ID	Project Title	Cost	Timeline
TO	*Secondary Treatment Facilities – Structural rehabilitation of West basins 1-12, improvements to scum and solids collection equipment (all 24 basins), overflow troughs and weirs were replaced.*	*$70.6M*	*Completion Expected Nov 2013*
BI	*Enhanced Nitrogen Removal North* – Installs new fine bubble diffusers in the Secondary Treatment Process.	*$71.9M*	*Completion Expected Sep 2016*

The current state of Secondary Treatment Processes and Facilities was provided during an interview on March 8, 2013. **Exhibit A-5** details interview observations and recommendations.

Exhibit A-5: Secondary Inspection

Secondary Treatment Facility	Recommended Improvements
Secondary Aeration Basins (Reactors) – West Side	• No Needs Observed or Discussed.
Secondary Aeration Basins (Reactors) – East Side	• No Needs Observed or Discussed.
Secondary Sedimentation Basins – West Side	• Improvements recently completed. No additional Improvements Discussed or Observed.
Secondary Sedimentation Basins – East Side	• Improvements recently completed. No additional Improvements Discussed or Observed.
Secondary Return Sludge Pumping Station	• No Needs Observed or Discussed.
Secondary Waste Sludge Pumping Station	• No Needs Observed or Discussed.
Blower Facilities	• Aeration is currently being provided by 6 blowers installed in the 1960's and 2 blowers installed in the 1970's. Although they are currently operating without incident and are in great condition, consideration should be made for their replacement in the near future.
Scum Handling Facilities	• No Needs Observed or Discussed.

Project BI – Plant-wide fine bubble aerator project will not be implemented in the secondary aeration basins because it was determined that the mixed liquor characteristics had low alphas. The alpha value is the ratio of oxygen transfer in wastewater to oxygen transfer in clean water. The clean water transfer efficiency multiplied by alpha yields the wastewater oxygen transfer efficiency. Using the fine bubble system as initially proposed with the low alpha wastewater would have required additional capital projects including a costly blower overhaul.

Instead of the fine bubble aerators, BPAWTP has made improvements to their current coarse bubble diffusers; one of the key improvements was creating aeration zones that offer better control and efficiency.

BPAWTP hasn't given up on fine bubble diffusers for the secondary aeration basins. They continue to research other fine bubble aeration systems with the goal to find a system that will give BPAWTP the energy saving benefits of fine bubble diffusers while working efficiently with the plant's low alpha wastewater. This is a common dilemma within wastewater treatment and JMT comments the plant staff's initiative.

A.5 Nitrification/Denitrification Processes and Facilities

The nitrification/denitrification processes and facilities enable the removal of biological nitrogen. Biological nitrogen removal is an aerobic process whereby bacteria convert ammonia nitrogen to nitrate nitrogen. Denitrification uses a different class of bacteria that thrives in an anaerobic environment and converts nitrite or nitrate ions to nitrogen gas bubbles. The bubbles attach to the biological flocs that buoy the floc to the surface of the secondary clarifiers.

Effluent from the secondary treatment process flows into a flow distribution basin at the head of the nitrification/denitrification reactors. Lime or sodium hydroxide is added to the distribution basin to maintain desired levels of alkalinity. The effluent is distributed to a set of 12 odd-numbered and even-numbered nitrification/denitrification reactors. Nitrification/denitrification is accomplished by a suspended growth biological system. Each of the 12 reactors has five stages; nitrification takes place in the first three stages and denitrification in the last two. The conversion of nitrate to nitrogen gas in the denitrification process requires methanol as a supplemental carbon source in the reaction. Turbine aerators in each stage of the reactors keep dissolved oxygen at desired levels and provide mixing to ensure uniform distribution of solids.

The mixed liquor from the nitrification/denitrification reactors flows to 24 odd-numbered and even-numbered sedimentation basins. Waste-activated solids that settle in the sedimentation basin are recycled back to the reactors to maintain optimal biological activity. Excess biological solids are pumped to the plant's dissolved air flotation thickeners for treatment and disposal. See the section on Solids/Biosolids Treatment Facilities for description of the solids treatment processes.

Condition Assessment

DC Water has completed or will soon complete several projects to improve the nitrification/denitrification facilities to meet required Total Nitrogen permit limits. **Exhibit A-6** provides a list of those projects.

Exhibit A-6: Nitrification/Denitrification Process and Facilities CIP

Project ID	Project Title	Cost	Timeline
E9 (TN/WW)	ENR Facilities Upgrades – Expands existing nitrification/denitrification facility for additional Biological Nitrogen removal.	$267.4M	Completion Expected FY2016
TK & TQ	Nitrification/Denitrification Reactor Upgrades – Improves flow control, process control, methanol feed control and rehabilitate/upgrade sedimentation basins.	$143.0M	Completion Expected 2013
BR	Nitrification/Denitrification Facility Electrical/HVAC upgrades	$52.0M	Completion Expected Oct 2017
BI	Enhanced Nitrogen Removal - North	$71.9M	Completion Expected Sep 2016
EV	Substation #6 Miscellaneous Switchgear Upgrades	$23.0M	Completion Expected 2014
EE (TN/WW)	Centrate Treatment Facilities – de-ammonification of recycle sludge centrate stream.	$89.1M	Construction Starts Nov 2013

Note: (TN/WW) represent Total Nitrogen –Wet Weather removal projects.

The current state of Nitrification/Denitrification Processes and Facilities was provided during an interview and site visit on March 8, 2013. **Exhibit A-7** details observations and recommendations.

Exhibit A-7: Nitrification/Denitrification Inspection

Nitrification/Denitrification Facility	Recommended Improvements
Flow Distribution Basin/Stilling Basin and Chemical Feed Systems	• New Methanol, Alternative Carbon feed systems, tanks and facilities are under construction. • New channel with mixers and single point supplemental carbon addition between nitrification and denitrification stages are under construction. • New 1 Billion Gallon per Day Nitrified Mixed Liquor Pump Station and Electrical Building are Under Construction.
Nitrification/Denitrification Reactors – West Side	• Improvements recently completed. No additional Improvements Discussed or Observed.
Nitrification/Denitrification Reactors – East Side	• Improvements recently completed. No additional Improvements Discussed or Observed.
Nitrification/Denitrification Sedimentation Basins – West Side	• No Needs Observed or Discussed.
Nitrification/Denitrification Sedimentation Basins – East Side	• No Needs Observed or Discussed.
Nitrification/Denitrification Reactor Aeration and Blower Facilities	• Improvements recently completed. No additional Improvements Discussed or Observed.
Nitrification/Denitrification Recycle and Waste Sludge Pumping Facilities	• Return sludge line continues to spring leaks. A project to start next year that should temporarily remedy the problem.
Centrate Treatment Facility	• No Needs Observed or Discussed.

Many of the aforementioned projects are intended to improve the nitrification/denitrification process at BPAWTP to meet the new total nitrogen limit of 4.2 mg/l at 370 mgd average annual flow required by the Chesapeake Bay Agreement and NPDES permit for nitrogen concentration. Total nitrogen concentration being the sum of organic nitrogen, ammonia nitrogen, plus nitrite and nitrate nitrogen concentrations.

The common channel that combines East and Westside nitrified mixed liquor, injects supplemental carbon, mixes and conveys effluent to all of the denitrification tanks is a NPDES permit required improvement. Parshall Flumes are being installed to better control and distribute denitrified mixed liquor to the nitrification/denitrification sedimentation basins. These improvements have the added benefit of simplifying the nitrification and denitrification treatment process.

BPAWTP has completed a fine bubble aerator retrofit and has improved efficiency of the mixers (surface aerators). The use of both mixers and fine bubble diffusers is required to optimize the operation of aerobic zones, anoxic zones, and “swing zones” in the reactor. The aerobic zone uses the fine bubble diffusers to efficiently increase dissolved oxygen while the mixers are used in the anoxic zones where dissolved oxygen should be minimized and efficient mixing is key. Where fine bubble diffusers could not be used in the secondary reactors, the fine bubble diffusers were determined to be sufficient for use in these reactors because the fine bubble diffusers have much better oxygen transfer than the sparged aerators that were removed. Also important to note, is that the mixer horsepower was reduced from 50

HP to 10 HP for 120 mixers. This change has had a significant, 5 Megawatt, drop on the Plant's electrical demands.

Return Sludge piping from the nitrification/denitrification sedimentation basins is leaking. Sump pumps collect the leaked return sludge and pump it back into the treatment process. An inspection and stabilization project anticipated to begin next year will provide temporary repairs by lining the inside and wrapping the outside of the 80-inch diameter pipe. A recycle line replacement project involving a more robust repair/replacement is under consideration and preliminary engineering design. However, pipe replacement is a complicated undertaking because it requires removing half of the Plant's nitrification/denitrification facilities from service. The Plant can't meet its permit with half of the nitrification/denitrification facilities out of service. The Plant is currently working with the EPA to develop a plan to replace the leaking return sludge pipe.

Photo 1 - Channel that conveys, mixes and adds supplemental carbon to nitrified mixed liquor. Under construction, March 8, 2013.

Photo 2 - New Electrical Building for 1 BGD Nitrified Mixed Liquor Pump Station

A.6 Dual Purpose Sedimentation Basins

The wastewater treatment process at Blue Plains uses eight dual purpose sedimentation basins to settle mixed liquor from the secondary treatment and nitrification/denitrification processes. The initial design intent for the dual purpose sedimentation basins was to support nitrification/denitrification process. However, existing plant piping and flow control can place these basins in service to provide additional secondary sedimentation basin volume when secondary mixed liquor has poor settling characteristics. Effluent from dual a purpose sedimentation basin used as a secondary sedimentation basin has to be pumped to the nitrification/denitrification reactor forebay. The effluent from a dual purpose sedimentation basin, when in service as a nitrification/denitrification sedimentation basin, can discharge directly to the filtration forebay.

Condition Assessment

DC Water will complete a project in 2016 to improve the dual purpose sedimentation basin facilities as reported in the 2008 Assessment. **Exhibit A-8** provides details of this project.

Exhibit A-8: Dual Purpose CIP Project

Project ID	Project Title	Cost	Timeline
BG	Dual Purpose Sedimentation Basin Rehabilitation – improvements made to scum/solids collection and pumping and process control upgrades.	$24.5M	Completion Expected Sep 2016

The current state of Dual Purpose Sedimentation Facilities was provided during an interview and site visit on March 8, 2013. There were no improvement needs observed or discussed.

One benefit that BPAWTP will be able to exploit from a reduction in peak flow though the Plant is repurposing the Dual Purpose Sedimentation Facility. Half of the Dual Purpose Sedimentation Basins will be permanently assigned to secondary sedimentation. The other half of the Dual Purpose Sedimentation Basins will be permanently assigned to nitrification/denitrification sedimentation and renamed “ENR – North”. Construction is now complete on making the Dual Purpose Sedimentation Basins dedicated to secondary treatment permanent. Construction on ENR – North is underway and is expected to be complete and in-service in 2015.

A.7 Filtration and Disinfection Process

The filtration process includes multimedia filtration of effluent from the nitrification and denitrification process. The filtration facility consists of 40 granular sand and anthracite filters identified and configured as odd-numbered and even-numbered units. The plant would be in violation of its NPDES phosphorous limits without the final effluent filters in service. Filter backwash is sent to the gravity thickeners for biosolids treatment.

The disinfection process begins in four disinfection tanks located beneath the 40 multimedia filters. Gaseous Chlorine is mixed with water and then injected into the disinfection tanks where sufficient contact time deactivates microbes prior to discharge into the Potomac River. Chlorinated water is harmful to natural systems; therefore, dechlorination is required prior to discharge.

Disinfection is accomplished using sodium hypochlorite and dechlorination uses sodium bisulfite. The Disinfection Facilities project included new full containment storage facilities for the sodium hypochlorite and sodium bisulfite storage as well as new computer process controls.

Condition Assessment

DC Water will complete projects that will improve the Filtration and Disinfection facilities as reported in the 2008 Assessment. **Exhibit A-9** provides a tabular list of those projects.

Exhibit A-9: Filtration and Disinfection CIP Projects

Project ID	Project Title	Cost	Timeline
UC	Filtration and Disinfection Facilities Upgrades – 2 construction contracts to install new air-water backwash system and improved backwash controls and instrumentation. Contract continued based on results of concrete structures reliability study.	$80.8M	Completion Expected Sep 2016
BT	Filtration and Disinfection Facilities Upgrades (Phase II) – provided new electrical building and electrical gear.	$19.0M	Completion Expected Dec 2014

The current state of the Filtration and Disinfection Facilities was provided during an interview and site visit on March 8, 2013 and April 10, 2013. **Exhibit A-10** details interview observations and recommendations.

Exhibit A-10: Filtration and Disinfection Inspection

Filtration and Disinfection Facilities	Recommended Improvements
Filter Influent Channels	• Leaking was still reported. Sump pumps collect and pump leaked partially treated wastewater back into the treatment process.
Multimedia Filters – West Side	• No Needs Observed or Discussed.
Multimedia Filters – East Side	• No Needs Observed or Discussed.
Chlorination and Dechlorination Basins	• No Needs Observed or Discussed.
Chlorination and Dechlorination Injection and Pumping Equipment	• No Needs Observed or Discussed.

The now operational air/water backwash system is reducing power costs and water usage. However, metrics quantifying these anticipated benefits were not available at this time.

A project is in the conceptual engineering stage that is looking at relining the influent channels to prevent leakage. This will likely become a future structural rehabilitation project. Structural integrity is necessary to prevent exfiltration of wastewater into the surrounding soil.

Total Nitrogen Removal Program

DC Water FY2012 – FY2021 CIP includes funds that will allow a series of projects (Projects E8, E9, and EE) to be completed that will be an initial step toward the 4.2 mg/l nitrogen limit. These projects distribute flow to the nitrification reactors, upgrade nitrification basins, improve process control and optimize methanol feed which will remove a significant amount of additional nitrogen

Additional projects are needed to meet the new 4.2 mg/l total nitrogen limit @ 370 mgd average annual flow. The FY2012 – FY2021 CIP outlines the heart of DC Water's comprehensive $966.9 million program to meet its NPDES stipulated 4.2 mg/l limit. These projects were conceived as part of the TN/WW Plan which then evolved, in part, into the DCCR. The mission of the DCCR is to address the requirements of both the CSO Long Term Control Plan during wet weather events and the Chesapeake Bay Tributary Strategies Nitrogen NPDES permit limitation.

The DCCR is described in greater detail in Chapter 5.

B. Solids/Biosolids Treatment Facilities

B.1 Primary Sludge Screening, Degriting and Grinding

Primary sludge from the West and East Sedimentation processes is pumped through screens to remove rags and debris from the sludge prior to the degritting facility.

Condition Assessment

DC Water will soon complete a project to improve operations of the Primary Sludge Screening, Degriting and Grinding facilities as reported in the 2008 Assessment. **Exhibit B-1** provides more information on the project.

Exhibit B-1: Primary Sludge Screening, Degritting and Grinding CIP Project

Project ID	Project Title	Cost	Timeline
YZ	Digestion Facilities Site Preparation – Sub-project YZ01 – Primary Sludge Screening and Degriting Wet Well Control – Installation of new controls for primary sludge screens and degritting and grinding facility wet well.	$2.2 M	Completion Expected Feb 2014

The current state of the Primary Sludge Screening, Degriting and Grinding was inspected and no improvement needs were observed or discussed during an interview and site visit on March 8, 2013.

The existing Primary Sludge Screening, Degriting and Grinding will remain in service for both biosolids treatment and disposal systems: the new Cambi Hydrolysis Process and the existing Lime Stabilization process.

B.2 Gravity Thickeners

The gravity thickeners accept primary sludge from the screened and thickened sludge from the primary clarifiers. The primary sludge enters a central distribution chamber that distributes the sludge among gravity thickeners in operation. Each gravity thickener provides volume and residence time to allow the sludge to settle and thicken. Each thickener is equipped with a collector mechanism that pushes the thickened sludge toward a central well where the sludge is collected and pumped to the raw sludge blending tanks. Peripheral weirs and troughs collect clarified water from the surface of the thickeners and discharge it to the primary sedimentation effluent.

Condition Assessment

DC Water will soon complete projects that will improve the Gravity Thickeners as reported in the 2008 Assessment. **Exhibit B-2** provides a tabular list of those projects. Construction of Project BX will result in the demolition of thickeners 5 and 6 resulting in two less gravity thickeners for a total of 8.

Exhibit B-2: Gravity Thickeners CIP Projects

Project ID	Project Title	Cost	Timeline
TP	Gravity Thickeners– Rehabilitation of thickeners 1-4; Replace circular thickener mechanisms, solids and scum pumps, piping systems and cover.	$20M	Project Completion Nov 2013
BX	Gravity Thickener Upgrades Phase II– Budget modified; alterations to primary screening, degritting, scum processing, major upgrades to Gravity Thickeners 5-10 and improvements to Gravity Thickeners 1-4	$31.2M	Construction Apr 2015

The current state of the Gravity Thickeners Facilities was provided during an interview and site visit on March 8, 2013 and April 10, 2013. **Exhibit B-3** details inspection observations and recommendations.

Exhibit B-3: Gravity Thickeners Inspection

Gravity Thickeners Facility	Recommended Improvements
Gravity Thickener Facility	• Blue Plains has improved control of solids retention time to below 10 hours. If solids retention time is longer, BPAWTP will use chlorinated water to minimize septicity.
Gravity Thickener Galleries	• Outdated sludge pumps that will be replaced in rehabilitation project TP are leaking large amounts of grease that is difficult to clean, leaving the gallery floors slippery and potential hazardous.
Thickened Sludge Pump Station	• No Needs Observed or Discussed.
Gravity Thickener Odor Control System	• No Needs Observed or Discussed.
Chemical Feed	• No Needs Observed or Discussed.

The rehabilitated gravity thickener facilities are anticipated to be in good operational order for the next 10 to 15 years following completion of the aforementioned projects.

B.3 Dissolved Air Flotation (DAF) Thickeners

Blue Plains has eighteen (18) flotation thickeners in operation arranged in groups of three or four units fed from a common splitter box. The DAF Thickeners thickens biological waste activated sludge from the secondary sedimentation basins and the nitrification/denitrification sedimentation basins. The DAF's also thicken scum from primary sedimentation and gravity thickening processes. Thickened sludge, oils and grease is pushed into a receiving wet well by collectors where pumps convey it to the sludge blending tanks.

DAF thickeners are used to thicken biological sludges and oils/grease that are less dense and more difficult to settle. They use a process of injecting fine bubbles into the influent sludge, the bubbles adhere to the suspended matter, causing the suspended matter to float to the surface. The "froth" layer containing sludge and oils/grease is then removed by a skimmer. Clarified water passes beneath a baffle and is recycled to the wastewater treatment process.

Condition Assessment

DC Water has completed a project that will improve the DAF Thickeners as reported in the 2008 Assessment. **Exhibit B-4** provides more information on the completed project.

Exhibit B-4: DAF Thickeners CIP Project

Project ID	Project Title	Cost	Timeline
XB	Biological Sludge Thickener Facility Upgrades – Project reduces sludge processing and chemical costs. Also, handle additional sludge produced by new nitrification/denitrification processes.	$48.4M	Completed

The current state of the Dissolved Air Floatation Facilities was provided during an interview and site visit on March 8, 2013 and April 10, 2013. **Exhibit B-5** details inspection observations and a recommendation.

Exhibit B-5: DAF Thickeners Inspection

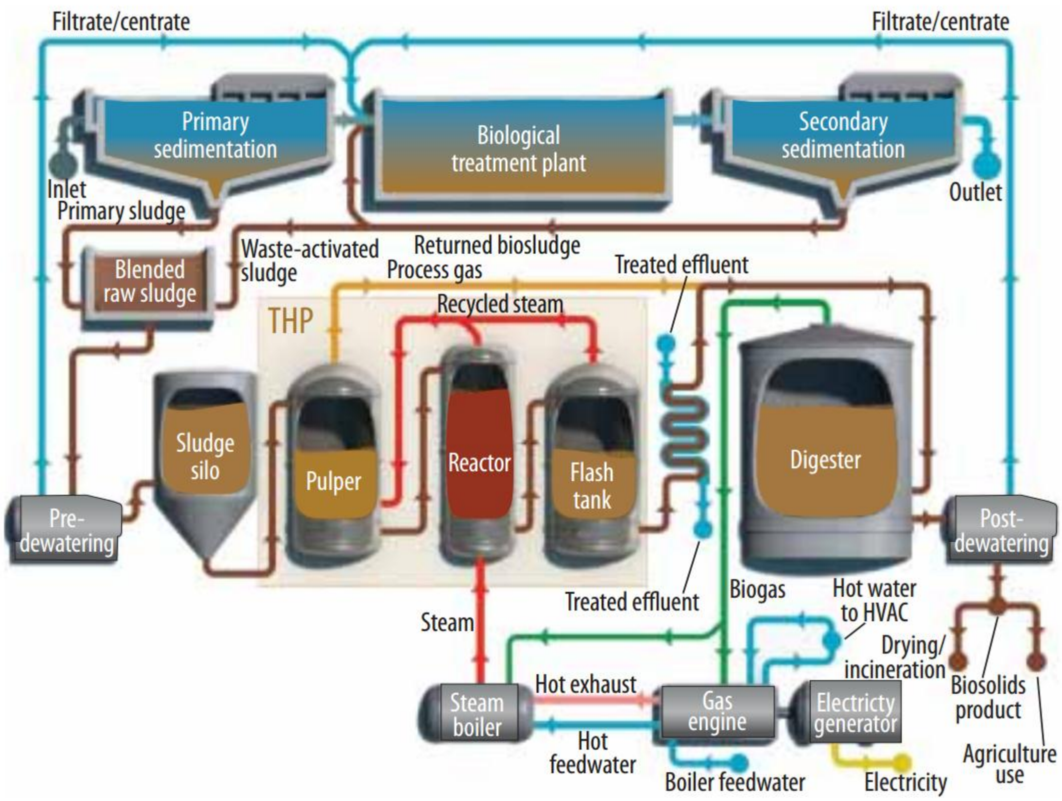
DAF Thickeners Facility	Recommended Improvements
Dissolved Air Floatation Thickener Facility	• Sludge was observed bubbling from DAF Thickeners onto nearby floors, which made the flooring slippery. JMT recommends installing additional paneling to prevent this safety hazard.
Thickened Sludge Pump Station	• No Needs Observed or Discussed.
DAF Compressed Air Station	• No Needs Observed or Discussed.
DAF Odor Control System	• No Needs Observed or Discussed.
DAF Chemical Feed	• No Needs Observed or Discussed.

In the past, three DAF thickeners were used to thicken nitrification/denitrification sludge while the remaining units were used to thicken secondary waste activated sludge. Recently, Blue Plains AWTP has implemented a new single-stream processing scheme that reduces supplemental carbon (Methanol) injection for denitrification. The new scheme simplifies the process by sending nitrification/denitrification sludge to the secondary aeration basins. This reduces supplemental carbon (Methanol) by taking waste nitrifying/denitrifying bacteria, inserting them into the carbon-rich secondary aeration basins and giving them a “head start” to remove Nitrogen from the wastewater. The secondary sludge, plus any nitrification/denitrification sludge settled in the secondary sedimentation basin, and then continues to the DAF Thickeners for thickening.

B.4 Sludge Digestion Facilities

In 2000, the existing digesters at Blue Plains were taken out of service having been replaced with a new innovative solids reduction process project. Four (4) Cambi Thermal Hydrolysis Trains are currently under construction and are scheduled to be completed in 2014. When this project is fully constructed and online, the upgraded process will nearly eliminate the need for lime sludge stabilization. The process will produce Class A Biosolids that will expand disposal and reuse options. DC Water currently produces Class B biosolids. **Exhibit B-6** illustrates the Cambi Thermal Hydrolysis process.

Exhibit B-6: Cambi Hydrolysis Process



This process is envisioned to provide DC Water with significant future cost savings associated with biosolids treatment and disposal. The sources of cost savings are listed below:

- Digester Gas (140 million BTU/day) produced by this process will be used to create steam that will be applied to influent sludge that will destroy pathogens and enhance digestion and solids reduction.
- Excess digester gas produced will be used to produce 13 MW of electricity that can be used to supplement Blue Plains electricity needs.
- DC Water can burn outside supplied natural gas with digester gas, when natural gas rates are competitive, and sell the electricity to PEPCO.
- Sludge volume reduction will result in less trucking fuel costs.
- Class A Biosolids will be less expensive for disposal (approx. $6-$7 less per wet ton)

- Savings associated with the Cambi Process is expected to exceed operational and debt service costs.

A 10-year long, thorough engineering investigation was required to ensure that the project benefits will exceed the project's capital and O&M costs throughout the new facility's lifecycle. A Blue Ribbon Panel comprised of academics, industry leaders, and DC Water management personnel selected the Cambi Thermal Hydrolysis Process from 15 evaluated alternatives. The primary criteria for selection were its cost-effective technology and its sustainable processes.

The financing for this project was structured with the following features:

- There is no financial impact to DC Water's rates during the construction period.
- Debt repayment was originally scheduled to begin after the facilities are in place and start producing their operational savings. However, DC Water decided to take advantage of low interest rates and is currently paying off up to half of the debt.
- The component of DC Water rate payers' water bill associated with biosolids treatment, handling and disposal is expected to be reduced compared to current levels in the future.

According to senior BPAWTP staff, once the Cambi System is in operation, they intend to retain and maintain the existing lime stabilization, dewatering centrifuges and truck loading facilities as a redundant system that can assist during rare daily or weekly peaks. Blue Plains operations staff plans to implement a standard operating procedure of keeping the existing equipment working and "exercised", which is a prudent measure for the handling of lime related systems.

Condition Assessment

DC Water will soon complete a project that will improve the DAF Thickeners as reported in the 2008 Assessment. As of the date of this 2013 Assessment, the construction of the sludge digestion (Cambi) facilities continues on schedule and on-cost as detailed in **Exhibit B-7**.

Exhibit B-7: Sludge Digestion CIP Project

Project ID	Project Title	Cost	Timeline
XA	New Sludge Digestion (Cambi) Facilities– Installation of 4 new Cambi Thermal Hydrolysis trains, new sludge digesters, new sludge screening facility, belt presses/truck loading and modifications to existing sludge blending tanks to enhance flexibility of feed sludge to Cambi System.	$514.8M	Awarded FY 2011; Completion Expected 2015

An inspection of the existing sludge handling facilities and the New Sludge Digestion (Cambi) Facilities (under construction) and sludge blending facilities was conducted on March 8, 2013. **Exhibit B-8** details inspection observations and recommendations.

Exhibit B-8: Sludge Digestion Inspection

Sludge Digestion Facility	Recommended Improvements
Cambi Thermal Hydrolysis Trains	• Under Construction (see progress photo below)
Digester Tanks	• Under Construction (see progress photo below). One sludge tank floor slab had honeycombed concrete; the contractor demolished and replaced concrete at his own cost.
Sludge Screening Facility	• Under Construction. Minimal progress – it appears construction recently started.
Sludge Blending Tank Modifications	• Under Construction. (see progress photo below)
Sludge Belt Presses and Truck Loading Facility	• Under Construction. (see progress photo below)

The installation of the Cambi Hydrolysis Trains is very impressive and attracts much attention within civil engineering circles. During the site visit JMT observed firsthand the rigorous quality control in place onsite. A couple of examples are:

- The contractor demolished and replaced concrete at his own cost as noted in Exhibit B-8.
- One component of the Cambi Process was damaged by the shipper when the truck carrying the component swung out wide and struck a jersey barrier. The Contractor could have used a hammer to “bang out” the dent and install; however, the manufacturer’s representative rejected the damaged component-out right which force the contractor to ship it back to Sweden for repairs.

BPAWTP senior staff has reported that this project is on schedule and the cost baseline remains intact.

Photo 3 – Cambi Hydrolysis Process Trains (left) and Concrete Sludge Digesters (left) under construction. Photo taken March 8, 2013.

Photo 4 - Piping Modifications to Existing Blending Tanks. Photo Taken March 8, 2013

Photo 5 – Belt Press and Truck Loading Facility Under Construction. Photo taken March 8, 2013

Adjacent to the Cambi Process facility, the Central Heat and Power (CHP) facility was under construction during the March 8, 2013 site inspection. This facility designed and constructed by PEPCO and Black and Veatch will generate electricity and steam from biogas generated by the sludge digesters. Photo 6 below shows construction progress on the CHP facility.

Photo 6 - Central Heat and Power Facility Under Construction. Photo Taken March 8, 2013)

B.5. Dewatering Centrifuges

The Centrifuge Dewatering Facility consists of the following equipment:

- 7 High-solid Centrifuges
- 7 Grinders
- Chemical addition system
- 2 Conveyors for each centrifuge (to transport dewatered sludge cake)
- 14 Centrifuge Sludge Feed Pumps
- 4 Blend Tanks
- Odor Control System
- 3 dewatered sludge loading conveyor trains

Chemicals, such as Polymer, are added to the blending tanks with sludge to help bind and thicken the influent sludge. The blended sludge is injected into the centrifuges to be dewatered. The dewatered sludge cake is transported from the centrifuges to one of three sludge loading conveyor trains. Centrate from this process is transported to the secondary treatment (liquids processes) via a waste liquor trough.

Condition Assessment

DC Water is implementing a project that will improve the DAF Thickeners as reported in the 2008 Assessment. **Exhibit B-9** provides more details on the project.

Exhibit B-9: Dewatering Centrifuge CIP Project

Project ID	Project Title	Cost	Timeline
XC	Additional Dewatering Facilities – New centrifuges to expand dewatering capacity and to increase efficiency.	$81.7M	Completed 2012

The current state of the Dewatering Centrifuge Facilities was inspected and no improvement needs were observed or discussed during an interview and site visit on March 8, 2013.

An additional project valued at $22 million was added to the centrifuge project. The added project completed repairs and upgrades to the chemical systems and truck loading facilities. This project also included replacing the oldest centrifuges to ensure on-going reliability of the dewatering operations. No additional improvements are anticipated on these facilities over the next 10-15 years.

B.6 Biosolids Lime Stabilization and Truck Loading

The lime stabilization chemical treatment facilities are required to stabilize the dewatered raw biosolids for safe transport for land applications. These facilities will not become a stranded asset. Rather, they will remain in service as the redundant biosolids treatment method after the Cambi Thermal Hydrolysis Trains are placed in service. The biosolids lime stabilization will be operational available in the rare instance when daily or weekly peaks exceed the capacity of the Cambi system.

The Dewatered Sludge Loading Facility (DSLF) and a Direct Sludge Loading Station (DSLS) are the two main components of the biosolids lime stabilization facility.

The DSLF contains the following equipment:

- Two 275-ton lime storage silos
- Three lime day bins
- One pneumatic lime transfer system
- A dosing system with 7,000 lbs lime/hr design capacity
- Sludge conveyors
- Three Leopold lime/sludge plow blenders

The DSLS is an alternative for the DSLF. The DSLS contains one lime silo, two lime day bins, sludge conveyors, and two lime/sludge blenders.

Condition Assessment

DC Water will implement a project that will improve the DAF Thickeners as envisioned in the 2008 Assessment. **Exhibit B-10** provides a detail of this project.

Exhibit B-10: Biosolids Lime Stabilization and Truck Loading CIP Project

Project ID	Project Title	Cost	Timeline
XZ	Solids Processing Building/DSLF– Repairs to chemical systems, improvements to Solids Processing Building and Dewatered Sludge Loading Facility	$23.7M	Completion Oct 2017

The current state of the Biosolids Lime Stabilization and Truck Loading Facilities was provided during an interview and site visit on March 8, 2013. There were no improvement needs observed or discussed relating to the Biosolids Lime Stabilization and Truck Loading Facilities.

A rapid truck loading station was recently installed as part of Project XC which primarily upgraded the new dewatering centrifuges. The truck loading facility operates on a first-in/first-out basis, which will reduce the potential for odor generation. This facility has been equipment with a three-stage packed tower odor control system for ammonia and hydrogen sulfide removal.

4.3.4.4 Condition Assessment Summary

In general, the condition assessments at the Blue Plains facilities revealed proper safety procedures and no major issues in operations, maintenance, or process function. Facilities and equipment identified as problematic were accounted for in the CIP. Housekeeping, though, was noted as lacking at many facilities throughout the plant. Pieces of wood, metal scraps, and other debris were observed in facilities and doors were left open in grit and screening buildings.

Interviews and observation revealed a few issues with the SCADA systems. Reportedly, user interfaces are not uniform between pump stations and some equipment is reportedly not shown in the system. JMT investigated this concern further by reviewing the SCADA Master Plan. Interviews with supervisory and engineering staff examined the supervisory control and acquisition of data points at Blue Plains for the wastewater pumping stations. A dashboard display has been created to facilitate information/data received from the pumping stations. SCADA systems as complex and evolving as the extensive DC Water system must constantly evolve and iterations of data points will occur. JMT considers the Process Control System and SCADA at Blue Plains to be an industry leader. A further iteration of data acquisition is being tested to provide to the supervisory control at Blue Plains upstream monitoring points in order to anticipate the incoming flow at the remote pumping stations. This will allow early pump activation rather than controlling from existing wet well levels.

4.4 Collection and Conveyance

DC Water collects and conveys separate and combined wastewater to BPAWTP for treatment. This includes wastewater generated by jurisdictions included in the IMA, the Potomac Interceptor Agreement (PIA) and Loudoun Water. Wastewater conveyance systems include: sanitary sewers and combined sewers and nine sewer pumping stations. In 2015, the first section of an elaborate and sophisticated wet weather storage tunnel system will be in service that will convey wet weather sewage to BPAWTP. DC Water is responsible for operating, maintaining and making improvements to sewer lines serving the District of Columbia and the major trunk sewers that convey wastewater from the IMA, PIA and Loudoun Water served communities.

4.4.1 Sewer Collection

DC Water collects wastewater from the District, covering 61 square miles. Separate storm water and sanitary collection systems account for 41 square miles, while a combined storm water and sanitary sewer collection system covers 20 square miles.

The following is a list of DC Water collection system characteristics in numbers:

- 41 square miles of separate sewage
- 20 square miles of combined sewage
- approximately 1,800 miles of sanitary and combined sewers
- 125 building sewers
- 22 flow metering stations
- 1810 – year sewer system began construction

Like most utilities around the country, DC Water is responsible for lateral sewer connections from the main sewer to the right-of-way/property lines regardless of the property owner. For large water and sewer users, DC Water meters each wholesale customer. Each wholesale customer permit establishes discharge limits with respect to the average wastewater flow rate and peak wastewater flow rate. Sewers constructed 50 years ago or more were constructed of vitrified clay, brick, and concrete. More recent, separated sewer installations use PVC, ductile iron, and concrete for sewer construction. The force mains are typically constructed of iron, steel, or concrete.

DC Water continues to use the services of an EPMC to manage projects improving the sanitary sewer system. The mission of the EPMC is to determine sewer system condition, confirm system capacity and develop new capital projects. A condition and criticality assessment of sewers will result in the most urgent repairs and rehabilitation taking place first. In turn, this has resulted in efficient use of DC Water money and resources.

The condition of the aged sewer system is typical for a system of this size and age. Because many sewers date back to the late 1800s, DC Water will have to continually invest in replacement, rehabilitation and renovation. An average of $50 million will be spent on sewer system improvements over the next 10 years. Projects in the CIP are indicative of DC Water's efforts to keep the system in good operating condition.

The Sewer System Facility Plan of 2009 is the asset management and planning document that maps the development of the sewer system CIP. This plan is the result of an in-depth study of the existing collection facilities, which included sewer inspections and condition assessments, development of a GIS database, and hydraulic monitoring and modeling to determine system capacity. Due to time and budgetary constraints, DC Water limited inspections to sewers identified as critical due to their location, tendency to be problematic, and importance to the system.

Sewer conditions were assessed using the National Association of Sewer Service Companies' (NASSCO) defect coding system. Uniform and consistent descriptions of pipe defects were accomplished using the Pipeline Assessment Certification Program (PACP). The PACP is an industry standard that JMT readily approves of.

JMT reviewed the 2009 Sewer System Facility Plan and approves of the plan summary found in the FY2012 – FY2021 CIP. These findings revealed that though the sewer pipe infrastructure is sufficient to meet current and future demands. However, investment and upgrades to the system are needed. The projected 20 year billings found in the CIP is required to address the sanitary sewers that serve DC rate payers.

Targeted performance measures identified and reported in DC Water's FY2013 – FY2014 Operating Budget indicate that Sewer Services has been meeting their goals. Since 2008 approximately 28,000 catch basins have been cleaned annually, 2,200 laterals have been investigated/relieved annually, 424 tons of floatable debris have been removed from the river annually, 365 sewer lateral have been repaired or replaced annually, 1,900 linear feet of sewer mains have been replaced annually, and 400 PI meters have been inspected. However, this productivity could not be verified within this assessment. JMT recommends establishing the appropriate metrics in order to track preventive measures against corrective maintenance needs. As discussed in Section 2.5, Asset Management, DC Water will be moving from corrective maintenance towards a more balanced proactive maintenance with a successful Asset Management Program.

Noteworthy projects are shown in **Exhibit 4.4-1**.

Exhibit 4.4-1: CIP Projects

Project ID	Project	Cost	Schedule
	Sanitary Collection Sewers	$162.7 M	
• G8	• Local Sewer Rehab		• FY 2015 Construction
	Sanitary On-going Projects	$173.8 M	
• Q3	• Pope Branch 12-Inch Sewer Replacement		• FY 2017 Design
	Sanitary Pumping Facilities	$30.5 M	
• L3 • L4 • L5	• Rock Creek Sewage Pumping Station • Upper Anacostia Sewage Pump Station • Earl Place Sewage Pumping Station		• Complete • Complete • Complete
	Sanitary Sewer Program Management	$91.1 M	•
• AU • DN	• Sanitary Sewer Program Management & Planning • Sewer Inspection Program		• Ongoing • Ongoing
	Sanitary Interceptor/Trunk Force Sewers	$466.5 M	
• DR • G5 • G6 • HS • HT • N7 • G4	• Lower Area Trunk Sewer Rehabilitation • Sewer Rehab Near Creek Beds • Sanitary Sewer Rehab Under Buildings • Outfall Sewer Rehabilitation • Rehabilitation of Anacostia Force Main • Potomac Interceptor Rehabilitation • Upper Potomac Interceptor Rehabilitation		• FY 2014 Construction • FY 2014 Construction • FY 2017 • FY 2013 Design • FY 2015 Construction • FY 2018 • FY2015

4.4.1.2 Combined Sewer Overflow Facilities

Approximately one-third or 20 square miles of the District's older neighborhoods are served by combined sewer systems (CSS). The majority (66%) of the collected CSS flow during wet weather events discharges to the Anacostia River, while the rest flows to Rock Creek and the Potomac River.

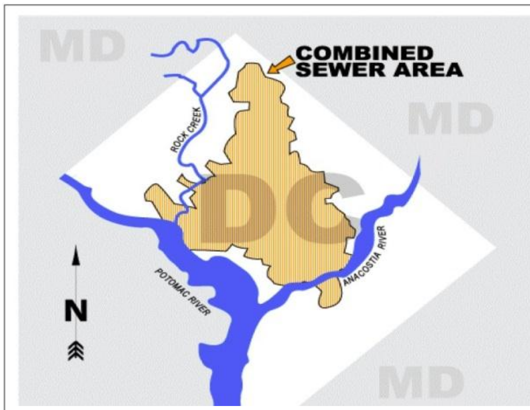


Exhibit 4.1-2: Combined Sewer Area (Obtained from 2008 Assessment)

The existing CSS is designed to protect the wastewater treatment plant and collection system from exceeding the designed hydraulic capacity for each.

Whenever significant wet weather events occur, inflatable dams, overflow weirs and other control methods allow the excess combined storm and sanitary flow to be discharged directly to the Anacostia River, Rock Creek, the Potomac River, or other tributary waters. The controlled release of combined sewage also prevents streets and basements from flooding. DC Water has 53 permitted CSO discharge locations on the aforementioned water courses. One of the outfalls discharges treated excess flow at Blue Plains.

The relatively stagnant Anacostia River (when compared to the Potomac River) is significantly impacted by combined sewer overflows. While the number and frequency of combined sewer overflows into the Potomac River is similar to the Anacostia River, the negative impact on the water quality of the higher flow rate Potomac River is less severe. Rock Creek has a light base flow rate that tends to concentrate urban runoff and combined sewer overflows that can cause short periods of high bacterial concentrations.

The District of Columbia and DC Water have entered an era when great expense, careful planning, extensive engineering and construction will yield projects that will greatly improve water quality in the Anacostia River, Potomac River, Rock Creek, and other smaller flowing water bodies.

In FY 2002, the Authority submitted its proposed Combined Sewer Overflow Long Term Control Plan (CSO LTCP) to the EPA, marking a major milestone after almost two decades of studying combined sewer overflows by DC Water and its predecessor agency. DC Water's current NPDES permit was issued September 30, 2010 and is discussed in Section 4.3.1. Permit Compliance. The goal of the CSO LTCP is to control combined sewer overflow discharges by approximately 96%. This rate compares favorably to the EPA guideline capture rate of 85 percent.

DC Water has included Low Impact Development (LID) practices as part of its solution to reducing CSO's from its system (see Section 5.2.1. for more detail on DC Water's Green Infrastructure initiatives). Low impact technologies used by DC Water and seen in the field during inspections include:

- Green Roofs
- Permeable Parking Pavers
- Environmental Site Design
- Rain Gardens

D.C. Clean Rivers

Many of the Anacostia River combined sewer overflow facilities are being improved as part of the D.C. Clean River Project. Because of the size of this project, the D.C. Clean Rivers projects are discussed in more detail in Chapter 5 under the same heading name.

CSO Nine Minimum Controls

Construction is near completion on the CSO Nine Minimum Controls projects that were settled in the CSO LTCP lawsuit of 2004. The Nine Minimum controls are standards for operations, maintenance and management of combined sewers and outfalls. These controls were established by the EPA in order to reduce the number, volume, and impact of CSO events. Implementation of the nine controls required

DC Water to undertake multiple projects that have a total estimated completion cost of $170 million and have successfully reduced CSO overflows by approximately 40 percent. Status summaries of the projects that address the Nine Minimum Controls are listed in **Exhibit 4.4-3** below.

Exhibit 4.4-3: CSO Nine Minimum Control CIP Projects

Project ID	Project	Cost	Schedule
	CSO Program Management	$55.2 M	
• AV • K2	• CSO Program Management • CSO-Long Term Control Plan		• Ongoing • FY 2013
	Combined Sewer Projects / Nine Minimum Controls Projects	$170 M	
• A7 • BA • BB • BH • BK • D2 • K1 • K3 • K4 • K5 • DZ	• Supplemental Environmental Projects • Low Impact Development Projects • Potomac Pumping Station Rehab • Rock Creek CSO Projects • CSO Nine Minimum Control Projects • Outfall Sewer Rehabilitation • Main & "O" St. Pump Stations • East Side Pumping Station • Poplar Point Pumping Station • Dry-Weather Overflow Elimination • CSO LTCP Rock Creek Projects		• Completed • Completion FY2014 • Completed FY 2013 • Completion FY 2015 • Completed • Completion FY2013 • Completed FY 2015 • Completion FY2013 • Completion FY2014 • Completion FY2013 • Design FY 2019
	Combined Sewer Projects	$25.9 M	
• DD • DS • EJ • EK • EL • EQ • FQ • FX • FZ • G7 • IH • IJ • IP • JT	• Main & O Pump Sta. Development • New DC Water Headquarters • Potomac Pumping Station - Phase III • Long Term Rehabilitation Main & O Pump Stations • Swirl Facility Rehabilitation • Potomac Pump Station Rehab - Phase IV • Main & O St PS Intermediate Upgrade • Rehab Northeast Boundary Sewer-PH 1 • Tiber Creek Sewer Lining -Ph 1 • Combined Sewers Under Buildings • Combined Sewer Rehabilitation 2 • Combined Sewer Rehabilitation 3 • Tiber Creek Trunk Sewer Rehabilitation • Combined Sewer Rehabilitation 4		• Completed FY 2012 • Construction FY 2012 • Completion FY 2017 • Design FY 2017 • Completion FY 2015 • Design FY2018 • Completion FY 2016 • Completion FY 2017 • Completion FY 2018 • Completion FY2019 • Completion FY2019 • Design FY 2017 • Design FY2014 • Design FY 2020
	D.C. Clean Rivers (See Chapter 5)	$1.9 B	
• CY • CZ	• CSO LTCP Anacostia Projects • CSO LTCP Potomac Projects		• Ongoing • Ongoing

4.4.1.3 Potomac Interceptor

The Potomac Interceptor is a 50 mile pipeline that conveys, by gravity, an average of 65 million gallons of wastewater daily to the Blue Plains treatment plant. There are four primary segments of the inceptor, the Potomac Interceptor Main Trunk, the Upper Potomac Interceptor, the Upper Potomac Interceptor Relief Sewer, and the Maryland Upper Potomac interceptor. WSSC operates and maintains the Maryland Upper Potomac Interceptor while the Authority operates and maintains the other three segments.

376 square miles of Virginia, Maryland, and the District are served by the Potomac Interceptor. The specific users of the interceptor are, the counties of Loudoun, Fairfax and Arlington in Virginia; Montgomery county in Maryland; the towns of Herndon and Vienna in Virginia; the National Park Service, the Naval Research Center in Maryland; and the Washington-Dulles International Airport.

The interceptor varies in size and shape, from the round 30-inch to 96-inch diameter reinforced concrete Main Trunk pipes to the 13-foot by 7.75-foot rectangular reinforced lower section of the tunnel. The variety of terrain covered by the interceptor has a number of unusual features including river crossings, steep hydraulic bends and siphons. Incorporated into the design are approximately 90 12-inch cast iron sewer vent structures and approximately 130 vented manholes that allow the exhaust of sewer gases or intake of air as required.

The responsibility to operate, maintain and make capital improvements to the Potomac Interceptor (excluding the Maryland Upper Potomac Interceptor section which is the responsibility of WSSC) is delegated to the authority as part of several agreements. The health of the system is monitored by the Authority, routine inspections are performed on above ground structures, internal piping is inspected with CCTV equipment and flows are measured. Maintenance of the system includes cleaning of the pipeline and repairing above-ground structures and manhole covers.

Currently the CIP identifies two capital projects for the Potomac Interceptor, an Erosion Control Study and Operation Clean Air. The Erosion Control Study will address areas along the interceptor where significant erosion has occurred near the C&O canal. Operation Clean Air is part of the Long Term Odor Abatement project that is an effort to provide six odor scrubber ventilation buildings along the length of the interceptor. Construction of the facilities in Maryland and the District are complete. Obtaining the required permits has been the bottleneck for construction in Virginia. Currently the last permit has been secured and construction is ready to commence. It is expected that construction will conclude by FY2015.

4.4.1.4 Anacostia Interceptor

The Anacostia Interceptor is a parallel force main and gravity sewer and serves the Authority’s East Side Pump Station and WSSC’s Anacostia Pump station. The force main and gravity sewer have a total carrying capacity of 135 mgd, of which, the Authority owns 45 mgd; the remaining carrying capacity is owned by WSSC.

In 1997, an internal inspection was conducted in parts of the interceptor. It was determined that the sewer was in fairly good condition; though, from the springline to the crown, there were signs of corrosion, including exposed rebar. Infiltration was not a problem; however, the condition of the manholes and sewer lead to the sewer being placed out of service. Flow is currently being pumped through the force main only. Testing of the 108-inch force main showed that some areas were weak, though no area was in danger of failure. During the 2012 board review of the CIP plan, the Anacostia Interceptor was considered for the 10-year CIP and rejected. This is typical based upon the pipeline investigation results and the consideration for the Anacostia Interceptor being a low pressure sewer.

4.4.1.5 Rock Creek Interceptor

The Rock Creek Interceptor serves WSSC, receiving flow along Beach Drive at Rock Creek. Under the current CIP, the upper part of the interceptor has been selected for rehabilitation. The broken pipes, holes, and exposed aggregate will be repaired using a lining method. Design is expected to start June FY2013 with a construction completion date scheduled for December FY 2017.

4.4.2 Pumping Stations

4.4.2.1 Overview

Nine pump stations move wastewater to Blue Plains. These pump stations are listed in **Exhibit 4.4-4**. The 3rd and Constitution pump station is currently out of service.

Exhibit 4.4-4: Wastewater Pumping Stations

Facility	Date Installed	Installed Capacity
Main	1905	300 mgd (Sanitary) 480 mgd (Stormwater)
Poplar Point	1915	64.8 mgd
Rock Creek	1921	60 mgd
Earl Place	1926	0.86 mgd
O Street	1963	60 mgd (Sanitary) 600 mgd (Stormwater)
Potomac	1965	576mgd
East Side	1967	60 mgd
Upper Anacostia	1970	15 mgd
3rd and Constitution (out of Service)	1983	7.85 mgd

The combined pumping capacity of these pumping stations is approximately 1150 million gallons of per day. The pumping stations are sized to handle both sanitary and combined sanitary and stormwater flows.

A number of pump stations have recently been upgraded. These upgrades were done in part to meet new code standards and regulations. The improvements have boosted the efficiency and effectiveness of the pump stations.

4.2.2.2 Description of Facilities and Planned Improvements

1. Main & O Street Pumping Stations

Built in 1905, the Main Pumping Station pumps from the Tiber Creek and B Street/New Jersey Avenue, which includes flows from the Potomac/Rock Creek system that enter the B Street/New Jersey Avenue Trunk Sewer, to Blue Plains under the Anacostia River. The pump station has an installed capacity of 300 mgd for sanitary sewer and 480 mgd for stormwater. Capacity with the largest pump out of service is 240 mgd and 400 mgd for sanitary and stormwater respectively.

The O Street Pumping Station, built next to the Main Pumping Station in 1963, is designed to pump flows to Blue Plains. One side of the facility pumps storm water while the other side is dedicated to sanitary pumping. The pumps allocated to sanitary flow pump wastewater from the Southwest Interceptor; whereas, the stormwater side pumps combined flow from the B Street/New Jersey Avenue Relief Sewer to the Anacostia River.

Condition Assessment

Under the CIP, the Main and O Street pumping station rehabilitation was completed in 2009. The project provided upgraded pumps, electrical and ventilation systems among other improvements.

The current state of Main & O Street Pumping Stations was provided during an interview and site visit on April 12, 2013. **Exhibit 4.4-5** details the inspection observations and recommendations.

Exhibit 4.4-5: Main & O Street Pumping Station Inspection

Main & O Street Pumping Stations	Recommended Improvements
Pumping Station	• Standing water was observed where sanitary pumps are housed. This requires pump seal maintenance.

2. Upper Anacostia

The Upper Anacostia Pumping Station, built in 1934, has an installed capacity of 15 mgd and a firm capacity of 10 mgd. In the 2008 Assessment, it was noted that the Authority's internal assessment indicated that the Upper Anacostia Pumping Station was in poor condition. Therefore, the Authority has identified a project to provide for new pumps, electrical system, HVAC system, odor control system, replacement of the screens with grinder pumps and structural repairs. This project has been designed and construction procurement is underway.

Condition Assessment

The current state of Upper Anacostia Pumping Station was provided during an interview and site visit on April 12, 2013. **Exhibit 4.4-6** details the inspection observations and recommendations.

Exhibit 4.4-6: Upper Anacostia Pumping Station Inspection

Upper Anacostia Pumping Station	Recommended Improvements
Pumping Station	• The metal roof of pumping station is un-insulated and may lead to excessive energy consumption during warmer weather. Sewer Services is performing an energy audit.
Emergency Power Generator	• An emergency generator is kept at the pumping station due to frequent power losses. This generator must be turned on manually. JMT recommends an automatic start diesel generator with an automatic transfer switch (ATS) for the pump station.
Hatches	• It was noted that the valve vault does not have an alarm to announce unauthorized openings. JMT recommends this valve vault to be upgraded to conform to DC Water security standards.

3. Earl Place

Earl Place Pumping Station, build in 1934 and refurbished in 2006 is one of the smaller pumping stations in the collection system with an install capacity of 0.86 mgd and a firm capacity of 0.43 mgd.

Condition Assessment

The current state of Earl Place Pumping Station was provided during an interview and site visit on April 12, 2013. **Exhibit 4.4-7** details the inspection observations and recommendations.

Exhibit 4.4-7: Earl Place Pumping Station Inspection

Earl Place Pumping Station	Recommended Improvements
SCADA	• SCADA was having issues with pump timer dropping out, which requires control adjustments
Debris basket	• It was observed that the wet well debris basket was ineffective at collecting solids in the wet well. JMT recommends modification.

4. Potomac

The Potomac Pumping Station, placed in service in 1963, has an install capacity of 576 mgd and a firm capacity of 460 mgd. Wastewater from the Potomac/Rock Creek system is pumped via force mains under the Anacostia River to Blue Plains. Under the CIP, the Potomac Pumping Station was identified as needing improvements. Currently, design is complete and construction is underway to rehabilitate the pump station. Improvements include, among other items, replacement of existing screens and gate valve actuators. Based on the interview with Sewer Services Pumping, JMT endorses the multi-phase upgrade to this integral pumping facility.

5. East Side

The East Side Pumping Station, brought on line in 1967, has an installed capacity of 60 mgd and firm capacity of 45 mgd. This station separately pumps wastewater from the East Side Interceptor Sewer and transports the material removed by the Northeast Boundary Swirl Facility. As part of the CIP, the East Side Pumping Station was replaced FY 2009 and is now operational. No operational deficiencies were observed.

6. 3rd and Constitution (out of service)

The 3rd and Constitution Pumping Station, completed in 1972, has an installed capacity of 7.88 mgd, and a firm capacity of 2.88 mgd. Currently, this pump station is out of service with its flows being pumped by the Main Pumping Station.

7. Rock Creek

The Rock Creek Pumping Station, first operational in 1921, pumps combined wastewater from Georgetown and West Rock Creek area to the Potomac Pumping Station. The pump station has an install capacity of 60 mgd and a firm capacity of 40 mgd. In FY 2009, a CIP project was completed that provided a comprehensive rehabilitation of the pumping station.

Condition Assessment

The current state of Rock Creek Pumping Station was provided during an interview and site visit on April 12, 2013. **Exhibit 4.4-8** details the inspection observations and recommendations.

Exhibit 4.4-8: Rock Creek Pumping Station Inspection

Upper Anacostia pumping station	Recommended Improvements
Depth transducer	• It was noted that debris in the wet well can affect the depth transducer causing issues with startup and stopping of pumps. JMT recommends appropriate collection of the debris.
Wet well weirs	• The replacement pumps were installed at a higher elevation than the previous pumps which has made it difficult to maintain wet well levels. This will require modification of the turn-down elbow.
Floor drains by odor scrubbers	• Some of the floor drains by the odor scrubbers were clogged by leaves and debris resulting in over 2 inches of water accumulation. This requires periodic maintenance.

8. Poplar Point

The Poplar Point Pumping Station, built in 1915, currently has an installed capacity of 65 mgd and a firm capacity of 45 mgd. In the 2008 Assessment, this pump station was a CIP project with a construction completion date of 2009. However, the pump station rehabilitation has been moved under the DC Clean

Rivers Project. Currently, design is underway and construction completion is slated for FY 2016. The Green Initiatives programmed into the design authenticate DC Water's leadership in energy savings.

4.5 Summary of Collection and Conveyance Facilities

Collection System

The sewer collection maintained and operated by DC Water has approximately 1,800 miles of sewer pipes. Dating back to 1810, the sewers are constructed from a variety of materials including brick and concrete, vitrified clay, reinforced concrete, ductile iron, plastic, steel, cast iron, and fiberglass. Up to the property line, sewer lateral connections are also administrated by DC water. Though the collection system is old, it is fairly typical for older systems along the east coast of the United States.

Pumping Stations

All major facility components are kept operational while modifications and improvements are designed or constructed. All pump stations (except 3rd and Constitution, which is out of service) are kept running to handle existing flows. The Authority's own assessment found some pumping stations to be in poor condition. Subsequent programming of improvements to address these concerns was added in the CIP. This is a positive indication of the Authority's commitment to ongoing assessment-driven improvements. The projects currently programmed in the CIP will adequately address deficiencies at Rock Creek, Upper Anacostia and Earl Place pumping stations. In general, there is a high regard for safety in the workplace.

4.6 Stormwater

The stormwater sewer system consists of approximately 8,200 catch basins, 600 hundred miles of storm sewers, over 400 separate storm sewer discharge points, and fifteen stormwater pumping stations; some of the stormwater sewer facilities exceed 100 years old. DC Water is responsible for maintenance and replacement of several combined stormwater and sanitary sewer facility discharge points on the Potomac River, Anacostia River, Rock Creek and other water courses in the District.

In 2000, U.S. EPA Region III issued a Municipal Separate Storm Sewer System (MS4) Permit to the District of Columbia Government for management of the separate storm sewer system. The DC Water was designated the lead agency responsible for coordination of permit compliance activities with the D.C. Departments of Public Works and Health. Since 2001, DC Water collected the MS4 stormwater fees on behalf of the District and acted as stormwater administrator until the creation of the District Columbia Department of the Environment (DDOE) and the transfer of duties in early 2007. Since inception of the DDOE, the District of Columbia's separate stormwater system has been regulated by an EPA MS4 permit that ensures compliance with the Clean Water Act. The goal of the MS4 stormwater NPDES permitting program is to improve the quality of stormwater discharged to water bodies. Currently, stormwater permits have specific requirements for control and monitoring of discharges from industrial and construction sites. Some of the results from the MS4 include an Anacostia TMDL Compliance Plan and the Rock Creek TMDL Compliance Plan estimated at approximately $7 million per year to meet all the requirements of the permit.

Although DC Water has reduced responsibility for the separate stormwater system other than collecting fees and transferring those fees to DDOE, DC Water continues to support other agencies (e.g. DDOT) that participate in the MS4 task force, and monitors the impact of other MS4 NPDES requirements on DC Water and its ratepayers. DC Water continues to operate and repair stormwater pumping stations at underpasses.

Noteworthy stormwater CIP projects are listed below in **Exhibit 4.6-1**.

Exhibit 4.6-1: Stormwater CIP Projects

Project ID	Project	Cost	Schedule
	Stormwater Local Drainage	$22.8 M	
• A6 • GY • ID • IE	• Lining, 22nd & P Sts., NW • Storm Rehab @ Various Locations • Storm Sewer Rehabilitation 2 • Storm Sewer Rehabilitation 3		• FY 2013 Design • FY 2014 Construction • FY 2017-2021 • FY 2019-2021
	Stormwater On-going Projects	$11.3 M	
• N/A	• N/A		• N/A
	Stormwater Pumping Facilities	$0.0 M	
• N/A	• N/A		• N/A
	DDOT Stormwater Projects	$3.2 M	
• N/A	• N/A		• N/A
	Stormwater Research and Program Management	$10.6 M	
• AT	• Stormwater Program Management		• Ongoing
	Stormwater Trunk/Force Sewers	$15.1 M	
• BO	• Stormwater design and construction services		• Completion FY2016

4.7 Operations, Maintenance, Security and Facilities and Safety

The preceding sections focused on identifying system deficiencies and assessing the planned capital improvements to address these deficiencies. Equally important is an evaluation of the operations and maintenance of the plant. Also heightened is emphasis on matters relating to the security of vital civil infrastructure, such as the Blue Plains plant.

4.7.1 Operations

The Assistant General Manager Blue Plains has overall responsibility for wastewater treatment Operations and Process Engineering groups and reports directly to the General Manager. Plant

Operations, Residual Energy and Nutrient Recycling, Clean Water Quality and Technology, Process Control Systems, Process Engineering, and Process Control Maintenance are functionally separated groups as can be seen in **Exhibit 4.7-1-A and Exhibit 4.7-1-B** below.

Exhibit 4.7-1-A: Department of Wastewater Treatment Operations

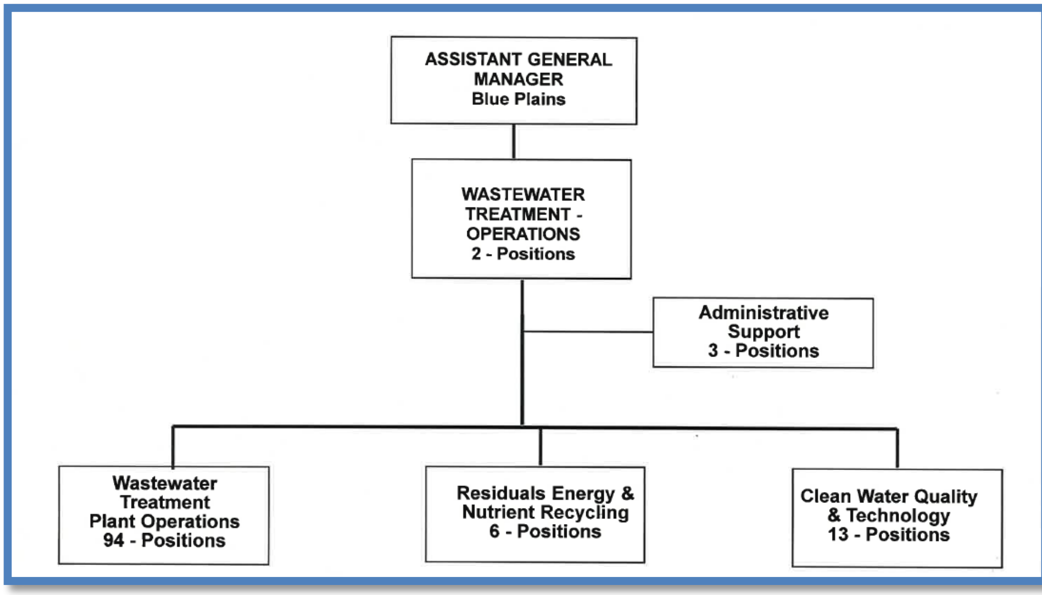
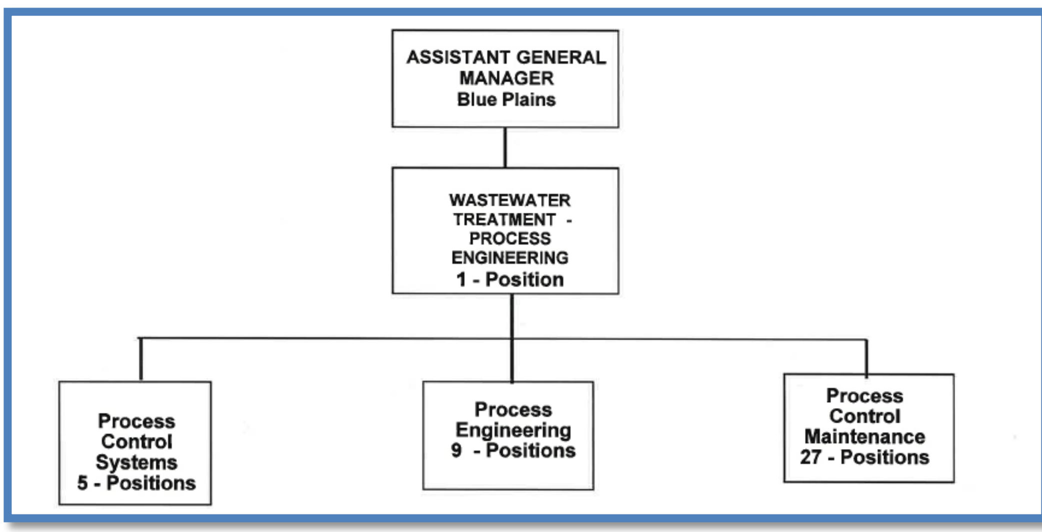


Exhibit 4.7-1-B: Department of Wastewater Treatment Operations



Wastewater Treatment Plant Operations

The Wastewater Treatment Plant Operations Branch is responsible for treatment of influent wastewater; removing pollutants and meeting NPDES permit requirements; and biosolids conditioning, dewatering and stabilization.

Residuals Energy & Nutrient Recycling

This section is responsible for the engineering functions related to storage, loading, hauling and utilization/disposal of biosolids at Blue Plains.

Clean Water Quality & Technology

This group is responsible to perform physical, chemical and biological analysis of wastewater and biosolids which are used for process control and permit reporting; monitors industrial discharges; engages in treatment process research and development.

Process Control Systems

The Process Control System is responsible for the PCS. In this capacity, they Maintain and trouble shoot the PCS while providing design and construction interfaces.

Process Engineering

The Process Engineering branch is responsible for wastewater and biosolids treatment, process control support, plant automation and design support, and planning and process optimization.

Process Control Maintenance

The Process Control Maintenance branch coordinate all activities for corrective and preventive maintenance for the electronic process control systems, flow measurement, metering and recording equipment for BPAWTP.

General Foremen and Process Engineering

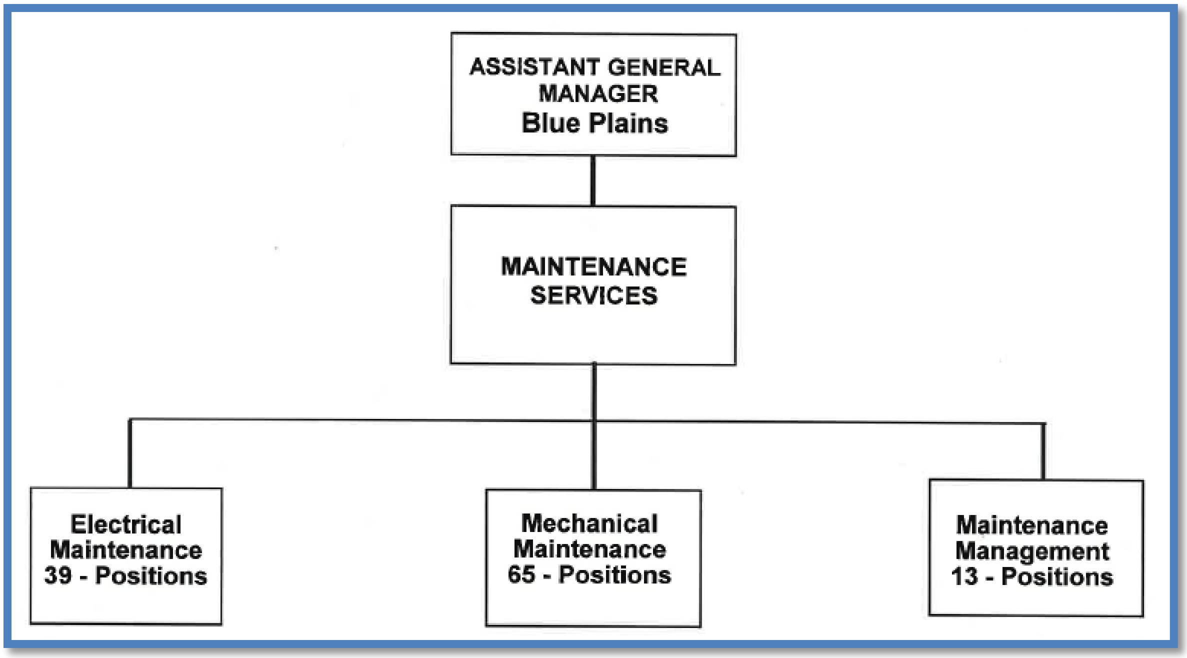
In addition to above-mentioned branches, there is a group of general foremen responsible for plant shift supervision.

The Authority's operating budget for FY 2014 has authorized a total of 118 and 42 positions for wastewater treatment operations and process engineering groups respectively. This represents an addition of 15 new positions since FY2013. JMT endorses the Blue Horizon 2020 Strategic Plan goal of 100% certification for operators.

4.7.2 Maintenance Services

Maintenance Services is responsible for maintaining process equipment and facilities at BPAWTP. There are four branches in Maintenance Services which are, Electrical Maintenance, Mechanical Maintenance, Maintenance Management, and Instrumentation. **Exhibit 4.7-2** illustrates the current maintenance services organization.

Exhibit 4.7-2: Department of Maintenance Services



Electrical Maintenance

Electrical Maintenance responsibilities are to maintain electrical process control systems, equipment, and components; operate and maintain electrical power distribution systems from 69kv to 5kv electrical control systems for all process equipment and facilities; inspect and maintain cranes.

Mechanical Maintenance

Mechanical Maintenance maintains process systems and equipment and plan, schedule, and performs condition monitoring for all process equipment.

Maintenance Management

Maintenance Management branch plan and coordinate corrective, preventive, and predictive maintenance; provide planning and administrative support to maintenance; coordinate work with operations and engineering.

Instrumentation

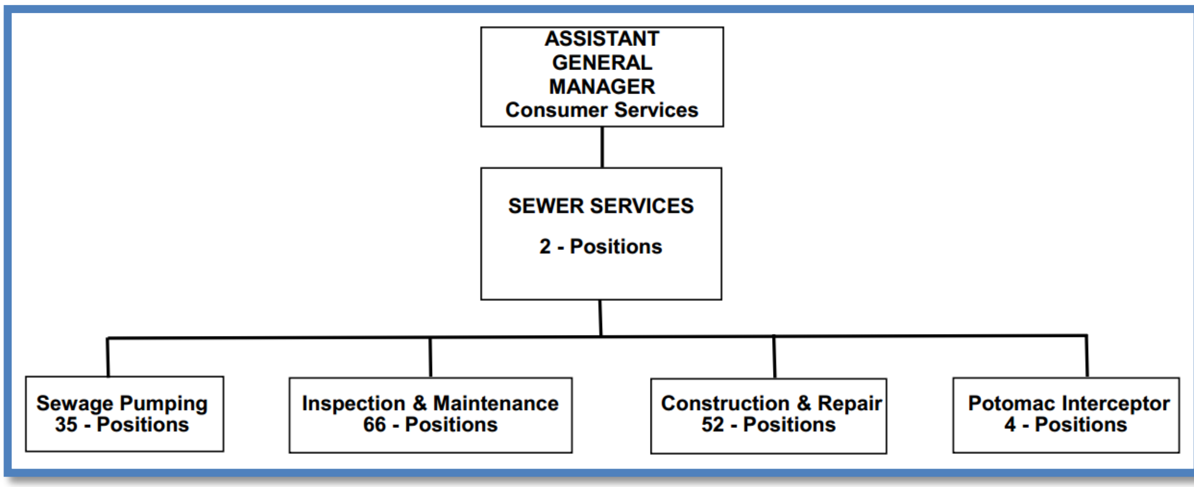
The Instrumentation branch maintains electronic process control systems, flow measurement, metering and recording equipment.

The Authority's operating budget for FY 2013 has authorized a total of 139 positions for wastewater treatment operations, the same number of positions as the FY 2012 budget.

4.7.3 Sewer Systems

The Department of Sewer Systems operate and maintain the sewer collection system, pump stations and process control center; and operate all wet weather monitoring systems. The department is divided into four divisions: Sewer Pumping Stations, Inspection & Maintenance, Construction & Repair and Potomac Interceptor. **Exhibit 4.7-3** illustrates the Department's organization

Exhibit 4.7-3: Department of Sewer Services



Sewer Pumping
The Sewer Pumping branch operate the sanitary and stormwater pumping stations and combined sewer system controls for the swirl concentrator and fabridams.

Inspection & Maintenance
The Inspection & Maintenance branch inspect public sewers and sewer laterals, operate and maintain sewer regulator structures, and clean catch basins.

Construction & Repair
The Construction & Repair branch install and repair sewer mains, replace and repair sewer laterals, manage CIP and construction contracts, install and repair catch basins, manage and inspect in-house projects; and coordinate work orders.

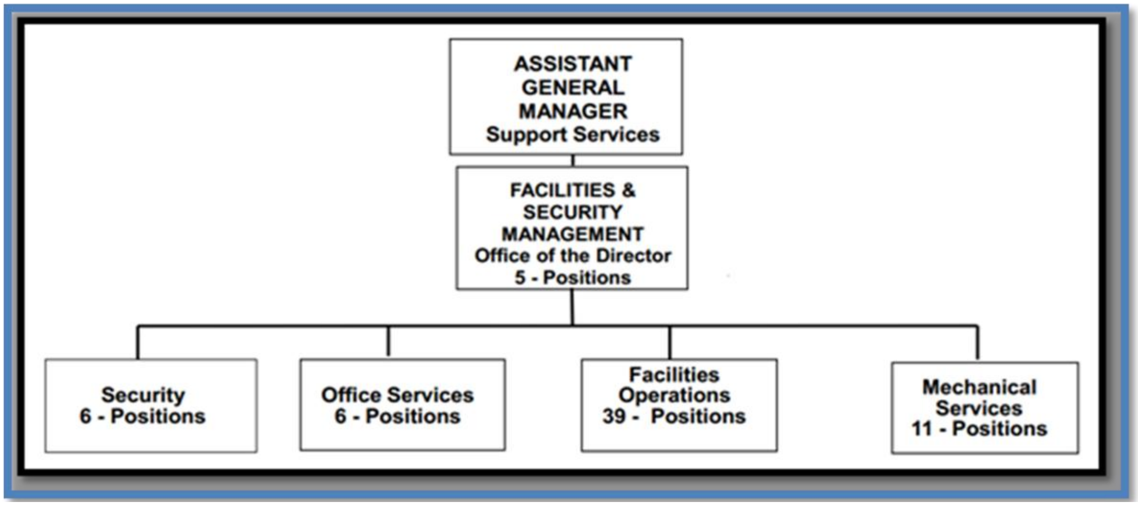
Potomac Interceptor
The Potomac Interceptor branch is responsibilities are to operate and maintain the Potomac Interceptor Sewer, flow meters, and odor control facilities; perform manhole inspections; and manage Right-of-Way maintenance and surveillance.

The Authority's operating budget for FY 2013 has authorized a total of 159 positions for sewer services the same number of positions as the FY 2012 budget. Based on interviews, JMT did not reveal any identified staffing deficiencies.

4.7.4 Security & Facilities

Since the last report, Security has been merged with Facilities to create the Securities and Facilities department. This department reports to the Assistant General Manager of Support Services. The new structure allows for better protection of facilities and assets. The Security and facilities branch has four program units: Security, Office Services, Facilities Operations, and Mechanical Services. **Exhibit 4.7-4** illustrates the Safety and Security Department Organization.

Exhibit 4.7-4: Facilities and Security Department



Security

The Security branch provides physical security and responds to safety and security emergencies; investigates theft incidents, illegal entries and other security concerns; and oversees the contracted guard services.

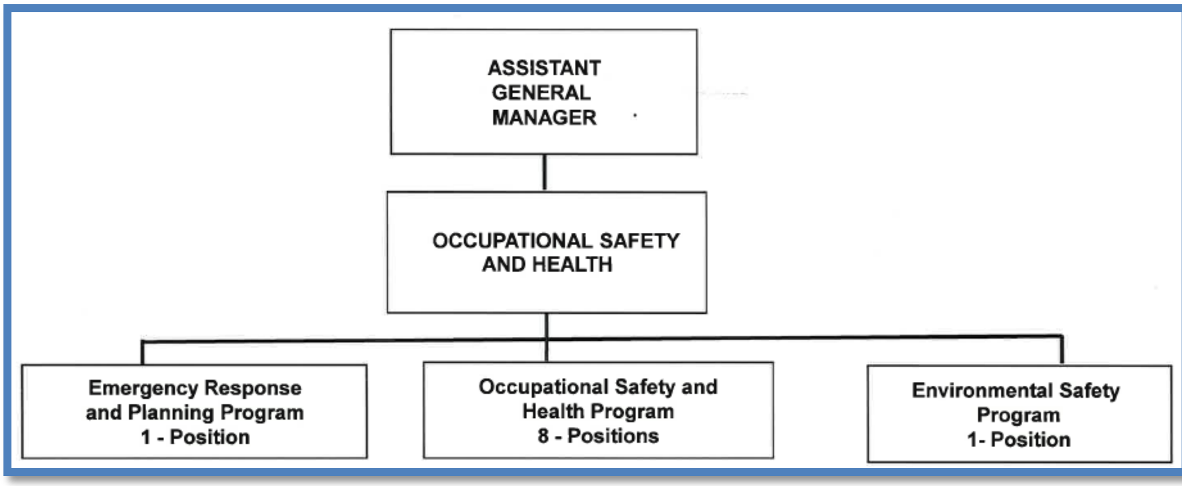
The events of September 11, 2001, forever changed the security requirements for water and wastewater treatment plants. As critical civil infrastructure, they are considered possible targets for sabotage. If physical disruption or sabotage to the potable drinking water and/or sewer system occurs, the local population could be put at tremendous risk. Additionally, many of the chemicals used in the treatment processes are extremely hazardous and could be used maliciously.

The Authority responded to the need for greater plant security. Immediately following the events of September 11, the Authority constructed a new security facility, contracted additional security personnel and adopted measures to control access to the Blue Plains. All persons entering the plant are now subject to security clearance at the outer gate as well as clearance to enter specific parts of the plant. The Authority also has plans to improve its electronic surveillance at the plant. It was noted that at this point it may be possible for persons to gain unauthorized entry from the plant's river frontage.

4.7.5 Occupational Health and Safety

Since the last report, Occupational Health and Safety was established as its own department. As a standalone department, it is expected that a greater focus can be placed on the health and safety of Authority employees and customers. The Occupational Safety and Health department has three branches, Emergency Response and Planning, Occupational Safety and Health, and Environmental Safety. **Exhibit 4.7-5** shows the organization chart for the Occupational Health and Safety department.

Exhibit 4.7-5: Department of Occupational Safety and Health



Emergency Response and Planning Program

The Emergency Response and Planning branch coordinates the emergency responses and planning; the implementation of National Incident Management System; and DC Water response activities with local and regional authorities. This branch also develops guidelines for training and conducting drills and updating emergency response plans.

Occupational Safety and Health Program

The Occupational Safety and Health Program maintains an Accident Prevention Safety and Safety Awareness Program; conducts safety inspections; develops and analyzes safety statistics; maintains safety training guidelines; and provides safety oversight of the Comprehensive Construction Safety Program and Rolling Owner controlled Insurance Program.

Environmental Safety Program

The Environmental Safety Program provide oversight and management of the Hazardous Waste Program and aboveground and underground storage tanks; create safety reports to regulatory agencies and ensure compliance with environmental safety regulations.

The Authority's operating budget for FY 2013 has authorized a total of 10 positions for the department of Occupational Health and Safety, 2 positions more than the FY2012 budget. JMT believes the staffing is adequate based on the observed safety program and practices in place.

4.7.6 Wastewater Operations Summary

In general, plant operations and maintenance are consistent with meeting the mission of treating wastewater to ensure compliance with the Clean Water Act as specified in the Authority's NPDES permit. The Department of Wastewater Treatment is organized to allocate functional responsibility over highly specialized activities to appropriately trained personnel, while providing opportunities for cross-training and career development. Maintenance Services boasts a fairly high level of internal expertise to address many of the routine maintenance requirements of a wastewater treatment plant, though housekeeping could be improved. The stated intention of reducing outsourcing of various aspects of maintenance should also result in a strengthening of the in-house expertise. Security has taken on greater prominence on the Authority's agenda and the expectation is that plant security will continue to improve.

Section 5 DC Clean Rivers

5.1 OVERVIEW

DC Water entered into a Consent Decree with the EPA in March 2005 for the Combined Sewer Overflow Long-term Control Plan. The objective of the 2005 Consent Decree is to ensure DC Water's compliance with the Clean Water Act, all applicable federal and local regulations, the terms of the Authority's NPDES permit, and meet the 1994 EPA CSO objectives. To meet these objectives the Consent Decree contains compliance requirements, milestone and completion timelines; and reporting requirements. The requirements included in the consent decree and their current status are summarized below in **Exhibit 5-1**. The Authority has met the majority of the requirements for implementation deadlines and improving facilities.

In addition, the Chesapeake Bay has been plagued by pollution, low dissolved oxygen and poor water quality. CSO events from DC Water's combined sewer system are one of the many components that contribute to these problems. When a CSO event occurs, harmful bacteria and pollutions are released into the water system. The pollutants include floatable debris, BOD and Nutrients loads which can negatively impact the river, decreasing the dissolved oxygen content, raising turbidity, and lowering the water quality. Reduced dissolved Oxygen in the Bay suffocates fish and crabs, while turbidity impedes light transmittance making it difficult for underwater grasses to grow; a food staple, oxygen source and habitat for many of the organisms living in the Bay. The aesthetics of the river are also affected by floating debris and algae blooms cause by the nutrient loads.

DC Water (along with many other wastewater agencies within the Chesapeake Bay region) are required to improve wastewater treatment facilities and remediate combined wastewater system overflows to prevent BOD and nutrient rich wastewater from entering tributaries of the Bay. The costs expended by DC Water (and other nutrient contributors) prevent these nutrients from entering the Bay, which improves the vitality of the Bay as a sustainable recreational, environmental and fisheries asset.

Exhibit 5-1: 2005 Consent Decree Requirements

Consent Decree Item	Requirements	Status
System Wide		
Low Impact Development – Retrofit (LID-R)	Implement LID-R projects on WASA facilities where feasible.	In progress
Anacostia River		
Rehabilitate Pumping Stations	Rehabilitate existing pumping stations as follows: • Interim improvements at Main and 'O' Street Pumping Stations • Rehabilitate Main Pumping Station to 240 mgd firm sanitary capacity. . • Rehabilitate Eastside and 'O' Street Pumping stations to 45 mgd firm sanitary capacity	Complete
Storage Tunnel from Poplar Point to Northeast Boundary Outfall	49 million gallon storage tunnel between Poplar Point and Northeast Boundary.	In progress
Storage/Conveyance Tunnel Parallel to Northeast Boundary Sewer	77 million gallon storage/conveyance tunnel parallel to the Northeast Boundary Sewer. Also includes side tunnels from main tunnel along West Virginia and Mt. Olivet Avenues, NE and Rhode Island and 4th St NE to relieve flooding.	In progress
Outfall Consolidation	Consolidate the following CSOs in the Anacostia Marina area: CSO 016, 017 and 018	In progress
Separate CSO 006	Separate this CSO in the Fort Stanton Drainage Area	Complete
Ft Stanton Interceptor	Pipeline from Fort Stanton to Poplar Point to convey CSO 005, 006 and 007 on the east side of the Anacostia to the storage tunnel.	In progress
Rock Creek		
Separate Luzon Valley	Separation was completed in 2002	Complete
Separation	Separate CSOs 031, 037, 053, and 058.	Complete
Monitoring at CSO 033, 036, 047 and 057	Conduct monitoring to confirm prediction of overflows. If overflows confirmed, then perform the following: • Regulator Improvements: Improve regulators for CSO 033, 036, 047 and 057 • Connection to Potomac Storage Tunnel: Relieve Rock Creek Main Interceptor to proposed Potomac Storage Tunnel when it is constructed	In progress
Storage Tunnel for Piney Branch (CSO 049)	9.5 million gallon storage tunnel	Not started
Potomac River		
Rehabilitate Potomac Pumping Station	Rehabilitate station to firm 460 mgd pumping capacity	In progress
Outfall Consolidation	Consolidate CSOs 023 through 028 in the Georgetown Waterfront Area.	Not started
Potomac Storage Tunnel	58 million gallon storage tunnel from Georgetown to Potomac Pumping Station. Includes tunnel dewatering pumping station.	Not started
Blue Plains Wastewater Treatment Plant		
Excess Flow Treatment Improvements	Four new primary clarifiers, improvements to excess flow treatment control and operations	Replaced by ECF

Due to the nature of the Consent Decree's objectives, as NPDS permits and regulations develop and change, so does the requirements of the Consent Decree. The bulk of the original requirements of the Consent Decree are completed or in a state of being satisfied. However, since 2005, the requirements have been modified. On April 5, 2007, the EPA issued a modification to DC Water's NPDES permit. In addition to meeting the new effluent limit for total nitrogen, the existing NPDES Permit requirements for treating wet weather flows at Blue Plains were established as part of DC Water's CSO-LTCP for the combined sewer system. On April 13, 2007, DC Water submitted a Draft TN/WW Plan to EPA. The purpose of the report was to present DC Water's approach to meet the new total nitrogen effluent limit and to comply with its existing permit conditions to treat wet weather flows. After submittal of the draft plan, a public participation program was conducted to solicit comments on the plan. The final report, dated October 2007, was DC Water's Final TN/WW Plan, which included a summary of the public participation program and responses to comments.

5.2 PENDING CONSENT DECREE MODIFICATIONS

There are modifications proposed by DC Water for the TN/WW Plan associated with the advancement of DC Water's Green Infrastructure initiative. In addition, other modifications are required for consistency with the NPDES permit and the aforementioned 2007 Wet Weather Plan, which was developed to address the changes to the Total Nitrogen Limit. There are also changes that are necessary as projects become better defined through the detailed design phase. Modifications in the latter two categories have largely been agreed to by EPA, according to DC Clean Rivers (DCCR) staff, and many have been or are in the process of implementation. DC Water continues to provide status reporting as each quarter required by the existing Consent Decree and is in compliance with those requirements pending final approval of the modifications. In general, the proposed modifications fall into three categories:

- Green Infrastructure
- The Nitrogen limit
- Other modifications

5.2.2 Total Nitrogen/Wet Weather Plan (TN/WW)

DC Water is required to include compliance schedules for attainment of total nitrogen effluent limits in its NPDES Permit within the TN/WW Plan with a proposal and schedule to attain the standards and optimize operations at Blue Plains. The Anacostia River Plan (approved by EPA) implements the wet weather aspects of the TN/Wet Weather Plan. This included reconfiguring and enlarging the Anacostia River Tunnels and related facilities including:

- Extending the Blue Plains Tunnel
- Moving the Tunnel Dewatering Pump Station to Blue Plains – the new terminal point of the tunnel system.
- Constructing an Enhanced Clarification Facility (ECF) in lieu of Excess Flow Treatment Facility

JMT concurs with DC Water's approach to TN/WW. It's outside of JMT's scope to assess every TN/WW engineering project detail, calculation and post-construction monitoring that has not occurred; however, JMT is supportive of DC Water's goal to be an industry leader in wastewater treatment and to capture and treat 96% of combined wastewater. DC Water's CIP planning process allows for the reassessment of priorities and funding needs on an annual basis and the flexibility to reprogram projects. As such, DC Water is currently taking advantage of a less costly construction market by exceeding the EPA Guideline of 85% capture and treatment rate, which presumably will lessen the cost impact of future regulatory actions.

Exhibit 5-2 includes a full list and description of the changes.

Exhibit 5-2: Affected Facilities and Intended Modifications

Affected Facility	Current Requirement	Proposed Modification	Reason
Tunnel	Tunnels ends at Poplar Point	Extend to Blue Plains	Additional storage to reduce plant peak flow
Dewatering PS	Located at Poplar Point	Location changed to Blue Plains	New terminal location for tunnel system
Treatment	Excess Flow Treatment at Poplar Point	ECF at Blue Plains	Optimize operations at Blue Plains

5.2.3 Additional Consent Decree Modifications

In the course of planning and designing the selected projects, DC Water concluded that several of the projects could be reconfigured to avoid conflicts with other projects, to accommodate third party requirements, and to allow more efficient construction without affecting the Consent Decree schedule for these projects. DC Water realized that planning and implementation was an iterative process and incorporated the following changes to provide more efficient and cost effective designs.These are listed and described in **Exhibit 5-3** as furnished by DCCR staff:

Exhibit 5-3: Additional Modifications

<table>
<tr><th>Current Requirement</th><th>Modification</th><th>Reason</th></tr>
<tr><td colspan="3">CSO 05,07</td></tr>
<tr><td>Conveyed to the tunnel system via the new Fort Stanton interceptor.</td><td>Conveyed directly to the tunnel</td><td>Determined during facility planning to accomplish same objective more efficiently</td></tr>
<tr><td colspan="3">Swirl Facility</td></tr>
<tr><td>To be demolished in 2025</td><td>Demolish in 2018</td><td>Not needed after 2018 and would allow work to be closed out early on NPS property</td></tr>
<tr><td colspan="3">North East Boundary Tunnel (NEBT) System</td></tr>
<tr><td>NEBT
• Award design 3/23/15
• Award construction 3/23/18
• Place in operation 3/23/25</td><td rowspan="2">Consider as one tunnel system with one set of dates
• Award design 1/2/16
• Award construction 3/23/20
• Place in operation 3/23/25</td><td rowspan="2">No reason to separate. Can combine within original consent decree time frame</td></tr>
<tr><td>NEB Side Tunnels
• Award design 3/23/19
• Award Construction 3/23/22
• Place in operation 3/23/25</td></tr>
<tr><td colspan="3">CSO 15,16,17,18</td></tr>
<tr><td>Consolidate and eliminate</td><td>Include CSO15 but not</td><td>Leave option to use these outfalls</td></tr>
</table>

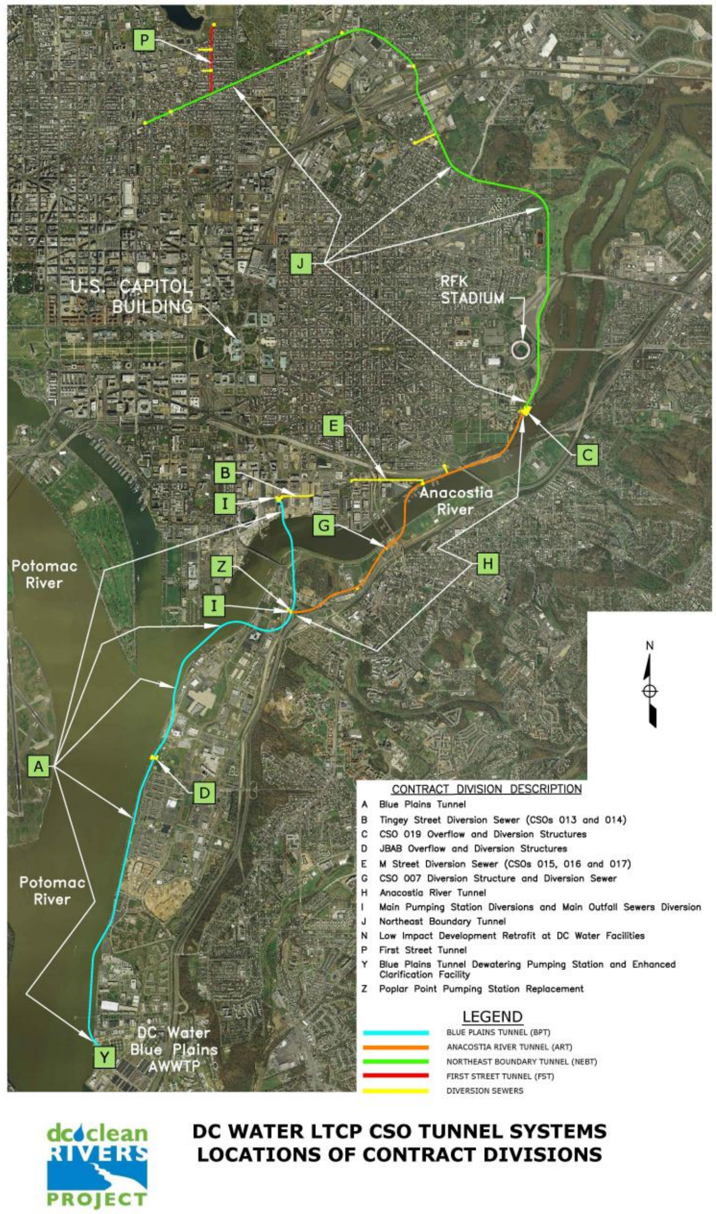
CSOs 16,17,18	completely eliminate CSOs	on rare occasions where there is a need to isolate tunnel facilities for service or repair
CSO 24,25,26, 27, 28		
Consolidate and eliminate these CSOs	Not completely eliminate these CSOs	Leave option to use these outfalls on rare occasions where there is a need to isolate tunnel facilities for service or repair
Warning Lights		
• Color A displayed as long as an overflow is occurring • Color B displayed for 24 hours after overflow has ceased • Color C displayed for 72 hours after overflow has ceased	• Color A displayed as long as an overflow is occurring • Color B displayed for 24 hours after overflow has ceased • Color C not used	To match current system installed in 2007 as part of the Third Party Consent Decree that works well and avoid ambiguity
There are several other changes to the wording to reflect work that is completed as opposed to required and to state milestones as actual dates as opposed to "years from entry"		

JMT has evaluated the modifications shown in **Exhibits 5-2** and **5-3** and concurs with each of them. These changes are prudent from construction, cost and operation and maintenance standpoints with a relatively low risk of environmental damage. Regulators may have concerns with keeping CSOs operational, however, access and flexibility provided by working CSOs is essential for safe and efficient repairs and maintain in the tunnels.

5.3 PROJECTS

Photo 5-2: Construction of the Blue Plains Tunnel Shaft *(Photo Taken March 1, 2013)* DC Water Clean Rivers projects are grouped into four CIP designations: CY – Anacostia Projects, CZ – Potomac Projects, DZ – Rock Creek Tunnels, and LJ - Green Infrastructure, which total $2.6 billion dollars. These projects will include 14 miles of tunnels with a combined storage capacity of 184 MG, two new tunnel dewatering pumping stations, various diversion structures and sewers to collect CSO overflows. Green Infrastructure projects will reduce can the amount of storm water entering the combined sewer system in the first place. Completion of these projects is expected in 2025 with significant CSO event reduction. These projects are broken down further into Divisions, as shown in **Exhibit 5-4**:

Exhibit 5-4: DC Clean Rivers Project Divisions[1]



5.3.1 Blue Plains Tunnel (Division A)

The Blue Plains Tunnel (BPT) is the first major tunnel segment of DCCR's Long Term Control Plan. When completed, the BPT will have 24,300 linear feet of 23 foot diameter tunnel that begins at Blue Plains and terminates at a shaft located at Main St. and O St. Pump Station (55-feet deep). The tunnel will wind its way north along the Anacostia River and Potomac Rivers from its discharge point 132-feet

[1] Obtained from I A/E Outreach Informational Meeting Handout

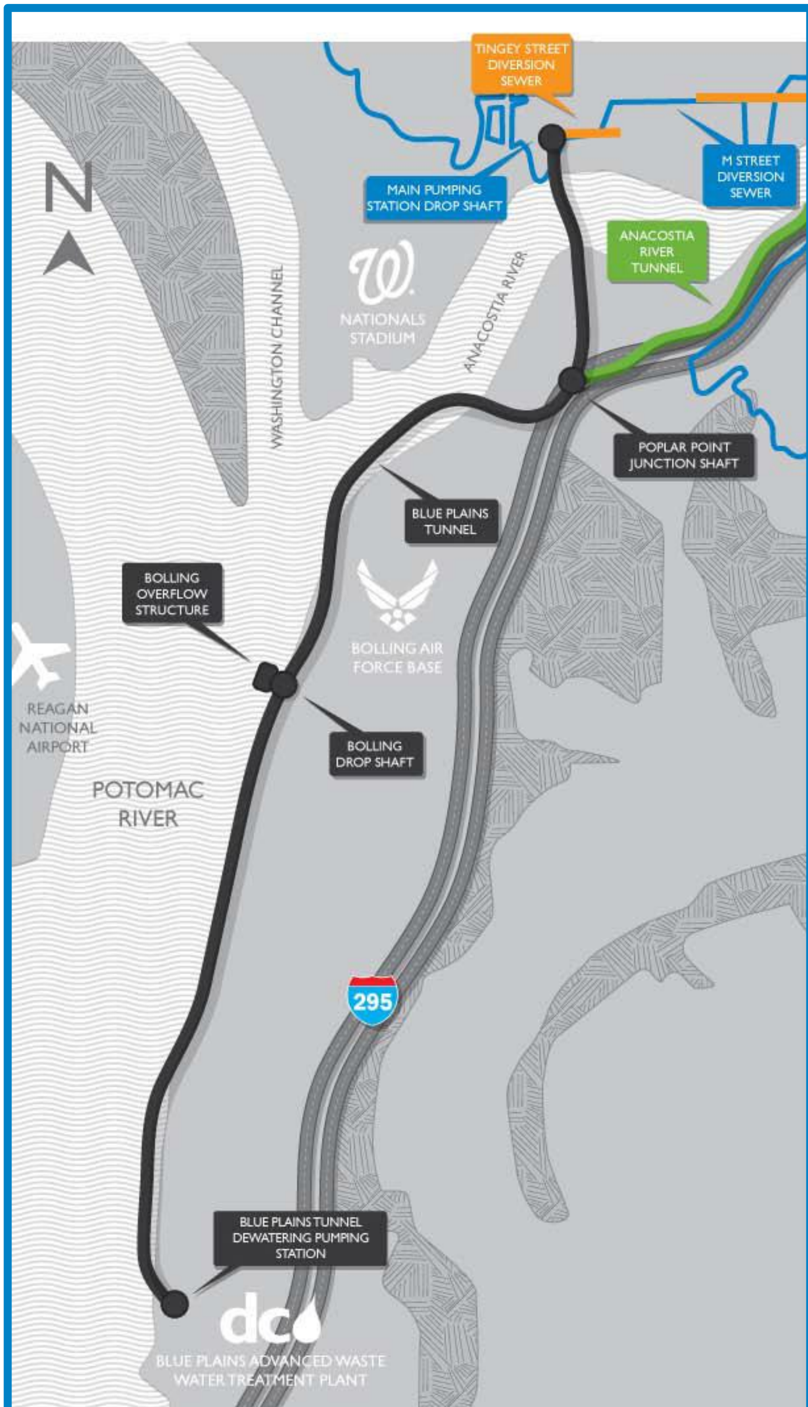
below Blue Plains Advanced Wastewater Treatment Plant. The alignment of the BPT is shown in **Exhibit 5-5** while **Photo 5-1** shows the tunnel boring machine used to dig the 23 foot tunnel. The is Not the BPT

Part of the BPT was added to store excess combined storm and sanitary wastewater during and following a wet weather event and prevents these excessive flows from inhibiting treatment at the treatment plant. During wet weather and when the tunnel is filling and treatment plant has capacity, a large dewatering pump station located in the Blue Plains Tunnel terminal shaft elevates the combined wastewater from the tunnel to the surface. The combined wastewater then passes through bar screens that remove floatables and a degritter before entering the wastewater treatment processes.

Because the BPAWTP has a limited complete treatment capacity of about 511MGD, storing excess flows allows for the eventual full treatment of the stored volume once the wet weather conditions subside except when the tunnel capacity is exceeded. Effluent water quality is improved by this method as more flow can pass through complete barrage of treatment rather than receiving partial treatment before being discharged into the river. This also reduces the possibility of CSO events occurring as more flow can leave the combined sewer collection system. The overall result is les pollution being discharged to District waters..

Photo 5-1: Tunnel Boring Machine (TBM) at BPAWTP ***(Photo Taken March 1, 2013)***

Exhibit 5-5: Blue Plains Tunnel ***(Obtained from DC Water Project Information Sheet)***



As shown in **Exhibit 5-6**, the BPT tunnel passes through two intermediate shafts .

1. **Poplar Point Junction Chamber and Shaft** - this structure is a confluence structure for the Blue Plains Tunnel and Anacostia River Tunnel. This structure also permits local sanitary and storm water to overflow into the BPT via a drop shaft.
2. **BAFB Overflow and Potomac Outfall Sewer Diversion (Division D)** - this structure located at Bolling Air Force Base (BAFB) is an access point for the BPT and allows combined wastewater to overflow into the Anacostia River when the BPT isexceeded. This is predicted to occur twice in an average rainfall year..

The BPT and all four shaft structures are currently under construction. **Photo 5-2** shows progress on the Blue Plains Shaft which will become the primary access to the tunnel system. **Exhibit 5-6** is an artist's rendering of the retrofitted Blue Plains Shaft showing dewatering pump configuration and bar screens.

Photo 5-2: Construction of the Blue Plains Tunnel Shaft ***(Photo Taken March 1, 2013)***

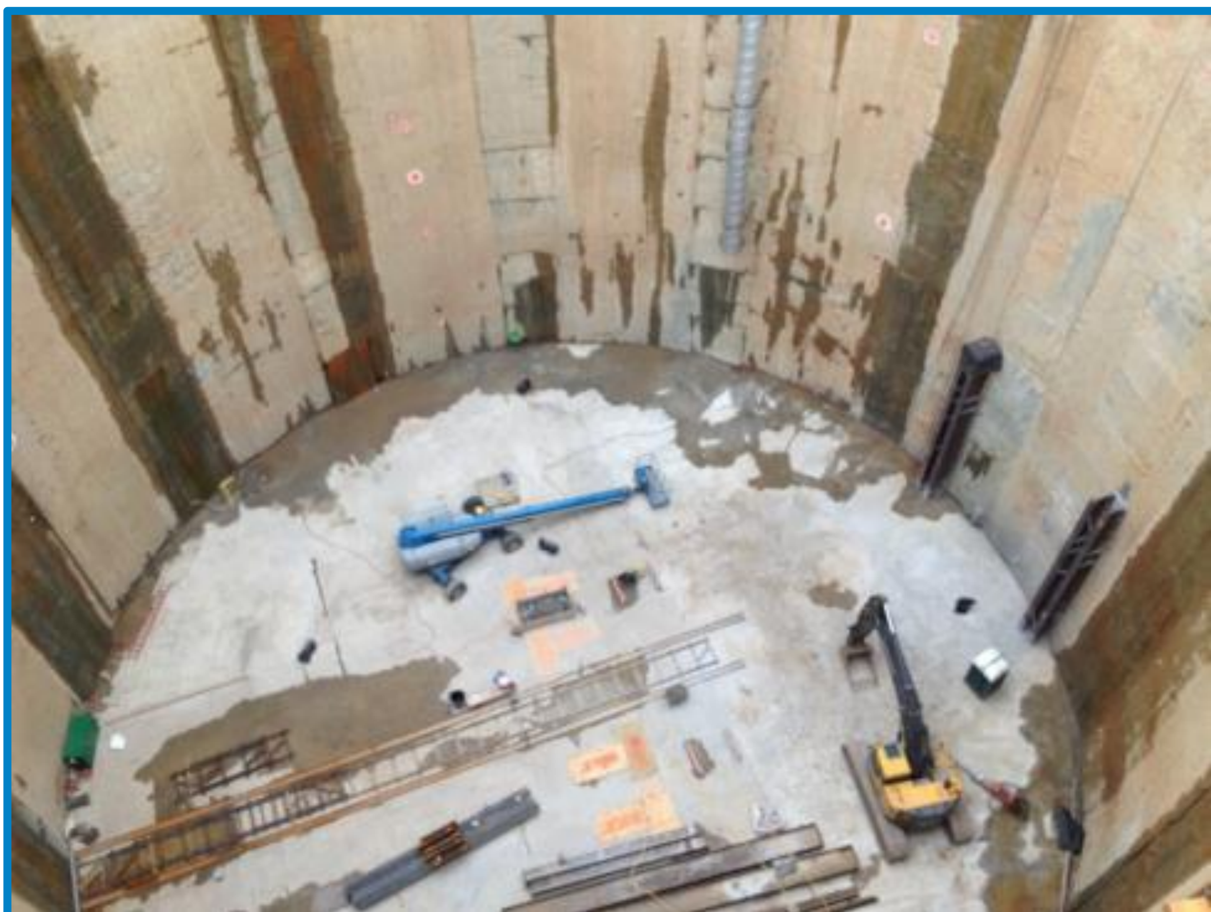
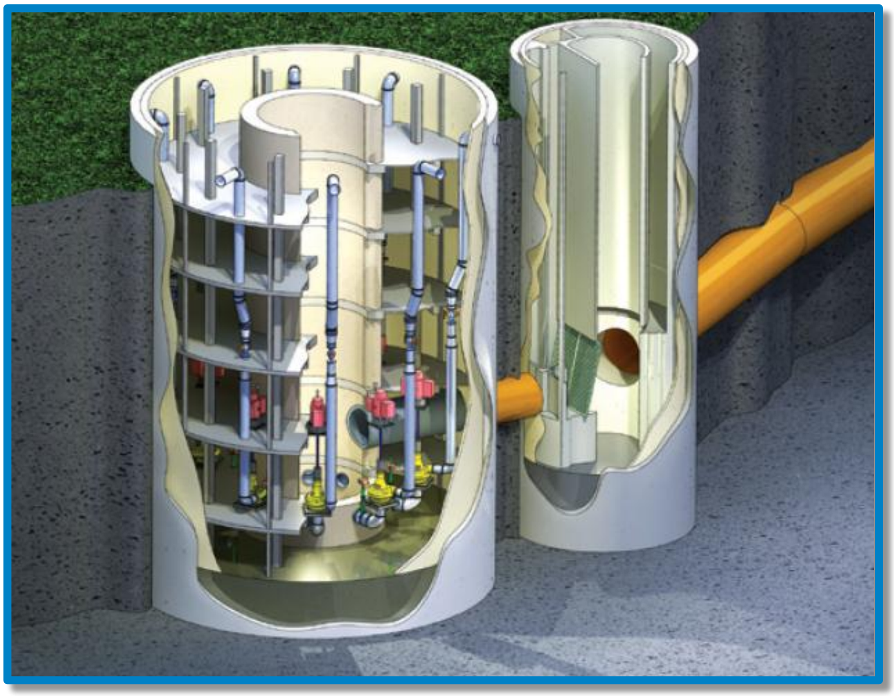


Exhibit 5-6: Artist Rendering of Blue Plains Tunnel Pump Station and Screens
(Obtained from DCCR Quarterly Report)



Condition Assessment

These projects are currently under construction and are considered new facilities. An inspection was conducted of the construction sites to ascertain progress and determine if there are any observable conditions that are detrimental to achieving the expected results. The inspection of these sites focused on safety practices as well as cost and schedule in relation to plan. **Exhibit 5-7** describes the findings.

Exhibit 5-7: Results of Blue Plains Tunnel Facility Site Inspections

Blue Plains Tunnel Facility	Recommended Improvements and Comments
BPT Dewatering Pump Station and Drop Shafts	• Inspection was conducted March 1, 2013 • Safety program appeared to be good at the time of the inspection; however, we cannot guarantee the effectiveness of the safety program beyond that time period. • No observable conditions detrimental to the project. • The approximately 400 foot long TBM and shaft gantry crane were being assembled the day of the inspection. • A schedule delay was incurred when a slurry panel seal failed which allowed the possibility of betonite to mix with the concrete compromising structural integrity of the concrete. A reasonable recovery schedule is in effect to get the project back on schedule. • A higher than anticipated concrete compressive strength was used on the slurry wall which required additional resources for localized demolition in order to maintain schedule. Presented to us as a minor cost impact; however, the schedule impact was more noticeable delaying TBM insertion.
Bolling Air Force Base Drop Shaft and Overflow Structure	• Due to security clearance requirements, an inspection of these facilities could not be conducted. • Construction of this facility is also on-time and on-budget.
Poplar Point Drop Shaft and Junction Chamber	• Inspection was conducted March 1, 2013 • Shaft was under construction; approximately 15-feet in depth. • Steel sheet piles were being driven for construction of the surge facility. • A sheet pile structure and temporary bridge was installed for traffic on ramp from DC 295 to the Pennsylvania Ave bridge. • Work has been ongoing on this site for 18 months and construction is progressing on schedule.

Based on the inspection of the BPT facilities currently under construction and interviews conducted with DC Water staff, JMT has concluded that the project is on schedule and on target with the cost estimate thus far. The contractor was described as being a “good steward” of its costs and schedule. For example, DC Water and the contractor have revised the plan of extracting each “car” of the TBM “train” from pulling back to the Blue Plains Shaft, and instead, pulling back to the Poplar Point Shaft and extracting the “cars” at that location.

Other feedback received from DC Water staff included:

- A great working relationship exists with Bolling Air Force Base with regard to security clearances and the Department of Public Works with regard to permitting.
- Large shaft excavations have not resulted in detectable settlement of adjacent structures and roadways to date.

Some challenges observed by DC Water staff:

- Environmental permitting rules are in constant flux.
- Federal Aviation Requirements on crane height has been limiting but has not had a negative effect on contractor's performance to date.

The contractor's safety training program is required to be comprehensive. When the inspection was conducted, there were no reportable accidents resulting in loss time. Visitors, including inspectors, were given a safety briefing before given access to the site. Features of the safety training program include:

- Extensive safety training for new employees.
- Morning stretch and flex.
- Heavy equipment hazard training.
- JHA – Job Hazard Analysis (conducted when new, unfamiliar activities are being conducted)
- Emergency Contact Cards and Meeting Locations.
- Near Miss Reporting
- Confined space training.
- Close coordination and project familiarization with DC Fire and Rescue.
- Documented safety management structure.

Failure to comply with safety procedures will result in a safety citation. Continuous improvement of the safety program is the responsibility of the Contractor's Safety Committee; a very important quality for a safety program dedicated to minimizing injury and financial losses.

5.3.2 Anacostia River Tunnel (Division H)

The Anacostia River Tunnel (ART) is another large tunnel of planned for the D.C. Clean Rivers Long Term Control Plan. When completed, the ART will have 12,500 linear feet of 23 foot diameter tunnel that starts at the drop shafts (north and south) located at CSO 019 (adjacent to RFK Stadium) and it winds its way south along the Anacostia River to its discharge point at the Blue Plains Tunnel - Poplar Point Drop Junction Chamber. The ART will be constructed approximately 100-feet below the surface.

Just like the BPT, the ART stores excess combined storm and sanitary wastewater during and following a wet weather event preventing these excessive flows from inhibiting treatment at the treatment plant and protecting the Anacostia River against pollution from CSO events. The ART is dewatered via the BPT pump station at the Blue Plains Advanced Wastewater Treatment Plant.

The APT tunnel passes through four intermediate drop shafts (other than the two aforementioned terminal drop shafts) that convey wet weather overflows from surface CSO combined sewer pipes down to the ART. These shafts may also serve as an emergency overflow to the Anacostia River in rare storm event when the ART and BPT are overwhelmed.

- CSO 018 Drop Shaft
- CSO 007 Drop Shaft
- M Street Diversion Sewer
- CSO 005 Drop Shaft

The BPT and all four shaft structures are currently under construction. **Photo 5-3** shows the Poplar Point BPT/ART Shaft showing construction progress. **Exhibit 5-8** shows the alignment of the ART from the Poplar Point Shaft northeast along the Anacostia River with the purpose to intercept CSO's adjacent to the tunnel.

Photo 5-3: Construction on the Poplar Point BPT/ART Shaft *(Photo Taken March 1, 2013)*

Exhibit 5-8: Anacostia River Tunnel ***(Obtained from DC Water Project Information Sheet)***

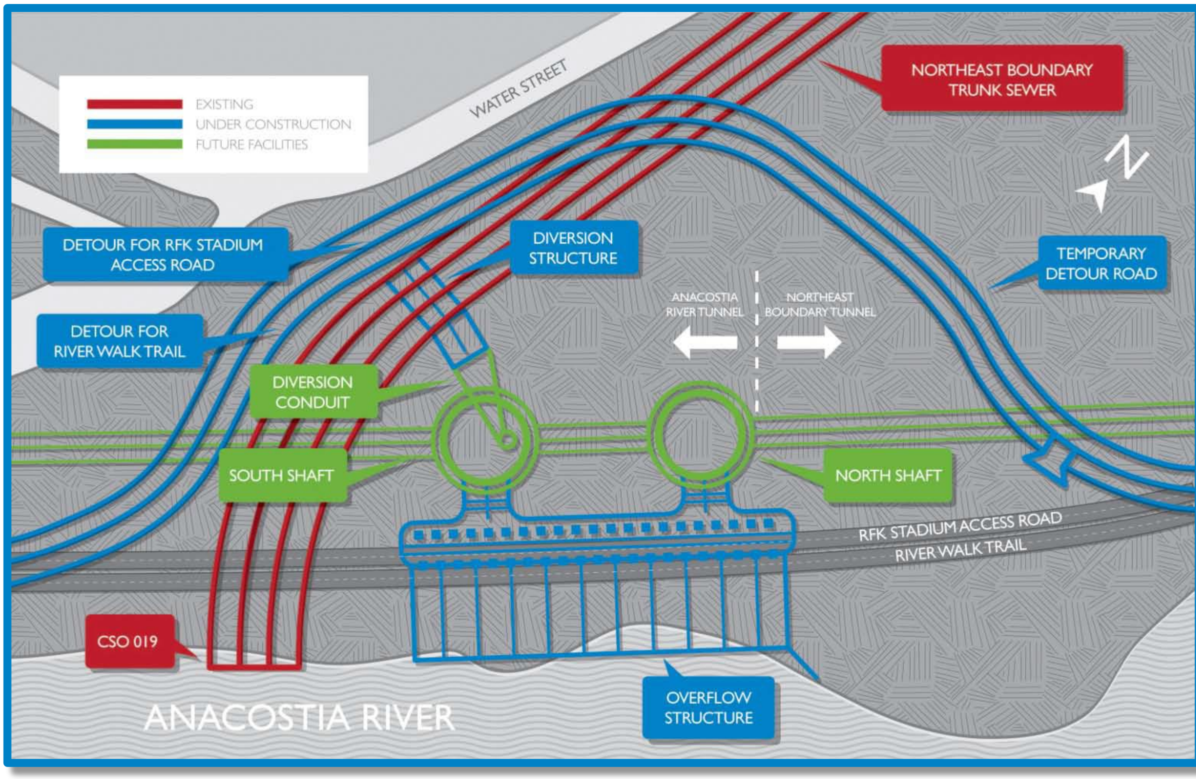
Condition Assessment

Inspections of the ART projects did not take place as construction is scheduled to commence November 2013.

5.3.3 CSO 019 Overflow and Diversion Structures (Division C)

The CSO 019 Overflow and Diversion Structures project are intended to divert CSOs out of the existing Northeast Boundary Trunk Sewer and convey it to the Anacostia River Tunnel. This project includes the construction of a new CSO 019 overflow structure which will provide flood relief to the northeast boundary area and discharge emergency CSOs to the Anacostia River. Although a new CSO structure will be constructed, it will "go active" far less often than the existing structure. The reconfiguration of the CSO structure will divert the majority of combined wastewater into the Anacostia River Tunnel for storage and treatment, while simultaneously protecting areas upstream from periodic flooding. **Exhibit 5-9** shows the phased construction of improvements at CSO 019.

Exhibit 5-9: CSO 019 Projects *(Obtained from DC Water Project Information Sheet)*



Condition Assessment

The CSO 019 Overflow and Diversion Structures are currently under construction and are considered new facilities. However, an inspection was conducted of the construction sites to ascertain progress and determine if there are any observable detrimental conditions. The inspection of these sites focused on safety practices and cost and schedule in relation to plan. **Photo 5-4** shows the state of construction at the CSO 019 site. **Exhibit 5-10** details the inspection observations and recommendations.

Photo 5-4: Construction of CSO 019 Overflow Structure *(Photo Taken March 1, 2013)*

Exhibit 5-10: Results of CSO 019 Facility Site Inspections

CSO 019 Facility	Recommended Improvements and Comments
CSO 019 Overflow and Diversion Structure	• Inspection was conducted March 1, 2013 • No observable unsafe conditions. The safety program appeared to be good at the time of the inspection. • No observable conditions detrimental to the project. • Project was described by DC Water to be on schedule. • Construction is scheduled to be complete by August 2013.

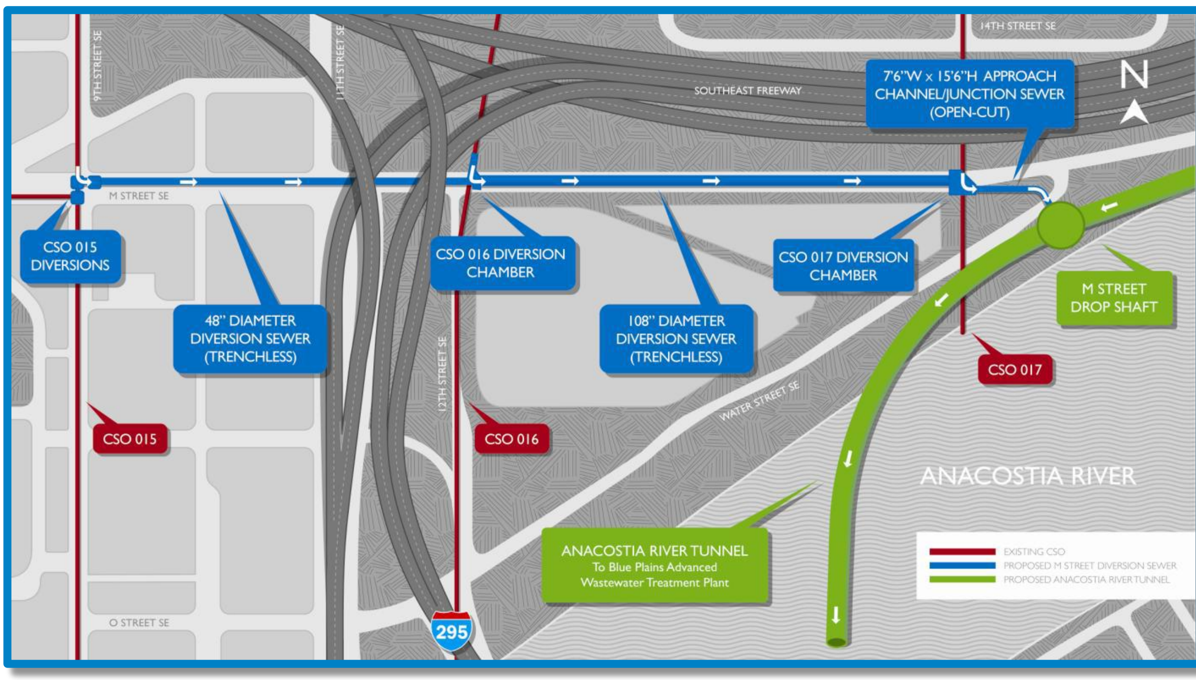
Construction of the CSO 019 Overflow Structure walls was described to be 80% complete and the infills were described as 40% complete. Anticipated progress includes: completion of the walls during the month of March 2013 and commencing mechanical work during the month of April 2013. DC Water was also able to obtain an environmental permit earlier than anticipated to install rip-rap stone on the CSO 019 overflow discharge into the Anacostia River.

This project had some schedule difficulty in the beginning. In response, DC Water prepared a recovery schedule that included revised placement of construction joints in the concrete away from columns. The recovery schedule helped to speed up project progress and meet the scheduled recovery.

5.3.4 M Street Diversion Sewers and CSOs 015, 016 and 017 (Division E)

A 48-inch and 108-inch diameter diversion sewer will be constructed beneath M Street using trenchless methods. This diversion sewer will intercept CSOs 015, 016 and 017 using newly constructed diversion structures and convey the combined storm and sanitary wastewater to the Anacostia River Tunnel drop shaft, thereby protecting the river from most CSO events. Division E also includes the work to reline selected portions of the Eastside Interceptor (ESI) sewer and the Southeast Relief Water Main (SRWM). **Exhibit 5-11** shows the horizontal alignment of the M Street Diversion Sewer.

Exhibit 5-11: M Street Diversion Sewer
(Graphic Obtained from DC Water Project Information Sheet)



Condition Assessment

The access shafts for the M Street Diversion Sewer and the shafts needed to rehabilitate the Eastside Interceptor (ESI) sewer and the Southeast Relief Water Main (SRWM) are under construction and are considered new facilities. Inspections were limited due to the location of the drop shafts and the high level of traffic and onsite construction. The inspection of these sites focused on ascertaining progress; as best as possible and are detailed in **Exhibit 5-12**. **Exhibit 5-13** and **Exhibit 5-14** show the location of the drop shafts.

Exhibit 5-12: CSO 015 Under Construction *(Image from Google Earth)*

Exhibit 5-13: CSO 017 Under Construction *(Image from Google Earth)*

Exhibit 5-14: Results of M Street Diversion Facility Site Inspections

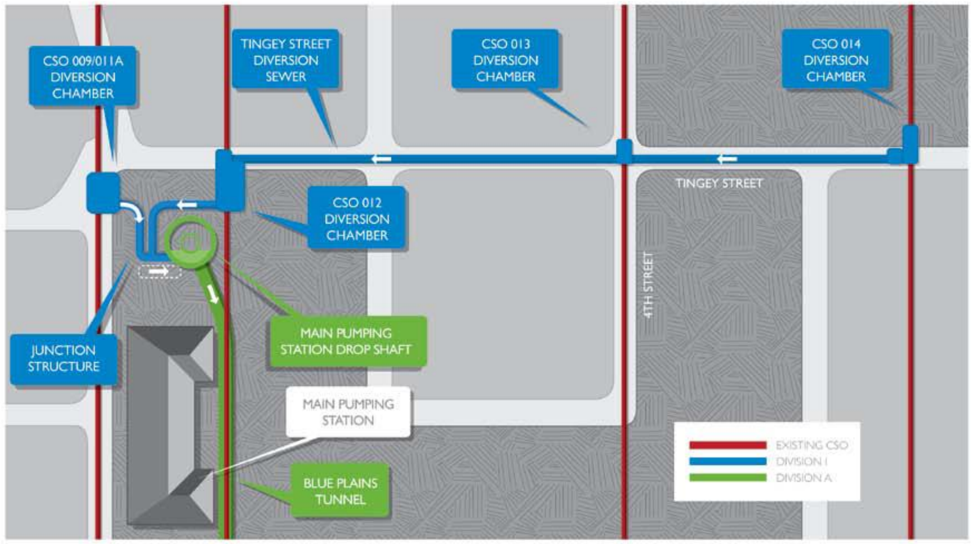
M Street Diversion Sewer Facility	Recommended Improvements and Comments
CSO 015 Diversion Structure	• An inspection was conducted March 1, 2013. • Maintenance of traffic features and steel panel liners were observed installed in a circular opening in the middle of the street.
CSO 016 Diversion Structure	• An inspection was conducted March 1, 2013. • Maintenance of traffic features was observed.
CSO 017 Diversion Structure	• An inspection was conducted March 1, 2013. • Maintenance of traffic features and steel panel liners were observed installed in a circular opening in the middle of the street.
M Street Drop Shaft Approach Sewer	• An inspection was conducted March 1, 2013. • Sheet piles were in place in preparation for approaching sewer construction.

In general, construction appeared to be progressing in a satisfactory manner and traffic safety features were in place. DC Water commented that coordinating Division E with other ongoing, unrelated projects (11th Street Bridge Replacement and the Navy Yard) has been a challenge; however, there was no indication of schedule or significant cost impacts related to coordination between these two very large projects. Project coordination with CSX Transportation near CSO 017 and the open cut approach sewer has also been difficult with negligible schedule and cost impacts.

5.3.5 Main Pumping Station and Tingey Street Diversion Sewer (Division I)

1,200 linear feet of 66-inch diameter diversion sewer is being constructed beneath Tinley Street using trenchless methods. This diversion sewer will intercept CSOs 009A, 011, 012, 013 and 014 using newly constructed diversion structures and convey the combined storm and sanitary wastewater to the 55-foot diameter Main Pumping Station drop shaft; the northern terminus of the BPT. The Main Pumping Station drop shaft is also the location of planned air ventilation for the Anacostia tunnel system. For Horizontal alignment of the Main Pumping Station and Tingey Street Diversion Sewer is depicted in **Exhibit 5-15**.

Exhibit 5-15: Main Pumping Station and Tingey Street Diversion Sewer
(Graphic Obtained from DC Water Project Information Sheet)



Condition Assessment

The Main Pumping Station Drop Shaft and the Tingey Street Diversion Sewer with diversion structures are new facilities. An inspection of these sites on March 1, 2013 focused on ascertaining progress and identifying any conditions that could be detrimental to construction progress. **Photos 5-5** and **Photo 5-6** show the Main Pumping Station drop shaft construction and slurry wall rebar while **Exhibit 5-16** details inspection results.

Photo 5-5: Main Pumping Station Drop Shaft Construction ***(Photo Taken March 1, 2013)***

Photo 5-6: Main Pumping Station Drop Shaft Slurry Wall Rebar Assembly
(Photo Taken March 1, 2013)

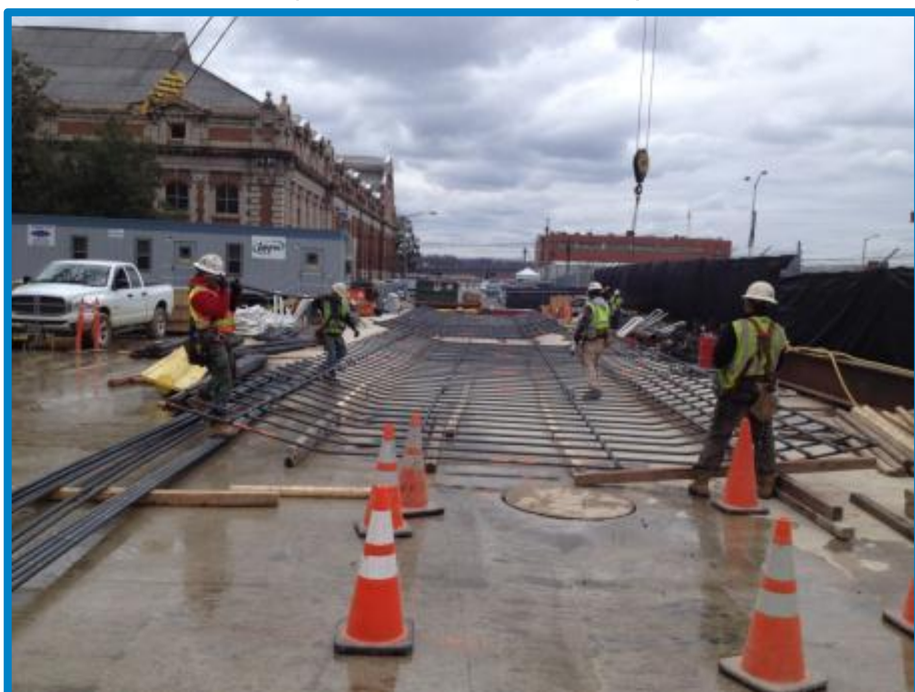


Exhibit 5-16: Results of Main Pumping Station and Tingey Street Diversion Sewer Facility Site Inspections

Main Pumping Station and Tingey Street Diversion Sewer Facility	Recommended Improvements and Comments
Main Pumping Station Drop Shaft	• Maintenance of traffic features were in place. • A reinforced concrete slab was installed to protect the 100 year old Tiber Branch Sewer. • Rebar for the slurry wall was being assembled. • Slurry wall construction equipment was mobilized. • Reconfiguration of overflow structure at CSO 013 to improve benefit traffic patterns resulted in a better and more cost effective design.
CSO 009A & 011 Diversion Structure	• An inspection was conducted March 1, 2013. • Construction of this facility takes place in the future.
CSO 012 Diversion Structure	• An inspection was conducted March 1, 2013. • Construction of this facility takes place in the future.
CSO 013 Diversion Structure	• An inspection was conducted March 1, 2013. • Construction of this facility appeared to be underway. Maintenance of Traffic features and some excavation was observed.
CSO 014 Diversion Structure	• An inspection was conducted March 1, 2013. • Construction of this facility takes place in the future.

In general, construction appeared to be progressing and traffic safety features were in place. DC Water commented that implementing a traffic control plan along Tingey Street was more difficult given that it impacted the parking garage entrances for the U.S. Department of Transportation building across the street. In response, DC Water re-designed the CSO 013 diversion structure to reduce traffic impacts which both satisfied the Department of Transportation and produced cost savings.

Starting in March 2013, construction will transition from 10 hour work days to 24/7 continuous work. The additional work hours are anticipated to help DC Water in accelerating construction progress and meeting the recovery schedule.

.

5.3.6 Northeast Boundary and Branch Tunnels (Division J, K, L & M)

The Northeast Boundary and Branch Tunnels project is a future large tunnel construction project that is anticipated to begin in 2018. When completed, the Northeast Boundary Tunnels will extend 26,600 linear feet (5 miles) and will include construction of diversion structures and drop shafts. The tunnel starts at the north drop shaft located at CSO 019 (adjacent to RFK Stadium) and it winds its way north then hooks northwest and then west along Rhode Island Avenue. An 18 foot diameter branch tunnel heads north up First Street off of the Rhode Island Avenue tunnel. **Photo 5-7** shows geotechnical borings in progress along First Street.

Construction of the Branch Tunnel along First Avenue is being accelerated to accommodate public concerns on frequent flooding in the area. This tunnel will be constructed from the abandoned slow sand filters and will end at Rhode Island Avenue where the future Northeast Boundary tunnel with intercept it prior to 2022. Until then, a temporary pump station will dewater the tunnel into an adjacent sewer. A design-build project will start in late 2013 to construct the Branch Tunnel along First Street.

Exhibit 5-17 includes the Northeast Boundary and First Street Tunnel projects.

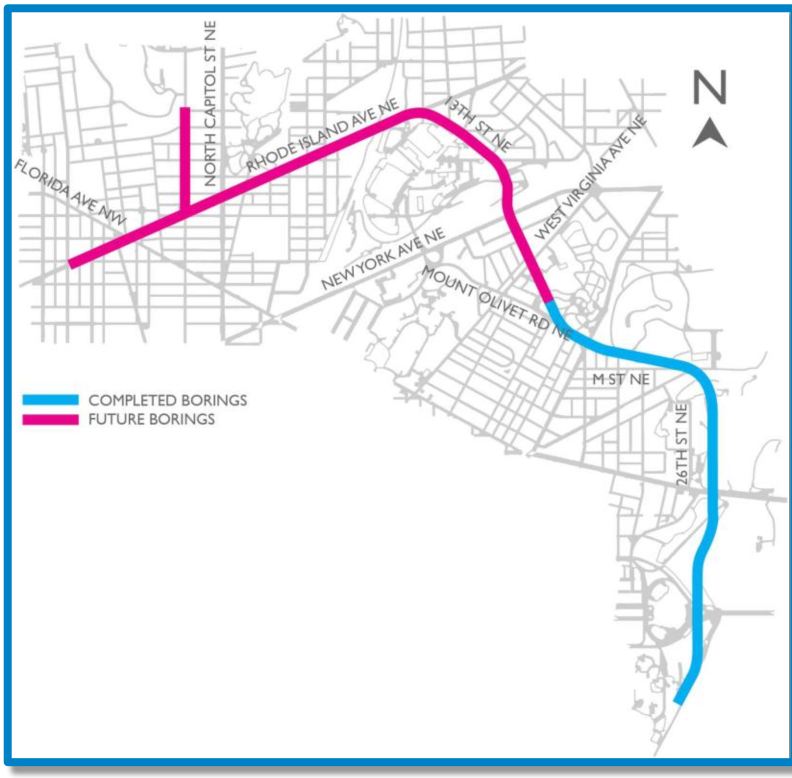
Exhibit 5-17: Northeast Boundary and First Street Tunnel CIP Projects

Project ID	Project Title	Cost	Timeline
	First Street Tunnel	$13M	Construction 2016
	Northeast Boundary Tunnel	$500M - $600M	Completion 2022

Photo 5-7: Geotechnical Borings Taking Place Along First Street
(Photo Taken February 2, 2013)

Field investigation activities including geotechnical test borings, groundwater monitoring, and land surveys are taking place along the tunnel alignments. The horizontal alignment of the tunnel is shown in **Exhibit 5-18**.

Exhibit 5-18: Northeast Boundary and Branch Tunnels
(Obtained from DC Water Project Information Sheet)



Condition Assessment

Construction on the First Street and Northeast Boundary Tunnels will start in 2014 and 2016. An inspection was conducted on February 2, 2013 of the First Street Branch Tunnel area proposed for accelerated design and construction. **Exhibit 5-19** details observations and recommendations from the inspection.

Exhibit 5-19: Results of Northeast Boundary and First Street Branch Tunnel Site Inspections

Northeast Boundary and Branch Tunnel Facility	Recommended Improvements and Comments
Northeast Boundary Tunnel	• Construction has not started.
First Street Branch Tunnel	• Construction has not started. • Geotechnical borings and groundwater monitoring wells were observed.

5.3.1.1 Future Tunnels and Potential Green Infrastructure Consent Decree Modifications

The 2005 Consent Decree requires additional wet weather storage tunnel projects categorized as the CSO LTCP Potomac Projects. These tunnels, like the Anacostia tunnel, will provide additional storage and conveyance of storm water from the combined storm and sanitary sewers. After completion, these projects are expected to reduce the CSO events by 96%. Both tunnel projects have not yet entered the Facility Planning stage and the details of the projects are not fully developed. DC Water's GI initiatives, discussed in section 5.2.1. of this report, are designed to reduce the volume of stormwater runoff. If successful, GI implementation may allow the downsizing of the Potomac and Rock Creek Tunnels. Known details of these tunnel projects are discussed below.

The Potomac Tunnel is required by the Consent Decree to provide at least 58 MG of storage. To accomplish this the project would include a tunnel approximately 9,500 feet long, 34 feet in diameter and a tunnel dewatering pump station. Facility planning is scheduled to start March 23, 2015 and the FY2012-2021 CIP Budget has identified $98.3 million for the project through 2021.

The Piney Branch Tunnel is required by the Consent Decree to provide at least 9.5 MG of storage. This would require 3,000 feet of tunnel with a diameter of 23 feet and gravity dewatering. Facility planning is scheduled to commence March 23, 2016 and the FY2012-2021 CIP Budget has identified $7.4 million for the project through 2021. The actual scope of these projects will depend on the outcome of the GI Initiative.

Though facility planning has not commenced and thus the scope of these projects has not been fully defined, JMT agrees with the approach DC Water has taken to address the Consent Decree requirements. JMT also agrees with the exploration efforts of DC Water to determine the potential of GI initiatives. DC Water could reduce the required capacity of the tunnels and thereby reduce the capital cost of the tunnel projects.

Section 6 Summary of Findings and Recommendations

This 2013 Independent Consulting Engineer Assessment reaffirms the continued improvement and success of DC Water in managing its water system and wastewater system. The administrative and engineering staff is well motivated and communicates a focus on continued improvement. Conformance to NPDES permit conditions has been well documented and DC Water has been recognized by the wastewater profession for meeting standards. The DCCR has successfully 'ramped up' during the past five years and meets the requirements of the Consent Decree. ENR and biosolids improvements at Blue Plains are well coordinated with DCCR construction activities within the limited footprint of Blue Plains. DCCR construction projects along the Anacostia are also on schedule with well-managed construction sites. It is the opinion of JMT that the capital improvement planning being managed by DCCR exceeds typical approaches for consent decree programs.

This assessment also substantiates that DC Water's wastewater collection system is functional and undergoing renewal programs. DC Water's water distribution system is operating within regulatory requirements. DC Water expects to meet all compliance and permit schedules and milestones. Also, DC Water is addressing the challenges of regulatory requirements and the reliability concerns of an aging infrastructure. DC Water maintains the proper leadership, engineering expertise and core competencies and certifications required to achieve the goal of being a world-class water and wastewater utility. The FY 2012 – 2021 CIP proposes expenditures of $3.8 billion over the ten-year budget. Planning, management and finance are all congruous with the desired objectives of DCCR, ENR, enhanced overall operational efficiency, and full permit compliance for all levels of regulatory control.

To meet its objectives, DC Water has strategically funded capital improvements on an ongoing and intensified basis. The state of the operating systems includes significant improvements compared to five years ago. Awareness and satisfaction among stakeholders and ratepayers appears to have noticeably improved based on our research. The increasing public outreach initiatives, such as the 75-year anniversary celebration of Blue Plains and the christening ceremony of the tunnel boring machine , raises public awareness and encourages public participation.

6.1 FINDINGS:

6.1.1 Governance, Organization, and Management

DC Water's governance, organization, and management processes are commensurate with those required for a complex utility. In addition, DC Water is a leader in many areas. One example is DC Water's solids/biosolids facilities; DC Water develops technologies and facilities to improve energy recovery, beneficial reuse, and efficient processing costs by implementing state-of-the-art facilities and equipment. The Washington Aqueduct, purveyor of wholesale water to DC water has a good track record of supplying water to the Authority.. Furthermore, DC Water, as part of the Wholesale Customer Board, has substantive avenues for influencing the operations and strategic activities of the Aqueduct. The Wholesale Customer Board was established to formalize the strategic role DC Water, along with other customers of the Aqueduct, plays in ensuring a reliable and safe water supply.

To further improve its organization efficacy and effectiveness, DC Water has undertaken major initiatives within the Department of Information Technology, Customer Service, and Risk Management . Earlier investments in customer service and meter infrastructure have reaped benefits in this reporting period.

6.1.2 System Condition and Operations

One of the primary indicators of the adequacy of system operations at a water and wastewater entity is its compliance with prevailing permit requirements. Regulatory oversight helps to ensure safe and dependable water while protecting the environment. DC Water has consistently operated within permit requirements and has demonstrated leadership in planning for future requirements. Meeting and exceeding this required threshold is a function of the condition of the system components, expertise of operating staff, and commitment to rehabilitation and replacement of aging infrastructure.

As DC Water undergoes a major renovation of processes and wet weather facilities at Blue Plains, the capital programming and construction sequencing provide adequate on-going treatment as measured by permit compliance. Safeguards are in place to ensure the minimization of permit non-compliance during emergency conditions while construction is being performed at or near operating processes.

DC Water's sewer collection system is typical of older sewer collection systems commonplace along the east coast of the United States particularly in urban areas. DC Water's EPMC for the sewer system has established a comprehensive evaluation of condition of the sewer system. DC Water has funded Infrastructure Improvement contracts to correct deficiencies identified in the sewer system evaluation. DCCR is aggressively pursuing the TN/WW Plan as required by EPA and the stipulated schedule within the Consent Decree.

The assets of the water system under the auspices of the Aqueduct are well maintained. Solids handling and backwash treatment facilities are now in operation and orthophosphate treatment is reducing the corrosiveness of the treated water. Risks have been significantly reduced by conversion to hypochlorite disinfection at the water treatment plants.

In general, the assets of the water and wastewater systems owned and operated by DC Water are in adequate condition. In the absence of a CIP and operation and maintenance initiatives, aging infrastructure concerns would threaten the continued reliability of the system. The on-going rehabilitation and the long-term planning programmed for rehabilitation of the water and sewer systems addresses these concerns within industry standards. Due mostly to the age of the assets, major projects have had to be initiated to repair or replace pumping stations, replace pipes, and eliminate cross-connections. Most pumping station repairs and cross-connection concerns have been addressed. Other improvements are ongoing or planned. The security of critical infrastructure has become an established procedure and DC Water continues to harden sites.

6.1.3 Capital Planning and Project Implementation

DC Water's capital planning process is comprehensive, aggressive, and encourages public participation. The CIP is in accord with the needs of an aging system operating in the context of increasingly more stringent environmental regulations.

DC water prepares a 10-Year Capital Improvements Program updated annually. The preparation of this program includes a review of major accomplishments, priorities, status of major projects and emerging regulatory and related issues impacting the capital program. The process is open and transparent. The CIP is integrated into DC Water's 10-year financial plan and serves as the primary driver of revenue-generating decisions, for example, the need for rate increases. The CIP is supported by a thorough, systematic process for determining and ranking, in order of importance, system needs over a twenty-year horizon. The Water and Sewer Facilities Plans govern the priorities used to develop the CIP. A review of the sequential CIP documents indicates a living document and an agile organization that is willing to make changes to improve efficiencies and effectiveness. The Biosolids Management Plan and the Water and Systems Processing Facilities Plan have proven to be worthy efforts in guiding improvements at Blue Plains. The CIP planning process allows for status monitoring and reassessment of priorities and funding needs on an annual basis and the flexibility to reprogram projects so that if new needs arise, DC Water can consider rescheduling non-mandated initiatives in order to accommodate more urgent needs. DC Water has relied on consultants, working closely with in-house staff, to ensure successful implementation of capital improvement projects.

6.1.4 Preventive Maintenance

DC Water manages assets that are worth billions of dollars with an added $3.6 billion in assets coming on-line in the next 10 years. The age of DC Water's systems makes preventive maintenance a strategic as well as an operational imperative. This has been an area of concern and DC Water is taking steps to improve its preventive maintenance capabilities and practices. Asset management is a comprehensive business program advocated by the EPA and the utility industry to optimize infrastructure sustainability. A comprehensive asset management program is being implemented by DC Water with the purpose of preserving these investments by incorporating best practices, improved service life and lower life cycle costs.

6.1.5 Sewer System

DC Water has instituted the rehabilitation or replacement of sewer mains with the EPMC contracts. The planned results provide prioritized renewal of 1% per annum in order to maintain an expected lifecycle of 100 years. The process demonstrates DC Water's ability to maintain the efficacy of the sewer system and positions DC Water with the expected goals of other large wastewater agencies.

6.1.6 Combined Sewer Overflow

DCCR aggressively pursues the expected results for a total system and Potomac combined sewer capture rate of 96%, thereby greatly improving the quality of the Anacostia Rivers and subsequently Rock Creek. This rate greatly exceeds EPA guidelines and consent decree capture rate guidelines.

6.2 RECOMMENDATIONS:

- During interviews, it has been observed that responsibility for maintenance of stormwater facilities is not formally structured and involves multiple stakeholders. DC Water maintains the combined stormwater and sanitary sewer systems. The District of Columbia Department of the Environment (DDOE) was created to maintain stormwater-only facilities and to manage the NPDES permitting and MS4 program. Moreover, DC Water also has agreements with DC Department of Transportation (DDOT) and other agencies to maintain their stormwater systems. JMT recommends that DC Water reassess its current stormwater facility maintenance responsibilities to determine if its responsibilities fall within its “One Water” mission and if compensation from other agencies for this responsibility is sufficient. It may be prudent to consider whether consolidating all stormwater and wastewater responsibility under one enterprise would enhance performance and the efficiency of operations, maintenance and capital improvements.

- DC Water could explore increasing its role in potable water treatment. Water supply, water treatment and water distribution as a monolithic arrangement under a single management and financing structure has proven to be effective throughout the United States. JMT has not studied this in great detail; however, there may be management and cost efficiencies that could be achieved to benefit both DC Water and its rate payers. In addition, DC Water could have better control to expand its water customer base and to be responsible for the quality of the potable water it produces.

- The Washington Aqueduct and DC Water have excess water treatment and distribution capacity, respectively. DC Water could look for opportunities to expand its sale of potable water by selling additional wholesale water to surrounding water agencies (on a routine or standby basis) or expanding its service area.

Bibliography

Washington D.C. Water and Sewer Authority (DC WASA) Sewer Overflows Consent Decree, Civ. Action No. 1:00CV00183TFH (Uninted States District Court for the District of Columbia March 13, 2003, Implemented March, 2005).

Allen Y. Lew, C. A. (2012, December). *Mayor's Task Force Report on the Prevention of Flooding in Bloomingdale and LeDroit Park.* Retrieved March 2013, from The District of Columbia: http://oca.dc.gov/node/415132

Allen Y. Lew, Chairman of the Board, George S. Hawkins, General Manager, Yvette Downs, Acting Chief Financial Officer. (2013, March 7). Budget In Brief.

Amawalk Consulting Group LLC. (2013, February 5). Report on the Renewal & Replacement Reserve Fund of the Authority.

Anthony A. Williams Mayor, G. o. (2002, September 29). Storm Water Advisory Panel Report Council of the District of Columbia. *Municipal Seperate Storm Sewer System NPDES Permit No. DC000221*. Washington, DC.

Aqueduct, W. (2012, December 12). Washington Aqueduct Capital Improvements Plan FY 2014-2023. *Furnished by Washington Aqueduct*.

Authority, D. o. (2011, April 7). By-Laws, Amended - April 7, 2011; Resolution 11-49.

Authority, D. o., Robin S. Martin, C., & Jerry N. Johnson, G. M. (2008, October 10). Revised FY2008 & Approved FY2009 Operating Budgets.

Bailey, W. (2013, April 8). Re: Update to Pretreatment Program 2012 Annual Report NPDES No. DC0021199.

Blue Plains Chief Administrative Officers Committee, B. P. (1985, July 22). Blue Plains Intermunicipal Agreement of 1985.

Commission, W. S. (2011, May 18). *Commission Work Session and Approval, Approval of Interconnections Memorandum of Agreement with DC Water.* Retrieved March 2013, from WSSCWater: http://www.wsscwater.com/file/CorpSec/2011Agenda/May18/Resolution%20No.%202011-1914.pdf

Committee, N. B. (2007, October). *Summary of North Branch Reservoir Operations.* Retrieved March 2013, from ICPRB: http://www.potomacriver.org/2012/drinkingwaterdocs/nbranchoperations.pdf

Council of the District of Columbia. (2013, 8 2). *Council of the District of Columbia.* Retrieved May 2013, from Appendix_23_-_MOUs.xlsx - Council of the District of Columbia: https://www.google.com/url?q=http://www.dccouncil.us/files/user_uploads/event_testimony/Appendix_23_-_MOUs.xlsx&sa=U&ei=eOCUUYq_LfPH4AOgqIDYBQ&ved=0CBQQFjAF&client=internal-uds-cse&usg=AFQjCNF2F6CSMJwHO_9m0VKPQ7ARzk5lgA

Council of the District of Columbia. (2013, February 14). *Council of the District of Columbia.* Retrieved May 2013, from Performac Oversight Questions DC Water.

DC WASA Board of Directors Operations Comittee, J. N., & Robin S. Martin, C. (2008). *District of Columbia Water and Sewer Authority Capital Improvement Program Report, FY2007 - FY2016, Adopted January 10, 2008.*

DC Water. (2008). *DC Water Strategic Plan.* Washington.

DC Water. (2011, July 1). *Fire Hydrant Inspection, Maintenance and Repair.* Retrieved April 2013, from DC Water: http://www.dcwater.com/news/testimony/Status_of_Public_Fire_Hydrants.pdf

DC Water. (2012). *Capital Improvement Program, approved fy 2011 – 2020.* Washington DC: DC Water.

DC Water. (2013, March 21). Board of Directors. *Water Qualit and Water Services Committee Meeting Agenda*.

DC Water. (2013). *Fire Hydrant Inspection, Maintenance and Repair, Testimony as prepared for delivery*. Retrieved April 2013, from http://www.dcwater.com/news/testimony/2011_HydrantTestimony.cfm

DC Water. (2013). *Nitrogen Reduction Program.* Retrieved March 2013, from DC Water: http://www.dcwater.com/education/pdfs/8-31-10_Final_fact_sheet.pdf

DC Water. (2013). *Nitrogen Reduction Program.* Retrieved March 2013, from DC Water: http://www.dcwater.com/education/pdfs/8-31-10_Final_blue_plains_permit.pdf

DC Water. (2013). *Nitrogen Reduction Program.* Retrieved March 2013, from DC Water: http://www.dcwater.com/education/pdfs/8-31-10_Final_blue_plains_permit.pdf

DC Water, A. Y. (2008, August). *Blue Horizon 2020, DC Water Strategic Plan, 2008-2013.* Retrieved 2013 March, from DC Water: http://www.dcwater.com/news/publications/2008%20Strategic%20Plan.pdf

DC Water, A. Y. (2013, January 3). Capital Improvement Program. *Approved FY 2012-2021*.

DC Water, A. Y. (2013, January 3). Operating Budgets. *Revised FY2013 Approved FY2014*.

DC Water, C. R. (2013, January 18). DC Clean Rivers Project Monthly Progress Report. *Report Number 37, Period Ending: December 31, 2012*.

DC Water, W. M., George S. Hawkins, G. M., & Olu Adebo, C. F. (2012, January 5). *"Operating Budgets, Revised FY2010 Approved FY2013"*. Retrieved March 2013, from District of Columbia Water and Sewer Authority: http://www.dcwater.com/news/publications/FY2012_and_Approved_FY2013_Operating_Budget_R01.pdf

DC Water, W. M., George S. Hawkins, G. M., & Olu Adebo, C. F. (2012, January 5). *Capital Imporvements Program, Approved FY2011 - 2020.* Retrieved March 2013, from DC Water: http://www.dcwater.com/news/publications/CIP_Approved_FY2011-2020_Budget_R01.pdf

District of Columbia Water and Sewer Authority. (2008, September 4). Resolution of the Board of Directors. *#08-75*.

District of Columbia Water and Sewer Authority. (2009, February 24). Public Utility Senior Lien Revenue Bonds Serise 2009A. Washington, DC.

District of Columbia Water and Sewer Authority. (2010, October). Combined Sewer Overflow (CSO) Control Activities Update. *Biannual Report October 2010*.

District of Columbia Water and Sewer Authority. (2013, Mar). Water Consumption Breakdown. *Furnished by DC Water*.

District of Columbia Water and Sewer Authority Engineering Program Management Consultants III Program Manager: Greeley and Hansen LLP, J. 2. (2002, June). Combined Sewer System Long Term Control Plan.

District of Columbia Water and Sewer Authority. (n.d.). *Tunnel Capacity Document.* Retrieved March 2013, from dcwater.com: http://www.dcwater.com/workzones/projects/pdfs/Tunnel_Capacity_Document.pdf

District of Columbia Water and Sewer Authority, A. Y. (2012, September 30). Comprehensive Annual Financial Report. *Fiscal Year Ended September 30, 2012*.

District of Columbia Water and Sewer Authority, B. o. (2013, March 21). Environmental Quality and Sewerage Services Committee.

District of Columbia Water and Sewer Authority, B. o. (2013, March 21). Water Quality and Water Services Committee Meeting Agenda.

District of Columbia Water and Sewer Authority, Board of Directors. (2012, January 24). DC Retail Water and Sewer Rates Committee.

District of Columbia Water and Sewer Authority, E. P.-K.-P. (2002). *Distribution System Valve Coordination Control Room, Standard Operating Procedures Manual.* Washington DC.

District of Columbia Water and Sewer Authority, G. S. (2013). Retrieved March 2013, from DC Water: http://www.dcwater.com/

District of Columbia Water and Sewer Authority, G. S. (2013). *DC Clean Rivers Project Program Update Power Point.*

District of Columbia Water and Sewer Authority, George S. Hawkins, General Manager. (2013, January 17). Briefing on: Bloomingdale Flooding Flooding Mitigation Performance. *Briefing for: Environmental Quality and Sewerage Services Committee*.

District of Columbia Water and Sewer Authority, J. N., Michael S. Marcotte, C. E., Paul L. Bender, C. F., & Leonard R. Benson, D.-D. o. (2002, July). FY2003 Revised and FY2004 Capital Budget Recommendation - Capital Improvement Program Project Descriptions and Operating Impacts.

District of Columbia Water and Sewer Authority, U.S. Environmental Protection Agency, the Government of the District of Columbia. (2012, December 10). Clean Rivers, Green District, Green Infrastructure Partnership Agreement.

District of Columbia, DC Water, Fairfax County, Virginia, Montgomery County, Maryland, PrinceGeorge's County, Maryland, Washington Suburban Sanitary Commission. (n.d.). Blue Plains Intermunicipal Agreement of 2012.

Downs, Y. (2012, January 24). DC Water and Sewer Rates Committee Meeting - 3. Pretreatment Fees (Attachment B), Adoption of Pretreatment Fees.

Government, M. W. (2012, January 1). 1985 IMA vs. 2012 IMA Comparison Table.

Greeley and Hansen, D. H.-T., & J-Dos International, I. (2009, June). *Sewer System Facilities Plan Executive Summary.* Retrieved March 2013, from DC Water: http://www.dcwater.com/news/publications/Sewer%20System%20Facilities%20Plan-Executive%20Summary%20June%202009.pdf

Hatch Mott MacDonald, D. o. (2009, June). Water System Facilities Plan Update Executive Summary.

Hawkins, G. S. (2012, May 21). Letter to Director, Water Protection Division USEPA Region III.

Janice Carroll, P. P. (2005). Optimization of Nitrification/Denitrification Process Performance and Reliability at the Blue Plains Advanced Wastewater Treatment Plant. *Water Environment Federation*.

Joe N. Ballard, L. G., & Michael C. Rogers, C. B. (1997, July 31). Washington Aqueduct Water Sales Agreement Between USA Acting Through the Secretary of the Army and District of Columbia Water and Sewer Authority.

Julian Thorton, T. I. (2005, April). Best Management Practice 3: . *System Water Audits and leak Detection*.

Larry W. Edwards, U. M. (2011, November 29). WASA AMR/Meter Replacement Controc No. WAS-2038-AA-AB Between DCWASA and Uninted Metering, Inc.

Malcolm Pernie Environmental Engineers, S. &. (1994, March). Washington Aqueduct Dalecarlia and McMillan Water Treatment Plants Conceptual Plan for Modernization Final Report (0285-564). *Prepared for U.S. Army Corps of Engineers Baltimore District*.

Metcalf & Eddy|AECOM, G. a.-T. (2007, April). *Blue Plains Total Nitrogen Removal/Wet Weather Plan, Long Term Control Plan Supplement No. 1, Draft.* Retrieved March 2013, from DC Water: http://www.dcwater.com/news/publications/Draft%20NTWW%20plan.pdf

NACWA. (2013). *Peak Performance Awards*. Retrieved March 2013, from http://www.nacwa.org/index.php?option=com_content&view=article&id=1030&Itemid=63

Olu Adebo, W. A. (2007, September 30). District of Columbia Water and Sewer Authority Comprehensive Annual Financial Report 2007, Fiscal Year: October 1, 2006 to September 30, 2007.

Parsons. (n.d.). *DC Water Biosolids Management Program*. Retrieved March 2013, from parsons.com: http://www.parsons.com/projects/Pages/dcwater.aspx

PB Consult Inc. (2007, 05 24). Feasibility Study for Public Utility Subordinated Lien Revenue Bonds, Series 2007 A and Series 2007 B. Washington: PB Consultants.

PB Consult Inc. (2008). *Independent Engineering Inspection of the District of Columbia Water and Sewer Authority's Wastewater and Water Systems, Findings and Recommendations.* Washington: PB Consult Inc.

Per Eggers, J. S. (2011, March 1). Internal Audit of Pumping & Stroage - Water Leakage.

Robert B. Benson, W. C., & LLP, B. &. (1998, March 11). District of Columbia Water and Sewer Authority Report on Engineering and Financial Bond Feasibility.

S.N. Ahmed, K. B. (2011, November). 2010 Washington Metropolitan Area Drought Operations - Summary and Lessons Learned. *ICPRB Publication number: ICPRB11-04*.

Sarah N. Ahmed, K. R. (2010, May). 2010 Washinton Metropolitan Area Water Supply Rehabilitation Study; Part 1: Demand and Resource Availability Forecast for the Year 2040. *ICPRB Publication number: ICPRB10-01*.

Straughan Environmental Services, Inc. (2010, January 13). Wetland Delineation Report for the Long Term Combined Sewer Overflow Control Program Anacostia River Projects.

The Metropolitan Washington Council of Governments', R. T. (2000, June 7). *Metropolitan Washington Water Supply and Drought Awarness Response Plan: Potomac River System.* Retrieved March 2013, from MWCOG: http://www.mwcog.org/pdf/drought-plan-response_plan.pdf

Uninted Sates National Library of Medicine. (n.d.). *TOXNET, Toxicology Data Network*. Retrieved April 2013

Uninted States Environmental Protection Agency. (1995, May 31). Combined Sewer Overflows, Guidance For Nine Minimum Controls.

Uninted States Environmental Protection Agency. (2002, August 15). Finished Wate Storage Facilities. *Distribution System Issue Paper*.

Uninted States Environmental Protection Agency Region III. (2010, September 30). *NPDEDS Permit, September 30, 2010 (Permit No. DC0021199).* Retrieved March 2013, from DC Water: http://www.dcwater.com/education/pdfs/8-31-10_Final_blue_plains_permit.pdf

Uninted States Environmental Protection Agency Region III. (2012, May 4). *FCCA Extension III.* Retrieved March 2013, from US Army Corps of Engineering: http://washingtonaqueduct.nab.usace.army.mil/residuals.htm

Uninted States Environmental Protection Agency Region III. (2012, May 4). *Water Treatment Residuals Management Project.* Retrieved March 2013, from US Army Corps of Engineers Washingont Aqueduct: http://washingtonaqueduct.nab.usace.army.mil/EPAFFCAExtensionApproval.pdf

Uninted States Environmental Protection Agency Region III. (2012, May 4). *Water Treatment Residuals Management Project.* Retrieved March 2013, from US Army Corps of Engineers Washington Aqueduct: http://washingtonaqueduct.nab.usace.army.mil/Residuals/Ext/FFCA.pdf

Uninted States Environmental Protection Agency RegionIII. (2003, 6 13). Federal Facility Compliance Agreement. *Docket No. CWA-03-2003-0136DN*.

Washington Aqueduct. (2010, October). FY 2011 Annual financial Report. Finance and Accounting Office Washington Aqueduct.

Washington Aqueduct, Finance and Accounting Office. (2012). Annual financial Report. *fiscal Year 2012, October 1, 2011 through September 30, 2012*.

Water Quality Laboratory, P. O. (2001). Washington Aqueduct U.S. Army Corps of Engineers Annual Report of Water Analysis. *Revised May 2007*.

Water Quality Laboratory, P. O. (2011). *Annual Report of Water Analysis.* Washinton Aqueduct, US Army Corps of Engineering.

William T. Donahue, A. C. (2012, March 02). *Memorandum of Understanding, Environmental Services, Water System - Aqueduct.* Retrieved March 2013, from arlingtonva.us: https://www.arlingtonva.us/departments/environmentalservices/uepd/aqueduct/EnvironmentalServicesCustbord.aspx